Advanced Photonics

Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials
Integrated Photonics Research, Silicon, and Nano-Photonics
Nonlinear Photonics
Novel Optical Materials and Applications
Optical Sensors
Photonic Networks and Devices
Signal Processing in Photonic Communications
Specialty Optical Fibers

2–5 July 2018
Zurich, Switzerland

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This meeting is supported in part by the Air Force Office of Scientific Research under award number FA9550-18-1-0172. Any opinions, finding, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the USA Air Force.

Special Events

Plenary Sessions

Monday, 2 July and Tuesday, 3 July, 07:45–10:00
Room F30.1 (Overflow Room: E3)

This year's Advanced Photonics Congress will feature six Plenary speakers. For more information on the Plenary speakers, see the Plenary descriptions on pages 10-11 of this program.

After the Plenary Sessions on each day, Best Student Prizes will be awarded by respective Sponsors.

Special Symposium on Optical Fiber Sensing Technologies for Monitoring in Harsh Environment

Monday, 2 July; 14:00–16:00 and 16:30–18:30
Room D1.1

Organizers: Guillaume Laffont, *CEA, France;* Matthieu Lancry, *Université Paris Sud, France*

Seeking submissions reporting on the latest research and development related to the use of fiber optic sensing technologies to perform monitoring under harsh environments. These elements can be low or high temperatures (typically well outside of standards defined for telecommunications), high strain, high pressures, high voltage, high magnetic fields, vibrations, dust, explosive environments, and aggressive chemical and biological environments.

Welcome Reception

Monday, 2 July, 18:30–20:00
Polyterrasse (Rain Location: Main Hall)

Join your fellow attendees for the Welcome Reception. Enjoy delectable fare while networking. The reception is open to all full conference attendees. Conference attendees may purchase extra tickets for their guests.

BGPP Industry Session

Tuesday, 3 July; 11:30–12:30
Room D1.1

BGPP 2018 continues the long-standing tradition of addressing fundamental and technical issues of immediate and long-term application of fiber Bragg gratings and other devices fabricated by laser-matter-interaction. While fundamental aspects are covered by invited and contributed proceeding papers, the technical aspect is addressed in the Industry Session.

Speakers from 6 different companies have been invited to make a 10 min presentation to showcase their advanced products, to explain the underlying technology and working principle. Company professionals that are also presenting scientific work during the conference have been favored. Therefore, the scientists in the auditorium working in closely related areas may get easily into contact with the company professionals for various reasons. Scientist may see how applied research translates into new products and applications. Junior scientists may be stimulated to create tomorrow a start-up in the field or join a company. In this way BGPP encourages greater interaction between the industry professionals and scientist.

Student & Early Career Professional Development & Networking Lunch and Learn

Tuesday, 3 July; 12:30–13:30
Room F33.1

Join us for an interactive lunch and learn program focused on professional development within the Advanced Photonics Field. This program will engage students and early career professionals with the key leaders in the field who will share their professional development journey and provide useful tips to those who attend. Lunch will be provided.

Programs are open to OSA Members. There is limited space. Separate RSVP required.

Hosted by: OSA Foundation

Joint Poster Sessions

Tuesday, 3 July, 10:00–11:30 and 16:00–17:30
D Level Foyers

The Congress will feature a joint poster sessions with over 150 poster presentations between 2 sessions. Each author is provided with a board on which to display their summary and results of his or her paper. Posters are an integral part of the technical program and offer a unique networking opportunity, where presenters can discuss their results one-to-one with interested parties.

Congress Banquet on Lake Zurich

(Separate Registration and Fee Required)

Tuesday, 3 July; 19:00–22:00
Zürich Bürkliplatz

Join colleagues for a special evening boat banquet on Lake Zurich. After a welcome beverage and brief welcome, take advantage of what Zurich has to offer and enjoy a dinner on picturesque Lake Zurich. An additional ticket ($70.00) is required for this event. Tickets can be purchased at the Registration Desk (if available).

Special Symposium on Innovative Grating-components and Grating-configurations for Fiber Lasers

Wednesday, 4 July; 14:00 – 16:00 and 16:30 – 18:30
Room D1.1

Organizers: Martin Bernier, *COPL, Canada;* Morten Ibsen, *ORC - Univ. of Southampton, UK*

Seeking submissions reporting on novel and innovative configurations of gratings, including fiber and volume Bragg gratings, in conjunction with fiber lasers to further their performance and facilitate new application areas. In particular, papers are being solicited to cover innovative gratings and grating configurations from their design and optimization, through to their fabrication and application.

Lab Automation Hackathon

Wednesday, 4 July; 19:00–21:00
Location: Room F33.1

Organizers: Nick Fontaine and Roland Ryf, *Nokia Bell Labs, USA*

Have you ever wanted to automate your lab, get better/ quicker at processing your data, make beautiful plots and figures and at the same time meet a bunch of cool scientists? Well, you are in luck! We have 8 demos for various common lab automation tasks, ranging from simple remote control of optical instrumentation, data processing and photonic design simulations, all the way to full lab automation. Students, professionals of all levels are welcome to learn and share their secret tips and tricks developed over the years. In this hackathon, we will provide 8 stations/demos, each staffed with a researcher experienced in lab automation, which will cover the following topics:

- Installing python on your computer (beginners)
- Introduction to the Python programming language (beginners)
- Python programming environment and web based tools (beginners)
- Plots and graphics in Python (beginners)
- Instrumentation control in Python
- Remote control and coordination of multiple computer for lab automation (advanced)
- Data processing on multicore and GPU based systems (advanced)
- Python software for photonic design

Bring a laptop to participate in the exercise. There will be plenty of time for mingling and discussion. Food and drinks included.

BGPP Reception at The Lion Pub (for BGPP-registered attendees only; RSVP required)

Wednesday, 4 July; 19:00–22:00
Location: The Lion Pub (Oetenbachgasse 6)

Sponsored by: Shenzhen JPT Opto-electronics

Join fellow BGPP attendees and sponsors for a BGPP-only reception at The Lion Pub Zurich. Network and enjoy drinks and hot & cold appetizers in this British Pub atmosphere. This is a free event for BGPP registered attendees. RSVP by email to matthieu.lancry@u-psud.fr.

General Information

Congress Wireless Internet

OSA is pleased to offer complimentary wireless internet services throughout the meeting space at ETH Zurich for all attendees and exhibitors.

SSID: OSAMeetings

Password: Photonics2018

Registration

E Level

Sunday, 1 July	15:00–18:00
Monday, 2 July	07:00–18:00
Tuesday, 3 July	07:00–17:30
Wednesday, 4 July	07:30–17:30
Thursday, 5 July	07:30–17:30

Please note; Registration:

- **will be closed from 12:30–14:00 each day**
- **times may differ onsite. Adjustments will be noted at the Registration Desk and within the posted Daily Update Sheet.**

Exhibits and Coffee Breaks

Monday, 2 July–Thursday, 5 July

D Level Foyers

The 2018 Advanced Photonics exhibit is open to all registered attendees. Visit a diverse group of companies representing every facet of optics. Coffee breaks and the joint poster session will be held with exhibits from Monday–Thursday.

Monday 2 July	10:00–10:30	Exhibit Hall Opening and Coffee Break
	16:00–16:30	Coffee Break with Exhibitors
	18:30–20:00	Welcome Reception with Exhibitors
Tuesday 3 July	10:00–11:30	Joint Poster Session I and Coffee Break with Exhibitors
	16:00–17:30	Joint Poster Session II and Coffee Break with Exhibitors
Wednesday 4 July	10:00–10:30	Coffee Break with Exhibitors
	16:00–16:30	Coffee Break with Exhibitors
Thursday 5 July	10:00–10:30	Coffee Break
	16:00–16:30	Coffee Break

About OSA Publishing's Digital Library

Registrants and current subscribers can access all of the congress papers, posters and postdeadline papers on OSA Publishing's Digital Library. The OSA Publishing's Digital Library is a cutting-edge repository that contains OSA Publishing's content, including 16 flagship, partnered and co-published peer-reviewed journals and 1 magazine. With more than 240,000 articles including papers from over 450 conferences, OSA Publishing's Digital Library is the largest peer-reviewed collection of optics and photonics.

Early Online Access to the Technical Digest and Postdeadline Papers

Full Technical Attendees have both early and free continuous access to the digest papers through OSA Publishing's Digital Library. To access the papers go to osa.org/PhotonicsOPC and select the "Access digest papers" essential link on the right hand navigation. As access is limited to Full Technical Congress Attendees only, you will be asked to validate your credentials by entering the same login email address and password provided during the Congress registration process.

If you need assistance with your login information, please use the "forgot password" utility or "Contact Help" link.

Poster Presentation PDFs

The PDFs of select poster presentations will be available two weeks after the Congress. While accessing the papers in OSA Publishing's Digital Library look for the multimedia symbol.

Congress Updates

All technical program changes will be communicated in the onsite Congress Program Daily Updates. **This program contains the latest information up to 22 June 2018.**

Code of Conduct

All Conference guests, attendees, and exhibitors are subject to the Code of Conduct policy, the full text of which is available at https://www.osa.org/en-us/meetings/code_of_conduct/. Conference management reserves the right to take any and all appropriate actions to enforce the Code of Conduct, up to and including ejecting from the Conference individuals who fail to comply with the policy.

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This group is also a high-volume manufacturer of **Vertical Cavity Surface Emitting Lasers (VCSELs)** for high speed data transmission, optical navigation and optical sensing applications.

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- HPL SE Pumps & Seeds
- VCSELs & Photodiodes

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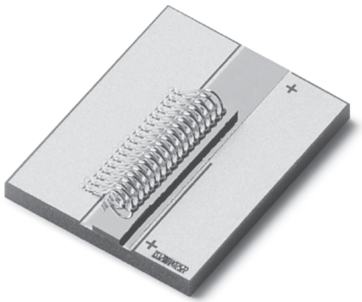

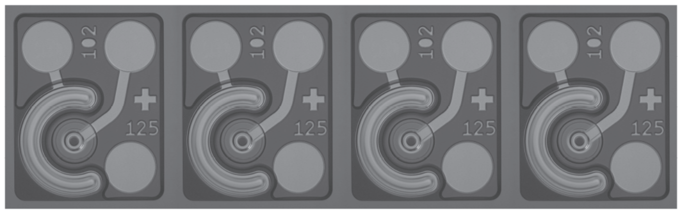

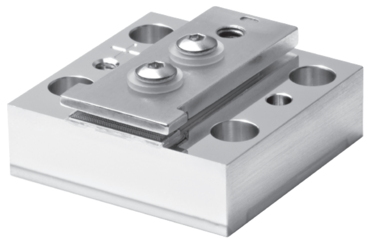

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Plenary Speakers

Joint Plenary Sessions I and II

Monday, 2 July and Tuesday, 3 July, 07:45–10:00
Room F30.1

Joint Plenary Session I

Monday, 2 July

State of the Art Ultra-long FBGs for Linear and Nonlinear Applications: Challenges and Opportunities

Raman Kashyap, *Polytechnique Montréal, Canada*

08:00–08:40

Raman Kashyap is a Professor at Polytechnique Montreal with a dual appointment in the Departments of Engineering Physics and Electronics Engineering, a holder of a Canada Research Chair in Future Photonics Systems since 2003, and the head of the FABULAS Laboratory. He was previously the Head of a photonics company in Montreal, Corvis Canada Inc. At BT Research Laboratories in the UK for 25 years, he researched optical devices and applications in photonics, and discovered the optical “fiber fuse”. His current research interests are focused on laser induced cooling, nonlinear optics, sensors, fiber Raman DFB lasers, Stimulated Brillouin scattering, Plasmonics, integrating photonics into cell-phones, and perfecting ultra-long fiber gratings. He is a Fellow of the Academy of Sciences of the Royal Society of Canada, the Optical Society of America, the SPIE, the Engineering Institute of Canada, the Canadian Academy of Engineering, and the Institute of Physics (UK).

Next Generation Photonics based on 2D Materials

Michal Lipson, *Columbia Univ., USA*

08:40–09:20

Professor Michal Lipson joined the Electrical Engineering faculty at Columbia University in July 2015. She completed her B.S., M.S., and Ph.D. degrees in Physics at the Technion in 1998 followed by a Postdoctoral position at MIT in the Materials Science Department until 2001. In 2001 she joined the School of Electrical and Computer Engineering at Cornell University. She was named Cornell Given Foundation Professor of Engineering in 2013. Lipson was one of the main pioneers in the field of silicon photonics and is the inventor of several of the critical building blocks in the field including the GHz silicon modulator. She holds over 20 patents and is the author of over 200 technical papers. Professor Lipson’s honors and awards include the MacArthur Fellow, Blavatnik Award, IBM Faculty Award, and the NSF Early Career Award. She is a fellow of OSA and IEEE. Since 2014 she has been named by Thomson Reuters as a top 1% highly cited researcher in the field of Physics.

Levitated Optomechanics

Lukas Novotny, *ETH Zurich, Switzerland*

09:20–10:00

Lukas Novotny is a Professor of Photonics at ETH Zürich. His research is focused on understanding and controlling light-matter interactions on the nanometer scale. Novotny did his PhD at ETH Zürich and from 1996-99 he was a postdoctoral fellow at the Pacific Northwest National Laboratory, working on new schemes of single molecule detection and nonlinear spectroscopy. In 1999 he joined the faculty of the Institute of Optics where he started one of the first research programs with focus on nano-optics. Novotny is the author of the textbook ‘Principles of Nano-Optics’, which is currently in its second edition. He is a Fellow of the Optical Society of America and the American Association for the Advancement of Science

Joint Plenary Session II

Tuesday, 3 July

Photonic Integration for Communication and Sensing-Economic Success and Failure

Martin Schell, *Heinrich Hertz Institute, Germany*

08:00–08:40

Martin Schell is professor for Optic and Optoelectronic Integration at Technical University Berlin, and director of the Fraunhofer Heinrich Hertz Institute HHI, Berlin. His research interest is photonic integration for communication and sensing.

Martin Schell joined HHI in 2005. From 2000 to 2005, he was first product line manager, then head of production and procurement at Infineon Fiber Optics. From 1996 to 2000 he was management consultant at The Boston Consulting Group. Before that, he spent one year as a visiting researcher at The Tokyo University, Japan. He received the Dipl.-Phys. degree from the RWTH Aachen in 1989, and the Dr. rer. nat. degree from the Technical University Berlin in 1993.

Martin Schell is a board member of EPIC (European Photonics Industry Consortium), speaker of the board of OptecBB (Competence Network Optical Technologies Berlin/Brandenburg), member of the Photonics21 Board of Stakeholders, and member of the Public Policy Committee of The Optical Society.

Progress and Challenges in Free-space Optical Networks

Linda Thomas, *Naval Research Laboratory, USA*

08:40–09:20

Linda Thomas is a Senior Research Engineer in the Electro-optics Technology Section, Code 8123, of the Naval Center for Space Technology, at the U. S. Naval Research Laboratory (NRL) in Washington, D.C. She has been working at NRL since 2004. Her current research interests are free-space laser communications, hybrid optical and RF communications networks, satellite laser ranging, and single photon detectors.

Dr. Thomas received her Bachelor's degree in Electrical Engineering from Duke University, Durham, NC, and has a Master's degree and Doctorate in the field of Electrical Engineering from the University of Maryland, College Park. She was an Associate Editor of the IEEE Journal of Lightwave Technology from 2014-2016, and prior Conference Chair of the SPIE Conference on Atmospheric Propagation.

Scaling Optical Networks into the Next Decade and Beyond

Peter Winzer, *Nokia Bell Labs, USA*

09:20–10:00

Peter J. Winzer received his Ph.D. in electrical engineering from the Vienna University of Technology, Austria, in 1998. Supported by the European Space Agency (ESA), he investigated photon-starved space-borne Doppler lidar and laser communications using high-sensitivity digital modulation and detection. At Bell Labs since 2000, he has focused on various aspects of high-bandwidth fiber-optic communication systems, including Raman amplification, advanced optical modulation formats, multiplexing schemes, and receiver concepts, digital signal processing and coding, as well as on robust network architectures for dynamic data services. He contributed to several high-speed and high-capacity optical transmission records with interface rates from 10 Gb/s to 1 Tb/s, including the first 100G and the first 400G electronically multiplexed optical transmission systems and the first field trial of live 100G video traffic over an existing carrier network. Since 2008 he has been investigating and internationally promoting spatial multiplexing as a promising option to scale optical transport systems beyond the capacity limits of single-mode fiber. He currently heads the Optical Transmission Systems and Networks Research Department at Bell Labs in Holmdel, NJ. He has widely published and patented and is actively involved in technical and organizational tasks with the IEEE Photonics Society and The Optical Society (OSA). Dr. Winzer is a Clarivate Highly Cited Researcher, the only one from industry in the Engineering category in 2015, a Bell Labs Fellow, a Fellow of the IEEE and the OSA, and an elected member of the US National Academy of Engineering. He received a Thomas Alva Edison Patent Award in 2017 and is the recipient of the 2018 John Tyndall Award.

Tutorial Speakers

Outperforming Conventional Optical Fibers Using a Hollow Core

Jonathan Knight, *Univ. of Bath, UK*

Specialty Optical Fibers (SOF)
Monday, 2 July
15:00–16:00
Room: D7.2

Two decades of research into photonic crystal and microstructured fibers have led to remarkable science and numerous opportunities for application. This presentation will describe what has been achieved, and what might come next.

Jonathan Knight is at the Centre for Photonics and Photonic Materials at the University of Bath. He has over twenty years of experience of research in the field of novel forms of optical fiber waveguide.

Ultra-large Mode Area Fibers for High Power Lasers

Jens Limpert, *Friedrich-Schiller-Universität Jena, Germany*

Specialty Optical Fibers (SOF)
Monday, 2 July
17:00–18:00
Room: D7.2

The most recent advances on ultra-large mode area fibers for high-power operation will be presented. Moreover, an approach to synthetize ultra-large mode area fibers that circumvents technical limitations by using multi-core fibers will be discussed.

Jens Limpert received his M.S in 1999 and Ph.D. in Physics from the Friedrich Schiller University of Jena in 2003. His research interests include high power lasers in the pulsed and continuous-wave regime. Jens Limpert is currently leading the Laser Development Group (including fiber- and waveguide lasers) at the Institute of Applied Physics. He is author or co-author of more than 300 peer-reviewed journal papers in the field of laser physics. His research activities have been awarded with the WLT-Award in 2006, an ERC starting grant in 2009 and an ERC consolidator grant in 2013. Jens Limpert is founder of the Active Fiber Systems GmbH a spin-off from the University Jena and the Fraunhofer-IOF Jena.

The most recent advances on ultra-large mode area fibers for high-power operation will be presented. Moreover, an approach to synthetize ultra-large mode area fibers that circumvents technical limitations by using multi-core fibers will be discussed.

Optical Dielectric Metasurfaces – Fundamentals and Applications

Dragomir Neshev, *Australian National Univ., Australia*

Novel Optical Materials and Applications (NOMA)
Wednesday, 4 July
08:30–09:30
Room: D1.2

The talk will overview the fundamental principles of operation of dielectric metasurfaces, as well as the plethora of their applications, including efficient beam shaping and holograms, biosensing, and characterization of entangled states.

Dragomir Neshev is a Professor of Physics and the leader of the Experimental Photonics Group at the Australian National University (ANU). He received the PhD from Sofia University, Bulgaria in 1999. His activities include nonlinear periodic structures, singular optics, plasmonics, and metamaterials.

Light in Diagnosis, Therapy, and Surgery

Seok-Hyun Yun, *Harvard Medical School, USA*

Novel Optical Materials and Applications (NOMA)
Wednesday, 4 July
16:30–17:30
Room: D1.2

In this Tutorial, we will revisit the fundamentals of light-tissue interactions, overview the biomedical applications of light and optical technologies, and discuss the promise of emerging light-based technologies.

Dr. Yun was born in Korea and received his Ph.D. in Physics from KAIST. He joined the faculty in Harvard Medical School and Massachusetts General Hospital in 2003, and is currently Professor and Patricia and Scott Eston MGH Research Scholar. He received 2016 NIH Director's Pioneer Award.

Keynote Speakers

Tilted Fiber Bragg Gratings with Plasmonic and Near Zero Permittivity Coatings for Biochemical Sensing

Jacques Albert, *Carleton Univ., Canada*

Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials (BGPP)
Tuesday, 3 July
14:00–14:45
Room: D1.1

The polarized evanescent fields of optical fiber cladding modes resonantly coupled from a single mode fiber core are used to probe materials and events on the fiber surface, including plasmonic nanoscale metal coatings

Jacques Albert currently holds the Canada Research Chair in Advanced Photonic Components at the Department of Electronics, Carleton University. Jacques does research in Electrical Engineering and Optics, and more specifically in optical fiber devices for sensing and light manipulation. The special emphasis of the group is on a structure called "Tilted fiber Bragg grating", TFBG in short. These are photoinduced gratings in the core of standard single mode fibers. Unlike conventional fiber Bragg gratings, TFBGs couple light from the core to multiple cladding modes, each at a different wavelength, thus allowing multiple sensing and light manipulation opportunities.

Internet Connectivity for the World's 3.8 Billion Unconnected

Hamid Hemmati, *Facebook Inc., USA*

Photonic Networks and Devices (Networks)
Wednesday, 4 July
10:30–11:15
Room: D3.2

Given the earth's population distribution varies by up to three orders of magnitude, expanding access to reliable internet connectivity will require a diverse array of technologies, including terrestrial, aerial, and satellite solutions.

Hamid Hemmati, PhD, is the director of engineering for telecom infrastructure at Facebook, Inc. Prior to that he was with the Jet Propulsion Laboratory (JPL), California Institute of Technology for 28 years as principal member of staff and the supervisor of the optical communications group. Previous to joining JPL in 1986, he was a researcher at NASA's Goddard Space Flight Center and at NIST. He has published over 200 journal and conference papers and nine patents. He is the editor and author of two books: Deep Space Optical Communications and Near-Earth Laser Communications, and author of five other book chapters. In 2011 he received NASA's Exceptional Service Medal. He has also received 3 NASA Space Act Board Awards, and 36 NASA certificates of appreciation. He is a Fellow member of The Optical Society and SPIE. His research interests are in providing global Internet connectivity, and greatly advancing laser and millimeter-wave communications technologies for terrestrial, airborne, and spacecraft applications.

Nonlinearity Engineering: From Mode-locked Lasers to Complex Laser-material Interactions

F. Ömer İlday, *Bilkent Universitesi, Turkey*

Novel Optical Materials and Applications (NOMA)
Monday, 2 July
10:30–11:15
Room: D1.2

Dr. F. Ömer Ilday received the BS degree in theoretical physics from Boğaziçi University, Istanbul, Turkey, in 1998. He took his PhD in applied physics from Cornell University, Ithaca, NY, USA, in 2003. He worked in the Department of Electrical Engineering at Massachusetts Institute of Technology (MIT) from 2003 to 2006. In 2006, he joined Bilkent University as faculty member. Dr. Ilday was the first to propose to manage nonlinear dynamics of mode-locked lasers in order to improve their performance (J. Opt. Soc. Am. B, 2002). This vision led to his invention of the similariton laser, the first laser to operate better with stronger nonlinear effects (Phys. Rev. Lett., 2004). In 2010, he invented the soliton-similariton laser (Nature Photon., 2010). Applying a similar approach to laser-material interactions, he developed Nonlinear Laser Lithography (Nature Photon., 2013), which was extended to 3D volume structures (Nature Photon., 2017) and invented ablation-cooled laser-material removal (Nature, 2016). Based on the original concept, he was awarded the European Research Council's prestigious Consolidator Grant in 2013, the first of its kind in Turkey. Dr. Ilday received numerous awards from MIT, Cornell University, Turkish Academy of Sciences (TÜBA-GEBIP), Scientific and Technological Research Council of Turkey (TÜBİTAK). He is a full member of the Science Academy of Turkey and a senior member of the Optical Society of America. He has served as editor and guest editor for Optics Letters, Optics Express and Optical Fiber Technology, in addition to serving on the technical committee of numerous international conferences.

Charge Transfer in Nanoplasmonics as an Avenue for Control of Chemical SERS Enhancement and Molecular Self-assembly

Stefan Maier, *Imperial College London, UK*

Novel Optical Materials and Applications (NOMA)
Wednesday, 4 July
14:00–14:45
Room: D1.2

We will demonstrate applications of plasmonic charge transfer such as control over chemical SERS enhancement, to locally induce chemical reactions in reactivity hot spots of nanoantennas and to facilitate designer molecular self-assembly.

Professor Maier is the Lee-Lucas Chair in Experimental Physics and head of the nanoplasmonics group in the Condensed Matter Physics Section. He further serves as Head of the Experimental Solid State Physics Group and as Director of Postgraduate Studies for the department. The group conducts a wide variety of fundamental and applied research in nanoplasmonics, nanophotonics, and metamaterials, ranging from unravelling light/matter interactions on the nanoscale, to the development of highly efficient optical biosensors, light harvesting nanostructures for photovoltaics, and the development of new materials and devices for photonic nanotechnology.

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Explanation of Session Codes

NeM2A.4

Meeting Name
B = BGPP
I = IPR
Ne = Networks
No = NOMA
Np = NP
Se = Sensors
So = SOF
Sp = SPPCom
J = Joint Session

Day of the Week
M=Monday
Tu=Tuesday
W=Wednesday
Th=Thursday

Series Number
1=First Series of Sessions
2=Second Series of Sessions

Session Designation
(alphabetically)

Number
(Presentation order within the session)

The first letter of the code designates the meeting (B = BGPP, I = IPR, Ne = Networks, No = NOMA, Np = NP, Se = Sensors, So = SOF, Sp = SPPCom). The second element denotes the day of the week (M=Monday, Tu-Tuesday, W=Wednesday, Th=Thursday). The third element indicates the session series in that day (for instance, 1 would denote the first parallel sessions in that day). Each day begins with the letter A in the fourth element and continues alphabetically through a series of parallel sessions. The lettering then restarts with each new series. The number on the end of the code (separated from the session code with a period) signals the position of the talk within the session (first, second, third, etc.). For example, a presentation coded NeM2A.4 indicates that this paper is part of the Networks topical meeting (Ne) and is being presented on Monday (M) in the second series of sessions (2), and is the first parallel session (A) in that series and the fourth paper (4) presented in that session.

Invited papers are noted with **Invited**

Tutorial papers are noted with **Tutorial**

Keynote papers are noted with **Keynote**

Plenary papers are noted with **Plenary**

Agenda of Sessions — Sunday, 1 July

15:00–18:00	**Registration,** *E Level*

Monday, 2 July

	Room D1.1	Room E5	Room E3	Room D1.2	Room D7.1	Room D3.2	Room D5.2	Room D7.2	Room E1.1	Room E1.2
07:00–18:00	**Registration,** *E Level*									
07:45–10:00	**JM1A • Introductory Remarks and Plenary Session I,** *Room F30.1 (Overflow Room: E3)*									
10:00–10:30	**Networking Coffee Break with Exhibitors,** *D Level Foyers*									
	BGPP	IPR	NP	NOMA	Sensors	Networks	SPPCom	SOF	NP	Sensors
10:30–12:30	**BM2A • Fundamentals for Glass Photosensitivity and Relaxation**	**IM2B • Nanophotonics**	**NpM2C • Mode Locking**	**NoM2D • Lasers and LED Gain Media**	**SeM2E • Biomedical Sensors I**	**NeM2F • Reliable Multi-layer Networking**	**SpM2G • Datacenter Interconnection**	**SoM2H • Novel Fibers and Materials**	**NpM2I • Quantum Applications of Nonlinear Photonic**	**SeM2J • Metrology** (ends at 12:00)
12:30–14:00	**Lunch** *(on own)*									
	BGPP	IPR	NP	NOMA	Sensors	Networks	SPPCom	SOF	IPR	NOMA
14:00–16:00	**BM3A • Symposium: Optical Fiber Sensing Technologies for Sensing/ monitoring in Harsh Environment I**	**IM3B • Silicon Photonics Integration**	**NpM3C • 2D Nonlinear Nanostructures**	**NoM3D • Optical Glasses, Crystals and Ceramics I**	**SeM3E • Biomedical Sensors II**	**NeM3F • Disaggregated Networking and Computing**	**SpM3G • Long-haul Transmission I**	**SoM3H • Fiber Lasers I**	**IM3I • Application of Frequency Combs and Microresonators**	**NoM3J • Nonlinear Optical Materials and Thin Films**
16:00–16:30	**Networking Coffee Break with Exhibitors,** *D Level Foyers*									
	BGPP	IPR	NP	NOMA	Sensors	Networks	SPPCom	SOF	NP	NOMA
16:30–18:30	**BM4A • Symposium: Optical Fiber Sensing Technologies for Sensing/ monitoring in Harsh Environment II**	**IM4B • Integrated Photonics for Sensing and Spectroscopy** (ends at 18:00)	**NpM4C • Metamaterials and Coherence Effects in Lasers**	**NoM4D • Materials for Solar Energy Applications**	**SeM4E • Optical Fiber Sensors** (ends at 18:15)	**NeM4F • Advanced Photonic Devices** (end at 18:00)	**SpM4G • Fiber Nonlinearity Mitigation** (ends at 18:00)	**SoM4H • Fiber Lasers II** (ends at 18:00)	**NpM4I • Measurements and Microscopy**	**NoM4J • Two-dimensional Materials I** (ends at 17:45)
18:30–20:00	**Conference Reception,** *Polyterrasse (Rain Location: Main Hall)*									

Key to Conference Abbreviations

BGPP	Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials
IPR	Integrated Photonics Research, Silicon and Nano Photonics
Networks	Photonic Networks and Devices
NP	Nonlinear Photonics
NOMA	Novel Optical Materials and Applications
Sensors	Optical Sensors
SOF	Specialty Optical Fibers
SPPCom	Signal Processing in Photonics Communications

Agenda of Sessions — Tuesday, 3 July

	Room D1.1	Room E5	Room E3	Room D1.2	Room D7.1	Room D3.2	Room D5.2	Room D7.2	Room E1.1	Room E1.2
07:00–17:30	**Registration,** *E Level*									
07:45–10:00	**JTu1A • Introductory Remarks and Plenary Session II,** *Room F30.1 (Overflow Room: E3)*									
10:00–11:30	**JTu2A • Poster Session I and Networking Coffee Break with Exhibitors,** *D Level Foyers*									
	BGPP	IPR		NOMA	Sensors	Networks	SPPCom	SOF	Sensors	
11:30–12:30	**BTu3A • Industry Session**	**ITu3B • Novel Nano-scale Structures**		**NoTu3C • Two-dimensional Materials II**	**SeTu3D • Micro- and Nano-Engineered Sensors I**	**NeTu3E • Autonomous and High-Capacity Systems**	**SpTu3F • Cloud Optics and Network Virtualization** (ends at 12:00)	**SoTu3G • Nonlinear Interactions in Fibers Specialty Optical Fibers & Applications**	**SeTu3H • Frequency Comb Sensors**	
12:30–13:30	**Student & Early Career Professional Development & Networking Lunch and Learn** *(Separate registration required), Room F33.1*									
12:30–14:00	**Lunch** *(on own)*									
	BGPP	IPR	NP	NOMA	Sensors	Networks	SPPCom	SOF	IPR	NOMA
14:00–16:00	**BTu4A • FBG and Laser Writing for Biomedical Sensing**	**ITu4B • Integrated Optical Sources**	**NpTu4C • Vectorial Effects**	**NoTu4D • Optical Glasses, Crystals and Ceramics II**	**SeTu4E • Optical Chemical & Biological Sensing I**	**NeTu4F • Data Center, Transport and Edge Networks** (begins at 14:15)	**SpTu4G • Digital Signal Processing and FEC Signal Processing in Photonics Communications**	**SoTu4H • Fiber Lasers III**	**ITu4I • Novel Materials for Photonics**	**NoTu4J • Nanomaterials I**
16:00–17:30	**JTu5A • Poster Session II and Networking Coffee Break with Exhibitors,** *D Level Foyers*									
17:30–18:00	**JTu6A • Postdeadline Session I**			**JTu6B • Postdeadline Session II**	**JTu6D • Postdeadline Session IV**		**JTu6C • Postdeadline Session III**	**JTu6E • Postdeadline Session V**	**JTu6F • Postdeadline Session VI**	**JTu6G • Postdeadline Session VII**
19:00–22:00	**Conference Banquet on Lake Zurich,** *Zürich Bürkliplatz (Separate Registration and Fee Required)*									

Key to Conference Abbreviations

BGPP	Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials
IPR	Integrated Photonics Research, Silicon and Nano Photonics
Networks	Photonic Networks and Devices
NP	Nonlinear Photonics
NOMA	Novel Optical Materials and Applications
Sensors	Optical Sensors
SOF	Specialty Optical Fibers
SPPCom	Signal Processing in Photonics Communications

Agenda of Sessions — Wednesday, 4 July

	Room D1.1	Room E5	Room E3	Room D1.2	Room D7.1	Room D3.2	Room D5.2	Room D7.2	Room E1.1	Room E1.2
07:30–17:30	**Registration,** *E Level*									
	BGPP	IPR	NP	NOMA	Sensors	Networks	SPPCom	SOF	Joint IPR/NP	NOMA
08:00–10:00	**BW1A • Femtosecond Laser Writing: From Fundamentals to Applications**	**IW1B • Optical Detectors and Transceivers**	**NpW1C • Instabilities and Synchronization**	**NoW1D • Metasurfaces and Metamaterials I** (begins at 08:15)	**SeW1E • Optical Chemical & Biological Sensing II**	**NeW1F • Multimode and Multicore** (begins at 08:45)	**SpW1G • Long-haul Transmission II**	**SoW1H • Sensing and Imaging**	**JW1I • Symposium: Microcomb Technology I (Joint IPR/NP)**	**NoW1J • Nanomaterials II**
10:00–10:30	**Networking Coffee Break with Exhibitors,** *D Level Foyers*									
	BGPP	IPR	NP	NOMA	Sensors	Networks	SPPCom	SOF	Joint IPR/NP	NOMA
10:30–12:30	**BW2A • FBG for Sensing Applications**	**IW2B • Integrated Photonics Applications**	**NpW2C • Spatiotemporal Phenomena I**	**NoW2D • Metasurfaces and Metamaterials II** (ends at 11:45)	**SeW2E • Micro- and Nano-Engineered Sensors II**	**NeW2F • Connecting the World**	**SpW2G • Optical Analog Signal Processing**	**SoW2H • Fiber Lasers IV**	**JW2I • Symposium: Microcomb Technology II (Joint IPR/NP)**	**NoW2J • Laser Materials and Photonics**
12:30–14:00	**Lunch** *(on own)*									
	BGPP	IPR	NP	NOMA	Sensors	Networks	SPPCom	SOF	Joint IPR/NP	Sensors
14:00–16:00	**BW3A • Symposium: Innovative Grating-components and Grating-configurations for Fiber Lasers I**	**IW3B • Modulators**	**NpW3C • Nonlinear Dielectric Nanostructures**	**NoW3D • Plasmonics**	**SeW3E • Optical Fiber Sensors II**	**NeW3F • Optical Network Design and Optimization**	**SpW3G • High Symbol Rate Systems** (ends at 15:15)	**SoW3H • Advanced Characterization and Processing Techniques**	**JW3I • Symposium: Microcomb Technology III (Joint IPR/NP)**	**SeW3J • Terahertz Sensing I**
16:00–16:30	**Networking Coffee Break with Exhibitors,** *D Level Foyers*									
	BGPP	IPR	NP	NOMA	Sensors	Networks	SPPCom	SOF	IPR	NOMA
16:30–18:30	**BW4A • Symposium: Innovative Grating-components and Grating-configurations for Fiber Lasers II**	**IW4B • Plasmonics**	**NpW4C • Waves and Solitons Interactions**	**NoW4D • Biomimetic and Biocompatable Materials**	**SeW4E • Laser-based Sensors I** (ends at 18:15)	**NeW4F • FreeSpace and UnderSea Optics + Workshop**	**SpW4G • Machine Learning for Optical Systems**	**SoW4H • Multimode Fibers**	**IW4I • Filter and Waveguide Devices** (ends at 18:15)	**NoW4J • Polaritonics** (ends at 18:00)
19:00–21:00	**Lab Automation Hackathon,** *Room F33.1*									
19:00–22:00	**BGPP Reception,** *The Lion Pub (Oetenbachgasse 6)*									

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NOMA	Novel Optical Materials and Applications
Sensors	Optical Sensors
SOF	Specialty Optical Fibers
SPPCom	Signal Processing in Photonics Communications

Agenda of Sessions — Thursday, 5 July

	Room D1.1	Room E5	Room E3	Room D1.2	Room D7.1	Room D3.2	Room D5.2	Room D7.2	Room E1.1	Room E1.2
07:30–17:30	**Registration,** *E Level*									
	Sensors	IPR	NP	NOMA	Sensors	Networks	NP		NP	IPR
08:00–10:00	**SeTh1A • Nanophotonic and Plasmonic Biosensors**	**ITh1B • Photonic Crystals and Nanocavities**	**NpTh1C • Applications of Quadratic Nonlinearities and Harmonic Generation**	**NoTh1D • Organic and Polymeric Materials** (ends at 09:45)	**SeTh1E • Optical Fiber Sensors III** (begins at 08:30)	**NeTh1F • Routing in Wavelength and Space**	**NpTh1G • Dynamical Effects in Lasers**		**NpTh1H • Opto-acoustic Effects, Raman and Brillouin Gain**	**ITh1I • Photonic Integrated Circuits** (begins at 08:15)
10:00–10:30	**Networking Coffee Break,** *D Level Foyers*									
	BGPP	IPR	NP	NOMA	Sensors	Networks	SPPCom	SOF	NP	IPR
10:30–12:30	**BTh2A • Poling and Laser-induced Crystallization in Glasses**	**ITh2B • Novel Photonic Platforms**	**NpTh2C • Spatiotemporal Phenomena II**	**NoTh2D • Tunable Metadevices I**	**SeTh2E • Sensing in Harsh Environment**	**NeTh2F • Network Resiliency and Security** (begins at 11:00, ends at 12:15)	**SpTh2G • Short Reach Systems** (ends at 12:15)	**SoTh2H • Novel Light Sources**	**NpTh2I • Applications of Supercontinuum**	**ITh2J • Microresonators**
12:30–14:00	**Lunch** *(on own)*									
	BGPP	IPR	NP	NOMA	Sensors	Networks	SPPCom	SOF	NP	IPR
14:00–16:00	**BTh3A • Fabrication and Properties of Gratings, Waveguides and Photonic Devices**	**ITh3B • Silicon Nitride Photonics**	**NpTh3C • Spatiotemporal Phenomena III**	**NoTh3D • Tunable Metadevices II** (ends at 15:30)	**SeTh3E • Laser-based Sensors II**	**NeTh3F • Short Reach Interconnects** (ends at 15:30)	**SpTh3G • Access Networks and Free Space Communications** (ends at 15:30)	**SoTh3H • Mid-infrared Supercontinuum Generation**	**NpTh3I • Novel Spatial Effects in Planar Photonics Structures**	**ITh3J • Metamaterial Photonic Devices**
16:00–16:30	**Networking Coffee Break,** *D Level Foyers*									
	Joint BGPP/SOF	IPR	NP	NOMA	Sensors		SPPCom		NP	IPR
16:30–18:30	**JTh4A • Joint BGPP-SOF Session**	**ITh4B • Novel Devices and Applications** (ends at 18:15)	**NpTh4C • Nonlinear Plasmonics** (ends at 18:00)	**NoTh4D • Nonlinear Metasurfaces and Plasmonics**	**SeTh4E • Terahertz Sensing II** (ends at 18:15)		**SpTh4F • Real-time Processing and ASIC Design** (ends at 18:00)		**NpTh4G • Applications of Complexity**	**ITh4H • Novel Optical Sources and High Precision Photonics**

Key to Conference Abbreviations

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07:00–18:00 **Registration,** *E Level*

Room F30.1 (Overflow Room: E3)

Joint

07:45–10:00
JM1A • Joint Plenary Session I

JM1A.1 • 08:00 Plenary
State of the Art Ultra-long FBGs for Linear and Nonlinear Applications: Challenges and Opportunities, Raman Kashyap[1]; [1]*Dept of Engineering Phy and Elect Eng., Polytechnique de Montreal, Canada.* For four decades, fiber Bragg grating (FBG) have delivered outstanding performance for applications in many fields of engineering and science, including sensing, lasers, dispersion management, and filters. However, most FBGs for these applications have been confined to lengths of less than 100mm. Recent developments have led to a demand for longer gratings (~meter length) in applications such as Raman and Brillouin distributed feedback FBG lasers. Until recently, controlling the spatial characteristics of the FBG with a precision necessary for these applications has been difficult to achieve, since small errors accumulate leading to unpredictable and unrepeatable characteristics. These errors make it impossible to utilise long FBGs for linear and nonlinear applications routinely. By undertaking a step by step approach to understand the limitations of not only the technology of FBG inscription, but surprisingly, also from the uniformity of the optical fiber has led to near perfect ultra-long gratings. Although challenges remain, these advances have allowed the fabrication of single frequency fiber Raman and Brillouin DFB lasers with outstanding performance, also opening the doors to other nonlinear optical applications.

JM1A.2 • 08:40 Plenary
Next Generation Photonics based on 2D Materials, Michal Lipson[1]; [1]*Columbia Univ., USA.* Two dimensional materials such as monolayer transition metal dichalcogenides (TMD) are expected to have large changes in their optical sheet conductivity by controlling their carrier densities. We demonstrate a platform for waveguide-integrated phase modulators in the near-infrared regime based on Tungsten disulphide (WS2) gating.

JM1A.3 • 09:20 Plenary
Levitated Optomechanics, Lukas Novotny[1]; [1]*ETH Zurich, Switzerland.* Optically levitated nanoparticles in ultrahigh vacuum exhibit very low damping and constitute a highly sensitive optomechanical system. By using active parametric feedback the particle's center-of-mass temperature can be cooled below 100 microKelvin, limitedby photon recoil heating.

10:00–10:30 **Networking Coffee Break with Exhibitors,** *D Level Foyers*

Room D1.1	Room E5	Room E3	Room D1.2	Room D7.1
Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials	Integrated Photonics Research, Silicon, and Nano-Photonics	Nonlinear Photonics	Novel Optical Materials and Applications	Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

Room D1.1

10:30–12:30
BM2A • Fundamentals for Glass Photosensitivity and Relaxation
Presider: Sylvain Girard; Universite Saint Etienne, France

BM2A.1 • 10:30 Invited
Optical Properties of Chlorine- and Oxygen-related Defects in SiO_2 Glass and Optical Fibers, Linards Skuja[1], Nadege Ollier[2]; [1]*Inst. of Solid State Physics, Univ. of Latvia, Latvia;* [2]*Ecole Polytechnique, Laboratoire des Solides Irradiés, France.* Photoinduced processes involving Cl_2 molecules in silica were studied. Interstitial Cl_2 in SiO_2 are prevented from UV photolysis by cage effect. However, they react with oxygen interstitials yielding photosensitive ClClO molecules absorbing at 264nm.

Room E5

10:30–12:30
IM2B • Nanophotonics
Presider: Amy Foster; Johns Hopkins Univ., USA

IM2B.1 • 10:30 Invited
Single-carbon-nanotube Photonics and Optoelectronics, Yuichiro K. Kato[1,2]; [1]*Nanoscale Quantum Photonics Laboratory, RIKEN, Japan;* [2]*Quantum Optoelectronics Research Team, RIKEN Center for Advanced Photonics, Japan.* Single-walled carbon nanotubes exhibit telecom-band emission at room temperature and they can be directly synthesized on silicon substrates. Here we discuss the use of individual carbon nanotubes for generation and manipulation of photons on a chip.

Room E3

10:30–12:30
NpM2C • Mode Locking
Presider: Neil Broderick; Univ. of Auckland , Australia

NpM2C.1 • 10:30
Nonlocality Induces Knotted Chains of Localized Structures in Lasers, Mathias Marconi[1], Julien Javaloyes[2], Massimo Giudici[3]; [1]*C2N-CNRS, France;* [2]*Universitat de les Illes Baleares,, Spain;* [3]*Université Côte d'Azur, France.* We show that pointwise nonlocality in a time-delayed laser system generates a new kind of localized structures molecule where bonds are not rigid and the elements can shift mutually one with respect to the other.

Room D1.2

10:30–12:30
NoM2D • Lasers and LED Gain Media
Presider: Ishwar Aggarwal; Univ of North Carolina at Charlotte, USA

NoM2D.1 • 10:30 Keynote
Nonlinearity Engineering: From Mode-locked Lasers to Complex Laser-material Interactions, F. Omer Ilday[1]; [1]*Bilkent Univ., Turkey.* The principle dictum of laser mode-locking is to create higher gain for modes that are in phase. Inspired by this, we outline nonlinear feedback-driven laser-material interactions, leading to self-organized, self-assembled nano/microstructures, more efficient ablation.

Room D7.1

10:30–12:30
SeM2E • Biomedical Sensors I
Presider: Björn Reinhard; Boston Univ., USA

SeM2E.1 • 10:30 Invited
Laser-emission based Microscopy for Cancer Diagnosis, Yu-Cheng Chen[1], Qiushu Chen[1], Xiaotian Tan[1], Xiaoqin Wu[1], Xudong Fan[1]; [1]*2158 Lurie Biomedical Engineering Bldg, Univ. of Michigan, USA.* We developed scanning laser-emission microscopy capable of mapping lasing emission from nuclear biomarkers in frozen and paraffin-embedded tissues, which may open a new field in bioimaging for cancer diagnosis and cell biology.

07:00–18:00 **Registration,** *E Level*

Room F30.1 (Overflow Room: E3)

Joint

07:45–10:00
JM1A • Joint Plenary Session I

JM1A.1 • 08:00 Plenary
State of the Art Ultra-long FBGs for Linear and Nonlinear Applications: Challenges and Opportunities, Raman Kashyap[1]; [1]*Dept of Engineering Phy and Elect Eng., Polytechnique de Montreal, Canada.* For four decades, fiber Bragg grating (FBG) have delivered outstanding performance for applications in many fields of engineering and science, including sensing, lasers, dispersion management, and filters. However, most FBGs for these applications have been confined to lengths of less than 100mm. Recent developments have led to a demand for longer gratings (~meter length) in applications such as Raman and Brillouin distributed feedback FBG lasers. Until recently, controlling the spatial characteristics of the FBG with a precision necessary for these applications has been difficult to achieve, since small errors accumulate leading to unpredictable and unrepeatable characteristics. These errors make it impossible to utilise long FBGs for linear and nonlinear applications routinely. By undertaking a step by step approach to understand the limitations of not only the technology of FBG inscription, but surprisingly, also from the uniformity of the optical fiber has led to near perfect ultra-long gratings. Although challenges remain, these advances have allowed the fabrication of single frequency fiber Raman and Brillouin DFB lasers with outstanding performance, also opening the doors to other nonlinear optical applications.

JM1A.2 • 08:40 Plenary
Next Generation Photonics based on 2D Materials, Michal Lipson[1]; [1]*Columbia Univ., USA.* Two dimensional materials such as monolayer transition metal dichalcogenides (TMD) are expected to have large changes in their optical sheet conductivity by controlling their carrier densities. We demonstrate a platform for waveguide-integrated phase modulators in the near-infrared regime based on Tungsten disulphide (WS2) gating.

JM1A.3 • 09:20 Plenary
Levitated Optomechanics, Lukas Novotny[1]; [1]*ETH Zurich, Switzerland.* Optically levitated nanoparticles in ultrahigh vacuum exhibit very low damping and constitute a highly sensitive optomechanical system. By using active parametric feedback the particle's center-of-mass temperature can be cooled below 100 microKelvin, limitedby photon recoil heating.

10:00–10:30 **Networking Coffee Break with Exhibitors,** *D Level Foyers*

Room D3.2	Room D5.2	Room D7.2	Room E1.1	Room E1.2
Photonic Networks and Devices	Signal Processing in Photonic Communications	Specialty Optical Fibers	Nonlinear Photonics	Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

10:30–12:30
NeM2F • Reliable Multi-layer Networking
Presider: Marija Furdek; KTH Royal Inst. of Technology, Sweden

NeM2F.1 • 10:30 Invited
Design Problems towards Reliable SDN Networks, Carmen Mas Machuca[1], Petra Vizarreta[1], Raphael Durner[1], Dorabella Santos[2], Amaro de Sousa[3]; [1]*Technische Universität Munchen, Germany;* [2]*Inst. of Telecommunications, Portugal;* [3]*Univ. of Aveiro, Portugal.* Software Defined Networking offers many advantages such as cost reduction, higher flexibility and network programmability by decoupling the control from the data plane. In order to also increase reliability, several design problems are presented.

10:30–12:30
SpM2G • Datacenter Interconnection
Presider: Chigo Okonkwo; Technische Universiteit Eindhoven, Netherlands

SpM2G.1 • 10:30 Invited
100/400G Technology for Cloud Data Centers, Frank Chang[1]; [1]*Inphi Corporation, USA.* Abstract not available.

10:30–12:30
SoM2H • Novel Fibers and Materials
Presider: Johann Troles; Université de Rennes, France

SoM2H.1 • 10:30 Invited
Future of Semiconductor-core Optical Fibers, Ursula J. Gibson[1,2], John Ballato[3], Anna C. Peacock[4], Fredrik Laurell[2], Michael Fokine[2]; [1]*Physics Dept, Norges Teknisk Naturvitenskapelige Univ, Norway;* [2]*Applied Physics, KTH Royal Inst. of Technology, Sweden;* [3]*Clemson Univ., USA;* [4]*Southampton Univ., UK.* Semiconductor-core optical fibers hold promise for long wavelength transmission systems as well as for nonlinear and active optoelectronic devices. This talk includes a status report on fiber properties and a prospectus of some future directions.

10:30–12:30
NpM2I • Quantum Applications of Nonlinear Photonic Devices
Presider: Sergey Polyakov; National Inst of Standards & Technology, USA

NpM2I.1 • 10:30 Invited
III-V Integrated Nonlinear Photonic Chips for the Generation and Manipulation of Quantum States of Light, Giorgio Maltese[1], Jonathan Belhassen[1], Saverio Francesconi[1], Aristide Lemaître[2], Maria Amanti[1], Florent Baboux[1], Sara Ducci[1]; [1]*Laboratoire MPQ, Université Paris Diderot, France;* [2]*Centre de Nanophotonique et Nanostructures, France.* I present our last results on AlGaAs photonic devices emitting quantum states of light at room temperature: monolithic integration of heralded single photon sources and beam splitters and engineering of frequency qudits and non-Gaussian entanglement.

10:30–12:00
SeM2J • Metrology

SeM2J.1 • 10:30 Invited
Lab on Fiber Technology: Advances and New Trends, Andrea Cusano[1]; [1]*Engineering Dept., Univ. of Sannio, Italy.* This lecture relies on the latest advances and future trends pertaining to the Lab on Fiber Technology roadmap.

Room D1.1	Room E5	Room E3	Room D1.2	Room D7.1
Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials	Integrated Photonics Research, Silicon, and Nano-Photonics	Nonlinear Photonics	Novel Optical Materials and Applications	Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

BM2A • Fundamentals for Glass Photosensitivity and Relaxation—Continued

BM2A.2 • 11:00
Femtosecond IR Laser Inscription and X-ray Radiation Response of Fiber Bragg Gratings in Aluminosilicate Optical Fibers, Adriana Morana[1], Emmanuel Marin[1], Thomas Blanchet[1,2], Laurent Lablonde[3], Thierry Robin[3], Aziz Boukenter[1], Youcef Ouerdane[1], Sylvain Girard[1]; [1]*Laboratory Hubert Curien (LabHC) CNRS UMR 5516, Univ-Lyon , France;* [2]*French Alternative Energies and Atomic Energy Commission (CEA), LIST, LCAE , France;* [3]*iXBlue, France.* We investigate the inscription conditions of FBGs in Al-doped and Al-La co-doped fibers with a femtosecond laser at 1030 nm and a CW UV laser at 244 nm. X-ray effects on such gratings are characterized.

BM2A.3 • 11:15
Mean Refractive Index Change Monitoring during FBG Regeneration using an OFDR Measurement System, Rudy Desmarchelier[1], Patrick Bulot[1], Stéphane Plus[2], Guillaume Laffont[1]; [1]*CEA Saclay, France;* [2]*Université Lille, France.* In this paper, we use a technique based on optical Rayleigh backscattering reflectometry to monitor mean refractive index change along a Fiber Bragg Grating during a regeneration process

BM2A.4 • 11:30
Raman Spectroscopic Study of Bragg Gratings Regeneration, Matthieu Lancry[1], Kevin Cook[3], David Pallarés-Aldeiturriaga[2], Jose-Miguel M. Lopez-Higuera[2], Bertrand Poumellec[1], John Canning[3]; [1]*Universite de Paris Sud, France;* [2]*Univ. of Cantabria, Spain;* [3]*Univ. of Technology Sydney, Australia.* After Fiber Bragg gratings regeneration, both the inner-cladding and the core materials of GF1 fiber appear to expand as revealed by a decrease of glass density local indicators through Raman spectroscopy.

IM2B • Nanophotonics—Continued

IM2B.2 • 11:00
Toward Complex 3D Nanophotonics by the Assembly of Building Blocks, Euan McLeod[1]; [1]*Univ. of Arizona, USA.* Directed nanoparticle assembly provides a way to fabricate complex heterogenous 3D nanophotonic devices. We present rapid optimization-based design methods and experimentally investigate the limits on attainable assembly speed using optical tweezers.

IM2B.3 • 11:15
Nanoparticles to Enhance Molecular Circular Dichroism, Karolina Slowik[1], Monika Kubek[1]; [1]*Inst. of Physics, Nicolaus Copernicus Univ., Poland.* Nanoparticles may unlock light-matter interaction channels hardly accessible in free space. We investigate parallel electric and magnetic interactions of chiral molecules inside nanoparticles with a magnetic response for enhanced circular dichroism.

IM2B.4 • 11:30 Invited
Harvesting the Coldness of the Universe with Nanophotonic Structures, Shanhui Fan[1]; [1]*Dept. of Elec. Engineering, Stanford Univ., USA.* Abstract not available

NpM2C • Mode Locking—Continued

NpM2C.2 • 11:00
Coherent Effects in Mode-locked Lasers: New Theory and Experiments, Auro M. Perego[1], Stéphane Barland[2], François Gustave[2], Bruno Garbin[3], Franco Prati[4], German J. de Valcárcel[5]; [1]*Aston Inst. of Photonic Technologies, UK;* [2]*CNRS, INPHYNI, Université Cote d'Azur,, France;* [3]*The Dodd-Walls Centre for Photonic and Quantum Technologies, Department of Physics, The Univ. of Auckland, New Zealand;* [4]*Dipartimento di Scienza e Alta Tecnologia, Università dell'Insubria, Italy;* [5]*Departament d'Optica, Universitat de València, Spain.* We present the predictions of a new theory for mode-locking in lasers valid also for fast gain media (e.g. semiconductor lasers). Substantial deviations from Haus theory are found, which are validated by experimental results.

NpM2C.3 • 11:15
Multi-soliton Explosions in a Mode-locked Fiber Laser, Ying Yu[1], Zhi-Chao Luo[1,2], Jiqiang Kang[1], Kenneth Kin-Yip Wong[1]; [1]*Univ. of Hong Kong, Hong Kong;* [2]*South China Normal Univ., China.* We experimentally observe the spectral dynamics of multi-soliton explosions in a mode-locked fiber laser. It is unveiled that explosion of one pulse will induce the other pulse to explode through transient gain response of EDF.

NpM2C.4 • 11:30
Pulse Formation in Mode Locked Lasers, Mark Popov[1], Omri Gat[1]; [1]*Physics, Hebrew Univ., Israel.* We show theoretically and verify numerically that the initial stage of formation of a pulse from perturbed cw in passive mode locked lasers consists of a long and slow buildup where power is transferred in a cascade from lower to higher axial modes.

NoM2D • Lasers and LED Gain Media—Continued

NoM2D.2 • 11:15 Invited
High Efficiency Blue Perovskite Nanocrystal LEDs, Daniel Congreve[1], Mahesh Gangishetty[1], Shaocong Hou[1], Qimin Quan[1]; [1]*Harvard Univ., Rowland Inst. at Harvard, USA.* Blue perovskite nanocrystal LEDs have typically lagged far behind their red and green cousins, yet are essential for commercial applications. I will discuss the reasons for this lag and demonstrate solutions to mitigate it.

SeM2E • Biomedical Sensors I—Continued

SeM2E.2 • 11:00
Surface Plasmon Resonator Biosensor Spatial Phase Sensitivity Enhancement through Optical Fiber Low Coherence Interferometry, Shih-Hsiang Hsu[1]; [1]*National Taiwan Univ of Science & Tech, Taiwan.* The spatial phase sensitivity on the effective reaction length using optical fiber low coherence interferometry demonstrates 10.4-rad/mM, 34 times more enhancement than the polarized light phase from spectral interferometry based SPR biosensors.

SeM2E.3 • 11:15
Bending-based Formulation of Light Intensity Modulation for Miniaturization of Optical Tactile Sensors, Naghmeh M. Bandari[1,2], Amir Hooshiar[1,2], Muthukumaran Packirisamy[1], Javad Dargahi[1]; [1]*Concordia Univ., Canada;* [2]*Experimental Surgery, McGill Univ., Canada.* Miniaturization is a major limitation in the application of optical sensors for compensation of the lack of touch in robotic minimally invasive surgeries. In this study, a miniaturized tactile sensor is proposed, formulated, and validated

SeM2E.4 • 11:30
Fiber-grating-based Hyperthermal Therapeutic Device for mm-sized *ex vivo* Lethal Volume , Sondos A. Alqarni[1], Jacques Albert[1], Christopher W. Smelser[1]; [1]*Carleton Univ., Canada.* Coated tilted fiber Bragg gratings are used for controlled heating of a limited area and for reading the local increase in temperature. Optical pumping at 1.8W produced a 7×15mm lesion in *ex vivo* porcine liver.

Room D3.2	Room D5.2	Room D7.2	Room E1.1	Room E1.2
Photonic Networks and Devices	Signal Processing in Photonic Communications	Specialty Optical Fibers	Nonlinear Photonics	Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

NeM2F • Reliable Multi-layer Networking—Continued

NeM2F.2 • 11:00 Invited

Multi-failure Resiliency and Cost-effectiveness in Transport Networks: A Contradiction?, Bodhisattwa Gangopadhyay[1], João Pedro[1,2], Jari Kivimaa[3], Stefan Spaelter[3]; [1]*Coriant Portugal, Portugal;* [2]*Instituto Superior Técnico, Instituto de Telecomunicações, Portugal;* [3]*Coriant GmbH, Germany.* This paper proposes an optical hyper-scale network architecture involving high-density transponders, 50-ms protection switching and shared regeneration for optical restoration. The architecture provides multi-failure resilience at an attractive cost.

NeM2F.3 • 11:30 Invited

Dynamic (re)Configuration of Optical Networks Based on Monitoring Information: Field Trial, Nicola Sambo[7], Kostas Christodoulopoulos[2], Nikos Argyris[3], Pietro Giardina[4], Camille Delezoide[5], Diego Roccato[6], Alessandro Percelsi[6], Robert Morro[6], Andrea Sgambelluri[1], Giannis Kanakis[3], Giacomo Bernini[4], Piero Castoldi[7]; [1]*Via G.Moruzzi, 1, Sant' Anna di Pisa, Italy;* [2]*CTI, Greece;* [3]*NTUA, Greece;* [4]*Nextworks, Italy;* [5]*Nokia Bell Labs, France;* [6]*Telecom Italia, Italy;* [7]*Scuola Superiore Sant'Anna, Italy.* We demonstrate dynamic reconfiguration based on an innovative control paradigm, named pre-programming. Experiment has been successfully carried on in a field trial at Telecom Italia.

SpM2G • Datacenter Interconnection—Continued

SpM2G.2 • 11:00 Invited

Direct Detection Optical Transmission Systems Employing Stokes Vector Kramers Kronig Transceivers, Thang M. Hoang[1], Qunbi Zhuge[1], Zhenping Xing[1], Mohammed Sowailem[1], Mohamed Osman[1], Meng Xiang[1], Eslam El-Fiky[1], David Plant[1]; [1]*ECE, McGill Univ., Canada.* We use a Stokes vector receiver to demonstrate polarization multiplexing Kramers Kronig detection signals. The impact of several parameters is discussed. 480-Gb/s capacity is achieved for 80 km of standard single mode fiber transmission.

SpM2G.3 • 11:30

Low Resolution Pre-compensation for DCI based on Dynamic Quantization, Yaron Yoffe[1], Eyal Wohlgemuth[1], Dan Sadot[1]; [1]*Ben Gurion Univ. of the Negev, Israel.* A novel dynamic quantization algorithm is proposed to support pre-compensation using low resolution DACs. Electrical back-to-back 50Gbaud PAM-4 transmission over 11Ghz bandlimited infrastructure is demonstrated using 3 bits DAC.

SoM2H • Novel Fibers and Materials—Continued

SoM2H.2 • 11:00 Invited

Recent Advances in Fabrication and Applications of Nanostructured Soft-glass Optical Fibres, Xin Jiang[1], Fehim Babic[1], Jiapeng Huang[1], Shangran Xie[1], zheqi wang[1], Rafal Sopalla[1], nicolas joly[2,1], Philip S. Russell[1,2]; [1]*Max-Planck-Inst. for the Science of, Max-Planck-Inst. for Sci. of Light, Germany;* [2]*Department of Physics, Univ. of Erlangen-Nuremberg, Germany.* The introduction of techniques e.g. 3D-printing, extrusion and preform spinning of soft-glass nanostructured fibers brings new opportunities. Applications in opto-mechanics, nonlinear wavelength conversion and laser light delivery will be reviewed.

SoM2H.3 • 11:30 Invited

Low Loss Fluoride Optical fibers: Fabrication and Applications, Solenn Cozic[1], Samuel Poulain[1], Marcel Poulain[1]; [1]*rue Gabriel Voisin, Le Verre Fluore, France.* Constant development of fluoride glass technology has led to producing commercial low loss fluoride fibers, paving the way to cutting-edge applications. We discuss prospects and challenges of such optical fibers for mid infrared applications.

NpM2I • Quantum Applications of Nonlinear Photonic Devices—Continued

NpM2I.2 • 11:00

Sum-Frequency- and Photon-Pair-Generation in AlGaAs Nano-Disks, Giuseppe Marino[2,3], Alexander S. Solntsev[1,2], Lei Xu[2], Valerio F. Gili[3], Luca Carletti[4], Alexander Poddubny[2], Mohsen Rahmani[2], Daria Smirnova[2], Haitao Chen[2], Guoquan Zhang[5], Anatoly Zayats[6], Costantino De Angelis[4], Giuseppe Leo[3], Yuri Kivshar[2], Andrey A. Sukhorukov[2], Dragomir N. Neshev[2]; [1]*Univeristy of Technology Sydney, Australia;* [2]*Australian National Univ., Australia;* [3]*Univ. Paris Diderot-CNRS, France;* [4]*Univ. of Brescia, Italy;* [5]*Nankai Univ., China;* [6]*King's College London, UK.* We demonstrate experimentally the generation of sum-frequency signal and heralded photons with non-classical correlations via spontaneous parametric down-conversion in AlGaAs nanodisks.

NpM2I.3 • 11:30

Quantum Control of Quantum Solitons, Giulia Marcucci[1], Simone Montangero[2], Tommaso Calarco[3], Claudio Conti[1]; [1]*Univ degli Studi di Roma La Sapienza, Italy;* [2]*Ulm Univ., Germany.* Controlling quantum nonlinear optical processes is a major challenge in optics. We apply novel quantum control techniques to optical solitons. By phase-space methods, we show that a proper control function alters the soliton evolution.

SeM2J • Metrology—Continued

SeM2J.2 • 11:00

Waveguide-based Multi-band Mid-IR Absorption spectroscopy on Water-containing Biofuel, Mohammadamir Ghaderi[1], Guanchu Wang[1], Jaco H. Visser[2], Reinoud F. Wolffenbuttel[1]; [1]*Microelectronics, Delft Univ. of Technology, Netherlands;* [2]*Research and Advanced Engineering, Ford Motor Company, USA.* Silicon waveguide structures with SiO_2 cladding and tapered on-chip couplers are fabricated on Si wafers for use in water-containing biofuel composition measurement in the 2.4-2.6μm respectively 3.5-3.8μm water and ethanol dominated absorption bands.

SeM2J.3 • 11:15

Longitudinal Temperature Distribution inside Active Optical Fiber in Lasing Condition, Victor Sypin[1], Nikita Voronkov[1,2], Oleg Ryabushkin[1,2]; [1]*Moscow Inst. of Physics and Technology, Russia;* [2]*Kotel'nikov Inst. of Radio Engineering and Electronics of RAS, Russia.* Presented new method of temperature measurement of optical fibers in lasing condition and nonlinear processes. Carried out measurement of longitudinal temperature distribution of polymer cladding of active fiber doped Yb^{3+}/Er^{3+} in lasing condition.

SeM2J.4 • 11:30

Helmholtz Resonator Diode Laser Photoacoustic Spectroscopy for Trace Gas Analysis in the Environment and the Biosciences, Saeed Alahmari[1], Michael Hippler[1]; [1]*Univ. of Sheffield, UK.* We report Helmholtz resonator photoacoustic detection of CO_2, H_2S, and O_2 with near-IR and visible diode lasers. First applications are introduced, including monitoring the aerobic metabolism of microbes and detection of H_2S in natural gas.

Room D1.1	Room E5	Room E3	Room D1.2	Room D7.1
Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials	Integrated Photonics Research, Silicon, and Nano-Photonics	Nonlinear Photonics	Novel Optical Materials and Applications	Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

BM2A • Fundamentals for Glass Photosensitivity and Relaxation—Continued

BM2A.5 • 11:45
Laser Wavelength Effects on the Refractive Index Change of Waveguides Written by Femtosecond Pulses in Silica Glasses, Vincenzo De Michele[1], Maxime Royon[1], Emmanuel Marin[1], Antonino Alessi[1], Guanghua cheng[3], Guodong Zhang[3], Razvan Stoian[1], Marco Cannas[2], Youcef Ouerdane[1]; [1]*Laboratoire Hubert Curien, France;* [2]*Dipartimento di Fisica e Chimica, Università degli Studi di Palermo, Italy;* [3]*State Key Laboratory of Transient Optics and Photonics, China.* We investigate the influence of two fs-laser wavelengths (343 and 800 nm) on the induced refractive index change (Δn) of waveguides written in silica materials. Results show that Δn is higher for waveguides photo-inscribed with UV photons.

BM2A.6 • 12:00 Invited
Inherent and Strain-assisted Radiation-induced Self-trapped Holes in Pure-silica Optical Fibers, Alexander L. Tomashuk[1]; [1]*Fiber Optics Research Center of the Russian Academy of Sciences, Russia.* Radiation-induced self-trapped holes (STHs) in silica optical fibers fall into two classes: those inherent, occurring in least strained network fragments, and those strain-assisted. The STH properties are reviewed based on this classification.

IM2B • Nanophotonics—Continued

IM2B.5 • 12:00 Invited
From Inverse Design to Implementation of Robust Nanophotonics, Jelena Vuckovic[1]; [1]*Spilker Bldg for Engineer & Applied Sci, Stanford Univ., USA.* We have recently developed a computational approach to inverse-design photonics based on desired performance, with fabrication constraints and structure robustness incorporated in design process.

NpM2C • Mode Locking—Continued

NpM2C.5 • 11:45
Bifurcation Analysis of Temporal Localized States in Passively Mode-locked Semiconductor Lasers, Svetlana Gurevich[1,2], Christian Schelte[3,1], Julien Javaloyes[3]; [1]*Physics, Inst. for Theoretical Physics, Germany;* [2]*Physics, Center for Nonlinear Science (CeNoS), Germany;* [3]*Universitat de les Illes Balears, Spain.* We study the emergence and the stability of temporal localized structures in a passively mode-locked laser. We show that additional multi-pulse solutions exist and disclose the pulse instabilities leading to complex temporal oscillations.

NpM2C.6 • 12:00
Performance Optimisation of Dual-pump NALM Fibre Laser using Machine Learning Inference, Ilya Gukov[5,4], Sonia Boscolo[1], Christophe Finot[2], Sergei Turitsyn[1,3]; [1]*Aston Inst. of Photonic Technologies, Aston Univ., UK;* [2]*Laboratoire Interdisciplinaire Carnot de Bourgogne, CNRS-Universite' de Bourgogne-Franche Comte', France;* [3]*Aston-NSU Joint Centre for Photonics, Novosibirsk State Univ., Russia;* [4]*Skolkovo Inst. of Science and Technology, Russia;* [5]*Moscow Inst. of Physics and Technology, Russia.* We apply predictive regression to find optimum operating regimes in a recently proposed layout of a flexible Figure-8 laser having two independently pumped segments of active fibre in its bidirectional ring.

NpM2C.7 • 12:15
A Functional Mapping for Passively Mode-locked Semiconductor Lasers, Julien Javaloyes[1], Christian Schelte[1], Svetlana Gurevich[2,3]; [1]*Universitat de les Illes Balears, Spain;* [2]*Physics, Inst. for Theoretical Physics, Germany;* [3]*Physics, Center for Nonlinear Science (CeNoS), Germany.* We present a modern approach for the analysis of passively mode-locked semiconductor lasers that allows for efficient parameter sweeps, time jitter analysis including slow (e.g. thermal) processes or diffractive transverse dynamics.

NoM2D • Lasers and LED Gain Media—Continued

NoM2D.3 • 11:45
Quantum Dot Semiconductor Disk Lasers: Record Performance Depending on Growth Techniques, Cesare Alfieri[1], Dominik Waldburger[1], Jacob Nuernberg[1], Matthias Golling[1], Ursula Keller[1]; [1]*ETH Zürich, Switzerland.* We investigate the benefits of quantum dots (QDs) as gain media for semiconductor disk lasers. Stranski-Krastanov QDs efficiently reach the shortest sub-200-fs pulses, while submonolayer QDs offer record output powers in continuous wave operation.

NoM2D.4 • 12:00
Radiative Energy Transfer in Color-conversion LEDs, Rustamzhon Melikov[1], Daniel Aaron Press[1], Baskaran Ganesh Kumar[1], Sadra Sadeghi[1], Sedat Nizamoglu[1]; [1]*Koc Univ., Turkey.* We developed a matrix method that calculates and reveals all the radiative energy transfer processes of absorption, reabsorption, inter-absorption and their iterative and combinatorial interactions in down-conversion layer of a light-emitting diode.

NoM2D.5 • 12:15
Pockels-Effect Materials for Plasmonic Modulators, Andreas Messner[1], Christian Haffner[1], Wolfgang Heni[1], Ueli Koch[1], Juerg Leuthold[1]; [1]*ETH Zurich, Switzerland.* Pockels effect-based plasmonic modulators are in the scope of recent research. We compare the characteristics of the linear electro-optic effect in both electro-optic organic and ferroelectric materials and derive a device performance estimate.

SeM2E • Biomedical Sensors I—Continued

SeM2E.5 • 11:45
Micro-fluidic based Fiber Optic Sensor for the Detection of DENV II E Proteins, Yasmin Mustapha Kamil[1], Muhammad Hafiz Abu Bakar[1], Mohd Hanif Yaakob[1], Mohd Adzir Mahdi[1], amir syahir[1], Asrulnizam Abd Manaf[2], Intan Sue Liana Abd Hamid[2]; [1]*Universiti Putra Malaysia, Malaysia;* [2]*Universiti Sains Malaysia, Malaysia.* We report an optical based sensor integrated in a micro-fluidic channel for the detection of DENV II E protein. The antibody-functionalized sensor exhibited good selectivity with a sensitivity value of 5.87 nM/nm.

SeM2E.6 • 12:00
Raman Spectroscopy and Biochemical Modeling of Ex-vivo Breast Tissues and Deparaffinized Tissue Samples, Aditya Pandya[1,2], Carl Kumaradas[1], Alexandre Douplik[1,2]; [1]*Ryerson Univ. , Canada;* [2]*Inst. of Biomedical Science and Technology, Canada.* Raman spectroscopy (RS) can provide a molecular vibrational fingerprint of an analyte. In this study, RS was used to distinguish normal tissues from tumor tissues

SeM2E.7 • 12:15
Non-invasive Multiparameter Fiber Optic Respiratory Breathing Monitor, Edgar Mendoza[1]; [1]*Redondo Optics, USA.* Our group is developing a minimally invasive, multi-parameter, fiber optic respiratory breathing monitor for continuous monitoring of the breathing activity of infants and children suffering from respiratory disorders in high risk conditions.

12:30–14:00 Lunch *(on own)*

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

NeM2F • Reliable Multi-layer Networking—Continued

NeM2F.4 • 12:00
Robust Optical Networks with Emerging Coherent Technologies and Traffic Trends, Onur Turkcu[1], Abishek Gopalan[1], Biao Lu[1], Marco Sosa[1], Wayne Wauford[1], Moran Roth[1], Steve Sanders[1]; [1]*Infinera, USA.* We analyze the impact of cloud, mobile, and NFV architectures on transport networks using advanced traffic models and emerging optical technologies. We show robustness of converged optical/digital switching designs with carrier speeds up to 600Gb/s.

NeM2F.5 • 12:15
Distributed Machine Learning Location Algorithm for Reliable C-RAN, Bahare M. Khorsandi[1], Cristina De Castro[2], Carla Raffaelli[1], Federico Tonini[1]; [1]*DEI - Univ. of Bologna, Italy;* [2]*IEIIT-CNR, Italy.* Two-phase distributed machine learning algorithm is proposed for reliable BBU hotel location in C-RAN. The effectiveness of the approach in optimizing the cost, in terms of BBU hotels, hops and wavelengths, is compared with centralized ILP solution.

SpM2G • Datacenter Interconnection—Continued

SpM2G.4 • 11:45
Transponder Requirements for 600 Gb/s Data Center Interconnection, Nelson M. Cost[1], Antonio Napoli[3], Talha Rahman[3], João Pedro[1,2]; [1]*Coriant Portugal, Germany;* [2]*Instituto de Telecomunicações, Instituto Superior Técnico, Universidade de Lisboa, Portugal;* [3]*Coriant Germany, Germany.* The requirements for 600 Gb/s single wavelength transmission in short links, namely data center interconnections, are assessed. It is shown that 600 Gb/s transmission is possible using available components and digital pre-emphasis.

SpM2G.5 • 12:00 Invited
DSP for Single-sideband Direct-detection Systems, Zhe Li[1], M.Sezer Erkilinc[2], Kai Shi[3], Eric Sillekens[2], Lidia Galdino[2], Tianhua Xu[4], Benn Thomsen[3], Polina Bayvel[2], Robert Killey[2]; [1]*200 Precision Road, Finisar Corporation, USA;* [2]*Optical Networks Group, UCL, UK;* [3]*Microsoft Research Ltd, UK;* [4]*School of Engineering, Univ. of Warwick, UK.* We review signal-signal beat interference mitigation techniques for direct-detection systems. Simulation and experiments have been carried out for ≥ 100 Gb/s/λ WDM systems transmitting over up to 160 km single-span SSMF.

SoM2H • Novel Fibers and Materials—Continued

SoM2H.4 • 12:00 Invited
Low Nonlinearity Fibers, Peter D. Dragic[1], Maxime Cavillon[2], Courtney Kucera[2], Nanjie Yu[3], Thomas Hawkins[2], John Ballato[2]; [1]*3106 Micro and Nanotechnology Lab, Univ of Illinois at Urbana-Champaign, USA;* [2]*Clemson Univ., USA;* [3]*Univ. of Illinois at Urbana-Champaign, USA.* Through judicious selection of glass composition, optical fibers with reduced susceptibility to deleterious light-matter interactions are achieved. The current state and future development of low nonlinearity fiber using this approach are discussed.

NpM2I • Quantum Applications of Nonlinear Photonic Devices—Continued

NpM2I.4 • 11:45
Photon Pair Nanosources with Hybrid Nonlinear/Plasmonic Antennas, Guillaume Laurent[1], Nicolas Chauvet[1], Gilles Nogues[1], Aurélien Drezet[1], Guillaume Bachelier[1]; [1]*CNRS - Université Grenoble Alpes, Institut Néel, France.* Nanoscale photon pair generation is quantitatively investigated in hybrid nonlinear/plasmonic antennas by coupling quantum and numerical approaches. We demonstrate that measureable signals are reachable at the single nanostructure level.

NpM2I.5 • 12:00
Generation of Photon and Plasmon Pairs by a Nonlinear Semiconductor Nanoparticle, Nikita A. Olekhno[1], Mihail Petrov[1,2], Ivan Iorsh[1]; [1]*Department of Nanophotonics and Metamaterials, ITMO Univ., Russia;* [2]*Department of Physics of Condensed Matter, St Petersburg Academic Univ., Russia.* In the present work, we consider the generation of entangled photon and plasmon-polariton pairs in the process of spontaneous parametric downconversion of light by a nanoparticle.

NpM2I.6 • 12:15
Generation of Spectrally Factorizable Counterpropagating Photon Pairs in Photonic Crystal Waveguides, Sina Saravi[1], Thomas Pertsch[1], Frank Setzpfandt[1]; [1]*Abbe Center of Photonics, Friedrich Schiller Univ. Jena, Germany.* We show how photonic crystal waveguides can generate and engineer spectrally factorizable photon pair states, through modally phase-matching a counterpropagating spontaneous parametric down-conversion process, without the need for periodic poling.

SeM2J • Metrology—Continued

SeM2J.5 • 11:45
Towards SPDC Spectroscopy on a $LiNbO_3$ Chip, Alexander S. Solntsev[1,2], Pawan Kumar[2], Thomas Pertsch[2], Andrey A. Sukhorukov[3], Frank Setzpfandt[2]; [1]*Univeristy of Technology Sydney, Australia;* [2]*Univ. of Jena, Germany;* [3]*Australian National Univ., Australia.* We demonstrate experimentally on-chip-integrated spontaneous parametric down-conversion spectroscopy by generating biphotons in a LiNbO3 waveguide and using signal photon detection in the NIR to study the dynamics of idler photons in the MIR.

SeM2J.6 • 12:00 Invited
Chiral Plasmonic Tips and Colloidal Nanoparticles, David Norris[1]; [1]*ETH Zürich, ETH Zurich, Switzerland.* We fabricate plasmonic tips and nanoparticles with a chiral shape. Due to their handedness, they can exhibit intense chiral near fields. We also discuss a far-field strategy to characterize these chiral electromagnetic hotspots.

12:30–14:00 Lunch *(on own)*

Room D1.1

Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials

Room E5

Integrated Photonics Research, Silicon, and Nano-Photonics

Room E3

Nonlinear Photonics

Room D1.2

Novel Optical Materials and Applications

Room D7.1

Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

14:00–16:00
BM3A • Symposium: Optical Fiber Sensing Technologies for Sensing/Monitoring in Harsh Environment I
Presider: Guillaume Laffont; CEA Saclay, France

BM3A.1 • 14:00 Invited
Extreme Temperature Fiber Bragg Gratings for Spacecraft Applications, Richard J. Black[1]; *[1]2363 Calle Del Mundo, Intelligent Fiber Optic Systems, USA.* The space environment provides an extreme range of temperatures. Fiber Bragg grating (FBG) sensors can have spacecraft application from cryogenic temperatures to over 1200°C with example applications being fuel tanks and thermal protection systems (TPS).

BM3A.2 • 14:30
OFDR Distributed Temperature Sensing at 800°C on a Fiber with Enhanced Rayleigh Scattering Profile by Doping, Patrick Bulot[1], Odile Critini[2], Monika Bouet[2], Aurélie Demol[2], Laurent Bigot[2], Géraud Bouwmans[2], Stéphane Plus[2], Rémi Habert[2], Guillaume Laffont[1], Marc Douay[2]; *[1]Laboratoire Capteurs et Architectures Électroniques, CEA LIST, France; [2]UMR 8523 - PhLAM - Physique des Lasers Atomes et Molécules, Univ. Lille, CNRS, France.* Distributed temperature sensing is performed up to 800°C by Optical Frequency Domain Reflectometry on a fiber with enhanced Rayleigh scattering profile. This fiber was drawn from a preform core-doped by zirconia-coated gold nanoparticles.

BM3A.3 • 14:45
Instrumentation of a Lead-bismuth Eutectic Cooled Nuclear Fuel Assembly using Fibre Bragg Gratings for Characterizing the Flow-induced Vibrations, Ben De Pauw[1,2], Thomas Geernaert[1,2], Francis Berghmans[1,2], Graham Kennedy[3], Katrien Van Tichelen[3]; *[1]Vrije Universiteit Brussel, Belgium; [2]Flanders Make, Belgium; [3]Belgian Nuclear Research Centre (SCK-CEN), Belgium.* We assess the vibration characteristics of a lead-bismuth cooled nuclear fuel assembly with 226 fibre Bragg gratings. We validate the mounting procedure and demonstrate that vibration levels corresponding to a few micro-strains can be measured.

14:00–16:00
IM3B • Silicon Photonics Integration
Presider: Bert Offrein; IBM Research GmbH, Switzerland

IM3B.1 • 14:00 Invited
Silicon Photonic Multi-chip Module Integration Platform, Keren Bergman[1], Nathan Abrams[1]; *[1]Electrical Eng Dept, Columbia Univ., USA.* Silicon photonic hybrid integration multi-chip module (MCM) platforms can deliver high-functionality and energy-efficient operation. The platform enables flexible interconnectivity among memory and compute modules for disaggregated architectures.

IM3B.2 • 14:30
Integrated CMOS-compatible Q-Switched-mode-locked Laser at 1.9µm with On-chip Artificial Saturable Absorber, Katia Shtyrkova[1], Patrick T. Callahan[1], Nanxi Li[1,2], E. Salih Madgen[1], Michael R. Watts[1], Franz X. Kartner[1,3], Erich P. Ippen[1]; *[1]Massachusetts Inst. of Technology, USA; [2]School of Engineering and Applied Sciences, Harvard Univ., USA; [3]Center for Free-Electron Laser Science, Deutsches Elektron-Synchrotron, Germany.* We present a CMOS-compatible, Q-switched mode-locked integrated laser at 1.9µm with a compact footprint of 23.6x0.6x0.78mm, a Q-switched rate of 720kHz, a mode-locked rate of 1.2GHz, and pulse durations of 215fs.

IM3B.3 • 14:45
Generation of Multiphoton Entangled Quantum States in a Single Silicon Nanowire, Ming Zhang[2], Lantian Feng[1], Daoxin Dai[2], Xifeng Ren[1]; *[1]Univ Sci & Tech China, China; [2]Zhejiang Univ., China.* We demonstrate that a silicon nanowire can be used to generate four-photon polarization entangled states. Our work paves a way for the revolution of multiphoton quantum science.

14:00–16:00
NpM3C • 2D Nonlinear Nanostructures
Presider: Dragomir Neshev; Australian National Univ., Australia

NpM3C.1 • 14:00 Invited
Collective Nonlinear Optical Effects on Metasurfaces, Tal Ellenbogen[1,3], Lior Michaeli[1,2], Shay Keren-Zur[1]; *[1]Department of Physical Electronics, Tel-Aviv Univ., Israel; [2]School of Physics, Tel Aviv Univ., Israel; [3]Center for Light Matter Interaction, Tel Aviv Univ., Israel.* We will discuss the effect of collective nonlinear interaction between building blocks of metasurfaces and show how these effects can be used to enhance and control the total nonlinear interaction.

NpM3C.2 • 14:30
Enhanced Optical Nonlinearity of Metasurfaces Made of Patterned Graphene Nanoribbons, Qun Ren[1], Jian Wei You[1], Nicolae Panoiu[1]; *[1]Univ. College London, UK.* We demonstrate that the effective optical nonlinearity of a graphene nanoribbon metasurface can be enhanced by 4 orders of magnitude as compared to that of a graphene sheet via a double-resonant plasmon excitation mechanism.

NpM3C.3 • 14:45
Kerr Nonlinear Properties of Isotropic and Anisotropic 2D Nonlinear Plasmonic Waveguides, Mahmoud Elsawy[1,2], Gilles Renversez[1,2]; *[1]Aix-Marseille Université, France; [2]Institut Fresnel CNRS, France.* We illustrate a general approach valid for anisotropic 2D Kerr nonlinear waveguides that generalyze the approaches developed for isotropic waveguides. This numerical approach is based on the power-dependent change of the complex propagation constant.

14:00–16:00
NoM3D • Optical Glasses, Crystals and Ceramics I
Presider: Lynda Busse; US Naval Research Laboratory, USA

NoM3D.1 • 14:00 Invited
Next Generation 3D Printing: The Emergence of Enabling Materials, Bastian E. Rapp[1]; *[1]Karlsruhe Inst. of Technology, Germany.* This paper introduces novel materials for additive manufacturing and 3D printing with a wide variety of applications in research, industry and everyday life.

NoM3D.2 • 14:30 Invited
Stoichiometry Assessment by LIBS for the Fabrication of Optical Ceramics, Romain M. Gaume[1], sudeep Pandey[1], Matthew Julian[1], Matthieu Baudelet[1]; *[1]4304 Scorpius street, Univ. of Central Florida, CREOL, USA.* This talk will discuss our most recent results on the use of Laser-Induced Breakdown Spectroscopy (LIBS) in assisting the fabrication of YAG and spinel transparent optical ceramics.

14:00–16:00
SeM3E • Biomedical Sensors II
Presider: Björn Reinhard; Boston Univ., USA

SeM3E.1 • 14:00 Invited
Lasing Microresonators: A New Paradigm for Biosensing Applications, Alexandre Francois[1,2], Nicolas Riesen[1,2], Tess Reynolds[2], Jonathan Hall[2], Yvonne Kang[1], Tanya Monro[1,2]; *[1]Univ. of South Australia, Australia; [2]The Univ. of Adelaide, Australia.* Lasing microresonators supporting Whispering Gallery Modes have now become contenders to more established label-free sensing techniques. We review the progress made in this field, discussing the intrinsic limitations and future prospects.

SeM3E.2 • 14:30
Sub-nano-Tesla, Shield-less, Field Compensation-Free Inelastic Wave Mixing Magnetometry for Bio-magnetism, Lu Deng[1], Yvonne Y. Li[2], Feng Zhou[1], Eric Zhu[3], Edward Hagley[1]; *[1]National Inst of Standards & Technology, USA; [2]Dana-Farber Cancer Inst. and Harvard Univ. Medical School, USA; [3]Univ. of Toronto, Canada.* We report an inelastic-wave-mixing-enhanced atomic magnetometry scheme that results in sub-nT magnetic field detection at human-body temperatures without employing magnetic field shielding, field compensation, and RF-modulation spectroscopy.

SeM3E.3 • 14:45
Multi-optrode Arrays: a New Path Towards Brain/Machine Interface, Francois Ladouceur[1], Nigel Lovell[1], Josiah Firth[1], Amr Al Abed[1], Leonardo Silvestri[1]; *[1]Univ. of New South Wales, Australia.* Brain/machine interfaces will play a significant role in the coming decades. We present here our latest work on multi-optrode arrays, a technology based on ferroelectric liquid crystals.

Room D3.2	Room D5.2	Room D7.2	Room E1.1	Room E1.2
Photonic Networks and Devices	Signal Processing in Photonic Communications	Specialty Optical Fibers	Integrated Photonics Research, Silicon, and Nano-Photonics	Novel Optical Materials and Applications

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

14:00–16:00
NeM3F • Disaggregated Networking and Computing
Presider: Nick Parsons; HUBER+SUHNER Polatis, Inc, UK

NeM3F.1 • 14:00 Invited
A Distance Relationship in the Cloud: Experiences and Challenges in Architecting and Prototyping Disaggregated Memory Systems, Kostas Katrinis[1]; [1]*IBM Research, Ireland, Ireland.* Abstract not available.

NeM3F.2 • 14:30 Invited
WDM Routing for Edge Data Centers and Disaggregated Computing, Theoni Alexoudi[2,3], Charoula Mitsolidou[2,3], Stelios Pitris[2,3], Jong Hun Han[1], Arash Farhadi Beldachi[1], Neelakandan Manihatty Bojan[1], Yanni Ou[1], Emilio Hugues-Salas[1], Ronald Broeke[4], Reza Nejabati[1], Nikos Pleros[2,3], Dimitra Simeonidou[1], George T. Kanellos[1]; [1]*HPN - High Performance Networks Group, Univ. of Bristol, UK;* [2]*Department of Informatics, Arsitotle Univ. of Thessaloniki, Greece;* [3]*Center for Interdisciplinary Research and Innovation, Aristotle Univ. of Thessaloniki, Greece;* [4]*Bright Photonics B.V., Netherlands.* In the present communication we review recent advances in o-band silicon photonics transceivers and wavelength routers and demonstrate their potential application in board-level and rack level interconnection for edge and disaggregated data centers.

14:00–16:00
SpM3G • Long-haul Transmission I
Presider: Jin-Xing Cai; TE SubCom, USA

SpM3G.1 • 14:00 Invited
Interplay of Probabilistic Shaping and the Unsupervised Blind Phase Search Algorithm, Fábio Barbosa[2,1], Jacklyn D. Reis[1], Darli Mello[2]; [1]*Idea! Electronic Systems, Brazil;* [2]*Univ. of Campinas, Brazil.* We investigate the impact of probabilistic shaping (PS) on the unsupervised blind phase search algorithm (BPS). The results indicate that PS can impair the BPS performance in practical implementation scenarios.

SpM3G.2 • 14:30
Dimensions-reduced Volterra-based Digital Predistortion for Band-Limited Nonlinear Components, Hananel Faig[1], Yaron Yoffe[1], Dan Sadot[1]; [1]*Ben-Gurion Univ. of the Negev, Israel.* A dimensions-reduced digital pre-distorter based on Volterra series for band-limited nonlinear components is proposed. Using orthogonal polynomials enables the selection of the most dominant dimensions resulting in significant complexity reduction

SpM3G.3 • 14:45
How to Statistically Model Coherent MPI in Optical Communications?, Luis G. Cancela[1,2], João O. Pires[3,2]; [1]*Instituto Universitário de Lisboa (ISCTE-IUL), Portugal;* [2]*Instituto de Telecomunicações, Portugal;* [3]*Instituto Superior Técnico, Portugal.* The Beta distribution is used to model coherent MPI in optical communications and its fitness to describe experimental results is evaluated. It fits quite well to symmetric scenarios, but has some troubles when skewness matters.

14:00–16:00
SoM3H • Fiber Lasers I
Presider: Jens Limpert; Friedrich Schiller Univ, Jena, Germany

SoM3H.1 • 14:00 Invited
Ultrafast Fiber Lasers at 2 Microns and Applications, Laure Lavoute[1], Dmitry Gaponov[1], Jean-Thomas Gomes[1], Mathieu Jossent[1], Kirill Zaytsev[1], Nicolas Ducros[1], Ammar Hideur[1], Ferenc Borondics[2], Hamed Merdji[3], Sebastien Fevrier[1]; [1]*Novae, France;* [2]*Synchrotron soleil, France;* [3]*CEA, France.* This paper reviews our recent results on the development of ultrafast (100 ps – 100 fs) fiber lasers at 2 µm wavelength and their applications from mid-infrared spectroscopy to UV generation in graphene and micromachining of polymers.

SoM3H.2 • 14:30
Tunable Dual-wavelength Laser in the 2 µm Region, Based on a Polarization-maintaining Large Mode Area Thulium-doped Fiber, Mostafa Sabra[1], Baptiste Leconte[1], Romain Dauliat[1], dia darwich[1], Raphael Jamier[1], Georges Humbert[1], Kay Schuster[2], Philippe ROY[1]; [1]*Xlim research Inst., France;* [2]*Leibniz Inst. of Photonic Technology, Germany.* We present the development of a tunable dual-wavelength fiber laser, based on a thulium-doped fiber and Volume Bragg Gratings (VBG). Dual-wavelength difference is continuously tunable from 1 nm to 144 nm (0.08-11.47 THz).

SoM3H.3 • 14:45
Tm/Ho-Codoped Silica Fiber Lasers Controlled with Dynamic and Tunable Microbending System, Hajime Sakata[1], Shimpei Dodo[1], Keisuke Hashimoto[1], Yuma Ushiro[1], Fuma Kosaka[1]; [1]*Shizuoka Univ., Japan.* We present tunable and Q-switched laser operation by turning a single-mode fiber into wavelength-selective attenuators in Tm/Ho-codoped fiber ring resonators. Peak pulse power of 6.3 W is attained with a pump laser diode at 168 mW.

14:00–16:00
IM3I • Application of Frequency Combs and Microresonators
Presider: Judith Su; Univ. of Arizona, USA

IM3I.1 • 14:00 Invited
Dual-comb Spectroscopy with One Unstabilized Semiconductor Laser, Jacob Nuernberg[1], Cesare Alfieri[1], Z. Chen[2], Dominik Waldburger[1], Matthias Golling[1], Nathalie Picque[2], Ursula Keller[1]; [1]*Physics Department, ETH Zurich, Switzerland;* [2]*Max-Planck Inst. of Quantum Optics, Germany.* A single free-running dual-comb MIXSEL is used to perform dual-comb spectroscopy on water vapour and acetylene. This ulrafast laser technology is based on passively modelocked optically pumped semiconductor lasers.

IM3I.2 • 14:30 Invited
A Brillouin Gyroscope using Chip-integrable High-Q Optical Cavities, Kerry J. Vahala[1]; [1]*Mail code 128-95, California Inst. of Technology, USA.* A chip-based, micro-optical gyroscope is demonstrated that uses counter-propagating Brillouin lasers to measure rotation as a Sagnac-induced frequency shift. Demonstration of rotation measurement below the Earth rotation rate is presented.

14:00–16:00
NoM3J • Nonlinear Optical Materials and Thin Films
Presider: Christian Haffner; ETH Zurich, Switzerland

NoM3J.1 • 14:00 Invited
Periodically Poled KTP with Sub-wavelength Periodicity: Nonlinear Optical Interactions with Counter Propagating Waves, Carlota Canalias[1], Andrius Zukauskas[1], Anne-Lise Viotti[1], Riaan Coetzee[1], Charlotte Liljestrand[1], Valdas Pasiskevicius[1]; [1]*KTH- Albanova, Kungliga Tekniska Hogskolan, Sweden.* We present the recent development on periodically poled nonlinear crystals with sub-wavelength periodicities as short as 500 nm. These devices show conversion efficiencies larger than 45%. Their unique properties will be presented and discussed.

NoM3J.2 • 14:30
Study of Absorption Saturation in InN Thin Films through the Z-Scan Technique at 1.55 µm, Marco Jiménez-Rodríguez[1], Laura Monroy[1], Arántzazu Núñez-Cascajero[1], Eva Monroy[2], Miguel González-Herráez[1], Fernando B. Naranjo[1]; [1]*Univ. of Alcala, Spain;* [2]*CEA, INAC-SP2M, 2Univ. Grenoble-Alpes, France.* We investigate the nonlinear absorption saturation effect of thin InN films at 1.55 µm through the z-scan technique, varying the pumping peak intensity. Over 30 % nonlinear change in sample transmittance has been estimated.

NoM3J.3 • 14:45
Measurement of Thermal Properties of Nonlinear Optical Materials over a Wide Temperature Range, Jean Wei[1], Valentin Petrov[2], Shekhar Guha[1]; [1]*US Air Force Research Laboratory , USA;* [2]*Max-Born-Inst. for Nonlinear Optics and Ultrafast Spectroscopy, Germany.* Values of thermal conductivity and specific heat of some nonlinear optical crystals of recent interest were measured over a wide range of temperatures for the first time.

Room D1.1	Room E5	Room E3	Room D1.2	Room D7.1
Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials	Integrated Photonics Research, Silicon, and Nano-Photonics	Nonlinear Photonics	Novel Optical Materials and Applications	Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

BM3A • Symposium: Optical Fiber Sensing Technologies for Sensing/ Monitoring in Harsh Environment I—Continued

BM3A.4 • 15:00
Flexible Phase-mask Writing Technique of Robust Femtosecond FBG for Distributed Sensing, Joé Habel[1], Tommy Boilard[1], Younès Messaddeq[1], Francois Trepanier[2], Martin Bernier[1]; [1]*COPL, Canada;* [2]*TeraXion Inc., Canada.* An array of ten distributed femtosecond fibers Bragg gratings (FBG) was written through the polyimide coating of a standard silica fiber using a single period uniform phase-mask. All FBG wavelengths are spectrally distributed over 40nm.

BM3A.5 • 15:15
Aerospace-grade Compatible Surface Mounted Optical Fibre Sensor for Structural Health Monitoring of Composite Structures, Sidney Goossens[1,2], Ben De Pauw[1,2], Thomas Geernaert[1,2], Mohammad Saleh Salmanpour[3], Zahra Sharif Khodaei[3], Hugo Thienpont[1,2], Francis Berghmans[1,2]; [1]*Vrije Universiteit Brussel, Belgium;* [2]*Flanders Make, Belgium;* [3]*Imperial College London, UK.* We suggest a robust optical fibre sensor package and its installation method for structural health monitoring purposes on carbon fibre reinforced polymer structures with potential to meet aerospace standards.

BM3A.6 • 15:30
Non-intrusive Fluid Flow Measurement by FBG Sensing of Flow-induced Vibrations, Paula M. Gouvea[1], Khrissy A. Medeiros[1], Alexandre S. Ribeiro[1], Carlos R H. Barbosa[1], José R. d'Almeida[1], Arthur M. Braga[1]; [1]*Pontificia Univ Catolica Rio de Janeiro, Brazil.* We developed a non-intrusive flow sensor for pipe flow based on FBG and FIV. The standard deviation of the strain time series signal obtained by the FBG and the flow rate present a quadratic dependence.

IM3B • Silicon Photonics Integration—Continued

IM3B.4 • 15:00
All-optical Sampling of a 40 GHz Signal using Hybrid Silicon Nanophotonics, Léa Constans[1,2], Sylvain Combrié[1], Dorian Sanchez[2,3], Fabrice Raineri[2,3], Alfredo De Rossi[1,3]; [1]*Thales Research & Technology, France;* [2]*Université Paris Saclay, France;* [3]*C2N, France.* Towards higher data rates using optical signal processing, we fabricated an all- optical gate made of III-V semiconductor integrated on Silicon. All-optical sampling of a 40 GHz signal was demonstrated

IM3B.5 • 15:15 Invited
Silicon Micro/Nanophotonic Optical Phased Arrays for Beam Steering, Michael Kossey[1], Neil MacFarlane[1], Keith Petrillo[2], Charbel Rizk[1], Amy C. Foster[1]; [1]*3400 N. Charles Street, Johns Hopkins Univ., USA;* [2]*Johns Hopkins Univ. Applied Physics Laboratory, USA.* Current OPA technologies are discussed in both the broadside and end-fire geometry. The design and performance of our end-fire OPA is discussed, and the performance of our OPA is compared to other current technologies.

NpM3C • 2D Nonlinear Nanostructures—Continued

NpM3C.4 • 15:00
Comparison of SERS-activity of Silver Dendrites and Nanoparticles on Structured Silicon, Nadia Khinevich[1], Siarhei Zavatski[1], Hanna Bandarenka[1], Kahramon Mamatkulov[2], Nelya Doroshkevich[2], Grigory Arzumanyan[2]; [1]*Belarusian State Univ. of Informatics and Radioelectronics, Belarus;* [2]*, Joint Inst. for Nuclear Research, Russia.* Silver dendrites and nanoparticles demonstrating activity in surface enhanced Raman scattering grown via immersion deposition on structured Si were found to detect DTNB adsorbed from its 10^{-16} and 10^{-12} M solutions on the Ag surfaces respectively.

NpM3C.5 • 15:15
Stimulation of Waveguide-enhanced Raman Spectroscopy of Liquids, Stéphane Clemmen[1,2], Haolan Zhao[1,2], Ali Raza[1,2], Roel Baets[1,2]; [1]*Photonics Research Group, Ghent Univ., Belgium;* [2]*Center for Nano- and Biophotonics, Ghent Univ., Belgium.* We report the experimental demonstration of stimulated Raman spectroscopy of liquids enhanced by nanophotonic waveguides. We show a signal enhancement of 10^5 versus the spontaneous counterpart and set the way towards 10^3 even higher signals.

NpM3C.6 • 15:30
Two-dimensional Semiconductors: a Novel Platform for Micron-sized Phase-matching-free Parametric Oscillators, Andrea Marini[1], Alessandro Ciattoni[2], Carlo Rizza[2], Claudio Conti[3,4]; [1]*Department of Physical and Chemical Sciences, Univ. of L'Aquila, Italy;* [2]*CNR-SPIN, Italy;* [3]*Inst. for Complex Systems (ISC-CNR), Italy;* [4]*Department of Physics, Univ. Sapienza, Italy.* We devise a novel kind of parametric micro-resonators adopting monolayer transition-metal dichalcogenides as quadratic nonlinear materials, showing that they are free of phase-matching requirements owing to their surface-like nonlinear interaction.

NoM3D • Optical Glasses, Crystals and Ceramics I—Continued

NoM3D.3 • 15:00
Ultra-precision Surface Figuring of Optical Aluminium Devices, Jens Bauer[1], Melanie Ulitschka[1], Frank Frost[1], Thomas Arnold[1], Lucas Alber[2,3], Markus Sondermann[2,3], Gerd Leuchs[2,3]; [1]*Leibniz Inst. of Surface Engineering, Germany;* [2]*Max-Planck Inst. for the Science of Light, Germany;* [3]*Friedrich-Alexander Univ. Erlangen-Nuremberg, Germany.* Direct aluminium surface figuring is succeeded for the first time up to 1 µm in height while preserving surface roughness. Sub-aperture reactively-driven ion beam tools allow ultra-precision figure error-correction of aspherical and freeform mirrors.

NoM3D.4 • 15:15
Template Assisted Dewetting of Optical Glasses for Large Area, Flexible and Stretchable All Dielectric Metasurfaces, Tapajyoti Das Gupta[1], Louis Martin-Monier[1], Wei Yan[1], Tùng Nguyen[1], Alexis Page[1], Yunpeng Qu[1], Fabien Sorin[1]; [1]*Ecole Polytechnique Federale de Lausanne, Switzerland.* Template assisted dewetting of chalcogenide glasses is proposed for low-cost manufacturing of large area all-dielectric metasurfaces on non rigid substrates. A fine control over particle gap is achieved, leading to sharp Fano resonances

NoM3D.5 • 15:30
When the Structure Becomes Insignificant: Invariance of the Mean Path Length in Light-scattering Media, Romolo Savo[1], Romain Pierrat[2], Ulysse Najar[1], Stefan Rotter[3], Rémi Carminati[2], Sylvain Gigan[1]; [1]*Laboratoire Kastler Brossel, ENS-PSL Research Univ., CNRS, UPMC, France;* [2]*ESPCI Paris, PSL Research Univ., CNRS, Institut Langevin, France;* [3]*Inst. for Theoretical Physics, Vienna Univ. of Technology (TU Wien), Austria.* We experimentally demonstrate that the mean path length of scattered light in disordered media is independent of the medium's micro-structure, but only depends on its outer geometry.

SeM3E • Biomedical Sensors II—Continued

SeM3E.4 • 15:00
Protein Detection using Hollow-core Tube Lattice Fibers, Fabio Giovanardi[1], Annamaria Cucinotta[2], Andrea Rozzi[2], Roberto Corradini[2], Fetah Benabid[3], Luca Vincetti[1]; [1]*Department of Engineering "Enzo Ferrari", Univ. of Modena and Reggio Emilia, Italy;* [2]*Univ. of Parma, Italy;* [3]*Xlim Research Inst., France.* We report on the use hollow core tube lattice fibers as sensors of proteins. After a functionalization of the fiber it was infiltrated with a solution containing streptavidin and a red shift of the transmission spectrum was experimentally observed.

SeM3E.5 • 15:15
A Miniaturized Ball-lensed Fiber Optic NIR Transmission Spectroscopy-based Glucose Sensor, Silje S. Fuglerud[1], Karolina Milenko[1], Ine L. Jernelv[1], Astrid Aksnes[1], Reinold Ellingsen[1], Dag R. Hjelme[1]; [1]*NTNU, Norway.* A novel ball-lensed fiber transmission sensor is presented aimed at in vivo continuous glucose monitoring of diabetics. Preliminary results yield 20mM RMSE limited by mechanical instability. The design enables flexibility and further miniaturization.

SeM3E.6 • 15:30 Invited
Exploring the Nanoscale with Optoplasmonic Sensors, Frank Vollmer[1]; [1]*Max-Planck-Inst Physik des Lichts, Germany.* My laboratory is developing a new class of nanophotonic architectures by combining optically resonant dielectric microcavities with plasmonically resonant metal nanostructures to enable detection at the nanoscale with extraordinary sensitivity.

Room D3.2	Room D5.2	Room D7.2	Room E1.1	Room E1.2
Photonic Networks and Devices	Signal Processing in Photonic Communications	Specialty Optical Fibers	Integrated Photonics Research, Silicon, and Nano-Photonics	Novel Optical Materials and Applications

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

NeM3F • Disaggregated Networking and Computing—Continued

NeM3F.3 • 15:00 Invited
Disaggregation at the Optical Layer: Toward an Optical White Boxes Ecosystem?, Emilio Riccardi[1]; [1]*Telecom Italia (TIM), Italy.* Disaggregation applied to WDM optical networks is discussed from a telecommunication Operator's point of view. High level requirements, constrains and open issues are briefly highlighted in a context of full automation of the network lifecycle.

NeM3F.4 • 15:30 Invited
Silicon Photonics Enabling the Disaggregated Data Center, Madeleine Glick[1], Sebastien Rumley[1], Keren Bergman[1]; [1]*Department of Electrical Engineering, Columbia Univ., USA.* The interconnection network is a technology block to improved performance of the data center. Disaggregation enabled by silicon photonics is a route to low latency, cost and energy efficient solutions.

SpM3G • Long-haul Transmission I—Continued

SpM3G.4 • 15:00 Invited
Time-frequency Signal Processing Based on Fractional Fourier Transform for Optical Communications, Ming Tang[1], Huibin Zhou[1], Hexun Jiang[1], Xi Chen[1], Songnian Fu[1], Deming Liu[1]; [1]*Room 322, N5 building, 1037 Luoyu Road, Huazhong Univ of Science and Technology, China.* We demonstrate that time-frequency DSP based on fractional Fourier transform is accurate, efficient and robust to estimate linear transmission distortions in optical communications including timing offset, frequency offset and chromatic dispersion.

SpM3G.5 • 15:30 Invited
Quantum Communications, Nicolas Gisin[1]; [1]*Group of Applied Physics, Universite de Geneve, Switzerland.* Quantum communication is the art of transferring quantum states from one location to distant ones. Commercial applications cover Random Number and Cryptography. Research covers quantum repeaters and Device Independent Quantum Information Processing.

SoM3H • Fiber Lasers I—Continued

SoM3H.4 • 15:00
Multi-megawatt, Self-seeded Mamyshev Oscillator, Pavel Sidorenko[1], Walter P. Fu[1], Logan G. Wright[1], Frank W. Wise[1]; [1]*School of Applied and Engineering Physics, Cornell Univ., USA.* We demonstrate a fiber oscillator that is environmentally stable and self-seeded. The oscillator generates 190 nJ, linearly chirped pulses that can be compressed to 35 fs resulting in 3 MW peak power.

SoM3H.5 • 15:15
Design Rules of Isolator-free MIR All-fiber Theta Cavity Lasers, Svyatoslav Kharitonov[1], Sida Xing[1], Camille-Sophie Bres[1]; [1]*Ecole Polytechnique Federale de Lausanne, Switzerland.* We developed the theta laser model to adjust main design parameters (intracavity coupling ratios) for maximized laser output and confirmed its high accuracy experimentally. The model enables optimization of MIR rare-earth-doped all-fiber lasers.

SoM3H.6 • 15:30
Actively Q-switched Bismuth-doped Fiber Laser at 1.35 μm, Aleksandr Khegai[1,2], Mikhail Melkumov[1], Sergei Firstov[1], Konstantin Riumkin[1], Fedor Afanasiev[3], Alexey Lobanov[3], Alexey Abramov[3], Evgeny M. Dianov[1]; [1]*Fiber Optics Research Center of the Russian Academy of Sciences, Russia;* [2]*A M Prokhorov General Physics Inst. of the Russian Academy of Sciences, Russia;* [3]*Inst. of Chemistry of High-Purity Substances of the Russian Academy of Sciences, Russia.* Bismuth-doped fiber laser operating at 1.35 μm actively Q-switched by acousto-optic modulator is studied. The pulses of ~80 ns duration and ~10 μJ pulse energy at repetition rate in the range 250-5000 Hz were obtained.

IM3I • Application of Frequency Combs and Microresonators—Continued

IM3I.3 • 15:00
Stable Kerr Solitons for Optical-frequency Synthesis and Direct Frequency-comb Atomic Spectroscopy, Jordan Stone[1], Travis Briles[1], Liron Stern[1], Daryl Spencer[1], Tara Drake[1], John Kitching[1], Kartik Srinivasan[1], Scott A. Diddams[1], Scott Papp[1]; [1]*NIST, USA.* We explore frequency-stable Kerr-soliton systems, one using a dual-microcomb architecture for self-referencing and another using atomic spectroscopy. We demonstrate an integrated-photonics frequency synthesizer and rubidium-referenced soliton pulses.

IM3I.4 • 15:15 Invited
Nonlinear Optics in Hybrid Organic-inorganic Ultra High Q Integrated Microcavities, Andrea M. Armani[1], Xiaoqin Shen[1], Hyungwoo Choi[1], Jinghan He[1], Vinh Diep[1], Soheil Soltani[1]; [1]*Dept of Chem E and Mat Sci, Univ. of Southern California, USA.* By grafting oriented monolayers of highly nonlinear organic small molecules to the surface of conventional optical resonators, we demonstrate a new strategy for fabricating high performance Raman lasers and frequency combs.

NoM3J • Nonlinear Optical Materials and Thin Films—Continued

NoM3J.4 • 15:00
The Interesting Case of SHG from Extreme Nano-scaled Heterodimers, Avi Niv[1]; [1]*The Jacob Blaustein Inst.s for desert research, Ben-Gurion Univ. of the Negev, Israel.* Failure of known theory to predict the SHG from extreme nanoscaled heterodimers, and the success of harmonic charge oscillations and their quasistatic interactions, opens the way for a new kind of nonlinear light-matter interactions.

NoM3J.5 • 15:15
Accurate Measurements of Second-order Nonlinear-optical Coefficients of a UV-generating Wavelength-conversion Material: $LaBGeO_5$, Ichiro Shoji[1], Shinta Kawasaki[1], Yusuke Honda[1]; [1]*Chuo Univ., Japan.* We accurately measure the second-order nonlinear-optical coefficients of $LaBGeO_5$ at the fundamental wavelength of 1064nm using the wedge technique. The values of d_{11}, d_{22}, d_{33}, and d_{31} are 0.35, 0.63, 0.70 and 0.18pm/V, respectively.

NoM3J.6 • 15:30
Simultaneous Localization of Light and Spin Waves In Dielectric Magnetic Layered Structures for Enhanced Photon-magnon Interaction, Petros-Andreas Pantazopoulos[1], Nikolaos Stefanou[1], Evangelos Almpanis[2], Nikolaos Papanikolaou[2]; [1]*Section of Solid State Physics, Department of Physics, National and Kapodistrian Univ. of Athens, Greece;* [2]*Inst. of Nanoscience and Nanotechnology, NCSR "Demokritos", Greece.* We report on periodic structures of dielectric magnetic layers with a localized defect that confines light and spin waves, resulting in enhanced interaction and dynamical optical frequency shift through multi-magnon absorption/emission processes.

Room D1.1	Room E5	Room E3	Room D1.2	Room D7.1
Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials	Integrated Photonics Research, Silicon, and Nano-Photonics	Nonlinear Photonics	Novel Optical Materials and Applications	Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

BM3A • Symposium: Optical Fiber Sensing Technologies for Sensing/ Monitoring in Harsh Environment I—Continued

BM3A.7 • 15:45
Classification of Small-spot Direct UV Written Fiber Bragg Gratings Through Extreme Thermal Treatment, Senta L. Scholl[1], Alex Jantzen[1], Rex H. Bannerman[1], James Field[1], James C. Gates[1], Lewis J. Boyd[2], Peter G. Smith[1], Christopher Holmes[1]; [1]*Univ. of Southampton, UK;* [2]*Parker Aerospace, Parker Hannifin Corporation, UK.* The high intensity and continuous nature of small-spot direct UV writing makes characterisation of gratings types difficult by conventional approaches. Investigating the thermal response of gratings up to 850 °C allows elucidation of grating type.

IM3B • Silicon Photonics Integration—Continued

IM3B.6 • 15:45
Silicon Electro-optically Tunable Delay Line, Giuseppe Brunetti[1], Donato Conteduca[1], Francesco Dell'Olio[1], C. Ciminelli[1], Mario Nicola Armenise[1]; [1]*Politecnico di Bari, Italy.* The design of a continuously tunable optical delay line based on a compact graphene-based silicon Bragg grating has been reported. Its performance makes the proposed optical delay line suitable for beamsteering/ beamforming for phased array antennas.

NpM3C • 2D Nonlinear Nanostructures—Continued

NpM3C.7 • 15:45
Observation of 2D Semiconductor Dark Exciton Lifetime Using Two-photon Ultrafast Spectroscopy, Dmitry Panna[1], Krishna B. Balasubramanian[1], Jayakrishna Khatei[1], Leonid Rybak[1], Hadar Steinberg[2], Alex Hayat[1]; [1]*Technion, Israel;* [2]*The Racah Inst. of physics, The Hebrew Univ. of Jerusalem, Israel.* Using two-photon pump-probe on MoS_2 we excite directly dark-excitons and probe bright-excitonic population with femtosecond resolution. Non-monotonic density changes in bright-exciton population determine directly dark-exciton lifetime in monolayers.

NoM3D • Optical Glasses, Crystals and Ceramics I—Continued

NoM3D.6 • 15:45
All-optical Intra and Inter Neuronal Communication Protocol Platform, maria ramos[1,2], Vibhav Bharadwaj[3,4], Belen Sotillo[3], Gianluca Galzerano[3], Behrad Gholipour[5], Shane Eaton[3], Cesare Soci[2]; [1]*Interdisciplinary Graduate School, Nanyang Technological Univ., Singapore;* [2]*Centre for Disruptive Photonic Technologies, Nanyang Technological Univ., Singapore;* [3]*Istituto di Fotonica e Nanotecnologie-Consiglio Nazionale delle Ricerche (IFN-CNR), Italy;* [4]*Centre for Nano Science and Technology, Istituto Italiano di Tecnologia, Italy;* [5]*Optoelectronics Research Centre, UK.* We demonstrate an all-optical neuromorphic implementation of photonic axons and synapses in laser-written gallium lanthanum sulfide waveguides.

SeM3E • Biomedical Sensors II—Continued

16:00–16:30 Networking Coffee Break with Exhibitors, *D Level Foyers*

Room D3.2	Room D5.2	Room D7.2	Room E1.1	Room E1.2
Photonic Networks and Devices	Signal Processing in Photonic Communications	Specialty Optical Fibers	Integrated Photonics Research, Silicon, and Nano-Photonics	Novel Optical Materials and Applications

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

NeM3F • Disaggregated Networking and Computing—Continued

SpM3G • Long-haul Transmission I—Continued

SoM3H • Fiber Lasers I—Continued

SoM3H.7 • 15:45
Rare Earth Co-doping for High Efficiency Resonantly Pumped Er-Fiber Lasers, Colin Baker[1], E J. Friebele[2], Ashley Burdett[3], Daniel Rhonehouse[1], Woohong Kim[1], Jasbinder S. Sanghera[1], Jun Zhang[4], Radha Pattnaik[4], Mark Dubinskii[4]; [1]*US Naval Research Laboratory, USA;* [2]*KeyW Corp, USA;* [3]*Univ. Research Foundation, USA;* [4]*Army Research Laboratory, USA.* Co-doping of Er with RE ions in silica fibers is used to reduce Er clustering. A single mode core pumped Er-La fiber with an Er ion concentration of $1.37x10^{25}$ ions/m^3 exhibited a slope efficiency of 76%

IM3I • Application of Frequency Combs and Microresonators—Continued

IM3I.5 • 15:45
The Investigation on Optoelectronic Oscillators Based on SiO_2 Optical Waveguide Ring Resonators, Yongqiu Zheng[1], Jiamin Chen[1], Chengfei Zhang[1], Chenyang Xue[1]; [1]*North Univ. of China, China.* A scheme of optoelectronic oscillators (OEOs) adopting SiO_2 resonators is proposed. Compared to the minimum loop, it has improved side mode suppression ratio about 20dB. It provides low cost and flexible process alternatives for the compact OEOs.

NoM3J • Nonlinear Optical Materials and Thin Films—Continued

NoM3J.7 • 15:45
Interference Coatings for Infrared Spectroscopy and Colorimetric Sensing, Gokhan Bakan[1,2], Sencer Ayas[3,2], Erol Ozgur[4,2], Kemal Celebi[5,2], Aykutlu Dana[3,2]; [1]*Atilim Univ., Turkey;* [2]*Bilkent Univ., Turkey;* [3]*Stanford Univ., USA;* [4]*Univ. of Arizona, USA;* [5]*ETH Zurich, Switzerland.* Constructive interference and strong interference surfaces are created to sense ultrathin probe materials such as monolayer protein molecules using enhanced infrared absorption spectroscopy and colorimetric detection, respectively.

16:00–16:30 Networking Coffee Break with Exhibitors, *D Level Foyers*

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

Room D1.1

Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials

16:30–18:30
BM4A • Symposium: Optical Fiber Sensing Technologies for Sensing/monitoring in Harsh Environment II
Presider: Paula Gouvea; Pontificia Univ Catolica Rio de Janeiro, Brazil

BM4A.1 • 16:30 Invited

Femtosecond Laser Written Fiber Bragg Grating Sensors for Combustion Environments, Robert B. Walker[1], Stephen Mihailov[1], Dan Grobnic[1], Cyril Hnatovsky[1], Ping Lu[1], Huimin Ding[1], David Coulas[1], Manny De Silva[1]; [1]*3701 Carling Ave., Box 11490, Station H, National Research Council Canada, Canada.* Femtosecond laser written fiber Bragg gratings are useful for extreme sensing, including combustor applications for energy and aerospace. This paper reviews our fabrication and deployment of such sensors, for monitoring temperature gradients within such environments.

BM4A.2 • 17:00

Physical Properties of Fiber Bragg Gratings in Single Crystalline Sapphire Fibers, Tino Elsmann[1], Tobias Habisreuther[1], Martin Becker[1], Anka Schwuchow[1], Jan Dellith[1], Adrian Lorenz[1], Manfred W. Rothhardt[1]; [1]*Leibniz-IPHT Jena, Germany.* Investigating the properties of fiber Bragg gratings in sapphire fibers we estimated an inscription induced loss of 3 dB, a lower limit for the refractive index modulation of $4.5x10^{-5}$, and reflectivity up to 15%.

Room E5

Integrated Photonics Research, Silicon, and Nano-Photonics

16:30–18:00
IM4B • Integrated Photonics for Sensing and Spectroscopy
Presider: Pascual Munoz; Universitat Politècnica de València, Spain

IM4B.1 • 16:30 Invited

III-V-on-silicon Photonic Integrated Circuits for Spectroscopic Sensing in the Mid-Infrared, Gunther Roelkens[1]; [1]*Ghent Univ. - imec, Belgium.* We present an overview of our work on mid-infrared photonic integrated circuits comprising silicon photonic ICs for the passive functionality and heterogeneously integrated III-V semiconductor devices for light generation and detection.

IM4B.2 • 17:00 Invited

Integrated Photonics for Trace Gas Sensors, Martijn J. Heck[1], Andreas Hänsel[1]; [1]*Dept. of Engineering, Aarhus Universitet, Denmark.* Environmental gas sensing requires sensitivities below 0.1 ppm. We show theoretically that a photonic integrated circuit based ammonia sensor can achieve this, using parameters based on mature foundry platform, showing the technological feasibility.

Room E3

Nonlinear Photonics

16:30–18:30
NpM4C • Metamaterials and Coherence Effects in Lasers
Presider: Alejandro Giacomotti; CNRS UPR 20, France

NpM4C.1 • 16:30 Invited

Title Not Available, Boubacar Kante[1]; [1]*Department of Electrical and Computer Engineering, Univ. of California San Diego, USA.* Abstract not available

NpM4C.2 • 17:00

Far-from-Equilibrium Route to Superthermal Light in Bimodal Nanolasers, Mathias Marconi[1], Julien Javaloyes[2], Fabrice Raineri[1], Ariel Levenson[1], Alejandro M. Giacomotti[1]; [1]*C2N-CNRS, France;* [2]*Universitat de les Illes Balears, Spain.* We investigate the photon statistics on the eigenmodes of coupled photonic crystal nanolasers using short pulse pumping. This far-from-equilibrium mechanism generates long-tailed superthermal fluctuations on the non-lasing mode of the system.

Room D1.2

Novel Optical Materials and Applications

16:30–18:30
NoM4D • Materials for Solar Energy Applications
Presider: Colin Baker; US Naval Research Laboratory, USA

NoM4D.1 • 16:30 Invited

Integrated Perovskite Devices: Scalable Lithography of Methylammonium Lead Iodide, Ofer Bar-On[1], Philipp Brenner[2], Uli Lemmer[2], Jacob Scheuer[1]; [1]*School of Elec. Eng./ Physical Elec., Tel-Aviv Univ., Israel;* [2]*Light Technology Inst., Karlsruhe Inst. of Technology , Germany.* Rendering metal halide an applicable platform for integrated optics necessitates the development of a simple and scalable patterning scheme. We present our recent progress in this field, demonstrating NIL based lithography of perovskites.

NoM4D.2 • 17:00 Invited

Resonant Infrared Matrix-Assisted Pulsed Laser Evaporation of Hybrid Perovskites, Adrienne Stiff-Roberts[1], David Mitzi[2,3], E. Tomas Barraza[1], Wiley Dunlap-Shohl[2]; [1]*Department of Electrical and Computer Engineering, Duke Univ., USA;* [2]*Department of Mechanical Engineering and Materials Science, Duke Univ., USA;* [3]*Department of Chemistry, Duke Univ., USA.* Resonant infrared matrix-assisted pulsed laser evaporation (RIR-MAPLE) was used to deposit the metal-halide perovskite (MHP), $CH_3NH_3PbI_3$, and solar cell performance was demonstrated, thereby establishing the potential for MAPLE growth of MHPs.

Room D7.1

Optical Sensors

16:30–18:15
SeM4E • Optical Fiber Sensors I
Presider: Frank Vollmer; Univ. of Exeter, USA

SeM4E.1 • 16:30 Invited

Single-mode-multimode-single-mode Fibre Structure for Sensing Applications: A Review, Ke Tian[1], Xianfan Wang[1], Gerald Farrell[3], Pengfei Wang[1,2]; [1]*Room 112 College of Science, Harbin Engineering Univ., China;* [2]*Shenzhen Univ., China;* [3]*Dublin Inst. of Technology, Ireland.* The development of the Single-mode-multimode-single-mode (SMS) fibre structure based sensors is reviewed, and this SMS fibre structure will also continue to open up new opportunities in broad areas ranging from fiber sensors to fiber lasers.

SeM4E.2 • 17:00

MOF-Coated Optical Fiber Sensor for Detection of 4-Aminopyridine in Water, Marziyeh Nazari[1], Stephen F. Collins[2], Matthew R. Hill[3,4], Mikel C. Duke[5]; [1]*Mathematics Department, Australian College of Kuwait, Kuwait;* [2]*Optical Technology Research Laboratory, College of Engineering and Science, Victoria Univ., Australia;* [3]*CSIRO Manufacturing, Australia;* [4]*Department of Chemical Engineering, Monash Univ., Australia;* [5]*Inst. for Sustainability and Innovation, College of Engineering and Science, Victoria Univ., Australia.* Metal organic framework (MOF) thin-films were introduced to optical fiber substrates to develop MOF-fiber sensors for instant measurement of the change in the optical path length of the thin-film upon the adsorption of chemical molecules.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

Room D3.2

Photonic Networks and Devices

16:30–18:00
NeM4F • Advanced Photonic Devices
Presider: Dan Marom; Hebrew Univ. of Jerusalem, Israel

NeM4F.1 • 16:30 Invited

Surface Micromachined Silicon Photonic MEMS: A Scalable Technology Platform for Photonic Network Components, Niels Quack[1], Tae Joon Seok[2], Sangyoon Han[3], Hamed Sattari[1], Teodoro Graziosi[1], Marcell Kiss[1], Richard S. Muller[4], Ming C. Wu[4]; [1]*Inst. of Microengineering, Ecole Polytechnique Fédérale de Lausanne, Switzerland;* [2]*Gwangju Inst. of Science and Technology, South Korea;* [3]*Korea Advanced Inst. of Science and Technology, South Korea;* [4]*Department of Electrical Engineering and Computer Sciences, Univ. of California, Berkeley, USA.* Exploiting mechanical movement of surface micromachined waveguides on passive silicon photonics provides scalable opportunities for efficient on-chip manipulation of optical signals in complex photonic integrated circuits for future photonic networks

NeM4F.2 • 17:00 Invited

Rethinking Data Storage for the Zettabyte Cloud Era: The Journey from Metal to Glass, Ant Rowstron[1]; [1]*Microsoft Research, UK.* I will describe some of the research we are doing to explore how to use Silica as a media for future cloud storage, and share some of the advances we have made. I will also provide an overview of current cloud storage technologies deployed today.

Room D5.2

Signal Processing in Photonic Communications

16:30–18:00
SpM4G • Fiber Nonlinearity Mitigation
Presider: Alan Pak Tao Lau; Hong Kong Polytechnic Univ., Hong Kong

SpM4G.1 • 16:30

Fiber Nonlinearity Equalization with Multi-label Deep Learning Scalable to High-order DP-QAM, Toshiaki Koike-Akino[1], David S. Millar[1], Kieran Parsons[1], Keisuke Kojima[1]; [1]*Mitsubishi Electric Research Labs, USA.* We use deep neural network (DNN) to compensate for Kerr nonlinearity in fiber-optic communications. The proposed DNN is scalable to high-order modulation by employing multi-label classification, achieving greater than 1.2dB gain in nonlinear regimes.

SpM4G.2 • 16:45

Transmission Performance of OFDM Signals Over 6,000 km Fiber Optic Links with Digital Back Propagation, Xiaojun Liang[2], Shiva Kumar[1], John Downie[2], William A. Wood[2], Jason Hurley[2]; [1]*McMaster Univ., Canada;* [2]*Corning Research & Development Coporation, USA.* We experimentally investigated transmission of 31 Gb/s/channel OFDM signals over 6,000 km fiber optic link. We obtained 1.8dB and 0.7dB Q-factor gains using the nonlinear equalization part of DBP for single-channel and WDM systems, respectively.

SpM4G.3 • 17:00 Invited

Combating the Kerr-nonlinearity Limit with Nonlinear Signal Multiplexing, Son T. LE[1], Vahid Aref[2], Henning Buelow[2]; [1]*Allmersbacher, 8, Nokia Bell Labs, Germany;* [2]*Nokia Bell Labs, Germany.* We discuss and compare the performance of two promising nonlinear signal multiplexing schemes, namely the b-modulation and continuous spectrum modulation, using nonlinear Fourier transform to combat the conventional Kerr-induced nonlinearity limit

Room D7.2

Specialty Optical Fibers

16:30–18:00
SoM4H • Fiber Lasers II
Presider: Axel Schulzgen; Univ. of Central Florida, USA

SoM4H.1 • 16:30 Invited

MW Peak Power Diffraction-limited Chirped-pulse Yb-doped Tapered Fiber Amplifier, Mikhail E. Likhachev[1], Konstantin Bobkov[2], Alexey Andrianov[2], Maxim Koptev[2], Sergey Muravyev[2], Andrei Levchenko[1], Vladimir Velmiskin[1], Svetlana Aleshkina[1], Mikhail Bubnov[1], Sergey Semjonov[1], Denis Lipatov[3], Alexey Guryanov[3], Arkady Kim[2]; [1]*38 Vavilov Street, Fiber Optics Research Center RAS, Russia;* [2]*Inst. of Applied Physics of the Russian Academy of Sciences, Russia;* [3]*Inst. of Chemistry of High Purity Substances of Russian Academy of Sciences, Russia.* In this work we demonstrate possibility of scaling peak power to MW level (before compression) using end-pumped monolithic amplifier based on a novel type of large mode area fibers, Yb-doped tapered fiber.

SoM4H.2 • 17:00 Tutorial

Ultra-large Mode Area Fibers for High Power Lasers, Jens Limpert[1]; [1]*Inst. of Applied Physics, Friedrich-Schiller-Universitat Jena, Germany.* The most recent advances on ultra-large mode area fibers for high-power operation will be presented. Moreover, an approach to synthetize ultra-large mode area fibers that circumvents technical limitations by using multi-core fibers will be discussed.

Room E1.1

Nonlinear Photonics

16:30–18:30
NpM4I • Measurements and Microscopy
Presider: Nathalie Vermeulen; Vrije Universiteit Brussel, Belgium

NpM4I.1 • 16:30

Frequency-Resolved Optical Gating Pulse Characterization with Chalcogenide Microwires, Nurmemet Abdukerim[1], Imtiaz Alamgir[1], Martin Rochette[1]; [1]*McGill Univ., Canada.* We report the first all-fiber frequency-resolved optical gating device operating in the 2 μm wavelength band. Picosecond pulses are accurately characterized in amplitude and phase from pulses with an energy as low as femtojoule.

NpM4I.2 • 16:45

Highly Sensitive Ultrafast Fibre Laser Gyroscopic Measurements using Dispersion Fourier Transform, Maria Chernysheva[1], Srikanth Sugavanam[1], Sergei Turitsyn[1]; [1]*Aston Univ., UK.* We demonstrate a methodology to obtain real-time gyroscopic measurements with an angular velocity resolution of 125 mrad/sec using a bi-directional mode-locked fibre laser via Dispersive Fourier Transform-based real-time spectral measurements.

NpM4I.3 • 17:00

Nonlinear Coefficient Measurement in Highly Dispersive Fibers, David Castello-Lurbe[2,1], Antonio A. Carrascosa[2,3], Enrique Silvestre[2,4], Antonio Díez[2,3], Nathalie Vermeulen[1], Miguel V. Andrés[2,3]; [1]*Vrije Universiteit Brussel, Belgium;* [2]*Institut Universitari de Ciències dels Materials, Universitat de València, Spain;* [3]*Departament de Física Aplicada i Electromagnetisme, Universitat de València, Spain;* [4]*Departament d'Òptica, Universitat de València, Spain.* We present a novel approach for measuring nonlinear coefficients in fibers with significant pulse broadening. We perform a proof-of-concept demonstration for 200-m-long polarization-maintaining and single-mode fibers pumped at 1060 nm with ps pulses.

Room E1.2

Novel Optical Materials and Applications

16:30–17:45
NoM4J • Two-dimensional Materials I
Presider: Stephen Foulger; Clemson Univ., USA

NoM4J.1 • 16:30 Invited

Polaritons in Two Dimensional Materials, Atac Imamoglu[1]; [1]*ETH Zurich, Switzerland.* I will present experiments on gate-tunable MoSe2 monolayer embedded in a van der Waals heterostructures that realize an atomically thin mirror and exhibit giant spin susceptibility.

NoM4J.2 • 17:00

Tomography of an Ultrastrongly Coupled Polariton State using Quantum Hall Transport Under Irradiation, Gian Lorenzo Paravicini-Bagliani[1], Felice Appugliese[1], Giacomo Scalari[1], Eli Richter[1], Janine Keller[1], Mattias Beck[1], Jérôme Faist[1]; [1]*ETH Zurich, Switzerland.* The ultrastong light-matter coupling regime is predicted to alter ground state properties of a system. Exploiting different selection rules in optics and transport, we experimentally access the response of different electronic states to this regime.

Room D1.1	Room E5	Room E3	Room D1.2	Room D7.1
Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials	Integrated Photonics Research, Silicon, and Nano-Photonics	Nonlinear Photonics	Novel Optical Materials and Applications	Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

BM4A • Symposium: Optical Fiber Sensing Technologies for Sensing/monitoring in Harsh Environment II—Continued

BM4A.3 • 17:15
Fiber Bragg Gratings for Dynamic High Pressure Measurements in Shock Wave Research, Garry Berkovic[1], Ehud Shafir[1], Shlomi Zilberman[1], Yair Saadi[1], Avi Ravid[1], Alexander Fedotov Gefen[1], Yonatan Schweitzer[1]; [1]*Soreq Nuclear Research Center, Israel.* Short Fiber Bragg Gratings of lengths 1mm and below are used to probe pressure changes in impact-induced shock waves with high spatial (0.1 – 1mm) and temporal (5-10 nsec) resolution.

BM4A.4 • 17:30
Fiber Bragg Grating Dynamic Extensometry on Metallic Samples Submitted to High Pulse Power Magnetic Fields, Sylvain Magne[1], Simon Nehr[1], Nicolas Roussel[1], Guillaume Laffont[1], Gael LeBlanc[2], Yohan Barbarin[2], Jerome Luc[2], Ophélie Lassalle[2], Frédéric Sinatti[2]; [1]*DM2I, CEA LIST, France;* [2]*CEA Gramat, France.* Isentropic compression of metallic samples is performed with High Pulse Powers (HPP). An electromagnetic-immune Fiber Bragg Grating (FBG) mainframe was designed. Dynamic FBG extensometry is compared to Photonic-Doppler Velocimetry (PDV).

BM4A.5 • 17:45
Combined Radiations and Temperature Effects on FBGs Photo-inscribed by Femtosecond Laser in Radiation-Hardened Optical Fibers, Thomas Blanchet[1,2], Adriana Morana[2], Simon Nehr[1], Guillaume Laffont[1], Emmanuel Marin[2], Aziz Boukenter[2], Youcef Ouerdane[2], Sylvain Girard[2]; [1]*CEA (LIST) LCAE, France;* [2]*Laboratoire Hubert Curien (LabHC), France.* We investigate the combined effects of X-rays and temperature (<450°C) on type II Fiber Bragg Gratings photo-inscribed with a femtosecond laser in two different radiation hardened optical fibers.

IM4B • Integrated Photonics for Sensing and Spectroscopy—Continued

IM4B.3 • 17:30 Invited
Tunable Mid-infrared VCSELs for Methane Detection, Stephen Segal[1], Vijaysekhar Jayaraman[2], Kevin Lascola[1], Christopher Burgner[2], Frederick Towner[1], Alan Donaldson[1], Anthony Cazabat[2]; [1]*Thorlabs Quantum Electronics, USA;* [2]*Praevium Research, USA.* Low-cost tunable mid-infrared lasers are a critical technology for sensing of methane and other gases. We have developed room temperature continuous wave (RTCW) vertical cavity surface emitting lasers (VCSELs) operating at 3.35 µm.

NpM4C • Metamaterials and Coherence Effects in Lasers—Continued

NpM4C.3 • 17:15
Buildup of Incoherent Laser Pulses Resolved by Real-Time Spectral Imaging, Philippe Grelu[1], Zhiqiang Wang[1], Aurélien Coillet[1]; [1]*Univ. Bourgogne Franche-Comté, France.* We resolve the buildup dynamics of noise-like pulses in both anomalous and normal dispersion fiber lasers for the first time, using the dispersive-Fourier-transform imaging technique,. Universal features and specific transition stages are highlighted

NpM4C.4 • 17:30
Superthermal Light from Single-mode VCSEL, Tao Wang[1,4], Djeylan Aktas[1,3], Olivier Alibart[1], Eric Picholle[1], Sebastien Tanzilli[1], GianPiero Puccioni[2], Gian Luca Lippi[1]; [1]*Institut de Physique de Nice, France;* [2]*Istituto dei Sistemi Complessi, CNR, Italy;* [3]*Quantum Engineering Technology Labs, H. H. Wills Physics Laboratory and Department of Electrical and Electronic Engineering, Univ. of Bristol, UK;* [4]*School of Electronics and Information, Hangzhou Dianzi Univ., China.* Superthermal light is observed in the emission of a room-temperature, electrically-pumped single mode microcavity pumped below continuous lasing. The observations are compared to Generalized Laser Rate Equations and stochastic simulations.

NpM4C.5 • 17:45
Manipulation and Measurement of Optical Coherence in PT-symmetric Photonic Structures, Kai Wang[1,2], Sergey V. Suchkov[1], James Titchener[1], Steffen Weimann[2], Demetrios N. Christodoulides[3], Alexander Szameit[2], Andrey A. Sukhorukov[1]; [1]*Nonlinear Physics Centre, Research School of Physics and Engineering, The Australian National Univ., Australia;* [2]*Inst. for Physics, Univ. of Rostock, Germany;* [3]*CREOL, The College of Optics and Photonics, Univ. of Central Florida, USA.* We predict a periodic variation of the coherence between optical modes in parity-time symmetric photonic structures, and show experimentally reversible purification of incoherent light propagating along coupled conservative and lossy waveguides.

NoM4D • Materials for Solar Energy Applications—Continued

NoM4D.3 • 17:30 Invited
Optical Materials for Luminescent Solar Concentrators and Solar Module Thermal Management, Vivian Ferry[1]; [1]*Univ. of Minnesota Twin Cities, USA.* This talk will discuss two complementary optical strategies to harvest sunlight for improved photovoltaic efficiency: luminescent solar concentrators that capture diffuse sunlight, and selective reflectors that reduce module operating temperature.

SeM4E • Optical Fiber Sensors I—Continued

SeM4E.3 • 17:15
Whispering-gallery-mode Temperature Sensing with Flying Dye-doped Particle in Hollow-Core PCF, Richard Zeltner[1], Riccardo Pennetta[1], Shangran Xie[1], Philip S. Russell[1]; [1]*Max-Planck-Inst Physik des Lichts, Germany.* We demonstrate distributed thermal sensing using the temperature-induced wavelength shift of the lasing modes of a dye-doped microparticle optically trapped and propelled inside a liquid-filled hollow-core photonic crystal fiber.

SeM4E.4 • 17:30
Analysis on Cladding Intensity of Dye-doped Polymeric Fiber-Optic Strain Sensor for Visual Detection of Strain, Rei Furukawa[1], So Kamimura[1]; [1]*Univ. of Electro-Communications, Japan.* A stress sensor based on a dye-doped polymeric optical fiber can detect stress by simple comparison of two luminescence peaks from a pair of organic dyes. How the cladding luminescence was induced was analyzed.

SeM4E.5 • 17:45
Partially Coated Long Period Fiber Bragg Gratings in Multicore Optical Fibers, David Barrera[1], Javier Goicoechea[2], Javier Madrigal Madrigal[1], Marta González-Larequi[2], Francisco J. Arregui[2], Salvador Sales[1]; [1]*ITEAM research Inst., Spain;* [2]*Inst. of Smart Cities, Universidad Publica de Navarra, Spain.* We study the use of multicore optical fibers for external refractive index sensing taking advantage of the spatial distribution of the cores by partially coating the surface of the optical fiber with a thin film SnO_2 layer

Room D3.2	Room D5.2	Room D7.2	Room E1.1	Room E1.2
Photonic Networks and Devices	Signal Processing in Photonic Communications	Specialty Optical Fibers	Nonlinear Photonics	Novel Optical Materials and Applications

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

NeM4F • Advanced Photonic Devices—Continued

NeM4F.3 • 17:30 Invited
Advanced Photoreceiver Technology for Space Division Multiplexing Communication, Toshimasa Umezawa[1], Takahide Sakamoto[1], Naokatsu Yamamoto[1]; [1]*National Inst. of Information and Communications Technology, Japan.* We present a two-dimensional high-speed photodetector array device for receiving SDM/MDM signals directly, without an optical multiplexer and demultiplexer. It will aid in establishing a compact, low-cost, and low-power-consumption SDM photoreceiver.

SpM4G • Fiber Nonlinearity Mitigation—Continued

SpM4G.4 • 17:30
Evolutionary Design of Pulse-shaping FIR Filter to Mitigate Fiber Nonlinearity, Toshiaki Koike-Akino[1], David S. Millar[1], Kieran Parsons[1], Keisuke Kojima[1]; [1]*Mitsubishi Electric Research Labs, USA.* We use evolutionary strategy to design an irregular pulse-shaping filter to mitigate nonlinear distortion. Our optimized filter achieves greater than 0.2dB gain over RRC Nyquist shaping with zero additional cost in computational complexity.

SpM4G.5 • 17:45
Nonlinear Fourier Transform Algorithm using a Higher Order Exponential Integrator, Shrinivas Chimmalgi[1], Peter J. Prins[1], Sander Wahls[1]; [1]*Delft Univ. of Technology, Netherlands.* We present a nonlinear Fourier transform algorithm whose accuracy, at a comparable runtime and for moderate step sizes, is orders of magnitude better than that of the classical Boffetta-Osborne method.

SoM4H • Fiber Lasers II—Continued

NpM4I • Measurements and Microscopy—Continued

NpM4I.4 • 17:15
Enhancing Axial Resolution and Background Rejection in Line-scanning Temporal Focusing Microscopy by Focal Modulation, Yuanlong Zhang[1], Lingjie Kong[1], Hao Xie[1], Xiaofei Han[1], Qionghai Dai[1]; [1]*Tsinghua Univ., China.* By spatio-spectral modulation at the pupil plane, we improve the axial resolution by 1.3-fold and enhance background rejection in line-scanning temporal focusing microscopy. We demonstrate the enhanced performance via *in vivo* imaging of mouse brains.

NpM4I.5 • 17:30
Nonlinear Photonic Structures by Pyroelectric-assisted Femtosecond Laser Lithography, Jorg Imbrock[1], Cornelia Denz[1], Mousa Ayoub[1], Haissam Hanafi[1]; [1]*Westfaelische Wilhelms Univ Munster, Germany.* We explore a ferroelectric domain inversion process that is based on a combination of femtosecond laser lithography and thermal control. Arbitrary 2D ferroelectric domain structures are created in the whole crystal without external electric field.

NpM4I.6 • 17:45
Nonlinear Surface THz-optical Mechanism at Extreme Excitations., Luke Peters[1], Jacob D. Tunesi[1], Alessia Pasquazi[1], Marco Peccianti[1]; [1]*Univ. of Sussex, UK.* Surface-Terahertz generation at high excitation is dominated by both the nonlinear response and surface field dynamics. Our experimental characterization sheds light on this synergy revealing that no hard saturated limit for the THz emission exists.

NoM4J • Two-dimensional Materials I—Continued

NoM4J.3 • 17:15
Hybrid Nano-gap LC-Metasurface at 300 GHz Ultra-strongly Coupled to Less than 100 Electrons, Janine Keller[1], Giacomo Scalari[1], Sara Cibella[2], Felice Appugliese[1], Curdin Maissen[1], Ennio Giovine[2], Roberto Leoni[2], Mattias Beck[1], Jérôme Faist[1]; [1]*ETH Zürich, Switzerland;* [2]*Istituto di Fotonica e Nanotecnologies (IFN), Italy.* We design a hybrid-dipole antenna split-ring resonator based cavities with extremely small effective mode volumes to probe ultra-strong coupling on less than 100 electrons, showing an effective mass heavier than the uncoupled cyclotron mass.

NoM4J.5 • 17:30
Large-scale Plasmon-mediated Laser Fabrication of Novel Multi-functional Black-silicon 2D-nanosheet Arrays, Sergey I. Kudryashov[1,2]; [1]*ITMO Univ., Russia;* [2]*Lebedev Physical Institute, Russia.* Large-scale plasmon-mediated nanopatterning of silicon surface as regular 1D-arrays of high-aspect ratio vertical nanosheets for promising applications was performed via ultrashort IR-laser ablation in carbon disulfide liquid environment.

Room D1.1	Room E5	Room E3	Room D1.2	Room D7.1
Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials	Integrated Photonics Research, Silicon, and Nano-Photonics	Nonlinear Photonics	Novel Optical Materials and Applications	Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

BM4A • Symposium: Optical Fiber Sensing Technologies for Sensing/monitoring in Harsh Environment II—Continued

BM4A.6 • 18:00 Invited
Multicore Fiber Draw-tower Grating MCF-DTG® Sensors, Eric Lindner[1], Christian Voigtländer[1], Bram Van Hoe[2], Johan Vlekken[2], Jan Van Roosbroeck[2]; [1]*Winzerlaer Str. 2, FBGS Technologies GmbH, Germany;* [2]*FBGS International Belgium.* We will report about the generation and the application of draw tower grating sensors in multicore optical fibers (MCF-DTG®s) for the measurement of curvature, shape and position.

IM4B • Integrated Photonics for Sensing and Spectroscopy—Continued

NpM4C • Metamaterials and Coherence Effects in Lasers—Continued

NpM4C.6 • 18:00
Nanojoule sub-100 fs Mid Infrared Pulse Generated From a Fully Fusion-spliced Fiber Laser, Hugo Delahaye[1], Geoffroy Granger[1], mathieu jossent[2], Jean-Thomas Gomes[2], Laure Lavoute[2], Dmitry Gaponov[2], Sebastien Fevrier[1]; [1]*Xlim, France;* [2]*87, novae, France.* We report on an all-fiber source of mid-infrared nanojoule sub-100 fs pulses based on the soliton frequency-shifting effect in a cascade of silica and germania fibers.

NpM4C.7 • 18:15
Suppressing Spatio-temporal Lasing Instabilities with Wave-chaotic Microcavity Lasers, Stefan Bittner[1], Stefano Guazzotti[2], Xiaonan Hu[3], Hasan Yilmaz[1], Kyungduk Kim[1], Yongquan Zeng[3], Sang Soon Oh[2], Qi Jie Wang[3], Ortwin Hess[2], Hui Cao[1]; [1]*Yale Univ., USA;* [2]*Department of Physics, Imperial College, UK;* [3]*School of Electrical and Electronic Engineering, Nanyang Technological Univ., Singapore.* The suppression of spatio-temporal instabilities of broad-area semiconductor lasers is demonstrated for microcavities with chaotic ray dynamics. We attribute the stabilization to the disruption of coherent instabilities by complex wave interference.

NoM4D • Materials for Solar Energy Applications—Continued

NoM4D.4 • 18:00
Engineering Efficient Upconversion in Core/Rod/Emitter Semiconductor Nanostructures, Eric Y. Chen[1], Christopher Milleville[1], Kyle Lennon[1], Jing Zhang[1], Jill Cleveland[1], James Bork[1], Joshua Zide[1], Matthew Doty[1]; [1]*Univ. of Delaware, USA.* We demonstrate upconversion (UC) photoluminescence (PL) in semiconductor quantum dot/rod/emitter nanostructures with cw excitation. We observe >800meV energy gain and engineer improvements in UC quantum efficiency to 3% of the PL emission efficiency.

NoM4D.5 • 18:15
InGaN-based Nanowires on Conductive Substrates for Enhanced Solar Hydrogen Generation, Mohamed H. Ebaid[1], Jung-Wook Min[1], Huafan Zhang[1], Chao Zhao[1], Tien Khee Ng[1], Hicham Idriss[2], Boon S. Ooi[1]; [1]*King Abdullah Univ of Sci & Technology, Saudi Arabia;* [2]*SABIC-Corporate Research and Development Center (CRD) at KAUST, Saudi Arabia.* InGaN nanowires were grown on metallic substrates such as Ti coated Si and flexible metallic membranes to enhance the solar hydrogen generation. Solar hydrogen generation was significantly improved using this semiconductor-on-metal approach.

SeM4E • Optical Fiber Sensors I—Continued

SeM4E.6 • 18:00
Fiber Optic Sensor for Ice Detection on Aerodynamic Surfaces using Plastic Optic Fiber Tapers, Kostas Amiropoulos[1], Dimosthenis Spasopoulos[1], Aris A. Ikiades[1]; [1]*Univ. of Ioannina, Greece.* We reports the developments of a fiber optical sensor using tapered fibers to measure the thickness, accretion rate and type of ice through optical diffusion to enhance the detection efficiency of the sensor

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18:30–20:00 Conference Reception, *Polyterrasse (Rain Location: Main Hall)*

Room D3.2	Room D5.2	Room D7.2	Room E1.1	Room E1.2
Photonic Networks and Devices	Signal Processing in Photonic Communications	Specialty Optical Fibers	Nonlinear Photonics	Novel Optical Materials and Applications

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

NeM4F • Advanced Photonic Devices—Continued

SpM4G • Fiber Nonlinearity Mitigation—Continued

SoM4H • Fiber Lasers II—Continued

NpM4I • Measurements and Microscopy—Continued

NpM4I.7 • 18:00
Indirect Transitions at a Free Carrier Front in a Silicon Slow Light Waveguide, Alexander Petrov[1,2], Mahmoud Gaafar[1,3], Dirk Jalas[1], Liam O'Faolain[4,5], Juntao Li[6], Thomas F. Krauss[7], Manfred Eich[1,8]; [1]*Hamburg Univ. of Technology, Germany;* [2]*ITMO Univ., Russia;* [3] *Menoufia Univ., Egypt;* [4]*Univ. of St. Andrews, UK;* [5]*Cork Inst. of Technology, Ireland;* [6] *Sun Yat-sen Univ., China;* [7] *Univ. of York, UK;* [8] *Helmholtz-Zentrum Geesthacht, Germany.* A signal wave interacting with a free carrier front in a slow light waveguide experiences indirect transitions leading to transmission or reflection from the front. Theory and experimental results are presented.

NpM4I.8 • 18:15
Coherent On-chip Frequency Combs Spanning 1.5-7.5 µm for Dual-comb Spectroscopy, Nima Nader[1], Jeff Chiles[1], Henry Timmers[1], Eric J. Stanton[1], Abijith Kowligy[1], Alex Lind[1,2], Sae Woo Nam[1], Scott A. Diddams[1,2], Richard P. Mirin[1]; [1]*National Institute of Standards and Tech, USA;* [2]*Department of Physics, Univ. of Colorado, USA.* We use suspended-Si waveguides for low input-power frequency comb generation spanning 2.3 octaves in the mid-infrared (1.5-7.5 µm). We also demonstrate dual-comb spectroscopy of atmospheric absorption at 7.0 µm with comb-line resolution of 100 MHz.

NoM4J • Two-dimensional Materials I—Continued

18:30–20:00 Conference Reception, *Polyterrasse (Rain Location: Main Hall)*

07:00–17:30 **Registration,** *E Level*

Room F30.1 (Overflow Room: E3)

Joint

07:45–10:00
JTu1A • Joint Plenary Session II

JTu1A.1 • 08:00 Plenary
Photonic Integration for Communication and Sensing-economic Success and Failure, Martin Schell[1]; [1]*Fraunhofer Institut, Germany.* Photonic Integration has the chance to revolutionize photonics probably as much as electronic integration has done since the 1970ies. Prior failures and successes will be analyzed, and current technologies and developments will be overviewed.

JTu1A.2 • 08:40 Plenary
Progress and Challenges in Free-space Optical Networks, Linda Thomas[1]; [1]*US Naval Research Laboratory, USA.* Free space optics (FSO) technology allows access to currently unregulated spectrum; and provides an augmentation to RF wireless in congested areas. In order to more broadly adopt the technology, FSO must be implemented as a networked wireless system, versus simply a point-to-point link.

JTu1A.3 • 09:20 Plenary
Scaling Optical Networks into the Next Decade and Beyond, Peter Winzer[1]; [1]*Nokia Bell Labs, USA.* Informed by long-term historic traffic and technology scaling, we extrapolate the evolution of optical networking technologies into the next decade and beyond, highlighting the challenges that research will have to address.

D Level Foyers

10:00–11:30
JTu2A • Poster Session I and Networking Coffee Break with Exhibitors

JTu2A.1
Few-Mode Characteristics of Long-period Fiber Gratings Made by Tilted Mask Method Measured with Offset Launch, Toru Mizunami[1], Ryuhei Shioya[1], Mamoru Minami[1]; [1]*Department of Electrical Engineering and Electronics, Graduate School of Engineering, Kyushu Inst. of Technology, Japan.* Spectral measurement for higher-order mode excitation was performed for LPGs with various grating periods. The higher-order modes by offset launch were observed using a diode laser. Attenuations for LP_{11} and LP_{21} input modes were observed.

JTu2A.2
Optimised Optical Fibre Poling Configurations: A Numerical Study, Francesco De Lucia[1], Pier Sazio[1]; [1]*Univ. of Southampton, UK.* We compare thermal poling configurations, demonstrating that a single-anode geometry offers high effective Chi(2) even in optical fibers with loose fabrication tolerances. Our model also reveals that PC fibers display an "inhibited poling" mechanism.

JTu2A.3
Highly Birefringent Photonic Crystal Fiber Compatible with IR Femtosecond Grating Inscription Methods, Tigran Baghdasaryan[1], Thomas Geernaert[1], Hugo Thienpont[1], Francis Berghmans[1]; [1]*Vrije Universiteit Brussel, Belgium.* We designed a hexagonal lattice highly birefringent photonic crystal fiber that allows for infrared femtosecond pulse laser-based fiber Bragg grating inscription, using both point-by-point and phase mask-based methods

JTu2A.4
Mach-Zehnder Interferometer based on Femtosecond Laser Waveguide Inscription, David Pallarés-Aldeiturriaga[1], Luis Rodriguez-Cobo[3], Matthieu Lancry[4], Bertrand Poumellec[4], Jose-Miguel M. Lopez-Higuera[1,2]; [1]*Photonics Engineering Group, Spain;* [2]*CIBER-bbn, IDIVAL, Spain;* [3]*CIBER-bbn, Spain;* [4]*SP2M, ICMMO, France.* Femtosecond laser written waveguides inside optical fiber are employed to manufacture in-fiber Mach-Zehnder Interferometers. Quantitative phase and birefringence measurements suggest light confinement below focal volume due to stress accumulation.

JTu2A.5
Temperature Reversible Self-trapped Holes in Fictive Temperature-treated Silica, Matthieu Lancry[1], Nadege Ollier[2], Christian Herrero[1], Bertrand Poumellec[1]; [1]*Universite de Paris Sud, France;* [2]*LSI, Ecole Polytechnique, France.* We examine radiation-induced Self-Trapped Hole in fictive temperature treated F300 silica. By repeating isochronal annealing cycles between 77 and 300 K, we observed that STH decreases with T but in a reversible manner.

JTu2A.6
Engineering Mode Size in Laser Inscribed Waveguides via Periodic Segmentation, James Grieve[1], Bo Xue Tan[1], Alexander Ling[1,2]; [1]*Centre for Quantum Technologies, Singapore;* [2]*Department of Physics, National Univ. of Singapore, Singapore.* We locally enlarge the guided mode of direct written waveguides using periodic segmentation, enabling evanescent coupling between otherwise isolated highly-confining waveguides written in dense flint glass.

JTu2A.7
Laser-induced Crystallization in $SrO-TiO_2-SiO_2$ glass: Formation of Polar $Sr_2TiSi_2O_8$ Phase and Second-Harmonic Generation, Yuta Hayashibara[1], Kosuke Funajima[1], Nobuaki Terakado[1], Yoshihiro Takahashi[1], Takumi Fujiwara[1]; [1]*Tohoku Univ., Japan.* Creation of polar $Sr_2TiSi_2O_8$ crystal was attempted by CO_2 laser-irradiation on the glass surface, aiming to control of the crystal-domain structure, and the second-harmonic generation was clearly observed in the laser-crystallized region.

JTu2A.8
In-depth Structural Investigation and Non-destructive Stress Evaluation in Chemically Strengthened Glass, Ryusei Sasaki[1], Nobuaki Terakado[1], Yoshihiro Takahashi[1], Takumi Fujiwara[1]; [1]*Tohoku Univ., Japan.* We performed structural analysis in Corning Gorilla Glass 3 by X-ray diffraction and micro-Raman spectroscopy. Based on the results obtained, we propose a non-destructive, non-contact depth analysis of stress for the chemically strengthened glass.

JTu2A.9
Generation of Ultrahigh Repetition Rate Pulse Bursts using Phase-modulated Grating, Xin Liu[2,1], Xuewen Shu[2], Adenowo Gbadebo[1], Lin Zhang[1]; [1]*Photonic Research Group Aston Univ., UK;* [2]*Wuhan National Laboratory for Optoelectronics, China.* Customized ultrahigh repetition rate pulse bursts are demonstrated with PM-FBGs in transmission. Examples of three, four and eight replicas with a repetition rate of 100GHz in one period of the input pulse are designed and numerically simulated.

JTu2A.10
Application of Multiplexed Bragg Gratings in Photo-thermo-refractive glass for Holographic Prism Manufacture, Nikolay V. Nikonorov[1], Sergey Ivanov[1], Alexander Angervaks[1], Roman Okun[1], Doan Van Bak[1]; [1]*ITMO Univ., Russia.* In the paper we present a multi-valued holographic plane angle measure, so called, holographic prism. The holographic prism is a small specimen of photosensitive material in which a system of multiplexed holographic gratings is written.

07:00–17:30 **Registration,** *E Level*

Room F30.1 (Overflow Room: E3)

Joint

07:45–10:00
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D Level Foyers

10:00–11:30
JTu2A • Poster Session I and Networking Coffee Break with Exhibitors

JTu2A.11
Fine-tuning the Fiber Bragg Grating Wavelength by Femtosecond Photo-treatment, Aviran Halstuch[1], Amiel Ishaaya[1]; [1]*Ben-Gurion Univ. of the Negev, Israel.* We use pre- and post-femtosecond treatment to fine-tune the Bragg grating wavelength in an optical fiber. We observe "red" shift when applying a suitable pre-treatment, and both "blue" and "red" shifts when applying post-treatment

JTu2A.12
Passively Mode-locked Erbium-doped Fiber Laser Operating at L-band based on a 45° Tilted Fiber Grating, Xi Cheng[1], Qianqian Huang[1], Chuanhang Zou[1], Chengbo Mou[1], Zhijun Yan[3], Kaiming Zhou[2], Lin Zhang[2]; [1]*Key Laboratory of Specialty Fiber Optics and Optical Access Networks, Shanghai Univ., China;* [2]*Aston Inst. of Photonic Technologies, Aston Univ., UK;* [3]*School of Optical and Electronic Information, Huazhong Univ. of Science and Technology, China.* We demonstrate a L-band passively all-fiber mode locked erbium-doped laser based on a single 45° titled fiber grating and the center wavelength of the fiber laser is 1598.5 nm.

JTu2A.13
Wavelength Switchable Bidirectional Q-switched Fiber Laser Based on 45° Tilted Fiber Grating and Carbon Nanotube, Chuanhang Zou[1], Zhijun Yan[2], Qianqian Huang[1], Tianxing Wang[1], Chengbo Mou[1], Mohammed AlAraimi[3,4], Aleksey Rozhin[5,3]; [1]*Key Laboratory of Specialty Fiber Optics and Optical Access Networks, Shanghai Univ., China;* [2]*School of Optical and Electronic Information, Huazhong Univ. of Science and Technology, China;* [3]*Nanoscience Research Group, Aston Univ., UK;* [4]*Al Musanna College of Technology, Oman;* [5]*Aston Inst. of Photonic Technologies, Aston Univ., UK.* A wavelength switchable bidirectional Q-switched fiber laser based on carbon nanotube saturable absorber and 45° tilted fiber grating induced nonlinear polarization rotating filtering effect is demonstrated for the first time.

JTu2A.14
Two-axis Fiber Optical Acceleration Sensor based on Cladding Waveguide Gratings, Jan Koch[1], Ahmad Abdalwareth[1,2], Alexander Doering[1], Martin Angelmahr[1], Wolfgang Schade[1,2]; [1]*Fraunhofer Heinrich Hertz Inst., Germany;* [2]*Clausthal Univ. of Technology, Germany.* A two-axis fiber optical acceleration sensor based on cladding waveguides and Bragg gratings is presented. The device consists of a functionalized standard single mode glass fiber, which works as flexible beam and bending sensor.

JTu2A.15
Spectral and Temporal Control of a Random Erbium Doped Fiber Laser, Can Yao[1], Camille-Sophie Bres[1], Luc Thevenaz[1]; [1]*Ecole Polytechnique Federale de Lausanne, Switzerland.* A random Q-switched Erbium fiber laser is obtained with an average repetition rate to several kilohertz, and its output spectrum can be easily flipped from 1535 to 1550 nm by a fiber loop mirror.

JTu2A.16
Functionalized THz Waveguide to Study Strain Generated by High Pressure and/or High Temperature Observed in Harsh Environments, Aparajita Bandyopadhyay[2], Nimisha Arora[1], Khushboo Singh[1], Amartya Sengupta[1]; [1]*Department of Physics, Indian Inst. of Technology Delhi, India;* [2]*DRDO-JATC, Indian Inst. of Technology Delhi, India.* The mechanism of the phase stabilities of materials under extreme pressure and temperature conditions are not well understood. We propose to study the same using hollow core waveguides in terahertz range functionalized with such material.

JTu2A.17
Smart Carbon Fiber Foot Prosthesis, Talita P. Bastos[1], José R. Galvão[1], Cicero Martelli[1], Jean C. da Silva[1]; [1]*UTFPR, Brazil.* A multiplexed network FBG sensors is embedded in a composite material foot prosthesis forming a smart device to assist people to enhance use performance as well as manufacturers. Human gait is monitored showing promising results.

JTu2A.18
Withdrawn

JTu2A.19
Bending Photoluminescence Study of 2D Layered GaSe, Ching-Hwa Ho[1], Ching-An Chuang[1]; [1]*National Taiwan Univ of Science & Tech, Taiwan.* Light emission property of 2D layered GaSe of different curvature has been investigated using bending photoluminescence experiment in the curvature range between R^{-1}=0.00 m^{-1} and R^{-1}=30.28 m^{-1} under upward bending condition herein.

JTu2A.20
Stress Modification in Praseodymium Fluoride Thin Films through Admixture with Barium Fluoride, Ping Xie[1]; [1]*Shanghai Inst. of Technical Physics,, China.* A new infrared low-index evaporation material, the admixture of PrF_3 with barium fluoride (BaF_2) was investigated. The stresses and optical constants were presented for thin films deposited using electron beam evaporation from the sintered pellets.

JTu2A.21
Near-field Optical Spectroscopy of $CsPbBr_3$ Microstructures, Fabio Gabelloni[1], Dario Balestri[1], Francesco Biccari[1], Giulia Andreotti[1], Francesca Intonti[1], Nicola Calisi[2], Stefano Caporali[3,4], Anna Vinattieri[1]; [1]*Department of Physics and Astronomy - LENS, Univ. of Florence, Italy;* [2]*Department of Chemistry, Univ. of Florence, Italy;* [3]*Department of Industrial Engineering DIEF, Univ. of Florence, Italy;* [4]*Consiglio Nazionale delle Ricerche-Istituto dei Sistemi Complessi CNR-ISC, Italy.* We present a high spatial resolution photoluminescence (PL) study of $CsPbBr_3$ microcrystals by means of near-field optical microscopy and micro-PL. Correlation between the PL emission features and the crystal size are presented and discussed.

10:00–11:30
JTu2A • Poster Session I and Networking Coffee Break with Exhibitors

JTu2A.22
A Highly Selective Bandpass Frequency Selective Surface, Qiming Yu[1], Shaobin Liu[1], Borui Bian[1], Yongdiao Wen[1]; [1]*College of Electronic and Information Engineering, Nanjing Univ. of Aeronautics and Astronautics, China.* A highly selective dual-band bandpass frequency-selective surface (FSS) has been proposed by using coupled resonance, which consisted of 3-layer double hexagonal loops(DHLs). The FSS show stable incident angles response with polarization insensitive.

JTu2A.23
Self-assembled Nanowire Structures for Solar Energy Harvesting Applications, Kyoungsik Kim[1], Yunha Ryu[1]; [1]*Yonsei Univ., South Korea.* Based on self-assembling process of anodic aluminum oxide (AAO) nanowires, we demonstrate a platform of perfect absorbers for broadband optical region from visible to infrared wavelength regions.

JTu2A.24
Synthesis of PbS Quantum Dots for High-efficiency, Uncooled and Active Infrared Detector, Jin-Beom Kwon[1], Sae-Wan Kim[1], Jae-Sung Lee[1], Ok-Sik Kim[1], In-Su Jung[1], Cheol-Eon Park[1], Shin-Won Kang[1]; [1]*Kyungpook National Univ., South Korea.* PbS quantum dots of the core structure having a peak wavelength band of 1400 nm absorbance were synthesized by controlling temperature and time parameters it was synthesized by sol-gel method.

JTu2A.25
High-aperture NUV and DUV Microscopy Based on Dioptric Optics. Optical Design, Dmitry N. Frolov[1], Olga Vinogradova[1], Alexey Frolov[1]; [1]*Labor-microscopes, Russia.* The aspects of the use of dioptric optics for DUV microscopy are considered. The transition to the NUV and DUV range can significantly improve the resolving power of the microscope. Different kinds of crystals can be used as optical materials.

JTu2A.26
Photoinduced, Thermo-reversible and Irreversible Transformations, and Accompanying Mechanical Transformations in Thin As_2S_3 Glass Films, Myroslav I. Kozak[1]; [1]*Uzhgorod National Univ., Ukraine.* Thermally reversible and irreversible photoinduced structural transformations in thin films of As_2S_3 chalcogenide glass were studied. As a concomitant result, possible mechanical transformations under thermal action are shown.

JTu2A.27
All Optical Intensity Modulator by Polarization Dependent Graphene Microfiber Waveguide, Man Jiang[1], Ruiduo Wang[1], Diao Li[1], Zhaoyu Ren[1]; [1]*Northwest Univ., China, China.* By controlling the polarization mode of incident light, a greatly adjustable enhanced interaction between the propagating light and the graphene-covered microfiber can be obtained, the strong interaction enables a maximum modulation depth of 20.86dB.

JTu2A.28
Description of Resonant and Percolation Effects in Particle Cumulus Immersed in Random Holes Distribution, Marco Antonio T. Rodriguez[1], Geovani Arenas Munoz[1], Saul Delos Santos Garcia[1], Patricia Martinez Vara[2], Gabriel Martinez Niconoff[1]; [1]*INAOE, Mexico;* [2]*BUAP, Mexico.* We study resonant effects in particle cumulus immersed in a random arrangement of holes, analyzing the conditions under which percolation effects appear. The study is supported by percolation analysis.

JTu2A.29
Focusing with Partially Coherent Light, Andrea A. Garcia Guzman[1], Marco Antonio T. Rodriguez[1], Elizabeth Saldivia Gomez[1], Gabriel Martinez Niconoff[1], Mayra Vargas-Morales[1]; [1]*Optics, INAOE, Mexico.* In following paper it is analyzed the synthesis of focusing regions using as illumination system partially coherent light sources. The description is performed by means of the temporal average for the optical field.

JTu2A.30
Plasma-Chemical Purification of Sulfur, Alexander A. Logunov[1], Leonid Mochalov[2], Aleksandr Mashin[1]; [1]*Lobachevsky State Univ., Russia;* [2]*Physics and Optical Science, Univ. of North Carolina at Charlotte, USA.* Sulfur for fabrication of IR optical materials with low losses was purified by plasma-chemical distillation at low pressure under dynamic vacuum conditions. RF (40 MHz) nonequilibrium plasma discharge was used for initiation of chemical interactions

JTu2A.31
Geometry Description of Localization Effects in Random Distributions, Mayra V. Morales[1], Marco Antonio T. Rodriguez[1], Andrea A. Garcia Guzman[1], Gabriel Martinez Niconoff[1], Patricia Martinez Vara[2]; [1]*Optics, INAOE, Mexico;* [2]*BUAP, Mexico.* We describe the changes of periodical structures perturbed with multiplicative noise, whose evolution generates localization effects. The model is implemented for moiré structures generating a single correlation trajectory.

JTu2A.32
Dependence of As-Se-Te Films Properties on the Plasma Parameters, Mikhail Kudryashov[2], Leonid Mochalov[2], Aleksey Nezhdanov[2], Roman Kornev[1], Alexander A. Logunov[2], Aleksandr Mashin[2]; [1]*Nizhny Novgorod Technical Univ., Russia;* [2]*Lobachevsky State Univ., Russia.* As-Se-Te films have been prepared by PECVD method in a low-temperature RF non-equilibrium plasma. The effect of the plasma discharge specific energy input and the plasma-feed gas type on morphology and structure has been studied.

JTu2A.33
Fine Purification of Tellurium by Plasma-enhanced Chemical Transport Reaction with Hydrogen, Alexander A. Logunov[1], Leonid Mochalov[2], Aleksandr Mashin[1]; [1]*Lobachevsky State Univ., Russia;* [2]*Univ. of North Carolina at Charlotte, USA.* Tellurium has been purified by means of plasma-enhanced chemical transport reaction with intermediate formation of tellurium hydride. The metal and carbon-containing impurities behavior was studied.

JTu2A.34
Thin Phase Tailoring and Laser Modification of As-Se-Te Phase Change Materials, Aleksey Nezhdanov[1], Mikhail Kudryashov[1], Dmitry Usanov[1], Leonid Mochalov[1], Alexander A. Logunov[1], Aleksandr Mashin[1]; [1]*Lobachevsky State Univ., Russia.* The possibility of usage of PECVD has been demonstrated in terms of its effectiveness for preparation of As-Se-Te chalcogenide films of different chemical composition. The films obtained have been also modified by laser irradiation.

JTu2A.35
Single Transverse Mode eGFP Modified Silk Fibroin Laser, Itir Bakis Dogru[1], kyungtaek Min[2], Muhammad Umar[2], Houman Bahmani Jalali[1], Efe Begar[1], Deniz Conkar[1], Elif Nur Firat Karalar[1], Sunghwan Kim[2], Sedat Nizamoglu[1]; [1]*Koc Univ., Turkey;* [2]*Ajou Univ., South Korea.* A single transverse mode distributed feedback laser is reported where the gain medium is composed enhanced green fluorescent protein in silk fibroin matrix. Moreover, optical feedback is increased with a high refractive index TiO2 layer.

JTu2A.36
Color-Generating 1D PC Dichroic Filter on Cu(In,Ga)$(S,Se)_2$ Thin-Film Photovoltaic Cells for Building Integrated Photovoltaics, Gang Yeol Yoo[1], Woong Kim[1], Byoung Koun Min[3], Young Rag Do[2]; [1]*Materials Science And Engineering, Korea Univ., South Korea;* [2]*kookmin Univ., South Korea;* [3]*KIST, South Korea.* High-performance and beautiful blue-color-generating Cu(In,Ga)$(S,Se)_2$ thin-film PV with one-dimensional photonic crystal dichroic films were fabricated for the building of integrated photovoltaics.

JTu2A.37
Scattering Directionality in the UV, Yael Gutierrez[1], Dolores Ortiz[1], José M. Saiz[1], Francisco González[1], Fernando Moreno[1]; [1]*Universidad de Cantabria, Spain.* UV nanoplasmonics and scattering directionality properties of High Refractive Index Dielectrics (HRID) launches this research in materials with HRID character in the UV: Photocatalysis and solar energy harvesting applications are the target.

JTu2A.38
Enhancing the Alignment Selectivity of p/MQW/n InGaN Nanorod LEDs, Yun Jae Eo[1], Gang Yeol Yoo[2], Young Kwon Jang[1], Ji Hye Oh[1], Keyong Nam Lee[1], Woong Kim[2], Young Rag Do[1]; [1]*Department of Chemistry, Kookmin Univ., South Korea;* [2]*Department of Materials Science and Engineering, Korea Univ., South Korea.* We introduced DC offset voltage in a dielectrophoresis assembly process used to align individually separated p/MQW/n InGaN nanorod LEDs to enhance the alignment selectivity for the DC operation of novel nanorod LED devices.

JTu2A.39
Controlling Extraordinary Transmission through Hole Arrays using Subwavelength Periodic Resonators, Lok Abhishikth Nakka[1], Dibakar Roy Chowdhury[1], Sabyasachi Banerjee[1,2], Shashank Rangu[1], Sreekar Kamireddy[1], Abul K. Azad[3]; [1]*Mahindra Ecole Centrale, India;* [2]*BITS Pilani – Hyderabad, India;* [3]*Los Alamos National Laboratory, Center for Integrated NanoTechnology, USA. In this work, we have demonstrated a unique method to control extraordinary transmission through a subwavelength hole array by hybridizing with metal resonators in stacked configuration.*

JTu2A.40
Withdrawn

JTu2A.41
Tissue Phantoms with Patterned Oxygenation for Photoacoustic Applications, Aditya Pandya[1,2], Harshad Karia[1,3], Slim Tajouri[1,4], Xiao Zheng[1,2], Csilla Gergely[4], Michael Kolios[1,2], Alexandre Douplik[1,2]; [1]*Ryerson Univ. , Canada;* [2]*Inst. of Biomedical Science and Technology, Canada;* [3]*Faculty of Life Science, Univ. College London , UK;* [4]*Bionanophotonics, Université de Montpellier, France.* Aluminium sulphonated phthalocyanine photosensitiser mixed with Hemoglobin was used to create patterned oxygenation states in tissue mimicking gelatin phantoms. Temporal study of Hb conversion and an oxygenation patterned phantom is presented.

JTu2A.42
Opto-mechanical-thermal System Design and Analysis for Space-borne Telescope, Dandan Zhang[1,2], Qunbo Lv[1,2], Yangyang Liu[1,2], Weiyan Li[1,2], Yu Fang[1,2], Libin Xiang[1,2]; [1]*Academy of Opto-Electronics, CAS, China;* [2]*Key Laboratory of Computational Optical Imaging Technology, CAS, China.* One type of space-borne telescope system with high-resolution and low-weight is proposed. The opto-mechanical-thermal analysis demonstrates that the prototype has adaptive surface accuracy, dynamic stiffness and thermal focusing ability.

JTu2A.43
Modeling of Ultrasound Detection by Silicon-photonics-based Sensors, Shai Tsesses[1], Daniel Aronovich[1], Assaf Grinberg[1], Evgeny Hahamovich[1], Amir Rosenthal[1]; [1]*Technion Israel Inst. of Technology, Israel.* We develop a model for assessing the sensitivity of silicon-photonics interferometric detectors of ultrasound for two types of acoustic waves. The sensitivity of the two polarization modes of a waveguide are calculated and experimentally verified.

JTu2A.44
Enhancing the Photo-response of Au/ZnO Schottky-barrier Photodiodes by Inserting an Intrinsic NiO Layer, Jun-Dar Hwang[1]; [1]*National Chiayi Univ., Taiwan.* Intrinsic NiO layer was inserted between Au/ZnO interface to improve the photo-response of Au/ZnO Schottky-barrier photodiodes (SPDs). Ultraviolet responsivity was increased from 0.0018 A/W to 1.83 A/W for the SPDs without and with NiO, respectively.

JTu2A.45
Fiber Optic Sensors Type LPG Applied to the Determination of Stresses and Deformations in Soils, Luis Mosquera[1], J. B. Pinao[1]; [1]*Universidad Nacional de Ingenieria, Peru.* LPG fiber optical sensors are applied to the determination of the transmitted stress and deformation of soil subjected to surface loads. The elasticity modules (Y=5,4 MPa; ν=0,52) are determined from the Bousinessq equations.

JTu2A.46
Positioning of Nanoparticles using a Whispering-gallery Microcavity, Youling Chen[1]; [1]*Inst. of semiconductors, CAS, China.* We propose to detect the 3D positions of nanoparticles using a whispering-gallery microcavity. We track the shift, broadening and splitting of several split polar modes to get the 3D position information.

10:00–11:30
JTu2A • Poster Session I and Networking Coffee Break with Exhibitors

JTu2A.47
Measurement of the Particle Size and Flame Area in Strong Light Based on Laser Imaging, Jianhua Shi[1], Hairong Zhong[1], Bing Lei[1], Sihua Fu[1], Wei Wang[1]; [1]*National Univ. of Defense Technology, China.* An experiment system has been designed and established to obtain the images of the particles and flames during they are burning, a software has been developed to compute the particles' sizes and the flame areas.

JTu2A.48
Resonant Wavelength Observation by 3D Printed Mechanically Induced Long-Period Fiber Grating Device, Ravivudh Khun-in[1,2], Masahiro Takagi[1], Kouya Nanjo[1], Yuttapong Jiraraksopakun[2], Apichai Bhatranand[2], Hideki Yokoi[1]; [1]*Shibaura Inst. of Technology, Japan;* [2]*King Mongkut's Univ. of Technology Thonburi, Thailand.* The mechanically induced long-period fiber grating device is fabricated using a 3D printer. The results show that with the 10 nm of grating period difference, the resonant wavelength can be shifted up to 19 nm.

JTu2A.49
Improving Multivariate Analysis in Mid-infrared Spectroscopy for Biosensing, Ine L. Jernelv[1], Karolina Milenko[1], Reinold Ellingsen[1], Dag R. Hjelme[1], Astrid Aksnes[1]; [1]*Department of Electronic Systems, Norwegian Univ. of Science and Technology, Norway.* Mid-infrared spectroscopy using multivariate analysis for quantification has high potential in biosensing. This case study on aqueous glucose solutions yields improved prediction errors by optimising preprocessing and wavelength selection procedures.

JTu2A.50
Photonics Platform for Liquid Biopsy, Ruta Grinyte[1]; [1]*Leitat, Spain.* In this study, we presented the high sensitive free DNA detection system based on high performance photonic chip. This technology could be applied to measure cell free circulating DNA in plasma for early cancer detection

JTu2A.51
Surface Plasmon Resonance Sensors in Far- and Deep-ultraviolet Regions, Ichiro Tanabe[1]; [1]*Osaka Univ., Japan.* We investigated the surface plasmon resonance (SPR) of Al thin films with varying refractive index of the environment near the films in the far-ultraviolet (FUV, ≤ 200 nm) and deep-ultraviolet (DUV, ≤ 300 nm) regions.

JTu2A.52
Micro-Scale Fringe Projection Based Optical Profilometry using a Fiber Optic Lloyd's Mirror, Arda Inanc[1], Gulsen Kosoglu[1,2], Mehmet N. Inci[1]; [1]*Bogazici Univ., Turkey;* [2]*Marmara Univ., Turkey.* The technique presents a 3-D optical profilometer at micron scale with pitch varying fringe patterns using a fiber optic Lloyd's mirror combined with a compound optical microscope.

JTu2A.53
Silica Spherical Micro Resonators Temperature Sensor, Experiments and Simulation, Daniela Cywiak[1], Carlos Saavedra[1], Alejandrina Martinez[1], José Lucio[1], Rigoberto Castro[1]; [1]*DCI, Mexico.* We developed near ambient temperature experiments based on spherical micro-resonators showing the relation between the wavelength shift of whispering gallery modes and the surrounding temperature, which are visualized in a finite element simulator.

JTu2A.54
Force Sensors based on Skew-ray-probed Optical Fibers, George Y. Chen[1], Soroush Shahnia[1], Tanya Monro[1], David Lancaster[1]; [1]*Univ. of South Australia, Australia.* We demonstrate a bend-loss-based force sensor where pure skew rays can enhance its sensitivity by a factor of 3.8. We show a compression-loss-based force sensor that is stable against changes in the light launch-angle.

JTu2A.55
An Improved FBG Interrogator Considering Fiber Fabry-Perot Tunable Filter Nonlinearity, Jae-Kyung Pan[1]; [1]*Chonbuk National Univ., South Korea.* An improved FBG interrogator for mitigating the effect the nonlinearity and ambient temperature dependence of FFP filter is proposed and experimentally demonstrated. Experimental results with calibration show better than those without calibration.

JTu2A.56
Surface Plasmon Resonance Sensor Based on D-shaped Dual-core Photonic Crystal Fiber, Shuai Wang[1,2], X H. Sun[1], Gangding Peng[2]; [1]*Zhengzhou Univ., China;* [2]*Univ. of New South Wales, Australia.* An SPR sensor based on D-shaped dual-core photonic crystal fiber is designed. The plasma resonance intensity of this structure is obviously higher than that of the single core structure. The sensitivity on amplitude is numerically investigated.

JTu2A.57
Design and Test of a RadOptic Detector Optimized for Pulsed MeV Gamma Rays, Bodong Peng[1], Yan Song[1], Dongwei Hei[1], Jun Zhao[1]; [1]*Northwest Inst. of Nuclear Technolog, China.* Pulsed MeV gamma ray detector, based on detection of excess carrier induced refractive index change in bulk semiconductor, operating remotely with high temporal resolution was reported.

JTu2A.58
Germanium-on-insulator Pedestal Waveguide for Mid-infrared Sensing Applications, Wei Li[1], P Anantha[1], Kwang Hong Lee[2], Jin Zhou[1], Xin Guo[1], Hong Wang[1], Chuan Seng Tan[1]; [1]*Nanyang Technological Univ., Singapore;* [2]*Low Energy Electronic System (LEES), Singapore-MIT Alliance for Research and Technology (SMART), Singapore.* The propagation loss of the fundamental TM mode is reduced significantly by 59% on pedestal waveguides fabricated on GOI platform. The sensitivity of the waveguides is 0.25% for acetic acid, based on evanescent field sensing.

JTu2A.59
The Study of Mutual Diffusion of Heavy Water in Normal Water Based on a Double Liquid-core Cylindrical Lens, Xiao-Yun Pu[1]; [1]*Yunnan Univ., China.* The mutual diffusion coefficient of heavy water in normal water has been measured by using a double liquid-core cylindrical lens and a novel optics method called the shift of equivalent refractive index slice.

JTu2A.60
Fast Interrogation of Equally-spaced Arrays of Fiber Bragg Gratings using Sparse Incoherent OFDR, Juan Clement Bellido[1], Javier Madrigal Madrigal[2], Javier Hervás Peralta[2], Carlos Rodríguez Fernández-Pousa[1]; [1]*Department of Communications Engineering, Universidad Miguel Hernández de Elche, Spain;* [2]*ITEAM Research Inst., Universitat Politècnica de València, Spain.* An I-OFDR interrogator of equally-spaced FBG arrays based on sparse sampling of the RF response and IDFT demodulation is shown to retrieve coarse reflectivity values with interrogation times as low as 10 ms per FBG.

JTu2A.61
Suppression of Signal Instability Caused by Polarization Cross-Talk in Interferometric Fiber-optic Current Sensors, Andreas Frank[1], Chen-Pu Hsu[1], Lin Yang[1], Georg M. Müller[1], Philippe Gabus[2], Klaus Bohnert[1]; [1]*Corporate Research, ABB Switzerland Ltd, Switzerland;* [2]*High Voltage Products, ABB Switzerland Ltd, Switzerland.* We investigate the effect of polarization cross-talk in interferometric fiber-optic current sensors particularly at fiber connectors and the phase modulator. With a modified optical circuit we suppress cross-talk related signal instability.

JTu2A.62
Pressure Sensing Based on Ratiometric Bragg Grating Loss in a Planar Silica Diaphragm Platform, Alex Jantzen[1], Paul C. Gow[1], Alan C. Gray[1], Senta L. Scholl[1], James C. Gates[1], Peter G. Smith[1], Lewis J. Boyd[2], Christopher Holmes[1]; [1]*Univ. of Southampton, UK;* [2]*Parker Aerospace, Fluid System Division, Parker Hannifin Corporation, UK.* In this paper the first demonstration of a planar silica-on-silicon chip pressure sensor based on monitoring ratiometric Bragg grating amplitude loss across a diaphragm is made. The device resolution was found to be 0.46 kPa.

JTu2A.63
New Opportunities for Optical Temperature Sensing with Mn^{4+}-Doped Magnesium Titanate, Francesca Venturini[1], Michael Baumgartner[1], Sergey M. Borisov[2]; [1]*Inst. of Applied Mathematics and Physics, Zurich Univ. of Applied Sciences, Switzerland;* [2]*Inst. of Analytical Chemistry and Food Chemistry, Graz Univ. of Technology, Austria.* The emission of Mn^{4+}:Mg_2TiO_4 is investigated for different temperatures. The potential of this material for temperature sensing is demonstrated by a fiber-optic temperature microsensor with high resolution and very fast response time.

JTu2A.64
Silica Spherical Micro Resonators Temperature Sensor, Experiments and Simulation, Daniela Cywiak[1], Carlos Saavedra[1], Alejandrina Martinez[1], José Lucio[1], Rigoberto Castro[1]; [1]*Universidad de Guanajuato, Mexico.* We developed near ambient temperature experiments based on spherical micro-resonators showing the relation between the wavelength shift of whispering gallery modes and the surrounding temperature, which are visualized in a finite element simulator.

JTu2A.65
Local Refractive Index Sensitivity of Nanoporous Gold Nanodisk Array, Wei-chuan Shih[1]; [1]*Univ. of Houston, USA.* The local refractive index sensitivity of nanoporous gold nanodisk array is quantified using bulk media and alkanethiol self-assembled monolayer. A potential application is to detect biomarker binding on such surfaces.

JTu2A.66
Assessment of Mutual Interference Potential and Impact with Off-the-shelf Mobile LIDAR, Jeongsook Eom[1], Gunzung Kim[1], Yongwan Park[1], Soojung Hur[1]; [1]*Yeungnam Univ., South Korea.* With the increasing number of autonomous cars equipped with mobile LIDAR, the probability of mutual interference becomes an important issue. We present several mutual interference scenarios with off-the-shelf LIDARs and offer an assessment of them.

JTu2A.67
Bi-focusing Fresnel Zone Plate with a Reduced Depth of Field for Enhanced Detecting Sensitivity, Jinseob Kim[1], Jeongkyun Na[1], Juhwan Kim[1], Yoonchan Jeong[1,2]; [1]*Department of Electrical and Computer Engineering, Seoul National Univ., South Korea;* [2]*ISRC & IAP, Seoul National Univ., South Korea.* An advanced binary metallic Fresnel zone plate is proposed for axial bi-focusing, which is designed by a novel phase-selection-rule method. It demonstrates a significantly narrower depth of field than that of a conventional design.

JTu2A.68
Performance Evaluation of Pixel-by-pixel Scanning {LIDAR} with Optical Coded Pulses, Gunzung Kim[1], Jeongsook Eom[1], Wonkyo Jeong[2], Soojung Hur[1], Yongwan Park[1]; [1]*Yeungnam Univ., South Korea;* [2]*Nineone, Co., LTD, South Korea.* We evaluated the performance of the pixel-by-pixel scanning LIDAR system with optical coded pulses. Compared with traditional LIDAR system, the accuracy is enhanced two times, and the precision is improved seven times.

JTu2A.69
Prototype Design of 3D Scanning LIDAR based on Direct-sequence Optical Code Division Multiple Access, Gunzung Kim[1], Jeongsook Eom[1], Soojung Hur[1], Yongwan Park[1]; [1]*Yeungnam Univ., South Korea.* We designed a prototype for testing feasibility of a new LIDAR system, which was designed to encode pixel location information in its laser pulses using the DS-OCDMA method in conjunction with a scanning-based MEMS mirror.

JTu2A.70
Towards Fiber-optic Raman Spectroscopy for Glucose Sensing, Karolina Milenko[1], Silje S. Fuglerud[1], Ine L. Jernelv[1], Astrid Aksnes[1], Reinold Ellingsen[1], Dag R. Hjelme[1]; [1]*Department of Electronic Systems, Norwegian Univ. of Science and Technology, Norway.* We demonstrate a multimode optical fiber sensor for spectroscopic Raman measurements of glucose concentration for the application in intraperitoneal glucose detection in diabetic patients. A regression model with a RMSEC of 2.2 mM was obtained.

JTu2A.71
3D Optical Tomography Image Reconstruction in Opaque Media, Otoniel G. da Rocha[1], Cicero Martelli[1], Marco José da Silva[1], Jean Carlos Cardozo da Silva[1]; [1]*Federal Univ. of Technology, Brazil.* Three-dimensional imaging reconstruction of objects immersed in crude and synthetic oils using MIR optical tomography is present. Results are promising and show the possibility for field applications.

10:00–11:30
JTu2A • Poster Session I and Networking Coffee Break with Exhibitors

JTu2A.72
Latest Developments of a Laser-based Spectrometer Devoted to the Monitoring of Gaseous CO2 for Enological Applications, Raphael Vallon[1], Anne-Laure Moriaux[1], Bertrand Parvitte[1], Clara Cilindre[1], Gérard Liger-Belair[1], Virginie Zeninari[1]; [1]*Universite de Reims Champagne-Ardenne, France*. We report the latest developments and the application of an infrared diode laser spectrometer devoted to the monitoring of gaseous carbon dioxide in the headspace of Champagne and sparkling wines glasses.

JTu2A.73
Latest Results of an Intra-cavity Quantum Cascade Laser Based Spectrometer for Atmospheric Gas Detection, Bertrand Parvitte[1], Laurent Bizet[1], Raphael Vallon[1], Grégory Maisons[2], Mathieu Carras[2], Virginie Zeninari[1]; [1]*Universite de Reims Champagne-Ardenne, France;* [2]*MirSense, France*. We report the latest results obtained with an intra-cavity quantum cascade laser emitting in the mid-infrared region and its application to the detectorless detection of atmospheric molecules such as methane and water vapor.

JTu2A.74
Dynamic Strain Analyses on Transformer Iron Core with Fiber Bragg Gratings, Gustavo G. Kuhn[1], Kleiton de Moraes Sousa[1], Jean Carlos Cardozo da Silva[1]; [1]*Federal Univ. of Technology - Parana, Brazil*. This paper presents an identification of dynamic strain directly transformer iron core using FBG sensor. Preliminary results demonstrate that the technique is promising in the monitoring of vibration in distribution transformers.

JTu2A.75
Biaxial Optical Accelerometer Based on Ultra-high Numerical Aperture Fiber for Structural and Electrical Machines Vibrations Analysis, Rafael Linessio[1], Jean C. da Silva[1], Lucas H. Tavares[2], Thiago Silva[2], Carlos A. Bavastri[2], Paulo F. Antunes[3]; [1]*Graduate Program in Electrical and Computer Engineering, Federal Univ. of Technology - Paraná, Brazil;* [2]*Graduate Program in Mechanical Engineering, Federal Univ. of Paraná, Brazil;* [3]*Univ. of Aveiro, Portugal*. This paper presents a biaxial optical accelerometer using the Ultra-High NA fiber, for vibrations analysis in structures and electrical machines. The main characteristic of this sensor is smaller size and the higher natural frequencies.

JTu2A.76
Metal-Coated Silica Fiber Sensor for High-Power Laser Radiation Measurement, Ivan O. Khramov[1], Nikolay N. Ishmametiev[1], Renat Shaidullin[1,2], Oleg Ryabushkin[1,2]; [1]*Moscow Inst. of Physics and Technology, Russia;* [2]*Kotelnikov Inst. of Radio-Engineering and Electronics of RAS, Russia*. A novel technique of fiber laser power measurement is presented. Optical power transmitting through a copper-coated silica fiber sensor is determined by measuring the metal coating electric resistance change due to the scattered radiation absorption.

JTu2A.77
Considerations for the Development of LMR-based Optical Fiber Sensors for Gas Sensing Applications, Uilian Dreyer[2], Aritz Ozcariz[1], Pablo Zubiate[1], Cicero Martelli[2], Jean C. da Silva[2], Carlos R. Zamarreño[1]; [1]*Electric and Electronic Engineering Department, Public Univ. of Navarra, Spain;* [2]*Graduate Program in Electrical and Computer Engineering, Federal Univesity of Technology - Paraná, Brazil*. This work presents a preliminary study of a LMR-based gas sensor. Results of the device subjected to annealing process show a stable and repetitive response that is required for the utilization in gas sensing applications.

JTu2A.78
Novel Concept of Optical Image Registration using Matrix of Piezoelectric Crystals, Vladimir Fedorov[2], Alexey Pigarev[1], Timur Bazarov[2], Oleg Ryabushkin[1,3]; [1]*MIPT, Russia;* [2]*DPQE, MIPT, Russia;* [3]*Kotelnikov Inst. of Radioengineering and Electronics, Russia*. We introduce a method of optical image registration using matrix made of transparent piezoelectric crystals. Distribution of radiation intensity is obtained by measuring the piezoelectric resonance frequency shift of corresponding matrix elements.

JTu2A.79
Constrained Restoring Force FBG-based Accelerometer, Suneetha Sebastian[1], Sai Prathyusha Malla[1], Sreejith A[2], Asokan Sunderrajan[1]; [1]*Department of Instrumentation and Applied Physics, Indian Inst. of Science, Bangalore, India;* [2]*International School of Photonics, Cochin Univ. of Science and Technology, India*. We propose a FBG-based accelerometer design which comprises of a spring mass system resting on a diaphragm. Theoretical sensitivity of 68.88 pm/g was obtained which matches the simulated sensitivity of 67.31 pm/g.

JTu2A.80
Integrated System SPR Array Sensors based on Side-Glow Fibers, Ramona V. Galatus[1]; [1]*Bases of Electronics, Technical Univ. of Cluj-Napoca, Romania*. The integrated system consisting of a customized number of plasmonic sensors array is presented. Time-domain monitoring of the sensors with a smartphone based spectroscopy application is a portable solution for environment applications.

Tuesday, 3 July

Room D1.1

Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials

Room E5

Integrated Photonics Research, Silicon, and Nano-Photonics

Room D1.2

Novel Optical Materials and Applications

Room D7.1

Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

11:30–12:30
BTu3A • Industry Session
Presider: Remco Nieuwland; Hittech Multin B.V., The Netherlands

BGPP 2018 continues the long-standing tradition of addressing fundamental and technical issues of immediate and long-term application of fiber Bragg gratings and other devices fabricated by laser-matter-interaction. While fundamental aspects are covered by invited and contributed proceeding papers, the technical aspect is addressed in the Industry Session.

Speakers from 6 different companies have been invited to make a 10 min presentation to showcase their advanced products, to explain the underlying technology and working principle. Company professionals that are also presenting scientific work during the conference have been favored. Therefore, the scientists in the auditorium working in closely related areas may get easily into contact with the company professionals for various reasons. Scientist may see how applied research translates into new products and applications. Junior scientists may be stimulated to create tomorrow a start-up in the field or join a company. In this way BGPP encourages greater interaction between the industry professionals and scientist.

11:30 - PhotoNova Inc, Victor Lambin Iezzi
Bragging About Gratings: Custom Optical Fiber Photonic Solutions from PhotoNova Inc.

11:40 - Northlab AB, P Karlsson
An industrial view on FBG manufacturing

11:50 - Micron Optics, D Costantini
Swept Lasers for both optical characterization and field sensing

12:00 - IFOS, R Black
IFOS Broadband FBG Interrogation and Sensing Products

12:10 - Redondo Optics, E Mendoza
Miniature FBG sensor interrogators for applications where size, weight, power, and cost are critical for operation

12:20 - ITF Technologies, B. Sevigny
Fiber Bragg Gratings for the Industry at ITF Technologies

11:30–12:30
ITu3B • Novel Nano-scale Structures
Presider: Martin Rochette; McGill Univ., Canada

ITu3B.1 • 11:30
Invisible Metal-wire-based Transparent Electrodes via Near-zero Scattering, Sangwoo Kim[1], Yoon-Jong Moon[1], Sun-Kyung Kim[1]; [1]*Nano Photonics Lab., South Korea.* Rationally designed Ag/oxide core/shell wires are optically cloaked in visible light owing to the broadband suppression of scattering. These cloaked metal wires enable a high-clarity, high-transmittance, and high-conductivity transparent electrode.

ITu3B.2 • 11:45
The Investigation of Multi-fold Photonic Quasicrystalline Structures, X H. Sun[1]; [1]*Zhengzhou Univ., China.* Complex photonic quasicrystals are designed theoretically in submicrometer scale by using a refractive interferometer. The calculated diffraction patterns prove their multi-fold rotational symmetry. Decagonal quasicrystals is prepared experimentally.

ITu3B.3 • 12:00
Surface Plasmon-induced Modification of Photoluminescence From GaN Quantum Dot Coupled to Al Nanoparticles, Wei Zhang[1], Zhiqiang Qi[1], Jiangnan Dai[1], Changqing Chen[1]; [1]*Wuhan National Lab for Optoelectronics, China.* We investigated the coupling structures of GaN quantum dots with size-tunable Al nanoparticle arrays and revealed the plasmon-induced modification mechanism of the photoluminescence from GaN quantum dots

ITu3B.4 • 12:15
Efficient Vortex Generation in Sub-wavelength Near-zero Index Slabs, Alessandro Ciattoni[1], Carlo Rizza[1], Andrea Marini[2]; [1]*CNR-SPIN, Italy;* [2]*Department of Physical and Chemical Sciences, Univ. of L'Aquila, Italy.* We demonstrate that a subwavelength near-zero index slab illuminated by a paraxial fundamental Bessel beam with circular symmetry acts as a vortex generator owing to the spin-orbit interaction triggered by the medium.

11:30–12:30
NoTu3C • Two-dimensional Materials II
Presider: Jason Myers; US Naval Research Laboratory, USA

NoTu3C.1 • 11:30 Invited
Graphene-CMOS Integration for Broadband Imaging and Integrated Photonics, Frank Koppens[1,2]; [1]*ICFO -The Inst. of Photonic Sciences, Spain;* [2]*ICREA, Spain.* We show several prototypes of graphene-CMOS integrated systems. This includes the first digital camera sensitive to UV, visible and infrared light (300 – 2000 nm) and optical tranceivers for integrated photonics networks (5G).

NoTu3C.2 • 12:00
Quantum Confined Colloidal Perovskite Nanoplatelets for Extremely Pure Green and Efficient LEDs, Sudhir Kumar[1], Jakub Jagielski[1], Chih-Jen Shih[1]; [1]*Inst. for Chemical and Bioengineering, ETH Zurich, Switzerland.* We demonstrate ultrapure-green electroluminescence by employing colloidal perovskite nanoplatelets (NPLs). Devices show a high current efficiency of >20 cd A^{-1} with the color gamut coverage >97% of Rec. 2020 gamut-area in CIE1931 color space.

NoTu3C.3 • 12:15
Ultra-broadband and Highly-sensitive Photoresponse of $EuBiSe_3$–metal Contacts, Yingxin Wang[1], Dong Wu[2], Yingying Niu[1], Meng Chen[1], Ziran Zhao[1]; [1]*Tsinghua Univ., China;* [2]*Peking Univ., China.* We report on the phototermoelectric properties of the ternary europium pnictogen chalcogenide compound of $EuBiSe_3$ contacted with meatal electrodes. The device exhibits significant and fast photoresponse to light from ultraviolet to terahertz range.

11:30–12:30
SeTu3D • Micro- and Nano-Engineered Sensors I
Presider: Ellen Holthoff; US Army Research Laboratory, USA

SeTu3D.1 • 11:30 Invited
Sizing Particulates with Nanofiber Sensors, Yun-Feng Xiao[1]; [1]*School of Physics, Peking Univ., China.* A size spectrometer using a nanofiber array is demonstrated. Detection and sizing of single nanoparticles in both aqueous and air environments are realized. The size spectrometer is also used for monitoring ultrafine particulates in Beijing.

SeTu3D.2 • 12:00 Invited
Optical Fiber Sensing Devices Fabricated with Femtosecond Laser, Xuewen Shu[1]; [1]*Wuhan National Lab for Optoelectron, Huazhong Univ of Science and Technology, China.* We report our recent research on the fabrication of various in-fiber structures with femtosecond laser and also discuss their applications for different sensing purposes.

12:30–13:30 Student & Early Career Professional Development & Networking Lunch and Learn *(Separate registration required), Room F33.1*

12:30–14:00 Lunch *(on own)*

Photonic Networks and Devices | Signal Processing in Photonic Communications | Specialty Optical Fibers | Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

Room D3.2 — Photonic Networks and Devices

11:30–12:30
NeTu3E • Autonomous and High-Capacity Systems
Presider: Nicola Sambo; Sant' Anna di Pisa, Italy

NeTu3E.1 • 11:30 Invited
Towards Multiband Optical Systems, Antonio Napoli[3], Nelson M. Cost[1], Johannes Fischer[2], João Pedro[1], Silvio Abrate[4], Nicola Calabretta[5], Wladek Forysiak[6], Erwan Pincemin[7], Juan F. Gimenez[11], Chris Matrakidis[8], Gunther Roelkens[9], Vittorio Curri[10]; [1]*Coriant, Portugal;* [2]*Fraunhofer HHI, Germany;* [3]*Coriant R&D GmbH, Italy;* [4]*ISMB, Italy;* [5]*TU/e, Netherlands;* [6]*ASTON Univ., UK;* [7]*Orange Lab, France;* [8]*Univ. of Peloponnese, Greece;* [9]*Ghent Univ.-IMEC, Belgium;* [10]*Politecnico di Torino, Italy;* [11]*Telefonica, Spain.* Multiband transmission is a valid option to significantly increase fiber capacity and efficiently utilize the available and deployed optical fiber infrastructure. In this contribution, we evaluate its challenges and possible implementation.

NeTu3E.2 • 12:00 Invited
Self-configuring Integrated Photonic Networks for Communications, Switching and Processing, David A. B. Miller[1]; [1]*Stanford Univ., USA.* New algorithms and architectures let us to exploit complex integrated photonic systems that design, perfect, and stabilize themselves. The underlying singular value decomposition mathematics gives further insight into optics, including new laws.

Room D5.2 — Signal Processing in Photonic Communications

11:30–12:30
SpTu3F • Cloud Optics and Network Virtualization
Presider: Xi Chen; Nokia Bell Labs, USA

SpTu3F.1 • 11:30 Invited
Cloud Optics - IEEE 802.3 Ethernet, OIF, and MSA Defined Optical Specifications in Data-center Aligned Form Factors, Jeffery J. Maki[1]; [1]*Juniper Networks Inc., USA.* Optical transceiver needs of hyper-scale data centers have increasing influence on the choice of optical signaling and form factor. Review is made of the industry response to these needs, including standards setting organization (SSO) specifications.

SpTu3F.2 • 12:00 Invited
Withdrawn

Room D7.2 — Specialty Optical Fibers

11:30–12:30
SoTu3G • Nonlinear Interactions in Fibers
Presider: Jesper Laegsgaard; Technical Univ. Denmark, Denmark

SoTu3G.1 • 11:30 Invited
Fibre-based Sources from the UV to the Mid Infra-Red, J. R. Taylor[1]; [1]*Imperial College London, UK.* Extensive spectral and temporal versatility are achieved by integrating nonlinear fibres and crystals with seeded master-oscillator power fibre amplifier configurations through diverse generation processes. Various schemes will be reviewed.

SoTu3G.2 • 12:00
Stimulated Brillouin Scattering in Germanium-doped-core Optical Fibers up to 98% Mol Doping Level, Moïse Deroh[1], Jean-Charles Beugnot[1], Bertrand Kibler[2], Hervé Maillotte[1], Thibaut Sylvestre[1]; [1]*FEMTO-ST Inst., France;* [2]*Laboratoire Interdisciplinaire Carnot de Bourgogne, France.* We experimentally investigate stimulated Brillouin scattering in several highly GeO_2-doped optical fibers and report wide frequency tunability over more than 3 GHz and Brillouin gain 7 times larger than in standard silica fibers.

SoTu3G.3 • 12:15
Prospects and Limitations of Low-noise Fiber Supercontinuum Sources, Alexander M. Heidt[1], Thomas Feurer[1]; [1]*Universitat Bern, Switzerland.* The boundary of coherent and incoherent nonlinear dynamics of supercontinuum generation in all-normal dispersion fibers is explored, yielding new insights in noise limitations, novel nonlinear phenomena, and future routes to push performance limits.

Room E1.1 — Optical Sensors

11:30–12:30
SeTu3H • Frequency Comb Sensors
Presider: Lynda Busse; US Naval Research Laboratory, USA

SeTu3H.1 • 11:30
Kerr Soliton Combs in Crystalline Microresonator with a Regular Multi-frequency Diode Lasers, Nikolay G. Pavlov[1,2], Sergey Koptyaev[3], Grigoriy Likhachev[4], Ramzil Galiev[4,2], Nikita Kondratiev[2], Alexandr Gorodnitskiy[1,2], Andrey Voloshin[2], Michael Gorodetsky[2,4]; [1]*Moscow Inst. of Physics and Technology, Russia;* [2]*Russian Quantum Center, Russia;* [3]*Samsung R&D Inst. Russia, SAIT-Russia Laboratory, Russia;* [4]*Faculty of Physics, M. V. Lomonosov Moscow State Univ., Russia.* We demonstrate theory and experiment of transformation of a multi-frequency Fabry-Perot laser diode spectrum to a single narrow-linewidth and coherent soliton Kerr frequency combs source via self-injection locking to an optical microresonator.

SeTu3H.2 • 11:45
Dual-comb Optical Coherence Tomography, Jiqiang Kang[1], Pingping Feng[1], Bowen Li[1], Kenneth Kin-Yip Wong[1]; [1]*Univ. of Hong Kong, Hong Kong.* An optical coherence tomography (OCT) system that leverages a dual-comb source based on electro-optic modulators and fiber nonlinear devices is demonstrated. The comb sources generate 270-fs pulses and the system achieves over 9-mm imaging depth.

SeTu3H.3 • 12:00
Line Shape Measurements of CO Using Frequency Comb Based Cavity-enhanced Absorption Spectroscopy, Akiko Nishiyama[2,1], Grzegorz Kowzan[2], Dominik Charczun[2], Vinicius Oliveira[3], Axel Ruehl[3,4], Ingmar Hartl[3], Kaoru Minoshima[1], Ryszard Trawinski[2], Piotr Maslowski[2]; [1]*Department of Engineering Science, Graduate School of Informatics, Univ. of Electro-Communications, Japan;* [2]*Inst. of Physics, Faculty of Physics, Astronomy and Informatics, Nicolaus Copernicus Univ., Poland;* [3]*Deutsches Elektronen-Synchrotron (DESY), Germany;* [4]*QUEST-Leibniz-Research School, Inst. for Quantum Optics, Leibniz Univ. Hannover, Germany.* We performed measurements of overtone band of CO using a frequency comb based cavity-enhanced absorption spectroscopy and FTS with sub-nominal resolution. The technique allows to measure and determine precisely line-shape parameters in wide range.

SeTu3H.4 • 12:15
Broadband Cavity-enhanced Molecular Absorption and Dispersion Spectroscopy with a Frequency Comb-based VIPA Spectrometer, Grzegorz Kowzan[1], Dominik Charczun[1], Agata Cygan[1], Ryszard Trawinski[1], Daniel Lisak[1], Piotr Maslowski[1]; [1]*Inst. of Physics, Faculty of Physics, Astronomy and Informatics, Nicolaus Copernicus Univ. in Torun, Poland.* We present cavity mode width and frequency measurements over 60-cm^{-1} range at Hz-level precision. We utilize a near-infrared frequency comb and a VIPA spectrometer to retrieve absorption and dispersion of a CO-N2 sample in a high-finesse cavity.

12:30–13:30 Student & Early Career Professional Development & Networking Lunch and Learn
(Separate registration required), Room F33.1

12:30–14:00 Lunch *(on own)*

Tuesday, 3 July

Room D1.1

Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

14:00–16:00
BTu4A • FBG and Laser Writing for Biomedical Sensing
Presider: Hans Limberger; Ecole Polytechnique Federale de Lausanne, Switzerland

BTu4A.1 • 14:00 Keynote
Tilted Fiber Bragg Gratings with Plasmonic and Near Zero Permittivity Coatings for Biochemical Sensing, Jacques Albert[1]; [1]*Department of Electronics, Carleton Univ., Canada.* The polarized evanescent fields of optical fiber cladding modes resonantly coupled from a single mode fiber core are used to probe materials and events on the fiber surface, including plasmonic nanoscale metal coatings

Room E5

Integrated Photonics Research, Silicon, and Nano-Photonics

14:00–16:00
ITu4B • Integrated Optical Sources
Presider: Andreas Beling; Univ. of Virginia, USA

ITu4B.1 • 14:00 Invited
Pushing the Quantum Linewidth Limit with Hybrid Integrated Semiconductor Lasers, Klaus Boller[1]; [1]*Twente Univ., Netherlands.* We present a hybrid semiconductor laser that is widely tunable in the 1.55 μm wavelength range with a quantum linewidth limit well below one kilohertz, obtained via feedback from low-loss dielectric waveguide circuits.

ITu4B.2 • 14:30 Invited
Novel Photonic Integration for Large-bandwidth and Power-efficient Lasers and Modulators, Shinji Matsuo[1], Tatsurou Hiraki[1], Hidetaka Nishi[1], Takuro Fujii[1], Koji Takeda[1], Takuma Aihara[1], Tai Tsuchizawa[1], Takaaki Kakitsuka[1], Hiroshi Fukuda[1]; [1]*NTT Device Technology Laboratories, Japan.* A thin membrane structure enables us to realize novel heterogeneous integration because it can increase tolerance to thermally induced strain. We have fabricated large-bandwidth and power-efficient lasers and modulators on Si.

Room E3

Nonlinear Photonics

14:00–16:00
NpTu4C • Vectorial Effects
Presider: Matteo Conforti; Centre National Recherche Scientifique, France

NpTu4C.1 • 14:00
Persisting Polarization Domain Walls for Buffering of Topological Data, Bruno Garbin[1], Julien Fatome[2], Yadong Wang[1], François Leo[3], Gian-Luca Oppo[4], Stuart Murdoch[1], Miro J. Erkintalo[1], Stephane Coen[1]; [1]*The Univ. of Auckland, New Zealand;* [2]*Université de Bourgogne Franche-Comté, France;* [3]*Université Libre de Bruxelles, Belgium;* [4]*Univ. of Strathclyde, UK.* We experimentally demonstrate the existence of dissipative polarization domain walls in a normally dispersive Kerr resonator. We excite and trap them with appropriate external signals thus realizing an all-optical buffer for topological data.

NpTu4C.2 • 14:30
Chiral Stimulated Raman Scattering and Pressure-tunable Polarization in Twisted Hollow-core PCF, Sona Davtyan[1], David Novoa[1], Philip S. Russell[1]; [1]*Max Planck Inst. for the Science of, Germany.* We show a circularly-polarized frequency comb generated in H_2-filled twisted hollow-core PCF by stimulated Raman scattering. Polarization of anti-Stokes field is pressure-tunable close to the phase-matching point where Raman gain suppression occurs.

Room D1.2

Novel Optical Materials and Applications

14:00–16:00
NoTu4D • Optical Glasses, Crystals and Ceramics II
Presider: Ishwar Aggarwal; Univ of North Carolina at Charlotte, USA

NoTu4D.1 • 14:00 Invited
Overview of NRL's R&D Efforts in Materials for High Power Lasers, Jasbinder S. Sanghera[1]; [1]*US Naval Research Lab, USA.* I will present an overview of developments in the area of rugged window materials for high power laser systems, as well as ceramic laser materials and fiber lasers based on nanoparticle doped silica and all-crystal.

NoTu4D.2 • 14:30 Invited
Chalcogenide Glass Materials for Novel Infrared Optics, Francois Chenard[1], Oseas Alvarez[1], Andrew Buff[1]; [1]*IRflex Corporation, USA.* Novel optical devices made of chalcogenide glass enable unique IR applications. Molded freeform micro-lens collimates and circularizes QCL. Extruded imaging fiber bundle transmits IR image. Broadband AR microstuctures are stamped on fiber tip.

Room D7.1

Optical Sensors

14:00–16:00
SeTu4E • Optical Chemical & Biological Sensing I
Presider: Ellen Holthoff; US Army Research Laboratory, USA

SeTu4E.1 • 14:00 Invited
Al_2O_3 Microresonators for Passive and Active Sensing Applications, Michiel de Goede[1], Lantian Chang[1], Meindert Dijkstra[1], Raquel Obregon[2], Javier Ramon-Azcon[2], Elena Martinez[2], Laura Padilla[3], Jaume Adan[3], Francesc Mitjans[3], Sonia Garcia-Blanco[1]; [1]*Univ. of Twente, Univ. of Twente, Netherlands;* [2]*IBEC, Spain;* [3]*LEITAT, Spain.* The Al_2O_3 waveguide technology was explored for sensing applications. The devices were successfully applied to the label-free detection of cancer biomarkers in urine.

SeTu4E.2 • 14:30
Highly Selective All-metamaterial Optical CO_2 Sensor, Alexander Lochbaum[1], Yuriy Fedoryshyn[1], Juerg Leuthold[1]; [1]*ETH Zurich, Switzerland.* We demonstrate an all-metamaterial optical CO_2 sensor by cascading metamaterial perfect absorber (MPA) structures on emitter and detector membranes, yielding a system quality factor of 21.5 and a humidity cross sensitivity of only 0.77 $ppmCO_2\%rH^{-1}$.

Room D3.2 | Room D5.2 | Room D7.2 | Room E1.1 | Room E1.2

Room D3.2 — Photonic Networks and Devices

Room D5.2 — Signal Processing in Photonic Communications

Room D7.2 — Specialty Optical Fibers

Room E1.1 — Integrated Photonics Research, Silicon, and Nano-Photonics

Room E1.2 — Novel Optical Materials and Applications

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

14:15–16:00
NeTu4F • Data Center, Transport and Edge Networks
Presider: Madeleine Glick; Columbia Univ., USA

NeTu4F.1 • 14:15
Dynamic Routing and Spectrum Assignment for Multi-fiber Elastic Optical Networks, Jingxin Wu[1], Suresh Subramaniam[1], Hiroshi Hasegawa[2]; [1]*the George Washington Univ., USA;* [2]*Nagoya Univ., Japan.* We consider dynamic Routing and Spectrum Assignment problem in elastic optical networks with multiple fibers per link. The proposed path selection and spectrum management scheme is demonstrated to improve spectrum efficiency.

NeTu4F.2 • 14:30 Invited
Design and Planning of Datacenter Networks, Josue Kuri[1]; [1]*Google, USA.* The increase in sophistication of Cloud services requires providers to constantly expand their compute, storage and networking capabilities. In this paper we outline our architecture and planning approach to build scalable datacenter networks.

14:00–16:00
SpTu4G • Digital Signal Processing and FEC
Presider: David Hillerkuss; Huawei Technologies Duesseldorf GmbH, Germany

SpTu4G.1 • 14:00 Invited
Advanced Technologies to Address the Capacity Crunch, Jin-Xing Cai[1]; [1]*TE SubCom, USA.* We review techniques to address transoceanic capacity crunch, including wide band C+L amplification, nonlinear transmission optimization, advanced modulation formats, constellation shaping, variable spectral efficiency and nonlinearity compensation.

SpTu4G.2 • 14:30 Invited
Optical SEFDM System: Bandwidth Saving Using Non-orthogonal Sub-carriers, Zhaohui Li[1]; [1]*Sun Yat-Sen Univ., China.* Abstract not available.

14:00–16:00
SoTu4H • Fiber Lasers III
Presider: Sebastien Fevrier; Universite de Limoges, France

SoTu4H.1 • 14:00 Invited
Tm-doped Large-Mode Area Fibers for Efficiency Scaling of 2µm Lasers and Amplifiers, Clemence Jollivet[1], Daniel Jeannotte[1], Richard Tumminelli[1], Joshua Bradford[1], Adrian Carter[1], Kanishka Tankala[1]; [1]*7 Airport Park Road, Coherent, Inc. Nufern, USA.* Recent improvements in the design of LMA Thulium-doped fibers are enabling further power scaling of 2µm laser sources. Optimized glass composition and waveguide design towards scaled efficiencies and diffraction-limited beam quality are discussed.

SoTu4H.2 • 14:30
Tm3+ Doped Germanate Large Mode Area Single Mode Fiber for 2 µm Lasers and Amplifiers, Fedia Ben Slimen[1], Sean Chen[1], Joris Lousteau[1], Yongmin Jung[1], Shaiful Alam[1], Nicholas White[1], David J. Richardson[1], Francesco Poletti[1]; [1]*Univ. of Southampton, UK.* We report the development of a large mode area, high concentration Tm3+ doped germanate fiber. Laser experiments confirm an encouraging slope efficiency of ~8.75% (16.19% allowing for current inter-cavity splice losses).

14:00–16:00
ITu4I • Novel Materials for Photonics
Presider: Benjamin Yang; Georgia Tech Research Inst. USA

ITu4I.1 • 14:00 Invited
Emerging Materials for High Efficiency Photovoltaics, Karin Hinzer[1]; [1]*Univ. of Ottawa, Canada.* To bring higher efficiencies to photovoltaics, present integrated architectures such as multijunction solar cells must include new materials and designs.We will describe new architectures such as multi-segments, nanostructures and junction materials.

ITu4I.2 • 14:30
Non-Volatile Switching of Polycrystalline Barium Titanate Films Integrated in Silicon Photonic Waveguides, Isis Maqueira Albo[1], Sara Varotto[2], Marco Asa[2], Christian Rinaldi[2], Matteo Cantoni[2], Riccardo Bertacco[2], Francesco Morichetti[1]; [1]*Dipartimento di Elettronica, Informazione e Bioingegneria, Politecnico di Milano, Italy;* [2]*Dipartimento di Fisica, Politecnico di Milano, Italy.* Domain switching in polycrystalline $BaTiO_3$ is exploited to realize self-holding phase actuators in Si-photonics. A non-volatile change of the $BaTiO_3$ refractive-index is achieved and poly-$BaTiO_3$-coated silicon photonic circuits are demonstrated.

14:00–16:00
NoTu4J • Nanomaterials I
Presider: Sedat Nizamoglu; Koc Univ., Turkey

NoTu4J.1 • 14:00 Invited
The Role of Vibrational Structure on the Optical Properties of Nanomaterials, Vanessa Wood[1]; [1]*Ramistrasse 101, ETH Zurich, Switzerland.* In this talk, I will present how vibrational modes play a role in the optical properties of nanocrystals such as thermal broadening and how these modes can be controlled through design of the atomistic structure.

NoTu4J.2 • 14:30
Measuring Gravity with Optically Levitated Nanoparticles, Erik Hebestreit[1], Martin Frimmer[1], Rene Reimann[1], Lukas Novotny[1]; [1]*ETZ Zürich, Switzerland.* Nanoparticles optically trapped in vacuum are excellent resonant force sensors. We introduce a scheme for measuring static forces with resonant sensors and demonstrate sensing of the gravitational interaction between a nanoparticle and the earth.

Room D1.1	Room E5	Room E3	Room D1.2	Room D7.1
Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials	Integrated Photonics Research, Silicon, and Nano-Photonics	Nonlinear Photonics	Novel Optical Materials and Applications	Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

BTu4A • FBG and Laser Writing for Biomedical Sensing—Continued

BTu4A.2 • 14:45
Ultrasensitive Label-free Immunosensor based on Graphene Oxide Integrated Dual-peak Long Period Grating, Chen Liu[1], Zhongyuan Sun[2], Lin Zhang[2], Xianfeng Chen[1]; [1]*Bangor Univ., UK;* [2]*Aston Univ., UK.* We propose a label-free immunosensor using graphene oxide-integrated dual-peak long period grating. This biosensor achieved an ultrahigh sensitivity with limit of detection of 7 ng/mL for anti-IgG detection.

BTu4A.3 • 15:00
Characterization of Disorder Induced Resonances in Fiber Bragg Gratings with Sub-picometer Resolution using Ensemble-averaged Homodyne Detection, Srikanth Sugavanam[1], Adenowo Gbadebo[1], Elena Turitsyna[1]; [1]*Aston Inst. of Photonic Technologies, Aston Univ., UK.* We use phase-diverse ensemble-averaged homodyne detection to characterize spectral widths and strengths of disorder induced resonances in fiber Bragg gratings with 16 fm (2 MHz) resolution. Spectral widths as narrow as 187 fm (56 MHz) are observed.

BTu4A.4 • 15:15
Toward Bioresorbable Photosensitive Fibers for Theranostics, Maria Konstantaki[2], Stavros Pissadakis[2], Diego Pugliese[1], Edoardo Ceci-Ginistrelli[1], Nadia G. Boetti[3], Daniel Milanese[1], Ioannis Konidakis[2], Davide Janner[1]; [1]*Politecnico di Torino, Italy;* [2]*FORTH-IESL, Greece;* [3]*Istituto Superiore Mario Boella, Italy.* Photosensitivity of phosphate optical fibers at 193 nm is combined with bio-resorbability in the prospect of developing multifunctional optical fiber probes for theranostic. Dissolution of the fiber in PBS is reported showing differential etching.

ITu4B • Integrated Optical Sources—Continued

ITu4B.3 • 15:00
A Regrowth-free, Facetless Multiple Quantum Wells AlInGaAs Semiconductor Laser Suitable for Photonic Integration, Mohamad Dernaika[1,2], Ludovic Caro[1,3], Hua Yang[1], Frank Peters[1,3]; [1]*Tyndall National Inst., Ireland;* [2]*Electrical and Electronics Engineering, Univ. College Cork, Ireland;* [3]*Physics, Univ. College Cork, Ireland.* A facetless, semiconductor laser suitable for photonic integration is presented in this paper. The laser fabrication process employs contact lithography and regrowth-free process. Moreover, the laser cavity is monolithically integrated with a SOA.

ITu4B.4 • 15:15
Inverse Scattering Method Design of Regrowth-free Single-mode Semiconductor Lasers for Monolithic Integration, Kevin J. Shortiss[1], Mohamad Dernaika[1], Ludovic Caro[1], Masoud Seifikar[1], Frank Peters[1]; [1]*Tyndall National Inst., Ireland.* An inverse scattering method is used to design single moded lasers, using etched depth insensitive pits as perturbations in the laser cavity. We compare 10, 15 and 20 pit devices, and report strongly single moded lasers (>40dB).

NpTu4C • Vectorial Effects—Continued

NpTu4C.3 • 14:45
Polarization Rotation during Nonlinear Propagation of Fully-structured Optical Beams, Christopher Gibson[1], Patrick Bevington[1], Gian-Luca Oppo[1], Alison Yao[1]; [1]*Univ. of Strathclyde, UK.* The polarization distribution of fully-structured light beams is heavily modified by cross-phase modulation in Kerr media. The polarization state can rotate and be controlled from radial through spiral to azimuthal using nonlinear propagation.

NpTu4C.4 • 15:00
Nonlinear Polarization Dynamics of Kerr Beam Self-cleaning in a GRIN Multimode Optical Fiber, Katarzyna Krupa[1], Alessandro Tonello[2], Marc Fabert[2], Vincent Couderc[2], Guy Millot[3], Umberto Minoni[1], Daniele Modotto[1], Stefan Wabnitz[1]; [1]*Universita degli Studi di Brescia, Italy;* [2]*XLIM, Université de Limoges, France;* [3]*ICB, Université Bourgogne Franche-Comté, France.* We experimentally study the polarization dynamics of Kerr beam self-cleaning in a multimode fiber. We reveal that spatial beam cleanup is accompanied by nonlinear polarization evolution and a significant increase of the degree of polarization.

NpTu4C.5 • 15:15
Self-repolarization of Light in an Optical Fiber Ring, Nicolas Berti[1], Adrien Fusaro[1], Antonio Picozzi[1], Massimiliano Guasoni[2], Hans-Rudolf jauslin[1], Dominique Sugny[1], Julien Fatome[1]; [1]*Université de Bourgogne Franche-Comté, France;* [2]*optoelectronics research center, UK.* We report on the experimental observation of a repolarization process in a fiber loop. An arbitrary polarized input signal self-organizes its polarization around two basins of attraction in the exact middle point of the system.

NoTu4D • Optical Glasses, Crystals and Ceramics II—Continued

NoTu4D.3 • 15:00
DLW of Silver Containing Phosphate Glass and Fiber, Thierry Cardinal[1], Theo Guerineau[1], Alain Abou Khalil[2,3], Sylvain Danto[1], Jean Philippe Berube[3], Yannick Petit[1,2], Clement Strutynski[1], Marc Dussauze[4], Lionel Canioni[2], Real Vallee[3]; [1]*ICMCB, France;* [2]*CELIA, France;* [3]*COPL, Canada;* [4]*ISM, France.* Direct Laser writing in silver containing phosphate glasses allows fabricating multi-scale photonic structures with various optical contrast (linear and nonlinear). The glass matrix composition determines the resulting photo-induced structures.

NoTu4D.4 • 15:15
Development of Thin Film Claddings for Single Crystal Optical Fiber, Jason D. Myers[1], Woohong Kim[1], Brandon Shaw[1], Shyam Bayya[1], Noor Qadri[1], Daniel Rhonehouse[1], Askins Charles[2], John Peele[2], Rajesh Thapa[2], Robel Y. Bekele[3], Collin McClain[3], Jasbinder S. Sanghera[1]; [1]*US Naval Research Laboratory, USA;* [2]*KeyW, USA;* [3]*Univ. Research Foundation, USA.* We have developed cladding layers for single crystal optical fiber using RF magnetron sputtering. We discuss the deposition and growth techniques, challenges, and prospects for these materials and their use as optical fiber claddings.

SeTu4E • Optical Chemical & Biological Sensing I—Continued

SeTu4E.3 • 14:45
Metal- Nanoparticles/Graphene Plasmonic Hybrids for Optical Label-free Chemical- and Bio-sensing, Maria Michela Giangregorio[1], Giovanni Bruno[1], Josef Humlicek[2], Maria Losurdo[1]; [1]*CNR-NANOTEC, Italy;* [2]*Masaryk Univ., Czechia.* Graphene coupled to plasmonic nanoparticles of gold, silver, aluminum, and gallium, creates hybrids that are further functionalized with porphyrins, drugs and antibodies for chemical and bio-sensors

SeTu4E.4 • 15:00
Volatile Organic Compound Detection using Porous-silicon-oxide Coated Disc-on-pillar Arrays, Bhavya Sharma[1], Terence J. Moore[1]; [1]*Univ. of Tennessee, USA.* Volatile organic compounds are ubiquitous and have potential environmental and health impacts. We describe the fabrication of surface-enhanced Raman spectroscopy substrates for rapid detection of VOCs, with reduced exposure and collection times.

SeTu4E.5 • 15:15
Highly Sensitive Lab-on-a-chip Biosensor utilizing Phase-modulated Mach-Zehnder Interferometer, Mukesh Yadav[1], Jens Høvik[1], Astrid Aksnes[1]; [1]*NTNU, Trondheim, Norway, Norway.* We report an integrated Mach-Zehnder interferometer biosensor utilizing subwavelength gratings in the sensing arm to enhance analyte-light interaction, and phase modulation to reduce ambiguity. This leads to 2-fold increase in sensitivity.

Room D3.2	Room D5.2	Room D7.2	Room E1.1	Room E1.2
Photonic Networks and Devices	Signal Processing in Photonic Communications	Specialty Optical Fibers	Integrated Photonics Research, Silicon, and Nano-Photonics	Novel Optical Materials and Applications

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

NeTu4F • Data Center, Transport and Edge Networks—Continued

NeTu4F.3 • 15:00 Invited
Opportunities for Next Generation Photonics in the Cloud, Hitesh Ballani[1]; [1]*Microsoft, UK.* Optical switches could revolutionize data centers by providing high bandwidth and low latency at low cost. I will discuss the remaining challenges that need to be solved to make this technology ready for production.

SpTu4G • Digital Signal Processing and FEC—Continued

SpTu4G.3 • 15:00
Digital Post-Distortion for Cost-Efficient Driverless Optical Transmitters, Arne Josten[1], Benedikt Baeuerle[1], Wolfgang Heni[1], Juerg Leuthold[1]; [1]*ETH Zurich, Switzerland.* Driverless transmitters deliver best performance if the electrical signal swing is maximized. The maximum electrical swing can be obtained by applying a digital post- rather than pre-distortion and a correct choice of the roll-off factor.

SpTu4G.4 • 15:15
Joint Recovery Scheme of Polarization and Carrier based on Adaptive Kalman Filter, Qian Xiang[1], Yanfu Yang[1], Qun Zhang[1], Ke Xu[1], Yong Yao[1]; [1]*EIE, Harbin Inst. of Technology(Shenzhen), China.* We propose an adaptive Kalman filter for tracking polarization, carrier frequency offset and laser phase jointly. The scheme has the advantages of adaptive **Q** configuration and better recovery performance compared with conventional schemes.

SoTu4H • Fiber Lasers III—Continued

SoTu4H.3 • 14:45
Efficient Thulium-doped Fiber Laser Operating in the 1890 – 2080nm Wavelength Band, Norberto J. Ramirez-Martinez[1], Martin Miguel Angel Núñez-Velázquez[1], Andrei Alexandrovich Umnikov[1], Jayanta K. Sahu[1]; [1]*Univ. of Southampton, UK.* We report an efficient thulium-doped fiber offering a laser efficiency >70% with respect to the absorbed pump power over a wide wavelength band of 1890 to 2080nm when cladding pumped at 793nm

SoTu4H.4 • 15:00 Tutorial
Outperforming Conventional Optical Fibers using a Hollow Core, Jonathan C. Knight[1]; [1]*Department of Physics, Univ. of Bath, UK.* Two decades of research into photonic crystal and microstructured fibers have led to remarkable science and numerous opportunities for application. This presentation will describe what has been achieved, and what might come next.

ITu4I • Novel Materials for Photonics—Continued

ITu4I.3 • 14:45
Emerging Optical Gain in Highly Strained Germanium, Francesco T. Armand Pilon[2], Nicolas Pauc[3], Julie Widiez[4], Vincent Reboud[4], Vincent Calvo[3], Jean-Michel Hartmann[4], Alexei Chelnokov[4], Jérôme Faist[1], Hans Sigg[2]; [1]*Inst. for Quantum Electronics, ETH Zürich, Switzerland;* [2]*Laboratory for Micro- and Nanotechnology, Paul Scherrer Institut, Switzerland;* [3]*Univ. Grenoble Alpes and CEA-INAC, France;* [4]*Univ. Grenoble Alpes and CEA-LETI, France.* Cavity mode analysis of photoluminescence spectra of uniaxial tensile stressed GeOI micro-bridges is shown. Several cavity modes show a strong increase of the Q-factor, which is signature of the emergent optical amplification due to gain

ITu4I.4 • 15:00 Invited
Revisiting the Photon-Drag Effect in Thin Metal Films, Henri J. Lezec[1], Glenn Holland[1], B. Robert Ilic[1], Cheng Zhang[1,2], Wenqi Zhu[1,2], Amit Agrawal[1,2], Domenico Pacifici[1,3], Jared H. Strait[1]; [1]*Center for Nanoscale Science and Technology, National Inst. of Standards and Technology, USA;* [2]*Maryland NanoCenter, Univ. of Maryland, USA;* [3]*Brown Univ., USA.* Using pristine metal films of Au, Cu, and Ni-doped Ag, we show that light-induced current flow – photon drag – has a fundamental sign that contradicts the intuitive, prevailing model of direct momentum transfer to free electrons.

NoTu4J • Nanomaterials I—Continued

NoTu4J.3 • 14:45
Optically Tunable Electric Rotations of Perovskite Nanowires, Fei Cao[1], Yu Gu[1], haibo zeng[1]; [1]*Nanjing Univ. of Sci. & Tech., China.* We proposed an optically tunable electric rotor by exploiting the photoconductivity of CsPb(Br/I)3 nanowires. The proof-of-concept experiment strong supports the theory and shows that the rotation speed linearly increases with the light intensity.

NoTu4J.4 • 15:00 Invited
Mid-Infrared Nanophotonics for Surface Enhanced Spectroscopy, Hatice Altug[1], Dordaneh Etezadi[1], Andreas Tittl[1], Daniel Rodrigo[1], Aurelian John-Herpin[1], Aleksandrs Leitis[1]; [1]*EPFL STI IBI-STI BIOS, Ecole Polytechnique Federale de Lausanne, Switzerland.* Mid-infrared spectrum is powerful for biosensing application, as it encompasses the molecular vibrations that uniquely identify the biochemicals. Here, we will present our contributions using metal, graphene and dielectric based Mid-IR nanophotonics.

Room D1.1	Room E5	Room E3	Room D1.2	Room D7.1
Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials	Integrated Photonics Research, Silicon, and Nano-Photonics	Nonlinear Photonics	Novel Optical Materials and Applications	Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

BTu4A • FBG and Laser Writing for Biomedical Sensing—Continued

BTu4A.5 • 15:30 Invited
Immunosensing using Narrowband Cladding Mode Resonances, Christophe Caucheteur[1]; [1]*Boulevard Dolez 31, Univ. of Mons, Belgium.* A near-infrared plasmonic optical fiber immunosensor is demonstrated for detection of cytokeratins, which are proteins of interest for the lung cancer diagnosis. Results obtained in fresh biopsied lung tissues are presented.

ITu4B • Integrated Optical Sources—Continued

ITu4B.5 • 15:30
Influence of Modulation p-doping Level on Multi-state Lasing in InAs/InGaAs Quantum Dot Lasers Having Different External Loss, Vladimir Korenev[1]; [1]*Saint-Petersburg Academic Univ. RAS, Russia.* We show that in short InAs/InGaAs QD lasers, p-doping results in higher output power from QD-GS whereas in longer cavities the effect is reverse. Optimal design of laser active region and doping level are discussed.

ITu4B.6 • 15:45
Integrated Indium Phosphide Transmitter for Free Space Optical Link, Hongwei Zhao[1], Sergio Pinna[1], Bowen Song[1], Ludovico Megalini[1], Simone Tommaso Šuran Brunelli[1], Larry Coldren[1], Jonathan Klamkin[1]; [1]*UC Santa Barbara, USA.* An integrated indium phosphide transmitter with 44-nm wavelength tuning range was demonstrated and inserted in a free space optical link. Error-free operation was achieved at 1 Gbps for an equivalent link length of 120 m.

NpTu4C • Vectorial Effects—Continued

NpTu4C.6 • 15:30
Polarization Modulation Instability in a Fiber Kerr Resonator, Julien Fatome[1], Bertrand Kibler[1], François Leo[2], Bendahmane Abdelkrim[1], Gian-Luca Oppo[4], Bruno Garbin[3], Yadong Wang[3], Stuart Murdoch[3], Miro Erkintalo[3], Stephane Coen[3]; [1]*CNRS/Université Bourgogne Franche-Comté, France;* [2]*Université Libre de Bruxelles, Belgium;* [3]*Univ. of Auckland, New Zealand;* [4]*Univ. of Strathclyde, UK.* We report on the observation of a polarization modulational instability process occurring in a fiber Kerr resonator. This phenomenon originates from a cross-phase modulation interaction between both circular components of the recirculating field.

NpTu4C.7 • 15:45
Optical Polarization Rogue Waves, Lei Gao[1], Tao Zhu[1], Stefan Wabnitz[2], Ping Gao[1]; [1]*Chongqing Univ., China;* [2]*Dipartimento di Ingegneria dell'Informazione, Università degli Studi di Brescia and INO-CNR, Italy.* We introduce new kind of optical rogue waves, polarization rogue waves, at the point of transition to polarization turbulence, which provides an additional degree of freedom for understanding of the rogue waves.

NoTu4D • Optical Glasses, Crystals and Ceramics II—Continued

NoTu4D.5 • 15:30
Comparison of Fluoride and Chloride Photo-thermo-refractive Glasses for Bragg Grating Recording, Sergey Ivanov[1], Victoria Krykova[1], Dmitry Klyukin[1,2], Nikolay Nikonorov[1]; [1]*ITMO Univ., Russia;* [2]*Univ. of Eastern Finland, Finland.* We report comparison of the conventional fluoride photo-thermo-refractive (PTR) glass with novel chloride one. We study exposure dependence of the refractive index modulation, saturation effect and photosensitivity of the chloride PTR glass.

NoTu4D.6 • 15:45
Synthesis of $Bi_{2-x}Sb_xTe_{3-y}Se_y$ Thin Film Saturable Absorbers on Silica Optical Fibers by MOCVD, Peter I. Kuznetsov[1], Aleksey P. Bazakutsa[1], Evgueny A. Savel'yev[1], Gailna G. Yakushcheva[1], Konstantin M. Golant[1]; [1]*Kotel'nikov IRE RAS, Russia.* The MOCVD technology is adapted to the manufacturing of $Bi_{1-x}Sb_xTe_{3-y}Se_y$ thin films on cleaved ends of silica optical fibers. Growth of the films is monitored *'in situ'* over light reflection from the silica/film interface.

SeTu4E • Optical Chemical & Biological Sensing I—Continued

SeTu4E.6 • 15:30
Waveguide-grating Sensor with Photo-switchable Functionalization, Moritz Paulsen[1], Martina Gerken[1], Christine Kallweit[1]; [1]*Kiel Univ., Germany.* We combine a waveguide-grating sensor with photo-responsive azobenzene-containing aptamers for binding and detection of human thrombin. We show that photo switching of the azoaptamer changes the dissociation rate and may serve sensor regeneration.

SeTu4E.7 • 15:45
Fourier-Transform Frequency Comb Cavity Mode Spectroscopy at Hz Level for Trace Gas Measurements, Dominik Charczun[1], Grzegorz Kowzan[1], Akiko Nishiyama[1,2], Michael Debus[3], Philipp Huke[3], Dorota Tomaszewska[4], Grzegorz Sobon[4], Agata Cygan[1], Daniel Lisak[1], Ryszard Trawinski[1], Piotr Maslowski[1]; [1]*Inst. of Physics, Faculty of Physics, Astronomy and Informatics, Nicolaus Copernicus Univ. in Torun, ul. Grudziadzka 5, 87-100 Torun, Poland, Poland;* [2]*Department of Engineering Science, Graduate School of Informatics, The Univ. of Electro-Communications (UEC), 1-5-1 Chofugaoka, Chofu, Tokyo 182-8585, Japan, Japan;* [3]*Institut für Astrophysik, Georg-August-Universität, Friedrich Hund-Platz 1, D-37077 Göttingen, Germany, Germany;* [4]*Faculty of Electronics, Laser & Fiber Electronics Group, Wroclaw Univ. of Science and Technology, Wybrzeze Wyspianskiego 27, 50-370 Wroclaw, Poland, Poland.* We present precise broadband measurements of absorption and dispersion spectra of carbon monoxide 0-3 band in argon. They were performed using frequency comb cavity mode width and dispersion spectroscopies with a mechanical FTS setup.

Room D3.2	Room D5.2	Room D7.2	Room E1.1	Room E1.2
Photonic Networks and Devices	Signal Processing in Photonic Communications	Specialty Optical Fibers	Integrated Photonics Research, Silicon, and Nano-Photonics	Novel Optical Materials and Applications

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

NeTu4F • Data Center, Transport and Edge Networks—Continued

NeTu4F.4 • 15:30 Invited

Slot switching for deterministic dynamic edge cloud networks, Yvan Pointurier[1], Nihel Benzaoui[1], Wolfram Lautenschlaeger[2], Ulrich Gebhard[2], Lars Dembeck[2], Sébastien Bigo[1]; [1]*Nokia Bell Labs, France;* [2]*Nokia Bell Labs, Germany.* We review how two optical slot switching technologies can provide end-to-end service guarantees in next generation edge-cloud-based networks: Optical Ethernet for fronthaul, midhaul and metro networks, and CBOSS for intra data center networking.

SpTu4G • Digital Signal Processing and FEC—Continued

SpTu4G.5 • 15:30 Invited

Nonuniform DAC Design for Combined Geometrically and Probabilistically Shaped Circular QAM, Fanny Jardel[1]; [1]*Route de Villejust, Nokia Bell Labs, France.* We design a 4-bit nonuniform DAC by selecting a few number of quantization levels of a uniform 8-bit DAC for power efficiency in metro links. We show that the SQNR can be improved up to 1 dB comparatively to the uniform 4-bit DAC.

SoTu4H • Fiber Lasers III—Continued

ITu4I • Novel Materials for Photonics—Continued

ITu4I.5 • 15:30

Light Emission from Direct Bandgap Hexagonal SiGe, Jos Haverkort[1]; [1]*Technische Universiteit Eindhoven, Netherlands.* Hexagonal crystal phase $Si_{1-x}Ge_x$ is a direct bandgap semiconductor for x>70%. We observe tunable light emission 1.8-3.5 µm at 4K. We observe amplified spontaneous emission as well as coherent light emission for Hex-Ge.

ITu4I.6 • 15:45

High Speed Optical Transmission at 2 µm in Subwavelength Waveguides Made of Various Materials, Manon Lamy[2], Christophe Finot[2], Julien Fatome[2], Jean-Claude Weeber[2], Guy Millot[2], Bart Kuyken[3], Gunther Roelkens[3], Mickael Brun[4], Pierre Labeye[4], Sergio Nicolleti[4], Adonis Bogris[5], Dimitris Syvridis[5], Mohammed Ettabib[6], David J. Richardson[6], Periklis Petropoulos[6], Kamal Hammani[1]; [1]*Universite de Bourgogne-Franche-Comté, France;* [2]*Laboratoire Interdisciplinaire CARNOT de Bourgogne, France;* [3]*Photonics Research Group, Department of Information Technology, Belgium;* [4]*CEA-Leti , France;* [5]*National and Kapodistrian Univ. of Athens, Greece;* [6]*Optoelectronics Research Centre, UK.* We report the transmission of a 10 Gbps telecommunication signal at 2 µm in waveguides made of three different materials: Si, SiGe and TiO_2. Bit error rates below 10^{-9} can be achieved after transmission in the devices with subwavelength dimensions.

NoTu4J • Nanomaterials I—Continued

NoTu4J.5 • 15:30

Investigating the Optical Properties of a Novel Three-Dimensional Self-Assembled Metamaterial made of Carbon Intercalated with Bimetal Nanoparticles, Muhammad Abdullah T. Butt[1,2], Martin Neugebauer[1,3], Antonino Calà Lesina[4,5], Lora Ramunno[4,5], Pierre Berini[4,5], Alessandro Vaccari[8], Thomas Bauer[6], Alina Manshina[7], Peter Banzer[1,3], Gerd Leuchs[1,3]; [1]*Max Planck Inst. for the Science of Light, Germany;* [2]*Graduate School of Advance Optical Technologies, Friedrich Alexander Universität Erlangen, Germany;* [3]*Inst. of Optics, Information and Photonics,, Univ. Erlangen-Nuremberg, Germany;* [4]*Department of Physics, Univ. of Ottawa, Canada;* [5]*Centre for Research in Photonics, Univ. of Ottawa, Canada;* [6]*Department of Quantum Nanoscience, TU Delft, Netherlands;* [7]*Inst. of Chemistry, St. Petersburg State Univ., Russia;* [8]*Centre for Materials and Microsystems, Fondazione Bruno Kessler, Italy.* We investigate a self-assembled three-dimensional metamaterial, a novel carbon allotrope intercalated with gold-silver alloy nanoparticles. The metamaterial exhibits strong linear birefringence, holding an immense potential for future applications.

NoTu4J.6 • 15:45

Polycrystalline Diamond Photonic Crystal Slabs Prepared by Focused Ion Beam Milling, Lukas Ondic[1], Jan Fait[1], Marian Varga[1], Jan Manak[1], Jaroslava Novakova[2]; [1]*Inst. of Physics, CAS, Czechia;* [2]*Department of Surface and Plasma Science, Faculty of Mathematics and Physics, Charles Univ. in Prague, Czechia.* Polycrystalline diamond-based photonic crystal slabs were designed using computer simulation and fabricated employing optimized focused ion beam milling technique. Such samples could be used to control light emission from diamond optical centers.

16:00–17:30
JTu5A • Poster Session II and Networking Coffee Break with Exhibitors

JTu5A.1
High Efficiency Branched CdS Nanowire Waveguides with the Assistant of Implanted Sn Nanoparticles, Shuai Guo[1], Ruibin Liu[1]; [1]*Beijing Inst. of Technology, China.* The multi-channel nanostructures with high optical transportation efficiency is demonstrated by implanting Sn nanoparticles into junctions of branched. Low propagation loss was realized even the route passed through acute angle branched parts.

JTu5A.2
Magneto-optic Waveguide in Optical Isolator Employing Nonreciprocal Guided-Radiation Mode Conversion for Athermal Operation, Salinee Choowitsakunlert[1], Rardchawadee Silapunt[2], Hideki Yokoi[1,3]; [1]*Graduate School of Engineering and Science, Shibaura Inst. of Technology, 3-7-5 Toyosu, Koto-ku, Tokyo 135-8548, Japan, Japan;* [2]*Electronic and Telecommunication Engineering, King Mongkut's Univ. of Technology Thonburi, 126 Soi Pracha Uthit 45, Bang Mot, Thung Khru, Bangkok 10140, Thailand, Thailand;* [3]*SIT Research Center for Green Innovation, Shibaura Inst. of Technlogy, Tokyo, Japan, Japan.* Temperature dependence of an optical isolator with an a-Si guiding layer employing a nonreciprocal guided-radiation mode conversion is described. The magneto-optic waveguide with a TiO_2 upper cladding layer is considered for athermal operation.

JTu5A.3
Wavelength Add/Drop Device Using Silicon Waveguide Polarization Rotator Grating, Hideaki Okayama[1,2], Yosuke Onawa[1,2], Daisuke Shimura[1,2], Hiroki Yaegashi[1,2], Hironori Sasaki[1,2]; [1]*Oki Electric Industry Co Ltd, Japan;* [2]*PETRA, Japan.* Silicon waveguide wavelength add/drop device composed of a center waveguide with polarization rotator grating and input/output waveguides placed near the center waveguide is proposed. The polarization insensitive device can be obtained.

JTu5A.4
Towards High Coupling Efficiency Integrated 2D MetasurfaceWaveguide Coupler for Mid-IR Wavelengths, Asif Bilal[2], Usman Younis[2,1], Kah-Wee Ang[1]; [1]*National Univ. of Singapore, Singapore;* [2]*Electrical Engineering, information Technology Univ., Pakistan.* Integrated 2D meta-surface waveguide coupler for 3.8 µm has been designed. The optimization in period and radius has been achieved using FDTD. The calculated coupling efficiency in the in-plane waveguide for the out-of-plane illumination is ~98%.

JTu5A.5
Metal-Based Near-infrared Transparent Electrodes, Jin-Young Na[1], Sun-Kyung Kim[1]; [1]*Kyung Hee Univ., South Korea.* An oxide/metal/oxide multilayer film serves as an ultrahigh figure-of-merit transparent electrode only for visible light. Here, we report a metal-based near-infrared transparent electrode using a two-dimensional deep-subwavelength metastructure.

JTu5A.6
The Effect of Adding a Shell to Plasmonic Nanoparticles on Particle's Fermi Energy Levels, Mandana Jalali[1], Tahmineh Jalali[2], Daniel Erni[1], Hamid Nadgaran[3]; [1]*Univ. of Duisburg-Essen, Germany;* [2]*Physics, Persian Gulf Univ., Iran ;* [3]*Physics, Shiraz Universoty, Iran* Within this study we investigate the effects of adding a dielectric shell to plasmonic nanoparticles in the context of thin-film solar cells. The shell modifies Fermi energy levels, hence improves electrical properties of the particle ambient medium

JTu5A.7
Optical Lasing Micro-cavities Fabricated in High Sn Content Active GeSn Layers Grown on GeSn Step-graded Buffers, Vincent Reboud[1], Mathieu Bertrand[1], Quang M. Thai[1], Jeremie Chretien[1], Nicolas Pauc[1], Rami Khazaka[1], Andrea Quintero[1], Francesco Armand-Pillon[2], Hans Sigg[2], Philippe Rodriguez[1], Alexei Chelnokov[1], Jean-Michel Hartmann[1], Vincent Calvo[1]; [1]*CEA Grenoble, France;* [2]*Paul Scherrer Inst., Switzerland.* We study optically pumped lasing in micro-cavities with high Sn content active GeSn layers. The crystalline quality of GeSn active layers are greatly improved when grown on GeSn step-graded buffers instead of Ge strain-relaxed buffers.

JTu5A.8
On-chip Attenuators based on Digitized All-silicon Nanostructures, Yingjie Liu[1], Wenzhao Sun[1], Shuai Liu[1], Hucheng Xie[1], Ke Xu[1], Yong Yao[1], Jiangbing Du[2], Zuyuan He[2], Qinghai Song[1]; [1]*Harbin Inst. of Technology, Shenzhen, China;* [2]*Shanghai Jiao Tong Univ., China.* We experimentally demonstrated the on-chip attenuators based on digital metamaterial. The device with arbitrary attenuations can be designed by algorithm. The device can operate over 50 nm spectral range and the footprint is only 2.4×2.4 µm^2.

JTu5A.9
Polarization-Independent Dielectric Metasurface Lens for Absorption Enhancement in Thin Solar Cells , Mohammad A. Shameli[1], Leila Yousefi[1,2]; [1]*Univ. of Tehran, Iran;* [2]*Electrical and Computer Engineering, Univ. of Waterloo, Canada.* The absorption of a thin solar cell is increased by integrating a metasurface lens inside the cell. The numerical results show 30% enhancement in the short circuit current for both TM and TE polarizations.

JTu5A.10
Tuning the Emission of Micro Ring Lasers Using Integrated Optical Feedback: Experiments and Traveling Wave Simulations, Mulham Khoder[1,2], Mindaugas Radziunas[3], Vasile Tronciu[4], Jan Danckaert[2], Guy Verschaffelt[2]; [1]*Brussels Photonics (B-PHOT), Vrije Universiteit Brussel, Belgium;* [2]*Applied Physcis Research Group (APHY), Vrije Universiteit Brussel, Belgium;* [3]*Weierstrass Inst., Germany;* [4] *TU of Moldova , Moldova (the Republic of).* We investigate the tuning of the wavelength of a micro-ring laser using on-chip feedback. We demonstrate tuning experimentally and numerically. The results also show that traveling-wave model is suitable for simulating complex laser configurations.

JTu5A.11
Using on-Chip Feedback to Stabilize the Emission of Micro Ring Laser in the Presence of Reflections, Mulham Khoder[1,2]; [1]*Brussels Photonics (B-PHOT), Vrije Universiteit Brussel, Belgium;* [2]*Applied Physcis Research Group (APHY), Vrije Universiteit Brussel, Belgium.* We propose to integrate a feedback section on-chip with micro ring laser to stabilize the emission of micro ring laser in the presence of reflections. The results show that feedback can decrease the undesired effects of the reflections.

JTu5A.12
Integrated Optoelectronic Chips for Short Wavelength Division Multiplexing Transceiver, Kai Liu[1], Yongqing Huang[1], Xiaofeng Duan[1]; [1]*State Key Laboratory of Information Photonics and Optical Communications, Beijing Univ. of Posts and Telecomm., China.* A pair of integrated optoelectronic chips is proposed for short WDM transceiver. One is emitting at 848.1nm and receiving at 805.3nm, while the other is emitting at 805.3nm and receiving at 848.1nm.

JTu5A.13
Continuous Variable Entanglement in Lossy Coupled Resonator Optical Waveguides, Hossein Seifoory[1], Marc M. Dignam[1]; [1]*Queen's Univ., Canada.* We analytically evaluate the time-dependant cross-correlation between the photons in different cavities in a lossy, coupled resonator optical waveguide to evaluate the evolution of quantum entanglement in the presence of loss.

JTu5A.14
Self-Coupling Modes in Periodic Resonant Metasurfaces, Kevin Müller[1]; [1]*SUSS MicroOptics SA, Switzerland.* The concept of self-coupling modes, which are eigen-vectors of the roundtrip matrix, is introduced. I investigate its use for the identification and analysis of the resonances taking place in periodic metasurfaces.

JTu5A.15
Withdrawn

JTu5A.16
Controllable Birefringence in Graphene-based Anisotropic Metamaterials, Bartosz Janaszek[1], Marcin Kieliszczyk[1], Anna Tyszka-Zawadzka[1], Pawel Szczepanski[1,2]; [1]*Inst. of Microelectronics and Optoelectronics, Warsaw Univ. of Technology, Poland;* [2]*National Inst. of Telecommunications, Poland.* We present anisotropic metamaterial nanostructure based on graphene to act as a potentially ultrafast voltage-controlled polarizer, suitable for any application requiring polarization splitting or nonmechanical beam steering.

JTu5A.17
Ultrathin Metal Based Mid-infrared Emitters for High-temperature Radiative Cooling, Yoon Jeong Shin[1], Jin-Woo Cho[1], Sun-Kyung Kim[1]; [1]*Nanophotonics Lap, Kyung Hee Univ., South Korea.* For most dielectrics, phonon-polariton resonances occur at 8-14 um, making the absence of absorption at shorter mid-infrared wavelengths. This study proposes ultrathin metal based full-mid-infrared emitters for high-temperature radiative cooling.

JTu5A.18
Symmetry Breaking in Directional Coupling to Radiation Modes of a Nanofiber by Dipole Emission, Shahraam Afshar[1], Feng Qiu Dong[2], Shaghik Atakaramians[2], Tanya Monro[1]; [1]*Univ. of South Australia, Australia;* [2]*School of Electrical Engineering and Telecommunications, The Univ. of New South Wales, Australia.* We investigate the coupling of the emission of a circularly polarised dipole into the radiation modes of a nanofiber and show symmetry breaking between forward and backward directions.

JTu5A.19
Loss Reduction of Electron-beam Lithography Fabricated Strip Wire Waveguide Bends, Jens Høvik[1], Astrid Aksnes[1]; [1]*Norwegian Univ. of Science and Tech, Norway.* Electron-beam lithography causes segmentation in curved components due to the fracturing of the mask pattern file. We investigate this effect and optimize the segmentation to achieve low-loss photonic strip-wire waveguide bends.

JTu5A.20
Bloch Surface Wave in Polymeric Slot Waveguides, Ezekiel Kuhoga[1], Matthieu Roussey[1]; [1]*Univ. of Eastern Finland, Finland.* We demonstrate through simulation how to excite and enhance a Bloch surface wave inside a slot waveguide. The reduced footprint of the device is ideal for on-chip integrated sensor and biosensor.

JTu5A.21
Nano-photonic Structures on Strip-loaded Slot Waveguide, Ségolène Pélisset[1], Matthieu Roussey[1]; [1]*Univ. of Eastern Finland, Finland.* We study the effect of the shape, at the nanoscale, of a loading-strip on top of a horizontal slot waveguide. We show how the weak effective index difference influences the spectral response of the device.

JTu5A.22
Plasmonic Structure Integrated superconducting Nanowire Single-photon Detectors for Quantum Information Processing, Maria Csete[1], András Szenes[1], Bendeguz Toth[1], Balázs Bánhelyi[1], Tibor Csendes[1], Gábor Szabó[1]; [1]*Szegedi Tudomanyegyetem, Hungary.* Optimization of superconducting nanowire single-photon detectors integrated with plasmonic structures allows to maximize the absorptance as well as the polarization contrast with and without a criterion regarding the absorptance.

JTu5A.23
Highly-Responsive Nanoscale Germanium Photodetector for Integrated Silicon Photonics, Igor A. Khramtsov[1], Ilya M. Fradkin[1], Dmitry Y. Fedyanin[1]; [1]*Moscow Inst. of Physics & Technology, Russia.* We demonstrate the possibility to greatly enhance the photocurrent without an avalanche effect. We show that instead of the avalanche breakdown, one can efficiently use the dark current to increase the photodetector responsivity.

JTu5A.24
Self-Heating Induced Bistability in Metal-Clad Semiconductor Nanolasers, Andrey A. Vyshnevyy[1], Dmitry Y. Fedyanin[1]; [1]*Laboratory of Nanooptics and Plasmonics, Moscow Inst. of Physics and Technology, Russia.* "Thermal rollover" is generally considered as the limitation imposed on the nanolaser performance. Here, we demonstrate how to turn it into a unique self-heating induced optical bistability, which can be further exploited in optical data processing.

JTu5A.25
Enhancement of the Phase Conjugation Degenerate Four-wave Mixing using the Bessel Beam, Qian Zhang[1], Xuemei Cheng[1], Zhaoyu Ren[1], Haowei Chen[1], Bo He[1], Jintao Bai[1]; [1]*Northwest Univ., China.* We report on the enhancement of phase conjugation degenerate four-wave mixing (DFWM) in the Rb vapor by using Bessel beam as the probe beam. The Bessel beam was generated based on thermal nonlinear optical effect.

16:00–17:30
JTu5A • Poster Session II and Networking Coffee Break with Exhibitors

JTu5A.26
Tunable Non-diffracting Beam under Oblique Incidence in a 2D PPLT Crystal Tunable Non-diffracting Beam under Oblique Incidence in a 2D PPLT Crystal, Dongmei Liu[2], Min Gu[2], Yong Zhang[1], Min Xiao[1,3], Peng Han[2]; [1]*Nanjing Univ., China;* [2]*South China Normal Univ., China;* [3]*Univ. of Arkansas, USA.* The tunable nondiffracting beam is investigated under oblique incidence of the fundamental wave in a 2D PPLT crystal. Our observation not only enriches the nonlinear nondiffracting optics, but also indicates potential applications in imaging.

JTu5A.27
Modeling the Kerr-nonlinearity in Mode-division Multiplexing Fiber Transmission Systems on GPUs, Marius Brehler[1], Malte Schirwon[2], Dominik Göddeke[2], Peter M. Krummrich[1]; [1]*Chair for High Frequency Technology, TU Dortmund, Germany;* [2]*Inst. for Applied Analysis and Numerical Simulation, Univ. of Stuttgart, Germany.* We discuss the GPU-acceleration of MDM transmission system simulations and how the required memory can be drastically reduced to simulate a high number of modes. Furthermore, we show how to reduce the runtime.

JTu5A.28
Catastrophic Process of Coherence Degradation, Gang Xu[1,4], Josselin Garnier[2], Benno Rumpf[3], Adrien Fusaro[1], Pierre Suret[4], Stephane Randoux[4], Alexandre Kudlinski[4], Guy Millot[1], Antonio Picozzi[1]; [1]*Univ. of Bourgogne Franche-Comte, France;* [2]*Ecole Polytechnique, France;* [3]*Southern Methodist Univ., USA;* [4]*Univ. of Lille, France.* We predict a catastrophic process of coherence degradation characterized by a virtually unlimited spectral broadening of the waves. This effect is described by self-similar solutions of the kinetic equations inherent to the wave turbulence theory.

JTu5A.29
Optical Peregrine Rogue Waves in Self-induced Transparent Media, Shihua Chen[1], Yanlin Ye[1], Fabio Baronio[2], Philippe Grelu[3]; [1]*Southeast Univ. (China), China;* [2]*Università di Brescia, Italy;* [3]*Université Bourgogne Franche-Comté, France.* We present universal fundamental rogue wave solutions in the context of self-induced transparency for the coupled optical and matter waves, and confirm numerically that they can be excited amid the onset of modulation instability.

JTu5A.30
Dependence of Excited Carrier Dynamics of $PtSe_2$ Thin Films on Thickness, Gaozhong Wang[1], Werner Blau[1]; [1]*Trinity College Dublin, Ireland.* The excited carrier relaxation of $PtSe_2$ shows a dependence of excited on the thickness. The recombination in thinner film is much faster than that in thicker samples due to different energy levels of trap states.

JTu5A.31
Uniform Theoretical Model of Second-harmonic Generation in Three-Dimensional Nonlinear Photonic Crystals, Jing Zhang[1], Honggen Li[1], Xianfeng Chen[1]; [1]*Shanghai Jiaotong Univ., China.* We built a theoretical model and derived a uniform expression of second-harmonic generation in three-dimensional nonlinear photonic crystals, which combines all the phase-matching conditions. The numerical simulation coincides with experiment result.

JTu5A.32
6.8 mW Deep-ultraviolet Laser at 165 nm from Eighth-harmonic Generation of a 1319 nm Nd:YAG Laser in $KBe_2BO_3F_2$, Zong Nan[1], Yu-Jiao Li[1], Zhi Min Wang[1], Feng-Feng Zhang[1], Feng Yang[1], Shen-Jin Zhang[1], Xiao-Yang Wang[1], Qin-Jun Peng[1], Ru-Kang Li[1], Chuang-Tian Chen[1], Da-Fu Cui[1], Zu-Yan Xu[1]; [1]*Technical Inst of Physics and Chemistry, China.* In this paper, we report a nanosecond (ns) 165 nm deep-ultraviolet (DUV) laser with a maximum average power of 6.8 mW by a homemade cascaded second-harmonic generation (SHG) system.

JTu5A.33
Investigation on Picosecond 2-12 μm Mid-infrared Optical Parametric Amplification Pumped at 1064 nm, Feng Yang[1], Jiyong Yao[1], Nan Zong[1], Shifeng Du[1], Yong Bo[1], Qin-Jun Peng[1], Dafu Cui[1], Zu-Yan Xu[1]; [1]*Technical Inst. of Physics and Chemistry, China.* Picosecond (ps) mid-infrared optical parametric amplification pumped at 1064nm was investigated in experiment. The high energy ps laser generation in 2-12μm wavelength region based on KTP, KTA, MgO:PPLN and BGSe crystals was demonstrated

JTu5A.34
Designing Multi-channel Quasi-phase Matching Devices for Standard Optical Frequency Grid, Toijam S. Meetei[1], Narayanan Balaji[1], Shanmugam Boomadevi[2], Krishnamoorthy Pandiyan[1]; [1]*SASTRA Deemed Univ., India;* [2]*Department of Physics, National Inst. of Technology, India.* We propose a scheme to develop multiple-frequency conversion in a single-QPM device with phase reversal domains. Using this approach, a seven-channel QPM device capable of phase-matching at the standard optical frequency grid has been designed.

JTu5A.35
Influence of Lateral Displacement and Angular Deflection on Mode Sorting for Beams Carrying Orbital Angular Momentum, Noriyuki Sakashita[1], Hiroki Kishikawa[1], Nobuo Goto[1]; [1]*Tokushima Univ., Japan.* We numerically investigate the influence on lateral displacement and angular deflection on mode sorting for Laguerre-Gaussian and perfect vortex beams. Both beams show almost the same tolerance to them in terms of crosstalk.

JTu5A.36
Nonlinear Features of Femtosecond Laser Written Waveguides in Gorilla® Glass, Franciele Henrique[1], Gustavo F. Almeida[1], Renato J. Martins[1], Ramon G. Rosa[1], Jonathas P. Siqueira[1], Marcelo B. Andrade[1], Cleber R. Mendonça[1]; [1]*São Carlos Inst. of Physics, Univ. of São Paulo, Brazil.* We performed the third-order nonlinear characterization of waveguides produced in Gorilla® Glass by fs-laser irradiation. Through the Dispersive-Scan technique, we found that their nonlinear refractive index is lower than the one for the bulk glass.

JTu5A.37
Longitudinal Phase Evolution of Peregrine-like breathers, Kamal Hammani[1], Bertrand Kibler[1], Amin Chabchoub[3], John Dudley[2], Christophe Finot[1]; [1]*Laboratoire Interdisciplinaire CARNOT de Bourgogne, France;* [2]*Institut FEMTO-ST, France;* [3]*Univ. of Sydney, Australia.* We report the first experimental study of the longitudinal evolution of breather pulses during nonlinear fiber propagation. Gerchberg-Saxton phase retrieval reveals a large phase shift across the point of maximum compression.

JTu5A.38
On Mitigation of Nonlinear Effects of PDM-OFDM-based Optical Signal using Constellation Shaping, Anton S. Skidin[1,2], Oleg S. Sidelnikov[1,2], Mikhail P. Fedoruk[1,2]; [1]*Novosibirsk State Univ., Russia;* [2]*Inst. of Computational Technologies SB RAS, Russia.* In this work we study nonlinear transmission regimes of a polarization-multiplexed OFDM signal in a long-haul optical link. We show that nonlinear distortion of such a signal can be significantly reduced using constellation shaping-based technique.

JTu5A.39
Mitigation of Self-phase Modulation by Sinusoidally Time Varying Phase, Frédéric Audo[1], Sonia Boscolo[2], Christophe Finot[1]; [1]*Laboratoire Interdisciplinaire CARNOT de Bourgogne, France;* [2]*Aston Inst. of Photonic Technologies, UK.* We report on our experimental and theoretical results on the use of a sinusoidally time varying phase to suppress undesirable self-phase modulation of optical pulses propagating in fiber-optic systems.

JTu5A.40
Three-dimensional Ultrastructural Characterization of Biomaterials with Polarization-Resolved Second-harmonic Generation Microscopy, Kamdin Mirsanaye[1], Ahmad Golaraei[1], Virginijus Barzda[1]; [1]*Department of Physics, Univ. of Toronto, Canada.* Polarization-resolved second-harmonic generation microscopy enables label-free imaging of materials. This method can be utilized in three-dimensional ultrastructural characterization and identification of subtle variations in biomaterial composition.

JTu5A.41
Measuring the Different "Thresholds" of a MicroVCSEL, Tao Wang[1,2], GianPiero Puccioni[3], Gian Luca Lippi[1]; [1]*Institut de Physique de Nice, France;* [2]*School of Electronics and Information, Hangzhou Dianzi Univ. China., China;* [3]*Istituto dei Sistemi Complessi, CNR, Italy.* The concept of laser threshold loses its meaning in micro- and nanocavities due to finite-size effects amd unfolds into an ensemble of characteristic points. We demonstrate the measurement of indicators which identify the different points.

JTu5A.42
Direct Measurements of Temperature-Dependent Refractive Indices of Stoichiometric $LiNbO_3$ and $LiTaO_3$, Junya Kawashima[1], Ichiro Shoji[1], Yasunori Furukawa[2]; [1]*Chuo Univ., Japan;* [2]*OXIDE Corporation, Japan.* We have measured the temperature-dependent refractive indices of undoped and Mg-doped stoichiometric $LiNbO_3$ and $LiTaO_3$ at the wavelengths from 436 to 1545 nm with an accuracy of better than 1×10^{-4}.

JTu5A.43
Dissipative Light Bullets in Passively Mode-locked Semiconductor Lasers, Svetlana Gurevich[1,2], Julien Javaloyes[3]; [1]*Physics, Inst. for Theoretical Physics, Germany;* [2]*Physics, Center for Nonlinear Science (CeNoS), Germany;* [3]*Universitat de les Illes Balears, Spain.* We study the transverse profile of three-dimensional light bullets found theoretically in passively mode-locked laser. Using numerical path-continuation and time simulations, we discuss the range of existence and stability of these structures.

JTu5A.44
Theoretical Optimization of Pulse Properties in Ultra-long Fiber Laser, Olga Shtyrina[1,2], Evgeniy Podivilov[1,3], Irina Yarutkina[1,2], Anton S. Skidin[1,2], Mikhail P. Fedoruk[1,2]; [1]*Novosibirsk State Univ., Russia;* [2]*Inst. of Computational Technologies SB RAS, Russia;* [3]*Inst. of Automation and Electrometry SB RAS, Russia.* We propose the method of analytical prediction of stable generation area in ultra-long dissipative fiber laser. The method is based on highly-chirped analytical solution of Ginzburg-Landau equation with the gain saturation and saturable absorption.

JTu5A.45
Stability of Spatio-temporal Solitons in Multi-mode Fibers, Olga Shtyrina[1,2], Yuri Kivshar[4], Sergei Turitsyn[1,3], Irina Yarutkina[1,2], Mikhail P. Fedoruk[1,2]; [1]*Novosibirsk State Univ., Russia;* [2]*Inst. of Computational Technologies SB RAS, Russia;* [3]*Aston Inst. of Photonics Technologies, Aston Univ., UK;* [4]*Research School of Physics and Engineering, Australian National Univ., Australia.* We analyze stability of spatiotemporal solitons in multimode fibers in graded-index waveguides. We find the area of stable soliton-like dynamics of initial Gaussian pulse and study pulse propagation by direct three-dimensional numerical modeling.

JTu5A.46
Discrete Phase Front Focusing in Multi-core Fibers with Simultaneous Pulse Compression, Igor Chekhovskoy[1,2], Alexander Rubenchik[4], Olga Shtyrina[1,2], Stefan Wabnitz[1,3], Mikhail P. Fedoruk[1,2]; [1]*Novosibirsk State Univ., Russia;* [2]*Inst. of Computational Technologies, SB RAS, Russia;* [3]*Department of Information Engineering, Univ. of Brescia, Italy;* [4]*Lawrence Livermore National Laboratory, USA.* We demonstrate numerically by a genetic algorithm the possibility of effective discrete phase front focusing implemented in the 7-core hexagonal multi-core fiber. Moreover, the compression of a focused pulse in an arbitrary core is demonstrated.

JTu5A.47
Parametric Instability of the Dissipative Soliton Resonance, Wei Lin[1], Huihui Cheng[1], Aiping Luo[2], Wenlong Wang[1], Tian Qiao[1], Zhongmin Yang[1]; [1]*South China Univ. of Technology, China;* [2]*South China Normal Univ., China.* We reveal parametric instability of the dissipative soliton resonance (DSR) in mode-locked fiber lasers. This instability is induced by intra-cavity parameter modulations, resulting in coherence loss of the DSR to limit further energy boost.

JTu5A.48
Advanced Methods to Mitigate Fiber Nonlinearies Using Neural Networks and Probabilistic Shaping, Oleg Sidelnikov[1,2], Anton S. Skidin[1,2], Stylianos Sygletos[3], Mikhail P. Fedoruk[1,2]; [1]*Novosibirsk State Univ., Russia;* [2]*Inst. of Computational Technologies SB RAS, Russia;* [3]*Aston Inst. of Photonic Technologies, UK.* We propose a combined approach to mitigate nonlinear fiber effects based on both the probabilistic shaping and static neural networks. We show that such combination can expand the system reach by 25-35%.

16:00–17:30
JTu5A • Poster Session II and Networking Coffee Break with Exhibitors

JTu5A.49
Delayed Luminescence and its Dependence on Nonlinear Organized Structures based Glucose Monomers, Rosaria Grasso[1,2], Francesco Musumeci[1,2], Larissa Brizhik[3], Agata Scordino[1,2]; [1]*Catania Univ., Italy;* [2]*Laboratori Nazionali del Sud, Istituto Nazionale di Fisica Nucleare, Italy;* [3]*Bogolyubov Inst. for Theoretical Physics, Ukraine.* The photoinduced ultraweak emission, Delayed Luminescence, of starch and cellulose, polymers having same glucose-based repeat units, are presented. The dependence of delayed luminescence on ordered structures and their nonlinear behavior is shown.

JTu5A.50
Analysis of Light Generation in Laser with PT-Symmetric Mirror, Agnieszka Mossakowska-Wyszynska[1], Paulina Niedzwiedziuk[2], Piotr Witonski[1], Pawel Szczepanski[1,3]; [1]*Inst. of Micro- and Optoelectronics, WUT, Poland;* [2]*Faculty of Physics, WUT, Poland;* [3]*National Inst. of Telecommunications, Poland.* The analysis of a small signal gain in a laser with Fabry-Perot resonator with a PT-symmetric mirror is presented for various PT structure parameters, such as number of elementary cells and imaginary part of refractive index.

JTu5A.51
Packing Multiple OAMs for Spatial Multiplexing, Mona Mihailescu[1], Eugen I. Scarlat[1], Irina A. Paun[1,2], Nicolae Mihale[1], Mircea M. Popa[1]; [1]*Politehnica Univ. from Bucharest, Romania;* [2]*National Inst. for Physics of Laser, Plasma and Radiation, Romania.* A packing algorithm for spatial multiplexing of orbital angular momentum states in a single diffractive structure is presented. Simulation results show the possibility to multiplex more than 200 states.

JTu5A.52
On-chip Optical Parametric Amplification in Subwavelength Lithium Niobate Nanowaveguides, Fabian Kaufmann[1], Anton Sergeyev[1], Marc Reig[1], Rachel Grange[1]; [1]*ETH Zurich, Switzerland.* We show an integrated optical parametric amplifier in the telecom C-band based on subwavelength lithium niobate thin-film nanowaveguides with a 40% gain for future applications in computation and miniaturized lab-on-a-chip experiments.

JTu5A.53
Nonlinear Stable Pulses in Dispersion-managed Fiber-optic Systems with Substantial Losses, Vladislav Neskorniuk[1,2], Anton Lukashchuk[3,2], Ildar Gabitov[4,1], Arkady Chipouline[1,5], Mohammadreza Malekizandi[5], Franko Küppers[5]; [1]*Skolkovo Inst. of Science and Technology, Russia;* [2]*Moscow Inst. of Physics and Technology, Russia;* [3]*École Polytechnique Fédérale de Lausanne, Switzerland;* [4]*Department of Mathematics, The Univ. of Arizona, USA;* [5]*Institut für Mikrowellentechnik und Photonik, Technische Universität Darmstadt, Germany.* We have found that the shape of nonlinear stable pulses in dispersion-managed fiber-optic system is highly dependent on the level of losses and other parameters of the system.

JTu5A.54
Cavity Soliton Dynamics under Lossy Phase Modulated Driving Field: A Variational Approach, Ambaresh Sahoo[1], Samudra Roy[1]; [1]*Indian Inst. of Technology Kharagpur, India.* Adopting a semi-analytical variational method we study the stability criteria and propagation dynamics of a cavity soliton under lossy and phase modulated driving field. The analytical treatment corroborate well with numerical results.

JTu5A.55
Vortex Michelson Interferometer as analog of Foucault Pendulum, Alex Okulov[1]; [1]*Russian Academy of Sciences, Russia.* The Michelson interferometer with ideal phase-conjugator in one arm is shown to transform rotations of reference frame with angular velocity into rotation of fringes interference pattern thereby being optical counterpart of Foucault pendulum.

JTu5A.56
All Fiber Mode-locked Ytterbium Laser Employing Chirped Fiber Bragg Grating and its Supercontinuum Application, Xia Li[1]; [1]*Shanghai Inst. of Opt. and Fine Mech., China.* All fiber polarization-maintaining mode-locked laser employing chirped fiber Bragg grating has been demonstrated. The MOPA construction can achieve a power of 30.3W from a linear Fabry-Perot cavity seed. Broadband supercontinuum can be generated.

JTu5A.57
The Longest Transmission Experiment of 200 m SI-Plastic Optical Fibre using A High-Luminous Green LED with a New Equalizing and Carrier Sweep Out Circuit, Nobuhiro Fujimoto[1]; [1]*Kinki Univ., Japan.* We have first confirmed the longest distance of 200m SI-POF transmission using a green LED to realize high-power 100 Mbit/s modulation by adopting a new equalizing with a chip inductor and carrier sweep out.

JTu5A.58
Holographic Optical Elements for SDM Interconnects, Christina Politi[1,2], Dimitris Alexandropoulos[3], Dimitra Simeonidou[2]; [1]*Departemt of Informatics and Telecommunications, Univ. of Peloponnese, Greece;* [2]*High Performance Networks Group, Univ. of Bristol, UK;* [3]*Department of Materials Science, Univ. of Patras, Greece.* Holographic Optical Elements couplers for photonic interconnects based on Spatial Division Multiplexing in multi core fibres are designed and studied with respect to their flexibility and tolerance to fabrication and integration errors.

JTu5A.59
Bistability in Oppositely Directed Coupler with Negative Index Material Channel, Kanagaraj Nithyanandan[1]; [1]*Universite de Bourgogne, India.* We observe that the oppositely directed coupler possesses Bistability. This property arises due to effective feedback mechanism as a result of opposite directionality of the phase velocity and energy flow in the negative index materials.

JTu5A.60
Performance Verification of Optical Modulation Format Conversion from 16QAM to Symbol Rate Doubled QPSK, Batdalai Sukh[1], Hiroki Kishikawa[1], Nobuo Goto[1]; [1]*Tokushima Univ., Japan.* We studied the format conversion from 16QAM to single symbol rate doubled QPSK modulation using FWM, linear polarizer, and pulse width compressor. Bit-error rate performance is numerically verified, resulting in error-free format conversion.

JTu5A.61
Investigation on MIMO OLED VLC System Performance, Quang Thai Pham[1], Duy Nguyen Hoang[1], Khoa Nguyen Ngoc Anh[1], Nghi V. Khanh[1]; [1]*HoChiMinh City Univ. of Technology, Viet Nam.* 5.38 Mbps data rate using 7-kHz modulation bandwidth light sources was achieved using a combination of active pre-equalizer, Filter Bank Multi-Carrier and MIMO techniques. Limitations of non-orthogonal multiple access was also investigated.

JTu5A.62
Fabrication and Optical Analysis of Bismuth Doped Germanosilicate Preforms to Develop ~830nm Fiber Laser, Arindam Halder[1], Edson H. Sekiya[1], Kazuya Saito[1]; [1]*Frontier Materials Laboratory, Toyota Technological Inst., Japan.* 550ppm Bi doped Li and Y germanosilicate preforms were fabricated through MCVD with solution-doping. 425nm, 457nm absorptions appeared from Bi centres. 828nm emission under excitation at 430nm, will be helpful to developed ~830nm fiber laser.

JTu5A.63
Multiple-color Stimulated Raman Scattering of Tetraphenylphosphonium Bromide Single-crystalline Micromicrofiber, Yan Ren[1]; [1]*Inst. of Crystal Materials, China.* Single-crystalline microfibers of tetraphenylphosphonium bromide with length-to-diameter ratio over 104:1 are grown. Multiple-color frequency-conversion with is realized by continuous-wave pumped stimulated Raman scattering of the TPPB microfibers.

JTu5A.64
Withdrawn

JTu5A.65
Analytical Estimation of Confinement Loss in Tube Lattice Fibers, Lorenzo Rosa[1], Luca Vincetti[1]; [1]*Department of Engineering "Enzo Ferrari", Univ. of Modena and Reggio Emilia, Italy.* In this work we propose an analytical formula for estimating confinement loss in Tube Lattice Fibers. The formula is based on single tube model and the comparison with numerical simulations of three TLFs shows a good agreement.

JTu5A.66
Comparison of Photo-darkening and Radio-darkening in Yb Doped Silica Fiber Prepared by Sol-gel Method and MCVD, Chunlei Yu[1]; [1]*Shanghai Inst of Optics & Fine Mechanics, China.* The photo-darkening and radio-darkening performance of YDF was investigated at low dose rate and the effect of preform preparation method on the PD and RD were also discussed.

JTu5A.67
Spectral-surfing CARS Hypermicroscopy of Pharmaceutical Samples with Commercial Supercontinuum Generating Photonic Crystal Fibres, Jeremy G. Porquez[1], Aaron D. Slepkov[1]; [1]*Trent Univ., Canada.* Spectral surfing CARS hypermicroscopy is designed to boost signals across an extended range of vibrational frequencies. We compare spectral surfing of two commercially-available supercontinuum sources being applied for pharmaceutical sample analysis.

JTu5A.68
Distributed Fiber Optic Hydrocarbon Leak Detection System, Edgar Mendoza[1]; [1]*Redondo Optics, USA.* This paper describes progress towards the development of a fast response, high sensitivity, distributed fiber optic hydrocarbon leak detection (HySense™) system based on the use of an optical fiber to detect the presence of hydrocarbon leaks.

JTu5A.69
Stack-and-draw Microstructured Optical Fiber with $Ge_{28}Sb_{12}Se_{60}$ Chalcogenide Glass, Shengling Wu[1], Simon C. Fleming[1], Boris T. Kuhlmey[1,2], Juliano G. Hayashi[1], Heike Ebendorff-Heidepriem[3], Alessio Stefani[1,4]; [1]*IPOS of the Univ. of Sydney, Australia;* [2]*School of Physics, Centre for Ultrahigh Bandwidth Devices for Optical Systems , Australia;* [3]*Inst. for Photonics and Advanced Sensing , Australia;* [4]*Department of Photonics Engineering, DTU Fotonik, Denmark.* A microstructured Optical fiber based on nontoxic and commercially available $Ge_{28}Sb_{12}Se_{60}$ chalcogenide glass was fabricated by stack-and-draw method. Potential applications include supercontinuum generation and metamaterials in mid-infrared region.

JTu5A.70
Accurate Analytical Model for Calculation of Multipath Interference in Bend-insensitive Fibers, Ankush Mahajan[1], Madhan Thollabandi[1], Nagaraju Bezawada[1]; [1]*Research & Development, Sterlite Tech, India.* We propose an accurate analytical model to calculate multipath interference in bend-insensitive fibers from estimated leakage loss of LP_{11} mode and splice loss. Proposed model is validated experimentally and found to be in good agreement

JTu5A.71
OAM Carrying Mode at Dirac Point in Twisted Hollow Core PCF, Rik Chattopadhyay[1], Shyamal Bahdra[1]; [1]*Raman Centre for Atomic Molecular and Optical Sciences, Indian Association for the Cultivation of Science, India.* We report trapping of orbital angular momentum carrying light in a central hollow defect of a twisted photonic crystal fiber. The topological crystal mode carrying OAM coupled in the central defect by Dirac frequency resonance.

JTu5A.72
Depolarization Effect of Graded-index Plastic Optical Fiber with Strong Mode Mixing, Hikari Suzuki[1], Azusa Inoue[1], Yasuhiro Koike[1]; [1]*Keio Univ., Japan.* We demonstrate that propagating light through plastic optical fibers is depolarized by intrinsic mode mixing due to microscopic heterogeneities. This depolarization effect allows for stable optical links through interference-induced noises reduction.

JTu5A.73
Reflection Noise Characteristics in Graded-index Plastic Optical Fiber Link Based on Ballpoint-pen Interconnect, Tomotaka Yagi[1], Azusa Inoue[1], Yasuhiro Koike[1]; [1]*Keio Univ., Japan.* We investigate the influence of reflection noises in graded-index plastic optical fiber link based on ballpoint-pen interconnect. The results suggest that link quality tend to improve through reflection noises reduction despite system loss increase.

16:00–17:30
JTu5A • Poster Session II and Networking Coffee Break with Exhibitors

JTu5A.74
Withdrawn

JTu5A.75
Self-optimizing Ultrafast Fiber Lasers, Manuel Ryser[1], Christoph Bacher[1], Christoph Lätt[1], Sheida Mahmoodi[1], Philippe Raisin[1], Jos Kohn[1], Alexander M. Heidt[1], Valerio Romano[1], Thomas Feurer[1]; [1]*Inst. of Applied Physics, Univ. of Bern, Switzerland.* We have equipped our ultrafast fiber lasers with software controlled fiberloop waveplates and online monitoring. We recorded high-resolution maps of the cavity dynamics and report multi-objective optimization with a genetic algorithm.

JTu5A.76
Thermo-optical Characteristics of Polysiloxane Polymers used in Industrial Fiber Lasers, Renata Ismagilova[1], Renat Shaidullin[1,2], Oleg Ryabushkin[1,2]; [1]*Moscow Inst. of Physics and Technology, Russia;* [2]*Kotelnikov Inst. of Radio Engineering and Electronics of RAS, Russia.* Optical properties of Silgel polysiloxane polymers was investigated. Laser radiation absorption coefficient of the polymer was measured. Portion of the optical power converted into heat during fiber laser operation was estimated.

JTu5A.77
Self-dissimilarity, Irreversibility and Robustness in Mode-locked Fiber Oscillators, Ghaith Makey[1], Tesfay Teamir[1], Serim Ilday[1], F. Omer Ilday[1]; [1]*Bilkent Univ., Turkey.* We introduce self-dissimilarity as measure of phase space complexity and predictor of robustness against perturbations. As nonlinearity increases, phase space becomes random fractal. Measurements confirm power-law dependence over 7 decades.

JTu5A.78
Bicomponent Melt-spinning of Polymer Optical Fibers, Konrad J. Jakubowski[1,2], Rudolf Hufenus[1], Jasmin Smajic[2,3], Manfred Heuberger[1,2]; [1]*Empa, Swiss Federal Laboratories for Materials Science and Technology, Switzerland;* [2]*ETH, Swiss Federal Inst. of Technology in Zurich, Switzerland;* [3]*HSR, Univ. of Applied Sciences Rapperswil, Switzerland.* A continuous and efficient production process of polymer optical fibers with varying core geometries is presented, along with mechanical and spectral characterization of prepared devices. Results are supported with finite element analysis.

JTu5A.79
Thermally-Driven Mode Coupling in Multi-Core Optical Fibers, Lorenzo Rosa[2], H. Mckee[1], F. Poli[1], S. Selleri[1], Luca Vincetti[2], Annamaria Cucinotta[1]; [1]*Universita degli Studi di Parma, Italy;* [2]*Univ. of Modena and Reggio Emilia, Italy.* Multi-core fibers for lasers obtained are analyzed by combined thermal-optical finite-element method simulations. Refractive index variation due to quantum defect caused heating is simulated to evaluate thermal dissipation-induced index gradients

Room D1.1 | Room D1.2 | Room D5.2 | Room D7.1 | Room D7.2

These concurrent sessions are grouped across two pages.
Please review both pages for complete session information.

Tuesday, 3 July

Room D1.1

17:30–18:00
JTu6A • Postdeadline Session I

JTu6A.1 • 17:30
Gamma Radiation Induced Attenuation in Ge-doped Fibers in Near IR Range: Influence of Irradiation Temperature and Doping Level, GeY- center, Pavel F. Kashaykin[1]; [1]*FORC RAS, Russia.* Radiation-induced absorption spectra are analyzed in germanosilicate fibers with different GeO_2-content (3.5-50 mol%) under gamma-irradiation at different temperatures. GeY-center peaking at ~1.38 eV is resolved for the first time.

JTu6A.2 • 17:45
Second-Harmonic Generation from Radially-Crystallized Glass-Ceramic Fiber, Yuta Hayashibara[1], Kosuke Funajima[1], Nobuaki Terakado[1], Yoshihiro Takahashi[1], Yuichi Kozawa[2], Shigeno Sato[2], Shigeno Nagano[3], Takumi Fujiwara[1]; [1]*Department of Applied physics, Tohoku Univ., Japan;* [2]*Inst. of Multidisciplinary Research for Advanced Materials, Tohoku Univ., Japan;* [3]*Optical Communications Laboratory, Sumitomo Electric Industries Ltd., Japan.* We fabricated the glass-ceramic fiber with nonlinear-optical crystal, which is radially-crystallized. Visible second-harmonic generation and its intensity-independence on the fundamental polarization were demonstrated.

Room D1.2

17:30–18:00
JTu6B • Postdeadline Session II

JTu6B.1 • 17:30
Soliton-induced Mid-infrared Cherenkov Radiation in Nano-photonic Hybrid Waveguides, Hairun Guo[1], Junqiu Liu[1], Wenle Weng[1], Tobias J. Kippenberg[1]; [1]*École Polytechnique Fédérale de Lausanne, Switzerland.* We demonstrated mid-infrared optical frequency comb generation in the regime of soliton induced Cherenkov radiation, in chip-based Si_3N_4 waveguide. We demonstrated an advanced dispersion engineering in nano-photonics platform using hybrid structures.

JTu6B.2 • 17:45
Single Entity Resolution Valving and Optically Studying Nanoscopic Objects in Liquids, Hadi Eghlidi[1], Patric Eberle[1], Christian Höller[1], Philipp Müller[1], Maarit Suomalainen[2], Urs F. Greber[2], Dimos Poulikakos[1]; [1]*ETH Zurich, Switzerland;* [2]*Univ. of Zurich, Switzerland.* We introduce a new concept of electrokinetic valving to confine, guide and optically characterize individual photonic and biological nano-objects with sizes down to few nanometer, and in liquids with a broad range of ionic strengths.

Room D5.2

17:30–17:45
JTu6C • Postdeadline Session III

JTu6C.1 • 17:30
Temperature-compensated FBG-based 3D Shape Sensor using Single-Mode Fibers, Samaneh Manavi Roodsari[1], Lilian Witthauer[1], Lorenzo Iafolla[1], Georg Rauter[1], Azhar Zam[1], Philippe C. Cattin[1]; [1]*Univ. of Basel, Switzerland.* We report a temperature-compensated FBG-based 3D shape sensor with an average positioning error of 1.4 %. The sensor consists of three single-mode fibers with four arrays of FBGs, which are glued on a substrate.

Room D7.1

17:30–18:00
JTu6D • Postdeadline Session IV

JTu6D.1 • 17:30
$LiNbO_3$ Waveguide Based Fourier Transform Spectrometer with Algorithmic Enhancement of Spectral Resolution, Zhi-mei Qi[1]; [1]*Chinese Academy of Sciences (CAS), China.* A small Fourier Transform spectrometer was prepared using a $LiNbO_3$ waveguide EO modulator and its spectral resolution was enhanced by extension of the measured interferogram based on the forward–backward linear prediction algorithm.

JTu6D.2 • 17:45
Performance of Fabry-Perrot Fiber Optic Microphone, Zhi-mei Qi[1]; [1]*Chinese Academy of Sciences (CAS), China.* Fiber optic microphones with high sensitivity and high thermal stability and high phase consistency have been developed based on single-mode fiber Fabry-Perrot interferometry. The microphone can be used for accurate sound source positioning.

Room D7.2

17:30–18:00
JTu6E • Postdeadline Session V
Presider: Sebastien Fevrier; Universite de Limoges, France

JTu6E.1 • 17:30
Ultralow Loss (2 dB/km) Hollow-Core Conjoined-Tube Negative-Curvature Fiber, Shoufei Gao[1], Yingying Wang[1], Wei Ding[2], Pu Wang[1]; [1]*Beijing Univ. of Technology, China;* [2]*Inst. of Physics, Chinese Academy of Sciences,, China.* We report a brand-new hollow-core conjoined-tube negative-curvature fiber with a minimum attenuation of 2 dB/km at 1512 nm, almost approaching the loss record of hollow-core photonic bandgap fiber with a 20-years history.

JTu6E.2 • 17:45
Supercontinuum Generation from Deep-UV to Mid-IR in a Noble Gas-filled Fiber Pumped with Ultrashort mid-IR Pulses, Abubakar I. Adamu[1], Md. Selim Habib[2], Christian R. Petersen[1], Binbin Zhou[1], Axel Schulzgen[2], Jose Enrique Antonio Lopez[2], Rodrigo Amezcua Correa[2], Ole Bang[1], Christos Markos[1]; [1]*DTU Fotonik, Denmark;* [2]*CREOL, USA.* We experimentally demonstrate record multi-octave supercontinuum (SC) generation spanning from 200 up to 4000 nm using a single Ar-filled hollow-core anti-resonant fiber pumped in the mid-IR region for the first time.

19:00–22:00 Conference Banquet on Lake Zurich, *Zürich Bürkliplatz*
(Separate Registration and Fee Required)

Room E1.1

Room E1.2

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

17:30–18:00
JTu6F • Postdeadline Session VI

JTu6F.1 • 17:30
Floquet Topological Transition in Response to Strong Driving, Jonathan Guglielmon[1], Sheng Huang[2], Kevin P. Chen[2], Mikael C. Rechtsman[1]; [1]*Department of Physics, Pennsylvania State Univ., USA;* [2]*Department of Electrical and Computer Engineering, Univ. of Pittsburgh, USA.* We observe a topological edge mode reverse its propagation direction in response to an increased gauge field amplitude. The reversed chirality results from an associated change in the topology of the bulk system.

JTu6F.2 • 17:45
Flip-Flop Polarization Domain Walls in a Kerr Resonator, Julien Fatome[1], Yadong Wang[2], Bruno Garbin[2], Bertrand Kibler[1], Abdelkrim Bendahmane[1], Nicolas Berti[1], Gian-Luca Oppo[3], François Leo[4], Stuart Murdoch[2], Miro Erkintalo[2], Stephane Coen[2]; [1]*Universite de Bourgogne, France;* [2]*The Univ. of Auckland, New Zealand;* [3]*Univ. of Strathclyde, UK;* [4]*Université Libre de Bruxelles, Belgium.* We report on the experimental observation of flipping polarization domain walls in a fiber Kerr resonator. These topological polarization knots exhibit a period-doubling behavior and can be addressed individually as bit-entities for data storage.

17:30–18:00
JTu6G • Postdeadline Session VII

JTu6G.1 • 17:30
Extra-ordinary Nonlinear-optical Behavior in Silica-core Waveguides Covered with Graphene, Nathalie Vermeulen[1], David Castello-Lurbe[1,2], Mulham Khoder[1], Iwona Pasternak[3,4], Aleksandra Krajewska[3], Tymoteusz Ciuk[3], Wlodek Strupinski[4], JinLuo Cheng[5], Hugo Thienpont[1], Juergen Van Erps[1]; [1]*Vrije Universiteit Brussel, Belgium;* [2]*Institut Universitari di Ciencies dels Materials, Spain;* [3]*Inst. of Electronic Materials Technology, Poland;* [4]*Warsaw Univ. of Technology, Poland;* [5]*Changchun Inst. of Optics, fine Mechanics and Physics, China.* We solve the long-standing discrepancy between the theoretically predicted and experimentally observed performance of nonlinear-optical refraction in graphene. Hereto we study self-phase modulation in silica-core waveguides covered with graphene.

JTu6G.2 • 17:45
Optical Fiber Analogous of the Piston Shock Problem, Abdelkrim Bendahmane[1], Arnaud Mussot[1], Gang Xu[1], Stefano Trillo[1], Alexandre Kudlinski[1], Matteo Conforti[1]; [1]*CNRS / Lille Univ., France.* We investigate the optical analogous of the piston shock problem in gas dynamics. Using fast temporal measurements, we recorded dispersive shock waves formed by the propagation of a bi-chromatic photon fluid along an optical fiber.

19:00–22:00 Conference Banquet on Lake Zurich, *Zürich Bürkliplatz (Separate Registration and Fee Required)*

NOTES

Room D1.1

Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials

Room E5

Integrated Photonics Research, Silicon, and Nano-Photonics

Room E3

Nonlinear Photonics

Room D1.2

Novel Optical Materials and Applications

Room D7.1

Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

07:30–17:30 Registration, *E Level*

08:00–10:00
BW1A • Femtosecond Laser Writing: From Fundamentals to Applications
Presider: Matthieu Lancry; Universite de Paris Sud, France

BW1A.1 • 08:00 Invited
Volume Nanogratings in Glass: From Self-organized to Well-controlled Laser Processing, Anton Rudenko[1], Jean-Philippe Colombier[1], Tatiana E. Itina[1,2]; [1]*Laboratoire Hubert Curien, CNRS UMR5516/Univ.Lyon/UJM-St.Etienne, France;* [2]*ITMO Univ., Russia.* Intrinsic mechanisms of glass decomposition by femtosecond pulses are investigated. The performed combined electromagnetic calculations demonstrate that the origin of the volume nanogratings is related to the formation and survival of the nanopores.

BW1A.2 • 08:30
Evidence by Mueller Spectropolarimetry of Optical Rotation Imprinted by Femtosecond Laser in Silica, Jing Tian[1], Matthieu Lancry[1], Sang H. Yoo[2], Enric G. Caurel[2], Razvigor Ossikovski[2], Bertrand Poumellec[1]; [1]*Université Paris Sud, France;* [2]*Ecole Polytechnique, France.* Mueller spectropolarimetry is applied to study fs-laser induced linear and circular properties in silica glass in the spectral range 450–1000 nm. We reveal that the laser polarization determines the amplitude and the sign of the circular properties.

08:00–10:00
IW1B • Optical Detectors and Transceivers
Presider: Andreas Beling; Univ. of Virginia, USA

IW1B.1 • 08:00 Invited
An All-Silicon Photodetector for 850 nm Wavelength Applications, Christopher Williams[1,2], Monireh Moayedi Pour Fard[2], Glenn Cowan[1], Odile Liboiron-Ladouceur[2]; [1]*Electrical and Computer Engineering, Concordia Univ., Canada;* [2]*Electrical and Computer Engineering, McGill Univ., Canada.* A silicon photodetector is presented with increased sensitivity using a focused grating coupler to efficiently redirect the incident light. At 35 Gb/s, the BER is 10^{-12}, making it the fastest of its type.

IW1B.2 • 08:30
100 Gbit/s Graphene Photodetector, Yannick Salamin[1], Ping Ma[1], Benedikt Baeuerle[1], Arne Josten[1], Alexandros Emboras[1], Juerg Leuthold[1]; [1]*ETH Zurich, Switzerland.* We report on a waveguide-integrated plasmon-enhanced graphene photodetector demonstrating simultaneously a responsivity of 0.5 A/W and a bandwidth beyond 67 GHz. The device capabilities are shown in a 100 Gbit/s PAM-4 data reception experiment.

08:00–10:00
NpW1C • Instabilities and Synchronization
Presider: Stéphane Barland; Université Côte d'Azur, France

NpW1C.1 • 08:00 Invited
Optimal Entrainment of the Power Dropouts of a Semiconductor Laser with Optical Feedback to Pump Current Modulation, Jordi Tiana-Alsina[1], Carlos Quintero-Quiroz[1], Mattia Panozzo[1], M. C. Torrent[1], Cristina Masoller[1]; [1]*Departament de Fisica, Universitat Politecnica de Catalunya, Spain.* We use a semiconductor laser with optical feedback in the LFF regime to study entrainment experimentally. In spite of the fact that the modulation is of small amplitude, wide regions of high-quality entrainment are found.

NpW1C.2 • 08:30
Resonance in Modulation Instability from Non-instantaneous Nonlinearities, Ray-Ching Hong[1], Chun-Yan Lin[1], You-Lin Chuang[1], Chien-Ming Wu[1], Yonan Su[1], Jeng Yi Lee[1], Chien-Chung Jeng[2], Ming-Feng Shih[3], Ray-Kuang Lee[1]; [1]*National Tsing Hua Univ., Taiwan;* [2] *National Chung-Hsing Univ., Taiwan;* [3]*National Taiwan Univ., Taiwan.* With a periodic modulation in the external bias voltage, corresponding to a modulation in the nonlinear strength, an enhancement in the visibility of MI at resonant frequency is reported through spontaneous optical pattern formations.

08:15–10:00
NoW1D • Metasurfaces and Metamaterials I
Presider: Christian Haffner; ETH Zurich, Switzerland

NoW1D.1 • 08:15
Holographic Anti-counterfeiting Tags Utilizing Speckle Pattern "Fingerprint", Yoav Blau[1], Ofer Bar-On[1], Omer Kotlicki[1], Yael Hanein[1], Amir Boag[1], Jacob Scheuer[1]; [1]*Tel-Aviv Univ., Israel.* A novel concept for an optical holographic anti-counterfeit tag is presented and demonstrated experimentally. Under laser illumination, the tag projects a 2D barcode image which carries a unique speckle pattern serving as its "fingerprint".

NoW1D.2 • 08:30 Tutorial
Optical Dielectric Metasurfaces - Fundamentals and Applications, Dragomir N. Neshev[1]; [1]*Nonlinear Physics Centre, RSPE, Australian National Univ., Australia.* The talk will overview the fundamental principles of operation of dielectric metasurfaces, as well as the plethora of their applications, including efficient beam shaping and holograms, biosensing, and characterization of entangled states.

08:00–10:00
SeW1E • Optical Chemical & Biological Sensing II
Presider: Ellen Holthoff; US Army Research Laboratory, USA

SeW1E.1 • 08:00 Invited
Plasmonic Chemical and Biological Sensors based on Plastic Optical Fibers, Nunzio Cennamo[1], Sabato D'Auria[2], Antonio Varriale[2], Maria Pesavento[3], Luigi Zeni[1]; [1]*Department of Engineering, Univ. of Campania Luigi Vanvitelli, Italy;* [2]*National Research Council, Inst. of Food Science (ISA-CNR), Italy;* [3]*Department of Chemistry, Univ. of Pavia, Italy.* A simple approach to low-cost plasmonic sensing is obtained by Plastic Optical Fibers (POFs). POFs are especially advantageous for their properties and, when receptors are used for bio/chemicals detection, are suitable for different application fields

SeW1E.2 • 08:30
Withdrawn

Room D3.2	Room D5.2	Room D7.2	Room E1.1	Room E1.2
Photonic Networks and Devices	Signal Processing in Photonic Communications	Specialty Optical Fibers	Joint Integrated Photonics Research, Silicon, and Nano-Photonics/ Nonlinear Photonics	Novel Optical Materials and Applications

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

07:30–17:30 Registration, *E Level*

Room D3.2

08:45–10:00
NeW1F • Multimode and Multicore Transmission and Devices
Presider: Nicolas Fontaine; Nokia Bell Labs, USA

Room D5.2

08:00–10:00
SpW1G • Long-haul Transmission II
Presider: Fan Zhang; Peking Univ., China

SpW1G.1 • 08:00 Invited
Polar Coding for Multilevel Shaped Constellations, Toshiaki Koike-Akino[1], Ye Wang[1], David S. Millar[1], Keisuke Kojima[1], Kieran Parsons[1]; [1]*201 Broadway, Mitsubishi Electric Research Labs, USA.* We present recent advancements of polar coding suitable for next-generation optical communications. We discuss polar coding design for high-order modulation with constellation shaping.

SpW1G.2 • 08:30
Polarization Dependent Loss Compensation with Mueller Matrix Monitor in Coherent Transmission System, Guoxiu Huang[1], Shoichiro Oda[1], Yuichi Akiyama[1], Tomofumi Oyama[1], Tomohiro Yamauchi[1], Takeshi Hoshida[1]; [1]*Fujitsu Laboratories Ltd., Japan.* We demonstrate a new proposal of polarization-dependent-loss compensation with digital-signal-processing based on Mueller matrix monitor technology. The experimental results show high Q improvement of 1.6dB for a polarization-dependent-loss of 5dB.

Room D7.2

08:00–10:00
SoW1H • Sensing and Imaging
Presider: Michalis Zervas; Univ. of Southampton, UK

SoW1H.1 • 08:00 Invited
New Fiber Probes for Biosensing and Imaging, Herve Rigneault[1]; [1]*Institut Fresnel, Centre National Recherche Scientifique, France.* We focus on bringing nonlinear contrast mechanisms such as 2photon fluorescence, second harmonic generation and stimulated Raman into endoscope flexible probes, the latter being as small as the diameter of the fiber itself.

SoW1H.2 • 08:30
Randomly Disordered Glass-Air Optical Fiber Imaging Based on Deep Learning, JIAN ZHAO[1], Yangyang Sun[1], Zheyuan Zhu[1], Jose Enrique Antonio Lopez[1], Rodrigo Amezcua Correa[1], Shuo Pang[1], Axel Schulzgen[1]; [1]*CREOL, College of Optics and Photonics, Univ. of Central Florida, USA.* We demonstrate that images can be reconstructed for objects away from the imaging plane without any distal optics by combining deep neural networks with meter-long glass-air disordered optical fibers. This imaging system is bending-independent.

Room E1.1

08:00–10:00
JW1I • Symposium: Microcomb Technology I
Presider: Marco Peccianti; Univ. of Sussex, UK

JW1I.1 • 08:00 Invited
Soliton Microcomb Physics and Applications, Kerry J. Vahala[1]; [1]*Mail code 128-95, California Inst. of Technology, USA.* Soliton generation in high-Q microcavities is reviewed including Stokes and counter-propagating solitons. Dual-comb spectroscopy and LIDAR using soliton microcombs is presented and efforts towards integrated clocks and synthesizers are discussed.

Room E1.2

08:00–10:00
NoW1J • Nanomaterials II
Presider: Stephen Foulger; Clemson Univ., USA

NoW1J.1 • 08:00
Efficient Machine Learning Algorithms to Analyze Time-Resolved Luminescence Data, Nikola D. Dordevic[1], Joseph S. Beckwith[2], Maksym Yarema[1], Olesya Yarema[1], Arnulf Rosspeintner[2], Nuri Yazdani[1], Juerg Leuthold[1], Eric Vauthey[2], Vanessa Wood[1]; [1]*Department of Information Technology and Electrical Engineering, ETH Zurich, Switzerland;* [2]*Department of Physical Chemistry, Univ. of Geneva, Switzerland.* A machine learning algorithm is applied to analyze decay rate distribution in time-resolved photoemission data without *a priori* assumptions. We show that our approach is efficient in identifying physical processes in colloidal nanocrystals.

NoW1J.2 • 08:15
Altering Spontaneous Emission Rate of Dye Molecules Confined in a Single Nanofiber via Humidity, Belkis Gokbulut[1], Ekrem Yartasi[1], Ezgi Sunar[1], Mehmet Naci Inci[1]; [1]*Bogazici Univ. , Turkey.* A single Polyethylene Glycol nanofiber is doped with Boradiazaindacene dye molecules and its hydrophilic material properties is utilized for the first time to alter the spontaneous transition rate via humidity.

NoW1J.3 • 08:30
Comparative Analysis of Photoluminescence Characteristics of Nanoporous Alumina Anodized in Different Electrolytes, Denis O. Ilin[1], Nikolay A. Martemyanov[1], Alexandr S. Vokhmintsev[1], Ilya A. Weinstein[1,2]; [1]*Ural Federal Univ., Russia;* [2]*Inst. of Solid State Chemistry, Ural Branch of the RAS, Russia.* Nanoporous anodic alumina membranes were synthesized in HF, $(COOH)_2$, H_3PO_4 and H_2SO_4 electrolytes. It was shown that characteristic blue emission had the same origin in all samples and was caused by F-type anion centers.

Room D1.1	Room E5	Room E3	Room D1.2	Room D7.1
Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials	Integrated Photonics Research, Silicon, and Nano-Photonics	Nonlinear Photonics	Novel Optical Materials and Applications	Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

BW1A • Femtosecond Laser Writing: From Fundamentals to Applications—Continued

BW1A.3 • 08:45
Aperiodic Fiber Bragg Gratings Written by Ultrashort Laser Pulses using the Line-by-line Technique, Thorsten A. Goebel[1,2], Gayathri Bharathan[3], Daniel Richter[1], Ria G. Krämer[1], Martin Ams[3], Alex Fuerbach[3], Stefan Nolte[1,4]; [1]*Inst. of Applied Physics, Friedrich Schiller Univ. Jena, Germany;* [2]*IMPRS-PL, Max Planck Inst. for the Science of Light, Germany;* [3]*MQ Photonics Research Centre, Department of Physics and Astronomy, Macquarie Univ., Australia;* [4]*Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany.* We demonstrate the successful inscription of aperiodic fiber Bragg gratings (AFBGs) by femtosecond laser pulses using the line-by-line technique. The AFBGs were designed with 10 transmission notches to work as wavelength filter elements in astronomy.

BW1A.4 • 09:00
Femtosecond Inscription of Phase-shifted Gratings by Exploiting Fiber Strain, Aviran Halstuch[1], Amiel Ishaaya[1]; [1]*Ben-Gurion Univ. of the Negev, Israel.* We apply controlled fiber strain during the inscription of two different Bragg gratings, one over the other, with femtosecond pulses and a phase-mask. High quality phase-shifted gratings are obtained in a simple and robust manner.

BW1A.5 • 09:15
Flexible Direct Write Inscription of Tilted Fibre Bragg Gratings using a Femtosecond Laser, Andreas Ioannou[2,1], Antreas Theodosiou[1], Christophe Caucheteur[2], Kyriacos Kalli[1]; [1]*Cyprus Univ. of Technology, Cyprus;* [2]*Univ. of Mons, Belgium.* A flexible, plane-by-plane, direct-write, fs-laser inscription method for tailored, tilted fibre Bragg gratings (TFBGs) is presented. We characterize 10th order gratings in the C-to-O bands and their refractometric sensitivity with grating order.

IW1B • Optical Detectors and Transceivers—Continued

IW1B.3 • 08:45
High Speed InP-based Type-II Multiple Quantum Well Integrated Waveguide Photodiode at 2.0-µm Wavelength, Bassem Tossoun[1], Sadhvikas Addamane[2], Ganesh Balakrishnan[2], Archie Holmes, Jr.[1], Andreas Beling[1]; [1]*Electrical Engineering, Univ. of Virginia, USA;* [2]*Electrical Engineering, Univ. of New Mexico, USA.* We present a high-speed integrated waveguide photodetector exhibiting a dark current of 2 nA at -2 V with an internal responsivity of 0.25 A/W and a 3-dB bandwidth above 8 GHz at 2 µm wavelength.

IW1B.4 • 09:00
50 Gb/s DMT and 120 Mb/s LTE Signal Transmission over 5 km of Optical Fiber using a Silicon Photonics Transceiver, Abdul Rahim[1], Amin Abbasi[1], Mahmoud Shahin[1], Nuno Sequeira André[2], Andre Richter[2], Joris Van Kerrebrouck[3], Kasper Van Gasse[1], Andrew Katumba[1], Bart Moeneclaey[3], Xin Yin[3], Geert Morthier[1], Roel Baets[1], Gunther Roelkens[1]; [1]*Ghent Univ., Belgium;* [2]*VPIphotonics: Simulation Software and Design Services, Germany;* [3]*IDLab, Ghent Univ. - IMEC, Belgium.* Combined DMT and LTE data is transmitted over 5 km SSMF using a directly modulated InP-on-Si laser and a silicon photonics receiver. We demonstrate DMT net capacity of 50 Gb/s while keeping the LTE EVM below 1%.

IW1B.5 • 09:15 Invited
Low-noise Digital Alloy Avalanche Photodiodes, Joe C. Campbell[1], Seth R. Bank[2]; [1]*P.O. Box 4000743, Univ. of Virginia, USA;* [2]*Univ. of Texas, USA.* The degree to which the internal gain of avalanche photodiodes (APDs) can provide improved receiver performance depends on the multiplication noise. We report APDs that have achieved low noise by using digital alloys materials in the gain regions.

NpW1C • Instabilities and Synchronization—Continued

NpW1C.3 • 08:45
Chaotic Switching in Coherently Driven, Passively Coupled Nonlinear Optical Resonators, Andrus Giraldo[1], Bernd Krauskopf[1], Neil Broderick[1], Alejandro M. Giacomotti[2], Juan A. Levenson[2]; [1]*The Univ. of Auckland, New Zealand;* [2]*Ctr. de Nanosciences et de Nanotechnologies, France.* We show that a system of coupled passive resonators that are coherently driven exhibit transitions to chaotic regimes due to the existence of a symmetric pair of homoclinic orbits of Shilnikov type.

NpW1C.4 • 09:00
Observation of Period-doubling Dynamics of Modulation Instability in Uniform and Dispersion Oscillating Fiber-ring Cavities, Arnaud Mussot[1], Francois Copie[1], Florent Bessin[1], Alexandre Kudlinski[1], Stefano Trillo[2], Matteo Conforti[1]; [1]*Univ Lille 1 Laboratoire PhLAM, France;* [2]**Univ. of Ferara, Italy.* We provide a direct observation of a period-doubling phenomenon associated to the modulation instability in both uniform and dispersion oscillating passive fiber ring cavities.

NpW1C.5 • 09:15
Experimental Analysis and Mean-field Dynamics of a Fully Connected Network of Chaotic Optical Devices, Axel Dolcemascolo[1], Francesco Marino[2], Romain Veltz[3], Stéphane Barland[1]; [1]*INPHYNI lab, CNRS - Sophia Antipolis, France, France;* [2]*Dipartimento di Fisica, Università di Firenze, INFN, Sezione di Firenze, Italy, Italy;* [3]*Inria Sophia Antipolis, MathNeuro Team, France, France.* We analyse experimentally a dynamical system consisting of hundreds of chaotic optical devices coupled as a fully connected network. We derive analytically a mean field theoretical model that underlies the global dynamic.

NoW1D • Metasurfaces and Metamaterials I—Continued

SeW1E • Optical Chemical & Biological Sensing II—Continued

SeW1E.3 • 08:45
Multi-Species, High-Precision MIR Trace Gas Detection for Environmental Applications, Lukas Emmenegger[1], Joachim Mohn[1], Jérôme Faist[2], Morten Hundt[1], Kristýna Kantnerová[1,3], Filippos Kapsalidis[2], Herbert Looser[1], Mehran Shahmohammadi[2], Béla Tuzson[1]; [1]*EMPA, Switzerland;* [2]*Quantum Optoelectronics Group, ETHZ, Switzerland;* [3]*Climate Geology Group, ETHZ, Switzerland.* MIR spectroscopy using QCL allows sensitive, selective, and fast detection of gases and their isotopes. Recent developments, including dual-wavelength QCL, create tantalizing options for compact, multi-species analysis in environmental applications.

SeW1E.4 • 09:00
Mid-IR Laser Spectroscopy in Life Sciences: Medical and Forensic Applications, Bela Tuzson[1], Oleg Aseev[1], Herbert Looser[2], Luc Tappy[2], Bernhard Niederhauser[3], Lukas Emmenegger[1]; [1]*Empa, Switzerland;* [2]*Université de Lausanne, Switzerland;* [3]*METAS, Switzerland.* Broadly tunable mid-IR laser sources open new exciting opportunities for the detection of volatile organic compounds. Real-time, fast, sensitive, and highly specific analysis of human breath with compact instrumentation is demonstrated.

SeW1E.5 • 09:15
Withdrawn

Room D3.2	Room D5.2	Room D7.2	Room E1.1	Room E1.2
Photonic Networks and Devices	Signal Processing in Photonic Communications	Specialty Optical Fibers	Joint Integrated Photonics Research, Silicon, and Nano-Photonics/ Nonlinear Photonics	Novel Optical Materials and Applications

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

NeW1F • Multimode and Multicore Transmission and Devices—Continued

NeW1F.1 • 08:45
Analysis of Optical OAM Mode Conversion Using Elastic Vortex Wave in Graded Index Optical Fiber, Takuya Shoro[1], Hiroki Kishikawa[1], Nobuo Goto[1]; [1]*Tokushima Univ., Japan.* OAM mode conversion executed by mode coupling using elastic vortex wave is theoretically discussed. We clarified the contributing components of dielectric perturbation caused by elastic vortex waves in a multi-mode fiber.

NeW1F.2 • 09:00 Invited
MIMO-less Mode Division Multiplexing, Giovanni Milione[1]; [1]*NEC Laboratories America Inc, USA.* Abstract not available.

SpW1G • Long-haul Transmission II

SpW1G.3 • 08:45
Multi-Core Fiber Channel Model and Core Dependent Loss Estimation, Akram A. Abouseif[1], Ghaya R. Ben-Othman[1], Yves Jeouen[1]; [1]*LTCI, Telecom ParisTech, France.* We propose a new Multi-Core Fiber channel model depending on the manufacturing parameterss for Multi-Core Fiber configuration. Using this model, we derived a theoretical model with Gaussian distribution of the Core Dependent Loss.

SpW1G.4 • 09:00 Invited
Interference Cancelling Techniques for Long-Haul MIMO-SDM Transmission, Kohki Shibahara[1]; [1]*NTT Corporation, NTT Network Innovation Laboratories, Japan.* We discuss the MDL impact in long-haul FM transmission. An interference canceller designed for optical MIMO signal detection operating in cooperation with a decoder is also described, and analyzed with transmission results over 2500-km MC-FM fiber.

SoW1H • Sensing and Imaging—Continued

SoW1H.3 • 08:45
Stretchable Optical Fibers *via* Thermal Drawing, Yunpeng Qu[1], Nicola Bartolomei[1], Maxime Lagier[1], Tùng Nguyen[1], Alexis Page[1], Wei Yan[1], Tapajyoti Das Gupta[1], Fabien Sorin[1]; [1]*EPFL, Switzerland.* Stretchable multi-material optical fibers are fabricated via the thermal drawing technique by identifying the proper thermoplastic elastomers. It offers unprecedented opportunities to realize complex soft optical fiber sensors.

SoW1H.4 • 09:00 Invited
Heavy Metal Oxide Glass Fibers: New Opportunities for Sensing, Heike Ebendorff-Heidepriem[1]; [1]*School of Physical Sciences, Univ. of Adelaide, Australia.* The low processing temperatures and high refractive indices of heavy metal oxide glasses enable unique fiber sensors such as magnetic field sensing with nanodiamond-doped fibers and in-vivo temperature sensing with upconversion glass coated fiber.

JW1I • Symposium: Microcomb Technology I—Continued

JW1I.2 • 08:45 Invited
Plasmonically Enhanced Kerr Frequency Combs, Andrea M. Armani[1], Rigoberto Castro[1], Soheil Soltani[1], Vinh Diep[1]; [1]*Dept of Chem E and Mat Sci, Univ. of Southern California, USA.* By coating optical resonators with metal nanorods functionalized with small molecule coatings, we fabricate an efficient frequency comb generator in the near-IR. Additional nonlinear behaviors, e.g. Anti-Stokes/Stokes generation, are also observed.

JW1I.3 • 09:15 Invited
Microwave and RF Applications of Micro-combs, David J. Moss[1]; [1]*Center for Microphotonics, Swinburne Univ. of Technology, Australia.* We report applications of integrated Kerr micro-combs to RF photonic systems and demonstrate a wide range of advanced functions including a microwave photonic intensity differentiator, filters and true time delays.

NoW1J • Nanomaterials II—Continued

NoW1J.4 • 08:45
Spectral Features and Luminescence Thermal Quenching of InP/ZnS Quantum Dots within 7.5 – 295 K Range, Sergey S. Savchenko[1], Alexandr S. Vokhmintsev[1], Ilya A. Weinstein[1]; [1]*Ural Federal Univ., Russia.* Fluorescence spectral shape of InP/ZnS core/shell quantum dots and its thermal behaviour were investigated in 7.5–295 K temperature range under pulsed UV excitation.

NoW1J.5 • 09:00
Fast Photothermoelectric Response of 3D Graphene Foam in the Terahertz Range, Meng Chen[1], Yingxin Wang[1], Fei Fan[2], Yi Huang[3], Ziran Zhao[1]; [1]*Key Laboratory of Particle & Radiation Imaging (Tsinghua Univ.), China;* [2]*Inst. of Modern Optics, China;* [3]*Key Laboratory of Functional Polymer Materials, Collaborative Innovation Center of Chemical Science and Engineering, China.* We investigated the photothermoelectric properties of 3D graphene foam in the terahertz range. An obvious photovoltage was achieved, while the response speed was significantly improved, about 25 times higher compared to the single-layer graphene.

NoW1J.6 • 09:15 Invited
Near-field Spectral Properties of Nano-engineered Metallic Nanoparticles, Kosei Ueno[1], Quan Sun[1], Hiroaki Misawa[1,2]; [1]*Research Inst. for Electronic Science, Hokkaido Univ., Japan;* [2]*Department of Applied Chemistry, National Chiao Tung Univ., Taiwan.* Near-field spectral properties of coupled plasmonic systems have been studied by multi-photon photoemission electron microscopy and the internal quantum efficiency of plasmon-induced photocurrent generations using Au nanostructured TiO_2 electrodes.

Room D1.1	Room E5	Room E3	Room D1.2	Room D7.1
Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials	Integrated Photonics Research, Silicon, and Nano-Photonics	Nonlinear Photonics	Novel Optical Materials and Applications	Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

BW1A • Femtosecond Laser Writing: From Fundamentals to Applications—Continued

BW1A.6 • 09:30 Invited
Femtosecond Laser Written Diamond Photonics, Shane Eaton[1]; [1]*Istituto di Fotonica e Nanotecnologie, Italy.* We demonstrated waveguides and NVs in diamond using femtosecond laser microfabrication. Raman spectroscopy was applied to understand the formation of the waveguides.

IW1B • Optical Detectors and Transceivers—Continued

IW1B.6 • 09:45
Characterization of a Narrowband Resonant Cavity Enhanced Detector in the Mid-Infrared, Cristina Consani[1], Thomas Söllradl[1], Gerald Pühringer[2], Christian Ranacher[1], Andreas Tortschanoff[1], Surabhi Lodha[3], Thomas Grille[3], Bernhard Jakoby[2]; [1]*Carinthian Tech Research CTR AG, Austria;* [2]*Inst. for Microelectronics and Microsensors, Johannes Kepler Univ., Austria;* [3]*Infineon Technologies Austria AG, Austria.* We present a silicon-based multilayer microstructure working as a narrowband detector in the mid-infrared. The structure was optimized for a central wavelength of 4.26 µm and shows 6.3-fold detection enhancement compared to the metal response.

NpW1C • Instabilities and Synchronization—Continued

NpW1C.6 • 09:30
A New Dissipation Induced Modulation Instability in Nonlinear Optics, Auro M. Perego[1], Sergei Turitsyn[2], Kestutis Staliunas[3,4]; [1]*Aston Inst. of Photonic Technologies, UK;* [2]*Novosibirsk State Univ., Russia;* [3]*Institució Catalana de Recerca i Estudis Avançats, Spain;* [4]*DONLL, Universitat Politecnica de Catalunya, Spain.* We present a new dissipation induced modulation instability occurring in nonlinear optical systems due to asymmetric losses for signal and idler waves. Applications for signals amplification and pulses generation are discussed.

NpW1C.7 • 09:45
Phase Stochastic Resonance in a Forced Nanoelectromechanical Oscillator, Rémy Braive[1,2], Avishek Chowdhury[1], Sylvain Barbay[1], Isabelle Robert-Philip[1], Marcel Clerc[3]; [1]*CNRS-C2N, France;* [2]*Université Paris Diderot, France;* [3]*Departamento de Física, Facultad de Ciencias Físicas y Matemáticas, Universidad de Chile, Chile.* Observation and theoretical analysis of phase stochastic resonance in an electromechanical photonic crystal membrane forced by a coherent drive which results in a bidimensional bistable behavior is shown. Such phase noise acts multiplicatively.

NoW1D • Metasurfaces and Metamaterials I—Continued

NoW1D.3 • 09:30
Mid-Infrared Microspectrometers Based on an Array of Differently Tuned Integrated Metamaterial Absorbers, Mohammadamir Ghaderi[1], Ehsan Karimi shahmarvandi[1], Reinoud F. Wolffenbuttel[1]; [1]*Microelectronics, Delft Univ. of Technology, Netherlands.* Integration of an array of differently tuned mid-infrared metamaterial-based absorbers on top of thermopile detector arrays in a compatible fabrication process is presented. UV lithography is used for patterning over large areas with high throughput.

NoW1D.4 • 09:45
Spatial Separation of Electric and Magnetic Fields in Toroidal Metamaterial, Maria V. Cojocari[1]; [1]*NUST MISiS, Russia.* In this paper, we propose a metamaterial with the advantage of spatial field separation, which is determined by combining resonances of two planar metamaterials: one with electric and another with magnetic field strong localizations in microwave.

SeW1E • Optical Chemical & Biological Sensing II—Continued

SeW1E.6 • 09:30
Full-vector Finite Element 3D Model for Waveguide-based Plasmonic Sensors in the Infrared, Gilles Renversez[1,2], Virginie Nazabal[5,6], Joel Charrier[3,4], Guillaume Demésy[1,2]; [1]*Aix-Marseille Université , France;* [2]*Institut Fresnel CNRS, France;* [3]*ENSSAT, France;* [4]*FOTON CNRS, France;* [5]*ISCR CNRS, France;* [6]*Université de Rennes 1, France.* The plasmonic sensor for the infrared we propose is integrated and based on a ridge waveguide upon which metallic nano-objects ensure the coupling between the guided modes and the transducer. Full vector finite element 3D model are used to model it.

SeW1E.7 • 09:45
Dual-wavelength DFB Quantum Cascade Lasers for Multispecies Trace Gas Spectroscopy, Mehran Shahmohammadi[1], Filippos Kapsalidis[1], Martin J. Suess[1], Johanna M. Wolf[1], Emilio Gini[3], Mattias Beck[1], Morten Hundt[2], Béla Tuzson[2], Lukas Emmenegger[2], Jérôme Faist[1]; [1]*ETH, Switzerland;* [2]*Empa, Switzerland;* [3]*First-lab, Switzerland.* We report on the design and performance of dual-wavelength distributed-feedback quantum cascade lasers emitting at several wavelengths in the mid-infrared spectrum, based on (i) neighbour QCLs or (ii) Vernier effect combined with digitalized gratings

10:00–10:30 Networking Coffee Break with Exhibitors, *D Level Foyers*

Room D3.2	Room D5.2	Room D7.2	Room E1.1	Room E1.2
Photonic Networks and Devices	Signal Processing in Photonic Communications	Specialty Optical Fibers	Joint Integrated Photonics Research, Silicon, and Nano-Photonics/ Nonlinear Photonics	Novel Optical Materials and Applications

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

NeW1F • Multimode and Multicore Transmission and Devices—Continued

NeW1F.3 • 09:30 Invited
High-capacity Few-mode Multicore Fiber Transmission, Yuta Wakayama[1], Daiki Soma[1], Shohei Beppu[1], Takehiro Tsuritani[1]; [1]*KDDI Research, Inc., Japan.* This paper reviews two experiments that demonstrated an ultra-high capacity transmission using a 6-mode 19-core fiber and a repeatered transmission with an inline C+L-band 6-mode EDFA.

SpW1G • Long-haul Transmission II

SpW1G.5 • 09:30
Novel Demodulation Algorithm Based on Duo-Binary Spectrum Shaping and MLSE for Mitigating Spectrum Narrowing Caused by Multiple Node Traversals, Shuhei Yamaoka[1], Yojiro Mori[1], Hiroshi Hasegawa[1], Ken-ichi Sato[1]; [1]*Nagoya Univ., Japan.* We propose a demodulation algorithm that uses duo-binary spectrum shaping and MLSE for mitigating the spectrum narrowing caused by traversing nodes. The maximum transmission distance and hop-count in ultra-dense WDM networks are drastically extended.

SpW1G.6 • 09:45
Transmitter IQ Skew Calibration in Coherent Transceivers based on DSP, Pavel Skvortcov[1], Christian Sanchez-Costa[1], Ian Phillips[1], Wladek Forysiak[1]; [1]*Aston Inst. of Photonic Technologies, Aston Univ., UK.* A calibration technique for transmitter in-phase/quadrature skews based on signal image spectrum measurement performed by DSP is proposed. Sub-picosecond accuracy of the technique is shown in numerical simulations and experiment.

SoW1H • Sensing and Imaging—Continued

SoW1H.5 • 09:30
Multi-material Optical Fibers, Fabien Sorin[1]; [1]*Ecole Polytechnique Federale de Lausanne, Switzerland.* We will present the field of multi-material fibers and its recent developments. The opportunities associated with the use of multi-material optical fibers in sensing, bioengineering and advanced textiles will also be discussed.

SoW1H.6 • 09:45
Significant Reduction of Nonlinear Signal Distortion by Graded-index Plastic Optical Fiber with Intrinsic Strong Mode Mixing, Kenta Muramoto[1], Azusa Inoue[1], Yasuhiro Koike[1]; [1]*Keio Univ., Japan.* We demonstrate that novel plastic optical fibers reduce nonlinear distortion of transmitted signals in optical links because of strong mode mixings caused by microscopic heterogeneities in polymers, enabling high-quality multilevel transmission.

JW1I • Symposium: Microcomb Technology I—Continued

JW1I.4 • 09:45
High-Power Frequency Combs from Periodic Waveforms in Kerr Microresonators, Dora Kholmyansky[1], Omri Gat[1]; [1]*Physics, Hebrew Univ., Israel.* We show that nonlinear frequency pulling shifts the stability region of periodic waveforms in strongly driven Kerr microresonators to shorter periods. Consequently, optimized narrow-band combs are obtained by judiciously adjusting the period.

NoW1J • Nanomaterials II—Continued

NoW1J.7 • 09:45
Surface Topography Studied by Off-axis Digital Holography, Elena Achimova[1], Vladimir Abaskin[1], Veronica Cazac[1], Alexei Meshalkin[1], Giancarlo Pedrini[2], Daniel Claus[2], Igor Shevkunov[3], Vladimir Katkovnik[3]; [1]*Inst. of Applied Physics, ASM, Moldova (the Republic of);* [2]*Institut fur Technische Optik, the Univ. of Stuttgart, Germany;* [3]*Tampere Univ. of Technology, Finland.* The surface relief gratings patterned on As_2S_3–Se was investigated by digital holographic microscopy. For the high-accuracy phase reconstruction of the topography we used the sparse wavefront modeling. Experimental results are presented.

10:00–10:30 Networking Coffee Break with Exhibitors, *D Level Foyers*

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

Room D1.1

Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials

10:30–12:30
BW2A • FBG for Sensing Applications
Presider: Dmitrii Stepanov; Defence Science Technology Group, Australia

BW2A.1 • 10:30 Invited
Wired Horses, Cicero Martelli[1]; [1]*Universidade Tecnológica Federal do PR, Brazil.* Horses are empowered by using a specialized network of optical fiber sensors integrated to augmented reality technology which enhances their communication with the rider/owner during training, racing and possibly entire life.

BW2A.2 • 11:00
A Temperature Insensitive FBG Load Cell with On-Board Intensity Based Interrogation, Gary Allwood[1], graham Wild[2], Steven Hinckley[3]; [1]*The Univ. of Western Australia, Australia;* [2]*RMIT, Australia;* [3]*Edith Cowan Univ., Australia.* A temperature insensitive fibre Bragg grating (FBG) load cell with on-board intensity-based interrogation is presented.We demonstrate that using dual FBGs in a push-pull configuration eliminates the need for a dedicated FBG interrogator.

BW2A.3 • 11:15
Combined Time and Wavelength Domain Interrogation Scheme for Readout of Fiber Bragg Grating Arrays, Alexander Doering[1,2], Wolfgang Schippers[1], Jan Koch[1], Martin Angelmahr[1], Wolfgang Schade[1]; [1]*Fraunhofer Heinrich Hertz Inst., Germany;* [2]*IEPT, Clausthal Univ. of Technology, Germany.* A novel interrogation scheme for the readout of fiber Bragg grating arrays is proposed. It bases on the simultaneous application of time and wavelength domain readout methods.

Room E5

Integrated Photonics Research, Silicon, and Nano-Photonics

10:30–12:30
IW2B • Integrated Photonics Applications
Presider: Dennis Prather; Univ. of Delaware, USA

IW2B.1 • 10:30 Invited
Nanophotonic Approaches to Optical Information Processing, Lukas Wesemann[1], Kalpana Singh[1], Eugene panchenko[1], Daniel Gomez[2], Timothy Davis[1], Ann Roberts[1]; [1]*School of Physics, Univ. of Melbourne, Australia;* [2]*RMIT Univ., Australia.* We discuss the potential use of nanophotonics in compact optical information processing systems and present recent progress in the development of plasmonics-integrated photodetectors.

IW2B.2 • 11:00 Invited
Integrated Quantum Entropy Sources, Carlos Abellan[1], Waldimar Amaya[1], Domenico Tulli[1], Morgan Mitchell[2,3], Valerio Pruneri[2,3]; [1]*Quside Technologies S.L., Spain;* [2]*ICFO-The Inst. of Photonic Sciences, Spain;* [3]*ICREA-Institució Catalana de Recerca i Estudis Avançats, Spain.* In this talk, we will discuss recent progress on the miniaturisation of quantum random number generators, including implementations of phase-diffusion quantum entropy sources in silicon photonics and indium phosphide platforms.

Room E3

Nonlinear Photonics

10:30–12:30
NpW2C • Spatiotemporal Phenomena I
Presider: Stephane Coen; Univ. of Auckland, New Zealand

NpW2C.1 • 10:30 Invited
Temporal Localized Structures and Light Bullets in Passively Mode-Locked Semiconductor Lasers, Julien Javaloyes[1], Patrice Camelin[2], Mathias Marconi[2], Christian Schelte[1], Svetlana Gurevich[3,4], Massimo Giudici[2]; [1]*Departament De Fisica Edifici M Orfila, Universitat de les Illes Balears, Spain;* [2]*Institut de Physique de Nice, France;* [3]*Physics, Inst. for Theoretical Physics, Germany;* [4]*Physics, Center for Nonlinear Science (CeNoS), Germany.* We review our recent theoretical and experimental results regarding the existence and the dynamics of temporal and spatio-temporal localized structures in the output of semiconductor mode-locked lasers.

NpW2C.2 • 11:00
Spatiotemporal Mode-Locking: What It Is, and Different Types, Logan Wright[1], Demetrios N. Christodoulides[2], Frank W. Wise[1]; [1]*Cornell Univ., USA;* [2]*CREOL/College of Optics and Photonics, Univ. of Central Florida, USA.* We describe, in general terms, what spatiotemporal mode-locking is and how it happens. Then we describe several recent new developments, including qualitatively distinct kinds of 3D pulses and mode-locking physics.

NpW2C.3 • 11:15
Magneto-Optic Splitting of Dissipative Solitons, Bogdan Kochetov[1], Vladimir Tuz[1,2]; [1]*International Center of Future Science, Jilin Univ., China;* [2]*Theoretical Radio Physics, Inst. of Radio Astronomy of National Academy of Sciences of Ukraine, Ukraine.* Dissipative soliton emission is modeled using Ginzburg-Landau equation with a potential term. The applied potential induces the emission of new solitons from a single one. The seed soliton can be both fundamental soliton and vortex.

Room D1.2

Novel Optical Materials and Applications

10:30–11:45
NoW2D • Metasurfaces and Metamaterials II
Presider: Jason Myers; US Naval Research Laboratory, USA

NoW2D.1 • 10:30 Invited
Gallium Nitride Metasurface, Industrially Relevant Manufacturing Processes, Patrice Genevet[1], Kedi Wu[2], Qijie Wang[2], Peinan Ni[3], Gauthier Briere[3]; [1]*CNRS-CRHEA, CNRS, France;* [2]*Cintra, Singapore;* [3]*CNRS, France.* We explore new fabrication technique of GaN-based metasurfaces. Several nanofabrication approaches are discussed including free standing metasurface membranes, direct etching and sublimation of GaN metastructures for visible wavelength applications.

NoW2D.2 • 11:00
Metamaterial Hyperlenses for Extreme Sub-diffraction Focusing of THz Radiation, Juliano G. Hayashi[1,2], Richard Lwin[1], Alexander Argyros[1], Simon C. Fleming[1], Boris T. Kuhlmey[1,2], Alessio Stefani[1,3]; [1]*Inst. of Photonics and Opical Sciences (IPOS), The Univ. of Sydney, Australia;* [2]*The Univ. of Sydney, Centre for Ultrahigh bandwidth Devices for Optical Systems (CUDOS), Australia;* [3]*DTU Fotonik, Technical Univ. of Denmark, Denmark.* Extreme sub-diffraction focusing of THz radiation is obtained by cascading two metamaterial wire array fiber hyperlenses. A record 1/176 of the wavelength is achieved, allowing squeezing 8.8 mm wavelength to a 50 micron spot.

NoW2D.3 • 11:15
Metasurfaces and Metalenses Based on Partial Control of the Phase of Light, Claudio U. Hail[1], Hadi Eghlidi[1], Dimos Poulikakos[1]; [1]*ETH Zürich, Switzerland.* We introduce a new class of metasurfaces and experimentally demonstrate efficient large angle beam deflection and immersion metalenses with unprecedented resolution (~0.35λ) at visible wavelengths based on our concept.

Room D7.1

Optical Sensors

10:30–12:30
SeW2E • Micro- and Nano-Engineered Sensors II
Presider: Mario F.S. Ferreira; Universidade de Aveiro, Portugal

SeW2E.1 • 10:30 Invited
Nanobiophotonics using Light Robotics, Jesper Glückstad[1]; [1]*DTU Fotonik, Danmarks Teknishe Universitet, Denmark.* A confluence of developments is now ripe for the emergence of a new nano-research branch – *Light Robotics* – combining advances in microfabrication and optical micromanipulation together with intelligent control ideas from robotics and Fourier optics.

SeW2E.2 • 11:00
A Method for Demonstration of the Feasibility of InP as an All-optical Imaging Sensor, Yan Song[1,2], Bodong Peng[2], Qing Xu[2], Na Cao[2], Guzhou Song[2], Zhiqin Yue[2], Binkang Li[2], Hong-Xing Wang[1]; [1]*Xi'an Jiaotong Univ., China;* [2]*Northwest Inst. of Nuclear Technology, China.* The feasibility of InP as an all-optical image sensor with 1064 nm probe beams has been demonstrated with an optical method, in which two 532 nm interference beams have been employed to generate transient grating.

SeW2E.3 • 11:15
Demonstration of CAOS Smart Camera Imaging for Color and Super Blue Moon Targets, Nabeel A. Riza[1], Mohsin A. Mazhar[1]; [1]*Univ. College Cork, Ireland.* Highlighted is the CAOS smart camera design suited for extreme dynamic range sensing. Experiments for the first time show CAOS imaging of a visible band color target and the super blue moon observed in Ireland.

Room D3.2

Photonic Networks and Devices

Room D5.2

Signal Processing in Photonic Communications

Room D7.2

Specialty Optical Fibers

Room E1.1

Joint Integrated Photonics Research, Silicon, and Nano-Photonics/ Nonlinear Photonics

Room E1.2

Novel Optical Materials and Applications

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

10:30–12:30
NeW2F • Connecting the World
Presider: Michela Svaluto Moreolo; Ctr Tecnològic de Telecom de Catalunya, Spain

NeW2F.1 • 10:30 Keynote
Internet Connectivity for the World's 3.8 Billion Unconnected, Hamid Hemmati[1]; [1]*Facebook Inc., USA.* Given the earth's population distribution varies by up to three orders of magnitude, expanding access to reliable internet connectivity will require a diverse array of technologies, including terrestrial, aerial, and satellite solutions.

NeW2F.2 • 11:15
Enriching Intent-based SDN to Ease Customer Service Management in Transport Networks, Antonio Marsico[1], Mohit Chamania[2], Roberto Doriguzzi-Corin[1], Chris Matrakidis[3], Dimitrios Klonidis[3], Pontus Sköldström[4], Abdul Ghafoor[4], Stephane Junique[4], Victor Lopez[5], Domenico Siracusa[1]; [1]*FBK CREATE-NET, Italy;* [2]*ADVA Optical Networking SE, Germany;* [3]*Athens Information Technology (AIT), Greece;* [4]*RISE ICT/Acreo, Sweden;* [5]*Telefónica Global CTO, Spain.* Intent-based Software-Defined Networking can automate mapping of customer services to transport services. We demonstrate this using a multi-layer orchestrator that provisions a complex customer service over an IP/Optical testbed.

10:30–12:30
SpW2G • Optical Analog Signal Processing
Presider: Bert Offrein; IBM Research GmbH, Switzerland

SpW2G.1 • 10:30 Invited
Optical Signal Processing in InP Photonic Integrated Circuits, Ripalta Stabile[1]; [1]*Den Dolech 2, Technische Universiteit Eindhoven, Netherlands.* Signal processing in photonic integration requires radical change in component density and wiring complexity. Single- and multi-plane InP photonics are researched for fast pulse processing (analog capability) and Tb/s routing (digital capability).

SpW2G.2 • 11:00
Ultrafast Spectral Analysis based on Swept-pump Four-wave Mixing Bragg Scattering, Bowen Li[1], Yuan Wei[1], Jiqiang Kang[1], Chi Zhang[2], Kenneth Kin-Yip Wong[1]; [1]*Univ. of Hong Kong, Hong Kong;* [2]*Huazhong Univ. of Science and Technology, China.* Parametric spectro-temporal analyzer (PASTA) utilizing four-wave mixing Bragg scattering (FWM-BS) process has been experimentally demonstrated. 30-nm spectral measurement range has been realized with 0.05-nm resolution at tens-of-MHz frame rate.

SpW2G.3 • 11:15
Denoising Amplification of Arbitrary Optical Waveforms by Linear Coherent Energy Redistribution, Benjamin G. Crockett[1], Luis Romero Cortés[1], José Azaña[1]; [1]*INRS, Canada.* We present a linear-optics scheme for noiseless passive amplification of arbitrary waveforms, based on the temporal Talbot effect. We achieve amplification factors as high as 15, allowing for extraction of signals buried under noise.

10:30–12:30
SoW2H • Fiber Lasers IV
Presider: Peter Mosley; Univ. of Bath, UK

SoW2H.1 • 10:30 Invited
Record Powers from Single-mode Directly-diode-pumped Fiber Lasers, Thomas Schreiber[1]; [1]*Albert-Einstein Str 7, Fraunhofer IOF, Germany.* We present our investigations on modal instabilities using low-NA fiber with multi-kw single-mode output powers. Additionally guidelines are given to perform in-situ temperature and other laser parameters measurements correctly at these power levels.

SoW2H.2 • 11:00
Spectrally and Modally Selective Large Mode Area Fiber Coupler for High Power Applications, Derrek R. Drachenberg[1], Paul H. Pax[1], Matthew J. Cook[1], Robert P. Crist[1], Victor V. Khitrov[1], Leily S. Kiani[1], Nick Schenkel[1], Jian Liu[2], Michael J. Messerly[1], Jay W. Dawson[1]; [1]*Lawrence Livermore National Laboratory, USA;* [2]*Polaronyx, Inc., USA.* A large mode area fiber coupler based on multi-core spectrally and modally filtered transfer is presented. Relative coupling to the cross-port above 80% was measured. Only fundamental mode transfer was observed given a multimode launch.

SoW2H.3 • 11:15
Fabrication of Cladded Single Crystal Fibers for All-Crystalline Fiber Lasers, Brandon Shaw[1], Shyam Bayya[1], Woohong Kim[1], Jason D. Myers[1], Daniel Rhonehouse[1], Noor Qadri[1], Askins Charles[3], John Peele[3], Rajesh Thapa[3], Dan Gibson[1], Rafael Gattass[1], Joseph Kolis[2], Brad Stadelman[2], Jasbinder S. Sanghera[1]; [1]*US Naval Research Laboratory, USA;* [2]*Clemson Univ., USA;* [3]*KeyW, USA.* We report on fabrication and optical properties of crystalline cladded single crystal Yb:YAG fiber. Net gain has been demonstrated in the cladded Yb:YAG fiber structures

10:30–12:30
JW2I • Symposium: Microcomb Technology II
Presider: Gian-Luca Oppo; Univ. of Strathclyde, UK

JW2I.1 • 10:30
Synchronization of Microresonator Optical Frequency Combs, Jae K. Jang[1], Alexander Klenner[1], Xingchen Ji[1,2], Yoshitomo Okawachi[1], Michal Lipson[1], Alexander L. Gaeta[1]; [1]*Columbia Univ., USA;* [2]*Cornell Univ., USA.* We experimentally demonstrate passive synchronization of two modelocked microresonator optical frequency combs separated by a path exceeding 20 m of optical fiber. We show that the output temporal cavity solitons can be coherently combined.

JW2I.2 • 11:00 Invited
Compact High Precision Optical Reference Based on Trapped Ions, Mathias Keller[1]; [1]*Sussex House, Falmer, Univ. of Sussex, UK.* Using optical, ultra-narrow transitions in trapped ions, we develop a highly accurate, compact optical reference with a fractional frequency uncertainty of less than 10-15. With a rugged and compact design, the system will be truly portable.

10:30–12:30
NoW2J • Laser Materials and Photonics
Presider: Shekhar Guha; US Air Force Research Laboratory , USA

NoW2J.1 • 10:30 Invited
Ultra-Lightweight Membrane Lasers -- Laser Beams from the Eye?, Markus Karl[1], James M. E. Glackin[1], Marcel Schubert[1], Nils M. Kronenberg[1], Graham A. Turnbull[1], Ifor D. W. Samuel[1], Malte C. Gather[1]; [1]*North Haugh, Univ. of St Andrews, UK.* We report on thin organic distributed feedback lasers that offer ultralow-weight and excellent mechanical flexibility. The lasers can be transferred onto various substrates, e.g. a contact lens, where they can be used as security tag.

NoW2J.2 • 11:00 Invited
Latest Advances on Solution-processed Thin Film Organic Lasers, Maria A. Diaz-Garcia[1], Rafael Muñoz-Marmol[1], Victor Bonal[1], Marta Morales-Vidal[1], Jose M. Villalvilla[1], Eva M. Calzado[2], Carmen Vazquez[3], Pedro Boj[3], Jose Quintana[3]; [1]*Dpto. Física Aplicada and Instituto Universitario de Materiales de Alicante, Universidad de Alicante, Spain;* [2]*Ingenieria de Sistemas Y Teoria De La Señal And Instituto Universitario de Materiales de Alicante, Universidad de Alicante, Spain;* [3]*Óptica, Farmacología y Anatomía, Universidad de Alicante, Spain.* Latest advances from our research group towards improving the performance of solution-processed distributed feedback lasers will be discussed. They include advances on the laser material and the resonator and their application as optical sensors.

Room D1.1

Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials

Room E5

Integrated Photonics Research, Silicon, and Nano-Photonics

Room E3

Nonlinear Photonics

Room D1.2

Novel Optical Materials and Applications

Room D7.1

Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

BW2A • FBG for Sensing Applications—Continued

BW2A.4 • 11:30
Fabricating a Prototype Spectrometer Using a Large-Angle Direct UV-Written Chirped Tilted Grating, James W. Field[1], Matthew T. Posner[1], Sam A. Berry, Rex H. Bannerman[1], James C. Gates[1], Peter G. Smith[1]; [1]*Optoelectronics Research Center, UK.* A prototype planar waveguide spectrometer is fabricated with a large angle direct UV-written grating and a chirp of 140 nm. The grating focus translates by 1-2 μm/nm of input wavelength tuning, over a bandwidth of more than 200 nm

BW2A.5 • 11:45
Femtosecond Laser Written Superimposed Fiber Bragg Gratings for Strain Independent 3D Shape Sensing, Christian Waltermann[2,1], Alexander Doehring[2], Martin Angelmahr[2], Wolfgang Schade[2], Anna Lena Baumann[2]; [1]*Photonik Inkubator GmbH, Germany;* [2]*Fraunhofer Heinrich Hertz Inst., Germany.* Fiber Bragg gratings are inscribed around the edge of a standard single mode fiber core by femtosecond laser technology. By analyzing the back reflected light intensities, a novel and precise 3D shape sensor is realized.

BW2A.6 • 12:00 Invited
Fiber Bragg Grating Inscription in Multicore and Specialty Optical Fibers, Martin Becker[1], Tino Elsmann[1], Manfred W. Rothhardt[1]; [1]*Inst. of Photonic Technology, Germany.* Applications of Fiber Bragg gratings in spectroscopy and fiber lasers require fibers with increased étendue (beam parameter product), which affects filtering performance of the FBGs. Additionally, updated concepts of photosensitivity are required.

IW2B • Integrated Photonics Applications—Continued

IW2B.3 • 11:30
Integrated Photonic Residue Number System Arithmetic, Volker J. Sorger[1], Jiaxin Peng[1], Shuai Sun[1], Vikram K. Narayana[1], Tarek El-Ghazawi[1]; [1]*George Washington Univ., USA.* Here we show a residue number system (RNS) engine based on integrated nanophotonics. The digit-wise shifting in RNS arithmetic is expressed as spatial routing of an optical signal in 2x2 hybrid photonic-plasmonic switches.

IW2B.4 • 11:45
Bacterial Stress Monitoring with a SOI Optical Microcavity, Manon Tardif[1,2], Rita Therisod[3], Emmanuel Picard[1], Pierre R. Marcoux[1], Victor Gaude[2], Jean-Baptiste Jager[1], Romuald Houdré[3], Emmanuel Hadji[1], David Peyrade[2]; [1]*CEA Grenoble, France;* [2]*CNRS, France;* [3]*Physics, Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland.* We report on the on-chip real-time state monitoring of a single bacterium trapped with optical 1D microcavities. Through a 2-laser setup, this label-free approach allows to monitor bacteria stressed by antibacterial agent (antibiotics, temperature).

IW2B.5 • 12:00
Photonic Integrated Circuits for Nanoscopy, Jean-Claude Tinguely[1], Øystein Helle[1], David Coucheron[1], Firehun Dullo[1], Cristina Øie[1], Balpreet Ahluwalia[1]; [1]*UiT, The Arctic Univ. of Norway, Norway.* Photonic chips have the potential to cause a paradigm shift in super-resolution optical microscopy. Here we discuss geometry optimization of high refractive index waveguides for bioimaging and the implementation of super-resolution methods.

NpW2C • Spatiotemporal Phenomena I—Continued

NpW2C.4 • 11:30
Directional Random Laser by Combining Cavity-less Lasing and Spatial Solitons in Liquid Crystals, Sreekanth Perumbilavil[2], Armando Piccardi[1], Martti Kauranen[2], Gaetano Assanto[1,2]; [1]*Universita degli Studi Roma Tre, Italy;* [2]*photonics, Tampere Univ. of Technology, Finland.* Combining a reorientational spatial optical soliton with optical gain and scattering in dye-doped liquid crystals, we demonstrate that a random laser can emit a smooth laser beam in a well-defined direction.

NpW2C.5 • 11:45
Vibrations and Oscillations of Tri-soliton Molecules in a Mode-locked Fiber Laser, J. Igbonacho[1], Kanagaraj Nithyanandan[1], Katarzyna Krupa[1], Patrice Tchofo Dinda[1], Philippe Grelu[1]; [1]*Universite de Bourgogne Franche Comté, France.* We present numerical simulations highlighting internal oscillations and vibrations within tri-soliton molecules generated by a mode-locked fiber laser. We highlight major qualitative differences as compared to two-soliton molecules.

NpW2C.6 • 12:00
Spontaneous Light-mediated Magnetism in Cold Atoms, Ivor Kresic[1,2], Guillaume Labeyrie[3], Gordon Robb[1], Gian-Luca Oppo[1], Pedro Gomes[1], Paul Griffin[1], William Firth[1], Robin Kaiser[3], Thorsten Ackemann[1]; [1]*SUPA and Department of Physics, Univ. of Strathclyde, UK;* [2]*Croatian Cold Atoms Group, Insitute of Physics, Croatia;* [3]*Institut de Physique de Nice, Universite Cote d'Azur, France.* We study theoretically and experimentally an unconventional form of magnetism where interaction is mediated by photons reflected from a feedback mirror. We identify phases related to dipolar and quadrupolar magnetic ordering in the transverse plane.

NoW2D • Metasurfaces and Metamaterials II—Continued

NoW2D.4 • 11:30
Withdrawn

SeW2E • Micro- and Nano-Engineered Sensors II—Continued

SeW2E.4 • 11:30 Invited
Dielectric and Low-dimensional-materials Nanocavities for Non-linear Nanophotonics and Sensing, Stefan A. Maier[1]; [1]*Physics, Ludwig-Maximilians-Universität München, Germany.* We will discuss a variety of dielectric nanocavity geometries sustaining anapole or higher-order resonances, for applications in non-linear light generation and surface-enhanced spectroscopies.

SeW2E.5 • 12:00
Aluminum-doped Zinc Oxide Trench Hyperbolic Metamaterial as a Mid-infrared Sensing Platform, Evgeniy Shkondin[1], Taavi Repän[1], Andrei V. Lavrinenko[1], Osamu Takayama[1]; [1]*Danmarks Teknishe Universitet, Denmark.* We demonstrate enhancement of infrared absorption of 5 nm thick silica layer in nanotrench structures that function as hyperbolic metamaterials. Such structures can serve as a highly sensitive platform for mid-infrared absorption spectroscopy.

Room D3.2	Room D5.2	Room D7.2	Room E1.1	Room E1.2
Photonic Networks and Devices	Signal Processing in Photonic Communications	Specialty Optical Fibers	Joint Integrated Photonics Research, Silicon, and Nano-Photonics/ Nonlinear Photonics	Novel Optical Materials and Applications

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

NeW2F • Connecting the World—Continued

NeW2F.3 • 11:30 Invited

Bridging of Digital Divide, Andrew Forbes[1]; [1]*School of Physics, Univ. of Witwatersrand, South Africa.* The "digital divide" suggests poor connectivity in rural areas, which is both economic and geographic in nature. We offer a South African perspective on bridging this divide, and speculate what the network future in Africa might be.

NeW2F.4 • 12:00 Invited

Optical Networking Technologies in Support of 5G, Anna Tzanakaki[1,2], Markos Anastasopoulos[2], Dimitra Simeonidou[2]; [1]*Physics, National and Kapodistrian Univ. of Athens, Greece;* [2]*Univ. of Bristol, UK.* We propose an elastic optical-wireless 5G infrastructure supporting converged fronthaul and backhaul services. Its performance is evaluated in terms of energy consumption through a novel modelling framework.

SpW2G • Optical Analog Signal Processing—Continued

SpW2G.4 • 11:30

Modulation Format Conversion from BPSK and OOK to 8QAM, Hiroki Kishikawa[1], Nobuo Goto[1]; [1]*Tokushima Univ., Japan.* We propose a modulation format conversion method from BPSK and OOK to 8QAM by using coherent superposition in a DLI, XPM and XGM in an SOA. Numerical simulation reveals that error-free format conversion is achieved.

SpW2G.5 • 11:45

All-Optical Modulation Format Conversion From 8QAM to QPSK and OOK Using Optical Threshold Device and SOA, Masaki uetai[1], Hiroki Kishikawa[1], Nobuo Goto[1]; [1]*Tokushima Univ., Japan.* All-optical 8QAM to QPSK and OOK modulation format conversion is numerically demonstrated by using optical thresholder and self-phase modulation and gain saturation effects in an SOA. As a result, error-free conversion is achieved.

SpW2G.6 • 12:00 Invited

Image Sensor Communications for future ITS, Takaya Yamazato[1]; [1]*Inst. of Liberal Arts and Sciences, Nagoya Univ., Japan.* This article overviews image sensor communication (ISC), a subset of visible light communication (VLC) system that uses an image sensor as a reception device for VLC signals, and its application to future intelligent transport systems (ITS).

SoW2H • Fiber Lasers IV—Continued

SoW2H.4 • 11:30

Large Mode Area Thulium-doped Fully Aperiodic Large-pitch Fiber Laser, Dia Darwich[1], Baptiste Leconte[1], Romain Dauliat[1], Mostafa Sabra[1], Remi de Mollerat Du Jeu[1], Marie-Alicia Malleville[1], Raphael Jamier[1], Francois Gutty[2], Christian Larat[2], Eric Lallier[2], Kay Schuster[3], Philippe Roy[1]; [1]*Xlim, France;* [2]*Thales Research and Technology, France;* [3]*IPHT, Germany.* A slope efficiency of 31% has been obtained using thulium-doped rod-type fully aperiodic large-pitch fiber with 40 µm core diameter synthesized using the REPUSIL technology. The M^2 measurement shows a value of 1.45.

SoW2H.5 • 11:45

Random Scattering and Optimization for Phase Control of a Laser Beam Array, Jérémy Saucourt[1,2], Paul Armand[1], Vincent Kermene[1], Agnès Desfarges-Berthelemot[1], Alain J. Barthelemy[1]; [1]*XLIM Research Insititute, France;* [2]*CILAS, France.* A laser beam array, whose phase relationships must be controlled, propagates through a device with random transmission. The resulting speckle pattern provides data to an innovative optimization process leading to efficient and fast phase locking.

SoW2H.6 • 12:00

Experimental and Theoretical Investigation of the Operating Principles of the Figure-9 laser, Ivan Cardea[1], Svyatoslav Kharitonov[1], Camille-Sophie Bres[1]; [1]*Ecole Polytechnique Fédérale de Lausanne (EPFL), Photonic Systems Laboratory, STI-IEL, Switzerland.* We present a theoretical vectorial model, validated by experimental measurements, describing the dependence of the Figure-9 laser output power, operating in continuous wave, on the coupling ratio of the directional coupler.

JW2I • Symposium: Microcomb Technology II—Continued

JW2I.3 • 11:30

16 Gb/s Microring-to-Microring Photonic Link in 45 nm Monolithic Zero-Change CMOS, Marco Eppenberger[1], David Moor[1], Arne Josten[1], Benedikt Baeuerle[1], Luca Benini[1], Juerg Leuthold[1], Luca Alloatti[1]; [1]*ETH Zurich, Switzerland.* We show a two-fold data-rate improvement for chip-to-chip links in the 45nm node. Both modulator and photodiode consist of microring resonators (MRRs). At the relevant working point, the MRR photodiode shows a ten-fold bandwidth increase.

JW2I.4 • 11:45

Pushing Integrated Semiconductor Disk Lasers Towards 100-fs Pulses, Jacob Nuernberg[1], Cesare Alfieri[1], Dominik Waldburger[1], Matthias Golling[1], Ursula Keller[1]; [1]*ETH Zurich, Switzerland.* We present an optically pumped modelocked integrated external-cavity surface-emitting laser generating pulses as short as 139 fs. The semiconductor laser chip is designed and optimized for dual-comb spectroscopy applications at 1030 nm.

JW2I.5 • 12:00

Microresonator Solitons for Astronomical Spectrometer Calibration, Ewelina Obrzud[1,2], Monica Rainer[3], Avet Harutyunyan[4], Miles Anderson[5], Junqui Liu[5], Michael Geiselmann[5,6], Bruno Chazelas[2], Stefan Kundermann[1], Steve Lecomte[1], Massimo Cecconi[4], Adriano Ghedina[4], Emilio Molinari[4,7], Francesco Pepe[2], Francois Wildi[2], Francois Bouchy[2], Tobias J. Kippenberg[5], Tobias Herr[1]; [1]*Swiss Cent for Electronics and Microtech, Switzerland;* [2]*Univ. of Geneva, Switzerland;* [3]*Observatory Brera / INAF, Italy;* [4]*Fundacion Galileo Galilei / INAF, Spain;* [5]*EPFL, Switzerland;* [6]*Ligentec, Switzerland;* [7]*Observatory Cagliari / INAF, Italy.* Absolute calibration of an astronomical spectrometer is demonstrated via a microresonator-soliton frequency comb. This novel approach achieves a precision of 25 cm/s without spectral filtering and is relevant to searches for Earth-like planets.

NoW2J • Laser Materials and Photonics—Continued

NoW2J.3 • 11:30 Invited

Flexible and Stretchable Integrated Microphotonics, Lan Li[1], Hongtao Lin[1], Shutao Qiao[2], Yizhong Huang[1], Junying Li[1], Jerome Michon[1], Carlos Alosno-Ramos[3], Laurent Vivien[3], Anupama Yadav[4], Kathleen Richardson[4], Nanshu Lu[2], Juejun Hu[1], Tian Gu[1]; [1]*Massachusetts Inst. of Technology, USA;* [2]*Univ. of Texas at Austin, USA;* [3]*Univ. of Paris Sud, France;* [4]*Univ. of Central Florida, USA.* Integrated flexible and stretchable photonics are presented. Key innovations are monolithic multimaterial integration and advanced micromechanical designs, enabling devices with extreme mechanical flexibility and excellent optical performance.

NoW2J.4 • 12:00

All-protein 3D Coffee Stain Lasers, Itir Bakis Dogru[1], Cagla Kosak Soz[1], Daniel Aaron Press[1], Rustamzhon Melikov[1], Efe Begar[1], Deniz Conkar[1], Elif Nur Firat Karalar[1], Emel Yilgor[1], Iskender Yilgor[1], Sedat Nizamoglu[1]; [1]*Koc Univ., Turkey.* The transition from a 2D to 3D coffee stain that has a well-defined and hollow sphere-like structure is demonstrated. Self-assembled all protein lasers are constructed by 3D coffee stains.

Wednesday, 4 July

Room D1.1	Room E5	Room E3	Room D1.2	Room D7.1
Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials	Integrated Photonics Research, Silicon, and Nano-Photonics	Nonlinear Photonics	Novel Optical Materials and Applications	Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

BW2A • FBG for Sensing Applications—Continued

IW2B • Integrated Photonics Applications—Continued

IW2B.6 • 12:15
Mapping Photonic Random Walks on a Flexible Waveguide Array, James Grieve[1], Kian Fong Ng[1], Manuel Rodrigues[2], José Viana-Gomes[2,3], Alexander Ling[1,3]; [1]*Centre for Quantum Technologies, Singapore;* [2]*Centre for Advanced 2D Materials and Graphene Research Centre, National Univ. of Singapore, Singapore;* [3]*Department of Physics, National Univ. of Singapore, Singapore.* We reconstruct the evolution of a photonic random walk by tuning the coupling coefficient of an optical lattice. This method is compatible with weak and nonclassical light sources, and is enabled by a flexible polymer waveguide platform.

NpW2C • Spatiotemporal Phenomena I—Continued

NpW2C.7 • 12:15
Imperfect Symmetry Breaking, Bruno Garbin[1], Julien Fatome[2], Yadong Wang[1], François Leo[3], Gian-Luca Oppo[4], Stuart Murdoch[1], Miro J. Erkintalo[1], Stephane Coen[1]; [1]*Univ. of Auckland, New Zealand;* [2]*Université de Bourgogne Franche-Comté, France;* [3]*Université Libre de Bruxelles, Belgium;* [4]*Univ. of Strathclyde, UK.* By considering a nonlinear cavity driven by an elliptically polarized beam, we study experimentally the robustness of spontaneous symmetry breaking to controlled asymmetries. In particular, we reveal that different asymmetries can balance each other.

NoW2D • Metasurfaces and Metamaterials II—Continued

SeW2E • Micro- and Nano-Engineered Sensors II—Continued

SeW2E.6 • 12:15
Microbubble and Disc Resonators as Physical Sensors, Maria Aymerich[1], Gabriele Frigenti[2,3], Daniele Farnesi[2], Alessandro Cosci[2,4], Matteo Cerminara[5], Stefano Pelli[2], Giancarlo C. Righini[2,4], Gualtiero Nunzi Conti[2], Maite Flores-Arias[1], Silvia Soria[2]; [1]*Photonics4Life Research Group, Universidade de Santiago de Compostela, Spain;* [2]*Ist di Fisica Applicata Nello Carrara, Italy;* [3]*LENS-Laboratorio Europeo di Spettroscopia Nonlineare , Italy;* [4]*Museo Storico della Fisica e Centro Studi e Ricerche "E.Fermi", Italy;* [5]*INGV-Istituto Nazionale di Geofisica e Vulcanologia, Italy.* We report on physical sensors based on microbubble and micro-disc whispering gallery mode resonators. We characterized the resonators, improved the mitigation of fluctuations, and developed a pressure, temperature and THz bolometer.

12:30–14:00 Lunch *(on own)*

Room D3.2	Room D5.2	Room D7.2	Room E1.1	Room E1.2
Photonic Networks and Devices	Signal Processing in Photonic Communications	Specialty Optical Fibers	Joint Integrated Photonics Research, Silicon, and Nano-Photonics/ Nonlinear Photonics	Novel Optical Materials and Applications

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

NeW2F • Connecting the World—Continued

SpW2G • Optical Analog Signal Processing—Continued

SoW2H • Fiber Lasers IV—Continued

SoW2H.7 • 12:15
Enhancing Mode Stability of Higher Order Modes in a Multimode Fiber, Aamir Gulistan[1], Souvik Ghosh[1], Siddharth Ramachandran[2], B. M. A Rahman[1]; [1]*City Univ. of London, UK;* [2]*College of Engineering, Boston Univ., USA.* An innovative strategy to increase the modal stability of the higher order modes of multimode fiber is proposed where the modal stability is increased by more than 80% between LP_{05} and its neighboring antisymmetric modes.

JW2I • Symposium: Microcomb Technology II—Continued

JW2I.6 • 12:15
Dual-Comb Spectroscopy around 2 µm Based on Intensity Modulators and Parametric Conversion, Alexandre Parriaux[1], Kamal Hammani[1], Guy Millot[1]; [1]*Université de Bourgogne, France.* We experimentally demonstrate a novel approach of generating frequency combs in a highly nonlinear fiber. Using fourth-order modulation instability, we converted around 2 µm two mutually coherent frequency combs to perform CO_2 spectroscopy.

NoW2J • Laser Materials and Photonics—Continued

NoW2J.5 • 12:15
A Physically Transient Distributed Feedback Laser for Highly Efficient Chemosensing, Muhammad Umar[1], Biswajit Roy[1], Kyungtaek Min[2], Sunghwan Kim[1]; [1]*Ajou Univ., South Korea;* [2]*Nano-Optical Engineering, Korea Polytechnic Univ., South Korea.* We report a physically transient distributed feedback laser using silk protein and its chemosensing application detecting hazard hydrogen chloride vapor efficiently by the attenuation of lasing signal.

12:30–14:00 Lunch *(on own)*

Room D1.1	Room E5	Room E3	Room D1.2	Room D7.1
Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials	Integrated Photonics Research, Silicon, and Nano-Photonics	Nonlinear Photonics	Novel Optical Materials and Applications	Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

14:00–16:00
BW3A • Symposium: Innovative Grating-components and Grating-configurations for Fiber Lasers I
Presider: Martin Bernier; Universite Laval, Canada

BW3A.1 • 14:00 Invited
New Perspectives for Mid-infrared Fiber Lasers, Real Vallee[1], Martin Bernier[1], Vincent Fortin[1], Frédéric Maes[1], Yigit O. Aydin[1], Simon Duval[1], Pascal Paradis[1], Frédéric Jobin[1], Jean-Christophe Gauthier[1], Louis-Rafael Robichaud[1]; [1]*Centre D'optique Photonique, Universite Laval, Canada.* The latest achievements in terms of spectral coverage and output power from both cw and pulsed Mid-infrared fiber lasers are presented with special emphasis on their key components as well as their possible applications.

BW3A.2 • 14:30
In-Fibre Polarizer for Mid-Infrared Fibre Lasers Based on 45° Tilted Fluoride Fibre Bragg Grating, Gayathri Bharathan[1], Robert Woodward[1], Darren Hudson[1], Stuart Jackson[1], Alex Fuerbach[1]; [1]*Macquarie Univ., Australia.* We report the femtosecond laser inscription of a 45° tilted fibre Bragg grating (TFBG) into ZBLAN fibre. Integrating this TFBG into a mid-IR fibre laser cavity resulted in 20.5 dB output polarization extinction ratio.

14:00–16:00
IW3B • Modulators
Presider: Jonathan Klamkin; Univ. of California Santa Barbara, USA

IW3B.1 • 14:00 Invited
Integrated, Thin Film, High Bandwidth Modulators for 5G Wireless Communication Systems, Dennis W. Prather[1], Andrew Mercante[1], Shouyuan Shi[1], Peng Yao[2]; [1]*Elect. & Comp. Eng. Dept., Univ. of Delaware, USA;* [2]*Phase Sensitive Innovations, Inc, USA.* This paper's focus is on a standalone crystal ion sliced (CIS) lithium niobate phase modulator. Simulated and experimental results are shown; indicating functionality across the entire millimeter wave spectrum (DC to 305 GHz).

IW3B.2 • 14:30
110 Attojoule-per-bit Graphene Plasmon Modulator on Silicon, Rubab Amin[1], Sikandar Khan[1], Cheol J. Lee[2], Hamid Dalir[3], Volker J. Sorger[1]; [1]*George Washington Univ., USA;* [2]*Korea Univ., South Korea;* [3]*Omega Optics Inc., USA.* We demonstrate a plasmonic Graphene-based electro-absorption modulator integrated in Silicon photonics consuming 110 aJ/bit and being 15 mm compact. We show how the plasmonic metal enables steep switching via improved contact resistance.

14:00–16:00
NpW3C • Nonlinear Dielectric Nanostructures
Presider: Thomas Zentgraf; Universität Paderborn, Germany

NpW3C.1 • 14:00
Ultraviolet Mie Resonances from $LiNbO_3$ Nanocubes for Enhancing Nonlinear Signals, Flavia Timpu[1], Joan Sendra Garcia[1], Maria Teresa Buscaglia[2], Vincenzo Buscaglia[2], Rachel Grange[1]; [1]*ETH Zürich, Switzerland;* [2]*Inst. of Condensed Matter Chemistry and Technologies for Energy, National Research Council, Italy.* We show that $LiNbO_3$ nanocubes fabricated by solvothermal synthesis are efficient scatterers and SHG emitters in the near-UV, with efficiencies of 10^{-9} at 350 nm. These $LiNbO_3$ nanocubes are a novel material for near-UV applications.

NpW3C.2 • 14:15
Dielectric Nanoparticles Excited at Telecom Wavelengths as Multiharmonic Multicolor Sources, Gabriel Campargue[1], Jeremy Riporto[2,1], Ronan Le Dantec[2], Yannick Mugnier[2], Jean-Pierre Wolf[1], Luigi Bonacina[1]; [1]*Applied Physics, Univ. of Geneva, Switzerland;* [2]*SYMME, Université Savoie Mont Blanc, France.* We demonstrate the simultaneous generation of more than four harmonics from individual dielectric nanoparticles excited by a telecom fiber laser at 1560. We discuss the possibility to control their relative intensities by the laser polarization.

NpW3C.3 • 14:30
Non-radiating Modes for Tunable Second Harmonic Generation in AlGaAs Nanodimers, Davide Rocco[1], Valerio F. Gili[2], Lavinia Ghirardini[3], Luca Carletti[1], Ivan Favero[2], Andrea Locatelli[1,4], Giuseppe Marino[2,5], Dragomir N. Neshev[5], Michele Celebrano[3], Marco Finazzi[3], Giuseppe Leo[2], Costantino De Angelis[1,4]; [1]*Department of Information Engineering, Università degli Studi di Brescia, Italy;* [2]*Matériaux et Phénomènes Quantiques, Université Paris Diderot, France;* [3]*Department of Physics, Politecnico di Milano, Italy;* [4]*National Inst. of Optics, Italy;* [5]*Nonlinear Physics Centre, The Australian National Univ., Australia.* We demonstrate a 5-fold enhancement of second harmonic generation efficiency and control on polarization of thereby generated photons exploiting the near-field coupling between electric and toroidal dipole modes in AlGaAs nanodimers.

14:00–16:00
NoW3D • Plasmonics
Presider: Ho Wai Lee; Baylor Univ., USA

NoW3D.1 • 14:00 Keynote
Charge Transfer in Nanoplasmonics as an Avenue for Control of Chemical SERS Enhancement and Molecular Self-assembly, Stefan A. Maier[1]; [1]*Physics, Ludwig-Maximilians-Universität München, Germany.* We will demonstrate applications of plasmonic charge transfer such as control over chemical SERS enhancement, to locally induce chemical reactions in reactivity hot spots of nanoantennas and to facilitate designer molecular self-assembly.

14:00–16:00
SeW3E • Optical Fiber Sensors II
Presider: Pengfei Wang; Harbin Engineering Univ., China

SeW3E.1 • 14:00
Fabrication and Characterization of Side-Polished Fiber Coupler for Mid-Infrared Applications, Yung Kim[1], Kwang Jo Lee[1]; [1]*Kyung Hee Univ., South Korea.* Fabrication and characterization of the side-polished optical fiber couplers operating in the mid-infrared spectrum are presented. The technique relies on the directional coupling between two stands of single-mode indium fluoride fibers.

SeW3E.2 • 14:15
Photonic Crystal Fiber based Magnetic Field Sensor Realizing Mach Zehnder Interference, Ananya Jana[1], Gaurav Sharma[1], Anand M. Shrivastav[1], Abhishek s. Rathore[1], Rajan Jha[1]; [1]*Indian Inst of Technology, Bhubaneswar, India.* Mach-Zehnder interference based fiber optic magnetic field sensor using photonic crystal fiber has been reported. The sensor works for the magnetic field range from 0 to 200 gauss with a sensitivity of about 8.48 pm/gauss.

SeW3E.3 • 14:30
Helically Twisted Seven-Core Fiber Based Optical Sensors, Zhifang Wu[2,1], Hailiang Zhang[1,3], Perry P. Shum[1,3], Xuguang Shao[1], Zhilin Xu[1,3]; [1]*Nanyang Technological Univ., Singapore;* [2]*College of Information Science and Engineering, Fujian Key Laboratory of Light Propagation and Transformation, China;* [3]*COFT, School of EEE, NTU, Singapore.* In this paper, we will present our recent works on sensors based on helical-structured seven-core fiber, including the principle, fabrication and as well as their performance of ultra-sensitive strain and directional torsion measurements.

Room D3.2

Photonic Networks and Devices

Room D5.2

Signal Processing in Photonic Communications

Room D7.2

Specialty Optical Fibers

Room E1.1

Joint Integrated Photonics Research, Silicon, and Nano-Photonics/ Nonlinear Photonics

Room E1.2

Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

14:00–16:00
NeW3F • Optical Network Design and Optimization
Presider: Anna Tzanakaki; Univ. of Athens, Greece

NeW3F.1 • 14:00 Invited

Cost Savings for Low Design Margins in WDM Elastic Networks, Jelena Pesic[1], Thierry Zami[2], Nicola Rossi[1]; [1]*Nokia, Bell Labs France, Nokia Corporation, France;* [2]*Nokia, France.* We illustrate the cost savings during 10-year life of a core WDM network enabled by elastic transponders when accounting for low design margins which are progressively growing with ageing, compared to end-of-life OSNR margins.

NeW3F.2 • 14:30 Invited

Programmable Optical Transmission Systems in the Hyperconnectivity Era: A Synergy of Photonic Technologies and Software-Defined Networking, Michela Svaluto Moreolo[1], Josep M. Fabrega[1], Laia Nadal[1]; [1]*Centre Tecnològic de Telecomunicacions de Catalunya (CTTC/ CERCA), Spain.* Photonic technologies and SDN are key to support hyperconnectivity in a globally-networked society. We present transmission systems based on SDN-enabled transceivers addressing this challenge. Programmability and technological aspects are discussed.

14:00–15:15
SpW3G • High Symbol Rate Systems
Presider: Son Le; Nokia Bell Labs, USA

SpW3G.1 • 14:00 Invited

DSP for Ultra-high Baud Rate Direct Detection Systems, Sebastian Randel[1]; [1]*Engesserstr 5, Karlsruhe Inst. of Technology, Germany.* We discuss how digital signal processing (DSP) can be utilized in the design of cost and power-efficient inter-datacenter optical communication links with direct detection at high symbol rates. We compare different receiver architectures including balanced detection and Kramers-Kronig detection with intradyne coherent receivers.

SpW3G.2 • 14:30 Invited

Signal Processing for High Symbol Rate Transmission: Challenges and Opportunities, Robert Maher[1]; [1]*OSG, Infinera Corporation, USA.* As commercial system vendors begin to introduce line cards with symbol rates approaching 70 GBd, we review the current challenges and opportunities associated with this unabated demand for ever increasing net data rates per wavelength.

14:00–16:00
SoW3H • Advanced Characterization and Processing Techniques
Presider: John Canning; Univ. of Sydney, Australia

SoW3H.1 • 14:00 Invited

Closed-loop Controlled Brillouin Optical Time-domain Analysis, Luc Thevenaz[1], Zhisheng Yang[1]; [1]*Group for Fibre Optics, Ecole Polytechnique Fédérale de Lausanne, Switzerland.* A novel concept to retrieve information in Brillouin distributed fiber sensors is presented, in which the interacting signals are conditioned to track a uniform gain along the fiber, showing 100x faster acquisition at similar accuracy.

SoW3H.2 • 14:30

Ultra-low Background Raman Sensing using a Negative-curvature Fibre, Stephanos Yerolatsitis[1], Fei Yu[1], Sarah McAughtrie[2], Michael G. Tanner[3], Holly Fleming[2], James Stone[1], Colin J. Campbell[2], Tim A. Birks[1], Jonathan C. Knight[1]; [1]*Univ. of Bath, UK;* [2]*Univ. of Edinburgh, UK;* [3]*Heriot-Watt Univ., UK.* We demonstrated hollow core negative curvature fibres (NCFs) for Raman sensing. The background Raman emission from the silica in the NCF was at least 1000x smaller than in a conventional solid fibre while maintaining the same collection efficiency.

14:00–16:00
JW3I • Symposium: Microcomb Technology III
Presider: David Moss; Swinburne Univ., Australia

JW3I.1 • 14:00 Invited

Linear and Nonlinear Mode Coupling in Microresonator Frequency Comb Generation, Xiaoxiao Xue[1]; [1]*30 Shuangqing Rd, Haidian Qu, Tsinghua Univ., China.* The Kerr comb dynamics in microresonators can be severely affected by linear and nonlinear mode coupling, providing a tool to enable comb generation in the normal dispersion region which is originally prohibited.

JW3I.2 • 14:30

Self-locking of the Frequency Comb Repetition Rate in Microring Resonators with Higher Order Dispersions, Dmitry V. Skryabin[1,2], Y Kartashov[1]; [1]*Univ. of Bath, UK;* [2]*ITMO Univ., Russia.* We predict that the free spectral range (FSR) of the soliton combs in microring resonators can self-lock through the back-action of the Cherenkov dispersive radiation on its parent soliton under the conditions typical for recent experiments on the generation of the octave wide combs.

14:00–16:00
SeW3J • Terahertz Sensing I
Presider: Hou-Tong Chen; Los Alamos National Laboratory, USA

SeW3J.1 • 14:00 Invited

Non-perturbative THz Sub-cycle Nonlinearities: From Atomically Strong Fields to Vacuum Fields, Christoph Lange[1], F. Langer[1], T. Maag[1], M. Mootz[2], U. Huttner[2], M. Kira[3], S. W. Koch[2], D. Bougeard[1], R. Huber[1]; [1]*Universität Regensburg, Germany;* [2]*Univ. of Marburg, Germany;* [3]*Univ. of Michigan, USA.* We investigate non-perturbative sub-cycle THz nonlinearities across extreme scale of electric field amplitudes: from atomically strong fields facilitating dynamical Bloch oscillations, to quantum vacuum fluctuations driving light-matter interactions.

SeW3J.2 • 14:30 Invited

Linear and Nonlinear Optics of Switchable Terahertz Metasurfaces, Nicholas Karl[1], George Keiser[1], Martin Heimbeck[2], Henry Everitt[2], Hou-Tong Chen[3], Antoinette J. Taylor[3], Igal Brener[4], John L. Reno[4], Daniel M. Mittleman[1]; [1]*School of Engineering, Brown Univ., USA;* [2]*Redstone Arsenal, US Army AMRDEC, USA;* [3]*Los Alamos National Laboratory, USA;* [4]*Sandia National Laboratories, USA.* We present experimental studies of the linear and nonlinear optical response of switchable terahertz metasurfaces, using terahertz ellipsometry and nonlinear transmission spectroscopy with intense THz pulses.

Room D1.1	Room E5	Room E3	Room D1.2	Room D7.1
Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials	Integrated Photonics Research, Silicon, and Nano-Photonics	Nonlinear Photonics	Novel Optical Materials and Applications	Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

BW3A • Symposium: Innovative Grating-components and Grating-configurations for Fiber Lasers I—Continued

BW3A.3 • 14:45
Optimization of Fluoride FBGs for Efficient Lasing at 3.5 µm, Frédéric Maes[1,2], Vincent Fortin[1,2], Martin Bernier[1,2], Real Vallee[1,2]; [1]*Universite Laval, Canada;* [2]*Centre d'optique, photonique et laser, Canada.* We report the design characteristics, and performances, of the FBGs bounding the first monolithic all-fiber laser at 3.55 µm that generates a record output power above 5W in continuous operation.

BW3A.4 • 15:00
Femtosecond Pulse Inscription of FBGs in Multicore Fibers for Applications in Sensors and Lasers, Alexander Dostovalov[1,2], Alexey A. Wolf[1,2], Mikhail I. Skvortsov[1,2], Sofia R. Abdullina[1], Alexander A. Vlasov[1], Ivan A. Lobach[1,2], Sergey A. Babin[1,2]; [1]*Inst. of Automation and Electrometry, Russia;* [2]*Novosibirsk State Universtiy, Russia.* In this paper, we present the results of femtosecond point-by-point inscription of fiber Bragg gratings in different cores of multicore fibers for applications in 3D shaping sensors, Raman and random fiber lasers based on dual-core fiber.

BW3A.5 • 15:15
Suppression of Parasitic Lasing Effects in Fiber Laser Amplifiers using Long Period Gratings, Maximilian Heck[1], Jean-Christophe Gauthier[2], Real Vallee[2], Andreas Tünnermann[1,3], Stefan Nolte[1,3], Martin Bernier[2]; [1]*Friedrich-Schiller-Univ. Jena, Germany;* [2]*COPL, Université Laval, Canada;* [3]*Fraunhofer IOF, Germany.* A concept to mitigate parasitic lasing effects in fiber amplifiers by means of efficient femtosecond inscribed long period gratings is shown.

IW3B • Modulators—Continued

IW3B.3 • 14:45
Dielectric Layers in Plasmonic-Organic Hybrid Modulators, Wolfgang Heni[1], Christian Haffner[1], Raphael Cottier[1], Yuriy Fedoryshyn[1], Delwin L. Elder[2], Larry R. Dalton[2], Juerg Leuthold[1]; [1]*ETH Zurich, Switzerland;* [2]*Department of Chemistry, Univ. of Washington, USA.* We investigate the applicability of nm-thin dielectric layers—as often used in macroscopic devices—to increase nanoscale-device nonlinearities. We show that modulator performances can be improved by a factor >2, compared to low-index dielectrics.

IW3B.4 • 15:00
Low Voltage, High Optical Power Handling, Bulk GaAs/AlGaAs Electro-optic Modulators, Prashanth Bhasker[1], Justin Norman[1], John Bowers[1], Nadir Dagli[1]; [1]*Univ. of California Santa Barbara, USA.* AlGaAs electro-optic modulators with V_π=1.1V are reported. Bandgap in the device is larger than twice the photon energy at 1550nm eliminating material absorption, including two-photon absorption, making these devices ideal for analog photonic links.

IW3B.5 • 15:15
Silicon-photonic Electro-optic Modulators based on Graphene and Epsilon-near-zero Materials, Georgios Sinatkas[1], Thomas Christopoulos[1], Odysseas Tsilipakos[2], Emmanouil E. Kriezis[1]; [1]*Electrical and Computer Engineering, Aristotle Univeristy of Thessaloniki, Greece;* [2]*Inst. of Electronic Structure and Laser Foundation for Research and Technology Hellas, Greece.* Silicon-photonic modulators are investigated, integrating either graphene or epsilon-near-zero films, tuned by the field effect. Both waveguide and resonance modulation schemes are demonstrated, allowing for compact, efficient, and broadband designs.

NpW3C • Nonlinear Dielectric Nanostructures—Continued

NpW3C.4 • 14:45
Resonant Harmonic Generation in AlGaAs Nanoantennas using Structured Light., Rocio Camacho-Morales[3], Godofredo Bautista[2], Xiaorun Zang[2], Lei Xu[3], Léo Turquet[2], Andrey Miroshnichenko[3], Hark Hoe Tan[1], Aristeidis Lamprianidis[3], Mohsen Rahmani[3], Chennupati Jagadish[1], Dragomir N. Neshev[3], Martti Kauranen[2]; [1]*Department of Electronic Materials Engineering, Australian National Univ., Australia;* [2]*Tampere Univ. of Technology, Laboratory of Photonics, Finland;* [3]*Nonlinear Physics Centre, Australian National Univ. , Australia.* We employ structured light to study resonantly-enhanced second- and third-harmonic emission from AlGaAs nanoantennas. We demonstrate correlation between nonlinear emissions with the pump polarization state and Mie-resonant excitation.

NpW3C.5 • 15:00
Wavelength Dependence of the Second-Order Nonlinear Susceptibility of Harmonic Nanoparticles, Jeremy Riporto[1,2], Mathias Urbain[1], Yannick Mugnier[1], Luigi Bonacina[2], Ronan Le Dantec[1]; [1]*Univ. Savoie Mont Blanc, France;* [2]*Université de Genève, Switzerland.* A tunable wavelength Hyper Rayleigh Scattering setup was developed to assess and compare Second Harmonic Scattering from Lithium Niobate, Zinc Oxide and Bismuth Ferrite nanocrystal suspensions in the 730-1150 nm excitation range.

NpW3C.6 • 15:15
Dielectric Metasurfaces for Unconventional Polarisation Control, Shaun Lung[1], Kai Wang[1], Andrey A. Sukhorukov[1]; [1]*Australian National Univ., Australia.* We establish that complex birefringence can be efficiently realised with all-dielectric metasurfaces without material losses, enabling new polarisation control regimes for unconventional interference and measurements of classical and quantum light.

NoW3D • Plasmonics—Continued

NoW3D.2 • 14:45
Plasmonic Resonators for High-speed Communication, Christian Haffner[1], Daniel Chelladurai[1], Lukas Juchli[1], Yuriy Fedoryshyn[1], Juerg Leuthold[1]; [1]*ETH Zurich, Switzerland.* We discuss fundamentals and fabrication of integrated plasmonic Fabry-Pérot and ring resonators used for electro-optic modulation. The ring resonator's ability to bypass loss and its simplicity in fabrication gives clear preference to those.

NoW3D.3 • 15:00
Multiresonant Antennas for Polarization Control, Eva De Leo[1], Ario Cocina[1], Preksha Tiwari[1], Lisa Poulikakos[1], Patricia Marqués Gallego[1], Boris le Feber[1], David Norris[1], Ferry Prins[2,1]; [1]*ETH Zurich, Switzerland;* [2]*Universidad Autonoma de Madrid, Spain.* Multiresonant plasmonic and quantum-dot bull's-eye antennas that map polarization states onto spectrally dependent beaming conditions are introduced. We show how this form of structured light enables advanced concepts for displays and spectroscopy.

NoW3D.5 • 15:15
Enhanced Spin Splitting of Laguerre-Gaussian Beams by Surface Plasmon Resonance, Linqing Zhuo[1], Mengjiang Jiang[1], Wenguo Zhu[1], Heyuan Guan[1], Jianhui Yu[1], Huihui Lu[1], Yunhan Luo[1], Jun Zhang[1], Zhe Chen[1]; [1]*Jinan Univ., China.* We investigate the spin splitting of reflected Laguerre-Gaussian beams while the surface plasmon resonance is excited. The spin splitting can be controlled by the incident linear polarization, and can reach 35.78µm for incident OAM *ı=3.*

SeW3E • Optical Fiber Sensors II—Continued

SeW3E.4 • 14:45
Simple Multi-core Optical Fiber Accelerometer, Joel Villatoro[1,2], Oskar Arrizabalaga[1], Mikel Diez[1], Eneko Arrospide[1], Enrique Antonio-Lopez[3], Joseba Zubia[1], Axel Schulzgen[3], Rodrigo Amezcua Correa[3]; [1]*Univ. of the Basque Country (UPV/EHU), Spain;* [2]*IKERBASQUE -Basque Foundation for Science, Spain;* [3]*CREOL, The College of Optics & Photonics, Univ. of Central Florida, USA.* We report on a compact accelerometer built with strongly coupled multi-core optical fiber. The device was placed in cantilever position. An ultra-miniature seismic mass was used to tune the device sensitivity and operating frequency range.

SeW3E.5 • 15:00
Fiber Optical Multifunctional Human-machine Interface for Motion Capture and Contact Pressure Monitoring, Yi Jiang[1], Vladislav Reimer[1], Martin Angelmahr[2], Tobias Schossig[3], Wolfgang Schade[1,2]; [1]*Inst. of Energy Research and Physical Technologies, Clausthal Univ. of Technology, Germany;* [2]*Fraunhofer HHI, Germany;* [3]*MIOPAS GmbH, Germany.* A compact and wireless multifunctional human-machine interface based on fiber Bragg gratings will be presented. The interface is integrated within a glove and enables the motion capture of a human hand with gesture and contact pressure detection.

SeW3E.6 • 15:15
Fiber-optic Ultrasonic Transducer Achieved at the Side-wall of Optic Fiber using Coreless Fiber, Jiajun Tian[1], Shaobo Ji[1], Yong Yao[1]; [1]*Harbin Inst. of Technology, China.* This paper presents a simple ultrasound transducer using cladding mode in the sidewall of optic fiber by splicing one section coreless fiber with single mode fibers. The simulation and experiment of this transducer is discussed.

Room D3.2	Room D5.2	Room D7.2	Room E1.1	Room E1.2
Photonic Networks and Devices	Signal Processing in Photonic Communications	Specialty Optical Fibers	Joint Integrated Photonics Research, Silicon, and Nano-Photonics/ Nonlinear Photonics	Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

NeW3F • Optical Network Design and Optimization—Continued

NeW3F.3 • 15:00
Profitable Deployment of Regenerators as Traffic Grows in WDM Elastic Networks featuring 32/64 GBaud Carriers, Thierry Zami[1], Jelena Pesic[1], Annalisa Morea[1], Bruno Lavigne[1]; [1]*Nokia Corporation, France.* We investigate the progressive regenerator deployment throughout traffic growth in two WDM core networks, by illustrating how this strategy is more profitable with 64 GBaud Elastic Optical Transponders (EOT) than with 32 GBaud EOTs

NeW3F.4 • 15:15
Routing, Modulation Format, Spectrum and Core Allocation in SDM Networks Based on Programmable Filterless Nodes, Vahid Abedifar[1], Marija Furdek[2], Ajmal Muhammad[2], Mohammad Eshghi[1], Lena Wosinska[2]; [1]*Faculty of Electrical Engineering, Department of Electronics, Shahid Beheshti Univ., Iran ;* [2]*School of Electrical Engineering and Computer Science, KTH Royal Inst. of Technology, Sweden.* An RMSCA approach based on binary particle swarm optimization is proposed for programmable filterless SDM networks, aimed at minimizing core and spectrum usage. Near-optimal resource consumption is obtained at a modest trade-off with component usage.

SpW3G • High Symbol Rate Systems—Continued

SpW3G.3 • 15:00
Turbo Equalization for High Baud-Rate Optical Transmission, Xiaozhou Wang[1], Stefano Calabro[2], Bernhard Spinnler[2], Berthold Lankl[1]; [1]*Univ. of the Federal Armed Forces Munich, Germany;* [2]*Coriant R&D GmbH, Germany.* We investigate turbo equalization based on fractionally spaced linear MMSE. Simulation results show that ~50% increase of the transmitted net-bit rate for dual-polarization 4QAM and 16QAM systems can be achieved in a band-limited scenario.

SoW3H • Advanced Characterization and Processing Techniques—Continued

SoW3H.3 • 14:45
Non-destructive Microscopic Characterization of Optical Fiber Preforms, Marilena Vivona[1], Michalis N. Zervas[1]; [1]*ORC - Univ. of Southampton, UK.* We present a non-destructive technique, based on optical emission computerized tomography principles, to measure accurately theYb^{3+} single ion and cluster distributions, as well as refractive-index distributions, within the core of optical preforms.

SoW3H.4 • 15:00 Invited
Brillouin Spectroscopy of Optical Microfibers and Nanofibers, Thibaut Sylvestre[1]; [1]*Department of Optics, Institut FEMTO-ST/CNRS, France.* We review our recent works on Brillouin light scattering in silica and chalcogenide tapered optical fibers, from the observation of surface acoustic waves and anti-crossing, to the precise measurement of taper diameter and uniformity.

JW3I • Symposium: Microcomb Technology III—Continued

JW3I.3 • 14:45
Atypical Trapping of Cavity Solitons in Kerr Resonators Driven with Optical Pulses, Ian Hendry[1], Wei Chen[1,2], Yadong Wang[1], Bruno Garbin[1], Julien Javaloyes[3], Gian-Luca Oppo[4], Stephane Coen[1], Stuart Murdoch[1], Miro J. Erkintalo[1]; [1]*Univ. of Auckland, New Zealand;* [2]*National Univ. of Defense Technology, China;* [3]*Department de Fisica, Universitat de les Illes Baleares, Spain;* [4]*Univ. of Strathclyde, UK.* We have investigated the behaviour of cavity solitons in resonators driven with optical pulses. We find that the solitons are attracted to particular values of the driving field rather than points of zero gradient.

JW3I.4 • 15:00
The Multi-resonant Lugiato-Lefever model, Matteo Conforti[1], Fabio Biancalana[2]; [1]*PhLAM, CNRS, Univ. of Lille, France;* [2]*School of Engineering and Physical Sciences, Heriot-Watt Univ., UK.* We introduce a new model describing multiple resonances in Kerr optical cavities. It agrees quantitatively with the Ikeda map and predicts complex phenomena such as super cavity solitons and coexistence of multiple nonlinear states

JW3I.5 • 15:15
Gallium Phosphide Microresonator Frequency Combs, Simon Hönl[1], Dalziel Wilson[1,2], Katharina Schneider[1], Miles Anderson[2], Tobias J. Kippenberg[2], Paul Seidler[1]; [1]*IBM Research -- Zurich, Switzerland;* [2]*École Polytechnique Fédérale de Lausanne, Switzerland.* We demonstrate the first microresonator frequency combs in GaP, a III-V semiconductor transparent above 549 nm. High Kerr nonlinearity (>10^(-18) m^2/W) yields a 10-mW parametric threshold and 100-nm-wide combs with THz spacing, centered at 1550nm.

SeW3J • Terahertz Sensing I—Continued

SeW3J.3 • 15:00 Invited
All-Dielectric Metasurfaces for THz Imaging and Sensing, Willie J. Padilla[1], Kebin Fan[1], Jonathan Suen[1], Xinyu Liu[1]; [1]*110 Science Drive, Duke Univ., USA.* We demonstrate an approach to terahertz imaging and sensing using all-dielectric metasurface absorbers. THz waves are absorbed by the metasurface, converted to heat, and detected by an infrared camera.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

Room D1.1

BW3A • Symposium: Innovative Grating-components and Grating-configurations for Fiber Lasers I—Continued

BW3A.6 • 15:30 Invited

Line-by-line Femtosecond FBG Inscription for Innovative Fiber Lasers, Alex Fuerbach[1], Gayathri Bharathan[1], Sergei Antipov[1], Martin Ams[1], Robert J. Williams[1], Darren Hudson[1], Robert Woodward[2], Stuart Jackson[2]; [1]*Physics and Astronomy, Macquarie Univ., Australia;* [2]*School of Engineering, Macquarie Univ., Australia.* We report the fabrication of Bragg gratings in passive and doped fibers using femtosecond laser line-by-line inscription. Narrow-linewidth and broadband chirped gratings with engineered dispersion are written into silica- and fluoride-glass fibers.

Room E5

IW3B • Modulators—Continued

IW3B.6 • 15:30

Electro-Optic Phase Matching in Si Photonic Crystal Slow Light Modulator, Yosuke Hinakura[1], Yosuke Terada[1], Hiroyuki Arai[1], Toshihiko Baba[1]; [1]*Yokohama National Univ., Japan.* We demonstrate Si photonic crystal Mach-Zehnder modulators with meander line electrodes which compensate the phase mismatch between slow light and RF signals. The cutoff frequency will reach 27 GHz, allowing 50 Gbps modulation speed.

IW3B.7 • 15:45

Silicon Micro-ring Modulator Assembly for Multi-core Fiber based SDM Optical Interconnection, Lifang Zheng[1], Jiangbing Du[1], Ke Xu[2], Guoyao Chen[1], Lin Ma[1], Yinping Liu[1], Zuyuan He[1]; [1]*Shanghai Jiao Tong Univ, China;* [2]*Department of Electronic and Information Engineering, Harbin Inst. of Technology (Shenzhen), China.* We demonstrated a 4 channel silicon micro-ring modulator (MRM) assembly for space-division-multiplexed optical interconnection. NRZ-OOK modulations up to 25-Gbps have been demonstrated, indicating a single-fiber aggregate rate of 100-Gbps.

Room E3

NpW3C • Nonlinear Dielectric Nanostructures—Continued

NpW3C.7 • 15:30

Active Tuning of High-Q Dielectric Metasurfaces by Liquid Crystals, Matthew B. Parry[1], Andrei Komar[1], Ben Hopkins[1], Salvatore Campione[2], Sheng Liu[2], Andrey Miroshnichenko[3], John Nogan[2], Michael Sinclair[2], Igal Brener[2], Dragomir N. Neshev[1]; [1]*Australian National Univ., Australia;* [2]*Center for Integrated Nanotechnologies, Sandia National Laboratories, USA;* [3]*Univ. of NSW, Australia.* We demonstrate active tuning of high-Q dielectric metasurfaces by embedding asymmetric silicon meta-atoms in liquid crystals, thus controlling the relative refractive index by heating. Spectral tuning of more than three resonance widths is achieved.

NpW3C.8 • 15:45

Optical Switching of the Second Harmonic Generation in AlGaAs Nanoantennas, Lavinia Ghirardini[1], Luca Carletti[2], Valerio F. Gili[3], Giovanni Pellegrini[1], Lamberto Duò[1], Marco Finazzi[1], Davide Rocco[2], Andrea Locatelli[2], Costantino De Angelis[2], Ivan Favero[3], Iännis Roland[3], Giuseppe Leo[3], Aristide Lemaître[4], Michele Celebrano[1]; [1]*Politecnico di Milano, Italy;* [2]*Università di Brescia, Italy;* [3]*Université Paris Diderot , France;* [4]*Centre de Nanosciences et de Nanotechnologies, France.* We demonstrate optical switching of second harmonic generation (SHG) in AlGaAs nanoantennas. We observe more than 50% enhancement/suppression of the SHG excited at telecom wavelength when pumping above the material bandgap with a CW laser.

Room D1.2

NoW3D • Plasmonics—Continued

NoW3D.6 • 15:30

Dense Nanoparticles Arrays for SERS Sensors and Plasmonic Solar Cells, Mukesh Ranjan[1], Mukul Bhatnagar[1]; [1]*FCIPT, Inst. for Plasma Research, India.* Highly ordered Ag nanoparticles arrays with 30 nm periodicity grown are reported using self-assembly process. Such arrays exhibit strong nearfield enhancement and produce large SERS signal for glucose and oral cancer detection.

NoW3D.7 • 15:45

Strong Coupling of Molecular Vibrational Resonances in a Metal-clad Microcavity, Kishan Menghrajani[1], Geoffrey R. Nash[1], William L. Barnes[1]; [1]*Univ. of Exeter, UK.* We demonstrate that in addition to the standard lowest-order cavity mode, an additional coupled plasmon mode in metal-clad cavities also leads to significant strong coupling of molecular resonances.

Room D7.1

SeW3E • Optical Fiber Sensors II—Continued

SeW3E.7 • 15:30

Ultrasensitive Phase Sensing Inside a Mode-locked Laser, Hanieh Afkhamiardakani[1], James Hendrie[1], :Luke Horstman[1], Mehran Tehrani[1], Jean-Claude M. Diels[1], ladan Arissian[1,2]; [1]*Univ. of New Mexico, USA;* [2]*Measurements Sciences and Standards, National Research Councill Canada, Canada.* A bidirectional ring laser generates two frequency combs producing a beat frequency proportional to the phase shift between the intracavity pulses. Methods of optical comb stabilization and multiplexing with intracavity resonators are presented.

SeW3E.8 • 15:45

Dynamic Polarization Direction Monitoring in Optical Fibers Based on Radially Polarized Light, Bing Lei[1], Xin Cheng[1], Chao Gao[1], Jianhua Shi[1], Hairong Zhong[1]; [1]*College of Advanced Interdisciplinary Studies, National Univ. of Defense Technology, China.* A new polarization analyzing scheme is presented by using radially polarized light and digital image processing, and the polarization direction of lightwave transmitted in optical fibers is measured and the error is less than 0.1degrees.

16:00–16:30 Networking Coffee Break with Exhibitors, *D Level Foyers*

Room D3.2	Room D5.2	Room D7.2	Room E1.1	Room E1.2
Photonic Networks and Devices	Signal Processing in Photonic Communications	Specialty Optical Fibers	Joint Integrated Photonics Research, Silicon, and Nano-Photonics/ Nonlinear Photonics	Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

NeW3F • Optical Network Design and Optimization—Continued

NeW3F.5 • 15:30 Invited

Machine Learning based Routing of QoS Constrained Connectivity Services in Optical Networks, Paolo Monti[1], C. N. Silva[1], M. R. Raza[1], Lena Wosinska[1], P. Ohlen[2]; [1]*KTH Royal Inst. of Technology, Sweden;* [2]*Ericsson Research, Sweden.* Quality of service constraints (QoS), e.g., latency, are crucial in today's 5G networks. The paper presents a service provisioning strategy based on reinforcement learning able to accommodate QoS requirements while maximizing the network provider revenues.

SpW3G • High Symbol Rate Systems—Continued

SoW3H • Advanced Characterization and Processing Techniques—Continued

SoW3H.5 • 15:30

CO_2 laser Radiation as a Versatile Tool for the Fabrication of Fiber-based Components, Michael Steinke[1], Thomas Theeg[1], Mateusz Wysmolek[1], Christoph Ottenhues[1], Tony Pulzer[1], Jörg Neumann[1], Dietmar Kracht[1]; [1]*Laser Zentrum Hannover e.V., Germany.* CO_2 laser radiation is a versatile tool for the fabrication of cladding light strippers in very thin claddings, in particular if combined with AR-coated end-caps as a monolithic and low-cost alternative to SMA-like connectors.

SoW3H.6 • 15:45

A New Technique for Efficient Input Coupling into Sub-wavelength Diameter Suspended Core Fibers, Alexander Hartung[1], Jörg Bierlich[1], Jens Kobelke[1], Matthias Jäger[1]; [1]*Inst. of Photonic Technology, Germany.* We discuss a new technique for efficient input coupling of light into sub-wavelength diameter suspended core fibers. Using a fiber with a low index cladding, it can be collapsed to an all-solid fiber with increased core.

JW3I • Symposium: Microcomb Technology III—Continued

JW3I.6 • 15:30

A Diode Made of Light – Optical Isolators and Circulators Based on the Intrinsic Nonreciprocity of the Kerr Effect, Jonathan M. Silver[1,2], Leonardo Del Bino[1,3], Michael T. Woodley[1,3], Sarah L. Stebbings[1], Xin Zhao[1,4], Pascal Del'Haye[1]; [1]*National Physical Laboratory, UK;* [2]*City, Univ. of London, UK;* [3]*Inst. of Photonics and Quantum Sciences, Heriot-Watt Univ., UK;* [4]*School of Electronic and Information Engineering, Beihang Univ., China.* We demonstrate optical nonreciprocity based on Kerr interaction of counterpropagating light in whispering gallery microresonators. This effect is used to realize compact optical isolators and circulators with >20 dB isolation.

JW3I.7 • 15:45

Silicon Nitride Waveguide Enables Self-referenced Frequency Comb from a Semiconductor Disk Laser, Dominik Waldburger[1], Aline Mayer[1], Cesare Alfieri[1], Jacob Nuernberg[1], Adrea R. Johnson[2,3], Xingchen Ji[4,5], Alexander Klenner[2], Yoshitomo Okawachi[2], Michal Lipson[4], Alexander L. Gaeta[2], Ursula Keller[1]; [1]*Inst. for Quantum Electronics, ETH Zurich, Switzerland;* [2]*Department of Applied Physics and Applied Mathematics, Columbia Univ., USA;* [3]*School of Applied and Engineering Physics, Cornell Univ., USA;* [4]*Department of Electrical Engineering, Columbia Univ., USA;* [5]*School of Electrical and Computer Engineering, Cornell Univ., USA.* We present silicon nitride waveguides optimized for low-energy supercontinuum generation, which allow for self-referenced carrier-envelope offset (CEO) frequency stabilization of ultrafast gigahertz semiconductor disk lasers without amplification.

SeW3J • Terahertz Sensing I—Continued

SeW3J.4 • 15:30 Invited

New Developments in Quartz Enhanced Photoacoustic Spectroscopy for Gas Sensing Applications, Vincenzo Spagnolo[1], Pietro Patimisco[1], Angelo Sampaolo[1], Marilena Giglio[1], Verena Mackowiak[2], Hubert Rossmadl[2], Bruno Gross[2], Alex Cable[3], Frank K. Tittel[4]; [1]*Via Amendola 173, Politecnico di Bari, Italy;* [2]*THORLABS GmbH, Germany;* [3]*THORLABS Inc., USA;* [4]*ECE department, Rice Univ., USA.* New results obtained in the development of quartz-enhanced photoacoustic gas sensors are reported. This will include recent advances provided by the implementation of the 2nd generation and 3rd generation of custom QTFs.

16:00–16:30 Networking Coffee Break with Exhibitors, *D Level Foyers*

Room D1.1

Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials

Room E5

Integrated Photonics Research, Silicon, and Nano-Photonics

Room E3

Nonlinear Photonics

Room D1.2

Novel Optical Materials and Applications

Room D7.1

Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

16:30–18:30
BW4A • Symposium: Innovative Grating-components and Grating-configurations for Fiber Lasers II
Presider: Morten Ibsen; Univ. of Southampton, UK

BW4A.1 • 16:30 Invited
Chirped Volume Bragg Gratings for Ultrafast Pulsed Lasers, Alexei L. Glebov[1], Ruslan Vasilyeu[1], Vadim Smirnov[1]; [1]*OptiGrate Corp, USA.* We present on recent advances in technology of Chirped Volume Bragg Gratings (CBGs). The results will be shown on CBGs with increased apertures, improved beam uniformities, extended wavelength application range, temporal and spatial pulse shaping.

BW4A.2 • 17:00
A Tunable, Single Frequency, Linearly Polarized DFB Raman Fiber Laser Operating at 1178-nm, Vladimir Karpov[2], Sébastien Loranger[1], Raman Kashyap[1,3]; [1]*Engineering Physics, Polytechnique Montreal, Canada;* [2]*MPB Communications Inc., Canada;* [3]*Electrical Engineering, Polytechnique Montreal, Canada.* We report the performance of a single frequency Raman DFB fiber laser operating at a wavelength of 1178-nm in which stimulated Brillouin scattering (SBS) and active burst-pulse Q-switching are observed and influence the laser performance.

16:30–18:30
IW4B • Plasmonics
Presider: Presider: Pascual Munoz; Universitat Politècnica de València, Spain

IW4B.1 • 16:30 Invited
Fundamental Limits to Graphene Plasmonics, Dmitri N. Basov[1]; [1]*1107 The Northwest Corner Building, Columbia Univ., USA.* We investigate, for the first time, propagating plasmons in high mobility graphene at cryogenic temperatures. The intrinsic plasmon propagation length in these samples can exceed 10 micrometers thus enabling new experiments and applications.

IW4B.2 • 17:00
A Hybrid Plasmonic Waveguide-based TE-Pass Slot Waveguide Polarizer, Bin Ni[1], Jinbiao Xiao[1]; [1]*School of Electronic Science and Engineering, Southeast Univ., China.* Utilizing a directional coupler comprised of an asymmetrical slot waveguide and a hybrid plasmonic waveguide, a broadband TE-pass polarizer is realized with an extinction ratio of 45 dB and an insertion loss of 0.44 dB.

16:30–18:30
NpW4C • Waves and Solitons Interactions
Presider: Cornelia Denz; Westfaelische Wilhelms Univ Munster, Germany

NpW4C.1 • 16:30
Observation of Nonequilibrium Precondensation of Classical Optical Waves, Neven Santić[1,2], Adrien Fusaro[3], Sabeur Salem[1], Josselin Garnier[4], Antonio Picozzi[3], Robin Kaiser[1]; [1]*Université Côte d'Azur, CNRS, Institut de Physique de Nice, France;* [2]*Inst. of Physics, Croatia;* [3]*Laboratoire Interdisciplinaire Carnot de Bourgogne, CNRS, Université Bourgogne Franche-Comté, France;* [4]*Centre de Mathematiques Appliquées, Ecole Polytechnique, France.* We report the observation of nonequilibrium precondensation of light propagating in atomic vapors. At variance with complete thermalization requiring prohibitive interaction lengths, this effect occurs by a fast relaxation to a precondensate state.

NpW4C.2 • 17:00
Observation of Molecule-like Breathers in Optical Fibers, Gang Xu[1], Andrey Gelash[2], Amin Chabchoub[3], Bertrand Kibler[1]; [1]*Laboratoire ICB, CNRS - UBFC, France;* [2]*Novosibirsk State Univ.,, Russia;* [3]*The Univ. of Sydney, Australia.* We investigate the nonlinear interaction of co-propagative breathers in optical fibers. We observe the formation of molecule-like breathers which is predicted by the exact two-breather solution of the nonlinear Schrödinger equation.

16:30–18:30
NoW4D • Biomimetic and Biocompatable Materials
Presider: Seok-Hyun Yun; Harvard Medical School, USA

NoW4D.1 • 16:30 Tutorial
Light in Diagnosis, Therapy, and Surgery, Seok-Hyun A. Yun[1]; [1]*Wellman Center for Photomedicine, Harvard Medical School, USA.* In this Tutorial, we will revisit the fundamentals of light-tissue interactions, overview the biomedical applications of light and optical technologies, and discuss the promise of emerging light-based technologies.

16:30–18:15
SeW4E • Laser-based Sensors I
Presider: Yoonchan Jeong; Seoul National Univ., South Korea

SeW4E.1 • 16:30 Invited
Design and Fabrication of Lensed Optical Fiber Probe for Various Optical Fiber Interferometry, Byeong Ha Lee[1,2], Soongho Park[1], Sunghwan Rim[1], Jae Hwi Lee[1], Ik-Bu Sohn[2]; [1]*School of Electrical Engineering and Computer Science, Gwangju Inst. of Science and Technology, South Korea;* [2]*Advanced Photonics Research Inst., Gwangju Inst. of Science and Technology, South Korea.* The optical fiber probe consisted of a lensed fiber is analyzed and experimentally characterized. The working distance and spot size of the probe could be simultaneously controlled by taking a proper combination of input parameters.

SeW4E.2 • 17:00 Invited
Versatile Laser and Optical Amplifier for Ultrafast Imaging, Jiqiang Kang[1], Xiaoming Wei[3], Arnaud Mussot[2], Alexandre Kudlinski[2], Kevin K. Tsia[1], Kenneth Kin-Yip Wong[1]; [1]*Univ. of Hong Kong, Hong Kong;* [2]*CNRS-Université Lille 1, France;* [3]*Caltech, USA.* Photonic technologies revolutionize optical imaging, from source generation to signal detection. Here we report MHz swept sources for ultrafast imaging. Their performance can be enhanced by broadband and sensitive fiber optical parametric amplifier.

Room D3.2 — Photonic Networks and Devices

Room D5.2 — Signal Processing in Photonic Communications

Room D7.2 — Specialty Optical Fibers

Room E1.1 — Integrated Photonics Research, Silicon, and Nano-Photonics

Room E1.2 — Novel Optical Materials and Applications

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

16:30–18:30
NeW4F • FreeSpace and UnderSea Optics + Workshop
Presider: Koji Igarashi; Osaka Univ., Japan

NeW4F.1 • 16:30 Invited
Ground Receiver Architectures Enabled by Digital Coherent Combining, David J. Geisler[1], Timothy M. Yarnall[1], Curt M. Schieler[1], Gavin Lund[1], Mark L. Stevens[1], Bryan S. Robinson[1], Scott A. Hamilton[1]; [1]*244 Wood St, Massachusetts Inst of Tech Lincoln Lab, USA.* Future optical ground stations will need to have scalable collection areas while providing efficient coupling from free space to single-mode fiber. We present a multi-aperture multi-spatial-mode receiver architecture along with experimental results.

NeW4F.2 • 17:00 Invited
When Wireless Networks Go Optical, Maite Brandt-Pearce[1]; [1]*Univ. of Virginia, USA.* Wireless optical networks include urban mesh architectures based on point-to-point laser communications and diffuse indoor visible light systems using LED lighting fixtures as transmitters. They enable high-speed data access and complement existing RF infrastructure.

16:30–18:30
SpW4G • Machine Learning for Optical Systems
Presider: Jeffery Maki; Juniper Networks Inc., USA

SpW4G.1 • 16:30 Invited
Application of Machine Learning Techniques in Fiber-Optic Communication Systems, Alan Pak Tao Lau[1], Faisal N. Khan[1], Qirui Fan[1], Chao Lu[1]; [1]*Department of Electrical Engineering, Hong Kong Polytechnic Univ., Hong Kong.* We discuss machine learning applications in different aspects of fiber-optic communications including fiber nonlinearity compensation, optical performance monitoring, cognitive fault detection/prevention, and planning and optimization of software-defined networks.

SpW4G.2 • 17:00
Maximum-Likelihood Symbol Detection by Dummy-assisted Low-complexity ANN for PAM-4 Transmission, Ryosuke Matsumoto[1], Masashi Binkai[1], Hayato Sano[1], Keisuke Matsuda[1], Tsuyoshi Yoshida[1], Naoki Suzuki[1]; [1]*Mitsubishi Electric, Japan.* An ANN based ML symbol detection is proposed for nonlinearity compensation in PAM-4. Its optimized architecture realizes 0.7-dB better sensitivity and 20-times lower complexity than the conventional ANN-based ML sequence detection.

16:30–18:30
SoW4H • Multimode Fibers
Presider: Axel Schulzgen; Univ. of Central Florida, USA

SoW4H.1 • 16:30 Invited
Space-time Control in Multimode Fiber Amplifiers, Raphaël Florentin[1], Vincent Kermene[1], Agnes Desfarges-Berthelemot[1], Alain J. Barthelemy[1]; [1]*XLIM, Faculte des Sciences, XLIM Research Insititute, France.* Control of the space-time distribution of femtosecond pulses amplified in a multimode active fiber was achieved by adaptive input wavefront shaping. Despite group delay dispersion, amplified pulses compressed both in space and time were demonstrated

SoW4H.2 • 17:00
Preservation of Good Beam Quality over Several Hundred Meters in Highly Multimode Fibers, Christian Röhrer[1,2], Christophe Codemard[3], Götz Kleem[1], Marwan Abdou Ahmed[1], Thomas Graf[1]; [1]*Institut für Strahlwerkzeuge (IFSW), Univ. of Stuttgart, Germany;* [2]*Graduate School of Excellence advanced Manufacturing Engineering (GSaME), Univ. of Stuttgart, Germany;* [3]*SPI Lasers UK Ltd, UK.* We analyze the requirements and demonstrate good beam quality transportation over several hundred meters in highly multimode step-index fibers. The beam quality factor is preserved over 100m ($M^2 \approx 1.3$) and degrades linearly to $M^2 \approx 2.0$ at 300m.

16:30–18:15
IW4I • Filter and Waveguide Devices
Presider: Jonathan Klamkin; Univ. of California Santa Barbara, USA

IW4I.2 • 16:30
Enhanced Spectral Resolution of AWG by Phase-shifted Fiber Bragg Grating, Kalaga Madhav[1], Ziyang Zhang[1], Andreas Stoll[1], Julia Fiebrandt[1,2], Vadim Makan[1], Martin Roth[1]; [1]*Leibniz Inst. for Astrophysics (AIP), Germany;* [2]*PicoQuant GmbH, Germany.* Phase-shifted fiber Bragg grating was implemented to enhance the spectral resolution of an AWG from 140pm to ~14pm at 1527.273nm. The compact, integrated spectrometer registers one of the highest resolving powers ~110,000 for NIR astronomy.

IW4I.4 • 16:45
Integrated Electro-optic Bragg Modulators in Lithium Niobate Nanowaveguides, Marc Reig[1], David Pohl[1], Wolfgang Heni[1], Benedikt Baeuerle[1], Arne Josten[1], Anton Sergeyev[1], Juerg Leuthold[1], Rachel Grange[1]; [1]*ETH Zürich, Switzerland.* We demonstrate a Bragg modulator integrated on a lithium niobate-on-insulator platform with a footprint of 10×500 μm^2 that operates at 56 Gbit/s. This electro-optic Bragg reflector has a DC tuning efficiency of 23.37±0.55 pm/V.

IW4I.5 • 17:00
Tunable Integrated Photonic Components on an Elastomer Chip, James Grieve[1], Kian Fong Ng[1], Manuel Rodrigues[2], José Viana-Gomes[2,3], Alexander Ling[1,3]; [1]*Centre for Quantum Technologies, Singapore;* [2]*Centre for Advanced 2D Materials and Graphene Research Centre, National Univ. of Singapore, Singapore;* [3]*Department of Physics, National Univ. of Singapore, Singapore.* We design, fabricate and test an integrated, waveguide-based beamsplitter with mechanically tunable splitting ratio. Devices are implemented on a soft polymer chip and support single mode guiding over a wide range of visible wavelengths.

16:30–18:00
NoW4J • Polaritonics
Presider: Ho Wai Lee; Baylor Univ., USA

NoW4J.1 • 16:30 Invited
Ultrafast Near-field Dynamics of Exciton-polariton in WSe_2 at Room Temperature, Haim Suchowski[1]; [1]*Tel Aviv Univ., Israel.* We observe the propagation of an exciton-polariton wave in a WSe2 nanometric slab. We directly visualize with unprecedented spatio-temporal resolution (50 nm, <70 fs) a strikingly slow polaritonic wave with a velocity of ~ 0.017c.

NoW4J.2 • 17:00
Sub-wavelength Microwave Photonic Hotspots in Fruit and Other Aqueous Dimers, Aaron D. Slepkov[2], Hamza K. Khattak[2], Pablo Bianucci[1]; [1]*Physics, Concordia Univ., Canada;* [2]*Physics & Astronomy, Trent Univ., Canada.* The sparking of grapes in a household microwave oven is a popular yet largely unexplained phenomenon. Using FDTD simulations, high-speed videography, and thermal imaging, we tie this phenomenon to low-Q Mie resonances in aqueous dimers.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

Room D1.1

Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials

BW4A • Symposium: Innovative Grating-components and Grating-configurations for Fiber Lasers II—Continued

BW4A.3 • 17:15
Direct Generation of 96nm Pulses in an All-fiber Mode-locked Er-doped Laser using a 45°-Titled Fiber Grating, Qianqian Huang[1], Zhijun Yan[3], Chuanhang Zou[1], Chengbo Mou[1], Kaiming Zhou[2], Lin Zhang[2]; [1]*Key Laboratory of Specialty Fiber Optics and Optical Access Networks, Shanghai Univ., China;* [2]*Aston Inst. of Photonic Technologies, Aston Univ., UK;* [3]*School of Optical and Electronic Information, Huazhong Univ. of Science and Technology, China.* We demonstrate a dispersion-managed Er-doped all-fiber laser based on nonlinear polarization rotation using a 45°-titled fiber grating. Ultrawide spectrum with full-width half-maximum of 96.41nm at 108MHz repetition rates can be generated directly.

BW4A.4 • 17:30
Splice-less Erbium All-fiber Laser using FBGs Written through the Coating, Louis-Philippe Pleau[1], Pascal Paradis[1], Jean-Simon Frenière[1], Mathieu Huneault[1], Samuel Gouin[1], Yigit O. Aydin[1], Salah M. Aljamimi[1], Simon Duval[1], Jean-Christophe Gauthier[1], Joé Habel[1], Frédéric Jobin[1], Frédéric Maes[1], Louis-Rafaël Robichaud[1], Nicolas Grégoire[1], Steeve Morency[1], Martin Bernier[1]; [1]*Centre d'optique, photonique et laser (COPL), Université Laval, Canada.* Using fiber Bragg gratings written directly in the gain fiber through the polymer coating, we demonstrate a scalable and extremely simple erbium fiber laser emitting over 20 W of power at 1610 nm.

BW4A.5 • 17:45
Optimizing an Er/Yb Doped Fiber Laser by Inscribing with fs Pulses Customized Output Couplers on the Fly, Zev Montz[1], Avry Shirakov[1], Udi Ben Ami[1], Sahar Genish[1], Amiel Ishaaya[1]; [1]*Ben Gurion Univ. of the Negev, Israel.* We demonstrate experimentally a novel method to optimize the output power of an Er/Yb doped fiber laser by fs inscription of the output coupler Bragg grating on-the-fly with the phase mask technique.

Room E5

Integrated Photonics Research, Silicon, and Nano-Photonics

IW4B • Plasmonics—Continued

IW4B.3 • 17:15
Plasmonic Metasurfaces and Metalines for Integrated Silicon Optics., Yulong Fan[1], Xavier Le Roux[1], anatole lupu[1], Andre de Lustrac[1,2]; [1]*Univ. of Paris-Sud XI, France;* [2]*Université Paris Nanterre, France.* We address the design and the experimental demonstration of two devices based on the nanoscale engineering of the effective index of a silicon waveguide by the plasmonic resonance of metallic wires implemented in metasurfaces and metalines.

IW4B.4 • 17:30
Photo-induced THz Plasmonics in Black Silicon, Luke Peters[1], Juan Sebastian Totero Gongora[1,2], Jacob D. Tunesi[1], Alessia Pasquazi[1], Andrea Fratalocchi[2], Marco Peccianti[1]; [1]*Univ. of Sussex, UK;* [2]*King Abdullah Univ. of Science and Technology, Saudi Arabia.* We experimentally investigated a novel form of photo-induced plasmonic response, in nanostructured silicon, at THz frequencies which can be employed to precisely control the full-wave properties, i.e. amplitude and phase, of the generated THz pulse.

IW4B.5 • 17:45
Photonic-plasmonic Hybrid Waveguide Couplers with a 91% Efficiency, Daniel B. Chelladurai[1], Michael Doderer[1], Ueli Koch[1], Yuriy Fedoryshyn[1], Christian Haffner[1], Juerg Leuthold[1]; [1]*Inst. of Electromagnetic Fields, Switzerland.* A directional coupling scheme with 91% efficiency (-0.4 dB) between silicon photonic waveguides and hybrid-plasmonic waveguides (metal-insulator-semiconductor) is demonstrated.

Room E3

Nonlinear Photonics

NpW4C • Waves and Solitons Interactions—Continued

NpW4C.3 • 17:15
Dark Solitons, Dispersive Waves and Their Collision in an Optical Fiber, Tomy Marest[1], Carlos Mas Arabi[1], Matteo Conforti[1], Arnaud Mussot[1], Carles Milian[2], Dmitry V. Skryabin[3], Alexandre Kudlinski[1]; [1]*Univ. of Lille, France;* [2]*icfo, Spain;* [3]*Univ. of Bath, UK.* We report the experimental observation of dispersive wave emission from dark solitons in an optical fiber. We also observed the nonlinear wave mixing occurring during the collision of a dark soliton and a linear wave.

NpW4C.4 • 17:30
Plasma-mediated Interactions Between Counter-propagating Solitons in Gas-filled Hollow-Core Photonic Crystal Fiber, Mallika I. Suresh[1], Barbara M. Trabold[1], Johannes R. Koehler[1], Francesco Tani[1], Philip S. Russell[1]; [1]*Max Planck Inst. for the Science of, Germany.* We investigate long-lived photoionization-induced refractive index changes in gas-filled photonic crystal fiber by observing the frequency shift of a dispersive wave emitted by a soliton propagating against the ionizing pulse.

NpW4C.5 • 17:45
Effects of Anti-crossings with Cladding Resonances on Soliton Dynamics in Gas-filled PCFs, Francesco Tani[1], Felix Köttig[1], David Novoa[1], Ralf Keding[1], Philip S. Russell[1]; [1]*Russell division, Max Planck Inst. for the Science of Light, Germany.* We study the effect on nonlinear pulse propagation of anti-crossings between hollow core modes and cladding resonances in anti-resonant-reflecting photonic crystal fibers and report how their effect can be minimized by tuning the core-wall thickness.

Room D1.2

Novel Optical Materials and Applications

NoW4D • Biomimetic and Biocompatable Materials—Continued

NoW4D.2 • 17:30 Invited
Silk Inverse Opal as a Biological Light Reflector and Emitter, Kyungtaek Min[2], Sookyoung Kim[2], Muhammad Umar[2], Sunghwan Kim[1]; [1]*Ajou Univ., Ajou Univ., South Korea;* [2]*Energy Systems Research, Ajou Univ., South Korea.* We introduce applications of the silk inverse opal as a biological light reflector and emitter. Using the natural protein, the artificial *tapetum lucidum*, amplified spontaneous emission, and random lasing could be demonstrated.

Room D7.1

Optical Sensors

SeW4E • Laser-based Sensors I—Continued

SeW4E.3 • 17:30
Use of Whispering Gallery Modes Frequency Splitting for Rotation Speed Measurement, Yurii V. Filatov[1], Egor V. Shalymov[1], Vladimir Y. Venediktov[1]; [1]*Saint Petersburg ElectroTech Univ "LETI", Russia.* We propose a new concept of the rotation speed measurement by means of measuring the splitting of frequencies of the neighboring whispering gallery modes with different azimuth index in a ball-shaped resonator.

SeW4E.4 • 17:45
Impact of Brillouin-enhanced Four-wave Mixing on the Stimulated Brillouin Scattering Threshold in Short Optical Fibers, Kyoungyoon Park[1], Achar V. Harish[2,4], Johan Nilsson[2], Yoonchan Jeong[1,3]; [1]*Department of Electrical and Computer Engineering, Seoul National Univ., South Korea;* [2]*ORC, Univ. of Southampton, UK;* [3]*ISRC and IAP, Seoul National Univ., South Korea;* [4]*Department of Physics, Karnataka Univ. Dharwad, India.* We analyze the Brillouin Stokes in optical fibers, taking four-wave-mixing effects into account, and report that the phase-mismatch in the four-wave-mixing process may have a significant impact on the stimulation process in short optical fibers.

Room D3.2 — Photonic Networks and Devices | Room D5.2 — Signal Processing in Photonic Communications | Room D7.2 — Specialty Optical Fibers | Room E1.1 — Integrated Photonics Research, Silicon, and Nano-Photonics | Room E1.2 — Novel Optical Materials and Applications

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

NeW4F • FreeSpace and UnderSea Optics + Workshop—Continued

NeW4F.3 • 17:30 Invited
Impact of Submarine Cable Design Approaches on Undersea OADM Node Architectures, Lara D. Garrett[1]; [1]*System Engineering, TE SubCom, USA.* Submarine fiber-optic cables have unusual design issues related to optimization of overall cable cost and capacity that impact Branch node architectures, including capabilities provided by the introduction of WSS technology into undersea networks.

SpW4G • Machine Learning for Optical Systems—Continued

SpW4G.3 • 17:15
Electrooptic Nonlinear Activation Functions for Vector Matrix Multiplications in Optical Neural Networks, Jonathan George[1], Rubab Amin[1], Armin Mehrabian[1], Jacob Khurgin[2], Tarek El-Ghazawi[1], Paul Prucnal[3], Volker J. Sorger[1]; [1]*George Washington Univ., USA;* [2]*Johns Hopkins Univ., USA;* [3]*Princeton Univ., USA.* We show how the nonlinear transfer function of electrooptic modulators enables vector matrix multiplications of photonic neural networks. Here the modulators energy function and signal-to-noise ratio are critical factors impacting system performance.

SpW4G.4 • 17:30 Invited
Optical Signal Processing for Neural Networks, Folkert Horst[1], Stefan Abel[1], Roger Dangel[1], Yannick Baumgartner[1], Jean Fompeyrine[1], Bert J. Offrein[1]; [1]*Saeumerstrasse 4, IBM Research GmbH, Switzerland.* We discuss two examples of photonic technologies for neuromorpic systems; a photonic non-volatile memory based analog accelerator for the training of deep neural networks and an integrated photonic reservoir computing system.

SoW4H • Multimode Fibers—Continued

SoW4H.3 • 17:15 Invited
Kerr Beam Self-Cleaning in Multimode Fibers, Alessandro Tonello[1], Richard Dupiol[1,2], Etienne Deliancourt[1], Katarzyna Krupa[3], Marc Fabert[1], Romain Guenard[1], Jean-Louis Auguste[1], Agnès Desfarges-Berthelemot[1], Vincent Kermene[1], Alain J. Barthelemy[1], Daniele Modotto[3], Guy Millot[2], Stefan Wabnitz[3,4], Vincent Couderc[1]; [1]*Institut XLIM, Université de Limoges, France;* [2]*ICB, Université de Bourgogne Franche-Comté, France;* [3]*Dipartimento di Ingegneria dell'Informazione, Università di Brescia, Italy;* [4]*Novosibirsk State Univ., Russia.* We overview recent experimental results of beam self-cleaning observed in various types of multimode fibers. We analyze the output spatial beam shapes and their connection with the refractive index profile of the fibers.

SoW4H.4 • 17:45
Multimode Interference Device in a Rounded Rectangle-core Fiber, Julia Fiebrandt[1,2], Ziyang Zhang[1], Dionne Haynes[1], Yu Wang[1], Kai Sun[1], Martin Roth[1]; [1]*Leibniz Inst. for Astrophysics (AIP), Germany;* [2]*PicoQuant GmbH, Germany.* 3D multimode interference device is demonstrated using a single-mode fiber center-aligned to a multimode fiber with rounded rectangle-core. Unique imaging profiles are obtained to enable application as asymmetric vector curvature sensor.

IW4I • Filter and Waveguide Devices—Continued

IW4I.6 • 17:15
New Method for Direct Laser Writing of High Performances Near and Mid-infrared Waveguides, Pascal Masselin[1], Eugène Bychkov[1], David Le Coq[2]; [1]*LPCA, Universite du Littoral-Côte d'Opale, France;* [2]*ISCR, Université de Rennes, France.* We present a new procedure for direct laser writing of high performance waveguides in chalcogenide glass. The propagation losses are measured to be lower than 0.2 dB/cm both in the near- (λ = 1.55 µm) and in the mid-infrared (λ = 4.5 µm).

IW4I.7 • 17:30
Characterization of Liquid Crystal Core Waveguide in the Visible and Near IR Wavelengths, M.R. Shenoy[1], Mukesh Sharma[1], Nithin Vogirala[1], Aloka Sinha[1]; [1]*Physics, Indian Inst. of Technology Delhi, India.* A liquid crystal waveguide with 5CB core, fabricated on ITO-coated glass substrate, has been characterized experimentally and numerically in visible and near IR region. The output characteristics indicate potential applications in photonic switching.

IW4I.8 • 17:45
Automatic Tuning of Hitless Add-drop Filter Array based on Microrings, Douglas O. Aguiar[1], Maziyar Milanizadeh[1], Emanuele Guglielmi[1], Francesco Zanetto[1], Marco Sampietro[1], Francesco Morichetti[1], Andrea Melloni[1]; [1]*Politecnico di Milano, Italy.* By labeling channels with a small amplitude modulation we demonstrate the automated tuning and locking of hitless silicon microring resonator filters in a multichannel WDM system, enabling applications as reconfigurable add-drop multiplexer.

NoW4J • Polaritonics—Continued

NoW4J.3 • 17:15
Ultra-narrow Surface Lattice Resonances in Periodic Structures of Refractory Titanium Nitride Nanodiscs, Vadim I. Zakomirnyi[1,2], Ilia Rasskazov[3], Valery Gerasimov[1], Alexander Ershov[1,4], Hans Ågren[2,1], Sergey Polyutov[1], Sergey Karpov[1,5]; [1]*Inst. of Nanotechnology, Spectroscopy and Quantum Chemistry, Siberian Federal Univ., Russia;* [2]*School of Engineering Sciences in Chemistry, Biotechnology and Health, KTH Royal Inst. of Technology, Sweden;* [3]*Beckman Inst. for Advanced Science and Technology, Univ. of Illinois at Urbana-Champaign, USA;* [4]*Inst. of Computational Modeling, Federal Research Center KSC SB RAS, Russia;* [5]*L. V. Kirensky Inst. of Physics, Federal Research Center KSC SB RAS, Russia.* We show that regular arrays of TiN nanodiscs support high-Q surface lattice resonances at telecom range. The obtained data open new prospects for utilization of refractory TiN in new photonics interconnects operating at high temperatures.

NoW4J.4 • 17:30
Superradiantly Limited Linewidth of Complementary THz Split Ring Resonators on Si-Membranes and Surface Plasmon Polaritons, Janine Keller[1], Johannes Haase[2], Felice Appugliese[1], Shima Rajabali[1], Zhixin Wang[1], Gian Lorenzo Paravicini-Bagliani[1], Curdin Maissen[1], Giacomo Scalari[1], Jérôme Faist[1]; [1]*ETH Zürich, Switzerland;* [2]*Paul Scherrer Inst., Switzerland.* We study complementary THz metasurfaces with changing lattice constant. On thick substrates the LC-resonance anticrosses with a surface plasmon polaritons mode. On 10 µm Si-membranes, we reveal a superradiantly limited linewidth of the LC-resonance.

NoW4J.5 • 17:45
Pseudocanalizating Propagation with Hyperbolic Surface Waves, Taavi Repän[1], Andrey Novitsky[1], Morten Willatzen[1], Andrei V. Lavrinenko[1]; [1]*DTU Fotonik, Technical Univ. of Denmark, Denmark.* Negative magnetic permeability allows for reversed phase propagation in HMMs. However, magnetic properties are difficult to realize in the visible wavelengths. We propose a similar effect for surface waves without requiring magnetic properties.

Room D1.1 — Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials

Room E5 — Integrated Photonics Research, Silicon, and Nano-Photonics

Room E3 — Nonlinear Photonics

Room D1.2 — Novel Optical Materials and Applications

Room D7.1 — Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

BW4A • Symposium: Innovative Grating-components and Grating-configurations for Fiber Lasers II—Continued

BW4A.6 • 18:00 Invited
Beyond Single Core Rare Earth Doped Fibers for Narrow Linewidths: Raman, Brillouin, and Multicore DFB Fiber Lasers, Paul Westbrook[1], Tristan Kremp[1], Kazi S. Abedin[1]; [1]*19 Schoolhouse Rd, OFS Laboratories, USA.* We discuss advances in fiber distributed feedback laser technology employing novel fiber DFB gain media, including Raman and Brillouin gain and multicore Er doped fiber.

IW4B • Plasmonics—Continued

IW4B.6 • 18:00 Invited
Attosecond Electron Transport in Plasmonic Nanostructures, Alfred Leitenstorfer[1], Markus Ludwig[1], Tobias Rybka[1], Felix Ritzkowsky[1], Daniele Brida[1]; [1]*Univ. of Konstanz, Germany.* Passively phase-locked single-cycle laser pulses and electrically contacted optical antennas enable studies of electronic transport on molecular time and length scales.

NpW4C • Waves and Solitons Interactions—Continued

NpW4C.6 • 18:00 Invited
Observation of the Symmetry Breaking of the Fermi Pasta Ulam Recurrence in Optical Fibers, Arnaud Mussot[1], Corentin Naveau[1], Matteo Conforti[1], Alexandre Kudlinski[1], Pascal Szriftgiser[1], Stefano Trillo[2], Francois copie[1]; [1]*CNRS - UMR 8523 - IRCICA, Univ Lille 1 Laboratoire PhLAM, France;* [2]*Univ. of Ferrara, Italy.* We provide the first longitudinal characterization in phase and amplitude of the Fermi Pasta Ulam recurrence. It allows to reveal the symmetry breaking of the process due to an initial condition change.

NoW4D • Biomimetic and Biocompatable Materials—Continued

NoW4D.3 • 18:00
Bioinspired Peptide-Based Photonic Integrated Devices, Amir Handelman[1], Boris Apter[1], Nadia Lapshina[2], Gil Rosenman[2]; [1]*Holon Inst. of Technology, Israel;* [2]*Electrical Engineering, Tel Aviv Univ., Israel.* We fabricated photonic integrated devices based on bioinspired peptide materials exhibiting wide optical transparency, nonlinear and electro-optical properties by combining bottom-up deposition of peptide wafers and top-down focus ion beam.

NoW4D.4 • 18:15
Eco-friendly Silk-hydrogel Lenses for LEDs , Rustamzhon Melikov[1], Daniel Aaron Press[1], Baskaran Ganesh Kumar[1], Itir Bakis Dogru[1], Sadra Sadeghi[1], Mariana Chirea[1], Iskender Yilgor[1], Sedat Nizamoglu[1]; [1]*Koc Univ., Turkey.* In this study, silk fibroin in hydrogel form is analyzed as an eco-friendly alternative to conventional polymers for lens applications in light-emitting diodes. The intensity profile was controlled via dome- and crater-type lenses.

SeW4E • Laser-based Sensors I—Continued

SeW4E.5 • 18:00
Ultra-Long Optical Fiber Tapering Technique for Sensing and Nonlinear Optic Applications, DongHwa Lee[1], Jinhun Kim[2], Kyungdeuk Park[2], Heedeuk Shin[2], Yoonho Kim[2], Kwang Jo Lee[1]; [1]*Kyung Hee Univ., South Korea;* [2]*Pohang Univ. of Science and Technology, South Korea.* Ultra-long, uniform micro-fiber tapering technique is reported. Fabrication of a stand of 20-cm-long micro-fiber with the diameter of 1 mm and its transmission property will be discussed. Experimental results confirm the validity of our approach.

19:00 –21:00 Lab Automation Hackathon, *Room F33.1*

Room D3.2	Room D5.2	Room D7.2	Room E1.1	Room E1.2
Photonic Networks and Devices	Signal Processing in Photonic Communications	Specialty Optical Fibers	Integrated Photonics Research, Silicon, and Nano-Photonics	Novel Optical Materials and Applications

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

NeW4F • FreeSpace and UnderSea Optics + Workshop—Continued

SpW4G • Machine Learning for Optical Systems—Continued

SpW4G.5 • 18:00
Recurrent Neural Network for Pre-distortion of Combined Nonlinear Optical Transmitter Impairments with Memory, Gil Paryanti[1], Hananel Faig[1], Lior Rokach[1], Dan Sadot[1]; [1]*BGU, Israel.* Pre-distortion for an optical transmitter with complex frequency selective nonlinearity, based on recurrent neural network is proposed. Several architectures are compared and above 20dB performance gain is presented

SpW4G.6 • 18:15
Withdrawn

SoW4H • Multimode Fibers—Continued

SoW4H.5 • 18:00 Invited
Multimode Fiber based Spectrometer, Hui Cao[1]; [1]*Applied Physics, Yale Univ., USA.* A multi-mode fiber functions as a high-resolution, low-loss spectrometer. Wavelength-dependent speckle patterns are used for spectrum recovery. Record-high resolution and extremely broad range of operation are achieved.

IW4I • Filter and Waveguide Devices—Continued

IW4I.9 • 18:00
Ultra-High Efficient Thermal Tuning of Dielectric Optical Waveguides, Faisal Ahmed Memon[1,2], Francesco Morichetti[1], Andrea Melloni[1]; [1]*Dipartimento di Elettronica, Informazione e Bioingegneria, Politecnico di Milano, Italy;* [2]*Department of Telecommunications Engineering, Mehran Univ. of Engineering & Technology , Pakistan.* We show that high-refractive index silicon oxycarbide exhibits a record thermo-optic coefficient (2.5×10-4 °C-1), about 30× larger than that of silica, enabling the realization of low-power-consumption thermally-tunable dielectric photonic platforms.

NoW4J • Polaritonics—Continued

19:00 –21:00 Lab Automation Hackathon, *Room F33.1*

Room D1.1	Room E5	Room E3	Room D1.2	Room D7.1
Optical Sensors	Integrated Photonics Research, Silicon, and Nano-Photonics	Nonlinear Photonics	Novel Optical Materials and Applications	Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

07:30–17:30 Registration, *E Level*

08:00–10:00
SeTh1A • Nanophotonic and Plasmonic Biosensors
Presider: Björn Reinhard; Boston Univ., US

SeTh1A.1 • 08:00 Invited

Sensing with Hybrid Metallodielectric Metasurfaces, the Best of Both Worlds?, Olivier J. Martin[1], Debdatta Ray[1], Christian Santschi[1]; [1]*Nanophotonics and Metrology Laboratory, Ecole Polytechnique Federale de Lausanne, Switzerland.* We have fabricated metasurfaces that combine silicon resonators with aluminium disks. While the latter produce strong near-field enhancement, the former support optical resonances that can be used to obtain well-controlled far-field signatures.

SeTh1A.2 • 08:30

Plasmon-enhanced Second-harmonic Sensing on a Microfluidic Chip, Lavinia Ghirardini[1], Anne-Laure Baudrion[2], Marco Monticelli[1], Daniela Petti[1], Giovanni Pellegrini[1], Lamberto Duò[1], Paolo Biagioni[1], Marco Finazzi[1], Pierre-Michel Adam[2], Michele Celebrano[1]; [1]*Politecnico di Milano, Italy;* [2]*Université de Technologie de Troyes, France.* We present a prototypical microfluidic plasmon-assisted nonlinear sensing device. We attain similar resolution both in the linear and nonlinear sensing regimes. The nonlinear sensitivity, however, results up to 3 times higher than the linear one.

08:00–10:00
ITh1B • Photonic Crystals and Nanocavities
Presider: Xiaoxiao Xue; Tsinghua Univ., China

ITh1B.1 • 08:00

Parametric Processes Induced by Ultrafast Dynamics in a Photonic Crystal Nanocavity Switch, Yi Yu[1], Per L. Hansen[1], Kristoffer B. Joanesarson[1], Jesper Mørk[1]; [1]*Danmarks Tekniske Universitet, Denmark.* We present measurements of time-resolved transmission spectra of a photonic-crystal nanocavity switch using a pump-probe technique, showing ultrafast dynamics which we interpret as results of parametric process induced by free carrier oscillations

ITh1B.2 • 08:15

Slow Light Propagation in Extended Photonic Crystal Coupled-CAVITY Waveguides featuring a Large Group Index-bandwidth Product, Mohamed S. Mohamed[5], Yiming Lai[1], Momchil Minkov[2], Vincenzo Savona[5], Antonio Badolato[3,4], Romuald Houdré[5]; [1]*The Inst. of Optics, Univ. of Rochester, USA;* [2]*Ginzton Laboratory, Stanford Univ., USA;* [3]*Department of Physics, Univ. of Ottawa, Canada;* [4]*Center for Nanoscale Science and Technology, National Inst. of Standards and Technology, USA;* [5]*Inst. of Physics, École Polytechnique Fédérale de Lausanne, Switzerland.* We present the experimental characterization of slow-light photonic crystal coupled-cavity waveguides in silicon with a group-index bandwidth product ≈ 0.47, comprising up to 800 cavities. Limitations on slow light propagation are identified.

ITh1B.3 • 08:30

Chirped Photonic Crystal Kerr Cavities, Hojoong Jung[1,2], Su-Peng Yu[1,2], Travis Briles[1], Jeff Chiles[1], Cindy A. Regal[2], Kartik Srinivasan[1], Scott A. Diddams[1,2], Scott Papp[1,2]; [1]*NIST, USA;* [2]*Physics, Univ. of Colorado, USA.* We explore Fabry-Perot silicon-nitride waveguide cavities composed of lattice-chirped photonic-crystal mirrors. We show how to engineer broad bandwidth and net-roundtrip anomalous group-velocity dispersion to enable photonic-chip Kerr cavity physics.

08:00–10:00
NpTh1C • Applications of Quadratic Nonlinearities and Harmonic Generation
Presider: Silvia Soria; Ist di Fisica Applicata Nello Carrara, Italy

NpTh1C.1 • 08:00

Soliton-Modelocked 153-W Thin-Disk Laser Oscillator in Air Enabled by Negative Nonlinearities in a Phase-Mismatched $\chi^{(2)}$ Crystal, Francesco Saltarelli[1], Andreas Diebold[1], Ivan J. Graumann[1], Christopher Phillips[1], Ursula Keller[1]; [1]*ETH Zurich, Switzerland.* We use a phase-mismatched $\chi^{(2)}$ crystal to cancel the nonlinearities caused by intracavity air. We obtain 153 W average output power in an air-filled cavity, which is a record value for non-vacuum/non-helium SESAM modelocked lasers.

NpTh1C.2 • 08:15

Second Harmonic Generation by Mixing Longitudinal and Transverse Electric Field Components in Indium Gallium Phosphide-on-insulator Wire Waveguides, Utsav Dave[2], Nicolas Poulvellarie[1,2], Koen Alexander[2], Simon-Pierre Gorza[1], Fabrice Raineri[3], Sylvain Combrié[4], Alfredo De Rossi[4], Gunther Roelkens[2], Bart Kuyken[2], François Leo[1]; [1]*Université libre de Bruxelles, Belgium;* [2]*Ghent Univ., Belgium;* [3]*CNRS, France;* [4]*Thales Research, France.* We demonstrate second harmonic generation in InGaP-on insulator wire waveguides. We show that the longitudinal component of the fundamental quasi-TE pump mode, inherent to high index contrast waveguides, plays a critical role in the process

NpTh1C.3 • 08:30

Cascading Second-order Nonlinear Processes in a Lithium Niobate-on-insulator Microdisk, Shijie Liu[1]; [1]*Shanghai Jiaotong Univ., China.* We demonstrate resonant second-harmonic generation and third-harmonic generation via cascading processes in a lithium niobate-on-insulator microdisk resonator. The cascading processes reveals simultaneous phase matching in the resonator.

08:00–09:45
NoTh1D • Organic and Polymeric Materials
Presider: Sedat Nizamoglu; Koc Univ., Turkey

NoTh1D.1 • 08:00 Invited

Organic Salt Semiconductors with Surprising Optical and Electronic Properties, Frank Nuesch[1,2]; [1]*Swiss Federal Labs for Materials Sci/Tec, EMPA, Switzerland;* [2]*Institut des matériaux, EPFL, Switzerland.* Cyanines represent a class of charged chromophores that today are most widely employed as bio labels for fluorescent imaging. Here their use as organic semiconductors in solar cells, photodiodes and light emitting devices is highlighted.

NoTh1D.2 • 08:30

OAM Generation, Tunable Metamaterials and Sensors with Highly Deformable Fibers, Alessio Stefani[1,2], Richard Lwin[1], Boris T. Kuhlmey[1], Simon C. Fleming[1]; [1]*Inst. of Photonics and Opical Sciences (IPOS), The Univ. of Sydney, Australia;* [2]*DTU Fotonik, Technical Univ. of Denmark, Denmark.* A flexible fiber-drawn material, i.e. polyurethane, allows for novel applications from THz to the visible. We exploit its elastic properties to generate orbital angular momentum modes, to make pressure sensors and to realize tunable metamaterials.

08:30–10:00
SeTh1E • Optical Fiber Sensors III
Presider: Ali Masoudi; Univ. of Southampton, UK

SeTh1E.1 • 08:30

High-Sensitivity Fiber Optic Magnetic Field Sensor with Balanced Single Fiber Interferometric Readout, Ke-Xun Sun[1]; [1]*Univ. of Nevada, Las Vegas, USA.* A novel high-sensitivity fiber optic magnetic field sensor with a simple single fiber interferometric readout is proposed. A polarization maintaining fiber enables balanced heterodyne detection of magnetic field induced rotation.

Room D3.2	Room D5.2	Room E1.1	Room E1.2
Photonic Networks and Devices	Nonlinear Photonics	Nonlinear Photonics	Integrated Photonics Research, Silicon, and Nano-Photonics

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

07:30–17:30 Registration, *E Level*

08:00–10:00
NeTh1F • Routing in Wavelength and Space
Presider: Werner Klaus; National Inst of Information & Comm Tech, Japan

NeTh1F.1 • 08:00 Invited
Wavelength-selective Switching for Mode-division Multiplexing, Dan M. Marom[1], Miri Blau[1]; [1]*Edmund J. Safra, Campus, Hebrew Univ. of Jerusalem, Israel.* Mode-division multiplexed communication channels may incur mixing in transmission; hence must be routed as an inseparable entity per wavelength. We review wavelength-selective switch designs to fulfill this role based on spatial diversity and multimode beams.

NeTh1F.2 • 08:30
An Inter-modal-coupling-aware Heuristic Algorithm for Routing, Spectrum and Mode Assignment in Few-mode Optical Networks, Cristina Rottondi[1], Massimo Tornatore[2]; [1]*IDSIA, Switzerland;* [2]*Dept. of Electronics, Information and Bioengineering, Politecnico di Milano, Italy.* We propose a heuristic approach for Routing, Modulation format, Baud rate and Spectrum Allocation in few-mode networks considering inter-modal coupling impairments. Performance is assessed in terms of spectrum utilization and transceiver cost.

08:00–10:00
NpTh1G • Dynamical Effects in Lasers
Presider: Cristina Masoller; Universitat Politecnica de Catalunya, Spain

NpTh1G.1 • 08:00 Invited
Non-Hermitian Photonics: Optics at an Exceptional Point, Mercedeh Khajavikhan[1]; [1]*4304 Scorpius St, Univ. of Central Florida, CREOL, USA.* Abstract not available.

NpTh1G.2 • 08:30
Overcoming the Q-switching Limitation in High Repetition-Rate Straight-cavity SESAM-Modelocked Lasers, Léonard M. Krüger[1], Aline Mayer[1], Christopher Phillips[1], Valentin Wittwer[2], Thomas Südmeyer[2], Ursula Keller[1]; [1]*ETH Zurich, Switzerland;* [2] *Université de Neuchâtel, Switzerland.* Self-defocusing nonlinearities in a fanout-apodized PPLN device suppress Q-switching-damage and enable a repetition-rate stabilized SESAM-modelocked 10 GHz Yb:CALGO laser with 171-fs-pulses at 1.44 W (104 fs at 0.81 W with dispersion compensation).

08:00–10:00
NpTh1H • Opto-acoustic Effects, Raman and Brillouin Gain
Presider: Alessandro Tonello; XLIM Research Insititute, France

NpTh1H.1 • 08:00 Invited
Stable GHz-rate Mode-locking of Fiber Lasers Using Optoacoustic Interactions in Photonic Crystal Fibers, Meng Pang[1], Wenbin He[1], Philip S. Russell[1]; [1]*Max-Planck Inst. for the Science of Light, Germany.* Intense optoacoustic interactions in solid-core photonic crystal fibers have been used for mode-locking fiber lasers at gigahertz repetition rates and storing supramolecular pulse sequences in laser cavities over many hours.

NpTh1H.2 • 08:30
Improved Design of Ultra-wideband Discrete Raman Amplifier with Low Noise and High Gain, Md A. Iqbal[1], Paul Harper[1], Wladek Forysiak[1]; [1]*Aston Univ., UK.* A novel dual stage discrete Raman amplifier design is presented numerically to obtain 165nm gain bandwidth over S+C+L bands with ~4dB higher net gain and ~2.3dB improved noise figure than a conventional single stage design

08:15–10:00
ITh1I • Photonic Integrated Circuits
Presider: Anna Tauke-Pedretti; Sandia National Laboratories Albuquerque, USA

ITh1I.1 • 08:15
Monolithic Integration of Al_2O_3 and Si_3N_4 for Double-layer Integrated Photonic Chips, Jinfeng Mu[1,2], Michiel de Goede[1,2], Meindert Dijkstra[1,2], Sonia García-Blanco[1,2]; [1]*Univ. of Twente, Netherlands;* [2]*MESA+ Inst. for Nanotechnology, Univ. of Twente, Netherlands.* Optical coupling for monolithic integration of Al_2O_3 and Si_3N_4 layers is presented using a vertical and lateral adiabatic taper. The measured loss of the fabricated couplers is 0.49±0.03 dB at the wavelength of 1030 nm.

ITh1I.2 • 08:30 Invited
Programmable Photonics: State of the Art and Future Trends, Daniel Perez Lopez[1], José Capmany Francoy[1]; [1]*Camí de Vera, s/n, Universidad Politecnica de Valencia, Spain.* Here we review past, present and future work in the next photonic ICs generation aiming the integration of multi-functional software-defined systems for signal processing operations.

Room D1.1

Optical Sensors

Room E5

Integrated Photonics Research, Silicon, and Nano-Photonics

Room E3

Nonlinear Photonics

Room D1.2

Novel Optical Materials and Applications

Room D7.1

Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

SeTh1A • Nanophotonic and Plasmonic Biosensors—Continued

SeTh1A.3 • 08:45 Invited

Recent Advances in Chiral Plasmonics, Harald W. Giessen[1]; [1]*4th Physics Inst., Universität Stuttgart, Germany.* Abstract not available.

SeTh1A.4 • 09:15

High-Fidelity Fast Tracking of Protein Motion, Kristýna Holanová[1], Lukasz Bujak[1], Antonio Marin[1], Marcus Braun[2], Zdeněk Lánský[2], Marek Piliarik[1]; [1]*Nano Optics, Inst. of Photonics and Electronics AS CR, Czechia;* [2]*Division BIOCEV, Inst. of Molecular Genetics AS CR, Czechia.* In this work, we aim at tracking the motion in biophysical system with a nanometer fidelity and at microseconds temporal resolution using interferometric scattering microscopy (iSCAT).

ITh1B • Photonic Crystals and Nanocavities—Continued

ITh1B.4 • 08:45

Consequences of Non-uniform Expansion of InP-on-Si Wafers for the Performance of Buried Heterostructure Photonic Crystal Lasers, Aurimas Sakanas[1], Yi Yu[1], Elizaveta Semenova[1], Luisa Ottaviano[1], Hitesh Sahoo[1], Jesper Mørk[1], Kresten Yvind[1]; [1]*Technical Univ. of Denmark, Denmark.* E-beam metrology is employed to investigate the consequences of non-uniform expansion of 250nm InP layer bonded to Si substrate by BCB and direct wafer bonding for the performance of photonic crystal lasers with buried heterostructure.

ITh1B.5 • 09:00

Gram-type Differentiation of Bacteria with 2D Hollow Photonic Crystal Cavities, Rita Therisod[1], Manon Tardif[2,3], Pierre R. Marcoux[4], Emmanuel Picard[3], Emmanuel Hadji[3], David Peyrade[2], Romuald Houdré[1]; [1]*Institut de Physique, Ecole Polytechnique Federale de Lausanne, Switzerland;* [2]*CNRS, LTM Micro and Nanotechnologies for Health, Univ. Grenoble Alpes, France;* [3]*CEA-INAC-PHELIQS_SINAPS, CEA Univ. Grenoble Alpes, France;* [4]*LETI Minatec Campus, CEA Univ. Grenoble Alpes, France.* We report on the optical trapping and Gram-type differentiation of seven types of living bacteria in 2D hollow photonic crystal cavities, thanks to the analysis of the membrane-dependent resonance frequency shift.

ITh1B.6 • 09:15

Coherence of Metal-Clad Semiconductor Nanolasers, Andrey A. Vyshnevyy[1], Dmitry Y. Fedyanin[1]; [1]*Laboratory of Nanooptics and Plasmonics, Moscow Inst. of Physics and Technology, Russia.* Threshold of semiconductor nanolasers, including “thresholdless” nanolasers, can be found by the study of second-order coherence, which is determined by the ratio of stimulated to spontaneous emission rate into the laser mode.

NpTh1C • Applications of Quadratic Nonlinearities and Harmonic Generation—Continued

NpTh1C.4 • 08:45

Broadband Phase-Matching using Tilted Quasi-phase-matching Gratings, Nicolas Bigler[1], Justinas Pupeikis[1], Stefan Hrisafov[1], Lukas Gallmann[1], Christopher Phillips[1], Ursula Keller[1]; [1]*Physics, ETH Zurich, Switzerland.* We investigate optical parametric amplification using tilted quasi-phase-matching (QPM) gratings. Adding a transverse k-vector component to the QPM grating allows decoupling the geometrical layout of the amplification stage from its bandwidth.

NpTh1C.5 • 09:00

Spatial Beam Cleaning in Quadratic Nonlinear Medium, Katarzyna Krupa[2], Riccardo Fona[2], Alessandro Tonello[1], alexis labruyère[1], Badr M. Shalaby[1], Stefan Wabnitz[2], Fabio Baronio[2], Alejandro B. Aceves[3], Guy Millot[4], Vincent Couderc[1]; [1]*XLIM Research Institute, France;* [2]*Dipartimento di Ingegneria dell'Informazione, Università di Brescia, Italy;* [3]*Department of Mathematics, Southern Methodist Univ., USA;* [4]*ICB, Université de Bourgogne Franche-Comté, France.* We show experimentally that a laser beam scrambled by propagation in a short segment of multimode fibermay be cleaned by the nonlinear propagation in KTP cristal with type-II second-harmonic generation.

NpTh1C.6 • 09:15

Developing PPLN Waveguides for Quantum Rubidium Atom Traps in Space, Lewis G. Carpenter[1], Sam A. Berry[1], Rex H. Bannerman[1], Alan C. Gray[1], James W. Field[1], Christopher Holmes[1], James C. Gates[1], Peter G. Smith[1], Corin B. Gawith[1]; [1]*Univ. of Southampton, UK.* We demonstrate single mode zinc-indiffused MgO:PPLN ridge waveguides with insertion losses of <1.3 dB (2 cm device length), developed towards rubidium atom traps. We will report on fabrication, modal engineering, loss, and second harmonic generation.

NoTh1D • Organic and Polymeric Materials—Continued

NoTh1D.3 • 08:45 Invited

Optochemical Waves: From Bio-inspired Optics, 3-D Printing to Materials that Compute with Light, Kalaichelvi Saravanamuttu[1]; [1]*Chemistry and Chemical Biology, McMaster Univ., Canada.* Solitonic optochemical waves can (i) fabricate waveguide encoded lattices with exceptionally large fields of view, (ii) 3-D print seamless objects inaccessible to current technologies and (iii) encode, transfer and compute with binary data.

NoTh1D.4 • 09:15

Rapid Reproduction of Anisotropic Optical Elements by Embossing of UV-crosslinkable Liquid Crystals, Markus Wahle[1], Ben Snow[2], Joe Sargent[2], J Cliff Jones[1]; [1]*Univ. of Leeds, UK;* [2]*Merck Chemicals Ltd, UK.* We present a processing method for the rapid manufacturing of anisotropic optical structures. This technique relies on embossing of polymerisable liquid crystals which can be cast into several different forms such as lenses and gratings.

SeTh1E • Optical Fiber Sensors III—Continued

SeTh1E.2 • 08:45

Pseudo Distributed Optic-fiber Ultra-acoustic Sensing System, Zi Ye[1], Chao Wang[1]; [1]*Fudan Univ., China.* A pseudo distributed optic-fiber ultra-acoustic sensing system is proposed to monitor up to 31 valves internal leakage. WDMs are associated with the white light wide spectrum interference technology to form a pseudo distributed detection network.

SeTh1E.3 • 09:00

Fading Signal Reconstruction for Q-Point Demodulation Based Interferometric Fiber Acoustic Sensor, Fu Xin[1], Ping Lu[1], Deming Liu[1]; [1]*Huazhong Univ. of Science and Technology, China.* A signal reconstruction technique is proposed for the Q-point demodulated acoustic sensor. Q-point drift is estimated from the characteristics of output waveform, and fading signal is compensated through an algorithm according to the estimation.

SeTh1E.4 • 09:15

Improved MZI-based Fiber Sensor By Introducing A Tapered Region Between Two Offset Splicing Points, Guan-Ting Lin[1], Chin-Ping Yu[1]; [1]*National Sun Yat-Sen Univ., Taiwan.* A sensitivity enhanced fiber MZI sensor has been proposed by making a tapered region between two offset splicing points. The measure results show that both the RI and strain sensing sensitivities can be efficiently improved.

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

Room D3.2 — Photonic Networks and Devices

NeTh1F • Routing in Wavelength and Space—Continued

NeTh1F.3 • 08:45
First WDM-SDM Optical Network with Spatial Sub-Group Routing ROADM Nodes Supporting Spatial Lane Changes, Shalva Ben-Ezra[1], Matteo Gerola[2], Domenico Siracusa[2], Federico Pederzolli[2], Dan M. Marom[3], Miri Blau[3], John Macdonald[4], nicholas psaila[4], Christian Sanchez-Costa[5], Andrew D. Ellis[5], Xavi Forns[6], Jordi F. Ferran[6], Felipe Jimenez[7], Nina Christodoulia[8], Behnam Shariati[9], Dimitrios Klonidis[9], Ioannis Tomkos[9]; [1]*Opsys Technologies, Israel;* [2]*Fondazione Bruno Kessler, Italy;* [3]*Hebrew Univ. of Jerusalem, Israel;* [4]*Optoscribe, UK;* [5]*Aston Univ., UK;* [6]*W-Onesys, Spain;* [7]*Telefonica I+D, Spain;* [8]*Optronics, Greece;* [9]*Athens Information Technologies, Greece.* 4-node, 4-lane SDM mesh network with CD-ROADM nodes performing dual spatial channel routing & lane changes is reported, under centralized SDN control for space/spectrum assignments. The architecture achieves high utilization & low implementation cost

NeTh1F.4 • 09:00
1,024x1,024 Optical Circuit Switch Using Wavelength-tunable and Bandwidth-variable Silicon Photonic Filter, Mungun-Erdene Ganbold[1], Hiroki Nagai[1], Yojiro Mori[1], Keijiro Suzuki[2], Hiroyuki Matsuura[2], Ken Tanizawa[2], Kazuhiro Ikeda[2], Shu Namiki[2], Hitoshi Kawashima[2], Ken-ichi Sato[1,2]; [1]*Nagoya Univ., Japan;* [2]*National Inst. of Advanced Industrial Science and Technology, Japan.* We fabricate a fast wavelength-tunable and bandwidth-variable optical filter using silicon-photonics technologies. Part of a 1024x1024 switch is constructed and adaptive support of 10-Gbps, 28-Gbps and 56-Gbps signals is experimentally demonstrated.

NeTh1F.5 • 09:15
Impact of Contention/-less ROADM Nodes on Switching Capacity, Abhishek Anchal[1], Dan M. Marom[1]; [1]*The Hebrew Univ. of Jerusalem, Israel.* We present a method to measure the capacity of ROADM by counting all permutations of switching of nodal directions and partitioning the receivers into all possible adds/drops and routing from nodal directions and wavelength channels.

Room D5.2 — Nonlinear Photonics

NpTh1G • Dynamical Effects in Lasers—Continued

NpTh1G.3 • 08:45
Dynamics of a Green High-power Tunable Broad-area GaN Diode Laser with External-cavity Feedback, Mingjun Chi[1], Ole Jensen[1], Anders Hansen[1], Paul M. Petersen[1]; [1]*Department of Photonics Engineering, Technical Univ. of Denmark, Denmark.* Different dynamic behaviors, such as regular pulse package oscillation, irregular pulse package oscillation, and chaos are observed in a green high power broad-area GaN diode laser system with a grating external-cavity feedback.

NpTh1G.4 • 09:00
Laser with Injected Signal, Beyond the Integrate and Fire Excitable Dynamics, Axel Dolcemascolo[1], bertrand peyce[1], Bruno Garbin[1], Romain Veltz[1], Giovanna Tissoni[1], Stéphane Barland[1]; [1]*Université Côte d'Azur, France.* A laser with coherent injection can mimick the response of neurons to external perturbations, opening avenues for neuromorphic computing. We analyze this system beyond the "integrate and fire" regime and show analog to digital conversion.

NpTh1G.5 • 09:15
Satellite Instabilities in Passively Mode-locked Vertical-cavity Surface-emitting Lasers, Julien Javaloyes[1], Christian Schelte[1], Svetlana Gurevich[2,3]; [1]*Universitat de les Illes Balears, Spain;* [2]*Physics, Inst. for Theoretical Physics, Germany;* [3]*Physics, Center for Nonlinear Science (CeNoS), Germany.* Passive mode-locking of vertical external-cavity surface-emitting lasers is based upon the dynamics of coupled cavities. We demonstrate that this simple fact as profound implications and that a new kind of instability for the pulse exists.

Room E1.1 — Nonlinear Photonics

NpTh1H • Opto-acoustic Effects, Raman and Brillouin Gain—Continued

NpTh1H.3 • 08:45
The Role of the Raman Gain in the Noise Dynamics of All-normal Dispersion Silica Fiber Supercontinuum Generation, Iván Bravo Gonzalo[1], Ole Bang[1,2]; [1]*DTU FOTONIK, Denmark;* [2]*NKT Photonics, Denmark.* We present a numerical investigation of the difference in the noise dynamics of all-normal dispersion silica fiber supercontinuum when the measured Raman gain, instead of the analytical Raman models, is used in the simulations.

NpTh1H.4 • 09:00
Frequency Preserving Coherent Opto-acoustic Storage, Birgit Stiller[1], Moritz Merklein[1], Christopher Poulton[2], Khu Vu[3], Pan Ma[3], Stephen Madden[3], Benjamin J. Eggleton[1]; [1]*Univ. of Sydney, Australia;* [2]*The Univ. of Technology Sydney, Australia;* [3]*Australian National Univ., Australia.* We experimentally demonstrate that the coherence of Brillouin-based storage is not affected by simultaneous storage on another frequency channel because of the accumulated phase mismatch over the length of the spatially extended acoustic phonon.

NpTh1H.5 • 09:15
Raman Amplification and Pulse Dynamics in Silicon Photonic Crystal Waveguides, Victor M. Fernandez Laguna[1,2], Nicolae Panoiu[1]; [1]*Univ. College London, UK;* [2]*Defence and Space, Airbus, UK.* A rigorous mathematical model is developed to study the Raman effect in silicon photonic crystal waveguides. We show how enhanced signal amplification without pulse distortion is achieved by adequately tuning the pulse group velocities.

Room E1.2 — Integrated Photonics Research, Silicon, and Nano-Photonics

ITh1I • Photonic Integrated Circuits—Continued

ITh1I.3 • 09:00 Invited
InGaP/GaP based Nonlinear Integrated Nanophotonics, Fabrice Raineri[1,2], Gabriel Marty[1], Dorian Sanchez[1], Sylvain Combrié[3], Alfredo De Rossi[3]; [1]*Route de Nozay, C2N-CNRS, France;* [2]*Physics department, Université Paris Diderot, France;* [3]*Thales Research and Technology, France.* InGaP and GaP-based photonic crystal structures were designed and fabricated with the view of obtaining efficient four wave mixing. We show that both nanocavities and slow light waveguides can be advantageously implemented for nonlinear CW operation.

Room D1.1	Room E5	Room E3	Room D1.2	Room D7.1
Optical Sensors	Integrated Photonics Research, Silicon, and Nano-Photonics	Nonlinear Photonics	Novel Optical Materials and Applications	Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

SeTh1A • Nanophotonic and Plasmonic Biosensors—Continued

SeTh1A.5 • 09:30 Invited

Plasmonically Enhanced Fluorescence Biosensors Actuated by Responsive Hydrogels, Nestor Quilis[1], Daria Kotlarek[1], Stefan Fossati[1], Simone Hageneder[1], Christian Petri[2], Ulrich Jonas[2], Jakub Dostalek[1]; [1]*Konrad-Lorenz-Strasse 24, Austrian Inst. of Technology, Austria;* [2]*Univ. of Siegen, Germany.* Actively tunable plasmonic materials were developed for advanced optical biosensors. They are composed of metallic nanostructures and responsive hydrogels and were tailored for plasmon-enhanced fluorescence analysis of trace amounts of analytes.

ITh1B • Photonic Crystals and Nanocavities—Continued

ITh1B.7 • 09:30

Overcoming the Fundamental Limit of Outcoupling Efficiency: A Low-refractive-index Cavity Grating, Ji-Hyun Kim[1], Yoon-Jong Moon[1], Sun-Kyung Kim[1]; [1]*Department of Applied Physics, Kyung Hee Univ., South Korea.* A high outcoupling efficiency dictates development of high-efficiency light-emitting diodes. Here, we demonstrate that low-refractive-index cavity gratings present a fundamental breakthrough in outcoupling efficiency via high-amplitude leaky modes.

ITh1B.8 • 09:45

2D Integrating Cell for Ultra-long Optical Path On chip, Alexander Petrov[1,2], Lena Simone Fohrmann[1], Gerrit Sommer[1], Giampaolo Pitruzzello[3], Thomas F. Krauss[3], Manfred Eich[1,4]; [1]*Hamburg Univ. of Technology, Germany;* [2]*ITMO Univ., Russia;* [3]*Univ. of York, UK;* [4]*Helmholtz-Zentrum Geesthacht, Germany.* We introduce a 2D waveguide platform employing an integrating cell approach which enables ultra-long optical propagation paths in a very small geometrical footprint. Effective propagation length of 25 cm is demonstrated.

NpTh1C • Applications of Quadratic Nonlinearities and Harmonic Generation—Continued

NpTh1C.7 • 09:30

Maker Fringe Measurement of Thermally Poled Thin-Film Layered Silica Structures, SeyedHamed Jafari[1], Salah M. Aljamimi[2], Jacques Albert[1], Christopher W. Smelser[1]; [1]*Department of Electronics, Carleton Univ., Canada;* [2]*Department of Physics, Laval Univ., Canada.* In this presentation second harmonic generation from thermally poled multilayer doped and un-doped silica structure is studied. We show how SHG efficiency changes with respect to various dopant types, concentration and duty cycle of thin-film samples

NpTh1C.8 • 09:45

Extreme Ultraviolet Light Source by High-Harmonic Generation Inside an Ultrafast Thin-Disk Laser, François Labaye[1], Maxim Gaponenko[1], Valentin Wittwer[1], Andreas Diebold[2], Clément Paradis[1], Norbert Modsching[1], Loïc Merceron[1], Florian Emaury[2], Ivan J. Graumann[2], Christopher Phillips[2], Clara Saraceno[3], Christian Kränkel[4,5], Ursula Keller[2], Thomas Südmeyer[1]; [1]*Université de Neuchâtel, Switzerland;* [2]*ETH Zurich, Switzerland;* [3]*Ruhr-Universität Bochum, Germany;* [4]*Universität Hamburg, Germany;* [5]*Leibniz Inst. for Crystal Growth, Germany.* We demonstrate a compact XUV source based on intracavity high-harmonic generation driven inside a modelocked thin-disk laser oscillator, generating photons with energy up to 20.4 eV (17^{th} harmonics) at a repetition rate of 17.35 MHz.

NoTh1D • Organic and Polymeric Materials—Continued

NoTh1D.5 • 09:30

Liquid Crystal Response in the Evanescent Field of a Planar Waveguide, Christopher M. Spillmann[1], Henry Gotjen[1], Jakub Kolacz[2], Jesse A. Frantz[1], Jason D. Myers[1], Robel Y. Bekele[3], Jawad Naciri[1]; [1]*US Naval Research Laboratory, USA;* [2]*American Society for Engineering Education, USA;* [3]*Univ. Research Foundation, USA.* The response time of liquid crystal proximal to an aligning interface, where surface anchoring energy dominates, is quantified as a function of voltage utilizing the evanescent field of the guided mode in a planar waveguide.

SeTh1E • Optical Fiber Sensors III—Continued

SeTh1E.5 • 09:30

A Long-Period Fiber-Grating Sensor Fabricated by Tilted Mask Method Using a Vertical-Cavity Surface-Emitting Laser, Toru Mizunami[1], Satoshi Arahira[1]; [1]*Department of Electrical Engineering and Electronics, Graduate School of Engineering, Kyushu Inst. of Technology, Japan.* A low-cost long-period grating (LPG) sensor using a VCSEL and a photodiode was developed. LPGs with controlled wavelengths were fabricated by tilted-mask method. Temperature sensing with reduction in error was demonstrated using a pigtailed VCSEL.

SeTh1E.6 • 09:45

Effect of Coupler Splitting Ratio on Frequency-Shifted Interferometry Fiber Loop Ring-Down Gas Sensing System, Zhangyong Yang[1], Chunfu Cheng[1], Yiwen Ou[1], Zehao Chen[1], Hui Lv[1]; [1]*Hubei Univ. of Technology, China.* The effect of coupler splitting ratio on the performance of frequency-shifted interferometry fiber loop ring-down gas sensing system is theoretically and experimentally investigated. There exists an optimal CSR for improving the measurement accuracy.

10:00–10:30 Networking Coffee Break, *D Level Foyers*

Room D3.2

Photonic Networks and Devices

Room D5.2

Nonlinear Photonics

Room E1.1

Nonlinear Photonics

Room E1.2

Integrated Photonics Research, Silicon, and Nano-Photonics

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

NeTh1F • Routing in Wavelength and Space—Continued

NeTh1F.6 • 09:30 Invited

On the Challenges and Benefits of Implementing Spatially-spectrally Flexible Optical Networks, Ioannis Tomkos[1]; [1]*AIT, Greece.* In this invited presentation we will discuss the technologies to support the operation of spectrally-spatially flexible optical networks, focusing on spatial integration of elastic optical network switching elements.

NpTh1G • Dynamical Effects in Lasers—Continued

NpTh1G.6 • 09:30

L-band Passively Harmonic Mode-locked Erbium-doped Fiber Laser based on Carbon Nanotubes Film, Qianqian Huang[1], Chuanhang Zou[1], Mohammed AlAraimi[3,4], Chengbo Mou[1], Aleksey Rozhin[2,3]; [1]*Key Laboratory of Specialty Fiber Optics and Optical Access Networks, Shanghai Univ., China;* [2]*Aston Inst. of Photonic Technologies, Aston Univ., UK;* [3]*Nanoscience Research Group, Aston Univ., UK;* [4]*Al Musanna College of Technology, Oman.* We have demonstrated a passively harmonic mode-locked Er-doped fiber laser operating at L band based on carbon nanotubes film. 456.76 MHz pulses at 49th harmonics centered at 1595.98nm with 45dB super-mode suppression ratio can be realized.

NpTh1G.7 • 09:45

Lasing on Nonlinear Localized Waves in Curved Geometry, Kou-Bin Hong[2], Chun-Yan Lin[1], Tsu-Chi Chang[2], Wei-Hsuan Liang[2], Ying-Yu Lai[2], Chien-Ming Wu[1], You-Lin Chuang[1], Tien-Chang Lu[2], Claudio Conti[3], Ray-Kuang Lee[1]; [1]*National Tsing Hua Univ., Taiwan;* [2]*National Chiao Tung Univ., Taiwan;* [3]*Univ. Sapienza, Italy.* By implementing surface structures in vertical cavity surface emitting lasers as manifolds for curved space, we experimentally study the impacts of geometrical constraints on nonlinear wave localization.

NpTh1H • Opto-acoustic Effects, Raman and Brillouin Gain—Continued

NpTh1H.6 • 09:30

Nanosecond-pumped Random Raman Lasing from Bulk Nanogranular Materials, Panuwat Srisamran[1,2], Paphon Pewkhom[1,2], Sirawit Boonsit[1,2], Pruet Kalasuwan[1,2], Paphavee v. Dommelen[1,2], Chalongrat Daengngam[1,2]; [1]*Department of Physics, Faculty of Science, Prince of Songkla Univ., Thailand;* [2]*Chaing Mai, Thailand Center of Excellence in Physics (ThEP), Thailand.* We demonstrate for the evidences of random Raman lasing obtained from highly disordered material, composed of submicron particles and their aggregates, pumped by nanosecond laser pulses and utilized multiple elastic scattering for optical feedback.

NpTh1H.7 • 09:45

Spatial Rogue Waves in Quadratic Optical Slab Waveguides, Roland Schiek[1], Frank Setzpfandt[2], Thomas Pertsch[2], Fabio Baronio[3], Costantino De Angelis[3]; [1]*Electrical Engineering, Ostbayerische Technische Hochschule Regensburg, Germany;* [2]*Institute of Applied Physics, Friedrich-Schiller-Universität Jena, Germany;* [3]*Universita di Brescia, Italy.* Spatial optical breather solutions of the Nonlinear Schrödinger Equation have been observed for the first time. The experiment was performed in an optical slab waveguide with the cascaded quadratic nonlinearity in second-harmonic generation.

ITh1I • Photonic Integrated Circuits—Continued

ITh1I.4 • 09:30 Invited

Interferometric Reflectance Imaging Sensor using Si-based Microfluidics, M. Selim Ünlü[1,2], Jacob Trueb[3], James Needham[4], Celalettin Yurdakul[1], Derin Sevenler[1], Fulya Ekiz Kanik[1], Ayca Yalcin Ozkumur[1], Nese Lortlar Unlu[2], Matthew Geib[2]; [1]*Electrical and Computer Engineering, Boston Univ., USA;* [2]*Biomedical Engineering, Boston Univ., USA;* [3]*Mechanical Engineering, Boston Univ., USA;* [4]*InBios, USA.* IRIS offers kinetic analysis of biomolecular binding and detection of single biomolecules and biological nanoparticles. We demonstrated low-cost and manufacturable sensor chips and microfluidic cartridges using standard Si processing techniques.

10:00–10:30 Networking Coffee Break, *D Level Foyers*

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

07:30–17:30 Registration, *E Level*

Room D1.1

Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials

10:30–12:30
BTh2A • Poling and Laser-induced Crystallization in Glasses
Presider: Walter Margulis; RISE Acreo AB, Sweden

BTh2A.1 • 10:30 Invited
Crystal Lattice Engineering during Laser-induced Single Crystal Growth , Keith Veenhuizen[3], Courtney Au-Yeung[1], Sean McAnany[4], Dmytro Savytskyy[4], Daniel A. Nolan[2], Bruce Aitken[2], Himanshu Jain[4], Volkmar Dierolf[1]; [1]*Dept of Physics, Lehigh Univ., USA;* [2]*Corning Inc, USA;* [3]*Physics, Lebanon Valley College, USA;* [4]*Materials Science and Engineering, Lehigh Univ., USA.* We demonstrate how the special environment for crystal growth in glass that are imposed by a laser can lead to rotation of the crystal lattice within a crystal and present potential applications

BTh2A.2 • 11:00
Silicate Glass-Ceramics toward Photonic Applications: Pockels Effect and Second-Harmonic Generation, Kazuya Takano[1], Kosuke Funajima[1], Yoshihiro Takahashi[1], Yoshiki Yamazaki[1], Nobuaki Terakado[1], Takumi Fujiwara[1]; [1]*Tohoku Univ., Japan.* We fabricated the highly-oriented glass-ceramics in silicate systems, and succeeded in estimating the Pockels and second-order nonlinear optical constants comparable to common inorganic nonlinear-optical crystals.

Room E5

Integrated Photonics Research, Silicon, and Nano-Photonics

10:30–12:30
ITh2B • Novel Photonic Platforms
Presider: Orad Reshef; Univ. of Ottawa, Canada

ITh2B.1 • 10:30
Integrated Photonics in Single-crystal Diamond: Demonstration of Mm-long Waveguides, High-efficiency Gratings and Wideband Directional Couplers, Nathalie Vermeulen[1], Juergen Van Erps[1], Zhihong Huang[2], Benjamin Feigel[1], Hugo Thienpont[1], Ray G. Beausoleil[2], Fei Gao[1]; [1]*Brussels Photonics - Department of Applied Physics and Photonics, Vrije Universiteit Brussel, Belgium;* [2]*Large-Scale Integrated Photonics Research Group, Hewlett Packard Laboratories, USA.* Single-crystal diamond (SCD) is a promising material for integrated photonics, yet technologically challenging. We show how to overcome these challenges and demonstrate long waveguides, efficient gratings and wideband directional couplers in SCD.

ITh2B.2 • 10:45 Invited
III-V Nanowires on Si for Applications in Photonics, Anna Fontcuberta-Morral[1]; [1]*EPFL, Switzerland.* Nanowires are filamentary crystals with a tailored diameter ranging from few to ~100 nm. We demonstrate their integration on silicon and show how they enable/improve applications in the areas of lasing, photodetection and solar cells.

Room E3

Nonlinear Photonics

10:30–12:30
NpTh2C • Spatiotemporal Phenomena II
Presider: Julien Javaloyes; Universitat de les Illes Balears, Spain

NpTh2C.1 • 10:30 Invited
Replica Symmetry Breaking in Disordered Nonlinear Waves, Claudio Conti[1,2], Davide Pierangeli[2], Andrea Tavani[2], Fabrizio Di Mei[2], Giulia Marcucci[2], Aharon Agranat[3], Eugenio Del Re[2]; [1]*P.le Aldo Moro 5, ISC-CNR Dep. Physics Univ. Sapienza, Italy;* [2]*Sapienza, Univ. Sapienza, Italy;* [3]*Hebrew Univ. of Jerusalem, Israel.* We report the experimental evidence of replica symmetry breaking in optical wave propagation, a phenomenon that emerges from the interplay of disorder and nonlinearity.

NpTh2C.2 • 11:00
Extreme Events in a Spatially Extended Laser, Cristina Rimoldi[1], Stéphane Barland[1], Franco Prati[2], Giovanna Tissoni[1]; [1]*Université Côte d'Azur, France;* [2]*Dipartimento di Fisica e Alta Tecnologia, Universita dell'insubria, Italy.* We show numerical results about spatiotemporal extreme events in a broad-area semiconductor laser with saturable absorber. We study the statistics of 3D(x, y, t) intensity maxima, identify extreme events and explore their existence in parameter space.

Room D1.2

Novel Optical Materials and Applications

10:30–12:30
NoTh2D • Tunable Metadevices I
Presider: Mikhail Kats; Univ. of Wisconsin-Madison, USA

NoTh2D.1 • 10:30 Invited
Towards Three-dimensionally Programmable Metadevices, Ann-Katrin Michel[1], Andreas Heßler[2], Thomas Taubner[2]; [1]*ETH D-MAVT, ETH Zurich, Switzerland;* [2]*Inst. of Physics (IA), RWTH Aachen Univ., Germany.* Programmed fine-tuning of hybrid metasurface resonances in the infrared spectral range is realized by applying single laser pulses to a phase-change material film covering metallic nanostructures and taking advantage of the local resonator's field.

NoTh2D.2 • 11:00 Invited
Ion Beam Designed Metasurfaces, Carsten Ronning[1]; [1]*Inst. of Solid State Physics, Univ. of Jena, Germany.* Using industrial relevant ion beam technologies holds high potential for the realization of large-scale and inherently flat metasurfaces. I will show several examples for optical engineering of materials using spatially selective ion irradiation.

Room D7.1

Optical Sensors

10:30–12:30
SeTh2E • Sensing in Harsh Environment
Presider: Xuewen Shu; Huazhong Univ of Science and Technology, China

SeTh2E.1 • 10:30 Invited
Dynamic Strain Measurement in Subsea Power Cables with Distributed Optical Fibre Vibration Sensor, Ali Masoudi[1], James Pilgrim[2], Trevor Newson[1], Gilberto Brambilla[1]; [1]*Optoelectronics Research Centre (ORC), Univ. of Southampton, UK;* [2]*Electronics and Computer Science, Univ. of Southampton, UK.* A distributed vibration sensor is used to measure vibrations along a subsea power cable. It is shown that the DVS can mapping vibrations along a 10km-long subsea power cable with perturbation frequencies as low as 0.1Hz.

SeTh2E.2 • 11:00
Embedded Sapphire Optical Fiber Sensor Development for Harsh Environments, Shuo Yang[1], Daniel Homa[1], Adam Hehr[2], Mark Norfolk[2], Anbo Wang[1], Gary Pickrell[1]; [1]*Virginia Tech, USA;* [2]*Fabrisonic, USA.* Single crystal sapphire fiber sensors have been embedded in an aluminum alloy component fabricated via ultrasonic additive manufacturing. Raman based distributed temperature measurements were obtained as a function of distance in the embedded fiber.

Room D3.2	Room D5.2	Room D7.2	Room E1.1	Room E1.2
Photonic Networks and Devices	Signal Processing in Photonic Communications	Specialty Optical Fibers	Nonlinear Photonics	Integrated Photonics Research, Silicon, and Nano-Photonics

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

07:30–17:30 Registration, *E Level*

11:00–12:15
NeTh2F • Network Resiliency and Security
Presider: Domenico Siracusa; Fondazione Bruno Kessler, Italy

NeTh2F.1 • 10:30 Invited
Withdrawn

NeTh2F.2 • 11:00
Towards Entangled Photon Distribution Over a Metropolitan Fiber Network, James Grieve[1], Kenneth Ho[1], Christian Kurtsiefer[1,2], Alexander Ling[1,2]; [1]*Centre for Quantum Technologies, Singapore;* [2]*Department of Physics, National Univ. of Singapore, Singapore.* Distribution of entangled photons over deployed fiber networks presents unique engineering challenges. We have developed a photon pair source for this application, and discuss how network constraints informed our design.

10:30–12:15
SpTh2G • Short Reach Systems
Presider: Qunbi Zhuge; Shanghai Jiao Tong Univ., Canada

SpTh2G.1 • 10:30 Invited
SSBI Mitigation Single-Sideband Transmission, Lidia Galdino[1], D. Semrau[1], Eric Sillekens[1], Dominac Lavery[1], Robert Killey[1], Polina Bayvel[1]; [1]*Dept of Electronic Engineering, Univ. College London, UK.* Challenges in the design of transceivers for ultra-high-capacity optical transmission systems are described, together with the details of some approaches to overcome them, description of theoretical models and metrics, and an outlook for the future.

SpTh2G.2 • 11:00
Optimizing Reach and Capacity of IM/DD Systems by using Multidimensional PAM and DSP, Simon Ohlendorf[1], Riya Joy[1], Stephan Pachnicke[1], Werner Rosenkranz[1]; [1]*Chair of Communications, CAU Kiel, Germany.* We experimentally compare how nonlinear equalization and Kramers-Kronig reception affect the OSNR requirements of data center interconnects with IM/DD and single-sideband transmission. We vary the spectral efficiency by using multidimensional PAM.

10:30–12:30
SoTh2H • Novel Light Sources
Presider: Ole Bang; DTU Fotonik, Denmark

SoTh2H.1 • 10:30 Invited
Spatio-temporal Mode-locking in Multimode Fiber Lasers, Frank W. Wise[1]; [1]*Department of Applied Physics, Cornell Univ., USA.* Locking of multiple transverse and longitudinal modes to produce spatiotemporal wave packets in a laser is demonstrated. Implications for laser science and high-power sources are discussed.

SoTh2H.2 • 11:00
Non-invasive Excitation of Meter-scale Electric Discharges in Gas-filled Hollow-core Photonic Crystal Fibers, Alexander M. Heidt[1], Tim Bradley[2], Natalie Wheeler[2], Marco Petrovich[2], Manuel Ryser[1], Thomas Feurer[1]; [1]*Universitat Bern, Switzerland;* [2]*Optoelectronics Research Centre, UK.* We introduce a novel non-invasive approach to excite electric gas discharges in hollow-core photonic crystal fibers based on external high voltage radio frequency excitation. We observe meter-scale plasma columns in neon and xenon mixed with helium.

10:30–12:30
NpTh2I • Applications of Supercontinuum
Presider: Costantino De Angelis; Universita' degli Studi di Brescia, Italy

NpTh2I.1 • 10:30
Two Octave Supercontinuum Generation by Cascaded Intermodal Four-wave Mixing in a Step-index Few-mode Fiber, Solveig Perret[1], Gil Fanjoux[1], Laurent Bigot[2], Julien Fatome[3], Guy Millot[3], John Dudley[1], Thibaut Sylvestre[1]; [1]*FEMTO-ST, France;* [2]*Université de Lille , France;* [3]*Université Bourgogne Franche-Comté, France.* We demonstrate broadband supercontinuum generation from 560 nm to 2350 nm in a simple step-index few-mode fiber pumped with a microchip laser at 1064 nm through cascaded intermodal four-wave mixing and Raman scattering.

NpTh2I.2 • 11:00
Soliton Self-compression and Raman-enhanced Supercontinuum Generation in the Ultraviolet, Pooria Hosseini[1], Alexey Ermolov[1], Francesco Tani[1], David Novoa[1], Philip S. Russell[1]; [1]*Max-Planck-Inst Physik des Lichts, Germany.* We report generation of spectrally flat deep-UV-to-visible supercontinua in H_2-filled hollow-core PCF, assisted by strong UV-enhanced Raman gain, as well as soliton self-compression of ~500 nJ, 400 nm pulses to sub-6-fs durations in Ar-filled PCF.

10:30–12:30
ITh2J • Microresonators
Presider: Lucia Caspani; Univ. of Stratchclyde, UK

ITh2J.1 • 10:30 Invited
Enhancing Sensitivity of Micro-resonators using Exceptional Points, Mercedeh Khajavikhan[1]; [1]*4304 Scorpius St, Univ. of Central Florida, CREOL, USA.* Non-Hermitian systems biased at exceptional points becomes fundamentally more sensitive to external perturbations. We demonstrate such enhanced sensitivities in photonic microcavities at second and third order exceptional points.

ITh2J.2 • 11:00 Invited
High-confinement high-Q silicon-rich Silicon Nitride Nonlinear Microresonators, Victor Torres Company[1], Zhichao Ye[1], Attila Fülöp[1], Clemens Krückel[1], Peter Andrekson[1]; [1]*MC2 Microtechnology and nanoscience, Chalmers Tekniska Hogskola, Sweden.* We show our results on high-Q high-confinement microresonators based on the silicon-rich silicon nitride (SiRN) platform, featuring broad anomalous dispersion and an enhanced nonlinear Kerr coefficient with respect to stoichiometric Si_3N_4 technology

Room D1.1	Room E5	Room E3	Room D1.2	Room D7.1
Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials	Integrated Photonics Research, Silicon, and Nano-Photonics	Nonlinear Photonics	Novel Optical Materials and Applications	Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

BTh2A • Poling and Laser-induced Crystallization in Glasses—Continued

BTh2A.3 • 11:15
Writing $LaBGeO_5$ Crystal-in-Glass Waveguide and Tailoring Its Cross-Section by Femtosecond Laser Beam, Alexey Lipatiev[1], Sergey V. Lotarev[1], Andrey G. Okhrimchuk[1], Tatiana O. Lipateva[1], Sergey S. Fedotov[1], Vladimir N. Sigaev[1]; [1]*Mendeleev Univ. of Chemical Technology of Russia, Russia.* We demonstrate a laser-induced growth of a crystal-in-glass channel waveguide with ability of frequency conversion via second harmonic generation and propose a technique enabling tailoring its cross-section by the femtosecond laser beam.

BTh2A.4 • 11:30
Thermal Poling of Fibers with Multi-anodes, Lin Huang[1,2], Honglin An[1], Juliano Grigoleto Hayashi[1], Guobin Ren[2], Alessio Stefani[1,3], Simon C. Fleming[1]; [1]*Inst. of Photonics and Optical Science (IPOS), School of Physics, The Univ. of Sydney, Australia;* [2]*Key Lab of All Optical Network & Advanced Telecommunication Network of EMC, Beijing Jiaotong Univ., China;* [3]*DTU Fotonik, Department of Photonics Engineering, Technical Univ. of Denmark, Denmark.* We demonstrate thermal poling of fibers with ~50 and ~500 anodes. The second order nonlinearity layers are developed surrounding all the rings of wires in the ~50 anode fiber and the outer rings of the ~500 anode fiber.

BTh2A.5 • 11:45
Glass Fiber Poling by an Extended Cavity Microchip Laser, Umberto Minoni[1], Giacomo Treccani[1], Alessandro Tonello[2], Katarzyna Krupa[1], Daniele Modotto[1], Stefan Wabnitz[1,3], Vincent Couderc[2]; [1]*Dipartimento di Ingegneria dell'Informazione, Università degli Studi di Brescia, Italy;* [2]*XLIM, Université de Limoges, France;* [3]*Istituto Nazionale di Ottica (INO-CNR), Consiglio Nazionale delle Ricerche, Italy.* We experimentally prove that glass fibers are efficiently optically poled when inserted in the extended cavity of a microchip laser. Methodical second harmonic measurements confirm the good quality of the poling.

ITh2B • Novel Photonic Platforms—Continued

ITh2B.3 • 11:15
Low Loss High Refractive Index Niobium Oxide Waveguide Platform for Visible Light Applications, Kristof Lodewijks[1], Suseendran Jayachandran[1], Tangla David Kongnyuy[1], Silvia Lenci[1], Sayantan Das[1], Pol Van Dorpe[1], Aurelie Humbert[1], Roelof Jansen[1], Simone Severi[1], Xavier Rottenberg[1]; [1]*IMEC, Belgium.* We investigate niobim oxide (NbO) as alternative waveguide material for applications in the visible spectral range. We benchmark NbO waveguides to our mature in-house SiN waveguide platform and observe fairly similar loss numbers for both materials.

ITh2B.4 • 11:30
High Precision Transfer Printing for Hybrid Integration of Multi-material Waveguide Devices, John R. McPhillimy[1], Benoit Guilhabert[1], Charalambos Klitis[2], Stuart May[2], Martin Dawson[1], Marc Sorel[2], Michael Strain[1]; [1]*Inst. of Photonics, Uni. Strathclyde, UK;* [2]*School of Engineering, Univ. of Glasgow, UK.* We present a transfer printing technique with sub-100nm absolute placement accuracy. Hybrid integration of pre-processed membrane waveguide devices is achieved across a range of materials, including silicon, polymer and III-V devices.

ITh2B.5 • 11:45 Invited
Group-IV Material Waveguide Platforms for the Long Wave Infrared, Goran Mashanovich[1,2], Milos Nedeljkovic[1], Jordi Soler Penades[1], Ahmed Osman[1], Yolanda Chang[1], Zhibo Qu[1], Wei Cao[1], Ali Z. Khokhar[1], Vinita Mittal[1], Ganapathy Senthil Murugan[1], James S. Wilkinson[1], Alejandro Sánchez-Postigo[3], J. Gonzalo Wangüemert-Pérez[3], Alejandro Ortega-Moñux[3], Robert Halir[3], Íñigo Molina-Fernández[3], Pavel Cheben[4]; [1]*Optoelectronics Research Centre, Univ. of Southampton, UK;* [2]*School of Electrical Engineering, Univ. of Belgrade, Serbia;* [3]*Dept. de Ingeniería de Comunicaciones, Universidad de Málaga, Spain;* [4]*National Research Council Canada, Canada.* We have demonstrated low loss light propagation in suspended silicon and germanium-on-silicon waveguide platforms at mid-infrared wavelengths above 7 um. Prospects for group-IV waveguides for above 10 um will also be discussed.

NpTh2C • Spatiotemporal Phenomena II—Continued

NpTh2C.3 • 11:15
Extreme Pulses in Optically Injected Semiconductor Lasers: Precursors and On-demand Generation, Cristina Masoller[1]; [1]*Universitat Politecnica de Catalunya, Spain.* I show that precursors of ultra-intense pulses (oscillatory patterns that tend to precede extreme pulses) can be identified. I also show that appropriated current perturbations can trigger extreme pulses on demand.

NpTh2C.4 • 11:30
Observation of Peregrine-like Events in Focusing Dispersive Dam Break Flows, Frédéric Audo[1], Bertrand Kibler[1], Julien Fatome[1], Christophe Finot[1]; [1]*Laboratoire Interdisciplinaire CARNOT de Bourgogne, France.* We experimentally observe the emergence of Peregrine-like events during the regularization of an initial super-Gaussian pulse propagating in an optical fiber with focusing nonlinearity.

NpTh2C.5 • 11:45
Fermi-Pasta-Ulam Recurrences of Incoherent Waves, Massimiliano Guasoni[1,4], Gang Xu[1], Josselin Garnier[2], Benno Rumpf[3], Dominique Sugny[1], Julien Fatome[1], Guy Millot[1], Antonio Picozzi[1]; [1]*Universiy of Bourgogne Franche-Comté, France;* [2]*Ecole Polytechnique, France;* [3]*Southern Methodist Univ., USA;* [4]*Univ. of Southampton, UK.* We predict the existence of Fermi-Pasta-Ulam recurrences of incoherent waves. They originate in the creation of correlated fluctuations and are characterized by a reduction of entropy that violates the Boltzmann's H-theorem of entropy growth.

NoTh2D • Tunable Metadevices I—Continued

NoTh2D.3 • 11:30 Invited
Tunable Metamaterials based on the Metal-insulator Transition in Vanadium Dioxide, Alberto Pique[1], Heungsoo Kim[1], Ryan J. Suess[1], Kristen M. Charipar[1], Raymond C. Auyeung[1], Nicholas S. Bingham[2], Nicholas A. Charipar[1]; [1]*US Naval Research Laboratory, USA;* [2]*National Research Council, USA.* Tunable metamaterials and THz devices based on vanadium dioxide films are demonstrated. The effects of strain engineering during film growth on the temperature and dynamics of the metal-insulator transition will also be discussed.

SeTh2E • Sensing in Harsh Environment—Continued

SeTh2E.3 • 11:15
Fiber-optic Diagnostics of Medium-voltage Circuit Breakers in the Harsh Environment of Electric Arcing, Axel Kramer[1], Mariya Porus[1], Nitesh Ranjan[1]; [1]*ABB, Switzerland.* We have developed a fiber-optic analyzer for gas diagnostics in medium-voltage circuit breakers and have demonstrated its reliable and robust setup for online monitoring of gas composition before, during and after multiple arcing events

SeTh2E.4 • 11:30
Optical Fibre-based Reflective Displacement Sensing System for High Sensitivity Blade Tip-Clearance Measurements, Josu Amorebieta[1], Rubén Fernández[1], Gaizka Durana[1], Josu Beloki[2], Joseba Zubia[1]; [1]*Univ. of the Basque Country, Spain;* [2]*Centro de Tecnologías Aeronáuticas (CTA), Spain.* The present contribution shows the results of the performance of a custom designed optical fibre-based reflective displacement sensor for Blade Tip Clearance (TC) measurements in a scaled turbine rotor. Results so far show great sensitivity.

SeTh2E.5 • 11:45
Passive Pulse Interferometry for Optical Detection of Ultrasound with a Large Dynamic Range, Yoav Hazan[1], Amir Rosenthal[1]; [1]*Technion Israel Inst. of Technology, Israel.* Optical detection of ultrasound is often characterized by limited dynamic range and lack of scalability. In this work, we present passive pulse interferometry (P-PI) as a solution to both these challenges.

Room D3.2	Room D5.2	Room D7.2	Room E1.1	Room E1.2
Photonic Networks and Devices	Signal Processing in Photonic Communications	Specialty Optical Fibers	Nonlinear Photonics	Integrated Photonics Research, Silicon, and Nano-Photonics

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

NeTh2F • Network Resiliency and Security—Continued

NeTh2F.3 • 11:15
Experimental High Speed Data Encryption via SDM-CV-QKD Signaling for High-Capacity Access Network, Rameez Asif[1], Haithem Mustafa[2], William Buchanan[1]; [1]*School of Computing, Edinburgh Napier Univ., UK;* [2]*School of Engineering, Case Western Reserve Univ., USA.* We report a high capacity Quantum-to-the-Home (QTTH) network in a spatial-division-multiplexing (SDM) network utilizing 7-core multicore fiber (MCF). Aggregate secure key rates of 33.6 Mbit/s over 9.8 km of fiber are the actual state-of-the-art.

NeTh2F.4 • 11:30 Invited
About Reliability in Dual Hub and Dual Spoke Metro Networks, Miguel Razo[2], Ali Shakeri[2], Zhen Lu[2], Marco Tacca[2], Gabriele Galimberti[3], Giovanni Martinelli[3], Andrea Fumagalli[1]; [1]*5809 Sandshell Ct., Univ. of Texas at Dallas, USA;* [2]*The Univ. of Texas at Dallas, USA Minor Outlying Islands;* [3]*Cisco Systems, Italy.* The authors present a classification of reliable routing solutions in a Multi-Protocol Label Switching over Wavelength Division Multiplexing metro area network with dual hub and dual spoke, and define the best reliable routing (BRR) solution.

SpTh2G • Short Reach Systems—Continued

SpTh2G.3 • 11:15 Invited
High-speed Optical Transmission with Single-sideband Modulation, Fan Zhang[1], Yixiao Zhu[1], Mingxuan Jiang[1]; [1]*Peking Univ., China.* We review the recent progress in high-speed optical transmission enabled by single-sideband modulation. The principle and implementation of several candidate schemes are compared.

SpTh2G.4 • 11:45 Invited
Long-wavelength VCSEL-based High-speed SDM Interconnects Enabled by Low-complexity Signal Processing Techniques, Xiaodan Pang[1,3], Joris Van Kerrebrouck[2], Oskars Ozolins[3], Rui Lin[1,4], Aleksejs Udalcovs[3], Lu Zhang[1], Silvia Spiga[5], Markus-Christian Amann[5], Geert Van Steenberge[6], Lin Gan[4], Ming Tang[4], Songnian Fu[4], Richard Schatz[1], Gunnar Jacobsen[3], Sergei Popov[1], Deming Liu[4], Weijun Tong[7], Guy Torfs[2], Johan Bauwelinck[2], Xin Yin[2], Jiajia Chen[1]; [1]*KTH Royal Inst. of Technology, Sweden;* [2]*IDLab, INTEC, Ghent Univ. – imec, Belgium;* [3]*NETLAB, RISE Acreo AB, Sweden;* [4]*Huazhong Univ. of Science and Technology, China;* [5]*Walter Schottky Institut, Technische Universität München, Germany;* [6]*CMST, Ghent Univ. – imec, Belgium;* [7]*Yangtze Optical fiber and Cable Joint Stock Limited Company, China.* We report on our recent work in supporting up to 100 Gbps/λ/core transmissions with a directly modulated 1.5-μm single mode VCSEL and multicore fiber, enabled by low-compleixty pre- and post- digital equalizations.

SoTh2H • Novel Light Sources—Continued

SoTh2H.3 • 11:15 Invited
All-fiber Single Photon Sources - Modal Control for Active Routing, Robert J. Francis-Jones[1,2], Rowan A. Hoggarth[1], Oliver R. Gibson[1], Peter J. Mosley[1]; [1]*Centre for Photonics and Photonic Materials, Univ. of Bath, UK;* [2]*Department of Physics, Univ. of Oxford, UK.* Speciality fiber has enabled the development of fully-integrated heralded single-photon sources incorporating feedforward and active switching to enhance performance. We present recent results and future directions.

SoTh2H.4 • 11:45
Tunable All-fiber PM Lasers with Single-and Dual-wavelength Emission and Extended Tuning Range at 1μm and 2μm, Tobias Tieß[1], Martin Becker[1], Manfred W. Rothhardt[1], Hartmut Bartelt[1,2], Matthias Jäger[1]; [1]*Leibniz Inst. of Photonic Technology, Germany;* [2]*Abbe Center of Photonics, Germany.* We present discretely tunable all-fiber lasers based on a theta ring cavity and an FBG array featuring single- and synchronized multi-wavelength emission. They cover extended tuning ranges of 50nm (Yb band) and 79nm (Tm band).

NpTh2I • Applications of Supercontinuum—Continued

NpTh2I.3 • 11:15
All-fiber-based All-normal Dispersion Supercontinuum Source using a Femtosecond Fiber Laser with Hollow-core Fiber Pulse Compression, Iván Bravo Gonzalo[1], Thomas Vestergaard[2], Ole Bang[1,2]; [1]*DTU FOTONIK, Denmark;* [2]*NKT Photonics, Denmark.* We develop and thoroughly characterize an all-fiber-based all-normal dispersion supercontinuum source pumped with a femtosecond fiber laser at 1036 nm using hollow-core fiber pulse compression. Pulse length, supercontinuum, and noise are measured.

NpTh2I.4 • 11:30
Visible Supercontinuum Light Generation in Integrated Diamond-on-insulator Waveguides, Benjamin Feigel[1], David Castello-Lurbe[1,2], Hugo Thienpont[1], Nathalie Vermeulen[1]; [1]*Brussels Photonics (B-PHOT), Department of Applied Physics and Photonics, Vrije Universiteit Brussel, Belgium;* [2]*Institut Universitari de Ciències dels Materials, Universitat de València (UV), Spain.* We numerically show that diamond-on-insulator (DOI) is more suitable than silicon-nitride waveguides to obtain a zero-dispersion wavelength in the VIS and hence to achieve VIS supercontinuum generation (SCG). We simulate SCG reaching 453 nm in DOI.

NpTh2I.5 • 11:45
Octave Spanning Supercontinuum in Titanium Dioxide Waveguides, Kamal Hammani[1], Laurent Markey[1], Manon Lamy[1], Bertrand Kibler[1], Juan Arocas[1], Julien Fatome[1], Alain Dereux[1], Jean-Claude Weeber[1], Christophe Finot[1]; [1]*Laboratoire Interdisciplinaire CARNOT de Bourgogne, France.* We report on the experimental generation of an octave spanning supercontinuum in a cm-long titanium dioxide waveguide with two zero dispersion wavelengths. A spectrum spanning from the visible up to 2.3 μm is generated from a femtosecond laser.

ITh2J • Microresonators—Continued

ITh2J.3 • 11:30 Invited
Temporal Soliton Generated in a Micro-resonator Directly with a Diode Laser, Nicolas Volet[1], Xu Yi[2], Qi-Fan Yang[2], Eric J. Stanton[1], Paul Morton[3], Ki Youl Yang[2], Kerry J. Vahala[2], John Bowers[1]; [1]*Inst. for Energy Efficiency, Univ. of California Santa Barbara, USA;* [2]*California Inst. of Technology, USA;* [3]*Morton Photonics, USA.* A single-soliton state is generated in a micro-resonator using a customized low-noise diode laser. This demonstration greatly simplifies the soliton generation setup and represents a significant step forward to a fully integrated soliton comb system.

Room D1.1	Room E5	Room E3	Room D1.2	Room D7.1
Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials	Integrated Photonics Research, Silicon, and Nano-Photonics	Nonlinear Photonics	Novel Optical Materials and Applications	Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

BTh2A • Poling and Laser-induced Crystallization in Glasses—Continued

BTh2A.6 • 12:00 Invited
Surface Nano-micro Glass Processing by Thermal Poling for the Design of Multifunctional Components, Evelyne Fargin[1,2], Marc Dussauze[2,3], Antoine Lepicard[2,3], Flavie Bondu[2], Frederic Adamietz[2,3], Vincent Rodriguez[2,3], Angeline Poulon-Quintin[2,1], Thierry Cardinal[1,2]; [1]*ICMCB de Bordeaux CNRS, France;* [2]*Univ. Bordeaux, France;* [3]*ISM, France.* Surface Nano-engineering of a silicate glass is performed by thermal poling, the correlation between the mechanism and the mechanical and durability surface properties is investigated. Surface Micro-engineering leads to direct GRIN lens imprinting.

ITh2B • Novel Photonic Platforms—Continued

ITh2B.6 • 12:15
Bright On-chip Mid-IR Supercontinuum Generation to 7.7µm in Silicon Germanium-on-silicon Platform, Milan Sinobad[1], Alberto Della Torre[2], Barry Luther-Davis[3], Pan Ma[3], Stephen Madden[3], David J. Moss[4], Arnan Mitchell[1], Regis Orobtchouk1[2], Salim Boutami[5], Jean-Michel Hartmann[5], Jean-Marc Fedeli[5], Christelle Monat[2], Christian Grillet[2]; [1]*RMIT, CUDOS and School of Engineering, Australia;* [2]*Institut des Nanotechnologies de Lyon, Université de Lyon, France;* [3]*Australian National Univ., CUDOS, Laser Physics Centre, Australia;* [4]*Swinburne Univ. of Technology, Centre for Microphotonics, Australia;* [5]*CEA-Leti, France.* We report mid-IR supercontinuum generation, from 2.9 to 7.7µm, in a CMOS compatible silicon-germanium waveguide. This 1.3 octave bright supercontinuum has been achieved in a low loss dispersion engineered air-clad $Si_{0.6}Ge_{0.4}/Si$ waveguide.

NpTh2C • Spatiotemporal Phenomena II—Continued

NpTh2C.6 • 12:00
Spatial Rogue Waves and Modulation Instability in Quadratic Media, Fabio Baronio[3], Shihua Chen[1], Dumitru Mihalache[2]; [1]*Department of Physics, Southeast Univ., China;* [2]*Department of Theoretical Physics, Horia Hulubei National Inst. for Physics and Nuclear Engineering, Romania;* [3]*Dipartimento di Ingegneria dell'Informazione, Università di Brescia, Italy.* We report the existence of Peregrine solitons and Akhmediev breathers in the regime of second-harmonic-generation. This finding opens the path for the demonstration of rogue waves and reinterpretation of modulation instability in quadratic media.

NpTh2C.7 • 12:15
The Picoseconds Structure of Ultrafast Rogue Waves, Moti Fridman[1]; [1]*Bar Ilan Univ., Israel.* We suggest a new mechanism for ultrafast rogue waves in fiber lasers. We claim that the ultrafast patterns arise from the non-instantaneous relaxation of the saturable absorber together with the polarization mode dispersion of the cavity.

NoTh2D • Tunable Metadevices I—Continued

NoTh2D.4 • 12:00 Invited
Phase-Change Metadevices for the Dynamic and Reconfigurable Control of Light, David Wright[1], Santiago Carrillo[1], Carlota Galarreta[1], Emanuele Gemo[1], Liam Trimby[1], Arseny Alexeev[1], Yat-Yin Au[1], V Karthik Nagareddy[1], Anna Baldycheva[1], Jacopo Bertolotti[1], Martin Lopez-Garcia[2], Majiec Klemm[2], Martin Cryan[2]; [1]*CEMPS, Univ. of Exeter, UK;* [2]*Univ. of Bristol, UK.* The combination of chalcogenide phase-change materials with optical metamaterial arrays is exploited to create new forms of dynamic, tuneable and reconfigurable photonic devices including perfect absorbers, modulators, beam steerers and filters.

SeTh2E • Sensing in Harsh Environment—Continued

SeTh2E.6 • 12:00 Invited
Advanced Photonic Sensors for Remote Undersea Surveillance, Scott B. Foster[1]; [1]*PO Box 1500, Defence Science & Tech Organisation, Australia.* A brief overview of the current status of fiber optic sensors for precision undersea sensing is provided. The fundamental importance of thermodynamic noise in predicting absolute performance limits and guiding future developments is emphasized.

12:30–14:00 Lunch *(on own)*

Room D3.2	Room D5.2	Room D7.2	Room E1.1	Room E1.2
Photonic Networks and Devices	Signal Processing in Photonic Communications	Specialty Optical Fibers	Nonlinear Photonics	Integrated Photonics Research, Silicon, and Nano-Photonics

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

NeTh2F • Network Resiliency and Security—Continued

NeTh2F.5 • 12:00
Two-Layer Network Solution for Reliable and Efficient Host-to-host Transfer of Big Data, Behzad Mirkhanzadeh[1], Alessio Ferrari[2], Zhen Lu[1], Ali Shakeri[1], Chencheng Shao[1], Marco Tacca[1], Miguel Razo[1], Mattia Cantono[2], Andrea Fumagalli[1], Vittorio Curri[2], Giovanni Martinelli[3], Gabriele Galimberti[3]; [1]*Univ. of Texas at Dallas, USA;* [2]*Politecnico Di Torino, Italy;* [3]*Cisco Photonic, Italy.* This paper describes a SDN-based solution that, by leveraging and coordinating many functionalities that reside at both WDM and Ethernet layers, orchestrates network resources with the aim to maximize host-to-host data transfer rate.

SpTh2G • Short Reach Systems—Continued

SoTh2H • Novel Light Sources—Continued

SoTh2H.5 • 12:00 Invited
Gas-filled Hollow Core Fiber Lasers in the Mid-infrared, William J. Wadsworth[1]; [1]*Department of Physics, Univ. of Bath, UK.* Hollow core optical fibres present an exciting platform for the mid-IR. They are able to combine the excellent mechanical properties and ease of fabrication of silica glass structures with mid-IR transmission. This opens up new laser applications.

NpTh2I • Applications of Supercontinuum—Continued

NpTh2I.6 • 12:00
Extending the UV Supercontinuum by Tapering Gas-filled Hollow-core Anti-resonant Fibers, Morten Bache[1], Md. Selim Habib[1,2], Christos Markos[1], Jose Enrique Antonio Lopez[2], Rodrigo Amezcua Correa[2], Ole Bang[1]; [1]*DTU Fotonik, Department of Photonics Engineering, Technical Univ. of Denmark, Denmark;* [2]*CREOL, The College of Optics and Photonics, Univ. of Central Florida, USA.* Resonant radiation phase-matched to a soliton in gas-filled hollow-core fibers is an efficient femtosecond UV source. By tapering the fiber our simulations show that the supercontinuum can be significantly extended into the extreme ultra-violet.

NpTh2I.7 • 12:15
Ultra-low Noise Supercontinuum Generation with Flat-near Zero All Normal Dispersion Pure Silica Fiber at GHz Repetition Rate, Shreesha Rao D S[1], Rasmus D. Engelsholm[1], Iván Bravo Gonzalo[1], Binbin Zhou[1], Patrick Bowen[2], Peter M. Moselund[2], Morten Bache[1], Ole Bang[1,2]; [1]*Department of Photonics Engineering, Technical Univ. of Denmark, Denmark;* [2]*NKT Photonics, Denmark.* A pure silica holey fiber with β_2 of 0.44 ps^2/km at 1.55 µm and less than 1 ps^2/km from 1.3 to 1.75 µm was designed and drawn. It is numerically shown to generate a flat coherent spectrum, pumped by a 2 kW peak power, 250 fs pulse propagating 20 m.

ITh2J • Microresonators—Continued

ITh2J.4 • 12:00
Dynamic Micro-assembly of $LiNbO_3$ Microresonators with Low-loss Suspended Waveguides, Alexis Caspar[1], Clément Eustache[1], Florent Behague[1], Venancio Calero[1], Roland Salut[1], Jean-Yves Rauch[1], Olivier Lehmann[1], Miguel Suarez[1], Maria-Pilar Bernal[1], Cédric Clévy[1], Philippe Lutz[1], Nadège COURJAL[1]; [1]*FEMTO-ST, France.* We report on a LiNbO3 microresonator integrated in a low-loss free-suspended waveguide. The photonic elements are made by optical-grade dicing, and they are assembled dynamically. This method opens the way to new 3D photonic architectures.

ITh2J.5 • 12:15
Micro-assembly of Hybrid Diamond-Si Resonator Devices, Paul D. Hill[1,2], Erdan Gu[1], Michael Strain[1]; [1]*Inst. of Photonics, Univ. of Strathclyde, UK;* [2]*Diamond Science & Technology CDT, UK.* Limitations in the dimensions of optical-grade diamond hinder its integration with on-chip photonics. This is overcome by micro-assembly of free-standing Di membranes to SOI devices; showing a high-quality optical interface with added loss of <0.4dB.

12:30–14:00 Lunch *(on own)*

Room D1.1	Room E5	Room E3	Room D1.2	Room D7.1
Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials	Integrated Photonics Research, Silicon, and Nano-Photonics	Nonlinear Photonics	Novel Optical Materials and Applications	Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

14:00–16:00
BTh3A • Fabrication and Properties of Gratings, Waveguides and Photonic Devices
Presider: Peter Smith; Optoelectronics Research Centre, UK

BTh3A.1 • 14:00 Invited
In-chip Microstructures and Photonic Devices Fabricated by Nonlinear Laser Lithography Deep Inside Silicon, F. Omer Ilday[1]; [1]*EE-506 Electrical Engr Dept, Bilkent Univ., Turkey.* Si electronics and photonics rely on surface-based fabrication techniques. We present direct-laser writing of functional elements, including lenses and waveguides, deep inside Si. This can optionally be followed by selective etching to render 3D structures.

BTh3A.2 • 14:30
Bragg Gratings in Polarization-maintaining, Large-area Higher-order-modes Fiber, Raja Ahmad[1], Paul Westbrook[1], Kazi S. Abedin[1], Jeffrey W. Nicholson[1], Clifford Headley[1], Patrick W. Wisk[1], Eric M. Monberg[1], Man F. Yan[1], David J. DiGiovanni[1]; [1]*OFS Laboratories, USA.* We report on the inscription of Bragg gratings in polarization-maintaining, large-effective-area, higher-order-modes fiber. We find that the Bragg gratings offer a convenient and superior platform for complete characterization of PM-multimode fibers.

14:00–16:00
ITh3B • Silicon Nitride Photonics
Presider: Sonia Garcia-Blanco; Univ. of Twente, Netherlands;

ITh3B.1 • 14:00 Invited
Visible Light Silicon Nitride Photonics Pilot Line, Jose David Domenech Gomez[1]; [1]*Cami de Vera S/N, VLC PHotonics S.L., Spain.* As key enabling technology, photonics has become critical in many fields. Advances in fabrication technologies have realized photonic integrated circuits not only for telecommunication wavelengths but also in the mid-infrared, and very importantly, in the visible. The latter can strongly benefit bio- and life-science applications where visible light is very commonly used in bulky and expensive optical systems. The pilot line, PIX4life, was established with the aid of the European Union to facilitate European R&D employing visible light PICs for visible applications, targeting mainly health and bio-science applications.

ITh3B.2 • 14:30
Advances in PZT-on-SiN Electro-optic Modulator Platform, John P. George[2,3], Koen Alexander[1,3], Bart Kuyken[1,3], Dries Van Thourhout[1,3], Jeroen Beeckman[1,2]; [1]*Ghent Univ., Belgium;* [2]*ELIS, Ghent Univ., Belgium;* [3]*INTEC, Ghent Univ., Belgium.* We demonstrate an O-band electro-optic modulator on SiN platform based on ferroelectric PZT thin films. A ring modulator with a small signal bandwidth in excess of 33 GHz is reported.

14:00–16:00
NpTh3C • Spatiotemporal Phenomena III
Presider: Daniele Modotto; Univ. of Brescia, Italy

NpTh3C.1 • 14:00 Invited
Spatiotemporal Phenomena in Multimode Fibers, Frank W. Wise[1]; [1]*Department of Applied Physics, Cornell Univ., USA.* New phenomena observed recently in multimode optical fibers will be reviewed, and their relevance to applications will be discussed.

NpTh3C.2 • 14:30
Efficient modelling of Nonlinear Propagation in Multimode Graded-index Fibers, Matteo Conforti[1], Carlos Mas Arabi[1], Arnaud Mussot[1], Abdelkrim Bendahmane[1], Alexandre Kudlinski[1]; [1]*PhLAM, Univ. of Lille, CNRS, France.* We develop an effective 1+1D model describing nonlinear propagation in multimode graded-index fibers. The model reproduces quantitatively recently observed phenomena like geometric parametric instability and broadband dispersive wave emission

14:00–15:30
NoTh3D • Tunable Metadevices II
Presider: Mikhail Kats; Univ. of Wisconsin-Madison, USA

NoTh3D.1 • 14:00 Invited
Gate-tunable Epsilon-Near-zero Nanophotonics, Aleksei Anopchenko[1], Long Tao[1], Sudip Gurung[1], Jingyi Yang[1], Catherine Arndt[1], Khant Minn[1], Ho Wai H. Lee[1,2]; [1]*Department of Physics, Baylor Univ., USA;* [2]*The Inst. for Quantum Science and Engineering, TexasA&M, USA.* We present our recent development on the use of tunable transparent conducting oxides to demonstrate electrically tunable epsilon-near-zero (ENZ) optical nano-devices and to excite ENZ resonance in nanostructured optical fibers.

NoTh3D.2 • 14:30 Invited
Phase Change Materials by Design: How to Realize Fast Optical Switches?, Matthias Wuttig[1]; [1]*Templergraben 55, Rheinish Westfalische Tech Hoch Aachen, Germany.* Phase change materials employ a remarkable property portfolio including the ability to rapidly switch between the amorphous and the crystalline state. This talk will discuss the origin of the unique material properties and how they can be utilized.

14:00–16:00
SeTh3E • Laser-based Sensors II
Presider: Christian Grillet; CNRS, France

SeTh3E.1 • 14:00 Invited
Helmholtz-based Photoacoustic Sensors for Trace Gases Detection, Virginie Zeninari[1]; [1]*UFR Sciences, Universite de Reims Champagne-Ardenne, France.* The author reports twenty years of developments of Helmholtz resonant photoacoustic cells in association with infrared sources for the optical sensing of atmospheric gases and the latest developments on this subject.

SeTh3E.2 • 14:30
Laser Speckle Contrast Imaging Method for Measurement of Transparent Fluid Flows, Seungsoo Hong[1], Hyuntai Kim[1], Kyoungyoon Park[1], Hanbyul Chang[1], songzhe Piao[2], Seung-june Oh[2], Yoonchan Jeong[1]; [1]*Seoul National Univ., South Korea;* [2]*Seoul National Univ. Hospital, South Korea.* A novel laser speckle contrast imaging method using an intermediate vibrating layer is proposed. By detecting the vortex shedding frequency with laser speckle contrast imaging, the measurement of flow rate for transparent fluids is demonstrated.

Room D3.2	Room D5.2	Room D7.2	Room E1.1	Room E1.2
Photonic Networks and Devices	Signal Processing in Photonic Communications	Specialty Optical Fibers	Nonlinear Photonics	Integrated Photonics Research, Silicon, and Nano-Photonics

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

14:00–15:30
NeTh3F • Short Reach Interconnects
Presider: Wolfgang Freude; Karlsruher Institut für Technologie , Germany

NeTh3F.1 • 14:00 Invited
The Kramers-Kronig Receiver: Opportunities and Challenges, Cristian Antonelli[1]; [1]*Dept. of Physical and Chemical Sciences, Universita degli Studi dell'Aquila, Italy.* The Kramers-Kronig (KK) scheme enables the reception of I/Q modulated signals through simple direct detection and digital signal processing, thereby significantly simplifying the receiver architecture. This presentation reviews the operation principles of the KK receiver and its various implementations.

NeTh3F.2 • 14:30 Invited
Optical Interconnects for Large Scale Computing Systems: Trends and Challenges, Marc A. Taubenblatt[1]; [1]*IBM T.J. Watson Res. Center, IBM TJ Watson Research Center, USA.* Future large scale systems will be faced with increasing challenges to maintain bandwidth growth trends. Tighter integration of optics with switch and compute chips, optical switching and specialized networks are potential solutions.

14:00–15:30
SpTh3G • Access Networks and Free Space Communications
Presider: Hany Elgala; State Univ. of New York at Albany, USA

SpTh3G.1 • 14:00 Invited
Transmission Schemes for Future Access Networks, Robert Killey[1], M.Sezer Erkilinc[1], Dominac Lavery[1], Polina Bayvel[1]; [1]*Dept of EEE, Univ. College London, UK.* We review recent work on low-complexity coherent transceivers for future optical access networks, using single-photodiode heterodyne detection with DSP-based linearization, and polarization-independent operation through the use of Alamouti coding.

SpTh3G.2 • 14:30
Digital Pre-emphasis for 10Gb/s with Low-cost Directly Phase-Modulated Lasers for PONs, Jeison A. Tabares[1], Antonio Napoli[2], Victor Polo[1], Stefano Calabro[2], Bernd Sommerkorn-Krombholz[2], Bernhard Spinnler[2], Josep Prat[1]; [1]*Polytechnic Univ. OF Catalonia, Spain;* [2]*Coriant R&D GmbH, Germany.* We apply digital pre-emphasis to compensate for the frequency response non-idealities of low-cost optical transmitters. It enables transmission beyond 10Gb/s with 2/4/8-DPSK using directly modulated lasers and coherent detection for optical access

14:00–16:00
SoTh3H • Mid-infrared Supercontinuum Generation
Presider: Sebastien Fevrier; Universite de Limoges, France

SoTh3H.1 • 14:00 Invited
Mid-IR Supercontinuum Generation, Alex Fuerbach[1], Darren Hudson[1], Stuart Jackson[2], Sergei Antipov[1], Robert Woodward[2], Lizhu Li[3], Imtiaz Alamgir[3], Mohammed El Amraoui[4], Younès Messaddeq[4], Martin Rochette[3]; [1]*Department of Physics and Astronomy, Macquarie Univ., Australia;* [2]*School of Engineering, Macquarie Univ., Australia;* [3]*Department of Electrical & Computer Engineering, McGill Univ., Canada;* [4]*Centre d'Optique, Photonique et Laser, Université Laval, Canada.* Output pulses from an ultrafast holmium-praseodymium co-doped fiber ring laser are spectrally broadened in highly nonlinear chalcogenide fibers. Under optimized conditions, an ultra-broadband supercontinuum spanning from 2 – 12 µm is demonstrated.

SoTh3H.2 • 14:30
Supercontinuum Generation in Suspended-core Heavy-metal Oxide Glass Photonic Crystal Fibers, Amar N. Ghosh[1], Mariusz @. Klimczak[2], Ryszard Buczynski[2], John Dudley[3,1], Thibaut Sylvestre[1]; [1]*CNRS FEMTO-ST, France;* [2]*Inst. of Electronic Materials Technology, Poland;* [3]*Université de Franche-Comté, France.* Supercontinuum generation from 0.9 µm up to 2.48 µm is experimentally demonstrated in suspended-core heavy metal oxide photonic crystal fibers pumped in both the normal and anomalous dispersion regimes

14:00–16:00
NpTh3I • Novel Spatial Effects in Planar Photonics Structures
Presider: Ole Bang; DTU Fotonik, Denmark

NpTh3I.1 • 14:00 Invited
Caustic-based Nonlinear Photonic Lattices, Cornelia Denz[1], Alessandro Zannotti[1], Carsten Mamsch[1], Matthias Rüschenbaum[1]; [1]*Univ. of Muenster, Inst. of Applied Physics, Germany.* We realize a portfolio of higher-order cuspoid and umbilic caustics, exploit them as fabricating light for advanced nonlinear photonic structures, and demonstrate nonlinear light propagation therein.

NpTh3I.2 • 14:30
Scalable Multi-dimensional Synthetic Space and Full State Reconstruction in Spectral Lattices, Kai Wang[1], James Titchener[1], Bryn A. Bell[2], Alexander S. Solntsev[3,1], Dragomir N. Neshev[1], Benjamin J. Eggleton[2], Andrey A. Sukhorukov[1]; [1]*Nonlinear Physics Centre, Research School of Physics and Engineering, The Australian National Univ., Australia;* [2]*Centre for Ultrahigh Bandwidth Devices for Optical Systems (CUDOS), Inst. of Photonics and Optical Science (IPOS), School of Physics, Univ. of Sydney, Australia;* [3]*School of Mathematical and Physical Sciences, Univ. of Technology Sydney, Australia.* We propose and experimentally realize spectral photonic lattices with pump-induced frequency couplings, which can emulate multi-dimensional dynamics with synthetic gauge fields and enable single-shot measurement of the signal phase and coherence.

14:00–16:00
ITh3J • Metamaterial Photonic Devices
Presider: Laden Arissian; National Research Council, Canada

ITh3J.1 • 14:00
Ultra-broadband 1×2 Optical Splitter based on Integrated Digital Metamaterial, Zhipeng Chu[1], Yingjie Liu[1], Hucheng Xie[1], Wenzhao Sun[1], Yujie Wang[1], Ke Xu[1], Yong Yao[1], Yanfu Yang[1], Yunxu Sun[1], Qinghai Song[1]; [1]*Harbin Inst. of Technology (Shenzhen, China.* We have experimentally demonstrated an integrated 1×2 splitter with a footprint of only 3.6×3.6 µm^2. It can operate over 200 nm spectral range with the total transmission efficiency above 90%.

ITh3J.2 • 14:15
Electrical Tuning of Reflectance of Graphene Metasurface for Unpolarized Long Wavelength Infrared Light, Vivek R. Shrestha[1], Yang Gao[4], Matin Amani[2,3], James Bullock[2,3], Ali Javey[2,3], Kenneth B. Crozier[1,4]; [1]*School of Physics, Univ. of Melbourne, Australia;* [2]*Electrical Engineering and Computer Sciences, Univ. of California, Berkeley, USA;* [3]*Materials Sciences Division, Lawrence Berkeley National Laboratory, USA;* [4]*Department of Electrical and Electronic Engineering, Univ. of Melbourne, Australia.* We demonstrate a graphene-metal metasurface for unpolarized long wavelength infrared light with electrically-tunable reflectance. By applying a gate voltage, we shift the wavelength of a resonant reflectance dip centered at ~9.4 micron by~156 nm.

ITh3J.3 • 14:30 Invited
Integrated Zero-index Metamaterials and Waveguides, Orad Reshef[1,2], Philip Camayd-Muñoz[2], Daryl I. Vulis[2], Yang Li[2], Marko Lončar[2], Eric Mazur[2]; [1]*Dept. of Physics, Univ. of Ottawa, Canada;* [2]*School of Engineering and Applied Sciences, Harvard Univ., USA.* Integrated Dirac-cone metamaterials enable effective refractive indices near zero in the standard silicon-on-insulator (SOI) platform. We experimentally demonstrate small-footprint (≈λ/2-wide) zero-index structures in the telecom regime.

Room D1.1	Room E5	Room E3	Room D1.2	Room D7.1
Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials	Integrated Photonics Research, Silicon, and Nano-Photonics	Nonlinear Photonics	Novel Optical Materials and Applications	Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

BTh3A • Fabrication and Properties of Gratings, Waveguides and Photonic Devices—Continued

BTh3A.3 • 14:45
Temperature Dependence of Grating Resonances and Two-mode interference in Few-mode Fiber, Soham Basu[1], Hans G. Limberger[1]; [1]*Ecole Polytechnique Federale de Lausanne, Switzerland.* We compare the temperature sensitivities of LP01-LP02 mode converter, L01-LP02 two-mode interference, including the group velocity equalization wavelength, and fiber Bragg grating in a few-mode fiber.

BTh3A.4 • 15:00
Spectral Broadening in Distributed-feedback Resonators due to Thermal Chirp, Cristine C. Kores[1], Markus Pollnau[2], Edward Bernhardi[1], Nur Ismail[1], Dimitri Geskus[1], Meindert Dijkstra[3]; [1]*KTH - Royal Inst. of technology, Sweden;* [2]*Advanced Technology Inst., Univ. of Surrey, UK;* [3]*Optical Sciences MESA+, Univ. of Twente, Netherlands.* We experimentally investigate the spectral response of an unpumped distributed-feedback waveguide resonator, subject to thermal chirp. Results indicate that such chirp causes an increase in outcoupling losses and, therefore, in the linewidth.

BTh3A.5 • 15:15
Random Long Period Fiber Gratings: Spectral Features and Perspectives, Francesco Chiavaioli[1], Cosimo Trono[1], Francesco Baldini[1], Avi Klein[2], Moti Fridman[2], Yaron Bromberg[3]; [1]*National Research Council of Italy, Inst. of Applied Physics "Nello Carrara", Italy;* [2]*Faculty of Engineering, Bar Ilan Univ., Inst. of Nanotechnology and Advanced Materials, Israel;* [3]*Faculty of Science, The Hebrew Univ. of Jerusalem, Racah Inst. of Physics, Israel.* We propose the fabrication of random long period fiber gratings (RLPGs). We characterized the spectral response of two types of RLPGs and discuss possible applications in the fields of telecommunication and sensing.

ITh3B • Silicon Nitride Photonics—Continued

ITh3B.3 • 14:45 Invited
Manufacturing Aspects for All-nitride-core Ultra-low Loss Silicon Nitride Photonics Platform, Michael Zervas[1]; [1]*LiGenTeC SA, Switzerland.* Thick film silicon nitride is a uniquely fit material for photonics, with low propagation losses, micron scale bends and efficient fiber coupling. Fabricating large scale circuits presents challenges in patterning, film stress control and uniformity.

ITh3B.4 • 15:15
Integrated Silicon Nitride Optical Beamforming Networks for Wideband Communications, Yuan Liu[1], Fengqiao Sang[1], Brandon Isaac[1], Jean Kalkavage[2], Eric Adles[2], Thomas Clark[2], Jonathan Klamkin[1]; [1]*Univ. of California Santa Barbara, USA;* [2] *The Johns Hopkins Univ. Applied Physics Laboratory, USA.* Two approaches to ripple free 1x4 optical beamforming networks are presented; one is based on a 5-stage Mach-Zehnder switchable delay line and the other on a 3-optical-ring-resonator delay line. Both are demonstrated for W-band communications.

NpTh3C • Spatiotemporal Phenomena III—Continued

NpTh3C.3 • 14:45
Modal Attraction on Low Order Modes by Kerr effect in a Graded Refractive Index multimode fiber, Etienne Deliancourt[1,2], Marc Fabert[1,2], Alessandro Tonello[1,2], Katarzyna Krupa[3], Agnes Desfarges-Berthelemot[1,2], Vincent Kermene[1,2], Alain J. Barthelemy[1,2], Daniele Modotto[3], Guy Millot[4], Stefan Wabnitz[3], Vincent Couderc[1,2]; [1]*XLIM, France;* [2]*Photonique, Univ. of Limoges, France;* [3]*Dipartimento di ingegneria, Universita di Brescia, Italy;* [4]*ICB, Université Bourgogne Franche-Comté, France.* Modal attraction towards low order modes in a GRIN multimode fiber was experimentally observed at high power and characterized, thus enriching the dynamics of the Kerr self-cleaning effect leading to quasi fundamental mode generation.

NpTh3C.4 • 15:00
Withdrawn

NpTh3C.5 • 15:15
Experimental Evidences of Light Superfluidity in a Bulk Nonlinear Crystal, Omar Boughdad[1], Claire Michel[1], matthieu bellec[1]; [1]*Institut de Physique de Nice, Université Côte d'Azur and CNRS, France.* We report a direct detection of the frictional-superfluid transition in the flow of a fluid of light past a localized obstacle in a bulk nonlinear photorefractive crystal.

NoTh3D • Tunable Metadevices II—Continued

NoTh3D.3 • 15:00
Refractive Index Sensing by High Aspect Ratio Titanium Nitride Trench Structures, Evgeniy Shkondin[1], Taavi Repän[1], Andrei V. Lavrinenko[1], Osamu Takayama[1]; [1]*Danmarks Teknishe Universitet, Denmark.* Titanium nitride grating structures are fabricated by a combination of deep reactive ion etching and atomic layer deposition. Such structures being analyzed as an ambient medium sensor, exhibit the refractive index sensitivity of 430 nm/RIU

NoTh3D.4 • 15:15
Multiphase Gallium-based Nanoparticles for a Versatile Plasmonic Platform, Maria Losurdo[1], Yael Gutierrez[2], Maria Michela Giangregorio[1], Josef Humlicek[3], Fernando Moreno[2], April Brown[4]; [1]*CNR-NANOTEC, Italy;* [2]*Department of Applied Physics,, Univ. of Cantabria, Spain;* [3]*CEITEC, Masaryk Univ., Czechia;* [4]*Duke Univ., USA.* Gallium nanoparticles on various substrates of technological interest. Interaction with substrate leads to two plasmon resonance modes that are tuned from UV to the visible and infrared, depending on liquid and solid phases of gallium

SeTh3E • Laser-based Sensors II—Continued

SeTh3E.3 • 14:45
Speckle Patterns as Structured Illumination in Diffuse Optical Imaging, Pranay Jain[1], Sanjay E. Sarma[1]; [1]*Massachusetts Inst. of Technology, USA.* Speckle patterns projected on turbid media appear blurred due to optical diffusion. Images of projected and backscattered patterns are compared to obtain wide-band spatial frequency response, and hence the optical properties of the medium.

SeTh3E.4 • 15:00
Withdrawn

SeTh3E.5 • 15:15
Optical Phase Locked Loop for the Linearization of Sweep Frequency of Laser Diode for Ranging, Jongpil La[1]; [1]*Hanwha Systems Co. Ltd., South Korea.* The optical frequency sweep linearization for the coherent FMCW laser radar system is addressed in this article. The optical frequency is linearized and locked to the external reference frequency signal by phase locked loop configuration.

Room D3.2	Room D5.2	Room D7.2	Room E1.1	Room E1.2
Photonic Networks and Devices	Signal Processing in Photonic Communications	Specialty Optical Fibers	Nonlinear Photonics	Integrated Photonics Research, Silicon, and Nano-Photonics

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

NeTh3F • Short Reach Interconnects—Continued

NeTh3F.3 • 15:00
112 Gbps/λ PAM4 Inter-DCI with Continuous-fiber Bragg Grating based Dispersion Compensators, Oskars Ozolins[1], Aleksejs Udalcovs[1], Xiaodan Pang[2,1], Rui Lin[2,4], Anders Djupsjöbacka[1], Jonas Mårtensson[1], Krister Fröjdh[3], Lin Gan[4], Ming Tang[4], Songnian Fu[4], Richard Schatz[2], Urban Westergren[2], Deming Liu[4], Weijun Tong[5], Jiajia Chen[2], Sergei Popov[2], Gunnar Jacobsen[1]; [1]*RISE Acreo AB, Sweden;* [2]*KTH Royal Inst. of Technology, Sweden;* [3]*Proximion AB, Pakistan;* [4]*Huazhong Univ. of Science and Technology, China;* [5]*Yangtze Optical fiber and Cable Joint Stock Limited Company, China.* We demonstrate 56 Gbaud/λ PAM4 inter - data center interconnects over 81 km single core single mode fiber and 33.6 km 7-core single mode fiber with continuous-fiber Bragg grating based chromatic dispersion compensators covering C-band.

NeTh3F.4 • 15:15
Advanced Polarization Diverse Coherent Receiver using Waveguide Integrated MQW Photodiodes, Tobias Beckerwerth[1], Shahram Keyvaninia[1], Gan Zhou[1], Patrick Runge[1]; [1]*Fraunhofer Heinrich Hertz Inst., Germany.* An concept for the monolithic integration of a polarization diverse coherent receiver on an InP waveguide platform is presented. Due to a serial connection of a MQW- and a PIN-photodiode, TE- and TM- light, can be detected separately

SpTh3G • Access Networks and Free Space Communications—Continued

SpTh3G.3 • 14:45
Multi-band Frequency Conversion Scheme with Multi-phase Shift based on Optical Frequency Comb, Tao Lin[1], Shanghong Zhao[1], Zihang Zhu[1], Xuan Li[1], Qiurong Zheng[1], Kun Qu[1], Dapeng Hu[1], Kun Zhang[1]; [1]*Air Force Engineering Univ., China.* A multi-band frequency conversion scheme with multi-phase shift is proposed. The dual polarization quadrature phase shift keying (DP-QPSK) modulator is employed to realize multi-band frequency conversion with multi-phase shift.

SpTh3G.4 • 15:00
8-ary Orbital Angular Momentum Shift Keying Using 8PSK Recognition Circuit for FSO Communication, Munkhbayar Adiya[1], Hiroki Kishikawa[1], Nobuo Goto[1]; [1]*Tokushima Univ., Japan.* We propose an 8-ary orbital angular momentum shift keying technique by using our previously reported recognition circuit of 8PSK for free-space optical communication to reduce the influence of loss by weather condition.

SpTh3G.5 • 15:15
Experimental Demonstration of Free Space Optical Card-to-Card Transmission Architecture Based on ADO-OFDM, Haozhe Chen[1], Junjie Ding[1], Hao Wu[1], Shihang Bian[1], Mingrui Yang[1], Wei Liu[1], Shanhong You[1], Jianling Hu[1], Honglong Cao[1], Minglai Zhou[1]; [1]*Soochow Univ., China.* A 60cm free space optical card-to-card transmission architecture based on ADO-OFDM is experimentally demonstrated with 4QAM and 16QAM, which can simultaneously offer high spectrum efficiency and low power consumption.

SoTh3H • Mid-infrared Supercontinuum Generation—Continued

SoTh3H.3 • 14:45 Invited
Mid-infrared Fibre Supercontinuum Generation, Ole Bang[1]; [1]*DTU Fotonik, Dept. of Photonics Engineer, Danmarks Teknishe Universitet, Denmark.* Supercontinuum generation in softglass fibers can offer a spatially coherent source covering the spectral region 1-12 µm. However, it requires to control double supercontinuum cascading in a setup with 3 or more vastly different fibers.

SoTh3H.4 • 15:15
Dispersion-engineered Step-index Tellurite Fibers for Mid-infrared Supercontinuum Generation from 1.5 to 4.5 µm, Paul Froidevaux[1], Arnaud Lemiere[1], Bertrand Kibler[1], Frederic Desevedavy[1], Pierre Mathey[1], Gregory Gadret[1], Jean-Charles Jules[1], Kenshiro Nagasaka[2], Yasutake Ohishi[2], Frederic Smektala[1]; [1]*Laboratoire ICB, CNRS - UBFC, France;* [2]*Toyota Technological Inst., Japan.* We present the experimental development of dispersion-engineered tellurite fibers based on a simple step-index profile for mid-infrared supercontinuum generation. A supercontinuum spanning from 1.5 to 4.5 µm is obtained in a 12-cm-long fiber.

NpTh3I • Novel Spatial Effects in Planar Photonics Structures—Continued

NpTh3I.3 • 15:00
High-dimensional Synthetic Lattice with Enhanced Defect Sensitivity in Planar Photonic Structures, Kai Wang[1], Lukas J. Maczewsky[2], Alexander A. Dovgiy[1], Andrey Miroshnichenko[3], Alexander Moroz[4], Demetrios N. Christodoulides[5], Alexander Szameit[2], Andrey A. Sukhorukov[1]; [1]*Nonlinear Physics Centre, Research School of Physics and Engineering, Australian National Univ., Australia;* [2]*Inst. for Physics, Universitat Rostock, Germany;* [3]*School of Engineering and Information Technology, Univ. of New South Wales, Australia;* [4]*Wave-scattering.com, Germany;* [5]*CREOL, The College of Optics and Photonics, Univ. of Central Florida, USA.* We introduce a general method to map multi-dimensional lattices to planar photonic structures, and predict a sharp switching from zero to strong localization at a critical surface defect strength in four and higher-dimensional synthetic lattices.

NpTh3I.4 • 15:15
Nonlinear Light Propagation in Hexagonal Morphing Umbilic Caustic Lattices, Alessandro Zannotti[1], Carsten Mamsch[1], Matthias Rüschenbaum[1], Cornelia Denz[1]; [1]*Univ. of Muenster, Germany.* We fabricate elliptic umbilic caustics photonic structures in photosensitive media. The lattice morphs from hexagonal patterns to a single hot spot. We demonstrate experimentally the formation of a soliton in these elliptic umbilic lattices.

ITh3J • Metamaterial Photonic Devices—Continued

ITh3J.4 • 15:00 Invited
Subwavelength Grating Metamaterial Engineering: A New Tool for Silicon Photonics, Alejandro Ortega-Moñux[1], José Manuel Luque-González[1], Alejandro Sánchez-Postigo[1], Robert Halir[1], J. Gonzalo Wangüemert-Pérez[1], Íñigo Molina-Fernández[1], Pavel Cheben[2], Jens H. Schmid[2], Dan-Xia Xu[2], Jordi Soler-Penades[3], Milos Nedeljkovic[3], Goran Mashanovich[3], Jiri Čtyroký[4]; [1]*ETSI Telecom Dpto. Ing. Comunic, Universidad de Malaga, Spain;* [2]*National Research Council Canada, Canada;* [3]*Optoelectronics Research Centre, Univ. of Southampton, UK;* [4]*Inst. of Photonics and Electronics, Czechia.* Subwavelength gratings are periodic structures with a pitch smaller than half the wavelength of the propagating light. In this talk we will summarize some of our recent contributions in the development of SWG waveguide devices.

Room D1.1	Room E5	Room E3	Room D1.2	Room D7.1
Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials	Integrated Photonics Research, Silicon, and Nano-Photonics	Nonlinear Photonics	Novel Optical Materials and Applications	Optical Sensors

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

BTh3A • Fabrication and Properties of Gratings, Waveguides and Photonic Devices—Continued

BTh3A.6 • 15:30
Influence of the Femtosecond Laser Induced Loss on the Type II Phase-Shifted FBG Passband, Dan Grobnic[1], Cyril Hnatovsky[1], Stephen Mihailov[1]; [1]*National Research Council Canada, Canada.* During the inscription of Type II Bragg gratings a certain amount of optical loss is induced in the fiber. For Type II phase-shifted gratings, this broadband loss imposes strong restrictions on the grating passband

BTh3A.7 • 15:45
Characterization and Integration of Photosensitive As_2S_3 Thin Layers in Optical Filters, Antoine Bourgade[1,2], Julien Lumeau[1]; [1]*Institut Fresnel, France;* [2]*Aix-Marseille Université, France.* Photosensitivity of As_2S_3 thin films exposed at 470 nm is studied. Large thickness change up to 8.3% and refractive index change reaching to 0.1 are demonstrated. Integration of such material in optical filters are shown.

ITh3B • Silicon Nitride Photonics—Continued

ITh3B.5 • 15:30
Characterization of Low Loss Waveguides with High-reflectivity Bragg Gratings , Yi-Wen Hu[1,3], Yang Zhang[1,3], Pradip Gatkine[1,2], Joss Bland-Hawthorn[4], Sylvain Veilleux[1,2], Mario Dagenais[1,3]; [1]*Univ. of Maryland at College Park, USA;* [2]*Department of Astronomy, Univ. of Maryland, USA;* [3]*ECE Department, Univ. of Maryland, USA;* [4]*School of Physics, Univ. of Sydney, Australia.* We have developed an innovative loss characterization approach suited for record-high Q (> 1×10^6) Bragg grating cavities. The demonstration sample's loss is evaluated to be 0.24 dB/cm, with a resolution limit of 0.001 dB/cm.

ITh3B.6 • 15:45
Ultra-Low Power Photonic Chip-Based Soliton Frequency Combs, Junqiu Liu[1], Arslan S. Raja[1], Maxim Karpov[1], Bahareh Ghadiani[1], Martin H. P. Pfeiffer[1], Nils J. Engelsen[1], Hairun Guo[1], Michael Zervas[2], Tobias J. Kippenberg[1]; [1]*Ecole Polytechnique Federale de Lausanne, Switzerland;* [2]*LiGenTec SA, Switzerland.* By improving the quality factor and device input optical coupling, we present soliton formation in 1-THz-FSR and 88-GHz-FSR Si3 N4 microresonators with < 10 mW and < 50 mW optical powers, respectively.

NpTh3C • Spatiotemporal Phenomena III—Continued

NpTh3C.6 • 15:30
Megawatt-class Pulses from a Solid-core Fiber, Geoffroy Granger[1], Hugo Delahaye[1], Dmitry Gaponov[2], Laure Lavoute[2], Jean-Thomas Gomes[2], Mathieu Jossent[2], Mikhail Salganskii[3], Mikhail E. Likhachev[3], Sebastien Fevrier[1]; [1]*Xlim, France;* [2]*87 000, novae, France;* [3]*Inst. of High Purity Substances , Russia.* 1.5 MW, 130 fs pulses are generated in the short wavelength infrared band (2.2-2.5µm) by pumping large mode area photonic bandgap Bragg fiber by a multi µJ CPA at 2µm.

NpTh3C.7 • 15:45
Nonlinear Phenomena in Phoxonic Microbubble Resonators, Daniele Farnesi[1], Giancarlo C. Righini[1,2], Gualtiero Nunzi Conti[1,2], Silvia Soria[1]; [1]*Ist di Fisica Applicata Nello Carrara, Italy;* [2]*Museo Storico della Fisica e Centro Studi e Ricerche "E. Fermi", Italy.* We report on nonlinear optical phenomena on phoxonic cavities based on microbubble whispering gallery mode resonators pumped with a continuous wave laser. We observed simultaneous excitation of Brillouin, Raman and Kerr effects in silica MBR.

NoTh3D • Tunable Metadevices II—Continued

SeTh3E • Laser-based Sensors II—Continued

SeTh3E.6 • 15:30 Invited
Optofluidic Devices for Mechanical Probing and Imaging of Cells by Laser Light, Francesca Bragheri[1]; [1]*P.zza Leonardo da Vinci 32, Istituto di Fotonica e Nanotecnologie - CNR, Italy.* Femtosecond laser micromachining allows fabricating optofludic devices for sensing by laser light. The devices have been validated on cancer cells either by probing mechanical properties at the single cell level or by 3D-imaging cell spheroids.

16:00–16:30 Networking Coffee Break, *D Level Foyers*

Room D3.2	Room D5.2	Room D7.2	Room E1.1	Room E1.2
Photonic Networks and Devices	Signal Processing in Photonic Communications	Specialty Optical Fibers	Nonlinear Photonics	Integrated Photonics Research, Silicon, and Nano-Photonics

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

NeTh3F • Short Reach Interconnects—Continued

SpTh3G • Access Networks and Free Space Communications—Continued

SoTh3H • Mid-infrared Supercontinuum Generation—Continued

SoTh3H.5 • 15:30 Invited
MIR Supercontinuum in All-normal Dispersion Chalcogenide Photonic Crystal Fibers, Camille-Sophie Bres[1], Sida Xing[1]; [1]*STI IEL PHOSL, Ecole Polytechnique Federale de Lausanne, Switzerland.* Generation of mid-infrared normal coherent supercontinuum in a chalcogenide photonic crystal fiber pumped at 2μm is reported, 3dB bandwidth of 30THz is measured. Improved design guidelines for further broadening and pulse compression are proposed.

NpTh3I • Novel Spatial Effects in Planar Photonics Structures—Continued

NpTh3I.5 • 15:30
Atom-mediated Spontaneous Parametric Down-conversion Using Bandgap Modes in Nonlinear Periodic Waveguides, Sina Saravi[1,4], Alexander Poddubny[3,2], Thomas Pertsch[1], Frank Setzpfandt[1], Andrey A. Sukhorukov[4]; [1]*Abbe Center of Photonics, Friedrich Schiller Univ. Jena, Germany;* [2]*ITMO Univ., Russia;* [3]*Ioffe Inst., Russia;* [4]*Nonlinear Physics Centre, Australian National Univ., Australia.* We propose the concept of atom-mediated pair-generation, using the bandgap evanescent modes of a nonlinear periodic waveguide, where spontaneous generation of one photon becomes conditional on the absorption of its pair by a 2-level emitter.

NpTh3I.6 • 15:45
2-in-1: Advanced High-throughput Nanopatterning and Self-consistent Nanosensing by Structured Femtosecond Laser Pulses, Sergey I. Kudryashov[1]; [1]*ITMO Univ., Russia.* Structured visible femtosecond fiber laser pulses after 0.65-NA focusing were used for advanced high-throughput high-fluence nanofabrication of intricate plasmonic elements and consequent spectrally, topographically adjusted low-intensity sensing.

ITh3J • Metamaterial Photonic Devices—Continued

ITh3J.5 • 15:30 Invited
Photonic Metasurfaces for Next-Generation Biosensors, Hatice Altug[1], Filiz Yesilkoy[1], Xiaokang Li[1], Maria Soler[1], Alexander Belushkin[1], Yasaman Jahani[1]; [1]*EPFL STI IBI-STI BIOS, Ecole Polytechnique Federale de Lausanne, Switzerland.* New healthcare initiatives including personalized medicine, global health, point-of-care diagnostic require breakthrough developments. I will introduce compact and high-throughput biosensors enabled by metasurfaces interfaced with biology, chemistry.

16:00–16:30 Networking Coffee Break, *D Level Foyers*

Room D1.1

Joint Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials/ Specialty Optical Fibers

Room E5

Integrated Photonics Research, Silicon, and Nano-Photonics

Room E3

Nonlinear Photonics

Room D1.2

Novel Optical Materials and Applications

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

16:30–18:30
JTh4A • Joint BGPP-SOF Session
Presider: Kyriacos Kalli; Cyprus Univ. of Technology, Cyprus

JTh4A.1 • 16:30
All-Fiber Normal-Dispersion Passively Mode-locked Laser Employing a Chiral Fiber Grating, Du Yueqing[1], Xuewen Shu[1]; *[1]Wuhan National Laboratory for Optoelectr, China.* We demonstrate an all-fiber mode-locked laser in all-normal-dispersion based on a chiral fiber grating. High-energy ultrashort pulses can be generated from laser. Our work paves a new way to realize all-fiber ultrafast lasers.

JTh4A.2 • 16:45
3D Printed Gratings: IR-THz Applications, Denver Linklater[1], Ryu Meguya[2], William Hart[1], Armandas Balcytis[1], Edvinas Skliutis[3], Mangirdas Milinauskas[3], Dominique Appadoo[4], Eugene Tan Yaw Ren[4], Elena Ivanova[1], Junko Morikawa[2,5], Saulius Juodkazis[1,5]; *[1]Swinburne Univ. of Technology, Australia; [2]Tokyo Inst. of Technology, Japan; [3]Quantum Electronics, Vilnius Univ. Laser Research Centre, Lithuania; [4]Infrared Microspectroscopy Beamline, Australian Synchrotron, Australia; [5]Melbourne Centre for Nanofabrication, Australia.* 3D printed gratings were tested for the polarization control of IR-THz beams and showed spectral regions where the dichroic ratio D_r >1 and < 1. 3D-printed optical elements can be useful in intensity and polarization control of IR-THz beams.

JTh4A.3 • 17:00
Pulse Reshaping and Stable Propagation through a Chirped-clad Dispersion Oscillating Bragg Fiber, Piyali Biswas[1], Somnath Ghosh[1]; *[1]Indian Inst. of Technology, Singapore.* We report stable propagation of parabolic similaritons through a specially designed Bragg fiber based on a two-fold engineering including transverse chirping and longitudinal tapering to mitigate the deleterious effect of third order dispersion.

JTh4A.4 • 17:15
Tunable Chirped Fiber Bragg Grating in mPOF, Rui Min[1], Beatriz Ortega[1], Carlos Marques[2]; *[1]Universitat Politecnica de ValencialTEAM, Spain; [2]IT, Portugal.* We demonstrated tunable chirped fiber Bragg gratings fabrication in tapered doped microstructured polymer fiber using a uniform phase mask. Strain sensitivity of the gratings was measured as 0.73 ± 0.02 pm/με as a tunable device.

16:30–18:15
ITh4B • Novel Devices and Applications
Presider: Anna Tauke-Pedretti; Sandia National Laboratories Albuquerque, USA

ITh4B.1 • 16:30 Invited
On the Use of Artificial Intelligence for the Next-generation of Computational Inverse Platforms, George Barbastathis[1,2], Alexandre Goy[1], Kwabena Arthur[1], Mo Deng[3], Shuai Li[1]; *[1]Department of Mechanical Engineering, Massachusetts Inst. of Technology, USA; [2]Singapore-MIT Alliance for Research and Technology (SMART) Centre, Massachusetts Inst. of Technology, USA; [3]Department of Electrical Engineering and Computer Science, Massachusetts Inst. of Technology, USA.* Deep Learning presents a promising opportunity to design computational architectures for solving inverse problems. In this talk, we will present several approaches for performing computational imaging in this fashion, and discuss their relative merits especially with respect to image delity and robustness to noise.

ITh4B.2 • 17:00
Long Propagating Bloch Surface Waves using Ion Beam Sputtering Technology, Babak Vosoughi Lahijani[1], Nicolas Descharmes[1], Raphaël Barbey[1], Valentin Wittwer[2], Olga Razskazovskaya[2], Thomas Südmeyer[2], Hans Peter Herzig[1]; *[1]Optics & Photonics Technology Laboratory (OPT), École Polytechnique Fédérale de Lausanne (EPFL), Switzerland; [2]Laboratoire Temps-Fréquence, Université de Neuchâtel, Switzerland.* We study the propagation length of Bloch surface waves in the visible spectrum. We show that a millimeter-range Bloch surface wave propagation may take place by improving the surface quality of the multilayer substrate.

ITh4B.3 • 17:15
Robust and Finely Controlled Coupling Coefficient for Sub-wavelength Nanostructured Waveguides Array: Towards an Optical Isolator Integrated on Silicon, Anne Talneau[1], Flore Hentinger[1], Nadia Belabas[1]; *[1]Centre National Recherche Scientifique, France.* Within Silicon-based waveguide arrays, we demonstrate that sub-l, below band-gap nanostructured waveguides can provide a robust control and a fine tuning of the coupling coefficient, which is considered for an optical isolator integrated on Silicon.

16:30–18:00
NpTh4C • Nonlinear Plasmonics
Presider: Andrey Sukhorukov; Australian National Univ., Australia

NpTh4C.1 • 16:30 Invited
Imaging by Nonlinear Plasmonic Metalenses, Thomas Zentgraf[1], Christian Schlickriede[1], Bernhard Reineke[1], Philip Georgi[1], Guixin Li[2]; *[1]Dept of Physics, Universität Paderborn, Germany; [2]Department of Materials Science and Engineering, Southern Univ. of Science and Engineering, China.* We demonstrate imaging of objects by nonlinear plasmonic metalenses that use the Pancharatnam-Berry phase in the nonlinear regime to provide a parabolic phase profile. The imaging properties can be described by a modified lens equation.

NpTh4C.2 • 17:00
Plasmonic Enhancement of Epsilon-Near-Zero Modes, Joshua Hendrickson[1], shivashankar vangala[1], Chandriker Dass[2,1], Ricky Gibson[3,1], John Goldsmith[2,1], Kevin Leedy[1], Dennis Walker[1], Justin Cleary[1], Ting Luk[4], Wonkyu Kim[5], Junpeng Guo[5]; *[1]US Air Force Research Laboratory, USA; [2]KBRWyle Laboratories, USA; [3]Univ. of Dayton Research Inst., USA; [4]Sandia National Labs, USA; [5]Electrical and Computer Engineering, Univ. of Alabama Huntsville, USA.* Integrating an ENZ nanofilm into a plasmonic patch antenna, various light-matter interaction affects are explored: strong coupling, wideband flattop perfect light absorption, and ~50,000× enhancement in second harmonic generation.

NpTh4C.3 • 17:15
Nonlinear Dynamics of Anisotropic Epsilon-near-zero Materials, Maria Antonietta Vincenti[1], Mohammad Kamandi[2], Domenico de Ceglia[3], Caner Guclu[2], Michael Scalora[4], Filippo Capolino[2]; *[1]DII - Univ. of Brescia, Italy; [2]Univ. of California Irvine, USA; [3]Univ. of Padova , Italy; [4]US Army - AMRDEC, USA.* Anisotropic epsilon-near-zero media enhance nonlinear phenomena with respect to isotropic counterparts, circumventing material damping limitations. These results are pivotal for centrosymmetric materials, paving the way for novel nonlinear devices.

16:30–18:30
NoTh4D • Nonlinear Metasurfaces and Plasmonics
Presider: Brandon Shaw; US Naval Research Laboratory, USA

NoTh4D.1 • 16:30 Invited
Giant Nonlinear Response at a Plasmonic Nanofocus Drives Efficient Four Wave Mixing, Michael Nielsen[1], Nicholas Gusken[1], Paul Dichtl[1], Xingyuan Shi[1], Stefan A. Maier[1], Rupert F. Oulton[1]; *[1]Department of Physics, Imperial College London, UK.* We demonstrate four wave mixing in an integrated plasmonic gap waveguide on silicon that strongly confines light within a nonlinear organic polymer. We report >1% signal to idler conversion efficiency over micron-scale interaction lengths.

NoTh4D.2 • 17:00
Chalcogenide Glass Films for Nonlinear Metasurface Applications, Jesse A. Frantz[1], Jason D. Myers[1], Robel Y. Bekele[2], Yun Xu[3], Jingbo Sun[3], Mikhail Shalaev[3], Wiktor Walasik[3], Natalia Litchinitser[3], Jasbinder S. Sanghera[1]; *[1]US Naval Research Laboratory, USA; [2]Univ. Research Foundation, USA; [3]Department of Electrical Engineering, State Univ. of New York, Univ. at Buffalo, USA.* We evaluate the suitability of chalcogenide glass films, of interest because of their exceptionally high optical nonlinearities, for applications in metasurface devices and discuss results for a chalcogenide film-based optical beam converter.

NoTh4D.3 • 17:15
Enhanced Fluorescence of Nitrogen Vacancy Diamond Color Center via Monomer and Dimer Core-Shell Nanoresonators, Maria Csete[1], András Szenes[1], Dávid Vass[1], Balázs Bánhelyi[1], Csendes Tibor[1], Gábor Szabó[1]; *[1]Szegedi Tudomanyegyetem, Hungary.* Fluorescence of nitrogen vacancy diamond color center was significantly enhanced via coupling to spherical and ellipsoidal, monomer and dimer, silica-silver core-shell type plasmonic nanoresonators in numerically optimized configurations.

Room D7.1	Room D5.2	Room E1.1	Room E1.2
Optical Sensors	Signal Processing in Photonic Communications	Nonlinear Photonics	Integrated Photonics Research, Silicon, and Nano-Photonics

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

16:30–18:15
SeTh4E • Terahertz Sensing II
Presider: Hou-Tong Chen; Los Alamos National Laboratory, USA

SeTh4E.1 • 16:30 Invited
Terahertz Microfluidic Chip Sensitivity-enhanced with a Few Arrays of Meta Atoms, Masayoshi Tonouchi[1]; [1]*Inst. of Laser Engineering, Osaka Univ., Japan.* We present a nonlinear optical crystal (NLOC)-based terahertz (THz) microfluidic chip with a few arrays of split ring resonators for ultra-trace and quantitative measurements of liquid solutions.

SeTh4E.2 • 17:00
Broadband Terahertz Linear Polarization Rotation and Linear-to-Circular Polarization Conversion using Metasurfaces, Hou-Tong Chen[1]; [1]*Los Alamos National Laboratory, USA.* We show metasurfaces consisting of few-layer anisotropic structures allow for highly efficient and broadband terahertz linear polarization rotation and linear-to-circular polarization conversion, operating either in reflection or in transmission.

SeTh4E.3 • 17:15 Invited
Cross Sectional Enhancements in Terahertz Nano Antennas, Dai-Sik Kim[1]; [1]*Department of Physics and Astronomy, Seoul National Univ., South Korea.* We take advantage of recent advances in nano technology to study quantum scale light matter interaction. Cross sections of molecules can be hugely enhanced in terahertz regime while the probing depth decreases.

16:30–18:00
SpTh4F • Real-time Processing and ASIC Design
Presider: Robert Maher; Infinera Corporation, USA

SpTh4F.1 • 16:30 Invited
ASIC Implementation Challenges for Next Generation Access Networks, Peter Ossieur[1], G. Coudyzer[1], D. Kelly[2], Xin Yin[1], P. D. Townsend[2], Johan Bauwelinck[1]; [1]*Imec, IDLab, Ghent Univ., INTEC, Belgium;* [2]*Photonic Systems Group, Tyndall National Inst. and Univ. College Cork, Ireland.* We consider challenges associated with increasing bitrates >10Gb/s for next generation access networks. We explain how burst-mode electronic dispersion compensation (BM-EDC) is attractive for the upstream, and show examples of the required linear burst-mode receiver.

SpTh4F.2 • 17:00 Invited
Implementation Challenges for Energy-efficient Error Correction in Optical Communication Systems, Per Larsson-Edefors[1], Christoffer Fougstedt[1], Kevin Cushon[1]; [1]*Rannvagen 6, Chalmers Tekniska Hogskola, Sweden.* We describe energy-efficient hard- and soft-decision forward error correction circuits for optical communication systems. We discuss challenges of implementing circuits that combine high energy efficiency, high throughput, and high net coding gain.

16:30–18:30
NpTh4G • Applications of Complexity
Presider: Arnaud Mussot; Univ. Lille 1 Laboratoire PhLAM, France

NpTh4G.1 • 16:30
Nonlinear Pulse Propagation Experiments in Multimode Fibers with Mode-resolved Control, Zimu Zhu[1], Logan G. Wright[1], Joel Carpenter[2], Daniel A. Nolan[3], Ming-Jun Li[3], Demetrios N. Christodoulides[4], Frank W. Wise[1]; [1]*Cornell Univ., USA;* [2]*The Univ. of Queensland, Australia;* [3]*Corning Incorporated, USA;* [4]*Univ. of Central Florida, USA.* Using spatial light modulators, we demonstrate control of modal excitation and mode-resolved measurement of nonlinear pulse propagation in multimode fiber, and present a representative experiment in which we observe discrete Raman beam clean-up.

NpTh4G.2 • 17:00
Polarization Chaos and Random Bit Generation in Nonlinear Fiber Optics Induced by a Timedelayed Counter-propagating Feedback Loop, Nicolas Berti[1], Jacopo Morosi[1], akram akrout[1], Massimiliano Guasoni[2], Julien Fatome[1]; [1]*Université de Bourgogne Franche-Comté, France;* [2]*Univ. of Southampton, UK.* We demonstrate that the nonlinear interaction in an optical fiber between an incident beam and its backward delayed replica leads to a chaotic dynamics of its output polarization state, enabling a powerful scrambling process.

NpTh4G.3 • 17:15
Spatiotemporal Beam Shaping in Nonlinear Multimode Fibers, Katarzyna Krupa[2], Vincent Couderc[1], Marc Fabert[1], Alessandro Tonello[1], Alain J. Barthelemy[1], Vincent Kermene[1], Agnes Desfarges-Berthelemot[1], Guy Millot[3], Daniele Modotto[2], Stefan Wabnitz[2]; [1]*XLIM Research Insititute, France;* [2]*Dipartimento di Ingegneria dell'Informazione, Università di Brescia, Italy;* [3]*ICB, Université de Bourgogne, France.* Kerr beam self-cleaning in graded-index multimode fibers is accompanied by power-dependent temporal pulse reshaping. We explore the complex nonlinear dynamics with a single long pulse, where the optical power is continuously varied across its profile.

16:30–18:30
ITh4H • Novel Optical Sources and High Precision Photonics
Presider: Nicolas Volet, Univ. of California Santa Barbara; USA

ITh4H.1 • 16:30
Multiple Colliding Pulse Mode-Locked Laser in Ring Configuration, Mu-Chieh Lo[1], Robinson Guzmán[1], Guillermo Carpintero[1]; [1]*Universidad Carlos III de Madrid, Spain.* We propose a 3.5-mm-long III-V laser for 1-THz-wide optical comb and 0.5-ps-fast pulse train generation using a generic approach. The ring cavity has 6 SOAs and 2 MMI couplers. With the on-chip booster, 2-mW power is obtained.

ITh4H.2 • 16:45
Withdrawn

ITh4H.3 • 17:00
All-in-one Fiber Laser based on Liquid Crystal Transducer, Xinyue LEI[1], Christoph Wieschendorf[2], Alex Fuerbach[2], Francois Ladouceur[1], Leonardo Silvestri[1]; [1]*Electrical Engineering and Telecommunications, The Univ. of New South Wales, Australia;* [2]*MQ Photonics Research Centre, Department of Physics and Astronomy, Macquarie Univ., Australia.* We demonstrate a novel all-fiber laser system with an integrated liquid crystal transducer cell that can electronically be switched between continuous-wave, mode-locked (achieved by both, amplitude and phase modulation) or q-switched operation.

ITh4H.4 • 17:15 Invited
Painting Silk Opals with Water and Light, Fiorenzo G. Omenetto[1]; [1]*Dept. of Biomedical Engineering, Tufts Univ., USA.* Absrtact not available.

Room D1.1	Room E5	Room E3	Room D1.2
Joint Bragg Gratings, Photosensitivity and Poling in Glass Waveguides & Materials/ Specialty Optical Fibers	Integrated Photonics Research, Silicon, and Nano-Photonics	Nonlinear Photonics	Novel Optical Materials and Applications

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

JTh4A • Joint BGPP-SOF Session—Continued

JTh4A.5 • 17:30
A Nitroaniline-based, All-solid Photonic Bandgap Fiber, Georgios Violakis[1], Stavros Pissadakis[1]; [1]*FORTH-IESL, Greece.* A photonic bandgap fiber realized using 2-methyl 4-nitroaniline in a silica microstructured cladding glass background is demonstrated. This hybrid optical fiber exhibits variable guidance characteristics over broad band of wavelengths.

JTh4A.6 • 17:45
Phase Mask-based IR Femtosecond Grating Inscription in a Photonic Crystal Fiber with Short Focal Length Cylindrical Lens, Tigran Baghdasaryan[1], Thomas Geernaert[1], Adriana Morana[2], Emmanuel Marin[2], Sylvain Girard[2], Mariusz Makara[3], Pawel Mergo[3], Hugo Thienpont[1], Francis Berghmans[1]; [1]*Vrije Universiteit Brussel, Belgium;* [2]*Laboratoire Hubert Curien, France;* [3]*Maria Curie-Sklodowska Univ., Poland.* We first numerically studied the alignment peculiarities and then successfully inscribed a 4 dB strong fiber Bragg grating in a hexagonal lattice photonic crystal fiber in less than 4 seconds using a femtosecond pulse laser at 1030 nm

JTh4A.7 • 18:00
Amplification Decay of Er-doped H2-loaded Fiber caused by UV Exposure, Alexey P. Bazakutsa[1], Oleg V. Butov[1], Konstantin M. Golant[1]; [1]*Kotel'nikov Inst Radio Engin & Elec RAS, Russia.* Twofold decrease in the amplification of the UV-irradiated hydrogen-loaded Er3+-doped silica fiber was observed. This effect has to be taken into accont at the DFB fiber laser design.

JTh4A.8 • 18:15
Mid-IR Supercontinuum Generation in the Waveguide Inscribed in a Tellurite Glass, Andrey G. Okhrimchuk[1], M P. Smaev[1], V O. Likhov[1], V V. Dorofeev[2]; [1]*D. Mendeleev Univ. of Chemical Technology of Russia, Russia;* [2]*G.G. Devyatykh Inst. of Chemistry of High-Purity Substances of the Russian Academy of Sciences, Russia.* Supercontinuum in the range of 1800 – 2200 nm is generated under femtosecond pulses pumping at 1900 nm in a 14 mm long waveguide inscribed by femtosecond laser pulses in tungstate-tellurite glass

ITh4B • Novel Devices and Applications—Continued

ITh4B.4 • 17:30
Ultrashort and Broadband Silicon Polarization Splitter-rotator using Fast Quasiadiabatic Dynamics, Hung-Ching Chung[1], Shuo-Yen Tseng[1]; [1]*National Cheng Kung Univ., Taiwan.* We propose an ultrashort and broadband silicon mode-conversion polarization splitter-rotator by the fast quasiadiabatic dynamics to speed up the adiabatic evolution. The designed device is 32.9 μm long and has a bandwidth > 100 nm.

ITh4B.5 • 17:45
All-lossy Quasi-guided Dual-mode Optical Waveguide Exhibiting Exceptional Singularities, Arnab laha[1], Abhijit Biswas[1], Somnath Ghosh[2]; [1]*Univ. of Calcutta, India;* [2]*Physics, Indian Inst. of Technology Jodhpur, India.* We explore exceptional points (*EP*) in a dual-mode symmetric planar optical waveguide with transverse variation of inhomogeneous loss profile; where modal evolution alongside an *EP* is reported in the context of selective optical mode conversion.

ITh4B.6 • 18:00
3D printed Polarization Micro-Optics: Fresnel Rhomb Printed on an Optical Fiber, Andrea Bertoncini[1], Carlo Liberale[1]; [1]*King Abdullah Univ of Sci & Technology, Saudi Arabia.* A miniaturized and fiber-integrated Fresnel Rhomb has been 3D printed with Direct Laser Writing on a polarization-maintaining fiber to act as a broadband quarter waveplate, allowing generation of circularly polarized light.

NpTh4C • Nonlinear Plasmonics—Continued

NpTh4C.4 • 17:30
Engineering Nanoantennas for Efficient Nonlinear Photon Conversion at the Nanoscale, Lavinia Ghirardini[1], Andrea Locatelli[2], Luca Carletti[2], Costantino De Angelis[2], Giovanni Pellegrini[1], Paolo Biagioni[1], Lamberto Duò[1], Xiaofei Wu[3], Swen Grossmann[3], Bert Hecht[3], Marco Finazzi[1], Michele Celebrano[1]; [1]*Politecnico di Milano, Italy;* [2]*Università di Brescia, Italy;* [3]*Univ. of Würzburg, Germany.* We investigate the nonlinear emission of non-centrosymmetric plasmonic nanoantennas by polarization-resolved nonlinear microscopy. We reveal a cascade process between pump and second harmonic photons contributing to the overall third harmonic signal.

NpTh4C.5 • 17:45
Directional Supercontinuum Generation, Simon Christensen[1], Morten Bache[1]; [1]*DTU, Denmark.* Directional supercontinuum is generated in a silicon-rich nitride waveguide with two zero dispersion wavelengths. The supercontinuum is caused by interaction between a soliton and a pulse in the normal dispersion regime leading to dispersive waves.

NoTh4D • Nonlinear Metasurfaces and Plasmonics—Continued

NoTh4D.4 • 17:30
Scintillating Crystalline Colloidal Arrays, Mary Burdette[1], Yuriy Bandera[1], Stephen H. Foulger[1]; [1]*Clemson Univ., USA.* Polystyrene colloidal particles (95 nm) were doped in situ with anthracene, an organic scintillator. These particles were then self-assembled into crystalline colloidal arrays.

NoTh4D.5 • 17:45
Plasmonic Nanoantenna for Single-photon Sources on Diamond: Pursuing 100% Collection Efficiency, Ilya M. Fradkin[1], Mario Agio[2], Dmitry Y. Fedyanin[1]; [1]*Moscow Inst. of Physics & Technology, Russia;* [2]*Univ. of Siegen, Germany.* We demonstrate a nanoantenna for single-photon photon sources on diamond, which does not only enhance the quantum efficiency via the Purcell effect, but also gives the possibility to collect more than 85% of emitted photons.

NoTh4D.6 • 18:00
Enhanced Visible Photocatalytic Activity by Mesoporous Morphology Dependent Resonator, Imon Kalyan[1]; [1]*Indian Inst. of Technology Madras, India.* We present the study of the effect of morphology dependent modes on photocatalysis by visible light active, anatase TiO_2 mesoporous microspheres via photodegradation of Rhodamine B dye.

NoTh4D.7 • 18:15
Enhancement of Evanescent Waves in a Multilayered Structure Composed of Graphene and Metamaterial, Abdollah Hassanzadeh[1], Darya Azami[1]; [1]*Univ. of Kurdistan, Iran* In this paper, the optical pressure arising from an enhancement of evanescent wave in a proposed multilayered structure composed of graphene and metamaterials is investigated for a transverse magnetic (TM) incident wave.

Room D7.1

Optical Sensors

Room D5.2

Signal Processing in Photonic Communications

Room E1.1

Nonlinear Photonics

Room E1.2

Integrated Photonics Research, Silicon, and Nano-Photonics

These concurrent sessions are grouped across two pages. Please review both pages for complete session information.

SeTh4E • Terahertz Sensing II—Continued

SeTh4E.4 • 17:45 Invited
Title Not Available, Juncheng Cao[1]; [1]*865 Changning Road, Shanghai Inst of Microsystem & Info Tech, China.* Abstract not available.

SpTh4F • Real-time Processing and ASIC Design—Continued

SpTh4F.3 • 17:30
Real-time 112 Gbit/s DMT for Data Center Interconnects, Annika Dochhan[1], Nicklas Eiselt[1], Jim Zou[1], Helmut Griesser[1], Michael H. Eiselt[1], Joerg-Peter Elbers[1]; [1]*ADVA Optical Networking, Germany.* We report on 112 Gbit/s real-time DMT transmission over up to 60 km, targeted at DCI applications. Chromatic dispersion mitigation by vestigial sideband filtering is compared to the use of dispersion compensating fiber.

SpTh4F.4 • 17:45
Low Complexity Real-time Carrier Recovery for 64APSK with Polar Coordinates Processing, Benedikt Baeuerle[1], Arne Josten[1], Juerg Leuthold[1]; [1]*ETH Zurich, Switzerland.* A real-time carrier recovery for 64APSK signals leveraging low complexity and high spectral efficiency is introduced. Our hardware implementation is enable by processing in polar coordinates and allows the detection beyond 32 GBd.

NpTh4G • Applications of Complexity—Continued

NpTh4G.4 • 17:30
Diffractive Coupling for Large Scale Photonic Reservoir Computers, Sheler Maktoobi[2], Luc Froehly[1], Maxime Jacquot[2], Laurent Larger[2], Daniel Brunner[1]; [1]*CNRS - FEMTO-ST, France;* [2]*FEMTO-ST, Univ. Bourgogne-Franche-Comte, France.* We experimentally create a neural network using diffractive coupling, implementing 2.025 connections in parallel and demonstrate photonic reinforcement learning. We numerically show validity of the scheme for coupling at least 34.000 elements.

NpTh4G.5 • 17:45
Fiber-optic Reservoir Computing, Mariia Sorokina[1], Sergey Sergeyev[1], Sergei Turitsyn[1]; [1]*Aston Univ., UK.* Here we propose a new design of all-optical fiber-based reservoir computing and demonstrate it applicability for prediction tasks using using the standard Mackey-Glass test.

NpTh4G.6 • 18:00
Mode-Independent Phase-sensitive Frequency Conversion in a Few-mode Elliptical-core Fiber, Joseph C. Slim[1]; [1]*Institut Foton, France.* We propose an elliptical-core graded-index dispersion-shifted few-mode fiber that allows simultaneous intramodal phase-sensitive frequency conversion.The fiber breaks the degeneracy between the LP_{11a} and LP_{11b} modes and prevents intermodal processes.

NpTh4G.7 • 18:15
Geometric Parametric Instability in Modulated Parabolic Graded-index Fibers, Carlos Mas Arabi[1], Alexandre Kudlinski[1], Arnaud Mussot[1], Matteo Conforti[1]; [1]*PhLAM, Univ. of Lille, CNRS, France.* We show that a periodic modulation of the diameter of a graded-index multimode fiber modify the intrinsic self-imaging pattern, generating new spectral components in the geometric parametric instability gain spectrum

ITh4H • Novel Optical Sources and High Precision Photonics—Continued

ITh4H.5 • 17:45 Invited
High Harmonic Generation in 2D and 3D Semiconductors, Hamed Merdji[1]; [1]*CEA, France.* We demonstrate field amplification through light confinement in ZnO nano-structured 3D waveguides. We will present strategies to manipulate the orbital angular momentum of light. Finally, we investigate high harmonic generation in 2D semiconductors.

ITh4H.6 • 18:15
Octave-spaced, Dual-frequency Comb Quantum Cascade Laser Source in a Single Monolithic Waveguide, Andres Forrer[1], Markus Rösch[1], Mattias Beck[1], Jérôme Faist[1], Giacomo Scalari[1]; [1]*ETH Zürich, Switzerland.* We present an octave-spaced, dual-color and simultaneous operating frequency comb source with central frequencies at 2.3 THz and 4.6 THz based on heterogeneous terahertz quantum cascade laser active region designs in a single double-metal waveguide.

Key to Authors and Presiders

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