

**2017**

# OPTICS + PHOTONICS

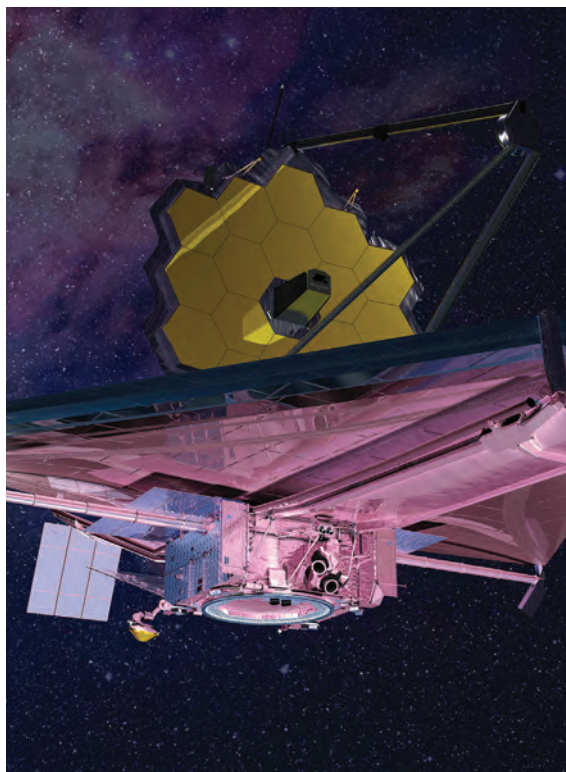
TECHNICAL PROGRAM

San Diego Convention Center  
San Diego, California, USA

Conferences and Courses: 6-10 August 2017

Exhibition: 8-10 August 2017

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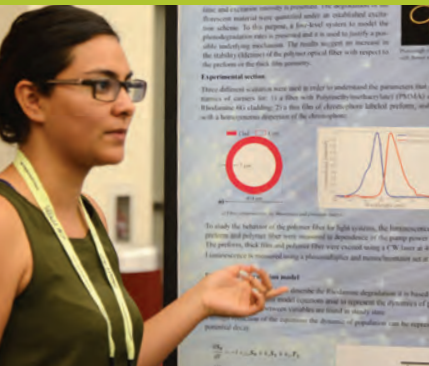
THE PREMIER EVENT FOR THE OPTICS  
AND PHOTONICS COMMUNITY

6-10 August 2017

Exhibition: 8-10 August 2017

San Diego Convention Center, San Diego, California, USA

CUTTING-EDGE RESEARCH AND COURSES  
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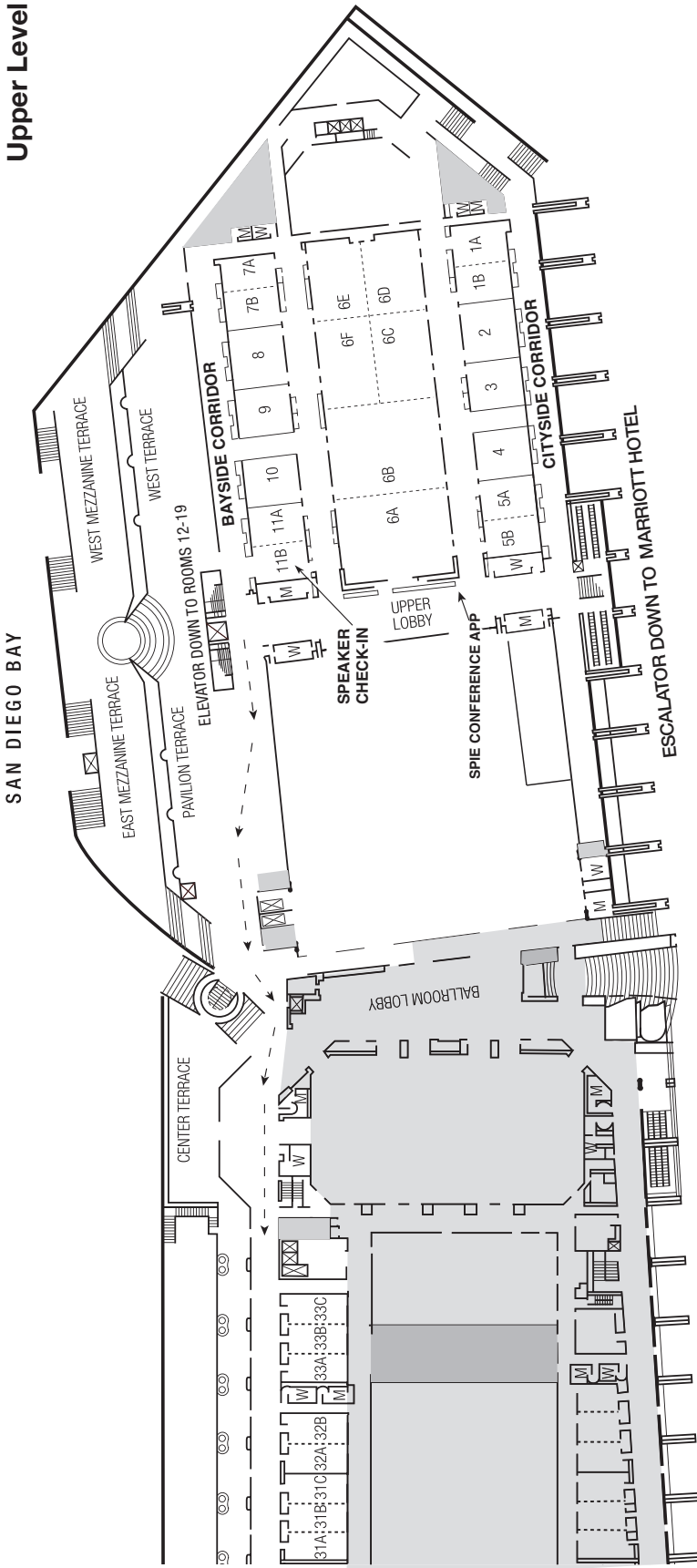
SPIE would like to express its deepest appreciation to the symposium chairs, conference chairs, program committees, session chairs, and authors who have so generously given their time and advice to make this symposium possible.

The symposium, like our other conferences and activities, would not be possible without the dedicated contribution of our participants and members. This program is based on commitments received up to the time of publication and is subject to change without notice.

# SAN DIEGO CONVENTION CENTER, SECOND LEVEL AND MEZZANINE

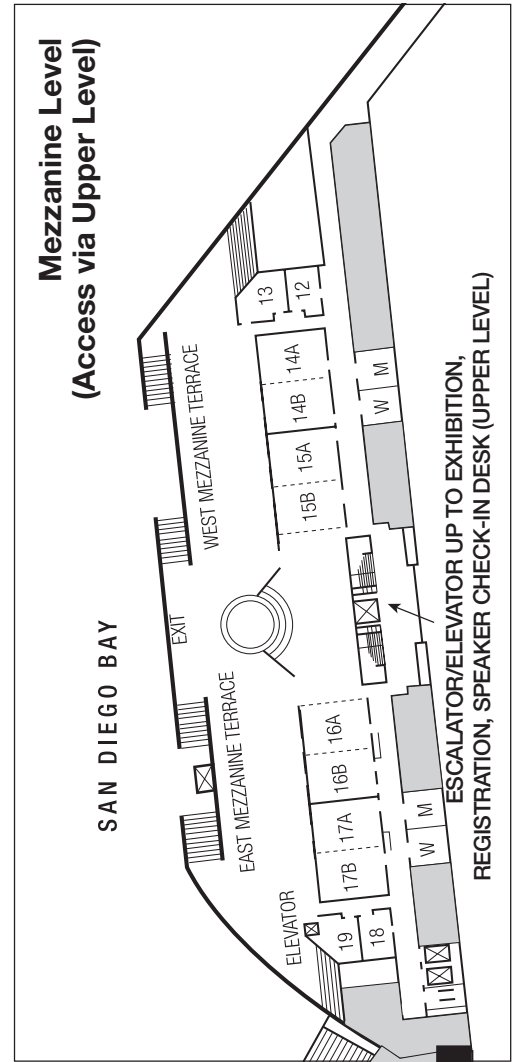
## Speaker Check-in Desk and Meeting Rooms

Upper Level



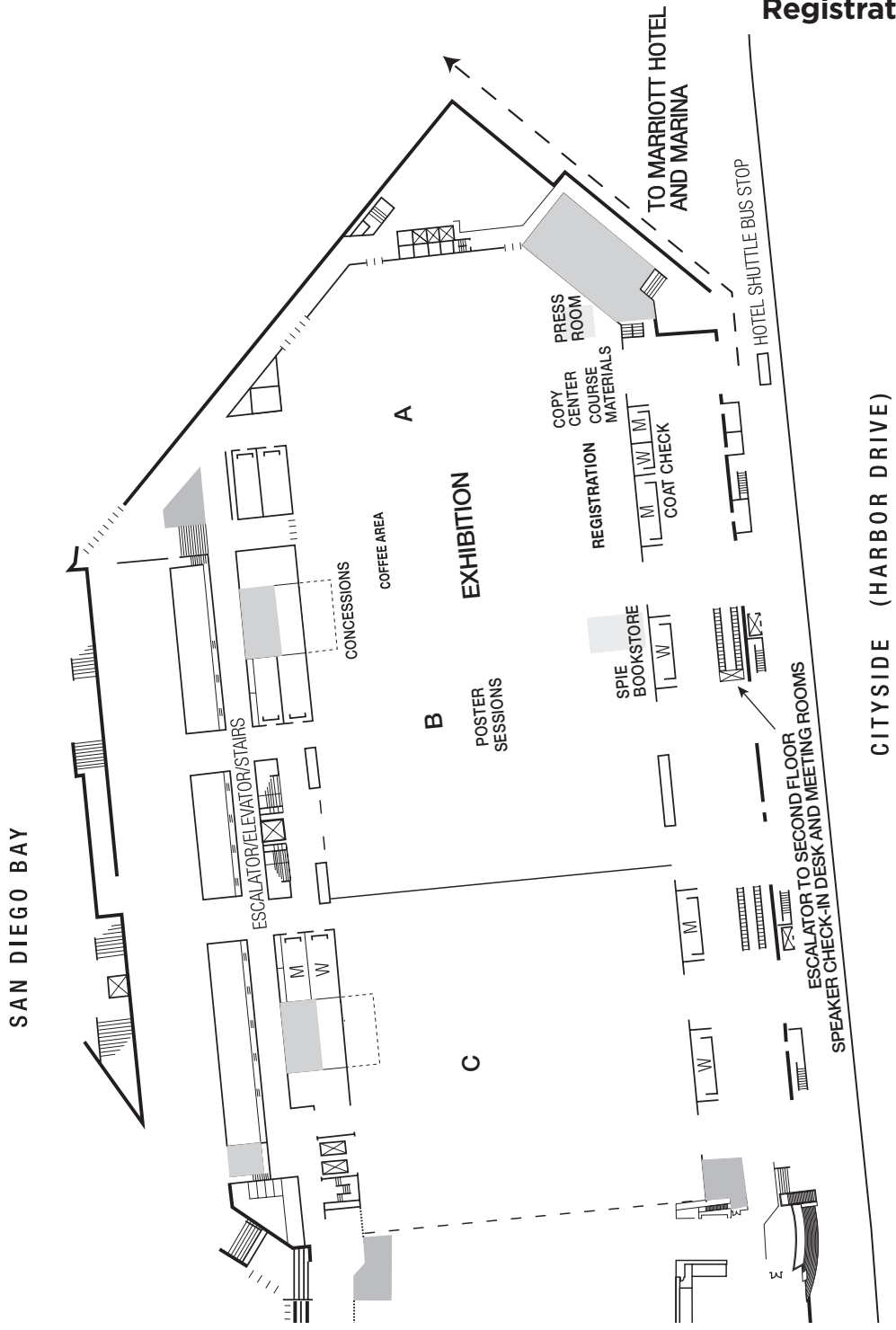
CITYSIDE (HARBOR DRIVE)

### Mezzanine Level (Access via Upper Level)



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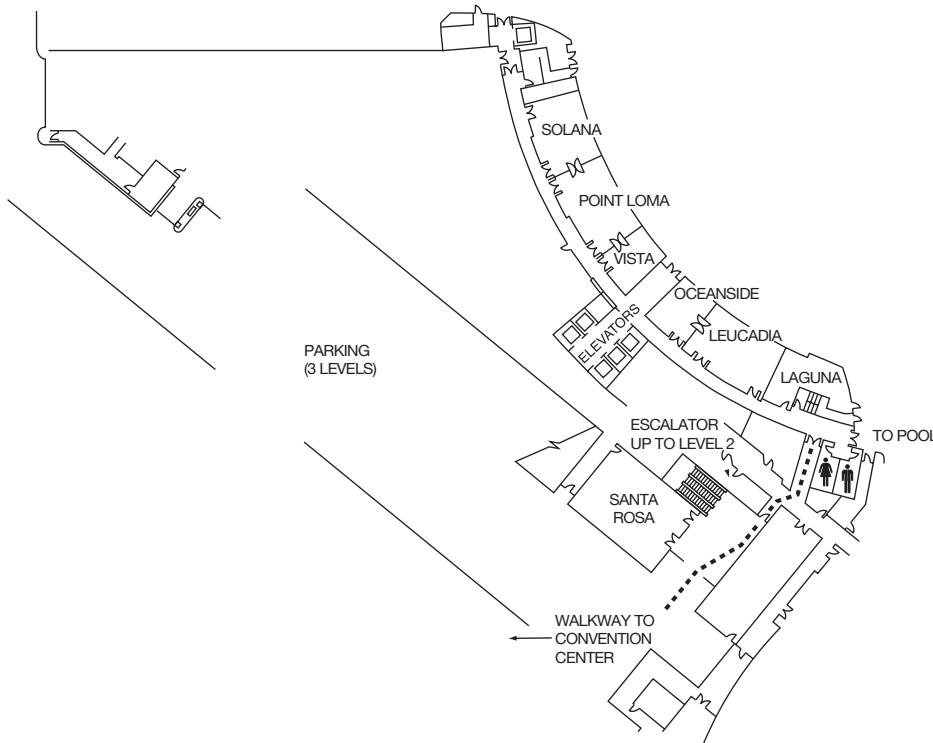
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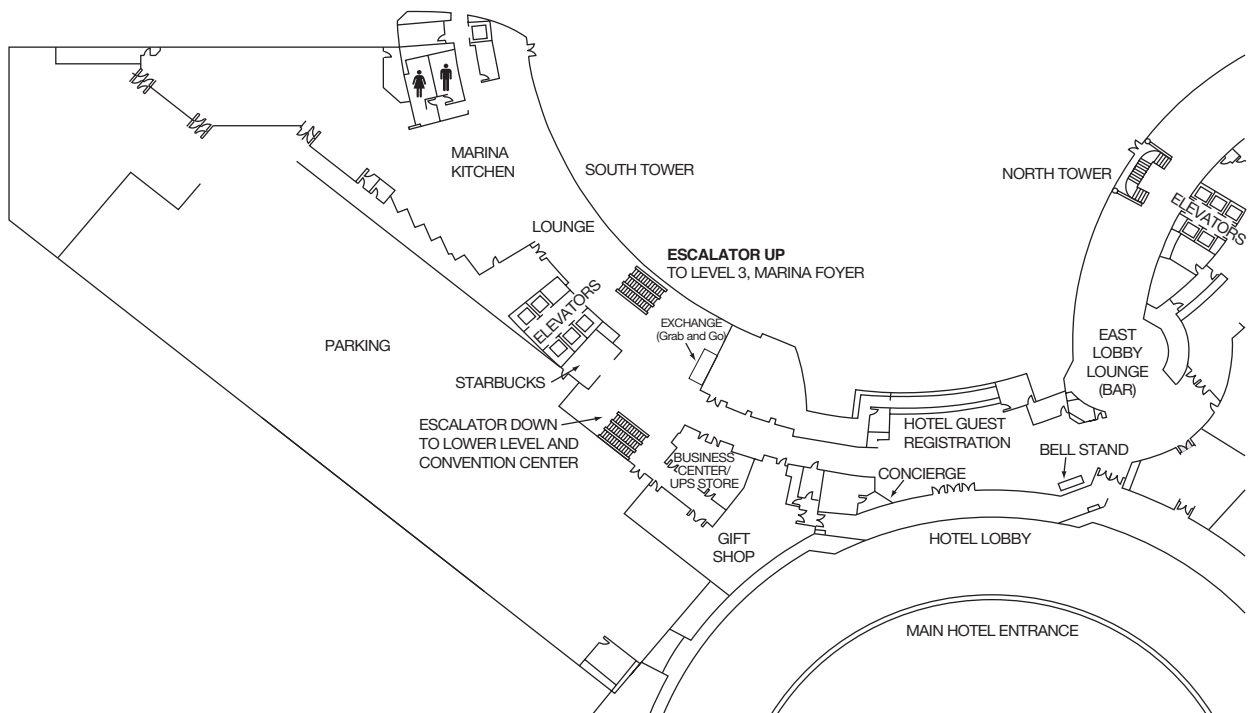
**Wireless Internet** access is available in the Exhibition Hall.



# SAN DIEGO MARRIOTT MARQUIS AND MARINA MEETING ROOMS

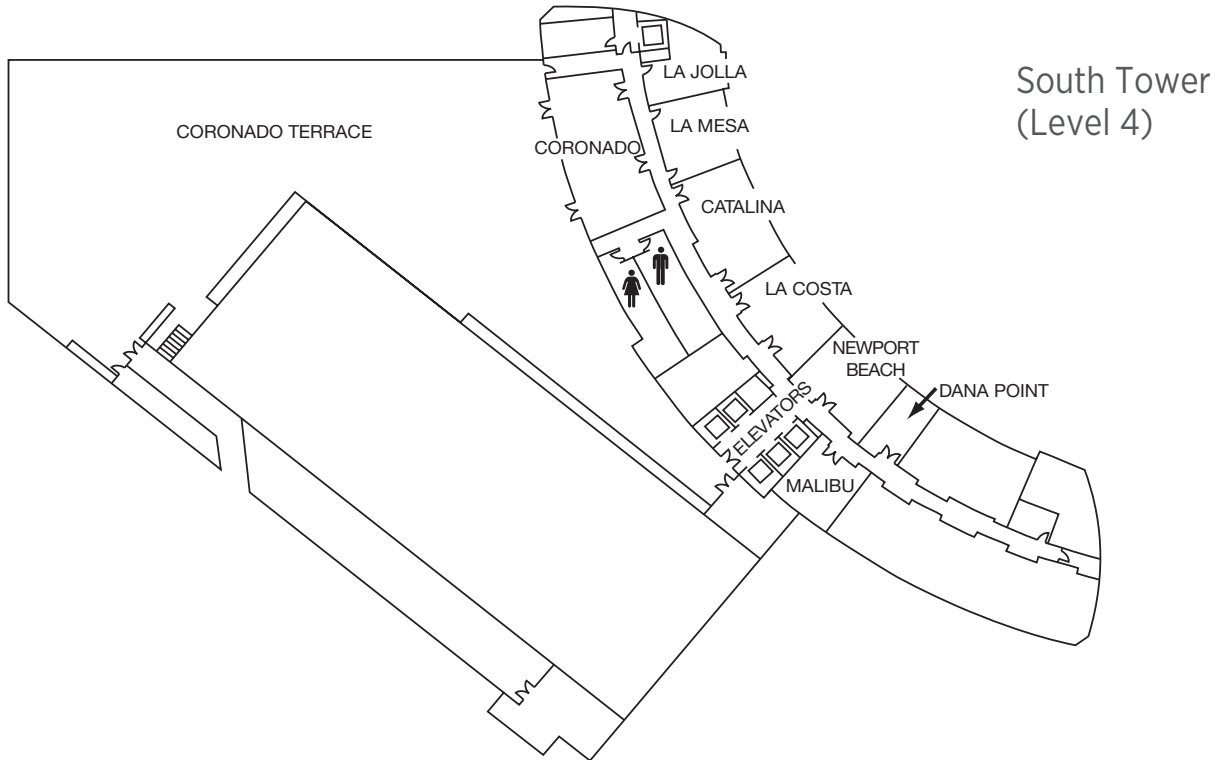
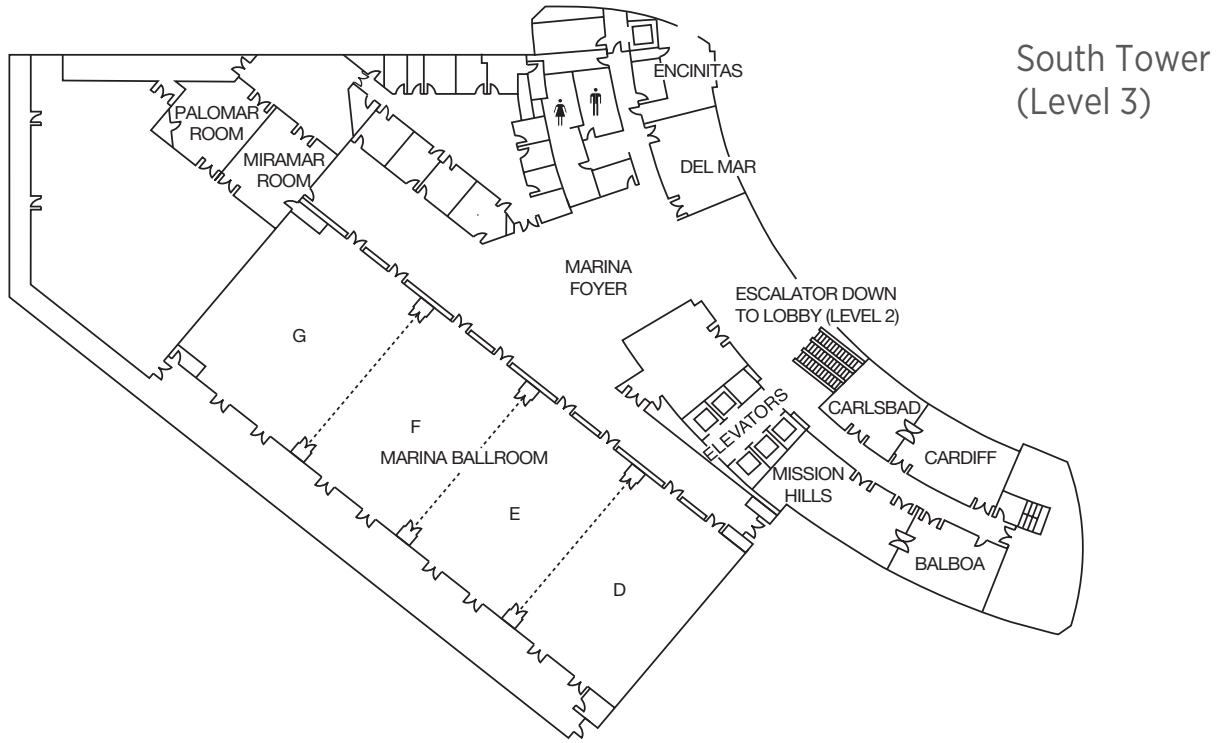


South Tower  
Pool Level  
(Level 1)



South Tower  
Lobby Level  
(Level 2)

# SAN DIEGO MARRIOTT MARQUIS AND MARINA MEETING ROOMS



# EVENTS SCHEDULE

SUNDAY	MONDAY	TUESDAY
<b>Career Choices Panel Discussion</b> , 9:00 to 10:15 am, p. 20	<b>Early Career Networking Breakfast</b> , 8:00 to 9:00 am, p. 17	<b>Photodetectors: Theory, Practice, Applications, and Selection</b> (Piatek) 8:00 to 9:45 am, p. 12
<b>Professional Development Speaker Series</b> , 10:30 am to 12:30 pm, p. 20	<b>Guest Hospitality Suite</b> , 8:30 to 10:00 am, p. 17	<b>Guest Hospitality Suite</b> , 8:30 to 10:00 am, p. 17
<b>Making the Most of your Presentation</b> (Doumont) 1:30 to 5:30 pm, p. 20	<b>Structuring your Research Paper</b> (Doumont) 8:30 am to 12:30 pm, p. 20	<i>Plenary Session: Hybrid Electro-Optics and Chip-scale Integration of Electronics and Photonics</i> (Dalton) 9:00 to 9:30 am, p. 24
<b>TECHNOLOGY HOT TOPICS: How Optics and Photonics Drive Innovation</b> (Soci, Lu, McEldowney, Cuk, Watzin) 6:00 to 7:50 pm, p. 22	<i>Plenary Session: 3D Laser Nanolithography</i> (Wegener) 9:15 to 10:00 am, p. 23	<i>Plenary Session: Molecular Plasmons</i> (Halas) 9:30 to 10:00 am, p. 24
<b>Optics Outreach Games</b> , 7:30 to 9:30 pm, p. 16	<i>Plenary Session: Controlling Light at the Atomic Scale</i> (García de Abajo) 10:30 to 11:15 am, p. 23	<b>Announcement of the Organic Photonics + Electronics Best Student Paper Award Winner</b> 10:00 to 10:15 am, p. 24
	<i>Plenary Session: Science, Engineering, and Commercialization of Flexible, Printable 2D Atomic Materials and Devices</i> (Akinwande) 11:15 am to 12:00 pm, p. 23	<b>Student Chapter Poster Exhibit</b> , 10:00 am to 5:00 pm, p. 19
	<b>Lunch with the Experts - A Student Networking Event</b> , 12:30 to 1:30 pm, p. 19	<b>Raman Spectroscopy: Theory and Practice</b> (Piatek) 10:15 am to 12:00 pm, p. 12
	<b>National Academies of Sciences Decadal Survey in Materials Science and Engineering</b> , 1:30 to 3:00 pm, p. 11	<i>Plenary Session: The History and Progress of Halide Perovskite Photovoltaics</i> (Park) 10:45 to 11:15 am, p. 25
	<b>Conveying Messages with Graphs</b> (Doumont) 1:30 to 5:30 pm, p. 21	<i>Plenary Session: Mesoscopic Photosystems for the Generation of Electricity and Fuels from Sunlight</i> (Grätzel) 11:15 to 11:45 am, p. 25
	<b>New Student Chapter Bootcamp</b> , 1:45 to 2:45 pm, p. 19	<b>SPIE Fellows Luncheon</b> , 12:00 to 1:30 pm, p. 15
	<i>Plenary Session: A Brief History of Photovoltaics: Yesterday, Today, and Tomorrow</i> (Gay) 2:00 to 2:30 pm, p. 23	<i>Plenary Session: Fast Automated 3D Modeling of Building Interiors</i> (Zakhor) 1:30 to 2:30 pm, p. 25
	<i>Plenary Session: Photovoltaics Moving into the Terawatt Age</i> (Weber) 2:30 to 3:00 pm, p. 24	<b>ABET Accreditation Workshop</b> , 3:00 to 5:00 pm, p. 21
	<i>Plenary Session: Bankability of Novel Energy Technologies</i> (Romero) 3:00 to 3:30 pm, p. 24	<b>Student Chapter Exhibit Mixer</b> , 3:30 to 5:00 pm, p. 17
	<b>Remembering Joe Yaver</b> , 3:00 to 4:30 pm, p. 17	<i>Plenary Session: Designing for one to one-million: how production quantities influence design</i> (Baldwin) 4:05 to 4:45 pm, p. 27
	<i>Panel Discussion: Astronauts and Astronomers to Enable the Most ambitious Space Observatories</i> (Thronson), 3:40 to 6:00 pm, p. 11	<i>Plenary Session: The Large Synoptic Survey Telescope</i> (Kahn) 4:50 to 5:30 pm, p. 27
	<b>Women in Optics Presentation and Reception</b> , 5:00 to 6:30 pm, p. 17	<b>Annual General Meeting of the SPIE Corporation</b> , 6:00 to 7:00 pm, p. 15
	<b>Poster Session</b> , 5:30 to 7:30 pm, p. 11	<b>SPIE Members Reception</b> , 7:00 to 8:30 pm, p. 15
	<b>All-Conference Welcome Reception</b> , 7:00 to 8:30 pm, p. 17	<b>An Optical Believe It or Not: Key Lessons Learned</b> (Kahan) 8:00 to 10:00 pm, p. 12
	<b>Illumination Technical Event</b> (Jacobsen) 8:00 to 10:00 pm, p. 11	<b>Lens Design Technical Event</b> , 8:00 to 10:00 pm, p. 12
		<b>Optomechanical/Instrument Technical Group Event</b> , 8:00 to 10:00 pm, p. 13
		<b>Penetrating Radiation Technical Event</b> , 8:00 to 10:00 pm, p. 13
		<b>Technology Roadmap for the Lynx X-Ray Mission</b> , 8:00 to 10:00 pm, p. 13
		<b>Workshop on X-Ray Optics</b> , 8:00 to 10:00 pm, p. 13



See course daily schedule, pages 52–55.  
 Register for courses or view course descriptions at the SPIE Cashier.

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# EVENTS SCHEDULE

WEDNESDAY	THURSDAY
<b>SPIE Senior Member Breakfast</b> , 8:00 to 9:00 am, p. 15	<b>Guest Hospitality Suite</b> , 8:30 to 10:00 am, p. 17
<b>Guest Hospitality Suite</b> , 8:30 to 10:00 am, p. 17	<b>Diversity and Inclusion Breakfast Reception</b> , 8:30 to 10:00 am, p. 17
<i>Plenary Session: Demonstrating Technologies for Hyperspectral Infrared Remote Sensing from Space on a CubeSat</i> (Pagano) 10:30 to 11:20 am, p. 27	<b>Software Demonstration in Computational Methods for X-Ray Optics</b> , 2:30 to 5:40 pm, p. 13
<b>Career Lab</b> , 3:30 to 5:00 pm, p. 17	
<b>Resumes to Interviews: Strategies for a Successful Job Search</b> (Krinsky, Welch) 3:30 pm to 5:30 pm, p. 21	
<b>Poster Session</b> , 5:30 to 7:30 pm, p. 13	
<b>SPIE 2017 Annual Awards Banquet</b> , 6:00 to 9:00 pm, p. 17	

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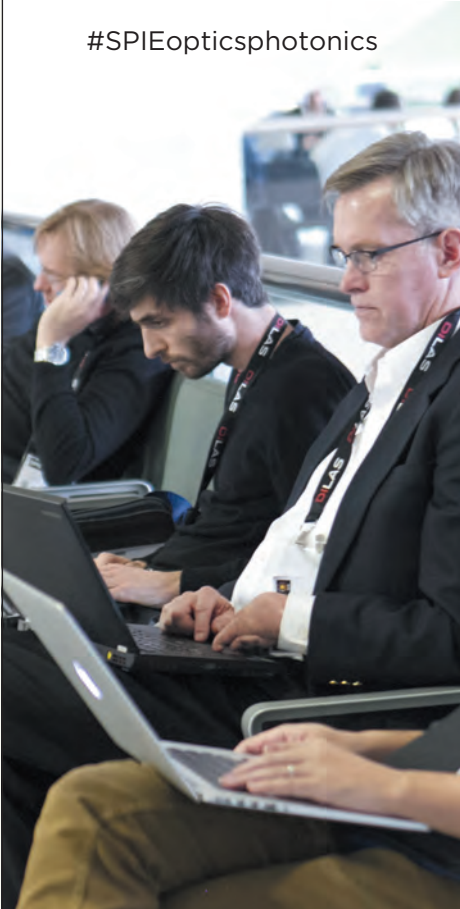


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# SEE THE EXHIBITION

**Tuesday 8 August · 10:00 am to 5:00 pm**  
**Wednesday 9 August · 10:00 am to 5:00 pm**  
**Thursday 10 August · 10:00 am to 2:00 pm**

See pages 28–29.



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## National Academies of Sciences Decadal Survey in Materials Science and Engineering

Monday 7 August 2017 · 1:30 PM to 3:00 PM

Location: Marriott Marquis, Marina F

The National Academies of Sciences, Engineering and Medicine is seeking community input for a study on the future of materials research (MR). Frontiers of Materials Research: A Decadal Survey will look at defining the frontiers of materials research ranging from traditional materials science and engineering to condensed matter physics. Please join members of the study committee for a town hall to discuss future directions for materials research in the United States in the context of worldwide efforts. In particular, input on the following topics will be of great value: progress, achievements, and principal changes in the R&D landscape over the past decade; identification of key MR areas that have major scientific gaps or offer promising investment opportunities from 2020-2030; and the challenges that MR may face over the next decade and how those challenges might be addressed. This study was requested by the Department of Energy and the National Science Foundation. The National Academies will issue a report in 2018 that will offer guidance to federal agencies that support materials research, science policymakers, and researchers in materials research and other adjoining fields. Learn more about the study at <http://nas.edu/materials>.

## Panel Discussion: Astronauts and Astronomers to Enable the Most Ambitious Space Observatories

Monday 7 August 2017 · 3:40 PM to 6:00 PM

Location: Conv. Ctr. Room 6E

*Moderator:* **Harley Thronson**, NASA Goddard Space Flight Ctr. (USA)

*Panelists:*

**Matthew A. Greenhouse**, NASA Goddard Space Flight Ctr. (USA)

**John M. Grunsfeld**, NASA Johnson Space Ctr. (USA)

**Rudranarayan Mukherjee**, Jet Propulsion Lab. (USA)

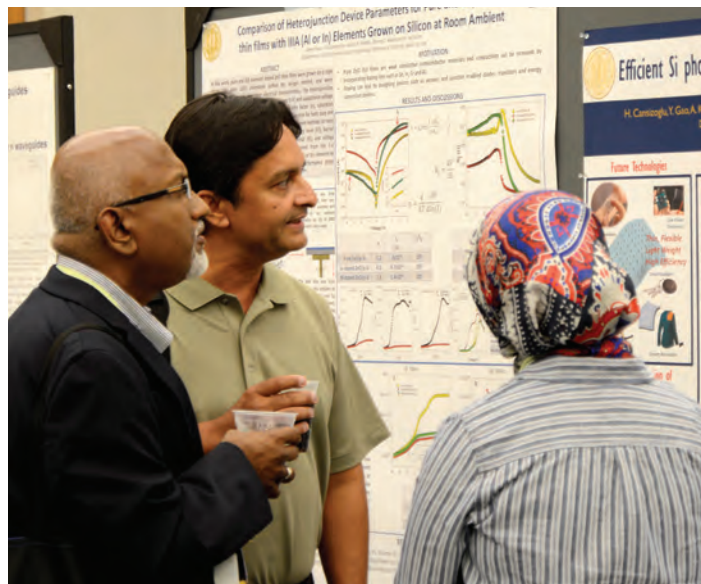
**Bradley M. Peterson**, Space Telescope Science Institute (USA)

**Nicholas Siegler**, Jet Propulsion Lab. (USA)

**Hsiao I. Smith**, NASA Goddard Space Flight Ctr. (USA)

This is a series of presentations and a discussion on using astronauts and robots to service, upgrade, and eventually assemble future space observatories that will achieve major breakthroughs in our understanding of the cosmos. These missions will be able to study in detail the structure of the first star-forming complexes in the earliest galaxies, the central engines in distant galaxies, and be sufficiently capable of searching very large numbers of extrasolar planets for evidence of life. The technical and engineering merits and challenges of in-space servicing and assembling large-aperture telescopes will be discussed, including issues of launching the telescope/instrument in parts, assembling it in space, and replacing outdated instruments. Also discussed will be possible future space infrastructure that may make more attractive on-orbit assembly. Precursors and demonstration activities will be noted, as well as the earliest candidate missions for in-space upgrade and servicing. The panel discussion will be initiated by the following featured presentations given by the Panelists:

- A vision for human space flight and scientific exploration and the search for life in the cosmos (Grunsfeld)
- Future space servicing: The GSFC Satellite Servicing Projects Division (Smith)
- Serviceability of future large space telescopes (Peterson)
- Robotic capabilities to enable large structures (Mukherjee)
- Candidate initial assembly mission: Starshade (Siegler/Greenhouse)



## Poster Session - Monday

Monday 7 August 2017 · 5:30 PM to 7:30 PM

Location: Conv. Ctr. Hall B2

Conference attendees are invited to view a collection of posters within the topics of Nanoscience and Engineering, Optics + Photonics for Sustainable Energy, Organic Photonics + Electronics, and Optical Engineering + Applications. Enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, visit <http://spie.org/OPPosterGuidelines> for set-up instructions.

## Illumination Technical Event

Monday 7 August 2017 · 8:00 PM to 10:00 PM

Location: Marriott Marquis, Mission Hills

*Chair:* **Jake Jacobsen**, Synopsys, Inc. (USA)

Please join us for an evening of stimulating discussion, networking, and conversation. This year we have two guest speakers.

**Dr. Charlie Gay** will be presenting a talk entitled "Where Have All the Photons Gone? Optimizing the Optical Properties of Solar Panels for Real World Applications". Dr. Gay is the Solar Energy Technologies Office Director for the Office of Energy Efficiency and Renewable Energy (EERE) of the U.S. Department of Energy (DOE).

**Dr. Bill Cassarly** will be giving us an overview of the submissions for this year's International Optical Design Conference's (IODC) Illumination Design Problem. Every four years the IODC sponsors a design competition for both imaging and illumination engineers. The problems posed are always highly challenging, very unusual, and completely ridiculous. Dr. Cassarly is a Synopsys Scientist in the Optical Solutions Group and Fellow of the SPIE and was an author and judge of this year's illumination design competition.

Don't miss what promises to be a fun and illuminating event. At the end of the presentations any member of the audience may present information within the broad field of illumination. Light refreshments will be served.

*Light refreshments sponsored by:*

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# TECHNICAL EVENTS

## Photodetectors: Theory, Practice, Applications, and Selection

Tuesday 8 August 2017 · 8:00 AM to 9:45 AM

Location: Marriott Marquis, Palomar

Photodetectors are essential components in a vast array of modern scientific and commercial instruments and devices; technological progress will make them even more ubiquitous. Understanding their opto-electronic properties, regimes of operation, circuit requirements, and noise characteristics is essential to a practitioner to make a proper photodetector selection for a given application.

The purpose of this presentation is to provide guidance in this process by discussing the above considerations for the four most common point photodetectors: photomultiplier tube, photodiode, avalanche photodiode, and silicon photomultiplier.

### Target Audience

The talk is open to anyone who uses low light level photodetectors or is involved with design of any system using photo detectors.

### Instructor



Slawomir Piatek, Hamamatsu

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## Raman Spectroscopy: Theory and Practice

Tuesday 8 August 2017 · 10:15 AM to 12:00 PM

Location: Marriott Marquis, Palomar

Information about the system under investigation may be contained in the spectrum of light received from it. Spectroscopy is an umbrella term referring to a multitude of measurement techniques that can be employed to access the information.

This presentation mentions several major dispersive and non-dispersive spectroscopic techniques such as, for example, fluorescence, Fourier transform, laser-induced breakdown, time-resolved, and discusses in greater detail three forms of Raman spectroscopy: normal, resonant, and surface enhanced. The discussion of Raman spectroscopy includes the theory behind the technique, the hardware components of a working setup, and the most common applications.

### Target Audience

The talk is open to anyone who would like to learn about theoretical and practical aspects of spectroscopy, in particular, dispersive Raman spectroscopy.

### Instructor



Slawomir Piatek, Hamamatsu

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## An Optical Believe It or Not: Key Lessons Learned

Tuesday 8 August 2017 · 8:00 PM - 10:00 PM

Location: Marriott Marquis, Carlsbad

Chair: **Mark Kahan**, Synopsys, Inc. (USA)

This event is dedicated to the sharing of key optical lessons learned. Nearly all optical engineers, scientists, researchers, or managers have dealt with the unexpected. Many of these situations in hindsight are quite funny, and have buried within them key optical/managerial lessons learned. The problem with simply listing lessons learned is that as a simple listing, they are clearly hard to remember, thus history repeats itself much to our collective debit. This evening event will help us all remember the important take-aways by presenting a collection of small stories or optical parables from Leaders in the fields of optics and optical systems engineering. In this evening Session there will be three primary speakers, and each speaker will be given the freedom to embellish their material (within editorial limits), and names, places, and dates may be changed to protect the guilty, but all the take-aways will have a basis in truth as avowed by the author.

## WAR STORIES FROM FORTY-FIVE YEARS IN OPTICAL PRODUCTION ENGINEERING

**Ray Williamson**, Ray Williamson Consulting, (USA)

## AN OPTICAL JOURNEY: TALES FROM THE LIGHT SIDE OF OPTICS

**Robert E. Schalck**, Optical Development Research Engineer (USA)

## LESSONS LEARNED IN LASER LAB DESIGN AND WORKINGS INCLUDING DOE LASER ACCIDENTS AND QUESTIONABLE SAFETY PRACTICES

**Kenneth Barat**, Laser Safety Solutions (USA)

Audience participation will be allowed/ encouraged, as time permits.

## Lens Design Technical Event

Tuesday 8 August 2017 · 8:00 PM to 10:00 PM

Location: Marriott Marquis, Marina F

Session Chair: **Rich Pfisterer**, Photon Engineering, LLC (USA)

### “LET’S GIVE ‘EM SOMETHING TO TALK ABOUT!”


Lens designers! Join us for our annual gathering to meet and discuss... lens design! Let’s talk about what we’re designing, how we’re going about doing it (what materials, software, techniques, etc.), and which problems we’re encountering. We’ll also explore current technical and commercial trends in the marketplace.

This year’s invited speaker will be Dave Shafer of David Shafer Optical Design, whose talk is entitled, “My 51 Years of Optical Design Using Husserl’s Phenomenology.” Many optical design examples will be shown that illustrate a systematic way of ‘thinking outside the box’ while doing creative design. This approach is based on insights of Edmund Husserl and his phenomenology school of philosophy.

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## Optomechanical/Instrument Technical Group Event

Tuesday 8 August 2017 · 8:00 PM to 10:00 PM

Location: Marriott Marquis, Mission Hills

*Session Chair:* **Alson E. Hatheway**, Alson E. Hatheway Inc. (USA)

This is the annual meeting of the premier group of optomechanical engineers that design and analyze the world's optical instruments and systems. This gathering is open to all technical attendees of SPIE Optics+Photonics. The featured speaker will be Daniel Vukobratovich of Raytheon Missile Systems, and a co-founder and previous chairman of our Optomechanical/Instrument Technical Group. He'll discuss the subtleties and challenges in designing and using what a "wag" might call the "common" binocular. He'll discuss both optical and environmental factors in selecting the right binocular for astronomy, birding, hunting and other general purpose uses. Following Dan, the floor will be open for other agenda items and a workshop session on Problems and Solutions. Anyone who wishes to put an item on the agenda should contact the Chair, Al Hatheway, at aeh@aehinc.com. Come prepared to present some challenges to the Group.

## Penetrating Radiation Technical Event

Tuesday 8 August 2017 · 8:00 PM to 10:00 PM

Location: Marriott Marquis, Balboa

*Chair:* **James E. Baciak**, Univ. of Florida (USA)

This event brings together technologists and scientists with interests in neutron, x- and gamma-ray detection, spectroscopy, and imaging for all applications. This year's featured speaker is Dr. Rachel Slaybaugh from University of California, Berkeley. She will be giving a talk on "Advanced Solvers and Innovation for Penetrating Radiation." Dr. Slaybaugh will cover the need innovation in the nuclear space to enable new (and maintain existing) reactors, enhance nuclear security, and improve nuclear science. To truly enable breakthroughs by investigating new ideas rapidly, we need accurate simulation and appropriate research tools. This requires new methods in computational neutron transport, better simulation and better tools for penetrating radiation detection and measurement. Finally, this talk will briefly cover educational initiatives bringing an innovative mindset into the nuclear field. After the featured speaker the floor will be open to discussions.

## Technology Roadmap for the Lynx X-Ray Mission

Tuesday 8 August 2017 · 8:00 PM to 10:00 PM

Location: Marriott Marquis, Marina D

*Session Moderator:* **Jessica A. Gaskin**, NASA Marshall Space Flight Ctr. (USA)

The NASA Astrophysics Division has commissioned four studies to be presented to the next Decadal Survey of Astronomy and Astrophysics as potential flagship missions for the next decade. One of these potential missions is the Lynx X-ray Mission. This will be an open forum/discussion regarding technologies for the optics and science instruments for the Lynx Mission. We will conduct a collaborative work space to discuss these technologies within the context of a technology Roadmap, with open discussion.

## Workshop on X-Ray Optics

Tuesday 8 August 2017 · 8:00 PM to 10:00 PM

Location: Marriott Marquis, Cardiff

*Chair:* **Ali M. Khounsary**, Illinois Institute of Technology (USA); **Daniele Cocco**, SLAC National Accelerator Lab. (USA)

The X-Ray Optics Working Group provides an informal setting for the interested engineers and scientists to meet and discuss issues related to the design, analysis, cooling, fabrication, and metrology of x-ray optics. Topics for discussion can be e-mailed to the organizer, Dr. Ali Khounsary (amk@iit.edu), prior to the meeting.

## Poster Session - Wednesday

Wednesday 9 August 2017 · 5:30 PM to 7:30 PM

Location: Conv. Ctr. Hall B2

Conference attendees are invited to view a collection of posters within the topics of Nanoscience and Engineering, Optics + Photonics for Sustainable Energy, and Optical Engineering + Applications. Enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, visit <http://spie.org/OPPosterGuidelines> for set-up instructions.

## Software Demonstration in Computational Methods for X-Ray Optics

Thursday 10 August 2017 · 2:30 PM to 5:40 PM

Location: Conv. Ctr. Room 15B

Computer codes that are extensively used for optical simulations in a broad spectral domain extending from THz to hard x-rays will be demonstrated in real-time by their authors/development teams. The codes use different simulation methods and different approximations, from geometrical to physical optics. Some allow for high-accuracy treatment of the effects of full and partial coherence of the radiation beams. Even though most of these codes were developed for simulation of sources and optics of large light source facilities -- synchrotrons and free-electron lasers -- some can be effectively used for table-top optical systems, e.g. for conventional steady-state or pulsed lasers.

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- SPIE Member Reception
- Student Leadership Workshop
- SPIE Career Center Booth 657



# ATTEND THE SPIE AWARDS BANQUET

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Wednesday 9 August 2017  
6 PM to 9 PM  
San Diego Marriott Marquis and Marina

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SPIE honors the top minds in optics and photonics at its annual Awards Banquet. This event is designed to recognize individuals for the exceptional achievements and outstanding contributions they've made to the science of light. SPIE President and host for the evening, Glenn Boreman, invites you to come celebrate with us. Plan on an evening honoring colleagues, relaxing with friends, and inspiring the next generation of scientists and engineers.

**Price \$60** - Purchase tickets onsite at SPIE Cashier Desk until 12 PM Tuesday 8 August. Space permitting.



SPIE.  
**AWARDS**





## SPIE Fellows Luncheon

Tuesday 8 August 2017 · 12:00 PM to 1:30 PM

Location: Marriott Marquis, Marina Ballroom G

All SPIE Fellows are invited to join your colleagues for this SPIE-hosted luncheon. The new Optics and Photonics SPIE Fellows will be introduced and receive their SPIE Fellow plaques and pins. Please join us for this informal gathering and a chance to interact with other fellows.

Fellows planning to attend are asked to RSVP to Brent Johnson, [brentj@spie.org](mailto:brentj@spie.org).

*Fellows Luncheon Presentation:*

### MINORITIES IN SCIENCE: WHY SO FEW?



#### Dr. Peter J. Delfyett

Director, Townes Laser Institute  
CREOL, The College of Optics & Photonics

This talk will briefly describe the challenges of attracting and retaining minorities in science. Personal examples from the speaker will be touched upon, highlighting the importance of key factors such as economics, role models and mentors.

## Annual General Meeting of the SPIE Corporation

Tuesday 8 August 2017 · 6:00 PM to 7:00 PM

Location: Marriott Marquis, Marina E  
San Diego Marriott Hotel and Marina

The Society of Photo-Optical Instrumentation Engineers (SPIE)

Agenda:

- 2017 Election Results
- Report on the "State of the Society"
- Treasurer's Report
- Q & A with SPIE Officers

This is the general business meeting of the Society. All SPIE members are welcome and encouraged to attend. This is your forum for expressing your ideas about the Society. Results of the 2017 election will be announced and the President and CEO will report on the "State of the Society." This meeting will be followed by the Members Reception. Both events are open to members only. Members will receive an email with instructions on how to live stream the AGM. Questions are encouraged.



## SPIE Members Reception

Tuesday 8 August 2017 · 7:00 PM to 8:30 PM

Location: Marriott Marquis, Coronado Terrace

For SPIE Members Only. (Membership will be checked at the entrance for admission.)

All SPIE Members are invited to this reception in their honor. Come relax and talk with your colleagues. Refreshments will be served. Please note: this reception is limited to SPIE Members only. Membership cards or invitations will be requested at the entrance. If you join SPIE onsite, please bring your registration receipt. Dress is casual or business attire.


## SPIE Senior Member Breakfast

Wednesday 9 August 2017 · 8:00 AM to 9:00 AM

Location: Marriott Marquis, Marina Ballroom G

All SPIE Senior Members are invited to join your colleagues for this sixth annual SPIE-hosted buffet breakfast. Please join us for this informal gathering and a chance to interact with other Senior Members. Please plan to wear your yellow Senior Member ribbon issued from the registration area for entry into this event.

Senior Members planning to attend are asked to RSVP to Brent Johnson, [brentj@spie.org](mailto:brentj@spie.org).



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# NETWORKING EVENTS



## Hidden Figures Film Screening

Saturday 5 August 2017 · 7:00 to 9:30 pm

Location: Marriott Marquis, La Costa

SPIE Diversity and Inclusion invites you to join the students for a screening of *Hidden Figures*, a 2016 film that explores the ways in which African American female mathematicians defied societal norms and helped make history working at NASA during the 20th Century Space Race. After the film, a discussion will be hosted by members of the SPIE Diversity and Inclusion Ad-hoc Subcommittee.

All attendees are welcome.

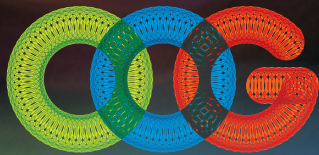
## Optics Outreach Games

Sunday 6 August 2017 · 7:30 PM to 9:30 PM

Location: Marriott Marquis, Marina Ballroom D/E

View optics and photonics demonstrations from student chapters worldwide while enjoying refreshments and networking in a casual atmosphere. Students relax and hang out with peers while engaging in a friendly competition.

For demonstration videos from last year's Games, visit [www.SPIE.org/OutreachGames](http://www.SPIE.org/OutreachGames).



# OPTICS OUTREACH GAMES 2017

Sunday 6 August 2017, 7:30 to 9:30 pm

San Diego Marriott Marquis, Marina D & E

**Optics Community:** View the best optics and photonics demonstrations from student chapters worldwide. Take part in outreach activities and competitions while enjoying refreshments.

**Student Chapters:** Showcase your best outreach efforts and compete for medals against other chapters from around the globe.

**Teachers:** Learn new activities for the classroom and collect materials to help get you started.

[www.spie.org/OutreachGames](http://www.spie.org/OutreachGames)

**SPIE.**



# NETWORKING EVENTS

## Guest Hospitality Suite

Monday–Thursday, 7–10 August 2017 · 8:30 to 10:00 am

Location: Marriott Marquis, South Tower, Suite 2573

Guests of attendees are invited to meet, relax, and enjoy a cup of coffee and light breakfast in the SPIE Guest Hospitality Suite. This suite is for guests of attendees only. The hotel concierge will be available during a portion of this time to answer travel, shopping, and tourist questions.

## Early Career Networking Breakfast

Monday 7 August · 8:00 to 9:00 AM

Location: Marriott Marquis, Mission Hills

Start your conference off with a good breakfast and network building with SPIE Leadership. All early career professionals are invited to attend this informal event. Connect with the volunteer leadership of SPIE and your peers. A breakfast buffet will be provided. An RSVP to [earlycareer@spie.org](mailto:earlycareer@spie.org) by 24 July is required to confirm your attendance.

## Remembering Joe Yaver

Monday 7 August · 3:00 PM to 4:30 PM

Location: Marriott Marquis, Marina Ballroom G

Join us as we celebrate the life of an extraordinary individual, Joe Yaver. Through the memories of his colleagues, friends and family we will reflect on his inspiration as a leader and his many contributions to SPIE.

## Women in Optics Presentation and Reception

Monday 7 August 2017 · 5:00 PM to 6:30 PM

Location: Marriott Marquis, Marina Ballroom F

Join us for a presentation made by our SPIE Gender Equity Task Force, highlighting ways in which we can improve gender equity and help keep women in the optics and photonics workplace.

The presentation will be followed by a panel discussion on overcoming mid-career obstacles moderated by Ms. Katie Schwartz, Optical Research Engineer at Edmund Optics Inc. Panelists include: Dr. Julia Craven, Principal Member of Technical Staff at Sandia National Labs; Dr. Eva Campo, Program Director at the National Science Foundation (NSF); Dr. Pernille Pedersen, Postdoctoral Fellow at Brown Univ.; and Prof. Julie Bentley, Associate Professor at the Univ. of Rochester.

A networking reception will follow the panel discussion.

This event is open to all attendees.

## All-Conference Welcome Reception

Monday 7 August 2017 · 7:00 PM to 8:30 PM

Location: Conv. Ctr. West Terrace (Upper Level)

All registered conference attendees are invited to relax, socialize, and enjoy refreshments with your colleagues. In addition, volunteers from the San Diego Astronomy Club will set up a variety of telescopes for those who want to view the wonders of the night sky, learn about different telescopes, and share their interest in astronomy. The reception and sky viewing are open to all registered conference attendees. Tickets for guests of registered conference attendees may be purchased during the registration process or at the registration desk onsite.

## Student Chapter Exhibit Mixer

Tuesday 8 August 2017 · 3:30 PM to 5:00 PM

Location: Conv. Ctr. Hall B1

Join us for refreshments and a late-afternoon mixer in the Student Chapter section of the Exhibition Hall. Meet our amazing students and learn about the innovative activities of some of the best and brightest Student Chapters across the globe!

## Career Lab

Wednesday 9 August 2017 · 3:30 PM to 5:00 PM

Location: Conv. Ctr., Hall B1

Join us at the Career Lab, where students and Early Career Professionals will have a chance to meet and greet with industry professionals and accomplished academics. It is a space for asking questions and providing career advice. Don't forget to tour the Job Fair while you are there!

All attendees are welcome.

## SPIE 2017 Annual Awards Banquet

Wednesday 9 August 2017 · 6:00 PM to 9:00 PM

Location: Marriott Marquis, Marina Ballroom

SPIE honors the top minds in optics and photonics at its annual Awards Banquet. This event is designed to recognize individuals for the exceptional achievements and outstanding contributions they've made to the science of light. SPIE President and host for the evening, Glenn Boreman, invites you to come celebrate with us. Plan on an evening honoring colleagues, relaxing with friends, and inspiring the next generation of scientists.

Purchase tickets onsite at the SPIE Cashier Desk (before 12 noon Tuesday 8 August, space permitting). \$60 USD includes drink, appetizer and dinner.

## Diversity and Inclusion Breakfast Reception

Thursday 10 August · 8:30 AM to 10:00 AM

Location: Marriott Marquis, Mission Hills

Join us at the end of the week to relax and learn. This networking event is a great time to connect and build relationships with others interested promoting diversity and inclusion. Light breakfast will be served. All are welcome.



# STUDENT EVENTS

## Student Chapter Leadership Workshop

Saturday 5 August 2017 · 8:00 AM to 5:00 PM

Location: Marriott Marquis, Marina Ballroom D/E

Open to SPIE Student Chapter members

Participate in the SPIE Student Chapter Leadership Workshop with 250 other student chapter leaders from around the world. During this highly interactive, all-day event facilitated by Dr. Jean-luc Doumont, you will discuss what being a leader is all about (and what it is not about), how to persuade others, and how to go from ideas to achievements for your chapter. Expect to gain new insights, make new friends, and overall spend a rich and enjoyable first day at the conference.



**Jean-luc Doumont**, Principiae

An engineer (Louvain) and PhD in applied physics (Stanford), Jean-luc is acclaimed worldwide for his no-nonsense approach and his highly applicable, often life-changing recommendations on a wide range of topics. During his workshops, he uses trees, maps, theorems, and other tools featured in his book about “effective communication for rational minds.” He is also a popular visiting lecturer for SPIE and travels several times a year to

speak to chapters around the world. For more information about Jean-luc, please visit [www.principiae.be](http://www.principiae.be).

All SPIE Chapter members are welcome but must register to attend. Please email [Students@spie.org](mailto:Students@spie.org) to register or request more information.

## Student Chapter Leadership Workshop Facilitators



**Dilia Aguirre-Olivas**  
National Autonomous University of Mexico (UNAM)



**Anel Garza Rivera**  
Vitro Automotriz



**Mark Knight**  
Northrop Grumman Corp.



**Kyla Ross**  
DRS Daylight Solutions



**Chia-Ming Chang**  
National Chiao Tung University



**Goldie Goldstein**  
Nikon Research Corporation of America



**Michael Mele**  
II-VI Optical Systems, Inc.



**Inga Saknite**  
Beckman Laser Institute, UC-Irvine; University of Latvia



**Robert Chen**  
Zoox, Inc.



**Dustin Haas**  
Eagleview Technologies



**Majid Najj**  
National Research Council of Canada



**Guillermo Sanchez-Guerrero**  
Universidad Autonoma de Nuevo Leon



**Cathy Chen**  
Exponent, Inc



**Yi Hua**  
Intel



**Kathy Nguyen**  
Raytheon



**Badrinath Vadakkapattu**  
Karlsruhe Institute of Technology



**Javier Concha**  
NASA Goddard Space Flight Center



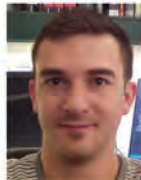
**Shayna Khatri**  
Coherent Inc



**Nishant Patel**  
Sandia National Laboratories



**Michael Williams**  
Delaware State University



**Alexander Doronin**  
Yale University



**Pernille Klarskov Pedersen**  
Brown University



**Aaswath Raman**  
SkyCool Systems Inc.



**Cheng Zhang**  
Center for Nanoscale Science and Technology, NIST

## Lunch with the Experts - A Student Networking Event

Monday 7 August 2017 · 12:30 PM to 1:30 PM  
Location: Marriott Marquis, Marina Ballroom D/E  
Open to Student Conference Attendees

Enjoy a casual meal with colleagues at this engaging networking opportunity. This event features experts willing to share their experience and wisdom on career paths in optics and photonics. It also includes an awards presentation for Newport travel grant winners and SPIE education and travel scholarship winners. Seating is limited and will be granted on a first-come, first-served basis.

Sponsored by:  **Newport**  
Experience | Solutions

## Student Chapter Bootcamp

Monday 7 August 2017 · 1:45 PM to 2:45 PM  
Location: Marriott Marquis, Palomar  
Open to Student Chapter Members

Members of SPIE student chapters are invited to this informal session to learn the nuts and bolts of chapter benefits and chapter management. Come learn what benefits are available, how to use them, and ask any questions you may have about running a chapter. Students interested in forming a student chapter also welcome to attend.

## Student Chapter Poster Exhibit

Tuesday 8 August 2017 · 10:00 AM to 5:00 PM  
Location: Conv. Ctr. Hall B1

Discover the research of some of the brightest SPIE student groups and the programs they have developed to increase optics awareness and literacy in their regions.



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Sunday–Thursday  
8:00 am to 5:00 pm  
Location: Conv. Ctr.,  
Ballroom 6 Lobby

Meet our app developers and get an in-depth tour of the Conference and Exhibition App. We want your feedback on current and future features to help improve the conference experience.



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**SPIE.**



# PROFESSIONAL DEVELOPMENT EVENTS



## Career Choices Panel Discussion

Sunday 6 August 2017 · 9:00 AM to 10:15 AM  
Location: Marriott Marquis, Marina F

Open to all Students and Early Career Professionals

What are the critical career choices and decisions that face new graduates in optics and photonics? What are some strategies for navigating the transition from student to professional? Get a perspective from our panelists in this wide-ranging discussion.

## Professional Development Speaker Series

Sunday 6 August 2017 · 10:30 AM to 12:30 PM  
Location: Marriott Marquis, Mission Hills and Balboa

Open to all Students and Early Career Professionals

Join us for exciting break-out sessions focusing on career and professional skills development. Come ready to share your thoughts and ideas!



10:30 to 11:20 AM · Balboa Room

### WORKING EFFICIENTLY DURING YOUR PHD

**Jean-luc Doumont**, Principia



10:30 to 11:20 AM · Mission Hills Room

### SUCCESSFUL SCIENCE OUTREACH

*Moderator:* **Mike McKee**, CREOL

*Panelists:* SPIE Student Chapter Members



11:30 AM to 12:20 PM · Balboa Room

### WRITING AN IMPACTFUL MANUSCRIPT FOR PUBLICATION

**Maryellen Giger**, The Univ. of Chicago,  
SPIE President-Elect



11:30 AM to 12:20 PM · Mission Hills Room

### NEGOTIATION IN PRACTICE

*Moderator:* **Robert Chen**, Zoux Inc.

## Making the Most of Your Presentation

Sunday 6 August 2017 · 1:30 PM to 5:30 PM  
Location: Marriott Marquis, Balboa

### WS897

Course Level: Introductory

Course Length: Half-day (3.5 hours)

Continuing Education Units (CEU): 0.35 Only available upon request.

Oral presentation skills are a key to success for researchers and professionals alike. This course offers a no-nonsense approach to preparing and giving presentations, with a particular focus on structure, slides, and delivery. It also offers tips on how to manage the nervousness associated with speaking in public.

### Learning Outcomes

This course will enable you to:

- organize your material into an effective structure
- create slides that get the message across
- deliver your presentation effectively, both verbally and nonverbally

### Intended Audience

This course is intended for anyone who must prepare and give oral presentations about his or her research work. Both novice and experienced speakers can expect to gain a lot from it.

### Instructor

**Jean-luc Doumont** runs lectures and workshops in scientific communication, pedagogy, critical thinking, and more for engineers, scientists, and other rational minds. He is an engineer from the University of Louvain and a doctor in applied physics from Stanford University. Articulate, entertaining, and thought-provoking, he is a popular invited speaker at top-notch universities and research centers worldwide.

Note: This course is free to technical attendees. No advance registration required.

## Structuring Your Research Paper

Monday 7 August 2017 · 8:30 AM to 12:30 PM  
Location: Marriott Marquis, Balboa

### WS908

Course Level: Introductory

Course Length: Half-day (3.5 hours)

Continuing Education Units (CEU): 0.35 Only available upon request.

Strong writing skills are a key to success for researchers and professionals alike. This course discusses how to structure research papers, dissertations, and other reports effectively at all levels to get the readers' attention, facilitate navigation, and thus get the message across optimally to their audiences.

### Learning Outcomes

This course will enable you to:

- create an effective abstract, introduction, and conclusion
- organize your material into an accessible structure
- construct paragraphs that get the message across

### Intended Audience

This course is intended for anyone who must write or edit technical documents in general and research papers in particular. Both novice and experienced authors can expect to gain a lot from it.

### Instructor

**Jean-luc Doumont** runs lectures and workshops in scientific communication, pedagogy, critical thinking, and more for engineers, scientists, and other rational minds. He is an engineer from the University of Louvain and a doctor in applied physics from Stanford University. Articulate, entertaining, and thought-provoking, he is a popular invited speaker at top-notch universities and research centers worldwide.

Note: This course is free to technical attendees. No advance registration required.

# PROFESSIONAL DEVELOPMENT EVENTS

## Conveying Messages with Graphs

Monday 7 August 2017 · 1:30 PM to 5:30 PM

Location: Marriott Marquis, Balboa

### WS1202

Course Level: Introductory

Course Length: Half-day (3.5 hours)

Continuing Education Units (CEU): 0.35 Only available upon request.

Widely used in research and development to analyze and communicate data, graphical displays are still poorly mastered by researchers (and popular software does not help). This course discusses how to create more effective graphs—graphs that are truly visual, are truthful to the data, and get the message across.

### Learning Outcomes

This course will enable you to:

- select the right graph for a given data set and a given research question
- optimize this graph to make it intuitive and to reveal the data
- phrase a caption that gets the message across

### Intended Audience

This course is intended for anyone who must create graphs for written documents or oral presentations. Both novice and experienced authors/speakers can expect to gain a lot from it.

### Instructor

**Jean-luc Doumont** runs lectures and workshops in scientific communication, pedagogy, critical thinking, and more for engineers, scientists, and other rational minds. He is an engineer from the University of Louvain and a doctor in applied physics from Stanford University. Articulate, entertaining, and thought-provoking, he is a popular invited speaker at top-notch universities and research centers worldwide.

Note: This course is free to technical attendees. No advance registration required.

## ABET Accreditation Workshop

Tuesday 8 August 2017 · 3:00 PM to 5:00 PM

Location: Marriott Marquis, Balboa

Join Scott Teare, an experienced ABET program evaluator, for a workshop covering the ins and outs of ABET accreditation. This workshop is intended for faculty or staff of programs that are considering ABET accreditation or that plan to renew their ABET accreditation in the future. Professor Teare will provide advice on approaches to navigating the accreditation process efficiently and successfully. Topics will include self-study writing, visit process management, and program requirements. Ample time will be reserved for questions and answers. The workshop is provided at no additional charge to paying attendees. Scott Teare is Professor of Electrical Engineering at New Mexico Tech, and serves ABET as a program evaluator (PEV), PEV Mentor, Team Chair, and Commissioner on the Engineering Accreditation Commission. ABET accredits college and university programs in applied science, computing, engineering, and engineering technology at approximately 3,700 programs in 30 countries.

## Resumes to Interviews: Strategies for a Successful Job Search

Wednesday 9 August 2017 · 3:30 PM to 5:30 PM

Location: Marriott Marquis, Mission Hills

### WS1059

Course Level: Introductory

Course Length: Two hours

Continuing Education Units (CEU): 0.35 Only available upon request.

This course reviews effective strategies and techniques for a successful job search such as: compiling resumes, writing cover letters, and interviewing tips. The primary goal of the course is to provide creative and proven techniques for new college graduates and professionals to plan and conduct their job search and secure a job. Creative and comprehensive job search techniques will be discussed as well as actual resume and interviewing examples and tips. Anyone who is getting ready to enter the work force who wants to answer questions such as, "when and how do I start my job search?", "what kind of cover letter and resume gets noticed?" or "how do I sell myself in an interview?" will benefit from taking this course.

### Learning Outcomes

This course will enable you to:

- start and create your job search plan
- create an online networking presence
- build and write effective cover letters and resumes that get noticed
- avoid common resume and cover letter mistakes
- interview with confidence

### Intended Audience

Graduate students, new graduates, and early-career professionals who wish to learn more about creating a job search plan, writing an effective cover letter and resume that gets you noticed, and techniques for successful interviews.

### Instructors

**Suzanne Krinsky** has been in human resources and corporate recruiting for more than 15 years. She has extensive experience with both in-house corporate environments as well as outside agency/consulting environments. Suzanne is currently the Human Resource Director for Daylight Solutions in San Diego, and also a long-time Board member for the Biotech Human Resource Development Coalition (BEDC) and Human Resource Roundtable member.

**Heather Welch** has been in human resources and corporate recruiting for more than 20 years. She has extensive experience with both in-house corporate environments as well as outside agency environments. Heather is currently the Sr. Recruiter for Daylight Solutions in San Diego, and also a member of SHRM, IEEE, and SWE.

Note: This course is free to technical attendees. No advance registration required. This workshop presents introductory information and is intended primarily for university students and others with little professional experience.



# PLENARY SESSIONS AND HOT TOPICS



## TECHNOLOGY HOT TOPICS

### How Optics and Photonics Drive Innovation

Sunday 6 August · 6:00 to 7:50 PM · Location: Conv. Ctr. Ballroom 6A

6:00 to 6:10 PM

#### Welcome and Opening Remarks



6:10 to 6:30 PM

#### QUANTUM DEVICES

**Cesare Soci,**  
Nanyang Technological Univ. (Singapore)



7:10 to 7:30 PM

#### SOLAR FUELS

**Tanja Cuk,**  
Univ. of California, Berkeley (USA)



6:30 to 6:50 PM

#### BIOELECTRONICS— WEARABLES AND IMPLANTABLES

**Nanshu Lu,**  
Univ. of Texas at Austin (USA)



7:30 to 7:50 PM

#### AUTONOMOUS VEHICLES

**James G. Watzin,**  
Director of NASA's Mars Exploration Program  
(USA)



6:50 to 7:10 PM

#### AR/VR

**Scott McEldowney,**  
Oculus (USA)

## Nanoscience + Engineering Plenary Session

Monday 7 August · 9:15 AM to 12:00 PM

Location: Conv. Ctr. Ballroom 6A

*Session Chairs:* **Harry A. Atwater**, California Institute of Technology (USA) and **Nikolay I. Zheludev**, Opto-electronics Research Ctr. (United Kingdom)

9:15 to 10:00 PM

### 3D LASER NANOLITHOGRAPHY



**Martin Wegener**, Karlsruhe Institut für Technologie (Germany)

Three-dimensional (3D) laser lithography has become a versatile, reliable, and widespread workhorse for fabricating 3D micro- and nanostructures. I will illustrate the current state-of-the-art by selected examples, including free-form micro-optics, 3D optical and other metamaterials, as well as functionalized 3D scaffolds for biological cell culture. I will speculate about near-term industrial applications and outline remaining technological

challenges regarding spatial resolution, scalability, and multi-material 3D nano-printing.

**Martin Wegener** is a Professor at the Institute of Applied Physics of Karlsruhe Institute of Technology (KIT) and Director and Research Unit Chair at Institute of Nanotechnology of KIT. His group currently works on 3D laser lithography, 3D metamaterials, and 3D scaffolds for cell culture. In 2014-2016, Thomson Reuters listed him as a "Highly Cited Researcher".

Coffee Break 10:00 to 10:30

10:30 to 11:15 PM

### CONTROLLING LIGHT AT THE ATOMIC SCALE



**F. Javier García de Abajo**, ICFO - Institut de Ciències Fotòniques (Spain)

Atomically thin materials such as graphene and molecular aromatic hydrocarbon exhibit unique optical properties that allow us to control the flow of light down to the atomic scale. These materials can sustain collective electron resonances -plasmons- involving a relatively small number of electrons, therefore enabling unprecedented electrical, magnetic, optical, and thermal control of those properties. In this talk, I will review recent progress in this

field and present illustrative examples of non-linear, quantum, and ultrafast phenomena in these materials, along with applications to optical sensing, optoelectronics, and quantum optics.

**Javier García de Abajo** received his PhD from the University of the Basque Country in 1993, moved to Lawrence Berkeley National Laboratory during 1997-2000, and became a Research Professor at the Spanish Scientific Research Council (CSIC) in 2008. He is an ICREA Research Professor at ICFO (Bar-celona) since 2013.

11:15 AM to 12:00 PM

### SCIENCE, ENGINEERING, AND COMMERCIALIZATION OF FLEXIBLE, PRINTABLE 2D ATOMIC MATERIALS AND DEVICES



**Deji Akinwande**, The Univ. of Texas at Austin (USA)

This talk will focus on the scientific progress, engineering achievements, and commercialization of flexible/printable atomically thin materials (graphene, TMDs, phosphorus, Xenon, etc.) and devices. A variety of advancements have been made in electronic, photonic, and passive devices over the past decade including the demonstration of 100GHz flexible transistors, discovery of novel switching properties, development of electronic tattoos, and understanding of interlayer coupling via

high-pressure physics. In addition, nanomanufacturing advancements have enabled large-area materials which for the case of graphene has resulted in several commercial products. The talk will conclude with a perspective for the next decade of research.

**Dr. Deji Akinwande** is an Endowed Faculty Fellow and Associate Professor at the University of Texas at Austin. He received the PhD degree from Stanford University in 2009. Prof. Akinwande has been honored with the 2016 Presidential PECASE award, the inaugural Gordon Moore Inventor Fellow award, the inaugural IEEE Nano Geim and Novoselov Graphene Prize, the IEEE "Early Career Award" in Nanotechnology, the NSF CAREER award, several DoD Young Investigator awards, and was a past recipient of fellowships from the Kilby/TI, Ford Foundation, Alfred P. Sloan Foundation, 3M, and Stanford DARE Initiative. His work on silicene has been featured by Nature News, Time magazine and was selected among the top 2015 science stories by Discover magazine. He serves as an Editor for the IEEE Electron Device Letters and Nature NPJ 2D Materials and Applications.

## Optics + Photonics for Sustainable Energy Plenary Session

Monday 7 August 2017 · 2:00 to 3:30 PM

Location: Conv. Ctr. Ballroom 6A

*Session Chair:* **Oleg V. Sulima**, GE Global Research (USA)

2:00 to 2:30 PM

### A BRIEF HISTORY OF PHOTOVOLTAICS: YESTERDAY, TODAY, AND TOMORROW



**Charles Gay**, U.S. Dept. of Energy (USA)

What can happen over the next 15 years, as photovoltaic (PV) power costs continue to decrease and markets expand? This talk will cover the range of opportunities associated with changes in energy supply in developed and developing economies. We will review the history of solar and discuss the key role of professionals in communicating a vision for the future. Our efforts to inform and educate a wide range of stakeholders will be essential to seeing the potential for wide adoption of PV

become a reality. This talk will endeavor to convey some of the stories essential to enabling our outreach.

**Dr. Charlie Gay** is the Solar Energy Technologies Office Director for the Office of Energy Efficiency and Renewable Energy (EERE) of the U.S. Department of Energy (DOE). Dr. Gay is an internationally recognized pioneer in photovoltaics. He earned a Ph.D. from the University of California, Riverside and was elected a member of the U.S. National Academy of Engineering in 2013.

# PLENARY SESSIONS

2:30 to 3:00 PM

## PHOTOVOLTAICS MOVING INTO THE TERAWATT AGE



**Eicke R. Weber**, Berkeley Education Alliance for Research in Singapore BEARS (Singapore) and Univ. of California, Berkeley (USA)

In the last few years, PV electricity became cost-competitive with electricity produced by conventional sources. Global PV production capacity will double within the next five years to 100-120 GWp/a, bringing PV installations into the Terawatt range. A key factor for this growth will be continuous technology advances aimed at higher efficiencies at reduced cost. In addition,

cell efficiency will be even more important than lowest cost, to optimize energy harvest from a given area. Crystalline Silicon technology currently represents 90% of the global PV market. This technology is approaching a ceiling of 29% efficiency for a single-bandgap semiconductor. New approaches for higher efficiencies require heterojunctions, and several approaches will be discussed. These include heterojunctions on silicon, allowing to combine well-established large-scale Silicon PV technology with new technologies, such as low-cost III/V or Perovskite layers.

Professor **Eicke R. Weber** is Director/CEO of the Berkeley Education Alliance for Research in Singapore (BEARS). Before, he has been Director of the Fraunhofer Institute for Solar Energy Systems ISE in Freiburg, Germany. From 1983-2006 he served on the faculty of the Department of Materials Science and Engineering of the University of California, Berkeley. He obtained his doctorate in Physics from the University of Cologne, Germany.

3:00 to 3:30 PM

## BANKABILITY OF NOVEL ENERGY TECHNOLOGIES



**Ralph Romero**, Black & Veatch (USA)

New technologies are helping energy system owners improve performance and service to their customers while creating a sustainable energy future. But many of these new tools and processes are unproven and costly, which may hinder their large scale deployment. This talk will address the topic of new technology bankability and how owners, technology providers and financial institutions assess their risk exposure before embarking on significant projects. The talk will focus on the lessons learned from

the rapid growth of the photovoltaic industry and discuss areas where technology risk should be further reduced.

**Dr. Ralph Romero** is a solar PV specialist with over 25 years' experience in the design and manufacturing of solar photovoltaics. He is a recognized expert in the commercial development of crystalline and thin-film photovoltaic technology. Dr. Romero leads the independent assessment of novel technologies practice at Black & Veatch Management Consulting. He advises domestic and international manufacturers, developers and financial institutions in the areas of technology, manufacturing, product and process design, among others.

# Organic Photonics + Electronics Plenary Session

Tuesday 8 August 2017 · 9:00 AM to 11:45 AM

Location: Conv. Ctr. Ballroom 6A

Session Chair: **Zakya H. Kafafi**, Lehigh Univ. (USA)

9:00 to 9:30 AM

## HYBRID ELECTRO-OPTICS AND CHIPSCALE INTEGRATION OF ELECTRONICS AND PHOTONICS



**Larry R. Dalton**, Univ. of Washington (USA)

Theory-guided nano-engineering of organic electro-optic materials and hybrid device architectures has permitted the dramatic improvement of the performance of electro-optic devices. For example, the voltage-length product has been improved by nearly a factor of 104, bandwidths have been extended to nearly 200 GHz, device footprints reduced to less than 200  $\mu\text{m}^2$ , and femtojoule energy efficiency achieved. This presentation discusses the utilization of new coarse-grained theoretical methods

together with advanced quantum mechanical methods to quantitatively simulate the physical properties of new classes of organic electro-optic materials and to evaluate their performance in nanoscopic device architectures, including the effect of material interfaces.

**Larry Dalton** is the George B. Kauffman Term Professor and B. Seymour Rabinovitch Chair Professor of Chemistry (Emeritus) at the University of Washington. He was the founding Director of the NSF Science & Technology Center on Materials & Devices for Information Technology Research. He is a Fellow of SPIE, ACS, MRS, OSA, and AAAS.

9:30 to 10:00 AM

## MOLECULAR PLASMONS



**Naomi J. Halas**, Rice Univ. (USA)

While graphene plasmonics has been well-studied in the IR, shifting the plasmon resonance of graphene to the visible region of the spectrum would require extremely small graphene structures with dimensions smaller than can be fabricated by the best currently available top-down fabrication methods. This is the length scale of polycyclic aromatic hydrocarbon (PAH) molecules, the picoscale versions of graphene. Charged PAH molecules can possess molecular plasmon resonances, where the addition of removal of one or more electrons leads to strong absorption features in the visible wavelength range. PAHs show outstanding potential as low-voltage electrochromic media for color-changing walls or windows.

**Naomi Halas** is the Stanley C. Moore Professor in Electrical Engineering at Rice University, and Director of the Smalley-Curl Institute. Halas is a pioneering researcher in plasmonics, creating the concept of the "tunable plasmon". She pursues research in plasmonics and its applications in biomedicine, optoelectronics, chemical sensing, photocatalysis and sustainability.

10:00 to 10:15 AM

## Announcement of the Organic Photonics + Electronics Best Student Paper Award Winner

Coffee Break · 10:15 to 10:45 AM



10:45 to 11:15 AM

## THE HISTORY AND PROGRESS OF HALIDE PEROVSKITE PHOTOVOLTAICS



**Nam-Gyu Park**, Sungkyunkwan Univ. (Korea, Republic of)

Since the first report on the solid-state perovskite solar cell with power conversion efficiency (PCE) of 9.7% in 2012 by our group, its certified PCE now reaches 22%. It is believed that perovskite solar cell is promising next-generation photovoltaics (PVs) due to superb performance and very low cost. In this talk, the history of perovskite photovoltaics will be briefly presented along with their scientific progress. Methodologies to achieve hysteresis-free, stable and high PCE perovskite solar cells will be introduced. Lewis acid-base adduct approach has been found to be very reliable and reproducible method to get high quality perovskite layer minimizing non-radiative recombination. Non-stoichiometric precursor in adduct process demonstrated grain boundary healing effect, which further improved voltage and fill factor due to long carrier life time of perovskite and improved charge transporting at grain boundary as well. Grain boundary healing process yields PCE as high as 20.4%. Moisture was effectively protected and hysteresis was significantly reduced by introducing 2-dimensional perovskite at grain boundary of 3-dimensional perovskite grains. Ion migration is one of factors affecting stability and hysteresis, which can be deactivated by 2-dimensional perovskite with higher barrier energy for ion migration. Thermal stability of perovskite material was found to be stable up to 120°C in the absence of moisture, but that of full device was sensitive to selective contacts, indicating that thermally stable selective contacts are equally important. Universal method to remove hysteresis will be also given in this talk.

**Nam-Gyu Park** is professor and SKKU-Fellow at School of Chemical Engineering, Sungkyunkwan Univ. He received his B.S., M.S. and Ph.D. from Seoul National Univ. He has been doing research on high efficiency mesoscopic solar cells including perovskite solar cell and dye-sensitized solar cell since 1997. He is pioneer in solid state perovskite solar cell, which was first developed in 2012. He received awards, including Scientist Award of the Month (MEST, Korea), KyungHyang Electricity and Energy Award (KEPCO, Korea), KIST Award of the Year (KIST, Korea) and Dupont Science and Technology Award (Dupont Korea), SKKU fellowship, and MRS Outstanding Research Award (MRS, Boston), WCPEC Paper Award (Kyoto, Japan), Hamakawa Award of PVSEC (Busan, Korea) and KAST Engineering Award (KAST, Korea). He published over 220 peer-reviewed scientific papers, including Science, Nature Materials, Nature Nanotechnology, Nature Energy and Nature Communications, 80 patent applications, 1 book editor, 7 book chapters. He received H-index of 66 as of January 2017.

11:15 to 11:45 AM

## MESOSCOPIC PHOTOSYSTEMS FOR THE GENERATION OF ELECTRICITY AND FUELS FROM SUNLIGHT



**Michael Grätzel**, Ecole Polytechnique Fédérale de Lausanne (Switzerland)

A planetary emergency has arisen from the continued depletion of fossil fuels, producing green house warming and unprecedented environmental pollution. Future energy options for renewable and carbon-free sources will need to fill the terra-watt gap that will open up during the next few decades due to the growth of the world population. A promising development is the recent emergence of a new generation of highly efficient photovoltaic converters based on molecular dyes or perovskite pigments as light harvesters. Mesoscopic photosystem that mimic the primary process of natural photosynthesis also offer the prospect of low cost fuel generation from sunlight.

**Michael Grätzel** is a Professor of Physical Chemistry at the EPFL, where he directs the Lab. of Photonics and Interfaces, conducting research on energy and electron transfer reactions in mesoscopic systems and their use to generate electricity and fuels from sunlight. He received a number of prestigious awards including the Global Energy Prize, Millennium Technology Grand Prize, and the Balzan Prize. He is a Fellow of several learned societies and holds ten honorary doctor's degrees from European and Asian Universities.

## Signal, Image, and Data Processing Plenary Session

Tuesday 8 August · 1:30 PM to 2:30 PM

Location: Conv. Ctr. Ballroom 6A

Session Chair: **Khan M. Iftakharuddin**, Old Dominion Univ. (USA)

1:30 to 2:30 PM

## FAST AUTOMATED 3D MODELING OF BUILDING INTERIORS



**Avideh Zakhor**, Univ. of California, Berkeley (USA)

In this talk, I will present a mapping and visualization platform for 3D modeling and documentation of indoor environments. Unlike existing mobile mapping systems with wheels, our proposed hardware acquisition devices are human wearable and hence must compensate for complex human gait. Furthermore, lack of GPS in indoor environments precludes us from applying existing outdoor mapping techniques indoors. We propose two distinct hardware systems to accomplish this task. The first one is an ambulatory backpack system equipped with a suite of sensors worn by an operator walking at normal speeds in and out of rooms inside a building in a continuous walk through. The second one is a handheld system carried by a human operator as s/he waves it at walls while walking inside the building. Both systems share a common software pipeline that results in 3D point clouds, texture mapped surface reconstructed 3D models, 3D architectural models and floor plans, and web based virtual navigation with tagging, annotation, and dimension measurement capability. We also describe a visual analytic platform that can be used to automatically recognize energy relevant assets such as windows, lights, and computers. The same walkthrough that generates 3D model can also be used to collect building sensor fingerprints which can later be used in a mobile app to locate building occupants, for example by first responders in emergency situations. I will describe some of the challenges in design and implementation of this platform and outline a number of open technical problems.

**Avideh Zakhor** is currently Qualcomm Chair and professor in EECS at U.C. Berkeley. Her areas of interest include theories and applications of signal, image, and video processing and 3D computer vision. She has won a number of best paper awards, including the IEEE Signal Processing Society in 1997 and 2009, IEEE Circuits and Systems Society in 1997 and 1999, IEEE Solid Circuits Society in 2008, IEEE international conference on image processing in 1999, Packet Video Workshop in 2002, and IEEE Workshop on Multimodal Sentient Computing in 2007. Prof. Zakhor received the B. S. degree from Caltech and the S. M. and Ph. D. degrees from MIT all in electrical engineering, in 1983, 1985, and 1987 respectively. She was a General Motors scholar from 1982 to 1983, was a Hertz fellow from 1984 to 1988, received the Presidential Young Investigators (PYI) award, and Office of Naval Research (ONR) young investigator award in 1992. In 2001, she was elected as IEEE fellow and received the Okawa Prize in 2004.

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## Optical Engineering Plenary Session

Tuesday 8 August 2017 · 4:00 to 5:30 PM

Location: Conv. Ctr. Ballroom 6A

Session Chair: **Julie L. Bentley**, Univ. of Rochester (USA)

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4:00 to 4:05 PM

### Welcome and Opening Remarks

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4:05 to 4:45 PM

### DESIGNING FOR ONE TO ONE-MILLION: HOW PRODUCTION QUANTITIES INFLUENCE DESIGN



**Leo B. Baldwin**, Amazon.com, Inc. (USA)

One of the most significant factors in product design is the production quantity. Along with unit price, it determines what is possible and what is prudent in allocating resources to the engineering, to the tooling, and to the material costs. From the extreme of producing one or two units to the other extreme of producing over a million units, these trade-offs are discussed in the context of optical and photonic systems. These trade-offs are illustrated using examples of products produced for the

capital equipment and consumer electronics markets covering the gamut of production quantities with particular attention given to optical components.

**Leo Baldwin** studied physics at Waterloo and modern optics at Rochester. He has spent his 37 year career designing products. Early products included missile guidance systems, reactor cores and submarines. Leo soon gravitated to photonics, designing high speed cameras, scopes, and a helicopter landing system. Moving from government systems to commercial systems, and moving from Canada to the US, Leo began designing inspection and guidance systems, first for containers and then for electronic and semiconductor capital equipment. This led to designing laser micro-machining systems and designing nanostructures. Leo moved to consumer electronics, designing a custom pixel, a custom sensor, and custom lenses for cell phones and tablets. Leo is currently designing the vision based infrastructure for a new kind of smart store where you Just Walk Out - no check-out lines! Leo's original design work has resulted in 58 US patents.

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4:50 to 5:30 PM

### THE LARGE SYNOPTIC SURVEY TELESCOPE



**Steven M. Kahn**, Large Synoptic Survey Telescope (USA) and SLAC National Accelerator Lab. (USA)

The Large Synoptic Survey Telescope (LSST) is a large aperture, wide-field, ground-based telescope designed to provide a time domain survey of the entire southern hemisphere in six optical bands. Over the ten-year duration of the survey, LSST will obtain ~800-1,000 images of every part of the southern sky, yielding a catalog of stars, galaxies, and moving small bodies in the solar system with nearly 40 billion objects. A diverse array of scientific

investigations can be performed with a common database addressing topics ranging from the detection of potentially hazardous asteroids to the structure and evolution of the Universe as a whole. LSST incorporates an 8-m class primary mirror with a 3.2 billion pixel camera. I will discuss the design of this facility and our technical progress with construction and fabrication of the key components.

**Steven M. Kahn** is the Cassius Lamb Kirk Professor in the Natural Sciences in the Physics Department at Stanford University, and a Professor of Particle Physics and Astrophysics at SLAC National Accelerator Laboratory. Prior to moving to his present position at Stanford in 2003, Kahn held faculty appointments at Columbia and Berkeley. He is an experimental astrophysicist who has led major programs in X-ray astronomy and experimental cosmology. He is currently the Director of the Large Synoptic Survey Telescope Project. Kahn is a Fellow of the American Physical Society, the American Association for the Advancement of Science, and the American Academy of Arts and Sciences.

## Remote Sensing Plenary

Wednesday 9 August 2017 · 10:30 AM to 11:20 AM

Location: Conv. Ctr. Ballroom 6A

Session Chair: **Allen H.-L. Huang**, Univ. of Wisconsin-Madison (USA)

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10:30 to 11:20 AM

### DEMONSTRATING TECHNOLOGIES FOR HYPERSPETRAL INFRARED REMOTE SENSING FROM SPACE ON A CUBESAT



**Thomas S. Pagano**, Jet Propulsion Lab. (USA)

CubeSats offer a low cost platform for remote sensing and in-situ measurements in space. Not only is the cost of the spacecraft low, but also the cost of the launch since typically CubeSats are secondary payloads to the primary satellite being launched. Despite the low available volume, mass and power and a typically less than ideal orbit, the platform can be ideal for demonstrating technology and even achieving certain science quality measurements. In this talk we discuss the CubeSat Infrared Atmospheric

Sounder (CIRAS) a new project at NASA JPL designed to demonstrate key technologies for hyperspectral infrared measurements of atmospheric temperature and water vapor from space.

**Mr. Thomas S. Pagano** is the Project Manager for the AIRS/AMSU/HSB Suite of instruments on the EOS Aqua Spacecraft and the Principal Investigator of the CubeSat Infrared Atmospheric Sounder (CIRAS). He was the lead engineer responsible for the calibration of the AIRS instrument in orbit and the Chief Systems Engineer on the MODIS instrument. He holds 2 US patents and is author of numerous papers on space remote sensing systems.





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## EXHIBITION HOURS

Tuesday 8 August · 10:00 am to 5:00 pm

Wednesday 9 August · 10:00 am to 5:00 pm

Thursday 10 August · 10:00 am to 2:00 pm

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*Symposium Co-chairs:* **James G. Grote**, Air Force Research Lab. (USA); **David L. Andrews**, Univ of East Anglia (United Kingdom)

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SPIE AWARDS

**SPIE GOLD MEDAL**

# *Katarina Swanberg*

Knitting together a  
winning combination  
of optics and oncology



Photo by Sune Swanberg



**O**n the small Swedish island of Ven, classes are beginning for the International Graduate Summer School in Biophotonics. In one classroom, students file in while their instructor, dressed in her trademark linen pantsuit and colorful silk scarves, is knitting — her favorite activity during rare moments of spare time.

The instructor is SPIE Fellow Katarina Svanberg, professor and chief consultant of oncology at Lund University Hospital (Sweden), and professor at South China Normal University. Svanberg is well known as an expert in both optics and oncology, specifically in the area of laser light interactions with biological tissue.

For her contributions to biophotonics, Svanberg is receiving the 2017 SPIE Gold Medal 9 August at SPIE Optics + Photonics. The award recognizes her clinical work exploring and verifying the efficacy of phototherapy and in vivo diagnosis in treating cancer patients.

“All the teachers were charismatic and engaging,” writes Jacqueline Andreozzi, who attended the Ven program in 2015 and blogged about it on the Photonics for a Better World blog. “But one of the highlights for me personally was the lecture by Dr. Katarina Svanberg where she conveyed her clinical experience in cancer treatment.”

In the lecture, Andreozzi says, Svanberg pointed out that, “we have responsibilities as scientists to be strategic in our research,” and she emphasized the humanitarian potential of our work in medicine, as well as the scope of health issues that impact people around the world.

“She is a truly inspiring individual, with a kind heart, sharp wit, and admirable outlook regarding her fellow citizens of this world,” Andreozzi writes.

Svanberg was instrumental in helping found the highly regarded International Graduate Summer School in Biophotonics on Ven.

SPIE Fellow Peter Andersen of Technical University of Denmark (DTU) and SPIE member Stefan Andersson-Engels, who moved from Lund University to Tyndall National Institute (Ireland) in 2016, launched the program in 2003 in a collaboration between DTU and Lund University. SPIE is now a cosponsor.

During the biennial, weeklong program, Svanberg makes sure her students learn not only the relevant biological and medical background of biomedical optics, but also that a clinical collaborator needs to learn and understand some of the physics and techniques “knitted” into the research.

Keeping the medical community involved with the science and engineering community is an ongoing challenge, says SPIE CEO Eugene Arthurs.

As Sweden’s leading oncologist working with medical lasers, “Dr. Svanberg played a major role in building SPIE biomedical programs, particularly in Europe,” Arthurs says. Because she is a practicing clinician, Svanberg’s leadership role in SPIE conferences and journals has lent strong and crucial credibility to those programs. “Her ideas, encouragement, and participation contribute to the very successful BiOS, the largest element of Photonics West,” Arthurs says.

“She is a truly inspiring individual, with a kind heart, sharp wit, and admirable outlook regarding her fellow citizens of this world.”

—Jacqueline Andreozzi

## Gold Medal of the Society

The highest honor SPIE bestows. In recognition of outstanding accomplishments in optics, electro-optics, or photographic technologies or applications.

## DESIGNING THE DREAM

As a child in the small town of Mariestad (Sweden), Svanberg dreamed of becoming a doctor, perhaps influenced by her parents, who both grew up poor and lost young siblings because of a lack of proper medications.

Although neither of her parents went beyond 6th grade in school, they worked hard to ensure that their only child, Katarina, would attend university.

“My mother had always wanted to study, but her situation did not allow that,” Svanberg says, “so she told me that she worked hard to let me study instead of her.”

Svanberg’s mother, who ran a yarn shop, also instilled in her daughter a lifelong love for designing and knitting clothing. This penchant for design would later play an important role in Svanberg’s ability to develop new medical procedures.

At the University of Gothenburg (GU), instead of medicine, Svanberg studied history and literature and became a high school teacher. Soon after starting her teaching career, she married a PhD candidate in physics, Sune Svanberg. Sune Svanberg would later serve on the Nobel Committee for Physics.

Katarina Svanberg taught high school for some years, eventually gaining a high-level position as a lead teacher, but the dream of studying medicine did not fade. She eventually decided to make her dream a reality, left her teaching job, and applied for medical studies at GU.

To help support the family, Svanberg gave lectures in economic history at night and studied medicine during the day.



Courtesy ICTP

Svanberg frequently attends the ICTP Winter College on Optics.

Continues



# SPIE AWARDS

Continued

“After all,” Svanberg jokes, “I had married a scientist who worked around the clock, so I had a lot of time to spend.”

She also found the time to have two daughters, Emilie and Kristina.

## A NET OF MEDICAL COLLABORATION

She received her MD at GU in 1984.

After Sune Svanberg transferred to Lund University for a professorship in physics, Katarina started her PhD program in medical science and studied laser light interaction in biological tissue.

Both Svanbergs had begun to consider the possibility of combining his knowledge of physics and her medical background while Katarina was still in medical school. The use of lasers in medicine came up — in particular photodynamic therapy (PDT), which entails using photosensitizing agents and light to kill cancer cells.

They studied current literature in the biophotonics field, which Svanberg notes was “infinitely less” than today, almost 35 years later. Working with the oncology division at Lund University Hospital, Svanberg conducted the first clinical PDT session in April 1987.

She earned her PhD in 1989 with a thesis in medical science that presented pre-clinical research work in experimental photodynamic therapy and tissue spectroscopy.

Over the years, the Svanbergs met with clinical heads from internal medicine to brain surgery and began the process of establishing the Lund University Medical Laser Centre. The center was officially inaugurated in 1991 to coordinate research and teaching in the field of laser applications in medicine.

“Together we were able to transfer our ideas to clinical use,” Svanberg says. “We developed both the PDT therapy as well as early cancer detection with me as a kind of spider in the complicated net of medical collaboration.”

Their equipment for fluorescence-based tumor imaging was used not only at Lund University Hospital but was also taken to several other universities and clinics in Europe and Africa.

“As a pioneering oncologist, Katarina has personally treated thousands of patients and mentored dozens of physicians and scientists in PDT methods around the world,” says SPIE Fellow Bruce Tromberg,



Photo courtesy Eugene Arthurs





**Katarina Svanberg and South China Normal University student Wansha Li work with a spectroscopic setup.**



**Katarina Svanberg and African colleagues treat a patient with photodynamic therapy in Dakar, Senegal, as part of a Swedish/African network for developing countries.**

director of the Beckman Laser Institute and Medical Clinic at the University of California, Irvine (USA). Tromberg notes that since introducing PDT to Sweden in the 1980s, Svanberg has played a key role in advancing PDT worldwide, particularly in Brazil and China, and led the first prospective randomized Phase III trial of PDT more than 15 years ago.

“In addition to her contributions to this technical field, Katarina has played a significant role in expanding the impact and visibility of optics and photonics in the broader communities of biology and medicine,” Tromberg says.

The Svanberg legacy of collaboration is being continued today through daughter Emilie. A specialist in anesthesiology and intensive care, Emilie Svanberg is currently involved in a project using diode laser spectroscopy to diagnose pulmonary disorders in newborns.

## TRANSLATIONAL RESEARCH

Katarina Svanberg’s contributions to the fields of tissue spectroscopy and photodynamic therapy have brought her recognition throughout the world, and her research collaborations cover five continents. Her groundbreaking work on laser-induced tissue fluorescence have made “optical biopsy” a reality for many types of cancer.

Now called “translational research,” her longstanding approach to

medical science and technology has been “a guiding light throughout her career and has served as a beacon to others,” says SPIE Fellow and 2016 SPIE President Robert Lieberman of Lumoptix (USA).

“This deep commitment to the practical application of optics and photonics for the diagnosis and treatment of disease has helped save and improve the lives of hundreds of individuals,” Lieberman says. “Furthermore, her activities in the developing world have changed countless other lives by bringing hope and guidance to many who would otherwise have no chance to contribute to science.”

Svanberg, who served as SPIE president in 2011 and was a member of the SPIE Board of Directors from 2005 to 2007, sees receiving the SPIE Gold Medal as a crown on top of her career.

She is quick to point out, however, that she would not have reached this level without the collaborative help of Sune Svanberg, now an SPIE Fellow, Andersson-Engels, Niels Bendsoe, and several others, as her work has reached across disciplines.

“I may have been instrumental in connecting people from the medical side,” Svanberg says, “but without the physicists, this would not have been possible.

Svanberg feels her involvement with SPIE, including serving as an editorial board member for the *Journal of Biomedical Optics*, is valuable not only to her work but also because through SPIE, she’s had the chance to meet young scientists around the world. She believes it is important to encourage young people, especially girls, and help them develop self-confidence.

“I have tried to tell them some useful things from my own experience,” Svanberg says. “If you feel you are not doing the thing you really want to do, do not be afraid to change your situation — even if it may mean a 180-degree turn-around.”

She tells her students and other young scientists that life is about facing new challenges, not being afraid of the unknown, and being open to change. She uses her own life as an example. “Myself, I switched from a being a teacher of history and literature to become a medical doctor!” she says. ■

—Karen Thomas is an editor at SPIE.





## Team that built optical instruments for Pluto flyby to receive SPIE George W. Goddard Award

The optical cameras and spectrometers developed for NASA's New Horizons mission to explore Pluto and the outer reaches of our solar system represent the most sophisticated instruments of their kind. After a 3-billion-mile journey of almost 10 years, scientists across the world celebrated history in July 2015 when the spacecraft flew close enough to Pluto to capture thousands of first-ever, high-resolution images, spectra, and particle data from the distant dwarf planet and the Kuiper Belt.

The 39 scientists from eight organizations that made up the New Horizons Optical Instrumentation Team have reason to celebrate again this year as the winners of the 2017 SPIE George W. Goddard Award.

The team, led by the Southwest Research Institute (SwRI), pushed the boundaries of space-based optical technology by designing and developing a suite of high-capability instruments that could withstand the freezing temperatures and low-light conditions of deep space, as well as meet the weight and power constraints needed for the years-long voyage.

This new generation of optical instruments that returned stunning images of Pluto's icy mountains and dynamic atmosphere included Alice, a vacuum UV imaging spectrograph; Ralph, a visible color imager and an IR spectral imager; and the LOng Range Reconnaissance Imager (LORRI), a panchromatic high-resolution visible imager.

Together, the three instruments weighed less than 24 kg and operated on less than 15 watts. In fact, the entire science payload of seven instruments fit inside a spacecraft the size of a grand piano.

The data obtained from the three optical instruments during a six-month-long reconnaissance flyby study of Pluto and its moons "have revolutionized our understanding of the Pluto system," said Carly Howett, senior research scientist and outer solar system section manager at SwRI. The New Horizons findings "turned this once remote and unknown world into one that continues to inspire and delight all of humankind," she said.

In addition to SwRI, the other organizations who collaborated on developing these instruments were SPIE corporate members Ball Aerospace and Materion Barr Precision Optics, Johns Hopkins University Applied Physics Laboratory (JHUAPL), NASA Goddard Space Flight Center, SSG Precision Optronics, Siegmund Scientific, and Corning.



The optical instruments aboard New Horizons captured images showing that Pluto is younger, slightly larger, colder, and far more complex than had previously been thought. Seven months after the launch of New Horizons in 2006, the International Astronomical Union downgraded the status of Pluto to a "dwarf planet." Earlier this year, a group of NASA scientists proposed a new definition of what constitutes as a planet that would allow Pluto to return to its former status.

Bill Gibson and Mark Tapley of SwRI served as optical instrument manager and science payload systems engineer, respectively.

### ALICE UV SPECTROGRAPH

The Alice imaging spectrometer, developed by SwRI, studied the composition of Pluto's atmosphere and was designed to operate in two modes. One mode measures UV emissions from atmospheric constituents; the other detects atmospheric constituents by the amount of sunlight they absorb. This unique method allows the instrument to measure even traces of atmospheric gases.

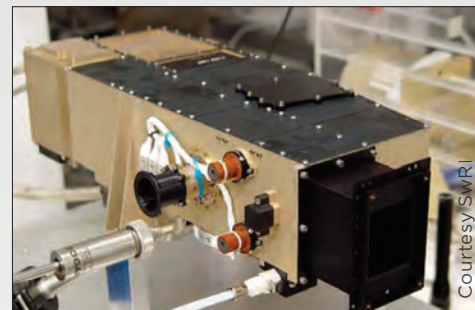
Additionally, Alice's innovative design gives the instrument a higher resolution for the same mass and less power as its earlier counterparts. For

example, Alice has 32,000 pixels compared to two pixels for a similar instrument on the Voyager spacecraft.

### EIGHT DETECTORS ON RALPH

The Ralph instrument, developed by Ball Aerospace, the Goddard Space Flight Center, and SwRI in just 22 months, provided most of the color images and global composition mapping of Pluto and its largest moon, Charon. A sensitive, three-mirror telescope feeds light into the instrument's suite of eight detectors.

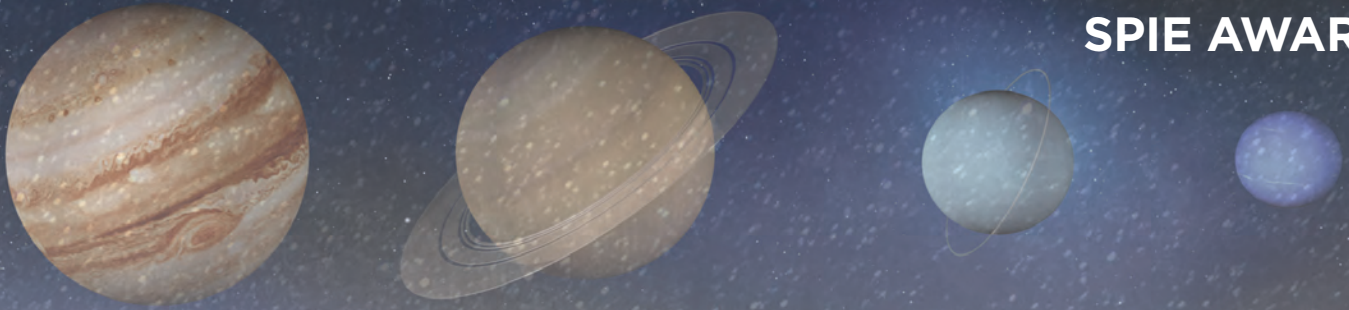
Ralph is specially designed to collect high resolution, color



Alice Imaging spectrograph.

Courtesy SwRI





**A Ball Aerospace employee working on the Ralph instrument.**



**LORRI, a long-range reconnaissance imager, is a 1000 × 1000-pixel sensor that, in combination with a telescopic camera, delivers monochrome images and high-resolution geological data. LORRI measured Pluto's diameter at 1473 miles (2370 km).**

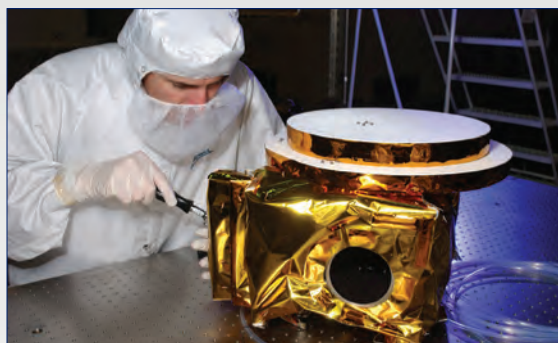
data equivalent to taking a panoramic image with a 42-megapixel camera while being subjected to extreme cold and radiation.

In order to produce images in light levels 1000 times fainter than daylight on Earth, the instrument team designed a hinged lens cover for the telescope, the only moving part on the instrument.

## LORRI'S THERMAL CONTROL

The LORRI instrument, developed by the JHUAPL, provided high-resolution, long-distance monochrome images of Pluto upon approach, playing a critical role in navigating the spacecraft's course of travel. It measured Pluto's diameter at 1473 miles (2370 km).

To ensure that LORRI's mirrors would stay focused despite extreme temperature dips, the team utilized silicon carbide (SiC) for the instrument structure and mirrors, making LORRI the first reaction-bonded SiC telescope to deliver high-quality, visible imaging for a deep space mission.



**The Ralph instrument combines panchromatic and color imaging capabilities with IR imaging spectroscopy.**

The SiC structure allowed the instrument's focus to remain unchanged during massive temperature changes and eliminated the need for focus adjustment mechanisms over various thermal conditions.

## FEAT OF A LIFETIME

Together, the New Horizons instruments delivered stunning images that captivate attention and interest from across the globe and provide a treasure trove of data for the scientific community to analyze for years to come.

"The Alice, Ralph, and LORRI instruments carried on New Horizons represent technical excellence in its highest form," said Michael D. Griffin, chairman and CEO of Schafer, who previously served as head of the Space Department at the JHUAPL where the spacecraft was built. Griffin was also the NASA administrator when New Horizons was launched in 2006.

With an unusually compressed schedule of four years from funding to launch, "the team developed innovative strategies to ensure that the instruments would survive their long, cold, dark journey to the outer rim of the solar system," he said. Griffin called their work "a feat never before accomplished and which is unlikely to be seen again within the lifetime of anyone now alive."

SPIE will present the 2017 George W. Goddard Award to team members 9 August at SPIE Optics + Photonics. The full list of team members, which includes seven SPIE members, is at right. ■

## George W. Goddard Award recipients

The New Horizons Optical Instrumentation Team was led by Bill Gibson, optical instrument manager at Southwest Research Institute (SwRI), and Mark Tapley, science payload systems engineer, also at SwRI.

Members of the Alice instrument team were Alan Stern, John Scherrer, John Stone, Greg Dirks, Leslie Young, Maarten Versteeg, Joel Parker, and SPIE member Michael Davis of SwRI, the late Dave Slater of SwRI, and SPIE member Ossy Siegmund of Siegmund Scientific (SS).

Members of the Ralph instrument team were Stern, Scherrer, Stone, Dirks, and SwRI colleagues John Andrews, Cathy Olkin, and Ed Weigle; Ball Aerospace employees Jim Contreras, Derek Sabatke, Pei Huang, SPIE member Jim Baer, and the late Lisa Hardaway; Stuart McMuldroy, formerly of Ball Aerospace; SPIE member Jeff Santman of Corning; George Alan and Tom Money of Materion Barr Precision Optics (MB); and Dennis Reuter and Allen Lunsford of the NASA Goddard Space Flight Center (GSFC).

On the LORRI instrument team were Matt Grey, Tom Magee, Kim Cooper, Hugo Darlington, Andy Cheng, Harold Weaver, John Boldt, John Hayes, and SPIE members Andy Mastandrea, Kevin Heffernan, and Steven Conard of the Johns Hopkins University Applied Physics Laboratory; Deepak Sampath of SSG Precision Optronics; and Kris Kosakowski, formerly of SSG.



# SPIE AWARDS

## SPIE BRITTON CHANCE BIOMEDICAL OPTICS AWARD

### Molecular imaging pioneer Christopher Contag

Molecular imaging pioneer Christopher Contag, the founding director of a new biomedical research institute at Michigan State University (USA), has been named recipient of the 2017 SPIE Britton Chance Biomedical Optics Award.

The award is presented annually in recognition of outstanding lifetime contributions to the field of biomedical optics through the development of innovative, high-impact technologies.

Contag, whose lab at Stanford University (USA) was the first to use biological sources of light to image key biological processes in living mammals, is being recognized for his invention of in vivo optical imaging using bioluminescent and fluorescent reporters.

These bioluminescent images (BLI) of bacterial infection, gene expression patterns, cancer growth, and other biological processes paved the way for the development of macroscopic and microscopic optical imaging tools to enable in vivo studies of drug targets and agents. The tools have significantly impacted the fields of oncology, regenerative medicine, and stem-cell biology and have resulted in virtually every pharmaceutical and biotechnology company now using BLI to accelerate drug development.

Contag accepted the award at SPIE Photonics West in San Francisco and gave a talk on his work during the BiOS Hot Topics session 28 January.

A frequent contributor to Photonics West, he has authored more than



three dozen SPIE conference papers on medical imaging and other areas of biophotonics and nearly 20 articles in the *Journal of Biomedical Optics*.

Contag was named director of the new Institute for Quantitative Health Science and Engineering and chair of the Department of Biomedical Engineering in the College of Engineering at Michigan State last year. He leads an interdisciplinary team of researchers whose goals are to build tools to understand complex biological processes and develop new therapies for cancer and other diseases.

He will become professor emeritus at Stanford, where he was a faculty member in the pediatrics, radiology, bioengineering, microbiology, and immunology departments and held the titles of associate chief of Neonatal and Developmental Medicine; director of Stanford's Center for Innovation in In Vivo Imaging; and co-director of the Molecular Imaging Program.

He earned an undergraduate degree in biology and a PhD in microbiology at University of Minnesota (USA).

Referring to Contag's "passion for unraveling cancer biology and his ability to recognize unmet needs and create new tools to solve them," Anna Moore, professor of radiology and director of the Molecular Imaging Laboratory at Massachusetts General Hospital (USA), called Contag an "extraordinary" candidate for the Britton Chance Biomedical Optics Award. ■

## SPIE TECHNOLOGY ACHIEVEMENT AWARD

### Multimedia security innovator Edward Delp

SPIE Fellow Edward Delp III, the Charles William Harrison Distinguished Professor of Electrical and Computer Engineering at Purdue University (USA), is the recipient of the 2017 SPIE Technology Achievement Award.

Delp, also a professor of biomedical engineering and psychological sciences, is recognized for his pioneering work in multimedia security, including watermarking and device forensics and for his contributions to image and video compression.

Delp is considered one of the founders of the multimedia security field, in particular in the areas of watermarking, data hiding, and device forensics. His early work in image compression resulted in the development of the widely used block truncation coding (BTC) algorithm, one of three final candidates for the JPEG compression standard.

His recent work has focused on closed-form performance bounds for scalable video compression and low-complexity encoding methods.

Colleagues know Delp as a visionary research leader whose contributions to image and video technology and device forensics have had worldwide impact.

Delp has a broad view of the field that gives him an insight into the direction of the research community well in advance of the actual events, said SPIE Fellow Dan Schonfeld, codirector of the Multimedia Communications Laboratory at University of Illinois at Chicago (USA).



"For example, much of his work in the area of image and video compression predates the release of the main compression standards by nearly a decade," Schonfeld said in supporting Delp's nomination for the award.

Delp is also being honored for his knowledge of the mathematical fundamentals of signal and multimedia processing and his energetic drive to search for new challenges in research.

Delp holds BSEE and MSEE degrees from University of Cincinnati (USA); a PhD from Purdue; and an honorary doctorate from Tampere University of Technology and has visited and lectured extensively all over the world. His unselfish support of the global image-processing community has contributed enormously to the field, said SPIE Fellow Jaakko Astola, professor in the Department of Signal Processing at Tampere University

of Technology in Finland.

"In addition to leading his active research group, he has initiated new research directions in many research groups in several countries," Astola said. "This has often resulted in a strong boost to their research activities as well as research cooperation."

The SPIE Technology Achievement Award, which recognizes outstanding technical accomplishment in optics, electro-optics, photonic engineering, or imaging, will be presented to Delp 30 January at the plenary session of SPIE OPTO, part of SPIE Photonics West in San Francisco, CA (USA). ■



## SPIE HAROLD E. EDGERTON AWARD

### High-speed imager Mikhail Y. Schelev



SPIE Fellow Mikhail Y. Schelev, the late head of the Picosecond Photonics Lab at Prokhorov General Physics Institute (Russia) and a leading developer of streak cameras and other high-speed image-recording instrumentation, has been named recipient of the 2017 SPIE Harold E. Edgerton Award. Schelev died in September 2016, just weeks after the SPIE Awards Committee voted to present him with the annual award.

A professor of physical electronics and the world's foremost expert in high-speed photoelectric image recording science, Schelev led a unique research group specializing in electro-optical image tube design and picosecond and femtosecond image recording in the visible, infrared, UV, and x-ray regions. His innovative methods and tools are important for studying high-speed processes in laser physics, nonlinear and fiber optics, photoemissive electronics, and laser plasma physics.

In addition to the Edgerton Award, Schelev's achievements earned him the Lenin Komsomol Prize in 1971, the German Physical Society's International Hubert Schardin Gold Medal in 1972, the USSR State Prize in 1986, and the 2009 "VIDE & CREDE" award established by the Japan Society for High-Speed Photography and Photonics and the Hamamatsu company. In 2014, he also received the Stoletov Prize, an award honoring the founder of electrical engineering.

Over the course of his long career, Schelev served as a visiting scientist at the National Research Council of Canada, VTEK (Republic of Korea), Beijing Institute of Technology (China) where he held the title of honored professor, and at other scientific organizations.

Schelev received his doctor of sciences degree in physics and mathematics from Lebedev Physical Institute and was the author of more than 400 research articles and reports, including more than 75 with SPIE.

He served on the program committee for the ultrafast x-ray detectors and applications conference at the SPIE annual meeting for many years, and he chaired an SPIE conference on high-speed photography and photonics several times.

His conference presentations, particularly those on his unique, ultrafast streak tubes, received great attention among participants, said Manfred Hugenschmidt of Karlsruhe Institute of Technology (Germany), who knew Schelev for more than 40 years. Manufacturers of high-speed equipment and high-speed cameras "frequently wanted to make use of Schelev's techniques or systems for improving their own products," Hugenschmidt said.

The Harold E. Edgerton Award is presented annually for outstanding contributions to optical or photonic techniques in the application and understanding of high speed physical phenomena. ■

## FRITS ZERNIKE AWARD FOR MICROLITHOGRAPHY

### R&D executive Donis Flagello



The 2017 SPIE Frits Zernike Award for Microlithography was presented in February at SPIE Advanced Lithography to SPIE Fellow Donis Flagello, president, CEO, and COO of the Nikon Research Center (USA).

A prominent member of the microlithography community since the early 1980s and a past symposium chair at SPIE Advanced Lithography, Flagello is being recognized for progress in the understanding and improvement of image formation in optical lithography for semiconductor manufacturing.

Throughout his career, which has included stints at IBM and ASML, Flagello has made contributions mostly focused on the rigorous application of physics to lithography modeling and problem solving. At IBM's T.J. Watson Research Center, he developed the first practical test for measuring flare in optical lithography tools and made major contributions to high numerical aperture (NA) modeling of imaging tools, including vector and polarization effects, and radiometric correction.

At ASML in The Netherlands, he helped create a culture to complement data collection for characterizing and specifying lithographic tools. Later, as director of ASML's Advanced Technology Development Center in Arizona (USA), his leadership resulted in advances in lithography capabilities for ASML tools, and his role in providing analysis of aberrations for new systems and high NA imaging effects due to polarization was critical.

Acquainted with Flagello for more than 30 years, 2006 Zernike Award recipient and SPIE Fellow Timothy A. Brunner noted that Flagello's contributions to the microlithography industry stand out as one of the key aspects of his career.

"His unusual career trajectory has made a large impact on the technical and the business success of the worldwide microlithography industry," Brunner said in supporting Flagello for the award.

A second notable aspect of his career, Flagello's presentations at lithography conferences and papers in various journals, have inspired a better understanding of optics and resist behavior and helped drive optical lithography forward.

SPIE Fellow David M. Williamson, the recipient of the 2007 Frits Zernike Award who also supported giving the 2017 award to Flagello, said Flagello's conference presentations are known for their "combination of humor with a deep understanding of the complex interactions between physical optics and lithographic process."

He called Flagello's theoretical and practical production experience and knowledge rare in the field.

Flagello served on the SPIE Board of Directors from 2009 to 2011. He has an MS and PhD in optical science from University of Arizona (USA).

SPIE presents the Frits Zernike Award annually for outstanding accomplishments in microlithographic technology, especially those furthering the development of semiconductor lithographic imaging solutions. ■



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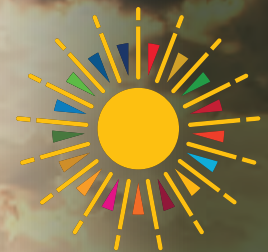
Send us up to two of your photos that highlight the world of light.

First Prize: US\$2,500

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Third Prize: US\$500

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International  
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For 2017 Contest: 15 May–15 Sept. 2017

For 2018 Contest: 16 Sept. 2017–15 Sept. 2018

Details: [www.spie.org/contest](http://www.spie.org/contest)



# Designs for interference microscopy objectives earn Zygo scientists Rudolf Kingslake Medal

Two researchers from Zygo Corp. are recipients of the Rudolf Kingslake Medal and Prize for 2016. SPIE presents the award annually for the most noteworthy original paper published in the journal *Optical Engineering*.

SPIE Fellow Peter de Groot, executive director of R&D at Zygo, and James Biegen, a senior technical staff member, are the authors of “Interference microscope objectives for wide-field areal surface topography measurements,” an open-access paper published in the July 2016 issue of the journal.

From the fabrication of diesel fuel injectors to patterned semiconductor wafers, surface metrology on the microscopic scale is an essential step in the precision manufacturing of many modern products.

To increase the field of view on current state-of-the-art microscopes for interferometry, multiple obstacles must be addressed, including the size, weight, and form factor of classical interference objectives.

Biegen and de Groot propose a type of low-magnification interference objective that extends the range of application for flexible microscope platforms to larger fields of view.

“The objective comprises a beam splitter plate and a partially transparent reference mirror arranged coaxially with the objective lens system,” according to the authors. “The coaxial



de Groot



Biegen

“This article is an important response to new requirements in industrial metrology.”

—SPIE Fellow Tomasz Tkaczyk, chair of the Kingslake Award Committee

plates are slightly tilted to direct unwanted reflections outside of the imaging pupil aperture, providing high fringe contrast with spatially extended white-light illumination.”

The study features two separate designs; a turret-mountable 1.4× magnification objective parfocal with high-magnification objectives up to 100×, and a dovetail mount 0.5× objective with a 34×34 mm field. Their designs are a practical alternative to the classical Michelson and Mirau type objectives, which have been the standard objectives for most of the history of surface topography interference microscopy.

“The authors of this article deserve the 2016 Rudolf Kingslake Medal and Prize for a useful article with a close-to-perfect overall presentation,” says Daniel Malacara Hernández, an associate editor for *Optical Engineering*.

“It is written in a clear and concise style, with excellent reference to the history and state of the art. The results are illustrative and convincing.”

Malacara Hernández notes that the paper could be a “wonderful introduction for newcomers to this field as well as students.” ■

## CHANDRA S. VIKRAM AWARD

### Mitsuo Takeda

SPIE Fellow Mitsuo Takeda, a professor at Utsunomiya University (Japan), is the 2017 recipient of the SPIE Chandra S. Vikram Award in Optical Metrology. He is honored for the invention of the Fourier transform method of interferogram fringe analysis, achievements in coherence holography, and many industrial applications of three-dimensional shape measurements.

“During more than 30 years of his career in the field of holography and optical metrology, Prof. Takeda has done a lot of innovative work,” said SPIE Fellow Christophe Gorecki of the Institut FEMTO-ST in France. “His pioneering work in the development and the establishment of Fourier fringe analysis is extremely important. His contributions are interdisciplinary and international, encompassing a broad area of optical science and technology, and have a large impact.”

Takeda is among the most recognized experts in full-field optical metrology. He is the author of more than 120 journal papers, nearly 50 invited papers, 10 review papers, seven book chapters, and nearly 20 patents. He has also given 13 plenary and keynote presentations. The 1982 paper he coauthored, “Fourier transform method of fringe pattern analysis for computer based topography and interferometry,” has surpassed 2500 citations, according to Web of Science.

He has continued his research in the field of optical metrology, with



emphasis on basic principles and industrial applications of optical interferometry, coherent and incoherent light holography, and profilometry. His particular focus is on fringe pattern analysis and image/optical information processing.

His sequential papers on application of Fourier transforms for automatic measurement of 3D object shape, including objects with large height steps and surface isolations, have received nearly 1400 citations. Combined with the 1982 paper, Takeda’s work makes up the essential core of full-field optical metrology and related techniques.

Takeda is one of the most innovative and productive scientists in modern optics, said Wolfgang Osten, a member of the SPIE Board of Directors and head of the Institute of Applied Optics at the University of Stuttgart (Germany). “His publication record is very large. However, in his case, quantity and quality are in a well-balanced relation. Several of his publications have stimulated new research fields and motivated many scientists for their own work.”

The SPIE Chandra S. Vikram Award in Optical Metrology is given annually for exceptional contribution to the field of optical metrology. The award may be presented for a specific achievement, development, or invention of significant importance to optical metrology or may be given for lifetime achievement.

Takeda will receive her award 9 August at SPIE Optics + Photonics. ■



# SPIE AWARDS

## Two earn SPIE Early Career Achievement Awards

### INDUSTRY AWARD

## Utkarsh Sharma

SPIE member Utkarsh Sharma, director of the advanced development team at Optovue (USA), has been awarded the SPIE Early Career Achievement Award in Industry, for leadership and innovation, particularly in the successful commercialization of optical coherence tomography (OCT) angiography. He received the award at SPIE Photonics West 2017 in January.

Sharma has “demonstrated an outstanding track record of scientific research, innovation, and technology development that has continued to push the state of the art in the OCT industry,” said SPIE Fellow Stephen A. Boppart of the University of Illinois at Urbana-Champaign (USA).

Sharma pioneered a revolutionary imaging technology now commonly known as OCT-based angiography. Some have called OCT angiography the second imaging revolution in ophthalmology, due to its ability to deliver detailed functional vascular networks in the human retina with contrasting dyes.



The technique may replace current imaging procedures for the detection and treatment of a number of diseases, such as glaucoma, age-related macular degeneration, and diabetic retinopathy.

His contributions in industry are illustrated by the successful commercialization efforts of two technological innovations and 22 patents. His scholarly body of work is well cited, with more than 500 citations, and highlights the wide-ranging impact of his research.

He has developed laser systems, fiber optic sensors, and new OCT imaging technologies for a range of applications, including environmental sensing and medical imaging. His work on development of an OCT imaging technology was one of the key technological advancements in the field of endoscopic OCT technology.

“It is clear to me that Dr. Sharma’s contributions to the imaging community will help detect eye diseases at an early stage, reduce healthcare costs, and improve patient care worldwide,” said SPIE Fellow Ruikang Wang of the University of Washington (USA).

### ACADEMIC AWARD

## Maiken H. Mikkelsen

SPIE member Maiken H. Mikkelsen, the Nortel Networks Assistant Professor of Electrical & Computer Engineering at Duke University (USA), is the 2017 recipient of the SPIE Early Career Achievement Award, Academic. She is being honored for outstanding contributions to the understanding of light-matter interactions and ultrafast emission dynamics in plasmonic systems.

“At Duke, she has built from scratch an impressive and advanced laboratory that has allowed her to obtain and publish groundbreaking results on plasmon-enhanced light-matter interactions, including the demonstration of strongly enhanced spontaneous emission rates of quantum emitters,” said 2005 Nobel laureate in physics John L. Hall of the University of Colorado at Boulder (USA).

Her research results have been published in *Nature Photonics*, *Nature Communications*, and *Nano Letters*, focusing significant attention on and impacting the fields of nanophotonics, plasmonics, and quantum optics. Her pioneering contributions are expected to define the future of these fields.



“Maiken is highly deserving of the SPIE Early Career Achievement Award,” said SPIE Fellow N. Asger Mortensen, professor at Technical University of Denmark. “She has already established herself as a leader in the field of quantum nanophotonics. I am deeply impressed with her vision, innovative ideas, understanding of the natural world, and innate ability to identify research areas with the potential for translational breakthroughs.”

Mikkelsen’s work points toward solutions to complex and pressing problems, including faster computers, enhanced communications security, simulation of complex structures, and improved solar cells. David R. Smith, director of the Center for Metamaterial and Integrated Plasmonics at Duke, praised the distinctive perspective Mikkelsen brings to her research.

“Her scientific knowledge and practical applications of engineering are brought together into a single line of research,” he said, bringing “a fresh approach to long-standing challenges in the field.”

Mikkelsen also recently received the Young Investigator Program award from the US Army Research Office and a \$2 million research award from the US National Science Foundation.

Mikkelsen will receive her award 9 August at SPIE Optics + Photonics. ■



## SPIE PRESIDENT'S AWARD

### Brian Lula

SPIE Fellow Brian Lula, a member of the SPIE Board of Directors and a past secretary/treasurer for the Society, is the recipient of the 2017 SPIE President's Award. The annual award is presented to an individual who has rendered unique and meritorious service to the Society.

Lula is president of Physik Instrumente USA, a leading manufacturer of piezoceramic-based micro- and nano-positioning equipment for research and applications in industry, such as adaptive optic positioners for astronomical telescopes, semiconductor fabricating equipment, mask alignment and autofocusing mechanisms, and high-resolution microscopy. He previously was a sales director and general manager with Newport Corporation.

The SPIE President's Award recognizes Lula's commitment to SPIE through outstanding service, leadership, guidance, involvement in governance, and public outreach on behalf of the Society.

Lula has had a lifelong passion for telescope making and astronomical imaging that sparked his interest in mechanical engineering. His photo of Elephant's Trunk Nebula in IC 1396 was featured in NASA's Astronomy Picture of the Day in 2007, and another of his astroimages in the design of an SPIE necktie.

Through the years, he has developed relationships with astronomy clubs, schools, and NASA (as above), with the goal of sparking interest in young people to pursue education and



careers in engineering and science. He also has spoken at local and national gatherings of amateur telescope makers about the many promising career opportunities for opto-mechanical and electro-optical engineers.

"When young people today express a desire to learn about telescope making, I encourage them strongly to pursue this hobby," Lula said in a 2008 *SPIE Professional* article. "The sky is truly the limit as they consider careers based on optical technologies. Understanding the fundamentals of telescope system design, from optics to mechanics to controls, can vault a young person to the head of his/her engineering or science class."

"It is amazing to me how many of my SPIE colleagues can point to an interest in optics that developed from some interaction in their childhood with telescopes," Lula said.

As secretary/treasurer from 2007-2014, Lula was responsible for financial oversight of SPIE during a period of significant growth as well as major shifts in the global economy. According to SPIE President Glenn Boreman, "the Society owes a debt of gratitude to Brian for his excellent stewardship of SPIE's resources and for his insightful leadership as a member of the SPIE Executive Committee, Board of Directors, and multiple other SPIE committees since 1998."

Lula and other 2017 SPIE award winners will be honored at an awards banquet 9 August during SPIE Optics + Photonics. ■

## SPIE AWARDS

Members of the photonics community may nominate colleagues for a 2018 SPIE award to recognize their outstanding achievements. Nominations may be made through 24 June 2018 and are considered active for three years from the submission date.

More information on SPIE awards:  
[spie.org/awards](http://spie.org/awards)



# SPIE AWARDS

## SPIE DIRECTORS' AWARD

### Kenneth M. Hanson

SPIE Fellow Kenneth M. Hanson, a research scientist in the medical imaging field and an accomplished nature photographer, has been selected as recipient of the 2017 SPIE Directors' Award.

The award recognizes Hanson's substantial contributions to SPIE Medical Imaging and to outstanding advancements in medical image quality, restoration, and 3D reconstruction techniques.

Hanson, who has volunteered his skills as a photographer to chronicle the SPIE Medical Imaging symposium for more than 30 years, served as symposium chair from 2002 to 2004. He also served on the program committee for the Imaging Processing Conference from 1984 to 1995 and was the chair of that conference from 1996-2001.

Hanson has worked in various capacities at the US Los Alamos National Laboratory (LANL) since 1975, including more than 20 years in the Dynamic Testing Division where he codeveloped the Bayes Inference Engine, the principal analysis tool for quantitative interpretation of dynamic radiographs. His work at LANL included developing a methodology for quantifying the uncertainties in simulation-code predictions and on the first Advanced Strategic Computing Initiative (ASCI) validation milestone.

His research at LANL also included innovations with tomographic reconstruction from limited image data; inversion of the diffusion equation for optical tomography based on IR photons; new approaches to assess the uncertainties in simulation codes for the verification and validation of



simulations; and other basic problems in image analysis.

Although he officially retired from LANL in 2016, he is still a guest scientist in the geophysics group there, working on a project aimed at improving ultrasound breast imaging.

Hanson is the author of 168 publications, including two book chapters and more than 100 papers in the fields of imaging science and tomographic reconstruction. He also used his expertise to help SPIE by developing LaTeX manuscript templates for the Society's proceedings and journals and by teaching an SPIE course on how to write for publications in medical imaging.

"In addition to his substantial contributions to SPIE conferences and publications as a chair, editor, and author, the support Ken provided in developing the LaTeX templates were invaluable in helping SPIE make a successful transition from print publishing to the SPIE Digital Library," said Eric Pepper, SPIE director of publications.

Hanson has received multiple awards including an Outstanding Achievement Award from SPIE in 2004, the US Department of Energy Award of Excellence in 1986, and the LANL Distinguished Performance Award in 1991.

He has a PhD and MS in physics from Harvard University (USA) and earned a bachelor's degree in engineering physics at Cornell University (USA).

Hanson will receive the award 9 August at SPIE Optics + Photonics. ■

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## SPIE DENNIS GABOR AWARD

### Toyohiko Yatagai

SPIE Fellow Toyohiko Yatagai, the 2015 SPIE president and a professor at Utsunomiya University (Japan), is the recipient of the 2017 SPIE Dennis Gabor Award for contributions to the development of computer-generated holography and related techniques for optical metrology, information processing, displays, and optical storage.

SPIE presents the award every year to recognize outstanding accomplishments in diffractive wavefront technologies, especially those that further the development of holography and metrology applications.

“Professor Yatagai is considered one of the best researchers in the world in the field. His research is closely followed by many great researchers in academia and industry at an international level,” said SPIE Fellow Bahram Javidi, the Board of Trustees Distinguished Professor at University of Connecticut (USA) and the 2005 Dennis Gabor award recipient.

Yatagai pioneered the development and establishment of holographic techniques and digital fringe analysis techniques for modern optical metrology. He proposed a scanning moiré method for three-dimensional shape measurements in a highly cited paper, which is believed to be the first successful application of today’s phase-shift technique to moiré 3D topography.



He also established the foundation of polarization contrast imaging by polarization-sensitive Fourier-domain optical coherence tomography. He has proved the advantage and viability of his technique in real-world clinical applications by putting it into a successful commercial product through collaboration with an optical company.

He was among the first to note the potential of computer-generated holography at its inception. His contributions include a 3D color display technique based on synthetic holograms generated from projection images and a fast computation algorithm for a cylindrical CGH.

Yatagai also is credited for contributing to the progress of optical information processing and optical storage. In the early 1980s, he developed cellular logic optical computing systems and optical neural networks.

He is a founding director of the Center for Optical Research and Education (CORE) at Utsunomiya University. By making CORE an internationally renowned center of excellence in optics and photonics, he wants to establish a new educational paradigm for optical engineering in Japan.

Yatagai will receive the award 9 August at SPIE Optics + Photonics. ■

## SPIE EDUCATOR AWARD

### John Greivenkamp

SPIE Fellow John Greivenkamp, professor of optical sciences and ophthalmology at University of Arizona (UA) (USA), is the recipient of the 2017 SPIE Educator Award for his dedication and passion to both formal and informal optics education for nearly 30 years.

Greivenkamp has taught geometrical optics to approximately 2000 students at the UA College of Optical Sciences since 1991 and is the founder and curator of the Museum of Optics there.

“I know of few others who are engaged in optics education over such a broad spectrum,” said SPIE Fellow MJ Soileau, vice president for research and commercialization at University of Central Florida (USA). Soileau noted that Greivenkamp has also taught many optics courses at SPIE conferences and through the UA distance-learning program, which provides professional enrichment to working adults across the world as well as credit toward an online degree program. Greivenkamp is also an advisor for the National Science Federation’s OpTec program that develops instructional materials for community colleges across the USA.

Greivenkamp started the collection of optical devices for the Museum of Optics in 2003 for demonstrations in his courses, which always emphasize the practical aspects of the design of optical systems. Today, more than



1000 antique and historic telescopes, cameras, lenses, prisms, scanners, binoculars, and microscopes, some dating to the 1600s, are displayed throughout the college, and the museum is one of the college’s major educational outreach programs.

“These physical components enable students to visualize the aspects of optical systems that are often difficult to interpret from simple two-dimensional white board discussions,” said fellow UA professor Jim Schwiegerling. “He has demonstrated a dedication to optics education that is inclusive of all comers and is passionate about transferring his knowledge to the next generation of engineers. A generation of optical engineers have benefitted from his education and training.”

Greivenkamp has a PhD in optical sciences from UA and worked as a researcher at Eastman Kodak Co. before joining the faculty at UA.

He is the editor of the *SPIE Field Guides* series and author of the *Field Guide to Geometrical Optics*. He has served on and chaired the SPIE Education and Publications committees and served two terms on the SPIE Board of Directors (1997-1999 and 2012-2014).

Greivenkamp will receive the 2017 SPIE Educator Award 9 August at SPIE Optics + Photonics. ■



# SPIE AWARDS

## SPIE G.G. STOKES AWARD

### Christian Brosseau

SPIE member Christian Brosseau, Distinguished Professor of Physics at Université de Brest (France), is the recipient the 2017 SPIE G.G. Stokes Award.

Brosseau is receiving the award in recognition of his contributions to the theory of polarization of light, particularly for work on statistical optics and polarization applications in optical information processing.

“Dr. Brosseau’s contribution to polarimetry is proved to be indispensable. Among his large amount of contributions to polarization optics, it is enough to mention the formulation and characterization of the statistical properties of polarized light,” said the 2013 Stokes award recipient, José Jorge Gil Pérez of the Universidad de Zaragoza (Spain). “The whole set of contributions of Dr. Brosseau to polarization science is simply outstanding.”

Throughout his career, Brosseau has helped advance the field of polarization optics and image processing. In 1994, he coauthored a paper on the depolarization of multiply scattered waves by spherical diffusers, which contains the first experimental observation of the characteristic lengths of depolarization for a scattering medium and a modelling based on Monte Carlo simulations.

His book *Fundamentals of Polarization Optics* has become a touchstone work on the history and main concepts in the field. More recently, he



coauthored a highly cited article that presented an amalgamation of a large amount of literature on image-processing techniques. He also cowrote a detailed chapter in *Progress in Optics* that describes innovative polarization-based techniques for increasing image quality and edge detection.

Brosseau’s body of research is influential in the applied optics community, notably for improving diagnostic methods for detection of cancerous tumors and functional imaging. These techniques also have many engineering applications.

Some of Brosseau’s recent projects have scientific as well as technological value for health care, developing novel biological diagnostics and biosensors based on magnetoplasmonic core-shell nanostructures and nanophotonics, as well as suggesting novel concepts and methods for manipulating light and waves at the nanoscale.

He is also known for his outstanding dedication to engaging middle school, high school, and college students in optical science and engineering education. As a physics and optics educator, he believes that his role is not only to transmit knowledge to students but also to guide them in how to think and to reason.

Brosseau will receive the award 9 August at SPIE Optics + Photonics. ■

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## CONGRATULATIONS, New SPIE Fellows

Seventy-one SPIE members have been named Fellows of the Society this year.

The honor recognizes each individual's significant scientific and technical contributions in the multidisciplinary fields of optics, photonics, and imaging as well as service to the Society and the greater optics and photonics community.

The newly promoted Fellows join more than 1200 SPIE members who have become Fellows since the Society's inception in 1955.

This year's new Fellows exemplify the full diversity of the photonics community, said SPIE Fellow Majid Rabbani of Rochester Institute of Technology (USA), the 2016 chair of the Fellows Committee.

"They represent 16 countries on 3 continents, and 13 of the 71 are women, which represents an all-time high for a single year," Rabbani said.

"Their affiliations encompass the full range of academia, industry, and government labs and institutes, with expertise spanning all aspects of the photonics community, including strong representation from the medical imaging community. I am honored by the association with such an elite group, and I congratulate them all for their outstanding contributions."

New Fellows are recognized at SPIE meetings of their choice throughout the year. The first new Fellows were announced at SPIE Photonics West, with others honored at SPIE Medical Imaging, SPIE Advanced Lithography, SPIE Optics and Optoelectronics, SPIE Defense + Commercial Sensing, and at SPIE Optics + Photonics.



**Fauzia Ahmad**  
Temple University  
(USA)



**Dave Aikens**  
Savvy Optics (USA)



**Andrea Alù**  
University of Texas at  
Austin (USA)



**Craig Arnold**  
Princeton University  
(USA)



**Pablo Artal**  
Lab de Óptica  
University de Murcia  
(Spain)



**Alexei Baranov**  
University Montpellier 2  
(France)



**Harrison Barrett**  
University of Arizona  
(USA)



**David Boas**  
Massachusetts General  
Hospital (USA)



**Alexandra Boltasseva**  
Purdue University (USA)



**John Boone**  
University of California,  
Davis Medical Center  
(USA)



**Eva Campo**  
National Science  
Foundation (USA)



**J.-C. Chiao**  
University of Texas at  
Arlington (USA)



**Abdalla Darwish**  
Dillard University  
(USA)



**Elder De la Rosa-Cruz**  
Centro de  
Investigaciones en  
Optica (Mexico)



**Liang Dong**  
Clemson University  
(USA)



**Anthony Durkin**  
Beckman Laser Institute  
& Medical Clinic (USA)



**Dean Evans**  
US Air Force  
Research Lab  
(USA)



**Xudong Fan**  
University of  
Michigan (USA)



# SPIE FELLOWS



**Sergio Fantini**  
Tufts University  
(USA)



**Elizabeth Hillman**  
Columbia University  
(USA)



**Jingyu Lin**  
Texas Tech University (USA)



**Raimund Ober**  
Texas A&M University (USA)



**Aaron Fenster**  
Robarts Research Institute (Canada)



**Steven Horii**  
University of Pennsylvania Health System (USA)



**Shawn-Yu Lin**  
Rensselaer Polytechnic Institute (USA)



**Marek Ogiela**  
AGH University of Science and Technology (Poland)



**Martin Frenz**  
University Bern (Switzerland)



**Mark Itzler**  
Princeton Lightwave (USA)



**Zetian Mi**  
McGill University (Canada)



**Craig Olson**  
L3 Communications (USA)



**Emily Gallagher**  
IMEC (Belgium)



**Masanori Iye**  
National Astronomical Observatory (Japan)



**Mary-Ann Mycek**  
University of Michigan (USA)



**Fahima Ouchen**  
US Air Force Research Lab (USA)



**Yuri Granik**  
Mentor Graphics (USA)



**Nigel Johnson**  
University of Glasgow (UK)



**Hani Naguib**  
University of Toronto (Canada)



**David Pan**  
University of Texas at Austin (USA)



**David Hagan**  
University of Central Florida (USA)



**Alexis Kudryashov**  
Active Optics Night N (Russia)



**Shouleh Nikzad**  
Jet Propulsion Lab (USA)



**Inmaculada Pascual**  
Universidad de Alicante (Spain)



**Jian-Jun He**  
Zhejiang University (China)



**Sin-Doo Lee**  
Seoul National University (Korea)



**Lars Johan Nilsson**  
University of Southampton (UK)



**Francesco Pavone**  
European Laboratory for Non-Linear Spectroscopy (Italy)



**Herbert Heise**  
Fachhochschule Südwestfalen (Germany)



**Paul Lightsey**  
Ball Aerospace & Technologies (USA)



**Robert Nishikawa**  
University of Pittsburgh (USA)



**David Payne**  
University of Southampton (UK)



**Peter Herman**  
University of Toronto (Canada)



**Qinghuang Lin**  
IBM Thomas J. Watson Research Center (USA)



**Vasilis Ntziachristos**  
Technical University of Munich and Helmholtz Center (Germany)



**Norbert Pelc**  
Stanford University (USA)

# SPIE FELLOWS



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Intel (USA)



**Colin Sheppard**  
Istituto Italiano di  
Tecnologia (Italy)



**Attila Tárnok**  
University Leipzig  
(Germany)



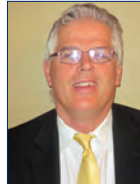
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NASA Goddard  
Space Flight  
Center (USA)



**Rebecca Richards-Kortum**  
Rice University  
(USA)



**Yakov Soskind**  
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Osaka University  
(Japan)



**Benjamin Rockwell**  
US Air Force  
Research Lab  
(USA)



**Dmitry Starodubov**  
FOMS (USA)



**Georgia Tourassi**  
Oak Ridge  
National Lab  
(USA)



**Shaoqun Zeng**  
Britton Chance  
Center for  
Biophotonics  
(China)



**John Sanders-Reed**  
Boeing (USA)



**Michele Stock**  
Michigan  
Photonics Cluster  
(USA)



**Ton van Leeuwen**  
Academisch  
Medisch Centrum  
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Georgia (USA)



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# SPIE SCHOLARSHIP WINNERS

## SPIE announces scholarship recipients for 2017-18 academic year

**S**PIE has awarded US \$298,000 in optics and photonics education scholarships for 2017 to 88 outstanding SPIE student members, based on their potential contribution to optics and photonics, or a related discipline.

Through 2016, SPIE has distributed over \$5 million in individual scholarships. The awards reflect the Society's commitment to education and to the next generation of optical scientists and engineers around the world. Individual awards range from \$2,500 to \$11,000.

SPIE Scholarship Committee chair and SPIE Senior Member Jeremy Bos of Michigan Technological University (USA) offered his thanks to all students who applied and congratulated the 2017 recipients.

"Every year, we take on the process of selecting awardees from an incredible group of smart, energetic, talented students," Bos said. "I want to thank the applicants, those who wrote helpful recommendations, and the members of the scholarship committee. I look forward to following

the winners and all of our applicants as they contribute to the Society and to our field."

SPIE scholarships are open to full- and part-time SPIE student members studying anywhere in the world. All scholarship applications are judged on merit and the experience and education level of the individual student. High school (pre-university/secondary school) and first- and second-year post-secondary, undergraduate, and graduate students are encouraged to apply and will be judged relative to other applicants with similar educational backgrounds.

For more information on SPIE's scholarship program, a complete list of 2017 scholarship winners, and the criteria used by the SPIE Scholarship Committee in selecting recipients, visit [spie.org/scholarships](http://spie.org/scholarships).

The awards for the 2017-2018 academic year include six named SPIE scholarships.

### D.J. LOVELL SCHOLARSHIP

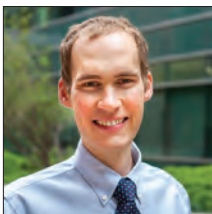
Logan Wright, a PhD student in applied physics at Cornell University (USA), was awarded the \$11,000 D.J. Lovell Scholarship for 2017. His research area is nonlinear wave propagation in multimode optical fibers. The scholarship is named for the radiometry and infrared optics consultant, author of *Optical Anecdotes*, and SPIE Fellow who died in 1984.



Wright

### JOHN KIEL SCHOLARSHIP

Travis Sawyer, a recent graduate of University of Cambridge (UK), was awarded the \$10,000 John Kiel Scholarship. He will begin a PhD in optical sciences at the University of Arizona (USA) in the fall, conducting research into developing a multimodal imaging system for tissue analysis. The John Kiel Scholarship honors SPIE founding member John Kiel, who died in 2014. The scholarship is awarded for a student's potential for long-term contributions in the field of optics and optical engineering.



Sawyer

### LASER TECHNOLOGY, ENGINEERING AND APPLICATIONS SCHOLARSHIP

Matthias Banet of the Air Force Institute of Technology (USA) is the recipient of the 2017 SPIE Laser Technology, Engineering and Applications Scholarship, which includes a \$5,000 award. He will be starting a PhD in optics in the fall. Banet recently developed the necessary wave-optics simulations to accurately predict the performance of digital holography wavefront sensing in the presence of distributed-volume atmospheric aberrations. He also has expanded his developments to include the deleterious effects of detection noise. The scholarship is awarded in recognition of a student's scholarly achievement in laser technology, engineering, or applications.



Banet

### TEDDI LAURIN SCHOLARSHIP

Brandon Born, a PhD student in optical design and engineering at the University of British Columbia (Canada), was awarded the Teddi Laurin Scholarship for 2017. He has conducted research in the field of ultra-fast optical switching through his investigation of photonic nanojets. Photonics Media partners with SPIE to fund the \$5,000 scholarship to raise awareness of optics and photonics and to foster growth and success in the photonics industry by supporting students involved in photonics. The scholarship is in memory of Laurin Publishing and Photonics Media founder Teddi Laurin.



Born

# SPIE SCHOLARSHIP WINNERS

## OPTICAL DESIGN AND ENGINEERING SCHOLARSHIP

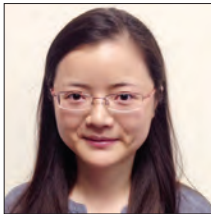
Meg Tidd, a master's student in optical design and engineering at the University of Arizona (USA), was awarded the SPIE Optical Design and Engineering Scholarship for 2017. The scholarship was established in memory of Bill Price and Warren Smith, both well-respected members of SPIE's technical community. Growth in her career as an optical engineer has led Tidd to pursue a graduate program in optical design, with hopes of building on her practical experience to learn new perspectives and develop new design approaches. The scholarship is awarded to a full-time student in the field of optical design and engineering.



Tidd

## BACUS SCHOLARSHIP

Jiaojiao Ou, a PhD student in micro/nanolithography and fabrication at the University of Texas at Austin (USA), is the recipient of the 2017 SPIE BACUS Scholarship. The \$5,000 scholarship is awarded to a full-time student in the field of microlithography with an emphasis on optical tooling and/or semiconductor manufacturing technologies. Ou's research has focused on mask synthesis and layout optimization for directed-self-assembly and emerging lithography. The scholarship is sponsored by BACUS, the international photomask technical group of SPIE.



Ou

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For more information on SPIE's scholarship program, a complete list of 2017 scholarship winners, and the criteria used by the SPIE Scholarship Committee in selecting recipients, visit [spie.org/scholarships](http://spie.org/scholarships).

## KIDGER SCHOLARSHIP

SPIE member Jonathan Papa of the University of Rochester (USA) has been awarded the 2017 Michael Kidger Memorial Scholarship in Optical Design.



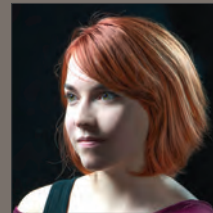
Papa

The \$5,000 award was presented to Papa by Andy Wood, chair of the Kidger Memorial Scholarship Award Committee, during the International Optical Design Conference in July.

The scholarship is supported by the Michael Kidger Memorial Scholarship Fund in memory of Michael John Kidger, a well-respected educator, design software developer, and member of the optical science and engineering community.

For more information on the Michael Kidger Memorial Scholarship, visit [www.kidger.com](http://www.kidger.com).

## THE FRIENDS OF TUCSON OPTICS SCHOLARSHIP



Guthery

Charlotte Guthery, of the Rochester Institute of Technology (USA) is the 2017-2018 recipient of the SPIE Graduate Student Endowed Scholarship in Optical Sciences, part of the Friends of Tucson Optics (FoTO) Scholarship Program. The College of Optical Sciences at The University of Arizona awards the FoTO

Graduate Student Scholarships competitively to promising incoming Ph.D. applicants, providing base stipend and tuition for the first academic year. In addition to demonstrating academic excellence in optical sciences, recipients display commitment to scholarship, involvement in extracurricular activities, and interests beyond science and technology.

For more information visit [www.optics.arizona.edu](http://www.optics.arizona.edu).





# COURSES

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Optical Design Design and Systems Engineering  
Astronomical Optics and Instrumentation  
Nanoscience  
Advanced Metrology  
Remote Sensing  
Detectors and Imaging  
Optics Educators  
Professional Development

[www.spie.org/education](http://www.spie.org/education)

### NEW AND FEATURED COURSES

Imaging Spectrometry  
Physiological Optics of the Eye for Engineers  
Deep Learning and its Applications in Image Processing  
A Crash Course on Spin Physics  
Introduction to Optomechanical Design  
Optomechanical Systems Engineering  
Stray Light Analysis and Control

Sending a few employees from your company to a course? Ask about our bulk sales discounts. [Education@spie.org](mailto:Education@spie.org)

#### MONEY-BACK GUARANTEE

We are confident that once you experience an SPIE course for yourself you will look to us for your future education needs. However, if for any reason you are dissatisfied, we will gladly refund your money. We just ask that you tell us what you did not like; suggestions for improvement are always welcome.

#### CONTINUING EDUCATION UNITS



SPIE is accredited by the International Association for Continuing Education and Training (IACET) and is authorized to issue the IACET CEU.

SPIE reserves the right to cancel a course due to insufficient advance registration.

## ADVANCED METROLOGY

- Sun SC213 **Introduction to Interferometric Optical Testing** (Wyant) 8:30 am to 12:30 pm, \$410 / \$465 / \$261
- Sun SC1164 **Wavefront Data Analysis** (Mahajan) 1:30 pm to 5:30 pm, \$450 / \$505 / \$277
- Mon SC1003 **Optical Scatter Metrology for Industry** (Stover) 8:30 am to 12:30 pm, \$445 / \$500 / \$275
- Mon SC492 **Predicting, Modeling, and Interpreting Light Scattered by Surfaces** (Germer) 1:30 pm to 5:30 pm, \$375 / \$430 / \$247

## ASTRONOMICAL OPTICS AND INSTRUMENTATION

- Sun SC213 **Introduction to Interferometric Optical Testing** (Wyant) 8:30 am to 12:30 pm, \$410 / \$465 / \$261
- Mon SC1114 **The Proper Care of Optics: Cleaning, Handling, Storage and Shipping** (Schalck) 1:30 pm to 5:30 pm, \$420 / \$475 / \$265
- Wed SC1086 **Optical Materials, Fabrication and Testing for the Optical Engineer** (DeGroot Nelson) 8:30 am to 12:30 pm, \$375 / \$430 / \$247

## ATMOSPHERIC AND SPACE OPTICAL SYSTEMS

- Mon SC1114 **The Proper Care of Optics: Cleaning, Handling, Storage and Shipping** (Schalck) 1:30 pm to 5:30 pm, \$420 / \$475 / \$265

## DETECTORS AND IMAGING

- Sun SC1222 **Deep Learning and its Applications in Image Processing** (Nasrabadi) 8:30 am to 5:30 pm, \$600 / \$715 / \$361
- Mon SC504 **Introduction to CCD and CMOS Imaging Sensors and Applications** (Janesick) 8:30 am to 5:30 pm, \$740 / \$855 / \$417
- Tue SC916 **Digital Camera and Sensor Evaluation Using Photon Transfer** (Janesick) 8:30 am to 5:30 pm, \$655 / \$770 / \$383
- Wed SC194 **Multispectral and Hyperspectral Image Sensors** (Lomheim) 1:30 pm to 5:30 pm, \$455 / \$510 / \$279

## NANOSCIENCE

- Mon SC1223 **A Crash Course on Spin Physics** (Dyakonov) 8:30 am to 12:30 pm, \$375 / \$430 / \$247

## OPTICAL DESIGN AND SYSTEMS ENGINEERING

- Sun SC690 **Optical System Design: Layout Principles and Practice** (Greivenkamp) 8:30 am to 5:30 pm, \$635 / \$750 / \$375
- Mon SC1112 **Introduction to Electro-Optical Systems Design** (Stotts) 8:30 am to 5:30 pm, \$710 / \$825 / \$405
- Mon SC003 **Practical Optical System Design** (Youngworth) 8:30 am to 5:30 pm, \$705 / \$820 / \$403
- Mon SC1114 **The Proper Care of Optics: Cleaning, Handling, Storage and Shipping** (Schalck) 1:30 pm to 5:30 pm, \$420 / \$475 / \$265
- Tue SC011 **Design of Efficient Illumination Systems** (Cassarly) 8:30 am to 12:30 pm, \$375 / \$430 / \$247
- Tue SC1178 **Fundamentals of Molded Optics** (Symmons, Schaub) 8:30 am to 12:30 pm, \$410 / \$465 / \$261
- Tue SC863 **Introduction to Modern Optical Drawings – the ISO 10110 Standard** (Aikens) 8:30 am to 12:30 pm, \$375 / \$430 / \$247
- Wed SC912 **Intermediate Lens Design** (Bentley) 8:30 am to 5:30 pm, \$635 / \$750 / \$375
- Wed SC1086 **Optical Materials, Fabrication and Testing for the Optical Engineer** (DeGroot Nelson) 8:30 am to 12:30 pm, \$375 / \$430 / \$247
- Wed SC1199 **Stray Light Analysis and Control** (Fest) 8:30 am to 5:30 pm, \$645 / \$760 / \$379

- Thu SC1221 **Physiological Optics of the Eye for Engineers** (Lakshminarayanan) 8:30 am to 5:30 pm, \$635 / \$750 / \$375

- Thu SC1165 **Probability for Systems Engineers** (Arenberg) 8:30 am to 12:30 pm, \$375 / \$430 / \$247

## OPTICAL SYSTEMS & LENS DESIGN

- Tue SC1179 **Optical Glass – Properties and Application-oriented Specification** (Hartmann) 8:30 am to 5:30 pm, \$645 / \$760 / \$379
- Wed SC1086 **Optical Materials, Fabrication and Testing for the Optical Engineer** (DeGroot Nelson) 8:30 am to 12:30 pm, \$375 / \$430 / \$247

## OPTOMECHANICS AND OPTICAL MANUFACTURING

- Sun SC213 **Introduction to Interferometric Optical Testing** (Wyant) 8:30 am to 12:30 pm, \$410 / \$465 / \$261
- Sun-Mon SC014 **Introduction to Optomechanical Design** (Vukobratovich) 8:30 am to 5:30 pm, \$1,075 / \$1,330 / \$607
- Mon SC781 **Optomechanical Analysis** (Hatheway) 8:30 am to 5:30 pm, \$645 / \$760 / \$379
- Mon SC1114 **The Proper Care of Optics: Cleaning, Handling, Storage and Shipping** (Schalck) 1:30 pm to 5:30 pm, \$420 / \$475 / \$265
- Tue SC010 **Introduction to Optical Alignment Techniques** (Castle) 8:30 am to 5:30 pm, \$600 / \$715 / \$361
- Tue SC1019 **Mounting of Optical Components** (Kasunic) 8:30 am to 5:30 pm, \$680 / \$795 / \$393
- Tue SC015 **Fastening Optical Elements with Adhesives** (Daly) 1:30 pm to 5:30 pm, \$375 / \$430 / \$247
- Wed SC218 **Advanced Composite Materials for Optomechanical Systems** (Zweber) 8:30 am to 5:30 pm, \$600 / \$715 / \$361
- Wed SC1086 **Optical Materials, Fabrication and Testing for the Optical Engineer** (DeGroot Nelson) 8:30 am to 12:30 pm, \$375 / \$430 / \$247
- Thu SC1120 **Finite Element Analysis of Optics** (Doyle, Genberg) 8:30 am to 5:30 pm, \$670 / \$785 / \$389
- Thu SC1085 **Optomechanical Systems Engineering** (Kasunic) 8:30 am to 5:30 pm, \$670 / \$785 / \$389

## REMOTE SENSING

- Sun SC567 **Introduction to Optical Remote Sensing Systems** (Shaw) 1:30 pm to 5:30 pm, \$375 / \$430 / \$247
- Wed SC1220 **Imaging Spectrometry** (Hagen) 8:30 am to 12:30 pm, \$375 / \$430 / \$247
- Thu SC152 **Infrared Focal Plane Arrays** (Hubbs) 8:30 am to 5:30 pm, \$600 / \$715 / \$361

## COURSES FOR INDUSTRY AND EXHIBITORS

- Mon SC609 **Basic Optics for Non-Optics Personnel** (Harding) 1:30 pm to 4:00 pm, \$150 / \$150 / \$60

## OPTICS EDUCATORS

- Tue WS1156 **Dumpster Optics: Teaching Optics with Junk** (Donnelly, Magnani) 10:30 am to 12:30 pm, \$10 / \$15 / \$10
- Tue WS1201 **I SEE THE LIGHT! An introduction to basic properties of light** (McKee) 1:30 pm to 5:30 pm, \$10 / \$15 / \$10

## PROFESSIONAL DEVELOPMENT

- Sun WS897 **Making the most of your Presentation** (Doumont) 1:30 pm to 5:30 pm, Free to attendees
- Mon WS908 **Structuring your Research Paper** (Doumont) 8:30 am to 12:30 pm, Free to attendees
- Mon WS1202 **Conveying Messages with Graphs** (Doumont) 1:30 pm to 5:30 pm, Free to attendees
- Wed WS1059 **Resumes to Interviews: Strategies for a Successful Job Search** (Welch, Krinsky) 3:30 pm to 5:30 pm, Free to attendees



# COURSES

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY
<b>Advanced Metrology</b>				
SC213 <b>Introduction to Interferometric Optical Testing</b> ( <i>Wyant</i> ) 8:30 am to 12:30 pm, \$410 / \$465 / \$261	SC1003 <b>Optical Scatter Metrology for Industry</b> ( <i>Stover</i> ) 8:30 am to 12:30 pm, \$445 / \$500 / \$275			
SC1164 <b>Wavefront Data Analysis</b> ( <i>Mahajan</i> ) 1:30 pm to 5:30 pm, \$450 / \$505 / \$277	SC492 <b>Predicting, Modeling, and Interpreting Light Scattered by Surfaces</b> ( <i>Germer</i> ) 1:30 pm to 5:30 pm, \$375 / \$430 / \$247			
<b>Astronomical Optics and Instrumentation</b>				
SC213 <b>Introduction to Interferometric Optical Testing</b> ( <i>Wyant</i> ) 8:30 am to 12:30 pm, \$410 / \$465 / \$261	SC1114 <b>The Proper Care of Optics: Cleaning, Handling, Storage and Shipping</b> ( <i>Schalck</i> ) 1:30 pm to 5:30 pm, \$420 / \$475 / \$265		SC1086 <b>Optical Materials, Fabrication and Testing for the Optical Engineer</b> ( <i>DeGroot Nelson</i> ) 8:30 am to 12:30 pm, \$375 / \$430 / \$247	
<b>Atmospheric and Space Optical Systems</b>				
	SC1114 <b>The Proper Care of Optics: Cleaning, Handling, Storage and Shipping</b> ( <i>Schalck</i> ) 1:30 pm to 5:30 pm, \$420 / \$475 / \$265			
<b>Detectors and Imaging</b>				
<b>NEW</b> SC1222 <b>Deep Learning and its Applications in Image Processing</b> ( <i>Nasrabadi</i> ) 8:30 am to 5:30 pm, \$600 / \$715 / \$361	SC504 <b>Introduction to CCD and CMOS Imaging Sensors and Applications</b> ( <i>Janesick</i> ) 8:30 am to 5:30 pm, \$740 / \$855 / \$417	SC916 <b>Digital Camera and Sensor Evaluation Using Photon Transfer</b> ( <i>Janesick</i> ) 8:30 am to 5:30 pm, \$655 / \$770 / \$383	SC194 <b>Multispectral and Hyperspectral Image Sensors</b> ( <i>Lomheim</i> ) 1:30 pm to 5:30 pm, \$455 / \$510 / \$279	
<b>Nanoscience</b>				
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<b>Remote Sensing</b>				
SC567 <b>Introduction to Optical Remote Sensing Systems</b> ( <i>Shaw</i> ) 1:30 pm to 5:30 pm, \$375 / \$430 / \$247			<b>NEW</b> SC1220 <b>Imaging Spectrometry</b> ( <i>Hagen</i> ) 8:30 am to 12:30 pm, \$375 / \$430 / \$247	SC152 <b>Infrared Focal Plane Arrays</b> ( <i>Hubbs</i> ) 8:30 am to 5:30 pm, \$600 / \$715 / \$361
<b>Courses for Industry and Exhibitors</b>				
	SC609 <b>Basic Optics for Non-Optics Personnel</b> ( <i>Harding</i> ) 1:30 pm to 4:00 pm, \$150 / \$150 / \$60			
<b>Optics Educators</b>				
		WS1156 <b>Dumpster Optics: Teaching Optics with Junk</b> ( <i>Donnelly, Magnani</i> ) 10:30 am to 12:30 pm, \$10 / \$15 / \$10		
		WS1201 <b>I SEE THE LIGHT! An introduction to basic properties of light</b> ( <i>McKee</i> ) 1:30 pm to 5:30 pm, \$10 / \$15 / \$10		
<b>Professional Development</b>				
WS897 <b>Making the most of your Presentation</b> ( <i>Doumont</i> ) 1:30 pm to 5:30 pm, Free to attendees.	WS908 <b>Structuring your Research Paper</b> ( <i>Doumont</i> ) 8:30 am to 12:30 pm, Free to attendees.		WS1059 <b>Resumes to Interviews: Strategies for a Successful Job Search</b> ( <i>Welch, Krinsky</i> ) 3:30 to 5:30 pm, Free to attendees.	
	WS1202 <b>Conveying Messages with Graphs</b> ( <i>Doumont</i> ) 1:30 pm to 5:30 pm, Free to attendees.			

Prices: SPIE Member / Nonmember / Student





# NANOSCIENCE + ENGINEERING

The largest nanotechnology conference anywhere highlighting nanoscience, nanoengineering, and quantum science.

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California Institute of Technology (USA)



*Symposium Chair*

**Nikolay I. Zheludev,**  
Optoelectronics Research Ctr. (United Kingdom) and Nanyang Technological Univ. (Singapore)



*Symposium Co-chair*

**James G. Grote,**  
Air Force Research Lab. (USA)



*Symposium Co-chair*

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Univ. of East Anglia (United Kingdom)

- LOW-D MATERIALS
- OPTICAL TRAPPING
- METAMATERIALS
- PLASMONICS
- NANOENGINEERING
- NANOBIOSYSTEMS
- SPINTRONICS
- NANOIMAGING
- QUANTUM SCIENCE

# DAILY SCHEDULE

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY
Technology Hot Topics, 6:00 to 8:00 PM	Nanoscience + Engineering Plenary Session, 9:15 AM to 12:00 PM		Poster Session, 5:30 to 7:30 PM	
	Poster Session, 5:30 to 7:30 PM			

## NANOSCIENCE

10343 <b>Metamaterials, Metadevices, and Metasystems 2017</b> ( <i>Engheta, Noginov, Zheludev</i> ) p. 59				
			10344 <b>Nanophotonic Materials XIV</b> ( <i>Cabrini, Léronde, Schwartzberg, Mokari</i> ) p. 65	
10345 <b>Active Photonic Platforms IX</b> ( <i>Subramania, Foteinopoulou</i> ) p. 67				
10346 <b>Plasmonics: Design, Materials, Fabrication, Characterization, and Applications XV</b> ( <i>Tsai, Tanaka</i> ) p. 72				
10347 <b>Optical Trapping and Optical Micromanipulation XIV</b> ( <i>Dholakia, Spalding</i> ) p. 77				
10348 <b>Physical Chemistry of Semiconductor Materials and Interfaces XVI</b> ( <i>Bronstein, Deschler, Bakulin</i> ) p. 83				
10350 <b>Nanoimaging and Nanospectroscopy V</b> ( <i>Verma, Egner</i> ) p. 89			10349 <b>Low-Dimensional Materials and Devices 2017</b> ( <i>Kobayashi, Talin, Islam, Davydov</i> ) p. 86	
10351 <b>UV and Higher Energy Photonics: From Materials to Applications 2017</b> ( <i>Léronde, Kawata, Cho</i> ) p. 92		10353 <b>Optical Sensing, Imaging, and Photon Counting: Nanostructured Devices and Applications 2017</b> ( <i>Razeghi, Mitrofanov, Pau Vizcaino, Tan</i> ) p. 96		
10352 <b>Biosensing and Nanomedicine X</b> ( <i>Mohseni, Agahi, Razeghi</i> ) p. 94				

## NANOENGINEERING

			10354 <b>Nanoengineering: Fabrication, Properties, Optics, and Devices XIV</b> ( <i>Campo, Dobisz, Eldada</i> ) p. 98	
			10355 <b>Nanobiosystems: Processing, Characterization, and Applications X</b> ( <i>Kobayashi, Ouchen, Rau</i> ) p. 101	
			10356 <b>Nanostructured Thin Films X</b> ( <i>Jen, Lakhtakia, Mackay</i> ) p. 103	

## QUANTUM SCIENCE

10357 <b>Spintronics X</b> ( <i>Drouhin, Wegrowe, Razeghi, Jaffrès</i> ) p. 105				
10358 <b>Quantum Photonic Devices</b> ( <i>Soci, Agio, Srinivasan</i> ) p. 114				
			10359 <b>Quantum Nanophotonics</b> ( <i>Dionne, Lawrence</i> ) p. 117	
10409 <b>Quantum Communications and Quantum Imaging XV</b> ( <i>Meyers, Shih, Deacon</i> ) p. 256				



# NANOSCIENCE + ENGINEERING

## NANOSCIENCE

- 10343 **Metamaterials, Metadevices, and Metasystems 2017** (*Engheta, Noginov, Zheludev*) . . . . . p. 59
- 10344 **Nanophotonic Materials XIV** (*Cabrini, Léronde, Schwartzberg, Mokari*) . . . . . p. 65
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- 10348 **Physical Chemistry of Semiconductor Materials and Interfaces XVI** (*Bronstein, Deschler, Bakulin*) . . . . . p. 83
- 10349 **Low-Dimensional Materials and Devices 2017** (*Kobayashi, Talin, Islam, Davydov*) . . . . . p. 86
- 10350 **Nanoimaging and Nanospectroscopy V** (*Verma, Egner*) . . . p. 89
- 10351 **UV and Higher Energy Photonics: From Materials to Applications 2017** (*Léronde, Kawata, Cho*) . . . . . p. 92
- 10352 **Biosensing and Nanomedicine X** (*Mohseni, Agahi, Razeghi*) p. 94
- 10353 **Optical Sensing, Imaging, and Photon Counting: Nanostructured Devices and Applications 2017** (*Razeghi, Mitrofanov, Pau Vizcaíno, Tan*) . . . . . p. 96

## NANOENGINEERING

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- 10355 **Nanobiosystems: Processing, Characterization, and Applications X** (*Kobayashi, Ouchen, Rau*) . . . . . p. 101
- 10356 **Nanostructured Thin Films X** (*Jen, Lakhtakia, Mackay*) . . . p. 103

## QUANTUM SCIENCES AND TECHNOLOGY

- 10357 **Spintronics X** (*Drouhin, Wegrowe, Razeghi, Jaffrès*) . . . . . p. 105
- 10358 **Quantum Photonic Devices** (*Soci, Agio, Srinivasan*) . . . . . p. 114
- 10359 **Quantum Nanophotonics** (*Dionne, Lawrence*) . . . . . p. 117
- 10409 **Quantum Communications and Quantum Imaging XV** (*Meyers, Shih, Deacon*) . . . . . p. 256

## TECHNICAL ORGANIZING COMMITTEE

- Massoud H. Agahi**, Harbor-UCLA Medical Ctr. (USA) and Cedars-Sinai Medical Ctr. (USA)
- Mario Agio**, Univ. Siegen (Germany)
- Artem A. Bakulin**, Imperial College London (United Kingdom)
- Hugo A. Bronstein**, Univ. College London (United Kingdom)
- Stefano Cabrini**, Lawrence Berkeley National Lab. (USA)
- Eva M. Campo**, Bangor Univ. (United Kingdom)
- Yong-Hoon Cho**, KAIST (Korea, Republic of)
- Albert V. Davydov**, National Institute of Standards and Technology (USA)
- Felix Deschler**, Univ. of Cambridge (United Kingdom)
- Kishan Dholakia**, Univ. of St. Andrews (United Kingdom)
- Jennifer A. Dionne**, Stanford Univ. (USA)
- Elizabeth A. Dobisz**, Spin Transfer Technologies, Inc. (USA)
- Henri-Jean Drouhin**, Ecole Polytechnique (France)
- Alexander Egner**, Laser-Lab. Göttingen e.V. (Germany)
- Louay A. Eldada**, Quanergy, Inc. (USA)
- Nader Engheta**, Univ. of Pennsylvania (USA)
- Stavroula Foteinopoulou**, The Univ. of New Mexico (USA)
- M. Saif Islam**, Univ. of California, Davis (USA)
- Henri Jaffrès**, Unité Mixte de Physique CNRS/Thales (France)
- Yi-Jun Jen**, National Taipei Univ. of Technology (Taiwan)
- Satoshi Kawata**, Osaka Univ. (Japan)
- Nobuhiko P. Kobayashi**, Univ. of California, Santa Cruz (USA)
- Norihisa Kobayashi**, Chiba Univ. (Japan)
- Akhlesh Lakhtakia**, The Pennsylvania State Univ. (USA)
- Mark Lawrence**, Stanford Univ. (USA)
- Gilles Léronde**, Univ. de Technologie Troyes (France)
- Tom G. Mackay**, The Univ. of Edinburgh (United Kingdom)
- Oleg Mitrofanov**, Univ. College London (United Kingdom)
- Hooman Mohseni**, Northwestern Univ. (USA)
- Taleb Mokari**, Ben-Gurion Univ. of the Negev (Israel)
- Mikhail A. Noginov**, Norfolk State Univ. (USA)
- Fahima Ouchen**, Air Force Research Lab. (USA)
- José Luis Pau Vizcaíno**, Univ. Autónoma de Madrid (Spain)
- Ileana Rau**, Polytechnical Univ. of Bucharest (Romania)
- Manijeh Razeghi**, Northwestern Univ. (USA)
- Adam M. Schwartzberg**, Lawrence Berkeley National Lab. (USA)
- Cesare Soci**, Nanyang Technological Univ. (Singapore)
- Gabriel C. Spalding**, Illinois Wesleyan Univ. (USA)
- Kartik Srinivasan**, National Institute of Standards and Technology (USA)
- Ganapathi S. Subramania**, Sandia National Labs. (USA)
- A. Alec Talin**, Sandia National Labs. (USA)
- Chee Hing Tan**, The Univ. of Sheffield (United Kingdom)
- Takuo Tanaka**, RIKEN Ctr. for Advanced Photonics (Japan)
- Din Ping Tsai**, National Taiwan Univ. (Taiwan)
- Prabhat Verma**, Osaka Univ. (Japan)
- Jean-Eric Wegrowe**, Ecole Polytechnique (France)
- Nikolay I. Zheludev**, Optoelectronics Research Ctr. (United Kingdom) and Nanyang Technological Univ. (Singapore)

# CONFERENCE 10343

LOCATION: CONV. CTR. ROOM 6D

Sunday–Thursday 6–10 August 2017 • Proceedings of SPIE Vol. 10343

# Metamaterials, Metadevices, and Metasystems 2017

*Conference Chairs:* **Nader Engheta**, Univ. of Pennsylvania (USA); **Mikhail A. Noginov**, Norfolk State Univ. (USA); **Nikolay I. Zheludev**, Optoelectronics Research Ctr. (United Kingdom), Nanyang Technological Univ. (Singapore)

*Program Committee:* **Andrea Alù**, The Univ. of Texas at Austin (USA); **David L. Andrews**, Univ. of East Anglia (United Kingdom); **Pierre Berini**, Univ. of Ottawa (Canada); **Alexandra Boltasseva**, Purdue Univ. (USA); **Igal Brener**, Sandia National Labs. (USA); **Mark Brongersma**, Stanford Univ. (USA); **Joshua D. Caldwell**, U.S. Naval Research Lab. (USA); **Che Ting Chan**, Hong Kong Univ. of Science and Technology (Hong Kong, China); **Luca Dal Negro**, Boston Univ. (USA); **Javier García de Abajo**, ICFO - Institut de Ciències Fotòniques (Spain); **Harald W. Giessen**, Univ. Stuttgart (Germany); **Richard Hammond**, U.S. Army Research Office (USA); **Yuri S. Kivshar**, The Australian National Univ. (Australia); **Jacob B. Khurgin**, Johns Hopkins Univ. (USA); **Uriel Levy**, The Hebrew Univ. of Jerusalem (Israel); **Natalia M. Litchinitser**, Univ. at Buffalo (USA); **Martin W. McCall**, Imperial College London (United Kingdom); **Peter Nordlander**, Rice Univ. (USA); **Alberto Piqué**, U.S. Naval Research Lab. (USA); **Alessandro Salandrino**, The Univ. of Kansas (USA); **Gennady B. Shvets**, The Univ. of Texas at Austin (USA); **David R. Smith**, Duke Univ. (USA); **Mark I. Stockman**, Georgia State Univ. (USA); **Philippe Tassin**, Chalmers Univ. of Technology (Sweden); **Päivi Törmä**, Aalto Univ. School of Science (Finland); **Sergei Tretyakov**, Aalto Univ. School of Science and Technology (Finland); **Din Ping Tsai**, National Taiwan Univ. (Taiwan); **Augustine M. Urbas**, Air Force Research Lab. (USA); **Martin Wegener**, Karlsruhe Institut für Technologie (Germany); **Jeong Weon Wu**, Ewha Womans Univ. (Korea, Republic of); **Xiang Zhang**, Univ. of California, Berkeley (USA)

## SUNDAY 6 AUGUST

LOCATION: CONV. CTR. ROOM 6D ..... 8:30 AM TO 8:35 AM

### Opening Remarks

Session Chair: **Mikhail A. Noginov**, Norfolk State Univ. (USA)

### SESSION 1

LOCATION: CONV. CTR. ROOM 6D .. SUN 8:35 AM TO 10:20 AM

### Novel Concepts I

Session Chair: **Alexander B. Khanikaev**, The City College of New York (USA)

8:35 am: **Real and imaginary properties of epsilon-near-zero materials** (*Invited Paper*), Mark I. Stockman, Georgia State Univ. (USA) ..... [10343-1]

9:00 am: **Universal spin-momentum locking of light** (*Invited Paper*), Todd Van Mechele, Farid Kalhor, Ward D. Newman, Zubin Jacob, Purdue Univ. (USA) ..... [10343-2]

9:25 am: **High order plasmonic resonances in time-varying media** (*Invited Paper*), Alessandro Salandrino, E. Alexander Ramos, The Univ. of Kansas (USA) ..... [10343-3]

9:50 am: **Index retrieval of finite thickness fishnet metamaterials tracking the phase accumulation**, Eyal Feigenbaum, Anna M. Hiszpanski, Lawrence Livermore National Lab. (USA) ..... [10343-4]

10:05 am: **Dynamic properties of large light filament arrays for complex photonic meta-structures in air**, Wiktor T. Walasik, Univ. at Buffalo (USA); Shermineh Rostami, Daniel Kepler, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Matthieu Baudelet, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) and Univ. of Central Florida (USA); Martin C. Richardson, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Natalia M. Litchinitser, Univ. at Buffalo (USA) ..... [10343-5]

Coffee Break ..... Sun 10:20 am to 10:50 am

### SESSION 2

LOCATION: CONV. CTR. ROOM 6D .. SUN 10:50 AM TO 12:25 PM

### Novel Concepts II

Session Chair: **Isabelle Staude**, Friedrich-Schiller-Univ. Jena (Germany)

10:50 am: **Meoscopic optics of two-dimensional random media** (*Invited Paper*), Hui Cao, Yale Univ. (USA) ..... [10343-6]

11:15 am: **Space-time super-resolution imaging** (*Invited Paper*), Evgenii E. Narimanov, Andrei Rogov, Purdue Univ. (USA) ..... [10343-7]

11:40 am: **Laser scanning using spatiotemporal beam dynamics in metasurfaces**, Amr M. Shaltout, Konstantinos Lagoudakis, Soo Jin Kim, Jelena Vuckovic, Stanford Univ. (USA); Vladimir M. Shalaev, Purdue Univ. (USA); Mark L. Brongersma, Stanford Univ. (USA) ..... [10343-8]

11:55 am: **Removing material singularities in Schwarz-Christoffel coordinate transformations**, Sophie Viaene, Vrije Univ. Brussel (Belgium) and Chalmers Univ. of Technology (Sweden); Vincent Ginis, Jan Danckaert, Vrije Univ. Brussel (Belgium); Philippe Tassin, Chalmers Univ. of Technology (Sweden) ..... [10343-9]

12:10 pm: **Experimental validation of tunable features in laser-induced plasma metamaterials**, Roberto A. Colon Quinones, Mark A. Cappelli, Stanford Univ. (USA) ..... [10343-10]

Lunch Break ..... Sun 12:25 pm to 1:55 pm

### SESSION 3

LOCATION: CONV. CTR. ROOM 6D .... SUN 1:55 PM TO 3:30 PM

### All-Dielectric Metamaterials I

Session Chair: **Zubin Jacob**, Purdue Univ. (USA)

1:55 pm: **Widely tunable semiconductor antennas for reconfigurable metasurfaces** (*Invited Paper*), Jon A. Schuller, Univ. of California, Santa Barbara (USA) ..... [10343-11]

2:20 pm: **All-dielectric photonic topological metamaterials and metasurfaces** (*Invited Paper*), Alexander B. Khanikaev, The City College of New York (USA) ..... [10343-12]

2:45 pm: **Light concentration in subwavelength volume by dielectric transducer and local sensing of plasmonic systems**, Andrey Karlovich Sarychev, Institute for Theoretical and Applied Electrodynamics (Russian Federation); Sergey Vergeles, L.D. Landau Institute for Theoretical Physics (Russian Federation) and Moscow Institute of Physics and Technology (Russian Federation); Gennady Tartakovskiy, Advanced Systems and Technologies, Inc. (USA) ..... [10343-13]

3:00 pm: **High-Q resonances with low azimuthal indices in all-dielectric high-index nanoparticles**, Kirill Koshelev, ITMO Univ. (Russian Federation) and The Academic Univ. (Russian Federation); Andrey A. Bogdanov, Zarina Sadrieva, ITMO Univ. (Russian Federation); Kirill B. Samusev, Mikhail V. Rybin, Mikhail F. Limonov, Ioffe Institute (Russian Federation); Yuri S. Kivshar, The Australian National Univ. (Australia) ..... [10343-14]

3:15 pm: **Metasurface axicon lens design at visible wavelengths**, Saleimah Alyammahi, Qiwen Zhan, Univ. of Dayton (USA) ..... [10343-15]

Coffee Break ..... Sun 3:30 pm to 4:00 pm



# CONFERENCE 10343

## SESSION 4

LOCATION: CONV. CTR. ROOM 6D . . . SUN 4:00 PM TO 5:35 PM

### All-Dielectric Metamaterials II

Session Chair: **Alessandro Salandrino**, The Univ. of Kansas (USA)

4:00 pm: **Nonlinear frequency conversion with all-dielectric nanoantennas** (*Invited Paper*), Dragomir N. Neshev, Sergey S. Kruk, Mohsen Rahmani, Maria del Rocio Camacho-Morales, Lei Wang, Lei Xu, Daria A. Smirnova, Alexander S. Soltsev, Yuri S. Kivshar, The Australian National Univ. (Australia) . . . . . [10343-16]

4:25 pm: **Active and tunable Mie-resonant semiconductor metasurfaces** (*Invited Paper*), Isabelle Staude, Friedrich-Schiller-Univ. Jena (Germany) [10343-17]

4:50 pm: **Directional second harmonic generation from AlGaAs nanoantennas**, Maria del Rocio Camacho Morales, Mohsen Rahmani, Sergey S. Kruk, Lei Wang, The Australian National Univ. (Australia); Lei Xu, The Australian National Univ. (Australia) and Nankai Univ. (China); Daria A. Smirnova, Alexander S. Soltsev, Andrey E. Miroshnichenko, Hark Hoe Tan, Fouad Karouta, Shagufta Naureen, Kaushal D. Vora, The Australian National Univ. (Australia); Luca Carletti, Costantino De Angelis, Chennupati Jagadish, Univ. degli Studi di Brescia (Italy); Yuri S. Kivshar, Dragomir N. Neshev, The Australian National Univ. (Australia) . . . . . [10343-18]

5:05 pm: **Characterization of Si-disk magnetic nanoprobe by photoinduced force microscopy**, Jinwei Zeng, Mohsen Rajaei, Mahsa Darvish, Mohammad Albooyeh, Brian Albee, Hemantha K. Wickramasinghe, Eric O. Potma, Filippo Capolino, Univ. of California, Irvine (USA) . . . . . [10343-19]

5:20 pm: **Dynamically tunable topologically protected edge-states in silicon photonic crystals with liquid crystal background**, Mikhail I. Shalaev, Wiktor T. Walasik, Sameerah Desnavi, Natalia M. Litchinitser, Univ. at Buffalo (USA) . . . . . [10343-20]

LOCATION: CONV. CTR. ROOM 6A . . SUN 6:00 PM TO 7:50 PM

### Technology Hot Topics: How Optics and Photonics Drive Innovation

6:00 pm to 6:10 pm: **Welcome and Opening Remarks**

6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)

6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)

6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)

7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)

7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)

## MONDAY 7 AUGUST

LOCATION: CONV. CTR. ROOM 6A MON 9:00 AM TO 12:00 PM

### Nanoscience + Engineering Plenary Session

Session Chairs: **Harry A. Atwater Jr.**, California Institute of Technology (USA); **Nikolay I. Zheludev**, Optoelectronics Research Ctr. (United Kingdom)

9:15 am: **3D laser nanolithography** (*Plenary*), Martin Wegener, Karlsruher Institut für Technologie (Germany) . . . . . [10354-500]

Coffee Break . . . . . Mon 10:00 am to 10:30 am

10:30 am: **Controlling light at the atomic scale** (*Plenary*), F. Javier García de Abajo, ICFO - Institut de Ciències Fotòniques (Spain) . . . . . [10359-500]

11:15 am: **Science, engineering, and commercialization of flexible, printable 2D atomic materials and devices** (*Invited Paper*), Deji Akinwande, The Univ. of Texas at Austin (USA) . . . . . [10349-500]

Lunch Break . . . . . Mon 12:00 pm to 1:30 pm

## SESSION 5

LOCATION: CONV. CTR. ROOM 6D . . . MON 1:30 PM TO 3:20 PM

### Strong Coupling

Session Chair: **Adam Dunkelberger**, U.S. Naval Research Lab. (USA)

1:30 pm: **Polariton lasing in organic semiconductor microcavities** (*Invited Paper*), David G. Lidzey, The Univ. of Sheffield (United Kingdom) . . . . . [10343-21]

1:55 pm: **Control of vibration-cavity polaritons in the frequency domain** (*Invited Paper*), Blake S. Simpkins, Kenan P. Fears, Adam Dunkelberger, U.S. Naval Research Lab. (USA); Wonmi Ahn, National Research Council (USA); Walter J. Dressick, Igor Vurgaftman, Jeffrey C. Owrutsky, U.S. Naval Research Lab. (USA) . . . . . [10343-22]

2:20 pm: **Effect of strong coupling on the photodegradation of poly(3-hexylthiophene)**, Vanessa N. Peters, Md. Omar Faruk, Norfolk State Univ. (USA); Rohan Alexander, Univ. of Michigan (USA) and Norfolk State Univ. (USA); D'Angelo A. Peters, Norfolk State Univ. (USA) and Purdue Univ. (USA); Mikhail A. Noginov, Norfolk State Univ. (USA) . . . . . [10343-23]

2:35 pm: **Directional spontaneous emission of dye on top of thin silver grating**, Ekemba K. Tanyi, Soheila Mashhadi, Norfolk State Univ. (USA); Sahana Das Bhattacharyya, Tal Galfsky, Vinod M. Menon, The City College of New York (USA); Natalia Noginova, Norfolk State Univ. (USA); Viktor A. Podolskiy, Univ. of Massachusetts Lowell (USA); Mikhail A. Noginov, Norfolk State Univ. (USA) . . . . . [10343-24]

2:50 pm: **Vibrational energy relaxation of vibration-cavity polariton modes**, Adam Dunkelberger, Kenan P. Fears, U.S. Naval Research Lab. (USA); Bryan T. Spann, National Institute of Standards and Technology (USA); Blake S. Simpkins, Jeffrey C. Owrutsky, U.S. Naval Research Lab. (USA) . . . . . [10343-25]

3:05 pm: **Reconfigurable Mie resonators embedded in a tunable ENZ cavity**, Prasad P. Iyer, Mihir Pendharkar, Chris J. Palmström, Jon A. Schuller, Univ. of California, Santa Barbara (USA) . . . . . [10343-26]

Coffee Break . . . . . Mon 3:20 pm to 3:50 pm

## SESSION 6

LOCATION: CONV. CTR. ROOM 6D . . . MON 3:50 PM TO 5:30 PM

### Active and Tunable Metamaterials

Session Chair: **Blake S. Simpkins**, U.S. Naval Research Lab. (USA)

3:50 pm: **Active tuning of surface-phonon polariton resonances** (*Invited Paper*), Adam Dunkelberger, Chase T. Ellis, Daniel Ratchford, Alexander J. Giles, U.S. Naval Research Lab. (USA); Mijin Kim, Sotera Defense Solutions, Inc. (USA); Chul Soo Kim, U.S. Naval Research Lab. (USA); Bryan T. Spann, National Institute of Standards and Technology (USA); Igor Vurgaftman, Joseph G. Tischler, Jeffrey C. Owrutsky, Joshua D. Caldwell, U.S. Naval Research Lab. (USA) . . . . . [10343-27]

4:15 pm: **Harnessing the metal-insulator transition for tunable metamaterials** (*Invited Paper*), Nicholas A. Charipar, Heungsoo Kim, U.S. Naval Research Lab. (USA); Nicholas Bingham, National Research Council (USA); Ryan Suess, Nova Research (USA); Kristin M. Charipar, U.S. Naval Research Lab. (USA); Scott A. Mathews, U.S. Naval Research Lab (USA); Raymond C. Y. Auyeung, Alberto Piqué, U.S. Naval Research Lab. (USA) . . . . . [10343-28]

4:40 pm: **Dynamic metasurfaces for the near to long-wave infrared** (*Invited Paper*), Jason G. Valentine, Zachary Coppens, Zhihua Zhu, Vanderbilt Univ. (USA); Philip G. Evans, Oak Ridge National Lab. (USA); Richard F. Haglund, Vanderbilt Univ. (USA) . . . . . [10343-29]

5:05 pm: **Controlling metasurfaces on demand** (*Invited Paper*), Jonathan Bar David, Jacob Engelberg, Liron Stern, Noa Mazurski, Uriel Levy, The Hebrew Univ. of Jerusalem (Israel) . . . . . [10343-30]

## TUESDAY 8 AUGUST

### SESSION 7

LOCATION: CONV. CTR. ROOM 6D . . . TUE 8:30 AM TO 10:15 AM

#### Metadevices and Metasystems I

Session Chair: **Augustine M. Urbas**, Air Force Research Lab. (USA)

8:30 am: **Optoelectronic device applications of metafilms** (*Invited Paper*), Mark L. Brongersma, Geballe Lab. for Advanced Materials (GLAM) (USA) . . . [10343-31]

8:55 am: **Laser printing of flat optics metasurfaces** (*Invited Paper*), Anders Kristensen, Xiaolong Zhu, Marcus Schultz Carstensen, Oeseze Ester Mobolanle Iyore, DTU Nanotech (Denmark); Rodolphe Marie, Technical Univ. of Denmark (Denmark); Mehdi K. Hedayati, DTU Nanotech (Denmark); N. Asger Mortensen, DTU Fotonik (Denmark); Uriel Levy, The Hebrew Univ. of Jerusalem (Israel) . . [10343-32]

9:20 am: **High-angle light bending and ultra-high NA lenses achieved through resonance interference effects in dielectric metasurfaces** (*Invited Paper*), Ramon Paniagua-Dominguez, Egor Khaidarov, Ye Feng Yu, Hanfang Hao, Reuben M. Bakker, Xinan Liang, Vytautas Valuckas, Yuan Hsing Fu, Arseniy I. Kuznetsov, A\*STAR - Data Storage Institute (Singapore) . . . [10343-33]

9:45 am: **Solar metadevice with enhanced absorption, scattering, and spectral control**, Richard M. Osgood III, Yassine Ait-Ei-Aoud, U.S. Army Natick Soldier Research, Development and Engineering Ctr. (USA); Lalitha Parameswaran, Vladimir Liberman, Mordechai Rothschild, MIT Lincoln Lab. (USA); Andrew Luce, Nicholas LeGrand, Michael Okamoto, U.S. Army Natick Soldier Research, Development and Engineering Ctr. (USA); Steven E. Kooi, MIT Institute for Soldier Nanotechnologies (USA); Diane M. Steeves, U.S. Army Natick Soldier Research, Development and Engineering Ctr. (USA); Richard P. Kingsborough, MIT Lincoln Lab. (USA); Stephen A. Giardini, U.S. Army Natick Soldier Research, Development and Engineering Ctr. (USA) . . . [10343-34]

10:00 am: **Sensitivities of large aperture multi-element plasmonic metasurface lenses**, Bryan Adomanis, Stephen E. Nauyoks, Air Force Research Lab. (USA); D. Bruce Burckel, Sandia National Labs. (USA); Michael A. Marciniak, Air Force Research Lab. (USA) . . . [10343-35]

Coffee Break . . . . . Tue 10:15 am to 10:45 am

### SESSION 8

LOCATION: CONV. CTR. ROOM 6D . . TUE 10:45 AM TO 12:30 PM

#### Metadevices and Metasystems II

Session Chair: **Arseniy I. Kuznetsov**, A\*STAR - Data Storage Institute (Singapore)

10:45 am: **Merging micro- and nanooptics** (*Invited Paper*), Harald Giessen, Simon Thiele, Univ. Stuttgart (Germany) . . . [10343-36]

11:10 am: **Optoelectronic metasurfaces** (*Invited Paper*), Pierre Berini, Univ. of Ottawa (Canada) . . . [10343-37]

11:35 am: **Cloaking of contact fingers on solar cells and OLEDs using free-form surfaces designed by coordinate transformations** (*Invited Paper*), Martin F. Schumann, Malte Langenhorst, Karlsruher Institut für Technologie (Germany); Michael Smeets, Kaining Ding, Forschungszentrum Jülich GmbH (Germany); Ulrich W. Paetzold, Benjamin Fritz, Karlsruher Institut für Technologie (Germany); Ralph Eckstein, Karlsruher Institut für Technologie (Germany) and InnovationLab GmbH (Germany); Guillaume Gomard, Martin Wegener, Karlsruher Institut für Technologie (Germany) . . . [10343-38]

12:00 pm: **Integrating quantum-dots and Mie resonators into a 2D metamaterial for sunlight downconversion**, Antonio Capretti, Arnon Lesage, Tom Gregorkiewicz, Univ. van Amsterdam (Netherlands) . . . [10343-39]

12:15 pm: **A Monte Carlo approach for investigating the fabrications imperfections for metasurfaces**, Li-Yi Hsu, Univ. of California, San Diego (USA) . . . [10343-40]

Lunch/Exhibition Break . . . . . Tue 12:30 pm to 2:15 pm

### SESSION 9

LOCATION: CONV. CTR. ROOM 6D . . . TUE 2:15 PM TO 3:35 PM

#### Nonlinear Metamaterials

Session Chair: **Martin F. Schumann**, Karlsruher Institut für Technologie (Germany)

2:15 pm: **Nonlinear metasurfaces: materials and directional generation** (*Invited Paper*), Augustine M. Urbas, Air Force Research Lab. (USA) . . . [10343-42]

2:40 pm: **Engineering optical nonlinearities in plasmonic titanium nitride thin films**, Nathaniel Kinsey, Virginia Commonwealth Univ. (USA); Heather J. Ferguson, Univ. of Michigan (USA); Jennifer M. Reed, Air Force Research Lab. (USA); Manuel R. Ferdinandus, Air Force Institute of Technology (USA); Clayton T. DeVault, Urcan Guler, Alexei S. Lagutchev, Purdue Univ. (USA); Theodore Norris, Univ. of Michigan (USA); Vladimir M. Shalaev, Alexandra Boltasseva, Purdue Univ. (USA); Augustine M. Urbas, Air Force Research Lab. (USA) . . . [10343-43]

2:55 pm: **Chiral metamaterials in the nonlinear regime: harmonic generation, multiphoton luminescence, and intensity-dependent optical activity** (*Invited Paper*), Wenshan Cai, Georgia Institute of Technology (USA) . . . [10343-44]

3:20 pm: **Organic molecular epsilon-near-zero ultrathin film: toward enhanced nonlinear optical response in visible spectral range**, Yeon Ui Lee, Ewha Womans Univ. (Korea, Republic of); Hyo Jung Kim, Pusan National Univ. (Korea, Republic of); Jean-Charles Ribierre, Ewha Womans Univ. (Korea, Republic of); Young Chul Jun, Ulsan National Institute of Science and Technology (Korea, Republic of); Kenji Kamada, National Institute of Advanced Industrial Science and Technology (Japan); Jeong Weon Wu, Ewha Womans Univ. (Korea, Republic of); Anthony D'Aléo, Ewha Womans Univ. (Korea, Republic of) and Aix Marseille Univ. (France) and Ctr. National de la Recherche Scientifique (France) . . . [10343-45]

Coffee Break . . . . . Tue 3:35 pm to 3:55 pm

### SESSION 10

LOCATION: CONV. CTR. ROOM 6D . . . TUE 3:55 PM TO 6:00 PM

#### Metasurfaces

Session Chair: **Anders Kristensen**, DTU Nanotech (Denmark)

3:55 pm: **Plasmonic metasurfaces by evolutionary design** (*Invited Paper*), Teri W. Odom, Northwestern Univ. (USA) . . . [10343-46]

4:20 pm: **Subwavelength Pancharatnam-Berry phase controlled metasurface for imaging with instantaneous SHG**, Christian Schlickriede, Univ. Paderborn (Germany); Naomi Waterman, The Univ. of Birmingham (United Kingdom); Bernhard Reineke, Philip Georgi, Univ. Paderborn (Germany); Guixin Li, Southern Univ. of Science and Technology (China); Shuang Zhang, The Univ. of Birmingham (United Kingdom); Thomas Zentgraf, Univ. Paderborn (Germany) . . . [10343-47]

4:35 pm: **Ultra-high refractive index in deep subwavelength coupled bi-layer free-standing flexible metamaterials**, Leena Singh, Oklahoma State Univ. (USA) . . . [10343-48]

4:50 pm: **Bianisotropy: a new route towards non-reciprocal optical metasurfaces**, Mark Lawrence, Jennifer A Dionne, Stanford Univ. (USA) [10343-49]

5:05 pm: **Nonlocal metasurfaces enable perfect anomalous reflection**, Viktor S. Asadchy, Aalto Univ. (Finland) and Francisk Skorina Gomel State Univ. (Belarus); Andreas Wickberg, Karlsruher Institut für Technologie (Germany); Ana Díaz-Rubio, Aalto Univ. (Finland); Martin Wegener, Karlsruher Institut für Technologie (Germany); Sergei A. Tretyakov, Aalto Univ. (Finland) . . . [10343-50]

5:20 pm: **Metasurface-based holograms and vortices**, Cheng-Wei Qiu, National Univ. of Singapore (Singapore) . . . [10343-51]

5:35 pm: **Embedded eigenstates and virtual absorption using metamaterials** (*Invited Paper*), Alexandr E. Krasnok, The Univ. of Texas at Austin (USA); Francesco Monticone, Cornell Univ. (USA); Andrea Alù, The Univ. of Texas at Austin (USA) . . . [10343-72]



# CONFERENCE 10343

## WEDNESDAY 9 AUGUST

### SESSION 11

LOCATION: CONV. CTR. ROOM 6D . WED 8:30 AM TO 10:00 AM

#### Chirality and Vortexes I

Session Chair: **Cesare Soci**, Nanyang Technological Univ. (Singapore)

8:30 am: **Reconfigurable chiroptical nanostructures** (*Invited Paper*), Nicholas A. Kotov, Univ. of Michigan (USA) . . . . . [10343-52]

8:55 am: **Towards all-optical chiral resolution with achiral plasmonic and dielectric nanostructures** (*Invited Paper*), Jennifer A. Dionne, Stanford Univ. (USA) . . . . . [10343-53]

9:20 am: **Symmetry induced topological Weyl points in chiral nanophotonic metamaterials** (*Invited Paper*), Ortwin Hess, Imperial College London (United Kingdom) . . . . . [10343-54]

9:45 am: **Realizations of Weyl points in reciprocal metamaterial**, Meng Xiao, Qian Lin, Stanford Univ. (USA); Wenjie Chen, Che Ting Chan, Hong Kong Univ. of Science and Technology (Hong Kong, China); Shanhui Fan, Stanford Univ. (USA) . . . . . [10343-55]

Coffee Break . . . . . Wed 10:00 am to 10:30 am

### SESSION 12

LOCATION: CONV. CTR. ROOM 6D . WED 10:30 AM TO 12:05 PM

#### Chirality and Vortexes II

Session Chair: **Vera N. Smolyaninova**, Towson Univ. (USA)

10:30 am: **Experiment of synthetic Weyl points in optical regime**, Hui Liu, Qiang Wang, Nanjing Univ. (China); Meng Xiao, Stanford Univ. (USA); Shi Ning Zhu, Nanjing Univ. (China); Che Ting Chan, Hong Kong Univ. of Science and Technology (Hong Kong, China) . . . . . [10343-56]

10:45 am: **Multiplexing of adjacent vortex modes with the forked grating coupler**, Christopher T. Nadovich, Derek J. Kosciolk, William D. Jemison, David T. Crouse, Clarkson Univ. (USA) . . . . . [10343-57]

11:00 am: **Singular optical beams enabled by photonic meta-structures** (*Invited Paper*), Natalia M. Litchinitser, Liang Feng, Pei Miao, Jingbo Sun, Zhifeng Zhang, Mikhail I. Shalae, Wiktor T. Walasik, Univ. at Buffalo (USA); Stefano Longhi, Politecnico di Milano (Italy) . . . . . [10343-58]

11:25 am: **Conversion of optical spin-to-orbital angular momentum on metasurfaces**, Feng Lin, Peking Univ. (China) . . . . . [10343-59]

11:40 am: **Chiral nanophotonics of plasmonic and dielectric nanoclusters: from Landau-Lifshitz constraint to flat blazed gratings** (*Invited Paper*), Gennady B. Shvets, Cornell Univ. (USA) . . . . . [10343-60]

Lunch/Exhibition Break . . . . . Wed 12:05 pm to 1:35 pm

### SESSION 13

LOCATION: CONV. CTR. ROOM 6D . . . . WED 1:35 PM TO 3:10 PM

#### Hyperbolic Metamaterials

Session Chair: **Natalia M. Litchinitser**, Univ. at Buffalo (USA)

1:35 pm: **Long range light matter interactions at hyperbolic meta surfaces** (*Invited Paper*), Girish Agarwal, Texas A&M Univ. (USA) . . . . . [10343-61]

2:00 pm: **Enhanced superconductivity in hyperbolic metamaterials** (*Invited Paper*), Vera N. Smolyaninova, Christopher Jensen, William Zimmerman, Towson Univ. (USA); Joseph C. Prestigiacomo, Michael S. Ososky, Heungsoo Kim, Nabil D. Bassim, U.S. Naval Research Lab. (USA); Zhen Xing, Mumtaz Qazilbash, The College of William & Mary (USA); Igor I. Smolyaninov, Univ. of Maryland, College Park (USA) . . . . . [10343-62]

2:25 pm: **Loss compensation in metamaterials with extraordinary high- and low-momentum plasmonic modes**, Anatoliy O. Pinchuk, Univ. of Colorado at Colorado Springs (USA) . . . . . [10343-63]

2:40 pm: **Hyperbolic metamaterial filter for angle-independent TM transmission in the infrared regime**, Golsa Mirbagheri, Kaitlin J. Dunn, Derek J. Kosciolk, Clarkson Univ. (USA); Igor Bendoy, Phoebus Optoelectronics, LLC (USA); David T. Crouse, Clarkson Univ. (USA) . . . . . [10343-64]

2:55 pm: **Non-local effect of hyperbolic metamaterial structure on photo-induced intramolecular charge transfer emissions**, Kwang Jin Lee, Yeon Ui Lee, Ewha Womans Univ. (Korea, Republic of); Frédéric Fages, Aix-Marseille Univ. (France) and Ctr. National de la Recherche Scientifique (Gabon) and CINaM - Ctr. Interdisciplinaire de Nanoscience de Marseille (France); Jean-Charles Ribierre, Jeong Weon Wu, Ewha Womans Univ. (Korea, Republic of); Anthony D'Aléo, Ewha Womans Univ. (Korea, Republic of) and Aix Marseille Univ. (France) and Ctr. National de la Recherche Scientifique (France) . . . . . [10343-65]

Coffee Break . . . . . Wed 3:10 pm to 3:35 pm

### SESSION 14

LOCATION: CONV. CTR. ROOM 6D . . . WED 3:35 PM TO 5:30 PM

#### Metadevices and Metasystems III

Session Chair: **Mark Lawrence**, Stanford Univ. (USA)

3:35 pm: **Active plasmonic devices and processes** (*Invited Paper*), Naomi J. Halas, Rice Univ. (USA) . . . . . [10343-66]

4:00 pm: **Plasmonic nanofocusing facilitates ultrafast point-projection electron microscopy** (*Invited Paper*), Christoph Lienau, Carl von Ossietzky Univ. Oldenburg (Germany) . . . . . [10343-67]

4:25 pm: **Hybrid perovskite metamaterials** (*Invited Paper*), Cesare Soci, Nanyang Technological Univ. (Singapore) . . . . . [10343-68]

4:50 pm: **Light manipulation with metasurface and meta-device** (*Invited Paper*), Pin Chieh Wu, Research Ctr. for Applied Sciences - Academia Sinica (Taiwan); Wei-Yi Tsai, Hui-Hsin Hsiao, National Taiwan Univ. (Taiwan); Hui Jun Wu, Research Ctr. for Applied Sciences - Academia Sinica (Taiwan); Chun Yen Liao, Hsiang-Chu Wang, National Taiwan Univ. (Taiwan); Ai Qun Liu, Nanyang Technological Univ. (Singapore); Greg Sun, Univ. of Massachusetts Boston (USA); Din Ping Tsai, Research Ctr. for Applied Sciences - Academia Sinica (Taiwan) . . . . . [10343-69]

5:15 pm: **Isotropic metamaterial perfect light absorber using 3D split ring resonator in the mid IR region**, Renilkumar Mudachathi, Takuo Tanaka, RIKEN (Japan) . . . . . [10343-70]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 . . . . . WED 5:30 PM TO 7:30 PM

#### Posters-Wednesday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Tunable plasmon induced transparency in a graphene-based waveguide structure and its applications in sensing**, Tao Wang, Xu Han, Huazhong Univ. of Science and Technology (China) . . . . . [10343-88]

**Structural metamaterials with Saint-Venant edge effect reversal**, Eduard Karpov, Larry Danso, Univ. of Illinois at Chicago (USA) . . . . . [10343-89]

**Bistability and thermal coupling in elastic metamaterials with negative compressibility**, Michelle Chen, Johns Hopkins Univ. (USA); Eduard Karpov, Univ. of Illinois at Chicago (USA) . . . . . [10343-90]

**Non-reciprocal manipulation of light with metamaterials in the deep UV light range**, Hirokyu Kurosawa, Shin-ichiro Inoue, National Institute of Information and Communications Technology (Japan) . . . . . [10343-91]

**LiTaO<sub>3</sub> microcubes based metamaterial perfect absorber**, Nishant Shankhwar, Reena Dalal, Yogita Kalra, Ravindra K. Sinha, Delhi Technological Univ. (India) . . . . . [10343-92]

**Ultrabroadband polarization-independent absorber based on hyperbolic metamaterial**, Igor Leonardo Gomes de Souza, Vitaly F. Rodriguez-Esquerre, Univ. Federal da Bahia (Brazil) . . . . . [10343-93]

**Plasmonic nanoballs comprised of gold nanoparticle shells**, Hiroshi Yabu, Tohoku Univ. (Japan) . . . . . [10343-94]

**Automated design of infrared digital metamaterials by genetic algorithm**, Yuya Sugino, Atsushi Ishikawa, Yasuhiko Hayashi, Kenji Tsuruta, Okayama Univ. (Japan) . . . . . [10343-95]

**Phase modulation in ultrathin lossy material**, Tsung Lin Chung, Jia-Wern Chen, Hsiang-Chu Wang, Yu Han Chen, Chun Yen Liao, Mu-Ku Chen, National Taiwan Univ. (Taiwan); Cheng Hung Chu, Pin Chieh Wu, Research Ctr. for Applied Sciences - Academia Sinica (Taiwan); Yi Chieh Lai, National Taiwan Univ. (Taiwan); Din Ping Tsai, National Taiwan Univ. (Taiwan) and Research Ctr. for Applied Sciences - Academia Sinica (Taiwan) . . . . . [10343-96]

**Aluminum plasmonic metasurfaces for control in reflection**, Elena I. Chaikina, Ctr. de Investigación Científica y de Educación Superior de Ensenada B.C. (Mexico); Liliana Avalon Murillo, Efrén García, Univ. Autónoma de Baja California (Mexico); Eugenio R. Mendez, Ctr. de Investigación Científica y de Educación Superior de Ensenada B.C. (Mexico) . . . . . [10343-97]

**Guided modes analysis in metamaterial bounded optical waveguides**, Juarez Caetano da Silva, Davi Araújo de Figueiredo, Vitaly F. Rodríguez-Esquerre, Univ. Federal da Bahia (Brazil) . . . . . [10343-98]

**Low-loss modes in a hyperbolic metamaterial**, Samantha Koutsares, Ekemba K. Tanyi, Michael Admassu, Norfolk State Univ. (USA); Ilya V. Shadrivov, The Australian National Univ. (Australia); Roman Saveliev, ITMO Univ. (Russian Federation); Mikhail A. Noginov, Norfolk State Univ. (USA) . . . . . [10343-99]

**Control of electric and magnetic dipole emission with metasurfaces**, Soheila Mashhadi, David M. Keene, Antoine C. Hardy, Natalia Noginova, Norfolk State Univ. (USA) . . . . . [10343-100]

**Spectral shifts of the first and second excited state transitions in R6G dye coupled with the cavity**, Ekemba K. Tanyi, Norfolk State Univ. (USA); Erin Harrison, Univ. of Delaware (USA); Cansu On, Mikhail A. Noginov, Norfolk State Univ. (USA) . . . . . [10343-101]

**Optically tunable Fano-resonant filter based on graphene**, Alexander Grebenchukov, Anton Zaitsev, Mikhail M. Novoselov, Egor Kornilov, Mikhail K. Khodzitsky, ITMO Univ. (Russian Federation) . . . . . [10343-102]

**A numerical investigation of difference frequency generation in nonlinear multilayered metamaterials**, Surawut Wicharn, Srinakharinwirot Univ. (Thailand); Jakkapol Visessamit, Prathan Buranasiri, King Mongkut's Institute of Technology Ladkrabang (Thailand) . . . . . [10343-103]

**Interscale mixing microscopy: towards 2D imaging beyond the diffraction limit**, Bo Fan, Christopher M. Roberts, Univ. of Massachusetts Lowell (USA); Nicolas Olivier, William P. Wardley, King's College London (United Kingdom); Sandeep Inampudi, Univ. of Massachusetts Lowell (USA); Wayne Dickson, Anatoly V. Zayats, King's College London (United Kingdom); Viktor A. Podolskiy, Univ. of Massachusetts Lowell (USA) . . . . . [10343-104]

**Design of fan-out diffractive optical elements based on dielectric geometric metasurfaces**, Guoxing Zheng, Zile Li, Song Li, Ping'an He, Wuhan Univ. (China) . . . . . [10343-105]

**Ultra-broadband absorption with gradient metasurface**, Tiancheng Han, Southwest Univ. (China) . . . . . [10343-106]

**Compact three-layered film of passive radiation cooling for LED heat dissipation**, Yung-Chiang Lan, Po Jui Chiu, Bo-Han Cheng, National Cheng Kung Univ. (Taiwan); Din Ping Tsai, Research Ctr. for Applied Sciences - Academia Sinica (Taiwan) and National Taiwan Univ. (Taiwan) . . . . . [10343-107]

**A highly efficient and broadband photonic circular polarizer in optical range**, Hossein Alizadeh, Björn M. Reinhard, Boston Univ. (USA) . . . . . [10343-108]

**Design and analysis of tip slotted square patch nanoantenna**, Shubhanshi Sharma, Nishant Shankhwar, Yogita Kalra, Ravindra K. Sinha, Delhi Technological Univ. (India) . . . . . [10343-109]

**A hybrid phononic waveguide using multilayer structure at mid-infrared**, Asma Al-Amri, Michael F. Finch, Claudio Augusto Barreto Saunders Filho, Brian A. Lail, Florida Institute of Technology (USA) . . . . . [10343-110]

**Electrically controlled free space THz polarization modulation using vanadium dioxide metasurfaces**, Muhammad Tayyab Nouman, Ji Hyun Hwang, Jae-Hyung Jang, Gwangju Institute of Science and Technology (Korea, Republic of) . . . . . [10343-111]

**THz beam-steering using VO2 deep-subwavelength metamaterials**, Sara Arezoomandan, Berardi Sensale-Rodriguez, Univ. of Utah (USA) . . . . . [10343-112]

**Magneto-optical nanowire metamaterials**, Bo Fan, Univ. of Massachusetts Lowell (USA); Mazhar E. Nasir, Anatoly V. Zayats, King's College London (United Kingdom); Viktor A. Podolskiy, Univ. of Massachusetts Lowell (USA) . . . . . [10343-113]

**Mass production compatible fabrication techniques of single-crystalline silver metamaterials and plasmonics devices**, Ilya A. Rodionov, Bauman Moscow State Technical Univ. (Russian Federation) and All-Russian Research Institute of Automatics (Russian Federation); Ilya A. Rizhikov, Institute for Theoretical and Applied Electrodynamics (Russian Federation) and Bauman Moscow State Technical Univ. (Russian Federation); Alexander S. Baburin, Bauman Moscow State Technical Univ. (Russian Federation); Alexey P. Vinogradov, Institute for Theoretical and Applied Electrodynamics (Russian Federation) and All-Russian Research Institute of Automatics (Russian Federation); Alexander V. Baryshev, All-Russian Research Institute of Automatics (Russian Federation); Elena V. Ryzhova, Bauman Moscow State Technical Univ. (Russian Federation); Nikolay A. Orlikovsky, All-Russian Research Institute of Automatics (Russian Federation); Alexander M. Merzlikin, Institute for Theoretical and Applied Electrodynamics (Russian Federation); Igor V. Trofimov, Alexander V. Zverev, Bauman Moscow State Technical Univ. (Russian Federation); Sergey S. Maklakov, Institute for Theoretical and Applied Electrodynamics (Russian Federation); Anton I. Ivanov, Ivan A. Philippov, Aidar Gabidulin, Alina Dobronosova, Bauman Moscow State Technical Univ. (Russian Federation) . . . . . [10343-115]

**Polarizing properties of chiral metasurface based on gammadion crosses with different geometry in THz frequency range**, Maxim S. Masyukov, Anna V. Voizanova, Alexander Grebenchukov, Mikhail K. Khodzitsky, ITMO Univ. (Russian Federation) . . . . . [10343-116]

## THURSDAY 10 AUGUST

### SESSION 15

**LOCATION: CONV. CTR. ROOM 6D . . THU 8:55 AM TO 10:30 AM**

### Novel Concepts III

Session Chair: **Meir Orenstein**, Technion-Israel Institute of Technology (Israel)

8:55 am: **Interscale mixing microscopy: far field imaging beyond the diffraction limit** (*Invited Paper*), Viktor A. Podolskiy, Christopher M. Roberts, Univ. of Massachusetts Lowell (USA); Nicolas Olivier, William P. Wardley, King's College London (United Kingdom); Bo Fan, Univ. of Massachusetts Lowell (USA); Sandeep Inampudi, Univ. of Massachusetts Lowell (USA) and Northeastern Univ. (USA); Wayne Dickson, Anatoly V. Zayats, King's College London (United Kingdom) . . . . . [10343-71]

9:20 am: **Surface-assisted carrier excitation in plasmonic nanostructures**, Tigran V. Shahbazyan, Jackson State Univ. (USA) . . . . . [10343-73]

9:35 am: **Fano metamaterial absorber for controlling mechanical resonances** (*Invited Paper*), Ertugrul Cubukcu, Hai Zhu, Univ. of California, San Diego (USA); Fei Yi, Huazhong Univ. of Science and Technology (China) . . . . . [10343-74]

10:00 am: **Mechanical metamaterials: recent advances and opportunities**, Eduard Karpov, Univ. of Illinois at Chicago (USA) . . . . . [10343-75]

10:15 am: **Electric field distribution on surface of the artificial magnetic conductor: miniaturization process**, Welyson Tiano Dos Santos Ramos, Renato Cardoso Mesquita, Elson José da Silva, Univ. Federal de Minas Gerais (Brazil) . . . . . [10343-76]

Coffee Break . . . . . Thu 10:30 am to 11:00 am



# CONFERENCE 10343

## SESSION 16

LOCATION: CONV. CTR. ROOM 6D . . THU 11:00 AM TO 12:30 PM

### 2D Metamaterials

Session Chair: **Viktor A. Podolskiy**, Univ. of Massachusetts Lowell (USA)

11:00 am: **Graphene metamaterials**, F. Javier García de Abajo, ICFO - Institut de Ciències Fotòniques (Spain) . . . . . [10343-77]

11:15 am: **Near-field study in graphene/hBN moiré superlattices**, Guangxin Ni, Univ. of San Diego (USA); Haomin Wang, Shanghai Institute of Microsystem and Information Technology (China); Jih-Sheng Wu, Zhe Fei, Alexander S. McLeod, Univ. of California, San Diego (USA); Fritz Keilmann, Ludwig-Maximilians-Univ. (Germany); Xiaoming Xie, Shanghai Institute of Microsystem and Information Technology (China); Michael M. Fogler, Dimitri Basov, Univ. of California, San Diego (USA) . . . . . [10343-78]

11:30 am: **Fractal metasurface enhanced graphene photodetector on glass substrate**, Di Wang, Jieran Fang, Clayton T. DeVault, Ting-Fung Chung, Yong P. Chen, Alexandra Boltasseva, Vladimir M. Shalaev, Alexander V. Kildishev, Purdue Univ. (USA) . . . . . [10343-79]

11:45 am: **Highly confined phonon polaritons in atomically thin interfaces**, Alexander M. Dubrovkin, Bo Qiang, Harish N. S. Krishnamoorthy, Nanyang Technological Univ. (Singapore); Nikolay I. Zheludev, Nanyang Technological Univ. (Singapore) and Optoelectronics Research Ctr. (United Kingdom); Qi Jie Wang, Nanyang Technological Univ. (Singapore) . . . . . [10343-80]

12:00 pm: **Plasmonic MXene for broadband absorber**, Krishnakali Chaudhuri, Purdue Univ. (USA); Mohamed Alhabeab, Drexel Univ. (USA); Zhuoxian Wang, Vladimir M. Shalaev, Purdue Univ. (USA); Yury Gogotsi, Drexel Univ. (USA); Alexandra Boltasseva, Purdue Univ. (USA) . . . . . [10343-81]

12:15 pm: **Flat and conformal meta-sheets for controlling light**, Samad Jafar-Zanjani, Sandeep Inampudi, Hossein Mosallaei, Northeastern Univ. (USA) . . . . . [10343-82]

Lunch/Exhibition Break . . . . . Thu 12:30 pm to 2:00 pm

## SESSION 17

LOCATION: CONV. CTR. ROOM 6D . . . THU 2:00 PM TO 4:30 PM

### Quantum Metamaterials and Concepts

Session Chair: **Ertugrul Cubukcu**, Univ. of California, San Diego (USA)

2:00 pm: **Quantum plasmonics (Invited Paper)**, Peter Nordlander, Rice Univ. (USA) . . . . . [10343-83]

2:25 pm: **Sources and detectors near metasurfaces (Invited Paper)**, Meir Orenstein, Technion-Israel Institute of Technology (Israel) . . . . . [10343-84]

2:50 pm: **Metasurface route to quantum photonics**, Pankaj K. Jha, Nir Shitrit, Jeonmin Kim, Xuexin Ren, Yuan Wang, Xiang Zhang, Univ. of California, Berkeley (USA) . . . . . [10343-85]

Coffee Break . . . . . Thu 3:05 pm to 3:35 pm

3:35 pm: **Lasing in arrays of metal nanoparticles**, Heikki Rekola, Tommi K. Hakala, Aaro I. Väkeväinen, Jani-Petri Martikainen, Marek Nečada, Antti J. Moilanen, Päivi Törmä, Aalto Univ. (Finland) . . . . . [10343-86]

3:50 pm: **Valley photonic crystals**, Jian-Wen Dong, Xiao-Dong Chen, Sun Yat-Sen Univ. (China) . . . . . [10343-87]

4:05 pm: **Quantum nanophotonics (Invited Paper)**, Jelena Vuckovic, Jingyuan Zhang, Stanford Univ. (USA) . . . . . [10343-117]

LOCATION: CONV. CTR. ROOM 6D . . . . . 4:30 PM TO 4:35 PM

### Closing Remarks

Session Chair: **Mikhail A. Noginov**, Norfolk State Univ. (USA)

# CONFERENCE 10344

LOCATION: CONV. CTR. ROOM 5A

Wednesday–Thursday 9–10 August 2017 • Proceedings of SPIE Vol. 10344

## Nanophotonic Materials XIV

**Conference Chairs:** **Stefano Cabrini**, Lawrence Berkeley National Lab. (USA); **Gilles L  rondel**, Univ. de Technologie Troyes (France); **Adam M. Schwartzberg**, Lawrence Berkeley National Lab. (USA); **Taleb Mokari**, Ben-Gurion Univ. of the Negev (Israel)

**Program Committee:** **David L. Andrews**, Univ. of East Anglia (United Kingdom); **Angus J. Bain**, Univ. College London (United Kingdom); **Mireille H. Blanchard-Desce**, Univ. de Rennes 1 (France); **Robert W. Boyd**, Univ. of Rochester (USA); **Zeno Gaburro**, Univ. degli Studi di Trento (Italy); **Aaron W. Harper**, The Univ. of Southern California (USA); **Ghassan E. Jabbour**, Arizona State Univ. (USA); **Fran  ois Kajzar**, Univ. Politehnica of Bucharest (Romania); **Dmitri I. Kovalev**, Univ. of Bath (United Kingdom); **Paras N. Prasad**, Univ. at Buffalo (USA); **Dmitri Talapin**, The Univ. of Chicago (USA); **Younan Xia**, Georgia Institute of Technology (USA)

### MONDAY 7 AUGUST

LOCATION: CONV. CTR. ROOM 6A MON 9:00 AM TO 12:00 PM

#### Nanoscience + Engineering Plenary Session

Session Chairs: **Harry A. Atwater Jr.**, California Institute of Technology (USA); **Nikolay I. Zheludev**, Optoelectronics Research Ctr. (United Kingdom)

9:15 am: **3D laser nanolithography (Plenary)**, Martin Wegener, Karlsruhe Institut f  r Technologie (Germany) . . . . . [10354-500]

Coffee Break . . . . . Mon 10:00 am to 10:30 am

10:30 am: **Controlling light at the atomic scale (Plenary)**, F. Javier Garc  a de Abajo, ICFO - Institut de Ci  ncies Fot  niques (Spain) . . . . . [10359-500]

11:15 am: **Science, engineering, and commercialization of flexible, printable 2D atomic materials and devices (Invited Paper)**, Deji Akinwande, The Univ. of Texas at Austin (USA) . . . . . [10349-500]

### SESSION 2

LOCATION: CONV. CTR. ROOM 5A . WED 10:40 AM TO 11:50 AM

#### Novel Plasmonic Materials

Session Chair: **Erika Penzo**, Lawrence Berkeley National Lab. (USA)

10:40 am: **Large area fabrication of robust plasmonic color metasurfaces by a high-speed roll-to-roll method**, Swathi Murthy, Inmold (Denmark); Henrik Pranov, Heliac (Denmark); Guggi Kofod, Inmold (Denmark); Rafael J. Taboryski, Technical Univ. of Denmark (Denmark) . . . . . [10344-6]

11:00 am: **Precipitation and spectral characteristics of silver nanoparticles and rare-earth ion doped oxide nanocrystals inside borate glasses**, Ki-Soo Lim, Chang-Hyuck Bae, Chungbuk National Univ. (Korea, Republic of) . . . . . [10344-8]

11:20 am: **DNA-assembled large-scale responsive multicomponent nanoparticle metamaterials (Invited Paper)**, Qingyuan Lin, Jarad Mason, Vinayak P. Dravid, Chad A. Mirkin, Northwestern Univ. (USA) . . . . . [10344-9]

Lunch/Exhibition Break . . . . . Wed 11:50 am to 2:00 pm

### WEDNESDAY 9 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 5A . WED 8:00 AM TO 10:10 AM

#### Nanoplasmonic Applications

Session Chair: **Joonhyuck Park**, Univ. of California, Los Angeles (USA)

8:00 am: **Designing the metal nanoparticle (MNP)-non linear optical (NLO) material: future nanophotonics**, Preeti Gupta, G.V. Pavan Kumar, Indian Institute of Science Education and Research Pune (India) . . . . . [10344-1]

8:20 am: **Nanoparticles induced light to vapor conversion for off-grid water purification: full multiphysics modeling (Invited Paper)**, Alessandro Alabastri, Pratiksha Dongare, Seth Pedersen, Rice Univ. (USA); Katherine Zodrow, Montana Tech (USA); Nathaniel J. Hogan, Oara Neumann, Jinjian Wu, Qilin Li, Peter Nordlander, Naomi J. Halas, Rice Univ. (USA) . . . . . [10344-2]

8:50 am: **Photocurrent generation from TiN nanostructures by visible light (Invited Paper)**, Satoshi Ishii, Satish L. Shinde, Tadaaki Nagao, National Institute for Materials Science (Japan) . . . . . [10344-3]

9:20 am: **Plasmonics: transformed quantum emitters (Invited Paper)**, Ajay Singh, Jennifer A. Hollingsworth, Los Alamos National Lab. (USA) . . . . . [10344-4]

9:50 am: **Heat dissipation control in plasmonic systems**, Alessandro Alabastri, Rice Univ. (USA); Andrea Toma, Mario Malerba, Eugenio Calandrini, Francesco De Angelis, Remo Proietti Zaccaria, Istituto Italiano di Tecnologia (Italy) . . . . [10344-5]

Coffee Break . . . . . Wed 10:10 am to 10:40 am

#### SESSION 3

LOCATION: CONV. CTR. ROOM 5A . . . WED 2:00 PM TO 3:10 PM

#### Photonics

Session Chair: **Stefano Cabrini**, The Molecular Foundry (USA)

2:00 pm: **3D femtosecond laser printing for angular momentum generators (Invited Paper)**, Xuewen Wang, Swinburne Univ. of Technology (Australia)[10344-10]

2:30 pm: **Formation and multi-imaging analysis of nascent surface structures generated by femtosecond laser irradiation in silicon**, Felice Gesuele, Jijil J. J. Navas, Pasqualino Maddalena, Salvatore Amoroso, Univ. degli Studi di Napoli Federico II (Italy) . . . . . [10344-11]

2:50 pm: **Spectral analysis of volume holograms in materials with diffusion-based formation mechanisms by means of coupled wave theory and Kramers-Kronig relations**, Vladimir N. Borisov, Aleksandr E. Angervaks, Aleksandr I. Ryskin, Andrey V. Veniaminov, ITMO Univ. (Russian Federation) . . . . . [10344-12]

Coffee Break . . . . . Wed 3:10 pm to 3:40 pm

#### SESSION 4

LOCATION: CONV. CTR. ROOM 5A . . . WED 3:40 PM TO 4:50 PM

#### Optoelectronic Properties of Nanomaterials

Session Chair: **Adam M. Schwartzberg**, Lawrence Berkeley National Lab. (USA)

3:40 pm: **Long-range exciton transport in cesium lead halide perovskite nanocrystals organized in ordered nanoscale assemblies (Invited Paper)**, Erika Penzo, Lawrence Berkeley National Lab. (USA); Anna Louidice, Ecole Polytechnique F  d  rale de Lausanne (Switzerland); Edward S. Barnard, Nicholas Borys, Lawrence Berkeley National Lab. (USA); Raffaella Buonsanti, Ecole Polytechnique F  d  rale de Lausanne (Switzerland); Adam M. Schwartzberg, Stefano Cabrini, Alexander Weber-Bargioni, Lawrence Berkeley National Lab. (USA) . . . . . [10344-13]

4:10 pm: **Possibility of cost effective and energy efficient high quality natural white light sources with a new nano-phosphor**, Dilip De, Covenant Univ. (Nigeria) and Sustainable Green Power Technologies (USA); Ikorya De, Univ. of the Free State (South Africa) . . . . . [10344-14]

4:30 pm: **Quantum-confined and pseudo Stark effects in the semiconductor conical quantum dot**, Karen G. Dvovyan, Ani Tshantshapanyan, Branislav Vlahovic, North Carolina Central Univ. (USA); Gregory J. Salamo, Univ. of Arkansas (USA) . . . . . [10344-15]



# CONFERENCE 10344

LOCATION: CONV. CTR.

EXHIBIT HALL B2 ..... WED 5:30 PM TO 7:30 PM

## Posters-Wednesday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**VOx nanofibers for IR detection**, Seong Hyun Kim, Su Jae Lee, Electronics and Telecommunications Research Institute (Korea, Republic of); Bong-Jun Kim, Mobic Co. Ltd. (Korea, Republic of) ..... [10344-29]

**Luminescence and transient lifetime studies for energy transfer of PbS QD films**, Joanna S. Wang, Bruno Ullrich, Chandriker K. Dass, Air Force Research Lab. (USA); Anirban Das, Chien M. Wai., Univ. of Idaho (USA); Gail J. Brown, Joshua R. Hendrickson, Air Force Research Lab. (USA) ..... [10344-30]

**Magnetic field influence on the intensity of ZnO random lasing and exciton luminescence**, Andrey P. Tarasov, Moscow Institute of Physics and Technology (Russian Federation) and Kotel'nikov Institute of Radio Engineering and Electronics of Russian Academy of Sciences (Russian Federation); Charus M. Briskina, Alexey Saveliev, Valery M. Markushev, Kotel'nikov Institute of Radio Engineering and Electronics of Russian Academy of Sciences (Russian Federation); Mikhail Shiryayev, M.V. Lomonosov Moscow State Univ. (Russian Federation) ..... [10344-31]

**Optical properties of cyanine dyes in nanotubes of chrysotile asbestos**, Anton A. Starovoytov, ITMO Univ. (Russian Federation); Vladimir I. Belotitskii, Yuri A. Kumzerov, Anna A. Sysoeva, Ioffe Institute (Russian Federation); Tigran A. Vartanyan, ITMO Univ. (Russian Federation) ..... [10344-32]

**Biocompatible Er, Yb co-doped fluoroapatite upconversion nanoparticles for imaging applications**, Anjana R., Jayaraj M. K., Cochin Univ. of Science & Technology (India) ..... [10344-33]

**ITO-Si heterojunction solar cell with nanocrystal line CdTe thin films**, Andrii Pocherpailo, Sergii Kondratenko, Taras Shevchenko National Univ. of Kyiv (Ukraine) ..... [10344-34]

## THURSDAY 10 AUGUST

### SESSION 5

LOCATION: CONV. CTR. ROOM 5A .. THU 8:00 AM TO 10:10 AM

## Synthesis and Characterization of Nanophotonic Materials I

Session Chair: **Gilles L rondel**, Univ. de Technologie Troyes (France)

8:00 am: **Optical transmittance of metallic nanowires**, Mazen S. Nairat, Mousa Imran, Al-Balqa Applied Univ. (Jordan) ..... [10344-18]

8:20 am: **Precise control over the morphology and dopant distribution in colloidal metal oxide nanocrystals**, Ajay Singh, Los Alamos National Lab. (USA); Delia J. Milliron, The Univ. of Texas at Austin (USA) ..... [10344-19]

8:40 am: **Controlling the emission spectra of white CdSe quantum dots by growth time**, Yu-Sheng Su, Shu-Ru Chung, National Formosa Univ. (Taiwan) ..... [10344-20]

9:00 am: **Tuning graphene photonic properties with a self-assembled molecular monolayer** (*Invited Paper*), Sylvain Le Liepvre, Tessnim Sghaier, CEA-Ctr. de SACLAY (France); Ping Du, David Kreher, Fabrice Mathevet, Andr -Jean Attias, Univ. Pierre et Marie Curie (France); C line Fiorini-Debuisschert, Ludovic Douillard, Fabrice Charra, CEA-Ctr. de SACLAY (France) ..... [10344-21]

9:30 am: **All-dielectric cylindrical nanoantennas in the visible range**, Reena Dalal, Nishant Shankhwar, Yogita Kalra, Ajeet Kumar, Delhi Technological Univ. (India); Ravindra K. Sinha, Delhi Technological Univ. (India) and Central Scientific Instruments Organisation (India) ..... [10344-22]

9:50 am: **Third order optical nonlinearity investigation of germanium quantum dots embedded in silicon matrix**, Liangmin Zhang, David Bishel, William Cheung, Joseph Mini Jr., Salvador Montes, California State Univ., Stanislaus (USA) ..... [10344-35]

Coffee Break ..... Thu 10:10 am to 10:40 am

### SESSION 6

LOCATION: CONV. CTR. ROOM 5A . THU 10:40 AM TO 12:20 PM

## Synthesis and Characterization of Nanophotonic Materials II

Session Chair: **Ajay Singh**, Los Alamos National Lab. (USA)

10:40 am: **Tuning the optical properties of colloidal quantum nanocrystal/Al2O3 composite films by atomic layer deposition**, Milan Palei, Vincenzo Caligiuri, Stefan Kudera, Prachi Rastogi, Roman Krahnke, Istituto Italiano di Tecnologia (Italy) ..... [10344-24]

11:00 am: **Nanostructured organosilicon luminophores for efficient and fast elementary particles photodetectors**, Sergey A. Ponomarenko, Institute of Synthetic Polymeric Materials (Russian Federation) and Lomonosov Moscow State Univ. (Russian Federation) and Luminescent Innovation Technologies LLC (Russian Federation); Oleg V. Borshchev, Nikolay M. Surin, Maxim S. Skorotetsky, Institute of Synthetic Polymeric Materials (Russian Federation) and Luminescent Innovation Technologies LLC (Russian Federation); Elena A. Kleymyuk, Institute of Synthetic Polymeric Materials (Russian Federation); Tatyana Y. Starikova, Institute of Synthetic Polymeric Materials (Russian Federation) and Lomonosov Moscow State Univ. (Russian Federation); Alexey S. Tereshenko, Luminescent Innovation Technologies LLC (Russian Federation) ..... [10344-25]

11:20 am: **Structural and optical characterization of highly anisotropic low loss Al:ZnO/ZnO multilayered metamaterial with hyperbolic dispersion grown by pulsed layer deposition** (*Invited Paper*), Priscilla N. Kelly, San Diego State Univ. (USA); Wenrui Zhang, Mingzhao Liu, Brookhaven National Lab. (USA); Lyuba Kuznetsova, San Diego State Univ. (USA) ..... [10344-26]

11:50 am: **Integrated freestanding two-dimensional transition metal dichalcogenides** (*Invited Paper*), Gilles L rondel, Univ. de Technologie Troyes (France) ..... [10344-27]

# CONFERENCE 10345

LOCATION: CONV. CTR. ROOM 6C

Sunday–Thursday 6–10 August 2017 • Proceedings of SPIE Vol. 10345

## Active Photonic Platforms IX

Conference Chairs: **Ganapathi S. Subramania**, Sandia National Labs. (USA); **Stavroula Foteinopoulou**, The Univ. of New Mexico (USA)

Program Committee: **Andrea Alù**, The Univ. of Texas at Austin (USA); **Paul V. Braun**, Univ. of Illinois at Urbana-Champaign (USA); **Che Ting Chan**, Hong Kong Univ. of Science and Technology (Hong Kong, China); **Zhigang Chen**, San Francisco State Univ. (USA); **Dmitry N. Chigrin**, RWTH Aachen Univ. (Germany); **Shanhui Fan**, Stanford Univ. (USA); **Didier Felbacq**, Univ. Montpellier 2 (France); **Joseph W. Haus**, Univ. of Dayton (USA); **Stephen Hughes**, Queen's Univ. (Canada); **Boubacar Kante**, Univ. of California, San Diego (USA); **A. Femius Koenderink**, FOM Institute for Atomic and Molecular Physics (Netherlands); **Alexander V. Kildishev**, Purdue Univ. (USA); **Yuri S. Kivshar**, The Australian National Univ. (Australia); **Cefe López**, Consejo Superior de Investigaciones Científicas (Spain); **Nicolae-Coriolan Panoiu**, Univ. College London (United Kingdom); **Michelle L. Povinelli**, The Univ. of Southern California (USA); **Christophe Sauvan**, Lab. Charles Fabry (France); **Jörg Schilling**, Martin-Luther-Univ. Halle-Wittenberg (Germany); **Gennady B. Shvets**, The Univ. of Texas at Austin (USA); **Volker J. Sorger**, The George Washington Univ. (USA); **Andrey A. Sukhorukov**, The Australian National Univ. (Australia); **Kosmas L. Tsakmakidis**, Univ. of Ottawa (USA); **Georgios Veronis**, Louisiana State Univ. (USA); **Daniel M. Wasserman**, Univ. of Illinois at Urbana-Champaign (USA); **Ralf B. Wehrspohn**, Fraunhofer-Institut für Werkstoffmechanik (Germany); **Sharon M. Weiss**, Vanderbilt Univ. (USA); **William Whelan-Curtin**, Univ. of St. Andrews (United Kingdom)

### SUNDAY 6 AUGUST

LOCATION: CONV. CTR. ROOM 6C ..... 8:10 AM TO 8:15 AM

#### Opening Remarks

Session Chair: **Ganapathi S. Subramania**, Sandia National Labs. (USA)

#### SESSION 1

LOCATION: CONV. CTR. ROOM 6C .. SUN 8:15 AM TO 10:00 AM

#### Active Photonic Devices I: Sources and Modulators

Session Chair: **Sanjay Krishna**, The Ohio State Univ. (USA)

8:15 am: **Novel nanophotonic light sources** (*Keynote Presentation*), Marin Soljacic, Massachusetts Institute of Technology (USA) ..... [10345-1]

8:55 am: **On-chip and planar optics with alternative plasmonic materials** (*Invited Paper*), Soham Saha, Krishnakali Chaudhuri, Aweek Dutta, Clayton T. DeVault, Purdue Univ. (USA); Nathaniel Kinsey, Virginia Commonwealth Univ. (USA); Vladimir M. Shalaev, Alexandra Boltasseva, Purdue Univ. (USA) .. [10345-2]

9:20 am: **Quantum well intermixed tunable wavelength single stripe laser diode**, Thamer Tabbakh, Patrick L. LiKamWa, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) ..... [10345-84]

9:35 am: **Ultrafast carrier capture and Auger recombination in individual III-nitride nanowires** (*Invited Paper*), Stephane A. Boubanga Tombet, Los Alamos National Lab. (USA); Jeremy B. Wright, Ping Lu, Sandia National Labs. (USA); Michael R. C. Williams, Los Alamos National Lab. (USA); Changyi Li, George T. Wang, Sandia National Labs. (USA); Rohit P. Prasankumar, Los Alamos National Lab. (USA) ..... [10345-4]

Coffee Break ..... Sun 10:00 am to 10:30 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 6C . SUN 10:30 AM TO 12:20 PM

#### Active Photonic Devices II: Detectors, Sensors, and Microscopy Systems

Session Chair: **Soham Saha**, Purdue Univ. (USA)

10:30 am: **Metamaterial infrared detectors** (*Invited Paper*), Sanjay Krishna, The Ohio State Univ. (USA) ..... [10345-5]

10:55 am: **A random metasurface for an all polarizations flat lens**, Matthieu Dupre, Junhee Park, Boubacar Kante, Univ. of California, San Diego (USA) [10345-6]

11:10 am: **Saturation of magnetic response of parallel slabs Metamaterials**, Mona H. Alsaleh, Raj K Vinnakota, Dentcho A Genov, Louisiana Tech Univ. (USA) ..... [10345-7]

11:25 am: **Fluorescence enhancement in fluidic nanochannels for dynamic molecular optical detection** (*Invited Paper*), Pablo A. Postigo, Raquel Alvaro, Instituto de Microelectrónica de Madrid (Spain); Aritz Juarros, IK4 Tekniker (Spain); Santos Merino, IK4 Tekniker (Spain) and Instituto de Microelectrónica de Madrid (Spain) ..... [10345-8]

11:50 am: **Whispering gallery mode polymer fiber refractive index sensors fabricated by near-field electrospinning**, Joseph E. Cheeney, Stephen T. Hsieh, Nosang V. Myung, Elaine D. Haberer, Univ. of California, Riverside (USA) [10345-9]

12:05 pm: **Active plasmonic antennas**, Kai Braun, Florian Laible, Alfred J. Meixner, Monika Fleischer, Eberhard Karls Univ. Tübingen (Germany) ..... [10345-10]

Lunch Break ..... Sun 12:20 pm to 1:20 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 6C ... SUN 1:20 PM TO 3:05 PM

#### Nanostructures for Harnessing Light-Matter Interaction and Lasing I

Session Chair: **Liam O'Faolain**, Cork Institute of Technology (Ireland)

1:20 pm: **Quantum dot light-matter interactions in complex nanophotonic environments** (*Keynote Presentation*), Stephen Hughes, Queen's Univ. (Canada) ..... [10345-11]

2:00 pm: **Anapole-mode-based nanolaser in integrated optical chips** (*Invited Paper*), Juan Sebastian Totoro Gongora, King Abdullah Univ. of Science and Technology (Saudi Arabia); Andrey E. Miroshnichenko, Yuri S. Kivshar, The Australian National Univ. (Australia); Andrea Fratallocchi, King Abdullah Univ. of Science and Technology (Saudi Arabia) ..... [10345-12]

2:25 pm: **Low-threshold lasing in coupled resonator optical waveguides with exceptional points of degeneracy**, Mohamed A. K. Othman, Mohamed Y. Nada, Mehdi Veysi, Alexander Figotin, Filippo Capolino, Univ. of California, Irvine (USA) ..... [10345-13]

2:40 pm: **Ultrafast and quantum dynamics of plasmonic nanolasing and surface-plasmon polariton condensation** (*Invited Paper*), Ortwin Hess, Imperial College London (United Kingdom) ..... [10345-14]

Coffee Break ..... Sun 3:05 pm to 3:30 pm

#### SESSION 4

LOCATION: CONV. CTR. ROOM 6C ... SUN 3:30 PM TO 5:50 PM

#### Nanostructures for Harnessing Light-Matter Interaction and Lasing II

Session Chair: **Pablo A. Postigo**, Instituto de Microelectrónica de Madrid (Spain)

3:30 pm: **Controlled and tunable multi-modal lasing from plasmonic superlattices** (*Invited Paper*), Teri W. Odom, Northwestern Univ. (USA). [10345-15]

3:55 pm: **Nanolasers based on high-quality factor plasmonic resonators**, Amit Agrawal, Wenqi Zhu, Henri J. Lezec, Shawn Divitt, National Institute of Standards and Technology (USA); Ting Xu, Nanjing Univ. (China) ..... [10345-16]

4:10 pm: **Spatial intensity of plasmonic distributed feedback lasers**, Ke Guo, Femius Koenderink, FOM Institute for Atomic and Molecular Physics (Netherlands) ..... [10345-17]

4:25 pm: **Dynamics and coherence of metal-clad nanolasers**, Si Hui Pan, Univ. of California, San Diego (USA); Qing Gu, The Univ. of Texas at Dallas (USA); Abdelkrim El Amili, Felipe Vallini, Univ. of California, San Diego (USA) .. [10345-18]



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4:40 pm: **Large Purcell enhancement in perovskite plasmonic nanolaser**, Sui Yang, Wei Bao, Xiaozhe Liu, Jeongmin Kim, Rongkuo Zhao, Yuan Wang, Xiang Zhang, Univ. of California, Berkeley (USA) . . . . . [10345-19]

4:55 pm: **Hybrid photonic crystal lasers for wavelength division multiplexing** (*Invited Paper*), Liam O'Faolain, Cork Institute of Technology (Ireland) and Univ. of St. Andrews (United Kingdom) and Tyndall National Institute (Ireland) . . [10345-20]

5:20 pm: **Fabrication of low-threshold ZnO nanorod array random lasers**, Hideki Fujiwara, Ryo Niyuki, Keiji Sasaki, Hokkaido Univ. (Japan) . . . . . [10345-21]

5:35 pm: **Nanowire array lasers on silicon for optical links**, Diana L. Huffaker, Cardiff Univ. (United Kingdom); Hyunseok Kim, Univ. of California, Los Angeles (USA); Wook-Jae Lee, Cardiff Univ. (United Kingdom) . . . . . [10345-87]

**LOCATION: CONV. CTR. ROOM 6A . . SUN 6:00 PM TO 7:50 PM**

## Technology Hot Topics: How Optics and Photonics Drive Innovation

6:00 pm to 6:10 pm: **Welcome and Opening Remarks**

6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)

6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)

6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)

7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)

7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)

## MONDAY 7 AUGUST

**LOCATION: CONV. CTR. ROOM 6A MON 9:00 AM TO 12:00 PM**

## Nanoscience + Engineering Plenary Session

Session Chairs: **Harry A. Atwater Jr.**, California Institute of Technology (USA); **Nikolay I. Zheludev**, Optoelectronics Research Ctr. (United Kingdom)

9:15 am: **3D laser nanolithography** (*Plenary*), Martin Wegener, Karlsruhe Institut für Technologie (Germany) . . . . . [10354-500]

Coffee Break . . . . . Mon 10:00 am to 10:30 am

10:30 am: **Controlling light at the atomic scale** (*Plenary*), F. Javier Garcia de Abajo, ICFO - Institut de Ciències Fotòniques (Spain) . . . . . [10359-500]

11:15 am: **Science, engineering, and commercialization of flexible, printable 2D atomic materials and devices** (*Invited Paper*), Deji Akinwande, The Univ. of Texas at Austin (USA) . . . . . [10349-500]

Lunch Break . . . . . Mon 12:00 pm to 1:15 pm

## SESSION 5

**LOCATION: CONV. CTR. ROOM 6C . . . . MON 1:15 PM TO 3:25 PM**

## Platforms for Extreme Absorption and Thermal Management

Session Chair: **Volker J. Sorger**, The George Washington Univ. (USA)

1:15 pm: **High temperature hyperbolic metamaterial for selective thermal emitters in thermophotovoltaic (TPV) systems** (*Invited Paper*), Manfred Eich, Technische Univ. Hamburg-Harburg (Germany) and Helmholtz-Zentrum Geesthacht (Germany); Alexander Y. Petrov, Technische Univ. Hamburg-Harburg (Germany); Pavel N. Dyachenko, Technische Univ. Hamburg-Harburg (Germany); Sean Molesky, Univ. of Alberta (Canada); Zubin Jacob, Purdue Univ. (USA); Michael Störmer, Helmholtz-Zentrum Geesthacht (Germany); Tobias Krekel, Martin Ritter, Technische Univ. Hamburg-Harburg (Germany) . . . . . [10345-22]

1:40 pm: **Perfect and tunable electromagnetic absorption using epsilon-near-zero metamaterials and graphene-polymer heterostructures** (*Invited Paper*), Michaël Lobet, Bruno Majerus, Luc Henrard, Michaël Sarrazin, Philippe Lambin, Univ. of Namur (Belgium) . . . . . [10345-23]

2:05 pm: **3D gradient refractive index micro-optics** (*Invited Paper*), Paul V. Braun, Christian Ocier, Univ. of Illinois at Urbana-Champaign (USA) . . . . . [10345-24]

2:30 pm: **Near-unidirectional superemitters enabled by cascaded phonon-polariton resonances**, Ganga C. R. Devarapu, Cork Institute of Technology (Ireland); Stavroula Foteinopoulou, The Univ. of New Mexico (USA) . . . . [10345-25]

2:45 pm: **Measuring and exploiting optical anisotropies in nanophotonic photovoltaics**, Jon A. Schuller, Univ. of California, Santa Barbara (USA) [10345-26]

3:00 pm: **Effectively infinite optical path-length created using a simple-cubic photonic crystal for extreme light-trapping** (*Invited Paper*), Shawn-Yu Lin, B. J. Frey, Rensselaer Polytechnic Institute (USA); Mei-Li Hsieh, National Chiao Tung Univ. (Taiwan); Ping Kuang, Rensselaer Polytechnic Institute (USA); J.-H. Jiang, Sajeev John, Univ. of Toronto (Canada) . . . . . [10345-27]

Coffee Break . . . . . Mon 3:25 pm to 3:55 pm

## SESSION 6

**LOCATION: CONV. CTR. ROOM 6C . . . MON 3:55 PM TO 5:30 PM**

## Carbon-Based and 2D Material Photonics I

Session Chair: **Philippe Tassin**, Chalmers Univ. of Technology (Sweden)

3:55 pm: **Extra-ordinary modulators with 2D photonic materials** (*Invited Paper*), Volker J. Sorger, The George Washington Univ. (USA) . . . . . [10345-28]

4:20 pm: **Fast and highly sensitive ionic polymer gated WS<sub>2</sub>-graphene photodetectors**, Jake Mehew, Selim Unal, Elias Torres Alonso, Gareth F. Jones, Saad Fadhil Ramadhan, Monica Craciun, Saverio Russo, Univ. of Exeter (United Kingdom) . . . . . [10345-29]

4:35 pm: **MoS<sub>2</sub> exciton-polaritons in dielectric photonic structures** (*Invited Paper*), Ertugrul Cubukcu, Xingwang Zhang, Univ. of California, San Diego (USA) . . . . . [10345-30]

5:00 pm: **Ultrafast radiative heat transfer**, Renwen Yu, ICFO - Institut de Ciències Fotòniques (Spain) and The Barcelona Institute of Science and Technology (Spain); Alejandro Manjavacas, The Univ. of New Mexico (USA); F. Javier Garcia de Abajo, ICFO - Institut de Ciències Fotòniques (Spain) and The Barcelona Institute of Science and Technology (Spain) and ICREA-Institució Catalana de Recerca i Estudis Avançats (Spain) . . . . . [10345-31]

5:15 pm: **Electrical properties of SiO<sub>2</sub>-based graphene under monochromatic visible light irradiation**, Xiangdi Li, Xianming Liu, Xueying Cao, Peng Zhang, Xiaohua Lei, Weimin Chen, Chongqing Univ. (China) . . . . . [10345-32]

## TUESDAY 8 AUGUST

## SESSION 7

**LOCATION: CONV. CTR. ROOM 6C . . TUE 8:20 AM TO 10:30 AM**

## Extraordinary Non-Linear Photonic Platforms I

Session Chair: **Michelle L. Povinelli**, The Univ. of Southern California (USA)

8:20 am: **Enhanced nonlinearities in transparent conducting oxides for ultrafast photonics** (*Keynote Presentation*), Clayton T. DeVault, Purdue Univ. (USA); Nathaniel Kinsey, Virginia Commonwealth Univ. (USA); Lucia Caspani, Heriot-Watt Univ. (United Kingdom); Matteo Clerici, Heriot-Watt Univ. (United Kingdom) and Univ. of Glasgow (United Kingdom); Kaipurath Muhammad Rishad, Thomas Roger, Enrico Carnemolla, Heriot-Watt Univ. (United Kingdom); Jongbum Kim, Amr M. Shaltout, Purdue Univ. (USA); Monica Pietrzyk, Andrea Di Falco, Univ. of St. Andrews (United Kingdom); Daniele Faccio, Heriot-Watt Univ. (United Kingdom); Alexandra Boltasseva, Purdue Univ. (USA); Marcello Ferrera, Heriot-Watt Univ. (United Kingdom); Vladimir M. Shalaev, Purdue Univ. (USA) . . . . . [10345-33]

9:00 am: **Molding optical wavefronts with nonlinear active photonic platforms** (*Invited Paper*), Xiang Zhang, Nir Shitrit, Univ. of California, Berkeley (USA) . . . . . [10345-34]

9:25 am: **Tunable chiral metasurfaces based on the transfer of electromagnetic angular momentum**, Sophie Viaene, Vrije Univ. Brussel (Belgium) and Chalmers Univ. of Technology (Sweden); Vincent Ginis, Jan Danckaert, Vrije Univ. Brussel (Belgium); Philippe Tassin, Chalmers Univ. of Technology (Sweden) . . . . [10345-35]

9:40 am: **Enhanced nonlinear optical interactions in 2D-3D heteromaterials** (*Invited Paper*), Nicolae Coriolan Panoiu, Jian Wei You, Univ. College London (United Kingdom) . . . . . [10345-36]

10:05 am: **Nonlinear tuning of resonance in metamaterial absorbers** (*Invited Paper*), Subramaniam Anantha Ramakrishna, Sriram Guddala, Indian Institute of Technology Kanpur (India) . . . . . [10345-37]

Coffee Break . . . . . Tue 10:30 am to 11:00 am

## SESSION 8

LOCATION: CONV. CTR. ROOM 6C . . TUE 11:00 AM TO 12:20 PM

### Carbon-Based and 2D Material Photonics II

Session Chair: **Ertugrul Cubukcu**, Univ. of California, San Diego (USA)

11:00 am: **Graphene terahertz photonics** (*Invited Paper*), Philippe Tassin, Chalmers Univ. of Technology (Sweden) . . . . . [10345-38]

11:25 am: **Terahertz transitions in quasi-metallic carbon nanotubes and graphene nanoribbons** (*Invited Paper*), Mikhail E. Portnoi, Vasil A. Saroka, Univ. of Exeter (United Kingdom); Richard R. Hartmann, De La Salle Univ. (Philippines) . . . . . [10345-39]

11:50 am: **Instantaneous and transient nonlinearities of graphene plasmons**, Joel D. Cox, ICFO - Institut de Ciències Fotòniques (Spain); F. Javier Garcia de Abajo, ICFO - Institut de Ciències Fotòniques (Spain) and ICREA-Institució Catalana de Recerca i Estudis Avançats (Spain) . . . . . [10345-40]

12:05 pm: **Electromagnetic properties of multilayered nanostructured 2D materials: application to graphene**, Bruno Majérus, Michaël Lobet, Mirko Cormann, Nicolas Reckinger, Philippe Lambin, Univ. of Namur (Belgium); Jérémy Butet, Gabriel D. Bernasconi, Raziman Thottungal Valapu, Olivier J. F. Martin, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Luc Henrard, Univ. of Namur (Belgium) . . . . . [10345-41]

Lunch/Exhibition Break . . . . . Tue 12:20 pm to 1:50 pm

## SESSION 9

LOCATION: CONV. CTR. ROOM 6C . . . . TUE 1:50 PM TO 3:30 PM

### Dynamic Photonics with Phase-Change Materials I

Session Chair: **Sharon M. Weiss**, Vanderbilt Univ. (USA)

1:50 pm: **On-chip phase-change photonic memories and computing** (*Invited Paper*), Zengguang Cheng, Carlos A. Rios, Harish Bhaskaran, Univ. of Oxford (United Kingdom) . . . . . [10345-42]

2:15 pm: **Switchable infrared nanophotonic elements enabled by phase-change materials** (*Invited Paper*), Thomas Taubner, RWTH Aachen Univ. (Germany) . . . . . [10345-43]

2:40 pm: **Chalcogenide active photonics** (*Invited Paper*), Robert Simpson, Weiling Dong, Hailong Liu, Sreekanth K. Vallyaveedu, Li Liu, Singapore Univ. of Technology & Design (Singapore); Tun Cao, Dalian Univ. of Technology (China); Joel Yang, Singapore Univ. of Technology & Design (Singapore) . . . . . [10345-44]

3:05 pm: **Thermal homeostasis using nanophotonic phase change materials** (*Invited Paper*), Michelle L. Povinelli, Shao-Hua Wu, Mingkun Chen, The Univ. of Southern California (USA); Michael Barako, Vladan Jankovic, Philip W. C. Hon, Luke A. Sweatlock, NG Next Northrop Grumman Corp. (USA) . . . . . [10345-45]

Coffee Break . . . . . Tue 3:30 pm to 4:00 pm

## SESSION 10

LOCATION: CONV. CTR. ROOM 6C . . . TUE 4:00 PM TO 5:30 PM

### Dynamic Photonics with Phase-Change Materials II

Session Chair: **Harish Bhaskaran**, Univ. of Oxford (United Kingdom)

4:00 pm: **Optical modulation in silicon-vanadium dioxide photonic structures** (*Invited Paper*), Kevin J. Miller, Kent A. Hallman, Richard F. Haglund, Sharon M. Weiss, Vanderbilt Univ. (USA) . . . . . [10345-46]

4:25 pm: **Dynamic control of infrared optical absorption and thermal emission using phase-transition materials** (*Invited Paper*), Mikhail A. Kats, Univ. of Wisconsin-Madison (USA) . . . . . [10345-47]

4:50 pm: **Photoinduced optical dynamics of phase-change vanadium oxides**, Nardeep Kumar, Armando Rúa, Lee R. Chevres, Larry Theran, Brian Ayala, Félix E. Fernández, Sergiy I. Lysenko, Univ. de Puerto Rico Mayagüez (USA) . . . [10345-48]

5:05 pm: **Electrically driven hybrid photonic metamaterials for multifunctional control** (*Invited Paper*), Lei Kang, Liu Liu, Sawyer D. Campbell, Taiwei Yue, Qiang Ren, Theresa S. Mayer, Douglas H. Werner, The Pennsylvania State Univ. (USA) . . . . . [10345-49]

## WEDNESDAY 9 AUGUST

### SESSION 11

LOCATION: CONV. CTR. ROOM 6C . . WED 8:15 AM TO 10:15 AM

### Topological Photonic Systems I

Session Chair: **Ganapathi S. Subramania**, Sandia National Labs. (USA)

8:15 am: **Topological photonics: from macro- to nano-scale** (*Keynote Presentation*), Gennady B. Shvets, Univ. of Texas at Austin (USA) . . . . . [10345-50]

8:55 am: **Self-induced topological solitons for nonlinear optical isolation** (*Invited Paper*), Yidong Chong, Daniel Leykam, Xin Zhou, You Wang, Nanyang Technological Univ. (Singapore) . . . . . [10345-51]

9:20 am: **Topological steering of the lasing beam in surface lasers**, Babak Bahari, Junhee Park, Felipe Vallini, Ricardo Tellez Limon, Ashok Kodigala, Thomas Lepetit, Yeshiahu Fainman, Boubacar Kante, Univ. of California, San Diego (USA) . . . . . [10345-52]

9:35 am: **Index ellipsoids at arbitrary k-points** (*Keynote Presentation*), Che Ting Chan, Wenjie Chen, Hong Kong Univ. of Science and Technology (Hong Kong, China) . . . . . [10345-53]

Coffee Break . . . . . Wed 10:15 am to 10:45 am

### SESSION 12

LOCATION: CONV. CTR. ROOM 6C . WED 10:45 AM TO 12:20 PM

### Topological Photonic Systems II

Session Chair: **Yidong Chong**, Nanyang Technological Univ. (Singapore)

10:45 am: **Topology emerging from photonic graphene** (*Keynote Presentation*), Xiao Hu, National Institute for Materials Science (Japan) . . . . . [10345-54]

11:25 am: **Topological photonics research at Sandia Lab**, Ganapathi S. Subramania, Sandia National Labs. (USA); P. Duke Anderson, Sandia National Labs. (USA) and The Univ. of Southern California (USA) . . . . . [10345-55]

11:40 am: **Topological edge states of distorted photonic Kagome lattices**, Xiang Ni, The City College of New York (USA); Andrea Alù, The Univ. of Texas at Austin (USA); Alexander B. Khanikaev, The City College of New York (USA) . . . . . [10345-56]

11:55 am: **Non-Hermitian defects in topologically protected photonic crystals** (*Invited Paper*), Tsampikos Kottos, Wesleyan Univ. (USA) . . . . . [10345-57]

Lunch/Exhibition Break . . . . . Wed 12:20 pm to 1:55 pm

### SESSION 13

LOCATION: CONV. CTR. ROOM 6C . . . WED 1:55 PM TO 3:00 PM

### Extraordinary Non-Linear Photonic Platforms II

Session Chair: **Nicolae Coriolan Panoiu**, Univ. College London (United Kingdom)

1:55 pm: **Dipolar second order nonlinear effects from goldnano-antennas by controlling radiation phase** (*Invited Paper*), Sylvain D. Gennaro, Vincenzo Giannini, Themistoklis P. H. Sidiropoulos, Imperial College London (United Kingdom); Miguel Navarro-Cía, The Univ. of Birmingham (United Kingdom); Stefan A. Maier, Rupert F. Oulton, Imperial College London (United Kingdom) . . . . . [10345-58]

2:20 pm: **Shaping of higher harmonic radiation in dielectric nanoantennas**, Massimiliano Guasoni, Univ. of Southampton (United Kingdom); Luca Carletti, Univ. degli Studi di Brescia (Italy); Dragomir N. Neshev, The Australian National Univ. (Australia); Costantino De Angelis, Univ. degli Studi di Brescia (Italy) . . . [10345-59]

2:35 pm: **Reconfigurable silicon photonics: shaping light on a chip** (*Invited Paper*), Otto L. Muskens, Roman Bruck, Nicholas Dinsdale, Univ. of Southampton (United Kingdom); Kevin Vynck, Philippe Lalanne, Lab. Photonique, Numérique et Nanosciences (France); Goran Z. Mashanovich, Graham T. Reed, Univ. of Southampton (United Kingdom) . . . . . [10345-60]

Coffee Break . . . . . Wed 3:00 pm to 3:20 pm



# CONFERENCE 10345

## SESSION 14

LOCATION: CONV. CTR. ROOM 6C . . . WED 3:20 PM TO 5:05 PM

### Topological Photonic Systems III

Session Chair: **Ganapathi S. Subramania**, Sandia National Labs. (USA)

3:20 pm: **Topological and complex birefringent metamaterial** (*Keynote Presentation*), Shanhui Fan, Alex Cerjan, Meng Xiao, Luqi Yuan, Qian Lin, Stanford Univ. (USA) . . . . . [10345-61]

4:00 pm: **Topological and non-reciprocal photonics** (*Keynote Presentation*), Andrea Alù, The Univ. of Texas at Austin (USA) . . . . . [10345-62]

4:40 pm: **Entangled photons in 2D topological photonic systems** (*Invited Paper*), Sunil Mittal, Venkata Vikram Orre, Joint Quantum Institute, Univ. of Maryland (USA) and National Institute of Standards and Technology (USA); Mohammad Hafezi, Joint Quantum Institute, Univ. of Maryland (USA) and National Institute of Standards and Technology (USA) . . . . . [10345-64]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 . . . . . WED 5:30 PM TO 7:30 PM

### Posters-Wednesday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPPosterGuidelines>.

**Polarization driven supramolecular chirality in soft-printed dielectric microstructures**, Angelo Angelini, Politecnico di Torino (Italy); Federica Pirani, Politecnico di Torino (Italy) and Istituto Italiano di Tecnologia (Italy); Federico Ferrarese Lupi, Istituto Nazionale di Ricerca Metrologica (Italy); Francesca Frascella, Serena Ricciardi, Politecnico di Torino (Italy); Natascia De Leo, Luca Boarino, Istituto Nazionale di Ricerca Metrologica (Italy); Emiliano Descrovi, Politecnico di Torino (Italy) . . . . . [10345-3]

**Incident femtosecond pulse chirp influence on nonlinear localization of laser energy in layered photonic crystal**, Vyacheslav A. Trofimov, Tatiana M. Lysak, Evgenii M. Trykin, M.V. Lomonosov Moscow SU (Russian Federation) . . [10345-82]

**Self-similar chirped laser pulse propagation in a medium with TOD and non-resonant TPA**, Vyacheslav A. Trofimov, Aleksey A. Kalinovich, Irina G. Zakharova, M.V. Lomonosov Moscow SU (Russian Federation) . . . . . [10345-83]

**Magnetic and magneto-optical properties on sub-micrometer thick Bi-doped iron garnets grown by liquid phase epitaxy**, Nathan Beaulieu, Souren P. Pogossian, Univ. de Bretagne Occidentale (France); Lucile Soumah, Abdelmadjid Anane, Paolo Bortolotti, Vincent Cros, Unité Mixte de Physique CNRS/Thales (France); Jamal Ben Youssef, Univ. de Bretagne Occidentale (France) . . [10345-85]

**Modeling and simulation analysis of graphene integrated silicon waveguide**, Swati Joshi, Brajesh Kumar Kaushik, Vikas Nehra, Indian Institute of Technology Roorkee (India) . . . . . [10345-86]

## THURSDAY 10 AUGUST

### SESSION 15

LOCATION: CONV. CTR. ROOM 6C . . THU 8:00 AM TO 10:20 AM

### Highly Asymmetric and Non-Reciprocal Photonic Platforms

Session Chair: **Tsampikos Kottos**, Wesleyan Univ. (USA)

8:00 am: **Photonic crystal Fano resonances for realizing optical switches, lasers, and non-reciprocal elements** (*Invited Paper*), Dagmawi A. Bekele, Jesper Mork, Yi Yu, Aurimas Sakanas, Luisa Ottaviano, Elizaveta Semenova, Kresten Yvind, Technical Univ. of Denmark (Denmark) . . . . . [10345-65]

8:25 am: **Metawaveguide for asymmetric interferometric light-light switching** (*Invited Paper*), Han Zhao, Univ. at Buffalo (USA); William S. Fegadolli, California Institute of Technology (USA); Jiakai Yu, Zhifeng Zhang, Univ. at Buffalo (USA); Li Ge, The City Univ. of New York (USA); Axel Scherer, California Institute of Technology (USA); Liang Feng, Univ. at Buffalo (USA) . . . . . [10345-66]

8:50 am: **Quantum optical circulator controlled by a single chirally coupled atom** (*Invited Paper*), Juergen Volz, Vienna Ctr. for Quantum Science and Technology (Austria) . . . . . [10345-67]

9:15 am: **Non reciprocal light propagation in a YIG based magnetic waveguide**, Lucile Soumah, Unité Mixte de Physique CNRS/Thales (France); Lilia Qassym, Thales Research & Technology (France); Cécile Carretero, Eric Jacquet, Unité Mixte de Physique CNRS/Thales (France); Jamal Ben Youssef, Nathan Beaulieu, Univ. de Bretagne Occidentale (France); Richard Lebourgeois, Alfredo De Rossi, Sylvain Combrie, Thales Research & Technology (France); Paolo Bortolotti, Abdelmadjid Anane, Unité Mixte de Physique CNRS/Thales (France) . . . . . [10345-68]

9:30 am: **Non-PT-symmetric plasmonic waveguide-cavity systems: unidirectional reflectionlessness and broadband near total light absorption** (*Invited Paper*), Georgios Veronis, Louisiana State Univ. (USA); Yin Huang, Central South Univ. (China); Changjun Min, Shenzhen Univ. (China) . . . . . [10345-69]

9:55 am: **Structure-induced asymmetry between counterpropagating modes and the reciprocity principle in whistle-geometry ring lasers** (*Invited Paper*), Marek Osinski, The Univ. of New Mexico (USA) . . . . . [10345-70]

Coffee Break . . . . . Thu 10:20 am to 10:50 am

### SESSION 16

LOCATION: CONV. CTR. ROOM 6C . . THU 10:50 AM TO 12:10 PM

### PT-Symmetry in Non-Hermitian Photonic Systems

Session Chair: **Georgios Veronis**, Louisiana State Univ. (USA)

10:50 am: **Active parity-time symmetric systems** (*Invited Paper*), Mercedeh Khajavikhan, Demetrios N. Christodoulides, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [10345-71]

11:15 am: **Towards nanoscale optical nonreciprocity with PT-symmetric metamaterials**, David R. Barton III, Stanford Univ. (USA); Hadiseh Alaeian, Northwestern Univ. (USA); Mark Lawrence, Jennifer A. Dionne, Stanford Univ. (USA) . . . . . [10345-72]

11:30 am: **Higher-order exceptional points in photonic systems**, Hossein Hodaei, Absar U. Hassan, Steffen Wittek, Midya Parto, Hipolito Garcia-Gracia, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Ramy A. H. El-Ganainy, Michigan Technological Univ. (USA); Demetrios N. Christodoulides, Mercedeh Khajavikhan, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [10345-74]

11:45 am: **PT symmetry in Kagome photonic lattices** (*Invited Paper*), Gia-Wei Chern, Univ. of Virginia (USA); Avadh Saxena, Los Alamos National Lab. (USA) . . . . . [10345-75]

Lunch/Exhibition Break . . . . . Thu 12:10 pm to 1:40 pm

### SESSION 17

LOCATION: CONV. CTR. ROOM 6C . . . . THU 1:40 PM TO 2:55 PM

### Platforms for Non-Classical Light Control I

Session Chair: **Kosmas L. Tsakmakidis**, Univ. of Ottawa (Canada)

1:40 pm: **Measuring photon non-classicality using quantum-dot light sources** (*Invited Paper*), Glenn S. Solomon, Joint Quantum Institute, Univ. of Maryland (USA) and National Institute of Standards and Technology (USA) . . . . . [10345-76]

2:05 pm: **Quantum dots in photonic crystals for integrated quantum photonics** (*Invited Paper*), Je-Hyung Kim, Univ. of Maryland, College Park (USA); Christopher J. K. Richardson, Richard P. Leavitt, Lab. for Physical Sciences (USA); Edo Waks, Univ. of Maryland, College Park (USA) . . . . . [10345-77]

2:30 pm: **Entanglement optimization in plasmonically coupled quantum dots** (*Invited Paper*), Matthew A. Pelton, Univ. of Maryland, Baltimore County (USA) . . . . . [10345-78]

LOCATION: CONV. CTR. ROOM 6C ..... 2:55 PM TO 3:10 PM

**Best Student Paper Award Announcement**

Session Chair: **Stavroula Foteinopoulou**, The Univ. of New Mexico (USA)

Coffee Break .....Thu 3:10 pm to 3:40 pm

**SESSION 18**

LOCATION: CONV. CTR. ROOM 6C ... THU 3:40 PM TO 4:55 PM

**Platforms for Non-Classical Light Control II**

Session Chair: **Glenn S. Solomon**, National Institute of Standards and Technology (USA)

3:40 pm: **Quantum self-organized criticality and nonequilibrium light localization** (*Invited Paper*), Kosmas L. Tsakmakidis, Univ. of Ottawa (Canada); Pankaj K. Jha, Xiang Zhang, Univ. of California, Berkeley (USA); Hatice Altug, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Robert W. Boyd, Univ. of Ottawa (Canada) .....[10345-79]

4:05 pm: **All-dielectric transparent metasurfaces for holography and quantum tomography** (*Invited Paper*), Sergey S. Kruk, Lei Wang, Kai Wang, Matthew Parry, The Australian National Univ. (Australia); Hung-Pin Chung, The Australian National Univ. (Australia) and National Central Univ. (Taiwan); Hanzhi Tao, The Australian National Univ. (Australia) and Nanjing Univ. (China); Ivan I. Kravchenko, Andrey Sukhorukov, Dragomir N. Neshev, Yuri S. Kivshar, The Australian National Univ. (Australia) .....[10345-80]

4:30 pm: **Photonic band control in a quantum metamaterial** (*Invited Paper*), Didier Felbacq, Emmanuel Rousseau, Univ. Montpellier (France) .....[10345-81]

LOCATION: CONV. CTR. ROOM 6C .....4:55 PM TO 5:00 PM

**Closing Remarks**

Session Chair: **Ganapathi S. Subramania**, Sandia National Labs. (USA)



# CONFERENCE 10346

LOCATION: CONV. CTR. ROOM 1B

Sunday–Thursday 6–10 August 2017 • Proceedings of SPIE Vol. 10346

## Plasmonics: Design, Materials, Fabrication, Characterization, and Applications XV

Conference Chairs: **Din Ping Tsai**, National Taiwan Univ. (Taiwan); **Takuo Tanaka**, RIKEN Ctr. for Advanced Photonics (Japan)

Program Committee: **Martin Aeschlimann**, Technische Univ. Kaiserslautern (Germany); **Harry A. Atwater Jr.**, California Institute of Technology (USA); **David J. Bergman**, Tel Aviv Univ. (Israel); **Allan D. Boardman**, Univ. of Salford (United Kingdom); **Che Ting Chan**, Hong Kong Univ. of Science and Technology (Hong Kong, China); **Yun-Chong Chang**, Academia Sinica (Taiwan); **Harald W. Giessen**, Univ. Stuttgart (Germany); **Jean-Jacques Greffet**, Institut d'Optique Graduate School (France); **Naomi J. Halas**, Rice Univ. (USA); **Martti Kauranen**, Tampere Univ. of Technology (Finland); **Fritz Keilmann**, LASNIX (Germany); **Dai-Sik Kim**, Seoul National Univ. (Korea, Republic of); **Laurens K. Kuipers**, FOM Institute for Atomic and Molecular Physics (Netherlands); **Mikhail Lapine**, The Univ. of Sydney (Australia); **Ai Qun Liu**, Nanyang Technological Univ. (Singapore); **Olivier J. F. Martin**, Ecole Polytechnique Fédérale de Lausanne (Switzerland); **Peter Nordlander**, Rice Univ. (USA); **Lukas Novotny**, Univ. of Rochester (USA); **Vahid Sandoghdar**, ETH Zurich (Switzerland); **George C. Schatz**, Northwestern Univ. (USA); **Tigran V. Shahbazyan**, Jackson State Univ. (USA); **Vladimir M. Shalaev**, Purdue Univ. (USA); **Gennady B. Shvets**, Institute for Fusion Studies (USA); **Niek F. van Hulst**, ICFO - Institut de Ciències Fotòniques (Spain); **Hongxing Xu**, Wuhan Univ. (China); **Nikolay I. Zheludev**, Optoelectronics Research Ctr. (United Kingdom), Nanyang Technological Univ. (Singapore); **Joseph Zyss**, Ecole Normale Supérieure de Cachan (France)

### SUNDAY 6 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 1B . . . SUN 8:30 AM TO 10:10 AM

#### Theory, Simulation, and Design for Plasmonics I

Session Chair: **Otto L. Muskens**, Univ. of Southampton (United Kingdom)

8:30 am: **Plasmon-induced hot carrier generation and applications** (*Invited Paper*), Peter Nordlander, Rice Univ. (USA) . . . . . [10346-1]

9:00 am: **Novel numerical method for electron energy-loss spectroscopy calculation: EELS-FDTD** (*Invited Paper*), Nicolas Large, The Univ. of Texas at San Antonio (USA) . . . . . [10346-2]

9:30 am: **Femtosecond dynamics of plasmon-induced hot electrons in nanostructured titanium nitride**, Brock Doiron, Yi Li, Andrei P. Mihai, Lesley F. Cohen, Peter K. Petrov, Neil M. Alford, Rupert F. Oulton, Stefan A. Maier, Imperial College London (United Kingdom) . . . . . [10346-3]

9:50 am: **Enabling new regimes of nanoparticle resonances through beam engineering**, Jon A. Schuller, Univ. of California, Santa Barbara (USA) . . [10346-4]

Coffee Break . . . . . Sun 10:10 am to 10:40 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 1B . . SUN 10:40 AM TO 11:50 AM

#### Plasmonic Nanostructures and Nanofabrication I

Session Chair: **Peter Nordlander**, Rice Univ. (USA)

10:40 am: **3D plasmonic nanoarchitectures for extreme light concentrating** (*Invited Paper*), Wei-Chuan Shih, Univ. of Houston (USA) . . . . . [10346-5]

11:10 am: **Plasmonic nanogap structures studied via cathodoluminescence imaging**, Stephen J. Bauman, Qigeng Yan, Mourad Benamara, Joseph B. Herzog, Univ. of Arkansas (USA) . . . . . [10346-6]

11:30 am: **Maskless patterning using surface plasmon enhanced electron beamlets**, Zhidong Du, Chen Chen, Liang Pan, Purdue Univ. (USA) . . . . [10346-8]

Lunch Break . . . . . Sun 11:50 am to 1:40 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 1B . . . . SUN 1:40 PM TO 3:10 PM

#### Plasmonic Applications I

Session Chair: **Andrey Karlovich Sarychev**, Institute for Theoretical and Applied Electrodynamics (Russian Federation)

1:40 pm: **Tunable plasmonics and metasurfaces for applications in optical switching and space technology** (*Invited Paper*), Otto L. Muskens, Kai Sun, Christoph A. Riedel, Bigeng Chen, Cornelis Hendrik De Groot, Univ. of Southampton (United Kingdom) . . . . . [10346-9]

2:10 pm: **Measurement of Stokes parameters using plasmonic metasurface** (*Invited Paper*), Chih-Ming Wang, National Dong Hwa Univ. (Taiwan) . . [10346-10]

2:40 pm: **Plasmon resonance sensors for compact plasmonic integrated device** (*Invited Paper*), Masanobu Haraguchi, Shun Kamada, Tokushima Univ. (Japan); Hiroyuki Okamoto, Nagaoka Univ. of Technology (Japan); Toshihiro Okamoto, Salah E. El-Zohary, Tokushima Univ. (Japan) . . . . . [10346-11]

Coffee Break . . . . . Sun 3:10 pm to 3:40 pm

#### SESSION 4

LOCATION: CONV. CTR. ROOM 1B . . . SUN 3:40 PM TO 5:40 PM

#### Plasmonic Sensing

Session Chair: **Chih-Ming Wang**, National Dong Hwa Univ. (Taiwan)

3:40 pm: **Metal-dielectric resonances in tip silicon metasurface and SERS based nanosensors** (*Invited Paper*), Andrey K. Sarychev, Andrey N. Lagarkov, Irina A. Boginskaya, Institute for Theoretical and Applied Electrodynamics (Russian Federation); Igor V. Bykov, Institute for Theoretical and Applied Electromagnetics (Russian Federation); Andrey V. Ivanov, Ilya A. Ryzhikov, Marina V. Sedova, Institute for Theoretical and Applied Electrodynamics (Russian Federation); Ilya N. Kurochkin, N.M. Emanuel Institute of Biochemical Physics (Russian Federation) . . . . . [10346-12]

4:10 pm: **Design of a colorimetric sensing platform using reflection mode plasmonic color filters**, Renilkumar Mudachathi, Takuo Tanaka, RIKEN (Japan) . . . . . [10346-13]

4:30 pm: **Nanoporous gold decorated with silver nanoparticle as large area efficient SERS substrate**, Eugenio Calandrini, Paolo Ponzellini, Matteo Ardini, Istituto Italiano di Tecnologia (Italy); Sandro Cattarin, CNR-IENI (Italy); Francesco De Angelis, Denis Garoli, Istituto Italiano di Tecnologia (Italy) . . . . . [10346-14]

4:50 pm: **Refractive index sensing with graphene plasmons**, Tobias Wenger, Giovanni Viola, Jari Kinaret, Mikael Fogelström, Philippe Tassin, Chalmers Univ. of Technology (Sweden) . . . . . [10346-15]

5:10 pm: **Labeling and imaging brain tumor cells with Raman tags** (*Invited Paper*), Li-Ching Huang, Yung-Ching Chang, Shuan-Yeh Chen, National Cheng Kung Univ. (Taiwan) . . . . . [10346-16]

**LOCATION: CONV. CTR. ROOM 6A . . SUN 6:00 PM TO 7:50 PM**

## Technology Hot Topics: How Optics and Photonics Drive Innovation

- 6:00 pm to 6:10 pm: **Welcome and Opening Remarks**
- 6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)
- 6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)
- 6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)
- 7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)
- 7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)

## MONDAY 7 AUGUST

**LOCATION: CONV. CTR. ROOM 6A MON 9:00 AM TO 12:00 PM**

## Nanoscience + Engineering Plenary Session

Session Chairs: **Harry A. Atwater Jr.**, California Institute of Technology (USA); **Nikolay I. Zheludev**, Optoelectronics Research Ctr. (United Kingdom)

- 9:15 am: **3D laser nanolithography (Plenary)**, Martin Wegener, Karlsruhe Institut für Technologie (Germany) . . . . . [10354-500]
- Coffee Break . . . . . Mon 10:00 am to 10:30 am
- 10:30 am: **Controlling light at the atomic scale (Plenary)**, F. Javier García de Abajo, ICFO - Institut de Ciències Fotòniques (Spain) . . . . . [10359-500]
- 11:15 am: **Science, engineering, and commercialization of flexible, printable 2D atomic materials and devices (Invited Paper)**, Deji Akinwande, The Univ. of Texas at Austin (USA) . . . . . [10349-500]

Lunch Break . . . . . Mon 12:00 pm to 1:40 pm

### SESSION 5

**LOCATION: CONV. CTR. ROOM 1B . . . . MON 1:40 PM TO 3:30 PM**

## Characterization for Plasmonics

Session Chair: **Vassili Savinov**, Univ. of Southampton (United Kingdom)

- 1:40 pm: **Ultra-thin transition metal nitrides for plasmonic applications (Invited Paper)**, Harsha Reddy, Deesha Shah, Purdue Univ. (USA); Nathaniel Kinsey, Virginia Commonwealth Univ. (USA); Vladimir M. Shalaev, Alexandra Boltasseva, Purdue Univ. (USA) . . . . . [10346-17]
- 2:10 pm: **Light twists around plasmonic nanowires (Invited Paper)**, Laurens Kuipers, Kavli Institute of Nanoscience Delft (Netherlands) . . . . . [10346-18]
- 2:40 pm: **Numerical simulation of nonlocal optical response in light scattering by nanoparticle on the substrate**, Ivan V. Lopushenko, M.V. Lomonosov Moscow SU (Russian Federation) . . . . . [10346-20]
- 3:00 pm: **Revealing the femtosecond dynamics of metallic and molecular nanostructures (Invited Paper)**, Benjamin Stadtmueller, Martin Aeschlimann, Technische Univ. Kaiserslautern (Germany) . . . . . [10346-21]
- Coffee Break . . . . . Mon 3:30 pm to 4:00 pm

### SESSION 6

**LOCATION: CONV. CTR. ROOM 1B . . . . MON 4:00 PM TO 5:20 PM**

## Novel Concepts of Plasmonics

Session Chair: **Alexandra Boltasseva**, Purdue Univ. (USA)

- 4:00 pm: **A link between the superconducting transition and the optical range plasmonics of niobium (Invited Paper)**, Chun Yen Liao, Univ. of Southampton (United Kingdom); Harish N. S. Krishnamoorthy, Nanyang Technological Univ. (Singapore); Vassili Savinov, Jun-Yu Ou, Univ. of Southampton (United Kingdom); Chunli Huang, Giorgio Adamo, Nanyang Technological Univ. (Singapore); Eric Plum, Kevin F. MacDonald, Univ. of Southampton (United Kingdom); Yidong Chong, Cesare Soci, Nanyang Technological Univ. (Singapore); Feodor V. Kusmartsev, Loughborough Univ. (United Kingdom); Din Ping Tsai, National Taiwan Univ. (Taiwan) and Academia Sinica (Taiwan); Nikolay I. Zheludev, Univ. of Southampton (United Kingdom) . . . . . [10346-22]

4:30 pm: **Mimicking general relativity through plasmonic spin hall effect**, Hui Liu, Nanjing Univ. (China) . . . . . [10346-23]

4:50 pm: **Novel platforms for plasmonics (Invited Paper)**, Alejandro Manjavacas, The Univ. of New Mexico (USA) . . . . . [10346-24]

## TUESDAY 8 AUGUST

### SESSION 7

**LOCATION: CONV. CTR. ROOM 1B . . . . TUE 8:20 AM TO 10:10 AM**

## Theory, Simulation, and Design for Plasmonics II

Session Chair: **Nobuyuki Takeyasu**, Okayama Univ. (Japan)

- 8:20 am: **Surface plasmon manipulated Smith-Purcell radiation on metallic periodic and gradient gratings (Invited Paper)**, Yung-Chiang Lan, Yi-Chieh Lai, Bo Han Cheng, Hsin-Yu Kuo, Tzu Cheng Kuang, National Cheng Kung Univ. (Taiwan) . . . . . [10346-25]
- 8:50 am: **Instantaneous spatial variation of Green's tensor in complex nanostructures via eigenmode expansion (Invited Paper)**, Parry Chen, David J. Bergman, Tel Aviv Univ. (Israel); Yonatan Sivan, Ben-Gurion Univ. of the Negev (Israel) . . . . . [10346-26]
- 9:20 am: **Plasmon-exciton energy transfer in nanoparticle-molecule aggregates**, Maicol A. Ochoa, Univ. of Pennsylvania (USA); Abraham Nitzan, Univ. of Pennsylvania (USA) and Tel Aviv Univ. (Israel) . . . . . [10346-27]
- 9:40 am: **Light control metasurfaces with randomly dispersed silver nanoparticles (Invited Paper)**, Masayuki Naya, Takeharu Tani, Hideki Yasuda, Shinya Hakuta, Hirotoshi Yoshizawa, FUJIFILM Advanced Research Labs. (Japan) . . . . . [10346-29]
- Coffee Break . . . . . Tue 10:10 am to 10:40 am

### SESSION 8

**LOCATION: CONV. CTR. ROOM 1B . . TUE 10:40 AM TO 12:00 PM**

## Metamaterials and Metasurfaces I

Session Chair: **Yung-Chiang Lan**, National Cheng Kung Univ. (Taiwan)

- 10:40 am: **New material platforms for dielectric nanoantennas and metasurfaces (Invited Paper)**, Naresh K. Emani, Hanfang Hao, Egor Khaidarov, Ramon Paniagua-Dominguez, Yuan Hsing Fu, Reuben M. Bakker, Vytautas Valuckas, Arseniy I. Kuznetsov, A\*STAR - Data Storage Institute (Singapore) . . . . . [10346-30]
- 11:10 am: **Mode-matched multi-resonant 2.5D plasmonic nano-terrace array for surface-enhanced spectroscopy**, Weihua Zhang, Shuang Zhou, Jie Bian, Nanjing Univ. (China) . . . . . [10346-31]
- 11:30 am: **Multimode metasurfaces: from direct observation of the phase front to advanced optical functions (Invited Paper)**, Chen Yan, Xiaolong Wang, Kuang-Yu Yang, Luc Driencourt, T. V. Raziman, Olivier J. F. Martin, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . . [10346-32]
- Lunch/Exhibition Break . . . . . Tue 12:00 pm to 1:30 pm

### SESSION 9

**LOCATION: CONV. CTR. ROOM 1B . . . . TUE 1:30 PM TO 3:40 PM**

## Plasmonic Applications II

Session Chair: **Weihua Zhang**, Nanjing Univ. (China)

- 1:30 pm: **Surface plasmon polaritons for opto-mechanical control of nanoparticles (Invited Paper)**, Mihail I. Petrov, Aliaksandra Ivinskaya, Natalia Kostina, Andrey A. Bogdanov, ITMO Univ. (Russian Federation); Sergey Sukhov, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Pavel Ginzburg, Tel Aviv Univ. (Israel) and ITMO Univ. (Russian Federation); Alexander S. Shalin, ITMO Univ. (Russian Federation) and Institute of Radio Engineering and Electronics (Russian Federation) and Ulyanovsk State Univ. (Russian Federation) . . . . . [10346-33]
- 2:00 pm: **Tuning the characteristics of surface plasmon polariton nanolasers by tailoring the dispersion relation (Invited Paper)**, Tien-Chang Lu, National Chiao Tung Univ. (Taiwan) . . . . . [10346-34]
- 2:30 pm: **Ultrafast carrier dynamics in bimetallic nanostructures-enhanced methylammonium lead bromide perovskites**, Rizia Bardhan, Holly Zarick, Vanderbilt Univ. (USA); Abdelaziz Boulesbaa, Alexander A. Puzretsky, Oak Ridge National Lab. (USA); Eric M. Talbert, Naiya Soetan, Vanderbilt Univ. (USA); David B. Geoghegan, Oak Ridge National Lab. (USA) . . . . . [10346-35]



# CONFERENCE 10346

2:50 pm: **Enhanced photovoltaics in metamaterial devices using transparent conducting oxides**, Nicholas Sharac, Heungsoo Kim, Chase T. Ellis, Alexander Vlasov, Jeffrey P. Calame, Joshua D. Caldwell, Joseph G. Tischler, Marc Curry, U.S. Naval Research Lab. (USA) . . . . . [10346-36]

3:10 pm: **Infrared localized surface plasmon polariton nanostructures for various applications** (*Invited Paper*), Min-Hsiung Shih, Academia Sinica (Taiwan) . . . . . [10346-37]

Coffee Break . . . . . Tue 3:40 pm to 4:00 pm

## SESSION 10

**LOCATION: CONV. CTR. ROOM 1B . . . . TUE 4:00 PM TO 5:10 PM**

### Nonlinear and Ultrafast Phenomena I

Session Chair: **Min-Hsiung Shih**, Academia Sinica (Taiwan)

4:00 pm: **Plasmonic nonlinear optical components** (*Invited Paper*), Euclides Almeida, Yehiam Prior, Weizmann Institute of Science (Israel) . . . . . [10346-38]

4:30 pm: **Femtosecond controlling mechanism of surface plasmon polaritons**, Kuidong Wang, Long Chen, Haijuan Zhang, Jie Chen, Shanghai Jiao Tong Univ. (China) . . . . . [10346-39]

4:50 pm: **Adiabatic nanofocusing in hybrid gap plasmon waveguides**, Michael P. Nielsen, Lucas Lafone, Aliaksandra Rakovich, Themistoklis P. H. Sidiropoulos, Mohsen Rahmani, Stefan A. Maier, Rupert F. Oulton, Imperial College London (United Kingdom) . . . . . [10346-40]

## WEDNESDAY 9 AUGUST

### SESSION 11

**LOCATION: CONV. CTR. ROOM 1B . . . WED 8:20 AM TO 10:10 AM**

### Radiation Engineering

Session Chair: **Meir Orenstein**, Technion-Israel Institute of Technology (Israel)

8:20 am: **Fabrication and characterization of coupled ensembles of epitaxial quantum dots and metal nanoparticles supporting localized surface plasmons** (*Invited Paper*), Tigran A. Vartanyan, ITMO Univ. (Russian Federation); Vladimir Chaldyshev, Ioffe Institute (Russian Federation) and Saint-Petersburg State Polytechnical Univ. (Russian Federation); Nikita A. Toropov, Igor A. Gladskikh, Polina V. Gladskikh, ITMO Univ. (Russian Federation); Valeriy V. Preobrazhenskiy, Mikhail A. Putyato, Boris R. Semyagin, A.V. Rzhavov Institute of Semiconductor Physics (Russian Federation); Alexander Kosarev, Saint-Petersburg State Polytechnical Univ. (Russian Federation) . . . . . [10346-41]

8:50 am: **In-plane plasmonic antenna arrays resolve nanoscopic phase separation in model lipid membranes**, Pamina Winkler, ICFO - Institut de Ciències Fotòniques (Spain); Raju Regmi, Institut Fresnel, Ctr. National de la Recherche Scientifique (France) and ICFO - Institut de Ciències Fotòniques (Spain) and Aix-Marseille Univ. (France); Valentin Flauraud, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Hervé Rigneault, Institut Fresnel, Ctr. National de la Recherche Scientifique (France) and Aix-Marseille Univ. (France); Jürgen Brugger, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Jérôme Wenger, Institut Fresnel, Ctr. National de la Recherche Scientifique (France) and Ctr. National de la Recherche Scientifique (France); María F. Garcia-Parajo, ICFO - Institut de Ciències Fotòniques (Spain) and Institutíó Catalana de Recerca i Estudis Avançats (Spain) . . . . . [10346-42]

9:10 am: **UV fluorescence modification by aluminum bowtie nanoantennas**, Emmanuel Lotubai, Yunshan Wang, Steve Blair, The Univ. of Utah (USA) [10346-43]

9:30 am: **UV plasmonic enhancement through three dimensional nano-cavity antenna array in aluminum**, Jieying Mao, Yunshan Wang, Steve Blair, The Univ. of Utah (USA) . . . . . [10346-44]

9:50 am: **Tunable coupling between exciton-polariton and exciton-surface plasmon in hybrid systems consisting of VO<sub>2</sub> nanoparticles and quantum dots**, Ali Hatef, Nipissing Univ. (Canada) . . . . . [10346-46]

Coffee Break . . . . . Wed 10:10 am to 10:40 am

### SESSION 12

**LOCATION: CONV. CTR. ROOM 1B . . WED 10:40 AM TO 12:10 PM**

### Fundamentals of Plasmonics I

Session Chair: **Keiji Sasaki**, Hokkaido Univ. (Japan)

10:40 am: **Topological features of plasmon polaritons** (*Invited Paper*), Meir Orenstein, Technion-Israel Institute of Technology (Israel) . . . . . [10346-47]

11:10 am: **Excitation of dark modes in plasmonic clusters by focused cylindrical vector beams**, Tian-Song Deng, John A. Parker, Nolan Shepherd, Norbert F. Scherer, The Univ. of Chicago (USA) . . . . . [10346-48]

11:30 am: **Suppression of infrared absorption in nanostructured metals by controlling Faraday inductance and electron path length**, Sang Eon Han, Samuel M. Clark, The Univ. of New Mexico (USA) . . . . . [10346-49]

11:50 am: **Magneto-plasmonic properties of metal nanostructures as novel functional nanomaterials for bio and gas sensing**, Roberto Rella, Istituto per la Microelettronica e Microsistemi (Italy) . . . . . [10346-50]

Lunch/Exhibition Break . . . . . Wed 12:10 pm to 1:40 pm

### SESSION 13

**LOCATION: CONV. CTR. ROOM 1B . . . WED 1:40 PM TO 3:00 PM**

### Metamaterials and Metasurfaces II

Session Chair: **Shangjr Gwo**, National Tsing Hua Univ. (Taiwan)

1:40 pm: **Functional multi-layered composite metasurfaces** (*Invited Paper*), Yehiam Prior, Euclides Almeida, Weizmann Institute of Science (Israel); Ori Avayu, Tal Ellenbogen, Tel Aviv Univ. (Israel) . . . . . [10346-51]

2:10 pm: **Light tunable fano resonance in metal-dielectric multilayer structures**, Zouheir Sekkat, Moroccan Foundation for Advanced Science, Innovation and Research (Morocco) . . . . . [10346-52]

2:30 pm: **Plasmonic nano-shaping and nano-manipulation** (*Invited Paper*), Keiji Sasaki, Masaki Ide, Shutaro Ishida, Kyosuke Sakai, Hokkaido Univ. (Japan) . . . . . [10346-53]

Coffee Break . . . . . Wed 3:00 pm to 3:30 pm

### SESSION 14

**LOCATION: CONV. CTR. ROOM 1B . . . WED 3:30 PM TO 5:20 PM**

### Novel Material for Plasmonics

Session Chair: **Yehiam Prior**, Weizmann Institute of Science (Israel)

3:30 pm: **Nonlinear optics based on hybrid 2D semiconductor-plasmonic metasurfaces** (*Invited Paper*), Shangjr Gwo, National Tsing Hua Univ. (Taiwan); Jinwei Shi, National Tsing Hua Univ. (Taiwan) and Beijing Normal Univ. (China); Wei-Yun Liang, National Chiao Tung Univ. (Taiwan); Yanrong Wang, National Tsing Hua Univ. (Taiwan) and Beijing Normal Univ. (China); Soniya S. Robert, Chun-An Chen, Cheng-Tse Chou, National Tsing Hua Univ. (Taiwan); Hyeyoung Ahn, National Chiao Tung Univ. (Taiwan); Yi-Hsien Lee, National Tsing Hua Univ. (Taiwan) . . . . . [10346-54]

4:00 pm: **Optical transition and amplification of organic phosphor coupling with graphene plasmon**, Seokho Kim, INHA Univ. (Korea, Republic of); Sunjong Lee, Korea Institute of Industrial Technology (Korea, Republic of); Dong Hyuk Park, INHA Univ. (Korea, Republic of); Bo-Hyun Kim, DGIST (Korea, Republic of) . . . . . [10346-55]

4:20 pm: **Modification of UV surface plasmon resonances in aluminum hole-arrays with graphene**, Yunshan Wang, Sourangsu Banerji, Jieying Mao, Sara Arezoomandan, Berardi Sensale-Rodriguez, Steve Blair, The Univ. of Utah . . . . . [10346-56]

4:40 pm: **Resonant coupling between molecular vibrations and localized surface plasmon resonance of faceted metal oxide nanocrystals**, Ajay Singh, Los Alamos National Lab. (USA); Delia J. Milliron, The Univ. of Texas at Austin (USA) . . . . . [10346-57]

5:00 pm: **Symbiotic plasmonic behavior of bimetallic Ag-Co nanoparticles in the conductive regime**, Abhinav Malasi, Jigxuan Ge, Ritesh Sachan, Humaira Taz, Mikayla Ehrsam, The Univ. of Tennessee Knoxville (USA); Jesse Goodwin, Webb School of Knoxville (USA); Gerd Duscher, The Univ. of Tennessee Knoxville (USA); Hernando Garcia, Southern Illinois Univ. Edwardsville (USA); Ramki Kalyanaraman, The Univ. of Tennessee Knoxville (USA) . . . . . [10346-58]

**LOCATION: CONV. CTR.  
EXHIBIT HALL B2 ..... WED 5:30 PM TO 7:30 PM**

## Posters-Wednesday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Directional and enhanced emission from a fluorescent nano-diamond**, Guowei Lu, Peking Univ. (China) ..... [10346-76]

**Broadband enhancement of infrared absorption using Ag nanocrystals**, Jae Hong Park, National Nanofab Ctr. (Korea, Republic of) ..... [10346-77]

**Resonance modes in unbalanced Mach-Zehnder interferometers embedded in plasmonic waveguides**, Shun Kamada, Toshihiro Okamoto, Masanobu Haraguchi, Tokushima Univ. (Japan) ..... [10346-78]

**Nano-metallic-planar-apex metamaterials**, Dong Wei, Qing Tong, Yu Lei, Huazhong Univ. of Science and Technology (China); Zhaowei Xin, Huazhong Univ. of Science and Technology (China); Xinyu Zhang, Haiwei Wang, Changsheng Xie, Huazhong Univ. of Science and Technology (China) ..... [10346-79]

**Flow-through nanohole array based sensor implemented on a smartphone**, Juan Gomez, Univ. Nacional Autónoma de México (Mexico); Srijit Nair, Queen's Univ. (Canada); Gabriel Ascanio, Univ. Nacional Autónoma de México (Mexico); Carlos Escobedo, Queen's Univ. (Canada) ..... [10346-80]

**Excitation of plasmonic waveguide modes using principles of holography**, Anton I. Ignatov, All-Russia Research Institute of Automatics (Russian Federation); Alexander M. Merzlikin, All-Russia Research Institute of Automatics (Russian Federation) and Institute for Theoretical and Applied Electromagnetics (Russian Federation) ..... [10346-81]

**Using split ring resonators to generate nanoscale hotspot for heat assisted magnetic recording**, Anurup Datta, Xianfan Xu, Purdue Univ. (USA) ... [10346-82]

**Surface plasmons on periodically corrugated surface**, Eugene Chubchev, Igor Nechepurenko, Dukhov Research Institute of Automatics (Russian Federation); Alexey P. Vinogradov, Dukhov Research Institute of Automatics (Russian Federation) and Moscow Institute of Physics and Technology (Russian Federation) and Institute for Theoretical and Applied Electromagnetics (Russian Federation); Alexander A. Lisyansky, Queens College (USA) and The Graduate Ctr. (USA) ..... [10346-83]

**Universal characterization of plasmons satellites in photoemission from nanostructures**, Sandra de Vega, ICFO - Institut de Ciències Fotòniques (Spain); F. Javier García de Abajo, ICFO - Institut de Ciències Fotòniques (Spain) and Institutí Catalana de Recerca i Estudis Avançats (Spain) ..... [10346-85]

**Ultrafast transient dynamics of optical loss mitigation in aggregated gain-plasmon hybrid systems**, Alireza Rahimi Rashed, Bilkent Univ. (Turkey); Mohamed El Kabbash, Case Western Reserve Univ. (USA); Betül Kucukoz, Ankara Univ. (Turkey); Quang Nguuyen, Case Western Reserve Univ. (USA); Ahmet Karatay, Halime Gul Yaglioglu, Ankara Univ. (Turkey); Giuseppe Strangi, Case Western Reserve Univ. (USA) and Univ. della Calabria (Italy); Ekmel Ozbay, Humeyra Caglayan, Bilkent Univ. (Turkey) ..... [10346-86]

**Bright off-axis directional light harvesting with plasmonic corrugations**, Alireza Rahimi Rashed, Bilkent Univ. (Turkey); Hamed Sattari, Ecole Polytechnique Fédérale de Lausanne (Switzerland) and Bilkent Univ. (Turkey); Ekmel Ozbay, Humeyra Caglayan, Bilkent Univ. (Turkey) ..... [10346-87]

**Handheld highly selective plasmonic chem/biosensor using engineered binding proteins for extreme conformational changes**, Derek J. Kosciolk, Ajay V. Sonar, Clarkson Univ. (USA); Lori A. Lepak, Phoebus Optoelectronics, LLC (USA); Peter Schnatz, The City College of New York (USA); Igor Bendoy, Phoebus Optoelectronics, LLC (USA); Mia C. Brown, The City Univ. of New York (USA); Ronald L. Koder, The City College of New York (USA); David T. Crouse, Phoebus Optoelectronics, LLC (USA) ..... [10346-88]

**Ultrafast room temperature dynamic modulation of spontaneous emission in plasmonic nano-cavities**, Mohamed El Kabbash, Case Western Reserve Univ. (USA); Ermanno Miele, National Univ. of Singapore (Singapore); Ahmad K. Fumani, Northwestern Univ. (USA); Michael Wolf, Elisha Haber, Jesse Berezovsky, Case Western Reserve Univ. (USA); Francesco De Angelis, Istituto Italiano di Tecnologia (Italy); Giuseppe Strangi, Case Western Reserve Univ. (USA) ..... [10346-89]

**Dislocated double-layered metal gratings: an efficient unidirectional coupler/beamsplitter**, Yang Shen, Wenjie Liu, XiaoYi She, Chongjun Jin, Sun Yat-Sen Univ. (China) ..... [10346-90]

**Plasmonic Fano resonances in novel nanostructure consisting of two rings with different diameter**, Maojin Yun, Tongtong Liu, Qingdao Univ. (China) ..... [10346-91]

**Infrared detector based on cross-shape nano-antenna**, Maojin Yun, Weipeng Hu, Qingdao Univ. (China) ..... [10346-92]

**Polarizing filter based on anisotropic absorption of graphene ribbons with varying width**, Maojin Yun, Peng Sun, Qingdao Univ. (China) ..... [10346-93]

**Plasmonic waveguides based and optical logic gate**, Sonia Tomer, Nishant Shankhwar, Yogita Kalra, Ravindra K. Sinha, Delhi Technological Univ. (India) ..... [10346-94]

**Tunable sub-10nm metal gap by manipulating PDMS substrate**, Wenjie Liu, Yang Shen, Chongjun Jin, Sun Yat-Sen Univ. (China) ..... [10346-95]

**Polarization-independent multi-peak plasmonic absorber**, Igor Leonardo Gomes de Souza, Vitaly F. Rodriguez-Esquerre, Univ. Federal da Bahia (Brazil) ..... [10346-96]

**Quasi-normal mode expansion of the interaction between light and dispersive nano-objects: a theoretical platform for nanoplasmonics**, Mathias Perrin, Ctr. National de la Recherche Scientifique (France) and Univ. Bordeaux 1 (France) ..... [10346-97]

**Plasmon-driven design of bimetallic catalysts with nanoscale resolution**, Evgenia Kontoleta, Lai-Hung Lai, Erik C. Garnett, FOM Institute for Atomic and Molecular Physics (Netherlands) ..... [10346-98]

**Polarization dependent second harmonic generations of equilateral triangular Au nanorods at localized surface plasmon resonances**, Atsushi Sugita, Hirofumi Yogo, Atsushi Ono, Yoshimasa Kawata, Shizuoka Univ. (Japan) ..... [10346-99]

**Theoretical analysis of near-field distribution by point dipole source located on metallic surface**, Changhoon Park, Jae W. Hahn, Yonsei Univ. (Korea, Republic of) ..... [10346-100]

**Broadband coherent perfect absorber based on symmetric layered thin films using indium tin oxide in epsilon-near-zero wavelength regime**, Tae Young Kim, Seoyoung Kim, Wonyoung Kim, Minsuk Kim, INHA Univ. (Korea, Republic of); Young Chul Jun, Ulsan National Institute of Science and Technology (Korea, Republic of); Chang Kwon Hwangbo, INHA Univ. (Korea, Republic of) . [10346-101]

**Design of dielectric to plasmonic waveguide power transfer couplers**, Emanuela Paranhos Lima, Univ. Federal da Bahia (Brazil) and Co. de Eletricidade do Estado do Bahia (Brazil); Vitaly F. Rodriguez-Esquerre, Univ. Federal da Bahia (Brazil) ..... [10346-102]

**Polarization independent asymmetric light absorption in plasmonic nanostructure**, Davi Franco Rego, Univ. Federal da Bahia (Brazil) and Instituto Federal da Bahia (Brazil); Igor Leonardo Gomes de Souza, Vitaly F. Rodriguez-Esquerre, Univ. Federal da Bahia (Brazil) ..... [10346-103]

**Strong terahertz wave coupling to plasmons in grating-grate GaN HEMT arrays**, Hugo Condoni, Ashish Chanana, The Univ. of Utah (USA); Jimmy Encomendero, Mingda Zhu, Cornell Univ. (USA); Yu Cao, IQE (USA); Ajay Nahata, The Univ. of Utah (USA); Huili Grace Xing, Cornell Univ. (USA); Berardi Sensale-Rodriguez, The Univ. of Utah (USA) ..... [10346-104]

**Surface plasmon-polaritons in graphene: antiferromagnet structure**, Igor V. Bychkov, Dmitry A. Kuzmin, Chelyabinsk State Univ. (Russian Federation) and South Ural State Univ. (Russian Federation); Valentin A. Tolkachev, Ivan Y. Biryukov, Chelyabinsk State Univ. (Russian Federation); Vladimir G. Shavrov, Kotelnikov Institute of Radio Engineering and Electronics of Russian Academy of Sciences (Russian Federation) ..... [10346-105]

**3D multifocal metalens**, Bo-Han Chen, National Taiwan Univ. (Taiwan); Pin Chieh Wu, Cheng Hung Chu, Academia Sinica (Taiwan); Mu-Ku Chen, Wei-Yi Tsai, Jia-Wern Chen, Tsung Lin Chung, National Taiwan Univ. (Taiwan); Din Ping Tsai, Academia Sinica (Taiwan) ..... [10346-106]

**Intrinsic exciton-plasmon coupling at polar surfaces of ZnO in the epsilon-near-zero region**, Munise Cobet, Johannes Kepler Univ. Linz (Austria); Markus R. Wagner, Axel Hoffmann, Technische Univ. Berlin (Germany) ..... [10346-107]

**Wideangle plasmonic filter for visible light applications**, Igor Leonardo Gomes de Souza, Vitaly F. Rodriguez-Esquerre, Univ. Federal da Bahia (Brazil); Davi Franco Rego, Univ. Federal da Bahia (Brazil) and Instituto Federal da Bahia (Brazil) ..... [10346-108]

**Optics of multiple grooves in metal: transition from high scattering to strong absorption**, Enok J. H. Skjølstrup, Thomas M. Sondergaard, Thomas G. Pedersen, Kjeld Pedersen, Aalborg Univ. (Denmark) ..... [10346-109]

**Analysis of near-field thermal energy transfer within nanoparticles**, Anil Yuksel, Michael Cullinan, Edward T. Yu, Jayathi Y. Murthy, The Univ. of Texas at Austin (USA) ..... [10346-110]

**Reducing back scattering of plasmonic scattering nanostructures for enhancing light absorption inside perovskite solar cells**, Omar A. M. Abdelraouf, The American Univ. in Cairo (Egypt) and Ain Shams Univ. (Egypt); Ahmed Shaker, Ain Shams Univ. (Egypt); Nageh K. Allam, The American Univ. in Cairo (Egypt) ..... [10346-111]

**Second harmonic generation from metal-dielectric-semiconductor nanoresonator**, Anatoly Khomenko, Paulina Segovia Olvera, Pamela Mastranzo-Ortega, Elena I. Chaikina, Ctr. de Investigación Científica y de Educación Superior de Ensenada B.C. (Mexico) ..... [10346-112]



# CONFERENCE 10346

**SPP-assisted sub-wavelength reflection-type THz imaging with THz time-domain spectrometer**, Senfeng Lai, Yanghui Wu, Wen Wu, Wenhua Gu, Nanjing Univ. of Science and Technology (China) . . . . . [10346-113]

**Orientational imaging of single plasmonic nanocube using dark-field hyperspectral imaging**, Manas R. Gartia, Nishir S. Mehta, Georgios Veronis, Amirreza Mahigir, Louisiana State Univ. (USA) . . . . . [10346-114]

**Exceptional points in hybridized plasmonic systems**, Ashok Kodigala, Thomas Lepetit, Boubacar Kante, Univ. of California, San Diego (USA) . . . . . [10346-115]

**Investigation of electron and ion beam exposures on a new HfO<sub>2</sub> based hybrid resist**, Paolo Ponzellini, Istituto Italiano di Tecnologia (Italy); Gioia Della Giustina, Univ. degli Studi di Padova (Italy); Matteo Ardini, Eugenio Calandrini, Francesco De Angelis, Istituto Italiano di Tecnologia (Italy); Denis Garoli, Univ. degli Studi di Padova (Italy) . . . . . [10346-116]

**Efficient OAM generation at the nanoscale level by means of plasmonic vortex lens**, Yuri Gorodetski, Ariel Univ. (Israel); Pierfrancesco Zilio, Paolo Ponzellini, Matteo Ardini, Xavier Zambrana-Puyalt, Andrea Jacassi, Eugenio Calandrini, Denis Garoli, Istituto Italiano di Tecnologia (Italy) . . . . . [10346-117]

**Ultrafast energy transfer between excitons and plasmons from weak to ultrastrong coupling regime**, Sinan Balci, Turk Hava Kurumu Univ. (Turkey); Betul Kucukoz, Ankara Univ. (Turkey); Osman Balci, Bilkent Univ. (Turkey); Ahmet Karatay, Ankara Univ. (Turkey); Coşkun Kocabaş, Bilkent Univ. (Turkey); Halime Gul Yaglioglu, Ankara Univ. (Turkey) . . . . . [10346-119]

**Experimentally quantifying losses of Fano resonances**, Junhee Park, Ashok Kodigala, Abdoulaye Ndao, Boubacar Kante, Univ. of California, San Diego (USA) . . . . . [10346-120]

**Photoluminescence of fullerene C<sub>60</sub> thin film in plasmon coupled Au NPs monolayer, C<sub>60</sub> film, Al film nanostructure**, Oleg A. Yeshchenko, Viktor Kozachenko, Nataliya Berezovska, Yurii Liakhov, Taras Shevchenko National Univ. of Kyiv (Ukraine) . . . . . [10346-121]

**Gold nanoparticle plasmon resonance in near-field coupled Au NPs monolayer / dielectric spacer / Al film nanostructure: tuning by variation of spacer thickness**, Oleg A. Yeshchenko, Viktor Kozachenko, Yurii Liakhov, Taras Shevchenko National Univ. of Kyiv (Ukraine); Anatoliy O. Pinchuk, Univ. of Colorado at Colorado Springs (USA) . . . . . [10346-122]

**Plasmonic detection of possible defects in multilayer nanohole array consisting of essential materials in simplified STT-RAM cell**, Parinaz Sadri Moshkenani, Qiancheng Zhao, Mohammad Wahiduzzaman Khan, Ilya N. Krivorotov, Mikael Nilsson, Nader Bagherzadeh, Ozdal Boyraz, Univ. of California, Irvine (USA) . . . . . [10346-123]

## THURSDAY 10 AUGUST

### SESSION 15

**LOCATION: CONV. CTR. ROOM 1B . . . THU 8:20 AM TO 10:00 AM**

## Plasmonic Nanostructures and Nanofabrication II

Session Chair: **Stephan Link**, Rice Univ. (USA)

8:20 am: **Self-assembly for plasmonic structures on large scale** (*Invited Paper*), Nobuyuki Takeyasu, Okayama Univ. (Japan) and RIKEN (Japan) . . . . . [10346-59]

8:50 am: **Plasmonic nanoparticle lithography**, Zhenying Pan, Ye Feng Yu, Vytautas Valuckas, Guillaume G. Vienne, Arseniy I. Kuznetsov, A\*STAR - Data Storage Institute (Singapore) . . . . . [10346-60]

9:10 am: **Electrohydrodynamic flow as a driving force for the directed chemical assembly of plasmonic meta-molecules**, William Thrift, Regina Ragan, Mahsa Darvishzadeh-Varcheie, Filippo Capolino, Univ. of California, Irvine (USA) [10346-62]

9:30 am: **Large-scale nanofabrication of three-dimensional chiral nanostructures using a method combining nanospherical-lens lithography and hole mask lithography** (*Invited Paper*), Chang-Han Wang, Research Ctr. for Applied Sciences - Academia Sinica (Taiwan); Jun-De Wu, National Taiwan Univ. (Taiwan); Zhan-Hong Lin, Yi-Hsin Chien, Chi-Ching Liu, Research Ctr. for Applied Sciences - Academia Sinica (Taiwan); Yang-Fang Chen, National Taiwan Univ. (Taiwan); Yun-Chorng Chang, Research Ctr. for Applied Sciences - Academia Sinica (Taiwan) . . . . . [10346-63]

Coffee Break . . . . . Thu 10:00 am to 10:30 am

### SESSION 16

**LOCATION: CONV. CTR. ROOM 1B . . THU 10:30 AM TO 12:00 PM**

## Nonlinear and Ultrafast Phenomena II

Session Chair: **Hui-Hsin Hsiao**, National Taiwan Univ. (Taiwan)

10:30 am: **Ultrafast nonlinearities of semiconductor metasurfaces** (*Invited Paper*), Maxim R. Shcherbakov, M.V. Lomonosov Moscow SU (Russian Federation) and Cornell Univ. (USA) . . . . . [10346-64]

11:00 am: **Graphene-plasmon lenses for enhanced harmonic generation**, José Ramón Martínez Saavedra, ICFO - Institut de Ciències Fotòniques (Spain); F. Javier García de Abajo, ICFO - Institut de Ciències Fotòniques (Spain) and Institutió Catalana de Recerca i Estudis Avançats (Spain) . . . . . [10346-65]

11:20 am: **Nonlinear plasmonic sensing with nanographene**, Renwen Yu, Joel D. Cox, ICFO - Institut de Ciències Fotòniques (Spain) and Barcelona Institute of Science and Technology (Spain); F. Javier García de Abajo, ICFO - Institut de Ciències Fotòniques (Spain) and Institutió Catalana de Recerca i Estudis Avançats (Spain) . . . . . [10346-66]

11:40 am: **Extreme nonlinear plasmonic phenomena in nanostructured graphene**, Joel D. Cox, Andrea Marini, ICFO - Institut de Ciències Fotòniques (Spain); F. Javier García de Abajo, ICFO - Institut de Ciències Fotòniques (Spain) and Institutió Catalana de Recerca i Estudis Avançats (Spain) . . . . . [10346-67]

Lunch/Exhibition Break . . . . . Thu 12:00 pm to 1:30 pm

### SESSION 17

**LOCATION: CONV. CTR. ROOM 1B . . . . THU 1:30 PM TO 3:20 PM**

## Fundamentals of Plasmonics II

Session Chair: **Yun-Chorng Chang**, Research Ctr. for Applied Sciences - Academia Sinica (Taiwan)

1:30 pm: **Ultrafast dynamics of plasmonic nanostructures** (*Invited Paper*), Stephan Link, Rice Univ. (USA) . . . . . [10346-68]

2:00 pm: **Superresolution imaging of the local density of states in plasmon lattices**, Ke Guo, FOM Institute for Atomic and Molecular Physics (Netherlands); Marc A. Verschuuren, Philips Research (Netherlands); Femius Koenderink, FOM Institute for Atomic and Molecular Physics (Netherlands) . . . . . [10346-69]

2:20 pm: **Necklace beams in engineered nonlinear media** (*Invited Paper*), Natalia M. Litchinitser, Jingbo Sun, Salih Z. Silahli, Wiktor T. Walasik, Univ. at Buffalo (USA); Eric G. Johnson, Clemson Univ. (USA) . . . . . [10346-70]

2:50 pm: **Plasmonic toroidal excitation with engineering metamaterials** (*Invited Paper*), Pin Chieh Wu, Research Ctr. for Applied Sciences - Academia Sinica (Taiwan); Hui-Hsin Hsiao, Chun Yen Liao, Tsung Lin Chung, Pei Ru Wu, National Taiwan Univ. (Taiwan); Vassili Savinov, Nikolay I. Zheludev, Univ. of Southampton (United Kingdom); Din Ping Tsai, Research Ctr. for Applied Sciences - Academia Sinica (Taiwan) . . . . . [10346-71]

Coffee Break . . . . . Thu 3:20 pm to 3:50 pm

### SESSION 18

**LOCATION: CONV. CTR. ROOM 1B . . . . THU 3:50 PM TO 5:40 PM**

## Plasmonic Applications III

Session Chair: **Pin Chieh Wu**, Research Ctr. for Applied Sciences - Academia Sinica (Taiwan)

3:50 pm: **Catching light in-flight: reshaping nanosecond laser pulses using active metasurfaces** (*Invited Paper*), Gennady B. Shvets, Cornell Univ. (USA) . . . . . [10346-72]

4:20 pm: **A three-dimensional negative index medium and a miniature surface plasmon polariton amplitude modulator** (*Invited Paper*), Ta-Jen Yen, National Tsing Hua Univ. (Taiwan); Chu-En Lin, National Chin-Yi Univ. of Technology (Taiwan); Chih-Jen Yu, Chang Gung Univ. (Taiwan); Tsung-Yu Huang, Ting-Tso Yeh, Cheng-Wei Chang, National Tsing Hua Univ. (Taiwan) . . . . . [10346-73]

4:50 pm: **Giant nonlinearity arising from the vertical split ring resonators** (*Invited Paper*), Hui-Hsin Hsiao, Hui Jun Wu, Research Ctr. for Applied Sciences - Academia Sinica (Taiwan); Tsung Lin Chung, Wei-Yi Tsai, Ren Jie Lin, Wei Hou Lee, National Taiwan Univ. (Taiwan); Din Ping Tsai, National Taiwan Univ. (Taiwan) and Research Ctr. for Applied Sciences - Academia Sinica (Taiwan) . . . . . [10346-74]

5:20 pm: **Periodic metal nanoparticle arrays for large-area enhanced light-trapping**, Yassine Ait-El-Aoud, U.S. Army Natick Soldier Research, Development and Engineering Ctr. (USA) and Univ. of Massachusetts Lowell (USA); Alkim Akyurtlu, Univ. of Massachusetts Lowell (USA); Richard M. Osgood III, U.S. Army Natick Soldier Research, Development and Engineering Ctr. (USA) . . . . . [10346-75]

# CONFERENCE 10347

LOCATION: CONV. CTR. ROOM 1A

Sunday–Thursday 6–10 August 2017 • Proceedings of SPIE Vol. 10347

# Optical Trapping and Optical Micromanipulation XIV

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## SUNDAY 6 AUGUST

### SESSION 1

LOCATION: CONV. CTR. ROOM 2 . . . SUN 8:00 AM TO 10:20 AM

### Using the Photonic Toolbox to Study Cells and Their Organelles

Session Chair: **Wolfgang Losert**, Univ. of Maryland, College Park (USA)

8:00 am: **Machined multicore optical fibers for on-chip optical manipulation**, Georgia Anastasiadi, Mark Leonard, Lynn Paterson, William N. MacPherson, Heriot-Watt Univ. (United Kingdom) . . . . . [10347-1]

8:20 am: **Revealing the micromechanics driving cellular division: optical manipulation of force bearing substructure in mitotic cells**, Matthew D. Ono, Daryl Preece, Michelle L. Duquette, Univ. of California, San Diego (USA); Michael W. Berns, Univ. of California, San Diego (USA), Beckman Laser Institute and Medical Clinic (USA) . . . . . [10347-2]

8:40 am: **Assessment of influence of nano-particles on the red blood cell aggregation** (*Invited Paper*), Alexey P. Popov, Tatiana I. Avsievich, Alexander Bykov, Igor Meglinski, Univ. of Oulu (Finland) . . . . . [10347-3]

9:10 am: **Manipulating mutant bacterial cells by tug-of-war multi-trap tweezers**, Josh Lamstein, San Francisco State Univ. (USA); Anna S. Bezryadina, Univ. of California, San Diego (USA) and San Francisco State Univ. (USA); Daryl Preece, Univ. of California, San Diego (USA); Joseph C. Chen, San Francisco State Univ. (USA); Zhigang Chen, San Francisco State Univ. (USA) and Nankai Univ. (China) . . . . . [10347-4]

9:30 am: **Optical measurements of cell adhesion** (*Invited Paper*), Josef A. Käs, Steffen Grosser, Univ. Leipzig (Germany) . . . . . [10347-5]

10:00 am: **Hydrodynamic stretching for analysing urological cancer cells**, Yuri Belotti, Tianjun Huang, Stephen J. McKenna, Ghulam Nabi, David McGloin, Univ. of Dundee (United Kingdom) . . . . . [10347-6]

Coffee Break . . . . . Sun 10:20 am to 10:50 am

Sessions 2A and 2B run concurrently.

### SESSION 2A

LOCATION: CONV. CTR. ROOM 1A . . SUN 9:20 AM TO 11:50 AM

### Shaped Light and Scattering Media

Session Chair: **Gabriel C. Spalding**, Illinois Wesleyan Univ. (USA)

9:20 am: **Coherent control of light transmission and focusing in strong scattering medium** (*Invited Paper*), Hui Cao, Yale Univ. (USA) . . . . . [10347-7]

9:50 am: **Gaussian vs. Bessel light-sheets: performance analysis in live large sample imaging** (*Invited Paper*), Michael P. MacDonald, Sascha L. Reidt, Ricardo B. C. Correia, Cornelis J. Weijer, Univ. of Dundee (United Kingdom) . . . . . [10347-9]

Coffee Break . . . . . Sun 10:20 am to 10:50 am

10:50 am: **3D microscopy with scattering media** (*Invited Paper*), Laura Waller, Univ. of California, Berkeley (USA) . . . . . [10347-10]

11:20 am: **Sculptured light for control and measurement on microscales** (*Invited Paper*), Alexander B. Stilgoe, Anatolii V. Kashchuk, Timo A. Nieminen, Halina H. Rubinsztein-Dunlop, The Univ. of Queensland (Australia) . . . . . [10347-11]

Lunch Break . . . . . Sun 11:50 am to 1:20 pm

### SESSION 2B

LOCATION: CONV. CTR. ROOM 2 . . . SUN 10:50 AM TO 11:50 AM

### Optical Neuroscience

Session Chair: **Daryl Preece**, Univ. of California, San Diego (USA)

10:50 am: **High fidelity beam shaping for optical neuroscience**, Wolfgang Losert, Mitchell Weikert, Samira Aghayee, Univ. of Maryland, College Park (USA) [10347-12]

11:10 am: **Probing mechanobiology with laser-induced shockwaves**, Christopher Carmona, Daryl Preece, Veronica Gomez-Godinez, Linda Z. Shi, Michael W. Berns, Univ. of California, San Diego (USA) . . . . . [10347-13]

11:30 am: **Printing hydrogel based living neural networks**, Anna M. Linnenberger, Meadowlark Optics, Inc. (USA) . . . . . [10347-14]

Lunch Break . . . . . Sun 11:50 am to 1:20 pm



Sessions 3A and 3B run concurrently.

## SESSION 3A

LOCATION: CONV. CTR. ROOM 1A . . . . SUN 1:20 PM TO 3:10 PM

### Raman Fingerprints, Nonlinear Responses, and Plasmonic Traps

Session Chair: **Halina H. Rubinsztein-Dunlop**, The Univ. of Queensland (Australia)

1:20 pm: **Nanohole optical tweezers in heterogeneous mixture analysis**, Reuven Gordon, Gurunatha K. Laxminarayana, Noa Hacohen, Timothy S. DeWolf, Univ. of Victoria (Canada) . . . . . [10347-15]

1:40 pm: **Optical trapping and Raman spectroscopy of single nanostructures using standing-wave Raman tweezers**, Mu-ying Wu, Lin He, Gui-hua Chen, Guang Yang, Dongguan Univ. of Technology (China); Yong-Qing Li, East Carolina Univ. (USA) and Dongguan Univ. of Technology (China) . . . . . [10347-16]

2:00 pm: **Interfacial resistances and other thermal effects in plasmonic optical tweezers and their implications for nano-biomolecule manipulation**, Steven Jones, Pawel Karpinski, Daniel Andr n, Mikael K ll, Chalmers Univ. of Technology (Sweden) . . . . . [10347-17]

2:20 pm: **Probing of biomolecular films with colloidal nanomotors**, Hana Sipova, Lei Shao, Nils Odebo L nk, Mikael K ll, Chalmers Univ. of Technology (Sweden) . . . . . [10347-18]

2:40 pm: **Electrostrictive in-situ nanoparticle detection with coherent Rayleigh-Brillouin scattering (Invited Paper)**, Alexandros Gerakis, Princeton Plasma Physics Lab. (USA); Mikhail N. Shneider, Princeton Univ. (USA); Yevgeny Raitses, Brentley C. Stratton, Princeton Plasma Physics Lab. (USA) . . . . . [10347-19]

Coffee Break . . . . . Sun 3:10 pm to 3:30 pm

## SESSION 3B

LOCATION: CONV. CTR. ROOM 2 . . . . .SUN 1:20 PM TO 3:00 PM

### Laser Beam Shaping I

Session Chairs: **Alexander V. Laskin**, AdlOptica Optical Systems GmbH (Germany); **Angela Dudley**, CSIR National Laser Ctr. (South Africa)

1:20 pm: **Reflective inverse diffusion method for dynamic compensation of small optical system perturbations**, Kenneth W. Burgi, Michael Marciniak, Air Force Institute of Technology (USA) . . . . . [10347-20]

1:40 pm: **Beam shaping by the transport-of-intensity equation**, Soheil Mehrabkhani, Thomas Schneider, Technische Univ. Braunschweig (Germany) . . . . . [10347-21]

2:00 pm: **Optimal trapping beam for spherical micro-particles**, Michael Mazilu, Univ. of St. Andrews (United Kingdom). . . . . [10347-22]

2:20 pm: **Multi-focus beam shaping of high power multimode lasers**, Alexander V. Laskin, AdlOptica Optical Systems GmbH (Germany); Joerg Volpp, Bremer Institut f r angewandte Strahltechnik GmbH (Germany); Vadim V. Laskin, AdlOptica Optical Systems GmbH (Germany); Aleksei B. Ostrun, ITMO Univ. (Russian Federation) . . . . . [10347-23]

2:40 pm: **Generation of arbitrary vector beams**, Benjamin Perez-Garcia, Tecnol gico de Monterrey (Mexico); Carlos L pez-Mariscal, Underwater Photonics (Mexico); Raul I. Hernandez-Aranda, Julio C. Guti rrez-Vega, Tecnol gico de Monterrey (Mexico) . . . . . [10347-24]

Coffee Break . . . . . Sun 3:00 pm to 3:30 pm

Sessions 4A and 4B run concurrently.

## SESSION 4A

LOCATION: CONV. CTR. ROOM 1A . . . SUN 3:30 PM TO 6:00 PM

### From Cells to Single-Molecule Manipulation and Study

Session Chair: **Michael W. Berns**, Beckman Laser Institute and Medical Clinic (USA)

3:30 pm: **Single-cell and single-molecule biosensing with optical nanosensors (Invited Paper)**, Qimin Quan, The Rowland Institute at Harvard (USA) . . . [10347-25]

4:00 pm: **An ultra-fast EOD-based force-clamp detects rapid biomechanical transitions**, Michael S. Woody, E. Michael Ostap, Yale E. Goldman, Pennsylvania Muscle Institute (USA) . . . . . [10347-26]

4:20 pm: **Jamming of a single DNA molecule during nanoscale 3D confinement with attractive self interactions**, Douglas E. Smith, Nicholas A. Keller, Univ. of California, San Diego (USA). . . . . [10347-27]

4:40 pm: **Evanescence single-molecule biosensing with quantum limited precision**, Nicolas P. Mauranyapin, Lars Madsen, Michael A. Taylor, Muhammad Waleed, Warwick P. Bowen, The Univ. of Queensland (Australia) . . . . . [10347-28]

5:00 pm: **Trapping-assisted analysis of single particles using integrated nanopores (Invited Paper)**, Holger Schmidt, Mahmud Rahman, Mark Harrington, Univ. of California, Santa Cruz (USA); Matthew A. Stott, Aaron R. Hawkins, Brigham Young Univ. (USA). . . . . [10347-29]

5:30 pm: **Direct measurement of a nonequilibrium system entropy using a feedback trap (Invited Paper)**, Momcilo Gavrilov, John Bechhoefer, Simon Fraser Univ. (Canada); Raphael Chetrite, Univ. de Nice Sophia Antipolis (France)[10347-30]

## SESSION 4B

LOCATION: CONV. CTR. ROOM 2 . . . . .SUN 3:30 PM TO 5:10 PM

### Laser Beam Shaping II

Session Chairs: **Alexander V. Laskin**, AdlOptica Optical Systems GmbH (Germany); **Angela Dudley**, CSIR National Laser Ctr. (South Africa)

3:30 pm: **Programmable diffractive optic for multi-beam processing: applications and limitations**, Patrick Gretzki, Arnold Gillner, Fraunhofer-Institut f r Lasertechnik (Germany). . . . . [10347-31]

3:50 pm: **Vectorial field propagation through high NA objectives using polarized Gaussian beam decomposition**, Norman Girma Worku, Herbert Gross, Friedrich-Schiller-Univ. Jena (Germany) . . . . . [10347-33]

4:10 pm: **Fraunhofer and Fresnel diffraction pattern of a Mathieu-Gauss beam through rectangular aperture**, Cristian Hernando Acevedo C ceres, Yezid Torres Moreno, Univ. Industrial de Santander (Colombia); Angela M. Guzm n, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [10347-34]

4:30 pm: **Arbitrary manipulation of micro-particles in three dimensions by steering of multiple orbital angular momentum modes**, Ting Xie, Huihui Wang, Fei Yuan, Shengqian Chang, Peng Sun, Siman Zhang, Huaye Li, Zhenrong Zheng, Zhejiang Univ. (China) . . . . . [10347-35]

4:50 pm: **Propagation of transverse linear and orbital angular momenta of beam waves**, Mikhail I. Charnotskii, Consultant (USA) . . . . . [10347-36]

**LOCATION: CONV. CTR. ROOM 6A . . SUN 6:00 PM TO 7:50 PM**

## Technology Hot Topics: How Optics and Photonics Drive Innovation

- 6:00 pm to 6:10 pm: **Welcome and Opening Remarks**
- 6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)
- 6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)
- 6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)
- 7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)
- 7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)

## MONDAY 7 AUGUST

**LOCATION: CONV. CTR. ROOM 6A MON 9:00 AM TO 12:00 PM**

## Nanoscience + Engineering Plenary Session

Session Chairs: **Harry A. Atwater Jr.**, California Institute of Technology (USA); **Nikolay I. Zheludev**, Optoelectronics Research Ctr. (United Kingdom)

- 9:15 am: **3D laser nanolithography (Plenary)**, Martin Wegener, Karlsruher Institut für Technologie (Germany) . . . . . [10354-500]
- Coffee Break . . . . . Mon 10:00 am to 10:30 am
- 10:30 am: **Controlling light at the atomic scale (Plenary)**, F. Javier García de Abajo, ICFO - Institut de Ciències Fotòniques (Spain) . . . . . [10359-500]
- 11:15 am: **Science, engineering, and commercialization of flexible, printable 2D atomic materials and devices (Invited Paper)**, Deji Akinwande, The Univ. of Texas at Austin (USA) . . . . . [10349-500]

Lunch Break . . . . . Mon 12:00 pm to 1:20 pm

## SESSION 5

**LOCATION: CONV. CTR. ROOM 1A . . . MON 1:20 PM TO 3:30 PM**

## Celebrating 25th Anniversary: Orbital Angular Momentum of Light and Transformation of LG Laser Modes

Session Chair: **Halina H. Rubinsztein-Dunlop**, The Univ. of Queensland (Australia)

- 1:20 pm: **Angular momentum exchange between light and small particles**, Masud Mansuripur, College of Optical Sciences, The Univ. of Arizona (USA) . . . . . [10347-37]
- 1:40 pm: **Hybrid entanglement for quantum communication and information applications**, Isaac M. Nape, Bienvenu I. Ndagano, Univ. of the Witwatersrand (South Africa); Benjamin Perez-Garcia, Tecnológico de Monterrey (Mexico); Stirling Scholes, Melanie McLaren, Univ. of the Witwatersrand (South Africa); Raul I. Hernandez-Aranda, Tecnológico de Monterrey (Mexico); Filippus S. Roux, National Metrology Institute of South Africa (South Africa); Thomas Konrad, Univ. of KwaZulu-Natal (South Africa); Andrew Forbes, Univ. of the Witwatersrand (South Africa) . . . . . [10347-38]
- 2:00 pm: **Dynamics of optically levitated microparticles in vacuum placed in 2D and 3D optical potentials possessing orbital angular momentum**, Yoshihiko Arita, Michael Mazilu, Mingzhou Chen, Tom Vetterburg, Juan M. Auñón García, Univ. of St. Andrews (United Kingdom); Ewan Wright, College of Optical Sciences, The Univ. of Arizona (USA); Kishan Dholakia, Univ. of St. Andrews (United Kingdom) . . . . . [10347-39]
- 2:20 pm: **Highly birefringent, liquid-crystalline microspheres are tuneable rotational probes for optical tweezers**, Avin Ramaiya, Basudev Roy, Erik Schäffer, Eberhard Karls Univ. Tübingen (Germany) . . . . . [10347-40]
- 2:40 pm: **Elliptical orbits of microparticles driven by an evanescent field (Invited Paper)**, Lulu Liu, Harvard School of Engineering and Applied Sciences (USA); Andrea Di Donato, Univ. Politecnica delle Marche (Italy) . . . . . [10347-41]
- 3:10 pm: **Speckles of an optical vortex and a perfect optical vortex: a comparative morphological study**, Cristian Hernando Acevedo Cáceres, Univ. Industrial de Santander (Colombia); Sergey Sukhov, Aristide Dogariu, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [10347-42]
- Coffee Break . . . . . Mon 3:30 pm to 4:00 pm

## SESSION 6

**LOCATION: CONV. CTR. ROOM 1A . . . MON 4:00 PM TO 5:30 PM**

## Enhanced Sensitivity, Resolution, and Depth

Session Chair: **Reuven Gordon**, Univ. of Victoria (Canada)

- 4:00 pm: **Avoiding induced heating in temperature sensing by optical trapping**, Patricia Haro-González, Paloma Rodriguez Sevilla, Univ. Autónoma de Madrid (Spain); Yuhai Zhang, National Univ. of Singapore (Singapore); Francisco Sanz-Rodríguez, Francisco F. Jaque, José García Solé, Univ. Autónoma de Madrid (Spain); Xiaogang Liu, National Univ. of Singapore (Singapore); Daniel Jaque, Univ. Autónoma de Madrid (Spain) . . . . . [10347-43]
- 4:20 pm: **High-speed position and force measurements in optical tweezers**, Anatolii V. Kashchuk, Alexander B. Stilgoe, Timo A. Nieminen, Halina H. Rubinsztein-Dunlop, The Univ. of Queensland (Australia) . . . . . [10347-44]
- 4:40 pm: **Multi-modal microscopy platform including optical tweezers and the need to perform spherical wave vectors decompositions for optical force and signal intensity calculations (Invited Paper)**, Carlos Lenz Cesar, Univ. Federal do Ceara (Brazil) and Instituto de Física "Gleb Wataghin" (Brazil); Wendel L. Moreira, Petrobras (Brazil); Antonio A. R. Neves, Univ. Federal do ABC (Brazil); André A. de Thomaz, Univ. Estadual de Campinas (Brazil); Diogo B. Almeida, Univ. of Michigan (USA); Adriana Fontes, Univ. Federal de Pernambuco (Brazil); Hernandes F. Carvalho, Vitor B. Pelegati, Univ. Estadual de Campinas (Brazil) . . . . . [10347-45]
- 5:10 pm: **Optical trapping of rare earth-doped nanorods using an optical fiber tweezers approach**, Jochen Fick, Institut NEEL (France); Godefroy Leménager, Maud Thiriet, Lahilil Khalid, Thierry Gacoin, Ecole Polytechnique (France); Francisco Valdivia-Valero, Gérard Colas des Francs, Univ. de Bourgogne (France) [10347-122]

## TUESDAY 8 AUGUST

## SESSION 7

**LOCATION: CONV. CTR. ROOM 1A . . . TUE 8:20 AM TO 10:10 AM**

## Special Session Honoring Monika Ritsch-Marte

Session Chairs: **Gabriel C. Spalding**, Illinois Wesleyan Univ. (USA); **Monika Ritsch-Marte**, Medizinische Univ. Innsbruck (Austria)

- 8:20 to 8:40: **Introduction by Halina Rubinsztein-Dunlop**, The Univ. of Queensland (Australia)
- 8:40 am: **Hybrid 3D optical and acoustic trapping (Invited Paper)**, Monika Ritsch-Marte, Medizinische Univ. Innsbruck (Austria) . . . . . [10347-46]
- 9:10 am: **Optically enhanced acoustophoresis**, Michael P. MacDonald, Craig McDougall, Paul O'Mahoney, Univ. of Dundee (United Kingdom); Alan McGuinn, Nicholas A. Willoughby, Heriot-Watt Univ. (United Kingdom); Yongqiang Qiu, Univ. of Glasgow (United Kingdom); Christine E. M. Demore, Univ. of Toronto (Canada) . . . . . [10347-47]
- 9:30 am: **Simultaneous optical trapping and imaging in axial plane**, Yansheng Liang, Ming Lei, Zhiliang Cao, Yue Wang, Shaohui Yan, Manman Li, Dan Dan, Yanan Cai, Zhaojun Wang, Baoli Yao, Xi'an Institute of Optics and Precision Mechanics, CAS (China) . . . . . [10347-48]
- 9:50 am: **Optical vortex response to introduced phase objects**, Mateusz M. Sztakowski, Agnieszka Popiolek-Masajada, Jan Masajada, Wroclaw Univ. of Science and Technology (Poland) . . . . . [10347-49]
- Coffee Break . . . . . Tue 10:10 am to 10:40 am

## SESSION 8

**LOCATION: CONV. CTR. ROOM 1A . . . TUE 10:40 AM TO 12:10 PM**

## Tutorial on Optomechanics

Session Chair: **Kishan Dholakia**, Univ. of St. Andrews (United Kingdom)

- 10:40 am: **Tutorial on optomechanics**, James Millen, Univ. Wien (Austria) . . . . . [10347-50]
- Lunch/Exhibition Break . . . . . Tue 12:10 pm to 1:40 pm



# CONFERENCE 10347

## SESSION 9

LOCATION: CONV. CTR. ROOM 1A . . . TUE 1:40 PM TO 3:40 PM

### Toward (or in) the Quantum Limit of Optomechanics I

Session Chair: **James Millen**, Univ. Wien (Austria)

1:40 pm: **Laser refrigeration of levitated nanocrystals**, A. T. M. Anishur Rahman, Peter F. Barker, Univ. College London (United Kingdom) . . . . . [10347-51]

2:00 pm: **Optical and magnetic measurements of a frequency-locked graphene nanoplatelet in a quadrupole ion trap**, Joyce E. Coppock, Univ. of Maryland, College Park (USA); Pavel Nagornykh, The Univ. of Texas at Austin (USA); Jacob P. J. Murphy, Bruce E. Kane, Univ. of Maryland, College Park (USA) . . . . . [10347-52]

2:20 pm: **Optomechanics of a levitated helium drop** (*Invited Paper*), Florian Marquardt, Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany) . . . [10347-53]

2:50 pm: **Cooperative effects between color centers in diamond: applications to optical tweezers and optomechanics** (*Invited Paper*), Mathieu L. Juan, Institut für Quantenoptik und Quanteninformation (Austria) . . . . . [10347-54]

3:20 pm: **Coherent control of single spins in optically levitated nanocrystals**, Robert M. Pettit, Univ. of Rochester (USA); Levi P. Neukirch, Los Alamos National Lab. (USA); Yi Zhang, A. Nick Vamivakas, Univ. of Rochester (USA) . . . . . [10347-55]

Coffee Break . . . . . Tue 3:40 pm to 4:00 pm

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## SESSION 10

LOCATION: CONV. CTR. ROOM 1A . . . TUE 4:00 PM TO 5:30 PM

### Toward (or in) the Quantum Limit of Optomechanics II

Session Chair: **Florian Marquardt**, Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany)

4:00 pm: **MilliKelvin cooling of the center of mass motion of a levitated nanoparticle**, Nathanaël P. Bullier, Antonio Pontin, Peter F. Barker, Univ. College London (United Kingdom) . . . . . [10347-56]

4:20 pm: **Optical trapping and control of nanospheres inside hollow core photonic crystal fibers**, David Grass, Nikolai Kiesel, Univ. Wien (Austria); Daniel R. Ladiges, John E. Sader, The Univ. of Melbourne (Australia); Markus Aspelmeyer, Univ. Wien (Austria) . . . . . [10347-57]

4:40 pm: **Developing optomechanical inertial sensors using whispering gallery mode resonances** (*Invited Paper*), Ying Lia Li, Peter F. Barker, Univ. College London (United Kingdom) . . . . . [10347-58]

5:10 pm: **Rotational optomechanics with levitated nanorods**, Stefan Kuhn, Univ. Wien (Austria); Benjamin A. Stickler, Univ. Duisburg-Essen (Germany); Alon Kosloff, Fernando Patolsky, Tel Aviv Univ. (Israel); Klaus Hornberger, Univ. Duisburg-Essen (Germany); Markus Arndt, James Millen, Univ. Wien (Austria) . . . . . [10347-59]

LOCATION: CONV. CTR. ROOM 1A . . . . . 5:30 PM TO 6:00 PM

### OTOM Conference Photo

All Optical Trapping and Micromanipulation conference participants are encouraged to gather for a group photo at the end of the day.

LOCATION: CONV. CTR. ROOM 1A . . . . . 6:00 PM TO 10:00 PM

### OTOM Conference Dinner

Conference attendees are welcome to enjoy dinner together. A sign-up sheet and details will be made available at the conference.

## WEDNESDAY 9 AUGUST

## SESSION 11

LOCATION: CONV. CTR. ROOM 1A . WED 8:00 AM TO 10:30 AM

### Microrheology / Photothermal Probes

Session Chairs: **H. Daniel Ou-Yang**, Lehigh Univ. (USA); **Gabriel C. Spalding**, Illinois Wesleyan Univ. (USA)

8:00 am: **Translational and rotational motion of Janus particles trapped in optical tweezers** (*Invited Paper*), Honglian Guo, South China Univ. of Technology (USA); Jing Liu, Institute of Physics, Chinese Academy of Sciences (China); Baoqin Chen, South China Univ. of Technology (China) . . . . . [10347-60]

8:30 am: **Maximum likelihood estimation in optical tweezers-based force sensing**, Robert Meissner, Cornelia Denz, Westfälische Wilhelms-Univ. Münster (Germany) . . . . . [10347-61]

8:50 am: **Dynamics of a driven two-particle system coupled by hydrodynamic interactions in optical tweezers**, Shuvojit Paul, Indian Institute of Science Education and Research Kolkata (India); Abhrajit Laskar, Ronjoy Adhikari, Institute of Mathematical Sciences (India); Ayan Banerjee, Indian Institute of Science Education and Research Kolkata (India) . . . . . [10347-62]

9:10 am: **Optically driven colloidal microscopic Taylor-Couette cell**, Antonio Ortiz-Ambriz, Pietro Tierno, Univ. de Barcelona (Spain) . . . . . [10347-63]

9:30 am: **Optical torques on upconverting particles for intracellular microrheometry**, Paloma Rodriguez Sevilla, Univ. Autónoma de Madrid (Spain); Yuhai Zhang, National Univ. of Singapore (Singapore); Nuno de Sousa, Manuel I. Marqués, Francisco Sanz-Rodríguez, Daniel Jaque, Univ. Autónoma de Madrid (Spain); Xiaogang Liu, National Univ. of Singapore (Singapore); Patricia Haro-González, Univ. Autónoma de Madrid (Spain) . . . . . [10347-64]

9:50 am: **Optical measurements of nanoparticle vibrations for fluid mechanics on the nanoscale**, Matthew A. Pelton, Univ. of Maryland, Baltimore County (USA) . . . . . [10347-65]

10:10 am: **Absolute temperature measurements in optical tweezers by synchronized position and force measurement**, Anatolii V. Kashchuk, Alexander B. Stilgoe, Timo A. Nieminen, Halina H. Rubinsztein-Dunlop, The Univ. of Queensland (Australia) . . . . . [10347-66]

Coffee Break . . . . . Wed 10:30 am to 10:50 am

## SESSION 12

LOCATION: CONV. CTR. ROOM 1A . . . WED 10:50 AM TO 12:00 PM

### Trapping at Extremes (“Gonzo Trapping”)

Session Chair: **Daryl Preece**, Univ. of California, San Diego (USA)

10:50 am: **Flow through oil nanothreads** (*Invited Paper*), Colin Bain, Alex Hargreaves, Joshua Bull, Durham Univ. (United Kingdom); Buddhapriya Chakrabarti, Sheffield Univ. (United Kingdom) . . . . . [10347-67]

11:20 am: **Development of a Bessel-beam-based optical guide of aerosolized nanoparticles for femtosecond x-ray diffractive imaging**, Andrei V. Rode, Woei Ming Lee, The Australian National Univ. (Australia); Salah Awel, Xiaoyan Sun, Daniel Horke, Ctr. for Free-Electron Laser Science (Germany); Richard A. Kirian, Arizona State Univ. (USA); Jochen Küpper, Henry N. Chapman, Ctr. for Free-Electron Laser Science (Germany) . . . . . [10347-68]

11:40 am: **Optical fabrication and trapping of superconducting nanoparticles in superfluid helium**, Masaaki Ashida, Yosuke Minowa, Osaka Univ. (Japan); Mitsutaka Kumakura, Univ. of Fukui (Japan); Yuta Takahashi, Fusakazu Matsushima, Yoshiki Moriwaki, Univ. of Toyama (Japan) . . . . . [10347-69]

Lunch/Exhibition Break . . . . . Wed 12:00 pm to 1:30 pm

## SESSION 13

LOCATION: CONV. CTR. ROOM 1A . . . WED 1:30 PM TO 3:40 PM

### Information, Thermodynamics, and the Statistical Mechanics of Small Systems I

Session Chair: **Alexander B. Stilgoe**, The Univ. of Queensland (Australia)

1:30 pm: **Thermodynamics of radiation pressure and photon momentum**, Masud Mansuripur, College of Optical Sciences, The Univ. of Arizona (USA) . . . . . [10347-70]

1:50 pm: **Thermophoretic levitation of generic objects**, Cheng Chin, Frankie Fung, Benjamin Foster, Mykhaylo Usatyuk, B. J. DeSalvo, Anita Gaj, The Univ. of Chicago (USA) . . . . . [10347-71]

2:10 pm: **Hopping hither and thither-examining Kramer’s law and stochastic resonance with a levitated nanoparticle** (*Invited Paper*), Jan Gieseler, Harvard Univ. (USA) and ICFO - Institut de Ciències Fotòniques (Spain); Francesco Ricci, ICFO - Institut de Ciències Fotòniques (Spain); Loic Rondin, ETH Zurich (Switzerland); Raúl A. Rica, ICFO - Institut de Ciències Fotòniques (Spain); Marko Spasenovic, ICFO - Institut de Ciències Fotòniques (Spain) and Univ. of Belgrade (Serbia); Christoph Dellago, Univ. Wien (Austria); Lukas Novotny, ETH Zurich (Switzerland); Romain Quidant, ICFO - Institut de Ciències Fotòniques (Spain) and Institutió Catalana de Recerca i Estudis Avançats (Spain) . . . . . [10347-72]

2:40 pm: **A realization of an information machine with temporal correlations** (*Invited Paper*), Yael Roichman, Tamir Admon, Tel Aviv Univ. (Israel); Saar Rahav, Technion-Israel Institute of Technology (Israel) . . . . . [10347-73]

3:10 pm: **New insights into barrier crossing processes using driven optical matter** (*Invited Paper*), Norbert F. Scherer, The Univ. of Chicago (USA) . [10347-74]

Coffee Break . . . . . Wed 3:40 pm to 4:00 pm

## SESSION 14

LOCATION: CONV. CTR. ROOM 1A .. WED 4:00 PM TO 5:30 PM

### Information, Thermodynamics, and the Statistical Mechanics of Small Systems II

Session Chair: **Gabriel C. Spalding**, Illinois Wesleyan Univ. (USA)

4:00 pm: **Particle trapped by a non-conservative force under Brownian motion**, Jack Ng, Hong Kong Baptist Univ. (Hong Kong, China); Yongyin Cao, Hong Kong Baptist Univ. (Hong Kong, China) and Harbin Institute of Technology (China); Xiao Li, Hong Kong Baptist Univ. (Hong Kong, China); Che Ting Chan, Hong Kong Univ. of Science and Technology (Hong Kong, China) ..... [10347-75]

4:20 pm: **Short-time Brownian motion** (*Invited Paper*), Mark G. Raizen, The Univ. of Texas at Austin (USA) ..... [10347-76]

4:50 pm: **High bandwidth optical tracking of micro/nanoparticles**, Muhammad Waleed, Lars Madsen, Catxere Andrade Casacio, Michael A. Taylor, Nicolas P. Mauranyapin, Warwick P. Bowen, Queensland Quantum Optics Lab. (Australia) ..... [10347-77]

5:10 pm: **Manipulating single and multiple biomolecules with dynamic temperature fields**, Tobias Thalheim, Univ. Leipzig (Germany); Katrin Günther, TU Dresden (Germany); Michael Mertig, TU Dresden (Germany) and Kurt-Schwabe-Institut für Mess- und Sensortechnik e.V. (Germany); Frank Cichos, Univ. Leipzig (Germany) ..... [10347-78]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 ..... WED 5:30 PM TO 7:30 PM

### Posters-Wednesday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Diffraction optical vortices by an angular aperture**, Angela M. Guzmán, Univ. Nacional de Colombia (Colombia); Paula López, Jesús Herman Mendoza Castro, Zayda Paola Reyes Quijano, Yezid Torres Moreno, Univ. Industrial de Santander (Colombia) ..... [10347-100]

**Angle-dependent rotation of calcite in elliptically polarized light**, Catherine M. Herne, Natalie A. Cartwright, Matthew T. Cattani, State Univ. of New York at New Paltz (USA) ..... [10347-101]

**Uncovering the radial modes of vortex beams**, Bereneice Sephton, Council for Scientific and Industrial Research (South Africa) and Univ. of the Witwatersrand (South Africa); Angela Dudley, Council for Scientific and Industrial Research (South Africa); Andrew Forbes, Univ. of the Witwatersrand (South Africa) ..... [10347-102]

**Progress on optical trapping assay to measure DNA folding pathways in sperm**, Ashley R. Carter, Luka Devenica, Amherst College (USA) ..... [10347-103]

**Investigation on unwinding motion of papillomavirus, E1 helicase with force spectroscopy**, Sihwa Joo, Korea Research Institute of Bioscience and Biotechnology (Korea, Republic of); Seung-Jae Lee, Seoul National Univ. (Korea, Republic of); Bong Hyun Chung, Korea Research Institute of Bioscience and Biotechnology (Korea, Republic of); Arne Stenlund, Cold Spring Harbor Lab. (USA); Mina Lee, Korea Research Institute of Standards and Science (Korea, Republic of); Tai Hwan Ha, Korea Research Institute of Bioscience and Biotechnology (Korea, Republic of) ..... [10347-104]

**Photoionization of water molecules by a train of attosecond pulses assisted by a near-infrared laser: delay and polarization control**, Lara Martini, Diego I. R. Boll, Omar A. Fojón, Consejo Nacional de Investigaciones Científicas y Técnicas (Argentina) ..... [10347-105]

**A single-molecule study of mutual relation between the vaccinia virus E3L protein and Z-DNA by magnetic tweezers**, Mina Lee, Korea Research Institute of Standards and Science (Korea, Republic of); Sihwa Joo, Bong Hyun Chung, Korea Research Institute of Bioscience and Biotechnology (Korea, Republic of) ..... [10347-106]

**Super-resolution plasmonic tweezers utilizing optical nonlinearity**, Masayuki Hoshina, Nobuhiko Yokoshi, Hajime Ishihara, Osaka Prefecture Univ. (Japan) ..... [10347-107]

**Manipulation of micro-bubbles in water by CW laser**, Peter P. Maksimyak, Oleg V. Angelsky, Andrew P. Maksimyak, Elena I. Kurek, Yuriy Fedkovych Chernivtsi National Univ. (Ukraine) ..... [10347-108]

**Microbubble trapping in inverted optical tweezers**, Thomas J. Smart, Univ. College London (United Kingdom); Mehmet B. Ünlü, Bogaziçi Univ. (Turkey); Philip H. Jones, Univ. College London (United Kingdom) ..... [10347-109]

**Controllable rotation of microsphere chain in dual-beam fiber-optic trap with transverse offset**, Xinlin Chen, Guangzong Xiao, Xiang Han, Wei Xiong, Hui Luo, Kaiyong Yang, National Univ. of Defense Technology (China) ..... [10347-110]

**Analysis of acceleration sensing in a dual-beam fiber-optic trap**, Wei Xiong, Guangzong Xiao, Xiang Han, Xinlin Chen, Hui Luo, Kaiyong Yang, National Univ. of Defense Technology (China) ..... [10347-111]

**Pancharatnam-Berry phase optical elements fabricated by 3D printing for shaping terahertz beams**, Arturo I. Hernandez-Serrano, Enrique Castro-Camus, Centro de Investigaciones en Óptica, A.C. (Mexico); Dorilian Lopez-Mago, Tecnológico de Monterrey (Mexico) ..... [10347-112]

**Analysis of the geometric phase produced by homogeneous and inhomogeneous Jones matrices for applications in space-variant polarized beams**, Arturo A. Canales-Benavides, Dorilian Lopez-Mago, Raul I. Hernandez-Aranda, Julio C. Gutiérrez-Vega, Tecnológico de Monterrey (Mexico) ..... [10347-113]

**Formation of optical energy flows using the biaxial crystal**, Peter P. Maksimyak, Oleg V. Angelsky, Andrew P. Maksimyak, Elena I. Kurek, Yuriy Fedkovych Chernivtsi National Univ. (Ukraine) ..... [10347-114]

**Optical trapping with femtosecond laser pulses**, Arijit K. De, Indian Institute of Science Education and Research Mohali (India); Anita Devi, Shaina Dhamija, Indian Institute of Science Education & Research Mohali (India) ..... [10347-115]

**Sorting and measurement of single gold nanoparticles in an optofluidic chip**, Yuzhi Shi, Xiong Sha, Lip Ket Chin, Nanyang Technological Univ. (Singapore); Jiahui Wu, Tianning Chen, Xi'an Jiaotong Univ. (China); Ai Qun Liu, Nanyang Technological Univ. (Singapore) ..... [10347-116]

**Parallel alignment of bacteria using near-field optical force array for cell sorting**, Haitao Zhao, Yi Zhang, Lip Ket Chin, Peng Huat Yap, Nanyang Technological Univ. (Singapore); Kuan Wang, Academia Sinica (Taiwan); Wee Ser, Ai Qun Liu, Nanyang Technological Univ. (Singapore) ..... [10347-117]

**Force tracing: a method to sculpt the optical force**, Alireza Akbarzadeh, Foundation for Research and Technology-Hellas (Greece); Christophe Caloz, Ecole Polytechnique de Montréal (Canada) ..... [10347-118]

**The total energy-momentum tensor for electromagnetic fields in a dielectric**, Michael E. Crenshaw, U.S. Army Aviation & Missile Research, Development & Engineering Ctr. (USA) ..... [10347-119]

## THURSDAY 10 AUGUST

### SESSION 15

LOCATION: CONV. CTR. ROOM 1A .. THU 8:30 AM TO 10:10 AM

### Optical Manipulation of Matter In Gaseous Media

Session Chair: **Simon Hanna**, Univ. of Bristol (United Kingdom)

8:30 am: **Probing chemical transformation in pL volume aerosol droplets**, Anatolij Miloserdov, Calum P. F. Day, Antonia E. Carruthers, Newcastle Univ. (United Kingdom) ..... [10347-79]

8:50 am: **Photoacoustic absorption spectroscopy of single optically trapped aerosol droplets**, Ruth Signorell, Johannes Cremer, Paul Covert, ETH Zurich (Switzerland) ..... [10347-80]

9:10 am: **Optical trapping, pulling, and Raman spectroscopy of airborne absorbing particles based on negative photophoretic force**, Gui-hua Chen, Lin He, Mu-ying Wu, Guang Yang, Dongguan Univ. of Technology (China); Yong-Qing Li, Dongguan Univ. of Technology (China) and East Carolina Univ. (USA) [10347-81]

9:30 am: **Robust optical trapping and manipulation of absorbing particles in air by single dual-mode optical fiber-based tweezers**, Souvik Sil, Tushar Kanti Saha, Ayan Banerjee, Indian Institute of Science Education and Research Kolkata (India) ..... [10347-82]

9:50 am: **A versatile system for optical manipulation experiments**, Dag Hanstorp, Kelken Chang, Göteborgs Univ. (Sweden); Alvin Varghese, Cochin Univ. of Science & Technology (India); Ana Maria Gallego, Univ Nacional Autónoma de México (Mexico); Oscar K. Isaksson, Jonas Enger, Göteborgs Univ. (Sweden) ..... [10347-83]

Coffee Break ..... Thu 10:10 am to 10:40 am



# CONFERENCE 10347

## SESSION 16

LOCATION: CONV. CTR. ROOM 1A . THU 10:40 AM TO 12:00 PM

### Optical Binding / Optically Bound Matter

Session Chair: **Kishan Dholakia**, Univ. of St. Andrews (United Kingdom)

10:40 am: **Optical binding of two microparticles levitated in vacuum**, Yoshihiko Arita, Univ. of St. Andrews (United Kingdom); Ewan Wright, College of Optical Sciences, The Univ. of Arizona (USA); Kishan Dholakia, Univ. of St. Andrews (United Kingdom) . . . . . [10347-84]

11:00 am: **Towards large-scale optically bound nanoparticles**, Fei Han, Zijie Yan, Clarkson Univ. (USA) . . . . . [10347-86]

11:20 am: **Dynamics of optically bound knotted and chiral nanoparticles**, Simon Hanna, Univ. of Bristol (United Kingdom); Stephen H. Simpson, Institute of Scientific Instruments of the ASCR, v.v.i. (Czech Republic) . . . . . [10347-87]

11:40 am: **Nonlinear force dependence on optically bound micro-particle arrays in the evanescent fields of fundamental and higher order microfiber modes**, Christiane Ebongue, Stefan Ostermann, Daniela Holzmann, Helmut Ritsch, Univ. of Innsbruck (Austria); Aili Maimiti, Viet Giang Truong, Sile Nic Chormaic, Okinawa Institute of Science and Technology Graduate Univ. (Japan) . [10347-123]

Lunch/Exhibition Break . . . . . Thu 12:00 pm to 1:30 pm

## SESSION 17

LOCATION: CONV. CTR. ROOM 1A . . . . THU 1:30 PM TO 3:10 PM

### Optical Sorting / Optical Lab-on-a-Chip / Microfluidics

Session Chair: **Michael P. MacDonald**, Univ. of Dundee (United Kingdom)

1:30 pm: **Nanoparticle size selection using near-field microphotonic array traps**, Aravind Krishnan, Shao-Hua Wu, Michelle L. Povinelli, The Univ. of Southern California (USA) . . . . . [10347-88]

1:50 pm: **Particle trapping and hopping in an optofluidic lattice**, Yuzhi Shi, Xiong Sha, Lip Ket Chin, Nanyang Technological Univ. (Singapore); Jiuhui Wu, Tianning Chen, Xi'an Jiaotong Univ. (China); Ai Qun Liu, Nanyang Technological Univ. (Singapore) . . . . . [10347-89]

2:10 pm: **Tracking Brownian particles in a standing-wave Bessel beam 2D optical trap**, Keith D. Bonin, Chad McKell, Wake Forest Univ. (USA) . . [10347-90]

2:30 pm: **Dielectrophoretic focusing integrated pulsed laser activated cell sorting**, Xiongfeng Zhu, Yu-Chun Kung, Univ. of California, Los Angeles (USA); Ting-Hsiang Wu, NantWorks, LLC (USA); Michael A. Teitell, Pei-Yu E. Chiou, Univ. of California, Los Angeles (USA) . . . . . [10347-91]

2:50 pm: **Nanoparticle sorting in silicon waveguide arrays**, Haitao Zhao, Yi Zhang, Lip Ket Chin, Peng Huat Yap, Nanyang Technological Univ. (Singapore); Kuan Wang, Academia Sinica (Taiwan); Wee Ser, Ai Qun Liu, Nanyang Technological Univ. (Singapore) . . . . . [10347-92]

Coffee Break . . . . . Thu 3:10 pm to 3:40 pm

## SESSION 18

LOCATION: CONV. CTR. ROOM 1A . . . THU 3:40 PM TO 4:30 PM

### Trapping with Resonators / Optothermal Assembly

Session Chair: **Reuven Gordon**, Univ. of Victoria (Canada)

3:40 pm: **Optothermal assemblers and tweezers (Invited Paper)**, Yuebing Zheng, The Univ. of Texas at Austin (USA) . . . . . [10347-93]

4:10 pm: **Blue- and red-detuned laser trapping of individual dye-doped polystyrene particles**, Tetsuhiro Kudo, National Chiao Tung Univ. (Taiwan); Hajime Ishihara, Osaka Prefecture Univ. (Japan); Hiroshi Masuhara, National Chiao Tung Univ. (Taiwan) . . . . . [10347-95]

## SESSION 19

LOCATION: CONV. CTR. ROOM 1A . . . THU 4:30 PM TO 6:00 PM

### Optically Manipulated Robotics and Novel Systems

Session Chair: **Simon Hanna**, Univ. of Bristol (United Kingdom)

4:30 pm: **A compact multi-trap optical tweezer system based on CD-ROM technologies**, Thomas J. McMenamin, Woei Ming Lee, The Australian National Univ. (Australia) . . . . . [10347-96]

4:50 pm: **A biophotonics platform based on optical trapping of photonic membranes**, Blair C. Kirkpatrick, Univ. of St. Andrews (United Kingdom); Tomáš Čížmár, Univ. of Dundee (United Kingdom); Kishan Dholakia, Andrea Di Falco, Univ. of St. Andrews (United Kingdom) . . . . . [10347-97]

5:10 pm: **Photochemical tweezing of films of polymer**, Zouheir Sekkat, Moroccan Foundation for Advanced Science, Innovation and Research (Morocco) . . . . . [10347-98]

5:30 pm: **Photonic arms, legs, and skin (Invited Paper)**, Diederik S. Wiersma, LENS - Lab. Europeo di Spettroscopie Non-Lineari (Italy) . . . . . [10347-99]

# CONFERENCE 10348

LOCATION: CONV. CTR. ROOM 4

Sunday–Wednesday 6–9 August 2017 • Proceedings of SPIE Vol. 10348

## Physical Chemistry of Semiconductor Materials and Interfaces XVI

Conference Chairs: **Hugo A. Bronstein**, Univ. College London (United Kingdom); **Felix Deschler**, Univ. of Cambridge (United Kingdom)

Conference Co-Chair: **Artem A. Bakulin**, Imperial College London (United Kingdom)

Program Committee: **John B. Asbury**, The Pennsylvania State Univ. (USA); **Natalie Banerji**, Univ. de Fribourg (Switzerland); **Jenny Clark**, The Univ. of Sheffield (United Kingdom); **Gitti Frey**, Technion-Israel Institute of Technology (Israel); **Alexandre Fürstenberg**, Univ. de Genève (Switzerland); **David S. Ginger**, Univ. of Washington (USA); **Robert Lovrincic**, Technische Univ. Braunschweig (Germany); **Naomi S. Ginsberg**, Univ. of California, Berkeley (USA); **Jeanne L. McHale**, Washington State Univ. (USA); **Paul Meredith**, The Univ. of Queensland (Australia); **Linda A. Peteanu**, Carnegie Mellon Univ. (USA); **Carlos Silva**, Georgia Tech Research Institute (Canada); **Sergei Tretiak**, Los Alamos National Lab. (USA); **Lauren Webb**, The Univ. of Texas at Austin (USA)

### SUNDAY 6 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 4 . . . . . SUN 1:00 PM TO 3:10 PM

#### Structure and Morphology in Organic and Hybrid Photovoltaics: Joint Session with Conferences 10348 and 10363

Session Chair: **Hugo A. Bronstein**, Univ. College London (United Kingdom)

1:00 pm: **Electronic processes, morphologies, and structural-functional correlations in conjugated oligomers and polymers for OPV** (*Invited Paper*), Lin X. Chen, Northwestern Univ. (USA) and Argonne National Lab. (USA). . . . [10348-1]

1:30 pm: **2D compact model to characterize phase separation in organic solar cell bulk heterojunctions**, Franklin L. Lee, Amir Barati Farimani, Kevin L. Gu, Stanford Univ. (USA); Hongping Yan, Stanford Synchrotron Radiation Lightsource (USA); Zhenan Bao, Stanford Univ. (USA); Vijay S. Pande, Stanford Univ. (USA) and Andreessen Horowitz (USA) . . . . . [10363-1]

1:50 pm: **Nanoscale energetic mapping of bulk heterojunction solar cells**, Sukumar Dey, Hanlin Hu, Weimin Zhang, Iain Macculloch, Aram Amassian, King Abdullah Univ. of Science and Technology (Saudi Arabia) . . . . . [10348-2]

2:10 pm: **Quantitative structure-function relations in PSCs from soft x-ray scattering** (*Invited Paper*), Harald W. Ade, North Carolina State Univ. (USA) . . . . . [10363-2]

2:40 pm: **Electronic structure and ion migration in lead-halide perovskites: a first-principles perspective** (*Invited Paper*), Leeor Kronik, Weizmann Institute of Science (Israel) . . . . . [10348-3]

Coffee Break . . . . . Sun 3:10 pm to 3:40 pm

#### SESSION 2

LOCATION: CONV. CTR. ROOM 4 . . . . . SUN 3:40 PM TO 5:20 PM

#### Charge and Energy Transfer Dynamics in Organic Photovoltaics: Joint Session with Conferences 10348 and 10363

Session Chair: **Felix Deschler**, Univ. of Cambridge (United Kingdom)

3:40 pm: **In situ transient absorption of thin film formation** (*Invited Paper*), Cathy Y. Wong, Kelly S. Wilson, Univ. of Oregon (USA) . . . . . [10348-4]

4:10 pm: **Triplet energy transfer and triplet exciton recycling in singlet fission sensitized organic heterojunctions**, Ajay Pandey, Queensland Univ. of Technology (Australia) . . . . . [10363-3]

4:30 pm: **Ultrafast terahertz snapshots of excitonic Rydberg states and electronic coherence in an organometal halide perovskite**, Liang Luo, Long Men, Zhaoyu Liu, Yaroslav Mudryk, Xin Zhao, Yongxin Yao, Joong-Mok Park, Ruth Shinar, Joseph Shinar, Kai-Ming Ho, Iowa State Univ. of Science and Technology (USA) and Ames Lab. (USA); Ilias E. Perakis, The Univ. of Alabama at Birmingham (USA); Javier Vela, Jigang Wang, Iowa State Univ. of Science and Technology (USA) and Ames Lab. (USA) . . . . . [10363-4]

4:50 pm: **Intra- and inter-molecular energy transfer in organic semiconductors: insights from nonadiabatic dynamics simulations** (*Invited Paper*), Sergei Tretiak, Los Alamos National Lab. (USA) . . . . . [10348-6]

LOCATION: CONV. CTR. ROOM 6A . . SUN 6:00 PM TO 7:50 PM

#### Technology Hot Topics: How Optics and Photonics Drive Innovation

6:00 pm to 6:10 pm: **Welcome and Opening Remarks**

6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)

6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)

6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)

7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)

7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)

### MONDAY 7 AUGUST

LOCATION: CONV. CTR. ROOM 6A MON 9:00 AM TO 12:00 PM

#### Nanoscience + Engineering Plenary Session

Session Chairs: **Harry A. Atwater Jr.**, California Institute of Technology (USA); **Nikolay I. Zheludev**, Optoelectronics Research Ctr. (United Kingdom)

9:15 am: **3D laser nanolithography** (*Plenary*), Martin Wegener, Karlsruher Institut für Technologie (Germany) . . . . . [10354-500]

Coffee Break . . . . . Mon 10:00 am to 10:30 am

10:30 am: **Controlling light at the atomic scale** (*Plenary*), F. Javier García de Abajo, ICFO - Institut de Ciències Fotòniques (Spain) . . . . . [10359-500]

11:15 am: **Science, engineering, and commercialization of flexible, printable 2D atomic materials and devices** (*Invited Paper*), Deji Akinwande, The Univ. of Texas at Austin (USA) . . . . . [10349-500]

Lunch Break . . . . . Mon 12:00 pm to 1:30 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 4 . . . . . MON 1:30 PM TO 3:30 PM

#### Novel Materials for Optoelectronics

Session Chair: **Hugo A. Bronstein**, Univ. College London (United Kingdom)

1:30 pm: **Optoelectronic properties of Ruddseden-Popper phase halide perovskites** (*Invited Paper*), Aditya D. Mohite, Los Alamos National Lab. (USA) . . . . . [10348-7]

2:00 pm: **Energy level alignment in hybrid perovskite solar cells** (*Invited Paper*), Philip Schulz, National Renewable Energy Lab. (USA) . . . . . [10348-8]

2:30 pm: **Colloidal APbX<sub>3</sub> nanocrystals [A=Cs<sup>+</sup>, CH<sub>3</sub>NH<sub>3</sub><sup>+</sup>, CH(NH<sub>2</sub>)<sub>2</sub><sup>+</sup>] with bright photoluminescence spanning from ultraviolet to near-infrared spectral regions** (*Invited Paper*), Maksym V. Kovalenko, ETH Zurich (Switzerland) [10348-9]

3:00 pm: **High efficiency OLEDs enabled by molecular rotation** (*Invited Paper*), Dan Credgington, Univ. of Cambridge (United Kingdom) . . . . . [10348-10]

Coffee Break . . . . . Mon 3:30 pm to 3:50 pm



# CONFERENCE 10348

## SESSION 4

LOCATION: CONV. CTR. ROOM 4 . . . . MON 3:50 PM TO 6:10 PM

### Interfaces and Photophysics of Devices

Session Chair: **Dan Credgington**, Univ. of Cambridge (United Kingdom)

3:50 pm: **Determining charge carrier extraction in lead sulfide quantum dot near infrared photodetectors**, Epimitheas Georgitzikis, IMEC (Belgium) and KU Leuven (Belgium); Pawel E. Malinowski, IMEC (Belgium); Mehedi Mamun, IMEC (Belgium) and Univ. Gent (Belgium); Oscar Enzing, IMEC (Belgium); Jorick Maes, Zeger Hens, Univ. Gent (Belgium); Paul Heremans, IMEC (Belgium) and KU Leuven (Belgium); David Cheyns, IMEC (Belgium) . . . . . [10348-11]

4:10 pm: **Engineering hybrid interfaces in organic and perovskite optoelectronic devices** (*Invited Paper*), Yana Vaynzof, Heidelberg Univ. (Germany); Paul Hopkinson, Yunus Sevinchan, Carsten Hinzmann, Qingzhi An, Yvonne Hofstetter, Paul Fassel, David Backer-Koch, Ruprecht-Karls-Univ. Heidelberg (Germany); Osnat Magen, Technion-Israel Institute of Technology (Israel); Artem A. Bakulin, Imperial College London (United Kingdom); Nir Tessler, Technion-Israel Institute of Technology (Israel) . . . . . [10348-12]

4:40 pm: **Ion migration in organo lead halide perovskite based photovoltaic devices** (*Invited Paper*), Sven Huettner, Univ. Bayreuth (Germany) . . . . . [10348-13]

5:10 pm: **Impact of band structure on recombination and efficiency in halide perovskite solar cells close to the radiative limit** (*Invited Paper*), Thomas Kirchartz, Uwe Rau, Forschungszentrum Jülich GmbH (Germany) . . . . . [10348-14]

5:40 pm: **Heavy atom organic semiconductors** (*Invited Paper*), Dwight Seferos, Univ. of Toronto (Canada) . . . . . [10348-54]

11:40 am: **Charge-carrier conduction and recombination mechanisms in hybrid metal halide perovskites** (*Invited Paper*), Laura Herz, Univ. of Oxford (United Kingdom) . . . . . [10348-23]

12:10 pm: **Correlating microscale luminescent, electronic, and photovoltaic heterogeneity in perovskite thin films and solar cells** (*Invited Paper*), Giles E. Eperon, Univ. of Washington (USA) . . . . . [10348-22]

Lunch/Exhibition Break . . . . . Tue 12:40 pm to 2:10 pm

## SESSION 7

LOCATION: CONV. CTR. ROOM 4 . . . . . TUE 2:10 PM TO 3:30 PM

### Structure-Property Relations I

Session Chair: **Giles E. Eperon**, Univ. of Washington (USA)

2:10 pm: **Linker-dependent singlet fission in tetracene dimers**, Jimmy Joy, Nadezhda Korovina, Mark E. Thompson, Stephen E. Bradforth, The Univ. of Southern California (USA) . . . . . [10348-24]

2:30 pm: **Measuring the electronic structure of buried organic semiconductor interfaces** (*Invited Paper*), Aaron P Moon, Univ. of Texas at Austin (USA); Ravindra Pandey, Aaron K. Le, Jon A. Bender, Daniel E. Cotton, Sean T Roberts, The Univ. of Texas at Austin (USA) . . . . . [10348-25]

3:00 pm: **Picosecond light-induced rotational disordering in the hybrid perovskites** (*Invited Paper*), Aaron M. Lindenberg, Stanford Univ. (USA) and SLAC National Accelerator Lab. (USA) . . . . . [10348-47]

Coffee Break . . . . . Tue 3:30 pm to 4:00 pm

## SESSION 8

LOCATION: CONV. CTR. ROOM 4 . . . . . TUE 4:00 PM TO 6:10 PM

### Nanostructure Fabrication and Applications

Session Chair: **Mark W. B. Wilson**, Univ. of Toronto (Canada)

4:00 pm: **Interface and defect engineering of core-shell quantum dots**, Ajay Singh, Jennifer A. Hollingsworth, Los Alamos National Lab. (USA) . . . . . [10348-27]

4:20 pm: **Highly luminescent nanocrystals of formamidinium tin iodide (FASnI<sub>3</sub>)** (*Invited Paper*), Maryna Bodnarchuk, EMPA (Switzerland); Sergii Yakunin, Maksym V. Kovalenko, ETH Zurich (Switzerland) . . . . . [10348-28]

4:50 pm: **The alkyl amines effect on the optical properties of inorganic perovskite quantum dot**, Ya Zhu Yang, Shu-Ru Chung, National Formosa Univ. (Taiwan) . . . . . [10348-29]

5:10 pm: **Colloidal perovskite nanocrystals: synthesis, optical properties, and applications** (*Invited Paper*), Alexander S. Urban, Ludwig-Maximilians-Univ. München (Germany) . . . . . [10348-30]

5:40 pm: **Photonic nanopatterns in organo-metal halide perovskites by thermal nanoimprint lithography** (*Invited Paper*), Neda Pourdavoud, Andre Mayer, Si Wang, Bergische Univ. Wuppertal (Germany); Ting Hu, Jie Zhao, Bergische Univ. Wuppertal (Germany) and Nanchang Univ. (China); Kai Brinkmann, Ralf Heiderhoff, Bergische Univ. Wuppertal (Germany); André Marianovich, Wolfgang Kowalsky, Technische Univ. Braunschweig (Germany); Hella-Christin Scheer, Thomas J. Riedl, Bergische Univ. Wuppertal (Germany) . . . . . [10348-31]

## WEDNESDAY 9 AUGUST

## SESSION 9

LOCATION: CONV. CTR. ROOM 4 . . WED 8:30 AM TO 10:20 AM

### Nanostructure Photophysics I

Session Chairs: **Hugo A. Bronstein**, Univ. College London (United Kingdom); **Felix Deschler**, Univ. of Cambridge (United Kingdom)

8:30 am: **Electron transfer and nonlinear activity in 2D semiconductors enhanced by nanoantenna through modeling and spectroscopy**, Donald K. Roper, Gregory T. Forcherio, Mourad Benamara, Univ. of Arkansas (USA); Luigi Bonacina, Univ. de Genève (Switzerland); Jeremy R. Dunklin, Univ. of Arkansas (USA) . . . . . [10348-32]

8:50 am: **Organic micro-LEDs and cell-embedded lasers: new tools based on organic nanomaterials to advance physical understanding of biological systems** (*Invited Paper*), Malte C. Gather, Marcel Schubert, Anja Kämpf, Andrew Morton, Caroline Murawski, Klara C. R. Volckaert, Markus Karl, Nils M. Kronenberg, Philipp Liehm, Gareth B. Miles, Simon J. Powis, Stefan R. Pulver, Univ. of St. Andrews (United Kingdom) . . . . . [10348-33]

## TUESDAY 8 AUGUST

## SESSION 5

LOCATION: CONV. CTR. ROOM 4 . . . TUE 8:00 AM TO 10:20 AM

### Thin-Film Photophysics I

Session Chair: **Sven Huettner**, Univ. Bayreuth (Germany)

8:00 am: **Mechanisms underlying emission quenching in conjugated polymers: the role of inter-chain interactions**, Linda A. Peteanu, Eric C. Wu, Carnegie Mellon Univ. (USA); Matthew Y. Sfeir, Brookhaven National Lab. (USA) . [10348-15]

8:20 am: **Intermolecular charge-transfer states for organic opto-electronics** (*Invited Paper*), Koen Vandewal, TU Dresden (Germany) . . . . . [10348-16]

8:50 am: **Strategies for reducing energy loss and increasing efficiency of organic solar cells** (*Invited Paper*), Barry P. Rand, Princeton Univ. (USA) [10348-17]

9:20 am: **Optics and photo-physics of hybrid perovskites revealed via multi-scale modeling** (*Invited Paper*), Andrew M. Rappe, Liang Z. Tan, Univ. of Pennsylvania (USA); Fan Zheng, Lawrence Berkeley National Lab. (USA); Shi Liu, Carnegie Institution for Science (USA); Omer Yaffe, Weizmann Institute of Science (Israel); Yinsheng Guo, Louis E Brus, Columbia Univ. (USA); Jasmine P. H. Rivett, Felix Deschler, Univ. of Cambridge (United Kingdom); Maya Isarov, Efrat Lifshitz, Technion-Israel Institute of Technology (Israel) . . . . . [10348-18]

9:50 am: **Understanding the device physics in polymer-based organic ratchets** (*Invited Paper*), Thuc-Quyen Nguyen, Univ. of California, Santa Barbara (USA) . . . . . [10348-19]

Coffee Break . . . . . Tue 10:20 am to 10:50 am

## SESSION 6

LOCATION: CONV. CTR. ROOM 4 . . . TUE 10:50 AM TO 12:40 PM

### Interfaces in Solution-Processed Materials

Session Chair: **Malte C. Gather**, Univ. of St. Andrews (United Kingdom)

10:50 am: **Field-induced exciton and CT-state dissociation probed by time-resolved luminescence quenching**, Uli Lemmer, Karlsruhe Institute of Technology (Germany); Marina Gerhard, Philipps-Univ. Marburg (Germany); Andreas P. Arndt, Karlsruher Institut für Technologie (Germany); Martin Koch, Philipps-Univ. Marburg (Germany); Ian A. Howard, Karlsruher Institut für Technologie (Germany) [10348-20]

11:10 am: **Structure and function of bilayer organic photovoltaics** (*Invited Paper*), Mark E. Thompson, Peter I. Djurovic, Piyumie Wickramasinghe, The Univ. of Southern California (USA) . . . . . [10348-21]

9:20 am: **Broadband excitation and nanoscale relaxation processes of excitons in monolayer MoS<sub>2</sub>** (*Invited Paper*), Nicholas Borys, Lawrence Berkeley National Lab. (USA) . . . . . [10348-35]

9:50 am: **Strained relations: optical tuning of electronic dynamics in nanoparticle and molecular systems using ultrafast spectroscopy** (*Invited Paper*), Vanessa Huxter, The Univ. of Arizona (USA) . . . . . [10348-36]

Coffee Break . . . . . Wed 10:20 am to 10:40 am

## SESSION 10

LOCATION: CONV. CTR. ROOM 4 . . WED 10:40 AM TO 12:30 PM

### Thin-Film Photophysics II

Session Chair: **Nicholas Borys**, Lawrence Berkeley National Lab. (USA)

10:40 am: **Investigating ion migration via photoluminescence blinking in perovskite films**, Gregory Tainter, Univ. of Cambridge (United Kingdom); Cheng Li, Univ. Bayreuth (Germany); Richard H. Friend, Hannah J. Joyce, Univ. of Cambridge (United Kingdom); Sven Huettner, Univ. Bayreuth (Germany); Felix Deschler, Univ. of Cambridge (United Kingdom) . . . . . [10348-37]

11:00 am: **Reversible laser induced amplified spontaneous emission from coexisting tetragonal and orthorhombic phases in hybrid lead halide perovskites** (*Invited Paper*), Anna Köhler, Univ. Bayreuth (Germany) . . . [10348-38]

11:30 am: **Excited state superposition in metal halide perovskites probed via two dimensional spectroscopy** (*Invited Paper*), Carlos Silva, Georgia Tech Research Institute (Canada) . . . . . [10348-39]

12:00 pm: **Solid-state organic/nanocrystal films for infrared/visible photon conversion via excitonics** (*Invited Paper*), Mark W. B. Wilson, Univ. of Toronto (Canada) and Massachusetts Institute of Technology (USA); Lea Nienhaus, Mengfei Wu, Massachusetts Institute of Technology (USA); Daniel Congreve, The Rowland Institute at Harvard (USA) and Massachusetts Institute of Technology (USA); Vladimir Bulovic, Mounji G. Bawendi, Marc A. Baldo, Massachusetts Institute of Technology (USA) . . . . . [10348-40]

Lunch/Exhibition Break . . . . . Wed 12:30 pm to 2:00 pm

## SESSION 11

LOCATION: CONV. CTR. ROOM 4 . . . WED 2:00 PM TO 3:20 PM

### Nanostructure Photophysics II

Session Chair: **Laura Herz**, Univ. of Oxford (United Kingdom)

2:00 pm: **Effects of surface and interface traps on exciton and multi-exciton dynamics in core/shell quantum dots**, Renato Bozio, Univ. degli Studi di Padova (Italy) and Consorzio Interuniversitario Nazionale per la Scienza e Tecnologia dei Materiali (Italy); Marcello Righetto, Alessandro Minotto, Univ. degli Studi di Padova (Italy) . . . . . [10348-41]

2:20 pm: **Ultrafast energy transfer in photosynthetic light harvesting** (*Invited Paper*), Gabriela Schlau-Cohen, John Ogren, Ashley Tong, Minjung Son, Massachusetts Institute of Technology (USA) . . . . . [10348-42]

2:50 pm: **Dopant-enhanced photoluminescence in solution processed semiconducting single crystals** (*Invited Paper*), Dmitry Y. Paraschuk, Olga D. Parashchuk, Vladislav G. Konstantinov, M.V. Lomonosov Moscow SU (Russian Federation); Oleg V. Borshchev, Nicolay M. Surin, Institute of Synthetic Polymeric Materials (Russian Federation); Sergey A. Ponomarenko, Institute of Synthetic Polymeric Materials (Russian Federation) and M.V. Lomonosov Moscow SU (Russian Federation); Artur A. Mannanov, M.V. Lomonosov Moscow SU (Russian Federation) and Zernike Institute for Advanced Materials (Netherlands); Maxim S. Pshenichnikov, Zernike Institute for Advanced Materials (Netherlands) . . [10348-43]

Coffee Break . . . . . Wed 3:20 pm to 3:40 pm

## SESSION 12

LOCATION: CONV. CTR. ROOM 4 . . . WED 3:40 PM TO 5:30 PM

### Structure-Property Relations II

Session Chair: **Felix Deschler**, Univ. of Cambridge (United Kingdom)

3:40 pm: **Nanostructural engineering towards high quality luminescent giant quantum dots**, Amita Joshi, Ajay Singh, Jennifer A. Hollingsworth, Los Alamos National Lab. (USA) . . . . . [10348-44]

4:00 pm: **Structural dynamics in lead-halide perovskites from first-principles molecular dynamics** (*Invited Paper*), David A. Egger, Weizmann Institute of Science (Israel) and Univ. Regensburg (Germany) . . . . . [10348-45]

4:30 pm: **Nanoscale structure measurements for flexible electronics manufacturing** (*Invited Paper*), Dean M. DeLongchamp, National Institute of Standards and Technology (USA) . . . . . [10348-46]

5:00 pm: **Effect of crystal packing on the electronic properties of molecular crystals** (*Invited Paper*), Noa Marom, Carnegie Mellon Univ. (USA) . . . . [10348-26]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 . . . . . WED 5:30 PM TO 7:30 PM

### Posters-Wednesday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Self-powered active acetylene gas sensing based on triboelectric nanogenerator by the semimetallic PEDOT:PSS hole transport layer**, Gwiy-Sang Chung, Univ. of Ulsan (Korea, Republic of) . . . . . [10348-50]

**Surface resistance change during nickel hydroxide phase transformations**, Ricardo I. Tucceri, Univ. Nacional de la Plata (Argentina) . . . . . [10348-51]

**Optical properties in Al<sub>2</sub>O<sub>3</sub>-Y<sub>2</sub>O<sub>3</sub> dielectric ultrathin multilayer stacks grown by atomic layer deposition**, Javier Lopez, Hugo Borbón, Roberto Machorro, Univ. Nacional Autónoma de México (Mexico); Nicola Nedev, Univ. Autónoma de Baja California (Mexico); Mario Farias, Hugo Tiznado, Gerardo Soto, Univ. Nacional Autónoma de México (Mexico) . . . . . [10348-52]

**Chemical and charge transfer studies on interfaces of a conjugated polymer and ITO**, Sam-Shajing Sun, Tanya S. David, Norfolk State Univ. (USA) . [10348-53]

**Spin-polarization effects upon light-induced charge separation at BHJ interfaces**, Oleg G. Poluektov, Jens Niklas, Argonne National Lab. (USA) [10348-55]

**Development of a single-shot transient absorption technique: studying exciton dynamics in non-static systems**, Kelly S. Wilson, Cathy Y. Wong, Univ. of Oregon (USA) . . . . . [10348-56]

**Mechanism of fluorescent silicon nanoparticles**, Woong Young So, Qi Li, Rongchao Jin, Linda A. Peteanu, Carnegie Mellon Univ. (USA) . . . . . [10348-57]

**Depth profile interface analysis on full photonic devices**, Yan Busby, Univ. of Namur (Belgium); Lucio Ciná, Sara Pescetelli, Aldo Di Carlo, Univ. degli Studi di Roma "Tor Vergata" (Italy); Jean-Jacques Pireaux, Laurent Houssiau, Univ. of Namur (Belgium) . . . . . [10348-58]

**Growth method and mechanism formation of the InP nanostructured thin films**, Orest Kvitsiani, Tinatin Laferashvili, Institute of Cybernetics (Georgia); Sch Lomithashvili, Georgian Technical Univ. (Georgia); Vladimer Mikelashvili, Institute of Cybernetics (Georgia) and Georgian Technical Univ. (Georgia) . . . . . [10348-59]

**Effects of plasmonic metal films on the emission properties of organic films**, Sikandar Abbas, Linda A. Peteanu, Carnegie Mellon Univ. (USA) . . . . . [10348-60]

**Ultrafast carrier dynamics in atomically thin 2D transition metal dichalcogenides**, Felice Gesuele, Carlo Altucci, Pasqualino Maddalena, Univ. degli Studi di Napoli Federico II (Italy) . . . . . [10348-61]



# CONFERENCE 10349

LOCATION: CONV. CTR. ROOM 5B

Wednesday–Thursday 9–10 August 2017 • Proceedings of SPIE Vol. 10349

## Low-Dimensional Materials and Devices 2017

*Conference Chairs:* **Nobuhiko P. Kobayashi**, Univ. of California, Santa Cruz (USA); **A. Alec Talin**, Sandia National Labs. (USA); **M. Saif Islam**, Univ. of California, Davis (USA); **Albert V. Davydov**, National Institute of Standards and Technology (USA)

*Program Committee:* **Can Bayram**, Univ. of Illinois at Urbana-Champaign (USA); **Kristine A. Bertness**, National Institute of Standards and Technology (USA); **Shadi A. Dayeh**, Los Alamos National Lab. (USA); **Supratik Guha**, IBM Thomas J. Watson Research Ctr. (USA); **Jung Han**, Yale Univ. (USA); **Chennupati Jagadish**, The Australian National Univ. (Australia); **Mutsumi Kimura**, Ryukoku Univ. (Japan); **Takhee Lee**, Gwangju Institute of Science and Technology (Korea, Republic of); **Marina S. Leite**, Univ. of Maryland, College Park (USA); **Francois Leonard**, Sandia National Labs., California (USA); **Samuel S. Mao**, Lawrence Berkeley National Lab. (USA); **Sanjay Mathur**, Univ. zu Köln (Germany); **Samuel T. Picraux**, Los Alamos National Lab. (USA); **Paola Prete**, Istituto per la Microelettronica e Microsistemi (Italy); **Sharka M. Prokes**, U.S. Naval Research Lab. (USA); **Zhifeng Ren**, Boston College (USA); **Atsuhito Sawabe**, Aoyama Gakuin Univ. (Japan); **Fred Semendy**, U.S. Army Research Lab. (USA); **Loucas Tsakalakos**, GE Global Research (USA); **Emanuel Tutuc**, The Univ. of Texas at Austin (USA); **Lionel Vayssieres**, Xi'an Jiaotong Univ. (China); **George T. Wang**, Sandia National Labs. (USA)

### MONDAY 7 AUGUST

LOCATION: CONV. CTR. ROOM 6A MON 9:00 AM TO 12:00 PM

#### Nanoscience + Engineering Plenary Session

Session Chairs: **Harry A. Atwater Jr.**, California Institute of Technology (USA); **Nikolay I. Zheludev**, Optoelectronics Research Ctr. (United Kingdom)

9:15 am: **3D laser nanolithography (Plenary)**, Martin Wegener, Karlsruhe Institut für Technologie (Germany) . . . . . [10354-500]

Coffee Break . . . . . Mon 10:00 am to 10:30 am

10:30 am: **Controlling light at the atomic scale (Plenary)**, F. Javier García de Abajo, ICFO - Institut de Ciències Fotòniques (Spain) . . . . . [10359-500]

11:15 am: **Science, engineering, and commercialization of flexible, printable 2D atomic materials and devices (Invited Paper)**, Deji Akinwande, The Univ. of Texas at Austin (USA) . . . . . [10349-500]

### WEDNESDAY 9 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 5B . WED 9:30 AM TO 10:35 AM

#### 2D Materials and Devices I

Session Chair: **Albert V. Davydov**, National Institute of Standards and Technology (USA)

9:30 am: **Highly sensitive and high-speed imaging of grain boundaries in graphene by transient absorption microscopy (Invited Paper)**, Chen Yang, Purdue Univ. (USA) . . . . . [10349-2]

9:55 am: **Plasmon-enhanced photon emission and absorption in monolayer, two-dimensional semiconductors (Invited Paper)**, Koray Aydin, Northwestern Univ. (USA) . . . . . [10349-3]

10:20 am: **Inkjet printed graphene-based field-effect transistors on flexible substrate**, Mahmuda Akter Monne, Evarestus Enuka, Texas State Univ. (USA); Zhuo Wang, Chang'an Univ. (China); Maggie Y. Chen, Texas State Univ. (USA) . . . . . [10349-49]

Coffee Break . . . . . Wed 10:35 am to 11:00 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 5B . WED 11:00 AM TO 12:05 PM

#### 2D Materials and Devices II

Session Chair: **Deji Akinwande**, The Univ. of Texas at Austin (USA)

11:00 am: **Correlated structural and optical properties of the MoTe<sub>2</sub>-WTe<sub>2</sub> alloy system (Invited Paper)**, Patrick Vora, George Mason Univ. (USA); Ryan Beams, National Institute of Standards and Technology (USA); Sean M. Oliver, Jaydeep Joshi, George Mason Univ. (USA); Sergiy Krylyuk, National Institute of Standards and Technology (USA) and Theiss Research (USA); Irina Kalish, Alina Bruma, National Institute of Standards and Technology (USA); Iris Stone, George Mason Univ. (USA); Arunima Singh, Francesca Tavazza, Stephan J. Stranick, Albert V. Davydov, National Institute of Standards and Technology (USA) . . . . . [10349-4]

11:25 am: **Characterization of few-layer 1T' MoTe<sub>2</sub> using polarization resolved Raman scattering and second harmonic generation (Invited Paper)**, Ryan Beams, National Institute of Standards and Technology (USA); Luiz Gustavo Cancado, Univ. Federal de Minas Gerais (Brazil); Sergiy Krylyuk, Irina Kalish, Berc Kalanyan, Alina Bruma, National Institute of Standards and Technology (USA); Arunima Singh, Lawrence Berkeley National Lab. (USA); Kamal Choudhary, National Institute of Standards and Technology (USA); Patrick Vora, George Mason Univ. (USA); Francesca Tavazza, Albert V. Davydov, Stephan J. Stranick, National Institute of Standards and Technology (USA) . . . . . [10349-5]

11:50 am: **Laser treated molybdenum disulfide nanosheets: towards engineering better 2D photodetectors**, Moh Amer, Univ. of California, Los Angeles (USA) and King Abdulaziz City for Science and Technology (Saudi Arabia); Frank DelRio, National Institute of Standards and Technology (USA); Fadel Alsaif, Abdullah Alrasheed, King Abdulaziz City for Science and Technology (Saudi Arabia) . . . . . [10349-6]

Lunch/Exhibition Break . . . . . Wed 12:05 pm to 1:35 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 5B . . . WED 1:35 PM TO 3:05 PM

#### 2D Materials and Devices III

Session Chair: **Nobuhiko Kobayashi**, Univ. of California, Santa Cruz (USA)

1:35 pm: **Two-dimensional van der Waals materials based nonvolatile memory field-effect transistors**, Do Kyung Hwang, Young Tack Lee, Won-Kook Choi, Min-Chul Park, Korea Institute of Science and Technology (Korea, Republic of) [10349-7]

1:50 pm: **Atomic layer deposition of tunable ZnO films for the application in resistive memory (Invited Paper)**, Ruomeng Huang, Kai Sun, Kian S. Kiang, Kees de Groot, Univ. of Southampton (United Kingdom) . . . . . [10349-8]

2:15 pm: **Highly efficient strain energy harvester through electrochemical intercalation into few layered graphene (Invited Paper)**, Cary L. Pint, Nitin Muralidharan, Adam P. Cohn, Karl Zelik, Vanderbilt Univ. (USA) . . . . . [10349-9]

2:40 pm: **Interfacial dynamics during lateral epitaxy of one-dimensional (1D) nanocrystals over 2D membranes (Invited Paper)**, Babak Nikoobakht, National Institute of Science and Technology (USA) . . . . . [10349-10]

Coffee Break . . . . . Wed 3:05 pm to 3:25 pm

## SESSION 4

LOCATION: CONV. CTR. ROOM 5B . . . WED 3:25 PM TO 5:30 PM

### Nanoionics for Energy and Computing

Session Chair: **A. Alec Talin**, Sandia National Labs. (USA)

3:25 pm: **Superionic conductivity in low-dimensional polyborate nanocages** (*Invited Paper*), Vitalie Stavila, A. Alec Talin, Sandia National Labs. (USA); Terrence Udovic, National Institute of Standards and Technology (USA) . . . . . [10349-11]

3:50 pm: **The challenge of dimensional scaling of the non-volatile redox transistor to achieve ultrafast switching**, Elliot Fuller, Francois Leonard, A. Alec Talin, Sandia National Labs. (USA) . . . . . [10349-12]

4:05 pm: **Revealing interphases in all-solid-state batteries through time-of-flight secondary ion mass spectroscopy** (*Invited Paper*), Marina S. Leite, Univ. of Maryland, College Park (USA) . . . . . [10349-13]

4:30 pm: **Reversible intercalation of lithium and sodium ions into layered and tunnel structured manganese oxides: one-dimensional versus two-dimensional diffusion**, Bryan W. Byles, Ekaterina Pomerantseva, Drexel Univ. (USA) . . . . . [10349-14]

4:45 pm: **The ion dependent change in the mechanism of charge storage of chemically preintercalated bilayered vanadium oxide electrodes**, Mallory Clites, Ekaterina Pomerantseva, Drexel Univ. (USA) . . . . . [10349-15]

5:00 pm: **Reversibility of water intercalation in potassium- and magnesium-intercalated Mxenes**, Iliia N. Ivanov, Eric S. Muckley, Michael Naguib, Jagjit Nanda, Oak Ridge National Lab. (USA) . . . . . [10349-16]

5:15 pm: **Structural and optical studies of ZnO:Mn nanostructures**, Arun Aravind, Univ. of Kerala (India); Jayaraj M. K., Cochin Univ. of Science & Technology (India) . . . . . [10349-17]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 . . . . . WED 5:30 PM TO 7:30 PM

### Posters-Wednesday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Comparison of structural properties of iron nano-particles prepared by sol-gel method and spin coating technique**, Sunil Dehipawala, Queensborough Community College (USA); Pubudu Samarasekara, Univ. of Peradeniya (Sri Lanka); Harry D. Gafney, Queens College (USA) . . . . . [10349-35]

**Visible light irradiation-induced conductivity change for CVD-grown graphene on different substrates**, Xiangdi Li, Xianming Liu, Yun Luo, Peng Zhang, Xiaohua Lei, Weimin Chen, Chongqing Univ. (China) . . . . . [10349-36]

**Hydrogen sensing properties based on self-assembly monolayer film of Pt/Pd core-shell nanocrystals**, Gwi-y-Sang Chung, Univ. of Ulsan (Korea, Republic of) . . . . . [10349-37]

**Formation properties of two-dimensional atomic layers for high-efficiency multi-layer-nanostructure smart packages**, Sungwon Hwang, Kyung-Jin Yeum, Konkuk Univ. (Korea, Republic of) . . . . . [10349-38]

**Molecular dynamics modeling and simulation on graphene nanoribbon trench for fullerene shuttle device**, Jeong-Won Kang, Korea National Univ. of Transportation (Korea, Republic of) . . . . . [10349-39]

**The performance of quantum dots-based white light-emitting diodes**, Kuan Lin Chen, Shu-Ru Chung, National Formosa Univ. (Taiwan) . . . . . [10349-40]

**Layer-number-dependent optical properties and application for thickness determination in 2D graphene-like materials**, Li Xiaoli, Wang Ying, Hebei Univ. (China) . . . . . [10349-41]

**Carrier transfer in coupled quantum dot-quantum well hybrid structure**, Ying Wang, Qinglin Guo, Suheng Zhang, Xiaoli Li, Baolai Liang, Shufang Wang, Guangsheng Fu, Hebei Univ. (China) . . . . . [10349-42]

**PECVD growth of high quality graphene on interdigital electrodes of MEMS supercapacitor**, Azrul Azlan Hamzah, Hafzaliza E. Zainal Abidin, Mohd A. Mohamed, Burhanuddin Y. Majlis, Univ. Kebangsaan Malaysia (Malaysia) [10349-43]

**Enhanced performance in quantum dot light-emitting diodes by adopting interfacial layer on ZnO**, Jinyoung Yun, Kukjin Lee, Hokyun Jang, Korea Univ. (Korea, Republic of); Jeonghun Kwak, The Univ. of Seoul (Korea, Republic of); Gytuae Kim, Korea Univ. (Korea, Republic of) . . . . . [10349-44]

**Synthesis and characterization of Au-MWCNT/PEDOT: PSS composite film for optoelectronic applications**, Jasna Mannayil, Anjana R., Jayaraj M. K., Cochin Univ. of Science & Technology (India) . . . . . [10349-45]

**Photon-trapping micro/nanostructures for high linearity in ultra-fast photodiodes**, Hilal Cansizoglu, Yang Gao, Cesar B. Perez, Soroush Ghandiparsi, Ekaterina Ponizovskaya Devine, Univ. of California, Davis (USA); Mehmet F. Cansizoglu, The Univ. of Texas Southwestern Medical Ctr. at Dallas (USA) and Univ. of California, Davis (USA); Toshishige Yamada, Univ. of California, Santa Cruz (USA); Aly Elrefaie, Shih-Yuan Wang, Saif M. Islam, Univ. of California, Davis (USA) . . . . . [10349-46]

**Highly efficient silicon photovoltaic using photon trapping micro/nano structures**, Yang Gao, Hilal Cansizoglu, Ahmet Kaya, Ahmed S. Mayet, Soroush Ghandiparsi, Cesar B. Perez, Univ. of California, Davis (USA); Ekaterina Ponizovskaya Devine, W&WSens Devices, Inc. (USA); Toshishige Yamada, Univ. of California, Santa Cruz (USA); Aly Elrefaie, Shih-Yuan Wang, W&WSens Devices, Inc. (USA); Saif M. Islam, Univ. of California, Davis (USA) . . . . . [10349-47]

**InAs/GaAs quantum dot lasers monolithically grown on Si substrates**, Mingchu Tang, Jiang Wu, Siming Chen, Mengya Liao, Alwyn Seeds, Huiyun Liu, Univ. College London (United Kingdom) . . . . . [10349-48]

**Modified Richardson Dushman thermionic emission equation for metals and nano-materials**, Olukunle Charles Olawole, Dilip K. De, Sunday O. Oyedepo, Covenant Univ. (Nigeria) . . . . . [10349-50]

## THURSDAY 10 AUGUST

### SESSION 5

LOCATION: CONV. CTR. ROOM 5B . . THU 9:00 AM TO 10:35 AM

### Integrated Nanoelectronics

Session Chair: **Babak Nikoobakht**, National Institute of Science and Technology (USA)

9:00 am: **2D emerging devices: from ordinary to extra-ordinary** (*Keynote Presentation*), Deji Akinwande, The Univ. of Texas at Austin (USA) . . . . [10349-18]

9:45 am: **Monolithic integration of III-V nanostructures for electronic and photonic applications** (*Invited Paper*), Benedikt Mayer, IBM Research - Zürich (Switzerland); Stephan Wirths, Svenja Mauthe, IBM Research - Zürich (Switzerland); Lukas Czornomaz, Heinz Schmid, Marilyne Sousa Petit, IBM Research - Zürich (Switzerland); Clarissa Convertino, IBM Research - Zürich (Switzerland); Yannick Baumgartner, IBM Research - Zürich (Switzerland); Heike Riel, IBM Research - Zürich (Switzerland); Kirsten E. Moselund, IBM Research - Zürich (Switzerland) . . . . . [10349-19]

10:10 am: **Self-aligned nanoscale processing solutions via selective atomic layer deposition of oxide, nitride, and metallic films** (*Invited Paper*), Necmi Biyikli, Utah State Univ. (USA); Ali Haider, Petro Deminskyi, Mehmet Yilmaz, Bilkent Univ. (Turkey) . . . . . [10349-20]

Coffee Break . . . . . Thu 10:35 am to 11:00 am

### SESSION 6

LOCATION: CONV. CTR. ROOM 5B . . THU 11:00 AM TO 12:05 PM

### Nanowire and Quantum Dot LEDs

Session Chair: **Saif M. Islam**, Univ. of California, Davis (USA)

11:00 am: **Triangle-lattice InGaN/GaN nanocolumn arrays exhibiting photonic crystal effect** (*Invited Paper*), Katsumi Kishino, Shunsuke Ishizawa, Yuzo Matsui, Jun Yoshida, Sophia Univ. (Japan); Ai Yanagihara, Sophia Univ. (Jordan) [10349-21]

11:25 am: **Top-down etching of GaN nanostructures for optoelectronics and beyond** (*Invited Paper*), George T. Wang, Benjamin Leung, Sandia National Labs. (USA); Miao-Chan Tsai, Changyi Li, Ganesh Balakrishnan, The Univ. of New Mexico (USA) . . . . . [10349-22]

11:50 am: **Controlling reabsorption effect of Bi-color CdSe quantum dots-based white light-emitting diodes**, Cyuan-Bin Siao, National Central Univ. (Taiwan); Shu-Ru Chung, National Formosa Univ. (Taiwan); Kuan-Wen Wang, National Central Univ. (Taiwan) . . . . . [10349-23]

Lunch/Exhibition Break . . . . . Thu 12:05 pm to 1:35 pm

# CONFERENCE 10349

## SESSION 7

LOCATION: CONV. CTR. ROOM 5B . . . . THU 1:35 PM TO 3:20 PM

### Nanostructured Si and Ge: Properties and Integration

Session Chair: **George T. Wang**, Sandia National Labs. (USA)

1:35 pm: **Semiconducting nanowires self-assembly towards solution processed electronics for sensing and RF applications** (*Invited Paper*), Maxim N. Shkunov, Marios Constantinou, Univ. of Surrey (United Kingdom); Sergiy Krylyuk, Theiss Research (USA); Grigorios-Panagiotis Rigas, Bobur Mirkhaydarov, Kaspar Snashall, Michael P. Hughes, Univ. of Surrey (United Kingdom); Brian A. Korgel, The Univ. of Texas at Austin (USA); Philippe Caroff, The Australian National Univ. (Australia) . . . . . [10349-24]

2:00 pm: **Fabrication of single crystalline stripe in Si and Ge film on rolled flexible glass substrate by UV cw micro-chevron laser beam** (*Invited Paper*), Wenchang Yeh, Shimane Univ. (Japan) . . . . . [10349-25]

2:25 pm: **Thermal transport and thermal management by silicon nanostructures** (*Invited Paper*), Jaeho Lee, Univ. of California, Irvine (USA) . . . . . [10349-26]

2:50 pm: **Fabrication of effective photon trapping and light manipulating micro/nano structures**, Yang Gao, Hilal Cansizoglu, Ahmet Kaya, Ahmed S. Mayet, Soroush Ghandiparsi, Cesar B. Perez, Univ. of California, Davis (USA); Ekaterina P. Devine, W&WSens Devices, Inc. (USA); Toshishige Yamada, Univ. of California, Santa Cruz (USA); Aly Elrefaie, Shih-Yuan Wang, W&WSens Devices, Inc. (USA); Saif M. Islam, Univ. of California, Davis (USA) . . . . . [10349-27]

3:05 pm: **Extreme bandwidth and efficiency in silicon photodetectors using photon-manipulating micro/nanostructures**, Hilal Cansizoglu, Yang Gao, Soroush Ghandiparsi, Ahmet Kaya, Cesar B. Perez, Ahmed S. Mayet, Ekaterina Ponizovskaya Devine, Univ. of California, Davis (USA); Mehmet F. Cansizoglu, The Univ. of Texas Southwestern Medical Ctr. at Dallas (USA) and Univ. of California, Davis (USA); Toshishige Yamada, Univ. of California, Santa Cruz (USA); Aly Elrefaie, Shih-Yuan Wang, Saif M. Islam, Univ. of California, Davis (USA) . . . . . [10349-28]

Coffee Break . . . . . Thu 3:20 pm to 3:50 pm

## SESSION 8

LOCATION: CONV. CTR. ROOM 5B . . . THU 3:50 PM TO 5:40 PM

### Functional Nanostructures: Fabrication and Properties

Session Chair: **Marina S. Leite**, Univ. of Maryland, College Park (USA)

3:50 pm: **Every atom counts: solving the structure of ligand protected Au<sub>102</sub> nanoparticles using electron microscopy and diffraction** (*Invited Paper*), Alina Bruma, National Institute of Standards and Technology (USA) . . . . . [10349-29]

4:15 pm: **Chroplasmonic and chiroexcitonic photonics** (*Invited Paper*), Wenchun Feng, Univ. of Michigan (USA); Chuanlai Xu, Jiangnan Univ. (China); Nicholas A. Kotov, Univ. of Michigan (USA) . . . . . [10349-30]

4:40 pm: **Broadband graphene optical modulator with 35 GHz speed and athermal performance**, Yang Xia, Univ. of California, San Diego (USA); Hamed Dalir, Yuan Wang, Xiang Zhang, Univ. of California, Berkeley (USA) . . . . [10349-31]

4:55 pm: **Silver film grain boundary pinning by ion bombardment decreases surface plasmon resonance absorption**, David M. Fryauf, Juan J. Díaz León, Univ. of California, Santa Cruz (USA); Andrew C. Phillips, Univ. of California Observatories (USA); Nobuhiko P. Kobayashi, Univ. of California, Santa Cruz (USA) . . . . . [10349-32]

5:10 pm: **Multi-physics simulation of monolithictantalum oxide memristor-selector structures illustrating negative differential resistance**, John F. Sevic, Nobuhiko P. Kobayashi, Univ. of California, Santa Cruz (USA) . . . . . [10349-33]

5:25 pm: **Study of thin film oxidation kinetics using a combination of simulations and advanced characterization**, Juan J. Díaz León, David M. Fryauf, Nobuhiko P. Kobayashi, Univ. of California, Santa Cruz (USA) . . . . . [10349-34]



# CONFERENCE 10350

LOCATION: CONV. CTR. ROOM 5B

Sunday–Tuesday 6–8 August 2017 • Proceedings of SPIE Vol. 10350

## Nanoimaging and Nanospectroscopy V

Conference Chairs: **Prabhat Verma**, Osaka Univ. (Japan); **Alexander Egner**, Laser-Lab. Göttingen e.V. (Germany)

Program Committee: **Balpreet Singh Ahluwalia**, Univ. of Tromsø (Norway); **Joerg Bewersdorf**, Yale School of Medicine (USA); **Alberto Diaspro**, Istituto Italiano di Tecnologia (Italy); **Christian Eggeling**, Univ. of Oxford (United Kingdom); **Joerg Enderlein**, Georg-August-Univ. Göttingen (Germany); **Katsumasa Fujita**, Osaka Univ. (Japan); **Stefan W. Hell**, Max-Planck-Institut für Biophysikalische Chemie (Germany); **Samuel Hess**, Univ. of Maine (USA); **Bo Huang**, Univ. of California, San Francisco (USA); **Satoshi Kawata**, Osaka Univ. (Japan); **Thomas A. Klar**, Johannes Kepler Univ. Linz (Austria); **Alfred J. Meixner**, Eberhard Karls Univ. Tübingen (Germany); **Peter Nordlander**, Rice Univ. (USA); **Bruno Pettinger**, Fritz-Haber-Institut der Max-Planck-Gesellschaft (Germany); **Markus B. Raschke**, Univ. of Colorado at Boulder (USA); **Bin Ren**, Xiamen Univ. (China); **Vahid Sandoghdar**, Max-Planck-Institut für die Physik des Lichts (Germany); **Markus Sauer**, Julius-Maximilians-Univ. Würzburg (Germany); **Yung Doug Suh**, Korea Research Institute of Chemical Technology (Korea, Republic of); **Din Ping Tsai**, National Taiwan Univ. (Taiwan); **Renato Zenobi**, ETH Zürich (Switzerland); **Xiaowei Zhuang**, Harvard Univ. (USA)

### SUNDAY 6 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 5B . . SUN 8:30 AM TO 10:20 AM

#### Plasmon-Enhanced Raman Spectroscopy/ Microscopy I

Session Chair: **Prabhat Verma**, Osaka Univ. (Japan)

8:30 am: **Recent progress in the study of surface chemistry on various noble metal surfaces by ultrahigh vacuum tip-enhanced Raman spectroscopy** (*Invited Paper*), Nan Jiang, Univ. of Illinois at Chicago (USA) . . . . . [10350-1]

9:00 am: **Tip-enhanced Raman scattering monitoring of a nanoscale pH at a solution/solid interface by chemically modified tip-enhanced Raman scattering tip** (*Invited Paper*), Prompong Pienpinijtham, Chulalongkorn Univ. (Thailand); Sanpon Vantasin, Yasutaka Kitahama, Kwansei Gakuin Univ. (Japan); Sanong Ekgasit, Chulalongkorn Univ. (Thailand); Yukihiko Ozaki, Kwansei Gakuin Univ. (Japan) . . . . . [10350-2]

9:30 am: **Hierarchical plasmonic metamaterials and metasurfaces for ultrasensitive, reproducible SERS** (*Invited Paper*), Danyuan Lei, Jiyuan Dai, The Hong Kong Polytechnic Univ. (Hong Kong, China) . . . . . [10350-18]

10:00 am: **Evaluation of probes for tip-enhanced Raman scattering by darkfield microspectroscopy and calculation**, Yasutaka Kitahama, Shohei Uemura, Ryota Katayama, Kwansei Gakuin Univ. (Japan); Yuko S. Yamamoto, Kagawa Univ. (Japan); Toshiaki Suzuki, UNISOKU Co., Ltd. (Japan); Tamitake Itoh, National Institute of Advanced Industrial Science and Technology (Japan); Yukihiko Ozaki, Kwansei Gakuin Univ. (Japan) . . . . . [10350-4]

Coffee Break . . . . . Sun 10:20 am to 10:50 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 5B . SUN 10:50 AM TO 12:30 PM

#### Superresolution: New Developments I

Session Chair: **Keith A. Lidke**, The Univ. of New Mexico (USA)

10:50 am: **Wavefront correction for superresolution microscopy** (*Invited Paper*), Peter Kner, Kayvan F. Tehrani, Benjamin Thomas, Abhijit Marar, The Univ. of Georgia (USA) . . . . . [10350-5]

11:20 am: **Fluorescence scanning microscopy with SPAD array** (*Invited Paper*), Marco Castello, Giorgio Tortarolo, Istituto Italiano di Tecnologia (Italy); Mauro Buttafava, Federica A. Villa, Politecnico di Milano (Italy); Sami Koho, Alberto Diaspro, Istituto Italiano di Tecnologia (Italy); Alberto Tosi, Politecnico di Milano (Italy); Giuseppe Vicidomini, Istituto Italiano di Tecnologia (Italy) . . . . . [10350-6]

11:50 am: **Tomographic STED microscopy**, Jennifer-Rose Krüger, Laser-Lab. Göttingen e.V. (Germany); Jan Keller-Findeisen, Max-Planck-Institut für Biophysikalische Chemie (Germany); Claudia Geisler, Alexander Egner, Laser-Lab. Göttingen e.V. (Germany) . . . . . [10350-7]

12:10 pm: **Beam shaping for superresolution nonlinear lifetime and Raman microscopy**, Ryan Beams, Stephan Stranick, National Institute of Standards and Technology (USA) . . . . . [10350-8]

Lunch Break . . . . . Sun 12:30 pm to 1:30 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 5B . . . . SUN 1:30 PM TO 3:20 PM

#### Plasmon-Enhanced Raman Spectroscopy/ Microscopy II

Session Chair: **Nan Jiang**, Univ. of Illinois at Chicago (USA)

1:30 pm: **Tip-enhanced Raman spectroscopy of semiconductor nanostructures** (*Invited Paper*), Edward T. Yu, The Univ. of Texas at Austin (USA) . . . . . [10350-9]

2:00 pm: **Enabling strain-sensing at the nanoscale with TERS** (*Invited Paper*), Erin Wood, Yanfei Yang, Will Gannett, Gordon A. Shaw, Randolph E. Elmquist, Mark Keller, Angela Hight Walker, National Institute of Standards and Technology (USA) . . . . . [10350-10]

2:30 pm: **Multimodal tip-enhanced microscopy** (*Invited Paper*), Kai Braun, Anke Homeber, Dai Zhang, Alfred J. Meixner, Eberhard Karls Univ. Tübingen (Germany) . . . . . [10350-11]

3:00 pm: **Reproducible plasmon nanofocusing on optimized plasmonic tip structure for optical nano-imaging**, Takayuki Umakoshi, Misaki Tanaka, Osaka Univ. (Japan); Yuika Saito, Gakushuin Univ. (Japan); Prabhat Verma, Osaka Univ. (Japan) . . . . . [10350-12]

Coffee Break . . . . . Sun 3:20 pm to 3:50 pm

#### SESSION 4

LOCATION: CONV. CTR. ROOM 5B . . . . SUN 3:50 PM TO 5:30 PM

#### Superresolution: Single Molecule Localization Microscopy

Session Chair: **Alexander Egner**, Laser-Lab. Göttingen e.V. (Germany)

3:50 pm: **Imaging nanoscale nuclear architecture in cancer development** (*Invited Paper*), Yang Liu, Jianquan Xu, Hongqiang Ma, Univ. of Pittsburgh (USA); Wei Jiang, West China Second Univ. Hospital, Sichuan Univ. (China) and Univ. of Pittsburgh (USA) . . . . . [10350-13]

4:20 pm: **Multiple emitter fitting using reversible jump Markov chain Monte Carlo** (*Invited Paper*), Keith A. Lidke, The Univ. of New Mexico (USA) . . [10350-14]

4:50 pm: **An ultra-fast algorithm for high-density localization microscopy**, Hongqiang Ma, Yang Liu, Univ. of Pittsburgh (USA) . . . . . [10350-15]

5:10 pm: **Single marker switching microscope with isotropic resolution over large axial range**, Haugen Mittelstädt, Claudia Geisler, Alexander Egner, Laser-Lab. Göttingen e.V. (Germany) . . . . . [10350-16]

# CONFERENCE 10350

LOCATION: CONV. CTR. ROOM 6A .. SUN 6:00 PM TO 7:50 PM

## Technology Hot Topics: How Optics and Photonics Drive Innovation

- 6:00 pm to 6:10 pm: **Welcome and Opening Remarks**
- 6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)
- 6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)
- 6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)
- 7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)
- 7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)

## MONDAY 7 AUGUST

LOCATION: CONV. CTR. ROOM 6A MON 9:00 AM TO 12:00 PM

## Nanoscience + Engineering Plenary Session

- Session Chairs: **Harry A. Atwater Jr.**, California Institute of Technology (USA); **Nikolay I. Zheludev**, Optoelectronics Research Ctr. (United Kingdom)
- 9:15 am: **3D laser nanolithography (Plenary)**, Martin Wegener, Karlsruhe Institut für Technologie (Germany) . . . . . [10354-500]
- Coffee Break . . . . . Mon 10:00 am to 10:30 am
- 10:30 am: **Controlling light at the atomic scale (Plenary)**, F. Javier García de Abajo, ICFO - Institut de Ciències Fotòniques (Spain) . . . . . [10359-500]
- 11:15 am: **Science, engineering, and commercialization of flexible, printable 2D atomic materials and devices (Invited Paper)**, Deji Akinwande, The Univ. of Texas at Austin (USA) . . . . . [10349-500]

Lunch Break . . . . . Mon 12:00 pm to 1:30 pm

## SESSION 5

LOCATION: CONV. CTR. ROOM 5B ... MON 1:30 PM TO 3:20 PM

## Plasmon-Enhanced Raman Spectroscopy/ Microscopy III

- Session Chair: **Erin Wood**, National Institute of Standards and Technology (USA)
- 1:30 pm: **Physical chemistry of Nanogap-Enhanced Raman Scattering (NERS) (Invited Paper)**, Yung Doug Suh, Korea Research Institute of Chemical Technology (Korea, Republic of) and Sungkyunkwan Univ. (Korea, Republic of); Hyun Woo Kim, Korea Research Institute of Chemical Technology (Korea, Republic of) . [10350-17]
- 2:00 pm: **In-situ electrochemical tip-enhanced optical spectroscopy and imaging (Invited Paper)**, Taka-aki Yano, Masahiko Hara, Tokyo Institute of Technology (Japan) . . . . . [10350-3]
- 2:30 pm: **3D plasmonic architectures for ultrasensitive Raman spectroscopy (Invited Paper)**, Manohar Chirumamilla, Aalborg Univ. (Denmark); Remo Proietti Zaccaria, Andrea Toma, Istituto Italiano di Tecnologia (Italy) . . . . . [10350-19]
- 3:00 pm: **TiO<sub>2</sub>-enhanced Raman spectroscopy and its relevance to electromagnetic and chemical enhancements**, Yusuke Tanaka, Taka-aki Yano, Masahiko Hara, Tokyo Institute of Technology (Japan) . . . . . [10350-20]
- Coffee Break . . . . . Mon 3:20 pm to 3:50 pm

## SESSION 6

LOCATION: CONV. CTR. ROOM 5B ... MON 3:50 PM TO 5:30 PM

## Superresolution: New Developments II

Session Chair: **Balpreet S. Ahluwalia**, UiT The Arctic Univ. of Norway (Norway)

- 3:50 pm: **Nanometer resolution imaging and tracking of fluorescent molecules with minimal photon fluxes (Invited Paper)**, Klaus Gwosch, Francisco Balzarotti, Yvan Eilers, Max-Planck-Institut für Biophysikalische Chemie (Germany); Arvid H. Gynnå, Uppsala Univ. (Sweden); Volker Westphal, Max-Planck-Institut für Biophysikalische Chemie (Germany); Fernando D. Stefani, Univ. de Buenos Aires (Argentina); Johan Elf, Uppsala Univ. (Sweden); Stefan W. Hell, Max-Planck-Institut für Biophysikalische Chemie (Germany) . . . . . [10350-21]
- 4:20 pm: **Angstrom resolution using Cryogenic Optical Localization in 3D (COLD) (Invited Paper)**, Daniel Böning, Siegfried Weisenburger, Max Planck Institute for the Science of Light (Germany); Benjamin Schomburg, Karin Giller, Stefan Becker, Christian Griesinger, Max-Planck-Institut für Biophysikalische Chemie (Germany); Vahid Sandoghdar, Max Planck Institute for the Science of Light (Germany) . . . . . [10350-22]
- 4:50 pm: **High-speed localized plasmonic structure illumination microscopy for biological imaging**, Anna S. Bezryadina, Junxiang Zhao, Joseph L. Posnetto, Yang Xu, Univ. of California, San Diego (USA); Xiang Zhang, Univ. of California, Berkeley (USA); Zhaowei Liu, Univ. of California, San Diego (USA) . . . . . [10350-23]
- 5:10 pm: **Nanoscale Photoacoustic Tomography (nPAT) for label-free super-resolution 3D imaging of red blood cells**, Pratik Samant, Armando Hernandez, Shelby Conklin, Liangzhong Xiang, The Univ. of Oklahoma (USA) . . . . . [10350-24]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 ... MON 5:30 PM TO 7:30 PM

## Posters-Monday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Turning Ag/PDA/CuO into a 3D glass microfiber as the SERS platform for monitoring the photoinduced surface catalytic coupling reaction of 4-nitrothiophenol to 4,4'-dimercaptoazobenzene**, Gongchun He, Jyunde Chen, Pei-Ying Lin, Worasaung Klinthong, National Sun Yat-Sen Univ. (Taiwan); Shuchen Hsieh, National Sun Yat-Sen Univ. (Taiwan) and Kaohsiung Medical Univ. (Taiwan) . . . . . [10350-36]

**Three-dimensional nanoscale optical vortex profilometry**, Bogdan V. Sokolenko, Dmitrii Poletaev, V.I. Vernadsky Crimean Federal Univ. (Russian Federation) . . . . . [10350-37]

**Dynamic modeling of AFM piezoelectric MC in liquid with various percentages of glycerin in the presence of rough surface in nanoscale**, Alireza Habibnejad Korayem, Iran Univ. of Science and Technology (Iran, Islamic Republic of) . . . . . [10350-38]

TUESDAY 8 AUGUST

SESSION 7

LOCATION: CONV. CTR. ROOM 5B . . . TUE 8:30 AM TO 10:10 AM

**Near-Field Spectroscopy/Microscopy**

Session Chairs: **Remo Proietti Zaccaria**, Istituto Italiano di Tecnologia (Italy); **Prabhat Verma**, Osaka Univ. (Japan)

8:30 am: **Hyperspectral mapping of optoelectronic properties at length scales that matter in 2D semiconductors** (*Invited Paper*), James P. Schuck, The Molecular Foundry (USA) . . . . . [10350-25]

9:00 am: **Efficient plasmonic tip for nano Raman microscopy** (*Invited Paper*), Atsushi Taguchi, Osaka Univ. (Japan) . . . . . [10350-26]

9:30 am: **Near-field visible light absorption imaging by Raman-nano-light source**, Ryo Kato, Osaka Univ. (Japan); Yuika Saito, Gakushuin Univ. (Japan) and Osaka Univ. (Japan); Takayuki Umakoshi, Prabhat Verma, Osaka Univ. (Japan) . . . . . [10350-27]

9:50 am: **Sharply focused azimuthally polarized beam characterized by photoinduced force microscopy**, Jinwei Zeng, Fei Huang, Caner Guclu, Mehdi Veysi, Hemantha K. Wickramasinghe, Filippo Capolino, Univ. of California, Irvine (USA) . . . . . [10350-28]

Coffee Break . . . . . Tue 10:10 am to 10:40 am

SESSION 8

LOCATION: CONV. CTR. ROOM 5B . TUE 10:40 AM TO 12:00 PM

**Superresolution: New Developments III**

Session Chair: **Claudia Geisler**, Laser-Lab. Göttingen e.V. (Germany)

10:40 am: **Improving axial resolution in nanoscopy with supercritical angle fluorescence emission** (*Invited Paper*), Nicolas Bourg, Clement Cabriel, Iván Coto Hernández, Institut des Sciences Moléculaires d'Orsay (France); Siddharth Sivankutty, Sandrine Lévêque-Fort, Guillaume Dupuis, Univ. Paris-Sud 11 (France); Emmanuel Fort, Institut Langevin (France); Sandrine Lévêque-Fort, Institut des Sciences Moléculaires d'Orsay (France) . . . . . [10350-29]

11:10 am: **Development of integrated optical nanoscopy using photonic chips** (*Invited Paper*), Balpreet S. Ahluwalia, Øystein I. Helle, Jean-Claude Tinguely, David A. Coucheron, Marcel Lahrberg, Firehun Tsige Dullo, Cristina I. Øie, UiT The Arctic Univ. of Norway (Norway) . . . . . [10350-30]

11:40 am: **Chip-based nanoscopy: towards integration and high-throughput imaging**, David A. Coucheron, Øystein I. Helle, Christina I. Øie, Firehun Tsige Dullo, Balpreet S. Ahluwalia, UiT The Arctic Univ. of Norway (Norway) . . . . . [10350-31]

Lunch/Exhibition Break . . . . . Tue 12:00 pm to 1:30 pm

SESSION 9

LOCATION: CONV. CTR. ROOM 5B . . . . TUE 1:30 PM TO 3:20 PM

**Plasmonics for Spectroscopy/Microscopy**

Session Chair: **Andrea Toma**, Istituto Italiano di Tecnologia (Italy)

1:30 pm: **Dynamics of surface plasmon polaritons and excitons in ultrastrong coupling regime** (*Invited Paper*), Remo Proietti Zaccaria, Istituto Italiano di Tecnologia (Italy) and Chinese Academy of Sciences (China); Hai Wang, Haiyu Wang, Hong-Bo Sun, Jilin Univ. (China); Andrea Toma, Istituto Italiano di Tecnologia (Italy) . . . . . [10350-32]

2:00 pm: **Nanoplasmonic multiplexing of optical angular momentum from the visible to terahertz range** (*Invited Paper*), Min Gu, Haoran Ren, RMIT Univ. (Australia) . . . . . [10350-33]

2:30 pm: **Plasmon-enhanced light-matter interactions on nanoporous gold nanoparticles and arrays** (*Invited Paper*), Wei-Chuan Shih, Univ. of Houston (USA) . . . . . [10350-34]

3:00 pm: **Planar plasmonic nano antennas explore membrane nanoscale heterogeneities in living cells**, Raju Regmi, Institut Fresnel (France) and ICFO - Institut de Ciències Fotòniques (Spain); Pamina Winkler, ICFO - Institut de Ciències Fotòniques (Spain); Valentin Flauraud, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Kyra J. E. Borgman, Carlo Manzo, ICFO - Institut de Ciències Fotòniques (Spain); Jürgen Brugger, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Hervé Rigneault, Jérôme Wenger, Institut Fresnel (France); María F. Garcia-Parajo, ICFO - Institut de Ciències Fotòniques (Spain) . . . . . [10350-35]



# CONFERENCE 10351

LOCATION: CONV. CTR. ROOM 10

Sunday–Monday 6–7 August 2017 • Proceedings of SPIE Vol. 10351

## UV and Higher Energy Photonics: From Materials to Applications 2017

Conference Chairs: **Gilles Léron del**, Univ. de Technologie Troyes (France); **Satoshi Kawata**, Osaka Univ. (Japan); **Yong-Hoon Cho**, KAIST (Korea, Republic of)

Program Committee: **Sanford A. Asher**, Univ. of Pittsburgh (USA); **Steve Blair**, The Univ. of Utah (USA); **Zhanghai Chen**, Fudan Univ. (China); **Yasin Ekinci**, Paul Scherrer Institut (Switzerland); **Naomi J. Halas**, Rice Univ. (USA); **Hans D. Hallen**, North Carolina State Univ. (USA); **Chennupati Jagadish**, The Australian National Univ. (Australia); **Junyong Kang**, Xiamen Univ. (China); **Yoichi Kawakami**, Kyoto Univ. (Japan); **Jong Kyu Kim**, Pohang Univ. of Science and Technology (Korea, Republic of); **Paul T. Matsudaira**, National Univ. of Singapore (Singapore); **Eva Monroy**, CEA Grenoble (France); **Keith A. Nugent**, Univ. of Melbourne (Australia); **Yukihiro Ozaki**, Kwansai Gakuin Univ. (Japan); **Jérôme Plain**, Univ. de Technologie de Troyes (France); **Atsushi Taguchi**, Osaka Univ. (Japan); **Richard P. Van Duyne**, Northwestern Univ. (USA); **Remo Proietti Zaccaria**, Istituto Italiano di Tecnologia (Italy)

### SUNDAY 6 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 10 . . . SUN 8:00 AM TO 10:00 AM

#### UV and Higher Energy Materials and Light Sources I

Session Chair: **Yong-Hoon Cho**, KAIST (Korea, Republic of)

8:00 am: **Research on AlGaIn deep UV lasers and B-III-N alloys** (*Invited Paper*), Xiaohang Li, King Abdullah Univ. of Science and Technology (Saudi Arabia) . . . . . [10351-1]

8:30 am: **Challenges and breakthroughs in the development of AlGaIn-based UVC lasers**, Ramon Collazo, North Carolina State Univ. (USA); Ronny Kirste, Adroit Materials, Inc. (USA); Zlatko Sitar, North Carolina State Univ. (USA) and Adroit Materials, Inc. (USA) . . . . . [10351-2]

8:50 am: **Broadband ultraviolet light emitter based on GaN quantum dots on truncated pyramids**, Jong-Hoi Cho, Seung-Hyuk Lim, Min Ho Jang, KAIST (Korea, Republic of); Samuel Matta, Julien Brault, Ctr. de Recherche sur l'Hétéro-Epitaxie et ses Applications (France); Yong-Hoon Cho, KAIST (Korea, Republic of) [10351-3]

9:10 am: **A design of energy detector for ArF excimer lasers**, Zebin Feng, Academy of Opto-Electronics, CAS (China) and Univ. of Chinese Academy of Sciences (China); Xiaoquan Han, Yi Zhou, Lujun Bai, Academy of Opto-Electronics, CAS (China) . . . . . [10351-4]

9:30 am: **Formation of p-type ZnO through cocktail implantation** (*Invited Paper*), Wei-Yen Woon, National Central Univ. (Taiwan) . . . . . [10351-5]

Coffee Break . . . . . Sun 10:00 am to 10:30 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 10 . . SUN 10:30 AM TO 12:00 PM

#### UV and Higher Energy Materials and Light Sources II

Session Chair: **Xiaohang Li**, King Abdullah Univ. of Science and Technology (Saudi Arabia)

10:30 am: **Performance stability of reflection-mode AlGaIn photocathode under different preparation methods**, Junju Zhang, Yijun Zhang, Nanjing Univ. of Science and Technology (China) . . . . . [10351-6]

10:50 am: **FUV-DUV spectra of graphene, carbon nanotubes, and polymer nanocomposites**, Kenta Kobashi, Kwansai Gakuin Univ. (Japan); Yusuke Morisawa, Kindai Univ. (Japan); Krzysztof Bec, Kwansai Gakuin Univ. (Japan); Ichiro Tanabe, Osaka Univ. (Japan); Masahiro Ehara, Institute for Molecular Science (Japan) and Kyoto Univ. (Japan); Harumi Sato, Kobe Univ. (Japan); Yukihiro Ozaki, Kwansai Gakuin Univ. (Japan) . . . . . [10351-7]

11:10 am: **Extended polariton condensate of GaN microwire with whispering gallery mode at room temperature**, Hyun Gyu Song, Min Kwan Kim, Min-Sik Kwon, Sunghan Choi, Kie Yong Woo, Yong-Hoon Cho, KAIST (Korea, Republic of) . . . . . [10351-8]

11:30 am: **Tunnel junctions based ultra-violet light emitting diodes** (*Invited Paper*), Siddharth Rajan, Yuewei Zhang, Jamal-Eddine Zane, Fatih Akylol, The Ohio State Univ. (USA) . . . . . [10351-9]

Lunch Break . . . . . Sun 12:00 pm to 1:30 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 10 . . . . . SUN 1:30 PM TO 2:50 PM

#### UV and Higher Energy Materials and Light Sources III

Session Chair: **Satoshi Kawata**, Osaka Univ. (Japan)

1:30 pm: **Recent advances in metals for plasmonics applications in the UV range** (*Invited Paper*), Yael Gutiérrez, Francisco González, José M. Saiz, Rodrigo Alcaraz de la Osa, Univ. de Cantabria (Spain); Juan M. Sanz, Textil Santanderina SA (Spain) and Univ. de Cantabria (Spain); Dolores Ortiz, Univ. de Cantabria (Spain); Henry O. Everitt, U.S. Army Aviation and Missile Command (USA) and Duke Univ. (USA); Fernando Moreno, Univ. de Cantabria (Spain) . . . . . [10351-10]

2:00 pm: **Reduction of plasmon damping in aluminum nanoparticles with rapid thermal annealing**, Feifei Zhang, Julien Proust, Davy Gerard, Jérôme Plain, Jérôme Martin, Univ. de Technologie Troyes (France) . . . . . [10351-11]

2:20 pm: **Aluminum plasmonics for UV nanooptics** (*Invited Paper*), Jérôme Martin, Davy Gerard, Jérôme Plain, Dmitry Khlopin, Feifei Zhang, Julien Proust, Univ. de Technologie Troyes (France) . . . . . [10351-12]

#### SESSION 4

LOCATION: CONV. CTR. ROOM 10 . . . . . SUN 2:50 PM TO 3:10 PM

#### UV and Higher Energy Spectroscopy

Session Chair: **Fernando Moreno**, Univ. de Cantabria (Spain)

2:50 pm: **Sample photodegradation and protection in UV resonance Raman spectroscopy**, Yasuaki Kumamoto, Kyoto Prefectural Univ. of Medicine (Japan) . . . . . [10351-13]

## SESSION 5

LOCATION: CONV. CTR. ROOM 10 . . . . SUN 3:10 PM TO 4:40 PM

### Applications of UV, Deep UV, Vacuum UV, and Extreme UV Photonics

Session Chair: **Fernando Moreno**, Univ. de Cantabria (Spain)

3:10 pm: **The role of light interference in the formation of laser-induced shallow pits from metal micro-particles on glass**, Eyal Feigenbaum, Omer Malik, Alexander M. Rubenchik, Manyalibo J. Matthews, Lawrence Livermore National Lab. (USA) . . . . . [10351-14]

Coffee Break . . . . . Sun 3:30 pm to 3:50 pm

3:50 pm: **Changes in electronic states of molecules resulted from interactions in the condensed phase** (*Invited Paper*), Yusuke Morisawa, Nami Ueno, Kindai Univ. (Japan); Shin Tachibana, Kwansai Gakuin Univ. (Japan); Masahiro Ehara, Institute of Molecular Science (Japan); Yukihiro Ozaki, Kwansai Gakuin Univ. (Japan) . . . . . [10351-15]

4:20 pm: **A measurement validated model for an infrared laser induced filament damage formation in fused silica glass**, Eyal Feigenbaum, Ted A. Laurence, Lawrence Livermore National Lab. (USA) . . . . . [10351-16]

## SESSION 6

LOCATION: CONV. CTR. ROOM 10 . . . . SUN 4:40 PM TO 6:00 PM

### UV and Deep UV Biosensing and Analysis with UV and Higher Energy Photonics

Session Chair: **Gilles Lérondel**, Univ. de Technologie Troyes (France)

4:40 pm: **Multiphoton ultraviolet excitation allows label free ratiometric imaging of neurotransmitters** (*Invited Paper*), Sudipta Maiti, Tata Institute of Fundamental Research (India) . . . . . [10351-17]

5:10 pm: **Enhanced thermoelectrical properties of new doped conjugated polymers**, Jiaee Lee, Han Young Woo, Korea Univ. (Korea, Republic of) . [10351-18]

5:30 pm: **DNA methylation detection using nano bowtie antenna enhanced Raman spectroscopy** (*Invited Paper*), Shuang Fang Lim, Ling Li, Robert E. Riehn, Hans D. Hallen, North Carolina State Univ. (USA) . . . . . [10351-19]

LOCATION: CONV. CTR. ROOM 6A . . SUN 6:00 PM TO 7:50 PM

### Technology Hot Topics: How Optics and Photonics Drive Innovation

6:00 pm to 6:10 pm: **Welcome and Opening Remarks**

6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)

6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)

6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)

7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)

7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)

## MONDAY 7 AUGUST

LOCATION: CONV. CTR. ROOM 6A MON 9:00 AM TO 12:00 PM

### Nanoscience + Engineering Plenary Session

Session Chairs: **Harry A. Atwater Jr.**, California Institute of Technology (USA); **Nikolay I. Zheludev**, Optoelectronics Research Ctr. (United Kingdom)

9:15 am: **3D laser nanolithography** (*Plenary*), Martin Wegener, Karlsruhe Institut für Technologie (Germany) . . . . . [10354-500]

Coffee Break . . . . . Mon 10:00 am to 10:30 am

10:30 am: **Controlling light at the atomic scale** (*Plenary*), F. Javier García de Abajo, ICFO - Institut de Ciències Fotòniques (Spain) . . . . . [10359-500]

11:15 am: **Science, engineering, and commercialization of flexible, printable 2D atomic materials and devices** (*Invited Paper*), Deji Akinwande, The Univ. of Texas at Austin (USA) . . . . . [10349-500]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 . . . . . MON 5:30 PM TO 7:30 PM

### Posters-Monday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Smartphone incorporated on-site crude oil analyzer based on CMOS image sensor**, Sangwoo Oh, Korea Research Institute of Ships and Ocean Engineering (Korea, Republic of); Kiyounn Ann, Dongmin Seo, Sanghoon Shin, Euijin Han, Korea Univ. (Korea, Republic of); Moonjin Lee, Korea Research Institute of Ships and Ocean Engineering (Korea, Republic of); Sungkyu Seo, Korea Univ. (Korea, Republic of) . . . . . [10351-20]

**Real-time label-free detection and sizing of protein molecules using a deep UV microfluidic platform**, Pavankumar Challa, Quentin Peter, Maya A. Wright, Yuewen Zhang, Jacqueline A. Carozza, Tuomas P. J. Knowles, Univ. of Cambridge (United Kingdom) . . . . . [10351-21]

**Probing Li-ion transport at carbon anode/solid electrolyte interfaces using in operando SEM**, Alexander Yulaev, National Institute of Standards and Technology (USA) and UMD (USA); Vladimir Oleshko, Paul Haney, National Institute of Standards and Technology (USA); A. Alec Talin, Sandia National Laboratories (USA); Marina S. Leite, Univ. of Maryland, College Park (USA); Andrei Kolmakov, National Institute of Standards and Technology (USA) . . . . . [10351-22]

# CONFERENCE 10352

LOCATION: CONV. CTR. ROOM 5A

Sunday–Monday 6–7 August 2017 • Proceedings of SPIE Vol. 10352

## Biosensing and Nanomedicine X

*Conference Chairs:* **Hooman Mohseni**, Northwestern Univ. (USA); **Massoud H. Agahi**, Harbor-UCLA Medical Ctr. (USA), Cedars-Sinai Medical Ctr. (USA); **Manijeh Razeghi**, Northwestern Univ. (USA)

*Program Committee:* **Gert Cauwenberghs**, Univ. of California, San Diego (USA); **Philippe M. Fauchet**, Vanderbilt Univ. (USA); **Ryan M. Gelfand**, CREOL, The College of Optics and Photonics, Univ. of Central Florida (Canada); **David H. Gracias**, Johns Hopkins Univ. (USA); **Kimberly S. Hamad-Schifferli**, Massachusetts Institute of Technology (USA); **Yu-Hwa Lo**, Univ. of California, San Diego (USA); **Omer G. Memis**, Northwestern Univ. (USA); **Masoud Panjehpour**, Thompson Cancer Survival Ctr. (USA); **Qimin Quan**, Harvard Univ. (USA); **Björn M. Reinhard**, Boston Univ. (USA); **Luisa Torsi**, Univ. degli Studi di Bari Aldo Moro (Italy); **Adam T. Woolley**, Brigham Young Univ. (USA); **John M. Zavada**, Polytechnic Institute of New York Univ. (USA)

### SUNDAY 6 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 5A .. SUN 8:30 AM TO 10:10 AM

#### Plasmonic Biosensing I

Session Chairs: **Hooman Mohseni**, Northwestern Univ. (USA); **Stephanie Fraley**, Univ. of California, San Diego (USA)

8:30 am: **Upconverting nanoparticles as optical sensors of nano- to micro-Newton forces**, Alice Lay, Derek S. Wang, Michael D. Wisser, Yang Zhao, Randy D. Mehlenbacher, Yu Lin, Stanford Univ. (USA); Holger Fehlauer, Stanford School of Medicine (USA); Michael Krieg, Wendy L. Mao, Miriam B. Goodman, Jennifer A. Dionne, Stanford Univ. (USA) ..... [10352-1]

8:50 am: **Plasmonic active rotary nanomotors for tunable biochemical release, removal, and microfluidic manipulation** (*Invited Paper*), Donglei Fan, The Univ. of Texas at Austin (USA) ..... [10352-2]

9:20 am: **Plasmonic biosensors for resource-limited settings** (*Invited Paper*), Srikanth Singamaneni, Washington Univ. in St. Louis (USA) ..... [10352-3]

9:50 am: **Novel approaches towards practical applications of CMOS-compatible integrated surface enhanced Raman scattering sensors**, Cuong Nguyen, William Thrift, Qiancheng Zhao, Mahsa Darvishzadeh-Varcheie, Arunima Bhattacharjee, Allon I. Hochbaum, Filippo Capolino, Ozdal Boyraz, Regina Ragan, Univ. of California, Irvine (USA) ..... [10352-4]

Coffee Break ..... Sun 10:10 am to 10:40 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 5A . SUN 10:40 AM TO 11:30 AM

#### Plasmonic Biosensing II

Session Chair: **Iman Hassani Nia**, Northwestern Univ. (USA)

10:40 am: **Exploring plasmonic nanoantenna arrays as a platform for biosensing** (*Invited Paper*), Kimani C. Toussaint Jr., Univ. of Illinois at Urbana-Champaign (USA) ..... [10352-5]

11:10 am: **Real-time label-free detection and sizing of protein molecules using a deep UV microfluidic platform**, Pavankumar Challa, Quentin Peter, Maya A. Wright, Yüewen Zhang, Jacqueline A. Carozza, Tuomas P. J. Knowles, Univ. of Cambridge (United Kingdom) ..... [10352-6]

Lunch Break ..... Sun 11:30 am to 1:20 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 5A .... SUN 1:20 PM TO 3:30 PM

#### Bio-Imaging

Session Chair: **Hooman Mohseni**, Northwestern Univ. (USA)

1:20 pm: **An automatic holographic adaptive phoropter** (*Keynote Presentation*), Gholam A. Peyman, Nasser N. Peyghambarian, Jim Schwiegerling, Babak Amirsoleimani, College of Optical Sciences, The Univ. of Arizona (USA) . . [10352-9]

2:10 pm: **Simultaneous multimodal ophthalmic imaging with spectrally encoded scanning laser ophthalmoscopy and optical coherence tomography at 400 kHz** (*Invited Paper*), Mohamed T. El-Haddad, Ivan Bozic, Joseph D. Malone, Jianwei D. Li, Amber M. Arquitola, Shriji N. Patel, Karen M. Joos, Yuankai K. Tao, Vanderbilt Univ. (USA) ..... [10352-10]

2:40 pm: **Multiplexed surface-enhanced Raman immunosensing in vivo with gold nanoantennas**, Rizia Bardhan, Yu-Chuan Ou, Joseph Webb, Vanderbilt Univ. (USA) ..... [10352-11]

3:00 pm: **Nanophotonics-enhanced intraocular pressure sensor for glaucoma management** (*Invited Paper*), Hyuck Choo, Jeong Eon Lee, Haeri Park, Vinayak Narasimhan, Blaise Ndjamen, California Institute of Technology (USA); Juan Du, David W. Sretavan, Univ. of California, San Francisco (USA) ..... [10352-12]

Coffee Break ..... Sun 3:30 pm to 3:50 pm

#### SESSION 4

LOCATION: CONV. CTR. ROOM 5A ... SUN 3:50 PM TO 6:00 PM

#### Novel Biosensing Methods

Session Chairs: **Srikanth Singamaneni**, Washington Univ. in St. Louis (USA); **Drew Hall**, Univ. of California, San Diego (USA)

3:50 pm: **Enabling rapid, quantitative detection of bacteria in blood with high resolution DNA melting, microfluidics, and machine learning** (*Invited Paper*), Stephanie Fraley, Daniel Ortiz Velez, Hannah Mack, Julietta Jupe, Sinead Hawker, Ninad Kulkarni, Behnam Hedayatnia, Yang Zhang, Shelley Lawrence, Univ. of California, San Diego (USA) ..... [10352-13]

4:20 pm: **Nanostraw mediated non-perturbative cell access and transfection** (*Invited Paper*), Nicholas A. Melosh, Yuhong Cao, Martin Hjort, Stanford Univ. (USA) ..... [10352-14]

4:50 pm: **Double emulsion electrospun nanofibers as a growth factor delivery vehicle for salivary gland regeneration**, Zahraa I. Foraida, SUNY Polytechnic Institute (USA); Alexander T. Khmaladze, Deirdre A. Nelson, Melinda Larsen, Univ. at Albany (USA); James Castracane, SUNY Polytechnic Institute (USA) . [10352-15]

5:10 pm: **Magneto-resistive biosensors for quantitative proteomics** (*Invited Paper*), Xiahuan Zhou, Chih-Cheng Huang, Drew Hall, Univ. of California, San Diego (USA) ..... [10352-16]

5:40 pm: **Micro-array isolation of circulating tumor cells: the nanotube-CTC chip**, Balaji Panchapakesan, Farhad Khosravi, Worcester Polytechnic Institute (USA); Eric Wickstrom, Thomas Jefferson Univ. (USA); Shesh N. Rai, Univ. of Louisville (USA); Alison Zibelli, Thomas Jefferson Univ. (USA); Goetz Kloecker, Univ. of Louisville (USA) ..... [10352-17]

LOCATION: CONV. CTR. ROOM 6A .. SUN 6:00 PM TO 7:50 PM

#### Technology Hot Topics: How Optics and Photonics Drive Innovation

6:00 pm to 6:10 pm: **Welcome and Opening Remarks**

6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)

6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)

6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)

7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)

7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)



## MONDAY 7 AUGUST

**LOCATION: CONV. CTR. ROOM 6A MON 9:00 AM TO 12:00 PM**

### Nanoscience + Engineering Plenary Session

Session Chairs: **Harry A. Atwater Jr.**, California Institute of Technology (USA); **Nikolay I. Zheludev**, Optoelectronics Research Ctr. (United Kingdom)

9:15 am: **3D laser nanolithography** (*Plenary*), Martin Wegener, Karlsruhe Institut für Technologie (Germany) . . . . . [10354-500]

Coffee Break . . . . . Mon 10:00 am to 10:30 am

10:30 am: **Controlling light at the atomic scale** (*Plenary*), F. Javier García de Abajo, ICFO - Institut de Ciències Fotòniques (Spain) . . . . . [10359-500]

11:15 am: **Science, engineering, and commercialization of flexible, printable 2D atomic materials and devices** (*Invited Paper*), Deji Akinwande, The Univ. of Texas at Austin (USA) . . . . . [10349-500]

Lunch Break . . . . . Mon 12:00 pm to 1:30 pm

### SESSION 5

**LOCATION: CONV. CTR. ROOM 5A . . . MON 1:30 PM TO 4:20 PM**

### Neural Sensing

Session Chair: **Hooman Mohseni**, Northwestern Univ. (USA)

1:30 pm: **Multi-area distributed network of implanted neural interrogators** (*Invited Paper*), David A. Borton, Marc Powell, Brown Univ. (USA) . . . . . [10352-18]

2:00 pm: **Advances in flexible optrode hardware for use in cybernetic insects** (*Invited Paper*), Joe Register, Dennis Callahan, Carlos Segura, John LeBlanc, Charles Lissandrello, Parshant Kumar, Chris Salthouse, Jesse Wheeler, Aaron Stoddard, Draper Lab. (USA) . . . . . [10352-19]

2:30 pm: **Electronic, optical, and chemical interrogation of neural circuits with multifunctional fibers** (*Invited Paper*), Andres Canales, Seongjun Park, Chi Lu, Yoel Fink, Polina O. Anikeeva, Massachusetts Institute of Technology (USA) . . . . . [10352-20]

3:00 pm: **Neural signal transmission through brain tissue with high spatial and temporal resolution using near infrared light** (*Invited Paper*), Iman Hassani Nia, Skylar Wheaton, Michael Adoff, Daniel Dombek, Hooman Mohseni, Northwestern Univ. (USA) . . . . . [10352-21]

3:30 pm: **Inorganic semiconductor nanorods for neural voltage sensing**, Yung Kuo, Joonhyuck Park, Univ. of California, Los Angeles (USA); Shvadchak Volodymyr, Institute of Organic Chemistry and Biochemistry (Czech Republic); Kyoungwon Park, Antonino Ingargiola, Jack Li, Shimon Weiss, Univ. of California, Los Angeles (USA) . . . . . [10352-22]

3:50 pm: **Shedding light to sleep studies** (*Invited Paper*), Alper Bozkurt, James Dieffenderfer, North Carolina State Univ. (USA) . . . . . [10352-23]

### SESSION 6

**LOCATION: CONV. CTR. ROOM 5A . . . MON 4:40 PM TO 6:00 PM**

### Bio-Inspired Materials and Systems

Session Chairs: **David A. Borton**, Brown Univ. (USA); **Alper Bozkurt**, North Carolina State Univ. (USA)

4:40 pm: **Dynamic materials inspired by cephalopods** (*Invited Paper*), Alon Gorodetsky, Univ. of California, Irvine (USA) . . . . . [10352-24]

5:10 pm: **Microfluidic body-on-a-chip platforms for mimicking the human drug metabolism** (*Invited Paper*), Mandy Esch, Hidetaka Ueno, National Institute of Standards and Technology (USA); Yang Yang, Syracuse Univ. (USA) . . . [10352-25]

5:40 pm: **On-demand drawing of high aspect-ratio, microsphere-tipped elastomeric micropillars**, Qiang Li, Tara Mina, Jaeyoun Kim, Iowa State Univ. of Science and Technology (USA) . . . . . [10352-26]

**LOCATION: CONV. CTR.**

**EXHIBIT HALL B2 . . . . . MON 5:30 PM TO 7:30 PM**

### Posters-Monday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Modeling electrical response of biofluids**, Anays Acevedo Barrera, Univ. Nacional Autónoma de México (Mexico); Augusto García Valenzuela, Ctr. de Ciencias Aplicadas y Desarrollo Tecnológico (Mexico); Asur Guadarrama Santana, Univ. Nacional Autónoma de México (Mexico) . . . . . [10352-27]

**Scale-selective polarimetry of the birefringence distribution of myocardium tissue**, Olexander V. Dubolazov, Alexander Ushenko, Vladimir Ushenko, Yuriy Fedkovych Chernivtsi National Univ. (Ukraine) . . . . . [10352-28]

**Wavelet analysis of myocardium polarization images in problems of diagnostic of necrotic changes**, Olexander V. Dubolazov, Alexander Ushenko, Vladimir Ushenko, Yuriy Fedkovych Chernivtsi National Univ. (Ukraine) . . . . . [10352-29]

**Electrical characteristics of Graphene Based Field Effect Transistor (GFET) biosensor for ADH detection**, Azrul Azlan Hamzah, Reena S. Selvarajan, Burhanuddin Y. Majlis, Univ. Kebangsaan Malaysia (Malaysia) . . . . . [10352-30]

**System of Mueller matrix polarization correlometry of biological polycrystalline layers**, Olexander V. Dubolazov, Alexander Ushenko, Yuriy Fedkovych Chernivtsi National Univ. (Ukraine) . . . . . [10352-31]

**Two-point Stokes vector parameters of object field for diagnosis and differentiation of optically anisotropic biological tissues**, Olexander V. Dubolazov, Alexander Ushenko, Yuriy Fedkovych Chernivtsi National Univ. (Ukraine) . . . . . [10352-32]

**Photochemically synthesized heparin-based silver nanoparticles antimicrobial activity study**, Pilar Rodriguez-Torres, Laura Susana Acosta Torres, Univ. Nacional Autónoma de México (Mexico); Luis Armando Díaz Torres, Centro de Investigaciones en Óptica, A.C. (Mexico); Paloma Netzayelli Serrano Díaz, Univ. Nacional Autónoma de México (Mexico) . . . . . [10352-33]

**Jones matrix polarization-correlation mapping of biological crystals networks**, Olexander V. Dubolazov, Yuriy Fedkovych Chernivtsi National Univ. (Ukraine) . . . . . [10352-34]

**Surface enhanced Raman spectroscopy in the prescence of hydroquinone assisted by gold nanorods**, Rodrigo Cabrera Alonzo, Francisco Javier González, Univ. Autónoma de San Luis Potosí (Mexico) . . . . . [10352-35]

**Photonic-plasmonic hybrid single molecule nanosensor measures the effect of fluorescence labels to DNA-protein dynamics**, Feng Liang, The Rowland Institute at Harvard (USA); Yuzheng Guo, Swansea Univ. (United Kingdom); Qimin Quan, Shaocong Hou, The Rowland Institute at Harvard (USA) . . . . . [10352-36]

**Biocompatibility and toxicity of colloidal plasmonic titanium nitride nanoparticles in epithelial cells**, Tejaswini Ronur Praful, Norfolk State Univ. (USA); Urcan Guler, Alexandra Boltasseva, Vladimir M. Shalaev, Purdue Univ. (USA); Nicholas A. Kotov, Univ. of Michigan (USA); Govindarajan T. Ramesh, Norfolk State Univ. (USA) . . . . . [10352-37]

**Innovative strategies in hepatic tissue engineering**, Laila M. Montaser M.D., Menoufia Univ. (Egypt); Sherin M. Fawzy, Society for Research on Nicotine and Tobacco (Egypt) . . . . . [10352-38]

# CONFERENCE 10353

LOCATION: CONV. CTR. ROOM 3

Wednesday–Thursday 9–10 August 2017 • Proceedings of SPIE Vol. 10353

## Optical Sensing, Imaging, and Photon Counting: Nanostructured Devices and Applications 2017

*Conference Chairs:* **Manijeh Razeghi**, Northwestern Univ. (USA); **Oleg Mitrofanov**, Univ. College London (United Kingdom); **José Luis Pau Vizcaíno**, Univ. Autónoma de Madrid (Spain); **Chee Hing Tan**, The Univ. of Sheffield (United Kingdom)

*Program Committee:* **Ravi Athale**, Office of Naval Research (USA); **Jeremy J. Baumberg**, Univ. of Cambridge (United Kingdom); **Gail J. Brown**, Air Force Research Lab. (USA); **Arvind I. D'Souza**, DRS Sensors & Targeting Systems, Inc. (USA); **Takeharu Goji Etoh**, Ritsumeikan Univ. (Japan); **Sergio Fernandez-Garrido**, Paul-Drude-Institut für Festkörperelektronik (Germany); **Robert J. Grasso**, EOIR Technologies (USA); **Christoph H. Grein**, Univ. of Illinois at Chicago (USA); **Carl Jackson**, SensL (Ireland); **Gerasimos Konstantatos**, ICFO - Institut de Ciències Fotòniques (Spain); **Jay Lewis**, Defense Advanced Research Projects Agency (USA); **Aizhen Li**, Shanghai Institute of Microsystem and Information Technology (China); **Ryan McClintock**, Northwestern Univ. (USA); **Philip Perconti**, U.S. Army Research Lab. (USA); **Ronen Rapaport**, The Hebrew Univ. of Jerusalem (Israel); **Andrés Redondo-Cubero**, Univ. Autónoma de Madrid (Spain); **Carlos Rivera**, Ingeniería de Sistemas para la Defensa de España (Spain); **Javier Miguel Sánchez**, Heptagon Micro Optics Pte. Ltd. (Switzerland); **Christian Seassal**, Ecole Centrale de Lyon (France); **Carlo Sirtori**, Univ. Paris 7-Denis Diderot (France); **Dorota S. Temple**, RTI International (USA); **Jose María M. Ulloa**, Univ. Politécnica de Madrid (Spain); **Usha Varshney**, National Science Foundation (USA); **Yong-Hang Zhang**, Arizona State Univ. (USA)

### MONDAY 7 AUGUST

LOCATION: CONV. CTR. ROOM 6A MON 9:00 AM TO 12:00 PM

#### Nanoscience + Engineering Plenary Session

Session Chairs: **Harry A. Atwater Jr.**, California Institute of Technology (USA); **Nikolay I. Zheludev**, Optoelectronics Research Ctr. (United Kingdom)

9:15 am: **3D laser nanolithography** (*Plenary*), Martin Wegener, Karlsruher Institut für Technologie (Germany) . . . . . [10354-500]

Coffee Break . . . . . Mon 10:00 am to 10:30 am

10:30 am: **Controlling light at the atomic scale** (*Plenary*), F. Javier García de Abajo, ICFO - Institut de Ciències Fotòniques (Spain) . . . . . [10359-500]

11:15 am: **Science, engineering, and commercialization of flexible, printable 2D atomic materials and devices** (*Invited Paper*), Deji Akinwande, The Univ. of Texas at Austin (USA) . . . . . [10349-500]

### WEDNESDAY 9 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 3 . . . WED 8:15 AM TO 10:20 AM

#### Optical Detectors I

Session Chair: **Oleg Mitrofanov**, Univ. College London (United Kingdom)

8:15 am: **UV and IR photodetection in single GaN/AlN nanowires** (*Invited Paper*), Jonas Lähnemann, Paul-Drude-Institut für Festkörperelektronik (Germany) and Univ. Grenoble-Alpes (France) and Institut Néel (France); Martien I. den Hertog, Univ. Grenoble-Alpes (France) and Institut Néel (France) and CEA-INAC-PHELIQS (France); Akhil Ajay, Maria Spies, Jakub Polaczyński, Univ. Grenoble-Alpes (France) and CEA-INAC-PHELIQS (France) and Institut Néel (France); Pascal Hille, Justus-Liebig-Universität Giessen (Germany); María de la Mata, Institut Català de Nanociència i Nanotecnologia (ICN2) (Spain); Jörg Schörmann, Justus-Liebig-Universität Giessen (Germany); Jordi Arbiol, Institut Català de Nanociència i Nanotecnologia (ICN2) (Spain); Martin Eickhoff, Justus-Liebig-Universität Giessen (Germany); Bruno Gayral, Eva Monroy, Univ. Grenoble-Alpes (France) and CEA-INAC-PHELIQS (France) and Institut Néel (France) . . . . . [10353-1]

8:40 am: **Colloidal quantum dots for mid-IR detection and emission** (*Invited Paper*), Philippe Guyot-Sionnest, The Univ. of Chicago (USA) . . . . . [10353-2]

9:05 am: **Infrared imaging using low-cost II-VI colloidal quantum dots** (*Invited Paper*), Richard E. Pimpinella, Christopher Buurma, Anthony J. Ciani, Christoph H. Grein, Sivananthan Labs., Inc. (USA); Philippe Guyot-Sionnest, The Univ. of Chicago (USA) . . . . . [10353-3]

9:30 am: **Interesting problems in superlattice detectors** (*Invited Paper*), Sanjay Krishna, The Ohio State Univ. (USA) . . . . . [10353-4]

9:55 am: **ZnO: from material to unipolar devices** (*Invited Paper*), Maxime Hugues, Ctr. de Recherches sur l'Hétéro-Epitaxie et ses Applications (France); Nolwenn Le Biavan, Denis Lefebvre, Ctr. de Recherche sur l'Hétéro-Epitaxie et ses Applications (France); Miguel Montes Bajo, Julien Tamayo-Arriola, Adrian Hierro, Univ. Politécnica de Madrid (Spain); Arnaud Jollivet, Maria Tchernycheva, François H. Julien, Univ. Paris-Sud 11 (France); Jean-Michel Chauveau, Ctr. de Recherche sur l'Hétéro-Epitaxie et ses Applications (France) . . . . . [10353-5]

Coffee Break . . . . . Wed 10:20 am to 10:50 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 3 . . . WED 10:50 AM TO 12:20 PM

#### Single Photon Detectors and Counters I

Session Chair: **José Luis Pau Vizcaíno**, Univ. Autónoma de Madrid (Spain)

10:50 am: **Single-photon detection and imaging by using superconducting nanowires** (*Invited Paper*), Karl K. Berggren, Qing-Yuan Zhao, Andrew E. Dane, Di Zhu, Massachusetts Institute of Technology (USA) . . . . . [10353-6]

11:15 am: **Ultrafast single photon detectors** (*Invited Paper*), Wolfram Pernice, Simone Ferrari, Westfälische Wilhelms-Universität Münster (Germany) . . . . . [10353-7]

11:40 am: **Time jitter and time walk in SLiK APD: characterization, measurements and implications for single photon counting applications**, Bernicy S. Fong, Excelitas Canada, Inc. (Canada); Murray Davies, Excelitas Canada Inc. (Canada); Pierre Deschamps, Excelitas Canada, Inc. (Canada) . . . . . [10353-8]

12:00 pm: **Modeling single photon detection**, Majeed M. Hayat, The Univ. of New Mexico (USA) . . . . . [10353-9]

Lunch/Exhibition Break . . . . . Wed 12:20 pm to 1:50 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 3 . . . . WED 1:50 PM TO 3:00 PM

#### Single Photon Detectors and Counters II

Session Chair: **Basilio Javier García**, Univ. Autónoma de Madrid (Spain)

1:50 pm: **Depth imaging using single photon detection** (*Invited Paper*), Gerald S. Buller, Aongus McCarthy, Ximing Ren, Aurora MacCarone, Rachael Tobin, Abderrahim Halimi, Yoann Altmann, Yvan R. Petillot, Stephen McLaughlin, Andrew M. Wallace, Heriot-Watt Univ. (United Kingdom) . . . . . [10353-10]

2:15 pm: **Smart single-photon detectors in CMOS technology** (*Invited Paper*), Angel Rodríguez-Vázquez, Univ. de Sevilla (Spain) . . . . . [10353-11]

2:40 pm: **Hot-spot relaxation time current dependence in niobium nitride waveguide-integrated superconducting nanowire single-photon detectors**, Simone Ferrari, Wolfram Pernice, Westfälische Wilhelms-Universität Münster (Germany) . . . . . [10353-12]

Coffee Break . . . . . Wed 3:00 pm to 3:30 pm

## SESSION 4

LOCATION: CONV. CTR. ROOM 3 . . . . WED 3:30 PM TO 5:05 PM

### Novel Concepts in Nanoengineered Sensors

Session Chair: **Jonas Lähnemann**, Paul-Drude-Institut für Festkörperelektronik (Germany)

3:30 pm: **Electromechanically tunable photonic crystal sensors for integrated spectrometry and nanometrology** (*Invited Paper*), Zarko Zobenica, Rob W. van der Heijden, Maurangelo Petruzella, Francesco M. Pagliano, Technische Univ. Eindhoven (Netherlands); Rick Leijssen, FOM Institute for Atomic and Molecular Physics (Netherlands); Tian Xia, Leonardo Midolo, Michele Cotrufo, Yongjin Cho, Frank W. M. van Otten, Technische Univ. Eindhoven (Netherlands); Ewold Verhagen, FOM Institute for Atomic and Molecular Physics (Netherlands); Andrea Fiore, Technische Univ. Eindhoven (Netherlands) . . . . . [10353-13]

3:55 pm: **Photodetector fabrication by dielectrophoretic assembly of GaAs nanowires grown by a two-steps method** (*Invited Paper*), Basilio J. García, Univ. Autónoma de Madrid (Spain); Carlos García Nuñez, Univ. Autónoma de Madrid (Spain) and Univ. of Glasgow (United Kingdom); Alejandro F. Braña, Univ. Autónoma de Madrid (Spain); Nair López, Univ. Politécnica de Madrid (Spain); José L. Pau, Univ. Autónoma de Madrid (Spain) . . . . . [10353-14]

4:20 pm: **Near-unity absorption in atomically thin optoelectronic devices with high quantum efficiency** (*Invited Paper*), Deep Jariwala, California Institute of Technology (USA) . . . . . [10353-15]

4:45 pm: **Photonic waveguide based evanescent excitation and near-field collection for improved surface to bulk fluorescence separation**, Md. Mahmud-Ul-Hasan, KU Leuven (Belgium) and IMEC (Belgium); Pieter Neutens, Rita Vos, IMEC (Belgium); Liesbet Lagae, Pol Van Dorpe, IMEC (Belgium) and KU Leuven (Belgium) . . . . . [10353-16]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 . . . . . WED 5:30 PM TO 7:30 PM

### Posters-Wednesday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Scalable nanoantennas**, Dmitrii Poletaev, Bogdan V. Sokolenko, Anna Kovaleva, V.I. Vernadsky Crimean Federal Univ. (Russian Federation); Nikolay V. Petrov, Igor A. Shevkunov, ITMO Univ. (Russian Federation) . . . . . [10353-32]

**Etched multimode fiber Bragg gratings based refractometer**, Umesh Kumar Tiwari, Central Scientific Instruments Organisation (India); Siddharth Kaushik, Central Scientific Instrumentation Organisation (India) . . . . . [10353-33]

**HgTe quantum dot photovoltaic detector at 5 micron**, Matthew Ackerman, Philippe Guyot-Sionnest, The Univ. of Chicago (USA) . . . . . [10353-34]

**PbS quantum dots with long wavelength absorption for SWIR photodetectors**, Chen Dong, Jaewoong Lee, Shuyi Liu, Franky So, North Carolina State Univ. (USA) . . . . . [10353-35]

## THURSDAY 10 AUGUST

### SESSION 5

LOCATION: CONV. CTR. ROOM 3 . . . . THU 8:30 AM TO 10:05 AM

### Optical Detectors II

Session Chair: **Wolfram H.P. Pernice**, Westfälische Wilhelms-Univ. Münster (Germany)

8:30 am: **III-nitride terahertz photodetectors for the reststrahlen gap of intersubband optoelectronics** (*Invited Paper*), Roberto Paiella, Habibe Durmaz, Faisal F. Sudradjat, Denis Nothorn, Gordie C. Brummer, Wei Zhang, Jeffrey Woodward, Theodore D. Moustakas, Boston Univ. (USA) . . . . . [10353-17]

8:55 am: **Hybrid cavity for photo-conductive detectors with nanoantenna arrays and distributed Bragg reflectors** (*Invited Paper*), Oleg Mitrofanov, Univ. College London (United Kingdom) . . . . . [10353-18]

9:20 am: **Light polarization sensitive photodetectors with non-polar and semi-polar homoepitaxial ZnO/ZnMgO MQWs** (*Invited Paper*), Gema Tabares, Univ. Autónoma de Madrid (Spain); Adrian Hierro, Alejandro Kurtz, Elias Muñoz, Univ. Politécnica de Madrid (Spain); Borge Vinter, Jean-Michel Chauveau, Ctr. de Recherche sur l'Hétéro-Epitaxie et ses Applications (France) . . . . . [10353-19]

9:45 am: **High-sensitivity refractometric sensor in a cylindrical resonator**, William Morrish, Peter West, Nathan West, Univ. of Alberta (Canada); Elizaveta Klantsataya, The Univ. of Adelaide (Australia); Kirsty Gardner, Stephen Lane, Raymond G. DeCorby, Univ. of Alberta (Canada); Alexandre François, Univ. of Adelaide (Australia); Al Meldrum, Univ. of Alberta (Canada) . . . . . [10353-20]

Coffee Break . . . . . Thu 10:05 am to 10:35 am

### SESSION 6

LOCATION: CONV. CTR. ROOM 3 . . . . THU 10:35 AM TO 12:50 PM

### Nanoscale Imaging Techniques and Applications

Session Chair: **Thierry Taliercio**, Institut d'Electronique du Sud (France)

10:35 am: **Time-resolved cathodoluminescence for wide bandgap nanostructures** (*Invited Paper*), Gwénolé Jacopin, Mehran Shahmohammadi, Wei Liu, Jean-François Carlin, Nicolas Grandjean, Benoit Deveaud, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . . [10353-21]

11:00 am: **Biaxial strain tuning of the optical properties of single-layer transition metal dichalcogenides** (*Invited Paper*), Riccardo Frisenda, Andres Castellanos-Gomez, David Perez de Lara, IMDEA Nanociencia (Spain) . . . . . [10353-22]

11:25 am: **Multi-purpose highly sensitive room temperature nano based detector** (*Invited Paper*), Yossi Paltiel, The Hebrew Univ. of Jerusalem (Israel) . . . . . [10353-23]

11:50 am: **Ratiometric 2D temperature mapping around plasmonic nanoparticles with one CCD using directional anisotropy in fluorescence**, Chen Chen, Zhidong Du, Liang Pan, Purdue Univ. (USA) . . . . . [10353-24]

12:10 pm: **Microring resonators for real-time study of antibody interaction**, Tatevik Chalyan, Univ. degli Studi di Trento (Italy); Geert A. J. Besselink, Eric Schreuder, Lennart Wevers, Floris H. Falke, René G. Heideman, Lionix BV (Netherlands); Lorenzo Pavesi, Univ. degli Studi di Trento (Italy) . . . . . [10353-25]

12:30 pm: **InP-based platform for sensing using telecom building blocks**, François Lelarge, Almae Technologies SAS (France) . . . . . [10353-36]

Lunch/Exhibition Break . . . . . Thu 12:50 pm to 2:00 pm

### SESSION 7

LOCATION: CONV. CTR. ROOM 3 . . . . THU 2:00 PM TO 4:20 PM

### Plasmonic Structures

Session Chair: **Gustavo Grinblat**, Imperial College London (United Kingdom)

2:00 pm: **Plasmonic bio-sensing based on highly doped semiconductors** (*Invited Paper*), Thierry Taliercio, Maria José Milla-Rodrigo, Fernando Gonzalez Posada Flores, Mario Bomers, Franziska B. Barho, Eric Tournié, Laurent Cerutti, Institut d'Electronique et des Systèmes (France) . . . . . [10353-26]

2:25 pm: **Low-loss dielectric nanoantennas for surface-enhanced spectroscopies and nonlinear photonics** (*Invited Paper*), Gustavo Grinblat, Yi Li, Javier Cambiasso, Toshishiko Shibanuma, Michael P. Nielsen, Emiliano Cortés, Pablo Albella Echave, Aliaksandra Rakovich, Rupert F. Oulton, Stefan A. Maier, Imperial College London (United Kingdom) . . . . . [10353-27]

2:50 pm: **Surface plasmon enhanced FRET**, Jennifer M. Steele, Chae Ramnarace, William Farner, Trinity Univ. (USA) . . . . . [10353-28]

Coffee Break . . . . . Thu 3:10 pm to 3:40 pm

3:40 pm: **Hydrogel-integrated plasmonic nanostructures on optical fiber facet for remote and real-time pH sensing**, Shijie Li, Wen-Di Li, The Univ. of Hong Kong (Hong Kong, China) . . . . . [10353-29]

4:00 pm: **Nanostructured diodes for the infrared detection through two photons absorption**, Baptiste Fix, Julien Jaeck, ONERA (France); Benjamin Vest, Lab. Charles Fabry (France); Jean-Luc Pelouard, Ctr. de Nanosciences et de Nanotechnologies (France); Riad Haïdar, ONERA (France) . . . . . [10353-30]



# CONFERENCE 10354

LOCATION: CONV. CTR. ROOM 19

Wednesday–Thursday 9–10 August 2017 • Proceedings of SPIE Vol. 10354

## Nanoengineering: Fabrication, Properties, Optics, and Devices XIV

*Conference Chairs:* **Eva M. Campo**, Bangor Univ. (United Kingdom); **Elizabeth A. Dobisz**, Spin Transfer Technologies, Inc. (USA); **Louay A. Eldada**, Quanergy Systems, Inc. (USA)

*Program Committee:* **André-Jean Attias**, Univ. Pierre et Marie Curie (France); **Maziar Ghazinejad**, California State Univ., Fresno (USA); **Sarah Haigh**, The Univ. of Manchester (United Kingdom); **Ghassan E. Jabbour**, Arizona State Univ. (USA); **Robert Magnusson**, The Univ. of Texas at Arlington (USA); **Balaji Panchapakesan**, Worcester Polytechnic Institute (USA); **Won Park**, Univ. of Colorado at Boulder (USA); **Dorota A. Pawlak**, Institute of Electronic Materials Technology (Poland); **Michael T. Postek**, National Institute of Standards and Technology (USA); **Dianne L. Poster**, National Institute of Standards and Technology (USA); **Anne E. Sakdinawat**, SLAC National Accelerator Lab. (USA); **Jun Tanida**, Osaka Univ. (Japan); **Richard Tiberio**, Stanford Univ. (USA); **Chee Wei Wong**, Columbia Univ. (USA); **Wei Wu**, The Univ. of Southern California (USA)

### MONDAY 7 AUGUST

LOCATION: CONV. CTR. ROOM 6A MON 9:00 AM TO 12:00 PM

#### Nanoscience + Engineering Plenary Session

Session Chairs: **Harry A. Atwater Jr.**, California Institute of Technology (USA); **Nikolay I. Zheludev**, Optoelectronics Research Ctr. (United Kingdom)

9:15 am: **3D laser nanolithography (Plenary)**, Martin Wegener, Karlsruher Institut für Technologie (Germany) . . . . . [10354-500]

Coffee Break . . . . . Mon 10:00 am to 10:30 am

10:30 am: **Controlling light at the atomic scale (Plenary)**, F. Javier García de Abajo, ICFO - Institut de Ciències Fotòniques (Spain). . . . . [10359-500]

11:15 am: **Science, engineering, and commercialization of flexible, printable 2D atomic materials and devices (Invited Paper)**, Deji Akinwande, The Univ. of Texas at Austin (USA). . . . . [10349-500]

### WEDNESDAY 9 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 19 . . WED 8:00 AM TO 10:00 AM

#### Photonic Devices

Session Chair: **Elizabeth A. Dobisz**, Spin Transfer Technologies, Inc. (USA)

8:00 am: **Large-scale fabrication of LP-CVD Si<sub>3</sub>N<sub>4</sub> photonic crystal structures as freestanding reflectors with 1 mm aperture for Fabry-Pérot interferometers**, Christian Helke, Karla Hiller, Technische Univ. Chemnitz (Germany); Marco Meinig, Steffen Kurth, Fraunhofer-Institut für Elektronische Nanosysteme (Germany); Christoph Nowak, Herberth Kleinjans, AMO GmbH (Germany); Thomas Otto, Fraunhofer-Institut für Elektronische Nanosysteme (Germany) . . . . . [10354-1]

8:20 am: **Actuated polymer based dielectric mirror for visual spectral range applications**, Pedro Pablo Vergara Gonzalez, Leda Lunardi, North Carolina State Univ. (USA) . . . . . [10354-2]

8:40 am: **Highly sensitive tunable room temperature infrared hybrid organic-nanocrystals detector**, Avner Neubauer, Shira Yochelis, Yossi Paltiel, The Hebrew Univ. of Jerusalem (Israel) . . . . . [10354-3]

9:00 am: **Pixel-sized guided-mode resonance filters for multispectral infrared focal plane arrays**, Antoine Bierret, ONERA (France) and Ctr. de Nanosciences et de Nanotechnologies (France); Grégory Vincent, ONERA (France); Fabrice Pardo, Lab. de Photonique et de Nanostructures (France); Jean-Luc Pelouard, Ctr. de Nanosciences et de Nanotechnologies (France); Riad Haïdar, ONERA (France) . . . . . [10354-4]

9:20 am: **Slotted photonic crystal nanobeams for enhanced light-matter interaction and optical forces**, Francis Afzal, Sharon M. Weiss, Vanderbilt Univ. (USA) . . . . . [10354-5]

9:40 am: **Color-selective and versatile light steering structure designed for up-scalable fabrication**, Giorgio Quaranta, Guillaume Basset, Benjamin Gallinet, Ctr. Suisse d'Electronique et de Microtechnique SA (Switzerland); Olivier J. F. Martin, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . . [10354-6]

Coffee Break . . . . . Wed 10:00 am to 10:30 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 19 . . WED 10:30 AM TO 12:10 PM

#### Innovative Devices

Session Chair: **Wei Wu**, The Univ. of Southern California (USA)

10:30 am: **Novel Light Effect Transistors (LET) based on hybrid Coupled Organic-Inorganic Nanostructures (COINs)**, Kai Braun, Alexander Andre, Marcus Scheele, Alfred J. Meixner, Eberhard Karls Univ. Tübingen (Germany) . . . [10354-7]

10:50 am: **Capacitive-based adiabatic logic**, Yann Perrin, Gaël Pillonnet, CEA-LETI (France) . . . . . [10354-8]

11:10 am: **Nanoimprinting optical fibers**, Peipei Jia, The Univ. of Adelaide (Australia); Depeng Kong, Xi'an Institute of Optics and Precision Mechanics, CAS (China); Heike Ebendorff-Heidepriem, The Univ. of Adelaide (Australia) . . [10354-9]

11:30 am: **Development of highly sensitive holographic devices for metal ion detection**, Sabad E. Gul, Suzanne Martin, John Cassidy, Izabela Naydenova, Dublin Institute of Technology (Ireland) . . . . . [10354-10]

11:50 am: **Pressure measurement using "photo-piezoelectric" effect: new MEMS design**, Boris Oskolkov, Saint-Petersburg State Univ. of Aerospace Instrumentation (Russian Federation) . . . . . [10354-11]

Lunch/Exhibition Break . . . . . Wed 12:10 pm to 2:00 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 19 . . . WED 2:00 PM TO 3:00 PM

#### Nanopatterning

Session Chair: **Elizabeth A. Dobisz**, Spin Transfer Technologies, Inc. (USA)

2:00 pm: **Scalable maskless patterning of nanostructures using high-speed scanning electrical probe arrays**, Chen Chen, Zhidong Du, Liang Pan, Purdue Univ. (USA) . . . . . [10354-13]

2:20 pm: **Self-catalyzed patterned growth of GaAs(Sb), GaAsSbN nanowires by molecular beam epitaxy**, Manish Sharma, Joint School of Nanoscience and Nanoengineering (USA); Pavan K. Kasanaboina, North Carolina A&T State Univ. (USA); Md Rezaul Karim, Joint School of Nanoscience and Nanoengineering (USA); Shanthi Iyer, North Carolina A&T State Univ. (USA) . . . . . [10354-14]

2:40 pm: **Innovative patterning method for modifying few-layer MoS<sub>2</sub> device geometries**, Fernando Jiménez Urbanos, Andrés Black, IMDEA Nanoscience (Spain); Ramón Bernardo Gavito, Lancaster Univ. (United Kingdom); Manuel R. Osorio, Santiago Casado, Daniel Granados, IMDEA Nanoscience (Spain) [10354-15]

Coffee Break . . . . . Wed 3:00 pm to 3:20 pm

## SESSION 4

LOCATION: CONV. CTR. ROOM 19 . . . . WED 3:20 PM TO 5:30 PM

### Engineered Materials

Session Chair: **Eva M. Campo**, Bangor Univ. (United Kingdom)

- 3:20 pm: **Update on bio-refining and nanocellulose composite materials manufacturing** (*Invited Paper*), Michael T. Postek, Dianne L. Poster, National Institute of Standards and Technology (USA) . . . . . [10354-16]
- 3:50 pm: **All dielectric metasurface nano-fabrication based on TiO<sub>2</sub> phase shifters**, Jeong Yub Lee, Jae Kwan Kim, Kiyeon Yang, Byonggwon Song, Yongsung Kim, Chang Seung Lee, Samsung Advanced Institute of Technology (Korea, Republic of) . . . . . [10354-17]
- 4:10 pm: **A nanostructure based on metasurfaces for optical interconnects**, Shulang Lin, Huarong Gu, Tsinghua Univ. (China) . . . . . [10354-18]
- 4:30 pm: **Nanostructures for commercial approaches**, Jae Hong Park, National Nanofab Ctr. (Korea, Republic of) . . . . . [10354-19]
- 4:50 pm: **Handling and assembling of low-density foam structures fabricated by two-photon polymerization**, Ori Stein, Schafer Corp. (USA); Ying Liu, Univ. of Nebraska-Lincoln (USA) . . . . . [10354-20]
- 5:10 pm: **Carbon films on silicon substrates made from polydopamine films at the air/water interface**, Hiroya Abe, Tomokazu Matsue, Hiroshi Yabu, Tohoku Univ. (Japan) . . . . . [10354-21]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 . . . . . WED 5:30 PM TO 7:30 PM

### Posters-Wednesday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

- Design and calibration of a nano dimensional standard**, Junjie Wu, Guoqing Ding, Xin Chen, Tao Han, Shanghai Jiao Tong Univ. (China); Yuan Li, Shanghai Institute of Measurement and Testing Technology (China) . . . . . [10354-37]
- Influence of electron interference effects on reflection of electron waves from potential barrier in 2D semiconductor nanostructures**, Victor Petrov, Institute of Radio Engineering and Electronics (Russian Federation); Andrey V. Nikitin, Kotel'nikov Institute of Radio Engineering and Electronics of Russian Academy of Sciences (Russian Federation) . . . . . [10354-38]
- Extreme-ultraviolet and electron beam lithography processing using water-developable resist material**, Satoshi Takei, Toyama Prefectural Univ. (Japan) . . . . . [10354-39]
- Bi-based Pb-free ceramic multilayer actuators using composite inner electrodes**, Jae-Shin Lee, Univ. of Ulsan (Korea, Republic of) . . . . . [10354-40]
- Physical and micro-mechanical properties of nanocomposites: iron-copper and iron with carbon nanotubes**, Mykola Kyruata, Sergey Revo, Mykola M. Melnichenko, Catherine Ivanenko, Taras Shevchenko National Univ. of Kyiv (Ukraine) . . . . . [10354-41]
- Modularized and water-cooled photo-catalyst cleaning devices for aquaponics based on ultraviolet light-emitting diodes**, Henglong Yang, Louis Lung, Yu-Chien Wei, Yi-Bo Huang, Zi-Yu Chen, National Taipei Univ. of Technology (Taiwan); Yu-Yang Chou, National Taipei Univ of Technology (Taiwan) . . . . . [10354-42]
- A study on high sensitivity planar waveguide Bragg grating sensor on Fabry-Perot cavity**, Junhan Park, Sang-Mae Lee, Bo-Sung Shin, DanHee Yun, Gyeong Ju Je, Pusan National Univ. (Korea, Republic of) . . . . . [10354-44]
- Octopus-frog inspired programmable hierarchical architectures for skin patches and medical applications**, Da Wan Kim, Sang Yul Baik, Changhyun Pang, Sungkyunkwan Univ. (Korea, Republic of) . . . . . [10354-45]
- Meniscus-controllable hierarchical architectures for wet and dry adhesion**, Sang Yul Baik, Jiwon Kim, Ui Dam Jung, Changhyun Pang, Sungkyunkwan Univ. (Korea, Republic of) . . . . . [10354-46]
- High resolution patterning of ultraviolet cross-linked resins using gas permeable mold derived from cellulose in nanoimprint lithography**, Shinya Nakajima, Satoshi Takei, Makoto Hanabata, Toyama Prefectural Univ. (Japan); Naoto Sugino, Takao Kameda, Sanko Gosei Ltd. (Japan); Yoko Matsumoto, Atsushi Sekiguchi, Litho Tech Japan Co., Ltd. (Japan) . . . . . [10354-47]
- High resolution optical system for the magnetic characterization of thin films by longitudinal magneto-optic Kerr effect**, Iulian Ionita, Mircea Bulinski, Univ. of Bucharest (Romania); Victor Kuncser, National Institute for Materials Physics (Romania) . . . . . [10354-48]

- The challenge of screen printed Ag metallization on nano-scale poly-silicon passivated contacts for silicon solar cells**, Lin Jiang, Heraeus Inc. (USA) . . . . . [10354-49]
- Temperature dependency of mechanical properties for crystalline cellulose added to silicone elastomer**, Takao Kameda, Naoto Sugino, Sanko Gosei Ltd. (Japan); Makoto Hanabata, Satoshi Takei, Toyama Prefectural Univ. (Japan) . . . . . [10354-50]
- Temperature dependence of viscoelasticity of crystalline cellulose with different molecular weights added to silicone elastomer**, Naoto Sugino, Takao Kameda, Sanko Gosei Ltd. (Japan); Satoshi Takei, Makoto Hanabata, Toyama Prefectural Univ. (Japan) . . . . . [10354-51]
- Amorphous In<sub>2</sub>O<sub>3</sub> oxide for resistive random access memory application**, Wei-Chiao Chang, Che-Chia Chang, National Chiao Tung Univ. (Taiwan); Wen-Tzu Chen, National Chiao Tung Univ. (Taiwan) and Institute of Electro-Optical Engineering (Taiwan); Po-Tsun Liu, Chung-Hao Tien, National Chiao Tung Univ. (Taiwan) . . . . . [10354-52]
- Formation of thin metal silicide (Ni, Ti) film by nano-second Nd:YAG laser annealing with Gaussian and flat-top beam profiles**, Sang Min Jung, Chul Jin Park, Jin Hwan Kim, Moo Whan Shin, Yonsei Univ. (Korea, Republic of) . [10354-53]
- One-dimensional metalodielectric photonic crystal (tantalum and aluminum oxide) as selective thermal emitter for thermophotovoltaic systems**, Jin Hwan Kim, Sang Min Jung, Chul Jin Park, Moo Whan Shin, Yonsei Univ. (Korea, Republic of) . . . . . [10354-54]
- Mechanical performance of SiC based MEMS capacitive microphone for ultrasonic detection in harsh environment**, Azrul A. Hamzah, Siti A. Zawawi, Burhanuddin Y. Majlis, Univ. Kebangsaan Malaysia (Malaysia); Faisal Mohd-Yasin, Griffith Univ. (Australia) . . . . . [10354-55]
- MoS<sub>2</sub> thin films prepared by sulfuration**, Michaela Sojkova, Institute of Electrical Engineering SAS (Slovakia) . . . . . [10354-56]
- Damage-free laser annealing process via heat transfer layer**, Chul Jin Park, Sang Min Jung, Jin Hwan Kim, Moo Whan Shin, Yonsei Univ. (Korea, Republic of) . . . . . [10354-57]
- The diffraction patterns of the output light from the tapered fiber tips**, Fang-Wei Sheu, National Chia Yi Univ. (Taiwan); Jiun-An Chen, National Chiayi Univ. (Taiwan) . . . . . [10354-58]
- Complementary methods of study for Zr<sub>1-x</sub>Ce<sub>x</sub>O<sub>2</sub> compounds for applications in medical prosthesis**, Alina Bruma, National Institute of Standards and Technology (USA); Adriana Savin, National Institute of Research & Development for Technical Physics (Romania); Mihai-Liviu Craus, Vitalii Turchenko, Joint Institute for Nuclear Research (Russian Federation); Pierre-Antoine Dubos, Sylvie Malo, ENSICAEN (France); Tatiana Konstantinova, Valerii Burkhovetsky, The National Academy of Sciences of Ukraine (Ukraine) . . . . . [10354-59]
- Highly transparent phthalocyanine derivative nanocrystal dispersions and their photopatterning**, Yutaro Hirai, Tohoku Univ. (Japan); Toshihiko Takaki, Sawano Bunji, Yamamoto Chemicals, Inc. (Japan); Yasutaka Matsuo, Hokkaido Univ. (Japan); Hiroshi Yabu, Tohoku Univ. (Japan) . . . . . [10354-60]
- Designer metamaterials using graphene for integrated nano-photonics applications**, Xinbo Wang, Berardi Sensale-Rodriguez, The Univ. of Utah (USA) . . . . . [10354-61]
- Organic-inorganic hybrid resist materials in advanced lithography**, Satoshi Takei, Naoto Sugino, Makoto Hanabata, Toyama Prefectural Univ. (Japan) . . . . . [10354-62]
- Study of the change in electrical properties of mechanically vibrating FET device with graphene**, Sungbae J. Lee, Gwangju Institute of Science and Technology (Korea, Republic of) . . . . . [10354-63]
- Zig-zag grating with quasi-random array for single order diffraction**, Ziwei Liu, Tanchao Pu, Lina Shi, Changqing Xie, Hailiang Li, Institute of Microelectronics (China) . . . . . [10354-64]
- N-state random switching based on quantum tunnelling**, Ramón Bernardo Gavito, Lancaster Univ. (United Kingdom); Fernando Jiménez Urbanos, IMDEA Nanociencia (Spain); Jonathan Roberts, Lancaster Univ. (United Kingdom); James Sexton, The Univ. of Manchester (United Kingdom); Benjamin Astbury, Hamzah Shokeir, Thomas McGrath, Yasir J. Noori, Christopher S. Woodhead, Lancaster Univ. (United Kingdom); Mohamed Missous, The Univ. of Manchester (United Kingdom); Utz Roedig, Robert J. Young, Lancaster Univ. (United Kingdom) . . . . . [10354-65]
- Three-dimensional printing and deformation behaviour of low-density target structures by two-photon polymerization**, Ying Liu, Univ. of Nebraska-Lincoln (USA); Ori Stein, Schafer Corp. (USA); Yongfeng Lu, Univ. of Nebraska-Lincoln (USA) . . . . . [10354-66]

# CONFERENCE 10354

**Implement of multi-channel spectral sensor by hybrid-coating and a related algorithm**, Yu-Jen Chen, Yu-Kuan Hsiao, VisEra Technologies, Inc. (Taiwan) . . . . . [10354-67]

**Nanofiber optic force transducers for high-resolution mechanical studies**, Donald J. Sirbuly, Univ of California San Diego (USA) . . . . . [10354-68]

**High throughput fabrication of transparent anti-reflective polymer foils by roll-to-roll extrusion coating**, Swathi Murthy, Inmold (Denmark); Henrik Pranov, Heliac a/s (Denmark); Peter Johansen, Danapak Flexibles A/S (Denmark); Guggi Kofod, Inmold a/s (Denmark) . . . . . [10354-69]

## THURSDAY 10 AUGUST

### SESSION 5

**LOCATION: CONV. CTR. ROOM 19 . . . THU 8:00 AM TO 10:00 AM**

### Carbon Nanotubes and Low-Dimensional Materials

Session Chair: **Eva M. Campo**, Bangor Univ. (USA)

8:00 am: **Direct laser writing of carbon nanotubes**, Kentaro Yamada, Makoto Nakazumi, Satoru Odate, Koichiro Iwahori, Nikon Corp. (Japan) . . . . . [10354-22]

8:20 am: **Low contact resistance of the MWCNTs ohmic contact to p-GaN and its application for high power LED**, Toshiya Yokogawa, Yamaguchi Univ (Japan); Syota Miyake, Yamaguchi Univ. (Japan) . . . . . [10354-23]

8:40 am: **High aspect ratio CNT structures produced by energetic ion bombardment**, Gregory A. Konesky, National Nanotech, Inc. (USA) . . . [10354-24]

9:00 am: **Time-domain finite-difference based analysis of induced crosstalk in multiwall carbon nanotube interconnects**, Amit Kumar, Brajesh K. Kaushik, Vikas Nehra, Indian Institute of Technology Roorkee (India) . . . . . [10354-25]

9:20 am: **Optical models for atomically thin sheets**, Jessica R. Piper, Exponent (USA) . . . . . [10354-26]

9:40 am: **Surface plasmon resonance based electro optic measurement of SBN thin films**, Surbhi Gupta, Ayushi Paliwal, Vinay Gupta, Monika Tomar, Univ. of Delhi (India) . . . . . [10354-27]

Coffee Break . . . . . Thu 10:00 am to 10:30 am

### SESSION 6

**LOCATION: CONV. CTR. ROOM 19 . . . THU 10:30 AM TO 12:10 PM**

### Light Trapping and Light Guiding

Session Chair: **Anne E. Sakdinawat**, SLAC National Accelerator Lab. (USA)

10:30 am: **Symmetry-breaking in light-trapping nanostructures on silicon for solar photovoltaics**, Seok Jun Han, Swapnadip Ghosh, Omar Abudayyeh, Brittany Hoard, Ethan Culler, Jose Bonilla, Sang M. Han, Sang Eon Han, The Univ. of New Mexico (USA) . . . . . [10354-28]

10:50 am: **Chromatic mechanical response in 2D layered Transition Metal Dichalcogenide (TMDs) based nanocomposites**, Balaji Panchapakesan, Vahid Rahneshin, Worcester Polytechnic Institute (USA) . . . . . [10354-29]

11:10 am: **Luminescence studies of laser MBE grown GaN on ZnO nanostructures**, Sheetal Dewan, Monika Tomar, Univ. of Delhi (India); Ashok K. Kapoor, Solid State Physics Lab. (India); Ram Pal Tandon, Vinay Gupta, Univ. of Delhi (India) . . . . . [10354-30]

11:30 am: **Ultra low reflectivity black silicon surfaces and devices enable unique optical applications**, Karl Y. Yee, Victor E. White, Kunjithapatham Balasubramanian, Daniel J. Ryan, Jet Propulsion Lab. (USA) . . . . . [10354-31]

11:50 am: **Quasi-triangle array of hexagonal apertures broadband binary transmission gratings**, Tanchao Pu, Ziwei Liu, Lina Shi, Changqing Xie, Hailiang Li, Institute of Microelectronics (China) . . . . . [10354-32]

Lunch/Exhibition Break . . . . . Thu 12:10 pm to 1:40 pm

### SESSION 7

**LOCATION: CONV. CTR. ROOM 19 . . . . THU 1:40 PM TO 3:00 PM**

### Nano-Optic Devices and Optic Engineering

Session Chair: **Eva M. Campo**, Bangor Univ. (United Kingdom)

1:40 pm: **Subwavelength 2D segmented waveguide taper light coupling optimization by evolutionary algorithms**, Anderson Dourado Sisnando, Vitaly F. Rodriguez-Esquerre, Univ. Federal da Bahia (Brazil); Cosme Eustaquio Rubio Mercedes, Univ. Estadual de mato Grosso do Sul (Brazil) . . . . . [10354-33]

2:00 pm: **Narrow line-width reflection infrared filter using subwavelength metal-dielectric grating structure**, Ziyi Wang, The Univ. of Alabama in Huntsville (USA); Rong-Jun Zhang, Fudan Univ. (China); Junpeng Guo, The Univ. of Alabama in Huntsville (USA) . . . . . [10354-35]

2:20 pm: **Design of binary patterns for speckle reduction in holographic display with compressive sensing and direct-binary search algorithm**, Thibault Leportier, Korea Institute of Science and Technology (Korea, Republic of) and Korea Univ. of Science and Technology (Korea, Republic of); Do Kyung Hwang, Korea Institute of Science and Technology (Korea, Republic of); Min-Chul Park, Korea Institute of Science and Technology (Korea, Republic of) and Korea Univ. of Science and Technology (Korea, Republic of) . . . . . [10354-36]

2:40 pm: **Vanadium dioxide switchable components based on wiregrids for mid-infrared applications**, Pengfei Guo, David Lombardo, Andrew M. Sarangan, Univ. of Dayton (USA) . . . . . [10354-43]



# CONFERENCE 10355

LOCATION: CONV. CTR. ROOM 18

Wednesday–Thursday 9–10 August 2017 • Proceedings of SPIE Vol. 10355

# Nanobiosystems: Processing, Characterization, and Applications X

Conference Chairs: **Norihisa Kobayashi**, Chiba Univ. (Japan); **Fahima Ouchen**, Air Force Research Lab. (USA); **Ileana Rau**, Polytechnical Univ. of Bucharest (Romania)

Program Committee: **Carrie M. Bartsch**, Air Force Research Lab. (USA); **Liming Dai**, Case Western Reserve Univ. (USA); **Ananth Dodabalapur**, The Univ. of Texas at Austin (USA); **James G. Grote**, Air Force Research Lab. (USA); **Emily M. Heckman**, Air Force Research Lab. (USA); **Kuniharu Ijro**, Hokkaido Univ. (Japan); **Jung-Il Jin**, Korea Univ. (Korea, Republic of); **Francois Kajzar**, Polytechnical Univ. of Bucharest (Romania); **Sang Nyon Kim**, Air Force Research Lab. (USA); **Oksana Krupka**, Univ. d'Angers (France); **Charles Y. C. Lee**, Air Force Office of Scientific Research (USA); **Misoon Y. Mah**, Asian Office of Aerospace Research and Development (Japan); **Bruce H. Robinson**, Univ. of Washington (USA); **Anna Samoc**, The Australian National Univ. (Australia); **Marek J. Samoc**, Wroclaw Univ. of Technology (Poland); **Niyazi Serdar Sariciftci**, Johannes Kepler Univ. Linz (Austria); **Kristi M. Singh**, Air Force Research Lab. (USA); **Andrew J. Steckl**, Univ. of Cincinnati (USA); **Morley O. Stone**, Air Force Research Lab. (USA); **Guru Subramanyam**, Univ. of Dayton (USA); **Perry P. Yaney**, Univ. of Dayton (USA)

## MONDAY 7 AUGUST

LOCATION: CONV. CTR. ROOM 6A MON 9:00 AM TO 12:00 PM

### Nanoscience + Engineering Plenary Session

Session Chairs: **Harry A. Atwater Jr.**, California Institute of Technology (USA); **Nikolay I. Zheludev**, Optoelectronics Research Ctr. (United Kingdom)

9:15 am: **3D laser nanolithography (Plenary)**, Martin Wegener, Karlsruhe Institut für Technologie (Germany) . . . . . [10354-500]

Coffee Break . . . . . Mon 10:00 am to 10:30 am

10:30 am: **Controlling light at the atomic scale (Plenary)**, F. Javier García de Abajo, ICFO - Institut de Ciències Fotòniques (Spain) . . . . . [10359-500]

11:15 am: **Science, engineering, and commercialization of flexible, printable 2D atomic materials and devices (Invited Paper)**, Deji Akinwande, The Univ. of Texas at Austin (USA) . . . . . [10349-500]

## SESSION 2

LOCATION: CONV. CTR. ROOM 18 . WED 10:40 AM TO 12:00 PM

### DNA Applications I

Session Chair: **André-Jean Attias**, Univ. Pierre et Marie Curie (France)

10:40 am: **Thin film DNA-complex-based dye lasers fabricated by immersion process (Invited Paper)**, Yutaka Kawabe, Yuki Suzuki, Chitose Institute of Science and Technology (Japan) . . . . . [10355-4]

11:10 am: **DNA-based frequency selective electromagnetic interference shielding (Invited Paper)**, Michael M. Salour, IPITEK, Inc. (USA); Fahima Ouchen, James G. Grote, Air Force Research Lab. (USA) . . . . . [10355-5]

11:40 am: **Vegetable extracts embedded in biological matrices for applications in photonics**, Ana-Maria Manea, Sorin Axinte, François Kajzar, Ileana Rau, Aurelia Meghea, Univ. Politehnica of Bucharest (Romania) . . . . . [10355-6]

Lunch/Exhibition Break . . . . . Wed 12:00 pm to 1:30 pm

## SESSION 3

LOCATION: CONV. CTR. ROOM 18 . . . WED 1:30 PM TO 3:00 PM

### Nanomaterials

Session Chair: **Norihisa Kobayashi**, Chiba Univ. (Japan)

1:30 pm: **Nanocrystal pinning for green perovskite distributed feedback lasers (Invited Paper)**, Jonathon R. Harwell, Guy L. Whitworth, Graham A. Turnbull, Ifor D. W. Samuel, Univ. of St. Andrews (United Kingdom) . . . . . [10355-7]

2:00 pm: **Fluorescent noncovalent functionalization of graphene by surface-confined supramolecular self-assembly: towards nano-optics on graphene (Invited Paper)**, Sylvain Le Liepvre, Commissariat à l'Énergie Atomique (France); Ping Du, Fabrice Mathevet, David Kreher, Univ. Pierre et Marie Curie (France); Fabrice Charra, Commissariat à l'Énergie Atomique (France); André-Jean Attias, Univ. Pierre et Marie Curie (France) . . . . . [10355-8]

2:30 pm: **Next polymer nanofibers: merging light emission and piezoelectric properties (Invited Paper)**, Luana Persano, Andrea Camposeo, Istituto Nanoscienze (Italy); Dario Pisignano, Univ. del Salento (Italy) . . . . . [10355-9]

Coffee Break . . . . . Wed 3:00 pm to 3:30 pm

## WEDNESDAY 9 AUGUST

### SESSION 1

LOCATION: CONV. CTR. ROOM 18 . . . WED 8:30 AM TO 10:10 AM

### Biomaterials Properties and Applications

Session Chair: **James G. Grote**, Air Force Research Lab. (USA)

8:30 am: **Bio-plasmonic and bio-electronic devices for human health and performance (Keynote Presentation)**, Rajesh R. Naik, Air Force Materiel Command (United States); Steve Sang Nyon Kim, Joseph M. Slocik, Zhifeng Kuang, Air Force Research Lab. (USA) . . . . . [10355-1]

9:10 am: **DNA scaffold nanostructures for efficient and directional propagation of light harvesting cascades (Invited Paper)**, Carl W. Brown III, Anirban Samanta, Sebastián A. Diaz, Susan Buckhout-White, Scott A. Walper, Ellen R. Goldman, Igor L. Medintz, U.S. Naval Research Lab. (USA) . . . . . [10355-2]

9:40 am: **Enhanced NLO response of lanthanides in DNA matrix (Invited Paper)**, François Kajzar, Cosmina Andreea Lazar, Ana-Maria Manea, Ileana Rau, Univ. Politehnica of Bucharest (Romania) . . . . . [10355-3]

Coffee Break . . . . . Wed 10:10 am to 10:40 am

# CONFERENCE 10355

## SESSION 4

LOCATION: CONV. CTR. ROOM 18 . . . WED 3:30 PM TO 5:30 PM

### DNA Applications II

Session Chair: **Ileana Rau**, Univ. Politehnica of Bucharest (Romania)

- 3:30 pm: **Colloidal photonic crystals: from lasing to microfluidics** (*Invited Paper*), Koen Clays, KU Leuven (Belgium) and Washington State Univ. (USA); Kuo Zhong, KU Leuven (Belgium); Kai Song, Chinese Academy of Sciences (China) . . . . . [10355-10]
- 4:00 pm: **Charge carrier blocking layers for polymer-based electro-optic devices** (*Invited Paper*), James G. Grote, Fahima Ouchen, Air Force Research Lab. (USA); Michael M. Salour, IPITEK, Inc. (USA) . . . . . [10355-11]
- 4:30 pm: **Photoelectronic application of DNA associated with metal complex** (*Invited Paper*), Norihisa Kobayashi, Chiba Univ. (Japan) . . . . . [10355-12]
- 5:00 pm: **DNA thin film fluorination for lower index of refraction** (*Invited Paper*), Fahima Ouchen, Perry P. Yaney, James G. Grote, Air Force Research Lab. (USA) . . . . . [10355-13]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 . . . . . WED 5:30 PM TO 7:30 PM

### Posters-Wednesday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Electrical performances of straight and castellated dielectrophoresis electrodes for biological molecules separation**, Azrul Azlan Hamzah, Farahdiana Wan Yunus, Muhamad R. Buyong, Jumril Yunas, Burhanuddin Y. Majlis, Univ. Kebangsaan Malaysia (Malaysia) . . . . . [10355-20]

**Effect of different AFM micro cantilever in fluid on the rough surface topography quality close to the surface**, Alireza Habibnejad Korayem, Moharam Habibnejad Korayem, Iran Univ. of Science and Technology (Iran, Islamic Republic of) . . . . . [10355-21]

## THURSDAY 10 AUGUST

### SESSION 5

LOCATION: CONV. CTR. ROOM 18 . . . THU 8:50 AM TO 10:00 AM

### DNA Photonics I

Session Chair: **Fahima Ouchen**, Air Force Research Lab. (USA)

- 8:50 am: **Increasing electric field strength in polymer capacitors**, James G. Grote, Fahima Ouchen, Air Force Research Lab. (USA); Michael M. Salour, IPITEK, Inc. (USA). . . . . [10355-14]
- 9:10 am: **Influence of the biomatrix on fluorescence efficiency of luminophores**, François Kajzar, Ana-Maria Manea, Cosmina Andreea Lazar, Ileana Rau, Univ. Politehnica of Bucharest (Romania). . . . . [10355-15]
- 9:30 am: **Fabrication of biomimetic sensing devices using bacteriorhodopsin via an inkjet printing method** (*Invited Paper*), Hiroyuki Hasegawa, Katsuyuki Kasai, Toshiaki Yamada, Shukichi Tanaka, Yukihiko Tominari, Takahiro Kajji, Akira Otomo, National Institute of Information and Communications Technology (Japan); Yoshiko Okada-Shudo, The Univ. of Electro-Communications (Japan) . . . . . [10355-16]
- Coffee Break . . . . . Thu 10:00 am to 10:30 am

## SESSION 6

LOCATION: CONV. CTR. ROOM 18 . . THU 10:30 AM TO 12:00 PM

### DNA Applications III

Session Chair: **François Kajzar**, Univ. Politehnica of Bucharest (Romania)

- 10:30 am: **Conjugated polymer thin films for dynamic generation of photothermal patterns** (*Invited Paper*), Eunkyong Kim, Yonsei Univ. (Korea, Republic of) . . . . . [10355-17]
- 11:00 am: **DNA-based electromagnetic interference shielding** (*Invited Paper*), Michael M. Salour, IPITEK, Inc. (USA); Fahima Ouchen, James G. Grote, Air Force Research Lab. (USA) . . . . . [10355-18]
- 11:30 am: **DNA brush-assisted vertical alignment of gold nanorods and those chiral plasmonics** (*Invited Paper*), Hideyuki Mitomo, Satoshi Nakamura, Hokkaido Univ. (Japan); Andrew Pike, Newcastle Univ. (United Kingdom); Yasutaka Matsuo, Kuniharu Ijiri, Hokkaido Univ. (Japan) . . . . . [10355-19]

# CONFERENCE 10356

LOCATION: CONV. CTR. ROOM 7B

Wednesday–Thursday 9–10 August 2017 • Proceedings of SPIE Vol. 10356

## Nanostructured Thin Films X

*Conference Chairs:* **Yi-Jun Jen**, National Taipei Univ. of Technology (Taiwan); **Akhlesh Lakhtakia**, The Pennsylvania State Univ. (USA); **Tom G. Mackay**, The Univ. of Edinburgh (United Kingdom)

*Program Committee:* **Bharat Bhushan**, The Ohio State Univ. (USA); **Stephane Bruynooghe**, Carl Zeiss AG (Germany); **Francesco Chiadini**, Univ. degli Studi di Salerno (Italy); **Pankaj K. Choudhury**, Univ. Kebangsaan Malaysia (Malaysia); **Didier Felbacq**, Univ. Montpellier 2 (France); **François Flory**, Institut Matériaux Microélectronique Nanosciences de Provence (France); **Frédéric Guittard**, Univ. de Nice Sophia Antipolis (France); **Anders Kristensen**, Technical Univ. of Denmark (Denmark); **H. Angus Macleod**, Thin Film Center, Inc. (USA); **Geoffrey B. Smith**, Univ. of Technology, Sydney (Australia); **Motofumi Suzuki**, Kyoto Univ. (Japan)

### MONDAY 7 AUGUST

LOCATION: CONV. CTR. ROOM 6A MON 9:00 AM TO 12:00 PM

#### Nanoscience + Engineering Plenary Session

Session Chairs: **Harry A. Atwater Jr.**, California Institute of Technology (USA); **Nikolay I. Zheludev**, Optoelectronics Research Ctr. (United Kingdom)

9:15 am: **3D laser nanolithography (Plenary)**, Martin Wegener, Karlsruhe Institut für Technologie (Germany) . . . . . [10354-500]

Coffee Break . . . . . Mon 10:00 am to 10:30 am

10:30 am: **Controlling light at the atomic scale (Plenary)**, F. Javier García de Abajo, ICFO - Institut de Ciències Fotòniques (Spain) . . . . . [10359-500]

11:15 am: **Science, engineering, and commercialization of flexible, printable 2D atomic materials and devices (Invited Paper)**, Deji Akinwande, The Univ. of Texas at Austin (USA) . . . . . [10349-500]

### WEDNESDAY 9 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 7B . . . WED 1:30 PM TO 2:30 PM

#### Inaugural Keynote Session

Session Chair: **Tom G. Mackay**, The Univ. of Edinburgh (United Kingdom)

1:30 pm: **Ultrahigh field enhancements from nanostructured metal thin films (Keynote Presentation)**, Ibrahim Abdulhalim, Ben-Gurion Univ. of the Negev (Israel) and Nanyang Technological Univ. (Singapore) . . . . . [10356-1]

#### SESSION 2

LOCATION: CONV. CTR. ROOM 7B . . . WED 2:30 PM TO 3:40 PM

#### Structured Thin Films

Session Chair: **Akhlesh Lakhtakia**, The Pennsylvania State Univ. (USA)

2:30 pm: **Optical liquid monitoring with sculptural multilayers Bragg microcavities incorporated to microfluidic chips (Invited Paper)**, Francisco Yubero, Manuel Oliva, Jorge Gil-Rostra, Agustín R. Gonzalez-Elipe, Instituto de Ciencia de Materiales de Sevilla (Spain) . . . . . [10356-2]

3:00 pm: **High efficient light absorption and nanostructure-dependent birefringence of a metal-dielectric symmetrical layered structure**, Yi-Jun Jen, Yi-Ciang Jhang, Wei-Chih Liu, National Taipei Univ. of Technology (Taiwan) . . . . . [10356-3]

3:20 pm: **Third order non-linear response as function of the laser power in SiO<sub>2</sub>:DR1 mesostructured and amorphous films**, Jorge A. Garcia-Macedo, Gerardo S. Gámez, Univ. Nacional Autónoma de México (Mexico) . . . . . [10356-4]

Coffee Break . . . . . Wed 3:40 pm to 4:00 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 7B . . WED 4:00 PM TO 5:30 PM

#### Hybrid Nanostructures

Session Chair: **Ibrahim Abdulhalim**, Ben-Gurion Univ. of the Negev (Israel)

4:00 pm: **Exotic nanophotonic behavior in systems of reduced dimensionality (Invited Paper)**, Marin Soljacic, Massachusetts Institute of Technology (USA) . . . . . [10356-5]

4:30 pm: **Engineered metasurface of gold funnels for microwave filtering**, Shayan Moghaddas, Masih Ghasemi, Pankaj K. Choudhury, Burhanuddin Y. Majlis, Univ. Kebangsaan Malaysia (Malaysia) . . . . . [10356-6]

4:50 pm: **Amorphous Fe-Dy-Tb-O (FDTO) thin films with transparent, magnetic, and semiconducting behaviors**, Abhinav Malasi, Humaira Taz, The Univ. of Tennessee Knoxville (USA); Tamil Sakthivel, Univ. of Central Florida (USA); Rama Vasudevan, Oak Ridge National Lab. (USA); Connor Carr, The Univ. of Tennessee Knoxville (USA); Nano Yamoah, North Carolina A&T State Univ. (USA); Benjamin J. Lawrie, Raphael C. Pooser, Oak Ridge National Lab. (USA); Hernando Garcia, Southern Illinois Univ. Edwardsville (USA); Dhananjay Kumar, North Carolina A&T State Univ. (USA); Gerd Duscher, The Univ. of Tennessee Knoxville (USA); Art P. Baddorf, Oak Ridge National Lab. (USA); Sudipta Seal, Univ. of Central Florida (USA); Ramki Kalyanaraman, The Univ. of Tennessee Knoxville (USA) . . . [10356-7]

5:10 pm: **Topology controlled functional nanoclustered thin films with tendency to superconductivity**, Sergey M. Arakelyan, Alexey O. Kucherik, Stella V. Kutrovskaia, Anton V. Osipov, Vladimir State Univ. (Russian Federation) . . . . . [10356-8]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 . . . . . WED 5:30 PM TO 7:30 PM

#### Posters-Wednesday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Development of batch producible hot embossing 3D nanostructured surface-enhanced Raman scattering chip technology**, Chu-Yu Huang, Ming-Shiuan Tsai, National Chung Hsing Univ. (Taiwan) . . . . . [10356-26]

**The effect of ion-beam etching on the sol-gel coating in the preparation of tri-wavelength antireflection coating**, Siyu Dong, Lingyun Xie, Tao He, Hongfei Jiao, Jinlong Zhang, Bin Ma, Zhanshan Wang, Xinbin Cheng, Tongji Univ. (China) . . . . . [10356-27]

**Transition from Dyakonov and Dyakonov-Tamm surface waves to surface-plasmon-polariton waves induced by temperature**, Tom G. Mackay, The Univ. of Edinburgh (United Kingdom); Francesco Chiadini, Univ. degli Studi di Salerno (Italy); Vincenzo Fiumara, Univ. degli Studi della Basilicata (Italy); Antonio Scaglione, Univ. degli Studi di Salerno (Italy); Akhlesh Lakhtakia, The Pennsylvania State Univ. (USA) . . . . . [10356-28]

**Non-linear and linear optical techniques for identification of functional groups on plasma treated surfaces on the monolayer level**, Munise Cobet, Matthias Kehrer, David Stifter, Johannes Kepler Univ. Linz (Austria) . . . . . [10356-29]

**Oblique angle deposition of Al films on nanopatterned substrates for wire grid polarizers**, Wonyoung Kim, Sungmin Hwang, Tae Young Kim, Won Gyu Ham, Myung Hoe Koo, Minbaek Lee, Chang Kwon Hwangbo, INHA Univ. (Korea, Republic of) . . . . . [10356-30]

**Non-exhibition of Bragg phenomenon by chevronic sculptured thin films: experiment and theory**, Vikas Vepachedu, Patrick D. McAtee, Akhlesh Lakhtakia, The Pennsylvania State Univ. (USA) . . . . . [10356-31]



# CONFERENCE 10356

**Electrophysical and gas-sensing properties of the nanoscale thin films of tin dioxide modified with silver and yttrium and with catalytic additives (Pt/Pd, Ag, Au or Pt/Pd/Au) on the surface**, Aleksei V. Almaev, Stanislav Kim, National Research Tomsk State Univ. (Russian Federation) . . . . . [10356-32]

**Enhanced water stability and thermoelectric properties of PEDOT:PSS films via a glycerol vapor treatment**, Sung Hyun Kim, Wonkwang Univ. (Korea, Republic of) . . . . . [10356-33]

**Photonic nanostructure design for high efficiency light absorber**, Yi-Fan Huang, National Taipei Univ. of Technology (Taiwan) and Institute of Atomic and Molecular Sciences - Academia Sinica (Taiwan); Yi-Jun Jen, National Taipei Univ. of Technology (Taiwan) . . . . . [10356-34]

**Influence of the crystal potential on the energetic spectrum of the vicinal superlattices in the quantum: confined films**, Victor Petrov, Kotelnikov Institute of Radio Engineering and Electronics of Russian Academy of Sciences (Russian Federation) . . . . . [10356-35]

**Photo-excited carrier dynamics of CuPc/C60 organic thin film structure**, Mitsuru Inada, Tomoki Miyake, Nozomi Isobe, Tadashi Saitoh, Kansai Univ. (Japan) . . . . . [10356-36]

**Photoelectric properties of ITO-p-Si structures**, Tetiana Batsko, Sergiy Kondratenko, Taras Shevchenko National Univ. of Kyiv (Ukraine) . . . . . [10356-39]

**Optical and structure properties of crystalline silver nano-layers with ultra-smooth surfaces**, Husam Abu-Safe, German Jordanian Univ. (Jordan); Hameed Naseem, Univ. of Arkansas (USA) . . . . . [10356-40]

## THURSDAY 10 AUGUST

### SESSION 4

**LOCATION: CONV. CTR. ROOM 7B . . THU 8:10 AM TO 10:00 AM**

#### Plasmonics

Session Chair: **Yi-Jun Jen**, National Taipei Univ. of Technology (Taiwan)

8:10 am: **Broadband perfect absorption of epsilon-near-zero thin films** (*Invited Paper*), Chang Kwon Hwangbo, INHA Univ. (Korea, Republic of) . . . . . [10356-9]

8:40 am: **Asymmetric metal-insulator-metal (MIM) structure formed by pulsed Nd:YAG laser deposition with titanium nitride (TiN) and aluminum nitride (AlN)**, Yasushi Oshikane, Osaka Univ. (Japan) . . . . . [10356-10]

9:00 am: **An advanced plasmonic cermet solar absorbers for high temperature solar energy conversion applications**, Maryna Bilokur, Angus R. Gentle, Matthew D. Arnold, Geoffrey B. Smith, Michael B. Cortie, Univ. of Technology, Sydney (Australia) . . . . . [10356-11]

9:20 am: **Optical and electronic functionality of 2D crystal-metal hybrids: computation and microscopy**, Donald K. Roper, Gregory T. Forcherio, Mourad Benamara, Univ. of Arkansas (USA); Luigi Bonacina, Univ. de Genève (Switzerland); Jeremy R. Dunklin, Univ. of Arkansas (USA); Drew DeJarnette, U.S. Dept. of Energy (USA); Claudia Backes, Yana Vaynzof, Ruprecht-Karls-Univ. Heidelberg (Germany) . . . . . [10356-12]

9:40 am: **Angular-insensitive plasmonic filters based on ultrathin metal patch array**, Chenying Yang, Weidong Shen, Yueguang Zhang, Xu Liu, Zhejiang Univ. (China); Jing Zhou, Chengang Ji, L. Jay Guo, Univ. of Michigan . . . . . [10356-13]

Coffee Break . . . . . Thu 10:00 am to 10:30 am

### SESSION 5

**LOCATION: CONV. CTR. ROOM 7B . THU 10:30 AM TO 12:00 PM**

#### Theoretical and Numerical Studies

Session Chair: **Chang Kwon Hwangbo**, INHA Univ. (Korea, Republic of)

10:30 am: **Advanced light management for liquid phase crystallized silicon thin-film solar cells** (*Invited Paper*), Klaus Jäger, Helmholtz-Zentrum Berlin für Materialien und Energie GmbH (Germany) and Konrad-Zuse-Zentrum für Informationstechnik Berlin (Germany); Grit Köppel, David Eisenhauer, Helmholtz-Zentrum Berlin für Materialien und Energie GmbH (Germany); Duote Chen, Helmholtz-Zentrum Berlin (Germany); Martin Hammerschmidt, Sven Burger, Konrad-Zuse-Zentrum für Informationstechnik Berlin (Germany); Bernd Rech, Christiane Becker, Helmholtz-Zentrum Berlin für Materialien und Energie GmbH (Germany) . . . . . [10356-14]

11:00 am: **Wave front design using multi-scale metasurfaces**, Didier Felbacq, Univ. Montpellier (France); Emmanuel Kling, Safran Electronics & Defense (France) . . . . . [10356-15]

11:20 am: **Asymmetries in surface waves and reflection/transmission characteristics associated with topological insulators**, Tom G. Mackay, The Univ. of Edinburgh (United Kingdom); Francesco Chiadini, Univ. degli Studi di Salerno (Italy); Vincenzo Fiumara, Univ. degli Studi della Basilicata (Italy); Antonio Scaglione, Univ. degli Studi di Salerno (Italy); Akhlesh Lakhtakia, The Pennsylvania State Univ. (USA) . . . . . [10356-16]

11:40 am: **On optical-absorption peaks in a nonhomogeneous dielectric material over a two-dimensional metallic surface-relief grating**, Faiz Ahmad, The Pennsylvania State Univ. (USA); Thomas H. Anderson, Benjamin J. Civiletti, Peter B. Monk, Univ. of Delaware (USA); Akhlesh Lakhtakia, The Pennsylvania State Univ. (USA) . . . . . [10356-17]

Lunch/Exhibition Break . . . . . Thu 12:00 pm to 1:30 pm

### SESSION 6

**LOCATION: CONV. CTR. ROOM 7B . . . THU 1:30 PM TO 3:00 PM**

#### Fabrication and Functionalization

Session Chair: **Klaus Jäger**, Helmholtz-Zentrum Berlin für Materialien und Energie GmbH (Germany)

1:30 pm: **New generation all-silica based optical elements for high power laser systems** (*Invited Paper*), Tomas Tolenis, Lina Grineviciute, Ctr. for Physical Sciences and Technology (Lithuania); Andrius Melninkaitis, Vilnius Univ. (Lithuania); Algirdas Selskis, Rytis Buzelis, Ctr. for Physical Sciences and Technology (Lithuania); Lina Mažule, Vilnius Univ. (Lithuania); Ramutis Drazdys, Ctr. for Physical Sciences and Technology (Lithuania) . . . . . [10356-18]

2:00 pm: **Pulsed laser deposition of multiferroic complex oxide superlattices**, John G. Jones, Air Force Research Lab. (USA); Zhongqiang Hu, Universal Technology Corp. (USA); Krishnamurthy Mahalingam, UES, Inc. (USA); Lawrence Grazulis, Univ. of Dayton Research Institute (USA); Matthew P. Zielewski, Wright State Univ. (USA); Gerald R. Landis, Univ. of Dayton Research Institute (USA); Yalin Lu, U.S. Air Force Academy (USA); Gail J. Brown, Air Force Research Lab. (USA) . . . . . [10356-19]

2:20 pm: **Optical anisotropy due to perpendicular azimuthal serial bi-deposition onto tilted substrates**, Matthew Tai, Matthew D. Arnold, Angus R. Gentle, Geoffrey B. Smith, Univ. of Technology, Sydney (Australia) . . . . . [10356-20]

2:40 pm: **Graphene oxide reduction induced by femtosecond laser irradiation**, Maren Kasischke, Stella Maragkaki, Evgeny L. Gurevich, Andreas Ostendorf, Ruhr-Univ. Bochum (Germany) . . . . . [10356-21]

Coffee Break . . . . . Thu 3:00 pm to 3:30 pm

### SESSION 7

**LOCATION: CONV. CTR. ROOM 7B . . . THU 3:30 PM TO 5:00 PM**

#### Multifunctional and Hybrid Nanostructures

Session Chair: **Tomas Tolenis**, Ctr. for Physical Sciences and Technology (Lithuania)

3:30 pm: **Zero-contrast silicon-based metasurfaces: resonance physics and applications** (*Invited Paper*), Yeong Hwan Ko, Robert Magnusson, The Univ. of Texas at Arlington (USA) . . . . . [10356-22]

4:00 pm: **Nitrogen doped silicon-carbon multilayer protective coatings on carbon obtained by TVA method**, Victor Ciupina, Univ. Ovidius Constanta (Romania) and Academy of Romanian Scientists (Romania) and Univ. of Bucharest (Romania); Eugeniu Vasile, Univ. Politehnica of Bucharest (Romania); Corneliu Porosnicu, National Institute for Laser, Plasma and Radiation Physics (Romania); Gabriel C. Prodan, Univ. Ovidius Constanta (Romania); Cristian P. Lungu, National Institute for Laser, Plasma and Radiation Physics (Romania); Rodica Vladioiu, Univ. Ovidius Constanta (Romania); Ionut Jecu, National Institute for Laser, Plasma and Radiation Physics (Romania); Aurelia Mandes, Virginia Dinca, Aureliana Caraiane, Univ. Ovidius Constanta (Romania); Virginia Nicolescu, Ovidiu Cupsa, Ceronav (Romania); Paul Dinca, National Institute for Laser, Plasma and Radiation Physics (Romania); Agripina Zaharia, Univ. Ovidius Constanta (Romania) . . . . . [10356-23]

4:20 pm: **Thin film grating reflector for high power lasers**, Jinlong Zhang, Shuaihai Shi, Hongfei Jiao, Bin Ma, Xinbin Cheng, Zhanshan Wang, Tongji Univ. (China) . . . . . [10356-24]

4:40 pm: **Advanced design of UV waveplates based on nano-structured silica thin films**, Lina Grineviciute, Tomas Tolenis, Rytis Buzelis, Ctr. for Physical Sciences and Technology (Lithuania); Mindaugas Andrulevicius, Algirdas Lazauskas, Kaunas Univ. of Technology (Lithuania); Algirdas Selskis, Ramutis Drazdys, Ctr. for Physical Sciences and Technology (Lithuania) . . . . . [10356-25]

# CONFERENCE 10357

LOCATION: CONV. CTR. ROOM 8

Sunday–Thursday 6–10 August 2017 • Proceedings of SPIE Vol. 10357

## Spintronics X

Conference Chairs: **Henri-Jean Drouhin**, Ecole Polytechnique (France); **Jean-Eric Wegrowe**, Ecole Polytechnique (France); **Manijeh Razeghi**, Northwestern Univ. (USA)

Conference Co-Chair: **Henri Jaffrès**, Unité Mixte de Physique CNRS/Thales (France)

Program Committee: **Franco Ciccacci**, Politecnico di Milano (Italy); **Russell P. Cowburn**, Univ. of Cambridge (United Kingdom); **Scott A. Crooker**, Los Alamos National Lab. (USA); **Vincent Cros**, Unité Mixte de Physique CNRS/Thales (France); **Hanan Dery**, Univ. of Rochester (USA); **Rogério de Sousa**, Univ. of Victoria (Canada); **Michel I. Dyakonov**, Univ. Montpellier 2 (France); **Michael E. Flatté**, The Univ. of Iowa (USA); **Joseph S. Friedman**, The Univ. of Texas at Dallas (USA); **Jean-Marie George**, Unité Mixte de Physique CNRS/Thales (France); **Erez Hasman**, Technion-Israel Institute of Technology (Israel); **Tomás Jungwirth**, Institute of Physics of the ASCR, v.v.i. (Czech Republic); **Giti A. Khodaparast**, Virginia Polytechnic Institute and State Univ. (USA); **Mathias Klaui**, Univ. Konstanz (Germany); **Daniel Lacour**, Institut Jean Lamour (France); **Connie H. Li**, U.S. Naval Research Lab. (USA); **Aurélien Manchon**, King Abdullah Univ. of Science and Technology (Saudi Arabia); **Xavier Marie**, INSA - Univ. of Toulouse (France); **Laurens W. Molenkamp**, Julius-Maximilians-Univ. Würzburg (Germany); **Hiro Munekata**, Tokyo Institute of Technology (Japan); **Yoshichika Otani**, The Univ. of Tokyo (Japan); **Vlad Pribiag**, Univ. of Minnesota, Twin Cities (USA); **Dafiné Ravelosona**, Institut d'Électronique Fondamentale (France); **Nicolas Rougemaille**, Institut NÉEL (France); **Georg Schmidt**, Martin-Luther-Univ. Halle-Wittenberg (Germany); **Jing Shi**, Univ. of California, Riverside (USA); **Vasily V. Temnov**, Univ. du Maine (France); **Luc Thomas**, Headway Technology (USA); **Evgeny Tsymlal**, Univ. of Nebraska-Lincoln (USA); **Olaf M. J. van 't Erve**, U.S. Naval Research Lab. (USA); **Joerg Wunderlich**, Hitachi Cambridge Lab. (United Kingdom); **Igor Zutic**, Univ. at Buffalo (USA)

### SUNDAY 6 AUGUST

Sessions 1A and 1B run concurrently.

#### SESSION 1A

LOCATION: CONV. CTR. ROOM 6F . . . SUN 8:30 AM TO 10:15 AM

#### Spin-Current and Spin-Hall Effects I

Session Chair: **Jean-Eric Wegrowe**, Ecole Polytechnique (France)

- 8:30 am: **Swapping spin currents and spin Hall magnetoresistance** (*Invited Paper*), Michel I. Dyakonov, Univ. Montpellier (France) . . . . . [10357-1]  
9:15 am: **Spintronic phenomena arising from bulk and interface spin-orbit interaction** (*Invited Paper*), Kazuya Ando, Keio Univ. (Japan) . . . . . [10357-2]  
9:45 am: **Theory of angular momentum transport** (*Invited Paper*), Shufeng Zhang, The Univ. of Arizona (USA) . . . . . [10357-3]  
Coffee Break . . . . . Sun 10:15 am to 10:45 am

#### SESSION 1B

LOCATION: CONV. CTR. ROOM 8 . . . . . SUN 9:15 AM TO 10:15 AM

#### Oxide Spintronics

Session Chair: **Henri Jaffrès**, Unité Mixte de Physique CNRS/Thales (France)

- 9:15 am: **Ferromagnetism and spin-dependent transport in NdTiO<sub>3</sub>/SrTiO<sub>3</sub> heterostructures** (*Invited Paper*), Vlad S. Pribiag, Univ. of Minnesota, Twin Cities (USA) . . . . . [10357-4]  
9:45 am: **Spin-dependant tunnelling in ultrathin Schottky junctions based on La<sub>0.66</sub>Sr<sub>0.33</sub>MnO<sub>3</sub> / SrTiO<sub>3</sub>:Nb interfaces** (*Invited Paper*), Philippe Lecoeur, Univ. Paris-Sud 11 (France); Georg Kurij, Ctr. de Nanosciences et de Nanotechnologies (France); Aurélie Solignac, CEA-Ctr. de SACLAY (France); Thomas Maroutian, Institut d'Électronique Fondamentale, Univ. Paris-Sud II (France); Guillaume Agnus, Univ. Paris-Sud 11 (France); Ruben Guerrero, IMDEA Nanociencia (Spain); Laurie E. Calvet, Ctr. de Nanosciences et de Nanotechnologies (France); Myriam Pannetier-Lecoeur, CEA-Ctr. de SACLAY (France) . . . . . [10357-5]  
Coffee Break . . . . . Sun 10:15 am to 10:45 am

Sessions 2A and 2B run concurrently.

#### SESSION 2A

LOCATION: CONV. CTR. ROOM 6F . . . SUN 10:45 AM TO 12:45 PM

#### Spin-Current and Spin-Hall Effects II

Session Chair: **Michel I. Dyakonov**, Univ. Montpellier (France)

- 10:45 am: **Theory of unidirectional magnetoresistance** (*Invited Paper*), Giovanni Vignale, Steven S. L. Zhang, Univ. of Missouri (USA) . . . . . [10357-6]  
11:15 am: **Spin Hall magnetoresistance and spin orbit torques in metallic heterostructures** (*Invited Paper*), Masamitsu Hayashi, The Univ. of Tokyo (Japan) . . . . . [10357-7]  
11:45 am: **Nonlocal spin diffusion driven by giant spin Hall effect at oxide heterointerfaces** (*Invited Paper*), Jung-Woo Yoo, Mi-Jin Jin, Ulsan National Institute of Science and Technology (Korea, Republic of); Seon Young Moon, Korea Institute of Science and Technology (Korea, Republic of); Jungmin Park, Junhyeon Jo, Ulsan National Institute of Science and Technology (Korea, Republic of); Hyun-Cheol Koo, Byoung-Chul Min, Korea Institute of Science and Technology (Korea, Republic of); Hyun-Woo Lee, Pohang Univ. of Science and Technology (Korea, Republic of); Seung-Hyub Baik, Korea Institute of Science and Technology (Korea, Republic of) . . . . . [10357-8]  
12:15 pm: **Conditions for the existence of spin to charge current conversion in spin-Hall devices: the Hall bar versus the Corbino disk** (*Invited Paper*), Jean-Eric Wegrowe, Robert Benda, Ecole Polytechnique (France); Miguel Rubi, Univ. de Barcelona (Spain) . . . . . [10357-9]  
Lunch Break . . . . . Sun 12:45 pm to 1:45 pm

#### SESSION 2B

LOCATION: CONV. CTR. ROOM 8 . . . . . SUN 10:45 AM TO 12:15 PM

#### Semiconductor Spintronics

Session Chair: **Philippe Lecoeur**, Univ. Paris-Sud 11 (France)

- 10:45 am: **Control of ferromagnetism and transport by material growth and wavefunction engineering in ferromagnetic semiconductors and heterostructures** (*Invited Paper*), Masaaki Tanaka, The Univ. of Tokyo (Japan) . . . . . [10357-10]  
11:15 am: **Spin signals in Si non-local transport devices with giant spin accumulation** (*Invited Paper*), Ron Jansen, Aurelie M. Spiesser, H. Saito, National Institute of Advanced Industrial Science and Technology (Japan); Y. Fujita, S. Yamada, K. Hamaya, Osaka Univ. (Japan); Shinji Yuasa, National Institute of Advanced Industrial Science and Technology (Japan) . . . . . [10357-11]  
11:45 am: **Magnetic and superconducting proximity effects on the transport properties of hybrid heterostructures** (*Invited Paper*), Alex Matos-Abiague, Igor Zutic, Univ. at Buffalo (USA) . . . . . [10357-12]  
Lunch Break . . . . . Sun 12:15 pm to 1:45 pm

# CONFERENCE 10357

## SESSION 3A

LOCATION: CONV. CTR. ROOM 6F . . . . SUN 1:45 PM TO 3:15 PM

### Multiferroics

Session Chair: **Jung-Woo Yoo**, Ulsan National Institute of Science and Technology (Korea, Republic of)

1:45 pm: **Spintronics probed with soft x-rays** (*Invited Paper*), Elke Arenholz, Lawrence Berkeley National Lab. (USA) . . . . . [10357-13]

2:15 pm: **Operando XMCD experiments: a tool for the investigation of magnetoelectric coupling in multiferroics** (*Invited Paper*), Piero Torelli, Istituto Officina dei Materiali, Consiglio Nazionale delle Ricerche (Italy) . . . . . [10357-14]

2:45 pm: **Magnetoelastic coupling at artificial multiferroic interfaces probed with soft x-ray techniques** (*Invited Paper*), Rajesh V. Chopdekar, Univ. of California, Davis (USA) . . . . . [10357-15]

Coffee Break . . . . . Sun 3:15 pm to 3:45 pm

## SESSION 3B

LOCATION: CONV. CTR. ROOM 8 . . . . . SUN 1:45 PM TO 3:15 PM

### Transition-Metal Dichalcogenides I

Session Chair: **Jaroslav Fabian**, Univ. Regensburg (Germany)

1:45 pm: **Monolayer transition metal dichalcogenide spin valves** (*Invited Paper*), Bo Hsu, Zheng Yang, Univ. of Illinois at Chicago (USA) . . . . . [10357-16]

2:15 pm: **Magneto-optical spectroscopy of excitons in semiconducting transition metal dichalcogenides** (*Invited Paper*), Ashish Arora, Westfälische Wilhelms-Univ. Münster (Germany) . . . . . [10357-17]

2:45 pm: **Spin-valley properties in transition metal dichalcogenides monolayers and heterostructures** (*Invited Paper*), Cedric Robert, Gang Wang, Fabian Cadiz, Bernhard Urbaszek, Xavier Marie, Lab. de Physique et Chimie des Nano-objets (France) . . . . . [10357-18]

Coffee Break . . . . . Sun 3:15 pm to 3:45 pm

Sessions 4A and 4B run concurrently.

## SESSION 4A

LOCATION: CONV. CTR. ROOM 6F . . . .SUN 3:45 PM TO 5:45 PM

### Spin Logic

Session Chair: **Shufeng Zhang**, The Univ. of Arizona (USA)

3:45 pm: **Spintronic logic: from switching devices to computing systems** (*Invited Paper*), Joseph S. Friedman, The Univ. of Texas at Dallas (USA) [10357-19]

4:15 pm: **Spintronics: a potential pathway to enable an exponential scaling for beyond-CMOS era** (*Invited Paper*), Jian-Ping Wang, Univ. of Minnesota (USA) . . . . . [10357-20]

4:45 pm: **Challenges and opportunities with spin-based logic** (*Invited Paper*), Michael Niemier, X. Sharon Hu, Robert Perricone, Li Tang, Univ. of Notre Dame (USA) . . . . . [10357-21]

5:15 pm: **Energy efficient switching of fixed magnetic skyrmions with an electric field for nanomagnetic computing devices** (*Invited Paper*), Dhritiman Bhattacharya, Md Mamun Al-Rashid, Jayasimha Atulasimha, Virginia Commonwealth Univ. (USA) . . . . . [10357-22]

## SESSION 4B

LOCATION: CONV. CTR. ROOM 8 . . . . .SUN 3:45 PM TO 5:45 PM

### Transition-Metal Dichalcogenides II

Session Chair: **Zheng Yang**, Univ. of Illinois at Chicago (USA)

3:45 pm: **Spin-orbit and exchange proximity effects in 2D materials** (*Invited Paper*), Jaroslav Fabian, Denis Kochan, Univ. Regensburg (Germany) . . [10357-23]

4:15 pm: **First principles investigation of the Co(0001)/MoS<sub>2</sub> and Ni(111)/WSe<sub>2</sub> interfaces for spin injection in a transition metal dichalcogenide monolayer** (*Invited Paper*), Lionel Calmels, Ctr. d'Elaboration de Matériaux et d'Etudes Structurales (France); Thomas Garandel, Ctr. d'Elaboration de Matériaux et d'Etudes Structurales, Ctr. National de la Recherche Scientifique (France) and Lab\* de Physique et Chimie des Nano-objets, Institut National des Sciences Appliquées de Toulouse (France); Rémi Arras, Ctr. d'Elaboration de Matériaux et d'Etudes Structurales (France); Xavier Marie, Lab. de Physique et Chimie des Nano-objets (France); Pierre Renucci, Institut National des Sciences Appliquées de Toulouse (France) . . . . . [10357-24]

4:45 pm: **A comparative spectroscopic study of the charge density wave features in 2H-NbSe<sub>2</sub> and 2H-TaS<sub>2</sub>** (*Invited Paper*), Utpal Chatterjee, Junjing Zhao, Kapila Wijayarathne, Univ. of Virginia (USA) . . . . . [10357-25]

5:15 pm: **Nature of the electromagnetic force between classical magnetic dipoles** (*Invited Paper*), Masud Mansuripur, College of Optical Sciences, The Univ. of Arizona (USA) . . . . . [10357-101]

LOCATION: CONV. CTR. ROOM 6A . . SUN 6:00 PM TO 7:50 PM

### Technology Hot Topics: How Optics and Photonics Drive Innovation

6:00 pm to 6:10 pm: **Welcome and Opening Remarks**

6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)

6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)

6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)

7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)

7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)



## MONDAY 7 AUGUST

**LOCATION: CONV. CTR. ROOM 6A MON 9:00 AM TO 12:00 PM**

### Nanoscience + Engineering Plenary Session

Session Chairs: **Harry A. Atwater Jr.**, California Institute of Technology (USA); **Nikolay I. Zheludev**, Optoelectronics Research Ctr. (United Kingdom)

9:15 am: **3D laser nanolithography** (*Plenary*), Martin Wegener, Karlsruhe Institut für Technologie (Germany) . . . . . [10354-500]

Coffee Break . . . . . Mon 10:00 am to 10:30 am

10:30 am: **Controlling light at the atomic scale** (*Plenary*), F. Javier Garcia de Abajo, ICFO - Institut de Ciències Fotòniques (Spain) . . . . . [10359-500]

11:15 am: **Science, engineering, and commercialization of flexible, printable 2D atomic materials and devices** (*Invited Paper*), Deji Akinwande, The Univ. of Texas at Austin (USA) . . . . . [10349-500]

Lunch Break . . . . . Mon 12:00 pm to 1:00 pm

### SESSION 5

**LOCATION: CONV. CTR. ROOM 6F . . . MON 1:00 PM TO 3:30 PM**

### Topological Insulators and Rashba Field I

Session Chair: **Mikhail Nestoklon**, Ioffe Institute (Russian Federation)

1:00 pm: **Rashba effect on the photophysical properties of hybrid perovskites and topological insulators** (*Invited Paper*), Andrew M. Rappe, Liang Z. Tan, Univ. of Pennsylvania (USA); Fan Zheng, Lawrence Berkeley National Lab. (USA); Shi Liu, Carnegie Institution for Science (USA); Youngkuk Kim, Univ. of Pennsylvania (USA); Maya Isarov, Efrat Lifshitz, Technion-Israel Institute of Technology (Israel) [10357-26]

1:30 pm: **Current-nonlinear magnetotransport and spin-orbit torque magnetization switching in a magnetic topological insulator** (*Invited Paper*), Kenji Yasuda, The Univ. of Tokyo (Japan); Atsushi Tsukazaki, Tohoku Univ. (Japan); Ryutarō Yoshimi, RIKEN (Japan); Kouta Kondou, RIKEN Ctr. for Emergent Matter Science (Japan); Kei S. Takahashi, RIKEN (Japan); YoshiChika Otani, Masashi Kawasaki, The Univ. of Tokyo (Japan); Yoshinori Tokura, RIKEN (Japan) [10357-27]

2:00 pm: **Voltage-driven magnetization control in topological insulator/magnetic insulator heterostructures** (*Invited Paper*), Michael E. Flatté, The Univ. of Iowa (USA) . . . . . [10357-28]

2:30 pm: **Superconductivity provides access to the chiral magnetic effect of an unpaired Weyl cone** (*Invited Paper*), Thomas O'Brien, Carlo W. J. Beenakker, Leiden Univ. (Netherlands); Inanc Adagideli, Sabanci Univ. (Turkey) . . . . [10357-29]

3:00 pm: **Emergent nanoscale superparamagnetism and electronic phase separation at oxide interfaces** (*Invited Paper*), Eli Zeldov, Weizmann Institute of Science (Israel) . . . . . [10357-30]

Coffee Break . . . . . Mon 3:30 pm to 4:00 pm

### SESSION 6

**LOCATION: CONV. CTR. ROOM 6F . . MON 4:00 PM TO 6:00 PM**

### Topological Insulators and Rashba Field II

Session Chair: **Vlad S. Pribiag**, Univ. of Minnesota (USA)

4:00 pm: **Spin-orbit splitting in quantum wells and 2D topological insulators** (*Invited Paper*), Mikhail Nestoklon, Ioffe Institute (Russian Federation) . . [10357-31]

4:30 pm: **Dynamical quantum anomalous Hall effect in the intense optical field regime** (*Invited Paper*), Wang-Kong Tse, The Univ. of Alabama (USA) . . [10357-32]

5:00 pm: **Emergent orbitronics and dissipationless magnetization control in complex magnets** (*Invited Paper*), Jan-Philipp Hanke, Institut für Fortgeschrittene Simulation, Forschungszentrum Jülich GmbH (Germany); Dongwook Go, Pohang Univ. of Science and Technology (Korea, Republic of); Patrick Buhl, Frank Freimuth, Stefan Blügel, Yuriy Mokrousov, Institut für Fortgeschrittene Simulation, Forschungszentrum Jülich GmbH (Germany) . . . . . [10357-33]

5:30 pm: **Spin to charge current conversion at surfaces and interfaces of Rashba systems and 3D topological insulators studied by spin pumping ferromagnetic resonance** (*Invited Paper*), Paul Noël, SPINTEC (France) and Univ. Grenoble Alpes (France); Edouard Lesne, Unité Mixte de Physique CNRS/Thales (France) and Univ. Paris-Sud (France) and Univ. Paris-Saclay (France); Yu Fu, SPINTEC (France) and Univ. Grenoble Alpes (France); Simón Oyarzún, Univ. de Santiago de Chile (Chile); Candice Thomas, MINATEC (France); Diogo C. Vaz, Juan-Carlos Rojas-Sánchez, Unité Mixte de Physique CNRS/Thales (France); Hiroshi Naganuma, Tohoku Univ. (Japan); Giuseppe Siccoli, CEA-INAC (France) and Univ. Grenoble Alpes (France); Serge Gambarelli, Commissariat à l'Énergie Atomique (France) and Univ. Grenoble Alpes (France); Jean-Philippe Attané, Commissariat à l'Énergie Atomique (France) and Ctr. National de la Recherche Scientifique (France) and Univ. Grenoble Alpes (France); Mathieu Jamet, SPINTEC (France) and Univ. Grenoble Alpes (France); Alain Marty, Commissariat à l'Énergie Atomique (France) and Ctr. National de la Recherche Scientifique (France) and Univ. Grenoble Alpes (France); Céline Vergnaud, SPINTEC (France) and CEA-INAC (France) and Univ. Grenoble Alpes (France); Eric Jacquet, Quentin Barbedienne, Jean-Marie George, Agnès Barthelemy, Unité Mixte de Physique CNRS/Thales (France); Yoshiyuki Ohtsubo, Osaka Univ. (Japan); Amina Taleb Ibrahim, Patrick Le Fèvre, Synchrotron SOLEIL (France); Henri Jaffrès, Nicolas Reyren, Albert Fert, Unité Mixte de Physique CNRS/Thales (France); Tristan Meunier, Institut NÉEL, Ctr. National de la Recherche Scientifique (France) and Univ. Grenoble Alpes (France); Philippe Ballet, Commissariat à l'Énergie Atomique (France) and MINATEC (France); Manuel Bibès, Unité Mixte de Physique CNRS/Thales (France); Laurent Vila, CEA-INAC (France) and Univ. Grenoble Alpes (France) and SPINTEC (France) . . . . . [10357-35]

Sessions 7A and 7B run concurrently.

### SESSION 7A

LOCATION: CONV. CTR. ROOM 6F . . TUE 8:00 AM TO 10:00 AM

#### Spin Pumping I

Session Chair: **Christopher M. Boehme**, The Univ. of Utah (USA)

8:00 am: **Evidence for a common origin of spin-orbit torque and the Dzyaloshinskii-Moriya interaction at a Py/Pt interface** (*Invited Paper*), Andrew Berger, Eric R. J. Edwards, Hans T. Nembach, Justin M. Shaw, National Institute of Standards and Technology (USA); Alexy D. Karenowska, Univ. of Oxford (United Kingdom); Mathias Weiler, Walther-Meißner-Institute (Germany); Thomas J. Silva, National Institute of Standards and Technology (USA) . . . . . [10357-36]

8:30 am: **Theory of spin loss at metallic interfaces** (*Invited Paper*), Kirill D. Belashchenko, Giovanni G. Baez Flores, Alexey A. Kovalev, Univ. of Nebraska-Lincoln (USA); Mark van Schilfgaarde, King's College London (United Kingdom) . . . . . [10357-37]

9:00 am: **Green's function formulation of spin pumping** (*Invited Paper*), Gen Tatara, RIKEN Ctr. for Emergent Matter Science (Japan) . . . . . [10357-38]

9:30 am: **Auto-oscillation and spin-wave propagation in ultra-thin YIG microstructures** (*Invited Paper*), Martin Collet, Paolo Bortolotti, Vincent Cros, Abdelmajid Anane, Unité Mixte de Physique CNRS/Thales (France) and Univ. Paris-Sud 11 (France) and Univ. Paris-Saclay (France); José Luis Prieto, Instituto de Microelectrónica de Madrid (Spain); Manuel Muñoz, Instituto de Sistemas Optoelectrónicos y Microtecnología (Spain); Jamal Ben Youssef, Lab. de Magnétisme de Bretagne, CNRS, Univ. de Bretagne Occidentale (France); Vladimir Naletov, Commissariat à l'Énergie Atomique (France) and Ctr. National de la Recherche Scientifique (France) and Univ. Grenoble Alpes (France); Grégoire de Loubens, Commissariat à l'Énergie Atomique (France); Olivier Klein, Commissariat à l'Énergie Atomique (France) and Ctr. National de la Recherche Scientifique (France) and Univ. Grenoble Alpes (France); Michael Evelt, Westfälische Wilhelms-Universität Münster (Germany); Vladimir Bessonov, M.N. Miheev Institute of Metal Physics, Ural Branch of Russian Academy of Sciences (Russian Federation); Sergej O. Demokritov, Vladislav E. Demidov, Westfälische Wilhelms-Universität Münster (Germany) . . . . . [10357-39]

Coffee Break . . . . . Tue 10:00 am to 10:30 am

### SESSION 7B

LOCATION: CONV. CTR. ROOM 8 . . . TUE 8:00 AM TO 10:00 AM

#### Ultrafast Spin Dynamics I

Session Chair: **Hiro Munekata**, Tokyo Institute of Technology (Japan)

8:00 am: **Understanding magnetization relaxation dynamics in half ferromagnet La<sub>0.66</sub>Sr<sub>0.33</sub>MnO<sub>3</sub>** (*Invited Paper*), Giancarlo Panaccione, Consiglio Nazionale delle Ricerche (Italy) . . . . . [10357-40]

8:30 am: **Ultrafast electrical switching of ferrimagnetic metals** (*Invited Paper*), Richard Wilson, Univ. of California, Riverside (USA); Yang Yang, Jon Gorchon, Univ. of California, Berkeley (USA); Charles-Henri Lambert, Univ. of California, Riverside (USA); Sayeef Salahuddin, Jeffrey Bokor, Univ. of California, Berkeley (USA) . . . . . [10357-41]

9:00 am: **Measuring ultrafast magnetisation dynamics in the sub 10 femtosecond regime** (*Invited Paper*), David Schmool, Univ. de Versailles Saint-Quentin-en Yvelines (France); Helder M. Crespo, Ana S. Vieira Silva, David Navas, Francisco Silva, Univ. do Porto (Portugal); Miguel Miranda, Lund Univ. (Sweden); Aurelio Hierro Rodriguez, Univ. do Porto (Portugal); Cledson S. L. Gonçalves, Univ. Federal do Pará (Brazil) . . . . . [10357-42]

9:30 am: **Non-equilibrium magnetic effects at interfaces for ultrafast dynamics** (*Invited Paper*), Ilya Razdolski, Alexandr Alekhin, Nikita Ilin, Fritz-Haber-Institut der Max-Planck-Gesellschaft (Germany); Jan P. Meyburg, Univ. Duisburg-Essen (Germany); Vladimir Roddatis, Institut für Materialphysik, Georg-August-Universität Göttingen (Germany); Detlef Dising, Uwe Bovensiepen, Univ. Duisburg-Essen (Germany); Alexey Melnikov, Fritz-Haber-Institut der Max-Planck-Gesellschaft (Germany) . . . . . [10357-43]

Coffee Break . . . . . Tue 10:00 am to 10:30 am

Sessions 8A and 8B run concurrently.

### SESSION 8A

LOCATION: CONV. CTR. ROOM 6F . TUE 10:30 AM TO 12:00 PM

#### Spin Pumping II

Session Chair: **Kirill D. Belashchenko**, Univ. of Nebraska-Lincoln (USA)

10:30 am: **Studying pure spin currents in weakly spin-orbit coupled materials using the pulsed ferromagnetic resonance driven inverse spin-Hall effect** (*Invited Paper*), Christoph M. Boehme, Marzieh Kavand, Kipp J. van Schooten, Dali Sun, Hans Malissa, Chuang Zhang, Matthew Groesbeck, Z. Vally Vardeny, The Univ. of Utah (USA) . . . . . [10357-44]

11:00 am: **Spin transfer torque mechanisms in three terminal spin-torque oscillators** (*Invited Paper*), Emilie Jué, National Institute of Standards and Technology (USA) . . . . . [10357-45]

11:30 am: **Perpendicular magnetic anisotropy in Bismuth substituted nanometers thick YIG films** (*Invited Paper*), Lucile Soumah, Unité Mixte de Physique CNRS/Thales (France); Lilia Qassym, Thales Research & Technology (France); Cécile Carretero, Eric Jacquet, Unité Mixte de Physique CNRS/Thales (France); Jamal Ben-Youssef, Univ. de Bretagne Occidentale (France); Richard Lebourgeois, Thales Research & Technology (France); Nathan Beaulieu, Univ. de Bretagne Occidentale (France); Vincent Cros, Paolo Bortolotti, Abdelmajid Anane, Unité Mixte de Physique CNRS/Thales (France) . . . . . [10357-46]

Lunch/Exhibition Break . . . . . Tue 12:00 pm to 1:30 pm

### SESSION 8B

LOCATION: CONV. CTR. ROOM 8 . . . TUE 10:30 AM TO 12:00 PM

#### Ultrafast Spin Dynamics and Spin-LEDs

Session Chair: **Richard Wilson**, Univ. of California, Riverside (USA)

10:30 am: **Progress in the room temperature operation of GaAs-based lateral-type spin-LED and spin-PD in near-infrared wavelength region** (*Invited Paper*), Hiro Munekata, Ronel C. Roca, Kazuhiro Nishibayashi, Nozomi Nishizawa, Tokyo Institute of Technology (Japan) . . . . . [10357-47]

11:00 am: **Efficient electrical spin injection into quantum dots at zero magnetic field** (*Invited Paper*), Fabian Cadiz, Delphine Lagarde, Lab. de Physique et Chimie des Nano-objets (France); Shiheng Liang, Institut Jean Lamour (France); Bingshan Tao, Institute of Physics, Chinese Academy of Sciences (China); Julien Frougier, Unité Mixte de Physique CNRS/Thales (France); Yuan Lu, Institut Jean Lamour (France); Bo Xu, Institute of Semiconductors, Chinese Academy of Sciences (China); Henri Jaffres, Unité Mixte de Physique CNRS/Thales (France); Zg Wang, Institute of Semiconductors, Chinese Academy of Sciences (China); X. Fhan, Institute of Physics, Chinese Academy of Sciences (China); Michel Hehn, Stephane Mangin, Institut Jean Lamour (France); Jean-Marie George, Unité Mixte de Physique CNRS/Thales (France); Thierry Amand, Xavier Marie, Bernhard Urbaszek, Lab. de Physique et Chimie des Nano-objets (France); Pierre Renucci, Institut National des Sciences Appliquées de Toulouse (France) . . . . . [10357-48]

11:30 am: **Injection of sub-picosecond ultrashort spin current pulses in semiconductors** (*Invited Paper*), Marco Battiato, Technical Univ. Vienna (Austria) . . . . . [10357-49]

Lunch/Exhibition Break . . . . . Tue 12:00 pm to 1:30 pm

Sessions 9A and 9B run concurrently.

## SESSION 9A

LOCATION: CONV. CTR. ROOM 6F . . . . TUE 1:30 PM TO 3:30 PM

### Graphene Spintronics

Session Chair: **Lionel Calmels**, Ctr. d'Elaboration de Matériaux et d'Etudes Structurales (France)

1:30 pm: **Modeling the negative magnetoresistance of ferromagnet-graphene-ferromagnet junctions** (*Invited Paper*), Olaf M. J. van 't Erve, Enrique Cobas, Berend T. Jonker, U.S. Naval Research Lab. (USA) . . . . . [10357-50]

2:00 pm: **Microwave magnetization dynamics in room temperature organic-based magnets: from fundamental studies to emerging applications** (*Invited Paper*), Ezekiel Johnston-Halperin, The Ohio State Univ. (USA) . . . . . [10357-51]

2:30 pm: **Spin to charge conversion in graphene and carbon nanotube mats** (*Invited Paper*), Yuichiro Ando, Sergey Dushenko, Ei Shigematsu, Masashi Shiraishi, Kyoto Univ. (Japan) . . . . . [10357-52]

3:00 pm: **Magnetically controllable graphene plasmonics** (*Invited Paper*), Dmitry A. Kuzmin, Igor V. Bychkov, Chelyabinsk State Univ. (Russian Federation) and South Ural State Univ. (Russian Federation); Vladimir G. Shavrov, Kotelnikov Institute of Radio Engineering and Electronics of Russian Academy of Sciences (Russian Federation); Vasily V. Temnov, Institut des Molécules et Matériaux du Mans, Univ. du Maine (France) . . . . . [10357-53]

Coffee Break . . . . . Tue 3:30 pm to 4:00 pm

## SESSION 9B

LOCATION: CONV. CTR. ROOM 8 . . . . . TUE 1:30 PM TO 3:30 PM

### Spin-Orbit Coupling and Spin-Orbit Torque

Session Chair: **Gen Tatara**, RIKEN Ctr. for Emergent Matter Science (Japan)

1:30 pm: **Spin orbit torque switching of compensated ferrimagnet** (*Invited Paper*), Luqiao Liu, Joseph Finley, Jiahao Han, Saima Siddiqui, Massachusetts Institute of Technology (USA) . . . . . [10357-54]

2:00 pm: **Spin-orbit fields at Fe/GaAs (001) interface** (*Invited Paper*), Lin Chen, Univ. Regensburg (Germany) . . . . . [10357-55]

2:30 pm: **Phonon-induced superconductivity in a self-consistent Hubbard model** (*Invited Paper*), Enrique Munoz, Pontificia Univ. Católica de Chile (Chile); Edson Vernek, Univ. Federal de Uberlândia (Brazil); Victor Apel, Univ. Católica del Norte (Chile) . . . . . [10357-56]

3:00 pm: **Characterizing spin orbit torque effective fields** (*Invited Paper*), Wen Siang Lew, Sarjoosing Goolaup, Feilong Luo, Nanyang Technological Univ. (Singapore) . . . . . [10357-57]

Coffee Break . . . . . Tue 3:30 pm to 4:00 pm

Sessions 10A and 10B run concurrently.

## SESSION 10A

LOCATION: CONV. CTR. ROOM 6F . . . TUE 4:00 PM TO 6:30 PM

### Spin Optics

Session Chair: **Olaf M. J. van 't Erve**, U.S. Naval Research Lab. (USA)

4:00 pm: **The engagement of optical angular momentum in nanoscale chirality** (*Invited Paper*), David L. Andrews, Univ. of East Anglia (United Kingdom) [10357-58]

4:30 pm: **Spin-orbit interaction of light on the surface of atomically thin crystals** (*Invited Paper*), Hailu Luo, Hunan Univ. (China) . . . . . [10357-59]

5:00 pm: **Controlling angular momentum at the micro scale** (*Invited Paper*), Daryl Preece, Univ. of California, San Diego (USA) . . . . . [10357-60]

5:30 pm: **Active mid IR plasmonics using giant magneto resistance** (*Invited Paper*), Gaspar Armelles Reig, Instituto de Microelectronica de Madrid, Consejo Superior de Investigaciones Científicas (Spain); Alfonso Cebollada, Instituto de Microelectrónica de Madrid, Consejo Superior de Investigaciones Científicas (Spain); Fernando García, Instituto de Microelectrónica de Madrid (Spain) [10357-61]

6:00 pm: **Anomalous optical properties of Rashba conductor** (*Invited Paper*), Gen Tatara, RIKEN Ctr. for Emergent Matter Science (Japan) . . . . . [10357-62]

## SESSION 10B

LOCATION: CONV. CTR. ROOM 8 . . . . . TUE 4:00 PM TO 6:30 PM

### Spin Acoustics

Session Chair: **Daniel Lacour**, Institut Jean Lamour (France)

4:00 pm: **Acoustic driven magnonics** (*Invited Paper*), Ivan Lisenkov, Mikkel Hansen, Albrecht Jander, Pallavi Dhagat, Oregon State Univ. (USA) . . . [10357-63]

4:30 pm: **From non-linear magnetoacoustics and spin reorientation transition to magnetoelectric micro/nano-systems** (*Invited Paper*), Nicolas Tiercelin, Institut d'Electronique de Microélectronique et de Nanotechnologie (France); Vladimir Preobrazhensky, Institut d'Electronique de Microélectronique et de Nanotechnologie (France) and A. M. Prokhorov General Physics Institute of the Russian Academy of Sciences (Russian Federation); Olivier Bou Matar, Abdelkrim Talbi, Stefano Giordano, Yannick Dusch, Institut d'Electronique de Microélectronique et de Nanotechnologie (France); Alexey Klimov, Institute of Radio Electronics (Russian Federation) and Institut d'Electronique de Microélectronique et de Nanotechnologie (France) and Moscow Technological Univ. (Russian Federation); Théo Mathurin, Institut d'Electronique de Microélectronique et de Nanotechnologie (France); Omar Elmazria, Michel Hehn, Institut Jean Lamour (France); Philippe Pernod, Institut d'Electronique de Microélectronique et de Nanotechnologie (France) . . . . . [10357-64]

5:00 pm: **High field bipolar magnetic field sensors based on surface acoustic wave resonators** (*Invited Paper*), Vincent Polewczyk, Karine Dumesnil, Daniel Lacour, Mohammed Moutaouekkil, Hamid Mjaded, Institut Jean Lamour (France); Nicolas Tiercelin, Institut d'Electronique de Microélectronique et de Nanotechnologie (France); Sébastien Petit Watelot, Institut Jean Lamour (France); Yannick Dusch, Institut d'Electronique de Microélectronique et de Nanotechnologie (France); Omar Elmazria, Institut Jean Lamour (France); Abdelkrim Talbi, Olivier Bou Matar, Institut d'Electronique de Microélectronique et de Nanotechnologie (France); Michel Hehn, Institut Jean Lamour (France) . . . . . [10357-65]

5:30 pm: **Traveling surface spin-wave resonance spectroscopy using surface acoustic waves** (*Invited Paper*), Praveen Gowtham, Univ. of California, Berkeley (USA) . . . . . [10357-66]

6:00 pm: **Generation of ultrashort shear acoustic pulses by femtosecond laser demagnetization of highly magnetostrictive Terfenol** (*Invited Paper*), Thomas T. P. Pezeril, Univ. du Maine (France) . . . . . [10357-67]



### SESSION 11A

LOCATION: CONV. CTR. ROOM 6F . WED 8:00 AM TO 10:00 AM

#### THz Spin Dynamics

Session Chair: **Markus Münzenberg**, Ernst Moritz Arndt Univ. Greifswald (Germany)

8:00 am: **Ultrafast terahertz spintronics** (*Invited Paper*), Dmitry Turchinovich, Max-Planck-Institut für Polymerforschung (Germany) . . . . . [10357-68]

8:30 am: **High performance THz emitters based on ferromagnetic/nonmagnetic heterostructures** (*Invited Paper*), Yang Wu, Mehrdad Elyasi, Mengji Chen, Hyunsoo Yang, National Univ. of Singapore (Singapore) . . . . . [10357-69]

9:00 am: **Tunable THz emitters based on the magnetic heterostructure** (*Invited Paper*), Jingbo Qi, Univ. of Electronic Science and Technology of China (China) and The Peac Institute of Multiscale Sciences (China) . . . . . [10357-70]

9:30 am: **Directly probing ultrafast spin dynamics in antiferromagnets using terahertz pulses** (*Invited Paper*), Pamela Bowlan, Stuart A. Trugman, Los Alamos National Lab. (USA); Xueyun Wang, Sang-Wook Cheong, Rutgers, The State Univ. of New Jersey (USA); Dmitry A. Yarotski, Antionette J. Taylor, Rohit P. Prasankumar, Los Alamos National Lab. (USA) . . . . . [10357-71]

Coffee Break . . . . . Wed 10:00 am to 10:20 am

### SESSION 11B

LOCATION: CONV. CTR. ROOM 8 . . . WED 8:00 AM TO 10:00 AM

#### Skymions

Session Chair: **Masaaki Tanaka**, The Univ. of Tokyo (Japan)

8:00 am: **The skyrmion switch: turning magnetic skyrmions on and off with an electric field** (*Invited Paper*), Anne Bernard-Mantel, Marine Schott, Laurent Ranno, Stéfania Pizzini, Jan Vogel, Institut NéEL, Ctr. National de la Recherche Scientifique (France) and Univ. Grenoble Alpes (France); Hélène Béa, Commissariat à l'Énergie Atomique (France) and Ctr. National de la Recherche Scientifique (France) and Univ. Grenoble Alpes (France); Claire Baraduc, Commissariat à l'Énergie Atomique (France) and Univ. Grenoble Alpes (France); Gilles Gaudin, SPINTEC, Ctr. National de la Recherche Scientifique (France) and Institut Nanosciences et Cryogénie, Commissariat à l'Énergie Atomique (France) and Univ. Grenoble Alpes (France); Stéphane Auffret, Commissariat à l'Énergie Atomique (France) and Ctr. National de la Recherche Scientifique (France) and Univ. Grenoble Alpes (France); Dominique Givord, Institut NéEL, Ctr. National de la Recherche Scientifique (France) and Univ. Grenoble Alpes (France) . . . . . [10357-72]

8:30 am: **Room-temperature skyrmion shift device for memory application** (*Invited Paper*), Guoqiang Yu, Pramey Upadhyaya, Qiming Shao, Univ. of California, Los Angeles (USA); Hao Wu, Institute of Physics, Chinese Academy of Sciences (China); Gen Yin, Xiang Li, Congli He, Univ. of California, Los Angeles (USA); Wanjun Jiang, State Key Lab. of Low-Dimensional Quantum Physics, Tsinghua Univ. (China) and Collaborative Innovation Ctr. of Quantum Matter (China); Xiufeng Han, Institute of Physics, Chinese Academy of Sciences (China); Pedram Khalili Amiri, Kang L. Wang, Univ. of California, Los Angeles (USA) . . . . . [10357-73]

9:00 am: **Electric field induced switching of magnetic skyrmions and strain relief effects** (*Invited Paper*), Aurore Finco, Pin-Jui Hsu, Niklas Romming, André Kubetzka, Kirsten von Bergmann, Roland Wiesendanger, Univ. Hamburg (Germany) . . . . . [10357-74]

9:30 am: **Skyrmion motion in inhomogeneous magnetic multilayers** (*Invited Paper*), William Legrand, Unité Mixte de Physique CNRS/Thales (France); Davide Maccariello, Unité Mixte de Physique CNRS/Thales (France); Nicolas Reyren, Karin Garcia, Karim Bouzehouane, Unité Mixte de Physique CNRS/Thales (France); Horia Popescu, Jean-Yves Chauleau, Nicolas Jaouen, Synchrotron SOLEIL (France); Christoforos Moutafis, The Univ. of Manchester (United Kingdom); Simone Finizio, Carlos A. F. Vaz, Jörg Raabe, Swiss Light Source, Paul Scherrer Institute (Switzerland); Stephen McVitie, Univ. of Glasgow (United Kingdom); Vincent Cros, Albert Fert, Unité Mixte de Physique CNRS/Thales (France) . . . . . [10357-75]

Coffee Break . . . . . Wed 10:00 am to 10:30 am

### SESSION 12A

LOCATION: CONV. CTR. ROOM 6F . WED 10:20 AM TO 12:05 PM

#### Bio-Inspired and Neuromorphic Computations I

Session Chair: **Matthew Pufall**, National Institute of Standards and Technology (USA)

10:20 am: **Nanodevices for bio-inspired computing** (*Invited Paper*), Julie Gröllier, Unité Mixte de Physique CNRS/Thales (France) . . . . . [10357-76]

11:05 am: **Analogue spin-orbit torque device for artificial-neural-network-based associative memory operation** (*Invited Paper*), Shunsuke Fukami, William A. Borders, Aleksandr Kurenkov, Hisanao Akima, Satoshi Moriya, Shouta Kurihara, Yoshihiko Horio, Shigeo Sato, Hideo Ohno, Tohoku Univ. (Japan) . . . . . [10357-77]

11:35 am: **Modulation and detection of single neuron activity using spin transfer nano-oscillators** (*Invited Paper*), Jose Miguel Algarin, Bharath Ramaswamy, Lucy Venuti, Matthew Swierzbinski, Pablo Villar, Univ. of Maryland, College Park (USA); Yu-Jin Chen, Univ. of California, Irvine (USA); Irving N. Weinberg M.D., Weinberg Medical Physics (USA); Jens Herberholz, Ricardo Arnedo, Benjamin Shapiro, Edo Waks, Univ. of Maryland, College Park (USA) . . . . . [10357-78]

Lunch/Exhibition Break . . . . . Wed 12:05 pm to 1:05 pm

### SESSION 12B

LOCATION: CONV. CTR. ROOM 8 . . . WED 10:30 AM TO 12:00 PM

#### Skymions and Topological Matter I

Session Chair: **Joseph S. Friedman**, The Univ. of Texas at Dallas (USA)

10:30 am: **Topological Hall effect in a system with magnetic skyrmions** (*Invited Paper*), Igor Rozhansky, Konstantin Denisov, Ioffe Institute (Russian Federation) and Lappeenranta Univ. of Technology (Finland); Nikita S. Averkiev, Ioffe Institute (Russian Federation); Erkki Lahderanta, Lappeenranta Univ. of Technology (Finland) . . . . . [10357-79]

11:00 am: **Skyrmion Hall effect revealed by direct time-resolved x-ray microscopy** (*Invited Paper*), Kai Litzius, Johannes Gutenberg Univ. Mainz (Germany) and Max-Planck-Institut für Intelligente Systeme (Germany); Ivan Lemesh, Massachusetts Institute of Technology (USA); Benjamin Krüger, Pedram Bassirian, Johannes Gutenberg Univ. Mainz (Germany); Lucas Caretta, Massachusetts Institute of Technology (USA); Johannes Gutenberg Univ. Mainz (Germany); Felix Büttner, Massachusetts Institute of Technology (USA); Koji Sato, Tohoku Univ. (Japan); Oleg A. Tretiakov, Tohoku Univ. (Japan) and Far Eastern Federal Univ. (Russian Federation); Johannes Förster, Max-Planck-Institut für Intelligente Systeme (Germany); Robert M. Reeve, Johannes Gutenberg Univ. Mainz (Germany); Markus Weigand, Iuliia Bykova, Hermann Stoll, Gisela Schuetz, Max-Planck-Institut für Intelligente Systeme (Germany); Geoffrey S. D. Beach, Massachusetts Institute of Technology (USA); Mathias Kläui, Johannes Gutenberg Univ. Mainz (Germany) . . . . . [10357-80]

11:30 am: **Topological orbital magnetic moments** (*Invited Paper*), Manuel dos Santos Dias, Juba Bouaziz, Mohammed Bouhassoune, Stefan Blügel, Samir Lounis, Forschungszentrum Jülich GmbH (Germany) . . . . . [10357-81]

Lunch/Exhibition Break . . . . . Wed 12:00 pm to 1:30 pm

Sessions 13A and 13B run concurrently.

## SESSION 13A

LOCATION: CONV. CTR. ROOM 6F ... WED 1:05 PM TO 3:20 PM

### Bio-Inspired and Neuromorphic Computations II

Session Chair: **Julie Grollier**, Unité Mixte de Physique CNRS/Thales (France)

1:05 pm: **Implementation of energy efficient learning in neural networks based on synaptic devices** (*Invited Paper*), Yuhan Shi, Leon Nguyen, Duygu Kuzum, Univ. of California, San Diego (USA) ..... [10357-127]

1:35 pm: **Memcomputing: a brain-inspired topological computing paradigm** (*Keynote Presentation*), Massimiliano Di Ventra, Univ. of California, San Diego (USA) ..... [10357-83]

2:20 pm: **Neuromorphic computing with stochastic spintronic devices** (*Invited Paper*), Damien Querlioz, Adrien F. Vincent, Alice Mizrahi, Damir Vodencarevic, Nicolas Locatelli, Univ. Paris-Sud 11 (France); Joseph S. Friedman, The Univ. of Texas at Dallas (USA); Jacques-Olivier Klein, Univ. Paris-Sud 11 (France); Julie Grollier, Univ. Paris-Sud (France) ..... [10357-84]

2:50 pm: **Degree of match determination using coupled spin-torque oscillators** (*Invited Paper*), Matthew Pufall, National Institute of Standards and Technology (USA) ..... [10357-89]

Coffee Break ..... Wed 3:20 pm to 3:40 pm

## SESSION 13B

LOCATION: CONV. CTR. ROOM 8 ..... WED 1:30 PM TO 3:30 PM

### Spin Lasers

Session Chair: **Dmitry Turchinovich**, Max-Planck-Institut für Polymerforschung (Germany)

1:30 pm: **High-frequency polarization dynamics in spin-lasers: pushing the limits** (*Invited Paper*), Nils C. Gerhardt, Markus Lindemann, Ruhr-Univ. Bochum (Germany); Tobias Pusch, Rainer Michalzik, Univ. Ulm (Germany); Martin R. Hofmann, Ruhr-Univ. Bochum (Germany) ..... [10357-85]

2:00 pm: **Quantum dot spin-V(E)CSELS: polarization switching and periodic oscillations** (*Invited Paper*), Nianqiang Li, Univ. of Essex (United Kingdom); Dimitris Alexandropoulos, Univ. of Patras (Greece); Hadi Susanto, Ian D. Henning, Michael J. Adams, Univ. of Essex (United Kingdom) ..... [10357-86]

2:30 pm: **Theory of wurtzite-based spin lasers** (*Invited Paper*), Paulo E. Faria Junior, Univ. Regensburg (Germany); Gaofeng Xu, Univ. at Buffalo (USA); Yang-Fang Chen, National Taiwan Univ. (Taiwan); Guilherme M. Sipahi, Univ. de São Paulo (Brazil); Igor Zutic, Univ. at Buffalo (USA) ..... [10357-87]

3:00 pm: **Eigenmodes of semiconductor spin-lasers with local linear birefringence and gain dichroism** (*Invited Paper*), Henri Jaffrès, Unité Mixte de Physique CNRS/Thales (France); Tibor Fordos, VSB-Technical Univ. of Ostrava (Czech Republic) and Ecole Polytechnique (France); Kamil Postava, Jaromir Pištora, VSB-Technical Univ. of Ostrava (Czech Republic); Arnaud Garnache, Univ. Montpellier (France); Henri-Jean Drouhin, Ecole Polytechnique (France) ..... [10357-88]

Coffee Break ..... Wed 3:30 pm to 4:00 pm

Sessions 14A and 14B run concurrently.

## SESSION 14A

LOCATION: CONV. CTR. ROOM 6F ... WED 3:40 PM TO 5:40 PM

### Bio-Inspired and Neuromorphic Computations III

Session Chair: **Massimiliano Di Ventra**, Univ. of California, San Diego (USA)

3:40 pm: **Mutually synchronized spin Hall nano-oscillators for neuromorphic computing** (*Invited Paper*), Mykola Dvornik, Ahmad A. Awad, Philipp Dürrenfeld, Afshin Houshang, Ezio Iacocca, Randy K. Dumas, Johan Åkerman, Göteborgs Univ. (Sweden) ..... [10357-90]

4:10 pm: **Stochastic p-bits for invertible logic** (*Invited Paper*), Kerem Yunus Camsari, Purdue Univ. (USA) ..... [10357-91]

4:40 pm: **Shock-waves and commutation speed of memristors** (*Invited Paper*), Marcelo Rozenberg, Ctr. National de la Recherche Scientifique (France) and Univ. of California, San Diego (USA) ..... [10357-92]

5:10 pm: **Reservoir computing with spin-torque nano-oscillators**, Flavio Abreu Araujo, Mathieu Riou, Jacob Torrejon, Unité Mixte de Physique CNRS/Thales (France); Guru Khalsa, Mark D. Stiles, National Institute of Standards and Technology (USA); Sumito Tsunegi, Akio Fukushima, Hitoshi Kubota, Shinji Yuasa, National Institute of Advanced Industrial Science and Technology (Japan); Damien Querlioz, Univ. Paris-Sud 11 (France); Vincent Cros, Julie Grollier, Unité Mixte de Physique CNRS/Thales (France) ..... [10357-93]

## SESSION 14B

LOCATION: CONV. CTR. ROOM 8 ..... WED 4:00 PM TO 5:30 PM

### Skymions and Topological Matter II

Session Chair: **Anne Bernard-Mantel**, Institut NÉEL (France)

4:00 pm: **Dispersive elastic properties governing Dzyaloshinskii domain wall creep** (*Invited Paper*), Vincent Sokalski, James P. Pellegren, Derek Lau, Carnegie Mellon Univ. (USA) ..... [10357-94]

4:30 pm: **Stabilization and control of Majorana bound states with skymions** (*Invited Paper*), Alexey A. Kovalev, Univ. of Nebraska-Lincoln (USA) ..... [10357-95]

5:00 pm: **Charge-spin conversion in topological insulators and graphene** (*Invited Paper*), Ching-Tzu Chen, IBM Thomas J. Watson Research Ctr. (USA) ..... [10357-96]

# CONFERENCE 10357

LOCATION: CONV. CTR.

EXHIBIT HALL B2 ..... WED 5:30 PM TO 7:30 PM

## Posters-Wednesday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**AuCl<sub>3</sub> doping-induced conductive instability for CVD-grown graphene on glass substrate**, Jiaqing Wang, Xianming Liu, Yun Luo, Peng Zhang, Xiaohua Lei, Weimin Chen, Chongqing Univ. (China) ..... [10357-123]

**Excitons and magnetic properties of InP nanowires in wurtzite phase**, Paulo E. Faria Junior, Univ. Regensburg (Germany); Davide Tedeschi, Sapienza Univ. di Roma (Italy); Marta De Luca, Sapienza Univ. di Roma (Italy) and Univ. Basel (Switzerland); Benedikt Scharf, Univ. Regensburg (Germany) and Julius-Maximilians-Univ. Würzburg (Germany); Antonio Polimeni, Sapienza Univ. di Roma (Italy); Jaroslav Fabian, Univ. Regensburg (Germany). ..... [10357-124]

**Spinorbitronics and spin Hall effects in metallic multilayers for THz emission and THz applications**, Thi-Huong Dang, Unité Mixte de Physique CNRS/Thales (France); Jérôme Tignon, Lab. Pierre Aigrain (France); Jean-Marie George, Sophie Collin, Unité Mixte de Physique CNRS/Thales (France); Henri-Jean Drouhin, Ecole Polytechnique (France); Gaetan Bracciale, Laurent Divay, Thales Research & Technology (France); Paolo Bortolotti, Unité Mixte de Physique CNRS/Thales (France); Sukhdeep Dhillon, Lab. Pierre Aigrain (France); Henri Jaffrès, Unité Mixte de Physique CNRS/Thales (France) ..... [10357-125]

## THURSDAY 10 AUGUST

Sessions 15A and 15B run concurrently.

### SESSION 15A

LOCATION: CONV. CTR. ROOM 6F ..THU 8:00 AM TO 10:00 AM

#### Spin Transport in Metallic Systems

Session Chair: **Matthew Doty**, Univ. of Delaware (USA)

8:00 am: **Disentangling interface and bulk contributions to the anisotropic magnetoresistance in Pt/Co/Pt sandwiches** (*Invited Paper*), André Philippi-Kobs, Deutsches Elektronen-Synchrotron (Germany) and Univ. Hamburg (Germany); Hans Peter Oepen, Univ. Hamburg (Germany). ..... [10357-97]

8:30 am: **Engineering spin accumulation and giant magnetoresistance in metallic nanostructures** (*Invited Paper*), Gilles Zahnd, Laurent Vila, Van Tuong Pham, Paul Noël, CEA Grenoble (France); Alain Marty, Jean-Philippe Attané, Commissariat à l'Énergie Atomique (France) ..... [10357-98]

9:00 am: **Temperature dependence of spin transport properties in Pt** (*Invited Paper*), Ryan Freeman, Andrei Zholud, Sergei Urazhdin, Emory Univ. (USA) ..... [10357-99]

9:30 am: **Imaging electrical rotation of antiferromagnetic domains** (*Invited Paper*), Sarnjeet Dhese, Diamond Light Source Ltd. (United Kingdom). . [10357-100]

Coffee Break ..... Thu 10:00 am to 10:30 am

### SESSION 15B

LOCATION: CONV. CTR. ROOM 8 . . . .THU 8:00 AM TO 10:00 AM

#### Spin-Dependent Transport

Session Chair: **Henri-Jean Drouhin**, Ecole Polytechnique (France)

8:00 am: **Spin superfluid triggered domain-wall motion and spin-transistor action** (*Invited Paper*), Pramey Upadhyaya, Se Kwon Kim, Yaroslav Tserkovnyak, Univ. of California, Los Angeles (USA) ..... [10357-126]

8:30 am: **Non-stationary spin-polarized tunneling currents tuning by means of applied bias changing** (*Invited Paper*), Vladimir N. Mantsevich, Natalia Maslova, M.V. Lomonosov Moscow SU (Russian Federation); Petr Arseyev, P.N. Lebedev Physical Institute (Russian Federation) ..... [10357-102]

9:00 am: **Spin-dependent electrical transport at finite temperatures from the first principles** (*Invited Paper*), David Wagenknecht, Charles Univ. in Prague (Czech Republic) and Institute of Physics of Materials of the ASCR, v.v.i., The Czech Academy of Sciences (Czech Republic); Karel Carva, Charles Univ. in Prague (Czech Republic); Ilja Turek, Charles Univ. in Prague (Czech Republic) and Institute of Physics of Materials of the ASCR, v.v.i., The Czech Academy of Sciences (Czech Republic) ..... [10357-103]

9:30 am: **First-principles calculation of spin transport and relaxation in magnetic heterostructures** (*Invited Paper*), Zhe Yuan, Beijing Normal Univ. (China) ..... [10357-104]

Coffee Break ..... Thu 10:00 am to 10:30 am



Sessions 16A and 16B run concurrently.

## SESSION 16A

LOCATION: CONV. CTR. ROOM 6F . THU 10:30 AM TO 12:30 PM

### Spin-Seebeck Effects

Session Chair: **Jean-Eric Wegrowe**, Ecole Polytechnique (France)

10:30 am: **Thermal generation of spin currents in oxides** (*Invited Paper*), Rafael Ramos, Takashi Kikkawa, Daichi Hirobe, Tohoku Univ. (Japan); Alberto Anadon, Irene Lucas, Univ. de Zaragoza (Spain); Ken-ichi Uchida, National Institute for Materials Science (Japan); Hiroto Adachi, Japan Atomic Energy Agency (Japan); Pedro Algarabel, Luis Morellon, Myriam Aguirre, Univ. de Zaragoza (Spain); Sadamichi Maekawa, Japan Atomic Energy Agency (Japan); Ricardo Ibarra, Instituto de Nanociencia de Aragon (Spain); Eiji Saitoh, Tohoku Univ. (Japan) . . . . . [10357-105]

11:00 am: **The contribution of the thermal Hall effect in the anomalous Nernst and spin Seebeck effects** (*Invited Paper*), Ssu-Yen Huang, Yi-Jia Chen, National Taiwan Univ. (Taiwan) . . . . . [10357-106]

11:30 am: **Spin-caloritronic nano-oscillator** (*Invited Paper*), Igor Barsukov, Univ. of California, Riverside (USA) . . . . . [10357-107]

12:00 pm: **Optimisation of Co<sub>2</sub>MnSi:Pt multilayers for giant spin Seebeck devices** (*Invited Paper*), Christopher Cox, Kelly Morrison, Michael D. Cropper, Loughborough Univ. (United Kingdom); Andrew Caruana, Loughborough Univ. (United Kingdom) and Science and Technology Facilities Council (United Kingdom); Christy Kinane, Science and Technology Facilities Council (United Kingdom); Timothy Charlton, Oak Ridge National Lab. (USA) . . . . . [10357-108]

Lunch/Exhibition Break . . . . . Thu 12:30 pm to 1:30 pm

## SESSION 16B

LOCATION: CONV. CTR. ROOM 8 . . . THU 10:30 AM TO 12:00 PM

### Ultrafast Spin Dynamics II

Session Chair: **David Schmool**, Univ. de Versailles Saint-Quentin-en Yvelines (France)

10:30 am: **All-optical magnetization switching of FePt magnetic recording medium** (*Invited Paper*), Markus Münzenberg, Ernst Moritz Arndt Univ. Greifswald (Germany) . . . . . [10357-109]

11:00 am: **Transient THz spin dynamics by spin pumping** (*Invited Paper*), Lars Bocklage, Deutsches Elektronen-Synchrotron (Germany) . . . . . [10357-110]

11:30 am: **Optically induced magnetization reversal dynamics in (Pt/Co)N multilayers** (*Invited Paper*), Roman Adam, Umot Parlak, Moritz Plötzing, Daniel E. Bürgler, Claus M. Schneider, Forschungszentrum Jülich GmbH (Germany) . . . . . [10357-111]

Lunch/Exhibition Break . . . . . Thu 12:00 pm to 1:00 pm

Sessions 17A and 17B run concurrently.

## SESSION 17A

LOCATION: CONV. CTR. ROOM 6F . . . THU 1:30 PM TO 4:00 PM

### Spin Coherence

Session Chair: **Zhe Yuan**, Beijing Normal Univ. (China)

1:30 pm: **Prolonging the coherence of spins in semiconductor quantum dots** (*Invited Paper*), Edwin Barnes, Virginia Polytechnic Institute and State Univ. (USA) . . . . . [10357-112]

2:00 pm: **Optically probing spin qubit coherence without coherent control** (*Invited Paper*), Kai Müller, Alexander Bechtold, Walter Schottky Institut, Technische Univ. München (Germany); Fuxiang Li, Los Alamos National Lab. (USA); Tobias Simmet, Walter Schottky Institut, Technische Univ. München (Germany); Nikolai A. Sinitsyn, Los Alamos National Lab. (USA); Jonathan J. Finley, Walter Schottky Institut, Technische Univ. München (Germany) . . . . . [10357-113]

2:30 pm: **Defects in SiC: electronic structure and spin-photon interfaces** (*Invited Paper*), Sophia Economou, Virginia Polytechnic Institute and State Univ. (USA) . . . . . [10357-114]

3:00 pm: **Coherent phenomena in ferromagnetic GaMnAs films** (*Invited Paper*), Brenden A. Magill, Giti A. Khodaparast, Virginia Polytechnic Institute and State Univ. (USA); Stephen A. McGill, National High Magnetic Field Lab. (USA); Hiro Munekata, Tokyo Institute of Technology (Japan); Gary D. Sanders, Chris J. Stanton, Univ. of Florida (USA) . . . . . [10357-115]

3:30 pm: **Molecular engineering with artificial atoms: designing a material platform for scalable quantum spintronics and photonics** (*Invited Paper*), Matthew Doty, Xiangyu Ma, Joshua M. Zide, Univ. of Delaware (USA); Garnett W. Bryant, National Institute of Standards and Technology (USA) . . . . . [10357-116]

## SESSION 17B

LOCATION: CONV. CTR. ROOM 8 . . . . THU 1:00 PM TO 4:00 PM

### Topological Matter

Session Chair: **Vincent Sokalski**, Carnegie Mellon Univ. (USA)

1:00 pm: **Observation of current-induced, long-lived persistent spin polarization in a topological insulator: a rechargeable spin battery** (*Invited Paper*), Yong P. Chen, Purdue Univ. (USA) . . . . . [10357-117]

1:30 pm: **Helicity-dependent photocurrent generation in Bi<sub>2</sub>Se<sub>3</sub> probed by THz emission spectroscopy** (*Invited Paper*), Jong Seok Lee, Sun Young Hamh, Soon Hee Park, Gwangju Institute of Science and Technology (Korea, Republic of); Sahng-Kyoon Jerng, Seung-Hyun Chun, Sejong Univ. (Korea, Republic of) . . . . . [10357-118]

2:00 pm: **Chiral magnetic monopoles in artificial spin systems** (*Invited Paper*), Yann Perrin, Ioan A. Chioar, Ctr. National de la Recherche Scientifique (France) and Institut NÉEL (France) and Univ. Grenoble Alpes (France); Hanna Riahi, Institut Jean Lamour (France); Van D. Nguyen, Univ. Grenoble Alpes (France); Aurélien Masseboeuf, Christophe Gatel, Ctr. d'Elaboration de Matériaux et d'Etudes Structurales (France); Stefan McMurtry, Institut Jean Lamour (France); Benito Santos Burgos, Tevfik Onur Menten, Andrea Locatelli, Elettra-Sincrotrone Trieste S.C.p.A. (Italy); Jean-Christophe Toussaint, Ctr. National de la Recherche Scientifique (France) and Institut NÉEL (France) and Univ. Grenoble Alpes (France); François Montaigne, Daniel Lacour, Institut Jean Lamour (France); Nicolas Rougemaille, Benjamin Canals, Institut NÉEL, Ctr. National de la Recherche Scientifique (France); Michel Hehn, Institut Jean Lamour (France) . . . . . [10357-119]

2:30 pm: **Massively degenerated ground state manifold in artificial square ice** (*Invited Paper*), Yann Perrin, CEA-LETI (France); Nicolas Rougemaille, Benjamin Canals, Institut NÉEL, Ctr. National de la Recherche Scientifique (France) . . . . . [10357-120]

3:00 pm: **Weyl node assisted conductivity switch in the interfacial phase change memory** (*Invited Paper*), Nicholas Kiousiss, Jinwoong Kim, California State Univ., Northridge (USA); Ruqian Wu, Univ. of California, Irvine (USA); Young-Sun Song, Seung-Hoon Jhi, Pohang Univ. of Science and Technology (Korea, Republic of) . . . . . [10357-121]

# CONFERENCE 10358

LOCATION: CONV. CTR. ROOM 9

Sunday–Monday 6–7 August 2017 • Proceedings of SPIE Vol. 10358

## Quantum Photonic Devices

*Conference Chairs:* **Cesare Soci**, Nanyang Technological Univ. (Singapore); **Mario Agio**, Univ. Siegen (Germany); **Kartik Srinivasan**, National Institute of Standards and Technology (USA)

*Program Committee:* **Igor Aharonovich**, Univ. of Technology, Sydney (Australia); **Vikas Anant**, Photon Spot, Inc. (USA); **Iñigo Artundo**, VLC Photonics (Spain); **Dirk R. Englund**, Massachusetts Institute of Technology (USA); **Hidetoshi Katori**, Univ. of Tokyo (Japan); **Christian Kurtsiefer**, National Univ. of Singapore (Singapore); **Peter Lodahl**, Niels Bohr Institute (Denmark); **Chao-Yang Lu**, Univ. of Science and Technology of China (China); **Patrick Maletinsky**, Univ. Basel (Switzerland), Qnami (Switzerland); **Shayan Mookherjee**, Univ. of California, San Diego (USA); **Sae Woo Nam**, National Institute of Standards and Technology (USA); **Kae Nemoto**, National Institute of Informatics (Japan); **Jeremy L. O'Brien**, Univ. of Bristol (United Kingdom); **Jian-Wei Pan**, Univ. of Science and Technology of China (China); **Fabio Sciarrino**, Sapienza Univ. di Roma (Italy); **Pascale Senellart**, Lab. de Photonique et de Nanostructures (France); **Andrew J. Shields**, Toshiba Research Europe Ltd. (United Kingdom); **Daniel L. Stick**, Sandia National Labs. (USA); **Wolfgang Tittel**, Univ. of Calgary (Canada)

### SUNDAY 6 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 9 ... SUN 8:05 AM TO 10:00 AM

#### Single Photon Emission and Applications

Session Chair: **Peter Lodahl**, Niels Bohr Institute (Denmark)

8:05 am: **Super-resolution from single photon emission: toward biological application** (*Invited Paper*), Marco Genovese, Istituto Nazionale di Ricerca Metrologica (Italy) ..... [10358-1]

8:30 am: **Preparation of single photon states with rising exponential shape** (*Invited Paper*), Christian Kurtsiefer, National Univ. of Singapore (Singapore); Bharat Srivathsan, National Univ. of Singapore (Singapore) and Max-Planck-Institut für die Physik des Lichts (Germany); Gurpreet Kaur Gulati, National Univ. of Singapore (Singapore) and Univ. of Sussex (United Kingdom); Mathias A. Seidler, Alessandro Cere, National Univ. of Singapore (Singapore) ..... [10358-2]

8:55 am: **From SHG to mid-infrared SPDC generation in strained silicon waveguides**, Claudio Castellan, Alessandro Trenti, Univ. degli Studi di Trento (Italy); Mattia Mancinelli, Alessandro Marchesini, Univ. degli Studi di Trento (Italy) and Univ. degli Studi di Trento (Italy); Mher Ghulinyan, Georg Pucker, Fondazione Bruno Kessler (Italy); Lorenzo Pavesi, Univ. degli Studi di Trento (Italy) and Univ. degli Studi di Trento (Italy) ..... [10358-3]

9:10 am: **Quantum internet: the certifiable road ahead** (*Invited Paper*), Stephanie Wehner, QuTech (Netherlands) ..... [10358-4]

9:35 am: **Quantum optics with nanowires** (*Invited Paper*), Valery Zwiller, Technische Univ. Delft (Netherlands); Klaus D. Jöns, Ali W. Elshaari, M. Versteegh, Lucas Schweickert, KTH Royal Institute of Technology (Sweden) ..... [10358-31]

Coffee Break ..... Sun 10:00 am to 10:30 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 9 ... SUN 10:30 AM TO 11:45 AM

#### Single Photon Detectors

Session Chair: **Valery Zwiller**, Technische Univ. Delft (Netherlands)

10:30 am: **Large-scale series-nanowire detectors packaged in a compact rack-mount cryostat** (*Invited Paper*), Vikas Anant, Photon Spot, Inc. (USA) ..... [10358-5]

10:55 am: **Quantum communication using amorphous SNSPDs** (*Invited Paper*), Félix Bussièrès, University of Geneva (Switzerland) ..... [10358-6]

11:20 am: **Towards integrated superconducting detectors on lithium niobate waveguides** (*Invited Paper*), Jan Philipp Höpker, Moritz Bartnick, Evan Meyer-Scott, Frederik Thiele, Stephan Krapick, Nicola M. Montaut, Matteo Santandrea, Harold Herrmann, Sebastian Lengeling, Raimund Ricken, Viktor Quiring, Torsten Meier, Univ. Paderborn (Germany); Adriana E. Lita, Varun B. Verma, Thomas Gerrits, Sae Woo Nam, National Institute of Standards and Technology (USA); Christine Silberhorn, Tim Bartley, Univ. Paderborn (Germany) ..... [10358-7]

Lunch Break ..... Sun 11:45 am to 1:25 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 9 ..... SUN 1:25 PM TO 3:20 PM

#### Hybrid Quantum Systems

Session Chair: **Christian Kurtsiefer**, Ctr. for Quantum Technologies (Singapore)

1:25 pm: **Chip scale interactions of light and vapors** (*Invited Paper*), Uriel Levy, Liron Stern, Meir Grajower, Eiran Talker, Jonathan Bar David, The Hebrew Univ. of Jerusalem (Israel) ..... [10358-8]

1:50 pm: **Quantum nonreciprocal devices based on chiral light-matter coupling** (*Invited Paper*), Juergen Volz, Arno Rauschenbeutel, Vienna Ctr. for Quantum Science and Technology (Austria) ..... [10358-9]

2:15 pm: **Photostable molecules on chip: integrated single photon sources for quantum technologies** (*Invited Paper*), Costanza Toninelli, Istituto Nazionale di Ottica (Italy) and LENS - Lab. Europeo di Spettroscopie Non-Lineari (Italy); Pietro E. Lombardi, Consiglio Nazionale delle Ricerche (Italy) and LENS - Lab. Europeo di Spettroscopie Non-Lineari (Italy); Anna P. Ovyvan, Westfälische Wilhelms-Univ. Münster (Germany); Sofia Pazzagli, Giacomo Mazzamuto, LENS - Lab. Europeo di Spettroscopie Non-Lineari (Italy); Günter Kewes, Oliver Neitzke, Humboldt-Univ. zu Berlin (Germany); Nico Gruhler, Westfälische Wilhelms-Univ. Münster (Germany); Oliver Benson, Humboldt-Univ. zu Berlin (Germany); Wolfram H. P. Pernice, Westfälische Wilhelms-Univ. Münster (Germany); Francesco S. Cataliotti, LENS - Lab. Europeo di Spettroscopie Non-Lineari (Italy) ..... [10358-11]

2:40 pm: **Superconducting atom chips** (*Invited Paper*), Rainer Dumke, Nanyang Technological Univ. (Singapore) ..... [10358-12]

3:05 pm: **Integration of optically active neodymium (Nd) ions in niobium thin films by ion implantation: room temperature photoluminescence characteristics and photoconductivity**, Patrick C. Sims, SPAWAR Systems Ctr. Pacific (USA); Brad Liu, SPAWAR Systems Ctr. Atlantic (USA); Saurabh Sharma, Carlos M. Torres, Lance Lerum, Mohammed Fahem, Sanja Zlatanovic, Vincent Dinh, Nenad Djapic, David Chao, Osama M. Nayfeh, Dave Rees, SPAWAR Systems Ctr. Pacific (USA) ..... [10358-13]

Coffee Break ..... Sun 3:20 pm to 3:50 pm

#### SESSION 4

LOCATION: CONV. CTR. ROOM 9 ..... SUN 3:50 PM TO 5:20 PM

#### Integrated Quantum Emitters

Session Chair: **Costanza Toninelli**, Istituto Nazionale di Ottica (Italy)

3:50 pm: **Quantum light-matter interfaces based on rare-earth-doped crystals and nano-photonics** (*Invited Paper*), Andrei Faraon, Tian Zhong, Jonathan M. Kindem, Evan Miyazono, Ioana Craiciu, Jake H. Rochman, John G. Bartholomew, California Institute of Technology (USA) ..... [10358-14]

4:15 pm: **Engineering quantum emitters in wide bandgap semiconductors** (*Invited Paper*), Igor Aharonovich, Univ. of Technology, Sydney (Australia) [10358-15]

4:40 pm: **Deterministic enhancement of coherent photon generation from a nitrogen-vacancy center in ultrapure diamond** (*Invited Paper*), Daniel Riedel, Immo Söllner, Brendan Shields, Sebastian Starsielec, Patrick Appel, Elke Neu, Patrick Maletinsky, Richard J. Warburton, Univ. Basel (Switzerland) . . . . [10358-16]

5:05 pm: **Formation of silicon carbide defect qubits with optically transparent electrodes and atomic layer deposited silicon oxide surface passivation**, Brad Liu, Patrick C. Sims, Carlos M. Torres, Bradley M. Davidson, Lance Lerum, Hector Romero, Mohammed Fahem, Mark E. Lasher, Anna M. Leese de Escobar, Osama M. Nayfeh, Ken Simonsen, Ayax D. Ramirez, SPAWAR Systems Ctr. Pacific (USA); Hunter Banks, Sam G. Carter, D. Kurt Gaskill, Thomas L. Reinecke, U.S. Naval Research Lab. (USA) ..... [10358-17]

**LOCATION: CONV. CTR. ROOM 6A . . SUN 6:00 PM TO 7:50 PM**

## Technology Hot Topics: How Optics and Photonics Drive Innovation

6:00 pm to 6:10 pm: **Welcome and Opening Remarks**  
 6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)  
 6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)  
 6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)  
 7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)  
 7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)

## MONDAY 7 AUGUST

**LOCATION: CONV. CTR. ROOM 6A MON 9:00 AM TO 12:00 PM**

## Nanoscience + Engineering Plenary Session

Session Chairs: **Harry A. Atwater Jr.**, California Institute of Technology (USA); **Nikolay I. Zheludev**, Optoelectronics Research Ctr. (United Kingdom)

9:15 am: **3D laser nanolithography (Plenary)**, Martin Wegener, Karlsruher Institut für Technologie (Germany) ..... [10354-500]  
 Coffee Break ..... Mon 10:00 am to 10:30 am  
 10:30 am: **Controlling light at the atomic scale (Plenary)**, F. Javier García de Abajo, ICFO - Institut de Ciències Fotòniques (Spain) ..... [10359-500]  
 11:15 am: **Science, engineering, and commercialization of flexible, printable 2D atomic materials and devices (Invited Paper)**, Deji Akinwande, The Univ. of Texas at Austin (USA) ..... [10349-500]

Lunch Break ..... Mon 12:00 pm to 1:00 pm

## SESSION 5

**LOCATION: CONV. CTR. ROOM 9 . . . . . MON 1:00 PM TO 1:15 PM**

## The COST Action “Nanoscale Quantum Optics”: implications for quantum photonics devices

Session Chair: **Félix Bussièrès**, Univ. de Genève (Switzerland)

1:00 pm: **The COST action “Nanoscale Quantum Optics”: implications for quantum photonics devices**, Mario Agio, Univ. Siegen (Germany) and COST Action MP1403 (Germany); Costanza Toninelli, Istituto Nazionale di Ottica (Italy) ..... [10358-19]

## SESSION 6

**LOCATION: CONV. CTR. ROOM 9 . . . . . MON 1:15 PM TO 3:20 PM**

## Integrated Quantum Circuits

Session Chair: **Andrei Faraon**, California Institute of Technology (USA)

1:15 pm: **A universal quantum module for quantum communication, computation, and metrology (Invited Paper)**, William J. Munro, NTT Basic Research Labs. (Japan) and National Institute of Informatics (Japan); Michael Hanks, Nicolò Lo Piparo, National Institute of Informatics (Japan); Michael Trupke, Jörg Schmiedmayer, Vienna Ctr. for Quantum Science and Technology (Austria); Kae Nemoto, National Institute of Informatics (Japan) ..... [10358-20]  
 1:40 pm: **Towards fault-tolerant quantum computing with spins in diamond (Invited Paper)**, Jiangfeng Du, Ya Wang, Univ. of Science and Technology of China (China) ..... [10358-21]  
 2:05 pm: **Integrated single photon circuits with electrical light source (Invited Paper)**, Wolfram Pernice, Westfälische Wilhelms-Univ. Münster (Germany) ..... [10358-22]  
 2:30 pm: **On-chip quantum photonics using quantum dots (Invited Paper)**, Peter Lodahl, Niels Bohr Institute (Denmark) ..... [10358-23]  
 2:55 pm: **A heterogeneous III-V / Si3N4 quantum photonic integration platform (Invited Paper)**, Marcelo I. Davanco, National Institute of Standards and Technology (USA); Jin Liu, Sun Yat-Sen Univ. (China); Luca Sapienza, Univ. of Southampton (United Kingdom); Chen-Zhao Zhang, South China Normal Univ. (China); Jose V. De Miranda Cardoso, Univ. Federal de Campina Grande (Brazil); Varun B. Verma, Richard P. Mirin, Sae-Woo Nam, National Institute of Standards and Technology (USA); Liu Liu, South China Normal Univ. (China); Kartik Srinivasan, National Institute of Standards and Technology (USA) ..... [10358-24]  
 Coffee Break ..... Mon 3:20 pm to 3:50 pm

## SESSION 7

**LOCATION: CONV. CTR. ROOM 9 . . . . . MON 3:50 PM TO 5:25 PM**

## Reconfigurable Quantum Devices

Session Chair: **Stephanie Wehner**, Technische Univ. Delft (Netherlands)

3:50 pm: **Electromechanical semiconductor quantum structures (Invited Paper)**, Hiroshi Yamaguchi, NTT Basic Research Labs. (Japan) ..... [10358-25]  
 4:15 pm: **Single photons from electrically driven reconfigurable photonic crystal cavities (Invited Paper)**, Maurangelo Petruzzella, Simone Birindelli, Francesco M. Pagliano, Daniele Pellegrino, Zarko Zobenica, Michele Cotrufo, Frank W. M. van Otten, Rob W. van der Heijden, Technische Univ. Eindhoven (Netherlands); Lianhe H. Li, Edmund Linfield, Univ. of Leeds (United Kingdom); Andrea Fiore, Technische Univ. Eindhoven (Netherlands) ..... [10358-26]  
 4:40 pm: **On-chip hybrid quantum circuits (Invited Paper)**, Klaus D. Jöns, Ali W. Elshaari, KTH Royal Institute of Technology (Sweden); Iman Esmaeil Zadeh, Andreas Fognini, Kavli Institute of Nanoscience Delft (Netherlands); Michael E. Reimer, Univ. of Waterloo (Canada); Dan Dalacu, Philip J. Poole, National Research Council Canada (Canada); Val Zwiller, KTH Royal Institute of Technology (Sweden) ..... [10358-27]  
 4:55 pm: **Fiber-integrated quantum switch**, Ruixiang Guo, Charles M. X. Altuzarra, Ctr. for Disruptive Photonic Technologies, Nanyang Technological Univ. (Singapore) and The Photonics Institute, Nanyang Technological Univ. (Singapore); Angelos Xomalis, Optoelectronics Research Ctr. (United Kingdom) and Ctr. for Photonic Metamaterials, Univ. of Southampton (United Kingdom); Cesare Soci, Ctr. for Disruptive Photonic Technologies, Nanyang Technological Univ. (Singapore) and The Photonics Institute, Nanyang Technological Univ. (Singapore); Nikolay I. Zheludev, Ctr. for Disruptive Photonic Technologies, Nanyang Technological Univ. (Singapore) and Optoelectronics Research Ctr., Univ. of Southampton (United Kingdom) and Ctr. for Photonic Metamaterials, Univ. of Southampton (United Kingdom) ..... [10358-28]  
 5:10 pm: **Engineering of spectral correlations of telecom-wavelength photons**, Maciej Gałka, Univ. of Warsaw (Poland) ..... [10358-33]



# CONFERENCE 10358

LOCATION: CONV. CTR.

EXHIBIT HALL B2 ..... MON 5:30 PM TO 7:30 PM

## Posters-Monday


Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Quantum dynamics of confined modes of a metasurface**, Didier Felbacq, Univ. Montpellier (France). . . . . [10358-10]

**Optimal quantum teleportation of coherent states of light**, Gerardo Adesso, Pietro Liuzzo-Scorpo, The Univ. of Nottingham (United Kingdom). . . . . [10358-29]

**Tunable light superfluids using 4-level quantum atomic optical systems**, Nuno Azevedo Silva, INESC Porto (Portugal) and Univ. do Porto (Portugal); Ariel Guerreiro, INESC TEC (Portugal). . . . . [10358-30]

**Highly-multimode photonic quantum memory in cold atoms**, Mateusz Mazelanik, Michał Pamiak, Wojciech Wasilewski, University of Warsaw (Poland). . . . . [10358-32]



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# CONFERENCE 10359

LOCATION: CONV. CTR. ROOM 10

Monday–Tuesday 7–8 August 2017 • Proceedings of SPIE Vol. 10359

## Quantum Nanophotonics

Conference Chairs: **Jennifer A. Dionne**, Stanford Univ. (USA); **Mark Lawrence**, Stanford Univ. (USA)

Program Committee: **Javier Aizpurua**, Ctr. de Fisica de Materiales (Spain); **Andrea Di Falco**, Univ. of St. Andrews (United Kingdom); **Nader Engheta**, Univ. of Pennsylvania (USA); **Andrei Faraon**, California Institute of Technology (USA); **Javier Garcia de Abajo**, ICFO - Institut de Ciències Fotòniques (Spain); **Mohammad Hafezi**, Joint Quantum Institute (USA); **Zubin Jacob**, Purdue Univ. (USA); **Satoshi Kawata**, Osaka Univ. (Japan); **Marko Loncar**, Harvard School of Engineering and Applied Sciences (USA); **Maiken H. Mikkelsen**, Duke Univ. (USA); **Sunil Mittal**, Joint Quantum Institute (USA); **Prineha Narang**, Harvard Univ. (USA); **Jeremy L. O'Brien**, Univ. of Bristol (United Kingdom); **Teri W. Odom**, Northwestern Univ. (USA); **Vladimir M. Shalaev**, Purdue Univ. (USA); **Matthew T. Sheldon**, Texas A&M Univ. (USA); **Mark Tame**, Univ. of KwaZulu-Natal (South Africa); **Ewold Verhagen**, FOM Institute for Atomic and Molecular Physics (Netherlands); **Ulrike Woggon**, Technische Univ. Berlin (Germany)

### SUNDAY 6 AUGUST

LOCATION: CONV. CTR. ROOM 6A .. SUN 6:00 PM TO 7:50 PM

#### Technology Hot Topics: How Optics and Photonics Drive Innovation

6:00 pm to 6:10 pm: **Welcome and Opening Remarks**

6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)

6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)

6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)

7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)

7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)

### MONDAY 7 AUGUST

LOCATION: CONV. CTR. ROOM 6A MON 9:00 AM TO 12:00 PM

#### Nanoscience + Engineering Plenary Session

Session Chairs: **Harry A. Atwater Jr.**, California Institute of Technology (USA); **Nikolay I. Zheludev**, Optoelectronics Research Ctr. (United Kingdom)

9:15 am: **3D laser nanolithography (Plenary)**, Martin Wegener, Karlsruhe Institut für Technologie (Germany) . . . . . [10354-500]

Coffee Break . . . . . Mon 10:00 am to 10:30 am

10:30 am: **Controlling light at the atomic scale (Plenary)**, F. Javier Garcia de Abajo, ICFO - Institut de Ciències Fotòniques (Spain) . . . . . [10359-500]

11:15 am: **Science, engineering, and commercialization of flexible, printable 2D atomic materials and devices (Invited Paper)**, Deji Akinwande, The Univ. of Texas at Austin (USA) . . . . . [10349-500]

Lunch Break . . . . . Mon 12:00 pm to 1:30 pm

### SESSION 1

LOCATION: CONV. CTR. ROOM 10 . . . . MON 1:30 PM TO 3:00 PM

#### Asymmetric and Nonreciprocal Phenomena

Session Chair: **Javier Aizpurua**, Ctr. de Fisica de Materiales (Spain)

1:30 pm: **Chiral quantum optics (Invited Paper)**, Peter Lodahl, Niels Bohr Institute (Denmark) . . . . . [10359-1]

2:00 pm: **Unidirectional electron tunneling via asymmetric plasmonic resonances (Invited Paper)**, Matthew T. Sheldon, Texas A&M Univ. (USA) [10359-2]

2:30 pm: **Giant vacuum friction: PT symmetric spectral singularity and negative frequency resonance (Invited Paper)**, Sarang Pendharker, Yu Guo, Farhad Khosravi, Univ. of Alberta (Canada); Zubin Jacob, Purdue Univ. (USA) . . . [10359-3]

Coffee Break . . . . . Mon 3:00 pm to 3:30 pm

### SESSION 2

LOCATION: CONV. CTR. ROOM 10 . . . . MON 3:30 PM TO 5:20 PM

#### Manipulating and Measuring Complex Quantum States

Session Chair: **Prineha Narang**, Harvard Univ. (USA)

3:30 pm: **Rb atomic vapor interaction with nanophotonic and plasmonic devices (Invited Paper)**, Hadiseh Alaeian, Northwestern Univ. (USA) . . . . [10359-4]

4:00 pm: **Quantum state reconstruction and photon statistics for coherent states interacting with few quantum dot states (Invited Paper)**, Fabian Boehm, Nicolai B. Grosse, Mirco Kolarczik, Nina Owschikow, Ulrike Woggon, Technische Univ. Berlin (Germany) . . . . . [10359-5]

4:30 pm: **Quantum localization issues in nonlinear frequency conversion and harmonic generation**, David L. Andrews, Kayn A. Forbes, Jack S. Ford, Univ. of East Anglia (United Kingdom) . . . . . [10359-6]

4:50 pm: **Engineering quantum light on photonic chips (Invited Paper)**, Qiang Lin, Univ. of Rochester (USA) . . . . . [10359-7]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 . . . . . MON 5:30 PM TO 7:30 PM

#### Posters-Monday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Quantum photoemission of confined nonlinear optical materials (Invited Paper)**, Subhamoy Singha Roy, JIS College of Engineering (India) . . . . . [10359-25]

### TUESDAY 8 AUGUST

### SESSION 3

LOCATION: CONV. CTR. ROOM 10 . . . TUE 8:00 AM TO 10:10 AM

#### Quantum Emitters

Session Chair: **Jennifer A. Dionne**, Stanford Univ. (USA)

8:00 am: **Nanophotonic enhanced quantum emitters (Invited Paper)**, Xin Li, Univ. of St. Andrews (United Kingdom); Zhang-Kai Zhou, Ying Yu, Sun Yat-Sen Univ. (China); Malte C. Gather, Andrea Di Falco, Univ. of St. Andrews (United Kingdom) . . . . . [10359-8]

8:30 am: **Ultrafast spontaneous emission from single quantum dots coupled to plasmonic nanocavities (Invited Paper)**, Maiken H. Mikkelsen, Duke Univ. (USA) . . . . . [10359-9]

9:00 am: **Two-photon bundles from a single two-level system**, Lukas Hanschke, Walter Schottky Institut, Technische Univ. München (Germany); Kevin A. Fischer, Ginzton Lab., Stanford Univ. (USA); Jakob Wierzbowski, Tobias Simmet, Walter Schottky Institut, Technische Univ. München (Germany); Constantin Dory, Ginzton Lab., Stanford Univ. (USA); Jonathan J. Finley, Walter Schottky Institut, Technische Univ. München (Germany); Jelena Vuckovic, Ginzton Lab., Stanford Univ. (USA); Kai Müller, Walter Schottky Institut, Technische Univ. München (Germany) . [10359-10]

# CONFERENCE 10359

9:20 am: **Quantum emitters in flatland** (*Invited Paper*), Igor Aharonovich, Univ. of Technology, Sydney (Australia) . . . . . [10359-11]  
9:50 am: **External quantum efficiency research of GaN-based laser diodes**, Pengyan Wen, Suzhou Institute of Nano-Tech and Nano-Bionics (SINANO) CAS (China) . . . . . [10359-12]  
Coffee Break . . . . . Tue 10:10 am to 10:40 am

## SESSION 4

**LOCATION: CONV. CTR. ROOM 10 . . TUE 10:40 AM TO 12:00 PM**

### Low-Loss Nanophotonics

Session Chair: **Andrea Di Falco**, Univ. of St. Andrews (United Kingdom)

10:40 am: **Flat and conformal optics with dielectric metasurfaces** (*Invited Paper*), Andrei Faraon, California Institute of Technology (USA) . . . . . [10359-13]  
11:10 am: **High performance metasurfaces based on inverse design** (*Invited Paper*), Jonathan A. Fan, Stanford Univ. (USA) . . . . . [10359-14]  
11:40 am: **Surface-wave phenomena and anisotropic Photoluminescence in nano-film structures**, Jan Heckmann, Karsten Pufahl, Philipp Franz, Nicolai B. Grosse, Ulrike Woggon, Technische Univ. Berlin (Germany) . . . . . [10359-15]  
Lunch/Exhibition Break . . . . . Tue 12:00 pm to 1:30 pm

## SESSION 5

**LOCATION: CONV. CTR. ROOM 10 . . . . . TUE 1:30 PM TO 3:10 PM**

### Nano-Optomechanics

Session Chair: **Mark Lawrence**, Stanford Univ. (USA)

1:30 pm: **Measurement and control of nanomechanical motion with photons confined at the nanoscale** (*Invited Paper*), Ewold Verhagen, Rick Leijssen, Giada R. La Gala, Lars Freisem, John Mathew, Juha T. Muhonen, FOM Institute for Atomic and Molecular Physics (Netherlands) . . . . . [10359-16]  
2:00 pm: **Molecular optomechanics in plasmonic cavities** (*Invited Paper*), Mikolaj Schmidt, Ctr. de Fisica de Materiales (Spain); Alejandro Gonzalez-Tudela, Max-Planck-Institut fur Quantenoptik (Germany); Geza Giedke, Donostia International Physics Ctr. (Spain) and Ikerbasque, Basque Foundation for Science (Spain); Tomas Neuman, Ctr. de Fisica de Materiales (Spain) and Donostia International Physics Ctr. (Spain); Yao Zhang, Ctr. de Fisica de Materiales (Spain) and Donostia International Physics Ctr. (Spain); Rubén Esteban, Ctr. de Fisica de Materiales (Spain); Javier Aizpurua, Ctr. de Fisica de Materiales (Spain) and Donostia International Physics Ctr. (Spain) . . . . . [10359-17]  
2:30 pm: **Towards optomechanics with one-dimensional gallium phosphide photonic crystal cavities**, Katharina Schneider, Pol Welter, Yannick Baumgartner, Herwig Hahn, Lukas Czornomaz, Paul F. Seidler, Simon Hönl, IBM Research - Zürich (Switzerland) . . . . . [10359-18]  
2:50 pm: **Optomechanical quantum non-demolition measurement of optical field fluctuations**, Antonio Pontin, Univ. College London (United Kingdom); Michele Bonaldi, Istituto Nazionale di Fisica Nucleare (Italy) and Istituto per la Fisica Fondamentale e Applicazione, Istituto Nazionale di Fisica Nucleare (Italy); Antonio L. Borrielli, Istituto dei Materiali per l'Elettronica ed il Magnetismo (Italy) and Istituto per la Fisica Fondamentale e Applicazione, Istituto Nazionale di Fisica Nucleare (Italy); Lorenzo Marconi, Istituto Nazionale di Fisica Nucleare (Italy) and Istituto Nazionale di Fisica Nucleare (Italy); Francesco Marino, Istituto Nazionale di Fisica Nucleare (Italy) and Istituto Nazionale di Fisica Nucleare (Italy); Gregory Pandraud, Technische Univ. Delft (Netherlands); Giovanni Andrea Prodi, Istituto Nazionale di Fisica Nucleare (Italy) and Univ. degli Studi di Trento (Italy); Pasqualina M. Sarro, Technische Univ. Delft (Netherlands); Enrico Serra, Istituto Nazionale di Fisica Nucleare (Italy) and Technische Univ. Delft (Netherlands); Francesco Marin, Univ. degli Studi di Firenze (Italy) and Istituto Nazionale di Fisica Nucleare (Italy) and Lab. Europeo di Spettroscopie Non-Lineari, Univ. degli Studi di Firenze (Italy) . . . . . [10359-19]  
Coffee Break . . . . . Tue 3:10 pm to 3:40 pm

## SESSION 6

**LOCATION: CONV. CTR. ROOM 10 . . . . TUE 3:40 PM TO 6:00 PM**

### Quantum Plasmonics

Session Chair: **Hadiseh Alaeian**, Northwestern Univ. (USA)

3:40 pm: **Towards integrated plasmonic quantum devices** (*Invited Paper*), Simeon Bogdanov, Mikhail Y. Shalaginov, Justus C. Ndukaife, Oksana A. Makarova, Purdue Univ. (USA); Alexey V. Akimov, Texas A&M Univ. (USA); Alexei S. Lagutchev, Alexander V. Kildishev, Alexandra Boltasseva, Vladimir M. Shalaev, Purdue Univ. (USA) . . . . . [10359-20]  
4:10 pm: **Inelastic-scattering tunnel electrons towards an electrically driven single-photon light source** (*Invited Paper*), Hasan Goktas, The George Washington Univ. (USA) . . . . . [10359-21]  
4:40 pm: **Theory directions in excited-state quantum plasmonics** (*Invited Paper*), Prineha Narang, Harvard Univ. (USA) . . . . . [10359-22]  
5:10 pm: **Plasmonic hot-carriers in the UV-VIS regime: experimental study of the internal quantum efficiency of generation and injection into GaN**, Giulia Tagliabue, California Institute of Technology (USA); Ravishankar Sundararaman, Rensselaer Polytechnic Institute (USA); Adam S. Jermyn, Univ. of Cambridge (United Kingdom); Prineha Narang, Harvard Univ. (USA); Harry A. Atwater Jr., California Institute of Technology (USA) . . . . . [10359-23]  
5:30 pm: **Quantum phenomena with graphene plasmons** (*Invited Paper*), F. Javier García de Abajo, ICFO - Institut de Ciències Fotòniques (Spain) . . [10359-24]





# ORGANIC PHOTONICS + ELECTRONICS

Organic-based materials have great potential for providing renewable energy sources, as well as playing a major role in creating significant commercial applications. If you work with organic materials and devices, this conference is a good fit for you.

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*Symposium Chairs*  
**Zakya H. Kafafi,**  
Lehigh Univ. (USA)



**Ifor D. W. Samuel,**  
Univ. of St. Andrews (United Kingdom)

- OLEDs
- OTFTs
- OPVs
- LIQUID CRYSTALS
- ORGANIC SENSORS
- PRINTED MEMORY AND CIRCUITS
- ORGANIC MATERIALS AND DEVICES

# DAILY SCHEDULE

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY
Technology Hot Topics, 6:00 to 8:00 PM		Organic Photonics + Electronics Plenary Session, 9:00 AM to 11:45 AM	Poster Session, 5:30 to 7:30 PM	

## ORGANIC PHOTONICS + ELECTRONICS

10360 <b>Light Manipulating Organic Materials and Devices IV</b> ( <i>Eich, Nunzi, Schuller, Haley</i> ) p. 121				10366 <b>Hybrid Memory Devices and Printed Circuits 2017</b> ( <i>List-Kratochvil</i> ) p. 140
10361 <b>Liquid Crystals XXI</b> ( <i>Khoo</i> ) p. 123				
10362 <b>Organic Light Emitting Materials and Devices XXI</b> ( <i>So, Adachi, Kim</i> ) p. 126				
10363 <b>Organic, Hybrid, and Perovskite Photovoltaics XVIII</b> ( <i>Kafafi, Lane, Lee</i> ) p. 130				
10364 <b>Organic Sensors and Bioelectronics X</b> ( <i>Kymissis, Shinar, Torsi</i> ) p. 136				
	10365 <b>Organic Field-Effect Transistors XVI</b> ( <i>McCulloch, Jurchescu</i> ) p. 138			

## Organic Photonics + Electronics

10360	<b>Light Manipulating Organic Materials and Devices IV</b> ( <i>Eich, Nunzi, Schuller, Haley</i> ) . . . . .	p. 121
10361	<b>Liquid Crystals XXI</b> ( <i>Khoo</i> ) . . . . .	p. 123
10362	<b>Organic Light Emitting Materials and Devices XXI</b> ( <i>So, Adachi, Kim</i> ) . . . . .	p. 126
10363	<b>Organic, Hybrid, and Perovskite Photovoltaics XVIII</b> ( <i>Kafafi, Lane, Lee</i> ) . . . . .	p. 130
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10365	<b>Organic Field-Effect Transistors XVI</b> ( <i>McCulloch, Jurchescu</i> ) . . . . .	p. 138
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# CONFERENCE 10360

LOCATION: CONV. CTR. ROOM 16A

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## Light Manipulating Organic Materials and Devices IV

Conference Chair: **Manfred Eich**, Technische Univ. Hamburg-Harburg (Germany)

Conference Co-Chairs: **Jean-Michel Nunzi**, Queen's Univ. (Canada); **Jon A. Schuller**, Univ. of California, Santa Barbara (USA); **Joy E. Haley**, Air Force Research Lab. (USA)

Program Committee: **Dean R. Evans**, Air Force Research Lab. (USA); **Mark G. Kuzyk**, Washington State Univ. (USA); **Charles Y. C. Lee**, Air Force Office of Scientific Research (USA); **Zouheir Sekkat**, Univ. Mohammed V (Morocco); **Matthew Y. Sfeir**, Brookhaven National Lab. (USA); **William M. Shensky III**, U.S. Army Research Lab. (USA); **Jayan Thomas**, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); **Naoto Tsutsumi**, Kyoto Institute of Technology (Japan)

### SUNDAY 6 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 16A . SUN 8:30 AM TO 10:10 AM

#### Nonlinear Optical Processes and Mechanisms I

Session Chair: **Manfred Eich**, Technische Univ. Hamburg-Harburg (Germany)

8:30 am: **Light-induced plasmonic properties of organic materials: surface polaritons, bistability and switching waves** (*Invited Paper*), Boris D. Fainberg, Holon Institute of Technology (Israel) and Tel Aviv Univ. (Israel) and ITMO Univ. (Russian Federation); Nikolay N. Rosanov, ITMO Univ. (Russian Federation) and Vavilov State Optical Institute (Russian Federation); Nikolay Veretenov, ITMO Univ. (Russian Federation) . . . . . [10360-1]

9:00 am: **Reverse saturable absorption (RSA) in fluorinated iridium derivatives**, Michael J. Ferry, Ryan M. O'Donnell, Neal Bambha, Trenton R. Ensley, William M. Shensky III, Jianmin Shi, U.S. Army Research Lab. (USA) . . . . . [10360-2]

9:20 am: **Nonlinear management of the optical angular momentum of light from liquid crystals**, Nina Kravets, Etienne Brasselet, Univ. Bordeaux 1 (France) and Ctr. National de la Recherche Scientifique (France) . . . . . [10360-3]

9:40 am: **On photochemical tweezing and photoassisted holography in azo dye containing polymers** (*Invited Paper*), Zouheir Sekkat, Moroccan Foundation for Advanced Science, Innovation and Research (Morocco) . . . . . [10360-4]

Coffee Break . . . . . Sun 10:10 am to 10:40 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 16A SUN 10:40 AM TO 12:30 PM

#### Nonlinear Optical Processes and Mechanisms II

Session Chair: **David J. Hagan**, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA)

10:40 am: **Dynamic amplification of light signals in photorefractive ferroelectric liquid crystal blends containing photoconductive chiral dopant** (*Invited Paper*), Takeo Sasaki, Tokyo Univ. of Science (Japan) . . . . . [10360-5]

11:10 am: **Silicon-organic hybrid devices for THz generation based on difference frequency generation**, Manfred Eich, Technische Univ. Hamburg-Harburg (Germany) and Helmholtz-Zentrum Geesthacht (Germany); Marvin Schulz, Technische Univ. Hamburg-Harburg (Germany); Alexander Yu. Petrov, Technische Univ. Hamburg-Harburg (Germany) and ITMO Univ. (Russian Federation) [10360-6]

11:30 am: **Measurement of the dynamics of nonlinear refraction and absorption via nonlinear beam deflection** (*Invited Paper*), David J. Hagan, Peng Zhao, Sepehr A. Benis, Eric W. Van Stryland, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [10360-7]

12:00 pm: **Enhanced optical limiting in 2D materials** (*Invited Paper*), Jitesh Kumar, Jayan Thomas, Sreekanth Varma, Katherine Layne, Univ. of Central Florida (USA); Yang Liu, Jingjie Wu, Pulickel M. Ajayan, Rice Univ. (USA) . . . . . [10360-8]

Lunch Break . . . . . Sun 12:30 pm to 2:30 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 16A . . . SUN 2:30 PM TO 3:10 PM

#### Materials, Devices and Applications I

Session Chair: **Zouheir Sekkat**, Moroccan Foundation for Advanced Science, Innovation and Research (Morocco)

2:30 pm: **Reconfigurable micro-holes array by directional laser manipulation**, Federica Pirani, Angelo Angelini, Francesca Frascella, Serena Ricciardi, Politecnico di Torino (Italy); Federico Ferrarese Lupi, Natascia De Leo, Luca Boarino, Istituto Nazionale di Ricerca Metrologica (Italy); Emiliano Descrovi, Politecnico di Torino (Italy) . . . . . [10360-10]

2:50 pm: **Solution-processed organic bulk-heterojunctions in optical cavities for continuously tunable narrowband photodetection**, Zheng Tang, Koen Vandewal, TU Dresden (Germany) . . . . . [10360-12]

Coffee Break . . . . . Sun 3:10 pm to 3:40 pm

#### SESSION 4

LOCATION: CONV. CTR. ROOM 16A .. SUN 3:40 PM TO 5:20 PM

#### Materials, Devices and Applications II

Session Chair: **Toshiyuki Watanabe**, Tokyo Univ. of Agriculture and Technology (Japan)

3:40 pm: **Simultaneous 10-fold brightness increase and emitted-light tunability in transparent ambipolar organic light-emitting transistor by integration with inorganic high-k photonic crystal**, Stefano Toffanin, Istituto per lo Studio dei Materiali Nanostrutturati (Italy); Marco Natali, Istituto per lo Studio dei Materiali Nanostrutturati (Italy); Santiago D. Quiroga, Istituto per lo Studio dei Materiali Nanostrutturati (Italy); Luca Passoni, Luigino Criante, Istituto Italiano di Tecnologia (Italy); Emilia Benvenuti, Istituto per lo Studio dei Materiali Nanostrutturati (Italy); Gabriele Bolognini, Istituto per la Microelettronica e Microsistemi (Italy); Laura Favaretto, Manuela Melucci, Istituto per la Sintesi Organica e la Fotoreattività (Italy); Michele Muccini, Istituto per lo Studio dei Materiali Nanostrutturati (Italy); Francesco Scotognella, Politecnico di Milano (Italy); Fabio Di Fonzo, Istituto Italiano di Tecnologia (Italy) . . . . . [10360-13]

4:00 pm: **A highly sensitive pyroresistive all-organic infrared bolometer**, Raphael Pfattner, Victor Lebedev, Elena Laukhina, Institut de Ciència de Materials de Barcelona (Spain); Majid Ebrahim-Zadeh, Gerasimos Konstantatos, ICFO - Institut de Ciències Fotòniques (Spain); Vladimir Laukhin, Marta Mas-Torrent, Concepció Rovira, Jaume Veciana, Institut de Ciència de Materials de Barcelona (Spain) . . . . . [10360-14]

4:20 pm: **Organic crystals with long-period diffraction gratings engraved directly on their surfaces by focused ion beam lithography** (*Invited Paper*), Takeshi Yamao, Kyoto Institute of Technology (Japan) . . . . . [10360-15]

4:50 pm: **Low power optical switching by use of long-lived room-temperature triplet excitons** (*Invited Paper*), Toshiyuki Watanabe, Kenro Totani, Tokyo Univ. of Agriculture and Technology (Japan) . . . . . [10360-16]



# CONFERENCE 10360

**LOCATION: CONV. CTR. ROOM 6A . . SUN 6:00 PM TO 7:50 PM**

## **Technology Hot Topics: How Optics and Photonics Drive Innovation**

6:00 pm to 6:10 pm: **Welcome and Opening Remarks**

6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)

6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)

6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)

7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)

7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)

## **MONDAY 7 AUGUST**

**LOCATION: CONV. CTR.**

**EXHIBIT HALL B2 . . . . . MON 5:30 PM TO 7:30 PM**

### **Posters-Monday**

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Flexible thin film polarizer with perylene-based reactive mesogens**, Seok-in Lim, Ja-hyeon Koo, Seohee Park, Kwang-Un Jeong, Chonbuk National Univ. (Korea, Republic of) . . . . . [10360-11]

**To enhance OLED brightness by an extraction glass layer**, Wei-Cheng Chien, Tatung Univ. (Taiwan); Chuang-Hung Chiu, Chunghwa Picture Tubes, Ltd. (Taiwan); Chao-Heng Chien, Yueh-Hao Chen, Tatung Univ. (Taiwan) . . . . . [10360-17]

**A remote-controllable light shutter by photochromic liquid crystalline amphiphile containing azobenzene**, Ja-hyeon Koo, Seok-in Lim, Seohee Park, Kwang-Un Jeong, Chonbuk National Univ. (Korea, Republic of) . . . . . [10360-18]

**Electronic structure at various substrates/perovskite interface**, Myung Joo Cha, Dong-A Univ. (Korea, Republic of) . . . . . [10360-19]

**The study of polyelectrolyte-containing photoanisotropic compositions**, Irakli Chaganava, Barbara N. Kilosanidze, George Kakauridze, Institute of Cybernetics (Georgia) . . . . . [10360-20]

# CONFERENCE 10361

LOCATION: CONV. CTR. ROOM 6B

Sunday-Monday 6-7 August 2017 • Proceedings of SPIE Vol. 10361

## Liquid Crystals XXI

Conference Chair: **Iam Choon Khoo**, The Pennsylvania State Univ. (USA)

Program Committee: **Timothy J. Bunning**, Air Force Research Lab. (USA); **Shaw-Horng Chen**, Univ. of Rochester (USA); **Neil Collings**, Two Trees Photonics Ltd. (United Kingdom); **Jean-Pierre Huignard**, Jphopto (France); **Tomiki Ikeda**, Chuo Univ. (Japan); **Malgosia Kaczmarek**, Univ. of Southampton (United Kingdom); **Oleg D. Lavrentovich**, Kent State Univ. (USA); **Sin-Doo Lee**, Seoul National Univ. (Korea, Republic of); **Tsung-Hsien Lin**, National Sun Yat-Sen Univ. (Taiwan); **Francesco Simoni**, Univ. Politecnica delle Marche (Italy); **Nelson V. Tabiryan**, BEAM Co. (USA); **David M. Walba**, Univ. of Colorado at Boulder (USA); **Shin-Tson Wu**, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA)

### SUNDAY 6 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 6B . . . SUN 8:30 AM TO 9:55 AM

#### Cholesterics LC Photonics

Session Chair: **Iam-Choon Khoo**, The Pennsylvania State Univ. (USA)

8:30 am: **Electro-optics of cholesterics with oblique helicoidal director** (*Keynote Presentation*), Oleg D. Lavrentovich, Olena Iadlovska, Kent State Univ. (USA); Sergij V. Shiyonovskii, Kent State Univ. (USA) . . . . . [10361-1]

8:55 am: **Self-assembly in chiral nematic LC** (*Invited Paper*), Julian S. Evans, Zhejiang Univ. (China); Nan Wang, Zhejiang Univ. (China); Sailing He, Zhejiang Univ. (China); Iam-Choon Khoo, The Pennsylvania State Univ. (USA) . . . . . [10361-2]

9:15 am: **Conditions for the formation of a uniformly lying helix structure induced by the electrohydrodynamic effect** (*Invited Paper*), Yu-Lin Nian, Po-Chang Wu, Wei Lee, National Chiao Tung Univ. (Taiwan) . . . . . [10361-3]

9:35 am: **Controlling optical phase in cholesteric and dye-doped liquid crystals** (*Invited Paper*), Stefania Residori, Aurélie Jullien, Umberto Bortolozzo, Institut Non Linéaire de Nice Sophia Antipolis (France); Jean-Pierre Huignard, Jphopto (France); Anis Alayet, Univ. of Tunis El Manar (Tunisia); Raouf Barboza, Tampere Univ. of Technology (Finland); Marcel G. Clerc, Univ. de Chile (Chile); Dong Wei, Beijing Genomics Institute (China) . . . . . [10361-4]

Coffee Break . . . . . Sun 9:55 am to 10:25 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 6B . . . SUN 10:25 AM TO 11:45 A M

#### Novel LC Optoelectronics

Session Chair: **Oleg D. Lavrentovich**, Kent State Univ. (USA)

10:25 am: **Optoelectronic applications of functional materials with aggregation-induced emissions** (*Keynote Presentation*), Ben Zhong Tang, Hong Kong Univ. of Science and Technology (Hong Kong, China) . . . . . [10361-5]

10:50 am: **Waveguiding with liquid crystal structures** (*Invited Paper*), Miha Ravnik, Univ. of Ljubljana (Slovenia) and Jožef Stefan Institute (Slovenia); Anja Bregar, Univ. of Ljubljana (Slovenia) . . . . . [10361-6]

11:10 am: **Functionalized liquid crystal polymers generate optical and polarization vortex beams** (*Invited Paper*), Moritsugu Sakamoto, Yuki Nakamoto, Tran Minh Tien, Kotaro Kawai, Kohei Noda, Tomoyuki Sasaki, Nagaoka Univ. of Technology (Japan); Nobuhiro Kawatsuki, Univ. of Hyogo (Japan); Hiroshi Ono, Nagaoka Univ. of Technology (Japan) . . . . . [10361-7]

11:30 am: **Role of the order parameter, electric field, and geometric confinement on the dynamics of the photoinduced nematic-isotropic transition**, Jayalakshmi Vallamkonda, National Institute of Technology, Warangal (India); Krishna Prasad Subbarao, Geetha G. Nair, Ctr. for Nano and Soft Matter Sciences (India); Gurumurthy Hegde, BMS College of Engineering (India). [10361-9]

Lunch Break . . . . . Sun 11:45 am to 1:30 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 6B . . . . . SUN 1:30 PM TO 3:30 PM

#### Novel LC Structures and Properties

Session Chair: **Tsung-Hsien Lin**, National Sun Yat-Sen Univ. (Taiwan)

1:30 pm: **Nano slippery interfaces in nematic gels -localization and lubrication of director motions** (*Keynote Presentation*), Jun Yamamoto, Kyoto Univ. (Japan); Isa Nishiyama, Dainippon Ink and Chemicals, Inc. (Japan) . . . . . [10361-10]

1:55 pm: **Optically robust photoalignment materials for liquid crystal device applications in the near-UV region** (*Invited Paper*), Kenneth L. Marshall, Debra J. Saulnier, Tanya Z. Kosci, Univ. of Rochester (USA); Oleg Didovets, Optimax Systems, Inc. (USA); Shaw-Horng Chen, Univ. of Rochester (USA) . . . . . [10361-11]

2:15 pm: **Hidden LC/polymer gratings** (*Invited Paper*), Timothy J. Bunning, Air Force Research Lab. (USA); Luciano De Sio, Nelson V. Tabirian, BEAM Engineering For Advanced Measurements Co. (USA) . . . . . [10361-44]

2:35 pm: **Smectic layer origami based on preprogrammed photoalignment** (*Invited Paper*), Yan-Qing Lu, Wei Hu, Nanjing Univ. (China) . . . . . [10361-24]

2:55 pm: **Fabrication of nearly-millimeter thick well aligned cholesteric liquid crystals for ultrafast pulsed laser modulation**, Chun-Wei Chen, Iam-Choon Khoo, The Pennsylvania State Univ. (USA); Tsung-Hsien Lin, National Sun Yat-Sen Univ. (Taiwan) . . . . . [10361-14]

3:10 pm: **Template effect of twist structure liquid crystal and its photonic application** (*Invited Paper*), Jiangang Lu, Shanghai Jiao Tong Univ. (China) . . . . . [10361-12]

Coffee Break . . . . . Sun 3:30 pm to 4:00 pm

#### SESSION 4

LOCATION: CONV. CTR. ROOM 6B . . . . . SUN 4:00 PM TO 5:40 PM

#### Blue-Phase, Cholesterics, and Polymer-dispersed LC

Session Chair: **Kenneth L. Marshall**, Univ. of Rochester (USA)

4:00 pm: **Single crystal blue-phase photonic crystal** (*Keynote Presentation*), Tsung-Hsien Lin, National Sun Yat-Sen Univ. (Taiwan); Iam-Choon Khoo, The Pennsylvania State Univ. (USA); Timothy J. Bunning, Air Force Research Lab. (USA); Chun-Wei Chen, The Pennsylvania State Univ. (USA) . . . . . [10361-15]

4:25 pm: **Ultrafast nonlinear photonic in cholesteric liquid crystals** (*Invited Paper*), Yikun Liu, Jianying Zhou, Sun Yat-Sen Univ. (China); Tsung-Hsien Lin, National Sun Yat-Sen Univ. (Taiwan); Iam-Choon Khoo, The Pennsylvania State Univ. (USA) . . . . . [10361-16]

4:45 pm: **Liquid-crystalline simple cubic blue phase stabilized via polymer networks** (*Invited Paper*), Suk-Won Choi, Kyung Hee Univ. (Korea, Republic of) . . . . . [10361-17]

5:05 pm: **Investigation of polarization-independent optical phases in polymer-dispersed liquid crystals originating from Kerr effect and molecular orientations** (*Invited Paper*), Yi-Hsin Lin, Chia-Ming Chang, Jing Yi Wang, Po-Ju Chen, National Chiao Tung Univ. (Taiwan); Eunjeong Shin, Ramesh Manda, Seung Hee Lee, Chonbuk National Univ. (Korea, Republic of) . . . . . [10361-18]

5:25 pm: **Azo-blue phase liquid crystals for high efficiency holographic Bragg grating with optically prolonged memory**, Tsung-Jui Ho, Chun-Wei Chen, Iam-Choon Khoo, The Pennsylvania State Univ. (USA) . . . . . [10361-19]

# CONFERENCE 10361

LOCATION: CONV. CTR. ROOM 6A .. SUN 6:00 PM TO 7:50 PM

## Technology Hot Topics: How Optics and Photonics Drive Innovation

- 6:00 pm to 6:10 pm: **Welcome and Opening Remarks**
- 6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)
- 6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)
- 6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)
- 7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)
- 7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)

## MONDAY 7 AUGUST

### SESSION 5

LOCATION: CONV. CTR. ROOM 6B .. MON 8:15 AM TO 10:00 AM

## Novel LC Structures

Session Chair: **Nelson V. Tabirian**, BEAM Engineering For Advanced Measurements Co. (USA)

- 8:15 am: **High quality alignment of the helical nanofilament phase by micro-confinement in polymer channels** (*Keynote Presentation*), David M. Walba, Eric Carlson, Lee M. Foley, Edward Guzman, Eva D. Korblova, Rayshan Visvanathan, Univ. of Colorado Boulder (United States); SeongHo Ryu, Min-Jun Gim, Dong Ki Yoon, KAIST (Korea, Republic of); Noel A. Clark, Univ. of Colorado Boulder (USA) ..... [10361-20]
- 8:40 am: **Shape and size effects in chirality transfer from chiral-ligand-capped nanomaterials to nematic liquid crystals** (*Invited Paper*), Torsten Hegmann, Lin Li, Leah E. Bergquist, Ahlam Nemati, Kent State Univ. (USA) ..... [10361-21]
- 9:00 am: **Light-melt adhesive based on a columnar liquid crystal** (*Invited Paper*), Shohei Saito, Kyoto Univ. (Japan) ..... [10361-22]
- 9:20 am: **Structure modifications directed towards obtaining SmAPf phases with broad temperature ranges** (*Invited Paper*), Eva D. Korblova, Edward Guzman, Edgardo Garcia, Joseph E. MacLennan, Matthew A. Glaser, Ren-Fan Shao, Rayshan Visvanathan, Noel A. Clark, David M. Walba, Univ. of Colorado Boulder (USA) ..... [10361-23]
- 9:40 am: **Magneto-optical properties of liquid crystal dimers** (*Invited Paper*), Seyyed M. Salihi, Matthew Murachver, Samuel N. Sprunt, James T. Gleeson, Antal I. Jákli, Kent State Univ. (USA) ..... [10361-13]
- Coffee Break ..... Mon 10:00 am to 10:30 am

### SESSION 6

LOCATION: CONV. CTR. ROOM 6B . MON 10:30 AM TO 12:00 PM

## Photo-alignment and Novel LC Structures

Session Chair: **David M. Walba**, Univ. of Colorado Boulder (USA)

- 10:30 am: **Photoalignment control of dye-doped and dye-free liquid crystal systems** (*Keynote Presentation*), Atsushi Shishido, Tokyo Institute of Technology (Japan) ..... [10361-25]
- 10:55 am: **Intrinsic and photo-induced optical properties of photoaligning azo-based materials coupled with liquid crystal systems** (*Invited Paper*), Nina Podoliak, Elena Mavrona, Univ. of Southampton (United Kingdom); Sakellaris Mailis, Optoelectronics Research Ctr., Univ. of Southampton (United Kingdom); Jordan R. E. Gill, Giampaolo D'Alessandro, Vasilis Apostolopoulos, Univ. of Southampton (United Kingdom); Nelson V. Tabirian, BEAM Engineering For Advanced Measurements Co. (USA); Malgosia Kaczmarek, Univ. of Southampton (United Kingdom) ..... [10361-26]
- 11:15 am: **Computational chemistry modeling and design of photoswitchable alignment materials for optically addressable liquid crystal devices II: Transition state modeling in azobenzene and spiroxyran oligomers**, Kenneth L. Marshall, Unni Kurumbail, Akif Hosein, Univ. of Rochester (USA) ..... [10361-27]
- 11:30 am: **Liquid crystal elastomers presenting a homochiral building block**, Elda Hegmann, Liquid Crystal Institute, Kent State Univ. (USA); Marianne Prévôt, Kent State Univ. (USA) ..... [10361-28]
- 11:45 am: **Relative permittivity imaging based on a liquid crystal sensor**, Amir Aizen, Ibrahim Abdulhalim, Ben-Gurion Univ. of the Negev (Israel) ..... [10361-29]
- Lunch Break ..... Mon 12:00 pm to 1:30 pm

### SESSION 7

LOCATION: CONV. CTR. ROOM 6B ... MON 1:30 PM TO 2:55 PM

## High Power and NLO Photonics and Phenomena

Session Chair: **Atsushi Shishido**, Tokyo Institute of Technology (Japan)

- 1:30 pm: **High power 4G optics** (*Keynote Presentation*), Nelson V. Tabirian, David E. Roberts, Sergiy Kaim, Svetlana V. Serak, Sarik Nersisyan, Haiqing Xianyu, BEAM Engineering For Advanced Measurements Co. (USA); Timothy J. Bunning, Air Force Research Lab. (USA); Diane M. Steeves, Brian R. Kimball, U.S. Army Natick Soldier Research, Development and Engineering Ctr. (USA) ..... [10361-30]
- 1:55 pm: **The Nematicon: A highly nonlocal regime wave singularity with ultra-sharp profile and random walk trajectory** (*Invited Paper*), Hélène Louis, Lab. de Physics des Laser, Atomes, et Molécules (France); Mustapha Tlidi, Univ. Libre de Bruxelles (Belgium); Eric Louvergneaux, Univ. des Sciences et Technologies de Lille (France) ..... [10361-31]
- 2:15 pm: **Nonlinear optical measurement of the twist elastic constant in thermotropic and lyotropic chiral nematics** (*Invited Paper*), Liana Lucchetti, Univ. Politecnica delle Marche (Italy); Tommaso Fraccia, Univ. degli Studi di Milano (Italy) and Univ. Telematica San Raffaele (Italy); Fabrizio Ciciulla, Univ. Politecnica delle Marche (Italy); Tommaso Bellini, Univ. degli Studi di Milano (Italy) ..... [10361-32]
- 2:35 pm: **Self-induced structured light transformations using liquid crystal topological defects** (*Invited Paper*), Nina Kravets, Etienne Brasselet, Univ. Bordeaux 1 (France) ..... [10361-33]
- Coffee Break ..... Mon 2:55 pm to 3:25 pm

### SESSION 8

LOCATION: CONV. CTR. ROOM 6B ... MON 3:25 PM TO 5:10 PM

## Photoresponsive LC Filters, Switches, and Gratings

Session Chair: **Iam-Choon Khoo**, The Pennsylvania State Univ. (USA)

- 3:25 pm: **Responsive optical filters prepared from polymer stabilized cholesteric liquid crystals** (*Keynote Presentation*), Timothy J. White, Kyung Min Lee, Vincent P. Tondiglia, Air Force Research Lab. (USA) ..... [10361-34]
- 3:50 pm: **Liquid crystal 3D periodic gratings based on photo-alignment** (*Invited Paper*), Kristiaan Neyts, Inge Nys, Varsenik Nersisyan, Jeroen Beeckman, Univ. Gent (Belgium) ..... [10361-35]
- 4:10 pm: **Intra-ocular accommodative implant using liquid crystal lenses** (*Invited Paper*), Tigran Galstian, Ctr. d'Optique, Photonique et Laser (Canada) ..... [10361-36]
- 4:30 pm: **Confined photovoltaic fields in a photo-responsive liquid crystal test cell** (*Invited Paper*), Atefeh Habibpoumoghdam, Lin Jiao, Faissal Omairat, Univ. Paderborn (Germany); Dean R. Evans, Air Force Research Lab. (USA); Liana Lucchetti, Univ. Politecnica delle Marche (Italy); Viktor Y. Reshetnyak, Taras Shevchenko National Univ. of Kyiv (United Arab Emirates); Alexander Lorenz, Univ. Paderborn (Germany) ..... [10361-37]
- 4:50 pm: **Chromatic-aberration correction in geometric-phase lenses, for red, green, and blue operation** (*Invited Paper*), Jihwan Kim, Kathryn J. Hornburg, Michael J. Escuti, North Carolina State Univ. (USA) ..... [10361-38]



**LOCATION: CONV. CTR.  
EXHIBIT HALL B2 ..... MON 5:30 PM TO 7:30 PM**

## Posters-Monday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Compact optical device for measuring liquid crystal elastic and dynamic properties**, Nina Podoliak, Elena Perivolari, Thomas P. Bennett, Matthew B. Proctor, Univ. of Southampton (United Kingdom); Thomas Regrettier, Thomas Heiser, Univ. de Strasbourg (France); Giampaolo D'Alessandro, Malgosia Kaczmarek, Univ. of Southampton (United Kingdom) ..... [10361-39]

**Light-driven liquid crystalline elastomeric devices: From micro-robotics to micro-photonics**, Sara Nocentini, Daniele Martella, Lab. Europeo di Spettroscopia Non-Lineari (Italy); Dmitry Nunhdin, Lab. Europeo di Spettroscopia Non-Lineari (Italy) and Karlsruher Institut für Technologie (Germany); Simone Zanotto, Istituto Nazionale di Ottica (Italy); Camilla Parmeggiani, Lab. Europeo di Spettroscopia Non-Lineari (Italy) and Consiglio Nazionale delle Ricerche (Italy); Diederik S. Wiersma, Lab. Europeo di Spettroscopia Non-Lineari (Italy) and Univ. degli Studi di Firenze (Italy) ..... [10361-40]

**High resolution all-optical image processing with azobenzene-doped blue-phase liquid crystals**, Tsung-Jui Ho, Chun-Wei Chen, Iam-Choon Khoo, The Pennsylvania State Univ. (USA) ..... [10361-41]

**Nonlinear optical logic circuits enabled by dye-doped twisted nematic liquid crystals**, Cheng-Yu Wang, Chun-Wei Chen, The Pennsylvania State Univ. (USA); Hung-Chang Jau, National Sun Yat-Sen Univ. (Taiwan); Iam-Choon Khoo, The Pennsylvania State Univ. (USA); Tsung-Hsien Lin, National Sun Yat-Sen Univ. (Taiwan) ..... [10361-42]

**The alignment of liquid crystalline nanowires using micropatterned elastomer molds**, Eric Carlson, Lee M. Foley, Edward Guzman, Eva D. Korblova, Rayshan Visvanathan, Univ. of Colorado Boulder (USA); SeongHo Ryu, Min-Jun Gim, Dong Ki Yoon, KAIST (Korea, Republic of); Noel A. Clark, David M. Walba, Univ. of Colorado Boulder (USA) ..... [10361-43]

# CONFERENCE 10362

LOCATION: CONV. CTR. ROOM 3

Sunday–Tuesday 6–8 August 2017 • Proceedings of SPIE Vol. 10362

# Organic Light Emitting Materials and Devices XXI

*Conference Chairs:* **Franky So**, North Carolina State Univ. (USA); **Chihaya Adachi**, Kyushu Univ. (Japan); **Jang-Joo Kim**, Seoul National Univ. (Korea, Republic of)

*Program Committee:* **Wolfgang Brütting**, Univ. Augsburg (Germany); **Malte C. Gather**, Univ. of St. Andrews (United Kingdom); **Hironori Kaji**, Kyoto Univ. (Japan); **Tae-Woo Lee**, Seoul National Univ. (Korea, Republic of); **Jian Li**, Arizona State Univ. (USA); **Dongge Ma**, South China Univ. of Technology (China); **Andrew P. Monkman**, Durham Univ. (United Kingdom); **Jongwook Park**, Kyung Hee Univ. (Korea, Republic of); **Yong-Jin Pu**, Yamagata Univ. (Japan); **Sebastian Reineke**, TU Dresden (Germany); **Ifor D. W. Samuel**, Univ. of St. Andrews (United Kingdom); **Joseph Shinar**, Iowa State Univ. (USA); **Ken-Tsung Wong**, National Taiwan Univ. (Taiwan); **Chung-Chih Wu**, National Taiwan Univ. (Taiwan); **Seunghyup Yoo**, KAIST (Korea, Republic of)

## SUNDAY 6 AUGUST

### SESSION 1

LOCATION: CONV. CTR. ROOM 3 . . . . SUN 8:00 AM TO 10:20 AM

#### TADF Materials I

Session Chairs: **Chihaya Adachi**, OPERA Ctr. for Organic Photonics and Electronics Research (Japan); **Jang-Joo Kim**, Seoul National Univ. (Korea, Republic of)

8:00 am: **The design and synthesis of n-dopants and TADF materials for OLED applications** (*Invited Paper*), Seth R. Marder, Georgia Institute of Technology (USA) . . . . . [10362-1]

8:25 am: **Highly efficient pure blue-to-green emission from pyrimidine-based TADF emitters** (*Invited Paper*), Hisahiro Sasabe, Ryutaro Komatsu, Tatsuya Ohsawa, Kohei Nakao, Yuya Hayasaka, Junji Kido, Yamagata Univ. (Japan) . . . . . [10362-2]

8:50 am: **Vibrational coupling in TADF and how molecular structure can control this complex triplet harvesting process** (*Invited Paper*), Andrew P. Monkman, Durham Univ. (United Kingdom) . . . . . [10362-3]

9:15 am: **Efficient TADF OLEDs using active materials with both efficient internal generation and external extraction** (*Invited Paper*), Chung-Chih Wu, National Taiwan Univ. (Taiwan) . . . . . [10362-4]

9:40 am: **High efficiency thermally activated delayed fluorescence through an excited-state intramolecular proton transfer** (*Invited Paper*), Masashi Mamada, Ko Inada, Takeshi Komino, William J. Potscavage Jr., Hajime Nakanotani, Chihaya Adachi, Kyushu Univ. (Japan) . . . . . [10362-5]

10:05 am: **Enhanced photoluminescence from a molecular tunneling junction**, Alfred J. Meixner, Kai Braun, Eberhard Karls Univ. Tübingen (Germany); Xiao Wang, Hunan Univ. (China); Dai Zhang, Eberhard Karls Univ. Tübingen (Germany) . . . . . [10362-13]

Coffee Break . . . . . Sun 10:05 am to 10:35 am

### SESSION 2

LOCATION: CONV. CTR. ROOM 3 . . . . SUN 10:50 AM TO 12:05 PM

#### TADF Materials II

Session Chairs: **Chihaya Adachi**, OPERA Ctr. for Organic Photonics and Electronics Research (Japan); **Jang-Joo Kim**, Seoul National Univ. (Korea, Republic of)

10:50 am: **Conventional fluorescent OLEDs toward EQE of 30%** (*Invited Paper*), Jang-Joo Kim, Seoul National Univ (Korea, Republic of); Hyun-Gu Kim, Seoul National Univ. (Korea, Republic of) . . . . . [10362-6]

11:15 am: **Molecular design and device architectures for high performance thermally activated delayed fluorescent OLEDs** (*Invited Paper*), Chun-Sing Lee, City Univ. of Hong Kong (Hong Kong, China) . . . . . [10362-7]

11:40 am: **High efficiency OLEDs based on exciplex** (*Invited Paper*), Ken-Tsung Wong, National Taiwan Univ. (Taiwan) . . . . . [10362-8]

Lunch Break . . . . . Sun 12:05 am to 1:20 pm

### SESSION 3

LOCATION: CONV. CTR. ROOM 3 . . . . .SUN 1:20 PM TO 3:00 PM

#### TADF Materials III

Session Chair: **Andrew P. Monkman**, Durham Univ. (United Kingdom)

1:20 pm: **Blue OLEDs based on thermally activated delayed fluorescent emitters with improved stability** (*Invited Paper*), Lian Duan, Dongdong Zhang, Tsinghua Univ. (China) . . . . . [10362-9]

1:45 pm: **Towards commercialization: Blue TADF emitter materials for next-generation AMOLED-displays** (*Invited Paper*), Thomas Baumann, Daniel Volz, cynora GmbH (Germany) . . . . . [10362-10]

2:10 pm: **Understanding spin-dependent processes in TADF light-emitting materials based on magneto-optical studies** (*Invited Paper*), Bin Hu, The Univ. of Tennessee Knoxville (USA) . . . . . [10362-11]

2:35 pm: **Device approach for extended lifetime in triplet exciton harvesting organic light-emitting diodes** (*Invited Paper*), Wook Song, Si Hyun Han, Jeong Min Choi, Jun Yeob Lee, Sungkyunkwan Univ. (Korea, Republic of) . . . . [10362-12]

Coffee Break . . . . . Sun 3:00 pm to 3:30 pm

### SESSION 4

LOCATION: CONV. CTR. ROOM 3 . . . . . SUN 3:30 PM TO 5:50 PM

#### Light Extraction

Session Chairs: **Andrew P. Monkman**, Durham Univ. (United Kingdom); **Chun-Sing Lee**, City Univ. of Hong Kong (Hong Kong, China)

3:30 pm: **Highly efficient flexible OLEDs with the extraction enhancement** (*Invited Paper*), Jianxin Tang, Yanqing Li, Soochow Univ. (China) . . . . . [10362-14]

3:55 pm: **Efficient light extraction of organic light-emitting diodes** (*Invited Paper*), Qibing Pei, Univ. of California, Los Angeles (USA) . . . . . [10362-15]

4:20 pm: **Enhanced outcoupling of light from OLEDs fabricated on corrugated polycarbonate and PET substrates** (*Invited Paper*), Chamika Hippola, Rajiv Kaudal, Eeshita Manna, Iowa State Univ. of Science and Technology (USA); Thomas Trovato, Trovato Mfg., Inc. (USA); Dennis Slafer, MicroContinuum, Inc. (USA); Rana Biswas, Joseph Shinar, Ruth Shinar, Iowa State Univ. of Science and Technology (USA) . . . . . [10362-16]

4:45 pm: **Molecular orientations and energy levels** (*Invited Paper*), Yiyi Li, Zheng-Hong Lu, Univ. of Toronto (Canada) . . . . . [10362-17]

5:10 pm: **OLED light extraction with corrugated substrate and hemispherical lens**, Xiangyu Fu, Cheng Peng, Univ. of Florida (USA); Dong-Hun Shin, Monica Samal, Franky So, North Carolina State Univ. (USA) . . . . . [10362-18]

5:25 pm: **Vacuum nanohole array embedded organic light emitting diodes for enhanced light extraction** (*Invited Paper*), Sohee Jeon, Jun-Ho Jeong, Korea Institute of Machinery & Materials (Korea, Republic of); Jang-Joo Kim, Seoul National Univ. (Korea, Republic of) . . . . . [10362-19]

**LOCATION: CONV. CTR. ROOM 6A . . SUN 6:00 PM TO 7:50 PM**

## Technology Hot Topics: How Optics and Photonics Drive Innovation

- 6:00 pm to 6:10 pm: **Welcome and Opening Remarks**
- 6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)
- 6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)
- 6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)
- 7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)
- 7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)

## MONDAY 7 AUGUST

### SESSION 5

**LOCATION: CONV. CTR. ROOM 3 . . . MON 8:00 AM TO 10:15 AM**

### Device Physics I

Session Chairs: **Franky So**, North Carolina State Univ. (USA); **Tae-Woo Lee**, Seoul National Univ. (Korea, Republic of)

- 8:00 am: **Extending the lifetime of blue phosphorescent OLEDs** (*Keynote Presentation*), Stephen R. Forrest, Univ. of Michigan (USA) . . . . . [10362-20]
- 8:35 am: **Blue emitting square planar metal complexes for displays and lighting applications** (*Invited Paper*), Jian Li, Arizona State Univ. (USA) . . . . . [10362-21]
- 9:00 am: **Recent advances in phosphorescent OLEDs: Molecular design for long lifetime and high color purity** (*Invited Paper*), Hirohiko Fukagawa, Takahisa Shimizu, Yukiko Iwasaki, Taku Oono, Toshihiro Yamamoto, NHK Japan Broadcasting Corp. (Japan) . . . . . [10362-22]
- 9:25 am: **Realizing high-performance and low-cost fluorescent OLEDs** (*Invited Paper*), Shi-Jian Su, South China Univ. of Technology (China) . . . . . [10362-23]
- 9:50 am: **Active control of OLED beam shapes** (*Invited Paper*), Sebastian Reineke, Felix Fries, Markus Fröbel, Pen Yiao Ang, Simone Lenk, TU Dresden (Germany) . . . . . [10362-24]
- Coffee Break . . . . . Mon 10:15 am to 10:45 am

### SESSION 6

**LOCATION: CONV. CTR. ROOM 3 . . . MON 10:45 AM TO 12:00 PM**

### Device Stability

Session Chairs: **Franky So**, North Carolina State Univ. (USA); **Tae-Woo Lee**, Seoul National Univ. (Korea, Republic of)

- 10:45 am: **Investigating the causes of the lower stability of solution-coated versus vacuum-deposited small-molecule organic light emitting devices** (*Invited Paper*), Hany Aziz, Yong Joo Cho, Hyeong Hwa Yu, Yingjie Zhang, Univ. of Waterloo (Canada) . . . . . [10362-25]
- 11:10 am: **Addition of lithium 8-quinolate into polyethylenimine/zinc oxide electron-injection layer improving driving voltage and lifetime of OLEDs** (*Invited Paper*), Yong-Jin Pu, Takayuki Chiba, Takafumi Ide, Satoru Ohisa, Hitoshi Fukuda, Tatsuya Hikichi, So Kawata, Junji Kido, Yamagata Univ. (Japan) [10362-26]
- 11:35 am: **Electroluminescent polymers for solution-processed PLEDs** (*Invited Paper*), Lixiang Wang, Changchun Institute of Applied Chemistry (China) [10362-27]
- Lunch Break . . . . . Mon 12:00 pm to 1:30 pm

### SESSION 7

**LOCATION: CONV. CTR. ROOM 3 . . . . . MON 1:30 PM TO 3:10 PM**

### Device Physics II

Session Chairs: **Seunghyup Yoo**, KAIST (Korea, Republic of); **Jian Li**, Arizona State Univ. (USA)

- 1:30 pm: **Highly efficient solution-processed small-molecule organic light-emitting diodes using novel electron transporting host** (*Invited Paper*), Tae-Woo Lee, Tae-Hee Han, Seoul National Univ. (Korea, Republic of); Mi-Ri Choi, Pohang Univ. of Science and Technology (Korea, Republic of); Chan-Woo Jeon, Yun-Hi Kim, Soon-Ki Kwon, Gyeongang National Univ. (Korea, Republic of) . . . [10362-28]
- 1:55 pm: **Elucidating the film structure in organic light-emitting diodes** (*Invited Paper*), Paul L. Burn, Claire Tonnele, Martin Stroet, Tom Lee, Andrew J. Clulow, Jake A. McEwan, Ian R. Gentle, Alan Mark, Ben J. Powell, The Univ. of Queensland (Australia) . . . . . [10362-29]
- 2:20 pm: **Unified analysis of transient and steady-state electrophosphorescence: Establishing an analytical formalism for OLED charge balance** (*Invited Paper*), Kyle W. Hershey, Russell J. Holmes, Univ. of Minnesota, Twin Cities (USA) . . . . . [10362-30]
- 2:45 pm: **Multiscale hopping-type charge transport simulation: the prediction and molecular-level analysis** (*Invited Paper*), Hironori Kaji, Kyoto Univ. (Japan) . . . . . [10362-31]
- Coffee Break . . . . . Mon 3:10 pm to 3:40 pm

### SESSION 8

**LOCATION: CONV. CTR. ROOM 3 . . . . . MON 3:40 PM TO 5:15 PM**

### Perovskite LEDs

Session Chairs: **Seunghyup Yoo**, KAIST (Korea, Republic of); **Jian Li**, Arizona State Univ. (USA)

- 3:40 pm: **Highly efficient perovskite LEDs from nanoscale perovskite crystallites** (*Invited Paper*), Barry P. Rand, Princeton Univ. (USA) . . . . . [10362-32]
- 4:05 pm: **Continuing to explore the unusual properties of hybrid perovskites**, (*Invited Paper*), Jinsong Huang, Univ. of Nebraska-Lincoln (USA) . . . . . [10362-33]
- 4:30 pm: **Tunable light emitting diodes utilizing quantum-confined layered perovskite emitters**, Dan Congreve, Massachusetts Institute of Technology (USA) and Harvard Univ. (USA); Mark Weidman, Michael Seitz, Watcharaphol Paritmongkol, Nabeel Dahod, William A. Tisdale, Massachusetts Institute of Technology (USA) . . . . . [10362-34]
- 4:45 pm: **Hybrid perovskite light-emitting field-effect transistors**, Francesco Maddalena, Xin Yu Chin, Daniele Cortecchia, Annalisa Bruno, Cesare Soci, Nanyang Technological Univ. (Singapore) . . . . . [10362-35]
- 5:00 pm: **Halide perovskite/polymer composites for fully printed and multifunctional LEDs**, Zhibin Yu, Florida State Univ. (USA) . . . . . [10362-36]

**LOCATION: CONV. CTR.**

**EXHIBIT HALL B2 . . . . . MON 5:30 PM TO 7:30 PM**

### Posters-Monday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPPosterGuidelines>.

**Quantitative analyses of photophysical processes in thermally activated delayed fluorescent emitters**, Wei-Kai Lee, Kuan-Chung Pan, Shiu Yi Jiun, Chung-Chih Wu, National Taiwan Univ. (Taiwan) . . . . . [10362-48]

**Conjugation-induced highly efficient thermally activated delayed fluorescence in polymer emitters**, Qiang Wei, Leibniz-Institut für Polymerforschung Dresden e.V. (Germany); Paul Kleine, TU Dresden (Germany); Yevhen Karpov, Xianping Qiu, Hartmut Komber, Karin Sahre, Anton Kiri, Leibniz-Institut für Polymerforschung Dresden e.V. (Germany); Ramunas Lygaitis, Simone Lenk, Sebastian Reineke, TU Dresden (Germany); Brigitte Voit, Leibniz-Institut für Polymerforschung Dresden e.V. (Germany) . . . . . [10362-49]

**Highly efficient fluorescent organic light emitting diodes using a novel blue TADF dopant**, Min Hyeong Hwang, Chil Won Lee, Byung-Doo Chin, Dankook Univ. (Korea, Republic of) . . . . . [10362-50]

**Identification of degradation mechanism of organic light emitting diodes based on cyan color thermally activated delayed fluorescence emitter**, Cheng Peng, Univ. of Florida (USA); Amin Salehi, Ying Chen, North Carolina State Univ. (USA); Georgios Liaptis, cynora GmbH (Germany); Franky So, North Carolina State Univ. (USA) . . . . . [10362-51]



# CONFERENCE 10362

**Development of new dopant materials for OLED**, Yun-Hi Kim, Soon-Ki Kwon, Gyeongsang National Univ. (Korea, Republic of); Jang-Joo Kim, Seoul National Univ. (Korea, Republic of) . . . . . [10362-52]

**A new class of hole-transporting material for simple-structured phosphorescent OLEDs**, Jaemin Lee, Hyejin Na, Korea Research Institute of Chemical Technology (Korea, Republic of); Byung-Jun Jung, The Univ. of Seoul (Korea, Republic of) . . . . . [10362-53]

**Highly efficient solution processed organic light emitting diode using low refractive index electron transport layer**, Amin Salehi, North Carolina State Univ. (USA); Suzheng Ho, Univ. of Florida (USA); Ying Chen, North Carolina State Univ. (USA); Cheng Peng, Univ. of Florida (USA); Franky So, North Carolina State Univ. (USA); Daniel Volz, cynora GmbH (Germany); Hartmut Yersin, Univ. Regensburg (Germany) . . . . . [10362-54]

**Polarized light emitters**, Kristiaan Neyts, Univ. Gent (Belgium) . . . . . [10362-55]

**Stable core-shell copolymer-perovskite nanohybrids**, Shaocong Hou, The Rowland Institute at Harvard (USA); Yuzheng Guo, The Rowland Institute at Harvard (USA) and Swansea Univ. (United Kingdom); Qimin Quan, The Rowland Institute at Harvard (USA) . . . . . [10362-56]

**Optical and electric properties of lead iodide-based layered perovskite with self-organized quantum-well structure**, Masanao Era, Saga Univ. (Japan); Kazuhiro Ema, Sophia Univ. (Japan); Yasunori Yamada, Saga Univ. (Japan); Kento Mori, Ryoka Systems Inc. (Japan); Norio Tomotsu, Idemitsu Kosan Co., Ltd. (Japan) . . . . . [10362-57]

**Charge-exciton interaction rate in organic field-effect transistors by means of transient photoluminescence electromodulated spectroscopy**, Stefano Toffanin, Istituto per lo Studio dei Materiali Nanostrutturati (Italy); Wouter A. Koopman, Univ. Potsdam (Germany); Marco Natali, Giovanni P. Donati, Michele Muccini, Istituto per lo Studio dei Materiali Nanostrutturati (Italy) . . . . . [10362-58]

**Universal charge carrier generation layers for all-solution processed, highly efficient tandem OLEDs**, Stefan Höfle, Min Zhang, Christian Kayser, Alexander Colsmann, Karlsruher Institut für Technologie (Germany) . . . . . [10362-59]

**Transparent electrode of silver network fabricated by using cracks of polymers as templates**, Beom Sun Choy, Jeong Hui Lee, Oh Young Kim, Ho Jong Kang, Dong Hyun Lee, Dankook Univ. (Korea, Republic of) . . . . . [10362-60]

**Organic light-emitting diodes with polyethylenimine as a solution-processed electron injection layer: Operational stability and degradation mechanisms**, Sebastian Stolz, Karlsruher Institut für Technologie (Germany) and InnovationLab GmbH (Germany); Yingjie Zhang, Univ. of Waterloo (Canada); Ulrich Lemmer, Karlsruher Institut für Technologie (Germany); Gerardo Hernandez-Sosa, Karlsruher Institut für Technologie (Germany) and InnovationLab GmbH (Germany); Hany Aziz, Univ. of Waterloo (Canada) . . . . . [10362-61]

**To eliminate coffee ring effect during Inkjet printing of functional polymers for PLED**, Yanchun Han, Changchun Institute of Applied Chemistry (China) [10362-62]

**Simulation of exciton effects in OLEDs based on the master equation**, Weifeng Zhou, Christoph Zimmermann, Christoph A. Jungemann, RWTH Aachen Univ. (Germany) . . . . . [10362-63]

**Monte Carlo simulation of OLEDs by hopping conduction in the distributed density of state**, Mun Chae Yoon, Il Hoo Park, Jinyoung Yun, Gytuae Kim, Korea Univ. (Korea, Republic of) . . . . . [10362-64]

**Boosting OLED efficiency by blending: spectroscopic identification of reduced charge trapping**, Elham Khodabakhshi, Gert-Jan Wetzelaer, Paul W. M. Blom, Jasper Michels, Max-Planck-Institut für Polymerforschung (Germany) . . [10362-65]

**Effect of dopant polarity on the recombination mechanism in organic light-emitting diodes**, Chang-Heon Lee, Jeong-Hwan Lee, Kwon-Hyeon Kim, Jang-Joo Kim, Seoul National Univ. (Korea, Republic of) . . . . . [10362-66]

**Electrical degradation model of OLEDs depending on driving conditions**, Ilhoo Park, Korea Univ. (Korea, Republic of) . . . . . [10362-67]

**Achievement of long device lifetime by decreasing dipole moment of hole-blocking layer**, Ko Inada, OPERA Ctr. for Organic Photonics and Electronics Research (Japan) and Japan Science and Technology Agency (JST), ERATO, Adachi Molecular Exciton Engineering Project (Japan); Hiroshi Fujimoto, i3-OPERA (Japan) and OPERA Ctr. for Organic Photonics and Electronics Research (Japan); Masayuki Yahiro, Institute of Systems, Information Technologies and Nanotechnologies (ISIT) (Japan) and i3-OPERA (Japan) and OPERA Ctr. for Organic Photonics and Electronics Research (Japan); Satoshi Yukiwaki, i3-OPERA (Japan); Keiko Kusuha, OPERA Ctr. for Organic Photonics and Electronics Research (Japan) and Japan Science and Technology Agency (JST), ERATO, Adachi Molecular Exciton Engineering Project (Japan); Nozomi Nakamura, OPERA Ctr. for Organic Photonics and Electronics Research (Japan) and International Institute for Carbon Neutral Energy Research (WPI-I2CNER) (Japan); Atula S. D. Sandanayaka, OPERA Ctr. for Organic Photonics and Electronics Research (Japan) and Japan Science and Technology Agency (JST), ERATO, Adachi Molecular Exciton Engineering Project (Japan); Chihaya Adachi, OPERA Ctr. for Organic Photonics and Electronics Research (Japan) and International Institute for Carbon Neutral Energy Research (WPI-I2CNER) (Japan) and Japan Science and Technology Agency (JST), ERATO, Adachi Molecular Exciton Engineering Project (Japan) . . . . . [10362-68]

**High thermal stability OLEDs**, Jared S. Price, Baomin Wang, Yufei Shen, Noel C. Giobink, The Pennsylvania State Univ. (USA) . . . . . [10362-69]

**Kirigami-based three-dimensional OLED concepts for architectural lighting**, Taehwan Kim, Jared S. Price, Alex Grede, Sora Lee, Thomas N. Jackson, Noel C. Giobink, The Pennsylvania State Univ. (USA) . . . . . [10362-70]

**How to distinguish scattered and absorbed light from re-emitted light for solid-state lighting?**, Maryna L. Meretska, Ad Lagendijk, Henri N. Thyrrstrup, Allard P. Mosk, Univ. Twente (Netherlands); Wilbert L. IJzerman, Philips Lighting B.V. (Netherlands); Willem L. Vos, Univ. Twente (Netherlands) . . . . . [10362-71]

**Semi-transparent vertical organic light emitting transistors based on a perforated indium-tin-oxide source electrode**, Suzheng Ho, Univ. of Florida (USA); Hyeonjeun Yu, Nilesh Barange, Ryan Larrabee, Franky So, North Carolina State Univ. (USA) . . . . . [10362-72]

**Experimental investigating distinguishable and non-distinguishable grayscale applicable in active-matrix organic light-emitting diodes for quality engineering**, Henglong Yang, Wen-Cheng Chang, Yu-Hsuan Lin, Ming-Hong Chen, National Taipei Univ. of Technology (Taiwan) . . . . . [10362-73]

**White emission based on excimer emission control of triple core chromophores**, Hyeoncheol Jung, Kyung Hee Univ. (Korea, Republic of); Jaehyun Lee, Kyoto Univ. (Japan); Hwangyu Shin, Joonghan Kim, The Catholic Univ. of Korea (Korea, Republic of); Daisuke Yokoyama, Yamagata Univ. (Japan); Hidetaka Nishimura, Atsushi Wakamiya, Kyoto Univ. (Japan); Jongwook Park, Kyung Hee Univ. (Korea, Republic of) . . . . . [10362-74]

**High-efficiency orange-red organic electrophosphorescent devices with excellent operational stability**, Pang-Chi Huang, Meng Hao Chang, Jin-Sheng Lin, Mei-Rung Tseng, Industrial Technology Research Institute (Taiwan) . . . [10362-75]

**White electroluminescence from single polymers with high power efficiency**, Shiyang Shao, Changchun Institute of Applied Chemistry (China) . . . . . [10362-76]

**Controlling preferential alignment of heteroleptic phosphors in organic guest-host systems via film preparation parameters**, Thomas Lampe, Philippe Linsmayer, Tobias D. Schmidt, Wolfgang Brütting, Univ. Augsburg (Germany) . . . . . [10362-77]

**Probing molecular orientation of organic molecules for organic light-emitting diode applications**, Johnny K. W. Ho, Hong Kong Baptist Univ. (Hong Kong, China); Sai Wing Tsang, City Univ. of Hong Kong (Hong Kong, China); Shu Kong So, Hong Kong Baptist Univ. (Hong Kong, China) . . . . . [10362-78]

**Controllable random nano-structures for organic light-emitting diodes**, Yungui Li, TU Dresden (Germany); Milan Kovacic, Univ. of Ljubljana (Slovenia); Paul-Anton Will, TU Dresden (Germany); Jasper Westphalen, Fraunhofer-Institut für Organische Elektronik, Elektronenstrahl- und Plasmatechnik (Germany); Manuela Junghänel, Fraunhofer-Institut für Organische Elektronik, Elektronenstrahl- und Plasmatechnik FEP (Germany); Steffen Oswald, Leibniz-Institut für Festkörper- und Werkstoffforschung Dresden (Germany); Simone Lenk, Sebastian Reineke, TU Dresden (Germany) . . . . . [10362-79]

**How high can the external quantum efficiency of OLEDs become by a scattering approach?**, Jinouk Song, KAIST (Korea, Republic of); Kwon-Hyeon Kim, Seoul National Univ. (Korea, Republic of); Eunhye Kim, KAIST (Korea, Republic of); Jang-Joo Kim, Seoul National Univ. (Korea, Republic of); Seunghyup Yoo, KAIST (Korea, Republic of) . . . . . [10362-80]

**Inkjet-printed polymer-based scattering layers for enhanced light outcoupling from top-emitting organic light-emitting diodes**, Armin Heinrichsdobler, OSRAM OLED GmbH (Germany) and Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany); Manuel Engelmayr, OSRAM OLED GmbH (Germany) and Univ. Augsburg (Germany); Daniel Riedel, OSRAM OLED GmbH (Germany) and Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany); Christoph J. Brabec, Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany); Thomas Wehlius, OSRAM OLED GmbH (Germany) . . . . . [10362-81]

**Complex 3D photonic films used as external diffractive layer to improve blue OLEDs**, Michal Mruczkiewicz, Univ. Bordeaux 1 (France); Frederic Dumur, Aix-Marseille Univ. (France); Mathias Perrin, Univ. Bordeaux 1 (France); Arthur Bertrand, Univ. de Pau et des Pays de l'Adour (France); Stéphane Reculusa, Institut des Sciences Moléculaires-NSySA (France); Christine Dagron-Lartigau, Antoine Bousquet, Univ. de Pau et des Pays de l'Adour (France); Laurence Vignau, Univ. Bordeaux 1 (France); Laurent Billon, Univ. de Pau et des Pays de l'Adour (France); Sophie Fasquel, Univ. Bordeaux 1 (France) . . . . . [10362-82]

**Cavity dependent Bragg scattering in red top-emitting organic LEDs**, Paul-Anton Will, Elisabeth Schwarz, Cornelius Fuchs, Reinhard Scholz, Simone Lenk, Sebastian Reineke, TU Dresden (Germany) . . . . . [10362-83]

**Towards continuous-wave operation of organic semiconductor lasers**, Atula S. D. Sandanayaka, Toshinori Matsushima, Fatima Bencheikh, Kou Yoshida, Munetomo Inoue, OPERA Ctr. for Organic Photonics and Electronics Research (Japan); Takashi Fujihara, Institute of Systems, Information Technologies and Nanotechnologies (ISIT) (Japan); Kenichi Goushi, Jean-Charles Ribierre, Chihaya Adachi, OPERA Ctr. for Organic Photonics and Electronics Research (Japan) . . . . . [10362-84]

**High quality white OLEDs with LED efficiencies**, Kyung-Hoon Han, Seoul National Univ. (Korea, Republic of); Sohee Jeon, Korea Institute of Machinery & Materials (Korea, Republic of); Sunghun Lee, Kwon-Hyeon Kim, Hyun Shin, Seoul National Univ. (Korea, Republic of); Jun-Ho Jeong, Korea Institute of Machinery & Materials (Korea, Republic of); Jang-Joo Kim, Seoul National Univ. (Korea, Republic of) ..... [10362-85]

**Simulation and optimization for the optical performance of top emitting OLED**, Shuwei Fan, Nana Chen, Zhaoxin Wu, Shenli Jia, Xi'an Jiaotong Univ. (China) ..... [10362-86]

**Down-conversion white OLEDs with high performance color-conversion light outcoupling structures.**, Joo Won Han, Siti Aisyah Nurmaulia Entifar, Pukyong National Univ. (Korea, Republic of); Chul Woong Joo, Jonghee Lee, Electronics and Telecommunications Research Institute (Korea, Republic of); Yong Hyun Kim, Pukyong National Univ. (Korea, Republic of) ..... [10362-87]

**The analysis of working mechanism for organic heterojunction charge generation layer**, Feiping Lu, Tianshui Normal Univ. (China) ..... [10362-88]

**The study of working mechanism of organic heterojunction charge generation layer**, Feiping Lu, Tianshui Normal Univ. (China); Bo Yao, Yan Li, Shaoying Univ. (China); Qin Liu, Yinglong Shi, Tianshui Normal Univ. (China) ..... [10362-89]

**Conductivity and injection ability enhancing of nickel (II) oxide hole injection layer for organic light-emitting diodes**, Moohyun Kim, KAIST (Korea, Republic of); Chul Woong Joo, Byoung-Hwa Kwon, Electronics and Telecommunications Research Institute (Korea, Republic of); Wonseok Choi, Dodam Kim, Duk Young Jeon, KAIST (Korea, Republic of) ..... [10362-90]

**The facile synthesis of 1,8-dibromo-9-heterofluorenes**, Jinzhu Cao, Chuanhao Sun, China Electronics Standardization Institute (China); Yijiang Jiang, Beijing University of Technology (China) ..... [10362-92]

**Optical materials based on organometallic complexes and quantum dots loaded in solid matrices**, Leandro P. Ravaro, Univ. of California, Santa Barbara (USA) and Univ. of São Paulo (Brazil); Peter C. Ford, Univ. of California, Santa Barbara (USA); Andrea S. S. de Camargo, Univ. of São Paulo (Brazil) . . . [10362-93]

## TUESDAY 8 AUGUST

**LOCATION: CONV. CTR. ROOM 6A . TUE 9:00 AM TO 11:45 AM**

### Organic Photonics + Electronics Plenary Session

9:00 am: **Hybrid Electro-Optics and Chipscale Integration of Electronics and Photonics (Plenary)**, Larry R. Dalton, Univ. of Washington (USA) ..... [10364-301]

9:30 am: **Molecular Plasmons (Plenary)**, Naomi J. Halas, Rice Univ. (USA) ..... [10360-302]

10:00 am: **Announcement of the Organic Photonics + Electronics Best Student Paper Awards**, Zakya H. Kafafi, Lehigh Univ. (USA)

Coffee Break ..... Tue 10:15 am to 10:45 am

10:45 am: **The History and Progress of Halide Perovskite Photovoltaics (Plenary)**, Nam-Gyu Park, Sungkyunkwan Univ. (Korea, Republic of) [10363-303]

11:15 am: **Mesoscopic Photosystems for the Generation of Electricity and Fuels from Sunlight (Plenary)**, Michael Grätzel, Ecole Polytechnique Fédérale de Lausanne (Switzerland) ..... [10363-304]

Lunch/Exhibition Break ..... Tue 11:45 am to 1:30 pm

## SESSION 9

**LOCATION: CONV. CTR. ROOM 3 . . . . . TUE 1:30 PM TO 3:05 PM**

### Device Physics III

Session Chairs: **Paul L. Burn**, The Univ. of Queensland (Australia); **Hany Aziz**, Univ. of Waterloo (Canada)

1:30 pm: **Unraveling origin of phosphors doped in organic semiconducting layers**, Chang-Ki Moon, Kwon-Hyeon Kim, Jang-Joo Kim, Seoul National Univ. (Korea, Republic of) ..... [10362-37]

1:45 pm: **Charge transport and light emission in anisotropic media: the liquid-crystalline light-emitting diode**, Changmin Keum, Shiyi Liu, Akram Al-Shadeedi, Vikash Kaphle, Robert J. Twieg, Antal I. Jákli, Björn Lüssem, Kent State Univ. (USA) ..... [10362-38]

2:00 pm: **Polymer gating white flexible field-induced lighting device**, Junwei Xu, Wake Forest Univ. (USA); David Loren Carroll, Ctr. for Nanotechnology and Molecular Materials (USA) ..... [10362-39]

2:15 pm: **Alternating current polymer electroluminescence for dynamic interactive display (Invited Paper)**, Cheolmin Park, Yonsei Univ. (Korea, Republic of) ..... [10362-40]

2:40 pm: **Universal ohmic electron and hole contacts for organic light-emitting diodes and electronics (Invited Paper)**, Peter Ho, Rui-Qi Png, Lay-Lay Chua, National Univ. of Singapore (Singapore) ..... [10362-41]

Coffee Break ..... Tue 3:05 pm to 3:30 pm

## SESSION 10

**LOCATION: CONV. CTR. ROOM 3 . . . . . TUE 3:30 PM TO 6:00 PM**

### Novel Devices

Session Chairs: **Paul L. Burn**, The Univ. of Queensland (Australia); **Hany Aziz**, Univ. of Waterloo (Canada)

3:30 pm: **Recent advances in OLEDs on unconventional substrates (Invited Paper)**, Bernard Kippelen, Xiaoqing Zhang, Canek Fuentes-Hernández, Felipe A. Larrain, Georgia Institute of Technology (USA) ..... [10362-42]

3:55 pm: **Highly efficient flexible OLEDs and their application to health-monitoring sensors (Invited Paper)**, Seunghyup Yoo, Hyeonwoo Lee, Eunhye Kim, Jaeho Lee, KAIST (Korea, Republic of) ..... [10362-43]

4:20 pm: **New materials for fabrication of efficient near infrared OLEDs and organic solid-state lasers (Invited Paper)**, Anthony D'Aleo, CInaM - Ctr. Interdisciplinaire de Nanoscience de Marseille (France); Dae Hyeon Kim, Atula S. D. Sandanayaka, OPERA Ctr. for Organic Photonics and Electronics Research (Japan); Dandan Yao, Elena Zaborova, Gabriel Canard, CInaM - Ctr. Interdisciplinaire de Nanoscience de Marseille (France); Toshinori Matsushima, Youichi Tsuchiya, OPERA Ctr. for Organic Photonics and Electronics Research (Japan); Eunyong Choi, Jeong Weon Wu, Ewha Womans Univ. (Korea, Republic of); Frédéric Fages, Aix-Marseille Univ. (France) and CInaM - Ctr. Interdisciplinaire de Nanoscience de Marseille (France); Jean-Charles Ribierre, Chihaya Adachi, OPERA Ctr. for Organic Photonics and Electronics Research (Japan) and Japan Science and Technology Agency (Japan) ..... [10362-44]

4:45 pm: **Fluorescent proteins and carbon nanotubes: unconventional materials for strong light-matter interaction and solid state lasers (Invited Paper)**, Malte C. Gather, Univ. of St. Andrews (United Kingdom); Christof P. Dietrich, Univ. of St. Andrews (United Kingdom) and Julius-Maximilians-Univ. Würzburg (Germany); Arko Graf, Univ. of St. Andrews (United Kingdom) and Ruprecht-Karls-Univ. Heidelberg (Germany); Laura Tropic, Markus Karl, Anja Kämpf, Marcel Schubert, Nils M. Kronenberg, Univ. of St. Andrews (United Kingdom); Yuriy Zakharko, Ruprecht-Karls-Univ. Heidelberg (Germany); Sven Höfling, Julius-Maximilians-Univ. Würzburg (Germany); Jana Zaumseil, Ruprecht-Karls-Univ. Heidelberg (Germany) ..... [10362-45]

5:10 pm: **Tunable solution processed metal organic perovskite distributed feedback lasers (Invited Paper)**, Ulrich Lemmer, Philipp Brenner, Florian Mathies, Dorothee Kapp, Gerardo Hernandez-Sosa, Ian A. Howard, Karlsruhe Institut für Technologie (Germany) ..... [10362-46]

5:35 pm: **Electrical simulation of organic light emitting diode under high current injection (Invited Paper)**, Fatima Bencheikh, Atula S. D. Sandanayaka, Toshiya Fukunaga, Toshinori Matsushima, Chihaya Adachi, OPERA Ctr. for Organic Photonics and Electronics Research (Japan) ..... [10362-47]

# CONFERENCE 10363

LOCATION: CONV. CTR. ROOM 4 AND CONV. CTR. ROOM 6B

Sunday–Thursday 6–10 August 2017 • Proceedings of SPIE Vol. 10363

## Organic, Hybrid, and Perovskite Photovoltaics XVIII

Conference Chair: **Zakya H. Kafafi**, Lehigh Univ. (USA)

Conference Co-Chairs: **Paul A. Lane**, U.S. Naval Research Lab. (USA); **Kwanghee Lee**, Gwangju Institute of Science and Technology (Korea, Republic of)

Program Committee: **Pierre M. Beaujuge**, King Abdullah Univ. of Science and Technology (Saudi Arabia); **Hendrik Bolink**, Univ. de València (Spain); **Paul L. Burn**, The Univ. of Queensland (Australia); **David S. Ginger**, Univ. of Washington (USA); **Fei Huang**, South China Univ. of Technology (China); **Gang Li**, The Hong Kong Polytechnic Univ. (USA); **Thuc-Quyen Nguyen**, Univ. of California, Santa Barbara (USA); **Ana Flavia Nogueira**, Univ. Estadual de Campinas (Brazil); **Hideo Ohkita**, Kyoto Univ. (Japan); **Nam-Gyu Park**, Sungkyunkwan Univ. (Korea, Republic of); **Barry P. Rand**, Princeton Univ. (USA); **Ifor D. W. Samuel**, Univ. of St. Andrews (United Kingdom); **Natalie Stingelin-Stutzmann**, Georgia Institute of Technology (USA)

Conference Sponsor:



### SUNDAY 6 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 4 . . . . SUN 1:00 PM TO 3:10 PM

#### Structure and Morphology in Organic and Hybrid Photovoltaics

JOINT SESSION WITH CONFERENCES 10348 AND 10363

Session Chair: **Hugo A. Bronstein**, Univ. College London (United Kingdom)

1:00 pm: **Electronic processes, morphologies, and structural-functional correlations in conjugated oligomers and polymers for OPV** (*Invited Paper*), Lin X. Chen, Northwestern Univ. (USA) and Argonne National Lab. (USA) . . . [10348-1]

1:30 pm: **2D compact model to characterize phase separation in organic solar cell bulk heterojunctions**, Franklin L. Lee, Amir Barati Farimani, Kevin L. Gu, Stanford Univ. (USA); Hongping Yan, Stanford Synchrotron Radiation Lightsource (USA); Zhenan Bao, Stanford Univ. (USA); Vijay S. Pande, Stanford Univ. (USA) and Andreessen Horowitz (USA) . . . . . [10363-1]

1:50 pm: **Nanoscale energetic mapping of bulk heterojunction solar cells**, Sukumar Dey, Hanlin Hu, Weimin Zhang, Iain Macculloch, Aram Amassian, King Abdullah Univ. of Science and Technology (Saudi Arabia) . . . . . [10348-2]

2:10 pm: **Quantitative structure-function relations in PSCs from soft x-ray scattering** (*Invited Paper*), Harald W. Ade, North Carolina State Univ. (USA) . . . . . [10363-2]

2:40 pm: **Electronic structure and ion migration in lead-halide perovskites: a first-principles perspective** (*Invited Paper*), Leeor Kronik, Weizmann Institute of Science (Israel) . . . . . [10348-3]

Coffee Break . . . . . Sun 3:10 pm to 3:40 pm

#### SESSION 2

LOCATION: CONV. CTR. ROOM 4 . . . . SUN 3:40 PM TO 5:20 PM

#### Charge and Energy Transfer Dynamics in Organic Photovoltaics

JOINT SESSION WITH CONFERENCES 10348 AND 10363

Session Chair: **Felix Deschler**, Univ. of Cambridge (United Kingdom)

3:40 pm: **In situ transient absorption of thin film formation** (*Invited Paper*), Cathy Y. Wong, Kelly S. Wilson, Univ. of Oregon (USA) . . . . . [10348-4]

4:10 pm: **Triplet energy transfer and triplet exciton recycling in singlet fission sensitized organic heterojunctions**, Ajay Pandey, Queensland Univ. of Technology (Australia) . . . . . [10363-3]

4:30 pm: **Ultrafast terahertz snapshots of excitonic Rydberg states and electronic coherence in an organometal halide perovskite**, Liang Luo, Long Men, Zhaoyu Liu, Yaroslav Mudryk, Xin Zhao, Yongxin Yao, Joong-Mok Park, Ruth Shinar, Joseph Shinar, Kai-Ming Ho, Iowa State Univ. of Science and Technology (USA) and Ames Lab. (USA); Ilias E. Perakis, The Univ. of Alabama at Birmingham (USA); Javier Vela, Jigang Wang, Iowa State Univ. of Science and Technology (USA) and Ames Lab. (USA) . . . . . [10363-4]

4:50 pm: **Intra- and inter-molecular energy transfer in organic semiconductors: insights from nonadiabatic dynamics simulations** (*Invited Paper*), Sergei Tretiak, Los Alamos National Lab. (USA) . . . . . [10348-6]

LOCATION: CONV. CTR. ROOM 6A . . SUN 6:00 PM TO 7:50 PM

#### Technology Hot Topics: How Optics and Photonics Drive Innovation

6:00 pm to 6:10 pm: **Welcome and Opening Remarks**

6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)

6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)

6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)

7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)

7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)



MONDAY 7 AUGUST

LOCATION: CONV. CTR.

EXHIBIT HALL B2 ..... MON 5:30 PM TO 7:30 PM

Posters-Monday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Study the effects of thickness variation of different layers on the light spectrum reaching active layers of organic solar cells**, Ronak Rahimi, Intel Corp. (USA) ..... [10363-57]

**EDOT-diketopyrrolopyrrole copolymers for polymer solar cells**, Chao Wang, Christopher R. McNeill, Monash Univ. (Australia) ..... [10363-58]

**Modeling of trap assisted interfacial in planer heterojunction perovskite solar cells**, Behzad Bahrami, QiQuan Qiao, South Dakota State Univ. (USA) . . [10363-59]

**Thick film high performance bulk-heterojunction solar cells retaining 90% PCEs of the optimized thin film cells**, Hang Yin, Shu Kong So, Hong Kong Baptist Univ. (Hong Kong, China) ..... [10363-60]

**Enhanced photovoltaic performance of PTB7:PCBM bulk heterojunction solar cells with Al doped TiO<sub>2</sub> interfacial layer**, Jun Young Kim, Korea Institute of Industrial Technology (Korea, Republic of) . . . . . [10363-61]

**Cationic dibenzothiophene-S,S-dioxide-bispyridinium-alt-fluorene copolymer as an efficient cathode modifier for polymer solar cells**, Wei Yang, Zhicai He, Yong Cao, South China Univ. of Technology (China) ..... [10363-62]

**Morphological effects of ZnO electron-collecting interlayers on the performance of organic solar cells**, Jisoo Goo, Dongguk Univ. (Korea, Republic of); Do Kyung Hwang, Ju Won Lim, Korea Institute of Science and Technology (Korea, Republic of); Jae Won Shim, Dongguk Univ. (Korea, Republic of) [10363-64]

**Fluorinated PCPDTBT and its efficient polymer solar cells from sequential solution processing**, Yong Zhang, Harbin Institute of Technology (China) ..... [10363-66]

**Fabrication of heterojunction film of lead halide perovskites by vacuum deposition using single crystal sources**, Senku Tanaka, Natsuki Ueyama, Takuya Yoshitomi, Kindai Univ. (Japan); Toshihiko Kaji, Tokyo Univ. of Agriculture and Technology (Japan) ..... [10363-67]

**Impact of 3D morphology on the performance of all-polymer solar cells processed by environmentally benign non-halogenated solvents**, Hyesung Jung, A-Ra Jung, Ewha Womans Univ. (Korea, Republic of); Seon-Mi Jin, Eunji Lee, Chungnam National Univ. (Korea, Republic of); Myung Hwa Kim, BongSoo Kim, Ewha Womans Univ. (Korea, Republic of) . . . . . [10363-68]

**Interfacial engineering of hybrid perovskite solar cells via fullerene derivatives**, Ka Kan Wong, Azhar Fakharuddin, Philipp Ehrenreich, Eugen Zimmermann, Michael Seybold, Carola Ebenhoch, Univ. Konstanz (Germany) ..... [10363-69]

**Driving intramolecular charge transfer by tuning molecular orbitals and dielectric constant**, Melissa P. Aplan, Youngmin Lee, Jason M. Munro, Christopher Grieco, Ismaila Dabo, Qing Wang, John B. Asbury, Enrique D. Gomez, The Pennsylvania State Univ. (USA) ..... [10363-70]

**Polarized soft x-ray scattering reveals chain orientation within block copolymer structures**, Joshua H. Litofsky, Melissa P. Aplan, Think P. Lee, Youngmin Lee, Enrique D. Gomez, The Pennsylvania State Univ. (USA) . [10363-71]

**Photoluminescence dynamics in perovskites with different grain sizes**, Hyung Do Kim, Yasunari Tamai, Hideo Ohkita, Kyoto Univ. (Japan) . . . . . [10363-72]

**Dual Förster resonance energy transfer and morphology control to boost the power conversion efficiency of all-polymer OPVs**, Jiangang Liu, Changchun Institute of Applied Chemistry (China) . . . . . [10363-74]

**Proton radiation effects of conjugated polymer composite thin films**, Sam-Shajing Sun, Harold O. Lee, Norfolk State Univ. (USA) . . . . . [10363-75]

**Dimethyl sulphoxide vapor annealing assisted morphology control for hysteresis-free organometal halide perovskite solar cells**, Yu Wang, Ping Liu, Dongwei Han, Dongying Zhou, Feng Lai, Soochow Univ. (China) . . . . . [10363-76]

**Inverted polymer solar cells with zinc oxide-modified vanadium-doped indium oxide as the electron-collecting electrode at room temperature**, Sung-Jin Lim, Min-Jun Choi, Dongguk Univ. (Korea, Republic of); Keun Yong Lim, Korea Institute of Science and Technology (Korea, Republic of); Jisoo Goo, Young-Jun You, Dongguk Univ. (Korea, Republic of); Do Kyung Hwang, Korea Institute of Science and Technology (Korea, Republic of); Kwun-Bum Chung, Jae Won Shim, Dongguk Univ. (Korea, Republic of) . . . . . [10363-77]

**Perylene-3,4,9,10-tetracarboxylic acid tetracesium salt (Cs4PTA) as efficient and inexpensive cathode interfacial layer for inverted planar perovskite solar cells**, Chen Wang, Ping Liu, Dongwei Han, Dongying Zhou, Lai Feng, Soochow Univ. (China) ..... [10363-78]

**Controlling hybrid charge transfer exciton properties at nitride-organic semiconductor heterojunctions**, Anurag Panda, Stephen R. Forrest, Univ. of Michigan (USA) ..... [10363-79]

**Hybrid tandem solar cells combining PbS quantum dot and organic subcells with complementary near infrared absorption**, Taesoo Kim, Ru-Ze Liang, Hanlin Hu, King Abdullah Univ. of Science and Technology (Saudi Arabia); Banavoth Murali, Univ. of Hyderabad (India); Ahmad R. Kirmani, King Abdullah Univ. of Science and Technology (Saudi Arabia); Mingjian Yuan, Univ. of Toronto (Canada); Pierre M. Beaujuge, King Abdullah Univ. of Science and Technology (Saudi Arabia); Edward H. Sargent, Univ. of Toronto (Canada); Aram Amassian, King Abdullah Univ. of Science and Technology (Saudi Arabia) ..... [10363-80]

**Optical excitations dynamics at quantum dots-fullerene heterointerface**, Marcello Righetto, Alberto Privitera, Renato Bozio, Univ. degli Studi di Padova (Italy) ..... [10363-81]

**Tuning charge transfer at organic/metal interfaces**, Afaf El-Sayed, Al Azhar Univ. (Egypt); Elizabeth Gouri, Donostia International Physics Ctr. (Spain); Patrizia Borghetti, Institut des NanoSciences de Paris (France); Dimas G. de Oteyza, Donostia International Physics Ctr. (Spain); Enrique Ortega, Univ. del País Vasco (Spain) ..... [10363-82]

**Fabrication of high coverage lead-free CH<sub>3</sub>NH<sub>3</sub>SnI<sub>3</sub> perovskite films using modified solvent bathing method**, Takashi Fujihara, Institute of Systems, Information Technologies and Nanotechnologies (ISIT) (Japan); Shinobu Terakawa, Toshinori Matsushima, Chuanjiang Qin, Masayuki Yahiro, Chihaya Adachi, OPERA Ctr. for Organic Photonics and Electronics Research (Japan) ..... [10363-83]

**Practically viable strategy for efficient and reliable semi-transparent organic solar cells: Face-seal encapsulation embedded with color-filter functionality**, Hyunwoo Lee, Jaewon Ha, Hyeonwoo Lee, Seunghyup Yoo, KAIST (Korea, Republic of) ..... [10363-84]

**Stability enhancement of organic-inorganic perovskite solar cells via thin film encapsulation**, Nochang Park, Korea Electronics Technology Institute (Korea, Republic of); Jincheol Kim, Jae S. Yun, The Univ. of New South Wales (Australia) ..... [10363-85]

**Perovskite thin films on insulators and in thin-film transistors applications**, Johnny K. W. Ho, Rocky K. H. Chan, Jenner H. L. Ngai, Sin Hang Cheung, Shu Kong So, Hong Kong Baptist Univ. (Hong Kong, China) ..... [10363-86]

**Optoelectronic properties of CuO-Cu<sub>2</sub>O complex layers in MAPbI<sub>3</sub> perovskite solar cells**, Kuan-Lin Lee, Lung-Chien Chen, Kai-Chieh Liang, National Taipei Univ. of Technology (Taiwan) ..... [10363-87]

**Plasmon enhanced power conversion efficiency in inverted bulk heterojunction organic solar cell**, Minu Mohan, Ramkumar Sekar, Manoj A. G. Namboothiry, Indian Institute of Science Education and Research Thiruvananthapuram (India) ..... [10363-88]

**The intrinsic photoproducts and their dynamic balance revealed by density-resolved spectroscopic method**, Shufeng Wang, Peking Univ. (China) [10363-89]

**High efficiency printable polymer solar cell modules with a new simplified series connection architecture**, Eunhag Lee, Jinho Lee, Soonil Hong, Kwanghee Lee, Gwangju Institute of Science and Technology (Korea, Republic of) . [10363-90]

**Femtosecond transient absorption spectroscopy of planar CH<sub>3</sub>NH<sub>3</sub>PbI<sub>3</sub> perovskite films**, In-Sik Kim, Cheol Jo, Gwangju Institute of Science and Technology (Korea, Republic of); Rira Kang, Korea Atomic Energy Research Institute (Korea, Republic of); Dong-Yu Kim, Do-Kyeong Ko, Gwangju Institute of Science and Technology (Korea, Republic of) . . . . . [10363-92]

**Crystalline MoO<sub>x</sub> thin-films as hole transport layer in organic photovoltaics**, André L. F. Cauduro, Mehrad Ahmadpour, Univ. of Southern Denmark (Denmark); Roberto Moreno Souza dos Reis, Gong Chen, Lawrence Berkeley National Lab. (USA); Andreas K. Schmid, Lawrence Berkeley National Lab. (USA) and Univ. of Southern Denmark (Denmark); Christophe Méthivier, Léo Bossard-Giannesini, Hervé Cruguel, Nadine Witkowski, UPMC Sorbonne Univ. (France); Horst-Günter Rubahn, Morten Madsen, Univ. of Southern Denmark (Denmark) . . . . . [10363-93]

**Role of energy transfer for charge generation at organic-inorganic interfaces**, Philipp Ehrenreich, Eugen Zimmermann, Lukas Schmidt-Mende, Univ. Konstanz (Germany) ..... [10363-94]

**Multiscale study of the formation of the PFI:PSS:PEDOT super structure and its HOMO-LUMO energies**, Min Huang, Tongji Univ. (China) ..... [10363-95]

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**Design of novel triphenylamine-based donor-acceptor oligomers for stable organic photovoltaics**, Sergey A. Ponomarenko, Institute of Synthetic Polymeric Materials (Russian Federation) and M.V. Lomonosov Moscow SU (Russian Federation); Yuriy N. Luponosov, Alexander N. Solodukhin, Institute of Synthetic Polymeric Materials (Russian Federation); Artur L. Mannanov, M.V. Lomonosov Moscow SU (Russian Federation) and Institute of Synthetic Polymeric Materials (Russian Federation); Oleg V. Kozlov, Zernike Institute for Advanced Materials (Netherlands) and M.V. Lomonosov Moscow SU (Russian Federation); Dmitry Y. Paraschuk, M.V. Lomonosov Moscow SU (Russian Federation) and Institute of Synthetic Polymeric Materials (Russian Federation); Maxim S. Pschenichnikov, Zernike Institute for Advanced Materials (Netherlands); Christoph J. Brabec, i-MEET (Germany) . . . . . [10363-96]

**Single phase high mobility Cu<sub>2</sub>O film as efficient and robust hole transporting layer for organic solar cells**, Yaxiong Guo, GuoJia Fang, Wuhan Univ. (China); Gang Li, The Hong Kong Polytechnic Univ. (Hong Kong, China) . . . . . [10363-97]

**Minimizing beam damage in the electron microscope to enable new imaging approaches for conjugated polymers**, Brooke Kuei, Enrique D. Gomez, The Pennsylvania State Univ. (USA) . . . . . [10363-98]

**On the ferroic properties of methylammonium lead iodide thin-films**, Tobias Leonhard, Holger Röhm, Alexander Colsmann, Karlsruher Institut für Technologie (Germany) . . . . . [10363-99]

**Porphyrin-based donor materials for highly efficient organic photovoltaics**, Xunjin Zhu, Hong Kong Baptist Univ. (China) . . . . . [10363-100]

**Effect of Cu<sub>2</sub>O inorganic hole conducting material in flexible perovskite based heterojunction solar cell**, Md. Asaduzzaman, Ali Newaz Bahar, Mawlana Bhashani Science and Technology Univ. (Bangladesh); Mohammad Maksudur R. Bhuiyan, Univ. Grants Commission of Bangladesh (Bangladesh) . . . . . [10363-101]

**Role of morphology in exciton dissociation and charge extraction in dilute donor-acceptor blend organic heterojunctions**, Kan Ding, Univ. of Michigan (USA) . . . . . [10363-102]

**Hybrid solar cell based on a-Si/polymer flat heterojunction on flexible substrates**, Antonio J. Olivares-Vargas, Svetlana Mansurova, Ismael Cosme-Bolaños, Andrey Kosarev, Carlos Alberto Ospina, Hiram Enrique Martinez, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico) . . . . . [10363-103]

**Investigation of charge generation and transport in fullerene-free ITIC-based organic solar cells**, Xueping Yi, Iordania Constantinou, Erik D. Klump, Bhoj Gautam, Sofia Garakyaraghi, Franky So, North Carolina State Univ. (USA) . . . . . [10363-104]

**Effect of polar sidechains on high efficiency organic solar cells**, Xueping Yi, North Carolina State Univ. (USA); Bing Xu, Georgia Institute of Technology (USA); Erik D. Klump, Franky So, North Carolina State Univ. (USA); John R. Reynolds, Georgia Institute of Technology (USA) . . . . . [10363-105]

**Ultrashort pulsed laser-dicing of silicon wafers for the decollating of conventional and hybrid solar cells**, Christian J. Hördemann, Christian Fornaroli, Arnold Gillner, Fraunhofer-Institut für Lasertechnik (Germany) . . . . . [10363-106]

**Determination of transport parameters of organic thin film based on PTB7:PCBM mixture**, Miriam Cuatrecatl Tlapapatl, Nikolay Korneev, Svetlana Mansurova, Julio C. Carrillo Sendejas, Andrey Kosarev, Ismael Cosme-Bolaños, Antonio J. Olivares Vargas, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico) . . . . . [10363-107]

**Organic solar cells based on graphene derivatives and eutectic alloys free-vacuum deposited as cathodes**, Álvaro Daniel Romero-Borja, Ctr. de Investigación en Química Aplicada (Mexico) and Centro de Investigaciones en Óptica, A.C. (Mexico); J. Oracio C. Barbosa-García, Centro de Investigaciones en Óptica, A.C. (Mexico); Enrique Pérez-Gutiérrez, Consejo Nacional de Ciencia y Tecnología (Mexico) and Benemérita Univ. Autónoma de Puebla (Mexico); Mario A. Rodríguez, Centro de Investigaciones en Óptica, A.C. (Mexico); Arxel de León, Centro de Investigaciones en Óptica, A.C. (Mexico) and Ctr. de Investigación en Química Aplicada (Mexico); Salvador Fernández, Ctr. de Investigación en Química Aplicada (Mexico); Canek Fuentes-Hernández, Georgia Institute of Technology (USA); José-Luis L. Maldonado, Centro de Investigaciones en Óptica, A.C. (Mexico) . . . . . [10363-108]

**Hybrid perovskite/polymer composite for moisture stability in the absorber layer**, John P. Murphy, Montana Tech (USA); Jessica M. Andriolo, Montana Tech (USA) and Univ. of Montana (USA); Jack L. Skinner, Montana Tech (USA) . . . . . [10363-109]

**Analysis of the aging/stability process of organic solar cells based on PTB7:[70]PCBM and an alternative free-vacuum deposited cathode: The effect of active layer scaling**, Mirna D. Barreiro Argüelles, Gabriel Ramos-Ortiz, José-Luis L. Maldonado, Centro de Investigaciones en Óptica, A.C. (Mexico); Álvaro Daniel Romero-Borja, Centro de Investigaciones en Óptica, A.C. (Mexico) and Ctr. de Investigación en Química Aplicada (Mexico); Marco-Antonio Meneses-Nava, Centro de Investigaciones en Óptica, A.C. (Mexico); Enrique Pérez-Gutiérrez, Consejo Nacional de Ciencia y Tecnología (Mexico) and Benemérita Univ. Autónoma de Puebla (Mexico) . . . . . [10363-110]

**Formation and diffusion of metal impurities in perovskite solar cell material CH<sub>3</sub>NH<sub>3</sub>PbI<sub>3</sub>: implications on the choice of electrode and solar cell degradation**, Mao-Hua Du, Wenmei Ming, Oak Ridge National Lab. (USA); Dongwen Yang, Lijun Zhang, Jilin Univ. (China) . . . . . [10363-112]

**Transparent wide bandgap metal halides for bifacial hybrid solar cells**, Karunakara Moorthy Boopathi, Chintam Hanmandlu, Chih-Wei Chu, Academia Sinica (Taiwan) . . . . . [10363-113]

**Solution processable lead free antimony based perovskite materials for photovoltaic applications**, Chih-Wei Chu, Karunakara Moorthy Boopathi, Anupriya Singh, Academia Sinica (Taiwan); Gang Li, The Hong Kong Polytechnic Univ. (Hong Kong, China) . . . . . [10363-114]

**Phase stability of perovskite nanocrystals**, Olivia Ashton, Henry J. Snaith, Univ. of Oxford (United Kingdom) . . . . . [10363-115]

**Improved efficiency of silicon nanoholes/gold nanoparticles/organic hybrid solar cells in both ultraviolet and visible regions**, Ling Xu, Nanjing Univ. (China) . . . . . [10363-116]

**K-space optoelectronic properties of organic-inorganic hybrid methylammonium lead halide crystals**, Hye Ri Jung, Trang T. T. Nguyen, Hye-Jin Jin, Bich Phuong Nguyen, Gee Yeong Kim, Seokhyun Yoon, William Jo, Ewha Womans Univ. (Korea, Republic of); Won Seok Woo, Chang Won Ahn, Shinuk Cho, Ill Won Kim, Univ. of Ulsan (Korea, Republic of) . . . . . [10363-117]

**Implications of ferroelectric polarization on ionic migration and hysteretic behaviors on hybrid perovskite absorber solar cells with mesoscopic and planar electron transport layers**, Hye Ri Jung, Bich Phuong Nguyen, Juran Kim, Hye-Jin Jin, William Jo, Ewha Womans Univ. (Korea, Republic of) . . . . . [10363-119]

**Excited state polarizability in polymer:fullerene blends via electroabsorption**, Erik D. Klump, Xueping Yi, Iordania Constantinou, Amin Salehi, North Carolina State Univ. (USA); Kin Lo, John R. Reynolds, Georgia Institute of Technology (USA); Franky So, North Carolina State Univ. (USA) . . . . . [10363-121]

**Optimization of regioregular polymer structure through synthesis and characterization of benzothiazole (BT)-based polymers**, Na Gyeong An, Ulsan National Institute of Science and Technology (Korea, Republic of); Mohammad Afsar Uddin, Yuxiang Li, Korea Univ. (Korea, Republic of); Seyeong Song, Ulsan National Institute of Science and Technology (Korea, Republic of); Hwasook Ryu, Han Young Woo, Korea Univ. (Korea, Republic of); Jin Young Kim, Ulsan National Institute of Science and Technology (Korea, Republic of) . . . . . [10363-122]

**Morphological characterization of fullerene and fullerene-free organic photovoltaics by combined real and reciprocal space techniques**, Subhrangsu Mukherjee, Andrew A. Herzing, National Institute of Standards and Technology (USA); Donglin Zhao, Qinghe Wu, Luping Yu, The Univ. of Chicago (USA); Harald W. Ade, North Carolina State Univ. (USA); Dean M. DeLongchamp, Lee J. Richter, National Institute of Standards and Technology (USA) . . . . . [10363-125]

**Over 11%-efficiency fullerene-free organic solar cells enabled by benign solvents**, Long Ye, North Carolina State Univ. (USA); Wenchao Zhao, Institute of Chemistry (China); Masoud Ghasemi, Yuan Xiong, North Carolina State Univ. (USA); Jianhui Hou, Institute of Chemistry (China); Harald W. Ade, North Carolina State Univ. (USA) . . . . . [10363-126]

**Revealing the high stability of non-fullerene polymer solar cells**, Masoud Ghasemi, Long Ye, Harald W. Ade, North Carolina State Univ. (USA) . . . . . [10363-127]

**Critical factors that affect complex morphology and device performance of multiple cases of organic solar cells**, Long Ye, Subhrangsu Mukherjee, North Carolina State Univ. (USA); Jianhui Hou, Institute of Chemistry (China); Harald W. Ade, North Carolina State Univ. (USA) . . . . . [10363-128]

**Effect of immerse an organic layer in isopropyl alcohol on characteristics of hybrid photovoltaic structures**, Antonio J. Olivares-Vargas, Ismael Cosme-Bolaños, Svetlana Mansurova, Andrey Kosarev, Adrian Itzmoyotl Toxqui, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico) . . . . . [10363-129]

**18% high-efficiency air-processed perovskite solar cells made in a humid atmosphere of 70% RH**, Sai Wing Tsang, Yuanhang CHENG, City Univ. of Hong Kong (Hong Kong, China) . . . . . [10363-130]

**On the study of exciton binding energy with direct charge generation in photovoltaic polymers**, Sai Wing Tsang, Ho-Wa Li, City Univ. of Hong Kong (Hong Kong, China) . . . . . [10363-131]

**Understanding of electronic and ionic transport at metal halide perovskites interfaces**, Ashwith Chilvery, Xavier Univ. (USA); Padmaja Guggilla, Alabama A&M Univ. (USA) . . . . . [10363-132]

**Solution-processable benzo[1,2-b:4,5-b']dithiophene-6,7-difluoroquinoxaline small molecule donors with solar cell efficiency >8%**, Ru-Ze Liang, Kai Wang, Jannic Wolf, Maxime Babics, Philipp Wucher, Pierre M. Beaujuge, King Abdullah Univ. of Science and Technology (Saudi Arabia) . . . . . [10363-133]

**Probing chemistry and structure of organic semiconductors with soft x-rays**, Gregory Su, Isvar Cordova, Michael Brady, Cheng Wang, David Prendergast, Lawrence Berkeley National Lab. (USA) . . . . . [10363-136]

**Optical probes of amplitude modes in PTB7 copolymer**, Shai Vardeny, College of Optical Sciences, The Univ. of Arizona (USA); Sangita Baniya, Evan Lafalce, The Univ. of Utah (USA); Nasser N. Peyghambarian, College of Optical Sciences, The Univ. of Arizona (USA); Z. Vally Vardeny, The Univ. of Utah (USA) . . . . [10363-137]

**Fabrication of semi-transparent and flexible organic solar cells**, Yeongjin Lee, Gwangju Institute of Science and Technology (Korea, Republic of); Hongkyu Kang, Imperial College London (United Kingdom) and Gwangju Institute of Science and Technology (Korea, Republic of); Nara Kim, Seok Kim, Jinho Lee, Kwanghee Lee, Gwangju Institute of Science and Technology (Korea, Republic of) . . . [10363-138]

**Multi-colored luminescent configuration with versatile nanopatterns for advanced photovoltaics**, Minwoo Nam, Jaehong Yoo, Doo-Hyun Ko, Kyung Hee Univ. (Korea, Republic of) . . . . [10363-139]

**Air-stable organic solar cells using an iodine-free solvent additive**, Seongyu Lee, Jaemin Kong, Kwanghee Lee, Gwangju Institute of Science and Technology (Korea, Republic of) . . . . [10363-140]

## SESSION 4

**LOCATION: CONV. CTR. ROOM 6B . . . . TUE 3:45 PM TO 5:45 PM**

### Towards Commercial Production of Solar Modules

Session Chair: **Ifor D. W. Samuel**, Univ. of St. Andrews (United Kingdom)

3:45 pm: **On the challenge to scale perovskite photovoltaic devices from mm-scale cells to 6-inch modules** (*Invited Paper*), Sjoerd C. Veenstra, Energy Research Ctr. of the Netherlands (Netherlands); Francesco Di Giacomo, Santhosh Shanmugam, Henri Fledderus, Holst Ctr. (Netherlands); Weiming Qiu, IMEC (Belgium); Wiljan J. H. Verhees, Energy Research Ctr. of the Netherlands (Netherlands); Dibyashree Koushik, Technische Univ. Eindhoven (Netherlands); Valerio Zardetto, Holst Ctr. (Netherlands); Mehrdad Najafi, Energy Research Ctr. of the Netherlands (Netherlands); Yinghuan Kuang, Technische Univ. Eindhoven (Netherlands); Dong Zhang, Energy Research Ctr. of the Netherlands (Netherlands); Marcel A. Verheijen, Technische Univ. Eindhoven (Netherlands) and Philips Research (Doorenkamper, Energy Research Ctr. of the Netherlands (Netherlands) and Technische Univ. Eindhoven (Netherlands); Robert Gehlhaar, IMEC (Belgium); Yulia Galagan, Herbert Lifka, Holst Ctr. (Netherlands); Ruud E. I. Schropp, Mariadriana Creatore, Technische Univ. Eindhoven (Netherlands); Tom Aernouts, IMEC (Belgium); Ronn Andriessen, Holst Ctr. (Netherlands) . . . . [10363-9]

4:10 pm: **Up-scaling perovskite solar cell manufacturing from Sheet-to-Sheet to Roll-to-Roll: Challenges and solutions**, Francesco Di Giacomo, Yulia Galagan, Santhosh Shanmugam, Harrie Gorter, Fieke van den Bruele, Gerwin Kirchner, Ike de Vries, Henri Fledderus, Herbert Lifka, Holst Ctr. (Netherlands) and Solliance (Netherlands); Sjoerd C. Veenstra, Energy Research Ctr. of the Netherlands (Netherlands) and Solliance (Netherlands); Tom Aernouts, IMEC (Belgium) and Solliance (Netherlands); Pim Groen, Holst Ctr. (Netherlands) and Solliance (Netherlands); Ronn Andriessen, Solliance (Netherlands) and Holst Ctr. (Netherlands) . . . . [10363-10]

4:25 pm: **Roll-to-roll production of organic solar cells** (*Invited Paper*), Christian L. Urich, Heliatek GmbH (Germany) . . . . [10363-11]

4:50 pm: **High performance roll-to-roll printed PTB7-Th/PCBM solar cells**, Kevin L. Gu, Stanford Univ. (USA); Xiaodan Gu, Stanford Univ. (USA) and Univ. of Southern Mississippi (USA); Yan Zhou, Stanford Univ. (USA); Hongping Yan, Stanford Univ. (USA) and SLAC National Accelerator Lab. (USA); Michael F. Toney, SLAC National Accelerator Lab. (USA); Zhenan Bao, Stanford Univ. (USA) . . . . [10363-12]

5:05 pm: **Self-doped n-type interfacial materials for high-performance polymer/perovskite solar cells** (*Invited Paper*), Fei Huang, South China Univ. of Technology (China) . . . . [10363-13]

5:30 pm: **A new series connection architecture for large area printed organic solar cell modules**, Soonil Hong, Jinho Lee, Hongkyu Kang, Kwanghee Lee, Gwangju Institute of Science and Technology (Korea, Republic of) . . . . [10363-14]

## TUESDAY 8 AUGUST

**LOCATION: CONV. CTR. ROOM 6A . TUE 9:00 AM TO 11:45 AM**

### Organic Photonics + Electronics Plenary Session

9:00 am: **Hybrid Electro-Optics and Chipscale Integration of Electronics and Photonics** (*Plenary*), Larry R. Dalton, Univ. of Washington (USA) . . . . [10364-301]

9:30 am: **Molecular Plasmons** (*Plenary*), Naomi J. Halas, Rice Univ. (USA) . . . . [10360-302]

10:00 am: **Announcement of the Organic Photonics + Electronics Best Student Paper Awards**, Zakya H. Kafafi, Lehigh Univ. (USA)

Coffee Break . . . . . Tue 10:15 am to 10:45 am

10:45 am: **The History and Progress of Halide Perovskite Photovoltaics** (*Plenary*), Nam-Gyu Park, Sungkyunkwan Univ. (Korea, Republic of) [10363-303]

11:15 am: **Mesoscopic Photosystems for the Generation of Electricity and Fuels from Sunlight** (*Plenary*), Michael Grätzel, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . [10363-304]

Lunch/Exhibition Break . . . . . Tue 11:45 am to 1:30 pm

## SESSION 3

**LOCATION: CONV. CTR. ROOM 6B . . . . TUE 1:30 PM TO 3:15 PM**

### NOTE ROOM CHANGE

### Keynote Session: Advances in Organic, Hybrid, and Perovskite Photovoltaics

Session Chair: **Kwanghee Lee**, Gwangju Institute of Science and Technology (Korea, Republic of)

1:30 pm: **Hybrid metal halide perovskites: optoelectronic properties and stability** (*Keynote Presentation*), Laura Herz, Univ. of Oxford (United Kingdom) . . . . [10363-5]

2:00 pm: **Oligomer-like small molecule based tandem solar cells with >12% PCEs** (*Invited Paper*), Yongsheng Chen, Nankai Univ. (China) . . . . [10363-6]

2:25 pm: **How are charge carriers protected in lead halide perovskite?** (*Invited Paper*), Xiaoyang Zhu, Columbia Univ. (USA) . . . . [10363-7]

2:50 pm: **A simple processing technique for the electrical doping of organic semiconductors** (*Invited Paper*), Bernard Kippelen, Georgia Institute of Technology (USA) . . . . [10363-8]

Coffee Break . . . . . Tue 3:15 pm to 3:45 pm

## WEDNESDAY 9 AUGUST

## SESSION 5

**LOCATION: CONV. CTR. ROOM 6B . . WED 8:30 AM TO 9:50 AM**

### Organic Photovoltaics: Beyond Fullerenes

Session Chair: **Guillermo C. Bazan**, Univ. of California, Santa Barbara (USA)

8:30 am: **Fullerene-free polymer solar cells with over 12% efficiencies** (*Invited Paper*), Sunsun Li, Wenchao Zhao, Institute of Chemistry (China); Shaoqing Zhang, Univ. of Science and Technology Beijing (China); Jianhui Hou, Institute of Chemistry (China) . . . . [10363-15]

8:55 am: **RAMP-ing the discovery of high-performance organic photovoltaic materials**, Andrew J. Ferguson, Bryon W. Larson, Bertrand J. Tremolet de Villers, Wade A. Braunecker, Ross E. Larsen, National Renewable Energy Lab. (USA) . . . . [10363-16]

9:10 am: **Charge generation in non-fullerene donor-acceptor blends for organic solar cells** (*Invited Paper*), Paul E. Shaw, Nasim Zarrabi, Dani Stoltzfus, Paul L. Burn, Paul Meredith, The Univ. of Queensland (Australia) . . . . [10363-17]

9:35 am: **Impact of exciton transfer dynamics on charge generation in polymer/nonfullerene solar cells**, Kenan Gundogdu, Harald W. Ade, Bhoj Gautam, North Carolina State Univ. (USA); He Yan, Hong Kong Univ. of Science and Technology (Hong Kong, China); Robert Younts, North Carolina State Univ. (USA); Shangshang Chen, Hong Kong Univ. of Science and Technology (Hong Kong, China) [10363-18]

Coffee Break . . . . . Wed 9:50 am to 10:20 am



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## SESSION 6

LOCATION: CONV. CTR. ROOM 6B . WED 10:20 AM TO 12:20 PM

### High Efficiency Perovskite Solar Cells

Session Chair: **David G. Lidzey**, The Univ. of Sheffield (United Kingdom)

10:20 am: **Perovskite tandem solar cells with greater than 25% efficiency and enhanced stability** (*Invited Paper*), Michael D. McGehee, Stanford Univ. (USA) ..... [10363-19]

10:45 am: **Towards a reliable measurement protocol for perovskite solar cells**, Eugen Zimmermann, Ka Kan Wong, Michael Müller, Hao Hu, Philipp Ehrenreich, Carola Ebenhoch, Thomas Pfadler, Lukas Schmidt-Mende, Univ. Konstanz (Germany) ..... [10363-20]

11:00 am: **Solution-processed inorganic-organic halide perovskite and charge transport layers for highly efficient and stable perovskite solar cells** (*Invited Paper*), Sang Il Seok, Ulsan National Institute of Science and Technology (Korea, Republic of) ..... [10363-21]

11:25 am: **Perovskite materials for LED and solar cells**, Ana F. Nogueira, Rodrigo Szostak, Adriano S. Marques, Emre Yassitepe, Univ. Estadual de Campinas (Brazil); Jilian N. Freitas, Ctr. de Tecnologia da Informacao Renato Archer (Brazil) [10363-22]

11:40 am: **Understanding the upper efficiency limit and stability in perovskite solar cells** (*Invited Paper*), Jinsong Huang, The Univ. of North Carolina at Chapel Hill (USA) ..... [10363-23]

12:05 pm: **New low-temperature approach for forming high performance CH<sub>3</sub>NH<sub>3</sub>PbI<sub>3</sub> solar cells with good productivity and stability**, Wallace C. H. Choy, The Univ. of Hong Kong (China) ..... [10363-24]

Lunch/Exhibition Break ..... Wed 12:20 pm to 1:45 pm

## SESSION 7

LOCATION: CONV. CTR. ROOM 6B ... WED 1:45 PM TO 3:20 PM

### Development of Electron Donors for Organic Photovoltaics

Session Chair: **Paul L. Burn**, The Univ. of Queensland (Australia)

1:45 pm: **Two-dimension-conjugated polymer donor materials for polymer solar cells** (*Invited Paper*), Yongfang Li, Institute of Chemistry (China) . . [10363-25]

2:10 pm: **Electron-donating polymers containing pyrrolo[3,4-f]benzotriazole-5,7-dione unit for all-polymer solar cells**, Lei Ying, South China Univ. of Technology (China) ..... [10363-26]

2:25 pm: **UV-visible-near-infrared absorption dimeric porphyrin donor for highly efficient organic solar cell applications**, Song Chen, Hong Kong Baptist Univ. (Hong Kong, China) ..... [10363-27]

2:40 pm: **Low bandgap conjugated polymers with high hole mobility for efficient thick-film polymer solar cells**, Junwu Chen, South China Univ. of Technology (China) ..... [10363-28]

2:55 pm: **Regioregular narrow bandgap conjugated polymers for solar cell and field effect transistor applications** (*Invited Paper*), Guillermo C. Bazan, Univ. of California, Santa Barbara (USA) ..... [10363-29]

Coffee Break ..... Wed 3:20 pm to 3:50 pm

## SESSION 8

LOCATION: CONV. CTR. ROOM 6B ... WED 3:50 PM TO 5:55 PM

### Interfaces in Perovskite Photovoltaics

Session Chair: **Michael D. McGehee**, Stanford Univ. (USA)

3:50 pm: **Stable perovskite solar cells by 2D/3D interface engineering** (*Invited Paper*), Mohammad Khaja Nazeeruddin, Giulia Grancini, Cristina Roldán Carmona, Iwan Zimmermann, Ecole Polytechnique Fédérale de Lausanne (Switzerland) ..... [10363-30]

4:15 pm: **Interlayer engineering for high Voc perovskite solar cells**, Paul L. Burn, Qianqian Lin, Dani Stoltzfus, Ardan Armin, Ravi Nagiri, Wei Jiang, Shanshan Zhang, Paul Meredith, The Univ. of Queensland (Australia) ..... [10363-31]

4:30 pm: **Pushing the lifetime of perovskite solar cell beyond 4500 h by the use of impermeable tin oxide electron extraction layers**, Kai Oliver Brinkmann, Bergische Univ. Wuppertal (Germany); Jie Zhao, Ting Hu, Bergische Univ. Wuppertal (Germany) and Nanchang Univ. (China); Tim Becker, Neda Pourdavoud, Bergische Univ. Wuppertal (Germany); Selina Olthof, Klaus Meerholz, Univ. zu Köln (Germany); Lukas Hoffmann, Tobias Gahlmann, Ralf Heiderhoff, Bergische Univ. Wuppertal (Germany); Marek Oszajca, Nanograde (Switzerland); Detlef Rogalla, Ruhr-Univ. Bochum (Germany); Norman A. Lüchinger, Nanograde (Switzerland); Yiwang Chen, Baochang Cheng, Nanchang Univ. (China); Thomas J. Riedl, Bergische Univ. Wuppertal (Germany) ..... [10363-32]

4:45 pm: **Tailored interfaces in halide perovskite thin films and nanocrystals** (*Invited Paper*), David S. Ginger, Univ. of Washington (USA) ..... [10363-33]

5:10 pm: **Enhancement of efficiency for mixed metal Sn/Pb perovskite solar cells from the view point of hetero-interface traps**, Yuhei Ogomi, Daiki Yamasuso, Ayumu Yonaha, Kengo Hamada, Daiki Yamasuso, Erina Yamaguchi, Kyushu Institute of Technology (Japan); Qing Shen, Taro Toyoda, The Univ. of Electro-Communications (Japan); Kenji Yoshino, Univ. of Miyazaki (Japan); Takashi Minemoto, Ritsumeikan Univ. (Japan); Shuzi Hayase, Kyushu Institute of Technology (Japan) ..... [10363-34]

5:25 pm: **Interface engineering for large-area planar perovskite solar cells**, Jinho Lee, Soonil Hong, Eunhag Lee, Hongkyu Kang, Kwanghee Lee, Gwangju Institute of Science and Technology (Korea, Republic of) ..... [10363-35]

5:40 pm: **Advanced plasmonic and perovskite solar cells**, Dong-Ha Kim, Ewha Womans Univ. (Korea, Republic of) ..... [10363-36]

## THURSDAY 10 AUGUST

## SESSION 9

LOCATION: CONV. CTR. ROOM 6B .. THU 8:10 AM TO 10:00 AM

### Challenges to Improving the Efficiency of Organic Photovoltaics

Session Chair: **Zakya H. Kafafi**, Lehigh Univ. (USA)

8:10 am: **Relating material properties to charge recombination mechanisms in solution processed solar cells** (*Invited Paper*), Jenny Nelson, Imperial College London (United Kingdom) ..... [10363-37]

8:35 am: **Reducing voltage losses in multilayer organic solar cells while keeping high external quantum efficiencies**, Vasileios C. Nikolis, Johannes Benduhn, Felix Holzmueller, TU Dresden (Germany); Fortunato Piersimoni, Dieter Neher, Univ. Potsdam (Germany); Christian Kömer, Donato F. Spoltore, Koen Vandewal, TU Dresden (Germany) ..... [10363-38]

8:50 am: **Intrinsic non-radiative voltage losses in fullerene-based organic solar cells**, Johannes Benduhn, TU Dresden (Germany); Kristofer Tvingstedt, Julius-Maximilians-Univ. Würzburg (Germany); Fortunato Piersimoni, Univ. Potsdam (Germany); Sascha Ullbrich, TU Dresden (Germany); Dieter Neher, Univ. Potsdam (Germany); Donato F. Spoltore, Koen Vandewal, TU Dresden (Germany) [10363-39]

9:05 am: **Transport and recombination considerations for charge generation efficiency in organic solar cells** (*Invited Paper*), Paul Meredith, Swansea Univ. (United Kingdom); Ardan Armin, The Univ. of Queensland (Australia); Martin Stollerfoht, Safa Shaoi, Univ. Potsdam (Germany); Ivan Kassal, The Univ. of Sydney (Australia); Paul L. Burn, The Univ. of Queensland (Australia) ..... [10363-40]

9:30 am: **Carbon dangling bonds in photodegraded polymer:fullerene solar cells**, Fadzai Fungura, William Robin Lindemann, Joseph Shinar, Ruth Shinar, Iowa State Univ. of Science and Technology (USA) ..... [10363-41]

9:45 am: **Limits for photocurrent generation in polymer solar cells consisting of near-IR polymers**, Yasunari Tamai, Shun Yamaguchi, Kota Tsujikawa, Hideo Ohkita, Kyoto Univ. (Japan) ..... [10363-42]

Coffee Break ..... Thu 10:00 am to 10:30 am

## SESSION 10

LOCATION: CONV. CTR. ROOM 6B . THU 10:30 AM TO 12:20 PM

### Growth and Characterization of Perovskite Films

Session Chair: **David S. Ginger**, Univ. of Washington (USA)

- 10:30 am: **Lead halide perovskites of different dimensionalities: growth, properties, and applications in optoelectronics** (*Invited Paper*), Osman M. Bakr, King Abdullah Univ. of Science and Technology (Saudi Arabia). . . . . [10363-43]
- 10:55 am: **Mapping structural properties of lead halide perovskites by scanning nanofocus x-ray diffraction**, David G. Lidzey, The Univ. of Sheffield (United Kingdom). . . . . [10363-44]
- 11:10 am: **Introduction of benzoquinone additive for efficient and stable planar perovskite solar cells**, Chuanjiang Qin, OPERA Ctr. for Organic Photonics and Electronics Research (Japan) and Japan Science and Technology Agency, ERATO (Japan); Toshinori Matsushima, OPERA Ctr. for Organic Photonics and Electronics Research (Japan) and Kyushu Univ. (Japan) and Japan Science and Technology Agency, ERATO (Japan); Takashi Fujihara, Institute of Systems, Information Technologies and Nanotechnologies (ISIT) (Japan); Chihaya Adachi, OPERA Ctr. for Organic Photonics and Electronics Research (Japan) and Kyushu Univ. (Japan) and Japan Science and Technology Agency, ERATO (Japan) . . . . . [10363-45]
- 11:25 am: **A surface science approach to perovskite material and solar cell research** (*Invited Paper*), Yabing Qi, Okinawa Institute of Science and Technology Graduate Univ. (Japan) . . . . . [10363-46]
- 11:50 am: **Unraveling the improved electronic and structural properties of methyl ammonium lead iodide deposited from acetonitrile**, Alexandra Ramadan, Nakita Noel, Univ. of Oxford (United Kingdom); Sarah Fearn, Imperial College London (United Kingdom); Neil Young, Univ. of Oxford (United Kingdom); Marc Walker, The Univ. of Warwick (United Kingdom); Luke Rochford, The Univ. of Birmingham (United Kingdom); Henry J. Snaith, Univ. of Oxford (United Kingdom). . . . . [10363-47]
- 12:05 pm: **Understanding the role of titanium dioxide (TiO<sub>2</sub>) surface chemistry on the nucleation and energetics of hybrid perovskite films**, R. Clayton Shallcross, The Univ. of Arizona (USA); Selina Olthof, Klaus Meerholz, Univ. zu Köln (Germany); Neal R. Armstrong, The Univ. of Arizona (USA) . . . . . [10363-48]
- Lunch/Exhibition Break . . . . . Thu 12:20 pm to 1:40 pm

## SESSION 11

LOCATION: CONV. CTR. ROOM 6B . . . THU 1:40 PM TO 3:00 PM

### Influence of Structure and Morphology in Organic Photovoltaics

Session Chair: **Paul A. Lane**, U.S. Naval Research Lab. (USA)

- 1:40 pm: **Molecular orientation-dependent photovoltaic performance in organic solar cells** (*Invited Paper*), Kilwon Cho, Pohang Univ. of Science and Technology (Korea, Republic of) . . . . . [10363-49]
- 2:05 pm: **Innovative architecture design for high performance organic and hybrid multi-junction solar cells**, Ning Li, i-MEET (Germany); George D. Spyropoulos, Bayerisches Zentrum für Angewandte Energieforschung e.V. (Germany); Christoph J. Brabec, i-MEET (Germany) and Bayerisches Zentrum für Angewandte Energieforschung e.V. (Germany) . . . . . [10363-50]
- 2:20 pm: **Ternary blend polymer solar cells with wide-range light harvesting** (*Invited Paper*), Hideo Ohkita, Ryosuke Shimizu, Yasunari Tamai, Kyoto Univ. (Japan). . . . . [10363-51]
- 2:45 pm: **Flexible polymer solar cells with synergistic light harvesting enhancement**, Yanqing Li, Jianxin Tang, Soochow Univ. (China) . . . . . [10363-52]
- Coffee Break . . . . . Thu 3:00 pm to 3:30 pm

## SESSION 12

LOCATION: CONV. CTR. ROOM 6B . . . THU 3:30 PM TO 4:40 PM

### Towards Efficient and Stable Organic Photovoltaics

Session Chair: **Paul A. Lane**, U.S. Naval Research Lab. (USA)

- 3:30 pm: **The importance of molecular packing, orientation and morphology control in performance and stability of all-polymer solar cells** (*Invited Paper*), Bumjoon Kim, KAIST (Korea, Republic of) . . . . . [10363-53]
- 3:55 pm: **Enhanced thermal stability of ternary bulk-heterojunctions**, Dominik Landerer, Adrian Mertens, Dieter Freis, Robert Droll, Daniel Bahro, Alexander Schulz, Tobias Leonhard, Alexander Colsmann, Karlsruher Institut für Technologie (Germany) . . . . . [10363-54]
- 4:10 pm: **Estimating the surface recombination velocity at contacts in organic devices using charge extraction by linearly increasing voltage**, Oskar J. Sandberg, Mathias Nyman, Staffan Dahlström, Ronald Österbacka, Åbo Akademi Univ. (Finland) . . . . . [10363-55]
- 4:25 pm: **Stabilizing organic solar cells using antioxidants, radical scavengers and light stabilizers**, Vida Engmann, Univ. of Southern Denmark (Denmark); Sebastian Engmann, National Institute of Standards and Technology (USA); Nikos Tsierkezos, Technische Univ. Ilmenau (Germany); Harald Hoppe, Friedrich-Schiller- Univ. Jena (Germany); Uwe Ritter, Gerhard Gobsch, Technische Univ. Ilmenau (Germany); Morten Madsen, Horst-Günter Rubahn, Univ. of Southern Denmark (Denmark) . . . . . [10363-56]

# CONFERENCE 10364

LOCATION: CONV. CTR. ROOM 7A

Sunday–Monday 6–7 August 2017 • Proceedings of SPIE Vol. 10364

## Organic Sensors and Bioelectronics X

*Conference Chairs:* **Ioannis Kymissis**, Columbia Univ. (USA); **Ruth Shinar**, Iowa State Univ. (USA); **Luisa Torsi**, Univ. degli Studi di Bari Aldo Moro (Italy)

*Program Committee:* **Magnus Berggren**, Linköping Univ. (Sweden); **Annalisa Bonfiglio**, Univ. degli Studi di Cagliari (Italy); **Fabio Cicoira**, Ecole Polytechnique de Montréal (Canada); **Alon Gorodetsky**, Univ. of California, Irvine (USA); **Emil J. W. List-Kratochvil**, Technische Univ. Graz (Austria); **George G. Malliaras**, Ecole Nationale Supérieure des Mines de Saint-Étienne (France); **Paul Meredith**, The Univ. of Queensland (Australia); **Róisín M. Owens**, Ecole Nationale Supérieure des Mines de Saint-Étienne (France); **Manijeh Razeghi**, Northwestern Univ. (USA); **Rosaria Rinaldi**, Univ. del Salento (Italy); **Ifor D. W. Samuel**, Univ. of St. Andrews (United Kingdom); **Franky So**, North Carolina State Univ. (USA)

### SUNDAY 6 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 7A .. SUN 8:15 AM TO 10:05 AM

#### Organic Sensors and Bioelectronics I

Session Chair: **Ioannis Kymissis**, Columbia Univ. (USA)

8:15 am: **Pushing the detection limit of organic and hybrid perovskites detectors to light and x-ray** (*Invited Paper*), Jinsong Huang, Univ. of North Carolina at Chapel Hill (USA). . . . . [10364-1]

8:40 am: **Organic plasmonic Schottky barrier photodetectors**, Ji-Ling Hou, Axel Fischer, Sheng-Chieh Yang, Johannes Benduhn, Daniel Kasemann, Johannes Widmer, Robert Brückner, Ronny Timmreck, Koen Vandewal, Karl Leo, TU Dresden (Germany) . . . . . [10364-2]

9:00 am: **Organic infrared photodiodes with charge blocking layers**, Gijun Seo, Vishal Yeddu, Do Young Kim, Oklahoma State Univ. (USA). . . . . [10364-3]

9:20 am: **Characterization of novel organic short wavelength infrared photosensors**, Weichuan Yao, Zhenghui Wu, Univ. of California, San Diego (USA); Jason D. Azoulay, The Univ. of Southern Mississippi (USA); Tse Nga Ng, Univ. of California, San Diego (USA). . . . . [10364-4]

9:40 am: **Photoresponse characteristics of small molecule organic photodetectors for image sensor applications** (*Invited Paper*), Dong-Seok Leem, Gae Hwang Lee, Kwang-Hee Lee, Sungyoung Yun, Seon-Jeong Lim, Younhee Lim, Hye Sung Choi, Moon Gyu Han, Kyung-Bae Park, Yeong Suk Choi, Yong Wan Jin, Sangyoon Lee, Samsung Advanced Institute of Technology (Korea, Republic of) . . . . . [10364-5]

Coffee Break . . . . . Sun 10:05 am to 10:35 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 7A .. SUN 10:35 AM TO 12:05 PM

#### Organic Sensors and Bioelectronics II

Session Chair: **Paul L. Burn**, The Univ. of Queensland (Australia)

10:35 am: **Microvolt-signal amplification circuits based on organic thin-film transistors** (*Invited Paper*), Tsuyoshi Sekitani, Osaka Univ. (Japan) . . . . . [10364-6]

11:00 am: **High sensitive biosensors based on water-stable organic field-effect transistors**, Amir Foudeh, Raphael Pfattner, Celine Liong, Desheng Kong, Chao Wang, Wen-Ya Lee, Stanford Univ. (USA) . . . . . [10364-7]

11:20 am: **Rylenediimide derivatives as a new molecular platform for n-type WG-OFETs: the role of thin-film 3D growth modality in engineering the electrolyte-semiconductor interface**, Stefano Toffanin, Federico Prescimone, Emilia Benvenuti, Marco Natali, Andrea Lorenzoni, Istituto per lo Studio dei Materiali Nanostrutturati (Italy); Zhihua Chen, Northwestern Univ. (USA); Franco Dinelli, Istituto Nazionale di Ottica (Italy); Fabiola Liscio, Silvia Milita, Institute for Microelectronics and Microsystems (Italy); Francesco Mercuri, Michele Muccini, Istituto per lo Studio dei Materiali Nanostrutturati (Italy); Antonio F. Facchetti, Northwestern Univ. (USA) . . . . . [10364-8]

11:40 am: **Prototype all solid state bioelectronic interfaces** (*Invited Paper*), Paul Meredith, Swansea Univ. (United Kingdom); Albertus B. Mostert, Margarita Sheliakina, The Univ. of Queensland (Australia); Adam P. Micolich, Damon J. Carrad, The Univ. of New South Wales (Australia) . . . . . [10364-9]

Lunch Break . . . . . Sun 12:05 pm to 1:35 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 7A . . . . SUN 1:35 PM TO 3:10 PM

#### Organic Sensors and Bioelectronics III

Session Chair: **Ruth Shinar**, Iowa State Univ. of Science and Technology (USA)

1:35 pm: **Sensing of non-nitro group containing explosive vapours** (*Invited Paper*), Paul L. Burn, Shengqiang Fan, Paul E. Shaw, The Univ. of Queensland (Australia). . . . . [10364-10]

2:00 pm: **Nitroaromatic explosive vapor detection using a digitally printed sensor array** (*Invited Paper*), Carsten Eschenbaum, Karlsruher Institut für Technologie (Germany) and InnovationLab GmbH (Germany) and Institut für Mikrostrukturtechnik, Karlsruher Institut für Technologie (Germany); Nico Bolse, Karlsruher Institut für Technologie (Germany); Ralph Eckstein, Karlsruher Institut für Technologie (Germany) and InnovationLab GmbH (Germany); Tobias Rödlmeier, Karlsruher Institut für Technologie (Germany) and InnovationLab GmbH (Germany); Anne Habermehl, Karlsruher Institut für Technologie (Germany); Gerardo Hernandez-Sosa, Karlsruher Institut für Technologie (Germany) and InnovationLab GmbH (Germany); Ulrich Lemmer, Karlsruher Institut für Technologie (Germany) and InnovationLab GmbH (Germany) and Institut für Mikrostrukturtechnik, Karlsruher Institut für Technologie (Germany) . . . . . [10364-11]

2:25 pm: **Poly(dendrimers) for explosives sensing**, Kinitra Hutchinson, Paul E. Shaw, Dani Lyons, Paul L. Burn, The Univ. of Queensland (Australia) . . . [10364-12]

2:45 pm: **Organic semiconductor sensing of explosives** (*Invited Paper*), Ifor D. W. Samuel, Ross Gillanders, James Glackin, Paulina Morawska, Graham A. Turnbull, Univ. of St. Andrews (United Kingdom). . . . . [10364-13]

Coffee Break . . . . . Sun 3:10 pm to 3:40 pm

#### SESSION 4

LOCATION: CONV. CTR. ROOM 7A . . . SUN 3:40 PM TO 5:20 PM

#### Organic Sensors and Bioelectronics IV

Session Chair: **Paul Meredith**, Swansea Univ. (United Kingdom)

3:40 pm: **Organic temperature sensor using 3D printed polymer surfaces**, Kyu-Sung Lee, Electronics and Telecommunications Research Institute (Korea, Republic of) and Korea Univ. of Science and Technology (Korea, Republic of); Yong Suk Yang, Ji-Young Oh, Electronics and Telecommunications Research Institute (Korea, Republic of); Seung Eon Moon, Electronics and Telecommunications Research Institute (Korea, Republic of); Myoung-Woon Moon, Korea Institute of Science and Technology (Korea, Republic of); ChangWoo Lee, Korea Institute of Machinery & Materials (Korea, Republic of). . . . . [10364-14]

4:00 pm: **Active matrix type large area flexible sensor arrays** (*Invited Paper*), Emil J. W. List-Kratochvil, Humboldt-Univ. zu Berlin (Germany) . . . . . [10364-15]

4:25 pm: **Synthesis and characterization of bioinspired organic nanowires and nanoribbons** (*Invited Paper*), Alon Gorodetsky, Univ. of California, Irvine (USA) . . . . . [10364-16]

4:50 pm: **Graphene electronic tattoo sensors** (*Keynote Presentation*), Nanshu Lu, The Univ. of Texas at Austin (USA) . . . . . [10364-34]



**LOCATION: CONV. CTR. ROOM 6A .. SUN 6:00 PM TO 7:50 PM**

## Technology Hot Topics: How Optics and Photonics Drive Innovation

- 6:00 pm to 6:10 pm: **Welcome and Opening Remarks**
- 6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)
- 6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)
- 6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)
- 7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)
- 7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)

## MONDAY 7 AUGUST

### SESSION 5

**LOCATION: CONV. CTR. ROOM 7A .. MON 8:30 AM TO 9:55 AM**

## Organic Sensors and Bioelectronics V

Session Chair: **Joseph Shinar**, Iowa State Univ. of Science and Technology (USA)

- 8:30 am: **Ultra-sensitive bio-markers detection with an electrolyte gated organic transistor** (*Keynote Presentation*), Luisa Torsi, Univ. degli Studi di Bari Aldo Moro (Italy) ..... [10364-17]
- 9:10 am: **Sulphonated mesoporous silica as proton exchanging layer in solid state organic transistors for bio-sensing**, Soniya D. Yambem, Queensland Univ. of Technology (Australia)..... [10364-18]
- 9:30 am: **Low voltage organic charge modulated FETs: A flexible approach for the fabrication of high sensitive biosensors** (*Invited Paper*), Piero Cosseddu, Andrea Spanu, Fabrizio Viola, Stefano Lai, Univ. degli Studi di Cagliari (Italy); Brunella Tedesco, Sergio Martinoia, Univ. degli Studi di Genova (Italy); Annalisa Bonfiglio, Univ. degli Studi di Cagliari (Italy) ..... [10364-19]
- Coffee Break ..... Mon 9:55 am to 10:25 am

### SESSION 6

**LOCATION: CONV. CTR. ROOM 7A . MON 10:25 AM TO 12:00 PM**

## Organic Sensors and Bioelectronics VI

Session Chair: **Luisa Torsi**, Univ. degli Studi di Bari Aldo Moro (Italy)

- 10:25 am: **Large-scale organic neural interface devices** (*Invited Paper*), Dion Khodagholy, Columbia Univ. (USA)..... [10364-20]
- 10:50 am: **A printed electronic platform for the specific detection of biomolecules**, Amadou Doumbia, Michelle Webb, Michael L. Turner, The Univ. of Manchester (United Kingdom); Jonathan Behrendt, Richard J. Wilson, Cambridge Display Technology Ltd. (United Kingdom)..... [10364-21]
- 11:10 am: **Microfluidics and BIO-encapsulation for drug- and cell-therapy** (*Invited Paper*), Rosaria Rinaldi, Univ. del Salento (Italy) and Istituto per la Microelettronica e Microsistemi, CNR (Italy); Alessandra Aloisi, Istituto per la Microelettronica e Microsistemi (Italy); Chiara Toma, Univ. del Salento (Italy) ..... [10364-22]
- 11:35 am: **Microfluidic methods in organic electronics and organic bioelectronics** (*Invited Paper*), John C. de Mello, Imperial College London (United Kingdom)..... [10364-23]
- Lunch Break ..... Mon 12:00 pm to 1:30 pm

### SESSION 7

**LOCATION: CONV. CTR. ROOM 7A ... MON 1:30 PM TO 2:40 PM**

## Organic Sensors and Bioelectronics VII

Session Chair: **John C. de Mello**, Imperial College London (United Kingdom)

- 1:30 pm: **Vertical organic transistors for optoelectronic and ferroelectric applications** (*Invited Paper*), Hyeonggeun Yu, Franky So, North Carolina State Univ. (USA) ..... [10364-24]
- 1:55 pm: **Effect of water adsorption on ionic and electronic transport in PEDOT:PSS**, Eric S. Muckley, Christopher B. Jacobs, Rajeev Kumar, Iliia N. Ivanov, Oak Ridge National Lab. (USA) ..... [10364-25]
- 2:15 pm: **Designing organic mixed conductors for bioelectronic applications** (*Invited Paper*), Jonathan Rivnay, Northwestern Univ. (USA) ..... [10364-26]

**LOCATION: CONV. CTR.**

**EXHIBIT HALL B2 ..... MON 5:30 PM TO 7:30 PM**

## Posters-Monday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**An enzyme-based lactate sensor incorporating a three-dimensional complementary inverter for high sensitivity**, Sanghoon Baek, Jimin Kwon, Pohang Univ. of Science and Technology (Korea, Republic of); Hiroyuki Matsui, Shizuo Tokito, Yamagata Univ. (Japan); Sungjune Jung, Pohang Univ. of Science and Technology (Korea, Republic of) ..... [10364-27]

**Porous silicon photoluminescence biosensor for rapid and sensitive detection of toxins**, Yuliia Melnyk, Karyna Pavlova, Valerii Myndrul, Valentyn Smyntyna, Odessa I.I. Mechnikov National Univ. (Ukraine); Roman Viter, Univ. of Latvia (Latvia); Igor Iatsunskiy, Adam Mickiewicz Univ. (Poland) ..... [10364-28]

**Au-Ag alloy nanoislands for high-sensitive localized surface plasmon resonance biochemical analytes detection**, Guangyu Qiu, Siu Pang Ng, Chi-Man L. Wu, City Univ. of Hong Kong (Hong Kong, China) ..... [10364-29]

**Development of fully organic moisture sensor**, Aramis A. Sanchez Juárez, Univ. Técnica Particular de Loja (Ecuador)..... [10364-30]

**Fully organic pH sensor development**, Aramis A. Sanchez Juárez, Johanna E. Jaramillo Q., Univ. Técnica Particular de Loja (Ecuador) ..... [10364-31]

**Novel biomimetic light-harvesting molecular architecture based on porphyrin-peptoid conjugates**, Jiwon Seo, Gwangju Institute of Science and Technology (Korea, Republic of)..... [10364-32]

**Fabrication and characteristics of composite metals for 3D printed electronics**, Yong Suk Yang, Hyun-Woo Dang, Bonjin Koo, Electronics and Telecommunications Research Institute (Korea, Republic of); ChangWoo Lee, Korea Institute of Machinery & Materials (Korea, Republic of) ..... [10364-33]

# CONFERENCE 10365

LOCATION: CONV. CTR. ROOM 2

Monday–Wednesday 7–9 August 2017 • Proceedings of SPIE Vol. 10365

## Organic Field-Effect Transistors XVI

Conference Chairs: **Iain McCulloch**, King Abdullah Univ. of Science and Technology (Saudi Arabia); **Oana D. Jurchescu**, Wake Forest Univ. (USA)

### MONDAY 7 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 2 . . . . . MON 1:30 PM TO 3:15 PM

#### Morphology

Session Chair: **Oana D. Jurchescu**, Wake Forest Univ. (USA)

1:30 pm: **Programmable and coherent crystallization of semiconductors** (*Invited Paper*), Aram Amassian, King Abdullah Univ. of Science and Technology (Saudi Arabia) . . . . . [10365-1]

1:55 pm: **Formation and growth of organic semiconductors with mm-scale grains** (*Invited Paper*), Barry P. Rand, Princeton Univ. (USA) . . . . . [10365-2]

2:20 pm: **Large-area solution-processed monolayer single crystals for organic field-effect devices**, Anastasia V. Glushkova, M.V. Lomonosov Moscow SU (Russian Federation); Elena Y. Poimanova, Donetsk National Univ. (Ukraine); Vladimir V. Bruevich, M.V. Lomonosov Moscow SU (Russian Federation); Yuriy N. Luponosov, Sergei A. Ponomarenko, Institute of Synthetic Polymeric Materials (Russian Federation); Dmitry Y. Paraschuk, M.V. Lomonosov Moscow SU (Russian Federation) . . . . . [10365-3]

2:35 pm: **Robust design and fabrication of three-dimensional printed dual-gate organic circuits on a flexible plastic film**, Jimin Kwon, Pohang Univ. of Science and Technology (Korea, Republic of); Yasunori Takeda, Rei Shiwaku, Shizuoka Univ., Yamagata Univ. (Japan); Sungjune Jung, Pohang Univ. of Science and Technology (Korea, Republic of) . . . . . [10365-4]

2:50 pm: **High-density polyethylene, an inert additive stabilizing organic field-effect transistors** (*Invited Paper*), Natalie Stingelin, Georgia Institute of Technology (USA) . . . . . [10365-5]

Coffee Break . . . . . Mon 3:15 pm to 3:45 pm

#### SESSION 2

LOCATION: CONV. CTR. ROOM 2 . . . . . MON 3:45 PM TO 5:10 PM

#### Printing

Session Chair: **Iain McCulloch**, King Abdullah Univ. of Science and Technology (Saudi Arabia)

3:45 pm: **All-printed organic transistors: integrating devices for flexible circuits** (*Invited Paper*), Mahsa Sadeghi, Lilian Cardoso, Ana Claudia Arias, Univ. of California, Berkeley (USA) . . . . . [10365-6]

4:10 pm: **Printed organic short wavelength infrared photo-transistors**, Moran Amit, Hyunwoong Kim, Zhenghui Wu, Univ. of California, San Diego (USA); Jason D. Azoulay, The Univ. of Southern Mississippi (USA); Tse Nga Ng, Univ. of California, San Diego (USA) . . . . . [10365-7]

4:25 pm: **Organic thin-film transistor fabrication using a laser printer**, Peter J. Diemer, Angela F. Harper, Wake Forest Univ. (USA); Muhammad Rizwan Khan Niazi, King Abdullah Univ. of Science and Technology (Saudi Arabia); John E. Anthony, Univ. of Kentucky (USA); Aram Amassian, King Abdullah Univ. of Science and Technology (Saudi Arabia); Oana D. Jurchescu, Wake Forest Univ. (USA) . . . . . [10365-8]

4:40 pm: **Inkjet-printed intrinsically stretchable conductors and interconnects**, Ulrike Kraft, Francisco Molina-Lopez, Chenxin Zhu, Yue Wang, Zhenan Bao, Boris Murmann, Stanford Univ. (USA) . . . . . [10365-9]

4:55 pm: **Organic vapor-jet printing with reduced heat transfer for low-cost flexible organic electronics**, Sungyeon Kim, Jung-Min Choi, Hanul Moon, Hyeokyun Kwon, Jaehyeok Park, Seunghyup Yoo, KAIST (Korea, Republic of) . . . . . [10365-10]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 . . . . . MON 5:30 PM TO 7:30 PM

#### Posters-Monday

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**A lattice-strained organic single-crystal nanowire array fabricated via solution-phase nanograting-assisted pattern transfer for use in high-mobility organic field-effect transistors**, Kyunghun Kim, Yebyeol Kim, Pohang Univ. of Science and Technology (Korea, Republic of); Se Hyun Kim, Yeungnam Univ. (Korea, Republic of); Chan Eon Park, Pohang Univ. of Science and Technology (Korea, Republic of) . . . . . [10365-37]

**Understanding doped organic field-effect transistors**, Shiyi Liu, Akram Al-Shadeedi, Vikash Kaphle, Changmin Keum, Björn Lüssem, Kent State Univ. (USA) . . . . . [10365-38]

**Enhanced performance in n-type organic field-effect transistors using non-conjugated polyelectrolytes**, Yu Jung Park, Dong-A Univ. (Korea, Republic of) . . . . . [10365-39]

**Submicron-channel-length n-channel organic thin-film transistors fabricated by stencil-mask lithography**, Ute Zschieschang, James W. Borchert, Max-Planck-Institut für Festkörperforschung (Germany); Florian Letzkus, Joachim N. Burghartz, Institut für Mikroelektronik Stuttgart (Germany); Hagen Klauk, Max-Planck-Institut für Festkörperforschung (Germany) . . . . . [10365-41]

**Optimization of a hydroxyl-containing polymer mixture as gate dielectric for low-temperature, solution-processed organic thin-film transistors and logic circuits on a flexible substrate**, Hyunjin Park, Jimin Kwon, Sungjune Jung, Pohang Univ. of Science and Technology (Korea, Republic of) . . . . . [10365-42]

**Thermal annealing effect on the stability of C<sub>60</sub> thin-film transistor with a lithium fluoride protective layer**, Bo Yao, Yan Li, Zebo Fang, Shaoping Univ. (China) . . . . . [10365-43]

### TUESDAY 8 AUGUST

LOCATION: CONV. CTR. ROOM 6A . TUE 9:00 AM TO 11:45 AM

#### Organic Photonics + Electronics Plenary Session

9:00 am: **Hybrid Electro-Optics and Chipscale Integration of Electronics and Photonics** (*Plenary*), Larry R. Dalton, Univ. of Washington (USA) . . . . . [10364-301]

9:30 am: **Molecular Plasmons** (*Plenary*), Naomi J. Halas, Rice Univ. (USA) . . . . . [10360-302]

10:00 am: **Announcement of the Organic Photonics + Electronics Best Student Paper Awards**, Zakya H. Kafafi, Lehigh Univ. (USA)

Coffee Break . . . . . Tue 10:15 am to 10:45 am

10:45 am: **The History and Progress of Halide Perovskite Photovoltaics** (*Plenary*), Nam-Gyu Park, Sungkyunkwan Univ. (Korea, Republic of) [10363-303]

11:15 am: **Mesoscopic Photosystems for the Generation of Electricity and Fuels from Sunlight** (*Plenary*), Michael Grätzel, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . . [10363-304]

Lunch/Exhibition Break . . . . . Tue 11:45 am to 1:30 pm

## SESSION 3

LOCATION: CONV. CTR. ROOM 2 . . . . . TUE 1:30 PM TO 3:15 PM

### Factors Governing Charge Transport

Session Chair: **Aram Amassian**, King Abdullah Univ. of Science and Technology (Saudi Arabia)

1:30 pm: **Exploring disorder and polymorphism in small-molecule organic semiconductors** (*Invited Paper*), John E. Anthony, Univ. of Kentucky (USA) . . . . . [10365-11]

1:55 pm: **Electronic and morphological traps in conjugated polymers** (*Invited Paper*), Alberto Salleo, Stanford Univ. (USA) . . . . . [10365-12]

2:20 pm: **Highly reproducible single-crystalline organic thin-film transistors by minimizing morphological defects in crystalline templating layers**, Robby Janneck, IMEC (Belgium) and KU Leuven (Belgium); Nicolas Pilet, Paul Scherrer Institut (Switzerland); Satya P. Bommanaboyena, IMEC (Belgium); Benjamin Watts, Paul Scherrer Institut (Switzerland); Paul Heremans, Jan Genoe, IMEC (Belgium) and KU Leuven (Belgium); Cedric Rolin, IMEC (Belgium) . . . . . [10365-13]

2:35 pm: **1D versus 2D growth of TIPS-pentacene in TIPS-pentacene/insulating polymer blends**, Wi Hyoung Lee, Konkuk Univ. (Korea, Republic of) . . . . . [10365-14]

2:50 pm: **Transport pathways in organic semiconducting polymers** (*Invited Paper*), Michael L. Chabinyk, Univ. of California, Santa Barbara (USA) . . . . . [10365-15]

Coffee Break . . . . . Tue 3:15 pm to 3:45 pm

## SESSION 4

LOCATION: CONV. CTR. ROOM 2 . . . . . TUE 3:45 PM TO 5:15 PM

### Devices I

Session Chair: **Alberto Salleo**, Stanford Univ. (USA)

3:45 pm: **Multi-component organic blend semiconductors for transistor applications** (*Invited Paper*), Thomas D. Anthopoulos, King Abdullah Univ. of Science and Technology (United Kingdom) . . . . . [10365-16]

4:10 pm: **Polarization-induced transport in organic field-effect transistors: the role of ferroelectric dielectrics** (*Invited Paper*), Suchi Guha, Univ. of Missouri (USA) . . . . . [10365-17]

4:35 pm: **Significance of the double-layer capacitor effect in solution-processable polymeric dielectrics and exceptionally stable low-voltage organic transistors**, Raphael Pfattner, Amir Foudeh, Celine Liong, Chao Wang, Wen-Ya Lee, Desheng Kong, Zhenan Bao, Stanford Univ. (USA) . . . . . [10365-19]

4:50 pm: **Tailoring organic electrochemical transistors through form factor and materials selection** (*Invited Paper*), Jonathan Rivnay, Northwestern Univ. (USA) . . . . . [10365-33]

## WEDNESDAY 9 AUGUST

## SESSION 5

LOCATION: CONV. CTR. ROOM 2 . . . . . WED 8:30 AM TO 10:15 AM

### Chemistry

Session Chair: **Iain McCulloch**, King Abdullah Univ. of Science and Technology (Saudi Arabia)

8:30 am: **Developing theory-driven approaches to design organic semiconducting materials** (*Invited Paper*), Chad Risko, Univ. of Kentucky (USA) . . . . . [10365-20]

8:55 am: **Indolo-naphthyridine-6,13-dione thiophene building block for conjugated polymer electronics: Molecular origin of ultrahigh n-type mobility** (*Invited Paper*), Kealan Fallon, Univ. College London (United Kingdom); Nilushi Wijeyasinghe, Imperial College London (United Kingdom); Eric Manley, Tobin Marks, Northwestern Univ. (USA); Thomas D. Anthopoulos, King Abdullah Univ. of Science and Technology (Saudi Arabia); Hugo A. Bronstein, Univ. College London (United Kingdom) . . . . . [10365-21]

9:20 am: **Truxenones on coinage metal surfaces: structure and epitaxial templating**, Luke A. Rochford, The Univ. of Birmingham (United Kingdom); Alexandra J. Ramadan, Univ. of Oxford (United Kingdom); Christian Nielsen, Queen Mary, Univ. of London (United Kingdom) . . . . . [10365-22]

9:35 am: **Organosilicon derivatives of BTBT for monolayer organic field effect transistors**, Sergey A. Ponomarenko, Institute of Synthetic Polymeric Materials (Russian Federation) and M.V. Lomonosov Moscow State Univ. (Russian Federation); Oleg V. Borshchev, Elena V. Agina, Marina S. Polinskaya, Alexey S. Sizov, Askold A. Trul, Institute of Synthetic Polymeric Materials (Russian Federation); Viktoria P. Chekusova, Bauman Moscow State Technical Univ. (Russian Federation) and Institute of Synthetic Polymeric Materials (Russian Federation); Maxim A. Shcherbina, Institute of Synthetic Polymeric Materials (Russian Federation) and Russian Research Ctr. Kurchatov Institute (Russian Federation); Sergei N. Chvalun, Russian Research Ctr. Kurchatov Institute (Russian Federation) and Institute of Synthetic Polymeric Materials (Russian Federation) . . . . . [10365-23]

9:50 am: **On the importance of alkyl chains in organic semiconductors** (*Invited Paper*), Bob C. Schroeder, Queen Mary, Univ. of London (United Kingdom) . . . . . [10365-24]

Coffee Break . . . . . Wed 10:15 am to 10:45 am

## SESSION 6

LOCATION: CONV. CTR. ROOM 2 . . . . . WED 10:45 AM TO 12:05 PM

### Devices II

Session Chair: **Thomas Anthopoulos**, King Abdullah Univ. of Science and Technology (Saudi Arabia)

10:45 am: **Fast unipolar and complementary circuits**

**based on organic thin-film transistors on flexible substrates** (*Invited Paper*), Hagen Klauk, Max-Planck-Institut für Festkörperforschung (Germany) . . . . . [10365-25]

11:10 am: **Understanding and improving the operational stability of polymer field-effect transistors** (*Invited Paper*), Thuc-Quyen Nguyen, Univ. of California, Santa Barbara (USA) . . . . . [10365-26]

11:35 am: **Understanding the working mechanisms of organic permeable-base transistors**, Akram Al-Shadeedi, Changmin Keum, Shiyi Liu, Vikash Kaphle, Kashi Subedi, Björn Lüssem, Kent State Univ. (USA) . . . . . [10365-27]

11:50 am: **Probing the origins of temperature dependence of charge transport in organic single crystal transistors**, Emily G. Bittle, Adam J. Bicchli, Lisa Fredin, Andrew A. Herzing, Thomas Allison, Angela Hight Walker, David J. Gundlach, National Institute of Standards and Technology (USA) . . . . . [10365-28]

Lunch/Exhibition Break . . . . . Wed 12:05 pm to 1:30 pm

## SESSION 7

LOCATION: CONV. CTR. ROOM 2 . . . . . WED 1:30 PM TO 3:15 PM

### Doping and Processing

Session Chair: **Chad Risko**, Univ. of Kentucky (USA)

1:30 pm: **Interplay between processing and doping of organic semiconductors** (*Invited Paper*), Christian Müller, Chalmers Univ. of Technology (Sweden)

1:55 pm: **Thiol-treated palladium and platinum in pentacene bottom contact thin-film transistors** (*Invited Paper*), Marco R. Cavallari, Columbia Univ. (USA) and Univ. de São Paulo (Brazil); Jiho Yoon, Amrita V. Masurkar, Columbia Univ. (USA); Fernando J. Fonseca, Univ. de São Paulo (Brazil); Ioannis Kyymissis, Columbia Univ. (USA) . . . . . [10365-30]

2:20 pm: **A rational design of polymer semiconductors for high-resolution solution tandem electronics**, Han Wool Park, Keun-Yeong Choi, Haejung Hwang, Soongsil Univ. (Korea, Republic of); Boseok Kang, Pohang Univ. of Science and Technology (Korea, Republic of); Kyung Ah Nam, Soongsil Univ. (Korea, Republic of); Yun-Hi Kim, Gyeongsang National Univ. (Korea, Republic of); Kilwon Cho, Pohang Univ. of Science and Technology (Korea, Republic of); Moon Sung Kang, Hojin Lee, Do Hwan Kim, Soongsil Univ. (Korea, Republic of) . . . . . [10365-31]

2:35 pm: **Self-organized (macro)molecular semiconducting materials for organic electronics and ambipolar charge transport** (*Invited Paper*), Yiming Xiao, Xiaolu Su, Univ. Pierre et Marie Curie (France); Martin Brinkmann, Institut Charles Sadron (France); Benoît Heinrich, Bertrand Donnio, Institut de Physique et Chimie des Matériaux de Strasbourg (France); Ji-Seon Kim, Imperial College London (United Kingdom); Jeong Weon Wu, Ewha Womans Univ. (Korea, Republic of); Jean-Charles Ribierre, Ewha Univ. (Japan); Emmanuelle Lacaze, Institut des NanoSciences de Paris (France); Thierry Barisien, David Kreher, André-Jean Attias, Fabrice Mathevet, Danli Zeng, Univ. Pierre et Marie Curie (France) . . . . . [10365-32]

3:00 pm: **Anomalous behaviors of FeFETs based on polar polymers with high glass temperature**, Vasileia Georgiou, National Institute of Standards and Technology (USA) and George Mason Univ. (USA); Dmitry Veksler, Jason P. Campbell, National Institute of Standards and Technology (USA); Pragya R. Shrestha, National Institute of Standards and Technology (USA) and Theiss Research (USA); Jason T. Ryan, National Institute of Standards and Technology (USA); Dimitris E. Ioannou, George Mason Univ. (USA); Kin P. Cheung, National Institute of Standards and Technology (USA) . . . . . [10365-35]



# CONFERENCE 10366

LOCATION: CONV. CTR. ROOM 2

Thursday 10 August 2017 • Proceedings of SPIE Vol. 10366

# Hybrid Memory Devices and Printed Circuits 2017

Conference Chair: **Emil J. W. List-Kratochvil**, Humboldt-Univ. zu Berlin (Germany)

Program Committee: **Paul W. M. Blom**, Max-Planck-Institut für Polymerforschung (Germany); **Wen-Chang Chen**, National Taiwan Univ. (Taiwan); **Norbert Koch**, Humboldt-Univ. zu Berlin (Germany); **Jang-Sik Lee**, Pohang Univ. of Science and Technology (Korea, Republic of); **Tae-Woo Lee**, Pohang Univ. of Science and Technology (Korea, Republic of); **Tse Nga Ng**, Univ. of California, San Diego (USA); **Ronald Österbacka**, Åbo Akademi Univ. (Finland); **Barbara Stadlober**, JOANNEUM RESEARCH Forschungsgesellschaft mbH (Austria); **Arul Lenus Roy Vellaisamy**, City Univ. of Hong Kong (Hong Kong, China); **Fei Zeng**, Tsinghua Univ. (China)

## THURSDAY 10 AUGUST

### SESSION 1

LOCATION: CONV. CTR. ROOM 2 . . . . THU 9:10 AM TO 10:20 AM

### Neuromorphic Devices and Hybrid Memories

Session Chair: **Emil J. W. List-Kratochvil**, Humboldt-Univ. zu Berlin (Germany)

9:10 am: **Organic neuromorphic devices based on electrochemical concepts** (*Invited Paper*), Paschalis Gkoupidenis, Ecole Nationale Supérieure des Mines de Saint-Étienne (France) and Max-Planck-Institut für Polymerforschung (Germany); Dimitrios Koutsouras, Thomas Lonjaret, Shahab Rezaei-Mazinani, Esma Ismailova, Ecole Nationale Supérieure des Mines de Saint-Étienne (France); Jessamyn A. Fairfield, National Univ. of Ireland, Galway (Ireland); George G. Malliaras, Ecole Nationale Supérieure des Mines de Saint-Étienne (France) . . . . . [10366-1]

9:30 am: **Adaptive 2D memory-like devices with molecules and nanoparticles for unconventional computing** (*Invited Paper*), Dominique Vuillaume, Ctr. National de la Recherche Scientifique (France) . . . . . [10366-2]

9:50 am: **The role of embedded nanoparticles in organic-based resistive nonvolatile memory devices**, Giovanni Ligorio, Humboldt-Univ. zu Berlin (Germany); Sebastian Nau, Stefan Sax, NanoTecCenter Weiz Forschungsgesellschaft mbH (Austria); Marco Vittorio Nardi, Humboldt-Univ. zu Berlin (Germany); Norbert Koch, Humboldt-Univ. zu Berlin (Germany) and Helmholtz Zentrum Berlin für Materialien und Energie GmbH (Germany); Emil J. W. List-Kratochvil, Humboldt-Univ. zu Berlin (Germany) . . . . . [10366-4]

10:05 am: **Spatial summation of pulse responses of a pair of organic heterogeneous junctions**, Fei Zeng, Tsinghua Univ. (China) . . . . . [10366-5]

Coffee Break . . . . . Thu 10:20 am to 10:50 am

### SESSION 2

LOCATION: CONV. CTR. ROOM 2 . . . THU 10:50 AM TO 12:30 PM

### Hybrid Memories

Session Chair: **Ana Claudia Arias**, Univ. of California, Berkeley (USA)

10:50 am: **Printed read-only memories and their operation in mobile readout system** (*Invited Paper*), Xiaojun Guo, Ruolin Wang, Sujie Chen, Wenjiang Liu, Shanghai Jiao Tong Univ. (China) . . . . . [10366-6]

11:10 am: **Towards all inkjet printed electronics** (*Invited Paper*), Piero Cosseddu, Giulia Casula, Stefano Lai, Silvia Conti, Univ. degli Studi di Cagliari (Italy); Annalisa Bonfiglio, Univ degli Studi di Cagliari (Italy) . . . . . [10366-7]

11:30 am: **Non-volatile memory diodes based on organic ferroelectrics** (*Invited Paper*), Kamal Asadi, Paul W. M. Blom, Dago M. de Leeuw, Max-Planck-Institut für Polymerforschung (Germany) . . . . . [10366-8]

11:50 am: **Organolead halide perovskites for low voltage resistive switching memories** (*Invited Paper*), Ho Won Jang, Seoul National Univ. (Korea, Republic of) . . . . . [10366-9]

12:10 pm: **Organic field-effect transistor nonvolatile memories: From fundamental understanding to prototype applications** (*Invited Paper*), Sui-Dong Wang, Soochow Univ. (China) . . . . . [10366-10]

Lunch/Exhibition Break . . . . . Thu 12:30 pm to 2:00 pm

### SESSION 3

LOCATION: CONV. CTR. ROOM 2 . . . . . THU 2:00 PM TO 3:20 PM

### Large Area Printed Electronic Devices

Session Chair: **Ho Won Jang**, Seoul National Univ. (Korea, Republic of)

2:00 pm: **Hybrid electronic systems powered by printed thermoelectric generators** (*Invited Paper*), Ulrich Lemmer, Karlsruher Institut für Technologie (Germany); André Gall, Matthias Hecht, Karlsruher Institut für Technologie (Germany) and Otego GmbH (Germany); Silas Aslan, Karlsruher Institut für Technologie (Germany); Frederick Lessmann, otego GmbH (Germany) and Karlsruher Institut für Technologie (Germany); Verena Schendel, Karlsruher Institut für Technologie (Germany) . . . . . [10366-11]

2:20 pm: **Methods for fabrication of flexible hybrid electronics** (*Invited Paper*), Yong Zhang, Brent S. Krusor, Ping Mei, David E. Schwartz, Steve E. Ready, Robert A. Street, PARC, A Xerox Co. (USA) . . . . . [10366-12]

2:40 pm: **Printed soft-electronics for remote body monitoring** (*Invited Paper*), Matti Mantysalo, Tiina Vuorinen, Mahmoud Mosallaei, Vala Jelihani, Antti T. Vehkaoja, Tampere Univ. of Technology (Finland) . . . . . [10366-13]

3:00 pm: **Printed and Flexible Dual-color polymer light-emitting diodes (PLEDs) for optoelectronic sensors** (*Invited Paper*), Donggeon Han, Jonathan Ting, Ana Claudia Arias, Univ. of California, Berkeley (USA) . . . . . [10366-14]

Coffee Break . . . . . Thu 3:20 pm to 3:50 pm

### SESSION 4

LOCATION: CONV. CTR. ROOM 2 . . . . . THU 3:50 PM TO 5:35 PM

### Memories and Printed Devices

Session Chair: **Uli Lemmer**, Karlsruher Institut für Technologie (Germany)

3:50 pm: **Development of printed large area organic transistors and integrated circuits** (*Invited Paper*), Yong-Young Noh, Dongguk Univ. (Korea, Republic of) . . . . . [10366-15]

4:10 pm: **Optogenetic electronic skins** (*Invited Paper*), Benjamin Tee, Institute of Materials Research and Engineering (IMRE) (Singapore) . . . . . [10366-16]

4:30 pm: **Large area processing and printing of conducting copper structures for use in (opto)electronics**, Felix Hermerschmidt, David Burmeister, Humboldt-Univ. zu Berlin (Germany); Stefan Sax, Karl Popovic, JOANNEUM RESEARCH Forschungsgesellschaft mbH (Austria); Gerburg Schider, NanoTecCenter Weiz Forschungsgesellschaft mbH (Austria); Christine Boeffel, Fraunhofer-Institut für Angewandte Polymerforschung (Germany); Efthymios Georgiou, Stelios A. Choulis, Cyprus Univ. of Technology (Cyprus); Frank Peuckert, 3D-Micromac AG (Germany); Graham Gray, Richard Ward, Intrinsic Materials Ltd. (United Kingdom); Emil J. W. List-Kratochvil, Humboldt-Univ. zu Berlin (Germany) . . . . . [10366-17]

4:45 pm: **Printed thin film transistors for flexible and transparent electronics applications** (*Invited Paper*), Yongtaek Hong, Seoul National Univ. (Korea, Republic of) . . . . . [10366-18]

5:05 pm: **Toward solution processed magnetic nanoparticles for non-volatile memory applications**, Hamed Sharifi Dehsari, Aniellen Halda Ribeiro, Kamal Asadi, Max-Planck-Institut für Polymerforschung (Germany) . . . . . [10366-19]

5:20 pm: **Elucidation of light effects in organic nano-floating-gate nonvolatile memories**, Xu Gao, Zhong-Da Zhang, Xiao-Jian She, Sui-Dong Wang, Soochow Univ. (China) . . . . . [10366-20]

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- SIGNAL IMAGE AND DATA PROCESSING
- REMOTE SENSING
- ATMOSPHERIC AND SPACE OPTICAL SYSTEMS

## Optical Engineering + Applications

### SPECIAL PROGRAM

10367 **Light in Nature VI** (Shaw, Creath, Lakshminarayanan) . . . . . p. 148

### OPTICS + PHOTONICS FOR SUSTAINABLE ENERGY

*Program Chair: Oleg V. Sulima, GE Global Research (USA)*

- 10368 **Next Generation Technologies for Solar Energy Conversion VIII** (Sulima, Conibeer) . . . . . p. 150
- 10369 **New Thermal Radiation Management for Energy Applications** (Bermel, Al-Jassim) . . . . . p. 152
- 10370 **Reliability of Photovoltaic Cells, Modules, Components, and Systems X** (Dhere, Sakurai, Kempe) . . . . . p. 153
- 10362 **Organic Light Emitting Materials and Devices XXI** (So, Adachi, Kim) . . . . . p. 126
- 10363 **Organic, Hybrid, and Perovskite Photovoltaics XVIII** (Kafafi, Lane, Lee) . . . . . p. 130
- 10378 **Sixteenth International Conference on Solid State Lighting and LED-based Illumination Systems** (Dietz, Ferguson) . . . . . p. 171
- 10379 **Nonimaging Optics: Efficient Design for Illumination and Solar Concentration XIV** (Winston, Kurtz) . . . . . p. 173



## OPTOMECHANICS AND OPTICAL MANUFACTURING

Program Chair: **H. Philip Stahl**, NASA Marshall Space Flight Ctr. (USA)

- 10371 **Optomechanical Engineering 2017** (*Hatheway, Stubbs*) . . . p. 155
- 10372 **Material Technologies and Applications to Optics, Structures, Components, and Sub-Systems III** (*Krödel, Robichaud, Goodman*) . . . . . p. 157
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- 10401 **Astronomical Optics: Design, Manufacture, and Test of Space and Ground Systems** (*Hull, Kim, Hallibert*) . . . . . p. 233

## OPTICAL DESIGN AND SYSTEMS ENGINEERING

Program Chair: **José Sasián**, College of Optical Sciences, The Univ. of Arizona (USA)

- 10375 **Current Developments in Lens Design and Optical Engineering XVIII** (*Johnson, Mahajan, Thibault*) . . . . . p. 163
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- 10378 **Sixteenth International Conference on Solid State Lighting and LED-based Illumination Systems** (*Dietz, Ferguson*) . . . . . p. 171
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Program Chairs: **Shizhuo Yin**, The Pennsylvania State Univ. (USA) and **Ruyan Guo**, The Univ. of Texas at San Antonio (USA)

- 10380 **Ultrafast Nonlinear Imaging and Spectroscopy V** (*Liu, Khoo, Psaltis, Shi*) . . . . . p. 175
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- 10382 **Photonic Fiber and Crystal Devices: Advances in Materials and Innovations in Device Applications XI** (*Yin, Guo*) . . . . . p. 179
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- 10384 **Optical Data Storage 2017: From New Materials to New Systems** (*Katayama, Takashima*) . . . . . p. 183
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- 10404 **Infrared Sensors, Devices, and Applications VII** (*LeVan, Sood, Wijewarnasuriya, D'Souza*) . . . . . p. 244

## X-RAY, GAMMA-RAY, AND PARTICLE TECHNOLOGIES

Program Chairs: **Ali M. Khounsary**, Illinois Institute of Technology (USA) and **Ralph B. James**, Savannah River National Lab. (USA)

- 10385 **Advances in Metrology for X-Ray and EUV Optics VII** (*Assoufid, Ohashi, Asundi*) . . . . . p. 184
- 10386 **Advances in X-Ray/EUV Optics and Components XII** (*Morawe, Khounsary, Goto*) . . . . . p. 186
- 10387 **Advances in Laboratory-based X-Ray Sources, Optics, and Applications VI** (*Khounsary, Pareschi*) . . . . . p. 189
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- 10393 **Radiation Detectors in Medicine, Industry, and National Security XVIII** (*Grim, Furenli, Barber*) . . . . . p. 204

## SIGNAL, IMAGE, AND DATA PROCESSING

Program Chair: **Khan M. Iftekharuddin**, Old Dominion Univ. (USA)

- 10394 **Wavelets and Sparsity XVII** (*Lu, Van De Ville, Papadakis*) . . p. 206
- 10395 **Optics and Photonics for Information Processing XI** (*Iftekharuddin, Awwal, García Vázquez, Márquez, Diaz-Ramirez*) . . . . . p. 210
- 10396 **Applications of Digital Image Processing XL** (*Tescher*) . . p. 213
- 10410 **Unconventional and Indirect Imaging, Image Reconstruction, and Wavefront Sensing 2017** (*Dolne, Millane*) . . . . . p. 258

## ASTRONOMICAL OPTICS AND INSTRUMENTATION

Program Chair: **Oswald H. Siegmund**, Univ. of California, Berkeley (USA)

- 10397 **UV, X-Ray, and Gamma-Ray Space Instrumentation for Astronomy XX** (*Siegmund*) . . . . . p. 217
- 10398 **UV/Optical/IR Space Telescopes and Instruments: Innovative Technologies and Concepts VIII** (*MacEwen, Breckinridge*) . . . . . p. 221
- 10399 **Optics for EUV, X-Ray, and Gamma-Ray Astronomy VIII** (*O'Dell, Pareschi*) . . . . . p. 224
- 10400 **Techniques and Instrumentation for Detection of Exoplanets VIII** (*Shaklan*) . . . . . p. 229
- 10401 **Astronomical Optics: Design, Manufacture, and Test of Space and Ground Systems** (*Hull, Kim, Hallibert*) . . . . . p. 233

## REMOTE SENSING

Program Chair: **Allen H.-L. Huang**, Univ. of Wisconsin-Madison (USA)

- 10402 **Earth Observing Systems XXII** (*Butler, Xiong, Gu*) . . . . . p. 236
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- 10404 **Infrared Sensors, Devices, and Applications VII** (*LeVan, Sood, Wijewarnasuriya, D'Souza*) . . . . . p. 244
- 10405 **Remote Sensing and Modeling of Ecosystems for Sustainability XIV** (*Gao, Chang, Wang*) . . . . . p. 246
- 10406 **Lidar Remote Sensing for Environmental Monitoring 2017** (*Singh*) . . . . . p. 248
- 10407 **Polarization Science and Remote Sensing VIII** (*Shaw, Snik*) . . . . . p. 250

## ATMOSPHERIC AND SPACE OPTICAL SYSTEMS

Program Chairs: **Stephen M. Hammel**, Space and Naval Warfare Systems Command (USA) and **Alexander M. J. van Eijk**, TNO Defence, Security and Safety (Netherlands)

- 10408 **Laser Communication and Propagation through the Atmosphere and Oceans VI** (*Bos, van Eijk, Hammel*) . . . . . p. 253
- 10409 **Quantum Communications and Quantum Imaging XV** (*Meyers, Shih, Deacon*) . . . . . p. 256
- 10410 **Unconventional and Indirect Imaging, Image Reconstruction, and Wavefront Sensing 2017** (*Dolne, Millane*) . . . . . p. 258

# DAILY SCHEDULE

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY
Technology Hot Topics, 6:00 to 8:00 PM	Optics + Photonics for Sustainable Energy Plenary Session, 2:00 to 3:30 PM	Signal, Image, and Data Processing Plenary Session, 1:30 to 2:30 PM	Remote Sensing Plenary Session, 10:30 to 11:20 AM	
	Poster Session, 5:30 to 7:30 PM	Optical Engineering Plenary Session, 4:00 to 5:30 PM	Poster Session, 5:30 to 7:30 PM	

## SPECIAL PROGRAM

10367 **Light in Nature VI** (Shaw, Creath, Lakshminarayanan) p. 148

## OPTICS + PHOTONICS FOR SUSTAINABLE ENERGY

Program Chair: **Oleg V. Sulima**, GE Global Research (USA)

		10368 <b>Next Generation Technologies for Solar Energy Conversion VIII</b> (Sulima, Conibeer) p. 150	10369 <b>Thermal Radiation Management for Energy Applications</b> (Bermel, Al-Jassim) p. 152
10370 <b>Reliability of Photovoltaic Cells, Modules, Components, and Systems X</b> (Dhere, Sakurai, Kempe) p. 153		10378 <b>Sixteenth International Conference on Solid State Lighting and LED-based Illumination Systems</b> (Dietz, Ferguson) p. 171	
10362 <b>Organic Light Emitting Materials and Devices XXI</b> (So, Adachi, Kim) p. 126			
10363 <b>Organic, Hybrid, and Perovskite Photovoltaics XVIII</b> (Kafafi, Lane, Lee) p. 130			
10379 <b>Nonimaging Optics: Efficient Design for Illumination and Solar Concentration XIV</b> (Winston) p. 173			

## OPTOMECHANICS AND OPTICAL MANUFACTURING

Program Chair: **H. Philip Stahl**, NASA Marshall Space Flight Ctr. (USA)

	10372 <b>Material Technologies and Applications to Optics, Structures, Components, and Sub-Systems III</b> (Krödel, Robichaud, Goodman) p. 157		10371 <b>Optomechanical Engineering 2017</b> (Hatheway, Stubbs) p. 155
		10373 <b>Applied Optical Metrology II</b> (Novak, Trolinger) p. 159	
		10374 <b>Optical Modeling and Performance Predictions IX</b> (Kahan, Levine-West) p. 161	
		10401 <b>Astronomical Optics: Design, Manufacture, and Test of Space and Ground Systems</b> (Hull, Kim, Hallibert) p. 233	

## OPTICAL DESIGN AND SYSTEMS ENGINEERING

Program Chair: **José Sasián**, College of Optical Sciences, The Univ. of Arizona (USA)

	10375 <b>Current Developments in Lens Design and Optical Engineering XVIII</b> (Johnson, Mahajan, Thibault) p. 163		
10377 <b>Optical System Alignment, Tolerancing, and Verification XI</b> (Sasián, Youngworth) p. 169		10376 <b>Novel Optical Systems Design and Optimization XX</b> (Davis, Hahlweg, Mulley) p. 166	
10379 <b>Nonimaging Optics: Efficient Design for Illumination and Solar Concentration XIV</b> (Winston, Kurtz) p. 173		10378 <b>Sixteenth International Conference on Solid State Lighting and LED-based Illumination Systems</b> (Dietz, Ferguson) p. 171	

# DAILY SCHEDULE

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY
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<b>PHOTONIC DEVICES AND APPLICATIONS</b>				
<i>Program Chairs: Shizhuo Yin, The Pennsylvania State Univ. (USA) and Ruyan Guo, The Univ. of Texas at San Antonio (USA)</i>				
10380 <b>Ultrafast Nonlinear Imaging and Spectroscopy V</b> (Liu, Khoo, Psaltis, Shi) p. 175		10381 <b>Wide Bandgap Power Devices and Applications II</b> (Matin, Chowdhury, Dutta) p. 178		10404 <b>Infrared Sensors, Devices, and Applications VII</b> (LeVan, Sood, Wijewarnasuriya, D'Souza) p. 244
10382 <b>Photonic Fiber and Crystal Devices: Advances in Materials and Innovations in Device Applications XI</b> (Yin, Guo) p. 179		10378 <b>Sixteenth International Conference on Solid State Lighting and LED-based Illumination Systems</b> (Dietz, Ferguson) p. 171		
10383 <b>Terahertz Emitters, Receivers, and Applications VIII</b> (Razeghi, Baranov, Zavada, Pavlidis) p. 181				
10384 <b>Optical Data Storage 2017: From New Materials to New Systems</b> (Katayama, Takashima) p. 183				

<b>X-RAY, GAMMA-RAY, AND PARTICLE TECHNOLOGIES</b>				
<i>Program Chairs: Ali M. Khounsary, Illinois Institute of Technology (USA) and Ralph B. James, Savannah River National Lab. (USA)</i>				
10385 <b>Advances in Metrology for X-Ray and EUV Optics VII</b> (Assoufid, Ohashi, Asundi) p. 184		10386 <b>Advances in X-Ray/EUV Optics and Components XII</b> (Morawe, Khounsary, Goto) p. 186		
10389 <b>X-Ray Nanoimaging: Instruments and Methods III</b> (Lai, Somogyi) p. 193		10388 <b>Advances in Computational Methods for X-Ray Optics IV</b> (Chubar, Sawhney) p. 190		
10387 <b>Advances in Laboratory-based X-Ray Sources, Optics, and Applications VI</b> (Khounsary, Pareschi) p. 189		10390 <b>Target Diagnostics Physics and Engineering for Inertial Confinement Fusion VI</b> (Koch, Grim) p. 196	10393 <b>Radiation Detectors in Medicine, Industry, and National Security XVIII</b> (Grim, Furenlid, Barber) p. 204	
		10391 <b>Developments in X-Ray Tomography XI</b> (Müller, Wang) p. 198		
10392 <b>Hard X-Ray, Gamma-Ray, and Neutron Detector Physics XIX</b> (Burger, James, Fiederle, Franks) p. 201				

<b>SIGNAL, IMAGE, AND DATA PROCESSING</b>				
<i>Program Chair: Khan M. Iftekharuddin, Old Dominion Univ. (USA)</i>				
10394 <b>Wavelets and Sparsity XVII</b> (Lu, Van De Ville, Papadakis) p. 206				
10395 <b>Optics and Photonics for Information Processing XI</b> (Iftekharuddin, Awwal, García Vázquez, Márquez, Diaz-Ramirez) p. 210		10410 <b>Unconventional and Indirect Imaging, Image Reconstruction, and Wavefront Sensing 2017</b> (Dolne, Millane) p. 258		
10396 <b>Applications of Digital Image Processing XL</b> (Tescher) p.213				

<b>ASTRONOMICAL OPTICS AND INSTRUMENTATION</b>				
<i>Program Chair: Oswald H. Siegmund, Univ. of California, Berkeley (USA)</i>				
10397 <b>UV, X-Ray, and Gamma-Ray Space Instrumentation for Astronomy XX</b> (Siegmund) p. 217				
10398 <b>UV/Optical/IR Space Telescopes and Instruments: Innovative Technologies and Concepts VIII</b> (MacEwen, Breckinridge) p. 221		10399 <b>Optics for EUV, X-Ray, and Gamma-Ray Astronomy VIII</b> (O'Dell, Pareschi) p. 224		
		10400 <b>Techniques and Instrumentation for Detection of Exoplanets VIII</b> (Shaklan) p. 229		
		10401 <b>Astronomical Optics: Design, Manufacture, and Test of Space and Ground Systems</b> (Hull, Kim, Hallibert) p. 233		



# DAILY SCHEDULE

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY
<b>REMOTE SENSING</b> <i>Program Chair: Allen H.-L. Huang, Univ. of Wisconsin-Madison (USA)</i>				
10402 <b>Earth Observing Systems XXII</b> (Butler, Xiong, Gu) p. 236				
10403 <b>Infrared Remote Sensing and Instrumentation XXV</b> (Strojnik, Kirk) p. 241		10404 <b>Infrared Sensors, Devices, and Applications VII</b> (LeVan, Sood, Wijewamasuriya, D'Souza) p. 244		
		10406 <b>Lidar Remote Sensing for Environmental Monitoring 2017</b> (Singh) p. 248	10405 <b>Remote Sensing and Modeling of Ecosystems for Sustainability XIV</b> (Gao, Chang, Wang) p. 246	
		10407 <b>Polarization Science and Remote Sensing VIII</b> (Shaw, Snik) p. 250		
<b>ATMOSPHERIC AND SPACE OPTICAL SYSTEMS</b> <i>Program Chairs: Stephen M. Hammel, Space and Naval Warfare Systems Command (USA) and Alexander M. J. van Eijk, TNO Defence, Security and Safety (Netherlands)</i>				
10409 <b>Quantum Communications and Quantum Imaging XV</b> (Meyers, Shih, Deacon) p. 256		10408 <b>Laser Communication and Propagation through the Atmosphere and Oceans VI</b> (Bos, van Eijk, Hammel) p. 253		
		10410 <b>Unconventional and Indirect Imaging, Image Reconstruction, and Wavefront Sensing 2017</b> (Dolne, Millane) p. 258		

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**Ralph B. James**, Savannah River National Lab. (USA)  
**Ali M. Khounsary**, Illinois Institute of Technology (USA)  
**José Sasián**, College of Optical Sciences, The Univ. of Arizona (USA)  
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# CONFERENCE 10367

LOCATION: CONV. CTR. ROOM 15A

Monday 7 August 2017 • Proceedings of SPIE Vol. 10367

## Light in Nature VI

Conference Chairs: **Joseph A. Shaw**, Montana State Univ. (USA); **Katherine Creath**, Optinering (USA), The Univ. of Arizona (USA); **Vasudevan Lakshminarayanan**, Univ. of Waterloo (Canada), Univ. of Michigan (USA)

Program Committee: **Rongguang Liang**, College of Optical Sciences, The Univ. of Arizona (USA); **Lorian Schweikert**, Duke Univ. (USA); **Mitsuo Takeda**, Univ. of Electro-Communications (Japan), Utsunomiya Univ. (Japan); **Qiwen Zhan**, Univ. of Dayton (USA)

### SUNDAY 6 AUGUST

LOCATION: CONV. CTR. ROOM 6A . . SUN 6:00 PM TO 7:50 PM

#### Technology Hot Topics: How Optics and Photonics Drive Innovation

6:00 pm to 6:10 pm: **Welcome and Opening Remarks**

6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)

6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)

6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)

7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)

7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)

### MONDAY 7 AUGUST

LOCATION: CONV. CTR. ROOM 15A . . . . . 8:20 AM TO 8:30 AM

#### Welcome and Opening Remarks

**Joseph A. Shaw**, Montana State Univ. (USA); **Katherine Creath**, Optinering (USA) and The Univ. of Arizona (USA)

#### SESSION 1

LOCATION: CONV. CTR. ROOM 15A . MON 8:30 AM TO 10:10 AM

#### The Physics of Light

Session Chairs: **Joseph A. Shaw**, Montana State Univ. (USA); **Katherine Creath**, Optinering (USA), The Univ. of Arizona (USA)

8:30 am: **Momentum of light**, Michael Mazilu, Univ. of St. Andrews (United Kingdom) . . . . . [10367-1]

8:50 am: **Enhanced high-harmonic generation in photonics crystal: theoretical and experimental studies**, Evgeny Gorbunov, Kirill I. Zaytsev, Egor Yakovlev, Arsen Zotov, Bauman Moscow State Technical Univ. (Russian Federation); Vladimir M. Masalov, Gennadi A. Emelchenko, Institute of Solid State Physics RAS (Russian Federation); Nikita Kruchkov, Stanislav O. Yurchenko, Bauman Moscow State Technical Univ. (Russian Federation) . . . . . [10367-2]

9:10 am: **2D and 3D graphical representation of the propagation of electromagnetic waves at the interface with a material with general effective complex permittivity and permeability**, Andres Diaz, Univ. Metropolitana (USA); Jonathan S. Friedman, Univ. Metropolitana (USA) and Arecibo Observatory (USA); Jose G. Ramos, Univ. Metropolitana (USA); Sarah C. Luciano, College of Optical Sciences, The Univ. of Arizona (USA) . . . . . [10367-3]

9:30 am: **Spectroscopic composition of corona discharge and some effects on materials**, Jorge A. García-Macedo, Univ. Nacional Autónoma de México (Mexico); Giulio Fanti, Univ. degli Studi di Padova (Italy) . . . . . [10367-4]

9:50 am: **The generation, propagation, and absorption of photons**, Nithin Kumar Goona, Priya Singh, Saidi Reddy Parne, Venugopal Reddy Barry, National Institute of Technology, Goa (India) . . . . . [10367-5]

Coffee Break . . . . . Mon 10:10 am to 10:40 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 15A . . MON 10:40 AM TO 12:20 PM

#### Optics in Biology

Session Chair: **Katherine Creath**, Optinering (USA), The Univ. of Arizona (USA)

10:40 am: **Not all butterflies have colorful wings** (*Invited Paper*), Akhlesh Lakhtakia, The Pennsylvania State Univ. (USA) . . . . . [10367-6]

11:20 am: **Nanophotonic structures discovered in wild comet moth**, Norman Shi, Cheng Chia Tsai, Columbia Univ. (USA); Catherine Craig, Harvard Univ. (USA); Nanfang Yu, Columbia Univ. (USA) . . . . . [10367-7]

11:40 am: **Light scattering optimization of chitin random network in ultrawhite beetle scales**, Francesco Utel, LENS - Lab. Europeo di Spettroscopia Non-Lineari (Italy); Lorenzo Cortese, ICFO - Institut de Ciències Fotòniques (Spain); Lorenzo Pattelli, LENS - Lab. Europeo di Spettroscopia Non-Lineari (Italy); Silvia Vignolini, Univ. of Cambridge (United Kingdom); Matteo Burrelli, Istituto Nazionale di Ottica (Italy); Diederik S. Wiersma, Univ. degli Studi di Firenze (Italy) . . . . . [10367-8]

12:00 pm: **Butterflies regulate wing temperatures using radiative cooling**, Cheng Chia Tsai, Norman Nan Shi, Crystal Ren, Columbia Univ. (USA); Julianne Pelaez, Univ. of California, Berkeley (USA); Gary D. Bernard, Univ. of Washington (USA); Nanfang Yu, Columbia Univ. (USA); Naomi Pierce, Harvard Univ. (USA) . . . . . [10367-9]

Lunch Break . . . . . Mon 12:20 pm to 1:50 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 15A . . MON 1:50 PM TO 3:10 PM

#### Color Effects

Session Chairs: **Kathy Creath**, Optinering (USA), The Univ. of Arizona (USA); **Joseph A. Shaw**, Montana State Univ. (USA)

1:50 pm: **Contributions of early Arab scholars to color science and the role of Ibn al Haytham**, Vasudevan Lakshminarayanan, Univ. of Waterloo (Canada) . . . . . [10367-10]

2:30 pm: **Effects of color in the learning of science**, Aramis A. Sanchez Juárez, Johanna E. Jaramillo Q., Univ. Técnica Particular de Loja (Ecuador) . . . . [10367-11]

2:50 pm: **Non-visual biological effects of light on human cognition, alertness, and mood**, Huaye Li, Huihui Wang, Junfei Shen, Peng Sun, Siman Zhang, Ting Xie, Zhenrong Zheng, State Key Lab. of Modern Optical Instrumentation, Zhejiang Univ. (China) . . . . . [10367-12]

Coffee Break . . . . . Mon 3:10 pm to 3:40 pm

#### SESSION 4

LOCATION: CONV. CTR. ROOM 15A . MON 3:40 PM TO 4:40 PM

#### Color and Light in Nature

Session Chair: **Vasudevan Lakshminarayanan**, Univ. of Waterloo (USA), Univ. of Michigan (USA)

3:40 pm: **Observing halos through airplane windows**, Joseph A. Shaw, Montana State Univ. (USA) . . . . . [10367-13]

4:20 pm: **Identifying the optical phenomena responsible for the blue appearance of veins**, Spencer R. Van Leeuwen, Gladimir V. G. Baranoski, Univ. of Waterloo (Canada) . . . . . [10367-14]



**LOCATION: CONV. CTR. ROOM 15A . . . . . 4:40 PM TO 5:00 PM**

**Discussion on Future Topics of Interest**

**Joseph A. Shaw**, Montana State Univ. (USA); **Katherine Creath**, Optoneering (USA) and The Univ. of Arizona (USA); **Vasudevan Lakshminarayanan**, Univ. of Waterloo (Canada) and Univ. of Michigan (USA)

**LOCATION: CONV. CTR.**

**EXHIBIT HALL B2 . . . . . MON 5:30 PM TO 7:30 PM**

**Posters-Monday**

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Color vision tests comparison: Farnsworth D-15 versus Lanthony D-15**, Marta A. Szmigiel, Malwina Geniusz, Wroclaw Univ. of Science and Technology (Poland) . . . . . [10367-15]

**Color effect + motivation = learning and teaching**, Darwin P. Castillo Malla, Aramis A. Sánchez Juárez, Univ. Técnica Particular de Loja (Ecuador) . . [10367-16]

**Determination of better protective eyeglasses depending on the shape and material**, Aramis A. Sánchez Juárez, Johanna E. Jaramillo Q., Univ. Técnica Particular de Loja (Ecuador) . . . . . [10367-17]

**Color vision deficiencies and the child's willingness for visual activity: preliminary research**, Malwina Geniusz, Marta A. Szmigiel, Maciej Geniusz, Wroclaw Univ. of Science and Technology (Poland) . . . . . [10367-18]

**Temporary effects of alcohol on color vision**, Maciej Geniusz, Malwina Geniusz, Marta A. Szmigiel, Wroclaw Univ. of Science and Technology (Poland) . [10367-19]

**Six years of vision screening tests in pre-school children of Wroclaw**, Ireneusz Szmigiel, Marta A. Szmigiel, Malwina Geniusz, Wroclaw Univ. of Science and Technology (Poland) . . . . . [10367-21]

# CONFERENCE 10368

LOCATION: CONV. CTR. ROOM 12

Monday-Tuesday 7-8 August 2017 • Proceedings of SPIE Vol. 10368

## Next Generation Technologies for Solar Energy Conversion VIII

Conference Chairs: **Oleg V. Sulima**, GE Global Research (USA); **Gavin Conibeer**, The Univ. of New South Wales (Australia)

Program Committee: **Partha Dutta**, Rensselaer Polytechnic Institute (USA); **Andrew J. Ferguson**, National Renewable Energy Lab. (USA); **Alberto Salleo**, Stanford Univ. (USA); **Sean E. Shaheen**, Univ. of Colorado at Boulder (USA); **Wilfried G. J. H. M. van Sark**, Utrecht Univ. (Netherlands); **Xianfan Xu**, Purdue Univ. (USA)

### MONDAY 7 AUGUST

LOCATION: CONV. CTR. ROOM 6A . MON 2:00 PM TO 3:30 PM

#### Optics + Photonics for Sustainable Energy Plenary Session

2:00 pm: **A Brief History of Photovoltaics: Yesterday, Today, and Tomorrow (Plenary)**, Charles Gay, U.S. Dept. of Energy (USA) . . . . . [10368-201]

2:30 pm: **Photovoltaics Moving into the Terawatt Age (Plenary)**, Eicke R. Weber, Berkeley Education Alliance for Research in Singapore BEARS (Singapore) and Univ. of California, Berkeley (USA) . . . . . [10368-202]

3:00 pm: **Bankability of Novel Energy Technologies (Plenary)**, Ralph Romero, Black & Veatch (USA) . . . . . [10368-203]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 . . . . . MON 5:30 PM TO 7:30 PM

#### Posters-Monday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Power saving using amorphous transformers**, Sarhan H. Hasan, Univ. of Denver (USA) . . . . . [10368-20]

**14.66%-efficient printing CIGS solar cells on stainless steel foil**, Tung-Po Hsieh, Yu-Kuang Liao, Lung-Teng Cheng, Chia-Ming Chang, Wei-Sheng Lin, Chou-Cheng Li, Yu-Yun Wang, Wei-Tse Hsu, Jen-Chuan Chang, Sheng-Wen Chan, Song-Yeu Tsai, Industrial Technology Research Institute (Taiwan) . . . . . [10368-21]

**Fabrication of p-type monocrystalline germanium thin films on silicon wafer by magnetron sputtering**, Cheng-Wei Luo, National Central Univ. (Taiwan) [10368-22]

**Using sputter epitaxial growth of SiGe films on mono-crystalline silicon substrate**, Chiu-Yi Shih, National Central Univ. (Taiwan) . . . . . [10368-23]

### TUESDAY 8 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 12 . . . TUE 8:30 AM TO 10:20 AM

#### Nanostructures and Nanomaterials for PV I

Session Chair: **Oleg V. Sulima**, GE Global Research (USA)

8:30 am: **Energy migration, exchange and dissipation in ensembles of semiconductor nanocrystals for photovoltaic applications (Invited Paper)**, Tom Gregorkiewicz, Univ. van Amsterdam (Netherlands) . . . . . [10368-1]

9:00 am: **A metamaterial sunlight down-converter for improved photovoltaics**, Antonio Capretti, Arnon Lesage, Tom Gregorkiewicz, Univ. van Amsterdam (Netherlands) . . . . . [10368-2]

9:20 am: **Optical modeling of nanowire array tandem solar cell**, Yang Chen, Johannes Svensson, Lund Univ. (Sweden); Oliver Höhn, Nico Tucher, Fraunhofer-Institut für Solare Energiesysteme (Germany); Mats-Erik Pistol, Lars-Erik Wernersson, Nicklas Anttu, Lund Univ. (Sweden) . . . . . [10368-3]

9:40 am: **Photovoltaic characteristics of organic-inorganic hybrid silicon quantum dot solar cell**, Mitsuru Inada, Nozomi Isobe, Tomoki Miyake, Tadashi Saitoh, Kansai Univ. (Japan) . . . . . [10368-4]

10:00 am: **Optimization of charge-carrier generation in amorphous-silicon thin-film tandem solar cell backed by two-dimensional metallic surface-relief grating**, Benjamin J. Civiletti, Thomas H. Anderson, Univ. of Delaware (USA); Faiz Ahmad, The Pennsylvania State Univ. (USA); Peter B. Monk, Univ. of Delaware (USA); Akhlesh Lakhtakia, Pennsylvania State Univ. (USA) . . . . . [10368-5]

Coffee Break . . . . . Tue 10:20 am to 10:50 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 12 . . . TUE 10:50 AM TO 12:10 PM

#### Nanostructures and Nanomaterials for PV II

Session Chair: **Andrew J. Ferguson**, National Renewable Energy Lab. (USA)

10:50 am: **Optimal indium-gallium-nitride Schottky-barrier thin-film solar cells**, Thomas H. Anderson, Peter B. Monk, Univ. of Delaware (USA); Tom G. Mackay, The Univ. of Edinburgh (United Kingdom); Akhlesh Lakhtakia, Pennsylvania State Univ. (USA) . . . . . [10368-6]

11:10 am: **Silicon-based infrared photodetectors enabled by hot electrons**, Seok Jun Han, Sang Eon Han, The Univ. of New Mexico (USA) . . . . . [10368-7]

11:30 am: **Highly efficient organic photovoltaics enabled by polymeric additives**, Taeshik Earmme, Brian J. Worfolk, Kathy A. Repa, Hualong Pan, Alyssa B. Chinen, Kathy B. Woody, Phillips 66 (USA) . . . . . [10368-8]

11:50 am: **Enhanced optical absorption of amorphous silicon films modulated by silicon nitride (Si<sub>3</sub>N<sub>4</sub>) nanostructures**, Hong Liu, Suzhou Univ. of Science and Technology (China) and Suzhou Thermoelectric Technology Co. (China) . [10368-9]

Lunch/Exhibition Break . . . . . Tue 12:10 pm to 2:20 pm

SESSION 3

LOCATION: CONV. CTR. ROOM 12 . . . . TUE 2:20 PM TO 3:30 PM

**New Approaches to Solar Energy Conversion I**

Session Chair: **Drew DeJarnette**, U.S. Dept. of Energy (USA)

2:20 pm: **Solar fuels** (*Keynote Presentation*), Tanja Cuk, Univ. of California, Berkeley (USA) . . . . . [10368-10]

2:50 pm: **Reactive colloidal optics for passive tracking of the sun**, Ido Frenkel, Avi Niv, Ben-Gurion Univ. of the Negev (Israel) . . . . . [10368-11]

3:10 pm: **Volume holographic lens spectrum splitting photovoltaic system for high energy yield with direct and diffuse solar illumination**, Benjamin D. Chrysler, Yuechen Wu, Raymond K. Kostuk, The Univ. of Arizona (USA) [10368-12]

Coffee Break . . . . . Tue 3:30 pm to 4:00 pm

SESSION 4

LOCATION: CONV. CTR. ROOM 12 . . . . TUE 4:00 PM TO 5:20 PM

**New Approaches to Solar Energy Conversion II**

Session Chair: **Sean E. Shaheen**, Univ. of Colorado Boulder (USA)

4:00 pm: **Transparent solar cell material processing using laser induced thin film epitaxial growth using laser beam holographic patterning and monitoring using RHEED**, Mohammad Masum Anwar, Forever Living Products (Bangladesh) . . . . . [10368-15]

4:20 pm: **Graphene for thermoelectronic solar energy conversion**, Dilip De, Covenant Univ. (Nigeria) and Sustainable Green Power Technologies (USA); Olukunle C. Olawole, Covenant Univ. (Nigeria) . . . . . [10368-17]

4:40 pm: **A solar powered device for chlorine generation**, Enrico Chinello, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Miguel Antonio Modestino, New York Univ. (USA); Laurent Coulot, Mathieu Ackermann, Insolight Sàrl (Switzerland); Christophe Moser, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . . [10368-18]

5:00 pm: **A study of the penetration of photovoltaic generation into the Libyan power system**, Abdulmunim Guwaeder, Oklahoma State Univ. (USA); Sarhan H. Hasan, Univ. of Denver (USA); Ibrahim Aldaouab, Univ. of Dayton (USA) [10368-19]



# CONFERENCE 10369

LOCATION: CONV. CTR. ROOM 12

Wednesday 9 August 2017 • Proceedings of SPIE Vol. 10369

# Thermal Radiation Management for Energy Applications

Conference Chairs: **Peter Bermel**, Purdue Univ. (USA); **Mowafak M. Al-Jassim**, National Renewable Energy Lab. (USA)

Program Committee: **Partha Dutta**, Rensselaer Polytechnic Institute (USA)

## WEDNESDAY 9 AUGUST

### SESSION 1

LOCATION: CONV. CTR. ROOM 12 .. WED 8:30 AM TO 10:00 AM

#### Solar Thermal Selective Absorbers

Session Chairs: **Mowafak M. Al-Jassim**, National Renewable Energy Lab. (USA); **Peter Bermel**, Purdue Univ. (USA)

8:30 am: **Nanostructured materials for selective solar absorbers and thermal emitters** (*Invited Paper*), Sheng Shen, Carnegie Mellon Univ. (USA) . . . . [10369-1]

9:00 am: **Analysis of monthly solar radiation in Libya**, Abdulmunim Guwaeder, Rama Ramakumar, Oklahoma State Univ. (USA) . . . . . [10369-2]

9:20 am: **Tailoring nanomaterials for solar driven interfacial steam generation**, Jia Zhu, Nanjing Univ. (China) . . . . . [10369-3]

9:40 am: **Spectrum splitting for thermal management in photovoltaic concentrators**, Harry N. Apostoleris, Matteo Chiesa, Ibraheem Al-Mansouri, Masdar Institute of Science & Technology (United Arab Emirates) . . . . . [10369-4]

Coffee Break . . . . . Wed 10:00 am to 10:30 am

### SESSION 2

LOCATION: CONV. CTR. ROOM 12 .. WED 10:30 AM TO 11:50 AM

#### High-Temperature Metamaterials

Session Chairs: **Peter Bermel**, Purdue Univ. (USA); **Zongfu Yu**, Univ. of Wisconsin-Madison (USA)

10:30 am: **Metasurfaces for angular and spectral control of thermal radiation** (*Invited Paper*), Luke A. Sweatlock, Katherine T. Fountaine, Northrop Grumman Aerospace Systems (USA) . . . . . [10369-5]

11:00 am: **Thermal radiation management by metasurfaces**, Sandeep Inampudi, Mohammad Mahdi Salary, Hossein Mosallaei, Northeastern Univ. (USA) . [10369-6]

11:20 am: **High temperature ENZ plasmonics and thermal graphene metamaterials** (*Invited Paper*), Zubin Jacob, Purdue Univ. (USA) . . . . . [10369-7]

Lunch/Exhibition Break . . . . . Wed 11:50 am to 1:20 pm

### SESSION 3

LOCATION: CONV. CTR. ROOM 12 . . . . WED 1:20 PM TO 2:30 PM

#### Novel Experiments in Radiative Cooling

Session Chairs: **Mowafak M. Al-Jassim**, National Renewable Energy Lab. (USA); **Peter Bermel**, Purdue Univ. (USA)

1:20 pm: **Amorphous metamaterials for large scale day-time radiative cooling** (*Invited Paper*), Xiaobo Yin, Univ. of Colorado Boulder (USA) . . . . . [10369-8]

1:50 pm: **Super-cool paints: Optimising composition with a modified four-flux model**, Marc A. Gali Labarias, Matthew D. Arnold, Angus R. Gentle, Geoffrey B. Smith, Univ. of Technology, Sydney (Australia) . . . . . [10369-9]

2:10 pm: **3D printable optical structures for sub-ambient sky cooling**, Angus R. Gentle, Altay Nuhoglu, Matthew D. Arnold, Geoffrey B. Smith, Univ. of Technology, Sydney (Australia) . . . . . [10369-10]

### SESSION 4

LOCATION: CONV. CTR. ROOM 12 . . . . WED 2:30 PM TO 3:40 PM

#### Novel Concepts in Radiative Cooling

Session Chairs: **Peter Bermel**, Purdue Univ. (USA); **Zubin Jacob**, Purdue Univ. (USA)

2:30 pm: **The superradiant effect in thermal emission** (*Invited Paper*), Zongfu Yu, Univ. of Wisconsin Madison (USA) . . . . . [10369-11]

3:00 pm: **Radiative cooling for concentrating photovoltaic systems**, Yubo Sun, Zhiguang Zhou, Xingshu Sun, Muhammad Ashraf Alam, Peter Bermel, Purdue Univ. (USA) . . . . . [10369-12]

3:20 pm: **Structure optimization of metallodielectric multilayer for high-efficiency daytime radiative cooling**, Takahiro Suichi, Atsushi Ishikawa, Yasuhiko Hayashi, Kenji Tsuruta, Okayama Univ. (Japan) . . . . . [10369-13]

Coffee Break . . . . . Wed 3:40 pm to 4:10 pm

### SESSION 5

LOCATION: CONV. CTR. ROOM 12 . . . . WED 4:10 PM TO 5:40 PM

#### Novel Applications for Thermal Radiation

Session Chairs: **Mowafak M. Al-Jassim**, National Renewable Energy Lab. (USA); **Luke A. Sweatlock**, Northrop Grumman Aerospace Systems (USA)

4:10 pm: **High performance incandescent light bulb using a selective emitter and nanophotonic filters** (*Invited Paper*), Arny Leroy, Bikram Bhatia, Kyle Wilke, Evelyn N. Wang, Massachusetts Institute of Technology (USA) . . . . . [10369-14]

4:40 pm: **Nanostructure enhanced near-field radiative heat transfer and designs for energy conversion devices**, Bingnan Wang, Chungwei Lin, Koon Hoo Teo, Mitsubishi Electric Research Labs. (USA) . . . . . [10369-15]

5:00 pm: **Fabrication and thermal analysis of micro thermocouples for energy harvesting**, Brhayllan Mora-Ventura, Gabriel González, Francisco Javier González, Univ. Autónoma de San Luis Potosí (Mexico) . . . . . [10369-16]

5:20 pm: **Demonstration of 24% efficient thermophotovoltaic energy conversion using 1055 C selective emitter**, David Woolf, Physical Sciences Inc. (USA); Emil A. Kadlec, Don Bethke, Eric A. Shaner, Sandia National Labs. (USA); Joel Hensley, Physical Sciences Inc. (USA) . . . . . [10369-17]

# CONFERENCE 10370

LOCATION: CONV. CTR. ROOM 12

Sunday–Monday 6–7 August 2017 • Proceedings of SPIE Vol. 10370

## Reliability of Photovoltaic Cells, Modules, Components, and Systems X

*Conference Chairs:* **Neelkanth G. Dhere**, Univ. of Central Florida (USA); **Keiichiro Sakurai**, National Institute of Advanced Industrial Science and Technology (Japan); **Michael D. Kempe**, National Renewable Energy Lab. (USA)

*Program Committee:* **David S. Albin**, National Renewable Energy Lab. (USA); **Glenn Alers**, Univ. of California, Santa Cruz (USA); **Ward I. Bower**, Sandia National Labs. (USA); **Leila R. O. Cruz**, Instituto Militar de Engenharia (Brazil); **Takuya Doi**, National Institute of Advanced Industrial Science and Technology (Japan); **Fernando Fabero**, Ctr. de Investigaciones Energéticas, Medioambientales y Tecnológicas (Spain); **Vivek S. Gade**, Jabil Circuit, Inc. (USA); **William J. Gambogi Jr.**, DuPont (USA); **Werner Herrmann**, TÜV Rheinland Group (Germany); **Stephen J. Hogan**, Spire Corp. (USA); **Aravinda Kar**, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); **Michael Köhl**, Fraunhofer-Institut für Solare Energiesysteme (Germany); **Ralf Leutz**, Concentrator Optics GmbH (Germany); **Xavier Mathew**, Ctr. de Investigación en Energía (Mexico); **Robert McConnell**, Arzon Solar, LLC (USA); **Yoichi Murakami**, Japan Electrical Safety & Environment Technology Labs. (Japan); **F. J. John Pern**, Sunshine Sci-Tech LLC (USA); **Laure-Emmanuelle Perret-Aebi**, Ecole Polytechnique Fédérale de Lausanne (Switzerland); **Shirish Pethe**, Applied Materials, Inc. (USA); **Ivan Sinicco**, Oerlikon Solar Ltd. (Switzerland); **Oleg V. Sulima**, GE Global Research (USA); **Bolko von Roedern**, von Roedern & Associates LLC (USA)

### SUNDAY 6 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 12 . . . . SUN 1:30 PM TO 3:10 PM

#### Backsheets

Session Chairs: **Neelkanth G. Dhere**, Univ. of Central Florida (USA); **Helio R. Moutinho**, National Renewable Energy Lab. (USA)

1:30 pm: **Comparison of higher irradiance and black panel temperature UV backsheet exposures to field performance** (*Invited Paper*), Thomas C. Felder, William J. Gambogi, Steven W. MacMaster, Bao-Ling Yu, T. John Trout, DuPont Photovoltaic Solutions (USA) . . . . . [10370-1]

2:00 pm: **Degradation analysis of field exposed photovoltaic modules with non-fluoropolymer-based backsheets**, Andrew Fairbrother, National Institute of Standards and Technology (USA); Scott Julien, Kai-Tak Wan, Northeastern Univ. (USA); Liang Ji, Kenneth P. Boyce, Underwriters Labs. Inc. (USA); Sebastian Merzlic, Amy A. Lefebvre, Greg O'Brien, Arkema Research Ctr. (USA); Yu Wang, Laura S. Bruckman, Roger H. French, Case Western Reserve Univ. (USA); Michael D. Kempe, National Renewable Energy Lab. (USA); Xiaohong Gu, National Institute of Standards and Technology (USA) . . . . . [10370-2]

2:20 pm: **Comparison of PV module backsheet materials under multi-factor accelerated UV light exposures**, Addison G. Klink, Case Western Reserve Univ. (USA); Abdulkerim Gok, Case Western Reserve Univ. (USA) and Gebze Technical Univ. (Turkey); Roger H. French, Laura S. Bruckman, Case Western Reserve Univ. (USA) . . . . . [10370-3]

2:40 pm: **Characterizing the weathering induced changes in the optical performance and properties of poly(ethylene-terephthalate) via MaPd:RTS spectroscopy** (*Invited Paper*), Devin A. Gordon, Case Western Reserve Univ. (USA); Lin DeNoyer, Deconvolution & Entropy Consulting (USA); Corey W. Meyer, Noah W. Sweet, Case Western Reserve Univ. (USA); David M. Burns, 3M Co. (USA); Laura S. Bruckman, Roger H. French, Case Western Reserve Univ. (USA) [10370-4]

Coffee Break . . . . . Sun 3:10 pm to 3:40 pm

#### SESSION 2

LOCATION: CONV. CTR. ROOM 12 . . . . SUN 3:40 PM TO 4:40 PM

#### Field to Chamber Comparison

Session Chair: **Michael D. Kempe**, National Renewable Energy Lab. (USA)

3:40 pm: **Comparison of modeled and experimental PV array temperature profiles for accurate interpretation of module performance and degradation**, Teri Elwood, Kelly Simmons-Potter, The Univ. of Arizona (USA) . . . . . [10370-5]

4:00 pm: **Artifact-free coring of solar modules**, Helio R. Moutinho, Steve Johnston, Bobby To, Chun-Sheng Jiang, Chuanxiao Xiao, Peter Hacke, John Moseley, Jerry Tynan, National Renewable Energy Lab. (USA); Neelkanth G. Dhere, Univ. of Central Florida (USA); Mowafak M. Al-Jassim, National Renewable Energy Lab. (USA) . . . . . [10370-6]

4:20 pm: **Temperature coefficient of power (Pmax) of field aged PV modules: Impact on performance ratio and degradation rate determinations**, Farrukh Mahmood, Hatif Majeed, Haider Agha, Saddam Ali, USPCAS-E, National Univ. of Sciences and Technology (Pakistan); Sai Tatapudi, Telia Curtis, GovindaSamy TamizhMani, Arizona State Univ. (USA) . . . . . [10370-22]

#### SESSION 3

LOCATION: CONV. CTR. ROOM 12 . . . . SUN 4:40 PM TO 5:30 PM

#### Thin Film Durability

Session Chair: **Michael D. Kempe**, National Renewable Energy Lab. (USA)

4:40 pm: **Exposure of CIGS solar cells to negative, zero and positive electrical biases in a damp-heat illumination environment** (*Invited Paper*), Mirjam Theelen, TNO (Netherlands) and Solliance (Netherlands); Klaas Bakker, Energy Research Ctr. of the Netherlands (Netherlands) and Solliance (Netherlands); Henk Steijvers, Gabriela De Amorim Soares, Soheyl Mortazavi, TNO (Netherlands) and Solliance (Netherlands); Jeroen Vink, ReRa Solutions B.V. (Netherlands); Nicolas Barreau, Institut des Matériaux Jean Rouxel (France); Erik Haverkamp, ReRa Solutions B.V. (Netherlands) . . . . . [10370-7]

5:10 pm: **Ultrashort pulsed laser ablation for decollating of solid state lithium-ion batteries**, Christian J. Hördemann, Hemanth Anand, Arnold Gillner, Fraunhofer-Institut für Lasertechnik (Germany) . . . . . [10370-17]

LOCATION: CONV. CTR. ROOM 6A . . SUN 6:00 PM TO 7:50 PM

#### Technology Hot Topics: How Optics and Photonics Drive Innovation

6:00 pm to 6:10 pm: **Welcome and Opening Remarks**

6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)

6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)

6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)

7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)

7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)

# CONFERENCE 10370

MONDAY 7 AUGUST

## SESSION 4

LOCATION: CONV. CTR. ROOM 12 . . . MON 8:30 AM TO 9:30 AM

### General PV Module Construction and Deployment

Session Chair: **Neelkanth G. Dhere**, Univ. of Central Florida (USA)

8:30 am: **Impact of PID on industrial roof-top PV-installations**, Claudia Buerhop-Lutz, Frank W. Fecher, Tobias Pickel, Tirth Patel, Bayerisches Zentrum für Angewandte Energieforschung e.V. (Germany); Cornelia Zetzmann, Rauschert GmbH (Germany); Christian Camus, Jens A. Hauch, Bayerisches Zentrum für Angewandte Energieforschung e.V. (Germany); Christoph J. Brabec, Bayerisches Zentrum für Angewandte Energieforschung e.V. (Germany) and i-MEET (Germany) . . . . . [10370-9]

8:50 am: **Effect of bias application or light irradiation during PID tests of CIGS modules and crystalline silicon modules**, Keiichiro Sakurai, Kinichi Ogawa, Hajime Shibata, Atsushi Masuda, National Institute of Advanced Industrial Science and Technology (Japan); Hiroshi Tomita, Darshan Schmitz, Shuuji Tokuda, Solar Frontier K.K. (Japan) . . . . . [10370-10]

9:10 am: **Mitigation of PID in commercial PV modules using current interruption method**, Birinchi Bora, National Institute of Solar Energy (India), TERI Univ. (India); Jaewon Oh, Sai Tatapudi, Arizona State Univ. (USA); Oruganty Sastry, Rajesh Kumar, National Institute of Solar Energy (India); Basudev Prasad, TERI Univ. (India); Govindasamy Tamizhmani, Arizona State Univ. (USA) . . . . [10370-21]

## SESSION 5

LOCATION: CONV. CTR. ROOM 12 . . . MON 9:30 AM TO 12:20 PM

### General PV Module Construction of Field Arrays

Session Chair: **Keiichiro Sakurai**, National Institute of Advanced Industrial Science and Technology (Japan)

9:30 am: **Development of calibration standards for extremely low permeation measurement** (*Invited Paper*), Michael D. Kempe, Matthew O. Reese, Arrelaine A. Dameron, Dylan L. Nobles, Talysa R. Klein, Byron McDanald, National Renewable Energy Lab. (USA) . . . . . [10370-11]

10:00 am: **Conducting paste based soldering process for thin crystalline silicon photovoltaic module**, Hyung-Jun Song, Woo Gyun Shin, Ga Eon Jin, Gi-Hwan Kang, Korea Institute of Energy Research (Korea, Republic of) . . . . . [10370-12]

Coffee Break . . . . . Mon 10:20 am to 10:50 am

10:50 am: **Data acquisition and PV module power production in upgraded TEP/AzRISE solar test yard**, Whit Bennett, Asher Fishgold, Barrett G. Potter Jr., Kelly Simmons-Potter, The Univ. of Arizona (USA) . . . . . [10370-13]

11:10 am: **Analyzing the degradation of pre-damaged PV-modules** (*Invited Paper*), Claudia Buerhop-Lutz, Sven Wirsching, Tobias Pickel, Christian Camus, Jens A. Hauch, Bayerisches Zentrum für Angewandte Energieforschung e.V. (Germany); Christoph J. Brabec, Bayerisches Zentrum für Angewandte Energieforschung e.V. (Germany) and i-MEET (Germany) . . . . . [10370-14]

11:40 am: **Numerical simulation of wind flow over a photovoltaic solar panel using RANS equations**, Andre Luiz Tenorio Rezende, Instituto Militar de Engenharia (Brazil) and Ctr. Univ. Augusto Motta - UNISUAM (Brazil); Katherine B. M. Leitão, Univ. Veiga de Almeida (Brazil); Neelkanth G. Dhere, Univ. of Central Florida (USA) . . . . . [10370-15]

12:00 pm: **Comparison of efficiency degradation in polycrystalline-Si and CdTe thin-film PV modules via accelerated lifecycle testing**, Teh Lai, Barrett G. Potter Jr., Kelly Simmons-Potter, The Univ. of Arizona (USA) . . . . . [10370-20]

Lunch Break . . . . . Mon 12:20 pm to 2:00 pm

LOCATION: CONV. CTR. ROOM 6A . MON 2:00 PM TO 3:30 PM

### Optics + Photonics for Sustainable Energy Plenary Session

2:00 pm: **A Brief History of Photovoltaics: Yesterday, Today, and Tomorrow** (*Plenary*), Charles Gay, U.S. Dept. of Energy (USA) . . . . . [10368-201]

2:30 pm: **Photovoltaics Moving into the Terawatt Age** (*Plenary*), Eicke R. Weber, Berkeley Education Alliance for Research in Singapore BEARS (Singapore) and Univ. of California, Berkeley (USA) . . . . . [10368-202]

3:00 pm: **Bankability of Novel Energy Technologies** (*Plenary*), Ralph Romero, Black & Veatch (USA) . . . . . [10368-203]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 . . . . . MON 5:30 PM TO 7:30 PM

### Posters-Monday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Image analysis of PV module electroluminescence**, Teh Lai, Claudia Ramirez, Barrett G. Potter Jr., Kelly Simmons-Potter, The Univ. of Arizona (USA) . [10370-16]

**Model development of degradation of PV modules backsheet with locating place of module**, Yu Wang, Case Western Reserve Univ. (USA); Sebastien Merzlic, Arkema Research Ctr. (USA); Andrew Fairbrother, National Institute of Standards and Technology (USA); Lucas Fridman, Case Western Reserve Univ. (USA); Scott Julien, Northeastern Univ. (USA); Amy A. Lefebvre, Arkema Research Ctr. (USA); Xiaohong Gu, National Institute of Standards and Technology (USA); Liang Ji, Kenneth P. Boyce, Underwriters Labs. Inc. (USA); Michael D. Kempe, National Renewable Energy Lab. (USA); Kai-Tak Wan, Northeastern Univ. (USA); Roger H. French, Laura S. Bruckman, Case Western Reserve Univ. (USA) . . . . . [10370-18]



# CONFERENCE 10371

LOCATION: CONV. CTR. ROOM 17B

Wednesday–Thursday 9–10 August 2017 • Proceedings of SPIE Vol. 10371

## Optomechanical Engineering 2017

Conference Chairs: **Alson E. Hatheway**, Alson E. Hatheway Inc. (USA); **David M. Stubbs**, Lockheed Martin Space Systems Co. (USA)

Program Committee: **Anees Ahmad**, Raytheon Missile Systems (USA); **Patrick A. Bournes**, MicroMeasure, Inc. (USA); **James H. Burge**, College of Optical Sciences, The Univ. of Arizona (USA); **John M. Casstevens**, Dallas Optical Systems, Inc. (USA); **Robert Gifford Chave**, RCAP Inc. (USA); **Patrick A. Coronato**, Raytheon Missile Systems (USA); **John G. Daly**, Vector Engineering (USA); **Keith B. Doyle**, MIT Lincoln Lab. (USA); **Robert C. Guyer**, BAE Systems (USA); **Mark J. Hegge**, Ball Aerospace & Technologies Corp. (USA); **Tony Hull**, Univ. of New Mexico at Albuquerque (USA); **Frank W. Kan**, Simpson Gumpertz & Heger Inc. (USA); **William Jeffrey Lees**, Johns Hopkins Univ. Applied Physics Lab. (USA); **John J. Polizotti**, BAE Systems (USA); **Santiago Royo Royo**, Univ. Politècnica de Catalunya (Spain); **Ann F. Shipley**, Univ. of Colorado at Boulder (USA); **Deming Shu**, Argonne National Lab. (USA); **Linda C. Usher**, Executive Search Group (USA); **Daniel Vukobratovich**, Raytheon Missile Systems (USA); **Carl H. Zweben**, Consultant (USA)

### TUESDAY 8 AUGUST

LOCATION: MARRIOTT MARQUIS,  
MISSION HILLS ..... 8:00 PM TO 10:00 PM

#### Optomechanical/Instrument Technical Group Event

Session Chair: **Alson E. Hatheway**, Alson E. Hatheway Inc. (USA)

This is the annual meeting of the premier group of optomechanical engineers that design and analyze the world's optical instruments and systems. This gathering is open to all technical attendees of SPIE Optics+Photonics. The feature speaker will be Daniel Vukobratovich of Raytheon Missile Systems, and a co-founder and previous chairman of our Optomechanical/Instrument Technical Group. Following Dan, the floor will be open for other agenda items and a workshop session on Problems and Solutions.

### WEDNESDAY 9 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 17B . . . WED 9:00 AM TO 10:15 AM

#### Adhesives and Materials

Session Chair: **Alson E. Hatheway**, Alson E. Hatheway Inc. (USA)

9:00 am: **Adhesive bonds for optics: analysis and trade-offs**, John G. Daly, Vector Engineering (USA); Matthew D. Hawk, M. Hawk Consulting (USA). [10371-1]

9:25 am: **Advancements in adhesive mounting of optics**, Brian M. McMaster, Corning Tropol Corp. (USA). [10371-2]

9:50 am: **ZERODUR - bending strength: review of achievements**, Peter Hartmann, SCHOTT AG (Germany). [10371-4]

Coffee Break ..... Wed 10:15 am to 10:40 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 17B WED 10:40 AM TO 11:30 AM

#### Elements

Session Chair: **Carl H. Zweben**, Consultant (USA)

10:40 am: **2- $\mu$ m optical time domain reflectometry measurements from novel Al-, Ge-, CaAlSi- doped and standard single-mode fibers**, Jose Rodriguez-Novelo, Ctr. de Investigación e Innovación Tecnológica (Mexico); Abel Sanchez-Nieves, Instituto Politécnico Nacional (Mexico); Abraham Sierra-Calderon, Jose A. Alvarez-Chavez, Ctr. de Investigación e Innovación Tecnológica (Mexico) [10371-5]

11:05 am: **Large area of MCP electronic rinse system design**, YaFeng Qiu, ChengXin Song, Nanjing Univ. of Science and Technology (China). [10371-6]

Lunch/Exhibition Break ..... Wed 11:30 am to 1:00 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 17B . . . WED 1:00 PM TO 2:15 PM

#### Optomechanical Analysis I

Session Chair: **Anees Ahmad**, Raytheon Missile Systems (USA)

1:00 pm: **LLIMAS: Revolutionizing integrated modeling and analysis at MIT Lincoln Laboratory**, Keith B. Doyle, Gerhard P. Stoeckel, Justin J. Rey, MIT Lincoln Lab. (USA). [10371-7]

1:25 pm: **The diffraction grating in Ivory's optomechanical constraint equations**, Alson E. Hatheway, Alson E. Hatheway Inc. (USA) [10371-8]

1:50 pm: **Linear analysis using secants for materials with temperature dependent nonlinear elastic modulus and thermal expansion properties**, John W. Pepi, L-3 SSG (USA) [10371-9]

#### SESSION 4

LOCATION: CONV. CTR. ROOM 17B . . . WED 2:15 PM TO 3:30 PM

#### Optomechanical Systems I

Session Chair: **William Jeffrey Lees**, Johns Hopkins Univ. Applied Physics Lab., LLC (USA)

2:15 pm: **System engineering of complex optical systems for mission assurance and affordability**, Anees Ahmad, Raytheon Missile Systems (USA) [10371-10]

2:40 pm: **Optoelectronic methods and tools for pipeline's internal surface diagnosis**, Radda A. Iureva, Evgenii O. Raskin, Nadezhda K. Maltseva, ITMO Univ. (Russian Federation); Alexandr V. Ilinsky, S.I. Vavilov State Optical Institute (Russian Federation) [10371-11]

3:05 pm: **HabEx primary mirror trade studies**, Jacqueline M. Davis, H. Philip Stahl, William R. Arnold Sr., W. Scott Smith, NASA Marshall Space Flight Ctr. (USA) [10371-12]

Coffee Break ..... Wed 3:30 pm to 4:00 pm

# CONFERENCE 10371

## SESSION 5

LOCATION: CONV. CTR. ROOM 17B . . WED 4:00 PM TO 6:05 PM

### Stability and Alignment

Session Chair: **David M. Stubbs**, Lockheed Martin Space Systems Co. (USA)

4:00 pm: **Design and test of precision vertical and horizontal linear nanopositioning flexure stages with centimeter-level travel range for x-ray instrumentation**, Deming Shu, Barry Lai, Steven P. Kearney, Argonne National Lab. (USA); Jayson Anton, Argonne National Lab. (USA) and Univ. of Illinois at Chicago (USA); Wenjun Liu, Jörg Maser, Christian Roehrig, Argonne National Lab. (USA); Jonathan Z. Tischler, Oak Ridge National Lab. (USA) . . . . . [10371-13]

4:25 pm: **Trajectory error analysis of a flexure pivot-type guide for linear nanopositioning**, Steven P. Kearney, Deming Shu, Argonne National Lab. (USA) . . . . . [10371-14]

4:50 pm: **The development of alignment turning system for precision lens cells**, Chien-Yao Huang, Cheng-Fang Ho, Wang Jung-Hsing, Lin Yi-hao, Chien-Kai Chung, Jun-Cheng Chen, Keng-Souo Chang, Kuo Ching-Hsiang, Wei-Yao Hsu, Instrument Technology Research Ctr. (Taiwan) . . . . . [10371-15]

5:15 pm: **Lithography lens mounting flexure design and aberration analysis**, Ming-Ying Hsu, Ting-Ming Huang, Instrument Technology Research Ctr. (Taiwan) . . . . . [10371-16]

5:40 pm: **Double Arm Linkage precision Linear motion (DALL) carriage: A simplified, rugged, high-performance linear motion stage for the moving mirror of an FTS (Fourier Transform Spectrometer) or other system requiring precision linear motion**, Kendall B. Johnson, Greg Hopkins, Space Dynamics Lab. (USA) . . . . . [10371-17]

LOCATION: CONV. CTR. EXHIBIT HALL B2 . . . . . WED 5:30 PM TO 7:30 PM

### Posters-Wednesday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Mirrors design, analysis, and manufacturing of the 550mm Korsch telescope experimental model**, Po-Hsuan Huang, Yi-Kai Huang, Jer Ling, National Space Organization (Taiwan) . . . . . [10371-29]

**Optimization of a sixteen-inch diameter primary mirror assembly of a ground-based telescope**, Yi-Kai Huang, Po-Hsuan Huang, National Space Organization (Taiwan); Chien-Wen Shen, Guan Sheng Optical Co., Ltd. (Taiwan) . . . . [10371-30]

**Development of an athermalized optomechanical system of large-aperture remote sensing instruments**, Chia-Yen Chan, Shenq-Tsong Chang, Ting-Ming Huang, Instrument Technology Research Ctr. (Taiwan) . . . . . [10371-31]

**Removal of diamond turning marks on an off-axis optics with magneto-rheological finishing**, Sangwon Hyun, Korea Basic Science Institute (Korea, Republic of); Min-Woo Jeon, Korea Basic Science Institute (Korea, Republic of) and Chungnam National Univ. (Korea, Republic of); Byeong-Joon Jeong, I. Jong Kim, Geon-Hee Kim, Korea Basic Science Institute (Korea, Republic of) . . . . [10371-32]

**Method validation of measurement of power flux of a flame with a thermopile for flame test of materials**, José G. Suárez-Romero, Instituto Tecnológico de Querétaro (Mexico) . . . . . [10371-33]

## THURSDAY 10 AUGUST

### SESSION 6

LOCATION: CONV. CTR. ROOM 17B . . . THU 8:00 AM TO 9:15 AM

### Optomechanical Analysis II

Session Chair: **Mark J. Hegge**, Ball Aerospace & Technologies Corp. (USA)

8:00 am: **Analysis technique for controlling system wavefront error with active optics**, Victor L. Genberg, Gregory J. Michels, Sigmadyne, Inc. (USA) . . [10371-18]

8:25 am: **Using integrated models to minimize environmentally induced wavefront error in optomechanical design and analysis**, Victor L. Genberg, Gregory J. Michels, Sigmadyne, Inc. (USA) . . . . . [10371-19]

8:50 am: **Using multidisciplinary optimization For CCD shim design in the transiting exoplanet survey satellite**, Gerhard P. Stoeckel IV, Keith B. Doyle, MIT Lincoln Lab. (USA) . . . . . [10371-20]

### SESSION 7

LOCATION: CONV. CTR. ROOM 17B . . . THU 9:15 AM TO 10:30 AM

### Mounting

Session Chair: **Alson E. Hatheway**, Alson E. Hatheway Inc. (USA)

9:15 am: **Adaptive optics mounting method for higher second harmonic generation efficiency of large aperture KDP crystal**, Zheng Zhang, Hui Wang, Menjiya Tian, Tsinghua Univ. (China); Xusong Quan, China Academy of Engineering Physics (China); Yiming Rong, South Univ. of Science and Technology of China (China) . . . . . [10371-21]

9:40 am: **Pre-construction results of giant steerable science mirror for TMT**, Fei Yang, Hongchao Zhao, Qichang An, Peng Guo, Haibo Jiang, Changchun Institute of Optics, Fine Mechanics and Physics (China) . . . . . [10371-22]

10:05 am: **Cryogenic, infrared, optical beamsplitter wavefront error analysis and test**, Trent Newswander, Tyrel Rupp, Space Dynamics Lab. (USA) . [10371-23]

Coffee Break . . . . . Thu 10:30 am to 11:00 am

### SESSION 8

LOCATION: CONV. CTR. ROOM 17B . . . THU 11:00 AM TO 1:00 PM

### Optomechanical Systems II

Session Chair: **Alson E. Hatheway**, Alson E. Hatheway Inc. (USA)

11:00 am: **Optomechanical design of TMT NFIRAOS subsystems at INO**, Frédéric Lamontagne, Nichola Desnoyers, Martin Grenier, Pierre Cottin, Mélanie Leclerc, Olivier Martin, Louis Buteau-Vaillancourt, INO (Canada); Marc-André Boucher, OMP inc. (Canada); Reston Nash, California Institute of Technology (USA); Olivier Lardière, David Andersen, Jenny Atwood, Alexis Hill, Peter W. G. Byrnes, Glen Herriot, Joeleff Fitzsimmons, Jean-Pierre Véran, National Research Council of Canada (Canada) . . . . . [10371-24]

11:25 am: **Recent advancements in robotic micro-optical assembly at Lockheed Martin Optical Payload Center of Excellence**, David Hwang, Lockheed Martin Coherent Technologies (USA) . . . . . [10371-25]

11:50 am: **The optomechanical design process: from vision to reality**, E. Todd Kvamme, David M. Stubbs, Michael S. Jacoby, Isaac Weingrod, Lockheed Martin Space Systems Co. (USA) . . . . . [10371-26]

12:15 pm: **The theory of acousto-optical correlator the radio signals and generalized superposition principle**, Georgy I. Korol, Saint-Petersburg State Univ. of Aerospace Instrumentation (Russian Federation) . . . . . [10371-27]

12:40 pm: **Comparison of lenses' thermal expansion formulation in Zemax versus ANSYS with SigFit post processing**, Joao Faria, José Alves, Eduardo Pereira, University of Minho (Portugal) . . . . . [10371-34]

# CONFERENCE 10372

LOCATION: CONV. CTR. ROOM 17A

Monday 7 August 2017 • Proceedings of SPIE Vol. 10372

## Material Technologies and Applications to Optics, Structures, Components, and Sub-Systems III

Conference Chairs: **Matthias Krödel**, ECM GmbH (Germany); **Joseph L. Robichaud**, L-3 Communications SSG (USA); **Bill A. Goodman**, Goodman Technologies LLC (USA)

Program Committee: **A. Marcel Bluth**, ATK Aerospace Structures (USA); **Nathan Carlie**, SCHOTT North America, Inc. (USA); **Richard A. Haber**, Rutgers, The State Univ. of New Jersey (USA); **Haeng Bok Lee**, Agency for Defense Development (Korea, Republic of); **Rob Michel**, Materion Technical Materials (USA); **Ted Mooney**, Harris Corp. (USA); **Takao Nakagawa**, Japan Aerospace Exploration Agency (Japan); **Tsuyoshi Ozaki**, Composites Research and Development Co., Ltd. (Japan); **John W. Pepi**, L-3 Communications SSG-Tinsley (USA); **Stefan Risse**, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); **Michael N. Sweeney**, General Dynamics-Global Imaging Technologies (USA)

### SUNDAY 6 AUGUST

LOCATION: CONV. CTR. ROOM 6A . . SUN 6:00 PM TO 7:50 PM

#### Technology Hot Topics: How Optics and Photonics Drive Innovation

- 6:00 pm to 6:10 pm: **Welcome and Opening Remarks**
- 6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)
- 6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)
- 6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)
- 7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)
- 7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)

### MONDAY 7 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 17A . . MON 8:30 AM TO 10:10 AM

#### Metals

Session Chair: **Rob Michel**, Materion Technical Materials (USA)

- 8:30 am: **High stability and low thermal expansion alloy (Fe<sub>36</sub>Ni) reinforced with Si<sub>3</sub>N<sub>4</sub>**, Timothy A. Stephenson, NASA Goddard Space Flight Ctr. (USA) . . . [10372-1]
- 8:50 am: **Mechanical alloyed aluminum metal matrix composites (MMC)**, Don H. Hashiguchi, Materion Brush Beryllium & Composites (USA); David Tricker, Andrew D. Tarrant, Materion Aerospace Metal Composites Ltd. (United Kingdom) . . . [10372-2]
- 9:10 am: **Enhanced aluminum reflecting and metal-dielectric solar blind filter coatings for the far-ultraviolet**, Javier Del Hoyo, Manuel A. Quijada, NASA Goddard Space Flight Ctr. (USA) . . . [10372-3]
- 9:30 am: **Characterization of PDMS samples varying its synthesis parameters for tunable optics applications**, Josimar Marquez-Garcia, Jorge González García, Angel S. Cruz-Félix, Agustín Santiago Alvarado, Univ. Tecnológica de la Mixteca (Mexico) . . . [10372-4]
- 9:50 am: **Visualization of diffusion mixing in a micro-mixer with flow paths fabricated by photolithography**, Toshiyuki Horiuchi, Yuta Morizane, Tokyo Denki Univ. (Japan) . . . [10372-18]
- Coffee Break . . . . . Mon 10:10 am to 10:40 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 17A MON 10:40 AM TO 12:00 PM

#### Glass Materials

Session Chair: **John W. Pepi**, L-3 SSG (USA)

- 10:40 am: **Interfacial studies of a metallurgical bond between "activated" ultrasonically applied solder and high-purity fused silica**, Lawrence W. Shacklette, Harris Corp. (USA); Donna L. Gerrity, E&S Consulting, Inc. (USA); Michael R. Lange, James C. Beachboard, Harris Corp. (USA); Ronald Smith, S-Bond Technologies, LLC (USA) . . . . . [10372-6]
- 11:00 am: **Comparison of material properties between ultra low thermal expansion ceramics and conventional low thermal expansion glasses**, Tomohiro Kamiya, Tadahito Mizutani, Japan Aerospace Exploration Agency (Japan) . . . . . [10372-7]
- 11:20 am: **Inverse problem of Bragg's scattering for measuring the spectrum surface roughness in the optical gradient waveguide**, Anatoly N. Osovitsky, Natalia Grishaeva, Peoples' Friendship Univ. of Russia (Russian Federation); Nikolai D. Espinosa Ortiz, Christian Vega, Army Polytechnic School (Ecuador) . . . [10372-8]
- 11:40 am: **Thermal and mechanical properties of tellurite glasses for mid-IR molded lens applications**, Ju Choi, Linganna Kadathala, Eui S. Lee, Ganesh L. Agawane, Korea Photonics Technology Institute (Korea, Republic of) . . . [10372-9]
- Lunch Break . . . . . Mon 12:00 pm to 1:50 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 17A . . . MON 1:50 PM TO 3:00 PM

#### Fabrication Processes

Session Chair: **Matthias Krödel**, ECM Engineered Ceramic Materials GmbH (Germany)

- 1:50 pm: **A review on the advances in 3D printing and additive manufacturing of ceramics and ceramic matrix composites for optical applications** (*Invited Paper*), William A. Goodman, Goodman Technologies, LLC (USA) . . . . . [10372-10]
- 2:20 pm: **Nano-diamond polishing of super hard materials**, Rajiv Singh, Arul Chakkaravarthi Arjunan, Sinmat, Inc. (USA) . . . . . [10372-11]
- 2:40 pm: **Time scales of radiation damage decay in five optical materials**, Frank U. Grupp, Univ.-Sternwarte München (Germany) and Max-Planck-Institut für extraterrestrische Physik (Germany); Norbert Geis, Reinhard Katterloher, Max-Planck-Institut für extraterrestrische Physik (Germany); Ralf Bender, Max-Planck-Institut für extraterrestrische Physik (Germany) and Univ.-Sternwarte München (Germany) . . . . . [10372-12]
- Coffee Break . . . . . Mon 3:00 pm to 3:30 pm



# CONFERENCE 10372

## SESSION 4

LOCATION: CONV. CTR. ROOM 17A . . . MON 3:30 PM TO 5:20 PM

### Ceramics and Composites

Session Chair: **Bill A. Goodman**, Goodman Technologies LLC (USA)

- 3:30 pm: **A rigid and thermally stable all-ceramic optical support bench assembly for the LSST Camera** (*Invited Paper*), Matthias Krödel, ECM Engineered Ceramic Materials GmbH (Germany); J. Brian Langton, SLAC National Accelerator Lab. (USA); Bill Wahl, Brookhaven National Lab. (USA) . . . . . [10372-13]
- 4:00 pm: **Quality evaluation of spaceborne SiC mirrors: the effects on mirror accuracy by variation in the thermal expansion property of the mirror surface**, Masaki Kotani, Tadashi Imai, Haruyoshi Katayama, Japan Aerospace Exploration Agency (Japan); Hidehiro Kaneda, Nagoya Univ. (Japan); Takao Nakagawa, Keigo Enya, Japan Aerospace Exploration Agency (Japan) . . . . . [10372-14]
- 4:20 pm: **Dimensional stability performance of a CFRP sandwich optical bench for microsatellite payload**, Nichola Desnoyers, Philippe Goyette, Bruno Leduc, INO (Canada); Marc-André Boucher, OMP Inc. (Canada). . . . . [10372-15]
- 4:40 pm: **Challenges of designing and testing a highly stable sensor platform: HB-Cesic solves MTG star sensor bracket thermo-elastic requirements**, Matthias Krödel, ECM Engineered Ceramic Materials GmbH (Germany); Christoph Zauner, KRP-Mechatec Engineering GbR (Germany). . . . . [10372-16]
- 5:00 pm: **Trade-off studies on LiteBIRD reflectors**, Hajime Sugai, Tomotake Matsumura, Kavli Institute for the Physics and Mathematics of the Universe (Japan); Junichi Suzuki, Muneyoshi Maki, Masashi Hazumi, High Energy Accelerator Research Organization, KEK (Japan); Nobuhiko Katayama, Shin Utsunomiya, Shingo Kashima, Yuki Sakurai, Kavli Institute for the Physics and Mathematics of the Universe (Japan); Hiroaki Imada, Japan Aerospace Exploration Agency (Japan); Hirokazu Ishino, Okayama Univ. (Japan); Takenori Fujii, Cryogenic Research Ctr., The Univ. of Tokyo (Japan) . . . . . [10372-17]

LOCATION: CONV. CTR.  
EXHIBIT HALL B2 . . . . . MON 5:30 PM TO 7:30 PM

### Posters-Monday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Manipulation of microbubbles through the phenomenon of thermocapillarity**, Julio Aurelio Sarabia-Alonso Sr., Univ. Politécnica de Tulancingo (Mexico); Jose Gabriel Ortega-Mendoza, Univ. Tecnológica de Tulancingo (Mexico) . . . . [10372-5]

**Successful fabrication of GaN epitaxial layer on non-catalytically-grown graphene for smart packages**, Sungwon Hwang, Kyung-Jin Yeum, Konkuk Univ. (Korea, Republic of). . . . . [10372-19]

**Characterization of ancient Chinese porcelains using optical coherence tomography**, Song Liu, Qinghui Li, Shanghai Institute of Optics and Fine Mechanics (China); Yongqing Hu, Henan Provincial Institute of Cultural Relics and Archaeology (China) . . . . . [10372-20]

**Polishing aspheric mirrors of zero-thermal expansion cordierite ceramics (NEXCERA) for space telescopes**, Jun Sugawara, Bumpei Mikashima, Krosaki Harima Corp. (Japan); Tomohiro Kamiya, Japan Aerospace Exploration Agency (Japan). . . . . [10372-21]

# CONFERENCE 10373

LOCATION: CONV. CTR. ROOM 17A

Tuesday–Wednesday 8–9 August 2017 • Proceedings of SPIE Vol. 10373

## Applied Optical Metrology II

Conference Chairs: **Erik Novak**, 4D Technology Corp. (USA); **James D. Trolinger**, MetroLaser, Inc. (USA)

Program Committee: **Anand Krishna Asundi**, d'Optron Pte. Ltd. (Singapore); **Angela Davies**, The Univ. of North Carolina at Charlotte (USA); **Peter J. de Groot**, Zygo Corporation (USA); **Sen Han**, Univ. of Shanghai for Science and Technology (China); **Kevin G. Harding**, GE Global Research (USA); **Pengda Hong**, Lehigh Univ. (USA); **Richard K. Leach**, National Physical Lab. (United Kingdom); **Kate Medicus**, Optimax Systems, Inc. (USA); **Matthew J. Novak**, Technical Optics, Inc. (USA); **Levent Onural**, Bilkent Univ. (Turkey); **Peter Roos**, Bridger Photonics, Inc. (USA); **Toru Yoshizawa**, 3D Associates (Japan)

### TUESDAY 8 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 17A . . . TUE 8:20 AM TO 10:10 AM

#### 3D Shape Measurement

Session Chair: **Erik Novak**, 4D Technology Corp. (USA)

8:20 am: **Usefulness of orthogonal basis sets for predicting optical performance of wavefronts with mid-spatial frequency error** (*Invited Paper*), Zahra Hosseinimakarem, Angela Davies, Christopher J. Evans, The Univ. of North Carolina at Charlotte (USA) . . . . . [10373-1]

8:50 am: **Improvement of accuracy in inner profile measurement of pipes and holes using an optical probe**, Toru Yoshizawa, Tokyo Univ. of Agriculture and Technology (Japan) and NPO 3D Associates (Japan); Toshitaka Wakayama, Saitama Medical Univ. (Japan) . . . . . [10373-3]

9:10 am: **Fusion of light-field and photogrammetric surface form data**, Danny Sims-Waterhouse, Samanta Piano, Richard K. Leach, The Univ. of Nottingham (United Kingdom) . . . . . [10373-4]

9:30 am: **Expansion of measurement area of three-dimensional deformation measurement speckle interferometry with same sensitivities in three directions under consideration of measurement sensitivity**, Yasuhiko Arai, Kansai Univ. (Japan) . . . . . [10373-5]

9:50 am: **3D boundary extraction strategy using vector slices for the inspection of sheet parts**, Liqun Ma, Changcheng Institute of Metrology & Measurement (China); Jingjing Fan, Yongqian Li, Northwestern Polytechnical Univ. (China); Zili Zhou, Changcheng Institute of Metrology & Measurement (China) . . . . . [10373-6]

Coffee Break . . . . . Tue 10:10 am to 10:40 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 17A TUE 10:40 AM TO 12:00 PM

#### Polarization Measurement and Techniques

Session Chair: **Pengda Hong**, Lehigh Univ. (USA)

10:40 am: **Application of polarization in high-speed, high-contrast inspection of sheet parts**, Liqun Ma, Changcheng Institute of Metrology & Measurement (China); Jingjing Fan, Yongqian Li, Northwestern Polytechnical Univ. (China); Zili Zhou, Changcheng Institute of Metrology & Measurement (China) . . . . . [10373-7]

11:00 am: **Deploying Mueller matrix polarimeter for characterizing diattenuation and retardation of subwavelength structure**, Achyut Adhikari, Nanyang Technological Univ. (Singapore) . . . . . [10373-8]

11:20 am: **Measurement of polarization state of light using in-plane spin splitting**, Xiaodong Qiu, Zhaoxue Li, Zhiyou Zhang, Jinglei Du, Sichuan Univ. (China) . . . . . [10373-9]

11:40 am: **The photonic spin Hall effect sensor**, Linguo Xie, Zhiyou Zhang, Jinglei Du, Sichuan Univ. (China) . . . . . [10373-10]

Lunch/Exhibition Break . . . . . Tue 12:00 pm to 1:30 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 17A . . . . TUE 1:30 PM TO 3:30 PM

#### Fine Scale Feature Metrology

Session Chair: **Angela Davies**, The Univ. of North Carolina at Charlotte (USA)

1:30 pm: **Vibration-immune compact optical metrology to enable production-line quantification of fine scale features**, Erik Novak, 4D Technology Corp. (USA) . . . . . [10373-11]

1:50 pm: **Experimental investigation of natural convection in a rectangular cavity with two protruded half cylinders using a Mach-Zehnder interferometer**, Akhil Krishnan Maliackal, Angarai R. Ganesan, Annamalai Mani, Indian Institute of Technology Madras (India) . . . . . [10373-13]

2:10 pm: **Authentication system using resonance evaluation spectroscopy (ASSURES)**, Amit K. Lal, OMS Corp. (United States); James D. Trolinger, MetroLaser, Inc. (United States); Dave Dimas, Univ. of California, Irvine (United States) . . . . . [10373-14]

2:30 pm: **Optical mapping of surface roughnesses by implementation of a spatial light modulator**, Laura M. Aulbach, Franziska Pöller, Min Lu, Shengjia Wang, Alexander W. Koch, Technische Univ. München (Germany) . . . . . [10373-15]

2:50 pm: **Effective technique for evaluation of periodically-poled ferroelectric waveguide domains with nanoscale resolution based on frequency mixing**, Pengda Hong, Yujie J. Ding, Lehigh Univ. (USA) . . . . . [10373-12]

Coffee Break . . . . . Tue 3:10 pm to 3:40 pm

3:10 pm: **Dimensional metrology of micro structure based on modulation depth in scanning broadband light interferometry**, Yi Zhou, Yan Tang, Qinyuan Deng, Lixin Zhao, Song Hu, Institute of Optics and Electronics, Chinese Academy of Sciences (China) . . . . . [10373-38]

LOCATION: CONV. CTR. ROOM 6A . . . . . 4:00 PM TO 5:30 PM

#### Optical Engineering Plenary Session

Session Chair: **Julie L. Bentley**, Univ. of Rochester (USA)

4:00 pm: **Welcome and Opening Remarks**

4:05 pm: **Designing for one to one-million: how production quantities influence design** (*Plenary*), Leo B. Baldwin, Amazon.com, Inc. (USA) . . . . . [10376-201]

4:50 pm: **The Large Synoptic Survey Telescope** (*Plenary*), Steven Kahn, Large Synoptic Survey Telescope (USA) and SLAC National Accelerator Lab. (USA) . . . . . [10401-202]

LOCATION: MARRIOTT MARQUIS,  
MISSION HILLS . . . . . 8:00 PM TO 10:00 PM

#### Optomechanical/Instrument Technical Group Event

Session Chair: **Alson E. Hatheway**, Alson E. Hatheway Inc. (USA)

This is the annual meeting of the premier group of optomechanical engineers that design and analyze the world's optical instruments and systems. This gathering is open to all technical attendees of SPIE Optics+Photonics. The feature speaker will be Daniel Vukobratovich of Raytheon Missile Systems, and a co-founder and previous chairman of our Optomechanical/Instrument Technical Group. Following Dan, the floor will be open for other agenda items and a workshop session on Problems and Solutions.

# CONFERENCE 10373

WEDNESDAY 9 AUGUST

## SESSION 4

LOCATION: CONV. CTR. ROOM 17A . . . WED 8:30 AM TO 10:10 AM

### Optical Testing

Session Chair: **Sen Han**, Univ. of Shanghai for Science and Technology (China)

8:30 am: **Phase measuring deflectometry for determining misalignment of segmented mirrors**, Angela Davies, Trent Vann, Chris Evans, The Univ. of North Carolina at Charlotte (USA) . . . . . [10373-16]

8:50 am: **Deflectometry for measuring mount-induced mirror surface deformations**, Eric H. Frater, Ball Aerospace & Technologies Corp. (USA) . . . . . [10373-17]

9:10 am: **General testing method for refractive surfaces based on reverse Hartmann test**, Ping Xu, Daodang Wang, Zhidong Gong, China Jiliang Univ. (China); Rongguang Liang, College of Optical Sciences, The Univ. of Arizona (USA); Kong Ming, Jun Zhao, China Jiliang Univ. (China) . . . . . [10373-18]

9:30 am: **Geometrical error calibration in reflective surface testing with reverse Hartmann test**, Zhidong Gong, Daodang Wang, Ping Xu, China Jiliang Univ. (China); Rongguang Liang, College of Optical Sciences, The Univ. of Arizona (USA); Ming Kong, Jun Zhao, China Jiliang Univ. (China) . . . . . [10373-20]

9:50 am: **Study of annular sub-aperture stitching interferometry for aspheric surfaces**, Zixin Zhao, Zhaoxian Xiao, Hangying Zhang, Xi'an Jiaotong Univ. (China) . . . . . [10373-21]

Coffee Break . . . . . Wed 10:10 am to 10:40 am

## SESSION 5

LOCATION: CONV. CTR. ROOM 17A WED 10:40 AM TO 12:00 PM

### Spectroscopic Techniques and Metrology

Session Chair: **James D. Trolinger**, MetroLaser, Inc. (USA)

10:40 am: **Development of an oxygen saturation measuring system using near-infrared spectroscopy**, Kirara Kono, Doshisha Univ. (Japan) . . . . . [10373-22]

11:00 am: **Metrology of semiconductor structures using novel Fabry Perot fringe stretching system**, Wojtek J. Walecki, Alexander Pravdivtsev, Frontier Semiconductor (USA) . . . . . [10373-23]

11:20 am: **Rapid, automated, quality control of diffraction grating efficiency**, Mark R. Fisher, Agilent Technologies, Inc. (USA) . . . . . [10373-24]

11:40 am: **Spatially and temporally resolved diagnostics of dense sprays using gated femtosecond digital holography**, James D. Trolinger, MetroLaser, Inc. (USA); Derek Dunn-Rankin, Ali Ziaee, Univ. of California, Irvine (USA); Andrej K. Dioumaev, MetroLaser, Inc. (USA); Marco Minniti, Univ. of California, Irvine (USA) . . . . . [10373-25]

Lunch/Exhibition Break . . . . . Wed 12:00 pm to 1:30 pm

## SESSION 6

LOCATION: CONV. CTR. ROOM 17A . . . WED 1:30 PM TO 3:20 PM

### Fringe Projection and Structured Light

Session Chair: **Matt J. Novak**, Technical Optics LLC (USA)

1:30 pm: **Multimodal and synthetic aperture approach to full-field 3D shape and displacement measurements (Invited Paper)**, Malgorzata Kujawińska, Robert Sitnik, Warsaw Univ. of Technology (Poland) . . . . . [10373-39]

2:00 pm: **Focusing schlieren systems using digitally projected grids**, Drew L'Esperance, Benjamin D. Buckner, Spectabit Optics, LLC (USA) . . . . . [10373-26]

2:20 pm: **Application of the instrument transfer function to a fringe projection system for measuring rough surfaces**, Bin Zhang, Angela Davies, John Ziegert, Christopher J. Evans, The Univ. of North Carolina at Charlotte (USA) . . . [10373-27]

2:40 pm: **A three-dimensional scanning apparatus based on structured illumination method and its application in dental scanning**, Jae Sung Ahn, Anjin Park, Korea Photonics Technology Institute (Korea, Republic of); Ju Wan Kim, Byeong Ha Lee, Gwangju Institute of Science and Technology (Korea, Republic of); Joo Beom Eom, Korea Photonics Technology Institute (Korea, Republic of) . . . . . [10373-28]

3:00 pm: **A calibration method immune to the projector errors in fringe projection profilometry**, Ruihua Zhang, Shanghai Univ. (China); Yulin Shang, Xi'an Polytechnic Univ. (China) . . . . . [10373-29]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 . . . . . WED 5:30 PM TO 7:30 PM

### Posters-Wednesday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Collimator focus check with interferometer**, Ho-Lin Tsay, Yu-Chuan Lin, Shenq-Tsong Chang, Ting-Ming Huang, Instrument Technology Research Ctr. (Taiwan) . . . . . [10373-30]

**Characterizing the surface fluctuation of an epitaxial wafer by using the Shack-Hartmann wave-front sensor**, Pao-Keng Yang, Yao-Kai Zhuang, Minghsin Univ. of Science and Technology (Taiwan) . . . . . [10373-31]

**Fabrication and testing of a long-scale physically stitched diffraction grating using a compact laser interference lithography system with a blu-ray laser diode**, Xinghui Li, Xiangwen Zhu, Qian Zhou, Graduate School at Shenzhen, Tsinghua Univ. (China); Haiou Lu, Tsinghua Univ. (China) and Graduate School at Shenzhen, Tsinghua Univ. (China); Kai Ni, Xiaohao Wang, Graduate School at Shenzhen, Tsinghua Univ. (China) . . . . . [10373-32]

**Combined subminiature infrared particulate matter sensors with humidity sensors for reliable mass concentration outputs**, Dong-Ik Kim, Han-Jung Kim, Taejoong Lee, Ctr. for Integrated Smart Sensors (Korea, Republic of) . . . [10373-33]

**Advanced polarization sensitive analysis in optical coherence tomography**, Aleksandra Wieloszyńska, Marcin R. Strakowski, Gdansk Univ. of Technology (Poland) . . . . . [10373-34]

**Optical stabilisation for time transfer infrastructure**, Josef Vojtech, Ondrej Havlis, Pavel Skoda, Vladimir Smotlacha, Petr Munster, Michal Altman, Tomas Horvath, Jan Radil, Martin Slapak, Radek Velc, Lada Altmannova, CESNET z.s.p.o. (Czech Republic) . . . . . [10373-35]

**Demodulation of single carrier-frequency interferogram by pixel-level Lissajous figure and ellipse fitting**, Fengwei Liu, Yongqian Wu, Fan Wu, Institute of Optics and Electronics (China) . . . . . [10373-36]

**Robust phase unwrapping algorithm for 3D profile measurement applications**, Meiqi Fang, Hong Zhao, Yueyang Ma, Xi'an Jiaotong Univ. (China) . . . . [10373-37]

**Measurement of vibration using phase-only correlation technique**, Settu Balachandrar, Vipin Karthikeyan, SRI Krishna College of Engineering & Technology (India) . . . . . [10373-40]



# CONFERENCE 10374

LOCATION: CONV. CTR. ROOM 17B

Monday–Tuesday 7–8 August 2017 • Proceedings of SPIE Vol. 10374

## Optical Modeling and Performance Predictions IX

Conference Chairs: **Mark A. Kahan**, Synopsys, Inc. (USA); **Marie B. Levine-West**, Jet Propulsion Lab. (USA)

Program Committee: **George Z. Angeli**, LSST (USA); **Edward B. Bragg**, Consultant (USA); **Robert P. Breault**, Breault Research Organization, Inc. (USA); **Robert J. Brown**, Ball Aerospace & Technologies Corp. (USA); **Thomas G. Brown**, Univ. of Rochester (USA); **William J. Cassarly**, Synopsys, Inc. (USA); **Mike Chainyk**, Jet Propulsion Lab. (USA); **Russell A. Chipman**, College of Optical Sciences, The Univ. of Arizona (USA); **Keith B. Doyle**, MIT Lincoln Lab. (USA); **G. Groot Gregory**, Synopsys, Inc. (USA); **James B. Hadaway**, The Univ. of Alabama in Huntsville (USA); **Alson E. Hatheway**, Alson E. Hatheway Inc. (USA); **Tony Hull**, The Univ. of New Mexico (USA); **Richard C. Juergens**, Raytheon Missile Systems (USA); **George N. Lawrence**, Applied Optics Research (USA); **Steven Peter Levitan**, Univ. of Pittsburgh (USA); **H. Angus Macleod**, Thin Film Center, Inc. (USA); **Gary W. Matthews**, Harris Corp. (USA); **Gregory J. Michels**, Sigmadyne, Inc. (USA); **Duncan T. Moore**, Univ. of Rochester (USA); **James D. Moore Jr.**, ManTech SRS Technologies (USA); **Gary E. Mosier**, NASA Goddard Space Flight Ctr. (USA); **Steven R. Murrill**, U.S. Army Research Lab. (USA); **Sean G. O'Brien**, U.S. Army Research Lab. (USA); **Malcolm Panthaki**, Comet Solutions, Inc. (USA); **David C. Redding**, Jet Propulsion Lab. (USA); **Harold Schall**, The Boeing Co. (USA); **David A. Thomas**, GMTO Corp. (USA); **David A. Vaughn**, NASA Goddard Space Flight Ctr. (USA); **James C. Wyant**, College of Optical Sciences, The Univ. of Arizona (USA); **Richard N. Youngworth**, Riyo LLC (USA); **Feng Zhao**, Jet Propulsion Lab. (USA)

### MONDAY 7 AUGUST

#### SESSION PMON

LOCATION: CONV. CTR.

EXHIBIT HALL B2 ..... MON 5:30 PM TO 7:30 PM

#### Posters-Monday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Measurements of the optical anisotropy parameter of Tb:CaF<sub>2</sub> crystal**, Alexey Yakovlev, Ilya L. Snetkov, Oleg V. Palashov, Institute of Applied Physics of the Russian Academy of Sciences (Russian Federation) ..... [10374-16]

**Aqueous ethanol detection using a fiber-optic sensor based on Fresnel reflection**, Umesh Sampath, Dae-gil Kim, Minho Song, Chonbuk National Univ. (Korea, Republic of) ..... [10374-18]

**The optical schemes of head-mounted displays**, Galina E. Romanova, Alexey V. Bakholdin, Vladimir N. Vasilyev, ITMO Univ. (Russian Federation) ..... [10374-19]

**Optical system for UV-laser technological equipment**, Yuri V. Fedosov, Galina E. Romanova, Maxim Y. Afanasiev, ITMO Univ. (Russian Federation) ..... [10374-20]

**Optical modeling of light scattering for refractive-index detection of liquids in a microcapillary with low-coherence rainbow diffractometry**, Grzegorz Swirniak, Wroclaw Univ. of Science and Technology (Poland) ..... [10374-21]

**Density of states of Cs<sub>3</sub>Sb calculated using density-functional theory for modeling photoemission**, Daniel Finkenstadt, U.S. Naval Academy (USA); Samuel G. Lambrakos, Kevin L. Jensen, Andrew Shabaev, U.S. Naval Research Lab. (USA); Nathan A. Moody, Los Alamos National Lab. (USA) ..... [10374-22]

**The effect of laser ablation parameters on optical limiting properties of silver nanoparticles**, Irmak Gürsoy, Roketsan A.S. (Turkey); Halime Gul Yagliglu, Ankara Univ. (Turkey) ..... [10374-23]

**Impact of the necking phenomenon on the spectral behavior of WO<sub>3</sub> aggregates**, Krzysztof Skorupski, Wroclaw Univ. of Technology (Poland) [10374-24]

### TUESDAY 8 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 17B ... TUE 8:10 AM TO 9:30 AM

#### Space Telescopes and Coronagraphs

Session Chair: **Mark A. Kahan**, Synopsys, Inc. (USA)

8:10 am: **Dynamic/jitter assessment of multiple potential HabEx structural designs**, Joseph B. Knight, H. Philip Stahl, NASA Marshall Space Flight Ctr. (USA) ..... [10374-1]

8:30 am: **Challenges in coronagraph optical design**, Russell A. Chipman, James Breckinridge, College of Optical Sciences, The Univ. of Arizona (USA) ... [10374-2]

8:50 am: **Improving wavefront estimation and control in high-contrast coronagraphy using a polarization compensation algorithm**, Jessica Gersh-Range, N. Jeremy Kasdin, Princeton Univ. (USA) ..... [10374-3]

9:10 am: **Optical performance prediction of space instruments using ray-tracing-based Earth system model**, Dongok Ryu, Sug-Whan Kim, Yonsei Univ. (Korea, Republic of); Robert P. Breault, Breault Research Organization, Inc. (USA) ..... [10374-4]

#### SESSION 2

LOCATION: CONV. CTR. ROOM 17B .. TUE 9:30 AM TO 10:30 AM

#### Instruments and Systems

Session Chair: **Marie B. Levine-West**, Jet Propulsion Lab. (USA)

9:30 am: **Augmented method to improve thermal data for the figure drift thermal distortion predictions during the JWST OTIS cryogenic vacuum test**, Sang C. Park, Smithsonian Astrophysical Observatory (USA); Timothy M. Carnahan, NASA Goddard Space Flight Ctr. (USA); Lester Cohen, Smithsonian Astrophysical Observatory (USA); Cherie B. Congedo, SGT, Inc. (USA); Michael J. Eisenhower, Smithsonian Astrophysical Observatory (USA); Wes Ousley, Genesis Engineering Solutions LLC (USA); Andrew Weaver, ATA Aerospace (USA); Kan Yang, NASA Goddard Space Flight Ctr. (USA) ..... [10374-5]

9:50 am: **Propagation of polarization domain walls in standard optical fibers: beyond the Manakov model**, Massimiliano Guasoni, Optoelectronics Research Ctr., Univ. of Southampton (United Kingdom) and Lab. Interdisciplinaire Carnot de Bourgogne, Univ. de Bourgogne (France); Pierre Yves Bony, Marin Gilles, Lab. Interdisciplinaire Carnot de Bourgogne, Univ. de Bourgogne (France); Josselin C. Garnier, Lab. de Probabilités et Modèles Aléatoires, Univ. Paris 7 (France); Antonio Picozzi, Julien Fatome, Lab. Interdisciplinaire Carnot de Bourgogne, Univ. de Bourgogne (France) ..... [10374-6]

10:10 am: **Coupled-fiber Bragg grating sensor structure for cryogenic conditions**, Umesh Sampath, Dae-gil Kim, Minho Song, Chonbuk National Univ. (Korea, Republic of) ..... [10374-7]

Coffee Break ..... Tue 10:30 am to 11:00 am

# CONFERENCE 10374

## SESSION 3

LOCATION: CONV. CTR. ROOM 17B . . TUE 11:00 AM TO 12:00 PM

### Aero-Optic Models and Systems

Session Chair: **Mark A. Kahan**, Synopsys, Inc. (USA)

11:00 am: **Improved ray tracing simulation for aero-optical effect of a hypersonic projectile in wind tunnel using multiple gradient-index layer method**, Seul Ki Yang, Yonsei Univ. (Korea, Republic of); Sehyun Seong, Dongok Ryu, Yonsei Univ. (Korea, Republic of) and SphereDyne Co., Ltd. (Korea, Republic of); Sug-Whan Kim, Yonsei Univ. (Korea, Republic of) and Ctr. for Galaxy Evolution Research (Korea, Republic of) and Yonsei Univ. Observatory (Korea, Republic of); Sang-Hun Jin, LIG Nex1 Co., Ltd (Korea, Republic of); Ho Jeong, Hyun Bae Kong, LIG Nex1 Co., Ltd. (Korea, Republic of) . . . . . [10374-8]

11:20 am: **The fluid field flow and optical system performance analysis**, Ming-Ying Hsu, Ting-Ming Huang, Instrument Technology Research Ctr. (Taiwan) . . . . . [10374-9]

11:40 am: **A fiber-optic ice detection system for large-scale wind turbine blades**, Dae-gil Kim, Sampath Umesh, Minho Song, Chonbuk National Univ. (Korea, Republic of) . . . . . [10374-10]

Lunch/Exhibition Break . . . . . Tue 12:00 pm to 1:40 pm

## SESSION 4

LOCATION: CONV. CTR. ROOM 17B . . . . TUE 1:40 PM TO 3:00 PM

### Materials and HEL Related Models

Session Chair: **Marie B. Levine-West**, Jet Propulsion Lab. (USA)

1:40 pm: **Balancing diffraction efficiency and laser damage in diffractive optics**, Steven T. Glass, Thomas J. Suleski, The Univ. of North Carolina at Charlotte (USA) . . . . . [10374-11]

2:00 pm: **Mounting and environmental effects on stress birefringence in silicon and zinc selenide windows**, Kevin W. Peters, Thomas Yurovchak, Benjamin Dwyer, David E. Thompson, Robert T. Carlson, BAE Systems (USA) . . . [10374-12]

2:20 pm: **Modeling the extremely lightweight Zerodur mirror (ELZM) thermal soak test**, Thomas Brooks, NASA Marshall Space Flight Ctr. (USA); Tony B. Hull, The Univ. of New Mexico (USA); Ron Eng, H. Philip Stahl, NASA Marshall Space Flight Ctr. (USA) . . . . . [10374-14]

2:40 pm: **Calculation of density of states for modeling photoemission using method of moments**, Daniel Finkenstadt, U.S. Naval Academy (USA); Samuel G. Lambrakos, Kevin L. Jensen, Andrew Shabaev, U.S. Naval Research Lab. (USA); Nathan A. Moody, Los Alamos National Lab. (USA) . . . . . [10374-15]

Coffee Break . . . . . Tue 3:00 pm to 4:00 pm

LOCATION: CONV. CTR. ROOM 6A . . . . . 4:00 PM TO 5:30 PM

### Optical Engineering Plenary Session

Session Chair: **Julie L. Bentley**, Univ. of Rochester (USA)

4:00 pm: **Welcome and Opening Remarks**

4:05 pm: **Designing for one to one-million: how production quantities influence design (Plenary)**, Leo B. Baldwin, Amazon.com, Inc. (USA) . . . . . [10376-201]

4:50 pm: **The Large Synoptic Survey Telescope (Plenary)**, Steven Kahn, Large Synoptic Survey Telescope (USA) and SLAC National Accelerator Lab. (USA) . . . . . [10401-202]

LOCATION: MARRIOTT MARQUIS, MISSION HILLS . . . . . 8:00 PM TO 10:00 PM

### Optomechanical/Instrument Technical Group Event

Session Chair: **Alson E. Hatheway**, Alson E. Hatheway Inc. (USA)

This is the annual meeting of the premier group of optomechanical engineers that design and analyze the world's optical instruments and systems. This gathering is open to all technical attendees of SPIE Optics+Photonics. The feature speaker will be Daniel Vukobratovich of Raytheon Missile Systems, and a co-founder and previous chairman of our Optomechanical/Instrument Technical Group. Following Dan, the floor will be open for other agenda items and a workshop session on Problems and Solutions.

# CONFERENCE 10375

LOCATION: CONV. CTR. ROOM 16A

Monday–Tuesday 7–8 August 2017 • Proceedings of SPIE Vol. 10375

## Current Developments in Lens Design and Optical Engineering XVIII

*Conference Chairs:* **R. Barry Johnson**, Alabama A&M Univ. (USA); **Virendra N. Mahajan**, College of Optical Sciences, The Univ. of Arizona (USA); **Simon Thibault**, Univ. Laval (Canada)

*Program Committee:* **Robert M. Bates**, FiveFocal LLC (USA); **Julie L. Bentley**, Univ. of Rochester (USA); **Florian Bociort**, Technische Univ. Delft (Netherlands); **Robert M. Bunch**, Rose-Hulman Institute of Technology (USA); **Pierre H. Chavel**, Institut d'Optique (France); **Chung-Tse Chu**, The Aerospace Corp. (USA); **Apostolos Deslis**, JENOPTIK Optical Systems (USA); **José Antonio Díaz Navas**, Univ. de Granada (Spain); **James E. Harvey**, Photon Engineering LLC (USA); **Lakshminarayan Hazra**, Univ. of Calcutta (India); **Irina L. Livshits**, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation); **Steven A. Macenka**, Jet Propulsion Lab. (USA); **Michael Mandina**, Optimax Systems, Inc. (USA); **Pantazis Mouroulis**, Jet Propulsion Lab. (USA); **Alfonso Padilla-Vivanco**, Univ. Politécnica de Tulancingo (Mexico); **Ching-Cherng Sun**, National Central Univ. (Taiwan); **Yuzuru Takashima**, College of Optical Sciences, The Univ. of Arizona (USA); **Yongtian Wang**, Beijing Institute of Technology (China); **Cornelius Willers**, Council for Scientific and Industrial Research (South Africa); **Andrew P. Wood**, Qioptiq Ltd. (United Kingdom); **María J. Yzuel**, Univ. Autònoma de Barcelona (Spain)

### SUNDAY 6 AUGUST

LOCATION: CONV. CTR. ROOM 6A .. SUN 6:00 PM TO 7:50 PM

#### Technology Hot Topics: How Optics and Photonics Drive Innovation

6:00 pm to 6:10 pm: **Welcome and Opening Remarks**

6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)

6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)

6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)

7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)

7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)

10:50 am: **Multilayer interference coatings with the Gaussian profile for Nd:YAG lasers**, Evgeni V. Kuznetsov, Vladimir V. Novopashin, Alexandr V. Shestakov, JSC "Research Institute" POLYUS "them. M.F. Stelmaha" (Russian Federation) ..... [10375-6]

11:10 am: **Introducing the quantum efficiency of fluorescence of SCHOTT optical glasses**, Ralf Jedamzik, Jana Pleitz, Axel Engel, Uwe Petzold, SCHOTT AG (Germany) ..... [10375-7]

11:30 am: **Cryogenic refractive index of Heraeus homosil glass**, Kevin H. Miller, Manuel A. Quijada, NASA Goddard Space Flight Ctr. (USA); Douglas B. Leviton, Leviton Metrology Solutions, Inc. (USA) ..... [10375-8]

Lunch Break ..... Mon 11:50 am to 1:00 pm

### SESSION 3

LOCATION: CONV. CTR. ROOM 16A .. MON 1:00 PM TO 3:30 PM

#### Analysis and Applications

Session Chair: **Pantazis Mouroulis**, Jet Propulsion Lab. (USA)

1:00 pm: **Wavefront analysis from its slope data**, Virendra N. Mahajan, College of Optical Sciences, The Univ. of Arizona (USA); Eva Acosta, Univ. de Santiago de Compostela (Spain) ..... [10375-43]

1:30 pm: **Parametric diffraction efficiency of non-paraxial sinusoidal reflection gratings**, James E. Harvey, Richard N. Pfisterer, Photon Engineering LLC (USA) ..... [10375-44]

1:50 pm: **Camera system MTF: combining optic with detector**, Torben B. Andersen, Zachary A. Granger, Lockheed Martin Space Systems Co. (USA) ..... [10375-9]

2:10 pm: **Diffraction and geometrical optical transfer function calculation time comparison**, José Antonio Díaz, Univ. de Granada (Spain); Virendra N. Mahajan, College of Optical Sciences, The Univ. of Arizona (USA) ..... [10375-10]

2:30 pm: **Polarisation effect on wide angle lens relative illumination**, Simon Thibault, Zhengeng Zhuang, Univ. Laval (Canada); Jocelyn Parent, ImmerVision (Canada) ..... [10375-11]

2:50 pm: **Linear decomposition of the optical transfer function for annular pupils**, Jim Schwiegerling, College of Optical Sciences, The Univ. of Arizona (USA) ..... [10375-12]

3:10 pm: **Assembly of a micro-optical resonator based on silicon micro mirrors for use in gyroscopes**, Ingmar Leber, Thalke Niesel, Technische Univ. Braunschweig (Germany); Christian Werner, Yu Liang, Physikalisch-Technische Bundesanstalt (Germany); Andreas H. Dietzel, Technische Univ. Braunschweig (Germany); Jens Flüge, Physikalisch-Technische Bundesanstalt (Germany) ..... [10375-13]

Coffee Break ..... Mon 3:30 pm to 4:00 pm

### MONDAY 7 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 16A MON 8:30 AM TO 10:00 AM

#### Lens Design Methodology I

Session Chair: **R. Barry Johnson**, Alabama A&M Univ. (USA)

8:30 am: **New tools for the design of freeform mirrors**, Donald C. Dilworth, Optical Systems Design, Inc. (USA) ..... [10375-1]

8:50 am: **Design of light guide sleeve on hyperspectral imaging system for skin diagnosis**, Yung-Jhe Yan, Chao-Hsin Chang, Hou-Chi Chiang, Mang Ou-Yang, National Chiao Tung Univ. (Taiwan) ..... [10375-2]

9:10 am: **Imaging spectrometer design for high data fidelity (Invited Paper)**, Pantazis Mouroulis, Jet Propulsion Lab. (USA) ..... [10375-3]

9:40 am: **Achieving linearity with an optical quadrant detector tracking system**, Victor J. Doherty, Dina Aouani, EIDOLON Optical, LLC (USA); Michael S. Costello, Franklin W. Olin College of Engineering (USA) ..... [10375-4]

Coffee Break ..... Mon 10:00 am to 10:30 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 16A MON 10:30 AM TO 11:50 AM

#### Materials and Coatings

Session Chair: **Robert M. Bunch**, Rose-Hulman Institute of Technology (USA)

10:30 am: **Multi-band filter design with less total film thickness for short-wave infrared application**, Yung-Jhe Yan, I-Pen Chien, National Chiao Tung Univ. (Taiwan); Po-Han Chen, National Central Univ. (Taiwan); Sheng-Hui Chen, Yi-Chun Tsai, Mang Ou-Yang, National Chiao Tung Univ. (Taiwan) ..... [10375-5]



# CONFERENCE 10375

## SESSION 4

LOCATION: CONV. CTR. ROOM 16A . MON 4:00 PM TO 5:40 PM

### Optical Fabrication and Tunable Optics

Session Chair: **Virendra N. Mahajan**, College of Optical Sciences, The Univ. of Arizona (USA)

4:00 pm: **Fabrication of multi-focal microlens array on curved surface for wide-angle camera module**, Guig-Gu Pan, Guo Dung J. Su, National Taiwan Univ. (Taiwan) . . . . . [10375-14]

4:20 pm: **The effect of optical system design for laser micro-hole drilling process**, Chien-Fang Ding, Yin-Te Lan, Yu-Lun Chien, Hong-Tsu Young, National Taiwan Univ. (Taiwan) . . . . . [10375-15]

4:40 pm: **Focal tunable liquid crystal lens with floating ring electrode**, Chi-Yen Huang, Che-Ju Hsu, National Changhua Univ. of Education (Taiwan); Jyun-Jia Jhang, National Changhua Univ. of Education (Taiwan); Jia-Cih Jhang, National Changhua Univ. of Education (Taiwan) . . . . . [10375-16]

5:00 pm: **Zoom system without moving element by using two liquid crystal lenses with spherical electrode**, Ren-Kai Yang, Guo Dung J. Su, Chia-Ping Lin, National Taiwan Univ. (Taiwan) . . . . . [10375-17]

5:20 pm: **Tunable refractive power by mutual rotation of helical lens parts**, Ingo Sieber, Thomas Martin, Peter Stiller, Karlsruher Institut für Technologie (Germany) . . . . . [10375-18]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 . . . . . MON 5:30 PM TO 7:30 PM

### Posters-Monday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**A lazy way to design infrared lens**, RongSheng Qiu, Jian Dong Wu, Long Jiang Chen, Kun Yu, Hao Jun Pang, Bai Zhen Hu, Shanghai Aerospace Control Technology Institute (China) . . . . . [10375-27]

**Design two-dimensional (crossed) diffraction grating in Czerny-Turner spectrometer using freeform mirrors**, Yuri Bazhanov, Elena Demura, Rasima Chercashina, Precision Systems and Instruments Corp. (Russian Federation); Vadim Vlahkho, DynaOptics (Singapore) . . . . . [10375-28]

**Off-axis Gregory telescope design with freeform mirror corrector**, Yuri Bazhanov, Precision Systems and Instruments Corp. (Russian Federation); Vadim Vlahkho, DynaOptics (Singapore) . . . . . [10375-29]

**Comparative analysis of characterization techniques for SLM-LC using Jones matrices**, Juan-Miguel Olvera-Angeles, Alfonso Padilla-Vivanco, Univ. Politécnica de Tulancingo (Mexico) . . . . . [10375-30]

**Optimization of wavefront coding imaging system using Heuristic algorithms**, Enrique Gonzalez Amador, Alfonso Padilla Vivanco, Carina Toxqui Quitl, Univ. Politécnica de Tulancingo (Mexico) . . . . . [10375-31]

**Optical schemes for compact space objectives**, Kseniia D. Butylkina, Galina E. Romanova, Alexey V. Bakholdin, ITMO Univ. (Russian Federation) . . . . [10375-32]

**Infrared simulation and performance validation of pinhole and 4-bar collimator targets for static performance evaluation of thermal imaging systems**, Doruk Kucukcelebi, Roketsan A.S. (Turkey) . . . . . [10375-33]

**Mask in thickness uniformity for three coating materials**, Cheng-Chung Jaing, Kai-Lun Wu, Jing-Han Xie, Jian-Wei Chen, Minghsin Univ. of Science and Technology (Taiwan); Yeuh-Yeong Liou, Chienkuo Technology Univ. (Taiwan); Pang-Shiu Chen, Minghsin Univ. of Science and Technology (Taiwan) . . [10375-34]

**Using the afocal compensator of the catadioptric systems for removal the thermal defocus**, Galina E. Romanova, Alexey V. Bakholdin, ITMO Univ. (Russian Federation); Stepan E. Ivanov, ITMO Univ. (Russian Federation) . . . . . [10375-35]

**The improved optical setup for Abbe-Porter experiment**, Volodymyr N. Borovytsky, Oleksii Hudz, Vytalyi Antonenko, National Technical Univ. of Ukraine (Ukraine) . . . . . [10375-36]

**Development of surgical binoculars on the basis of polymeric lenses**, Anna O. Voznesenskaya, ITMO Univ. (Russian Federation); Alisa Ekimenkova, Artem Muratov, Lev Andreev, ITMO Univ. (Russian Federation) . . . . . [10375-37]

**Optical spherometer for measuring large curvature radii of convex surfaces**, Jorge Alvarado-Martínez, Univ. Politécnica de Tulancingo (Mexico); Sergio Vazquez y Montiel, Univ. Tecnológica de la Huasteca Hidalguense (Mexico); César Joel Camacho Bello, Univ. Politécnica de Tulancingo (Mexico) . . . . . [10375-38]

**Optimization of corneal topography maps by bio-inspired algorithms**, Gerardo Diaz-Gonzalez, José Alfredo Jiménez-Hernández, Univ. Tecnológica de la Mixteca (Mexico); Marcelo David Iturbe-Castillo, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico); Rigoberto Juárez-Salazar, Ctr. de Investigación y Desarrollo de Tecnología Digital (Mexico); Agustín Santiago-Alvarado, Univ. Tecnológica de la Mixteca (Mexico) . . . . . [10375-39]

**Ray tracing for inhomogeneous media applied to the human eye**, Gerardo Diaz-Gonzalez, José Alfredo Jiménez-Hernández, Univ. Tecnológica de la Mixteca (Mexico); Marcelo David Iturbe-Castillo, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico); Rigoberto Juárez-Salazar, Ctr. de Investigación y Desarrollo de Tecnología Digital (Mexico) . . . . . [10375-40]

**Iterative paraxial design method based on an analytic calculation and its application to a three-group inner-focus zoom system**, Euisam S. Lee, Juhyeon Choi, Yeon Hwang, Youngbok Kim, Korea Photonics Technology Institute (Korea, Republic of) . . . . . [10375-41]

**Analysis and design of a liquid-filled lens with controllable parameters and variable focus**, Gerardo Diaz-Gonzalez, Agustín Santiago-Alvarado, Jorge González García, Univ. Tecnológica de la Mixteca (Mexico); Javier Muñoz-Lopez, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico) . . . . . [10375-42]

## TUESDAY 8 AUGUST

### SESSION 5

LOCATION: CONV. CTR. ROOM 16A . TUE 8:30 AM TO 10:10 AM

### Solid State Smart Lighting

Session Chair: **Ching-Cherng Sun**, National Central Univ. (Taiwan)

8:30 am: **Optical modeling of bullet-shaped LED for use in self-luminous traffic signs**, Ted Liang-tai L. Lee, Yi-Chun Chen, Ming-Siou Tsai, Ching-Cherng Sun, National Central Univ. (Taiwan) . . . . . [10375-19]

8:50 am: **Visual ergonomic evaluations on four different designs of LED traffic signs**, Yi-Chun Chen, Ting-Yuan Huang, National Central Univ. (Taiwan); Tsung-Xian Lee, National Taiwan Univ. of Science and Technology (Taiwan); Ching-Cherng Sun, National Central Univ. (Taiwan) . . . . . [10375-20]

9:10 am: **Smart lighting using a liquid crystal modulator**, Alexandre Baril, Simon Thibault, Tigran Glastian, Univ. Laval (Canada) . . . . . [10375-21]

9:30 am: **High-efficiency zoom spotlight based on solid-state lighting**, Shih-Kang Lin, Xuan-Hao Lee, Mao-Teng Ho, Tsung-Hsun Yang, Ching-Cherng Sun, National Central Univ. (Taiwan) . . . . . [10375-22]

9:50 am: **Combining the transformation and the integration methods to design a refractive lens-array for signal lighting applications**, Mahmoud Essameldin, Friedrich Fleischmann, Thomas Henning, Hochschule Bremen Univ. of Applied Sciences (Germany); Walter Lang, Univ. Bremen (Germany) . . . . . [10375-23]

Coffee Break . . . . . Tue 10:10 am to 10:40 am

SESSION 6

LOCATION: CONV. CTR. ROOM 16A .TUE 10:40 AM TO 11:40 AM

**Lens Design Methodology II**

Session Chair: **Simon Thibault**, Univ. Laval (Canada)

10:40 am: **Development of the infrared instrument for gas detection**, Ching-Wei Chen, Chia-Ray Chen, National Space Organization (Taiwan) . . . . . [10375-24]

11:00 am: **Optical design of an athermalised dual field-of-view step zoom optical system in MWIR**, Doruk Kucukcelebi, Roketsan A.S. (Turkey) . . [10375-25]

11:20 am: **Contact lens design with slope-constrained Q-type aspheres for myopia correction**, Wei-Jei Peng, Yuan-Chieh Cheng, Wei-Yao Hsu, Zong-Ru Yu, Cheng-Fang Ho, Instrument Technology Research Ctr. (Taiwan); Khaled Abou-El-Hossein, Nelson Mandela Metropolitan Univ. (South Africa) . . . . . [10375-26]

LOCATION: CONV. CTR. ROOM 6A . . . . . 4:00 PM TO 5:30 PM

**Optical Engineering Plenary Session**

Session Chair: **Julie L. Bentley**, Univ. of Rochester (USA)

4:00 pm: **Welcome and Opening Remarks**

4:05 pm: **Designing for one to one-million: how production quantities influence design (Plenary)**, Leo B. Baldwin, Amazon.com, Inc. (USA) . . . . . [10376-201]

4:50 pm: **The Large Synoptic Survey Telescope (Plenary)**, Steven Kahn, Large Synoptic Survey Telescope (USA) and SLAC National Accelerator Lab. (USA) . . . . . [10401-202]

LOCATION: MARRIOTT MARQUIS, MARINA F . . . . . 8:00 PM TO 10:00 PM

**Lens Design Technical Event**

Session Chair: **Rich Pfisterer**, Photon Engineering, LLC (USA)

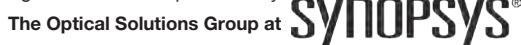
**“Let’s Give ‘Em Something to Talk About!”**

Lens designers! Join us for our annual gathering to meet and discuss... lens design! Let’s talk about what we’re designing, how we’re going about doing it (what materials, software, techniques, etc.), and which problems we’re encountering. We’ll also explore current technical and commercial trends in the marketplace. This year’s invited speaker will be Dave Shafer of David Shafer Optical Design, whose talk is entitled, “My 51 Years of Optical Design Using Husserl’s Phenomenology.” Many optical design examples will be shown that illustrate a systematic way of ‘thinking outside the box’ while doing creative design. This approach is based on insights of Edmund Husserl and his phenomenology school of philosophy.

Cosponsored by:



Light refreshments sponsored by:



# CONFERENCE 10376

LOCATION: CONV. CTR. ROOM 16A

Tuesday–Wednesday 8–9 August 2017 • Proceedings of SPIE Vol. 10376

# Novel Optical Systems Design and Optimization XX

Conference Chairs: **Arthur J. Davis**, ORAFOL Americas, Inc. (USA); **Cornelius F. Hahlweg**, bbw Hochschule (Germany); **Joseph R. Mulley**, Melles Griot (USA)

Program Committee: **Francois Callewaert**, Northwestern Univ. (USA); **Joseph S. Choi**, Raytheon Space and Airborne Systems (USA); **Yi Chin Fang**, National Kaohsiung First Univ. of Science and Technology (Taiwan); **Peter I. Goldstein**, Philips Color Kinetics (USA); **G. Groot Gregory**, Synopsys, Inc. (USA); **Eric Herman**, The Aerospace Corp. (USA); **R. John Koshel**, College of Optical Sciences, The Univ. of Arizona (USA); **Scott A. Lerner**, Carl Zeiss AG (Germany); **Bharathwaj Appan Narasimhan**, CeDInt-UPM (Spain); **Craig Olson**, L-3 Communications (USA); **José Sasián**, College of Optical Sciences, The Univ. of Arizona (USA); **Hamilton Shepard III**, X (USA); **Haiyin Sun**, ChemImage Corp. (USA); **Udo Zölzer**, Helmut-Schmidt Univ. (Germany), Univ. of the Federal Armed Forces Hamburg (Germany)

## MONDAY 7 AUGUST

LOCATION: MARRIOTT MARQUIS,  
MARINA F ..... 8:00 PM TO 10:00 PM

### Illumination Technical Event

Chair: **Jake Jacobsen**, Synopsys, Inc. (USA)


Please join us for an evening of stimulating discussion, networking, and conversation. This year we have two guest speakers.

**Dr. Charlie Gay** will be presenting a talk entitled “Where Have All the Photons Gone? Optimizing the Optical Properties of Solar Panels for Real World Applications”. Dr. Gay is the Solar Energy Technologies Office Director for the Office of Energy Efficiency and Renewable Energy (EERE) of the U.S. Department of Energy (DOE).

**Dr. Bill Cassarly** will be giving us an overview of the submissions for this year’s International Optical Design Conference’s (IODC) Illumination Design Problem. Every four years the IODC sponsors a design competition for both imaging and illumination engineers. The problems posed are always highly challenging, very unusual, and completely ridiculous. Dr. Cassarly is a Synopsys Scientist in the Optical Solutions Group and Fellow of the SPIE and was an author and judge of this year’s illumination design competition.

Don’t miss what promises to be a fun and illuminating event. At the end of the presentations any member of the audience may present information within the broad field of illumination. Light refreshments will be served.

Light refreshments sponsored by:

The Optical Solutions Group at 

2:30 pm: **Ideal-lens stars**, Jakub Bělin, Univ. of Glasgow (United Kingdom); Tomáš Tyc, Masaryk Univ. (Czech Republic); Stephen Oxburgh, Johannes Courtial, Univ. of Glasgow (United Kingdom) ..... [10376-3]

2:50 pm: **High-speed video analysis of ballistic trials to investigate the crack propagation in glass laminates**, Arash Ramezani, Hendrik Rothe, Helmut-Schmidt Univ. (Germany) ..... [10376-4]

3:10 pm: **Imaging with pairs of skew lenses**, Jakub Bělin, Stephen Oxburgh, Univ. of Glasgow (United Kingdom); Tomáš Tyc, Masaryk Univ. (Czech Republic); Johannes Courtial, Univ. of Glasgow (United Kingdom) ..... [10376-5]

Coffee Break ..... Tue 3:30 pm to 4:00 pm

LOCATION: CONV. CTR. ROOM 6A ..... 4:00 PM TO 5:30 PM

### Optical Engineering Plenary Session

Session Chair: **Julie L. Bentley**, Univ. of Rochester (USA)

4:00 pm: **Welcome and Opening Remarks**

4:05 pm: **Designing for one to one-million: how production quantities influence design (Plenary)**, Leo B. Baldwin, Amazon.com, Inc. (USA) ..... [10376-201]

4:50 pm: **The Large Synoptic Survey Telescope (Plenary)**, Steven Kahn, Large Synoptic Survey Telescope (USA) and SLAC National Accelerator Lab. (USA) ..... [10401-202]

## TUESDAY 8 AUGUST

LOCATION: CONV. CTR. ROOM 16A ..... 1:30 PM TO 1:40 PM

### Welcome and Opening Remarks

**Arthur J. Davis**, ORAFOL Americas, Inc. (USA); **Cornelius F. Hahlweg**, bbw Hochschule (Germany); **Joseph R. Mulley**, Melles Griot (USA)

### SESSION 1

LOCATION: CONV. CTR. ROOM 16A ... TUE 1:40 PM TO 3:30 PM

### Exotic and Unconventional Optics and Systems

Session Chair: **Craig Olson**, L-3 Sonoma EO (USA)

1:40 pm: **Curved sensors for compact high-resolution wide field designs (Invited Paper)**, Christophe Gaschet, CEA-LETI (France); Emmanuel Hugot, Lab. d’Astrophysique de Marseille (France); Bertrand Chambion, Stéphane Gétin, Gaid Moulin, Stéphane Caplet, Aurélie Vandeneynde, CEA-LETI (France); David Henry, Commissariat à l’Énergie Atomique (France); Wilfried Jahn, Lab. d’Astrophysique de Marseille (France) ..... [10376-1]

2:10 pm: **Focus-induced photoresponse: a fundamentally novel approach to optical distance measurements**, Christoph Lungenschmied, TrinamiX GmbH (Germany); Oili Pekkola, TrinamiX GmbH (Germany); Christian Lennartz, TrinamiX GmbH (Germany); Ingmar Bruder, TrinamiX GmbH (Germany) ..... [10376-2]

LOCATION: MARRIOTT MARQUIS,

MARINA F ..... 8:00 PM TO 10:00 PM

### Lens Design Technical Event

Session Chair: **Rich Pfisterer**, Photon Engineering, LLC (USA)


“Let’s Give ‘Em Something to Talk About!”

Lens designers! Join us for our annual gathering to meet and discuss... lens design! Let’s talk about what we’re designing, how we’re going about doing it (what materials, software, techniques, etc.), and which problems we’re encountering. We’ll also explore current technical and commercial trends in the marketplace. This year’s invited speaker will be Dave Shafer of David Shafer Optical Design, whose talk is entitled, “My 51 Years of Optical Design Using Husserl’s Phenomenology.” Many optical design examples will be shown that illustrate a systematic way of ‘thinking outside the box’ while doing creative design. This approach is based on insights of Edmund Husserl and his phenomenology school of philosophy.

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The Optical Solutions Group at 



**LOCATION: MARRIOTT MARQUIS,  
MISSION HILLS . . . . . 8:00 PM TO 10:00 PM**

## Optomechanical/Instrument Technical Group Event

Session Chair: **Alson E. Hatheway**, Alson E. Hatheway Inc. (USA)

This is the annual meeting of the premier group of optomechanical engineers that design and analyze the world's optical instruments and systems. This gathering is open to all technical attendees of SPIE Optics+Photonics. The featured speaker will be Daniel Vukobratovich of Raytheon Missile Systems, and a co-founder and previous chairman of our Optomechanical/Instrument Technical Group. Following Dan, the floor will be open for other agenda items and a workshop session on Problems and Solutions.

### WEDNESDAY 9 AUGUST

**LOCATION: CONV. CTR. ROOM 16A . . . . . 8:40 AM TO 8:50 AM**

## Welcome and Opening Remarks

**Arthur J. Davis**, ORAFOL Americas, Inc. (USA); **Cornelius F. Hahlweg**, bbw Hochschule (Germany); **Joseph R. Mulley**, Melles Griot (USA)

### SESSION 2

**LOCATION: CONV. CTR. ROOM 16A WED 8:50 AM TO 10:00 AM**

## Multi- and Hyperspectral Applications

Session Chair: **Hamilton Shepard III**, X (USA)

8:50 am: **Temporal focal plane filter arrays**, Israel J. Vaughn, The Univ. of New South Wales (Australia); Andrey S. Alenin, Scott Tyo, UNSW Canberra (Australia) . . . . . [10376-7]

9:10 am: **Aberrations of temporally modulated optical wavefronts in dispersive optical systems** (*Invited Paper*), David H. Parker, Parker Intellectual Property Enterprises, LLC (USA) . . . . . [10376-8]

9:40 am: **A novel surface plasmon-coupled tunable wavelength filter for hyperspectral imaging**, John F. Turner II, Ajaykumar H. Zalavadia, Cleveland State Univ. (USA) . . . . . [10376-10]

Coffee Break . . . . . Wed 10:00 am to 10:30 am

### SESSION 3

**LOCATION: CONV. CTR. ROOM 16A WED 10:30 AM TO 12:10 PM**

## Novel Systems

Session Chair: **Francois Callewaert**, Northwestern Univ. (USA)

10:30 am: **Thermally tunable III-V photonic crystals for coherent nonlinear optical circuits**, Ranojoy Bose, Hewlett-Packard Labs. (USA); Marina Radulaski, Hewlett Packard Labs. (USA); Tho Tran, Ray Beausoleil, Hewlett-Packard Labs. (USA) . . . . . [10376-11]

10:50 am: **Short range, >100Kbits/s, visible light communication protocol design for high-gamma smartphones**, Jaime R. Ek-Ek, Ctr. de Investigación e Innovación Tecnológica (Mexico); Ponciano J. Escamilla-Ambrosio, Ctr. de Investigación en Computación (Mexico); Abraham Sierra-Calderon, Ctr. de Investigación e Innovación Tecnológica (Mexico); Abel Sanchez-Nieves, Escuela Superior de Ingeniería Mecánica y Eléctrica (Mexico); Abraham Rodríguez-Mota, Escuela Superior de Ingeniería Mecánica y Eléctrica, Unidad Zacatenco (Mexico) . . . . . [10376-12]

11:10 am: **Experimental realisability of lens cloaks**, Stephen Oxburgh, Jakub Béliň, Euan Cowie, Johannes Courtial, Univ. of Glasgow (United Kingdom) . . . . . [10376-13]

11:30 am: **Design and implementation of a large depth-of-field and large aperture optical system**, Xiaohu Guo, China North Vehicle Research Institute (China); Lingqin Kong, Yijian Wu, Yuejin Zhao, Liqun Dong, Ming Liu, Beijing Institute of Technology (China) . . . . . [10376-14]

11:50 am: **Dip-and-bake low-cost high-performance lenses for smartphone-based microscopy**, Bhuvaneshwari Karunakaran, Joseph Tharion, Debjani Paul, Soumy Mukherji, Indian Institute of Technology Bombay (India) . . . . . [10376-15]

Lunch/Exhibition Break . . . . . Wed 12:10 pm to 1:40 pm

### SESSION 4

**LOCATION: CONV. CTR. ROOM 16A . . WED 1:40 PM TO 3:30 PM**

## Biomedical Applications and Human Factors

Session Chair: **Peter I. Goldstein**, Philips Color Kinetics (USA)

1:40 pm: **Thin head-mounted display utilizing reflective optics design**, Chia-Ping Lin, Guo Dung J. Su, National Taiwan Univ. (Taiwan) . . . . . [10376-35]

2:00 pm: **Gait motion analysis using optical and inertial sensor fusion to design human kinetic energy harvesting systems** (*Invited Paper*), Oliver Kröning, Hendrik Rothe, Helmut-Schmidt Univ. (Germany) . . . . . [10376-16]

2:30 pm: **Design, manufacture, and evaluation of prototype telescope windows for use in low-vision aids**, Euan Cowie, Univ. of Glasgow (United Kingdom); Cyril Bourgenot, Durham Univ. (United Kingdom); Johannes Courtial, Univ. of Glasgow (United Kingdom); John Girkin, Gordon Love, David Robertson, Laura Young, Durham Univ. (United Kingdom) . . . . . [10376-17]

2:50 pm: **Design of a three-view cooperative scanning handheld OCT probe for intraoperative microvascular imaging**, Shizhao Peng, Yong Huang, Shaoyan Xia, Yuanzhen Jiang, Yanfeng Wu, Xiaodi Tan, Beijing Institute of Technology (China) . . . . . [10376-18]

3:10 pm: **Research of the optical scheme for an endoscopic optical coherent tomography**, Helen A. Tsyganok, Alina Dubrovskaya, ITMO Univ. (Russian Federation) . . . . . [10376-19]

Coffee Break . . . . . Wed 3:30 pm to 4:00 pm

### SESSION 5

**LOCATION: CONV. CTR. ROOM 16A . WED 4:00 PM TO 4:40 PM**

## Volumetric Displays and 3D Imaging

Session Chair: **Joseph S. Choi**, Raytheon Space and Airborne Systems (USA)

4:00 pm: **Glasses-free 2D-3D switchable display using an integrated single-light guide plate with a trapezoidal light-extraction film**, Jin-Ho Lee, Yoonsun Choi, Samsung Advanced Institute of Technology (Korea, Republic of); Igor Yanusik, Alexander Morozov, SAMSUNG R&D Institute Rus. (Russian Federation); Hyoseok Hwang, Samsung Advanced Institute of Technology (Korea, Republic of); Dongkyung Nam, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); Du Sik Park, Samsung Advanced Institute of Technology (Korea, Republic of) . [10376-20]

4:20 pm: **Combining three wavelength illumination and parallel phase shift interferometry for high-speed high-resolution and real-time motion tracking and 3D imaging**, Michael Ney, Ibrahim Abdulhalim, Ben-Gurion Univ. of the Negev (Israel) . . . . . [10376-21]

### SESSION 6

**LOCATION: CONV. CTR. ROOM 16A . WED 4:40 PM TO 6:00 PM**

## Metrology and Inspection Systems

Session Chair: **Joseph S. Choi**, Raytheon Space and Airborne Systems (USA)

4:40 pm: **Development of quadruplet-camera system for pipe thread measurement**, Shudo Takenaka, Toshifumi Kodama, Takahiro Yamasaki, JFE Steel Corp. (Japan); Kingo Sawada, JFE Tubic Corp. (Japan) . . . . . [10376-22]

5:00 pm: **Robust shearography system for inspection of defects in composite material using diffractive optics**, Fabio A. da Silva, Mauro E. Benedet, Analucia V. Fantin, Daniel P. Willemann, Armando A. Gonçalves Jr., Univ. Federal de Santa Catarina (Brazil) . . . . . [10376-23]

5:20 pm: **540nm pulsed laser design for particle image velocimetry applications**, Abraham Sierra-Calderon, Jaime R. Ek-Ek, Ctr. de Investigación e Innovación Tecnológica (Mexico); Abel Sanchez Nieves, Escuela Superior de Ingeniería Mecánica y Eléctrica (Mexico); Gabriel Plascencia-Barrera, Jose A. Alvarez Chavez, Ctr. de Investigación e Innovación Tecnológica (Mexico) [10376-24]

5:40 pm: **A confocal microscope with programmable aperture arrays by polymer-dispersed liquid crystal**, Ting-Jui Chang, Guo Dung Su, National Taiwan Univ. (Taiwan) . . . . . [10376-25]

# CONFERENCE 10376

LOCATION: CONV. CTR.

EXHIBIT HALL B2 ..... WED 5:30 PM TO 7:30 PM

## Posters-Wednesday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Imaging application based on an electrically tunable polarization-independent liquid crystal microlens array.** Zhaowei Xin, Qing Tong, Yu Lei, Dong Wei, Xinyu Zhang, Haiwei Wang, Changsheng Xie, Huazhong Univ. of Science and Technology (China) ..... [10376-26]

**Fast sub-wavelength imaging using scattering medium and computational phase mask,** Shenghang Zhou, Nanjing Univ. of Science and Technology (China) ..... [10376-27]

**Focus-induced photoresponse: Insights into the microscopic mechanisms and optical features behind the novel technique for optical distance measurements.** Olli Pekkola, TrinamiX GmbH (Germany); Christoph Lungenschmied, TrinamiX GmbH (Germany); Christian Lennartz, Ingmar Bruder, TrinamiX GmbH (Germany) ..... [10376-28]

**An optical chip aggregometer based on laser transmission to detect alterations in the aggregation of glycosylated RBC,** Martín A. Toderi, CONICET-UNR (Argentina) and Univ. Nacional de Rosario (Argentina); Natalia Lerda, Patricia Buszniesz, Univ. Nacional de Rosario (Argentina); Bibiana D. Riquelme, Univ. Nacional de Rosario (Argentina) and CONICET-UNR (Argentina) . . . . . [10376-29]

**Optical design of optical synthetic aperture telescope,** Chenghao Zhou, Zhile Wang, Harbin Institute of Technology (China) . . . . . [10376-30]

**Method for synthesis of high-accuracy dynamic non-linear control systems,** Vladimir L. Kodkin, South Ural State Univ. (Russian Federation) . . . . . [10376-31]

**Common-path holographic objective for conventional photographic camera,** Vira R. Besaga, Nils C. Gerhardt, Ruhr-Univ. Bochum (Germany); Peter P. Maksimyak, Yuriy Fedkovych Chernivtsi National Univ. (Ukraine); Martin R. Hofmann, Ruhr-Univ. Bochum (Germany) . . . . . [10376-32]

**Computer tool for achromatic and aplanatic cemented doublet design and analysis,** Tatiana Ivanova, Galina Romanova, Tatiana Zhukova, Olga Kalinkina, ITMO Univ. (Russian Federation) . . . . . [10376-33]

**Offset pixel aperture technique for extracting depth information,** Byoung-Soo Choi, Myunghan Bae, Sang-Hwan Kim, Jimin Lee, Chang-Woo Oh, Kyungpook National Univ. (Korea, Republic of); Seunghyuk Chang, Jongho Park, Sang-Jin Lee, Ctr. for Integrated Smart Sensors (Korea, Republic of); Jang-Kyoo Shin, Kyungpook National Univ. (Korea, Republic of) . . . . . [10376-36]

# CONFERENCE 10377

LOCATION: CONV. CTR. ROOM 17A

Sunday–Monday 6–7 August 2017 • Proceedings of SPIE Vol. 10377

# Optical System Alignment, Tolerancing, and Verification XI

Conference Chairs: **José Sasián**, College of Optical Sciences, The Univ. of Arizona (USA); **Richard N. Youngworth**, Riyo LLC (USA)

Program Committee: **Matthew B. Dubin**, College of Optical Sciences, The Univ. of Arizona (USA); **Jonathan D. Ellis**, Univ. of Rochester (USA); **Sen Han**, Univ. of Shanghai for Science and Technology (China); **Marco Hanft**, Carl Zeiss AG (Germany); **William P. Kuhn**, Opt-E (USA); **Chao-Wen Liang**, National Central Univ. (Taiwan); **Norbert Lindlein**, Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany); **Robert M. Malone**, National Security Technologies, LLC (USA); **Raymond G. Ohl IV**, NASA Goddard Space Flight Ctr. (USA); **Craig W. Pansing**, Synopsys, Inc. (USA); **Robert E. Parks**, Optical Perspectives Group, LLC (USA); **Brian C. Primeau**, Ball Aerospace & Technologies Corp. (USA); **Martha Rosete-Aguilar**, Univ. Nacional Autónoma de México (Mexico); **Peng Su**, ASML US, Inc. (USA); **Yana Z. Williams**, Atlas Material Testing Technology (USA)

## SUNDAY 6 AUGUST

### SESSION 1

LOCATION: CONV. CTR. ROOM 17A . . SUN 8:30 AM TO 10:20 AM

### Verification and System Alignment

Session Chair: **Brian C. Primeau**, Ball Aerospace & Technologies Corp. (USA)

8:30 am: **Sub-cell turning to accomplish micron-level alignment of precision assemblies**, Jay Kumler, JENOPTIK Optical Systems, LLC (USA); Christian Buß, TRIOPTICS GmbH (Germany) . . . . . [10377-1]

8:50 am: **Tolerancing a lens for LED uniform illumination**, Jieun Ryu, The Univ. of Arizona (USA); Jose Sasián, College of Optical Sciences, The Univ. of Arizona (USA) . . . . . [10377-15]

9:10 am: **Photonic Doppler velocimetry probe used to measure grain boundaries of dynamic shocked materials** (*Invited Paper*), Robert M. Malone, Morris I. Kaufman, Daniel K. Frayer, Kevin D. McGillivray, National Security Technologies, LLC (USA); Steven A. Clarke, Saryu J. Fensin, David R. Jones, Los Alamos National Lab. (USA) . . . . . [10377-3]

9:40 am: **Slope-based precision optical testing using portable laser coordinate measuring instruments**, Manal Khreishi, NASA Goddard Space Flight Ctr. (USA) and The Univ. of Arizona (USA); Raymond G. Ohl, Theodore J. Hadjimichael, NASA Goddard Space Flight Ctr. (USA); Joseph E. Hayden, Sigma Space Corp. (USA) . . . . . [10377-4]

10:00 am: **Integrated confocal Raman probe combined with a freeform reflector-based lab-on-chip**, Qing Liu, Vrije Univ. Brussel (Belgium); Giancarlo Barbieri, Univ. degli Studi di Pavia (Italy); Hugo Thienpont, Vrije Univ. Brussel (Belgium); Heidi Ottevaere, Univ. degli Studi di Pavia (Belgium) and Vrije Univ. Brussel (Belgium) . . . . . [10377-5]

Coffee Break . . . . . Sun 10:20 am to 10:40 am

### SESSION 2

LOCATION: CONV. CTR. ROOM 17A . . SUN 10:40 AM TO 12:10 PM

### Optical Tolerancing

Session Chair: **William P. Kuhn**, Opt-E (USA)

10:40 am: **Understanding product cost vs performance through an in-depth system Monte Carlo analysis** (*Invited Paper*), Mark C. Sanson, Corning Incorporated (USA) . . . . . [10377-7]

11:10 am: **Specifying tilts, decenters, and beam deviations using the new edition of ISO 10110-6**, Ray Williamson, Ray Williamson Consulting (USA) [10377-8]

11:30 am: **Specification and tolerancing of bulk glass material imperfections with ISO standards**, Allen Krisloff, Triptar Lens Co., Inc. (USA) . . . . . [10377-9]

11:50 am: **Generalized surface contributions for misalignment sensitivity analysis**, Mateusz Oleszko, Herbert Gross, Friedrich-Schiller-Univ. Jena (Germany) . . . . . [10377-10]

Lunch Break . . . . . Sun 12:10 pm to 1:40 pm

### SESSION 3

LOCATION: CONV. CTR. ROOM 17A . . . SUN 1:40 PM TO 3:30 PM

### Alignment of Optical Systems I

Session Chair: **Robert M. Malone**, National Security Technologies, LLC (USA)

1:40 pm: **Optical alignment using a CGH and an autostigmatic microscope**, Robert E. Parks, Optical Perspectives Group, LLC (USA); Chunyu Zhao, Arizona Optical Metrology LLC (USA) . . . . . [10377-11]

2:00 pm: **Measurement of low-order aberrations with an autostigmatic microscope**, William P. Kuhn, Opt-E (USA) . . . . . [10377-12]

2:20 pm: **Review of Zernike polynomials and their use in describing the impact of misalignment in optical systems** (*Invited Paper*), Jim Schwiegerling, College of Optical Sciences, The Univ. of Arizona (USA) . . . . . [10377-13]

2:50 pm: **Ground to on-orbit alignment study of the WFIRST and resulting architecture changes in the telescope architecture**, John G. Hagopian, Lambda Consulting (USA); Lisa Bartusek, NASA Goddard Space Flight Ctr. (USA); Thomas M. Casey, Sigma Space Corp. (USA); David A. Content, NASA Goddard Space Flight Ctr. (USA); Guangjun Gao, Sigma Space Corp. (USA); Alden S. Jurling, Catherine T. Marx, Bert A. Pasquale, Qian Gong, NASA Goddard Space Flight Ctr. (USA); Arthur L. Whipple, Conceptual Analytics, LLC (USA) . . . . . [10377-25]

3:10 pm: **SFR test fixture for hemispherical and hyperhemispherical camera systems**, John M. Tamkin, Imaging Insights, LLC (USA) . . . . . [10377-2]

Coffee Break . . . . . Sun 3:30 pm to 4:00 pm

### SESSION 4

LOCATION: CONV. CTR. ROOM 17A . . . SUN 4:00 PM TO 5:40 PM

### Alignment of Optical Systems II

Session Chair: **Robert E. Parks**, Optical Perspectives Group, LLC (USA)

4:00 pm: **Simultaneous angular alignment of segment mirrors using sinusoidal pattern analysis**, Heejoo Choi, Isaac Trumper, Dae Wook Kim, College of Optical Sciences, The Univ. of Arizona (USA) . . . . . [10377-16]

4:20 pm: **Alignment and testing of the James Webb Space Telescope observatory vibration fixture and handling and integration fixture**, Kyle McLean, NASA Goddard Space Flight Ctr. (USA); Paul Bagdanove, SGT, Inc. (USA); Joshua A. Berrier, Tech Innovations (USA); Emmanuel Cofie, SGT, Inc. (USA); Tiffany M. Glassman, Northrop Grumman Aerospace Systems (USA); Theodore J. Hadjimichael, Eric L. Johnson, NASA Goddard Space Flight Ctr. (USA); Joshua Levi, Amy Lo, Northrop Grumman Aerospace Systems (USA); Joseph C. McMann, Sierra Lobo, Inc. (USA); Raymond G. Ohl, NASA Goddard Space Flight Ctr. (USA); Dean Osgood, Sierra Lobo, Inc. (USA); James E. Parker, NASA Goddard Space Flight Ctr. (USA); Kevin W. Redman, Vicki Roberts, Sierra Lobo, Inc. (USA); Matthew Stephens, Genesis Engineering Solutions, Inc. (USA); Adam Sutton, Northrop Grumman Aerospace Systems (USA); Gregory W. Wenzel, Sierra Lobo, Inc. (USA); Jerrod L. Young, NASA Goddard Space Flight Ctr. (USA) . . . . . [10377-17]



# CONFERENCE 10377

4:40 pm: **Metrology for trending alignment of the James Webb Space Telescope before and after ambient environmental testing**, Theodore J. Hadjimichael, NASA Goddard Space Flight Ctr. (USA); Joshua A. Berrier, InteltecTechs (USA); Jeffery S. Gum, NASA Goddard Space Flight Ctr. (USA); Joseph E. Hayden, Sigma Space Corp. (USA); Manal Khreishi, Kyle McLean, Raymond G. Ohl, NASA Goddard Space Flight Ctr. (USA); Kevin W. Redman, Sierra Lobo, Inc. (USA); Joseph F. Sullivan, Ball Aerospace & Technologies Corp. (USA); Gregory W. Wenzel, Sierra Lobo, Inc. (USA); Jerrod L. Young, NASA Goddard Space Flight Ctr. (USA) ..... [10377-18]

5:00 pm: **Assembly, alignment, and test of the Transiting Exoplanet Survey Satellite (TESS) flight optical assemblies**, Gregory Balonek, Michael P. Chrisp, Kristin E. Clark, Christian D. Chesbrough, James E. Andre, Joshua J. Brown, Benjamin C. Richards, Michael Dalpiaz, Joseph Lennon, MIT Lincoln Lab. (USA) ..... [10377-19]

5:20 pm: **High-precision laser microcutting and laser microdrilling using diffractive beam-splitting and high-precision flexible beam alignment**, Frank Zibner, Fraunhofer-Institut für Lasertechnik (Germany); Jens Holtkamp, Pulsar Photonics GmbH (Germany); Clemens Hönninger, Amplitude Systèmes (France); Arnold Gillner, Fraunhofer-Institut für Lasertechnik (Germany) . . . . . [10377-20]

**LOCATION: CONV. CTR. ROOM 6A .. SUN 6:00 PM TO 7:50 PM**

## **Technology Hot Topics: How Optics and Photonics Drive Innovation**

6:00 pm to 6:10 pm: **Welcome and Opening Remarks**

6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)

6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)

6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)

7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)

7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)

## **MONDAY 7 AUGUST**

**LOCATION: CONV. CTR.**

**EXHIBIT HALL B2 ..... MON 5:30 PM TO 7:30 PM**

### **Posters-Monday**

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Calculation of lens alignment errors using the ray transfer matrices for the lens assembly system with an autocollimator and a rotation stage**, Jiyoung Chu, Sungwhi Cho, Won Don Joo, Sangdon Jang, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) . . . . . [10377-21]

**Self-compensation for trefoil aberration of symmetric dioptric microlithographic lens**, Wei-Jei Peng, Cheng-Fang Ho, Wei-Yao Hsu, Instrument Technology Research Ctr. (Taiwan) ..... [10377-22]

**Research methodologies and justification of technical means of determining the accuracy characteristics of alignment control optical-electronic system**, Maksim A. Kleshchenok, Valery V. Korotaev, Ivan S. Nekrylov, ITMO Univ. (Russian Federation) ..... [10377-23]

**Raman laser spectrometer optical head: qualification model assembly and integration verification**, Gonzalo Ramos Zapata, Miguel Sanz-Palomino, Andoni Moral Inza, Carlos Pérez, Tomás Belenguier-Dávila, María del Rosario Canchal, INTA Instituto Nacional de Técnica Aeroespacial (Spain); Jose Antonio Rodriguez Prieto, Amaia Santiago, Cecilia Gordillo, Ingeniería de Sistemas para la Defensa de España (Spain); David Escribano, INTA Instituto Nacional de Técnica Aeroespacial (Spain); Guillermo López-Reyes, Fernando Rull, Univ. de Valladolid (Spain) ..... [10377-24]

# CONFERENCE 10378

LOCATION: CONV. CTR. ROOM 16B

Tuesday–Wednesday 8–9 August 2017 • Proceedings of SPIE Vol. 10378

## Sixteenth International Conference on Solid State Lighting and LED-based Illumination Systems

Conference Chairs: **Nikolaus Dietz**, Georgia State Univ. (USA); **Ian T. Ferguson**, Missouri Univ. of Science and Technology (USA)

Program Committee: **Lianghui Chen**, Institute of Semiconductors (China); **Wood-Hi Cheng**, National Sun Yat-Sen Univ. (Taiwan); **Hugo J. Cornelissen**, Philips Research (Netherlands); **John W. Curran**, LED Transformations, LLC (USA); **Zhe Chuan Feng**, Guangxi Univ. (China); **Christoph Hoelen**, Philips Lighting B.V. (Netherlands); **Jian-Jang Huang**, National Taiwan Univ. (Taiwan); **Jianzhong Jiao**, Consultant (USA); **Matthew H. Kane**, Texas A&M Univ. at Galveston (USA); **Asif M. Khan**, Univ. of South Carolina (USA); **Mike R. Krames**, Arkeso (USA); **Martin Kuball**, Univ. of Bristol (United Kingdom); **Yung Sheng Liu**, National Tsing Hua Univ. (Taiwan); **Na Lu**, Purdue Univ. (USA); **Eun-Hyun Park**, Semicon Light Co., Ltd. (Korea, Republic of); **Seong-Ju Park**, Gwangju Institute of Science and Technology (Korea, Republic of); **Jeff Quinlan**, Acuity Brands Lighting, Inc. (USA); **Tae-Yeon Seong**, Korea Univ. (Korea, Republic of); **Nelson Tansu**, Lehigh Univ. (USA); **Chih-Chung Yang**, National Taiwan Univ. (Taiwan); **Yiting Zhu**, Rensselaer Polytechnic Institute (USA)

### TUESDAY 8 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 16B . . . TUE 1:20 PM TO 3:30 PM

#### Applications for Solid State Lighting using LEDs and OLEDs

Session Chair: **Ian T. Ferguson**, Missouri Univ. of Science and Technology (USA)

1:20 pm: **Opportunities and challenges for 3D printing of solid-state lighting systems** (*Invited Paper*), Nadarajah Narendran, Indika U. Perera, Xi Mou, Dinusha R. Thotagamuwa, Rensselaer Polytechnic Institute (USA) . . . . . [10378-35]

1:50 pm: **Efficiency droop mitigation progress in blue and green III-nitride LEDs** (*Invited Paper*), Hee Jin Kim, Robert Armitage, Tsutomu Ishikawa, Isaac Wildeson, Parijat Deb, Lumileds, LLC (USA); Andrew M. Armstrong, Sandia National Labs. (USA); Zhibo Zhao, Akshay Singh, Silviya Gradecak, Massachusetts Institute of Technology (USA); Eric A. Stach, Brookhaven National Lab. (USA) . . . . . [10378-1]

2:20 pm: **Challenges and new developments for conversion in solid state lighting** (*Invited Paper*), David O'Brien, JeKaterina Jurkova, Rainer Butendeich, Marcus Adam, Robert Schulz, Benjamin Gruber, Ralph Bertram, OSRAM Opto Semiconductors GmbH (Germany); Maria J. Anc, OSRAM SYLVANIA Inc. (USA); Britta Göötz, OSRAM Opto Semiconductors GmbH (Germany) . . . . . [10378-2]

2:50 pm: **Cryogenic characterization of LEDs for space application**, Jerome Carron, Ctr. National d'Études Spatiales (France); Anne Philippon, Institut d'Astrophysique Spatiale (France); Lip Sun How, Audrey Delbergue, David Cillierre, AdvEOTec (France); Sahar Hassanzadeh, Institut d'Astrophysique Spatiale (France); Mathieu Boutilier, Pascale Danto, Ctr. National d'Études Spatiales (France) . . . . . [10378-4]

3:10 pm: **Analysis of spectral power distributions for multi-channel platforms in a patient room application**, James J. Kim, Tony Esposito, Patricia Rizzo, Dorene Maniccia, Philips Research Americas (USA) . . . . . [10378-5]

Coffee Break . . . . . Tue 3:30 pm to 4:00 pm

#### SESSION 2

LOCATION: CONV. CTR. ROOM 16B . . . TUE 4:00 PM TO 5:20 PM

#### Testing, Reliability, and Standards for LED and Solid State Lighting

Session Chair: **Ian T. Ferguson**, Missouri Univ. of Science and Technology (USA)

4:00 pm: **Comparison of methods for measurement of HP-LEDs based on the junction temperature** (*Invited Paper*), Yuqin Zong, Noe V. Medina, National Institute of Standards and Technology (USA) . . . . . [10378-7]

4:30 pm: **A comparison of color fidelity metrics for light sources using simulation of color samples under lighting conditions** (*Invited Paper*), Hyeokjun Kwon, Yoojin Kang, Junwoo Jang, LG Display (Korea, Republic of) . . . . . [10378-6]

5:00 pm: **Low-NEP pyroelectric detector for calibration of UV and IR sources and detectors**, George P. Eppeldauer, Vyacheslav B. Podobedov, Leonard M. Hanssen, Catherine C. Cooksey, National Institute of Standards and Technology (USA) . . . . . [10378-9]

### WEDNESDAY 9 AUGUST

#### SESSION 3

LOCATION: CONV. CTR. ROOM 16B . WED 8:30 AM TO 11:40 AM

#### Device Level Packaging for Solid State Lighting I

Session Chair: **Nikolaus Dietz**, Georgia State Univ. (USA)

8:30 am: **Ultra-high power semiconductor devices: Heat-sinking using GaN-on-diamond** (*Invited Paper*), Martin Kuball, Univ of Bristol (United Kingdom) . . . . . [10378-10]

9:00 am: **Growth and characterization of GaN/InN/GaN heterostructures on GaN substrate templates using migration-enhanced, plasma-assisted MOCVD**, Daniel Seidlitz, Brendan Cross, Viktoriia E. Babicheva, Yohannes Abate, Georgia State Univ. (USA); Axel Hoffmann, Technische Univ. München (Germany); Nikolaus Dietz, Georgia State Univ. (USA) . . . . . [10378-11]

9:20 am: **High-resolution spectroscopy and imaging of interfacial strain fields in InN/GaN and GaN/InN/GaN heterostructures**, Yohannes Abate, Alireza Fali, Viktoriia E. Babicheva, Nikolaus Dietz, Georgia State Univ. (USA) . . . . . [10378-12]

9:40 am: **Growth and characterization of GaN/GaAIN heterostructures on GaN substrate templates**, Lance Hubbard, Pacific Northwest National Lab. (USA); Viktoriia E. Babicheva, Yohannes Abate, Georgia State Univ. (USA); Vincent T. Woods, Pacific Northwest National Lab. (USA); Nikolaus Dietz, Georgia State Univ. (USA) . . . . . [10378-13]

Coffee Break . . . . . Wed 10:00 am to 10:30 am

10:30 am: **The optical properties of phosphor converted white LED with adding Zirconium dioxide particles** (*Invited Paper*), Quang-Khoi Nguyen, Yu-Yu Chang, National Central Univ. (Taiwan); Benoit Glorieux, Institut de Chimie de la Matière Condensée de Bordeaux (France); Tsung-Hsun Yang, Ching-Cheng Sun, Chien-Hung Hsu, National Central Univ. (Taiwan) . . . . . [10378-14]

11:00 am: **Spectra control of RE doped calcium silicate through topochemical reduction strategy for white LED application**, Jingshan Hou, Yongzheng Fang, Shanghai Institute of Technology (China) . . . . . [10378-15]

11:20 am: **Strong coupling between ordered Ag nanosphere and a-SiN<sub>x</sub>:O induced highly efficient blue LED**, Zhongyuan Ma, Nanjing Univ. (China) . . . . . [10378-16]

Lunch/Exhibition Break . . . . . Wed 11:40 am to 1:10 pm

# CONFERENCE 10378

## SESSION 4

LOCATION: CONV. CTR. ROOM 16B .. WED 1:10 PM TO 3:00 PM

### Device Level Packaging for Solid State Lighting II

Session Chair: **Nikolaus Dietz**, Georgia State Univ. (USA)

1:10 pm: **Next generation III-nitride materials and devices: From photonics to new applications** (*Invited Paper*), Nelson Tansu, Lehigh Univ. (USA) . . . [10378-17]

1:40 pm: **Improving the thermal stability of  $K_2SiF_6:Mn^{4+}$  red phosphor using atomic layer deposition in a fluidized bed reactor**, Otmar M. Ten Kate, Technische Univ. Delft (Netherlands); Y. Zhao, Technische Univ. Delft (Netherlands) and Xiamen Univ. (China); H. T. Hintzen, J. R. van Ommen, Technische Univ. Delft (Netherlands) . . . [10378-18]

2:00 pm: **New phosphors  $Eu^{2+}$  and  $Ce^{3+}$  doped  $Sr_{4-x}(Si,Al)^{19+x}(N,O)^{29+x}$  for white LED applications**, Chunyun Wang, Takashi Takeda, Hokkaido Univ. (Japan) and National Institute for Materials Science (Japan); Shiro Funahashi, Rong-Jun Xie, Naoto Hirosaki, National Institute for Materials Science (Japan) . . . [10378-19]

2:20 pm: **Selecting the optimal synthesis parameters of  $InP/Cd_xZn_{1-x}Se$  quantum dots when combined with different broad band phosphors to optimize color rendering and efficiency of a remote phosphor white LED**, Jana Ryckaert, António Correia, Kevin Smet, KU Leuven (Belgium); Mickaël D. Tessier, Dorian Dupont, Zeger Hens, Univ. Gent (Belgium); Peter Hanselaer, Youri Meuret, KU Leuven (Belgium) . . . [10378-20]

2:40 pm: **Fabrication of  $CuInS_2/ZnS$  quantum dots-based white light-emitting diodes with high color rendering index**, Chih-Chun Hsiao, Shu-Ru Chung, Yu-Sheng Su, National Formosa Univ. (Taiwan) . . . [10378-21]

Coffee Break . . . . . Wed 3:00 pm to 3:30 pm

## SESSION 5

LOCATION: CONV. CTR. ROOM 16B .. WED 3:30 PM TO 5:10 PM

### System Level Design and Optimization

Session Chair: **Ian T. Ferguson**, Missouri Univ. of Science and Technology (USA)

3:30 pm: **High lumen density sources based on LED-pumped phosphor rods: opportunities for performance improvement** (*Invited Paper*), Dick K. G. de Boer, Philips Research (Netherlands) . . . [10378-22]

4:00 pm: **Progress in extremely high brightness LED-based light sources** (*Invited Paper*), Christoph G. A. Hoelen, Philips Lighting B.V. (Netherlands) . . . [10378-23]

4:30 pm: **The impact of the driving frequency on the output flux of high-power  $InGaAlP$ -LEDs during high-current pulsed operation**, Benjamin Schulz, Stefan Morgott, OSRAM Opto Semiconductors GmbH (Germany) . . . [10378-24]

4:50 pm: **Opto-thermal design of a white light point source based on high power blue laser diodes**, António Correia, Peter Hanselaer, Youri Meuret, KU Leuven (Belgium) . . . [10378-25]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 ..... WED 5:30 PM TO 7:30 PM

### Posters-Wednesday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Dome diagnostics system of optical parameters and characteristics of LEDs**, Vladimir S. Peretyagin, Nikita A. Pavlenko, ITMO Univ. (Russian Federation) . . . [10378-8]

**Universal fixture design for body mounted LED lights**, Debdyut Hajra, B.P. Poddar Institute of Management & Technology (India) . . . [10378-26]

**Self CCT stabilization for white LEDs from turn-on stage to thermal equilibrium**, Tsung-Hsun Yang, Shin-Mei Wu, National Central Univ. (Taiwan); Benoit Glorieux, Institut de Chimie de la Matière Condensée de Bordeaux (France); Xuan-Hao Lee, Ching-Yi Chen, Yu-Yu Chang, Yeh-Wei Yu, Ching-Cherng Sun, National Central Univ. (Taiwan) . . . [10378-27]

**Modeling and simulation of a solar simulator with multi-wavelength high-power LEDs**, Yoon Kim, Reuben T. Lewis, Calvin College (USA) . . . [10378-28]

**The color enhancement and collimation features of the multi-colored LEDs with different periodic microstructure on the top surface of TIR lens**, Shang-Ping Ying, Minghsin Univ. of Science and Technology (Taiwan); Han-Kuei Fu, Industrial Technology Research Institute (Taiwan) . . . [10378-29]

**Analysis of stereo depth for 3D LED autostereoscopic displays based on physiological limitations**, Shu An, Graduate School at Shenzhen, Tsinghua Univ. (China); Ping Su, Graduate School at Shenzhen Tsinghua Univ (China); Zehao He, Jianshe Ma, Graduate School at Shenzhen, Tsinghua Univ. (China) . . . [10378-30]

**The fabrication and performance of laser light engine used in next-generation laser projector system**, Yung-Peng Chang, National Chung Hsing Univ. (Taiwan) and Taiwan Color Optics, Inc. (Taiwan); Jin-Kai Chang, National Sun Yat-Sen Univ. (Taiwan); Wei-Chih Cheng, Taiwan Color Optics, Inc. (Taiwan); Chun-Nien Liu, Wood-Hi Cheng, National Chung Hsing Univ. (Taiwan) . . . [10378-31]

**Light box for investigation of characteristics of optoelectronics detectors**, Agnieszka Szreder, Gdansk Univ. of Technology (Poland) . . . [10378-32]

**Smart street lighting solution for remote rural areas of India**, Debdyut Hajra, B.P. Poddar Institute of Management & Technology (India) . . . [10378-33]

**High-speed modulation of GaN-based light-emitting diode with embedded photonic crystals**, Zi-Xuan You, Tung-Ching Lin, Jian-Jang Huang, National Taiwan University (Taiwan) . . . [10378-34]



# CONFERENCE 10379

LOCATION: CONV. CTR. ROOM 16B

Sunday–Monday 6–7 August 2017 • Proceedings of SPIE Vol. 10379

## Nonimaging Optics: Efficient Design for Illumination and Solar Concentration XIV

Conference Chairs: **Roland Winston**, Univ. of California, Merced (USA); **Sarah R. Kurtz**, Univ. of California, Merced (USA)

Program Committee: **Pablo Benítez**, CeDInt-UPM (Spain), Light Prescriptions Innovators LLC (USA); **William J. Cassarly**, Synopsys, Inc. (USA); **Daniel Feuermann**, Ben-Gurion Univ. of the Negev (Israel); **Juan Carlos Miñano**, CeDInt-UPM (Spain), Light Prescriptions Innovators LLC (USA); **Narkis E. Shatz**, SureFire, LLC (USA)

### SUNDAY 6 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 16B .SUN 8:30 AM TO 10:00 AM

#### New Concepts

Session Chair: **Lun Jiang**, Univ. of California, Merced (USA)

8:30 am: **Optical design: Why perfect optics (inside the solar cell) are needed to approach the theoretical limit** (*Invited Paper*), Sarah R. Kurtz, Univ. of California, Merced (USA) . . . . . [10379-15]

9:00 am: **How the Hilbert integral theorem inspired flowlines**, Roland Winston, Lun Jiang, Univ. of California, Merced (USA) . . . . . [10379-4]

9:20 am: **New frontiers in solar concentrator design enabled by optically transparent thermal insulators**, Thomas A. Cooper, Massachusetts Institute of Technology (USA) . . . . . [10379-27]

9:40 am: **Étendue and angular acceptance of the asymmetric compound parabolic concentrator**, Melissa N. Ricketts, Roland Winston, Jonathan Ferry, Univ. of California, Merced (USA) . . . . . [10379-3]

Coffee Break . . . . . Sun 10:00 am to 10:30 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 16B .SUN 10:30 AM TO 11:50 AM

#### Solar Applications

Session Chair: **Roland Winston**, Univ. of California, Merced (USA)

10:30 am: **Why do we still care about CPV?**, Marco Stefancich, Dubai Electricity and Water Authority (United Arab Emirates); Matteo Chiesa, Harry N. Apostoleris, Masdar Institute of Science & Technology (United Arab Emirates) . . . . . [10379-2]

10:50 am: **Optical performance effects of the misalignment of nonimaging optics solar collectors**, Jonathan Ferry, Melissa N. Ricketts, Roland Winston, Univ. of California, Merced (USA) . . . . . [10379-5]

11:10 am: **Optimization of photovoltaic V-Trough concentrators through genetic algorithms based on the interactions with beam radiation**, Andrés Arias-Rosales, Ricardo Mejía-Gutiérrez, Univ. EAFIT (Colombia) . . . . . [10379-6]

11:30 am: **Broadband angular selectivity in solar concentrators**, Harry N. Apostoleris, Masdar Institute of Science & Technology (United Arab Emirates); Yichen Shen, Duncan C. Wheeler, Thomas A. Cooper, Massachusetts Institute of Technology (USA); Matteo Chiesa, Masdar Institute of Science & Technology (United Arab Emirates); Marin Soljacic, Massachusetts Institute of Technology (USA) . . . . . [10379-7]

Lunch Break . . . . . Sun 11:50 am to 1:40 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 16B . . SUN 1:40 PM TO 3:00 PM

#### Numerical and Freeform Methods

Session Chair: **Marco Stefancich**, Dubai Energy and Water Authority (United Arab Emirates)

1:40 pm: **Testing light concentrators prototypes for the Cherenkov Telescope Array**, François B. Hénault, Pierre-Olivier Petrucci, Laurent Jocou, Institut de Planétologie et d'Astrophysique de Grenoble (France) . . . . . [10379-8]

2:00 pm: **Synthesis of freeform refractive surfaces forming various radiation patterns using interpolation**, Iana Mazur, Anna O. Voznesenskaya, Pavel Krizskiy, ITMO Univ. (Russian Federation) . . . . . [10379-9]

2:20 pm: **Designing freeform reflectors using new source-target mapping method**, Egor V. Byzov, Leonid L. Doskolovich, Evgeniy S. Andreev, Nikolay L. Kazanskiy, Image Processing Systems Institute, Russian Academy of Sciences (Russian Federation) and Samara Univ. (Russian Federation) . . . . . [10379-10]

2:40 pm: **Efficiency of geometric designs of non-tracing flexible solar panels: Mathematical simulation**, Malgorzata Marciniak, Yasser Y. Hassebo, LaGuardia Community College (USA); Delfino Enriquez, Maria-Ignacia Serey-Roman, LaGuardia Community College, The City Univ. of New York (USA) . . . . . [10379-11]

Coffee Break . . . . . Sun 3:00 pm to 3:30 pm

#### SESSION 4

LOCATION: CONV. CTR. ROOM 16B . . SUN 3:30 PM TO 4:30 PM

#### Illumination

Session Chair: **Melissa N. Ricketts**, Univ. of California, Merced (USA)

3:30 pm: **Shaping and homogenization of LED white light using aperiodic scattering cell arrays**, Daniel Asoubar, Roberto Knoth, Hagen Schweitzer, LightTrans International UG (Germany); Frank Wyrowski, Huiying Zhong, Friedrich-Schiller-Univ. Jena (Germany) . . . . . [10379-12]

3:50 pm: **Compact collimators designed with a modified point approximation for light-emitting diodes**, Tao Luo, Gang Wang, Sun Yat-Sen Univ. (China) . . . . . [10379-13]

4:10 pm: **Control of ray deflection angles in the design of secondary optics with multiple surfaces**, Sergey V. Kravchenko, Kseniya V. Andreeva, Samara Univ. (Russian Federation) and Image Processing Systems Institute, Russian Academy of Sciences (Russian Federation); Mikhail A. Moiseev, Image Processing Systems Institute, Russian Academy of Sciences (Russian Federation) and Samara Univ. (Russian Federation); Leonid L. Doskolovich, Image Processing Systems Institute (Russian Federation) and Samara Univ. (Russian Federation) . . . . . [10379-14]

LOCATION: CONV. CTR. ROOM 6A . . SUN 6:00 PM TO 7:50 PM

#### Technology Hot Topics: How Optics and Photonics Drive Innovation

6:00 pm to 6:10 pm: **Welcome and Opening Remarks**

6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)

6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)

6:50 pm to 7:10 pm: **AR/VR**, Scott McElDowney, Oculus (USA)

7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)

7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)

# CONFERENCE 10379

MONDAY 7 AUGUST

SESSION 5

LOCATION: CONV. CTR. ROOM 16B MON 8:30 AM TO 10:00 AM

## Advanced Developments

Session Chair: **Boaz Ilan**, Univ. of California, Merced (USA)

8:30 am: **Thermodynamic foundation of nonimaging optics**, Lun Jiang, Roland Winston, Univ. of California, Merced (USA). . . . . [10379-1]

8:50 am: **Advances on geometric flux optical design method** (*Invited Paper*), Ángel García-Botella, Univ. Politécnica de Madrid (Spain); Antonio A. Fernandez-Balbuena, Daniel Vázquez-Moliní, Univ. Complutense de Madrid (Spain) [10379-28]

9:20 am: **Point to point multispectral light projection applied to cultural heritage**, Daniel Vázquez-Moliní, Antonio A. Fernandez-Balbuena, Univ. Complutense de Madrid (Spain); Ángel García-Botella, Univ. Politécnica de Madrid (Spain) . . . . . [10379-29]

9:40 am: **Thermodynamic investigation of segmented CPC**, Bennett K. Widyolar, Univ. of California, Merced (USA) . . . . . [10379-16]

Coffee Break . . . . . Mon 10:00 am to 10:30 am

SESSION 5

LOCATION: CONV. CTR. ROOM 16B MON 10:30 AM TO 12:20 PM

## Concentrator Designs

Session Chair: **Daniel Vázquez-Moliní**, Univ. Complutense de Madrid (Spain)

10:30 am: **The error tolerance of nonimaging optic systems**, Ali Hassanzadeh, Bennett K. Widyolar, Lun Jiang, Roland Winston, Univ. of California, Merced (USA) . . . . . [10379-17]

10:50 am: **Tracking and shape errors measurement of concentrating heliostats**, Mathieu Coquand, Institut de Planétologie et d'Astrophysique de Grenoble (France) and PROMES-CNRS (France); Cyril Caliot, PROMES-CNRS (France); François B. Hénault, Institut de Planétologie et d'Astrophysique de Grenoble (France) . . . . . [10379-18]

11:10 am: **Optimizing luminescent solar concentrators** (*Invited Paper*), Boaz Ilan, Univ. of California, Merced (USA) . . . . . [10379-19]

11:40 am: **Enhancing the light conversion efficiency in a luminescent solar concentrator by using a prism film**, Pao-Keng Yang, Hua-Yu Tseng, Chia-Wei Lin, Min-Hsiu Chung, Tsung-Wei Huang, Minghsin Univ. of Science and Technology (Taiwan). . . . . [10379-20]

12:00 pm: **The characteristics of luminescent solar concentrators (LSCs) using inorganic phosphors**, Shang-Ping Ying, Bing-Mau Chen, An-Ting Li, Minghsin Univ. of Science and Technology (Taiwan). . . . . [10379-21]

Lunch Break . . . . . Mon 12:20 pm to 2:00 pm

LOCATION: CONV. CTR. ROOM 6A . MON 2:00 PM TO 3:30 PM

## Optics + Photonics for Sustainable Energy Plenary Session

2:00 pm: **A Brief History of Photovoltaics: Yesterday, Today, and Tomorrow** (*Plenary*), Charles Gay, U.S. Dept. of Energy (USA) . . . . . [10368-201]

2:30 pm: **Photovoltaics Moving into the Terawatt Age** (*Plenary*), Eicke R. Weber, Berkeley Education Alliance for Research in Singapore BEARS (Singapore) and Univ. of California, Berkeley (USA). . . . . [10368-202]

3:00 pm: **Bankability of Novel Energy Technologies** (*Plenary*), Ralph Romero, Black & Veatch (USA). . . . . [10368-203]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 . . . . . MON 5:30 PM TO 7:30 PM

## Posters-Monday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Optimization design of nonimaging Fresnel lens using total internal reflection prisms for light concentration**, Perla M. Viera-González, Guillermo E. Sánchez-Guerrero, Edgar Martínez-Guerra, Univ. Autónoma de Nuevo León (Mexico); Daniel Enrique Ceballos-Herrera, Univ. Nacional Autónoma de México (Mexico) [10379-22]

**Numerical analysis of lateral illumination lightpipes using elliptical grooves**, Guillermo E. Sánchez-Guerrero, Perla M. Viera-González, Edgar Martínez-Guerra, Univ. Autónoma de Nuevo León (Mexico); Daniel Enrique Ceballos Herrera, Univ. Nacional Autónoma de México (Mexico). . . . . [10379-23]

**Design and manufacturing of cascaded DCG based holograms for spectrum-splitting PV systems**, Yuechen Wu, Benjamin D. Chrysler, Silvana Ayala Pelaez, Raymond K. Kostuk, The Univ. of Arizona (USA) . . . . . [10379-24]

**Impact of internal forced air cooling on radiative absorption of a gas-particle medium in a small particle solar receiver**, James O'Hara, San Diego State Univ. (USA) . . . . . [10379-25]

**Optical coatings for luminescent solar concentrators**, Cheng-Chung Jaing, Po-Chun Lu, Jian-Wei Chen, Wei-Gwo Yu, Jing-Han Xie, Pao-Keng Yang, Bing-Mau Chen, Minghsin Univ. of Science and Technology (Taiwan). . . . . [10379-26]

**Real time 3D photometry**, Antonio A. Fernandez-Balbuena, Daniel Vázquez-Moliní, Univ. Complutense de Madrid (Spain); Ángel García-Botella, Univ. Politécnica de Madrid (Spain); Jesus Romo, Valeo (Spain) . . . . . [10379-30]

LOCATION: MARRIOTT MARQUIS,  
MARINA F . . . . . 8:00 PM TO 10:00 PM

## Illumination Technical Event

Chair: **Jake Jacobsen**, Synopsys, Inc. (USA)

Please join us for an evening of stimulating discussion, networking, and conversation. This year we have two guest speakers.

**Dr. Charlie Gay** will be presenting a talk entitled "Where Have All the Photons Gone? Optimizing the Optical Properties of Solar Panels for Real World Applications". Dr. Gay is the Solar Energy Technologies Office Director for the Office of Energy Efficiency and Renewable Energy (EERE) of the U.S. Department of Energy (DOE).

**Dr. Bill Cassarly** will be giving us an overview of the submissions for this year's International Optical Design Conference's (IODC) Illumination Design Problem. Every four years the IODC sponsors a design competition for both imaging and illumination engineers. The problems posed are always highly challenging, very unusual, and completely ridiculous. Dr. Cassarly is a Synopsys Scientist in the Optical Solutions Group and Fellow of the SPIE and was an author and judge of this year's illumination design competition.

Don't miss what promises to be a fun and illuminating event. At the end of the presentations any member of the audience may present information within the broad field of illumination. Light refreshments will be served.

Light refreshments sponsored by:

The Optical Solutions Group at **SYNOPSYS**<sup>®</sup>

# CONFERENCE 10380

LOCATION: CONV. CTR. ROOM 18

Sunday–Monday 6–7 August 2017 • Proceedings of SPIE Vol. 10380

## Ultrafast Nonlinear Imaging and Spectroscopy V

Conference Chair: **Zhiwen Liu**, The Pennsylvania State Univ. (USA)

Conference Co-Chairs: **Iam Choon Khoo**, The Pennsylvania State Univ. (USA); **Demetri Psaltis**, Ecole Polytechnique Fédérale de Lausanne (Switzerland); **Kebin Shi**, Peking Univ. (China)

Program Committee: **George Barbastathis**, Massachusetts Institute of Technology (USA); **Randy A. Bartels**, Colorado State Univ. (USA); **Martin Centurion**, Univ. of Nebraska-Lincoln (USA); **Jason M. Eichenholz**, Open Photonics, Inc. (USA); **Kenan Gundogdu**, North Carolina State Univ. (USA); **Hans D. Hallen**, North Carolina State Univ. (USA); **Zhenyu Li**, The George Washington Univ. (USA); **Fiorenzo Gabriele Omenetto**, Tufts Univ. (USA); **Michelle Y. Sander**, Boston Univ. (USA); **Jigang Wang**, Iowa State Univ. of Science and Technology (USA); **Yong Xu**, Virginia Polytechnic Institute and State Univ. (USA)

### SUNDAY 6 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 18 . . . . SUN 8:00 AM TO 9:55 AM

#### SFG/SHG Spectroscopy

Session Chair: **Kebin Shi**, Peking Univ. (China)

8:00 am: **Effects of cations and cholesterol with sphingomyelin membranes Investigated by high-resolution broadband sum frequency vibrational spectroscopy** (*Invited Paper*), Zhen Zhang, Yi-Yi Li, Rong-Juan Feng, Li-Li Lu, Yuan Guo, Institute of Chemistry, Chinese Academy of Sciences (China) . [10380-1]

8:25 am: **High resolution vibrational sum frequency generation spectroscopy revealing new properties of the complex interfacial molecular systems: Spectral splitting, molecular symmetry, and supramolecular chirality** (*Invited Paper*), Zhou Lu, Yi-Yi Li, Rongjuan Feng, Jian Hou, Yingxue Ma, Zhen Zhang, Yuan Guo, Minghua Liu, Institute of Chemistry, Chinese Academy of Sciences (China) . . . . . [10380-2]

8:50 am: **Second-harmonic generation in semiconductor nanostructures and applications** (*Invited Paper*), Kai Wang, Huazhong Univ. of Science and Technology (China) . . . . . [10380-3]

9:15 am: **Observation of polar domains in metallic layered oxides** (*Invited Paper*), Gregory A. Stone, Shiming Lei, Ke Wang, The Pennsylvania State Univ. (USA); Danilo Puggioni, Northwestern Univ. (USA); Zhiqiang Mao, Tulane Univ. (USA); James M. Rondinelli, Northwestern Univ. (USA); Venkatraman Gopalan, The Pennsylvania State Univ. (USA) . . . . . [10380-4]

9:40 am: **Nonlinear characterization of two dimensional materials**, Alexander S. Cocking, William Murray, Kazunori Fujisawa, Pennsylvania State Univ. (USA); Anna Laura-Elias, The Pennsylvania State Univ. (USA); Mauricio Terrones, Zhiwen Liu, Pennsylvania State Univ. (USA) . . . . . [10380-5]

Coffee Break . . . . . Sun 9:55 am to 10:25 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 18 . . . . SUN 10:25 AM TO 11:55 AM

#### Novel Ultrafast Sources and Applications

Session Chair: **William Murray**, The Pennsylvania State Univ. (USA)

10:25 am: **Supercontinuum generation using longitudinal z-polarized vectorial beam** (*Invited Paper*), Wenkai Zhang, Beijing Normal Univ. (China) . . . . . [10380-6]

10:50 am: **Tunable optical source based on divided pulse soliton self-frequency shift**, Chenji Zhang, Pennsylvania State Univ. (USA); Victor Bucklew, Perry S. Edwards, Atoptix, LLC (USA); Corey Janisch, The Pennsylvania State Univ. (USA); Zhiwen Liu, Pennsylvania State Univ. (USA) . . . . . [10380-7]

11:05 am: **Iteratively-seeded mode-locking for high performance ultrashort pulsed lasers** (*Invited Paper*), Victor Bucklew, Atoptix, LLC (USA); William Renninger, Yale Univ. (USA); Perry S. Edwards, Atoptix, LLC (USA); Zhiwen Liu, Pennsylvania State Univ. (USA) . . . . . [10380-8]

11:30 am: **High power fiber laser pumped femtosecond optical parametric resources** (*Invited Paper*), Jintao Fan, Minglie Hu, Tianjin Univ. (China) . . [10380-9]

Lunch Break . . . . . Sun 11:55 am to 1:30 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 18 . . . . SUN 1:30 PM TO 3:00 PM

#### Ultrafast Electron Diffraction and Imaging I

Session Chair: **William Renninger**, Yale Univ. (USA)

1:30 pm: **Ultrafast MeV electron diffraction/microscopy at SLAC** (*Invited Paper*), Xiaozhe Shen, Renkai Li, Jie Yang, Stephen P. Weatherspy, Xijie Wang, SLAC National Accelerator Lab. (USA) . . . . . [10380-10]

1:55 pm: **Ultrafast imaging of molecular dynamics with electron diffraction** (*Invited Paper*), Martin Centurion, Univ. of Nebraska-Lincoln (USA); Jie Yang, SLAC National Accelerator Lab. (USA); Markus Guehr, Univ. Potsdam (Germany); Xiaozhe Shen, Renkai Li, SLAC National Accelerator Lab. (USA); Omid Zandi, Kyle J. Wilkin, Univ. of Nebraska-Lincoln (USA); Theodore Vecchione, Ryan N. Coffee, Jeff Corbett, Alan R. Fry, Nick Hartmann, Carsten Hast, Kareem Hegazy, Keith R. Jobe, Igor V. Makasyuk, Joseph S. Robinson, SLAC National Accelerator Lab. (USA); Matthew S. Robinson, Univ. of Nebraska-Lincoln (USA); Sharon Vetter, Stephen P. Weathersby, Chales Yoneda, Xijie Wang, SLAC National Accelerator Lab. (USA) . . . . . [10380-11]

2:20 pm: **Imaging electronic motions by ultrafast electron diffraction** (*Invited Paper*), Hua-Chieh Shao, Univ. of Nebraska-Lincoln (USA); Anthony F. Starace, Univ. of Nebraska-Lincoln (USA) . . . . . [10380-12]

2:45 pm: **Charge carrier dynamics in semiconductors studied by scanning ultrafast electron microscopy**, Ebrahim Najafi, California Institute of Technology (USA) . . . . . [10380-13]

Coffee Break . . . . . Sun 3:00 pm to 3:30 pm

#### SESSION 4

LOCATION: CONV. CTR. ROOM 18 . . . . SUN 3:30 PM TO 4:45 PM

#### Ultrafast Electron Diffraction and Imaging II

3:30 pm: **Serial single molecule electron diffraction imaging: A possible solution to the crystallization problem** (*Invited Paper*), Wei Kong, Oregon State Univ. (USA) . . . . . [10380-14]

3:55 pm: **Momentum-space imaging of ultrafast electron-phonon coupling in functional materials** (*Invited Paper*), Hermann A. Dürr, SLAC National Accelerator Lab. (USA) . . . . . [10380-15]

4:20 pm: **Spatiotemporal visualization of molecular rotational dynamics in femtosecond laser fields** (*Invited Paper*), Hui Li, Jian Wu, Heping Zeng, Peifen Lu, Kang Lin, Junyang Ma, Xiaochun Gong, Qinying Ji, Qiyong Song, Wenbin Zhang, East China Normal Univ. (China) . . . . . [10380-16]



# CONFERENCE 10380

## SESSION 5

LOCATION: CONV. CTR. ROOM 18 . . . SUN 4:45 PM TO 5:30 PM

### Biological Imaging and Sensing Applications I

Session Chair: **Martin Centurion**, Univ. of Nebraska-Lincoln (USA)

4:45 pm: **Smartphone chloridometer for point-of-care diagnosis of cystic fibrosis**, Chenji Zhang, Jimin Kim, Jian Yang, Zhiwen Liu, Pennsylvania State Univ. (USA) . . . . . [10380-17]

5:00 pm: **Step-index optical fiber based on citrate-based synthetic polymers**, Chenji Zhang, Dingying Shan, Jian Yang, Zhiwen Liu, Pennsylvania State Univ. (USA) . . . . . [10380-18]

5:15 pm: **Measure the spatial distribution of corneal elasticity by combining femtosecond laser induced breakdown spectroscopy and acoustic radiation force elasticity microscope**, Hui Sun, Xin Li, Zhongwei Fan, Academy of Opto-Electronics, CAS (China); Mingyong Hu, Hefei Univ. of Technology (China) . . . . . [10380-19]

LOCATION: CONV. CTR. ROOM 6A . . SUN 6:00 PM TO 7:50 PM

### Technology Hot Topics: How Optics and Photonics Drive Innovation

6:00 pm to 6:10 pm: **Welcome and Opening Remarks**

6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)

6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)

6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)

7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)

7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)

## MONDAY 7 AUGUST

### SESSION 6

LOCATION: CONV. CTR. ROOM 18 . . MON 8:00 AM TO 10:05 AM

### Nanoscale Phenomena

Session Chair: **Michelle Y. Sander**, Boston Univ. (USA)

8:00 am: **Infrared fingerprint spectroscopy of nanoscale molecules with graphene plasmons** (*Invited Paper*), Qing Dai, National Ctr. for Nanoscience and Technology of China (China) . . . . . [10380-20]

8:25 am: **Ultrafast optical spectroscopy of individual nano-materials** (*Invited Paper*), Kaihui Liu, Peking Univ. (China) . . . . . [10380-22]

8:50 am: **Ultrafast imaging of microstructures and coherent transients in hybrid perovskite materials** (*Invited Paper*), Jigang Wang, Ames Lab., Iowa State Univ. (USA) . . . . . [10380-23]

9:15 am: **Ultrafast pump-probe and Raman experiments of individual plasmonic junctions** (*Invited Paper*), Eric O. Potma, Alexander Fast, Kevin T. Crampton, Vartkess A. Apkarian, Univ. of California, Irvine (USA) . . . . . [10380-24]

9:40 am: **Efficient triplet exciton generation in hybrid perovskites** (*Invited Paper*), Kenan Gundogdu, North Carolina State Univ. (USA) . . . . . [10380-25]

Coffee Break . . . . . Mon 10:05 am to 10:35 am

### SESSION 7

LOCATION: CONV. CTR. ROOM 18 . . . MON 10:35 AM TO 12:15 PM

### Biological Imaging and Sensing Applications II

Session Chair: **Kenan Gundogdu**, North Carolina State Univ. (USA)

10:35 am: **Redox-sensitive heme imaging with transient absorption microscopy** (*Invited Paper*), Jesse W. Wilson, Erkang Wang, Colorado State Univ. (USA) . . . . . [10380-26]

11:00 am: **Simultaneous two-photon photoactivation and readout of brain activity in 3D with single neuron resolution** (*Invited Paper*), Nicolas C. Pegard, Alan Mardinly, Hillel Adesnik, Laura Waller, Univ. of California, Berkeley (USA) . . . . . [10380-27]

11:25 am: **Molecular spectroscopy and dynamics of novel FRET Sensors in crowded environments** (*Invited Paper*), Hannah Leopold, Jacob Schwarz, Megan Currie, Erin D. Sheets, Ahmed A. Heikal, Univ. of Minnesota Duluth (USA) [10380-28]

11:50 am: **Second harmonic generation chiral imaging in biological tissues** (*Invited Paper*), Shi-Wei Chu, National Taiwan Univ. (Taiwan) . . . . . [10380-29]

Lunch Break . . . . . Mon 12:15 pm to 2:00 pm

### SESSION 8

LOCATION: CONV. CTR. ROOM 18 . . . MON 2:00 PM TO 3:30 PM

### Novel Imaging Techniques I

Session Chair: **Ye Pu**, Ecole Polytechnique Fédérale de Lausanne (Switzerland)

2:00 pm: **Femtosecond pulse delivery through multi-core fibers for imaging and ablation** (*Invited Paper*), Demetri Psaltis, Eirini Kakava, Nicolino Stasio, Donald B. Conkey, Christophe Moser, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . . [10380-30]

2:25 pm: **Label-free mid-Infrared photothermal imaging: High spatial resolution beyond the mid-Infrared diffraction limit** (*Invited Paper*), Michelle Y. Sander, Boston Univ. (USA) . . . . . [10380-31]

2:50 pm: **Practical masks for multimodel spatial frequency modulation imaging fabricated with femtosecond laser micromachining** (*Invited Paper*), Jeffrey A. Squier, Colorado School of Mines (USA); Randy A. Bartels, Colorado State Univ. (USA); Michael D. Young, Colorado School of Mines (USA); Jeffrey J. Field, Colorado State Univ. (USA); Nathan Worts, Colorado School of Mines (USA); Keith A. Wernsing, Patrick A. Stockton, Colorado State Univ. (USA); Alyssa M. Allende Motz, Colorado School of Mines (USA) . . . . . [10380-32]

3:15 pm: **Sum frequency generation holography**, Ding Ma, Pennsylvania State Univ. (USA); Christopher M. Lee, The Pennsylvania State Univ. (USA); Yizhu Chen, Nikhil Mehta, Seong H. Kim, Zhiwen Liu, Pennsylvania State Univ. (USA) [10380-33]

Coffee Break . . . . . Mon 3:30 pm to 4:00 pm

### SESSION 9

LOCATION: CONV. CTR. ROOM 18 . . . MON 4:00 PM TO 5:40 PM

### Novel Imaging Techniques II

Session Chair: **Zhiwen Liu**, The Pennsylvania State Univ. (USA)

4:00 pm: **Non-degenerate two-photon excitation for increasing the fluorescence photon yield and maximum microscopy imaging depth** (*Invited Paper*), Mu-Han Yang, Christopher G. L. Ferri, Payam A. Saisan, Maxim Abashin, Univ. of California, San Diego (USA); Peifang Tian, John Carroll Univ. (USA); Yeshaiahu Fainman, Anna Devor, Univ. of California, San Diego (USA) . . [10380-34]

4:25 pm: **High resolution nonlinear imaging based on optical field engineering** (*Invited Paper*), Kebin Shi, Dashan Dong, Yanhui Cai, Wei Liu, Chendi Shao, Peking Univ. (China) . . . . . [10380-35]

4:50 pm: **Ultrafast all-optical laser scanning imaging with spatiotemporally encoded pulses** (*Invited Paper*), Kevin K. Tsia, The Univ. of Hong Kong (Hong Kong, China) . . . . . [10380-36]

5:15 pm: **Coherence-domain imaging with harmonic holography** (*Invited Paper*), Ye Pu, Demetri Psaltis, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . . [10380-37]

**LOCATION: CONV. CTR.  
EXHIBIT HALL B2 ..... MON 5:30 PM TO 7:30 PM**

## Posters-Monday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Research study of the treatment efficacy of staphylococci in the palatine tonsils by using Raman-scattering spectroscopy method**, Anna A. Asadova, Elena V. Timchenko, Pavel E. Timchenko, Elena G. Zarubina, Evgeniy S. Burenkov, Yuriy D. Ityaksov, Anna S. Tyumchenkova, Samara Univ. (Russian Federation) ..... [10380-39]

**Research studies of aging changes of hyaline cartilage surface by using Raman-scattering spectroscopy**, Anna S. Tyumchenkova, Elena V. Timchenko, Pavel E. Timchenko, Samara Univ. (Russian Federation); Larisa T. Volova, Dmitry A. Dolgyskin, Samara State Medical Univ. (Russian Federation); Maria D. Markova, Elena F. Yagofarova, Samara Univ. (Russian Federation)..... [10380-40]

**Research of vertical sections of rats' tubular bones in simulation of reduction bone tissue mineral density using Raman spectrum method**, Yana V. Fedorova, Elena V. Timchenko, Pavel E. Timchenko, Samara Univ. (Russian Federation); Dmitry A. Dolgyskin, Larisa T. Volova, Samara State Medical Univ. (Russian Federation); Anna A. Asadova, Anna S. Tyumchenkova, Samara Univ. (Russian Federation) ..... [10380-41]

**Optical surface evaluation of bone implants during its processing**, Oleg O. Frolov, Pavel E. Timchenko, Elena V. Timchenko, Samara Univ. (Russian Federation); Larisa T. Volova, Dmitry A. Dolgyskin, Violetta V. Boltovskaya, Samara State Medical Univ. (Russian Federation); Vadim D. Meshcheryakov, Yana Fedorova, Anna S. Tyumchenkova, Samara Univ. (Russian Federation) . [10380-42]

**Extension of supercontinuum spectrum, generated in photonic crystal fiber, by using chirped femtosecond pulses**, Julius Vengelis, Vygandas Jarutis, Valdas Sirutkaitis, Vilnius Univ. (Lithuania) ..... [10380-43]

**Temporal focusing multiphoton excitation fluorescence imaging using the excitation wavelength-selected configuration**, Fan-Ching Chien, National Central Univ. (Taiwan); Chi-Hsiang Lien, National United Univ. (Taiwan); Gerald Abrigo, National Central Univ. (Taiwan) ..... [10380-44]

**Imaging of thick, transparent samples by time-of-flight detection of optical pulse trains**, Xing Lu, Jiarui Wu, Wentao Yu, Ziheng Ji, Qihuang Gong, Kebin Shi, Peking Univ. (China) ..... [10380-45]

**Holographic imaging of two dimensional materials**, Joshua Noble, Atriya Ghosh, Zhiwen Liu, The Pennsylvania State Univ. (USA) ..... [10380-46]

**Tomographic diffractive microscopy for better 3D imaging**, Dashan Dong, Yanhui Cai, Ziheng Ji, Hong Yang, Qihuang Gong, Kebin Shi, Peking Univ. (China) ..... [10380-47]

# CONFERENCE 10381

LOCATION: CONV. CTR. ROOM 19

Monday–Tuesday 7–8 August 2017 • Proceedings of SPIE Vol. 10381

## Wide Bandgap Power Devices and Applications II

Conference Chairs: **Mohammad Matin**, Univ. of Denver (USA); **Srabanti Chowdhury**, Univ. of California, Davis (USA); **Achyut K. Dutta**, Banpil Photonics, Inc. (USA)

Program Committee: **Mowafak M. Al-Jassim**, National Renewable Energy Lab. (USA); **Abdul A. S. Awwal**, Lawrence Livermore National Lab. (USA); **M. Saif Islam**, Univ. of California, Davis (USA); **Hidenori Mimura**, Shizuoka Univ. (Japan); **Rebecca J. Nikolic**, Lawrence Livermore National Lab. (USA); **Madan Niraula**, Nagoya Institute of Technology (Japan); **Bart Van Zeghbroeck**, Univ. of Colorado at Boulder (USA)

### MONDAY 7 AUGUST

LOCATION: CONV. CTR.

EXHIBIT HALL B2 ..... MON 5:30 PM TO 7:30 PM

#### Posters-Monday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Molding and simulating of GaN step-up power switched capacitor converter**, Ayoob Alateeq, Yasser A. Almalaq, Mohammad A. Matin, Univ. of Denver (USA) ..... [10381-16]

**Design and performance study of a DC-DC flyback converter based on wide bandgap power devices for photovoltaic applications**, Salah S. Alharbi, Saleh S. Alharbi, Ali M. S. Al-bayati, Mohammad Matin, Univ. of Denver (USA) . . . [10381-18]

**Design of a high-performance cascaded boost converter with SiC power devices for photovoltaic applications**, Saleh S. Alharbi, Ali M. S. Al-bayati, Salah S. Alharbi, Mohammad Matin, Univ. of Denver (USA) . . . [10381-19]

**Properties of reactively sputtered Al<sub>x</sub>N<sub>y</sub> thin films for pyroelectric detectors**, Nicholas P. Calvano, Phillip C. Chrostoski, Andrew Voshell, Keesean Braithwaite, Delaware State Univ. (USA); Dennis W. Prather, Univ. of Delaware (USA); Murzy D. Jhabvala, NASA Goddard Space Flight Ctr. (USA); Mukti M. Rana, Delaware State Univ. (USA) ..... [10381-20]

### TUESDAY 8 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 19 ... TUE 9:00 AM TO 10:15 AM

#### Wide Bandgap Materials and Devices I

Session Chair: **Achyut K. Dutta**, Banpil Photonics, Inc. (USA)

9:00 am: **Junction formation by laser irradiation through semiconductor substrate for CdTe and wide-band gap materials** (*Keynote Presentation*), Toru Aoki, Junichi Nishizawa, Jinwei Lee, Kento Tabata, Akifumi Koike, Shizuoka Univ. (Japan)..... [10381-1]

9:35 am: **A study of the effect of surface pretreatment on atomic layer deposited Al<sub>2</sub>O<sub>3</sub> interface with GaN**, Jianyi Gao, Wenwen Li, Srabanti Chowdhury, Univ. of California, Davis (USA)..... [10381-2]

9:55 am: **3D analysis of thermal and electrical performance of wide bandgap VDMOSFETs**, Mahesh Manandhar, Mohammad A. Matin, Univ. of Denver (USA) ..... [10381-3]

Coffee Break ..... Tue 10:15 am to 10:45 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 19 ... TUE 10:45 AM TO 11:35 AM

#### Wide Bandgap Materials and Devices II

Session Chairs: **M. Saif Islam**, Univ. of California, Davis (USA); **Achyut K. Dutta**, Banpil Photonics, Inc. (USA)

10:45 am: **Emission control of multilayered thin films of ZnO/CuO prepared by pulsed laser deposition** (*Invited Paper*), Hong-Kun Lyu, DGIST (Korea, Republic of); Bunyod Allabergenov, DGIST (Korea, Republic of) and Urgench State Univ. (Uzbekistan); Hyunseok Shim, Myoung-Jae Lee, Byeongdae Choi, DGIST (Korea, Republic of) ..... [10381-4]

11:15 am: **Development of an efficient DC-DC SEPIC converter using wide bandgap power devices for high step-up applications**, Ali M. S. Al-bayati, Salah S. Alharbi, Saleh S. Alharbi, Mohammad A. Matin, Univ. of Denver (USA) . [10381-6]

Lunch/Exhibition Break ..... Tue 11:35 am to 1:30 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 19 ..... TUE 1:30 PM TO 3:00 PM

#### Wide Bandgap Materials and Devices III

Session Chairs: **Srabanti Chowdhury**, Univ. of California, Davis (USA); **Mohammad A. Matin**, Univ. of Denver (USA)

1:30 pm: **Defect-induced optical breakdown in aluminum nitride** (*Invited Paper*), Jae-Hyuck Yoo, Lawrence Livermore National Lab. (USA); Andrew Lange, Lawrence Livermore National Lab. (USA) and Univ. of California, Davis (USA); Selim Elhadji, Lawrence Livermore National Lab. (USA) ..... [10381-7]

2:00 pm: **Comparison between dielectric and p-GaN gates for CAVETs with Mg ion-implanted current blocking layers**, Saptarshi Mandal, Univ. of California, Davis (USA) ..... [10381-8]

2:20 pm: **Highly efficient GaN HEMTs transformerless single-phase inverter for grid-tied fuel cell**, Khaled S. Alatawi, Fahad M. Almasoudi, Mohammad A. Matin, Univ. of Denver (USA) ..... [10381-9]

2:40 pm: **The wide bandgap of optical absorption coefficient for optoelectronic materials**, Subhamoy Singha Roy, JIS College of Engineering (India) . . . [10381-10]

Coffee Break ..... Tue 3:00 pm to 3:30 pm

#### SESSION 4

LOCATION: CONV. CTR. ROOM 19 ..... TUE 3:30 PM TO 5:30 PM

#### Wide Bandgap Materials and Devices IV

Session Chairs: **Mohammad A. Matin**, Univ. of Denver (USA); **Srabanti Chowdhury**, Univ. of California, Davis (USA)

3:30 pm:  **$\beta$ -Ga<sub>2</sub>O<sub>3</sub> films grown via oxidation of GaAs substrates and their device demonstrations** (*Invited Paper*), Ahmet Kaya, Daniel M. Dryden, Howard Mao, Dewyani Patil-Chaudhuri, Andrew Philip Lange, Subhash Mahajan, Jerry M. Woodall, M. Saif Islam, Univ. of California, Davis (USA) ..... [10381-11]

4:00 pm: **Simulation and performance comparison of Si and SiC-based interleaved boost converter**, Yasser A. Almalaq, Ayoob Alateeq, Mohammad A. Matin, Univ. of Denver (USA)..... [10381-12]

4:20 pm: **High efficiency H6 single-phase transformerless grid-tied PV inverter with proposed modulation for reactive power generation**, Fahad M. Almasoudi, Khaled S. Alatawi, Mohammad A. Matin, Univ. of Denver (USA) ..... [10381-13]

4:40 pm: **Low-crosstalk optimization in 2D segmented waveguide crossings by evolutionary algorithms** (*Invited Paper*), Cosme Eustaquio Rubio Mercedes, Maicon de Souza Alcântara, Univ. Estadual de Mato Grosso do Sul (Brazil); Anderson Dourado Sinsando, Vitaly Felix Rodriguez Esquerre, Univ. Federal da Bahia (Brazil) ..... [10381-14]

5:10 pm: **III-nitride based N-polar current aperture vertical electron transistors**, Saba Rajabi, Saptarshi Mandal, Univ. of California, Davis (USA); Haoran Li, Univ. of California, Santa Barbara (USA); Matthew A. Laurent, Univ. of California, Davis (USA); Stacia Keller, Univ. of California, Santa Barbara (USA); Srabanti Chowdhury, Univ. of California, Davis (USA) ..... [10381-15]



# CONFERENCE 10382

LOCATION: CONV. CTR. ROOM 19

Sunday–Monday 6–7 August 2017 • Proceedings of SPIE Vol. 10382

## Photonic Fiber and Crystal Devices: Advances in Materials and Innovations in Device Applications XI

Conference Chairs: **Shizhuo Yin**, The Pennsylvania State Univ. (USA); **Ruyan Guo**, The Univ. of Texas at San Antonio (USA)

Program Committee: **Manmohan D. Aggarwal**, Alabama A&M Univ. (USA); **Partha P. Banerjee**, Univ. of Dayton (USA); **Liliana Braescu**, Institut National de la Recherche Scientifique (Canada); **Liangcai Cao**, Tsinghua Univ. (China); **Ken-Yuh Hsu**, National Chiao Tung Univ. (Taiwan); **Rongqing Hui**, The Univ. of Kansas (USA); **Suganda Jutamulia**, Univ. of Northern California (USA); **Nickolai V. Kukhtarev**, Alabama A&M Univ. (USA); **Ravindra B. Lal**, Alabama A&M Univ. (USA); **ByoungHo Lee**, Seoul National Univ. (Korea, Republic of); **Sergei F. Lyuksyutov**, The Univ. of Akron (USA); **Paul B. Ruffin**, U.S. Army Research, Development and Engineering Command (USA); **Narsingh B. Singh**, Univ. of Maryland, Baltimore County (USA); **Wei-Hung Su**, National Sun Yat-Sen Univ. (Taiwan); **Ching-Cherng Sun**, National Central Univ. (Taiwan); **Xiang Zhang**, Univ. of California, Berkeley (USA)

Founding Chair: **Fancis T.S. Yu**, The Pennsylvania State Univ. (USA)

### SUNDAY 6 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 19 . . . SUN 8:30 AM TO 11:50 AM

#### Photonic Crystals, Fibers, and Thin Films: Materials and Properties I

Session Chairs: **Abdalla M. Darwish**, Dillard Univ. (USA); **Ruyan Guo**, The Univ. of Texas at San Antonio (USA)

8:30 am: **Inorganic nanocomposite films with polymer nanofillers made by the concurrent multi-beam multi-target pulsed laser deposition** (*Invited Paper*), Abdalla M. Darwish, Abdel Aziz Mohammed, Shaelynn Moore, Wydglif Dorlus, Tyler Bastian, Dillard Univ. (USA); Sergey S. Sarkisov, SSS Optical Technologies, LLC (USA); Paolo Mele, Muroran Institute of Technology (Japan); Shrikant Saini, The Univ. of Utah (USA); Junichiro Shiomi, Susumu Yada, The Univ. of Tokyo (Japan); Darayas N. Patel, Oakwood Univ. (USA); Brent Koplitz, Xiaodong Zhang, Tulane Univ. (USA) . . . . . [10382-1]

9:00 am: **Analysis of photonic spot profile converter and bridge structure on SOI platform for horizontal and vertical integration**, Rajib Chakraborty, Saikat Majumder, Univ. of Calcutta (India); Amit K. Jha, Aishik Biswas, Debasmita Banerjee, Dipankar Ganguly, Techno India (India) . . . . . [10382-2]

9:20 am: **Enhanced nonlinear light conversion in globular photonic crystals at the band-gap pumping**, Arsen Zotov, Stanislav O. Yurchenko, Kirill I. Zaytsev, Egor Yakovlev, Evgeny Gorbunov, Bauman Moscow State Technical Univ. (Russian Federation); Gleb M. Katyba, Institute of Solid State Physics RAS (Russian Federation); Nikita V. Chernomyrdin, Bauman Moscow State Technical Univ. (Russian Federation) . . . . . [10382-3]

9:40 am: **Terahertz waves and its interaction with ferroics and multiferroics, for the design of modulators**, Moumita Dutta, Soutik Betal, Xomalin G. Peralta, Amar S. Bhalla, Ruyan Guo, The Univ. of Texas at San Antonio (USA) . . . . . [10382-4]

Coffee Break . . . . . Sun 10:00 am to 10:30 am

10:30 am: **Magnetoelectric nanorobot for therapeutic applications**, Soutik Betal, The Univ. of Texas at San Antonio (USA) . . . . . [10382-5]

10:50 am: **Nonlinear optical crystalline structures grown by laser precipitation in glass**, Carl M. Liebig, Jonathan T. Goldstein, Air Force Research Lab. (USA); Sean A. McDaniel, Air Force Research Lab. (USA) and Leidos, Inc. (USA); Douglas M. Krein, Air Force Research Lab. (USA) and General Dynamics Information Technology (USA); Gary Cook, Air Force Research Lab. (USA) . . . . . [10382-6]

11:10 am: **Characteristic study on circularly bent plastic optical fiber based refractometer**, Mayank Upadhyay, Aman Kumar Srivatsava, National Institute of Technology, Warangal (India) . . . . . [10382-7]

11:30 am: **Study on u-bent plastic fiber optic sensor for nitrite compounds detection by evanescent field modulation techniques**, Aruna Gupta, National Institute of Technology, Warangal (India) . . . . . [10382-8]

Lunch Break . . . . . Sun 11:50 am to 2:10 pm

#### SESSION 2

LOCATION: CONV. CTR. ROOM 19 . . . SUN 2:10 PM TO 4:40 PM

#### Photonic Crystals, Fibers, and Thin Films: Materials and Properties II

Session Chairs: **Partha P. Banerjee**, Univ. of Dayton (USA); **Ruyan Guo**, The Univ. of Texas at San Antonio (USA)

2:10 pm: **Computation of the total number of particles in a spherical microbubble in optical trapping using an equation**, Arjun Krishnappa, Univ. of Dayton (USA) . . . . . [10382-9]

2:30 pm: **Organic-metal hybrid nanostructures for toward high-performance photonic devices: Photo-detector and waveguide**, Sunjong Lee, Korea Institute of Industrial Technology (Korea, Republic of); Seokho Kim, INHA Univ. (Korea, Republic of); Bo-Hyun Kim, DGIIST (Korea, Republic of); Dong Hyuk Park, INHA Univ. (Korea, Republic of) . . . . . [10382-11]

2:50 pm: **Optical fiber Fabry-Perot sensing system based on Blackbody radiation in high temperature applications**, Xiaohua Lei, Tao Chen, Lei Xie, Yijun Deng, Weimin Chen, Chongqing Univ. (China) . . . . . [10382-12]

Coffee Break . . . . . Sun 3:10 pm to 3:40 pm

3:40 pm: **Fiber-optic refractive index sensor based on tapered single mode-thin core-single mode fiber structure**, Ameni Ben Khalifa, Amine Ben Salem, Rim Cherif, SUP'COM (Tunisia) . . . . . [10382-13]

4:00 pm: **Anti-resonant hollow core fiber for precision timing applications**, Amy Van Newkirk, The Pennsylvania State Univ. (USA); J. Enrique Antonio Lopez, Rodrigo Amezcua Correa, Axel Schülzgen, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); John Mazurowski, The Pennsylvania State Univ. (USA) . . . . . [10382-14]

4:20 pm: **High light extraction efficiency (LEE) LEDs with asymmetric patterned sapphire substrate**, Shizhuo Yin, Chang-Jiang Chen, Wenbin Zhu, Ju-Hung Chao, Haonan Zhou, The Pennsylvania State Univ. (USA) . . . . . [10382-15]

LOCATION: CONV. CTR. ROOM 6A . . SUN 6:00 PM TO 7:50 PM

#### Technology Hot Topics: How Optics and Photonics Drive Innovation

6:00 pm to 6:10 pm: **Welcome and Opening Remarks**

6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)

6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)

6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)

7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)

7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)

# CONFERENCE 10382

MONDAY 7 AUGUST

## SESSION 3

LOCATION: CONV. CTR. ROOM 19 . . . MON 8:30 AM TO 12:00 PM

### Photonic Crystals, Fibers, and Thin Films: Devices and Applications I

Session Chairs: **Wei-Hung Su**, National Sun Yat-Sen Univ. (Taiwan); **Ching-Cherng Sun**, National Central Univ. (Taiwan)

8:30 am: **Characteristics of gold nanorods in volume holographic nanocomposites** (*Invited Paper*), Liangcai Cao, Shenghan Wu, Song Zong, Guofan Jin, Tsinghua Univ. (China) . . . . . [10382-16]

9:00 am: **Intermodal four-wave-mixing and multimode parametric amplification in km-long fibers**, Massimiliano Guasoni, Francesca Parmigiani, Peter Horak, Optoelectronics Research Ctr., Univ. of Southampton (United Kingdom); Julien Fatome, Lab. Interdisciplinaire Carnot de Bourgogne (France); David J. Richardson, Optoelectronics Research Ctr., Univ. of Southampton (United Kingdom) [10382-17]

9:20 am: **Moderate temperature-dependent surface and volume resistivity and low-frequency dielectric constant measurements of pure and multi-walled carbon nanotubes (MWCNT) doped polyvinyl alcohol thin films**, Matthew E. Edwards Sr., Padmaja Guggilla, Angela Reedy, Alabama A&M Univ. (USA); Quratulann Ijaz, Troy Univ. (USA); Afef Janen, Alabama A&M Univ. (USA) [10382-18]

9:40 am: **Opposite virtual objective**, Yeh-Wei Yu, Szu-Yu Chen, Che-Chu Lin, Ching-Cherng Sun, National Central Univ. (Taiwan) . . . . . [10382-19]

Coffee Break . . . . . Mon 10:00 am to 10:30 am

10:30 am: **Time: The enigma of space** (*Invited Paper*), Francis T. S. Yu, The Pennsylvania State Univ. (USA) . . . . . [10382-20]

11:00 am: **Rapid silicon carbide (SiC) crystal growth by laser heating in a vacuum chamber**, Shizhuo Yin, Haonan Zhou, Chang-Jiang Chen, Wenbin Zhu, Ju-Hung Chao, The Pennsylvania State Univ. (USA) . . . . . [10382-21]

11:20 am: **Projected fringe profilometry for transparent objects**, Wei-Hung Su, National Sun Yat-Sen Univ. (Taiwan); Chau-Jern Cheng, National Taiwan Normal Univ. (Taiwan) . . . . . [10382-22]

11:40 am: **A scanning approach using a binary grid pattern for 3D shape measurements**, Nai-Jen Cheng, National Kaohsiung Univ. of Applied Sciences (Taiwan); Wei-Hung Su, National Sun Yat-Sen Univ. (Taiwan) . . . . . [10382-23]

Lunch Break . . . . . Mon 12:00 pm to 1:30 pm

## SESSION 4

LOCATION: CONV. CTR. ROOM 19 . . . . MON 1:30 PM TO 4:30 PM

### Photonic Crystals, Fibers, and Thin Films: Devices and Applications II

Session Chairs: **Paul B. Ruffin**, Alabama A&M Univ. (USA); **Shizhuo Yin**, The Pennsylvania State Univ. (USA)

1:30 pm: **Highly efficient cladding-pumped double-clad fiber laser based on a concentrically co-grown Yb:YAG/YAG crystal structure** (*Invited Paper*), Jun Zhang, Youming Chen, U.S. Army Research Lab. (USA); Shizhuo Yin, The Pennsylvania State Univ. (USA); Claire Luo, General Opto Solutions, LLC (USA); Mark Dubinskiy, U.S. Army Research Lab. (USA) . . . . . [10382-24]

2:00 pm: **A large capacity time division multiplexed (TDM) laser beam combining technique enabled by nanosecond speed KTN deflector**, Shizhuo Yin, Ju-Hung Chao, Wenbin Zhu, Chang-Jiang Chen, Adrian Campbell, Michael Henry, The Pennsylvania State Univ. (USA); Mark Dubinskiy, Robert C. Hoffman, U.S. Army Research Lab. (USA) . . . . . [10382-25]

2:20 pm: **Crystal fiber lasers**, Woohong Kim, Brandon Shaw, Shyam Bayya, U.S. Naval Research Lab. (USA); Charles G. Askins, John R. Peele, Sotera Defense Solutions, Inc. (USA); Daniel L. Rhonehouse, Univ. Research Foundation (USA); Jason D. Myers, Syed Qadri, U.S. Naval Research Lab. (USA); Rajesh Thapa, Sotera Defense Solutions, Inc. (USA); Jasbinder S. Sanghera, U.S. Naval Research Lab. (USA) . . . . . [10382-26]

2:40 pm: **Nanosecond KTN varifocal lens without electric field induced phase transition**, Shizhuo Yin, Wenbin Zhu, Ju-Hung Chao, Chang-Jiang Chen, Adrian Campbell, Michael Henry, The Pennsylvania State Univ. (USA); Robert C. Hoffman, U.S. Army Research Lab. (USA) . . . . . [10382-27]

Coffee Break . . . . . Mon 3:00 pm to 3:30 pm

3:30 pm: **Ultrafast laser written arrayed waveguide gratings with integrated photonic lanterns**, Glen Douglass, Simon Gross, Michael J. Withford, Macquarie Univ. (Australia) . . . . . [10382-28]

3:50 pm: **One shot profile sensing using a 2D fringe-encoded pattern**, Wei-Hung Su, Sih-Yue Chen, National Sun Yat-Sen Univ. (Taiwan) . . . . . [10382-30]

4:10 pm: **Phase-shifting projected fringe profilometry using binary-encoded patterns**, Sih-Yue Chen, National Sun Yat-Sen Univ. (Taiwan); Nai-Jen Cheng, National Kaohsiung Univ. of Applied Sciences (Taiwan); Wei-Hung Su, National Sun Yat-Sen Univ. (Taiwan) . . . . . [10382-31]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 . . . . . MON 5:30 PM TO 7:30 PM

## Posters-Monday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**1 kW fiber cladding light stripper with 36 dB attenuation coefficient**, Shuzhen Zou, Han Chen, Haijuan Yu, Zhiyan Zhang, Institute of Semiconductors, Chinese Academy of Sciences (China); Jingyuan Zhang, Institute of Semiconductors, Chinese Academy of Sciences (China) and Georgia Southern Univ. (USA); Jing Sun, Pengfei Zhao, Ling Zhang, Xuechun Lin, Institute of Semiconductors, Chinese Academy of Sciences (China) . . . . . [10382-32]

**The study of graphene thin film affects the heat conduction of HPLED**, Ming Seng Hsu, Chinese Military Academy (Taiwan); Ching Yao Hsu, Cantwell-Sacred Heart of Mary High School (USA); Jen Wei Huang, Feng Lin Shyu, Chinese Military Academy (Taiwan) . . . . . [10382-33]

**FBG sensing system to study the bridge weigh-in-motion**, Sravanthi Alamandala, Putha Kishore, L. N. Sai Prasad Ravinuthala, Mayank Upadhyay, Rathish Kumar P., National Institute of Technology, Warangal (India) . . . . . [10382-34]

**A dual tapered Mach-Zehnder interferometer for magnetic field sensing**, Emmanuel A. Hernandez, Julián Moisés Estudillo-Ayala, Juan Manuel Sierra-Hernandez, Daniel Jáuregui-Vázquez, Roberto Rojas-Laguna, José Ramón Martínez Angulo, Univ. de Guanajuato (Mexico) . . . . . [10382-35]

**Detection of trace amounts of chromium (VI) using polymer gel coated etched Fiber Bragg grating**, Vayu Nandana Kishore Pabbiseti, National Institute of Technology, Warangal (India) . . . . . [10382-36]

**Raman monitoring and evaluation of the aging effects of rocket propellant stabilizers**, Jonathan A. Mills, Carlton W. Farley III, Aschalew Kassu, Michael Curley, Anup Sharma, Paul B. Ruffin, Alabama A&M Univ. (USA); Christopher A. Marshall, Jeremy Rice, Brian A. McDonald, U.S. Army Research, Development and Engineering Command (USA) . . . . . [10382-37]

**An ultra-high contrast optical modulator with 30 dB isolation at 1.55  $\mu\text{m}$  with 25 THz bandwidth**, Mohsen Jafari, University of Michigan (USA); Mina Rais-Zadeh, University of Michigan (USA) and NASA Jet Propulsion Laboratory (USA) [10382-38]

# CONFERENCE 10383

LOCATION: CONV. CTR. ROOM 17B

Sunday–Monday 6–7 August 2017 • Proceedings of SPIE Vol. 10383

# Terahertz Emitters, Receivers, and Applications VIII

*Conference Chairs:* **Manijeh Razeghi**, Northwestern Univ. (USA); **Alexei N. Baranov**, Univ. Montpellier 2 (France); **John M. Zavada**, Polytechnic Institute of New York Univ. (USA); **Dimitris Pavlidis**, National Science Foundation (USA)

*Program Committee:* **Maria Amanti**, Univ. Paris 7-Denis Diderot (France); **Richard D. Averitt**, Univ. of California, San Diego (USA); **Stefano Barbieri**, Univ. Paris 7-Denis Diderot (France); **Robert J. Grasso**, EOIR Technologies (USA); **Sven Höfling**, Univ. of St. Andrews (United Kingdom); **Hiroshi Ito**, Kitasato Univ. (Japan); **Wojciech Knap**, Univ. Montpellier 2 (France); **Juliette Mangeney**, Ecole Normale Supérieure (France); **Oleg Mitrofanov**, Univ. College London (United Kingdom); **Gaël Mouret**, Univ. du Littoral Côte d'Opale (France); **Naoki Oda**, NEC Corp. (Japan); **Mauro F. Pereira**, Sheffield Hallam Univ. (United Kingdom); **Edik U. Rafailov**, Aston Univ. (United Kingdom); **Pascale Roy**, Synchrotron SOLEIL (France); **Gaetano Scamarcio**, Univ. degli Studi di Bari Aldo Moro (Italy); **Carlo Sirtori**, Univ. Paris 7-Denis Diderot (France); **Zachary D. Taylor**, Univ. of California, Los Angeles (USA); **Roland Teissier**, Univ. Montpellier 2 (France); **Vladimir V. Vaks**, Institute for Physics of Microstructures (Russian Federation); **Gintaras Valušis**, Ctr. for Physical Sciences and Technology (Lithuania); **Miriam S. Vitiello**, Consiglio Nazionale delle Ricerche (Italy); **Benjamin S. Williams**, Univ. of California, Los Angeles (USA)

## SUNDAY 6 AUGUST

### SESSION 1

LOCATION: CONV. CTR. ROOM 17B . . SUN 8:30 AM TO 10:00 AM

#### Generation of THz Radiation

Session Chairs: **Alexei N. Baranov**, Univ. Montpellier (France); **Mauro F. Pereira**, Sheffield Hallam Univ. (United Kingdom)

8:30 am: **Enhancement of terahertz generation in QD antennae by introduction of a silver nanoantennae pattern** (*Invited Paper*), Edik U. Rafailov, Sergei Lepeshov, Andrei Gorodetsky, Aston Univ. (United Kingdom) . . . . . [10383-1]

9:00 am: **Backward wave oscillator for high power generation at THz frequencies** (*Invited Paper*), Diana Gamzina, SLAC National Accelerator Lab. (USA); Claudio Paoloni, Lancaster Univ. (United Kingdom); Ye Tang, Beijing Vacuum Electronics Research Institute (China); Xiang Li, Lancaster Univ. (United Kingdom); Xuejiao Hao, Yuan Zheng, Beijing Vacuum Electronics Research Institute (China); Branko Popovic, Logan Himes, Robert Barchfeld, Univ. of California, Davis (USA); Hanyan Li, Pan Pan, Beijing Vacuum Electronics Research Institute (China); Rosa Letizia, Lancaster Univ. (United Kingdom); Jinjun Feng, Beijing Vacuum Electronics Research Institute (China); Neville C. Luhmann Jr., Univ. of California, Davis (USA) . . . . . [10383-2]

9:30 am: **Coherent terahertz emission from nanomaterials without external bias** (*Invited Paper*), Lyubov V. Titova, Kateryna Kushnir, Worcester Polytechnic Institute (USA); Mengjing Wang, Brown Univ. (USA); Kristie J. Koski, Univ. of California, Davis (USA) . . . . . [10383-3]

Coffee Break . . . . . Sun 10:00 am to 10:30 am

### SESSION 2

LOCATION: CONV. CTR. ROOM 17B . . SUN 10:30 AM TO 12:15 PM

#### QCL THz Sources

Session Chairs: **Edik U. Rafailov**, Aston Univ. (United Kingdom); **Alexander Pavlovich Shkurinov**, M.V. Lomonosov Moscow SU (Russian Federation)

10:30 am: **To be announced** (*Keynote Presentation*), Manijeh Razeghi, Northwestern Univ. (USA) . . . . . [10383-4]

11:15 am: **Terahertz metasurface quantum-cascade VECSEL** (*Invited Paper*), Luyao Xu, Christopher A. Curwen, Daguang Chen, Univ. of California, Los Angeles (USA); John L. Reno, Sandia National Labs. (USA); Tatsuo Itoh, Benjamin S. Williams, Univ. of California, Los Angeles (USA) . . . . . [10383-5]

11:45 am: **High-performance broadly-tunable THz quantum cascade laser sources based on intracavity difference-frequency mixing on silicon substrates** (*Invited Paper*), Mikhail A. Belkin, The Univ. of Texas at Austin (USA) . . . . . [10383-6]

Lunch Break . . . . . Sun 12:15 pm to 1:30 pm

### SESSION 3

LOCATION: CONV. CTR. ROOM 17B . . . SUN 1:30 PM TO 3:10 PM

#### Novel Concepts and Materials for THz Technology

Session Chairs: **Mikhail A. Belkin**, The Univ. of Texas at Austin (USA); **Gintaras Valušis**, Ctr. for Physical Sciences and Technology (Lithuania)

1:30 pm: **Spintronic terahertz generation** (*Invited Paper*), Dmitry Turchinovich, Max-Planck-Institut für Polymerforschung (Germany) . . . . . [10383-7]

2:00 pm: **Tunable terahertz devices using graphene and metallic heterostructures**, Yang Wu, Hyunsoo Yang, National Univ. of Singapore (Singapore) . . . . . [10383-8]

2:20 pm: **Design of a multistep phase mask for high-energy THz pulse generation in ZnTe crystal**, Yuri H. Avetisyan, Armen Makaryan, Vahe Tadevosyan, Yerevan State Univ. (Armenia) . . . . . [10383-9]

2:40 pm: **THz nonlinearities in semiconductor superlattices** (*Invited Paper*), Mauro F. Pereira, Sheffield Hallam Univ. (United Kingdom) . . . . . [10383-10]

Coffee Break . . . . . Sun 3:10 pm to 3:40 pm

### SESSION 4

LOCATION: CONV. CTR. ROOM 17B . . . SUN 3:40 PM TO 5:50 PM

#### Fundamentals of Generation, Detection, and Propagation of THz Waves I

Session Chairs: **Dmitry Turchinovich**, Max-Planck-Institut für Polymerforschung (Germany); **Lyubov V. Titova**, Worcester Polytechnic Institute (USA)

3:40 pm: **Temperature-driven massless fermions in HgCdTe heterostructures** (*Invited Paper*), Frédéric Teppe, Sergey Krishtopenko, Sandra Ruffenach, Univ. Montpellier (France) . . . . . [10383-11]

4:10 pm: **Complex delay dynamics of high power quantum cascade oscillators** (*Invited Paper*), Frédéric Grillot, Télécom ParisTech (France); Timothy C. Newell, Air Force Research Lab. (USA); Athanasios Gavrielides, The Univ. of New Mexico (USA); Mathieu Carras, mirSense (France) . . . . . [10383-12]

4:40 pm: **Characterization of THz wave generated from air plasma induced by two-color laser with long wavelength**, Shijing Zhang, Beijing Institute of Technology (China); LiangLiang Zhang, Capital Normal Univ. (China); Tong Wu, Beijing Institute of Technology (China); Hang Zhao, Capital Normal Univ. (China); Yuejin Zhao, Beijing Institute of Technology (China); Xiaomei Yu, Peking Univ. (China) . . . . . [10383-13]

5:00 pm: **Terahertz and x-ray generation in nano-cluster jets: Origin of nonlinear interaction** (*Invited Paper*), Alexander P. Shkurinov, M.V. Lomonosov Moscow SU (Russian Federation) . . . . . [10383-14]

5:30 pm: **Generation of ultra-broadband terahertz radiation from LiNbO<sub>3</sub> waveguides excited by femtosecond optical pulses**, Brett N. Carnio, Abdulhakem Y. Elezzabi, Univ. of Alberta (Canada) . . . . . [10383-15]



# CONFERENCE 10383

LOCATION: CONV. CTR. ROOM 6A . . SUN 6:00 PM TO 7:50 PM

## Technology Hot Topics: How Optics and Photonics Drive Innovation

- 6:00 pm to 6:10 pm: **Welcome and Opening Remarks**
- 6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)
- 6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)
- 6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)
- 7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)
- 7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)

## MONDAY 7 AUGUST

### SESSION 5

LOCATION: CONV. CTR. ROOM 17B MON 8:30 AM TO 10:00 AM

## THz Spectroscopy

Session Chairs: **Diana Gamzina**, Univ. of California, Davis (USA); **Gregory N. Goltsman**, Moscow State Pedagogical Univ. (Russian Federation)

8:30 am: **Substance identification by pulsed THz spectroscopy in the presence of disordered structure** (*Invited Paper*), Vyacheslav A. Trofimov, Irina G. Zakharova, Dmitry Y. Zagursky, Svetlana A. Varentsova, M.V. Lomonosov Moscow SU (Russian Federation) . . . . . [10383-16]

9:00 am: **Using ultrafast terahertz spectroscopy to study low energy excitations in quantum materials** (*Invited Paper*), Pamela Bown, Kamaraju Natarajan, Dmitry A. Yarotski, Antoinette J. Taylor, Rohit P. Prasankumar, Los Alamos National Lab. (USA) . . . . . [10383-17]

9:30 am: **Dual THz comb spectroscopy** (*Invited Paper*), Takeshi Yasui, Tokushima Univ. (Japan) . . . . . [10383-18]

Coffee Break . . . . . Mon 10:00 am to 10:30 am

### SESSION 6

LOCATION: CONV. CTR. ROOM 17B MON 10:30 AM TO 12:40 PM

## Fundamentals of Generation, Detection, and Propagation of THz Waves II

Session Chairs: **Frédéric Grillot**, Télécom ParisTech (France); **Robert J. Grasso**, EOIR Technologies (USA)

10:30 am: **Using a gate electrode to control the tunneling current in a geometrically-asymmetric nanoantenna**, Mohammad S. Khalifa, Zewail City of Science and Technology (Egypt) and Cairo Univ. (Egypt); Ashraf H. Badawi, Zewail City of Science and Technology (Egypt); Tamer A. Ali, Cairo Univ. (Egypt) and Zewail City of Science and Technology (Egypt); Nadia H. Rafat, Ahmed A. Abouelsaood, Cairo Univ. (Egypt) . . . . . [10383-19]

10:50 am: **Spectral emission control of terahertz quantum cascade laser via injection seeding technique** (*Invited Paper*), Hanond Nong, Feihu Wang, Lab. Pierre Aigrain (France); Tobias Fobbe, Ruhr-Univ. Bochum (Germany); Valentino Pistore, Sarah Houver, Lab. Pierre Aigrain (France); Sergej Markmann, Nathan Jukam, Ruhr-Univ. Bochum (Germany); Maria Amanti, Carlo Sirtori, Univ. Paris 7-Denis Diderot (France); Souad Moundji, Raffaele Colombelli, Institut d'Électronique Fondamentale (France); Lianhe H. Li, Edmund H. Linfield, Giles A. Davies, Univ. of Leeds (United Kingdom); Juliette Mangeney, Jérôme Tignon, Sukhdeep Dhillon, Lab. Pierre Aigrain (France) . . . . . [10383-20]

11:20 am: **Wavefront phase modulation based on terahertz wave polyethylene lens**, Tielin Lu, Instrumentation Technology and Economy Institute (China); Xiaohu Guo, China North Vehicle Research Institute (China); Yuejin Zhao, Jingshui Zhang, Lingqin Kong, Beijing Institute of Technology (China) . . . . . [10383-21]

11:40 am: **Band engineering of metal/semiconductor nanocomposites for longer wavelength high performance terahertz photoconductive switches** (*Invited Paper*), Joshua M. Zide, Univ. of Delaware (USA) . . . . . [10383-22]

12:10 pm: **Superconducting thin film nanostructures as terahertz and infrared heterodyne and direct detectors** (*Invited Paper*), Gregory N. Goltsman, Moscow State Pedagogical Univ. (Russian Federation) . . . . . [10383-23]

Lunch Break . . . . . Mon 12:40 pm to 2:00 pm

### SESSION 7

LOCATION: CONV. CTR. ROOM 17B . . MON 2:00 PM TO 3:40 PM

## THz Imaging

Session Chairs: **Manijeh Razeghi**, Northwestern Univ. (USA); **John M. Zavadra**, Polytechnic Institute of New York Univ. (USA)

2:00 pm: **Near-field wave transformation in THz super-resolution imaging**, Mariano Flammini, Michele Ortolani, Sapienza Univ. di Roma (Italy); Valeria Giliberti, Sapienza Univ. di Roma (Italy) and Istituto Italiano di Tecnologia (Italy); Chiara Ciano, Emanuele Pontecorvo, Eugenio Del Re, Sapienza Univ. di Roma (Italy) . . . . . [10383-24]

2:20 pm: **Terahertz imaging for subsurface investigation of art paintings**, Alexandre Locquet, Junliang Dong, Georgia Tech-Lorraine (France); Marcello Melis M.D., Proficolore Srl (Italy); David S. Citrin M.D., Georgia Institute of Technology (USA) . . . . . [10383-25]

2:40 pm: **All-dielectric metamaterial resonators for room temperature terahertz imaging** (*Invited Paper*), Willie J. Padilla, Kebin Fan, Jonathan Y. Suen, Duke Univ. (USA) . . . . . [10383-26]

3:10 pm: **Compact solutions for spectroscopic solid-state based terahertz imaging systems** (*Invited Paper*), Gintaras Valušis, Rimvydas Venckevičius, Linas Minkevicius, Antanas Reklaitis, Vincas Tamošiūnas, Irmantas Kašalynas, Bogdan Voisiat, Dalius Seliuta, Gediminas Račiukaitis, Ctr. for Physical Sciences and Technology (Lithuania) . . . . . [10383-27]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 . . . . . MON 5:30 PM TO 7:30 PM

## Posters-Monday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Organic conjugated material-based THz wave modulators**, Joong-Wook Lee, Chonnam National Univ. (Korea, Republic of); Hyung Keun Yoo, SAMSUNG Electronics Co., Ltd. (Korea, Republic of); Chul Kang, Chul-Sik Kee, In-Wook Hwang, Gwangju Institute of Science and Technology (Korea, Republic of) . . . . . [10383-28]

**Optical properties and relaxation times of oil and fuel in frequency range of 0.2-0.8 THz**, Anna Simonova, Uliya Komarova, Petr Demchenko, Roman Grigorev, Roman Orlov, Mikhail K. Khodzitsky, ITMO Univ. (Russian Federation) . . [10383-29]

**Frequency division multiplexing THz light field imaging**, Xianshun Ming, Tsinghua Univ. (China); Willie J. Padilla, Duke Univ. (USA); Liqun Sun, Tsinghua Univ. (China) . . . . . [10383-30]

# CONFERENCE 10384

LOCATION: CONV. CTR. ROOM 14A

Sunday 6 August 2017 • Proceedings of SPIE Vol. 10384

# Optical Data Storage 2017: From New Materials to New Systems

Conference Chairs: **Ryuichi Katayama**, Fukuoka Institute of Technology (Japan); **Yuzuru Takashima**, College of Optical Sciences, The Univ. of Arizona (USA)

Program Committee: **Min Gu**, RMIT Univ. (Australia); **Thomas D. Milster**, College of Optical Sciences, The Univ. of Arizona (USA); **Kimihito Saito**, Kindai Univ. Technical College (Japan); **Luping Shi**, Tsinghua Univ. (China); **Kenichi Shimada**, Hitachi, Ltd. (Japan); **Xiaodi Tan**, Beijing Institute of Technology (China); **Din Ping Tsai**, Research Ctr. for Applied Sciences - Academia Sinica (Taiwan)

## SUNDAY 6 AUGUST

### SESSION 1

LOCATION: CONV. CTR. ROOM 14A .SUN 8:00 AM TO 10:00 AM

### Systems and Applications

Session Chair: **Yuzuru Takashima**, The Univ. of Arizona (USA)

8:00 am: **Optical technologies for the Internet of Things era** (*Invited Paper*), Philip N. Ji, NEC Labs. America, Inc. (USA) . . . . . [10384-1]

8:30 am: **Big data innovation hubs: Opportunities for optical data storage partnerships** (*Invited Paper*), Meredith M. Lee, West Big Data Innovation Hub (USA) . . . . . [10384-2]

9:00 am: **The possibility of the market expansion of large capacity optical cold archive** (*Invited Paper*), Ikuo Matsumoto, Emiko Sakata, Fujiwara-Rothchild, Ltd. (Japan) . . . . . [10384-3]

9:30 am: **A rack-based optical storage system with inline accessibility for long-term data preservation** (*Invited Paper*), Jie Yao, Changsheng Xie, Huazhong Univ. of Science and Technology (China) . . . . . [10384-4]

Coffee Break . . . . . Sun 10:00 am to 10:30 am

### SESSION 2

LOCATION: CONV. CTR. ROOM 14A SUN 10:30 AM TO 12:00 PM

### Holographic Data Storage

Session Chair: **Xiaodi Tan**, Beijing Institute of Technology (China)

10:30 am: **Cavity enhanced eigenmode multiplexing for volume holographic data storage**, Bo E. Miller, College of Optical Sciences, The Univ. of Arizona (USA); Yuzuru Takashima, The Univ. of Arizona (USA) . . . . . [10384-5]

10:45 am: **Cavity enhanced eigenmode multiplexing with spatial light modulators for volume holographic data storage**, Guanghao Chen, The Univ. of Arizona (USA); Bo E. Miller, College of Optical Sciences, The Univ. of Arizona (USA); Yuzuru Takashima, The Univ. of Arizona (USA) . . . . . [10384-6]

11:00 am: **Analytic function expression of signal wave for data retrieve in holographic data storage**, Daisuke Barada, Shaqueeb Sarwar, Toyohiko Yatagai, Utsunomiya Univ. (Japan) . . . . . [10384-7]

11:15 am: **Temperature tolerance analysis on the volume holographic data storage**, Liangcai Cao, Shenghan Wu, Song Zong, Guofan Jin, Tsinghua Univ. (China) . . . . . [10384-8]

11:30 am: **Effect of temperature change in microholographic recording**, Ryuichi Katayama, Fukuoka Institute of Technology (Japan) . . . . . [10384-9]

11:45 am: **Research of circular polarized holography with a large crossing angle under a common condition**, Yifan Hong, Jinliang Zang, Yiying Zhang, Fenglan Fan, Ying Liu, Guoguo Kang, Xiaodi Tan, Beijing Institute of Technology (China); Tsutomu Shimura, The Univ. of Tokyo (Japan); Kazuo Kuroda, Beijing Institute of Technology (China) and Utsunomiya Univ. Ctr. for Optical Research & Education (Japan) . . . . . [10384-10]

Lunch Break . . . . . Sun 12:00 pm to 1:15 pm

### SESSION 3

LOCATION: CONV. CTR. ROOM 14A . . . . SUN 1:15 PM TO 3:15 PM

### Nanophotonics

Session Chair: **Kimihito Saito**, Kindai Univ. Technical College (Japan)

1:15 pm: **Near-field coupling and readout of nano recording marks** (*Invited Paper*), Din Ping Tsai, Research Ctr. for Applied Sciences - Academia Sinica (Taiwan) and National Taiwan Univ. (Taiwan) . . . . . [10384-11]

1:45 pm: **The reduction of graphene oxide induced by rare-earth doped nanocrystals towards super-resolution optical data storage** (*Invited Paper*), Simone Lamon, Qiming Zhang, RMIT Univ. (Australia); Yiming Wu, Xiaogang Liu, National Univ. of Singapore (Singapore); Min Gu, RMIT Univ. (Australia) . [10384-12]

2:15 pm: **Nanophotonics mediated ultra-high capacity optical memory towards big data storage** (*Invited Paper*), Xiangping Li, Jinan Univ. (China) . . . . [10384-13]

2:45 pm: **Improved STED microscopy using high NA of SIL** (*Invited Paper*), No-Cheol Park, Yonsei Univ. (Korea, Republic of); Hyungbae Moon, Asan Medical Ctr. (Korea, Republic of); Wonsup Lee, Geon Lim, Guk-Jong Choi, Young-Pil Park, Yonsei Univ. (Korea, Republic of) . . . . . [10384-14]

Coffee Break . . . . . Sun 3:15 pm to 3:45 pm

### SESSION 4

LOCATION: CONV. CTR. ROOM 14A . . SUN 3:45 PM TO 5:30 PM

### Emerging and Elemental Technologies

Session Chair: **Ryuichi Katayama**, Fukuoka Institute of Technology (Japan)

3:45 pm: **Active metasurfaces for optical data storage** (*Invited Paper*), Cheng Hung Chu, Pin Chieh Wu, Research Ctr. for Applied Sciences - Academia Sinica (Taiwan); Hui-Hsin Hsiao, Hsiang-Chu Wang, National Taiwan Univ. (Taiwan); Hui Jun Wu, Research Ctr. for Applied Sciences - Academia Sinica (Taiwan); Din Ping Tsai, Research Ctr. for Applied Sciences - Academia Sinica (Taiwan) . . [10384-15]

4:15 pm: **Mastering multi-depth bio-chip patterns with DVD LBR's** (*Invited Paper*), Doug Carson, DCA, Inc. (USA) . . . . . [10384-16]

4:45 pm: **An application of OFDM method to optical disc recording**, Kimihito Saito, Kindai Univ. Technical College (Japan) . . . . . [10384-17]

5:00 pm: **Adaptive optics for data recovery on optical disk fragments**, Thomas D. Milster, Young Sik Kim, College of Optical Sciences, The Univ. of Arizona (USA) . . . . . [10384-18]

5:15 pm: **Optical mapping of oscillatory stresses in transparent media**, Igor A. Sokolov, Mikhail A. Bryushinin, Alexander A. Petrov, Ioffe Institute (Russian Federation); Anatoli M. Balbashov, National Research University "MPEI" (Russian Federation) . . . . . [10384-19]

LOCATION: CONV. CTR. ROOM 6A . . SUN 6:00 PM TO 7:50 PM

### Technology Hot Topics: How Optics and Photonics Drive Innovation

6:00 pm to 6:10 pm: **Welcome and Opening Remarks**

6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)

6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)

6:50 pm to 7:10 pm: **AR/VR**, Scott McElDowney, Oculus (USA)

7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)

7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)

# CONFERENCE 10385

LOCATION: CONV. CTR. ROOM 14B

Sunday–Monday 6–7 August 2017 • Proceedings of SPIE Vol. 10385

## Advances in Metrology for X-Ray and EUV Optics VII

*Conference Chairs:* **Lahsen Assoufid**, Argonne National Lab. (USA); **Haruhiko Ohashi**, Japan Synchrotron Radiation Research Institute (Japan); **Anand Krishna Asundi**, Nanyang Technological Univ. (Singapore)

*Program Committee:* **Simon G. Alcock**, Diamond Light Source Ltd. (United Kingdom); **Raymond Barrett**, European Synchrotron Radiation Facility (France); **Daniele Cocco**, SLAC National Accelerator Lab. (USA); **Uwe Flechsig**, Paul Scherrer Institut (Switzerland); **Ralf D. Geckeler**, Physikalisch-Technische Bundesanstalt (Germany); **Kenneth A. Goldberg**, Lawrence Berkeley National Lab. (USA); **Mikhail V. Gubarev**, NASA Marshall Space Flight Ctr. (USA); **Christian F. Guertin**, Vermont Photonics Technologies Corp. (USA); **Mourad Idir**, Brookhaven National Lab. (USA); **Weiguo Liu**, Xi'an Technological Univ. (China); **Jonathan Manton**, Inprentus, Inc. (USA); **Hidekazu Mimura**, The Univ. of Tokyo (Japan); **Josep Nicolas**, CELLS - ALBA (Spain); **Lorenzo Raimondi**, Elettra-Sincrotrone Trieste S.C.p.A. (Italy); **Rajdeep Singh Rawat**, National Institute of Education (Singapore); **Kawal Sawhney**, Diamond Light Source Ltd. (United Kingdom); **Frank Siewert**, Helmholtz-Zentrum Berlin für Materialien und Energie GmbH (Germany); **Regina Soufli**, Lawrence Livermore National Lab. (USA); **Daniele Spiga**, INAF - Osservatorio Astronomico di Brera (Italy); **Peter Z. Takacs**, Brookhaven National Lab. (USA); **Muriel Thomasset**, Synchrotron SOLEIL (France); **Maurizio Vannoni**, European XFEL GmbH (Germany); **Amparo Vivo**, European Synchrotron Radiation Facility (France); **Zhanshan Wang**, Tongji Univ. (China); **Kazuto Yamauchi**, Osaka Univ. (Japan); **Tanfer Yandayan**, TÜBITAK UME (Turkey); **Valeriy V. Yashchuk**, Lawrence Berkeley National Lab. (USA); **Brian W. Yates**, Canadian Light Source Inc. (Canada)

### SUNDAY 6 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 14B . . SUN 2:00 PM TO 3:20 PM

#### At-Wavelength Metrology

Session Chair: **Lahsen Assoufid**, Argonne National Lab. (USA)

2:00 pm: **Single shot Talbot imaging for wavefront sensing and x-ray metrology**, Walan C. Grizolli, Xianbo Shi, Lahsen Assoufid, Argonne National Lab. (USA) . . . . . [10385-1]

2:20 pm: **High-performance at-wavelength metrology with an efficient high-order suppression system**, Franz Schäfers, Andrey A. Sokolov, Andreas Gaupp, Martin Luetkecke, Helmholtz-Zentrum Berlin für Materialien und Energie GmbH (Germany) . . . . . [10385-2]

2:40 pm: **Speckle-based portable device for in-situ metrology of x-ray mirrors at Diamond Light Source**, Hongchang Wang, Tunhe Zhou, Yogesh Kashyap, Kawal J. S. Sawhney, Diamond Light Source Ltd. (United Kingdom) . . . . . [10385-3]

3:00 pm: **Investigation of HF-plasma-treated soft x-ray optical elements**, Frank Eggenstein, Andrey A. Sokolov, Andrei Varykhalov, Maxim Krivenkov, Ivo Rudolph, Johannes Wolf, Mewael Giday Sertsu, Thomas Zeschke, Franz Schäfers, Helmholtz-Zentrum Berlin für Materialien und Energie GmbH (Germany) . [10385-4]

Coffee Break . . . . . Sun 3:20 pm to 3:50 pm

#### SESSION 2

LOCATION: CONV. CTR. ROOM 14B . . SUN 3:50 PM TO 4:50 PM

#### Metrology of VLS Gratings

Session Chair: **Haruhiko Ohashi**, Japan Synchrotron Radiation Research Institute (JASRI) (Japan)

3:50 pm: **Intrinsic resolving power of XUV diffraction gratings measured with Fizeau interferometry**, Samuel Gleason, Jonathan Manton, Janet Sheung, Taylor Byrum, Cody Jensen, Lingyun Jiang, Inprentus, Inc. (USA); Joseph Dvorak, Ignace Jarrige, Brookhaven National Lab. (USA); Peter Abbamonte, Inprentus, Inc. (USA) . . . . . [10385-5]

4:10 pm: **Characterization of a 150-mm long variable line spacing plane grating through interferometry**, Maurizio Vannoni, Idoia Freijo-Martín, European XFEL GmbH (Germany) . . . . . [10385-7]

4:30 pm: **Metrology of variable-line-spacing x-ray gratings using the APS Long Trace Profiler**, Janet Sheung, Argonne National Lab. (USA) and Univ. of Illinois (USA); Jun Qian, Argonne National Lab. (USA); Muriel Thomasset, Synchrotron SOLEIL (France); Jonathan Manton, Inprentus, Inc. (USA); Sunil Bean, Argonne National Lab. (USA); Peter Z. Takacs, Joseph Dvorak, Brookhaven National Lab. (USA); Lahsen Assoufid, Argonne National Lab. (USA) . . . . . [10385-8]

LOCATION: CONV. CTR. ROOM 6A . . SUN 6:00 PM TO 7:50 PM

#### Technology Hot Topics: How Optics and Photonics Drive Innovation

6:00 pm to 6:10 pm: **Welcome and Opening Remarks**

6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)

6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)

6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)

7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)

7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)

### MONDAY 7 AUGUST

#### SESSION 3

LOCATION: CONV. CTR. ROOM 14B MON 9:00 AM TO 10:00 AM

#### Calibration and Nanoradian Metrology

Session Chair: **Lahsen Assoufid**, Argonne National Lab. (USA)

9:00 am: **Recent developments on nanoradian-angle metrology**, Tanfer Yandayan, TÜBITAK UME (Turkey) . . . . . [10385-9]

9:20 am: **A new ultra-high-accuracy angle generator: current status and future direction**, Christian F. Guertin, Vermont Photonics Technologies Corp. (USA); Ralf D. Geckeler, Physikalisch-Technische Bundesanstalt (Germany) . . . . . [10385-10]

9:40 am: **A portable device for calibration of autocollimators with nanoradian precision**, Tanfer Yandayan, TÜBITAK UME (Turkey) . . . . . [10385-11]

Coffee Break . . . . . Mon 10:00 am to 10:30 am



## SESSION 4

LOCATION: CONV. CTR. ROOM 14B MON 10:30 AM TO 11:30 AM

### Metrology Facilities

Session Chair: **Anand Krishna Asundi**, Nanyang Technological Univ. (Singapore)

10:30 am: **A new optics metrology laboratory at CNPEM: metrology capabilities, performance, and future plans**, Bernd C. Meyer, Murilo B. da Silva, Harry Westfahl Jr., Ctr. Nacional de Pesquisa em Energia e Materiais (Brazil) ..... [10385-12]

10:50 am: **X-ray optics laboratory at the ALS: current capabilities, new challenges, and tasks for further development**, Ian Lacey, Lawrence Berkeley National Lab. (USA); Gary P. Centers, Helmholtz-Institut Mainz (Germany) and Lawrence Berkeley National Lab. (USA); Gevork S. Gevorkyan, Sergey M. Nikitin, Brian V. Smith, Valeriy V. Yashchuk, Lawrence Berkeley National Lab. (USA) ..... [10385-13]

11:10 am: **Status of the metrology laboratory for the LCLS II project**, May Ling Ng, Corey L. Hardin, Josep Nicolas, Daniele Cocco, SLAC National Accelerator Lab. (USA) ..... [10385-14]

Lunch Break ..... Mon 11:30 am to 1:00 pm

## SESSION 5

LOCATION: CONV. CTR. ROOM 14B .. MON 1:00 PM TO 3:20 PM

### Novel Instruments and Methods

Session Chairs: **Haruhiko Ohashi**, Japan Synchrotron Radiation Research Institute (JASRI) (Japan); **Daniele Cocco**, SLAC National Accelerator Lab. (USA)

1:00 pm: **New surface slope profiler reaching sub-millimeter spatial resolution**, Fugui Yang, Ming Li, Quan Cai, Ya Du, Dingxiao Liu, Xiaowei Zhang, Yuhui Dong, Peng Liu, Institute of High Energy Physics (China) ..... [10385-15]

1:20 pm: **Development of a high-performance surface slope profiler for two-dimensional mapping of x-ray optics**, Ian Lacey, Lawrence Berkeley National Lab. (USA); Jérôme Adam, Ecole Nationale Supérieure d'Ingenieurs de Caen et Ctr. de Recherche (France); Gary P. Centers, Helmholtz-Institut Mainz (Germany); Gevork S. Gevorkyan, Sergey M. Nikitin, Valeriy V. Yashchuk, Lawrence Berkeley National Lab. (USA) ..... [10385-16]

1:40 pm: **Surface slope metrology of highly curved x-ray optics with an interferometric microscope**, Gevork S. Gevorkyan, Lawrence Berkeley National Lab. (USA); Gary P. Centers, Helmholtz-Institut Mainz (Germany) and Lawrence Berkeley National Lab. (USA); Kateryna S. Polonska, Yuriy Fedkovych Chernivtsi National Univ. (Ukraine) and Lawrence Berkeley National Lab. (USA); Ian Lacey, Valeriy V. Yashchuk, Lawrence Berkeley National Lab. (USA) ..... [10385-18]

2:00 pm: **New twist in the optical schematic of surface-slope measuring long-trace profiler**, Gevork S. Gevorkyan, Lawrence Berkeley National Lab. (USA); Wayne R. McKinney, Diablo Valley College (USA); Ian Lacey, Sergey M. Nikitin, Lawrence Berkeley National Lab. (USA); Peter Z. Takacs, Brookhaven National Lab. (USA); Valeriy V. Yashchuk, Lawrence Berkeley National Lab. (USA) ..... [10385-19]

2:20 pm: **Fabrication and metrology of OSAKA MIRROR for synchrotron applications**, Yoshio Ichii, Hiromi Okada, Shinya Aono, Shinsaku Shiroma, Akihiko Ueda, Takashi Tsumura, JTEC Corp. (Japan) ..... [10385-29]

2:40 pm: **Development of measurement system for ellipsoidal mirrors**, Hiroki Nakamori, JTEC Corp. (Japan) and Osaka Univ. (Japan); Yoshio Ichii, Hiromi Okada, Akihiko Ueda, Takashi Tsumura, JTEC Corp. (Japan); Satoshi Matsuyama, Kazuto Yamauchi, Osaka Univ. (Japan) ..... [10385-30]

3:00 pm: **Optomechanical development progress of high-accuracy long-trace profiler at the planning HEPS**, Shanzhi Tang, Ming Li, Institute of High Energy Physics (China) ..... [10385-17]

Coffee Break ..... Mon 3:20 pm to 3:50 pm

## SESSION 6

LOCATION: CONV. CTR. ROOM 14B .. MON 3:50 PM TO 5:10 PM

### Stitching and Sub-Nanometer Surface Metrology

Session Chair: **Lahsen Assoufid**, Argonne National Lab. (USA)

3:50 pm: **Development of relative angle determinable stitching interferometry for high-accuracy x-ray focusing mirrors**, Yingna Shi, Xudong Xu, Qishi Huang, Zhanshan Wang, Tongji Univ. (China) ..... [10385-20]

4:10 pm: **Fizeau stitching at the ESRF**, Amparo Vivo, Raymond Barrett, ESRF - The European Synchrotron (France) ..... [10385-21]

4:30 pm: **Three-dimensional shape measurement for x-ray ellipsoidal mirror**, Takehiro Kume, Yoshinori Takei, Satoru Egawa, Gota Yamaguchi, Hiroto Motoyama, Hidekazu Mimura, The Univ. of Tokyo (Japan) ..... [10385-22]

4:50 pm: **Testing Resistive Element Adjustable Length (REAL) cooling for sub-nanometer figure preservation in high-heat load FEL optics**, Corey L. Hardin, May Ling Ng, Venkat N. Srinivasan, Daniel S. Morton, Peter M. Stefan, Nicholas M. Kelez, Josep Nicolas, Lin Zhang, Daniele Cocco, SLAC National Accelerator Lab. (USA) ..... [10385-23]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 ..... MON 5:30 PM TO 7:30 PM

### Posters-Monday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Calibration devices and methods for soft x-ray detector at Beijing Synchrotron Radiation Facility (BSRF)**, Mingqi Cui, Yidong Zhao, Lei Zheng, Institute of High Energy Physics (China) ..... [10385-24]

**X-ray multilayer mid-frequency characterizations using speckle scanning techniques**, Hui Jiang, Shanghai Synchrotron Radiation Facility (China) [10385-25]

**Optimization of pencil beam F-Theta lens for high-accuracy metrology**, Chuanqian Peng, Yumei He, Jie Wang, Shanghai Institute of Applied Physics (China) ..... [10385-26]

**A novel scanning deflectometry based on secondary light source normal tracing method**, Chuanqian Peng, Yumei He, Jie Wang, Shanghai Institute of Applied Physics (China) ..... [10385-27]

# CONFERENCE 10386

LOCATION: CONV. CTR. ROOM 14B

Tuesday–Wednesday 8–9 August 2017 • Proceedings of SPIE Vol. 10386

## Advances in X-Ray/EUV Optics and Components XII

*Conference Chairs:* **Christian Morawe**, ESRF - The European Synchrotron (France); **Ali M. Khounsary**, Illinois Institute of Technology (USA); **Shunji Goto**, Japan Synchrotron Radiation Research Institute (Japan)

*Program Committee:* **Lucia Alianelli**, Diamond Light Source Ltd. (United Kingdom); **Lahsen Assoufid**, Argonne National Lab. (USA); **Stefan Braun**, Fraunhofer IWS Dresden (Germany); **Shih-Lin Chang**, National Tsing Hua Univ. (Taiwan); **Daniele Cocco**, SLAC National Accelerator Lab. (USA); **Raymond Conley Jr.**, Argonne National Lab. (USA); **Sultan B. Dabagov**, Istituto Nazionale di Fisica Nucleare (Italy); **Christian David**, Paul Scherrer Institut (Switzerland); **Hans M. Hertz**, KTH Royal Institute of Technology (Sweden); **Werner H. Jark**, Elettra-Sincrotrone Trieste S.C.p.A. (Italy); **George A. Kyrala**, Los Alamos National Lab. (USA); **Eric Louis**, MESA+ Institute for Nanotechnology (Netherlands); **Carolyn A. MacDonald**, Univ. at Albany (USA); **Hidekazu Mimura**, The Univ. of Tokyo (Japan); **Howard A. Padmore**, Lawrence Berkeley National Lab. (USA); **Ladislav Pina**, Czech Technical Univ. in Prague (Czech Republic); **Yuriy Ya Platonov**, Rigaku Innovative Technologies, Inc. (USA); **Seungyu Rah**, Pohang Univ. of Science and Technology (Korea, Republic of); **Peter Revesz**, Cornell Univ. (USA); **Horst Schulte-Schrepping**, Deutsches Elektronen-Synchrotron (Germany); **Regina Soufli**, Lawrence Livermore National Lab. (USA); **Daniele Spiga**, INAF - Osservatorio Astronomico di Brera (Italy); **Stanislav Stoupin**, Cornell Univ. (USA); **Mau-Tsu Tang**, National Synchrotron Radiation Research Ctr. (Taiwan); **Akihiko Ueda**, JTEC Corp. (Japan); **Zhanshan Wang**, Tongji Univ. (China); **Joerg Wiesmann**, Incoatec GmbH (Germany); **Makina Yabashi**, RIKEN (Japan), Japan Synchrotron Radiation Research Institute (Japan); **Kazuto Yamauchi**, Osaka Univ. (Japan); **Brian W. Yates**, Canadian Light Source Inc. (Canada)

### TUESDAY 8 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 14B . TUE 8:20 AM TO 10:20 AM

#### Multilayers

Session Chairs: **Kawal J. S. Sawhney**, Diamond Light Source Ltd. (United Kingdom); **Eric Louis**, MESA+ Institute for Nanotechnology (Netherlands)

8:20 am: **Pd-based multilayer mirrors for 8-12nm soft x-ray region**, Zhanshan Wang, Qiushi Huang, Yiwen Wang, Wenbin Li, Tongji Univ. (China); Igor V. Kozhevnikov, A.V. Shubnikov Institute of Crystallography (Russian Federation); Zhong Zhang, Tongji Univ. (China) . . . . . [10386-1]

8:40 am: **Double multilayer monochromators for upgraded ESRF beamlines**, Christian Morawe, Damien Carau, Jean-Christophe Peffen, ESRF - The European Synchrotron (France) . . . . . [10386-2]

9:00 am: **Laterally-graded multilayer as x-ray mirror for the laser-induced plasma x-ray sources**, Xianchao Cheng, China Academy of Engineering Physics (China) . . . . . [10386-3]

9:20 am: **Fabrication and characterization of W/B<sub>4</sub>C lamellar multilayer grating and NbC/Si multilayer phase-shift reflector**, Paresh C. Pradhan, Raja Ramanna Ctr. for Advanced Technology (India) and Homi Bhabha National Institute (India); S. Bhartiya, Raja Ramanna Ctr. for Advanced Technology (India); A. Singh, National Institute of Science Education and Research (India) and Homi Bhabha National Institute (India); A. Majhi, Raja Ramanna Ctr. for Advanced Technology (India) and Homi Bhabha National Institute (India); A. Gome, UGC-DAE Consortium for Scientific Research (India); R. Dhawan, Raja Ramanna Ctr. for Advanced Technology (India); M. Nayak, Raja Ramanna Ctr. for Advanced Technology (India) and Homi Bhabha National Institute (India); Pratap K. Sahoo, National Institute of Science Education and Research (India) and Homi Bhabha National Institute (India); S. K. Rai, Raja Ramanna Ctr. for Advanced Technology (India); V. R. Reddy, UGC-DAE Consortium for Scientific Research (India) . . . . . [10386-4]

9:40 am: **Ruthenium growth on B, C, and B<sub>4</sub>C studied by LEIS**, Andrey Zameshin, Andrey E. Yakshin, Marko Sturm, Eric Louis, Fred Bijkerk, MESA+ Institute for Nanotechnology (Netherlands) . . . . . [10386-5]

10:00 am: **Growth of x-ray multilayer coatings on sculptured surfaces**, Dmitry L. Voronov, Farhad H. Salmassi, Lawrence Berkeley National Lab. (USA); Peter Gawlitza, Fraunhofer IWS Dresden (Germany); Eric M. Gullikson, Lawrence Berkeley National Lab. (USA); Stefan Braun, Fraunhofer IWS Dresden (Germany); Howard A. Padmore, Lawrence Berkeley National Lab. (USA) . . . . . [10386-6]

Coffee Break . . . . . Tue 10:20 am to 10:50 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 14B . TUE 10:50 AM TO 12:10 PM

#### Focusing

Session Chairs: **Christian Morawe**, ESRF - The European Synchrotron (France); **Kazuto Yamauchi**, Osaka Univ. (Japan)

10:50 am: **Ultra-high-aspect multilayer zone plates for even higher x-ray energies**, Markus Osterhoff, Christian Eberl, Jakob Soltau, Hans-Ulrich Krebs, Georg-August-Univ. Göttingen (Germany) . . . . . [10386-7]

11:10 am: **Development of EUV focusing system based on ellipsoidal mirror**, Hiroto Motoyama, Hidekazu Mimura, The Univ. of Tokyo (Japan) . . . . . [10386-8]

11:30 am: **Perfect x-ray focusing via corrective glasses made to measure**, Frank Seiboth, Deutsches Elektronen-Synchrotron (Germany) and SLAC National Accelerator Lab. (USA); Andreas Schropp, Maria Scholz, Felix Wittwer, Deutsches Elektronen-Synchrotron (Germany); Christian Rödel, Martin Wünsche, Tobias Ullsperger, Stefan Nolte, Friedrich-Schiller-Univ. Jena (Germany); Jussi Rahomäki, Karolis Parfeniukas, Stylianos Giakoumidis, Ulrich Vogt, KTH Royal Institute of Technology (Sweden); Ulrich H. Wagner, Christoph Rau, Diamond Light Source Ltd. (United Kingdom); Ulrike Boesenberg, Jan Garrevoet, Gerald Falkenberg, Deutsches Elektronen-Synchrotron (Germany); Eric C. Galtier, Hae Ja Lee, Bob Nagler, SLAC National Accelerator Lab. (USA); Christian G. Schroer, Deutsches Elektronen-Synchrotron (Germany) . . . . . [10386-9]

11:50 am: **Refractive optics to compensate x-ray mirror shape-errors**, Kawal J. S. Sawhney, David Laundry, Diamond Light Source Ltd. (United Kingdom); Vishal Dhamgaye, Raja Ramanna Ctr. for Advanced Technology (India); Ian Pape, Diamond Light Source Ltd. (United Kingdom) . . . . . [10386-10]

Lunch/Exhibition Break . . . . . Tue 12:10 pm to 1:40 pm

## SESSION 3

LOCATION: CONV. CTR. ROOM 14B . . . TUE 1:40 PM TO 2:40 PM

### Mirrors

Session Chairs: **Ali M. Khounsary**, Illinois Institute of Technology (USA); **Daniele Cocco**, SLAC National Accelerator Lab. (USA)

1:40 pm: **Development of precision Wolter mirrors for solar x-ray observations**, Taro Sakao, Institute of Space and Astronautical Science (Japan) and The Graduate Univ. for Advanced Studies (Japan); Satoshi Matsuyama, Takumi Goto, Jumpei Yamada, Shuhei Yasuda, Kazuto Yamauchi, Osaka Univ. (Japan); Yoshiki Kohmura, RIKEN Harima Branch (Japan); Ayumi Kime, Japan Aerospace Exploration Agency (Japan); Yoshinori Suematsu, Noriyuki Narukage, National Astronomical Observatory of Japan (Japan); Shin-nosuke Ishikawa, Institute of Space and Astronautical Science (Japan) . . . . . [10386-11]

2:00 pm: **Development of concave-convex imaging mirror system for a compact and achromatic full-field x-ray microscope**, Jumpei Yamada, Satoshi Matsuyama, Shuhei Yasuda, Yasuhisa Sano, Osaka Univ. (Japan); Yoshiki Kohmura, RIKEN Harima Branch (Japan); Makina Yabashi, Tetsuya Ishikawa, SPring-8, RIKEN Harima Branch (Japan); Kazuto Yamauchi, Osaka Univ. (Japan) . . . . . [10386-12]

2:20 pm: **Advances toward micron resolution optics for x-ray instrumentation and applications**, Mark Cordier, Benjamin Stripe, Wenbing Yun, S. H. Lau, Alan Lyon, David Reynolds, Sylvia J. Y. Lewis, Sharon Chen, Vladimir A. Semenov, Richard I. Spink, Sigray, Inc. (USA) . . . . . [10386-13]

## SESSION 4

LOCATION: CONV. CTR. ROOM 14B . . TUE 2:40 PM TO 3:20 PM

### Beamlines and Facilities

Session Chairs: **Shunji Goto**, Japan Synchrotron Radiation Research Institute (JASRI) (Japan); **Zhanshan Wang**, Tongji Univ. (China)

2:40 pm: **Development of x-ray optical components for DLSRs**, Makina Yabashi, Inoue Ichiro, Taito Osaka, RIKEN SPring-8 Ctr. (Japan); Hiroshi Yamazaki, Japan Synchrotron Radiation Research Institute (JASRI) (Japan); Kenji Tamasaku, RIKEN SPring-8 Ctr. (Japan); Haruhiko Ohashi, Shunji Goto, Japan Synchrotron Radiation Research Institute (JASRI) (Japan) . . . . . [10386-14]

3:00 pm: **Current status and future plan of the soft x-ray beamline at SACLA**, Shigeki Owada, RIKEN Harima Branch (Japan); Kyo Nakajima, Kensuke Tono, Yasumasa Joti, Tadashi Togashi, Kazuaki Togawa, Japan Synchrotron Radiation Research Institute (JASRI) (Japan); Takahiro Inagaki, RIKEN Harima Branch (Japan); Toru Hara, Japan Synchrotron Radiation Research Institute (JASRI) (Japan); Takashi Tanaka, RIKEN Harima Branch (Japan); Mitsuhiro Yamaga, Yasunori Senba, Hirokatsu Yumoto, Takahisa Koyama, Haruhiko Ohashi, Hitoshi Tanaka, Makina Yabashi, Japan Synchrotron Radiation Research Institute (JASRI) (Japan) . . . . . [10386-15]

Coffee Break . . . . . Tue 3:20 pm to 3:50 pm

## SESSION 5

LOCATION: CONV. CTR. ROOM 14B . . . TUE 3:50 PM TO 5:10 PM

### Opto-Thermomechanics

Session Chairs: **Markus Osterhoff**, Georg-August-Univ. Göttingen (Germany); **Werner H. Jark**, Elettra-Sincrotrone Trieste S.C.p.A. (Italy)

3:50 pm: **REAL cooled mirror for FEL application: FEA modelling and wavefront propagation simulation**, Lin Zhang, Corey L. Hardin, Daniele Cocco, SLAC National Accelerator Lab. (USA) . . . . . [10386-16]

4:10 pm: **Finite element analysis for the Bragg crystal of D-line at SSRF**, Zhongmin Xu, Limin Jin, Xiangjun Wei, Yajun Tong, Wei Li, Shanghai Institute of Applied Physics (China) . . . . . [10386-17]

4:30 pm: **Development of hybrid adaptive x-ray focusing system based on piezoelectric bimorph mirror and mirror bender**, Takumi Goto, Satoshi Matsuyama, Hiroki Hayashi, Osaka Univ. (Japan); Juniki Sonoyama, Kazuki Akiyama, TOYAMA Co., Ltd. (Japan); Hiroki Nakamori, JTEC Corp. (Japan); Yasuhisa Sano, Kazuto Yamauchi, Osaka Univ. (Japan) . . . . . [10386-18]

4:50 pm: **LCLS-II dynamically bendable and water-cooled KB mirrors**, Lin Zhang, Daniel S. Morton, Daniele Cocco, Lance Lee, SLAC National Accelerator Lab. (USA) . . . . . [10386-19]

LOCATION: MARRIOTT MARQUIS, CARDIFF . . . . . 8:00 PM TO 10:00 PM

### Workshop on X-Ray Optics

Chair: **Ali M. Khounsary**, Illinois Institute of Technology (USA); **Daniele Cocco**, SLAC National Accelerator Lab. (USA)

The X-Ray Optics Working Group provides an informal setting for the interested engineers and scientists to meet and discuss issues related to the design, analysis, cooling, fabrication, and metrology of x-ray optics. Topics for discussion can be e-mailed to the organizer, Dr. Ali Khounsary (amk@iit.edu), prior to the meeting.

## WEDNESDAY 9 AUGUST

### SESSION 6

LOCATION: CONV. CTR. ROOM 14B WED 9:00 AM TO 10:00 AM

### Crystals

Session Chairs: **Christian Morawe**, ESRF - The European Synchrotron (France); **Stanislav Stoupin**, Cornell Univ. (USA)

9:00 am: **Development of crystal-based split-and-delay optics with wavefront splitting at SACLA**, Takashi Hirano, Osaka Univ. (Japan); Taito Osaka, Osaka Univ. (Japan) and RIKEN SPring-8 Ctr. (Japan); Yasuhisa Sano, Osaka Univ. (Japan); Yuichi Inubushi, Tadashi Togashi, Japan Synchrotron Radiation Research Institute (JASRI) (Japan); Ichiro Inoue, RIKEN SPring-8 Ctr. (Japan); Satoshi Matsuyama, Osaka Univ. (Japan); Kensuke Tono, Japan Synchrotron Radiation Research Institute (JASRI) (Japan); Kazuto Yamauchi, Osaka Univ. (Japan); Makina Yabashi, RIKEN SPring-8 Ctr. (Japan) . . . . . [10386-20]

9:20 am: **Application of MEMS-based x-ray optics as tuneable nanosecond choppers**, Pice Chen, Donald A. Walko, Il Woong Jung, Zhilong Li, Gao Ya, Daniel Lopez, Jin Wang, Argonne National Lab. (USA) . . . . . [10386-21]

9:40 am: **The development of crystal fabrication in SSRF**, Li Song, Shanghai Institute of Applied Physics (China) . . . . . [10386-22]

Coffee Break . . . . . Wed 10:00 am to 10:30 am

### SESSION 7

LOCATION: CONV. CTR. ROOM 14B WED 10:30 AM TO 11:50 AM

### Gratings

Session Chairs: **Shunji Goto**, Japan Synchrotron Radiation Research Institute (JASRI) (Japan); **Daniele Spiga**, INFN - Osservatorio Astronomico di Brera (Italy)

10:30 am: **Single-order diffraction grating for soft x-ray: state of the art and perspective**, Leifeng Cao, China Academy of Engineering Physics (China) . . . . . [10386-23]

10:50 am: **Fabrication and test of quasiperiodic x-ray reflection gratings for high-order diffraction suppression**, Yilei Hua, Lina Shi, Hailiang Li, Changqing Xie, Institute of Microelectronics (China) . . . . . [10386-24]

11:10 am: **Nanofabrication of free-standing spectroscopic photon sieves operating in soft-x ray region**, Xiaoli Zhu, Institute of Microelectronics (China); Lai Wei, China Academy of Engineering Physics (China); Hailiang Li, Institute of Microelectronics (China); Leifeng Cao, China Academy of Engineering Physics (China); Changqing Xie, Institute of Microelectronics (China) . . . . . [10386-25]

11:30 am: **Soft x-ray grating compressors for free-electron-laser pulses**, Paolo Miotti, Nicola Fabris, CNR-IFN Padova (Italy) and Univ. degli Studi di Padova (Italy); Fabio Frassetto, CNR-IFN Padova (Italy); Ennio Giovine, CNR-Istituto di Fotonica e Nanotecnologie (Italy); Luca Poletto, CNR-IFN Padova (Italy) . . . . . [10386-26]



# CONFERENCE 10386

LOCATION: CONV. CTR.

EXHIBIT HALL B2 ..... WED 5:30 PM TO 7:30 PM

## Posters-Wednesday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**High-aspect ratio zone plate fabrication for hard x-ray nanoimaging**, Karolis Parfeniukas, Stylianos Giakoumidis, Rabia Akan, Ulrich Vogt, KTH Royal Institute of Technology (Sweden) ..... [10386-27]

**Design and first commissioning results of the EMIL beamlines at BESSY-II**, Stefan Hendel, Franz Schäfers, Helmholtz-Zentrum Berlin für Materialien und Energie GmbH (Germany); Michael Hävecker, Fritz-Haber-Institut der Max-Planck-Gesellschaft (Germany); Gerd Reichardt, Klaus Lips, Mihaela Gorgoi, Helmholtz-Zentrum Berlin für Materialien und Energie GmbH (Germany) ..... [10386-28]

**Design of the test beamline at SSRF**, Zhongliang Li, Lian Xue, Zengyan Zhang, Hongxin Luo, Jie Wang, Shanghai Synchrotron Radiation Facility (China) [10386-29]

**Thickness uniformity study on the ESRF multilayer deposition system**, Damien Carau, Jean-Christophe Peffen, Christian Morawe, ESRF - The European Synchrotron (France) ..... [10386-30]

**Development of multilayer-based reflection and diffraction optics for the XUV applications**, Zhanshan Wang, Qiushi Huang, Zhong Zhang, Wenbin Li, Shengzhen Yi, Tongji Univ. (China); Igor V. Kozhevnikov, A.V. Shubnikov Institute of Crystallography (Russian Federation); Friedmar Senf, Alexei Erko, Helmholtz-Zentrum Berlin für Materialien und Energie GmbH (Germany); Hongchang Wang, Kawal J. S. Sawhney, Diamond Light Source Ltd. (United Kingdom); Eric Louis, Fred Bijkerk, Univ. Twente (Netherlands) ..... [10386-31]

**Spatial coherence measurement of hard synchrotron radiation using a combined pinhole and grating**, Wenqiang Hua, Yuzhu Wang, Chunxia Hong, Fenggang Bian, Xiuhong Hong, Jie Wang, Shanghai Institute of Applied Physics (China) ..... [10386-32]

**Diffraction effects in diamond x-ray refractive lenses**, Maxim Polikarpov, Immanuel Kant Baltic Federal Univ. (Russian Federation); Irina Snigireva, Hermann Emerich, ESRF - The European Synchrotron (France); Nataliya Klimova, Anatoly A. Snigirev, Immanuel Kant Baltic Federal Univ. (Russian Federation) ..... [10386-33]

**Micromirror-based manipulation of synchrotron x-ray beams**, Donald A. Walko, Pice Chen, Il Woong Jung, Daniel Lopez, Craig P. Schwartz, Gopal K. Shenoy, Jin Wang, Argonne National Lab. (USA) ..... [10386-34]

**A tool of X-LAB v1.5 for optical design and its application**, Zuhua Yang, China Academy of Engineering Physics (China) ..... [10386-35]

**Initial growth characteristics for Cr layer and Cr-based multilayers**, Hui Jiang, Shanghai Synchrotron Radiation Facility (China) ..... [10386-36]

**APS modular deposition system**, Raymond P. Conley Jr., Argonne National Lab. (USA) ..... [10386-37]

# CONFERENCE 10387

LOCATION: CONV. CTR. ROOM 13

Monday 7 August 2017 • Proceedings of SPIE Vol. 10387

## Advances in Laboratory-based X-Ray Sources, Optics, and Applications VI

Conference Chairs: **Ali M. Khounsary**, Illinois Institute of Technology (USA); **Giovanni Pareschi**, INAF - Osservatorio Astronomico di Brera (Italy)

Conference Co-Chairs: **Alex Murokh**, RadiaBeam Technologies, LLC (USA); **J. Scott Price**, GE Global Research (USA)

Program Committee: **Mark A. Anastasio**, Washington Univ. in St. Louis (USA); **Sandra G. Biedron**, Colorado State Univ. (USA); **Björn Hansson**, Exillum AB (Sweden); **George A. Kyrala**, Los Alamos National Lab. (USA); **Ladislav Pina**, Czech Technical Univ. in Prague (Czech Republic); **Donald P. Umstadter**, Univ. of Nebraska-Lincoln (USA); **Gert van Dorssen**, PANalytical B.V. (Netherlands)

### MONDAY 7 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 13 .. MON 8:40 AM TO 10:00 AM

#### X-Ray Sources I

Session Chairs: **Alex Murokh**, RadiaBeam Technologies, LLC (USA); **Giovanni Pareschi**, INAF - Osservatorio Astronomico di Brera (Italy)

8:40 am: **5th-generation light source development based on inverse Compton scattering**, James B. Rosenzweig, Univ. of California, Los Angeles (USA) [10387-15]

9:00 am: **The Lyncean Compact Light Source: x-ray synchrotron radiation for analytical and imaging applications**, Michael Feser, Lyncean Technologies, Inc. (USA) [10387-1]

9:20 am: **Compact Linac-driven light sources utilizing mm-period RF undulators**, Filippou Toufexis, Valery A Dolgashev, Cecile Limborg-Deprey, Sami G. Tantawi, SLAC National Accelerator Lab. (USA) [10387-2]

9:40 am: **Developments in compact sources of synchrotron radiation**, Timur Shaftan, Brookhaven National Lab. (USA) [10387-3]

Coffee Break ..... Mon 10:00 am to 10:30 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 13 .. MON 10:30 AM TO 11:50 AM

#### X-Ray Sources II

Session Chairs: **Ali M. Khounsary**, Illinois Institute of Technology (USA); **J. Scott Price**, GE Global Research (USA)

10:30 am: **New developments in ultra-high brightness microstructured x-ray sources for applications in Talbot-Lau imaging and dual-energy microanalytical/microXRF**, Wenbin Yun, David Reynolds, Vladimir A. Semenov, Janos Kirz, Alan Lyon, Sharon Chen, Benjamin Stripe, Richard I. Spink, Sigray, Inc. (USA) [10387-4]

10:50 am: **120-kV and 5-watt compact x-ray source**, Eric Miller, Sterling W. Cornaby, G. Smith, R. Steck, B. Harris, Kris Kozaczek, Sanjay Kamtekar, MOXTEK, Inc. (USA) [10387-6]

11:10 am: **The compact x-ray source ThomX**, Pierre Favier, Lab. de l'Accelérateur Lineaire, Ctr. Scientifique d'Orsay (France) [10387-17]

11:30 am: **1D heat transfer problems for a CNT as an electron emitter**, Yozo Mikata, Bechtel (USA); Scott Price, GE Global Research (US) (USA) [10387-7]

Lunch Break ..... Mon 11:50 am to 1:30 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 13 .... MON 1:30 PM TO 3:00 PM

#### Optics and Applications I

Session Chairs: **George A. Kyrala**, Los Alamos National Lab. (USA); **Sandra G. Biedron**, Colorado State Univ. (USA)

1:30 pm: **X-ray metrology in the semiconductor industry (Invited Paper)**, R. Joseph Kline, Daniel F. Sunday, National Institute of Standards and Technology (USA) [10387-8]

2:00 pm: **New developments in laboratory-based x-ray sources and optics**, Bernd Hasse, Jens N. Schmidt-May, Frank Hertlein, Carsten Michaelisen, Incoatec GmbH (Germany) [10387-9]

2:20 pm: **High-energy radiography of dense material with high flux Inverse-Compton x-ray source**, Shouyuan Chen, Ping Zhang, Grigory Golovin, Baozhen Zhao, Colton Fruhling, Daniel Haden, Wenchao Yan, Cheng Liu, Sudeep Banerjee, Univ. of Nebraska-Lincoln (USA); Cameron Miller, Shaun Clarke, Sara A. Pozzi, Univ. of Michigan (USA); Donald P. Umstadter, Univ. of Nebraska-Lincoln (USA) [10387-10]

2:40 pm: **Lobster eye as a collector for water window microscopy**, Ladislav Pina, Czech Technical Univ. in Prague (Czech Republic); Veronika Marsikova, Rigaku Innovative Technologies Europe (Czech Republic); Alexandr Jancarek, Radka Havlikova, Czech Technical Univ. in Prague (Czech Republic); Adolf Inneman, Daniela Doubravova, Rigaku Innovative Technologies Europe (Czech Republic); Rene Hudec, Astronomical Institute of the ASCR, v.v.i. (Czech Republic) [10387-16]

Coffee Break ..... Mon 3:00 pm to 3:30 pm

#### SESSION 4

LOCATION: CONV. CTR. ROOM 13 .... MON 3:30 PM TO 4:30 PM

#### Optics and Applications II

Session Chairs: **Ladislav Pina**, Czech Technical Univ. in Prague (Czech Republic); **J. Scott Price**, GE Global Research (USA)

3:30 pm: **Image processing methods for analyzer-based phase-contrast imaging**, Oriol Caudevilla Torras, Illinois Institute of Technology (USA) [10387-12]

3:50 pm: **Strain-free polished channel-cut crystal monochromators: a new approach and results**, Elina Kasman, Jonathan Montgomery, Xianrong Huang, Lahsen Assoufid, Argonne National Lab. (USA) [10387-13]

4:10 pm: **High-energy XRF device for heavy metal identification utilizing the triboelectric effect**, T. Lopez, Eli Van Cleve, Matthew Ibbotson, M. Dahl, Carlos G. Camara, Tribogenics, Inc. (USA) [10387-5]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 ..... MON 5:30 PM TO 7:30 PM

#### Posters-Monday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**X-ray microscope with refractive x-ray optics and microfocus laboratory source**, Dmitry Serebrennikov, Immanuel Kant Baltic Federal Univ. (Russian Federation); Yuriy I. Dudchik, Belarusian State Univ. (Belarus); Aleksandr Barannikov, Anatoly A. Snigirev, Nataliya Klimova, Immanuel Kant Baltic Federal Univ. (Russian Federation) [10387-11]

**Moxtek's compact x-ray sources**, Rick Steck, Sterling W. Cornaby, B. Harris, T. Parker, Kris Kozaczek, C. Smith, Eric Miller, Sanjay Kamtekar, MOXTEK, Inc. (USA) [10387-14]

# CONFERENCE 10388

LOCATION: CONV. CTR. ROOM 15B

Wednesday–Thursday 9–10 August 2017 • Proceedings of SPIE Vol. 10388

## Advances in Computational Methods for X-Ray Optics IV

Conference Chairs: **Oleg Chubar**, Brookhaven National Lab. (USA); **Kawal Sawhney**, Diamond Light Source Ltd. (United Kingdom)

Conference Co-Chairs: **Manuel Sanchez del Rio**, European Synchrotron Radiation Facility (France); **Carolyn MacDonald**, Univ. at Albany (USA)

Program Committee: **Lucia Alianelli**, Diamond Light Source Ltd. (United Kingdom); **Johannes Bahrtdt**, Helmholtz-Zentrum Berlin für Materialien und Energie GmbH (Germany); **Edoardo Busetto**, Elettra-Sincrotrone Trieste S.C.p.A. (Italy); **Roger J. Dejus**, Argonne National Lab. (USA); **Claudio Ferrero**, ESRF - The European Synchrotron (France); **Gianluca Aldo Geloni**, European XFEL GmbH (Germany); **Kenneth W. Hill**, Princeton Plasma Physics Lab. (USA); **Mourad Idir**, Brookhaven National Lab. (USA); **Tetsuya Ishikawa**, RIKEN (Japan); **Ali M. Khounsary**, X-ray Optics, Inc. (USA), Illinois Institute of Technology (USA); **Erik Bergbäck Knudsen**, Technical Univ. of Denmark (Denmark); **Jacek Krzywinski**, SLAC National Accelerator Lab. (USA); **Bernd C. Meyer**, Lab. Nacional de Luz Sincrotron (Brazil); **Giovanni Pareschi**, INAF - Osservatorio Astronomico di Brera (Italy); **Ruben Y. Reiningner**, Brookhaven National Lab. (USA), Scientific Answers & Solutions LLC (USA); **Liubov Samoylova**, European XFEL GmbH (Germany); **Yuri V. Shvyd'ko**, Argonne National Lab. (USA); **Peter C. Sondhaus**, MAX IV Lab., Lund Univ. (Sweden); **Timm Weitkamp**, Synchrotron SOLEIL (France); **Garth J. Williams**, Brookhaven National Lab. (USA); **Valeriy V. Yashchuk**, Lawrence Berkeley National Lab. (USA)

Conference Co-Sponsor: 

### TUESDAY 8 AUGUST

LOCATION: MARRIOTT MARQUIS,  
CARDIFF ..... 8:00 PM TO 10:00 PM

#### Workshop on X-Ray Optics

Chair: **Ali M. Khounsary**, Illinois Institute of Technology (USA); **Daniele Cocco**, SLAC National Accelerator Lab. (USA)

The X-Ray Optics Working Group provides an informal setting for the interested engineers and scientists to meet and discuss issues related to the design, analysis, cooling, fabrication, and metrology of x-ray optics. Topics for discussion can be e-mailed to the organizer, Dr. Ali Khounsary (amk@iit.edu), prior to the meeting.

### WEDNESDAY 9 AUGUST

LOCATION: CONV. CTR. ROOM 15B ..... 8:30 AM TO 8:40 AM

#### Welcome and Introduction

**Oleg Chubar**, Brookhaven National Lab. (USA)

#### SESSION 1

LOCATION: CONV. CTR. ROOM 15B ... WED 8:40 AM TO 10:00 AM

#### Keynote Session

Session Chair: **Oleg Chubar**, Brookhaven National Lab. (USA)

8:40 am: **Computational methods in development of modern synchrotrons and their applications** (*Keynote Presentation*), Qun Shen, Brookhaven National Lab. (USA) ..... [10388-1]

9:20 am: **Data handling at SACLA x-ray free electron laser facility and future SPing-8-II synchrotron radiation facility** (*Keynote Presentation*), Tetsuya Ishikawa, RIKEN (Japan) ..... [10388-2]

Coffee Break .....Wed 10:00 am to 10:30 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 15B WED 10:30 AM TO 12:00 PM

#### Computer Codes: Overviews, Methods, and Applications I

Session Chair: **Kawal J. S. Sawhney**, Diamond Light Source Ltd. (United Kingdom)

10:30 am: **Recent progress of the synchrotron radiation calculation code SPECTRA** (*Invited Paper*), Takashi Tanaka, RIKEN (Japan) ..... [10388-4]

11:00 am: **Main functions, recent updates, and applications of Synchrotron Radiation Workshop code** (*Invited Paper*), Oleg Chubar, Maksim S. Rikitin, Brookhaven National Lab. (USA); Yu-Chen Chen-Wiegart, Brookhaven National Lab. (USA) and Stony Brook Univ. (USA); Yong S. Chu, Andrei Fluierasu, Dean Hidas, Lutz Wiegart, Brookhaven National Lab. (USA) ..... [10388-5]

11:30 am: **Recent progress of the XRT: ray tracing and wave propagation toolkit** (*Invited Paper*), Roman Chernikov, Deutsches Elektronen-Synchrotron (Germany); Konstantin Klementiev, Max IV Lab. (Sweden) ..... [10388-6]

Lunch/Exhibition Break .....Wed 12:00 pm to 1:00 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 15B .. WED 1:00 PM TO 2:20 PM

#### Computer Codes: Overviews, Methods, and Applications II

Session Chair: **Kawal J. S. Sawhney**, Diamond Light Source Ltd. (United Kingdom)

1:00 pm: **RAY, RAY-UI, and REFLEC: new developments** (*Invited Paper*), Franz Schäfers, Peter Baumgaertel, Helmholtz-Zentrum Berlin für Materialien und Energie GmbH (Germany) ..... [10388-7]

1:30 pm: **Interoperability and complementarity of simulation tools for beamline design in the OASYS environment** (*Invited Paper*), Luca Rebuffi, Elettra-Sincrotrone Trieste S.C.p.A. (Italy); Manuel Sanchez del Rio, ESRF - The European Synchrotron (France) ..... [10388-8]

2:00 pm: **McXtrace 1.4: latest developments in the new release**, Erik B. Knudsen, Peter K. Willendrup, Technical Univ. of Denmark (Denmark) ... [10388-9]



## SESSION 4

LOCATION: CONV. CTR. ROOM 15B . . WED 2:20 PM TO 5:30 PM

### New Instruments and Beamlines

Session Chair: **Qun Shen**, Brookhaven National Lab. (USA)

2:20 pm: **Application of x-ray simulations in development of instruments at Linear Coherent Light Source (LCLS) at National Accelerator Laboratory (SLAC)** (*Invited Paper*), Jacek Krzywinski, Lin Zhang, Gabriel Marcus, Yiping Feng, SLAC National Accelerator Lab. (USA) . . . . . [10388-10]

2:50 pm: **European XFEL optics: current status** (*Invited Paper*), Liubov Samoylova, Harald Sinn, Maurizio Vannoni, European XFEL GmbH (Germany) . . . . . [10388-11]

Coffee Break . . . . . Wed 3:20 pm to 3:50 pm

3:50 pm: **X-ray optics simulation and beamline design for the APS upgrade** (*Invited Paper*), Xianbo Shi, Ruben Reininger, Dean R. Haefner, Argonne National Lab. (USA) . . . . . [10388-12]

4:20 pm: **Simulation and optimization of the Sirius IPE soft x-ray beamline**, Bernd C. Meyer, Tulio C. R. Rocha, Sergio A. L. Luiz, Artur Clarindo Pinto, Harry Westfahl Jr., Ctr. Nacional de Pesquisa em Energia e Materiais (Brazil) . [10388-13]

4:40 pm: **Optical design and simulation of a new coherence beamline at NSLS-II**, Garth J. Williams, Oleg Chubar, Ian K. Robinson, Brookhaven National Lab. (USA) . . . . . [10388-14]

5:00 pm: **Theory of x-ray echo spectrometers** (*Invited Paper*), Yuri V. Shvyd'ko, Argonne National Lab. (USA) . . . . . [10388-15]

LOCATION: CONV. CTR. EXHIBIT HALL B2 . . . . . WED 5:30 PM TO 7:30 PM

### Posters-Wednesday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Numerical analysis of partially coherent radiation at soft x-ray beamline**, Xiangyu Meng, Chaofan Xue, Huaina Yu, Yong Wang, Renzhong Tai, Yanqing Wu, Shanghai Synchrotron Radiation Facility (China) . . . . . [10388-32]

**A fast and reliable approach to simulating the output from an x-ray tube used for developing security backscatter imaging**, Anna Vella, Andre M. A. Munoz, Matthew J. F. Healy, David W. Lane, Cranfield Univ. (United Kingdom); Joseph G. Zhou, VJ Technologies, Inc. (USA); David Lockley, Defence Science and Technology Lab. (United Kingdom) . . . . . [10388-33]

**The use of simulation to optimize the pinhole diameter and mask thickness for an x-ray backscatter imaging system**, Anna Vella, Andre M. A. Munoz, Matthew J. F. Healy, David W. Lane, Cranfield Univ. (United Kingdom); David Lockley, Defence Science and Technology Lab. (United Kingdom) . . . . . [10388-34]

**Alignment of KB mirrors with at-wavelength metrology tool simulated using SRW**, Lei Huang, Brookhaven National Lab. (USA); Bo Gao, Shanghai Institute of Applied Physics (China) and Univ. of Chinese Academy of Sciences (China); Maksim S. Rakitin, Brookhaven National Lab. (USA); Junpeng Xue, Brookhaven National Lab. (USA) and Sichuan Univ. (China); Oleg Chubar, Mourad Idir, Brookhaven National Lab. (USA) . . . . . [10388-36]

**Collaborative simulation of x-ray optics and electron beam dynamics**, David L. Bruhwiler, RadiaSoft LLC (USA); Paul Moeller, RadiaSoft LLC (USA) and Bivio LLC (USA); Robert Nagler, RadiaSoft LLC (USA); Maksim S. Rakitin, Oleg Chubar, Brookhaven National Lab. (USA); Gerard Andonian, RadiaBeam Technologies, LLC (USA) and Univ. of California, Los Angeles (USA) . . . . . [10388-37]

**Simulation of experiments with partially-coherent x-rays using Synchrotron Radiation Workshop**, Oleg Chubar, Maksim S. Rakitin, Brookhaven National Lab. (USA); Yu-Chen Chen-Wiegart, Brookhaven National Lab. (USA) and Stony Brook Univ. (USA); Andrei Fluerasu, Lutz Wiegart, Brookhaven National Lab. (USA) . . . . . [10388-38]

**Hard x-ray FEL SASE pulses propagation through perfect single crystals diffracting in Bragg and Laue geometry**, Angel Rodriguez-Fernandez, Paul Scherrer Institut (Switzerland); Liubov Samoylova, European XFEL GmbH (Germany); Alexey V. Buzmakov, A.V. Shubnikov Institute of Crystallography (Russian Federation) . . . . . [10388-39]

**Simulation of x-ray images of an IXS echo spectrometer**, Alexey Y. Suvorov, Oleg Chubar, Yong Q. Cai, Brookhaven National Lab. (USA); Yuri V. Shvyd'ko, Argonne National Lab. (USA) . . . . . [10388-40]

**Advanced commissioning of the Soft Matter Interfaces Beamline at NSLS-II**, Mikhail Zhernenkov, Elaine DiMasi, Oleg Chubar, Maksim S. Rakitin, Brookhaven National Lab. (USA) . . . . . [10388-41]

## THURSDAY 10 AUGUST

### SESSION 5

LOCATION: CONV. CTR. ROOM 15B . THU 8:30 AM TO 10:10 AM

### X-Ray Optics: Simulation, Development, and Metrology I

Session Chair: **Mourad Idir**, Brookhaven National Lab. (USA)

8:30 am: **Modelling imperfect x-ray optics** (*Invited Paper*), David Laundry, Kawal J. S. Sawhney, Diamond Light Source Ltd. (United Kingdom) . . . . . [10388-16]

9:00 am: **Mutual optical intensity propagation through non-ideal optics**, Xiangyu Meng, Shanghai Institute of Applied Physics (China); Xianbo Shi, Argonne National Lab. (USA); Yong Wang, Shanghai Institute of Applied Physics (China); Ruben Reininger, Lahsen Assoufid, Argonne National Lab. (USA); Renzhong Tai, Shanghai Institute of Applied Physics (China) . . . . . [10388-17]

9:20 am: **Speckle-based at-wavelength metrology of x-ray optics at Diamond Light Source** (*Invited Paper*), Hongchang Wang, Tunhe Zhou, Yogesh Kashyap, Kawal J. S. Sawhney, Diamond Light Source Ltd. (United Kingdom) . . . [10388-18]

9:50 am: **Stochastic surface metrology analysis**, Anastasia Y. Tyurina, Yury N. Tyurin, Second Star Algonumerix, LLC (USA); Valeriy V. Yashchuk, Lawrence Berkeley National Lab. (USA) . . . . . [10388-19]

Coffee Break . . . . . Thu 10:10 am to 10:40 am

### SESSION 6

LOCATION: CONV. CTR. ROOM 15B .THU 10:40 AM TO 11:30 AM

### X-Ray Optics: Simulation, Development, and Metrology II

Session Chair: **Yuri V. Shvyd'ko**, Argonne National Lab. (USA)

10:40 am: **Latest developments of x-ray refractive optics for coherent applications** (*Invited Paper*), Anatoly A. Snigirev, Immanuel Kant Baltic Federal Univ. (Russian Federation) . . . . . [10388-20]

11:10 am: **Aberrations in compound refractive lens systems: analytical and numerical calculations**, Markus Osterhoff, Georg-August-Univ. Göttingen (Germany); Carsten Detlefs, Claudio Ferrero, ESRF - The European Synchrotron (France) . . . . . [10388-21]

Lunch/Exhibition Break . . . . . Thu 11:30 am to 1:00 pm

### SESSION 7

LOCATION: CONV. CTR. ROOM 15B . . .THU 1:00 PM TO 2:30 PM

### Simulation of Experiments and Data Processing

Session Chair: **Jacek Krzywinski**, SLAC National Accelerator Lab. (USA)

1:00 pm: **Simulations of x-ray free-electron laser experiments with the SIMEX platform** (*Invited Paper*), Carsten Fortmann-Grote, European XFEL GmbH (Germany); Zoltan Jurek, Ctr. for Free-Electron Laser Science (Germany) and The Hamburg Ctr. for Ultrafast Imaging (Germany); Beata Ziaja-Motyka, Ctr. for Free Electron Laser Science (Germany) and The Hamburg Ctr. for Ultrafast Imaging (Germany) and Institute of Nuclear Physics (Poland); Robin Santra, Ctr. for Free-Electron Laser Science (Germany) and The Hamburg Ctr. for Ultrafast Imaging (Germany) and Hamburg Univ. (Germany); Adrian P. Mancuso, European XFEL GmbH (Germany) . . . . . [10388-22]

1:30 pm: **X-ray optical simulations supporting advanced commissioning of the coherent hard x-ray beamline at NSLS-II**, Lutz Wiegart, Oleg Chubar, Andrei Fluerasu, Maksim S. Rakitin, Brookhaven National Lab. (USA) . . . . . [10388-23]

1:50 pm: **Nano-focused hard x-ray beam measured by ptychography**, Xiaojing Huang, Hanfei Yan, Evgeny Nazaretski, Mingyuan Ge, Nathalie Bouet, Juan Zhou, Weihe Xu, Petr P. Ilinski, Yong S. Chu, Brookhaven National Lab. (USA) [10388-24]

2:10 pm: **A Monte Carlo simulation of scattering reduction in spectral x-ray computed tomography**, Matteo Busi, Ulrik L. Olsen, Erik B. Knudsen, Jan Kehres, Technical Univ. of Denmark (Denmark); Erik D. Christensen, Niels Bohr Institute (Denmark); Mohamad Khalil, Jeppe Revall Frisvad, Kristoffer Haldrup, Technical Univ. of Denmark (Denmark) . . . . . [10388-25]

# CONFERENCE 10388

## SESSION 8

LOCATION: CONV. CTR. ROOM 15B .. THU 2:30 PM TO 5:40 PM

### Software Demonstration in Computational Methods for X-Ray Optics

Session Chair: **Oleg Chubar**, Brookhaven National Lab. (USA)

Computer codes that are extensively used for optical simulations in a broad spectral domain extending from THz to hard x-rays will be demonstrated in real-time by their authors/development teams. The codes use different simulation methods and different approximations, from geometrical to physical optics. Some allow for high-accuracy treatment of the effects of full and partial coherence of the radiation beams. Even though most of these codes were developed for simulation of sources and optics of large light source facilities -- synchrotrons and free-electron lasers -- some can be effectively used for table-top optical systems, e.g. for conventional steady-state or pulsed lasers.

Light refreshments sponsored by:



2:30 pm: **SPECTRA demonstration** (*Invited Paper*), Takashi Tanaka, RIKEN (Japan) . . . . . [10388-26]

Coffee Break . . . . . Thu 3:00 pm to 3:10 pm

3:10 pm: **Sirepo: a web-based interface for physical optics simulations - its deployment and use at NSLS-II** (*Invited Paper*), Maksim S. Rakitin, Oleg Chubar, Brookhaven National Lab. (USA); Paul Moeller, RadiaSoft LLC (USA) and Bivio LLC (USA); Robert Nagler, David L. Bruhwiler, RadiaSoft LLC (USA) . . . . . [10388-27]

3:40 pm: **OASYS (OrAnge SYNchrotron Suite): an open-source graphical environment for x-ray virtual experiments** (*Invited Paper*), Luca Rebuffi, Elettra-Sincrotrone Trieste S.C.p.A. (Italy); Manuel Sanchez del Rio, ESRF - The European Synchrotron (France) . . . . . [10388-28]

4:10 pm: **RAY, RAY-UI, and REFLEC demonstration** (*Invited Paper*), Franz Schäfers, Helmholtz-Zentrum Berlin für Materialien und Energie GmbH (Germany) . . . . . [10388-29]

4:40 pm: **McXtrace demonstration** (*Invited Paper*), Erik B. Knudsen, Technical Univ. of Denmark (Denmark) . . . . . [10388-30]

5:10 pm: **XRT demonstration** (*Invited Paper*), Roman Chernikov, Deutsches Elektronen-Synchrotron (Germany) . . . . . [10388-31]

# CONFERENCE 10389

LOCATION: CONV. CTR. ROOM 15B

Monday–Tuesday 7–8 August 2017 • Proceedings of SPIE Vol. 10389

## X-Ray Nanoimaging: Instruments and Methods III

Conference Chairs: **Barry Lai**, Argonne National Lab. (USA); **Andrea Somogyi**, Synchrotron SOLEIL (France)

Program Committee: **Yong S. Chu**, Brookhaven National Lab. (USA); **Michael Feser**, Lyncean Technologies, Inc. (USA); **Hans M. Hertz**, Royal Institute of Technology (Sweden); **Ian McNulty**, Argonne National Lab. (USA); **David Paterson**, Australian Synchrotron (Australia); **Christian G. Schroer**, DESY, Univ. of Hamburg (Germany); **Kazuto Yamauchi**, Osaka Univ. (Japan)

Conference Co-Sponsor: 

### SUNDAY 6 AUGUST

LOCATION: CONV. CTR. ROOM 6A . . SUN 6:00 PM TO 7:50 PM

#### Technology Hot Topics: How Optics and Photonics Drive Innovation

- 6:00 pm to 6:10 pm: **Welcome and Opening Remarks**
- 6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)
- 6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)
- 6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)
- 7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)
- 7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)

### MONDAY 7 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 15B MON 8:30 AM TO 10:30 AM

#### Full-Field Imaging

Session Chair: **Hans M. Hertz**, KTH Royal Institute of Technology (Sweden)

- 8:30 am: **Propagation-based phase-contrast imaging using laboratory sources** (*Invited Paper*), William Vågberg, Daniel H. Larsson, KTH Royal Institute of Technology (Sweden); Mei Li, Anders Arner, Laszlo Szekeley, Jonas Persson, Karolinska Institutet (Sweden); Andre Yaroshenko, Technische Univ. München (Germany); Ali Önder Yildirim, Helmholtz Zentrum München GmbH (Germany); Hans M. Hertz, KTH Royal Institute of Technology (Sweden) . . . . . [10389-1]
- 9:00 am: **Increasing spatial resolution in full-field soft x-ray nanotomography of cells** (*Invited Paper*), Eva Pereiro, ALBA Synchrotron (Spain); Joaquín Otón, Ctr. Nacional de Biotecnología (Spain); Javier Conesa, ALBA Synchrotron (Spain); Javier Chichon, Ctr. Nacional de Biotecnología (Spain); Ana Perez-Berna, Andrea Sorrentino, ALBA Synchrotron (Spain); Jose L. Carrascosa, Jose Maria Carazo, Ctr. Nacional de Biotecnología (Spain) . . . . . [10389-2]
- 9:30 am: **Coherent high-energy x-ray microscopy for mesoscopic materials**, Irina Snigireva, ESRF - The European Synchrotron (France); Anatoly A. Snigirev, Immanuel Kant Baltic Federal Univ. (Russian Federation) . . . . . [10389-3]
- 9:50 am: **The imaging and coherence beamline I13L at DIAMOND**, Christoph Rau, Diamond Light Source Ltd. (United Kingdom) and Manchester Univ. (United Kingdom) and Northwestern Univ. (USA); Ulrich H. Wagner, Malte Ogurreck, Xiaowen Shi, Darren Batey, Silvia Cipiccia, Shashidhara Marathe, Andrew J. Bodey, Diamond Light Source Ltd. (United Kingdom); Marie-Christine Zdora, Diamond Light Source Ltd. (United Kingdom) and Univ. College London (United Kingdom); Irene Zanette, Diamond Light Source Ltd. (United Kingdom); Mirna Saliba, Diamond Light Source Ltd. (United Kingdom) and Univ. Zürich (Switzerland); Venkata S. C. Kupplli, Diamond Light Source Ltd. (United Kingdom) and Univ. College London (United Kingdom); Simone Sala, Stefanos H. Chalkidis, Univ. College London (United Kingdom); Pierre Thibault, Univ. of Southampton (United Kingdom) and Univ. College London (United Kingdom) . . . . . [10389-4]

10:10 am: **Development of full-field x-ray fluorescence microscope using total-reflection mirrors**, Satoshi Matsuyama, Jumpei Yamada, Shuhei Yasuda, Osaka Univ. (Japan); Yoshiaki Kohmura, Makina Yabashi, Tetsuya Ishikawa, RIKEN Harima Branch (Japan); Kazuto Yamauchi, Osaka Univ. (Japan) . . . . . [10389-5]

Coffee Break . . . . . Mon 10:30 am to 11:00 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 15B MON 11:00 AM TO 12:30 PM

#### Optics

Session Chair: **Christian G. Schroer**, Deutsches Elektronen-Synchrotron (Germany)

- 11:00 am: **Double-sided Fresnel zone plates for high-efficiency x-ray nanofocusing** (*Invited Paper*), Istvan Mohacsi, Deutsches Elektronen-Synchrotron (Germany) and Synchrotron SOLEIL (France) and Paul Scherrer Institut (Switzerland); Ismo Vartiainen, Paul Scherrer Institut (Switzerland) and Univ. of Eastern Finland (Finland); Manuel Guizar-Sicairos, Vitaliy A. Guzenko, Paul Scherrer Institut (Switzerland); Ian McNulty, Robert P. Winarski, Martin V. Holt, Argonne National Lab. (USA); Elisabeth Mueller, Paul Scherrer Institut (Switzerland); Andréa Somogyi, Synchrotron SOLEIL (France); Christian David, Paul Scherrer Institut (Switzerland) . . . . . [10389-6]
- 11:30 am: **Development of 2D monolithic multilayer Laue lens nanofocusing optics for x-ray microscopy**, Evgeny Nazaretski, Weihe Xu, Nathalie Bouet, Juan Zhou, Hanfei Yan, Xiaojing Huang, Yong S. Chu, Brookhaven National Lab. (USA) . . . . . [10389-7]
- 11:50 am: **Focus of a multilayer Laue lens with an aperture of 102 microns determined by ptychography at beamline APS/1-BM**, Albert T. Macrander, Michael Wojcik, Jörg Maser, Argonne National Lab. (USA); Nathalie Bouet, Brookhaven National Lab. (USA); Raymond P. Conley, Argonne National Lab. (USA) . . . . . [10389-8]
- 12:10 pm: **Commissioning of the Montel nano-optics for the x-ray nanoprobe at Taiwan Photon Source**, Gung-Chian Yin, Shi-Hung Chang, Bo-Yi Chen, Chien-yu Lee, Bi-Hsuan Lin, Shao-Chin Tseng, Xiao-Yun Li, Huang-Yeh Chen, Jian-Xing Wu, Mau-Tsu Tang, National Synchrotron Radiation Research Ctr. (Taiwan) . . . . . [10389-9]
- Lunch Break . . . . . Mon 12:30 pm to 1:50 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 15B . . MON 1:50 PM TO 4:40 PM

#### Nano-Imaging/Correlative Methods

Session Chair: **Stefan Vogt**, Argonne National Lab. (USA)

- 1:50 pm: **Integration of ptychography with the nanoscale multimodality imaging instrument at HXN of NSLS-II** (*Invited Paper*), Xiaojing Huang, Hanfei Yan, Evgeny Nazaretski, Mingyuan Ge, Nathalie Bouet, Juan Zhou, Petr P. Ilnski, Yong S. Chu, Brookhaven National Lab. (USA) . . . . . [10389-10]
- 2:20 pm: **Multislice x-ray ptychography towards 3D high-resolution imaging**, Kei Shimomura, Makoto Hirose, Osaka Univ. (Japan) and RIKEN SPring-8 Ctr. (Japan); Nicolas Burdet, RIKEN SPring-8 Ctr. (Japan); Yukio Takahashi, Osaka Univ. (Japan) and RIKEN SPring-8 Ctr. (Japan) . . . . . [10389-11]



# CONFERENCE 10389

2:40 pm: **Nanoscale x-ray imaging using the GINIX Instrument: combining zoom-holography and nano-scanning**, Markus Osterhoff, Georg-August-Universität Göttingen (Germany); Michael Sprung, Deutsches Elektronen-Synchrotron (Germany); Tim Salditt, Georg-August-Universität Göttingen (Germany) . . . . . [10389-12]

3:00 pm: **PtyNAMI: Ptychographic nano-analytical x-ray microscope at PETRA III**, Christian G. Schroer, Deutsches Elektronen-Synchrotron (Germany) and Univ. Hamburg (Germany); Andreas Schropp, Ralph Döhrmann, Stephan Botta, Deutsches Elektronen-Synchrotron (Germany); Dirk Samberg, TU Dresden (Germany); Maik Kahnt, Mikhail Lyubomirskiy, Juliane Reinhardt, Maria Scholz, Martin Seyrich, Felix Wittwer, Dennis Brückner, Jan Garrevoet, Gerald Falkenberg, Deutsches Elektronen-Synchrotron (Germany) . . . . . [10389-13]

Coffee Break . . . . . Mon 3:20 pm to 3:50 pm

3:50 pm: **High-energy cryo x-ray nano-imaging at the ID16A beamline of ESRF (Invited Paper)**, Julio C. da Silva, Alexandra Pacureanu, Yang Yang, Florin Fus, Maxime Hubert, Leonid Bloch, Murielle Salome, ESRF - The European Synchrotron (France); Sylvain Bohic, ESRF - The European Synchrotron (France) and Grenoble Institut des Neurosciences (France); Peter Cloetens, ESRF - The European Synchrotron (France) . . . . . [10389-14]

4:20 pm: **X-ray fluorescence nanotomography of single cells at 20-nm voxel resolution**, Tiffany W. Victor, Stony Brook Univ. (USA); Lindsey M. Easton, Katherine H. O'Toole, Boston Univ. (USA); Hanfei Yan, Xiaojing Huang, Mingyuan Ge, Brookhaven National Lab. (USA); Karen Allen, Boston Univ. (USA); Barbara Imperiali, Massachusetts Institute of Technology (USA); Yong S. Chu, Lisa M. Miller, Brookhaven National Lab. (USA) . . . . . [10389-15]

## SESSION 4

**LOCATION: CONV. CTR. ROOM 15B . . MON 4:40 PM TO 5:30 PM**

### Control Schemes, Data Analysis, Image Reconstruction, and Modeling

Session Chair: **Stefan Vogt**, Argonne National Lab. (USA)

4:40 pm: **Rapid alignment of projection images in x-ray nanotomography: extension to phase-contrast imaging (Invited Paper)**, Doga Gürsoy, Argonne National Lab. (USA); Young Pyo Hong, Kuan He, Karl Hujak, Seunghwan Yoo, Northwestern Univ. (USA); Si Chen, Vincent De Andrade, Argonne National Lab. (USA); Kai He, Oliver Cossairt, Aggelos K. Katsaggelos, Chris J. Jacobsen, Northwestern Univ. (USA) . . . . . [10389-16]

5:10 pm: **Self-absorption correction in x-ray fluorescence nanotomography**, Mingyuan Ge, Xiaojing Huang, Hanfei Yan, Evgeny Nazaretski, Li Li, Petr P. Ilinski, Brookhaven National Lab. (USA); Wilson K. S. Chiu, Univ. of Connecticut (USA); Kyle S. Brinkman, Clemson Univ. (USA); Yong S. Chu, Brookhaven National Lab. (USA) . . . . . [10389-17]

**LOCATION: CONV. CTR.**

**EXHIBIT HALL B2 . . . . . MON 5:30 PM TO 7:30 PM**

### Posters-Monday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Faster scanning and higher resolution: New setup for multilayer zone plate imaging**, Markus Osterhoff, Christian Eberl, Jakob Soltan, Hans-Ulrich Krebs, Georg-August-Universität Göttingen (Germany) . . . . . [10389-29]

**PyXRF: Python-based x-ray fluorescence analysis package**, Li Li, Brookhaven National Lab. (USA) . . . . . [10389-30]

**Device for interferometric characterization of rotation stages for x-ray nanotomography**, Stefan Kubsky, Synchrotron SOLEIL (France); Tomas Stankevic, Max IV Lab. (Sweden); Christer Engblom, Florent Langlois, Filipe Alves, Alain Lestrade, Nicolas Jobert, Gilles Cauchon, Synchrotron SOLEIL (France); Ulrich Vogt, KTH Royal Institute of Technology (Sweden) . . . . . [10389-31]

**Quantitative analysis of the reoxidation stability of Ni-Fe anode for solid oxide fuel cells using x-ray nanotomography**, Yong Guan, Yangchao Tian, Univ. of Science and Technology of China (China) . . . . . [10389-32]

**An analytical method for extending the depth-of-focus in x-ray microscopy**, Yangchao Tian, Yong Guan, Univ. of Science and Technology of China (China) . . . . . [10389-33]

**Three-dimensional imaging of biological samples and nanomaterials using soft x-ray nanotomography**, Gang Liu, Jianhong Liu, Yong Guan, Univ. of Science and Technology of China (China) . . . . . [10389-34]

**Fully automatic sample alignment with VLM at the STXM beamline of SSRF**, Xiangzhi Zhang, Zhi Guo, Limei Ma, Zijian Xu, Haigang Liu, Zhenhua Chen, Jiefeng Cao, Yong Wang, Renzhong Tai, Shanghai Institute of Applied Physics (China) . . . . . [10389-35]

**Detection limits for the inverse analysis of Bragg coherent diffraction data**, Hande Öztürk, Xiaojing Huang, Hanfei Yan, Yong S. Chu, Brookhaven National Lab. (USA) . . . . . [10389-36]

**Progress of ptychography method at STXM beamline of SSRF**, Zijian Xu, Haigang Liu, Chunpeng Wang, Xulei Tao, Renzhong Tai, Shanghai Institute of Applied Physics (China) . . . . . [10389-38]

**Complementing cryo x-ray microscopy with a compatible confocal microscope for biological applications**, Si Chen, Oliver Schmidt, Argonne National Lab. (USA); Qiaoling Jin, Northwestern Univ. (USA); Amanda Petford-Long, Chris J. Jacobsen, Argonne National Lab. (USA) . . . . . [10389-39]

**Streamlining data analysis for x-ray fluorescence microscopy**, Arthur Glowacki, Argonne National Lab. (USA) . . . . . [10389-40]

**Fast hierarchical length-scale morphological, compositional, and speciation imaging at the Nanoscopium Beamline Synchrotron Soleil**, Kadda Medjoubi, Gil Baranton, Synchrotron SOLEIL (France); Maria Sancho-Tomas, Synchrotron SOLEIL (France) and Institut de Physique du Globe de Paris (France); Pascal Philippot, Institut de Physique du Globe de Paris (France); Andr ea Somogyi, Synchrotron SOLEIL (France) . . . . . [10389-41]

## TUESDAY 8 AUGUST

### SESSION 5

**LOCATION: CONV. CTR. ROOM 15B . . TUE 8:30 AM TO 10:20 AM**

### Scanning Nanoprobes

Session Chair: **Andrea Somogyi**, Synchrotron SOLEIL (France)

8:30 am: **Current status of the Hard X-Ray Nanoprobe beamline at the SSRF (Invited Paper)**, Aiguo Li, Hui Jiang, Yan He, Hua Wang, Zhaohong Zhang, Gaofeng Zhao, Shanghai Institute of Applied Physics (China) . . . . . [10389-19]

9:00 am: **First x-ray nanoimaging experiments at NanoMAX**, Ulrich Vogt, Karolis Parfeniukas, KTH Royal Institute of Technology (Sweden); Tomas Stankevic, Sebastian Kalbfleisch, Zdenek Matej, Alexander Bj rling, Marianne Liebi, Gerardina Carbone, Max IV Lab. (Sweden); Anders Mikkelsen, Lund Univ. (Sweden); Ulf Johansson, Max IV Lab. (Sweden) . . . . . [10389-20]

9:20 am: **Development of the PtychoProbe Beamline at the Advanced Photon Source**, Volker Rose, J rg Maser, Junjing Deng, Barry Lai, Argonne National Lab. (USA); Tonio Buonassisi, Massachusetts Institute of Technology (USA); David Fenning, Univ. of California, San Diego (USA); Ross Harder, Chris J. Jacobsen, Argonne National Lab. (USA); Rafael Jaramillo, Massachusetts Institute of Technology (USA); Antonio Lanzirrotti, The Univ. of Chicago (USA); Eugene M. Lavelly, BAE Systems (USA); Karen Mulfort, Argonne National Lab. (USA); Conal E. Murray, IBM Thomas J. Watson Research Ctr. (USA); Stephen R. Sutton, David Tiede, Curt A. Preissner, Argonne National Lab. (USA); Gayle Woloschak, Northwestern Univ. (USA); Stefan Vogt, Argonne National Lab. (USA) . . . [10389-21]

9:40 am: **The Velociprobe: A fast hard x-ray nanoprobe for ptychographic imaging**, Junjing Deng, Curt A. Preissner, Christian Roehrig, Michael Wojcik, Shane Sullivan, Argonne National Lab. (USA); David J. Vine, Lawrence Berkeley National Lab. (USA); Barry Lai, Stefan Vogt, Argonne National Lab. (USA) . . . . . [10389-22]

10:00 am: **High-resolution chemical imaging using hard x-ray spectro-ptychography**, Makoto Hirose, Kei Shimomura, Osaka Univ. (Japan) and Japan Synchrotron Radiation Research Institute (JASRI) (Japan); Nicolas Burdet, Japan Synchrotron Radiation Research Institute (JASRI) (Japan); Yukio Takahashi, Osaka Univ. (Japan) and Japan Synchrotron Radiation Research Institute (JASRI) (Japan) . . . . . [10389-23]

Coffee Break . . . . . Tue 10:20 am to 10:50 am

SESSION 6

LOCATION: CONV. CTR. ROOM 15B .TUE 10:50 AM TO 12:30 PM

**Instruments for Nanoimaging and Nanopositioning**

Session Chair: **Barry Lai**, Argonne National Lab. (USA)

10:50 am: **Time-resolved x-ray diffraction microscopy at Advanced Photon Source**, Zhonghou Cai, Yi Zhu, Haidan Wen, Martin V. Holt, Argonne National Lab. (USA) . . . . . [10389-24]

11:10 am: **A new cryo scanning transmission x-ray microscope at the Canadian Light Source**, Jan Geilhufe, Adam F. G. Leontowich, Russ Berg, Chris Regier, Darwin M. Taylor, Jian Wang, John Swirsky, Chithra Karunakaran, Robert Peters, Canadian Light Source Inc. (Canada); Mirwais Aktary, Applied NanoTools Inc. (Canada); Adam P. Hitchcock, Brockhouse Institute for Materials Research (Canada); Stephen G. Urquhart, Univ. of Saskatchewan (Canada) . . . . . [10389-25]

11:30 am: **New type of on-the-fly scanning data acquisition system for x-ray nanoprobe at Taiwan Photon Source**, Chien-yu Lee, Gung-Chian Yin, Bo-Yi Chen, Bi-Hsuan Lin, Shao-Chin Tseng, Shi-Hung Chang, Jian-Xing Wu, Xiao-Yun Li, Mau-Tsu Tang, National Synchrotron Radiation Research Ctr. (Taiwan) . . . . . [10389-26]

11:50 am: **X-ray beam stabilization for nanoscale imaging**, Yong S. Chu, Petr P. Ilinski, Hanfei Yan, Xiaojing Huang, Mingyuan Ge, Joseph Mead, Alfred Dellapenna, Anthony Caraccappa, Brookhaven National Lab. (USA) . . . . . [10389-27]


12:10 pm: **Beamline for extremely high-resolution Bragg coherent x-ray diffraction imaging with in-situ and operando capabilities**, Wonsuk Cha, Evan Maxey, Ross Harder, Argonne National Lab. (USA) . . . . . [10389-28]

**LOCATION: CONV. CTR. ROOM 15B . . . . 12:30 PM TO 12:40 PM**

**X-Ray Nanoimaging Young Investigator Award Ceremony**

Join us as we announce the winner of the X-Ray Nanoimaging Young Investigator Award. Qualifying presentations are judged on scientific merit, technical impact, and overall quality of the work by a committee of expert scientists in the field.

Award sponsored by:



**LOCATION: MARRIOTT MARQUIS, BALBOA . . . . . 8:00 PM TO 10:00 PM**

**Penetrating Radiation Technical Event**

Chair: **James E. Baciak**, Univ. of Florida (USA)

This event brings together technologists and scientists with interests in neutron, x- and gamma-ray detection, spectroscopy, and imaging for all applications. This year's featured speaker is Dr. Rachel Slaybaugh from University of California, Berkeley. She will be giving a talk on "Advanced Solvers and Innovation for Penetrating Radiation." Dr. Slaybaugh will cover the need innovation in the nuclear space to enable new (and maintain existing) reactors, enhance nuclear security, and improve nuclear science. To truly enable breakthroughs by investigating new ideas rapidly, we need accurate simulation and appropriate research tools. This requires new methods in computational neutron transport, better simulation and better tools for penetrating radiation detection and measurement. Finally, this talk will briefly cover educational initiatives bringing an innovative mindset into the nuclear field. After the featured speaker the floor will be open to discussions.

# CONFERENCE 10390

LOCATION: CONV. CTR. ROOM 13

Monday–Tuesday 7–8 August 2017 • Proceedings of SPIE Vol. 10390

## Target Diagnostics Physics and Engineering for Inertial Confinement Fusion VI

Conference Chairs: **Jeffrey A. Koch**, National Security Technologies, LLC (USA); **Gary P. Grim**, Lawrence Livermore National Lab. (USA)

Program Committee: **W. Jack Armstrong**, Univ. of Rochester (USA); **Perry M. Bell**, Lawrence Livermore National Lab. (USA); **David K. Bradley**, Lawrence Livermore National Lab. (USA); **Frank E. Merrill**, Los Alamos National Lab. (USA); **T. Craig Sangster**, Univ. of Rochester (USA)

### MONDAY 7 AUGUST

LOCATION: CONV. CTR.

EXHIBIT HALL B2 ..... MON 5:30 PM TO 7:30 PM

#### Posters-Monday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPPosterGuidelines>.

**Implementation of the next-generation Gas Cherenkov Detector at the National Ignition Facility**, Jorge A. Carrera, Arthur C. Carpenter, Hans W. Herrmann, Alex B. Zylstra, Bart V. Beeman, Hesham Y. Khater, Jose E. Hernandez, Lawrence Livermore National Lab. (USA); Frank E. Lopez, Jeffrey R. Griego, Yong Ho H. Kim, Los Alamos National Lab. (USA); E. Kirk Miller, National Security Technologies, LLC (USA); Steve A. Gales, Colin J. Horsfield, AWE plc (United Kingdom); James S. Milnes, Photek Ltd. (United Kingdom); Jonathan D. Hares, Kentech Instruments Ltd. (United Kingdom) ..... [10390-15]

**Solid-state streak camera prototype electronic performance testing and characterization**, Yekaterina P. Opachich, Lawrence P. MacNeil, National Security Technologies, LLC (USA); John L. Porter, Sandia National Labs. (USA); Alicia Alarie, National Security Technologies, LLC (USA); Mark W. Kimmel, Joel Long, Quinn Looker, Sandia National Labs. (USA); Don Max, National Security Technologies, LLC (USA); John W. Stahoviak, Sandia National Labs. (USA); Vu Tran, National Security Technologies, LLC (USA); Caleb Wolf, Northwest Nazarene Univ. (USA); Thomas B. Waltman, National Security Technologies, LLC (USA) ..... [10390-20]

### TUESDAY 8 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 13 ... TUE 8:30 AM TO 10:40 AM

#### Optical Diagnostics and Recording

Session Chair: **Gary P. Grim**, Lawrence Livermore National Lab. (USA)

8:30 am: **Design of a line-VISAR interferometer system for the Sandia Z-Machine**, Justin D. Galbraith, John R. Celeste, Todd J. Clancy, Simon J. Cohen, Michael K. Crosley, Phillip S. Datte, Dayne Fratanduono, James Hammer, John L. Jackson, Lawrence Livermore National Lab. (USA); Michael C. Jones, Sandia National Labs. (USA); Don Koen, Jeremy Lusk, Thomas J. McCarville, Harry S. McLean, Kumar Raman, Samuel Rodriguez, Lawrence Livermore National Lab. (USA); Decker Spencer, Sandia National Labs. (USA); Paul T. Springer, Nan J. Wong, Lawrence Livermore National Lab. (USA); Kevin Austin, Jacob Baker, Drew Johnson, Sandia National Labs. (USA) ..... [10390-1]

8:50 am: **An optically passive method that rate doubles 2-GHz timing fiducials**, Joshua D. Kendrick, Robert Boni, Charles Sorce, Univ. of Rochester (USA) [10390-2]

9:10 am: **Using S-parameters for calibration of deployed cables on NIF**, Alexander Wargo, California Polytechnic State Univ., San Luis Obispo (USA); Bart V. Beeman, Lawrence Livermore National Lab. (USA) and California Polytechnic State Univ., San Luis Obispo (USA) ..... [10390-3]

9:30 am: **Recording system upgrade for the Dante x-ray diagnostic on NIF**, Bart V. Beeman, Alastair S. Moore, Perry M. Bell, Klaus Widmann, Todd J. Clancy, Lawrence Livermore National Lab. (USA) ..... [10390-4]

9:50 am: **Performance of a 2ns gated hybrid CMOS burst mode imager**, Pratik Patel, Arthur C. Carpenter, Matthew S. Dayton, Brad T. Funsten, Jeremy Hill, Christopher C. Macaraeg, Brian Pepmeier, Lawrence Livermore National Lab. (USA); Brandon Mitchell, Liam D. Claus, Marcos Sanchez, Sandia National Labs. (USA) ..... [10390-5]

10:10 am: **Radiation effects on active camera electronics in the target chamber at the National Ignition Facility (Invited Paper)**, Matthew S. Dayton, Arthur C. Carpenter, Hesham Y. Khater, Philip S. Datte, Perry M. Bell, Lawrence Livermore National Lab. (USA) ..... [10390-6]

Coffee Break ..... Tue 10:40 am to 11:00 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 13 ... TUE 11:00 AM TO 12:10 PM

#### X-Ray Diagnostics

Session Chair: **Jay J. Ayers**, Lawrence Livermore National Lab. (USA)

11:00 am: **X-ray Doppler velocimetry for diagnosis of fluid motion in ICF implosions (Invited Paper)**, Jeffrey A. Koch, National Security Technologies, LLC (USA); John E. Field, Lawrence Livermore National Lab. (USA); Joseph D. Kilkenny, General Atomics (USA); Eric Harding, Gregory A. Rochau, Sandia National Labs. (USA); Aaron M. Covington, Univ. of Nevada, Reno (USA); Eric C. Dutra, Richard R. Freeman, National Security Technologies, LLC (USA); Gareth N. Hall, Lawrence Livermore National Lab. (USA); Michael J. Haugh, James A. King, National Security Technologies, LLC (USA) ..... [10390-7]

11:30 am: **On the design of the NIF Continuum Spectrometer**, Daniel B. Thorn, Andrew MacPhee, Jay J. Ayers, Justin D. Galbraith, Michael C. Hardy, Nobuhiko Izumi, David K. Bradley, Lousia A. Pickworth, Benjamin Bachmann, Otto L. Landon, Marilyn B. Schneider, Perry M. Bell, Hesham Y. Khater, Joseph D. Kilkenny, Lawrence Livermore National Lab. (USA) ..... [10390-8]

11:50 am: **Design and characterization of an improved 2-ns multi-frame imager for the Ultra-Fast X-ray Imager (UXI) program at Sandia National Laboratories**, Liam D. Claus, Marcos Sanchez, Gideon A. Robertson, Mark W. Kimmel, John L. Porter, Lu Fang, Douglas Trotter, John W. Stahoviak, Troy England, Andrew Montoya, Brandon Mitchell, Gregory A. Rochau, Sandia National Labs. (USA); Arthur C. Carpenter, Matthew S. Dayton, Pratik Bhogilal, Lawrence Livermore National Lab. (USA) ..... [10390-9]

Lunch/Exhibition Break ..... Tue 12:10 pm to 1:40 pm



SESSION 3

LOCATION: CONV. CTR. ROOM 13 . . . . . TUE 1:40 PM TO 3:10 PM

**X-Ray and Nuclear Diagnostics**

Session Chair: **Justin D. Galbraith**, Lawrence Livermore National Lab. (USA)

1:40 pm: **X-ray penumbral imaging diagnostic developments at the National Ignition Facility** (*Invited Paper*), Benjamin Bachmann, Lawrence Livermore National Lab. (USA); Hatim Abu Shawareb, Neil B. Alexander, General Atomics (USA); Jay J. Ayers, Christopher G. Bailey, Perry M. Bell, Laura R. Benedetti, David K. Bradley, Laurent Divol, Tilo Doeppner, John E. Field, Lawrence Livermore National Lab. (USA); Andrew Forsman, General Atomics (USA); Justin D. Galbraith, Michael C. Hardy, Lawrence Livermore National Lab. (USA); Terance Hilsabeck, General Atomics (USA); Nobuhiko Izumi, Leonard C. Jarrot, Lawrence Livermore National Lab. (USA); Joseph D. Kilkenny, General Atomics (USA); Steve Kramer, Otto L. Landen, Tammy Ma, Andrew MacPhee, Nathan D. Masters, Sabrina R. Nagel, Arthur E. Pak, Pravesh K. Patel, Louisa A. Pickworth, Joseph E. Ralph, Lawrence Livermore National Lab. (USA); Christopher Reed, General Atomics (USA) . . . . . [10390-10]

2:10 pm: **X-ray calibration and characterization at NSSL Livermore operations**, James A. King, Michael J. Haugh, Richard R. Freeman, Kenneth D. Jacoby, Gabe Torres, Peter Torres III, Patrick W. Hillyard, Jeffrey A. Koch, National Security Technologies, LLC (USA) . . . . . [10390-11]

2:30 pm: **Offline metrology and alignment of a passive neutron imaging pinhole on the National Ignition Facility**, Jay J. Ayers, Nick Shingleton, Robin L. Hibbard, David N. Fittinghoff, David A. Barker, Lawrence Livermore National Lab. (USA); Valerie E. Fatherley, Frank E. Merrill, Los Alamos National Lab. (USA); Daniel H. Kalantar, Lawrence Livermore National Lab. (USA) . . . . . [10390-12]

2:50 pm: **Pulsed x-ray sources for characterization of gated framing cameras**, Catalin Filip, Jeffrey A. Koch, Richard R. Freeman, James A. King, National Security Technologies, LLC (USA) . . . . . [10390-13]

Coffee Break . . . . . Tue 3:10 pm to 3:30 pm

SESSION 4

LOCATION: CONV. CTR. ROOM 13 . . . . . TUE 3:30 PM TO 5:30 PM

**Nuclear Diagnostics**

Session Chair: **Jeffrey A. Koch**, National Security Technologies, LLC (USA)

3:30 pm: **System design of the NIF neutron imaging system North pole** (*Invited Paper*), Valerie E. Fatherley, Los Alamos National Lab. (USA); Jay J. Ayers, David A. Barker, Lawrence Livermore National Lab. (USA); Steve H. Batha, Christopher R. Danly, Los Alamos National Lab. (USA); David N. Fittinghoff, Lawrence Livermore National Lab. (USA); Lynne A. Goodwin, Hans W. Herrmann, Los Alamos National Lab. (USA); Robin L. Hibbard, Los Alamos National Lab. (USA) and Lawrence Livermore National Lab. (USA); Justin J. Jorgenson, John I. Martinez, Frank E. Merrill, John A. Oertel, Derek W. Schmidt, Los Alamos National Lab. (USA); Nick Shingleton, Michael Vitalich, Lawrence Livermore National Lab. (USA); Petr L. Volegov, Carl H. Wilde, Los Alamos National Lab. (USA) . . . . . [10390-14]

4:00 pm: **Fielding the LANL Gas Cherenkov Detector (GCD-3) at the National Ignition Facility: The mechanical engineering challenges of designing, analyzing, fabricating, testing, and commissioning the next-generation GCD detector and WellDIM3.9m insertion manipulator within a 3.9 meter well on the National Ignition Facility target chamber**, Frank E. Lopez, Hans W. Herrmann, Ramon J. Leeper, Steve H. Batha, John A. Oertel, Jeffrey R. Griego, Brian C. Steinfeld, Paul J. Polk, Lynne A. Goodwin, Valerie E. Fatherley, Thomas N. Archuleta, Robert J. Aragonéz, Benjamin J. Pederson, Los Alamos National Lab. (USA); John R. Celeste, Robin L. Hibbard, Arthur C. Carpenter, Jose E. Hernandez, Jorge A. Carrera, Hesham Y. Khater, Lawrence Livermore National Lab. (USA); Justin J. Jorgenson, Los Alamos National Lab. (USA) . . . . . [10390-16]

4:20 pm: **Large-area solid radiochemistry collector (LASR) at the National Ignition Facility**, Cory Waltz, Donald R. Jedlovec, Michael C. Hardy, Dawn Shaughnessy, Narek Gharibyan, Cal A. Smith, Lawrence Livermore National Lab. (USA) . . . . . [10390-17]

4:40 pm: **Measuring the down scattered neutron ratio using the NiToF detector system at the National Ignition Facility** (*Invited Paper*), Gary P. Grim, Lawrence Livermore National Lab. (USA); George L. Morgan, Carl H. Wilde, Los Alamos National Lab. (USA); Edward Hartouni, Robert Hatari, Mark J. Eckart, Lawrence Livermore National Lab. (USA) . . . . . [10390-18]

5:10 pm: **Development of the Real-Time Neutron Activation Diagnostic System for NIF**, Jaben Root, Phil Adams, Gordon K. Brunton, Ellen R. Edwards, Tony Golod, Jose E. Hernandez, Donald R. Jedlovec, Charles Yeaman, Lawrence Livermore National Lab. (USA) . . . . . [10390-19]

# CONFERENCE 10391

LOCATION: CONV. CTR. ROOM 15A

Tuesday–Thursday 8–10 August 2017 • Proceedings of SPIE Vol. 10391

## Developments in X-Ray Tomography XI

Conference Chair: **Bert Müller**, Univ. Basel (Switzerland)

Conference Co-Chair: **Ge Wang**, Rensselaer Polytechnic Institute (USA)

Program Committee: **Felix Beckmann**, Helmholtz-Zentrum Geesthacht (Germany); **Graham R. Davis**, Queen Mary, Univ. of London (United Kingdom); **Francesco De Carlo**, Argonne National Lab. (USA); **Sherry C. Mayo**, Commonwealth Scientific and Industrial Research Organisation (Australia); **Atsushi Momose**, Tohoku Univ. (Japan); **Françoise Peyrin**, CREATIS, CNRS, INSERM, Univ. de Lyon (France); **Mark L. Rivers**, The Univ. of Chicago (USA); **Stuart R. Stock**, Northwestern Univ. (USA)

### TUESDAY 8 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 15A . . TUE 8:30 AM TO 10:15 AM

#### Instrumentation I: Trends in CT

Session Chair: **Stuart Stock**, Northwestern Univ. (USA)

8:30 am: **Recent trends in high-resolution X-ray tomography**, Bert Müller, Univ. Basel (Switzerland) . . . . . [10391-1]

8:50 am: **A comparison study: image-based vs. signal-based retrospective gating on microCT**, Xuan Liu, Phil L. Salmon, Kjell Laperre, Alexander Sasov, Bruker microCT (Belgium) . . . . . [10391-2]

9:10 am: **Improving Material Identification by Combining X-ray and Neutron Tomography**, Jacob M. LaManna, Daniel S. Hussey, Elias M. Baltic, David L. Jacobson, National Institute of Standards and Technology (USA) . . . . . [10391-3]

9:30 am: **Nanoscale holographic tomography based on x-ray waveguide optics**, Tim Salditt, Malte Vassholz, Mareike Toepperwien, Aike Ruhlandt, Markus Osterhoff, Georg-August-Univ. Göttingen (Germany) . . . . . [10391-4]

9:50 am: **High energy near- and far-field ptychographic tomography at the ESRF** (*Invited Paper*), Julio C. da Silva, Alexandra Pacureanu, Leonid Bloch, Yang Yang, Peter Cloetens, ESRF - The European Synchrotron (France) . . . . . [10391-5]

Coffee Break . . . . . Tue 10:15 am to 10:45 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 15A . TUE 10:45 AM TO 12:10 PM

#### Instrumentation II: Alternatives to Attenuation-based Tomography

Session Chair: **Graham R. Davis**, Queen Mary, Univ. of London (United Kingdom)

10:45 am: **Fast and low-dose phase contrast CT with non-microfocal laboratory x-ray sources** (*Invited Paper*), Alessandro Olivo, Paul C. Diemoz, Marco Endrizzi, Charlotte K. Hagen, Fabio A. Vittoria, Alberto Astolfo, Peter R. T. Munro, Peter Modregger, Gibril K. N. Kallon, Dario Basta, Ian Buchanan, Charlotte Maughan Jones, Anna Zamir, Univ. College London (United Kingdom) . . . [10391-6]

11:10 am: **High-Resolution Grating Interferometer for Phase-Contrast Imaging at PETRA III**, Alexander C. Hipp, Helmholtz-Zentrum Geesthacht (Germany); Matthias Vogelgesang, Jürgen Mohr, Andreas Kopmann, Karlsruher Institut für Technologie (Germany); Felix Beckmann, Helmholtz-Zentrum Geesthacht (Germany) . . . . . [10391-7]

11:30 am: **Quantitative phase contrast and x-ray scattering micro-tomography with the 9.2 keV liquid metal jet anode: applications on materials and life science**, Simon A. Zabler, Fraunhofer-Institut für Integrierte Schaltungen (IIS) (Germany); Andreas Balles, Jonas Dittmann, Julius-Maximilians-Univ. Würzburg (Germany); Christian Fella, Rolf Hanke, Fraunhofer-Institut für Integrierte Schaltungen (IIS) (Germany) . . . . . [10391-8]

11:50 am: **Tomography with energy dispersive diffraction**, John S. Okasinski, Russel Woods, Antonino Miceli, Argonne National Lab. (USA); David P. Siddons, Brookhaven National Lab. (USA); Jonathan D. Almer, Argonne National Lab. (USA); Stuart R. Stock, Northwestern Univ. (USA) . . . . . [10391-9]

Lunch Break . . . . . Tue 12:10 pm to 1:40 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 15A . . . TUE 1:40 PM TO 3:05 PM

#### Applications I: Advanced Non-Destructive Characterization

Session Chair: **Atsushi Momose**, Tohoku Univ. (Japan)

1:40 pm: **Microanatomy of the cochlear hook** (*Invited Paper*), Claus-Peter Richter, Changyow Claire Kwan, Xiaodong Tan, Stuart R. Stock, Northwestern Univ. (USA); Carmen Soriano Hoyuelos, Argonne National Lab. (USA) . . . . . [10391-10]

2:05 pm: **Microcomputed tomography and x-ray diffraction of intact archeological human second metacarpal bones as a function of individuals' age at death**, Stuart R. Stock, Northwestern Univ. (USA); J. S. Park, Argonne National Lab. (USA); Malene Laugesen, Aarhus Univ. (Denmark); Simon Mays, Historic England (United Kingdom); Jonathan D. Almer, Argonne National Lab. (USA); Henrik Birkedal, Aarhus Univ. (Denmark); Carmen Soriano Hoyuelos, Argonne National Lab. (USA) . . . . . [10391-11]

2:25 pm: **3D mapping grain morphology and grain orientations by laboratory diffraction contrast tomography**, Christian Holzner, Carl Zeiss X-ray Microscopy, Inc. (USA); Nicolas Gueninichault, Florian Bachmann, Xnovo Technology ApS (Denmark); Hrishikesh Bale, Leah Lavery, Carl Zeiss X-ray Microscopy, Inc. (USA); Erik Lauridsen, Xnovo Technology ApS (Denmark) . . . . . [10391-12]

2:45 pm: **In-situ observation of phase separation of polymer blend using x-ray Talbot-Lau interferometer**, Yanlin Wu, Hidekazu Takano, Atsushi Momose, Tohoku Univ. (Japan) . . . . . [10391-13]

Coffee Break . . . . . Tue 3:05 pm to 3:35 pm

#### SESSION 4

LOCATION: CONV. CTR. ROOM 15A . . . TUE 3:35 PM TO 5:25 PM

#### Algorithms I: Computational Tools

Session Chair: **Ge Wang**, Rensselaer Polytechnic Institute (USA)

3:35 pm: **Numerical study on simultaneous emission and transmission tomography in the MRI framework**, Lars Gjestebj, Wenxiang Cong, Ge Wang, Rensselaer Polytechnic Institute (USA) . . . . . [10391-14]

3:55 pm: **A spectral CT reconstruction algorithm based on weighted block matching 3D filtering**, Morteza Salehjehromi, Yanbo Zhang, Hengyong Yu, Univ. of Massachusetts Lowell (USA) . . . . . [10391-15]

4:15 pm: **Applications of compressed sensing image reconstruction to sparse-view phase tomography**, Ryosuke Ueda, Hiroyuki Kudo, Jian Dong, Univ. of Tsukuba (Japan) . . . . . [10391-16]

4:35 pm: **Deep learning for low-dose CT** (*Invited Paper*), Hu Chen, Yi Zhang, Jiliu Zhou, Sichuan Univ. (China); Ge Wang, Rensselaer Polytechnic Institute (USA) . . . . . [10391-17]

5:00 pm: **Machine learning for micro-tomography** (*Invited Paper*), Dilworth Y. Parkinson, Daniela M. Ushizima, Daniel Pelt, Talita Perciano, Harinarayan Krishnan, Holden Parks, Alexander Hexemer, Harold S. Barnard, Alastair A. MacDowell, Lawrence Berkeley National Lab. (USA); James A. Sethian, Univ. of California, Berkeley (USA) . . . . . [10391-18]

**LOCATION: MARRIOTT MARQUIS,  
BALBOA ..... 8:00 PM TO 10:00 PM**

## Penetrating Radiation Technical Event

Chair: **James E. Bacia**, Univ. of Florida (USA)

This event brings together technologists and scientists with interests in neutron, x- and gamma-ray detection, spectroscopy, and imaging for all applications. This year's featured speaker is Dr. Rachel Slaybaugh from University of California, Berkeley. She will be giving a talk on "Advanced Solvers and Innovation for Penetrating Radiation." Dr. Slaybaugh will cover the need innovation in the nuclear space to enable new (and maintain existing) reactors, enhance nuclear security, and improve nuclear science. To truly enable breakthroughs by investigating new ideas rapidly, we need accurate simulation and appropriate research tools. This requires new methods in computational neutron transport, better simulation and better tools for penetrating radiation detection and measurement. Finally, this talk will briefly cover educational initiatives bringing an innovative mindset into the nuclear field. After the featured speaker the floor will be open to discussions.

## WEDNESDAY 9 AUGUST

### SESSION 5

**LOCATION: CONV. CTR. ROOM 15A WED 8:30 AM TO 10:20 AM**

## Applications II: Structural Analysis

Session Chair: **Xuan Liu**, Bruker microCT (Belgium)

8:30 am: **Imaging human brain tissue using tomography with conventional and synchrotron x-ray sources** (*Invited Paper*), Anna Khimchenko, Georg Schulz, Christos Bikis, Simone E. Hieber, Marzia Buscema, Hans Deyhle, Univ. Basel (Switzerland); Gabriel Schweighauser, Jürgen Hench, Univ. Hospital Basel (Switzerland); Alexandra Pacureanu, ESRF - The European Synchrotron (France); Peter Thalmann, Natalia Chicherova, Bert Müller, Univ. Basel (Switzerland) ..... [10391-19]

8:55 am: **Assessment of imaging quality in magnified phase CT of human bone tissue at the nanoscale**, Boliang Yu, Max Langer, Institut National des Sciences Appliquées de Lyon (France); Alexandra Pacureanu, ESRF - The European Synchrotron (France); Remy Gauthier, Institut Français des Sciences et Technologies des Transports de l'aménagement et des Réseaux (France); Cécile Olivier, ESRF - The European Synchrotron (France); Helene Follet, Institut National de la Santé et de la Recherche Médicale (France); David Mitton, Institut Français des Sciences et Technologies des Transports de l'aménagement et des Réseaux (France); Peter Cloetens, ESRF - The European Synchrotron (France); Françoise Peyrin, Institut National des Sciences Appliquées de Lyon (France) and ESRF - The European Synchrotron (France) ..... [10391-20]

9:15 am: **Micro-CT in situ study of carbonate rock porosity for CO<sub>2</sub> storage**, Yi Zheng, Technical Univ. of Denmark (Denmark); Melania Rogowska, Yi Yang, Univ. of Copenhagen (Denmark); Carsten Gundlach, Technical Univ. of Denmark (Denmark) ..... [10391-21]

9:35 am: **Establishment of metrological traceability in porosity measurements by x-ray computed tomography**, Petr Hermanek, Simone Carmignato, Univ. degli Studi di Padova (Italy) ..... [10391-22]

9:55 am: **Biodegradable magnesium-based implants in bone studied by synchrotron-radiation microtomography** (*Invited Paper*), Julian Moosmann, Jörg U. Hammel, Felix Beckmann, Diana Krüger, Helmholtz-Zentrum Geesthacht (Germany); Silvia Galli, Malmö Univ. (Sweden); Regine Willumeit-Römer, Florian Wieland, Berit Zeller-Plumhoff, Helmholtz-Zentrum Geesthacht (Germany); Martin Bech, Niccolò Peruzzi, Lund Univ. (Sweden) ..... [10391-23]

Coffee Break ..... Wed 10:20 am to 10:50 am

### SESSION 6

**LOCATION: CONV. CTR. ROOM 15A WED 10:50 AM TO 12:35 PM**

## Instrumentation III: Synchrotron Radiation-based Tomography

Session Chair: **Felix Beckmann**, Helmholtz-Zentrum Geesthacht (Germany)

10:50 am: **The NOVA project: maximizing beamtime efficiency through synergistic analyses of SRμCT data** (*Invited Paper*), Sebastian Schmelzle, Technische Univ. Darmstadt (Germany); Vincent Heuveline, Ruprecht-Karls- Univ. Heidelberg (Germany); Jürgen Becker, Karlsruher Institut für Technologie (Germany); Michael Heethoff, Technische Univ. Darmstadt (Germany); Thomas van de Kamp, Karlsruher Institut für Technologie (Germany) ..... [10391-24]

11:15 am: **Detector response artefacts in spectral reconstruction**, Ulrik L. Olsen, Jan Kehres, Yun Gu, Technical Univ. of Denmark (Denmark); Erik D. Christensen, Univ. of Copenhagen (Denmark); Mohamad Khalil, Technical Univ. of Denmark (Denmark) ..... [10391-25]

11:35 am: **Simulated data for synchrotron radiation based microtomography at the imaging beamline P05/PETRA III**, Felix Beckmann, Helmholtz-Zentrum Geesthacht (Germany) ..... [10391-26]

11:55 am: **Comparison of data processing techniques for single-grating x-ray Talbot interferometer data**, Shashidhara Marathe, Diamond Light Source Ltd. (United Kingdom); Marie-Christine Zdora, Diamond Light Source Ltd. (United Kingdom) and Univ. College London (United Kingdom); Irene Zanette, Silvia Cippiccia, Christoph Rau, Diamond Light Source Ltd. (United Kingdom) ..... [10391-27]

12:15 pm: **Micro- and nano-tomography at the DIAMOND beamline I13L imaging and coherence**, Christoph Rau, Andrew J. Bodey, Malte Ogurreck, Shashidhara Marathe, Silvia Cippiccia, Marie-Christine Zdora, Irene Zanette, Ulrich H. Wagner, Xiaowen Shi, Darren Batey, Diamond Light Source Ltd. (United Kingdom) ..... [10391-28]

Lunch/Exhibition Break ..... Wed 12:35 pm to 2:00 pm

### SESSION 7

**LOCATION: CONV. CTR. ROOM 15A . WED 2:00 PM TO 3:30 PM**

## Algorithms II: Fast Reconstruction

Session Chair: **Francesco De Carlo**, Argonne National Lab. (USA)

2:00 pm: **Design of 4D x-ray tomography experiments based on reconstruction analysis** (*Invited Paper*), K. Aditya Mohan, Lawrence Livermore National Lab. (USA) ..... [10391-29]

2:25 pm: **Reduction of metal artifacts in x-ray CT images using fully convolutional networks**, Yanbo Zhang, Ying Chu, Hengyong Yu, Univ. of Massachusetts Lowell (USA) ..... [10391-30]

2:45 pm: **Deep learning methods for CT image-domain metal artifact reduction**, Lars Gjestebj, Qingsong Yang, Rensselaer Polytechnic Institute (USA); Yan Xi, Shanghai Jiao Tong Univ. (USA); Bernhard E. H. Claus, Yannan Jin, Bruno De Man, GE Global Research (USA); Ge Wang, Rensselaer Polytechnic Institute (USA) ..... [10391-31]

3:05 pm: **Sliding ordered-subset algorithm for real-time x-ray tomography** (*Invited Paper*), Doga Gürsoy, Tekin Bicer, Daniel Ching, Vincent De Andrade, Argonne National Lab. (USA) ..... [10391-32]

Coffee Break ..... Wed 3:30 pm to 4:00 pm

### SESSION 8

**LOCATION: CONV. CTR. ROOM 15A . WED 4:00 PM TO 5:35 PM**

## Instrumentation IV: Data Acquisition

Session Chair: **Christian Holzner**, Carl Zeiss X-ray Microscopy, Inc. (USA)

4:00 pm: **Recent Advance in grating-based x-ray phase tomography** (*Invited Paper*), Atsushi Momose, Tohoku Univ. (Japan) and Japan Science and Technology Agency (Japan) and Japan Synchrotron Radiation Research Institute (JASRI) (Japan); Hidekazu Takano, Tohoku Univ. (Japan) and Japan Science and Technology Agency (Japan); Yanlin Wu, Tohoku Univ. (Japan) and Japan Synchrotron Radiation Research Institute (JASRI) (Japan); Masato Hoshino, Japan Synchrotron Radiation Research Institute (JASRI) (Japan) and Japan Science and Technology Agency (Japan) ..... [10391-33]

4:25 pm: **Thomson scattering x-ray source: a novel tool for x-ray imaging** (*Invited Paper*), Yingchao Du, Zhijun Chi, Chuanxiang Tang, Wenhui Huang, Lixin Yan, Zhen Zhang, Tsinghua Univ. (China) ..... [10391-34]

4:50 pm: **High spatial resolution x-ray phase tomography based on laboratory source**, Hidekazu Takano, Yanlin Wu, Atsushi Momose, Tohoku Univ. (Japan) ..... [10391-35]

5:10 pm: **Seeing inhomogeneous buried layers and interfaces: image reconstruction from x-ray reflection projections** (*Invited Paper*), Jinxing Jiang, Univ. of Tsukuba (Japan) and National Institute for Materials Science (Japan); Keiichi Hirano, High Energy Accelerator Research Organization, KEK (Japan); Kenji Sakurai, National Institute for Materials Science (Japan) and Univ. of Tsukuba (Japan) ..... [10391-36]



# CONFERENCE 10391

LOCATION: CONV. CTR.  
EXHIBIT HALL B2 ..... WED 5:30 PM TO 7:30 PM

## Posters-Wednesday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPPosterGuidelines>.

**Development of high-energy micro-tomography system at SPring-8**, Kentaro Uesugi, Masato Hoshino, Japan Synchrotron Radiation Research Institute (JASRI) (Japan) ..... [10391-47]

**Spectral CT material decomposition in the presence of poisson noise: a KL approach**, Tom Hohweiller, Nicolas Ducros, CREATIS (France); Françoise Peyrin, CREATIS (France) and ESRF - The European Synchrotron (France); Bruno Sixou, CREATIS (France) ..... [10391-48]

**Evaluating the precision of intraoral scans by means of micro-computed tomography measurements and three-dimensional rigid registration**, Christoph Vögtlin, Georg Schulz, Kurt Jäger, Univ. Basel (Switzerland); Dieter Müssig, Danube Private Univ. (DPU) (Austria); Bert Müller, Univ. Basel (Switzerland) . . . . [10391-49]

**Characterization of a spectroscopic detector for application in x-ray computed tomography**, Alex A. Dooraghi, Brian J. Fix, Jerel A. Smith, William D. Brown, Stephen G. Azevedo, Harry E. Martz, Lawrence Livermore National Lab. (USA) ..... [10391-50]

**Integrated high-throughput tomography experiment control environment**, Igor Khokhriakov, Felix Beckmann, Lars Lottermoser, Helmholtz-Zentrum Geesthacht (Germany) ..... [10391-51]

**Innervation of the cow's inner ear derived from micro-computed tomography data**, Loic Costeur, Bastien Mennecart, Naturhistorisches Museum Basel (Switzerland); Anna Khimchenko, Bert Müller, Georg Schulz, Univ. Basel (Switzerland) ..... [10391-52]

## THURSDAY 10 AUGUST

### SESSION 9

LOCATION: CONV. CTR. ROOM 15A . THU 8:30 AM TO 10:20 AM

## Algorithms III: Image Quality

Session Chair: **Mark L. Rivers**, The Univ. of Chicago (USA)

8:30 am: **Sparse reconstruction methods in x-ray CT** (*Invited Paper*), Juan Felipe Perez Juste Abascal, Univ. de Lyon (France) and Univ. Jean Monnet Saint-Etienne (France) and CREATIS (France); Monica Abella, Univ. Carlos III de Madrid (Spain) and Instituto de Investigación Sanitaria Gregorio Marañón (Spain); Cyril Mory, Univ. de Lyon (France) and Univ. Jean Monnet Saint-Etienne (France) and CREATIS (France); Claudia de Molina, Univ. Carlos III de Madrid (Spain) and Instituto de Investigación Sanitaria Gregorio Marañón (Spain); Nicolas Ducros, Institut National des Sciences Appliquées de Lyon (France) and Univ. de Lyon (France) and Univ. Jean Monnet Saint-Etienne (France); Eugenio Marinetto, Univ. Carlos III de Madrid (Spain) and Instituto de Investigación Sanitaria Gregorio Marañón (Spain); Françoise Peyrin, CREATIS (France) and Univ. de Lyon (France) and Univ. Jean Monnet Saint-Etienne (France); Manuel Desco, Univ. Carlos III de Madrid (Spain) and Instituto de Investigación Sanitaria Gregorio Marañón (Spain) and Ctr. de Investigación en Red de Salud Mental (Spain) ..... [10391-37]

8:55 am: **Spectral CT data reduction for material classification**, Mina Kheirabadi, Wail Mustafa, Technical Univ. of Denmark (Denmark); Mark Lyksborg, Fingerprint Cards (Denmark); Ulrik Lund Olsen, Anders Bjorholm Dahl, Technical Univ. of Denmark (Denmark) ..... [10391-38]

9:15 am: **Removing ring artifacts from synchrotron radiation-based hard x-ray tomography data**, Peter Thalmann, Christos Bikis, Georg Schulz, Univ. Basel (Switzerland); Pierre Paleo, Alessandro Mirone, Alexander Rack, ESRF - The European Synchrotron (France); Bert Müller, Univ. Basel (Switzerland) . . [10391-39]

9:35 am: **Comparison of different phase retrieval algorithms**, Rolf Kaufmann, Mathieu Plamondon, Jürgen Hofmann, EMPA (Switzerland) . . . . . [10391-40]

9:55 am: **Nonlinear problems in fast tomography** (*Invited Paper*), William Lionheart, The Univ. of Manchester (United Kingdom) ..... [10391-41]

Coffee Break ..... Thu 10:20 am to 10:50 am

### SESSION 10

LOCATION: CONV. CTR. ROOM 15A . THU 10:50 AM TO 12:35 PM

## Applications III: Non-Destructive Evaluation of Fascinating Objects

Session Chair: **Bert Müller**, Univ. Basel (Switzerland)

10:50 am: **Grating-based tomography applications in biomedical engineering** (*Invited Paper*), Georg Schulz, Univ. Basel (Switzerland) ..... [10391-42]

11:15 am: **Displaying of the human tooth cementum ultrastructure of archeological teeth by non-invasive and high-resolution imaging techniques to determine age-at-death and stress periods**, Gabriela Mani-Caplazi, Georg Schulz, Gerhard Hotz, Univ. Basel (Switzerland); Ursula Wittwer-Backofen, Univ. of Freiburg (Germany); Bert Müller, Univ. Basel (Switzerland) ..... [10391-43]

11:35 am: **High-contrast x-ray microtomography in dental research**, Graham R. Davis, David Mills, Queen Mary, Univ. of London (United Kingdom) . . . . [10391-44]

11:55 am: **The inside view of 3D photonic nanostructures**, Diana A. Grishina, Univ. Twente (Netherlands); Peter Cloetens, ESRF - The European Synchrotron (France); Cornelis A. M. Hartevelde, Univ. Twente (Netherlands); Alexandra Pacureanu, ESRF - The European Synchrotron (France); Pepijn W. H. Pinkse, Ad Lagendijk, Willem L. Vos, Univ. Twente (Netherlands) ..... [10391-45]

12:15 pm: **Recovery of text from locked 17th-century letters**, David Mills, Graham R. Davis, Queen Mary, Univ. of London (United Kingdom) . . . . [10391-46]

# CONFERENCE 10392

LOCATION: CONV. CTR. ROOM 14A

Monday–Wednesday 7–9 August 2017 • Proceedings of SPIE Vol. 10392

## Hard X-Ray, Gamma-Ray, and Neutron Detector Physics XIX

Conference Chairs: **Arnold Burger**, Fisk Univ. (USA); **Ralph B. James**, Savannah River National Lab. (USA); **Michael Fiederle**, Freiburger Materialforschungszentrum (Germany); **Larry Franks**, Consultant (USA)

Conference Co-Chair: **Stephen A. Payne**, Lawrence Livermore National Lab. (USA)

Program Committee: **Toru Aoki**, Shizuoka Univ. (Japan); **Jim E. Bacia Jr.**, Univ. of Florida (USA); **David B. Beach**, Y-12 National Security Complex (USA); **Zane W. Bell**, Oak Ridge National Lab. (USA); **Koushik Biswas**, Arkansas State Univ. (USA); **Lynn A. Boatner**, Oak Ridge National Lab. (USA); **Aleksey E. Bolotnikov**, Brookhaven National Lab. (USA); **Edith Bourret Courchesne**, Lawrence Berkeley National Lab. (USA); **Mary Ellen Braunreuther**, Brookhaven National Lab. (USA); **Giuseppe S. Camarda**, Brookhaven National Lab. (USA); **Bill Cardoso**, Creative Electron (USA); **Henry Chen**, Brimrose Corp. of America (USA); **Nerine J. Cherepy**, Lawrence Livermore National Lab. (USA); **Jeffrey J. Derby**, Univ. of Minnesota (USA); **Kim F. Ferris**, Pacific Northwest National Lab. (USA); **Petro M. Fochuk**, Yuriy Fedkovych Chernivtsi National Univ. (Ukraine); **Jan Franc**, Charles Univ. in Prague (Czech Republic); **Fei Gao**, Pacific Northwest National Lab. (USA); **Zhong He**, Univ. of Michigan (USA); **Keitaro Hitomi**, Tohoku Univ. (Japan); **Alan Janos**, U.S. Dept. of Homeland Security (USA); **Mercouri Kanatzidis**, Northwestern Univ. (USA); **KiHyun Kim**, Korea Univ. College of Health Sciences (Korea, Republic of); **Henric Krawczynski**, Washington Univ. in St. Louis (USA); **Kelvin G. Lynn**, Washington State Univ. (USA); **Krishna C. Mandal**, Univ. of South Carolina (USA); **Robert D. McLaren**, Consultant (USA); **Shariq Motakef**, CapeSym, Inc. (USA); **Sanjoy Mukhopadhyay**, National Security Technologies, LLC (USA); **Madan Niraula**, Nagoya Institute of Technology (Japan); **Utpal N. Roy**, Brookhaven National Lab. (USA); **Michael R. Squillante**, Radiation Monitoring Devices, Inc. (USA); **Ashley C. Stowe**, Y-12 National Security Complex (USA); **Csaba Szeles**, Nious Technologies Inc. (USA); **Sergey E. Uljin**, National Research Nuclear Univ. MEPhI (Russian Federation); **Edgar V. van Loef**, Radiation Monitoring Devices, Inc. (USA); **Aaron L. Washington II**, Savannah River National Lab. (USA); **Richard T. Williams**, Wake Forest Univ. (USA); **Kan Yang**, Saint-Gobain Crystals (USA)

### SUNDAY 6 AUGUST

LOCATION: CONV. CTR. ROOM 6A . . SUN 6:00 PM TO 7:50 PM

#### Technology Hot Topics: How Optics and Photonics Drive Innovation

6:00 pm to 6:10 pm: **Welcome and Opening Remarks**

6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)

6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)

6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)

7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)

7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)

### MONDAY 7 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 14A . MON 8:30 AM TO 10:10 AM

#### Scintillators I

Session Chair: **Stephen A. Payne**, Lawrence Livermore National Lab. (USA)

8:30 am: **History and current status of strontium iodide scintillators** (*Invited Paper*), Nerine J. Cherepy, Patrick R. Beck, Stephen A. Payne, Erik L. Swanberg, Peter A. Thelin, Scott E. Fisher, Steven L. Hunter, Brian Wihl, Lawrence Livermore National Lab. (USA); Arnold Burger, Fisk Univ. (USA); Kanai S. Shah, Rastgo Hawrami, Radiation Monitoring Devices, Inc. (USA); Lynn A. Boatner, Oak Ridge National Lab. (USA); Michael Momayezi, Bridgeport Instruments, LLC (USA); Kevin T. Stevens, Mark H. Randles, Denys Solodovnikov, Northrop Grumman SYNOPTICS (USA) . . . . . [10392-1]

9:00 am: **Organic spectroscopic scintillators based on nanoparticles** (*Invited Paper*), Qibing Pei, Univ. of California, Los Angeles (USA) . . . . . [10392-2]

9:30 am: **Plastic scintillator enhancement through QD**, Alan Tam, Mikael Nilsson, Univ. of California, Irvine (USA) . . . . . [10392-3]

9:50 am: **Design and development of position sensitive detector for hard x-ray using SiPM and new-generation scintillators**, Shiv Kumar Goyal, Physical Research Lab. (India); Amisha P. Naik, Nirma Univ. (India); Santosh Vadawale, Mithun N. P. S., Neeraj K. Tiwari, Physical Research Lab. (India); Tanmoy Chattopadhyay, The Pennsylvania State Univ. (USA) . . . . . [10392-4]

Coffee Break . . . . . Mon 10:10 am to 10:40 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 14A MON 10:40 AM TO 11:50 AM

#### CZT I

Session Chair: **Ralph B. James**, Savannah River National Lab. (USA)

10:40 am: **Implementation of accelerated crucible rotation (ACRT) in vertical Bridgman growth of CdZnTe** (*Invited Paper*), Kelvin G. Lynn, Washington State Univ. (USA); Jeffrey J. Derby, Univ. of Minnesota (USA); Jedidiah J. McCoy, Saketh Kakkireni, Santosh K. Swain, Washington State Univ. (USA); Mia S. Divecha, Univ. of Minnesota (USA) . . . . . [10392-5]

11:10 am: **Spatial calibration of the CdZnTe hard x-ray detectors for textit(NuSTAR)**, Brian W. Grefenstette, California Institute of Technology (USA); Varun Bhalerao, Indian Institute of Technology Bombay (India); Fiona A. Harrison, Kristin K Madsen, Hiromasa Miyasaka, Peter Mao, Vikram R. Rana, California Institute of Technology (USA) . . . . . [10392-6]

11:30 am: **Electronic and thermodynamic properties of CdZnTeSe alloys from first-principles calculations: candidate room temperature radiation detector materials**, Joel B. Varley, Vincenzo Lordi, Lawrence Livermore National Lab. (USA); Utpal N. Roy, Brookhaven National Lab. (USA); Ralph B. James, Savannah River National Lab. (USA) . . . . . [10392-7]

Lunch Break . . . . . Mon 11:50 am to 1:20 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 14A . . MON 1:20 PM TO 3:00 PM

#### Detector Devices

Session Chair: **Larry Franks**, Consultant (USA)

1:20 pm: **Towards the development of a SiPM-based module for the camera of the Schwarzschild-Couder Telescope prototype of the Cherenkov Telescope Array**, Giovanni Ambrosi, Michelangelo Ambrosio, Carla Aramo, Istituto Nazionale di Fisica Nucleare (Italy); Elisabetta Bissaldi, Politecnico di Bari (Italy) and Istituto Nazionale di Fisica Nucleare (Italy); Alfonso Boiano, Carmela Bonavolontà, Istituto Nazionale di Fisica Nucleare (Italy); Leonardo Di Venere, Univ. degli Studi di Bari Aldo Moro (Italy) and Istituto Nazionale di Fisica Nucleare (Italy); Emanuele Fiandrini, Univ. degli Studi di Perugia (Italy) and Istituto Nazionale di Fisica Nucleare (Italy); Nicola Giglietto, Politecnico di Bari (Italy) and Istituto Nazionale di Fisica Nucleare (Italy); Francesco Giordano, Univ. degli Studi di Bari Aldo Moro (Italy) and Istituto Nazionale di Fisica Nucleare (Italy); Maria Ionica, Univ. degli Studi di Perugia (Italy); Francesco Licciulli, Istituto Nazionale di Fisica Nucleare (Italy); Serena Loporchio, Univ. degli Studi di Bari Aldo Moro (Italy); Vincenzo Masone, Istituto Nazionale di Fisica Nucleare (Italy); Riccardo Paoletti, Univ. degli Studi di Siena (Italy) and Istituto Nazionale di Fisica Nucleare (Italy); Vasile Postolache, Istituto Nazionale di Fisica Nucleare (Italy); Andrea Rugliancich, Univ. degli Studi di Siena (Italy) and Istituto Nazionale di Fisica Nucleare (Italy); Daniela Simone, Istituto Nazionale di Fisica Nucleare (Italy); Valerio Vagelli, Univ. degli Studi di Perugia (Italy) and Istituto Nazionale di Fisica Nucleare (Italy); Massimo Valentino, Consiglio Nazionale delle Ricerche (Italy) and Istituto Nazionale di Fisica Nucleare (Italy) . . . . . [10392-8]

# CONFERENCE 10392

1:40 pm: **Anti-coincidence scintillation detector for the device "signal" of the spacecraft Interheliozond**, Sergey E. Ulin, Alexander S. Novikov, Alexander E. Shustov, Valery V. Dmitrenko, Ziyaetdin M. Uteshev, Konstantin F. Vlasik, National Research Nuclear Univ. MEPhI (Russian Federation) . . . . . [10392-9]

2:00 pm: **Analysis of the energy gamma-spectrum measured by xenon gamma-spectrometer**, Alexander S. Novikov, Sergey E. Ulin, Irina V. Chernysheva, Valery V. Dmitrenko, Konstantin F. Vlasik, Ziyaetdin M. Uteshev, Alexander E. Shustov, National Research Nuclear Univ. MEPhI (Russian Federation) . . . . . [10392-10]

2:20 pm: **High-performance neutron spectrometer for planetary hydrogen**, Masayuki Naito, Nobuyuki Hasebe, Hiroshi Nagaoka, Junya Ishii, Daisuke Aoki, Waseda Univ. (Japan); Kyeong J. Kim, Korea Institute of Geoscience & Mineral Resources (Korea, Republic of); José A. Matias Lopes, Univ. de Coimbra (Portugal); Jesús Martínez-Frías, Univ. Complutense de Madrid (Spain) . . . . . [10392-11]

2:40 pm: **A pixelated x-ray detector for diffraction imaging at next-generation high-rate FEL sources**, Luca Lodola, Istituto Nazionale di Fisica Nucleare (Italy) and Univ. degli Studi di Pavia (Italy); Daniele Comotti, Lorenzo Fabris, Univ. degli Studi di Bergamo (Italy); Marco Grassi, Univ. degli Studi di Pavia (Italy); Lodovico Ratti, Piero Malcovati, Univ. degli Studi di Pavia (Italy) and Istituto Nazionale di Fisica Nucleare (Italy); Massimo Manghisoni, Valerio Re, Gianluca Traversi, Univ. degli Studi di Bergamo (Italy); Carla Vacchi, Univ. degli Studi di Pavia (Italy); Giovanni Batignani, Stefano Bettarini, Francesco Forti, Istituto Nazionale di Fisica Nucleare (Italy) and Univ. di Pisa (Italy); Fabio Morsani, Istituto Nazionale di Fisica Nucleare (Italy); Antonio Paladino, Eugenio Paoloni, Giuliana Rizzo, Istituto Nazionale di Fisica Nucleare (Italy) and Univ. di Pisa (Italy); Gian-Franco Dalla Betta, Roberto Mendicino, Lucio Pancheri, Univ. degli Studi di Trento (Italy) and Trento Institute for Fundamental Physics and Applications (Italy); Giovanni Verzellesi, Univ. degli Studi di Modena e Reggio Emilia (Italy) and Trento Institute for Fundamental Physics and Applications (Italy); Hesong Xu, Univ. degli Studi di Trento (Italy) and Trento Institute for Fundamental Physics and Applications (Italy) . . . . . [10392-12]

Coffee Break . . . . . Mon 3:00 pm to 3:30 pm

## SESSION 4

LOCATION: CONV. CTR. ROOM 14A . . MON 3:30 PM TO 5:10 PM

### Scintillators II

Session Chair: **Arnold Burger**, Fisk Univ. (USA)

3:30 pm: **Plastic scintillators for gamma spectroscopy and neutron radiography** (*Invited Paper*), H. Paul Martinez, Nerine J. Cherepy, Robert D. Sanner, Patrick R. Beck, Stephen A. Payne, Lawrence Livermore National Lab. (USA); Charles R. Hurlbut, Eljen Technology (USA) . . . . . [10392-13]

4:00 pm: **Directional gamma detection from the occlusion method and singular value decomposition** (*Invited Paper*), Rusty P. Trainham, National Security Technologies, LLC (USA) . . . . . [10392-14]

4:30 pm: **Applications of very fast inorganic crystal scintillators for future HEP experiments**, Ren-Yuan Zhu, California Institute of Technology (USA) . . [10392-15]

4:50 pm: **Development of the LunaH-Map miniature neutron spectrometer**, Erik B. Johnson, Radiation Monitoring Devices, Inc. (USA); Craig Hardgrove, The Univ. of Arizona (USA); Samuel Vogel, Rebecca Frank, Graham Stoddard, James F. Christian, Radiation Monitoring Devices, Inc. (USA) . . . . . [10392-16]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 . . . . . MON 5:30 PM TO 7:30 PM

### Posters-Monday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Effects of post-growth annealing on the properties of Cd<sub>1-x</sub>Mn<sub>x</sub>Te crystals**, Serhii Solodin, Petro Fochuk, Yuriy Fedkovych Chernivtsi National Univ. (Ukraine); Yevgen Nykonyuk, National Univ. of Water Management and Nature Resources Use (Ukraine); Zinaida Zakharuk, Serhii Dremlyuzhenko, Yuriy Fedkovych Chernivtsi National Univ. (Ukraine); Aleksey E. Bolotnikov, Brookhaven National Lab. (USA); Ralph B. James, Savannah River National Lab. (USA) . . . . . [10392-38]

**Vertical Bridgman growth and characterization of Cd<sub>0.95-x</sub>Mn<sub>x</sub>Zn<sub>0.05</sub>Te (x=0.20, 0.30) single-crystal ingots**, Vasylyna Kopach, Oleh Kopach, Larysa Shcherbak, Petro Fochuk, Yuriy Fedkovych Chernivtsi National Univ. (Ukraine); Aleksey E. Bolotnikov, Brookhaven National Lab. (USA); Ralph B. James, Savannah River National Lab. (USA) . . . . . [10392-39]

**Improved pyroelectric x-ray generator for planetary active x-ray spectrometer**, Masayuki Naito, Nobuyuki Hasebe, Hiroshi Nagaoka, Yusuke Oshima, Miho Mizuno, Eido Shibamura, Haruyoshi Kuno, Waseda Univ. (Japan); Kyeong J. Kim, Korea Institute of Geoscience & Mineral Resources (Korea, Republic of); José A. Matias Lopes, Univ. de Coimbra (Portugal); Jesús Martínez-Frías, Univ. Complutense de Madrid (Spain) . . . . . [10392-40]

**Improved materials process for two promising semiconductors Rb<sub>3</sub>Bi<sub>2</sub>Br<sub>9</sub> and Cs<sub>3</sub>Bi<sub>2</sub>Br<sub>9</sub> for room-temperature gamma-ray detector applications**, Duck Young Chung, Fang Meng, Mercouri G. Kanatzidis, Argonne National Lab. (USA) . . . . . [10392-41]

**Effect of cathode energy spectrum on the depth of interaction correction and anode signal recovery in CZT detectors**, Mohan Li, Shiva Abbaszadeh, Univ. of Illinois at Urbana-Champaign (USA) . . . . . [10392-42]

**Silicon grid collimator for CsI:TI scintillator**, Toru Aoki, Kento Tabata, Shizuoka Univ. (Japan); Akifumi Koike, ANSeeN Inc. (Japan); Hidenori Mimura, Junichi Nishizawa, Shizuoka Univ. (Japan) . . . . . [10392-43]

**Characterization of CdTe x-ray detector with modulative depletion layer**, Tsuyoshi Terao, Shizuoka Univ. (Japan); Akifumi Koike, ANSeeN Inc. (Japan); Katsuyuki Takagi, Toru Aoki, Shizuoka Univ. (Japan) . . . . . [10392-44]

**The development of a low-cost CsI(Tl)-SiPM detector for radiation monitoring by members of the public**, Steven J. Bell, National Physical Lab. (United Kingdom); Craig Duff, Kromek (United Kingdom) . . . . . [10392-45]

**Doping and metallization of the CdTe crystal surface by laser irradiation of the metal substrate through the semiconductor**, Volodymyr A. Gnatyuk, V.E. Lashkaryov Institute of Semiconductor Physics (Ukraine); Kateryna Zelenska, Taras Shevchenko National Univ. of Kyiv (Ukraine); Toru Aoki, Shizuoka Univ. (Japan) . . . . . [10392-46]

**Challenges in the quantitative optical detection of radiation**, Sean Fournier, Jeffrey B. Martin, Richard Harrison, Dora K. Wiemann, Sandia National Labs. (USA) . . . . . [10392-47]

**Characterization of Yb-doped silica optical fibre as real-time dosimeter**, Ivan Veronese, Univ. degli Studi di Milano (Italy); Norberto Chiodini, Univ. degli Studi di Milano-Bicocca (Italy); Simone Cialdi, Edoardo D'ippolito, Univ. degli Studi di Milano (Italy); Mauro Fasoli, Univ. degli Studi di Milano-Bicocca (Italy); Salvatore Gallo, Univ. degli Studi di Milano (Italy); Eleonora Mones, Azienda Ospedaliera Maggiore della Carità (Italy); Anna Vedda, Univ. degli Studi di Milano-Bicocca (Italy); Gianfranco Loi, Azienda Ospedaliera Maggiore della Carità (Italy) . . . . . [10392-48]

## TUESDAY 8 AUGUST

### SESSION 5

LOCATION: CONV. CTR. ROOM 14A . TUE 8:30 AM TO 10:20 AM

### Semiconductor Detector Materials

Session Chair: **Krishna C. Mandal**, Univ. of South Carolina (USA)

8:30 am: **First report on printed contacts for CdZnTe detectors**. (*Invited Paper*), Arie Ruzin, Artem Brovko, Sergey Marunko, Tel Aviv Univ. (Israel) . . . . . [10392-17]

9:00 am: **Perovskite CsPbBr<sub>3</sub> single crystals with improved physical properties for gamma-ray detector** (*Invited Paper*), Duck Young Chung, Fang Meng, Argonne National Lab. (USA); Christos Malliakas, Northwestern Univ. (USA); Gregory A. Bizarri, Tetiana Shalapska, Edith D. Bourret-Courchesne, Lawrence Berkeley National Lab. (USA); Mercouri G. Kanatzidis, Northwestern Univ. (USA); Anton S. Tremsin, Space Sciences Lab. (USA) . . . . . [10392-18]

9:30 am: **Highly stable thallium bromide devices for long-term room temperature field applications** (*Invited Paper*), Amlan Datta, John Fiala, Piotr Becla, Shariar Motakef, CapeSym, Inc. (USA) . . . . . [10392-19]

10:00 am: **High-efficiency and high-sensitivity thermal neutron detectors based on hexagonal BN epilayers**, Avisk Maity, Sam Grenadier, Jing Li, Jingyu Lin, Hongxing Jiang, Texas Tech Univ. (USA) . . . . . [10392-20]

Coffee Break . . . . . Tue 10:20 am to 10:50 am

### SESSION 6

LOCATION: CONV. CTR. ROOM 14A . TUE 10:50 AM TO 12:10 PM

### Neutron Detectors

Session Chair: **Nerine J. Cherepy**, Lawrence Livermore National Lab. (USA)

10:50 am: **Neutron detector development for microsattellites** (*Invited Paper*), Julia G. Bodnarik, Dave Hamara, The Univ. of Arizona (USA); Arnold Burger, Fisk Univ. (USA) and Vanderbilt Univ. (USA); Vladimir Buliga, Joanna C. Egner, Michael Groza, Fisk Univ. (USA); Walter M. Harris, The Univ. of Arizona (USA); Liviu Matei, Fisk Univ. (USA); Thomas H. Prettyman, Planetary Science Institute (USA); Keivan G. Stassun, Vanderbilt Univ. (USA) and Fisk Univ. (USA); Ashley C. Stowe, Y-12 National Security Complex (USA) . . . . . [10392-21]

11:20 am: **Lithium indium diselenide pressed ceramics** (*Invited Paper*), Ashley C. Stowe, Jeff Preston, Y-12 National Security Complex (USA); Joseph Bell, Vanderbilt Univ. (USA); Arnold Burger, Fisk Univ. (USA) . . . . . [10392-22]



11:50 am: **Cs<sub>2</sub>LiCeCl<sub>6</sub>: An intrinsic scintillator for dual gamma and neutron detector applications**, Utpal N. Roy, Giuseppe S. Camarda, Yonggang Cui, Rubi Gul, Brookhaven National Lab. (USA); Anwar Hossain, Brookhaven National Lab (USA); Ge Yang, Brookhaven National Lab. (USA); Ralph B. James, Savannah River National Lab. (USA); Steven L. Hunter, Patrick R. Beck, Nerine J. Cherepy, Stephen A. Payne, Lawrence Livermore National Lab. (USA) . . . . . [10392-23]

Lunch/Exhibition Break . . . . . Tue 12:10 pm to 1:40 pm

## SESSION 7

**LOCATION: CONV. CTR. ROOM 14A . . . TUE 1:40 PM TO 3:10 PM**

### CZT II

Session Chair: **Robert D. McLaren**, Consultant (USA)

1:40 pm: **Arrays of position sensitive virtual Frisch-grid detectors** (*Invited Paper*), Aleksey E. Bolotnikov, Giuseppe S. Camarda, Rubi Gul, Gianluigi De Geronimo, Jack Fried, Ge Yang, Anwar Hossain, Brookhaven National Lab. (USA); Luis A. Ocampo Giraldo, Brookhaven National Lab. (USA) and The Pennsylvania State Univ. (USA); Emerson Vernon, Brookhaven National Lab. (USA); Ralph B. James, Savannah River National Lab. (USA) . . . . . [10392-24]

2:10 pm: **Bridgman growth of scintillator crystals via neutron imaging and finite-element modeling**, Jeffrey J. Derby, Jeffrey H. Peterson, Chang Zhang, Jan Seebeck, Univ. of Minnesota (USA); Anton S. Tremsin, Univ. of California, Berkeley (USA); Didier Perrodin, Gregory A. Bizarri, Edith D. Bourret-Courchesne, Lawrence Berkeley National Lab. (USA); Sven Vogel, Mark A. M. Bourke, Los Alamos National Lab. (USA) . . . . . [10392-25]

2:30 pm: **Real-time leakage current monitoring in two-step annealing process**, Kihyun Kim, Seokjin Hwang, Hwanseung Yu, Korea Univ. (Korea, Republic of); Aleksey E. Bolotnikov, Brookhaven National Lab. (USA); Ralph B. James, Savannah River National Lab. (USA) . . . . . [10392-26]

2:50 pm: **Transient current waveforms and electric-field profile in CZT detectors**, Rubi Gul, Brookhaven National Lab. (USA) and Idaho State Univ. (USA); Aleksey E. Bolotnikov, Giuseppe S. Camarda, Anwar Hossain, Louis Iocampo, Brookhaven National Lab. (USA); Rene Rodriguez, Idaho State Univ. (USA); Utpal N. Roy, Ge Yang, Brookhaven National Lab. (USA); Ralph B. James, Savannah River National Lab. (USA) . . . . . [10392-27]

Coffee Break . . . . . Tue 3:10 pm to 3:40 pm

## SESSION 8

**LOCATION: CONV. CTR. ROOM 14A . . . TUE 3:40 PM TO 5:10 PM**

### CZT III

Session Chair: **Arie Ruzin**, Tel Aviv Univ. (Israel)

3:40 pm: **Mechanistic study of the accelerated crucible rotation technique (ACRT) applied to vertical Bridgman growth of CZT** (*Invited Paper*), Mia S. Divecha, Univ. of Minnesota (USA); Jedidiah J. McCoy, Saketh Kakkireni, Santosh K. Swain, Kelvin G. Lynn, Washington State Univ. (USA); Jeffrey J. Derby, Univ. of Minnesota (USA) . . . . . [10392-28]

4:10 pm: **Through-Silicon Vias (TSVs) for 3D readout of ASIC for nearly gapless CdZnTe detector arrays**, Jaesub Hong, Branden Allen, Jonathan Grindlay, Harvard-Smithsonian Ctr. for Astrophysics (USA); Sankgi Hong, Tezzaron Semiconductor Corp. (USA); Hiromasa Miyasaka, Jill Burnham, California Institute of Technology (USA); Robert Patti, Tezzaron Semiconductor Corp. (USA); Fiona A. Harrison, California Institute of Technology (USA); Scott Barthelmy, NASA Goddard Space Flight Ctr. (USA) . . . . . [10392-29]

4:30 pm: **Sub-pixel resolution in pixelated CdZnTe gamma ray detectors with different pixel sizes (0.5 mm to 1.72 mm) using a focused laser beam**, Luis A. Ocampo Giraldo, The Pennsylvania State Univ. (USA); Aleksey E. Bolotnikov, Giuseppe S. Camarda, Gianluigi De Geronimo, Rubi Gul, Jack Fried, Anwar Hossain, Brookhaven National Lab. (USA); Kenan Unlu, The Pennsylvania State Univ. (USA); Emerson Vernon, Ge Yang, Brookhaven National Lab. (USA); Ralph B. James, Savannah River National Lab. (USA) . . . . . [10392-30]

4:50 pm: **Analysis of accelerated crucible rotation technique (ACRT) in the traveling heater method (THM) growth of CZT**, Jeffrey H. Peterson, Jeffrey J. Derby, Univ. of Minnesota (USA) . . . . . [10392-31]

**LOCATION: MARRIOTT MARQUIS, BALBOA . . . . . 8:00 PM TO 10:00 PM**

## Penetrating Radiation Technical Event

Chair: **James E. Baciak**, Univ. of Florida (USA)

This event brings together technologists and scientists with interests in neutron, x- and gamma-ray detection, spectroscopy, and imaging for all applications. This year's featured speaker is Dr. Rachel Slaybaugh from University of California, Berkeley. She will be giving a talk on "Advanced Solvers and Innovation for Penetrating Radiation." Dr. Slaybaugh will cover the need innovation in the nuclear space to enable new (and maintain existing) reactors, enhance nuclear security, and improve nuclear science. To truly enable breakthroughs by investigating new ideas rapidly, we need accurate simulation and appropriate research tools. This requires new methods in computational neutron transport, better simulation and better tools for penetrating radiation detection and measurement. Finally, this talk will briefly cover educational initiatives bringing an innovative mindset into the nuclear field. After the featured speaker the floor will be open to discussions.

## WEDNESDAY 9 AUGUST

### SESSION 9

**LOCATION: CONV. CTR. ROOM 14A WED 8:40 AM TO 10:20 AM**

### Other Gamma Detection Materials

Session Chair: **Richard T. Williams**, Wake Forest Univ. (USA)

8:40 am: **Recent advances in garnet scintillator gamma spectrometers** (*Invited Paper*), Erik L. Swanberg, Zachary M. Seeley, Patrick R. Beck, Brian Wihl, Nerine J. Cherepy, Stephen A. Payne, Steven L. Hunter, Scott E. Fisher, Peter A. Thelin, Lawrence Livermore National Lab. (USA); Todd Stefanik, Nanocerox, Inc. (USA); Joel Kindem, Cokiya, Inc. (USA) . . . . . [10392-32]

9:10 am: **Crystal growth of CdZnTeSe (CZTS) gamma detectors: a promising alternative to CdZnTe** (*Invited Paper*), Utpal N. Roy, Giuseppe S. Camarda, Yonggang Cui, Rubi Gul, Ge Yang, Anwar Hossain, Brookhaven National Lab. (USA); Ralph B. James, Savannah River National Lab. (USA); Jakub Zázvorka, Václav Dedic, Jan Franc, Charles Univ. in Prague (Czech Republic); Vincenzo Lordi, Joel B. Varley, Lawrence Livermore National Lab. (USA) . . . . . [10392-33]

9:40 am: **Stoichiometry and extended defects in Cd(Zn,Mn)Te and CdTeSe crystals**, Anwar Hossain, Aleksey E. Bolotnikov, Giuseppe S. Camarda, Yonggang Cui, Utpal N. Roy, Ge Yang, Brookhaven National Lab. (USA); Ralph B. James, Savannah River National Lab. (USA) . . . . . [10392-34]

10:00 am: **Ionizing organic-based nanocomposites for efficient  $\gamma$ -ray sensor**, Narsingh B. Singh, Fow-Sen Choa, Bradley Arnold, Stacey Sova, Christopher Cooper, Jayati Bhavsar, Univ. of Maryland, Baltimore County (USA) . . . . . [10392-35]

Coffee Break . . . . . Wed 10:20 am to 10:50 am

### SESSION 10

**LOCATION: CONV. CTR. ROOM 14A WED 10:50 AM TO 11:40 AM**

### Defect Characterization in Crystals

Session Chair: **Robert D. McLaren**, Consultant (USA)

10:50 am: **Deep level analysis of CdZnTeSe radiation detectors: their effect on the internal electric field** (*Invited Paper*), Ge Yang, Utpal N. Roy, Yonggang Cui, Giuseppe S. Camarda, Anwar Hossain, Rubi Gul, Brookhaven National Lab. (USA); Ralph B. James, Savannah River National Lab. (USA) . . . . . [10392-36]

11:20 am: **Three-dimensional mapping and analysis of mid-gap defect distributions in TlBr by a femtosecond two-photon photocurrent microscope**, Drew Onken, Sergii Gridin, Kamil B. Ucer, Richard T. Williams, Wake Forest Univ. (USA); Shariar Motakef, Amlan Datta, CapeSym, Inc. (USA) . . . . . [10392-37]

# CONFERENCE 10393

LOCATION: CONV. CTR. ROOM 13

Wednesday–Thursday 9–10 August 2017 • Proceedings of SPIE Vol. 10393

## Radiation Detectors in Medicine, Industry, and National Security XVIII

*Conference Chairs:* **Gary P. Grim**, Lawrence Livermore National Lab. (USA); **Lars R. Furenlid**, The Univ. of Arizona (USA); **H. Bradford Barber**, The Univ. of Arizona (USA)

*Program Committee:* **Stuart A. Baker**, National Security Technologies, LLC (USA); **Yonggang Cui**, Brookhaven National Lab. (USA); **F. Patrick Doty**, Sandia National Labs. (USA); **Patrick Feng**, Sandia National Labs., California (USA); **Paul P. Guss**, National Security Technologies, LLC (USA); **Geoffrey Harding**, Morpho Detection (Germany); **Khalid M. Hattar**, Sandia National Labs. (USA); **Ralph B. James**, Savannah River National Lab. (USA); **Edward Steven Jimenez Jr.**, Sandia National Labs. (USA); **Will E. Johns**, Vanderbilt Univ. (USA); **Michael J. King**, Rapiscan Systems Labs. (USA); **Edward A. McKigney**, Los Alamos National Lab. (USA); **Wondwosen Mengesha**, Physical Optics Corp. (USA); **Frank E. Merrill**, Los Alamos National Lab. (USA); **Rex A. Moats**, The Univ. of Southern California (USA); **Vivek V. Nagarkar**, Radiation Monitoring Devices, Inc. (USA); **Eiichi Sato**, Iwate Medical Univ. (Japan); **Michael R. Squillante**, Radiation Monitoring Devices, Inc. (USA)

### WEDNESDAY 9 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 13 .. WED 8:30 AM TO 10:00 AM

#### Safeguards Applications

Session Chair: **H. Bradford Barber**, The Univ. of Arizona (USA)

8:30 am: **Threat detection of liquid explosives and precursors from their x-ray scattering pattern using energy dispersive detector technology**, Jan Kehres, Mark Lyksborg, Ulrik Lund Olsen, Technical Univ. of Denmark (Denmark) [10393-1]

8:50 am: **Rapid and accurate detection of uranium in aqueous solutions**, Gary Tepper, Brandon Dodd, Virginia Commonwealth Univ. (USA) . . . . . [10393-2]

9:10 am: **Small unmanned aircraft system for remote contour mapping of a nuclear radiation field** (*Invited Paper*), Paul P. Guss, Karen McCall, Russell Malchow, Richard Fischer, Michael Lukens, Mark Adan, Ki Park, Roy Q. Abbott, Michael E. Howard, Eric Wagner, Rusty P. Trainham, Tanushree Luke, National Security Technologies, LLC (USA); Sanjoy Mukhopadhyay, International Atomic Energy Agency (Austria); Paul Oh, Pareshkumar Brahmbratt, Eric Henderson, Univ. of Nevada, Las Vegas (USA); Jinlu Han, Justin Huang, Casey Huang, Astro Flight, Inc. (USA); Jon Daniels, Univ. of Nevada, Las Vegas (USA) . . . . . [10393-3]

9:40 am: **International Radiation Monitoring and Information System (IRMIS)**, Sanjoy Mukhopadhyay, Florian Baciu, Jan Stowisek, Gurdeep Saluja, Patrick Kenny, International Atomic Energy Agency (Austria); Franck Albinet, Independent Contractor - GIS & Data Analyst Consultant (France) . . . . . [10393-4]

Coffee Break . . . . . Wed 10:00 am to 10:30 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 13 .. WED 10:30 AM TO 12:10 PM

#### Novel Detector Concepts

Session Chair: **Gary P. Grim**, Lawrence Livermore National Lab. (USA)

10:30 am: **Development and deployment of the Collimated Directional Radiation Detection System** (*Invited Paper*), Amber L. Guckes, National Security Technologies, LLC (USA); Alexander Barzilov, Univ. of Nevada, Las Vegas (USA) . . . . . [10393-5]

11:00 am: **Performance of pulse-shape discriminating plastic scintillation modules using SiPMs for detecting fast neutrons**, James F. Christian, Erik B. Johnson, Daniel E. Fernandez, Samuel Vogel, Rebecca Frank, Graham Stoddard, Radiation Monitoring Devices, Inc. (USA); Jorge Pereira, Remco Zegers, National Superconducting Cyclotron Lab. (USA); Christopher J. Stapels, Mathworks (USA) . . . . . [10393-6]

11:20 am: **High-resolution photon spectroscopy with a microwave-multiplexed four-pixel transition edge sensor array**, Paul P. Guss, National Security Technologies, LLC (USA); Mike Rabin, Mark Croce, Los Alamos National Lab. (USA); Nathan Hoteling, National Security Technologies, LLC (USA); Sanjoy Mukhopadhyay, International Atomic Energy Agency (Austria) . . . . . [10393-7]

11:40 am: **Large-area CdTe imaging sensor and its applications** (*Invited Paper*), Tadayuki Takahashi, Shin Watanabe, Institute of Space and Astronautical Science (Japan); Shin'ichiro Takeda, Okinawa Institute of Science and Technology Graduate Univ. (Japan) . . . . . [10393-8]

Lunch/Exhibition Break . . . . . Wed 12:10 pm to 1:30 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 13 . . . . WED 1:30 PM TO 3:30 PM

#### Novel Detector Applications

Session Chair: **Lars R. Furenlid**, The Univ. of Arizona (USA)

1:30 pm: **X-ray backscatter radiography with lower open fraction coded masks** (*Invited Paper*), Andre M. A. Munoz, Anna Vella, Matthew J. F. Healy, David W. Lane, Cranfield Univ. (United Kingdom); David Lockley, Defence Science and Technology Lab. (United Kingdom) . . . . . [10393-9]

2:00 pm: **Recent developments in high-speed proton radiography at LANSCE**, Johnny Goett, Los Alamos National Lab. (USA) . . . . . [10393-10]

2:20 pm: **New results from sub-3 MeV Compton spectrometer experiments** (*Invited Paper*), Amanda E. Gehring, Michelle A. Espy, Todd J. Haines, Los Alamos National Lab. (USA) . . . . . [10393-11]

2:50 pm: **Modeling charge collection in x-ray imagers**, Giovanni Pinaroli, Univ. degli Studi di Udine (Italy) and Elettra-Sincrotrone Trieste S.C.p.A. (Italy); Pierpaolo Palestri, Luca Selmi, Alessandro Pilotto, Univ. degli Studi di Udine (Italy) [10393-12]

3:10 pm: **A multi-purpose RTSD readout electronics for XRD and photon-counting x-ray imaging**, Zhi Deng, Xiaobing Yue, Yuxiang Xing, Yinong Liu, Tsinghua Univ. (China) . . . . . [10393-13]

Coffee Break . . . . . Wed 3:30 pm to 4:00 pm

#### SESSION 4

LOCATION: CONV. CTR. ROOM 13 . . . WED 4:00 PM TO 5:30 PM

#### Simulations and Data Acquisition

Session Chair: **Xin Li**, College of Optical Sciences, The Univ. of Arizona (USA)

4:00 pm: **3D-printed coded apertures for x-ray backscatter radiography** (*Invited Paper*), Andre M. A. Munoz, Anna Vella, Matthew J. F. Healy, David W. Lane, Cranfield Univ. (United Kingdom); David Lockley, Defence Science and Technology Lab. (United Kingdom) . . . . . [10393-14]

4:30 pm: **Leveraging multi-channel detector technology to improve quality metrics for industrial and security applications**, Edward S. Jimenez, Kyle R. Thompson, Noelle M. Collins, Srivathsan Koundinyan, Sandia National Labs. (USA) . . . . . [10393-15]

4:50 pm: **Spectral correction algorithm for multispectral CdTe x-ray detectors**, Erik D. Christensen, Niels Bohr Institute (Denmark); Yun Gu, Jan Kehres, Technical Univ. of Denmark (Denmark); Robert Feidenhans'l, European XFEL GmbH (Germany); Ulrik L. Olsen, Technical Univ. of Denmark (Denmark) . . . . . [10393-16]

5:10 pm: **Optimization of input parameters to improve big-data computed tomography reconstruction performance**, Celia J. Flicker, Edward S. Jimenez, Sandia National Labs. (USA) . . . . . [10393-17]

**LOCATION: CONV. CTR.  
EXHIBIT HALL B2 ..... WED 5:30 PM TO 7:30 PM**

## Posters-Wednesday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**The dual-channel ultraviolet/low-light CMOS camera using image fusion technique**, Yunsheng Qian, Xiangyu Kong, Xiaoyu Zhou, Xiaodong Tang, Yijun Zhang, Nanjing Univ. of Science and Technology (China) ..... [10393-32]

## THURSDAY 10 AUGUST

### SESSION 5

**LOCATION: CONV. CTR. ROOM 13 ... THU 8:30 AM TO 10:10 AM**

## Digital Radiography and CT

Session Chair: **Gary P. Grim**, Lawrence Livermore National Lab. (USA)

8:30 am: **Measurement of x-ray spectra using a recent YAP(Ce)-MPPC detector**, Eiichi Sato, Yasuyuki Oda, Sohei Yoshida, Satoshi Yamaguchi, Yuichi Sato, Iwate Medical Univ. (Japan); Tomotaka Ishii, Osahiko Hagiwara, Hiroshi Matsukiyo, Toshiyuki Enomoto, Manabu Watanabe, Shinya Kusachi, Toho Univ. (Japan) ..... [10393-18]

8:50 am: **Analysis of the effect of dielectric interlayer on modulation transfer function of granular x-ray scintillator detector**, Hyeon Bo Shim, Jookwon Song, Jae W. Hahn, Yonsei Univ. (Korea, Republic of) ..... [10393-19]

9:10 am: **Silicon strip photon-counting detectors for breast CT** (*Invited Paper*), William C. Barber, DxRay, Inc. (USA) and Interon AS (Norway); H. Ding, L. Singh, K. Habashi, Univ. of California, Irvine (USA); Nail Malakhov, Gregor Wawrzyniak, Interon AS (Norway); Neal E. Hartsough, DxRay, Inc. (USA); Eirik Næss-Ulseth, Interon AS (Norway); Jan Christopher Wessel, Interon AS (Norway) and DxRay, Inc. (USA); Jan S. Iwanczyk, DxRay, Inc. (USA); Sabee Molloy, Univ. of California, Irvine (USA) ..... [10393-20]

9:40 am: **Scintillator performance considerations for dedicated breast computed tomography** (*Invited Paper*), Srinivasan Vedantham, The Univ. of Arizona (USA); Linxi Shi, Georgia Institute of Technology (USA); Andrew Karellas, The Univ. of Arizona (USA) ..... [10393-21]

Coffee Break ..... Thu 10:10 am to 10:40 am

### SESSION 6

**LOCATION: CONV. CTR. ROOM 13 ... THU 10:40 AM TO 12:10 PM**

## Radioisotope Imaging

Session Chair: **Edward S. Jimenez**, Sandia National Labs. (USA)

10:40 am: **Optimized modeling of powder-based x-ray scintillator screen for improved total efficiency by double-layer scintillator design**, Jookwon Song, Hyeon Bo Shim, Jae W. Hahn, Yonsei Univ. (Korea, Republic of) ..... [10393-22]

11:00 am: **3D position-sensitive scintillation detectors for a high-resolution loco-regional PET imaging system** (*Invited Paper*), David Hsu, David Freese, Derek Innes, Craig S. Levin, Molecular Imaging Instrumentation Lab., Stanford School of Medicine (USA) ..... [10393-23]

11:30 am: **Applications of IQID cameras**, Ling Han, Brian W. Miller, Harrison H. Barrett, H. Bradford Barber, Lars R. Furenlid, The Univ. of Arizona (USA) [10393-24]

11:50 am: **Pulse timing in edge-readout PET detectors**, Xin Li, Maria D. Ruiz-Gonzalez, Lars R. Furenlid, Ctr. for Gamma-Ray Imaging, The Univ. of Arizona (USA) ..... [10393-25]

Lunch/Exhibition Break ..... Thu 12:10 pm to 1:30 pm

### SESSION 7

**LOCATION: CONV. CTR. ROOM 13 .... THU 1:30 PM TO 3:00 PM**

## Novel Detector Applications

Session Chair: **Ling Han**, The Univ. of Arizona (USA)

1:30 pm: **A framework for optimizing micro-CT in dual-modality micro-CT/XFCT small-animal imaging system**, Srinivasan Vedantham, Suman Shrestha, Univ. of Massachusetts Medical School (USA); Andrew Karellas, The Univ. of Arizona (USA); Sang Hyun Cho, The Univ. of Texas M.D. Anderson Cancer Ctr. (USA) ..... [10393-26]

1:50 pm: **A compact energy-independent CZT-based gamma camera** (*Invited Paper*), Youngho Seo, Univ. of California, San Francisco (USA); Yonggang Cui, Paul O'Connor, Brookhaven National Lab. (USA); Qiu Huang, Shanghai Jiao Tong Univ. (China); Zhi Deng, Yu Chen, Tsinghua Univ. (China); Ralph B. James, Savannah River National Lab. (USA) ..... [10393-27]

2:20 pm: **Simulation modeling of a TIBr double-sided strip detector**, Amanjot Gill, H. Bradford Barber, The Univ. of Arizona (USA); Leonard J. Cirignano, Hadong Kim, Radiation Monitoring Devices, Inc. (USA) ..... [10393-28]

2:40 pm: **Investigation of a high-sensitivity near-infrared-ray computed tomography scanner**, Eiichi Sato, Yasuyuki Oda, Sohei Yoshida, Yuichi Sato, Iwate Medical Univ. (Japan); Tomotaka Ishii, Toho Univ. (Japan); Osahiko Hagiwara, Iwate Medical Univ. (Japan) and Toho Univ. (Japan); Hiroshi Matsukiyo, Toshiyuki Enomoto, Manabu Watanabe, Shinya Kusachi, Toho Univ. (Japan) ..... [10393-29]

Coffee Break ..... Thu 3:00 pm to 3:30 pm

### SESSION 8

**LOCATION: CONV. CTR. ROOM 13 .... THU 3:30 PM TO 4:20 PM**

## Other Applications

Session Chair: **H. Bradford Barber**, The Univ. of Arizona (USA)

3:30 pm: **An integrated circuit readout for TOF-PET detectors for PET/MRI** (*Invited Paper*), Ilaria Sacco, Chen-Ming Chang, Stanford University (USA); Michael Ritzert, Peter Fischer, Heidelberg University (Germany); Craig Levin, Stanford University (USA) ..... [10393-30]

4:00 pm: **Hardware strategies for adaptive molecular imaging**, Lars R. Furenlid, Ctr. for Gamma-Ray Imaging, The Univ. of Arizona (USA) ..... [10393-31]



# CONFERENCE 10394

LOCATION: CONV. CTR. ROOM 32A

Sunday–Wednesday 6–9 August 2017 • Proceedings of SPIE Vol. 10394

## Wavelets and Sparsity XVII

Conference Chairs: **Yue M. Lu**, Harvard Univ. (USA); **Dimitri Van De Ville**, Ecole Polytechnique Fédérale de Lausanne (Switzerland), Univ. of Geneva (Switzerland); **Manos Papadakis**, Univ. of Houston (USA)

Program Committee: **Sophie Achard**, Gipsa-lab (France); **Selin Aviyente**, Michigan State Univ. (USA); **Radu V. Balan**, Univ. of Maryland, College Park (USA); **Bernhard G. Bodmann**, Univ. of Houston (USA); **Pierre Borgnat**, Lab. de Physique (France); **Peter G. Casazza**, Univ. of Missouri-Columbia (USA); **Matthew Fickus**, Air Force Institute of Technology (USA); **Vivek K. Goyal**, Boston Univ. (USA); **Mathews Jacob**, The Univ. of Iowa (USA); **Gitta Kutyniok**, Technische Univ. Berlin (Germany); **Demetrio Labate**, Univ. of Houston (USA); **Fernanda Laezza**, The Univ. of Texas Medical Branch (USA); **Jean-Christophe Olivo-Marin**, Institut Pasteur (France); **Audrey Repetti**, Heriot-Watt Univ. (United Kingdom); **Naoki Saito**, Univ. of California, Davis (USA); **Michael Unser**, Ecole Polytechnique Fédérale de Lausanne (Switzerland); **Yves Wiaux**, Heriot-Watt Univ. (United Kingdom); **Jong Chul Ye**, KAIST (Korea, Republic of)

### SUNDAY 6 AUGUST

LOCATION: CONV. CTR. ROOM 32A . . . . . 9:10 AM TO 9:20 AM

#### Welcome and Introduction

Session Chairs: **Yue M. Lu**, Harvard Univ. (USA); **Dimitri Van De Ville**, Ecole Polytechnique Fédérale de Lausanne (Switzerland) and Univ. of Geneva (Switzerland); **Manos Papadakis**, Univ. of Houston (USA)

#### SESSION 1

LOCATION: CONV. CTR. ROOM 32A . SUN 9:20 AM TO 10:20 AM

#### Computational Bioimaging

Session Chair: **Jean-Christophe Olivo-Marin**, Institut Pasteur (France)

9:20 am: **Compressive hyperspectral time-resolved wide-field fluorescence lifetime imaging**, Xavier Intes, Rensselaer Polytechnic Institute (USA) . . . [10394-1]

9:40 am: **Recovering higher-dimensional image data using multiplexed structured illumination**, Guoan Zheng, Univ. of Connecticut (USA) . . . . [10394-2]

10:00 am: **A sparsity-based simplification method for segmentation of spectral-domain optical coherence tomography images**, William Meinel, Institut Pasteur (France) and Télécom ParisTech (France); **Jean-Christophe Olivo-Marin**, Institut Pasteur (France); **Elsa D. Angelini**, Télécom ParisTech (France) and Imperial College London (United Kingdom) . . . . . [10394-3]

Coffee Break . . . . . Sun 10:20 am to 10:50 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 32A . SUN 10:50 AM TO 12:10 PM

#### Unconventional Optical Imaging

Session Chair: **Vivek K. Goyal**, Boston Univ. (USA)

10:50 am: **Direct and indirect photon pathway imaging: an information-theoretic perspective**, Amit Ashok, Liang-Chih Huang, Eric W. Clarkson, The Univ. of Arizona (USA); **Sumanta Pattanaik**, Univ. of Central Florida (USA) . . . . [10394-4]

11:10 am: **Computational memory-effect imaging**, Michael E. Gehm, Joel A. Greenberg, Xiaohan Li, Duke Univ. (USA) . . . . . [10394-5]

11:30 am: **Photon-efficient super-resolution laser radar**, Donggeek Shin, Jeffrey H. Shapiro, Massachusetts Institute of Technology (USA); **Vivek K. Goyal**, Boston Univ. (USA) . . . . . [10394-6]

11:50 am: **Iterative back-projection techniques for non-line-of-sight imaging**, Marco La Manna, Eric C. Breitbach, Jonathan Jackson, Fiona Kine, Andreas Velten, Univ. of Wisconsin-Madison (USA) . . . . . [10394-7]

Lunch Break . . . . . Sun 12:10 pm to 1:30 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 32A . . . SUN 1:30 PM TO 3:30 PM

#### Neuroimaging Data Analytics

Session Chair: **Selin Aviyente**, Michigan State Univ. (USA)

1:30 pm: **Riemannian multi-manifold modeling and clustering in brain networks**, Konstantinos Slavakis, Shiva Salsabilian, David S. Wack, Sarah F. Muldoon, Henry E. Baidoo-Williams, Univ. at Buffalo (USA); **Jean M. Vettel**, U.S. Army Research Lab. (USA); **Matthew Cieslak**, Scott T. Grafton, Univ. of California, Santa Barbara (USA) . . . . . [10394-8]

1:50 pm: **Probing the dynamics of resting-state cortical activities via wide field Ca<sup>2+</sup> imaging in GCaMP6 transgenic mice**, Li Zhu, Christian Lee, David Margolis, Laleh Najafizadeh, Rutgers, The State Univ. of New Jersey (USA) . . . . . [10394-9]

2:10 pm: **MR correlation spectroscopic imaging of multidimensional exponential decays: probing microstructure with diffusion and relaxation**, Daeun Kim, Justin P. Haldar, The Univ. of Southern California (USA) . . . [10394-10]

2:30 pm: **A regularized clustering approach to brain parcellation from functional MRI data**, Keith Dillon, Yu-Ping Wang, Tulane Univ. (USA) . . [10394-11]

2:50 pm: **Joint fMRI analysis and subject clustering using sparse dictionary learning**, Seung-Jun Kim, Univ. of Maryland, Baltimore County (USA) . . . [10394-12]

3:10 pm: **Detecting brain dynamics during resting state: a tensor based evolutionary clustering approach**, Esraa Al-sharoua, Mahmood Al-Khassaweneh, Selin Aviyente, Michigan State Univ. (USA) . . . . . [10394-13]

Coffee Break . . . . . Sun 3:30 pm to 4:00 pm

#### SESSION 4

LOCATION: CONV. CTR. ROOM 32A . . SUN 4:00 PM TO 5:40 PM

#### Imaging and Inverse Problems

Session Chair: **Dimitri Van De Ville**, Ecole Polytechnique Fédérale de Lausanne (Switzerland)

4:00 pm: **Optimal transport-based dictionary learning and its application to Euclid-like Point Spread Function representation**, Morgan A. Schmitz, CEA-Ctr. de SAACLAY (France); **Matthieu Heitz**, Lab. d'InfoRmatique en Image et Systèmes d'information (France) and Univ. de Lyon 1 (France); **Nicolas Bonneel**, Univ. de Lyon 1 (France) and Lab. d'InfoRmatique en Image et Systèmes d'information, Ctr. National de la Recherche Scientifique (France); **Fred-Maurice Ngolè-Mboula**, CEA-Ctr. de SAACLAY (France); **David Coeurjolly**, Univ. de Lyon 1 (France) and Lab. d'InfoRmatique en Image et Systèmes d'information, Ctr. National de la Recherche Scientifique (France); **Marco Cuturi**, École Nationale de la Statistique et de l'Administration Économique (France) and Ctr. de Recherche en Économie et Statistique, Univ. Paris-Saclay (France); **Gabriel Peyré**, Ecole Normale Supérieure (France); **Jean-Luc Starck**, CEA-Ctr. de SAACLAY (France) . . . . . [10394-14]

4:20 pm: **Localization of sound sources in a room by one microphone**, Helena Peic Tukuljac, Hervé Lissek, Pierre Vandergheynst, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . . [10394-15]

4:40 pm: **Limited memory trust-region methods for sparse relaxation**, Lasith Adhikari, Univ. of California, Merced (USA); **Jennifer B. Erway**, Wake Forest Univ. (USA); **Omar DeGuchy**, Univ. of California, Merced (USA); **Shelby Lockhart**, Wake Forest Univ. (USA); **Marcia F. Roummel**, Univ. of California, Merced (USA) . . . . . [10394-16]

5:00 pm: **Underwater object classification using scattering transform of sonar signals**, David Weber, Naoki Saito, Univ. of California, Davis (USA) . . . [10394-17]

5:20 pm: **Non-convex Shannon entropy for photon-limited imaging**, Lasith Adhikari, Omar DeGuchy, Marcia F. Roummel, Univ. of California, Merced (USA) . . . [10394-18]

**LOCATION: CONV. CTR. ROOM 6A . . SUN 6:00 PM TO 7:50 PM**

## Technology Hot Topics: How Optics and Photonics Drive Innovation

6:00 pm to 6:10 pm: **Welcome and Opening Remarks**

6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)

6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)

6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)

7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)

7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)

## MONDAY 7 AUGUST

### SESSION 5

**LOCATION: CONV. CTR. ROOM 32A . MON 8:30 AM TO 10:10 AM**

## Applied Harmonic Analysis I

Session Chair: **Matthew Fickus**, Air Force Institute of Technology (USA)

8:30 am: **Binary channel codes with decoding by linear programming**, Bernhard G. Bodmann, Univ. of Houston (USA) . . . [10394-19]

8:50 am: **Finding the closest probabilistic Parseval frame**, Desai Cheng, Univ. of Missouri (USA); Kasso A. Okoudjou, Univ. of Maryland, College Park (USA) . . . [10394-20]

9:10 am: **Characterizing Grassmannian frames with a generalized simplex bound**, John Haas, Univ. of Missouri (USA); Bernhard G. Bodmann, Univ. of Houston (USA) . . . [10394-21]

9:30 am: **Equiangular tight frames from association schemes**, John Jasper, Univ. of Cincinnati (USA) . . . [10394-22]

9:50 am: **Optimal approximation by sparse deep neural networks**, Philipp Grohs, Technische Univ. Wien (Austria); Gitta Kutyniok, Philipp Petersen, Technische Univ. Berlin (Germany) . . . [10394-23]

Coffee Break . . . . . Mon 10:10 am to 10:40 am

### SESSION 6

**LOCATION: CONV. CTR. ROOM 32A MON 10:40 AM TO 12:00 PM**

## Mathematical Data Analysis and Frame Theory I

Session Chairs: **Gitta Kutyniok**, Technische Univ. Berlin (Germany); **Radu V. Balan**, Univ. of Maryland, College Park (USA); **Bernhard G. Bodmann**, Univ. of Houston (USA)

10:40 am: **Phase retrieval**, Peter G. Casazza, Tin Tran, Univ. of Missouri (USA) . . . [10394-24]

11:00 am: **Methods for localized regression using graph Laplacians**, Alexander Cloninger, Yale Univ. (USA) . . . [10394-25]

11:20 am: **Harmonic equi-chordal and equi-isoclinic tight fusion frames**, Matthew Fickus, Air Force Institute of Technology (USA); John Jasper, Univ. of Cincinnati (USA); Dustin G. Mixon, Cody E. Watson, Air Force Institute of Technology (USA) . . . [10394-26]

11:40 am: **Soft recovery**, Axel Flinth, Technische Univ. Berlin (Germany) [10394-27]

Lunch Break . . . . . Mon 12:00 pm to 1:30 pm

### SESSION 7

**LOCATION: CONV. CTR. ROOM 32A . . MON 1:30 PM TO 2:10 PM**

## Keynote Session I

Session Chair: **Yue M. Lu**, Harvard Univ. (USA)

1:30 pm: **Speeding up sparse signal recovery using sparse-graph codes (Keynote Presentation)**, Kannan Ramchandran, Univ. of California, Berkeley (USA) . . . [10394-74]

### SESSION 8

**LOCATION: CONV. CTR. ROOM 32A . . MON 2:10 PM TO 3:10 PM**

## Applied Harmonic Analysis II

Session Chairs: **Matthew Fickus**, Air Force Institute of Technology (USA); **Peter G. Casazza**, Univ. of Missouri (USA)

2:10 pm: **Optimal packings of many lines**, John Haas, Univ. of Missouri (USA); Nathaniel Hammen, Dustin G. Mixon, Air Force Institute of Technology (USA) . . . [10394-28]

2:30 pm: **K-means clustering on the space of persistence diagrams**, Joshua Mike, Andrew Marchese, The Univ. of Tennessee, Knoxville (USA); Vasileios Maroulas, The Univ. of Tennessee Knoxville (USA) . . . [10394-29]

2:50 pm: **Phase retrieval from localized two-dimensional measurements**, Mark Iwen, Michigan State Univ. (USA); Brian Preskitt, Rayan Saab, Univ. of California, San Diego (USA); Aditya Viswanathan, Michigan State Univ. (USA) . . . [10394-30]

Coffee Break . . . . . Mon 3:10 pm to 3:40 pm

### SESSION 9

**LOCATION: CONV. CTR. ROOM 32A . . MON 3:40 PM TO 5:40 PM**

## Directional and Scattering Transforms in Neuroscience Imaging

Session Chairs: **Fernanda Laezza**, The Univ. of Texas Medical Branch (USA); **Demetrio Labate**, Univ. of Houston (USA); **Manos Papadakis**, Univ. of Houston (USA)

3:40 pm: **Shearlet-based regularization in limited data and sparse tomography**, Tatiana A. Bubba, Samuli Siltanen, Matti Lassas, Univ. of Helsinki (Finland) . . . [10394-31]

4:00 pm: **Detecting neuronal activity from calcium imaging data using FRI methods**, Stephanie Reynolds, Jon Oñativia, Simon R. Schultz, Pier Luigi Dragotti, Imperial College London (United Kingdom) . . . [10394-32]

4:20 pm: **GASPACHO: a generic automatic solver using proximal algorithms for convex huge optimization problems**, Bart Goossens, Hiêp Q. Luong, Wilfried Philips, Univ. Gent (Belgium) . . . [10394-33]

4:40 pm: **Adaptive windowing and windowless approaches to estimate dynamic functional brain connectivity**, Maziar Yaesoubi, Vince D. Calhoun, The Mind Research Network (USA) . . . [10394-34]

5:00 pm: **Wavelet scattering transforms and machine learning for many particle systems**, Matthew Hirn, Michigan State Univ. (USA) . . . [10394-35]

5:20 pm: **Exploring neuronal synapses with directional filters with small support**, Nikolaos Karantzas, Demetrio Labate, Manos Papadakis, Univ. of Houston (USA) . . . [10394-36]

# CONFERENCE 10394

## TUESDAY 8 AUGUST

### SESSION 10

LOCATION: CONV. CTR. ROOM 32A . . TUE 8:30 AM TO 10:10 AM

### Mathematical Data Analysis and Frame Theory II

Session Chairs: **Gitta Kutyniok**, Technische Univ. Berlin (Germany); **Radu V. Balan**, Univ. of Maryland, College Park (USA); **Bernhard G. Bodmann**, Univ. of Houston (USA)

8:30 am: **Edge-augmented Fourier partial sums with applications to Magnetic Resonance Imaging (MRI)**, Jade Larriva-Latt, Wellesley College (USA); Angela Morrison, Albion College (USA); Alison Radgowski, Goucher College (USA); Joseph Tobin, Univ. of Virginia (USA); Mark Iwen, Aditya Viswanathan, Michigan State Univ. (USA) . . . . . [10394-37]

8:50 am: **Reconstruction of finite-valued sparse signals**, Sandra Keiper, Technische Univ. Berlin (Germany) . . . . . [10394-38]

9:10 am: **Tolerant compressed sensing with partially coherent sensing matrices**, Tobias Birnbaum, Department of Electronics and Information Processing (Belgium); Yonina Eldar, Technion (Israel); Deanna M. Needell, Claremont McKenna College (USA) . . . . . [10394-39]

9:30 am: **De-biasing one-step matrix completion**, Yaniv Plan, The Univ. of British Columbia (Canada) . . . . . [10394-40]

9:50 am: **Energy decay in deep convolutional neural networks**, Thomas Wiatowski, ETH Zurich (Switzerland) . . . . . [10394-41]

Coffee Break . . . . . Tue 10:10 am to 10:40 am

### SESSION 11

LOCATION: CONV. CTR. ROOM 32A . TUE 10:40 AM TO 12:00 PM

### Applied Harmonic Analysis III

Session Chairs: **Matthew Fickus**, Air Force Institute of Technology (USA); **Peter G. Casazza**, Univ. of Missouri (USA)

10:40 am: **On distribution of a product of  $\mathbb{S}^N$  Gaussian variables**, Martin Kliesch, Univ. of Gdańsk (Poland); Daniel Suess, Zeljka Stojanac, Univ. zu Köln (Germany) . . . . . [10394-42]

11:00 am: **Framed frames for data frames**, Nathaniel Strawn, Georgetown Univ. (USA) . . . . . [10394-43]

11:20 am: **You can have it all: rapid, robust, and rigorous algorithms for bilinear problems in signal processing and communications**, Thomas Strohmer, Univ. of California, Davis (USA) . . . . . [10394-44]

11:40 am: **A polynomial-time relaxation of the Gromov-Hausdorff distance**, Soledad Villar, The Univ. of Texas at Austin (USA); Afonso S. Bandeira, New York Univ. (USA); Andrew Blumberg, Rachel A. Ward, The Univ. of Texas at Austin (USA) . . . . . [10394-45]

Lunch/Exhibition Break . . . . . Tue 12:00 pm to 1:30 pm

LOCATION: CONV. CTR. ROOM 6A . . . TUE 1:30 PM TO 2:30 PM

### Signal, Image, and Data Processing Plenary Session

Session Chair: **Abdul A. S. Awwal**, Lawrence Livermore National Lab. (USA)

1:30 pm: **Fast automated 3D modeling of building interiors (Plenary)**, Avideh Zakhori, Univ. of California, Berkeley (USA) . . . . . [10395-500]

### SESSION 12

LOCATION: CONV. CTR. ROOM 32A . . TUE 2:40 PM TO 3:40 PM

### Mathematical Data Analysis and Frame Theory III

Session Chairs: **Gitta Kutyniok**, Technische Univ. Berlin (Germany); **Radu V. Balan**, Univ. of Maryland, College Park (USA); **Bernhard G. Bodmann**, Univ. of Houston (USA)

2:40 pm: **Structured sparse recovery with sparse sensing matrices**, Bubacarr Bah, African Institute for Mathematical Sciences (South Africa) and Stellenbosch Univ. (South Africa) . . . . . [10394-46]

3:00 pm: **Blind demixing and deconvolution with noisy data at near optimal rate**, Dominik Stöger, Technische Univ. München (Germany); Peter Jung, Technische Univ. Berlin (Germany); Felix Kraemer, Technische Univ. München (Germany) . . . . . [10394-47]

3:20 pm: **The scaling limit and dynamics of nonconvex algorithms for low-rank subspace estimation**, Chuang Wang, Yue M. Lu, Harvard Univ. (USA) . [10394-48]

Coffee Break . . . . . Tue 3:40 pm to 4:00 pm

### SESSION 13

LOCATION: CONV. CTR. ROOM 32A . . TUE 4:00 PM TO 5:40 PM

### Theory and Applications of Structured Low-Rank Matrix Completion

Session Chairs: **Jong Chul Ye**, KAIST (Korea, Republic of); **Mathews Jacob**, The Univ. of Iowa (USA)

4:00 pm: **Convex relaxations of spectral sparsity for robust super-resolution and line spectrum estimation**, Yuejie Chi, The Ohio State Univ. (USA) . [10394-49]

4:20 pm: **2D phaseless super-resolution**, Myung Cho, The Univ. of Iowa (USA); Christos Thrampoulidis, Massachusetts Institute of Technology (USA); Babak Hassibi, California Institute of Technology (USA); Weiyu Xu, The Univ. of Iowa (USA) . . . . . [10394-51]

4:40 pm: **Recovery of continuous domain piecewise smooth images: theory, algorithms, and applications**, Mathews Jacob, The Univ. of Iowa (USA); Gregory Ongie, Univ. of Michigan (USA); Sampurna Biswas, The Univ. of Iowa (USA) and Univ. of Michigan (USA); Arvind Balachandrasekaran, The Univ. of Iowa (USA) . . . . . [10394-52]

5:00 pm: **Learning-based low-rank Hankel structured matrix approach**, Jong Chul Ye, KAIST (Korea, Republic of) . . . . . [10394-53]

5:20 pm: **Fast and provable algorithms for spectrally sparse signal reconstruction via low-rank Hankel matrix completion**, Jian-Feng Cai, Hong Kong Univ. of Science and Technology (Hong Kong, China) . . . . . [10394-54]

## WEDNESDAY 9 AUGUST

### SESSION 14

LOCATION: CONV. CTR. ROOM 32A WED 8:40 AM TO 10:00 AM

### Optimization and Sparse Inverse Problems I

Session Chairs: **Audrey Repetti**, Heriot-Watt Univ. (United Kingdom); **Yves Wiaux**, Heriot-Watt Univ. (United Kingdom)

8:40 am: **Noise and outlier tolerance of RobustPhaseMax**, Paul Hand, Rice Univ. (USA); Thang Huynh, Univ. of California, San Diego (USA) . . . . . [10394-55]

9:00 am: **Comparison of sampling strategies for 3D scene reconstruction from sparse multispectral lidar waveforms**, Yoann Altmann, Rachael Tobin, Ximing Ren, Aongus McCarthy, Gerald S. Buller, Stephen McLaughlin, Heriot-Watt Univ. (United Kingdom) . . . . . [10394-56]

9:20 am: **Semidefinite programming relaxations for inverse scattering, blind deconvolution, and matrix completion**, Augustin Cosse, New York Univ. (USA) . . . . . [10394-57]

9:40 am: **Faster PET reconstruction with a stochastic primal-dual hybrid gradient method**, Matthias J. Ehrhardt, Univ. of Cambridge (United Kingdom); Pawel J. Markiewicz, Univ. College London (United Kingdom); Peter Richtárik, The Univ. of Edinburgh (United Kingdom); Antonin Chambolle, Ecole Polytechnique (France); Carola-Bibiane Schoenlieb, Univ. of Cambridge (United Kingdom) . . . . . [10394-58]

Coffee Break . . . . . Wed 10:00 am to 10:30 am



## SESSION 15

LOCATION: CONV. CTR. ROOM 32A . WED 10:30 AM TO 11:10 AM

### Keynote Session II

Session Chair: **Dimitri Van De Ville**, Ecole Polytechnique Fédérale de Lausanne (Switzerland)

10:30 am: **Sketchy decisions: convex optimization with optimal storage** (Keynote Presentation), Joel A. Tropp, California Institute of Technology (USA) ..... [10394-75]

## SESSION 16

LOCATION: CONV. CTR. ROOM 32A . WED 11:10 AM TO 12:30 PM

### Data Representation with Graphs and Multi-Scale Processing, Application to fMRI Brain Connectivity I

Session Chairs: **Sophie Achard**, Gipsa-lab (France); **Pierre Borgnat**, Lab. de Physique (France)

11:10 am: **Local stationarity of graph signals: insights and experiments**, Benjamin Girault, Shrikanth S. Narayanan, Antonio Ortega, The Univ. of Southern California (USA) ..... [10394-60]

11:30 am: **Multiscale space-frequency analysis of functions defined on directed graphs**, Harry Sevi, Ecole Normale Supérieure de Lyon (France) and Commissariat à l'Énergie Atomique (France); Gabriel Rilling, Commissariat à l'Énergie Atomique (France); Pierre Borgnat, Ecole Normale Supérieure de Lyon (France) ..... [10394-61]

11:50 am: **Extending classical multirate signal processing theory to graphs**, Oguzhan Teke, Palghat P. Vaidyanathan, California Institute of Technology (USA) ..... [10394-62]

12:10 pm: **Semi-parametric, parametric, and possibly sparse models for multivariate long-range dependence**, Vlasos Pipiras, The Univ. of North Carolina at Chapel Hill (USA); Stefanos Kechagias, SAS Institute Inc. (USA); Changyong Baek, Sungkyunkwan Univ. (Korea, Republic of) ..... [10394-63]

Lunch/Exhibition Break ..... Wed 12:30 pm to 2:10 pm

## SESSION 17

LOCATION: CONV. CTR. ROOM 32A . WED 2:10 PM TO 3:30 PM

### Optimization and Sparse Inverse Problems II

Session Chairs: **Audrey Repetti**, Heriot-Watt Univ. (United Kingdom); **Yves Wiaux**, Heriot-Watt Univ. (United Kingdom)

2:10 pm: **Simultaneous sparse reconstruction using copula functions**, Joao Mota, Heriot-Watt Univ. (United Kingdom); Evangelos Zimos, Vrije Univ. Brussel (Belgium); Miguel Rodrigues, Univ. College London (United Kingdom); Nikos Deligiannis, Vrije Univ. Brussel (Belgium) ..... [10394-64]

2:30 pm: **A proximal Hamiltonian Monte Carlo algorithm: theory, method, and algorithm**, Marcelo Pereyra, Heriot-Watt Univ. (United Kingdom) ..... [10394-65]

2:50 pm: **Recovery guarantees for low complexity models**, Samuel Vaiter, Univ. De Bourgogne (France) and Ctr. National de la Recherche Scientifique (France) ..... [10394-66]

3:10 pm: **Non-convex blind deconvolution approach for sparse image processing**, Audrey Repetti, Yves Wiaux, Heriot-Watt Univ. (United Kingdom) ..... [10394-67]

Coffee Break ..... Wed 3:30 pm to 4:00 pm

## SESSION 18

LOCATION: CONV. CTR. ROOM 32A . WED 4:00 PM TO 5:00 PM

### Data Representation with Graphs and Multi-Scale Processing, Application to fMRI Brain Connectivity II

Session Chairs: **Sophie Achard**, Gipsa-lab (France); **Pierre Borgnat**, Lab. de Physique (France)

4:00 pm: **Analytic wavelets for multivariate time series analysis**, Irène Gannaz, Institut National des Sciences Appliquées de Lyon (France); Sophie Achard, Ctr. National de la Recherche Scientifique (France); Marianne Clausel, Univ. Grenoble Alpes (France); François Roueff, Télécom ParisTech (France) ..... [10394-68]

4:20 pm: **Laplacian embedding with tuned localization and spectral bandwidth using graph Slepians**, Maria Giulia Preti, Dimitri Van De Ville, Ecole Polytechnique Fédérale de Lausanne (Switzerland) ..... [10394-69]

4:40 pm: **Change point detection in covariance/network structures**, Yi Yu, Univ. of Bristol (United Kingdom) ..... [10394-70]

## SESSION 19

LOCATION: CONV. CTR. ROOM 32A . WED 5:00 PM TO 6:00 PM

### Multiscale Analysis

Session Chair: **Yue M. Lu**, Harvard Univ. (USA)

5:00 pm: **Adaptive synchrosqueezing based on a quilted short-time Fourier transform**, Alexander Berrian, Naoki Saito, Univ. of California, Davis (USA) ..... [10394-71]

5:20 pm: **Coupling wavelets and non-stationary Gaussian process models for the reconstruction of highly heterogeneous data**, Sébastien Marmin, Jean Baccou, Institut de Radioprotection et de Sureté Nucléaire (France); Jacques Liandrat, Ecole Centrale Marseille (France) and Institut de Mathématiques de Marseille (France); David Ginsbourger, Idiap Research Institute, Ecole Polytechnique Fédérale de Lausanne (Switzerland) and Univ. Bern (Switzerland) ..... [10394-72]

5:40 pm: **Affine shear tight frames with two-layer structure**, Zhihua Che, Xiaosheng Zhuang, City Univ. of Hong Kong (Hong Kong, China) ..... [10394-73]

# CONFERENCE 10395

LOCATION: CONV. CTR. ROOM 31A

Monday–Tuesday 7–8 August 2017 • Proceedings of SPIE Vol. 10395

## Optics and Photonics for Information Processing XI

*Conference Chairs:* **Khan M. Iftekharruddin**, Old Dominion Univ. (USA); **Abdul A. S. Awwal**, Lawrence Livermore National Lab. (USA); **Mireya García Vázquez**, Ctr. de Investigación y Desarrollo de Tecnología Digital (Mexico)

*Conference Co-Chairs:* **Andrés Márquez**, Univ. de Alicante (Spain); **Víctor H. Díaz-Ramirez**, Ctr. de Investigación y Desarrollo de Tecnología Digital (Mexico)

*Program Committee:* **George Barbastathis**, Massachusetts Institute of Technology (USA); **Juan Campos**, Univ. Autònoma de Barcelona (Spain); **Liangcai Cao**, Tsinghua Univ. (China); **Xinbin Cheng**, Tongji Univ. (China); **Laurence G. Hassebrook**, Univ. of Kentucky (USA); **Kazuyoshi Itoh**, Osaka Univ. (Japan); **Rigoberto Juarez-Salazar**, Ctr. de Investigación y Desarrollo de Tecnología Digital (Mexico); **Mohammad Ataul Karim**, Univ. of Massachusetts Dartmouth (USA); **ByoungHo Lee**, Seoul National Univ. (Korea, Republic of); **Abhijit Mahalanobis**, Lockheed Martin Missiles and Fire Control (USA); **Mohammad A. Matin**, Univ. of Denver (USA); **Osamu Matoba**, Kobe Univ. (Japan); **Alastair D. McAulay**, Lehigh Univ. (USA); **Nasser M. Nasrabadi**, U.S. Army Research Lab. (USA); **Mark A. Neifeld**, The Univ. of Arizona (USA); **Takanori Nomura**, Wakayama Univ. (Japan); **Marek R. Ogiela**, AGH Univ. of Science and Technology (Poland); **Ting-Chung Poon**, Virginia Polytechnic Institute and State Univ. (USA); **Philippe Réfrégier**, Institut Fresnel (France); **Joseph Rosen**, Ben-Gurion Univ. of the Negev (Israel); **John T. Sheridan**, Univ. College Dublin (Ireland); **Jun Tanida**, Osaka Univ. (Japan); **Cardinal Warde**, Massachusetts Institute of Technology (USA); **Eriko Watanabe**, The Univ. of Electro-Communications (Japan); **Toyohiko Yatagai**, Utsunomiya Univ. (Japan); **María J. Yzuel**, Univ. Autònoma de Barcelona (Spain)

### MONDAY 7 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 31A MON 8:40 AM TO 10:00 AM

#### Optical Systems Characterization

Session Chair: **Andrés Márquez**, Univ. de Alicante (Spain)

8:40 am: **Real time adaptation of spatial resolution for high resolution space cameras**, Ralf Reulke, Andreas Eckardt, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) . . . . . [10395-1]

9:00 am: **Ronchigrams of parabolic concave mirrors by inverse ray tracing**, Rigoberto Juarez-Salazar, Ctr. de Investigación y Desarrollo de Tecnología Digital (Mexico); Carlos I. Robledo-Sanchez, Fermín Guerrero-Sanchez, Benemérita Univ. Autónoma de Puebla (Mexico); Víctor H. Díaz-Ramirez, Ctr. de Investigación y Desarrollo de Tecnología Digital (Mexico); Antonio Barcelata-Pinzón, Univ. Tecnológica de Puebla (Mexico); Gerardo Díaz-Gonzalez, Univ. Tecnológica de la Mixteca (Mexico) . . . . . [10395-2]

9:20 am: **Radiometric calibration of digital cameras using neural networks**, Michael Grunwald, Martin Schall, Pascal Laube, Georg Umlauf, Matthias O. Franz, Hochschule Konstanz (Germany) . . . . . [10395-3]

9:40 am: **An optimized knife-edge method for on-orbit MTF estimation of optical sensors using powell parameter fitting**, Lu Han, Chen Gong, Kun Gao, Zhenyu Zhu, Yue Guo, Beijing Institute of Technology (China) . . . . . [10395-4]

Coffee Break . . . . . Mon 10:00 am to 10:30 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 31A MON 10:30 AM TO 12:10 PM

#### Spatial Light Modulation and Holography

Session Chair: **Abdul A. S. Awwal**, Lawrence Livermore National Lab. (USA)

10:30 am: **Generation of arbitrary complex phases by a spatial light modulator in a common path interferometer**, Ceciibet Mendoza-Rodríguez, Rafael Rueda Ramos, Carlos I. Robledo-Sanchez, Areli Montes-Pérez, Benemérita Univ. Autónoma de Puebla (Mexico); Rigoberto Juarez-Salazar, Ctr. de Investigación y Desarrollo de Tecnología Digital (Mexico) . . . . . [10395-5]

10:50 am: **Complex amplitude modulation with a single phase-only spatial light modulator**, Liangcai Cao, Dezhao Kong, Song Zong, Hao Zhang, Guofan Jin, Tsinghua Univ. (China) . . . . . [10395-6]

11:10 am: **SF-FDTD analysis of a predictive physical model for parallel aligned liquid crystal devices**, Andrés Márquez, Jorge Francés, Francisco J. Martínez-Guardiola, Sergi Gallego, Mariela L. Álvarez López, Eva M. Calzado, Inmaculada Pascual, Augusto Beléndez, Univ. de Alicante (Spain) . . . . . [10395-7]

11:30 am: **Particle field diagnose using angular multiplexing volume holography**, Yu Zhao, China Academy of Engineering Physics (China) . . [10395-8]

11:50 am: **Design and manufacture of volume phase holographic gratings used in VIS/NIR wavebands**, Qijing Mei, Peng Liu, Minxue Tang, Soochow Univ. (China) . . . . . [10395-9]

Lunch Break . . . . . Mon 12:10 pm to 1:40 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 31A . . MON 1:40 PM TO 3:20 PM

#### Optical Applications in Sensing and Communications

Session Chair: **Liangcai Cao**, Tsinghua Univ. (China)

1:40 pm: **On the use of video projectors for three-dimensional scanning**, Rigoberto Juarez-Salazar, Víctor H. Díaz-Ramirez, Ctr. de Investigación y Desarrollo de Tecnología Digital (Mexico); Carlos I. Robledo-Sanchez, Benemérita Univ. Autónoma de Puebla (Mexico); Gerardo Díaz-Gonzalez, Univ. Tecnológica de la Mixteca (Mexico) . . . . . [10395-10]

2:00 pm: **Light output enhancement for a plastic scintillator using nano-fibers**, Zhangkai Cheng, Samuel J. Blake, The Univ. of Sydney (Australia) and Ingham Institute (Australia); Philip Vial, Sydney South West Health Service (Australia) and The Univ. of Sydney (Australia) and Ingham Institute (Australia); Steven R. Meikle, The Univ. of Sydney (Australia); Minghui Lui, PerkinElmer, Inc. (USA); Zdenka Kuncic, Shaghik Atakaramians, The Univ. of Sydney (Australia) . . . . . [10395-11]

2:20 pm: **Development spectroellipsometric technology for the diagnosis of aquatic environments**, Ferdenant A. Mkrtchyan, Vladimir V. Kovalev, Kotel'nikov Institute of Radio Engineering and Electronics of Russian Academy of Sciences (Russian Federation) . . . . . [10395-12]

2:40 pm: **Optical frequency comb generator using FWM for modern WDM system design**, Abel Sanchez-Nieves, Escuela Superior de Ingeniería Mecánica y Eléctrica (Mexico); Ivan A. Aldaya-Garde, Univ. Estadual de Campinas (Brazil); Mauro A. Enciso Aguilar, Ctr. de Educación Continua (Mexico); Abraham Sierra-Calderon, Jose A. Alvarez-Chavez, Ctr. de Investigación e Innovación Tecnológica (Mexico) . . . . . [10395-13]

3:00 pm: **A novel symmetric 40 Gbps RZ-DPSK-based colorless WDM-PON**, Aftab Hussain, Swedish College of Engineering and Technology (Pakistan) . . . . . [10395-14]

Coffee Break . . . . . Mon 3:20 pm to 3:50 pm

## SESSION 4

LOCATION: CONV. CTR. ROOM 31A . . MON 3:50 PM TO 5:30 PM

### Image Restoration and Computation

Session Chair: **Victor H. Diaz-Ramirez**, Ctr. de Investigación y Desarrollo de Tecnología Digital (Mexico)

- 3:50 pm: **Restoration of degraded images using stereo vision**, Jose Enrique Hernandez-Beltran, Victor H. Diaz-Ramirez, Ctr. de Investigación y Desarrollo de Tecnología Digital (Mexico) . . . . . [10395-15]
- 4:10 pm: **Modeling apparent color for visual evaluation of camouflage fabrics**, Scott Ramsey, Troy Mayo, Andrew Shabaev, Samuel G. Lambrakos, U.S. Naval Research Lab. (USA) . . . . . [10395-16]
- 4:30 pm: **Restoration of motion blurred images**, Leopoldo N. Gaxiola, Rigoberto Juarez-Salazar, Victor H. Diaz-Ramirez, Ctr. de Investigación y Desarrollo de Tecnología Digital (Mexico) . . . . . [10395-17]
- 4:50 pm: **Computational reduction of the image sets required in conventional phase shifting methods applied to digital photoelasticity**, Juan Carlos Briñez de León, Alejandro Restrepo Martínez, John W. Branch Bedoya, Univ. Nacional de Colombia Sede Medellín (Colombia) . . . . . [10395-18]
- 5:10 pm: **An adaptive template-matched filtering approach for object segmentation in real-life scenes**, Kenia Picos Espinoza, CETYS Univ. Baja California (Mexico) and Ctr. de Investigación y Desarrollo de Tecnología Digital (Mexico); Victor H. Diaz-Ramirez, Ctr. de Investigación y Desarrollo de Tecnología Digital (Mexico) . . . . . [10395-19]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 . . . . . MON 5:30 PM TO 7:30 PM

### Posters-Monday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

- An improved silhouette for human pose estimation**, Anthony H. Hawes, Khan M. Iftekharruddin, Old Dominion Univ. (USA) . . . . . [10395-22]
- Spectrum refinement and correction for laser Doppler velocimeter**, Qiucheng Gong, Xiaoming Nie, Jian Zhou, National Univ. of Defense Technology (China) . . . . . [10395-36]
- Influence of fiber-optic system of transmission of analyzed signals to spread function of diffraction grating spectral device**, Vasily Kazakov, Oleg D. Moskaletz, Saint-Petersburg State Univ. of Aerospace Instrumentation (Russian Federation) . . . . . [10395-37]
- Acousto-optic modulator as an element of signal processing systems of radio and optical diaphragms**, Vasilisa Romashova, Oleg D. Moskaletz, Saint-Petersburg State Univ. of Aerospace Instrumentation (Russian Federation); Dmitriy Moskaletz, Saint Petersburg Electrotechnical Univ. "LETI" (Russian Federation) . . . . . [10395-38]
- An edge detection method with boundary reserved based on non-sampled contourlet transform for remote sensing imagery**, Zizheng Hua, chen gong, Kun Gao, Yan Lu, su chen, Beijing Institute of Technology (China); Yanqin Jia, Southwest Jiaotong Univ. (China) . . . . . [10395-39]
- Security analysis of the first random phase mask in double random phase encryption**, Lingfei Zhang, Thomas J. Naughton, National Univ. of Ireland, Maynooth (Ireland) . . . . . [10395-41]
- Imaging simulation for three-FOV daytime star sensors based on ray tracing**, Feng Wu, Xifang Zhu, Ruxi Xiang, Xiaoyan Jiang, Qingquan Xu, Gong Chen, Tao Wu, Changzhou Institute of Technology (China) . . . . . [10395-42]
- Optical-microstructures for read-only holograms**, Joo Yeon Kim, Electronics and Telecommunications Research Institute (Korea, Republic of); Seung-Yeol Lee, Kyungpook National Univ. (Korea, Republic of); Yong-Hae Kim, Sanghoon Cheon, Seong-Mok Cho, Hojun Ryu, Tae-Youb Kim, Electronics and Telecommunications Research Institute (Korea, Republic of) . . . . . [10395-43]
- Rapid and high-throughput microalgae monitoring platform based on lens-free shadow imaging technology**, Dongmin Seo, Sanghoon Shin, Korea Univ. (Korea, Republic of); Sangwoo Oh, Korea Research Institute of Ships and Ocean Engineering (Korea, Republic of); Kiyoung Ann, Euijin Han, Korea Univ. (Korea, Republic of); Moonjin Lee, Korea Research Institute of Ships and Ocean Engineering (Korea, Republic of); Sungkyu Seo, Korea Univ. Sejong Campus (Korea, Republic of) . . . . . [10395-44]
- Polarization characteristic pulse electromagnetic signals**, Valentina Akperova, Oleg D. Moskaletz, Saint-Petersburg State Univ. of Aerospace Instrumentation (Russian Federation) . . . . . [10395-45]

**Optic fields transformation in acousto-optical signal processing systems**, Aleksei Orlov, Oleg D. Moskaletz, Saint-Petersburg State Univ. of Aerospace Instrumentation (Russian Federation) . . . . . [10395-46]

**Diffraction lenses in biocompatible photopolymers using LCoS**, Sergi Gallego, Roberto Fernández, Víctor Navarro-Fuster, Manuel Ortuño, Andrés Mázquez, Cristian Neipp, Augusto Beléndez, Inmaculada Pascual, Univ. de Alicante (Spain) . . . . . [10395-47]

**Laser radiation scattering by the cement in the process of setting and hardening**, Peter P. Maksimyak, Mykhaylo P. Gorsky, Andrew P. Maksimyak, Yuriy Fedkovych Chernivtsi National Univ. (Ukraine) . . . . . [10395-48]

**Phase-depth mapping in structured light field: analysis and application**, Zewei Cai, Xiaoli Liu, Dingnan Deng, Xiang Peng, Shenzhen Univ. (China) . . . . . [10395-49]

**Spectral analysis of a secure chaotic free space optical communication system**, Marc M. Sepantaie, Nader M. Namazi, Amir M. Sepantaie, The Catholic Univ. of America (USA) . . . . . [10395-50]

**Aerosol detection using Lidar-based atmospheric profiling**, Mohamed I. Elbakary, Old Dominion Univ. (USA); Hossam M. Abdelghaffar, Virginia Polytechnic Institute and State Univ. (USA); Kwasi Afrifa, Old Dominion Univ. (USA); Hesham A. Rakha, Virginia Polytechnic Institute and State Univ. (USA); Mecit Cetin, Khan M. Iftekharruddin, Old Dominion Univ. (USA) . . . . . [10395-52]

**Phase demodulation for digital fringe projection profilometry: a review**, Juana Martinez Laguna, Rigoberto Juarez-Salazar, Victor H. Diaz-Ramirez, Ctr. de Investigación y Desarrollo de Tecnología Digital (Mexico) . . . . . [10395-53]

**Polarimetric and diffractive evaluation of 3.74 micron pixel-size LCoS in the telecommunications C-band**, Mi Wang, Huawei Technologies Duesseldorf GmbH (Germany); Francisco J. Martínez-Guardiola, Andrés Márquez, Univ. de Alicante (Spain); Yabin Ye, Huawei Technologies Duesseldorf GmbH (Germany); Liangjia Zong, Huawei Technologies Co., Ltd. (China); Inmaculada Pascual, Augusto Beléndez, Univ. de Alicante (Spain) . . . . . [10395-54]

**Quantification of absolute blood velocity using LDA**, Mariya A. Borozdova, Ivan Fedosov, Valery Tuchin, Saratov State Univ. (Russian Federation) . . . . . [10395-55]

**Research on characteristic of scattered light in laser Doppler velocimeter**, Xiaoming Nie, Qiucheng Gong, Jian Zhou, National Univ of Defense Technology (China) . . . . . [10395-56]

**Classification of cognitive systems dedicated to data sharing**, Lidia Dominika Ogiela, Marek R. Ogiela, AGH Univ. of Science and Technology (Poland) [10395-57]

## TUESDAY 8 AUGUST

### SESSION 5

LOCATION: CONV. CTR. ROOM 31A . TUE 8:20 AM TO 10:00 AM

### Algorithms and Automation

Session Chair: **Khan M. Iftekharruddin**, Old Dominion Univ. (USA)

- 8:20 am: **Unassisted reduction and segmentation of large hyperspectral image datasets**, Leanna N. Ergin, John F. Turner, Cleveland State Univ. (USA) [10395-20]
- 8:40 am: **Visual environment recognition for robot path planning using template matched filters**, Ulises Orozco-Rosas, Kenia Picos Espinoza, CETYS Univ. Baja California (Mexico); Victor H. Diaz-Ramirez, Oscar Montiel, Roberto Sepulveda, Ctr. de Investigación y Desarrollo de Tecnología Digital (Mexico) . . . . . [10395-21]
- 9:00 am: **Optical beam classification using deep learning: a comparison with rule and feature based classification**, Md. Zahangir Alom, Univ. of Dayton (USA); Abdul A. S. Awwal, Roger R. Lowe-Webb, Lawrence Livermore National Lab. (USA); Tarek M. Taha, Univ. of Dayton (USA) . . . . . [10395-58]
- 9:20 am: **Dynamic vehicle guidance by B-spline curves**, Rigoberto Juarez-Salazar, Victor H. Diaz-Ramirez, Ctr. de Investigación y Desarrollo de Tecnología Digital (Mexico); Edgar Hernandez-Garcia, Jose Ramiro-Ramiro, Marcos A. Alvarez-Trejo, Instituto Tecnológico Superior de Zacapoaxtla (Mexico) . . . . . [10395-23]
- 9:40 am: **Road mark recognition using HOG-SVM and correlation**, Ayman Alfalou, Younsri Ouerhani, C. Brosseau, ISEN Brest (France) . . . . . [10395-24]
- Coffee Break . . . . . Tue 10:00 am to 10:30 am



# CONFERENCE 10395

## SESSION 6

LOCATION: CONV. CTR. ROOM 31A . TUE 10:30 AM TO 12:10 PM

### Algorithms and Encryption

Session Chair: **Mireya Sarai García Vázquez**, Ctr. de Investigación y Desarrollo de Tecnología Digital (Mexico)

10:30 am: **Cognitive approaches for patterns analysis and security applications**, Marek R. Ogiela, Lidia D. Ogiela, AGH Univ. of Science and Technology (Poland) . . . . . [10395-25]

10:50 am: **Bimodal database classification**, Mireya Sarai García Vázquez, Luis Miguel Zamudio Fuentes, Ctr. de Investigación y Desarrollo de Tecnología Digital (Mexico); Alejandro Álvaro Ramírez Acosta, MIRAL R&D&I (USA) . . . . . [10395-26]

11:10 am: **A study of multiple correct keys and heuristic attacks in optical encryption**, Lingfei Zhang, Thomas J. Naughton, National Univ. of Ireland, Maynooth (Ireland) . . . . . [10395-27]

11:30 am: **Performance evaluation of the multiple-image optical compression and encryption (MIOCE) method by increasing target images number**, Ayman Alfalou, M. Aldossari, C. Brosseau, ISEN Brest (France) . . . . . [10395-28]

11:50 am: **A low-light-level video recursive filtering technology based on the three-dimensional coefficients**, Rongguo Fu, Shu Feng, Tianyu Shen, Hao Luo, Yifang Wei, Nanjing Univ. of Science and Technology (China); Qi Yang, Institute of Electric Science of Shanxi Province (China) . . . . . [10395-29]

Lunch/Exhibition Break . . . . . Tue 12:10 pm to 1:30 pm

LOCATION: CONV. CTR. ROOM 6A . . . TUE 1:30 PM TO 2:30 PM

### Signal, Image, and Data Processing Plenary Session

Session Chair: **Abdul A. S. Awwal**, Lawrence Livermore National Lab. (USA)

1:30 pm: **Fast automated 3D modeling of building interiors (Plenary)**, Avideh Zakhor, Univ. of California, Berkeley (USA) . . . . . [10395-500]

## SESSION 7

LOCATION: CONV. CTR. ROOM 31A . . . TUE 2:40 PM TO 5:10 PM

### Algorithms and Systems

Session Chair: **Mohammad A. Matin**, Univ. of Denver (USA)

2:40 pm: **Audio classification**, Mireya Sarai García Vázquez, Luis Miguel Zamudio Fuentes, Ctr. de Investigación y Desarrollo de Tecnología Digital (Mexico); Alejandro Álvaro Ramírez Acosta, MIRAL R&D&I (USA) . . . . . [10395-30]

3:00 pm: **Adaptive noise filtering of sinusoidal signals with unknown nonlinear phase**, Rigoberto Juarez-Salazar, Victor H. Díaz-Ramírez, Ctr. de Investigación y Desarrollo de Tecnología Digital (Mexico) . . . . . [10395-31]

Coffee Break . . . . . Tue 3:20 pm to 3:50 pm

3:50 pm: **Ultra-high-speed multiframe imaging with all-optical information shutters**, Guanghua Chen, China Academy of Engineering Physics (China) . . . . . [10395-32]

4:10 pm: **Experimental demonstration of OFDM/OQAM transmission with DFT-based channel estimation for visible laser light communication system**, Jing He, Jin Shi, Rui Deng, Lin Chen, Hunan Univ. (China) . . . . . [10395-33]

4:30 pm: **The least-squares algorithm for interferograms with random phase shifts**, Zhongsheng Zhai, Hubei Univ. of Technology (China) . . . . . [10395-34]

4:50 pm: **Research on active polarization-based target detection on sea surface**, Dongming Lu, Guohua Gu, Lixiang Geng, Jiang Xu, Nanjing Univ. of Science and Technology (China) . . . . . [10395-51]

# CONFERENCE 10396

LOCATION: CONV. CTR. ROOM 31C

Monday–Thursday 7–10 August 2017 • Proceedings of SPIE Vol. 10396

## Applications of Digital Image Processing XL

Conference Chair: **Andrew G. Tescher**, AGT Associates (USA)

Program Committee: **Anne Margot Aaron**, Netflix, Inc. (USA); **Vasudev Bhaskaran**, Qualcomm Inc. (USA); **Antonin Descampe**, intoPIX s.a. (Belgium); **Frederic Dufaux**, Télécom ParisTech (France); **Touradj Ebrahimi**, Ecole Polytechnique Fédérale de Lausanne (Switzerland); **Ofer Hadar**, Ben-Gurion Univ. of the Negev (Israel); **Arianne T. Hinds**, CableLabs (USA); **C.-C. Jay Kuo**, The Univ. of Southern California (USA); **Ajay Luthra**, ARRIS Group, Inc. (USA); **Andre J. Oosterlinck**, Kuleuven R & D (Belgium); **Sethuraman Panchanathan**, Arizona State Univ. (USA); **Fernando Pereira**, Instituto de Telecomunicações (Portugal); **Yuriy A. Reznik**, InterDigital, Inc. (USA); **Thomas Richter**, Univ. Stuttgart (Germany); **John A. Saghri**, California Polytechnic State Univ., San Luis Obispo (USA); **Peter Schelkens**, Vrije Univ. Brussel (Belgium); **Gary J. Sullivan**, Microsoft Corp. (USA); **David S. Taubman**, The Univ. of New South Wales (Australia); **Pankaj Topiwala**, FastVDO Inc. (USA); **Mihaela van der Schaar**, Univ. of California, Los Angeles (USA); **Anthony Vetro**, Mitsubishi Electric Research Labs. (USA)

### MONDAY 7 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 31C MON 8:50 AM TO 10:30 AM

#### Image Restoration and Tracking

Session Chair: **Andrew G. Tescher**, AGT Associates (USA)

8:50 am: **Joint denoising, demosaicing, and chromatic aberration correction for UHD video**, Ljubomir Jovanov, Wilfried Philips, Univ. Gent (Belgium); Klaas Jan Damstra, Frank Ellenbroek, Grass Valley Nederland B.V. (Netherlands) . . . [10396-2]

9:10 am: **A hardware architecture for real-time shadow removal in high-contrast video**, Pablo Verdugo, Jorge E. Pezoa Nunez, Miguel Figueroa, Univ. de Concepción (Chile) . . . [10396-3]

9:30 am: **High quality image recovery**, Xiteng Liu, QualVisual Technology (Canada) . . . [10396-4]

9:50 am: **Image quality assessment for determining efficacy and limitations of image processing methods**, Chris M. Ward, Joshua D. Harguess, Shubin Parameswaran, SPAWAR Systems Ctr. Pacific (USA) . . . [10396-5]

10:10 am: **The role of optical flow in automated quality assessment of full-motion video**, Joshua D. Harguess, Scott Shafer, SPAWAR Systems Ctr. Pacific (USA) . . . [10396-6]

Coffee Break . . . . . Mon 10:30 am to 11:00 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 31C MON 11:00 AM TO 12:20 PM

#### Future Video I

Session Chair: **Pankaj Topiwala**, FastVDO Inc. (USA)

11:00 am: **Prediction of HDR quality by combining perceptually transformed display measurements with machine learning**, Anustup Choudhury, Suzanne Farrell, Robin Atkins, Scott J. Daly, Dolby Labs., Inc. (USA) . . . [10396-7]

11:20 am: **Low complexity reference frame selection in QTBT structure for JVET future video coding**, Sang-hyo Park, Tianyu Dong, Euee S. Jang, Hanyang Univ. (Korea, Republic of) . . . [10396-8]

11:40 am: **Performance analysis of the AV1 video codec on 360 video coding**, Adeel Abbas, Sandeep Doshi, GoPro, Inc. (USA); Pankaj Topiwala, Wei Dai, Madhu Krishnan, FastVDO Inc. (USA) . . . [10396-9]

12:00 pm: **Viewport analysis for omnidirectional videos**, Adeel Abbas, Sandeep Doshi, GoPro, Inc. (USA); Pankaj Topiwala, Wei Dai, Madhu Krishnan, FastVDO Inc. (USA) . . . [10396-10]

Lunch Break . . . . . Mon 12:20 pm to 1:30 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 31C . . MON 1:30 PM TO 5:30 PM

#### Future Video II

Session Chair: **Pankaj Topiwala**, FastVDO Inc. (USA)

1:30 pm: **Verification testing of the HEVC screen content coding extensions**, Gary J. Sullivan, Microsoft Corp. (USA); Vittorio A. Baroncini, GBTech (Italy); Rajan L. Joshi, Qualcomm Inc. (USA); Shan Liu, MediaTek USA Inc. (USA); Jizheng Xu, Microsoft Research Asia (China); Haoping Yu, Huawei Technologies Co., Ltd. (USA); Xiaoyu Xiu, InterDigital Communications, Inc. (USA) . . . [10396-11]

1:50 pm: **JPEG XS-based frame buffer compression inside HEVC for power-aware video compression**, Alexandre Willème, Antonin Descampe, Univ. Catholique de Louvain (Belgium); Gaël Rouvroy, Pascal Pellegrin, intoPIX s.a. (Belgium); Benoît M. Macq, Univ. Catholique de Louvain (Belgium) . . . [10396-12]

2:10 pm: **Comparison and enhancements of JVET, AV1, and HEVC codecs**, Pankaj Topiwala, Wei Dai, FastVDO Inc. (USA) . . . [10396-13]

2:30 pm: **Advanced single-stream HDR coding with SDR backward compatibility**, Pankaj Topiwala, FastVDO Inc. (USA) . . . [10396-14]

2:50 pm: **Novel inter and intra prediction tools under consideration for the emerging AV1 video codec**, Urvang B. Joshi, Debargha Mukherjee, Jingning Han, Yue Chen, Sarah Parker, Hui Su, Angie Chiang, Yaowu Xu, Google (USA); Zoe Liu, Google (USA); Yunqing Wang, Jim Bankoski, Google (USA) . . . [10396-15]

Coffee Break . . . . . Mon 3:10 pm to 3:30 pm

3:30 pm: **Novel intra prediction modes for AV1 codec**, Ariel Shleifer, Ofer Hadar, Ben-Gurion Univ. of the Negev (Israel) . . . [10396-16]

3:50 pm: **Display of high dynamic range images under varying viewing conditions**, Tim Borer, British Broadcasting Corp. (United Kingdom) . . . [10396-17]

4:10 pm: **Spherical rotation orientation indication for HEVC and JEM coding of 360 degree video**, Jill M. Boyce, Qian Xu, Intel Corp. (USA) . . . [10396-18]

4:30 pm: **Complexity and performance tradeoff for next generation video coding standard development**, Elena A. Alshina, SAMSUNG Electro-Mechanics (Korea, Republic of) . . . [10396-19]

4:50 pm: **Optimal design of encoding profiles for ABR streaming**, Yuriy A. Reznik, Karl O. Lillevold, Abhijith Jagannath, Justin Greer, Manish Rao, Brightcove, Inc. (USA) . . . [10396-20]

5:10 pm: **Performance comparison of AV1, JEM, VP9, and HEVC encoders**, Dan Grois, Tung Nguyen, Detlev Marpe, Fraunhofer-Institut für Nachrichtentechnik Heinrich-Hertz-Institut (Germany) . . . [10396-120]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 . . . . . MON 5:30 PM TO 7:30 PM

#### Posters-Monday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Dynamic frame resizing with convolutional neural network for efficient video compression**, Jaehwan Kim, Youngo Park, Kwang Pyo Choi, Jong-Seok Lee, Sunyoung Jeon, Jeong-Hoon Park, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) . . . [10396-63]

**Variable block Harris-based-features image watermarking**, Issam J. Dagher, Univ. of Balamand (Lebanon) . . . [10396-64]

**A multi-scale segmentation algorithm for high resolution remote sensing images**, Tingting Zhou, Lingjia Gu, Ruizhi Ren, Jilin Univ. (China) . . . [10396-65]

**Automated extraction of complex shape buildings from high resolution imagery**, Qiong Cao, Lingjia Gu, Ruizhi Ren, Tingting Zhou, Jilin Univ. (China) . . . [10396-66]

**Blind image quality evaluation using the conditional histogram patterns of divisive normalization transform coefficients**, Ying Chu, Shenzhen Univ. (China); Xuanqin Mou, Xi'an Jiaotong Univ. (China); Hengyong Yu, Univ. of Massachusetts Lowell (USA) . . . [10396-67]

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- An effective road extraction algorithm from high resolution remote sensing images**, Yushan Zhang, Tingfa Xu, Beijing Institute of Technology (China); Tingting Zhou, Jilin Univ. (China) . . . . . [10396-68]
- Investigation of methods for construct a system of optical sensors for measure relative orientation of industrial robots for monitoring of the technosphere objects**, Andrey V. Petrochenko, Igor A. Konyakhin, ITMO Univ. (Russian Federation) . . . . . [10396-69]
- Siamese convolutional networks for tracking the lumbar spine**, Yuan Liu, Nanjing Univ. of Science and Technology (China) . . . . . [10396-70]
- Research on node extraction based on line feature**, Xiaofeng Li, Sheng Chen, Weimin Li, Yuhai Zhang, Univ. of Science and Technology of China (China) . . . . . [10396-71]
- An efficient algorithm for coplanar feature points matching in binocular vision photogrammetry**, Weimin Li, Siyu Shan, Yuhai Zhang, Gang Liu, Sheng Chen, Univ. of Science and Technology of China (China); Xiaofeng Li, Univ of Science and Technology of China (China) . . . . . [10396-72]
- Real-time heartrate measurement for multi-people using compressive tracking**, Ling Liu, Yuejin Zhao, Ming Liu, Lingqin Kong, Liqun Dong, Feilong Ma, Zhi Cai, Zongguang Pang, Yachu Zhang, Peng Hua, Ruifeng Yuan, Beijing Institute of Technology (China) . . . . . [10396-73]
- Vision-based mobile robot navigation through deep convolutional neural networks and end-to-end learning**, Yachu Zhang, Yuejin Zhao, Ming Liu, Liqun Dong, Mei Hui, Lingqin Kong, Xiaohua Liu, Beijing Institute of Technology (China) . . . . . [10396-74]
- A locally adaptive algorithm for shadow correction in color images**, Victor Karnaukhov, Vitaly Kober, Institute for Information Transmission Problems (Russian Federation) . . . . . [10396-75]
- Tracking of multiple objects with time-adjustable composite correlation filters**, Alexey Ruchay, Chelyabinsk State Univ. (Russian Federation); Vitaly Kober, Ctr. de Investigación Científica y de Educación Superior de Ensenada B.C. (Mexico); Ilya Chernoskulov, Chelyabinsk State Univ. (Russian Federation) . . . . . [10396-76]
- Fast perceptual image hash based on cascade algorithm**, Alexey Ruchay, Chelyabinsk State Univ. (Russian Federation); Vitaly Kober, Ctr. de Investigación Científica y de Educación Superior de Ensenada B.C. (Mexico); Evgeniya Evtushenko, Chelyabinsk State Univ. (Russian Federation) . . . . . [10396-77]
- Removal of impulse noise clusters from color images with local order statistics**, Alexey Ruchay, Chelyabinsk State Univ. (Russian Federation); Vitaly Kober, Ctr. de Investigación Científica y de Educación Superior de Ensenada B.C. (Mexico) . . . . . [10396-78]
- Impulsive noise removal from color video with morphological filtering**, Alexey Ruchay, Chelyabinsk State Univ. (Russian Federation); Vitaly Kober, Ctr. de Investigación Científica y de Educación Superior de Ensenada B.C. (Mexico) . . . . . [10396-79]
- Application of white-light phase-shifting interferometry in white-light scanning interferometry**, Yujing Wu, Yunsheng Qian, Nanjing Univ. of Science and Technology (China) . . . . . [10396-80]
- Edge detection for optical synthetic aperture based on deep neural network**, Wenjie Tan, Mei Hui, Ming Liu, Lingqin Kong, Liqun Dong, Yuejin Zhao, Beijing Institute of Technology (China) and Beijing Key Lab. of Precision Photoelectric Measuring Instrument and Technology (China) . . . . . [10396-81]
- Accurate generation of the 3D map of environment with a RGB-D camera**, Jose A. González-Fraga, Univ. Autónoma de Baja California (Mexico); Vitaly Kober, Ctr. de Investigación Científica y de Educación Superior de Ensenada B.C. (Mexico); Victor H. Diaz-Ramirez, Ctr. de Investigación y Desarrollo de Tecnología Digital-IPN (Mexico); Everardo Gutiérrez López, Omar Alvarez-Xochihua, Univ. Autónoma de Baja California (Mexico) . . . . . [10396-82]
- Veterinary software application for comparison of thermograms for pathology evaluation**, Gita Pant, Scott E. Umbaugh, Rohini Dahal, Norsang Lama, Southern Illinois Univ. Edwardsville (USA); Dominic J. Marino, Joseph Sackman, Long Island Veterinary Specialists (USA) . . . . . [10396-83]
- Haze removal method based on decomposition**, Xifang Zhu, Ruxi Xiang, Feng Wu, Qingquan Xu, Xiaoyan Jiang, Chunyu Zhao, Changzhou Institute of Technology (China) . . . . . [10396-84]
- Texture analysis integrated to infrared light sources for identifying high fringe concentrations in digital photoelasticity**, Hermes Fandiño Toro, Univ. Nacional de Colombia Sede Medellín (Colombia) and Instituto Tecnológico Metropolitano (Colombia); Juan Carlos Briñez de León, Alejandro Restrepo Martínez, John W. Branch Bedoya, Univ. Nacional de Colombia Sede Medellín (Colombia) . . . . . [10396-85]
- Robot path planning algorithm based on symbolic tags in dynamic environment**, Aleksandr Vokhmintcev, Andrey Melnikov, Aleksandr Kozko, Chelyabinsk State Univ. (Russian Federation) . . . . . [10396-86]
- Application of speckle-field images processing for concrete hardening diagnostics**, Mykhaylo P. Gorsky, Peter P. Maksymyak, Yuriy Fedkovych Chernivtsi National Univ. (Ukraine) . . . . . [10396-87]
- Transform extension for block-based hybrid video codec with decoupling transform sizes from prediction sizes and coding sizes**, Jing Chen, Peking Univ. Shenzhen Graduate School (China) . . . . . [10396-88]
- A new cloud detection method based on CNN and SVM joint algorithm**, Zhicheng Yu, China Academy of Space Technology (China) . . . . . [10396-89]
- Robot mapping algorithm based on Kalman filtering and symbolic tags**, Aleksandr Vokhmintcev, Tatiana Botova, Ilya Sochenkov, Chelyabinsk State Univ. (Russian Federation); Anastasia S. Sochenkova, RUDN Univ. (Russian Federation); Artyom Makovetskii, Chelyabinsk State Univ. (Russian Federation) . . . . . [10396-90]
- An efficient point-to-plane registration algorithm for affine transformations**, Artyom Makovetskii, Sergei Voronin, Chelyabinsk State Univ. (Russian Federation); Vitaly Kober, Ctr. de Investigación Científica y de Educación Superior de Ensenada B.C. (Mexico); Dmitrii Tihonkih, Chelyabinsk State Univ. (Russian Federation) . . . . . [10396-91]
- A generalized Condat's algorithm of 1D total variation regularization**, Artyom Makovetskii, Sergei Voronin, Chelyabinsk State Univ. (Russian Federation); Vitaly Kober, Ctr. de Investigación Científica y de Educación Superior de Ensenada B.C. (Mexico) . . . . . [10396-92]
- Convolutional neural networks for face recognition**, Ilya Sochenkov, Chelyabinsk State Univ. (Russian Federation) and RUDN Univ. (Russian Federation); Anastasiia S. Sochenkova, RUDN Univ. (Russian Federation); Artyom Makovetskii, Andrey Melnikov, Chelyabinsk State Univ. (Russian Federation) . . . . . [10396-93]
- System of multifunctional Jones matrix tomography of phase anisotropy in diagnostics of endometriosis**, Alexander Ushenko, Vladimir Ushenko, Yuriy Fedkovych Chernivtsi National Univ. (Ukraine) . . . . . [10396-94]
- Azimuthally invariant Mueller-matrix mapping of biological optically anisotropic network**, Olexander V. Dubolazov, Alexander Ushenko, Yuriy Fedkovych Chernivtsi National Univ. (Ukraine) . . . . . [10396-95]
- Polarization-interference mapping of biological fluids polycrystalline films in differentiation of weak changes of optical anisotropy**, Olexander V. Dubolazov, Alexander Ushenko, Yuriy Fedkovych Chernivtsi National Univ. (Ukraine) [10396-96]
- Methods and means of 3D diffuse Mueller-matrix tomography of depolarizing optically anisotropic biological layers**, Olexander V. Dubolazov, Alexander Ushenko, Yuriy Fedkovych Chernivtsi National Univ. (Ukraine) . . . . . [10396-97]
- Feature recognition of metal salt spray corrosion based on color spaces statistics analysis**, Liqun Ma, Zhi Zou, Changcheng Institute of Metrology & Measurement (China) . . . . . [10396-98]
- New opportunities of differential diagnosis of biological tissues polycrystalline structure using methods of Stokes correlometry mapping of polarization inhomogeneous images**, Olexander V. Dubolazov, Yuriy Fedkovych Chernivtsi National Univ. (Ukraine) . . . . . [10396-99]
- Fuzzy logic for cognitive impairment prediction in structural imaging**, Annarita Fanizzi, I.R.R.C.C.S. Oncologico di Bari (Italy); Nicola Amoroso, Univ. degli Studi di Bari (Italy) and Istituto Nazionale di Fisica Nucleare (Italy); Roberto Bellotti, Univ. degli Studi di Bari Aldo Moro (Italy) and Istituto Nazionale di Fisica Nucleare (Italy); Sabina Tangaro, Istituto Nazionale di Fisica Nucleare (Italy) . . . . . [10396-100]
- Resolution analysis of archive films for the purpose of their optimal digitization and distribution**, Karel Fliegel, Stanislav Vitek, Petr Páta, Czech Technical Univ. in Prague (Czech Republic); Jiri Myslík, Josef Pecák, Marek Jícha, Film and TV School of Academy of Performing Arts in Prague (Czech Republic) . . . . . [10396-101]
- An efficient direct method for image registration of flat objects**, Dmitry Nikolaev, Artyom Makovetskii, Sergei Voronin, Chelyabinsk State Univ. (Russian Federation) . . . . . [10396-102]
- Smoothing of astronomical images with Poisson distribution**, Zuzana Krbcová, Univ. of Chemistry and Technology Prague (Czech Republic); Jaromír Kukal, Czech Technical Univ. in Prague (Czech Republic); Jan Švihlík, Univ. of Chemistry and Technology Prague (Czech Republic); Karel Fliegel, Czech Technical Univ. in Prague (Czech Republic) . . . . . [10396-103]
- A modified iterative closest point algorithm for noisy data**, Dmitrii Tihonkih, Artyom Makovetskii, Aleksei Voronin, Chelyabinsk State Univ. (Russian Federation) . . . . . [10396-104]
- Estimation of Poisson noise characteristics in wavelet domain**, Jan Švihlík, Univ. of Chemistry and Technology Prague (Czech Republic); Karel Fliegel, Czech Technical Univ. in Prague (Czech Republic); Jaromír Kukal, Zuzana Krbcová, Univ. of Chemistry and Technology Prague (Czech Republic) . . . . . [10396-105]
- Discrete Fourier transform limitations regarding the MTF measurement of optoelectronic imaging systems**, Oleg A. Perezyabov, ITMO Univ. (Russian Federation); Aleksandr V. Ilinski, S.I. Vavilov State Optical Institute (Russian Federation); Nadezhda K. Maltseva, ITMO Univ. (Russian Federation) . . . . . [10396-106]



**Efficient encryption of image data in video sequences using discrete orthogonal moments**, José Saúl Rivera López, Univ. Politécnica de Tulancingo (Mexico); César Joel Camacho Bello, Univ. Tecnológica de Tulancingo (Mexico) . . . . . [10396-107]

**High speed camera recording in the service of research of dependences between kinetics of eye pupil parameters and blood pulsation**, Marta A. Szmigiel, Henryk T. Kasprzak, Wrocław Univ. of Science and Technology (Poland) . . . . . [10396-108]

**The relation between the retinal image quality and the refractive index of defects arising in IOL: numerical analysis**, Malwina Geniusz, Wrocław Univ. of Science and Technology (Poland) . . . . . [10396-109]

**Analysis of image reconstruction artifacts in structured illumination microscopy**, Jakub Pospíšil, Czech Technical Univ. in Prague (Czech Republic); Tomáš Lukeš, Czech Technical Univ. in Prague (Czech Republic), Ecole Polytechnique Fédérale de Lausanne (Switzerland); Karel Fliegel, Miloš Klíma, Czech Technical Univ. in Prague (Czech Republic); Guy M. Hagen, Univ. of Colorado at Colorado Springs (USA) . . . . . [10396-110]

**FPGA implementation of image dehazing algorithm for real time applications**, Rahul Kumar, Brajesh Kumar Kaushik, Indian Institute of Technology Roorkee (India) . . . . . [10396-111]

**Radiometric calibration of wide-field camera system with an application in astronomy**, Stanislav Vitek, Czech Technical Univ. in Prague (Czech Republic) . . . . . [10396-112]

**Robust parameterization of time-frequency characteristics for recognition of musical genres of Mexican culture**, Osvaldo Gerardo Perez Rosas, Ctr. de Investigación y Desarrollo de Tecnología Digital (Mexico); Luis Alejandro Maldonado Cano, Ctr. de Investigación y Desarrollo de Tecnología Digital (Mexico); Mario Lopez Rodriguez, Ctr. de Investigación y Desarrollo de Tecnología Digital-IPN (Mexico); Laura Mariel Amaya Reyes, Ctr. de Investigación y Desarrollo de Tecnología Digital-IPN (Mexico); Elizabeth Cano Martinez, Ctr. de Investigación y Desarrollo de Tecnología Digital (Mexico); Mireya Sarai Garcia Vazquez, Ctr. de Investigación y Desarrollo de Tecnología Digital-IPN (Mexico); Alejandro Álvaro Ramirez Acosta, MIRAL R&D&I (USA) . . . . . [10396-113]

**Recognition of uncorrelated characters in maritime environment**, Chris M. Ward, SPAWAR Systems Ctr. Pacific (USA) . . . . . [10396-114]

**Text detection in natural scenes with phase congruency approach**, Julia Diaz-Escobar, Vitaly Kober, Ctr. de Investigación Científica y de Educación Superior de Ensenada B.C. (Mexico) . . . . . [10396-115]

**Enhancing user experience by using multi-sensor data fusion to predict phone's illumination**, Asmaa H. A. Al-Marhoubi, Higher College of Technology (Oman) . . . . . [10396-116]

**Global stereo matching algorithm based on disparity range estimation**, Jing Li, Hong Zhao, Xi'an Jiaotong Univ. (China); Feifei Gu, Shenzhen Institutes of Advanced Technology (China) . . . . . [10396-117]

**The error model of the handheld target in Target-based Vision Measurement System (T-VMS)**, Yueyang Ma, Hong Zhao, Xi'an Jiaotong Univ. (China); Feifei Gu, Shenzhen Institutes of Advanced Technology (China); Meiqi Fang, Hehui Geng, Keja Li, Xi'an Jiaotong Univ. (China) . . . . . [10396-118]

**Multiscale imaging of collagen**, Michael Pinkert, Zachary J Simmons, University of Wisconsin-Madison (USA); Brittany L Woods, Appalachian State University (USA); Adib Keikhosravi, Bing Dai, Timothy J Hall, Jeremy Rogers, Paul Campagnola, Kevin Eliceiri, University of Wisconsin-Madison (USA) . . . . . [10396-119]

## TUESDAY 8 AUGUST

### SESSION 4

**LOCATION: CONV. CTR. ROOM 31C . TUE 8:30 AM TO 12:00 PM**

### Low-Latency Lightweight Image Compression

Session Chairs: **Antonin Descampe**, intoPIX s.a. (Belgium); **David S. Taubman**, The Univ. of New South Wales (Australia); **Thomas Richter**, Univ. Stuttgart (Germany)

8:30 am: **JPEG XS: a new standard for visually lossless low-latency lightweight image compression**, Antonin Descampe, intoPIX s.a. (Belgium); Joachim Keinert, Fraunhofer-Institut für Integrierte Schaltungen (IIS) (Germany); Thomas Richter, Univ. Stuttgart (Germany); Siegfried Föbel, Fraunhofer-Institut für Integrierte Schaltungen (IIS) (Germany); Gaël Rouvroy, intoPIX s.a. (Belgium) . . . . . [10396-21]

8:50 am: **Overview of the JPEG XS objective evaluation procedures**, Alexandre Willème, Univ. Catholique de Louvain (Belgium); Thomas Richter, Univ. Stuttgart (Germany); Chris Rosewarne, Canon Information Systems Research Australia Pty. Ltd. (Australia); Benoît M. Macq, Univ. Catholique de Louvain (Belgium) . [10396-22]

9:10 am: **New procedures to evaluate visually lossless compression for display systems and mezzanine networks**, Dale Stolitzka, SAMSUNG Electronics Co., Ltd. (USA); Tim Bruylants, Vrije Univ. Brussel (Belgium) . . . . . [10396-23]

9:30 am: **JPEG XS call for proposals subjective evaluations**, David McNally, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Tim Bruylants, Vrije Univ. Brussel (Belgium) and IMEC (Belgium); Alexandre Willème, Univ. Catholique de Louvain (Belgium); Peter Schelkens, Vrije Univ. Brussel (Belgium) and IMEC (Belgium); Touradj Ebrahimi, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Benoît M. Macq, Univ. Catholique de Louvain (Belgium) . . [10396-24]

9:50 am: **High-speed low-complexity video coding with EDICTus: a DCT coding proposal for JPEG XS**, Thomas Richter, Univ. Stuttgart (Germany); Joachim Keinert, Siegfried Föbel, Fraunhofer-Institut für Integrierte Schaltungen (IIS) (Germany) . . . . . [10396-25]

Coffee Break . . . . . Tue 10:10 am to 10:40 am

10:40 am: **On a parallel rate control method for JPEG2000**, Miguel Ángel Martínez del Amor, Volker Bruns, Heiko Sparenberg, Fraunhofer-Institut für Integrierte Schaltungen (IIS) (Germany) . . . . . [10396-26]

11:00 am: **Lossless medical image compression through lightweight binary arithmetic coding**, Joan Bartrina Rapesta, Univ. Autònoma de Barcelona (Spain); Víctor Sanchez, The Univ. of Warwick (United Kingdom); Joan Serra Sagrsitá, Univ. Autònoma de Barcelona (Spain); Michael W. Marcellin, The Univ. of Arizona (USA); Francesc Aulí Llinàs, Ian Blanes, Univ. Autònoma de Barcelona (Spain) . [10396-27]

11:20 am: **FBCOT: a fast block coding option for JPEG2000**, David S. Taubman, Aous Naman, Reji Mathew, The Univ. of New South Wales (Australia) . . [10396-28]

11:40 am: **Advanced display stream compression for mobile applications**, Natan Jacobson, Vijayaraghavan Thirumalai, Rajan L. Joshi, James Goel, Qualcomm Inc. (USA) . . . . . [10396-29]

Lunch/Exhibition Break . . . . . Tue 12:00 pm to 1:30 pm

**LOCATION: CONV. CTR. ROOM 6A . . . TUE 1:30 PM TO 2:30 PM**

### Signal, Image, and Data Processing Plenary Session

Session Chair: **Abdul A. S. Awwal**, Lawrence Livermore National Lab. (USA)

1:30 pm: **Fast automated 3D modeling of building interiors (Plenary)**, Avideh Zakhor, Univ. of California, Berkeley (USA) . . . . . [10395-500]

### SESSION 5

**LOCATION: CONV. CTR. ROOM 31C . . TUE 2:40 PM TO 6:20 PM**

### VR and 360 Video

Session Chair: **Ajay Luthra**, ARRIS Group, Inc. (USA)

2:40 pm: **A novel projection for omnidirectional video**, Adeel Abbas, Sandeep Doshi, GoPro, Inc. (USA) . . . . . [10396-30]

3:00 pm: **Geometry padding for intra prediction in 360 video coding**, Philippe Hanhart, Yuwen He, Yan Ye, InterDigital Communications, Inc. (USA) . . [10396-31]

Coffee Break . . . . . Tue 3:20 pm to 3:40 pm

3:40 pm: **Segment scheduling method for reducing 360° video streaming latency**, Yong He, InterDigital Communications, Inc. (USA); Srinivas Gudumasu, Aricent Technologies (India); Eduardo Asbun, Yan Ye, InterDigital Communications, Inc. (USA) . . . . . [10396-32]

4:00 pm: **An ROI multi-resolution compression method for 3D-HEVC**, Chunli Ti, Yudong Guan, Guodong Xu, Yidan Teng, Xinyuan Miao, Harbin Institute of Technology (China) . . . . . [10396-33]

4:20 pm: **Key factors for a high quality VR experience**, Mary-Luc Champel, Technicolor S.A. (France) . . . . . [10396-34]

4:40 pm: **Wider angle viewports for omnidirectional video**, Adeel Abbas, Sandeep Doshi, GoPro, Inc. (USA) . . . . . [10396-35]

5:00 pm: **Depth map estimation using multiple captured images**, José Luis López Martínez, Univ. Autónoma de Yucatán (Mexico); Vitaly Kober, Ctr. de Investigación Científica y de Educación Superior de Ensenada B.C. (Mexico); Joel Antonio Trejo Sánchez, Ctr. de Investigación en Matemáticas, A.C., CONACyT (Mexico) . . . . . [10396-36]

5:20 pm: **Omnidirectional video quality metrics and evaluation process**, Elena A. Alshina, SAMSUNG Electro-Mechanics (Korea, Republic of); Vladyslav S. Zakharchenko, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) . . . [10396-37]

5:40 pm: **Measuring quality of omnidirectional high dynamic range content**, Anne-Flore Perrin, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Camodge Bist, Institut de recherche technologique B-Com (France); Touradj Ebrahimi, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . [10396-38]

6:00 pm: **True 3D digital holographic tomography for virtual reality applications**, Alexander Downham, Ujitha A. Abeywickrema, Partha P. Banerjee, Univ. of Dayton (USA) . . . . . [10396-39]

# CONFERENCE 10396

WEDNESDAY 9 AUGUST

SESSION 6

LOCATION: CONV. CTR. ROOM 31C .WED 8:50 AM TO 12:20 PM

## Medical Imaging

Session Chair: **Peter Schelkens**, Vrije Univ. Brussel (Belgium)

8:50 am: **Forming intermediate spatial resolution of microscopy images for continuous zooming on multi-resolution processing system**, Evan Hutomo Eka Putranto, Tomohiro Suzuki, Shin Usuki, Kenjiro Takai Miura, Shizuoka Univ. (Japan) . . . . . [10396-40]

9:10 am: **Hough transform for microcalcification detection in digital mammograms**, Annarita Fanizzi, I.R.C.C.S. Istituto Tumori "Giovanni Paolo II" (Italy); Teresa M. A. Basile, Univ. degli Studi di Bari Aldo Moro (Italy); Ubaldo Bottigli, Univ. degli Studi di Siena (Italy); Rosalba Dentamaro, Vittorio Didonna, I.R.C.C.S. Istituto Tumori "Giovanni Paolo II" (Italy); Alfonso Fausto, Azienda Ospedaliera Univ. Senese (Italy); Raffaella Massafra, I.R.C.C.S. Istituto Tumori "Giovanni Paolo II" (Italy); Marco Moschetta, Univ. degli Studi di Bari Aldo Moro (Italy); Liliana Losurdo, Pasquale Tamborra, I.R.C.C.S. Istituto Tumori "Giovanni Paolo II" (Italy); Sonia Tangaro, Istituto Nazionale di Fisica Nucleare (Italy); Roberto Bellotti, Univ. degli Studi di Bari Aldo Moro (Italy) and Istituto Nazionale di Fisica Nucleare (Italy); Daniele La Forgia, I.R.C.C.S. Istituto Tumori "Giovanni Paolo II" (Italy) . . . . . [10396-41]

9:30 am: **Smartphone assisted microscopy for automated quantification of ER, PR, and Ki-67 molecular markers**, Suman Tewary, Chandan Chakraborty, Indian Institute of Technology Kharagpur (India); Indu Arun, Rosina Ahmed, Sanjoy Chatterjee, Tata Medical Ctr. (India) . . . . . [10396-42]

9:50 am: **A multi-layer description of Parkinson's disease**, Marianna La Rocca, Nicola Amoroso, Roberto Bellotti, Univ. degli Studi di Bari Aldo Moro (Italy); Sabina Tangaro, Istituto Nazionale di Fisica Nucleare (Italy) . . . . . [10396-44]

Coffee Break . . . . . Wed 10:10 am to 10:40 am

10:40 am: **Machine learning for the assessment of Alzheimer's disease through DTI**, Eufemia Lella, Nicola Amoroso, Roberto Bellotti, Univ. degli Studi di Bari Aldo Moro (Italy); Domenico Diacono, Istituto Nazionale di Fisica Nucleare (Italy); Tommaso Maggipinto, Univ. degli Studi di Bari Aldo Moro (Italy); Alfonso Monaco, Sabina Tangaro, Istituto Nazionale di Fisica Nucleare (Italy) . . . . . [10396-45]

11:00 am: **Association between MRI structural features and cognitive measures in multiple sclerosis**, Nicola Amoroso, Univ. degli Studi di Bari Aldo Moro (Italy) and Istituto Nazionale di Fisica Nucleare (Italy); Roberto Bellotti, Istituto Nazionale di Fisica Nucleare (Italy) and Univ. degli Studi di Bari Aldo Moro (Italy); Alfonso Monaco, Istituto Nazionale di Fisica Nucleare (Italy); Maria Liguori, Consiglio Nazionale delle Ricerche (Italy); L. Margari, Univ. degli Studi di Bari Aldo Moro (Italy); Marta Simone, Univ. degli Studi di Bari Aldo Moro (Italy); R.G. Viterbo, Univ. degli Studi di Bari Aldo Moro (Italy); Sabina Tangaro, Istituto Nazionale di Fisica Nucleare (Italy) . . . . . [10396-46]

11:20 am: **Brain's tumor image processing using shearlet transform**, Luis Cadena, Univ. de las Fuerzas Armadas-ESPE (Ecuador) and Siberian State Aerospace Univ. (Russian Federation); Franklin Cadena, Colegio Juan Suarez Chacon (Ecuador); Nikolai D. Espinosa Ortiz, Univ. de las Fuerzas Armadas-ESPE (Ecuador); Anna Korneeva, Alexey Kruglyakov, Alexander Legalov, Siberian Federal Univ. (Russian Federation); Alexey Romanenko, Novosibirsk State Univ. (Russian Federation); Alexander Zotin, Siberian State Aerospace Univ. (Russian Federation) . . . . . [10396-47]

11:40 am: **Demyelinating disease and cerebral ischemia: detection algorithm through MRI**, Darwin P. Castillo Malla, Univ. Técnica Particular de Loja (Ecuador); René Samaniego, Hospital UTPL (Ecuador); María José Rodríguez-Álvarez, Univ. Politècnica de València (Spain) . . . . . [10396-48]

12:00 pm: **Breast thermograms analysis in the search of temperature gradients linked with breast injuries**, Osmond Abraham Zermeño Loreto, Carina Toxqui Quitl, Univ. Politécnica de Tulancingo (Mexico); Eber E. Orozco Guillen, Univ. Politécnica de Sinaloa (Mexico); Alfonso Padilla Vivanco, Univ. Politécnica de Tulancingo (Mexico) . . . . . [10396-49]

Lunch/Exhibition Break . . . . . Wed 12:20 pm to 2:10 pm

SESSION 7

LOCATION: CONV. CTR. ROOM 31C .WED 2:10 PM TO 4:40 PM

## Plenoptic Imaging

Session Chairs: **Peter Schelkens**, Vrije Univ. Brussel (Belgium); **Arianne T. Hinds**, CableLabs (USA)

2:10 pm: **Weighted bi-prediction for light field image coding**, Caroline Conti, Instituto de Telecomunicações (Portugal) and Instituto Univ. de Lisboa (Portugal); Paulo Nunes, Luís Ducla Soares, Instituto de Telecomunicações (Portugal) and Instituto Universitário de Lisboa (ISCTE-IUL) (Portugal) . . . . . [10396-50]

2:30 pm: **A new framework for interactive quality assessment with application to light field coding**, Irene Viola, Touradj Ebrahimi, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . . [10396-51]

2:50 pm: **Liborg: a lidar-based robot for efficient 3D mapping**, Michiel Vlamincq, Hiệp Q. Luong, Wilfried Philips, Univ. Gent (Belgium) . . . . . [10396-52]

Coffee Break . . . . . Wed 3:10 pm to 3:40 pm

3:40 pm: **On the performance of metrics to predict quality in point cloud representations**, Evangelos Alexiou, David McNally, Touradj Ebrahimi, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . . [10396-53]

4:00 pm: **A new similarity measure for complex amplitude holographic data**, Ayyoub Ahar, Tobias Birnbaum, Vrije Univ. Brussel (Belgium) and IMEC (Belgium); Christian Jäh, Loughborough Univ. (United Kingdom); Peter Schelkens, Vrije Univ. Brussel (Belgium) and IMEC (Belgium) . . . . . [10396-54]

4:20 pm: **Computer-generated holographic near-eye display system based on LCoS phase only modulator**, Peng Sun, Fei Fei, Shengqian Chang, Siman Zhang, Ting Xie, Huaye Li, Liu Siqi, Wang Chang, Zhenrong Zheng, Zhejiang Univ. (China) . . . . . [10396-55]

THURSDAY 10 AUGUST

SESSION 8

LOCATION: CONV. CTR. ROOM 31C .THU 9:00 AM TO 11:10 AM

## Object Detection and Tracking

Session Chairs: **Vasudev Bhaskaran**, Qualcomm Inc. (USA); **Ofer Hadar**, Ben-Gurion Univ. of the Negev (Israel)

9:00 am: **A neighborhood vector PCA method for small defect target detection**, Zhengzhou Wang, Xi'an Jiaotong Univ. (China); Bingliang Hu, Xi'an Institute of Optics and Precision Mechanics, CAS (China) . . . . . [10396-56]

9:20 am: **3D+T motion analysis with nanosensors**, Jean-Pierre Leduc, Reliance Core Consulting (USA) . . . . . [10396-59]

9:40 am: **Low-complexity object detection with deep convolutional neural network for embedded system**, Subarna Tripathi, Univ. of California, San Diego (USA); Gökçe Dane, Qualcomm Inc. (USA); Byeongkeun Kang, Truong Nguyen, Univ. of California, San Diego (USA) . . . . . [10396-60]

Coffee Break . . . . . Thu 10:00 am to 10:30 am

10:30 am: **An embedded system for face classification in infrared video using sparse representations**, Antonio Saavedra, Jorge E. Pezoa Nunez, Univ. de Concepción (Chile); Payman Zarkesh-Ha, The Univ. of New Mexico (USA); Miguel Figueroa, Univ. de Concepción (Chile) . . . . . [10396-61]

10:50 am: **BDVC (Bimodal Database of Violent Content): a database of violent audio and video**, Jose L. Rivera, Mario Humberto Mijes Cruz, Ctr. de Investigación y Desarrollo de Tecnología Digital-IPN (Mexico); Abraham Montoya Obeso, Luis Rodríguez Espejo, Manuel Antonio Rodríguez Vazquez, Mireya García, Ctr. de Investigación y Desarrollo de Tecnología Digital-IPN (Mexico); Alejandro Álvaro Ramírez Acosta, MIRAL R&D&I (USA) . . . . . [10396-62]

# CONFERENCE 10397

LOCATION: CONV. CTR. ROOM 7B

Sunday–Tuesday 6–8 August 2017 • Proceedings of SPIE Vol. 10397

## UV, X-Ray, and Gamma-Ray Space Instrumentation for Astronomy XX

Conference Chair: **Oswald H. Siegmund**, Univ. of California, Berkeley (USA)

Program Committee: **Camden Ertley**, Univ. of California, Berkeley (USA); **Brian T. Fleming**, Univ. of Colorado at Boulder (USA); **James C. Green**, Univ. of Colorado at Boulder (USA); **Stephan R. McCandliss**, Johns Hopkins Univ. (USA); **Anton Tremis**, Univ. of California, Berkeley (USA)

### SUNDAY 6 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 7B . . . SUN 11:00 AM TO 12:00 PM

#### Solid State Detectors I

Session Chair: **Camden Ertley**, Space Sciences Lab. (USA)

11:00 am: **Modeling and measuring charge sharing in hard x-ray imagers using HEXITEC CdTe detectors**, Daniel F. Ryan, Steven D. Christe, Albert Y. Shih, Andrew Inglis, Wayne H. Baumgartner, NASA Goddard Space Flight Ctr. (USA); Matthew D. Wilson, Paul Seller, STFC Rutherford Appleton Lab. (United Kingdom); Jessica A. Gaskin, NASA Marshall Space Flight Ctr. (USA) . . . . . [10397-1]

11:20 am: **Developing monolithic CMOS detectors as x-ray imaging spectrometers**, Almus T. Kenter, Thomas M. Gauron, Ralph P. Kraft, Stephen M. Amato, Harvard-Smithsonian Ctr. for Astrophysics (USA) . . . . . [10397-2]

11:40 am: **Recent x-ray hybrid CMOS detector developments and measurements**, Sam Hull, Abe Falcone, David Burrows, Mitchell Wages, Tanmoy Chattopadhyay, Maria McQuaide, Evan Bray, The Pennsylvania State Univ. (USA); David Schendt, The Pennsylvania State Univ. (USA) . . . . . [10397-3]

Lunch Break . . . . . Sun 12:00 pm to 1:30 pm

#### SESSION 2

LOCATION: CONV. CTR. ROOM 7B . . . . SUN 1:30 PM TO 2:30 PM

#### Solid State Detectors II

Session Chair: **Stephan R. McCandliss**, Johns Hopkins Univ. (USA)

1:30 pm: **Kyoto's event-driven x-ray astronomical SOI pixel sensor**, Takeshi Go Tsuru, Hideki Hayashi, Katsuhiro Tachibana, Makoto Itou, Shunichi Ohmura, Hideaki Matsumura, Hiroyuki Uchida, Takaaki Tanaka, Kyoto Univ. (Japan); Shinya Nakashima, Institute of Space and Astronautical Science (Japan); Yasuo Arai, Ikuo Kurachi, High Energy Accelerator Research Organization, KEK (Japan); Koji Mori, Ayaki Takeda, Yusuke Nishioka, Nobuaki Takebayashi, Shoma Yokoyama, Univ. of Miyazaki (Japan); Takayoshi Kohmura, Kouki Tamasawa, Yusuke Ozawa, Tadashi Sato, Tokyo Univ. of Science (Japan); Shoji Kawahito, Keiichiro Kagawa, Keita Yasutomi, Hiroki Kamehama, Sumeet Shrestha, Shizuoka Univ. (Japan) . [10397-4]

1:50 pm: **Characterizing subpixel spatial resolution of a hybrid CMOS detector**, Evan Bray, The Pennsylvania State Univ. (USA) . . . . . [10397-5]

2:10 pm: **Overview of high-efficiency and low-noise solid-state detectors for future missions including the Habitable Exoplanet Imaging Mission and the Large UV/Optical/Infrared (LUVOR) Surveyor**, Shouleh Nikzad, Jet Propulsion Lab. (USA) . . . . . [10397-6]

#### SESSION 3

LOCATION: CONV. CTR. ROOM 7B . . . . SUN 2:30 PM TO 3:10 PM

#### Solar Missions and Technology

Session Chair: **Judy A. Fennelly**, Air Force Research Lab. (USA)

2:30 pm: **The VUV instrument SPICE for Solar Orbiter: performance ground testing**, Martin E. Caldwell, Nigel Morris, Mark Anderson, Carmen Pastor, Davide Bruzzi, Samuel Tustain, Chris Howe, Jenny Davenne, Timothy Grundy, Roisin Speight, Paul Eccleston, Sunil D. Sidher, Alessandra Giunta, STFC Rutherford Appleton Lab. (United Kingdom); Douglas K. Griffin, Univ. of New South Wales (Australia); Anne Philippon, Frédéric Auchère, Donald M. Hassler, Institut d'Astrophysique Spatiale (France); Udo H. Schuehle, Stefan Meinung, Max-Planck-Institut für Sonnensystemforschung (Germany); Joseph M. Davila, William T. Thompson, NASA Goddard Space Flight Ctr. (USA); Buddy Walls, P. Phelan, Greg Dunn, Southwest Research Institute (USA); Manfred Gyo, Physikalisch-Meteorologisches Observatorium Davos (Switzerland); Grant J. Munro, William Holmes, Peter Doyle, ESR Technology Ltd. (United Kingdom); Roman M. Klein, Thomas Reichel, Physikalisch-Technische Bundesanstalt (Germany) . . . [10397-7]

2:50 pm: **Photon counting type imaging spectrometer for solar soft x-rays**, Noriyuki Narukage, National Astronomical Observatory of Japan (Japan); Shinosuke Ishikawa, Tomoko Kawate, Japan Aerospace Exploration Agency (Japan); Taro Sakao, Institute of Space and Astronautical Science (Japan); Lindsay Glesener, Univ. of Minnesota, Twin Cities (USA); Sasha Courtade, Space Sciences Lab. (USA); Säm Krucker, Univ. of California, Berkeley (USA) and Fachhochschule NordWestschweiz (Switzerland); Steven Christe, NASA Goddard Space Flight Ctr. (USA) . . . . . [10397-10]

Coffee Break . . . . . Sun 3:10 pm to 3:40 pm

#### SESSION 4

LOCATION: CONV. CTR. ROOM 7B . . . . SUN 3:40 PM TO 5:20 PM

#### X-Ray Missions and Technology I

Session Chair: **Brian T. Fleming**, Univ. of Colorado Boulder (USA)

3:40 pm: **Calibration of the hard x-ray detectors for the FOXSI solar sounding rocket**, Subramania Athiray, Univ. of Minnesota (USA); Lindsay Glesener, Univ. of Minnesota, Twin Cities (USA); Sam Krucker, Univ. of California, Berkeley (USA) and Fachhochschule NordWestschweiz (Switzerland); Sasha Courtade, Univ. of California, Berkeley (USA); Steven D. Christe, NASA Goddard Space Flight Ctr. (USA); Shinosuke Ishikawa, Institute of Space and Astronautical Science (Japan); Tadayuki Takahashi, Shin Watanabe, Institute of Space and Astronautical Science (Japan) and The Univ. of Tokyo (Japan); Juan Camilo Buitrago Casas, Space Sciences Lab. (USA); Juliana Vievering, Sophie Musset, Kendra Bergstedt, Keith Goetz, Steven Monson, Univ. of Minnesota (USA) . . . . . [10397-11]

4:00 pm: **Strontium Iodide Radiation Instrumentation (SIRI)**, Lee Mitchell, Bernard Philips, U.S. Naval Research Lab. (USA); Emily Jackson, National Research Council (USA); Neil Johnson, Praxis Inc. (USA) . . . . . [10397-12]

4:20 pm: **Modeling contamination migration on the Chandra X-ray Observatory: IV**, Stephen L. O'Dell, NASA Marshall Space Flight Ctr. (USA); Douglas A. Swartz, Universities Space Research Association (USA); Neil W. Tice, Massachusetts Institute of Technology (USA); Paul P. Plucinsky, Smithsonian Astrophysical Observatory (USA); Herman Marshall, Massachusetts Institute of Technology (USA); Akos Bogdan, Smithsonian Astrophysical Observatory (USA); Catherine E. Grant, Massachusetts Institute of Technology (USA); Allyn F. Tennant, NASA Marshall Space Flight Ctr. (USA); Matthew T. Dahmer, Northrop Grumman (USA) . . . . . [10397-13]



# CONFERENCE 10397

4:40 pm: **An update to the Chandra ACIS contamination model**, Herman Marshall, Massachusetts Institute of Technology (USA); Akos Bogdan, Harvard-Smithsonian Ctr. for Astrophysics (USA); Paul P. Plucinsky, Smithsonian Astrophysical Observatory (USA) ..... [10397-14]

5:00 pm: **The evaluation of the Hitomi (Astro-H)/SXS spare beryllium window in 3.8-30 keV**, Akio Hoshino, Yuki Yoshida, Shunji Kitamoto, Rikkyo Univ. (Japan); Ryuichi Fujimoto, Kanazawa Univ. (Japan); Noriko Y. Yamasaki, Institute of Space and Astronautical Science (Japan); Toshiaki Ina, Tomoya Uruga, Japan Synchrotron Radiation Research Institute (Japan); Megan E. Eckart, Maurice A. Leutenegger, NASA Goddard Space Flight Ctr. (USA) ..... [10397-15]

**LOCATION: CONV. CTR. ROOM 6A .. SUN 6:00 PM TO 7:50 PM**

## Technology Hot Topics: How Optics and Photonics Drive Innovation

6:00 pm to 6:10 pm: **Welcome and Opening Remarks**

6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)

6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)

6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)

7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)

7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)

## MONDAY 7 AUGUST

### SESSION 5

**LOCATION: CONV. CTR. ROOM 7B .. MON 8:50 AM TO 10:10 AM**

### IXPE

Session Chair: **Oswald H. W. Siegmund**, Space Sciences Lab. (USA)

8:50 am: **The gas pixel detector on board the IXPE mission**, Carmelo Sgrò, Istituto Nazionale di Fisica Nucleare (Italy) ..... [10397-16]

9:10 am: **Calibrating IXPE from ground to space**, Fabio Muleri for the IXPE team, INAF - Istituto di Astrofisica e Planetologia Spaziali (Italy) ..... [10397-17]

9:30 am: **Imaging as a tool for the characterization of the gas pixel detector photoelectric polarimeter**, Sergio Fabiani, INAF - Istituto di Astrofisica e Planetologia Spaziali (Italy) ..... [10397-18]

9:50 am: **IXPE: The Imaging X-ray Polarimetry Explorer**, Paolo Soffitta, INAF - Istituto di Astrofisica e Planetologia Spaziali (Italy) ..... [10397-19]

Coffee Break ..... Mon 10:10 am to 10:40 am

### SESSION 6

**LOCATION: CONV. CTR. ROOM 7B .MON 10:40 AM TO 12:00 PM**

### X-Ray Polarimetry

Session Chair: **Camden Ertley**, Space Sciences Lab. (USA)

10:40 am: **The optomechanical design of the REDSoX sounding rocket experiment**, Mark D. Egan, Timothy Hellickson, MIT Kavli Institute for Astrophysics and Space Research (USA); Herman Marshall, Massachusetts Institute of Technology (USA) ..... [10397-20]

11:00 am: **The rocket experiment demonstration of a soft x-ray polarimeter**, Herman Marshall, Norbert Schulz, Ralf K. Heilmann, Massachusetts Institute of Technology (USA); Brian Ramsey, NASA Marshall Space Flight Ctr. (USA); Sarah Heine, Massachusetts Institute of Technology (USA); Mark D. Egan, MIT Kavli Institute for Astrophysics and Space Research (USA); Timothy Hellickson, Massachusetts Institute of Technology (USA) ..... [10397-21]

11:20 am: **Preparations for the Advanced Scintillator Compton Telescope (ASCOT) balloon flight**, Tejaswita Sharma, Peter Bloser, Jason Legere, Christopher M. Bancroft, Mark McConnell, James M. Ryan, Alex M. Wright, The Univ. of New Hampshire (USA) ..... [10397-22]

11:40 am: **ximpol: a new x-ray polarimetry observation-simulation and analysis framework**, Nicola Omodei, Stanford Univ. (USA) and MIT Kavli Institute for Astrophysics and Space Research (USA); Luca Baldini, Istituto Nazionale di Fisica Nucleare (Italy) and Univ. di Pisa (Italy); Niccolò Di Lalla, Melissa Pesce-Rollins, Istituto Nazionale di Fisica Nucleare (Italy) ..... [10397-23]

Lunch Break ..... Mon 12:00 pm to 1:30 pm

### SESSION 7

**LOCATION: CONV. CTR. ROOM 7B ... MON 1:30 PM TO 3:10 PM**

### X-Ray Missions and Technology II

Session Chair: **James C. Green**, Univ. of Colorado Boulder (USA)

1:30 pm: **Development of digital system for the wide-field x-ray imaging detector aboard Kanazawa-SAT3**, Yasuaki Kagawa, Daisuke Yonetoku, Tatsuya Sawano, Kanazawa Univ. (Japan); Tatehiro Mihara, RIKEN (Japan); Hirokazu Ikeda, Atsushi Harayama, Institute of Space and Astronautical Science (Japan); Makoto Arimoto, Waseda Univ. (Japan); Kazuki Yoshida, Masao Ina, Kaichi Ota, Yuki Minami, Kanazawa Univ. (Japan) ..... [10397-24]

1:50 pm: **The survey and time-domain astrophysical research explorer (STAR-X)**, William W. Zhang, NASA Goddard Space Flight Ctr. (USA) .. [10397-25]

2:10 pm: **Arcus: Exploring the formation and evolution of clusters, galaxies, and stars**, Randall K. Smith, Harvard-Smithsonian Ctr. for Astrophysics (USA) ..... [10397-27]

2:30 pm: **Performance of a double tilted-Rowland-spectrometer on ARCUS**, Hans Moritz Günther, Massachusetts Institute of Technology (USA); The ARCUS Collaboration, Smithsonian Astrophysical Observatory (USA) ..... [10397-26]

2:50 pm: **The water recovery x-ray rocket (WRX-R)**, Drew M. Miles, The Pennsylvania State Univ. (USA) ..... [10397-28]

Coffee Break ..... Mon 3:10 pm to 3:40 pm

### SESSION 8

**LOCATION: CONV. CTR. ROOM 7B ... MON 3:40 PM TO 5:40 PM**

### X-Ray Missions and Technology III

Session Chair: **Stephan R. McCandliss**, Johns Hopkins Univ. (USA)

3:40 pm: **Lynx mission concept status**, Jessica A. Gaskin, NASA Marshall Space Flight Ctr. (USA) ..... [10397-29]

4:00 pm: **Conceptual design of the SMART dosimeter**, Erik B. Johnson, Sam Vogel, Rebecca Frank, Graham Stoddard, Radiation Monitoring Devices, Inc. (USA); Alonzo Vera, COSMIAC (USA); David Alexander, David Alexander LLC (USA); James F. Christian, COSMIAC (USA) ..... [10397-30]

4:20 pm: **ATHENA: System design of the ATHENA x-ray telescope**, Mark R. Ayre, Marcos Bavdaz, Ivo Ferreira, Eric Wille, David H. Lumb, Martin Linder, Alexander Stefanescu, European Space Research and Technology Ctr. (Netherlands) ..... [10397-55]

4:40 pm: **First results of Athena WFI prototype detectors**, Wolfgang Treberspurg, Johannes Müller-Seidlitz, Robert Andritschke, Günter Hauser, Valentin Emberger, Annika Behrens, Norbert Meidinger, Max-Planck-Institut für extraterrestrische Physik (Germany) ..... [10397-31]

5:00 pm: **The wide-field imager instrument for Athena**, Norbert Meidinger, Kirpal Nandra, Markus Plattner, Arne Rau, Max-Planck-Institut für extraterrestrische Physik (Germany) ..... [10397-32]

5:20 pm: **Updates on experimental grazing angle soft proton scattering**, Sebastian Diebold, Sarah Hanschke, Emanuele Perinati, Eberhard Karls Univ. Tübingen (Germany); Randall K. Smith, Harvard-Smithsonian Ctr. for Astrophysics (USA); Christopher Tenzer, Andrea Santangelo, Josef Jochum, Eberhard Karls Univ. Tübingen (Germany) ..... [10397-33]

**LOCATION: CONV. CTR.  
EXHIBIT HALL B2 ..... MON 5:30 PM TO 7:30 PM**

**TUESDAY 8 AUGUST**

## Posters-Monday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**An improved version of the Shadow Position Sensor readout electronics on board the ESA PROBA-3 Mission**, Vladimiro Noce, Mauro Focardi, INAF - Osservatorio Astrofisico di Arcetri (Italy); Steve Buckley, SensL Technologies Ltd. (Ireland); François Denis, Ctr. Spatial de Liège (Belgium); Kevin O'Neill, SensL Technologies Ltd. (Ireland); Alessandro Bemporad, INAF - Osservatorio Astronomico di Torino (Italy); Silvano Fineschi, INAF - Osservatorio Astrofisico di Torino (Italy); Maurizio Pancrazzi, Federico Landini, Cristian Baccani, INAF - Osservatorio Astrofisico di Arcetri (Italy); Gerardo Capobianco, INAF - Osservatorio Astrofisico di Torino (Italy); Davide Loreggia, INAF - Osservatorio Astronomico di Torino (Italy); Marta Casti, INAF - Osservatorio Astrofisico di Torino (Italy); Marco Romoli, INAF - Osservatorio Astrofisico di Arcetri (Italy); Giuseppe Massone, Gianalfredo Nicolini, INAF - Osservatorio Astrofisico di Torino (Italy); Cédric Thizy, Ctr. Spatial de Liège (Belgium); Idriss Mechmech, Ctr. Spatial de Liège (Belgium); Etienne Renotte, Ctr. Spatial de Liège (Belgium) ..... [10397-8]

**Test plan for the PROBA3/ASPIICS scaled model measurement campaign**, Federico Landini, INAF - Osservatorio Astrofisico di Arcetri (Italy); Cristian Baccani, Univ. degli Studi di Firenze (Italy); Sébastien Vives, Lab. d'Astrophysique de Marseille (France); Silvano Fineschi, INAF - Osservatorio Astrofisico di Torino (Italy); Marco Romoli, Univ. degli Studi di Firenze (Italy); Gerardo Capobianco, Giuseppe Massone, Marta Casti, INAF - Osservatorio Astrofisico di Torino (Italy); Alessandro Bemporad, INAF - Osservatorio Astronomico di Torino (Italy); Mauro Focardi, INAF - Osservatorio Astrofisico di Arcetri (Italy); Maurizio Pancrazzi, Univ. degli Studi di Firenze (Italy); Davide Loreggia, INAF - Osservatorio Astrofisico di Torino (Italy); Vladimiro Noce, INAF - Osservatorio Astrofisico di Arcetri (Italy); Alain Jody Corso, CNR-IFN Padova (Italy); Cédric Thizy, Etienne Renotte, Ctr. Spatial de Liège (Belgium) ..... [10397-9]

**Transmission measurement of the spare Beryllium window of the SXS onboard the Hitomi satellite in 2.0-12 keV with KEK-PF**, Yuki Yoshida, Akio Hoshino, Shunji Kitamoto, Jyuri Sugimoto, Ryouta Ishii, Yuki Ohgi, Sayaka Sato, S. Nukamori, Rikkyo Univ. (Japan); Ryuichi Fujimoto, Kanazawa Univ. (Japan); Noriko Y. Yamasaki, Institute of Space and Astronautical Science (Japan); Toshiaki Ina, Japan Synchrotron Radiation Research Institute (Japan); Tomoya Uruga, Japan Synchrotron Radiation Research Institute (Japan) ..... [10397-47]

**Semi-automated high-efficiency reflectivity chamber for vacuum UV measurements**, James H. Wiley, Brian T. Fleming, Arika Egan, Univ. of Colorado Boulder (USA) ..... [10397-48]

**EXACT: The experiment for characterization and timing cubesat**, Trevor Knuth, Univ. of Minnesota (USA); Lindsay Glesener, Univ. of Minnesota, Twin Cities (USA); Demoz Gebre-Egziabher, Univ. of Minnesota, Twin Cities (USA); Ryan Vogt, Hannah Weiher, Joel Runnels, Kale Hedstrom, Tim Kukowski, Maxwell Yurs, Kendra Bergstedt, Cynthia Cattell, Jeffrey Chaffin, Richard Linares, Gjerda Rhode-Humphries, Univ. of Minnesota (USA) ..... [10397-49]

**The third flight of the Colorado high-resolution echelle stellar spectrograph (CHESSE): improvements, calibrations, and preliminary results**, Nicholas Kruczek, Lab. for Atmospheric and Space Physics (USA); Kevin C. France, Keri Hoadley, Nicholas Nell, Robert Kane, Brian T. Fleming, Univ. of Colorado Boulder (USA) ..... [10397-50]

**On-ground characterization of the IXPE polarization angle knowledge**, Yuri Evangelista, INAF - Istituto di Astrofisica e Planetologia Spaziali (Italy) . . [10397-51]

**The Marshall Grazing Incidence X-ray Spectrometer**, Ken Kobayashi, Amy R. Winebarger, Sabrina Savage, NASA Marshall Space Flight Ctr. (USA); Patrick Champey, The Univ. of Alabama in Huntsville (USA); Peter N. Cheimets, Edward Hertz, Leon Golub, Smithsonian Astrophysical Observatory (USA); Brian Ramsey, Jaganathan Ranganathan, NASA Marshall Space Flight Ctr. (USA); Vanessa Marquez, Ryan Allured, Theodore Parker, Smithsonian Astrophysical Observatory (USA); Ralf K. Heilmann, Mark L. Schattenburg, Massachusetts Institute of Technology (USA) ..... [10397-52]

**ART-XC/SRG: Joint calibration of mirror modules and x-ray detectors**, Alexey Tkachenko, Mikhail N. Pavlinsky, Vasily Levin, Valeriy V. Akimov, Aleksandr Krivchenko, Alexey Rotin, Maria M. Kuznetsova, Igor Y. Lapshov, Alexander Yaskovich, Vladimir Alexandrovich Oleynikov, Space Research Institute (Russian Federation); Mikhail V. Gubarev, Brian Ramsey, NASA Marshall Space Flight Ctr. (USA) ..... [10397-53]

**Characterization of the UV detector of Solar Orbiter/METIS**, Michela C. Uslenghi, INAF - IASF Milano (Italy); Udo H. Schühle, Luca Teriaca, Max-Planck-Institut für Sonnensystemforschung (Germany) ..... [10397-54]

## SESSION 9

**LOCATION: CONV. CTR. ROOM 7B .. TUE 8:40 AM TO 10:20 AM**

## UV Missions and Technology I

Session Chair: **Brian T. Fleming**, Univ. of Colorado Boulder (USA)

8:40 am: **Life testing of ALD-GCA MCPs: recent results**, Mark A. Popecki, Christopher A. Craven, Till Cremer, William A. Worstell, Michael J. Minot, Bernhard W. Adams, Michael R. Foley, Alexey Lyashenko, Justin L. Bond, Michael E. Stochaj, Incom, Inc. (USA); Camden Ertley, Oswald H. W. Siegmund, Space Sciences Lab. (USA); Jeffrey W. Elam, Anil U. Mane, Argonne National Lab. (USA) . . . [10397-34]

9:00 am: **ALD-microchannel plates for cryogenic applications**, Till Cremer, Bernhard W. Adams, Melvin Aviles, Justin L. Bond, Christopher A. Craven, Michael R. Foley, Alexey Lyashenko, Michael J. Minot, Mark A. Popecki, Michael E. Stochaj, William A. Worstell, Incom, Inc. (USA); Jeffrey W. Elam, Anil U. Mane, Argonne National Lab. (USA); Oswald H. W. Siegmund, Camden Ertley, Univ. of California, Berkeley (USA) . . . . . [10397-35]

9:20 am: **Epitaxial deposition of high-efficiency GaN photocathodes on microchannel plates using lattice-matched metallic buffers**, Amir Dabiran, Sara Rothwell, Stephenie Tandean, Robert J. Jorgenson, Lightwave Photonics, Inc. (USA); Anton S. TRemins, Oswald H. W. Siegmund, Univ. of California, Berkeley (USA) . . . . . [10397-36]

9:40 am: **Microchannel plate detector technology potential for LUVOR and HabEx**, Oswald H. W. Siegmund, Space Sciences Lab. (USA); Eric R. Schindhelm, Southwest Research Institute (USA); Camden Ertley, Space Sciences Lab. (USA); Brian T. Fleming, Kevin C. France, Univ. of Colorado Boulder (USA); Walter M. Harris, The Univ. of Arizona (USA); Alex Harwit, Ball Aerospace & Technologies Corp. (USA); Stephan R. McCandliss, Johns Hopkins Univ. (USA); John V. Vallerga, Space Sciences Lab. (USA) . . . . . [10397-37]

10:00 am: **Microchannel plate life testing for UV spectroscopy instruments**, Nathan Darling, Univ. of California, Berkeley (USA) . . . . . [10397-38]

Coffee Break . . . . . Tue 10:20 am to 10:50 am

## SESSION 10

**LOCATION: CONV. CTR. ROOM 7B .. TUE 10:50 AM TO 12:10 PM**

## UV Missions and Technology II

Session Chair: **Oswald H. W. Siegmund**, Space Sciences Lab. (USA)

10:50 am: **The LUVOR Ultraviolet Multi-Object Spectrograph (LUMOS): instrument definition and design**, Kevin C. France, Brian T. Fleming, Univ. of Colorado Boulder (USA); Garrett J. West, NASA Goddard Space Flight Ctr. (USA); Stephan R. McCandliss, Johns Hopkins Univ. (USA); John O'Meara, Saint Michael's College (USA); Jason Tumlinson, Space Telescope Science Institute (USA); David Schiminovich, Columbia Univ. (USA); Matthew R. Bolcar, NASA Goddard Space Flight Ctr. (USA); Walter M. Harris, The Univ. of Arizona (USA); Leonidas A. Moustakas, Jet Propulsion Lab. (USA) . . . . . [10397-39]

11:10 am: **The synergy instrument**, Jonathan W. Arenberg, Northrop Grumman Aerospace Systems (USA); Carlton Wong, Xinetics Inc. (USA); Tom Mallen, Northrop Grumman Aerospace Systems (USA); Thomas Mooney, Materion Corp. (USA); John W. MacKenty, Jason Tumlinson, Space Telescope Science Institute (USA) . . . . . [10397-40]

11:30 am: **The development and characterization of advanced broadband mirror coatings for the far-UV**, Arika Egan, Brian T. Fleming, James H. Wiley, Univ. of Colorado Boulder (USA); Manuel A. Quijada, Javier G. Del Hoyo, NASA Goddard Space Flight Ctr. (USA); John Hennessy, Jet Propulsion Lab. (USA); Brian A. Hicks, Univ. of Maryland, College Park (USA) and NASA Goddard Space Flight Ctr. (USA); Kevin C. France, Nicholas Kruczek, Nicholas Erickson, Univ. of Colorado Boulder (USA) . . . . . [10397-41]

11:50 am: **Optical measurements of the mirrors and of the interferential filter of the Metis coronagraph on Solar Orbiter**, Paolo Sandri, Paolo Sarra, Paolo Radaelli, D. Morea, OHB Italia SpA (Italy); Radek Melich, Institute of Plasma Physics, TOPTEC department (Czech Republic); Arkadiusz Berlicki, Astronomical Institute, Academy of Sciences of the Czech Republic (Czech Republic); Ester Antonucci, INAF - Astrophysical Observatory of Torino (Italy); Marco M. Castronuovo, ASI - Agenzia Spaziale Italiana (Italy); Silvano Fineschi, INAF - Astrophysical Observatory of Torino (Italy); Giampiero Naletto, Dept. of Information Engineering - University of Padova (Italy) and CNR-IFN UOS Padova LUXOR (Italy); Gianalfredo Nicolini, INAF - Astrophysical Observatory of Torino (Italy); Marco Romoli, Dept. of Physics and Astronomy, University of Florence, (Italy) . [10397-42]

Lunch/Exhibition Break . . . . . Tue 12:10 pm to 1:40 pm

# CONFERENCE 10397

## SESSION 11

LOCATION: CONV. CTR. ROOM 7B . . . .TUE 1:40 PM TO 3:00 PM

### UV Missions and Technology III

Session Chair: **James C. Green**, Univ. of Colorado Boulder (USA)

1:40 pm: **LRO-LAMP failsafe door-open performance: improving FUV measurements of dayside lunar hydration**, Michael W. Davis, Thomas K. Greathouse, David E. Kaufmann, Kurt D. Retherford, Maarten H. Versteeg, Southwest Research Institute (USA) . . . . . [10397-43]

2:00 pm: **Scattered light characterization of FORTIS**, Stephan R. McCandless, Anna Carter, Keith Redwine, Johns Hopkins Univ. (USA); Alexander S. Kutyrav, John G. Hagopian, Mary J. Li, Harvey H. Moseley, NASA Goddard Space Flight Ctr. (USA); Russell Pelton, Johns Hopkins Univ. (USA) . . . . . [10397-44]

2:20 pm: **Low-latitude ionospheric research using the CIRCE mission**, Kenneth F. Dymond, Andrew C. Nicholas, Scott A. Budzien, Andrew W. Stephan, U.S. Naval Research Lab. (USA) . . . . . [10397-45]

2:40 pm: **The Colorado Ultraviolet Transit Experiment (CUTE): A dedicated cubesat mission for the study of exoplanetary mass loss and magnetic fields**, Brian T. Fleming, Kevin C. France, Nicholas Nell, Richard A. Kohnert, Keri Hoadley, Jean-Michel Desert, Univ. of Colorado Boulder (USA); Pascal M. Petit, Univ. de Toulouse (France); Aline A. Vidotto, Univ. de Genève (Switzerland); Matthew Beasley, Planetary Resources, Inc. (USA); Luca Fossati, Austrian Academy of Sciences (Austria); Tommi T. Koskinen, The Univ. of Arizona (USA) . . . . [10397-46]

**LOCATION: MARRIOTT MARQUIS,  
MARINA D . . . . . 8:00 PM TO 10:00 PM**

### Technology Roadmap for the Lynx X-Ray Mission

Session Moderator: **Jessica A. Gaskin**, NASA Marshall Space Flight Ctr. (USA)

The NASA Astrophysics Division has commissioned four studies to be presented to the next Decadal Survey of Astronomy and Astrophysics as potential flagship missions for the next decade. One of these potential missions is the Lynx X-ray Mission. This will be an open forum/discussion regarding technologies for the optics and science instruments for the Lynx Mission. We will conduct a collaborative work space to discuss these technologies within the context of a technology Roadmap, with open discussion.



# CONFERENCE 10398

LOCATION: CONV. CTR. ROOM 6E

Sunday–Monday 6–7 August 2017 • Proceedings of SPIE Vol. 10398

## UV/Optical/IR Space Telescopes and Instruments: Innovative Technologies and Concepts VIII

Conference Chairs: **Howard A. MacEwen**, Reviresco LLC (USA); **James B. Breckinridge**, College of Optical Sciences, The Univ. of Arizona (USA), California Institute of Technology (USA)

Program Committee: **Allison A. Barto**, Ball Aerospace & Technologies Corp. (USA); **Richard W. Capps**, Jet Propulsion Lab. (USA); **Giovanni Fazio**, Harvard-Smithsonian Ctr. for Astrophysics (USA); **Lee D. Feinberg**, NASA Goddard Space Flight Ctr. (USA); **Matthew A. Greenhouse**, NASA Goddard Space Flight Ctr. (USA); **David Leisawitz**, NASA Goddard Space Flight Ctr. (USA); **Paul A. Lightsey**, Ball Aerospace & Technologies Corp. (USA); **Charles F. Lillie**, Lillie Consulting LLC (USA); **Amy Lo**, Northrop Grumman Aerospace Systems (USA); **Makenzie Lystrup**, Ball Aerospace & Technologies Corp. (USA); **Gary W. Matthews**, Harris Corp. (USA); **Ronald S. Polidan**, Polidan Science Systems & Technologies, LLC (USA); **David C. Redding**, Jet Propulsion Lab. (USA); **Bernard D. Seery**, NASA Goddard Space Flight Ctr. (USA); **H. Philip Stahl**, NASA Marshall Space Flight Ctr. (USA)

### SUNDAY 6 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 6E .. SUN 8:50 AM TO 10:20 AM

#### HabEx I

Session Chair: **Charles F. Lillie**, Lillie Consulting LLC (USA)

8:50 am: **The Habitable Exoplanet Imaging Mission (HabEx) (Invited Paper)**, Bertrand P. Mennesson, Jet Propulsion Lab. (USA) ..... [10398-1]

9:20 am: **Habitable Exoplanet Imaging Mission (HabEx) initial flight system design**, Farah Alibay, Gary M. Kuan, Keith R. Warfield, Jet Propulsion Lab. (USA) ..... [10398-2]

9:40 am: **HabEx yield modeling with for systems engineering**, Rhonda M. Morgan, Michael Bottom, Michael Turmon, Bertrand P. Mennesson, Keith R. Warfield, Jet Propulsion Lab. (USA); Dmitry Savransky, Christian Delacroix, Space Imaging and Optical Systems Lab., Cornell Univ. (USA) and Carl Sagan Institute (USA) ..... [10398-3]

10:00 am: **HabEx space telescope optical system**, Stefan R. Martin, Mayer Rud, Daniel K. Stern, Jet Propulsion Lab. (USA); Paul A. Scowen, Arizona State Univ. (USA) ..... [10398-4]

Coffee Break ..... Sun 10:20 am to 10:50 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 6E .. SUN 10:50 AM TO 11:50 AM

#### HabEx II

Session Chair: **Gary W. Matthews**, Harris Corp. (USA)

10:50 am: **Science and architecture drivers for the HabEx Ultraviolet Spectrograph (UVS)**, Paul A. Scowen, Arizona State Univ. (USA); Daniel K. Stern, Jet Propulsion Lab. (USA); Rachel Somerville, Rutgers, The State Univ. of New Jersey (USA); Mayer Rud, Stefan R. Martin, Jet Propulsion Lab. (USA); Matthew Beasley, Planetary Resources, Inc. (USA) ..... [10398-6]

11:10 am: **Structural design of a 4-meter off-axis space telescope for the Habitable-zone Exoplanet Direct Imaging Mission**, William R. Arnold Sr., a.i. solutions, Inc. (USA) and NASA Marshall Space Flight Ctr. (USA); Brent Knight, Jacqueline M Davis, H. Philip Stahl, NASA Marshall Space Flight Ctr. (USA) ..... [10398-7]

11:30 am: **Overview of a telescope concept design for the Habitable-zone Exoplanet Direct Imaging Mission**, H. Philip Stahl, NASA Marshall Space Flight Ctr. (USA) ..... [10398-5]

Lunch Break ..... Sun 11:50 am to 1:20 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 6E . . . . SUN 1:20 PM TO 3:30 PM

#### LUVOIR

Session Chair: **Bernard D. Seery**, NASA Goddard Space Flight Ctr. (USA)

1:20 pm: **The Large UV/Optical/Infrared (LUVOIR) Surveyor: Decadal Mission concept design update (Invited Paper)**, Matthew R. Bolcar, NASA Goddard Space Flight Ctr. (USA) ..... [10398-9]

1:50 pm: **The Large UV/Optical/Infrared (LUVOIR) surveyor: Decadal Mission concept technology development overview**, Matthew R. Bolcar, NASA Goddard Space Flight Ctr. (USA) ..... [10398-10]

2:10 pm: **Ultra-stable segmented telescope sensing and control architecture**, Lee D. Feinberg, Matthew R. Bolcar, NASA Goddard Space Flight Ctr. (USA); J. Scott Knight, Ball Aerospace & Technologies Corp. (USA); David C. Redding, Jet Propulsion Lab. (USA) ..... [10398-27]

2:30 pm: **Dynamic stability with the disturbance-free payload architecture as applied to the Large UV/Optical/Infrared (LUVOIR) mission**, Larry D. Dewell, Kiarash Tajdaran, Raymond M. Bell, Lockheed Martin Space Systems Co. (USA); Kuo-Chia Liu, NASA Goddard Space Flight Ctr. (USA); Carl A. Blaurock, NightSky Systems, Inc. (USA); Lia Sacks, Matthew R. Bolcar, Julie A. Crooke, NASA Goddard Space Flight Ctr. (USA) ..... [10398-12]

2:50 pm: **First-order error-budgeting for LUVOIR mission**, J. Scott Knight, Paul A. Lightsey, Ball Aerospace & Technologies Corp. (USA); Lee D. Feinberg, Matthew R. Bolcar, NASA Goddard Space Flight Ctr. (USA); Stuart B. Shaklan, Jet Propulsion Lab. (USA) ..... [10398-13]

3:10 pm: **LUVOIR backplane thermal architecture development through the composite CTE sensitivity study**, Sang C. Park, Harvard-Smithsonian Ctr. for Astrophysics (USA); Michael J. Eisenhower, Smithsonian Astrophysical Observatory (USA); Marcel Bluth, SGT, Inc. (USA); Matthew R. Bolcar, Lee D. Feinberg, NASA Goddard Space Flight Ctr. (USA); J. Scott Knight, Ball Aerospace & Technologies Corp. (USA); Joel A. Nissen, David C. Redding, Jet Propulsion Lab. (USA) ..... [10398-14]

Coffee Break ..... Sun 3:30 pm to 4:00 pm

# CONFERENCE 10398

## SESSION 4

LOCATION: CONV. CTR. ROOM 6E . . . SUN 4:00 PM TO 5:40 PM

### LUVOIR/OST

Session Chair: **Makenzie Lystrup**, Ball Aerospace & Technologies Corp. (USA)

4:00 pm: **The LUVOIR coronagraph instrument: definition and design**, Laurent Pueyo, Space Telescope Science Institute (USA). . . . . [10398-15]

4:20 pm: **Effects of space telescope primary mirror segment errors on coronagraph instrument performance**, Mark T. Stahl, H. Philip Stahl, NASA Marshall Space Flight Ctr. (USA); Stuart B. Shaklan, Jet Propulsion Lab. (USA); Bijan Nemati, The Univ. of Alabama in Huntsville (USA). . . . . [10398-16]

4:40 pm: **Space technology for directly imaging and characterizing exo-Earths**, Brendan P. Crill, Stuart B. Shaklan, Nicholas Siegler, Jet Propulsion Lab. (USA). . . . . [10398-17]

5:00 pm: **Laser metrology for ultra-stable space-based coronagraphs**, Joel A. Nissen, Alireza Azizi, Feng Zhao, Shannon Kian G. Zareh, Shanti R. Rao, Jeffrey B. Jewell, Jet Propulsion Lab. (USA). . . . . [10398-18]

5:20 pm: **Design considerations for future far-IR observatories**, Jonathan W. Arenberg, John Pohner, George M. Harpole, Michael B. Petach, Danny Chi, Perry J. Knollenberg, Northrop Grumman Aerospace Systems (USA). . . . . [10398-19]

LOCATION: CONV. CTR. ROOM 6A . . . SUN 6:00 PM TO 7:50 PM

### Technology Hot Topics: How Optics and Photonics Drive Innovation

6:00 pm to 6:10 pm: **Welcome and Opening Remarks**

6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)

6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)

6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)

7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)

7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)

## MONDAY 7 AUGUST

### SESSION 5

LOCATION: CONV. CTR. ROOM 6E . . . MON 8:00 AM TO 9:00 AM

### Origins Space Telescope (OST) Technology

Session Chair: **Ronald S Polidan**, Polidan Science Systems & Technologies, LLC (USA)

8:00 am: **Technology advancements for future astronomical missions**, J. Scott Knight, Paul A. Lightsey, Chip Barnes III, Alex Harwit, Ball Aerospace & Technologies Corp. (USA). . . . . [10398-20]

8:20 am: **Stray-light field dependence for large astronomical space telescopes**, Paul A. Lightsey, Ball Aerospace & Technologies Corp. (USA); Charles W. Bowers, NASA Goddard Space Flight Ctr. (USA). . . . . [10398-21]

8:40 am: **Cryogenic system for the Origins Space Telescope: cooling a large space telescope to 4K with today's technology**, Michael J. DiPirro, David T. Leisawitz, Edgar R. Canavan, Louis G. Fantano, Anel Florez, James W. Kellogg, NASA Goddard Space Flight Ctr. (USA). . . . . [10398-22]

### SESSION 6

LOCATION: CONV. CTR. ROOM 6E . . . MON 9:00 AM TO 11:30 AM

### Candidate Concepts for Future Large Space Telescopes

Session Chair: **H. Philip Stahl**, NASA Marshall Space Flight Ctr. (USA)

9:00 am: **Highly-adjustable systems: an architecture for future space observatories**, Jonathan W. Arenberg, Northrop Grumman Aerospace Systems (USA); Charles R. Lawrence, Robert A. Laskin, David C. Redding, John Steeves, Jet Propulsion Lab. (USA); Alberto Conti, Northrop Grumman Aerospace Systems (USA). . . . . [10398-23]

9:20 am: **Revolutionary astrophysics using an incoherent synthetic optical aperture**, Gerard L. Rafanelli, Susan B. Spencer, Douglas W. Wolfe, Raytheon Space and Airborne Systems (USA); Ronald S. Polidan, Polidan Science Systems & Technologies, LLC (USA). . . . . [10398-24]

9:40 am: **The crisis in space astronomy: program structure and fatsats as a path to cheaper flagship missions**, Martin Elvis, Harvard-Smithsonian Ctr. for Astrophysics (USA). . . . . [10398-25]

Coffee Break . . . . . Mon 10:00 am to 10:30 am

10:30 am: **An evolvable space telescope configured for NASA's Habex mission**, Charles F. Lillie, Lillie Consulting LLC (USA); Howard A. MacEwen, Reviresco LLC (USA); James B Breckinridge, Breckinridge Associates, LLC (USA); Ronald S. Polidan, Polidan Science Systems & Technologies LLC (USA). . . . . [10398-26]

10:50 am: **APERTURE--a precise extremely-large reflective telescope using re-configurable element: a progress report**, Melville P. Ulmer, Jian Cao, Yip-Wah Chung, Xiaoli Wang, David B. Buchholz, Northwestern Univ. (USA); Victoria L. Coverstone, Turgut B. Baturalp, Texas Tech Univ. (USA). . . . . [10398-11]

11:10 am: **Active optics for next-generation space telescopes**, Vincent Costes, Lionel Perret, David Laubier, Christian Imbert, Laurent Cadiergues, Jean-Marc Delvit, Claude Faure, Ctr. National d'Études Spatiales (France). . . . . [10398-28]

Lunch Break . . . . . Mon 11:30 am to 1:00 pm

### SESSION 7

LOCATION: CONV. CTR. ROOM 6E . . . MON 1:00 PM TO 3:20 PM

### Ultraviolet

Session Chair: **David T. Leisawitz**, NASA Goddard Space Flight Ctr. (USA)

1:00 pm: **Recent developments in next-generation UV-visible space telescope planning and design**, Paul A. Scowen, Arizona State Univ. (USA); Kevin C. France, Univ. of Colorado Boulder (USA); Jason Tumlinson, Space Telescope Science Institute (USA); Stephan R. McCandliss, Johns Hopkins Univ. (USA); Todd Tripp, Univ. of Massachusetts Amherst (USA); Jay C. Howk, Univ. of Notre Dame (USA). . . . . [10398-29]

1:20 pm: **CETUS: An innovative UV probe-class mission concept**, Sara R. Heap, NASA Goddard Space Flight Ctr. (USA); Anthony B. Hull, The Univ. of New Mexico (USA); Stephen E. Kendrick, Kendrick Aerospace Consulting LLC (USA) [10398-30]

1:40 pm: **Medium UV/optical/IR observatory (MUVOIR) concept**, Gary W. Matthews, ATA Aerospace, LLC (USA). . . . . [10398-31]

2:00 pm: **SYNERGY: An Explorer mission concept for a next-generation ultraviolet survey**, John W. MacKenty, Jason Tumlinson, Space Telescope Science Institute (USA); Jonathan W. Arenberg, Craig Elder, Adam Gunderson, Steven Warwick, Terri O'Connell, Carlton Wong, Northrop Grumman Aerospace Systems (USA). . . . . [10398-32]

2:20 pm: **Coatings for large-aperture UV optical infrared space telescope mirrors**, Kunjithapatham Balasubramanian, John Hennessy, Shouleh Nikzad, Nasrat A. Raouf, Jet Propulsion Lab. (USA); Manuel A. Quijada, Javier G. Del Hoyo, NASA Goddard Space Flight Ctr. (USA). . . . . [10398-33]

2:40 pm: **Progress towards adding EUV reflectance to broadband Al mirrors for space-based observatories**, David D. Allred, R. Steven Turley, Stephanie Thomas, Spencer Willett, Spencer B. Perry, Michael J. Greenburg, Brigham Young Univ. (USA). . . . . [10398-34]

3:00 pm: **Improved mirror coatings for use in the Lyman Ultraviolet to enhance astronomical instrument capabilities**, Manuel A. Quijada, Javier G. Del Hoyo, NASA Goddard Space Flight Ctr. (USA). . . . . [10398-35]

Coffee Break . . . . . Mon 3:20 pm to 3:40 pm

**LOCATION: CONV. CTR. ROOM 6E . . . . . 3:40 PM TO 6:00 PM**

## **Panel Discussion: Astronauts and Astronomers to Enable the Most Ambitious Space Observatories**

*Moderator:* **Harley Thronson**, NASA Goddard Space Flight Ctr. (USA)

*Panelists:* **Matthew A. Greenhouse**, NASA Goddard Space Flight Ctr. (USA); **John M. Grunsfeld**, NASA Johnson Space Ctr. (USA);

**Rudranarayan Mukherjee**, Jet Propulsion Lab. (USA); **Bradley M. Peterson**, Space Telescope Science Institute (USA); **Nicholas Siegler**, Jet Propulsion Lab. (USA); **Hsiao I. Smith**, NASA Goddard Space Flight Ctr. (USA)

This is a series of presentations and a discussion on using astronauts and robots to service, upgrade, and eventually assemble future space observatories that will achieve major breakthroughs in our understanding of the cosmos. These missions will be able to study in detail the structure of the first star-forming complexes in the earliest galaxies, the central engines in distant galaxies, and be sufficiently capable of searching very large numbers of extrasolar planets for evidence of life. The technical and engineering merits and challenges of in-space servicing and assembling large-aperture telescopes will be discussed, including issues of launching the telescope/instrument in parts, assembling it in space, and replacing outdated instruments. Also discussed will be possible future space infrastructure that may make more attractive on-orbit assembly. Precursors and demonstration activities will be noted, as well as the earliest candidate missions for in-space upgrade and servicing. The panel discussion will be initiated by the following featured presentations given by the Panelists:

- \* A vision for human space flight and scientific exploration and the search for life in the cosmos (Grunsfeld)
- \* Future space servicing: The GSFC Satellite Servicing Projects Division (Smith)
- \* Serviceability of future large space telescopes (Peterson)
- \* Robotic capabilities to enable large structures (Mukherjee)
- \* Candidate initial assembly mission: Starshade (Siegler/Greenhouse)

**LOCATION: CONV. CTR. EXHIBIT HALL B2 . . . . . MON 5:30 PM TO 7:30 PM**

## **Posters-Monday**

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**James Webb Space Telescope optical simulation testbed IV: linear control alignment of the primary segmented mirror and the secondary mirror**, Sylvain Egrou, ONERA (France) and Space Telescope Science Institute (USA) and Lab. d'Astrophysique de Marseille (France); Rémi Soummer, Space Telescope Science Institute (USA); Vincent Michau, Aurelie Bonnefois, ONERA (France); Marc Ferrari, Emmanuel Hugot, Lab. d'Astrophysique de Marseille (France); Marshall D. Perrin, Laurent Pueyo, Space Telescope Science Institute (USA); Lucie Leboulleux, Space Telescope Science Institute (USA) and Lab. d'Astrophysique de Marseille (France) and ONERA (France) . . . . . [10398-37]

**The afocal telescope of the ESA ARIEL mission: analysis of the layout**, Vania Da Deppo, CNR-IFN Padova (Italy) and INAF - Osservatorio Astrofisico di Arcetri (Italy); Kevin F. Middleton, STFC Rutherford Appleton Lab. (United Kingdom); Mauro Focardi, INAF - Osservatorio Astrofisico di Arcetri (Italy); Gianluca Morgante, INAF - IASF Bologna (Italy); Emanuele Pace, Univ. degli Studi di Firenze (Italy); Riccardo U. Claudi, INAF - Osservatorio Astronomico di Padova (Italy); Giuseppina Micela, INAF - Osservatorio Astronomico di Palermo Giuseppe S. Vaiana (Italy) . . . . . [10398-38]

**Aligning the EUCLID NISP near infrared optics using a multi-zone hologram: stability of the set-up and achieved position readings**, Frank U. Grupp, Univ.-Sternwarte München (Germany) and Max-Planck-Institut für extraterrestrische Physik (Germany); Andreas Bode, Jennifer Kaminski, Daniela Penka, Carolin Wimmer, Christof Bodendorf, Norbert Geis, Max-Planck-Institut für extraterrestrische Physik (Germany); Ralf Bender, Max-Planck-Institut für extraterrestrische Physik (Germany) and Univ.-Sternwarte München (Germany) . . . . . [10398-39]

**Predictive thermal control applied to HabEx**, Thomas Brooks, H. Philip Stahl, NASA Marshall Space Flight Ctr. (USA) . . . . . [10398-40]

**ACCESS: integration, pre-flight performance, and calibration**, Mary Elizabeth Kaiser, Matthew J. Morris, Johns Hopkins Univ. (USA); Jeffrey W. Kruk, Randy A. Kimble, Bernard J. Rauscher, NASA Goddard Space Flight Ctr. (USA); Edward L. Wright, Univ. of California, Los Angeles (USA); Robert Kurucz, Harvard-Smithsonian Ctr. for Astrophysics (USA); Stephan R. McCandliss, Russell Pelton, Lauren N. Aldoroty, Paul D. Feldman, H. Warren Moos, Johns Hopkins Univ. (USA); Adam G. Riess, Johns Hopkins Univ. (USA) and Space Telescope Science Institute (USA); Jonathan P. Gardner, NASA Goddard Space Flight Ctr. (USA); Ralph C. Bohlin, Susana E. Deustua, William V. Dixon, David J. Sahnou, Space Telescope Science Institute (USA); Saul Perlmutter, Univ. of California, Berkeley (USA) and Lawrence Berkeley National Lab. (USA) . . . . . [10398-41]

**Technology pathways for a habitable-zone exoplanet direct imaging mission**, Rhonda M. Morgan, Keith R. Warfield, Bertrand P. Mennesson, Jet Propulsion Lab. (USA); H. Philip Stahl, NASA Marshall Space Flight Ctr. (USA); Shouleh Nikzad, Joel A. Nissen, John E. Krist, Kunjithapatham Balasubramanian, Jet Propulsion Lab. (USA); Dimitri Mawet, California Institute of Technology (USA); Karl Stapelfeldt, Jet Propulsion Lab. (USA); Steven Warwick, Northrop Grumman Aerospace Systems (USA) . . . . . [10398-42]

**Monitoring solar irradiance from L2 with Gaia**, Edmund Serpell, European Space Operations Ctr. (Germany) . . . . . [10398-43]



# CONFERENCE 10399

LOCATION: CONV. CTR. ROOM 9

Tuesday–Thursday 8–10 August 2017 • Proceedings of SPIE Vol. 10399

## Optics for EUV, X-Ray, and Gamma-Ray Astronomy VIII

Conference Chairs: **Stephen L. O'Dell**, NASA Marshall Space Flight Ctr. (USA); **Giovanni Pareschi**, INAF - Osservatorio Astronomico di Brera (Italy)

Program Committee: **Hisamitsu Awaki**, Ehime Univ. (Japan); **Nicolas M. Barrière**, cosine Science & Computing B.V. (Netherlands); **Marcos Bavdaz**, European Space Research and Technology Ctr. (Netherlands); **Vadim Burwitz**, Max-Planck-Institut für extraterrestrische Physik (Germany); **Finn E. Christensen**, DTU Space (Denmark); **Peter Friedrich**, Max-Planck-Institut für extraterrestrische Physik (Germany); **Filippo Frontera**, Univ. degli Studi di Ferrara (Italy); **Tim Greenshaw**, Univ. of Liverpool (United Kingdom); **Fiona A. Harrison**, California Institute of Technology (USA); **René Hudec**, Astronomical Institute of the ASCR, v.v.i. (Czech Republic); **Hideyo Kunieda**, Nagoya Univ. (Japan); **Randall L. McEntaffer**, Pennsylvania State Univ. (USA); **Noriyuki Narukage**, National Astronomical Observatory of Japan (Japan); **Mikhail N. Pavlinsky**, Space Research Institute (Russian Federation); **Robert Petre**, NASA Goddard Space Flight Ctr. (USA); **Brian D. Ramsey**, NASA Marshall Space Flight Ctr. (USA); **Paul B. Reid**, Harvard-Smithsonian Ctr. for Astrophysics (USA); **Suzanne E. Romaine**, Harvard-Smithsonian Ctr. for Astrophysics (USA); **Mark L. Schattenburg**, Massachusetts Institute of Technology (USA); **Daniele Spiga**, INAF - Osservatorio Astronomico di Brera (Italy); **Yuzuru Tawara**, Nagoya Univ. (Japan); **Richard Willingale**, Univ. of Leicester (United Kingdom); **David L. Windt**, Reflective X-Ray Optics LLC (USA); **William W. Zhang**, NASA Goddard Space Flight Ctr. (USA)

### TUESDAY 8 AUGUST

LOCATION: CONV. CTR. ROOM 9 .....8:15 AM TO 8:20 AM

#### Welcome and Introduction

Stephen L. O'Dell, NASA Marshall Space Flight Ctr. (USA)

#### SESSION 1

LOCATION: CONV. CTR. ROOM 9 ... TUE 8:20 AM TO 10:00 AM

#### Cherenkov Telescopes

Session Chair: **Tim Greenshaw**, Univ. of Liverpool (United Kingdom)

8:20 am: **Cherenkov Telescope Array: the next-generation gamma ray observatory**, Jan Ebr, Institute of Physics of the ASCR, v.v.i. (Czech Republic) ..... [10399-1]

8:40 am: **Aplanatic telescopes based on Schwarzschild optical configuration: from grazing incidence Wolter-like x-ray optics to Cherenkov two-mirror normal incidence telescopes**, Giorgia Sironi, Paolo Conconi, Giovanni Pareschi, INAF - Osservatorio Astronomico di Brera (Italy) ..... [10399-2]

9:00 am: **The ASTRI SST-2M prototype for the Cherenkov Telescope Array: status after the commissioning phase of the telescope**, Rodolfo Canestrari, INAF - Osservatorio Astronomico di Brera (Italy); Enrico Giro, INAF - Osservatorio Astronomico di Padova (Italy); Giorgia Sironi, INAF - Osservatorio Astronomico di Brera (Italy); Elisa Antolini, Univ. degli Studi di Perugia (Italy); Dino Fugazza, INAF - Osservatorio Astronomico di Brera (Italy); Salvatore Scuderi, INAF - Osservatorio Astrofisico di Catania (Italy); Gino Tosti, Univ. degli Studi di Perugia (Italy); Claudio Tanci, INAF - Osservatorio Astronomico di Brera (Italy); Federico Russo, INAF - Osservatorio Astrofisico di Torino (Italy); Daniele Gardiol, INAF - Osservatorio Astronomico di Torino (Italy); Carlos E. Fermio, Univ. de São Paulo (Brazil); Giovanni Pareschi, INAF - Osservatorio Astronomico di Brera (Italy); ASTRI collaboration, INAF Osservatorio Astronomico di Brera (Italy); CTA consortium, CTA observatory (Italy); Gianpietro Marchiori, Andrea Busatta, Enrico Marcuzzi, EIE Group s.r.l. (Italy); Ivan Folla, Galbiati Group (Italy) ..... [10399-3]

9:20 am: **The GCT small-sized dual-mirror telescopes for CTA**, Tim Greenshaw, Univ. of Liverpool (United Kingdom) ..... [10399-4]

9:40 am: **First light on a new fully digital camera based on SiPM for CTA SST-1M telescope**, Domenico della Volpe, Teresa Montaruli, Matthieu Heller, Victor Coco, Imen Al Samarai, Franck Cadoux, Yannick Favre, Cyril Alispach, Isaac Troyano Pujadas, Andrii Nagai, Theodore R. Njoh Ekoume, Roland Walter, Etienne Lyard, Andrii Neronov, Vitalii Sliusar, Univ. de Genève (Switzerland); Jacek Niemiec, Emil Mach, Jerzy Michalowski, Jacek Blocki, Jakub Rafalski, Krzysztof Skowron, Magdalena Stodulska, Institute of Nuclear Physics (Poland); Marek Stodulski, The Henryk Niewodniczanski Institute of Nuclear Physics (Poland); Marek Jamroz, Michał Ostrowski, Lukasz Stawarz, Krzysztof Zietara, Jagiellonian Univ. in Krakow (Poland); Jerzy Borkowski, Mateusz Janiac, Adam Frankowski, Rafał Moderski, Nicolaus Copernicus Astronomical Ctr. (Poland); Tomasz Bulik, Mira Grudzińska, Univ. of Warsaw (Poland); Paweł Paško, Karol Seweryn, Space Research Ctr. (Poland); Dusan Mandat, Miroslav Pech, Petr Schovánek, Institute of Physics of the ASCR, v.v.i. (Czech Republic); Krzysztof Lalik, Paweł J. Rajda, AGH Univ. of Science and Technology (Poland) ..... [10399-5]

Coffee Break ..... Tue 10:00 am to 10:30 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 9 ... TUE 10:30 AM TO 11:50 AM

#### X-Ray Telescopes

Session Chair: **Hisamitsu Awaki**, Ehime Univ. (Japan)

10:30 am: **Optics for the Imaging X-ray Polarimetry Explorer**, Brian D. Ramsey, NASA Marshall Space Flight Ctr. (USA) ..... [10399-6]

10:50 am: **The STAR-X X-Ray Telescope Assembly (XTA)**, Ryan S. McClelland, Timo T. Saha, William W. Zhang, Peter M. Solly, Joseph A. Bonafede, NASA Goddard Space Flight Ctr. (USA) ..... [10399-7]

11:10 am: **Miniature Lightweight X-ray Optics (MiXO) and CubeSat X-ray Telescope (CubeX) for solar system exploration**, Suzanne E. Romaine, Jaesub Hong, Harvard-Smithsonian Ctr. for Astrophysics (USA); Brian D. Ramsey, National Space Sciences and Technology Ctr. (USA); Larry Nittler, Carnegie Institution for Science (USA); Keith Gendreau, NASA Goddard Space Flight Ctr. (USA); Daniele Spiga, INAF - Osservatorio Astronomico di Brera (Italy); Martin Elvis, Jonathan Grindlay, Harvard-Smithsonian Ctr. for Astrophysics (USA) ..... [10399-8]

11:30 am: **The Lynx Optics Working Group: objectives and current status**, Mark Schattenburg, MIT Kavli Institute for Astrophysics and Space Research (USA) ..... [10399-9]

Lunch/Exhibition Break ..... Tue 11:50 am to 1:20 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 9 ..... TUE 1:20 PM TO 3:20 PM

#### ATHENA Telescope

Session Chairs: **Marcos Bavdaz**, European Space Research and Technology Ctr. (Netherlands); **Randall L. McEntaffer**, The Univ. of Iowa (USA)

1:20 pm: **The Athena telescope and optics status**, Marcos Bavdaz, Eric Wille, Mark Ayre, Ivo Ferreira, Brian Shortt, Sebastiaan Fransen, European Space Research and Technology Ctr. (Netherlands); Maximilien J. Collon, cosine B.V. (Netherlands); Giuseppe Vacanti, cosine Science & Computing B.V. (Netherlands); Nicolas M. Barrière, Boris Landgraf, cosine B.V. (Netherlands); Jeroen Haneveld, Micronit Microfluidics B.V. (Netherlands); Coen van Baren, SRON Netherlands Institute for Space Research (Netherlands); Karl-Heinz Zunkin, OHB-System AG (Germany); Desirée Della Monica Ferreira, Sonny Massahi, Finn E. Christensen, DTU Space (Denmark); Michael Krummy, Physikalisch-Technische Bundesanstalt (Germany); Vadim Burwitz, Max-Planck-Institut für extraterrestrische Physik (Germany); Giovanni Pareschi, Daniele Spiga, INAF - Osservatorio Astronomico di Brera (Italy); Giuseppe Valsecchi, Media Lario Technologies S.r.l. (Italy); Dervis Vernani, Thales Alenia Space (Switzerland); Paul Oliver, e2v technologies plc (United Kingdom) ..... [10399-10]

1:40 pm: **Development of Athena mirror modules**, Maximilien J. Collon, cosine B.V. (Netherlands); Giuseppe Vacanti, cosine Science & Computing B.V. (Netherlands); Nicolas M. Barrière, Boris Landgraf, cosine B.V. (Netherlands); Ramses Günther, Mark Vervest, Roy van der Hoeven, cosine Science & Computing B.V. (Netherlands); Marco W. Beijersbergen, cosine B.V. (Netherlands); Marcos Bavdaz, Eric Wille, Brian Shortt, European Space Agency (Netherlands); David Girou, cosine B.V. (Netherlands); Sebastiaan Fransen, European Space Agency (Netherlands); Jeroen Haneveld, Arenda Koelewijn, Karin Booysen, Maurice Wijnperle, Micronit Microfluidics B.V. (Netherlands); Coen van Baren, Alexander Eigenraam, SRON Netherlands Institute for Space Research (Netherlands); Peter Müller, Physikalisches-Technische Bundesanstalt (Germany); Michael Krumrey, European Space Agency (Netherlands) and Physikalisches-Technische Bundesanstalt (Germany); Vadim Burwitz, Max-Planck-Institut für extraterrestrische Physik (Germany); Giovanni Pareschi, Paolo Conconi, INAF - Osservatorio Astronomico di Brera (Italy); Sonny Massahi, Finn E. Christensen, DTU Space (Denmark); Giuseppe Valsecchi, Media Lario Technologies S.r.l. (Italy); Paul Oliver, Ian Checquer, Kevin Ball, e2v technologies plc (United Kingdom); Karl-Heinz Zuknik, OHB-System AG (Germany); Desirée Della Monica Ferreira, DTU Space (Denmark) . . . . . [10399-11]

2:00 pm: **Silicon pore optics mirror module assembly process**, Nicolas M. Barrière, Maximilien J. Collon, cosine B.V. (Netherlands); Giuseppe Vacanti, cosine Science & Computing B.V. (Netherlands); Boris Landgraf, cosine B.V. (Netherlands); Ramses Günther, Mark Vervest, Roy van der Hoeven, cosine Science & Computing B.V. (Netherlands); David Girou, Marco W. Beijersbergen, cosine B.V. (Netherlands); Marcos Bavdaz, Eric Wille, Sebastiaan Fransen, European Space Research and Technology Ctr. (Netherlands); Coen van Baren, Alexander Eigenraam, SRON Netherlands Institute for Space Research (Netherlands); Peter Müller, Michael Krumrey, Physikalisches-Technische Bundesanstalt (Germany); Giuseppe Valsecchi, Media Lario Technologies S.r.l. (Italy); Karl-Heinz Zuknik, OHB-System AG (Germany) . . . . . [10399-12]

2:20 pm: **Optical integration of SPO mirror modules in the ATHENA telescope**, Giovanni Bianucci, Giuseppe Valsecchi, Fabio Marioni, Media Lario Technologies S.r.l. (Italy); Daniele Gallieni, Paolo Lazzarini, A.D.S. International S.r.l. (Italy); Giancarlo Parodi, Matteo Ottolini, BCV Progetti S.r.l. (Italy); Maximilien J. Collon, cosine B.V. (Netherlands); Marta M. Civitani, Giovanni Pareschi, Daniele Spiga, INAF - Osservatorio Astronomico di Brera (Italy); Marco Nebiolo, Thales Alenia Space (Italy); Marcos Bavdaz, Eric Wille, European Space Research and Technology Ctr. (Netherlands) . . . . . [10399-13]

2:40 pm: **Integration of the Athena mirror modules: development of indirect and x-ray direct AIT methods**, Dervis Vernani, Thales Alenia Space (Switzerland); Thibault Seure, Steffen Blum, Thales Alenia Space (Switzerland); Eric Wille, Marcos Bavdaz, European Space Agency (Netherlands); Uwe Schaeffer, Airbus Deutschland (Germany); Nicolas Lièvre, MICOS (Switzerland); Adeeb Nazeeruddin, Micos Engineering GmbH (Switzerland); Maximilien J. Collon, Nicolas M. Barrière, cosine B.V. (Netherlands); Vadim Burwitz, Max-Planck-Institut für extraterrestrische Physik (Germany); Michael Krumrey, Peter Müller, Levent Cibik, Physikalisches-Technische Bundesanstalt (Germany) . . . . . [10399-14]

3:00 pm: **Environmental testing of the ATHENA mirror modules**, Boris Landgraf, David Girou, Maximilien J. Collon, cosine B.V. (Netherlands); Giuseppe Vacanti, cosine Science & Computing B.V. (Netherlands); Nicolas M. Barrière, cosine B.V. (Netherlands); Ramses Günther, Mark Vervest, Roy van der Hoeven, cosine Science & Computing B.V. (Netherlands); Marco W. Beijersbergen, cosine B.V. (Netherlands); Marcos Bavdaz, European Space Agency (Netherlands); Eric Wille, Sebastiaan Fransen, Brian Shortt, European Space Research and Technology Ctr. (Netherlands); Coen van Baren, Alexander Eigenraam, SRON Netherlands Institute for Space Research (Netherlands) . . . . . [10399-15]

Coffee Break . . . . . Tue 3:20 pm to 3:50 pm

## SESSION 4

**LOCATION: CONV. CTR. ROOM 9 . . . . .TUE 3:50 PM TO 5:30 PM**

### Design and Analyses

Session Chair: **Richard Willingale**, Univ. of Leicester (United Kingdom)

3:50 pm: **Optical simulations for design, alignment, and performance prediction of silicon pore optics for the ATHENA x-ray telescope**, Daniele Spiga, INAF - Osservatorio Astronomico di Brera (Italy); Finn E. Christensen, DTU Space (Denmark); Marcos Bavdaz, European Space Research and Technology Ctr. (Netherlands); Giovanni Bianucci, Media Lario Technologies S.r.l. (Italy); Marta M. Civitani, INAF - Osservatorio Astronomico di Brera (Italy); Maximilien J. Collon, cosine B.V. (Netherlands); Paolo Conconi, INAF - Osservatorio Astronomico di Brera (Italy); Desirée Della Monica Ferreira, DTU Space (Denmark); Fabio Marioni, Media Lario Technologies S.r.l. (Italy); Sonny Massahi, DTU Space (Denmark); Giovanni Pareschi, Bianca Salmaso, INAF - Osservatorio Astronomico di Brera (Italy); Brian Shortt, European Space Research and Technology Ctr. (Netherlands); Kashmira Tayabaly, Politecnico di Milano (Italy); Giuseppe Valsecchi, Media Lario Technologies S.r.l. (Italy); Giuseppe Vacanti, cosine Science & Computing B.V. (Netherlands); Niels Joergen S. Westergaard, DTU Space (Denmark); Eric Wille, European Space Research and Technology Ctr. (Netherlands) . . . . . [10399-16]

4:10 pm: **Optical design of the STAR-X telescope**, Timo T. Saha, William W. Zhang, Ryan S. McClelland, NASA Goddard Space Flight Ctr. (USA) . . . [10399-17]

4:30 pm: **Methods for reducing ghost rays on the Wolter-I focusing figures of the FOXSI rocket payload**, Juan Camilo Buitrago Casas, Space Sciences Lab. (USA); Lindsay Glesener, Univ. of Minnesota, Twin Cities (USA); Steven D. Christe, NASA Goddard Space Flight Ctr. (USA); Brian D. Ramsey, Ronald Elsner, NASA Marshall Space Flight Ctr. (USA); Sasha Courtade, Space Sciences Lab. (USA); Juliana Vievering, Univ. of Minnesota (USA); Athiray Subramania, Univ. of Minnesota, Twin Cities (USA); Säm Krucker, Stuart Bale, Space Sciences Lab. (USA) . . . . . [10399-18]

4:50 pm: **Design and simulations of a short optical baffle for the Lightweight Asymmetry and Magnetism Probe (LAMP)**, Yujie Xing, Zhanshan Wang, Tongji Univ. (China); Hua Feng, Tsinghua Univ. (China) . . . . . [10399-19]

5:10 pm: **Optical design and simulations of the soft x-ray telescope for Einstein Probe mission**, Yingyu Liao, Zhengxiang Shen, Qiushi Huang, Zhanshan Wang, Tongji Univ. (China) . . . . . [10399-20]

**LOCATION: MARRIOTT MARQUIS, MARINA D . . . . . 8:00 PM TO 10:00 PM**

### Technology Roadmap for the Lynx X-Ray Mission

Session Moderator: **Jessica A. Gaskin**, NASA Marshall Space Flight Ctr. (USA)

The NASA Astrophysics Division has commissioned four studies to be presented to the next Decadal Survey of Astronomy and Astrophysics as potential flagship missions for the next decade. One of these potential missions is the Lynx X-ray Mission. This will be an open forum/discussion regarding technologies for the optics and science instruments for the Lynx Mission. We will conduct a collaborative work space to discuss these technologies within the context of a technology Roadmap, with open discussion.

## WEDNESDAY 9 AUGUST

### SESSION 5

**LOCATION: CONV. CTR. ROOM 9 . . WED 8:00 AM TO 10:00 AM**

### Metrology and Testing

Session Chairs: **Vadim Burwitz**, Max-Planck-Institut für extraterrestrische Physik (Germany); **Yuzuru Tawara**, Nagoya Univ. (Japan)

8:00 am: **Predicting silicon pore optics**, Giuseppe Vacanti, cosine Science & Computing B.V. (Netherlands); Marcos Bavdaz, European Space Research and Technology Ctr. (Netherlands); Nicolas M. Barrière, Abdelhakim Chatbi, Maximilien J. Collon, D. Dekker, David Girou, cosine B.V. (Netherlands); Ramses Günther, cosine Science & Computing B.V. (Netherlands); Boris Landgraf, cosine B.V. (Netherlands); Roy van der Hoeven, Mark Vervest, cosine Science & Computing B.V. (Netherlands); Eric Wille, European Space Research and Technology Ctr. (Netherlands) . . . . . [10399-21]

8:20 am: **Measuring silicon pore optics**, Giuseppe Vacanti, cosine Science & Computing B.V. (Netherlands); Marcos Bavdaz, European Space Research and Technology Ctr. (Netherlands); Nicolas M. Barrière, Abdelhakim Chatbi, Maximilien J. Collon, D. Dekker, David Girou, cosine B.V. (Netherlands); Ramses Günther, cosine Science & Computing B.V. (Netherlands); Michael Krumrey, Physikalisches-Technische Bundesanstalt (Germany); Boris Landgraf, cosine B.V. (Netherlands); Peter Müller, Physikalisches-Technische Bundesanstalt (Germany); Roy van der Hoeven, Mark Vervest, cosine Science & Computing B.V. (Netherlands); Eric Wille, European Space Research and Technology Ctr. (Netherlands) . . . . . [10399-22]

8:40 am: **Testing and calibrating the Athena optics at PANTER**, Vadim Burwitz, Max-Planck-Institut für extraterrestrische Physik (Germany) . . . . . [10399-23]

9:00 am: **Calibration of the FOXSI sounding rocket x-ray optics**, Steven D. Christe, NASA Goddard Space Flight Ctr. (USA); Brian D. Ramsey, Mikhail Gubarev, NASA Marshall Space Flight Ctr. (USA); Juan Camilo Buitrago-Casas, Space Sciences Lab. (USA); Lindsay Glesener, Univ. of Minnesota, Twin Cities (USA); Säm Krucker, Fachhochschule Nordwestschweiz (Switzerland); Subramania Athiray, Univ. of Minnesota, Twin Cities (USA); Sasha Courtade, Space Sciences Lab. (USA); Shin-nosuke Ishikawa, The Univ. of Tokyo (Japan); Juliana Vievering, Univ. of Minnesota (USA) . . . . . [10399-24]

# CONFERENCE 10399

9:20 am: **The Hitomi (ASTRO-H) Soft X-ray Telescope (SXT): current status of calibration.** Yoshitomo Maeda, Institute of Space and Astronautical Science (Japan); Takashi Okajima, Yang Soong, Peter J. Serlemitsos, Hideyuki Mori, Lawrence G. Olsen, David Robinson, Richard G. Koenecke, William S. Chang, NASA Goddard Space Flight Ctr. (USA); Devin J. Hahne, Johns Hopkins Univ. Applied Physics Lab., LLC (USA); Ryo Iizuka, Manabu Ishida, Institute of Space and Astronautical Science (Japan); Toshiki Sato, Sho Kurashima, Nozomi Nakaniwa, Ryota Asai, Tokyo Metropolitan Univ. (Japan); Takayuki Hayashi, Tokyo Metropolitan Univ. (Japan); Takuya Miyazawa, Okinawa Institute of Science and Technology Graduate Univ. (Japan); Kazunori Ishibashi, Kenji Tachibana, Keisuke Tamura, Yuzuru Tawara, Nagoya Univ. (Japan); Akihiro Furuzawa, Fujita Health Univ. (Japan); Satoshi Sugita, Tokyo Institute of Technology (Japan) . . . [10399-25]

9:40 am: **The Hitomi (ASTRO-H) Hard X-ray Telescope (HXT): current status of calibration.** Hisamitsu Awaki, Ehime Univ. (Japan); Hideyo Kunieda, Hironori Matsumoto, Kazunori Ishibashi, Keisuke Tamura, Yuzuru Tawara, Ikuyuki Mitsuishi, Nagoya Univ. (Japan); Akihiro Furuzawa, Fujita Health Univ. (Japan); Takuya Miyazawa, Okinawa Institute of Science and Technology Graduate Univ. (Japan); Manabu Ishida, Yoshitomo Maeda, Ryo Iizuka, Institute of Space and Astronautical Science (Japan); Shigeo Yamauchi, Nara Women's Univ. (Japan); Yoshito Haba, Aichi Univ. of Education (Japan); Satoshi Sugita, Tokyo Institute of Technology (Japan); Tessei Yoshida, Ehime Univ. (Japan); Takashi Okajima, Hideyuki Mori, NASA Goddard Space Flight Ctr. (USA); Takayuki Hayashi, Nagoya Univ. (Japan) and NASA Goddard Space Flight Ctr. (USA) . . . [10399-26]

Coffee Break . . . . . Wed 10:00 am to 10:30 am

## SESSION 6

**LOCATION: CONV. CTR. ROOM 9 . . WED 10:30 AM TO 11:30 AM**

### Monocrystalline-Silicon Optics

Session Chair: **Michael J. Pivovarov**, Lawrence Livermore National Lab. (USA)

10:30 am: **Silicon mirror segments, meta-shells, and mirror assemblies for x-ray astronomy,** William W. Zhang, NASA Goddard Space Flight Ctr. (USA) . . . . . [10399-27]

10:50 am: **Progress on the fabrication of lightweight single-crystal silicon x-ray mirrors,** Raul E. Riveros, NASA Goddard Space Flight Ctr. (USA) and Univ. of Maryland, Baltimore County (USA); Michael P. Biskach, NASA Goddard Space Flight Ctr. (USA); Kim D. Allgood, Marton V. Sharpe, John D. Kearney, Stinger Ghaffarian Technologies, Inc. (USA); William W. Zhang, NASA Goddard Space Flight Ctr. (USA) . . . . . [10399-28]

11:10 am: **Kinematic alignment and bonding of mirrors for high-resolution x-ray optics,** Kai-Wing Chan, NASA Goddard Space Flight Ctr. (USA) and Univ. of Maryland, Baltimore County (USA) . . . . . [10399-29]

## SESSION 7

**LOCATION: CONV. CTR. ROOM 9 . . WED 11:30 AM TO 12:30 PM**

### Fused-Silica Optics

Session Chair: **Paul B. Reid**, Harvard-Smithsonian Ctr. for Astrophysics (USA)

11:30 am: **A hybrid concept (segmented plus monolithic fused silica shells) for a high-throughput and high-angular resolution x-ray mission (Lynx/X-Ray Surveyor like),** Giovanni Pareschi, Stefano Basso, Marta M. Civitani, Bianca Salmaso, INAF - Osservatorio Astronomico di Brera (Italy) . . . . . [10399-30]

11:50 am: **Thin fused silica shells for high-resolution and large collecting area x-ray telescopes (like Lynx/XRS),** Marta M. Civitani, Stefano Basso, Oberto Citterio, Joanna Holyszko, Mauro Ghigo, Giovanni Pareschi, INAF - Osservatorio Astronomico di Brera (Italy); Giancarlo Parodi, BCV Progetti S.r.l. (Italy); Giorgio Toso, INAF - IASF Milano (Italy); Gabriele Vecchi, INAF - Osservatorio Astronomico di Brera (Italy) . . . . . [10399-31]

12:10 pm: **Fused silica segments: a possible solution for x-ray telescopes with very high angular resolution like Lynx/XRS,** Bianca Salmaso, Stefano Basso, Marta M. Civitani, Mauro Ghigo, INAF - Osservatorio Astronomico di Brera (Italy); Joanna Holyszko, INAF - Osservatorio Astronomico di Bologna (Italy); Daniele Spiga, Gabriele Vecchi, Giovanni Pareschi, INAF - Osservatorio Astronomico di Brera (Italy) . . . . . [10399-32]

Lunch/Exhibition Break . . . . . Wed 12:30 pm to 2:00 pm

## SESSION 8

**LOCATION: CONV. CTR. ROOM 9 . . . WED 2:00 PM TO 3:40 PM**

### Slumped Optics

Session Chair: **William W. Zhang**, NASA Goddard Space Flight Ctr. (USA)

2:00 pm: **Thermal forming of glass substrates for adjustable optics,** Vincenzo Cotroneo, Paul B. Reid, Ryan Allured, Vanessa Marquez, Casey T. DeRoo, Eric D. Schwartz, Kenneth L. Gurski, Harvard-Smithsonian Ctr. for Astrophysics (USA) . . . . . [10399-33]

2:20 pm: **Indirect glass slumping of grazing incidence mirror segments for lightweight x-ray telescopes,** Laura Proserpio, Peter Friedrich, Emanuel Madarasz, Elias Breunig, Vadim Burwitz, Max-Planck-Institut für extraterrestrische Physik (Germany); Thorsten Döhning, Anne-Catherine Probst, Hochschule Aschaffenburg (Germany) . . . . . [10399-34]

2:40 pm: **Recent progress on experiments and numerical analysis of air bearing slumping for x-ray telescope mirror substrates,** Heng Zuo, Brandon D. Chalifoux, Massachusetts Institute of Technology (USA); Michael D. DeTienne, Izentis LLC (USA); Ralf K. Heilmann, Youwei Yao, Mark L. Schattenburg, MIT Kavli Institute for Astrophysics and Space Research (USA) . . . . . [10399-35]

3:00 pm: **X-ray mirror prototype based on cold shaping of thin glass foils,** Stefano Basso, Marta M. Civitani, Mauro Ghigo, Joanna Holyszko, Giovanni Pareschi, Bianca Salmaso, Daniele Spiga, Gabriele Vecchi, INAF - Osservatorio Astronomico di Brera (Italy) . . . . . [10399-36]

3:20 pm: **Lamination of ultra-thin silicon and glass wafers for producing high-quality and low-cost x-ray telescope mirrors,** Youwei Yao, Mark L. Schattenburg, MIT Kavli Institute for Astrophysics and Space Research (USA) . . . . . [10399-37]

Coffee Break . . . . . Wed 3:40 pm to 4:10 pm

## SESSION 9

**LOCATION: CONV. CTR. ROOM 9 . . . . WED 4:10 PM TO 5:50 PM**

### Spectrometer and Polarimeter Optical Components

Session Chair: **Nicolas M. Barrière**, cosine B.V. (Netherlands)

4:10 pm: **Diffraction efficiency of a replicated large-format x-ray reflection grating,** Drew M. Miles, Jake McCoy, Randall L. McEntaffer, The Pennsylvania State Univ. (USA); Casey T. DeRoo, Harvard-Smithsonian Ctr. for Astrophysics (USA) . . . . . [10399-38]

4:30 pm: **Critical-angle transmission gratings for high resolving power soft x-ray spectrometers on Arcus and Lynx,** Ralf K. Heilmann, MIT Kavli Institute for Astrophysics and Space Research (USA); Alexander R. Bruccoleri, Izentis LLC (USA); Mark L. Schattenburg, MIT Kavli Institute for Astrophysics and Space Research (USA) . . . . . [10399-39]

4:50 pm: **Toward measurement of period variation in Critical-Angle Transmission (CAT) gratings,** Jungki Song, Ralf K. Heilmann, MIT Kavli Institute for Astrophysics and Space Research (USA); Mark L. Schattenburg, Massachusetts Institute of Technology (USA) . . . . . [10399-40]

5:10 pm: **Laboratory progress in soft x-ray polarimetry,** Sarah Heine, Herman L. Marshall, Norbert Schulz, Massachusetts Institute of Technology (USA); Ralf K. Heilmann, MIT Kavli Institute for Astrophysics and Space Research (USA); David Windt, Reflective X-Ray Optics LLC (USA); Kyle A. Beeks, Massachusetts Institute of Technology (USA) . . . . . [10399-41]

5:30 pm: **REDSOX: Monte-Carlo ray-tracing for a soft x-ray spectroscopy polarimeter,** Hans Moritz Günther, Mark D. Egan, Ralf K. Heilmann, Tim Hellickson, MIT Kavli Institute for Astrophysics and Space Research (USA); Jason Frost, Stanford Univ. (USA) and MIT Kavli Institute for Astrophysics and Space Research (USA); Herman L. Marshall, Norbert Schulz, Adam Theriault-Shay, Sarah M. Trowbridge Heine, MIT Kavli Institute for Astrophysics and Space Research (USA) . . . . . [10399-42]



**LOCATION: CONV. CTR.  
EXHIBIT HALL B2 ..... WED 5:30 PM TO 7:30 PM**

## Posters-Wednesday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Development of multilayer coatings for hard x-ray optics at NASA Marshall Space Flight Center**, Danielle N. Gurgew, The Univ. of Alabama in Huntsville (USA); David M. Broadway, Brian D. Ramsey, NASA Marshall Space Flight Ctr. (USA); Don Gregory, The Univ. of Alabama in Huntsville (USA) ..... [10399-44]

**Readout electronics testing during mass production of FlashCam cameras for the Cherenkov Telescope Array**, Sebastian Diebold, Felix Eisenkolb, Christoph Kalkuhl, Gerd Puehlofer, Andrea Santangelo, Thomas Schanz, Chris Tenzer, Eberhard Karls Univ. Tübingen (Germany); the FlashCam Team, see F. Werner et al., NIM A, 2016, for all team members (Germany); the CTA Consortium, Full author and affiliation list on <http://www.cta-observatory.org> (Italy) ..... [10399-63]

**McXtrace simulation of x-ray optics for astronomical telescopes**, Desirée Della Monica Ferreira, DTU Space (Denmark); Erik B. Knudsen, Technical Univ. of Denmark (Denmark); Niels Joergen S. Westergaard, Sonny Massahi, Finn E. Christensen, DTU Space (Denmark) ..... [10399-64]

**Development of the thermal shield with high x-ray transmission for PRAXyS x-ray telescopes**, Yuzuru Tawara, Ikuyuki Mitsuishi, Ryoki Suganuma, Taisuke Futamura, Takafumi Onishi, Kazushi Tachibana, Kenji Tachibana, Ikuya Sakurai, Nagoya Univ. (Japan) ..... [10399-65]

**Industrialization of the mirror plate coatings for the Athena mission**, Sonny Massahi, Finn E. Christensen, Desirée D. M. Ferreira, DTU Space (Denmark); Brian Shortt, European Space Research and Technology Ctr. (Netherlands); Maximilien J. Collon, Boris Landgraf, cosine B.V. (Netherlands) ..... [10399-66]

**Characterization of multilayer coated replicated Wolter optics for fusion experiments at the Z Pulsed Power Facility**, Andrew Ames, Harvard-Smithsonian Ctr. for Astrophysics (USA); David Ampleford, Sandia National Labs. (USA); Ricardo Bruni, Harvard-Smithsonian Ctr. for Astrophysics (USA); Chris Bourdon, Sandia National Labs. (USA); Bernard Koziolowski, Lawrence Livermore National Lab. (USA); Suzanne E. Romaine, Harvard-Smithsonian Ctr. for Astrophysics (USA); Brian D. Ramsey, National Space Sciences and Technology Ctr. (USA); Michael J. Pivovarov, Julia Vogel, Christopher Walton, Lawrence Livermore National Lab. (USA); M. Wu, Sandia National Labs. (USA) ..... [10399-67]

**Development of a second generation SiLC-based Laue lens**, David Girou, Nicolas M. Barrière, Maximilien J. Collon, cosine B.V. (Netherlands); Eric Ford, Univ. of Washington Medical Ctr. (USA); Ramses Günther, cosine Science & Computing B.V. (Netherlands); Lorraine Hanlon, Univ. College Dublin (Ireland); John Tomsick, Space Sciences Lab. (USA); Alexey Uliyanov, Univ. College Dublin (Ireland); Giuseppe Vacanti, cosine Science & Computing B.V. (Netherlands); Colin Wade, Univ. College Dublin (Ireland); Andreas Zoglauer, Space Sciences Lab. (USA) ..... [10399-68]

## THURSDAY 10 AUGUST

### SESSION 10

**LOCATION: CONV. CTR. ROOM 9 .... THU 8:20 AM TO 9:20 AM**

## Multilayer Coatings

Session Chair: **Zhanshan Wang**, Tongji Univ. (China)

8:20 am: **Design, development, and performance of x-ray mirror coatings for the Athena mission**, Desirée Della Monica Ferreira, Sonny Massahi, Finn E. Christensen, DTU Space (Denmark); Brian Shortt, European Space Research and Technology Ctr. (Netherlands); Maximilien J. Collon, cosine B.V. (Netherlands); Chantal Silvestre, DTU Space (Denmark); Michael Krumrey, Levent Cibik, Swenja Schreiber, Physikalisch-Technische Bundesanstalt (Germany) ..... [10399-43]

8:40 am: **Cross-fertilization of multilayer coated Wolter optics: developing optics for fusion experiments at the Z Pulsed Power Facility**, Suzanne E. Romaine, Andrew Ames, Harvard-Smithsonian Ctr. for Astrophysics (USA); David Ampleford, Chris Bourdon, Sandia National Labs. (USA); Bernard Koziolowski, Lawrence Livermore National Lab. (USA); Ricardo Bruni, Harvard-Smithsonian Ctr. for Astrophysics (USA); Michael J. Pivovarov, Lawrence Livermore National Lab. (USA); Brian D. Ramsey, National Space Sciences and Technology Ctr. (USA); Julia Vogel, Christopher Walton, Lawrence Livermore National Lab. (USA); M. Wu, Sandia National Labs. (USA) ..... [10399-45]

9:00 am: **Simulation and optimization of a soft gamma-ray concentrator using thin film multilayer structures**, Farzane Shirazi, Peter Bloser, James Krzanowski, Jason Legere, Mark McConnell, The Univ. of New Hampshire (USA) ... [10399-46]

### SESSION 11

**LOCATION: CONV. CTR. ROOM 9 ... THU 9:20 AM TO 10:20 AM**

## Coating Stress

Session Chair: **Suzanne Romaine**, Harvard-Smithsonian Ctr. for Astrophysics (USA)

9:20 am: **In-situ stress measurement of single and multilayer thin-films used in x-ray astronomy optics applications**, David M. Broadway, Stephen L. O'Dell, Brian D. Ramsey, NASA Marshall Space Flight Ctr. (USA); Danielle N. Gurgew, The Univ. of Alabama in Huntsville (USA) ..... [10399-47]

9:40 am: **Development of iridium-coated x-ray mirrors for astronomical applications**, Veronika Stehliková, Max-Planck-Institut für extraterrestrische Physik (Germany) and Czech Technical Univ. in Prague (Czech Republic); Thorsten Döhning, Anne-Catherine Probst, Florian Emmerich, Manfred Stollenwerk, Hochschule Aschaffenburg (Germany); Laura Proserpio, Peter Friedrich, Max-Planck-Institut für extraterrestrische Physik (Germany) ..... [10399-48]

10:00 am: **Effects of ion implantation in different substrate materials: stress, relaxation, and strength**, Brandon D. Chalifoux, Graham Wright, Massachusetts Institute of Technology (USA); Youwei Yao, MIT Kavli Institute for Astrophysics and Space Research (USA); Claire Burch, Harvard Univ. (USA); Ralf K. Heilmann, Mark L. Schattenburg, MIT Kavli Institute for Astrophysics and Space Research (USA) ..... [10399-49]

Coffee Break ..... Thu 10:20 am to 10:50 am

### SESSION 12

**LOCATION: CONV. CTR. ROOM 9 ... THU 10:50 AM TO 12:10 PM**

## Erosion/Deposition Figuring

Session Chair: **Mark Schattenburg**, MIT Kavli Institute for Astrophysics and Space Research (USA)

10:50 am: **Advancements in ion beam figuring of very thin glass plates**, Marta M. Civitani, Mauro Ghigo, Joanna Holyszko, Gabriele Vecchi, Stefano Basso, INAF - Osservatorio Astronomico di Brera (Italy); Vincenzo Cotroneo, Ryan Allured, Paul B. Reid, Harvard-Smithsonian Ctr. for Astrophysics (USA) ..... [10399-50]

11:10 am: **Improving x-ray optics via differential deposition**, Kiranmayee Kilaru, Universities Space Research Association (USA) ..... [10399-51]

11:30 am: **Additive manufactured x-ray optics for astronomy**, Carolyn Atkins, UK Astronomy Technology Ctr. (United Kingdom); Charlotte H. Feldman, Univ. of Leicester (United Kingdom); David Brooks, Univ. College London (United Kingdom); Richard Willingale, Univ. of Leicester (United Kingdom); Peter Doel, Univ. College London (United Kingdom) ..... [10399-52]

11:50 am: **Design and modeling of an additive manufactured thin shell for x-ray astronomy**, Charlotte H. Feldman, Univ. of Leicester (United Kingdom); Carolyn Atkins, UK Astronomy Technology Ctr. (United Kingdom); Richard Willingale, Univ. of Leicester (United Kingdom); David Brooks, Peter Doel, Univ. College London (United Kingdom) ..... [10399-53]

Lunch/Exhibition Break ..... Thu 12:10 pm to 1:40 pm

### SESSION 13

**LOCATION: CONV. CTR. ROOM 9 .... THU 1:40 PM TO 3:50 PM**

## Adjustable Optics

Session Chair: **Daniele Spiga**, INAF - Osservatorio Astronomico di Brera (Italy)

1:40 pm: **Experimental evaluation of solder bonding and actuation for thin-shell x-ray telescope mirror assembly**, Michael D. DeTienne, Alexander R. Brucocoleri, Ross Tedesco, Massachusetts Institute of Technology (USA); Ralf K. Heilmann, Mark L. Schattenburg, MIT Kavli Institute for Astrophysics and Space Research (USA) ..... [10399-54]

2:00 pm: **Adjustable optics applied to Laue lenses**, Enrico Virgilli, Piero Rosati, Filippo Frontera, Univ. degli Studi di Ferrara (Italy); Ezio Caroli, John B. Stephen, Natalia Auricchio, Stefano Silvestri, Angelo Basili, INAF - IASF Bologna (Italy) ..... [10399-55]

2:20 pm: **Design and fabrication of adjustable x-ray optics using piezoelectric thin films**, Julian Walker, Tianning Liu, Mohit Tendulkar, David Burrows, The Pennsylvania State Univ. (USA); Casey T. DeRoo, Ryan Allured, Edward Hertz, Vincenzo Cotroneo, Paul B. Reid, Eric D. Schwartz, Harvard-Smithsonian Ctr. for Astrophysics (USA); Thomas N. Jackson, The Pennsylvania State Univ. (USA); Susan Trolter-McKinstry, Harvard-Smithsonian Ctr. for Astrophysics (USA) ..... [10399-56]

# CONFERENCE 10399

2:40 pm: **Characterizing the poling process for piezoelectric cells in adjustable x-ray optics**, Casey T. DeRoo, Ryan Allured, Sagi Ben-Ami, Paul B. Reid, Vincenzo Cotroneo, Daniel A. Schwartz, Edward Hertz, Harvard-Smithsonian Ctr. for Astrophysics (USA); Julian Walker, Tianning Liu, Mohit Tendulkar, David Burrows, Tom N. Jackson, Susan Trolier-McKinstry, The Pennsylvania State Univ. (USA) . . . . . [10399-57]

Coffee Break . . . . . Thu 3:00 pm to 3:10 pm

3:10 pm: **Deterministic figure correction of piezoelectrically adjustable slumped glass optics**, Ryan Allured, Paul B. Reid, Casey T. DeRoo, Vincenzo Cotroneo, Alexey Vikhlinin, Edward Hertz, Vanessa Marquez, Eric D. Schwartz, Harvard-Smithsonian Ctr. for Astrophysics (USA); Susan Trolier-McKinstry, Julian Walker, Thomas N. Jackson, Tianning Liu, The Pennsylvania State Univ. (USA) . . . . . [10399-58]

3:30 pm: **Controlling the shaping of Si and glass substrates via stresses in the coatings: via bias stress control and magnet fields**, Melville P. Ulmer, Xiaoli Wang, Jian Cao, David B. Buchholz, Northwestern Univ. (USA); Lahsen Assoufid, Argonne National Lab. (USA) . . . . . [10399-59]

## SESSION 14

**LOCATION: CONV. CTR. ROOM 9 . . . . THU 3:50 PM TO 4:50 PM**

### Other Imaging Technologies

Session Chair: **Brian Ramsey**, NASA Marshall Space Flight Ctr. (USA)

3:50 pm: **Characterization of x-ray lobster optics with a hybrid CMOS sensor**, Tanmoy Chattopadhyay, Mitchell Wages, David Burrows, Evan Bray, The Pennsylvania State Univ. (USA); Adolf Inneman, Rene Hudec, Veronika Stehlikova, Czech Technical Univ. in Prague (Czech Republic); David Schendt, Sam Hull, Abe Falcone, Maria McQuaide, The Pennsylvania State Univ. (USA) . . . . . [10399-60]

4:10 pm: **Testing and modelling of the SVOM MXT narrow field lobster-eye telescope**, Charlotte H. Feldman, James F. Pearson, Richard Willingale, Jonathan M. Sykes, Christopher L. Bicknell, Paul R. Houghton, Paul Drumm, Adrian Martindale, Julian P. Osborne, Paul T. O'Brien, Univ. of Leicester (United Kingdom); Ray Fairbend, Sylvain Petit, Romain Roudot, Emile Schyns, PHOTONIS France S.A.S. (France); Karine Mercier, Jean-Michel Le Duigou, Ctr. National d'Études Spatiales (France); Diego Gotz, CEA-IRFU (France) . . . . . [10399-61]

4:30 pm: **A principle for an x-ray defocusing telescope system with an angular resolution booster**, Yoshitomo Maeda, Institute of Space and Astronautical Science (Japan) and The Graduate Univ. for Advanced Studies (Japan); Ryo Iizuka, Institute of Space and Astronautical Science (Japan); Takayuki Hayashi, Nagoya Univ. (Japan) and NASA Goddard Space Flight Ctr. (USA); Manabu Ishida, Institute of Space and Astronautical Science (Japan) . . . . . [10399-62]

**LOCATION: CONV. CTR. ROOM 9 . . . . . 4:50 PM TO 5:00 PM**

### Concluding Remarks

**Giovanni Pareschi**, INAF - Osservatorio Astronomico di Brera (Italy)

# CONFERENCE 10400

LOCATION: CONV. CTR. ROOM 6E

Tuesday–Thursday 8–10 August 2017 • Proceedings of SPIE Vol. 10400

# Techniques and Instrumentation for Detection of Exoplanets VIII

Conference Chair: **Stuart Shaklan**, Jet Propulsion Lab. (USA)

Program Committee: **Olivier Guyon**, Subaru Telescope, National Astronomical Observatory of Japan (USA), Research Corp. of Univ. of Hawaii (USA), The Univ. of Arizona (USA); **Lucas Labadie**, Univ. of Cologne (Germany); **Bruce A. Macintosh**, Stanford Univ. (USA); **Dimitri P. Mawet**, California Institute of Technology (USA); **M. Charley Noecker**, Jet Propulsion Lab. (USA); **Rémi Soummer**, Space Telescope Science Institute (USA)

## MONDAY 7 AUGUST

LOCATION: CONV. CTR. ROOM 6E . . . . . 3:40 PM TO 6:00 PM

### Panel Discussion: Astronauts and Astronomers to Enable the Most Ambitious Space Observatories

Moderator: **Harley Thronson**, NASA Goddard Space Flight Ctr. (USA)

Panelists: **Matthew A. Greenhouse**, NASA Goddard Space Flight Ctr. (USA); **John M. Grunsfeld**, NASA Johnson Space Ctr. (USA); **Rudranarayan Mukherjee**, Jet Propulsion Lab. (USA); **Bradley M. Peterson**, Space Telescope Science Institute (USA); **Nicholas Siegler**, Jet Propulsion Lab. (USA); **Hsiao I. Smith**, NASA Goddard Space Flight Ctr. (USA)

This is a series of presentations and a discussion on using astronauts and robots to service, upgrade, and eventually assemble future space observatories that will achieve major breakthroughs in our understanding of the cosmos. These missions will be able to study in detail the structure of the first star-forming complexes in the earliest galaxies, the central engines in distant galaxies, and be sufficiently capable of searching very large numbers of extrasolar planets for evidence of life. The technical and engineering merits and challenges of in-space servicing and assembling large-aperture telescopes will be discussed, including issues of launching the telescope/instrument in parts, assembling it in space, and replacing outdated instruments. Also discussed will be possible future space infrastructure that may make more attractive on-orbit assembly. Precursors and demonstration activities will be noted, as well as the earliest candidate missions for in-space upgrade and servicing. The panel discussion will be initiated by the following featured presentations given by the Panelists:

- \* A vision for human space flight and scientific exploration and the search for life in the cosmos (Grunsfeld)
- \* Future space servicing: The GSFC Satellite Servicing Projects Division (Smith)
- \* Serviceability of future large space telescopes (Peterson)
- \* Robotic capabilities to enable large structures (Mukherjee)
- \* Candidate initial assembly mission: Starshade (Siegler/Greenhouse)

## TUESDAY 8 AUGUST

### SESSION 1

LOCATION: CONV. CTR. ROOM 6E . . .TUE 8:20 AM TO 10:10 AM

### WFIRST Coronagraph I

Session Chair: **Stuart Shaklan**, Jet Propulsion Lab. (USA)

8:20 am: **Science capabilities of the WFIRST coronagraph (Invited Paper)**, Bruce A. Macintosh, Stanford Univ. (USA); Margaret Turnbull, SETI Institute (USA); N. Jeremy Kasdin, Princeton Univ. (USA); John H. Debes, Space Telescope Science Institute (USA); Tom Greene, NASA Ames Research Ctr. (USA); Nikole Lewis, Space Telescope Science Institute (USA); Mark S. Marley, NASA Ames Research Ctr. (USA); Bijan Nemati, Jet Propulsion Lab. (USA); Aki Roberge, NASA Goddard Space Flight Ctr. (USA); Tyler Robinson, Univ. of California, Santa Cruz (USA); Dmitry Savransky, Cornell Univ. (USA); Christopher C. Stark, Space Telescope Science Institute (USA) . . . . . [10400-1]

8:50 am: **The WFIRST coronagraph instrument optical design update**, Hong Tang, Richard Demers, John E. Krist, James McGuire, Mayer Rud, Feng Zhao, Jet Propulsion Lab. (USA) . . . . . [10400-2]

9:10 am: **WFIRST coronagraph optical modeling**, John E. Krist, Nikta Amiri, Gary Gutt, Luis Marchen, James McGuire, Bijan Nemati, Navtej Saini, Hong Tang, Jet Propulsion Lab. (USA) . . . . . [10400-4]

9:30 am: **Wavefront control performance modeling with WFIRST shaped pupil coronagraph testbed**, Hanying Zhou, Bijan Nemati, John E. Krist, Eric J. Cady, Brian D. Kern, Ilya Poberezhskiy, Jet Propulsion Lab. (USA) . . . . . [10400-5]

9:50 am: **Sensitivity of WFIRST coronagraph broadband contrast performance to DM actuator errors**, Erkin Sidick, Byoung-Joon Seo, Brian D. Kern, Ilya Poberezhskiy, Bijan Nemati, Jet Propulsion Lab. (USA) . . . . . [10400-6]

Coffee Break . . . . . Tue 10:10 am to 10:40 am

### SESSION 2

LOCATION: CONV. CTR. ROOM 6E . .TUE 10:40 AM TO 12:20 PM

### WFIRST Coronagraph II

Session Chair: **Stuart Shaklan**, Jet Propulsion Lab. (USA)

10:40 am: **Sensitivity of the WFIRST coronagraph performance to key instrument parameters**, Bijan Nemati, John E. Krist, Bertrand Mennesson, Jet Propulsion Lab. (USA) . . . . . [10400-7]

11:00 am: **IMPipeline: an integrated STOP modeling pipeline for the WFIRST coronagraph**, Navtej Saini, Kevin Anderson, Zensheu Chang, Gary Gutt, Bijan Nemati, Jet Propulsion Lab. (USA) . . . . . [10400-8]

11:20 am: **Current science requirements and planned implementation for the WFIRST-CGI Integral Field Spectrograph (IFS)**, Avi M. Mandell, Tyler D. Groff, Qian Gong, Michael W. McElwain, Maxime J. Rizzo, Prabal Saxena, Neil T. Zimmerman, NASA Goddard Space Flight Ctr. (USA) . . . . . [10400-9]

11:40 am: **Flight Integral Field Spectrograph (IFS) optical design for WFIRST coronagraphic exoplanet demonstration**, Qian Gong, Tyler D. Groff, Avi M. Mandell, Michael W. McElwain, Maxime J. Rizzo, Prabal Saxena, NASA Goddard Space Flight Ctr. (USA) . . . . . [10400-10]

12:00 pm: **Simulating the WFIRST coronagraph Integral Field Spectrograph**, Maxime J. Rizzo, Universities Space Research Association (USA) and NASA Goddard Space Flight Ctr. (USA); Ewan S. Douglas, Massachusetts Institute of Technology (USA); Timothy Brandt, Institute for Advanced Study (USA); Kerri L. Cahoy, Massachusetts Institute of Technology (USA); Qian Gong, Tyler D. Groff, NASA Goddard Space Flight Ctr. (USA); John E. Krist, Jet Propulsion Lab. (USA); Avi M. Mandell, Michael W. McElwain, NASA Goddard Space Flight Ctr. (USA); A. J. Eldorado Riggs, Jet Propulsion Lab. (USA); Aki Roberge, Prabal Saxena, Neil T. Zimmermann, NASA Goddard Space Flight Ctr. (USA) . . . . . [10400-11]

Lunch/Exhibition Break . . . . . Tue 12:20 pm to 1:50 pm



# CONFERENCE 10400

## SESSION 3

LOCATION: CONV. CTR. ROOM 6E . . . . TUE 1:50 PM TO 3:10 PM

### WFIRST Coronagraph III

Session Chair: **Stuart Shaklan**, Jet Propulsion Lab. (USA)

- 1:50 pm: **Systematic errors and defects in fabricated coronagraph masks and laboratory scale star-shade masks and their performance impact**, Kunjithapatham Balasubramanian, Eric J. Cady, Richard Muller, Bijan Nemati, Ilya Poberezhskiy, A. J. Eldorado Riggs, Daniel Ryan, Victor White, Daniel Wilson, Karl Yee, Hanying Zhou, Jet Propulsion Lab. (USA) . . . . . [10400-12]
- 2:10 pm: **Testbed demonstration of low-order wavefront sensing and control for WFIRST coronagraph**, Fang Shi, Xin An, Kunjithapatham Balasubramanian, Randall Bartos, Eric J. Cady, Brian D. Kern, Raymond Lam, David S. Marx, Camilo Mejia Prada, Dwight Moody, Richard Muller, Keith Patterson, Ilya Poberezhskiy, A. J. Eldorado Riggs, Daniel Ryan, Byoung-Joon Seo, Chris Shelton, Joel Shields, Erkin Sidick, Hong Tang, John Trauger, Tuan Truong, Victor White, Daniel Wilson, Hanying Zhou, Robert Zimmer, Jet Propulsion Lab. (USA) . . . . . [10400-13]
- 2:30 pm: **Shaped pupil coronagraphy for WFIRST: high-contrast broadband testbed demonstration**, Eric J. Cady, Kunjithapatham Balasubramanian, Jet Propulsion Lab. (USA); Jessica Gersh-Range, N. Jeremy Kasdin, Princeton Univ. (USA); Brian D. Kern, Raymond Lam, Camilo Mejia Prada, Dwight Moody, Keith Patterson, Ilya Poberezhskiy, A. J. Eldorado Riggs, Byoung-Joon Seo, Fang Shi, Hong Tang, John Trauger, Hanying Zhou, Jet Propulsion Lab. (USA); Neil T. Zimmerman, Space Telescope Science Institute (USA) . . . . . [10400-14]
- 2:50 pm: **Hybrid Lyot coronagraph for WFIRST: high-contrast broadband testbed demonstration**, Byoung-Joon Seo, Eric J. Cady, Brian Gordon, Brian D. Kern, David S. Marx, Dwight Moody, Richard Muller, Keith Patterson, Ilya Poberezhskiy, Fang Shi, Erkin Sidick, John Trauger, Daniel Wilson, Jet Propulsion Lab. (USA) . . . . . [10400-15]
- Coffee Break . . . . . Tue 3:10 pm to 3:40 pm

## SESSION 4

LOCATION: CONV. CTR. ROOM 6E . . . . TUE 3:40 PM TO 6:00 PM

### Segmented Aperture Coronagraphs

Session Chair: **Bruce A. Macintosh**, Stanford Univ. (USA)

- 3:40 pm: **Two deformable mirror methods for the correction of aperture discontinuities**, Johan Mazoyer, Johns Hopkins Univ. (USA); Laurent Pueyo, Space Telescope Science Institute (USA); Mamadou N'Diaye, Observatoire de la Côte d'Azur (France); Kevin Fogarty, Johns Hopkins Univ. (USA); Rémi Soummer, Space Telescope Science Institute (USA); Neil T. Zimmerman, NASA Goddard Space Flight Ctr. (USA); Colin Norman, Johns Hopkins Univ. (USA); Stuart B. Shaklan, Jet Propulsion Lab. (USA) . . . . . [10400-16]
- 4:00 pm: **Optimization of coronagraph design for segmented aperture telescopes**, Jeffrey B. Jewell, Jet Propulsion Lab. (USA); Garreth Ruane, California Institute of Technology (USA); Stuart B. Shaklan, Jet Propulsion Lab. (USA); Dimitri Mawet, California Institute of Technology (USA); David Redding, Jet Propulsion Lab. (USA) . . . . . [10400-17]
- 4:20 pm: **Apodized/shaped pupil Lyot coronagraph designs for segmented aperture space telescopes**, Neil T. Zimmerman, NASA Goddard Space Flight Ctr. (USA); Mamadou N'Diaye, Observatoire de la Côte d'Azur (France); Kathryn St. Laurent, Rémi Soummer, Christopher C. Stark, Laurent Pueyo, Anand Sivaramakrishnan, Marshall D. Perrin, Space Telescope Science Institute (USA); Robert J. Vanderbei, Princeton Univ. (USA) . . . . . [10400-18]
- 4:40 pm: **Performance and sensitivity of vortex coronagraphs on segmented space telescopes**, Garreth Ruane, California Institute of Technology (USA); Jeffrey B. Jewell, Jet Propulsion Lab. (USA); Dimitri Mawet, California Institute of Technology (USA) and Jet Propulsion Lab. (USA); Stuart B. Shaklan, Jet Propulsion Lab. (USA) . . . . . [10400-19]
- 5:00 pm: **Phase-induced amplitude apodization complex mask coronagraphy (PIAACMC) for large segmented apertures**, Olivier Guyon, The Univ. of Arizona (USA) and Subaru Telescope, National Astronomical Observatory of Japan (USA); Brian D. Kern, Jet Propulsion Lab. (USA); Alexander T. Rodack, Justin M. Knight, The Univ. of Arizona (USA); Ruslan Belikov, Dan Sirbu, Stephen T. Bryson, Christopher E. Henze, NASA Ames Research Ctr. (USA); Johanan L. Codona, The Univ. of Arizona (USA); Stuart B. Shaklan, Jet Propulsion Lab. (USA) . . . [10400-20]
- 5:20 pm: **Incorporating deformable mirrors into shaped pupil coronagraph optimizations to increase throughput**, Jessica Gersh-Range, N. Jeremy Kasdin, Princeton Univ. (USA) . . . . . [10400-21]
- 5:40 pm: **Sensitivity analysis for high-contrast missions with segmented telescopes**, Lucie Leboulleux, ONERA (France) and Space Telescope Science Institute (USA) and Aix Marseille Université (France); Jean-François Sauvage, Thierry Fusco, ONERA (France) and Aix Marseille Univ. (France); Rémi Soummer, Laurent Pueyo, Space Telescope Science Institute (USA) . . . . . [10400-22]

## WEDNESDAY 9 AUGUST

## SESSION 5

LOCATION: CONV. CTR. ROOM 6E . WED 8:00 AM TO 10:00 AM

### Coronagraph Design, Components, and Analysis I

Session Chair: **Lucas Labadie**, Univ. zu Köln (Germany)

- 8:00 am: **Electric field conjugation in the presence of model uncertainty**, David S. Marx, Byoung-Joon Seo, Erkin Sidick, Brian D. Kern, Bijan Nemati, Ilya Poberezhskiy, Jet Propulsion Lab. (USA) . . . . . [10400-23]
- 8:20 am: **Wavefront control methods for high-contrast integral field spectroscopy**, Tyler D. Groff, NASA Goddard Space Flight Ctr. (USA); Olivier Guyon, Subaru Telescope, National Astronomical Observatory of Japan (USA); Camilo Mejia Prada, Eric J. Cady, Jet Propulsion Lab. (USA); Maxime J. Rizzo, Prabal Saxena, Avi M. Mandell, Qian Gong, Michael W. McElwain, NASA Goddard Space Flight Ctr. (USA); N. Jeremy Kasdin, Princeton Univ. (USA) . . . . . [10400-24]
- 8:40 am: **Improved high-contrast wavefront controllers for exoplanet coronagraphic imaging systems**, He Sun, N. Jeremy Kasdin, Princeton Univ. (USA); A. J. Eldorado Riggs, Jet Propulsion Lab. (USA); Tyler D. Groff, NASA Goddard Space Flight Ctr. (USA) and Princeton Univ. (USA); Robert J. Vanderbei, Princeton Univ. (USA) . . . . . [10400-25]
- 9:00 am: **Low-order wavefront sensing for coronagraphic telescopes**, Hari Subedi, N. Jeremy Kasdin, Princeton Univ. (USA) . . . . . [10400-26]
- 9:20 am: **Polynomial apodized vortex coronagraphs for obscured telescope pupils**, Kevin Fogarty, Johns Hopkins Univ. (USA); Laurent Pueyo, Space Telescope Science Institute (USA); Johan Mazoyer, Johns Hopkins Univ. (USA) and Space Telescope Science Institute (USA); Mamadou N'Diaye, Lab. J.L. Lagrange (France) and Space Telescope Science Institute (USA) . . . . . [10400-27]
- 9:40 am: **Patterned liquid-crystal optics for broadband coronagraphy and wavefront sensing**, David Doelman, Frans Snik, Leiden Observatory (Netherlands); Zane Warriner, Michael Escuti, North Carolina State Univ. (USA) . . . . . [10400-28]
- Coffee Break . . . . . Wed 10:00 am to 10:30 am

## SESSION 6

LOCATION: CONV. CTR. ROOM 6E . WED 10:30 AM TO 12:30 PM

### Coronagraph Design, Components, and Analysis II

Session Chair: **Lucas Labadie**, Univ. zu Köln (Germany)

- 10:30 am: **Optimal design of apodizing phase plate coronagraphs**, Emiel Por, Leiden Observatory (Netherlands) . . . . . [10400-29]
- 10:50 am: **High-contrast imaging in multi-star systems: progress in technology development and lab results**, Ruslan Belikov, Eugene A. Pluzhnik, Eduardo A. Bendek, Dan Sirbu, NASA Ames Research Ctr. (USA) . . . . . [10400-30]
- 11:10 am: **High-contrast spectroscopy testbed for segmented telescopes (HCST)**, Dimitri Mawet, Jason Fucik, California Institute of Technology (USA); James K. Wallace, Jet Propulsion Lab. (USA); Jacques-Robert Delorme, Nikita S. Klimovich, Garreth Ruane, California Institute of Technology (USA); Wenhao J. Xuan, Pomona College (USA); Daniel Echeverri, Princeton Univ. (USA); Reed Riddle, Richard G. Dekany, California Institute of Technology (USA); Michael Randolph, California Polytechnic State Univ., San Luis Obispo (USA); Gautam Vasisht, Bertrand Mennesson, Élodie Choquet, Jet Propulsion Lab. (USA); Ji Wang, California Institute of Technology (USA) . . . . . [10400-31]
- 11:30 am: **Utilizing active single-mode fiber injection for speckle nulling in exoplanet characterization**, Nikita S. Klimovich, Dimitri Mawet, Garreth Ruane, Wenhao J. Xuan, Daniel Echeverri, Michael Randolph, Jason Fucik, Ji Wang, Richard G. Dekany, Jacques-Robert Delorme, California Institute of Technology (USA); James K. Wallace, Gautam Vasisht, Bertrand Mennesson, Élodie Choquet, Eugene Serabyn, Jet Propulsion Lab. (USA) . . . . . [10400-32]
- 11:50 am: **Simulating instruments using the high-dispersion coronagraphy technique**, Ji Wang, Dimitri Mawet, Garreth Ruane, Bjorn Benneke, California Institute of Technology (USA); Renyu Hu, Jet Propulsion Lab. (USA) . . . [10400-33]
- 12:10 pm: **Optical tolerances for the PICTURE-C mission: Error budget for electric field conjugation, beam walk, surface scatter, and polarization aberration**, Christopher B. Mendillo, Glenn A. Howe, Kuravi Hewawasam, Jason Martel, Susanna C. Finn, Timothy A. Cook, Supriya Chakrabarti, Univ. of Massachusetts Lowell (USA) . . . . . [10400-34]
- Lunch/Exhibition Break . . . . . Wed 12:30 pm to 2:00 pm

## SESSION 7

LOCATION: CONV. CTR. ROOM 6E . . WED 2:00 PM TO 3:00 PM

### Deformable Mirrors

Session Chair: **Dimitri Mawet**, California Institute of Technology (USA)

2:00 pm: **Characterization of low-mass deformable mirrors and ASIC drivers for high-contrast imaging**, Camilo Mejia Prada, Jet Propulsion Lab. (USA); Li Yao, Yuqian Wu, Microscale, Inc. (USA); Lewis C. Roberts Jr., Chris Shelton, Jet Propulsion Lab. (USA) . . . . . [10400-35]

2:20 pm: **Ferrofluid deformable mirror for high-contrast imaging: performance evaluation and design improvements**, Aaron J. Lemmer, Princeton Univ. (USA); Tyler D. Groff, NASA Goddard Space Flight Ctr. (USA) and Princeton Univ. (USA); N. Jeremy Kasdin, Princeton Univ. (USA) . . . . . [10400-36]

2:40 pm: **Design of the deformable mirror demonstration CubeSat (DeMi)**, Ewan S. Douglas, Gregory Allan, Derek Barnes, Massachusetts Institute of Technology (USA); Ruslan Belikov, Eduardo A. Bendek, NASA Ames Research Ctr. (USA); Anne Marinan, Jet Propulsion Lab. (USA); John Merck, Aurora Flight Sciences Corp. (USA); Tenzin Ukyab, Kerri L. Cahoy, Massachusetts Institute of Technology (USA) . . . . . [10400-37]

Coffee Break . . . . . Wed 3:00 pm to 3:30 pm

## SESSION 8

LOCATION: CONV. CTR. ROOM 6E . . . WED 3:30 PM TO 4:50 PM

### Ground-based Instruments

Session Chair: **Olivier Guyon**, The Univ. of Arizona (USA)

3:30 pm: **Combining angular differential imaging and accurate polarimetry with SPHERE/IRDIS to characterize young giant exoplanets**, Rob van Holstein, Frans Sniik, Leiden Observatory (Netherlands); Julien Girard, European Southern Observatory (Chile); Jozua de Boer, Christoph Keller, Leiden Observatory (Netherlands); Daphne Stam, Technische Univ. Delft (Netherlands); Jean-Luc Beuzit, David Mouillet, Institut de Planétologie et d'Astrophysique de Grenoble (France); Markus Kasper, European Southern Observatory (Germany); Maud Langlois, Ctr. de Recherche Astronomique de Lyon (France); Arthur Vigan, Lab. d'Astrophysique de Marseille (France); Alice Zurlo, Univ. Diego Portales (Chile) and Univ. de Chile (Chile); Remco de Kok, Leiden Observatory (Netherlands) [10400-38]

3:50 pm: **First light of the CHARIS high-contrast integral-field spectrograph**, Tyler D. Groff, NASA Goddard Space Flight Ctr. (USA); Jeffrey K. Chilcote, Univ. of Toronto (Canada); Timothy Brandt, Institute for Advanced Study (USA); N. Jeremy Kasdin, Michael B. Galvin, Craig Loomis, Gillian Knapp, Princeton Univ. (USA); Olivier Guyon, Nemanja Jovanovic, Julien Lozi, Naruhisa Takato, Subaru Telescope, National Astronomical Observatory of Japan (USA); Masahiko Hayashi, Subaru Telescope, National Astronomical Observatory of Japan (Japan) . . . . . [10400-39]

4:10 pm: **Subaru coronagraphic extreme adaptive optics (SCEAO): wavefront control optimized for high-contrast imaging**, Olivier Guyon, The Univ. of Arizona (USA) and Subaru Telescope, National Astronomical Observatory of Japan (USA); Nemanja Jovanovic, Julien Lozi, Subaru Telescope, National Astronomical Observatory of Japan (USA); Jared Males, The Univ. of Arizona (USA); Frantz Martinache, Observatoire de la Côte d'Azur (France); Ben Mazin, Univ. of California, Santa Barbara (USA); Barnaby Norris, The Univ. of Sydney (Australia); Prashant Pathak, Subaru Telescope, National Astronomical Observatory of Japan (USA) . . . . . [10400-40]

4:30 pm: **NIRPS: an adaptive-optics assisted radial velocity spectrograph to chase exoplanets around M-stars**, François Wildi, Observatoire de Genève (Switzerland); François Bouchy, Lab. d'Astrophysique de Marseille (Switzerland); Rene Doyon, Étienne Artigau, Univ. de Montréal (Canada); Nicolas Blind, Observatoire de Genève (Switzerland); Vladimir Reshetov, NRC - Herzberg Astronomy & Astrophysics (Canada); Olivier Hernandez, Univ. de Montréal (Canada) . . . . . [10400-41]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 . . . . . WED 5:30 PM TO 7:30 PM

### Posters-Wednesday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Commissioning and performance results of the PISCES instrument**, Prabal Saxena, Maxime J. Rizzo, NASA Goddard Space Flight Ctr. (USA); Camilo Mejia Prada, Jet Propulsion Lab. (USA); Jorge D. Llop Sayson, California Institute of Technology (USA); Qian Gong, NASA Goddard Space Flight Ctr. (USA); Eric J. Cady, Jet Propulsion Lab. (USA); Avi M. Mandell, Tyler D. Groff, Michael W. McElwain, NASA Goddard Space Flight Ctr. (USA) . . . . . [10400-58]

**Development status and performance of the evanescent wave coronagraph testbed**, Mary Angelie M. Alagao, Christophe Buisset, National Astronomical Research Institute of Thailand (Thailand); Yves Rabbia, Observatoire de la Côte d'Azur (France); Thierry Lépine, Lab. Hubert Curien (France); Saran Poshyachinda, Boonruksar Soonthornthum, National Astronomical Research Institute of Thailand (Thailand) . . . . . [10400-60]

**Further exoplanet suppression using microlens/pinole mask for Luvoir coronagraph**, Qian Gong, Lee Feinberg, Michael W. McElwain, Neil T. Zimmerman, Tyler D. Groff, Avi M. Mandell, Matthew R. Bolcar, Brian A. Hicks, NASA Goddard Space Flight Ctr. (USA); Rémi Soummer, Laurent Pueyo, Space Telescope Science Institute (USA) . . . . . [10400-61]

**Detection and characterization of exoplanets and disks in starshade mission**, Mengya Hu, Anthony D. Harness, N. Jeremy Kasdin, Robert J. Vanderbei, Princeton Univ. (USA); Stuart B. Shaklan, Jet Propulsion Lab. (USA) . . . . . [10400-62]

**Shape accuracy requirements on starshades for large and small apertures**, Stuart B. Shaklan, Luis Marchen, Eric J. Cady, Jet Propulsion Lab. (USA) [10400-63]

**Design, fabrication, and testing of stellar coronagraphs for exoplanet imaging**, Justin M. Knight, John Brewer, Ryan Hamilton, Karen Ward, Thomas D. Milster, The Univ. of Arizona (USA); Olivier Guyon, The Univ. of Arizona (USA) and Subaru Telescope, National Astronomical Observatory of Japan (Japan) . . . . . [10400-64]

**Starshade orbital maneuver study for WFIRST**, Gabriel Soto, Dmitry Savransky, Christian Delacroix, Daniel Garrett, Amlan Sinha, Cornell Univ. (USA) . . . [10400-65]

**Line profile analysis of the laser frequency comb in FOCES**, Liang Wang, Hanna Kellermann, Max-Planck-Institut für extraterrestrische Physik (Germany); Anna Brucalassi, European Southern Observatory (Germany); Frank U. Grupp, Max-Planck-Institut für extraterrestrische Physik (Germany) and Univ.-Sternwarte München (Germany); Ralf Bender, Univ.-Sternwarte München (Germany) and Max-Planck-Institut für extraterrestrische Physik (Germany) . . . . . [10400-66]

**Performance evaluation of the frequency comb calibrated Echelle spectrograph FOCES**, Hanna Kellermann, Liang Wang, Max-Planck-Institut für extraterrestrische Physik (Germany); Frank U. Grupp, Max-Planck-Institut für extraterrestrische Physik (Germany) and Univ.-Sternwarte München (Germany); Anna Brucalassi, European Southern Observatory (Germany); Florian Lang-Bardl, Ulrich Hopp, Univ.-Sternwarte München (Germany); Ralf Bender, Univ.-Sternwarte München (Germany) and Max-Planck-Institut für extraterrestrische Physik (Germany) . . . . . [10400-67]

**Optimization of high-inclination orbits using planetary flybys for a zodiacal light-imaging mission**, Gabriel Soto, James Lloyd, Dmitry Savransky, Cornell Univ. (USA); Keith Grogan, Jet Propulsion Lab. (USA) and California Institute of Technology (USA); Amlan Sinha, Cornell Univ. (USA) . . . . . [10400-68]

**Detected exoplanet population distributions found analytically**, Daniel Garrett, Dmitry Savransky, Cornell Univ. (USA) . . . . . [10400-69]

**The low-order wavefront control system for the PICTURE-C mission: preliminary testbed results from the Shack-Hartmann sensor**, Glenn A. Howe, Christopher B. Mendillo, Kuravi Hewawasam, Jason Martel, Susanna C. Finn, Supriya Chakrabarti, Timothy A. Cook, Univ. of Massachusetts Lowell (USA) . . . . . [10400-70]

**The low-order wavefront control system for the PICTURE-C mission: high-speed image acquisition and processing**, Kuravi Hewawasam, Christopher B. Mendillo, Glenn A. Howe, Jason Martel, Susanna C. Finn, Supriya Chakrabarti, Timothy A. Cook, Univ. of Massachusetts Lowell (USA) . . . . . [10400-71]

**Post-processing of the HST STIS coronagraphic observations**, Bin Ren, Johns Hopkins Univ. (USA); John H. Debes, Laurent Pueyo, Marshall D. Perrin, Space Telescope Science Institute (USA); Élodie Choquet, Jet Propulsion Lab. (USA) . . . . . [10400-72]

**Shaped pupil coronagraph design developments for the WFIRST coronagraph instrument**, A. J. Eldorado Riggs, Jet Propulsion Lab. (USA) and California Institute of Technology (USA); Neil T. Zimmerman, NASA Goddard Space Flight Ctr. (USA); Stuart B. Shaklan, Jeffrey B. Jewell, Jet Propulsion Lab. (USA) and California Institute of Technology (USA); Jessica Gersh-Range, Princeton Univ. (USA) . . . . . [10400-73]

**Optimizing the regularization in broadband wavefront control algorithm for WFIRST coronagraph**, Erkin Sidick, Byoung-Joon Seo, Brian D. Kern, David S. Marx, Ilya Poberezhskiy, Bijan Nemati, Jet Propulsion Lab. (USA) . . . . . [10400-74]

**Mission design concept for detection of biosignatures of transiting planets**, Jonathan W. Arenberg, Northrop Grumman Aerospace Systems (USA); Daniel Apai, The Univ. of Arizona (USA); Thomas D. Milster, College of Optical Sciences, The Univ. of Arizona (USA) . . . . . [10400-75]

**Focal-plane-based wavefront sensing with random DM probes**, Eugene A. Pluzhnik, Dan Sibrú, Ruslan Belikov, Eduardo A. Bendek, NASA Ames Research Ctr. (USA); Vladimir N. Dudinov, Kharkiv National Univ. of Radio Electronics (Ukraine) . . . . . [10400-76]

# CONFERENCE 10400

**Modeling of planetary signal detection through ray-tracing-based beam propagation**, Donggok Ryu, Sug-Whan Kim, Yonsei Univ. (Korea, Republic of) ..... [10400-77]

**The automated data processing architecture for the GPI Exoplanet Survey**, Jason J. Wang, Univ. of California, Berkeley (USA); Marshall D. Perrin, Space Telescope Science Institute (USA); Dmitry Savransky, Cornell Univ. (USA); Pauline Arriaga, Univ. of California, Los Angeles (USA); Jeffrey K. Chilcote, Univ. of Toronto (Canada); Robert J. De Rosa, Univ. of California, Berkeley (USA); Maxwell A. Millar-Blanchaer, Jet Propulsion Lab. (USA); Jacob Shapiro, Cornell Univ. (USA); Julien Rameau, Univ. de Montréal (Canada); Schuyler G. Wolff, Johns Hopkins Univ. (USA) and Space Telescope Science Institute (USA); James R. Graham, Univ. of California, Berkeley (USA); Bruce A. Macintosh, Stanford Univ. (USA) . . . [10400-78]

**Improving exoplanet sensitivity of the GPI Exoplanet Survey with a forward model matched filter**, Jean-Baptiste Ruffio, Bruce A. Macintosh, Stanford Univ. (USA); Jason J. Wang, Univ. of California, Berkeley (USA); Laurent Pueyo, Space Telescope Science Institute (USA); Eric L. Nielsen, Stanford Univ. (USA); Robert J. De Rosa, Univ. of California, Berkeley (USA); Mark S. Marley, NASA Ames Research Ctr. (USA) . . . [10400-79]

**Fundamental limits to high-contrast wavefront control**, Laurent Pueyo, Space Telescope Science Institute (USA) . . . [10400-80]

**Identification of the focal plane wavefront control system using E-M algorithm**, He Sun, N. Jeremy Kasdin, Robert Vanderbei, Princeton Univ. (USA) . . . [10400-81]

**A fiber injection unit for the Keck Planet Imager and Characterizer (KPIC)**, Jacques-Robert Delorme, California Institute of Technology (USA); Dimitri Mawet, California Institute of Technology (USA) and Jet Propulsion Lab. (USA); James K. Wallace, Jet Propulsion Lab. (USA); Peter L. Wizinowich, W. M. Keck Observatory (USA); Garreth Ruane, Nikita S. Klimovich, Ji Wang, California Institute of Technology (USA) . . . [10400-82]

**Keck Institute for Space Studies. Report on exoplanet imaging and characterization: coherent differential imaging and signal detection statistics**, Dimitri Mawet, California Institute of Technology (USA); Gautam Vasishth, Jet Propulsion Lab. (USA); Michael P. Fitzgerald, Univ. of California, Los Angeles (USA) . . . [10400-83]

## THURSDAY 10 AUGUST

### SESSION 9

**LOCATION: CONV. CTR. ROOM 6E . . . THU 8:00 AM TO 9:40 AM**

#### Starshades

Session Chair: **Stuart Shaklan**, Jet Propulsion Lab. (USA)

8:00 am: **Modeling and performance predictions for the Princeton Starshade Testbed**, Anthony D. Harness, N. Jeremy Kasdin, Robert J. Vanderbei, Yunjong Kim, Princeton Univ. (USA); Philip Dumont, Stuart B. Shaklan, Jet Propulsion Lab. (USA) . . . [10400-42]

8:20 am: **Optical demonstration of a starshade at flight Fresnel numbers in the laboratory**, Yunjong Kim, Anthony D. Harness, Princeton Univ. (USA); Dan Sirbu, NASA Ames Research Ctr. (USA); Mia Hu, Michael B. Galvin, N. Jeremy Kasdin, Robert J. Vanderbei, Princeton Univ. (USA); Stuart B. Shaklan, Jet Propulsion Lab. (USA) . . . [10400-43]

8:40 am: **Precise starshade stationkeeping and pointing with a Zernike wavefront sensor**, Michael Bottom, Carl Seubert, Shannon K. G. Zareh, Stefan R. Martin, Eric J. Cady, Stuart B. Shaklan, Jet Propulsion Lab. (USA) . . . [10400-44]

9:00 am: **Starshade mechanical design for the Habitable Exoplanet Imaging Mission (HabEx)**, Manan Arya, Jet Propulsion Lab. (USA); Steve Warwick, Northrop Grumman Aerospace Systems (USA); David Webb, P. D. Lisman, Stuart B. Shaklan, S. C. Bradford, John Steeves, Evan Hilgemann, Jet Propulsion Lab. (USA); Brian Trease, The Univ. of Toledo (USA); Mark Thomson, Northrop Grumman Aerospace Systems (USA); Neal Beidleman, Gregg Freebury, TENDEG, LLC (USA) . [10400-45]

9:20 am: **Prospects for exoplanet imaging in multi-star systems with starshades**, Dan Sirbu, Ruslan Belikov, NASA Ames Research Ctr. (USA) . . . [10400-46]

### SESSION 10

**LOCATION: CONV. CTR. ROOM 6E . . THU 9:40 AM TO 11:20 AM**

#### Astrometry

Session Chair: **Olivier Guyon**, The Univ. of Arizona (USA)

9:40 am: **Gaia and exoplanets: a revolution in the making (Invited Paper)**, Alessandro Sozzetti, INAF - Osservatorio Astrofisico di Torino (Italy) . . . [10400-47]

Coffee Break . . . . . Thu 10:10 am to 10:40 am

10:40 am: **The exoplanet program of the microarcsecond astrometric observatory Theia**, Lucas Labadie, Univ. zu Köln (Germany); Fabien Malbet, Institut de Planétologie et d'Astrophysique de Grenoble (France); Alain Léger, Institut d'Astrophysique Spatiale (France); Céline Boehm, Durham Univ. (United Kingdom); Antoine Crouzier, Institut de Planétologie et d'Astrophysique de Grenoble (France); Alberto Krone-Martins, Univ. de Lisboa (Portugal) . . [10400-48]

11:00 am: **Results of the astrometry and direct imaging testbed for exoplanet detection**, Eduardo A. Bendek, Ruslan Belikov, Eugene A. Pluzhnik, NASA Ames Research Ctr. (USA); Emily Finan, The Univ. of Arizona (USA) . . . [10400-49]

### SESSION 11

**LOCATION: CONV. CTR. ROOM 6E . . THU 11:20 AM TO 12:20 PM**

#### Interferometric Coronagraphy

Session Chair: **Olivier Guyon**, The Univ. of Arizona (USA)

11:20 am: **New technologies for nulling interferometry: laboratory demonstration of integrated optics beam combiners in the L and M bands**, Lucas Labadie, Univ. zu Köln (Germany); Stefano Minardi, Friedrich-Schiller-Univ. Jena (Germany); Jan Tepper, Univ. zu Köln (Germany); Romina Diener, Friedrich-Schiller-Univ. Jena (Germany); Robert R. Thomson, Heriot-Watt Univ. (United Kingdom); Jörg-Uwe Pott, Max-Planck-Institut für Astronomie (Germany); Stefan Nolte, Friedrich-Schiller-Univ. Jena (Germany) . . . [10400-50]

11:40 am: **Segmented Aperture Interferometric Nulling Testbed (SAINT) II: component systems update**, Brian A. Hicks, Univ. of Maryland (USA) and NASA Goddard Space Flight Ctr. (USA); Matthew R. Bolcar, NASA Goddard Space Flight Ctr. (USA); Michael A. Helmbrecht, Iris AO, Inc. (USA); Peter Petrone III, Sigma Space Corp. (USA) and NASA Goddard Space Flight Ctr. (USA); Jeffrey A. Bolognese, Mark Clampin, NASA Goddard Space Flight Ctr. (USA); James A. Corsetti, Univ. of Rochester (USA) and NASA Goddard Space Flight Ctr. (USA); Andrew Eberhardt, Univ. of Washington (USA); Corina Koca, NASA Goddard Space Flight Ctr. (USA); Andrew M. Lea, Stinger Ghaffarian Technologies (USA) and NASA Goddard Space Flight Ctr. (USA); Ron Shiri, Neil T. Zimmerman, NASA Goddard Space Flight Ctr. (USA) . . . [10400-51]

12:00 pm: **Phase-shifting coronagraph**, François B. Hénault, Alexis Carlotti, Christophe Verinaud, Institut de Planétologie et d'Astrophysique de Grenoble (France) . . . [10400-59]

Lunch/Exhibition Break . . . . . Thu 12:20 pm to 1:50 pm

### SESSION 12

**LOCATION: CONV. CTR. ROOM 6E . . . . THU 1:50 PM TO 3:30 PM**

#### Mission and Data Analysis

Session Chair: **Lucas Labadie**, Univ. zu Köln (Germany)

1:50 pm: **ExEP yield modeling tool and validation test results**, Rhonda M. Morgan, Michael Turmon, Jet Propulsion Lab. (USA); Dmitry Savransky, Christian Delacroix, Daniel Garrett, Cornell Univ. (USA); Patrick Lowrance, Xiang Cate Liu, California Institute of Technology (USA); Paul Nunez, Jet Propulsion Lab. (USA) . . . [10400-53]

2:10 pm: **Multi-mission modeling for space-based exoplanet imagers**, Dmitry Savransky, Christian Delacroix, Daniel Garrett, Cornell Univ. (USA) . . . [10400-54]

2:30 pm: **Report on EXOPAG study analysis group 19: exoplanet imaging signal detection theory and rigorous contrast metrics**, Dimitri Mawet, Rebecca Jensen-Clem, California Institute of Technology (USA) . . . [10400-55]

2:50 pm: **Quantifying the impact of small statistics at small inner working angles**, Stephen T. Bryson, Ruslan Belikov, NASA Ames Research Ctr. (USA) . . . [10400-56]

3:10 pm: **Planet signal extraction from direct imaging using common spatial pattern filtering**, Jacob Shapiro, Nikhil Ranganathan, Dmitry Savransky, Cornell Univ. (USA); Jean-Baptiste Ruffio, Bruce A. Macintosh, Stanford Univ. (USA) . . . [10400-57]



# CONFERENCE 10401

LOCATION: CONV. CTR. ROOM 7A

Tuesday–Thursday 8–10 August 2017 • Proceedings of SPIE Vol. 10401

## Astronomical Optics: Design, Manufacture, and Test of Space and Ground Systems

*Conference Chairs:* **Tony B. Hull**, The Univ. of New Mexico (USA); **Dae Wook Kim**, College of Optical Sciences, The Univ. of Arizona (USA); **Pascal Hallibert**, European Space Research and Technology Ctr. (Netherlands)

*Conference Co-Chairs:* **Gary B. Hughes**, California Polytechnic State Univ., San Luis Obispo (USA); **Ronald G. Pirich**, Northrop Grumman Aerospace Systems (USA)

*Program Committee:* **Stephanie Behar-Lafenetre**, Thales Alenia Space (France); **Raymond M. Bell Jr.**, Lockheed Martin Space Systems Co. (USA); **Alain J. Corso**, CNR-IFN UoS Padova (Italy); **Laura E. Coyle**, Ball Aerospace & Technologies Corp. (USA); **James P. Hamilton**, Univ. of Wisconsin-Platteville (USA); **John M. Hill**, Large Binocular Telescope Observatory (USA); **Frank Stefan Höller**, Carl Zeiss AG (Germany); **Pengda Hong**, Lehigh Univ. (USA); **Joseph M. Howard**, NASA Goddard Space Flight Ctr. (USA); **Steven A. Macenka**, Jet Propulsion Lab. (USA); **Luca Maresi**, ESTEC (Netherlands); **Maria Guglielmina Pelizzo**, CNR-IFN Padova (Italy); **Narasimha S. Prasad**, NASA Langley Research Ctr. (USA); **Stuart B. Shaklan**, Jet Propulsion Lab. (USA); **Thomas Westerhoff**, SCHOTT AG (Germany)

### MONDAY 7 AUGUST

LOCATION: CONV. CTR. ROOM 6E . . . . . 3:40 PM TO 6:00 PM

#### Panel Discussion: Astronauts and Astronomers to Enable the Most Ambitious Space Observatories

*Moderator:* **Harley Thronson**, NASA Goddard Space Flight Ctr. (USA)

*Panelists:* **Matthew A. Greenhouse**, NASA Goddard Space Flight Ctr. (USA); **John M. Grunsfeld**, NASA Johnson Space Ctr. (USA); **Rudranarayan Mukherjee**, Jet Propulsion Lab. (USA); **Bradley M. Peterson**, Space Telescope Science Institute (USA); **Nicholas Siegler**, Jet Propulsion Lab. (USA); **Hsiao I. Smith**, NASA Goddard Space Flight Ctr. (USA)

This is a series of presentations and a discussion on using astronauts and robots to service, upgrade, and eventually assemble future space observatories that will achieve major breakthroughs in our understanding of the cosmos. These missions will be able to study in detail the structure of the first star-forming complexes in the earliest galaxies, the central engines in distant galaxies, and be sufficiently capable of searching very large numbers of extrasolar planets for evidence of life. The technical and engineering merits and challenges of in-space servicing and assembling large-aperture telescopes will be discussed, including issues of launching the telescope/instrument in parts, assembling it in space, and replacing outdated instruments. Also discussed will be possible future space infrastructure that may make more attractive on-orbit assembly. Precursors and demonstration activities will be noted, as well as the earliest candidate missions for in-space upgrade and servicing. The panel discussion will be initiated by the following featured presentations given by the Panelists:

- \* A vision for human space flight and scientific exploration and the search for life in the cosmos (Grunsfeld)
- \* Future space servicing: The GSFC Satellite Servicing Projects Division (Smith)
- \* Serviceability of future large space telescopes (Peterson)
- \* Robotic capabilities to enable large structures (Mukherjee)
- \* Candidate initial assembly mission: Starshade (Siegler/Greenhouse)

### TUESDAY 8 AUGUST

#### SESSION 1

#### LOCATION: CONV. CTR. ROOM 7A .. TUE 8:20 AM TO 10:00 AM Laser Applications for Planetary Defense and Exploration

Session Chair: **Ronald G. Pirich**, Northrop Grumman Aerospace Systems (USA)

8:20 am: **NEO deflection by laser ablation: experimental results**, Jessie Su, Jonathan A. Madajian, Philip M. Lubin, Travis R. Brashears, Nicholas Rupert, Univ. of California, Santa Barbara (USA); Gary B. Hughes, California Polytechnic State Univ., San Luis Obispo (USA) . . . . . [10401-2]

8:40 am: **Deflection of inert objects in comet-like orbits by laser ablation**, Qicheng Zhang, Philip M. Lubin, Univ. of California, Santa Barbara (USA); Gary B. Hughes, California Polytechnic State Univ., San Luis Obispo (USA) . . . . . [10401-3]

9:00 am: **High-beam quality all-solid-state nanosecond Nd:YAG laser system of high-repetition frequency for space-debris detection**, Zhongwei Fan, Academy of Opto-Electronics, CAS (China) . . . . . [10401-4]

9:20 am: **Deep-space laser communication hardware driver**, Jonathan A. Madajian, Nicholas Rupert, Victoria Rosborough, Univ. of California, Santa Barbara (USA); Steven Estrella, Freedom Photonics, LLC (USA); Philip M. Lubin, Jonathan Klamkin, Univ. of California, Santa Barbara (USA) . . . . . [10401-5]

9:40 am: **Near-field optical model for directed energy-propelled spacecrafts**, Gary B. Hughes, California Polytechnic State Univ., San Luis Obispo (USA); Lauren R. F. Busby, Univ. of California, Santa Barbara (USA) . . . . . [10401-6]

Coffee Break . . . . . Tue 10:00 am to 10:30 am

#### SESSION 2

#### LOCATION: CONV. CTR. ROOM 7A .. TUE 10:30 AM TO 12:30 PM

#### Optical Systems for Deep Space Missions

Session Chair: **Pengda Hong**, Lehigh Univ. (USA)

10:30 am: **Switchable optical materials for space propulsion and attitude control** (*Invited Paper*), Jeremy N. Munday, Univ. of Maryland, College Park (USA) . . . . . [10401-7]

11:00 am: **The Trillion Planet Survey: A search for directed intelligence**, Philip M. Lubin, Univ. of California, Santa Barbara (USA) . . . . . [10401-61]

11:20 am: **Evolution of wafer-scale space systems for terrestrial and deep-space missions**, Nicholas Rupert, Philip M. Lubin, Univ. of California, Santa Barbara (USA); Gary B. Hughes, California Polytechnic State Univ., San Luis Obispo (USA); Russell Woods, Univ. of California, Santa Barbara (USA); Peter Ateshian, Naval Postgraduate School (USA); Prashant Srinivasan, California Polytechnic State Univ., San Luis Obispo (USA); Jonathan A. Madajian, Travis R. Brashears, Alexander Cohen, Qicheng Zhang, Jessie Su, Lauren R. F. Busby, Univ. of California, Santa Barbara (USA) . . . . . [10401-9]

# CONFERENCE 10401

11:40 am: **Ions irradiation on bi-layer coatings**, Enrico Tessarolo, Alain Jody Corso, CNR-IFN Padova (Italy); Alessandro Martucci, Univ. degli Studi di Padova (Italy); Marco Angiola, Maria Guglielmina Pelizzo, CNR-IFN Padova (Italy)[10401-10]

12:00 pm: **Systematic investigation of the optical coatings damages induced in harsh space environment** (*Invited Paper*), Alain Jody Corso, Enrico Tessarolo, CNR-IFN Padova (Italy); Alessandro Martucci, Univ. degli Studi di Padova (Italy); Marco Angiola, Maria Guglielmina Pelizzo, CNR-IFN Padova (Italy). . . . . [10401-11]

Lunch/Exhibition Break . . . . . Tue 12:30 pm to 2:00 pm

## SESSION 3

**LOCATION: CONV. CTR. ROOM 7A . . . TUE 2:00 PM TO 4:00 PM**

### Timing, Phase, and Thermal Contributions to System Design

Session Chair: **Ronald G. Pirich**, Northrop Grumman Aerospace Systems (USA)

2:00 pm: **Restoration of image distorted by atmospheric turbulence achieved by optical phase conjugation** (*Invited Paper*), Pengda Hong, Yujie J. Ding, Lehigh Univ. (USA) . . . . . [10401-12]

2:30 pm: **Characterizing phase noise in long optical fibers** (*Invited Paper*), Prashant Srinivasan, California Polytechnic State Univ., San Luis Obispo (USA); Peter Krogen, Massachusetts Institute of Technology (USA); Gary B. Hughes, California Polytechnic State Univ., San Luis Obispo (USA); Philip M. Lubin, Peter Meinhold, Jonathan A. Madajian, Qicheng Zhang, Alexander Cohen, Benton Miller, Daniel Brouwer, Travis R. Brashears, Lauren R. F. Busby, Nicholas Rupert, Univ. of California, Santa Barbara (USA) . . . . . [10401-13]

3:00 pm: **Anti-resonant hollow core fiber for precision timing applications** (*Invited Paper*), Amy Van Newkirk, The Pennsylvania State Univ. (USA); J. Enrique Antonio Lopez, Rodrigo Amezcua Correa, Axel Schülzgen, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); John Mazurowski, The Pennsylvania State Univ. (USA). . . . . [10401-14]

3:30 pm: **Thermal assessment of sunlight impinging on OSIRIS-Rex OCAMS PolyCam, OTES, and IMU-sunshade MLI blankets in flight** (*Invited Paper*), Michael K. Choi, NASA Goddard Space Flight Ctr. (USA) . . . . . [10401-15]

**LOCATION: CONV. CTR. ROOM 6A . . . . . 4:00 PM TO 5:30 PM**

### Optical Engineering Plenary Session

Session Chair: **Julie L. Bentley**, Univ. of Rochester (USA)

4:00 pm: **Welcome and Opening Remarks**

4:05 pm: **Designing for one to one-million: how production quantities influence design** (*Plenary*), Leo B. Baldwin, Amazon.com, Inc. (USA) . . . . . [10376-201]

4:50 pm: **The Large Synoptic Survey Telescope** (*Plenary*), Steven Kahn, Large Synoptic Survey Telescope (USA) and SLAC National Accelerator Lab. (USA) . . . . . [10401-202]

## WEDNESDAY 9 AUGUST

### SESSION 4

**LOCATION: CONV. CTR. ROOM 7A . . . WED 10:30 AM TO 12:10 PM**

### Glass and Materials

Session Chair: **Thomas Westerhoff**, SCHOTT AG (Germany)

10:30 am: **SCHOTT optical glass in space**, Ralf Jedamzik, Uwe Petzold, SCHOTT AG (Germany) . . . . . [10401-16]

10:50 am: **Parametric criteria for optimal selection of materials for spaceborne mirrors**, Tony B. Hull, The Univ. of New Mexico (USA); Stephanie Behar-Lafenetre, Thales Alenia Space (France); Dominic Doyle, European Space Research and Technology Ctr. (Netherlands); Ralf Jedamzik, Thomas Westerhoff, SCHOTT AG (Germany) . . . . . [10401-19]

11:10 am: **Homogeneity of the coefficient of linear thermal expansion of ZERODUR(R): a review of a decade of evaluations**, Ralf Jedamzik, Thomas Westerhoff, SCHOTT AG (Germany) . . . . . [10401-17]

11:30 am: **ZERODUR 4-m blank surviving up to 20 g acceleration**, Thomas Westerhoff, Thomas Werner, Thorsten Gehindy, SCHOTT AG (Germany)[10401-18]

11:50 am: **Review of space radiation interaction with ZERODUR**, Antoine Carré, Thomas Westerhoff, SCHOTT AG (Germany); Tony B. Hull, The Univ. of New Mexico (USA). . . . . [10401-20]

Lunch/Exhibition Break . . . . . Wed 12:10 pm to 1:40 pm

### SESSION 5

**LOCATION: CONV. CTR. ROOM 7A . . . WED 1:40 PM TO 3:20 PM**

### Mirror/Lens Design and Modeling

Session Chair: **Pascal Hallibert**, European Space Research and Technology Ctr. (Netherlands)

1:40 pm: **Design and component test results of the LSST Camera L1-L2 lens assembly**, Allison A. Barto, Ball Aerospace & Technologies Corp. (USA); Scott E. Winters, Lawrence Livermore National Lab. (USA); James H. Burge, College of Optical Sciences, The Univ. of Arizona (USA); Deborah Davies, Heather A. Doty, Ball Aerospace & Technologies Corp. (USA); John Richer, Peter Seyforth, Alliance Spacesystems, LLC (USA) . . . . . [10401-21]

2:00 pm: **Advanced mirror technology development (AMTD): year five status**, H. Philip Stahl, NASA Marshall Space Flight Ctr. (USA) . . . . . [10401-22]

2:20 pm: **Lightweight ZERODUR: Validation of mirror performance and mirror modeling predictions**, Tony B. Hull, The Univ. of New Mexico (USA); H. Phillip Stahl, NASA Marshall Space Flight Ctr. (USA); Thomas Westerhoff, SCHOTT AG (Germany); Martin J. Valente, Arizona Optical Systems, LLC (USA); Thomas Brooks, Ron Eng, NASA Marshall Space Flight Ctr. (USA); Ralf Jedamzik, SCHOTT AG (Germany) . . . . . [10401-23]

2:40 pm: **Development of the camera lens system for total solar eclipse observation**, Jihun Kim, Seonghwan Choi, Ji-Hye Beck, Jongyeob Park, Su-Chan Bong, Bi-Ho Jang, Korea Astronomy and Space Science Institute (Korea, Republic of); Heesu Yang, Seoul National Univ. (Korea, Republic of); Jinho Kim, Green Optics Co., Ltd. (Korea, Republic of); Geon-Hee Kim, Korea Basic Science Institute (Korea, Republic of); Kyungsook Cho, Sung-Joon Park, Korea Astronomy and Space Science Institute (Korea, Republic of) . . . . . [10401-24]

3:00 pm: **ZERODUR expanding capabilities and capacity for future spaceborne and ground-based telescopes**, Thomas Westerhoff, Thomas Werner, SCHOTT AG (Germany) . . . . . [10401-25]

Coffee Break . . . . . Wed 3:20 pm to 3:50 pm

### SESSION 6

**LOCATION: CONV. CTR. ROOM 7A . . . WED 3:50 PM TO 5:10 PM**

### Optical Testing and Alignment

Session Chair: **Laura E. Coyle**, Ball Aerospace & Technologies Corp. (USA)

3:50 pm: **Instantaneous phase measuring deflectometry for dynamic deformable mirror characterization**, Isaac Trumper, Heejoo Choi, Dae Wook Kim, College of Optical Sciences, The Univ. of Arizona (USA) . . . . . [10401-26]

4:10 pm: **JWST center of curvature test method and results**, David M. Chaney, Ball Aerospace & Technologies Corp. (USA); Babak N. Saif, NASA Goddard Space Flight Ctr. (USA); Perry E. Greenfield, Kyle Van Gorkom, Keira J. Brooks, Warren Hack, Space Telescope Science Institute (USA); Marcel Bluth, Josh Bluth, SGT, Inc. (USA); James Sanders, NASA Goddard Space Flight Ctr. (USA); Koby Z. Smith, Larkin B. Carey, Ball Aerospace & Technologies Corp. (USA); Sze M. Chung, Orbital ATK (USA); Severine C. Tournois, Ritva Keski-Kuha, Lee D. Feinberg, NASA Goddard Space Flight Ctr. (USA); W. Scott Smith, NASA Marshall Space Flight Ctr. (USA) . . . . . [10401-27]

4:30 pm: **Slanted-edge MTF testing for establishing focus alignment at infinite conjugate of space optical systems with gravity sag effects**, Trent Newswander, David W. Riesland, Duane Miles, Lennon Reinhart, Space Dynamics Lab. (USA) . . . . . [10401-28]

4:50 pm: **Diffractive optics for precision alignment of Euclid space telescope optics**, Jean-Michel Asfour, Frank Weidner, Dioptic GmbH (Germany). . [10401-29]

**LOCATION: CONV. CTR.**

**EXHIBIT HALL B2 . . . . . WED 5:30 PM TO 7:30 PM**

### Posters-Wednesday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPPosterGuidelines>.

**Customized broadband sloan-filters filters for the JST/T250 and JAST/T80 telescopes: summary of results**, Ulf Brauneck, SCHOTT Suisse SA (Switzerland); Ruediger Sprengard, SCHOTT AG (Germany); Sébastien Bourquin, SCHOTT Suisse SA (Switzerland); Antonio Marin-Franch, Ctr. de Estudios de Física del Cosmos de Aragón (Spain). . . . . [10401-43]

**An empirical comparison of primary baffle and vanes for optical astronomical telescope**, Taoran Li, Yingwei Chen, National Astronomical Observatories (China) ..... [10401-44]

**A friction compensating method based on data fusion in telescope controller design**, YongMei Huang, Qiang Wang, Dong He, ZhiJun Song, Institute of Optics and Electronics, Chinese Academy of Sciences (China) ..... [10401-46]

**Advanced slicer design for integral field spectrograph**, Shaojie Chen, Suresh Sivanandam, Univ. of Toronto (Canada) ..... [10401-47]

**Optical design of pyramid wavefront sensor for multiple mirror telescope**, Shaojie Chen, Suresh Sivanandam, Siqi Liu, Univ. of Toronto (Canada); Jean-Pierre Veran, NRC - Herzberg Astronomy & Astrophysics (Canada); Phillip M. Hinz, The Univ. of Arizona (USA); Etsuko Mieda, Tim Hardy, Olivier Lardière, NRC - Herzberg Astronomy & Astrophysics (Canada) ..... [10401-48]

**Design of large aspherical SiC mirror for spaceborne application**, Il K. Moon, Young Ha Kim, Ho-Soon Yang, Yun Woo Lee, Korea Research Institute of Standards and Science (Korea, Republic of) ..... [10401-50]

**Optical design of the long slit spectrograph for 1m telescope**, Dmitry E. Sazonenko, Dmitriy E. Kukushkin, Alexey V. Bakholdin, ITMO Univ. (Russian Federation); Gennady G. Valyvin, Special Astrophysical Observatory (Russian Federation) ..... [10401-51]

**Control code for laboratory adaptive optics teaching system**, Moon-Seob Jin, Ryan J. Luder, Lucas R. W. Sanchez, Michael Hart, College of Optical Sciences, The Univ. of Arizona (USA) ..... [10401-52]

**Design and simulation of image-based 2D BRDF measurement system using semicircular ring reflector**, Seul Ki Yang, Yonsei Univ. (Korea, Republic of); Eunsong Oh, Yonsei Univ. (Korea, Republic of) and Korea Institute of Ocean Science & Technology (Korea, Republic of); Sug-Whan Kim, Yonsei Univ. (Korea, Republic of) ..... [10401-53]

**Fused silica polishing and figuring using CO<sub>2</sub> laser radiation**, Ting He, Shanghai Institute of Optics and Fine Mechanics (China) and Univ. of Chinese Academy of Sciences (China); Chaoyang Wei, Zhigang Jiang, Xiaoli Teng, Jianda Shao, Shanghai Institute of Optics and Fine Mechanics (China) ..... [10401-54]

**A fast measuring method of the small aperture convex hyperboloid surface reflector**, Zhe Wang, Xueke Xu, Lingqi Wu, Chaoyang Wei, Jianda Shao, Shanghai Institute of Optics and Fine Mechanics (China) ..... [10401-55]

**Elemental analysis of meteorites using laser-induced breakdown spectroscopy (LIBS)**, Adarsh Ananthachar, Dept. of Atomic and Molecular Physics, Manipal University (India); Santhosh Chidangil, Dept. of Atomic and Molecular Physics (India) ..... [10401-57]

**Optical design for CETUS: a wide-field 1.5m aperture UV payload being studied for a NASA probe class mission study**, Robert A. Woodruff, Lockheed Martin Autonomous Systems (USA); Sara R. Heap, William C. Danchi, NASA Goddard Space Flight Ctr. (USA); Tony B. Hull, The Univ. of New Mexico (USA); Lloyd R. Purves, NASA Goddard Space Flight Ctr. (USA); Stephen E. Kendrick, Kendrick Aerospace Consulting (USA) ..... [10401-59]

## THURSDAY 10 AUGUST

### SESSION 7

**LOCATION: CONV. CTR. ROOM 7A . . THU 8:00 AM TO 10:00 AM**

### Imaging and Sensing I

Session Chair: **Tony B. Hull**, The Univ. of New Mexico (USA)

8:00 am: **Multiplexing in astrophysics with a UV multi-object spectrometer on CETUS, a probe-class mission study**, Stephen E. Kendrick, Kendrick Aerospace Consulting (USA); Robert A. Woodruff, Lockheed Martin Autonomous Systems (USA); Tony B. Hull, The Univ. of New Mexico (USA); Sara R. Heap, NASA Goddard Space Flight Ctr. (USA) ..... [10401-60]

8:20 am: **Operation and performance of the New Horizons Long-Range Reconnaissance Imager during the Pluto encounter**, Steven J. Conard, Harold A. Weaver, Jorge I. Núñez, Howard W. Taylor, John R. Hayes, Andrew F. Cheng, Johns Hopkins Univ. Applied Physics Lab., LLC (USA) ..... [10401-30]

8:40 am: **High-performance integrated photonic spectrometers: arrayed waveguide gratings or echelle gratings**, Andreas Stoll, Ziyang Zhang, Martin M. Roth, Leibniz-Institut für Astrophysik Potsdam (Germany) ..... [10401-31]

9:00 am: **Adaptation of Dunn Solar Telescope for Jovian Doppler spectro imaging**, Thomas A. Underwood, David G. Voelz, New Mexico State Univ. (USA); François-Xavier Schmider, Lab. J.L. Lagrange, Observatoire de la Côte d'Azur (France); Jason Jackiewicz, New Mexico State Univ. (USA); Julien Dejonghe, Yves Bresson, Lab. J.L. Lagrange, Observatoire de la Côte d'Azur (France); Robert Hull, New Mexico State Univ. (USA); Ivan Gonçalves, Lab. J.L. Lagrange, Observatoire de la Côte d'Azur (France); Patrick Gualme, New Mexico State Univ. (USA); Frédéric Morand, Olivier Preis, Lab. J.L. Lagrange, Observatoire de la Côte d'Azur (France) ..... [10401-32]

9:20 am: **An acquisition technology of optical ground station in satellite-ground QKD**, Dong He, YongMei Huang, Qiang Wang, Bo Qi, WanSheng Liu, Institute of Optics and Electronics, Chinese Academy of Sciences (China) ..... [10401-33]

9:40 am: **Imaging and spectral performance of the New Horizons Ralph instrument during the 2015 Pluto encounter**, Allen W. Lunsford, Dennis Reuter, Donald E. Jennings, NASA Goddard Space Flight Ctr. (USA); Catherine B. Olkin, S. Alan Stern, Southwest Research Institute (USA); Gerald E. Weigle, Big Head Endian, LLC (USA) ..... [10401-34]

Coffee Break ..... Thu 10:00 am to 10:20 am

### SESSION 8

**LOCATION: CONV. CTR. ROOM 7A . THU 10:20 AM TO 12:20 PM**

### Imaging and Sensing II

Session Chair: **Stephanie Behar-Lafetretre**, Thales Alenia Space (France)

10:20 am: **Mission systems engineering for the Cosmic Evolution Through UV Spectroscopy (CETUS) space telescope concept**, Lloyd R. Purves, NASA Goddard Space Flight Ctr. (USA) ..... [10401-58]

10:40 am: **Reducing SOFIA's image jitter: an ongoing challenge**, Friederike M. Graf, NASA Ames Research Ctr. (USA); Andreas Reinacher, Daniel Spohr, Holger Jakob, Deutsches SOFIA Institut (Germany); Stefanos Fasoulas, Univ. of Stuttgart (Germany) ..... [10401-35]

11:00 am: **A second-order spherical optoelectronic detector**, Francesco Romano, Consultant (Italy) ..... [10401-36]

11:20 am: **4MOST optical system: presentation and design details**, Nicolas Azais, Samuel C. Barden, Gregory A. Smith, Steffen Frey, Leibniz-Institut für Astrophysik Potsdam (Germany); Damien J. Jones, Prime Optics (Australia); Bernard-Alexis Delabre, European Southern Observatory (Germany) ... [10401-37]

11:40 am: **Voltage linear transformation circuit design**, Lucas R. W. Sanchez, Randy P. Scott, Ryan J. Luder, Moon-Seob Jin, The Univ. of Arizona (USA); Michael Hart, The Univ. of Arizona (USA) ..... [10401-38]

12:00 pm: **Design of the telescope controller rejecting ground-based disturbance based on data fusion**, Qiang Wang, YongMei Huang, Dong He, Xiang Liu, Jin-ying Li, ShengPing Du, Yu Jiang, Institute of Optics and Electronics, Chinese Academy of Sciences (China) ..... [10401-45]

Lunch/Exhibition Break ..... Thu 12:20 pm to 1:50 pm

### SESSION 9

**LOCATION: CONV. CTR. ROOM 7A . . . THU 1:50 PM TO 3:30 PM**

### Filter and Mirror Technology

Session Chair: **James P. Hamilton**, Photonic Cleaning Technologies (USA)

1:50 pm: **Active optics as enabling technology for future large missions: current developments for astronomy and Earth observation at ESA**, Pascal Hallibert, European Space Research and Technology Ctr. (Netherlands) [10401-39]

2:10 pm: **Atomic layer deposition and etching methods for far ultraviolet aluminum mirrors**, John Hennessy, Jet Propulsion Lab. (USA); Christopher S. Moore, Univ. of Colorado Boulder (USA); Kunjithapatham Balasubramanian, April D. Jewell, Shouleh Nikzad, Jet Propulsion Lab. (USA); Kevin C. France, Univ. of Colorado Boulder (USA) ..... [10401-40]

2:30 pm: **A dense grid of narrow bandpass steep edge filters for the JST/T250 telescope: summary of results**, Ulf Brauneck, SCHOTT Suisse SA (Switzerland); Ruediger Sprengard, SCHOTT AG (Germany); Sébastien Bourquin, SCHOTT Suisse SA (Switzerland); Antonio Marin-Franch, Ctr. de Estudios de Física del Cosmos de Aragón (Spain) ..... [10401-41]

2:50 pm: **The study of optimization on process parameters of high-accuracy computerized numerical control polishing**, Wei-Ren Huang, Shih-Pu Huang, Tsung-Yueh Tsai, National Taiwan Univ. (Taiwan); Yi-Chun Lin, National Taiwan Univ. (Taiwan); Zong-Ru Yu, Instrument Technology Research Ctr., National Applied Research Labs. (Taiwan); Ching-Hsiang Kuo, Instrument Technology Research Ctr., National Applied Research Labs (Taiwan); Wei-Yao Hsu, Instrument Technology Research Ctr., National Applied Research Labs. (Taiwan); Hong-Tsu Young, National Taiwan Univ. (Taiwan) ..... [10401-42]

3:10 pm: **Lithographic manufacturing of adaptive optics components**, R Phillip Scott, Michael Hart, Tom Milster, Madison Jean, Ryan Bronson, Lauren Schatz, Lee Johnson, University of Arizona (USA) ..... [10401-56]



# CONFERENCE 10402

LOCATION: CONV. CTR. ROOM 33B

Sunday–Thursday 6–10 August 2017 • Proceedings of SPIE Vol. 10402

## Earth Observing Systems XXII

*Conference Chairs:* **James J. Butler**, NASA Goddard Space Flight Ctr. (USA); **Xiaoxiong (Jack) Xiong**, NASA Goddard Space Flight Ctr. (USA); **Xingfa Gu**, Institute of Remote Sensing Applications (China)

*Program Committee:* **Philip E. Ardanuy**, Innovim, LLC (USA); **Jeffrey S. Czaplá-Myers**, College of Optical Sciences, The Univ. of Arizona (USA); **Armin Doerry**, Sandia National Labs. (USA); **Christopher N. Durell**, Labsphere, Inc. (USA); **Bertrand Fougny**, Ctr. National d'Études Spatiales (France); **Mitchell D. Goldberg**, NOAA National Environmental Satellite, Data, and Information Service (USA); **Dennis L. Helder**, South Dakota State Univ. (USA); **Joel McCorkel**, NASA Goddard Space Flight Ctr. (USA); **Vijay Murgai**, Raytheon Space and Airborne Systems (USA); **Thomas S. Pagano**, Jet Propulsion Lab. (USA); **Jeffery J. Puschell**, Raytheon Space & Airborne Systems (USA); **Carl F. Schueler**, Schueler Consulting-Santa Barbara (USA); **Mark A. Schwarz**, Stellar Solutions Inc. (USA)

### SUNDAY 6 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 33B . . . SUN 1:20 PM TO 3:20 PM

#### New Instruments and Missions

Session Chair: **Jeffery J. Puschell**, Raytheon Space and Airborne Systems (USA)

1:20 pm: **The EarthCARE mission BBR instrument: Ground testing of radiometric performance**, Martin E. Caldwell, William Grainger, Martin S. Whalley, Anthony K. Ward, David Parker, John Delderfield, STFC Rutherford Appleton Lab. (United Kingdom); David Spilling, Nigel Wright, Thales Alenia Space UK Ltd. (United Kingdom); Evangelos Theocharous, National Physical Lab. (United Kingdom); Grant J. Munro, Oliver Poyzn Wright, Matthew Hampson, David Forster, ESR Technology Ltd. (United Kingdom) . . . . . [10402-3]

1:40 pm: **A status update on EUMETSAT programmes and plans**, K. Dieter Klaes, EUMETSAT (Germany) . . . . . [10402-1]

2:00 pm: **MTG-IRS: From raw measurements to calibrated radiances**, Dorothee Coppens, Bertrand Theodore, K. Dieter Klaes, EUMETSAT (Germany); Stefano Gigli, European Organisation for the Exploitation of Meteorological Satellites (Germany) . . . . . [10402-2]

2:20 pm: **Focal plane subsystem design and performance for atmospheric chemistry from geostationary orbit tropospheric emissions monitoring of pollution**, Angelo S. Gilmore, Robert H. Philbrick, Josh Funderburg, Ball Aerospace & Technologies Corp. (USA) . . . . . [10402-4]

2:40 pm: **Landsat 9: OLI-2 focal plane subsystem: Design, performance, and status**, Kevin J. Malone, Ball Aerospace & Technologies Corp. (USA) . . . . . [10402-5]

3:00 pm: **Mission studies on constellation of LEO satellites with remote-sensing and communication payloads**, Chia-Ray Chen, National Space Organization (Taiwan) . . . . . [10402-6]

Coffee Break . . . . . Sun 3:20 pm to 3:50 pm

#### SESSION 2

LOCATION: CONV. CTR. ROOM 33B . . SUN 3:50 PM TO 5:30 PM

#### Small Satellite Instruments and Technologies

Session Chair: **Armin W. Doerry**, Sandia National Labs. (USA)

3:50 pm: **Pathway to future sustainable land imaging: The compact hyperspectral prism spectrometer**, Thomas U. Kampe, William S. Good, Ball Aerospace & Technologies Corp. (USA) . . . . . [10402-7]

4:10 pm: **Design and development of the CubeSat Infrared Atmospheric Sounder (CIRAS)**, Thomas S. Pagano, Jet Propulsion Lab. (USA) . . . . . [10402-8]

4:30 pm: **Snow and water imaging spectrometer (SWIS): A CubeSat-compatible instrument**, Holly A. Bender, Justin M. Haag, Pantazis Mouroulis, Jet Propulsion Lab. (USA); Christopher Smith, Sierra Lobo, Inc. (USA) . . . . . [10402-9]

4:50 pm: **Design and qualification of the STREEGO multispectral payload**, Massimiliano Rossi, Luigina Arcangeli, Giovanni Bianucci, Ruben Mazzoleni, Sebastiano Spinelli, Marco Terraneo, Fabio Emilio Zocchi, Media Lario Technologies S.r.l. (Italy); Giuseppe Capuano, Giuseppe Formicola, Pasquale Longobardi, Techno System Developments S.r.l. (Italy); Luca Maresi, Matteo Taccolla, European Space Research and Technology Ctr. (Netherlands) . [10402-10]

5:10 pm: **Technical and cost advantages of silicon carbide telescopes for small-satellite imaging applications**, Keith Kasunic, Optical Systems Group LLC (USA); Dave Aikens, Savvy Optics Corp. (USA); Dean Szwabowski, Chip Ragan, Flemming Tinker, Aperture Optical Sciences Inc. (USA) . . . . . [10402-11]

LOCATION: CONV. CTR. ROOM 6A . . SUN 6:00 PM TO 7:50 PM

#### Technology Hot Topics: How Optics and Photonics Drive Innovation

6:00 pm to 6:10 pm: **Welcome and Opening Remarks**

6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)

6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)

6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)

7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)

7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)

### MONDAY 7 AUGUST

#### SESSION 3

LOCATION: CONV. CTR. ROOM 33B MON 8:00 AM TO 10:20 AM

#### Hyperspectral Instruments and Technologies

Session Chair: **John F. Silny**, Raytheon Space and Airborne Systems (USA)

8:00 am: **MOS+P: A combined spectrometer and polarimeter optimized for ocean color**, William S. Good, Rainer Illing, Derek Sabatke, Ball Aerospace & Technologies Corp. (USA); Nicholas Tuffillaro, Oregon State Univ. (USA) . [10402-12]

8:20 am: **Radiometric and spectral stray light correction for the portable remote imaging spectrometer (PRISM) coastal ocean sensor**, Justin M. Haag, Byron E. Van Gorp, Pantazis Mouroulis, David R. Thompson, Jet Propulsion Lab. (USA) . . . . . [10402-13]

8:40 am: **High altitude hyperspectral remote sensing in the thermal infrared: recent instrument improvements**, William R. Johnson, Simon Hook, Jet Propulsion Lab. (USA) . . . . . [10402-14]

9:00 am: **Imaging spectroscopy using embedded diffractive optical arrays**, Michele Hinnrichs, Bradford R. Hinnrichs, Pacific Advanced Technology, Inc. (USA) . . . . . [10402-15]

9:20 am: **Assembly and test of a visible and near-infrared imaging spectrometer with a Shack-Hartmann wavefront sensor**, Jun Ho Lee, Sung Lyoung Hwang, Kongju National Univ. (Korea, Republic of); Jin Suk Hong, Young Soo Kim, Hanwha Systems Co., Ltd. (Korea, Republic of); Yeon Soo Kim, Hyun Sook Kim, Agency for Defense Development (Korea, Republic of) . . . . . [10402-16]

9:40 am: **Curved focal plane array for hyperspectral imaging system**, Mohammad A. Saleh, Corning Incorporated (USA) . . . . . [10402-17]

10:00 am: **Imaging gratings: Technology and applications for spectrometers**, Peter Triebel, Tobias Moeller, Carl Zeiss Microscopy GmbH (Germany); Torsten Diehl, Carl Zeiss Spectroscopy GmbH (Germany); Alexandre Gatto, Alexander Pesch, Lars Erdmann, Matthias Burkhardt, Alexander Kalies, Carl Zeiss Jena GmbH (Germany) . . . . . [10402-18]

Coffee Break . . . . . Mon 10:20 am to 10:50 am

## SESSION 4

LOCATION: CONV. CTR. ROOM 33B MON 10:50 AM TO 11:30 AM

### Vicarious Calibration and Postlaunch Validation

Session Chair: **James J. Butler**, NASA Goddard Space Flight Ctr. (USA)

10:50 am: **Analysis of a commercial small unmanned airborne system (sUAS) in support of the Radiometric Calibration Test Site (RadCaTS) at Railroad Valley**, Jeffrey S. Czaplá-Myers, Nikolaus J. Anderson, College of Optical Sciences, The Univ. of Arizona (USA) . . . . . [10402-19]

11:10 am: **Calibration and use of an ultra-portable field transfer radiometer for automated vicarious calibration**, Kurtis J. Thome, NASA Goddard Space Flight Ctr. (USA); Jeffrey S. Czaplá-Myers, The Univ. of Arizona (USA); Brian N. Wenny, Science Systems and Applications, Inc. (USA); Nikolaus J. Anderson, The Univ. of Arizona (USA) . . . . . [10402-20]

Lunch Break . . . . . Mon 11:30 am to 1:20 pm

## SESSION 5

LOCATION: CONV. CTR. ROOM 33B . . MON 1:20 PM TO 3:20 PM

### On-orbit Calibration I

Session Chair: **Mark A. Schwarz**, Stellar Solutions Inc. (USA)

1:20 pm: **Updates of MODIS On-orbit calibration uncertainty assessments**, Xiaoxiong J. Xiong, NASA Goddard Space Flight Ctr. (USA); Amit Angal, Hongda Chen, Science Systems and Applications, Inc. (USA); Kwofu Chiang, Science Systems and Applications, Inc. (USA); Xu Geng, Yonghong Li, Kevin A. Twedt, Zhipeng Wang, Truman Wilson, Aisheng Wu, Science Systems and Applications, Inc. (USA) . . . . . [10402-22]

1:40 pm: **Crosstalk effect and its mitigation in Aqua MODIS middle wave infrared bands**, Junqiang Sun, Global Science & Technology, Inc. (USA); Sriharsha Madhavan, Science Systems and Applications, Inc. (USA); Menghua Wang, Ctr. for Satellite Applications and Research (USA) . . . . . [10402-23]

2:00 pm: **Improvements to Terra MODIS L2 science products through using crosstalk corrected radiances**, Christopher C. Moeller, Richard A. Frey, Eva Borbas, W. Paul Menzel, Cooperative Institute for Meteorological Satellite Studies, Univ. of Wisconsin-Madison (USA); Truman Wilson, Aisheng Wu, Xu Geng, Science Systems and Applications, Inc. (USA) . . . . . [10402-24]

2:20 pm: **The performance of DC restoration function for MODIS thermal emissive bands**, Zhipeng Wang, Science Systems and Applications, Inc. (USA); Xiaoxiong J. Xiong, NASA Goddard Space Flight Ctr. (USA); Ashish Shrestha, NASA Goddard Space Flight Ctr. (USA) and Science Systems and Applications, Inc. (USA) . . . . . [10402-25]

2:40 pm: **AIRS visible light channels: Lessons from 15 years of using internal calibration sources, vicarious calibration, and the use of deep convective clouds**, Steven E. Broberg, Hartmut H. Aumann, Evan M. Manning, Jet Propulsion Lab. (USA) . . . . . [10402-26]

3:00 pm: **A strategy to assess the pointing accuracy of the CERES FM1-FM5 scanners**, Nathaniel P. Smith, Z. Peter Szweczyk, Phillip C. Hess, Susan Thomas, Science Systems and Applications, Inc. (USA); Kory J. Priestley, NASA Langley Research Ctr. (USA) . . . . . [10402-27]

Coffee Break . . . . . Mon 3:20 pm to 3:50 pm

## SESSION 6

LOCATION: CONV. CTR. ROOM 33B . . MON 3:50 PM TO 5:30 PM

### On-orbit Calibration II

Session Chair: **Xiaoxiong J. Xiong**, NASA Goddard Space Flight Ctr. (USA)

3:50 pm: **Initial post-launch radiometric calibration performance of GOES-16 ABI**, Fangfang Yu, ERT, Inc. (USA); Xiangqian Wu, NOAA NESDIS Office of Satellite and Product Operations (USA); Hyelim Yoo, National Oceanic and Atmospheric Administration (USA) and ERT, Inc. (USA); Xi Shao, ERT, Inc. (USA) . . . . . [10402-28]

4:10 pm: **Calibration/validation status for GOES-16 products**, Jon P. Fulbright, Arctic Slope Technical Services (USA); Elizabeth Kline, Science and Technology Corp. (USA); David R. Pogorzala, Integrity Applications, Inc. (USA); Wayne MacKenzie, Kathryn Mozer, James Sims, Matthew Seybold, NOAA NESDIS Office of Satellite and Product Operations (USA) . . . . . [10402-29]

4:30 pm: **Evaluation of GOES-16 ABI geospatial calibration accuracy using SNO method**, Fangfang Yu, Xi Shao, ERT, Inc. (USA); Xiangqian Wu, National Oceanic and Atmospheric Administration (USA) and National Environmental Satellite, Data, and Information Service (USA) and Ctr. for Satellite Application and Research (USA); Vladimir Kondratovich, ERT, Inc. (USA) . . . . . [10402-30]

4:50 pm: **Sentinel 2B: the image quality performances at the beginning of the mission**, Thierry L. Trémas, Vincent Lonjou, Arthur Dick, Florie Languille, Angélique Gaudel, Bruno Vidal, Ctr. National d'Études Spatiales (France) . . . . . [10402-31]

5:10 pm: **Compact, on-demand broad spectral range (visible to long wave infrared) calibrator**, James Chow, Edward Ward Jr., Raytheon Space and Airborne Systems (USA) . . . . . [10402-32]

## TUESDAY 8 AUGUST

### SESSION 7

LOCATION: CONV. CTR. ROOM 33B . TUE 8:00 AM TO 10:00 AM

### Data Acquisition, Analysis, and Models I

Session Chair: **Philip E. Ardanuy**, Innovim, LLC (USA)

8:00 am: **Rapid acquisition, processing, and delivery of advanced infrared and microwave sounder data from polar orbiting satellites for numerical weather prediction and other time-sensitive applications**, Liam Gumley, Univ. of Wisconsin-Madison (USA) . . . . . [10402-33]

8:20 am: **Comparison between point-based and line-based parallel-projection transformation models in rectifying satellite images**, Ahmed Elaksher, California State Polytechnic Univ., Pomona (USA) . . . . . [10402-34]

8:40 am: **Integrating satellite images and LIDAR data for shoreline mapping**, Ahmed Elaksher, California State Polytechnic Univ., Pomona (USA) . . . . . [10402-35]

9:00 am: **Satellite-based shoreline change detection analysis using operational land imager data**, Wasim Pervez, Shoab Ahmad Khan, National Univ. of Sciences and Technology (Pakistan) . . . . . [10402-36]

9:20 am: **Applicability of Distrad technique for downscaling of thermal images in different seasons over Raipur city and its surroundings**, Subhanil Guha, Himanshu Govil, National Institute of Technology, Raipur (India); Sandip Mukherjee, TERI Univ. (India) . . . . . [10402-37]

9:40 am: **HT-FRTC: Fast radiative transfer using Gaussian processes**, Gerald J. Wong, Stephan Havemann, Met Office (United Kingdom) . . . . . [10402-38]

Coffee Break . . . . . Tue 10:00 am to 10:30 am

### SESSION 8

LOCATION: CONV. CTR. ROOM 33B . TUE 10:30 AM TO 11:30 AM

### Data Acquisition, Analysis, and Models II

Session Chair: **John F. Silny**, Raytheon Space and Airborne Systems (USA)

10:30 am: **High efficiency signal acquisition**, Xiteng Liu, QualVisual Technology (Canada) . . . . . [10402-40]

10:50 am: **Experimentally validated modification to Cook-Torrance BRDF model for improved accuracy**, Samuel D. Butler, Air Force Institute of Technology (USA); James A. Ethridge, Air Force Institute of Technology (USA) and Southwestern Ohio Council for Higher Education (USA); Stephen E. Nauyoks, Air Force Institute of Technology (USA) and Oak Ridge Institute for Science and Education (USA); Michael A. Marciniak, Air Force Institute of Technology (USA) . . . . . [10402-41]

11:10 am: **Wave optics simulation of statistically rough surface scatter**, Ann Lanari, Samuel D. Butler, Michael A. Marciniak, Air Force Institute of Technology (USA); Mark F. Spencer, Air Force Research Lab. (USA) . . . . . [10402-42]

Lunch/Exhibition Break . . . . . Tue 11:30 am to 1:20 pm

# CONFERENCE 10402

## SESSION 9

LOCATION: CONV. CTR. ROOM 33B . . . TUE 1:20 PM TO 3:20 PM

### Sentinel-4

Session Chair: **Thomas S. Pagano**, Jet Propulsion Lab. (USA)

1:20 pm: **The Sentinel 4 focal plane subsystem**, Rüdiger Hohn, Airbus Defence and Space (Germany); Michael Skegg, Airbus Defence and Space (Germany); Markus Hermsen, Airbus Defence and Space (Germany); Christian Williges, Ralf Reulke, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) . . . [10402-43]

1:40 pm: **The Sentinel-4 UVN focal plane assemblies**, Jürgen Hinger, Rüdiger Hohn, Airbus Defence and Space (Germany); Ralf Reulke, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) . . . [10402-44]

2:00 pm: **The Sentinel-4 detectors: Architecture and performance**, Michael Skegg, Markus Hermsen, Rüdiger Hohn, Airbus Defence and Space (Germany); Christian Williges, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); Charles Woffinden, e2v technologies plc (United Kingdom); Yves Levillain, European Space Research and Technology Ctr. (Netherlands); Ralf Reulke, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) . . . [10402-45]

2:20 pm: **The Sentinel 4 detector electrical system integration**, Markus Hermsen, Rüdiger Hohn, Michael Skegg, Airbus Defence and Space (Germany); Christian Williges, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); Charles Woffinden, e2v technologies plc (United Kingdom); Ralf Reulke, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) . . . [10402-46]

2:40 pm: **Verification of the Sentinel-4 focal plane subsystem**, Christian Williges, Mathias Uhlrig, Stefan Hilbert, Hannes Rossmann, Kevin Buchwinkler, Steffen Babben, Ilse Sebastian, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); Rüdiger Hohn, Airbus Defence and Space (Germany); Ralf Reulke, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) . . . [10402-47]

3:00 pm: **RTS effect detection in Sentinel-4 data**, Henrique Candeias, Xavier Gnata, Maximilian Harlander, Markus Hermsen, Rüdiger Hohn, Stefan Riedl, Michael Skegg, Airbus Defence and Space (Germany); Ralf Reulke, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) . . . [10402-48]

Coffee Break . . . . . Tue 3:20 pm to 3:50 pm

## SESSION 10

LOCATION: CONV. CTR. ROOM 33B . . . TUE 3:50 PM TO 6:10 PM

### Landsat 8

Session Chair: **Dennis L. Helder**, South Dakota State Univ. (USA)

3:50 pm: **Radiometric characterization of Landsat Collection 1 products**, Esad Micijevic, Md. Obaidul Haque, U.S. Geological Survey (USA) and SGT, Inc. (USA); Nischal Mishra, U.S. Geological Survey (USA) and Virtuoso Technologies Inc. (USA) . . . [10402-49]

4:10 pm: **Using earth data to evaluate Landsat 8 collection-1 products radiometric uniformity stability of the focal plane array sensor chips**, Raviv Levy, NASA Goddard Space Flight Ctr. (USA) and Science Systems and Applications, Inc. (USA); Brian L. Markham, NASA Goddard Space Flight Ctr. (USA) . . . [10402-50]

4:30 pm: **Statistical relative gain calculation for Landsat 8**, Cody Anderson, SGT, Inc. (USA); Dennis L. Helder, Drake Jenko, South Dakota State Univ. (USA) . . . [10402-51]

4:50 pm: **Landsat-8 TIRS radiometric calibration status**, Julia A. Barsi, Brian L. Markham, NASA Goddard Space Flight Ctr. (USA); Matthew Montanaro, Rochester Institute of Technology (USA); Simon Hook, Jet Propulsion Lab. (USA) and NASA Goddard Space Flight Ctr. (USA); John R. Schott, Nina G. Raqueno, Aaron D. Gerace, Rochester Institute of Technology (USA) . . . [10402-52]

5:10 pm: **Landsat 8 TIRS calibration with external sensors**, Yue Wang, Emmett J. Ientilucci, Nina G. Raqueno, John R. Schott, Rochester Institute of Technology (USA) . . . [10402-53]

5:30 pm: **Assessing the potential to use the split window technique to retrieve surface temperature with Landsat 8's thermal infrared sensor (TIRS)**, Aaron D. Gerace, Matthew Montanaro, Rochester Institute of Technology (USA); Ronald A. Morfitt, U.S. Geological Survey (USA) . . . [10402-54]

5:50 pm: **A reflectance-based cross calibration of the Landsat archive**, Cibele Teixeira Pinto, South Dakota State Univ. (USA); Sandeep Chittimalli, NASA Goddard Space Flight Ctr. (USA); Larry Leigh, Timothy Ruggles, Dennis L. Helder, South Dakota State Univ. (USA) . . . [10402-21]

## WEDNESDAY 9 AUGUST

## SESSION 11

LOCATION: CONV. CTR. ROOM 33B WED 8:20 AM TO 10:00 AM

### Prelaunch Calibration

Session Chair: **Christopher N. Durell**, Labsphere, Inc. (USA)

8:20 am: **JPSS-1 VIIRS RSB sensor spectral response calibration and its applications**, Jinan Zeng, Fibertek Inc. (USA) and NASA Goddard Space Flight Ctr. (USA); James J. Butler, Xiaoxiong J. Xiong, NASA Goddard Space Flight Ctr. (USA); Hassan Oudrari, Jeffery McIntire, Thomas Schwarting, Qiang Ji, Science Systems and Applications, Inc. (USA) . . . [10402-55]

8:40 am: **Atmospheric correction for JPSS-2 VIIRS response versus scan angle measurements**, Jeffrey McIntire, Science Systems and Applications, Inc. (USA); Christopher C. Moeller, Univ. of Wisconsin-Madison (USA); Hassan Oudrari, Science Systems and Applications, Inc. (USA); Xiaoxiong J. Xiong, NASA Goddard Space Flight Ctr. (USA) . . . [10402-56]

9:00 am: **VIIRS pre-launch near field response characterization**, Thomas Schwarting, Jeffrey McIntire, Hassan Oudrari, Science Systems and Applications, Inc. (USA); Xiaoxiong J. Xiong, NASA Goddard Space Flight Ctr. (USA) . [10402-57]

9:20 am: **Spectralon solar diffuser BRDF variation for NPP, JPSS J1, and JPSS J2**, Vijay Murgai, Lindsay H. Johnson, Staci N. Klein, Raytheon Space and Airborne Systems (USA) . . . [10402-58]

9:40 am: **Establishing BRDF calibration capabilities through shortwave infrared**, Georgi T. Georgiev, NASA Langley Research Ctr. (USA); James J. Butler, Kurtis J. Thome, NASA Goddard Space Flight Ctr. (USA); Catherine C. Cooksey, National Institute of Standards and Technology (USA) . . . [10402-59]

Coffee Break . . . . . Wed 10:00 am to 10:30 am

LOCATION: CONV. CTR. ROOM 6A WED 10:30 AM TO 11:20 AM

### Remote Sensing Plenary

10:30 am: **Demonstrating Technologies for Hyperspectral Infrared Remote Sensing from Space on a CubeSat (Plenary)**, Thomas S. Pagano, Jet Propulsion Lab. (USA) . . . [10402-500]

## SESSION 12

LOCATION: CONV. CTR. ROOM 33B . WED 11:30 AM TO 12:30 PM

### Suomi NPP VIIRS I

Session Chair: **James J. Butler**, NASA Goddard Space Flight Ctr. (USA)

11:30 am: **Operational correction and validation of the VIIRS TEB longwave infrared band calibration bias during blackbody temperature changes**, Wenhui Wang, ERT, Inc. (USA); Changyong Cao, National Oceanic and Atmospheric Administration (USA) and National Environmental Satellite, Data, and Information Service (USA) and Ctr. for Satellite Applications and Research (USA); Bin Zhang, ERT, Inc. (USA); Likun Wang, Univ. of Maryland, College Park (USA) . . . [10402-60]

11:50 am: **Electronic crosstalk effect in SNPP VIIRS thermal emissive bands**, Junqiang Sun, Global Science & Technology, Inc. (USA); Menghua Wang, Ctr. for Satellite Applications and Research (USA) . . . [10402-61]

12:10 pm: **Update on the status of Agua MODIS cold focal plane assembly temperature fluctuation**, Zhipeng Wang, Science Systems and Applications, Inc. (USA); Xiaoxiong J. Xiong, NASA Goddard Space Flight Ctr. (USA); Aisheng Wu, Yonghong Li, Science Systems and Applications, Inc. (USA) . . . [10402-62]

Lunch/Exhibition Break . . . . . Wed 12:30 pm to 2:00 pm



## SESSION 13

LOCATION: CONV. CTR. ROOM 33B . . WED 2:00 PM TO 3:20 PM

### Suomi NPP VIIRS II

Session Chair: **Xingfa Gu**, Institute of Remote Sensing and Digital Earth (China)

2:00 pm: **Monitoring of VIIRS ocean clear-sky brightness temperatures against CRTM simulation in ICVS for TEB/M bands**, Xingming Liang, National Oceanic and Atmospheric Administration (USA) and ERT, Inc. (USA); Ninghai Sun, Quanhua Liu, National Oceanic and Atmospheric Administration (USA); Wenhui Wang, ERT, Inc. (USA) and National Oceanic Atmospheric Administration (USA); Bin Zhang, National Oceanic and Atmospheric Administration (USA) and ERT, Inc. (USA); Taeyoung J. Choi, National Environmental Satellite, Data, and Information Service (USA) and ERT, Inc. (USA); Fuzhong Weng, National Oceanic and Atmospheric Administration (USA); Alexander Ignatov, National Environmental Satellite, Data, and Information Service (USA); Changyong Cao, National Oceanic and Atmospheric Administration (USA) . . . . . [10402-63]

2:20 pm: **Improvements in the calibration of the SNPP VIIRS day-night band**, Junqiang Sun, Global Science & Technology, Inc. (USA); Menghua Wang, Ctr. for Satellite Applications and Research (USA) . . . . . [10402-64]

2:40 pm: **Prediction of S-NPP VIIRS DNB gains and dark offsets**, Chengbo Sun, Global Science & Technology, Inc. (USA); Thomas Schwarting, Hongda Chen, Kwofu Chiang, Science Systems and Applications, Inc. (USA); Xiaoxiong J. Xiong, NASA Goddard Space Flight Ctr. (USA) . . . . . [10402-65]

3:00 pm: **Suomi-NPP VIIRS initial reprocessing improvements and validations in the reflective solar bands (RSBs)**, Taeyoung J. Choi, National Environmental Satellite, Data, and Information Service (USA); Junqiang Sun, Global Science & Technology, Inc. (USA) and National Oceanic and Atmospheric Administration (USA) and Ctr. for Satellite Application and Research (USA); Bin Zhang, National Environmental Satellite, Data, and Information Service (USA) and Univ. of Maryland (USA); Zhuo Wang, National Oceanic and Atmospheric Administration (USA) and Univ. of Maryland (USA); Changyong Cao, National Oceanic and Atmospheric Administration (USA); Fuzhong Weng, National Environmental Satellite, Data, and Information Service (USA); Menghua Wang, National Oceanic and Atmospheric Administration (USA) and National Environmental Satellite, Data, and Information Service (USA) . . . . . [10402-66]

Coffee Break . . . . . Wed 3:20 pm to 3:50 pm

## SESSION 14

LOCATION: CONV. CTR. ROOM 33B . . WED 3:50 PM TO 5:50 PM

### Suomi NPP VIIRS III

Session Chair: **Vijay Murgai**, Raytheon Space and Airborne Systems (USA)

3:50 pm: **Reflective solar bands calibration improvements and look up tables for SNPP VIIRS operational mission-long SDR reprocessing**, Menghua Wang, Ctr. for Satellite Applications and Research (USA); Junqiang Sun, Global Science & Technology, Inc. (USA) . . . . . [10402-67]

4:10 pm: **On-orbit noise characterization of the SNPP VIIRS reflective solar bands**, Kevin A. Twedt, Ning Lei, Science Systems and Applications, Inc. (USA); Xiaoxiong J. Xiong, NASA Goddard Space Flight Ctr. (USA) . . . . . [10402-68]

4:30 pm: **RSB calibration of SNPP VIIRS using solar diffuser illuminated by scattered light**, Junqiang Sun, Global Science & Technology, Inc. (USA) and Ctr. for Satellite Applications and Research (USA); I-Wen Mike Chu, Menghua Wang, Ctr. for Satellite Applications and Research (USA) . . . . . [10402-69]

4:50 pm: **Suomi-NPP visible infrared imaging radiometer suite (VIIRS) calibration uncertainty its effect on trends in the ocean color data record**, Kevin R. Turpie, NASA Goddard Space Flight Ctr. (USA) and Univ. of Maryland (USA); Robert E. Eplee Jr., NASA Goddard Space Flight Ctr. (USA) and SAIC (USA); Gerhard Meister, Bryan A. Franz, NASA Goddard Space Flight Ctr. (USA) [10402-70]

5:10 pm: **Advances in the on-orbit calibration of SNPP VIIRS for ocean color applications**, Robert E. Eplee Jr., NASA Goddard Space Flight Ctr. (USA); Kevin R. Turpie, Univ. of Maryland, Baltimore (USA); Gerhard Meister, Frederick S. Patt, Bryan A. Franz, NASA Goddard Space Flight Ctr. (USA) . . . . . [10402-71]

5:30 pm: **Assessment of S-NPP VIIRS band-to-band registration using Earth-scene features**, Daniel Link, Zhipeng Wang, Science Systems and Applications, Inc. (USA); Xiaoxiong J. Xiong, NASA Goddard Space Flight Ctr. (USA) . [10402-72]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 . . . . . WED 5:30 PM TO 7:30 PM

### Posters-Wednesday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Design and implementation of JOM-3 Overhauser magnetometer analog circuit**, Xiao Zhang, Xue Jiang, Jianchang Zhao, Shuang Zhang, Xin Guo, Tingting Zhou, Jilin Univ. (China) . . . . . [10402-85]

**The curious case of the intersensor radiometric comparison of SNPP VIIRS M11 with Aqua MODIS B7**, I-Wen Mike Chu, Ctr. for Satellite Applications and Research (USA) and Cooperative Institute for Research in the Atmosphere (USA) and ERT, Inc. (USA); Junqiang Sun, Global Science & Technology, Inc. (USA) and Ctr. for Satellite Applications and Research (USA); Menghua Wang, Ctr. for Satellite Applications and Research (USA) . . . . . [10402-86]

**Bridging the thermal band comparison between LEO-LEO sensors and between GEO-GEO sensors**, Tiejun Chang, Graziela R. Keller, Science Systems and Applications, Inc. (USA); Xiaoxiong J. Xiong, NASA Goddard Space Flight Ctr. (USA) . . . . . [10402-87]

**Status of the MODIS spatial and spectral characterization and performance after recent SRCA operational changes**, Daniel Link, Zhipeng Wang, Kevin A. Twedt, Science Systems and Applications, Inc. (USA); Xiaoxiong J. Xiong, NASA Goddard Space Flight Ctr. (USA) . . . . . [10402-88]

**CrIS sub-pixel level VIIRS radiance clustering analysis**, Haibing Sun, I. M. Systems Group, Inc. (USA); Walter Wolf, Ctr. for Satellite Applications and Research (USA); Thomas S. King, Shanna Sampson, I. M. Systems Group, Inc. (USA) . . . . . [10402-89]

**MTF analysis using lunar observations for Himawari-8/AHI**, Graziela R. Keller, Tiejun Chang, Zhipeng Wang, Science Systems and Applications, Inc. (USA); Xiaoxiong J. Xiong, NASA Goddard Space Flight Ctr. (USA) . . . . . [10402-90]

**Prediction of S-NPP VIIRS DNB stray light correction**, Chengbo Sun, Global Science & Technology, Inc. (USA); Thomas Schwarting, Hongda Chen, Kwofu Chiang, Science Systems and Applications, Inc. (USA); Xiaoxiong J. Xiong, NASA Goddard Space Flight Ctr. (USA) . . . . . [10402-91]

**MODIS solar diffuser degradation at short-wave infrared band wavelengths**, Kevin A. Twedt, Amit Angal, Science Systems and Applications, Inc. (USA); Xiaoxiong J. Xiong, NASA Goddard Space Flight Ctr. (USA); Xu Geng, Hongda Chen, Science Systems and Applications, Inc. (USA) . . . . . [10402-92]

**Prism spectrometer analysis for field use**, Adam Abdelatif, Nikolaus J. Anderson, College of Optical Sciences, The Univ. of Arizona (USA); Oscar Hernandez, The Univ. of Arizona (USA); Jeffrey S. Czaplak-Myers, College of Optical Sciences, The Univ. of Arizona (USA) . . . . . [10402-93]

**Site selection and characterization at Uyuni desert for the calibration and validation of GOES solar reflective bands**, Hyelim Yoo, National Oceanic and Atmospheric Administration (USA); Fangfang Yu, ERT, Inc. (USA) and National Oceanic and Atmospheric Administration (United Kingdom); Xianqian Wu, National Oceanic and Atmospheric Administration (USA) . . . . . [10402-94]

**The space-borne hyperspectral imager (SPARK) based on curved prisms**, Juanjuan Jing, Jinsong Zhou, Academy of Opto-Electronics, CAS (China) and Univ. of Chinese Academy of Sciences (China); Lei Feng, Academy of Opto-Electronics, CAS (China) and Univ. of Chinese Academy of Sciences (China); Guifeng Zhang, Academy of Opto-Electronics, CAS (China) . . . . . [10402-95]

**El Niño southern oscillation: Nonlinear modeling, satellite data, and Fourier analysis**, Nour Hadjih, Ahmed Hassebo, The City College of New York (USA); Yasser Y. Hassebo, The City College of New York (USA) and LaGuardia Community College (USA); Frank Wang, LaGuardia Community College (USA) and The City College of New York (USA) . . . . . [10402-96]

**Principle and analysis of a rotational motion Fourier transform infrared spectrometer**, Qisheng Cai, Huang Min, Wei Han, Yixuan Liu, Lulu Qian, Xiangning Lu, Academy of Opto-Electronics, CAS (China) . . . . . [10402-97]

**Impact of fluorescence on the underwater polarized light field: Comparison of theory and field measurements**, Ahmed El-Habashi, Robert Foster, Carlos Carrizo, Thomas Legbandt, Sam Ahmed, The City College of New York (USA) . . . . . [10402-98]

# CONFERENCE 10402

THURSDAY 10 AUGUST

## SESSION 15

LOCATION: CONV. CTR. ROOM 33B . THU 8:00 AM TO 10:00 AM

### Instrument Intercomparisons

Session Chair: **Jeffrey S. Czapla-Myers**, College of Optical Sciences, The Univ. of Arizona (USA)

8:00 am: **The updated intersensor radiometric comparison of SNPP VIIRS M1-M8 with Aqua MODIS bands through June 2017**, I-Wen Mike Chu, Ctr. for Satellite Applications and Research (USA) and Cooperative Institute for Research in the Atmosphere (USA) and ERT, Inc. (USA); Menghua Wang, Ctr. for Satellite Applications and Research (USA) . . . . . [10402-73]

8:20 am: **GEO-LEO reflectance band inter-comparison with BRDF and atmospheric scattering corrections**, Tiejun Chang, Science Systems and Applications, Inc. (USA); Xiaoxiong J. Xiong, NASA Goddard Space Flight Ctr. (USA); Graziela R. Keller, Science Systems and Applications, Inc. (USA); Xiangqian Wu, National Oceanic and Atmospheric Administration (USA) and Ctr. for Satellite Applications and Research (USA) . . . . . [10402-74]

8:40 am: **Validation of VIIRS with CrIS by taking into account the sub-pixel cloudiness and viewing geometry**, Jun Li, Univ. of Wisconsin-Madison (USA); Changyong Cao, National Environmental Satellite, Data, and Information Service (USA); Zhenglong Li, Xinya Gong, Univ. of Wisconsin-Madison (USA); Wenhui Wang, ERT, Inc. (USA); Christopher C. Moeller, Univ. of Wisconsin-Madison (USA) . . . . . [10402-76]

9:00 am: **Using AIRS level-1c for AIRS/CrIS full-resolution longwave band comparisons**, Evan M. Manning, Hartmut H. Aumann, Jet Propulsion Lab. (USA) . . . . . [10402-77]

9:20 am: **AIRS/CrIS data continuity: Evaluation for extreme conditions**, Hartmut H. Aumann, Evan M. Manning, Jet Propulsion Lab. (USA) . . . . . [10402-78]

9:40 am: **Intercomparisons of IASI on METOP and infrared multi-spectral instruments**, Bertrand Theodore, Mayte Vasquez, Dorothee Coppens, K. Dieter Klaes, EUMETSAT (Germany) . . . . . [10402-79]

Coffee Break . . . . . Thu 10:00 am to 10:30 am

## SESSION 16

LOCATION: CONV. CTR. ROOM 33B . THU 10:30 AM TO 12:10 PM

### On-orbit Calibration Using the Moon and Stars

Session Chair: **James J. Butler**, NASA Goddard Space Flight Ctr. (USA)

10:30 am: **The stars: An absolute radiometric reference for the on-orbit calibration of PLEIADES-HR satellites**, Aimé Meygret, Gwendoline Blanchet, Ctr. National d'Études Spatiales (France); Flore Mounier, Capgemini Sud (France); Christian Buil, Ctr. National d'Études Spatiales (France) . . . . . [10402-80]

10:50 am: **Absolute, SI-traceable lunar irradiance tie-points for the USGS Lunar Model**, Steven W. Brown, Keith R. Lykke, National Institute of Standards and Technology (USA); Robert E. Eplee Jr., Xiaoxiong J. Xiong, NASA Goddard Space Flight Ctr. (USA) . . . . . [10402-81]

11:10 am: **Improving ROLO lunar albedo model using PLEIADES-HR satellites extra-terrestrial observations**, Aimé Meygret, Gwendoline Blanchet, Ctr. National d'Études Spatiales (France); Stéphane Colzy, Capgemini Sud (France) . [10402-82]

11:30 am: **MODIS and VIIRS reflective solar calibration inter-comparisons using lunar observations**, Xiaoxiong J. Xiong, NASA Goddard Space Flight Ctr. (USA); Junqiang Sun, Global Science & Technology, Inc. (USA); Zhipeng Wang, Amit Angal, Science Systems and Applications, Inc. (USA); Jon P. Fulbright, ASTS (USA) . . . . . [10402-83]

11:50 am: **In-orbit verification of MHS spectral channels co-registration using the moon**, Roberto Bonsignori, European Organisation for the Exploitation of Meteorological Satellites (Germany) . . . . . [10402-84]

# CONFERENCE 10403

LOCATION: CONV. CTR. ROOM 33A

Monday–Tuesday 7–8 August 2017 • Proceedings of SPIE Vol. 10403

# Infrared Remote Sensing and Instrumentation XXV

Conference Chairs: **Marija Strojnik**, Centro de Investigaciones en Óptica, A.C. (Mexico); **Maureen S. Kirk**, Texas A&M Univ. (USA)

Program Committee: **Gabriele E. Arnold**, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); **Gerald T. Fraser**, National Institute of Standards and Technology (USA); **Guillermo Garcia-Torales**, Univ. de Guadalajara (Mexico); **Sarath D. Gunapala**, Jet Propulsion Lab. (USA); **Sven Höfling**, Julius-Maximilians-Univ. Würzburg (Germany); **Pengda Hong**, Lehigh Univ. (USA); **Maureen L. Savage**, SOFIA / USRA (USA); **Stanley J. Wellard**, Space Dynamics Lab. (USA)

## MONDAY 7 AUGUST

LOCATION: CONV. CTR. ROOM 33A . . . . . 8:00 AM TO 8:10 AM

### Welcoming Remarks

**Marija Strojnik**, Centro de Investigaciones en Óptica, A.C. (Mexico) and **Maureen S. Kirk**, Texas A&M Univ. (USA)

### SESSION 1

LOCATION: CONV. CTR. ROOM 33A . . MON 8:10 AM TO 9:20 AM

### Emerging Infrared Technologies

Session Chairs: **Pengda Hong**, Lehigh Univ. (USA); **Marija Strojnik**, Centro de Investigaciones en Óptica, A.C. (Mexico)

8:10 am: **Integrated optical filters on chip for miniature spectrometer** (*Invited Paper*), Shao-Wei Wang, Wei Lu, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences (China) and Shanghai Engineering Research Ctr. of Energy-Saving Coatings (China) . . . . . [10403-1]

8:40 am: **Research on active imaging information transmission technology of satellite borne quantum remote sensing**, Siwen Bi, Institute of Remote Sensing and Digital Earth (China) and Beijing Institute of Space Mechanics and Electricity (China); Ming Zhen, Institute of Remote Sensing and Digital Earth (China); Song Yang, Xuling Lin, Zhiqiang Wu, Beijing Institute of Space Mechanics and Electricity (China) . . . . . [10403-2]

9:00 am: **Narrowband infrared emitter constructed with metal-DBR cavity**, Shao-Wei Wang, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences (China) and Shanghai Engineering Research Ctr. of Energy-Saving Coatings (China); Mingfei Wu, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences (China) and Shanghai Engineering Research Ctr. of Energy-Saving Coatings (China) and Shanghai Normal Univ. (China); Jialiang Lu, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences (China); Xingxing Liu, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences (China) and Shanghai Engineering Research Ctr. of Energy-Saving Coatings (China); Zhiwei Li, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences (China); Huaifen Li, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences (China) and Shanghai Engineering Research Ctr. of Energy-Saving Coatings (China); Jiameing Hao, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences (China); Wei Lu, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences (China) and Shanghai Engineering Research Ctr. of Energy-Saving Coatings (China) . . . . . [10403-3]

## SESSION 2

LOCATION: CONV. CTR. ROOM 33A . MON 9:20 AM TO 12:10 PM

### Mid IR Sources and Detectors

Session Chairs: **Fabian Hartmann**, Julius-Maximilians-Univ. Würzburg (Germany); **Guillermo Garcia-Torales**, Univ. de Guadalajara (Mexico)

9:20 am: **Long wavelength interband cascade lasers on GaSb substrates** (*Invited Paper*), Anne Schade, Julius-Maximilians-Univ. Würzburg (Germany); Sven Höfling, Julius-Maximilians-Univ. Würzburg (Germany) and Univ. of St. Andrews (United Kingdom) . . . . . [10403-4]

9:50 am: **Antimonide-based resonant tunneling photodetectors for mid infrared wavelength light detection** (*Invited Paper*), Fabian Hartmann, Andreas Pfenning, Georg Knebl, Robert Weih, Andreas Bader, Monika Emmerling, Martin Kamp, Julius-Maximilians-Univ. Würzburg (Germany); Sven Höfling, Julius-Maximilians-Univ. Würzburg (Germany) and Univ. of St. Andrews (United Kingdom); Lukas Worschech, Julius-Maximilians-Univ. Würzburg (Germany) . . . . . [10403-5]

Coffee Break . . . . . Mon 10:20 am to 10:50 am

10:50 am: **Trace gas spectroscopy using state-of-the-art mid-infrared semiconductor laser sources: Progress, status, and applications** (*Invited Paper*), Frank K. Tittel, Rice Univ. (USA) . . . . . [10403-6]

11:20 am: **Mid infrared DFB interband cascade lasers** (*Invited Paper*), Johannes Koeth, Robert Weih, Marc O. Fischer, nanoplus Nanosystems and Technologies GmbH (Germany); Martin Kamp, Sven Höfling, Julius-Maximilians-Univ. Würzburg (Germany) . . . . . [10403-7]

11:50 am: **A GaAs-based up-converter for mid-infrared detection utilizing quantum cascade transport**, Zhibiao Hao, Lili Xie, Chao Wang, Yaqi Liu, Lai Wang, Jian Wang, Bing Xiong, Changzheng Sun, Yanjun Han, Hongtao Li, Yi Luo, Tsinghua Univ. (China) . . . . . [10403-8]

Lunch Break . . . . . Mon 12:10 pm to 1:40 pm

## SESSION 3

LOCATION: CONV. CTR. ROOM 33A . . MON 1:40 PM TO 3:10 PM

### Focal Plane Technology and Image Processing

Session Chair: **Guillermo Garcia-Torales**, Univ. de Guadalajara (Mexico); **Maureen S. Kirk**, Texas A&M Univ. (USA)

1:40 pm: **High bit depth infrared image compression via low bit depth codecs** (*Invited Paper*), Evgeny A. Belyaev, Claire Mantel, Søren O. Forchhammer, Technical Univ. of Denmark (Denmark) . . . . . [10403-9]

2:10 pm: **Observation and analysis of modulation and noise in visible and near-infrared diffuse ambient daylight**, John Kielkopf, Elijah Jensen, Frank O. Clark, Univ. of Louisville (USA); Jeff Hay, RDI Technologies (USA) . . . . . [10403-10]

2:30 pm: **Flexible thermistors: MCNO films with low resistivity and high TCR deposited on flexible organic sheets by RF magnetron sputtering**, Jing Wu, Zhiming Huang, Yanqing Gao, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences (China) . . . . . [10403-11]

2:50 pm: **Nanoantenna integrated infrared pixels**, Fei Yi, Huazhong Univ. of Science and Technology (China) . . . . . [10403-12]

Coffee Break . . . . . Mon 3:10 pm to 3:40 pm



# CONFERENCE 10403

## SESSION 4

LOCATION: CONV. CTR. ROOM 33A . . MON 3:40 PM TO 5:10 PM

### Infrared System Calibration and Performance Assessment

Session Chairs: **John Kielkopf**, Univ. of Louisville (USA); **Marija Strojnik**, Centro de Investigaciones en Óptica, A.C. (Mexico)

3:40 pm: **Assessing the GOES-16 ABI onboard calibration using deep convective cloud** (*Invited Paper*), Hyelim Yoo, National Oceanic and Atmospheric Administration (USA) and ERT, Inc. (USA); Fangfang Yu, ERT, Inc. (USA) and National Oceanic and Atmospheric Administration (USA); Xianqian Wu, Ctr. for Satellite Applications and Research (USA) and National Oceanic and Atmospheric Administration (USA) . . . . . [10403-13]

4:10 pm: **Preliminary study of the on-orbit radiometric traceability and artifacts for the VIIRS longwave infrared channels during blackbody temperature changes**, Changyong Cao, National Environmental Satellite, Data, and Information Service (USA); Wenhui Wang, ERT, Inc. (USA) . . . . . [10403-14]

4:30 pm: **Millikelvin thermal dynamics of infrared scenes**, Nathan Hagen, Utsunomiya Univ. (Japan) . . . . . [10403-15]

4:50 pm: **Utilizing the precessing orbit of TRMM to produce hourly corrections of geostationary infrared imager data with the VIIRS sensor**, Benjamin R. Scarino, Science Systems and Applications, Inc. (USA); David R. Doelling, NASA Langley Research Ctr. (USA); Conor O. Haney, Science Systems and Applications, Inc. (USA); Kristopher M. Bedka, Univ. of Wisconsin-Madison (USA); Patrick Minnis, NASA Langley Research Ctr. (USA); Arun Gopalan, Rajendra Bhatt, Science Systems and Applications, Inc. (USA) . . . . . [10403-45]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 . . . . . MON 5:30 PM TO 7:30 PM

### Posters-Monday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Thermal pulse propagation in the search of subcutaneous masses**, Marija Strojnik, Centro de Investigaciones en Óptica, A.C. (Mexico) . . . . . [10403-32]

**Noncoding sequences classification based on wavelet transform analysis**, Omar Paredes, Rebeca Romo Vázquez, Hugo Vélez Pérez, J. Alejandro Morales, Univ. de Guadalajara (Mexico); Radu Ranta, Univ. de Lorraine (France) and Ecole Nationale Supérieure d'Electricité et de Mécanique - Nancy (France); Guillermo Garcia-Torales, Univ. de Guadalajara (Mexico); Marija Strojnik, Univ. de Guadalajara (Mexico) and Centro de Investigaciones en Óptica, A.C. (Mexico) . . . . . [10403-33]

**Optical spectral characterization of leaves for endemic species from La Primavera forest**, Roberto Carlos Barragan Campos, Antonio Rodríguez Rivas, Guillermo Garcia-Torales, Univ. de Guadalajara (Mexico); Francisco Javier González Contreras, Univ. Autónoma de San Luis Potosí (Mexico); Marija Strojnik, Univ. de Guadalajara (Mexico) and Centro de Investigaciones en Óptica, A.C. (Mexico) . . . . . [10403-34]

**Solar irradiance forecasting with an artificial vision system for Short-time horizons**, Cesar Mauricio M. Peña Martínez, Manuel I. Peña-Cruz, Centro de Investigaciones en Óptica, A.C. (Mexico) . . . . . [10403-35]

**High precision phase shifter modulator in a shearing interferometric system**, Alejandro Reynoso Alvarez, Guillermo Garcia-Torales, Univ. de Guadalajara (Mexico); Marija Strojnik, Univ. de Guadalajara (Mexico) and Centro de Investigaciones en Óptica, A.C. (Mexico); Jorge Luis Flores Nuñez, Univ. de Guadalajara (Mexico) . . . . . [10403-36]

**Differential shearing interferometer**, Guillermo Garcia-Torales, Univ. de Guadalajara (Mexico); Marija Strojnik, Univ. de Guadalajara (Mexico) and Centro de Investigaciones en Óptica, A.C. (Mexico); Azael Mora-Nuñez, Beethoven Bravo-Medina, Univ. de Guadalajara (Mexico) . . . . . [10403-37]

**Alignment of a shearing interferometer for faint sources detection using a spatial light modulator**, Guillermo Garcia-Torales, Marija Strojnik, Roberto Carlos Barragan Campos, Alejandro Reynoso Alvarez, Jorge Luis Flores Nuñez, Univ. de Guadalajara (Mexico) . . . . . [10403-38]

**Tracking pointer using Risley Prisms**, Guillermo Garcia-Torales, Univ. de Guadalajara (Mexico); Marija Strojnik, Univ. de Guadalajara (Mexico) and Centro de Investigaciones en Óptica, A.C. (Mexico); Anuar B. Beltran-Gonzalez, Jorge Luis Flores Nuñez, Univ. de Guadalajara (Mexico) . . . . . [10403-39]

**Three-dimensional shape profiling by projection of binary patterns: generated by a deterministic optimization approach**, Adriana Silva, Antonio Muñoz, Jorge Luis Flores Nuñez, Univ. de Guadalajara (Mexico); Jesus Villa, Univ. Autónoma de Zacatecas (Mexico) . . . . . [10403-40]

**Online 3D measurement by an efficient iterative algorithm**, Jorge Luis Flores Nuñez, Antonio Muñoz, Guillermo Garcia-Torales, Sotero Ordoñez Nogales, Adán Cruz, Univ. de Guadalajara (Mexico) . . . . . [10403-41]

**Piezoresistive method for a laser induced shock waves detection on solids**, J. R. Gonzalez Romero, Guillermo Garcia-Torales, Gilberto Gomez-Rosas, Univ. de Guadalajara (Mexico); Marija Strojnik, Univ. de Guadalajara (Mexico) and Centro de Investigaciones en Óptica, A.C. (Mexico) . . . . . [10403-42]

**Experiments to measure salient feature characteristics of laser-induced shock waves**, Gilberto Gomez Rosas, J. R. Gonzalez Romero, Guillermo Garcia-Torales, Univ. de Guadalajara (Mexico) . . . . . [10403-43]

**The detection of heat emission to solar cell using drone-based thermal infrared sensor and GIS technology**, Geun Sang Lee, VISION Univ. of Jeonju (Korea, Republic of) . . . . . [10403-44]

## TUESDAY 8 AUGUST

### SESSION 5

LOCATION: CONV. CTR. ROOM 33A . TUE 8:30 AM TO 10:00 AM

### Planetary and Comet Missions

Session Chair: **Gabriele E. Arnold**, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany)

8:30 am: **Rosetta's studies of comet 67P: A review after the end of the mission** (*Invited Paper*), Gabriele E. Arnold, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) . . . . . [10403-16]

9:00 am: **The Venus emissivity mapper** (*Invited Paper*), Joern Helbert, Gabriele E. Arnold, Ingo Walter, Dennis Wendler, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); Thomas Widemann, Lab. d'Etudes Spatiales et d'Instrumentation en Astrophysique (France); Gabriel Guignard, Emmanuel Marq, LATMOS (France); Anko Börner, Judit Jänchen, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) . . . . . [10403-17]

9:30 am: **Fourier spectrometer TIRVIM/ACS aboard ExoMars 16 orbiter** (*Invited Paper*), Alexei V. Grigoriev, Alexey Shakun, Boris E. Moshkin, Dmitry V. Patsaev, Alexander V. Zharkov, Victor Shashkin, Andrey S. Kungurov, Alexander Santos-Skripko, Fedor G. Martynovich, Igor A. Stupin, Dmitry Merzlyakov, Vladislav Makarov, Oleg M. Sazonov, Yuriy Nikolskiy, Nikolai I. Ignatiev, Igor A. Maslov, Dmitry Gorinov, Elena Efremenkova, Alexander Terentiev, Oleg Korablev, Space Research Institute (Russian Federation) . . . . . [10403-18]

Coffee Break . . . . . Tue 10:00 am to 10:30 am

### SESSION 6

LOCATION: CONV. CTR. ROOM 33A . TUE 10:30 AM TO 12:00 PM

### Modeling Infrared Systems and Processes

Session Chairs: **Vijayan K. Asari**, Univ. of Dayton (USA); **Maureen S. Kirk**, Texas A&M Univ. (USA)

10:30 am: **Directional ringlet intensity feature transform (DRIFT) based object tracking in IR imagery** (*Invited Paper*), Theus H. Aspiras, Evan W. Krieger, Vijayan K. Asari, Univ. of Dayton (USA) . . . . . [10403-19]

11:00 am: **Automatic building change detection through linear feature fusion and difference of Gaussian classification**, Daniel Prince, Vijayan K. Asari, Univ. of Dayton (USA) . . . . . [10403-20]

11:20 am: **Spectrum modeling of mid-infrared flare considering realistic measurement environment**, Kiwook Han, Yonsei Univ. (Korea, Republic of); Wondong Lee, Korea Military Academy (Korea, Republic of) and Yonsei Univ. (Korea, Republic of); Jae W. Hahn, Yonsei Univ. (Korea, Republic of) . . . [10403-21]

11:40 am: **Object parameters optimization on pure and mixed pixels in thermal hyperspectral imagery**, Xinyuan Miao, Ye Zhang, Junping Zhang, Sheng Wei Zhong, Harbin Institute of Technology (China) . . . . . [10403-22]

Lunch/Exhibition Break . . . . . Tue 12:00 pm to 2:00 pm

SESSION 7

LOCATION: CONV. CTR. ROOM 33A . . . TUE 2:00 PM TO 3:10 PM

**Instruments, Missions and Their Returns**

Session Chairs: **Maureen S. Kirk**, Texas A&M Univ. (USA); **Marija Strojnik**, Centro de Investigaciones en Óptica, A.C. (Mexico)

2:00 pm: **Sentinel-5, the new generation European operational atmospheric chemistry mission in polar orbit** (*Invited Paper*), Abelardo Pérez Albiñana, Didier D. Martin, Matthias Erdmann, Norrie Wright, European Space Research and Technology Ctr. (Netherlands); Markus Melf, Peter Bartsch, Wolfgang Seefelder, Airbus Defence and Space (Germany) . . . . . [10403-23]

2:30 pm: **Tissue characterization by transillumination interferometry**, Brenda Guzman Valdivia, Marija Strojnik, Centro de Investigaciones en Óptica, A.C. (Mexico) . . . . . [10403-30]

2:50 pm: **Design and characterization of a low cost CubeSat multi-band optical receiver to map water ice on the lunar surface for the Lunar Flashlight mission**, Quentin Vinckier, Jet Propulsion Lab. (USA); Karlton Crabtree, Photon Engineering LLC (USA); Christopher G. Paine, Paul O. Hayne, R. Glenn Sellar, Jet Propulsion Lab. (USA) . . . . . [10403-25]

Coffee Break . . . . . Tue 3:10 pm to 3:40 pm

SESSION 8

LOCATION: CONV. CTR. ROOM 33A .. TUE 3:40 PM TO 4:40 PM

**Recent Developments in Terahertz Technology**

Session Chairs: **Abelardo Pérez Albiñana**, European Space Research and Technology Ctr. (Netherlands); **Guillermo Garcia-Torales**, Univ. de Guadalajara (Mexico)

3:40 pm: **Millimeter-wave/terahertz detection and photonic double-mixing by transistors** (*Invited Paper*), Akira Satou, Taiichi Otsuji, Tohoku Univ. (Japan) . . . . . [10403-27]

4:10 pm: **Generation of ultra-stable signal twins and idler twins by coupled optical parametric oscillators: Applications in remote sensing** (*Invited Paper*), Pengda Hong, Yujie J. Ding, Lehigh Univ. (USA) . . . . . [10403-28]

LOCATION: CONV. CTR. ROOM 33A . . . . . 4:40 PM TO 4:45 PM

**Concluding Remarks**

**Marija Strojnik**, Centro de Investigaciones en Óptica, A.C. (Mexico) and **Maureen S. Kirk**, Texas A&M Univ. (USA)

# CONFERENCE 10404

LOCATION: CONV. CTR. ROOM 33A

Wednesday–Thursday 9–10 August 2017 • Proceedings of SPIE Vol. 10404

## Infrared Sensors, Devices, and Applications VII

Conference Chairs: **Paul D. LeVan**, Air Force Research Lab. (USA); **Ashok K. Sood**, Magnolia Optical Technologies, Inc. (USA); **Priyalal Wijewarnasuriya**, U.S. Army Research Lab. (USA); **Arvind I. D'Souza**, DRS Sensors & Targeting Systems, Inc. (USA)

Program Committee: **Sachidananda R. Babu**, NASA Goddard Space Flight Ctr. (USA); **Vincent M. Cowan**, Air Force Research Lab. (USA); **Eric A. DeCuir Jr.**, U.S. Army Research Lab. (USA); **Eustace L. Dereniak**, College of Optical Sciences, The Univ. of Arizona (USA); **Nibir K. Dhar**, U.S. Army Night Vision & Electronic Sensors Directorate (USA); **Sarath D. Gunapala**, Jet Propulsion Lab. (USA); **Sanjay Krishna**, Ctr. for High Technology Materials (USA); **Jay S. Lewis**, Defense Advanced Research Projects Agency (USA); **Hooman Mohseni**, Northwestern Univ. (USA); **Hiroshi Murakami**, Japan Aerospace Exploration Agency (Japan); **Ünal Sakoglu**, Texas A&M Univ.-Commerce (USA)

### WEDNESDAY 9 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 33A WED 8:20 AM TO 10:00 AM

#### SLS & Barrier Detectors I

Session Chairs: **Priyalal Wijewarnasuriya**, U.S. Army Research Lab. (USA); **Arvind I. D'Souza**, DRS Sensors & Targeting Systems, Inc. (USA)

8:20 am: **Noise and detectivity of InAs/GaSb T2SL 4.5 um IR detectors**, Andrzej Kolek, Lukasz Ciura, Rzeszów Univ. of Technology (Poland); Krzysztof Czuba, Iwona Sankowska, Janusz B. Kaniewski, Institute of Electron Technology (Poland); Jaroslaw Jurenczyk, Institute of Electron Technology (Poland) and VIGO System S.A. (Poland); Agata Jasik, Institute of Electron Technology (Poland) . . . [10404-2]

8:40 am: **Resonantly enhanced infrared detectors based on type-II superlattice absorbers**, Michael D. Goldflam, Emil A. Kadlec, Benjamin V. Olson, John F. Klem, Samuel D. Hawkins, S. Parameswaran, Wesley T. Coon, Gordon A. Keeler, Torben R. Fortune, Anna Tauke-Pedretti, Joel R. Wendt, Eric A. Shaner, Paul S. Davids, Jin K. Kim, David W. Peters, Sandia National Labs. (USA) . . . [10404-3]

9:00 am: **Theoretical simulation of mid-wave type-II InAs/GaSb superlattice interband cascade photodetector**, Piotr Martyniuk, Klaudia Hackiewicz, Jaroslaw Rutkowski, Tetina Manyk, Andrzej Kowalewski, Wojskowa Akademia Techniczna im. Jarosława Dąbrowskiego (Poland) . . . [10404-4]

9:20 am: **Effects of 4.5 MeV and 63 MeV proton irradiation on carrier lifetime of InAs/InAsSb type-II superlattices**, Emil A. Kadlec, Michael D. Goldflam, Edward Bielejec, Jin K. Kim, Benjamin V. Olson, John F. Klem, Samuel D. Hawkins, Johnathan Moussa, Peter A. Schultz, Sandia National Labs. (USA); Christian P. Morath, Geoffrey D. Jenkins, Vincent M. Cowan, Air Force Research Lab. (USA); Eric A. Shaner, Sandia National Labs. (USA) . . . [10404-5]

9:40 am: **Extraction of minority carrier diffusion length of MWIR type-II superlattice nBp detector**, Zahra Taghipour, The Univ. of New Mexico (USA); Alireza Kazemi, The Ohio State Univ. (USA); Stephen Myers, SKInfrared LLC (USA); Priyalal S. Wijewarnasuriya, U.S. Army Research Lab. (USA); Sen Mathews, The Univ. of New Mexico (USA); Elizabeth Steenbergen, Christian P. Morath, Vincent M. Cowan, Gamini Ariyawansa, John Scheihing, Air Force Research Lab. (USA); Sanjay Krishna, The Ohio State Univ. (USA) and Univ. of New Mexico (USA) and SKInfrared LLC (USA) . . . [10404-6]

Coffee Break . . . . . Wed 10:00 am to 10:30 am

LOCATION: CONV. CTR. ROOM 6A WED 10:30 AM TO 11:20 AM

#### Remote Sensing Plenary

10:30 am: **Demonstrating Technologies for Hyperspectral Infrared Remote Sensing from Space on a CubeSat (Plenary)**, Thomas S. Pagano, Jet Propulsion Lab. (USA) . . . [10402-500]

Lunch/Exhibition Break . . . . . Wed 11:20 am to 1:20 pm

#### SESSION 2

LOCATION: CONV. CTR. ROOM 33A . . WED 1:20 PM TO 2:00 PM

#### SLS & Barrier Detectors II

Session Chairs: **Sachidananda R Babu**, NASA Goddard Space Flight Ctr. (USA); **Arvind I. D'Souza**, DRS Sensors & Targeting Systems, Inc. (USA)

1:20 pm: **Active modulation of surface plasmon polaritons at degenerate semiconductor interfaces**, Raj K. Vinnakota, Dentcho A. Genov, Louisiana Tech Univ. (USA) . . . [10404-7]

1:40 pm: **Distance and temperature dependent plasmon-enhanced carrier generation and diffusion in InAs/InGaAs/GaAs near-infrared photodetectors**, Terefe Habteyes, Sharmin Haq, Sadhvikas Addamane, Ganesh Balakrishnan, The Univ. of New Mexico (USA); Danhong Huang, Air Force Research Lab. (USA) . . . [10404-8]

#### SESSION 3

LOCATION: CONV. CTR. ROOM 33A . WED 2:00 PM TO 3:00 PM

#### Applications: Medical

Session Chairs: **Paul D. LeVan**, Air Force Research Lab. (USA); **Priyalal Wijewarnasuriya**, U.S. Army Research Lab. (USA)

2:00 pm: **The photonic device for integrated evaluation of collateral circulation of lower extremities**, Volodymyr S. Pavlov, Vinnitsa State Technical Univ. (Ukraine) . . . [10404-9]

2:20 pm: **In vivo noninvasive detection of blood glucose by near-infrared spectroscopy with machine learning techniques**, Siman Zhang, Siqi Liu, Ting Xie, Peng Sun, Chang Wang, Huaye Li, Zhenrong Zheng, Zhejiang Univ. (China) . . . [10404-10]

2:40 pm: **Photoacoustic signal detection using interferometric fiber-optic ultrasound transducers**, Amanda D. Salas-Caridad, Geminiano Martinez-Ponce, Rodolfo Martinez Manuel, Centro de Investigaciones en Óptica, A.C. (Mexico) . . . [10404-11]

Coffee Break . . . . . Wed 3:00 pm to 3:30 pm

#### SESSION 4

LOCATION: CONV. CTR. ROOM 33A . . WED 3:30 PM TO 4:50 PM

#### Detectors, FPAs, and Calibration I

Session Chairs: **Ashok K. Sood**, Magnolia Optical Technologies, Inc. (USA); **Sachidananda R Babu**, NASA Goddard Space Flight Ctr. (USA)

3:30 pm: **Improved performance of GaAs photocathodes using effective activation technique**, Yijun Zhang, Jingzhi Zhang, Cheng Feng, Nanjing Univ. of Science and Technology (China); Hongchang Cheng, Science and Technology on Low-Light-Level Night Vision Lab. (China); Xiang Zhang, Yunsheng Qian, Nanjing Univ. of Science and Technology (China) . . . [10404-13]

3:50 pm: **Extended wavelength InGaAs SWIR FPAs with high performance**, Xue Li, Xiu-Mei Shao, HaiMei Gong, Xianliang Zhu, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences (China) . . . [10404-14]

4:10 pm: **640x512 pixel InGaAs FPAs for short-wave infrared and visible light imaging**, Xiu-Mei Shao, Bo Yang, Songlei Huang, Yang Wei, Xue Li, Xianliang Zhu, Tao Li, HaiMei Gong, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences (China) . . . [10404-15]

4:30 pm: **Life test of the InGaAs focal plane arrays detector for space applications**, Xianliang Zhu, HaiYan Zhang, Xue Li, ZhangCheng Huang, HaiMei Gong, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences (China) . . . [10404-16]



## SESSION 5

LOCATION: CONV. CTR. ROOM 33A . . WED 4:50 PM TO 5:50 PM

### Detectors, FPAs, and Calibration II

Session Chairs: **Paul D. LeVan**, Air Force Research Lab. (USA); **Ashok K. Sood**, Magnolia Optical Technologies, Inc. (USA)

4:50 pm: **Mid-infrared photo detector using pyroelectric response of LiNbO<sub>3</sub>**, Kavitha K. Gopalan, ICFO - Institut de Ciències Fotòniques (Spain); Davide Janner, Politecnico di Torino (Italy); Sebastien Nanot, Romain Parret, Mark B. Lundeberg, Frank H. L. Koppens, Valerio Pruneri, ICFO - Institut de Ciències Fotòniques (Spain) . . . . . [10404-17]

5:10 pm: **Low dark current p-on-n technology for space applications**, Nicolas Péré-Laperne, SOFRADIR (France); Nicolas Baier, Cyril Cervera, Jean-Louis Santallier, Clément Lobre, CEA-LETI (France); Christine Cassillo, Jocelyn Berthoz, Vincent Destefanis, Diane Sam-Giao, Adrien Lamoure, SOFRADIR (France) . . . . . [10404-18]

5:30 pm: **Germanium photodetectors fabricated on 300 mm silicon wafers for near-infrared focal plane arrays**, Ashok K. Sood, John W. Zeller, Magnolia Optical Technologies, Inc. (USA); Caitlin Rouse, Pradeep Haldar, Harry Efstathiadis, SUNY Polytechnic Institute (USA); Nibir K. Dhar, U.S. Army Night Vision & Electronic Sensors Directorate (USA) . . . . . [10404-19]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 . . . . . WED 5:30 PM TO 7:30 PM

### Posters-Wednesday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Effect of antimony segregation on the electronic properties of InAs/InAsSb superlattices**, Heather J. Haugan, Frank Szmulowicz, John J. Hudgins, Logan E. Cordonnier, Gail J. Brown, Air Force Research Lab. (USA) . . . . . [10404-11]

**Improved calibration-based non-uniformity correction method for uncooled infrared camera**, Chengwei Liu, Xiubao Sui, Nanjing Univ. of Science and Technology (China) . . . . . [10404-12]

**Chalcogenide based rib waveguide for compact on-chip supercontinuum sources in mid-infrared domain**, Than Singh Saini, Umesh K. Tiwari, Central Scientific Instruments Organisation (India); Ravindra K. Sinha, Delhi Technological Univ. (India) . . . . . [10404-23]

**High security Infrared biometrics authentication system for financial application**, Xiaofeng Jin, Sun Yat-Sen Univ. (China); Tiancai Liang, Research Institute of GRG Banking Equipment Co., Ltd. (China); Biao Wang, Sun Yat-Sen Univ. (China); Ming Li, Jun Xu, Research Institute of GRG Banking Equipment Co., Ltd. (China); Jianfeng Sun, Shanghai Institute of Optics and Fine Mechanics (China) . . . . . [10404-37]

**A comparison of approximate and exact modes in few-mode micro-optical fibres**, José Á. Flores-Bravo, Fernando Martínez-Piñón, Ctr. de Investigación e Innovación Tecnológica (Mexico); Grethell G. Pérez-Sánchez, Univ. Autónoma Metropolitana (Mexico) . . . . . [10404-38]

**Elongation-based fiber optic tunable filter**, Grethell G. Pérez-Sánchez, José A. Mejía-Islas, Edgar A. Andrade-González, Univ. Autónoma Metropolitana (Mexico); José R. Pérez-Torres, Tecnológico de Estudios Superiores de Coacalco (Mexico) . . . . . [10404-39]

**Laser goniometer used for remote non-contact measurement of angular position and movement**, Nkpoikanke Eno, Saint Petersburg Electrotechnical Univ. "LETI" (Russian Federation) . . . . . [10404-41]

## THURSDAY 10 AUGUST

### SESSION 6

LOCATION: CONV. CTR. ROOM 33A . THU 8:30 AM TO 10:10 AM

### New Techniques, Optical Fibers, Lasers

Session Chairs: **Paul D. LeVan**, Air Force Research Lab. (USA); **Ashok K. Sood**, Magnolia Optical Technologies, Inc. (USA)

8:30 am: **Wave study of compound eyes for efficient infrared detection**, Takiyettin O. Kilinc, Roketsan A.S. (Turkey) and TOBB Univ. of Economics and Technology (Turkey); Zeki Hayran, Hamza Kurt, TOBB Univ. of Economics and Technology (Turkey) . . . . . [10404-21]

8:50 am: **Probing infrared detectors through energy-absorption interferometry**, Dan Moinard, Stafford Withington, Christopher N. Thomas, Univ. of Cambridge (United Kingdom) . . . . . [10404-22]

9:10 am: **Frequency-selective surfaces for infrared imaging**, Emeline Lesmanne, François Boulard, CEA-LETI (France); Roch Espiau de Lamaestre, MINATEC (France); Giacomo Badano, CEA-LETI (France) . . . . . [10404-24]

9:30 am: **Plasmo-thermomechanical suspended nanowire array detectors for mid-infrared spectrum**, Qiancheng Zhao, Mohammad W. Khan, Univ. of California, Irvine (USA); Parinaz Sadri-Moshkenani, Univ. of California Irvine (USA); Rasul Torun, Imam-Uz Zaman, Ozdal Boyraz, Univ. of California, Irvine (USA) . [10404-25]

9:50 am: **PbS and HgTe quantum dots for SW IR devices**, Witold Palosz, Sudhir Trivedi, Brimrose Corp. of America (USA); Gregory Meissner, Kimberley Olver, Eric DeCuir Jr., Priyalal S. Wijewarnasuriya, U.S. Army Research Lab. (USA); Janet Jensen, U.S. Army Edgewood Chemical Biological Ctr. (USA) . . . . . [10404-26]

Coffee Break . . . . . Thu 10:10 am to 10:40 am

### SESSION 7

LOCATION: CONV. CTR. ROOM 33A . THU 10:40 AM TO 12:10 PM

### Applications I

Session Chairs: **Priyalal Wijewarnasuriya**, U.S. Army Research Lab. (USA); **Arvind I. D'Souza**, DRS Sensors & Targeting Systems, Inc. (USA)

10:40 am: **Innovations in imaging technology and NASA/ESTO investments in technology development (Invited Paper)**, Sachidananda R. Babu, NASA Goddard Space Flight Ctr. (USA) . . . . . [10404-27]

11:10 am: **Target detection in sun glint using the improved MWIR polarization technique**, Ji Zheng, Huijie Zhao, Yansong Li, BeiHang Univ. (China); Xiaofeng Sun, Pengfei Song, Shitao Wang, China Academy of Space Technology (China); Chi Cheng, BeiHang Univ. (China) . . . . . [10404-28]

11:30 am: **Temperature measurements on fast-rotating objects using a thermographic camera with an optomechanical image derotator**, Bettina Altmann, Christian Pape, Eduard Reithmeier, Leibniz Univ. Hannover (Germany) . . . . . [10404-29]

11:50 am: **Modeling of IR spectra for nerve agent-sorbent binding**, Michael R. Papantonakis, Courtney A. Roberts, Andrew Shabaev, Youngchan Kim, R. Andrew McGill, Christopher A. Kendziora, Robert Furstenberg, Samuel G. Lambrakos, U.S. Naval Research Lab. (USA) . . . . . [10404-30]

Lunch/Exhibition Break . . . . . Thu 12:10 pm to 1:30 pm

### SESSION 8

LOCATION: CONV. CTR. ROOM 33A . . . THU 1:30 PM TO 3:30 PM

### Applications II

Session Chairs: **Paul D. LeVan**, Air Force Research Lab. (USA); **Arvind I. D'Souza**, DRS Sensors & Targeting Systems, Inc. (USA)

1:30 pm: **NDIR gas sensing using high performance AllnSb mid-infrared LED as light source**, Edson G. Camargo, Yuji Goda, Osamu Morohara, Hromi Fujita, Hirota Geka, Koichiro Ueno, Yoshihiko Shibata, Naohiro Kuze, Asahi Kasei Microdevices Corp. (Japan) . . . . . [10404-31]

1:50 pm: **Development of nanostructured antireflection coatings for infrared technologies and applications**, Gopal G. Pethuraja, John W. Zeller, Roger E. Welsler, Ashok K. Sood, Magnolia Optical Technologies, Inc. (USA); Pradeep Haldar, Harry Efstathiadis, SUNY Polytechnic Institute (USA); Eric DeCuir Jr., Priyalal Wijewarnasuriya, U.S. Army Research Lab. (USA); Nibir K. Dhar, U.S. Army Night Vision & Electronic Sensors Directorate (USA) . . . . . [10404-33]

2:10 pm: **Long wavelength infrared (LWIR) acousto-optical (AOTF) and acousto-optic modulators (AOM) using Hg<sub>2</sub>Br<sub>2</sub> crystals (Invited Paper)**, Priyanthi Amarasinghe, Joo-Soo Kim, Feng Jin, Sudhir Trivedi, Brimrose Technology Corp. (USA); Syed Qadri, U.S. Naval Research Lab. (USA); Jolanta Soos, Mark Diestler, Brimrose Technology Corp. (USA); Neelam Gupta, U.S. Army Research Lab. (USA); Janet Jensen, James O. Jensen, U.S. Army Edgewood Chemical Biological Ctr. (USA) . . . . . [10404-34]

2:40 pm: **Overview of detector technologies and IRFPA's for various sensor applications (Invited Paper)**, Siva Sivananthan, Univ. of Illinois at Chicago (USA) and EPIR Technologies Inc. (USA) . . . . . [10404-35]

3:10 pm: **Thermal sensitivity of the fundamental natural frequency of a resonant MEMS IR detector pixel**, Sedat Pala, Kivanc Azgin, Middle East Technical Univ. (Turkey) . . . . . [10404-36]

# CONFERENCE 10405

LOCATION: CONV. CTR. ROOM 32B

Wednesday 9 August 2017 • Proceedings of SPIE Vol. 10405

## Remote Sensing and Modeling of Ecosystems for Sustainability XIV

Conference Chairs: **Wei Gao**, Colorado State Univ. (USA); **Ni-Bin Chang**, Univ. of Central Florida (USA); **Jinnian Wang**, CHINARS SHENZHEN Institute for Satellite Applications Innovation (China)

Program Committee: **May Chui**, The Univ. of Hong Kong (Hong Kong, China); **E. Raymond Hunt Jr.**, Agricultural Research Service (USA); **Brian Robert Johnson**, National Snow and Ice Data Ctr. (USA); **Thomas U. Kampe**, Ball Aerospace & Technologies Corp. (USA); **Xin-Zhong Liang**, Univ. of Maryland, College Park (USA); **Dennis Ojima**, Colorado State Univ. (USA); **David Riaño**, Univ. of California, Davis (USA); **Runhe Shi**, East China Normal Univ. (China); **Jiong Shu**, East China Normal Univ. (China); **Zhibin Sun**, Colorado State Univ. (USA); **Hongjie Xie**, The Univ. of Texas at San Antonio (USA); **Xiaobing Zhou**, Montana Tech (USA)

### WEDNESDAY 9 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 32B WED 8:40 AM TO 10:00 AM

#### Remote Sensing, Modeling Application, and GIS I

Session Chairs: **Zhibin Sun**, Colorado State Univ. (USA); **Jinnian Wang**, CHINARS SHENZHEN Institute for Satellite Applications Innovation (China)

8:40 am: **Use of artificial neural network and satellite data to predict Boro rice yield in Bangladesh**, Kawsar A. Akhand, The City Univ. of New York (USA); Mohammad Nizamuddin, Leonid Roytman, The City College of New York (USA); Felix Kogan, National Oceanic and Atmospheric Administration (USA) . . . [10405-1]

9:00 am: **Using deep recurrent neural network for direct beam solar irradiance cloud screening**, Maosi Chen, John M. Davis, Zhibin Sun, Colorado State Univ. (USA); Chaoshun Liu, East China Normal Univ. (China); Melina Maria Zempila, Wei Gao, Colorado State Univ. (USA) . . . [10405-2]

9:20 am: **Comparison of two satellite imaging platforms for monitoring quasi-circular vegetation patch in the Yellow River Delta, China**, Qing-sheng Liu, Li Liang, Gaohuan Liu, Chong Huang, Institute of Geographic Sciences and Natural Resources Research (China) . . . [10405-3]

9:40 am: **Retrieval of crop leaf area index from SPOT-5 data using a look-up-table approach based on PROSAIL**, Xiaohua Zhu, Academy of Opto-Electronics, CAS (China) . . . [10405-41]

Coffee Break . . . . .Wed 10:00 am to 10:30 am

LOCATION: CONV. CTR. ROOM 6A WED 10:30 AM TO 11:20 AM

#### Remote Sensing Plenary

10:30 am: **Demonstrating Technologies for Hyperspectral Infrared Remote Sensing from Space on a CubeSat (Plenary)**, Thomas S. Pagano, Jet Propulsion Lab. (USA) . . . . . [10402-500]

#### SESSION 2

LOCATION: CONV. CTR. ROOM 32B .WED 11:30 AM TO 12:30 PM

#### Remote Sensing, Modeling Application, and GIS II

Session Chairs: **Zhibin Sun**, Colorado State Univ. (USA); **Jinnian Wang**, CHINARS SHENZHEN Institute for Satellite Applications Innovation (China)

11:30 am: **Using feature information in neural networks for ultraviolet retrieval in the USA**, Zhibin Sun, Colorado State Univ. (USA); Ni-Bin Chang, Univ. of Central Florida (USA); Wei Gao, Maosi Chen, Melina Maria Zempila, Colorado State Univ. (USA) . . . . . [10405-4]

11:50 am: **Introducing a new total ozone column retrieval algorithm: Evaluation at Mauna Loa station**, Melina Maria Zempila, USDA UV-B Monitoring and Research Program (USA); Konstantinos Fragkos, National Institute of R&D for Optoelectronics (Romania); John Davis, Zhibin Sun, Maosi Chen, Wei Gao, USDA UV-B Monitoring and Research Program (USA) . . . . . [10405-5]

12:10 pm: **An integrated hyperspectral and SAR small satellite constellation for environment monitoring**, Jinnian Wang, CHINARS SHENZHEN Institute for Satellite Applications Innovation (China) . . . . . [10405-6]

Lunch/Exhibition Break . . . . .Wed 12:30 pm to 2:00 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 32B . WED 2:00 PM TO 5:20 PM

#### Remote Sensing for Agriculture, Ecosystems, and Hydrology

Session Chairs: **Ni-Bin Chang**, Univ. of Central Florida (USA); **Ramona M. Galatus**, Technical Univ. of Cluj Napoca (Romania)

2:00 pm: **Deep and fast learning for feature extraction of merged or fused satellite remote sensing images to observe lake eutrophication (Invited Paper)**, Ni-Bin Chang, Univ. of Central Florida (USA) . . . . . [10405-7]

2:30 pm: **Quality assurance of the UV irradiances of the UV-B monitoring and research program: the Mauna Loa test case**, Melina Maria Zempila, John M. Davis, George T. Janson, Elizabeth Olson, Maosi Chen, Bill Durham, Scott Simpson, Jonathan Straube, Zhibin Sun, Wei Gao, USDA UV-B Monitoring and Research Program (USA) . . . . . [10405-8]

2:50 pm: **Spatio-temporal anomaly detection for environmental impact assessment: A case of an abandoned coal mine site in Turkey**, Hilal Soydan, Alper Koz, Hafize Sebnem Duzgun, Middle East Technical Univ. (Turkey). [10405-9]

3:10 pm: **Remote hybrid electro-optic biosensor with fluorescent fiber optic for cephalosporins determination in water**, Ramona M. Galatus, Technical Univ. of Cluj Napoca (Romania); Cecilia Cristea, Bogdan Feier, Iuliu Hatieganu Univ. of Medicine and Pharmacy (Romania); Nunzio Cennamo, Luigi Zeni, Seconda Univ. degli Studi di Napoli (Italy). . . . . [10405-10]

Coffee Break . . . . .Wed 3:30 pm to 4:00 pm

4:00 pm: **Effects of microphysics parameterization on simulations of summer heavy precipitation in the Yangtze-Huaihe Region, China**, Yu Kan, East China Normal Univ. (China); Bo Chen, Air Traffic Management Bureau of East China (China); Tao Shen, Shanghai Shixi High School (China); Chaoshun Liu, Fengxue Qiao, East China Normal Univ. (China) . . . . . [10405-11]

4:20 pm: **Assessment and verification of rainfall threshold through antecedent soil-moisture model in Lambagarh and Pipalkoti landslides (Chamoli District) of Garhwal Himalaya, in Gis & remote sensing environment**, Mahesh K. Tripathi, Himanshu Govil, National Institute of Technology, Raipur (India); Prashant K. Chamapatiray, Indian Institute of Remote Sensing (India); Monkia Besoya, National Institute of Technology, Raipur (India). . . . . [10405-12]

4:40 pm: **Watershed management using geospatial data: A case study of Beas upper catchment of India**, Monkia Besoya, Himanshu Govil, National Institute of Technology, Raipur (India); Sagar Salunkhe, Regional Remote Sensing Service Ctr. (India) and National Remote Sensing Ctr., Government of India (India); Mahesh K. Tripathi, National Institute of Technology, Raipur (India) . . . . . [10405-13]

5:00 pm: **The relationship of Aleutian low and sea surface heat flux**, Junqiang Gong, East China Normal Univ. (China) . . . . . [10405-14]

**LOCATION: CONV. CTR.  
EXHIBIT HALL B2 ..... WED 5:30 PM TO 7:30 PM**

## Posters-Wednesday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Remote sensing estimates of reclamation-induced carbon loss in coastal wetland of Yangtze River estuary**, Jinquan Ai, East China Normal Univ. (China); Wei Gao, Colorado State Univ. (USA); Zhiqiang Gao, Yantai Institute of Coastal Zone Research (China); Runhe Shi, Chao Zhang, East China Normal Univ. (China); Fuxiang Xu, Yantai Institute of Coastal Zone Research (China); Debin Song, Yantai Institute of Coastal Zone Researches, (China) ..... [10405-15]

**Comparison of snow depth retrieval algorithm in Northeastern China based on AMSR2 and FY3B-MWRI data**, Xintong Fan, Lingjia Gu, Ruizhi Ren, Tingting Zhou, Jilin Univ. (China) ..... [10405-16]

**Research on snow cover monitoring of northeast China using Fengyun geostationary satellite**, Tong Wu, Jilin Univ. (China); Lingjia Gu, Ruizhi Ren, Tingting Zhou, Jilin Univ. (China) ..... [10405-17]

**Analysis of relationships between NDVI and land surface temperature in coastal area**, Jicai Ning, Yantai Institute of Coastal Zone Research (China) ..... [10405-18]

**Study of waterline extraction based on object-oriented method**, Yuanyuan Zhang, Yantai Institute of Coastal Zone Research (China) ..... [10405-19]

**Temporal and spatial characteristics of macroalgae blooms in the Yellow Sea based on MODIS data**, Fuxiang Xu, Yantai Institute of Coastal Zone Research (China); Zhiqiang Gao, Yantai Institute of Coastal Zone Research (China) and East China Normal Univ. (China); Jicai Ning, Xiangyu Zheng, Yantai Institute of Coastal Zone Research (China); Jinquan Ai, Yantai Institute of Coastal Zone Research (China) and East China Normal Univ. (China); Debin Song, Yantai Institute of Coastal Zone Research (China) ..... [10405-20]

**Multi-resource data-based research on remote sensing monitoring over the green tide in the Yellow Sea**, Zhiqiang Gao, Yantai Institute of Coastal Zone Research (China) ..... [10405-21]

**Correlation analysis between green tide evolution and secchi disk depth variation in south Yellow Sea**, Xuerong Li, Qianguo Xing, Yantai Institute of Coastal Zone Research (China) ..... [10405-22]

**Spectrum analysis of plants growing in the oil-fields**, Ekaterina A. Selezneva, Elena V. Timchenko, Pavel E. Timchenko, Nikolay V. Tregub, Yana Fedorova, Anna S. Tyumchenkova, Samara Univ. (Russian Federation) ..... [10405-23]

**The extraction of coastal windbreak forest information based on UAV remote sensing images**, WeiTao Shang, Zhiqiang Gao, XiaoPeng Jiang, Yantai Institute of Coastal Zone Research (China) ..... [10405-24]

**A GIS-based health assessment of marine ecosystem in the Bohai Sea**, Debin Song, Zhiqiang Gao, Fuxiang Xu, Xiangyu Zheng, Yantai Institute of Coastal Zone Research (China); Jinquan Ai, East China Normal Univ. (China) ..... [10405-25]

**Monitoring of coastal zone pollution using unmanned aerial vehicle remote sensing system**, XiaoPeng Jiang, Zhiqiang Gao, WeiTao Shang, Yantai Institute of Coastal Zone Research (China) ..... [10405-26]

**The trend of the Tropospheric NO<sub>2</sub> over the Yangtze River delta and the impact of the rapid urbanization on it**, Ming-Liang Ma, East China Normal Univ. (China); Yue Song, Shanghai Shixi High School (China); Qiyang Liu, Runhe Shi, Wei Gao, East China Normal Univ. (China) ..... [10405-27]

**Remote sensing of atmospheric aerosols by MFRSR**, Xiaoli Wei, Wei Gao, Runhe Shi, East China Normal Univ. (China) ..... [10405-28]

**A study of long-term ground settlement behavior of muddy coastal lands in Shanghai with time-series InSAR**, Hongbin Dong, Shanghai Shixi High School (China); Qing Zhao, East China Normal Univ. (China) and ECNU-CSU Joint Research Institute for New Energy and the Environment (China) ..... [10405-29]

**Effects of climate change on peanut's yield in China**, Hanqing Xu, Shanghai Institute of Technology (China) and Shanghai Climate Ctr., Shanghai Meteorological Bureau (China); Zhan Tian, Shanghai Institute of Technology (China) and Shanghai Climate Ctr., Shanghai Meteorological Bureau (China); Dongli Fan, Shanghai Institute of Technology (China); Runhe Shi, East China Normal Univ. (China) ..... [10405-30]

**Residual settlements detection of ocean reclaimed lands with multi-platform SAR time series and SBAS technique: A case study of Shanghai Pudong International Airport**, Lei Yu, East China Normal Univ. (China) and ECNU-CSU Joint Research Institute for New Energy and the Environment (China); Tianliang Yang, Ministry of Land and Resources (China) and Shanghai Institute of Geological Survey (China); Hongbin Dong, Shanghai Shixi High School (China); Qing Zhao, East China Normal Univ. (China) and ECNU-CSU Joint Research Institute for New Energy and the Environment (China); Antonio Pepe, Istituto per il Rilevamento Elettromagnetico dell'Ambiente (Italy) ..... [10405-31]

**The estimation model of chlorophyll content based on spectral index of Spartina alterniflora leaf**, Jiapeng Wang, Runhe Shi, Chao Zhang, Pudong Liu, Yuyan Zeng, East China Normal Univ. (China) ..... [10405-32]

**Calculation of mean solar exo-atmospheric irradiances of GF-4 data**, Chunying Guo, Runhe Shi, East China Normal Univ. (China) ..... [10405-33]

**Vegetation dynamics and their response to climatic variability in Yangtze River watershed region**, Bowen Zhang, Shanghai Institute of Technology (China); Linli Cui, Jun Shi, Shanghai Meteorological Bureau (China); Peipei Wei, Shanghai Institute of Technology (China) ..... [10405-34]

**Effects of distribution density of 3D vegetation model on canopy NDVI simulation**, Zhu Tao, Runhe Shi, East China Normal Univ. (China) ..... [10405-35]

**Comparison of satellite hyperspectral infrared sounder temperature and relative humidity profiles with ECMWF reanalysis datasets and radiosonde observations in East China**, Yaru Gu, East China Normal Univ. (China); Yan-An Liu, Chaoshun Liu, East China Normal Univ. (China) and ECNU-CSU Joint Research Institute for New Energy and the Environment (China); Runhe Shi, East China Normal Univ. (China); Wei Gao, ECNU-CSU Joint Research Institute for New Energy and the Environment (China); Siying Cao, Shanghai Shixi High School (China) ..... [10405-36]

**The preliminary analysis of the occultation atmospheric products of FY-3C satellite**, Zhenxiang Shen, Chaoshun Liu, East China Normal Univ. (China); Yan Chen, Shanghai Shixi High School (China) ..... [10405-37]

**Assessing the potential productivity of summer maize using WOFOST in north China plain**, Mingnuo Jiang, Chaoshun Liu, East China Normal Univ. (China) ..... [10405-38]

**Satellite observations of autumn-winter floating brown macroalgae blooms drifted from the Yellow Sea to the East China Sea**, Qianguo Xing, Xuerong Li, Yantai Institute of Coastal Zone Research (China) ..... [10405-39]

**Measurement of changes in the land cover and classification of regions of interest**, Wendy Barrera Garcia, Juan Carlos Valdiviezo Navarro, Univ. Politécnica de Tulancingo (Mexico); César Joel Camacho Bello, Univ. Tecnológica de Tulancingo (Mexico) ..... [10405-40]

**A sampling strategy based on CGM for LAI measurements over non-uniform surface**, Xiaohua Zhu, Lingling Ma, Yongguang Zhao, Academy of Opto-Electronics, CAS (China) ..... [10405-42]

**About remote monitoring systems for aquatic environment**, Ferdenant A. Mkrtchyan, Kotel'nikov Institute of Radio Engineering and Electronics of Russian Academy of Sciences (Russian Federation) ..... [10405-43]



# CONFERENCE 10406

LOCATION: CONV. CTR. ROOM 32B

Tuesday–Wednesday 8–9 August 2017 • Proceedings of SPIE Vol. 10406

# Lidar Remote Sensing for Environmental Monitoring 2017

Conference Chair: **Upendra N. Singh**, NASA Langley Research Ctr. (USA)

Program Committee: **Parminder Ghuman**, NASA Goddard Space Flight Ctr. (USA); **Floyd E. Hovis**, Fibertek, Inc. (USA); **George J. Komar**, NASA Headquarters (USA); **Kohei Mizutani**, National Institute of Information and Communications Technology (Japan); **Fred Moshary**, The City College of New York (USA); **Georgios Tzeremes**, ESTEC, European Space Agency (Netherlands); **Carl Weimer**, Ball Aerospace & Technologies Corp. (USA)

## TUESDAY 8 AUGUST

### SESSION 1

LOCATION: CONV. CTR. ROOM 32B . . . TUE 8:30 AM TO 9:15 AM

#### Keynote Session

Session Chair: **Upendra N. Singh**, NASA Langley Research Ctr. (USA)

8:30 am: **A survey of enabling active remote sensing technologies for NASA's Earth science observations** (*Keynote Presentation*), George J. Komar, NASA Headquarters (USA). . . . . [10406-1]

### SESSION 2

LOCATION: CONV. CTR. ROOM 32B . . . TUE 9:15 AM TO 11:55 AM

#### Enabling Technologies and Techniques for Trace Gases Measurements

Session Chair: **Upendra N. Singh**, NASA Langley Research Ctr. (USA)

9:15 am: **Progress on development of an airborne two-micron IPDA lidar for water vapor and carbon dioxide column measurements** (*Invited Paper*), Upendra N. Singh, Mulugeta Petros, Tamer Refaat, Jirong Yu, Charles W. Antill, Bryant D. Taylor, Ruben G. Remus, Teh-Hwa Wong, Karl Reithmaier, Jane Lee, Syed Ismail, NASA Langley Research Ctr. (USA) . . . . . [10406-2]

9:45 am: **GreenLITE™: A new laser-based tool for near-real-time monitoring and mapping of CO<sub>2</sub> and CH<sub>4</sub> concentrations on scales from 0.4-25 km<sup>2</sup>**, Jeremy T. Dabler, Nathan Blume, Michael Braun, Harris Corp. (USA); Scott Zaccheo, Timothy G. Pernini, Atmospheric and Environmental Research, Inc. (USA) . . . . . [10406-3]

Coffee Break . . . . . Tue 10:05 am to 10:35 am

10:35 am: **New semiconductor laser technology for gas sensing applications in the 1650nm range**, Milan L. Mashanovitch, Gordon Morrison, Paul O. Leisher, Jeremy Thomas, Freedom Photonics, LLC (USA); Mark Stephen, Kenji Numata, Stewart Wu, Haris Riris, NASA Goddard Space Flight Ctr. (USA) . . . . . [10406-4]

10:55 am: **Compact, highly efficient, single-frequency 25W,2051nm Tm Fiber-based MOPA for CO<sub>2</sub> trace-gas laser space transmitter**, Doruk Engin, Fibertek, Inc. (USA); Ti Chuang, Fibertek (USA); Mark Storm, Fibertek, Inc. (USA) . . [10406-5]

11:15 am: **Wide area methane emissions mapping with airborne IPDA lidar**, Jarett Bartholomew, Philip Lyman, Carl Weimer, Lyle Ruppert, Ball Aerospace & Technologies Corp. (USA) . . . . . [10406-6]

11:35 am: **Single frequency Er:YAG methane/water vapor DIAL source**, Patrick M. Burns, Moran Chen, Dave Pachowicz, Jeremy E. Young, Fran Fitzpatrick, Nicholas Sawruk, Fibertek, Inc. (USA) . . . . . [10406-7]

Lunch/Exhibition Break . . . . . Tue 11:55 am to 1:30 pm

### SESSION 3

LOCATION: CONV. CTR. ROOM 32B . . . TUE 1:30 PM TO 3:00 PM

#### Wind Lidar Technologies and Observations

Session Chairs: **Parminder Ghuman**, NASA Goddard Space Flight Ctr. (USA); **Shibin Jiang**, AdValue Photonics, Inc. (USA)

1:30 pm: **Application of Doppler wind lidar observations to hurricane analysis and prediction** (*Invited Paper*), Robert M. Atlas, National Oceanic and Atmospheric Administration (USA); George D. Emmitt, Simpson Weather Associates, Inc. (USA); Lisa Bucci, Kelly Ryan, Jun A. Zhang, National Oceanic and Atmospheric Administration (USA) . . . . . [10406-8]

2:00 pm: **Status of pulsed coherent-detection wind lidars at NASA LaRC and recent airborne science campaign results**, Michael J. Kavaya, NASA Langley Research Ctr. (USA); George D. Emmitt, Simpson Weather Associates, Inc. (USA); Zhaoyan Liu, Upendra N. Singh, NASA Langley Research Ctr. (USA) . . . . [10406-9]

2:20 pm: **Efficient, space-based, 100W thulium fiber laser for pumping Q-switched 2µm Ho:YLF for global winds and carbon dioxide lidar**, Doruk Engin, Brian Mathason, Mark Storm, Fibertek, Inc. (USA) . . . . . [10406-10]

2:40 pm: **Fast widely-tunable single-frequency 2-micron laser for remote sensing applications**, Sammy W. Henderson, Charles P. Hale, Beyond Photonics (USA) . . . . . [10406-11]

Coffee Break . . . . . Tue 3:00 pm to 3:30 pm

### SESSION 4

LOCATION: CONV. CTR. ROOM 32B . . . TUE 3:30 PM TO 5:40 PM

#### Enabling Lidar Technologies and Observations

Session Chairs: **Floyd Hovis**, Fibertek, Inc. (USA); **Sammy W. Henderson**, Beyond Photonics (USA)

3:30 pm: **First principle calibration of water vapor Raman lidars** (*Invited Paper*), Valentin B. Simeonov, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . . [10406-12]

4:00 pm: **Greater than 2mJ pulse energy and 65kW peak power single frequency fiber laser at 1.03 micron**, Shibin Jiang, AdValue Photonics, Inc. (USA) . . . . . [10406-13]

4:20 pm: **Stabilized diode seed laser for flight and space-based remote lidar sensing applications**, Shirley McNeil, Phillip Battle, AdvR, Inc. (USA); Floyd Hovis, Joe Rudd, Fibertek, Inc. (USA) . . . . . [10406-14]

4:40 pm: **Development of a wing-beat-modulation scanning lidar system for insect studies**, Martin J. Tauc, Montana State Univ. (USA); Kurt M. Frstrup, U.S. National Park Service (USA); Joseph A. Shaw, Montana State Univ. (USA) . . . . . [10406-15]

5:00 pm: **1550 nm eye-safe wavelength watt-level laser transmitter for space communication and lidar**, Ray R. Y. Tang, Ramadas Pillai, NuPhoton Technologies, Inc. (USA) . . . . . [10406-16]

5:20 pm: **The Scheimpflug lidar method**, Mikkel Brydegaard, Elin Malmqvist, Samuel Jansson, Jim Larsson, Sandra Török, Lund Univ. (Sweden); Guangyu Zhao, South China Normal Univ. (China) . . . . . [10406-17]

WEDNESDAY 9 AUGUST

LOCATION: CONV. CTR.

EXHIBIT HALL B2 ..... WED 5:30 PM TO 7:30 PM

Posters-Wednesday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at http://spie.org/OPPosterGuidelines.

**A photon-efficient method based on curve fitting for photon counting 3D imaging lidar**, Ling Ye, Guohua Gu, Weiji He, Wenye Yin, Jie Lin, Jian Fang, Nanjing Univ. of Science and Technology (China) ..... [10406-18]

**11 years of Rayleigh lidar observations of gravity wave activity above the southern tip of South America (Río Gallegos, Argentina, 51.6°S, 69.3°W)**, Jacobo O. Salvador, Instituto de Investigaciones Científicas y Técnicas para la Defensa (Argentina) and CONICET (Argentina); Pablo Llamedo Soria, Univ. Austral (Argentina); Jonathan Quiroga, Consejo Nacional de Investigaciones Científicas y Técnicas (Argentina); Eduardo Quel, Instituto de Investigaciones Científicas y Técnicas para la Defensa (Argentina); Peter Alexander, Univ. de Buenos Aires (Argentina); Rodrigo Hierro, Alejandro de la Torre, Univ. Austral (Argentina) ..... [10406-19]

**Potential of UAV LIDAR systems for geospatial mapping**, Ahmed Elaksher, Subodh Bhandari, California State Polytechnic Univ., Pomona (USA) . . . [10406-20]

**Lidar observations of long range dust transport over Mauna Loa Observatory**, Jalal-ud-din Butt, Nimmi C. P. Sharma, Central Connecticut State Univ. (USA); John E. Barnes, National Oceanic and Atmospheric Administration (USA) . . . [10406-21]

**Applications of synergistic combination of remote sensing and in-situ monitoring of urban air quality**, Adrian Diaz Fortich, NOAA-CREST (USA) ..... [10406-22]

# CONFERENCE 10407

LOCATION: CONV. CTR. ROOM 33C

Tuesday–Wednesday 8–9 August 2017 • Proceedings of SPIE Vol. 10407

## Polarization Science and Remote Sensing VIII

Conference Chairs: **Joseph A. Shaw**, Montana State Univ. (USA); **Frans Snik**, Leiden Univ. (Netherlands)

Program Committee: **Bruce E. Bernacki**, Pacific Northwest National Lab. (USA); **David B. Chenault**, Polaris Sensor Technologies, Inc. (USA); **Russell A. Chipman**, College of Optical Sciences, The Univ. of Arizona (USA); **Julia M. Craven**, Sandia National Labs. (USA); **Aristide C. Dogariu**, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); **Dennis H. Goldstein**, Polaris Sensor Technologies Inc. (USA); **Michael Kudenov**, North Carolina State Univ. (USA); **Kazuhiko Oka**, Hokkaido Univ. (Japan); **Yoav Y. Schechner**, Technion-Israel Institute of Technology (Israel); **Jean-Marc Thériault**, Defence Research and Development Canada, Valcartier (Canada); **J. Scott Tyo**, UNSW Canberra (Australia)

### TUESDAY 8 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 33C . TUE 8:20 AM TO 10:00 AM

#### Polarimetric Instruments

Session Chair: **Frans Snik**, Leiden Observatory (Netherlands)

8:20 am: **A fast Stokes polarimeter**, Israel J. Vaughn, The Univ. of New South Wales (Australia); Andrey S. Alenin, J. Scott Tyo, UNSW Canberra (Australia). . . . . [10407-1]

8:40 am: **Real-time Stokes polarimeter using three polarized beam splitter**, Shuhei Shibata, Utsunomiya Univ. (Japan); Shuichi Kawabata, Tokyo Polytechnic Univ. (Japan); Yukitoshi Otani, Utsunomiya Univ. (Japan) . . . . . [10407-2]

9:00 am: **Snapshot spatially heterodyned imaging Fourier transform spectropolarimeter**, Eddie J. Youngs, Michael W. Kudenov, Michael J. Escuti, North Carolina State Univ. (USA); Jim Schwiegerling, The Univ. of Arizona (USA) . . . . . [10407-3]

9:20 am: **Intrinsic coincident full-Stokes polarimeter using stacked organic photovoltaics and architectural comparison of polarimeter techniques**, Ruonan Yang, Pratik Sen, Brendan T. O'Connor, Michael W. Kudenov, North Carolina State Univ. (Japan); Yukitoshi Otani, Utsunomiya Univ. (Japan) . . . . . [10407-4]

9:40 am: **Characterization of cameras for all-sky polarization measurements during the 2017 solar eclipse**, Taiga Hashimoto, Hokkaido Univ. (Japan); Laura M. Dahl, Seth A. Laurie, Joseph A. Shaw, Montana State Univ. (USA) . . . . . [10407-5]

Coffee Break . . . . . Tue 10:00 am to 10:30 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 33C .TUE 10:30 AM TO 12:00 PM

#### Polarization Analysis of Optical Systems

Session Chair: **Kazuhiko Oka**, Hokkaido Univ. (Japan)

10:30 am: **Advances in modeling polarimeter performance (Invited Paper)**, Russell A. Chipman, College of Optical Sciences, The Univ. of Arizona (USA) and Airy Optics, Inc. (USA). . . . . [10407-6]

11:00 am: **Modeling the polarization aberrations of optical elements**, Kyle Hawkins, Russell A. Chipman, Airy Optics, Inc. (USA) . . . . . [10407-7]

11:20 am: **End-to-end multi-scale simulations of optical systems containing isotropic and anisotropic components with arbitrary geometries using full vector wave propagation**, Steven Bos, Sebastiaan Haffert, Christoph Keller, Leiden Observatory (Netherlands). . . . . [10407-8]

11:40 am: **Polarization fringe modeling for the DKIST retarders**, David M. Harrington, National Solar Observatory (USA) . . . . . [10407-9]

Lunch/Exhibition Break . . . . . Tue 12:00 pm to 1:30 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 33C . . . TUE 1:30 PM TO 2:30 PM

#### Polarimetric Data Analysis

Session Chair: **J. Scott Tyo**, UNSW Canberra (Australia)

1:30 pm: **Statistics for linear Stokes polarimetry**, Nathan Hagen, Utsunomiya Univ. (Japan) . . . . . [10407-10]

1:50 pm: **Single image super-resolution via regularized extreme learning regression for imagery from microgrid polarimeters**, Garrett C. Sargent, Univ. of Dayton (USA); Bradley M. Ratliff, Univ. of Dayton Research Institute (USA); Vijayan K. Asari, Univ. of Dayton (USA) . . . . . [10407-11]

2:10 pm: **Channeled linear imaging polarimetry using iterative reconstruction**, Dennis J. Lee, Charles F. LaCasse IV, Julia M. Craven, Sandia National Labs. (USA) . . . . . [10407-12]

#### SESSION 4

LOCATION: CONV. CTR. ROOM 33C . . . TUE 2:30 PM TO 3:10 PM

#### Methods of Displaying Polarization Data

Session Chair: **Joseph A. Shaw**, Montana State Univ. (USA)

2:30 pm: **Moving towards more intuitive display strategies for polarimetric image data**, Bradley M. Ratliff, Univ. of Dayton Research Institute (USA); J. Scott Tyo, UNSW Canberra (Australia) . . . . . [10407-13]

2:50 pm: **Engaging Montana high school students in optical sciences with a polarization photo contest**, Martin J. Tauc, Montana State Univ. (USA); Jim Boger, Flathead Valley Community College (USA); Andrew Hohne, Laura M. Dahl, Paul W. Nugent, David W. Riesland, Benjamin Moon, Carol L. Baumbauer, Orrin Boese, Joseph A. Shaw, Wataru Nakagawa, Montana State Univ. (USA) . . . . . [10407-14]

LOCATION: CONV. CTR. ROOM 33C . . . . . 3:10 PM TO 3:30 PM

#### Polarization Photo Award Ceremony

Chairs: Frans Snik, Leiden Univ. (Netherlands) and Joseph A. Shaw, Montana State Univ. (USA)

<http://spie.org/PolarizationPhotoContest>

Coffee Break . . . . . Tue 3:30 pm to 4:00 pm



## SESSION 5

LOCATION: CONV. CTR. ROOM 33C .. TUE 4:00 PM TO 5:40 PM

### Polarization-Based Optical Systems and Components

Session Chair: **Michael W. Kudenov**, North Carolina State Univ. (USA)

4:00 pm: **Adaptive display strategies for polarization data**, J. Scott Tyo, UNSW Canberra (Australia); Bradley M. Ratliff, Univ. of Dayton Research Institute (USA); Andrey S. Alenin, Israel J. Vaughn, UNSW Canberra (Australia). . . . . [10407-40]

4:20 pm: **Polarization-selective infrared bandpass filter based on a two-layer subwavelength metallic grating**, Andrew Hohne, Benjamin Moon, Carol L. Baumbauer, Tristan Gray, James Dilts, Joseph A. Shaw, David L. Dickensheets, Wataru Nakagawa, Montana State Univ. (USA) . . . . . [10407-16]

4:40 pm: **Achromatic and chromatic liquid crystal polymer films at near-infrared wavelengths**, Nathaniel Z. Warriner, Michael J. Escuti, Shuojia Shi, Kathrynn J. Hornburg, North Carolina State Univ. (USA) . . . . . [10407-17]

5:00 pm: **Polarization conversion systems based on geometric-phase microlenses**, Jihwan Kim, Michael W. Kudenov, Michael J. Escuti, North Carolina State Univ. (USA). . . . . [10407-18]

5:20 pm: **Fraunhofer line optical correlator for improvement of initial orbit determination**, Brett A. Pantalone, Michael W. Kudenov, North Carolina State Univ. (USA) . . . . . [10407-19]

## WEDNESDAY 9 AUGUST

### SESSION 6

LOCATION: CONV. CTR. ROOM 33C . WED 8:20 AM TO 9:00 AM

### Mueller Matrix Polarimeters

Session Chair: **Russell A. Chipman**, College of Optical Sciences, The Univ. of Arizona (USA)

8:20 am: **A nine-channeled partial Mueller matrix polarimeter**, Andrey S. Alenin, Israel J. Vaughn, J. Scott Tyo, UNSW Canberra (Australia) . . . . . [10407-20]

8:40 am: **Hyperspectroscopic Mueller-matrix polarimeter based on channeled polarimetry**, Kazuhiko Oka, Kodai Sayama, Hiroshi Michida, Hokkaido Univ. (Japan). . . . . [10407-21]

### SESSION 7

LOCATION: CONV. CTR. ROOM 33C WED 9:00 AM TO 10:00 AM

### Polarization in Remote Sensing: Atmospheric

Session Chair: **Joseph A. Shaw**, Montana State Univ. (USA)

9:00 am: **Remote sensing of atmospheric aerosols and clouds using the AirMSPI imaging polarimeter**, Gerard van Harten, David J. Diner, Feng Xu, Brian E. Rheingans, Jet Propulsion Lab. (USA); Mick Tosca, The School of the Art Institute of Chicago (USA) and Jet Propulsion Lab. (USA); Felix C. Seidel, Jet Propulsion Lab. (USA) . . . . . [10407-22]

9:20 am: **Cloud thermodynamic phase detection using an all-sky polarimeter**, Laura M. Dahl, Martin J. Tauc, Joseph A. Shaw, Montana State Univ. (USA) . . . . . [10407-23]

9:40 am: **Polarimetric time-lapse imaging of aurorae with DSLR color cameras**, Frans Snik, Michael J. Wilby, Louis Martin, Felix C. M. Bettonvil, Leiden Observatory (Netherlands); Michiel Rodenhuis, Ramón Navarro, Netherlands Research School for Astronomy (Netherlands); Hervé Lamy, Belgian Institute for Space Aeronomy (Belgium) . . . . . [10407-24]

Coffee Break . . . . . Wed 10:00 am to 10:30 am

LOCATION: CONV. CTR. ROOM 6A WED 10:30 AM TO 11:20 AM

### Remote Sensing Plenary

10:30 am: **Demonstrating Technologies for Hyperspectral Infrared Remote Sensing from Space on a CubeSat (Plenary)**, Thomas S. Pagano, Jet Propulsion Lab. (USA) . . . . . [10402-500]

Lunch/Exhibition Break. . . . . Wed 11:20 am to 1:10 pm

## SESSION 8

LOCATION: CONV. CTR. ROOM 33C . . . WED 1:10 PM TO 1:30 PM

### Polarimetry Applications: Medical

Session Chair: **Julia M. Craven**, Sandia National Labs. (USA)

1:10 pm: **The hand-held polarization-sensitive spectral domain optical coherence and its applications**, Hao Liu, Nanjing Univ. of Science and Technology (China) . . . . . [10407-25]

## SESSION 9

LOCATION: CONV. CTR. ROOM 33C . . WED 1:30 PM TO 2:50 PM

### Polarimetry Applications: Target Detection/Characterization

Session Chair: **Julia M. Craven**, Sandia National Labs. (USA)

1:30 pm: **Polarimetric LIDAR with FRI sampling for target characterization, breaking sensing**, Erandi Wijerathna, Charles D. Creusere, David G. Voelz, New Mexico State Univ. (USA); Juan Castorena, Ford Motor Co. (USA) . . . . . [10407-26]

1:50 pm: **Active infrared polarimetric imaging demonstrator by orthogonality**, Francois Parnet, Julien Fade, Institut de Physique de Rennes (France); Noé Ortega-Quijano, Deneb Medical, S.L. (Spain); Ludovic Frein, Goulc'hen Loas, Mehdi Alouini, Institut de Physique de Rennes (France) [10407-27]

2:10 pm: **Polarization vector signatures for target identification**, Diane Beamer, Ujjitha A. Abeywickrema, Partha P. Banerjee, Univ. of Dayton (USA) . . . . [10407-28]

2:30 pm: **Surface parameter based image estimation from application of a scattering model to polarized light measurements**, Hanyu Zhan, New Mexico State Univ. (USA) and Research Institute of Highway, Ministry of Transport (China); Hanwan Jiang, New Mexico State Univ. (USA) and Research Institute of Highway, Ministry of Transportation (China); David G. Voelz, New Mexico State Univ. (USA); Zhan Li, Research Institute of Highway, Ministry of Transportation (China); Pengfei Li, Research Institute of Highway, Ministry of Transportation (China); Shoushan Cheng, Research Institute of Highway, Ministry of Transportation (China)[10407-29]

Coffee Break . . . . . Wed 2:50 pm to 3:20 pm

## SESSION 10

LOCATION: CONV. CTR. ROOM 33C . . WED 3:20 PM TO 4:10 PM

### Polarization in Remote Sensing: Astronomy

Session Chair: **Frans Snik**, Leiden Observatory (Netherlands)

3:20 pm: **High contrast observations of circumstellar disks with the Gemini Planet Imager's polarimetry mode (Invited Paper)**, Maxwell A. Millar-Blanchaer, Jet Propulsion Lab. (USA); Marshall D. Perrin, Space Telescope Science Institute (USA); Bruce A. Macintosh, Stanford Univ. (USA); James R. Graham, Univ. of California, Berkeley (USA); Michael P. Fitzgerald, Univ. of California, Los Angeles (USA); Paul R. Kalas, Univ. of California, Berkeley (USA); Jeffrey K. Chilcote, Dunlap Institute for Astronomy & Astrophysics (Canada); Jason J. Wang, Univ. of California, Berkeley (USA); Li-Wei Hung, Univ. of California, Los Angeles (USA); Sloane J. Wiktorowicz, The Aerospace Corp. (USA); Sebastian Bruzzone, Western Univ. (Canada) . . . . . [10407-30]

3:50 pm: **Visible, near infrared spectropolarimeter for characterization of the DKIST optical system and polarization properties**, Stacey R. Sueoka, David M. Harrington, National Solar Observatory (USA) . . . . . [10407-31]

# CONFERENCE 10407

## SESSION 11

LOCATION: CONV. CTR. ROOM 33C . . WED 4:10 PM TO 4:50 PM

### Mathematics of Coherence, Polarization, and Scattering

Session Chair: **Frans Snik**, Leiden Observatory (Netherlands)

4:10 pm: **Controlling the spatial coherence and polarization of a quasi-homogeneous, planar electromagnetic source for remote sensing applications**, Oscar G. Rodríguez-Herrera, Univ. Nacional Autónoma de México (Mexico) . . . . . [10407-32]

4:30 pm: **Statistics of partially-polarized fields: Beyond the Stokes vector and coherence matrix**, Mikhail I. Charnotskii, Consultant (USA) . . . . . [10407-33]

## SESSION 12

LOCATION: CONV. CTR. ROOM 33C . . WED 4:50 PM TO 5:30 PM

### Polarization in Remote Sensing: Biology

Session Chair: **Joseph A. Shaw**, Montana State Univ. (USA)

4:50 pm: **Estimating the relative water content of leaves in a cotton canopy**, Vern C. Vanderbilt, NASA Ames Research Ctr. (USA); Craig S. T. Daughtry, U.S. Dept. of Agriculture (USA); Meredith K. Kupinski, Christine L. Bradley, College of Optical Sciences, The Univ. of Arizona (USA); Andrew N. French, Kevin Bronson, U.S. Arid-Land Agriculture Research Ctr. (USA); Russell A. Chipman, College of Optical Sciences, The Univ. of Arizona (USA); Robert P. Dahlgren, NASA Ames Research Ctr. (USA) . . . . . [10407-34]

5:10 pm: **A high-sensitivity circular spectropolarimeter for remote sensing of homochirality in photosynthetic organisms**, Lucas Patty, Vrije Univ. Amsterdam (Netherlands); Frans Snik, Luuk Visser, Leiden Observatory (Netherlands) [10407-35]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 . . . . . WED 5:30 PM TO 7:30 PM

### Posters-Wednesday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**Passive millimeter-wave polarization characteristics of several common structures**, Yayun Cheng, Fei Hu, Liangqi Gui, Huazhong Univ. of Science and Technology (China) . . . . . [10407-36]

**Active polarization imaging system based on optical heterodyne balanced receiver**, Qian Xu, Jianfeng Sun, Zhiyong Lu, Yu Zhou, Zhu Luan, Peipei Hou, Liren Liu, Shanghai Institute of Optics and Fine Mechanics (China) . . . . . [10407-37]

**A partial Mueller matrix polarimeter using two photoelastic modulator and polarizer pairs**, Nia Natasha Tipol, Utsunomiya Univ. (Japan); Shuichi Kawabata, Tokyo Polytechnic Univ. (Japan); Yukitoshi Otani, Utsunomiya Univ. (Japan) . . . . . [10407-38]

**System of Mueller-Jones matrix polarizing mapping of blood plasma films in breast pathology**, Natalia I. Zabolotna, Kostiantyn O. Radchenko, Mykola H. Tarnovskiy, Vinnytsia National Technical Univ. (Ukraine) . . . . . [10407-39]

# CONFERENCE 10408

LOCATION: CONV. CTR. ROOM 31B

Tuesday–Wednesday 8–9 August 2017 • Proceedings of SPIE Vol. 10408

## Laser Communication and Propagation through the Atmosphere and Oceans VI

Conference Chairs: **Jeremy P. Bos**, Michigan Technological Univ. (USA); **Alexander M. J. van Eijk**, TNO Defence, Security and Safety (Netherlands); **Stephen M. Hammel**, Space and Naval Warfare Systems Command (USA)

Program Committee: **Larry C. Andrews**, Univ. of Central Florida (USA); **Jaime Anguita**, Univ. de Los Andes (Chile); **Shlomi Arnon**, Ben-Gurion Univ. of the Negev (Israel); **Sukanta Basu**, Delft Univ. of Technology (Netherlands); **Matthew M. Bold**, Lockheed Martin Space Systems Co. (USA); **Mikhail I. Charnotskii**, MC Consulting (USA); **Gang Chen**, Univ. of California, Riverside (USA); **Christopher C. Davis**, Univ. of Maryland, College Park (USA); **Robert J. Grasso**, RJG Consulting (USA); **Jony Jiang Liu**, U.S. Army Research Lab. (USA); **Arun K. Majumdar**, Naval Air Warfare Ctr. Weapons Div. (USA); **Vladimir B. Markov**, Advanced Systems & Technologies, Inc. (USA); **Dominic C. O'Brien**, Univ. of Oxford (United Kingdom); **Ronald L. Phillips**, Florida Space Institute (USA); **William S. Rabinovich**, U.S. Naval Research Lab. (USA); **Karin Stein**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Miranda van Iersel**, TNO Defence, Security and Safety (Netherlands); **Thomas Weyrauch**, Univ. of Dayton (USA); **Otakar Wilfert**, Brno Univ. of Technology (Czech Republic); **Heba Yuksel**, Bogaziçi Univ. (Turkey)

### TUESDAY 8 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 31B . TUE 8:30 AM TO 10:00 AM

#### Free Space Optical Communications I

Session Chairs: **Alexander M. J. van Eijk**, TNO Defence, Security and Safety (Netherlands); **Stephen Hammel**, Space and Naval Warfare Systems Command (USA)

8:30 am: **Testing of a compact 10G Lasercomm system for maritime platforms (Invited Paper)**, Juan C. Juarez, Katherine T. Souza, Dustin D. Nicholes, James L. Riggins II, Hala J. Tomey, Radha A. Venkat, Johns Hopkins Univ. Applied Physics Lab., LLC (USA) . . . . . [10408-1]

9:00 am: **Phase and amplitude modification of a laser beam by two deformable mirrors using conventional 4f image encryption techniques**, Chensheng Wu, Jonathan Ko, John R. Rzasa, Christopher C Davis, Univ. of Maryland, College Park (USA) . . . . . [10408-2]

9:20 am: **Design and flight test results of high speed optical bidirectional link between stratospheric platforms for aerospace applications**, Simone Briatore, Rustam Akhtyamov, Skolkovo Institute of Science and Technology (Russian Federation); Alessandro Golkar, Skolkovo Institute of Science and Technology (Russian Federation) . . . . . [10408-3]

9:40 am: **Overwater ultraviolet non-line-of-sight communication channel modeling and experiment verification**, Tian Lang, Crystal Han, Juan Marquez, Gang Chen, Univ. of California, Riverside (USA) . . . . . [10408-5]

Coffee Break . . . . . Tue 10:00 am to 10:30 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 31B . TUE 10:30 AM TO 11:50 AM

#### Free Space Optical Communications II

Session Chairs: **Jeremy P. Bos**, Michigan Technological Univ. (USA); **Robert J. Grasso**, EOIR Technologies (USA)

10:30 am: **Experimental evaluation and determination of free space optical link at 532nm wavelength under rain conditions and comparison with the link performance at 850nm wavelength**, Gaurav Soni, Amritsar College of Engineering and Technology (India) . . . . . [10408-6]

10:50 am: **Performance analysis of stationary Hadamard matrix diffusers in free-space optical communication links**, Derek J. Burrell, Christopher T. Middlebrook, Michigan Technological Univ. (USA) . . . . . [10408-7]

11:10 am: **Simulating the performance of adaptive optics techniques on FSO communications through the atmosphere**, Noelia Martinez, Luis Fernando Rodriguez-Ramos, Instituto de Astrofísica de Canarias (Spain) . . . . . [10408-8]

11:30 am: **Capacity and outage performance of multiple-input multiple-output free space optical system over double-Weibull atmospheric turbulence channel and weather conditions**, Omar Hasan, Princess Sumaya Univ. for Technology (Jordan) . . . . . [10408-9]

Lunch/Exhibition Break . . . . . Tue 11:50 am to 1:40 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 31B . . . TUE 1:40 PM TO 3:30 PM

#### Beam Propagation

Session Chairs: **Stephen Hammel**, Space and Naval Warfare Systems Command (USA); **Matthew M. Bold**, Lockheed Martin Space Systems Co. (USA)

1:40 pm: **Atmospheric propagation of coherently and incoherently combined quantum cascade lasers (Invited Paper)**, Robert J. Grasso, EOIR Technologies (USA) . . . . . [10408-10]

2:10 pm: **A study on the effect of anisotropy on a propagating beam**, Melissa Beason, Larry C. Andrews, Ronald L. Phillips, Townes Institute Science and Technology Experimentation Facility, Univ. of Central Florida (USA) . . . . . [10408-11]

2:30 pm: **Beam control of the ultra-short laser pulse in turbid medium**, Vladimir Markov, Anatoliy Khizhnyak, Advanced Systems & Technologies, Inc. (USA); Phillip Sprangle, Univ. of Maryland, College Park (USA) . . . . . [10408-12]

2:50 pm: **Analysis of the covariance function and aperture-averaged fluctuations of irradiance to calculate  $Cn^2$** , Galen Cauble, David T. Wayne, SPAWAR Systems Ctr. Pacific (USA) . . . . . [10408-13]

3:10 pm: **Optimization of wavefront-sensorless adaptive optics for horizontal laser beam propagation in a realistic turbulence environment**, Max Segel, Esdras Anzuola, Szymon Gladysz, Karin U. Stein, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) . . . . . [10408-14]

Coffee Break . . . . . Tue 3:30 pm to 4:00 pm

#### SESSION 4

LOCATION: CONV. CTR. ROOM 31B . . TUE 4:00 PM TO 5:20 PM

#### Airborne Satellite Applications

Session Chairs: **Jeremy P. Bos**, Michigan Technological Univ. (USA); **Jaime A. Anguita**, Univ. de los Andes (Chile)

4:00 pm: **Cloud free optical link probabilities to satellites from multiple ground stations**, Lindsey Willstatter, Taylor A. Page, Christopher I. Moore, Jake Griffiths, Linda M. Thomas, U.S. Naval Research Lab. (USA) . . . . . [10408-15]

4:20 pm: **Modeling of ground based laser propagation to low earth orbit object for maneuver**, Matthew M. Bold, Liam Smith, Lockheed Martin Space Systems Co. (USA) . . . . . [10408-16]

4:40 pm: **Atmospheric applications of intense ultrashort-pulse lasers**, Pavel Polynkin, College of Optical Sciences, The Univ. of Arizona (USA) . . . . . [10408-46]

5:00 pm: **Polarized photon transport through fog**, Brett H. Hokr, U.S. Army Space and Missile Defense Command (USA); Jonathan Farmer, Eikon Research, Inc. (USA); Christopher M. Persons, IERUS Technologies, Inc. (USA); Robert Desilva, James H. Kirkland, Eikon Research, Inc. (USA); Greg A Finney, IERUS Technologies, Inc. (USA); Kirk A. Fuller, The Univ. of Alabama in Huntsville (USA) . . . . . [10408-47]



# CONFERENCE 10408

WEDNESDAY 9 AUGUST

## SESSION 5

LOCATION: CONV. CTR. ROOM 31B . WED 8:20 AM TO 9:30 AM

### Orbital Angular Momentum

Session Chairs: **Jeremy P. Bos**, Michigan Technological Univ. (USA);  
**Chensheng Wu**, Univ. of Maryland, College Park (USA)

8:20 am: **Wavefront analysis of optical vortices propagating through terrestrial atmospheric turbulence** (*Invited Paper*), Jaime A. Anguita, Gustavo Funes, Univ. de los Andes (Chile). . . . . [10408-19]

8:50 am: **OAM of beam waves in random inhomogeneous medium**, Mikhail I. Charnotskii, Consultant (USA). . . . . [10408-20]

9:10 am: **Shack-Hartmann measurements of the transverse linear and orbital angular momenta after propagation through turbulence**, Mikhail I. Charnotskii, Consultant (USA); Terry J. Brennan, Prime Plexus, LLC (USA). . . . . [10408-21]

## SESSION 6

LOCATION: CONV. CTR. ROOM 31B WED 9:30 AM TO 10:30 AM

### Image Deblurring

Session Chairs: **Alexander M. J. van Eijk**, TNO Defence, Security and Safety (Netherlands); **John S. deGrassie**, SPAWAR Systems Ctr. Pacific (USA)

9:30 am: **Image blurring due to turbulent wakes for airborne systems: Flight tests**, Stanislav V. Gordeyev, Univ. of Notre Dame (USA); Yakov Diskin, Matthew R. Whiteley, MZA Associates Corp. (USA); Aaron Archibald, Air Force Institute of Technology (USA); Nicholas G. De Lucca, Eric J. Jumper, Univ. of Notre Dame (USA). . . . . [10408-22]

9:50 am: **Image blurring due to turbulent wakes for airborne systems: Simulation and modeling**, Yakov Diskin, David J. Goorskey, Matthew R. Whiteley, Richard Drye, MZA Associates Corp. (USA); Nicholas G. De Lucca, Stanislav V. Gordeyev, Univ. of Notre Dame (USA); Eric J. Jumper, MZA Associates Corp. (USA). . . . . [10408-23]

10:10 am: **Motion deblurring of simulated light-field images**, Shuo Wang, Jeremy P. Bos, Michigan Technological Univ. (USA). . . . . [10408-24]

Coffee Break . . . . . Wed 10:30 am to 11:00 am

## SESSION 7

LOCATION: CONV. CTR. ROOM 31B WED 11:00 AM TO 12:20 PM

### Atmospheric Characterization I

Session Chairs: **Stephen Hammel**, Space and Naval Warfare Systems Command (USA); **Mikhail I. Charnotskii**

11:00 am: **Atmospheric characterization on the Kennedy Space Center Shuttle Landing Facility**, Jonathan Ko, Univ. of Maryland, College Park (USA); Joseph T. Coffaro, Univ. of Central Florida (USA); Chensheng Wu, Christopher C. Davis, Univ. of Maryland, College Park (USA). . . . . [10408-25]

11:20 am: **A machine learning approach for predicting atmospheric aerosol size distributions**, Joshua J. Rudiger, Kevin Book, SPAWAR Systems Ctr. Pacific (USA); Brooke Baker, SPAWAR Systems Ctr. Atlantic (USA); John S. deGrassie, Stephen Hammel, SPAWAR Systems Ctr. Pacific (USA). . . . . [10408-26]

11:40 am: **Climatological assessment of maritime atmospheric profiles: model-based and LIDAR-based approaches**, Kevin M. McBryde, SPAWAR Systems Ctr. Pacific (USA). . . . . [10408-27]

12:00 pm: **Variability of refractive index structure parameter and aerosols in the marine atmospheric boundary layer**, Qing Wang, Naval Postgraduate School (USA); Denny P. Alappattu, Moss Landing Marine Labs. (USA); Benjamin J. Wauer, Ryan T. Yamguchi, Naval Postgraduate School (USA); John A. Kalogiros, National Observatory of Athens (Greece); Hafidi Jonsson, Naval Postgraduate School (USA). . . . . [10408-28]

Lunch/Exhibition Break . . . . . Wed 12:20 pm to 1:50 pm

## SESSION 8

LOCATION: CONV. CTR. ROOM 31B . . WED 1:50 PM TO 3:10 PM

### Atmospheric Characterization II

Session Chairs: **Alexander M. J. van Eijk**, TNO Defence, Security and Safety (Netherlands); **Chensheng Wu**, Univ. of Maryland, College Park (USA)

1:50 pm: **Determination of accurate vertical atmospheric profiles of extinction and turbulence**, Stephen Hammel, Eric Hallenborg, SPAWAR Systems Ctr. Pacific (USA); James R. Campbell, U.S. Naval Research Lab. (USA). . . . . [10408-29]

2:10 pm: **Investigation of the height dependency of optical turbulence in the surface layer over False Bay (South Africa)**, Detlev Sprung, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); Alexander M. J. van Eijk, TNO Defence, Security and Safety (Netherlands); Willem H. Gunter, Institute for Maritime Technology (South Africa); Derek J. Griffith, Council for Scientific and Industrial Research (South Africa); Christian Eisele, Erik Sucher, Karin U. Stein, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany). . . . . [10408-30]

2:30 pm: **In-situ and path-averaged measurements of aerosol optical properties over False Bay (South Africa)**, Sven A. van Binsbergen, TNO Defence, Security and Safety (Netherlands); Peter Grossmann, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); Faith J. February, Institute for Maritime Technology (South Africa); Leo H. Cohen, TNO Defence, Security and Safety (Netherlands); Alexander M. J. van Eijk, TNO Defence, Security and Safety (Netherlands) and Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); Karin U. Stein, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany). . . . . [10408-31]

2:50 pm: **Determination of the spectral behaviour of atmospheric soot using different particle models**, Krzysztof Skorupski, Wrocław Univ. of Science and Technology (Poland). . . . . [10408-32]

Coffee Break . . . . . Wed 3:10 pm to 3:40 pm

## SESSION 9

LOCATION: CONV. CTR. ROOM 31B . WED 3:40 PM TO 4:40 PM

### Horizontal Imaging and Beam Propagation

Session Chairs: **Jeremy P. Bos**, Michigan Technological Univ. (USA); **Alexander M. J. van Eijk**, TNO Defence, Security and Safety (Netherlands)

3:40 pm: **Saturation of anisoplanatic error in horizontal imaging scenarios**, Jeffrey R. Beck, Jeremy P. Bos, Michigan Technological Univ. (USA). . . [10408-33]

4:00 pm: **Hybrid wavefront sensing and image correction algorithm for imaging through turbulent media**, Chensheng Wu, John R. Rzasa, Jonathan Ko, Christopher C. Davis, Univ. of Maryland, College Park (USA). . . . . [10408-34]

4:20 pm: **Numerical simulation and analysis of aero-optical effect of the 3D side window**, Yi Liu, Ming Liu, Yuejin Zhao, Liqun Dong, Lingqin Kong, Mei Hui, Xiaohua Liu, Beijing Institute of Technology (China). . . . . [10408-35]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 . . . . . WED 5:30 PM TO 7:30 PM

### Posters-Wednesday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPPosterGuidelines>.

**Hemispherical optical dome for underwater communication**, Ron Shiri, Patrick L. Coronado, Emily L. Lunde, NASA Goddard Space Flight Ctr. (USA). . . [10408-4]

**Coherent optical communication detection device based on modified balanced optical phase-locked loop**, Bo Zhang, Jianfeng Sun, Guangyu Cai, Mengmeng Xu, Guangyuan Li, Guo Zhang, Hongyu He, Chenzhe Lao, Zhiyong Lu, Liren Liu, Shanghai Institute of Optics and Fine Mechanics (China) and Key Lab. of Space Laser Communication and Detection Technology, Univ. of Chinese Academy of Sciences (China). . . . . [10408-37]

**The integration of laser communication and ranging**, Mengmeng Xu, Jianfeng sun, Bo Zhang, Guangyu cai, Guo Zhang, Guangyuan Li, Shanghai Institute of Optics and Fine Mechanics (China). . . . . [10408-38]

**Radial partially coherent beams for free-space optical communications**, Minghao Wang, Xiuhua Yuan, Huazhong Univ. of Science and Technology (China). . . . . [10408-39]

- A variable rate communicate method for self-differential coherent DPSK**,  
Chenzhe Lao, Jianfeng Sun, Guangyu Cai, Guangyuan Li, Guo Zhang, Bo Zhang,  
Mengmeng Xu, Hongyu He, Shanghai Institute of Optics and Fine Mechanics  
(China) ..... [10408-40]
- Optical axis stability system based on acousto-optic deflector**, Peipei Hou,  
Jianfeng Sun, Yu Zhou, Qian Xu, Wei Lu, Zhiyong Lu, Zhu Luan, Lijuan Wang, Liren  
Liu, Shanghai Institute of Optics and Fine Mechanics (China) ..... [10408-41]
- Fine track system of space coherent optical communication without position  
detector**, Hongyu He, Jianfeng Sun, Liren Liu, Shanghai Institute of Optics and  
Fine Mechanics (China) ..... [10408-42]
- Condition for keeping polarization invariance on propagation in space-to-  
ground optical communication downlink**, Jiajie Wu, Jing Ma, Liying Tan, Siyuan  
Yu, Harbin Institute of Technology (China) ..... [10408-43]
- Multiple wavelength spectral system simulating background light noise  
environment in satellite laser communications**, Wei Lu, Jianfeng Sun, Peipei  
Hou, Qian Xu, Yueli Xi, Yu Zhou, Funan Zhu, Liren Liu, Shanghai Institute of Optics  
and Fine Mechanics (China) ..... [10408-44]
- A survey of POAM in starlight**, Stephen Grulke, Jeremy P. Bos, Michigan  
Technological Univ. (USA) ..... [10408-45]

# CONFERENCE 10409

LOCATION: CONV. CTR. ROOM 31B

Sunday–Monday 6–7 August 2017 • Proceedings of SPIE Vol. 10409

## Quantum Communications and Quantum Imaging XV

*Conference Chairs:* **Ronald E. Meyers**, U.S. Army Research Lab. (USA); **Yanhua Shih**, Univ. of Maryland, Baltimore County (USA); **Keith S. Deacon**, U.S. Army Research Lab. (USA)

*Program Committee:* **Stefania A. Castelletto**, RMIT Univ. (Australia); **Milena D'Angelo**, Univ. degli Studi di Bari (Italy); **Warren P. Grice**, Oak Ridge National Lab. (USA); **Mark T. Gruneisen**, Air Force Research Lab. (USA); **Richard J. Hughes**, Los Alamos National Lab. (USA); **Yoon-Ho Kim**, Pohang Univ. of Science and Technology (Korea, Republic of); **Todd B. Pittman**, Univ. of Maryland, Baltimore County (USA); **Barry C. Sanders**, Univ. of Calgary (Canada); **Alexander V. Sergienko**, Boston Univ. (USA); **Dmitry V. Strekalov**, Jet Propulsion Lab. (USA); **Shigeki Takeuchi**, Hokkaido Univ. (Japan); **Xiao Tang**, National Institute of Standards and Technology (USA); **Arnold Tunick**, U.S. Army Research Lab. (USA)

### SUNDAY 6 AUGUST

#### SESSION 1

LOCATION: CONV. CTR. ROOM 31B .SUN 8:00 AM TO 10:00 AM

#### Quantum Entanglement and Interference

Session Chair: **Ronald E. Meyers**, U.S. Army Research Lab. (USA)

8:00 am: **Applications of photon-number-resolving measurements for quantum interferometry and quantum state tomography** (*Invited Paper*), Olivier Pfister, Aye Win, Rajveer Nehra, Univ. of Virginia (USA); Sae-Woo Nam, Thomas Gerrits, National Institute of Standards and Technology (USA) . . . . . [10409-1]

8:25 am: **Coincidence rates and permutation symmetry** (*Invited Paper*), Hubert de Guise, Lakehead Univ. (Canada); Barry C. Sanders, Univ. of Calgary (Canada) and Canadian Institute for Advanced Research (Canada) . . . . . [10409-2]

8:50 am: **Photon number statistics of entanglement generated by multiple single photon sources** (*Invited Paper*), Junyi Wu, Holger F. Hofmann, Hiroshima Univ. (Japan) . . . . . [10409-3]

9:15 am: **Entanglement detection with single Hong-Ou-Mandel interferometry** (*Invited Paper*), Joonwoo Bae, Hanyang Univ. (Korea, Republic of); Leong-Chuan Kwek, Nanyang Technological Univ. (Singapore); Simone Felicetti, Lab. Matériaux et Phénomènes Quantiques (France); Chang Jian Kwong, Univ. of Darmstadt (Germany) . . . . . [10409-4]

9:40 am: **Erasing the orbital angular momentum information of a photon**, Isaac M. Nape, Bienvenu I. Ndagano, Melanie McLaren, Andrew Forbes, Univ. of the Witwatersrand (South Africa) . . . . . [10409-5]

Coffee Break . . . . . Sun 10:00 am to 10:30 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 31B SUN 10:30 AM TO 12:20 PM

#### Quantum Communications, Internet I

Session Chair: **Keith S. Deacon**, U.S. Army Research Lab. (USA)

10:30 am: **Optical hybrid quantum teleportation and its applications** (*Invited Paper*), Shuntaro Takeda, Masanori Okada, Akira Furusawa, The Univ. of Tokyo (Japan) . . . . . [10409-6]

10:55 am: **Quantum interference in topological photonic circuits**, Jean-Luc Tambasco, RMIT Univ. (Australia); Giacomo Corrielli, Politecnico di Milano (Italy); Robert Chapman, RMIT Univ. (Australia); Andrea Crespi, Politecnico di Milano (Italy); Oded Zilberberg, ETH Zürich (Switzerland); Roberto Osellame, CNR-Istituto di Fotonica e Nanotecnologie (Italy); Alberto Peruzzo, RMIT Univ. (Australia) . . . . . [10409-7]

11:15 am: **Towards the strong-coupling regime with a trapped ion coupled to a fiber cavity** (*Invited Paper*), Klemens Schüppert, Florian R. Ong, Pierre Jobez, Florian Kranz, Konstantin Friebe, Dario A. Fioretto, Moonjoo Lee, Markus Teller, Univ. Innsbruck (Austria); Konstantin T. Ott, Jakob Reichel, Lab. Kastler Brossel (France); Rainer Blatt, Univ. Innsbruck (Austria) and Institut für Quantenoptik und Quanteninformation (Austria); Tracy E. Northup, Univ. Innsbruck (Austria) [10409-8]

11:40 am: **PPLN-waveguide-based polarization entangled QKD simulator**, John Gariano, Ivan B. Djordjevic, The Univ. of Arizona (USA) . . . . . [10409-9]

12:00 pm: **Hamiltonian dynamics for entanglement distribution in quantum networks**, Laszlo Gyongyosi, Budapest Univ. of Technology and Economics (Hungary) and Hungarian Academy of Sciences (Hungary); Sandor Imre, Budapest Univ. of Technology and Economics (Hungary) . . . . . [10409-10]

Lunch Break . . . . . Sun 12:20 pm to 1:30 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 31B . . . SUN 1:30 PM TO 5:35 PM

#### Quantum Communications, Internet II

Session Chair: **Yanhua Shih**, Univ. of Maryland, Baltimore County (USA)

1:30 pm: **Discrimination of coherent-state phase-shift-keys with quantum non-demolition sequential measurements** (*Invited Paper*), Si-Hui Tan, Singapore Univ. of Technology & Design (Singapore) . . . . . [10409-11]

1:55 pm: **Quantum communication with spectrally correlated photons**, Piotr L. Kolenderski, Mikolaj Lasota, Karolina Sedziak, Nicolaus Copernicus Univ. (Poland) . . . . . [10409-12]

2:15 pm: **Approaches to a global quantum key distribution network** (*Invited Paper*), Md Tanvirul Islam, Robert Bedington, National Univ. of Singapore (Singapore); Doug K. Griffin, Russell Boyce, UNSW Canberra (Australia); Christian Kurtsiefer, National Univ. of Singapore (Singapore); Alexander Ling, Ctr. for Quantum Technologies (Singapore) . . . . . [10409-13]

2:40 pm: **On photonic spectral entanglement improving quantum communication**, Piotr L. Kolenderski, Karolina Sedziak, Mikolaj Lasota, Nicolaus Copernicus Univ. (Poland) . . . . . [10409-14]

Coffee Break . . . . . Sun 3:00 pm to 3:30 pm

3:30 pm: **The design of a continuous variable quantum repeater** (*Invited Paper*), William J. Munro, Fabian Furrer, NTT Basic Research Labs. (Japan); Kae Nemoto, National Institute of Informatics (Japan) . . . . . [10409-15]

3:55 pm: **The rise of silicon carbide as a promising integrated quantum nanophotonics platform** (*Invited Paper*), Stefania Castelletto, RMIT Univ. (Australia); Alexander Lohrmann, The Univ. of Melbourne (Australia); Takeshi Ohshima, National Institutes for Quantum and Radiological Science and Technology (Japan); Jeffrey C. McCallum, Brett C. Johnson, The Univ. of Melbourne (Australia) . . . . . [10409-16]

4:20 pm: **Experimental investigation of security parameters of Y-00 quantum stream cipher transceiver with randomization technique: Part I** (*Invited Paper*), Fumio Futami, Kentaro Kato, Osamu Hirota, Tamagawa Univ. (Japan) . . [10409-17]

4:45 pm: **Permutation modulation for quantization and information reconciliation in CV-QKD systems** (*Invited Paper*), Fred Daneshgaran, California State Univ., Los Angeles (USA); Marina Mondin, California State Univ., Los Angeles (USA) and Politecnico di Torino (Italy); Khashayar Olia, California State Univ., Los Angeles (USA) . . . . . [10409-18]

5:10 pm: **A unified analysis of optical signal modulation formats for quantum enigma cipher** (*Invited Paper*), Kentaro Kato, Tamagawa Univ. (Japan) . [10409-19]



**LOCATION: CONV. CTR. ROOM 6A . . SUN 6:00 PM TO 7:50 PM**

## **Technology Hot Topics: How Optics and Photonics Drive Innovation**

- 6:00 pm to 6:10 pm: **Welcome and Opening Remarks**
- 6:10 pm to 6:30 pm: **Quantum devices**, Cesare Soci, Nanyang Technological Univ. (Singapore)
- 6:30 pm to 6:50 pm: **Wearables/implantables: graphene electronic tattoo sensors**, Nanshu Lu, Univ. of Texas at Austin (USA)
- 6:50 pm to 7:10 pm: **AR/VR**, Scott McEldowney, Oculus (USA)
- 7:10 pm to 7:30 pm: **Solar fuels**, Tanja Cuk, Univ. of California, Berkeley (USA)
- 7:30 pm to 7:50 pm: **Autonomous vehicles**, James G. Watzin, Director of NASA's Mars Exploration Program (USA)

## **MONDAY 7 AUGUST**

### **SESSION 4**

**LOCATION: CONV. CTR. ROOM 31B MON 8:00 AM TO 10:25 AM**

## **Quantum Imaging**

Session Chair: **Ronald E. Meyers**, U.S. Army Research Lab. (USA)

- 8:00 am: **The first sub shot noise wide field microscope** (*Invited Paper*), Marco Genovese, Istituto Nazionale di Ricerca Metrologica (Italy) . . . . . [10409-20]
- 8:25 am: **Cancelling out aberrations through high order correlations** (*Invited Paper*), Juarez G. Silva, Eduardo J. S. Fonseca, Alcenisio J. de Jesus Silva, Univ. Federal de Alagoas (Brazil) . . . . . [10409-21]
- 8:50 am: **Squeezed light enhanced sensing of a micro-mechanical oscillator** (*Invited Paper*), Ulrik Lund Andersen, Technical Univ. of Denmark (Denmark) . . . . . [10409-22]
- 9:15 am: **Future outlook for diamond-based quantum information devices** (*Invited Paper*), Philip R. Hemmer, Texas A&M Univ. (USA) . . . . . [10409-23]
- 9:40 am: **Verification of quantum entanglement of two-mode squeezed light source towards quantum radar and imaging**, Genta Masada, Tamagawa Univ. (Japan) . . . . . [10409-24]
- 10:00 am: **Superresolution via structured illumination quantum correlation microscopy** (*Invited Paper*), Girish Agarwal, Texas A&M Univ. (USA) . . . [10409-25]
- Coffee Break . . . . . Mon 10:25 am to 10:55 am

### **SESSION 5**

**LOCATION: CONV. CTR. ROOM 31B MON 10:55 AM TO 12:35 PM**

## **Quantum Mechanics, Physics**

Session Chair: **Keith S. Deacon**, U.S. Army Research Lab. (USA)

- 10:55 am: **Quantum walks with twisted classical light** (*Invited Paper*), Berenice Sephton, Council for Scientific and Industrial Research (South Africa) and Univ. of the Witwatersrand (South Africa); Angela Dudley, CSIR National Laser Ctr. (South Africa); Andrew Forbes, Univ. of the Witwatersrand (South Africa) . . . . . [10409-26]
- 11:20 am: **Sum uncertainty relations for compact classical Lie algebra** (*Invited Paper*), Namrata Shukla, Institute for Quantum Science and Technology (Canada); Lorenzo Maccone, Univ. degli Studi di Pavia (Italy); Hubert de Guise, Lakehead Univ. (Canada); Barry C. Sanders, Univ. of Calgary (Canada) . . . . . [10409-27]
- 11:45 am: **Optical trapping and control of levitated nanoparticles** (*Invited Paper*), David Grass, Uros Delic, Nikolai Kiesel, Univ. Wien (Austria); Daniel R. Ladiges, John E. Sader, The Univ. of Melbourne (Australia); Markus Aspelmeyer, Univ. Wien (Austria) . . . . . [10409-28]
- 12:10 pm: **A repository for quantum measurement trajectories** (*Invited Paper*), Durga B. Rao Dasari, Univ. Stuttgart (Germany); Sen Yang, The Chinese Univ. of Hong Kong (China); Jörg Wrachtrup, Univ. Stuttgart (Germany) . . . . . [10409-29]

# CONFERENCE 10410

LOCATION: CONV. CTR. ROOM 31A

Wednesday–Thursday 9–10 August 2017 • Proceedings of SPIE Vol. 10410

## Unconventional and Indirect Imaging, Image Reconstruction, and Wavefront Sensing 2017

Conference Chairs: **Jean J. Dolne**, The Boeing Co. (USA); **Rick P. Millane**, Univ. of Canterbury (New Zealand)

Program Committee: **Mark A. Anastasio**, Washington Univ. in St. Louis (USA); **Philip J. Bones**, Univ. of Canterbury (New Zealand); **Stephen C. Cain**, Air Force Institute of Technology (USA); **Joe Chen**, Arizona State Univ. (USA); **Richard Clare**, Univ. of Canterbury (New Zealand); **David C. Dayton**, Applied Technology Associates (USA); **Peter C. Doerschuk**, Cornell Univ. (USA); **Veit Elser**, Cornell Univ. (USA); **James Fienup**, Univ. of Rochester (USA); **Victor L. Gamiz**, Air Force Research Lab. (USA); **Richard B. Holmes**, Boeing LTS Inc. (USA); **Kenneth J. Jerkatis**, Applied Technology Associates (USA); **Thomas J. Karr**, Defense Advanced Research Projects Agency (USA); **Andrew J. Lambert**, UNSW Canberra (Australia); **Liren Liu**, Shanghai Institute of Optics and Fine Mechanics (China); **Julian Maclaren**, Stanford Univ. (USA); **Sergio R. Restaino**, U.S. Naval Research Lab. (USA); **Mark F. Spencer**, Air Force Research Lab. (USA); **Markus E. Testorf**, Dartmouth College (USA); **David G. Voelz**, New Mexico State Univ. (USA); **Kevin J. Webb**, Purdue Univ. (USA); **David Wojtas**, Univ. of Canterbury (New Zealand); **Jong Chul Ye**, KAIST (Korea, Republic of); **Chun Hong Yoon**, SLAC Stanford Univ. (USA)

### WEDNESDAY 9 AUGUST

LOCATION: CONV. CTR. ROOM 31A . . . . . 8:20 AM TO 8:30 AM

#### Opening Remarks

Jean J. Dolne, The Boeing Co. (USA) and Rick P. Millane, Univ. of Canterbury (New Zealand)

#### SESSION 1

LOCATION: CONV. CTR. ROOM 31A WED 8:30 AM TO 10:30 AM

#### Wavefront Sensing and Compensation

Session Chair: **David C. Dayton**, Applied Technology Associates (USA)

8:30 am: **Impact of beacon anisochromatism on phase-compensation performance**, Colleen T. Gross, Air Force Institute of Technology (USA); Mark F. Spencer, Air Force Research Lab. (USA) . . . . . [10410-1]

8:50 am: **Adaptive optics using a MEMS deformable mirror for a segmented mirror telescope**, Norihide Miyamura, Meisei Univ. (Japan) . . . . . [10410-2]

9:10 am: **Deep turbulence wavefront sensing using digital holographic detection in the phase-shifting recording geometry**, Douglas E. Thornton, Air Force Institute of Technology (USA); Mark F. Spencer, Air Force Research Lab. (USA); Glen P. Perram, Air Force Institute of Technology (USA) . . . . . [10410-3]

9:30 am: **Shack-Hartmann electronic densitometer (SHED)**, Anthony R. Valenzuela, U.S. Army Research Lab. (USA); Aaron Schweinsberg, Oak Ridge Institute for Science & Education (USA) . . . . . [10410-4]

9:50 am: **Simultaneous measurements of density field and wavefront distortions in high speed flows**, Jacob George, Thomas P. Jenkins, James D. Trolinger, MetroLaser, Inc. (USA); Benjamin D. Buckner, Spectabit Optics, LLC (USA); Cecil F Hess, MetroLaser (USA) . . . . . [10410-5]

10:10 am: **Horizontal atmospheric turbulence, beam propagation, and simulation using collected data and predictive techniques**, Christopher C. Wilcox, Freddie Santiago, Ty Martinez, K. Peter Judd, Sergio R. Restaino, U.S. Naval Research Lab. (USA) . . . . . [10410-49]

Coffee Break . . . . . Wed 10:30 am to 11:00 am

#### SESSION 2

LOCATION: CONV. CTR. ROOM 31A WED 11:00 AM TO 12:10 PM

#### Synthetic Aperture, Super Resolution, Holographic and Compressive Imaging, and Tracking I

Session Chair: **Rick P. Millane**, Univ. of Canterbury (New Zealand)

11:00 am: **Using optical interferometry for GEO satellites imaging: An update (Invited Paper)**, Sergio R. Restaino, J. Thomas Armstrong, Elynn K. Baines, Henrique R. Schmitt, James H. Clark III, U.S. Naval Research Lab. (USA) . . . . . [10410-6]

11:30 am: **Improving spatial resolution of the light field microscope with Fourier ptychography**, Yoshitake Tani, Tomohiro Suzuki, Kenjiro Takai Miura, Shizuoka Univ. (Japan) . . . . . [10410-7]

11:50 am: **System compression theory and application**, Xiteng Liu, QualVisual Technology (Canada) . . . . . [10410-8]

Lunch/Exhibition Break . . . . . Wed 12:10 pm to 1:30 pm

#### SESSION 3

LOCATION: CONV. CTR. ROOM 31A .. WED 1:30 PM TO 3:20 PM

#### Synthetic Aperture, Super Resolution, Holographic and Compressive Imaging, and Tracking II

Session Chair: **Rick P. Millane**, Univ. of Canterbury (New Zealand)

1:30 pm: **Synthetic-aperture direct-detection coherent imaging (Invited Paper)**, James R. Fienup, Univ. of Rochester (USA) . . . . . [10410-9]

2:00 pm: **Method and algorithm for efficient calibration of compressive hyperspectral imaging system based on a liquid crystal retarder**, Liat Revah, Yaniv Oiknine, Isaac Y. August, Adrian Stern, Ben-Gurion Univ. of the Negev (Israel) . . . . . [10410-10]

2:20 pm: **Drift in correlation tracking algorithms**, David C. Dayton, Applied Technology Associates (USA) . . . . . [10410-11]

2:40 pm: **Efficiency measurements for a digital-holography imaging system**, Matthias T. Banet, MZA Associates Corp. (USA); Mark F. Spencer, Air Force Research Lab. (USA) and Air Force Institute of Technology (USA) . . . . . [10410-12]

3:00 pm: **Local sharpening and subspace wavefront correction with predictive dynamic digital holography**, Sennan Sulaiman, Steve Gibson, Univ. of California, Los Angeles (USA) . . . . . [10410-50]

Coffee Break . . . . . Wed 3:20 pm to 3:50 pm

## SESSION 4

LOCATION: CONV. CTR. ROOM 31A . . WED 3:50 PM TO 5:10 PM

### 3D Image Reconstruction

Session Chair: **James R. Fienup**, Univ. of Rochester (USA)

3:50 pm: **Use of (N-1)-D expansions for N-D phase unwrapping in MRI**, Philip J. Bones, Laura J. King, Rick P. Millane, Univ. of Canterbury (New Zealand)[10410-13]

4:10 pm: **High resolution depth reconstruction from monocular images and sparse point clouds using deep convolutional neural network**, Martin Dimitrievski, Peter Veelaert, Wilfried Philips, Univ. Gent (Belgium) . . . . . [10410-14]

4:30 pm: **Improving 3D registration by up-sampling of sparse point cloud through fusion with high-resolution 2D image**, Hyukseong Kwon, Kyungnam Kim, HRL Labs., LLC (USA); Jean J. Dolne, Boeing Co. (USA) . . . . . [10410-16]

4:50 pm: **Rapid 3D registration using local subtree caching in iterative closest point (ICP) algorithm**, Ryan Uhlenbrock, Kyungnam Kim, Heiko Hoffmann, HRL Labs., LLC (USA); Jean J. Dolne, Boeing Co. (USA) . . . . . [10410-17]

LOCATION: CONV. CTR.

EXHIBIT HALL B2 . . . . . WED 5:30 PM TO 7:30 PM

### Posters-Wednesday

Conference attendees are invited to view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions. Poster authors, view poster presentation guidelines at <http://spie.org/OPPosterGuidelines>.

**An edge sensitive 3D measurement using two directional laser stripe scanning with a MEMS scanner**, Dong Li, Xiang Zhou, Chang da Xu, Chao Wang, Jia yu Guo, Rui Jin, Xi'an Jiaotong Univ. (China) . . . . . [10410-18]

**Three dimensional interferometric synthetic aperture ladar based on Pseudo-random Code**, Guangyuan Li, Zhiyong Lu, Jianfeng Sun, Yu Zhou, Guo Zhang, Bo Zhang, Mengmeng Xu, Chenzhe Lao, Hongyu He, Liren Liu, Shanghai Institute of Optics and Fine Mechanics (China) . . . . . [10410-36]

**Imaging processing with bidirectional modulation in down-looking synthetic aperture imaging ladar**, Zhiyong Lu, Yu Zhou, Jianfeng Sun, Zhu Luan, Lijuan Wang, Qian Xu, Liren Liu, Shanghai Institute of Optics and Fine Mechanics (China) . . . . . [10410-37]

**Influence of polarization features of target reflection on synthetic aperture imaging ladar**, Qian Xu, Zhiyong Lu, Jianfeng Sun, Lijuan Wang, Peipei Hou, Wei Lu, Liren Liu, Shanghai Institute of Optics and Fine Mechanics (China) . . [10410-38]

**A three dimensional point cloud registration method based on rotation matrix eigenvalue**, Chao Wang, Xiang Zhou, Xi'an Jiaotong Univ. (China); Zixuan Fei, Xiaofei gao, Rui Jin, Xi'an Jiaotong Univ. (China) . . . . . [10410-39]

**A multi-resolution texture fusion algorithm**, Yuqin Li, Xiang Zhou, Xi'an Jiaotong Univ. (China); Jia yu Guo, Tao Yang, Zixuan Fei, Xi'an Jiaotong Univ. (China) . . . . . [10410-40]

**A novel 360-degree shape measurement using a simple setup with two mirrors and a laser MEMS scanner**, Rui Jin, Xi'an Jiaotong Univ. (China); Xiang Zhou, Xi'an Jiaotong Univ. (China); Tao Yang, Dong Li, Xi'an Jiaotong Univ. (China); Chao Wang, Xi'an Jiaotong Univ. (China) . . . . . [10410-41]

**Enhancement of incoherent imaging through turbulence by using multi-aperture receivers**, Vadim V. Dudorov, Anna S. Eremina, V.E. Zuev Institute of Atmospheric Optics (Russian Federation) . . . . . [10410-42]

**Super-resolution imaging with one complex filter based on compressive sensing**, Yicheng Sun, Nanjing Univ. of Science and Technology (China) and NRIIE (China); Guohua Gu, Xiubao Sui, Nanjing Univ. of Science and Technology (China); Yuqi Li, NRIIE (China) . . . . . [10410-43]

**Optical method of separating of isotropic and anisotropic parts of polymer-dispersed liquid crystals images**, Andriy L. Nehrych, Peter P. Maksimyak, Yuriy Fedkovych Chernivtsi National Univ. (Ukraine) . . . . . [10410-44]

**Adaptive compressed photon counting 3D imaging based on wavelet trees and Hadamard multiplexing**, Huidong Dai, Guohua Gu, Nanjing Univ. of Science and Technology (China); Weiji He, Nanjing Univ. of Science and Technology (China) and Key Lab. of Intelligent Perception and Systems for High-Dimensional Information (China); Ling Ye, Nanjing Univ. of Information Science & Technology (China); Tianyi Mao, Qian Chen, Nanjing Univ. of Science and Technology (China) . . . . . [10410-45]

**Using virtual reality to test the regularity priors used by the human visual system**, Eric Palmer, Purdue Univ. (USA); TaeKyu Kwon, The Ohio State Univ. (USA); Zygumnt Pizlo, Purdue Univ. (USA) . . . . . [10410-46]

**Ghost imaging using shifted speckles and bucket detection**, Tianyi Mao, Qian Chen, Weiji He, Guohua Gu, Nanjing Univ. of Science and Technology (China) . . . . . [10410-47]

**Shape from shading using a linear filtering approach**, Oscar E. Castillo, Jorge Luis Flores Nuñez, Univ. de Guadalajara (Mexico) . . . . . [10410-48]

## THURSDAY 10 AUGUST

### SESSION 5

LOCATION: CONV. CTR. ROOM 31A . THU 8:10 AM TO 10:00 AM

### Adaptive Optical System, Phase Retrieval, Ghost and Shadow Imaging

Session Chair: **Jean J. Dolne**, The Boeing Co. (USA)

8:10 am: **Phase retrieval in the presence of multiplicative noise (Invited Paper)**, Joe P. J. Chen, Richard A. Kirian, Arizona State Univ. (USA) . . . . . [10410-19]

8:40 am: **Fast adaptive optical system for the high-laser power laser beam correction in the atmosphere**, Alexis V. Kudryashov, Institute of Geosphere Dynamics (Russian Federation) and Institute of Atmospheric Optics (Russian Federation); Ann Lylova, Vadim Samarkin, Julia V. Sheldakova, Alexey Rukosuev, Institute of Geosphere Dynamics (Russian Federation) . . . . . [10410-20]

9:00 am: **Laser beam focusing through the atmosphere aerosol**, Alexis V. Kudryashov, Institute of Geosphere Dynamics (Russian Federation) and Institute of Atmospheric Optics (Russian Federation); Ilya Galaktionov, Julia V. Sheldakova, Vadim Samarkin, Alexander N. Nikitin, Institute of Geosphere Dynamics (Russian Federation) . . . . . [10410-21]

9:20 am: **Phase retrieval for crystalline specimens**, Romain Arnal, Rick P. Millane, Univ. of Canterbury (New Zealand) . . . . . [10410-22]

9:40 am: **Advances in shadow imaging of geosynchronous satellites**, Dennis M. Douglas, Bobby R. Hunt, David Sheppard, Integrity Applications, Inc. (USA) . . . . . [10410-24]

Coffee Break . . . . . Thu 10:00 am to 10:30 am

### SESSION 6

LOCATION: CONV. CTR. ROOM 31A THU 10:30 AM TO 12:00 PM

### Structured Illumination, Speckle, and Underwater Imaging

Session Chair: **Thomas J. Karr**, Defense Advanced Research Projects Agency (USA)

10:30 am: **Opportunities for sub-wavelength imaging based on motion in structured illumination (Invited Paper)**, Kevin J. Webb, Qiaoen Luo, Vivek RAGhuram, Yulu Chen, Purdue Univ. (USA) . . . . . [10410-25]

11:00 am: **Long-range speckle imaging theory, simulation, and brassboard results**, Jim F. Riker, the Optical Sciences Co. (USA); Glenn A. Tyler, Jeffrey L. Vaughn, the Optical Sciences Co. (USA) . . . . . [10410-26]

11:20 am: **An underwater turbulence degraded image restoration algorithm**, Md Hasan Furhad, Murat Tahtali, Andrew J. Lambert, UNSW Canberra (Australia) . . . . . [10410-27]

11:40 am: **Object detection from images obtained through underwater turbulence medium**, Md Hasan Furhad, Murat Tahtali, Andrew J. Lambert, UNSW Canberra (Australia) . . . . . [10410-28]

LOCATION: CONV. CTR. ROOM 31A . . . . 12:00 PM TO 12:10 PM

### Discussion on the Next Conference

**Jean J. Dolne**, The Boeing Co. (USA) and **Rick P. Millane**, Univ. of Canterbury (New Zealand)

Lunch/Exhibition Break . . . . . Thu 12:10 pm to 1:30 pm



# CONFERENCE 10410

## SESSION 7

LOCATION: CONV. CTR. ROOM 31A . . . THU 1:30 PM TO 3:50 PM

### Image Simulation and Performance Improvement Techniques: Hardware and Software

Session Chair: **Philip J. Bones**, Univ. of Canterbury (New Zealand)

1:30 pm: **GPU-enhanced computational platform for performance evaluation of atmospheric optical systems**, Svetlana L. Lachinova, Mathieu Aubailly, Morris Maynard, Optonicus (USA); Mikhail A. Vorontsov, Optonicus (USA) and Univ. of Dayton (USA); Mark F. Spencer, Air Force Research Lab. (USA) . . . . . [10410-29]

1:50 pm: **ANN-based model to compensate for the error phase in the 3D reconstruction of small objects**, Carlos Andrés Madrigal González, Instituto Tecnológico Metropolitano (Colombia); Alejandro Restrepo Martínez, John W. Branch Bedoya, Univ. Nacional de Colombia Sede Medellín (Colombia). [10410-30]

2:10 pm: **Simulation of the effects that lead to the degradation of the images obtained using a ground based telescope**, Youness Bentahar, Univ. Hassan II Mohammedia - Casablanca (Morocco). . . . . [10410-31]

2:30 pm: **Unconventional imaging with contained granular media**, Marco B. Quadrelli, Jet Propulsion Lab., California Institute of Technology (USA); Erkin Sidick, Jet Propulsion Lab., California Institute of Technology (USA) . . . . . [10410-32]

2:50 pm: **Modeling coherence propagation in a homogenizing light pipe for speckle mitigation**, Robert Raynor, Mark F. Spencer, Trevor Moore, Air Force Research Lab. (USA). . . . . [10410-33]

3:10 pm: **Incoherent image simulation through atmospheric turbulence with ray optics**, Xifeng Xiao, Erandi Wijerathna, Thomas A. Underwood, David G. Voelz, New Mexico State Univ. (USA); Andreas Muschinski, NorthWest Research Associates (USA). . . . . [10410-34]

3:30 pm: **Crosswind measurements based on the turbulent distortions analysis in incoherent images**, Vadim V. Dudorov, Anna S. Eremina, V.E. Zuev Institute of Atmospheric Optics (Russian Federation). . . . . [10410-35]

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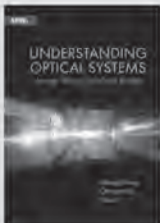
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# GENERAL INFORMATION

## REGISTRATION

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### Onsite Registration and Badge Pick-up Hours

Marriott Marquis, Marina Foyer (Level 3)

#### STUDENT REGISTRATION

Saturday 5 August · 7:30 am to 10:00 am

#### GENERAL CONFERENCE REGISTRATION

Saturday 5 August · 10:00 am to 5:00 pm

#### CONFERENCE AND EXHIBITION REGISTRATION

Conv. Ctr., Hall A/B

Sunday 6 August · 7:00 am to 5:00 pm

Monday 7 August · 7:30 am to 5:00 pm

Tuesday 8 August · 7:30 am to 5:00 pm

Wednesday 9 August · 7:30 am to 5:00 pm

Thursday 10 August · 7:45 am to 4:00 pm

### Conference Registration

Includes admission to all conference sessions, plenaries, panels, and poster sessions, admission to the Exhibition, Welcome Reception, coffee breaks, and a choice of online proceedings.

### Course and Workshop Registration

Courses and workshops are priced separately. Course-only registration includes your selected course(s), course notes, coffee breaks, and admittance to the exhibition. Course prices include applicable taxes. Onsite, please go to Course Materials Desk after you pick up your badge.

Multiple facilities may be used for courses; allow yourself enough time to register, pick up your materials, and possibly walk to a nearby facility before your course begins.

### Exhibition Registration

Exhibition-Only visitor registration is complimentary.

#### SPIE MEMBER, SPIE STUDENT MEMBER, AND STUDENT PRICING

- SPIE Members receive conference and course registration discounts. Discounts are applied at the time of registration.
- SPIE Student Members receive a 60% discount on all courses.
- Student registration rates are available only to undergraduate and graduate students who are enrolled full time and have not yet received their Ph.D. Post-docs may not register as students. A student ID number or proof of student status is required with your registration.

### Press Registration

For credentialed press and media representatives only. Please email contact information, title, and organization to [media@spie.org](mailto:media@spie.org).

### SPIE Cashier

Registration Area, Open during registration hours

#### REGISTRATION PAYMENTS

If you are paying by cash or check as part of your onsite registration, wish to add a course, workshop, or special event requiring payment, or have questions regarding your registration, visit the SPIE Cashier.

#### RECEIPT AND CERTIFICATE OF ATTENDANCE

Preregistered attendees who did not receive a receipt or attendees who need a Certificate of Attendance may obtain those at Badge Corrections and Receipts.

#### BADGE CORRECTIONS

Badge corrections can be made at the Badge Corrections station. Please have your badge removed from the badge holder and marked with your changes before approaching the counter.

#### REFUND INFORMATION

There is a US\$50 service charge for processing refunds. Requests for refunds must be received by 27 July 2017; all registration fees will be forfeited after this date. Membership dues, SPIE Digital Library subscriptions, or Special Events purchased are not refundable.

#### U.S. GOVERNMENT CREDIT CARDS

U.S. Government credit card users: have your purchasing officer contact the credit card company and get prior authorization before attempting to register. Advise your purchasing agent that SPIE is considered a 5968 company for authorization purposes.



## AUTHOR / PRESENTER INFORMATION

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### Speaker Check-In and Preview Station

Conv. Ctr., Room 11B (Upper Lobby)

Sunday through Thursday · 7:00 am to 5:00 pm

All presenters must stop by Speaker Check-In to upload their file(s) at least four hours before their scheduled talk. Authors are not able to present using their own devices. All conference rooms have a laptop, projector, screen, lapel microphone, and laser pointer.

### Poster Setup Instructions

Monday 7 August

Setup: 10:00 am to 4:30 pm, Session: 5:30 pm to 7:30 pm

Wednesday 9 August

Setup: 10:00 am to 4:30 pm, Session: 5:30 pm to 7:30 pm

Poster presenters must set up their posters between 10:00 am and 4:30 pm on the day of their assigned presentation.

- Paper numbers will be posted on the poster boards in numerical order; please find your paper number and post your poster in the designated space.
- A poster author or coauthor is required to stand by the poster during the scheduled poster session to answer questions from attendees.
- Presenters who have not placed their papers on their assigned board by 4:30 pm on the day of their presentation will be considered a “no show” and their manuscript will not be published.
- Presenters must remove their posters immediately after the poster session. Posters not removed will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of each poster session.

## ONSITE SERVICES

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### Internet Access

Complimentary wireless access is available; instructions will be posted onsite.

### SPIE Conference and Exhibition App

Search and browse the program, special events, participants, exhibitors, courses, and more. Free Conference App available for iPhone and Android phones.

### SPIE Bookstore

Stop by the SPIE Bookstore to browse the latest SPIE Press Books, proceedings, and educational materials. While there, get a t-shirt or educational toy to bring home to the family.

### SPIE Education Services

Browse course offerings or learn more about SPIE courses available in portable formats such as Online and customized, In-company courses.

### SPIE Press Room

Conv. Ctr. Hall A/B, Registration Area

Open during Registration hours

For Registered Press only. The Press Room provides meeting space, refreshments, access to exhibitor press releases, and Internet connections. Press are urged to register before the meeting by emailing name, contact information, and name of publication to [media@spie.org](mailto:media@spie.org). Preregistration closes approximately 10 days before the start of the event.

### SPIE Luggage & Coat Check

Conv. Ctr. Hall B Lobby (Ground Level)

Sunday through Wednesday · 7:30 am to 6:00 pm

Thursday · 8:00 am to 6:00 pm

Complimentary luggage, package, and coat storage are available. Please note hours; no late pickup available.

### Business Center

Conv. Ctr., Hall D Lobby (Ground Level)

Monday through Thursday · 8:00 am to 6:00 pm

Services include photocopying, faxing, printing services, and shipping. Office supplies are also available. Phone 619.525.5450

# GENERAL INFORMATION

## Restaurant & City Information

Conv. Ctr. Hall B Lobby

Sunday through Thursday · 9:00 am to 6:00 pm

Services include sightseeing, shopping, and restaurant information

## Child Care Services

Marion's Childcare, Inc.

Email: amy@hotelchildcare.com

619-303-4379 office, or 619-663-4379

Make a reservation: <http://hotelchildcare.com/make-a-reservation/>

Note: SPIE does not imply an endorsement nor recommendation of these services. They are provided on an "information only" basis for your further analysis and decision. Other services may be available.

## Urgent Message Line

An urgent message line is available during registration hours: 619.525.6200

## Lost and Found

Cashier, Convention Center, Hall B1

Open during Registration Hours

Found items will be kept at Cashier the duration of the meeting. At the end of the meeting, all found items will be turned over to the San Diego Convention Center Security, lost and found hotline: 619.525.5407

## Guest Hospitality Suite

Monday–Thursday, 7–10 August 2017 · 8:30 to 10:00 am

Location: San Diego Marriott Marquis Hotel Marina

Guests of attendees are invited to meet, relax, and enjoy a cup of coffee and light breakfast in the SPIE Guest Hospitality Suite. This suite is for guests of attendees only. The hotel concierge will be available during a portion of this time to answer travel, shopping, and tourist questions.

## FOOD AND BEVERAGE SERVICES

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### Coffee Breaks

Sunday

· Upper Level Lobbies, and Mezzanine Lobby

Monday

· Upper Level Lobbies, and Mezzanine Lobby

Tuesday · Exhibition Hall A

Wednesday · Exhibition Hall A

Thursday morning · Exhibition Hall A

Thursday afternoon

· Upper Level Lobbies and Mezzanine Lobby

Complimentary coffee will be served twice daily at 10:00 am and 3:00 pm. Check individual conference listings for exact times and locations.

### Food & Refreshments for Purchase

Hot and cold snacks, hot entrees, deli sandwiches, salads, and pastries are available for purchase. Cash and credit cards accepted.

### STARBUCKS

Convention Center, Lobby B

Sunday & Monday · 7:00 am to 3:00 pm

Tuesday & Wednesday · 7:00 am to 4:00 pm

Thursday · 7:00 am to Noon

### MRS. FIELD'S COOKIES / AUNTIE ANNE'S PRETZELS

Convention Center, Upper Lobby 6A

Sunday through Thursday · 7:30 am to 4:00 pm

### Concessions

Exhibition Hall B

Tuesday and Wednesday · 11:00 am to 2:00 pm

Assorted Gourmet Salads and Sandwiches, Fruit, Chips, Snacks and Beverages are available for purchase. Cash and credit cards accepted.

### Desserts

Exhibition Hall, Coffee Area

Tuesday and Wednesday · 3:00 pm to 4:00 pm

Complimentary tickets for dessert snacks are included in course and conference attendee registration packets.

### Beer & Pretzel Closing Celebration

Exhibition Hall A/B1

Thursday · 12:00 pm to 1:30 pm

Join exhibitors and colleagues for beer and pretzels to celebrate the closing of the event. A raffle and prize drawing are also offered. Open to all paid attendees.

### Hotels

Reserve your hotel room in SPIE contracted hotels for discounted rates. Attendees receive discounted convention rates by reserving their hotel room through the official housing reservation system for SPIE Optics + Photonics. Book your reservation online today!

# GENERAL INFORMATION

## TRAVEL

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### Welcome to San Diego

With 70 miles of beautiful beaches, near-perfect weather year-round, and a variety of magnificent settings countywide, San Diego offers a fun and inexpensive getaway, for kids and adults, any time of year. No stay in San Diego is complete without a trip to the waterfront. San Diego Bay is bustling with activity, as it serves as the homeport for Navy ships, a large sportfishing fleet, thousands of pleasure craft, and the USS Midway Museum is a retired aircraft carrier that now serves as a fascinating interactive floating museum. The largest urban cultural park in the United States, Balboa Park is often referred to as the "Smithsonian of the West." Its 1,200 lush acres are home to 85 cultural attractions, including 15 museums, eight gardens and the San Diego Zoo.

### Airport Information

San Diego International Airport (SAN) is conveniently located three miles northwest of downtown San Diego.

### Transportation from the Airport

Taxi service from the San Diego Airport to the downtown hotels is approximately \$12 - \$16 depending on traffic.

### Shuttles and Public Transportation

#### SuperShuttle

SPIE Optics + Photonics attendees will receive a discount of \$1 off one way, or \$2 off roundtrip when booking SuperShuttle with an advance reservation. Make a reservation online or call 1-800-258-3826. Refer to the group code SPIE to receive the discount. If you do not provide the group code to the phone agent, you will not receive the discount. You do not have to make an advance reservation to ride SuperShuttle, but without a reservation, you will pay the full rate at the ticket counter.

#### Ground Transportation Instructions for SuperShuttle

Arriving in Terminal 1 - Follow the signs to Ground Transportation Sky Bridge. Proceed to the 'Shuttle for Hire Island' and ask the Transportation Coordinator for a Supershuttle van.

Arriving in Terminal 2 - Exit the Terminal 2 doors; cross the street using the cross walk to the 'Shuttle for Hire Island' and ask the Transportation Coordinator for a Supershuttle van.

#### Complimentary Shuttle for guests at the Westin Hotel

Westin Hotel guests receive complimentary shuttle to/from SAN. On arrival, at baggage claim, call the hotel from the Westin Kiosk or dial 619-239-4500. The shuttle will arrive within 20 minutes. Departing guests should sign up with the front desk bellman one day prior to departure. Shuttle leaves every 30 minutes at the top and bottom of the hour from 6:00 am.

#### Bayfront Shuttle

Bayfront Shuttle - \$3 to ride all day - Hop on the Big Bay Shuttle to visit the numerous hotels, attractions, shops and restaurants along the scenic San Diego bay. Shuttle route includes Hilton Bayfront, Marriott Marquis & Marina, Seaport Village, Broadway/Navy Pier, Maritime Museum, Sheraton Hotel & Marina.

### San Diego Trolley - Metropolitan Transit System

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- Driving Directions (PDF) to the San Diego Convention Center and Hotels
- San Diego Convention Center Parking, Exhibitor Set-Up and Hotel Parking Rates (PDF)
- Parking in the vicinity of the San Diego Convention Center

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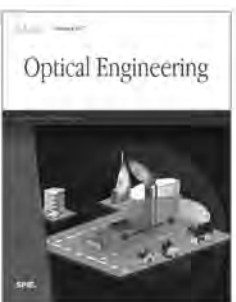
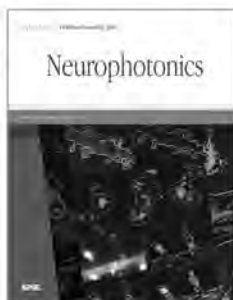
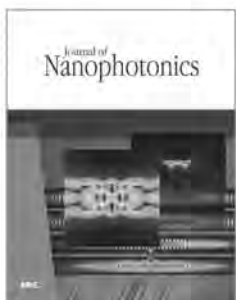
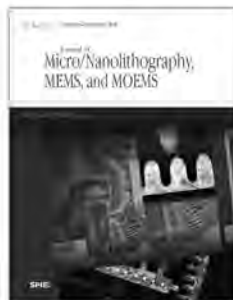
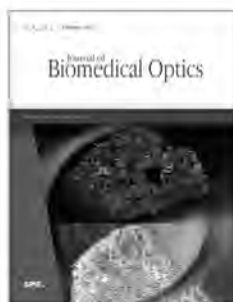
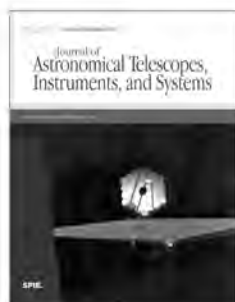
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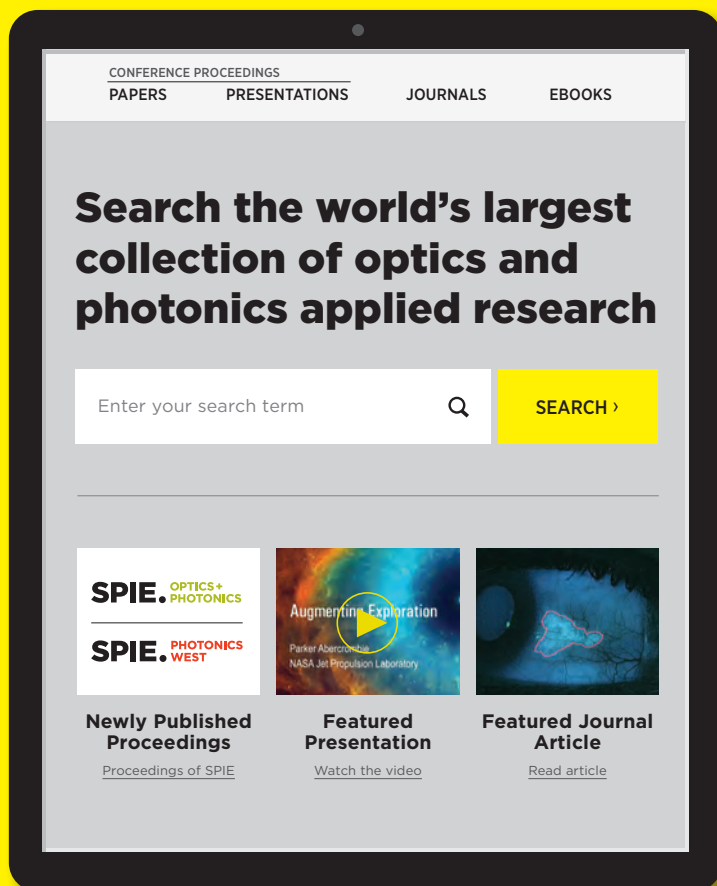
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