ISSN 0002-9920

Notices

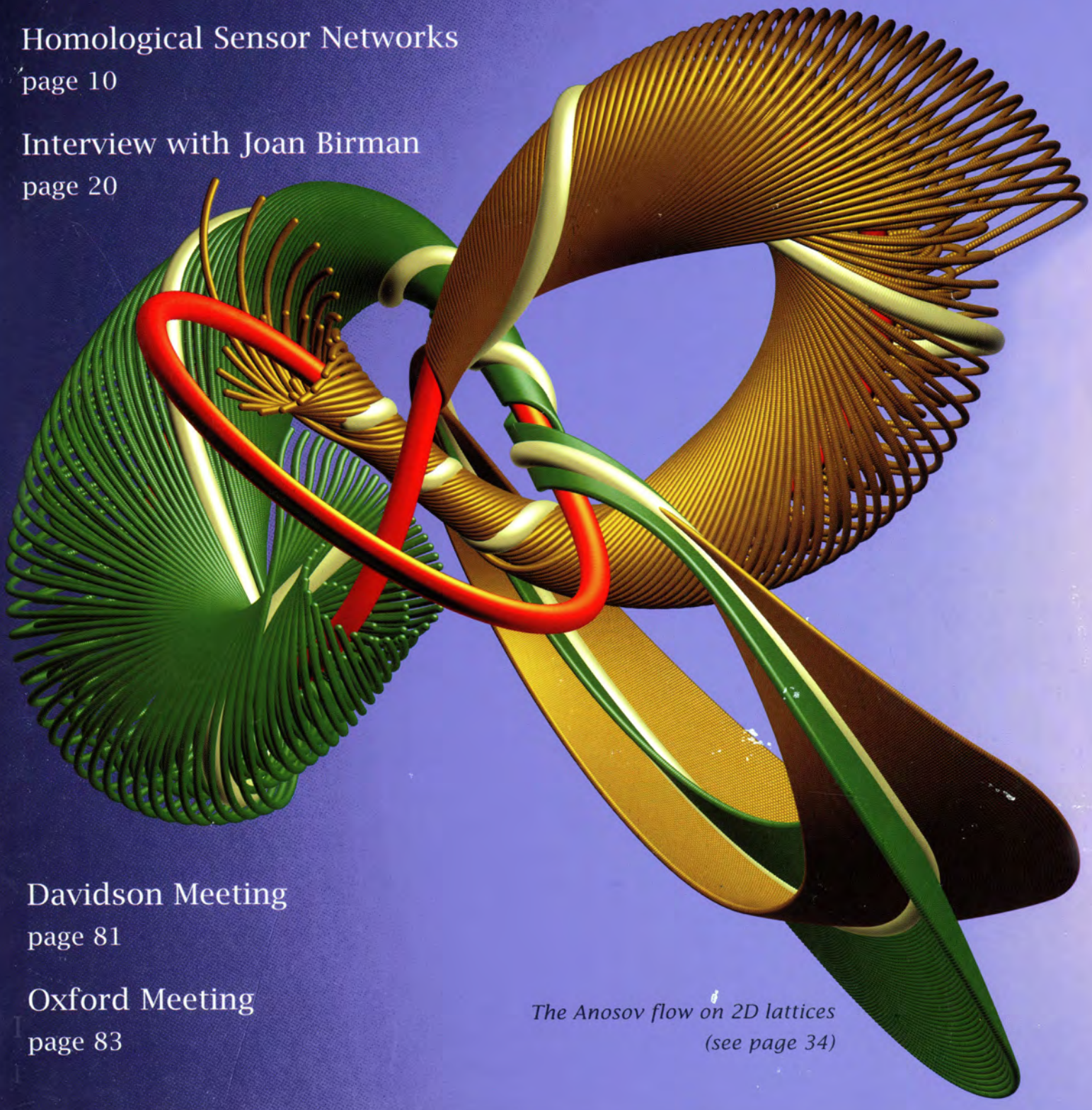
of the American Mathematical Society

January 2007

Volume 54, Number 1

Homological Sensor Networks
page 10

Interview with Joan Birman
page 20



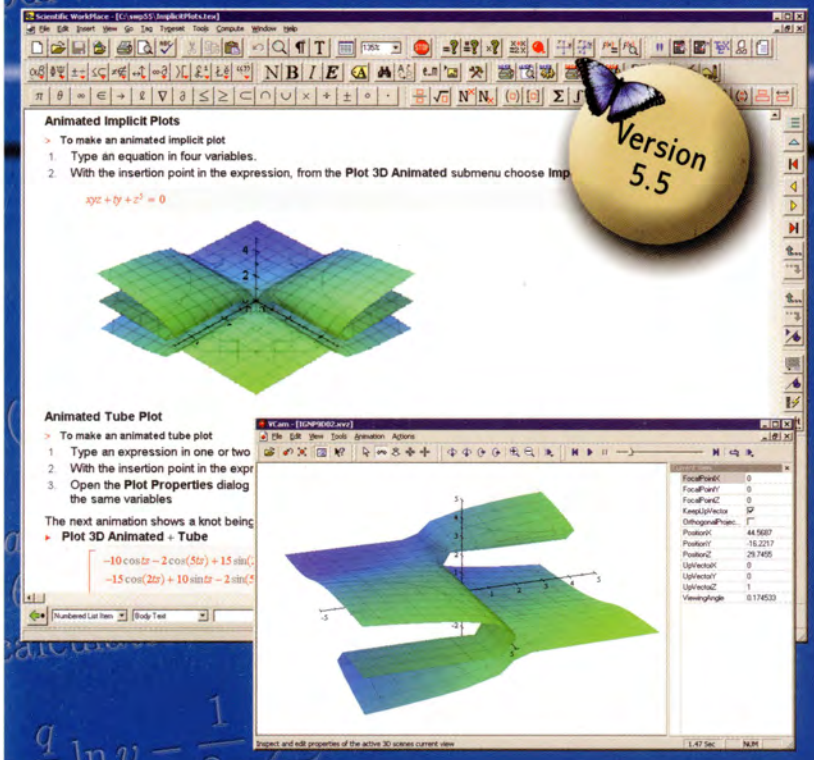
Davidson Meeting
page 81

Oxford Meeting
page 83

The Anosov flow on 2D lattices
(see page 34)

Scientific WorkPlace®

Mathematical Word Processing • LaTeX Typesetting • Computer Algebra



Animate, Rotate, Zoom, and Fly

New in Version 5.5

- Compute and plot using the *MuPAD® 3* computer algebra engine
- Animate 2D and 3D plots using *MuPAD's VCAM*
- Rotate, move, zoom in and out, and fly through 3D plots with new OpenGL® 3D graphics
- Label 2D and 3D plots so that the label moves when you rotate or zoom a plot
- Import LaTeX files produced by other programs
- Use many new LaTeX packages
- Get help from the new, extensive troubleshooting section of *Typesetting Documents with Scientific WorkPlace and Scientific Word, Third Edition*

The Gold Standard for Mathematical Publishing

Scientific WorkPlace 5.5 makes writing, sharing, and doing mathematics easier. You compose and edit your documents directly on the screen, without having to think in a programming language. A click of a button allows you to typeset your documents in LaTeX. You choose to print with or without LaTeX typesetting, or publish on the web. *Scientific WorkPlace* enables both professionals and support staff to produce stunning books and articles.

MacKichan SOFTWARE, INC.

www.mackichan.com/notices
Visit our website for free trial versions of all our products.

Visit us at
The Joint Mathematics Meetings
in New Orleans, Booth 108

NEW! MuPAD® Pro 4

The Open Computer Algebra System

The latest version of *MuPAD Pro* offers a new and enhanced user interface and more. It is available for Windows, Macintosh, and Linux.

Visit our website for details and to download a free trial version.

Email: info@mackichan.com • Toll free: 877-724-9673
Fax: 360-394-6039

AMERICAN MATHEMATICAL SOCIETY

Headlines & Deadlines
for students

E-mail notifications of news, helpful websites, special programs, book sales, and deadlines for applications for fellowships and grants, meeting registrations, and more.

Sign up Today!

Headlines & Deadlines for Students, a new service from the AMS Public Awareness Office, provides email notification of mathematics news and of upcoming deadlines. These email notifications will be issued about once a month, and when there's special news. Imminent deadlines will be included in these emails, which will link to a web page that's a centralized source for information relevant to students and faculty advisors, at: **www.ams.org/news-for-students/**

Sign up for the email service at: **www.ams.org/news-for-students/signup**

Check out the latest *Headlines & Deadlines for Students* for news and due dates for applications, registrations, proposals...

Pi Mu Epsilon Student Paper Presentation Awards

Fellowships and Grants

New Mathematical Moments

Marshall Scholarships

Stipends for Study and Travel

Trjitzinsky Awards

Math in Moscow Semester - Call for Applications

AWM Essay Contest

Special Book Sales on AMS Bookstore

Poster Session Proposals

Putnam Exam Results

Employment Center Registration

Clay Research Fellowships

AMS
AMERICAN MATHEMATICAL SOCIETY

www.ams.org/news-for-students

NEW & NOTEWORTHY *from Birkhäuser*

Mathematical Olympiad Challenges

Second Edition

TITU ANDREESCU, *The University of Texas at Dallas, Richardson, TX;* **RAZVAN GELCA**, *Texas Tech University, Lubbock, TX*

Review of the First Edition: *"This [book] is... much more than just another collection of interesting, challenging problems, but is instead organized specifically for learning. The book expertly weaves together related problems, so that insights gradually become techniques, tricks slowly become methods, and methods eventually evolve into mastery.... The book is aimed at motivated high school and beginning college students and instructors.... I strongly recommend this book for anyone interested in creative problem-solving in mathematics...."* **—THE MATHEMATICAL GAZETTE**

With many new or expanded examples, problems, and solutions, this second edition adopts a more user-friendly style with more accessible and inviting examples. Featuring enhanced motivation for advanced high school and beginning college students, as well as instructors and Olympiad coaches, this text can be used for creative problem-solving courses, for professional teacher development seminars and workshops, for self-study, or as a resource for training for mathematical competitions.

2007/APPROX. 320 PP./SOFTCOVER
ISBN 978-0-8176-4528-1/$29.95 (TENT.)

The Math Problems Notebook

VALENTIN BOJU, *MontrealTech, Institute de Technologie de Montreal, Quebec, Canada;* **LOUIS FUNAR**, *CNRS, Université de Grenoble I, Institut Fourier, France*

The Math Problems Notebook is a collection of non-trivial, unconventional problems requiring deep insight and imagination nostalgic of those discussed at the Sunday Math Circles. These Circles were comprised of college students who had a common passion for mathematics, and became a place for disseminating beautiful mathematics at an elementary level. Following in the tradition of these math circles, the authors hope to inspire further enjoyment of mathematics with their collection of problems. Undergraduates and teachers of advanced mathematics, as well as the casual mathematician will mutually enjoy the collection.

Part I. Problems * Number Theory * Algebra and Combinatorics * Geometry * Analysis * **Part II. Solutions and Comments to the Problems** * Number Theory Solutions * Algebra and Combinatorics Solutions * Geometry Solutions * Analysis Solutions * Glossary * Index

2007/APPROX. 290 PP., 21 ILLUS./SOFTCOVER
ISBN 978-0-8176-4546-5/$39.95 (TENT.)

By **MARIANO GIAQUINTA**, *Scuola Normale Superiore, Pisa, Italy;* **GIUSEPPE MODICA**, *Università degli Studi di Firenze, Italy*

Mathematical Analysis

Linear and Metric Structures and Continuity

This self-contained work on linear and metric structures focuses on studying continuity and its applications to finite- and infinite-dimensional spaces. The book motivates the study of linear and metric structures with examples, observations, exercises, and illustrations. It may be used in the classroom setting or for self-study by advanced undergraduate and graduate students and as a valuable reference for researchers in mathematics, physics, and engineering.

2007/XX, 468 PP., 128 ILLUS./HARDCOVER
ISBN 978-0-8176-4374-4/$149.00
2007/XX, 468 PP., 128 ILLUS./SOFTCOVER
ISBN 978-0-8176-4375-1/$69.95

Mathematical Analysis

Foundations and Advanced Techniques for Functions of Several Variables

This work builds upon the basic ideas and techniques of differential and integral calculus for functions of several variables, as outlined in an earlier introductory volume. The presentation is largely focused on the foundations of measure and integration theory. This work may be used as a supplementary text in the classroom or for self-study by advanced undergraduate and graduate students and as a valuable reference for researchers in mathematics, physics, and engineering. It motivates understanding of the subject through examples, observations, exercises, and illustrations.

2008/APPROX. 380 PP., 108 ILLUS./HARDCOVER
ISBN 978-0-8176-4508-3/$149.95 (TENT.)
2008/APPROX. 380 PP., 108 ILLUS./SOFTCOVER
ISBN 978-0-8176-4506-9/$69.95 (TENT.)

Mathematical Analysis

Functions of One Variable

2003/XII, 353 PP./HARDCOVER
ISBN 978-0-8176-4312-6/$89.95

Mathematical Analysis

Approximation and Discrete Processes

2004/XII, 388 PP., 152 ILLUS./HARDCOVER
ISBN 978-0-8176-4313-3/$149.00
2005/XII, 388 PP., 152 ILLUS./SOFTCOVER
ISBN 978-0-8176-4337-9/$69.95

New Birkhäuser Series

Modern Birkhäuser Classics

Many of the original research and survey monographs in pure and applied mathematics published by Birkhäuser in recent decades have been groundbreaking and have come to be regarded as foundational to the subject. Through the MBC Series, a select number of these modern classics, entirely uncorrected, are being re-released in paperback (and as eBooks) to ensure that these treasures remain accessible to new generations of students, scholars, and researchers.

Metric Structures for Riemannian and Non-Riemannian Spaces

MIKHAIL GROMOV, *Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France;*
Edited by **JACQUES LAFONTAINE**, *Université de Montpellier, France;* **PIERRE PANSU**, *Université de Paris-Sud, Orsay, France;*

Appendices by **MIKHAIL KATZ**, *Université de Nancy, Vandoeuvre, France;* **PIERRE PANSU**, *Université de Paris-Sud, Orsay, France;* **STEPHEN SEMMES**, *Rice University, Houston, TX;*

Translated by **SEAN M. BATES**, *Columbia University, New York, NY*

2007/XX, 586 PP., 100 ILLUS./SOFTCOVER
ISBN 978-0-8176-4582-3/$39.95

Notions of Convexity

LARS HÖRMANDER, *University of Lund, Sweden*

2007/VIII, 414 PP./SOFTCOVER
ISBN 978-0-8176-4584-7/$39.95

Tata Lectures on Theta I

DAVID MUMFORD, *Brown University, Providence, RI;*

The first of a series of three volumes surveying the theory of theta functions and its significance in the fields of representation theory and algebraic geometry, this volume deals with the basic theory of theta functions in one and several variables, and some of its number theoretic applications. Requiring no background in advanced algebraic geometry, the text serves as a modern introduction to the subject.

2007/XIV, 236 PP., 7 ILLUS./SOFTCOVER
ISBN 978-0-8176-4572-4/$39.95

Volume II

2007/XIV, 272 PP., 21 ILLUS./SOFTCOVER
ISBN 978-0-8176-4569-4/$39.95

Volume III

2007/VIII, 202 PP., 2 ILLUS./SOFTCOVER
ISBN 978-0-8176-4570-0/$39.95

CALL: 1-800-777-4643 • FAX: (201) 348-4505
E-MAIL: orders@birkhauser.com • www.birkhauser.com

Please mention promotion **#012489** when ordering. Prices are valid in the Americas only and are subject to change without notice. For price and ordering information outside the Americas, please contact Birkhäuser Verlag AG by E-mail: birkhauser@springer.de

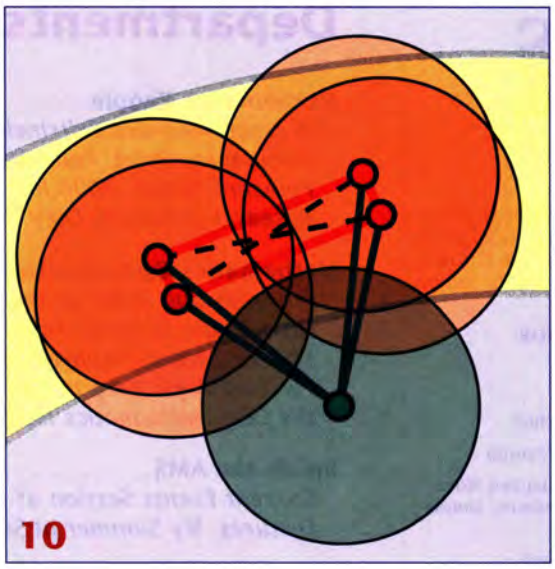
Birkhäuser
Boston · Basel · Berlin

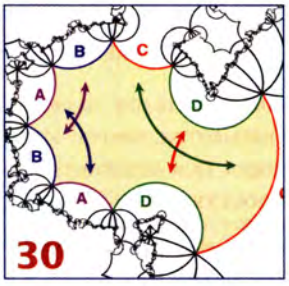
012797x

Notices

of the American Mathematical Society

January 2007





Communications

30 WHAT IS...a Projective Structure?
William M. Goldman

34 About the Cover
Bill Casselman

43 Mississippi Mathematics Renaissance
Gerard Buskes

45 What Is Good for Mathematics? Thoughts on the Clay Millennium Prizes
Anatoly Vershik

Commentary

5 Letter from the Editor: Share the Wealth?
Andy Magid

6 Letters to the Editor

36 *Fearless Symmetry: Exposing the Hidden Patterns of Numbers*—A Book Review
Reviewed by Dino Lorenzini

38 *Mathematical Illustrations: A Manual of Geometry and PostScript*—A Book Review
Reviewed by Denis Roegel

Features

10 Homological Sensor Networks

Vin de Silva and Robert Ghrist

A sensor network is an array of detection devices, or nodes, which can communicate with nearby sensors, lying in a fixed compact connected plane domain with connected piecewise-linear boundary. The nodes themselves can move. Each node connects in a radially symmetric domain. The authors use applied computational topology, in particular homology theory, to study holes in the coverage network.

20 Interview with Joan Birman

Allyn Jackson and Lisa Traynor

The *Notices* talks to the distinguished American topologist about her work and personal history.

Notices

of the American Mathematical Society

EDITOR: Andy Magid

ASSOCIATE EDITORS:
Susanne C. Brenner, Bill Casselman (*Graphics Editor*), Robert J. Daverman, Nathaniel Dean, Rick Durrett, Susan Friedlander, Robion Kirby, Steven G. Krantz, Elliott H. Lieb, Mark Saul, Karen E. Smith, Audrey Terras, Lisa Traynor

SENIOR WRITER and DEPUTY EDITOR:
Allyn Jackson

MANAGING EDITOR: Sandra Frost

CONTRIBUTING WRITER: Elaine Kehoe

PRODUCTION ASSISTANT: Muriel Toupin

PRODUCTION: Kyle Antonevich, Stephen Moye, Erin Murphy, Lori Nero, Karen Ouellette, Donna Salter, Deborah Smith, Peter Sykes

ADVERTISING SALES: Anne Newcomb

SUBSCRIPTION INFORMATION: Subscription prices for Volume 54 (2007) are US$447 list; US$358 institutional member; US$268 individual member. (The subscription price for members is included in the annual dues.) A late charge of 10% of the subscription price will be imposed upon orders received from nonmembers after January 1 of the subscription year. Add for postage: Surface delivery outside the United States and India—US$27; in India—US$40; expedited delivery to destinations in North America—US$35; elsewhere—US$88. Subscriptions and orders for AMS publications should be addressed to the American Mathematical Society, P.O. Box 845904, Boston, MA 02284-5904 USA. All orders must be prepaid.

ADVERTISING: *Notices* publishes situations wanted and classified advertising, and display advertising for publishers and academic or scientific organizations. Advertising material or questions may be faxed to 401-331-3842 (indicate "*Notices* advertising" on fax cover sheet).

SUBMISSIONS: Articles and letters may be sent to the editor by email at `notices@math.ou.edu`, by fax at 405-325-5765, or by postal mail at Department of Mathematics, 601 Elm, PHSC 423, University of Oklahoma, Norman, OK 73019-0001. Email is preferred. Correspondence with the managing editor may be sent to `notices@ams.org`. For more information, see the section "Reference and Book List".

NOTICES ON THE AMS WEBSITE: Most of this publication is available electronically through the AMS website, the Society's resource for delivering electronic products and services. Use the URL `http://www.ams.org/notices/` to access the *Notices* on the website.

[*Notices of the American Mathematical Society* (ISSN 0002-9920) is published monthly except bimonthly in June/July by the American Mathematical Society at 201 Charles Street, Providence, RI 02904-2294 USA, GST No. 12189 2046 RT****. Periodicals postage paid at Providence, RI, and additional mailing offices. POSTMASTER: Send address change notices to *Notices of the American Mathematical Society*, P.O. Box 6248, Providence, RI 02940-6248 USA.] Publication here of the Society's street address and the other information in brackets above is a technical requirement of the U.S. Postal Service. Tel: 401-455-4000, email: `notices@ams.org`.

© Copyright 2007 by the
American Mathematical Society.
All rights reserved.

Printed in the United States of America. The paper used in this journal is acid-free and falls within the guidelines established to ensure permanence and durability.

Opinions expressed in signed *Notices* articles are those of the authors and do not necessarily reflect opinions of the editors or policies of the American Mathematical Society.

Departments

Mathematics People 48
Bressan Awarded Feltrinelli Prize; Tao Awarded 2006 SASTRA Ramanujan Prize; Faddeev, Ruelle, and Witten Awarded Poincaré Prizes; 2006 Information-Based Complexity Young Researcher Award; DMV Prizes.

Mathematics Opportunities 50
Proposal Due Dates at the DMS, NDSEG Fellowships, AMS-AAAS Mass Media Summer Fellowships, Maria Mitchell Women in Science Award, Departments Coordinate Job Offer Deadlines, Focused Topic Area in Computational Mathematics, News from the Clay Mathematics Institute, News from the Bernoulli Center.

Inside the AMS 53
Current Events Session at Joint Meetings, Erdős Memorial Lectures, My Summer at Scientific American.

Reference and Book List 56

Mathematics Calendar 61

New Publications Offered by the AMS 65

Classified Advertising 72

AAAS Conference in San Francisco, CA 77

General Information Regarding Meetings & Conferences of the AMS 78

Meetings & Conferences of the AMS 79

Presenters of Papers, New Orleans Meeting 95

Program of the Sessions, New Orleans Meeting 102

Meetings and Conferences Table of Contents 183

Share the Wealth?

A *Notices* reader, who is a well placed and insightful observer of the American mathematical community, took exception to the statement in a recent Opinion column that "It is hard to imagine how our profession would operate without federal grants." Our reader pointed out that "the vast majority of researchers don't have [federal] grants", and went on to note that, in his view, the real problem we face in mobilizing the support of the mathematical community for increasing federal support for mathematics is that so few mathematicians receive support (or anticipate receiving support), there isn't a critical mass of people who care much about federal funding. This is why, our reader claims, that "physics and chemistry can mobilize people and mathematics can't."

I have to admit these observations are a bit of a surprise. Of course the fraction of academic mathematicians who are regularly named investigators of federal research grants in their research specialties is unfortunately a small number. But many more mathematicians receive other kinds of federal support, perhaps most significantly support to attend, or organize, conferences. And one can hope that the constituency for federal support for mathematics is not limited to grant recipients, or prospective recipients.

Nonetheless, our reader may have a point, or rather two points. First, there is the alleged apathy of a large part of the American mathematical community, at least as far as agitation for federal funding of mathematics is concerned. Second, there is the assumption that this apathy is the product of the bleak prospects for receiving federal research funding. For the sake of argument, let's grant the first point and consider what could be done if the majority of American mathematicians were eager to push for increased federal funding. The Division of Mathematical Sciences (DMS) budget of the National Science Foundation—which is the most popular source for federal funding of mathematics research—is about one ten thousandth of the total federal budget, which is the same order of magnitude as the fraction of mathematicians in the American population (I'm being generous with the definition of mathematician). Despite this fortuitous proportionality, the obvious conclusion is that as both a constituency and as a budget line research mathematics is too small to warrant direct political action. Indeed, this is our correspondent's conclusion: he argues that mathematicians should be part of the science lobby, and make sure that the public understands that mathematics is science.

Again for the sake of argument, let's grant the second point as well. Suppose we gave the entire mathematical community a stake in the federal funding process by funding everyone. For instance, if, as an experiment, the DMS budget were divided equally among all mathematicians (using my same generous definition) for, say, five years, each mathematician would receive US$20,000 annually to support their research. We can speculate whether this would cure the alleged apathy, and, with the apathy problem solved, whether the now committed mathematical community could have the desired impact on future federal funding. We can also speculate on whether the current federal funders (and fundees) would be willing to support such an experiment.

The *Notices*, of course, will continue to keep readers informed of developments and opportunities regarding federal support for mathematics research. In addition to news items about proposal deadlines and about AMS activities highlighting the need for, and successes of, funded mathematics research, scheduled *Notices* articles for 2007 include Allyn Jackson's annual analysis of DMS budget prospects, an article in our series for graduate students about the process for applying for a federal grant, an interview with outgoing DMS Director William Rundell, and others.

And speaking of 2007, I note that with this issue I begin my second term as *Notices* editor. *Notices* readers are well aware of Allyn Jackson's contributions as *Notices* Senior Writer; authors and others know of her major contributions as Deputy Editor as well. Our authors also know of the huge role Managing Editor Sandra Frost plays in the design and production of the *Notices*. The *Notices* is an important benefit to many AMS members, and we all (especially me) owe a large debt of gratitude to Sandy and Allyn for what they do to bring you the *Notices* each month. There are others I'd like to thank as well. Graphics Editor Bill Casselman continues to bring mathematically significant and esthetically pleasing images to *Notices* covers and articles. If you like the mathematical graphics in the *Notices*, and I do, you should know that Bill deserves the credit. The *Notices* is supported by a hard working production staff in the AMS offices, especially Production Assistant Muriel Toupin, all of whom deserve recognition and thanks. And finally, I'd like to recognize AMS Executive Director John Ewing, whose commitment to the editorial independence of the *Notices* is gratefully acknowledged.

—Andy Magid

Letters to the Editor

Visibility of Asian Americans in Mathematics

During the Madrid ICM-2006, there was considerable popular press coverage on a focal topic leading to it, namely the Poincaré Conjecture. Among the coverage is an August 28 article in the *New Yorker* by Nasar and Gruber. It was a much talked-about piece of publicity on mathematics at many dinner tables. Jackson's "Conjectures No More?" in your September issue of the *Notices* followed.

After reading these two articles in parallel, it is then particularly gratifying to read Goel's article on "An Invisible Minority" concerned with the need for Asian American mathematicians in the context of our social political environment. There are many reasons for it being gratifying.

A difference between Jackson's piece and the Nasar-Gruber piece is in the latter adding the spice of S. T. Yau being "Chern's successor" or "Chern's heir". While some mathematicians may interpret this plot in terms of Chern and Yau's professional accomplishment, due to the political incarnation of "heir" and "successor" the *New Yorker* actually creates for its general readers the plot of a political power struggle. We find the addition of this plot being a way to stereotype Asian Americans in the shadow of a politburo. It is particularly ironic that when Yau has the courage to speak openly against corruption in China in the past year, he never got the usual kudos in the American popular press, and is instead portrayed as an aggressor. It brings us to Goel's article concerned with the challenge facing all Asian mathematicians in the USA. As people with South Asia origins are subjected to the stereotype of a terrorist, people of East Asia origins are subjected to the stereotype of a communist. Both are taboos in the American society.

Yau's achievement in mathematics is well known within the mathematics community. It is equally well known that he has successfully produced nearly 50 Ph.D. students in mathematics and has many collaborators across the globe. Perhaps, it is less well known that he has donated personal funds to establish scholarships for mathematics students, has donated tens of thousands of books to educational institutions, has helped raise tens of millions of dollars to promote mathematics education and research, and has raised funds to promote interaction among scientists across subject boundaries and national borders. For the Asian Americans below the glass ceiling, it is disheartening to see such a successful and dedicated academic being subjected to the smear of popular press. For the Asian American scientists and their children negotiating their ways through the minority situation in our political system but excluded outside the "under-represented" designation, especially in academic institutions, Goel's piece provides a much needed, timely and refreshing perspective.

—Bun Wong and Yat Sun Poon
University of California at Riverside

(Received September 23, 2006)

Mathematical Community Should Police Itself

I would like to comment on recent events revolving about the awarding of the Fields Medal to Grigory Perelman, and the article in the *New Yorker* magazine about it.

I have always felt proud to be a member of a professional community that embraces talent, with all the human diversity that can accompany it. As mathematicians, we have an extraordinary tolerance of eccentricity, and I truly believe that many individuals who might do badly in a different social milieu find acceptance and thrive in the mathematics community. Sylvia Nasar's book, *A Beautiful Mind*, describes this in rich detail. Reading it, I was proud of our decency as a community.

But there is another, and a darker, side to the same phenomenon, i.e. a tolerance for bad behavior, especially when the individuals whose actions might be questioned are highly talented. To put it plainly, we do not police ourselves very well.

I focus on one small part of the complex array of matters discussed in the Nasar-Gruber article, namely the manner in which the normal peer review process, essential to the integrity of the profession, was tossed out the window when the paper of Cao and Zhu was accepted for publication in the *Asian Journal of Mathematics* (AJM). The submitted paper appears to be mainly an exposition of Perelman's work on the Geometrization Conjecture, however it asserted that there were gaps in Perelman's proof, which the authors filled. That was a serious assertion. The decision to publish the Cao-Zhu paper was made by the two editors-in-chief of the AJM, without consultation with the journal's twenty-six member editorial board, even though it was known that the authors had deep personal attachments to the editors-in-chief. The members of the editorial board of the AJM were notified of the pending publication a few days before the journal issue appeared, but were not shown the paper, an abstract, or reports by independent referees. Their names continue to appear on the journal cover, so one must assume that they approved that process. Thus those who were in a position to say "wait a minute, we will not let our names be used in this way" remained silent. This was just one of the many moments in this sad tale when there were no whistle-blowers. As a result the entire profession has received a very public and very bad black mark.

—Joan S. Birman
Professor Emeritus of Mathematics
Barnard College and
Columbia University

(Received September 23, 2006)

Poincaré's Vision

The recent proof by Hamilton and Perelman of the celebrated 3-d Poincaré conjecture has occasioned a dramatic upsurge of controversies concerning priorities and individual personalities.

We want to bring to the reader's attention a specific aspect which has been neglected in this discussion. Namely, the connection of this proof with the vision of Poincaré. Up to now the unsuccessful attempts to prove

the conjecture had relied on methods of topology. The Hamilton-Perelman proof rests upon two essential ingredients:

1) The study of the deformation theory of these manifolds under a nonlinear evolution equation, namely the Ricci flow.

2) The careful control of Ricci flows based on a priori estimates for this PDE and Thurston's decomposition.

These two ingredients are closely linked to some of the earlier works of Poincaré. In particular Poincaré had a vivid insight of the role of PDEs within pure mathematics. This is illustrated very sharply in the introduction to Poincaré's paper in the *Amer. J. Math.*, vol. 12 (1890), in which Poincaré sets forth the foundations of the modern theory of PDEs. We quote this section in our English translation.

After listing some outstanding examples of PDEs in mathematical physics (Laplace, heat and wave equations) he writes:

"All these problems have a family resemblance that one cannot disregard. One should therefore expect to find a large number of common properties. Unfortunately, the first common property is their extreme difficulty. Not only can one not resolve these equations in explicit form, but it is only at the price of great effort that one can prove their solvability rigorously.

"Is this demonstration necessary? Most physicists wouldn't care less. Experience does not permit one to doubt the possibility of electric equilibrium. One cannot doubt, it seems, the solvability of these equations which express this equilibrium.

"The differential equations which physical phenomena obey have often been established with lack of rigor. One can regard these only as approximations.[...]. Thus absolute rigor has limited interest. It seems often that there is no place for such rigor if it involves too much effort.

"Nevertheless, each time I can, I aim at absolute rigor for two reasons. In the first place, it is always hard for a geometer to consider a problem without resolving it completely. In the second place, these equations that I will study are susceptible, not only to physical applications, but also to analytical applications. It is using the existence theory of the Dirichlet problem that Riemann founded his magnificent theory of Abelian functions. Since then, other geometers have made important applications of the same principle to the most fundamental parts of pure analysis. Is it still permitted to content oneself with a demi-rigor? And who will say that the other problems of mathematical physics will not, one day, be called to play in analysis a considerable role, as has been the case of the most elementary of them?"

—Haïm Brezis, Paris VI and Rutgers University
—Felix E. Browder, Rutgers University
—Louis Nirenberg, Courant Institute

(Received October 3, 2006)

Correction

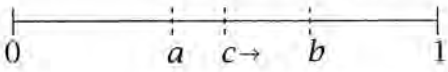
The October 2006 issue of the *Notices*, page 1007, carried a Letter to the Editor from William C. Waterhouse that mentioned the famous "taxicab number" 1729. Due to an editing error, the factorization of 1729 was given as $7 \cdot 1 \cdot 19$ rather than $7 \cdot 13 \cdot 19$. The *Notices* regrets the error.

—Allyn Jackson

Correction

In the diagram on the lower right of p. 1316 of the Brams, Jones, and Klamler article, "Better Ways To Cut a Cake" (December 2006), the c' should have been $c\rightarrow$ (see revised figure below), showing the movement of c rightward that is described in the text just above the diagram.

—Steven J. Brams, Michael A. Jones, and Christian Klamler



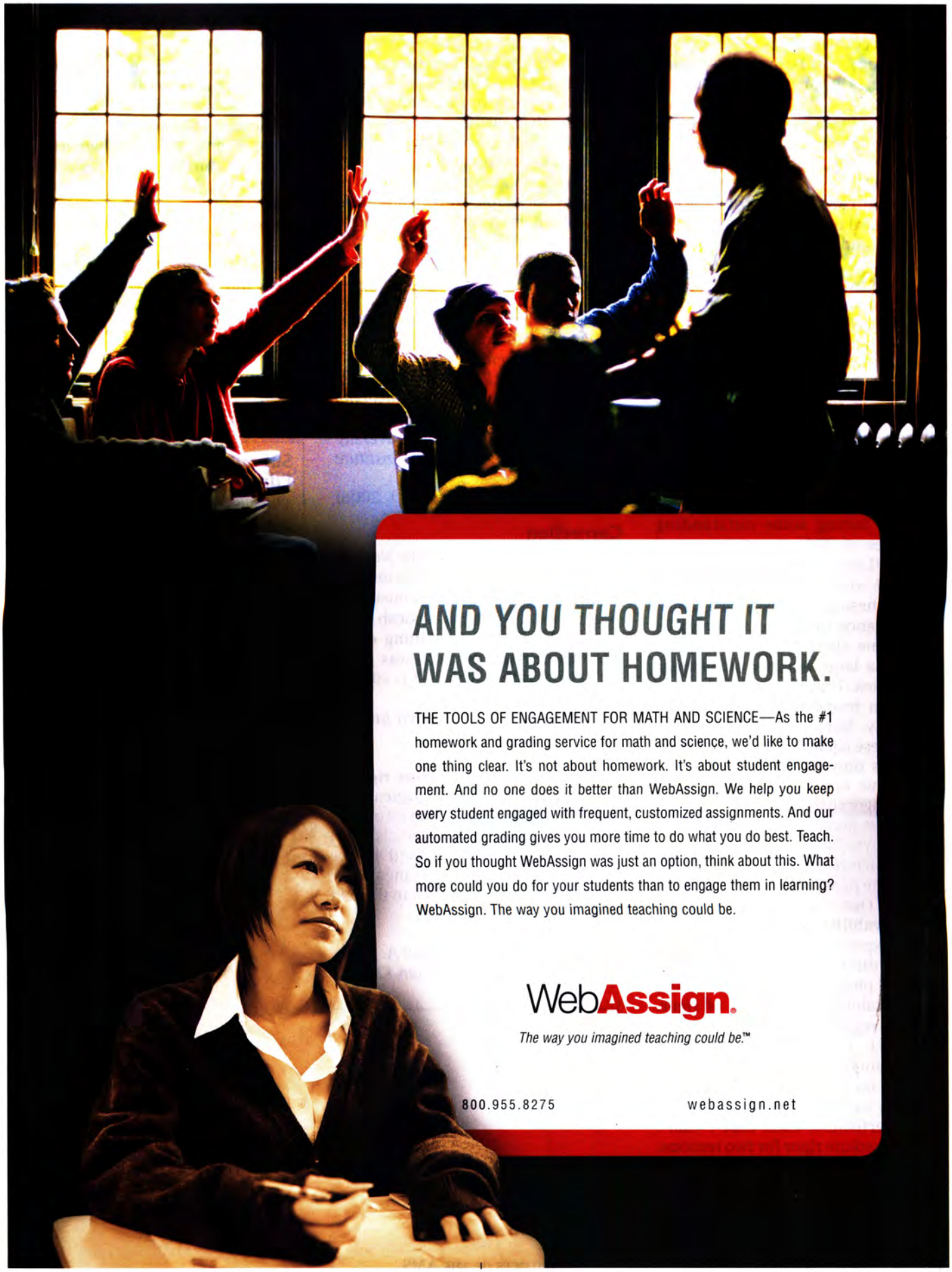
Correction

The December issue of the *Notices* carried an article abut the 2006 International Congress of Mathematicians, at which the new logo of the International Mathematical Union was unveiled. The logo was displayed in the article (page 1338), and the caption gave the wrong affiliation for the creator of the logo, John Sullivan. Sullivan is at the Technische Universität Berlin, not at the Humboldt Universität.

—Allyn Jackson

Submitting Letters to the Editor

The *Notices* invites readers to submit letters and opinion pieces on topics related to mathematics. Electronic submissions are preferred (`notices-letters@ams.org`); see the masthead for postal mail addresses. Opinion pieces are usually one printed page in length (about 800 words). Letters are normally less than one page long, and shorter letters are preferred.


AND YOU THOUGHT IT WAS ABOUT HOMEWORK.
THE TOOLS OF ENGAGEMENT FOR MATH AND SCIENCE—As the #1 homework and grading service for math and science, we'd like to make one thing clear. It's not about homework. It's about student engagement. And no one does it better than WebAssign. We help you keep every student engaged with frequent, customized assignments. And our automated grading gives you more time to do what you do best. Teach. So if you thought WebAssign was just an option, think about this. What more could you do for your students than to engage them in learning? WebAssign. The way you imagined teaching could be.
WebAssign.
The way you imagined teaching could be.™
800.955.8275
webassign.net

AMERICAN MATHEMATICAL SOCIETY

CURRENT EVENTS BULLETIN

Sunday, January 7, 2007 • 1:00 – 5:00 PM

Joint Mathematics Meetings, New Orleans

Organized by David Eisenbud, Mathematical Sciences Research Institute

1:00 PM

Robert Ghrist

Barcodes: The Persistent Topology of Data

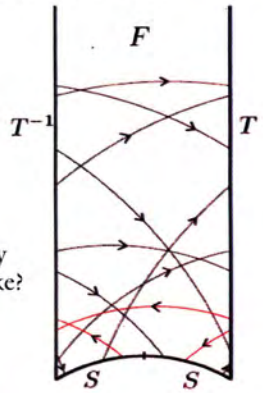
Scientists everywhere are struggling with an explosion in the quantity of data they can gather. Ideas in topology give new ways to extract qualitative properties.

2:00 PM

Akshay Venkatesh

Flows on the Space of Lattices: work of Einsiedler, Katok and Lindenstrauss

A lattice is a grid (discrete subgroup of maximal rank) in $\mathbb{R}^n$. Dilations give a simple way of transforming one lattice into another. What are the orbits of these transformations like? Answers to this question have interesting connections with number theory.



3:00 PM

Izabella Laba

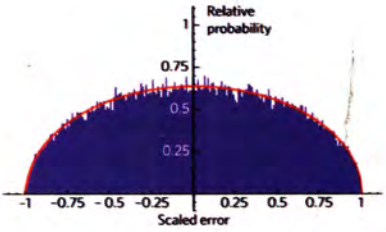
From Harmonic Analysis to Arithmetic Combinatorics

This talk will show some connections between an old question in Euclidean geometry, a variety of deep combinatorial problems, recent advances in analytic number theory, classical harmonic analysis and PDE regularity estimates.

4:00 PM

Barry Mazur

The Structure of Error Terms in Number Theory and an Introduction to the Sato-Tate Conjecture



Number theoretic quantities can often be well approximated by simple expressions. All the fun, at that point, is in the nature of the error term, i.e., the difference between the quantity being studied and our approximation of it. Some recent work has proven an old conjecture of Sato and Tate about the distribution of error terms in many important cases.

AMS
AMERICAN MATHEMATICAL SOCIETY

Homological Sensor Networks

Vin de Silva and Robert Ghrist

Sensors and Sense-ability

A sensor is a device that measures some feature of a domain or environment and returns a signal from which information may be extracted. Sensors vary in scope, resolution, and ability. The information they return can be as simple as a binary flag, as with a metal detector that beeps to indicate a detection threshold being crossed. A more complex sensor, such as a video camera, can return a signal requiring sophisticated analysis to extract relevant data.

An increasingly common application for sensors is to scan a region for a particular object or substance. For example, one might wish to determine the existence and location of an outbreak of fire in a national forest. Questions of more interest to national security involve detection of radiological or biological hazards, hidden mines and munitions, or specific individuals in a crowd. All of these scenarios pose difficult and challenging data management problems.

Numerous strategies exist, aided by the fact that sensor technology provides an expansive array of available hardware. A fundamental dichotomy exists in the approach to sensing an environment based on the number and complexity of sensors. For a fixed cost (monetary, or perhaps "total complexity"), one can deploy a small number of sophisticated "global" sensors with high signal complexity and precise readings. In contrast, one can deploy a large number of small, coarse, "local" devices that may have large uncertainties in their readings. Different strategies are appropriate for different tasks. The human body contains examples of sensor systems with a small multiplicity of highly complex devices (for sight) as well as vast networks of local sensors (for touch).

Technology promises to push the envelope on both sides of this spectrum, yielding new types of powerful, global sensors, as well as local sensors of surprisingly small size. The relevant question for the mathematician is which types of mathematics will be useful in analyzing sophisticated sensor networks.

It may be that the most exciting possibilities lie in the domain of the small. Swarms of local sensors at micro- or nanoscale have the potential to revolutionize the way that we think about security and surveillance problems [4]. However, this brings with it the difficulty of integration. How does one collect local information and collate it into global environmental data?

From Local to Global

Fortunately, mathematicians have spent centuries carefully contemplating local-to-global transitions. The very term we use to indicate the collection and collation of local data—*integration*—harks back to the well established means of relating local information about a function (pointwise derivatives) with a global quantity (the integral).

A more relevant example for our purposes is to be found in simple ideas about the topology of surfaces. What are the global features of a surface given "local data" in the form of a triangulation? The Classification Theorem for Surfaces implies that the Euler characteristic $\chi(\Sigma)$ suffices to determine the homeomorphism type of a closed orientable surface Σ. The computation is as simple as one could hope for:

$$\chi(\Sigma) = \#V - \#E + \#F,$$

Vin de Silva is assistant professor of mathematics at Pomona College. His email address is vin.desilva@pomona.edu.

Robert Ghrist is associate professor of mathematics at the University of Illinois, Urbana-Champaign. His email address is ghrist@math.uiuc.edu.

The authors acknowledge the support of DARPA (Defense Advanced Research Projects Agency) and the National Science Foundation.

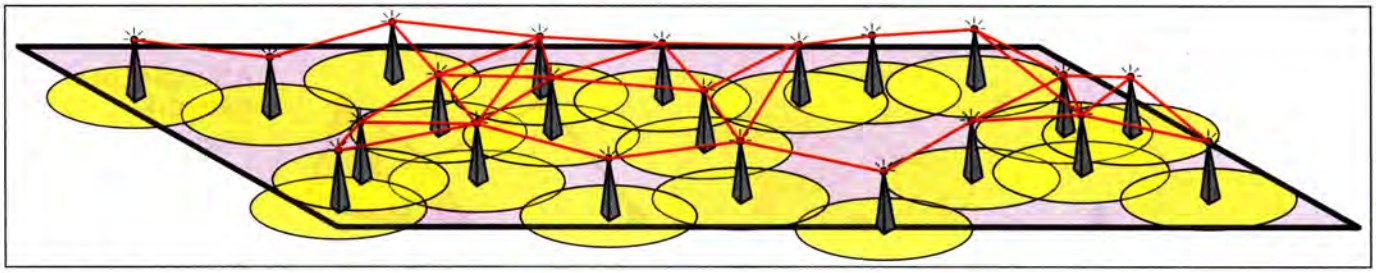


Figure 1. A network of small, local sensors samples an environment at a set of nodes. How can one answer global questions from this network of local data?

where the triangulated surface Σ has $\#V$ vertices, $\#E$ edges, and $\#F$ faces.

The information contained in $\chi(\Sigma)$ is not restricted to topological classification. The Euler characteristic $\chi(\Sigma)$ can be used to infer geometric properties of Σ (specifically, the Gauss curvature, via the Gauss-Bonnet Theorem) and dynamical properties of Σ (specifically, the number and types of fixed points of a vector field, via the Hopf Index Theorem).

The efficacy of the Euler characteristic in this example is a consequence of the restricted nature of surfaces. For a more arbitrary space, the challenge of characterizing global features of the space becomes a more fundamental problem in topology. With surfaces, simple arithmetic suffices to determine global properties. For arbitrary complexes, more sophisticated algebraic topology is required. Roughly speaking, algebraic topology provides two ways in which to associate to a given space X a collection of algebraic objects that gauge the global features of X.

The first such set of invariants are the *homotopy groups*, $\pi_k(X)$, for $k = 0, 1, \ldots$, the *fundamental group* $\pi_1(X)$ being very well known. These groups measure in how many and which ways one can map a k-dimensional sphere S^k into X, two spheres in X being deemed equivalent if they are homotopic relative to some fixed basepoint. Homotopy groups comprise very powerful data; however, they are in practice quite difficult to compute. The general computation of homotopy groups of spheres is unknown and indeed is the premier unsolved problem in algebraic topology at this time.

The second set of invariants provide a weaker but more computable option. These are the *homology groups*, $H_k(X)$, for $k = 0, 1, \ldots$. (Properly speaking, homology defers to its algebraic dual—the cohomology groups $H^k(X)$—as a finer invariant.) Instead of measuring k-spheres in a space up to homotopy, homology measures certain types of *chains*, or objects built from simple oriented pieces: *simplices*. These simplices are defined differently depending on the type of homology used. The simplest instantiation is that of a simplicial complex X, where the combinatorial simplices from which X is built form a basis for simplicial chains. The elements of $H_k(X)$ are *cycles*, or chains with vanishing boundary, and two k-cycles are deemed *homologous* if there is an oriented $(k+1)$-chain that has as its boundary the pair of cycles (with opposite orientation).

Like homotopy groups, the homology groups are an invariant of the homotopy type of the underlying space. This explains why the Euler characteristic χ of a surface is independent of both the triangulation and the homeomorphism type of the surface: χ is the alternating sum of the dimensions of the homology groups.

Unlike homotopy groups, homology groups can be computed via linear algebra. Recent advances in algorithms for the rapid computation of homology (see [7] and references therein) make this a feasible tool for realistic problems in science and engineering.

Blanket Coverage

Motivated by the potential of pervasive computing in sensor-rich environments [4], we consider a class of simple sensors that can solve global problems based on local communication.

For concreteness, we consider the case where nodes lie in a planar Euclidean domain with polygonal boundary. Each node can perform some sensing task within a certain radially symmetric neighborhood. Within this *coverage disk*, the sensor performs its unspecified task, whether it involves video surveillance, detection of radiological or biohazard material, motion detection, etc. We do not model this sensing task at all: it is completely implicit except for the assumption that it is radially symmetric. For such a network, we consider the problem of *blanket coverage*.

> Does the union of the coverage discs about the nodes cover the domain $\mathcal{D}$?

We wish to solve this problem using small-scale (and therefore cheap) devices without GPS or other sophisticated positioning systems. The intended lesson is that topological methods permit sensors that are remarkably minimal, having no means of measuring distance, orientation, or location in their environment.

The coverage problem is of clear significance to security and surveillance. A similar coverage problem vexes anyone with a cell phone in an area of

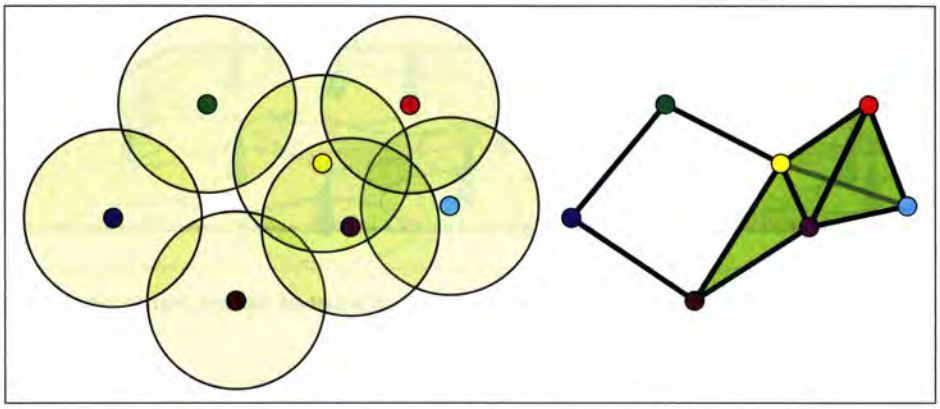


Figure 2. The Čech complex of a cover by convex sets captures the homotopy type of the cover.

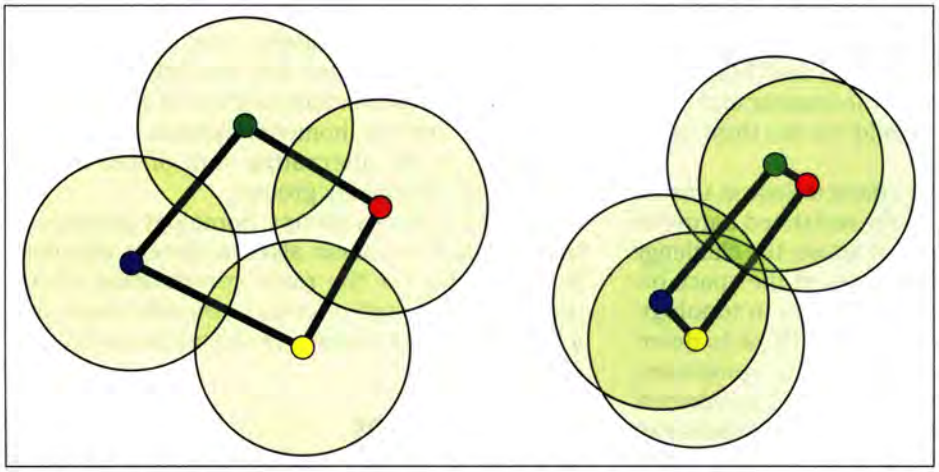


Figure 3. Changing the positions of nodes can change the topology of the radius r_c cover without changing the topology of the radius r_b network graph.

low cell phone tower density. This latter coverage problem is simpler because the network of cell phone towers is fixed and intentional. The company that built the towers knows exactly where they were built and is certain that the towers have not moved. One can thus compute the union of the coverage discs "by hand" with ease (assuming no hardware failure). Standard algorithms from computational geometry can check for holes quickly, even in cases with many nodes, so long as the node positions are known.

The scenario that we envision differs in that there is no means of determining relative position. This is not an insurmountable difficulty. Indeed, there is an extensive literature on probabilistic methods for coverage problems in networks of randomly distributed points. See, e.g., [8]. Unfortunately, these methods have very strong assumptions on the uniformity or density of the random distribution of points. We would like to solve coverage problems in more realistic settings where one "dumps a bucketful" of sensors in a field, forest, or ocean and then queries the network, perhaps after environmental influences have moved the sensors to unknown positions.

A Simple Local Network

What minimal capabilities must the sensor nodes possess, for there to be a solution (or reasonable partial solution) to the blanket coverage problem? We focus on node-to-node communication. Assume that each node broadcasts its unique ID and listens to determine its neighbors. These unique IDs may take the form of RFID tags.

The one strong assumption we make concerns the boundary of the domain $\mathcal{D}$ in which the nodes lie. We suppose (for now) that the vertices of the polygonal boundary $\partial\mathcal{D}$ are defined by special *fence nodes* in a known cyclic configuration (although their coordinates remain unknown). Our precise assumptions are as follows:

A1: Nodes $\mathcal{X}$ broadcast their unique ID numbers. Each node can detect the identity of any node within *broadcast* radius r_b.

A2: Nodes have radially symmetric covering domains of *cover* radius $r_c \geq r_b/\sqrt{3}$.

A3: Nodes $\mathcal{X}$ lie in a compact connected domain $\mathcal{D} \subset \mathbb{R}^2$ whose boundary $\partial\mathcal{D}$ is connected and piecewise-linear with vertices marked *fence nodes* $\mathcal{X}_f$.

A4: Each fence node $v \in \mathcal{X}_f$ knows the identities of its neighbors on $\partial\mathcal{D}$ and these neighbors both lie within distance r_b of v.

To summarize, each node is aware of the identities of those nodes that are within broadcast range r_b. The orientations and distances of these neighboring nodes are unknown. The fence nodes have two additional pieces of data: (1) they know that they are on the boundary of the domain; and (2) each knows the identities of the two neighboring fence nodes.

Apart from the fence nodes (which are used to simplify the statements of theorems), the type of information that this network encodes is very similar to that encoded by a simplicial complex. Local

combinatorial data about how elementary pieces are assembled give rise to a global object whose large-scale topological features are revealing.

Simplices for Sensors

The obvious way to begin is to build the *network graph* of the system. This is a combinatorial graph, Γ, in which vertices correspond to the labeled nodes and (undirected) edges correspond to pairs of nodes that are in mutual broadcast range (within distance r_b). In this graph, the boundary $\partial\mathcal{D}$ is naturally identified with a particular cycle $\mathcal{F} \subset \Gamma$ traversing the fence nodes, thanks to A4. The problem at hand is to determine whether the set $\mathcal{U}$ given by the union of radius r_c balls at $\mathcal{X}$ contains the domain $\mathcal{D}$. The input for this problem is the pair of graphs $(\Gamma, \mathcal{F})$.

Determining the topology of a union of balls is a classical problem and is easily solved using the notion of a Čech complex (also known as the *nerve*). Given a collection of sets $\mathcal{U} = \{U_\alpha\}$, the *Čech complex* of $\mathcal{U}$, $C(\mathcal{U})$, is the abstract simplicial complex whose k-simplices correspond to nonempty intersections of $k+1$ distinct elements of $\mathcal{U}$. Thus, the vertices are in bijective correspondence with the cover sets U_α, and edges of $C(\mathcal{U})$ are in bijective correspondence with nonempty intersections between two cover sets. Higher order intersections generate higher dimensional simplices: see Figure 2.

Theorem 1. *[The Čech Theorem] If the sets $\{U_\alpha\}$ and all nonempty finite intersections are contractible, then the union $\bigcup_\alpha U_\alpha$ has the homotopy type of the Čech complex C.*

The equivalence in the Čech theorem is functorial, and in particular there is a relative version that gives us the following result.

Corollary 2. *Under assumptions A1-A4 above, the coverage area $\bigcup_\alpha U_\alpha$ contains the domain $\mathcal{D}$ if and only if the fence 1-cycle $\mathcal{F}$ is null-homologous in $C(\mathcal{U})$.*

This would appear to be exactly what one wants for sensor networks. Unfortunately, it is not possible to compute the Čech complex from the network graph Γ alone. Precise distances between nodes are needed to determine the higher-dimensional simplices of $C(\mathcal{U})$. All we have are two radii: the broadcast radius r_b and the coverage radius r_c. For no (physically realistic) choice of these radii can the radius r_c Čech complex be derived from the radius r_b network graph. It is not even possible to recover the homotopy type of $C(\mathcal{U})$. See Figure 3 for one example of the difficulty.

On the other hand, with the bound on coverage and broadcast radii in A2, it follows that for any triple of nodes that are in pairwise communication distance, the convex hull of these nodes in $\mathbb{R}^2$ is contained in the cover $\mathcal{U}$. The extremal case, in which all three nodes are at pairwise distance r_b, yields an equilateral triangle in $\mathbb{R}^2$ that is covered by balls at the nodes of radius r_c only if $r_c \geq r_b/\sqrt{3}$.

This motivates the following construction. We consider the network graph as the 1-dimensional skeleton of a larger simplicial complex. Denote by $\mathcal{R}$ the largest simplicial complex whose 1-skeleton is the network graph. That is, for every collection of k nodes that are pairwise within distance r_b, we assign an abstract $k-1$ simplex. This is also known as the *flag complex* associated to the network graph.

A nearly identical construction was used by Vietoris in the 1930s in the beginnings of homology theory [9]. It was largely forgotten and later reformulated by Rips in his work on geometric groups. Given a set of points $\mathcal{X} = \{x_\alpha\} \subset \mathbb{R}^n$ in Euclidean n-space and a fixed radius ϵ, the **Vietoris–Rips complex** of $\mathcal{X}$ is the abstract simplicial complex whose k-simplices correspond to unordered $(k+1)$-tuples of points in $\mathcal{X}$ that are pairwise within Euclidean distance ϵ of each other.

For brevity, we refer to the complex $\mathcal{R}$ constructed above as the **Rips complex** of the network, with the radius r_b understood implicitly. Unfortunately, the Rips complex does not necessarily capture the topology of the union of cover discs: we have traded accuracy for computability. In the remainder of this article, we will outline two methods for extracting coverage information from a Rips complex, the latter of which infers Čech data.

The Homological Criterion

The Rips complex does contain enough topological information about the cover to certify coverage, if the cover is sufficiently robust. One might guess that the right criterion measures $H_1(\mathcal{R})$, since $H_1(\mathcal{U})$ collates holes in the cover. For reasons to be seen, it is more natural to consider the second homology of $\mathcal{R}$ relative to the fence $\mathcal{F} \subset \mathcal{R}$ that defines $\partial\mathcal{D}$.

Theorem 3. *[1] For a set of nodes $\mathcal{X}$ in a domain $\mathcal{D} \subset \mathbb{R}^2$ satisfying Assumptions A1-A4, the sensor cover $\mathcal{U}$ contains $\mathcal{D}$ if there exists $[\alpha] \in H_2(\mathcal{R}, \mathcal{F})$ such that $\partial\alpha \neq 0$.*

The proof of this result is straightforward with an elementary knowledge of homology as in, say, Chapter 2 of [6]. We present an abbreviated proof.

Proof sketch. Define a simplicial realization map $\sigma : \mathcal{R} \to \mathbb{R}^2$ which sends vertices of $\mathcal{R}$ to the nodes $\mathcal{X} \subset \mathcal{D}$ and sends a k-simplex of $\mathcal{R}$ to the (potentially degenerate) k-simplex given by the convex hull of the vertices implicated. This σ takes the pair $(\mathcal{R}, \mathcal{F})$ to $(\mathbb{R}^2, \partial\mathcal{D})$. The long exact sequences on these two pairs yields the following commutative square:

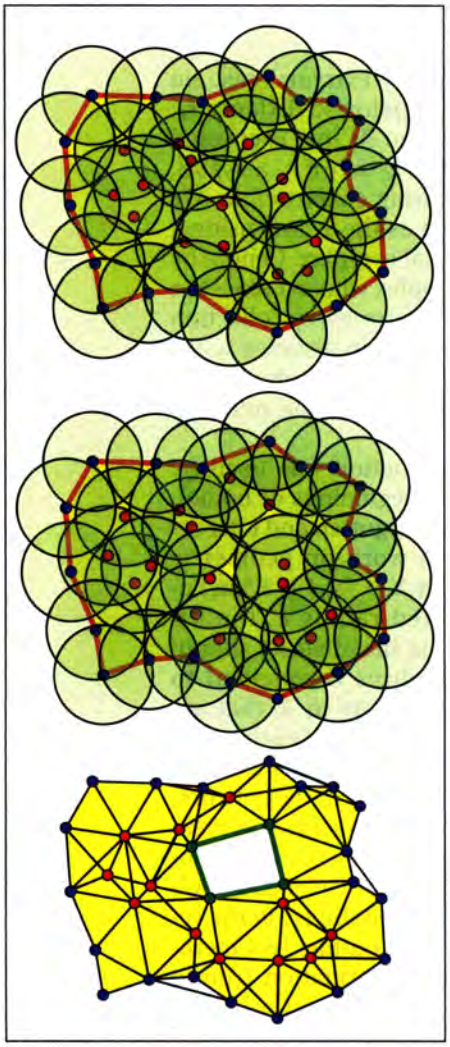


Figure 4. The homological criterion holds for some covers [top] but not for others [middle]. Failure is caused by a 1-cycle in the Rips complex [bottom].

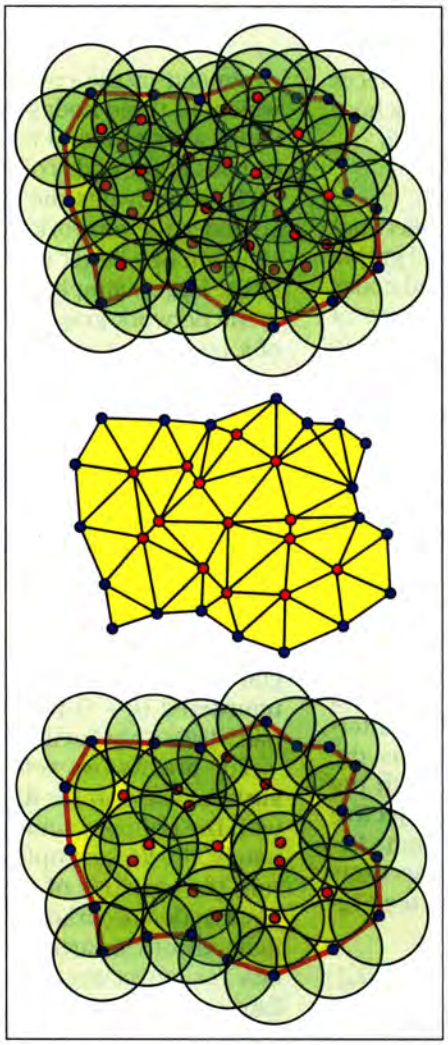


Figure 5. A redundant cover [top] can be simplified [bottom] by the appropriate choice of generator for $H_2(\mathcal{R}, \mathcal{F})$ [middle].

$$\begin{array}{ccc} H_2(\mathcal{R},\mathcal{F}) & \xrightarrow{\delta_*} & H_1(\mathcal{F}). \\ \downarrow \sigma_* & & \downarrow \sigma_* \\ H_2(\mathbb{R}^2,\partial\mathcal{D}) & \xrightarrow{\delta_*} & H_1(\partial\mathcal{D}) \end{array} \tag{1}$$

The homology class $\sigma_*\delta_*[\alpha]$ is the winding number of $\partial\alpha$ about $\partial\mathcal{D}$. Observe that $\sigma_*\delta_*[\alpha] = \sigma_*[\partial\alpha] \neq 0$, since, by assumption, $\partial\alpha \neq 0$. By commutativity of Equation (1), $\delta_*\sigma_*[\alpha] \neq 0$, and thus $\sigma_*[\alpha] \neq 0$.

Assume that $\mathcal{U}$ does not contain $\mathcal{D}$ and choose $p \in \mathcal{D} - \mathcal{U}$. Since, by the choice of r_c, every point in $\sigma(\mathcal{R})$ lies within $\mathcal{U}$, we have that $\sigma : (\mathcal{R}, \mathcal{F}) \to (\mathbb{R}^2, \partial\mathcal{D})$ factors through the pair $(\mathbb{R}^2 - p, \partial\mathcal{D})$. However, $H_2(\mathbb{R}^2 - p, \partial\mathcal{D}) = 0$: contradiction via commutativity.

This homological criterion is sufficient but not necessary to verify coverage. The two networks illustrated in Figure 4 both cover the domain completely. Yet the homological criterion holds for one [top] and fails for the other [bottom]. The culprit in the case of failure is a cycle of length four in $H_1(\mathcal{R})$. This creates a hole in the Rips complex that is not present in the cover. Note, however, that a small change in the positions of the nodes implicated in this 4-cycle can create a hole in the cover without changing the topology of the network. No technique that relies solely upon the network topology can determine coverage in such a case. The homological criterion is effective for covers that are sufficiently robust with respect to perturbing the points while maintaining the network topology.

Generators for Power Conservation

The addition of some homological algebra to the sensor network can do more than confirm coverage. Indeed, it is a straightforward consequence of the proof that the domain $\mathcal{D}$ lies within the subcover of $\mathcal{U}$ given by those nodes implicated in the generator $[\alpha]$.

For a sensor network that has a highly redundant cover, one can save power and bandwidth by placing nonessential nodes in a *sleep mode*. The crucial question: which nodes can be deactivated without sacrificing coverage? Or, in a dynamic setting, how does one cycle nodes from sleep to wake modes without losing coverage? The answer lies in choosing the appropriate "minimal" generators for $H_2(\mathcal{R}, \mathcal{F})$ that implicate as few 0-simplices as possible. Figure 5 gives an example of a "small" generator yielding a more efficient cover.

Pursuit and Evasion

There are a number of related contexts in which a homological criterion can solve a global problem. Consider the situation in which the nodes change position as a function of time. For simplicity, assume that the fence nodes are fixed. Such a situation might arise with sensors used to detect a forest fire, since one could establish a ring of fixed nodes outside the forest and allow the nodes inside the forest to be passively locomoted by environmental forces (e.g., animals).

It may well be the case that there are not enough sensors to cover the domain bounded by the outer ring. However, as the sensors change locations, holes in the cover can open and close in a complex fashion. The *evasion problem* for this scenario is whether an unknown *evader* can navigate through

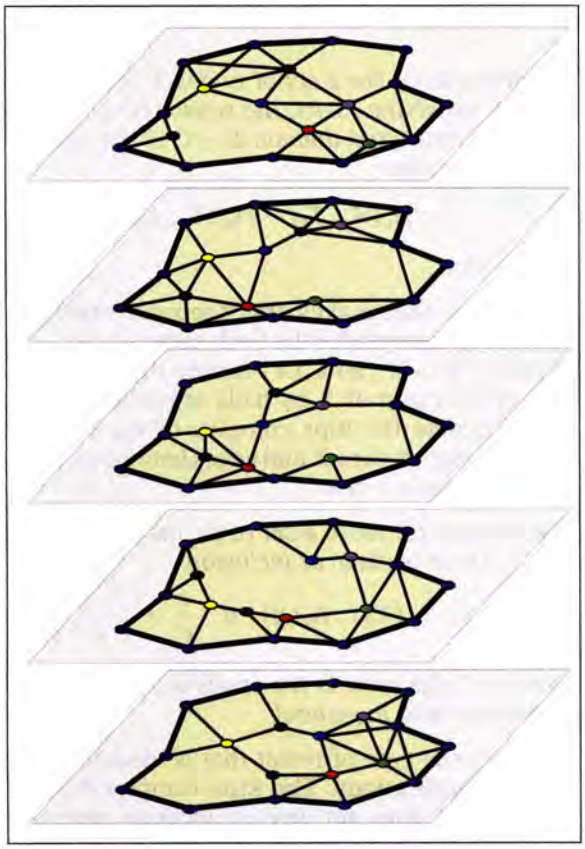


Figure 6. A time-sequence of network graphs for a mobile network. Does this network admit a wandering hole?

holes in the sensor cover without being detected. Even if coverage is never attained, one can still hope that any hole in which the evader begins is "squeezed" out eventually.

To address this problem, one proceeds as follows. Assume that the network communication graph is updated at certain time intervals $0 = t_1 < \ldots < t_i < \ldots < t_N = 1$, producing an ordered sequence of communication graphs Γ_i, for $i = 1 \ldots N$. These induce a corresponding sequence of Rips complexes $\mathcal{R}_i$. We impose the following additional assumptions:

A5: If two nodes are within broadcast radius at time steps t_i and t_{i+1}, then they remain so for all $t_i \le t \le t_{i+1}$.

A6: Nodes may go off-line or come on-line, represented by deleting or inserting the nodes in the appropriate graph Γ_i.

A7: Fence nodes remain fixed and on-line.

Given this sequence of network graphs (see Figure 6), it is by no means obvious whether there is a wandering hole in the coverage network. We amalgamate the sequence of Rips complexes into a single simplicial cell complex $\mathcal{AR}$ as follows. For each $i = 1, \ldots, N-1$, let $\mathcal{R}_i \cap \mathcal{R}_{i+1}$ denote the largest labeled subcomplex common to $\mathcal{R}_i$ and $\mathcal{R}_{i+1}$. This is well defined since all vertices (and thus all simplices) have unique labels. We define the *amalgamated Rips complex* to be the quotient of the disjoint union $\coprod \mathcal{R}_i$ obtained by identifying $\mathcal{R}_i \cap \mathcal{R}_{i+1} \subset \mathcal{R}_i$ with $\mathcal{R}_i \cap \mathcal{R}_{i+1} \subset \mathcal{R}_{i+1}$ for each i. This yields a cell complex built from simplices (though not necessarily a combinatorial simplicial complex, since multiple simplices may share the same vertex set). Note that, given A7, the fence $\mathcal{F}$ is a subcomplex of each $\mathcal{R}_i$ and thus is identified to a well defined cycle $\mathcal{F} \subset \mathcal{AR}$.

Theorem 4. *[1] Consider a set of mobile nodes $\mathcal{X}(t)$ in a domain $\mathcal{D} \subset \mathbb{R}^2$ satisfying A1-A7. Any continuous curve $p : [0,1] \to \mathcal{D}$ must have $p(t) \in \mathcal{U}(t)$ for some $0 \le t \le 1$ if there exists $[\alpha] \in H_2(\mathcal{AR}, \mathcal{F})$ such that $\partial\alpha \neq 0$.*

The proof of this result is in the same spirit as that of Theorem 3. Note that there are no bounds on the speed or cunning of the evader.

Persistence of Homology

The ease with which Theorem 3 is proved is due chiefly to the restrictions placed on the fence nodes in A4. With this condition, it is relatively easy to extend these results. Besides the time-dependent case reviewed above, homological methods work for domains that are not simply connected, for barrier coverage problems in 3-dimensions, for systems with communication errors or variable radii, and for hole detection and repair [1]. The control over the fence nodes is manifested in the proof of Theorem 3 in Equation (1), where $\sigma_* : H_1(\mathcal{F}) \to H_1(\partial\mathcal{D})$ is known to be an isomorphism.

Such control over the fence may be physically realistic in some settings where, say, one can explicitly build a ring of sensors around a potentially hazardous environment and then inject sensors in the interior of the domain. Equivalently, given an unbounded network and a cycle in the communication graph, one can query whether the region of the plane bounded by this cycle lies in the cover. A more realistic setting for boundary phenomena is one in which nodes can sense if they are near the boundary $\partial\mathcal{D}$ and can register themselves as fence nodes. For example, a very coarse range-finder can detect the presence of a wall within a set distance, without necessarily knowing the distance to the wall.

We therefore consider a system of stationary nodes which can detect the presence of the boundary of the domain $\partial\mathcal{D}$ within some fixed *fence radius* r_f. This choice of system leads to a collection of fence nodes $\mathcal{X}_f \subset \mathcal{X}$ which spans a *fence subcomplex* $\mathcal{F} \subset \mathcal{R}$, the maximal simplicial complex generated by the fence nodes and edges between them. The analogous coverage criterion in this case should be the existence of a generator $[\alpha] \in H_2(\mathcal{R}, \mathcal{F})$ such that $\partial\alpha \neq 0$. Unfortunately, this is no longer sufficient for coverage. Consider the network in Figure 7, in which the fence

subcomplex $\mathcal{F}$ has a loop that is coned off to a disc in $\mathcal{R}$. This complex has $H_2(\mathcal{R}, \mathcal{F}) \neq 0$, yet the map $\sigma_* : H_1(\mathcal{F}) \to H_1(\partial\mathcal{D})$ is the zero-map, and Equation (1) is no longer useful in guaranteeing a cover. It is the existence of these *fake cycles* that complicates matters. To a "global" observer, the example of Figure 7 is easily seen to have degree zero. The challenge is to have the network determine this by "local" observations.

There is a simple homological criterion for coverage in this setting where the fence nodes are not controlled [2]: it uses *persistent homology* and requires some additional capabilities on the part of the sensor network. The heuristic behind this use of persistence is that the fake cycle of Figure 7 does not survive if the network increases its broadcast radius a small amount. Were this to happen, the "diagonals" of the 1-cycle in the fence subcomplex would be filled in, killing the relative 2-cycle.

We can generalize this one example to deal with arbitrary fake cycles by allowing for two broadcast radii: a "weak" and a "strong" signal. This also has the advantage of generalizing easily to compact domains $\mathcal{D} \subset \mathbb{R}^n$ for any $n \geq 2$. The precise assumptions are as follows:

P1: Nodes broadcast their unique ID numbers. Each node can detect the identity of any node within radius r_s via a *strong* signal, or via a *weak* signal within a larger radius r_w, where $r_w \geq r_s\sqrt{10}$.

P2: Nodes have radially symmetric covering domains of *cover* radius $r_c \geq r_s/\sqrt{2}$.

P3: Nodes lie in a compact domain $\mathcal{D} \subset \mathbb{R}^d$ and can detect the presence of the boundary $\partial\mathcal{D}$ within a *fence detection radius* r_f.

P4: The restricted domain $\mathcal{D} - C$ is connected, where

$$C = \left\{x \in \mathcal{D} : \|x - \partial\mathcal{D}\| \leq r_f + r_s/\sqrt{2}\right\}.$$

P5: The fence detection hypersurface $\{x \in \mathcal{D} : \|x - \partial\mathcal{D}\| = r_f\}$ has internal injectivity radius at least $r_s/\sqrt{2}$ and external injectivity radius at least r_s.

The crucial feature is that sensors that are within signal detection range can distinguish weak versus strong signals, yielding a binary measure of in-range distance. The fence nodes are not controlled, but there is a need for (somewhat severe) restrictions on the shape of the domain so as to exclude pinching (P4) and wrinkling (P5).

Such a system gives rise to a pair of Rips complexes, $\mathcal{R}_s$ and $\mathcal{R}_w$, computed at the strong and weak radii respectively. Each is outfitted with a fence subcomplex, $\mathcal{F}_s \subset \mathcal{R}_s$ and $\mathcal{F}_w \subset \mathcal{R}_w$. There is a natural inclusion of pairs

$$\iota : (\mathcal{R}_s, \mathcal{F}_s) \hookrightarrow (\mathcal{R}_w, \mathcal{F}_w), \tag{2}$$

since increasing the signal detection radius from r_s to r_w only increases network connectivity.

Theorem 5. *[2] For a set of nodes X in a domain $\mathcal{D} \subset \mathbb{R}^d$ satisfying P1-P5, the sensor cover $\mathcal{U}$ contains the restricted domain $\mathcal{D} - C$ if the induced homomorphism*

$$\iota_* : H_d(\mathcal{R}_s, \mathcal{F}_s) \to H_d(\mathcal{R}_w, \mathcal{F}_w)$$

is nonzero.

The key that makes this theorem work is a squeezing theorem for the Čech complex. For a set of points $X \subset \mathbb{R}^d$, let $C_\epsilon(X)$ denote the Čech complex of the cover of X by balls of radius $\epsilon/2$. Let $\mathcal{R}_\epsilon(X)$ denote the Rips complex of the network graph having vertices X and edges between vertices within distance ϵ in $\mathbb{R}^d$.

Theorem 6. *[2] Fix X a set of points in $\mathbb{R}^d$. Given $\epsilon' < \epsilon$, There is chain of inclusions*

$$\mathcal{R}_{\epsilon'}(X) \subset C_\epsilon(X) \subset \mathcal{R}_\epsilon(X) \quad \text{if} \quad \frac{\epsilon}{\epsilon'} \geq \sqrt{\frac{2d}{d+1}}.$$

Moreover, this ratio is the smallest for which the inclusions hold in general.

This is the type of result that is ideal for engineering applications. The Rips complex is computable, but does not give an accurate representation of the topology of the cover. The Čech complex gives the exact homotopy type of the cover, but it is not computable with the coarse information available from the network. Theorem 6 tells how to infer Čech data from Rips data.

This technique of comparison between Rips complexes at two different scales ϵ, ϵ' is a simple instance of the more general theory of persistent homology [3], [10]. This concerns the homological properties of nested families of topological spaces. Although the algebra and ideas involved are classical, the subject has been heavily driven by applications in computational geometry and nonlinear data analysis. Persistent homology is an algebraic topology for the twenty-first century.

Theorem 5 is not the final word in homological coverage criteria for systems with a fence radius and is best thought of as a proof-of-concept for homological methods. The hypotheses for this theorem flow from the mathematical details as opposed to the engineering details. For topological methods to make a serious contribution to security and sensor networks, it is important for the mathematics (and mathematicians) to work in conjunction with the engineers implementing the sensor networks.

The homological coverage criteria surveyed here are the beginning of a larger foray of topological ideas in the theories of networks and sensing. We note in particular the need for these coverage criteria to be distributed (so that networks can compute local homology and agree on global coverage), asynchronous (so that updates to the network are

not dependent on a simultaneous sampling of the network), and fault tolerant (to accommodate the stochastic nature of sensor networks).

On Computational Topology

> "Topology! The stratosphere of human thought! In the twenty-fourth century it might possibly be of use to someone..."
>
> —*The First Circle*, A. Solzhenitsyn

The results we review here are but one branch of the rapidly evolving area of *applied computational topology*. The need to move from local to global is one that a large spectrum of engineers and scientists are finding to be prevalent. Very few of the calculus-based tools with which they are most familiar prove sufficient. Recently, it has been demonstrated that homology theory is useful for problems in data analysis and shape reconstruction, computer vision, robotics, rigorous dynamics from experimental data, and control theory. See [7] for an overview of some current applications.

Topology is especially keen at giving criteria for when one can or cannot find a particular global object (a homeomorphism, a nonzero section, an isotopy, etc.): this falls under the rubric of *obstruction theory*. This perspective is one that has not yet permeated the applied sciences, in which the question, *"What is possible?"* is usually approached from the top-down, *"Here's something we can build,"* as opposed to the bottom-up approach that topological methods yield. A brilliant example of this obstruction-theoretic viewpoint in an applied context is Farber's *topological complexity* for robot motion planning [5].

In this article, we use homology theory to give coverage criteria for networked sensors which are "nearly senseless". It seems counterintuitive that one can provide rigorous answers for a network with neither localization capabilities nor distance measurements. A topologist is not surprised that such coarse data can be integrated into a global picture. Some engineers are. Homological methods have the pleasant consequence that they may allow engineers to focus on designing simpler sensors that are nevertheless useful in a security network. Why bother miniaturizing GPS for "smart dust" if you can solve the problem without it? If topological methods can determine the minimal sensing needed to solve a global problem, then such methods may have significant impact on the way systems and sensors are developed and deployed.

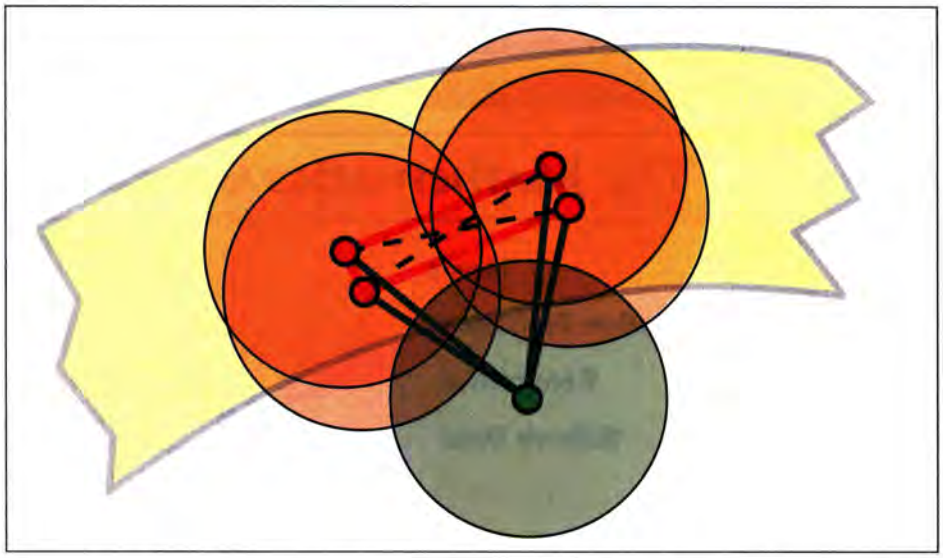


Figure 7. A fake relative 2-cycle in a system with a 1-cycle in the fence complex which is nullhomologous in the boundary collar.

References

[1] V. de Silva and R. Ghrist, Coordinate-free coverage in sensor networks with controlled boundaries via homology, to appear, *Intl. J. Robotics Research.*

[2] ____, Coverage in sensor networks via persistent homology, conditionally accepted for publication, *Alg. & Geom. Top.*

[3] H. Edelsbrunner, D. Letscher, and A. Zomorodian, Topological persistence and simplification, *Discrete Comput. Geom.* **28** (2002), 511–33.

[4] D. Estrin, D. Culler, K. Pister, and G. Sukhatme, Connecting the physical world with pervasive networks, *IEEE Pervasive Computing*, **1**(1) (2002), 59–69.

[5] M. Farber, Topological complexity of motion planning *Discrete Comput. Geom.* **29**, no. 2, (2003), 211–21.

[6] A. Hatcher, *Algebraic Topology*, Cambridge University Press, 2002.

[7] T. Kaczynski, K. Mischaikow, and M. Mrozek, *Computational Homology*, Applied Mathematical Sciences 157, Springer-Verlag, 2004.

[8] H. Koskinen, On the coverage of a random sensor network in a bounded domain, *Proceedings of 16th ITC Specialist Seminar*, pp. 11-18, 2004.

[9] L. Vietoris, Über den höheren Zusammenhang kompakter Räume und eine Klasse von zusammenhangstreuen Abbildungen, *Math. Ann.* **97** (1927), 454–72.

[10] A. Zomorodian and G. Carlsson, Computing Persistent Homology, *Discrete Comput. Geom.* **33** (2005), 249–74.

AMERICAN MATHEMATICAL SOCIETY

The Mathematics Genealogy Project

News
Mission Statement
Recognition
Submit Data

Posters
Acknowledgements
Staff
Links

Search the Database

The searchable database includes over 102,000 records dating back to 1634 of mathematicians in more than 100 countries. Entries include the degree recipient, university, name of advisor (linked to a list of his/her other students), dissertation title, year in which the degree was awarded, list of the degree recipient's students (if any), and the MSC code of the thesis.

Courant

Submit additions and corrections on the website at

www.genealogy.ams.org

Minkowski

Hilbert

The Mathematics Genealogy Project is a service of North Dakota State University and the American Mathematical Society.

Supported in part by a grant from the Clay Mathematics Institute.

AMS
AMERICAN MATHEMATICAL SOCIETY

See a demonstration of the website and submit information at the AMS booth during the Joint Mathematics Meetings.

Lindemann

AMERICAN MATHEMATICAL SOCIETY

Announcing

A Selection of the Bestselling AMS Titles in 2006

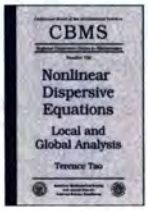
Bourbaki

COURSE ADOPTION

A Secret Society of Mathematicians

Maurice Mashaal, *Pour la Science, Paris, France*

2006; 168 pages; Softcover; ISBN-10: 0-8218-3967-5; ISBN-13: 978-0-8218-3967-6; List US$29; All AMS members US$23; Order code BOURBAKI



Nonlinear Dispersive Equations

Local and Global Analysis

Terence Tao, *University of California, Los Angeles, CA*

CBMS Regional Conference Series in Mathematics, Number 106; 2006; 373 pages; Softcover; ISBN-10: 0-8218-4143-2; ISBN-13: 978-0-8218-4143-3; List US$55; All individuals US$44; Order code CBMS/106

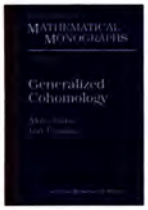
Probability Theory in Finance

COURSE ADOPTION

A Mathematical Guide to the Black-Scholes Formula

Seán Dineen, *University College Dublin, Ireland*

Graduate Studies in Mathematics, Volume 70; 2005; 294 pages; Hardcover; ISBN-10: 0-8218-3951-9; ISBN-13: 978-0-8218-3951-5; List US$55; All AMS members US$44; Order code GSM/70



Generalized Cohomology

Akira Kono, *Kyoto University, Japan*, and Dai Tamaki, *Shinshu University, Matsumoto, Japan*

Translations of Mathematical Monographs (*Iwanami Series in Modern Mathematics*), Volume 230; 2006; 254 pages; Softcover; ISBN-10: 0-8218-3514-9; ISBN-13: 978-0-8218-3514-2; List US$49; All AMS members US$39; Order code MMONO/230

Enumerative Geometry and String Theory

COURSE ADOPTION

Sheldon Katz, *University of Illinois at Urbana-Champaign, IL*

This volume was copublished with the Institute for Advanced Study/Park City Mathematics Institute.

Student Mathematical Library, Volume 32; 2006; 206 pages; Softcover; ISBN-10: 0-8218-3687-0; ISBN-13: 978-0-8218-3687-3; List US$35; All AMS members US$28; Order code STML/32

Euler through Time

COURSE ADOPTION

A New Look at Old Themes

V. S. Varadarajan, *University of California, Los Angeles, CA*

2006; 302 pages; Hardcover; ISBN-10: 0-8218-3580-7; ISBN-13: 978-0-8218-3580-7; List US$59; All AMS members US$47; Order code EULER

Function Theory of One Complex Variable

COURSE ADOPTION

Third Edition

Robert E. Greene, *University of California, Los Angeles, CA*, and Steven G. Krantz, *Washington University, St. Louis, MO*

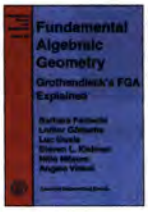
Graduate Studies in Mathematics, Volume 40; 2006; 504 pages; Hardcover; ISBN-10: 0-8218-3962-4; ISBN-13: 978-0-8218-3962-1; List US$79; All AMS members US$63; Order code GSM/40.R

The Millennium Prize Problems

James Carlson, *Clay Mathematics Institute, Cambridge, MA*, Arthur Jaffe, *Harvard University, Cambridge, MA*, and Andrew Wiles, *Institute for Advanced Study, Princeton, NJ*, Editors

A co-publication of the AMS and the Clay Mathematics Institute (Cambridge, MA).

2006; 165 pages; Hardcover; ISBN-10: 0-8218-3679-X; ISBN-13: 978-0-8218-3679-8; List US$29; All AMS members US$23; Order code MPRIZE



Fundamental Algebraic Geometry

Barbara Fantechi, *SISSA, Trieste, Italy*, Lothar Göttsche, *International Centre for Theoretical Physics, Trieste, Italy*, Luc Illusie, *Université Paris–Sud, Orsay, France*, Steven L. Kleiman, *MIT, Cambridge, MA*, Nitin Nitsure, *Tata Institute of Fundamental Research, Mumbai, India*, and Angelo Vistoli, *Università di Bologna, Italy*

Mathematical Surveys and Monographs, Volume 123; 2005; 339 pages; Hardcover; ISBN-10: 0-8218-3541-6; ISBN-13: 978-0-8218-3541-8; List US$85; All AMS members US$68; Order code SURV/123

Celebrate the 10th Anniversary of the AMS Bookstore.
VISIT www.ams.org/bookstore/tenthanniversary.html

Contact the AMS: 1-800-321-4AMS (4267), in the U. S. and Canada, or 1-401-455-4000 (worldwide);
fax: 1-401-455-4046; email: cust-serv@ams.org.
American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294 USA

AMS
AMERICAN MATHEMATICAL SOCIETY

N

1/07

Interview with Joan Birman

Joan S. Birman is a leading topologist and one of the world's foremost experts in braid and knot theory. She was born on May 30, 1927, in New York City. She received a B.A. degree in mathematics in 1948 from Barnard College and an M.A. degree in physics two years later from Columbia University. She worked on mathematical problems in industry for several years, raised three children, and eventually returned to graduate school in mathematics. She received her Ph.D. in 1968 at the Courant Institute at New York University, under the direction of Wilhelm Magnus. She was on the faculty of the Stevens Institute of Technology (1968–1973), during which time she also held a visiting position at Princeton University. Her influential book *Braids, Links, and Mapping Class Groups* (Annals of Mathematics Studies, number 82, 1974) is based on a series of lectures she gave during her time at Princeton. In 1973 she joined the faculty of Barnard College, Columbia University, where she has remained ever since and where she is now Research Professor Emeritus.

Joan Birman

Birman's honors include a Sloan Foundation Fellowship (1974–1976), a Guggenheim Fellowship (1994–1995), and the Chauvenet Prize of the Mathematical Association of America (1996). She was a member of the Institute for Advanced Study, Princeton, in spring 1987. In 1997 she received an honorary doctorate from Technion Israel Institute of Technology. She received the New York City Mayor's Award for Excellence in Science and Technology in 2005.

Birman has had twenty-one doctoral students and numerous collaborators. She has served on the editorial boards of several journals and was among the founding editors of two journals, *Geometry and Topology* and *Algebraic and Geometric Topology*. Both journals are now published by the nonprofit Mathematical Sciences Publishing Company, for which Birman serves on the board of directors.

In 1990 Birman donated funds to the AMS for the establishment of a prize in memory of her sister, Ruth Lyttle Satter, who was a plant physiologist. The AMS Ruth Lyttle Satter Prize honors Satter's commitment to research and to encouraging women in science. It is awarded every other year to a woman who has made an outstanding contribution to mathematics research.

What follows is an edited version of an interview with Joan Birman, conducted in May 2006 by *Notices* Deputy Editor Allyn Jackson and Associate Editor Lisa Traynor.

Early Years

Notices: *Let's start at the beginning of your life. Were your parents American? Were they immigrants?*

Birman: My father was born in Russia. He grew up in Liverpool, England, and came to the United States when he was seventeen, to search for lost relatives and to seek a better life. My mother was born in New York, but her parents were immigrants from Russia-Poland.

Notices: *What did your father do?*

Birman: He started as a shipping clerk in the dress industry and worked his way up to become a successful dress manufacturer. He told his four daughters repeatedly that the U.S. was the best country in the world, a land of opportunity. Paradoxically, he also told them, "do anything but go into business." He wanted us all to study.

Notices: *Did your mother have a profession?*

Birman: No, she was a housewife. Neither of my parents finished high school.

Birman's parents, Lillian and George Lyttle.

Notices: *Why did they emphasize their four daughters getting an education?*

Birman: Jewish culture, as it was handed down to us, included the strong belief that Jews survived for so many years in the Diaspora because they were "the people of the book". The free translation, when I brought home an exam with a grade of 98, was "what happened to the other 2 points?" Becoming an educated person, and using that education to do something bigger than just to earn money, was set up to my generation as a very important goal.

Notices: *When you were a child, did you like mathematics?*

Birman: Yes, I liked math, from elementary school, and even earlier than that, although I did not know enough to pinpoint what I liked.

Notices: *Were there teachers in your early years who encouraged you in mathematics, or who were inspiring?*

Joan Birman, age 11.

Birman: In elementary school that's hard to say, although we certainly had challenging math. I went to an all-girls high school in New York, Julia Richmond High School. It was really a rough inner-city high school, but within it there was a small academic unit, a school within a school. We had some very good teachers. We had a course in Euclidean geometry, and every single night we would have telephone conversations and argue over the solutions to the geometry problems. That was my introduction to proof, and I just loved it, it was wonderful. When the course ended, I joined a small group of girls who campaigned for more geometry, but the teacher (her name was Miss Mahoney) was willing but perhaps not knowledgeable enough to know how to continue to challenge the intellectual interests of this eager group of girls! She taught us 3-dimensional Euclidean geometry, and that was a little dull. If she had taught us hyperbolic geometry, or group theory, where we would have encountered new ideas, we would have been in heaven!

Notices: *Usually high school girls are on the phone talking about their hair.*

Birman: We did that too! Actually I was in this little group, and we were definitely regarded as being nerds. Most of the girls in our selective school within a school worked hard and got good grades, but talked all the time about boys and clothes. I was a late developer and wasn't ready for that. I didn't date at all until I was in college. Still, at one point I was elected president of the class, so the other students could not have been really hostile. I felt accepted, and even liked. There was an atmosphere of tolerance.

Notices: *Were your sisters also interested in math?*

Birman: Yes. My oldest sister, Helen, was a math major at Barnard, and the next one, Ruth, was a physics major. Ruth ultimately became a plant physiologist. She was Ruth Satter of the Satter Prize. She had a fine academic career, before her untimely death from leukemia. Helen is independently wealthy and is a philanthropist, with very special interests of her own. My younger sister, Ada, became a kindergarten teacher. She was less oriented toward academics.

The Lyttle sisters (left to right), Ada, Ruth, Helen, and Joan.

Notices: *Did you like math when you went to college?*

Birman: Two things changed. First, the college math course that I was advised to take at Swarthmore was a cookbook calculus course, and it was both boring and unconvincing. So I looked around and found other things that appealed to me (astronomy, literature, psychology), although I did major in math. Then I transferred to Barnard College, in order to be able to live in New York. At Barnard, the math offerings were all low-level. When you got to the point where you were ready for serious math, you were directed to courses at Columbia, which at that time was an all-male school. That was the first time that I hit a situation where I was one of a very small number of girls. Most of the Barnard women were cowed by it and gave up. Eventually I was the only girl in my classes, and I caught the idea that maybe math was not for girls.

From Bachelor's Degree to Industry

Notices: *But then you did get a bachelor's degree.*

With husband Joe in 1954.

Birman: Yes. But there was a long gap before I went on to graduate school. The social atmosphere had presented unexpected difficulties. My parents not only expected their four daughters to get married, but we were to get married in order! There was all kinds of nonsense like that. But on the other hand, the only way that a respectable girl could get out from under her parents control was to marry, so I was not averse to the idea. But I did not want to make a mistake in my choice, and that took attention. I *did* think about going to graduate school, but I understood how hard math was. I thought it would take lots of concentrated effort, as it must for any serious student. I was afraid that I would wreck my life if I gave math that kind of attention at that time. (I think I was right. As we talk, Joe and I have been married for fifty-six years, and he has been my biggest supporter.) Actually, I didn't really decide *not* to go to graduate school, but when the opportunity arose to put it off and accept an interesting job, the job was appealing.

The job was very nice. I was extremely lucky. It was at an engineering firm that made microwave frequency meters. These meters were cylindrical cans with two parameters, the radius of the base and the depth (or height). The radius was fixed, but the depth could be changed with a plunger, changing the resonant frequency. The (depth-to-resonant frequency) curve was nonlinear, and the problem was that they had a hard time calibrating the dials, putting the notches on to indicate what the frequency would be as you pushed the plunger in. They hired me because they had the idea that they could sell more meters if they could push in the plunger in a novel way that would yield an approximately linear response curve. In calculus I had learned about ladders sliding against a wall, and in the job interview the idea came up that the curve that gave the height of the ladder as a function of its distance from the wall might be a curve that could be fitted to the experimental data. The idea worked very well. For about eight months I computed the parameters, and they constructed meters of all sizes with plungers that pushed in along an axis orthogonal to the axis of the can. The dials were for all practical purposes linear. I was very happy!

But when that project ended, they set me to work taking measurements on an oscilloscope, and that was pretty dull. One day I happened to run into my old physics professor from Barnard, and he offered me a position as the physics lab assistant at Barnard. I took the position and applied to graduate school in physics. I realized that my job possibilities would improve if I had a physics degree.

I did get a master's degree in physics, but I do not have good intuition for the subject. I felt they could just tell me anything, and I would have to believe it. I am astonished these days at the way in which physics has fed into math. Physicists do seem to have an intuition that goes beyond what mathematicians very often see, and they have different tests of truth. I just didn't have that intuition. Yet I really enjoyed the physics lab, because when I saw things in the lab, I knew they were true. But I didn't always trust the laws of physics that we learned. On the other hand, I got an MA, and then I got a better job.

Notices: *This was in the aircraft industry?*

Birman: Yes. It was in the days of analog computers. I worked on a navigation computer. The pilot would be flying a plane, and the computer would send a radar signal to the ground. The signal would be bounced back to the plane. The computer measured the Doppler shift and used it to compute air speed and altitude. My part of the whole thing was error analysis—to figure out the errors when the plane was being bounced around by changes in air pressure. A second problem was that of maximizing aircraft range for a fixed amount of fuel. A third was the design of a collision avoidance system.

Notices: *Were there many women?*

Birman: I worked at three different engineering firms. At one of them there were several women, but at the others I don't recall any other women.

Wandering toward Graduate School

Notices: *You got married when you were studying physics in graduate school. Did you stop working then?*

Birman: No, I continued to work until I had a child, five years later. When my first child was born, I planned to go back to work because I really liked what I was doing. But that posed a problem. In those days, there was no day care. Unless you had a family member to take care of your children (and my mother and mother-in-law were unable to do that), it was almost impossible. My husband and I had thought, very unrealistically, we will put an ad in the paper and hire somebody. But then, I had this huge responsibility for our baby, and I just couldn't see leaving him with somebody about whom I knew very little. My husband was very encouraging about my going back to work. I did work a few days a week. First I worked two days a week,

then one day a week after we had a second child. Just before our third child was born, my husband had been invited to teach in a distant city. He had been in industry and was thinking about a switch to academia. During that year, I had to stop my part-time job, but it had already dwindled down to one day a week. When I came back I knew I couldn't work that way anymore. So I went to graduate school with the idea of learning some new things for when I'd go back to work. You can see that I led a very wandering and undirected life! It amazes me that I got a career out of it—and it has been a really good career!

Notices: *When did you then decide that you would get a Ph.D.?*

Birman: I started grad school in math right after my younger son was born, on January 12, 1961. I went to New York University, where my husband was on the faculty, so that my tuition was free. NYU's Courant Institute had an excellent part-time program, with evening courses that were essentially open admissions. I took linear algebra the first semester, and then real and complex analysis the following year. And then I decided I could handle two courses a year, and did.

One of the first courses I took was complex analysis, with Louis Nirenberg. In the first lecture he said, "A complex number is a pair of real numbers, with the following rules for adding and multiplying them." I certainly knew about "imaginary numbers", but he put them into a framework that was sound mathematics. It sounds like a trivial change, but it was not. Eventually, I also had a course in topology, which I loved, with Jack Schwartz. He was not a topologist, and when I go back and look at my notes, I see it was a weird topology course! He was somebody who liked to try new things. He taught us cohomology in a beginning topology course—not homology, not even the fundamental group! But I really loved that course. It really grabbed me, although the approach had its down side, as I knew almost no examples. I had started studying at Courant with the intention of learning some applied mathematics. But everything I learned pushed me toward pure mathematics.

At Courant I was starting to pile up enough courses for an MA, and there was a required master's final exam. When I took the exam, I didn't realize it was also the Ph.D. qualifying exam. I was surprised when I passed it for the Ph.D. That's when I applied for financial assistance, but to get it I had to be a full-time student. So that's really when I started on a Ph.D. track. There were not many women around. The people in the department were very nice to me—they realized that I had three children, and they did not give me heavy TA assignments. Karen Uhlenbeck was one of the students there, but she transferred out. Cathleen Morawetz was on the faculty, and I took one course from her.

Notices: *Your adviser was Wilhelm Magnus. How did he end up being your adviser?*

Birman: After passing the qualifying exams, one had to take a series of more specialized exams for admission to research. My husband was on the NYU faculty, and the first question I was asked in one of the exams was, "Who is smarter, you or your husband?"

Notices: *That was the first question?*

Birman: Yes, it's ludicrous, in 2006. Later on when I became a mathematician, I met the person who asked this question and reminded him of it, and he said, "Oh no, not me! I didn't say that!"

Notices: *How did you answer the question?*

Birman: I laughed. It was the only thing to do. Afterwards I started to get really angry about it. It was a stupid question!

The Birman children (left to right), Kenneth, Deborah, and Carl David, around 1968.

Anyway, I passed that exam too and went looking for an advisor. The first person I approached was the topologist Michel Kervaire, but he wasn't interested. He said, "You're too old and you don't know enough topology." He was right, I didn't know enough topology. And I can understand why he would be skeptical of a person my age. You have to be convinced when you see someone who is outside of the usual framework that the person is a serious student, and he had never been my classroom teacher.

I went to speak to Nirenberg. He was very helpful to me. I read the *Notices* interview with him, and he had told you that he loved inequalities. That's funny, because I remember he asked me, "Do you like inequalities?" And I said, "No, I don't like inequalities!" He said, "Then you don't want to study applied math." And he was right!

Notices: *That was a good question to ask!*

Birman: It was an excellent question. After that I went to talk to Wilhelm Magnus. He had noticed me, because I had done some grading for him. He was an algebraist, but he had noticed that I loved topology, and so he met me halfway and gave me a paper to read about braids. That showed great sensitivity on his part. It was a terrific topic. He later told me of his habit of picking up strays, and in some way I was a stray.

Notices: *What paper was it that he gave you?*

Birman: It was a paper by Fadell and Neuwirth [1]. The braid groups were defined in that paper as the fundamental group of a certain configuration

space. Magnus said that he didn't understand the definition, and it took me a long time to understand it. Finally I did, and I was very happy. Magnus had worked on the mapping class group of a twice-punctured torus, and he had suggested that I could extend this work to a torus with 3 or 4 punctures. My thesis ended up being about the mapping class group of surfaces of any genus with any number of punctures. He thought that was a real achievement. As soon as I understood the problem well enough, I solved it. It was both fun and very encouraging.

Around this time there was a very different paper by Garside on braids that interested me greatly [2]. I was aware of the fact that there was a scheme for classifying knots with braids. When I saw that Garside had solved the conjugacy problem in the braid group, I thought that was going to solve the knot problem. I couldn't have been more mistaken, but still, it grabbed my interest. I am still working on it—right now I am trying to show that Garside's algorithm can be made into a polynomial algorithm. This is important in complexity theory. So my interest in that problem dates back to graduate school.

Moving Into Research

Notices: *After you got your Ph.D., you got a job at Stevens Institute of Technology.*

Birman: I had not done a thorough job on applications and was not offered any job until late August 1968, when Stevens Institute had some unexpected departures. The first year I was there I started working with Hugh M. Hilden (who is known as Mike). We solved a neat problem that year and wrote several really good papers. The one I like best is the first in the series [3].

The work with Hilden was very rewarding. My thesis had been on the mapping class group of a punctured surface. I showed there is a homomorphism from the mapping class group of a punctured surface to that of a closed surface, induced by filling in the punctures. I worked out the exact sequence that identified the kernel of that homomorphism, but I didn't know a presentation for the cokernel, the mapping class group of a closed surface, and realized that was a problem that I would like to solve. The whole year I talked about it to Mike, whose office was next to mine, and finally we solved the problem for the special case of genus 2. As it turned out, our solution had many generalizations, but the key case was a closed surface Σ of genus 2. In that case, the mapping class group has a center, and the center is generated by the class of an involution that I'll call $\mathcal{I}$. The orbit space $\Sigma/\mathcal{I}$ is a 2-sphere S^2, and the orbit space projection $\Sigma \to \Sigma/\mathcal{I} = S^2$ gives it the structure of a branched covering space, the branch points being the images on S^2 of the 6 fixed points of $\mathcal{I}$. We were able to use the fact that the mapping class group of S^2_6 of S^2 minus those 6 points was a known group (related to the braid group), to find a presentation for the mapping class group $\mathcal{M}(\Sigma)$ of Σ. The difficulty we had to overcome was that mapping classes are well-defined only up to isotopy. We knew that in genus 2, every mapping class was represented by a map that commuted with $\mathcal{I}$, but we did not know whether every *isotopy* could be deformed to a new isotopy that commuted with $\mathcal{I}$. We felt it had to be true, but we couldn't see how to prove it. One day Mike and I had the key idea, together. The idea was to look at the path traversed on Σ by one of the 6 fixed points, say p, under the given isotopy. This path is a closed curve on Σ based at p. Could that closed curve represent a nontrivial element in $\pi_1(\Sigma, p)$? It was a key question. Once we asked the right question, it was easy to prove that the answer was no, and as a consequence our given isotopy could be deformed to one that projected to an isotopy on S^2_6. As a consequence, there is a homomorphism $\mathcal{M}(\Sigma) \to \mathcal{M}(S^2_6)$, with kernel $\mathcal{I}$. Our hoped-for presentation followed immediately. It was a very fine experience to work with Mike, to get to know him as a person via shared mathematics. It was the first time I had done joint work, and I enjoyed it so much that ever since I have been alert to new collaborations. They are different each time, but have almost all been rewarding.

At that point I was thoroughly involved in mathematics. But my husband had a sabbatical, and I had promised him that I would take a year off so that he could spend his sabbatical with collaborators in France. So I took a leave of absence from my job and found myself in Paris, and in principle it should have been a lovely year. But we had three children, and once again I had lots of home responsibilities! Moreover, I didn't know any of the French mathematicians, because I had come to France without any real introductions, and nobody was interested in braids. French mathematics at that time was heavily influenced by the Bourbaki school. I found myself very isolated and discouraged. Looking for a problem that I could handle alone, I decided to do a calculation.

There is a homomorphism from the mapping class group of a surface to the symplectic group. People knew defining relations for the symplectic group, but not for the mapping class group, unless the genus is ≤ 2. I was interested in the kernel of that homomorphism, which is called the Torelli group. It was an immense calculation. I finished it, and I did get an answer [4], which was later improved with the help of a Columbia graduate student, Jerome Powell. In 2006 a graduate student at the University of Chicago, Andy Putman, constructed the first conceptual proof of the theorem that Powell and I had proved. Putman's proof finally verifies the calculation I did that year in France!

When I returned from France I was invited to give a talk at Princeton on the work that Hilden and I had done together. That was when my career really began to get going, because people were interested in what we had done. I was invited to visit Princeton the following year. I did that, commuting from my home in New Rochelle, New York, to Princeton, New Jersey. That was a very long commute.

Notices: *Was it around this time that you gave the lectures that became your book* Braids, Links, and Mapping Class Groups *[5] ?*

Birman: Exactly. The lectures were attended by a small but interested group, including Ralph Fox and Kunio Murasugi, and James Cannon, at that time a postdoc. Dmitry Papakyriakopolous was also at Princeton, and he was very welcoming to me.

Braids had not been fashionable mathematics, and their role in knot theory had been largely undeveloped. Three topics that I developed in the lectures and put into the book were: (1) Alexander's theorem that every link type could be represented, nonuniquely, by a closed braid, (2) Markov's theorem, which described the precise way in which two distinct braid representatives of the same link type were related, one of those moves being conjugacy in the braid group, and (3) Garside's solution to the problem of deciding whether two different braids belonged to the same conjugacy class. I had chosen those topics because I was interested in studying knots via closed braids, and together (1), (2), and (3) yielded a new set of tools.

When I had planned the lectures at Princeton, to my dismay I learned that there was no known proof of Markov's theorem! Markov had announced it in 1935, and he had sketched a proof but did not give details, and the devil is always in the details. When I told my former thesis advisor, Wilhelm Magnus, he remarked that the sketched proof was very likely wrong! But luckily, I was able to follow Markov's sketch, with the help of some notes that Ralph Fox had taken at a seminar lecture given by a former Princeton grad student (his name vanished when he dropped out of grad school). After some number of 2:00 a.m. bedtimes I was able to present a proof. There are now some six or seven conceptually different proofs of this theorem, but the one in my 1974 book was the first.

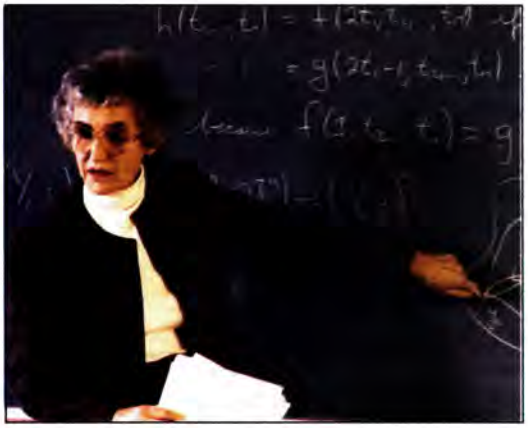
Knot Polynomials and Invariants

Notices: *Can you tell us about your interaction with Vaughan Jones, when he was getting his ideas about his knot polynomial?*

Birman: One day in early May 1984, Vaughan Jones called to ask whether we could get together to talk about mathematics. He contacted me because he had discovered certain representations of the braid group and what he called a "very special" trace function on them, and people had told him that I was the braid expert and might have some ideas about its usefulness. He was living in New Jersey at the time, so he was in the area, and we agreed to meet in my office. We worked in very different parts of mathematics and we had the expected difficulties in understanding each other's languages. His trace arose in his work on von Neumann algebras, and it was related to the index of a type II_1 subfactor in a factor. All that was far away from braids and links. When we met, I told him about Alexander's theorem, and Markov's theorem, and Garside's work. He told me about his representations and about his trace function. Of course, his explanations were given in the context of operator algebras. I recall that I said to him at one point, Is your trace a matrix trace? And he said no, it was not. Well, that answer was correct, but he did *not* say that his trace was a weighted sum of matrix traces, and so I did not realize that, if one fixed the braid index, the trace was a class invariant in the braid group. He understood that very well and did not understand what I had missed. He would willingly have said more, if he had, because

Left to right: Vaughan Jones, Bill Menasco, Joan Birman.

he is super-generous and truly decent. In between our meetings he gave the matter much thought (which I did not!), and one night he had the key idea that by a simple rescaling of his trace, it would in fact become invariant under all the moves of Markov's theorem, and so become a link invariant. He told me all this, in great excitement, on the telephone. The proof that his normalized trace was a link invariant was immediate and crystal clear. After all, a good part of my book had been written with the goal of making the Alexander and Markov theorems into useful tools in knot theory, and Vaughan had used them in a very straightforward way.



Birman teaching at Columbia, 1985.

Was his new invariant really new, or a new way to look at something known? He did not know. Examples were needed, and a few days later we met again, in my office, to work some out. That was probably May 22, 1984. The new link invariant was a Laurent polynomial. My first thought was: it must be the Alexander polynomial. So I said, "Here are two knots (the trefoil and its mirror image) that have the same Alexander polynomial. Let's see if your polynomial can distinguish them." To my astonishment, it did! Well, we checked that calculation very carefully, on lots more examples, because the implications were hard to believe. By pure accident, I had recently worked out a closed braid representative of the Kinoshita-Terasake 11-crossing knot, whose Alexander polynomial was zero. Fishing it out of my file cabinet we learned very quickly, that same day, that the new polynomial was nonzero on it. So in just that one afternoon, we knew that he not only had a knot invariant, but even more it was brand new. I remember crossing Broadway on my way home that night and thinking that nobody else knows this thing exists! It was an amazing discovery. Very quickly, other parts of the new machinery came to bear, and the world of knot theory experienced an earthquake. There was not just the Jones polynomial, but also its cousins, the HOMFLY and the Kaufman polynomials, and lots more. And some of the stuff in my book about mapping class groups was relevant too. Much later, Garside's machinery appeared too, in a particular irreducible representation of the braid group that arose via the same circle of ideas. Garside's solution to the word problem was used by Daan Krammer to prove that braid groups are linear.

There was another related part to this story. In 1991 Vladimir Arnold came to the United States to visit Columbia for a semester. I knew Arnold and met him in the lobby as he arrived, in September, with his suitcase. He is a very excitable and enthusiastic man. He put down his suitcase right then and there and opened it on the floor next to the elevator to get out a paper he had brought for me. It was by his former student Viktor Vassiliev. He said, "You have to read this paper, it's wonderful, it contains new knot invariants, and they come from singularity theory, and it's fine work, and I would like your help in publicizing it!" Of course I looked at the paper. At that point there had been an explosion in new knot invariants, and the open question was what they meant geometrically. And here Arnold was, with more invariants! The old ones were polynomials, the new ones were integers (lots of integers!). Arnold asked me to copy and distribute the paper in the United States. So one afternoon shortly after his arrival I made lots of photocopies, and sent them out to everyone I could think of who seemed appropriate. But even as I did it I suspected the knot theory community might not be so overjoyed to have yet more knot invariants coming unexpectedly out of left field! There is resistance to learning new things. We had just learned about operator algebras, and suddenly we had to learn about singularity theory! But Arnold kept after me, at tea every day.

Xiao-Song Lin was an assistant professor in the department, and his field is knot theory. We ran a seminar together and talked every day. We were good friends, and he was always ready to talk about math. I told him about the paper of Vassiliev. We read it together, and we finally understood most of it. We said, here are the Vassiliev invariants, and there are the knot polynomials—and they must be related in some way. But how? For a fixed knot or link, its Jones polynomial was a one-variable Laurent polynomial with integer coefficients, whereas its Vassiliev invariants were an infinite sequence of integers, or possibly of rational numbers.

Birman with Xiao-Song Lin, March 1998.

We had an idea that perhaps we should, for the moment, set aside the fact that the Vassiliev invariants came from the machinery of singularity theory, and try to construct them from their properties. We did that because we knew that the Jones polynomial (the simplest of the knot polynomials) could be constructed from its properties. We thought that might be a way for us see a connection. That had good and bad consequences. The bad one was that later, Vassiliev invariants were renamed "finite type invariants", and were defined via our axioms. In the process their origins in singularity theory were lost and remain underdeveloped to this day.

Soon Lin and I realized how to make the connection we had been seeking. We had the idea of making a change of variables in the Jones polynomial, changing its variable from x to t, with $x = e^t$.

The Jones polynomial was a Laurent polynomial in x, and e^{kt} has an expansion in positive powers of t for every positive and negative integer k. This change in variables changes the Jones polynomial to an infinite series in powers of t. We were able to prove that the coefficients in that infinite series satisfied all of our axioms for Vassiliev invariants, and so were Vassiliev invariants [6]. Everything went quickly with that idea—eventually all the knot polynomials were related to Vassiliev invariants in this way. They are generating functions for particular infinite sequences of FT invariants. But in fact the set of FT invariants is larger than those coming from knot polynomials. They are more fundamental objects.

Rich Problems, Rich Collaborations

Notices: *Can you tell us about your recent work with Menasco that involved the Markov theorem?*

Birman: That is another aspect of the same underlying project, to understand knots through braids. In 1990 at the International Congress in Kyoto, when Vaughan Jones got the Fields Medal, I gave a talk on his work. Afterward Bill Menasco invited me to give a colloquium based on it in the math department in Buffalo. So I gave a talk there about Vaughan Jones's work, and I stayed at Bill's house that night. We started to talk, and he said, "What problems are you working on? What's your dream?" I told him my dream is to classify knots by braids. I had an idea about how you could avoid the "stabilization" move in Markov's theorem. Then about three weeks later, I got a letter from him saying "I have an idea how we might try to prove the 'Markov theorem without stabilization' (MTWS)." And that's when our collaboration began. Of course, my original conjecture was much too simple. We kept solving little pieces of the sought-for theorem. We wrote eight papers together. The last one stated and proved the MTWS [7]. There was also an application to contact topology [8].

I like to collaborate. My collaborators are also my best friends. Bill Menasco and I are very good friends. We have had such a long collaboration. But we have very different styles. He can sit in a chair and stare at the ceiling as he works on mathematics, but I like to talk about it all the time.

Notices: *Why do you do mathematics?*

Birman: To put it simply, I love it. I'm retired right now, I don't have any obligations, and I keep right on working on math. Sometimes mathematics can be frustrating, and often I feel as if I'll never do another thing again, and I often feel stupid because there are always people around me who seem to understand things faster than I do. Yet, when I learn something new it feels so good! Also, if I work with somebody else, and it's a good piece of mathematics, we get to know each other on a level that is very hard to come by in other friendships.

Kirbyfest, MSRI, February 1998. Joan Birman in front row, fifth from right, with Robion Kirby on her right.

I learn things about how people think, and I find it very moving and interesting. Mathematics puts me in touch with people on a deep level. It's the creativity that other people express that touches me so much. I find that, and the mathematics, very beautiful. There is something very lasting about it also.

Notices: *Let's go back to the connections between your work and complexity theory. Did you come up with an algorithm that can tell whether a knot is the trivial knot?*

Birman: Yes. But the algorithm that Hirsch and I discovered [9] is slow on simple examples, and it is slow as the complexity of the example grows. Yet it has the potential to be a polynomial algorithm, and I don't think that's the case for the more fashionable algorithms coming from normal surface theory. There is a misunderstanding of our paper. Readers who did not read carefully saw that we used normal surfaces in our paper (in a somewhat tangential manner). They dismissed our paper as being derivative, but it was not. There are ideas in our work that were ignored and not developed.

However, at the present moment it seems most likely that the problem of algorithmically recognizing the unknot will be solved via Heegaard Floer knot homology. That is a very beautiful new approach, and fortunately there is an army of graduate students working on it and making rapid progress. It was, somehow, fashionable from day one and received lots of attention. That can make a big difference in mathematics.

Notices: *Are there connections between this and the P versus NP problem?*

Birman: Yes, there are connections, but they are not directly related to the unknot algorithm. A problem that has been shown to be NP-complete is "non-shortest words in the standard generators of the braid group". If you had an algorithm to show that a word in the standard generators of the braid group is not the shortest representative of the element it defines, and could do that in polynomial

Birman with some of her former graduate students.

time, then you would have proved that P is equal to NP. Of course, if you are given any word in the generators of the braid group and want to know whether it is shortest or not, all you have to do is try all the words that are shorter than it—and since there is a polynomial solution to the word problem, you can test quickly whether any fixed word that's shorter than the one that you started with represents the same element. However, the collection of all words that are shorter than the given one is exponential, so that solution to the non-shortest word problem is exponential. But the normal forms that I am working on in the braid group are such that if you could understand them better, you might learn how to improve this test. But I am not holding that up as a goal. At the moment it seems like a question that is out of reach.

I have been working on a related question: the conjugacy search problem in the braid group. It's complicated and difficult, but I believe strongly that it won't be long before someone proves that it has a solution that's polynomial in both braid index and word length. It's a matter of understanding the combinatorics well enough. It is related to (but considerably weaker than) the P versus NP problem. I am working on that problem right now with two young mathematicians, Juan González-Meneses from Seville, Spain, and Volker Gebhardt from Sydney, Australia.

Notices: *It's amazing that knot theory and braids are connected to so many things.*

Birman: I think I was very lucky because my Ph.D. thesis led me to many different parts of mathematics. The particular problems that are suggested by braids have led me to knot theory, to operator algebras, to mapping class groups, to singularity theory, to contact topology, to complexity theory and even to ODE [ordinary differential equations] and chaos. I'm working in a lot of different fields, and in most cases the braid group had led me there and played a role, in some way.

Notices: *Why do braids have all these different connections?*

Birman: Braiding and knotting are very fundamental in nature, even if the connections do not jump out at you. They can be subtle.

Notices: *Which result of yours gave you particular pleasure?*

Birman: There are many ways to answer that question. I have had much pleasure from discovering new mathematics. That happened, for example, when I was working on my thesis. The area was rich for the discovery of new structure, and (unlike most students) I experienced very little of the usual suffering, to bring me down from that high. I have also gotten much pleasure from collaborations and the friendships they brought with them. I would probably single out my good friend Bill Menasco as one of the best of my collaborators. It has been a particular pleasure to me when others have built on my ideas, and I see them grow into something that will be there forever, for others to enjoy. In that regard, I would single out the work that was done by Dennis Johnson in the 1980s, which built in part on the calculation I had done alone in Paris in 1971 and in another part on my joint work with Robert Craggs [10]. In a related way, I get great pleasure when I understand an idea that came from way back. An example was when I read several papers of J. Nielsen from the 1930s on mapping class groups. (I had to cut open the pages in the library, they had been overlooked for a long time.) Nielsen's great patience and care in explaining his ideas, and their originality and beauty, reached out over the years. I also feel privileged to have worked as an advisor of very talented young people and to have been a participant in the process by which they found their own creative voices.

It would be dishonest not to add that the competitive aspect of math is something I dislike. I also find that the pleasure in various honors that have come to me is not so lasting and have the disagreeable aspect of making me feel undeserving. The pleasure in ideas and in work well done is, on the other hand, lasting. But it's easy to forget that.

Women in Mathematics

Notices: *The situation for women in mathematics has changed greatly. Have all the problems been solved?*

Birman: No, of course not. The disparity in the numbers of men and women at the most prestigious universities (and I include Columbia in that) is striking. Anyone who enters a room in the math building at Columbia when a seminar is in progress can see it.

Notices: *Do you think attitudes toward women in mathematics have improved?*

Birman: Enormously, in my lifetime. On the whole, I think the profession is now very accepting

of women. When I took my first job I was the first woman faculty member at Stevens Institute of Technology. A few years later, I was the only woman faculty member (and I was a visitor) in the Princeton math department. Now one sees ever-increasing numbers of women faculty members, although the numbers in the top research faculties are still very small. That is certainly the case at Columbia, but this year for the first time, Columbia's freshman class of graduate students was half men, half women. Just six years ago it was all men, no women.

Recently several young people I know who are husband-and-wife mathematicians have gotten jobs in the same department. There used to be nepotism rules against that. It's such a big effort for a department to make, to hire two people at the same time, in whatever fields they happen to be in, sometimes the same field. It's impressive that departments care enough about doing right by women to do it. So yes, I think things are changing.

But there are serious issues regarding women in research. At the moment there are a very small number of women at the top of the profession. This is the very thing that Lawrence Summers [former Harvard University president] pointed out. What are the reasons for it, and what can we do about it? It would be good to try to understand why, and if we don't admit all possibilities, then we may never find out. So I was rather shocked that women on the whole did not want to look at that problem openly.

Notices: *He offended a lot of women when he speculated that there might be a biological difference between men and women that accounts for the difference of performance.*

Birman: Yes, he offended, but the reaction "stop, don't ask that question" was not a good response. Women in math have done so much to help other women, and the issues are so complex, that I was distressed that political correctness overshadowed the need to understand things better. The truth may not always be pleasant, but let's find out what it is. If women mathematicians refuse to face the issue openly, then who will do it for them? The sociologists? I hope not. However, that kind of discussion is not my strong point. I am too opinionated and tactless to say what needs to be said. Ralph Fox gave me tongue-in-cheek advice long ago: "Speak often and not to the point, and soon they will drop you from all the committees."

I did, however, wonder for many years whether there was a way for me to help other women. Rather early in my career I began to work with male graduate students, and I enjoyed that very much. Yet the first time a Columbia woman graduate student (Pei-Jun Xu, Ph.D. Columbia 1987) asked whether she could work with me, my private reaction was "together we will probably make a total mess of it!". We did not, and she wrote a fine thesis, and on the way I understood that I could help her in more ways than math just because we were both women and I sensed some of her unspoken concerns. Ever since then I realized that was the unique way that I could help other women—simply by taking an interest, working with them when it was appropriate, and being open to their conflicts and sensitive to their concerns.

Notices: *That's what it comes down to, the women actually doing mathematics.*

Birman: Yes, of course it does.

I have heard some women who are bitter because they feel the rewards of research don't seem big enough for the sacrifice. Of course there are men who feel that way too. Fritz John, a very fine research mathematician, once said to me that at the end of the day the reward was "the grudging admiration of a few colleagues". Well, if what you are looking for is admiration because you have done a great piece of work, admiration is often not there (and maybe the work isn't so great either). What is much more important, to me, is when somebody has really read and understood what I have done, and moved on to do the next thing. I am thrilled by that. Sure, it's nice to get a generous acknowledgment, but that is a bonus. The real pleasure is to be found in the mathematics.

References

[1] Edward Fadell and Lee Neuwirth, Configuration spaces, *Math. Scand.* **10** (1962), 111–18.

[2] F. A. Garside, The braid group and other groups, *Quart. J. Math. Oxford* Ser. (2) **20**, (1969), 235–54.

[3] Joan S. Birman and Hugh M. Hilden, On the mapping class groups of closed surfaces as covering spaces, *Proc. Conf. Stony Brook, NY 1969*, 81–115, Annals of Math. Studies, no. 66, Princeton Univ. Press.

[4] Joan S. Birman, On Siegal's modular group, *Math. Annalen* **191** (1971), 59–6.

[5] ____ , *Braids, Links, and Mapping Class Groups*, Annals of Math. Studies, no. 82. Princeton Univ. Press, 1974.

[6] Joan S. Birman and Xiao-Song Lin, Knot polynomials and Vassiliev's invariants, *Invent. Math.* **111** (1993), no. 2, 225–70.

[7] Joan S. Birman and William W. Menasco, Stabilization in the braid groups. I. MTWS., *Geom. Topol.* **10** (2006), 413–540.

[8] ____ , Stabilization in the braid groups II: Transversal simplicity of knots, *Geom. Topol.* **10** (2006), 1425–1452.

[9] Joan S. Birman and Michael D. Hirsch, A new algorithm for recognizing the unknot, *Geom. Topol.* **2** (1998), 175–220.

[10] Joan S. Birman and R. Craggs, The μ-invariant of 3-manifolds and certain structural properties of the group of homeomorphisms of a closed, oriented 2-manifold, *Trans. AMS* **237** (1978), pp. 283–309.

WHAT IS . . .

a Projective Structure?

William M. Goldman

The theory of *locally homogeneous geometric structures* on manifolds is a rich playground of examples on the border of topology and geometry. While *geometry* concerns quantitative relationships between collections of points, *topology* concerns the loose qualitative organization of points. Given a geometry (such as Euclidean geometry) and a manifold with some topology (such as the round 2-sphere), how many ways can one put the geometry, at least locally, on the manifold? The familiar fact that no metrically accurate world atlas exists is just the fact that the sphere admits no Euclidean geometry. However, the wide variety of geometries (homogeneous spaces of Lie groups) and manifolds leads to a fascinating array of questions.

Here is a precise definition. Consider a homogeneous space X with a transitive Lie group G of diffeomorphisms. In the spirit of Felix Klein's 1872 Erlangen program, X admits a *geometry* defined by the symmetry group G.

Klein simply defined the "geometry" to be all the objects on X together with the G-invariant relations between them.

So a Euclidean structure on a manifold is simply a system of Euclidean coordinates related by isometries on overlapping coordinate patches. Such a structure defines a Riemannian metric locally isometric to Euclidean space (and hence having zero curvature). In fact this structure is equivalent to a flat Riemannian metric.

A *projective structure* on a manifold M is a system of local coordinates modeled on a projective space P so that on any two overlapping coordinate patches, the change of coordinates is locally a projective transformation of P. Recall that a *projective space* is the n-dimensional space $\mathsf{P}(V)$ of all 1-dimensional linear subspaces of a vector space V of dimension $n+1$.

A *collineation* (or *projective transformation*) of $\mathsf{P}(V)$ is the map induced on projective space by a linear transformation of V. *Projective geometry* (in the spirit of Felix Klein's Erlangen program) is the study of objects on projective space P invariant under the collineation group $\mathsf{Aut}(P)$ of P. For example, lines, hyperplanes, conics, quadrics, and cross-ratio are all meaningful concepts in projective geometry. On a manifold with a projective structure there is a *local projective geometry* that, at least locally, agrees with the geometry of the model space P. Projective structures arise in many areas of mathematics, including differential geometry, mathematical physics, topology, and analysis.

This definition is what may also be called a *flat projective structure,* since the coordinate changes are *locally constant* maps into the Lie group of collineations of P. More general projective structures, defined as Cartan connections modelled on projective space, can be defined, although we do not discuss them here. The analogous Cartan connections for Euclidean geometry are just Riemannian metrics, where the Euclidean geometry is defined *infinitesimally* (on each tangent space). We are interested in structures where the geometry is defined *locally,* and this is detected by the vanishing of a certain curvature tensor. See Sharpe [3] for an excellent treatment of Cartan connections, including general projective connections.

Coordinate atlases may be a bit unwieldy and can be replaced by a *developing map* dev, which is

William M. Goldman is professor of mathematics at the University of Maryland, College Park. His email address is wmg@math.umd.edu.

defined on the universal covering $\tilde{M}$ into the model space X and which *globalizes* the coordinate charts.

One simply begins with one coordinate chart and analytically continues it over all of $\tilde{M}$ (the action of G is analytic). Since the analytic continuation may depend on the path (or chain of overlapping coordinate patches), dev is defined only on a covering space—a *multi-valued function* in nineteenth-century parlance. The *coordinate changes* globalize to a *holonomy representation* $\pi_1(M) \longrightarrow G$ with respect to which the developing map dev is equivariant.

A *complex-projective structure* or a $\mathbb{C}P^1$*-structure* is a structure locally modelled on the Riemann sphere $\mathbb{C}P^1$, with coordinate changes restrictions of complex linear fractional transformation. Since projective transformations are analytic, every $\mathbb{C}P^1$-structure determines an *underlying complex structure.* For $n = 1$, these structures were studied in the nineteenth century in relation to Schwarzian differential equations and their monodromy.

A *Schwarzian differential equation* on a domain $\Omega \in \mathbb{C}P^1$ is given by

$$w''(z) + \frac{1}{2}q(z)w(z) = 0 \tag{1}$$

where $\Omega \xrightarrow{q} \mathbb{C}$ is a holomorphic function. In a neighborhood of $z_0 \in \Omega$, the solutions form a two-dimensional complex vector space, and one chooses a basis $w_1(z), w_2(z)$ of solutions. Any other basis is related by a linear transformation. Analytic continuation defines a holomorphic map

$$(\tilde{w}_1, \tilde{w}_2) : \tilde{\Omega} \longrightarrow \mathbb{C}^2$$

on the universal covering $\tilde{\Omega} \longrightarrow \Omega$, such that the deck transformations are realized by linear transformations of $\mathbb{C}^2$. The corresponding quotient

$$\tilde{\phi} : \tilde{M} \longrightarrow \mathbb{C}P^1$$
$$z \longmapsto \tilde{w}_1(z)/\tilde{w}_2(z)$$

is a developing map for a projective structure on Ω.

More generally, let Σ be a Riemann surface and regard $q(z)$ as a *holomorphic quadratic differential* on Σ—the holomorphic tensor field $\Phi = q(z)dz^2$ is a section of the tensor product square of the *canonical line bundle* (the holomorphic cotangent bundle) of Σ. The solution $w(z)$ is a section of another holomorphic line bundle over Σ, and the developing map ϕ relates to the quadratic differential by the *Schwarzian derivative:*

$$\phi, z := \left(\frac{\phi''(z)}{\phi'(z)}\right)' - \frac{1}{2}\left(\frac{\phi''(z)}{\phi'(z)}\right)^2 = q(z),$$

which is equivalent to ϕ being the projective solution to (1). By standard existence and uniqueness of solutions to systems of (holomorphic) differential equations, any holomorphic developing map arises from a holomorphic quadratic differential Φ.

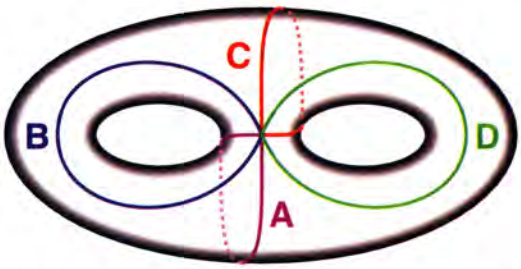


Figure 1. A genus two surface M can be cut along four curves to produce an octagon. The sides of the octagon identify in pairs to reconstruct M. The octagon defines a fundamental domain for the fundamental group of M acting on the universal covering $\tilde{M}$.

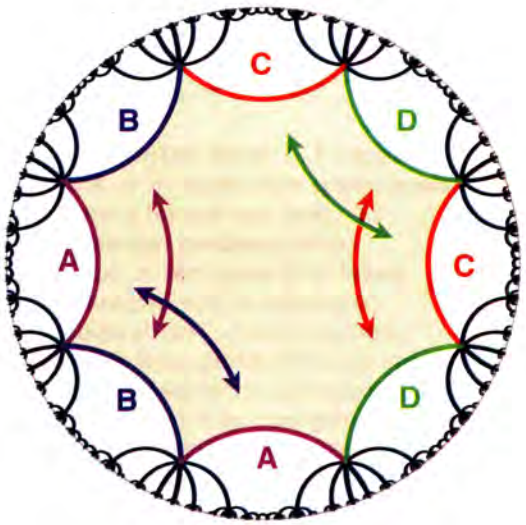


Figure 2. The fundamental octagon is realized geometrically by a regular octagon in the Poincaré disc with all interior angles $\pi/4$. The identifications of the sides are realized by unique isometries of the Poincaré disc, generating the fundamental group, and defining a *Fuchsian representation* of $\pi_1(M) \longrightarrow \mathrm{PSL}(2, \mathbb{C})$. The fundamental domains in $\tilde{M}$ tile $\tilde{M}$, and the resulting developing map takes this topological tiling to a tiling of the Poincaré disc by regular octagons.

Conversely, every holomorphic quadratic differential determines a developing map ϕ, unique up to composition with a Möbius transformation.

Thus a $\mathbb{C}P^1$-structure on a surface M corresponds to a pair (Σ, Φ) where Σ is a Riemann surface homeomorphic to M and Φ is a holomorphic quadratic differential. The *marked complex structures* (that is, the Σ's) form a complex manifold, *Teichmüller space,* homeomorphic to $\mathbb{C}^{3g-3}$

(where g is the genus of M) and, given Σ, the quadratic differentials form a complex vector space $\cong \mathbb{C}^{3g-3}$. Thus all the $\mathbb{C}P^1$-structures form a space homeomorphic to $\mathbb{C}^{6g-6}$. *Furthermore, without even "seeing" one structure, one understands the whole moduli space globally as a cell of dimension* $12g-12$.

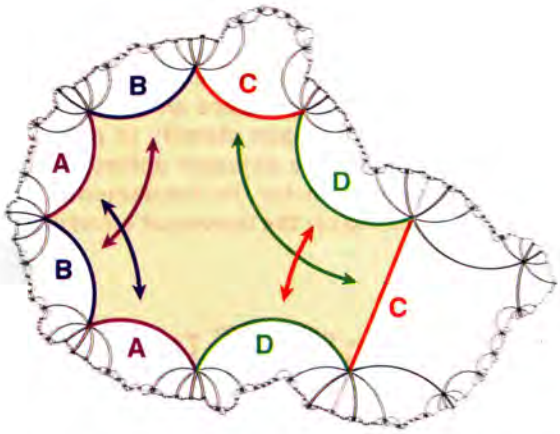


Figure 3. A small deformation of this developing map maps $\tilde{M}$ to a domain in $\mathbb{C}\mathbb{P}^1$ that has fractal boundary. The corresponding representation is *quasi-Fuchsian*, that is, topologically conjugate to the original Fuchsian representation. The developing map remains an embedding, and the holonomy representation embeds $\pi_1(M)$ onto a discrete subgroup of $\mathrm{PSL}(2,\mathbb{C})$. In contrast to the Fuchsian uniformization, where the developing image is a round disc, now the developing image has nonrectifiable boundary.

The individual structures are rich and fascinating, however. One may start with the *Fuchsian uniformization*, that is, the representation of the Riemann surface M as the quotient of a geometric disc by a Fuchsian group and deform it along a path of projective structures. (See Figure 1.)

In another direction, the uniformization of M as the quotient of a domain by a *Schottky group* gives another projective structure whose developing map is not injective although the holonomy group is discrete. See [2] for more information and other examples of Kleinian groups.

For $\mathbb{R}P^2$*-structures*, which are structures modelled on the real projective plane, similar results are known.

For compact surfaces of genus $g > 1$, the deformation space is completely known to be a countable disjoint union of open cells of dimension $16(g-1)$ [1]. One component consists of structures that are quotients of convex domains in $\mathbb{R}P^2$. However, it is not immediately clear how these structures relate to Riemann surfaces. Through a long development of the theory of *hyperbolic affine spheres*, culminating with work of Labourie and Loftin, this space naturally identifies with a holomorphic vector bundle over Teichmüller space whose fiber over a point $\langle M \rangle$ is the space of *holomorphic cubic differentials* on M. An example of such a projectively symmetrical convex domain is depicted on the cover of the November 2002 issue of the *Notices* (See Figure 5).

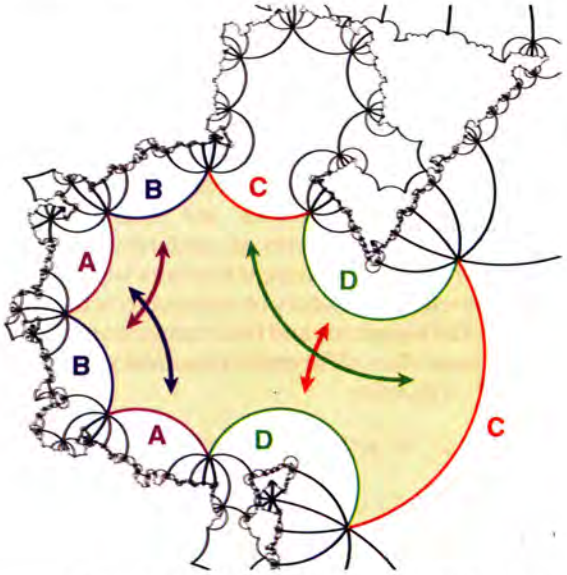


Figure 4. As the deformation parameter increases, the images of the fundamental octagons eventually meet and overlap each other. The developing map ceases to be injective, and in fact winds all over $\mathbb{C}P^1$. Typically the image of the holonomy representation is dense in $\mathrm{PSL}(2,\mathbb{C})$.

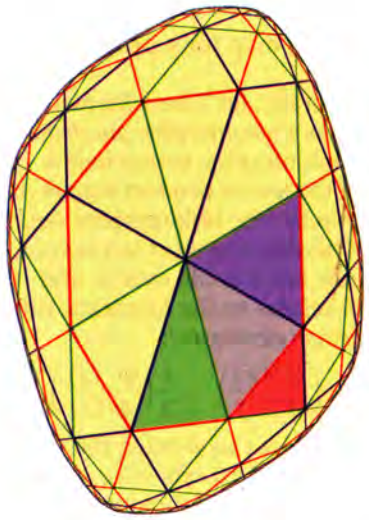


Figure 5.

Although all eight of Thurston's 3-dimensional geometries [4] can be given $\mathbb{R}P^3$-structures, not every closed 3-manifold admits such a structure (for example, Daryl Cooper has proved that $\mathbb{R}P^3 \# \mathbb{R}P^3$ admits no $\mathbb{R}P^3$-structure). The Poincaré conjecture for $\mathbb{R}P^3$-manifolds follows easily from the existence of the developing map. However, finding an $\mathbb{R}P^3$-structure on a connected sum seems particularly difficult. Yet recent examples of Benoist and Kapovich indicate a rich abundance of projective structures in dimensions three and higher.

The author gratefully acknowledges partial support from National Science Foundation grant DMS-0405605 and a Semester Research Award from the General Research Board of the University of Maryland in Fall 2005. He thanks Bill Casselman and the members of the Experimental Geometry Lab at the University of Maryland (in particular Anton Lukyanenko and Ryan Hoban) for their help in producing the illustrations.

References

[1] S. CHOI and W. GOLDMAN, The classification of real projective structures on compact surfaces, *Bull. Amer. Math. Soc.* (N.S.), **34** (1997), 161–170.

[2] D. MUMFORD, C. SERIES, and D. WRIGHT, *Indra's Pearls: The Vision of Felix Klein*, Cambridge University Press, 2002.

[3] R. SHARPE, *Differential Geometry: Cartan's Generalization of Klein's Erlangen Program*, Graduate Texts in Mathematics 166, Springer-Verlag, New York, 1997.

[4] W. THURSTON, *Three-dimensional Geometry and Topology*, Princeton University Press, 1997.

[5] V. OVSKIENKO, and S. TABACHNIKOV, *Projective Differential Geometry Old and New*, Cambridge University Press, 2005.

Join A K PETERS at JMM in January 2007

You can find us at booth #702-704 at the 2007 Joint Mathematics Meeting in New Orleans.

In Celebration of 15 years of Independent Publishing, we're offering vouchers for 15% discounts to all attendees during the first 15 minutes after the Grand Opening, while supplies last!

... on top of our 20% Conference Discount on all of our Titles on Display!

SATURDAY

book signings with
Steve Batterson
Pursuit of Genius

and **Calvin C. Moore**
Mathematics at Berkeley

SUNDAY

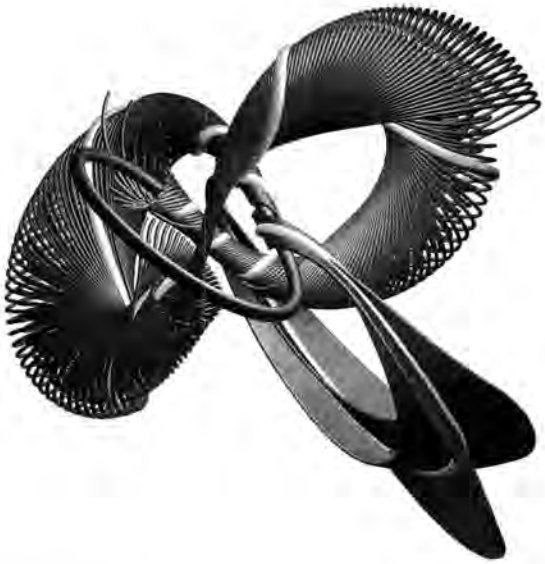
hands-on
origami activity and
book signing with
Thomas Hull
Project Origami

demonstration and book signing
with **Greg N. Frederickson**
Piano-Hinged Dissections

RAFFLE DRAWING!

Our GRAND PRIZE is an original origami construction, created by **Robert J. Lang**
Origami Design Secrets

www.akpeters.com



About the Cover

The cover for this issue was produced by Étienne Ghys and Jos Leys. It shows the trajectories of the stable and unstable curves at a point with respect to the Anosov flow due to the one-parameter subgroup of diagonal matrices of $SL_2(\mathbb{R})$ acting on $SL_2(\mathbb{R})/SL_2(\mathbb{Z})$. As the figure illustrates, the flow has chaotic aspects. Many more—indeed, an astonishing abundance of—such pictures are part of the remarkable article "Lorenz and modular flows: A visual introduction", which Ghys and Leys contributed as the November 2006 installment of the Feature Column on the AMS website `http://www.ams.org/featurecolumn`.

This picture is in fact a still shot from one of a collection of QuickTime™ animations embedded in the article which demonstrate better than any number of still shots the nature of the flow. The article derives from Ghys's presentation at the ICM in Madrid last summer and represents a very promising development in mathematical exposition. The beautiful result of Ghys's work was the coincidence, hitherto unsuspected, of two families of knots: one arising as periodic trajectories in the Anosov flow on $SL_2(\mathbb{R})/SL_2(\mathbb{Z})$ pictured here, and the other arising similarly in the flow of the well-known Lorenz attractor.

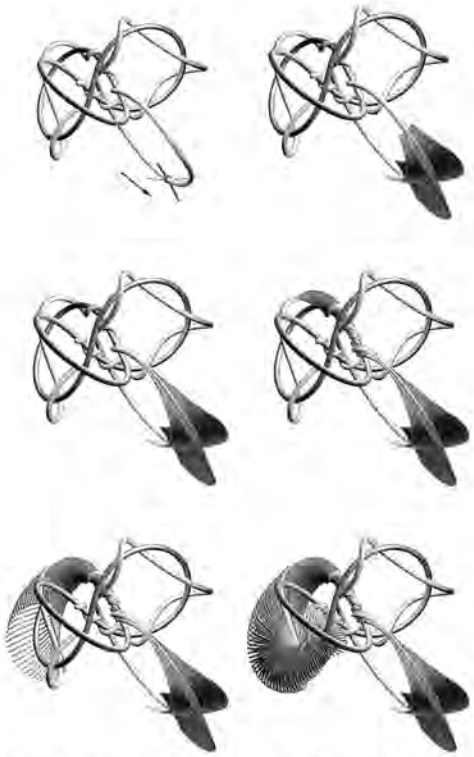
Hyperbolic Flow on the Space of Unit Lattices

The quotient $SL_2(\mathbb{R})/SL_2(\mathbb{Z})$ may be identified with the space of unit lattices L in $\mathbb{C}$, and via the classical Weierstrass functions $g_2(L)$ and $g_3(L)$ this may in turn be identified with the complement of the discriminant locus $\Delta = g_2^3 - 27g_3^2 = 0$ in the unit three-sphere in $\mathbb{C}^2$, which happens to be a trefoil knot.

The trefoil discriminant locus.

Keep in mind here that the three-sphere may be identified through stereographic projection with $\mathbb{R}^3 \cup \{\infty\}$.

Through each point in the complement there exist several interesting curves. One is its orbit O with respect to the group of diagonal matrices, shown on the cover in white. Others are the stable and unstable manifolds at that point, which in this case correspond to the subgroups of upper and lower unipotent matrices. The flow compresses the stable points into O but uncompresses the unstable ones into a surface that winds chaotically in space around it. The past and future of these trajectories are shown on the cover, one in green and the other in gold. The figures opposite exhibit the forward flow of parts of the stable and unstable curves through one point, as well as the orbit O. (The motion is initially towards the reader). This can give only a feeble idea of what's in the animations of Ghys and Leys.



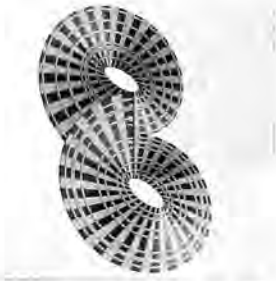
The development of stable and unstable manifolds (scan across and down).

The Lorenz Flow

In an impressive paper published in 1983, Joan Birman and Bob Williams discussed the problem of classifying the knots that appeared as periodic orbits in the attractor associated to the Lorenz equation, the one discovered by Edward Lorenz much earlier as a model for deterministic chaos.

Knots in the Lorenz attractor.

They did carry out a classification, but not quite for the original problem. Instead, they used a geometric model proposed earlier by John Guckenheimer and Williams that transformed the problem into one involving two-dimensional flow on a branched surface and thence into one involving intersections with a slice, hence symbolic dynamics.



Intersecting the transverse slice on a branched surface.

They left open, albeit with some evidence to make their claim plausible, the very difficult problem of justifying this transformation. Recently, Warwick Tucker has shown by machine computation involving interval arithmetic that their model was justified.

Bob Williams commented, "Our paper was essentially the first one that treated periodic orbits as knots. 'Essentially' because ... my then colleague, John Franks, had written a paper connecting the Alexander polynomial of knots to a Weil type zeta function that a lot of us were thinking about at the time.... I had given a talk in a seminar on turbulence in Berkeley in 1976 in which I computed one of the zeta functions for the Lorenz periodic orbits. I concluded with the statement that most of them were knotted.

"At this time many dynamicists were thinking about knots—in particular when Vaughan Jones had his breakthrough. ... I think the Birman-Williams paper definitely had more impact in dynamics than it did in knot theory."

Joan Birman added, "Our paper was almost ignored by knot theorists.... In some sense the work of Ghys proves that Lorenz made an incredible discovery when he found those equations. They are, in a very real way, the simplest example you can find of the onset of chaos."

References

[1] JOAN S. BIRMAN and ROBERT F. WILLIAMS, Knotted periodic orbits and dynamical systems—I. Lorenz's equation, *Topology* **22** (1983), 47-82.

[2] ÉTIENNE GHYS, Knots and dynamics, to appear in the proceedings of the ICM in Madrid, 2006. More, equally striking, images on this and other mathematical topics can be found at `http://www.josleys.com/`.

[3] WARWICK TUCKER, A rigorous ODE solver and Smale's 14th problem, *Foundations of Computational Mathematics* **2** (2002), 53-117. Also available at `http://www.math.uu.se/~warwick/main/rodes.html`. A more informal note by Tucker is the short "The Lorenz attractor exists—an auto-validated proof", at `http://www.cs.utep.edu/interval-comp/interval.02/tuck.pdf`. An informal account of this by Ian Stewart can be found in "The Lorenz attractor exists", *Nature* **406** (2000), 948-9; and another by Marcelo Viana in "What's new on Lorenz strange attractors?", *Mathematical Intelligencer* **22** (2000), 6-19.

All of the figures in this article are due to joint work by Ghys and Leys, but I wish to thank Leys especially for his tireless efforts in producing graphics files on short notice. I wish to thank both of them also for a great deal of patience in preparing the AMS feature column as well as for helping me to write this. Leys used the programs `Knotplot`, `Povray`, *and* `Ultrafractal` *as his graphics tools. Of the last he says, "UF is probably the best program around for drawing fractal patterns. It comes with an extensive library of fractal formulas, which is constantly being extended, since UF allows users to write their own formulas and publish them for general use. It was this scripting feature that I found so appealing, as it opens the door for possibilities beyond fractals into the representation of geometric objects in general. ... UF is very fast—the final image of one of our animations, with its* $2,400,000$ *spheres takes about 45 seconds to complete on screen. In that time it calculates three Jacobi* θ *functions* 2.4 *million times!"*

—Bill Casselman, Graphics Editor
(`notices-covers@ams.org`)

Book Review

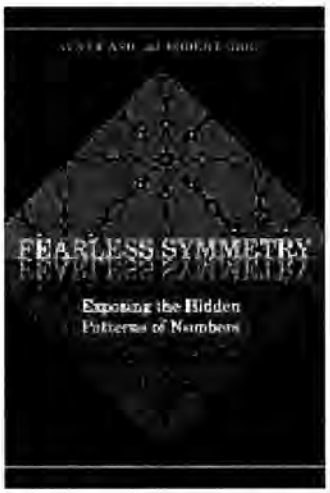
Fearless Symmetry

Reviewed by Dino Lorenzini

Fearless Symmetry: Exposing the Hidden Patterns of Numbers
Avner Ash and Robert Gross
Princeton University Press, 2006
302 pages, US$24.95
ISBN 0691124922

Every professional mathematician who has ever attended a cocktail party has had to answer the question: what is research in mathematics? For most of us, there is no easy answer, especially when the person asking adds, as an afterthought, "I thought that everything was known by now in mathematics." The professional mathematician then gauges the length of time that he or she has before the querier becomes sorry he asked, and then proceeds to discuss in down-to-earth terms a catchy mathematical subject. For number theorists, public key cryptography or Fermat's Last Theorem often has the potential to interest the casual listener.

Ash and Gross, in this welcome book, answer the question in the way we would all like to have the opportunity to do: at a leisurely pace, with motivating examples, and with digressions on how mathematicians really think, and how mathematics is "made". They chose a central, easy-to-state mathematical subject—equations and how to solve them—to motivate the mathematical adventure they are proposing to their readers. Starting from scratch, they explain some fundamental tools developed by mathematicians to tackle this motivating problem and many others. Their ultimate, fearless, goal is to explain the concept of reciprocity law for a representation of the Galois group of $\mathbb{Q}$, culminating in the use of such a reciprocity law in Andrew Wiles' proof of Fermat's Last Theorem. In this, they more than succeed.



Fearless Symmetry is written to be accessible to a broad audience, centered principally on those who have studied calculus. This is not a textbook, and very few proofs are offered. On the other hand, concrete examples are discussed, motivating the given definitions.

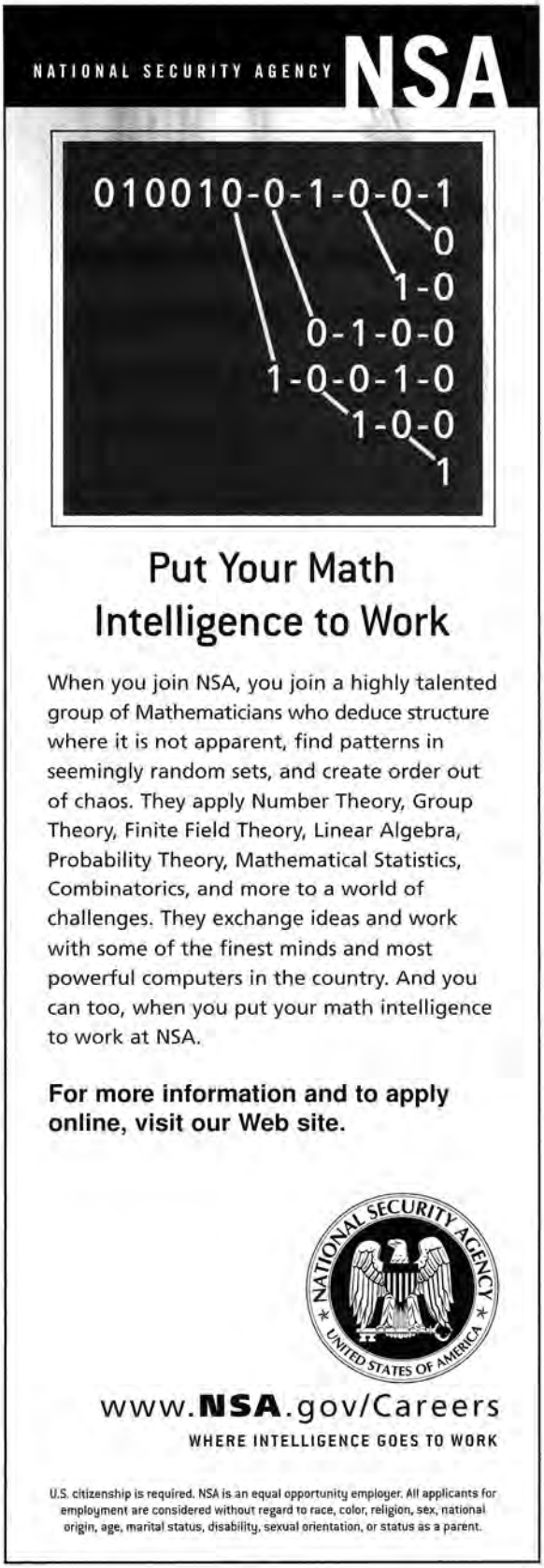
The first part of the book introduces groups, representations, complex numbers, modular arithmetic, and quadratic reciprocity. This could serve as a primer for a first course in abstract algebra. Undergraduates learning such topics for the first time would benefit from reading this book as a complement to a course, as this book makes for a relaxed introduction to the concepts and provides an interesting overview of where these may lead.

The second part of the book introduces the basics of Galois theory, elliptic curves, algebraic integers, Frobenius elements, and the far-reaching link that representations of the Galois group of $\mathbb{Q}$ can

Dino Lorenzini is Distinguished Research Professor of Mathematics at the University of Georgia. His email address is lorenzini@math.uga.edu.

be obtained from geometric objects such as elliptic curves.

The third part of the book is the culmination of this adventure. Reciprocity laws are introduced and succinctly described by the authors as "the bringing together of two patterns. One pattern is the set of traces of Frobenius elements acting in a Galois representation. The other pattern comes from the black box—another mathematical object of some different type" (page 235). In the work of Wiles, the black box is analytic in nature, as the pattern is the set of coefficients in a Taylor expansion of a modular form. This is by no means an easy subject, but the reader is well-rewarded for her effort when seeing these tools applied to concrete mathematical problems such as the description of all rational solutions to a given equation. That it took over 300 years to prove that the integer solutions to Fermat's equation $x^n + y^n = z^n, n > 2$, consist only in the trivial ones is a testimony to the difficulty of the field. The authors have taken the challenge and have succeeded admirably in bringing the essence of these cutting-edge research topics to a lay audience.



Book Review

Mathematical Illustrations: A Manual of Geometry and PostScript

Reviewed by Denis Roegel

Mathematical Illustrations:
A Manual of Geometry and PostScript
Bill Casselman
Cambridge University Press, 2005
336 pages, ISBN 0521839211
Hardcover, US$90.00; Paperback US$39.99

High quality mathematical illustration has long been a specialized craft, akin to the layout of musical scores or mathematical formulæ. Illustrating a proof, or drawing a graph, used to be difficult, and it is easy to find errors in the drawings in old books. Drawing errors are of course a problem for the understanding of a proof. Unfortunately, such cases are still common in the current scientific literature, perhaps because mouse-made drawings do not take full advantage of the power now available. The shift of power, from hand-quality drawings to computer-quality drawings, goes back to the 1970s and started with the advent of good printers. New computer languages were developed for graphical tasks. In 1981, Brian Kernighan described his high-level PIC language for typesetting graphics [3]. At about the same time, the first version of the PostScript language was made public. Unlike languages such as PIC, PostScript was designed not as a user-oriented language but rather as a page description language to serve as an interface between graphics-producing software and printers. Printers with PostScript interpreters were then manufactured, and consequently software was written to produce PostScript files. These files were

Denis Roegel is maître de conférences at Université Nancy. His email address is roegel@loria.fr.

normally independent of the printer, provided the printer knew PostScript. This independence is still a major asset of typesetting software such as TEX, where one often first produces a PostScript file, then prints it. The software has to know only about PostScript, not about the printer.

PostScript can also be used directly as a graphics programming language, and Bill Casselman's book *Mathematical Illustrations: A Manual of Geometry and PostScript* is devoted to the use of PostScript in the context of geometry.

A graphics language designed for the user has different requirements from one designed as a back-end for typesetting software. High-level languages such as PIC, MetaPost (created by Donald Knuth and John Hobby [4]), and others, try to achieve abstraction, flexibility, and naturalness. In MetaPost, for instance, drawing a segment from (0, 0) to (100, 40) is done with

```
draw (0,0)--(100,40)
```

PostScript, instead, is a language designed to be interpreted easily by a machine, and the burden of creating PostScript code normally lies not on the user, but on some software's driver. The same segment as above is drawn in PostScript with:

```
newpath 0 0 moveto 100 40 lineto stroke
```

Although there is a correspondence between the two expressions, the latter is obviously less user-friendly.

PostScript, in fact, is a stack- and list-based language. The language inherits features found in HP calculators using the Reverse Polish Notation. Other examples of such languages are FORTH and the BibTEX style language for typesetting bibliographies in TEX.

In a stack-based language, operands are given first (and put on a stack), then the operations. `2 3 mul 4 add 12 sub` will, for instance, push 2 and 3 on the stack, multiply them, push 4, adding it to the previous result 6, and subtracting 12, resulting in -2 on the stack. `100 40 lineto` means "draw a line from the current point to point $(100, 40)$." Casselman's book shows how far one can go with such a language, and how it can be used for mathematical illustrations.

In fact, Casselman's book is not only an introduction to PostScript, but actually a book covering two topics: geometry and PostScript. It was used by Casselman as a text for a third-year undergraduate course in geometry. Casselman is a mathematician interested in graphics [1, 2] and the book will appeal as much to mathematicians as it will appeal to programmers.

Casselman's book certainly does its best to address the two topics of geometry and PostScript, and in this respect it is excellent. The real problem lies in the PostScript language, which quite honestly is not the simplest graphical language, especially for beginners. Mathematicians who already have some familiarity with programming will find the book interesting and will enjoy its dual perspective. Those who are beginning in graphics might however be misled, or even deterred, depending on how far their graphical notions extend and what their aims are. If the reader is interested in an introduction to PostScript, Casselman's book certainly suits the purpose very well. But if the reader is looking for a practical language for making his/her own figures, I am doubtful that PostScript is the right choice. One should not forget that learning a language is an investment, and it may take years to take full advantage of certain languages. A better choice in this respect might be MetaPost, a language meant for users. One criterion for choosing a programming language for a given task is the number of people using that language. There are certainly more people programming in MetaPost than in PostScript (although many people manipulate PostScript files, of course).

One question raised by Casselman's book concerns the communication between its two readerships, the mathematicians and the programmers. Will the worlds of these two kinds of users really merge, as the book would like them to? Before answering this question, let us ponder a number of other issues.

Mathematical Illustrations

The book is aimed at producing mathematical illustrations, but what are mathematical illustrations? A perusal of the book will show that what is meant are geometrical constructions (for instance for the Pythagorean Theorem), curves, 3-dimensional surfaces, and 3-dimensional objects. To a great extent, these illustrations are made of straight or curved lines, or of surfaces delimited by curves and colored in some way. Labels appear only seldom, and we will come back to this topic later.

PostScript is well suited to the task of making technical illustrations such as plans, diagrams, flow charts, etc. But technical illustrations are different from mathematical illustrations, and for the latter other languages, such as MetaPost, seem better suited.

Throughout the book, the author tries to develop his methodology. For instance, he writes that "programs should reflect concepts" or that "To get good results from PostScript, first get a simple picture up on the screen that comes somewhere close to what you want and then refine it and add to it until it is exactly what you want."

I would rather say that first a drawing should be on paper, and its logical structure analyzed. It is essential to separate the design of the drawing from its implementation, because the implementation choices can cripple the design and make it more difficult to change. Afterwards, when the design has been stabilized to some extent, we know better what we want to draw and how, and we can observe the result and fine-tune it.

The Content

Let us now review some of the content of the book. The first chapter, in little more than twenty pages, gives the basics of polygonal drawing. The second chapter adds nothing about PostScript but is a refresher on coordinate geometry. Chapter 3 develops the language by presenting the means to store and reuse data. Although the chapter distinguishes between variables and procedures, both are actually data and are stored in the same way. A variable stores a value, such as an integer or a string, and a procedure stores some text, which usually is a list of commands; these commands are grouped with braces. Chapter 4 explains quite extensively and very clearly how coordinate changes are handled through matrices representing affine transformations. A 2-dimensional transformation is represented by a matrix stored as an array of 6 elements, and these matrices can easily be inverted and multiplied.

This chapter also shows how affine transformations in the plane can be represented as 3-dimensional matrices in the plane $z = 1$. The book is full of interesting problems, but sometimes the problems seem quite complex and disproportionate with the notions they purport to introduce. Conditionals, for instance, are introduced after stating a problem of line intersection taking up more than three pages. There are probably easier ways to introduce these concepts. However, the problem is interesting for other reasons, as it puts into practice the various coordinate systems and the handling of arrays.

Chapter 5 discusses programming loops and arrays and illustrates them by the drawing of regular polygons. Function graphs are a natural application of loops. Incidentally, a PostScript path can be created with a loop, somewhat like a machine leaving a trail, but the path itself is drawn only at the end of the construction. This is convenient, as there is no need to store the coordinates in an array, and we find the same useful features in MetaPost, for instance. Arrays are a natural structure to loop on, and the drawing of general polygons given by a list of pairs is a good application. Arrays also provide a very general structure and can contain lists of heterogeneous elements. The first element could be an integer, the second a pair, and so on. Readers acquainted with more recent languages such as Python will find themselves in familiar territory.

Chapter 6 extends the basic drawing facilities introduced in chapter 1. Up to now, only segments could be drawn. The main topic of this chapter is Bézier curves. The theory of Bézier curves and the more general Bernstein polynomials is sketched. The author shows for instance that points of a Bézier curve are weighted averages of its control points, that is, of the points that define the curve.

Chapter 7 shows how curves can be drawn automatically. In general, the author stresses the importance of separating the construction of a curve from its drawing. For instance, drawing a hyperbola using the procedure `hyperbola` could be written as

```
newpath -2 2 4 hyperbola stroke
```

the path being drawn only when the `stroke` command is executed.

The author shows how a procedure `f` can be defined in such a way that, taking a value x, it outputs a pair $[f(x)\ f'(x)]$ on the stack. This procedure can be used to produce the control points of the Bézier curves approximating the graph of the function f. Eventually, in order to draw a function `quartic` between -1 and 1 using 8 Bézier segments, one merely writes

```
newpath
-1 1 8 /quartic mkgraph
stroke
```

The "/" here means that the name "quartic", and not the definition of the function, is pushed on the stack. This allows the `mkgraph` function to call `quartic` as needed for various values of its parameter.

One such quartic given as an example is x^4 and this is coded by

```
/quartic { 2 dict begin
 /x exch def
 [
  x x mul x mul x mul % f(x)=x^4
  x x mul x mul 4 mul % f'(x)=4x^3
 ]
end } def
```

Although the syntax is quite verbose, this gives the general idea of how function graphs can be drawn. (What follows "%" are comments.) It is, by the way, possible to define a function taking a string representing an expression such as `x^4` and producing `x x mul x mul x mul`. One could even imagine defining a function computing the formal derivative of a function. These topics are beyond the scope of this book, although they are tackled in Appendix 6 in the case of polynomials.

An extension of these ideas is the drawing of parameterized curves, where it is assumed that the array $[[x(t)\ x'(t)]\ [y(t)\ y'(t)]]$ is given. This is for instance applied to draw a circle out of 8 Bézier segments.

Chapter 8 is about the analysis of paths. Up to now, paths have been rather static. They were accumulated, and then drawn, but it is actually possible to work on a path as data. As an example, the author introduces 2-dimensional transformations and explains the role of the Jacobian derivative in the approximation of a map. If certain conditions are met, such a transformation is conformal and preserves angles. A path can then be transformed by going through its components using `pathforall` and building an array representing a new path, obtained from the transformed components of the initial one. Finally, the commands in the array are executed, and this produces the new path. This chapter then applies this technique to map transformations, such as cylindrical projections, Mercator projections, and stereographic projections.

Chapter 9 is about programming and takes as natural applications replicating structures, such as arrays or fractals. Recursion is a very natural expression of certain algorithms, but this naturalness requires some care, in particular when local variables are involved.

Sorting is an application of arrays. An array of integers can be sorted for instance by subdividing an array, and this can be done recursively. The first half can be sorted, then the second half, and then

the sorted subarrays can be merged. Two sorting algorithms are presented in this chapter, the "bubble sort" and the "quicksort".

An interesting application to sorting is a procedure finding the convex hull of a set of points in the plane. The algorithm is stated very clearly, but the procedures are not broken down enough for my taste.

Chapter 10 is an introduction to perspective and projective geometry. The author introduces the projective plane and homogeneous coordinates. This chapter is therefore a mathematical preliminary to the representation of 3-dimensional objects in two dimensions.

Chapters 11 and 12 are about transformations in three dimensions and introduce the various mathematical prerequisites and the matrix representations of the different operations, such as projections, rotations, etc.

Chapter 13 and the next one describe a 3-dimensional extension to PostScript. This extension facilitates the creation of simple 3-dimensional scenes. When it is used, the location of the eye can be defined and coordinates can be changed by translation, scaling, or rotation. Paths can be defined in 3 dimensions. The extension is provided with matrix operations that operate on 4×4 matrices.

Chapter 14 shows how convex polyhedra can be represented and how visibility and shading algorithms are used for its faces. Smooth surfaces are obtained either by a fine computation of the shading and the use of small grids, or by the use of the more elaborate shading features introduced in version 3 of PostScript. Casselman's book takes the reader to advanced topics such as Gouraud shading and illustrates them, for instance, on a sphere.

This chapter also serves as an introduction to more general 3-dimensional rendering, involving objects that are not mere convex polyhedra. We are introduced to an algorithm of binary space partition, whose code is available online.

The concluding chapter 15 is particularly interesting as it details algorithms for splitting arbitrary 2-dimensional surfaces into small triangles, for the purpose of shading and visibility control.

The book is supplemented by several useful appendices giving in particular a summary of commands, details about the editing and running environment, the inclusion of labels, and zooming.

The appendix on labels, called "Simple text display," runs only four pages, and in my opinion this treatment is too brief. It may surprise the reader to find that labels actually seldom appear in the drawings for which code is given in the book, and there are two reasons for this. First, the author claims that a good drawing should speak for itself and does not need crutches such as labels. This is certainly true for some drawings, but not everyone will agree that it applies to all drawings. In particular, the author actually uses labels in certain figures (for instance in the pentagon on page 82) when he explains their structure. A second reason is that labels go somewhat beyond graphics and represent a bridge with text typesetting. Putting a label requires both the typesetting of text (and therefore dealing with fonts, symbols, special rules of positioning for exponents, etc.), and the location of this text with respect to the graphics. Hence, text and graphics somehow must communicate, and this is of course difficult. Casselman shows several cases of graphics labeling, but they are very basic.

Two Tracks

The two tracks of Casselman's book, mathematics and programming, are interleaved, but are also to a great extent independent. This is both an advantage and a drawback. It is an advantage because it allows the mathematician to learn about the theory of Bézier curves, projective geometry, homogeneous coordinates, and other interesting matters, including some that are given as (mathematical) exercises, without being bothered by the programming. Similarly, the programmer who wants to learn about PostScript will find an excellent introduction and will be able to skip all the mathematics. The exposition in both tracks is very clear and should satisfy readers from each field.

But the independence of the tracks, or rather, the fact that a reader need not read everything in order to progress, will also be likely to discourage mathematicians from reading the PostScript parts, and programmers from reading the mathematical parts. Still this could be interpreted positively, as it allows a programmer to finish his part of the book, and then to return to it for the remaining bits.

Will the mathematicians grasp the programming part? I am somewhat doubtful. The PostScript language is very unusual and, although very interesting and informative, it can hardly be viewed as an introductory programming language. It is likely, therefore, that only those readers with an interest in graphics, and with previous programming experience, will dive into the PostScript programming.

Yet, learning about PostScript is very rewarding. To most of us who are not familiar with a stack-based language, the book shows its beauty and versatility. Moreover, it illustrates the basic features of a general programming language, such as conditionals, loops, and structures like lists and trees, and shows how these structures can be used. The language is also graphics-oriented, and therefore has features that do not have a parallel in nongraphical languages, for instance path traversal.

The book could have been improved in several ways. First, the book is two-color, and perhaps

there could have been a few four-color pages, although that would have increased the cost. Second, although the author stresses the importance of good programming, the use of comments, etc., I feel that some pieces of code (pages 157–158, for instance) are too lengthy. They will frighten the mathematician; they could have been broken into smaller pieces. A procedure occupying two pages may be acceptable with certain languages, but I do not think it is with a stack-based language. There are also some technical inaccuracies. The author writes for instance (page 47) that "A procedure in PostScript is just any sequence of commands enclosed in brackets {...}." This is not correct. A sequence of commands enclosed in brackets {...} is a group, and it is possible to have groups without naming them. A procedure is a stored group of commands with some name. So, it is not true that a procedure is assigned to a variable, but a procedure is a variable. There is also an inaccuracy concerning pixel coloring. The author writes (page 237) that "pixels are colored in the order of their depth." This is not quite true for rendering engines such as OpenGL; instead, pixels get a new color if the color corresponds to a point in space nearer than the previous one used for coloring that pixel; the result does not depend on the order in which the pixels or objects are traversed. Finally, it is too bad that the author does not offer a comparison with other 2-dimensional or 3-dimensional graphical languages, such as MetaPost or OpenGL, although MetaPost is mentioned in the preface.

References

[1] BILL CASSELMAN, Visual explanations, *Notices of the AMS*, **46** (January 1999), 43–46.

[2] _____ , Pictures and Proofs, *Notices of the AMS*, **47** (November 2000), 1257–66.

[3] BRIAN W. KERNIGHAN, PIC: a language for typesetting graphics, *Proceedings of the ACM SIGPLAN SIGOA Symposium on Text Manipulation*, 92-98, ACM Press, 1981.

[4] JOHN HOBBY, *A User's Manual for MetaPost*, Bell Labs, 1994.

New from OXFORD

New!

OUT OF THE LABYRINTH

Setting Mathematics Free

ROBERT KAPLAN and **ELLEN KAPLAN**

Out of the Labyrinth offers an engaging and practical guide for parents and educators, and a delight for anyone interested in sharing the pleasures of mathematics. Enhanced throughout with puzzles, practical equations, and colorful anecdotes from their own classrooms, *Out of the Labyrinth* will delight readers with its engaging exploration of mathematics.

2007 304 pp.; 53 line illus, 1 ht
978-0-19-514744-5 $25.00

New!

AN INTRODUCTION TO QUANTUM COMPUTING

PHILLIP KAYE, RAYMOND LAFLAMME, and **MICHELE MOSCA**

This concise, accessible text provides a thorough introduction to quantum computing —an exciting emergent field at the interface of the computer, engineering, mathematical and physical sciences. Aimed at advanced undergraduate and beginning graduate students in these disciplines, the text is technically detailed and is clearly illustrated throughout with diagrams and exercises.

2006 288 pp.; numerous line illus.
978-0-19-857049-3 paper $49.50
978-0-19-857000-4 cloth $139.50

SYMMETRY AND THE MONSTER

The Story of One of the Greatest Quests of Mathematics

MARK RONAN

Mathematics is driven forward by the quest to solve a small number of major problems—the four most famous challenges being Fermat's Last Theorem, the Riemann Hypothesis, Poincaré's Conjecture, and the quest for the "Monster" of Symmetry. Now, in an exciting, fast-paced historical narrative ranging across two centuries, Mark Ronan takes us on an exhilarating tour of this final mathematical quest.

2006 272 pp.; 15 b/w illus.
978-0-19-280722-9 $27.00

SOLVING MATHEMATICAL PROBLEMS

A Personal Perspective

TERENCE TAO

Authored by a leading name in mathematics, this engaging and clearly presented text leads the reader through the various tactics involved in solving mathematical problems at the Mathematical Olympiad level. Covering number theory, algebra, analysis, Euclidean geometry, and analytic geometry, *Solving Mathematical Problems* includes numerous exercises and model solutions throughout.

2006 115 pp.; numerous line drawings, tables and mathmatical examples
978-0-19-920561-5 cloth $74.50
978-0-19-920560-8 paper $24.95

New!

AGENCY AND THE SEMANTIC WEB

CHRISTOPHER WALTON

This highly topical text considers the construction of the next generation of the Web, called the Semantic Web. This text is ideal for final-year undergraduate and graduate students in Mathematics, Computer Science, Artificial Intelligence, and Logic and researchers interested in Multi-Agent Systems and the Semantic Web.

2006 280 pp.; numerous line illus.
978-0-19-929248-6 $54.50

OXFORD UNIVERSITY PRESS

Prices are subject to change and apply only in the US. To order, please call 1-800-451-7556. In Canada, call 1-800-387-8020. Never miss an Oxford sale! Visit our Web site at **www.oup.com/us**. Satisfaction Guaranteed or your money back.

Mississippi Mathematics Renaissance

Gerard Buskes

In the spring of 2006 four African-Americans received the Ph.D. degree in mathematics in one commencement at the University of Mississippi, a national record. This is a joyous note of reflection.

In 1848 a group of people just below the northern hills of Mississippi lobbied the legislature in Jackson to place a university where dense hickory-oak forest ruled supreme, a land filled with the mystique of Faulkner's Yoknapatawpha. When granted, the "other Oxford" established an ambitious plan for an institution of higher learning. What would have been the biggest refracting telescope of the then-modern world was ordered from Alvan Clark and Sons of Boston. Civil war erupted while the telescope was en route to Oxford, and the giant lens never arrived.

The news of the four African-American Ph.D.'s signals the opening to a new renaissance, long after that first promise. The university, with about fourteen thousand students on its main campus, has fourteen faculty members in its mathematics department. In 2000 the Department of Mathematics applied for a Graduate Assistance in Areas of National Need (GAANN) grant. Its arguments in the proposal were simple: Mississippi has a large constituency of African-Americans and a huge need for a technology renaissance for which it needs highly trained mathematicians. The mathematics department promised in particular to recruit, train, and graduate future African-American and female Ph.D.'s. The Department of Education bought into these arguments. The availability of a US$20,000 stipend for a GAANN fellowship at the Department of Mathematics of the University of Mississippi, where the going rate for a graduate assistantship was US$9,650, had enormous consequences. The GAANN grant first doubled the graduate student budget and then the graduate student population. Finally, it more than quadrupled the number of Ph.D. students. It was a transforming moment. Eight GAANN fellows were supported from that first grant. Six have obtained their Ph.D.'s in mathematics (three of them African-American) and one more African-American is close to the finish line. Six of the eight fellows are female and four of these have obtained their Ph.D.'s. The grant created purpose and cohesion to the graduate program. The GAANN grant provided, as it were, a new lens from which to look outward. For the first time in more than fifty years the sectional meeting of the Mathematical Association of America took place on the Oxford campus in 2001. The GAANN grant enabled the GAANN fellows to go first to the national AMS/MAA meeting in New Orleans in 2001 and then to the International Congress of Mathematicians in Beijing, China, in 2002.

The transformation of the mathematics department at the University of Mississippi does not arrive in isolation. Bob Moses was the recipient of a MacArthur fellowship for an approach to teaching mathematics in his Algebra Project in Mississippi, based on understanding of the social and economic background of pupils. The university's commitment to diversity and its sense of responsibility to all citizens of Mississippi have created what its administration now calls the Renaissance Decade. The accomplishment of the four African-American Ph.D.'s in mathematics in Mississippi also is connected to other universities in the nation. At the University of Maryland, three female African-Americans received their mathematics Ph.D.'s in one commencement in 2003. The University of Iowa received a Presidential Award for its exemplary program that promises to deliver three minority Ph.D.'s in mathematics every year.

In reflecting on all these achievements, I was reminded of the following quote by Etta Falconer (the eleventh African-American female Ph.D.) upon

Gerard Buskes is professor of mathematics at the University of Mississippi. His email address is mmbuskes@sunset.olemiss.edu.

Three of the four young Ph.D.'s: Adrian Wilson, Carla Cotwright, and Bryan Williams (not pictured: Joe Anderson).

moving to Wisconsin in pursuit of a masters degree in 1954:

> Can you imagine what it was like for a nineteen-year-old black female from Tupelo, Mississippi, who has been immersed in segregation for all her life to attend the University of Wisconsin? I underwent a major culture shock.

The University of Iowa, with a low percentage of African-Americans in the region, is successful in breaking new ground for potentially very different reasons from the University of Mississippi in a region with a very high percentage of African-Americans. For historic, geographic, and economic reasons, recruiting and retaining students at UM is different from recruiting and retaining students in Iowa, which in turn is different from graduating Ph.D.'s in Maryland. What then could these diverse places of success have in common? For one, they have important role models. At the University of Mississippi, the African-American mathematician Donald Cole, with a Ph.D. from the University of Mississippi, has inspired generations of students to achieve their highest academic dreams. At the University of Iowa, appealing to the underlying humanity of it all, Philip Kutzko suggests another beautiful answer:

> ... such a transformation (of a department) is not based on recruitment and retention, although it leads to success ... It is based on a profound desire to live and work in a department that encourages and supports the hopes, dreams, and aspirations of young mathematicians from all parts and populations of our nation.

What is needed is a national strategy that studies similarities, but even more so differences between universities where success has arrived on the doorstep, and that then tries to replicate success in locales with a similar background. For instance, regional differences in economic prosperity could have a large and at times unexpected influence on a national concerted effort to raise the overall number of minority Ph.D.'s. A national strategy should include questioning practices in the culture of advancing mathematics research that hinder achievement of the highest degree for minorities, if such turn out to exist.

The Department of Education renewed GAANN funding to the Department of Mathematics at the University of Mississippi for 2006-2009. A student applying for a GAANN fellowship recently wrote to me:

> It is very discouraging to have gone to predominantly African-American schools and institutions and not have one African-American mathematics professor. And what is even more disappointing is to go to a school, and be the only African-American student in all of your classes! It makes one feel that maybe "your kind" was not meant to do this.

Whether it be Iowa, Maryland, or Mississippi, a diverse cadre of teachers and researchers in mathematics will be a renaissance for all of American mathematics.

On a personal note, I arrived in Lafayette county from Europe more than twenty years ago, largely unaware of the complexity of the Yoknapatawpha region and I had not read Faulkner. I would like to take this opportunity to thank Carl Pomerance for his advice and inspiration to me when he visited the University of Mississippi, twice in the mid- and late 1990s and then once more a couple of years ago. He gave two beautiful lectures on mathematics at the university and an even more beautiful talk for high school kids at South Panola High School in Batesville, twenty miles west of Oxford, where he volunteered during Freedom Summer in 1964. I dedicate the accomplishment of the four African-American Ph.D.'s in mathematics at the University of Mississippi to him and all others who worked so hard to make success at the spring commencement 2006 at UM possible.

What Is Good for Mathematics? Thoughts on the Clay Millennium Prizes

Anatoly Vershik

Around the year 2000, when information about the Clay Millenium Prizes for the solution of the seven specially selected mathematical problems became public, I met my old friend Arthur Jaffe, who was then president of the Clay Mathematics Institute. I asked him: "What is this being done for?" At the time I felt that the assignment of huge (million-dollar) prizes was more in keeping with the style of show business, aiming at drawing attention to something or somebody at any price, whereas scientific life should avoid cheap popularization.

Indeed, thought I, will "money tags" attached to the solution of scientific problems, and not their intrinsic interest, add to the mathematicians' enthusiasm?: if one of us is already working on the Riemann Hypothesis or the Poincaré Conjecture, no additional enticement is needed. And it will attract serious mathematicians to one these problems only if that person worked on the problem before or was an expert in the corresponding field.

Arthur answered me decidedly and professionally: "You understand nothing about the American way of life. If a politician, a businessman, a housewife will see that one can earn a million by doing mathematics, they will not discourage their children from choosing that profession, will not insist on their doing medicine, law, or going in for some other lucrative activity. And other rich philanthropists will be more likely to give money to mathematics, which is in such need of it."

At the time that answer partially convinced me. Nevertheless, in the years that followed, I have not learned to understand the American way of life any better, and seem to understand the logic of life in Russia less and less.

Anatoly Vershik is affiliated with the St. Petersburg Department of the Steklov Institute of Mathematics and also St. Petersburg State University, Russia. His email address is vershik@pdmi.ras.ru. *Translated by A. Sossinsky.*

Now that one of the "million dollar problems"—the Poincaré Conjecture—has been solved, I would like to come back to my original question: was the million-dollar venture useful for mathematics? Let me say at once that I have returned to my original position.

As I mentioned above, the number of people working on the Poincaré Conjecture and, probably, the other six problems, has not increased after the Clay millenium problems were announced. The person who solved it, G. Ya. Perelman, started working on it long before. The Clay Mathematics Institute has nothing to do with his solution. And the other mathematicians who still claim to have solved it, as far as I know, were also working on it before. And it is foolish to think that one of the nonspecialists (even a mathematician), having heard of the prize, has any chance of solving a problem of that level. Thus no rise in the progress of mathematics due to the new financial stimulus has occurred.

Intrinsically, the solution of the problem, as well as the method used to solve it, is a remarkable success of mathematics, an outstanding scientific achievement. And the Clay Institute has played no role in this.

I would also like to note that the stir created around the seven "millenium problems" creates the wrong impression in society about the work of mathematicians, supporting the hackneyed notion that it consists only in solving concrete problems.[1] You don't have to be an expert to understand how misleading that notion is. The discovery of new domains and relationships between different branches of mathematics, the setting of new problems, the development and perfection of the mathematical apparatus, and so on, are no less

[1] *A journalist from Russia once asked me: "In order to get the million, do you have to solve all seven problems, or will one do?"!*

important and difficult parts of our science, without which it cannot exist.

More generally, will the approach of the Clay Institute increase interest in mathematics and increase the influx of young people into the field? I am not sure. One must understand that somebody fascinated by mathematics as a teenager needs no additional stimuli, while those who, in their choice of profession, are primarily interested in ensuring a normal comfortable life do not need a million-dollar prize for solving an inaccessible problem, but need something completely different.

As to the interest of the general public in mathematics, it certainly did flare up for a while. No newspaper or TV channel passed by the sensational news. From August 20 and 21, when articles in the *New York Times* and the *New Yorker* appeared, to mid-September, passions did not die down. How many journalists inquired at our institute, seeking out mathematicians they knew or didn't know, asking for interviews, asking questions about the nature of the problem, demanding what its impact on everyday life is! Now at least everyone knows the name of Henri Poincaré and, of course, that of Perelman, and people interested in science did learn something about the problem. This was the case, and it was a good thing.

But what interests nonmathematicians above all? What questions are heard most often in this clamor? Such was the fate of the first test of the Clay Institute's initiative that it involved unexpected tragicomic circumstances. One can say that these circumstances were apparently unrelated to the expectations of the organizers, although who knows what is related, what isn't. The main question that interests the mass media and the general public is not the problem whose solution mathematicians were eagerly waiting for so many years, not what is going on in mathematics—all that was too difficult to understand, too inaccessible. And not even the personality of G. Ya. Perelman ("Completely nuts, he's a mathematician, they're all like that"). No. The main question was: "Why did he refuse the million?" Actually, after numerous explanations, some journalists (not all), and through them part of the public, finally understood that so far only the Fields Medal has been refused, the million has not been awarded yet. Nevertheless, the overwhelming part of the commentaries, at least in the Russian media, concerned that question only. Unfortunately, most of these commentaries were unintelligent, tactless, or even obnoxious.

All this moves to the background the meaningful part of the event and impedes the reader's real understanding of it. And, of course, the most improbable gossip is picked up with enthusiasm, such as that Perelman was supposedly slighted, thrown out of the institute, his results were plagiarized and so on. For example, see the article by N. Lobastova and M. Hirst in the *Sunday Telegraph* of August 28, or in the Wikipedia article about G. Ya. Perelman (which, most unfortunately, are referenced by the site of the International Mathematical Union). There are other, obviously unforeseen, consequences of the million-dollar undertaking.

Here is one of them. As the present example shows, some serious mathematicians have succumbed to the temptation of engaging in a discussion of the question of priority, involving real and imaginary complications. This is being done quite professionally, but it is difficult to avoid the thought that the aim is not only to share in the honor of solving an outstanding problem, but also to share in the spoils. Let us hope that the mathematical community will reject these claims, but where is the guarantee that in less obvious situations such attempts will not be successful?

In my opinion, all this clamor and fuss show that this method of promoting mathematics is warped and unacceptable, it does not popularize mathematics as a science, on the contrary, it only bewilders the public and leads to unhealthy interest. I don't think that these passions are only explained by the peculiarities in the behavior of today's hero, which of course tend to aggravate the emotions; things are deeper. The question is, does mathematics need such an indecent interest? Would such a reaction have occurred if not for the conspicuous presentation of the Clay prizes? Probably not. The proof of Fermat's Last Theorem in 1996 by Andrew Wiles did not lead to such a tumult, although the problem solved was no less important than Poincaré's.

The explanation is simple: two poorly compatible things became too closely connected: a serious scientific result and, out there in the forefront, the "million".

Within their own community, certain mathematicians, e.g., Paul Erdős, when setting a problem, liked to estimate their value by a number of bottles of beer, or glasses of martini, or a small number of dollars, but that was done in fun and was harmless. The French Academy at one time also proposed prizes for the solution of some mathematical problems, but the prizes were rather modest and were never presented with such pomp. The prestigious Fields Medal is above all a medal; the monetary prize given in parallel is modest, remains in the background, and is hardly ever talked about. The Nobel Prize and the Abel Prize, despite discussions about the equity of the choice of prizewinner, bring to mind, above all, the idea of outstanding scientific achievements. Rare refusals to accept the prizes have occurred in the past, but always had concrete motivations; convincing or not—but that is another question.

Certainly, after an important mathematical problem is solved, and many were solved in the twentieth century, the author should be

significantly encouraged (provided he/she does not refuse), and means for this are usually found. There is one thing wrong about mathematical prizes—there just aren't enough of them. Unfortunately, as things stand now, the few prizes that exist are distributed among the same small group of people. But again, this is another question.

In our case we are dealing with an a priori, an excessive monetary estimate of the solution of one of several scientific problems. Is it really necessary to estimate their cash equivalent (with a long line of zeros), and if so, how are we to go about it? The Hilbert problems were not evaluated in millions, but their popularity among active mathematicians did not suffer from this. To transform serious research problems into something like a million-dollar lottery is a totalistic means to indulge the bad taste of the mob. In response, we get a social effect in keeping with the underlying scale of "values". Science should be promoted by more sophisticated means, while the funds that far-seeing business people are willing to bestow on mathematics, and which we need so badly, should be used more efficiently. Popularization of math for the general public is indeed necessary, but not of the kind that is characteristic of the worst manifestations of present-day mass culture.

Undoubtedly, mathematics is in dire need of serious support, including financial support, as well as in the need of a general public much better informed about what goes on in our field. In contrast to this, the newspapers, especially in Russia, are presently "discussing" a completely different question: Is mathematical education, and mathematics itself, really necessary in contemporary society (see the series of articles on the subject in `http://www.gazeta.ru` and other sources)? However strange it may seem, the topic of the "millions" only inflames such passions and guides them in the wrong direction, while the situation of Russian scientists, especially the younger ones, remains as difficult as ever.

The Clay Institute conducts a very useful and successful program for supporting young mathematicians, helps organize scientific conferences and seminars, and so on, and this work can serve as an example for other foundations or private individuals.

But I firmly believe that the mathematical community can and must find new reasonable means of propaganda and promotion (and I don't mean popularization only). New means (including monetary ones, of course) are needed to attract attention to mathematics and to the outstanding events in our science, as are dignified ways of expressing recognition to its most outstanding representatives.

Take a fresh look at undergraduate mathematics.

While at the 2007 Joint Mathematics Meetings, attend our *Sketchpad*™ and *Fathom* User Group events, meet our new authors at a cordial reception, demo software, and examine new titles.

Visit Booth #308 for more details.

Also ask about:

Key College Publishing
888.877.7240 • www.keycollege.com

Sketchpad is a trademark of Key Curriculum Press.

Mathematics People

Bressan Awarded Feltrinelli Prize

ALBERTO BRESSAN of Pennsylvania State University has been selected to receive the Antonio Feltrinelli Prize in Mathematics, Mechanics, and Applications of the Accademia Nazionale dei Lincei. The prize carries a monetary award of 65,000 euros (approximately US$82,000), a certificate, and a gold medal.

Bressan has done important research in nonlinear analysis, differential equations, and control theory. He is best known for his breakthrough work in hyperbolic conservation laws, in which he established the uniqueness and other fundamental properties of solutions and the convergence of vanishing viscosity approximations.

The Accademia Nazionale dei Lincei, founded in 1603, is considered to be Italy's most prestigious scientific society. One of its first members was Galileo Galilei. The Feltrinelli Prize is among the highest awards given to Italian citizens for achievements in the arts, music, literature, history, philosophy, medicine, and physical and mathematical sciences. The prize is awarded in the area of physical and mathematical sciences only once every five years. Among the previous winners have been Francesco Tricomi, Guido Stampacchia, and Enrico Bombieri.

—From a Pennsylvania State University announcement

Tao Awarded 2006 SASTRA Ramanujan Prize

The 2006 SASTRA Ramanujan Prize will be awarded to TERENCE TAO of the University of California, Los Angeles. This annual prize, which was launched in 2005, is for outstanding contributions to areas of mathematics influenced by the genius Srinivasa Ramanujan. The age limit for the prize has been set at thirty-two, because Ramanujan achieved so much in his brief life of thirty-two years. The US$10,000 prize will be awarded at the International Conference on Number Theory and Combinatorics, December 19–22, 2006, at SASTRA University in Kumbakonam, India, Ramanujan's hometown.

The 2006 prize citation is as follows: "Terence Tao is awarded the 2006 SASTRA Ramanujan Prize for his path-breaking contributions in number theory, harmonic analysis, representation theory, and partial differential equations, which have had a major impact in combinatorics and ergodic theory as well. Among other things, the prize recognizes his notable contributions to the famous Kakeya Problem in higher dimensions, which has major applications in Fourier analysis and partial differential equations, especially his joint work with Nets Katz, Izabella Laba and others, that significantly improves all previously known estimates for the fractal dimension using new and surprisingly simple combinatorial ideas in an ingenious way. The prize also recognizes his outstanding joint work with Ben Green on long arithmetic progressions of prime numbers, in particular, the resolution of the long-standing conjecture that there are arbitrarily long arithmetic progressions of prime numbers, by brilliantly combining methods of ergodic theory with the ideas of Tim Gowers. In addition, the prize recognizes Tao's joint work with Jean Bourgain and Nets Katz in generalizing a fundamental problem of Erdős and Szemeredi on the sumsets and product sets of integers, by developing a 'sum-product theory' that has led to breakthroughs in harmonic analysis and number theory. The prize also makes note of Tao's fundamental work on wave maps that figure prominently in Einstein's general theory of relativity, the new insights that he and his collaborators provided in the study of Schrödinger equations, and the resolution of the saturation conjecture in representation theory in collaboration with Allen Knutson."

Tao was born in Adelaide, Australia, in 1975 and lived there until 1992. He did his B.Sc. (Honours) and M.Sc. at Flinders University of South Australia. He then went to Princeton University in 1992 for his Ph.D., which he completed in 1996 under the direction of Elias Stein. He

received a Sloan Dissertation Fellowship for the final year of his Ph.D. work. He is currently professor at the University of California in Los Angeles. He received the Salem Prize (2000), the AMS Bôcher Prize (2002), and the AMS Conant Prize (2005). In 2006 he received a Fields Medal as well as a MacArthur Fellowship.

The 2006 SASTRA Ramanujan Prize Committee consisted of: Krishnaswami Alladi (chair), George Andrews, Manjul Bhargava, James Lepowsky, Tom Koornwinder, Kannan Soundararajan, and Michel Waldschmidt.

—From a SASTRA Ramanujan Prize announcement

Faddeev, Ruelle, and Witten Awarded Poincaré Prizes

The International Association of Mathematical Physics (IAMP) has awarded the 2006 Henri Poincaré Prizes for mathematical physics to LUDVIG D. FADDEEV of the Steklov Institute of Mathematics, St. Petersburg, and the Euler International Mathematical Institute; DAVID RUELLE of the Institut des Hautes Études Scientifiques, Bures-sur-Yvette; and EDWARD WITTEN of the Institute for Advanced Study, Princeton. Faddeev was honored for his contributions to the theory of quantum fields, quantization of noncommutative gauge theories, scattering in quantum mechanics and quantum field theory, and the theory of integrable systems. Ruelle was cited for his contributions to quantum field theory, to both classical and quantum statistical mechanics, and to dynamical systems theory. Witten was honored for his work on string theory, which has also influenced geometry and topology. Each prize carries a cash award of 10,000 euros (approximately US$12,000).

The Poincaré Prize, which is sponsored by the Daniel Iagolnitzer Foundation, recognizes outstanding contributions that set the foundation for novel developments in mathematical physics. The prize is awarded every three years. The 2006 prizes were presented at the International Congress on Mathematical Physics in Rio de Janeiro.

—From an IAMP announcement

2006 Information-Based Complexity Young Researcher Award

JAKOB CREUTZIG of Technische Universität Darmstadt, Germany, and DIRK NUYENS of Katholieke Universiteit, Leuven, Belgium, have been awarded the Information-Based Complexity (IBC) Young Researcher Award for 2006. The award is given for significant contributions to information-based complexity by a young researcher who has not reached his or her thirty-fifth birthday by September 30 in the year of the award. The award carries a cash prize of US$1,000 and a plaque.

The award committee consisted of Josef Dick, University of New South Wales; Frances Kuo, University of New South Wales; Christiane Lemieux, University of Calgary; Friedrich Pillichshammer, University of Linz; Joseph F. Traub, Columbia University; and Henryk Wozniakowski, Columbia University and University of Warsaw.

—Joseph F. Traub

DMV Prizes

The Deutsche Mathematiker-Vereinigung (DMV, German Mathematical Society) awarded prizes at a meeting in Bonn in September 2006.

HANS FÖLLMER of the Humboldt-Universität Berlin received the DMV Cantor Medal. Föllmer is the leading German probability theorist of his generation. He has had a decisive influence on the development of the field of stochastics, especially stochastic analysis and applications to financial markets. Previous recipients of the Cantor Medal are Friedrich Hirzebruch, Yuri Manin, Volker Strassen, Jacques Tits, Erhard Heinz, Jürgen Moser, and Karl Stein.

GEORGE SZPIRO received the DMV Media Prize of 4,000 euros (approximately US$5,000) for his monthly column in the Swiss newspaper *Neue Zürcher Zeitung*. The column presents a wide range of mathematical themes that Szpiro has carefully researched and written up. He regularly succeeds in making complex mathematical ideas accessible and enjoyable to a wide public. His columns have been collected into two books, *Mathematics for Sunday Morning* (2005) and *Mathematics for Sunday Afternoon* (2006), both available in English.

ULF VON RAUCHHAUPT received the DMV Journalism Prize for his article "Professor Gödel und der Wahrheit (Professor Gödel and Truth)", which appeared in the *Frankfurter Allgemeine Sonntagszeitung* on April 23, 2006. The article, written on the occasion of the 100th anniversary of the birth of Kurt Gödel, describes how his ideas shook the foundations of mathematics.

The DMV also recognized the contributions of HANS MAGNUS ENZENSBERGER to mathematical popularization. Enzensberger, a prominent German poet and essayist, presented a much-admired lecture at the International Congress of Mathematicians in Berlin in 1998 about the role of mathematics in culture. The lecture, *Zugbrücke Ausser Betrieb*, was published as a booklet in German with facing English translation by A K Peters. Enzensberger has also written a children's book, *The Number Devil* (1999), which has appeared in both German and English.

—Allyn Jackson

Mathematics Opportunities

Proposal Due Dates at the DMS

The Division of Mathematical Sciences (DMS) of the National Science Foundation (NSF) has a number of programs in support of mathematical sciences research and education. Listed below are some of the programs and their proposal due dates for the year 2007. Please refer to the program announcement or contact the program director for more information.

December 12, 2006 (full proposal): East Asia and Pacific Summer Institutes for U.S. Graduate Students

December 15, 2006 (full proposal): Joint DMS/NIGMS Initiative to Support Research in the Area of Mathematical Biology

January 13, 2007 (full proposal): Mathematical Biology

January 25, 2007 (full proposal): Scientific Computing Research Environments for the Mathematical Sciences (SCREMS)

February 1, 2007 (full proposal): Collaboration in Mathematical Geosciences

February 19, 2007 (full proposal): Interdisciplinary Grants in the Mathematical Sciences (IGMS)

June 2, 2007 (full proposal): University-Industry Cooperative Research Programs in the Mathematical Sciences

June 5, 2007 (full proposal): Enhancing the Mathematical Sciences Workforce in the Twenty-First Century

June 6, 2007 (full proposal): Research Experiences for Undergraduates: REU site proposals to the Antarctic program

August 23, 2007 (full proposal): Conferences, Workshops, and Special Meetings in the Mathematical Sciences: Special Meetings only

September 21, 2007 (full proposal): Focused Research Groups (FRG) in the Mathematical Sciences

October 2, 2007 (full proposal): Algebra, Number Theory and Combinatorics; Analysis

For further information see the website `http://www.nsf.gov/funding/pgm_list.jsp?ord=date&type=all&org=DMS&sel_org=DMS&status=1`. The mailing address is Division of Mathematical Sciences, National Science Foundation, Room 1025, 4201 Wilson Boulevard, Arlington, VA 22230. The telephone number is 703-292-5111.

—From the DMS website

NDSEG Fellowships

As a means of increasing the number of U.S. citizens trained in disciplines of military importance in science and engineering, the Department of Defense (DoD) awards National Defense Science and Engineering Graduate (NDSEG) Fellowships each year to individuals who have demonstrated ability and special aptitude for advanced training in science and engineering. The fellowships are awarded for a period of three years for study and research leading to doctoral degrees in mathematical, physical, biological, ocean, and engineering sciences. Approximately 200 fellowships will be awarded in 2007.

The NDSEG Fellowship Program is open only to applicants who are citizens or nationals of the United States. NDSEG Fellowships are intended for students at or near the beginning of their graduate studies in science or engineering. Applicants must have received or be on track to receive their bachelor's degrees by fall of 2007. Applications are encouraged from women, persons with disabilities, and minorities, including members of ethnic minority groups such as African American, American Indian and Alaska Native, Asian, Native Hawaiian and other Pacific Islander, Hispanic, or Latino.

Complete applications must be submitted electronically or postmarked by **January 8, 2007.** Application materials are available from, and completed applications should be returned to, the American Society for Engineering Education (ASEE) at: NDSEG Fellowship Program, c/o American Society for Engineering Education, 1818 N Street, N.W., Suite 600, Washington, DC 20036; telephone 202-331-3516; email:

ndseg@asee.org. For further information, see the website http://www.asee.org/ndseg/preface.cfm.

—From an NDSEG announcement

AMS-AAAS Mass Media Summer Fellowships

The American Association for the Advancement of Science (AAAS) sponsors the Mass Media Science and Engineering Summer Fellows Program through which graduate students work during the summer in major media outlets. The AMS provides support each year for one or two graduate students in the mathematical sciences to participate in the program. In past years the AMS-sponsored fellows have held positions at *Scientific American*, *Business Week*, Voice of America, Discovery Channel Online, National Geographic Television, *Popular Science*, the *Chicago Tribune*, and *Time* magazine.

Fellows receive a weekly stipend of US$450 plus travel expenses to work for ten weeks during the summer as reporters, researchers, and production assistants in media organizations. They observe and participate in the process by which events and ideas become news, improve their ability to communicate about complex technical subjects in a manner understandable to the public, and increase their understanding of editorial decision making and of how information is effectively disseminated. Each fellow attends an orientation and evaluation session in Washington DC and begins the internship in mid-June. Fellows submit interim and final reports to AAAS. A wrap-up session is held at the end of the summer.

Mathematical sciences faculty are urged to make their graduate students aware of this program. The deadline to apply for fellowships for the summer of 2007 is **January 15, 2007**. Further information about the fellowship program and application procedures is available online at http://www.aaas.org/programs/education/MassMedia/index.shtml, or applicants may contact Stacey Pasco, Manager, Mass Media Program, AAAS Mass Media Science and Engineering Fellows Program, 1200 New York Avenue, NW, Washington, DC 20005; telephone: 202-326-6441; fax: 202-371-9849; email: spasco@aaas.org.

Further information is also available at http://www.ams.org/government/massmediaann.html and through the AMS Washington office, 1527 Eighteenth Street, NW, Washington, DC 20036; telephone: 202-588-1100; fax: 202-588-1853; email: amsdc@ams.org.

—AMS-AAAS announcement

Maria Mitchell Women in Science Award

The Maria Mitchell Association offers an annual award to recognize an individual, program, or organization that encourages the advancement of girls and women in studies and careers in science and technology. Maria Mitchell (1818–1889) was the first woman astronomer and first woman astronomy professor in the United States.

The award may be given in the natural and physical sciences, mathematics, engineering, computer science, or technology. The winner will be chosen by a national jury of distinguished educators and scientists and will receive a cash award of US$5,000. Funding for the award is provided by a grant from the Henry Luce Foundation.

Nominations will be accepted in **January 2007.** Guidelines and nomination forms are available from the website http://www.mmo.org/category.php?cat_id=14, or contact the Maria Mitchell Women in Science Award Committee, Maria Mitchell Association, 4 Vestal Street, Nantucket, MA 02554; telephone 508-228-9198.

—From a Maria Mitchell Association announcement

Departments Coordinate Job Offer Deadlines

A group of mathematical sciences departments has adopted an agreement to coordinate deadlines for acceptance of postdoctoral job offers. The purpose is to ensure that applicants do not have to make decisions about job offers before the results of the National Science Foundation (NSF) postdoctoral fellowship competition are announced. The agreement applies only to offers of postdoctoral positions and not tenure-track positions, and only to applicants who are less than two years past the Ph.D. The departments have agreed not to require these applicants to decide about a job offer before Monday, February 12, 2007. The NSF has already agreed that it will complete its review of applications by January 31, 2007, at the latest, and that all awardees of NSF postdoctoral fellowships will receive notification by February 8, 2007. The list of participating departments, together with additional information, may be found on the Web at http://www.ams.org/employment/postdoc-offers.html.

—Ellen Maycock, AMS Meetings and Professional Services Department

Focused Topic Area in Computational Mathematics

The Computational Mathematics Program of the Division of Mathematical Sciences (DMS) at the National Science Foundation has a long history of supporting basic research on numerical methods and algorithm design in large-scale computation for problems in science and engineering. The program has a focused topic area in fiscal year 2007 that addresses longtime behavior of numerical methods in large-scale scientific computing. This area of emphasis should not discourage the community from submitting proposals in the usual wide variety of computation-

related fields, but should be viewed as a special topic of interest.

Unsolicited research proposals to DMS addressing cross-cutting topics in one or more aspects of large-scale scientific computing may be considered in this focused topic area. Novel and creative numerical approaches that address solving real physical problems are invited. Such proposals should be submitted to the Computational Mathematics Program before **January 15, 2007**. For more information see the NSF website, http://www.nsf.gov/div/index.jsp?div=DMS. Prior to submitting a proposal, investigators are strongly encouraged to contact the Computational Mathematics Program. The primary contacts are: Leland Jameson, 703-292-4883, ljameson@nsf.gov; Thomas Russell, 703-292-4863, trussell@nsf.gov; and Junping Wang, 703-292-4488, jwang@nsf.gov.

—From a DMS announcement

News from the Clay Mathematics Institute

CMI Annual Meeting

Each year the Clay Mathematics Institute (CMI) holds a meeting at which it presents the Clay Research Awards and lectures on the awardees' work. In past years this event has been held in November.

Beginning in 2006 the Institute will hold its annual meeting in the spring using an expanded format which includes the awards and a two-day series of ten lectures. The lectures are intended for an audience of nonspecialists and will generally address recent breakthroughs.

The next CMI annual meeting will be held in Cambridge, Massachusetts, May 14–15, 2007. Below is the list of confirmed speakers and topics. Two additional speakers, as well as exact titles of the talks and information about schedule and venue, will be announced later.

Alessio Corti and Shigefumi Mori: Recent progress in higher-dimensional algebraic geometry and minimal models

Alex Eskin: Dynamics of rational billiards

David Fisher: Quasi-isometries and rigidity of solvable groups

Mark Kisin: Modularity of Galois representations

Curt McMullen: Complex dynamical systems

Peter Oszvath: New invariants in low-dimensional topology

Richard Taylor: The Sato-Tate conjecture

Further information about the meeting and the lectures will be posted at http://www.claymath.org/annual_meeting; for general information about the CMI, see http://www.claymath.org.

Past recipients of the Clay Research Award are: Manindra Agrawal, Manjul Bhargava, Alain Connes, Nils Dencker, Ben Green, Richard Hamilton, Laurent Lafforgue, Gérard Laumon, Bao-Châu Ngô, Oded Schramm, Stanislav Smirnov, Terence Tao, Edward Witten, and Andrew Wiles. Recipients receive a bronze sculpture by Helaman Ferguson and substantial, flexible research support for one year. Information on past recipients is available at http://claymath.org/research_award/.

CMI 2007 Summer School

The CMI Summer School on "Homogeneous flows, moduli spaces, and arithmetic" will be held at the Centro di Ricerca Matematica Ennio De Giorgi, Pisa, Italy, from June 11 to July 6, 2007.

Designed for graduate students and mathematicians within five years of their Ph.D., the program is an introduction to the theory of flows on homogeneous spaces, moduli spaces, and their many applications.

These flows give concrete examples of dynamical systems with highly interesting behavior and a rich and powerful theory. They are also a source of many interesting problems and conjectures. Furthermore, understanding the dynamics of such concrete systems leads to numerous applications in number theory and geometry regarding equidistributions, diophantine approximations, rational billiards, and automorphic forms.

The school will consist of three weeks of foundational courses and one week of mini-courses focusing on more advanced topics. The foundational courses will be: "Unipotent flows and application" by Alex Eskin and Dmitry Kleinbock, "Diagonalizable actions and arithmetic applications" by Manfred Einsiedler and Elon Lindenstrauss, and "Interval exchange maps and translation surfaces" by Jean-Christophe Yoccoz. Shorter courses will be given by Svetlana Katok and Shahar Mozes. Advanced minicourses will be given by Nalini Anantharaman, Artur Avila, Hee Oh, Akshay Venkatesh, and others.

Funding is available to graduate students and postdoctoral fellows who are within five years of receipt of their Ph.D. Standard support amounts will include funds for local expenses and accommodation plus economy travel.

The organizers of the CMI 2007 Summer School are: Manfred Einsiedler, David Ellwood, Alex Eskin, Dmitry Kleinbock, Elon Lindenstrauss, Gregory Margulis, Stefano Marmi, Peter Sarnak, Jean-Christophe Yoccoz, and Don Zagier.

The deadline for application is **February 28, 2007**. For more information and an application form see http://www.claymath.org/programs/summer_school/2007/ or contact summerschool@claymath.org; telephone: 617-995-2600.

—CMI announcement

News from the Bernoulli Center

The Bernoulli Center (CIB), funded jointly by the Swiss National Science Foundation and the Swiss Federal Institute of Technology in Lausanne, has issued a call for proposals of two one-semester programs during the period July 1, 2009–June 30, 2010. Those who are interested in organizing a program at the CIB should submit a two-page letter of intent by **February 1, 2007**. For more details see http://bernoulli.epfl.ch/recruiting.

—Bernoulli Center Announcement

Inside the AMS

Current Events Session at Joint Meetings

The Joint Mathematics Meetings in New Orleans in January 2007 will feature a special session called "Current Events Bulletin", which will showcase four expository lectures on topics at the frontier of mathematical research. The session is organized by AMS past-president David Eisenbud, director of the Mathematical Sciences Research Institute in Berkeley.

The format for the talks follows the model of the famous Bourbaki Seminars in that mathematicians with especially strong expository skills speak on work not their own and written versions of the talks are prepared beforehand and distributed at the session. But there are some novel features too. The talks are generally more accessible than those of the Bourbaki Seminars, and the coverage is broader and includes applied areas. Often a talk begins with a general, nontechnical presentation of the topic, lasting about twenty minutes. There is a short break, and then the talk continues with a more detailed presentation of how the topic is used in a particular setting. The "Current Events" sessions have drawn large audiences and have turned out to be one of the most popular activities at the Joint Meetings. The written versions of the talks are collected in an attractive booklet distributed at the session.

A tradition has also developed for the talks to appear in print. Some of them have been expanded to appear as articles in the *Bulletin of the AMS*.

For the session in New Orleans, the speakers and their lecture titles follow.

ROBERT GHRIST, University of Illinois, Urbana-Champaign, *Barcodes: The persistent topology of data.*

AKSHAY VENKATESH, New York University, *Flows on the space of lattices: Work of Einsiedler, Katok and Lindenstrauss.*

IZABELLA LABA, University of British Columbia, *From harmonic analysis to arithmetic combinatorics.*

BARRY MAZUR, Harvard University, *The structure of error terms in number theory and an introduction to the Sato-Tate Conjecture.*

The session will take place Sunday, January 7, 2007, from 1:00 p.m. to 4:45 p.m. Information about this and other Joint Meetings activities is available on the AMS Meetings website, `http://www.ams.org/meetings`.

—Allyn Jackson

Erdős Memorial Lectures

In April 2006 Béla Bollobás of the University of Memphis and Cambridge University presented the 2006 Erdős Memorial Lecture at the Central Section Meeting at the University of Notre Dame. The title of his lecture was "Inhomogeneous Random Graphs".

The Erdős Memorial Lectures are presented annually at AMS sectional meetings. This lecture series is made possible through the generosity of Andrew Beal, a Dallas banker who has committed US$100,000 as a prize for the solution of the so-called Beal Conjecture. The AMS holds the prize funds, and Beal has requested that income from the funds be used to support the lecture series. See the webpage `http://www.math.unt.edu/~mauldin/beal.html` for more information about the Beal Conjecture and prize.

The next Erdős Memorial Lecture will be given by Andrew J. Granville from the Université de Montréal at the 2007 Spring Southeastern Section Meeting in Davidson, NC, in March 2007. Previous Erdős Lecturers are Persi Diaconis, Bernd Sturmfels, Avi Wigderson, Hillel Furstenberg, Carl Pomerance, John H. Conway, and Ronald L. Graham. For further information, see the webpage `http://www.ams.org/meetings/erdos-lect.html`.

—Allyn Jackson

My Summer at *Scientific American*

Each year the AMS sponsors a fellow to participate in the Mass Media Fellowship program of the American Association for the Advancement of Science. This program places science and mathematics graduate students in summer internships at media outlets. In the piece below, the 2006 AMS Fellow, Brie Feingold of the University of California, Santa Barbara, describes her experiences during her fellowship at Scientific American *magazine. For information about applying for the fellowship, see "Mathematics Opportunities" in this issue of the* Notices *or visit the website* `http://ehrweb.aaas.org/massmedia.htm`. *The application deadline is* **January 15, 2007**.

Words often trigger emotions, and "mathematics" is no exception. A Yahoo search for "I hate math" triggered 158,000 hits. But I was hard-pressed to find another subject equally as disliked. "I hate literature" produced a paltry 300 hits, and even "I hate science" yielded only 14,900. Why does the word "math" elicit revulsion?

While there is no outright propaganda against mathematics, the public lacks reliable information about what mathematics is and who studies it. Whereas many people are familiar with branches of science, most can name few, if any, branches of mathematics. Topology is often confused with topography, algebra is synonymous with what was learned in high school, and real analysis is mostly known for its listing in the college course catalogues as "Real Anal.".

If we were a country with such an unfavorable image, we might try boosting tourism, creating diplomatic ties, and using positive advertising. In this scenario, mathematicians, scientists, and their students are natives of foreign lands; science journalists are tour guides; media consumers are tourists. This summer, I stepped out of my role as native and into the role of guide for those wishing to tour science and math country.

Just as a tour guide is responsible to both locals and tourists, a science writer must balance the interests of both scientists and readers while maintaining friendly relations with each. I was beholden to *Scientific American*'s readers, who spend an average of 71 minutes reading up to 130 pages of articles and ads. As short a time as this may seem, it is longer than the time that magazine buyers devote to reading the *Economist* or *Reader's Digest*. On the other side of the equation, the researchers who write for *Scientific American* are well known in their fields and usually write for journals read only by their colleagues. Staff editors write the remaining articles according to their interests and expertise. Thus, I interned at a fairly elite touring agency where both tourists and tour guides were willing to travel to remote areas.

But even my editors complained that good math stories were too few and too difficult to find. Were it not for *Square One* (a television show I watched on PBS), one might think Mathland had not sent any photos of the beautiful scenery or encouraged any visits to its regional monuments. Some may argue that we need new inhabitants (math students), not tourists (math fans). But many students arrive in Mathland with no perspective. They visit one city—for example, Algebra—for a year, where one family (a few math teachers) hosts them. But what if they took a few side trips through Combinatorics, Graph Theory, or even Differential Equations? One good tour could inspire subsequent longer visits and eventually even citizenship. The science writer can initiate that chain of events by giving the first tour.

From my first day as an intern, I looked forward to writing a story that would both pique readers' interest and explain new ideas in mathematics. Were I looking for a biology, chemistry, or physics story, I might find ideas on Eurekalert, an Internet resource specifically for science journalists where public information offices and organizations post catchy summaries of recent research. Or I could look at the weekly "tip sheets" provided by the *Proceedings of the National Academy of Sciences*. But in my eight weeks of internship, I remember only one mathematics story posted in such a manner. So at the suggestion of my mentor, Mariette DiChristina, I hopped on the subway and interviewed mathematicians at the Courant Institute at New York University. I called professors whose websites described applications of topology (my field of interest). During my time at *Scientific American* I was able to use only a small fraction of the information I gathered, but thanks to those discussions I have some ideas for future articles.

To set up a viable trip to Mathland, I needed to collaborate with a local who would share directions as well as local color. Even amiable and available locals often assumed that I already knew the major landmarks and had the equipment necessary for the trip. As scientific papers are naturally addressed to the locals, such papers cannot serve as a guide for tourists, and even I used them only as prompts to guide my interviews. Of course, the best way to enjoy the rugged terrain is by traveling there oneself: diving into the lakes, exploring the forests, digging in the dirt. The best way to enjoy math is by doing it. Without that firsthand experience, a tour guide is needed to describe those activities and their power, to give an aerial view, and to point out the amazing forces at work. I tried to perform the role of tour guide by extracting from scientists essential characteristics of their research, their inspiration for conducting it, and the landscape in which it was situated.

Eventually my editor accepted one of my math-related stories. While talking to mathematician Leslie Greengard at the Courant Institute, I learned about his fast algorithms research and about the video inpainting research of computer scientist Guillermo Sapiro at the University of Minnesota. In October 2006 my one-page article titled "Inpaint by Number" described how Sapiro used partial differential equations in an algorithm to automatically edit video. The article could contain no equations or unexplained jargon. And the phrase "partial differential equations" was considered jargon. Although I relied heavily on analogies and indirect means to describe the algorithm, it occurred to me that even technical proofs leave some explorations up

to the reader. As a guide, I aimed to appeal to the reader's sense of the aesthetic as well as the pragmatic and to provoke further investigation. I was pleased that my editor retained the words "partial differential equations" (even if they were in parentheses) in the article rather than simply replacing them with "mathematics".

Aside from writing about video software, I wrote other short pieces about Caesarean births, schizophrenia, American social life, robots, and engineered tissue. I also transcribed and shortened interviews conducted by editor Steve Mirsky with Nobel Prize winners in medicine and physics. During one of these transcriptions I learned the confusion a little jargon can create, especially in radio. As I was listening to the tape, I heard the speaker say something like "I like to say that these computers go Teraclops speed in order to..." Not knowing what he was talking about, I dutifully searched "Teraclops" on the Internet, thinking that it might be some sort of mythical creature or dinosaur. Twenty minutes later I decided that I must have heard the word incorrectly. Maybe he was saying "Teraflops". Thinking that this made even less sense, I was surprised to read that "TeraFLOPS" means "10^{12} floating point operations per second". Had the speaker used simpler language to deliver the same idea, I would have avoided the detour I took.

After my summer of interviewing, searching, and composing, I no longer become defensive on hearing the statement "I hate math." Instead, I feel the urgent need to respond with the sincere question, "What kind of math do you hate?" By asking such an essential question, I issue a passport to Mathland, forcing the recipient to explain his/her thoughts more clearly. Having observed my native land from an outsider's perspective, I am now more prepared to encourage my students to go beyond being tourists and to explore the terrain independently. Through this internship I discovered new reasons to study mathematics and new ways to think about my role as a mathematician.

—Brie Feingold, University of California, Santa Barbara

Reference and Book List

*The **Reference** section of the* Notices *is intended to provide the reader with frequently sought information in an easily accessible manner. New information is printed as it becomes available and is referenced after the first printing. As soon as information is updated or otherwise changed, it will be noted in this section.*

Contacting the *Notices*

The preferred method for contacting the *Notices* is electronic mail. The editor is the person to whom to send articles and letters for consideration. Articles include feature articles, memorial articles, communications, opinion pieces, and book reviews. The editor is also the person to whom to send news of unusual interest about other people's mathematics research.

The managing editor is the person to whom to send items for "Mathematics People", "Mathematics Opportunities", "For Your Information", "Reference and Book List", and "Mathematics Calendar". Requests for permissions, as well as all other inquiries, go to the managing editor.

The electronic-mail addresses are notices@math.ou.edu in the case of the editor and notices@ams.org in the case of the managing editor. The fax numbers are 405-325-7484 for the editor and 401-331-3842 for the managing editor. Postal addresses may be found in the masthead.

Upcoming Deadlines

December 12, 2006: Applications for NSF East Asia and Pacific Summer Institutes (EAPSI) program. See http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5284&org=NSF.

December 15, 2006: Proposals for DMS/NIGMS Initiative to Support Research in the Area of Mathematical Biology. See http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf06607.

December 15, 2006: Applications for AMS Epsilon Fund. See the website http://www.ams.org/outreach/epsilon.html or contact Membership and Programs Department, American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294; telephone 800-321-4267, ext. 4170; email: prof-serv@ams.org.

December 31, 2006: Nominations and supporting materials for NSF Alan T. Waterman Award.

Where to Find It

A brief index to information that appears in this and previous issues of the *Notices*.

AMS Bylaws—*November 2005, p. 1239*

AMS Email Addresses—*February 2006, p. 251*

AMS Ethical Guidelines—*June/July 2006, p. 701*

AMS Officers 2005 and 2006 (Council, Executive Committee, Publications Committees, Board of Trustees)—*May 2006, p. 604*

AMS Officers and Committee Members—*October 2006, p. 1076*

Conference Board of the Mathematical Sciences—*September 2006, p. 911*

Information for *Notices* Authors—*June/July 2006, p. 696*

Mathematics Research Institutes Contact Information—*August 2006, p. 798*

National Science Board—*January 2007, p. 57*

New Journals for 2004—*June/July 2006, p. 697*

NRC Board on Mathematical Sciences and Their Applications—*March 2006, p. 369*

NRC Mathematical Sciences Education Board—*April 2006, p. 488*

NSF Mathematical and Physical Sciences Advisory Committee—*February 2006, p. 255*

Program Officers for Federal Funding Agencies—*October 2006, p. 1072 (DoD, DoE); December 2006 p. 1369 (NSF)*

Stipends for Study and Travel—*September 2006, p. 913*

See http://www.nsf.gov/od/waterman/waterman.jsp.

December 31, 2006: Entries for Pirelli INTERNETional Award competition. See http://www.pirelliaward.com.

January 2007: Nominations for Maria Mitchell Women in Science Award. See "Mathematics Opportunities" in this issue.

January 5, 2007: Applications for IMA postdoctoral and New Directions programs. See http://www.ima.umn.edu.

January 8, 2007: Applications for NDSEG Fellowship Program. See "Mathematics Opportunities" in this issue.

January 10, 2007: Applications for AAUW Selected Professions Fellowships. See http://www.aauw.org/fga/fellowships_grants/selected.cfm or contact the AAUW Educational Foundation, Selected Professions Fellowships, P.O. Box 4030, Iowa City, IA 52243-4030.

January 15, 2007: Applications for AMS-AAAS Mass Media Summer Fellowships. See http://www.aaas.org/programs/education/MassMedia/ or contact Stacey Pasco, Manager, Mass Media Program, AAAS Mass Media Science and Engineering Fellows Program, 1200 New York Avenue, NW, Washington, DC 20005; telephone 202-326-6441; fax 202-371-9849; email: spasco@aaas.org. Further information is also available at http://www.ams.org/government/massmediaann.html and through the AMS Washington Office, 1527 Eighteenth Street, NW, Washington, DC 20036; telephone 202-588-1100; fax 202-588-1853; email: amsdc@ams.org.

January 25, 2007: Proposals for NSF Scientific Computing Research Environments for the Mathematical Sciences (SCREMS). See http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf05627.

January 31, 2007: Applications for AMS Congressional Fellowship. See http://www.ams.org/government/congressfellowann.html or contact the AMS Washington office at 202-588-1100, email: amsdc@ams.org.

February 1, 2007: Applications for AWM Travel Grants and Mentoring Travel Grants. See http://www.awm-math.org/travelgrants.html; telephone 703-934-0163; email: awm@math.umd.edu; or contact Association for Women in Mathematics, 11240 Waples Mill Road, Suite 200, Fairfax, VA 22030.

February 9, 2007: Applications for Newton Fellowships of the Math for America Foundation (MfA). See http://www.mathforamerica.org/.

February 16, 2007: Nominations for CMI Liftoff fellowships. See http://claymath.org/fas/liftoff_fellows/; telephone: 617-995-2600; email: nominations@claymath.org.

March 1, 2007: Applications for National Academies Christine Mirzayan Graduate Fellowships for the summer program. See http://www7.nationalacademies.org/policyfellows or contact The National Academies Christine Mirzayan Science and Technology Policy Graduate Fellowship Program, 500 Fifth Street, NW, Room 508, Washington, DC 20001; telephone: 202-334-2455; fax: 202-334-1667; email: policyfellows@nas.edu.

April 15, 2007: Applications for AMS "Math in Moscow" Scholarships for fall 2007. See http://www.mccme.ru/mathinmoscow or contact Math in Moscow, P.O. Box 524, Wynnewood, PA 19096; fax +7095-291-65-01; email: mim@mccme.ru. For information and application forms for the AMS scholarships see http://www.ams.org/outreach/mimoscow.html or contact Math in Moscow Program, Membership and Programs Department, American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294; email: student-serv@ams.org.

May 1, 2007: Applications for AWM Travel Grants. See http://www.awm-math.org/travelgrants.html; telephone 703-934-0163; email: awm@math.umd.edu; or contact Association for Women in Mathematics, 11240 Waples Mill Road, Suite 200, Fairfax, VA 22030.

June 1, 2007: Applications for National Academies Christine Mirzayan Graduate Fellowships for the fall program. See http://www7.nationalacademies.org/policyfellows or contact The National Academies Christine Mirzayan Science and Technology Policy Graduate Fellowship Program, 500 Fifth Street, NW, Room 508, Washington, DC 20001; telephone: 202-334-2455; fax: 202-334-1667; email: policyfellows@nas.edu.

June 5, 2007: Proposals for Enhancing the Mathematical Sciences Workforce in the Twenty-First Century. See http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf05595.

June 30, 2007: Nominations for 2007 Fermat Prize. See http://www.math.ups-tlse.fr/Fermat/.

October 1, 2007: Applications for AWM Travel Grants. See http://www.awm-math.org/travelgrants.html; telephone 703-934-0163; email: awm@math.umd.edu; or contact Association for Women in Mathematics, 11240 Waples Mill Road, Suite 200, Fairfax, VA 22030.

July 1, 2009–June 30, 2010: Call for proposals for programs at the Bernoulli Center. See "Mathematics Opportunities" in this issue.

National Science Board

The National Science Board is the policymaking body of the National Science Foundation. Listed below are the current members of the NSB. For further information, visit the website http://www.nsf.gov/nsb/.

Mark R. Abbott
Dean and Professor
College of Oceanic and Atmospheric Sciences
Oregon State University

Dan E. Arvizu
Director and Chief Executive
National Renewable Energy Laboratory (NREL)

Barry C. Barish
Linde Professor of Physics Emeritus
Director, Laser Interferometer Gravitational-Wave Observatory (LIGO)
California Institute of Technology

Steven C. Beering (Chair)
President Emeritus
Purdue University

Camilla P. Benbow
Patricia and Rodes Hart Dean of Education and Human Development
Peabody College of Education and Human Development
Vanderbilt University

Ray M. Bowen
President Emeritus
Texas A&M University

John T. Bruer
President
James S. McDonnell Foundation
St. Louis, Missouri

G. Wayne Clough
President
Georgia Institute of Technology

Kelvin K. Droegemeier
Associate Vice President for Research
Regents' Professor of Meteorology and Weathernews Chair
University of Oklahoma

Kenneth M. Ford
Director and Chief Executive Officer
Institute for Human and Machine Cognition
Pensacola, Florida

Patricia D. Galloway
Chief Executive Officer
Nielsen-Wurster Group, Inc.
Seattle, Washington

José-Marie Griffiths
Dean
School of Information and Library Science
University of North Carolina at Chapel Hill

Daniel E. Hastings
Dean for Undergraduate Education
Professor, Aeronautics and Astronautics and Engineering Systems
Massachusetts Institute of Technology

Karl Hess
Swanlund Chair
Advanced Study Professor Emeritus
University of Illinois

Elizabeth Hoffman
Executive Vice President and Provost
Iowa State University

Louis J. Lanzerotti
Distinguished Research Professor of Physics
Center for Solar Terrestrial Research
Department of Physics
New Jersey Institute of Technology

Alan I. Leshner
Chief Executive Officer
American Association for the Advancement of Science

Douglas D. Randall
Professor of Biochemistry and Thomas Jefferson Fellow
Director, Interdisciplinary Plant Group
University of Missouri

Arthur K. Reilly (Consultant)
Senior Director
Cisco Systems, Inc.

Jon C. Strauss
President Emeritus
Harvey Mudd College

Kathryn D. Sullivan (Vice Chair)
Science Advisor
Center of Science and Industry
Columbus, Ohio

Thomas N. Taylor
Roy A. Roberts Distinguished Professor
Department of Ecology and Evolutionary Biology
Curator of Paleobotany in the Natural History Museum and Biodiversity Research Center
University of Kansas

Richard F. Thompson
Keck Professor of Psychology and Biological Sciences
University of Southern California

Jo Anne Vasquez
Director of Public Policy
Center for Research on Education in Science, Mathematics, Engineering, and Technology
Arizona State University

Arden L. Bement Jr.
(member ex officio)
Director
National Science Foundation

Michael P. Crosby
Executive Officer and Office Director
National Science Board

The contact information for the Board is: National Science Board, National Science Foundation, 4201 Wilson Boulevard, Suite 1225, Arlington, VA 22230; telephone 703-292-5111; World Wide Web `http://www.nsf.gov/nsb/`.

Book List

The Book List highlights books that have mathematical themes and are aimed at a broad audience potentially including mathematicians, students, and the general public. When a book has been reviewed in the Notices, *a reference is given to the review. Generally the list will contain only books published within the last two years, though exceptions may be made in cases where current events (e.g., the death of a prominent mathematician, coverage of a certain piece of mathematics in the news) warrant drawing readers' attention to older books. Suggestions for books to include on the list may be sent to* `notices-booklist@ams.org`.

*Added to "Book List" since the list's last appearance.

Alan Turing's Automatic Computing Engine: The Master Codebreaker's Struggle to Build the Modern Computer, edited by B. Jack Copeland. Oxford University Press, June 2005. ISBN 0-198-56593-3.

**Analysis and Probability: Wavelets, Signals, Fractals* by Palle E. T. Jorgensen. Springer, September 2006. ISBN 0-387-29519-4.

Arthur Cayley: Mathematician Laureate of the Victorian Age, by Tony Crilly. Johns Hopkins University Press, December 2005. ISBN 0-801-88011-4.

**The Artist and the Mathematician: The Story of Nicolas Bourbaki, the Genius Mathematician Who Never Existed*, by Amir D. Aczel. Thunder's Mouth Press, August 2006. ISBN 1-560-25931-0.

A Beautiful Math: John Nash, Game Theory, and the Modern Quest for a Code of Nature, by Tom Siegfried. Joseph Henry Press, October 2006. ISBN 0-309-10192-1.

Beyond Coincidence: Amazing Stories of Coincidence and the Mystery and Mathematics Behind Them, by Martin Plimmer and Brian King. Thomas Dunne Books, December 2005. ISBN 0-312-34036-2.

Change Is Possible: Stories of Women and Minorities in Mathematics, by Patricia Clark Kenschaft. AMS, September 2005. ISBN 0-8218-3748-6.

The Coxeter Legacy: Reflections and Projections, edited by Chandler Davis and Erich W. Ellers. AMS, March 2006. ISBN 0-8218-3722-2.

The Curious Incident of the Dog in the Night-time, by Mark Haddon. Vintage, May 2004. ISBN 1-400-03271-7. (Reviewed March 2006.)

Dark Hero of the Information Age: In Search of Norbert Wiener, by Flo Conway and Jim Siegelman. Basic Books, December 2004. ISBN 0-738-20368-8. (Reviewed May 2006.)

Decoding the Universe: How the New Science of Information Is Explaining Everything in the Cosmos, from Our Brains to Black Holes, by Charles Seife. Viking Adult, February 2006. ISBN 0-670-03441-X.

Descartes: A Biography, by Desmond Clarke. Cambridge University Press, March 2006. ISBN 0-521-82301-3.

Divine Proportions: Rational Trigonometry to Universal Geometry, by N. J. Wildberger. Wild Egg Books, September 2005. ISBN 0-9757492-0-X.

The Equations: Icons of Knowledge, by Sander Bais. Harvard University Press, November 2005. ISBN 0-674-01967-9.

M. C. Escher's Legacy: A Centennial Celebration, edited by Doris Schattschneider and Michele Emmer. Springer, September 2005 (paperback edition). ISBN 3-540-20100-9.

The Essential Turing, edited by B. Jack Copeland. Oxford University Press, September 2004. ISBN 0-198-25080-0. (Reviewed November 2006.)

Euclid in the Rainforest: Discovering Universal Truths in Logic and Math, by Joseph Mazur. Pi Press, October 2004. ISBN 0-131-47994-6.

Euler through Time: A New Look at Old Themes, by V. S. Varadarajan. AMS, June 2006. ISBN 0-8218-3580-7.

**Fearless Symmetry: Exposing the Hidden Patterns of Numbers*, by Avner Ash and Robert Gross. Princeton University Press, May 2006. ISBN 0-691-12492-2. (Reviewed in this issue.)

**From Zero to Infinity: What Makes Numbers Interesting*, by Constance Reid. Fiftieth anniversary edition, A K Peters, February 2006. ISBN 1-568-81273-6. (Reviewed in this issue.)

Gödel's Theorem: An Incomplete Guide to Its Use and Abuse, by Torkel Franzen. A K Peters, May 2005. ISBN 1-56881-238-8.

Hiding in the Mirror: The Mysterious Allure of Extra Dimensions, from Plato to String Theory and Beyond, by Lawrence M. Krauss. Viking Adult, October 2005. ISBN 0-670-03395-2.

Incompleteness: The Proof and Paradox of Kurt Gödel, by Rebecca Goldstein. W. W. Norton, February 2005. ISBN 0-393-05169-2. (Reviewed April 2006.)

Infinite Ascent: A Short History of Mathematics, by David Berlinski. Modern Library, September 2005. ISBN 0-679-64234-X.

The Infinite Book: A Short Guide to the Boundless, Timeless and Endless, by John D. Barrow. Pantheon, August 2005. ISBN 0-375-42227-7.

It's About Time: Understanding Einstein's Relativity, by N. David Mermin. Princeton University Press, September 2005. ISBN 0-691-12201-6.

**John von Neumann: Selected Letters*, edited by Miklós Rédei. AMS, November 2005. ISBN 0-8218-3776-1.

King of Infinite Space: Donald Coxeter, the Man Who Saved Geometry, by Siobhan Roberts. Walker and Company, September 2006. ISBN 0-802-71499-4.

The Lifebox, the Seashell, and the Soul: What Gnarly Computation Taught Me about Ultimate Reality, the Meaning of Life, and How to Be Happy, by Rudy Rucker. Thunder's Mouth Press, October 2005. ISBN 1-560-25722-9.

A Madman Dreams of Turing Machines, by Janna Levin. Knopf, August 2006. ISBN 1-400-04030-2.

The Man Who Knew Too Much: Alan Turing and the Invention of the Computer, by David Leavitt. Great Discoveries series, W. W. Norton, December 2005. ISBN 0-393-05236-2. (Reviewed November 2006.)

The Math Instinct: Why You're a Mathematical Genius (Along with Lobsters, Birds, Cats, and Dogs), by Keith Devlin. Thunder's Mouth Press, March 2005. ISBN 1-56025-672-9.

Mathematical Musings: A Collection of Quotes, edited by Dan Sonnenschein. Clarium Press, November 2005. ISBN 0-9697688-8-5.

More Mathematical Astronomy Morsels, by Jean Meeus. Willmann-Bell, 2002. ISBN 0-943396-743.

Musimathics: The Mathematical Foundations of Music, Volume 1, by Gareth Loy. MIT Press, September 2006. ISBN 0-262-12282-0.

Mystic, Geometer, and Intuitionist: The Life of L. E. J. Brouwer. Volume 2: Hope and Disillusion, by Dirk van Dalen. Oxford University Press, October 2005. ISBN 0-198-51620-7.

New Mexico Mathematics Contest Problem Book, by Liong-shin Hahn. University of New Mexico Press, November 2005. ISBN 0-8263-3534-9.

The Newtonian Moment: Isaac Newton and the Making of Modern Culture, by Mordechai Feingold. New York Library and Oxford University Press, December 2004. ISBN 0-195-17735-5.

Not Even Wrong: The Failure of String Theory and the Continuing Challenge to Unify the Laws of Physics, by Peter Woit. Jonathan Cape, April 2006. ISBN 0-224-07605-1.

Once Upon Einstein, by Thibault D'Amour. A K Peters, March 2006. ISBN 1-568-81289-2.

The Pea and the Sun: A Mathematical Paradox, by Leonard M. Wapner. A K Peters, April 2005. ISBN 1-568-81213-2. (Reviewed October 2006.)

Piano Hinged Dissections: Time to Fold!, by Greg Frederickson. A K Peters, October 2006. ISBN 1-56881-299-X.

Piero della Francesca: A Mathematician's Art, by J. V. Field. Yale University Press, August 2005. ISBN 0-300-10342-5.

PopCo, by Scarlett Thomas. Harvest Books, October 2005. ISBN 0-156-03137-X. (Reviewed February 2006.)

Pursuit of Genius: Flexner, Einstein, and the Early Faculty at the Institute

Dynamic Publishers

INTERNATIONAL JOURNALS

JOURNAL OF INFORMATION ASSURANCE AND SECURITY

CALL FOR PAPERS: Authors are cordially invited to submit papers to http://www.dynamicpublishers.com, **A. Abraham,** School of Computer Science, Chung-Ang University, 221, Heukseok-dong,Dongjak-gu, Seoul 156-756, Korea

ISSN 1554-1010 Subscription Rate for Vol 1, 2006 (4 Issues): Library/Inst.: US$ 300.00; Personal: US$ 100.00, S/H

NEURAL, PARALLEL & SCIENTIFIC COMPUTATIONS

CALL FOR PAPERS: Authors are cordially invited to submit papers to http://www.dynamicpublishers.com, M. SAMBANDHAM, Department of Mathematics, Morehouse College, Atlanta, GA 30314, USA.

ISSN 1061-5369. Subscription Rate for Vol 14, 2006 (4 Issues): Library/Inst.: US $ 400.00; Personal: US$ 100.00, S/H

DYNAMIC SYSTEMS & APPLICATIONS

CALL FOR PAPERS: Authors are cordially invited to submit papers to http://www.dynamicpublishers.com M. SAMBANDHAM, Department of Mathematics, Morehouse College, Atlanta, GA 30314, USA, http://www.dynamicpublishers.com/.

ISSN 1056-2176. Subscription Rate for Vol 15, 2006 (4 Issues): Library/Inst.: US$ 400.00; Personal: US$ 100.00, S/H

DYNAMIC PUBLISHERS, INC,
P. O. BOX 48654,
Atlanta, GA 30362-0654, USA
www.dynamicpublishers.com

FAX : 1-(772) 293-9251

for Advanced Study, by Steve Batterson. A K Peters, June 2006. ISBN 1-56881-259-0.

Reality Conditions: Short Mathematical Fiction, by Alex Kasman. Mathematical Association of America, May 2005. ISBN 0-88385-552-6. (Reviewed August 2006.)

Reflections: V. I. Arnold's Reminiscences, by V. I. Arnold. Springer, April 2006. ISBN 3-540-28734-5.

The Road to Reality: A Complete Guide to the Laws of the Universe, by Roger Penrose. Knopf, February 2005. ISBN 0-679-45443-8. (Reviewed June/July 2006.)

The Secret Life of Numbers: 50 Easy Pieces on How Mathematicians Work and Think, by George G. Szpiro. Joseph Henry Press, March 2006. ISBN 0-309-09658-8.

Shadows of Reality: The Fourth Dimension in Relativity, Cubism, and Modern Thought, by Tony Robbin. Yale University Press, March 2006. ISBN 0-300-11039-1.

The Shoelace Book: A Mathematical Guide to the Best (and Worst) Ways to Lace Your Shoes, by Burkard Polster. AMS, June 2006. ISBN 0-8218-3933-0. (Reviewed December 2006.)

Stalking the Riemann Hypothesis: The Quest to Find the Hidden Law of Prime Numbers, by Dan Rockmore. Pantheon, April 2005. ISBN 0-375-42136-X. (Reviewed September 2006.)

Symmetry and the Monster: The Story of One of the Greatest Quests of Mathematics, by Mark Ronan. Oxford University Press, May 2006. ISBN 0-192-80722-6.

The Three Body Problem, by Catherine Shaw. Allison and Busby, March 2005. ISBN 0-749-08347-6. (Reviewed October 2006.)

The Trouble with Physics: The Rise of String Theory, the Fall of a Science, and What Comes Next, by Lee Smolin. Joseph Henry Press, October 2006. ISBN 0-309-10192-1.

Unknown Quantity: A Real and Imaginary History of Algebra, by John Derbyshire. Joseph Henry Press, May 2006. ISBN 0-309-09657-X.

Yearning for the Impossible: The Surprising Truths of Mathematics, by John Stillwell. A K Peters, May 2006. ISBN 1-568-81254-X.

Mathematics Calendar

The most comprehensive and up-to-date Mathematics Calendar information is available on e-MATH at http://www.ams.org/mathcal/.

January 2007

*8-13 **Geometry, Topology, and their interactions**, Morelia, Mexico.
Description: This conference will bring together mathematicians who use geometric methods to study topological problems and mathematicians who use topological methods to study geometric problems, for example, geometric group theorists with high dimensional topologists. The conference is held in honor of the mathematical contributions of Tom Farrell and Lowell Jones.
Speakers: Alejandro Adem, Igor Belegradek, Ken Brown, Fred Cohen, Chris Connell, Frank Connolly, Mike Davis, Tsachik Gelander, Ian Hambleton, Luis Hernandez-Lamoneda, Bruce Hughes, Tadeusz Januszkiewicz, Lizhen Ji, Qayum Khan, Bruce Kleiner, Chris Leininger, Peter Linnell, Bob Oliver, Ivonne Ortiz, Erik Pedersen, Frank Quinn, M. S. Raghunathan, Holger Reich, Xiaochun Rong, Ben Schmidt, Anna Wienhard, Kevin Wortman, and Guoliang Yu.
Contact: If you have any questions, contact one of the organizers: Jim Davis (Indiana University), jfdavis@indiana.edu; Daniel Juan-Pineda (IM-UNAM), daniel@matmor.unam.mx; Jean-Francois Lafont (Ohio State University), jlafont@math.ohio-state.edu; Stratos Prassidis (Canisius College), prasside@canisius.edu.
Information: http://www.math.ohio-state.edu/~jlafont/MoreliaConf.html.

*15-19 **Higher Structures in Geometry and Physics Conference in honor of Murray Gerstenhaber's 80th and Jim Stasheff's 70th birthdays**, IHP, Paris, France.
Speakers: Paul Baum (Penn State), Lawrence Breen (Paris 13), Giovanni Felder (ETH Zurich), Kenji Fukaya (Kyoto), Ezra Getzler (Northwestern), Anthony Giaquinto (Loyola U. Chicago), Simone Gutt (UL Brussels), Johannes Huebschmann (Lille 1), Hiroshige Kajiura (Kyoto), Mikhail Kapranov* (Yale), Bernhard Keller (Paris 7), Maxim Kontsevich (IHES), Yvette Kosmann-Schwarzbach (Polytechnique), Janko Latschev (Humboldt U. Berlin), Jean-Louis Loday (Strasbourg 1), Sergei Merkulov (Stockholm), Pierre Schapira (Paris 6), Daniel Sternheimer (Dijon), Dennis Sullivan (CUNY), Charles Torossian (ENS Paris), Boris Tsygan (Northwestern), Alan Weinstein (UC Berkeley).
Information: http://www.math.psu.edu/ping/IHP07/.

*18-19 **DIMACS Workshop on Information Security Economics**, DIMACS Center, CoRE Bldg, Rutgers University, Piscataway, New Jersey.
Description: The goal of this workshop is to expand the interest in economics of information security. Topics of interest include economics of identity and identity theft, liability, torts, negligence, other legal incentives, game theoretic models, security in open source and free software, cyber-insurance, disaster recovery, reputation economics, network effects in security and privacy, return on security investment, security risk management, security risk perception both of the firm and the individual, economics of trust, economics of vulnerabilities, economics of malicious code, economics of electronic voting security, and economic perspectives on spam.
Local Arrangements: Workshop Coordinator, DIMACS Center, workshop@dimacs.rutgers.edu, 732-445-5928.
Information: http://dimacs.rutgers.edu/Workshops/InformationSecurity/.

*22-26 **Geometric linearization of graphs and groups**, Centre Bernoulli, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland.
Topics: Embeddings of graphs, groups and metric spaces in Hilbert and Banach spaces, with applications.

This section contains announcements of meetings and conferences of interest to some segment of the mathematical public, including ad hoc, local, or regional meetings, and meetings and symposia devoted to specialized topics, as well as announcements of regularly scheduled meetings of national or international mathematical organizations. A complete list of meetings of the Society can be found on the last page of each issue.
An announcement will be published in the *Notices* if it contains a call for papers and specifies the place, date, subject (when applicable), and the speakers; a second announcement will be published only if there are changes or necessary additional information. Once an announcement has appeared, the event will be briefly noted in every third issue until it has been held and a reference will be given in parentheses to the month, year, and page of the issue in which the complete information appeared. Asterisks (*) mark those announcements containing new or revised information.
In general, announcements of meetings and conferences held in North America carry only the date, title of meeting, place of meeting, names of speakers (or sometimes a general statement on the program), deadlines for abstracts or contributed papers, and source of further information. Meetings held outside the North American area may carry more detailed information. In any case, if there is any application deadline with respect to participation in the meeting, this fact should be noted. All communications on meetings and conferences in the mathematical sciences should be sent to the Editor of the *Notices* in care of the American Mathematical Society in Providence or electronically to notices@ams.org or mathcal@ams.org.
In order to allow participants to arrange their travel plans, organizers of meetings are urged to submit information for these listings early enough to allow them to appear in more than one issue of the *Notices* prior to the meeting in question. To achieve this, listings should be received in Providence **eight months** prior to the scheduled date of the meeting.
The complete listing of the Mathematics Calendar will be published only in the September issue of the *Notices*. The March, June/July, and December issues will include, along with new announcements, references to any previously announced meetings and conferences occurring within the twelve-month period following the month of those issues. New information about meetings and conferences that will occur later than the twelve-month period will be announced once in full and will not be repeated until the date of the conference or meeting falls within the twelve-month period.
The Mathematics Calendar, as well as Meetings and Conferences of the AMS, is now available electronically through the AMS website on the World Wide Web. To access the AMS website, use the URL: http://www.ams.org/.

Speakers: Indira Chatterji (The Ohio State University); Alexander Dranishnikov (University of Florida); Cornelia Drutu (Université Lille I); Misha Gromov (IHES); Erik Guentner (University of Hawaii, Manoa); Nati Linial (The Hebrew University of Jerusalem); Jiri Matousek (The Charles University, Prague); Graham Niblo (University of Southampton); Yann Ollivier (ENS Lyon); Stratos Prassidis (Canisius College, New York); Mark Sapir (Vanderbilt University); Amin Shokrollahi (EPFL, Lausanne); Romain Tessera (Vanderbilt University); Jean-Philippe Vert (Ecole des Mines de Paris); Gerhard Wanner (Université de Genève); Guoliang Yu (Vanderbilt University)
Deadlines: For abstracts with application for fellowship travel grants: December 25, 2006. For regular abstracts: January 5, 2007. For registration: January 10, 2007
Information: http://bernoulli.epfl.ch/graphs/conf.html.

February 2007

*10-11 **14th Southern California Geometric Analysis Seminar**, University of California, San Diego, California.
Description: Graduate students, fresh Ph.D.s and minorities are especially welcome to join our annual seminar.
Funding: Partial financial support is available.
Information: http://www.math.ucsd.edu/~scgas/.

*15-16 **February Fourier Talks**, University of Maryland, College Park, Maryland.
Description: Each year the two-day February Fourier Talks, organized by the Norbert Wiener Center in the Department of Mathematics at the University of Maryland, College Park, feature a diverse array of invited talks in the field of Harmonic Analysis and Applications. A single track of presentations from top academic, industry, and government researchers is scheduled, allowing ample time for interaction with other participants.
Information: For updated details and registration information, please see the conference site at http://www.norbertwiener.umd.edu/FFT/.

*24 **Combinatexas'07: Combinatorics in the South Central U.S.**, Texas A&M University, College Station, Texas.
Program and Speakers: This one-day conference will focus on Algebraic Combinatorics and Algebraic Graph Theory.
Confirmed speakers: Ioana Dumitriu (University of Washington), Art Duval (University of Texas, El Paso), Miguel Mendez (Veneruelan Institute of Scientific Research), Douglas West (University of Illinois), Herbert Wilf (University of Pennsylvania).
Deadline: February 15, 2007. There is no registration fee for the conference.
Information: http://www.math.tamu.edu/~cyan/combinatexas/2007/.

March 2007

*10-13 **2007 ASL Annual Meeting**, University of Florida, Gainesville, Florida.
Invited Speakers: A. Blass, M. Benedikt, N. Dobrinen, N. Greenberg, D.R. Hirschfeldt, S. Kuhlmann, H. Leitgeb, WJ Mithcell, R. Zach and T. Wilke.
18th Annul Goedel Lecturer: E. Hrushovski.
Special Sessions: Computability Theory (N. Greenberg) Algebraic Model Theory (M. Aschenbrenner) Logic Research for Undergraduates (W. White) Connections of Set Theory with Boolean Algebras and Topology (M. Dzamonja and J. Larson).
Information: http://www.math.ufl.edu/~jal/logicyear/asl/.

*22-25 **Analysis on Homogeneous Spaces**, Tucson, Arizona.
Goal: The main goal of the conference is to to gather leading specialists from several different fields, which all relate to homogeneous spaces, to foster cross-disciplinary interaction, communicate recent advances and assist younger participants in devel oping successful research strategies. Women and minority participants are especially encouraged to apply.
Principal Speakers: Robert Bryant (Duke), Michael Gekhtman (Notre Dame), Simon Gindikin (Rutgers), Carolyn Gordon (Dartmouth), James Isenberg (Oregon), Michael Kapovich (UC Davis), Gestur Olafsson (Louisiana State), Nolan Wallach (UCSD).
Deadlines: Travel and accommodation support is available for advanced graduate students and young researchers without their own travel funds. Deadline for applications is January 10, 2007. Deadline for contributed talks is December 20, 2006.
Organizers: Philip Foth, David Glickenstein, and Kirti Joshi (University of Arizona).
Information: http://math.arizona.edu/~ahs/.

*26-29 **International Colloquium On Stochastic And Potential Analysis**, Abounawas hotel, Hammamet, Tunisia.
Main Topics: Stochastic Analysis-Potential Theory-Probability theory.
Invited Speakers: Albert Shiryaev (Moscow, Russia), Marta Sanz Solè (Barcelone, Spain), Tusheng Zheng (Manchester, U.K.), Wolfhard Hansen (Bielefeld, Germany), Youssef Ouknine (Marrakesh, Morroco), Henri Schurz (Southern Illinois-U.S.A.), Eckhard Platen (Sydney, Australia), Dominique Bakry (Toulouse, France), Lucian Beznea (Bucharest-Romania), Zhen-Qing Chen (Washington, U.S.A.), Klaus Janssen (Dusseldorf-Germany), Said Hamadene (Lemans, France).
Deadline: The deadline for registration is February 26, 2007.
Information: email: ibtissem_hdhiri@yahoo.fr.

April 2007

*9-13 **Geometry of Integrable Systems**, Hanoi University of Education, Hanoi, Vietnam.
Topics: Various notions of integrability; Local and global properties of integrable (non)Hamiltonian systems in finite and infinite dimension; Obstructions to integrability; Quantum integrable systems; Perturbations of integrable systems.
Speakers: (*) to be confirmed. Michèle Audin (Univ. of Strasbourg, France), Alexei Bolsinov (Loughborough Univ., UK), Francesco Calogero (Univ. "La Sapienza", Italy), Boris Dubrovin* (SISSA, Italy), Holger Dullin (Loughborough Univ., UK), Gregorio Falqui* (Univ. Milano, Italy), Jean-Pierre Françoise (Univ. Paris 6, France), Jarmo Hietarinta (Univ. of Turku, Finland), Thomas Kappeler (Univ. of Zurich, Switzerland), Yuji Kodama (Ohio State Univ., USA), Juan Morales (UP Barcelona, Spain), Peter Olver* (Univ. Minnesota, USA), Duong Hong Phong (Columbia Univ., USA), Jean-Pierre Ramis (Univ. of Toulouse, France), Jonathan Robbins (Univ. Bristol, UK), Tudor Ratiu (EPFL, Switzerland), San Vu-Ngoc (Univ. of Grenoble, France), Haruo Yoshida* (National Astronomical Obs., Japan). Visa information: Most foreigners need a visa to enter Vietnam, but it is very easy to obtain the visa in general. We will take care of it for you, or if you wish you can ask for a tourist visa by yourself.
Deadlines: In case you want us to take care of your hotel and visa, then we need your passport information before January 31, 2007.
Information: http://zung.zetamu.com/Vietnam2007.html. Registration: Please send an email to Nguyen Tien Zung (tienzung AT picard.ups-tlse.fr) if you are interested in the conference.

*10-13 **PADGE 2007, International Congress on Pure and Applied Differential Geometry**, Brussels, Belgium.
Organizer: K. U. Brussel, K. U. Leuven, EHSAL.
Information/Registration: http://www.cmmc.be/padge2007/.

*18-20 **DIMACS Workshop on Discrete Mathematical Problems in Computational Biomedicine**, DIMACS Center, CoRE Bldg, Rutgers University, Piscataway, New Jersey.
Short Description: How to process very large volumes of high-dimensional data and discover vital information contained in those data are among the most challenging issues in computational biomedicine. These data could be experimental data in protein structures, spatial-temporal data in medical imaging, and DNA

sequences in human genome database, to name just a few. Mathematical modeling and computer technologies are playing important roles in this investigation. We are particularly interested in discrete mathematical problems and modeling in high-dimensional data clustering algorithms, high-dimensional data mining techniques, and high-dimensional spatial-temporal data storage for fast information retrievals. This workshop provides a forum for researchers and practitioners to discuss new directions and identify open problems in the development and deployment of this area.
Organizers: Jie Wang, University of Massachusetts, wang@cs.uml.edu; Weili Wu, University of Texas, weiliwu@utdallas.edu.
Information: http://dimacs.rutgers.edu/Workshops/Biomedicine/.

*18-21 **2007 ASL Spring Meeting (with APA)**, Chicago, Illinois.
Program Committee: D. Leivant, L. Moss and W. Tait (Chair).
Abstract deadline: January 12, 2007.
Information: email: asl@vassar.edu.

*21-22 **Graduate Student Topology Conference**, University of Chicago, Chicago, Illinois.
Purpose: Of this conference is to gather graduate students in topology and provide them with the opportunity to give talks, communicate recent advances, exchange ideas, and meet other students in their field. The schedule will consist of keynote lectures by Ib Madsen (Aarhus) and Haynes Miller (MIT), and many student talks. Talks should be accessible to an audience of graduate students of varying levels and need not be about original research, but simply something the speaker enjoys and wishes to share. Some (NSF) funding will be available, but we encourage participants to ask their own departments for support.
Keynote Speakers: Ib Madsen (Aarhus) and Haynes Miller (MIT).
Deadlines: Registration will begin in December.
Funding: Please submit your registration by February 23, 2007, to be considered for funding.
Information: http://www.math.uchicago.edu/~gstc/.

May 2007

*14-18 **Conference on Cryptography and Digital Content Security**, Centre de Recerca Matemàtica, Barcelona, Spain.
Scientific Committee: Touradj Ebrahimi, Franck Leprévost.
Co-ordinators: Enric Nart, Jorge Luis Villar.
Speakers: Warusfel Bertrand, Alex Biryukov, Pascal Bouvry, Leonardo Chiariglione, Jean-Sébastien Coron, Ronald Cramer, Charles Delbrassine, Andrzej Drygajlo, Touradj Ebrahimi, Javier Espinosa Garcia, Arjen K. Lenstra, Franck Leprévost, Yannick Maret, Ueli Maurer, Carles Padró, François Thill, León Van der Torre, Sébastien Varrette, Bernd Weber, Pierre Zimmer.
Information: http://www.crm.cat/ContentSecurity.

*18-20 **Workshop on p-adic Methods and Rational Points**, Alfréd Rényi Institute of Mathematics, Budapest, Hungary.
Description: The Rényi Institute will host a focused workshop on the application of p-adic techniques to the study of rational points on varieties defined over finite, local or global fields. The aim is to present the latest developments in the area and to stimulate further research. Graduate students and postdocs interested in this rapidly developing field are also warmly welcome.
Speakers: Pierre Berthelot (Rennes), Amnon Besser (Be'er Sheva and Princeton), Antoine Chambert-Loir (Rennes), Bruno Chiarellotto (Padova), Kiran S. Kedlaya (Boston), Minhyong Kim (West Lafayette), Vadim Vologodsky (Chicago).
Information: http://www.renyi.hu/conferences/padic/.

*27-June 2 **Spring School on Analysis: Function Spaces, Inequalities and Interpolation**, Paseky nad Jizerou, Czech Republic.
Main speakers: Grahame Bennett, Björn Jawerth, Mario Milman.
Language: English.
Grants: Probably support for a limited number of students.
Deadlines: For reduced fee and support: February 15, 2007.
Information: email: pasejune@karlin.mff.cuni.cz; http://www.karlin.mff.cuni.cz/katedry/kma/ss/jun07/.

*28-June 2 **Advanced Course on Group-Based Cryptography**, Centre de Recerca Matemàtica, Barcelona, Spain.
Co-ordinator: Enric Ventura.
Speakers: Vladimir Shpilrain, City College of New York, Noncommutative Cryptography; Alexei Miasnikov, McGill University, Complexities of Algorithms.
Information: http://www.crm.cat/ACGroupBased.

*29-30 **DIMACS Workshop on Computational Methods for Predicting Outcome in Cancer**, DIMACS Center, CoRE Bldg, Rutgers University, Piscataway, New Jersey.
Short Description: The practice of medicine depends on the science of prediction. Prediction depends on clinical observations or laboratory variables or factors that are linked to outcome. These factors can be anatomic, histological, and/or molecular. Found in all specialties of medicine, predictive factors take on significant clinical meaning when treatment options are available, and they become more important if treatment options are limited and not always effective.
Purpose: The purpose of the workshop will be to consider new computational models for validating predictive factors and combining them into predictive systems. The workshop will bring together investigators and practitioners to exchange research ideas and interests, as well as to discuss new directions and identify open problems in the development and application of cancer predictive systems for personalized medicine.
Local Arrangements: Workshop Coordinator, DIMACS Center, workshop@dimacs.rutgers.edu, 732-445-5928.
Information: http://dimacs.rutgers.edu/Workshops/ComputationalMethods/.

June 2007

*4-15 **Moduli spaces of Riemann surfaces and related topics**, Centre de Recherches Mathematiques, Montreal, Canada.
Topics: Moduli spaces and Frobenius manifolds, Hurwitz spaces and Hurwitz numbers, Spaces of Abelian and quadratic differentials and billiards in polygons, Weil-Petersson geometry, Moduli spaces, Graph combinatorics and random matrices, Riemann-Hilbert problems, Determinants of Laplacians.
Invited Speakers: Igor Artamkin (Moscow), Indranil Biswas (Tata), Alexander Bobenko (Berlin), Leonid Chekhov (Steklov, Moscow), Boris Dubrovin (SISSA), Vladimir Fock (ITEP), Ian P. Goulden (Waterloo), Tamara Grava (SISSA), John Harnad (Concordia), Claus Hertling (Stuttgart), Jacques Hurtubise (McGill), Ilia Itenberg (Strasburg) David Jackson (Waterloo), Lisa Jeffrey (Toronto), Maxim Kazarian (Moscow), Christian Klein (MPG Leipzig), Alexey Kokotov (Montreal), Sergei K. Lando (Moscow), Marta Mazzocco (Manchester), Andrew McIntyre (CRM, Concordia), John McKay (Concordia), Todor Milanov (Stanford), Ian Morrisson (Fordham), Robert Penner (USC), Emma Previato (Boston U), Sergei Shadrin (Moscow and Paris), Mikhail Shapiro (Michigan State U), Vasilisa Shramchenko (Oxford), Ian Strachan (Glasgow), Leon Takhtajan (Stony Brook), Marc Troyanov (EPFL, Switzerland), Ravi Vakil (Stanford), Richard A. Wentworth (John Hopkins), Scott Wolpert (Michigan), Ken-Ichi Yoshikawa (Tokyo), Peter Zograf (St.Petersburg), Dimitri Zvonkine* (Jussieu, Paris)
Information: http://www.mathstat.concordia.ca/faculty/bertola/Conference/index.html.

*5-8 **Days on Diffraction-2007**, St. Petersburg, Russia.
Scope: Mathematical aspects of wave propagation, asymptotic techniques, electromagnetics: sound propagation and vibration, elastic waves and seismology, nonlinear waves, microwave and quantum waveguides, inverse problems, numerical approaches, non-stationary phenomena.

Deadlines: Session proposals abstract submissions: February 15, 2007. Notification of acceptance: March 15, 2007. Registration: April 1, 2007.
Information: http://math.nw.ru/DD/.

* 7-9 **Ordinal and Symbolic Data Analysis (OSDA) 2007**, Ghent University, Ghent, Belgium.
Call for Papers: This is a preliminary announcement. The first announcement, with a list of invited speakers and a call for contributed talks, will be mailed in November 2006.
Theme: The common theme of the conferences is motivated by the fact that ordinal and symbolic data occur quite frequently, but theoretical tools for handling such data still require further development.
Registration Fees: They should be limited to a small amount, about $150 including a get-together party (in the evening before the conference) and a banquet.
Information: email: thierry.marchant@ugent.be.

* 11-15 **Barcelona Conference on C*- Algebras and Their Invariants**, Centre de Recerca Matemàtica, Barcelona, Spain.
Co-ordinator: Francesc Perera.
Speakers: Bruce Blackadar, Nathanial P. Brown, Guillermo Cortiñas, Joachim Cuntz, Marius Dadarlat, Soren Eilers, Eberhard Kirchberg, Huaxin Lin, Christopher Phillips, Ian Putnam, Iain Raeburn, Andrew Toms, Wilhelm Winter.
Information: http://www.crm.cat/OAlgebras.

* 18-24 **Algebraic Topology: Old and New (M. M. Postnikov Memorial Conference)**, Stefan Banach International Mathematical Center (Bedlewo, Poland).
Plenary speakers: R. Cohen, M. Furuta, S. Galatius, S. Haller, K. Ono, V. Sharko, S. Stolz, P. Teichner.
Information: email: at2007pm@yahoo.co.uk; http://at2007pm.org/.

* 18-29 **Flow in Porous Media with Emphasis on Modeling Oil Reservoirs**, University of Wyoming, Laramie, Wyoming.
Description: Oil production and the factors involved in the process are of prime importance in today's world. The understanding and modeling of the physical and chemical processes are necessary to increase oil production. It is also a very difficult subject since oil reservoirs are very complex. Simulation of flow inside a porous medium involves dealing with several phases, multiple scales and heterogeneity. Among the topics to be covered are the physical and chemical properties of reservoirs, mathematical and numerical models of multiphase flow in porous media, and geostatistics and stochastic differential equations.
Main Speakers: Zhangxin Chen (Southern Methodist University), Martin Diaz (Instituto Mexicano del Petroleo), Malgorzata Peszynska (Oregon State University) and Mohammad Piri (University of Wyoming).
Deadline: For applications/abstracts of talks: April 1, 2007.
Information: B. Chen-Charpentier, Department of Mathematics, University of Wyoming, Laramie, Wyoming 82071; email: bchen@uwyo.edu; http://www.uwyo.edu/rmmc/.

* 25-29 **Conference on Enumeration and Probabilistic Methods in Combinatorics**, Centre de Recerca Matemàtica, Barcelona, Spain.
Co-ordinators: Marc Noy, Oriol Serra, and Dominic Welsh.
Speakers: Béla Bollobás, Josep Díaz Cort, Philippe Flajolet, Geoffrey Grimmett, Christian Krattenthaler, Tomasz Luczak, Colin McDiarmid, Angelika Steger, Andrew Thomason, Herbert Wilf, Peter Winkler, Nick Wormald.
Information: http://www.crm.cat/Enumeration.

* 25-30 **International Conference "Algebraic Analysis and Around"- in honor of Professor Masaki Kashiwara's 60th birthday**, Kyoto University, Kyoto, Japan.
Topics: Algebraic analysis (mirolocal analysis, representation theory, D-modules, crystal basis, applications to number theory and algebraic geometry)
Information:http://www.math.kyoto-u.ac.jp/alan2007/enter.html.

July 2007

* 2-6 **Des équations aux dérivées partielles au calcul scientifique: Congrès en l'honneur de Luc Tartar à l'occasion de son soixantième anniversaire**, Carré des Sciences, Ancienne Ecole Polytechnique, Paris, France.
Speakers: Giovanni Alberti (Università di Pisa), Abbas Bahri (Rutgers University), Yann Brenier (Université de Nice), Luis Caffarelli (University of Texas at Austin), Michael Crandall (University of California at Santa Barbara), Constantine Dafermos (Brown University), Maria Esteban (Université Paris Dauphine), Craig Evans (University of California at Berkeley), Nicola Fusco (Università di Napoli), Patrick Gérard (Université Paris Sud), Roland Glowinski (University of Houston), Peter Lax (New York University), Pierre-Louis Lions (Collège de France), Nader Masmoudi (New York University), Yves Meyer (Ecole Normale Supérieure de Cachan), Graeme Milton (University of Utah), Louis Nirenberg (New York University), Olivier Pironneau (Université Pierre et Marie Curie), Tristan Rivière (ETH Zürich), Evariste Sanchez-Palencia (Université Pierre et Marie Curie), Denis Serre (Ecole Normale Supérieure de Lyon), Didier Smets (Université Pierre et Marie Curie), Vsevolod Solonnikov (Steklov Institute & Università di Ferrara), Mete Soner (Koc University), Vladimir Sverak (University of Minnesota),
Information: http://www.cmap.polytechnique.fr/edp-cs/.

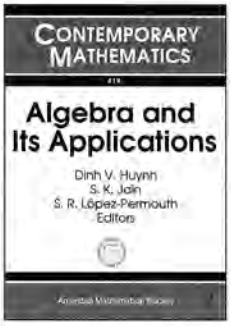
* 13-19 **1007 ASL European Summer Meeting (Logic Colloquium '07)**, Wroclaw, Poland.
Abstract Deadline: Contributed Papers: April 17, 2006.
Information: email: asl@vassar.edu.

December 2007

* 7-11 **Fourth Pacific Rim Conference on Mathematics: Celebrating the Tenth Anniversary of the Liu Bie Ju Centre for Mathematical Sciences**, City University of Hong Kong, Hong Kong.
Description: The Conference, which is open to all areas of mathematics, will have eight Focus Sessions. Each Focus Session will include a Plenary Speaker and several Invited Speakers. In addition, seven Plenary Speakers will give talks to celebrate the Tenth Anniversary of the Liu Bie Ju Centre for Mathematical Sciences, City University of Hong Kong.
Focus Sessions: Algebraic Geometry, Conformal Geometry, Heisenberg Geometry - Curve and Surface Theories, Homogenization and its Impact on Physics, Inverse Problems, Kinetic Equations and Fluid Dynamical Systems, Partial Differential Equations, Representation Theory and Group Theory.
Plenary Speakers: Jean-Pierre Bourguignon (Institut des Hautes Études Scientifiques), Philippe G. Ciarlet (City Univ. of Hong Kong), Hyeonbae Kang (Seoul National Univ.), Ta-Tsien Li (Fudan Univ.), Tai-Ping Liu (Stanford Univ.), Gaven Martin (Univ. of Auckland), Amnon Neeman (Australian National Univ.), Michael J.D. Powell (Univ. of Cambridge), Steve Smale (Toyota Technological Institute, Chicago), Seiji Ukai (City Univ. of Hong Kong), Muthusamy Vanninathan (Tata Institute of Fundamental Research), Roderick S.C. Wong (City Univ. of Hong Kong), Paul Yang (Princeton Univ.), Xiping Zhu (Zhongshan Univ.), Jiping Zhang (Peking Univ.).
Deadline: For submission of abstract of contributed papers: October 1, 2007.
Information: http://www6.cityu.edu.hk/rcms/PRCM4/. For enquiries, please e-mail to Ms Sophie Xie at MCLBJ@cityu.edu.hk. Note: Registration is compulsory.

New Publications Offered by the AMS

Algebra and Algebraic Geometry



Algebra and Its Applications

Dinh V. Huynh, S. K. Jain, and **S. R. López-Permouth,** *Ohio University, Athens, OH,* Editors

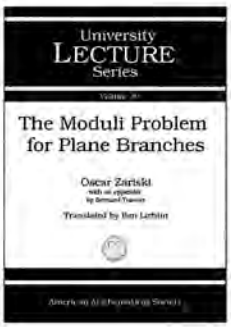
This volume consists of contributions by speakers at a Conference on Algebra and its Applications that took place in Athens, Ohio, in March of 2005. It provides a snapshot of the diversity of themes and applications that interest algebraists today. The papers in this volume include some of the latest results in the theory of modules, noncommutative rings, representation theory, matrix theory, linear algebra over noncommutative rings, cryptography, error-correcting codes over finite rings, and projective-geometry codes, as well as expository articles that will provide algebraists and other mathematicians, including graduate students, with an accessible introduction to areas outside their own expertise.

The book will serve both the specialist looking for the latest result and the novice seeking an accessible reference for some of the ideas and results presented here.

Contents: **A. N. Alahmadi, H. S. Al-Hazmi,** and **P. A. Guil Asensio,** On countably Σ-CS modules; **E. Babson, B. Huisgen-Zimmermann,** and **R. Thomas,** Moduli spaces of graded representations of finite dimensional algebras; **G. F. Birkenmeier, J. K. Park,** and **S. T. Rizvi,** An essential extension with nonisomorphic ring structures; **V. Camillo** and **S. Lima,** Supplemented principal ideals; **V. Camillo** and **J. J. Simón,** Some properties of rings reflected in infinite matrix rings; **R. M. Dimitrić,** Slender monoids; **J. Ding** and **D. Schmidt,** Multivariable public key crytosystems; **H. Q. Dinh,** Repeated-root constacyclic codes of length 2^s over $\mathbb{Z}_{2^a}$; **N. V. Dung,** Contravariant finiteness and pure semisimple rings; **A. Facchini,** A characterization of additive categories with the Krull-Schmidt property; **K. R. Goodearl,** A Dixmier-Moeglin equivalence for Poisson algebras with torus actions; **P. A. Guil Asensio** and **I. Herzog,** Pure-injectivity in the category of flat modules; **C. R. Johnson, A. L. Duarte, C. M. Saiago,** and **D. Sher,** Eigenvalues, multiplicities and graphs; **C. R. Johnson** and **R. L. Smith,** Closure of matrix classes under Schur complementation, including singularities; **T. Y. Lam** and **R. G. Swan,** Sums of alternating matrices and invertible matrices; **S. H. Mohamed,** Internal exchange rings; **D. Mundici,** Representations of σ-complete MV-algebras and their associated Dedekind σ-complete ℓ-groups; **B. L. Osofsky,** Noncommutative linear algebra; **C. Otto** and **M. Penkava,** The moduli space of three-dimensional Lie algebras; **E. R. Puczylowski,** Questions related to Koethe's nil ideal problem; **R. Smarandache** and **M. Wauer,** Bounds on the pseudo-weight of minimal pseudo-codewords of projective geometry codes; **G. Szeto** and **L. Xue,** On Galois extensions with automorphism group as Galois group; **M. Tocón,** A *-Litoff theorem for associative pairs; **J. Ding, D. Mundici, D. S. Passman, J. B. Srivastava,** and **L. Vaš,** Open problems.

Contemporary Mathematics, Volume 419

December 2006, 319 pages, Softcover, ISBN-10: 0-8218-3842-3, ISBN-13: 978-0-8218-3842-6, LC 2006049094, 2000 *Mathematics Subject Classification:* 15-XX, 16-XX, 94-XX, **All AMS members US$71,** List US$89, Order code CONM/419



The Moduli Problem for Plane Branches

Oscar Zariski
with an appendix by Bernard Teissier
Translated by Ben Lichtin

Moduli problems in algebraic geometry date back to Riemann's famous count of the $3g - 3$ parameters needed to determine a curve of genus g. In this book, Zariski studies the moduli space of curves of the same equisingularity class. After setting up and reviewing the basic material, Zariski devotes one chapter to the topology of the moduli space, including an explicit determination of the rare cases when the space is compact. Chapter V looks at specific examples where the dimension of the generic component can be determined through rather concrete methods. Zariski's last chapter concerns the application of deformation theory to the moduli problem, including the determination of the

dimension of the generic component for a particular family of curves.

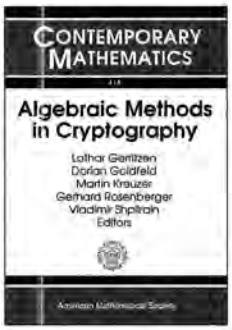
An appendix by Bernard Teissier reconsiders the moduli problem from the point of view of deformation theory. He gives new proofs of some of Zariski's results, as well as a natural construction of a compactification of the moduli space.

Contents: Preliminaries; Equisingularity invariants; Parametrizations; The moduli space; Examples; Applications of deformation theory; Bibliography; Appendix.

University Lecture Series, Volume 39

December 2006, 151 pages, Softcover, ISBN-10: 0-8218-2983-1, ISBN-13: 978-0-8218-2983-7, LC 2006049936, 2000 *Mathematics Subject Classification:* 14H20, **All AMS members US$28,** List US$35, Order code ULECT/39

Applications



Algebraic Methods in Cryptography

Lothar Gerritzen, *Ruhr-Universität Bochum, Germany,* **Dorian Goldfeld,** *Columbia University, New York, NY,* **Martin Kreuzer** and **Gerhard Rosenberger,** *Universität Dortmund, Germany,* and **Vladimir Shpilrain,** *The City College of New York, NY,* Editors

The book consists of contributions related mostly to public-key cryptography, including the design of new cryptographic primitives as well as cryptanalysis of previously suggested schemes. Most papers are original research papers in the area that can be loosely defined as "non-commutative cryptography"; this means that groups (or other algebraic structures) which are used as platforms are non-commutative.

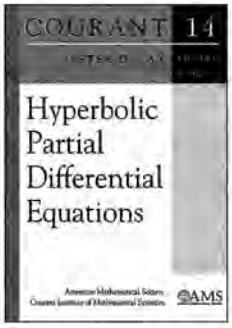
This item will also be of interest to those working in algebra and algebraic geometry.

Contents: **I. Anshel, M. Anshel, D. Goldfeld,** and **S. Lemieux,** Key agreement, the Algebraic Eraser^{TM}, and lightweight cryptography; **G. Baumslag, T. Camps, B. Fine, G. Rosenberger,** and **X. Xu,** Designing key transport protocols using combinatorial group theory; **A. Berenstein** and **L. Chernyak,** Geometric key establishment; **P. Dehornoy,** Using shifted conjugacy in braid-based cryptography; **D. Garber, S. Kaplan, M. Teicher, B. Tsaban,** and **U. Vishne,** Length-based conjugacy search in the braid group; **M. I. González Vasco, R. Steinwandt,** and **J. L. Villar,** Towards provable security for cryptographic constructions arising from combinatorial group theory; **D. Grigoriev** and **I. Ponomarenko,** Constructions in public-key cryptography over matrix groups; **A. Groch, D. Hofheinz,** and **R. Steinwandt,** A practical attack on the root problem in braid groups; **D. Hofheinz** and **D. Unruh,** An attack on a group-based cryptoraphic scheme; **N. G. Leander,** Algebraic problems in symmetric cryptography: Two recent results on highly nonlinear functions; **E. Lee,** Inverting the Burau and Lawrence-Krammer representations; **V. Shpilrain** and **A. Ushakov,** A new key exchange protocol based on the decomposition problem; **V. Shpilrain** and **G. Zapata,** Using the subgroup membership search problem in public key cryptography.

Contemporary Mathematics, Volume 418

December 2006, 178 pages, Softcover, ISBN-10: 0-8218-4037-1, ISBN-13: 978-0-8218-4037-5, LC 2006043028, 2000 *Mathematics Subject Classification:* 94A60, 20Fxx, 68P25, 68W20, 68W30, 11T71, 57M05, **All AMS members US$47,** List US$59, Order code CONM/418

Differential Equations



Hyperbolic Partial Differential Equations

Peter D. Lax, *New York University, Courant Institute, NY* with an appendix by Cathleen S. Morawetz

The theory of hyperbolic equations is a large subject, and its applications are many: fluid dynamics and aerodynamics, the theory of elasticity, optics, electromagnetic waves, direct and inverse scattering, and the general theory of relativity. This book is an introduction to most facets of the theory and is an ideal text for a second-year graduate course on the subject.

The first part deals with the basic theory: the relation of hyperbolicity to the finite propagation of signals, the concept and role of characteristic surfaces and rays, energy, and energy inequalities. The structure of solutions of equations with constant coefficients is explored with the help of the Fourier and Radon transforms. The existence of solutions of equations with variable coefficients with prescribed initial values is proved using energy inequalities. The propagation of singularities is studied with the help of progressing waves.

The second part describes finite difference approximations of hyperbolic equations, presents a streamlined version of the Lax-Phillips scattering theory, and covers basic concepts and results for hyperbolic systems of conservation laws, an active research area today.

Four brief appendices sketch topics that are important or amusing, such as Huygens' principle and a theory of mixed initial and boundary value problems. A fifth appendix by Cathleen Morawetz describes a nonstandard energy identity and its uses.

Titles in this series are copublished with the Courant Institute of Mathematical Sciences at New York University.

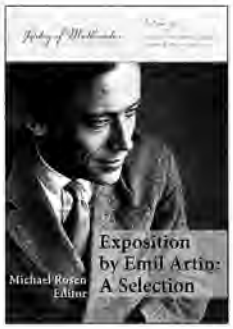
Contents: Basic notions; Finite speed of propagation of signals; Hyperbolic equations with constant coefficients; Hyperbolic equations with variable coefficients; Pseudodifferential operators and energy inequalities; Existence of solutions; Waves and rays; Finite difference approximation to hyperbolic equations; Scattering theory; Hyperbolic systems of conservation laws; Huygens' principle for the wave equation on odd-dimensional spheres; Hyperbolic polynomials; The multiplicity of eigenvalues;

Mixed initial and boundary value problems; Energy decay for star-shaped obstacles.

Courant Lecture Notes, Volume 14

January 2007, 217 pages, Softcover, ISBN-10: 0-8218-3576-9, ISBN-13: 978-0-8218-3576-0, LC 2006050151, 2000 *Mathematics Subject Classification:* 35L05, 35L10, 35L15, 35L20, 35L25, 35L30, 35L35, 35L40, 35L45, 35L50, 35L55, 35L60, 35L65, 35L67, 35P25, **All AMS members US$26**, List US$33, Order code CLN/14

General and Interdisciplinary



Exposition by Emil Artin: A Selection

Michael Rosen, *Brown University, Providence, RI*, Editor

Emil Artin was one of the great mathematicians of the twentieth century. He had the rare distinction of having solved two of the famous problems posed by David Hilbert in 1900. He showed that every positive definite rational function of several variables was a sum of squares. He also discovered and proved the Artin reciprocity law, the culmination of over a century and a half of progress in algebraic number theory.

Artin had a great influence on the development of mathematics in his time, both by means of his many contributions to research and by the high level and excellence of his teaching and expository writing. In this volume we gather together in one place a selection of his writings wherein the reader can learn some beautiful mathematics as seen through the eyes of a true master.

The volume's Introduction provides a short biographical sketch of Emil Artin, followed by an introduction to the books and papers included in the volume. The reader will first find three of Artin's short books, titled *The Gamma Function, Galois Theory*, and *Theory of Algebraic Numbers*, respectively. These are followed by papers on algebra, algebraic number theory, real fields, braid groups, and complex and functional analysis. The three papers on real fields have been translated into English for the first time.

The flavor of these works is best captured by the following quote of Richard Brauer. "There are a number of books and sets of lecture notes by Emil Artin. Each of them presents a novel approach. There are always new ideas and new results. It was a compulsion for him to present each argument in its purest form, to replace computation by conceptual arguments, to strip the theory of unnecessary ballast. What was the decisive point for him was to show the beauty of the subject to the reader."

This item will also be of interest to those working in number theory.

Copublished with the London Mathematical Society beginning with Volume 4. Members of the LMS may order directly from the AMS at the AMS member price. The LMS is registered with the Charity Commissioners.

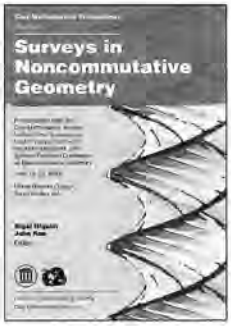
Contents: M. Rosen, Introduction; *Books by Emil Artin:* **E. Artin**, The Gamma Function; **E. Artin**, Galois Theory; **E. Artin**, Theory of Algebraic Numbers; *Papers by Emil Artin:* **E. Artin** and **G. Whaples**, Axiomatic characterization of fields by the product formula for valuations; **E. Artin** and **G. Whaples**, A note on axiomatic characterization of fields; **E. Artin**, A characterization of the field of real algebraic numbers; **E. Artin** and **O. Schreier**, The algebraic construction of real fields; **E. Artin** and **O. Schreier**, A characterization of real closed fields; **E. Artin**, The theory of braids; **E. Artin**, Theory of braids; **E. Artin**, On the theory of complex functions; **E. Artin**, A proof of the Krein-Milman theorem; **E. Artin**, The influence of J. H. M. Wedderburn on the development of modern algebra.

History of Mathematics, Volume 30

December 2006, approximately 343 pages, Softcover, ISBN-10: 0-8218-4172-6, ISBN-13: 978-0-8218-4172-3, 2000 *Mathematics Subject Classification:* 01A75, 11-06, **All AMS members US$47**, List US$59, Order code HMATH/30

Geometry and Topology

COURSE ADOPTION



Surveys in Noncommutative Geometry

Nigel Higson and **John Roe**, *Pennsylvania State University, University Park, PA*, Editors

In June 2000, the Clay Mathematics Institute organized an Instructional Symposium on Noncommutative Geometry in conjunction with the AMS-IMS-SIAM Joint Summer Research Conference. These events were held at Mount Holyoke College in Massachusetts from June 18 to 29, 2000. The Instructional Symposium consisted of several series of expository lectures which were intended to introduce key topics in noncommutative geometry to mathematicians unfamiliar with the subject. Those expository lectures have been edited and are reproduced in this volume.

The lectures of Rosenberg and Weinberger discuss various applications of noncommutative geometry to problems in "ordinary" geometry and topology. The lectures of Lagarias and Tretkoff discuss the Riemann hypothesis and the possible application of the methods of noncommutative geometry in number theory. Higson gives an account of the "residue index theorem" of Connes and Moscovici.

Noncommutative geometry is to an unusual extent the creation of a single mathematician, Alain Connes. The present volume gives an extended introduction to several aspects of Connes' work in this fascinating area.

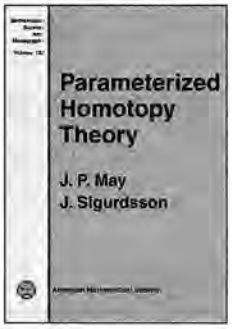
This item will also be of interest to those working in mathematical physics.

Titles in this series are copublished with the Clay Mathematics Institute (Cambridge, MA).

Contents: **J. Rosenberg**, A minicourse on applications of non-commutative geometry to topology; **S. S. Chang** and **S. Weinberger**, On Novikov-type conjectures; **N. Higson**, The residue index theorem of Connes and Moscovici; **J. C. Lagarias**, The Riemann hypothesis: Arithmetic and geometry; **P. Tretkoff**, Noncommutative geometry and number theory.

Clay Mathematics Proceedings, Volume 6

November 2006, 189 pages, Softcover, ISBN-10: 0-8218-3846-6, ISBN-13: 978-0-8218-3846-4, LC 2006049865, 2000 *Mathematics Subject Classification:* 46L80, 46L89, 58B34, **All AMS members US$39**, List US$49, Order code CMIP/6



Parametrized Homotopy Theory

J. P. May, *The University of Chicago, IL*, and **J. Sigurdsson**, *University of Sheffield, England*

This book develops rigorous foundations for parametrized homotopy theory, which is the algebraic topology of spaces and spectra that are continuously parametrized by the points of a base space. It also begins the systematic study of parametrized homology and cohomology theories.

The parametrized world provides the natural home for many classical notions and results, such as orientation theory, the Thom isomorphism, Atiyah and Poincaré duality, transfer maps, the Adams and Wirthmüller isomorphisms, and the Serre and Eilenberg–Moore spectral sequences. But in addition to providing a clearer conceptual outlook on these classical notions, it also provides powerful methods to study new phenomena, such as twisted K-theory, and to make new constructions, such as iterated Thom spectra.

Duality theory in the parametrized setting is particularly illuminating and comes in two flavors. One allows the construction and analysis of transfer maps, and a quite different one relates parametrized homology to parametrized cohomology. The latter is based formally on a new theory of duality in symmetric bicategories that is of considerable independent interest.

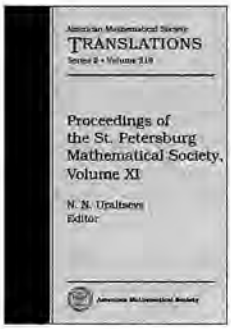
The text brings together many recent developments in homotopy theory. It provides a highly structured theory of parametrized spectra, and it extends parametrized homotopy theory to the equivariant setting. The theory of topological model categories is given a more thorough treatment than is available in the literature. This is used, together with an interesting blend of classical methods, to resolve basic foundational problems that have no nonparametrized counterparts.

Contents: Prologue; *Point-set topology, change functors, and proper actions:* Introduction to Part I; The point-set topology of parametrized spaces; Change functors and compatibility relations; Proper actions, equivariant bundles and fibrations; *Model categories and parametrized spaces:* Introduction to Part II; Topologically bicomplete model categories; Well-grounded topological model categories; The qf-model structure on $\mathcal{K}_B$; Equivariant qf-type model structures; Ex-fibrations and ex-quasifibrations; The equivalence between $\mathrm{Ho}G\mathcal{K}_B$ and $hG\mathcal{W}_B$; *Parametrized equivariant stable homotopy theory:* Introduction to Part III; Enriched categories and G-categories; The category of orthogonal G-spectra over B; Model structures for parametrized G-spectra; Adjunctions and compatibility relations; Module categories, change of universe, and change of groups; *Parametrized duality theory:* Introduction to Part IV; Fiberwise duality and transfer maps; Closed symmetric bicategories; The closed symmetric bicategory of parametrized spectra; Costenoble-Waner duality; Fiberwise Costenoble-Waner duality; *Homology and cohomology, Thom spectra, and addenda:* Introduction to Part V; Parametrized homology and cohomology theories; Equivariant parametrized homology and cohomology; Twisted theories and spectral sequences; Parametrized FSP's and generalized Thom spectra; Epilogue: Cellular philosophy and alternative approaches; Bibliography; Index; Index of notation.

Mathematical Surveys and Monographs, Volume 132

December 2006, 441 pages, Hardcover, ISBN-10: 0-8218-3922-5, ISBN-13: 978-0-8218-3922-5, LC 2006049935, 2000 *Mathematics Subject Classification:* 19D99, 55N20, 55P42; 19L99, 55N22, 55T25, **All AMS members US$79**, List US$99, Order code SURV/132

Number Theory



Proceedings of the St. Petersburg Mathematical Society, Volume XI

N. N. Uraltseva, *St. Petersburg State University, Russia*, Editor

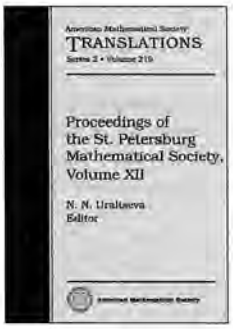
This and the next volume in the series (see TRANS2/219) consist of articles written on the occasion of the 60th birthday anniversary of the well-known St. Petersburg specialist in number theory Sergey Vostokov. Among the authors are many students and colleagues of Vostokov. The articles are devoted to topics in number theory that are close to Vostokov's scientific interests.

The book is suitable for graduate students and researchers interested in number theory.

Contents: **M. V. Bondarko**, Explicit classification of formal groups over complete discrete valuation fields with imperfect residue field; **S. O. Gorchinskiĭ** and **A. N. Parshin**, Adelic Lefschetz formula for the action of a one-dimensional torus; **I. B. Zhukov**, Singularities of arcs and cyclic coverings of surfaces; **Yu. G. Zarhin**, Del Pezzo surfaces of degree 2 and Jacobians without complex multiplication; **N. A. Karpenko**, A relation between higher Witt indices; **Ph. Cassou-Noguès**, **B. Erez**, and **M. J. Taylor**, On Fröhlich twisted bundles; **S. Koyama** and **N. Kurokawa**, Multiple Euler products; **Yu. Mehlig** and **E.-W. Zink**, Invariants of micro primes for p-adic fields.

American Mathematical Society Translations—Series 2, Volume 218

November 2006, approximately 182 pages, Hardcover, ISBN-10: 0-8218-4204-8, ISBN-13: 978-0-8218-4204-1, 2000 *Mathematics Subject Classification:* 11-06, **All AMS members US$68**, List US$85, Order code TRANS2/218



Proceedings of the St. Petersburg Mathematical Society, Volume XII

N. N. Uraltseva, *St. Petersburg State University, Russia*, Editor

This and the previous volume in the series (see TRANS2/218) consist of articles written on the occasion of the 60th birthday anniversary of the well-known St. Petersburg specialist in number theory Sergey Vostokov. Among the authors are many students and colleagues of Vostokov. The articles are devoted to topics in number theory that are close to Vostokov's scientific interests.

The book is suitable for graduate students and researchers interested in number theory.

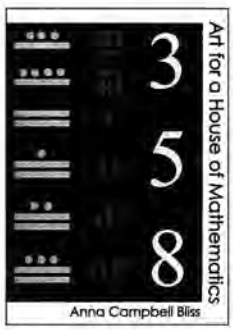
Contents: T. Fukaya and **K. Kato**, A formulation of conjectures on p-adic zeta functions in noncommutative Iwasawa theory; **B. Eick** and **H. Koch**, On maximal 2-extensions of $\mathbb{Q}$ with given ramification; **A. Merkurjev**, On the norm residue homomorphism of degree two; **A. Suslin**, SK_1 of division algebras and Galois cohomology revisited; **I. Fesenko**, Measure, integration and elements of harmonic analysis on generalized loop spaces.

American Mathematical Society Translations—Series 2, Volume 219

November 2006, approximately 165 pages, Hardcover, ISBN-10: 0-8218-4205-6, ISBN-13: 978-0-8218-4205-8, 2000 *Mathematics Subject Classification:* 11-06, **All AMS members US$63**, List US$79, Order code TRANS2/219

New AMS-Distributed Publications

General and Interdisciplinary



Art for a House of Mathematics

Anna Campbell Bliss, *Bliss Studio Publications, Salt Lake City, UT*

The book, like the mural it describes, develops structural connections with the arts, sciences, and culture while conveying the range and beauty of mathematics.

A publication of Bliss Studio Publications. Distributed non-exclusively worldwide by the American Mathematical Society.

August 2006, 53 pages, Softcover, ISBN-10: 0-9754915-1-2, ISBN-13: 978-0-9754915-1-5, 2000 *Mathematics Subject Classification:* 00-XX, List US$10, Order code AHM

Proceedings of the International Congress of Mathematicians, Madrid 2006

Marta Sanz-Solé and **Javier Soria**, *University of Barcelona, Spain*, **Juan Luis Varona**, *University of La Rioja, Logroño, Spain*, and **Joan Verdera**, *University Autònoma, Barcelona, Spain*, Editors

The International Congress of Mathematicians (ICM) is held every four years. It is a major scientific event, bringing together mathematicians from all over the world and demonstrating the vital role that mathematics play in our society. In particular, the Fields Medals are awarded to recognize outstanding mathematical achievement. At the same time, the International Mathematical Union awards the Nevanlinna Prize for work in the field of theoretical computer science.

The proceedings of ICM 2006, published as a three-volume set, present an overview of current research in all areas of mathematics and provide a permanent record the congress. The first volume features the works of Fields Medallists and the Nevanlinna Prize winner, the plenary lectures, and the speeches and pictures of the opening and closing ceremonies and award sessions. The other two volumes present the invited lectures, arranged according to their mathematical subject.

A publication of the European Mathematical Society (EMS). Distributed within the Americas by the American Mathematical Society.

Contents: Volume I: Contents to be announced later. Volume II: *Logic and foundations:* **R. Downey**, Algorithmic randomness and computability; **I. Neeman**, Determinacy and large cardinals; **M. Rathjen**, The art of ordinal analysis; **T. Scanlon**, Analytic difference rings; **S. Thomas**, Borel superrigidity and the classification problem for the torsion-free abelian groups of finite rank; *Algebra:* **W. Crawley-Boevey**, Quiver algebras, weighted projective lines, and the Deligne–Simpson problem; **M. du Sautoy** and **F. Grunewald**, Zeta functions of groups and rings; **B. Keller**, On differential graded categories; **R. Rouquier**, Derived equivalences and finite dimensional algebras; **M. Sapir**, Algorithmic and asymptotic properties of groups; **A. Seress**, A unified approach to computations with permutation and matrix groups; **A. Smoktunowicz**, Some results in noncommutative ring theory; *Number theory:* **M. Bhargava**, Higher composition laws and applications; **C.-L. Chai**, Hecke orbits as Shimura varieties in positive characteristic; **H. Darmon**, Heegner points, Stark-Heegner points and values of L-series; **K. Fujiwara**, Galois deformations and arithmetic geometry of

Shimura varieties; **B. Green**, Generalising the Hardy–Littlewood method for primes; **G. Laumon**, Aspects géométriques du Lemme Fondamental de Langlands-Shelstad; **P. Michel** and **A. Venkatesh**, Equidistribution, L-functions and ergodic theory: on some problems of Yu. Linnik; **W. Nizioł**, p-adic motivic cohomology in arithmetic; **C. Skinner** and **E. Urban**, Vanishing of L-functions and ranks of Selmer groups; **V. Vatsal**, Special values of L-functions modulo p; *Algebraic and complex geometry:* **V. Alexeev**, Higher-dimensional analogues of stable curves; **J.-B. Bost**, Evaluation maps, slopes, and algebraicity criteria; **T. Bridgeland**, Derived categories of coherent sheaves; **L. Ein** and **M. Mustaţă**, Invariants of singularities of pairs; **T. Graber**, Rational curves and rational points; **J.-M. Hwang**, Rigidity of rational homogeneous spaces; **T. Terasoma**, Geometry of multiple zeta values; **Y. Tschinkel**, Geometry over nonclosed fields; **J. Włodarczyk**, Algebraic Morse theory and the weak factorization theorem; *Geometry:* **C. Böhm** and **B. Wilking**, Manifolds with positive curvature operators are space forms; **S. Brendle**, Elliptic and parabolic problems in conformal geometry; **K. Honda**, The topology and geometry of contact structures in dimension three; **M. Kapovich**, Generalized triangle inequalities and their applications; **B. Kleiner**, The asymptotic geometry of negatively curved spaces: uniformization, geometrization and rigidity; **F. Lalonde**, Lagrangian submanifolds: from the local model to the cluster complex; **X. Liu**, Gromov–Witten invariants and moduli spaces of curves; **T. Mabuchi**, Extremal metrics and stabilities on polarized manifolds; **G. Mikhalkin**, Tropical geometry and its applications; **W. P. Minicozzi II**, Embedded minimal surfaces; **Y.-G. Oh** and **K. Fukaya**, Floer homology in symplectic geometry and in mirror symmetry; **A. Ros**, Properly embedded minimal surfaces with finite topology; **C.-L. Terng**, Applications of loop group factorization to geometric soliton equations; *Topology:* **I. Agol**, Finiteness of arithmetic Kleinian reflection groups; **M. R. Bridson**, Non-positive curvature and complexity for finitely presented groups; **M. Khovanov**, Link homology and categorification; **Y. N. Minsky**, Curve complexes, surfaces and 3-manifolds; **F. Morel**, $\mathbb{A}^1$-algebraic topology; **K. Ono**, Development in symplectic Floer theory; **P. Ozváth** and **Z. Szabó**, Heegaard diagrams and Floer homology; **K. Vogtmann**, The cohomology of automorphism groups of free groups; *Lie groups and Lie algebras:* **R. Bezrukavnikov**, Noncommutative counterparts of the Springer resolution; **A. Braverman**, Spaces of quasi-maps into the flag varieties and their applications; **G. Henniart**, On the local Langlands and Jacquet–Langlands correspondences; **N. Monod**, An invitation to bounded cohomology; **B.-C. Ngô**, Fibration de Hitchin et structure endoscopique de la formule des traces; **E. M. Opdam**, Hecke algebras and harmonic analysis; **P. Schneider**, Continuous representation theory of p-adic Lie groups; **Y. Shalom**, The algebraization of Kazhdan's property (T); **D. Soudry**, Rankin–Selberg integrals, the descent method, and Langlands functorality; **B. Speh**, Representation theory and the cohomology of arithmetic groups; **T. A. Springer**, Some results on compactifications of semisimple groups; *Analysis:* **M. Bonk**, Quasiconformal geometry of fractals; **S. Hofmann**, Local Tb theorems and applications in PDE; **S. V. Konyagin**, Almost everywhere convergence and divergence of Fourier series; **L. P. Rothschild**, Iterated Segre mappings of real submanifolds in complex space and applications; **S. Smirnov**, Towards conformal invariance of 2D lattice models; **E. J. Straube**, Aspects of the L^2-Sobolev theory of the $\overline{\partial}$-Neumann problem; **V. N. Temlyakov**, Greedy approximations with regard to bases; **X. Tolsa**, Analytic capacity, rectifiability, and the Cauchy integral; *Operator algebras and functional analysis:* **F. Barthe**, The Brunn–Minkowski theorem and related geometric and functional inequalities; **B. Klartag**, Isomorphic and almost-isometric problems in high-dimensional convex geometry; **N. Ozawa**, Amenable actions and applications; **M. Rørdam**, Structure and classification of C^*-algebras; **S. J. Szarek**, Convexity, complexity, and high dimensions; **G. Yu**, Higher index theory of elliptic operators and geometry of groups; *Ordinary differential equations and dynamical systems:* **O. N. Ageev**, On spectral invariants in modern ergodic theory; **V. Bergelson**, Ergodic Ramsey theory: a dynamical approach to static theorems; **N. Chernov** and **D. Dolgopyat**, Hyperbolic billiards and statistical physics; **R. de la Llave**, Some recent progress in geometric methods in the instability problem in Hamiltonian mechanics; **M. Einsiedler** and **E. Lindenstrauss**, Diagonalizable flows on locally homogeneous spaces and number theory; Author index; **Volume III:** *Ordinary differential equations and dynamical systems (continued):* **R. Ghrist**, Braids and differential equations; **A. Gorodetski**, **B. Hunt**, and **V. Kaloshin**, Newton interpolation polynomials, discretization method, and certain prevalent properties in dynamical systems; **B. Kra**, From combinatorics to ergodic theory and back again; **P. Le Calvez**, From Brouwer theory to the study of homeomorphisms of surfaces; **M. Shub**, All, most, some differentiable dynamical systems; **A. Zorich**, Geodesics on flat surfaces; *Partial differential equations:* **S. Bianchini**, Asymptotic behavior of smooth solutions for partially dissipative hyperbolic systems and relaxation approximation; **P. Gérard**, Nonlinear Schrödinger equations in inhomogeneous media: wellposedness and illposedness of the Cauchy problem; **F. Golse**, The periodic Lorentz gas in the Boltzmann-Grad limit; **M. J. Gursky**, Conformal invariants and nonlinear elliptic equations; **H. Ishii**, Asymptotic solutions for large time of Hamilton–Jacobi equations; **M. Pulvirenti**, The weak-coupling limit of large classical and quantum systems; **O. Savin**, Symmetry of entire solutions for a class of semilinear elliptic equations; **S. Serfaty**, Vortices in the Ginzburg–Landau model of superconductivity; **N. S. Trudinger**, Recent developments in elliptic partial differential equations of Monge–Ampère type; **L. Vega**, The initial value problem for nonlinear Schrödinger equations; **J. J. L. Velázquez**, Singular solutions of partial differential equations modelling chemotactic aggregation; *Mathematical physics:* **A. S. Cattaneo**, From topological field theory to deformation quantization and reduction; **B. Derrida**, Matrix ansatz and large deviations of the density in exclusion processes; **J.-M. Maillet**, Correlation functions of the XXZ Heisenberg spin chain: Bethe anastz approach; **M. Mariño**, Gromov–Witten invariants and topological strings: a progress report; **I. Rodnianski**, The Cauchy problem in general relativity; **C. Schweigert**, **J. Fuchs**, and **I. Runkel**, Categorification and correlation functions in conformal field theory; **A. Soffer**, Soliton dynamics and scattering; **C. Villani**, Hypocoercive diffusion operators; *Probability and statistics:* **A. Bovier**, Metastability: a potential theoretic approach; **R. Cerf**, On Ising droplets; **A. Dembo**, Simple random covering, disconnection, late and favorite points; **P. Donnelly**, Modelling genes: mathematical and statistical challenges in genomics; **K. D. Elworthy** and **X.-M. Li**, Geometric stochastic analysis on path spaces; **J. Fan** and **R. Li**, Statistical challenges with high dimensionality: feature selection in knowledge discovery; **A. Guionnet**, Random matrices and enumeration of maps; **S. P. Lalley**, The weak/strong survival transition on trees and nonamenable graphs; **Y. Le Jan**, New developments in stochastic dynamics; **P. McCullagh** and **J. Yang**, Stochastic classification models; **A. Okounkov**, Random partitions and instanton counting; **D. Picard** and **G. Kerkyacharian**, Estimation in inverse problems and second-generation wavelets; **W. Werner**, Conformal restriction properties; *Combinatorics:* **A. Barvinok**, The complexity of generating functions for integer points in polyhedra and beyond; **M. Bousquet-Mélou**, Rational and algebraic series in combinatorial enumeration;

J. Geelen, **B. Gerards**, and **G. Whittle**, Towards a structure theory for matrices and matroids; **M. Haiman**, Cherednik algebras, Macdonald polynomials and combinatorics; **J. H. Kim**, Poisson cloning model for random graphs; **T. Łuczak**, Randomness and regularity; **I. Z. Ruzsa**, Additive combinatorics and geometry of numbers; **F. Santos**, Geometric bistellar flips: the setting, the context and a construction; **R. Thomas**, A survey of Pfaffian orientations of graphs; *Mathematical aspects of computer science:* **M. Agrawal**, Determinant versus permanent; **A. S. Holevo**, The additivity problem in quantum information theory; **J. Kleinberg**, Complex networks and decentralized search algorithms; **O. Reingold**, On expander graphs and connectivity in small space; **T. Roughgarden**, Potential functions and the inefficiency of equilibria; **R. Rubinfeld**, Sublinear time algorithms; **L. Trevisan**, Pseudorandomness and combinatorial constructions; *Numerical analysis and scientific computing:* **P. Bochev** and **M. Gunzburger**, Least-squares finite element methods; **Z. Chen**, A posteriori error analysis and adaptive methods for partial differential equations; **R. G. Durán**, Error estimates for anisotropic finite elements and applications; **N. Dyn**, Linear subdivision schemes for the refinement of geometric objects; **R. J. LeVeque**, Wave propagation software, computational science, and reproducible research; **Y. Maday**, Reduced basis method for the rapid and reliable solution of partial differential equations; **E. Süli**, Finite element algorithms for transport-diffusion problems: stability, adaptivity, tractability; *Control theory and optimization:* **V. S. Borkar**, Ergodic control of diffusion processes; **S. Boyd**, Convex optimization of graph Laplacian eigenvalues; **O. Y. Emanouilov (Imanuvilov)**, Controllability of evolution equations of fluid dynamics; **A. van der Schaft**, Port-Hamiltonian systems: an introductory survey; **O. J. Staffans**, Passive linear discrete time-invariant systems; **E. Zuazua**, Control and numerical approximation of the wave and heat equations; *Application of mathematics in the sciences:* **R. E. Caflisch**, Multiscale modeling for epitaxial growth; **E. J. Candès**, Compressive sampling; **V. Caselles**, Total variation based image denoising and restoration; **M. Griebel** and **J. Hamaekers**, A wavelet based sparse grid method for the electronic Schrödinger equation; **C. Le Bris**, Mathematical and numerical analysis for molecular simulation: accomplishments and challenges; **M. A. Nowak**, Evolutionary dynamics of cooperation; **D. Nualart**, Fractional Brownian motion: stochastic calculus and applications; **A. Szepessy**, Atomistic and continuum models for phase change dynamics; *Mathematics education and popularization of mathematics:* **P. S. Kenderov**, Competitions and mathematics education; **A. Siegel**, Understanding and misunderstanding the Third International Mathematics and Science Study: what is at stake and why K–12 education studies matter; **I. Stewart**, Mathematics, the media, and the public; **M. Artigue**, **E. de Shalit**, and **A. Ralston**, Panel A: Controversial issues in K–12 mathematical education; **L. P. Yee**, **J. de Lange**, and **W. Schmidt**, Panel B: What are PISA and TIMSS? What do they tell us?; **Fr. Nebres**, **S.-Y. Cheng**, **K. Osterwalder**, and **H.-H. Wu**, Panel C: The role of mathematicians in K–12 mathematics education; *History of mathematics:* **L. Corry**, On the origins of Hilbert's sixth problem: physics and the empiricist approach to axiomatization; **N. Guicciardini**, Method versus calculus in Newton's criticisms of Descartes and Leibniz; *Special activity:* **S. X. Descamps**, **H. Bass**, **G. B. Evia**, **R. Seiler**, and **M. Seppälä**, e-learning mathematics; Author index.

February 2007, 4500 pages, Hardcover, ISBN-10: 3-03719-022-1, ISBN-13: 978-3-03719-022-7, 2000 *Mathematics Subject Classification:* 00Bxx, **All AMS members US$342**, List US$428, Order code PICM/2006

Classified Advertisements

Positions available, items for sale, services available, and more

CALIFORNIA

CALIFORNIA STATE UNIVERSITY, LOS ANGELES
Department of Mathematics and Department of Biological Sciences

Applications are invited for a tenured or tenure-track joint position in mathematics and biological sciences at the level of assistant, associate or full professor (rank commensurate with experience), starting September 2007. Candidates must have a strong background in applied mathematics, bioinformatics, or computational biology. Ability to teach a range of undergraduate and graduate (M.S.) courses in mathematics and biology relevant to the candidate's experience is essential. Publications in peer reviewed journals and/or grant activity is required. Applicants with relevant academic/industrial postdoctoral research experience and those who can involve undergraduate and graduate students in their research will be given preference. Send letter of application, vita, three letters of recommendation and official transcript from institution awarding doctorate to Dr. P. K. Subramanian, Chair, Department of Mathematics, California State University at Los Angeles, 5151 State University Drive, Los Angeles, CA 90032. An Equal Opportunity, Title IX, Disabled Employer.

000003

DISTRICT OF COLUMBIA

GEORGE WASHINGTON UNIVERSITY

In an effort to increase its research stature and expand its undergraduate and doctoral programs, the Mathematics Department of The George Washington University is recruiting a tenure-track associate professor in either applied mathematics or probability. The successful applicant is expected to teach at all undergraduate and graduate levels, excel in research, interact with researchers in mathematics or other disciplines, and become actively involved in the life of the department and the university. Basic Qualifications: Applicants must possess a Ph.D., excellent teaching credentials as demonstrated by your teaching approach and either teaching evaluations or letters from peers or supervisors, a record of excellent research as demonstrated by publications in research journals, the potential for leadership as demonstrated in your letters of recommendation. Preferred Qualifications: Preference will be given those applicants with prior research funding. For those applicants in applied mathematics, preference will be shown those applicants with experience in computing. To Apply: Send a brief cover letter, CV, synopsis of your research plans (not to exceed three pages), and evidence of good teaching (which should include an overview of your teaching approach) to: Professor John B. Conway, Associate Professor Search, Mathematics, Old Main, 1922 F Street NW, Washington, DC 20052. Also arrange to have at least three letters of recommendation sent to the same address or to mathsrch@gwu.edu. Only complete applications will be considered. Review of applications will begin on January 1, 2007, and will continue until the position is filled. The George Washington University is an Equal Opportunity/Affirmative Action Employer and seeks to attract culturally diverse faculty of the highest caliber.

000013

GEORGE WASHINGTON UNIVERSITY

In an effort to increase its research stature and expand its undergraduate and doctoral programs, the Mathematics Department of The George Washington University is recruiting a tenure-track assistant

---

Suggested uses for classified advertising are positions available, books or lecture notes for sale, books being sought, exchange or rental of houses, and typing services.

The 2007 rate is $100 per inch or fraction thereof on a single column (one-inch minimum), calculated from top of headline. Any fractional text of 1/2 inch or more will be charged at the next inch rate. No discounts for multiple ads or the same ad in consecutive issues. For an additional $10 charge, announcements can be placed anonymously. Correspondence will be forwarded.

Advertisements in the "Positions Available" classified section will be set with a minimum one-line headline, consisting of the institution name above body copy, unless additional headline copy is specified by the advertiser. Headlines will be centered in boldface at no extra charge. Ads will appear in the language in which they are submitted.

There are no member discounts for classified ads. Dictation over the telephone will not be accepted for classified ads.

Upcoming deadlines for classified advertising are as follows: February 2007 issue–November 28, 2006; March 2007 issue–December 29, 2006; April 2007 issue–January 29, 2007; May 2007 issue–February 28, 2007; June/July 2007 issue–April 27, 2007; August 2007 issue–May 29, 2007.

U.S. laws prohibit discrimination in employment on the basis of color, age, sex, race, religion, or national origin. "Positions Available" advertisements from institutions outside the U.S. cannot be published unless they are accompanied by a statement that the institution does not discriminate on these grounds whether or not it is subject to U.S. laws. Details and specific wording may be found on page 1373 (vol. 44).

Situations wanted advertisements from involuntarily unemployed mathematicians are accepted under certain conditions for free publication. Call toll-free 800-321-4AMS (321-4267) in the U.S. and Canada or 401-455-4084 worldwide for further information.

Submission: Promotions Department, AMS, P.O. Box 6248, Providence, Rhode Island 02940; or via fax: 401-331-3842; or send email to classads@ams.org. AMS location for express delivery packages is 201 Charles Street, Providence, Rhode Island 20904. Advertisers will be billed upon publication.

professor in an area where the department has strength: applied mathematics, combinatorics, dynamical systems, logic, and topology. The successful applicant is expected to teach at all undergraduate and graduate levels, excel in research, interact with researchers in mathematics or other disciplines, and become actively involved in the life of the department and the university. Basic Qualifications: Applicants must possess a Ph.D. and good teaching credentials as demonstrated by your teaching approach and either teaching evaluations or letters from peers or supervisors. To Apply: Send a brief cover letter, CV, synopsis of your research plans (not to exceed three pages), and evidence of good teaching (which should include an overview of your teaching approach) to: Professor John B. Conway, Assistant Professor Search T, Mathematics, Old Main, 1922 F Street NW, Washington, DC 20052. Also arrange to have at least three letters of recommendation sent to the same address or to mathsrch@gwu.edu. Only complete applications will be considered. Applicants with postdoctoral experience will be given preference. Review of applications will begin on January 1, 2007, and will continue until the position is filled. The George Washington University is an Equal Opportunity/Affirmative Action Employer and seeks to attract culturally diverse faculty of the highest caliber.

000014

GEORGE WASHINGTON UNIVERSITY

In an effort to increase its research stature and expand its undergraduate and doctoral programs, the Mathematics Department of The George Washington University is recruiting for a three-year (renewable) contract position at the level of assistant professor in either applied mathematics or probability. The successful candidate is expected to teach at all undergraduate and graduate levels, do research, and become actively involved in the life of the department and the university. Basic Qualifications: Applicants must possess a Ph.D., have good research potential as evidenced by strong publications and letters of recommendation, and excellent teaching credentials as demonstrated by your approach to teaching and either teaching evaluations or letters from peers or supervisors. Preferred Qualifications: For those applicants in applied mathematics, preference will be shown those applicants with experience in computing. To Apply: Send a brief cover letter, CV, synopsis of your research plans (not to exceed three pages), and evidence of good teaching (which should include an overview of your teaching approach) to: Professor John B. Conway, Assistant Professor Search C, Mathematics, Old Main, 1922 F Street NW, Washington, DC 20052. Also arrange to have at least three letters of recommendation (which should include an assessment of research potential) sent to the same address or to mathsrch@gwu.edu. Only complete applications will be considered. Review of applications will begin on January 1, 2007, and will continue until the position is filled. The George Washington University is an Equal Opportunity/Affirmative Action Employer and seeks to attract culturally diverse faculty of the highest caliber.

000015

GEORGIA

GEORGIA INSTITUTE OF TECHNOLOGY
School of Mathematics

The School of Mathematics at Georgia Tech is now in the third year of an ambitious faculty recruitment program—one which will be sustained over a five year period. During the first two years, eight appointments were made, including four tenured appointments, two at the full professor level and two at the associate professor level. Building on past successes, this recruiting effort is intended to make rapid advances in the scope and quality of our research and graduate education programs. Candidates will be considered at all ranks, with priority given to those candidates who (1) bring exceptional quality research credentials to Georgia Tech; (2) complement existing strengths in the School of Mathematics; (3) reinforce bridges to programs in engineering and the physical, computing and life sciences; (4) have strong potential for external funding; and (5) have a demonstrated commitment to high quality teaching at both the undergraduate and graduate levels. Consistent with these priorities, candidates will be considered in all areas of Pure and Applied Mathematics and Statistics. Candidates should arrange for a resume, at least three letters of reference, and a summary of future research plans to be sent to the Hiring Committee, School of Mathematics, Georgia Institute of Technology, Atlanta, GA, 30332-0160, USA. Candidates for Associate and Full Professor positions should also submit a statement outlining their vision for service as a senior faculty member at Georgia Tech. Review of applications will begin in September 2006, and the roster of candidates being considered will be updated on a monthly basis. Georgia Tech, an institution of the University System of Georgia, is an Equal Opportunity/Affirmative Action Employer.

000322

ILLINOIS

ILLINOIS WESLEYAN UNIVERSITY
Department of Mathematics

The Department of Mathematics and Computer Science at Illinois Wesleyan University invites applications for a tenure-track position in mathematics at the assistant professor level. Employment would begin in August 2007 and the teaching load would be six courses per year. All candidates should have completed a Ph.D. in mathematics by August 1, 2007, and have a specialization in graph theory or combinatorics. Candidates should also have a significant amount of graduate training in computer science. The successful candidate must be able to teach our core mathematics curriculum, as well as courses in discrete mathematics using Mathematica. Teaching assignments could include some courses in computer science. Candidates should be dedicated to excellent teaching in a liberal arts environment where undergraduate research is encouraged. The opportunity to participate in university-wide, general education programs is available for interested faculty.

Illinois Wesleyan University is a highly selective, undergraduate university of approximately 2,200 students located in Bloomington, Illinois, a community of about 120,000. This year the average ACT for Illinois Wesleyan's first-year students is 28.3. In past years as many as 4% of the undergraduate population at Illinois Wesleyan University have declared majors in mathematics. The department maintains a healthy balance between applied mathematics and pure mathematics. Faculty areas of professional expertise include number theory, topology, category theory, algebra, linear algebra, operations research, numerical analysis, approximation theory, wavelet analysis, differential equations, dynamical systems, probability and statistics, survival analysis, computational statistics, logic, and fuzzy sets. The Department of Mathematics and Computer Science is located in the Center for Natural Science Learning and Research, a $25,000,000 facility opened in 1995. For additional information on the mathematics curriculum, facilities, and faculty interests see http://www2.iwu.edu/academics/math.shtml.

Candidates for the position should submit a letter of application, a curriculum vitae, an AMS Standard Cover Sheet, a teaching statement, a research statement, and have three letters of recommendation sent separately to Melvyn Jeter, Department of Mathematics and Computer Science, Illinois Wesleyan University, P.O. Box 2900, Bloomington, IL 61702-2900. Email applications are strongly discouraged. Interviews for this position will be held at the Joint Mathematics Meeting in New Orleans, Louisiana (January 2007). Applications received after December 1, 2006, may not receive full consideration. Women and minorities are encouraged to apply. Illinois Wesleyan is an Equal Opportunity Employer.

000347

KANSAS

UNIVERSITY OF KANSAS
Department of Mathematics

Applications are invited for one tenure-track assistant professor position in commutative algebra/algebraic geometry beginning August 18, 2007; January 1, 2008; or as negotiated. Candidates must have a Ph.D. in math or a related field or its requirements completed by August 18, 2007. For complete position announcement go to http://www.math.ku.edu/jobs or contact kumath@math.ku.edu. Letter of application, detailed vita, research description, teaching statement, completed AMS application form, and at least three recommendation letters (teaching ability must be addressed in at least one letter) should be mailed to Jack Porter, Chair, Department of Mathematics, 1460 Jayhawk Boulevard, University of Kansas, Lawrence, KS 66045-7523 (or faxed to 785-864-5255). In addition, upon receipt of materials, you will be sent instructions for completing required sections of the Faculty and Academic Staff Applicant Data Form. Deadlines: Review of applications will begin on November 15, 2006, and will continue until the position is filled. EO/AA Employer.

000008

UNIVERSITY OF KANSAS
Department of Mathematics

Applications are invited for tenure-track assistant/associate professor positions in statistics beginning August 18, 2007; January 1, 2008; or as negotiated. Candidates must have a Ph.D. in math, statistics, or a related field or its requirements completed by August 18, 2007. For complete position announcement go to http://www.math.ku.edu/jobs or contact kumath@math.ku.edu.

Letter of application, detailed vita, research description, teaching statement, completed AMS application form, and at least three recommendation letters (teaching ability must be addressed in at least one letter) should be mailed to Jack Porter, Chair, Department of Mathematics, 1460 Jayhawk Boulevard, University of Kansas, Lawrence, KS 66045-7523 (or faxed to (785) 864-5255). In addition, upon receipt of materials, you will be sent instructions for completing required sections of the Faculty and Academic Staff Applicant Data Form.

Deadlines: Review of applications begins November 15, 2006 and will continue until the positions are filled. EO/AA Employer.

000009

MARYLAND

UNITED STATES NAVAL ACADEMY
Mathematics Department

The USNA Mathematics Department anticipates at least one tenure-track position (subject to approval and funding) at the assistant professor level to start in August 2007. See website http://www.usna.edu/MathDept/website/Hire.htm for full information. Tel: 410-293-6701; Fax: 410-293-6707; email: amg@usna.edu. The United States Naval Academy is an Affirmative Action/Equal Employment Opportunity Employer and provides reasonable accommodations to applicants with disabilities.

000004

MICHIGAN

NORTHERN MICHIGAN UNIVERSITY
Department of Mathematics

The Department of Mathematics and Computer Science invites applications for two tenure-track positions in mathematics at the rank of assistant professor. Visit http://www.higheredjobs.com/ or call (906) 227-2020 for job description and requirements. Salary is competitive. Screening will begin January 3, 2007, and will continue until the positions are filled. NMU is an AA/EOE.

000005

NORTH CAROLINA

UNIVERSITY OF NORTH CAROLINA, CHARLOTTE
Assistant Professor in Mathematics

Tenure-track position at the assistant professor level in Analysis beginning in August 2007. Candidates must have a Ph.D., demonstrated strength in research, and a commitment to teaching. Preference will be given to applicants with strong potential for interdisciplinary research and external funding.

Send letter of interest, curriculum vitae, statement of research and teaching interests, and arrange to have 3 letters of reference sent to Analysis Search Committee, Department of Mathematics and Statistics, University of North Carolina at Charlotte, Charlotte, NC 28223. Review of applications will begin on January 18, 2007. Contact Dr. Alan Dow at adow@uncc.edu for more information.

AA/EOE. Women and underrepresented minorities are urged to apply.

000012

OHIO

CASE WESTERN RESERVE UNIVERSITY
Department of Mathematics
Tenure-track and temporary positions

Open rank; however appointment at the rank of assistant professor is strongly preferred. Tenure-track in area of numerical analysis/scientific computing to enhance department program. For more information, see http://www.case.edu/artsci/math/employment.htm. The successful tenure-track candidate will hold the Ph.D. or equivalent and have, relative to career stage, a distinguished record of publication, research, service, and teaching. Compensation commensurate with qualifications. Applications will be considered on receipt; applications will be accepted until position is filled. Electronic applications to: James Alexander, math-faculty-position@cwru.edu, consisting of a letter of application, AMS cover sheet, CV, and have three letters of reference sent. Case is a recipient of an NSF ADVANCE institutional transformation grant to increase the participation of women in science and engineering. Case Western Reserve University is committed to diversity and is an Affirmative Action, Equal Opportunity Employer. Applications from women or minorities are especially encouraged.

000002

OKLAHOMA

THE UNIVERSITY OF TULSA
Department of Mathematical and Computer Sciences
Tenure-track Faculty Position in Mathematics

The University of Tulsa invites applications for a full-time, tenure-track position in applied mathematics at the rank of assistant professor, to begin in Fall 2007. Appointment at a higher rank may be considered for exceptional candidates. The Department of Mathematical and Computer Sciences is part of the College of Engineering and Natural Sciences. Preference will be given to candidates working in applied analysis whose research interests match those of the Center for Boundary Integral Methods in the department. Applicants must have a doctorate in mathematics and show a clear commitment to research and to teaching at both undergraduate and graduate levels.

Candidates must submit a letter of application, a full curriculum vitae, a detailed description of research interests, a statement of teaching experience and philosophy, and names, mailing addresses, telephone numbers, and e-mail addresses of at least three references to:

Chair, Faculty Search Committee
Department of Mathematical and Computer Sciences
The University of Tulsa

600 S. College Avenue
Tulsa, OK 74104-3189

Applications will be considered until the position is filled. The University of Tulsa is an Affirmative Action/Equal Opportunity Employer and encourages applications from women and underrepresented minorities.

000007

TEXAS

TEXAS A&M UNIVERSITY, QATAR
Department of Mathematics

The Department of Mathematics expects to have two or more open positions at its affiliate campus in Doha, Qatar. Texas A&M-Qatar (TAMUQ) is a relatively new university funded by the Qatar Foundation and is operated under the auspices of Texas A&M in College Station, Texas. TAMUQ offers bachelor's degrees in engineering, and the mathematics faculty is expected to provide supporting classes in calculus, differential equations, linear algebra, numerical methods, mathematical modeling, and other related coursework. The campus has modern facilities that include a 100-node supercomputer and full library services (electronic and loan access). Teaching loads are kept low (approximately two small classes per academic year) to promote teacher-student mentoring and to allow time for faculty to pursue research. Any level of appointment will be considered depending on the qualifications of the applicant. It is anticipated that most appointments will be non-tenure-accruing, with an initial appointment period of one year, which is renewable for additional years, subject to satisfactory performance. A Ph.D. degree is required for all professorial level appointments (the equivalent of an assistant professor or higher). Applicants with a master's degree and teaching experience will be considered for non-professorial positions (e.g., lecturer) for more elementary instruction (and a higher teaching load). Salary rates are competitive and, in general, average 30% higher than comparable salary rates of similar positions here in the U.S. In addition, summer funding is guaranteed. Liberal allowances for professional travel and for relocation to Qatar are provided. Fringe benefits include free housing, K-12 education for dependents, and a car allowance. General information about TAMUQ is available at their website: `http://www.qatar.tamu.edu/`.

Applicants should send the completed "AMS Application Cover Sheet", a vita, and arrange to have at least three letters of recommendation sent to: TAMU-Qatar-Faculty Hiring, Department of Mathematics, Texas A&M University, College Station, Texas 77843-3368. Further information and a link to our on-line application form is available at `http://www.math.tamu.edu`. At least one recommendation letter should address the candidate's teaching qualifications. The complete dossier should be received by January 15, 2007. Early applications are encouraged since applications will be reviewed as they are received.

Texas A&M University is an Equal Opportunity Employer. The university is dedicated to the goal of building a culturally diverse and pluralistic faculty and staff committed to teaching and working in a multicultural environment and strongly encourages applications from women, minorities, individuals with disabilities, and veterans. The university is responsive to the needs of dual career couples.

000340

THE UNIVERSITY OF TEXAS AT SAN ANTONIO
Department of Mathematics
Chair

The University of Texas at San Antonio (UTSA) is accepting applications for the position of Chair of the Department of Mathematics, starting Fall 2007. The appointment will be at the rank of professor, with tenure. The newly formed department merges the Department of Applied Mathematics, the Department of Science and Mathematics Education, and the core curriculum mathematics program. The combined department will have more than twenty tenured/ tenure-track faculty members and offers B.S. and B.A. degrees in mathematics and M.S. degrees in mathematics and applied mathematics. New faculty positions and new Ph.D. programs are planned for the department.

The required qualifications are: an internationally recognized program of research in mathematics, excellence in teaching, experience in directing doctoral dissertations, a record of success in obtaining external funding, and administrative experience.

Responsibilities include a commitment to developing the new UTSA Department of Mathematics, developing new Ph.D. programs in mathematics, teaching, supervising research students at all levels, and maintaining an externally funded research program. Descriptions of current departmental research efforts can be found at `http://math.utsa.edu/`. UTSA, the second largest component university of The University of Texas System, has an enrollment in excess of 28,000 students and offers courses at the Loop 1604 and Downtown Campuses.

Screening of completed applications will continue until the position is filled. Applicants who are not U.S. citizens must state their current visa and residency status. Applicants must submit a letter of application, a dated current curriculum vitae, a statement of leadership and administrative philosophy, a description of research, and the names, addresses, and email addresses of three individuals who can provide recommendation letters. Application materials may be sent either by email (`mathchairsearch@utsa.edu`) or regular mail (Math Chair Search Committee, Office of the Dean, College of Sciences, The University of Texas at San Antonio, One UTSA Circle, San Antonio, Texas 78249-0661). Applications will be treated as confidential.

UTSA is an Affirmative Action/Equal Opportunity Employer. Women, minorities, veterans, and individuals with disabilities are encouraged to apply.

000001

CANADA

McGILL UNIVERSITY
Department of Mathematics

The Department of Mathematics and Statistics invites applications for a tenure-track position in probability. The department welcomes applications at the assistant professor level, as well as more senior levels.

Candidates must have a doctoral degree at the date of appointment. Candidates are expected to have demonstrated excellence in research. They should also have the potential to contribute to the educational programs of the department at the graduate and undergraduate levels.

Applications with a curriculum vitae, a list of publications; a research outline; an account of teaching experience; a statement on teaching; and the names, phone numbers, and e-mail addresses of at least four references (with one addressing the teaching record) should be sent to: Professor David A. Stephens, Chair, Probability Search Committee, Department of Mathematics and Statistics, McGill University, 805 Sherbrooke Street West, Montreal QC H3A 2K6 Canada.

Candidates must arrange to have the four letters of recommendation sent directly to the above address. Candidates are encouraged to include copies of up to 3 selected reprints or preprints with their applications.

To ensure full consideration, applications must be received by January 31, 2007.

Only those applicants selected for an interview will be contacted. All qualified candidates are encouraged to apply; however Canadians and permanent residents of Canada will be given priority. McGill University is committed to equity in employment.

000011

CHILE

PONTIFICIA UNIVERSIDAD CATOLICA DE CHILE
Departamento de Matemáticas

The Department of Mathematics invites applications for two tenure-track positions at the assistant professor level beginning in September 2007. For one of the positions there is a strong preference in applied mathematics and related areas. Applicants should have a Ph.D. in mathematics, proven research potential and a strong commitment to teaching and research. The

Mathematics Advanced Study Semesters (MASS)

Department of Mathematics of the Penn State University runs a yearly semester-long intensive program for undergraduate students seriously interested in pursuing career in mathematics. MASS is held during the fall semester of each year. For most of its participants, the program is a spring board to graduate schools in mathematics. The participants are usually juniors and seniors.

The MASS program consists of three core courses (4 credits each), Seminar (3 credits) and Colloquium (1 credit), fully transferable to the participants' home schools. The core courses offered in 2006 are:

- *Computability, unsolvability and randomness* (S. Simpson),
- *Surfaces: everything you wanted to know about them* (A. Katok),
- *Topics in probability theory* (O. Sarig).

Applications for fall semester of 2007 are accepted now.

Financial arrangements:

Successful applicants are awarded *Penn State MASS Fellowship* which reduces their tuition to the in-state level. Applicants who are US citizens or permanent residents receive *NSF MASS Fellowship* which covers room and board, travel to and from Penn State and provides additional stipend. Applicants with outstanding previous record are awarded additional *MASS Merit Fellowship*. Participants who significantly exceed expectations during the program will be awarded *MASS Performance Fellowships* at the end of the semester.

For complete information, see
http://www/math/psu.edu/mass
e-mail to mass@math.psu.edu
or call (814)865-8462

teaching load for assistant professors consists of three one-semester courses per year. The salary will be $19,000 per year.

Please send a letter indicating your main research interests, detailed curriculum vitae, and three letters of recommendation to:

Director
Pontificia Universidad Catolica de Chile
Departamento de Matemáticas
Vicuña Mackenna 4860
Santiago-CHILE
fax: (56-2) 5525916;
email: griera@mat.puc.cl

For full consideration, complete application materials must arrive by February 28, 2007. Further information about the department http://www.mat.puc.cl.

000010

TAIWAN

NATIONAL CHIAO TUNG UNIVERSITY
Department of Applied Mathematics
Institute of Mathematical Modeling and Scientific Computing

The Department of Applied Mathematics and the newly established Institute of Mathematical Modeling and Scientific Computing at National Chiao Tung University invite applications for several tenure-track (associate or assistant) or tenured full professorships. Preference will be given to applicants whose research expertise are mathematical modeling, scientific computing, and other related topics with important applications to science. Candidates whose research interests are close to those of the department's faculty members inculding PDE, dynamical system, discrete mathematics, and probability will also be considered. The appointment will start in August 2007.

A Ph.D. in mathematics/applied mathematics or a related field is required and the successful candidate should have a good record in research and teaching. Interested applicants should arrange a cover letter, a curriculum vitae, a statement of teaching philosophy, a future research plan, and three letters of references to: Chih-Wen Shih, Chair, Department of Applied Mathematics, National Chiao Tung University, Hsinchu, 300, Taiwan. Review of applications will begin January 30, 2007, and will continue until the positions are filled.

000006

AAAS Meeting in San Francisco Features Interdisciplinary Mathematics Program

The 2007 Annual Meeting of the American Association for the Advancement of Science will be February 15-19, in San Francisco, CA. This year's program features many outstanding expository talks by prominent mathematicians. The theme of the meeting is "Science and Technology for Sustainable Well-Being", and many of the symposia sponsored by Section A (Mathematics) are interdisciplinary sessions that fit this theme.

The eight symposia sponsored by Section A are:

- The Science and Modeling of Hurricanes (organized by Clint Dawson)
- New Vistas in the Mathematics of Ecology and Evolution (organized by Simon Levin)
- Prime Numbers: New Developments on Ancient Problems (organized by Dan Goldston)
- New Mathematical Methods in the Visual Arts (organized by Dan Rockmore)
- Are We a Democracy? Vote Counting in the United States (organized by Stephanie Singer)
- How Should Elementary Mathematics Be Taught? (organized by Cathy Kessel)
- Controversies in Forest Fire Suppression and Management (organized by John Braun)
- Blockbuster Science: Math & Science Behind Movies & Entertainment (organized by Tony Chan)

Other symposia that will be of interest to the mathematical community include:

Decision-Making Under Uncertainty: The Challenge of Sustainable Well-Being

Climate Change: Treatment of Uncertainty in Assessment and Decision-Making

Numbers and Nerves: Affect and Meaning in Risk Information

The Digital Promise: Using Advanced Learning Technologies to Revolutionize Education

Mathematics and America's Future: A Call to Action

Examining TIMSS Teaching and Learning through Videos and Assessments

New Approaches to the Development of the U.S. Computing Work Force

Internet Searching in 2017

The above symposia are only a few of the 200 or so AAAS program offerings in the physical, life, social, and biological sciences. For further details about the 2007 AAAS program, see the October 20, 2006, issue of *Science*. (See also `www.aaasmeeting.org` under "Program and Events".)

AAAS annual meetings are the showcases of American science, and they encourage participation by mathematicians and mathematics educators. (AAAS acknowledges the generous contributions of AMS for travel support and SIAM for support of media awareness.) The AAAS Program Committee is genuinely interested in offering symposia on pure and applied mathematical topics of current interest, and in previous years there have been symposia on subjects such as the changing nature of mathematical proof, models for how insects fly, and mathematical oncology.

The 2008 meeting will be February 14-18, 2008, in Boston. The Steering Committee for Section A seeks organizers and speakers who can present substantial new material in an accessible manner to a large scientific audience. All are invited to attend the Section A Committee business meeting in San Francisco on Friday, February 16, 2007, at 7:45 PM, where we will brainstorm ideas for symposia. In addition, I invite you to send me, and encourage your colleagues to send me, proposals for future AAAS annual meetings.

The following are the members of the Steering Committee for Section A from February 2006 to February 2007:

Chair: Jack Cowan (University of Chicago)
Chair-Elect: Carl Pomerance (Dartmouth College)
Retiring Chair: Barbara Lee Keyfitz (Fields Institute and University of Houston)
Secretary: Edward Aboufadel (Grand Valley State University)
Members at Large:
Tamar Schlick (New York University)
Walter Craig (McMaster University)
Mary Beth Ruskai (Tufts University)
David Isaacson (Rensselaer Polytechnic Institute)

by Edward Aboufadel, Secretary of Section A of the AAAS
aboufade@gvsu.edu

General Information Regarding Meetings & Conferences of the AMS

Speakers and Organizers: The Council has decreed that no paper, whether invited or contributed, may be listed in the program of a meeting of the Society unless an abstract of the paper has been received in Providence prior to the deadline.

Although an individual may present only one ten-minute contributed paper at a meeting, any combination of joint authorship may be accepted, provided no individual speaks more than once. An author can speak by invitation in more than one Special Session at the same meeting.

Special Sessions: The number of Special Sessions at an Annual Meeting is limited. Special Sessions at annual meetings are held under the supervision of the Program Committee for National Meetings and, for sectional meetings, under the supervision of each Section Program Committee. They are administered by the associate secretary in charge of that meeting with staff assistance from the Meetings and Conferences Department in Providence. (See the list of associate secretaries on page 183 of this issue.)

Each person selected to give an Invited Address is also invited to generate a Special Session, either by personally organizing one or by having it organized by others. Proposals to organize a Special Session are sometimes solicited either by a program committee or by the associate secretary. Other proposals should be submitted to the associate secretary in charge of that meeting (who is an ex officio member of the program committee) at the address listed on page 183. These proposals must be in the hands of the associate secretary at least seven months (for sectional meetings) or nine months (for national meetings) prior to the meeting at which the Special Session is to be held in order that the committee may consider all the proposals for Special Sessions simultaneously. Special Sessions must be announced in the Notices in a timely fashion so that any Society member who so wishes may submit an abstract for consideration for presentation in the Special Session.

Talks in Special Sessions are usually limited to twenty minutes; however, organizers who wish to allocate more time to individual speakers may do so within certain limits. A great many of the papers presented in Special Sessions at meetings of the Society are invited papers, but any member of the Society who wishes to do so may submit an abstract for consideration for presentation in a Special Session, provided it is submitted to the AMS prior to the special early deadline for consideration. Contributors should know that there is a limit to the size of a single Special Session, so sometimes all places are filled by invitation. Papers submitted for consideration for inclusion in Special Sessions but not accepted will receive consideration for a contributed paper session, unless specific instructions to the contrary are given.

The Society reserves the right of first refusal for the publication of proceedings of any Special Session. If published by the AMS, these proceedings appear in the book series Contemporary Mathematics. For more detailed information on organizing a Special Session, see `www.ams.org/meetings/specialsessionmanual.html`.

Contributed Papers: The Society also accepts abstracts for ten-minute contributed papers. These abstracts will be grouped by related *Mathematical Reviews* subject classifications into sessions to the extent possible. The title and author of each paper accepted and the time of presentation will be listed in the program of the meeting.

Other Sessions: In accordance with policy established by the AMS Committee on Meetings and Conferences, mathematicians interested in organizing a session at an annual or sectional meeting on employment opportunities inside or outside academia for young mathematicians should contact the associate secretary for the meeting with a proposal by the stated deadline. Also, potential organizers for poster sessions on a topic of choice should contact the associate secretary before the deadline.

Abstracts: Abstracts for all papers must be received by the meeting coordinator in Providence by the stated deadline. Unfortunately, late papers cannot be accommodated.

Submission Procedures: Visit the Meetings and Conferences homepage on the Web at `http://www.ams.org/meetings` and select "Submit an abstract".

See the inside front cover of *Abstracts of Papers Presented to the American Mathematical Society* for information on abstracts published by title and not presented at a meeting.

Site Selection for Sectional Meetings

Sectional meeting sites are recommended by the associate secretary for the section and approved by the Secretariat. Recommendations are usually made eighteen to twenty-four months in advance. Host departments supply local information, ten to fifteen rooms with overhead projectors for contributed paper sessions and Special Sessions, an auditorium with twin overhead projectors for Invited Addresses, space for registration activities and an AMS book exhibit, and registration clerks. The Society partially reimburses for the rental of facilities and equipment and for staffing the registration desk. Most host departments volunteer; to do so, or for more information, contact the associate secretary for the section.

Meetings & Conferences of the AMS

IMPORTANT INFORMATION REGARDING MEETINGS PROGRAMS: AMS Sectional Meeting programs do not appear in the print version of the *Notices*. However, comprehensive and continually updated meeting and program information with links to the abstract for each talk can be found on the AMS website. See `http://www.ams.org/meetings/`. Final programs for Sectional Meetings will be archived on the AMS website accessible from the stated URL and in an electronic issue of the *Notices* as noted below for each meeting.

New Orleans, Louisiana

New Orleans Marriott and Sheraton New Orleans Hotel

January 5–8, 2007

Friday - Monday

Meeting #1023

Joint Mathematics Meetings, including the 113th Annual Meeting of the AMS, 90th Annual Meeting of the Mathematical Association of America (MAA), annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association for Symbolic Logic (ASL), with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).

Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: October 2006
Program first available on AMS website: November 1, 2006
Program issue of electronic *Notices*: January 2007
Issue of *Abstracts*: Volume 28, Issue 1

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: Expired

Program Updates

Social Events

Tulane University Department of Mathematics, Friday, 6:30 p.m. to 7:30 p.m. All meeting participants are invited to this reception in recognition of the effort of the U.S. mathematics community on our behalf in the aftermath of Hurricane Katrina, and the support of the Deutsch Mathematiker-Vereiningung and the Deutsch Forschungsgemeinschaft through travel fellowships awarded young mathematicians from Germany.

Institute in the History of Mathematics and Its Use in Teaching (IHMT) Reunion, Saturday, 6:30 p.m. to 8:30 p.m. This was a MAA project funded by the NSF from 1995 to 2001. Although there will not be a formal program, all participants who wish to speak about their IHMT experiences should notify Victor Katz at `vkatz@udc.edu`. The reunion will include a memorial to Karen Dee Michalowicz, who died in July. All Institute participants, including those who participated in the Historical Modules Project, are welcome to attend. If you are planning to do so, please notify Herb Kasube at `hkasube@bumail.bradley.edu`.

The Ohio State University Friends and Alumni Reception, Sunday, 6:00 p.m. to 8:00 p.m.

University of Wisconsin-Madison Department of Mathematics Reception, Saturday, 5:45 p.m. to 7:30 p.m.

Activities of Other Organizations

Association for Women in Mathematics Critical Career Decision Stages: Research and Funding Opportunities, Monday, 1:00 p.m. to 2:15 p.m. This AWM Workshop event

features **Claudia Polini**, University of Notre Dame as moderator, and panelists **Valentina S. Harizanov**, The George Washington University; **Kathleen O'Hara**, Mathematical Sciences Research Institute; **Barbara Lee Keyfitz**, Fields Institute and University of Houston; and **Michelle D. Wagner**, National Security Agency.

Registering at the Meetings

Individuals who registered by November 14 and who so elected will have their badge and program book mailed to them before the meetings. All other registrants will pick up their material at the meeting. The information below is to assist those who will register at the meetings and those who registered in advance who either elected not to receive the materials by mail or were not eligible to do so.

Advance and on-site meeting registration fees only partially cover expenses of holding meetings. All mathematicians who wish to attend sessions are expected to register and should be prepared to show the meetings badge, if so requested. Badges are required to enter the exhibit area and to obtain discounts at the AMS and MAA book sales.

Registration fees may be paid at the meetings in cash, personal ot traveler's check, or credit card (VISA, MasterCard, American Express, or Discover credit cards (not debit cards) are acceptable). Letters verifying attendance at the meetings may be obtained from the cashier or at the Registration Assistance section of the registration desk.

Participants who wish to attend sessions for one day only may take advantage of a one-day fee. These special fees are effective daily, January 5 through 8, and are available at the meetings to both members and nonmembers. One-day fees are not applicable in other categories.

Joint Mathematics Meetings Registration Fees

Member of AMS, ASL, Canadian Mathematical Society, MAA, SIAM	US$271
Emeritus Member of AMS, MAA; Graduate Student; Unemployed; Librarian; High School Teacher; Developing Countries Special Rate	52
Undergraduate Student	27
Temporarily Employed	194
Nonmember	419
High School Student	6
One-Day Member of AMS, ASL, CMS, MAA, SIAM	149
One-Day Nonmember	231
Nonmathematician Guest	15

MAA Minicourses

Minicourses #1–6 (computers)	$95*
Minicourse #7–10 and 12-16	60*
Minicourse #11 (origami)	70*

*if space is available

Employment Center

Employer (first table, computer or self-scheduled)	US$315
Employer (each additional table, computer or self-scheduled)	115
Applicants (all services)	82
Applicants (*Winter List* & message center only)	22

AMS Short Course

Member of AMS or MAA	US$120
Nonmember	151
Student/Unemployed/Emeritus	60

MAA Short Course

MAA or AMS Member	$US140
Nonmember	190
Student/Unemployed/Emeritus	60

Registration Dates, Times, and Locations

AMS and MAA Short Courses

Outside the Rhythms Ballrooms, Sheraton

Wednesday, January 3	8:00 a.m. to noon

Joint Mathematics Meetings and MAA Minicourses

La Galeries 5 & 6, Marriott

Thursday, January 4	3:00 p.m. to 7:00 p.m.
Badge/program pickup only	7:00 p.m. to 8:00 p.m.
Friday, January 5	7:30 a.m. to 4:00 p.m.
Badge/program pickup only	4:00 p.m. to 6:00 p.m.
Saturday, Jan. 6–Monday, Jan. 8	7:30 a.m. to 4:00 p.m.

Employment Center

Preservation Hall, Marriott

Friday, January 5	
Registration for scheduled interviews, materials pickup	7:30 a.m. to 4:00 p.m.
Interview Center	9:30 a.m. to 6:00 p.m.
Saturday, January 6	
Schedule distribution, interviews	7:00 a.m. to 4:40 p.m.
Interview Center	8:00 a.m. to 7:30 p.m.
Sunday, January 7	
Scheduled interviews	8:15 a.m. to 4:40 p.m.
Interview Center	8:00 a.m. to 7:30 p.m.
Monday, January 8	
Interview Center only	9:00 a.m. to noon

Employment Center registrants who are participating in the computer-scheduled interviews must register and fill out interview request forms on **Friday, January 5**. There will be no registration on Saturday and Sunday; only interviews will take place on these days.

Accommodations and Travel

Participants who did not reserve a room during advance registration but who would like to obtain a room at one of the hotels listed on pages 1149-1150 in the October issue of the *Notices* should call the hotels directly after **December 12**. However, we regret that after that date the MMSB can no longer guarantee availability of rooms or the special convention rates.

Please see the October issue for special discount fare information on American Airlines.

Davidson, North Carolina

Davidson College

March 3–4, 2007
Saturday - Sunday

Meeting #1024
Southeastern Section
Associate secretary: Matthew Miller
Announcement issue of *Notices*: January 2007
Program first available on AMS website: January 18, 2007
Program issue of electronic *Notices*: March 2007
Issue of *Abstracts*: Volume 28, Issue 2

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: January 9, 2007

Invited Addresses

Nigel Boston, University of South Carolina and University of Wisconsin, Madison, *Novel applications of algebra to engineering.*

Chaim Goodman-Strauss, University of Arkansas at Fayetteville, *Growth, aperiodicity, and undecidability.*

Andrew J. Granville, University of Montreal, *Erdős's dream and pretentious characters* (Erdős Memorial Lecture).

Alex Iosevich, University of Missouri-Columbia, *Analysis, combinatorics, and arithmetic of incidence theory.*

Shrawan Kumar, University of North Carolina, *Eigenvalue problem for Hermitian matrices and its generalization to arbitrary reductive groups.*

Special Sessions

Algebraic and Extremal Combinatorics (Code: SS 7A), **Gábor Hetyei**, University of North Carolina-Charlotte, and **László A. Székely**, University of South Carolina.

Applicable Algebra (Code: SS 12A), **Nigel Boston**, University of South Carolina, and **Hiren Maharaj**, Clemson University.

Between Harmonic Analysis, Number Theory, and Combinatorics (Code: SS 1A), **Alex Iosevich**, University of Missouri-Columbia, **Michael T. Lacey**, Georgia Institute of Technology, and **Konstantin Oskolkov**, University of South Carolina.

Commutative Algebra and Algebraic Geometry (Code: SS 6A), **Florian Enescu**, Georgia State University, and **Andrew R. Kustin** and **Adela N. Vraciu**, University of South Carolina.

Commutative Rings and Monoids (Code: SS 5A), **Evan G. Houston** and **Thomas G. Lucas**, University of North Carolina, Charlotte.

Computational Group Theory (Code: SS 3A), **Arturo Magidin**, University of Louisiana at Lafayette, **Luise Charlotte Kappe**, Binghamton University, and **Robert F. Morse**, University of Evansville.

Computational and Combinatorial Aspects of Tiling and Substitutions (Code: SS 14A), **Chaim Goodman-Strauss**, University of Arkansas, **Casey Mann**, University of Texas at Tyler, and **Edmund O. Harriss**, Queen Mary University of London.

Dynamical Systems (Code: SS 10A), **Emily B. Gamber**, Santa Fe Institute, **Donna K. Molinek**, Davidson College, and **James S. Wiseman**, Agnes Scott College.

Geometric and Combinatorial Methods in Representation Theory (Code: SS 2A), **Brian Boe** and **William A. Graham**, University of Georgia, and **Kailash C. Misra**, North Carolina State University.

Microlocal Analysis and Partial Differential Equations (in Honor of Michael E. Taylor's 60th Birthday) (Code: SS 11A), **Anna L. Mazzucato**, Pennsylvania State University, and **Martin Dindos**, University of Edinburgh.

Noncommutative Algebra (Code: SS 8A), **Ellen E. Kirkman** and **James J. Kuzmanovich**, Wake Forest University, and **James Zhang**, University of Washington.

Recent Applications of Numerical Linear Algebra (Code: SS 13A), **Timothy P. Chartier**, Davidson College, and **Amy Langville**, College of Charleston.

Representation Theory and Galois Cohomology in Number Theory (Code: SS 4A), **Ján Mináč**, University of Western Ontario, and **John R. Swallow**, Davidson College.

Stochastic Analysis and Applications (Code: SS 9A), **Armando Arciniéga**, University of Texas at San Antonio.

Accommodations

Participants should make their own arrangements directly with a hotel of their choice as early as possible. Special rates have been negotiated with the hotels listed below. Rates quoted do not include sales tax of 15.5%. The AMS is not responsible for rate changes or for the quality of the accommodations. When making a reservation, participants should state that they are with the **American Mathematical Society (AMS) Meeting at Davidson College group**. Cancellation and early checkout policies vary; be sure to check when you make your reservation.

N.B. The number of hotel rooms in Davidson proper is very limited. All of the following hotels are about five miles from campus at exit 25 off of Interstate 77 on the same side of the highway, and within walking distance of several dining options. Blocks of rooms at each hotel are limited, so be sure to call early to obtain your first choice. Participants are encouraged to use personal/rental cars to facilitate transportation to and from hotels, campus, and restaurants.

Country Suites by Carlson, 16617 Statesville Rd., Huntersville, NC 28078; 704-895-6565 (phone) or 704-895-5456 (fax), US$109/single or double, an all-suites hotel (separate bedroom/parlor) with microwave, refrigerator, coffee maker, complimentary deluxe continental breakfast

with hot entrees (make your own waffles!), free high-speed Internet, free wireless in lobby; free parking; fitness center, indoor heated pool. **Deadline for reservations is February 2, 2007.** Be sure to check cancellation and early checkout policies.

Hawthorne Suites, 16905 Caldwell Creek Dr., Huntersville, NC 28078; 704-892-9478 (phone), 704-892-9402 (fax); US$84/single or double in a studio suite (upgrades available at a higher rate); an all-suites hotel with in-room coffee maker, microfridge; outdoor pool, exercise room; complimentary hot breakfast buffet, complimentary wireless access. **Deadline for reservations is February 2, 2007.** Be sure to check cancellation and early checkout policies.

Quality Inn, 16825 Caldwell Creek Dr., Huntersville, NC 28078; 704-892-6597 (phone), 704-892-1628 (fax); US$69/single or double; complimentary continental breakfast. **Deadline for reservations is February 2, 2007.** Be sure to check cancellation and early checkout penalties.

Food Service

There are numerous restaurants within walking distance of campus:

Bonsai Grill and Sushi Bar: Extensive à la carte menu; lunch specials US$6–7; entrées US$9–22.

The Brickhouse Tavern: Large restaurant; American; salads and sandwiches US$6–10; pizzas US$10–14; entrées US$11–22.

Davino's Restaurant and Bar: Italian; burgers, subs, and salads US$5–8; pizzas US$9–16; lunch entrées US$6–8; dinner entrées US$10–13.

Fuel Pizza Café: Slices US$2–3; subs US$6–7; pizzas US$9–16.

Jasper's at Davidson: Eclectic; soups and salads US$5–8; dinner entrées US$15–28.

Kudzu on the Green: Eclectic; lunch entrées US$7–9; dinner entrées US$15–23.

Palermo's Pizza: Slices US$2–3; subs US$6–7; pizzas US$9–16.

The Soda Shop: Small, historic restaurant; American; sandwiches US$4–7.

A more extensive list, including restaurants near the hotels we have contracted with for sleeping rooms, will be available on site.

Local Information

The university's website is `www.davidson.edu`; the department of mathematics is at `www.davidson.edu/math`. The hotels where the AMS has contracted blocks of sleeping rooms are in the Lake Norman area; see `www.lakenormancvb.org` for information about the area.

Other Activities

Book Sales: Examine the newest titles from the AMS! Many of the AMS books will be available at a special 50% discount available only at the meeting. Complimentary coffee will be served courtesy of AMS Membership Services.

AMS Editorial Activity: An acquisitions editor from the AMS book program will be present to speak with prospective authors. If you have a book project that you would like to discuss with the AMS, please stop by the book exhibit.

Parking

Parking will be available in the visitor parking lot of the Baker Sports Complex, as indicated on the campus map. There is no charge. See the links below for directions.

Registration and Meeting Information

The meeting is on the campus of Davidson College. Sessions and Invited Addresses will take place in the Chambers Building and the Performance Hall of the Knobloch Campus Center. See a campus map at `http://www2.davidson.edu/welcome/wel_imgs/g_dcmapcolor03.gif`.

The registration desk will be in the Chambers Building and will be open Saturday, March 3, 7:30 a.m. to 4:00 p.m., and Sunday, April 4, 8:00 a.m. to noon. Fees are US$40 for AMS or CMS members, US$60 for nonmembers; and US$5 for students, unemployed mathematicians, and emeritus members. Fees are payable on site by cash, check, or credit card; debit cards are not accepted.

Travel, Campus Map, and Directions

The nearest airport is in Charlotte, NC (CLT) and is about 25 miles from campus. Cabs and shuttles may be found at the curbside of the lower baggage claim level. Shuttles may be reserved with Lake Norman Airport Transportation, 704-892-8879 (office) or 704-506-0788 (cell). The fare for a one-way cab or shuttle trip is about US$50. Driving directions to campus from the airport: Exit onto Josh Birmingham Parkway. At the end of the parkway choose the path to I-85; you will then be traveling north on the Billy Graham Parkway. As you approach the interstate interchange, take the ramp on the right for I-85 north. Continue on and then take exit 38 for I-77 north. Davidson College is located at exit 30, while the hotels the AMS has contracted with are located at Exit 25.

For driving directions from major arteries to Davidson and the Baker Sports Complex parking lot see the directions and detailed map that prints nicely at `http://www2.davidson.edu/welcome/wel_maps.asp`.

Car Rental

Avis is the official car rental company for the sectional meeting in Davidson, North Carolina.

All rates include unlimited free mileage. Weekend daily rates are available from noon Thursday–Monday at 11:59 P.M. Rates for this meeting are effective February 24, 2007–March 11, 2007 and begin at US$25/day (weekend rate). Should a lower qualifying rate become available at the time of booking, Avis is pleased to offer a 5% discount off the lower qualifying rate or the meeting rate, whichever is lowest. Rates do not include any state or local surcharges, tax, optional coverages, or gas refueling charges. Renters must meet Avis' age, driver, and credit requirements. Reservations can be made by calling 800-331-1600 or online at `www.avis.com`. Meeting Avis Discount Number **B159266**.

Weather

March temperatures in Davidson range from 40° F. to 60° F. An umbrella may be desirable.

Information for International Participants

Visa regulations are continually changing for travel to the United States. Visa applications may take from three to four months to process and require a personal interview, as well as specific personal information. International participants should view the important information about traveling to the U.S. found at `http://www7.nationalacademies.org/visas/Traveling_to_US.html` and `http://travel.state.gov/visa/index.html`. If you need a preliminary conference invitation in order to secure a visa, please send your request to `dls@ams.org`.

If you discover you do need a visa, the National Academies website (see above) provides these tips for successful visa applications:

* Visa applicants are expected to provide evidence that they are intending to return to their country of residence. Therefore, applicants should provide proof of "binding" or sufficient ties to their home country or permanent residence abroad. This may include documentation of the following:

- family ties in home country or country of legal permanent residence
- property ownership
- bank accounts
- employment contract or statement from employer stating that the position will continue when the employee returns;

* Visa applications are more likely to be successful if done in a visitor's home country than in a third country;

* Applicants should present their entire trip itinerary, including travel to any countries other than the United States, at the time of their visa application;

* Include a letter of invitation from the meeting organizer or the U.S. host, specifying the subject, location and dates of the activity, and how travel and local expenses will be covered;

* If travel plans will depend on early approval of the visa application, specify this at the time of the application;

* Provide proof of professional scientific and/or educational status (students should provide a university transcript).

This list is not to be considered complete. Please visit the web sites above for the most up-to-date information.

Oxford, Ohio

Miami University

March 16–17, 2007

Friday - Saturday

Meeting #1025

Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: January 2007
Program first available on AMS website: February 1, 2007
Program issue of electronic *Notices*: March 2007
Issue of *Abstracts*: Volume 28, Issue 2

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: January 23, 2007

Invited Addresses

Sergey Fomin, University of Michigan, *Title to be announced.*

Naichung Conan Leung, University of Minnesota, *Title to be announced.*

Emil J. Straube, Texas A&M University, *Title to be announced.*

Shouhong Wang, Indiana University, *Title to be announced.*

Special Sessions

Combinatorial and Geometric Group Theory (Code: SS 5A), **John Donnelly**, Mount Union College, and **Daniel Farley**, Mathematisches Institut Einsteinstrasse and Miami University.

Complex Dynamics and Complex Function Theory (Code: SS 9A), **Stephanie Edwards**, University of Dayton, and **Rich Lawrence Stankewitz**, Ball State University.

Finite Geometry and Combinatorics (Code: SS 3A), **Mark A. Miller**, Marietta College.

Geometric Topology (Code: SS 2A), **Jean-Francois LaFont**, Ohio State University, and **Ivonne J. Ortiz**, Miami University.

Graph Theory (Code: SS 4A), **Tao Jiang**, **Zevi Miller**, and **Dan Pritikin**, Miami University.

Large Cardinals in Set Theory (Code: SS 1A), **Paul B. Larson**, Miami University, **Justin Tatch Moore**, Boise State University, and **Ernest Schimmerling**, Carnegie Mellon University.

Noncommutative Algebraic Geometry (Code: SS 7A), **Dennis S. Keeler**, Miami University, **Rajesh Shrikrishna Kulkarni**, Michigan State University, and **Daniel S. Rogalski**, University of California San Diego.

Optimization Theory and Applications (Code: SS 11A), **Olga Brezhneva** and **Doug E. Ward**, Miami University.

PDE Methods in Several Complex Variables (Code: SS 6A), **Jeffery D. McNeal**, Ohio State University, and **Emil J. Straube**, Texas A&M University.

Quantum Topology (Code: SS 13A), **Sergei Chmutov** and **Thomas Kerler**, Ohio State University.

Random Matrices and Non-commutative Probability (Code: SS 12A), **Wlodzimierz Bryc**, University of Cincinnati, and **Narcisse J. Randrianantoanina**, Miami University.

Spectral Theory, Orbifolds, Symplectic Reduction and Quantization. (Code: SS 15A), **William Kirwin**, University of Notre Dame, and **Christopher Seaton**, Rhodes College.

Theoretical and Numerical Issues in Fluid Dynamics (Code: SS 14A), **Jie Shen**, Purdue University, and **Shouhong Wang**, Indiana University.

Time Scales: Theory and Applications (Code: SS 10A), **Ferhan M. Atici**, Western Kentucky University, and **Paul W. Eloe**, University of Dayton.

Vector Measures, Banach Spaces and Applications (Code: SS 8A), **Patrick N. Dowling**, Miami University, and **Christopher J. Lennard**, University of Pittsburgh.

Accommodations

Participants should make their own arrangements directly with the hotel of their choice and state that they will be attending the American Mathematical Society (AMS) meeting at Miami University and use **group code AMS**. The AMS is not responsible for rate changes or for the quality of the accommodations. Rates quoted do not include taxes. Hotels have varying cancellation or early checkout penalties; be sure to ask for details when making your reservation.

Best Western/Sycamore Inn (four blocks from campus), 6 E. Sycamore Street, Oxford, OH 45056; Tel: 513-523-0000, Toll Free 800-523-4678; $79/night plus applicable taxes. Includes continental breakfast and free wireless high-speed Internet access. For more information please visit `http://book.bestwestern.com/bestwestern/productInfo.do?propertyCode=36123`. **Deadline for reservations is March 1, 2007.**

Hampton Inn (one mile from campus), 5056 College Corner Pike, Oxford, OH 45056; Tel: 513-524-0114, Toll Free 800-426-7866; $80/night plus applicable taxes. Includes continental breakfast and free wireless high-speed Internet access. **Deadline for reservations is February 15, 2007.** For more information please visit `http://hamptoninn.hilton.com/en/hp/hotels/index.jhtml?ctyhocn=OXFOHHX`.

Marcum Conference Center & Inn (located on campus), 100 N. Patterson Avenue, Oxford, OH 45056; Tel: 513-529-2104; $84/night plus applicable taxes. Includes continental breakfast and free wireless high-speed Internet access. For more information please visit `www.muohio.edu/marcum`. **Deadline for reservations is February 15, 2007.**

Food Service

A list of restaurants will be available at the registration desk.

Local Information

Please visit the websites maintained by the Department of Mathematical Sciences `http://unixgen.muohio.edu/%7EMathStat/` and Miami University at `http://www.miami.muohio.edu/`. Detailed campus maps can be found at `http://www.miami.muohio.edu/about_miami/virtual_tour/campusmap/index.cfm`. A basic map of Oxford streets can be found at `http://www.miami.muohio.edu/about_miami/visitingmiami/oxfordstreets.cfm`.

Other Activities

AMS Book Sale: Examine the newest titles from AMS! Complimentary coffee will be served, courtesy of AMS Membership Services. The AMS Book Sale will operate during the same hours as registration. The Book Sale is in Room 118, Bachelor Hall.

AMS Editorial Activity: An acquisitions editor from the AMS Book program will be present to speak with Prospective authors. If you have a book project that you would like to discuss with the AMS please stop by the book exhibit.

Parking

Visitors to campus should park in the Cook Field parking lot across the street from Bachelor Hall. A temporary visitor parking pass can be obtained at the registration desk.

Registration and Meeting Information

The registration desk will be open 7:30 a.m. to 4:00 p.m. on Friday, and 8:00 a.m. to noon on Saturday in Room 115, Bachelor Hall. Talks will take place in Bachelor and Culler Halls.

Registration fees: (payable on-site only) $40/AMS members; $60/nonmembers; $5/emeritus members, students, or unemployed mathematicians. Fees are payable by cash, check, VISA, Mastercard, Discover, and American Express. Debit cards are not accepted.

Travel

By air: The Cincinnati/Northern Kentucky Airport (approximately an hour south of Oxford in northern Kentucky off I-275), and Dayton International Airport (approximately an hour northeast of Oxford in Vandalia off I-70E) are the two major facilities located within the shortest distance to Oxford (approximately one hour).

There is no regular public transportation from either of these airports to Oxford. The most reliable airport transportation service is provided by appointment only by Bob's Need-A-Ride: 513-523-6840 or 800-891-0064, or e-mail: `oxfordlimo@aol.com`. Prices vary according to the number of passengers.

By Car: Most persons driving to the campus will come by way of one of the routes below. Should you be coming by a different route please check MapQuest.

Directions to Oxford: State Route 27 and State Route 73 are the main highways to Oxford.

From the northeast: I-70 to State Route 127 south to State Route 73 west.

From the northwest: I-70 to State Route 27 south.

From the south: I-275 to State Route 27 north.

From the southwest: I-74 to I-275 north/east to State Route 27 north.

From the east and north: I-75 to State Route 129 west to State Route

177 west to State Route 73 west; or I-70 to State Route 127 south to 73 west.

For more travel-related information please visit `http://www.miami.muohio.edu/parents/transportation.cfm`.

Car Rental

Avis is the official car rental company for the sectional meeting in Oxford, Ohio.

All rates include unlimited free mileage. Weekend daily rates are available from noon Thursday–Monday at 11:59 p.m. and start at US$24 per day. Rates for this meeting are effective March 3, 2007–March 9, 2007. Should a lower qualifying rate become available at the time of booking, Avis is pleased to offer a 5% discount off the lower qualifying rate or the meeting rate, whichever is lowest. Rates do not include any state or local surcharges, tax, optional coverages, or gas refueling charges. Renters must meet Avis' age, driver, and credit requirements. Reservations can be made by calling 800-331-1600 or online at `www.avis.com`. Meeting **Avis Discount Number B159266**.

Weather

Weather conditions in Oxford during mid-March are cool. Temperatures range from around 52° F during the day to around 32° F at night. There is a 40% chance of precipitation.

Information for International Participants

Visa regulations are continually changing for travel to the United States. Visa applications may take from three to four months to process and require a personal interview, as well as specific personal information. International participants should view the important information about traveling to the U.S. found at `http://www7.nationalacademies.org/visas/Traveling_to_US.html` and `http://travel.state.gov/visa/index.html`. If you need a preliminary conference invitation in order to secure a visa, please send your request to `dls@ams.org`.

If you discover you do need a visa, the National Academies website (see above) provides these tips for successful visa applications:

* Visa applicants are expected to provide evidence that they are intending to return to their country of residence. Therefore, applicants should provide proof of "binding" or sufficient ties to their home country or permanent residence abroad. This may include documentation of the following:
- family ties in home country or country of legal permanent residence
- property ownership
- bank accounts
- employment contract or statement from employer stating that the position will continue when the employee returns;

* Visa applications are more likely to be successful if done in a visitor's home country than in a third country;

* Applicants should present their entire trip itinerary, including travel to any countries other than the United States, at the time of their visa application;

* Include a letter of invitation from the meeting organizer or the U.S. host, specifying the subject, location and dates of the activity, and how travel and local expenses will be covered;

* If travel plans will depend on early approval of the visa application, specify this at the time of the application;

* Provide proof of professional scientific and/or educational status (students should provide a university transcript).

This list is not to be considered complete. Please visit the web sites above for the most up-to-date information.

Hoboken, New Jersey

Stevens Institute of Technology

April 14–15, 2007

Saturday - Sunday

Meeting #1026

Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: February 2007
Program first available on AMS website: March 8, 2007
Program issue of electronic *Notices*: April 2007
Issue of *Abstracts*: Volume 28, Issue 2

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: December 26, 2006
For abstracts: February 27, 2007

Invited Addresses

Neal Koblitz, University of Washington, *Title to be announced.*

Florian Luca, Universidad Nacional Autónoma de México, *Title to be announced.*

Natasa Pavlovic, Princeton University, *Title to be announced.*

Elisabeth Werner, Case Western Reserve University, *Title to be announced.*

Special Sessions

Affine Invariants, Randomness, and Approximation in Convex Geometry (Code: SS 2A), **Elisabeth Werner**, Case West-

ern Reserve University, and **Artem Zvavitch**, Kent State University.

Automorphic Forms and Arithmetic Geometry (Code: SS 5A), **Gautam Chinta**, City College of New York, and **Paul E. Gunnells**, University of Massachusetts, Amherst.

Combinatorial Algebraic Geometry (Code: SS 9A), **Angela C. Gibney**, University of Pennsylvania, and **Diane Maclagan**, Rutgers University.

Convex Sets (Code: SS 1A), **David Larman**, University College London, and **Valeriu Soltan**, George Mason University.

Differential Algebra (Code: SS 4A), **Phyllis J. Cassidy**, Smith College and The City College of CUNY, **Richard C. Churchill**, Hunter College and The Graduate Center of CUNY, **Li Guo** and **William F. Keigher**, Rutgers University at Newark, and **Jerald J. Kovacic** and **William Sit**, The City College of CUNY.

Fourier Analysis and Convexity (Code: SS 3A), **Alexander Koldobsky**, University of Missouri Columbia, and **Dmitry Ryabogin**, Kansas State University.

Graph Theory and Combinatorics (Code: SS 11A), **Daniel J. Gross**, **Nathan W. Kahl**, and **John T. Sacoman**, Seton Hall University, and **Charles L. Suffel**, Stevens Institute of Technology.

History of Mathematics on Leonhard Euler's Tercentenary (Code: SS 8A), **Patricia R. Allaire**, Queensborough Community College, CUNY, and **Robert E. Bradley** and **Lee J. Stemkoski**, Adelphi University.

Languages and Groups (Code: SS 6A), **Sean Cleary**, The City College of New York and CUNY Graduate Center, **Murray J. Elder**, Stevens Institute of Technology, and **Gretchen Ostheimer**, Hofstra University.

Mathematical Aspects of Cryptography (Code: SS 7A), **Robert H. Gilman**, Stevens Institute of Technology, **Neal I. Koblitz**, University of Washington, and **Susanne Wetzel**, Stevens Institute of Technology.

Nonlinear Waves in Disipative/Dispersive Media (Code: SS 12A), **Keith S. Promislow**, Michigan State University, and **Yi Li**, Stevens Institute of Technology.

Number Theory (Code: SS 10A), **Florian Luca**, Universidad Nacional Autónoma de México, and **Allison M. Pacelli**, Williams College.

Tucson, Arizona

University of Arizona

April 21–22, 2007
Saturday - Sunday

Meeting #1027
Western Section
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: February 2007
Program first available on AMS website: March 8, 2007
Program issue of electronic *Notices*: April 2007
Issue of *Abstracts*: Volume 28, Issue 2

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: January 2, 2007
For abstracts: February 27, 2007

Invited Addresses

Liliana Borcea, Rice University, *Title to be announced.*

James Cushing, University of Arizona, Tucson, *Title to be announced.*

Hans Lindblad, University of California, San Diego, *Title to be announced.*

Vinayak Vatsal, University of British Columbia, Vancouver, *Title to be announced.*

Special Sessions

Advances in Spectral Theory of Operators (Code: SS 12A), **Roger Roybal**, California State University, Channel Islands, and **Michael D. Wills**, Weber State University.

Algebraic Combinatorics (Code: SS 14A), **Helene Barcelo** and **Susanna Fishel**, Arizona State University.

Automorphisms of Curves (Code: SS 4A), **Aaron D. Wootton**, University of Portland, **Anthony Weaver**, Bronx Community College, and **S. Allen Broughton**, Rose-Hulman Institute of Technology.

Graph Theory and Combinatorics (Code: SS 9A), **Sebastian M. Cioaba**, University of California at San Diego, and **Joshua Cooper**, University of South Carolina.

Inverse Problems for Wave Propagation (Code: SS 2A), **Liliana Borcea**, Rice University.

Mathematical Modeling in Biology and Medicine (Code: SS 3A), **Carlos Castillo-Chavez**, **Yang Kuang**, **Hal L. Smith**, and **Horst R. Thieme**, Arizona State University.

Moduli Spaces and Invariant Theory (Code: SS 7A), **Philip Foth** and **Yi Hu**, University of Arizona.

New Developments and Directions in Random Matrix Theory (Code: SS 13A), **Peter David Miller**, University of Michigan, and **Estelle Basor**, California Polytechnic State University.

Number Theory in the Southwest (Code: SS 10A), **Dinesh S. Thakur** and **Douglas L. Ulmer**, University of Arizona.

Operator Algebras (Code: SS 6A), **Steven P. Kaliszewski**, **Jack Spielberg**, and **John C. Quigg**, Arizona State University.

Partial Differential Equations and Geometric Analysis (Code: SS 11A), **Sunhi Choi**, **Lennie Friedlander**, and **David Alan Glickenstein**, University of Arizona.

Representations of Algebras (Code: SS 1A), **Frauke Maria Bleher**, University of Iowa, **Birge K. Huisgen-Zimmermann**, University of California Santa Barbara, and **Dan Zacharia**, Syracuse University.

Special Functions and Orthogonal Polynomials (Code: SS 15A), **Diego Dominici**, State University of New York at New Paltz, and **Robert S. Maier**, University of Arizona.

Spectral Analysis on Singular and Noncompact Manifolds (Code: SS 8A), **Juan Bautista Gil**, Pennyslvania State University, and **Thomas Krainer**, Pennsylvania State University.

Subjects in and Around Fluid Dynamics (Code: SS 5A), **Robert Owczarek**, Los Alamos National Laboratory, and **Mikhail Stepanov**, University of Arizona.

Zacatecas, Mexico

Universidad Autónoma de Zacatecas

May 23–26, 2007

Wednesday – Saturday

Meeting #1028

Seventh Joint International Meeting of the AMS and the Sociedad Matematica Mexicana.
Associate secretary: Matthew Miller
Announcement issue of *Notices*: March 2007
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: To be announced
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Warsaw, Poland

University of Warsaw

July 31 – August 3, 2007

Tuesday – Friday

Meeting #1029

First Joint International Meeting between the AMS and the Polish Mathematical Society
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: To be announced
Program first available on AMS website: Not applicable
Program issue of electronic *Notices*: Not applicable
Issue of *Abstracts*: Not applicable

Deadlines

For organizers: December 31, 2006
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Invited Addresses

Henryk Iwaniec, Rutgers University, *Title to be announced.*

Tomasz J. Luczak, Adam Mickiewicz University, *Title to be announced.*

Tomasz Mrowka, Massachusetts Institute of Technology, *Title to be announced.*

Ludomir Newelski, University of Wroclaw, *Title to be announced.*

Madhu Sudan, Massachusetts Institute of Technology, *Title to be announced.*

Anna Zdunik, Warsaw University, *Title to be announced.*

Special Sessions

Complex Dynamics, **Robert Devaney**, Boston University, **Jane N. Hawkins**, University of North Carolina, and **Janina Kotus**, Warsaw University of Technology.

Dynamical Systems, **Steven Hurder**, University of Illinois at Chicago, **Michal Misiurewicz**, Indiana University-Purdue University Indianapolis, and **Pawel Walczak**, University of Lodz.

Geometric Applications of Homotopy Theory, **Yuli B. Rudyak**, University of Florida, **Boguslaw Hajduk**, Warsaw University, **Jaroslaw Kedra**, University of Aberdeen, and **Aleksy Tralle**, The College of Economics & Comp Science.

Geometric Group Theory, **Mladen Bestvina**, University of Utah, **Tadeusz Januszkiewicz**, Ohio State University, and **Jacek Swiatkowski**, University of Wroclaw.

Partial Differential Equations of Evolution Type, **Susan J. Friedlander**, University of Illinois at Chicago, and **Grzegorz A. Karch**, University of Wroclaw.

Chicago, Illinois

DePaul University

October 5–6, 2007

Friday – Saturday

Meeting #1030

Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: August 2007
Program first available on AMS website: August 16, 2007
Program issue of electronic *Notices*: October 2007
Issue of *Abstracts*: Volume 28, Issue 3

Deadlines

For organizers: March 6, 2007
For consideration of contributed papers in Special Sessions: June 19, 2007
For abstracts: August 7, 2007

Invited Addresses

Martin Golubitsky, University of Houston, *Title to be announced.*

Matthew J. Gursky, University of Notre Dame, *Title to be announced.*

Alex Iosevich, University of Missouri, *Title to be announced.*

David E. Radford, University of Illinois at Chicago, *Title to be announced.*

Special Sessions

Algebraic Combinatorics: Association Schemes and Related Topics (Code: SS 1A), **Sung Y. Song**, Iowa State University and **Paul Terwilliger**, University of Wisconsin.

New Brunswick, New Jersey

Rutgers University-New Brunswick, Busch Campus

October 6–7, 2007

Saturday - Sunday

Meeting #1031

Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: August 2007
Program first available on AMS website: August 16, 2007
Program issue of electronic *Notices*: October 2007
Issue of *Abstracts*: Volume 28, Issue 3

Deadlines

For organizers: March 6, 2007
For consideration of contributed papers in Special Sessions: June 19, 2007
For abstracts: August 7, 2007

Invited Addresses

Sir Roger Penrose, University of Oxford, *Title to be announced* (Einstein Public Lecture in Mathematics).

Special Sessions

Commutative Algebra (Code: SS 4A), **Jooyoun Hong**, University of California Riverside, and **Wolmer V. Vasconcelos**, Rutgers University.

Mathematical and Physical Problems in the Foundations of Quantum Mechanics (in Honor of Shelly Goldstein's 60th Birthday) (Code: SS 3A), **Roderich Tumulka** and **Detlef Dürr**, München University, and **Nino Zanghi**, University of Genova.

Partial Differential Equations in Mathematical Physics (in Honor of Shelly Goldstein's 60th Birthday) (Code: SS 2A), **Sagun Chanillo**, **Michael K.-H. Kiessling**, and **Avy Soffer**, Rutgers University.

Probability and Combinatorics (Code: SS 1A), **Jeffry N. Kahn** and **Van Ha Vu**, Rutgers University.

Set Theory of the Continuum (Code: SS 5A), **Simon R. Thomas**, Rutgers University.

Albuquerque, New Mexico

University of New Mexico

October 13–14, 2007

Saturday - Sunday

Meeting #1032

Western Section
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: August 2007
Program first available on AMS website: August 30, 2007
Program issue of electronic *Notices*: October 2007
Issue of *Abstracts*: Volume 28, Issue 4

Deadlines

For organizers: March 13, 2007
For consideration of contributed papers in Special Sessions: June 26, 2007
For abstracts: August 21, 2007

Invited Addresses

Emmanuel Candes, California Institute of Technology, *Title to be announced.*

Alexander Polischuk, Univerity of Oregon, *Title to be announced.*

Eric Raines, University of California Davis, *Title to be announced.*

William E. Stein, University of California San Diego, *SAGE: Software for Algebra and Geometry Experimentation.*

Murfreesboro, Tennessee

Middle Tennessee State University

November 3–4, 2007

Saturday - Sunday

Meeting #1033

Southeastern Section
Associate secretary: Matthew Miller
Announcement issue of *Notices*: September 2007
Program first available on AMS website: September 20, 2007
Program issue of electronic *Notices*: November 2007
Issue of *Abstracts*: Volume 28, Issue 4

Deadlines

For organizers: April 3, 2007
For consideration of contributed papers in Special Sessions: July 17, 2007
For abstracts: September 11, 2007

Invited Addresses

Daniel K. Nakano, University of Georgia, *Title to be announced.*

Carla D. Savage, North Carolina State University, *Title to be announced.*

Sergei Tabachnikov, Pennsylvania State University, *Title to be announced.*

Special Sessions

Advances in Algorithmic Methods for Algebraic Structures (Code: SS 3A), **James B. Hart**, Middle Tennessee State University.

Applied Partial Differential Equations (Code: SS 4A), **Yuri A. Melnikov**, Middle Tennessee State University, and **Alain J. Kassab**, University of Central Florida.

Differential Equations and Dynamical Systems (Code: SS 1A), **Wenzhang Huang** and **Jia Li**, University of Alabama, Huntsville, and **Zachariah Sinkala**, Middle Tennessee State University.

Graph Theory (Code: SS 2A), **Rong Luo**, **Chris Stephens**, and **Xiaoya Zha**, Middle Tennessee State University.

Wellington, New Zealand

To be announced

December 12–15, 2007

Wednesday – Saturday

Meeting #1034

First Joint International Meeting between the AMS and the New Zealand Mathematical Society (NZMS).
Associate secretary: Matthew Miller
Announcement issue of *Notices*: To be announced
Program first available on AMS website: Not applicable
Program issue of electronic *Notices*: Not applicable
Issue of *Abstracts*: Not applicable

Deadlines

For organizers: March 31, 2007
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

AMS Special Sessions

Computability Theory, **Rodney G. Downey** and **Noam Greenberg**, Victoria University of Wellington.

Hopf Algebras and Quantum Groups, **M. Susan Montgomery**, University of Southern California, and **Yinhuo Zhang**, Victoria University of Wellington.

Infinite-dimensional Groups and Their Actions, **Christopher Atkin**, Victoria University of Wellington, **Greg Hjorth**, University of California Los Angeles/University of Melbourne, **Alica Miller**, University of Louisville, and **Vladimir Pestov**, University of Ottawa.

New Trends in Spectral Analysis and Partial Differential Equations, **Boris P. Belinskiy**, University of Tennessee, Chattanooga, **Anjan Biswas**, Delaware State University, and **Boris Pavlov**, University of Auckland.

San Diego, California

San Diego Convention Center

January 6–9, 2008

Sunday – Wednesday
Joint Mathematics Meetings, including the 114th Annual Meeting of the AMS, 91st Annual Meeting of the Mathematical Association of America (MAA), annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association for Symbolic Logic (ASL), with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: October 2007
Program first available on AMS website: November 1, 2007
Program issue of electronic *Notices*: January 2008
Issue of *Abstracts*: Volume 29, Issue 1

Deadlines

For organizers: April 1, 2007
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

New York, New York

Courant Institute of New York University

March 22–23, 2008

Saturday – Sunday
Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: August 22, 2007
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Special Sessions

L-Functions and Automorphic Forms (Code: SS 1A), **Alina Bucur**, Institute for Advanced Study, **Ashay Venkatesh**, Courant Instituteof Mathematical Sciences, **Stephen D.**

Miller, Rutgers University, and **Steven J. Miller**, Brown University.

Baton Rouge, Louisiana

Louisiana State University, Baton Rouge

March 28–30, 2008
Friday - Sunday
Southeastern Section
Associate secretary: Matthew Miller
Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines
For organizers: August 28, 2007
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Bloomington, Indiana

Indiana University

April 4–6, 2008
Friday - Sunday
Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines
For organizers: September 4, 2007
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Claremont, California

Claremont McKenna College

May 3–4, 2008
Saturday - Sunday
Western Section
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines
For organizers: October 4, 2007
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Rio de Janeiro, Brazil

Instituto Nacional de Matemática Pura e Aplicada (IMPA)

June 4–7, 2008
Wednesday - Saturday
First Joint International Meeting between the AMS and the Sociedade Brasileira de Matemática.
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines
For organizers: To be announced
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Vancouver, Canada

University of British Columbia and the Pacific Institute of Mathematical Sciences (PIMS)

October 4–5, 2008
Saturday - Sunday
Western Section
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines
For organizers: March 9, 2008
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Middletown, Connecticut

Wesleyan University

October 11–12, 2008

Saturday – Sunday
Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: March 11, 2008
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Huntsville, Alabama

University of Alabama, Huntsville

October 24–26, 2008

Friday – Sunday
Southeastern Section
Associate secretary: Matthew Miller
Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: March 24, 2008
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Shanghai, People's Republic of China

Fudan University

December 17–21, 2008

Wednesday – Sunday
First Joint Interntional Meeting Between the AMS and the Shanghai Mathematical Society
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: To be announced
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Washington, District of Columbia

Marriott Wardman Park Hotel and Omni Shoreham Hotel

January 7–10, 2009

Wednesday – Saturday
Joint Mathematics Meetings, including the 115th Annual Meeting of the AMS, 92nd Annual Meeting of the Mathematical Association of America (MAA), annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association for Symbolic Logic (ASL), with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: October 2008
Program first available on AMS website: November 1, 2008
Program issue of electronic *Notices*: January 2009
Issue of *Abstracts*: Volume 30, Issue 1

Deadlines

For organizers: April 1, 2008
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Urbana, Illinois

University of Illinois at Urbana-Champaign

March 27–29, 2009

Friday – Sunday
Southeastern Section
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: August 29, 2008
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Raleigh, North Carolina

North Carolina State University

April 4–5, 2009

Saturday – Sunday
Southeastern Section
Associate secretary: Matthew Miller
Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: September 4, 2008
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

San Francisco, California

San Francisco State University

April 25–26, 2009

Saturday – Sunday
Western Section
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: September 25, 2008
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

San Francisco, California

Moscone Center West and the San Francisco Marriott

January 6–9, 2010

Wednesday – Saturday
Joint Mathematics Meetings, including the 116th Annual Meeting of the AMS, 93rd Annual Meeting of the Mathematical Association of America (MAA), annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association for Symbolic Logic (ASL), with sessions contributed by the Society of Industrial and Applied Mathematics (SIAM).
Associate secretary: Matthew Miller
Announcement issue of *Notices*: October 2009
Program first available on AMS website: November 1, 2009
Program issue of electronic *Notices*: January 2010
Issue of *Abstracts*: Volume 31, Issue 1

Deadlines

For organizers: April 1, 2009
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

New Orleans, Louisiana

New Orleans Marriott and Sheraton New Orleans Hotel

January 5–8, 2011

Wednesday – Saturday
Joint Mathematics Meetings, including the 117th Annual Meeting of the AMS, 94th Annual Meeting of the Mathematical Association of America, annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association for Symbolic Logic (ASL), with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: October 2010
Program first available on AMS website: November 1, 2010
Program issue of electronic *Notices*: January 2011
Issue of *Abstracts*: Volume 32, Issue 1

Deadlines

For organizers: April 1, 2010
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Boston, Massachusetts

John B. Hynes Veterans Memorial Convention Center, Boston Marriott Hotel, and Boston Sheraton Hotel

January 4–7, 2012

Wednesday – Saturday
Joint Mathematics Meetings, including the 118th Annual Meeting of the AMS, 95th Annual Meeting of the Mathematical Association of America, annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association for Symbolic Logic (ASL), with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: October 2011
Program first available on AMS website: November 1, 2011
Program issue of electronic *Notices*: January 2012
Issue of *Abstracts*: Volume 33, Issue 1

Deadlines

For organizers: April 1, 2011
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

San Diego, California

San Diego Convention Center and San Diego Marriott Hotel and Marina

January 9–12, 2013

Wednesday – Saturday
Joint Mathematics Meetings, including the 119th Annual Meeting of the AMS, 96th Annual meeting of the Mathematical Association of America, annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association for Symbolic Logic (ASL), with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).
Associate secretary: Lesley M. Sibner
Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

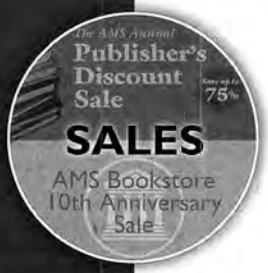
For organizers: April 1, 2012
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

AMERICAN MATHEMATICAL SOCIETY

The AMS Bookstore

www.ams.org/bookstore

Where you can ...



- **Get the best deals on AMS titles**
  - Special Member Pricing — up to 20% off
  - Online sales every month – discounts up to 75%

- **Browse new and forthcoming books from the AMS**
  - View the Table of Contents
  - Read a sample chapter
  - Visit the author's supplementary material page
  - Browse the "What's New" section for upcoming titles

- **Find the right textbook for your course**
  - Course adoption titles sorted by subject area
  - Specifically designed for undergraduate or graduate courses

Go to the AMS Online Bookstore

www.ams.org/bookstore

Presenters of Papers

New Orleans, Louisiana; January 5–8, 2007

Numbers following the name indicate the speaker's position on the program.
*◇ AMS-MAA Invited Lecturer, • AMS Invited Lecturer, ○ MAA Invited Lecturer, □ AWM Emmy Noether Lecturer, ■ NAM Invited Lecturer, ◊ ASL Invited Lecturer, ▲ SIAM Invited Lecturer, * Special Session Speaker, ► Graduate Student, ◄ Undergraduate Student*

Abbey, M. K. 909
Abi Khuzam, F. F. 506
►Abramov, V. 1445
*Abrams, A. D. 246
Abrams, W. P. 1485
*Ackerberg-Hastings, A. .. 1578
Ackleh, A. S. 409
*Ackleh, A. S. 1403
Ackleh, A. 891
Adams, C. C. 366
*Adams, M. E. 1184
Adams, S. S. 796
*Adams, S. S. 52
Adams, S. 866
*Adams, S. 1134
►Adhikari, D. R. 1690
Agbegha, G. Y. 1523
Agras, N. M. 107
Agras, N. 910
Agrawal, K. M. 567
*Ahmed, N. 957
*Ahner, D. K. 731
*Akbas, E. 1597
*Akhmedov, A. 1409
*Akin-Bohner, E. 1421
Alayont, F. 579
Alekseenko, A. 764
Alewine, J. A. 385
Allali, M. 603
Allali, M. 892
►Allen, P. T. 535
*Alm, J. F. 1185
Almog, Y. 187
Almonte, R. M. 98
*Alperin, J. L. 482
*Alvarez Paiva, J.-C. 721
*Ambartsoumian, G. 461
►Ameur, K. 1011
*Anastassiou, G. A. 959
►Andersen, T. D. 763
*Anderson, D. 1646
Anderson, J. 1354
*Arino, J. 1616
Arrigo, D. 302
*Arthur, J. 950
Aryana, C. P. 1255
*Asaeda, M. 39
Ash, J. M. 862
Ashbacher, C. 1063
Ashe, D. J. 995
Ashton, B. A. 599
►Ashton, T. 1072
Aslaksen, H. 606
►Aslan, B. C. 77
►Atanasov, R. 1262
Atela, P. 180
Athanassov, Z. S. 737
◄Attarian, A. R. 1696
*Atzema, E. J. 1388
Aubrey, J. A. 148
Averkov, G. 757
Awanou, G. 1705
Axtell, M. 612
Ayati, B. P. 639
Azarian, M. K. 1703
Bacon, M. R. 388
►Badertscher, E. M. 626
►Badiu, F. V. 538
Baggett, P. 820
Bahls, P. 803
Bahls, P. 1207
*Baker, M. H. 1656
*Baldridge, S. 1572
*◄Bansal, R. 432
►Bao, N. 1019
Barannyk, L. 544
►Bard, G. V. 95
Bardzell, M. J. 1746
Bardzell, M. 894
►Barg, M. 1694
Barnett, J. 7
Barnhill, A. K. 1537
Barrett, D. 660
*◄Barrette, B. P. 1110
*Barrow-Green, J. 1122
Barry, M. J. 1524
Bartelt, M. W. 861
◄Bass, J. A. 551
*Bauman, P. 470
*►Baykur, R. I. 1628
►Bayless, J. W. 552
*Bayraktar, E. 67
Bayram, S. 1015
Beaugris, L. M. 1330
Beaugris, L. M. 1757
Beaver, S. F. 198
Beck, S. R. 1045
*►Beck, V. 243
*Beckmann, C. E. 1569
*Becnel, J. J. 1148
►Beeler, R. A. 1233
Behrens, C. E. 596
*Behrstock, J. A. 25
Beineke, J. 319
Bekralas, R. 1795
Belcastro, S.-M. 377
*Bell, R. W. 27
Bendame, M. 667
Bendame, M. 1088
*Bendel, C. P. 56
Benedetto, J. J. 1292
*Benedetto, J. J. 1123
*Benedetto, R. L. 1655
Benesh, B. 610
Benjamin, A. T. 368
Bennethum, L. S. 1549
Benson, S. R. 816
*Bentz, W. 1186
Benzel, S. 542
*Berggren, J. L. 942
*von Bergmann, J. 1621
Bergner, J. 1536
*Bernstein, M. 207
Berry, M. L. 1281
Besana, G. 773
Betcke, T. 1462
►Bevzushenko, M. 524
Bezandry, P. H. 1788
*Bezrukavnikov, R. V. 262
•Bhargava, M. 924
Bhatnagar, S. C. 1303
Bhatta, D. D. 308
Bhattacharya, C. 634
Biebighauser, D. P. 644
*Bielecki, T. R. 487
Bimbó, K. 1362
Birgen, B. J. 589
*Blair, M. D. 474
Blyth, R. D. 158
Blyth, R. D. 605
►Bode, J. S. 1266
*Boden, H. U. 1413
*Boe, B. D. 266
►Boester, T. C. 619
*Bona, J. L. 188
*Bona, J. L. 694
*Bona, J. L. 978
○Bona, J. L. 1552
*Bonin, J. E. 1640
*Borden, A. G. 213
*►Boronski, J. P. 233
*Borwein, J. M. 59
Boubendir, Y. 402
*Bourdin, B. 656
Bouthellier, P. R. 132
Bouthellier, P. R. 604
Bovell, C. R. 1050
Bovell, C. 395
*Bracken, P. F. 1197
*Bradley, D. M. 276
Bradley, R. E. 6
Bradley, R. E. 131
*Bradley, R. E. 1386
*Brady, N. 224
*Breard, A. 1113
*►Bredies, K. 1603
►Bremer, C. L. 777
*Brendle, T. E. 688
*Brennan, J. P. 449
Bressoud, D. M. 1283
*Bressoud, D. M. 1571
Bridger, M. 785
*Broaddus, N. D. 1596
○Brock, J. F. 1080
Brooks, B. P. 1073
►Brooks, C. D. 1245
*Brown, J. D. 1170
*Brown, L. G. 1138
Brueggeman, S. 555
Bruff, D. 381
Brunson, B. 109
*Buchman, L. T. 1167
Bucki, A. 751
►Buckner, J. 1212
Buechner, J. 595
Buescu, C. 1723
Burdick, B. S. 130
Burkholder, D. G. 637
►Burks, R. E. 1373
Burns, A. M. 331
Burton, K. S. 115
*◄Burwood, J. L. 429
*Buser, P. 1665
*Buss, A. 732
*Buss, S. 214
Buteau, C. 753

► Butler, S. 1239
* Bux, K.-U. 28
Byrne, J. W. 380
*◄ Cahn, P. R. 1103
Cai, W. 397
Caldwell, C. K. 164
Calinger, R. S. 4
* Callender, C. 454
► Callender, H. L. 1016
Calzada, M. E. 1793
Camacho, E. T. 641
* Campbell, H. E. 442
Candel, A. 1755
Canfield, W. E. 576
Caniglia, J. C. 1499
◄ Caraiani, A. 314
► Carden, R. L. 99
* Carter, D. W. 729
Carter, N. C. 159
* Carvalho, L. N. 1600
* Casati, P. 980
* Casazza, P. G. 948
Case, J. O. 376
Chakrabarti, M. 172
Chakrabarti, M. 568
* Chamberland, M. 60
* Champanerkar, A. 237
Charlwood, K. E. 1486
* Charney, R. 242
* Charny, A. 203
Chartier, T. 364
Che, A. 869
Che, Z. 993
Chelst, D. N. 499
Chelst, D. N. 1299
Chen, D. 1244
Chen, G. 645
* Chen, H. 439
* Chen, J.-P. J. 1385
Chen, M. 334
* Chen, M. 437
► Chen, X. 304
Chen, Z. 1032
Cherepinsky, V. 566
Cherepinsky, V. 1782
* Cheridito, P. 69
Cherif, C. 1341
* Cherkaev, A. 726
* Chew, E. 717
* Choi, D. 1169
Choi, J. 546
Choi, J. 1522
► Choi, J. 855
Choi, Y. 1083
* Chow, P.-L. 1143
◄ Chowdhury, A. 1223
* Chowell, G. 1618
► Chrisman, M. W. 1264
*► Christensen, J. G. 1132
*► Chuan, C.-H. 718
*► Chun, C. 1418
Chung, J. 791
* Ciubotaru, D. 1533
* Clampitt, D. 451
Clark, J. W. 163
Clark, K. M. 665
Clemence, D. 901
Cobb, P. A. 1061
* Cochran, T. D. 234
Coe, P. R. 1295
Cofer, T. 577
Cofer, T. 818
Cogan, N. G. 638
► Cogdill, T. 1287
* Cojocaru, A. 1662
Collins, D. G. 530
* Colombeau, J. 1606
Comanici, A. N. 998
Comar, T. D. 572
Comar, T. D. 1278
Comar, T. D. 1539
Comfort, W. W. 1222
* Conant, J. R. 692
Conjura, E. J. 1482
Connors, M. 332
Connors, M. 658
* Constantin, E. 958
Constantinescu, C. D. 1452
Cook, S. V. 787
*◄ Cooley, C. A. 936
Coomes, B. A. 515
Cooper, C. N. 557
*► Corry, S. 1429
Cortez, R. 642
* Costello, D. J. 49
Cotwright, C. D. 1355
Covington, J. 807
Covington, J. 1766
* Cox, D. A. 1669
Cox, S. J. 640
Cox, T. B. 1317
Coxson, G. E. 1288
* Craig, W. 436
Crans, A. S. 1534
* Crass, S. 249
Crawford, P. 831
Crawley, J. W. 1314
Crisman, K.-D. 782
Crittenden, K. 839
Crumb, C. A. 1074
Cudia, D. F. 1803
Cunningham, K. A. 1504
* Curran, R. P. 1438
* Curry, E. 274
Curry, J. 875
* Curtis, C. L. 239
* Cushing, J. M. 1402
* Cutkosky, S. D. 1679
► Daenzer, C. 295
◄ Dahlhaus, C. K. 1084
Dai, J. 1328
* Daniels, M. L. 1574
Dannon, H. V. 1502
D'Antonio, L. D. 11
Darken, B. 629
Dastrange, N. 494
* Dauben, J. W. 941
► David, R. J. 1466
*► Davie, E. K. 1595
* Davis, J. M. 1653
* Davis, J. R. 1408
* Davis, M. D. 1584
Dean, N. 372
DeCoste, R. C. 522
DeCoste, R. C. 1351
DeDeo, M. R. 1352
Deemer, T. 920
Deka Baruah, N. 90
DeLand, D. 671
DeLand, D. 1089
◄ Del Angel, R. A. 1721
Delcroix, S. D. 1214
De Leon, D. 1706
DeLong, M. E. 620
DeMaio, J. 1064
* Deng, K. 1404
* Denham, G. 45
Derek, B. 827
* Derksen, H. 244
* Derksen, H. 701
▲ DeRose, T. 676
Dettori, L. 1710
Devlin, S. 1743
◇ Diaconis, P. W. 1095
Diaz, D. 874
► Dib, Y. M. 1020
Diesl, A. J. 101
* Dijkstra, J. J. 232
Dillery, D. S. 111
Ding, G. 850
Ding, W. 1535
Dinov, I. D. 1791
◄ Dixon, C. M. 618
Dobranski, M. 1768
Dobrinen, N. 677
Doehler, K. 1798
von Dohlen, P. 1071
* Dominici, D. E. 273
* Domokos, M. 700
Dorais, F. 1799
◄ Dorcely, R. 371
Dorff, M. 369
Dorsey, T. J. 102
Douady, S. 181
◄ Dovidio, N. A. 416
*◄ Dowdall, N. E. 682
► Draganova, A. 1735
◄ Drake, A. 1758
Dray, T. 631
Dray, T. 867
Dray, T. 868
► Drew, A. J. 1013
► Drew, S. 768
* van den Driessche, P. 1615
Dudík, M. 2
Dumett, M. A. 1701
Dumitraşcu, C. D. 1347
► Dumitru, R. 1515
Dunham, P. H. 578
Dunham, P. H. 1313
* Dupire, B. 278
Durfee, A. 1268
Dye, H. A. 614
* Dye, H. A. 704
Edwards, C. C. 630
Edwards, S. 498
* Effros, E. G. 1137
▫ Efron, B. 425
* Eftekhary, E. 1629
Egge, E. S. 1738
Ehme, J. A. 739
► Ehrke, J. E. 742
* Eisenbud, D. 1677
Elalaoui-Talibi, H. 1443
* Elaydi, S. N. 1405
* Elder, K. R. 719
Elezi, A. 778
ELHoubi, A. F. 1796
Elkhader, A. S. 1297
* Elkin, A. 1435
* Ellenberg, J. S. 1427
Ellermeyer, S. F. 1068
Ellingham, M. 854
Ellington, A. J. 1767
* Eloe, P. W. 1420
► Ely, R. E. 1027
Emelianenko, M. 762
Emerson, N. D. 516
Emerson-Stonnell, S. S. 802
Englund, T. F. 1371
► Epshteyn, Y. 1553
Epstein, J. S. 632
Epstein, J. S. 1481
* Erbe, L. H. 1419
*◄ Erickson, C. 1108
Erickson, K. A. 1714
Erickson, S. 561
Ernie, K. T. 824
* Esedoglu, S. 1158
► Esselstein, R. 989
Evan, J. 1217
► Everson, J. A. 776
Evitts, T. 663
* Evitts, T. 1381
Exner, G. R. 1687
Exner, G. R. 1775
Fadimba, K. B. 1709
Fairweather, G. 373
* Falk, M. J. 44
Farley, D. S. 1206
► Farnsworth, D. K. 1514
Fasanelli, D. F. 127
Fawaz, A. 750
* Feldvoss, J. 264
* Felea, R. 977
► Felix, D. 1229
Felkel, B. H. 146
► Feller, H. A. 147
* Feng, B.-F. 1202
Feng, P. 311
* Feng, X. 654
* Fenster, D. D. 1390
▫ Fenster, D. D. 1098
* Ferrini-Mundy, J. 1382
Ferro, R. 594
* Fickus, M. 1124
*◄ Field, K. V. 935
Fillebrown, S. 329
► Finch, C. E. 313
* Finch, D. V. 460
Fink, J. B. 1762
Finn, D. L. 299
Fischer, J. F. 1306
Fisher, M. 1236
Fitzpatrick, B. 913
Flagg, M. K. 1805
Flahive, M. 872
Flashman, M. E. 592
Flint, D. 865
Flood, T. W. 350
*► Forde, M. S. 279
◊ Foreman, M. D. 1566
Forest, M. G. 186
* Forester, M. 225
Foster, L. 888
Fowler, K. E. 842
Fox, J. A. 1338
► Fox, J. C. 1759
Fox, W. P. 1058
Fox, W. P. 1492
Fox, W. P. 1511
Fraboni, M. 508
* Francfort, G. A. 650
Francisco, C. A. 563
* Franke, J. E. 1407
* van Frankenhuijsen, M. 1664
*◄ Franklin, B. D. 931
► Franko, J. M. 1556
* Franks, J. 34
* Frauendiener, J. 1166
Freed, W. 1505
de Freitas, E. M. 1000

*◂ Fried, S. ... 933
* Friedlander, E. M. ... 269
* Friedlander, S. ... 250
▸ Friedman, O. ... 1259
Friedman, T. ... 916
▸ Frietze, S. E. ... 543
* Frittelli, M. ... 65
* Frohman, C. D. ... 36
* Fu, M. C. ... 483
Fuller, W. R. ... 927
Fulmer, J. ... 124
Fulmer, J. ... 1751
Fulton, J. P. ... 138
Fung, M. G. ... 659
* Funke, J. P. ... 1530
Funkhouser, C. P. ... 1302
Funkhouser, C. ... 921
▸ Funk-Neubauer, D. R. ... 284
▸ Furdui, O. ... 1686
* Furman, A. ... 1135
* Furst, V. ... 1128
▸ Futamura, F. ... 1563
* Futer, D. ... 235
* Gabrielov, A. ... 215
Gaff, H. D. ... 406
Gagola III, S. ... 287
Gal, C. G. ... 301
▸ Gal, N. J. ... 1253
Gallegos, A. ... 143
*▸ Galloway, M. L. ... 490
◊ Gao, S. ... 1378
* Garcia, R. ... 1183
* Garcia-Puente, L. D. ... 1673
Garfunkel, S. ... 882
Garfunkel, S. ... 883
Garfunkel, S. ... 884
Garner, M. ... 119
Garner, M. ... 819
* Garroni, A. ... 652
▸ Garthwaite, S. A. ... 1564
Gauthier, Y. ... 1366
Gaze, E. ... 392
Gaze, E. ... 1494
* Gebauer, B. ... 1609
Gebhard, D. D. ... 352
* Geelen, J. ... 1642
▸ Genova, D. ... 1561
Gera, R. M. ... 986
* Gerards, B. ... 1638
Gerenrot, D. M. ... 1274
* Gerhardy, P. ... 18
▸ Ghandehari, M. ... 310
Ghenciu, E. A. ... 339
Ghenciu, I. ... 1248
Ghenciu, P. I. ... 608
Ghenciu, P. I. ... 788
Gheorghiciuc, I. ... 988
▸ Ghimire, K. C. ... 1005
• Ghrist, R. ... 1099
Gieger, J. L. ... 805
Gieger, J. L. ... 1780
* Giesecke, K. ... 282
* Gil, J. B. ... 1192
Gillespie, J. R. ... 289
* Gilmer, P. M. ... 241
* Giné, E. ... 1145
Giorgi, T. ... 1042
Givens, B. N. ... 84
* Glass, D. B. ... 1431
▸ Glomski, M. J. ... 540
Godbole, A. P. ... 574
Godbole, A. P. ... 1784
Goff, C. ... 584
* Goins, E. H. ... 1428
Gold, B. ... 1781
Goldberg, M. J. ... 1447
Goldstein, A. ... 285
* Goldstein, G. R. ... 956
* Goldstein, J. A. ... 954
Goldsztein, G. H. ... 185
Goldsztein, G. ... 917
* Golovaty, D. ... 468
* Goncalves, D. L. ... 228
Goncharov, Y. ... 1256
* Goodstein, J. R. ... 1582
Gordon, F. S. ... 1320
Gordon, S. P. ... 112
* Goss, D. M. ... 1174
* Graef, J. R. ... 1645
Graham, K. J. ... 815
▸ Granda, L. M. ... 1276
Grant, A. E. ... 1356
* Grasmair, M. ... 1608
Gray, S. ... 907
Green, K. H. ... 1322
*▸ Greene, M. ... 1425
* Greenleaf, A. ... 464
Greeno, C. L. ... 601
Greeno, C. L. ... 1783
Greeno, C. ... 1318
* Greenspan, I. L. ... 212
Greenwald, S. J. ... 1040
Greenwell, R. N. ... 171
Greer, M. L. ... 136
◂ Grigoriev, I. ... 1726
Grimaldi, R. P. ... 1474
▸ Groh, K. ... 1275
* Gross, L. ... 1141
Grossman, J. W. ... 114
▸ Grout, J. ... 96
▸ Grout, J. ... 1748
▸ Grover, G. R. ... 740
* Groves, D. P. ... 223
Grynkiewicz, D. J. ... 1228
*▸ Gu, N. ... 1672
* Guaschi, J. ... 35
* Guermond, J.-L. ... 192
Guichard, D. R. ... 1500
Gulick, D. ... 1350
Gurel, O. ... 752
Gurski, K. F. ... 582
Gustafson, P. ... 792
▸ Gutierrez, J. B. ... 1716
* Ha, T. H. ... 1440
Haas, R. ... 1041
Habre, S. ... 1740
Hadlock, C. R. ... 404
▸ Hageman, R. S. ... 1557
* Hager, W. W. ... 1601
Haghighi, A. M. ... 1787
Hagler, B. A. ... 864
Hale, E. T. ... 598
Hale, E. T. ... 1700
Hale, P. ... 1301
◂ Hale, T. A. ... 1725
Haley, J. M. ... 518
* Hall, B. C. ... 953
* Hall, C. ... 967
Hall, J. A. ... 1046
* Hall, R. ... 456
Hamblen, S. ... 316
Hamblin, J. E. ... 156
Hamdan, M. F. ... 387
Hamid, M. A. ... 1508
Hamid, S. M. ... 1519
Hammack, R. ... 1226
▸ Hammett, A. J. ... 1237
Hampton, M. E. ... 575
▸ Han, X. ... 837
▸ Hancioglu, B. ... 1021
* Handel, M. ... 691
▸ Hanes, J. ... 994
Hanson, A. C. ... 1315
Hardin, C. S. ... 1727
* Hardin, D. ... 1126
◊ Harizanov, V. S. ... 1551
Harker, H. ... 1260
Harnish, S. ... 1365
Harris, J. M. ... 361
Harris, W. R. ... 1503
Harrison, J. ... 761
Harshbarger, R. J. ... 1488
Hartke, S. G. ... 1737
Hartshorn, K. ... 1067
Hartzler, R. ... 877
* Harvey, S. ... 240
Hassen, A. ... 556
Hathaway, D. K. ... 1076
Haver, B. ... 108
◦ Haxell, P. ... 202
* Hayes, D. R. ... 968
▸ Head, J. D. ... 123
▸ Head, J. D. ... 1764
▸ Heath, J. ... 766
* Hedden, M. E. ... 1626
Heidenberg, A. ... 890
Heine, G. W. ... 1293
* Helgason, S. ... 458
▸ Helleloid, G. T. ... 294
Hellerstein, L. ... 3
* Hemmer, D. J. ... 481
Henderson, J. R. ... 812
* Henderson, J. ... 1650
Henderson, T. ... 793
* Henderson, T. ... 1125
◂ Hendrix, A. ... 915
* Hering, M. S. ... 1670
Herman, E. P. ... 826
▸ Hernandez-Padilla, W. J. ... 1022
* Herrmann, F. J. ... 1155
Hersberger, J. R. ... 615
Herty, M. ... 305
* Herzberg, F. S. ... 491
Herzig, A. H. ... 1043
Heyer, L. J. ... 1540
Hickernell, F. J. ... 859
Hickey, R. J. ... 1495
Hickman, R. E. ... 1057
* Hickman, R. E. ... 730
◂ Hicks, A. S. ... 985
* Hida, T. ... 952
Hilbert, S. ... 607
Hill, R. O. ... 383
Hill, R. ... 880
Hindman, N. ... 1221
* Hirose, S. ... 1594
* Hodge, T. L. ... 54
▸ Hoelscher, C. ... 536
*▸ Hoelscher, J. L. ... 1179
Hofacker, E. B. ... 621
Hofacker, E. B. ... 1490
* Hoffacker, J. ... 1651
* Hoffman, J. W. ... 1637
Holden, J. B. ... 585
* Holmer, J. ... 440
* Holst, M. J. ... 1168
▸ Holthouse, B. ... 736
* Hook, J. ... 450
Hooley, D. E. ... 346
*▸ Hoover, K. R. ... 947
Hopkins, B. ... 1039
Horn, J. M. ... 801
Hotton, S. G. ... 176
* Hovhannisyan, G. ... 1648
* Howard, B. J. ... 712
Howard, K. E. ... 1473
* Howard, R. ... 459
*▸ Howard, T. K. ... 1632
Howard, T. M. ... 303
* Howe, R. ... 1391
* Howe, R. ... 1630
▸ Howell, J. S. ... 1707
▸ Hower, J. K. ... 321
▸ Hower, V. M. ... 771
Hritonenko, N. ... 1026
* Hruska, G. C. ... 222
Huber, M. R. ... 738
Huber, M. ... 194
▸ Huber, T. ... 734
▸ Huggins, P. M. ... 846
◂ Huizenga, J. ... 749
Humphrey, P. B. ... 1327
* Hunziker, M. ... 443
Hurdal, M. K. ... 848
Hurlbert, G. ... 1056
Hurri-Syrjanen, R. M. ... 1251
Hyman, J. M. ... 843
▸ Ibrahimou, B. ... 1692
▸ Ignatyev, O. ... 1444
* Im, B.-H. ... 965
◂ Ince, N. J. ... 1733
Inlow, M. H. ... 1325
Ion, P. ... 411
* Iosevich, A. ... 465
* Ismail, M. E. ... 1194
* Jabuka, S. ... 1410
*▸ Jackson, B. J. ... 1654
Jackson, M. A. ... 1210
Jacobbe, T. ... 384
▸ Jacobbe, T. ... 1051
Jacobsen, J. ... 338
* Jaffe, A. ... 1140
Jaggard, A. D. ... 1230
* Jang, S. R. ... 1620
* Januszkiewicz, T. ... 218
Jardine, D. ... 133
▸ Jasso-Hernandez, E. F. ... 1261
Javaheri, M. ... 495
Javier, W. R. ... 1790
Jedrzejewski, F. ... 1002
* Jensen, C. A. ... 30
* Jensen, C. ... 689
Jensen, J. A. ... 375
Jensen, J. A. ... 1009
Jernigan, R. W. ... 1319
Ji, J. ... 94
▸ Jiang, L. ... 1465
Jiang, S. ... 399
Jimenez, J. A. ... 363
▸ Jin, Y. ... 1451
Johnson, C. M. ... 1343
* Johnson, J. E. ... 1592
*◂ Johnson, T. L. ... 934
Jones, J. ... 161
Jones, J. ... 871
Jones, L. ... 554
Jones, M. A. ... 770
Jones, M. A. ... 1745
*▸ Jorgensen, J. B. ... 1598
* Jorgensen, P. E. ... 943
* Jorgensen, P. E. ... 1392
* Joyce, M. O. ... 1660

∗Ju, N. 254
Judson, T. W. 142
Kahl, N. 1730
Kalai, A. T. 8
∗Kalfagianni, E. 236
Kanaana, I. 1060
∗◂Kane, D. M. 1109
Kane, J. M. 1062
∗Kania-Bartoszynska, J. 40
▸Kannan, L. 1527
Kanno, J. 1521
◂Kaplan, N. 326
∗Kaplan, R. 14
∗Kapovich, I. 221
Kappe, L.-C. 1216
∗▸Kapralov, M. 462
▸Karadayi, E. 1270
▸Karakok, G. 627
Karsai, I. 573
∗Kashyap, N. 51
Kasturiarachi, A. B. 297
Kasturiarachi, A. B. 1053
Kasube, H. E. 116
Katz, A. A. 1252
∗Kauers, M. 64
Kaur, M. 1030
Kawarabayashi, K.-i. 852
Keeton, S. L. 1357
∗Kelley, C. A. 48
Kelly, A. R. 1044
Kelly, B. P. 355
∗Kelly, D. C. 206
∗Kempf, A. 1171
∗Kent, D. A. 1117
Kerins, B. 661
∗Kern, D. L. 1619
◂Khachatryan, G. A. 1449
Khadivi, M. R. 394
Khadivi, M. 1518
∗Khamsemanan, N. 230
∗Khan, A. A. 1157
∗Kholodnyi, V. A. 493
Kicey, C. J. 1770
∗Kidwell, P. A. 1577
◂Kiley, E. M. 1458
∗Kilford, L. J. 1663
∗Kim, H. 1624
∗Kim, J.-L. 257
Kim, J. 549
Kim, J. 1691
King, D. R. 1219
∗King, J. R. 1570
∗Kingan, S. 1415
∗Kirillov, A. 951
Kirtland, J. 1208
Klages, C. 379
∗▸Klein, T. 31
Klima, R. E. 420
Klima, V. W. 196
Klingner, B. 887
Kloke, J. D. 835
▸Klyve, D. W. 88
∗▸Knapp, A. C. 1622
Knapp, M. P. 559
Knisley, J. R. 1542
∗Knudson, K. 476
∗Koban, N. 32
◂Koberda, T. M. 520
Koçak, H. 341
Kocak, H. 879
Koch, A. 91
Koch, G. A. 833
∗Kocic, V. L. 1611
∗Kofman, I. 708
∗Kohlenbach, U. 19
◊Kohlenbach, U. 1545
Kolacinski, J. F. 1538
∗Koldobsky, A. 725
▸Kolomiets, Y. V. 1453
Kombe, I. 1242
Kondrashov, D. A. 1023
∗◂Konfisakher, I. 1106
∗Konkowski, D. A. 962
∗Kopeliovich, Y. 1667
Kopperman, R. 755
Korlie, M. S. 1463
Kortsarts, Y. 569
Kortsarts, Y. 1471
Koshy, T. 1741
Kosiak, J. J. 118
Kosiak, J. J. 422
▸Kostic, D. N. 1234
▸Kotschwar, B. L. 73
▸Kozek, M. 322
◇Kra, B. R. 200
∗Krainer, T. 1191
Krat, S. 526
∗◂Kravitz, R. D. 1104
Krebs, M. 160
Krebs, M. 529
Krebs, M. 1336
Kreminski, R. 1077
Kreston, E. J. 1493
Krevisky, S. A. 1779
Krinik, A. 1786
Krishnamoorthy, B. 93
Krishnamoorthy, B. 902
Krishnamurti, T. N. 410
Krowne, A. 414
Krowne, A. 1090
Kruczek, K. 349
Krueger, R. J. 1478
∗Kujawa, J. R. 267
Kumar, A. 1769
∗Kung, J. P. 1644
▸Kunkel, C. J. 856
Kuo, Y.-J. 795
▸Kurkcu, H. 547
Kurt, Y. 86
Kuster, C. M. 1704
Kwembe, T. 904
•Laba, I. 1101
Lacke, C. J. 1054
Lacke, C. J. 1323
∗◂Lackney, L. M. 428
∗LaDuke, J. 1586
∗Lafortune, S. 982
∗Laguna, P. 1163
▸Laing, C. 834
▸Laing, C. 1728
Lamm, T. 306
▸Landa, Y. 1559
∗◂Langdon, H. J. 1107
Langton, S. G. 10
▸Lankham, I. P. 1235
Lanz, A. 623
Lanz, A. 1037
Lapp, D. A. 664
∗Larsen, C. 651
∗Larsen, C. 728
Laubenbacher, R. 845
Laughbaum, E. D. 1048
Laurent, T. 1497
Lauve, A. 87
▸Lavicza, Z. 386
Lavrentiev, A. 1789
∗Lawrence, B. 1647
∗Lawton, S. D. 702
•Lax, P. D. 427
∗Lax, P. 1204
Le, L. H. 545
▸Le, T. 1512
Leary, C. C. 571
Lebow, A. 602
Ledder, G. 405
Ledder, G. 878
Ledder, G. 1541
Lee, H. 167
Lee, H. 744
Lee, J. 1232
Lee, K.-H. M. 1489
LeGrand, D. J. 152
∗Leitao, A. 1159
∗Lemire, N. 444
∗Lenhart, S. 1612
de León, A. d. 1774
▸Leonetti, C. C. 863
∗Leuschke, G. J. 1682
∗Leustean, L. 20
◂Levavi, A. R. 1238
Levendorskii, S. 769
∗Levendorskiĭ, S. 489
◂Levin, A. 511
▸Levine, M. S. 182
Levitt, B. L. 162
∗Lewis, A. C. 1579
∗Lewis, M. 484
Lewis, R. H. 528
Leykin, A. 780
Li, A. 354
∗Li, C. X. 983
∗Li, J. 252
▸Li, J. 1744
▸Li, Y. 548
Lih, K. W. 1528
∗Lim, C. C. 251
∗Lin, Z. 55
▸Lindaman, B. J. 611
∗Lindblom, L. 960
Lindquist, J. M. 417
∗Linetsky, V. 281
▸Lins, B. C. 514
Liu, C. 521
▸Liu, C. 165
∗Liu, F. 1160
▸Llosent, G. 103
∗◂LoBue, J. 434
Lock, P. F. 137
Lock, R. H. 1321
▸Lockard, S. R. 1747
Lopez, K. D. 345
▸Lopez, T. M. 374
Lorch, J. 1335
Lorch, L. 1305
∗Lorenz, M. 445
∗Los, J. 33
Loth, P. 1209
Lott, D. A. 79
∗◂Love, E. L. 433
Ludwick, K. E. 155
∗Ludwig, M. 722
∗Luo, F. 703
Luo, L. 679
∗Luo, L. 699
▸Luo, X. 1246
Luther, K. H. 145
Luther, K. H. 1070
Luther, K. 1480
Lutzer, C. 808
▸Lyle, S. J. 1736
▸Lyo, G. K. 1560
∗Lyubeznik, G. 1680
∗Ma, W.-X. 981
▫van Maanen, J. 675
Mabrouk, S. L. 353
Mabrouk, S. L. 419
Maceli, J. C. 106
Maciel, J. 1213
MacKichan, B. 412
MacKichan, B. 672
Macula, A. 922
Magee, E. F. 333
Magidin, A. 1211
Magnus, T. D. 809
Mahavier, W. S. 1279
Mailhot, J. M. 92
Majerus, M. F. 1025
Maldonado, A. R. 151
Maldonado, A. R. 1763
∗▸Malik, V. 1668
Malisoff, M. 643
∗▸Malte, P. A. 441
∗Mamon, R. 492
Manders, K. 814
Mann, C. 532
∗Manna, D. V. 277
Marchand, R. J. 1069
∗Margalit, D. 1400
Marion, B. 1468
Marquez-Lago, T. T. 1456
▸Marr, A. M. 1224
Marrongelle, K. A. 817
Marsh, M. T. 1324
▸Martens, M. 1470
Martin, A. D. 597
Martin, C. D. 97
Martin, C. D. 1294
∗▸Martin, E. J. 973
◂Martin, E. L. 836
Martin, J. W. 317
Martin, M. 139
Martin, M. 358
Martin, M. 881
∗Martini, L. 1120
∗Maruno, K. 1203
Mason, D. E. 1344
Mathews, B. 1091
Mathews, B. 1093
Matos, C. A. 588
Matsumoto, S. 357
Matsuura, A. 365
◂Matteson, A. L. 1717
Maurer, S. B. 580
Maurer, S. B. 609
Mawhinney, K. 1040
∗Maxim, L. G. 47
▸Maxin, D. 1718
∗Maxwell, D. 485
Maxwell, M. S. 351
Mayans, R. A. 421
Maycock, E. J. 153
Mays, M. 418
Mays, M. 885
Mays, M. 1773
Mazel, D. S. 1289
•Mazur, B. 1102
∗◂Mazur, K. 431
∗McCallum, W. 1567
∗McCammond, J. 26
∗McCarthy, J. D. 1396
∗McCleary, J. 1389
McClendon, D. M. 517

McClure, M. 340
McClure, M. 1282
∗ McCullough, D. 1401
McDevitt, R. J. 797
McDevitt, T. 798
McGivney-Burelle, J. M. 1509
McGowen, M. A. 113
∗► McGregor, A. 261
∗ McGuinness, S. 1639
McGuire, L. 800
◄ McKay, J. C. 1055
McKemie, M. J. 783
McKenzie, J. D. 1326
∗ McKenzie, R. 974
McLaughlin, P. H. 525
McLoud-Mann, J. 533
∗ McMurdy, K. 1657
McMurran, S. 1372
∗ McNinch, G. J. 53
∗ McNulty, G. F. 1189
Meade, D. B. 423
Meade, D. 674
∗◄ Meek, K. 684
Meel, D. E. 193
► Megow, N. 1742
Melendez, B. S. 382
Melendez, B. S. 1754
∗ Mendoza, G. A. 1193
► Mendoza, G. 1215
∗► Mengesha, T. 466
Meredith, D. 923
Merkel, J. C. 840
◄ Merling, M. B. 296
∗ Merrill, K. D. 946
Mertz, J. E. 1034
Mesa, V. 613
Metcalfe, G. 1363
∗ Metcalfe, G. 972
∗ Meyer, K. 971
◄ Meyer, M. J. 360
Michael, B. K. 914
Michev, I. P. 70
Mickens, R. E. 830
Mickens, R. E. 1546
∗ Mickens, R. E. 1406
Mihaila, I. 121
Mihaila, I. 784
► Milan, D. 1689
∗ Milenkovic, O. 260
Mileti, J. 1800
◄ Miller, A. B. 984
∗ Miller, D. J. 216
Miller, J. 897
Miller, J. 898
Miller, M. J. 501
► Miller, M. S. 1008
Miller, N. 813
► Miller, S. K. 678
Miller, S. 1801
Mills, D. D. 558
Millspaugh, R. 918
Miner, R. 1086
∗ Mints, G. 21
Misaghian, M. 1205
∗ Misirpashaev, T. 488
► Mitchell, L. H. 1685
Mjolsness, E. 177
Mohammed-Awel, J. S. 1719
∗ Mohapatra, R. N. 1150
Mohar, B. 849
Mohlala, M. 537
Molitierno, J. J. 1475
Moller, T. 1049
Montes, R. R. 748
Montgomery, A. 1776
Montgomery, K. A. 1712
Moore, A. B. 1806
∗ Moore, C. C. 949
Moore, H. 1310
Moore, L. 668
∗ Moore, M. E. 1580
Moore, T. E. 666
∗ de Mora, M. 1116
Morin, B. R. 1024
Morrell, J. J. 1298
∗ Mosco, U. 1152
► Moseman, E. 1231
∗ Mosher, L. 690
Moskal, B. M. 1483
Moskol, A. E. 1749
∗ Mossinghoff, M. J. 61
∗ Mosteig, E. C. 62
Mueller, C. D. 992
∗◄ Muggy, T. L. 430
Muhanna, Y. A. 500
∗ Muhly, P. S. 1139
Muir, C. 1065
Muir, C. 1311
Muir, Jr., J. R. 507
Mukherjee, A. 541
Mulcahy, C. 359
Mulcahy, C. 622
Mulekar, M. S. 1329
► Müller, M. 759
Munasinghe, S. 505
Murdock, J. H. 512
∗ Murnaghan, F. 1589
Murphy, T. J. 895
∗ Murty, R. 1176
◄ Music, J. M. 1337
Nacin, D. 100
Nagarkatte, U. P. 1547
∗► Nagrath, A. K. 1182
► Naidu, D. 290
∗ Namazi, H. 1599
Namazi, J. 496
Narayan, D. 900
∗ Narayanan, K. R. 259
∗ Nashed, M. Z. 1602
Navaratna, M. B. 1713
Navarra-Madsen, J. P. 832
Navarra-Madsen, J. P. 1277
Neal, C. 1765
∗ Negri, M. 655
Nelsen, R. B. 1454
Neuerburg, K. M. 1339
∗ Neusel, M. D. 446
Nevai, A. L. 1017
Nguyen, H. D. 324
► Nguyen, M. N. 1697
∗► Nguyen, N. Q. 1130
Nguyen, T. V. 298
∗► Ni, Y. 1412
► Nicely, D. A. 1461
Nicholls, D. P. 396
∗► Nicholson, N. R. 37
Nigam, N. 398
Nita, B. G. 765
∗ Niziol, W. 1430
Noble, L. L. 1290
∗ Nobre, S. 1121
∗ Noll, T. 452
∗◄ Noris, O. Y. 685
Obara, S. 1033
Obara, S. 1358
∗ Oberste-Vorth, R. W. 1423
Oehrlein, C. 149
► Okamoto, F. 990
∗ Okoudjou, K. A. 944
• Okounkov, A. 201
• Okounkov, A. 680
• Okounkov, A. 1096
∗ Olafsson, G. 1393
Olsen, C. L. 625
Oman, G. G. 772
► Ongiti, O. K. 1304
Onica, C. 75
∗► Onofrei, D. T. 467
Orrison, M. E. 794
∗► Ortiz-Navarro, J. A. 41
Osler, T. J. 858
∗ Ostrik, V. 263
Otero, D. E. 129
► Ott, K. 1558
∗ Ouerdiane, H. 1146
∗ Ournycheva, E. 463
► Ovchinnikov, A. 564
► Owens, L. N. 1455
∗ Ozsvath, P. S. 1623
∗ Packer, J. A. 945
∗ Packer, J. A. 1394
Pajoohesh, H. 1711
Palfrey, T. C. 553
Palmer, K. M. 1375
∗ Pan, R. 963
∗ Pan, S.-Y. 1529
Pantano, A. 1807
∗ Pantano, A. 1532
∗ Papadakis, M. 1131
∗ Papageorgiou, N. S. 1607
∗ Papanikolas, M. 969
Papick, I. J. 122
∗ Papikian, M. 1661
► Paquin, D. C. 841
∗► Park, J. 190
Parker, D. B. 1225
Parker, G. E. 811
Parker, M. R. 135
Parker, M. 893
► Parrish, A. M. 1258
∗ Parshall, B. 57
Pascali, D. D. 1688
∗ Patch, S. K. 1154
Patel, R. 356
Patel, R. 1802
∗ Patrick, D. 15
Patton, B. 1785
∗► Paulhus, J. 1172
∗ Peck, R. 715
∗ Peeva, I. 1439
∗ Peiffer, J. 1115
Peirce, J. P. 81
► Pejic, B. 756
∗ Pelinovsky, D. 696
Pendergrass, C. A. 283
Pendergrass, M. 1507
Peng, C. 83
Pengelley, D. J. 134
Pengelley, D. J. 925
Perry, A. B. 1079
◦ Peters, K. 930
∗ Petersen, K. 1180
Peterson, A. C. 1249
Petrenko, B. 104
∗ Pettet, A. R. 693
∗ Pfister, H. D. 258
∗► Pham, D. X. 253
Phillips, Y. 1550
∗ Piepmeyer, G. 1681
Pierce, P. B. 1484
∗ Piggott, A. 24
∗ Pillen, C. 475
de Pillis, L. G. 847
Pinchbeck, D. J. 503
Pinter, M. 586
Pizer, A. 870
∗ Plofker, K. 939
Pogozelski, W. K. 565
◄ Pohl, M. A. 1334
∗ Polini, C. 1684
∗► Pollack, P. 1175
∗ Pollack-Johnson, B. 1384
► Ponce-Escudero, M. 1516
► Pons, M. A. 1513
Poodiack, R. D. 1771
• Poonen, B. 1094
∗ Popescu, C. D. 1173
Porter, M. A. 309
Porter, M. A. 335
Porter, M. A. 1467
Potocka, K. 144
► Potsepun, N. 1446
Powell, J. S. 1734
∗ Powell, W. 486
Prado, L. 504
Presley, B. S. 1756
Presser, K. J. 628
Price, L. E. 344
∗ Protsak, V. 1635
Prusinkiewicz, P. 178
∗ Przytycki, J. H. 705
► Pudipeddi, S. 307
∗► Putman, A. 1398
Putz, J. F. 591
Qazi, T. 860
∗◄ Qian, J. 687
∗ Qiao, Z. 1198
∗ Qing, J. 961
∗◄ Quinn, C. B. 435
∗ Quinn, I. 457
Quinn, J. J. 1369
Rack, M. 1316
∗ Raffoul, Y. N. 1649
∗ Rahman, M. 1195
Raich, A. S. 733
Rainbolt, J. G. 157
Rajagopalan, M. 1003
∗► Rajagopalan, S. 1627
► Ramras, D. A. 293
∗ Ramsay, A. 1136
Ranalli, R. 378
∗ Randall, D. 226
► Rasmussen, K. E. 758
Ratheal, J. D. 1029
◊ Rathjen, M. 1097
Rawdon, E. J. 1273
Raychaudhuri, D. 823
Raynor, S. G. 1804
Razzaghi, M. 509
∗ Reading, N. 245
Reba, M. 175
► Reff, N. H. 527
Regis, R. G. 1333
∗ Reid, T. J. 1643
• Reiner, V. S. 1544
∗ Reiner, V. 447
∗ Reite, A. A. 229
Reiter, C. 328
∗ Resmerita, E. 1605
∗ Reys, R. 1568
Rhoades, B. E. 857
◄ Rhodes, D. J. 1724

*► Richardson, C. L. 653
► Richardson, R. M. 534
Richeson, D. 1353
Richman, S. C. 1777
* Rickey, V. F. 1583
* Rider, R. E. 1387
* Rieffel, M. A. 1588
Risley, J. 413
Risley, J. 673
Roberts, G. E. 336
Roberts, G. E. 539
Roberts, L. 896
Robertson, N. 649
Robeva, R. S. 141
Robeva, R. 570
* Robins, S. 275
► Rodriguez-Martinez, A. .. 1517
Rodríguez Ordóñez, H. .. 1010
* Roeger, L.-I. W. 1617
Rogers, E. C. 583
*◄ Rogers, I. A. 932
► Rogers, J. W. 78
Rogers, R. 1284
*◄ Rohal, J. J. 1112
Rolf, J. S. 1752
Rosencrans, S. 184
Rosenhouse, J. 745
Rosin, A. 85
Rossa, B. E. 1280
Rowell, G. H. 905
Roy, A. N. 1772
Royer, M. G. 1345
* Rubin, K. 1426
Rubinshtein, E. 1794
Rublein, G. 899
Rudd, M. 743
Rudin, C. 2
* Ruffing, A. L. 1652
*► Ruffo, J. 1674
Rushanan, J. J. 1291
► Rusinko, J. P. 775
*◄ Ruth, S. P. 686
Sabo, D. E. 1501
* Sacker, R. J. 1613
Safer, A. M. 1797
* Saito, K. 940
* Saito, K. 955
Salinas, R. A. 407
Salinas, T. 117
* Salmasian, H. 1636
Salminen, A. D. 1218
* Salvy, B. 271
► Samuels, C. L. 550
► Sanacory, F. 1254
Sanchis, G. 903
Sanders, M. J. 168
◦ Sandifer, C. E. 929
Sandifer, E. 12
* Sapir, M. 29
* Sarbach, O. 1165
Saul, L. 9
* Saul, M. 13
* Saunders, B. S. 1573
* Savin, G. 1633
* Saxton, R. 438
*► Sazdanovic, R. 706
Schaefer, E. 1376
Schaffer, K. 367
Schapire, R. E. 1
* Scharlemann, M. 1591
* Scheidler, R. 1177
* Scheidler, R. 1432
* Schenck, H. 42
* Schenck, H. 1671
* Scherzer, O. 1604
Schield, M. 1476
* Schleimer, S. 1397
Schlicker, S. 330
► Schmoyer, S. L. 315
Schramm, M. J. 1285
* Schroeder, B. S. 1181
► Schroeder, L. B. 829
Schroeder, S. 1028
* Schroll, S. 247
* Schroll, S. 477
Schubert, C. 312
Schuette, P. H. 1296
Schulteis, M. 810
► Schwell, R. 1012
Scott, D. 786
Scott, J. 911
* Scott, L. 58
► Sealey, V. L. 617
* Sega, L. F. 1678
* Segal, S. L. 1585
Seggev, I. 197
* Seif, S. 1188
Selgrade, J. F. 1014
► Sell, E. A. 1562
Semmler, G. 497
Seppälä, M. 1092
Serrano, S. 919
* Sethares, W. A. 716
Sethi, W. 1309
► Setyadi, A. 320
Sevilla, A. 1496
Sfaxi, R. 735
Shafii-Mousavi, M. 799
Shafii-Mousavi, M. 1082
► Shah, M. 1702
Shahin, M. 1038
Shahverdian, J. 662
Shahverdian, J. 1477
► Shallue, A. 318
Sheen, D. 401
Shell-Gellasch, A. E. 128
Shelton, T. 1753
Shen, J. 403
* Shen, J. 191
* Shen, S. S. 698
* Sheng, Q. 1424
Shepherd, M. D. 170
* Shepler, A. V. 448
Shibberu, Y. 1457
► Shieh, T.-T. 1699
Shilgba, L. K. 80
Shipman, P. D. 179
* Shor, C. M. 1434
Short, J. W. 1220
Shrikhande, M. S. 1729
* Shubin, T. 16
Shvartsman, I. 1695
* Shvartsman, I. 1610
► Siedel, H. 1036
Sieg, W. 876
Siegel, M. H. 110
Siegel, M. H. 1307
Siegel, M. 912
* Sills, A. V. 63
Simmons, C. 389
Simoson, A. J. 600
Simundza, G. 1308
Singh, D. 1368
* Sinha, K. B. 1142
* Sinwell, B. J. 1383
* Sirbu, M. 68
► Sircar, S. 183
Sivasundaram, S. 741
Sklar, J. K. 1075
Skoug, D. L. 1450
► Skripka, A. 1554
* Smirnov, R. G. 1196
► Smith, B. R. 560
Smith, C. 390
* Smith, D. A. 1575
Smith, D. 1087
Smith, S. B. 1265
Smith, S. 1498
* Smoller, J. A. 964
* Snow, J. W. 970
So, S. S. 531
* Soderlund, C. L. 231
Soiffer, N. 669
Soiffer, N. 670
*◄ Solis, P. R. 683
◊ Solomon, R. 1085
Somers, K. 1047
* Sondow, J. 272
Song, Z. 853
Sottile, F. 774
Souhan, B. E. 806
Spickler, D. 154
Spindler, R. P. 1035
Spivey, M. Z. 1241
Spivey, M. Z. 1506
* Sritharan, S. S. 1144
► Srivastava, A. K. 1469
Staecker, P. C. 590
* Staecker, P. C. 227
► Staic, M. D. 291
* Stan, A. I. 1147
Stancu, A. A. 292
* Stancu, R. 480
► Staninska, A. 1750
Stanish, K. B. 1479
* Stankova, Z. E. 211
Starbird, M. 906
Starbird, M. 1370
* Starbird, M. 1576
Steele, D. A. 926
* Stefanov, P. 976
* Stein, A. 1178
* Stein, A. 1433
Stein, R. G. 343
Stemkoski, L. 125
◄ Stephens, B. N. 1227
Stephens, D. C. 851
Stern, L. 325
* Stevens, G. 1379
Stevenson, H. 1052
Stevenson, H. 1312
Stewart, C. D. 825
Stickles, Jr., J. A. 1349
Stickles, P. R. 581
* Stoltzfus, N. W. 38
► Storm, C. K. 1240
Strigul, N. S. 1018
Stueckle, S. 593
Sturdivant, R. 889
Su, C. 1263
* Suciu, A. I. 46
► Suh, C.-H. 1269
Sulewski, C. A. 415
Sullivan, S. L. 987
► Sun, L. 1247
Sung, C.-H. 991
Surovyatkina, E. D. 513
Sutton, B. D. 1448
Suzuki, J. 5
* Swallow, J. 479
Switkes, J. 1472
* Szabo, Z. I. 720
Szaniszlo, Z. 1066
Szydlik, J. E. 120
Szymanski, A. A. 754
Tadesse, A. 1243
* Takeda, S. 1634
* Tamasan, A. 1161
* Tanton, J. S. 205
*► Tapp, D. S. 1436
Tawfeeq, D. A. 173
Taylor, R. 1364
Taylor, T. D. 327
* Teitler, Z. 1683
* Temple, B. 1164
* Terao, H. 709
Tesemma, M. 562
► Thibodeaux, J. J. 1715
Thiel, J. 1510
* Thiem, N. 478
* Thieme, H. R. 1614
*► Thomas, A. 220
Thomas, D. M. 370
* Thomas, R. 1416
Thompson, J. W. 624
Thrower, T. 174
◄ Tiedeman, H. C. 1342
*◄ Tirrell, J. O. 1105
* Tisdell, C. C. 1422
*► Todd, R. G. 238
*► Todd, R. S. 1666
Toews, C. 1693
*► Tohaneanu, S. O. 713
* Tomova, M. 1399
Tong, S. 828
Tong, Z. 1001
► Tou, E. R. 89
* Toussaint, G. T. 453
* Tovbis, A. 979
Townsley, L. 195
◄ Trevino, R. 519
Truman, C. B. 1272
Tsishchanka, K. I. 323
Tsynkov, S. 400
Tudorascu, A. 74
*► Turner, L. E. 1119
* Tymoczko, D. 455
Uckath, B. V. 1340
* Uhlmann, G. 975
* Uhlmann, G. 1153
Ulgen Yildirim, S. 150
* Ulmer, D. 966
Usmanov, S. M. 1257
* Vainchtein, A. 727
Vakalis, I. E. 838
*► Validashti, J. 1676
* Van Brummelen, G. R. 1114
* Vandervelde, S. 209
*► Van Horn-Morris, J. 1625
* Varadarajan, V. S. 1587
* Varlamov, V. V. 1200
► Vasquez, P. A. 1555
• Vasy, A. 199
*► Velasco, M. 1441
• Venkatesh, A. 1100
Vernerey, D. E. 72
► Vernon, R. P. 1006
* Verrill, H. A. 1659
* Vese, L. A. 1156
► Villanueva, A. 746
Vincent, K. M. 393
► Visinescu, B. C. 1250

∗ Vogan, D. A. 1590
□ Vogtmann, K. 657
∗ Voisei, M. D. 1151
Vulis, M. 166
∗ Wachs, M. L. 710
∗ Wagner, D. G. 1417
∗ Wakefield, M. D. 711
∗ Walker, J. L. 50
Walker, R. K. 348
∗ Wall, B. E. 1118
Wallis, W. D. 1332
Walsh, D. P. 1078
Walsh, J. A. 342
∗◂ Walters, R. S. 1111
∗ Wang, C. 469
Wang, J.-T. 1348
Wang, J. 1720
∗▸ Wang, J. 1411
Wang, L. 789
Wang, L. 996
∗ Wang, S. 256
∗ Wang, X. 255
Wang, Y. 1526
∗ Wang, Y. 1129
▸ Wangberg, A. D. 286
Ward, M. B. 391
Ward, M. B. 1059
Wardlaw, W. P. 635
Warrington, G. S. 362
∗ Warshauer, M. 1380
Washington, T. M. 1374
▸ Wei, J. 1792
∗ Weiermann, A. 22
∗ Weissman, M. H. 1658
Weller, K. 616
Weller, K. 1286
Wells, C. 790
Weng, P. B. 1346
Werner, C. 781
▸ Wesley, C. L. 523
West, K. I. 1031
West, R. 105
Weyhaupt, A. G. 747
■ Whitaker, N. 1565
∗▸ White, D. M. 1442
White, H. S. 126
∗ White, H. S. 938
White, J. A. 1487
White, J. D. 1543
◂ White, K. 1548
Whittle, A. 408
Wick, D. 633
∗ Wiegand, R. 1675
▸ Wiegers, B. S. 1760
∗▸ Wiegers, B. S. 17
Wierman, J. C. 1525
∗ Wiesner, E. 265
Wightman, J. 587
▸ Wijesiri, S. 779
▸ Wildstrom, D. J. 1739
Willard, D. E. 1367
∗ Willard, R. D. 1190
Williams, B. L. 1359
∗ Williams, D. P. 1395
Williams, G. B. 347
▸ Williams, S. A. 1300
▸ Williams, S. A. 1464
∗ Williams, S. G. 707
■ Williams, S. 1377
▸ Williamson, M. 1267
▸ Wills, R. S. 636
Wills, R. 873
Wilson, A. A. 1360
Wilson, J. 140
Wilson, L. 908
∗ Wilson, R. J. 714
◦ Wilson, R. J. 426
Wilson, R. T. 1361
Winicki-Landman, G. 821
Winn, B. 760
Wiseman, J. 510
∗ Witherspoon, S. 268
◊ Wood, C. S. 1081
∗ Wood, J. 1187
Woodburn, C. J. 1331
Worth, F. 169
∗ Wortman, K. 219
Wovchko, P. M. 804
∗ Wright, D. G. 210
• Wright, M. H. 928
Wu, H. J. 1007
∗ Wu, H. 1641
∗ Wu, J. 189
∗ Wu, J. 697
◂ Wu, S. X. 1731
∗ Wunsch, J. 473
Xie, Z. 997
∗ Xu, T. 1201
∗ Xu, Y. 937
Yahdi, M. 1004
Yakes, C. J. 822
Yang, C.-C. 502
Yang, X. 844
Yarkulov, B. 1761
Yarrish, C. 886
∗ Yaskin, V. 724
∗ Yaskina, M. 723
Yasskin, P. B. 424
∗ Yasskin, P. B. 208
Yasskin, P. 674
Yatsenko, Y. 767
∗ Yee, W. 1631
∗◂ Yi, H. 681
∗ Yoshinaga, M. 248
Young, E. S. 1491
Yu, G. 646
∗▸ Yu, J. 1437
Yu, X. 647
∗ Yuan, G. X. 1149
∗ Yuzvinsky, S. 43
∗ Zablow, J. 1593
▸ Zack, L. M. 288
◂ Zahl, J. 1520
Zarringhalam, K. 337
∗ Zayed, A. I. 1127
∗ Zeilberger, D. 270
∗ Zeitz, P. A. 204
∗ Zelditch, S. 471
∗ Zell, T. 217
Zeng, H. 1778
Zha, X. 648
∗ Zhang, B.-Y. 695
Zhang, G. 71
◂ Zhang, Y. 1732
Zhang, Z. 1722
▸ Zhao, A. 1708
Zhao, J. 1460
∗ Zheng, W. 280
∗ Zhou, R. 1199
∗ Zhou, X. 1414
∗ Zhu, C.-B. 1531
∗▸ Zhu, C. 1162
▸ Zhu, W. 1698
▸ Zhuang, Y. 1459
∗ Zimmer, R. J. 1133
∗ Zitarelli, D. E. 1581
∗ Zitkovic, G. 66
▸ Zorn, C. A. 999
∗ Zucker, J. 23
▸ Zuniga, J. J. 82
▸ Zuniga, J. J. 1271
∗ Zworski, M. 472
Zyskin, M. 76
Zyskin, M. 300

Program of the Sessions

New Orleans, Louisiana, January 5–8, 2007

Wednesday, January 3

AMS Short Course on Aspects of Statistical Learning, I

8:00 AM – 4:45 PM

Organizers: **Cynthia Rudin**, Courant Institute, New York University
Miroslav Dudík, Princeton University

8:00AM Registration.
9:00AM Opening remarks by Cynthia Rudin and Miroslav Dudík.
9:15AM (1) *Machine Learning Algorithms for Classification.*
Robert E. Schapire, Princeton University
10:30AM Break.
11:00AM (2) *Occam's Razor and Generalization Bounds.*
Cynthia Rudin*, Center for Neural Science and Courant Institute, New York University, and **Miroslav Dudík***, Princeton University
2:00PM (3) *Exact Learning of Boolean Functions and Finite Automata with Queries.*
Lisa Hellerstein, Polytechnic University
3:15PM Break.
3:45PM Panel Discussion.

MAA Short Course on Leonhard Euler: Looking Back after 300 Years, I

8:00 AM – 4:45 PM

Organizers: **Ed Sandifer**, Western Connecticut State University
Robert E. Bradley, Adelphi University

8:00AM Registration.
9:00AM Introductions.
9:15AM (4) *A mathematical life in the enlightenment.*
Ronald S. Calinger, Catholic University of America
10:30AM Break.
10:45AM (5) *Euler and number theory: A study in mathematical invention.*
Jeff Suzuki, Brooklyn College
2:00PM (6) *D'Alembert, Clairaut and Lagrange: Euler and the French mathematical community.*
Robert E. Bradley, Adelphi University
3:15PM Break.
3:30PM (7) *Enter, stage center: The early drama of hyperbolic functions in the age of Euler.*
Janet Barnett, Colorado State University-Pueblo

Thursday, January 4

MAA Board of Governors

8:00 AM – 5:00 PM

AMS Short Course on Aspects of Statistical Learning, II

9:00 AM – 1:00 PM

Organizers: **Cynthia Rudin**, Courant Institute, New York University
Miroslav Dudík, Princeton University

9:00AM (8) *Online Learning.*
Adam Tauman Kalai, Weizmann Institute of Science and Toyota Technological Institute
10:15AM Break.
10:45AM (9) *Spectral Methods for Visualization and Analysis of High Dimensional Data.*
Lawrence Saul, University of California San Diego
NOON Question and answer session.

MAA Short Course on Leonhard Euler: Looking Back after 300 Years, II

9:00 AM – 5:00 PM

Organizers: **Ed Sandifer**, Western Connecticut State University
Robert E. Bradley, Adelphi University

9:00AM Questions and answers.

The time limit for each AMS contributed paper in the sessions is ten minutes. The time limit for each MAA contributed paper varies. In the Special Sessions the time limit varies from session to session and within sessions. To maintain the schedule, time limits will be strictly enforced.
For papers with more than one author, an asterisk follows the name of the author who plans to present the paper at the meeting.
Papers flagged with a solid triangle (►) have been designated by the author as being of possible interest to undergraduate students.
Abstracts of papers presented in the sessions at this meeting will be found in Volume 28, Issue 1 of *Abstracts of papers presented to the American Mathematical Society*, ordered according to the numbers in parentheses following the listings.

9:15AM *Euler and classical physics.*
(10) **Stacy G. Langton**, University of San Diego
10:30AM Break.
10:45AM *Elliptic intergrals, mechanics, and differential*
(11) *equations.*
Lawrence D. D'Antonio, Ramapo College
2:00PM *Euler's great theorems.*
(12) **Edward Sandifer**, Western Connecticut State University
3:15PM Break.
3:30PM Panel discussion.

AMS Council

1:30 PM – 10:00 PM

Joint Meetings Registration

3:00 PM – 8:00 PM

Full registration will be conducted from 3:00 p.m. to 7:00 p.m. Badge/program pickup for those registered in advance will be open until 8:00 p.m.

Friday, January 5

Joint Meetings Registration

7:30 AM – 6:00 PM

Full registration will be conducted from 7:30 a.m. to 4:00 p.m. Badge/program pickup for those registered in advance will be open until 6:00 p.m.

Employment Center

7:30 AM – 6:00 PM

AMS-MAA Special Session on Math Circles and Similar Programs for Students and Teachers, I

8:00 AM – 10:55 AM

Organizers: **Morris Kalka**, Tulane University
Kathleen O'Hara, Mathematical Sciences Research Institute
Hugo Rossi, Mathematical Sciences Research Institute
Tatiana Shubin, San Jose State University
Zvezdelina E. Stankova, Mills College
Daniel H. Ullman, George Washington University
Paul A. Zeitz, University of San Francisco

8:00AM *Backyard Mathematics.*
► (13) **Mark Saul**, Bronxville Schools (ret.) (1023-97-704)
8:30AM *The Great Conversation.*
► (14) **Robert Kaplan*** and **Ellen Kaplan**, The Math Circle (1023-97-914)
9:00AM *The San Diego Math Circle.*
(15) **David Patrick**, Art of Problem Solving (1023-97-325)
9:30AM *Mathematical Circles (Silicon Valley Experience).*
► (16) **Tatiana Shubin**, San Jose State University (1023-97-705)
10:00AM *University of California, Davis's Explore Math*
► (17) *Program: Graduate students bringing cutting-edge research into the classroom to share with undergraduate and high school students.* Preliminary report.
Brandy S. Wiegers*, **Yuan-Juang Yvonne Lai**, **Sarah A. Williams** and **Spyridon Michalakis**, University of California, Davis (1023-97-1723)
10:30AM Discussion.

AMS-ASL Special Session on Logical Methods in Computational Mathematics, I

8:00 AM – 10:55 AM

Organizers: **Saugata Basu**, Georgia Institute of Technology
Charles N. Delzell, Louisiana State University

8:00AM *General logical metatheorems for functional*
(18) *analysis.*
Philipp Gerhardy, Department of Philosophy, Carnegie Mellon University (1023-03-1468)
8:30AM *New effective uniformity results in fixed point*
(19) *theory.*
Ulrich Kohlenbach, Darmstadt University of Technology (1023-03-361)
9:00AM *Proof mining in $CAT(0)$-spaces and $\mathbb{R}$-trees.*
(20) **Laurentiu Leustean**, TU Darmstadt, Germany and Institute of Mathematics "Simion Stoilow" of the Romanian Academy, Bucharest, Romania (1023-03-1261)
9:30AM *Model elimination and cut elimination.* Preliminary
(21) report.
Grigori Mints, Stanford University (1023-03-79)
10:00AM *Phase transitions in logic and combinatorics.*
► (22) **Andreas Weiermann**, Ghent University (1023-03-1102)
10:30AM *Primitive Recursive Selection Functions for Provable*
(23) *Existential Assertions over Abstract Algebras.* Preliminary report.
Jeffery Zucker, McMaster University, Hamilton, Canada (1023-03-628)

AMS-AWM Special Session on Geometric Group Theory, I

8:00 AM – 10:55 AM

Organizers: **Ruth M. Charney**, Brandeis University
Karen Vogtmann, Cornell University

8:00AM *Automorphisms of right-angled groups.*
(24) **Adam Piggott*** and **Mauricio Gutierrez**, Tufts University (1023-20-237)
8:30AM *Quasi-isometric classification of graph manifolds.*
(25) **Jason A. Behrstock***, University of Utah, and **Walter D. Neumann**, Barnard College, Columbia University (1023-20-136)
9:00AM *Dual presentations for Artin groups.* Preliminary
► (26) report.
Jon McCammond, U C Santa Barbara (1023-20-476)
9:30AM *Spaces with nonpositive immersions.* Preliminary
(27) report.
Robert W. Bell, Michigan State University (1023-20-1164)
10:00AM *A geometric perspective on the conjugacy problem*
(28) *in Thompson's group F.* Preliminary report.
Kai-Uwe Bux* and **Dimitriy Sonkin**, University of Virginia (1023-20-1088)

10:30AM ► (29) *Hilbert space compression of groups.* Preliminary report.
Mark Sapir, Vanderbilt University (1023-20-1372)

AMS Special Session on Fixed Point Theory, Dynamics, and Group Theory, I

8:00 AM – 10:55 AM

Organizers: **Michael R. Kelly**, Loyola University
Peter N. Wong, Bates College

8:00AM (30) *The Euler characteristic of the Whitehead automorphism group of a free product.*
Craig A Jensen*, University of New Orleans, **Jon McCammond**, UC Santa Barbara, and **John Meier**, Lafayette College (1023-20-253)

8:30AM (31) *Strong monotonicity for filtered ends of pairs of groups.*
Tom Klein, Binghamton University (1023-20-1244)

9:00AM (32) *Some Topological Invariants of Groups and Actions.*
Nic Koban, University of Maine at Farmington (1023-20-616)

9:30AM (33) *Roots and symetries of pseudo-Anosov.*
Jerome Los*, CNRS, University Aix-Marseille1, and **Jerome Fehrenbach**, University of Toulouse (1023-20-1027)

10:00AM (34) *Fixed points of abelian group actions on surfaces.*
John Franks*, Northwestern University, **Michael Handel**, Herbert H. Lehman College (CUNY), and **Kamlesh Parwani**, Univ. of Houston (1023-37-590)

10:30AM (35) *From dynamical systems to surface braid groups.*
Daciberg Lima Goncalves, Universidade de Sao Paulo, and **John Guaschi***, Laboratoire de Mathematiques Emile Picard, UMR CNRS 5580, Universite Toulouse III (1023-20-989)

AMS Special Session on Knots, 3-Manifolds, and Their Invariants, I

8:00 AM – 10:55 AM

Organizers: **Oliver T. Dasbach**, Louisiana State University
Xiao-Song Lin, University of California Riverside

8:00AM (36) *Quantum Teichmuller Theory.* Preliminary report.
Charles D. Frohman*, The University of Iowa, and **Adam Sikora**, The State University of New York at Buffalo (1023-57-1745)

8:30AM (37) *Nonalternating knots and the Jones polynomial.*
Neil R. Nicholson, The University of Iowa (1023-54-31)

9:00AM ► (38) *Dessins d'enfant and Link Invariants.* Preliminary report.
Neal W. Stoltzfus*, Louisiana State University, **Xiao-Song Lin**, UC Riverside, **Oliver T. Dasbach**, Louisiana State University, **Efstratia Kalfagianni** and **David Futer**, Michigan State University (1023-57-1148)

9:30AM ► (39) *New Skein modules of three manifolds (with C. Frohman).*
Marta Asaeda*, Univ. of California Riverside, and **Charlie Frohman**, University of Iowa (1023-57-1591)

10:00AM (40) *Turaev-Viro Invariants of 3-Manifolds and the Reidemeister torsion.*
Charles D. Frohman, The University of Iowa, and **Joanna Kania-Bartoszynska***, National Science Foundation (1023-57-1847)

10:30AM (41) *Khovanov Homology & Reidemeister Torsion.*
Juan Ariel Ortiz-Navarro*, University of Iowa, and **Chris Truman**, University of Maryland (1023-55-1693)

AMS Special Session on Arrangements and Related Topics, I

8:00 AM – 10:50 AM

Organizers: **Daniel C. Cohen**, Louisiana State University
Anne V. Shepler, University of North Texas

8:00AM (42) *A spectral sequence stratification of cohomology jump loci.* Preliminary report.
Hal Schenck*, Texas A&M University, and **Graham Denham**, University of Western Ontario (1023-13-518)

8:30AM (43) *Upper bound on the number of split fibers in a pencil of curves.*
Jorge V. Pereira, IMPA, and **Sergey Yuzvinsky***, University of Oregon (1023-14-796)

9:00AM ► (44) *Resonant weights and critical loci of rational functions.* Preliminary report.
Daniel C. Cohen, Lousiana State University, **Graham Denham**, University of Western Ontario, **Michael J. Falk***, Northern Arizona University, and **Alexander N. Varchenko**, University of North Carolina (1023-14-1410)

9:30AM (45) *Resonance: getting past H^1.*
Graham Denham*, University of Western Ontario, and **Hal Schenck**, Texas A&M University (1023-13-1583)

10:00AM (46) *Non-finiteness properties of fundamental groups of smooth projective varieties.*
Alexandru Dimca, Université de Nice Sophia-Antipolis, **Stefan Papadima**, Institute of Mathematics of the Romanian Academy, and **Alexander I. Suciu***, Northeastern University (1023-20-712)

10:30AM (47) *Topological invariants of singular complex hypersurfaces.* Preliminary report.
Laurentiu G. Maxim, University of Illinois at Chicago (1023-55-1006)

AMS Special Session on Coding Theory and Its Applications, I

8:00 AM – 10:55 AM

Organizers: **Roxana N. Smarandache**, University of Notre Dame and San Diego State University
Pascal O. Vontobel, Hewlett-Packard Laboratories

8:00AM (48) *Pseudocodeword weights of codes from expander graphs.*
Christine A. Kelley, The Fields Institute (1023-94-1500)

8:30AM (49) *LDPC Convolutional Codes: What Are They? How Do They Work? Are They Any Good?*
Daniel J. Costello* and **Ali Emre Pusane**, Univ. of Notre Dame (1023-94-1236)

9:30AM (50) *Towards explaining decoding errors for LDPC codes.*
Lance C. Pérez and **Judy L. Walker***, University of Nebraska (1023-94-1554)

10:00AM (51) *A code decomposition theory.*
Navin Kashyap, Queen's University (1023-68-446)

10:30AM (52) *On the Minimum Achievable Decoding Delay of Maximum Rate Complex Orthogonal Space-Time Block Codes.*
Sarah Spence Adams, Olin College of Engineering (1023-94-218)

AMS Special Session on Cohomology and Representation Theory, I

8:00 AM – 10:50 AM

Organizers: **Jon F. Carlson**, University of Georgia
Daniel K. Nakano, University of Georgia
Julia Pevtsova, University of Washington

8:00AM (53) *The centralizer of a nilpotent section.*
George J. McNinch, Tufts University (1023-22-1152)

8:30AM (54) *On Some Nilpotent Orbits and Desingularizations of Their Closures.* Preliminary report.
Terrell L. Hodge*, Western Michigan University (on sabbatical leave 2006-2007 at the University of Virginia), and **David C. Murphy**, Kalamazoo College (1023-20-884)

9:00AM ► (55) *Quiver representations with bilinear forms and nilpotent orbits of graded classical Lie algebras.* Preliminary report.
Zongzhu Lin*, Kansas State University, and **Bangming Deng**, Beijing Normal University (1023-20-1656)

9:30AM (56) *Quantum Group Cohomology.*
Christopher P. Bendel*, University of Wisconsin-Stout, **Daniel K. Nakano**, University of Georgia, **Brian J. Parshall**, University of Virginia, and **Cornelius Pillen**, University of South Alabama (1023-20-627)

10:00AM (57) *Cohomology formulas, old and new.* Preliminary report.
Brian Parshall* and **Leonard Scott**, University of Virginia (1023-20-904)

10:30AM (58) *Character formulas, old and new.*
Leonard Scott* and **Brian Parshall**, University of Virginia (1023-20-905)

AMS Special Session on Experimental Mathematics in Action, I

8:00 AM – 10:50 AM

Organizers: **Victor H. Moll**, Tulane University
Tewodros Amdeberhan, Tulane University

8:00AM ► (59) *Experimental discovery of Apéry-type identities for even zeta values.*
Jonathan M. Borwein, Dalhousie University (1023-11-65)

8:30AM ► (60) *PSLQ Does Functions Too!* Preliminary report.
Marc Chamberland, Grinnell College (1023-11-222)

9:00AM ► (61) *Isodiametric problems for polygons.*
Michael J. Mossinghoff, Davidson College (1023-52-100)

9:30AM ► (62) *Fixed Points of Maps on the Space of Rational Functions.*
Edward C. Mosteig, Loyola Marymount University (1023-33-963)

10:00AM ► (63) *Disturbing the Dyson Conjecture (in a "GOOD" Way).*
Andrew V. Sills* and **Doron Zeilberger**, Rutgers University (1023-05-207)

10:30AM (64) *Computer Algebra for Special Function Inequalities.*
Manuel Kauers, RISC-Linz (1023-05-217)

AMS Special Session on Financial Mathematics, I

8:00 AM – 10:55 AM

Organizers: **Jean-Pierre Fouque**, University of California Santa Barbara
Craig A. Nolder, Florida State University
Knut Solna, University of California Irvine
Thaleia Zariphopoulou, University of Texas Austin

8:00AM (65) *Indifference prices and convex risk measures in Orlicz spaces.*
Marco Frittelli, Università degli Studi di Milano, Italy (1023-60-614)

9:00AM (66) *Stability of utility maximization.*
Gordan Zitkovic*, University of Texas at Austin, and **Kasper Larsen**, Carnegie Mellon University (1023-91-659)

9:30AM ► (67) *Correspondence between Lifetime Minimum Wealth and Utility of Consumption.*
Erhan Bayraktar, University of Michigan (1023-60-1396)

10:00AM (68) *Asymptotic analysis of utility-based hedging strategies for small number of contingent claims.*
Dmitry Kramkov, Carnegie Mellon University, and **Mihai Sirbu***, Columbia University (1023-90-581)

10:30AM (69) *Dynamic monetary risk measures in discrete time.*
Patrick Cheridito*, Princeton University, and **Michael Kupper**, Technical University Vienna (1023-91-828)

AMS Session on Partial Differential Equations, I

8:00 AM – 10:55 AM

8:00AM (70) *On Fay Identity.*
Iordan P. Michev, SUNY, Suffolk CC College (1023-35-1013)

8:15AM (71) *A simple direct approach for constructing single solitons of nonlinear wave equations.* Preliminary report.
Guoping Zhang* and **Zhijun Qiao**, University of Texas-Pan American (1023-35-1316)

8:30AM ► (72) *Mathematical Modeling of Frontal Polymerization with Encapsulated Initiators.* Preliminary report.
Divya E. Vernerey*, Salisbury University (on leave at Northwestern University), **Esteban Urdiales** and **Vladimir A. Volpert**, Northwestern University (1023-35-1329)

8:45AM (73) *On complete rotationally invariant gradient Ricci shrinking solitons.*
Brett L Kotschwar, UC San Diego (1023-35-1330)

9:00AM (74) *The two-point boundary problem for the Euler-Poisson system.*
Wilfrid Gangbo, **Truyen Nguyen** and **Adrian Tudorascu***, Georgia Institute of Technology (1023-35-1333)

9:15AM (75) *Forced Two Layer Beta-Plane Quasi-Geostrophic Flow, Part II: Time and Space Analyticity.*
Constantin Onica*, Indiana University, and **Lee R. Panetta**, Texas A&M University (1023-35-1483)

9:30AM (76) *Nematic liquid crystals and harmonic maps on polyhedral domains: theory and applications.* **A. Majumdar**, University of Oxford, **J. M. Robbins**, University of Bristol, and **Maxim Zyskin***, University of Oxford (1023-35-1517)

9:45AM (77) *A continuous approach to the lightning discharge.* Preliminary report. **Beyza Caliskan Aslan*** and **William W. Hager**, University of Florida (1023-35-1521)

10:00AM (78) *Grid transformation numerical methods for laser beam propagation in nonhomogeneous media.* Preliminary report. **James W. Rogers*** and **Qin Sheng**, Baylor University (1023-35-1531)

10:15AM ▸ (79) *On the use of second order finite difference approximations to determine plate deflections.* **Dawn Alisha Lott*** and **Patrice Danielle Green**, Delaware State University (1023-35-1569)

10:30AM (80) *An application of a critical points theorem.* **Leonard Karshima Shilgba**, Abti-American University of Nigeria, Yola. (1023-35-713)

10:45AM (81) *Motion of a Vortex Line in an Averaged Velocity Field.* Preliminary report. **James P. Peirce**, University of Wisconsin - La Crosse (1023-35-827)

AMS Session on Algebra and Number Theory, I

8:00 AM – 10:55 AM

8:00AM (82) *On Quantum Master Equation of Open-Closed String Theory.* Preliminary report. **Eric Harrelson, Alexander Voronov** and **J. Javier Zuniga***, University of Minnesota (1023-08-12)

8:15AM (83) *Addition Theorems of Fuzzy Integers of Linear Triangular Types.* Preliminary report. **Chuang Peng**, Morehouse College (1023-08-1896)

8:30AM ▸ (84) *Interassociates of the Free Commutative Semigroup on n Generators.* **Berit Nilsen Givens***, **Amber Rosin, Karen Linton**, Cal Poly Pomona, and **Laurie Dishman**, Cumberland University (1023-08-869)

8:45AM ▸ (85) *A Class of Interassociates of the Bicyclic Semigroup.* Preliminary report. **Amber Rosin***, **Berit Nilsen Givens** and **Karen Linton**, Cal Poly Pomona (1023-08-872)

9:00AM ▸ (86) *A New Key Exchange Primitive.* Preliminary report. **Yesem Kurt**, Pomona College (1023-08-928)

9:15AM ▸ (87) *On novel ways to invert a matrix.* Preliminary report. **Aaron Lauve*** and **Christophe Reutenauer**, LaCIM, University of Quebec at Montreal (1023-08-96)

9:30AM (88) *Summing prime reciprocals in an arithmetic progression.* **Dominic W. Klyve**, Dartmouth College (1023-11-1009)

9:45AM (89) *Zeta Functions on Cocompact Arithmetic Subgroups of $SL(3, R)$.* Preliminary report. **Erik R. Tou**, Dartmouth College (1023-11-1036)

10:00AM (90) *Partition Identities Arising from Ramanujan's Modular Equations and Theta Functions.* **Nayandeep Deka Baruah*** and **Bruce C. Berndt**, University of Illinois at Urbana-Champaign (1023-11-1143)

10:15AM (91) *The Breuil Module of a p-Torsion Group Scheme Represented by a Monogenic Hopf Algebra.* Preliminary report. **Alan Koch**, Agnes Scott College (1023-11-1186)

10:30AM (92) *On Selmer groups in a family of elliptic curves with reducible 2- and 3-torsion and 3-ranks of class groups of quadratic number fields.* Preliminary report. **James M. Mailhot**, Columbus, Ohio (1023-11-1291)

10:45AM (93) *A Knapsack Cryptosystem Secure Against Attacks using Basis Reduction and Integer Programming.* **Bala Krishnamoorthy***, **William Webb** and **Nathan Moyer**, Washington State University (1023-68-1853)

AMS Session on Algebra and Group Theory, I

8:00 AM – 10:40 AM

8:00AM ▸ (94) *Eigenvalue Comparisons for a Class of Boundary Value Problems of Second Order Difference Equations.* Preliminary report. **Jun Ji*** and **Bo Yang**, Kennesaw State University (1023-15-1060)

8:15AM ▸ (95) *Algorithms for Inverting or LUP-Factoring Matrices over $GF(2)$ in time $O(n^3 / \log n)$.* **Gregory V. Bard**, University of Maryland at College Park (1023-15-1667)

8:30AM ▸ (96) *The Minimum Rank Problem Over F_2.* Preliminary report. **Jason Grout***, **Wayne Barrett**, Brigham Young University, and **Raphael Loewy**, Technion-Israel Institute of Technology (1023-15-1710)

8:45AM (97) *The Rank of a Tensor.* Preliminary report. **Carla D. Martin***, James Madison University, and **Charles F. Van Loan**, Cornell University (1023-15-224)

9:00AM ▸ (98) *Estudio Sobre El Proceso De Ortogonalizacion De Grschmidt.* **Rosa M. Almonte**, Universidad Autonoma de Santo Domingo (1023-15-345)

9:15AM (99) *Extension and Acceleration of Diagonal Preconditioners.* **Russell L Carden*** and **Pablo Tarazaga**, Texas A&M University-Corpus Christi (1023-15-840)

9:30AM (100) *Noncommutative Vieta's Theorem and Graph Associated Algebras.* **David Nacin**, William Paterson University (1023-16-1274)

9:45AM (101) *Strongly Clean Rings and a Generalized Fitting's Lemma.* **Alexander J. Diesl**, Vassar College (1023-16-1524)

10:00AM (102) *Rings generated by their units.* **Thomas J. Dorsey**, Vassar College (1023-16-1533)

10:15AM (103) *Stable endomorphisms in characteristic two for the symmetric group S_4.* **Giovanna Llosent**, University of Iowa (1023-16-1708)

10:30AM (104) *On pairs of matrices generating matrix rings and their presentations.* **Bogdan Petrenko***, Texas A&M University, and **Said Sidki**, University of Brasilia (1023-16-334)

MAA Session on College Algebra: Concepts, Data, and Models, I

8:00 AM – 10:55 AM

Organizers: **Florence S. Gordon**, New York Institute of Technology
Mary Robinson, University of New Mexico Valencia Campus
Norma Agras, Miami Dade Community College

Laurette Foster, Prairie View A&M University

8:00AM ► (105) *Discrete Dynamical Systems as a College Algebra Thread.*
Rich West, Francis Marion University (1023-F1-781)

8:20AM (106) *An Active Classroom Using Modelng.*
John C. Maceli* and **Eric Robinson**, Ithaca College (1023-F1-1607)

8:40AM (107) *CRAFTY's College Algebra: Guidelines for the Nation.*
Norma M. Agras, Miami Dade College (1023-F1-1537)

9:00AM ► (108) *Modeling based College Algebra Pilot Study.* Preliminary report.
Bill Haver, Virginia Commonwealth University (1023-F1-1573)

9:20AM ► (109) *Toward a Lean and Lively Algebra.* Preliminary report.
Barry Brunson, Western Kentucky University (1023-F1-1672)

9:40AM ► (110) *Learning About Algebraic Functions Using Data Models.*
Murray H. Siegel, SC GSSM (1023-F1-203)

10:00AM ► (111) *A Departure from College Algebra.*
D. Scott Dillery, Lindsey Wilson College (1023-F1-786)

10:20AM ► (112) *Integrating College Algebra and Statistics to Meet Students' and Other Disciplines' Needs.*
Sheldon P. Gordon, Farmingdale State University of New York (1023-F1-450)

10:40AM ► (113) *A Report on One College's Efforts to re-structure the mathematics courses below Calculus.* Preliminary report.
Mercedes A. McGowen, William Rainey Harper College (1023-F1-1860)

MAA Session on Content Courses for the Mathematical Education of Middle School Teachers, I

8:00 AM - 10:55 AM

Organizers: **Laurie Burton**, Western Oregon University
Maria G. Fung, Western Oregon University
Klay Kruczek, Western Oregon University

8:00AM (114) *What's for Dessert? An Enrichment Course for Prospective Middle School Mathematics Teachers.*
Jerrold W. Grossman, Oakland University, Rochester, Michigan (1023-G1-525)

8:20AM ► (115) *Meeting the Challenge for the Preparation of Preservice Teachers of Middle School Mathematics - The Fayetteville State University (FSU) Answer.*
Genevieve M. Knight and **Kimberly Smith Burton***, Fayetteville State University (1023-G1-576)

8:40AM ► (116) *An Upper Level Series of Mathematics Courses for Prospective Middle School Teachers.*
Herbert E. Kasube, Bradley University (1023-G1-563)

9:00AM ► (117) *Aha! Now I Understand Why! - Creating Self-Reliance in Mathematical Content through a Problem-Centered Course Sequence.* Preliminary report.
Tracie McLemore Salinas* and **Mary Elizabeth Searcy**, Appalachian State University (1023-G1-1598)

9:20AM ► (118) *Making Sense: Developing the Mathematical Understanding of Prospective Middle School Teachers.*
Jennifer J. Kosiak, University of Wisconsin - La Crosse (1023-G1-1413)

9:40AM (119) *A Problem Analysis Course for Middle Grades Teachers.*
Mary Garner, Kennesaw State University (1023-G1-1587)

10:00AM (120) *Four Content Courses and Activity-Based Materials Designed for Preservice Middle School Teachers and Elementary Mathematics Specialists.*
Jen E. Szydlik, University of Wisconsin Oshkosh (1023-G1-429)

10:20AM ► (121) *Teaching Concepts and Problems Solving Skills through Mathematical Stories.* Preliminary report.
Ioana Mihaila* and **Patricia Hale**, Cal Poly Pomona (1023-G1-684)

10:40AM ► (122) *Mathematics Materials for Middle School Teachers.*
Ira J. Papick, University of Missouri-Columbia (1023-G1-198)

MAA Session on Euler in the Classroom

8:00 AM - 10:55 AM

Organizers: **Robert E. Bradley**, Adelphi University
Amy Shell-Gellasch, Grafenwoer, Germany

8:00AM ► (123) *Euler Enriches Summer High School Program.* Preliminary report.
Julia Darby Head* and **G. Brock Williams**, Texas Tech University (1023-H5-1721)

8:15AM ► (124) *Mathematics of Euler—Euler Line and Euler's Formula for Polyhedra.*
Jim Fulmer, University of Arkansas at Little Rock (1023-H5-1804)

8:30AM ► (125) *Investigating Euler's Polyhedral Formula Using Original Sources.*
Lee Stemkoski, Adelphi University (1023-H5-1275)

8:45AM ► (126) *Euler and Honors Students.* Preliminary report.
Homer S. White, Georgetown College, Kentucky (1023-H5-877)

9:00AM ► (127) *Jospeh Darbes' 1778 portraits of Euler: their provenance, the method of construction and reproduction.* Preliminary report.
D. Florence Fasanelli, American Association for the Advancment of Science (1023-H5-1888)

9:15AM ► (128) *Napier's e.* Preliminary report.
Amy E. Shell-Gellasch, Pacific Lutheran University (1023-H5-913)

9:30AM (129) *E29, or Pell's equation in the number theory classroom.*
Daniel E. Otero, Xavier University (1023-H5-1343)

9:45AM ► (130) *Euler and the Circular Functions in the Classroom.* Preliminary report.
Bruce S. Burdick, Roger Williams University (1023-H5-1760)

10:00AM ► (131) *Functions vs. Equations in Euler's Work.*
Robert E. Bradley, Adelphi University (1023-H5-1617)

10:15AM ► (132) *Euler Angles, Rotation Matrices, Euler's Identity and Quaternions.*
Paul R. Bouthellier, University of Pittsburgh-Titusville (1023-H5-406)

10:30AM ► (133) *Euler's Method for Differential Equations.*
Dick Jardine, Keene State College (1023-H5-1084)

10:45AM ► (134) *Dances between continuous and discrete: Euler's summation formula in his owns words.*
David J. Pengelley, New Mexico State University (1023-H5-282)

MAA Session on Integrating Mathematics and Biology in Undergraduate Education, I

8:00 AM - 10:55 AM

Organizers: **Glenn W. Ledder**, University of Nebraska-Lincoln
Yajun Yang, Farmingdale State University of New York
Jack Bookman, Duke University
James P. Fulton, Suffolk County Community College

8:00AM ► (135) *A Bridge Course to Prepare Students for a Biotechnology Program.* Preliminary report.
Mary R. Parker, Austin Community College (1023-K1-1657)

8:20AM ► (136) *From Edge to Center: Retooling a Math/Bio Course.*
Meredith L. Greer, Bates College (1023-K1-1112)

8:40AM ► (137) *An Integrated Mathematics Course for Biology Students.* Preliminary report.
Patti Frazer Lock*, St. Lawrence University, **Michael Caplan**, Yale Medical School, **Dan Flath**, Macalaster College, and **Jeff Tecosky-Feldman**, Haverford College (1023-K1-1365)

9:00AM ► (138) *Using the Scientific Method to Integrate Biology into a Precalculus Course.*
James P. Fulton* and **Linda Sabatino**, Suffolk Community College (1023-K1-1632)

9:20AM ► (139) *Get Rhythm, If You Get to Choose!*
Mike Martin, Johnson County Community College (1023-K1-629)

9:40AM ► (140) *Mathematical Models in Nature - a project-based course in mathematical biology.*
Jennifer Wilson, Eugene Lang College, the New School for Liberal Arts (1023-K1-1665)

10:00AM (141) *An Undergraduate Course in Biomathematics with an Accompanying Textbook.*
Raina S. Robeva*, Sweet Briar College, and **Michael L. Johnson**, University of Virginia School of Medicine (1023-K1-1575)

10:20AM (142) *Biology, Differential Equations, and Learning to Read the Research.*
Thomas W. Judson, Harvard University (1023-K1-175)

10:40AM ► (143) *Mathematical Biology in the Short Term: A Mini Course for a Summer Program.*
Angela Gallegos, Occidental College, Los Angeles, CA (1023-K1-1875)

MAA Session on Teaching Mathematics Courses Online

8:00 AM - 10:55 AM

Organizers: **Cheryl Olsen**, Shippensburg University
Kate McGivney, Shippensburg University

8:00AM ► (144) *Teaching developmental mathematics with coursecompass.com.* Preliminary report.
Katarzyna Potocka* and **Pangyen Weng**, Ramapo College of New Jersey (1023-Q5-541)

8:20AM ► (145) *On-Line Calculus Courses at Valparaiso University.*
Kenneth H. Luther, Valparaiso University (1023-Q5-573)

8:40AM (146) *Investigating Student Success in Virtual Business Calculus: A Mostly Online Course.* Preliminary report.
Brian H. Felkel, Appalachian State University (1023-Q5-1215)

9:00AM ► (147) *Evolution of a Long Distance Education Course for In-Service Middle School Math Teachers.* Preliminary report.
Heidi A. Feller, University of Nebraska-Lincoln (1023-Q5-656)

9:20AM (148) *Using Camtasia Studio to Teach Mathematics Online.*
Jason A. Aubrey, University of Missouri - Columbia (1023-Q5-1881)

9:40AM ► (149) *Integrating Graphing Calculator Emulator Software into Live Webcasts.*
Chris Oehrlein, Oklahoma City Community College (1023-Q5-1823)

10:00AM ► (150) *Online Class Experience in Mathematics at the University of Mississippi.* Preliminary report.
Semail Ulgen Yildirim*, Grand Valley State University, and **Robert Hunt**, University of Mississippi (1023-Q5-1774)

10:20AM ► (151) *Teaching mathematics online: The Park University experience.*
Aldo R. Maldonado, Park University (1023-Q5-266)

10:40AM ► (152) *Full Speed Ahead with a Tablet PC.* Preliminary report.
Denise J. LeGrand, University of Arkansas at Little Rock (1023-Q5-183)

MAA Session on Use of Technology in Abstract Algebra and Number Theory

8:00 AM - 10:55 AM

Organizers: **Byungchul Cha**, Hendrix College
Bo-Hae Im, Chung-Ang University

8:00AM ► (153) *Laboratory Experiences in Group Theory.*
Ellen J. Maycock, American Mathematical Society (1023-S1-1292)

8:15AM ► (154) *PascGalois JE: Visualizing Group Structures.*
Don Spickler, Salisbury University (1023-S1-1342)

8:30AM ► (155) *Using Pascal's Triangle modulo p to visualize the Lucas Correspondence Theorem.* Preliminary report.
Kurt E. Ludwick, Salisbury University (1023-S1-1628)

8:45AM ► (156) *Flash Tools for Finite Groups.*
James E. Hamblin, Shippensburg University (1023-S1-669)

9:00AM (157) *Teaching Abstract Algebra Using the Software GAP.*
Julianne G. Rainbolt, Saint Louis University (1023-S1-867)

9:15AM ► (158) *Using XGAP to explore the structure of groups.*
Russell D. Blyth, Saint Louis University (1023-S1-723)

9:30AM ► (159) *Visualizing Group Theory with Group Explorer.*
Nathan C. Carter, Bentley College (1023-S1-668)

9:45AM (160) *Tell Me What You Can About A Group Of Order n.*
Mike Krebs, Cal State LA (1023-S1-432)

10:00AM (161) *An inquiry-based number theory course.*
John Jones*, Arizona State University, and **Jeff Holt**, University of Virginia (1023-S1-526)

10:15AM ► (162) *Using PARI/GP in a Number Theory Class.*
Benjamin L. Levitt, California State University, Chico (1023-S1-1620)

10:30AM ► (163) *Computational Group Theory and Symmetry.*
Jeffrey W. Clark, Elon University (1023-S1-211)

10:45AM ► (164) *Teaching Discovery: Technology and Entrenchment.* Preliminary report.
Chris K. Caldwell, University of Tennessee at Martin (1023-S1-1623)

MAA General Contributed Paper Session, I

8:00 AM – 10:55 AM

Organizers: **Eric S. Marland**, Appalachian State University
Jay A. Malmstrom, Oklahoma City Community College

8:00AM (165) *Mathematical modeling of ferro-antiferromagnet (F-AF) exchange coupled systems.*
Congxiao Liu*, **Min Sun**, and **Hideo Fujiwara**, MINT Center, The University of Alabama (1023-Z1-608)

8:15AM ► (166) *Put-call parity in the classroom.*
Maryam Vulis, Forest Hills, New York (1023-Z1-1017)

8:30AM ► (167) *Labs on Public Key Cryptograph and Subgroups of S_4 using technologies.*
Heakyung Lee, Winthrop University (1023-Z1-940)

8:45AM ► (168) *Using Mapping Software in the Mathematics Classroom.* Preliminary report.
Manuel J. Sanders, University of South Carolina at Beaufort (1023-Z1-831)

9:00AM ► (169) *Some of My Favorite Calculus Homework Problems.*
Fred Worth, Henderson State University (1023-Z1-370)

9:15AM ► (170) *Some Calculus 2 Students Seem to Prefer Procedural Approaches to Exercises over Conceptual Ones.*
Mary D. Shepherd, Northwest Missouri State University (1023-Z1-1320)

9:30AM Break.

9:45AM ► (171) *A Method for Generating Integer Solutions to Matrix Equations.* Preliminary report.
Raymond N. Greenwell* and **Stanley Kertzner**, Hofstra University (1023-Z1-126)

10:00AM (172) *Innovations in teaching a rings first abstract algebra course.*
M. Chakrabarti, Grand Valley State University (1023-Z1-1821)

10:15AM ► (173) *The review of relevant mathematical content for the teaching of middle and secondary mathematics via a methods course: An integrated approach.* Preliminary report.
Dante A. Tawfeeq, Adelphi University (1023-Z1-634)

10:30AM ► (174) *An Experimental Study on the Implementation of Online Resources in Pre-Calculus Algebra.*
Tasha Thrower*, **Jan Case**, **Audria White** and **Fred Kelley**, Jacksonville State University (1023-Z1-482)

10:45AM (175) *Mobile-Technology and the College Math Core Curriculum.*
Marilyn Reba, Clemson University (1023-Z1-358)

SIAM Minisymposium on Phyllotaxis

8:00 AM – 10:55 AM

Organizers: **Pau Atela**, Smith College
Christope Gole, Smith College

8:00AM (176) *Mathematical techniques in Phyllotaxis.*
Scott G. Hotton, Harvard University - Department of Organismic and Evolutionary Biology (1023-92-1347)

8:30AM (177) *Mathematical models of likely mechanisms for phyllotaxis: Polarized auxin transport, cell growth, and dynamic connectivity.*
Eric Mjolsness*, Departments of Computer Science and Mathematics, University of California Irvine, **Marcus Heisler**, Division of Biology, California Institute of Technology, **Henrik Jonsson**, Computational Biology & Biological Physics Group, Lund University, **Elliot Meyerowitz** and **Bruce Shapiro**, Division of Biology, California Institute of Technology (1023-92-1820)

9:00AM (178) *Modeling phyllotaxis: from molecules to patterns.*
Richard S. Smith, University of Calgary, **Soazig Guyomarc'h**, **Therese Mandel**, **Didier Reinhardt**, University of Berne, **Adam Runions**, University of Calgary, **Cris Kuhlemeier**, University of Berne, and **Przemyslaw Prusinkiewicz***, University of Calgary (1023-92-1890)

9:30AM (179) *An Amplitude-Equation Approach to Phyllotaxis.*
Alan C. Newell, University of Arizona, and **Patrick D. Shipman***, University of Maryland (1023-92-1563)

10:00AM (180) *New Geometric concepts for Phyllotaxis.*
Pau Atela*, Smith College, **Jacques Dumais**, Harvard University, **Christophe Gole**, Smith College, and **Scott Hotton**, Harvard University (1023-92-1269)

10:30AM (181) *A new characterization of irregular phyllotactic patterns.*
Stephane Douady, Ecole Normale Superieure, Paris (1023-92-1644)

SIAM Minisymposium on Mathematics and Materials Science

8:00 AM – 10:55 AM

Organizer: **Robert P. Lipton**, Louisiana State University

8:00AM (182) *Modeling the Self-Assembly of Quantum Dots in Thin Solid Films.*
Margo S. Levine*, **Alexander A. Golovin**, **Stephen H. Davis**, Northwestern University, and **Peter W. Voorhees**, Department of Materials Science, Northwestern University (1023-74-1257)

8:30AM (183) *Phase of biaxial liquid crystal polymers and particle suspensions in simple flows.* Preliminary report.
Sarthok Sircar* and **Qi Wang**, Florida State University (1023-82-1015)

9:00AM (184) *Estimates for the principal Dirichlet eigenvalue of anisotropic elliptic operator on a ball and their applications.*
Steve Rosencrans*, **Xuefeng Wang**, **Bill Winter**, Tulane University, and **Shan Zhao**, University of Alabama (1023-80-1276)

9:30AM (185) *Solute tramsport in porous media.*
Guillermo H Goldsztein, Georgia Tech (1023-35-1376)

10:00AM (186) *Nano-rod composites: a flow strategy to control anisotropic percolation.*
M. Gregory Forest*, University of North Carolina at Chapel Hill, **Xiaoyu Zheng**, Kent State University, **Richard Vaia**, Air Force Research Laboratory, **Michael Arlen**, University of North Carolina at Chapel Hill, **Ruhai Zhou**, Old Dominion University, **Qi Wang**, Florida State University, and **Robert Lipton**, Louisiana State University (1023-76-1794)

10:30AM (187) *Stability of the normal state of superconductors in the presence of electric currents.*
Yaniv Almog, Louisiana State University (1023-82-1288)

AMS Special Session on Recent Developments in Analysis and Numerics of Geophysical Fluid Dynamics Problems, I

8:30 AM – 10:55 AM

Organizers: **Jie Shen**, Purdue University
Shouhong Wang, Indiana University

8:30AM (188) *Sediment Transport Models.* Preliminary report.
Jerry L Bona, University of Illinois at Chicago (1023-86-1827)

9:00AM (189) *The 2D surface quasi-geostrophic equation with supercritical dissipation.* Preliminary report.
Ming-Chih Lai, **Yu-Hou Tseng**, National Chiao Tung University, Taiwan, and **Jiahong Wu***, Oklahoma State University (1023-76-639)

9:30AM (190) *Two-dimensional infinite Prandtl number convection: Structure of bifurcated solutions.*
Jungho Park, Indiana University, Bloomington (1023-35-1585)

10:00AM (191) *Modeling and simulation of multiphase incompressible flows using an energetic variational phase field model.*
Jie Shen, Purdue University (1023-76-1549)

10:30AM Discussion.

(192) *Finite-Element-based Faedo-Galerkin weak solutions to the Navier-Stokes equations with Dirichlet boundary conditions are suitable.*
Jean-Luc Guermond, Texas A&M University (1023-65-1919)

MAA Minicourse #12: Part A

9:00 AM – 11:00 AM

Combinatorially thinking.

Organizers: **Arthur T. Benjamin**, Harvey Mudd College
Jennifer J. Quinn, Association for Women in Mathematics

MAA Minicourse #1: Part A

9:00 AM – 11:00 AM

Introduction to the mathematics of modern cryptography.

Organizers: **Colm K. Mulcahy**, Spelman College
Jeffrey Ehme, Spelman College

MAA Minicourse #7: Part A

9:00 AM – 11:00 AM

Directing undergraduate research.

Organizer: **Aparna W. Higgins**, University of Dayton

MAA Session on Innovative and Effective Ways to Teach Linear Algebra, I

9:00 AM – 10:55 AM

Organizers: **David Strong**, Pepperdine University
Gilbert Strang, Massachusetts Institute of Technology

8:40AM ► (193) *Using concept maps to look at linear algebra understandings.*
David E. Meel, Bowling Green State University (1023-J1-850)

9:00AM ► (194) *Optimizing Singular Values for Images.* Preliminary report.
Michael Huber, Muhlenberg College (1023-J1-180)

9:20AM Break.

9:40AM (195) *Using DERIVE to Emphasize Understanding in Linear Algebra.*
Lisa Townsley, Benedictine University (1023-J1-389)

10:00AM ► (196) *Using Maple to See the Solution to the Least Squares Problem.* Preliminary report.
Vicky Williams Klima, Appalachian State University (1023-J1-176)

10:20AM (197) *Quantum Mechanics: A Different Spin on Linear Algebra.*
Itai Seggev, University of Mississippi (1023-J1-162)

10:40AM ► (198) *Löwdin Orthogonalization - A Natural Supplement to Gram-Schmidt.*
Scott F. Beaver, Western Oregon University (1023-J1-597)

AMS Special Presentation

9:30 AM – 10:55 AM

Report on the findings of the 2005 CBMS survey of undergraduate mathematical and statistical sciences in the U.S.

Moderator: **James W. Maxwell**, AMS

Presenters: **David Lutzer**, College of William and Mary
Ellen J. Kirkman, Wake Forest University
Stephen B. Rodi, Austin Community College

MAA-Project NExT-YMN Panel Discussion

9:30 AM – 10:50 AM

Keeping your research alive.

Organizers: **Brian Birgen**, Wartburg College
William M. Higdon, University of Indianapolis
James E. Hamblin, Shippensburg University

Panelists: **Jean Bee Chan**, Sonoma State University
Michael J. Dorff, Brigham Young University
Asamoah Nkwanta, Morgan State University

MAA Special Presentation

9:30 AM – 10:50 AM

National Science Foundation programs supporting learning and teaching in the mathematical sciences.

Organizers: **Camille McKayle**, NSF
Lloyd E. Douglas, NSF
Elizabeth J. Teles, NSF
Lee L. Zia, NSF
David C. Royster, NSF

SIGMAA on the Teaching of Advanced High School Mathematics Panel Discussion

9:30 AM – 10:50 AM

What mathematical content should future mathematics majors learn while in high school?

Organizer: **Daniel J. Teague**, North Carolina School of Science and Mathematics

Panelists: **Benjamin G. Klein**, Davidson College
Susan S. Wildstrom, Walt Whitman High School
Daniel J. Teague

AMS Special Presentation

10:00 AM – 10:55 AM

Who wants to be a mathematician?

Organizers: **Michael A. Breen**, AMS
William T. Butterworth, DePaul University

AMS Invited Address

10:05 AM – 10:55 AM

(199) *Diffraction by edges.*
Andras Vasy, Stanford University (1023-35-05)

AMS-MAA Invited Address

11:10 AM – NOON

(200) *Dynamics of integer sets.*
Bryna R. Kra, Northwestern University (1023-37-13)

Exhibits and Book Sales

12:15 PM – 5:30 PM

AMS Colloquium Lecture: Lecture I

1:00 PM – 2:00 PM

(201) *Limit shapes, real and imagined, I: Random surfaces around us.*
Andrei Okounkov, Princeton University (1023-60-02)

MAA Invited Address

2:15 PM – 3:05 PM

(202) *Forming committees.*
Penny Haxell, University of Waterloo (1023-A0-19)

AMS-MAA Special Session on Math Circles and Similar Programs for Students and Teachers, II

2:15 PM – 7:00 PM

Organizers: **Morris Kalka**, Tulane University
Hugo Rossi, Mathematical Sciences Research Institute
Tatiana Shubin, San Jose State University
Zvezdelina E. Stankova, Mills College
Daniel H. Ullman, George Washington University
Paul A. Zeitz, University of San Francisco

2:15PM (203) *Experience with Teaching Algorithmics in a Public School Setting.*
Anna Charny, Advanced Math and Science Academy Charter School (1023-97-706)

2:40PM ► (204) *The San Francisco Math Circle: A teacher-centered math circle for underrepresented student populations.*
Paul A. Zeitz, University of San Francisco (1023-97-1222)

3:05PM ► (205) *Seeking Points of Intersection: High-School Curricula vs. Math Circle Goals.*
James S. Tanton, St. Mark's Institute of Mathematics (1023-97-1007)

3:30PM ► (206) *How and Why the Hampshire College Summer Studies in Mathematics Works. YP17.*
David C. Kelly, Hampshire College (1023-97-763)

3:50PM ► (207) *Canada/USA Mathcamp: a summer math program for talented high-school students.*
Mira Bernstein, Wellesley College (1023-97-1178)

4:10PM ► (208) *SEE-Math - Summer Educational Enrichment at Texas A&M for Middle School Students.*
Philip B. Yasskin, Texas A&M University (1023-97-235)

4:30PM (209) *Circle in a Box.*
Sam Vandervelde, Stanford University (1023-97-49)

4:55PM ► (210) *A Math Circle sponsored by Brigham Young University.* Preliminary report.
David G. Wright, Brigham Young University (1023-97-185)

5:20PM ► (211) *10 years of the Berkeley Math Circle.*
Zvezdelina Entcheva Stankova, Mills College and UC Berkeley (1023-97-711)

5:45PM ► (212) *Building and Supporting Extracurricular Mathematics in Chicago.* Preliminary report.
Isaac L. Greenspan, Illinois Mathematics and Science Academy (1023-97-791)

6:15PM Panel discussion moderated by Mark Saul.

AMS-ASL Special Session on Logical Methods in Computational Mathematics, II

2:15 PM – 4:40 PM

Organizers: **Saugata Basu**, Georgia Institute of Technology
Charles N. Delzell, Louisiana State University

2:15PM ► (213) *Managing an NP-Complete Problem.*
Andrew G. Borden, St. Mary';s University, San Antonio, Texas (1023-68-321)

2:45PM ► (214) *Computational power of bounded arithmetic from the predicative viewpoint.*
Sam Buss, University of California, San Diego (1023-03-604)

3:15PM (215) *Mystery of Point Charges.*
Andrei Gabrielov*, Purdue University, **Dimitri Novikov**, The Weizmann Institute of Science, and **Boris Shapiro**, Stockholm University (1023-14-756)

3:45PM (216) *Constructing expansions of the real field by restricted transcendental analytic functions with decidable theories.* Preliminary report.
Daniel J. Miller, Emporia State University (1023-03-88)

4:15PM (217) *Quantitative results in o-minimal topology.*
Thierry Zell, Georgia State University (1023-03-153)

AMS-AWM Special Session on Geometric Group Theory, II

2:15 PM – 6:10 PM

Organizers: **Ruth M. Charney**, Brandeis University
Karen Vogtmann, Cornell University

2:15PM (218) ► *Systolic spaces: Minimal surfaces, Flat Torus Theorem and related results, according to Tomasz Elsner.*
Tadeusz Januszkiewicz, Ohio State University (1023-20-297)

2:45PM (219) $\mathbf{SL_3}(\mathbb{Z}[t])$ *is not* FP_2. Preliminary report.
Kai-Uwe Bux, University of Virginia, and **Kevin Wortman***, Yale University (1023-20-1678)

3:15PM (220) *Lattices in automorphism groups of polygonal complexes with symmetric links.*
Anne Thomas, University of Chicago (1023-20-421)

3:45PM (221) *Algebraic finiteness for Kleinian and relatively hyperbolic groups.* Preliminary report.
Ilya Kapovich*, University of Illinois at Urbana-Champaign, and **Richard Weidmann**, Heriott-Watt University (1023-20-442)

4:15PM (222) *Relative hyperbolicity of countable groups.* Preliminary report.
G. Christopher Hruska, University of Wisconsin-Milwaukee (1023-20-906)

4:45PM (223) *The Isomorphism Problem for toral relatively hyperbolic groups.*
Daniel P. Groves*, California Institute of Technology, and **Francois Dahmani**, Laboratoire Emile Picard, University Paul Sabatier, Toulouse (1023-20-391)

5:15PM (224) *High dimensional isoperimetric functions of groups.*
Noel Brady* and **Max Forester**, University of Oklahoma (1023-20-1530)

5:45PM (225) *High dimensional isoperimetric functions of groups.*
Noel Brady and **Max Forester***, University of Oklahoma (1023-20-1532)

AMS Special Session on Fixed Point Theory, Dynamics, and Group Theory, II

2:15 PM – 6:10 PM

Organizers: **Michael R. Kelly**, Loyola University
Peter N. Wong, Bates College

2:15PM (226) *Self-coincidences of mappings between spheres. Preliminary report.* Preliminary report.
Duane Randall, Loyola University New Orleans (1023-55-1273)

2:45PM (227) *The uniqueness of the coincidence index on orientable differentiable manifolds.*
P. Christopher Staecker, Messiah College (1023-57-1220)

3:15PM (228) *Reidemeister classes for automorphisms of nilpotent groups and applictions for Fixed Point Theory.* Preliminary report.
Daciberg Lima Goncalves*, University of São Paulo, and **Peter Wong**, Bates College (1023-55-179)

3:45PM (229) *Fixed points on model solvmanifold pairs.*
Aaron A. Reite, California State University Fresno (1023-55-870)

4:15PM (230) *Estimating Nielsen numbers on wedge product spaces.*
Nirattaya Khamsemanan*, University of Connecticut, Storrs, and **Seugwon Kim**, University of California, Los Angeles (1023-14-594)

4:45PM (231) *Fixed point bundles of fiber-preserving maps.* Preliminary report.
Christina L. Soderlund*, California Lutheran University, and **Robert F. Brown**, University of California, Los Angeles (1023-55-1311)

5:15PM (232) *On explosion points and fixed points.*
Mohammad Abry, **Jan J Dijkstra*** and **Jan van Mill**, Vrije Universiteit Amsterdam (1023-54-30)

5:45PM (233) *Antipodal-like theorems and symmetric continua in euclidean spaces.*
Jan P. Boronski*, Auburn University, and **Marian Turzanski**, Cardinal Stefan Wyszynski University (1023-26-484)

AMS Special Session on Knots, 3-Manifolds, and Their Invariants, II

2:15 PM – 6:10 PM

Organizers: **Oliver T. Dasbach**, Louisiana State University
Xiao-Song Lin, University of California Riverside

2:15PM (234) *Generalizations of Gropes.* Preliminary report.
Tim D. Cochran*, Rice University, **Carol Gee**, St. Edwards University, **Shelly L. Harvey**, Rice University, and **Constance Leidy**, University of Pennsylvania and Wesleyan University (1023-57-1010)

2:45PM (235) *Volume, twist number, and Jones polynomial of hyperbolic links I.*
David Futer*, **Efstratia Kalfagianni**, Michigan State University, and **Jessica S. Purcell**, University of Texas at Austin (1023-57-1047)

3:15PM (236) *Volume, twist number and Jones polynomial of hyperbolic links, II.* Preliminary report.
D. Futer, **E. Kalfagianni***, Michigan State University, and **J. Purcell**, University of Texas, Austin (1023-57-1044)

3:45PM (237) ► *Spanning tree filtration on the reduced Khovanov complex and the associated spectral sequence.*
Abhijit Champanerkar*, University of South Alabama, and **Ilya Kofman**, College of Staten Island, CUNY (1023-57-966)

4:15PM (238) *Khovanov Homology, Twist Number and Surfaces.*
Robert G. Todd, University of Iowa (1023-57-494)

4:45PM (239) *SL(2,ℂ) and PSL(2,ℂ) Casson invariants and A-polynomials.* Preliminary report.
Hans U. Boden, McMaster University, and **Cynthia L. Curtis***, The College of New Jersey (1023-57-1534)

5:15PM (240) *Knot Concordance and Blanchfield Duality.*
Shelly Harvey, Rice University (1023-57-1016)

5:45PM (241) *Surgery of type-p and quantum invariants of 3-manifolds.*
Patrick M. Gilmer, Louisiana State University (1023-57-512)

AMS Special Session on Arrangements and Related Topics, II

2:15 PM – 6:05 PM

Organizers: **Daniel C. Cohen**, Louisiana State University
Anne V. Shepler, University of North Texas

2:15PM (242) *Hyperbolic Deligne complexes and Artin groups.*
Ruth Charney*, Brandeis University, and **John Crisp**, Universite de Bourgogne, Dijon (1023-20-462)

2:45PM (243) *Relative Invariants : An Exterior Algebra.*
Vincent Beck, Institut Mathematiques de Jussieu - Universite Paris 7 (1023-20-503)

3:15PM (244) *A symmetric function generalization of the Tutte polynomial.*
Harm Derksen, University of Michigan (1023-05-936)

3:45PM (245) *Lattice theory of the poset of regions, with applications to W-Catalan combinatorics.*
Nathan Reading, North Carolina State University (1023-05-1097)

4:15PM ► (246) *A problem about tilings of squares.* Preliminary report.
Aaron D. Abrams, Emory University (1023-51-1571)

4:45PM ► (247) *The Rauzy tiling and associated algebras.*
Alex Clark, University of North Texas, **Karin Erdmann** and **Sibylle Schroll***, University of Oxford (1023-16-615)

5:15PM (248) *Logarithmic vector fields and truncated affine Weyl arrangements.*
Masahiko Yoshinaga, The Abdus Salam International Centre for Theoretical Physics (1023-05-931)

5:45PM (249) *Rational maps with the symmetries of complex reflection groups.* Preliminary report.
Scott Crass, CSU, Long Beach (1023-51-909)

AMS Special Session on Recent Developments in Analysis and Numerics of Geophysical Fluid Dynamics Problems, II

2:15 PM – 5:40 PM

Organizers: **Jie Shen**, Purdue University
Shouhong Wang, Indiana University

2:15PM (250) *A Dyadic Model for the Inviscid Fluid Equations.* Preliminary report.
Susan Friedlander, University of Illinois-Chicago (1023-35-342)

2:45PM ► (251) *Exact solutions of a spherical model for the energy-enstrophy theory of a barotropic fluid coupled to rotating massive sphere.*
Chjan C. Lim, Rensselaer Polytechnic Institute (1023-86-312)

3:15PM (252) *Nonlinear local Lyapunov exponent and predictability.*
Jianping Li* and **Ruiqiang Ding**, LASG, Institute of Atmospheric Physics, Chinese Academy of Sciences (1023-37-202)

3:45PM (253) *A Finite volume implicit Euler scheme for the linearized shallow water equations: stability and convergence.*
Du X. Pham*, The Institute for Scientific Computing and Applied Mathematics, Indiana University, and **Karine Adamy**, Numerique, Universite Paris-Sud (1023-65-346)

4:15PM (254) *The Global Attractor for the Solutions to the 3D Viscous Primitive Equations in H^2 space.*
Ning Ju, Oklahoma State University (1023-35-1141)

4:45PM (255) *Large Prandtl Number Behavior of the Boussinesq System of Rayleigh-Benard Convection.*
Xiaoming Wang, Florida State University (1023-76-360)

5:15PM (256) *Stability and transitions for the double-diffusive convections.*
Chun-Hsiung Hsia, University of Illinois at Chicago, **Tian Ma**, Sichuan University, and **Shouhong Wang***, Indiana University (1023-86-1510)

AMS Special Session on Coding Theory and Its Applications, II

2:15 PM – 6:10 PM

Organizers: **Roxana N. Smarandache**, University of Notre Dame and San Diego State University
Pascal O. Vontobel, Hewlett-Packard Laboratories

2:15PM Discussion.

2:45PM (257) *Skew Hadamard Designs and Their Codes.* Preliminary report.
Jon-Lark Kim, University of Louisville (1023-94-1037)

3:15PM (258) *Rediscovering Our Roots: Coding Theory and Reed-Solomon Codes.*
Henry D. Pfister, Texas A&M University (1023-94-1868)

3:45PM (259) *Algebraic Soft Decision Decoding of Reed Solomon Codes Using Bit-level Soft Information.*
Jing Jiang and **Krishna R Narayanan***, Texas A&M University (1023-94-1886)

4:15PM Break.

4:45PM ► (260) *On the generalized reversal distance.*
Olgica Milenkovic, University of Colorado, Boulder (1023-05-1849)

5:15PM (261) *String Reconstruction: Putting right what once went wrong.*
Sampath Kannan and **Andrew McGregor***, University of Pennsylvania (1023-60-1375)

5:45PM Discussion.

AMS Special Session on Cohomology and Representation Theory, II

2:15 PM – 6:05 PM

Organizers: **Jon F. Carlson**, University of Georgia
Daniel K. Nakano, University of Georgia
Julia Pevtsova, University of Washington

2:15PM (262) *Special bases via positive characteristic.*
Roman V. Bezrukavnikov, MIT (1023-20-1254)

2:45PM (263) *Tensor categories attached to cells in finite Weyl groups.*
Victor Ostrik, University of Oregon (1023-20-990)

3:15PM (264) *Injective Modules and Cohomology of Lie Algebras.*
Jorg Feldvoss, University of South Alabama (1023-17-545)

3:45PM (265) *Cohomology of Category $\mathcal{O}$ for the Virasoro algebra.*
Brian Boe, Daniel Nakano and **Emilie Wiesner***, University of Georgia (1023-17-471)

4:15PM (266) *Cohomology for Lie superalgebras.*
Brian D. Boe*, **Jonathan R. Kujawa** and **Daniel K Nakano**, University of Georgia (1023-17-1201)

4:45PM (267) *Support Varieties for Lie Superalgebras.*
Jonathan R. Kujawa*, **Brian Boe** and **Daniel K. Nakano**, University of Georgia (1023-17-1166)

5:15PM (268) *Varieties for modules of quantum elementary abelian groups.*
Julia Pevtsova, University of Washington, and **Sarah Witherspoon***, Texas A&M University (1023-16-1310)

5:45PM (269) *The exact category of modules of constant Jordan type.* Preliminary report.
Jon F. Carlson, University of Georgia, **Eric M. Friedlander***, Northwestern University, and **Julia Pevtsova**, University of Washington (1023-20-501)

AMS Special Session on Experimental Mathematics in Action, II

2:15 PM – 6:05 PM

Organizers: **Victor H. Moll**, Tulane University
Tewodros Amdeberhan, Tulane University

2:15PM ▸ (270) *Symbol-Crunching the Gambler's Ruin Problem.*
Shalosh B. Ekhad and **Doron Zeilberger***, Rutgers University (1023-05-228)

2:45PM ▸ (271) *GFUN: 15 years later.*
Bruno Salvy, INRIA Rocquencourt, France (1023-40-227)

3:15PM ▸ (272) *Which Partial Sums of the Taylor Series for e Are Convergents to e? (with an Appendix by Kyle Schalm).*
Jonathan Sondow, New York City (1023-11-115)

3:45PM ▸ (273) *Asymptotic analysis of differential-difference equations.* Preliminary report.
Diego Ernesto Dominici, State University of New York at New Paltz (1023-41-319)

4:15PM ▸ (274) *Experimental Mathematics and Radix Representations for Vectors.*
Eva Curry, Acadia University (1023-37-1903)

4:45PM ▸ (275) *Polyhedral theta functions – theorems and experiments.* Preliminary report.
Sinai Robins, Temple University (1023-11-305)

5:15PM (276) *Hypergeometric Functions that Generate Series Acceleration Formulae for Values of the Riemann Zeta Function.*
David M. Bradley, University of Maine (1023-33-903)

5:45PM (277) *Divisibility Properties of Integer Sequences.*
Dante V. Manna*, Dalhousie University, **Tewodoros Amdeberhan** and **Victor H. Moll**, Tulane University (1023-11-67)

AMS Special Session on Financial Mathematics, II

2:15 PM – 6:10 PM

Organizers: **Jean-Pierre Fouque**, University of California Santa Barbara
Craig A. Nolder, Florida State University
Knut Solna, University of California Irvine
Thaleia Zariphopoulou, University of Texas Austin

2:15PM (278) *Arbitrage Bounds for Volatility Derivatives and the Skorokhod embedding Problem.*
Bruno Dupire, Bloomberg (1023-60-1703)

3:15PM (279) *Small-time and tail asymptotics for diffusion and time-changed diffusion processes.* Preliminary report.
Martin S. Forde, UCBS (1023-60-1404)

3:50PM (280) *Mathematical Foundation for Technial Analysis of Stock price.* Preliminary report.
Wei Liu, Department of Statistics, East China Normal University, Shanghai, and **Weian Zheng***, University of California Irvine (1023-60-892)

4:45PM (281) *Unified Modeling of Corporate Debt, Credit Derivatives, and Equity Derivatives.*
Vadim Linetsky, Northwestern University (1023-60-566)

5:45PM (282) *Pricing credit from the top down with affine point processes.*
Kay Giesecke, Stanford University, Department of Management Science and Engineering (1023-60-569)

MAA Minicourse #13: Part A

2:15 PM – 4:15 PM

Teaching a course in the history of mathematics.

Organizers: **Victor J. Katz**, University of the District of Columbia
V. Frederick Rickey, U.S. Military Academy

MAA Minicourse #2: Part A

2:15 PM – 4:15 PM

Some deterministic models in mathematical biology and their simulations.

Organizers: **James F. Selgrade**, North Carolina State University
Cammey E. Cole, Meredith College
Hüseyin Koçak, University of Miami, Coral Gables

MAA Minicourse #8: Part A

2:15 PM – 4:15 PM

Mathematics and geometry of voting.

Organizer: **Donald G. Saari**, University of California Irvine

AMS Session on Algebra and Group Theory, II

2:15 PM – 6:10 PM

2:15PM (283) *The Primeness of Just Infinite Algebras.*
Cayley A. Pendergrass*, Albion College, and **John Farina**, University of California, San Diego (1023-16-490)

2:30PM ▸ (284) *Tridiagonal pairs and the q-tetrahedron algebra.* Preliminary report.
Darren R. Funk-Neubauer, University of Wisconsin-Madison (1023-16-527)

2:45PM (285) *On distributive properties of operations with ideals in an algebra.* Preliminary report.
Avraham Goldstein* and **Chokri Cherif**, BMCC (1023-16-710)

3:00PM Break.

3:15PM ▸ (286) E_6: *The Group.* Preliminary report.
Aaron Daniel Wangberg* and **Tevian Dray**, Oregon State University (1023-17-1743)

3:30PM (287) *Maximal subalgebras of the octonions.*
Stephen Gagola III, Case Western Reserve University (1023-17-1894)

3:45PM Break.

4:00PM (288) *Nilpotent Lie Algebras with Property $L'' \neq 0$ and $\dim(L'/L'') = 3$.* Preliminary report.
Laurie M. Zack, North Carolina State University (1023-17-232)

4:15PM (289) *Cotorsion pairs of chain complexes and possible Quillen model structures.* Preliminary report.
James R. Gillespie, Penn State McKeesport (1023-18-1300)

4:30PM (290) *Categorical Morita Equivalence For Group-Theoretical Categories.*
Deepak Naidu, University of New Hampshire (1023-18-293)

4:45PM (291) *Symmetric Cohomology for Groups.*
Mihai D. Staic, SUNY at Buffalo (1023-18-93)

5:00PM (292) *Hochschild Cohomology and Derived Categories.*
Alin A. Stancu, Drexel University (1023-18-94)

5:15PM (293) *Deformation K-theory of surface groups via Yang-Mills theory.*
Daniel A. Ramras, Stanford University (1023-19-1865)

5:30PM ► (294) *The Automorphism Group of a Finite p-Group is Almost Always a p-Group.*
Geir T. Helleloid*, Stanford University, and **Ursula Martin**, Queen Mary University of London (1023-20-1001)

5:45PM (295) *On applications of Mackey imprimitivity for gerbes.* Preliminary report.
Calder Daenzer, University of Pennsylvania (1023-20-1424)

6:00PM ► (296) *Gassmann Equivalent Dessins.*
Mona Brigitta Merling, Bard College (1023-20-1442)

AMS Session on Partial Differential Equations, II

2:15 PM – 5:55 PM

2:15PM (297) *On the Painleve Property of certain Partial Differential Equations.*
A. Bathi Kasturiarachi, Kent State University, Stark Campus (1023-35-1661)

2:30PM (298) *Minimal action for Lagrangians in the Wasserstein space of probability measures.*
Wilfrid Gangbo, **Truyen V. Nguyen*** and **Adrian Tudorascu**, Georgia Institute of Technology (1023-35-1725)

2:45PM ► (299) *Convexity of Level Curves for solutions to $\Delta u = f(u)$.* Preliminary report.
David L. Finn, Rose-Hulman Institute of Technology (1023-35-1781)

3:00PM (300) *Harmonic maps of polyhedra to a sphere with tangent boundary conditions on faces.*
Maxim Zyskin, University of Oxford (1023-35-1782)

3:15PM (301) *Exponential attractors for the Allen-Cahn equation with dynamic boundary conditions.* Preliminary report.
Ciprian G. Gal, Morgan State University (1023-35-1876)

3:30PM ► (302) *Symmetry analysis of a two dimensional diffusion equation with a nonlinear source term.*
Danny Arrigo*, University of Central Arkansas, **Luis Suazo** and **Olabode Sule** (1023-35-1911)

3:45PM (303) *Hyperbolic Monge-Ampère Equation.*
Tamani M. Howard, University Of North Texas (1023-35-229)

4:00PM (304) *Saddle point characterization and computation for strongly indefinite functionals.* Preliminary report.
Xianjin Chen* and **Jianxin Zhou**, Texas A&M University, College Station (1023-35-245)

4:15PM ► (305) *Existence of solutions to nonlinear hyperbolic equations arising in gas dynamics in pipe networks.*
Michael Herty, TU Kaiserslautern (1023-35-278)

4:30PM (306) *Conservation laws for fourth order systems in four dimensions.*
Tobias Lamm, Max-Planck-Institute for Gravitational Physics (1023-35-374)

4:45PM ► (307) *Radial solutions for $\Delta_p u + f(u) = 0$, with $\lim_{|x|\to\infty} u(x) = 0$.* Preliminary report.
Sridevi Pudipeddi, University of North Texas (1023-35-398)

5:00PM (308) *Asymptotic behavior of the integrand for free surface elevation in axisymmetric water wave problem.*
Dambaru D. Bhatta, The University of Texas-Pan American, Edinburg, TX (1023-35-453)

5:15PM (309) *Localized and Spatially Extended Waves in Bose-Einstein Condensates in Periodic Potentials.*
Mason A. Porter, California Institute of Technology (1023-35-46)

5:30PM (310) *A system of delay partial differential equations for traffic flow.*
Mostafa Ghandehari* and **Sia Ardekani**, University of Texas at Arlington (1023-35-53)

5:45PM (311) *On explosive solutions of a class of semilinear elliptic equations.*
Peng Feng, Florida Gulf Coast University (1023-35-314)

AMS Session on Algebra and Number Theory, II

2:15 PM – 5:55 PM

2:15PM (312) *Going Up of the u-Invariant over Formally Real Fields.*
Claus Schubert, University of California, Los Angeles (1023-11-1313)

2:30PM ► (313) *Sequences of reducible 0, 1-polynomials with exponents in arithmetic progression.* Preliminary report.
Carrie E. Finch, University of South Carolina (1023-11-1373)

2:45PM (314) *Generalizations of Wild semigroups related to the $3x + 1$ problem.*
Ana Caraiani, Princeton University (1023-11-1418)

3:00PM (315) *The Triviality and Nontriviality of Tate-Lichtenbaum Self-Pairings.*
Susan L. Schmoyer, University of Maryland (1023-11-1490)

3:15PM (316) *The reducible case of Serre's Conjecture.*
Spencer Hamblen*, Queen's University, and **Ravi Ramakrishna**, Cornell University (1023-11-1558)

3:30PM (317) *An improvement on the known bounds of discriminants of number fields.*
Jason Worth Martin, James Madison University (1023-11-1580)

3:45PM (318) *A Faster Algorithm for Random Dense Subset Sums.*
Andrew Shallue, University of Wisconsin-Madison (1023-68-810)

4:00PM (319) *Atkinson's formula for the mean square of the Riemann zeta function.* Preliminary report.
Jennifer Beineke*, Western New England College, and **Daniel Bump**, Stanford University (1023-11-1595)

4:15PM (320) *Buildings and Combinatorics: Preliminary Report.* Preliminary report.
Alison Setyadi, Dartmouth College (1023-11-165)

4:30PM (321) *Ruling out elliptic curves of prime conductor.* Preliminary report.
Jeremiah K. Hower, University of Georgia (1023-11-1770)

4:45PM ▸ (322) *On composite numbers that remain composite after any insertion of a digit.*
Mark Kozek* and **Michael Filaseta**, University of South Carolina (1023-11-1803)

5:00PM (323) *On integer quadratic polynomials which are small at a given point.* Preliminary report.
Kiryl I. Tsishchanka, DePaul University (1023-11-1850)

5:15PM ▸ (324) *Appell Sequences and Hypergeometric Bernoulli Polynomials.*
Abdul Hassen and **Hieu D. Nguyen***, Rowan University (1023-11-256)

5:30PM (325) *On the Number of Norm Subgroups of the Multiplicative Group of an Algebraic Number Field.* Preliminary report.
Leonid Stern, Towson University (1023-11-265)

5:45PM (326) *Cyclotomic Polynomials of Order Three and Maximal Height of Divisors of $x^n - 1$.*
Nathan Kaplan, Princeton University (1023-11-348)

4:45PM (337) *An Adaptive Multiresolution Analysis for Image Compression Using Compact CUPOLETS.*
Kourosh Zarringhalam* and **Kevin M. Short**, University of New Hampshire (1023-E5-290)

5:00PM ▸ (338) *Approximations of Continuous Newton's Method & Cayley's Problem.*
Jon Jacobsen*, Harvey Mudd College, **Brad Tennis**, Stanford, and **Owen Lewis**, Harvey Mudd College (1023-E5-343)

5:15PM (339) *Limit Sets in Graph Directed Constructions.*
Eugen Andrei Ghenciu, University of Alaska at Fairbanks (1023-E5-1204)

5:30PM ▸ (340) *Eigenvectors of recursively defined matrices and self-similar measures.*
Mark McClure, University of North Carolina at Asheville (1023-E5-860)

5:45PM ▸ (341) *Periodic and connecting orbits as source of chaos in ODEs.*
Brian A. Coomes, **Hüseyin Koçak***, University of Miami, and **Kenneth J. Palmer**, National Taiwan University (1023-E5-1242)

6:00PM ▸ (342) *An elementary approach to a symplectic integration algorithm.*
Daniel Hemberger and **James A Walsh***, Oberlin College (1023-E5-255)

MAA Session on Chaos and Fractals

2:15 PM – 3:45 PM

Organizers: **Denny Gulick**, University of Maryland
Jon W. Scott, Montgomery College

2:15PM ▸ (327) *Finding Gold In The Forest: Fractal Trees and the Golden Ratio.*
T. D. Taylor, St. Francis Xavier University, Antigonish, Nova Scotia, Canada (1023-E5-78)

2:30PM ▸ (328) *Fractal Forecasting Missing Image Data.*
Ning Chen, Shenyang Jianzhu University, and **Clifford Reiter***, Lafayette College (1023-E5-164)

2:45PM ▸ (329) *Describing Points in Sierpinski-Like Fractals.*
Sandra Fillebrown* and **Joseph Pizzica**, Saint Joseph's University (1023-E5-257)

3:00PM ▸ (330) *The Geometry of the Hausdorff Metric.*
Steven Schlicker, Grand Valley State University (1023-E5-269)

3:15PM ▸ (331) *From Sierpinski Triangle to Fractal Flowers.* Preliminary report.
Anne M. Burns, Long Island University, C.W. Post Campus (1023-E5-270)

3:30PM ▸ (332) *Exploring Fractals from Cantor Dust to the Fractal Skewed Web.*
Mary Ann Connors, Westfield State College (1023-E5-375)

3:45PM ▸ (333) *Why Include Fractal Geometry in a Non-Euclidean Geometry Course?*
Elaine F. Magee, Shenandoah University (1023-E5-1692)

4:00PM ▸ (334) *Fractals Based on Iterative Structural Self-Cloning Method.* Preliminary report.
Mingjang Chen, Center for General Education, National Chiao Tung, Taiwan (1023-E5-1862)

4:15PM (335) *Billiards with Mixed Regular and Chaotic Dynamics.*
Mason A. Porter, California Institute of Technology (1023-E5-50)

4:30PM ▸ (336) *An Amazing Bifurcation Diagram Arising from Newton's Method.*
Gareth E. Roberts* and **Trevor M. O'Brien**, College of the Holy Cross (1023-E5-907)

MAA Session on Content Courses for the Mathematical Education of Middle School Teachers, II

2:15 PM – 5:10 PM

Organizers: **Laurie Burton**, Western Oregon University
Maria G. Fung, Western Oregon University
Klay Kruczek, Western Oregon University

2:15PM (343) *Mathematical Courses for Middle School Teachers: The CSUSB Approach.*
Robert G. Stein, California State University, San Bernardino (1023-G1-199)

2:35PM (344) *Mathematics Content for Middle School Teachers Design at the University of Louisiana at Lafayette.*
Lee E. Price, University of Louisiana at Lafayette (1023-G1-1246)

2:55PM ▸ (345) *A Problem-Solving Course for Pre-Service Middle School Teachers.*
Kathleen D. Lopez, University of Louisiana at Lafayette (1023-G1-1378)

3:15PM ▸ (346) *Bluffton's Explore and Explain Mathematics Courses for Middle School Teachers.*
Donald E. Hooley, Bluffton University (1023-G1-139)

3:35PM (347) *Using LOGO to Teach Geometry and Problem Solving To Future Middle School Teachers.*
Jerry Dwyer, **Gary Harris** and **G. Brock Williams***, Texas Tech University (1023-G1-1235)

3:55PM ▸ (348) *Constructivist Integrated Mathematics and Methods for Middle Grades Teachers.*
Rebecca K. Walker*, Grand Valley State University, and **Charlene E. Beckmann**, Grand Valley State University (1023-G1-1450)

4:15PM (349) *Western Oregon University's Middle School Mathematics Focus.*
Laurie Burton, **Maria Fung** and **Klay Kruczek***, Western Oregon University (1023-G1-277)

4:35PM ► (350) *A (Pre)Calculus and Discrete Math Course for Pre-Service Middle School Teachers.* Preliminary report.
Timothy W. Flood, Pittsburg State University (1023-G1-143)

4:55PM ► (351) *Reflections from a journey: Diary excerpts highlighting the content preparation of a middle school mathematics teacher.*
Mandi S. Maxwell*, **David B. Klanderman** and **Mary Webster Moore**, Trinity Christian College (1023-G1-883)

MAA Session on Getting Students to Discuss and to Write about Mathematics, I

2:15 PM - 3:40 PM

Organizers: **Martha Ellen (Murphy) Waggoner**, Simpson College
Charlotte Knotts-Zides, Wofford College
Harrison W. Straley, Wheaton College

2:15PM (352) *Building Communication Skills - A Gradual Process.*
David D. Gebhard, Wisconsin Lutheran College (1023-I1-761)

2:30PM ► (353) *On the Evening News.*
Sarah L. Mabrouk, Framingham State College (1023-I1-1844)

2:45PM ► (354) *Projects that Encourage Students to Talk and Write about Mathematics.*
Aihua Li, Montclair State University (1023-I1-1729)

3:00PM ► (355) *Writing assessments in a college algebra course.*
Brian P. Kelly, Roger Williams University (1023-I1-1870)

3:15PM ► (356) *An Inter-disciplinary Writing Project in a Liberal Arts Mathematics Course.*
Rehana Patel, St. John's University (1023-I1-1864)

3:30PM ► (357) *Relations... Human Relations.* Preliminary report.
Saburo Matsumoto, The Master's College (1023-I1-326)

MAA Session on Entertaining with Math

2:15 PM - 5:50 PM

Organizer: **Timothy P. Chartier**, Davidson College

2:15PM ► (358) *Concept Videos for Calculus: A Context that Encapsulates a Lesson.*
Mike Martin, Johnson County Community College (1023-H1-635)

2:35PM ► (359) *Better Poker Hands Guaranteed.*
Card Colm Mulcahy, Spelman College (1023-H1-1341)

2:55PM ► (360) *The value of entertainment in a mathematics course.*
Mark John Meyer*, **Hilary C. Singer** and **Artur Elezi**, American University (1023-H1-1487)

3:15PM ► (361) *Mathematical Mentalism.*
John M. Harris, Furman University (1023-H1-652)

3:35PM ► (362) *Graphs and juggling.*
Gregory S. Warrington, Wake Forest University (1023-H1-1437)

3:55PM (363) *Mathemagic.*
J. Alfredo Jimenez, Penn State University Hazleton (1023-H1-1351)

4:15PM ► (364) *Mathematics in Mime.*
Tim Chartier, Davidson College (1023-H1-311)

4:35PM ► (365) *Learning Groups via Object Manipulation.* Preliminary report.
Akihiro Matsuura, College of Science and Engineering, Tokyo Denki University (1023-H1-1832)

4:55PM ► (366) *Mangum, P.I.*
Colin C. Adams*, Williams College, and **Mikhail Chkhenkeli**, Western New England College (1023-H1-279)

5:15PM ► (367) *Dancing with Mathematics.*
Karl Schaffer, De Anza College / Dr. Schaffer and Mr. Stern Dance Ensemble (1023-H1-130)

5:35PM ► (368) *An Amazing Mathematical Card Trick.*
Arthur T. Benjamin, Harvey Mudd College (1023-H1-73)

MAA Session on Research and Other Mathematical Experiences for Students Outside the Classroom

2:15 PM - 6:00 PM

Organizers: **Sarah Spence Adams**, Franklin W. Olin College of Engineering
James A. Davis, University of Richmond
Susan E. Morey, Texas State University, San Marcos

2:15PM ► (369) *Center for Mentoring Undergraduate Research in Mathematics at BYU.*
Michael Dorff, Brigham Young University (1023-P1-382)

2:45PM ► (370) *Research Opportunities for Commuter Students.*
Diana M. Thomas* and **Michael A. Jones**, Montclair State University (1023-P1-1682)

3:00PM ► (371) *Significance of Using Principal Component Analysis on Large Data Sets.* Preliminary report.
Reginald Dorcely*, **Frantz Mackenzy Voltaire**, **Karl C. Clarke**, **Umesh P. Nagarkatte** and **Wilbert Hope**, Medgar Evers College-CUNY (1023-P1-768)

3:15PM ► (372) *Student Research Projects: Success and Failure.* Preliminary report.
Nathaniel Dean, Texas State University University-San Marcos (1023-P1-1430)

3:30PM ► (373) *An International REU Site in Mathematics: Hong Kong.*
Graeme Fairweather* and **Barbara Moskal**, Colorado School of Mines (1023-P1-1438)

3:45PM ► (374) *Math Research in Brazil, I.R.E.S. 2006.*
Tania M. Lopez, California State University, Northridge (1023-P1-557)

4:00PM ► (375) *Designing a "Methods of Research" Course.* Preliminary report.
Jacqueline A. Jensen, Sam Houston State University (1023-P1-1318)

4:15PM ► (376) *The Evolution of an Arts and Sciences Student Symposium.*
Jan O. Case, Jacksonville State University (1023-P1-491)

4:30PM ► (377) *Undergraduate Teaching which Leads to Undergraduate Research.*
Sarah-Marie Belcastro, Smith College and Hampshire College Summer Studies in Mathematics (1023-P1-1021)

4:45PM ► (378) *Initiating A. Sonya Kovelevsky Day.* Preliminary report.
Ramona Ranalli* and **Jennifer McLoud-Mann**, The University of Texas at Tyler (1023-P1-776)

5:00PM (379) *Pedagogical practice outside the traditional mathematics classroom:Enriching teacher candidates experiences.* Preliminary report.
Carol Klages* and **Barba Patton**, University of Houston-Victoria (1023-P1-1813)

5:15PM ► (380) *Mathematical Ideas: Tricks of the Trade.* Preliminary report.
Jesse W. Byrne* and **Charlotte K. Simmons**, University of Central Oklahoma (1023-P1-1639)

5:30PM Discussion.

MAA General Contributed Paper Session, II

2:15 PM – 5:55 PM

Organizers: **Eric S. Marland**, Appalachian State University
Jay A. Malmstrom, Oklahoma State Community College

2:15PM (381) *Valuing and Evaluating Teaching in the Mathematics Faculty Hiring Process.*
Derek Bruff, Vanderbilt University (1023-Z1-1709)

2:30PM (382) *Faculty Development: Promoting a Collegiate and Cooperative Environment and Preparing New Faculty for Success in the Classroom.* Preliminary report.
Barbra S. Melendez* and **Gerald C. Kobylski**, United States Military Academy (1023-Z1-1209)

2:45PM ► (383) *On the Transition in Mathematics from High School to College.* Preliminary report.
Richard O. Hill* and **Jon Star**, Michigan State University (1023-Z1-698)

3:00PM ► (384) *Results of the 2005 AP Statistics Curriculum Survey.*
Tim Jacobbe, Educational Testing Service (1023-Z1-47)

3:15PM ► (385) *Running a Mathematics Capstone Course in a Small Department.* Preliminary report.
J. Alan Alewine, McKendree College (1023-Z1-331)

3:30PM ► (386) *Exploring the similarities and differences in the use of Computer Algebra Systems in teaching at American and British universities.* Preliminary report.
Zsolt Lavicza, Cambridge University (1023-Z1-856)

3:45PM ► (387) *Moving from objects to process; the case of representations.*
May F. Hamdan, Lebanese American University (1023-Z1-819)

4:00PM ► (388) *Houston . . . we have a bug problem.*
Michael R. Bacon, USC Sumter (1023-Z1-1551)

4:15PM ► (389) *Observations on Sir William Rowan Hamilton and George Boole.* Preliminary report.
Charlotte Simmons, University of Central Oklahoma (1023-Z1-1457)

4:30PM ► (390) *Euler Converses Euclid.*
Charlie Smith, Park University (1023-Z1-1170)

4:45PM ► (391) *Everything you want to know about bridge courses – except whether they work.* Preliminary report.
Michael B. Ward, Western Oregon University (1023-Z1-299)

5:00PM ► (392) *Quantitative Literacy Topics: The Need for an "Industry Standard"?*
Eric Gaze, Alfred University (1023-Z1-770)

5:15PM (393) *Quantitative Literacy (QL) in the major at a large University.*
Kimberly M. Vincent, Washington State University (1023-Z1-1684)

5:30PM (394) *Mathematical Philosophies, and Computers in Educational Trends.*
Mohammad R. Khadivi, Jackson State University (1023-Z1-1646)

5:45PM ► (395) *Can Philosophers Learn How to Solve Problems from Mathematicians (Meno 86e-87c)?* Preliminary report.
Carlos Bovell, Mercer County Community College (1023-Z1-923)

SIAM Minisymposium on Recent Advances in Computational Scattering

2:15 PM – 6:10 PM

Organizer: **Jie Shen**, Purdue University

2:15PM (396) *Boundary perturbation methods for high-frequency scattering.*
David P. Nicholls*, University of Illinois at Chicago, and **Fernando Reitich**, University of Minnesota (1023-78-1279)

2:45PM ► (397) *Discontinuous Galerkin Method for PDEs with Dirac sources with applications in Optical Fiber Laser.* Preliminary report.
Wei Cai, UNC Charlotte (1023-65-1594)

3:15PM (398) *Exact Dirichlet-to-Neumann maps on general geometries for elasticity.* Preliminary report.
Nilima Nigam*, McGill University, and **D.P. Nicholls**, U. Illinois Chicago (1023-65-1577)

3:45PM (399) *Scattering by Open Surfaces.*
Shidong Jiang, New Jersey Institute of Technology (1023-65-479)

4:15PM (400) *Numerical Solution of the Nonlinear Helmholtz Equation.*
Guy Baruch, **Gadi Fibich**, Tel Aviv University, and **Semyon Tsynkov***, North Carolina State University (1023-65-528)

4:45PM (401) *Dispersion analysis of nonconforming finite element methods for the Helmholtz equation.*
Dongwoo Sheen*, Seoul National University and Purdue University, **Taeyoung Ha**, Seoul National University, and **Kitak Lee**, Samsung SDS (1023-65-1154)

5:15PM (402) *Acceleration of an iterative method for the evaluation of high-frequency multiples scattering effects.*
Yassine Boubendir* and **Fernando Reitich**, University of Minnesota (1023-65-1734)

5:45PM (403) *Efficient and Stable Spectral Methods for the Helmholtz equation in exterior domains.*
Jie Shen, Purdue University (1023-65-564)

SIAM Minisymposium on Environmental Modeling: Challenges in Practical Applications and in Teaching

2:15 PM – 5:55 PM

Organizer: **William L. Briggs**, University of Colorado at Denver

2:15PM ► (404) *Hazardous materials modeling and other opportunities for student applied mathematics projects.*
Charles R. Hadlock, Bentley College (1023-97-1670)

2:45PM ► (405) *Ecological Problems for Undergraduate Research.*
Glenn Ledder, University of Nebraska-Lincoln (1023-92-1305)

3:15PM ► (406) *Making Models Useful to Decision-Makers.*
Holly D. Gaff*, University of Maryland, School of Medicine, and **Louis Gross**, University of Tennessee, Knovxille (1023-92-1207)

3:45PM (407) *Undergraduate Mathematical Biology Research at Appalachian State University.*
Rene A. Salinas, Appalachian State University (1023-92-1203)

4:15PM ► (408) *Using integro-difference equations to model the effect of growing season length on the spread of the Eurasian collared dove in North America.*
Andrew Whittle*, Kennesaw State University, **Erika Asano**, USF St. Petersburg, and **Michael Fuller**, University of Tennessee (1023-92-1155)

4:45PM (409) *A Mathematical Biology Program at the University of Louisiana: Curriculum Development and Research.*
Azmy S. Ackleh, University of Louisiana at Lafayette (1023-92-767)

5:15PM (410) *Hurricane modeling and Katrina.*
T. N. Krishnamurti, Department of Meteorology, Florida State University (1023-92-1806)

Math on the Web, I

2:15 PM – 4:50 PM

2:15PM (411) *MathML 3: Where are we going from here?*
Patrick Ion, American Mathematical Society

2:45PM (412) *Creating mathematical documents for the Web with Scientific WorkPlace.*
Barry MacKichan, MacKichan Software, Inc.

3:30PM (413) *Writing questions with randomized parameters in proper mathematical notation for online homework assignments.*
John Risley, WebAssign

4:30PM (414) *Adventures in sustainability: Development, direction, and lessons from PlanetMath.*
Aaron Krowne, Emory University

Project NExT-YMN Poster Session

2:15 PM – 4:15 PM

Organizers: **Kevin E. Charlwood**, Washburn University
Michael C. Axtell, Wabash College

MAA Committee on the Profession Panel Discussion

2:15 PM – 3:35 PM

Ethics in the mathematical sciences.
Organizer: **Susan C. Geller**, Texas A&M University
Panelists: **Donald L. Bentley**, Pomona College
John D. Fulton, Clemson University
Linda Keen, Herbert H. Lehman College of CUNY
Henry Walker, Grinnell University

MAA Committee on the Undergraduate Program in Mathematics and the SIGMAA on Statistics Education Panel Discussion

2:15 PM – 3:35 PM

Preparing majors for the nonacademic workforce: Projects and internships in applied mathematics and statistics.
Organizers: **Thomas L. Moore**, Grinnell College
Harriet S. Pollatsek, Mount Holyoke College
Moderator: **Thomas L. Moore**
Panelists: **Matthew P. Richey**, St. Olaf College
Nagambal Shah, Spelman College
Suzanne L. Weekes, Worcester Polytechnic Institute

MAA Panel Discussion

2:15 PM – 3:35 PM

The role of assessment in helping students learn.
Organizers: **Catherine M. Murphy**, Purdue University Calumet
Daniel P. Maki, Indiana University
Panelists: **Bernard L. Madison**, University of Arkansas
William A. Marion, Jr, Valparaiso University
Barbara Moskal, Colorado School of Mines

AWM Panel Discussion

2:15 PM – 3:40 PM

Women advancing to leadership: When and how.
Organizer: **Barbara L. Keyfitz**, The Fields Institute and University of Houston
Moderator: **Barbara L. Keyfitz**
Panelists: **Lisa Fauci**, Tulane University
Cathy B. Kessel, Berkeley, CA
Johanna Levelt Sengers, NIST
Joan R. Leitzel, University of New Hampshire
Carolyn R. Mahoney, Lincoln University

MAA Session on Mathlets for Teaching and Learning Mathematics

2:20 PM – 5:35 PM

Organizers: **David Strong**, Pepperdine University
Thomas Leathrum, Jacksonville State University
Joe Yanik, Emporia State University

2:20PM ► (415) *Experiments with Matrices Showing How to Transform and Animate Computer Images to New Students.* Preliminary report.
Charles A. Sulewski* and **Frank Wattenberg**, United States Military Academy at West Point (1023-M5-746)

2:40PM ► (416) *A Mathlet to Interactively Explore Ordinary Differential Equation Solvers.*
Nicholas A. Dovidio, Davidson College (1023-M5-1637)

3:00PM ► (417) *Modeling with Functions: A Student Centered, Discovery Approach.*
Joseph M. Lindquist* and **James Dzwonchyk**, United States Military Academy (1023-M5-1779)

3:20PM ► (418) *Parameter passing in Mathematical Java Toolkit applets.*
Michael Mays, West Virginia University (1023-M5-309)

3:40PM ► (419) *Interactive Workbooks for Classifying Distributions and Balancing Chemical Equations.*
Sarah L. Mabrouk, Framingham State College (1023-M5-1856)

4:00PM ► (420) *Using Maplets and Java to Teach Reed-Solomon Codes.* Preliminary report.
Richard E. Klima*, Appalachian State University, and **Neil P. Sigmon**, Radford University (1023-M5-117)

4:20PM ► (421) *An Applet-Based Presentation of the Chebyshev Equioscillation Theorem.*
Robert A. Mayans, Fairleigh Dickinson University (1023-M5-44)

4:40PM ► (422) *The UW Praxis Project.*
Jennifer J. Kosiak* and **Bob Hoar**, University of Wisconsin - La Crosse (1023-M5-1810)

5:00PM ► (423) *Multilingual Maplets for WebALT Calculus.*
Douglas B. Meade*, University of South Carolina, **Philip B. Yasskin**, Texas A&M University, and **Mika Seppala**, University of Helsinki (1023-M5-1567)

5:20PM ► (424) *Maplets for Calculus - Now with Proofs.*
Philip B. Yasskin*, Texas A&M University, **Douglas B. Meade**, University of South Carolina, and **Mika Seppala**, University of Helsinki (1023-M5-254)

MAA Section Officers

2:30 PM – 5:00 PM

Project NExT Panel Discussion

3:00 PM – 5:00 PM

Becoming a leader in your department.

Organizers: **Edwin P. Herman**, University of Wisconsin-Stevens Point
J. Lyn Miller, Slippery Rock University

Panelists: **Stuart Boersma**, Central Washington University
Linda Braddy, East Central University
Duff Campbell, Hendrix College
Jill E. Guerra, University of Arkansas, Fort Smith
Thomas C. Ratliff, Wheaton College
Judy L. Walker, University of Nebraska-Lincoln

MAA Invited Address

3:40 PM – 4:30 PM

(425) *Baseball, Shakespeare, and modern statistical theory.*
Bradley Efron, Stanford University (1023-A0-20)

AWM Business Meeting

3:45 PM – 4:15 PM

SIGMAA on the History of Mathematics Panel Discussion

3:50 PM – 5:40 PM

The practice of math history.

Organizers: **William Branson**, St. Cloud State University
Amy E. Shell-Gellasch, Pacific Lutheran University

Panelists: **V. Frederick Rickey**, U.S. Military Academy
Karen H. Parshall, University of Virginia
Joseph W. Dauben, Herbert H. Lehman College of CUNY

MAA Study Abroad Tours Subcommittee Panel Discussion

3:50 PM – 5:40 PM

Mathematics and mathematicians in emerging nations.

Organizers: **M. Leigh Lunsford**, Longwood University
Lisa Elaine Marano, West Chester University of Pennsylvania

Panelists: **Joel K. Haack**, University of Northern Iowa
Aihua Li, Montclair State University
Kate McGivney, Shippensburg University of Pennsylvania
Claudio H. Morales, University of Alabama, Huntsville
Miranda I. Teboh-Ewungkem, Lafayette College

MAA Committee on Graduate Students-YMN Panel Discussion

3:50 PM – 5:10 PM

How to interview for a job in the mathematical sciences.

Organizer: **David C. Manderscheid**, University of Iowa

Panelists: **Allen Butler**, Daniel H. Wagner Associates, Inc.
Sharon M. Clarke, Pepperdine University
James H. Freeman, Cornell College
David T. Kung, St. Mary's College of Maryland
David C. Manderscheid

SIGMAA on Environmental Mathematics Annual Meeting and Guest Lecture

4:00 PM – 5:30 PM

Organizer: **Ben A. Fusaro**, Florida State University

Welcome Reception for Undergraduate Students

4:00 PM – 5:00 PM

AMS Committee on the Profession Presentation

4:30 PM – 6:00 PM

Katrina and its aftermath: Institutional survival in New Orelans since the storm.

Organizer: **Jim E. Hoste**, Pitzer College

Moderator: **Jim E. Hoste**

Panelists: **Kenneth W. Holladay**, University of New Orleans
Morris Kalka, Tulane University
Vlajko L. Kocic, Xavier University of Louisiana
Katarzyna Saxton, Loyola University New Orleans

MAA Minicourse #14: Part A

4:45 PM – 6:45 PM

Contemporary college algebra: A refocused college algebra course.

Organizers: **Donald B. Small**, U. S. Military Academy
Laurette Foster, Prairie View A&M University

MAA Minicourse #3: Part A

4:45 PM – 6:45 PM

A tool to implement quantitative literacy (QL): Spreadsheets Across the Curriculum.

Organizers: **Semra Kiliç-Bahi**, Colby-Sawyer College
Gary T. Franchy, Davenport University
Cheryl Coolidge, Colby-Sawyer College
William A. Thomas, Colby-Sawyer College

MAA Minicourse #9: Part A

4:45 PM – 6:45 PM

Evaluating student presentations in mathematics.

Organizers: **Suzanne Dorée**, Augsburg College
Richard J. Jardine, Keene State College
Thomas J. Linton, Central College

MAA Information Session

4:45 PM – 6:45 PM

Current issues in actuarial science education.

Organizers: **Robert E. Buck**, Slippery Rock University
Bettye Anne Case, Florida State University
Matthew J. Hassett, Arizona State University
Steve Paris, Florida State University

Reception for Graduate Students and First-Time Participants

5:30 PM – 6:30 PM

The AMS and MAA warmly invite these special groups to meet the leadership of your sponsoring organizations.

SIGMAA on the History of Mathematics Annual Meeting and Guest Lecture

6:00 PM – 7:00 PM

Organizer: **Amy E. Shell-Gellasch**, Pacific Lutheran University

► (426) *Hardy's Oxford Years.*
Robin J. Wilson, The Open University, UK (1023-A0-204)

AMS Josiah Willard Gibbs Lecture

8:30 PM – 9:30 PM

(427) *Mathematics and physics.*
Peter D. Lax, New York University-Courant Institute (1023-01-10)

Saturday, January 6

MAA Department Liaisons Breakfast Meeting

7:00 AM – 8:30 AM

Joint Meetings Registration

7:30 AM – 4:00 PM

AMS-MAA-SIAM Special Session on Research in Mathematics by Undergraduates, I

8:00 AM – 11:55 AM

Organizers: **Darren A. Narayan**, Rochester Institute of Technology
Carl V. Lutzer, Rochester Institute of Technology
Bernard Brooks, Rochester Institute of Technology
Tamas I. Wiandt, Rochester Institute of Technology
Michael J. Fisher, California State University, Fresno

8:00AM ► (428) *Automorphisms and Lattices of the Heisenberg Group.* Preliminary report.
Lisa M. Lackney*, University of Akron, and **Rebecca Black**, Swarthmore College (1023-20-112)

8:30AM ► (429) *The Steiner problem on the cone.*
Jamie L. Burwood*, Bowdoin College, and **Caroline Nielson**, University of Southern Utah (1023-51-146)

9:00AM ► (430) *The 3-point Steiner problem on the projective plane of constant Gaussian curvature.*
Timothy Luke Muggy*, University of Nebraska - Lincoln, and **Daniel Murphree**, Berry College, Georgia (1023-51-151)

9:30AM ► (431) *Delay differential equations modeling vertically transmitted diseases.* Preliminary report.
Jonathan Adler, Worcester Polytechnic Institute, **Lynne Erickson**, Ursinus College, **L. Thomas Hill**, **Kristen Mazur***, Lafayette College, and **Thomas Tyrrell**, Boston University (1023-34-209)

10:00AM ► (432) *A Mathematical Model for the Progression of Idiopathic Pulmonary Fibrosis and its Potential Treatments.*
Rahul Bansal, The University of Texas at Austin (1023-92-280)

10:30AM ► (433) *On Singular and Nonsingular Magic Squares.*
Elizabeth L. Love*, Howard University, **Elizabeth A. Wascher** and **Michael Z. Lee**, Central Michigan University (1023-15-366)

11:00AM ► (434) *On the Parameterized Complexity of Independent Set.* Preliminary report.
Teruhisha Haruguchi, Lafayette College, **Janine LoBue***, Loyola College in Maryland, **James Pierce**, Illinois Institute of Technology, and **David Roberson**, North Carolina State University (1023-00-332)

11:30AM ► (435) *The Honeycomb Conjecture on the Sphere.*
Conor B. Quinn, Williams College (1023-51-679)

AMS Special Session on Initial- and Boundary-Value Problems, Solvability, and Stability for some Nonlinear PDEs: Theorem, Computation, and Application, I

8:00 AM – 10:55 AM

Organizers: **Jerry L. Bona**, University of Illinois at Chicago
Laihan Luo, New York Institute of Technology

8:00AM (436) *Remarks on the singular set of the Navier - Stokes equations.*
Andrei Biryuk, **Walter Craig***, McMaster University, and **Slim Ibrahim**, Arizona State University (1023-35-613)

8:30AM ► (437) *Numerical investigation of three-dimensional water waves.* Preliminary report.
Min Chen, Purdue University (1023-76-487)

9:00AM (438) *Global Existence of Stagnation-Point Class Solutions for a Perfect Incompressible Fluid.*
Ralph Saxton* and **Feride Tiglay**, University of New Orleans (1023-35-402)

9:30AM (439) *Two point boundary value problems: the BBM and KdV equations.*
Jerry L. Bona, University of Illinois at Chicago, **Hongqiu Chen***, University of Memphis, **Shuming Sun**, Virginia Polytechnic Institute and State University, and **Bingyu Zhang**, University of Cincinnati (1023-35-661)

10:00AM (440) *Local Ill-posedness of the 1D Zakharov system.* Preliminary report.
Justin Holmer*, University of California, Berkeley, and **Nikolaos Tzirakis**, University of Toronto (1023-35-1730)

10:30AM (441) *Analysis of a system of PDEs arising in the homogenisation of chemical degradation mechanisms of porous media inducing an evolution of the microstructure.*
Peter A. Malte, Centre for Industrial Mathematics, FB 3, University of Bremen, Germany (1023-35-142)

AMS Special Session on Invariant Theory, I

8:00 AM – 11:55 AM

Organizers: **Mara D. Neusel**, Texas Tech University
Frank D. Grosshans, West Chester University

8:00AM (442) *Modular Invariants of Cyclic 2-groups.*
H. E. A. Eddy Campbell*, Memorial University, **R. J. Shank**, University of Kent, Canterbury, and **D. L. Wehlau**, Royal Military College and Queen's University (1023-13-649)

8:30AM (443) *Conformal symmetries of the wave equation and the ladder representation of $SO(2, n+1)$.* Preliminary report.
Markus Hunziker*, **Mark R. Sepanski** and **Ronald J. Stanke**, Baylor University (1023-22-1259)

9:00AM (444) *Linearisation of Multiplicative Group Actions.* Preliminary report.
Nicole Lemire, University of Western Ontario (1023-20-951)

9:30AM ► (445) *Multiplicative invariant theory.*
Martin Lorenz, Temple University (1023-13-356)

10:00AM ► (446) *Rings of Invariants Satisfying the Weak Splitting Principle.*
Mara D. Neusel, Texas Tech University (1023-13-443)

10:30AM (447) *A generalization of the Chevalley-Mitchell theorem.*
Victor Reiner*, University of Minnesota, **Larry Smith**, Universitat Gottingen, and **Peter Webb**, University of Minnesota (1023-05-367)

11:00AM (448) *Invariant Theory, Hochschild Cohomology, and Graded Hecke Algebras.*
Anne V. Shepler*, University of North Texas, and **Sarah Witherspoon**, Texas A&M University (1023-16-1195)

11:30AM ► (449) *Apolarity.* Preliminary report.
Joseph P. Brennan*, North Dakota State University and University of Central Florida, and **Robert M. Fossum**, University of Illinois at Urbana-Champaign (1023-14-1495)

AMS Special Session on Mathematical Techniques in Musical Analysis, I

8:00 AM – 11:55 AM

Organizers: **Robert W. Peck**, Louisiana State University
Julian Hook, Indiana University-Bloomington
Rachel W. Hall, Saint Joseph's University

8:00AM ► (450) *Introduction to Musical Spaces and Transformations.* Preliminary report.
Julian Hook, Indiana University (1023-00-181)

8:30AM (451) *Mathematical Aspects of Pairwise Well-formed Scales.*
David Clampitt, Yale University (1023-05-516)

9:00AM (452) *Musical Intervals and Special Linear Transformations.*
Thomas Noll, Escola Superior de Musica de Catalunya (1023-11-1349)

9:30AM ► (453) *Elementary Proofs of the Hexachordal Theorem.* Preliminary report.
Godfried T. Toussaint, School of Computer Science, McGill University (1023-00-252)

10:00AM ► (454) *Homometric sets and Z-related chords.*
Clifton Callender*, Florida State University, and **Rachel Hall**, St. Joseph's University (1023-00-1264)

10:30AM (455) *Orbifolds and musical scales.*
Dmitri Tymoczko, Princeton University (1023-51-1118)

11:00AM (456) *Voice leading, submajorization, and the distribution constraint.*
Rachel Hall*, Saint Joseph's University, and **Dmitri Tymoczko**, Princeton University (1023-00-1634)

11:30AM (457) *Chord Quality and Callender-Quinn-Tymoczko Spaces.* Preliminary report.
Ian Quinn, Yale University (1023-00-1791)

AMS Special Session on Radon Transforms, Convex Geometry, and Geometric Analysis, I

8:00 AM – 11:55 AM

Organizers: **Eric L. Grinberg**, University of New Hampshire
Peter Kuchment, Texas A&M University
Gestur Olafsson, Louisiana State University
Eric Todd Quinto, Tufts University

Boris S. Rubin, Louisiana State University

8:00AM (458) *An Inversion Formula for the X-ray Transform on a Compact Symmetric Space.*
Sigurdur Helgason, MIT (1023-81-268)

8:30AM (459) *An injectivity theorem for Radon transforms restricted to isotropic functions.* Preliminary report.
Paul Goodey, University of Oklahoma, and **Ralph Howard***, University of South Carolina (1023-44-350)

9:00AM (460) *Integral geometric problems arising in thermoacoustic tomography.*
David V. Finch*, Oregon State University, **Rakesh**, U. Delaware, and **Markus Haltmeier**, Dept of Computer Science, U. Innsbruck (1023-35-858)

9:30AM (461) *On reconstruction in limited view tomography.* Preliminary report.
Gaik Ambartsoumian, The University of Texas at Arlington (1023-44-699)

10:00AM (462) *A 1PI algorithm for helical trajectories that violate the convexity condition.*
Michael Kapralov* and **Alexander Katsevich**, University of Central Florida (1023-44-934)

10:30AM (463) *Semyanistyi's integrals and Radon transforms on matrix spaces.*
Elena Ournycheva*, Kent State University, and **Boris Rubin**, Louisiana State University (1023-42-547)

11:00AM (464) *Microlocal analysis of the linearized attenuated Radon transform.* Preliminary report.
Allan Greenleaf*, University of Rochester, and **Karthik Ramaseshan**, Vancouver, B.C. (1023-44-449)

11:30AM (465) *Analytic, number theoretic and combinatorial aspects of incidence theory.*
Alex Iosevich, University of Missouri-Columbia (1023-42-853)

AMS Special Session on Calculus of Variations and Nonlinear PDEs: Theory and Applications, I

8:00 AM - 11:45 AM

Organizers: **Marian Bocea**, North Dakota State University
Cristina M. Popovici, North Dakota State University

8:00AM (466) *Sufficient conditions for smooth strong local minimizers.*
Tadele Mengesha* and **Yury Grabovsky**, Temple University (1023-49-205)

8:30AM (467) *Boundary layers in the study of the error estimates for the classical problem of homogenization. Improvement of the existing results and applications.*
Daniel T. Onofrei* and **Bogdan Vernescu**, Worcester Polytechnic Institute (1023-35-1156)

9:00AM (468) *Capacity of a Multiply-connected Domain and Nonexistence of Ginzburg-Landau Minimizers with Prescribed Degrees on the Boundary.*
Dmitry Golovaty*, The University of Akron, **Leonid Berlyand**, Penn State University, and **Volodymyr Rybalko**, Institute for Lower Temperature Physics and Engineering (1023-49-1415)

10:00AM (469) *Finite time singularity of Landan-Lifshitz-Gilbert equation.* Preliminary report.
Shijin Ding, South China Normal University, and **Changyou Wang***, University of Kentucky (1023-35-1165)

11:00AM (470) *Analysis on the Lawrence-Doniach Energy for Layered Superconductors.*
Patricia Bauman, Purdue University (1023-35-1528)

AMS Special Session on Microlocal Analysis and Singular Spaces, I

8:00 AM - 11:40 AM

Organizers: **Paul A. Loya**, Binghamton University
Andras Vasy, Massachusetts Institute of Technology

8:00AM (471) *Patterson-Sullivan distributions are asymptotic to Wigner distributions on hyperbolic manifolds: An exact conjugacy between classical and quantum mechanics.* Preliminary report.
Steve Zelditch*, Johns Hopkins University, and **Nalini Anantharaman**, Ecole Normale Superieure de Lyon (1023-37-41)

9:00AM (472) *Quantum decay rates in chaotic scattering.*
Maciej Zworski*, University of California, Berkeley, and **Stephane Nonnenmacher**, CEA, Saclay (1023-81-1732)

10:00AM (473) *Spreading of regularity for quasimodes.*
Jared Wunsch, Northwestern University (1023-35-543)

11:00AM (474) *On multilinear eigenfunction estimates for compact manifolds with boundary.*
Matthew D. Blair*, Johns Hopkins University, **Hart F. Smith**, University of Washington, and **Christopher D. Sogge**, Johns Hopkins University (1023-42-383)

AMS Special Session on Cohomology and Representation Theory, III

8:00 AM - 11:50 AM

Organizers: **Jon F. Carlson**, University of Georgia
Daniel K. Nakano, University of Georgia
Julia Pevtsova, University of Washington

8:00AM (475) *Cohomology and Extensions for Finite Groups of Lie Type and Small Primes.*
Christopher P. Bendel, University of Wisconsin-Stout, **Daniel K. Nakano**, University of Georgia, and **Cornelius Pillen***, University of South Alabama (1023-20-667)

8:30AM (476) *On the kernel of the Gassner representation.*
Kevin Knudson, Mississippi State University (1023-20-1325)

9:00AM (477) *Decomposition numbers and Alvis-Curtis duality.*
Bernd Ackermann, Universität Stuttgart, and **Sibylle Schroll***, University of Oxford (1023-16-650)

9:30AM (478) *A supercharacter theory for unipotent groups.*
P. Diaconis and **N. Thiem***, Stanford University (1023-20-1026)

10:00AM ► (479) *Galois module structure of square classes in Klein 4-group extensions.*
F. Chemotti, University of Wisconsin, **J. Mináč**, University of Western Ontario, and **J. Swallow***, Davidson College (1023-12-60)

10:30AM ► (480) *Control of Fusion and Normal Fusion Subsystems*
Radu Stancu, The Ohio State University (1023-20-1104)

11:00AM (481) *Cohomology of Specht Modules.*
David J. Hemmer*, University of Toledo, and **Daniel K. Nakano**, University of Georgia (1023-20-1101)

11:30AM (482) *Endo-trivial modules and finite p-groups.* Preliminary report.
J. L. Alperin, University of Chicago (1023-20-15)

AMS Special Session on Dynamic Programming, I

8:00 AM – 11:45 AM

Organizers: **Gerald C. Kobylski**, United States Military Academy
Randal Hickman, United States Military Academy

8:00AM (483) *Population-Based Evolutionary Approaches for Solving Markov Decision Processes.*
Michael C. Fu*, University of Maryland, **Hyeong Soo Chang**, Sogang University, **Jiaqiao Hu**, SUNY Stonybrook, and **Steven Marcus**, University of Maryland (1023-49-1187)

9:00AM (484) *Optimality Equations and Inequalities for Markov Decision Processes with Applications to Inventory Control.* Preliminary report.
Mark Lewis, Cornell University (1023-49-1202)

10:00AM (485) *Dynamic Decision Networks, an Efficient Approach to Automated Decision Support in Complex, Uncertain, and Evolving Decision Situations.* Preliminary report.
Dan Maxwell*, Innovative Decisions Inc., **Gerald Kobylski**, United States Military Academy, **Dennis Buede**, **Gary Smith**, Innovative Decisions Inc., and **Brian E. Souhan**, United States Military Academy (1023-49-1247)

11:00AM (486) *Approximate Dynamic Programming for Military Applications.* Preliminary report.
Warren Powell, Princeton University (1023-49-1196)

AMS Special Session on Financial Mathematics, III

8:00 AM – 11:55 AM

Organizers: **Jean-Pierre Fouque**, University of California Santa Barbara
Craig A. Nolder, Florida State University
Knut Solna, University of California Irvine
Thaleia Zariphopoulou, University of Texas Austin

8:00AM (487) *Pricing and Trading Credit Default Swaps.*
Tomasz R. Bielecki*, Illinois Institute of Technology, **Monique Jeanblanc**, Universite d'Evry Val d'Essonne, and **Marek Rutkowski**, University of New South Wales (1023-60-1045)

9:00AM (488) *Markovian Projection in the Problems of Credit Basket Modeling.*
Timur Misirpashaev* and **Andrei Lopatin**, NumeriX LLC (1023-60-426)

9:30AM (489) *Optimal stopping in regime switching Lévy models, with applications to American options and real options.*
Svetlana Boyarchenko and **Sergei Levendorskiĭ***, The University of Texas at Austin (1023-60-630)

10:00AM (490) *Option Pricing with Parsimonious Time-inhomogeneous Additive Models.*
Mack L. Galloway* and **Craig Nolder**, Florida State University (1023-60-1051)

10:30AM (491) *Continuity corrections for certain perpetual American and Bermudan options on multiple assets.*
Frederik S. Herzberg, Universitaet Bonn (1023-91-37)

11:00AM (492) *Pricing credit default swaps under a Markov-modulated structural model.* Preliminary report.
Tak Kuen Siu, Heriot-Watt University, **Rogemar Mamon***, University of Western Ontario, and **Christina Erlwein**, Brunel University (1023-91-660)

11:30AM (493) *The Non-Markovian Approach to the Valuation and Hedging of European Contingent Claims on Power with Scaling Spikes.*
Valery A. Kholodnyi, Middle Tennessee State University (1023-90-933)

MAA Minicourse #4: Part A

8:00 AM – 10:00 AM

Creating visual mathematics applets using flash programming.
Organizers: **Douglas E. Ensley**, Shippensburg University
Barbara Kaskosz, University of Rhode Island

AMS Session on Analysis and Ordinary Differential Equations, I

8:00 AM – 11:55 AM

8:00AM ► (494) *Functional equations associated with some mean value theorems of differential calculus.* Preliminary report.
Nasser Dastrange, Buena Vista University (1023-26-1018)

8:15AM ► (495) *A Tale of Two Integrals on Graphs and Manifolds.* Preliminary report.
Mohammad Javaheri, University of Oregon (1023-28-1390)

8:30AM ► (496) *A Generalized Wallis Formula.* Preliminary report.
Javad Namazi, Fairleigh Dickinson University (1023-28-859)

8:45AM (497) *Boundary interpolation problems for finite Blaschke products.*
Gunter Semmler, Munich University of Technology (1023-30-1198)

9:00AM (498) *A Hellerstein-Williamson type theorem for functions in U^*_{2p}.* Preliminary report.
Stephanie Edwards, University of Dayton (1023-30-1474)

9:15AM ► (499) *Counterexamples: Limiting Generalizations of Schwarz's Lemma.*
Dov N. Chelst* and **Doug Cahl**, DeVry University (1023-30-1722)

9:30AM (500) *The Dual of a Space OF Cauchy Transforms.* Preliminary report.
Yusuf A. Muhanna, American University of Sharjah (1023-30-248)

9:45AM (501) *Unexpected local extrema for the Sendov conjecture, part 2.*
Michael J. Miller, Le Moyne College (1023-30-537)

10:00AM (502) *Functional equations of meromorphic functions with small function coefficients.*
Chung-Chun Yang, Hong Kong Univ. of Sci.&Tech. (1023-30-552)

10:15AM (503) *Fuchsian Differential Equations with Regular Singularities.*
David J. Pinchbeck, St. Joseph's College (1023-30-583)

10:30AM (504) *A Characterization of p-Hyperbolicty/ p-Parabolicity and Decomposition of p-Dirichlet Spaces on Infinite Graphs.* Preliminary report.
Lucio Prado, BMCC - The City University of New York (1023-31-1574)

10:45AM (505) *Geometric sufficient conditions for compactness of the $\bar{\partial}$-Neumann operator.* Preliminary report.
Samangi Munasinghe*, College of the Holy Cross, and **Emil J. Straube**, Texas A&M University (1023-32-1043)

11:00AM (506) *On the growth of vector functions of several complex variables.* Preliminary report.
Faruk F. Abi Khuzam, American University of Beirut (1023-32-1078)

11:15AM (507) *A Class of Loewner Chain Preserving Extension Operators.* Preliminary report.
Jerry R. Muir, Jr., University of Scranton (1023-32-1193)

11:30AM (508) *Strong q-Convexity in Uniform Neighborhoods of Subvarieties in Coverings of Complex Spaces.* Preliminary report.
Michael Fraboni*, Moravian College, and **Terrence Napier**, Lehigh University (1023-32-1701)

11:45AM (509) *Solution of Delay Systems by Orthogonal Functions and Taylor Series.*
Mohsen Razzaghi, Mississippi State University (1023-49-234)

AMS Session on Dynamical Systems

8:00 AM – 11:55 AM

8:00AM (510) *Recurrence and chain-recurrence dimension.*
Jim Wiseman, Agnes Scott College (1023-37-1034)

8:15AM ► (511) *Dynamics of the p-adic Shift and Applications.*
Alex Levin, Harvard University (1023-37-1071)

8:30AM (512) *Pulse Solutions of Multi-Parameter Oscillatory Coupling Functions in Neural Networks.* Preliminary report.
J. Angela Hart Murdock, Rhodes College (1023-37-1136)

8:45AM (513) *Pre-bifurcation Amplification and Nonlinear Saturation of Noise Correlation Time.*
Elena D. Surovyatkina*, Space Research Institute of Russian Academy of Science, Moscow, Russia and Delaware State University, and **Mazen Shahin**, Delaware State University (1023-37-1157)

9:00AM (514) *A Denjoy-Wolff Theorem for Hilbert Metric Nonexpansive Maps on Polyhedral Domains.*
Brian C. Lins, Rutgers University - New Brunswick (1023-37-116)

9:15AM (515) *Homoclinic Tangencies, Periodic Orbits and Connecting Orbits: An Investigation of the Hénon Map.*
Brian A. Coomes*, **Hüseyin Koçak**, University of Miami, and **Kenneth J. Palmer**, National Taiwan University (1023-37-1253)

9:30AM (516) *Return tims of polynomials as meta-Fibonacci numbers.*
Nathaniel D. Emerson, University of Southern California (1023-37-1550)

9:45AM (517) *A universal model for Borel semiflows.* Preliminary report.
David M. McClendon, Northwestern University (1023-37-1750)

10:00AM Break.

10:15AM (518) *How the Fed Chaotically Distorts the Relationship Between Risk and Return.*
James Michael Haley, Point Park University (1023-37-1871)

10:30AM ► (519) *Algorithms for Rigorous Symbolic Dynamics and Topological Entropy.*
Rodrigo Trevino*, University of Texas at Austin, and **Rafael Frongillo**, Cornell University (1023-37-1889)

10:45AM (520) *On ergodic transformations that are simultaneously weakly mixing and uniformly rigid.*
Thomas M. Koberda*, University of Chicago, **Jennifer James, Kathryn Lindsey**, Williams College, **Peter Speh**, Princeton University, and **Cesar E. Silva**, Williams College (1023-37-294)

11:00AM (521) *Strong Extimate for Lebesgue Derivatives and Ergodic Averages.* Preliminary report.
Chaoyuan Liu, Eastern Kentucky University (1023-37-542)

11:15AM (522) *Lie Symmetries for a Model of Growth-death Kinetics.*
Rachelle C. DeCoste, United States Military Academy, West Point (1023-37-686)

11:30AM (523) *A Rodent-Hantavirus Model Structured by Disease, Developmental Stage, and Sex.*
Curtis Lawrence Wesley* and **Linda J. S. Allen**, Texas Tech University (1023-37-806)

11:45AM (524) *Mathematical analysis of an integro-differential equation arising in neuroscience.*
Marina Bevzushenko, Boston University (1023-37-814)

AMS Session on Geometry and Topology, I

8:00 AM – 11:40 AM

8:00AM (525) *The Three-Point Problem of Chinese Checker Circles.* Preliminary report.
Phoebe H. McLaughlin* and **Shing So**, University of Central Missouri (1023-51-1240)

8:15AM (526) *Approximating short maps by PL-isometries and Arnold's "Can you make your dollar bigger" problem.*
Dmitri Burago, Pennsylvania State University, **Svetlana Krat***, Georgia Institute of Technology, and **Anton Petrunin**, Pennsylvania State University (1023-51-1302)

8:30AM ► (527) *An Analysis of Convex Shapes Using Tridrafters.* Preliminary report.
Nathan H. Reff, Rochester Institute of Technology (1023-51-1819)

8:45AM ► (528) *Algorithmic Search for Flexibility Using Resultants of Polynomial Systems.* Preliminary report.
Robert H. Lewis, Fordham University (1023-51-1906)

9:00AM (529) *Toledo invariants of Higgs bundles on elliptic surfaces associated to base orbifolds of Seifert-fibered homology 3-spheres.*
Mike Krebs, California State University, Los Angeles (1023-51-71)

9:15AM Break.

9:45AM ► (530) *An algorithm to measure symmetry of n points.* Preliminary report.
Dennis Glenn Collins, Univ. of Puerto Rico, Mayaguez (1023-52-1900)

10:00AM (531) *A Decomposition Theorem in Cyclic Element Theory.*
Shing S. So, University of Central Missouri (1023-54-821)

10:15AM ► (532) *Minimal Knotting Numbers.*
Casey Mann*, The University of Texas at Tyler, **Benjamin McCarty**, Louisiana State University, **Jennifer McLoud-Mann**, **Ramona Ranalli** and **Nathan Smith**, The University of Texas at Tyler (1023-52-260)

10:30AM ► (533) *Distance in Three-Dimensional Lattices.*
Jennifer McLoud-Mann*, **Casey Mann**, The University of Texas at Tyler, **Benjamin McCarty**, Louisiana State University, **Ramona Ranalli** and **Nathan Smith**, The University of Texas at Tyler (1023-52-261)

10:45AM ► (534) *Local/Global Phenomena in Geometric Random Graphs.* Preliminary report.
Ross M. Richardson, University of California, San Diego (1023-52-956)

11:00AM (535) *Timelike minimal submanifolds in Robertson-Walker spacetimes.* Preliminary report.
Paul T. Allen, University of Oregon (1023-53-1181)

11:15AM (536) *Cohomogeneity One Manifolds and Non-negative Curvature.*
Corey Hoelscher, University of Pennsylvania (1023-53-1384)

11:30AM (537) *On Enriched Quantum Yang-Baxter Principal Fiber Bundles.* Preliminary report.
Molobe Mohlala* and **S. M. Einstein-Matthews**, Howard University (1023-53-1507)

AMS Session on Applications of Mathematics, I

8:00 AM – 10:40 AM

8:00AM ► (538) *Rigid Body Multiple Impact With the Ground.*
Florin V. Badiu*, **Jianzhong Su** and **Shan Hua**, University of Texas at Arlington (1023-70-1706)

8:15AM ► (539) *Saari's Conjecture for the Restricted Three-body Problem.*
Gareth E. Roberts*, College of the Holy Cross, and **Lisa Melanson**, Northwestern University (1023-70-902)

8:30AM (540) *Further results on the critical Rayleigh number R_c and wave number k_* for the planar Bénard problem with asymmetric boundary conditions.* Preliminary report.
Matthew J. Glomski, University at Buffalo (1023-76-1072)

8:45AM (541) *Analysis of a Simple sheared Ferro-fluid.*
Arup Mukherjee*, **Mark Korlie**, **Bogdan Nita**, **John Stevens** and **Philip Yecko**, Montclair State University (1023-76-1107)

9:00AM (542) *Symplectic Approximation of Euler Flow on a Riemannian Manifold.* Preliminary report.
Steven Benzel, Berry College (1023-76-1162)

9:15AM ► (543) *The inviscid limit of incompressible fluid flow in an annulus.*
Sara E. Frietze*, California State University, Northridge, **Robert Gerrity**, Pomona College, and **Tiago Picon**, Universidade Federal de São Carlos (1023-76-1299)

9:30AM (544) *Numerical Simulations of Vortex Sheets and Electron Sheets Using Boundary Integral Methods.*
Lyudmyla Barannyk, University of Michigan (1023-76-1616)

9:45AM ► (545) *Stability of geophysical two-phase flow in two dimensions.* Preliminary report.
Long H. Le, University of Central Arkansas (1023-76-640)

10:00AM (546) *On the Stability of KdV equation with a forcing term.*
Jeongwhan Choi*, Korea University, and **Shuming Sun**, Virginia Polytech (1023-76-969)

10:15AM ► (547) *An efficient algorithm for the solution of high-frequency scattering by infinite rough surfaces.*
Harun Kurkcu* and **Fernando Reitich**, University of Minnesota (1023-78-1773)

10:30AM (548) *Lp estimates of Maxwell's Equations in a bounded domain.*
Gang Bao, **Ying Li*** and **Zhengfang Zhou**, Michigan State University (1023-78-1790)

AMS Session on Algebra and Number Theory, III

8:00 AM – 11:55 AM

8:00AM (549) *Arf equivalence classes of quadratic number fields.*
Jeonghun Kim, Louisiana State University (1023-11-352)

8:15AM (550) *A lower bound on the Weil height in terms of an auxiliary polynomial.*
Charles L. Samuels, The University of Texas at Austin (1023-11-447)

8:30AM (551) *Improving The Erdős-Ginzburg-Ziv Theorem For Some Non-Abelian Groups.*
Jared Alexander Bass, Harvard University (1023-11-467)

8:45AM (552) *The Lucas-Pratt primality tree.* Preliminary report.
Jonathan W. Bayless, Dartmouth College (1023-11-483)

9:00AM (553) *Fundamental Units of Norm One in Real Quadratic Number Fields.* Preliminary report.
Thomas C. Palfrey, University of New Orleans (1023-11-496)

9:15AM ► (554) *Polynomial Variations on a Theme of Sierpiński.* Preliminary report.
Lenny Jones, Shippensburg University (1023-11-591)

9:30AM (555) *Martinet Searches and Some Nonexistence Theorems.* Preliminary report.
Sharon Brueggeman, University of Tennessee at Chattanooga (1023-11-664)

9:45AM (556) *Zero-free Region for a Hypergeometric zeta function.* Preliminary report.
Abdulkadir Hassen*, Rowan University, and **Nguyen D Hieu**, Rowan Univeristy (1023-11-675)

10:00AM (557) *An Identity for Period k Second Order Linear Recurrence Systems.*
Curtis N. Cooper, University of Central Missouri (1023-11-825)

10:15AM ► (558) *Roots of Fibonacci-Coefficient Polynomials.*
Donald D Mills, Rose-Hulman Institute of Technology (1023-11-861)

10:30AM (559) *Systems of diagonal forms over p-adic fields.* Preliminary report.
Michael P. Knapp, Loyola College (1023-11-890)

10:45AM (560) *Annihilation of Class Groups in Abelian Number Field Extensions of Degree $2p$.* Preliminary report.
Barry R. Smith, University of California, San Diego (1023-11-949)

11:00AM ► (561) *Prime Divisibility in the Lucas Numbers.*
Stefan Erickson, Colorado College (1023-11-983)

11:15AM (562) *Monomial orders on certain ring of invariants.* Preliminary report.
Mohammed Tesemma*, Spelman College, and **Haohao Wang**, South East Missouri State University (1023-13-1309)

11:30AM (563) *A combinatorial approach to tetrahedral curves.* **Christopher A. Francisco**, University of Missouri (1023-13-822)

11:45AM (564) *Bounding Orders in Rosenfeld-Gröbner algorithm.* **Oleg Golubitsky**, University of Western Ontario, **Marina Kondratieva**, Moscow State University, **Marc Moreno Maza**, University of Western Ontario, and **Alexey Ovchinnikov***, North Carolina State University (1023-13-887)

MAA Session on Mathematics and Biology 2010: Building Connections

8:00 AM – 11:55 AM

Organizers: **G. Elton Graves**, Rose-Hulman Institute of Technology
Catherine M. Murphy, Purdue University

8:00AM ► (565) *A Course in DNA Chemistry for Mathematicians at the State University of New York at Geneseo.* **Wendy K. Pogozelski*** and **Anthony J. Macula**, SUNY Geneseo (1023-K5-1624)

8:20AM ► (566) *Mathematics in Genomic Analysis—A Module for Biology Students.* **Vera Cherepinsky**, Fairfield University (1023-K5-1690)

8:40AM (567) *Designing an Introductory course in Mathematical Biology with Team Teaching.* **Krishan M. Agrawal**, Virginia State University (1023-K5-1458)

9:00AM (568) *A course in computational biology—Reaching out and reaching within.* **M. Chakrabarti**, Grand Valley State University (1023-K5-1834)

9:20AM ► (569) *Introductory Bioinformatics Interdisciplinary Course.* Preliminary report. **Yana Kortsarts***, Widener University, Computer Science Department, and **Robert W. Morris**, Widener University, Biology Department (1023-K5-264)

9:40AM ► (570) *A Story of Developing a Course and a Textbook in Mathematical Biology.* **Raina Robeva*** and **Robin Davies**, Sweet Briar College (1023-K5-1796)

10:00AM ► (571) *The Mother of Invention: From Desperation to Collaboration.* **Christopher C. Leary***, **Colin Kremer**, **Rachel VanCott** and **Gregg Hartvigsen**, SUNY Geneseo (1023-K5-1747)

10:20AM ► (572) *Biocalculus at Benedictine University and College of DuPage: A Collaboration Between Mathematicians and Biologists and Between Four-Year and Two-Year Institutions.* **Timothy D. Comar**, Benedictine University (1023-K5-158)

11:00AM (573) *Building an Interdisciplinary Institute: The Institute for Quantitative Biology at ETSU.* **Istvan Karsai***, Dept. of Biological Sciences, The Institute for Quantitative Biology, East Tennessee State University, and **Jeff R. Knisley**, The Institute for Quantitative Biology, East Tennessee State University (1023-K5-1441)

11:20AM ► (574) *Collaborations between the ETSU Math and Biology Departments.* Preliminary report. **Anant P. Godbole**, East Tennessee State University (1023-K5-418)

11:40AM ► (575) *Integrating students from mathematics and biology.* Preliminary report. **Marshall E. Hampton**, University of Minnesota, Duluth (1023-K5-505)

MAA Session on Getting Students to Discuss and to Write about Mathematics, II

8:00 AM – 11:55 AM

Organizers: **Martha Ellen (Murphy) Waggoner**, Simpson College
Charlotte Knotts-Zides, Wofford College
Harrison W. Straley, Wheaton College

8:00AM ► (576) *Writing, Learning, and Mathematics.* **Ward E. Canfield**, National-Louis University (1023-I1-1114)

8:15AM ► (577) *Concepts in Context: Writing and Reasoning about Quantitative Issues.* **Tanya Cofer***, Northeastern Illinois University, and **David C. Jabon**, DePaul University, Chicago (1023-I1-1124)

8:30AM ► (578) *Reading and Discussing Mathematics with Peers.* **Penelope H Dunham**, Muhlenberg College (1023-I1-1192)

8:45AM ► (579) *Converting Calculus Students from Showing Work to Explaining.* Preliminary report. **Feryal Alayont**, Grand Valley State University (1023-I1-1280)

9:00AM ► (580) *Getting Math Students to Take Writing Seriously.* Preliminary report. **Stephen B. Maurer**, Swarthmore College (1023-I1-173)

9:15AM ► (581) *What Is an Assignment Like You Doing in a Class Like This?!* **Paula R. Stickles**, Millikin University (1023-I1-1338)

9:30AM ► (582) *Group Consulting Projects Using Matrices and Linear Programming.* **Katharine F. Gurski**, George Washington University (1023-I1-140)

9:45AM (583) *Using Research Projects to Develop Mathematical Knowledge While Expanding Communication Skills.* **Elizabeth C. Rogers**, Piedmont College (1023-I1-1409)

10:00AM ► (584) *Transitions: Using a Variety of Writing Assignments in a Bridge Course.* Preliminary report. **Christopher Goff**, University of the Pacific (1023-I1-1423)

10:15AM ► (585) *Writing projects and rubrics in foundational mathematics courses.* **Joshua Brandon Holden**, Rose-Hulman Institute of Technology (1023-I1-1439)

10:30AM ► (586) *A Problem-Solving Project for a General Education Course.* **Mike Pinter**, Belmont University (1023-I1-1497)

10:45AM ► (587) *Using Mythbusters Episodes to Prompt Discussion in a Mathematical Modeling Course.* **Jennifer Wightman**, Coastal Carolina University (1023-I1-1315)

11:00AM ► (588) *Implementing Problem-Based Learning in Introductory Statistics Courses, a Preliminary Report.* Preliminary report. **Catherine A. Matos**, Clayton State University (1023-I1-1780)

11:15AM ► (589) *Using Group Homework in Calculus to Develop Written and Verbal Communication Skills.* **Brian J. Birgen**, Wartburg College (1023-I1-201)

11:30AM (590) *Wiki in the mathematics classroom.* Preliminary report.
P. Christopher Staecker, Messiah College (1023-J1-238)

11:45AM ▸ (591) *A Course with a Focus on the Other Two R's.*
John F. Putz, Alma College (1023-J1-300)

MAA Session on Philosophy of Mathematics, I

8:00 AM – 11:55 AM

Organizers: **Bonnie Gold**, Monmouth University
Charles R. Hampton, The College of Wooster

8:00AM ▸ (592) *What Place Does Philosophy Have in Teaching Mathematics?* Preliminary report.
Martin E. Flashman, Humboldt State University (1023-N1-1867)

8:40AM ▸ (593) *Mathematics as Representational Art.* Preliminary report.
Sam Stueckle, Trevecca Nazarene University (1023-N1-1392)

9:20AM (594) *From an analysis of definitions to a view of mathematics.*
Ruggero Ferro, University of Verona, Italy (1023-N1-637)

10:00AM (595) *Searle's Metaphysics of Computation and Alternative Logics: A Surprising Connection.*
Jeff Buechner, Rutgers University/Newark (1023-N1-973)

10:40AM ▸ (596) *Why do we all get the same answers? Kitcher's anti-apriorism and the problems of social constructivism.*
Carl E. Behrens, Alexandria, VA (1023-N1-882)

11:20AM ▸ (597) *In Praise of Cranks: Are You Thinking What I'm Thinking?* Preliminary report.
Andy D. Martin, University of Kentucky (1023-N1-292)

MAA Session on Innovative and Effective Ways to Teach Linear Algebra, II

8:00 AM – 11:55 AM

Organizers: **David Strong**, Pepperdine University
Gilbert Strang, Massachusetts Institute of Technology

8:00AM (598) *Introducing Eigenvalues by way of the Resolvent.*
Elaine T. Hale*, and **Steven Cox**, Rice University (1023-J1-1663)

8:20AM ▸ (599) *Cross Stitching, Graph Theory and a Least Path Problem.*
Barbara A. Ashton*, Borough of Manhattan Community College, CUNY, and **Kevin L. Dove**, Lander University (1023-J1-1758)

8:40AM ▸ (600) *A matrix route to Snell's law.*
Andrew J. Simoson, King College (1023-J1-259)

9:00AM (601) *Linear Algebra For Everyone: The Arithmetic Portal Into Vector-Spaces.*
Clyde L. Greeno, The MALEI Mathematics Institute (1023-J1-1805)

9:20AM ▸ (602) *Vector spaces and linear functionals in elementary probabiliy.*
Arnold Lebow, Yeshiva University (1023-J1-987)

9:40AM ▸ (603) *Approximate Contour Image Generation: A Project in Linear Algebra.*
Mohamed Allali, Chapman University (1023-J1-1306)

10:00AM ▸ (604) *Visually Illustrating Rotations, Reflections and Translations in Flash.*
Paul R. Bouthellier, University of Pittsburgh-Titusville (1023-J1-405)

10:20AM ▸ (605) *Pedagogy and Visualization: Two Aspects of the Use of a CAS in Linear Algebra.*
Russell D. Blyth* and **Mike May, S. J.**, Saint Louis University (1023-J1-170)

10:40AM ▸ (606) *Using gimbal lock in 3d programs to illustrate linear algebra Concepts.* Preliminary report.
Helmer Aslaksen, National University of Singapore (1023-J1-1918)

11:00AM (607) *Using a Markov Matrix Model as a Thread Throughout the First Linear Algebra Course.* Preliminary report.
Stephen Hilbert, Ithaca College, Ithaca NY (1023-J1-1600)

11:20AM (608) *Using the discovery learning method in linear algebra.*
Petre Ion Ghenciu, University of Wisconsin-Stout (1023-J1-1535)

11:40AM (609) *An Honors First-year Seminar in Linear Algebra.*
Stephen B. Maurer, Swarthmore College (1023-J1-174)

MAA Session on Research on the Teaching and Learning of Undergraduate Mathematics

8:00 AM – 11:55 AM

Organizers: **David E. Meel**, Bowling Green State University
Michael Oehrtman, Arizona State University
Chris Rasmussen, San Diego State University

8:00AM ▸ (610) *How your students use their textbook: A preliminary report.* Preliminary report.
Bret Benesh*, Harvard University, **Tim Boester**, University of Wisconsin-Madison, **Aaron Weinberg**, Ithaca College, and **Emilie Wiesner**, University of Georgia-Athens (1023-P5-92)

8:20AM ▸ (611) *Making Sense of the Infinite: A Study Investigating the Learning and Teaching of Infinite Series.*
Brian J. Lindaman, University of Kansas (1023-P5-1763)

8:40AM ▸ (612) *Examining the Effectiveness of Reading Questions in Introductory University Mathematics Courses.*
M. Axtell* and **W. Turner**, Wabash College (1023-P5-168)

9:00AM (613) *Controlling the work in Solving Initial Value Problems: Contrasting Introductory Calculus Textbooks.*
Vilma Mesa, University of Michigan (1023-P5-863)

9:20AM (614) *Diagrammatic Reasoning.*
H. A. Dye, U.S. Military Academy (1023-P5-878)

9:40AM ▸ (615) *An analysis of equation solving strategies of mathematics professors versus undergraduate mathematics majors and secondary mathematics teachers while using graphing calulators.*
James R. Hersberger, Indiana University Purdue University Fort Wayne (1023-P5-1241)

10:00AM (616) *Study of the Cognitive Relation Between an Infinite Decimal and the Real Number It Represents: How Does an Individual Understand the Truth or Falsity of the Relation* $0.999\ldots = 1$*?*
Kirk Weller, University of Michigan Flint (1023-P5-1287)

10:20AM ► (617) *A Framework for Characterizing Understanding of the Riemann Integral.*
Vicki L. Sealey, Arizona State University (1023-P5-1557)

10:40AM ► (618) *Mathematics Anxiety: A Multivariate Examination of Gender Differences between Moberly Area Community College and Truman State University Students.*
Carolyn M. Dixon, Truman State University (1023-P5-1660)

11:00AM (619) *A Classroom Study of Undergraduates' Understandings of Limits.* Preliminary report.
Timothy C. Boester, University of Wisconsin-Madison (1023-P5-1699)

11:20AM ► (620) *Students' Intuitive and Formal Solutions of Calculus Optimization Problems.*
Matthew E. DeLong*, Taylor University, and **Dale J. Winter**, University of Michigan (1023-P5-147)

11:40AM (621) *The Effect of Different College Algebra Courses on Students' Understanding of Linear and Exponential Function Concepts.*
Erick Brian Hofacker, University of Wisconsin – River Falls (1023-P5-1852)

MAA General Contributed Paper Session, III

8:00 AM – 11:55 AM

Organizers: **Eric S. Marland**, Appalachian State University
Jay A. Malmstrom, Oklahoma State Community College

8:00AM ► (622) *The Gilbreath Principle in Mathematical Magic.*
Card Colm Mulcahy, Spelman College (1023-Z1-1348)

8:15AM (623) *Uniqueness and Existence for Unbounded Boundary Value Problems.*
Aprillya Lanz*, Clayton State University, and **Jeffrey Ehme**, Spelman College (1023-Z1-1772)

8:30AM ► (624) *Incorporating Technology into Mathematics Courses for Secondary Education Mathematics Majors.* Preliminary report.
John W. Thompson, U. of Pittsburgh at Johnstown (UPJ) (1023-Z1-106)

8:45AM (625) *Discrete Mathematics for Middle Level Teachers.* Preliminary report.
Cheryl L. Olsen, University of Nebraska-Lincoln (1023-Z1-1752)

9:00AM (626) *Developing Middle School Teachers' Content Knowledge Through Inquiry In and About Mathematics.*
Eden M. Badertscher, University of Maryland, College Park (1023-Z1-347)

9:15AM ► (627) *Enhancing Middle School Teachers' Knowledge of Mathematics.*
Gulden Karakok*, **Tina L. Johnston**, **Maggie Niess** and **Tevian Dray**, Oregon State University (1023-Z1-1799)

9:30AM (628) *Balancing Mathematical Content with Classroom Applications: Experiences from Our Third Year.* Preliminary report.
Kimberly J. Presser, Shippensburg University (1023-Z1-474)

9:45AM ► (629) *Comparing the K-8 Mathematical Content Knowledge of Future Teachers to College Algebra and Calculus Students: Results of a Pretest-Posttest Study.*
Betsy Darken, University of Tennessee at Chattanooga (1023-Z1-349)

10:00AM ► (630) *Using Handheld Technology in Teaching Geometry.*
Constance C. Edwards, Western Kentucky University (1023-Z1-1486)

10:15AM ► (631) *Using non-Euclidean geometry to teach Euclidean geometry to K-12 teachers.* Preliminary report.
David Damcke, University of Portland, **Tevian Dray***, Oregon State University, **Maria Fung**, Western Oregon University, **Dianne Hart** and **Lyn Riverstone**, Oregon State University (1023-Z1-1828)

10:30AM ► (632) *The Integrated Laboratory Program – Guided Discovery in the Education of Teachers.*
Jerome S. Epstein, Polytechnic University, Brooklyn, NY (1023-Z1-396)

10:45AM ► (633) *Fraction Sets for Basic Digit Sets.* Preliminary report.
Darren Wick, Ashland University (1023-Z1-584)

11:00AM ► (634) *Factoring (16,6,2) difference sets.*
C. Bhattacharya*, Randolph-Macon College, and **Ken Smith**, Central Michigan University (1023-Z1-1417)

11:15AM ► (635) *The Extended Euclidean Algorithm.* Preliminary report.
William P. Wardlaw*, **Richard F. Maruszewski**, U. S. Naval Academy, and **Allen J. Schwenk**, Western Michigan University (1023-Z1-691)

11:30AM ► (636) *Identifying when computed PageRank scores are accurately ranked.* Preliminary report.
Rebecca S. Wills, North Carolina State University (1023-Z1-1484)

11:45AM ► (637) *Planarizing Non-Planar Polygons.*
Douglas G. Burkholder, Lenoir-Rhyne College (1023-Z1-524)

SIAM Minisymposium on Mathematical Modeling of Complex Systems in Biology, I

8:00 AM – 10:50 AM

Organizer: **Lisa J. Fauci**, Tulane University

8:00AM (638) *Modeling Biofilm Disinfection: How much is enough?*
Nick G. Cogan, Florida State University (1023-92-216)

8:30AM (639) *A Multiscale Model of Biofilm as a Senescence-Structured Fluid.*
Bruce P. Ayati*, Southern Methodist University, and **Isaac Klapper**, Montana State University (1023-92-657)

9:00AM ► (640) *Voices from the fringe - How distal synapses make themselves heard.*
Steven J. Cox*, Rice University, and **Kresimir Josic**, University of Houston (1023-35-836)

9:30AM (641) *Alcohol's Effect on Neuron Firing.*
Erika T. Camacho, Loyola Marymount University (1023-92-1421)

10:00AM ► (642) *The Method of Regularized Stokeslets for Biological Flows.*
Ricardo Cortez, Tulane University (1023-76-1874)

10:30AM (643) *On the Stability of Periodic Solutions in the Perturbed Chemostat.*
Frederic Mazenc, Projet MERE, INRIA-INRA, France, **Michael Malisoff***, Louisiana State University, Baton Rouge, and **Patrick De Leenheer**, University of Florida (1023-92-57)

SIAM Minisymposium on Structure and Topology in Graph Theory, I

8:00 AM - 10:55 AM

Organizers: **Mark N. Ellingham**, Vanderbilt University
Chris Stephens, Middle Tennessee State University
Xiaoya Zha, Middle Tennessee State University

8:00AM (644) *Infinite 2-walks in 3-connected planar graphs.*
Daniel P. Biebighauser*, Concordia College, Moorhead, Minnesota, and **M. N. Ellingham**, Vanderbilt University (1023-05-771)

8:30AM (645) *Circumferences of 3-connected graphs with bounded degrees.* Preliminary report.
Guantao Chen*, Georgia State University, **Zhicheng Gao**, Carleton University, **Xingxing Yu**, Georgia Institute of Technology, and **Wenan Zang**, University of Hong Kong (1023-05-554)

9:00AM (646) *Packing of Sparse Graphs.* Preliminary report.
Alexandr V. Kostochka and **Gexin Yu***, University of Illinois at Urbana-Champaign (1023-05-167)

9:30AM (647) *On the Reconstruction of Planar Graphs.*
Mark Bilinski, **Young Soo Kwon** and **Xingxing Yu***, Georgia Institute of Technology (1023-05-824)

10:00AM (648) *Spanning subsets of toroidal and Klein bottle embeddings.*
D. Christopher Stephens and **Xiaoya Zha***, Middle Tennessee State University (1023-05-848)

10:30AM (649) *Excluding induced subgraphs by degree sequence.*
Neil Robertson, Ohio State University (1023-05-1838)

SIGMAA Officers Meeting

8:00 AM - 10:00 AM

AMS Special Session on Free Discontinuity Problems: From Image Processing to Materials Science

8:30 AM - 11:55 AM

Organizers: **Blaise Bourdin**, Louisiana State University
Christopher J. Larsen, Worcester Polytechnic Institute

8:30AM (650) *Variational Fracture and Minimality.*
Gilles A. Francfort, Université Paris 13, France (1023-49-992)

9:00AM (651) *Quasistatic evolution in brittle fracture based on a type of strict local energy minimization.*
Chris Larsen, WPI (1023-49-1614)

9:30AM (652) *Quasi static evolution for damage.*
Adriana Garroni*, Universita' di Roma "La Sapienza", Italy, and **Christopher Larsen**, Worcester Polytechnic Institute (1023-49-1317)

10:00AM (653) *Existence for a model of fracture evolution based on crack fronts.*
Christopher J. Larsen, Worcester Polytechnic Institute, **Michael Ortiz**, California Institute of Technology, and **Casey L. Richardson***, Worcester Polytechnic Institute (1023-49-1640)

10:30AM (654) *Heat Flows of Linear Growth Maps and Color Image Denoising.*
Xiaobing Feng, The University of Tennessee (1023-35-1613)

11:00AM (655) *Fracture energies as limit of non-local damage energies.*
Matteo Negri, Universita' di Pavia (1023-49-715)

11:30AM (656) *Numerical implementation of variational brittle fracture.*
Blaise A. Bourdin, Louisiana State University (1023-49-1229)

MAA Panel Discussion

8:30 AM - 9:50 AM

Euler's continuing influence.
Organizer: **Ed Sandifer**, Western Connecticut State University
Panelists: **William W. Dunham**, Muhlenberg College
Charles R. Hampton, College of Wooster
June E. Barrow-Green, The Open University

Project NExT Panel Discussion

8:30 AM - 9:50 AM

Getting your first book published.
Organizers: **T. Christine Stevens**, St. Louis University
Aparna W. Higgins, University of Dayton
Joseph A. Gallian, University of Minnesota Duluth
Panelists: **Thomas C. Hull**, Merrimack College
Donald J. Albers, MAA
Laura A. Taalman, James Madison University
Ruth Baruth, W. H. Freeman

AWM Emmy Noether Lecture

9:00 AM - 9:50 AM

(657) *Automorphisms of free groups, outer space, and beyond.*
Karen Vogtmann, Cornell University (1023-20-27)

MAA Minicourse #10: Part A

9:00 AM - 11:00 AM

A beginner's guide to the scholarship of teaching and learning in mathematics.
Organizers: **Curtis D. Bennett**, Loyola Marymount University
Jacqueline M. Dewar, Loyola Marymount University

MAA Minicourse #16: Part A

9:00 AM - 11:00 AM

More music and mathematics.
Organizer: **Leon Harkleroad**, Wilton, ME

MAA Session on Reconceptualizing Content Courses for Prospective High School Mathematics Teachers, I

9:00 AM - 11:55 AM

Organizers: **Jean McGivney-Burelle**, University of Hartford

Neil Portnoy, Stony Brook University

9:00AM ► (658) *Effective Mathematics Course Experiences for Prospective High School Mathematics Teachers.* **Mary Ann Connors**, Westfield State College (1023-N5-1485)

9:20AM ► (659) *Mathematical Explorations as a Gateway to High-school Content Mastery: a Number Theory Approach.* Preliminary report. **Maria G. Fung**, Western Oregon University (1023-N5-1422)

9:40AM ► (660) *A Multi-Angled Approach to Geometry for Secondary Mathematics Teachers.* Preliminary report. **Diane Barrett**, St. John Fisher College (1023-N5-54)

10:00AM (661) *Developing Mathematics: A Mathematics Content Course for Teachers Resulting In a Proof of the Fundamental Theorem of Algebra.* **Benjamin J. Sinwell**, Montgomery County Public Schools and Park City Mathematics Institute, and **Bowen Kerins***, Education Development Center, Inc. (1023-N5-1366)

10:20AM ► (662) *Famous Mathematical Constants.* **Jill Shahverdian**, Quinnipiac University (1023-N5-1358)

10:40AM ► (663) *Methods, Math, and Madness.* **Tom Evitts**, Shippensburg University (1023-N5-1278)

11:00AM ► (664) *Merging Mathematics, Pedagogy, and Technology: A New Design for Preparing Secondary Mathematics Teachers.* Preliminary report. **Douglas A. Lapp**, Central Michigan University (1023-N5-1238)

11:20AM (665) *The History of Mathematics: An Investigation of Particular Course Assignments on Student Conceptions of Its Use in Teaching.* Preliminary report. **Kathleen M. Clark**, Florida State University (1023-N5-523)

11:40AM ► (666) *Learning and Learning to Teach Modern Geometry.* Preliminary report. **Teresa E. Moore***, Ithaca College, and **L. Christine Kinsey**, Canisius College (1023-N5-1150)

MAA Poster Session on MAA/Tensor Foundation Projects which Increase the Participation of Women in Mathematics

9:00 AM – 11:00 AM

Organizers: **Elizabeth G. Yanik**, Emporia State University
Jennifer Hontz, Meredith College
Kathleen A. Sullivan, Seattle University

Joint AMS-MAA Committee on Teaching Assistants and Part-Time Instructors Panel Discussion

9:00 AM – 10:20 AM

Strategic thinking about nonladder faculty.

Organizers: **Judith L. Baxter**, University of Illinois at Chicago
Kevin E. Charlwood, Washburn University
Natasha M. Speer, Michigan State University

Panelists: **Charles Hale**, California State University, Pomona
Diane L. Herrmann, University of Chicago
Penelope Kirby, Florida State University
Fred Peskoff, Borough of Manhattan Community College/CUNY

Exhibits and Book Sales

9:30 AM – 5:30 PM

Math on the Web, II

10:00 AM – 3:35 PM

10:00AM (667) *Interactive math on the Web by Maplesoft.* **Mohamed Bendame**, Maplesoft

10:45AM (668) *The Math Gateway: A NSDL portal for undergraduate math.* **Lang Moore**, Duke University

11:30AM (669) *Math for the visually disabled: What you can do to help.* **Neil Soiffer**, Design Science, Inc.

12:15PM (670) *MathML everywhere: Web pages, blogs, Wikis, computation and more.* **Neil Soiffer**, Design Science, Inc.

1:00PM (671) *Math support for instant messaging, chat rooms, and other collaboration environments.* **Don DeLand**, Integre Technical Publishing Co.

1:45PM (672) *Creating mathematical documents for the Web with Scientific WorkPlace.* **Barry MacKichan**, MacKichan Software, Inc.

2:30PM (673) *Student answers to math homework on the Web using proper mathematical notation: A scalable, universal approach.* **John Risley**, WebAssign

3:15PM (674) *Maplets for calculus.* **Philip Yasskin***, Texas A&M University, and **Doug Meade***, University of South Carolina

MAA Panel Discussion

10:00 AM – 11:20 AM

Using student portfolios for assessment.

Organizers: **Alex J. Heidenberg**, U.S. Military Academy
Michael D. Phillips, U.S. Military Academy

Panelists: **Connie S. Schrock**, Emporia State University
Dennis Kern, Texas A&M University at Texarkana
Cathy Liebars, College of New Jersey
Archie Willmer, III, U.S. Military Academy

MAA Committee on Technologies in Mathematics Education and WEBSIGMAA Panel Discussion

10:00 AM – 11:20 AM

Best practices for expository mathematics in the digital age.

Organizer: **Kyle T. Siegrist**, University of Alabama, Huntsville

Panelists: **Thomas E. Leathrum**, Jacksonville State University
Douglas E. Ensley, Shippensburg State University
Franklin A. Wattenberg, U.S. Military Academy

David Smith, Duke University
Kyle T. Siegrist

MAA Invited Address

10:05 AM – 10:55 AM

(675) *The Bernoulli brothers in the arena of the early calculus.*
Jan van Maanen, Utrecht University (1023-A0-21)

MAA Minicourse #5: Part A

10:30 AM – 12:30 PM

Wavelets and applications: A multidisciplinary undergraduate course with emphasis on scientific computing.
Organizer: **Patrick J. Van Fleet**, University of St. Thomas

MAA Special Presentation

10:30 AM – 11:50 AM

Proposal writing workshop for grant applications to the NSF Division of Undergraduate Education.
Organizers: **Elizabeth J. Teles**, NSF Division of Undergraduate Education
Lee L. Zia, NSF Division of Undergraduate Education

SIAM Invited Address

11:10 AM – NOON

► (676) *Geometry in the movies.*
Tony DeRose, Pixar Animation Studios (1023-00-14)

AMS Session on Logic

11:15 AM – 11:55 AM

11:15AM (677) *Coding a new countable-length sequence.*
Natasha Dobrinen, Kurt Goedel Research Center for Mathematical Logic (1023-03-1479)

11:30AM (678) *On the Free Left Distributive Algebra on κ-many Generators.* Preliminary report.
Sheila K. Miller, University of Colorado, Boulder (1023-03-1545)

11:45AM (679) *On Non-Standard Set Theory Models and the Relativity of Real Numbers.*
L. Luo, Beijing Normal University (1023-03-89)

AMS Colloquium Lecture: Lecture II

1:00 PM – 2:00 PM

(680) *Limit shapes, real and imagined, II: Algebraic geometry of random surfaces.*
Andrei Okounkov, Princeton University (1023-60-03)

AMS-MAA-SIAM Special Session on Research in Mathematics by Undergraduates, II

1:00 PM – 4:25 PM

Organizers: **Darren A. Narayan**, Rochester Institute of Technology
Carl V. Lutzer, Rochester Institute of Technology
Bernard Brooks, Rochester Institute of Technology
Tamas I. Wiandt, Rochester Institute of Technology
Michael J. Fisher, California State University, Fresno

1:00PM ► (681) *Modeling the Spread of Smallpox in the Mayan Population with Excel.* Preliminary report.
Hye Yon Yi, Rochester Institute of Technology (1023-00-1100)

1:30PM ► (682) *Colorability of Knots and the Kauffman-Harary Conjecture.*
Nicholas E. Dowdall*, Sonoma State University, California, **Thomas Mattman**, Chico State University, **Kevin Meek**, Florida State University, and **Pablo Solis**, MIT (1023-54-805)

2:00PM ► (683) *Turk's Head Knots and the Kauffman-Harary Conjecture.*
Pablo R. Solis, Massachusetts Institute of Technology (1023-54-807)

2:30PM ► (684) *The Kauffman-Harary Conjecture, Turk's Head Knots and Pell Primes.*
Nick Dowdall, Sonoma State University, **Kevin Meek***, Florida State University, and **Pablo Solis**, Massachusetts Institute of Technology (1023-51-1058)

3:00PM (685) *A Compartmental Model for an Activity-Dependent Perforated Synapse.*
Olga Yuliana Noris* and **Diana W. Verzi**, San Diego State University-Imperial Valley Campus (1023-92-1119)

3:30PM ► (686) *Normal Subgroups of a Wreath p-Group and Corresponding Doubly-Invariant Vector Subspaces: Preliminary Report.* Preliminary report.
Sam P. Ruth*, Northwestern University, **Arran Christopher Hamm**, Wake Forest University, and **Sarah Renee Bockting**, University of Evansville (1023-20-64)

4:00PM ► (687) *Pricing Convertible Bonds.* Preliminary report.
Jinjin Qian* and **Lindsay Bryant**, Lafayette College (1023-90-1553)

AMS-AWM Special Session on Geometric Group Theory, III

1:00 PM – 3:55 PM

Organizers: **Ruth M. Charney**, Brandeis University
Karen Vogtmann, Cornell University

1:00PM (688) *Wicket groups and ring groups.*
Tara E. Brendle*, Louisiana State University, and **Allen Hatcher**, Cornell University (1023-57-1754)

1:30PM (689) *Brownstein-Lee Conjecture.*
Craig Jensen*, University of New Orleans, **Jon McCammond**, UC - Santa Barbara, and **John Meier**, Lafayette College (1023-20-69)

2:00PM (690) *Core and intersection number in compactified outer space, Part I.* Preliminary report.
Michael Handel, Lehman College, CUNY, and **Lee Mosher***, Rutgers University, Newark (1023-20-838)

2:30PM (691) *Core and intersection number in compactified outer space, Part II.* Preliminary report.
Michael Handel*, Lehman College, CUNY, and **Lee Mosher**, Rutgers University, Newark (1023-20-839)

3:00PM (692) *Unstable Morita Classes in the Homology of the Mapping Class Group.* Preliminary report.
James R. Conant, University of Tennessee (1023-20-258)

3:30PM (693) *Cohomology of some subgroups of the automorphism group of a free group.* **Alexandra R. Pettet**, Stanford University (1023-20-1070)

AMS Special Session on Initial- and Boundary-Value Problems, Solvability, and Stability for some Nonlinear PDEs: Theorem, Computation, and Application, II

1:00 PM – 3:55 PM

Organizers: **Jerry L. Bona**, University of Illinois at Chicago
Laihan Luo, New York Institute of Technology

1:00PM (694) *Initial-boundary-value Problems for a Three-dimensional Model for Surface Water Waves.* Preliminary report. **Jerry L. Bona**, University of Illinois at Chicago (1023-76-1022)

1:30PM (695) *Time Periodic Solution of the Korteweg-de Vries Equation on a Bounded Domain and Its Stability.* Preliminary report. **Muhammad Usman** and **Bing-Yu Zhang***, University of Cincinnati (1023-35-1362)

2:00PM ► (696) *Stability of incompressible viscous fluid flows.* **Dmitry Pelinovsky**, McMaster University (1023-34-422)

2:30PM (697) *Fifth-order Korteweg-de Vries type equations in Sobolev spaces with negative indices.* Preliminary report. **Jiahong Wu***, Oklahoma State University, **Jie Shen**, Purdue University, and **Juan-Ming Yuan**, Providence University, Taiwan (1023-35-641)

3:00PM ► (698) *Approximate and Numerical Solutions of the Initial- and Boundary-Value Problems for fKdV Equation, Mass Postulate, and Satellite Observations.* **Samuel S. Shen**, San Diego State University (1023-76-400)

3:30PM (699) *Asymptotic Linearization of Some Nonlinear Partial Differential Equations.* Preliminary report. **Thanasis Fokas**, Department of Applied Mathematics and Theoretical Physics, University of Cambridge, and **Laihan Luo***, New York Institute of Technology (1023-35-813)

AMS Special Session on Invariant Theory, II

1:00 PM – 3:55 PM

Organizers: **Mara D. Neusel**, Texas Tech University
Frank D. Grosshans, West Chester University

1:00PM (700) *On the invariant theory of the orthogonal group.* **Matyas Domokos**, Renyi Institute of Mathematics, Hungarian Academy of Sciences (1023-13-1081)

2:00PM Problem session on Invariant Theory.

3:00PM (701) *Black Box Algebras.* **Harm Derksen**, University of Michigan (1023-17-935)

3:30PM (702) *Symmetry in SL(3,C)-Character Varieties.* **Sean D. Lawton**, Kansas State University (1023-14-97)

AMS Special Session on Knots, 3-Manifolds, and Their Invariants, III

1:00 PM – 3:55 PM

Organizers: **Oliver T. Dasbach**, Louisiana State University
Xiao-Song Lin, University of California Riverside

1:00PM ► (703) *Some applications of the cosine law to surface geometry and 3-manifolds.* **Feng Luo**, Rutgers University (1023-57-1527)

1:30PM (704) *Virtual Homotopy.* Preliminary report. **H. A. Dye***, U.S. Military Academy, and **Louis H. Kauffman**, University of Illinois at Chicago (1023-55-529)

2:00PM (705) *Hochschild homology, cones, and combinatorial patterns in Khovanov type graph homology.* **Jozef H. Przytycki***, George Washington University, **Milena D. Pabiniak** and **Radmila Sazdanovic**, GWU (1023-57-1406)

2:30PM (706) *Analyzing torsion in Khovanov-type graph cohomology over algebra* $Z[x]/(x^m)$. **Radmila Sazdanovic***, George Washington University, **Milena Pabiniak** and **Jozef H. Przytycki**, GWU (1023-57-846)

3:00PM (707) *Mahler measures of twisted Alexander polynomials.* **Daniel S. Silver** and **Susan G. Williams***, University of South Alabama (1023-57-1561)

3:30PM ► (708) *The Mahler measure of Jones polynomials and the twist-bracket polynomial.* **Abhijit Champanerkar**, Univ. of South Alabama, and **Ilya Kofman***, College of Staten Island, CUNY (1023-57-1262)

AMS Special Session on Arrangements and Related Topics, III

1:00 PM – 3:50 PM

Organizers: **Daniel C. Cohen**, Louisiana State University
Anne V. Shepler, University of North Texas

1:00PM ► (709) *On the Heavyside functions of arrangements and the impossibility theorem by Kenneth Arrow.* **Hiroaki Terao**, Hokkaido University (1023-32-1880)

1:30PM (710) *The* 1 mod *k partition poset and graph connectivity.* Preliminary report. **John Shareshian**, Washington University, and **Michelle L. Wachs***, University of Miami (1023-05-1742)

2:00PM (711) *Degeneration varieties and Macaulay inverse systems.* Preliminary report. **Max D. Wakefield**, Hokkaido University (1023-13-1073)

2:30PM Break.

3:00PM (712) *The space of n ordered points on the line is cut out by simple quadrics if n is not six.* **Benjamin J. Howard***, Institute for Mathematics and its Applications, **John Millson**, University of Maryland College Park, **Andrew Snowden**, Princeton University, and **Ravi Vakil**, Stanford University (1023-14-1068)

3:30PM (713) *Freeness of Line-Conic Arrangements in* $\mathbb{P}^2$. **Stefan O. Tohaneanu*** and **Hal Schenck**, Texas A&M University (1023-52-1402)

AMS Special Session on Mathematical Techniques in Musical Analysis, II

1:00 PM – 3:55 PM

Organizers: **Robert W. Peck**, Louisiana State University
Julian Hook, Indiana University-Bloomington
Rachel W. Hall, Saint Joseph's University

1:00PM ▸ (714) *Yea, Why Try Her Raw Wet Hat?* **Robin J. Wilson**, The Open University, UK (1023-00-289)

1:30PM ▸ (715) *An order 1152 group of triadic transformations and its relevance to music-theoretical structures.* Preliminary report. **Robert Peck***, Louisiana State University, and **Jack Douthett**, Albuquerque, New Mexico (1023-20-1231)

2:00PM (716) *Consistent Fingerings for a Continuum of Syntonic Tunings.* **William A. Sethares***, University of Wisconsin, **Andrew Milne**, London, UK, and **Plamondon Jim**, Thumbtronics Ltd, Busselton, Western Australia (1023-51-689)

2:30PM ▸ (717) *A multi-pronged approach to the creating of an interdisciplinary research program in mathematics and computation in music.* **Elaine Chew**, University of Southern California (1023-00-1757)

3:00PM (718) *A Dynamic Programming Approach to the Extraction of Phrase Boundaries from Tempo Variations in Expressive Performances.* Preliminary report. **Ching-Hua Chuan***, Computer Science, University of Southern California, and **Elaine Chew**, Industrial and Systems Engineering, University of Southern California (1023-68-1756)

3:30PM ▸ (719) *Information Theory and Melody: Zero and First Order Markov Models.* **Kathryn R. Elder**, New York, NY (1023-62-551)

AMS Special Session on Radon Transforms, Convex Geometry, and Geometric Analysis, II

1:00 PM – 3:55 PM

Organizers: **Eric L. Grinberg**, University of New Hampshire
Peter Kuchment, Texas A&M University
Gestur Olafsson, Louisiana State University
Eric Todd Quinto, Tufts University
Boris S. Rubin, Louisiana State University

1:00PM ▸ (720) *Isospectral metrics on balls, spheres, and other manifolds with different local geometries.* **Zoltan I. Szabo**, Lehman College and Graduate Center of the City University of New York (1023-58-510)

1:30PM (721) *Some applications of integral geometry to Finsler geometry.* Preliminary report. **Juan-Carlos Alvarez Paiva***, Universite des Sciences et Technologies de Lille, and **Gautier Berck**, Scuola Normale Superiore di Pisa (1023-44-511)

2:00PM (722) *L_p Intersection Bodies.* **Monika Ludwig*** and **Christoph Haberl**, Technische Universität Wien (1023-52-609)

2:30PM (723) *The geometry of L_0.* **Nigel Kalton**, **Alexander Koldobsky**, University of Missouri, **Vladyslav Yaskin** and **Maryna Yaskina***, University of Oklahoma (1023-52-750)

3:00PM (724) *A solution to the lower dimensional Busemann-Petty problem in the hyperbolic space.* **Vladyslav Yaskin**, University of Oklahoma (1023-52-745)

3:30PM (725) *Determination of convex bodies from derivatives of section functions.* **Alexander Koldobsky*** and **Chris Shane**, University of Missouri-Columbia (1023-52-169)

AMS Special Session on Calculus of Variations and Nonlinear PDEs: Theory and Applications, II

1:00 PM – 3:45 PM

Organizers: **Marian Bocea**, North Dakota State University
Cristina M. Popovici, North Dakota State University

1:00PM (726) *New exact bounds for effective properties of multicomponent conducting composites and Localized polyconvexity.* Preliminary report. **Andrej Cherkaev**, University of Utah (1023-51-559)

2:00PM (727) *Dynamics of steps along a martensitic phase boundary.* Preliminary report. **Anna Vainchtein***, University of Pittsburgh, and **Yubao Zhen**, Harbin Institute of Technology (1023-74-455)

3:00PM (728) *ε-stable Γ-convergence.* Preliminary report. **Andrea Braides**, University of Rome, and **Chris Larsen***, WPI (1023-49-1631)

AMS Special Session on Dynamic Programming, II

1:00 PM – 3:45 PM

Organizers: **Gerald C. Kobylski**, United States Military Academy
Randal Hickman, United States Military Academy

1:00PM (729) *Dynamic Programming and the Dragonfly Guided Airdrop System.* Preliminary report. **David W. Carter***, Draper Laboratory, Cambridge, MA, and **Steve Tavan**, U.S. Army, RDECOM, Natick, MA (1023-49-1182)

1:30PM (730) *Applications of Dynamic Programming in a Network of Autonomous Vehicles and Sensors.* Preliminary report. **Randal E. Hickman**, United States Military Academy (1023-49-1371)

2:00PM (731) *Stochastic UAV Route Planning Using Adaptive Dynamic Programming.* Preliminary report. **Darryl K. Ahner**, U.S. Army TRADOC Analysis Center, Monterey, CA (1023-49-1227)

3:00PM (732) *Assignment Scheduling Capability for UAVs—an Approximate Dynamic Programming Simulation Implementation to a Combinatorial Scheduling Problem.* Preliminary report. **Arnold Buss**, Naval Postgraduate School, Monterey, CA (1023-49-1232)

MAA Minicourse #11: Part A

1:00 PM – 3:00 PM

Origami in undergraduate mathematics courses.
Organizer: **Thomas C. Hull**, Merrimack College

MAA Minicourse #13: Part B

1:00 PM – 3:00 PM

Teaching a course in the history of mathematics.
Organizers: **Victor J. Katz**, University of the District of Columbia
V. Frederick Rickey, U. S. Military Academy

MAA Minicourse #6: Part A

1:00 PM – 3:00 PM

WeBWorK 2: An Internet-based system for generating and delivering homework.
Organizers: **Arnold K. Pizer**, University of Rochester
Michael E. Gage, University of Rochester
Vicki Roth, University of Rochester

AMS Session on Analysis and Ordinary Differential Equations, II

1:00 PM – 3:55 PM

1:00PM (733) *Heat kernel estimates with applications to several complex variables.*
Andrew S. Raich, Texas A&M University (1023-32-397)

1:15PM (734) *Zeros of Generalized Rogers Ramanujan Series.* Preliminary report.
Tim Huber, University of Illinois at Urbana-Champaign (1023-33-1177)

1:30PM ► (735) *On Some Inverse Problem Leading to a Second-Order Linear Functional.*
Ridha Sfaxi, Institut Superieur de Gestion de Gabes, Tunisia (1023-33-1556)

1:45PM ► (736) *Monotone Solutions of Nonlinear Differential Equations.*
Bryce Holthouse*, University of Central Missouri, and **Lianwen Wang**, Department of Mathematics and Computer Science, University of Central Missouri (1023-34-1331)

2:00PM (737) *Stability of Invariant Sets for Functional Differential Equations.*
Zhivko S. Athanassov, Bulgarian Academy of Sciences (1023-34-1433)

2:15PM ► (738) *Blending Mechanical Engineering With Mathematics to Create Interdisciplinary Lively Application Projects (ILAPs).* Preliminary report.
Michael R. Huber*, Muhlenberg College, **Jonathan L. Paynter** and **Zachary W. Seidel**, United States Military Academy (1023-34-154)

2:30PM (739) *Uniqueness implies existence for nth order boundary value problems.*
Jeffrey A. Ehme, Spelman College (1023-34-1635)

2:45PM ► (740) *Minimal Periods of Closed Curves in $\mathbb{R}^n$.*
George R. Grover* and **Diana M. Thomas**, Montclair State University (1023-34-1676)

3:00PM (741) *Impulsive hybrid set valued integro-differential equations and the monotone iterative technique.*
Seenith Sivasundaram, Embry-Riddle Aeronautical University (1023-34-323)

3:15PM (742) *Positive Solutions of an n^{th} Order Boundary Value Problem: A Functional Approach.*
John E. Ehrke, Baylor University (1023-34-477)

3:30PM (743) *Analysis of a family of model quasilinear boundary-value problems.* Preliminary report.
Matthew Rudd, University of Idaho (1023-34-485)

3:45PM (744) *Existence Results for Nonautonomous Evolution Equations with Nonlocal Initial Conditions.* Preliminary report.
Sergiu Aizicovici, Ohio University, and **Haewon Lee***, Dillard University (1023-34-880)

AMS Session on Geometry and Topology, II

1:00 PM – 4:10 PM

1:00PM (745) *Cheeger Constants of Certain Arithmetic Hyperbolic Three-Manifolds.* Preliminary report.
Dominic Lanphier, Western Kentucky University, and **Jason Rosenhouse***, James Madison University (1023-53-1726)

1:15PM (746) *On Conformal Invariant First Order Symmetry Operators of Powers of the Laplacian.* Preliminary report.
Alfredo Villanueva, The University of Iowa (1023-53-1808)

1:30PM (747) *Deformations of the gyroid and Lidinoid minimal surfaces.*
Adam G. Weyhaupt, Southern Illinois University Edwardsville (1023-53-1839)

1:45PM (748) *A Family of Minimal Tori in the Sphere S^5.*
Rodrigo Ristow Montes, Washington University in St Louis (1023-53-330)

2:00PM (749) *Techniques for classifying nonnegatively curved left-invariant metrics on compact Lie groups.*
Jack Huizenga, University of Chicago (1023-53-401)

2:15PM (750) *Energy and Riemannian Flows.* Preliminary report.
Amine Fawaz, The University of Texas of the Permian Basin (1023-53-588)

2:30PM (751) *Lie Groups of Automorphisms on Almost r-Paracontact Riemannian Manifolds.* Preliminary report.
Andrew Bucki, Langston University (1023-53-917)

2:45PM ► (752) *Tessellation of Klein Bottle by Congruence (mod 6) and Theorems of Fermat (1640) and Joncourt (1762).* Preliminary report.
Okan Gurel*, New York, NY, and **Demet Gurel**, Touro College (1023-54-1293)

3:00PM (753) *Topological Model of Melodic Clustering of a Music Score: Theory and Application to Schumann's Träumerei.*
Chantal Buteau, Brock University (1023-54-1605)

3:15PM (754) *On ê-Baire and ê-Shanin spaces.* Preliminary report.
Andrzej A. Szymanski, Slippery Rock University of Pennsylvania (1023-54-1650)

3:30PM ► (755) *A weighted quasimetric for digital topology.* Preliminary report.
Ralph Kopperman, The City College of CUNY (1023-54-1785)

3:45PM (756) *Uniqueness of Polish group topologies.* Preliminary report.
Bojana Pejic* and **Paul Gartside**, University of Pittsburgh (1023-54-1836)

4:00PM ► (757) *On results from convexity related to the phase retrieval problem.*
Gennadiy Averkov, University of Magdeburg (1023-52-1922)

AMS Session on Applications of Mathematics, II

1:00 PM - 4:10 PM

1:00PM ► (758) *Numerical simulations of resonant optics in meta-materials with negative refractive index.* Preliminary report.
Kathryn E. Rasmussen, Rensselaer Polytechnic Institute (1023-78-826)

1:15PM (759) *Strongly Universal Quantum Turing Machines and Invariance of Kolmogorov Complexity.*
Markus Müller, Technische Universitaet Berlin, Germany (1023-81-1132)

1:30PM (760) *Wave-functions of Šeba billiards.*
B. Winn, Texas A&M University (1023-81-1748)

1:45PM (761) *The spectral form factor for quantum graphs with spin-orbit coupling.*
Jonathan Harrison, Texas A&M University (1023-81-1884)

2:00PM (762) *Mathematical modeling and simulation of texture evolution.*
Maria Emelianenko*, **David Kinderlehrer**, **Shlomo Ta'asan**, Carnegie Mellon University, and **Dmitry Golovaty**, University of Akron (1023-82-1901)

2:15PM (763) *Statistical Equilibrium of Slender Vortex Filaments.*
Timothy D. Andersen* and **Chjan C. Lim**, Rensselaer Polytechnic Institute (1023-82-601)

2:30PM ► (764) *Well-Posed Initial-Boundary Value Constrained Evolution Problems.*
Alexander Alekseenko, California State University Northridge (1023-83-1833)

2:45PM ► (765) *Imaging conditions in geophysical depth migration algorithms.*
Bogdan G. Nita, Montclair State University (1023-86-295)

3:00PM ► (766) *Global Optimization in Model-Based Clustering.*
Jeffrey Heath*, **Michael Fu** and **Wolfgang Jank**, Univ. of Maryland, College Park (1023-90-1158)

3:15PM (767) *Discrete OR and continuous vintage capital models.*
Natali Hritonenko, Prairie View A&M University, and **Yuri Yatsenko***, Houston Baptist University (1023-90-1174)

3:30PM (768) *A Hybrid Sampling Algorithm for Stochastic Optimization.* Preliminary report.
Shane Drew* and **Tito Homem-de-Mello**, Northwestern University (1023-90-1283)

3:45PM (769) *General option exercise rules for regime-switching models.*
Svetlana Boyarchenko and **Sergei Levendorskii***, Department of Economics, The University of Texas at Austin (1023-90-131)

4:00PM ► (770) *Portfolio Selection as a Nash Bargaining Game.*
Youngna Choi and **Michael A. Jones***, Montclair State University (1023-90-1414)

AMS Session on Algebra and Number Theory, IV

1:00 PM - 3:55 PM

1:00PM (771) *$\mathbb{Z}_2$ Homology of Singular Real Toric Varieties.* Preliminary report.
Valerie M. Hower, University of Georgia (1023-14-961)

1:15PM (772) *Some Results on Jónsson Modules over Commutative Rings with Identity.*
Greg G. Oman, The Ohio State University (1023-13-959)

1:30PM (773) *Instability of projective reconstruction from 1-view in higher dimension.* Preliminary report.
Marina Bertolini, Universita' degli Studi di Milano, **GianMario Besana***, DePaul Univeristy - CTI, and **Cristina Turrini**, Universita' degli Studi di Milano (1023-14-118)

1:45PM (774) *Optimal fewnomial bounds from Gale dual polynomial systems.*
Frank Sottile*, Texas A&M University, and **Frederic Bihan**, Universite de Savoie (1023-14-1560)

2:00PM (775) *Equivalence of Mirror Families Constructed from Toric Degenerations of Flag Varieties.* Preliminary report.
Joseph P. Rusinko, University of Georgia (1023-14-1649)

2:15PM (776) *Algebraic Geometric Codes on Anticanonical Surfaces.*
Jennifer A. Everson, University of Nebraska-Lincoln (1023-14-1712)

2:30PM (777) *A generalized Euler integral formula for ε-factors of irregular singular connections.*
Christopher L. Bremer, University of Chicago (1023-14-1744)

2:45PM (778) *A mirror conjecture for projective bundles.*
Artur Elezi, American University (1023-14-1872)

3:00PM Break.

3:15PM (779) *Vanishing theta nulls of algebraic curves with automorphisms.* Preliminary report.
Sujeeva Wijesiri, Oakland University (1023-14-797)

3:30PM (780) *Numerical deflation of multiple solution components of systems of polynomial equations.*
Anton Leykin*, University of Minnesota, **Jan Verschelde** and **Ailing Zhao**, University of Illinois at Chicago (1023-14-798)

3:45PM (781) *Surfaces of general type with zero geometric genus.* Preliminary report.
Caryn Werner, Allegheny College (1023-14-876)

MAA Session on Teaching Innovations in Real Analysis, I

1:00 PM - 3:55 PM

Organizers: **Robert W. Vallin**, Slippery Rock University
Erik O. Talvila, University College of the Fraser Valley

1:00PM ► (782) *A Spoonful of Sugar: Using Just Enough Innovation For Success.*
Karl-Dieter Crisman, Gordon College (1023-Q1-1539)

1:20PM ► (783) *Enticing the Reluctant Analyst.*
M. Jean McKemie, St. Edward's University (1023-Q1-1425)

1:40PM ► (784) *To Cantor and Beyond.*
Ioana Mihaila, Cal Poly Pomona (1023-Q1-662)

2:00PM ► (785) *A Constructive Approach to Real Analysis.*
Mark Bridger, Northeastern University (1023-Q1-1776)

2:20PM ► (786) *A More Student Friendly Definition of Limit.* Preliminary report.
David Scott, University of Puget Sound (1023-Q1-381)

2:40PM *Making it "Real".* Preliminary report.
► (787) **Sarah V. Cook**, Washburn University (1023-Q1-1599)

3:00PM (788) *Using the discovery learning method in Real Analysis.*
Petre Ion Ghenciu, University of Wisconsin-Stout (1023-Q1-1529)

3:20PM *How Logical Thinking Can Be Enhanced in Learning*
► (789) *Real Analysis.* Preliminary report.
Long Wang, Southern Polytechnic State University (1023-Q1-638)

3:40PM (790) *Guided Discovery of "Big Picture" Results in Analysis.*
Clark Wells, Grand Valley State University (1023-Q1-948)

MAA Session on Communication Theory in Undergraduate Courses

1:00 PM – 3:35 PM

Organizer: **Tim McDevitt**, Elizabethtown College

1:00PM *Simple Signal Processing in the Engineering*
► (791) *Mathematics Classroom.*
Jong Chung*, **Joseph D. Myers** and **Sebastien P. Joly**, U.S. Military Academy (1023-F5-1213)

1:20PM *Fourier Analysis in a Calculus Course Using*
► (792) *Student-Generated Sound Waves.* Preliminary report.
Phil Gustafson, Mesa State College (1023-F5-1094)

1:40PM (793) *Using Frames to Provide Repetitiously Repetitive Redundancy in Signal Processing.*
Troy Henderson, United States Military Academy (1023-F5-1582)

2:00PM *Using the Complex Spectral Theorem to Introduce*
► (794) *the Discrete Fourier Transform.*
Michael E. Orrison, Harvey Mudd College (1023-F5-1080)

2:20PM *Edge Detection.*
► (795) **Yu-Ju Kuo**, Indiana University of Pennsylvania (1023-F5-1662)

2:40PM (796) *A Motivational Course in Cryptology and Coding Theory.*
Sarah Spence Adams*, Olin College of Engineering, and **Gordon Prichett**, Babson College (1023-F5-152)

3:00PM *A Matlab GUI for teaching Cryptography and*
► (797) *Cryptanalysis.*
Robert J. McDevitt, Naval Surface Warfare Center, Dahlgren Division (1023-F5-1008)

3:20PM *Toward Making Elliptic Curves Accessible to*
► (798) *Undergraduates.* Preliminary report.
Tim McDevitt, Elizabethtown College (1023-F5-1581)

MAA Session on Getting Students to Discuss and to Write about Mathematics, III

1:00 PM – 3:55 PM

Organizers: **Martha Ellen (Murphy) Waggoner**, Simpson College
Charlotte Knotts-Zides, Wofford College
Harrison W. Straley, Wheaton College

1:00PM *Service Learning Projects for Discussing and*
► (799) *Writing about Mathematics and Computer Technology: Implementation and Assessments.*
Morteza Shafii-Mousavi* and **Paul Kochanowski**, Indiana University South Bend (1023-I1-39)

1:15PM *Student Problem Writing Exercises Used to Enhance*
► (800) *and Develop Mathematical Exposition.* Preliminary report.
Linda McGuire, Muhlenberg College (1023-I1-393)

1:30PM *Can You Understand Me Now? Mathematics as*
► (801) *Another Language.*
Jean M. Horn*, NVCC - Woodbridge, and **Toni T. Robertson**, NVCC-Woodbridge (1023-I1-486)

1:45PM *Using Groups and Peer Reviews in a Proof Course.*
► (802) Preliminary report.
Sharon S. Emerson-Stonnell, Longwood University (1023-I1-506)

2:00PM *"Writing-Intensive" Linear Algebra.*
► (803) **Patrick Bahls**, University of North Carolina, Asheville (1023-I1-611)

2:15PM *The Best Bluffer Contest: Rewarding Students for*
► (804) *Creating Invalid Proofs.* Preliminary report.
Pam Miltenberger Wovchko, West Virginia Wesleyan College (1023-I1-620)

2:30PM *Are you a Mathematical Maoist? Writing Exercises*
► (805) *to Explore the Mathematical Self.*
Judith L. Gieger* and **John C. Nardo**, Oglethorpe University (1023-I1-674)

2:45PM *Involving Students in Their Own Learning: Follow up*
► (806) *After the First Implementation.*
Rodney X. Sturdivant, **Robert E. Burks** and **Brian E. Souhan***, United States Military Academy (1023-I1-769)

3:00PM *Writing in a Number Sense Course for Future*
► (807) *Elementary Teachers.*
Judith Covington, Louisiana State University Shreveport (1023-I1-855)

3:15PM (808) *The Mathematics of Politics & Power as an Alternative to Trigonometry.*
Carl Lutzer* and **Bernard Brooks**, Rochester Institute of Technology (1023-I1-894)

3:30PM (809) *Teaching Writing in a General Education Geometry Course.* Preliminary report.
Teresa D. Magnus, Rivier College (1023-I1-900)

3:45PM *Let's Talk Mathematics.*
► (810) **Melinda Schulteis**, Concordia University, Irvine (1023-I1-916)

MAA Session on Philosophy of Mathematics, II

1:00 PM – 3:45 PM

Organizers: **Bonnie Gold**, Monmouth University
Charles R. Hampton, The College of Wooster

1:00PM *Why the Universe MUST be Complicated.* Preliminary
► (811) report.
G. Edgar Parker*, **James S. Sochacki** and **David C. Carothers**, James Madison University (1023-N1-243)

1:40PM *Catching the Tortoise: A Case Study in the Rules of*
► (812) *Mathematical Engagement.*
James R. Henderson, University of Pittsburgh-Titusville (1023-N1-133)

2:20PM *The Philosophical Status of Diagrams in Euclidean*
► (813) *Geometry.*
Nathaniel Miller, University of Northern Colorado (1023-N1-459)

3:00PM *Representations in Knot Classification.*
► (814) **Kenneth Manders**, University of Pittsburgh (1023-N1-1387)

MAA Session on Reconceptualizing Content Courses for Prospective High School Mathematics Teachers, II

1:00 PM – 3:55 PM

Organizers: **Jean McGivney-Burelle**, University of Hartford
Neil Portnoy, Stony Brook University

1:00PM (815) *Connecting Postsecondary and Secondary Mathematics: Prospective Teachers' Understanding of Transformational Geometry.* **Karen J. Graham***, University of New Hampshire, **Todd Grundmeier**, California Polytechnic State University, San Luis Obispo, and **Neil Portnoy**, University of New Hampshire (1023-N5-1515)

1:20PM (816) *Connecting Postsecondary and Secondary Mathematics: Content for Preservice Teacher Courses.* **Steven R. Benson***, Education Development Center, **Karen J. Graham**, University of New Hampshire, **Todd Grundmeier**, California Polytechnic State University, San Luis Obispo, and **Neil Portnoy**, University of New Hampshire (1023-N5-1494)

1:40PM ► (817) *The role of professional development resources in generating mathematical discourse.* **Karen A. Marrongelle*** and **Sean Larsen**, Portland State University (1023-N5-1822)

2:00PM ► (818) *Connections in Abstract Algebra for Teachers: Bridging Theory and Practice.* **Tanya Cofer***, Northeastern Illinois University, and **Bradford R. Findell**, University of Georgia (1023-N5-1360)

2:20PM (819) *A Senior Capstone Course for Future Secondary Mathematics Teachers.* **Mary Garner*** and **Josip Derado**, Kennesaw State University (1023-N5-1536)

2:40PM ► (820) *A "reconceptualized" university calculus course—with hands-on applications—designed for prospective and practicing high school teachers.* **Patricia Baggett***, New Mexico State University, and **Andrzej Ehrenfeucht**, University of Colorado at Boulder (1023-N5-141)

3:00PM ► (821) *Facilitating genuine discovery experiences for future high-school mathematics teachers.* Preliminary report. **Greisy Winicki-Landman**, Calif. State Polytechnic University Pomona (1023-N5-72)

3:20PM ► (822) *Changing Math Education Students' Perceptions of the Role of Graphs in Understanding Functions.* Preliminary report. **Christopher J. Yakes*** and **Jorgen Berglund**, California State University, Chico (1023-N5-1379)

3:40PM ► (823) *Psychology, pedagogy and epistemiology in context of secondary mathematics: A content course for secondary mathematics teachers.* **Debasree Raychaudhuri**, California State University at Los Angeles (1023-N5-1891)

MAA Session on The Scholarship of Teaching and Learning in Mathematics

1:00 PM – 4:00 PM

Organizers: **Curtis D. Bennett**, Loyola Marymount University
Jacqueline M. Dewar, Loyola Marymount University

1:00PM ► (824) *Choices, Representations, and Strategies Used in Posing and Solving Problems by Elementary Education Students in the First Math Content Course.* Preliminary report. **Kathryn T. Ernie**, University of Wisconsin - River Falls (1023-R5-1814)

1:20PM ► (825) *Using Clinical Interviewing to Inform Teaching: The Experiences of Three Prospective K-8 Teachers.* Preliminary report. **Cindia D. Stewart**, Shenandoah University (1023-R5-1546)

1:40PM ► (826) *Using Reading Questions in an Introductory Statistics Course to Enhance Understanding of Concepts.* Preliminary report. **Edwin P. Herman**, University of Wisconsin, Stevens Point (1023-R5-599)

2:00PM (827) *What Are Students Likely to Learn by Reading Their Textbooks Before Class?* **Bruff Derek**, Vanderbilt University (1023-R5-1728)

2:20PM ► (828) *How to Engage and Challenge Students in Learning Calculus.* Preliminary report. **Simei Tong**, University of Wisconsin-Eau Claire (1023-R5-368)

2:40PM ► (829) *Partial Notes: A tool for understanding calculus.* Preliminary report. **Larissa B. Schroeder***, University of Connecticut, **Nicholas Gorgievski**, Nichols College, and **Thomas C. DeFranco**, University of Connecticut (1023-R5-1248)

3:00PM (830) *Curve Sketching Difficulties of Students in Upper Level Courses.* **Ronald E. Mickens**, Clark Atlanta University (1023-R5-34)

3:20PM ► (831) *Student Engagement in History of Mathematics.* Preliminary report. **Pam Crawford**, Jacksonville University (1023-R5-1915)

3:40PM Discussion.

MAA General Contributed Paper Session, IV

1:00 PM – 3:40 PM

Organizers: **Eric S. Marland**, Appalachian State University
Jay A. Malmstrom, Oklahoma State Community College

1:00PM ► (832) *Understanding Protein-DNA Binding via Fox Coloring.* Preliminary report. **Junalyn P. Navarra-Madsen*** and **Angela McMichael**, Texas Woman's University (1023-Z1-129)

1:15PM ► (833) *Modeling Cell Division in Escherichia coli.* Preliminary report. **Gretchen A. Koch***, Goucher College, and **Donald A. Drew**, Rensselaer Polytechnic Institute (1023-Z1-1654)

1:30PM ► (834) *Geometric Measures as Brain Shape Descriptors.* Preliminary report. **Christian Laing*** and **Juan B. Gutierrez**, Florida State University (1023-Z1-1817)

1:45PM (835) *A Second Course in Biostatistics at a Liberal Arts College?* Preliminary report. **John D. Kloke**, Pomona College (1023-Z1-1411)

2:00PM ► (836) *A Model for the Peopling of the Americas Using Logistic-Diffusion Simulations.* Preliminary report. **Elizabeth L. Martin*** and **Charles Collins**, The University of Tennessee (1023-Z1-1403)

2:15PM (837) *Surface segregation and solute trapping during planar film growth.*
Xiaoying Han* and **Brain Spencer**, University at Buffalo, The State University of New York (1023-Z1-1381)

2:30PM (838) *Curricula Models for Undergraduate Computational Science Education.*
Ignatios E. Vakalis, Computer Science, Cal Poly State Univ. (1023-Z1-373)

2:45PM ► (839) *Louisiana Tech University's STEM Talent Expansion Program.*
Kelly Crittenden*, **James D. Nelson** and **Galen E. Turner III**, Louisiana Tech University (1023-Z1-1596)

3:00PM ► (840) *Undergraduate Research Projects using Artificial Neural Networks.*
John C. Merkel, Morehouse College (1023-Z1-1892)

3:15PM (841) *Hybrid Multiscale Landmark and Deformable Image Registration.*
Dana C. Paquin*, **Doron Levy**, Stanford University, and **Lei Xing**, Stanford University Department of Radiation Oncology (1023-Z1-818)

3:30PM (842) *Normal Functions of the First Category and the Interaction Between Coefficient Conditions and Solution Conditions of Differential Equations in the Unit Disk.* Preliminary report.
Kari E. Fowler, University of Tampa (1023-Z1-138)

SIAM Minisymposium on Mathematical Modeling of Complex Systems in Biology, II

1:00 PM – 3:50 PM

Organizer: **Lisa J. Fauci**, Tulane University

1:00PM (843) *Mathematical Models for Estimating the Number of People Infected with HIV.*
J. Mac Hyman* and **Gerardo Chowell**, Los Alamos National Laboratory (1023-92-1167)

1:30PM ► (844) *Fluid dynamics and computer simulations of mucociliary transport.* Preliminary report.
Xingzhou Yang*, Center for Computational Science, Tulane University, **Lisa J. Fauci**, Tulane University, and **Robert H. Dillon**, Washington State University (1023-92-1133)

2:00PM ► (845) *Parametric inference of biochemical network models.* Preliminary report.
Abdul S. Jarrah, **Reinhard Laubenbacher***, **Paola M. Vera-Licona**, Virginia Tech, and **Bernd Sturmfels**, University of California, Berkeley (1023-92-651)

2:30PM (846) *Towards the Human Genotope.* Preliminary report.
Peter M. Huggins*, **Lior Pachter** and **Bernd Sturmfels**, UC Berkeley (1023-92-1429)

3:00PM ► (847) *Modeling Cancer, the Immune System and Treatment.*
L. G. de Pillis, Harvey Mudd College (1023-92-362)

3:30PM ► (848) *Modeling the Shape and Structure of the Human Brain.*
Monica K. Hurdal, Florida State University (1023-92-673)

SIAM Minisymposium on Structure and Topology in Graph Theory, II

1:00 PM – 4:15 PM

Organizers: **Mark N. Ellingham**, Vanderbilt University
Chris Stephens, Middle Tennessee State University
Xiaoya Zha, Middle Tennessee State University

1:00PM (849) *1-embedded minors of 1-embedded graphs.* Preliminary report.
Bojan Mohar, Simon Fraser University, Burnaby (1023-05-1353)

1:30PM ► (850) *An extension of Kuratowski Theorem.* Preliminary report.
Guoli Ding, LSU (1023-05-1377)

2:00PM (851) *Representativity of Cayley maps.*
D. Christopher Stephens*, Middle Tennessee State University, **Thomas W. Tucker**, Colgate University, and **Xiaoya Zha**, Middle Tennessee State University (1023-05-1454)

2:30PM (852) *Progress on Lovász' Path Removal Conjecture.*
Ken-ichi Kawarabayashi, Natoinal Institute of Informatics (1023-05-1075)

3:00PM ► (853) *Some Remarks on Δ-critical Graphs.*
Zixia Song, University of Central Florida (1023-05-1221)

3:30PM (854) *Orientable strong embeddings for cubic projective-planar graphs.*
Mark Ellingham*, Vanderbilt University, and **Xiaoya Zha**, Middle Tennessee State University (1023-05-578)

3:55PM (855) *Degree-Splittability of k-regular graphs.*
Jeong Ok Choi*, **Lale Ozkahya** and **Douglas B. West**, University of Illinois at Urbana-Champaign (1023-05-1658)

AMS-ASL-MAA Panel Discussion

1:00 PM – 2:30 PM

Contemporary perspectives on Hilbert's Second Problem and the Gödel Incompleteness Theorems.

Moderator: **Akihiro Kanamori**, Boston University

Panelists: **Harvey M. Friedman**, Ohio State University
David E. Marker, University of Illinois at Chicago
Michael Rathjen, University of Leeds

MAA CUPM Subcommittee on Curriculum Renewal Across the First Two Years Panel Discussion

1:00 PM – 2:20 PM

Reshaping undergraduate mathematics for biology-related disciplines: Ideas and innovations.

Organizer: **Jenna P. Carpenter**, Louisiana Tech University

Panelists: **Eric S. Marland**, Appalachian State University
Debra L. Hydorn, University of Mary Washington
Ami Radunskaya, Pomona College
Kathy Taylor, Duquesne University

MAA Committee on Two-Year Colleges and Committee on Articulation and Placement Panel Discussion

1:00 PM – 2:20 PM

Placement: Friend or foe?

Organizers: **Susan L. Forman**, Bronx Community College
Reginald K. U. Luke, Middlesex County College

Stephen B. Rodi, Austin Community College

Panelists: **Geoffrey Akst**, Borough of Manhattan Community College
Steve Newman, Northern Kentucky University
Gordon S. Woodward, University of Nebraska-Lincoln

MAA Committee on Undergraduate Student Activities and Chapters Panel Discussion

1:00 PM – 2:20 PM

Engaging students in research, clubs, student chapters, and internships.

Organizers: **Kay B. Somers**, Moravian University
Jody Sorenson, Augsburg College

Panelists: **Gary Gordon**, Lafayette College
Deanna B. Haunsperger, Carleton College
Angela Spalsbury, Youngstown State University
Richard A. Zang, University of New Hampshire, Manchester

AMS Session on Analysis and Functional Analysis, I

1:15 PM – 3:40 PM

1:15PM ► (856) *Singular Discrete Third Order Boundary Value Problems.*
Curtis J. Kunkel, Baylor University (1023-39-445)

1:30PM (857) *Total regularity revisited.* Preliminary report.
B. E. Rhoades, Indiana University, Bloomington, IN (1023-40-188)

1:45PM ► (858) *Euler's little summation formula and special values of the zeta function.*
Thomas J. Osler, Rowan University (1023-40-696)

2:00PM ► (859) *Energy and Discrepancy Are Equivalent.*
Fred J. Hickernell, Illinois Institute of Technology (1023-41-1281)

2:15PM (860) *On Bernstein's Inequality for Entire Functions of Exponential Type.*
Tariq Qazi, Virginia State University (1023-41-562)

2:30PM (861) *On The Existence of Haar Sets.* Preliminary report.
Martin W. Bartelt*, Christopher Newport University, and **John Swetits**, Old Dominion University (1023-41-982)

2:45PM Break.

3:00PM (862) *A halfspace is a multiplier on $L^p(\mathbb{T}^d)$.*
J. Marshall Ash, DePaul University (1023-42-1149)

3:15PM (863) *Non-uniform sampling and reconstruction from sampling sets with unknown jitter.*
Akram Aldroubi and **Casey C. Leonetti***, Vanderbilt University (1023-42-1369)

3:30PM (864) *Ordered OLPS and CF Nth Numerators.*
Brian A. Hagler, University of Texas of the Permian Basin (1023-42-534)

MAA Poster Session on Projects Supported by the NSF Division of Undergraduate Education

2:00 PM – 4:00 PM

Organizer: **Jon W. Scott**, Montgomery Community College

2:00PM (865) *Renewal of College Algebra at South Dakota State University.*
Donna Flint*, **Becky Hunter** and **Dan Kemp**, South Dakota State University

2:00PM (866) *A motivational course in cryptology and coding theory.*
Sarah Spence Adams*, Franklin W. Olin College of Engineering, and **Gordon Prichett**, Babson College

2:00PM (867) *Bridging the Vector Calculus Gap: Episode II.*
Tevian Dray* and **Corinne Manogue**, Oregon State University

2:00PM (868) *Paradigms in Physics: Multiple Entry Points.*
Corinne Manogue, **Tevian Dray***, **Barbara Edwards**, **David McIntyre** and **Emily van Zee**, Oregon State University

2:00PM (869) *Statistics Online Computational Resource for Education (SOCRE).*
Annie Che*, **Ivo Dinov** and **Juana Sanchez**, University of California at Los Angeles

2:00PM (870) *WeBWorK, a Web-based Interactive Homework System.*
Arnold Pizer*, **Michael Gage** and **Vicki Roth**, University of Rochester

2:00PM (871) *A Comprehensive WeBWorK Problem Library.*
John Jones*, Arizona State University, **Jeff Holt**, University of Virginia, and **William Ziemer**, California State University, Long Beach

2:00PM (872) *Adapting and Implementing Guided Discovery Notes in Combinatorics for Large Classes.*
Mary Flahive, Oregon State University

2:00PM (873) *College Algebra in Southeast Louisiana Post Katrina.*
Randall Wills*, **Sarah Clifton** and **Ana Wills**, Southeastern Louisiana University

2:00PM (874) *Adapting K-8 Mathematics Curricular Materials for Pre-Service Teacher Education.*
Donna Diaz* and **William Moss**, Clemson University

2:00PM (875) *Transforming Science and Mathematics Teacher Preparation.*
James Curry*, **Richard McCray**, **Carl Wieman**, **Valerie Otero** and **William Wood**, University of Colorado at Boulder

2:00PM (876) *Proof, Functions & Computations (A web-based course as a laboratory for enhanced teaching and learning in logic, mathematics, and computer science).*
Wilfried Sieg*, **Joseph Ramsey** and **Klaus Sutner**, Carnegie Mellon University

2:00PM (877) *Math Across the Community College Curriculum.*
Rebecca Hartzler*, Seattle Central Community College, **Christie Gilliland**, Green River Community College, **Deann Leoni**, Edmonds Community College, **Patrick Bibby**, Miami Dade College, and **Ruth Collins**, Delaware Technical and Community College

2:00PM (878) *RUTE: Research for Undergraduates in Theoretical Ecology.*
Glenn Ledder*, **Bo Deng**, **Robert Gibson**, **Irakli Loladze** and **Svata Louda**, University of Nebraska-Lincoln

2:00PM (879) *Phaser: A universal simulator for dynamical systems.*
Huseyin Kocak*, **Brian Coomes** and **Burton Rosenberg**, University of Miami

2:00PM (880) *Mathematicians and Mathematics Educators Collaborating on Capstone Courses for Secondary Mathematics Teachers.*
Richard Hill*, **Sharon Senk** and **Natasha Speer**, Michigan State University

2:00PM (881) *Mathematical Methods for Biology and Medicine.*
Michael Martin*, Johnson County Community College, and **Glenn Ledder**, University of Nebraska-Lincoln

2:00PM (882) *MathematicsModels.org Expansion Project.*
Solomon Garfunkel*, Consortium For Mathematics & Its Applications, and **John Stroyls**, Georgia Southwestern State University

2:00PM (883) *WorkMAP: Students' Mathematical Preparation for Work.*
Solomon Garfunkel*, Consortium For Mathematics & Its Applications, and **Susan Forman**, Bronx Community College

2:00PM (884) *Dynamic Algebra for Technical Students.*
Solomon Garfunkel*, Consortium For Mathematics & Its Applications, and **Susan Forman**, Bronx Community College

2:00PM (885) *Collaborative Development of Java Laboratories for College Algebra and Trigonometry.*
Michael Mays* and **Laura Pyzdrowski**, West Virginia University

2:00PM (886) *College Algebra Reform at HACC.*
Chris Yarrish* and **Dan Fahringer**, Harrisburg Area Community College

2:00PM (887) *Enhancing the Mathematical Foundation of Students through Online Course Modules.*
Beth Klingner, Pace University

2:00PM (888) *Refocusing College Algebra.*
Laurette Foster*, Prairie View A&M University, and **Don Small**, U.S. Military Academy

2:00PM (889) *Center for Data Analysis and Statistics.*
Rod Sturdivant* and **Krista Watts**, U.S. Military Academy

2:00PM (890) *Core Mathematics.*
Alex Heidenberg*, **Jerry Kobylski** and **Don Small**, U.S. Military Academy

2:00PM (891) *UBM: Training Undergraduate Students in Mathematics and Biology at UL Lafayette.*
Azmy Ackleh*, University of Louisiana at Lafayette, **Jacoby Carter**, USGS-National Wetlands Research Center, and **Susan Mopper**, University of Louisiana at Lafayette

2:00PM (892) *Enhancing the Teaching of Linear Algebra with Digital Image Processing.*
Mohamed Allali, Chapman University

2:00PM (893) *Math Questions to Engage Students (Math QUEST).*
Mark Parker*, **Holly Zullo** and **Kelly Cline**, Carroll College

2:00PM (894) *The PascGalois Project: Visualization in Abstract Mathematics.*
Michael Bardzell*, **Kathleen Shannon**, Salisbury University, and **Eirini Poimenidou**, New College of Florida

2:00PM (895) *Classroom Response Systems in Statistics Courses.*
Teri J. Murphy*, **Curtis McKnight**, **Michael Richman** and **Robert Terry**, University of Oklahoma

2:00PM (896) *An Accessible Online Resource for Mathematics Students and Instructors.*
Lila Roberts*, Georgia College & State University, and **Gloria Reece**, Southern College of Optometry

2:00PM (897) *UBM, RUI: Research-Focused Learning Communities in Mathematical Biology.*
Jason Miller*, **Jon Beck**, **Michael Kelrick** and **Laura Fielden-Rechav**, Truman State University

2:00PM (898) *The Next STEP: Integrating STEM Learning Communities.*
Jason Miller*, **Maria Nagan** and **Jennifer Thompson**, Truman State University

2:00PM (899) *Embedding Chemistry Problems in Calculus Courses.*
George Rublein* and **Robert Orwoll**, College of William and Mary

2:00PM (900) *Real World STEM Application Modules.*
Darren Narayan*, **Moises Sudit**, **Paul Tymann**, **William Basener** and **Matthew Coppenbarger**, Rochester Institute of Technology

2:00PM (901) *A Biomathematical Learning Enhancement Network for Diversity (BLEND).*
Dominic Clemence*, **Mingxiang Chen**, **Gregory Goins**, **Mary Smith**, **Vinaya Kelkar**, **Catherine White**, **Venkateswarlu Divi**, **Yohang Li** and **Gelonia Dent**, North Carolina A&T State University

2:00PM (902) *UBM: Foundation in mathematical biology through interdisciplinary research, training, and curriculum development.*
Bala Krishnamoorthy*, **Richard Gomulkiewicz**, **Robert Dillon**, **Judith McDonald**, **Martin Morgan** and **Charlotte Omoto**, Washington State University

2:00PM (903) *History Across the Mathematics Curriculum for Preservice Teachers.*
Gabriela Sanchis, Elizabethtown College

2:00PM (904) *Interdisciplinary Training of Undergraduates in Biological and Mathematical Sciences with Emphasis on Marine/Coastal Science.*
Tor Kwembe*, **Hyung Cho** and **Zhenbu Zhang**, Jackson State University

2:00PM (905) *CAUSEweb: An Undergraduate Statistics Education Digital Library.*
Ginger Holmes Rowell*, Middle Tennessee State University, **Dennis Pearl**, The Ohio State University, and **Roger Woodard**, North Carolina State University

2:00PM (906) *Inquiry Based Learning in Mathematics.*
Michael Starbird*, **Edward Odell**, **Sarah Simmons** and **Jennifer Smith**, The University of Texas at Austin

2:00PM (907) *The National Curve Bank Project - A MATH Archive.*
Shirley Gray*, California State University Los Angeles, **Bill Austin**, University of Tennessee at Martin, **Phillip Johnson**, Appalachian State University, and **Lou Talman**, Metropolitan State College of Denver

2:00PM (908) *Research Experiences in Mathematical Biology.*
Leslie Wilson*, **Ann Castlefranco**, **Steven Robinow** and **Andrew Taylor**, University of Hawaii

2:00PM (909) *Science Learning Community.*
Mary Kay Abbey, Montgomery College

2:00PM (910) *Renewal of College Algebra.*
Norma Agras*, Miami Dade College, and **J. Michael Pearson**, Mathematical Association of America

2:00PM (911) *PRofessional Enhancement Program (PREP).*
J. Michael Pearson, Mathematical Association of America, **William Haver**, Virginia Commonwealth University, **Nancy Baxter Hastings**, Dickinson College, **Nathaniel Dean**, Texas State University-San Marcos, and **Jon Scott***, Montgomery College

2:00PM (912) *Equipment and Modules for a Capstone Course in Applied Mathematics.*
Dan Goldman, **Michael Booty**, **Bruce Bukiet**, **Lou Kondic** and **Michael Siegel***, New Jersey Institute of Technology

2:00PM (913) *Analysis of Stress in Biological Systems.*
Ben Fitzpatrick*, **Erika Camacho**, **Wendy Binder**, **Kam Dahlquist** and **Gary Kuleck**, Loyola Marymount University

2:00PM (914) *ESP: Enhancing Secondary Mathematics Teacher Preparation.*
Beverly K. Michael*, **Margaret Smith**, **Ellen Ansel** and **Paul Gartside**, University of Pittsburgh

2:00PM (915) *Preparing Computational Biologists by Encouraging an Academic Minor.*
Angelean Hendrix*, **David Senseman**, **Dmitry Gokhman**, **Kay Robbins**, **James Bower** and **Nandini Kannan**, University of Texas at San Antonio

2:00PM (916) *Teaching College Algebra from a Modeling Perspective.*
Tracii Friedman* and **Cathy Bonan-Hamada**, Mesa State College

2:00PM (917) *UBM:Quantitative Systems Biology.*
Guillermo Goldsztein*, **Mark Borodovsky**, **Leonid Bunimovich** and **Jung Choi**, Georgia Institute of Technology

2:00PM (918) *Revitalizing College Algebra at UND.*
Richard Millspaugh*, **Michele Iiams** and **Katrina Nagel**, University of North Dakota

2:00PM (919) *Florida Southern College: Experiences with Modeling in College Algebra.*
Susan Serrano*, **Daniel Jelsovsky** and **Kenneth Henderson, Jr**, Florida Southern College

2:00PM (920) *College Algebra with Data Analysis.*
Tina Deemer*, **Elias Toubassi** and **Ted Laetsch**, The University of Arizona

2:00PM (921) *Native American-based Materials for Integration into Undergraduate Mathematics Courses.*
Charles Funkhouser*, University of Montana Missoula, **A. Duane Porter**, University of Wyoming, **Armando Martinez-Cruz**, California State University-Fullerton, and **Miles Pfahl**, Turtle Mountain Community College

2:00PM (922) *Undergraduate Biomathematical Research Career Initiative at SUNY-Geneseo.*
Anthony Macula*, **Christopher Leary**, **Gregg Hartvigsen** and **Wendy Pogozelski**, SUNY College at Geneseo

2:00PM (923) *UBM: Undergraduate Training in Quantitative Environmental Biology.*
David Meredith* and **Edward Connor**, San Francisco State University

Project NExT Panel Discussion

2:00 PM – 3:30 PM

Updating the undergraduate mathematics major.

Organizers: **Timothy R. Ray**, Southeast Missouri State University
John W. Thompson, University of Pittsburgh, Johnstown

Panelists: **William H. Barker**, Bowdoin College
Laurette B. Foster, Prairie View A&M University
David O. Lomen, University of Arizona
Paul Zorn, St. Olaf College

Summer Program for Women in Mathematics (SPWM) Reunion

2:00 PM – 4:00 PM

Participants will describe their experiences from past programs.

Organizer: **Murli M. Gupta**, George Washington University

AMS Invited Address

2:15 PM – 3:05 PM

(924) *Gauss composition and generalizations.*
Manjul Bhargava, Princeton University (1023-11-25)

MAA Committee on Technologies in Mathematics Education Panel Discussion

2:30 PM – 3:50 PM

Electronic student assessment systems.

Organizers: **Michael D. Hvidsten**, Gustavus Adolphus College
Bruce W. Yoshiwara, Los Angeles Pierce College

Panelists: **David P. Bell**, Florida Community College
Michael E. Gage, University of Rochester
Jolene Rhodes, Valencia Community College
Phoebe B. Rouse, Louisiana State University

SIGMAA on Quantitative Literacy Panel Discussion

2:30 PM – 3:50 PM

Current practices in quantitative literacy: An interdisciplinary perspective.

Organizer: **Maura B. Mast**, University of Massachusetts, Boston

Panelists: **John A. Winn, Jr**, SUNY Farmingdale
William O. Martin, North Dakota State University
Dogan Comez, North Dakota State University
Robert Kantrowitz, Hamilton College
Mary O'Neill, Hamilton College

SIGMAA on Research in Undergraduate Mathematics Education Panel Discussion

2:30 PM – 4:10 PM

Featured presentations from the Ninth Conference on Research in Undergraduate Mathematics Education.

Organizers: **Chris Rasmussen**, San Diego State University
David E. Meel, Bowling Green State University

Panelists: **Michael Oehrtman**, Arizona State University
Susan Nickerson, San Diego State University

Kyeong Hah Roh, Arizona State University

AMS Session on History

3:00 PM – 3:45 PM

3:00PM ► (925) *Did Fermat inspire Euler to discover the Quadratic Reciprocity Law for prime numbers?*
David J. Pengelley, New Mexico State University (1023-01-119)

3:15PM ► (926) *Irrationality, Incommensurability, and the Euclidean Algorithm.*
David A. Steele, University of North Carolina at Asheville (1023-01-1307)

3:30PM ► (927) *Myths of Hypatia.* Preliminary report.
William Roger Fuller, Ohio Northern University (1023-01-1370)

AMS Invited Address

3:20 PM – 4:10 PM

► (928) *A Tale of Three Complexities: the Worst of Times, the Best of Times, the Spring of Hope.*
Margaret H. Wright, Courant Institute of Mathematical Sciences, New York University (1023-68-07)

Joint Prize Session

4:25 PM – 5:25 PM

Joint Prize Session Reception

5:25 PM – 6:25 PM

SIGMAA on the History of Mathematics Guest Lecture

5:45 PM – 6:30 PM

► (929) *The Story of the Euler Story.*
C. Edward Sandifer, Western Connecticut State University (1023-A0-492)

SIGMAA on the Philosophy of Mathematics Annual Meeting and Guest Lecture

5:45 PM – 6:15 PM

Organizers: **Bonnie Gold**, Monmouth University
Kevin M. Iga, Pepperdine University

► (930) *Does a proof exist if nobody has read it?*
Klaus Peters, A K Peters Publishers (1023-A0-1399)

SIGMAA on Business, Industry, and Government Reception

5:45 PM – 6:45 PM

SIGMAA on Quantitative Literacy Annual Business Meeting and Reception

5:45 PM – 6:30 PM

Organizer: **Maura B. Mast**, University of Massachusetts Boston

SIGMAA on Research in Undergraduate Mathematics Education Business Meeting and Presentation of the 2006 RUME Best Paper Award

5:45 PM – 8:15 PM

Organizers: **Chris Rasmussen**, San Diego State University
David E. Meel, Bowling Green State University
Michael Oehrtman, Arizona State University

SIGMAA on Mathematical and Computational Biology Business Meeting and Reception

5:45 PM – 7:00 PM

Organizer: **Eric S. Marland**, Appalachian State University

SIGMAA on Statistics Education Business Meeting

5:45 PM – 7:00 PM

Organizer: **Ginger Holmes Rowell**, Middle Tennessee State University

MAA Two-Year College Reception

5:45 PM – 7:00 PM

Mathematics in Art Presentation

6:00 PM – 6:45 PM

Tetrahedral variations.
Presenter: **Arthur Silverman**, New Orleans sculptor

The Institute in the History of Mathematics and Its Use in Teaching (IHMT) Reunion

6:30 PM – 8:30 PM

All former participants of this MAA project (including those from the Historical Modules Project) are invited.

Young Mathematicians Network Town Meeting

7:30 PM – 8:30 PM

Sunday, January 7

MAA Student Chapter Advisors' Breakfast

7:00 AM – 8:00 AM

Joint Meetings Registration

7:30 AM – 4:00 PM

AMS-MAA-SIAM Special Session on Research in Mathematics by Undergraduates, III

8:00 AM – 10:55 AM

Organizers: **Darren A. Narayan**, Rochester Institute of Technology

Carl V. Lutzer, Rochester Institute of Technology
Bernard Brooks, Rochester Institute of Technology
Tamas I. Wiandt, Rochester Institute of Technology
Michael J. Fisher, California State University, Fresno

8:00AM ► (931) *The Nonexistence of Cyclic Difference Sets.*
Bridget D. Franklin*, University of Kansas, and **Steven Sam**, University of California, Berkeley (1023-05-84)

8:30AM ► (932) *On the Minimum Vector Rank of a Multigraph.* Preliminary report.
Ian A. Rogers, Rose-Hulman Institute of Technology (1023-05-85)

9:00AM (933) *Combinatorial symmetry of the 24-cell via matroids.*
Stephanie Fried*, Grinnell College, **Aydin Gerek**, **Gary Gordon**, Lafayette College, and **Andrija Perunicic**, Bard College (1023-05-318)

9:30AM ► (934) *Universal Cycles of Multisets.* Preliminary report.
Tobias L. Johnson*, Yale University, and **Joshua Zahl**, California Institute of Technology (1023-05-448)

10:00AM ► (935) *Counting Lower Hessenberg Matrices.* Preliminary report.
Katherine Victoria Field*, **Hakan Seyalioglu** and **Charles R. Johnson**, The College of William and Mary (1023-05-815)

10:30AM (936) *Combinatorial Formulas for an Involution Poset.*
Chelsey A. Cooley*, North Carolina State University, and **Nathan Williams**, Carleton College (1023-05-1041)

AMS-MAA Special Session on History of Mathematics, I

8:00 AM – 10:55 AM

Organizers: **Joseph W. Dauben**, Lehman College
Patti Hunter, Westmont College
Victor J. Katz, University of the District of Columbia
Karen H. Parshall, University of Virginia

8:00AM ► (937) *Mathematical Concepts of Infinity in Ancient China.*
Yibao Xu, Borough of Manhattan Community College of the City University of New York (1023-01-603)

8:30AM ► (938) *An Exploration of Indian Upapatti (Proof) in Nīlakaṇṭha Somayājin.* Preliminary report.
Homer S. White, Georgetown College, Kentucky (1023-01-244)

9:00AM ► (939) *Is addition a fundamental operation in arithmetic? and other foundational issues in Indian mathematics.*
Kim Plofker, Providence, RI (1023-01-874)

9:30AM ► (940) *Diagrams — sources hitherto ignored.*
Ken Saito, Department of Human Sciences, School of Humanities and Social Sciences, Osaka Prefecture University, Japan (1023-01-404)

10:00AM ► (941) *Mirrors of the Sea and Jade: Chinese Mathematics in the Song and Yuan Dynasties.* Preliminary report.
Joseph W. Dauben, Herbert H. Lehman College, City University of New York (1023-01-619)

10:30AM ► (942) *Geometry and Islamic Art in Tenth-Century Baghdad.*
J. Lennart Berggren, Simon Fraser University (1023-01-944)

AMS Special Session on Frames and Wavelets in Harmonic Analysis, Geometry, and Applications, I

8:00 AM – 10:50 AM

Organizers: **Palle E. T. Jorgensen**, University of Iowa
David R. Larson, Texas A&M University
Peter R. Massopust, Institute of Biomathematics and Biometry, Neuherberg, and Technical University of Munich
Gestur Olafsson, Louisiana State University

8:00AM (943) *Bases and frames in L^2-spaces in affine iterated function systems (IFS).*
Palle E. T. Jorgensen*, University of Iowa, and **Dorin E. Dutkay**, Rutgers University (1023-42-08)

8:30AM ► (944) *Uncertainty principle for fractals, graphs and metric measure spaces.* Preliminary report.
Kasso A. Okoudjou*, University of Maryland, **Laurent Saloff-Coste**, Cornell University, and **Alexander Teplyaev**, University of Connecticut (1023-42-1115)

9:00AM (945) *Isometries arising from filter functions and wavelets.* Preliminary report.
Judith A. Packer, University of Colorado, Boulder (1023-42-964)

9:30AM (946) *Smooth, well-localized frame wavelets based on new simple wavelet sets in R^2.* Preliminary report.
Kathy D. Merrill, Colorado College (1023-43-550)

10:00AM (947) *The Dimension Function of a Rationally Dilated Wavelet Associated With a GMRA.*
Kenneth R. Hoover, University of Oregon (1023-42-1615)

10:30AM (948) *The Kadison-Singer Problem in Frame Theory and Harmonic Analysis.*
Peter G. Casazza, University of Missouri (1023-42-75)

AMS Special Session on Group Representations, Ergodic Theory, and Mathematical Physics: Honoring the Memory of George W. Mackey, I

8:00 AM – 10:45 AM

Organizers: **Robert S. Doran**, Texas Christian University
Calvin C. Moore, University of California Berkeley
Robert J. Zimmer, The University of Chicago

8:00AM (949) *Virtual Groups 45 Years Later.*
Calvin C. Moore, University of California Berkeley (1023-22-310)

9:00AM (950) *Induced representations, intertwining operators and transfer.*
James Arthur, University of Toronto (1023-22-847)

10:00AM ► (951) *Some thoughts about George Mackey and his Imprimitivity theorem.*
Alexandre Kirillov, University of Pennsylvania, Philadelphia, PA (1023-22-376)

AMS Special Session on Infinite Dimensional Analysis Honoring H.-H. Kuo, I

8:00 AM – 10:50 AM

Organizers: **Ambar N. Sengupta**, Louisiana State University

P. Sundar, Louisiana State University

8:00AM (952) *Complex white noise and infinite dimensional unitary group.*
Takeyuki Hida, Meijo University (1023-60-1652)

8:30AM Discussion.

9:00AM (953) *The Segal-Bargmann transform for symmetric spaces.* Preliminary report.
Brian C. Hall*, Univ. of Notre Dame, and **Jeffrey J. Mitchell**, Robert Morris University (1023-22-1609)

9:30AM (954) *A new explicit formula for the solution of the Black-Merton-Scholes equation.* Preliminary report.
Jerome A. Goldstein*, University of Memphis, **Rosa Maria Mininni** and **Silvia Romanelli**, Universita di Bari (1023-35-1260)

10:00AM (955) *Kuo's Fourier-Mehler transform and the Lévy Laplacian.*
Kimiaki Saito, Meijo University (1023-60-967)

10:30AM (956) *Derivation and Applications of Dynamic Boundary Conditions to Nonlinear Partial Differential Equations.*
Gisele Ruiz Goldstein, University of Memphis (1023-35-1840)

AMS Special Session on Nonlinear Variational Inclusion Problems and Optimization Theory, I

8:00 AM - 10:45 AM

Organizer: **Ram U. Verma**, University of Toledo, and International Publications

8:00AM (957) *Differential Inclusions Driven by Vector Measures and their Optimal Control.*
N. U. Ahmed, SITE and Department of Mathematics, University of Ottawa (1023-49-135)

9:00AM (958) *Necessary and Sufficient Conditions for Isolated Local Minima of Nonsmooth Functions.*
Elena Constantin, University of Pittsburgh - Johnstown (1023-49-783)

10:00AM (959) *Multivariate Euler Type Identity and Optimal Multivariate Ostrowski Type Inequalities.* Preliminary report.
George A. Anastassiou, University of Memphis (1023-26-184)

AMS Special Session on Numerical Relativity, I

8:00 AM - 10:55 AM

Organizers: **Alexander M. Alekseenko**, California State University Northridge
Arup Mukherjee, Montclair State University

8:00AM (960) *Generalized Harmonic Evolutions of Binary Black Hole Spacetimes.*
Lee Lindblom, Caltech (1023-83-985)

9:00AM (961) *On the uniqueness of asymptotically AdS space-times.* Preliminary report.
Mingliang Cai, University of Miami, and **Jie Qing***, UC Santa Cruz (1023-53-912)

9:30AM (962) *Quantum mechanical healing of classical spacetime singularities.*
Deborah A. Konkowski*, U.S. Naval Academy, and **Thomas M. Helliwell**, Harvey Mudd College (1023-83-666)

10:00AM (963) *Blowup of smooth solutions for relativistic Euler equations.*
Ronghua Pan*, Georgia Institute of Technology, and **Joel A. Smoller**, The University of Michigan (1023-35-1197)

10:30AM (964) *Linearized Stability of the Schwarzschild Black Hole.*
Joel A. Smoller, University of Michigam (1023-83-830)

AMS Special Session on Arithmetic of Function Fields, I

8:00 AM - 10:45 AM

Organizers: **Allison M. Pacelli**, Williams College
Michael J. Rosen, Brown University

8:00AM (965) *Heegner points and the rank of elliptic curves over large extensions of global fields.*
Bo-Hae Im*, Chung-Ang University, Seoul, Korea, and **Florian Breuer**, University of Stellenbosch (1023-11-1030)

8:30AM (966) *Ranks of abelian varieties in towers of function fields.*
Douglas Ulmer, University of Arizona (1023-11-1368)

9:00AM (967) *Families of Twists and Inverse Galois.* Preliminary report.
Chris Hall, University of Texas at Austin (1023-11-600)

9:30AM (968) *Euler systems in algebraic function fields over a finite field.*
David R. Hayes, University of Massachusetts at Amherst (1023-12-719)

10:00AM (969) *Galois groups of difference equations and algebraic relations among periods of Drinfeld modules.* Preliminary report.
Chieh-Yu Chang, National Tsing-Hua University, and **Matthew Papanikolas***, Texas A&M University (1023-11-1542)

AMS Special Session on Universal Algebra and Order, I

8:00 AM - 10:40 AM

Organizers: **John W. Snow**, Sam Houston State University
Japheth Wood, Bard College

8:00AM (970) *Characterizing Lattice Terms.* Preliminary report.
John W. Snow*, Sam Houston State University, and **Eric J. Martin**, University of Waterloo (1023-06-408)

8:30AM ► (971) *Eliminating Eve's Eavesdropping (or How to Stop a Snoop).*
Kristen Meyer, Wisconsin Lutheran College (1023-94-192)

9:00AM (972) *Density and Ordered Algebraic Structures.*
George Metcalfe, Vanderbilt University (1023-06-324)

9:30AM ► (973) *On the automorphisms of the congruence lattice of the semilattice 2^n.* Preliminary report.
John W. Snow, Sam Houston State University, and **Eric J. Martin***, University of Waterloo (1023-06-399)

10:00AM (974) *Existence theorems for weakly symmetric operations.*
Ralph McKenzie, Vanderbilt University (1023-08-186)

AMS Special Session on Microlocal Analysis and Singular Spaces, II

8:00 AM - 10:40 AM

Organizers: **Paul A. Loya**, Binghamton University
Andras Vasy, Massachusetts Institute of Technology

8:00AM (975) *Invisibility and singular metrics.*
Allan Greenleaf, University of Rochester, **Matti Lassas**, Helsinki University of Technology, and **Gunther Uhlmann***, University of Washington (1023-35-454)

9:00AM (976) *Tensor Tomography and Boundary and Lens Rigidity of Riemannian manifolds.* Preliminary report.
Plamen Stefanov, Purdue University (1023-35-977)

10:00AM (977) *Reduction of artifacts for two sided folds.*
Raluca Felea, Rochester Institute of Technology (1023-42-548)

AMS Special Session on Continuous and Discrete Integrable Systems and Their Applications, I

8:00 AM – 10:55 AM

Organizers: **Wen-Xiu Ma**, University of South Florida
Taixi Xu, Southern Polytechnic State University
Bao-Feng Feng, University of Texas-Pan American
Zhijun Qiao, University of Texas-Pan American

8:00AM (978) *Long time bounds on higher derivatives of nearly integrable equations.* Preliminary report.
Jerry L. Bona, University of Illinois at Chicago (1023-35-1019)

8:30AM (979) *On solitonless semiclassical solutions for the focusing Nonlinear Schroedinger Equation.* Preliminary report.
Alexander Tovbis, University of Central Florida (1023-35-775)

9:00AM (980) *New integrable hierachies from vertex operators representations of polynomial Lie algebras.*
Paolo Casati, Universita' Milano Bicocca (1023-58-841)

9:30AM (981) *Integrable Couplings and Semi-Direct Sums of Lie Algebras.*
Wen-Xiu Ma, University of South Florida (1023-58-1005)

10:00AM (982) *Stability analysis of persisting periodic solutions to a Complex Ginzburg Landeau perturbation of the nonlinear Shrodinger equation.*
Stephane Lafortune, College of Charleston (1023-35-1135)

10:30AM (983) *On an integrable symmetric (2 + 1)-dimensional Lotka-Volterra equation and the corresponding modified (2 + 1)-dimensional Lotka-Volterra equation.*
H. B. Hu, Institute of Computational Mathematics and Scientific Engineering Computing, AMSS, Chinese Academy of Sciences, **C. X. Li***, Tsinghua University, and **J. J. C. Nimmo**, University of Glasgow (1023-35-1063)

AMS Session on Combinatorics, I

8:00 AM – 10:55 AM

8:00AM (984) *Asymptotic Bounds for Permutations Containing Many Different Patterns.*
Alison B. Miller, Harvard University (1023-05-1057)

8:15AM (985) *The Metric Dimension of the Cayley Digraphs of Finite Abelian Groups.*
Angela S. Hicks, Furman University (1023-05-1062)

8:30AM ► (986) *Alliance Partitions in Graphs.* Preliminary report.
Ralucca M. Gera*, Naval Postgraduate School, and **Linda Eroh**, University of Wisconsin Oshkosh (1023-05-1067)

8:45AM ► (987) *Counting Isomorphic (16,6,2) Configurations to a particular (16,6,2) Design.*
Sharon L. Sullivan, Catawba College (1023-05-1151)

9:00AM (988) *Generalized correlation matrices and their relation to the de Bruijn Graph.*
Irina Gheorghiciuc, University of Delaware (1023-05-1173)

9:15AM ► (989) *Local Properties of Colored Trees.*
Rachel Esselstein, Dartmouth College (1023-05-1183)

9:30AM ► (990) *From a Banquet Seating Problem to a Graph Coloring Problem.*
Ping Zhang, **Futaba Okamoto*** and **Mary Radcliffe**, Western Michigan University (1023-05-1206)

9:45AM ► (991) *A Study of Code Switching in Coding Theory.*
Chen-Han Sung, Texas A&M International University (1023-05-122)

10:00AM (992) *Disjunctive Rado Numbers for some Linear Equations.*
Carl D. Mueller*, Georgia Southwestern State University, and **Daniel Schaal**, South Dakota State University (1023-05-1228)

10:15AM ► (993) *Forcing hexagons in a hexagonal system.* Preliminary report.
Zhongyuan Che*, Penn State University, Beaver Campus, and **Zhibo Chen**, Penn State University, McKeesport Campus (1023-05-1252)

10:30AM ► (994) *Distance Graphs on the Integers.*
Tristan Denley and **Joshua Hanes***, University of Mississippi (1023-05-1340)

10:45AM ► (995) *2-Regular Leaves of Partial 10-cycle Systems.* Preliminary report.
D. J. Ashe, University of Tennessee at Chattanooga (1023-05-271)

AMS Session on Analysis and Ordinary Differential Equations, III

8:00 AM – 8:40 AM

8:00AM (996) *Impact of Travel Between Patches for Spatial Spread of Disease.*
Lin Wang, University of British Columbia (1023-34-489)

8:15AM ► (997) *Regularization of Simultaneous Binary Collisions and Periodic Solutions with Singularity in the Collinear Four-Body Problem.*
Tiancheng Ouyang, Brigham Young University, and **Zhifu Xie***, College of William & Mary (1023-34-531)

8:30AM (998) *Pattern Formation on Growing Square Domains.*
Adela Nicoleta Comanici*, Rice University, and **Martin Golubitsky**, University of Houston (1023-34-549)

AMS General Session

8:00 AM – 8:55 AM

8:00AM (999) *Computing local L-factors for principal series representations of $Sp_4(F)$ and $\widetilde{Sp_4}(F)$ over p-adic fields.* Preliminary report.
Christian A. Zorn, University of Maryland, College Park (1023-00-1200)

8:15AM *Critical Mathematics: Enhancing the equity*
► (1000) *principle in mathematics methods courses.*
Elizabeth M. de Freitas, Adelphi University, NY (1023-00-1499)

8:30AM *The Generalized Extension Principle in Fuzzy Set*
(1001) *Theory and Its Applications.* Preliminary report.
Zengxiang Tong, Otterbein College (1023-00-1677)

8:45AM *Neo-Riemannian Permutations.*
(1002) **Franck Jedrzejewski**, French Atomic Energy Commission (CEA) (1023-00-560)

AMS Session on Geometry and Topology, III

8:00 AM – 10:40 AM

8:00AM *Some results on shifts on o-dimensional compacta.*
(1003) Preliminary report.
Minaksundaram Rajagopalan, Tennessee State University (1023-54-246)

8:15AM *On the Spectrum of Operators on Banach Spaces.*
(1004) Preliminary report.
Mohammed Yahdi, Ursinus College (1023-54-473)

8:30AM *An Interesting Map on the Hilbert Cube.* Preliminary
(1005) report.
Kailash C. Ghimire, Oregon State University (1023-54-502)

8:45AM *Preimages Under $f(z) = z^n$ of Continua in the*
(1006) *Complex Plane.* Preliminary report.
R. Patrick Vernon, Tulane University (1023-54-521)

9:00AM *Any Hausdorff compactification of X obtained by a*
(1007) *semi-Wallman base for X.* Preliminary report.
Hueytzen J. Wu*, Texas A&M University - Kingsville, and **Wan-Hong Wu**, Institute for Drug Development, Cancer Therapy & Research Center (1023-54-700)

9:15AM Break.

9:30AM *Colie algebras and orbit configuration spaces of*
(1008) *lens spaces.* Preliminary report.
Matthew Sean Miller, University of Oregon (1023-55-1225)

9:45AM *Canonical genus and the Whitehead doubles of*
(1009) *pretzel knots.* Preliminary report.
Mark Brittenham, University of Nebraska - Lincoln, and **Jacqueline A. Jensen***, Sam Houston State University (1023-55-1256)

10:00AM *Homotopy classification of a bilinear map related to*
(1010) *octonion polynomial multiplications.*
Hugo Rodríguez Ordóñez, Colorado State University-Pueblo (1023-55-1314)

10:15AM *Polynomial quandle cocycles and obstructions to*
(1011) *embedding disjoint union of tangles.*
Kheira Ameur, University of South Florida (1023-55-1407)

10:30AM *Solving Deligne's Conjecture via Polytopes.*
(1012) Preliminary report.
Rachel Schwell, University of Connecticut (1023-55-1445)

AMS Session on Applications of Mathematics, III

8:00 AM – 10:55 AM

8:00AM *Stochastic Metapopulation Models for Patch*
(1013) *Occupancy.*
Amy J. Drew* and **Linda J. S. Allen**, Texas Tech University (1023-92-1055)

8:15AM *Uniqueness of an equilibrium for a discrete*
(1014) *selection-migration model in population genetics.*
James F. Selgrade*, North Carolina State University, and **James H. Roberds**, USDA Forest Service (1023-92-1230)

8:30AM *Dynamics of Closely Coupled Nephrons.*
► (1015) **Saziye Bayram**, SUNY-Buffalo State College (1023-92-1295)

8:45AM *Purinergic Receptor Signaling in the RAW*
► (1016) *264.7 Macrophage: Modeling Species-Specific Diacylglycerol Dynamics Following Receptor Activation by Uridine 5'-Diphosphate.*
Hannah L. Callender, Vanderbilt University (1023-92-1324)

9:00AM *Asymptotic Profiles of the Steady States for an SIS*
(1017) *Epidemic Patch Model.*
L. J. S. Allen, Texas Tech University, **B. M. Bolker**, Department of Biology, University of Florida, **Y. Lou**, The Ohio State University, and **A. L. Nevai***, Mathematical Biosciences Institute, The Ohio State University (1023-92-1364)

9:15AM *Analytically tractable approximation of a forest*
(1018) *individual-based simulator.*
Nikolay S. Strigul*, Department of Ecology and Evolutionary Biology, Princeton University, **Denis Pristinski**, Stevens Institute of Technology, and **Stephen Pacala**, Department of Ecology and Evolutionary Biology, Princeton University. (1023-92-1427)

9:30AM *Application of Matrix Tree Theorem in Chinese*
► (1019) *Medicine.*
Najia Bao, University of Georgia (1023-92-148)

9:45AM *Competitive Exclusion and Coexistence in a*
(1020) *Nonlinear Refuge-Mediated Selection Model.*
Youssef M. Dib, University of Louisiana Lafayette (1023-92-1516)

10:00AM *A Dynamical Model of Influenza A Virus Infection*
(1021) *and Its Clinical and Epidemiological Relevance.*
Baris Hancioglu*, **David Swigon** and **Gilles Clermont**, University of Pittsburgh (1023-92-1523)

10:15AM *A discrete competition model using a numbercal*
(1022) *method.* Preliminary report.
Wendy Jacqueline Hernandez-Padilla* and **Lih-Ing Wu Roeger**, Texas Tech University (1023-92-1544)

10:30AM *Markov process modeling of biochemical reaction*
► (1023) *kinetics.*
Dmitry A. Kondrashov*, Department of Biochemistry, University of Wisconsin - Madison, **George N. Phillips**, Deparment of Biochemistry and Computer Science, University of Wisconsin - Madison, and **Joseph C. Watkins**, University of Arizona (1023-92-1576)

10:45AM *The Effect of Static and Dynamic Spatially*
(1024) *Structured Disturbances on a Locally Dispersing Population Model.*
David E. Hiebeler, University of Maine, and **Benjamin R. Morin***, Oregon State University (1023-92-642)

AMS Session on Education

8:00 AM – 10:25 AM

8:00AM *Making Physiology Significant and Statistics*
► (1025) *Meaningful.*
Mary F. Majerus* and **April Collins-Potterfield**, Westminster College (1023-97-1012)

8:15AM *Teaching to succeed.*
(1026) **Natali Hritonenko*** and **Edward Mason**, Prairie View A&M University (1023-97-1169)

8:30AM *Conceptions of infinitesimals in undergraduate*
► (1027) *calculus students and in history.*
Robert E. Ely, University of Wisconsin-Madison (1023-97-1301)

8:45AM ► (1028) *An Overview of Ohio Northern University's Mathematical Assessments being used to Satisfy NCATE's New Guidelines.* Preliminary report.
Sandy Schroeder, Ohio Northern Universtiy (1023-97-1389)

9:00AM ► (1029) *Engaging Students in College Algebra.*
Juli D'Ann Ratheal, West Texas A & M University (1023-97-313)

9:15AM ► (1030) *A Fertile Ground for Undergraduate Research: Cryptography.* Preliminary report.
Manmohan Kaur, Benedictine University (1023-97-465)

9:30AM (1031) *Japanese High School Mathematics Teacher Competence in Real World Problem Solving and its Implication for the Use of Modeling to Improve Japanese Mathematics Education.*
Kazuko Ito West, Keio Academy of New York (1023-97-56)

9:45AM ► (1032) *The Reasoning of Bayesian and Empirical Bayes Analysis in Undergraduate Statistics Education.*
Zhao Chen, Florida Gulf Coast University (1023-97-677)

10:00AM (1033) *The process and impact of implementing performance standards in mathematics.*
Samuel Obara, Texas State University, San Marcos (1023-97-823)

10:15AM ► (1034) *Girls Can Do Math, But Most Don't Due to Cultural Factors.*
Janet E. Mertz, University of Wisconsin – Madison (1023-97-971)

MAA Session on Building Diversity in Advanced Mathematics: Models that Work, I

8:00 AM – 10:55 AM

Organizers: **Patricia Hale**, California State Polytechnic University, Pomona
Abbe H. Herzig, University of Albany, SUNY

8:00AM (1035) *Case Study: My Experience Teaching Mathematics to a Student Who is Blind.*
Richard P. Spindler, Bemidji State University (1023-E1-231)

8:20AM ► (1036) *Improving engineering student retention by enhancing their mathematical preparation in a case study at the University of Michigan.*
Zsolt Lavicza, University of Cambridge, **Darryl M. Koch** and **Helen Siedel***, University of Michigan (1023-E1-1111)

8:40AM (1037) *Summer Undergraduate Research Program at Clayton State University.*
Aprillya Lanz, Clayton State University (1023-E1-1797)

9:00AM ► (1038) *Bifurcation and Chaos in One-dimensional Discrete Dynamical Systems (BaC): A National Research Experience for Undergraduates Program Attracting a Diverse Group of Mathematics Students.* Preliminary report.
Mazen Shahin*, Delaware State University, and **Elena Surovyatkina**, Space Research Institute, Russian Academy of Science, and Delaware State University (1023-E1-565)

9:20AM ► (1039) *Coloring Groups in Jersey City and Park City.* Preliminary report.
Brian Hopkins* and **Stephanie Charles**, Saint Peter's College (1023-E1-1428)

9:40AM ► (1040) *Vertically Integrated Workshop for Women in Mathematics.* Preliminary report.
Sarah J. Greenwald* and **Katherine Mawhinney***, Appalachian State University (1023-E1-390)

10:00AM (1041) *Center for Women in Mathematics at Smith College.*
Ruth Haas* and **James Henle**, Smith College (1023-E1-764)

10:20AM ► (1042) *Advance Program at NMSU: A Formalized Mentoring for STEM faculty.*
Tiziana Giorgi, New Mexico State University (1023-E1-1217)

10:40AM ► (1043) *The Importance of Community in Supporting Diverse Learners in Mathematics.*
Abbe H. Herzig, University at Albany, State University of New York (1023-E1-481)

MAA Session on Countering "I Can't Do Math": Strategies For Teaching Under-Prepared, Math-Anxious Students, I

8:00 AM – 10:55 AM

Organizers: **Winston Crawley**, Shippensburg University
Kim Presser, Shippensburg University

8:00AM ► (1044) *Games and Hands-on Activities in Introductory Mathematics Course for Non-Majors.*
Annela R. Kelly, Roger Williams University (1023-G5-1869)

8:20AM ► (1045) *Thinking of Using Software? Why it Works for Us!*
Sue R. Beck, Morehead State University (1023-G5-242)

8:40AM ► (1046) *I Can Prove It!*
J. A. Hall, Longwood University; Farmville, VA (1023-G5-958)

9:00AM (1047) *Engaging Students in Quantitative Reasoning: Activities, Real Data, and Relevant Issues.*
Kay Somers* and **Alicia Sevilla**, Moravian College (1023-G5-678)

9:20AM (1048) *Breaking student math anxiety by doing something different.*
Ed D. Laughbaum, The Ohio State University (1023-G5-799)

9:40AM ► (1049) *Reading, Writing, and How Not to be a Fat Head.* Preliminary report.
Trisha Moller, DeSales University (1023-G5-766)

10:00AM Break.

10:20AM ► (1050) *So They Don't Want to Hear About Math? Tell a Story Instead.* Preliminary report.
Carlos R. Bovell, Mercer County Community College (1023-G5-150)

10:40AM ► (1051) *Overcoming Students' Anxiety With Translation Problems via Polya.*
Tim Jacobbe, Clemson University (1023-G5-45)

MAA Session on Teaching Operations Research in the Undergraduate Classroom

8:00 AM – 10:50 AM

Organizers: **Gerald Kobylski**, United States Military Academy
Steve Horton, United States Military Academy
Christopher J. Lacke, Rowan University
William Fox, Francis Marion University

8:00AM *A Freshman Introduction to Operations Research.*
► (1052) Preliminary report.
Heather Stevenson, United States Military Academy (1023-R1-1775)

8:25AM *Redesign of Undergraduate Mathematical*
► (1053) *Optimization.* Preliminary report.
A. Bathi Kasturiarachi, Kent State University, Stark Campus (1023-R1-1679)

8:50AM *So, You Think That You Have Problems?*
(1054) **Christopher J. Lacke**, Rowan University (1023-R1-1522)

9:15AM *Project MathWORKS! Introducing Systems*
► (1055) *Engineering to High Schools.* Preliminary report.
Jason C. McKay* and **Ernest Y. Wong**, United States Military Academy (1023-R1-1447)

9:40AM *Linear Optimization: The Simplex Workbook.*
(1056) Preliminary report.
Glenn Hurlbert, Arizona State University (1023-R1-938)

10:05AM *Applications of Computer Technology in an*
► (1057) *Undergraduate Probability Curriculum.* Preliminary report.
Randal E. Hickman, United States Military Academy, West Point, NY (1023-R1-1393)

10:30AM *Teaching Mathematical Modeling/ Quantitative*
(1058) *Analysis as part of a core sequence to Students without a Calculus.*
William P. Fox, Naval Postgraduate School (1023-R1-623)

MAA Session on The Mathematics of Sudoku and Other Puzzles, I

8:00 AM – 10:55 AM

Organizer: **Laura A. Taalman**, James Madison University

8:00AM *Cayley-Sudoku tables: An undergraduate research*
► (1059) *project.* Preliminary report.
Jennifer Carmichael and **Michael B. Ward***, Western Oregon University (1023-M1-298)

8:20AM *Row-Filled Completion Problem for Sudoku Latin*
► (1060) *Squares.*
Izabela Kanaana*, Sonoma State University, and **Bala Ravikumar**, Department of Computer Science, Sonoma State University (1023-M1-1559)

8:40AM *A Computer Alogrithm for Solving Sudoku.*
(1061) **Philip A. Cobb**, Queensborough Community College (1023-M1-275)

9:00AM *Sudoku Studio.*
► (1062) **Jonathan M. Kane**, University of Wisconsin – Whitewater (1023-M1-532)

9:20AM *A Java Program to Solve Kakuro Puzzles.*
► (1063) **Charles Ashbacher**, Mount Mercy College (1023-M1-493)

9:40AM *A Hard Day's Knight.*
► (1064) **Joe DeMaio**, Kennesaw State University (1023-M1-182)

10:00AM *Classroom Uses for the Game of "Dots": A Simple*
► (1065) *Bridge to Advanced Ideas.*
Carrie Muir, University of Colorado - Boulder (1023-M1-1766)

10:20AM *SET and Combinatorics.*
► (1066) **Anna Bickel** and **Zsuzsanna Szaniszlo***, Valparaiso University (1023-M1-281)

10:40AM *Using SET to Visualize Higher Mathematics.*
► (1067) Preliminary report.
Ben Coleman and **Kevin Hartshorn***, Moravian College (1023-M1-1917)

MAA General Contributed Paper Session, V

8:00 AM – 10:55 AM

Organizers: **Eric S. Marland**, Appalachian State University
Jay A. Malmstrom, Oklahoma State Community College

8:00AM *A Closer Look at the Crease Length Problem.*
► (1068) **S. F. Ellermeyer**, Kennesaw State University (1023-Z1-213)

8:15AM *Visualizing Elastic Wave Interactions with Multiple*
► (1069) *Interfaces.*
Richard J. Marchand, Slippery Rock University (1023-Z1-1448)

8:30AM *Double Layers, Solid Angles and Cubic Splines: Fun*
► (1070) *With a Well in a Stratified Aquifer.* Preliminary report.
Kenneth H. Luther, Valparaiso University (1023-Z1-575)

8:45AM *Particle Tracking in Three-Dimensional Flows:*
► (1071) *Evolution and Refinement of a Smooth Surface.*
Paul von Dohlen*, William Paterson University, and **Patrick Miller**, Stevens Institute of Technology (1023-Z1-1339)

9:00AM *A Glimpse of Infinite-dimensional Tensegrities.*
► (1072) Preliminary report.
Ted Ashton, University of Georgia (1023-Z1-1680)

9:15AM *Mathematical modelling of rumor transmission*
► (1073) *during a dialogue.*
Bernard P. Brooks*, **Nicholas DiFonzo** and **David S. Ross**, Rochester Institute of Technology (1023-Z1-1659)

9:30AM *Seeing sums of single digit numbers.*
► (1074) **Cynthia A. Crumb**, University of South Alabama, Mobile, AL (1023-Z1-1334)

9:45AM *A Comparison of Online Homework Systems.*
► (1075) Preliminary report.
Jessica K. Sklar* and **Mei Zhu**, Pacific Lutheran University (1023-Z1-127)

10:00AM *The Birthday Problem: The Making of a Classic.*
► (1076) **Dale K. Hathaway**, Olivet Nazarene University (1023-Z1-250)

10:15AM *π to (hundreds of) thousands of digits, from Vieta's*
► (1077) *formula.*
Rick Kreminski, Texas A&M University - Commerce (1023-Z1-585)

10:30AM *Amazing Explorations.* Preliminary report.
► (1078) **Dennis P. Walsh**, Middle Tennessee State University (1023-Z1-1830)

10:45AM *Early Nineteenth Century Elementary Algebra*
► (1079) *Textbooks.*
Andrew B. Perry, Springfield College (1023-Z1-287)

PME Council

8:00 AM – 11:00 AM

MAA Invited Address

9:00 AM – 9:50 AM

(1080) *The Genome Project for Three-Manifolds.*
Jeffrey F. Brock, Brown University (1023-A0-23)

ASL Invited Address

9:00 AM – 9:50 AM

(1081) *Reducts of Omega-Categorical Theories.*
Carol S. Wood, Wesleyan University (1023-03-414)

MAA Minicourse #12: Part B

9:00 AM – 11:00 AM

Combinatorially thinking.
Organizers: **Arthur T. Benjamin**, Harvey Mudd College
Jennifer J. Quinn, Association for Women in Mathematics

MAA Minicourse #1: Part B

9:00 AM – 11:00 AM

Introduction to the mathematics of modern cryptography.
Organizers: **Colm K. Mulcahy**, Spelman College
Jeffrey Ehme, Spelman College

MAA Minicourse #8: Part B

9:00 AM – 11:00 AM

Mathematics and geometry of voting.
Organizer: **Donald G. Saari**, University of California Irvine

MAA Session on How to Start and Develop Undergraduate Level Financial Mathematics Programs

9:00 AM – 10:20 AM

Organizer: **Youngna Choi**, Montclair State University

9:00AM ► (1082) *Financial Mathematics in a Mathematically Accurate but Accessible Way.*
Morteza Shafii-Mousavi, Indiana University South Bend (1023-I5-28)

9:30AM ► (1083) *Starting a B.S. in Mathematics-Mathematics of Finance Concentration Track: case of Montclair State University.* Preliminary report.
Youngna Choi, Montclair State University (1023-I5-1354)

10:00AM ► (1084) *The Mathematics of Refinancing.* Preliminary report.
Youngna Choi and **Crystal K Dahlhaus***, Montclair State University (1023-I5-1356)

MAA Panel Discussion

9:00 AM – 10:20 AM

The top ten things you should know if you intend to implement the standards of Beyond Crossroads.
Organizer: **Richelle Blair**, Lakeland Community College
Panelists: **Kathy Mowers**, Owensboro Community and Technical College
Robert L. Kimball, Jr, Wake Technical Community College
Brad Chin, West Valley College
Richelle Blair

MAA Panel Discussion

9:00 AM – 10:20 AM

Calculus, liberal arts, and quantitative literacy.
Organizer: **Richard A. Gillman**, Valparaiso University
Panelists: **William E. Briggs**, University of Colorado, Denver
Deborah Hughes-Hallett, University of Arizona
Michael Starbird, University of Texas at Austin
Richard A. Gillman

Project NExT Panel Discussion

9:00 AM – 10:30 AM

Publishing undergraduate research and expository articles.
Organizers: **Chawne M. Kimber**, Lafayette College
Kimberly A. Roth, Wheeling Jesuit University
Panelists: **Ezra A. Brown**, Virginia Polytechnic Institute & State University
Paul J. Campbell, Beloit College
Clifford A. Reiter, Lafayette College
Jody Sorensen, Augsburg College

AMS Special Presentation on Congressional Fellowships

9:30 AM – 10:55 AM

Learn about this program and speak with former Fellows.
Organizer: **Samuel M. Rankin, III**, AMS
Presenters: **David Weinreich**, AMS Congressional Fellow 2005-06
Dan Ullman, AMS Congressional Fellow 2006-07

Exhibits and Book Sales

9:30 AM – 5:30 PM

ASL Invited Address

10:00 AM – 10:50 AM

(1085) *Almost everywhere domination.*
Reed Solomon, University of Connecticut, Storrs (1023-03-413)

Math on the Web, III

10:00 AM – 5:05 PM

0:30PM (1086) *The MathFind search engine.*
Robert Miner, Design Science, Inc.

10:00PM (1087) *Project CALC on the Web.*
David Smith, Duke University

1:15PM (1088) *Interactive math on the Web by Maplesoft.*
Mohamed Bendame, Maplesoft

2:00PM (1089) *Online assessment and problem-solving environments: The advantages of using content MathML.*
Don DeLand, Integre Technical Publishing Co.

2:45PM (1090) *PlanetMath and free mathematics.*
Aaron Krowne, Emory University

3:15PM (1091) *Using MathML with Blackboard and WebCT.*
Bob Mathews, Design Science, Inc.

4:00PM (1092) *WebALT online courses.*
Mika Seppälä, WebALT

4:45PM (1093) *Techniques for using the equation editor in Blackboard and WebCT.*
Bob Mathews, Design Science, Inc.

AMS Invited Address

10:05 AM – 10:55 AM

(1094) *Extensions of Hilbert's Tenth Problem.*
Bjorn Poonen, University of California, Berkeley (1023-03-06)

AMS-MAA Invited Address

11:10 AM – NOON

(1095) *Statistics for smart people who don't know anything about statistics.*
Persi W. Diaconis, Stanford University (1023-62-32)

AMS Colloquium Lecture: Lecture III

1:00 PM – 2:00 PM

(1096) *Limit shapes, real and imagined, III: Instantons, and how random surfaces count them.*
Andrei Okounkov, Princeton University (1023-60-04)

ASL Invited Address

1:00 PM – 1:50 PM

(1097) *Independence and equiconsistency results in intuitionistic set theory.*
Michael Rathjen, Ohio State University and University of Leeds (1023-03-412)

MAA Student Lecture

1:00 PM – 1:50 PM

► (1098) *Mathematics: A Question of History.*
Della D. Fenster, University of Richmond (1023-A0-24)

AMS Current Events Bulletin

1:00 PM – 4:45 PM

Organizer: **David Eisenbud**, Mathematical Sciences Research Institute

► (1099) *Barcodes: The Persistent Topology of Data.*
Robert Ghrist, University of Illinois, Urbana-Champaign (1023-55-1038)

► (1100) *Flows on the space of lattices: Work of Einsiedler, Katok and Lindenstrauss.*
Akshay Venkatesh, Courant Institute of Mathematical Sciences (1023-37-778)

(1101) *From harmonic analysis to arithmetic combinatorics.*
Izabella Laba, UBC (1023-42-1431)

(1102) *The structure of error terms in number theory and an introduction to the Sato-Tate Conjecture.*
Barry Mazur, Harvard University (1023-11-1245)

AMS-MAA-SIAM Special Session on Research in Mathematics by Undergraduates, IV

1:00 PM – 5:55 PM

Organizers: **Darren A. Narayan**, Rochester Institute of Technology
Carl V. Lutzer, Rochester Institute of Technology
Bernard Brooks, Rochester Institute of Technology
Tamas I. Wiandt, Rochester Institute of Technology
Michael J. Fisher, California State University, Fresno

1:00PM ► (1103) *Computational Efficiency in Weyl Groups.* Preliminary report.
Patricia R. Cahn*, **Juan Li**, Smith College, and **Jeremy Schwartz**, Brandeis University (1023-08-1056)

1:30PM ► (1104) *An equivalent characterization of half-factorial restricted block monoids over $\mathbb{Z}$ and torsion groups, with applications to factorization in Dedekind domains.* Preliminary report.
R. D. Kravitz, Williams College (1023-13-132)

2:00PM ► (1105) *Matrix Generation of the Diophantine Solutions to Sums of $3 \leq n \leq 9$ Squares that are Square.*
Jordan O. Tirrell* and **Clifford A. Reiter**, Lafayette College (1023-11-626)

2:30PM ► (1106) *Looking for Patterns in Multinomial Coefficients.* Preliminary report.
Igor Konfisakher*, Washington University in St. Louis, and **Michael Wijaya**, University of Rochester (1023-11-472)

3:00PM ► (1107) *Number Base Representations in the Gaussian Integers.* Preliminary report.
Heather J. Langdon, St. Mary's College of Maryland (1023-11-854)

3:30PM ► (1108) *Orders at Infinity of Modular Forms with Heegner Divisors.*
Carl Erickson*, Stanford University, **Alison Miller**, Harvard University, and **Aaron Pixton**, Princeton University (1023-11-80)

4:00PM ► (1109) *The number of ways of expressing t as a binomial coefficient.*
Daniel Mertz Kane, Massachusetts Institute of Technology (1023-11-1083)

4:30PM ► (1110) *Realizations of subspaces of L_p, $p > 2$, with norm given by partitions and weights.*
Brandon P. Barrette* and **Simei Tong**, University of Wisconsin-Eau Claire (1023-46-86)

5:00PM ► (1111) *Surfaces with Density and their Isoperimetric Regions.*
Robin S. Walters, Harvard University (1023-53-898)

5:30PM ► (1112) *Self-similar periodic tilings of nilpotent Lie groups.* Preliminary report.
James J. Rohal*, College of Wooster, and **William P. Hudelson**, University of Notre Dame (1023-22-808)

AMS-MAA Special Session on History of Mathematics, II

1:00 PM – 5:55 PM

Organizers: **Joseph W. Dauben**, Lehman College
Patti Hunter, Westmont College
Victor J. Katz, University of the District of Columbia
Karen H. Parshall, University of Virginia

1:00PM ► (1113) *The ellipse seen from China.* Preliminary report.
Andrea Breard, Université des Sciences et Technologies de Lille; Laboratoire Paul Painlevé (1023-01-930)

1:30PM (1114) *The Other Book Nobody Read: Georg Rheticus and the Opus Palatinum.*
Glen R. Van Brummelen, Quest University (1023-01-749)

2:00PM (1115) *Communicating Mathematics in the Journal des savants (1675-1737).*
Jeanne Peiffer, CNRS Paris (1023-01-1077)

2:30PM (1116) *Problems of Infinitesimals: Descartes, Leibniz, and Peirce.*
Maria Sol de Mora, University of Basque Country (1023-01-610)

3:00PM (1117) *Motivation and Context for B. Peirce's Linear Associative Algebra.* Preliminary report.
Deborah A. Kent, Simon Fraser University (1023-01-683)

3:30PM (1118) *Robert Leslie Ellis on the misuse of the principle of insufficient reason.*
Byron E. Wall, York University, Toronto, Canada (1023-01-946)

4:00PM (1119) *The Mittag-Leffler Theorem: Interpretation and Reception of a Mathematical Result, 1876-1884.* Preliminary report.
Laura E. Turner* and **Thomas Archibald**, Simon Fraser University (1023-01-291)

4:30PM (1120) *A Political and Mathematical Unification: The Case of Nineteenth-Century Italy.*
Laura Martini, Siena, Italy (1023-01-296)

5:00PM (1121) *Mathematics in Brazil during the first half of the 20th century: institutionalization and professionalization.*
Sergio Nobre, UNESP - Rio Claro - Brazil (1023-01-722)

5:30PM (1122) *Mathematics and pacifism in Cambridge 1915-1916: a student perspective.*
June Barrow-Green, The Open University, Milton Keynes, UK (1023-01-226)

AMS Special Session on Frames and Wavelets in Harmonic Analysis, Geometry, and Applications, II

1:00 PM – 5:50 PM

Organizers: **Palle E. T. Jorgensen**, University of Iowa
David R. Larson, Texas A&M University
Peter R. Massopust, Institute of Biomathematics and Biometry, Neuherberg, and Technical University of Munich
Gestur Olafsson, Louisiana State University

1:00PM (1123) *Pointwise comparison of pulse code and Sigma-Delta modulation.*
John J. Benedetto*, Norbert Wiener Center, University of Maryland, College Park, and **Onur Oktay**, University of Maryland, College Park (1023-42-437)

1:30PM (1124) *Maximally Equiangular Frames and Finite Wigner Distributions.*
Matthew Fickus, Air Force Institute of Technology (1023-42-843)

2:00PM (1125) *Causal Relationships Between Frames*, Preliminary report.
Troy Henderson*, United States Military Academy, and **David R Larson**, Texas A&M University (1023-47-978)

2:30PM (1126) *Orthogonal wavelets centered on an arbitrary knot sequence.*
Derek Bruff, Vanderbilt University, **Jeffrey Geronimo**, Georgia Institute of Technology, and **Doug Hardin***, Vanderbilt University (1023-41-1503)

3:00PM (1127) *Texture Identification of Tissues Using Directional Wavelet, Ridgelet and Curvelet Transforms.*
Ahmed I. Zayed* and **Lucia Dettori**, DePaul University (1023-42-320)

3:30PM (1128) *A characteristic equation of semiorthogonal Parseval wavelets.* Preliminary report.
Veronika Furst, University of Arizona (1023-43-1566)

4:00PM (1129) *Wavelet Sets with Nonexpanding Dilation Matrices.*
Yang Wang*, Georgia Institute of Technology, and **Eugene Ionascu**, Columbus State University (1023-42-468)

4:30PM (1130) *Surgery and push-outs on frames.* Preliminary report.
David R. Larson and **Nga Q. Nguyen***, Texas A&M University (1023-46-695)

5:00PM (1131) *Isotropic Multiresolution Analysis.*
Simon K. Alexander, **Shika Baid**, **Saurabh Jain**, **Juan R. Romero** and **Manos Papadakis***, University of Houston (1023-42-885)

5:30PM (1132) *Gelfand triples and time frequency analysis.* Preliminary report.
Jens Gerlach Christensen* and **Gestur Olafsson**, Louisiana State University (1023-43-1762)

AMS Special Session on Group Representations, Ergodic Theory, and Mathematical Physics: Honoring the Memory of George W. Mackey, II

1:00 PM – 5:45 PM

Organizers: **Robert S. Doran**, Texas Christian University
Calvin C. Moore, University of California Berkeley
Robert J. Zimmer, The University of Chicago

1:00PM (1133) *Induced Actions.*
Robert J. Zimmer, University of Chicago (1023-22-68)

2:00PM (1134) *From Lorentzian dynamics to the decay of matrix coefficients.*
Scot Adams, University of Minnesota (1023-37-241)

2:30PM (1135) *Cohomology of measurable cocycles.* Preliminary report.
Alex Furman, University of Illinois at Chicago (1023-37-780)

3:00PM (1136) *The Work of G. W. Mackey on Unitary Representations of Group Extensions.*
Arlan Ramsay, University of Colorado, Boulder (1023-46-580)

3:30PM (1137) *The Mackey Dichotomy in Classification Problems.*
Edward G. Effros, UCLA (1023-46-233)

4:00PM (1138) *MASA's and certain type I closed faces of C^*–algebras.*
Lawrence G. Brown, Purdue University (1023-46-760)

4:30PM (1139) *Groupoid Methods in Wavelet Analysis.*
Marius Ionescu, Dartmouth College, and **Paul S. Muhly***, University of Iowa (1023-46-663)

5:00PM (1140) *Quantum Fields and George Mackey.*
Arthur Jaffe, Harvard University (1023-00-225)

AMS Special Session on Infinite Dimensional Analysis Honoring H.-H. Kuo, II

1:00 PM - 5:20 PM

Organizers: **Ambar N. Sengupta**, Louisiana State University
P. Sundar, Louisiana State University

1:00PM (1141) *Nonlinear maps of Wiener processes.*
Leonard Gross, Cornell University (1023-46-1511)

1:30PM (1142) *Examples of Stochastic Flows in Non-Commutative Manifolds.*
Kalyan B. Sinha, J.N.Centre for Advanced Scientific Research, Jakkur, Bangalore, India. (1023-60-1344)

2:00PM (1143) *Invariant Measures and Kolmogorov Equations for Stochastic PDEs.* Preliminary report.
Pao-Liu Chow, Wayne State University (1023-60-937)

2:30PM ► (1144) *Nonlinear Filtering Theory of Stochastic Navier-Stokes Equations.*
S. S. Sritharan, University of Wyoming (1023-60-274)

3:00PM (1145) *Empirical graph Laplacian approximation of Laplace-Beltrami operators.*
Evarist - Giné*, University of Connecticut, and **Vladimir Koltchinskii**, Geeorgia Institute of Technology (1023-60-457)

3:30PM (1146) *Infinite dimensional heat equation of convolution type, solutions and probabilistic interpretation.*
Habib Ouerdiane, University of Tunis El Manar, Tunisia (1023-60-747)

4:00PM ► (1147) *Best constants in norms of non-gaussian Wick products.* Preliminary report.
Aurel Iulian Stan, The Ohio State University at Marion (1023-60-926)

4:30PM (1148) *White Noise Delta Function for an Affine Subspace.*
Jeremy J. Becnel, Stephen F. Austin State University (1023-46-837)

5:00PM Discussion.

AMS Special Session on Nonlinear Variational Inclusion Problems and Optimization Theory, II

1:00 PM - 3:45 PM

Organizer: **Ram U. Verma**, University of Toledo, and International Publications

1:00PM ► (1149) *The Minimax Inequality Inequality and Applications to Fixed Points, Nash Equilibrium Points and Some Links for Problems of Financial Mathematics in the Practice.* Preliminary report.
George X. Yuan, Management School, Chinese Academy of Science , Beijing , China (1023-91-137)

2:00PM (1150) *Senistivity Analysis for Cocoercively Monotone Variational Inclusions.*
R. N. Mohapatra* and **Ram U. Verma**, University of Central Florida (1023-49-972)

3:00PM (1151) *Identification of Nonlinearities in Divergence Type Elliptic Boundary Value Problems.*
Mircea D. Voisei, The University of Texas - Pan American (1023-49-55)

AMS Special Session on Nonsmooth Analysis in Inverse and Variational Problems, I

1:00 PM - 6:25 PM

Organizers: **M. Zuhair Nashed**, University of Central Florida
Otmar Scherzer, University of Innsbruck

1:00PM (1152) *Variational problems for measure-valued Lagrangeans.*
Umberto Mosco, Worcester Polytechnic Institute (1023-35-984)

1:30PM (1153) *Travel Time Tomography and Lens Rigidity.*
Gunther Uhlmann, University of Washington (1023-58-1401)

2:00PM (1154) *Ultrasound Absorption vs. Causality & Hyperbolicity.*
Sarah K. Patch, Department of Physics, UW Milwaukee (1023-44-1239)

2:30PM (1155) *Sparsity- and continuity-promoting seismic image recovery with curvelet frames.*
Felix J. Herrmann, EOS, UBC, Vancouver, Canada (1023-86-555)

3:00PM ► (1156) *Multilayer segmentation and application to MRI brain imaging.* Preliminary report.
Ginmo Chung and **Luminita Aura Vese***, UCLA (1023-35-1914)

3:30PM (1157) *Parameter Identification in Elliptic Inverse Problems and in Variational and Quasi-variational Inequalities.*
Akhtar A. Khan, University of Wisconsin-Barron County (1023-49-1885)

4:00PM (1158) *A segmentation algorithm based on convex duality.*
Selim Esedoglu, University of Michigan (1023-49-1898)

4:30PM (1159) *Regularization of systems of nonlinear ill-posed equations.*
Antonio Leitao, Federal Univ of St Catarina (1023-65-929)

5:00PM (1160) *Modified Back-Projection Methods for Synthetic Aperture Radar Imaging.*
Fengshan Liu*, Delaware State University, **Guoping Zhang**, University of Texas at Pan American, **Jiguang Sun** and **Xiquan Shi**, Delaware State University (1023-86-1465)

5:30PM (1161) *Electrical Impedance Tomography with Interior Measurements.*
Alexandru Tamasan, University of Central Florida (1023-35-1655)

6:00PM ► (1162) *On Stability of a Class of Nonsmooth Dynamic Systems.*
Chao Zhu*, **George Yin** and **Q. S. Song**, Wayne State University (1023-93-81)

AMS Special Session on Numerical Relativity, II

1:00 PM - 5:55 PM

Organizers: **Alexander M. Alekseenko**, California State University Northridge
Arup Mukherjee, Montclair State University

1:00PM ► (1163) *Binary Black Hole Simulations and the Hunt for Gravitational Waves.*
Pablo Laguna* and **Deirdre M. Shoemaker**, Penn State University (1023-83-1145)

2:00PM ► (1164) *A Proposal to Numerically Simulate a Cosmic Shock Wave by Use of a Locally Inertial Glimm Scheme.* Preliminary report.
Blake Temple, University of California, Davis (1023-65-1882)

2:30PM (1165) *A minimization problem for the lapse and the initial-boundary value problem for Einstein's field equations.*
Gabriel Nagy, University of California at San Diego, and **Olivier Sarbach***, Universidad Michoacana de San Nicolas de Hidalgo (1023-83-372)

3:00PM (1166) *Geometric discretisation of General Relativity.*
Jörg Frauendiener, Institut für Astronomie und Astrophysik, Universität Tübingen (1023-83-1014)

3:30PM ► (1167) *Towards absorbing outer boundaries in General Relativity.*
Luisa T. Buchman*, Center for Relativity, University of Texas at Austin, and **Olivier C. A. Sarbach**, Universidad Michoacana de San Nicolas de Hidalgo (1023-83-1265)

4:00PM (1168) *Some Results on Constraints in GR.*
Michael J. Holst, UC San Diego (1023-83-1861)

4:30PM (1169) *Simulations of Binary Black Hole Mergers.*
Dale Choi, Supercomputing Center, Korea Institute of Science and Technology Information (1023-83-832)

5:00PM (1170) *Modifying the Einstein equations off the constraint hypersurface.*
J. David Brown, North Carolina State University (1023-83-1548)

5:30PM (1171) *A method for covariant discretization of space-time using Shannon sampling theory.*
Achim Kempf* and **Robert Martin**, University of Waterloo, Canada (1023-83-1751)

AMS Special Session on Arithmetic of Function Fields, II

1:00 PM - 5:55 PM

Organizers: **Allison M. Pacelli**, Williams College
Michael J. Rosen, Brown University

1:00PM (1172) *Isogenous elliptic factors in the Jacobians of curves.*
Jennifer Paulhus, University of Illinois at Urbana-Champaign (1023-11-1216)

1:30PM (1173) *Special values of equivariant p-adic and global L-functions.* Preliminary report.
Cristian D. Popescu, University of California at San Diego (1023-11-1065)

2:00PM (1174) *Hecke Operators and L-series in Characteristic p.* Preliminary report.
David M. Goss, Ohio State University (1023-11-451)

2:30PM (1175) *Simultaneous Prime Values of Polynomials in Positive Characteristic.*
Paul Pollack, Dartmouth College (1023-11-1359)

3:00PM (1176) *Variations of the Sato-Tate Conjecture.* Preliminary report.
Ram Murty, Queen's University, Kingston, Ontario, Canada (1023-11-794)

4:00PM (1177) *Biquadratic Function Fields.*
Qingquan Wu, University of Illinois at Urbana-Champaign, and **Renate Scheidler***, University of Calgary (1023-11-1160)

4:30PM (1178) *Approximatiing Euler Products and Computing the Class Number of an Algebraic Function Field.*
Andreas Stein, University of Wyoming (1023-11-1039)

5:00PM (1179) *Galois Theory for the line over finite fields.*
Jing Long Hoelscher, University of Pennsylvania (1023-14-893)

5:30PM (1180) *The Euclidean Algorithm and Applications to Hyperbolic Geometry.*
Kathleen Petersen, Queen's University (1023-11-1584)

AMS Special Session on Universal Algebra and Order, II

1:00 PM - 5:50 PM

Organizers: **John W. Snow**, Sam Houston State University
Japheth Wood, Bard College

1:00PM (1181) *Can We Change the Paradigm for Reconstruction?*
Bernd S. W. Schroeder, Louisiana Tech University (1023-06-221)

1:30PM (1182) *Free Complete Extension of Distributive Lattices.* Preliminary report.
Aditya K. Nagrath, University of Denver (1023-06-200)

2:00PM (1183) *The Coadunation of Generalized Crowns.*
Rebecca Garcia, Sam Houston State University (1023-06-428)

2:30PM (1184) *Minimal extensions of bounded distributive lattices.* Preliminary report.
M. E. Adams*, State University of New York at New Paltz, and **Jürg Schmid**, University of Bern (1023-06-785)

3:00PM (1185) *Lyndon's algebras and the equational complexity of RRA.* Preliminary report.
Jeremy F. Alm, Department of Philosophy, Iowa State University (1023-03-495)

3:30PM (1186) *A result on Complete Hausdorffness in topological algebras.*
Wolfram Bentz, University of Northern British Columbia (1023-08-434)

4:00PM (1187) *Minimal generating band semigroups.* Preliminary report.
Japheth Wood, Bard College (1023-08-380)

4:30PM (1188) *The free spectrum of the Perkins semigroup is sub-log-exponential.*
Steve Seif, University of Louisville (1023-08-385)

5:00PM ► (1189) *There is no algorithm for deciding whether an equation is compatible with the real line.* Preliminary report.
George F. McNulty, University of South Carolina (1023-08-671)

5:30PM (1190) *Full natural dualities.*
David M. Clark, SUNY New Paltz, **Brian A. Davey**, **Jane G. Pitkethly**, La Trobe University, and **Ross D. Willard***, University of Waterloo (1023-08-1355)

AMS Special Session on Microlocal Analysis and Singular Spaces, III

1:00 PM - 4:40 PM

Organizers: **Paul A. Loya**, Binghamton University
Andras Vasy, Massachusetts Institute of Technology

1:00PM (1191) *Elliptic boundary problems on a class of noncompact manifolds.*
Thomas Krainer, Penn State Altoona (1023-35-1899)

2:00PM (1192) *On the heat trace for cone operators.* Preliminary report.
Juan B. Gil, Penn State Altoona (1023-58-1308)

3:00PM (1193) *Hypoellipticity of $\Box_b$ and vanishing of cohomology.* Preliminary report.
Gerardo A. Mendoza, Temple University (1023-58-685)

4:00PM Discussion.

AMS Special Session on Continuous and Discrete Integrable Systems and Their Applications, II

1:00 PM – 6:15 PM

Organizers: **Wen-Xiu Ma**, University of South Florida
Taixi Xu, Southern Polytechnic State University
Bao-Feng Feng, University of Texas-Pan American
Zhijun Qiao, University of Texas-Pan American

1:00PM (1194) *Chaotic and Periodic Asymptotics for q-Orthogonal Polynomials.*
Mourad E. H. Ismail*, University of Central Florida, and **Ruiming Zhang**, Guangxi Normal University, Guilin City (1023-41-1161)

1:30PM (1195) *Green's function for the second order Askey-Wilson operator.* Preliminary report.
Mizan Rahman, Carleton University (1023-33-386)

2:00PM (1196) *A class of superintegrable systems of Calogero-Moser type.*
Roman G. Smirnov*, Dalhousie University, and **Pavel Winternitz**, University of Montreal and Centre de Recherches Mathematiques (CRM) (1023-53-1024)

2:30PM (1197) *Some Methods for Generating Explicit Solutions to the Generalized KDV Equation and an Associated Hierarchy.*
Paul F. Bracken, University of Texas (1023-35-364)

3:00PM (1198) *Peaked Solitons Equations.* Preliminary report.
Zhijun Qiao, University of Texas - Pan American (1023-35-910)

3:30PM (1199) *Nonlinearization of spectral problem with reality condition.*
Ruguang Zhou, Xuzhou Normal University (1023-37-267)

4:00PM (1200) *Fractional derivatives of products of Airy functions and their applications.*
Vladimir V. Varlamov, University of Texas - Pan American (1023-33-965)

4:30PM (1201) *New Finite-Dimensional Integrable Systems by Reduction.*
Taixi Xu, Southern Polytechnic State University (1023-35-1505)

5:00PM (1202) *A numerical method to Cammassa-Holm and Degasperis-Procesi equations.* Preliminary report.
Bao-Feng Feng, Univ. of Texas-Pan American (1023-45-1480)

5:30PM (1203) *Some properties of higher-order mappings and their ultra-discrete analogues.*
Kenichi Maruno, University of Texas-Pan American (1023-39-1391)

6:00PM (1204) *Integrable systems.*
Peter Lax, New York University, Courant Institute (1023-35-1920)

MAA Minicourse #15: Part A

1:00 PM – 3:00 PM

Geometry with history for teaching teachers.
Organizers: **David W. Henderson**, Cornell University
Daina Taimina, Cornell University

MAA Minicourse #2: Part B

1:00 PM – 3:00 PM

Some deterministic models in mathematical biology and their simulations.
Organizers: **James F. Selgrade**, North Carolina State University
Cammey E. Cole, Meredith College
Hüseyin Koçak, University of Miami, Coral Gables

MAA Minicourse #7: Part B

1:00 PM – 3:00 PM

Directing undergraduate research.
Organizer: **Aparna W. Higgins**, University of Dayton

AMS Session on Algebra and Group Theory, III

1:00 PM – 5:40 PM

1:00PM (1205) *Construction of the Irreducuble characters of the Heisenberg group and a similar special group.*
Mohammad Reza Darafsheh, University of Tehran, Iran, and **Manouchehr Misaghian***, Johnson C. Smith University (1023-20-1493)

1:15PM (1206) *Graph Braid Groups.*
Daniel S. Farley*, Miami University of Ohio, and **Lucas Sabalka**, University of California, Davis (1023-20-1518)

1:30PM (1207) *On growth series of Coxeter groups.*
Patrick Bahls, University of North Carolina, Asheville (1023-20-1778)

1:45PM (1208) *Using Formations to Determine Factorizations.* Preliminary report.
Joseph Kirtland, Marist College (1023-20-219)

2:00PM (1209) *Almost pure subgroups of locally compact abelian groups.* Preliminary report.
Peter Loth, Sacred Heart University (1023-20-263)

2:15PM (1210) *The Strong Symmetric Genus of the Finite Coxeter Groups.*
Michael A. Jackson, King College (1023-20-371)

2:30PM (1211) *Capability of p-nilpotent products of cyclic p-groups.*
Arturo Magidin, University of Louisiana at Lafayette (1023-20-38)

2:45PM (1212) *Zassenhaus Rings of Finite Rank.*
Joshua Buckner, Baylor University (1023-20-420)

3:00PM (1213) *Central Extensions and Unramified Brauer Groups.*
Fedor Bogomolov, CIMS-New York University, and **Jorge Maciel***, BMCC-The City University of New York (1023-20-519)

3:10PM Break.

3:30PM (1214) *Local Characterization of LFS-Groups of p-Type.* Preliminary report.
Stefaan D. Delcroix, California State University, Fresno (1023-20-596)

3:45PM (1215) *For a given prime p, what is the smallest nonabelian simple group whose order is divisible by p?*
Gabriela Mendoza, State University of New York at Binghamton (1023-20-680)

4:00PM (1216) *Variations on a Theme by Desmond MacHale.*
Luise-Charlotte Kappe*, **Gabriela Mendoza**, State University of New York at Binghamton, and **Michael Ward**, Western Oregon University (1023-20-682)

4:15PM (1217) *Subgroups in a Direct Product that Satisfy the Strong Frattini Argument.*
Joseph Evan, King's College (1023-20-774)

4:30PM (1218) *On the Sources of Simple Modules in Certain Blocks.*
Adam D. Salminen, University of Evansville (1023-20-99)

4:45PM (1219) *Small spherical nilpotent orbits and K-types of Harish Chandra modules.* Preliminary report.
Donald R. King, Northeastern University (1023-22-1597)

5:00PM (1220) *Completions of altered topological subgroups of $\mathbb{R}^n$.*
Jon W. Short, Sam Houston State University (1023-22-1610)

5:15PM (1221) *Characterization of simplicity and cancellativity in βS.*
Neil Hindman*, Howard University, and **Dona Strauss**, University of Hull (1023-22-357)

5:30PM (1222) *The supremum of the set of pseudocompact group topologies.*
W. W. Comfort*, Wesleyan University, and **Jan van Mill**, Vrije Universiteit (1023-22-947)

AMS Session on Combinatorics, II

1:00 PM – 5:40 PM

1:00PM (1223) *Constructing m-articulate collections of de Bruijn sequences.*
Atoshi Chowdhury, Princeton University (1023-05-1383)

1:15PM ► (1224) *Magic labelings of directed graphs.* Preliminary report.
Alison M. Marr, Southern Illinois University (1023-05-1385)

1:30PM (1225) *Helly and Radon Independence in Clone-Free Multipartite Tournaments.* Preliminary report.
Darren B. Parker*, University of Dayton, **Randy F. Westhoff** and **Marty J. Wolf**, Bemidji State University (1023-05-1469)

1:45PM (1226) *Minimum cycle bases of direct products of bipartite graphs.*
Richard Hammack, Virginia Commonwealth University (1023-05-1472)

2:00PM ► (1227) *Enumeration of Orientable Embeddings of Odd Graphs.*
Brent N. Stephens* and **Xiaoya Zha**, Middle Tennessee State University (1023-05-1512)

2:15PM ► (1228) *Extending the Freiman $3k-3$ Theorem to distinct sets.* Preliminary report.
David J. Grynkiewicz*, **Oriol Serra**, Universitat Politecnica de Catalunya, Spain, and **Yahya Hamidoune**, Universite de Paris VI (1023-05-1526)

2:30PM ► (1229) *Density Relations in Simple Graphs.*
Daniel Felix, University of California, San Diego (1023-05-1602)

2:45PM (1230) *Generating tree isomorphisms for pattern-avoiding involutions.*
Aaron D. Jaggard*, Tulane University, and **Joseph J. Marincel**, Washington University (1023-05-1618)

3:00PM ► (1231) *Combinatorial Methods in Coordinate Percolation.* Preliminary report.
Elizabeth Moseman, Dartmouth College (1023-05-1619)

3:15PM ► (1232) *Geometric structure of sumsets within their convex hulls.*
Jaewoo Lee, Borough of Manhattan Community College, The City University of New York (1023-05-1412)

3:30PM ► (1233) *Intersection Graphs Generated By An Edge Decomposition.*
Robert A. Beeler, Clemson University (1023-05-1651)

3:45PM (1234) *G-Multiparking Functions and Dirichlet Configurations.*
Dimitrije N Kostic, Texas A&M University (1023-05-1705)

4:00PM (1235) *Interval Avoidance in the Symmetric Group.*
Isaiah P. Lankham* and **Alexander K. Woo**, UC Davis (1023-05-1711)

4:15PM ► (1236) *The Jump Number of a Split Graph.*
Mike Fisher, California State University, Fresno (1023-05-1842)

4:30PM ► (1237) *On the Likelihood of Comparability in Bruhat Order.*
Adam J. Hammett* and **Boris G. Pittel**, The Ohio State University (1023-05-189)

4:45PM ► (1238) *Properties of Permutation Tableaux.*
Ariel R. Levavi, Carnegie Mellon University (1023-05-236)

5:00PM Break.

► (1239) *The Moebius transform of the triangular numbers.*
Steve Butler, University of California, San Diego (1023-05-435)

5:15PM (1240) *Applications of hypergraph zeta functions.*
Christopher K. Storm, Dartmouth College (1023-05-286)

5:30PM ► (1241) *Combinatorial Sums via Finite Differences.*
Michael Z. Spivey, University of Puget Sound (1023-05-304)

AMS Session on Analysis and Functional Analysis, II

1:00 PM – 5:25 PM

1:00PM (1242) *Rellich type inequality on Carnot Groups.*
Ismail Kombe, Oklahoma City University (1023-43-1180)

1:15PM (1243) *Characterization Of bounded/compact composition operators on the 'Hardy–Simirnov' spaces.* Preliminary report.
Abebaw Tadesse, Langston University (1023-43-336)

1:30PM (1244) *Transference of Maximal Multiplier Operators on Local Hardy-Lorentz Spaces.*
Daning Chen, Jackson State University (1023-43-873)

1:45PM (1245) *A Discrepancy Principle for Local Regularization.*
Cara D. Brooks* and **Patricia K. Lamm**, Michigan State University (1023-45-1622)

2:00PM (1246) *Local Regularization Methods for Nonlinear Volterra Integral Equations of Hammerstein Type.*
Xiaoyue Luo* and **P. K. Lamm**, Michigan State University (1023-45-1685)

2:15PM (1247) *A Poincaré inequality on the complex sphere in CR setting.*
Lijing Sun, Wayne State University (1023-46-104)

2:30PM (1248) *Almost Weakly Compact Operators.*
Ioana Ghenciu*, University of Wisconsin, River Falls, and **Paul Lewis**, University of North Texas, TX (1023-46-1223)

2:45PM ► (1249) *A Dynamic Equation on a Time Scale.*
Allan C. Peterson*, University of Nebraska-Lincoln 68588-0130, **Lynn Erbe**, University of Nebraska, and **Samir Saker**, Mansoura University (1023-39-748)

3:00PM (1250) *Topological Structure of the Unitary Group of Certain C*-Algebras.*
Bogdan Costin Visinescu, University of Cincinnati (1023-46-1408)

3:15PM (1251) *On the Rellich inequality.*
Ritva M. Hurri-Syrjanen*, University of Helsinki, and **David E. Edmunds**, Cardiff University (1023-46-1496)

3:30PM (1252) *On Ergodic type theorems for finite Jordan algebras.*
Genady Ya. Grabarnik, T.J. Watson IBM Reserach Center, **Alexander A. Katz***, St. John's University, and **Laura Shwartz**, University of South Africa (1023-46-1737)

3:45PM (1253) *Isometries on A^{Φ}.* Preliminary report.
Nadia J Gal, University of Memphis (1023-46-1897)

4:00PM (1254) *On the "Multiple of the Inclusion plus Compact" Problem.*
G. Androulakis and **F. Sanacory***, University of South Carolina (1023-46-212)

4:15PM (1255) *On the existence of eigenvalues of Toeplitz operators associated with representing measures on multiply connected planar regions.*
Cyrus P. Aryana, Saginaw Valley State University (1023-46-540)

4:30PM (1256) *On the properties of endogenous mortgage rates.* Preliminary report.
Yevgeny Goncharov, Florida State University (1023-46-63)

4:45PM (1257) *Flows of weights associated with AFD real factors of type III.* Preliminary report.
Shukhrat M. Usmanov, Ashford University (1023-46-812)

5:00PM (1258) *The q-concavity and q-convexity constants in Lorentz spaces.*
Anna Kamińska and **Anca M. Parrish***, University of Memphis (1023-46-895)

5:15PM (1259) *On Gelfand-Naimark type theorems for representations of nuclear barelled real locally C*- and locally JB-algebras.*
Alexander A. Katz, St. John's University, **Oleg Friedman***, University of South Africa, and **Roman Kushnir**, St. John's University (1023-46-980)

AMS Session on Geometry and Topology, IV

1:00 PM – 5:55 PM

1:00PM (1260) *The locally finite functor and the Steenrod algebra.* Preliminary report.
Hayden Harker, Vassar College (1023-55-1590)

1:15PM (1261) *Khovanov Type Categorification for the Tutte Polynomial.*
Edna Fanny Jasso-Hernandez* and **Yongwu Rong**, The George Washington University (1023-55-1604)

1:30PM (1262) *Local Conditions for a 2-dimensional Duality Group.* Preliminary report.
Risto Atanasov, Binghamton University (1023-55-1696)

1:45PM (1263) *Relative Homotopy Groups of Modules - from a Different Viewpoint.*
C. Joanna Su, Providence College (1023-55-1787)

2:00PM ► (1264) *Periodic Dold Sequences.*
Micah W. Chrisman, University of Hawaii at Manoa (1023-55-344)

2:15PM (1265) *Rank of the fundamental group of any component of a function space.*
Samuel B. Smith*, Saint Joseph's University, and **Gregory Lupton**, Cleveland State University (1023-55-40)

2:30PM (1266) *Comparing self-avoiding walks and polygons on hyperbolic Coxeter groups.*
Jason S. Bode, Cornell University (1023-55-795)

2:45PM Break.

3:00PM (1267) *Kauffman-Harary Conjecture for Virtual Knots.*
Mathew Williamson, University of South Florida (1023-55-911)

3:15PM ► (1268) *Polynomial knots.* Preliminary report.
Alan Durfee, Mount Holyoke College (1023-57-1159)

3:30PM ► (1269) *Menasco normal form and recognizing unknot diagrams.*
Chan-Ho Suh, University of California at Davis (1023-57-1335)

3:45PM ► (1270) *Coloring Random Knots.* Preliminary report.
Enver Karadayi, University of South Florida (1023-57-1386)

4:00PM (1271) *Stable Ribbon Graphs and Quantum Master Equation.* Preliminary report.
J. Javier Zuniga, University of Minnesota (1023-57-1698)

4:15PM (1272) *Turaev torsion and cohomology determinants for 3-manifolds with boundary.* Preliminary report.
Christopher B. Truman, University of Maryland (1023-57-1755)

4:30PM ► (1273) *Statistical methods for studying spatial properties of random polygonal knots.*
Eric J. Rawdon, University of St. Thomas (1023-57-939)

4:45PM (1274) *Residue Formulation of the Chern Character on Smooth Manifolds.*
Dmitry M. Gerenrot, Georgia Institute of Technology (1023-58-1471)

5:00PM (1275) *Singularities of equivariant lagrangian mean curvature flow.*
Konrad Groh, Institut fuer Differentialgeometrie, Hannover (1023-58-339)

5:15PM (1276) *Dehn surgery on singular knots.*
Simrat M. Ghuman, San Francisco, California, **Larry M. Granda*** and **Chichen M. Tsau**, Saint Louis University (1023-57-74)

5:30PM ► (1277) *Generalized Coloring and n-String Tangles.*
Isabel K. Darcy, University of Iowa, and **Junalyn P. Navarra-Madsen***, Texas Woman's University (1023-57-111)

5:45PM ► (1278) *Upper Bounds for Regular Stick Numbers of Torus Knots.* Preliminary report.
Timothy D. Comar* and **Debra Witczak**, Benedictine University (1023-57-113)

MAA Session on Teaching Innovations in Real Analysis, II

1:00 PM – 3:35 PM

Organizers: **Robert W. Vallin**, Slippery Rock University
Erik O. Talvila, University College of the Fraser Valley

1:00PM ► (1279) *Getting students to prove theorems in analysis.*
William S. Mahavier, Emory University (1023-Q1-1572)

1:20PM ► (1280) *When I switched from lecturing to using the Moore Method...*
Bernd E. Rossa, Xavier University (Cincinnati) (1023-Q1-1127)

1:40PM (1281) *Facilitating Student Understanding of Concepts in Real Analysis.* Preliminary report.
Michael L. Berry, West Virginia Wesleyan College (1023-Q1-1296)

2:00PM (1282) *Technical illustration for second semester real analysis.*
Mark McClure, University of North Carolina at Asheville (1023-Q1-844)

2:20PM (1283) *Using History to Understand How To Teach Real Analysis.*
David M. Bressoud, Macalester College (1023-Q1-618)

2:40PM (1284) *Introductory Real Analysis - Let Series be Your Guide.*
Robert Rogers, SUNY Fredonia (1023-Q1-758)

3:00PM (1285) *Using Calculus to Motivate Compactness and Connectedness.*
Michael J. Schramm, Le Moyne College (1023-Q1-1272)

3:20PM (1286) *Using a Laboratory Approach in the Teaching of Real Analysis.*
Kirk Weller*, University of Michigan Flint, and **Joanne Snow**, Saint Mary's College (1023-Q1-1130)

MAA Session on Mathematics Experiences in Business, Industry and Government

1:00 PM - 4:30 PM

Organizers: **Philip E. Gustafson**, Mesa State College
Michael Monticino, University of North Texas

1:00PM Opening Remarks and BIG SIGMAA Announcements.

1:15PM (1287) *Teller Staffing in Retail Banks.* Preliminary report.
Travis Cogdill* and **Michael Monticino**, University of North Texas (1023-L1-1405)

1:35PM (1288) *Statistics of the Peak Sidelobe Distribution for Binary Codes.* Preliminary report.
Matthew Ferrara, Michael Kupferschmid, RPI, and **Gregory E. Coxson***, Technology Service Corporation (1023-L1-1812)

1:55PM (1289) *Fractal measures to quantify agent-based combat with EINSTein.*
David S. Mazel*, Technology Service Corporation, and **Andy Ilachinski**, The CNA Corporation (1023-L1-500)

2:15PM (1290) *Characterizing internal stress states in advanced ceramics using fractal analysis.* Preliminary report.
Leigh L. Noble, United States Military Academy & Army Research Lab (1023-L1-1753)

2:35PM (1291) *Number Theory and a New GPS Signal.*
Joseph J. Rushanan, The MITRE Corporation (1023-L1-976)

2:55PM (1292) *Norbert Wiener Center - mission and methods.*
John J. Benedetto* and **Ioannis Konstantinidis**, Norbert Wiener Center, University of Maryland, College Park (1023-L1-1455)

3:15PM (1293) *Statistics to Detect Danger Underground.* Preliminary report.
George W. Heine, Bureau of Land Management (1023-L1-1902)

3:35PM (1294) *Why Consulting Firms Need Mathematicians.*
Carla D. Martin, James Madison University (1023-L1-223)

3:55PM (1295) *My Experiences as a Summer Contract Employee at a Pharmaceutical Company.*
Paul R. Coe, Dominican University (1023-L1-1857)

4:15PM (1296) *A Model of Randomized Drug Testing.* Preliminary report.
Paul H. Schuette, Meredith College (1023-L1-1352)

MAA Session on Building Diversity in Advanced Mathematics: Models that Work, II

1:00 PM - 3:55 PM

Organizers: **Patricia Hale**, California State Polytechnic University, Pomona
Abbe H. Herzig, University of Albany, SUNY

1:00PM (1297) *Successful Practices on Integrating Diversity into the Teaching of General Education Mathematics courses at Northern State University.*
A. S. Elkhader, Northern State University (1023-E1-1211)

1:20PM (1298) *Project SMART III - Characteristics of a Successful NREUP at a Two-Year Institution.*
John J. Morrell, Atlanta Metropolitan College (1023-E1-1636)

1:40PM (1299) *A "DeVry-Style" REU: The Outcome of a Summer Semester of Undergraduate Research in Probability and Networking at DeVry.* Preliminary report.
Dov. N Chelst, DeVry University (1023-E1-1835)

2:00PM (1300) *Strategies for Inclusion in the UC Davis Math Modeling Experience for Undergraduates and High School Students.* Preliminary report.
Sarah A. Williams, Graduate Group in Applied Mathematics, University of California, Davis (1023-E1-1739)

2:20PM (1301) *Academic Excellence Workshops, Why They Work at Cal Poly Pomona.*
Patricia Hale, California State Polytechnic University, Pomona (1023-E1-1176)

2:40PM (1302) *Native American-based Materials for Undergraduate Mathematics Courses.*
Charles Peter Funkhouser*, University of Montana Missoula, and **A. Duane Porter**, University of Wyoming (1023-E1-59)

3:00PM (1303) *A Diversity Perspective.*
Satish C. Bhatnagar, University of Nevada Las Vegas (1023-E1-283)

3:20PM (1304) *The Impact of Departmental Leadership on the Success of Women in Doctoral Level Mathematical Sciences.*
Orpha K. Ongiti* and **Abbe H. Herzig**, University at Albany (1023-E1-804)

3:40PM (1305) *From the Perspective of Lee Lorch.*
Lee Lorch, York University (1023-E1-1552)

MAA Session on Countering "I Can't Do Math": Strategies For Teaching Under-Prepared, Math-Anxious Students, II

1:00 PM - 5:15 PM

Organizers: **Winston Crawley**, Shippensburg University
Kim Presser, Shippensburg University

1:00PM (1306) *How Can I Help My Students Enjoy Learning Mathematics Instead of Being Afraid of It? Fostering Positive Mathematics Experiences With Special Needs and English Language Learner Populations.*
Joyce F. Fischer, Texas State University-San Marcos (1023-G5-1312)

1:20PM (1307) *Linking Polynomials to Whole Numbers to Ease the Anxiety of the Under-Prepared Students.*
Murray H. Siegel, SC GSSM (1023-G5-210)

1:40PM ► (1308) *Engaging Developmental Mathematics Students with Activities: A First Look at Quadratics.* **Gary Simundza***, Wentworth Institute of Technology, and **Nancy Crisler**, Washington University (1023-G5-66)

2:00PM (1309) *How to improve student's performance in Developmental Mathematics course with the use of computer-aided instruction and a personal touch.* **Wendiann Sethi**, Seton Hall University (1023-G5-1168)

2:20PM (1310) *Changing Paradigms: A department in a state of flux leading to technology transitions which affect student learning.* Preliminary report. **Hassan Moore*** and **Gerald Y. Agbegha**, Johnson C. Smith University (1023-G5-1638)

2:40PM (1311) *The Math "Journal" Assignment: Finding Applications, Seeing Connections, and Getting Over that Seventh Grade Algebra Class.* **Carrie Muir**, University of Colorado - Boulder (1023-G5-1777)

3:00PM (1312) *Improving Student Performance in a College Core Math Program by Emphasizing Fundamental Mathematical Skills.* Preliminary report. **Heather Stevenson*** and **Gerald Kobylski**, United States Military Academy (1023-G5-1714)

3:20PM ► (1313) *The Thrill of Victory: Conquering Anxiety with Mastery Grading.* **Penelope H. Dunham**, Muhlenberg College (1023-G5-1113)

3:40PM ► (1314) *Transitioning to College Mathematics - Creating a Program to Help Developmental Level Students Succeed in College Level Mathematics.* Preliminary report. **J. Winston Crawley*** and **Kimberly J. Presser**, Shippensburg University (1023-G5-881)

4:00PM (1315) *Strategies for Reaching Under-prepared Math Students.* **Ann C. Hanson**, Columbia College (1023-G5-621)

4:20PM ► (1316) *Learning Disabilities and the Post-Secondary Math Student.* **Mary Rack**, Johnson County Community College (1023-G5-101)

4:40PM ► (1317) *Elementary Teachers' Perceptions of the Nature of Mathematics and Math Anxiety: Implications for Teaching Mathematics.* **Teodora B. Cox**, SUNY Fredonia (1023-G5-1759)

5:00PM ► (1318) *For Victims of the Mathematics-Distress Syndrome: A Radical Alternative Curriculum.* Preliminary report. **Clyde Greeno**, The MALEI Mathematics Institute (1023-G5-925)

MAA Session on Innovative Examples of Using Graphs in Statistics

1:00 PM – 5:30 PM

Organizers: **Christopher J. Lacke**, Rowan University
Ginger Holmes Rowell, Middle Tennessee State University

1:00PM ► (1319) *Statistics Before Your Eyes: Photographs of Statistical Concepts.* **Robert W. Jernigan**, American University (1023-J5-834)

1:25PM ► (1320) *Sampling + Simulation = Statistical Understanding: Graphical Simulations in Excel for Introductory Statistics.* **Sheldon P. Gordon**, Farmingdale State University of New York, and **Florence S. Gordon***, New York Institute of Technolgy (Retired) (1023-J5-452)

1:50PM ► (1321) *What is R^2? Using Dynamic Graphs to Illustrate Ideas in Regression.* **Robin H. Lock**, St. Lawrence Uinversity (1023-J5-1451)

2:15PM ► (1322) *Using Boxplots and Histograms to Draw Inferences.* **Kris H. Green**, St. John Fisher College (1023-J5-509)

2:40PM ► (1323) *Using Graphs To Assess Normality When Performing a t-Test for a Population Mean.* **Christopher J. Lacke**, Rowan University (1023-J5-1459)

3:05PM ► (1324) *Using Dynamic, Interactive Models to Teach Statistical Concepts.* **Michael T. Marsh**, Shippensburg University of Pennsylvania (1023-J5-572)

3:30PM ► (1325) *Graphical Methods for Teaching and Assessing the IID Assumption.* **Mark H. Inlow**, Rose-Hulman Institute of Technology (1023-J5-1784)

3:55PM ► (1326) *Creating Graphs for Better Analyses, Explanations, and Presentations.* **John D. McKenzie***, Babson College, and **Robert N. Goldman**, Simmons College (1023-J5-1746)

4:20PM ► (1327) *Graphing Data Badly, or Things I Swear my Statistics Teacher Never Told Me!* **Patricia B. Humphrey**, Georgia Southern University (1023-J5-1564)

4:45PM ► (1328) *Examples of Misdisplaying Statistical Graphs in Presentations.* Preliminary report. **Jialing Dai**, Dept. of Mathematics, University of the Pacific (1023-J5-1694)

5:10PM (1329) *Graphs: Different Faces of Data.* **Madhuri S. Mulekar**, University of South Alabama (1023-J5-1627)

MAA Session on The Mathematics of Sudoku and Other Puzzles, II

1:00 PM – 3:35 PM

Organizer: **Laura A. Taalman**, James Madison University

1:00PM ► (1330) *Some Observations on the Sudoku Puzzle.* Preliminary report. **Louis M. Beaugris**, Kean University (1023-M1-1824)

1:20PM ► (1331) *Proofs, Equivalence Classes and Groups Sudoku-Style.* **Cynthia J. Woodburn**, Pittsburg State University (1023-M1-1460)

1:40PM ► (1332) *One-and-one-third orthogonal Latin squares.* Preliminary report. **W. D. Wallis**, Southern Illinois University, Carbondale, IL (1023-M1-1905)

2:00PM ► (1333) *Partial Latin Squares with the Sudoku Structure.* Preliminary report. **Rommel G. Regis**, Cornell University (1023-M1-1795)

2:20PM ► (1334) *On Mutually Orthogonal Sudokus.* Preliminary report. **Michael Anthony Pohl**, University of Richmond (1023-M1-886)

2:40PM ► (1335) *Two methods for counting small sudoku puzzles.* **John Lorch*** and **Crystal Lorch**, Ball State University (1023-M1-1916)

3:00PM *Beaucoup de Sudoku.*
► (1336) **Carlos Arcos, Gary Brookfield** and **Mike Krebs***, California State University, Los Angeles (1023-M1-70)

3:20PM *Book Embeddings of Sudoku Graphs.* Preliminary
► (1337) report.
Joyce Maxine Music* and **Robin Blankenship**, Morehead State University (1023-M1-1267)

MAA General Contributed Paper Session, VI

1:00 PM – 4:55 PM

Organizers: **Eric S. Marland**, Appalachian State University
Jay A. Malmstrom, Oklahoma State Community College

1:00PM *A new proof of a theorem on the closure ordering*
► (1338) *on nilpotent orbits of algebraic groups of Type A.* Preliminary report.
Joseph A. Fox*, Salem State College, **Terrell L. Hodge**, Western Michigan University, and **Brian J. Parshall**, University of Virginia (1023-Z1-1286)

1:15PM *Ideals in Dorroh Extensions of Rings.*
► (1339) **Kent M. Neuerburg*** and **G. Alan Cannon**, Southeastern Louisiana University (1023-Z1-214)

1:30PM *Primes and twin primes near some large numbers.*
(1340) **Balakrishnan Variyath Uckath**, Eritrea Institute of Technology (1023-Z1-1586)

1:45PM *The Syllogism Needed to Negate the Definition of a*
(1341) *Converging Sequence.*
Chokri Cherif* and **Avraham Goldstein**, BMCC-City University of New York (1023-Z1-587)

2:00PM *A Note on Weighted Identric and Logarithmic*
► (1342) *Means.*
Kendall C. Richards and **Hilari Celeste Tiedeman***, Southwestern University (1023-Z1-522)

2:15PM *Inversion Cosets in Music Theory.*
► (1343) **Craig M. Johnson**, Marywood University (1023-Z1-58)

2:30PM *Developing a successful undergraduate colloquium*
► (1344) *course.*
Darren E. Mason* and **David A. Reimann**, Albion College (1023-Z1-1695)

2:45PM *Success Stories from a First Semester Seminar for*
► (1345) *Math Majors.*
Melvin G. Royer, Indiana Wesleyan University (1023-Z1-1171)

3:00PM *Redesigning the first course of differential*
► (1346) *equations.* Preliminary report.
Pangyen Ben Weng, Ramapo College of New Jersey (1023-Z1-1199)

3:15PM *Writing in the Vector Calculus class.*
► (1347) **Constantin Dorin Dumitraşcu**, University of Arizona, Tucson AZ (1023-Z1-1363)

3:30PM *Some Determinants of Student Performance in the*
► (1348) *Course of Introductory Statistics.*
Jen-Ting Wang*, SUNY-Oneonta, NY, and **Shu-Yi Tu**, University of Michigan – Flint (1023-Z1-1764)

3:45PM *Come on down! Learn about the probability of*
► (1349) *winning a car on* The Price is Right*!*
Joe A. Stickles, Jr., Millikin University (1023-Z1-1147)

4:00PM *Developmental Mathematics Program at the*
(1350) *University of Maryland: 5 years of Success.*
Denny Gulick, MD (1023-Z1-974)

4:15PM *A team-teaching (Math and CS) approach to a*
► (1351) *Discrete Mathematics course.*
Rachelle C. DeCoste, United States Military Academy, West Point (1023-Z1-470)

4:30PM *Incorporating Software in College Algebra: Five*
► (1352) *Years Later.*
Michelle R. DeDeo, Univ. of North Florida (1023-Z1-208)

4:45PM *A π-less Buffon's Needle Problem.*
► (1353) **David Richeson**, Dickinson College (1023-Z1-1121)

NAM Granville-Brown-Haynes Session of Presentations by Recent Doctoral Recipients in the Mathematical Sciences

1:00 PM – 3:35 PM

Organizer: **Dawn A. Lott**, University of Maryland

1:00PM *Elements belonging to 2-element cocircuits in*
► (1354) *connected matroids.*
Joe Anderson*, Mississippi Valley State University, and **Haidong Wu**, University of Mississippi (1023-05-648)

1:20PM *Clones and Minors in Matroids.*
(1355) **Carla D. Cotwright**, Wake Forest University (1023-05-690)

1:40PM *Finding Optimal Orbits on Chaotic Systems.*
► (1356) **Angela E. Grant**, Northwestern University (1023-37-647)

2:00PM *The Semiparametric Exchangeable Model.*
► (1357) **Stephine L. Keeton***, U.S. Food and Drug Administration, and **Hanxiang Peng**, The University of Mississippi (1023-00-1606)

2:20PM *The Mathematics Coach and the Implementation of*
(1358) *Performance Standards.*
Samuel Obara, Texas State University, San Marcos (1023-97-1179)

2:40PM *Large Circuit Pairs in Matroids.*
(1359) **Bryan L. Williams**, Hampton University (1023-05-646)

3:00PM *Graph Groupoids and their topology.*
(1360) **Adrian A. Wilson**, The University of Mississippi (1023-54-568)

3:20PM *Knots With Infinitely Many Incompressible Seifert*
(1361) *Surfaces.*
Robin Todd Wilson, UC Santa Barbara (1023-57-504)

MAA Committee on the Undergraduate Program in Mathematics Panel Discussion

1:00 PM – 2:20 PM

The "bridge" course.
Organizer: **George R. Exner**, Bucknell University
Moderator: **George R. Exner**
Panelists: **David M. Bressoud**, Macalester College
Amy Cohen, Rutgers University
Barbara E. Edwards, Oregon State University
Annie Selden, New Mexico State University

ASL Contributed Papers

2:00 PM – 4:50 PM

Organizer: **Marcia Groszek**, Dartmouth College

2:00PM *On the failure of Craig interpolation in dynamic*
(1362) *logics.*
Katalin Bimbó, Indiana University

2:25PM *Proof theory for admissible rules.*
(1363) **George Metcalfe***, Vanderbilt University, and **Rosalie Iemhoff**, Utrecht University

2:50PM *Symmetric propositions and logical quantifiers.*
(1364) **R. Gregory Taylor**, Manhattan College

3:15PM *Hypersets with a universal set—two*
(1365) *axiomatizations for Bi-AFA⁻ set theories.*
Stephen Harnish, Bluffton University

3:40PM *The notion of 1-consistency and Gödel polynomials.*
(1366) **Yvon Gauthier**, University of Montreal

4:05PM *On computer robots recognizing their own*
(1367) *geometric self-consistency.*
Dan E. Willard, SUNY Albany

4:30PM *A note on the definition of a multisubset.*
(1368) **Dasharath Singh***, Ahmadu Bello University, and **J.N. Singh**, Barry University

RMMC Board of Directors

2:15 PM – 4:10 PM

MAA Presentations by Teaching Award Recipients

2:30 PM – 4:00 PM

(1369) *My practice of mathematics.*
Jennifer J. Quinn, Association for Women in Mathematics (1023-A0-1188)

(1370) *Title to be announced.*
Michael Starbird, University of Texas at Austin

AMS Committee on Science Policy Panel Discussion

2:30 PM – 4:00 PM

NSF funding for mathematics.
Organizer: **De Witt L. Sumners**, Florida State University
Panelists: **Tony Chan**, NSF
Peter March, NSF

MAA Panel Discussion

2:30 PM – 3:50 PM

Attracting underrepresented students to graduate study through research.
Organizers: **William Hawkins, Jr**, MAA and the University of the District of Columbia
Robert E. Megginson, University of Michigan, Ann Arbor
Panelists: **Carlos Castillo-Chavez**, Arizona State University
Dennis Davenport, Miami University of Ohio
Lloyd E. Douglas, National Science Foundation
Herbert A. Medina, Loyola Marymount University
Ivelisse M. Rubio, University of Puerto Rico
Michelle D. Wagner, National Security Agency
Robert E. Megginson

MAA Minicourse #14: Part B

3:30 PM – 5:30 PM

Contemporary college algebra: A refocused college algebra course.
Organizers: **Donald B. Small**, U. S. Military Academy
Laurette Foster, Prairie View A&M University

MAA Minicourse #3: Part B

3:30 PM – 5:30 PM

A tool to implement quantitative literacy (QL): Spreadsheets Across the Curriculum.
Organizers: **Semra Kiliç-Bahi**, Colby-Sawyer College
Gary T. Franchy, Davenport University
Cheryl Coolidge, Colby-Sawyer College
William A. Thomas, Colby-Sawyer College

MAA Minicourse #9: Part B

3:30 PM – 5:30 PM

Evaluating student presentations in mathematics.
Organizers: **Suzanne Dorée**, Augsburg College
Richard J. Jardine, Keene State College
Thomas J. Linton, Central College

MAA Undergraduate Poster Session

3:30 PM – 5:30 PM

Organizer: **Diana M. Thomas**, Montclair State University

MAA Session on Integrating Mathematics and Biology in Undergraduate Education, II

4:15 PM – 6:10 PM

Organizers: **Glenn W. Ledder**, University of Nebraska-Lincoln
Yajun Yang, Farmingdale State University of New York
Jack Bookman, Duke University
James P. Fulton, Suffolk County Community College

4:15PM *Balancing Selection and The Evolution of Color*
► (1371) *Variation in Pacific Treefrogs (Hyla regilla) - An Interactive Lively Activity Project (ILAP).*
Timothy F. Englund* and **R. Steven Wagner**, Central Washington University (1023-K1-1578)

4:35PM *Using Tic-Tacs to Freshen up Carbon Dating.*
► (1372) Preliminary report.
Shawnee McMurran, US Military Academy (1023-K1-1733)

4:55PM *Leslie Matrices: A Biological Application to Matrices*
► (1373) *and Difference Equations.*
Robert E. Burks* and **Joseph Lindquist**, United States Military Academy (1023-K1-1153)

5:15PM *Discrete Logistic Model in Calculus II.*
► (1374) **Talitha M. Washington**, University of Evansville (1023-K1-1713)

5:35PM (1375) *Biological Applications Across the Mathematics Curriculum at Appalachian State University.*
Katrina M. Palmer* and **Rene Salinas**, Appalachian State University (1023-K1-1218)

► 5:55PM (1376) *CoMBiNe: Teaching modules to encourage cross-education in mathematics and biology classrooms.*
Elsa Schaefer, Marymount University (1023-K1-187)

AMS Mathematical Reviews Reception

6:00 PM - 7:00 PM

NAM Cox-Talbot Address

8:30 PM - 9:15 PM

(1377) *Why "Mathematicians of the African Dispora"?*
Scott Williams, University at Buffalo, SUNY (1023-01-417)

MAA-Project NExT Reception

8:30 PM - 10:30 PM

Organizers: **T. Christine Stevens**, St. Louis University
Joseph A. Gallian, University of Minnesota Duluth
Aparna W. Higgins, University of Dayton

Monday, January 8

MAA Minority Chairs Breakfast Meeting

7:00 AM - 8:45 AM

Joint Meetings Registration

7:30 AM - 4:00 PM

ASL Invited Address

8:00 AM - 8:50 AM

(1378) *Countable group actions and hyperfinite equivalence relations.*
Su Gao, University of North Texas (1023-03-409)

AMS-MAA-MER Special Session on Mathematics and Education Reform, I

8:00 AM - 10:55 AM

Organizers: **William H. Barker**, Bowdoin College
Dale R. Oliver, Humboldt State University
Bonnie S. Saunders, University of Illinois at Chicago
Michael Starbird, University of Texas, Austin

► 8:00AM (1379) *Building a Community of Mathematicians, Teachers, and Educators.*
Al Cuoco, Center for Mathematics Educaiton, and **Glenn Stevens***, Boston University (1023-97-665)

► 8:30AM (1380) *Creating Math Learning Communities Locally and using ITV.*
Max Warshauer*, **Hiroko Warshauer**, **Alex White**, **Terry McCabe** and **Alejandra Sorto**, Texas State University (1023-97-395)

9:00AM (1381) *Connecting Teacher Learning to Classroom Practice: The Story of a Large-scale Professional Community.*
Tom Evitts* and **Kate McGivney**, Shippensburg University (1023-97-625)

► 9:30AM (1382) *Building and Sustaining Communities of Mathematicians and Teachers.*
Joan Ferrini-Mundy, Michigan State University (1023-97-1641)

► 10:00AM (1383) *A Teacher's Perspective on Communities of Mathematicians and Teachers.*
Benjamin J. Sinwell, Montgomery Country Public Schools and Park City Mathematics Institute (1023-97-1214)

► 10:30AM (1384) *A Project-Based Re-Engineering of Business Calculus Focusing on Solving Real Problems Using Models and Technology: Change "Will I Ever Use This?" to "Wow! Math Can Really Help Me!".* Preliminary report.
Bruce Pollack-Johnson, Villanova University (1023-00-871)

AMS-MAA Special Session on History of Mathematics, III

8:00 AM - 10:55 AM

Organizers: **Joseph W. Dauben**, Lehman College
Patti Hunter, Westmont College
Victor J. Katz, University of the District of Columbia
Karen H. Parshall, University of Virginia

8:00AM (1385) *Proof (without Words) in 17th-18th Century China.*
Jiang-Ping Jeff Chen, St. Cloud State University (1023-01-335)

► 8:30AM (1386) *Cramer's Paradox from Euler to Bézout.*
Robert E. Bradley, Adelphi University (1023-01-694)

► 9:00AM (1387) *Publishing Mathematics in 18th-Century France.* Preliminary report.
Robin E. Rider, University of Wisconsin-Madison (1023-01-801)

► 9:30AM (1388) *An Exceedingly Beautiful Theorem: Halley's 1706 edition of Apollonius'* De Sectione Rationis *and his discovery of the anharmonic tangent ratio property for a parabola.* Preliminary report.
Eisso J. Atzema, University of Maine (1023-01-262)

► 10:00AM (1389) *Geometric constructions and algebra: Wanzel's impossibility proof.* Preliminary report.
John McCleary, Vassar College (1023-01-762)

10:30AM (1390) *A Delicate Collaboration: A. Adrian Albert and Helmut Hasse and the Principal Theorem in Division Algebras in the Early 1930's.*
Della D. Fenster*, University of Richmond, and **Joachim Schwermer**, University of Vienna (1023-01-922)

AMS Special Session on Group Representations, Ergodic Theory, and Mathematical Physics: Honoring the Memory of George W. Mackey, III

8:00 AM - 10:55 AM

Organizers: **Robert S. Doran**, Texas Christian University
Calvin C. Moore, University of California Berkeley
Robert J. Zimmer, The University of Chicago

8:00AM (1391) *Recent Applications of Induced Representations.* **Roger Howe**, Yale University (1023-22-62)

9:00AM (1392) *Broken symmetry.* **Palle E. T. Jorgensen**, University of Iowa (1023-47-29)

9:30AM (1393) *Complex methods in harmonic analysis on symmetric spaces.* **Gestur Olafsson**, Louisiana State University (1023-22-981)

10:00AM (1394) *Projective representations and the Mackey obstruction.* Preliminary report. **Judith A. Packer**, University of Colorado, Boulder (1023-22-918)

10:30AM (1395) *Inducing Primitive Ideals.* **Siegfried Echterhoff**, Westfälische Wilhelms-Universität Münster, and **Dana P. Williams***, Dartmouth College (1023-46-338)

AMS Special Session on Mapping Class Groups and Handlebodies, I

8:00 AM - 10:55 AM

Organizers: **Tara E. Brendle**, Louisiana State University
William R. Vautaw, Southeastern Louisiana University

8:00AM (1396) *Injective Simplicial Maps of the Arc Complex.* **Elmas Irmak**, Bowling Green State University, and **John D. McCarthy***, Michigan State University (1023-57-1146)

8:30AM (1397) *Automorphisms of the disk complex.* **Saul Schleimer**, Rutgers - New Brunswick (1023-57-997)

9:00AM (1398) *Infinite Presentations of the Torelli Group.* **Andrew Putman**, University of Chicago (1023-57-1303)

9:30AM (1399) *Comparing bridge surfaces.* **Martin Scharlemann**, University of California, Santa Barbara, and **Maggy Tomova***, University of Iowa (1023-57-1388)

10:00AM (1400) *Dimension of Torelli groups.* **Mladen Bestvina**, University of Utah, **Kai-Uwe Bux**, University of Virginia, and **Dan Margalit***, University of Utah (1023-20-533)

10:30AM (1401) *Applications of the disk complex of the genus-2 handlebody to knot theory.* Preliminary report. **Sangbum Cho** and **Darryl McCullough***, University of Oklahoma (1023-57-301)

AMS Special Session on Recent Advances in Mathematical Biology, Ecology, and Epidemiology, I

8:00 AM - 10:55 AM

Organizers: **Lih-Ing Roeger**, Texas Tech University
Linda J. Allen, Texas Tech University
Sophia Jang, University of Louisiana at Lafayette

8:00AM (1402) *Multiple attractors and non-equilibrium competitive coexistence.* **J. M. Cushing***, University of Arizona, **Shandelle M. Henson**, Andrews University, **Lih-Ing Roeger**, Texas Tech University, and **Chantel C. Blackburn**, University of Arizona (1023-92-908)

8:30AM (1403) *Difference Approximation for Measure-Valued Solutions to a Hierarchically Size-Structured Population Model.* Preliminary report. **Azmy S. Ackleh***, University of Louisiana at Lafayette, and **Kazufumi Ito**, North Carolina State University (1023-92-772)

9:00AM (1404) *On a nonlocal reaction-diffusion population model.* **Keng Deng**, University of Louisiana at Lafayette (1023-35-792)

► 9:30AM (1405) *Attractors in nonautonomous systems and Applications to population models.* Preliminary report. **Saber N. Elaydi**, Trinity University (1023-39-1704)

10:00AM (1406) *Numerical Integration of Population Models Satisfying Conservation Laws: NSFD Methods.* **Ronald E. Mickens**, Clark Atlanta University (1023-92-329)

10:30AM (1407) *Multiple Attractors and Their Basins of Attraction in a Periodically Forced Discrete-time SIS Epidemic Model.* Preliminary report. **John E. Franke***, North Carolina State University, and **Abdul-Aziz Yakubu**, Howard University (1023-92-941)

AMS Special Session on Recent Developments in Floer Homology, I

8:00 AM - 10:55 AM

Organizers: **Scott J. Baldridge**, Louisiana State University
Ronald A. Fintushel, Michigan State University
Thomas E. Mark, Southeastern Louisiana University
Brendan E. Owens, Louisiana State University

8:00AM (1408) *Singular Relative Gromov-Witten Invariants.* **Joshua R. Davis**, Duke University (1023-53-1332)

► 8:30AM (1409) *Construction of new symplectic cohomolgy $S^2 \times S^2$.* Preliminary report. **Anar Akhmedov**, Georgia Institute of Technology (1023-57-943)

9:00AM (1410) *Torsion in Heegaard Floer homology.* **Stanislav Jabuka***, University of Nevada Reno, and **Thomas Mark**, University of Virginia (1023-57-1205)

9:30AM (1411) *A combinatorial description to some Heegaard Floer homologies.* **Jiajun Wang**, UC Berkeley & Columbia Univ (1023-51-178)

10:00AM (1412) *Knot Floer homology detects fibred knots.* **Yi Ni**, Princeton University (1023-57-425)

10:30AM (1413) *The SU(3) Casson invariant and spliced sums.* Preliminary report. **Hans U. Boden***, McMaster University, and **Benjamin Himpel**, University of Bonn (1023-57-1249)

AMS Special Session on Structure Theory for Matroids and Graphs, I

8:00 AM – 10:55 AM

Organizers: **Joseph P. Kung**, University of North Texas
Bogdan S. Oporowski, Louisiana State University
James G. Oxley, Louisiana State University

8:00AM (1414) *Distinguishability of Locally Finite Trees.* **Xiangqian Zhou***, the University of Mississippi, and **Mark Watkins**, Syracuse University (1023-05-687)

8:30AM (1415) *Stabilizers for matroids over finite fields.* **Sandra Kingan**, Clayton State University (1023-05-1090)

9:00AM ► (1416) *Coloring graphs on surfaces with all faces even.* Preliminary report. **Daniel Kral**, Charles University, Czech Republic, and **Robin Thomas***, Georgia Institute of Technology (1023-05-1125)

10:00AM (1417) *Negative correlations for spanning forests of graphs.* **David G. Wagner**, University of Waterloo (1023-05-327)

10:30AM ► (1418) *Unavoidable Minors in Graphs.* Preliminary report. **Carolyn Chun***, **Guoli Ding**, **Bogdan Oporowski** and **Dirk Vertigan**, Louisiana State University (1023-05-1321)

AMS Special Session on Time Scales: Dynamic Equations with Applications, I

8:00 AM – 10:55 AM

Organizers: **Martin J. Bohner**, University of Missouri-Rolla
Allan C. Peterson, University of Nebraska-Lincoln

8:00AM (1419) *Delay Dynamic Equations.* Preliminary report. **Lynn H. Erbe*** and **Allan C. Peterson**, University of Nebraska, Lincoln, Nebraska (1023-39-888)

8:30AM (1420) *Fractional q-calculus on a time scale.* **Ferhan M. Atici**, Western Kentucky University, and **Paul W. Eloe***, University of Dayton (1023-39-441)

9:00AM ► (1421) *A generalized upper and lower solution method for singular boundary value problems for the one-dimensional p-Laplacian on time scales.* Preliminary report. **Elvan Akin-Bohner***, University of Missouri-Rolla, and **Ravi Agarwal**, Florida Institute of Technology (1023-34-1234)

9:30AM ► (1422) *Solvability of some nonlinear boundary value problems.* **Christopher C. Tisdell**, The University of New South Wales (1023-34-433)

10:00AM (1423) *Convergence of Solutions of Dynamic Equations on Time Scales.* **Bonita A. Lawrence** and **Ralph W. Oberste-Vorth***, Marshall University (1023-34-1298)

10:30AM (1424) *Feasible Approximations of Hybrid Dynamic Derivatives on Time Scales.* Preliminary report. **Qin Sheng**, Baylor University (1023-39-979)

AMS Special Session on Arithmetic Geometry, I

8:00 AM – 10:55 AM

Organizers: **Matthew H. Baker**, Georgia Institute of Technology
Bjorn Poonen, University of California Berkeley

8:00AM (1425) *Improvements on the Index of Cyclotomic Units.* **Mairead Greene**, University of Massachusetts (1023-11-109)

8:30AM (1426) *Finding large Selmer groups over Galois extesions of number fields.* **Barry Mazur**, Harvard University, and **Karl Rubin***, UC Irvine (1023-11-1011)

9:00AM (1427) *Bounds for torsion in class groups.* **Jordan S. Ellenberg***, University of Wisconsin, and **Akshay Venkatesh**, New York University (1023-11-423)

9:30AM (1428) *There exist infinitely many rational Diophantine 6-tuples – almost.* Preliminary report. **Edray Herber Goins**, Purdue University (1023-11-456)

10:00AM (1429) *Galois Covers of the Open p-adic Disc.* Preliminary report. **Scott Corry**, University of Pennsylvania (1023-12-103)

10:30AM (1430) *On uniqueness of p-adic period morphisms.* **Wieslawa Niziol**, University of Utah (1023-11-1789)

AMS Special Session on Computational Algebraic and Analytic Geometry for Low-Dimensional Varieties, I

8:00 AM – 10:55 AM

Organizers: **Mika K. Seppälä**, Florida State University
Tanush T. Shaska, Oakland University
Emil J. Volcheck, Association for Computing Machinery

8:00AM (1431) *The p-torsion of hyperelliptic curves with extra automorphisms.* **Darren B. Glass**, Gettysburg College (1023-14-1337)

8:30AM (1432) *Cantor Versus NUCOMP on Hyperelliptic Curves.* **Michael J. Jacobson Jr.**, **Renate Scheidler***, University of Calgary, and **Andreas Stein**, University of Wyoming (1023-11-1191)

9:00AM ► (1433) *What is NUCOMP?* Preliminary report. **Andreas Stein***, University of Wyoming, **Michael J. Jacobson** and **Renate Scheidler**, University of Calgary (1023-11-1042)

9:30AM (1434) *Genus calculations for towers of function fields arising from equations of C_{ab} curves.* **Caleb M. Shor**, Bates College (1023-14-953)

10:00AM (1435) *Endomorphism algebras of hyperelliptic jacobians.* **Arsen Elkin***, Colorado State University, and **Yuri Zarhin**, Pennsylvania State University (1023-14-1175)

10:30AM (1436) *Bernstein Sato polynomial in low dimension.* **Darren Salven Tapp**, Purdue University (1023-14-942)

AMS Special Session on Commutative Algebra and Algebraic Geometry, I

8:00 AM – 10:55 AM

Organizers: **Paul C. Roberts**, University of Utah
Anurag K. Singh, University of Utah
Oana Veliche, University of Utah

8:00AM (1437) *The Newton Polytope of the Implicit Equation.* **Bernd Sturmfels**, UC Berkeley, **Jenia Tevelev**, University of Massachusetts, Amherst, and **Josephine Yu***, UC Berkeley (1023-14-285)

8:30AM (1438) *Resultant formula for the $A-$ discriminant and dual defect toric varieties.*
Raymond P. Curran, Metropolitan State College of Denver (1023-14-1697)

9:00AM (1439) *Generalized Green's Theorem.*
Irena Peeva*, Cornell Univ., and **Jeff Mermin**, Univ. of Kansas (1023-13-302)

9:30AM ► (1440) *Resolutions of square-free monomial ideals.*
Tai Huy Ha, Tulane University (1023-13-1144)

10:00AM (1441) *The homogeneous coordinate rings of some Del Pezzo surfaces.*
Mike Stillman, **Damiano Testa** and **Mauricio Velasco***, Cornell University (1023-13-1020)

10:30AM (1442) *Relative and Tate Cohomology for modules of fintie G_C-dimension.* Preliminary report.
Diana M. White*, University of Nebraska, and **Ryo Takahashi**, Meiji University (1023-13-957)

AMS Session on Probability and Statistics, I

8:00 AM – 10:55 AM

8:00AM (1443) *Convergence in Distribution of Random Compact Sets in Polish Spaces.*
Hussain Elalaoui-Talibi*, Tuskegee University, and **Lisa D. Peterson**, Auburn, Alabama (1023-60-1285)

8:15AM (1444) *On the compact support property of solutions of hyperbolic SPDE.*
Hassan Allouba and **Oleksiy Ignatyev***, Kent State University (1023-60-1319)

8:30AM (1445) *A New Look at Stopping Times Related to Trading Techniques.*
Vilen Abramov* and **Kazim M. Khan**, Kent State University (1023-60-1328)

8:45AM (1446) *On the Replicator Dynamics behavior under Stratonovich type random perturbations.*
R. Khasminskii and **N. Potsepun***, Wayne State University (1023-60-1394)

9:00AM (1447) *Using the pmf of the time to reach a subset of states in an irreducible finite Markov chain for clustering.* Preliminary report.
Maxim J. Goldberg*, Ramapo College of NJ, and **Seonja Kim**, Fairleigh Dickinson University (1023-60-1400)

9:15AM (1448) *From Random Matrices to Stochastic Operators.*
Brian D. Sutton*, Randolph-Macon College, and **Alan Edelman**, Massachusetts Institute of Technology (1023-60-149)

9:30AM ► (1449) *The Theory of Lumpness: A Geometric Approach to the Expected Distance Between Two Points in a Probability Distribution Function in R^n.* Preliminary report.
George A. Khachatryan, University of Chicago (1023-60-1568)

9:45AM (1450) *Evaluation formulas for conditional functional space integrals II.*
Seung Jun Chang, Dankook University, **Jae Gil Choi**, Dankook University, Cheonan, Korea, and **David L. Skoug***, University of Nebraska-Lincoln (1023-60-1674)

10:00AM (1451) *Maximum queue length for a Gaussian queueing model.*
Yasong Jin* and **Tyrone E. Duncan**, University of Kansas (1023-60-171)

10:15AM (1452) *Asymptotic Decay of the Ruin Probability in a Renewal Risk Process with Uncertain Investments.* Preliminary report.
Corina D. Constantinescu* and **Enrique A. Thomann**, Oregon State University (1023-60-1765)

10:30AM (1453) *Fractional Stability Of Functional CLT.*
Yuriy V. Kolomiets, Kent State University (1023-60-1769)

10:45AM ► (1454) *On the relationship between Spearman's rho and Kendall's tau for continuous random variables.*
Gregory A. Fredricks and **Roger B. Nelsen***, Lewis & Clark College (1023-62-144)

AMS Session on Numerical Analysis and Computer Science, I

8:00 AM – 10:55 AM

8:00AM (1455) *A W-Cycle Multigrid Algorithm for a New NIPG Method.*
Susanne C. Brenner, Louisiana State University and the Unversity of South Carolina, and **Luke N. Owens***, University of South Carolina (1023-65-1049)

8:15AM (1456) *Binomial tau-leap Spatial Stochastic Simulation Algorithm.*
Tatiana T Marquez-Lago* and **Kevin Burrage**, Advanced Computational Modelling Centre, University of Queensland (1023-65-1066)

8:30AM (1457) *Is symplectic-energy-momentum integration well-posed?*
Yosi Shibberu, Rose-Hulman Institute of Technology (1023-65-1367)

8:45AM ► (1458) *Electromagnetic-Thermal Model of Microwave Processing.* Preliminary report.
Erin M. Kiley* and **Dena Feldman**, WPI Center for Industrial Mathematics and Statistics (1023-65-1513)

9:00AM (1459) *Solving polynomial systems by parallel polyhedral homotopies.*
Jan Verschelde, University of Illinois at Chicago, and **Yan Zhuang***, UIC (1023-65-1520)

9:15AM ► (1460) *High-order, compact difference schemes of heat-conducting problems.* Preliminary report.
Jennifer Zhao*, University of Michigan-Dearborn, **Weizhong Dai** and **Suyang Zhang**, Louisiana Tech. University (1023-65-1541)

9:30AM (1461) *Restarted Nonsymmetric Lanczos and Two-Sided Arnoldi.* Preliminary report.
Dywayne A. Nicely, Baylor University (1023-65-1603)

9:45AM (1462) *The quality of approximation bases for the Helmholtz equation.* Preliminary report.
Timo Betcke, TU Braunschweig (1023-65-166)

10:00AM ► (1463) *Mathematical Modeling of Elastic Snap Through.* Preliminary report.
Mark S. Korlie, Montclair State University (1023-65-1669)

10:15AM (1464) *Numerical Methods for the Stochastic Landau-Lifshitz Navier-Stokes Equations.*
John B. Bell, Center for Computational Science and Engineering, Lawrence Berkeley National Laboratory, **Sarah A. Williams***, Graduate Group in Applied Mathematics, University of California, Davis, and **Alejandro L. Garcia**, Department of Physics, San Jose State Univesity (1023-65-1702)

10:30AM (1465) *Global multiscale finite element methods for elliptic equations.*
Lijian Jiang, Texas A&M University (1023-65-1893)

10:45AM (1466) *A Cayley transformed Lanczos-Schur algorithm for large unitary eigenproblems.*
Roden J. A. David, Washington State University (1023-65-784)

MAA Session on Applications of Discrete Mathematics, I

8:00 AM – 10:55 AM

Organizers: **Thomas Koshy**, Framingham State College
Thomas Moore, Bridgewater State College

8:00AM ► (1467) *Community Structure in the United States Congress.* **Mason A. Porter**, California Institute of Technology (1023-D1-48)

8:20AM ► (1468) *Computer Science, Stong Induction and Pile-Splitting.* **Bill Marion**, Valparaiso University (1023-D1-52)

8:40AM ► (1469) *Matching Columns in a Cyclically Repeated Pattern of 3 Colors.* **Ashish K. Srivastava*** and **Steve Szabo**, Ohio University (1023-D1-98)

9:00AM (1470) *Network Flow Problems with Path Capacities.* Preliminary report. **Maren Martens*** and **Martin Skutella**, Dortmund University (1023-D1-128)

9:20AM ► (1471) *A Real-World Scheduling Problem in the Undergraduate Algorithms Course.* Preliminary report. **Yana Kortsarts**, Widener University, Computer Science Department (1023-D1-172)

9:40AM ► (1472) *Discrete Approximation to a Steady-State Temperature Distribution.* **Jenny Switkes***, **Gordon Safely** and **Anh Tran**, Cal Poly Pomona (1023-D1-353)

10:00AM ► (1473) *Integrating Programming into Discrete Mathematics.* Preliminary report. **Keith E. Howard**, Mercer University (1023-D1-439)

10:20AM ► (1474) *Jacobsthal Compositions.* **Ralph P. Grimaldi**, Rose-Hulman Institute of Technology (1023-D1-488)

10:40AM (1475) *The Spectral Radius of Submatrices of Laplacian Matrices for Graphs.* Preliminary report. **Jason J. Molitierno**, Sacred Heart University (1023-D1-561)

MAA Session on Assessment of Student Learning in Undergraduate Mathematics, I

8:00 AM – 10:55 AM

Organizers: **William Martin**, North Dakota State University
Bernard L. Madison, University of Arkansas

8:00AM ► (1476) *Assessing Student Attitudes On the Value of Introductory Statistics.* Preliminary report. **Milo Schield**, Augsburg College (1023-D5-76)

8:15AM ► (1477) *Assessment as a Vehicle for Change.* **Jill Shahverdian**, Quinnipiac University (1023-D5-1361)

8:30AM (1478) *Building an Assessment Program for a Liberal Arts Math Major from Scratch.* **Sarah Hutcheson Jahn** and **Robert J. Krueger***, Concordia University, St. Paul (1023-D5-592)

8:45AM ► (1479) *Programmatic Assessment of Proof Writing.* Preliminary report. **Karen Batt Stanish**, Keene State College (1023-D5-1686)

9:00AM ► (1480) *Implementing Assessment Plans for Programs in Mathematics and Computer Science: What We Have Learned through Two Cycles.* **Ken Luther*** and **Bill Marion**, Valparaiso University (1023-D5-51)

9:15AM ► (1481) *The Calculus Concept Inventory, Validation and Analysis of Results Correlated with Teaching Methodology.* **Jerome S. Epstein**, Polytechnic University (1023-D5-394)

9:30AM ► (1482) *A Case Study of Assessment of the Academic Major and the Quantitative Reasoning Component of the Liberal Learning Curriculum at The College of New Jersey and Its Possible Application Elsewhere.* Preliminary report. **Edward J. Conjura*** and **Cathy Liebars**, The College of New Jersey (1023-D5-701)

9:45AM ► (1483) *The Mathematics Core: A Question of Fairness.* **Barbara M. Moskal***, **Scott Strong** and **Graeme Fairweather**, Colorado School of Mines (1023-D5-717)

10:00AM (1484) *Assessment of the Major Made Simple.* **Pamela B. Pierce*** and **James L. Hartman**, The College of Wooster (1023-D5-1519)

10:15AM ► (1485) *Teaching to the Test (or how I stopped worrying and learned to love the Major Field Achievement Test).* **William P. Abrams*** and **Jeffery Peden**, Longwood University (1023-D5-354)

10:30AM (1486) *Undergraduate Assessment in Mathematics at a Four-Year Comprehensive University.* Preliminary report. **Kevin E. Charlwood**, Washburn University (1023-D5-415)

10:45AM ► (1487) *A Follow-up on Using Portfolios in Mathematics Education Programs to Assess Content and Connect to Future Practice.* **Janet A. White*** and **Dorothee J. Blum**, Millersville University of PA (1023-D5-427)

MAA Session on College Algebra: Concepts, Data, and Models, II

8:00 AM – 10:55 AM

Organizers: **Florence S. Gordon**, New York Institute of Technology
Mary Robinson, University of New Mexico Valencia Campus
Norma Agras, Miami Dade Community College
Laurette Foster, Prairie View A&M University

8:00AM ► (1488) *Integrating Applications, Modeling, and Technology in a College Algebra Course.* **Ronald J. Harshbarger***, University of South Carolina Beaufort, and **Lisa S. Yocco**, Georgia Southern University (1023-F1-497)

8:15AM ► (1489) *"Search for Meaning" in a College Algebra Course.* Preliminary report. **Kyong-Hee M. Lee**, Colby-Sawyer College (1023-F1-120)

8:30AM (1490) *Designing, Teaching, and Researching Contemporary Based College Algebra Courses.* **Erick Brian Hofacker**, University of Wisconsin - River Falls (1023-F1-1855)

8:45AM ► (1491) *Data Exploration and Modeling in a College Algebra Course: Use of Heart Rate Data to Investigate Recovery Time of Athletes.* **Erica Slate Young**, United States Military Academy at West Point (1023-F1-1718)

9:00AM (1492) *Beginning with a 21st Century View: Mathematical Modeling and Problem Solving Courses with Interdisciplinary Applications in College Algebra.* **William P. Fox**, Naval Postgraduate School (1023-F1-624)

9:15AM ► (1493) *College Algebra across the City.* **Elizabeth Jane Kreston**, University of the Incarnate Word (1023-F1-388)

9:30AM (1494) *An Excel-lent Approach to College Algebra.* **Eric Gaze**, Alfred University (1023-F1-754)

9:45AM ► (1495) *Mathematics, Geography, and Data: Introducing Geographic Concepts in Mathematics Classes.* **Robert J. Hickey*** and **Stuart Boersma**, Central Washington University (1023-F1-1271)

10:00AM (1496) *Understanding Algebra while Learning Calculus: A successful integrated course.* **Alicia Sevilla*** and **Kay Somers**, Moravian College (1023-F1-688)

10:15AM ► (1497) *Steroids, Alcohol and Birth Control: Precalculus Investigations of Current Health Issues.* **Theresa Laurent**, St. Louis College of Pharmacy (1023-F1-896)

10:30AM ► (1498) *The Optimal Origami Box.* **Shelly Smith**, Grand Valley State University (1023-F1-589)

10:45AM (1499) *The Traveling Salesman Solves a Meals on Wheels Problem: Utilizing Academic Service Learning in an Integrated Algebra and Computer Science Course.* **Joanne C. Caniglia*** and **Krish Narayanan**, Eastern Michigan University (1023-F1-18)

MAA General Contributed Paper Session, VII

8:00 AM – 10:55 AM

Organizers: **Eric S. Marland**, Appalachian State University
Jay A. Malmstrom, Oklahoma State Community College

8:00AM ► (1500) *Perfect Matchings in Pruned Grid Graphs.* **David R. Guichard**, Whitman College (1023-Z1-697)

8:15AM ► (1501) *Disjunctive Rado Numbers for a pair of Schur Like Equations.* **Dusty E. Sabo***, Southern Oregon University, **Daniel Schaal**, South Dakota State University, and **Jacent Tokaz**, National Security Agency (1023-Z1-1336)

8:30AM ► (1502) *Cantor's Set and the Continuum Hypothesis.* **H. Vic Dannon**, California (1023-Z1-17)

8:45AM ► (1503) *Computational Exercises on Carmichael Numbers and Pollard Rho Factorization.* **William R. Harris**, Georgetown College (1023-Z1-507)

9:00AM (1504) *An Explicit Plancherel Formula for Certain Completely Solvable Homogeneous Spaces.* **Katrina Ashford Cunningham**, Southern University and A&M College (1023-Z1-1040)

9:15AM ► (1505) *Natural Parameterizations of a Region.* **William Freed**, Concordia University College of Alberta (1023-Z1-387)

9:30AM ► (1506) *An Introduction to Product Calculus.* **Michael Z. Spivey**, University of Puget Sound (1023-Z1-303)

9:45AM ► (1507) *When Is the Derivative of a Composition the Composition of the Derivatives?* Preliminary report. **Marcus Pendergrass**, Hampden-Sydney College (1023-Z1-1783)

10:00AM ► (1508) *Using mnemonic and Ausubelian concept mapping to teach "and/or" probability problems.* Preliminary report. **M. A. Hamid**, Temple University (1023-Z1-1380)

10:15AM ► (1509) *Whad'Ya Know?: Classroom Voting in a Liberal Arts Mathematics Course.* Preliminary report. **Jean M. McGivney-Burelle*** and **Raymond J. McGivney**, University of Hartford (1023-Z1-1184)

10:30AM ► (1510) *More than Just Math: A Study of Collaboration and Community Building in the Undergraduate Math Classroom.* Preliminary report. **Janet Thiel**, Villa Julie College, Stevenson, MD & Towson University (1023-Z1-653)

10:45AM ► (1511) *Teaching Optimization at a Liberal Arts College to Math and CS Majors.* **William P. Fox**, Naval Postgraduate School (1023-Z1-622)

AMS Session on Operator Theory and Optimal Control, I

8:15 AM – 10:25 AM

8:15AM (1512) *On The Commutator Ideal of the Toeplitz Algebra on the Bergman Space of the Unit Ball in $\mathbb{C}^n$.* **Trieu Le**, University at Buffalo (1023-47-114)

8:30AM (1513) *Composition operators on Banach spaces of analytic functions of the unit ball.* **Matthew A. Pons**, University of Virginia (1023-47-1185)

8:45AM (1514) *Determining the Membership of Hankel Operators in the Symmetrically-Normed Ideals of the Segal-Bargmann Space.* Preliminary report. **D. K. Farnsworth**, University at Buffalo (1023-47-1194)

9:00AM (1515) *Compact quantum group actions on C*-algebras.* **Raluca Dumitru**, University of Cincinnati (1023-47-1397)

9:15AM (1516) *Invariant subspaces of parabolic non-automorphisms in the Hardy space.* Preliminary report. **Alfonso Montes-Rodriguez, Manuel Ponce-Escudero*** and **Stanislav A. Shkarin**, Universidad de Sevilla (1023-47-1434)

9:30AM (1517) *Basic sequencies, non-cyclicity and quasinilpotent supercyclic operators.* Preliminary report. **Alfonso Montes-Rodriguez, Alejandro Rodriguez-Martinez*** and **Stanislav Shkarin**, Universidad de Sevilla (1023-47-1435)

9:45AM Break.

10:00AM ► (1518) *Operator Means and its application in solving a class of operator equation.* **Mohammad Khadivi**, Jackson State University (1023-47-1675)

10:15AM (1519) *Hyperinvariant Subspaces for some Operator-Weighted Bilateral Shifts.* **Sami M. Hamid***, University of North Florida, and **Carl Pearcy**, Texas A&M University (1023-47-1883)

AMS Session on Combinatorics, III

8:15 AM – 10:40 AM

8:15AM ► (1520) *On the expected height of t-ary trees under random edge compression.* Preliminary report. **Joshua Zahl**, California Institute of Technology (1023-05-424)

8:30AM (1521) *Splitter Theorems for 4-regular Planar Graphs.* **Guoli Ding**, Louisiana State University, and **Jinko Kanno***, Louisiana Tech University (1023-05-431)

8:45AM Break.

9:00AM (1522) *Multi-restrained Stirling numbers.* Preliminary report.
Ji Young Choi, Shippensburg University of PA (1023-05-478)

9:15AM ► (1523) *An Analysis of Random Words of Fixed Length.* Preliminary report.
Gerald Y. Agbegha, Johnson C. Smith University (1023-05-571)

9:30AM ► (1524) *A Variation on Binomial Coefficients and an Application to Probability.*
Michael J. J. Barry, Allegheny College (1023-05-598)

9:45AM ► (1525) *Line graphs, average degree, and percolation threshold approximation formulas.* Preliminary report.
John C. Wierman, Johns Hopkins University (1023-05-602)

10:00AM (1526) *Some results on graphs with non-surjective optimal $L(2,1)$-labelings.*
John P. Georges, **David Mauro** and **Yan Wang***, Trinity College (1023-05-655)

10:15AM (1527) *Obtaining a uniformly dense graph from a non-uniformly dense graph.*
Lavanya Kannan*, Texas A&M University, **Hong-Jian Lai**, West Virginia University, and **Hongyuan Lai**, School craft College (1023-05-709)

10:30AM ► (1528) *On Fully Orientability of Graphs.* Preliminary report.
H. H. Lai, National Taiwan University, and **K. W. Lih***, Academia Sinica (1023-05-721)

AWM Workshop

8:20 AM – 4:30 PM

This session has several parts listed separately by time in the program. Listed Workshop presentations are open to all JMM participants.

AMS Special Session on Representation Theory and the Theta Correspondence, I

8:30 AM – 10:55 AM

Organizers: **Wee Teck Gan**, University of California San Diego
Hongyu He, Louisiana State University
Annegret Paul, Western Michigan University

8:30AM (1529) *Preservation principle of local theta correspondence and supercuspidal representations of p-adic groups.* Preliminary report.
Shu-Yen Pan, National Tsing Hua University (1023-22-1488)

9:00AM (1530) *Special cohomology classes arising from the Weil representation.*
Jens P. Funke, New Mexico State University (1023-22-1323)

9:30AM (1531) *Transfer of unitary representations.*
Nolan Wallach, University of California at San Diego, and **Chen-Bo Zhu***, National University of Singapore (1023-22-1350)

10:00AM (1532) *Methods for studying complementary series of split groups.* Preliminary report.
Dan Barbasch and **Alessandra Pantano***, Cornell University (1023-22-612)

10:30AM (1533) *On the unitary dual of Iwahori-Hecke algebras.* Preliminary report.
Dan Ciubotaru, M.I.T. (1023-22-1579)

AWM Workshop: Research Presentations by Recent Ph.D.'s, I

8:30 AM – 10:20 AM

8:30AM ► (1534) *Categorical Self-Distributivity.*
Alissa S. Crans*, Loyola Marymount University, **J. Scott Carter**, University of South Alabama, **Mohamed Elhamdadi** and **Masahico Saito**, University of South Florida (1023-81-1268)

9:00AM (1535) *Optimal Harvesting of a Semilinear Elliptic Fishery Model.*
Wandi Ding* and **Suzanne Lenhart**, University of Tennessee-Knoxville (1023-49-857)

9:30AM (1536) *Thirteen ways of looking at a topological group.*
Julie Bergner, Kansas State University (1023-55-753)

10:00AM (1537) *Nonpositively curved decompositions of Coxeter groups.*
Angela Kubena Barnhill, The Ohio State University (1023-20-1284)

AMS Committee on Education Panel Discussion

8:30 AM – 10:00 AM

A panel on the National Math Panel.
Organizer: **William G. McCallum**, University of Arizona
Presenters: **Francis Fennell**, National Council of Teachers of Mathematics
Larry R. Faulkner, University of Texas at Austin

MAA Session on Integrating Mathematics and Biology in Undergraduate Education, III

8:40 AM – 10:35 AM

Organizers: **Glenn W. Ledder**, University of Nebraska-Lincoln
Yajun Yang, Farmingdale State University of New York
Jack Bookman, Duke University
James P. Fulton, Suffolk County Community College

8:40AM ► (1538) *Biology Content in Calculus Labs.* Preliminary report.
Joseph F. Kolacinski*, Elmira College, and **John E. Beam**, University of Wisconsin Oshkosh (1023-K1-1826)

9:00AM (1539) *Bringing Life to Biocalculus: Lab Projects and Seminar Series.*
Timothy D. Comar, Benedictine University (1023-K1-161)

9:20AM ► (1540) *Computing with Bacteria: The New Wave of Synthetic Biology.* Preliminary report.
Laurie J. Heyer* and **A. Malcolm Campbell**, Davidson College (1023-K1-617)

9:40AM ► (1541) *An "Experimental" Interdisciplinary Course in Mathematical Ecology.*
Glenn Ledder*, University of Nebraska-Lincoln, and **Brigitte Tenhumberg**, School of Biological Sciences, Univesity of Nebraska-Lincoln (1023-K1-272)

10:00AM ► (1542) *Symbiosis: Integrating Mathematics and Statistics with an Introductory Biology Sequence.*
Jeff R. Knisley*, East Tennessee State University, and **Istvan Karsai**, Dept. of Biological Sciences, East Tennessee State University (1023-K1-1462)

10:20AM (1543) *Integrating Mathematics into the Introductory Biology Laboratory Course.*
James D. White* and **Jenna P. Carpenter**, Louisiana Tech University (1023-K1-899)

AMS Invited Address

9:00 AM - 9:50 AM

(1544) *New combinatorics from the invariant theory of reflection groups.*
Victor S. Reiner, School of Mathematics, University of Minnesota (1023-05-09)

ASL Invited Address

9:00 AM - 9:50 AM

(1545) *Recent Uses of Proof Theory in Nonlinear Analysis and Geodesic Geometry.*
Ulrich Kohlenbach, Darmstadt University of Technology (1023-03-411)

MAA Minicourse #10: Part B

9:00 AM - 11:00 AM

A beginner's guide to the scholarship of teaching and learning in mathematics.
Organizers: **Curtis D. Bennett**, Loyola Marymount University
Jacqueline M. Dewar, Loyola Marymount University

MAA Minicourse #16: Part B

9:00 AM - 11:00 AM

More music and mathematics.
Organizer: **Leon Harkleroad**, Wilton, ME

MAA Minicourse #4: Part B

9:00 AM - 11:00 AM

Creating visual mathematics applets using flash programming.
Organizers: **Douglas E. Ensley**, Shippensburg University
Barbara Kaskosz, University of Rhode Island

MAA Session on Mathematics of Chemistry

9:00 AM - 10:55 AM

Organizer: **George Rublein**, The College of William and Mary

9:00AM (1546) *A Combustion Model Exhibiting Metastability.*
Ronald E. Mickens, Clark Atlanta University (1023-L5-33)

9:20AM ► (1547) *Use of Singular Value Decomposition Theorem and Principal Component Analysis in Environmental Research—Research with Undergraduate Students.* Preliminary report.
Umesh P. Nagarkatte* and **Wilbert W. Hope**, Medgar Evers College, CUNY (1023-L5-1735)

9:40AM ► (1548) *Inquiry-based Exercises for Physical Chemistry: Hydrogenic Model.* Preliminary report.
Katie White*, **Megan Boyle**, **Toni L. O. Barstis**, **Joanne Snow** and **Jennifer Herdman**, Saint Mary's College, Notre Dame (1023-L5-1482)

10:00AM Break.

10:20AM ► (1549) *Total Differential and Partial Derivatives - A Different Perspective for Chemistry Students.* Preliminary report.
Lynn S. Bennethum, University of Colorado DHSC (1023-L5-773)

10:40AM ► (1550) *Calculus of Chemical Engineering Thermodynamics.*
Youyu Phillips, Keystone College (1023-L5-703)

MAA-YMN Panel Discussion

9:00 AM - 10:20 AM

Undergraduate career paths in mathematics.
Organizers: **Dov N. Chelst**, DeVry University
Vanessa Garcia, Texas State University, San Marcos
Panelists: **Ellen Pierce**, Casualty Actuarial Consultants, Inc.
Robert J. Frey, Stony Brook University
Kathy Lange, SAS Institute Inc.

MAA Panel Discussion

9:00 AM - 10:20 AM

Teaching and learning mathematics in a Computer Algebra Systems (CAS) enriched environment: College algebra to real analysis.
Organizer: **Wade Ellis, Jr.**, West Valley College
Panelists: **William C. Bauldry**, Appalachian State University

MAA Special Report

9:00 AM - 10:20 AM

Algebra: Gateway to a technological future.
Organizer: **Michael Pearson**, MAA

NAM Panel Discussion

9:00 AM - 9:50 AM

Exhibits and Book Sales

9:00 AM - 1:00 PM

ASL Invited Address

10:00 AM - 10:50 AM

(1551) *Back and forth through computable model theory.*
Valentina S. Harizanov, George Washington University (1023-03-410)

NAM Business Meeting

10:00 AM - 10:50 AM

MAA Invited Address

10:05 AM - 10:55 AM

(1552) *Big waves on deep water.*
Jerry L. Bona, University of Illinois at Chicago (1023-A0-22)

AWM Workshop: Poster Session with Presentations from Women Recent Ph.D.s and Graduate Students

10:30 AM – 10:30 AM

10:30AM (1553) *High Order Fully Coupled Discontinuous Finite Element Methods For Two-Phase Flow.*
Yekaterina Epshteyn* and **Beatrice Riviere**, University of Pittsburgh (1023-65-765)

10:30AM (1554) *Spectral averaging in von Neumann algebras.* Preliminary report.
Vadim Kostrykin, Technische Universität Clausthal, **Konstantin A. Makarov** and **Anna Skripka***, University of Missouri-Columbia (1023-47-800)

► 10:30AM (1555) *Modeling Wormlike Micellar Solutions.* Preliminary report.
Paula A. Vasquez* and **L. Pamela Cook**, University of Delaware (1023-76-802)

► 10:30AM (1556) *Representations of the Braid Group via the Yang Baxter Equation.* Preliminary report.
Jennifer M. Franko, Indiana University, Bloomington (1023-54-842)

10:30AM (1557) *Large scale Bayesian parameter estimation and sensitivity analysis for the cardiac metabolism during ischemia.*
Rachael S. Hageman*, Case Western Reserve University, Center for Modeling Integrated Metabolic Systems, **Erkki Somersalo**, Helsinki University of Technology, and **Daniela Calvetti**, Case Western Reserve University, Center for Modeling Integrated Metabolic Systems (1023-92-950)

10:30AM (1558) *Transmission Boundary Value Problems in Non-Smooth Domains.*
Katharine Ott* and **Irina Mitrea**, University of Virginia (1023-35-1025)

► 10:30AM (1559) *Visibility of Point Clouds and Mapping of Unknown Environments.*
Yanina Landa, University of California Los Angeles (1023-49-1069)

10:30AM (1560) *Semilinear Actions of Galois Groups and Descent in Algebraic K-Theory.*
G. K. Lyo, University of California, Berkeley (1023-55-1076)

10:30AM (1561) *Topological Properties of a DNA Computing Model.*
Daniela Genova, University of South Florida, Tampa, Florida (1023-68-1128)

10:30AM (1562) *Universal abelian covers of normal surface singularities of the form* $\{z^n = f(x, y)\}$.
Elizabeth A. Sell, University of North Carolina at Chapel Hill (1023-14-1374)

10:30AM (1563) *Localized Operators and the Construction of Localized Frames.* Preliminary report.
Akram Aldroubi and **Fumiko Futamura***, Vanderbilt University (1023-42-1508)

► 10:30AM (1564) *"Ramanujan's very interesting functions": mock theta functions and vector-valued Maass-Poincare series.*
Sharon Anne Garthwaite, University of Wisconsin - Madison (1023-11-1540)

AMS Business Meeting

11:10 AM – 11:40 AM

MAA Business Meeting

11:45 AM – 12:15 PM

Organizer: **Martha J. Siegel**, Towson University
Moderator: **Carl C. Cowen**, IUPUI

NAM Claytor-Woodard Lecture

1:00 PM – 1:50 PM

(1565) *Some mathematical models for modeling blood flow in the kidney.*
Nathaniel Whitaker, University of Massachusetts, Amherst (1023-76-416)

ASL Invited Address

1:00 PM – 1:50 PM

(1566) *Classifying Measure Preserving Transformations.*
Matthew D. Foreman, University of California Irvine (1023-03-407)

AMS-MAA-MER Special Session on Mathematics and Education Reform, II

1:00 PM – 5:55 PM

Organizers: **William H. Barker**, Bowdoin College
Dale R. Oliver, Humboldt State University
Bonnie S. Saunders, University of Illinois at Chicago
Michael Starbird, University of Texas, Austin

1:00PM ► (1567) *The Institute for Mathematics and Education at the University of Arizona.* Preliminary report.
William McCallum, University of Arizona (1023-97-1687)

1:30PM ► (1568) *A National Conference on Doctoral Programs in Mathematics Education: What issues should be addressed?* Preliminary report.
Robert Reys, University of Missouri (1023-97-544)

2:00PM ► (1569) *Enhancing the Teaching of Euclidean Geometry.*
Charlene E. Beckmann, Grand Valley State University (1023-97-1501)

2:30PM ► (1570) *Mathematicians and Teachers: From Summer Institutes to the School Year.*
James R. King, University of Washington (1023-97-1322)

3:00PM ► (1571) *Report on Calculus at Macalester College.* Preliminary report.
David M. Bressoud, Macalester College (1023-97-777)

3:30PM ► (1572) *Preparing Prospective Teachers to Teach AP Calculus.* Preliminary report.
Scott Baldridge, Louisiana State University (1023-97-355)

4:00PM ► (1573) *Teaching Calculus with Future Middle School Teachers.*
Bonnie S. Saunders, University of Illinois at Chicago (1023-97-1608)

4:30PM ► (1574) *What is the effect of implementing a content/methods Calculus I course into a university science and mathematics secondary teacher preparation program?* Preliminary report.
Mark L. Daniels, University of Texas (1023-97-11)

5:00PM ► (1575) *An Interactive Online Calculus Text.*
David A. Smith* and **Lawrence C. Moore**, Duke University (retired) (1023-97-1653)

5:30PM ► (1576) *Calculus for the Public.*
Michael Starbird, University of Texas at Austin (1023-97-833)

AMS-MAA Special Session on History of Mathematics, IV

1:00 PM – 5:55 PM

Organizers: **Joseph W. Dauben**, Lehman College
Patti Hunter, Westmont College
Victor J. Katz, University of the District of Columbia
Karen H. Parshall, University of Virginia

1:00PM (1577) *Euler Incorporated in the United States: Textbooks, Mathematical Instruments, and Telescopes.* Preliminary report.
Peggy Aldrich Kidwell, National Museum of American History, Smithsonian Institution (1023-01-351)

1:30PM (1578) *"The Acknowledged National Standard": Charles Davies, A. S. Barnes, and Textbooks as Teaching Tools.*
Amy Ackerberg-Hastings, University of Maryland University College (1023-01-458)

2:00PM (1579) *Janos Bolyai's American supporter, G. B. Halsted.* Preliminary report.
Albert C. Lewis, Indiana Univ. - Purdue Univ. Indianapolis (1023-01-240)

2:30PM (1580) *Peirce's Cantor.* Preliminary report.
Matthew E. Moore, Brooklyn College of the City University of New York (1023-01-787)

3:00PM (1581) *The other American mathematical congress.*
David E. Zitarelli, Temple University (1023-01-378)

3:30PM (1582) *Volterra in America.*
Judith R. Goodstein, California Institute of Technology (1023-01-645)

4:00PM (1583) *A punishment tour for "P" Echols.* Preliminary report.
Shawnee McMurran, California State University, San Bernardino, and U. S. Military Academy, and **V. Frederick Rickey***, U. S. Military Academy (1023-01-868)

4:30PM (1584) *Frege's Diary and Frege's Politics.*
Martin D. Davis, UC Berkeley (visitor); NYU-Courant (Emeritus) (1023-01-276)

5:00PM (1585) *Applied Mathematics in Nazi Germany.*
Sanford L. Segal, University of Rochester (1023-01-444)

5:30PM (1586) *World War II and After: Impact on American Women in Mathematics.* Preliminary report.
Judy Green, Marymount University, and **Jeanne LaDuke***, DePaul University (1023-01-586)

AMS Special Session on Group Representations, Ergodic Theory, and Mathematical Physics: Honoring the Memory of George W. Mackey, IV

1:00 PM – 3:45 PM

Organizers: **Robert S. Doran**, Texas Christian University
Calvin C. Moore, University of California Berkeley
Robert J. Zimmer, The University of Chicago

1:00PM (1587) *George W. Mackey's work on representation theory and foundations of physics.*
V. S. Varadarajan, University of California, Los Angeles, CA 90095-1555 (1023-22-273)

2:00PM (1588) *Induced representations, vector bundles, and projections.*
Marc A. Rieffel, University of California, Berkeley (1023-46-177)

2:30PM (1589) *Characters of tame supercuspidal representations.* Preliminary report.
Fiona Murnaghan, University of Toronto (1023-22-1588)

3:00PM (1590) *Counting intertwining operators for real reductive groups.*
David A. Vogan, MIT (1023-22-654)

AMS Special Session on Mapping Class Groups and Handlebodies, II

1:00 PM – 5:55 PM

Organizers: **Tara E. Brendle**, Louisiana State University
William R. Vautaw, Southeastern Louisiana University

1:00PM (1591) *Straightening tube sums.*
Martin Scharlemann, U. C. Santa Barbara (1023-57-670)

1:30PM (1592) *Mapping class groups of Heegaard splittings.* Preliminary report.
Jesse E. Johnson*, Yale University, and **Hyam Rubinstein**, University of Melbourne (1023-57-921)

2:00PM (1593) *On some relations and homology of the Dehn twist quandle.*
Joel Zablow, Rochester Institute of Technology, Rochester N.Y. (1023-57-553)

2:30PM (1594) *Some homological properties on a handlebody group.*
Susumu Hirose, Saga University (1023-57-811)

3:00PM (1595) *Right-Veering Diffeomorphisms of Bordered Surfaces and the Burau Representation of B_3.*
Emille K. Davie, University of Georgia (1023-57-1050)

3:30PM (1596) *Heegaard splitting and 3-manifold invariants from the Johnson-Morita homomorphims.* Preliminary report.
Joan S. Birman, Columbia University, **Tara E. Brendle**, Louisiana State University, and **Nathan D. Broaddus***, University of Chicago (1023-57-1243)

4:00PM (1597) *A Presentation For The Automorphisms of the 3-Sphere that Preserve a Genus Two Heegaard Splitting.* Preliminary report.
Erol Akbas, University of Arkansas (1023-57-1033)

4:30PM (1598) *Surface homeomorphisms that do not extend to any handlebody.* Preliminary report.
Jamie Bradley Jorgensen, Rice University (1023-57-1172)

5:00PM (1599) *From handlebodies to closed 3-manifolds: a geometric approach.*
Hossein Namazi, Princeton University (1023-57-945)

5:30PM (1600) *A classification of automorphisms of 3-manifolds.* Preliminary report.
Leonardo N. Carvalho*, Universidade Federal Fluminense - Brazil, and **Ulrich Oertel**, Rutgers University - Newark (1023-57-1212)

AMS Special Session on Nonsmooth Analysis in Inverse and Variational Problems, II

1:00 PM – 5:55 PM

Organizers: **M. Zuhair Nashed**, University of Central Florida

Otmar Scherzer, University of Innsbruck

1:00PM (1601) *Asymptotic Convergence Analysis of a New Class of Proximal Point Methods.*
William W. Hager* and **Hongchao Zhang**, University of Florida (1023-49-530)

1:30PM (1602) *Slant Differentiability of Nonlinear Operators with Applications to Ill-Posed Inverse Problems.*
M. Zuhair Nashed, University of Central Florida (1023-49-1664)

2:00PM (1603) *Generalized gradient methods for non-linear inverse problems with sparsity constraints.*
Kristian Bredies, University of Bremen (1023-49-1117)

2:30PM (1604) *TV Regularization versus Taut String for Density Estimation.*
Otmar Scherzer, Computer Science (1023-35-1912)

3:00PM (1605) *Convergence rates for non-quadratic regularization of nonlinear inverse problems.*
Elena Resmerita*, Johann Radon Institute for Computational and Applied Mathematics, and **Otmar Scherzer**, University of Innsbruck (1023-49-1688)

3:30PM (1606) *Nonlinear Generalized Functions as a tool for Nonsmooth Nonlinear Problems in Mathematics and Physics.*
J. F. Colombeau, Université de Grenoble 1 (1023-46-480)

4:00PM (1607) *Existence of multiple solutions of nonlinear elliptic equations driven by the p-Laplacian.*
Nikolaos S. Papageorgiou, National Technical University, Athens, Greece (1023-35-1921)

4:30PM (1608) *Dual settings for total variation regularization.*
Markus Grasmair, Department of Computer Science, University of Innsbruck, Austria (1023-49-1498)

5:00PM (1609) *Detecting Interfaces in a Parabolic-Elliptic Problem.*
Florian Frühauf, University of Innsbruck, Austria, **Bastian Gebauer***, Joh. Gutenberg-Universität Mainz, Germany, and **Otmar Scherzer**, University of Innsbruck, Austria (1023-35-716)

5:30PM (1610) *On Nonsmooth Approximate Maximum Principle.*
Ilya Shvartsman*, Miami University, and **Boris S. Mordukhovich**, Wayne State University (1023-49-782)

AMS Special Session on Recent Advances in Mathematical Biology, Ecology, and Epidemiology, II

1:00 PM - 5:55 PM

Organizers: **Lih-Ing Roeger**, Texas Tech University
Linda J. Allen, Texas Tech University
Sophia Jang, University of Louisiana at Lafayette

1:00PM ► (1611) *Dynamics of a Discontinuous Discrete Model of West Nile-Like Epidemics.*
Vlajko L. Kocic, Xavier University of Louisiana (1023-39-365)

1:30PM ► (1612) *Control of an Epidemic Model of Rabies in Raccoons.* Preliminary report.
Suzanne Lenhart, University of Tennessee (1023-92-249)

2:00PM (1613) *Dynamic Reduction, the Periodic Ricker Map and Genetically Altered Mosquitos.*
Robert J. Sacker*, University of Southern California, and **Hubertus F. von Bremen**, California State Polytechnic University (1023-92-1255)

2:30PM (1614) *Disease extinction and persistence in spatially heterogeneous host-parasite models with inter-patch travel.* Preliminary report.
Thanate Dhirasakdanon, **Horst R. Thieme***, Arizona State University, and **Pauline van den Driessche**, University of Victoria (1023-92-1282)

3:00PM (1615) *Modeling relapse in infectious diseases.*
P. van den Driessche, Department of Mathematics and Statistics, University of Victoria (1023-92-593)

3:30PM (1616) *Effect of the introduction of refractory vectors in a vector-borne disease.*
Julien Arino, University of Manitoba (1023-92-1642)

4:00PM (1617) *The Final Size of a SARS Epidemic Model Without Quarantine.* Preliminary report.
Sze-Bi Hsu, National Tsing Hua University, and **Lih-Ing W. Roeger***, Texas Tech University (1023-92-515)

4:30PM (1618) *Comparative estimation of the reproduction number for pandemic influenza from daily case notification data.*
Gerardo Chowell*, Los Alamos National Laboratory, **Hiroshi Nishiura**, Institut fuer Medizinische Biometrie, Universitaet Tuebingen, and **Luis M. A. Bettencourt**, Los Alamos National Laboratory (1023-92-816)

5:00PM (1619) *Optimal Flooding and Native-Invasive Plant Population Dynamics.*
Daniel L. Kern*, University of Nevada, Las Vegas, and **Suzanne M. Lenhart**, University of Tennessee (1023-92-110)

5:30PM (1620) *On a discrete West Nile epidemic model.*
Sophia R.-J. Jang, University of Louisiana at Lafayette (1023-92-1140)

AMS Special Session on Recent Developments in Floer Homology, II

1:00 PM - 5:55 PM

Organizers: **Scott J. Baldridge**, Louisiana State University
Ronald A. Fintushel, Michigan State University
Thomas E. Mark, Southeastern Louisiana University
Brendan E. Owens, Louisiana State University

1:00PM (1621) *Compactness for folded holomorphic maps.*
Jens von Bergmann, University of Notre Dame (1023-58-1593)

1:30PM (1622) *Computations of Floer Homology for certain Lagrangian Tori in closed 4-manifolds.*
Adam C. Knapp, Michigan State University (1023-53-1691)

2:00PM (1623) *On knot Floer homology.*
Peter S. Ozsvath, Columbia University (1023-57-1129)

3:00PM (1624) *Topological triviality of smoothly knotted surfaces in 4-manifolds.*
Hee Jung Kim*, McMaster University, and **Daniel Ruberman**, Brandeis University (1023-57-636)

3:30PM (1625) *Open Book Decompositions of Torus Bundles over S^1.*
Jeremy Van Horn-Morris, University of Texas at Austin (1023-54-1555)

4:00PM (1626) *Thurston-Bennequin bounds for knots in more general contact manifolds.* Preliminary report.
Matthew E. Hedden, Massachusetts Institute of Technology (1023-51-558)

4:30PM (1627) *Heegaard Floer homology and Periodic Knots.* Preliminary report.
Sridhar Rajagopalan, Brandeis University (1023-55-1509)

5:00PM (1628) *Generalizations of symplectic structures and Lefschetz fibrations on smooth 4-manifolds.*
R. Inanc Baykur, Michigan State University (1023-53-341)

5:30PM (1629) *Floer homology and gluing three-manifolds along torus boundary.*
E. Eftekhary, Harvard University (1023-55-1538)

AMS Special Session on Representation Theory and the Theta Correspondence, II

1:00 PM – 6:00 PM

Organizers: **Wee Teck Gan**, University of California San Diego
Hongyu He, Louisiana State University
Annegret Paul, Western Michigan University

1:00PM (1630) *An approach to the local theta correspondence through invariants?*
Roger Howe, Yale University (1023-22-307)

2:00PM (1631) *Signatures of invariant Hermitian forms on irreducible highest weight modules and signed Kazhdan-Lusztig polynomials.*
Wai Ling Yee, University of Windsor (1023-22-1525)

2:30PM (1632) *Lifting of characters on p-adic orthogonal and metaplectic groups.*
Tatiana K. Howard, University of Maryland College Park (1023-22-436)

3:00PM (1633) *Bernstein's center for real groups.*
Gordan Savin*, University of Utah, and **Goran Muic**, University of Zagreb (1023-22-464)

3:30PM (1634) *On the global non-vanishing of theta lifts from even orthogonal groups.*
Shuichiro Takeda, University of California, San Diego (1023-11-1289)

4:00PM (1635) *Minimal polynomials and elementary divisors for simple highest weight modules.* Preliminary report.
Victor Protsak, University of Oklahoma (1023-22-1432)

4:30PM (1636) *Small principal series and representations of rank two.*
Hadi Salmasian, Queen's University, Kingston, Ontario, Canada (1023-22-1108)

5:00PM (1637) *Topology of Siegel modular threefolds and theta lifting.* Preliminary report.
Hongyu He and **Jerome William Hoffman***, Louisiana State University (1023-14-692)

5:30PM Discussion.

AMS Special Session on Structure Theory for Matroids and Graphs, II

1:00 PM – 5:55 PM

Organizers: **Joseph P. Kung**, University of North Texas
Bogdan S. Oporowski, Louisiana State University
James G. Oxley, Louisiana State University

1:00PM (1638) *Towards a structure theory for matroids.*
Bert Gerards, Centrum voor Wiskunde en Informatica, Amsterdam & Technische Universiteit Eindhoven (1023-05-1266)

2:00PM (1639) *Ore-Type and Dirac-Type Theorems for Matroids.*
Sean McGuinness, Dartmouth College (1023-05-752)

2:30PM (1640) *Transversal Lattices.*
Joseph E. Bonin, The George Washington University (1023-05-220)

3:00PM (1641) *Non-separating cocircuits in 3-connected binary matroids.*
Haidong Wu, University of Mississippi (1023-05-788)

3:25PM Break

4:00PM (1642) *On Kung's Growth-Rate Conjecture.*
Jim Geelen, University of Waterloo (1023-05-1277)

5:00PM (1643) *Conjectures on clones, connectivity, and cycles in matroids.*
Talmage J. Reid, The University of Mississippi (1023-05-520)

5:30PM (1644) *Can anything general be said about minor-closed classes of matroids?* Preliminary report.
Joseph P. Kung, University of North Texas (1023-05-333)

AMS Special Session on Time Scales: Dynamic Equations with Applications, II

1:00 PM – 5:55 PM

Organizers: **Martin J. Bohner**, University of Missouri-Rolla
Allan C. Peterson, University of Nebraska-Lincoln

1:00PM ► (1645) *A Nonlinear Sturm-Picone Comparison Theorem for Dynamic Equations on Time Scales.*
Boris Belinskiy, **John R. Graef***, University of Tennessee at Chattanooga, and **Sonja Petrovic**, University of Kentucky (1023-39-1131)

1:30PM (1646) *Asymptotic Behavior of Solutions for Neutral Dynamic Equations on Time Scales.*
Douglas Anderson, Concordia College-Moorhead (1023-34-316)

2:00PM (1647) *Oscillatory Criteria for a Three Dimensional System on a Time Scale.* Preliminary report.
E. Akin-Bohner, University of Missouri Rolla, **Z. Dosla**, Masarykova Univerzita, and **B. Lawrence***, Marshall University (1023-34-1263)

2:30PM ► (1648) *Asymptotic stability for 2x2 dynamic systems on time scales.* Preliminary report.
Gro Hovhannisyan, Kent State University (1023-34-369)

3:00PM (1649) *Boundedness in Functional Dynamic Equations On Time Scales.*
Elvan Bohner, University of Missouri-Rolla, and **Youssef Naim Raffoul***, University of Dayton (1023-34-475)

3:30PM (1650) *Oscillation and nonoscillation for impulsive dynamic equations on certain time scales.*
Mouffak Benchohra, **Samira Hamani**, Universite de Sidi Bel Abbes, and **Johnny Henderson***, Baylor University (1023-34-26)

4:00PM (1651) *On the number of positive periodic solutions of functional dynamic equations on time scales and population models.*
Jo Hoffacker*, Clemson University, and **Doug Anderson**, Concordia College (1023-34-803)

4:30PM (1652) *A Fourier Transform on a Basic Adaptive Grid.*
Andreas L. Ruffing, Munich University of Technology (1023-39-820)

5:00PM (1653) *The Time Scale Fourier Transform.* Preliminary report.
John M. Davis*, **Ian A. Gravagne**, **Billy J. Jackson**, **Robert J. Marks** and **Alice A. Ramos**, Baylor University (1023-42-1290)

5:30PM ► (1654) *The Time Scale Fourier Transform.* Preliminary report.
John M. Davis, **Ian Gravagne**, **Billy J. Jackson***, **Robert J. Marks**, and **Alice Ramos**, Baylor University (1023-39-751)

AMS Special Session on Arithmetic Geometry, II

1:00 PM – 5:55 PM

Organizers: **Matthew H. Baker**, Georgia Institute of Technology
Bjorn Poonen, University of California Berkeley

1:00PM (1655) *Another n-point abc Conjecture.*
Robert L. Benedetto, Amherst College (1023-11-720)

1:30PM (1656) *Arithmetic of dynamical Green's functions.*
Matthew H. Baker, Georgia Institute of Technology (1023-11-631)

2:00PM (1657) *Stable Reduction of $X_0(p^n)$, a Progress Report.*
Ken McMurdy, Rose-Hulman Institute of Technology (1023-11-988)

2:30PM (1658) *Multiplying Modular Forms.*
Martin H. Weissman, University of California, Santa Cruz (1023-11-556)

3:00PM (1659) *A family of K3 surfaces associated to a series for 1/pi.* Preliminary report.
H. A. Verrill*, Louisiana State University, and **Heng Huat Chan**, National University of Singapore (1023-11-1304)

3:30PM (1660) *A nef cone volume for generalized Del Pezzo surfaces.* Preliminary report.
Michael O. Joyce*, Tulane University, and **Zachariah C. Teitler**, Southeastern Louisiana University (1023-14-574)

4:00PM (1661) *Drinfeld modular varieties as varieties with many rational points over finite fields.*
Mihran Papikian, Stanford University (1023-11-337)

4:30PM (1662) *Average twin prime conjecture for elliptic curves.*
Alina Carmen Cojocaru*, University of Illinois at Chicago, **Antal Balog**, Hungarian Academy of Sciences, and **Chantal David**, Concordia University (1023-11-1768)

5:00PM (1663) *Explicit computations of Hecke operators on automorphic forms.*
Lloyd J. Kilford, University of Oxford (1023-11-693)

5:30PM (1664) *The abc conjecture implies Vojta's height inequality for curves.*
Machiel van Frankenhuijsen, Utah Valley State College (1023-11-889)

AMS Special Session on Computational Algebraic and Analytic Geometry for Low-Dimensional Varieties, II

1:00 PM – 5:55 PM

Organizers: **Mika K. Seppälä**, Florida State University
Tanush T. Shaska, Oakland University
Emil J. Volcheck, Association for Computing Machinery

1:00PM (1665) *The 100th anniversary of the Uniformization theorem.*
Peter Buser*, EPF Lausanne, and **Mika Seppälä**, Florida State University and University of Helsinki (1023-30-718)

1:30PM (1666) *Myrberg Numerical Uniformization of Elliptic and Hyperelliptic Curves.*
Robert S. Todd, Florida State University (1023-30-1570)

2:00PM ► (1667) *Special identities for cyclic covers of order 3 and representation theory of symmetric group.*
Yaacov Kopeliovich, New York, NY (1023-32-247)

2:30PM (1668) *Curves generated on surfaces by the G-M algorithm.*
Vidur Malik, Rutgers University, Newark (1023-51-1382)

3:00PM (1669) *The Rees Algebra and the Moving Curve Ideal.*
David A. Cox, Amherst College (1023-14-952)

3:30PM (1670) *Syzygies of toric varieties.*
Milena S. Hering*, Institute of Mathematics and its Applications, **Henry Schenck**, Texas A&M, and **Gregory Smith**, Queen's University (1023-14-1673)

4:00PM (1671) *Toric surface codes and Minkowski sums.*
H. Schenck*, Texas A&M University, and **John Little**, College of the Holy Cross (1023-14-1123)

4:30PM (1672) *Simultaneous Surface Resolution.*
Nan Gu, Purdue University (1023-14-1029)

5:00PM ► (1673) *Linear precision for parametric patches.* Preliminary report.
Luis D. Garcia-Puente* and **Frank Sottile**, Texas A&M University (1023-14-1716)

5:30PM (1674) *Equations for the space of rational curves on the Lagrangian Grassmannian.* Preliminary report.
James Ruffo, Texas A&M University (1023-14-1589)

AMS Special Session on Commutative Algebra and Algebraic Geometry, II

1:00 PM – 5:55 PM

Organizers: **Paul C. Roberts**, University of Utah
Anurag K. Singh, University of Utah
Oana Veliche, University of Utah

1:00PM (1675) *Extended modules.* Preliminary report.
W. Hassler, Karl-Franzens-Universitaet Graz, **R. Karr**, **L. Klingler**, Florida Atlantic University, and **R. Wiegand***, University of Nebraska (1023-13-1139)

1:30PM (1676) *A criterion for integral dependence of modules.*
Javid Validashti* and **Bernd Ulrich**, Purdue University (1023-13-466)

2:00PM (1677) *Asymptotic Castelnuovo-Mumford Regularity.* Preliminary report.
David Eisenbud, University of California, Berkeley, and MSRI (1023-13-1456)

2:30PM (1678) *Ideal Class Semigroups of Overrings.*
Lucian F. Sega, West Lafayette, IN (1023-13-817)

3:00PM (1679) *Failure of Tameness for Local Cohomology.*
Steven Dale Cutkosky*, University of Missouri, and **Juergen Herzog**, University of Duisburg-Essen, Campus Essen (1023-13-1224)

3:30PM (1680) *A counterexample to an open problem concerning a comparison between the quasicoherent and étale cohomological dimension of a scheme.*
Gennady Lyubeznik, University of Minnesota (1023-14-681)

4:00PM (1681) *Adams operations and New Intersection.*
Greg Piepmeyer* and **Mark E. Walker**, University of Nebraska, Lincoln (1023-19-1237)

4:30PM (1682) *Non-commutative desingularization of the generic determinant.* Preliminary report.
Ragnar-Olaf Buchweitz, University of Toronto, **Graham J. Leuschke***, Syracuse University, and **Michel Van den Bergh**, Universiteit Hasselt (1023-13-1297)

5:00PM (1683) *On the intersection of the curves through a set of points in $\mathbb{P}^2$.*
Z. Teitler, Southeastern Louisiana University (1023-14-42)

5:30PM (1684) *Cayley-Bacharach schemes and their cores.* Preliminary report.
Claudia Polini, University of Notre Dame (1023-13-851)

MAA Minicourse #11: Part B

1:00 PM - 3:00 PM

Origami in undergraduate mathematics courses.
Organizer: **Thomas C. Hull**, Merrimack College

MAA Minicourse #15: Part B

1:00 PM - 3:00 PM

Geometry with history for teaching teachers.
Organizers: **David W. Henderson**, Cornell University
Daina Taimina, Cornell University

MAA Minicourse #5: Part B

1:00 PM - 3:00 PM

Wavelets and applications: A multidisciplinary undergraduate course with emphasis on scientific computing.
Organizer: **Patrick J. Van Fleet**, University of St. Thomas

AMS Session on Operator Theory and Optimal Control, II

1:00 PM - 5:25 PM

1:00PM (1685) *Simplicity of C*-algebras using unique eigenstates.*
Lon H. Mitchell, University of Kansas (1023-47-322)

1:15PM (1686) *On a class of Integral Operators related to the Fock Spaces.*
Ovidiu Furdui, Western Michigan University (1023-47-36)

1:30PM (1687) *Weighted shifts whose pth root shifts are subnormal.* Preliminary report.
George R. Exner, Bucknell University (1023-47-498)

1:45PM (1688) *Monotone variational inequalities revisited.*
Dan D. Pascali, Courant Institute, New York University (1023-47-508)

2:00PM (1689) *C*-Algebras of Inverse Semigroups: Amenability and Weak Containment.* Preliminary report.
David Milan, University of Nebraska (1023-47-582)

2:15PM (1690) *Topological Degree Theories and Nonlinear Operator Equations in Banach Spaces.*
Dhruba R. Adhikari* and **Athanassios G. Kartsatos**, University of South Florida (1023-47-643)

2:30PM (1691) *Rank Preserving Maps on CSL Algebras.*
Jaedeok Kim*, Jacksonville State University, and **Robert L. Moore**, University of Alabama (1023-47-793)

2:45PM (1692) *Using the Leray-Schauder Degree for a Degree Involving Maximal Monotone Perturbations of (S+)-operators.*
Boubakari Ibrahimou* and **Athanassios G. Kartsatos**, University of South Florida (1023-47-932)

3:00PM (1693) *Position Registration from Voltage Samples.*
Fadil Santosa and **Carl Toews***, IMA (1023-49-757)

3:15PM Break.

3:30PM (1694) *Existence Theorems for Thin Inflated Wrinkled Membranes Subjected to a Hydrostatic Pressure Load.* Preliminary report.
Frank Baginski, **Michael Barg***, The George Washington University, and **William Collier**, Washington, DC (1023-49-308)

► 3:45PM (1695) *Minimax Approach to Feedback Control of Distributed-Parameter Systems.*
Ilya Shvartsman*, Miami University, and **Boris S. Mordukhovich**, Wayne State University (1023-49-779)

4:00PM (1696) *Optimization of Traveling Wave Tubes using Large Signal Codes and Optical Beam Analysis.*
Adam R. Attarian*, North Carolina State University, **Jeremy Zuckero**, Wilkes University, **Laura Tarko**, Mt. Holyoke University, **John David**, North Carolina State University, and **Lawrence Ives**, Calabazas Creek Research, Inc. (1023-49-1489)

4:15PM Break.

4:30PM (1697) *Exact subdifferential calculus and optimality conditions in nondifferentiable programming.*
Boris Mordukhovich and **Mau Nam Nguyen***, Wayne State University (1023-49-134)

► 4:45PM (1698) *A regularity theory for multiple-valued Dirichlet minimizing maps.* Preliminary report.
Wei Zhu, Rice University (1023-49-897)

5:00PM (1699) *The onset problem for a thin superconducting loop in a large magnetic field.*
Tien-Tsan Shieh* and **Peter Sternberg**, Indiana University (1023-49-1506)

► 5:15PM (1700) *Convergence Rate of an Interior Point Gradient Method for the Totally Non-Negative Least Squares Problem.* Preliminary report.
Elaine T. Hale* and **Yin Zhang**, Rice University (1023-49-1647)

AMS Session on Numerical Analysis and Computer Science, II

1:00 PM - 4:25 PM

► 1:00PM (1701) *Immersed Interface Method for wave equations.* Preliminary report.
Miguel A. Dumett, University of Southern California (1023-65-206)

1:15PM (1702) *Calculating Symmetric Modes of Motion in Molecular Dynamics.*
Mili Shah* and **Danny C. Sorensen**, Rice University (1023-65-463)

► 1:30PM (1703) *On the Fixed Points of a Function and its Corresponding Composite Functions.*
Mohammad K. Azarian, University of Evansville (1023-65-513)

1:45PM (1704) *A fast iterative numerical method for the free boundary Bernoulli problem.*
Christopher M. Kuster, North Carolina State University (1023-65-514)

2:00PM (1705) *Robustness of the Multivariate Spline Method for numerical solution of partial differential equations.* Preliminary report.
Gerard Awanou, Northern Illinois University (1023-65-538)

2:15PM (1706) *A New Wavelet Multigrid Method.*
Doreen De Leon, California State University, Fresno (1023-65-644)

2:30PM (1707) *Defect-correction methods for finite element computations of viscoelastic fluid flow.*
Vincent J. Ervin, **Jason S. Howell*** and **Hyesuk Lee**, Clemson University (1023-65-759)

2:45PM Break.

3:15PM (1708) *Newton's method with deflation for isolated singularities of polynomial systems.*
Anton Leykin, **Jan Verschelde** and **Ailing Zhao***, University of Illinois at Chicago (1023-65-849)

3:30PM Break.

3:45PM ► (1709) *A Linearization of a Backward Euler Scheme for the Saturation Equation: A Regularity Result.* Preliminary report.
Koffi B. Fadimba, University of South Carolina Aiken (1023-65-915)

4:00PM ► (1710) *Wavelet, Ridgelet, and Curvelet-Based Texture Classification of Normal Tissues in Computed Tomography Images.*
Lucia Dettori* and **Lindsay Semler**, DePaul University, School of Computer Science, Telecommunications, and Information Systems (1023-68-121)

4:15PM (1711) *Composition of comparison based algorithms as an algebraic operation.*
Homeira Pajoohesh, Georgia Southern University (1023-68-1736)

AMS Session on Applications of Mathematics, IV

1:00 PM – 5:25 PM

1:00PM ► (1712) *A bifurcation analysis of pattern formation in the developing ear.* Preliminary report.
K. A. Montgomery, University of Utah (1023-92-1643)

1:15PM (1713) *Control of synchronization in coupled oscillatory networks.*
Menaka Bandara Navaratna, Florida Gulf Coast University (1023-92-1738)

1:30PM ► (1714) *Agent-based model of therapeutic intervention following exposure to botulinum neurotoxin.* Preliminary report.
Keith A. Erickson, United States Military Academy (1023-92-1749)

1:45PM (1715) *A Monotone Approximation for a Size-Structured Population Model with a Generalized Environment.*
Azmy S. Ackleh, **Keng Deng** and **Jeremy J. Thibodeaux***, University of Louisiana at Lafayette (1023-92-1767)

2:00PM ► (1716) *Generalized Trojan Gene Hypothesis.*
Juan B. Gutierrez, Florida State University (1023-92-1788)

2:15PM ► (1717) *An Enzyme Kinetic Model of Tumor Dormancy; Regulation and Control of Secondary Metastases by Plasmin, Intratumoral Distance and Surgical Removal of the Primary Tumor.* Preliminary report.
Andrew Lewis Matteson, Texas A&M University (1023-92-1904)

2:30PM (1718) *The influence of segregation from reproduction in the long term dynamics of persistent sexually transmitted diseases.*
Daniel Maxin* and **Fabio A. Milner**, Purdue University (1023-92-469)

2:45PM (1719) *A Situation in which a Local Nontoxic Refuge Promotes Pest Resistance To Toxic Crops.*
Jemal Said Mohammed-Awel*, Valdosta State University, **Karen Kopecky**, University of Western Ontario, and **John Ringland**, SUNY Buffalo (1023-92-702)

3:00PM Break.

3:15PM (1720) *A computational model of tumor therapy.*
Jin Wang, Duke University (1023-92-707)

3:30PM ► (1721) *Do implicit measures for female associations with mathematics display cultural or regional biases?* Preliminary report.
Rosa A. Del Angel* and **Diana W. Verzi**, San Diego State University-Imperial Valley Campus (1023-92-920)

3:45PM (1722) *Effect of Input Noise on a Magnetometer with Quantum Feedback.*
Zhigang Zhang, Texas A&M University (1023-93-1645)

4:00PM (1723) *An ergodic control problem of a diffusion with jumps.* Preliminary report.
Cristin Buescu* and **Michael I. Taksar**, University of Missouri-Columbia (1023-93-1740)

4:15PM ► (1724) *The Pivotal Role of Commutators in Action.* Preliminary report.
Dov J. Rhodes*, Indiana University, Bloomington, and **Nathan Olson**, Cal Poly, Pomona (1023-93-1815)

4:30PM ► (1725) *Electromagnetic Analysis of a MEMS Integrated Frequency Reconfigurable Antenna.*
Toby Ann Hale* and **Bedri A. Cetiner**, Morehead State University (1023-94-1436)

4:45PM ► (1726) *Resistor Networks with Finitely Many Solutions to the Discrete Inverse Boundary Problem.* Preliminary report.
Ilya Grigoriev, University of Chicago (1023-94-1846)

5:00PM ► (1727) *Agreement in Circular Societies.* Preliminary report.
Christopher S. Hardin, Smith College (1023-91-1629)

5:15PM ► (1728) *From RNA Molecules to Brain Structures: Geometric Measures as Shape Descriptors.* Preliminary report.
Christian Laing, Florida State University (1023-92-125)

AMS Session on Combinatorics, IV

1:00 PM – 3:25 PM

1:00PM (1729) *Incidence Matrices and Inequalities for Combinatorial Designs.*
D. Raghavarao, Temple University, **S. S. Shrikhande**, Mt. Pleasant, MI, and **M. S. Shrikhande***, Central Michigan University (1023-05-724)

1:15PM (1730) *On Long Cycles in Triangle-Free Graphs.*
Doug Bauer, Stevens Institute of Technology, **Nathan Kahl***, Seton Hall University, **Linda McGuire**, Muhlenberg College, and **Edward Schmeichel**, San Jose State University (1023-05-77)

1:30PM (1731) *Cycles in the Cartesian Product of Two Directed Cycles.*
Sherry Xiaohua Wu, Cornell University (1023-05-790)

1:45PM (1732) *A Relationship between the Robinson-Schenstead-Knuth Correspondence (RSK) and Permutation Containment.*
Yan Zhang, Harvard University (1023-05-919)

2:00PM (1733) *On the Minimum Number of Subsums of a Zero-Sum-Free Sequence.*
N. J. Ince, Massachusetts Institute of Technology (1023-05-924)

2:15PM ► (1734) *A New Ore-Condition for H-linked Graphs.* Preliminary report.
Ron J. Gould, Emory University, **Jeffrey S. Powell***, Samford University, and **Thor Whalen**, Methodic Solutions, Atlanta (1023-05-960)

2:30PM (1735) *The directed case of decompositions of edge-colored complete digraphs.*
Anna Draganova*, University of California, Los Angeles, **Yukiyasu Mutoh**, Keio University, Japan, and **Richard M. Wilson**, California Institute of Technology (1023-05-962)

2:45PM (1736) *Fall Coloring of Cartesian Products of Graphs.* Preliminary report.
S. Jeremy Lyle* and **Renu Laskar**, Clemson University (1023-05-968)

3:00PM ► (1737) *DNA Codewords and De Bruijn Sequences.* Preliminary report.
Stephen G. Hartke, University of Illinois at Urbana-Champaign (1023-05-975)

3:15PM ► (1738) *Restricted Symmetric Permutations.*
Eric S. Egge, Carleton College (1023-05-986)

MAA Session on Applications of Discrete Mathematics, II

1:00 PM – 4:55 PM

Organizers: **Thomas Koshy**, Framingham State College
Thomas Moore, Bridgewater State College

1:00PM (1739) *Dynamic service scheduling on directed graphs.* Preliminary report.
D. Jacob Wildstrom, University of California, San Diego (1023-D1-633)

1:20PM ► (1740) *Borderline Behavior for 2x2 Iterative Systems.*
Samer Habre*, Lebanese American University, Beirut, and **Jean Marie McDill**, California Polytechnic State University (1023-D1-879)

1:40PM ► (1741) *Derangements, Probability, and Calculus.*
Thomas Koshy, Framingham State College (1023-D1-1126)

2:00PM (1742) *Approximative policies for Preemptive Stochastic Online Scheduling.*
Nicole Megow*, TU Berlin, and **Tjark Vredeveld**, Maastricht University (1023-D1-1226)

2:20PM ► (1743) *Generating Functions and the Prisoner's Dilemma on Graphs.*
Stephen Devlin* and **Reza Dibadj**, University of San Francisco (1023-D1-1327)

2:40PM ► (1744) *Counting Point-Determining Graphs Using Joyal's Theory of Species.*
Ji Li, Brandeis University (1023-D1-1357)

3:00PM ► (1745) *The Geometry Behind Paradoxes of Voting Power.*
Michael A. Jones, Montclair State University (1023-D1-1419)

3:20PM ► (1746) *Visualizing Binomial Identities using PascGaloisJE.* Preliminary report.
Michael J. Bardzell, Salisbury University (1023-D1-1601)

3:40PM ► (1747) *Dependence Among Random Binary Vectors.* Preliminary report.
Neil J. Calkin and **Shannon R. Lockard***, Clemson University (1023-D1-1625)

4:00PM ► (1748) *Exploring Graph Theory Using a Comprehensive Database of Graphs.*
Jason Grout, Brigham Young University (1023-D1-1700)

4:20PM ► (1749) *The Hat Problem and Coding Theory.* Preliminary report.
Ann E. Moskol, Rhode Island College (1023-D1-1811)

4:40PM (1750) *Designing the right mix for DNA self-assembly.*
N. Jonoska, **G. L. McColm** and **Ana Staninska***, University of South Florida (1023-D1-1878)

MAA Session on Assessment of Student Learning in Undergraduate Mathematics, II

1:00 PM – 2:40 PM

Organizers: **William Martin**, North Dakota State University
Bernard L. Madison, University of Arkansas

1:00PM (1751) *Program Assessment - What Worked and What Did Not Work.*
Jim Fulmer*, University of Arkansas at Little Rock, and **Tom McMillan**, State University of New York at Utica (1023-D5-1793)

1:15PM ► (1752) *Learning-focused Exam Construction.*
James S. Rolf*, **Michael A. Brilleslyper** and **R. Scott Callihan**, United States Air Force Academy (1023-D5-1837)

1:30PM (1753) *From Pre-tests to Capstones.* Preliminary report.
Therese Shelton, Southwestern University (1023-D5-1633)

1:45PM ► (1754) *Students Assessing Other Students: Competition is the Great Motivator to Learn.* Preliminary report.
Barbra S. Melendez* and **Tasha Williams**, United States Military Academy (1023-D5-438)

2:00PM (1755) *Assessing Student Performance in College Algebra with WeBWorK.*
Alberto Candel*, CSUN, and **Juana Sanchez**, UCLA (1023-D5-1420)

2:15PM (1756) *Using Cumulative Assessment to Enhance the Mathematics Experience of College Students at the Entry Level.*
Blanche S. Presley* and **Barry J. Monk**, Macon State College (1023-D5-123)

2:30PM (1757) *A Misadventure with a Web-based Assessment Method.*
Louis M. Beaugris, Kean University (1023-D5-1816)

MAA General Contributed Paper Session, VIII

1:00 PM – 4:25 PM

Organizers: **Eric S. Marland**, Appalachian State University
Jay A. Malmstrom, Oklahoma State Community College

1:00PM ► (1758) *Primordial Black Holes and Large Scale Structure.* Preliminary report.
Adam Drake, University of Houston-Downtown (1023-Z1-1096)

1:15PM ► (1759) *The Aeroacoustics of Turbulent Coanda Jet Flows.*
Jason C. Fox* and **Caroline P. Lubert**, James Madison University (1023-Z1-317)

1:30PM (1760) *Three Dimensional Computational Model of Water Movement in Plant Root Growth Zone.* Preliminary report.
Brandy S. Wiegers*, **Angela Y. Cheer**, and **Wendy K. Silk**, University of California, Davis (1023-Z1-1689)

1:45PM (1761) *Verifying hydraulic design of the water-conducting networks taking into account the maintenance of the reliability.*
Boli Yarkulov, Samarkand State Civil Engineering and Architectural Institute (1023-Z1-230)

2:00PM (1762) *Keeping the Doors Open: A Summer Algebra Camp for Underrepresented Minority Middle Schoolers.* Preliminary report.
John B. Fink, Kalamazoo College (1023-Z1-835)

2:15PM (1763) *Models in my head "How a blind student sees graphs and their equations".*
Aldo R. Maldonado, Park University (1023-Z1-517)

2:30PM (1764) *What do business students need to know about math?* Preliminary report.
Julia Darby Head*, **G. Brock Williams** and **Amanda Michelle Wheeler**, Texas Tech University (1023-Z1-1731)

2:45PM (1765) *Journeys in Mathematics: Courses in Problem Solving, Number and Operation, Algebra, Geometry and Measurement, Probability and Data Analysis, and Concepts of Trig and Calculus for K-8 teachers.*
Cora Neal*, Sonoma State University, and **Deborah Narang**, University of Alaska Anchorage (1023-Z1-306)

3:00PM (1766) *Mathematics Courses for Future Grade 1-6 Teachers at Louisiana State University Shreveport.*
Judith Covington, Louisiana State University Shreveport (1023-Z1-852)

3:15PM (1767) *K-5 teachers explore the nature of rational numbers: A case for inquiry in a mathematics specialist program.*
Aimee J. Ellington* and **Joy W. Whitenack**, Virginia Commonwealth University (1023-Z1-359)

3:30PM (1768) *Professors in the Schools at Morehead State University.* Preliminary report.
Mike Dobranski, Morehead State University (1023-Z1-1761)

3:45PM (1769) *Inequalities Through Geometry.*
Anand Kumar, Ramanujan School of Mathematics (1023-Z1-606)

4:00PM (1770) *Sharing Triangles, Geometric Triangles, and Pascal's Triangle.* Preliminary report.
Charles J. Kicey*, Valdosta State University, **Jun Ji**, Kennesaw State University, and **Arsalan Wares**, Valdosta State University (1023-Z1-1091)

4:15PM (1771) *Circles, Diamonds, and Squares: A New Trigonometry for a New π.* Preliminary report.
Robert D. Poodiack, Norwich University (1023-Z1-1395)

MAA General Contributed Paper Session, IX

1:00 PM – 4:25 PM

Organizers: **Eric S. Marland**, Appalachian State University
Jay A. Malmstrom, Oklahoma City Community College

1:00PM (1772) *Enhancing student interest in mathematics with the course related multimedia tools.*
Atul N. Roy, Montgomery College (1023-Z1-1210)

1:15PM (1773) *WvEB Math: College Algebra and Trigonometry for High School Students.*
Michael Mays* and **Laura Pyzdrowski**, West Virginia University (1023-Z1-315)

1:30PM (1774) *ORICUT: Proposal of teaching in Basic Education (Level K4 and K5).*
Alberto de León de León* and **Lineth Alejandra De León Torres**, Instituto Tecnológico de Cd. Madero (1023-Z1-1611)

1:45PM (1775) *Using WeBWorK to foster reading.* Preliminary report.
George R. Exner, Bucknell University (1023-Z1-499)

2:00PM (1776) *Pre-calculus ILAPs as a path to QL.*
Aaron Montgomery, Central Washington University (1023-Z1-1398)

2:15PM (1777) *A Guideline for Students to Master the Skills of Writing Equations for Words Problems.* Preliminary report.
Shumei C. Richman, Midlands Technical College (1023-Z1-1258)

2:30PM (1778) *Couple Interactive Computer Based Math Games.*
Hongbiao Zeng, Fort Hays State University (1023-Z1-1233)

2:45PM (1779) *Who Are the Best Sluggers in Baseball?*
Steve Alan Krevisky*, Middlesex Community College, **Randy Taylor**, Las Positas College, and **Rodrigo Faria**, University of Sao Paulo Western (1023-Z1-1786)

3:00PM (1780) *Placement Made Personal.* Preliminary report.
John C. Nardo and **Judith L. Gieger***, Oglethorpe University (1023-Z1-672)

3:15PM (1781) *Helping First-Semester Freshmen Mathematics Majors Develop Proofs.* Preliminary report.
Bonnie Gold, Monmouth University (1023-Z1-632)

3:30PM (1782) *Getting Students to Learn from their Mistakes.*
Vera Cherepinsky, Fairfield University (1023-Z1-1724)

3:45PM (1783) *Navigational Mathematics Instructology: A Scientific Scholarship Of Teaching And Learning.* Preliminary report.
Clyde L. Greeno, The MALEI Mathematics Institute (1023-Z1-927)

4:00PM (1784) *Mathematics and the TBR Teacher Preparation Collaborative.* Preliminary report.
Anant P. Godbole, East Tennessee State University (1023-Z1-567)

4:15PM (1785) *Pre-service Teachers enhance their Mathematical Understanding Through Journal writing.* Preliminary report.
Barba Patton* and **Carol Klages**, University of Houston-Victoria (1023-Z1-1818)

MAA Panel Discussion

1:00 PM – 2:20 PM

Knowing mathematics for teaching: Issues in assessment and teacher preparation.

Organizers: **Joan Ferrini-Mundy**, Michigan State University
Raven McCrory, Michigan State University

Presenters: **Michael Frasier**, University of Tennessee
Joan Ferrini-Mundy
Raven McCrory
Sharon Senk, Michigan State University
William Schmidt, Michigan State University

Gail Burrill, Michigan State University

MAA Panel Discussion

1:00 PM – 2:20 PM

MathNerds, Moore Method, and mathematics education: What do they have in common?

Organizers: **W. Ted Mahavier**, Lamar University
Laurie O. Cavey, James Madison University

Panelists: **Terry McCabe**, Texas State University
G. Edgar Parker, James Madison University
Hiroko K. Warshauer, Texas State University
Max L. Warshauer, Texas State University
Alexander White, Texas State University
Laurie O. Cavey

AWM Workshop Panel Discussion

1:00 PM – 2:15 PM

Critical career decision stages: Research and funding opportunities.

Moderator: **Claudia Polini**, University of Notre Dame

Panelists: **Valentina S. Harizanov**, The George Washington University
Kathleen O'Hara, Mathematical Sciences Research Institute
Barbara Lee Keyfitz, Fields Institute and University of Houston
Michelle D. Wagner, National Security Agency

AMS Session on Probability and Statistics, II

1:30 PM – 4:55 PM

1:30PM (1786) *Gambler's Ruin with Catastrophes and Windfalls.* **Blake Hunter**, University of California, Davis, **Alan Krinik***, **Chau Nguyen**, **Jenny Switkes** and **Hubertus von Bremen**, California State Polytechnic University, Pomona (1023-60-1863)

1:45PM (1787) *A Single-server Poisson Queueing System with Delayed-Service.* **Aliakbar Montazer Haghighi***, **Dimitar P. Mishev**, Prairie View A&M University, and **Stefanka S. Chukova**, Victoria University of Wellington (1023-60-239)

2:00PM (1788) *Laws of Large Numbers in D[0, 1].* **Paul H. Bezandry**, Howard University (1023-60-658)

2:15PM (1789) *The submartingale problem for a class of degenerate elliptic operators.* **Richard F. Bass**, University of Connecticut, and **Alexander Lavrentiev***, University of Wisconsin - Fox (1023-60-708)

2:30PM (1790) *Mutual Information for a Multivariate T-Distribution.* Preliminary report. **Walfredo R. Javier***, Southern University-BR, and **Arjun K. Gupta**, Bowling Green State University (1023-60-970)

2:45PM (1791) *Pedagogical Utilization and Assessment of the Statistic Online Computational Resource in Introductory Probability and Statistics Courses.* **Ivo D. Dinov***, **Juana Sanchez** and **Nicolas Christou**, UCLA Statistics (1023-62-01)

3:00PM (1792) *Statistical Modeling of Terrain Profiles.* **Tze-Chien Sun** and **Jinfeng Wei***, Wayne State University (1023-62-809)

3:15PM (1793) *Comparing Control Charts With Estimated Parameters.* **Maria E. Calzada*** and **Stephen M. Scariano**, Loyola University New Orleans (1023-62-1326)

3:30PM Break.

3:45PM (1794) *Linear Dimension Reduction of Images Using Geometrical Tools.* Preliminary report. **Evgenia Rubinshtein***, University of Central Arkansas, and **Anuj Srivastava**, Florida State University (1023-62-1492)

4:00PM (1795) *Impact of exogeneous factors on patients expiratory volume.* Preliminary report. **Rachid Bekralas**, BMCC City University (1023-62-1681)

4:15PM (1796) *Sample Size Issues in Resource Selection Studies.* **Ashraf F. ELHoubi**, Lamar University (1023-62-377)

4:30PM (1797) *A Comparison of Data Mining Courses Taught Across Disciplines.* Preliminary report. **Alan M. Safer**, California State University, Long Beach (1023-62-379)

4:45PM (1798) *Smooth Inference for Survival Functions with Arbitrarily Censored Data.* **Kirsten Doehler***, University of North Carolina Greensboro, and **Marie Davidian**, North Carolina State University (1023-62-676)

ASL Contributed Papers

2:00 PM – 4:00 PM

Organizer: **Marcia Groszek**, Dartmouth College

2:00PM (1799) *Effective Souslin trees and degrees in α-recursion theory.* **François Dorais**, Dartmouth College

2:25PM (1800) *The strength of the rainbow Ramsey theorem.* **Joe Mileti***, University of Chicago, and **Barbara Csima**, University of Waterloo

2:50PM (1801) *Turing computable embeddings into equivalence structures.* **Sara Miller**, University of Notre Dame

3:15PM (1802) *Classification of a family of countably universal H-free graphs.* **Rehana Patel**, St. John's University

3:40PM (1803) *The Boltzmann principle and protein primary structure.* **Dennis F. Cudia**, Rockford, IL

AWM Workshop: Research Presentations by Recent Ph.D.'s, II

2:30 PM – 4:20 PM

2:30PM (1804) *Nonvariational Methods for Semilinear Elliptic Equations of Critical Growth.* **Sarah G. Raynor**, Wake Forest University (1023-35-755)

3:00PM (1805) *The Role of the Jacobson Radical in the Baer-Kaplansky Theorem for Torsion-Free Modules over a Complete Discrete Valuation Domain.* **Mary K. Flagg**, University of Houston (1023-20-845)

3:30PM (1806) *Diffusion Flame Stability.*
Amy B. Moore*, Alma College, and **Milan Miklavcic**, Michigan State University
(1023-35-1082)

4:00PM (1807) *Petite K-types and Unitary Representations.*
Allessandra Pantano, Cornell University
(1023-22-901)

MAA Minicourse #6: Part B

3:30 PM - 5:30 PM

WeBWorK 2: An Internet-based system for generating and delivering homework.
Organizers: **Arnold K. Pizer**, University of Rochester
Michael E. Gage, University of Rochester
Vicki Roth, University of Rochester

AMS Banquet Reception

6:30 PM - 7:30 PM

AMS Banquet

7:30 PM - 10:30 PM

Susan J. Friedlander
AMS Associate Secretary
Chicago, Illinois

James J. Tattersall
MAA Associate Secretary
Providence, Rhode Island

DIRECTOR INSTITUTE FOR MATHEMATICS AND ITS APPLICATIONS

The Board of Governors of the Institute for Mathematics and Its Applications (IMA) and the University of Minnesota seek a new Director of the IMA for an appointment beginning August 2008 (or possibly earlier in the summer). The new Director will be offered a tenured Professorship at the University of Minnesota. Candidates should have the qualifications to provide scientific and administrative leadership to the IMA. Distinguished academic credentials, including a Ph.D. or equivalent, and a record of scientific leadership are required. Salary and term as Director of the IMA are negotiable.

The IMA was established in 1982 with financial support from the National Science Foundation. The Foundation has now renewed the funding for the IMA until 2010. The mission of the Institute is to identify areas of research in science, engineering and industry where mathematics can have an impact and to encourage participation of mathematicians in these areas. Nominations and applications should be sent to Chair of the School of Mathematics, University of Minnesota, 206 Church Street S.E., Minneapolis, MN 55455. Consideration of applications will begin March 15, 2007.

The University of Minnesota is an equal opportunity employer and educator

Research topic:
Statistical Mechanics

Education Theme:
Knowledge for Teaching Mathematics

A three-week summer program for
graduate students
undergraduate students
mathematics researchers
undergraduate faculty
secondary school teachers
math education researchers

IAS/Park City Mathematics Institute (PCMI)
July 1 - 21, 2007
Park City, Utah

Organizers: Scott Sheffield, Courant Institute; Thomas Spencer, Institute for Advanced Study.
Graduate Summer School Lecturers: David Brydges, University of British Columbia; Alice Guionnet, Ecole Normale Supérieure de Lyon; Richard Kenyon, University of British Columbia; Gregory Lawler, University of Chicago; Yuval Peres, Microsoft Research and University of California Berkeley; Wendelin Werner, Université Paris-Sud.
Clay Senior Scholars in Residence: Andrei Okounkov, Princeton University; Srinivasa Varadhan, Courant Institute.
Other Organizers: Secondary School Teachers Program: Gail Burrill, Michigan State University; Carol Hattan, Vancouver, WA; James King, University of Washington. Undergraduate Summer School: Aaron Bertram, University of Utah. Undergraduate Faculty Program: William Barker, Bowdoin College.

Applications: www.ias.edu/parkcity
Deadline: February 15, 2007
IAS/Park City Mathematics Institute
Institute for Advanced Study, Princeton, NJ 08540
Financial Support Available

2007 AMS Sectional Meetings

March 3-4, 2007 (Saturday-Sunday)
Davidson College, Davidson, NC
(2007 Spring Southeastern Section Meeting)

March 16-17, 2007 (Friday-Saturday)
Miami University, Oxford, OH
(2007 Spring Central Section Meeting)

April 14-15, 2007 (Saturday-Sunday)
Stevens Institute of Technology, Hoboken, NJ
(2007 Spring Eastern Section Meeting)

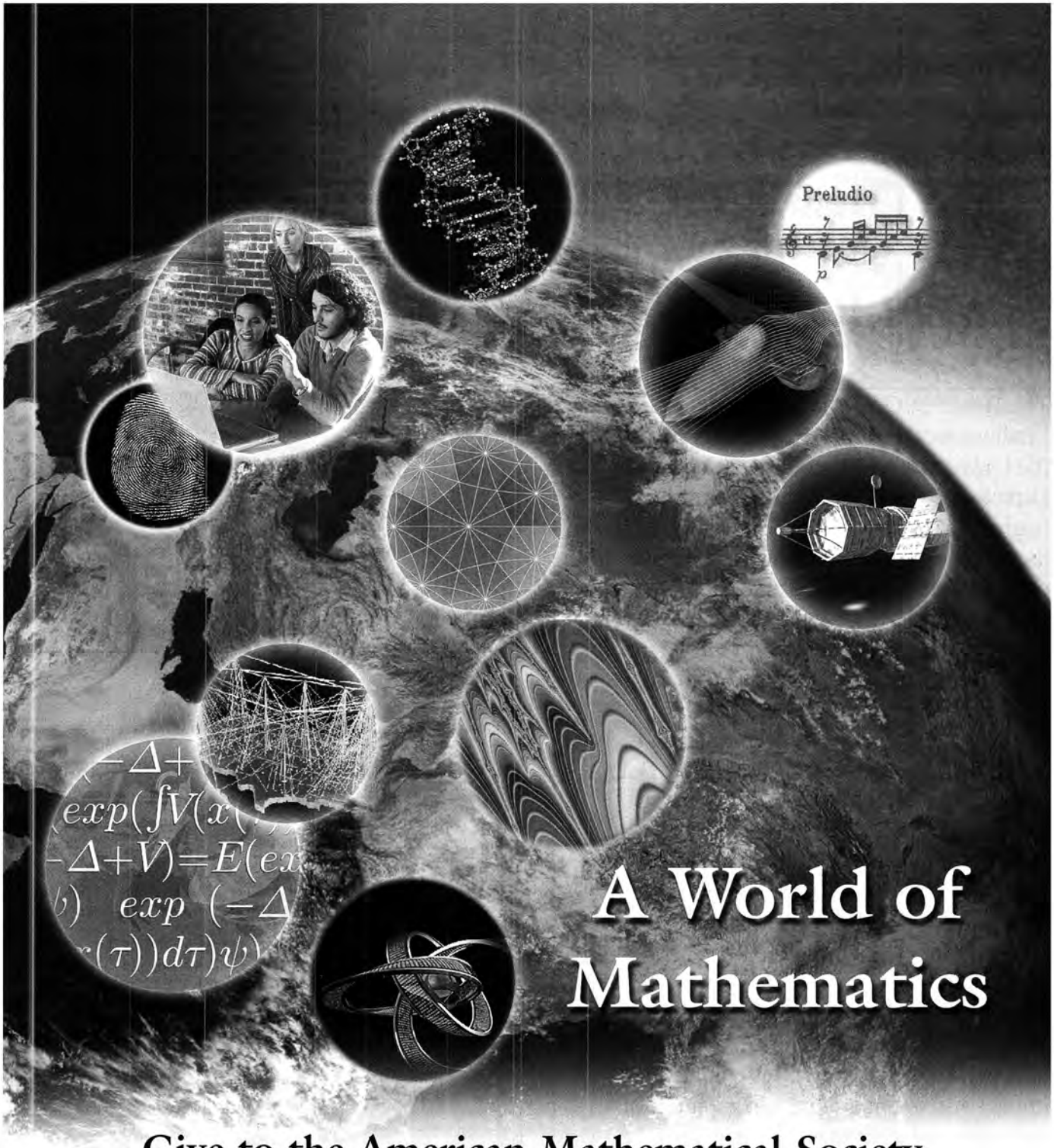
April 21-22, 2007 (Saturday-Sunday)
University of Arizona, Tucson, AZ
(2007 Spring Western Section Meeting)

October 5-6, 2007 (Friday-Saturday)
DePaul University, Chicago, IL
(2007 Fall Central Section Meeting)

October 6-7, 2007 (Saturday-Sunday)
Rutgers University-New Brunswick, Busch Campus, New Brunswick, NJ
(2007 Fall Eastern Section Meeting)
3rd Annual Einstein Lecture

October 13-14, 2007 (Saturday-Sunday)
University of New Mexico, Albuquerque, NM
(2007 Fall Western Section Meeting)

November 3-4, 2007 (Saturday-Sunday)
Middle Tennessee State University, Murfreesboro, TN
(2007 Fall Southeastern Meeting)



Give to the American Mathematical Society

Your donations support:

- Career paths of young mathematicians
- Recognition of important work
- Public awareness and appreciation of mathematics
- Inspiration of young scholars (Epsilon Fund)
- International outreach

Learn about giving opportunities and estate planning
www.ams.org/giving-to-ams

Contact the AMS Development Office 1.800.321.4267 (U.S. and Canada) or 1.401.455.4000 (worldwide)
email: development@ams.org

AMS
AMERICAN MATHEMATICAL SOCIETY
www.ams.org

08/04

Meetings and Conferences of the AMS

Associate Secretaries of the AMS

Western Section: Michel L. Lapidus, Department of Mathematics, University of California, Sproul Hall, Riverside, CA 92521-0135; e-mail: lapidus@math.ucr.edu; telephone: 951-827-5910.

Central Section: Susan J. Friedlander, Department of Mathematics, University of Illinois at Chicago, 851 S. Morgan (M/C 249), Chicago, IL 60607-7045; e-mail: susan@math.nwu.edu; telephone: 312-996-3041.

Eastern Section: Lesley M. Sibner, Department of Mathematics, Polytechnic University, Brooklyn, NY 11201-2990; e-mail: lsibner@duke.poly.edu; telephone: 718-260-3505.

Southeastern Section: Matthew Miller, Department of Mathematics, University of South Carolina, Columbia, SC 29208-0001, e-mail: miller@math.sc.edu; telephone: 803-777-3690.

The Meetings and Conferences section of the *Notices* gives information on all AMS meetings and conferences approved by press time for this issue. Please refer to the page numbers cited in the table of contents on this page for more detailed information on each event. Invited Speakers and Special Sessions are listed as soon as they are approved by the cognizant program committee; the codes listed are needed for electronic abstract submission. For some meetings the list may be incomplete. **Information in this issue may be dated. Up-to-date meeting and conference information can be found at** www.ams.org/meetings/.

Meetings:

2007

January 5–8	New Orleans, Louisiana Annual Meeting	p. 79
March 3–4	Davidson, North Carolina	p. 81
March 16–17	Oxford, Ohio	p. 83
April 14–15	Hoboken, New Jersey	p. 85
April 21–22	Tucson, Arizona	p. 86
May 23–26	Zacatecas, Mexico	p. 87
July 31–August 3	Warsaw, Poland	p. 87
October 5–6	Chicago, Illinois	p. 87
October 6–7	New Brunswick, New Jersey	p. 88
October 13–14	Albuquerque, New Mexico	p. 88
November 3–4	Murfreesboro, Tennessee	p. 88
December 12–15	Wellington, New Zealand	p. 89

2008

January 6–9	San Diego, California Annual Meeting	p. 89
March 22–23	New York, NY	p. 89
March 28–30	Baton Rouge, Louisiana	p. 90
April 4–6	Bloomington, Indiana	p. 90
May 3–4	Claremont, California	p. 90
June 4–7	Rio de Janeiro, Brazil	p. 90
October 4–5	Vancouver, Canada	p. 90
October 11–12	Middletown, Connecticut	p. 91
October 24–26	Huntsville, Alabama	p. 91
December 17–21	Shanghai, People's Republic of China	p. 91

2009

January 7–10	Washington, DC Annual Meeting	p. 91
March 27–29	Urbana, Illinois	p. 91
April 4–5	Raleigh, North Carolina	p. 92
April 25–26	San Franciso, California	p. 92

2010

January 6–9	San Franciso, California Annual Meeting	p. 92

2011

January 5–8	New Orleans, Louisiana Annual Meeting	p. 92

2012

January 4–7	Boston, Massachusetts Annual Meeting	p. 93

2013

January 9–12	San Diego, California Annual Meeting	p. 93

Important Information Regarding AMS Meetings

Potential organizers, speakers, and hosts should refer to page 78 in the this issue of the *Notices* for general information regarding participation in AMS meetings and conferences.

Abstracts

Speakers should submit abstracts on the easy-to-use interactive Web form. No knowledge of LaTeX is necessary to submit an electronic form, although those who use LaTeX may submit abstracts with such coding, and all math displays and similarly coded material (such as accent marks in text) must be typeset in LaTeX. Visit http://www.ams.org/cgi-bin/abstracts/abstract.pl. Questions about abstracts may be sent to abs-info@ams.org. Close attention should be paid to specified deadlines in this issue. Unfortunately, late abstracts cannot be accommodated.

Conferences: (see http://www.ams.org/meetings/ for the most up-to-date information on these conferences.)

June 16–July 6, 2007: Joint Summer Research Conferences, Snowbird, Utah.

July 8–July 12, 2007: von Neumann Symposium on Sparse Representation and High-Dimensional Geometry, Snowbird, Utah.

CAMBRIDGE

OUTSTANDING SCHOLARSHIP

NEW MATHEMATICAL MONOGRAPHS

Hilbert's Tenth Problem
Diophantine Classes and Extensions to Global Fields

Alexandra Shlapentokh

This book presents an account of results extending Hilbert's Tenth Problem to integrally closed subrings of global fields including, in the function field case, the fields themselves.

$99.00: Hardback: 0-521-83360-4: 330 pp.

Theory of Finite Simple Groups

Gerhard O. Michler

This book provides the first representation theoretic and algorithmic approach to the theory of abstract finite simple groups.

$145.00: Hardback: 0-521-86625-1: 614 pp.

Free Ideal Rings and Localization in General Rings

P. M. Cohn

This book presents the theory of free ideal rings (firs) in detail. Particular emphasis is placed on rings with a weak algorithm, exemplified by free associative algebras.

$140.00: Hardback: 0-521-85337-0: 594 pp.

Representation Theory of Finite Reductive Groups

Marc Cabanes and Michel Enguehard

At the crossroads of representation theory, algebraic geometry, and finite group theory, this book blends together many of the main concerns of modern algebra, with full proofs of some of the most remarkable achievements in the area.

$120.00: Hardback: 0-521-82517-2: 454 pp.

The Mathematics of Behavior

Earl Hunt

This book illustrates how mathematics can be used to understand human and animal behavior, through examples in psychology, sociology, economics, ecology, and even marriage counseling.

$80.00: Hardback: 0-521-85012-6: 368 pp.
$34.99: Paperback: 0-521-61522-4

Nonlinear Analysis and Semilinear Elliptic Problems

Antonio Ambrosetti and Andrea Malchiodi

Starting from elementary tools of bifurcation theory and analysis, this graduate text covers a number of more modern topics from critical point theory to elliptic partial differential equations.

Cambridge Studies in Advanced Mathematics
$75.00: Hardback: 0-521-86320-1: 328 pp.

Optimization Methods in Finance

Gerard Cornuejols and Reha Tutuncu

This is the first textbook devoted to explaining how recent advances in optimization models, methods, and software can be applied to solve problems in computational finance more efficiently and accurately.

Mathematics, Finance and Risk
$70.00: Hardback: 0-521-86170-5: 360 pp.

Quantum Groups
A Path to Current Algebra

Ross Street

This book is for the reader at ease with at least one algebraic structure and keen to learn the latest algebraic concepts and techniques.

Australian Mathematical Society Lecture Series
$52.00*: Paperback: 0-521-69524-4: c.150 pp.

Quantum Stochastic Processes and Noncommutative Geometry

Kalyan B. Sinha and Debashish Goswami

This book will be of interest to graduate students and researchers in functional analysis, probability, and mathematical physics.

Cambridge Tracts in Mathematics
$90.00*: Hardback: 0-521-83450-3: c.304 pp.

Random Dynamical Systems
Theory and Applications

Rabi Bhattacharya and Mukul Majumdar

This treatment provides an exposition of discrete time dynamic processes evolving over an infinite horizon.

$90.00: Hardback: 0-521-82565-2: 525 pp.
$39.99: Paperback: 0-521-53272-8

Spectral Methods for Time-Dependent Problems

Jan Hesthaven, Sigal Gottlieb, and David Gottlieb

This class-tested introduction to spectral methods, the first on the subject, is ideal for graduate courses or self-study.

Cambridge Monographs on Applied and Computational Mathematics
$75.00: Hardback: 0-521-79211-8: 288 pp.

Surveys in Geometry and Number Theory

Edited by Nicholas Young

The focus of this book is the continuing strength of pure mathematics in Russia after the post-Soviet diaspora. Mathematical researchers and graduate students in algebraic geometry and number theory worldwide will find it of great interest.

London Mathematical Society Lecture Note Series
$70.00: Paperback: 0-521-69182-6: 325 pp.

Groups St. Andrews 2005

Edited by C. M. Campbell, M. R. Quick, E. F. Robertson, and G. C. Smith

These two volumes contain selected papers from the international conference held at the University of St. Andrews in 2005; together they provide a snapshot of the state of research in group theory.

London Mathematical Society Lecture Note Series

Volume 1
$75.00: Paperback: 0-521-69469-8: 360 pp.

Volume 2
$75.00: Paperback: 0-521-69470-1: 350 pp.

www.cambridge.org/us *or* **CALL 1-800-872-7423**

CAMBRIDGE UNIVERSITY PRESS

** prices subject to change*

Journals in Mathematics and Physics

COMMUNICATIONS IN ANALYSIS AND GEOMETRY

EDITOR-IN-CHIEF: K. LIU

Publishes high-quality papers on subjects related to classical analysis, partial differential equations, algebraic geometry, differential geometry, and topology.

ISSN: 1019-8385. 5 issues per year.
2007 Institutional Subscription: US$593.00
2007 Individual Subscription: US$207.00

ADVANCES IN THEORETICAL AND MATHEMATICAL PHYSICS

EDITORS-IN-CHIEF: A. ASHTEKAR, E. LIEB, S.-T. YAU, & B. ZWIEBACH

A bimonthly publication featuring papers on all areas in which theoretical physics and mathematics meet and interact

ISSN: 1095-0761. 6 issues per year.
2007 Institutional Subscription: US$649.00
2007 Individual Subscription: US$228.00

ASIAN JOURNAL OF MATHEMATICS

EDITORS-IN-CHIEF: R. CHAN & S.-T. YAU

This journal aims to stimulate mathematical research in the Asian region. Publications include original research papers and survey articles on all areas of pure mathematics and theoretical applied mathematics.

ISSN: 1093-6106. 4 issues per year.
2007 Institutional Subscription: US$436.00
2007 Individual Subscription: US$174.00

JOURNAL OF SYMPLECTIC GEOMETRY

MANAGING EDITORS: S. DONALDSON, V. GUILLEMIN, T. MROWKA, & G. TIAN

A new journal focusing on the impact of symplectic geometry in mathematics.

ISSN: 1527-5256. 4 issues per year.
2007 Institutional Subscription: US$324.00
2007 Individual Subscription: US$174.00

MATHEMATICAL RESEARCH LETTERS

EDITORS-IN-CHIEF: L. P. ROTHSCHILD & M. S. BAOUENDI

Dedicated to rapid publication of short complete papers, up to 20 journal pages, of original research in all areas of mathematics.

ISSN: 1073-2780. 6 issues per year.
2007 Institutional Subscription: US$400.00
2007 Individual Subscription: US$150.00

DYNAMICS OF PARTIAL DIFFERENTIAL EQUATIONS

EDITORS-IN-CHIEF: Y. CHARLES LI & S.-T. YAU

Publishes novel results in the areas of partial differential equations and dynamical systems in general.

ISSN: 1548-159X. 4 issues per year.
2007 Institutional Subscription: US$304.00
2007 Individual Subscription: US$174.00

PURE AND APPLIED MATHEMATICS QUARTERLY

EDITORS-IN-CHIEF: K. LIU & S.-T. YAU

With the rapid development of mathematics in China, International Press is proud to announce the debut of a premium journal based in China. *Pure and Applied Mathematics Quarterly* (previously the *Quarterly Journal of Pure and Applied Mathematics*) publishes high-quality, original papers in all fields of mathematics. To facilitate fruitful interchanges between mathematicians from different regions and specialties, and to effectively disseminate new breakthroughs in mathematics, the journal also welcomes submissions of well-written survey articles in significant areas of research. The editors are committed to promoting the highest in mathematical scholarship.

ISSN: 1549-6724. 4 issues per year.
2007 Institutional Subscription: US$360.00
2007 Individual Subscription: US$174.00

2007 Journal Debut:

COMMUNICATIONS IN NUMBER THEORY AND PHYSICS

EDITORS-IN-CHIEF: R. DIJKGRAAF, D. KAZHDAN, M. KONTSEVICH, & S.-T. YAU

In recent years, the world has seen explosive interactions between number theory, arithmetic geometry and theoretical physics, particularly in string theory. *Communications in Number Theory and Physics (CNTP)* is an international journal focused on applications of number theory in the broadest sense to theoretical physics. The journal offers a forum for communication among researchers in number theory and theoretical physics by publishing primarily research, review, and expository articles regarding the relationship and dynamics between the two fields.

ISSN: 1931-4523. 4 issues per year.
2007 Institutional Subscription: US$593.00
2007 Individual Subscription: US$207.00

JOURNAL OF DIFFERENTIAL GEOMETRY

EDITORS-IN-CHIEF: C.-C. HSIUNG & S.-T. YAU

Now in its 40th year of publication, the *Journal of Differential Geometry* is devoted to the dissemination of research papers in differential geometry and related subjects such as differential equations, mathematical physics, algebraic geometry, and geometric topology.

ISSN: 0022-040X. 9 issues per year.
2007 Institutional Subscription: US$972.00
2007 Individual Subscription: US$320.00

All prices include shipping and online access

HOMOLOGY, HOMOTOPY AND APPLICATIONS

EDITOR-IN-CHIEF: G. CARLSSON

One of the only journals in the world that publishes primarily on homology and homotopy as they relate to algebra, algebraic topology, and other areas of mathematics.

ISSN: 1532-0073. 2 issues per year.
2007 Institutional Subscription: US$324.00
2007 Individual Subscription: US$174.00

JOURNAL OF COMBINATORICS

EDITORS-IN-CHIEF: R. BRUALDI, R. CANFIELD, C. GODSIL, B. MCKAY, B. SAGAN, C. THOMASSEN, Q. XIANG

The printed version of a fully-refereed electronic journal that welcomes papers in all branches of discrete mathematics, including combinatorics, graph theory, discrete algorithms, etc.

ISSN: 1097-1440. 4 issues per year.
2007 Institutional Subscription: US$347.00
2007 Individual Subscription: US$124.00

METHODS AND APPLICATIONS OF ANALYSIS

EDITORS-IN-CHIEF: Z.-P. XIN & S.-T. YAU

Features high-quality papers in the area of pure and applied analysis, ranging from applications to different branches of natural sciences and engineering.

ISSN: 1073-2772. 4 issues per year.
2007 Institutional Subscription: US$488.00
2007 Individual Subscription: US$197.00

COMMUNICATIONS IN MATHEMATICAL SCIENCES

EDITOR-IN-CHIEF: SHI JIN

This journal covers modern applied mathematics in modeling, applied and stochastic analyses, and numerical computations on problems that arise in physical, biological, engineering, and financial applications.

ISSN: 1539-7555. 4 issues per year.
2007 Institutional Subscription: US$324.00
2007 Individual Subscription: US$174.00

COMMUNICATIONS IN INFORMATION AND SYSTEMS

EDITORS-IN-CHIEF: W.-S. WONG & STEPHEN S.-T. YAU

Areas include: information and coding theory, cryptology, decision and estimation, control theory, mathematical system theory, signal and image processing, bioinformatics, communication theory, image database, data mining, probabilistic reasoning, learning theory, speech recognition, computer vision, and discrete event systems.

ISSN: 1526-7555. 4 issues per year.
2007 Institutional Subscription: US$304.00
2007 Individual Subscription: US$152.00

How To Order: Call: +(617) 623-3016 **Fax:** +(617) 623-3101 **Email:** ipb-orders@intlpress.com
Write: International Press, P.O. Box 43502, Somerville, MA 02143, USA

International Press
http://intlpress.com

Springer
the language of science

springer.com

New and Noteworthy

Superior Beings

2ND EDITION

If They Exist, How Would We Know? Game-Theoretic Implications of Omnipotence, Omniscience, Immortality, and Incomprehensibility

Steven Brams, New York University

Superior Beings is an extraordinary book … ► **American Scientist**

Brams has performed a service in demonstrating that rational analysis need not stop where issues involving faith and emotion begin. ► **New Scientist**

Nowadays game theory is being applied to an array of subjects, from finance and economics to law, political science and natural science to name a few. In 1983, Brams applied game theory to theology in his book **Superior Beings** to create a masterful work that posed provocative questions about religion from a game theorist's viewpoint. This second edition includes all of the rigorous, yet comprehensible and fascinating applications of game theory from the previous edition, but with a new, modern look and feel.

2nd Edition. 2007. approx. 202 pp., 32 illus. Softcover
ISBN 978-0-387-48065-7 ► **$29.95**

A Course in Enumeration

Martin Aigner, Freie Universität Berlin, Germany

Combinatorial enumeration is a readily accessible subject full of easily stated, but sometimes tantalizingly difficult problems. This book leads the reader in a leisurely way from the basic notions to a variety of topics, ranging from algebra to statistical physics. Its aim is to introduce the student to a fascinating field, and to be a source of information for the professional mathematician who wants to learn more about the subject. The book is organized in three parts: Basics, Methods, and Topics. There are 666 exercises, and as a special feature every chapter ends with a highlight, discussing a particularly beautiful or famous result.

2007. approx. 550 pp. (Graduate Texts in Mathematics, Vol. 238) Hardcover
ISBN 978-3-540-39032-9 approx.
► **$79.95**

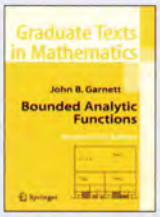
Approval Voting

2ND EDITION

Steven Brams, New York University and **Peter C. Fishburn**

Approval Voting proposes a compelling way to elect some 500,000 officials in public elections. Under this system voters may vote for, or approve of, as many candidates as they like in multicandidate elections. Since the publication of the first edition of this book, its arguments in favor of an election reform practically unknown in 1983 have stood the test of time. Perhaps the proof of the pudding lies in the adoption of approval voting by about a dozen professional societies—several with tens of thousands of members—and their generally favorable experience with it. After a generation of discussion and debate on the subject, the authors remain convinced that Approval Voting is as relevant today as it was when rigorous analysis and systematic empirical research on this election reform began more than 30 years ago.

2nd Edition. 2007. 200 pp., 4 illus. Softcover
ISBN 978-0-387-49895-9 approx. ► **$39.95**



Bounded Analytic Functions

John Garnett, University of California, Los Angeles

The book, which covers a wide range of beautiful topics in analysis, is extremely well organized and well written, with elegant, detailed proofs. The book has educated a whole generation of mathematicians with backgrounds in complex analysis and function algebras. It has had a great impact on the early careers of many leading analysts and has been widely adopted as a textbook for graduate courses and learning seminars in both the US and abroad. ► **From the Citation for the 2003 Leroy P. Steele Prize for Exposition.**

2007. 466 pp., 31 illus. (Graduate Texts in Mathematics, Vol. 236) Hardcover
ISBN 978-0-387-33621-3 ► **$69.95**

3RD EDITION

Ideals, Varieties, and Algorithms

An Introduction to Computational Algebraic Geometry and Commutative Algebra

David A. Cox, Amherst College, Massachusetts; **John Little**, College of the Holy Cross, Massachusetts; and **Donal O'Shea**, Mt. Holyoke College, Massachusetts

I consider the book to be wonderful. … The exposition is very clear, there are many helpful pictures, and there are a great many instructive exercises, some quite challenging … offers the heart and soul of modern commutative and algebraic geometry. ► **The American Mathematical Monthly**

This third edition has been revised and includes updated sections on Maple, AXIOM, CoCoA, Macaulay 2, Magma, Mathematica and SINGULAR, as well as a shorter proof of the Extension Theorem.

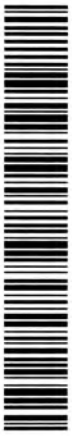
2007. approx. 560 pp., 93 illus. (Undergraduate Texts in Mathematics) Hardcover
ISBN 978-0-387-35650-1 ► **$54.95**

An Invitation to Morse Theory

Liviu Nicolaescu, University of Notre Dame, Indiana

This self-contained treatment of Morse Theory focuses on applications and is intended for a graduate course on differential or algebraic topology. This is the first textbook to include topics such as Morse-Smale flows, min-max theory, moment maps and equivariant cohomology, and complex Morse theory. The exposition is enhanced with examples, problems, and illustrations.

2007. approx. 236 pp., 32 illus. (Universitext) Softcover
ISBN 978-0-387-49509-5 ► **$49.95**

Easy Ways to Order for the Americas ► **Write:** Springer Order Department, PO Box 2485, Secaucus, NJ 07096-2485, USA ► **Call: (toll free)** 1-800-SPRINGER ► **Fax:** +1(201)348-4505 ► **Email:** orders-ny@springer.com or **for outside the Americas** ► **Write:** Springer Distribution Center GmbH, Haberstrasse 7, 69126 Heidelberg, Germany ► **Call:** +49 (0) 6221-345-4301 ► **Fax :** +49 (0) 6221-345-4229 ► **Email:** SDC-bookorder@springer.com ► Prices are subject to change without notice. All prices are net prices.

012799x