

Notices

of the American Mathematical Society

January 2009

Volume 56, Number 1

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in Science and
Engineering

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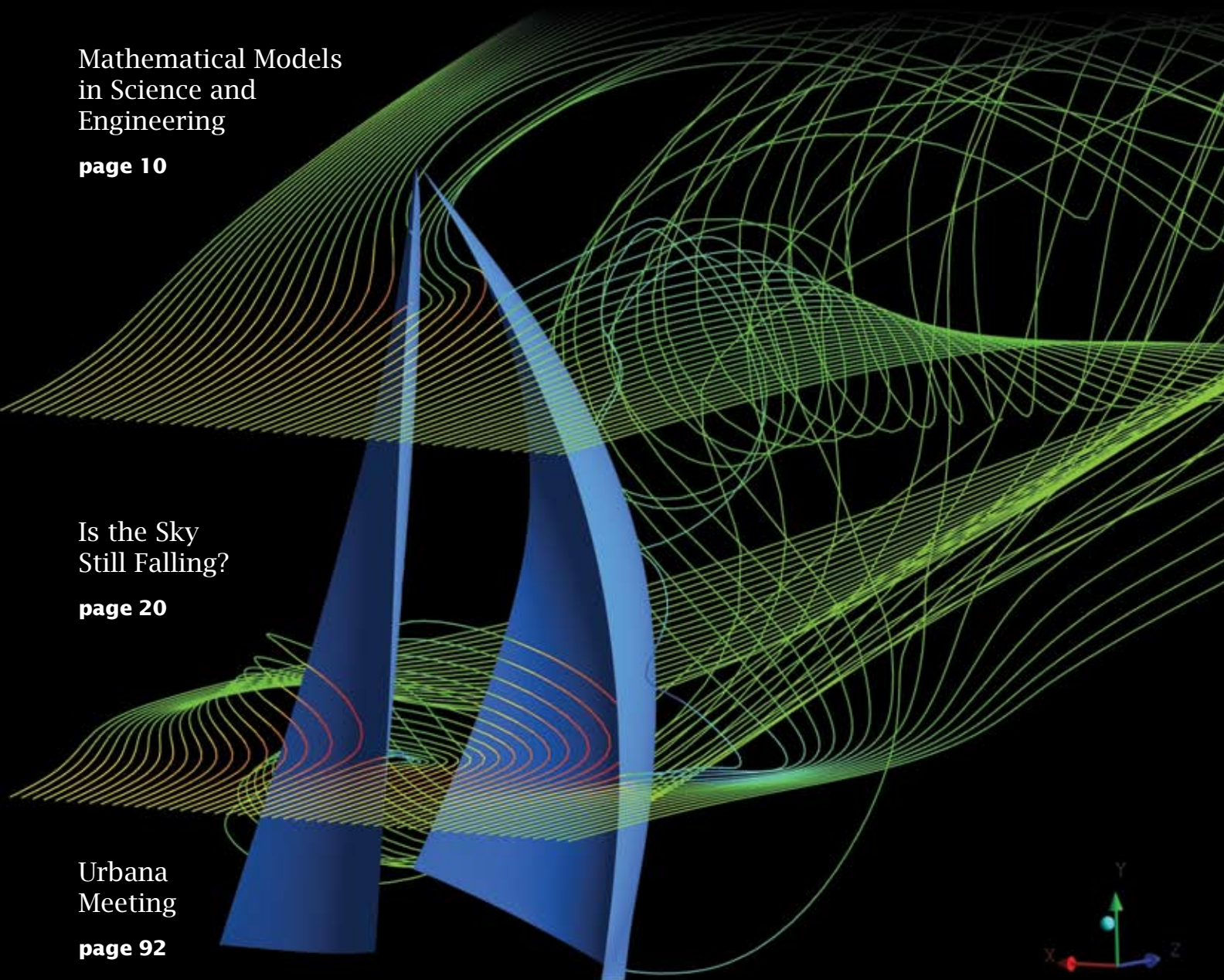
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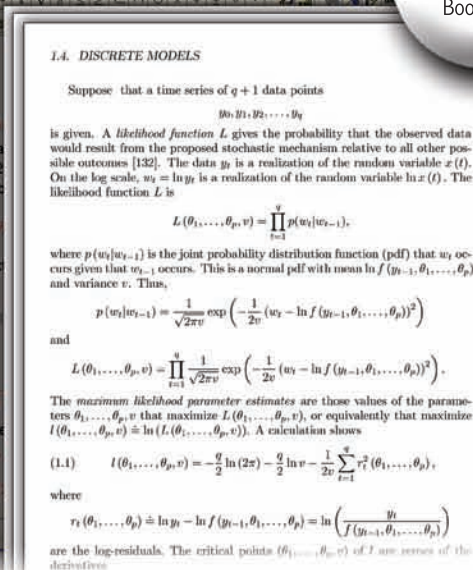
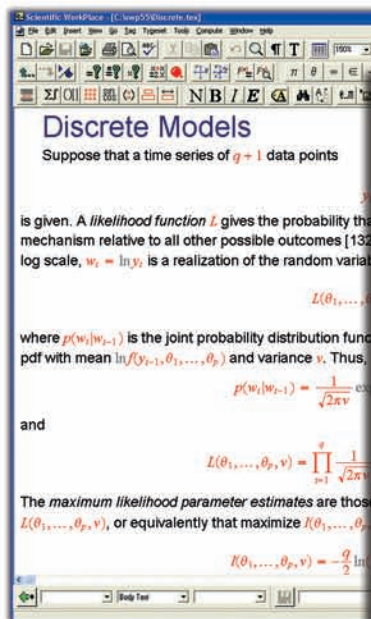


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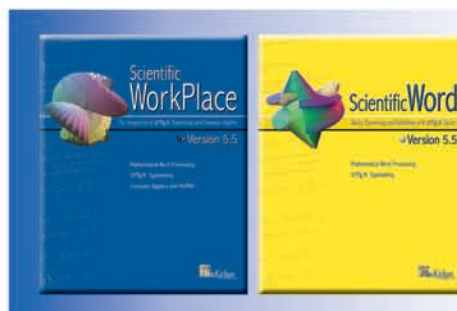


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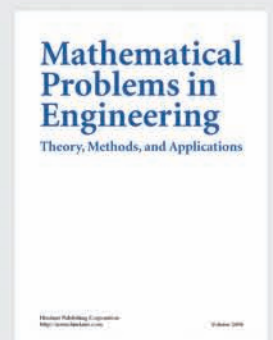
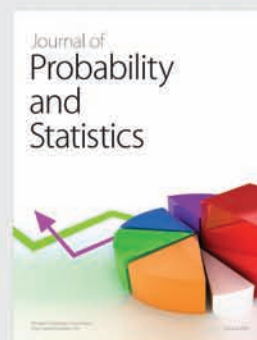
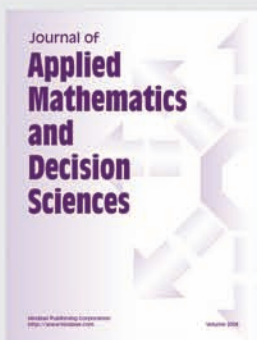
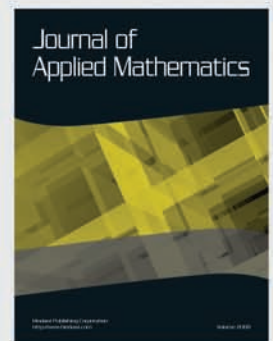
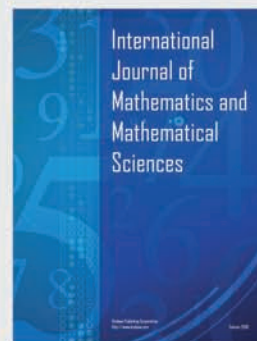
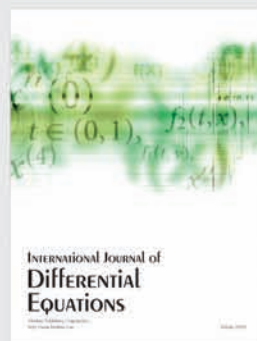
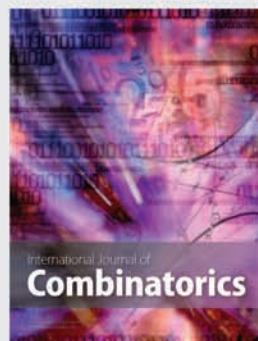
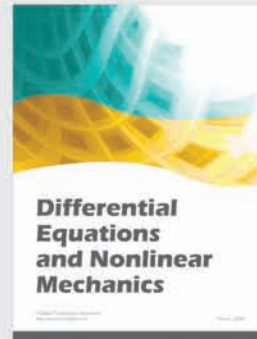
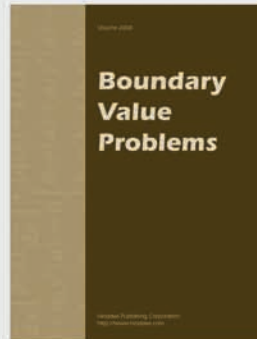
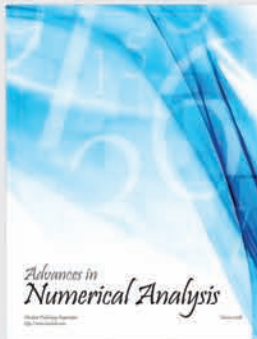
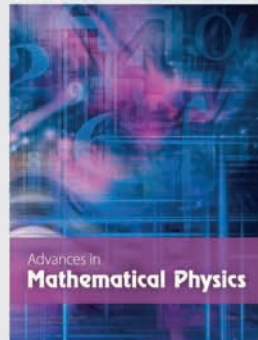
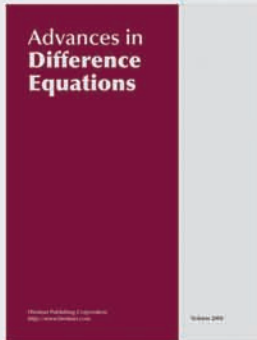
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John J. Benedetto; Wojciech Czaja, both
University of Maryland, College Park, USA

This textbook begins with the fundamentals of classical real variables and leads to Lebesgue's definition of the integral, the theory of integration and the structure of measures in a measure theoretical format. The core chapters are followed by chapters of a topical nature, which illuminate the authors' intellectual vision of modern real analysis. These topics include weak convergence, the Riesz representation theorem, the Lebesgue differential theorem, and self-similar sets and fractals. Historical remarks, illuminating problems and examples, and appendices on functional analysis and Fourier analysis provide insight into the theory and its applications.

2009. APPROX. 565 P. 21 ILLUS. HARDCOVER
ISBN 978-0-8176-4306-5 CA. \$79.95
BIRKHÄUSER ADVANCED TEXTS

Explorations in Harmonic Analysis

with Applications to Complex
Function Theory and the
Heisenberg Group

Steven G. Krantz, Washington University,
St. Louis, MO, USA

This text on modern harmonic analysis provides an introduction to the subject in the context in which it is actually applied, in particular, through complex function theory and partial differential equations. The exposition begins with the fundamentals of Fourier analysis, complex function theory, and integral operators and further introduces students to cutting edge ideas about the Heisenberg group.

This self-contained text serves as an introduction to analysis on the Heisenberg group. It is an ideal text for advanced undergraduate and graduate students and will aid them in forging new paths of research.

2009. APPROX. 350 P. HARDCOVER
ISBN 978-0-8176-4668-4 \$69.95
APPLIED AND NUMERICAL HARMONIC
ANALYSIS

Journal Special Issue

Transformation Groups

Dedicated to Bertram Kostant on
the Occasion of his 80th Birthday

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Basic Algebra & Advanced Algebra

Anthony W. Knap, State University of New
York, Stony Brook, NY, USA

"Finally, the author's notorious masterly style of writing, which stands out by its high degree of clarity, elegance, refinement, and accuracy, also rules over this newest textbook of his, which is very likely to become one of the great standard texts in algebra for generations."

—Zentralblatt Math

Basic Algebra

2006. XXII, 717 P. 42 ILLUS. HARDCOVER
ISBN 978-0-8176-3248-9 \$69.95

Advanced Algebra

2008. XXIV, 730 P. 10 ILLUS. HARDCOVER
ISBN 978-0-8176-4522-9 \$69.95

Basic Algebra and Advanced Algebra (SET)

ISBN 978-0-8176-4533-5 \$89.95
CORNERSTONES

Elliptic Equations: An Introductory Course

Michel Chipot, University of Zürich,
Switzerland

The aim of this book is to introduce the reader to elliptic partial differential equations by avoiding technicalities and refinements. Apart from the basic theory of equations in divergence form, it includes topics such as singular perturbation problems, homogenization, computations, asymptotic behaviour of problems in cylinders, elliptic systems, nonlinear problems, regularity theory, Navier-Stokes system, p-Laplace equation. A minimal portion on Sobolev spaces is presented, while work or integration on the boundary has been carefully avoided. Numerous results presented are original and have not been published elsewhere.

2009. APPROX. 300 P. HARDCOVER
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Dynamical Systems with Applications using MAPLE

Second Edition

Stephen Lynch, Manchester Metropolitan
University, UK

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—Mathematical Reviews
(Review of First Edition)

This new edition has been thoroughly updated and expanded to include more applications, examples, and exercises, all with solutions; two new chapters on neural networks and Maplelets have also been added. A supplementary e-book with interactive exercises, examples, and solutions will also be published.

2009. 2ND ED. APPROX. 500 P. 350 ILLUS.
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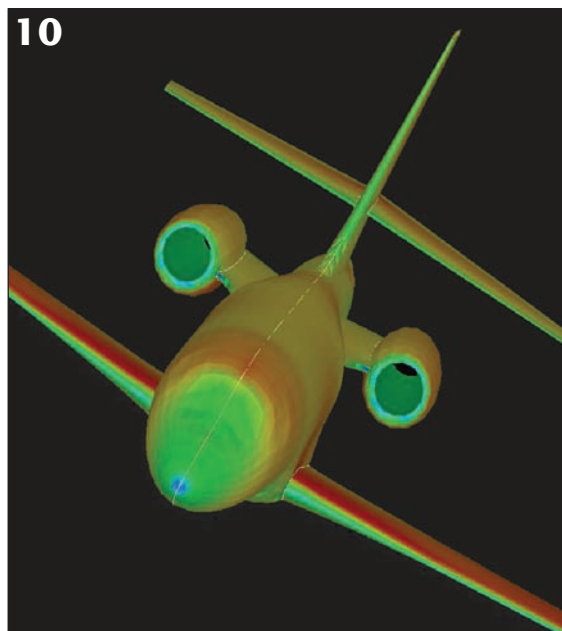
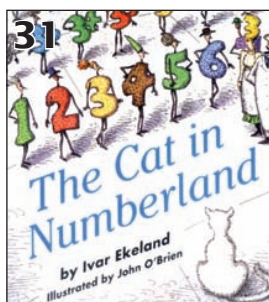
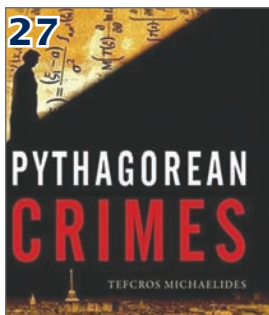
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Alfio Quarteroni

Mathematical models, along with scientific theory and practical experiments, are a crucial part of modern engineering and science. The author takes a look at the role mathematical models play in topics ranging from vascular simulation to weather forecasting to designing America's Cup sailboats.

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David M. Bressoud

Over the past decade mathematicians have been increasingly concerned about the number of undergraduate students studying mathematics and the consequences thereof, an important one being a possible decreasing need for mathematics faculties to teach them. The author reviews current data, finding cause for both optimism, in increasing numbers, and pessimism, in declining percentages.

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Mathematics Genealogy Project

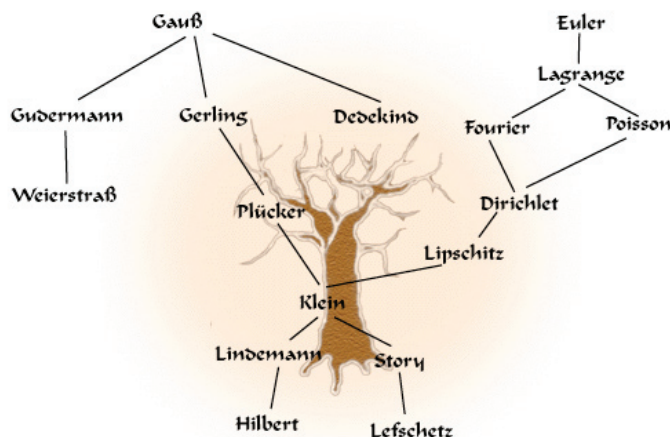


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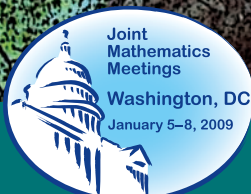
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Preserving Our History

The use of \TeX over the last decade and a half to write papers, lecture notes, and even ephemera has moved from the unusual to the commonplace. Indeed, some of my younger colleagues can't remember using anything else but \TeX to write mathematics. For those of us somewhat longer in the tooth, we remember using other software, which was preceded by the little golf balls that allowed typing of mathematical symbols, which in turn was preceded by writing in the mathematics by hand (with the hope that the typesetting would introduce only a few errors).

The utility of this wonderful piece of software has been greatly enhanced by the continuing and massive growth in the capability of the accompanying hardware. Indeed, in the early 1990s when the first implementations of \TeX appeared on desktop machines, I wrote a review for the *Notices* with some comparative timings.¹ I had a test document of about 100 pages that contained an appropriate mixture of ordinary (for that time, English, without accents) text and mathematics. It could be run though \TeX in times varying between one and five minutes. When I try the same thing on my newest desktop machine, the job takes 0.004 seconds. Viewing it another way, three such jobs can be run in the time it takes to refresh the screen once.

One of the happier results of this migration to \TeX and the improvement in hardware has been the ability to put our papers on personal webpages so that anyone with a standard computer configuration can acquire them. This usually means making a PDF or a PostScript file available for download. The infrastructure of the Internet makes this transfer of files easy and transparent, and, as a result, the little postcards that were mailed to request reprints has joined those little golf balls as historical curiosities.

Improvements in hardware have another happy consequence: papers written in the predigital era and consequently not available on the Internet are not beyond redemption. They, too, may be made available for download. Over the past few years there have been significant advances in the hardware and software used to scan paper documents. With the right equipment, scanning several hundred or even a thousand pages is not difficult.

There are two approaches, both of which work well. The first is to use a standalone scanner. Robust models with document sheet feeders are available for under US\$1,000. These usually include the software for doing the scanning, and sometimes OCR (optical character recognition) software is also included. There are lots of options when using such software, so here are some suggestions.

When scanning the pages, the software can produce color, grayscale, or black and white files. Unless there is a compelling reason, black and white is usually the best choice for older documents. There is also a choice of

resolution: 200, 300, 600, or 1200 dpi (dots per inch). Usually the 600 dpi is the best choice.

There are also several different types of files that can be produced by the scanning software. All of them have some compression: these come in two types: lossless (no data lost during the compression) and lossy (some data irretrievable). A lossless compression is the best. There are also different file formats, the most common being PDF and TIFF. The PDF files are the ones to put on your webpage; they can be read on any modern computer with readily available software. Note that there are two different types of PDF files: ones that are image only and those that are also text searchable. The latter type is preferable, and most scanners can produce them.

There is also a compelling reason to keep lossless TIFF files. Newer and smarter software will emerge that will do things we can't do today. If you keep the TIFF files, there will be no need to rescan since the information is already in an industry-standard format.

There are frequently other options to consider. For example, many scanners allow the page to be autostraightened, that is, pages that are tilted because of inaccurate feeding or printing will be rotated into horizontal and vertical alignment. This is, more often than not, useful. Another option is despeckling, that is, the removal of very small dots on the page on the assumption that they are either background to the page text or errors introduced while scanning. The despeckling may be set to be more or less aggressive. This choice depends on the quality of the material being scanned. If there are handwritten symbols, it's probably best to leave the despeckling off. If the document being scanned is printed, despeckling may be useful. For those with an experimental bent, running a few sample pages with different settings can be very helpful.

A second approach is to use a photocopier. Many of them come with scanning software built in: you feed in the pages and the image files are emailed back to you. Usually there are fewer options than with a scanner. The default resolution is usually 200 dpi, so be sure to set it to 600 dpi. Most of the provisos given above for scanners are also valid for photocopiers.

I recently carried out a two-month project that involved scanning of some 53,000 pages. It really wasn't difficult. In fact the hardest part of preserving your mathematical history may be taking the staples out of those old pages.

Our mathematical history is important and worth preserving. A bit of effort by all of us can produce a significant body of mathematical literature. Let's get our history out of the file cabinet and onto the Web!

—Michael Doob
University of Manitoba
mdoob@ccu.umanitoba.ca

A version of this article appeared in IMU-Net, September 2008.

¹ \TeX and the Single CPU (I), March 1990, and (II) December 1991.

Letters to the Editor

More on Non-English Names

My letter “Non-English names of prominent mathematicians” appeared in the April 2008 issue of the *Notices*. Since then I have received numerous emails with additions and corrections. The original list of names has grown from two pages to five pages. The address of the updated PDF file is http://www2.onu.edu/~mcaragiul/bonus_files/Names.pdf. It can be found easily on the department page of the Department of Mathematics at Ohio Northern University. Many thanks to all contributors! Further additions and corrections are welcome.

—*Khristo Boyadzhiev*
Ohio Northern University
k-boyadzhiev@onu.edu

(Received September 3, 2008)

WHAT IS...a Mathematics Professor?

With much interest, I've been following the “What is...?” Communications column in the *Notices*. It seems to me that a valuable contribution to mathematics and mathematics education could be made by discussing, in detail, what it means to be a professor. However, with hundreds of disciplines in the larger universities, this might be much too broad a subject to treat easily. Hence, what does it mean to be a mathematics professor? Note that I am not asking the narrower question of what it means to be either a great or a good mathematics professor. Later on, one could discuss those special subclasses of mathematics professors or even generalize the discussions to professors in other disciplines. I conjecture that it would not be good for mathematics if no one can propose a satisfactory answer or most everyone ignores such simple questions. What is a mathematics professor? Surely a candidate for a degree or a position would have a suitable answer.

—*Albert A. Mullin*
1orrm@earthlink.net
(Received October 4, 2008)

A Formula for Citations

The article “Citation statistics: An IMU report” (*Notices*, September 2008), summarizing the report (<http://www.mathunion.org/publications/report/citationstatistics/>), makes it once again clear how flawed the impact factor is. However, as to the right way to count citations, I felt the issue of single-author versus co-author was neglected. Moreover, in order to not only discard self-citations but also citations from one's “circle of friends”, I propose the following tough but fair (as much as a single number can possibly be) citation count $f(X)$ of an individual X .

Some fixed article A that cites some fixed article Y of X should be accounted for as follows. First, in order for A to have any effect at all,

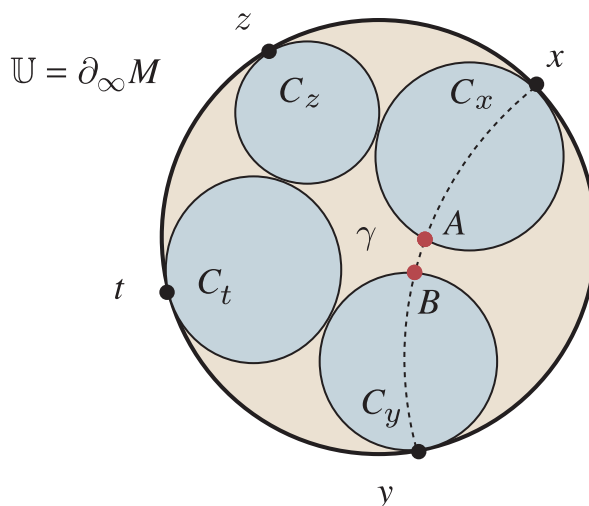
the group of authors of A must not contain X , nor anybody who has ever been a co-author of X . That condition being satisfied, the contribution of A to Y 's count $g(Y)$ should be $1/n$ where $n - 1$ is the number of authors that X relied upon to produce Y . The fraction $1/n$ is not a slighting of Y 's impact, it only takes into account that in the same time that a hypothetical single author X' of X 's caliber writes one article of Y 's quality, the co-author X produces n such articles (assuming all co-authors contribute equally). By definition $f(X)$ is the sum of all $g(Y)$ where Y ranges over all articles of X .

—*Marcel Wild*
University of Stellenbosch
mwild@sun.ac.za
(Received October 9, 2008)

Correction

There was an error in the drawing that accompanied the article “WHAT IS... a Cross Ratio?” by François Labourie in the November 2008 issue of *Notices* (page 1234). The corrected drawing is shown below and the accompanying relevant text “...let finally z and t be the centres of two horospheres tangent to both C_x and C_y respectively. Then ... x, y, z, t .” should instead read “... let finally z and t be the centres of two horospheres tangent to each other as well as to C_x and C_y respectively. Then ... y, z, x, t .”


—*Sandy Frost*





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Mathematical Models in Science and Engineering

Alfio Quarteroni

Mathematical modeling aims to describe the different aspects of the real world, their interaction, and their dynamics through mathematics. It constitutes the third pillar of science and engineering, achieving the fulfillment of the two more traditional disciplines, which are theoretical analysis and experimentation. Nowadays, mathematical modeling has a key role also in fields such as the environment and industry, while its potential contribution in many other areas is becoming more and more evident. One of the reasons for this growing success is definitely due to the impetuous progress of scientific computation; this discipline allows the translation of a mathematical model—which can be explicitly solved only occasionally—into algorithms that can be treated and solved by ever more powerful computers. See Figure 1 for a synthetic view of the whole process leading from a problem to its solution by scientific computation. Since 1960 numerical analysis—the discipline that allows mathematical equations (algebraic, functional, differential, and integrals) to be solved through algorithms—had a leading role in solving problems linked to mathematical modeling derived from engineering and applied sciences. Following this success, new disciplines started to use mathematical modeling, namely information and communication technology, bioengineering, financial engineering, and so on. As a matter of fact, mathematical models offer new possibilities to manage the increasing complexity of technology, which is at the basis of modern industrial

production. They can explore new solutions in a very short time period, thus allowing the speed of innovation cycles to be increased. This ensures a potential advantage to industries, which can save time and money in the development and validation phases. We can state therefore that mathematical modeling and scientific computation are gradually and relentlessly expanding in manifold fields, becoming a unique tool for qualitative and quantitative analysis. In the following paragraphs we will discuss the role of mathematical modeling and of scientific computation in applied sciences; their importance in simulating, analyzing, and decision making; and their contribution to technological progress. We will show some results and underline the perspectives in different fields such as industry, environment, life sciences, and sports.

Scientific Computation for Technological Innovation

Linked to the incredible increase of computer calculation speed, scientific computation may be decisive enough to define the border between complex problems that can be treated and those that, on the contrary, cannot. The aim of scientific computation is the development of versatile and reliable models, detailed in closed form, and tested on a wide range of test cases, either analogical or experimental, for which there are helpful reference solutions.

A mathematical model must be able to address universal concepts, such as, for instance, the conservation of mass or the momentum of a fluid, or the moment of inertia of a structure; moreover, in order to obtain a successful numerical simulation, it is necessary to define which level of detail must be introduced in the different parts of a model

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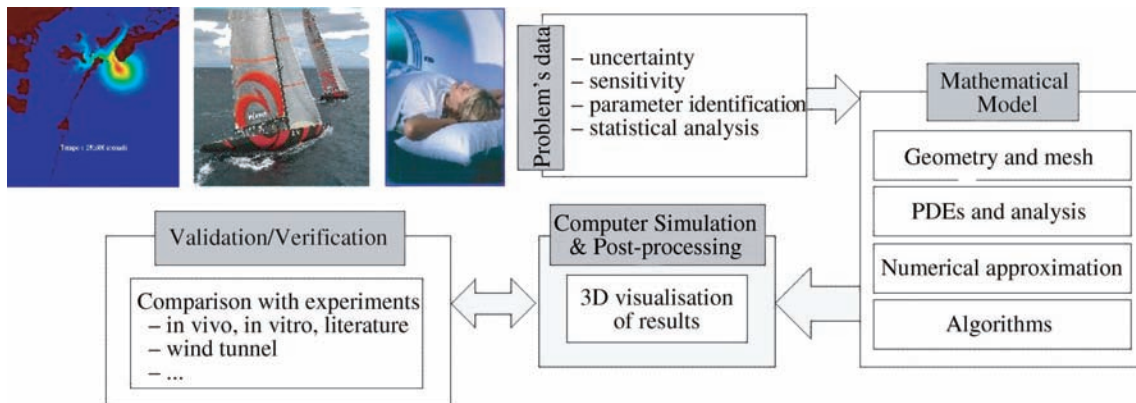


Figure 1. Scientific computing at a glance.

and which simplifications must be carried out to facilitate its integration into different models. Models able to simulate very complex problems should take into account uncertainty due to the lack of data (or data affected by noise) that feed the model itself. These kinds of models will be used to foresee natural, biological, and environmental processes, in order to better understand how complex phenomena work, and also to contribute to the design of innovative products and technologies.

An important aspect of scientific computation is represented by computational fluid dynamics (CFD), a discipline that aims to solve by computers problems governed by fluids. In aerospace, for example, CFD can be applied in many ways. Numerical models based on potential flow equations or on the more sophisticated Euler or Navier-Stokes equations can be used, for example, in the aerodynamic analysis of wing tips or for the whole fuselage for performance optimization. See Figure 2 and Figure 3 for numerical simulations carried out on, respectively, a civil aircraft (the Falcon 50) and the X29 experimental aircraft using the Euler equations solved by a stabilized finite element approximation [1]. Simulation implies validation and optimization, with the aim of designing aircraft able to meet certain requirements: better structural reliability, better aerodynamic performance, lower environmental impact thanks to the reduction in noise emissions (in the case of commercial airplanes), speed optimization, and improvement of maneuverability (in the case of military aircraft). The solution to these problems requires multi-objective optimization algorithms: deterministic, stochastic, or genetic. Moreover, models of electromagnetic diffusion are used to simulate external electromagnetic fields in order to restrain them from interfering with those generated by the several electronic circuits that are

contained in the instrumentation on board. Models are used to simulate the stresses and the deformation of some parts of the aircraft (for the simulation of the analysis of materials strain), through algorithms for the interaction between fluid and structure with the aim of improving structural and dynamic stability. Similar analyses are studied in the car industry, where numerical simulation is used in virtually every aspect of design and car production. Models are used to simulate internal engine combustion in order to save fuel, improve the quality of emissions, and reduce noise. Moreover, to improve performance, security, and comfort, several kinds of equations must be solved, such as those modeling external and internal fluid dynamics, aero-elasticity, and aero-acoustic vibration dynamics, but also those governing thermal exchange, combustion processes, shock waves (occurring during the opening phase of an air bag), structural dynamics under large stresses, and large deformations to simulate the consequences of car crashes. The chemical industry uses mathematical models to simulate polymerization processes, pressing, or extrusion for complex rheologic materials, where the typical macro analysis of continuum mechanics must be connected to the micro one, the latter being more adequate to describe the complex rheology of materials with nanostructure. This requires the development of multiscale analysis techniques and algorithms, which are able to describe the exchange of mechanical, thermal, and chemical processes in heterogeneous spatial scales. In the electronics industry, the simulation of drift-diffusion, hydrodynamics, Boltzmann, or Schrödinger equations plays a key role in designing ever smaller and faster integrated circuits, with growing functionality and with dramatic waste reduction (which are fundamental, for example, in different applications of mobile phones). Efficient algorithms are

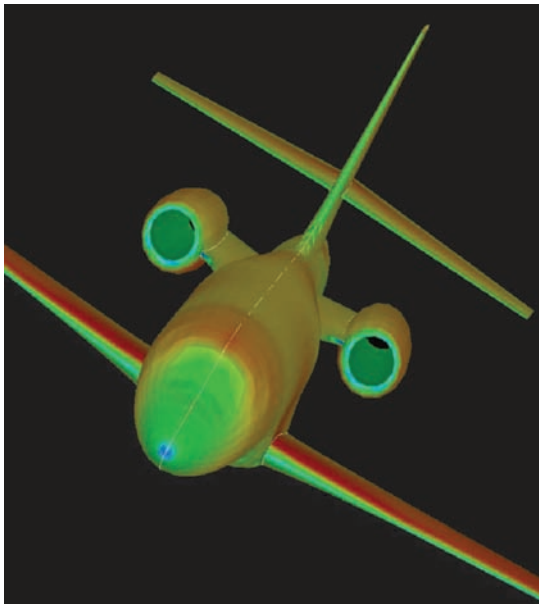


Figure 2. Mach number distribution and streamlines for a civil aircraft.

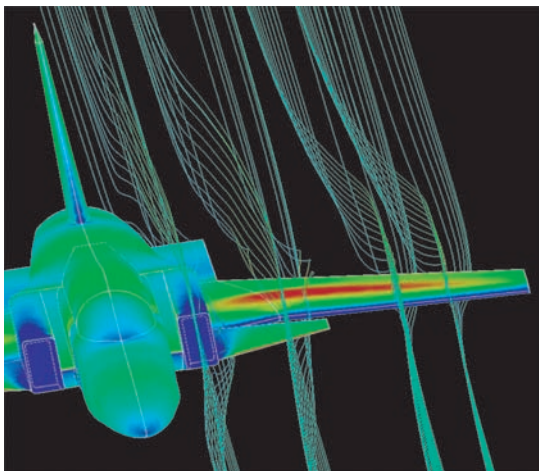


Figure 3. Mach number and streamlines on the X29 experimental aircraft.

useful also for coding and decoding multi-user messages.

Modeling the Weather

In the last few decades, the critical problem of predicting the weather in a short time (daily or weekly) has become more and more linked to long-term prediction (for a decade or even a century), to climatic evolution, and to atmospheric pollution problems. Luckily, there are natural climatic changes in a particular area that obey physical law, and can thus be simulated through mathematical models. Also, from a global point of view (over

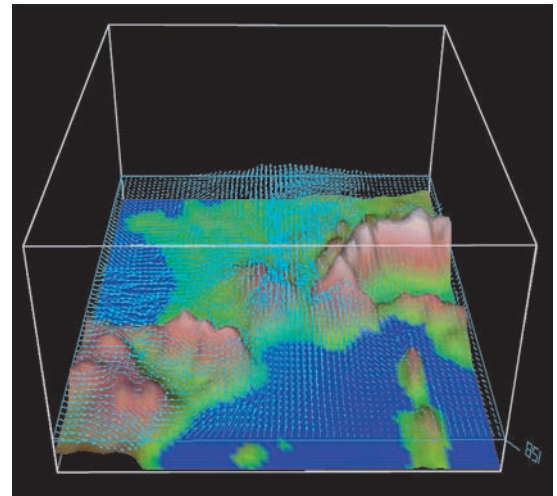


Figure 4. Wind velocity simulation over the Mediterranean Sea.

either a continental or worldwide scale) there are changes due to deterministic phenomena, for example to variation in the inclination of the earth's axis, the eccentricity of the earth's orbit, the oceanic circulation, or intense geological phenomena like volcanic eruptions. The meteorological prediction problem was formulated as a mathematical issue only at the beginning of the twentieth century by the Norwegian mathematician Vilhelm Bjerknes, who described atmospheric motion using the Euler equations for perfect gas dynamics (well known at that time), suitably modified in order to take into account the action of the force of gravity and the earth's rotation. Unluckily, data regarding the atmosphere were available only in a few points, and they referred to heterogeneous variables and to different periods of time.

Moreover, Euler equations described an extremely wide range of atmospheric motions, which can take place on spatial and temporal scales that are very different from each other (feet instead of miles, seconds instead of days). The lack of data regarding some of these scales may generate spurious motions (which do not exist in nature) and reduce the prediction quality. A realistic description of meteorological phenomena cannot but take into account the prediction of water steam distribution, its changes (from liquid to gas), and consequent rainfall. The first attempt to solve this problem from a numerical point of view was carried out by Lewis Richardson, who succeeded in calculating a concrete example of the solution of atmospheric motion on a region as wide as the whole of North Europe. The results obtained by Richardson through extremely complicated hand calculations led to completely wrong predictions, though: as a matter of fact, at that time there was no theory able to dominate

the traps of the equations to be solved. The contribution of Carl-Gustaf Rossby, one of Richardson's students, was decisive enough to optimize the efforts made by Richardson. After immigrating to the USA in the 1920s, he contributed to founding the meteorological service for civil and military aviation during the Second World War. Among the indirect contributions he gave, the weather prediction made by the Americans for D-Day (June 4, 1944) can be included. The simplified mathematical models introduced by Rossby allowed the first meteorological prediction to be made with an electronic computer, resulting from cooperation between John von Neumann and Jules Charney, which started in Princeton in the 1940s. In particular, it was possible to make a prediction for the whole of North America through a simplified model that described the atmosphere as a unique fluid layer. Even though it took 24 hours to make a prediction for the following 12 hours on the only electronic computer available (ENIAC), the efforts of von Neumann and Charney showed for the first time that a prediction based only on a mathematical model could achieve the same results as those by an expert on meteorology of that time. The modern approach to numerical weather prediction was born. As a matter of fact, beyond the spectacular improvements in computer performance, there have also been radical improvements in the accuracy of mathematical prediction tools, the development of a theory on the predictability of chaotic dynamical systems, and an improvement in data assimilation techniques. In the 1970s, the systematic use of surveys made by satellites was introduced, and it constitutes nowadays the most relevant part of the data used to start numerical models. Since then, the impact of scientific and technological progress has been very important. For instance, the IFS global model of the European Center for Medium Range Weather Forecasts (ECMWF) uses a computation grid with an average spatial resolution of about 22km horizontal and 90km vertical. This allows part of the stratosphere to be included. This model can make a 10-day prediction in about 1 hour on a modern parallel supercomputer, even though 6 further hours, necessary to insert the data, must be added. The IFS model allows reliable predictions to be made for about 7.5 days on a continental scale in Europe. See Figure 4 for an example of weather prediction.

Models for Life Sciences

In the 1970s, in vitro experiments, and those on animals, represented the main approach to cardiovascular studies. Recently, the progress of computational fluid dynamics and the great improvements of computer performance produced remarkable advances that revolutionize vascular research [7].

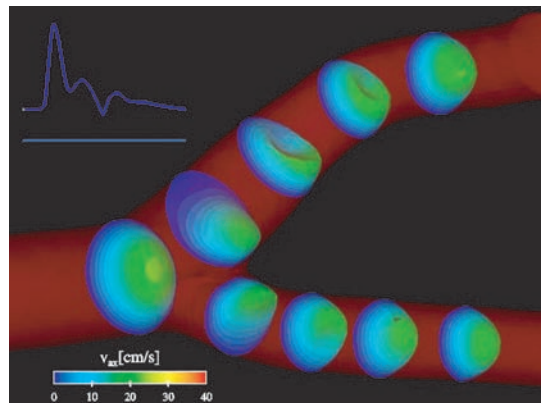


Figure 5. Computed velocity profiles downstream a carotid bifurcation.

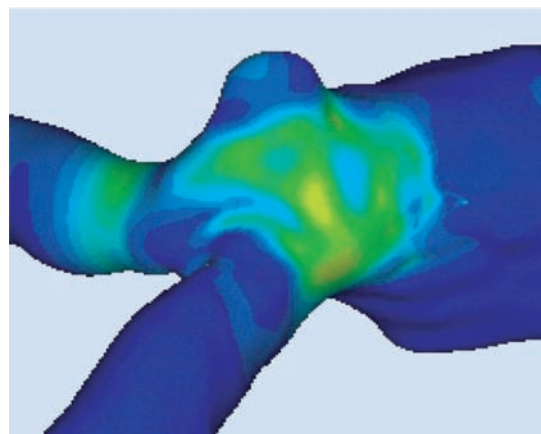


Figure 6. Shear stress distribution on a pulmonary artery.

For instance, a physical magnitude such as the shear stress on the endothelial membrane, which is very difficult to test in vitro, can be easily calculated on real geometries obtained with tri-dimensional algorithms, thanks to the support of modern and noninvasive data acquisition technology (such as nuclear magnetic resonance, digital angiography, axial tomography, and Doppler anemometry). Flowing in arteries and veins, blood mechanically interacts with vessel walls, generating complex fluid-structural interaction problems. As a matter of fact, the pressure wave transfers mechanical energy to the walls, which dilate; such an energy is returned to the blood flow while the vessels are compressed. Vascular simulation of the interaction between the fluid and the wall requires algorithms that describe both the energy transfer between the fluid (typically modeled by the Navier-Stokes equations) and the structure (modeled by solid mechanics equations) at a macroscopic level, and the influence—at a microscopic level—of the shear stress on orientation, deformation, and

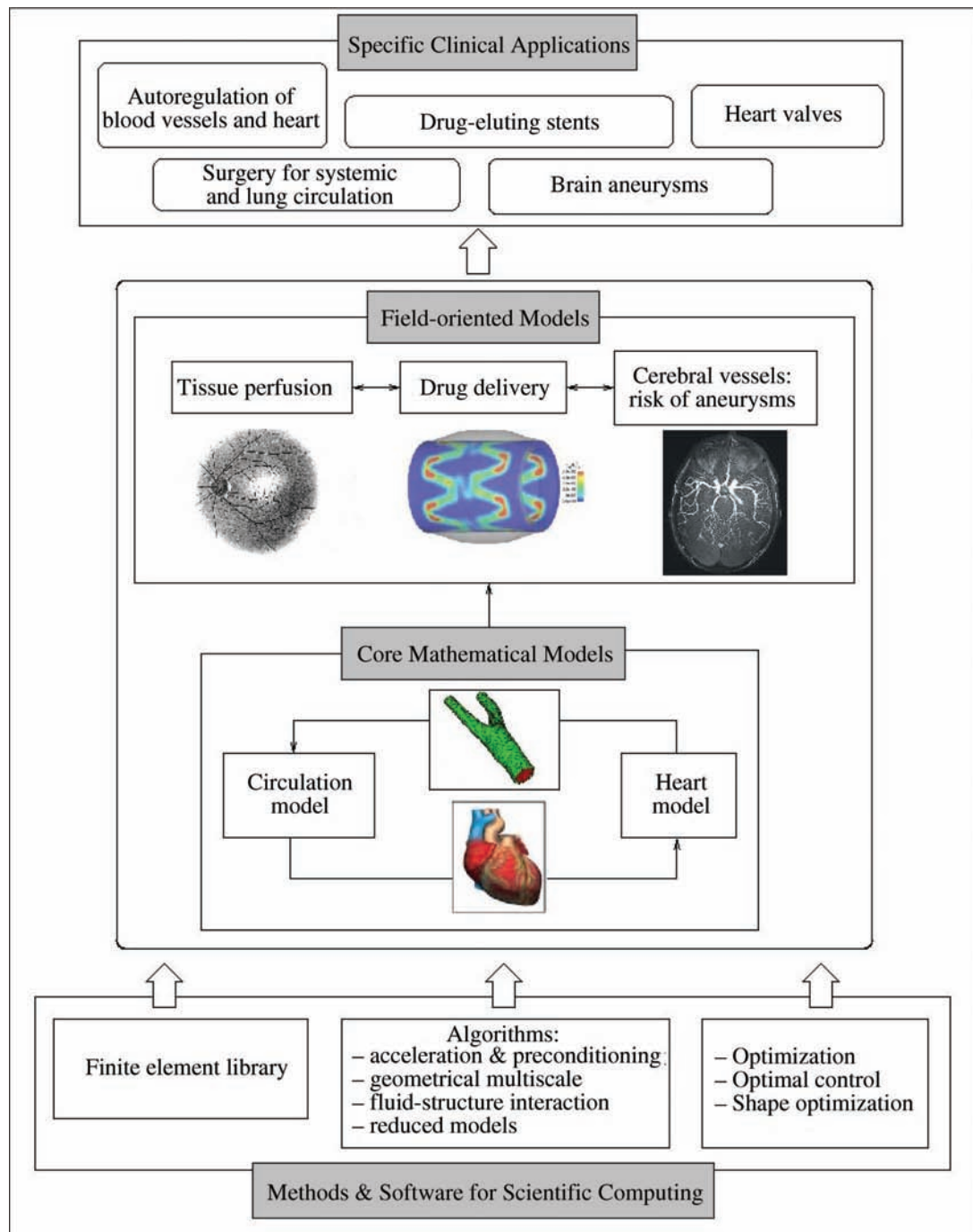


Figure 7. Scientific computing for cardiovascular flow simulation and related topics.

damage of endothelial cells [8]. At the same time, flow equations must be coupled to appropriate models in order to describe the transport, diffusion, and absorption of chemical components in the blood (such as oxygen, lipids, and drugs), in the different layers that constitute artery walls (tunica intima, tunica media, and tunica adventitia). Numerical simulations of this kind may help to clarify biochemical modifications produced by

changes in the flow field, generated, for example, by the presence of a stenosis, i.e., an artery narrowing. In the cardiovascular system, conditions of separated flow and secondary circulatory motions are met, not only in the presence of vessels featuring large curvature (e.g., the aortic bend or the coronary arteries), but also downstream of bifurcations (for instance the carotid artery in its internal and external branches) or regions with

restrictions due to the presence of stenosis. There are other areas with a flow inversion (from distal to proximal regions) and also areas with low shear stress with temporal oscillations [9]. These cases are nowadays recognized as potential factors in the development of arterial pathologies. A detailed comprehension of local haemodynamic change, of the effects of vascular wall modifications on the flow scheme, and of the gradual adaptation in the medium to long period of the whole system following surgical interventions, is nowadays possible thanks to the use of sophisticated computer simulations, and may be extremely useful in the preliminary phase before a therapeutic treatment. A similar scenario may provide specific data for surgical procedures. Simulating the flow in a coronary bypass, in particular the re-circulation that takes place downstream of the graft in the coronary artery, may help us to understand the effects of artery morphology on the flow and thus of the post-surgical progression. The theory of optimal shape control may be useful for designing a bypass able to minimize the vorticity produced downstream of the graft in the coronary artery. Similarly, the study of the effects of a vascular prosthesis and of implantation of artificial heart valves on local and global haemodynamics may progress thanks to more accurate simulations in the field of blood flow. In virtual surgery, the result of alternative treatments for a specific patient may be planned through simulations. This numerical approach is an aspect of a paradigm of practice, known as predictive medicine. See Figure 7 for a comprehensive picture on our current research projects in the field of cardiovascular flow simulations.

Models for Simulation and Competition

The application of mathematical models is not limited to the technological, environmental, or medical field. As a matter of fact, deterministic and stochastic models have been adopted for many years in analyzing the risk of financial products, thus facilitating the creation of a new discipline known as financial engineering. Moreover, the new frontier has already begun to touch sociology, architecture, free time, and sports.

As far as competitive sports are concerned, CFD for some years now has been assuming a key role in analyzing and designing Formula One cars. But Formula One racing is not the only field where mathematical/numerical modelling has been applied. As a matter of fact, my research group from EPFL has been involved in an extremely interesting experience, which saw the Swiss yacht Alinghi win the America's Cup both in 2003 and again in 2007. Until twenty years ago, the different designing teams used to develop different shapes of sails, hulls, bulbs, and keels. Nowadays the different

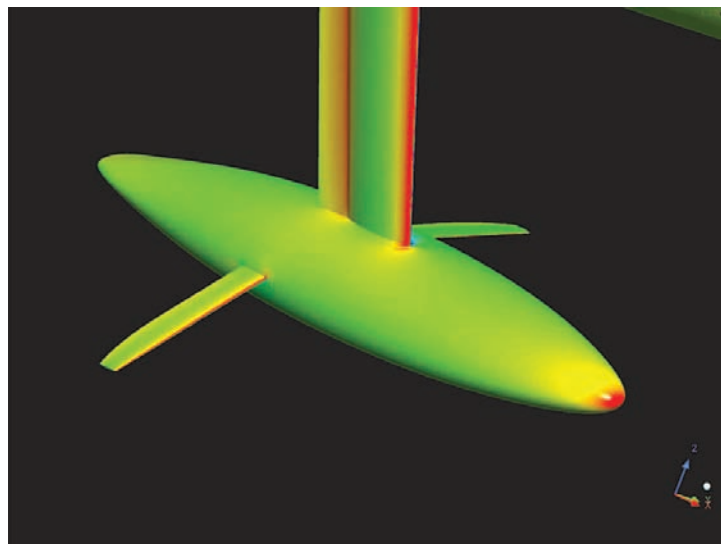


Figure 8. Pressure distribution around yacht appendages.

geometric shapes have been standardized, and even the smallest details may make a difference from the results point of view. Quoting Jerome Milgram, a professor from MIT and an expert in advising different American America's Cup teams: "America's Cup teams require an extreme precision in the design of the hull, the keel, and the sails. A new boat able to reduce the viscous resistance by one percent, would have a potential advantage on the finish line of as much as 30 seconds." To optimize a boat's performance, it is necessary to solve the fluid-dynamics equations around the whole boat, taking into account the variability of wind and waves, of the different conditions during the yacht race, of the position, and of the moves of the opposing boat, but also the dynamics of the interaction between fluids (water and air) and the structural components (hull, appendages, sails, and mast) must be considered. Moreover, the shape and dynamics of the so-called free surface (the interface between air and water) has to be accurately simulated as well. A complete mathematical model must take into account all these aspects characterizing the physical problem. The aim is to develop together with the designers optimal models for the hull, the keel, and appendages.

Ideally, one wishes to minimize water resistance on the hull and appendages and to maximize the boost produced by the sails. Mathematics allows different situations to be simulated, thus reducing costs and saving time usually necessary to produce a great number of prototypes to be tested in a towing tank and wind tunnel. For each new boat simulation proposed by the designers (which were

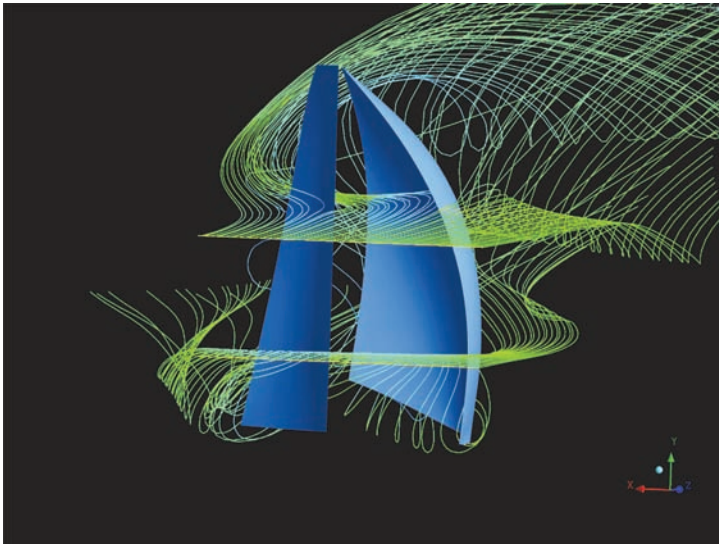


Figure 9. Streamlines around mainsails and spinnaker in a downwind leg.

several hundred), it was necessary to build the geometrical model—about 300 splines surfaces are needed to overlay the whole boat—to create the grid on the surface of all the elements of the boat reliable enough to enable the determination of the transition between laminar flow and turbulent flow regions, and consequently to generate the volumetric grid in external domain. The Navier-Stokes equations for incompressible viscous flows must be used to describe both water and wind dynamics and the consequent free surface, which need to be completed by additional equations that allow the computation of turbulent energy and its dissipation rate. These equations cannot be solved exactly to yield explicit solutions in closed form. Their approximate solution requires the introduction of refined discretization methods, which allow an infinite dimensional problem to be transformed into a big but finite dimensional one. The typical calculation, based on finite volume schemes, involved the solution of nonlinear problems with many millions of unknowns. Using parallel algorithms, 24 hours on parallel calculation platforms with 64 processors were necessary to produce a simulation, characterized by more than 160 million unknowns. A further computation is concerned with the simulation of the dynamical interaction between wind and sails by fluid-structure algorithms. These simulations enable the design team to eliminate those solutions that seem innovative and to go on with those that actually guarantee better performance. Moreover, by simulating the effects of aerodynamic interaction between two boats, one can determine the consistency of shadow regions (the areas with less wind because of the position of a boat with respect to the other), the flow perturbation, and the

turbulence vorticity generated by the interaction of the air, thus obtaining useful information for the tactician as well. These studies aim to design a boat having an optimal combination of the four features that an America's Cup yacht must have: lightness, speed, resistance, and maneuverability necessary to change the race outcome.

A more in-depth description of the mathematical tools necessary for this kind of investigation is provided in the next section.

Mathematical Models for America's Cup

The standard approach adopted in the America's Cup design teams to evaluate whether a design change (and all the other design modifications that this change implies) is globally advantageous, is based on the use of a Velocity Prediction Program (VPP), which can be used to estimate the boat speed and attitude for any prescribed wind condition and sailing angle. A numerical prediction of boat speed and attitude can be obtained by modeling the balance between the aerodynamic and hydrodynamic forces acting on the boat.

For example, on the water plane, a steady sailing condition is obtained imposing two force balances in the x direction (aligned with the boat velocity) and the y direction (normal to x on the water plane) and a heeling moment balance around the centerline of the boat:

$$(1) \quad \begin{aligned} D_h + T_a &= 0, \\ S_h + S_a &= 0, \\ M_h + M_a &= 0, \end{aligned}$$

where D_h is the hydrodynamic drag (along the course direction), T_a is the aerodynamic thrust, S_h is the hydrodynamic side force perpendicular to the course, S_a is the aerodynamic side force, M_h and M_a are, respectively, the hydromechanical righting moment and the aerodynamic heeling moment around the boat mean line. The angle β_Y between the course direction and the boat centerline is called yaw angle. The aerodynamic thrust and side force can be seen as a decomposition in the reference system aligned with the course direction of the aerodynamic lift and drag, which are defined on a reference system aligned with the apparent wind direction. Similar balance equations can be obtained for the other degrees of freedom.

In a VPP program, all the terms in system (1) are modeled as functions of boat speed, heel angle, and yaw angle. Suitable correlations between the degrees of freedom of the system and the different force components can be obtained based on different sources of data: experimental results, theoretical predictions, and numerical simulations.

The role of advanced computational fluid dynamics is to supply accurate estimates of the

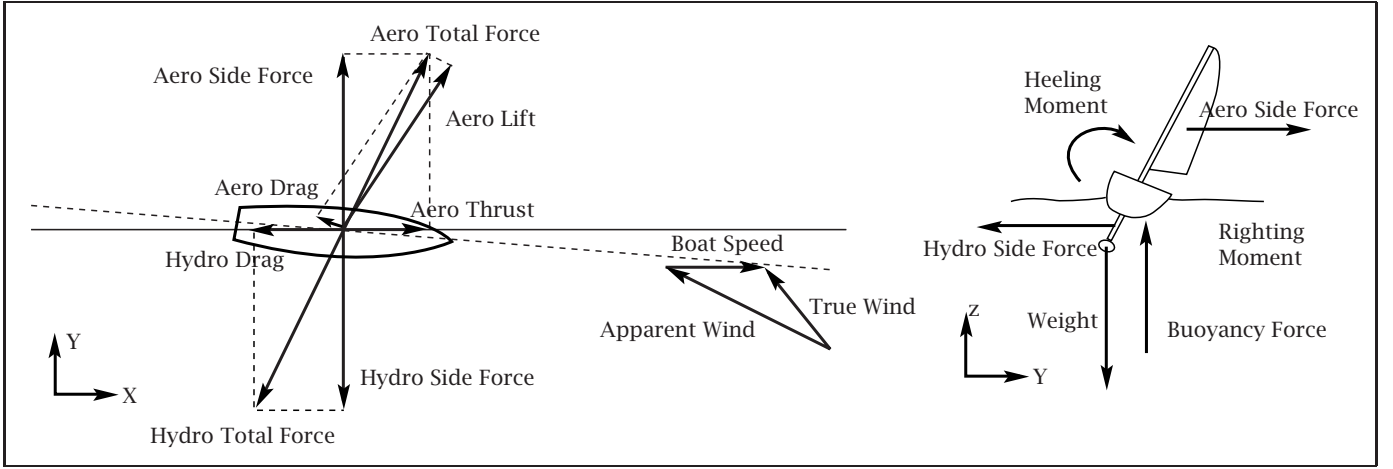


Figure 10. Forces and moments acting on boat.

forces acting on the boat in different sailing conditions in order to improve the reliability of the prediction of the overall performance associated with a given design configuration.

The flow equations

Let Ω denote the three-dimensional computational domain in which we solve the flow equations. If $\hat{\Omega}$ is a region surrounding the boat B , the computational domain is the complement of B with respect to $\hat{\Omega}$, that is $\Omega = \hat{\Omega} \setminus B$. The equations that govern the flow around B are the density-dependent (or inhomogeneous) incompressible Navier-Stokes equations, which read:

$$(2) \quad \frac{\partial \rho}{\partial t} + \nabla \cdot (\rho u) = 0$$

$$(3) \quad \frac{\partial(\rho u)}{\partial t} + \nabla \cdot (\rho u \otimes u) - \nabla \cdot \tau(u, p) = \rho g$$

$$(4) \quad \nabla \cdot u = 0$$

for $x \in \Omega$ and $0 < t < T$, and where ρ is the (variable) density, u is the velocity field, p is the pressure, $g = (0, 0, g)^T$ is the gravity acceleration, and $\tau(u, p) = \mu(\nabla u + \nabla u^T) - pI$ is the stress tensor with μ indicating the (variable) viscosity. The above equations have to be complemented with suitable initial conditions and boundary conditions. For the latter we typically consider a given velocity profile at the inflow boundary, with a flat far field free-surface elevation.

In the case we are interested in, the computational domain Ω is made of two regions, the volume Ω_w occupied by the water and that Ω_a occupied by the air. The interface Γ separating Ω_w from Ω_a is the (unknown) free-surface, which may be a disconnected two-dimensional manifold if wave breaking is accounted for. The unknown density ρ actually takes two constant states, ρ_w (in

Ω_w) and ρ_a (in Ω_a). The values of ρ_w and ρ_a depend on the fluid temperatures, which are considered to be constant in the present model. The fluid viscosities μ_w (in Ω_w) and μ_a (in Ω_a) are constants that depend on ρ_w and ρ_a , respectively.

The set of equations (2)-(4) can therefore be seen as a model for the evolution of a two-phase flow consisting of two immiscible incompressible fluids with constant densities ρ_w and ρ_a and different viscosity coefficients μ_w and μ_a . In this respect, in view of the numerical simulation, we could regard equation (2) as the candidate for updating the (unknown) interface location Γ , then treat equations (3)-(4) as a coupled system of Navier-Stokes equations in the two sub-domains Ω_w and Ω_a :

$$\frac{\partial(\rho_w u_w)}{\partial t} + \nabla \cdot (\rho_w u_w \otimes u_w) - \nabla \cdot \tau_w(u_w, p_w) = \rho_w g,$$

$$\nabla \cdot u_w = 0,$$

$$\text{in } \Omega_w \times (0, T),$$

$$\frac{\partial(\rho_a u_a)}{\partial t} + \nabla \cdot (\rho_a u_a \otimes u_a) - \nabla \cdot \tau_a(u_a, p_a) = \rho_a g,$$

$$\nabla \cdot u_a = 0,$$

$$\text{in } \Omega_a \times (0, T). \text{ We have set } \tau_w(u_w, p_w) = \mu_w(\nabla u_w + \nabla u_w^T) - p_w I, \text{ while } \tau_a(u_a, p_a) \text{ is defined similarly.}$$

The free surface Γ is a sharp interface between Ω_w and Ω_a , on which the normal components of the two velocities $u_a \cdot n$ and $u_w \cdot n$ should agree. Furthermore, the tangential components must match as well since the two flows are incompressible. Thus we have the following kinematic condition

$$(5) \quad u_a = u_w \quad \text{on } \Gamma.$$

Moreover, the forces acting on the fluid at the free-surface are in equilibrium. This is a dynamic condition and means that the normal forces on either side of Γ are of equal magnitude and opposed

direction, while the tangential forces must agree in both magnitude and direction:

$$(6) \quad \tau_a(u_a, p_a) \cdot n = \tau_w(u_w, p_w) \cdot n + \kappa \sigma n \quad \text{on } \Gamma,$$

where σ is the surface tension coefficient, that is a force per unit length of a free surface element acting tangentially to the free-surface. It is a property of the liquid and depends on the temperature as well as on other factors. The quantity κ in (6) is the curvature of the free-surface, $\kappa = R_{t_1}^{-1} + R_{t_2}^{-1}$, where R_{t_1} and R_{t_2} are radii of curvature along the coordinates (t_1, t_2) of the plane tangential to the free-surface (orthogonal to n).

Coupling with a 6-DOF rigid body dynamical system

The attitude of the boat advancing in calm water or wavy sea is strictly correlated with its performance. For this reason, a state-of-the-art numerical tool for yacht design predictions should be able to account for the boat motion.

Following the approach adopted in [2, 3], two orthogonal cartesian reference systems are considered: an inertial reference system (O, X, Y, Z) , which moves forward with the mean boat speed, and a body-fixed reference system (G, x, y, z) , whose origin is the boat center of mass G , which translates and rotates with the boat. The XY plane in the inertial reference system is parallel to the undisturbed water surface, and the Z -axis points upward. The body-fixed x -axis is directed from bow to stern, y positive starboard, and z upwards.

The dynamics of the boat in the 6 degrees of freedom are determined by integrating the equations of variation of linear and angular momentum in the inertial reference system, as follows

$$(7) \quad m\ddot{X}_G = F$$

$$(8) \quad \bar{T}\bar{T}^T\bar{\Omega} + \Omega \times \bar{T}\bar{T}^T\bar{\Omega} = M_G$$

where m is the boat mass, \ddot{X}_G is the linear acceleration of the center of mass, F is the force acting on the boat, $\bar{\Omega}$ and Ω are the angular acceleration and velocity, respectively, M_G is the moment with respect to G acting on the boat, \bar{T} is the tensor of inertia of the boat about the body-fixed reference system axes, and \bar{T} is the transformation matrix between the body-fixed and the inertial reference system (see [2] for details).

The forces and moments acting on the boat are given by

$$\begin{aligned} F &= F_{\text{Flow}} + mg + F_{\text{Ext}} \\ M_G &= M_{\text{Flow}} + (X_{\text{Ext}} - X_G) \times F_{\text{Ext}} \end{aligned}$$

where F_{Flow} and M_{Flow} are the force and moment, respectively, due to the interaction with the flow and F_{Ext} is an external forcing term (which may model, e.g., the wind force on sails) while X_{Ext} is its application point.

The equations for wind-sails interaction

The sail deformation is due to the fluid motion: the aerodynamic pressure field deforms the sail surfaces and this, in its turn, modifies the flow field around the sails.

From a mathematical viewpoint, this yields a coupled system that comprises the incompressible Navier-Stokes equations with constant density $\rho = \rho_{\text{air}}$ (3-4) and a second order elastodynamic equation that models the sail deformation as that of a membrane. More specifically, the evolution of the considered elastic structure is governed by the classical conservation laws for continuum mechanics.

Considering a Lagrangian framework, if $\hat{\Omega}_s$ is the reference 2D domain occupied by the sails, the governing equation can be written as follows:

$$(9) \quad \rho_s \frac{\partial^2 d}{\partial t^2} = \nabla \cdot \alpha_s(d) + f_s \quad \text{in } \hat{\Omega}_s \times (0, T],$$

where ρ_s is the material density, the displacement d is a function of the space coordinates $x \in \hat{\Omega}_s$ and of the time $t \in [0, T]$, α_s are the internal stresses while f_s are the external loads acting on the sails (these are indeed the normal stresses $\tau(u, p) \cdot n$ on the sail surface exerted by the flowfield). In fact, $\hat{\Omega}_s$ represents a wider (bounded and disconnected) domain that includes also the mast and the yarns as parts of the structural model. The boundary of $\hat{\Omega}_s$ is denoted by $\partial\hat{\Omega}_s$ and $[0, T] \subset \mathbb{R}^+$ is the time interval of our analysis. For suitable initial and boundary conditions and an assignment of an appropriate constitutive equation for the considered materials (defining $\alpha_s(d)$), the displacement field d is computed by solving (9) in its weak form:

$$(10) \quad \int_{\hat{\Omega}_s} \rho_s \frac{\partial^2 d_i}{\partial t^2} (\delta d_i) dx + \int_{\hat{\Omega}_s} \sigma_{ik}^{\text{II}} (\delta \epsilon_{ki}) dx = \int_{\hat{\Omega}_s} f_{si} (\delta d_i) dx,$$

where σ^{II} is the second Piola-Kirchhoff stress tensor, ϵ is the Green-Lagrange strain tensor, and δd are the test functions expressing the virtual deformation. The second coupling condition enforces the continuity of the two velocity fields, u and $\frac{\partial d}{\partial t}$, on the sail surface.

Fluid-structural coupling algorithm

As previously introduced, the coupling procedure iteratively loops between the fluid solver (passing sail velocities and getting pressure fields) and the structural solver (passing pressures and getting velocities and structural deformations) until the structure undergoes no more deformations because a perfect balance of forces and moments is reached. When dealing with transient simulations, this must be true for each time step, and the sail geometry evolves over time as a sequence of

converged states. On the other hand, a steady simulation can be thought of as a transient one with an infinite time step, such that “steady” means a sort of average of the true (unsteady) solution over time. More formally, we can define two operators called **Fluid** and **Struct** that represent the fluid and structural solvers, respectively. In particular, **Fluid** can be any procedure that can solve the incompressible Navier-Stokes equations while **Struct** should solve a membrane-like problem, possibly embedding suitable nonlinear models to take into account complex phenomena such as, for example, the structural reactions due to a fabric wrinkle.

The fixed-point problem can be reformulated with the new operators as follows:

$$(11) \quad \text{Fluid}(\text{Struct}(p)) = p.$$

A resolving algorithm can be devised as follows. At a given iteration the pressure field on sails p is passed to the structural solver (**Struct**), which returns the new sail geometries and the new sail velocity fields. Afterwards, these quantities are passed to the fluid solver (**Fluid**) which returns the same pressure field p on sails. Clearly, the “equal” sign holds only at convergence. The resulting fixed-point iteration can be rewritten more explicitly as follows: Given a pressure field on sails p_k , do:

$$(12) \quad \begin{aligned} (G_{k+1}, \mathbf{U}_{k+1}) &= \text{Struct}(p_k) \\ \tilde{p}_{k+1} &= \text{Fluid}(G_{k+1}, \mathbf{U}_{k+1}) \\ p_{k+1} &= (1 - \theta_k)p_k + \theta_k\tilde{p}_{k+1} \end{aligned}$$

where G_{k+1} and \mathbf{U}_{k+1} are the sail geometry and the sail velocity field at step $k + 1$, respectively, while θ_k is a suitable acceleration parameter.

Even though the final goal is to run an unsteady simulation, the fluid-structure procedure has to run some preliminary steady couplings to provide a suitable initial condition. The steady run iterates until a converged sail shape and flow field are obtained, where converged means that there does exist a value of k_c such that (11) is satisfied for every $k > k_c$ (within given tolerances on forces and/or displacements). When running steady simulations the velocity of the sails is required to be null at each coupling, thus somehow enforcing the convergence condition (which prescribes null velocities at convergence). This explains why convergence is slightly faster when running steady simulations with respect to transient ones (clearly only when such a solution reflects a steady state physical solution).

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Is the Sky Still Falling?

David M. Bressoud

In the 1998 *Notices* article “The Sky is Falling” [4], Garfunkel and Young drew attention to the alarming decrease in the number of students who study mathematics in college. In their words, “Our profession is in desperate trouble—immediate and present danger [...] If something is not done soon, we will see mathematics department faculties decimated and an already dismal job market completely collapse.” In the past ten years the situation seems to have reversed. The mathematical community is not in the desperate straits that Garfunkel and Young predicted. Yet, as this article will show, the situation is far from healthy, and in many respects we are worse off now than we were in 1995. Today we teach a smaller percentage of the total enrollment than ever before. The growth that has occurred has been entirely within our research universities, and there it can be explained by a short-term increase in the number of engineering students. This article concludes with three action items that the mathematical community needs to undertake if we are to reverse this decline.

Garfunkel and Young’s argument rested on data from the Conference Board of the Mathematical Sciences (CBMS) showing a drop in enrollments from 1985 to 1995. As Table 1 shows, the situation in 1995 looked far worse than it does today. Enrollment in precollege (remedial) mathematics has continued to decline at 4-year colleges.¹ For all other categories of courses,² enrollments are up

over the 1995 numbers by between 9% and 17%. While we are still well below the 1985 numbers for courses at the level of calculus and above, whatever was going wrong in the early 1990s seems to have been corrected.

But if we compare the number of students studying mathematics to the number of students enrolled in our 4-year undergraduate programs, we see that mathematics has been accounting for an ever-decreasing slice of the pie. The figures for 1995 were bad, but the percentages for 2005 are considerably worse (see Table 2).

These percentages should be alarming. The true situation is revealed to be even more discouraging once we unpack these numbers and look at what is happening in individual courses and at specific types of institutions. Because of its central role in the undergraduate curriculum, I will focus on calculus.

Calculus in High School

In the spring of 1985, 46,000 students took the Advanced Placement Calculus exam. In spring 2008, the number was 292,000. By 2009, it will be well over 300,000. In fact, the number of AP Calculus exams given each year has grown steadily over the past decade at an average rate of over 7% per year with no sign yet that it is approaching its inflection point (see Figure 1). AP Calculus exam takers are only a piece of the broader population of students who study calculus while in high school, a population that includes those who take an AP Calculus course but not the exam as well as those in the International Baccalaureate program, dual enrollment programs, registration in 2- or 4-year college calculus classes, and the many students who are given a soft introduction to calculus while in high school in the hope of easing the transition to college calculus. Based on the NELS study from spring 2004 [3], the NAEP transcript study from 2005 [12], and the growth of AP Calculus since then, it is safe to conclude that we have reached the point where each year over half a million high school students study calculus.

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¹Most precollege or remedial mathematics is taught at 2-year colleges where it now accounts for 61% of all mathematics taught at these colleges.

²Introductory level includes College Algebra, Precalculus, and Math for Liberal Arts. Calculus level is Calculus I through Differential Equations, Linear Algebra, and Discrete Math. Advanced is everything above calculus level including Introduction to Proofs. Statistics courses are not included in these numbers.

| | 1985 | 1990 | 1995 | 2000 | 2005 |
|--------------------|------|------|------|------|------|
| precollege level | 251 | 261 | 222 | 219 | 201 |
| introductory level | 593 | 592 | 613 | 723 | 706 |
| calculus level | 637 | 647 | 538 | 570 | 587 |
| advanced | 138 | 119 | 96 | 102 | 112 |

Table 1. Mathematics enrollments (thousands) for fall term at 4-year colleges and universities in the United States. Sources: [1, 5–7].

| | 1985 | 1990 | 1995 | 2000 | 2005 |
|--------------------|-------|-------|-------|-------|-------|
| precollege level | 3.25% | 3.04% | 2.53% | 2.34% | 1.83% |
| introductory level | 7.69% | 6.90% | 6.99% | 7.72% | 6.42% |
| calculus level | 8.26% | 7.54% | 6.14% | 6.09% | 5.34% |
| advanced | 1.79% | 1.39% | 1.09% | 1.09% | 1.02% |

Table 2. Mathematics enrollments at 4-year colleges as a percentage of total number of students enrolled in fall term. Sources: [1, 5–7, 13].

| | 1985* | 1990 | 1995 | 2000 | 2005 |
|-------------------|-------|------|------|------|------|
| Calculus I | 217 | 201 | 192 | 192 | 201 |
| Calculus II | 95 | 88 | 83 | 87 | 85 |
| Calculus III & IV | 90 | 84 | 62 | 73 | 74 |

Table 3. Mainstream calculus enrollments (thousands for fall term in 4-year colleges). *1985 breakdown is estimate based on total number of students in all mainstream calculus classes. Sources: [1, 5–7, 13].

Most of the students who study calculus in high school do not receive college credit for this course. Morgan [8] estimates that about half of the students who take the AP Calculus exam are entitled to and choose to use credit for Calculus I. Perhaps another 30,000 receive college credit via dual enrollment, IB, or enrollment in a college class. A reasonable estimate is that between 150,000 and 200,000 students arrive at college each fall bringing with them credit for calculus. That suggests that we should be seeing dramatically increasing numbers of students taking Calculus II in the fall term. As Table 3 shows, this is not the case. In fact, Calculus II enrollments in the fall term actually *dropped* over the period 2000–05.

What about the other 300,000–350,000 students who took calculus but not for college credit? One would hope that the increasing numbers of these students would translate into increasing numbers of students taking calculus in college. But combining all mainstream Calculus I classes in all 2- and 4-year colleges in the United States, fall enrollments have been stuck at very close to 250,000 over the past quarter century.

Calculus in College

At least we have seen some increase in the Calculus I, III, and IV enrollments over the period 2000–05. In fact, even that is less robust than it seems. When we break down calculus enrollments

by type of institution,³ we see that the growth is occurring entirely at the research universities (see Figures 2–4).

For all levels of college calculus, the increase since 1995 is entirely within the research universities. Everywhere else, enrollment has declined. There is a distinctive pattern of enrollments across all levels of calculus that occurred at the research universities and at no other type of institution: a five-year decline from 1990 to 1995 followed by steady growth. This pattern can be explained by the fact that most large research universities have large engineering programs. If we consider the number of incoming freshmen who intend to major in engineering (Figure 5 and Table 4), we see that it also decreased from 1990 to 1995, then grew. The scatterplot in Figure 6 shows a high correlation (correlation coefficient of 0.99) between the number of entering freshmen who intend to major in engineering and the total number of students in research universities each fall who enroll in any level of calculus. The downturn at the end of the graph in Figure 5 suggests that the 2005 CBMS numbers may be overly optimistic. As Table 4 shows, the number of students who intend to major in engineering began a steady decrease following a record large number in 2004.

It is interesting to compare the number of intended majors in engineering with those in the other STEM (science, technology, engineering, university”, and “undergraduate college” are substituted as descriptive of the general type of institution and to clarify that the categorization is by type of institution.

³ The CBMS categories of 4-year institutions are based on the highest degree offered in mathematics: Ph.D., M.A., or B.A. The labels “research university”, “comprehensive

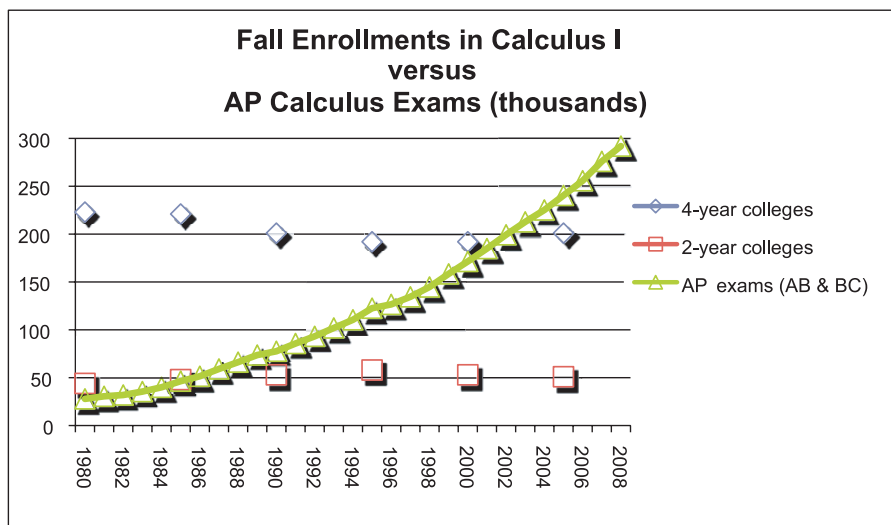


Figure 1. Fall enrollments in mainstream Calculus I and number of AP Calculus exams (thousands). Sources [1, 2, 5–7, 11].

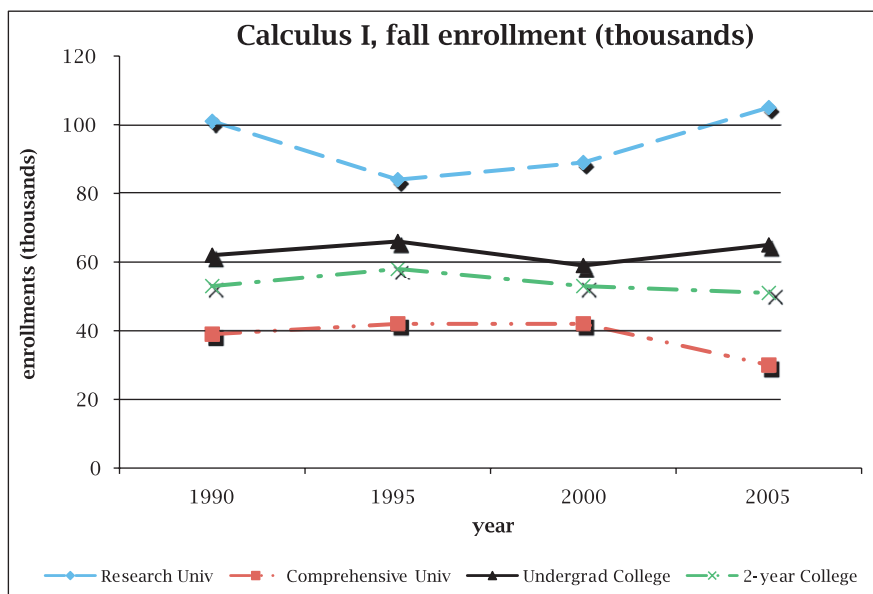


Figure 2. Fall enrollments in mainstream Calculus I by type of institution (thousands). Sources: [1, 5–7].

mathematics) disciplines: the biological sciences in Figure 7 and the physical sciences (including mathematics⁴) in Figure 8.

Conclusions

We have seen growth in enrollments in mathematics courses over the past ten years, but that growth is well below the rate of increase in total enrollments. The only place where it has been robust has been where it is tied to the increase in engineering

⁴The number of freshmen intending to major in mathematics dropped from 1.1% in 1985 to 0.5% in 2000. It has since grown to 0.8%, approximately the current percentage of graduates who earn majors in mathematics.

majors, a phenomenon that appears to be cyclical and has now entered a downturn.

The mathematical community needs to look at what it can do to strengthen enrollments. One solution is to get a lot more high school students to plan careers in engineering. It would be interesting to know what caused the reversal in engineering enrollments in the mid-1990s. These projections of intent to major in engineering were measured during freshman orientation, and thus the increase after 1995 was the result of something that happened in high school. What role did the introduction and widespread acceptance of graphing calculators and reform teaching methods within high schools have on the increased interest in and willingness to pursue highly technical majors? What is causing the current downturn in interest in engineering?

Engineering has served us well, but there is no reason why the fate of mathematics should be so dependent on just this discipline. The key to getting students into our advanced courses is to first get them into first-year courses that teach solid mathematics and pique their interest to continue in mathematics. This does not have to be a course tied to the engineering curriculum. Nevertheless, calculus is at the heart of the mathematics curriculum, and we must begin by taking a serious look at what is happening in college calculus and how well it articulates with the experiences that today's students have in high school. This is the basis for my first two recommendations.

Recommendation 1: *We need to understand what happens in college to students who study calculus in high*

school.

The half million students who study calculus in high school are a reasonable approximation of the top 15% of all high school graduates. They should be swelling the ranks of the students taking calculus- and advanced-level mathematics. We need a better understanding of what happens to these students after they enter college. For the 150,000 to 200,000 who arrive with and use credit for calculus taken in high school, how many continue to pursue mathematics and how well do they succeed? What happens to the other 300,000 to 350,000? For all of these students, what are the programs that most

effectively engage them, preparing and encouraging them into the further study of mathematics?

Recommendation 2: *We need to know more about the preparation of the students who take calculus in college and what they need in order to succeed once they get to our classes.*

We must have a better sense of who these students are who sit in our college calculus classes. What is the preparation that has gotten them to this point? How can we modify our courses so as to capitalize on the strengths and correct the weaknesses that these students bring? The answers to these questions will necessarily be local, highly dependent on the nature of a given college or university, but the entire mathematical community should be able to identify commonalities among similar types of institutions. The entire community should also promote programmatic and course structures that are particularly effective for each of the different populations we encounter.

Recommendation 3: *Mainstream calculus should not be the only entry to good college-level mathematics.*

The department of mathematics should be at the core of its college or university, interacting with every other department and working collaboratively to develop courses that meet the needs of each group of students. These should be courses that involve real mathematics and that open the way to the further, deeper study of mathematics. This conviction should be part of the vision of every department of mathematics.

I look with longing at those 120,000 prospective biological science majors coming in each year. We need courses that are attractive to them, courses that give them the tools from linear algebra that they will need for sophisticated statistical modeling, courses that enable them to read and write differential equations and turn them into computer simulations. We are not going to be able to convince the biologists that their students need to take more of the courses that we have created for the engineers, nor is it enough to take an engineering course and throw in some biological examples. These courses must be designed from the ground

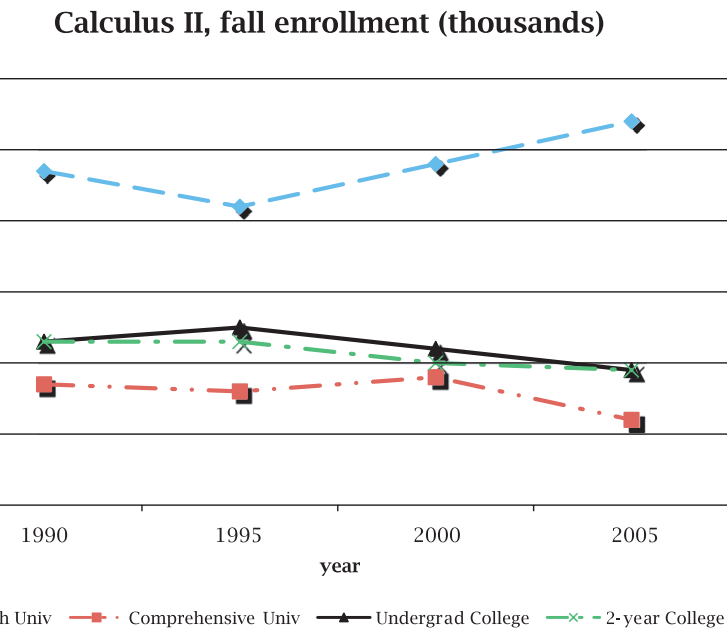


Figure 3. Fall enrollments in mainstream Calculus II and number of AP Calculus exams (thousands). Sources: [1, 2, 5–7].

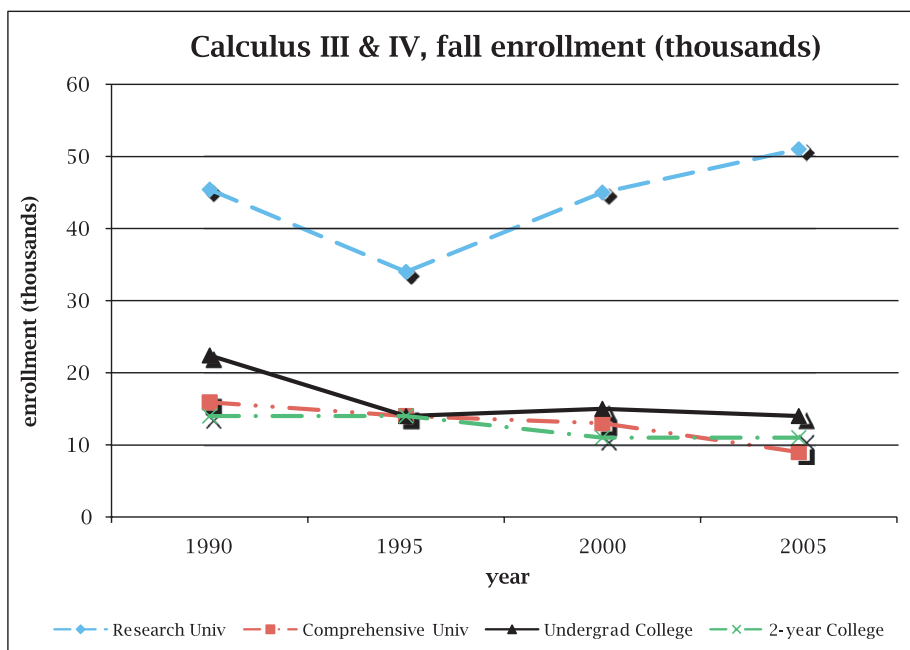


Figure 4. Fall enrollments in mainstream Calculus III & IV and number of AP Calculus exams (thousands). Sources: [1, 2, 5–7].

up in collaboration with biologists. Many colleges and universities have begun this process. See, for example, *Math & Bio: 2010* [14]. Doing this for biology is just the beginning of what should be a broad program of outreach and development.

The surge in engineering enrollments since 1995 coupled with the growth in physical science enrollments over the past five years has given us

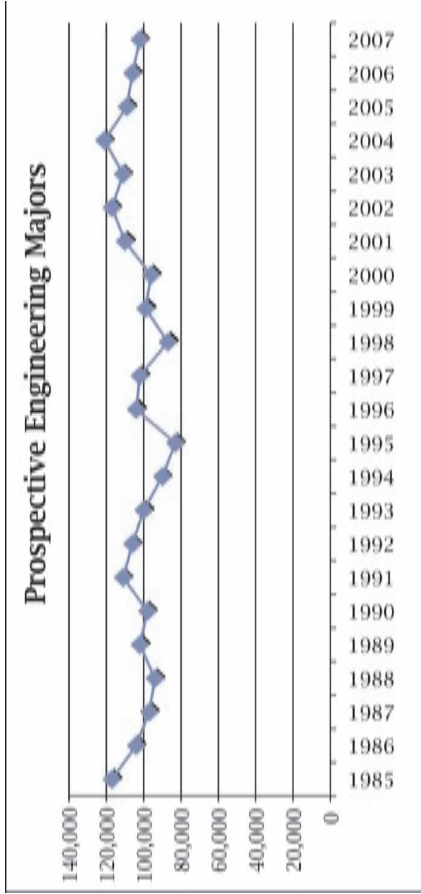


Figure 5. Number of freshmen in 4-year undergraduate programs who intend to major in engineering. Sources: [9, 10].

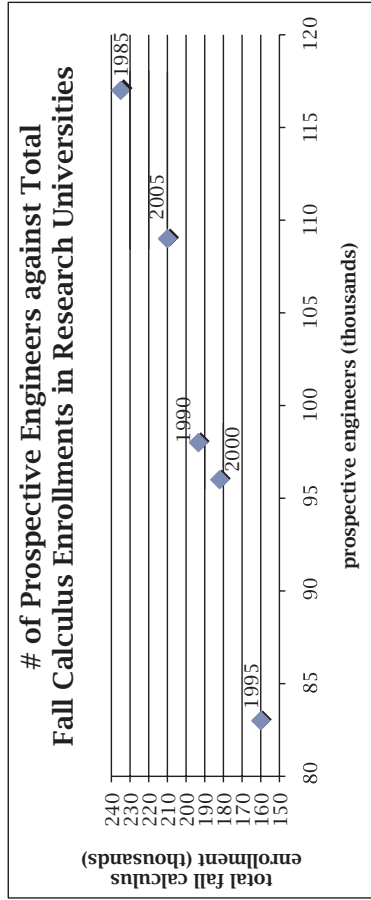


Figure 6. Number of prospective engineering majors against total fall calculus enrollment at research universities. Sources: [1, 5-7, 9, 10].

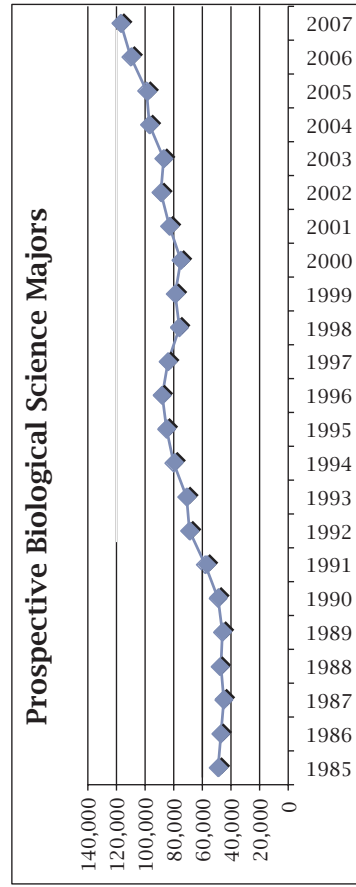


Figure 7. Number of freshmen in 4-year undergraduate programs who intend to major in biological sciences. Sources: [9, 10].

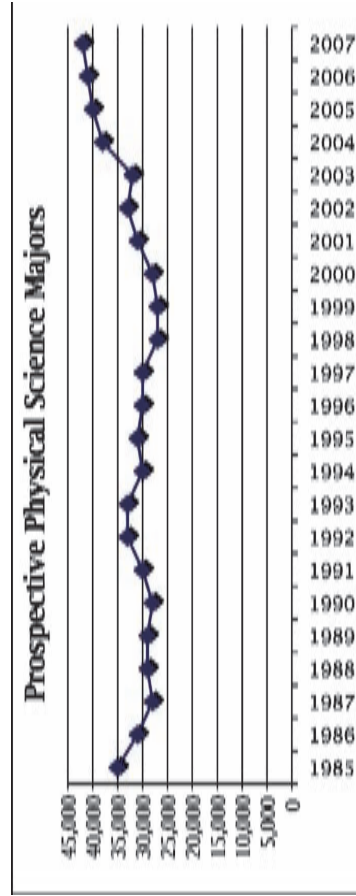


Figure 8. Number of freshmen in 4-year undergraduate programs who intend to major in physical sciences. Sources: [9, 10].

a reprieve. Yet, unless we address fundamental weaknesses, the long-term prognosis for the health of undergraduate mathematics is not good. I am still optimistic. Many talented people are working hard to improve the undergraduate program in mathematics. With a better sense of where we are and widespread dissemination of what works, we can build a foundation for the future.

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| year | 4-year freshman enrollment | % engineering | # prospective engineers |
|------|----------------------------------|------------------|-------------------------------|
| 1985 | 1,067,928 | 11.0% | 117,000 |
| 1986 | 1,023,762 | 10.2% | 104,000 |
| 1987 | 1,031,968 | 9.4% | 97,000 |
| 1988 | 1,076,036 | 8.7% | 94,000 |
| 1989 | 1,028,143 | 9.9% | 102,000 |
| 1990 | 1,010,548 | 9.7% | 98,000 |
| 1991 | 1,024,976 | 10.8% | 111,000 |
| 1992 | 1,060,087 | 10.0% | 106,000 |
| 1993 | 996,690 | 10.0% | 100,000 |
| 1994 | 1,017,725 | 8.8% | 90,000 |
| 1995 | 1,024,550 | 8.1% | 83,000 |
| 1996 | 1,076,035 | 9.7% | 104,000 |
| 1997 | 1,054,500 | 9.7% | 102,000 |
| 1998 | 1,066,679 | 8.2% | 87,000 |
| 1999 | 1,098,833 | 9.0% | 99,000 |
| 2000 | 1,101,817 | 8.7% | 96,000 |
| 2001 | 1,204,240 | 9.1% | 110,000 |
| 2002 | 1,234,968 | 9.5% | 117,000 |
| 2003 | 1,196,089 | 9.3% | 111,000 |
| 2004 | 1,258,333 | 9.6% | 121,000 |
| 2005 | 1,298,093 | 8.4% | 109,000 |
| 2006 | 1,320,824 | 8.0% | 106,000 |
| 2007 | 1,354,958 | 7.5% | 102,000 |

Table 4. Number of freshmen in 4-year undergraduate programs who intend to major in engineering. Sources: [9, 10].

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Pythagorean Crimes

Reviewed by Alex Kasman

Pythagorean Crimes

Tefcros Michaelides

Parmenides Publishing, October 2008

US\$14.95, 300 pages

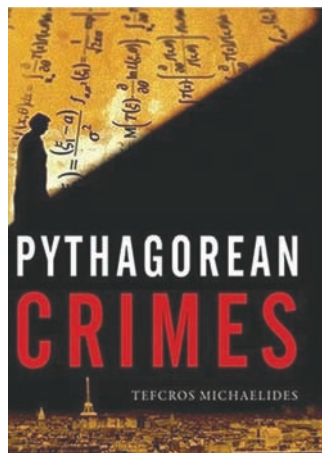
ISBN-13: 978-1930972278

There are many different ways in which mathematics can show up in a work of fiction. The author could have conceived of an interesting, but entirely fictional, mathematical result that advances the plot—such as the hidden message in the decimal expansion of the number π from Carl Sagan's novel *Contact*. Sometimes, the mathematical specifics are of no particular importance—as in David Auburn's *Proof*, where the interest is in the question of authorship of a theorem that is never described. Yet other works of fiction make use of a story to enhance the reader's understanding and appreciation of a real mathematical result.

Pythagorean Crimes by Tefcros Michaelides is a mathematical mystery novel that falls into the last of these categories. The narrator, Michael Igerinos, is a man from an aristocratic family who studied math in Göttingen at the turn of the twentieth century but wound up taking over his father's business in Greece and so only keeps up with mathematics as an amateur. As the novel begins we learn that his good friend, Stefanos Kandartzis, has been murdered. The murder victim, who like the novel's author holds a Ph.D. in mathematics from a French university and teaches high school in his native Greece, used to meet weekly with Michael to play chess and discuss mathematics. Seemingly in response to questions

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from the police, we are treated to a long digression in "flashback form" that recalls their friendship from the time they met until the day of the murder, all of which happens to coincide with many exciting developments in the history of mathematics and art during the years 1900 through 1931.



The title of the book refers to the supposed murder of Hippasus by the Pythagoreans for his discovery that the length of the diagonal of a unit square is not a rational number. According to the legend, because the Pythagoreans believed that "all is number" and lacked any concept of an irrational number, they drowned Hippasus at sea in order to keep his "dangerous" discovery secret. Although it is certainly possible that this tragic story is true, we have so little reliable information about the Pythagoreans that it seems equally probable that it is no more than a myth. (In another common version of the legend, he is merely exiled rather than killed. Moreover, there are different stories about Hippasus in which he was killed for crimes unrelated to the discovery of irrational numbers, such as revealing the secrets of geometry to those outside of the Pythagorean cult or for claiming someone else's results as his own.) In the novel, however, we read about Hippasus in three brief sections that expand on the traditional legend of his discovery and subsequent murder. These well written passages succeed in taking a

mathematical discovery that many nonmathematicians would probably perceive as dry and ensuring that it is emotionally powerful. Michaelides' prose generates the atmosphere of a cult in which a mathematical discovery could be perceived as outrageous heresy and the feelings of excitement and uncertainty as Hippias wonders whether to reveal his discovery to the group.

Most of the novel, however, takes place in the more recent past and focuses on history that is much more certain. As it turns out, the two good friends first met at the International Congress of Mathematicians in 1900 at which David Hilbert delivered his famous lecture on the future of mathematics. Michaelides does a great job of putting this lecture in its historical context by explaining how it was motivated by Poincaré's lecture at the previous Congress and the discussion of the limits of science begun by physiologist Emile du Bois-Remond whose motto was "*ignoramus et ignorabimus*" (we do not know and we will not know). When it relates this sort of factual information the novel begins to sound like a textbook. The reader is expected to absorb a great deal of information about mathematicians and their discoveries in a short amount of time. A reader who is a mathematician has the dual advantage of already knowing about many of these people and having read dense mathematical texts. For those with less prior mathematical experience, however, it may be difficult. That is precisely why the inclusion of these facts in a murder mystery—where one must pay close attention to many small details, never being sure which ones will be relevant to the eventual resolution—is potentially so useful.

I do not mean to suggest that reading *Pythagorean Crimes* will be easy or unenlightening for a mathematician. Michaelides appears to have done very careful research in writing it, and it is so detailed that nearly anyone is sure to learn something. Even those who know all of the mathematical results are unlikely to be as familiar with the political contexts in which they developed. Here, I use the word "political" in the sense of interactions between different groups of mathematicians as well as its more traditional sense. For instance, although I have had several occasions to read the text of Hilbert's speech, I was not previously aware of the tension between him and Peano or the subtle verbal "warfare" between their two groups at the Congress. Another example arises as Michael and Stefanos gossip while observing a discussion between Hadamard and de la Vallée-Poussin:

"Whether it was Gauss or Legendre," I replied, "what does it matter who formulated the question first? You are telling me these two discovered the answer independently. I am amazed they haven't yet come to

blows." I made this last comment in jest, of course, wishing to keep the conversation at the level of simple gossip...

My friend swallowed the bait. "If they were to come to blows, they would have a thousand and one reasons for doing so, quite apart from the disputed theorem. Can't you see? Hadamard is a Jew, de la Vallée-Poussin a Catholic—and a graduate of a Jesuit college, to boot; Belgian, but of French extraction. And observe what each is wearing: one a fedora, the other a silk tie and pince-nez. If you ask the latter who Dreyfus is, he may not even know. As for the other, he is passionately committed to the campaign for a retrial. A follower of Zola and all that. In fact, I think Hadamard and Dreyfus are related."

Moreover, encountering them in this novel gives one a sense of going beyond simply knowing *about* these historical figures. Of course, I knew of David Hilbert before, but having read this book I now feel as if I knew him personally and had occasion to run into him among the can-can dancers at the Moulin Rouge!

The artistic culture in Paris at the time is also a major focus of the novel. Stefanos takes Michael away from the math conference to introduce him to some of his friends, including a painter named Pablo Ruiz. They have a discussion with the artist about the possibility of tiling the plane with different regular polygons. When Michael returns to Paris years later, Ruiz is instead going by his mother's name, Picasso, and is still interested in mathematics. In fact, Michael is there (and so also is the reader) at the dramatic moment when Maurice Princet discusses non-Euclidean geometries with Picasso, helping inspire the artist to create "cubism". Like the discussions of mathematics, the discussion of art is dense with historical details.

In historical fiction such as this, it is reasonable to wonder whether the history is presented accurately and fairly. (See, for example, Frans Oort's review, in the June/July 2008 *Notices*, of *Measuring the World*, which criticizes that novel's portrayal of Gauss.) No obvious inaccuracies or slanderous representations jumped out at me as I read this book. However, it is clear that the author knows a great deal more about this period in history than I do, and I am merely trusting that he is offering a historically accurate portrayal. This faith is reinforced by the author's guilty tone in the postscript to the book when he admits to certain trivial inaccuracies. For instance, he confesses, "I had to place Picasso in Paris a couple of months too

early (in fact, he first visited Paris in the autumn of 1900)." It may be that my faith is misplaced, but I like to think that an author who is so concerned about whether Picasso was in Paris in August as opposed to "the autumn" is one who can be trusted.

There are other portions of the book that are more fictional than fact-based. They address such nonmathematical topics as Stefanos' heroic adventures as a soldier, Michael's open marriage with an unusually independent woman, his dealings with the underworld in order to free a young prostitute, and Stefanos' romantic involvement with each of these women (unknowingly with the former and secretly with the latter). These bits of sex and violence, perhaps necessary to maintain the interest of readers, are handled tastefully and are relevant to the mystery.

As for the mystery, it is unfortunately not terribly mysterious. To a perspicacious reader, the fact that the novel spans the years from 1900 until 1931 may itself suggest which mathematical result eventually becomes essential to the plot: Kurt Gödel's 1931 paper in which he provides a negative answer to one of the problems posed by Hilbert in 1900.

It was certainly a shock to many people when Gödel demonstrated the necessary existence of undecidable propositions in mathematics, destroying Hilbert's hope that for mathematicians there was "no *ignorabimus*". Combining knowledge of this fact with the title of the book (and its reference to a man who was killed for making a discovery deemed to be dangerous to the faith of other mathematicians), one might fear that the resolution of the mystery will be a little too obvious to anyone who already knows some of the history of mathematics. Fortunately, the author was clever enough to include one additional surprise "twist", so that even if you are knowledgeable enough to suspect that a discussion of incompleteness is certain to arise in the final chapters, things still do not work out quite the way that you might expect.

Michaelides not only knows about the history of mathematics, but also knows about connections between mathematics and fiction. He has written essays on this subject and has also translated into Greek several works of "mathematical fiction" that were written in French and English. So I am sure he is very familiar with the three books that I consider to be most similar to *Pythagorean Crimes*. Since it was written originally in Greek and is infused with modern Greek culture and history, it is sure to be compared to Apostolos Doxiadis' novel *Uncle Petros and Goldbach's Conjecture* (*Notices* review, November 2000). However, it is arguably much more similar to two other relatively recent novels of mathematical fiction: *A Certain Ambiguity* by Gaurav Suri and Hartosh Singh Bal (*Notices* review, February 2008) and Denis Guedj's *The Parrot's*

Theorem (*Notices* review, March 2001). It is interesting to me that Gödel's Theorem is of central importance to three out of these four "fact heavy" novels. Only *The Parrot's Theorem* avoids using this literarily potent mathematical result as a key plot device.

The mystery story is presumably there to help those with less knowledge of the history of mathematics to stay focused and interested while learning all that is necessary to appreciate Gödel's theorem. For those novices who successfully get through to the conclusion, this will certainly be an emotionally charged introduction to one of the most interesting results in mathematical history. Another tool provided to aid these less mathematically experienced readers—mentioned but not actually present in the "uncorrected proof" of the book that I read—is a glossary with separate sections for people, concepts, places, events, and "things". Sadly, I fear that the number of people who are not already familiar with Gödel's work and yet are still sufficiently interested in mathematics to read through the new English translation of this fact-filled novel will be very small. In any case, many readers of the *AMS Notices* will enjoy reading this book for the feeling that they have been able to spend some time with famous historical figures whom we all know by name, providing a context that can enhance our appreciation of these researchers and their work.

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The Cat in Numberland

Reviewed by James Propp

The Cat in Numberland

Ivar Ekeland, illustrated by John O'Brien
Cricket Books, 2006 (reading level ages 9–12)
US\$19.95, 56 pages
ISBN-13: 978-0812627442

The Cat in Numberland is a well-thought-out and stylish attempt to present ideas about infinity to children who are ready to take a step beyond the notion of infinity as “the largest number”. I found Ekeland’s text engaging, with enough whimsy to keep the story from being dry but not so much as to be cutesy or condescending, and I thought O’Brien’s charming black-and-white illustrations compensated for their lack of color through their loopy, nervy vigor.

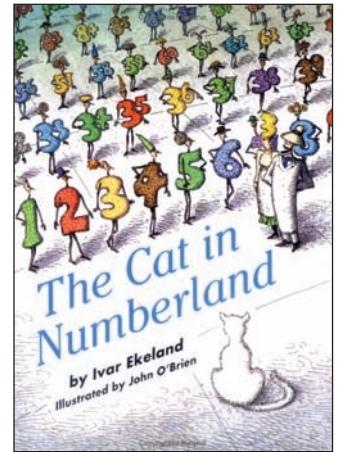
There’s something mind-numbing about the concept of infinity, and for many students, even the word itself invites a retreat from forward-moving thought into static wonder; so, when leading a first-timer on a trip to infinity, it’s best to use the word as little as possible. Ekeland borrows a famous pedagogical device from David Hilbert’s popularization of Cantor’s ideas about infinity, namely the idea of a hotel with infinitely many rooms, but even though Ekeland’s hotel is called “Hotel Infinity”, you will not find any other occurrence of the words “infinity” or “infinite” in his book. Ekeland honors Hilbert by making him the proprietor of this hotel on the planet of Numberland, though the character’s fastidiousness, quarrelsomeness, and lack of creativity make this homage a mixed compliment at best. Where Ekeland departs from Hilbert is his fancy that the guests in the hotel are not people but the actual numbers One, Two, Three, etc., personified. The number One starts out in room 1 of the hotel, the number Two starts out in room 2, and so on. The use of names for the numbers, and numerals for the rooms they occupy, at first struck me as strange, but I later realized that this is an astute authorial choice that wards off numerous potential confusions.

The plot is driven by the difference between the temperaments of Mr. Hilbert and his wife

(Mr. Hilbert wants to keep all the rooms occupied, while Mrs. Hilbert wants to admit new guests), and all the puzzles that the Hilberts and their guests tackle are driven by the pursuit of marital harmony. The tension between Mr. and Mrs. Hilbert as described by Ekeland is just one instance of a fictionalizing touch that might at first seem to pull the story away from mathematical issues but actually plays a pedagogical role. Another example is the discussion in Chapter 1 of the “games” (addition, subtraction, multiplication, and division) that the numbers play with one another; this leads to a seemingly incidental discussion of odd and even numbers that lays the groundwork for the problem faced in Chapter 4 (how can you keep the hotel full when infinitely many guests leave?). Likewise, the discussion of how the letters A through Z attempt to participate in these games, while it plays no role in later developments in the book, serves as a nice preparation for the idea of using a letter as a place-holder, which the young reader will encounter when starting the study of algebra.

The climax of the book occurs in Chapter 5, when the hotel must be made to accommodate an infinite number of new guests, the Fractions, who arrive in an infinite rectangular two-dimensional array, each of whose rows is infinite. The solution to this problem comes from a change in perspective, quite literally: the number Zero, by looking out the high window of Room 1,234,566, is able to see his old hotel-mates and all the new arrivals as forming a triangular array each of whose rows is finite, which makes it possible to fit them into the hotel.

If you have a copy of the book available, jump immediately to page 55 for a masterly visual rendition of the key idea. The scene can be parsed in two different ways, and the viewer can go back and forth between them: now you see it, now you don’t, now you do again. “I see it now!” says Mr. Hilbert. “But we could not see it from where we were standing.” This is a fine motto for every



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stage of the process of learning mathematics, from pre-kindergarten to post-graduate. Each time we make a conceptual advance, we should jump back and forth across the divide we have crossed, to understand what made the leap so difficult the first time and so easy afterward, with the goal of enabling ourselves to make other jumps with less trouble in the future.

I have one mathematical quibble with this otherwise excellent little book, namely, the description of the layout of the hotel. We are told in Chapter 1 that there is a first room, which is Room 1; but we are also told that each odd-numbered room lies between two even-numbered rooms and vice versa (and there is no Room 0, at least at the outset). This inconsistency is easily fixed by treating Room 1 as an exception, but what are we to make of the fact that Hotel Infinity has infinitely many floors? If Room n lies between Room $n - 1$ and Room $n + 1$ for all n (as is strongly implied by the text), then which numbers are on the hotel's higher floors? Indeed, you can lead any young reader to see that Rooms 1 through 1,234,566 must all be on the ground floor, so that room 1,234,566 cannot play the pivotal role required by the plot. And, leaving that aside, if there were infinitely many floors, why couldn't the whole numbers and fractions be accommodated by putting the whole numbers on the ground floor, the fractions with denominator 2 on the second floor, the fractions with denominator 3 on the third floor, etc.?

Since this is a work of fiction designed to awaken the imagination, I view these imperfections of the book as a plus, not a minus; if you know a child who likes this book, you might try to lead him or her to discover these inconsistencies with a little bit of Socratic prodding (and perhaps challenge the child to redesign the hotel in various ways). At some point or other, the question may arise whether there could be a hotel with more than one floor such that Room n lies between Room $n - 1$ and Room $n + 1$ for all $n > 1$. At this point the child might embark on a project equivalent to proving the axiom of induction, and experience both confusion and frustration. This would be an excellent occasion for explaining that when we learn or create mathematics, confusion is often a good thing: it means we have understood a tension between two opposed ideas that must somehow be reconciled. Indeed, if you are a mathematical researcher, you might explain to the child that the way you make a living is by finding good things to be confused about and then trying to un-confuse yourself.

The topic of confusion leads us to the title character of the book, the unnamed cat, who is the reader's surrogate, and who can serve as a stand-in for both the future mathematician and the future nonmathematician. The cat's role is to express puzzlement at what is really going on, when everyone else seems content that a solution has been

found. The cat can see that the move-everyone-to-the-next-room trick has worked, but is mystified as to how the trick works. Since all the rooms were full before, and all the rooms are full now, and one new guest has been accommodated, there must be a new room in the hotel somewhere—but where is it? Ekeland wisely does not introduce a character to resolve the cat's confusion. Some confusions need to be left unresolved, and revisited from year to year as we gain new ways of thinking.

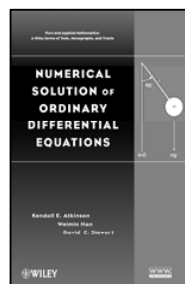
Most mathematicians, as young students, played the role of the cat at one time or another, feeling (and perhaps voicing) confusion in a classroom situation in which the other students, who were satisfied with a more superficial level of understanding, didn't see anything to be confused about. Our schools need teachers who understand that confusion can sometimes be evidence of a deeper approach to the subject matter. Indeed, who can say how many potential mathematicians were driven away from mathematics at an early age by classmates and teachers who made them feel stupid for feeling rightly confused about deep matters?

In the end the cat opts to leave Numberland for a place that is easier to understand, namely, our own world (more specifically, Corsica—which may be an arbitrary or personal choice of Ekeland's, or may hold some meaning that eludes me). The cat still dreams of Numberland, but she enjoys living in a place where puzzlement is not a fact of daily life. Like Alice, or the Dorothy of the MGM version of *The Wizard of Oz*, the cat's sojourn in a land governed by strange rules has given her a heightened appreciation of the mundane (though unlike Alice or Dorothy, she ends up on Earth as a refugee, not a returning native).

In this final stage of her journey the cat strikes me as a stand-in for the student who retreats from the counterintuitive constructs of abstract mathematics in favor of the concrete and the graspable. Whether these students become engineers or accountants or artists, what we mathematicians hope for them is not that they become good at solving fanciful puzzles like the ones the Hilberts face, but that they accord some respect to the challenge of these puzzles, and that, in some corner of their minds, they have an esthetic response to such puzzles and their solutions. Such “dreams of Numberland” should be part of the residue that students are left with after their mathematical education is completed.

We should not expect all of our students to want to live in Numberland, or even to visit very often, but we should hope they will acquire the view of mathematics that is tacitly advertised by Ekeland and O'Brien: a view of mathematics as not just a mountain of facts but also a fountain of paradox.

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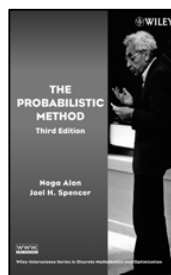


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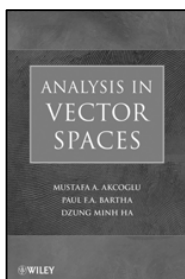


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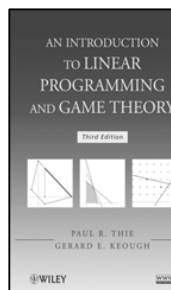


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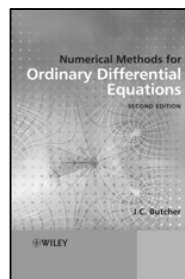


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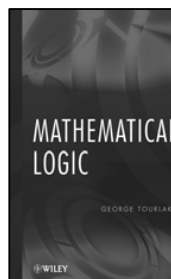


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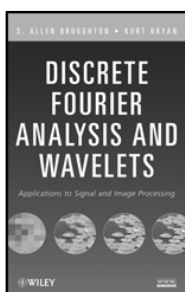


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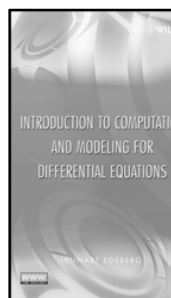


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W H A T I S . . .

the Schwarzian Derivative?

Valentin Ovsienko and Sergei Tabachnikov

Almost every mathematician has encountered, at some point of his or her education, the following rather intimidating expression and, most likely, tried to forget it right away:

$$(1) \quad S(f(x)) = \frac{f'''(x)}{f'(x)} - \frac{3}{2} \left(\frac{f''(x)}{f'(x)} \right)^2.$$

Here $f(x)$ is a function in one (real or complex) variable and $f'(x), f''(x), \dots$ are its derivatives. This is the celebrated Schwarzian derivative, or the *Schwarzian*, for short. It was discovered by Lagrange in his treatise “Sur la construction des cartes géographiques” (1781); the Schwarzian also appeared in a paper by Kummer (1836), and it was named after Schwarz by Cayley.

Expression (1) is ubiquitous and tends to appear in seemingly unrelated fields of mathematics: classical complex analysis, differential equations, and one-dimensional dynamics, as well as, more recently, Teichmüller theory, integrable systems, and conformal field theory. Leaving these numerous applications aside, we focus on the basic properties of the Schwarzian itself.

Two examples. a) The first example is perhaps the oldest one. Consider the simplest second-order differential equation, the Sturm-Liouville equation,

$$(2) \quad \varphi''(x) + u(x) \varphi(x) = 0$$

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where the potential $u(x)$ is a (real or complex valued) smooth function. The space of solutions is two-dimensional and spanned by any two linearly independent solutions, φ_1 and φ_2 . Suppose that we know the quotient $f(x) = \varphi_1(x)/\varphi_2(x)$; can one reconstruct the potential? The reader can carry out the relevant computations to check that $u = \frac{1}{2} S(f)$. The geometrical meaning of this formula is as follows. The quotient $t = \varphi_1/\varphi_2$ is an *affine coordinate* on the projective line \mathbb{P}^1 so that $t = f(x)$ is a parametrized curve in \mathbb{P}^1 . This curve has non-vanishing speed, i.e., $f' \neq 0$, since the Wronski determinant of two solutions of (2) is a non-zero constant. The Schwarzian then reconstructs a Sturm-Liouville equation from such a curve.

b) The next example is due to C. Duval, L. Guieu, and the first author (2000). Consider the Lorentz plane with the metric $g = dx dy$ and a curve $y = f(x)$. If $f'(x) > 0$, then its Lorentz curvature can be easily computed: $\varrho(x) = f''(x) (f'(x))^{-3/2}$, and the Schwarzian enters the game when one computes $\varrho' = S(f)/\sqrt{f'}$. Thus, informally speaking, *the Schwarzian derivative is curvature*.

The following beautiful theorem of E. Ghys (1995) is a manifestation of this principle: *for an arbitrary diffeomorphism f of the real projective line, its Schwarzian derivative $S(f)$ vanishes at least at 4 distinct points*. Ghys' theorem is analogous to the classical 4 vertex theorem of Mukhopadhyaya (1909): *the Euclidean curvature of a smooth closed convex curve in \mathbb{R}^2 has at least 4 distinct extrema*.

Not a function. A surprise hidden in formula (1) is that the Schwarzian is actually not a function. The difference between a function and a more complicated tensor field is in its behavior

under coordinate changes. Choose another coordinate y . What is the formula for $S(f)(y)$? For a function the answer is simply $f(y) = f(x(y))$, but for its derivative, due to the Chain Rule, it is different: $f'(y) = f'(x(y))x'(y)$; this is why the invariant (geometric) quantity is not the derivative but the differential $df = f'(x)dx$ —a distinction that tortures countless calculus students. The geometric quantity corresponding to (1) is the quadratic differential: $S(f) = S(f(x))(dx)^2$. In other words, $S(f)$ is a quadratic function on the tangent space $T\mathbb{R}$, just like a metric but without the non-vanishing condition. We denote by $\mathcal{Q}_2(\mathbb{RP}^1)$ the space of the quadratic differentials on the real projective line \mathbb{RP}^1 .

Main properties. 1. $S(f) = S(g)$ if and only if $g(x) = (af(x) + b)/(cf(x) + d)$, where a, b, c, d are (real or complex) constants with $ad - bc \neq 0$. In particular, $S(f) = 0$ if and only if f is a linear-fractional transformation:

$$(3) \quad f(x) = \frac{ax + b}{cx + d}.$$

Note that $f(-d/c) = \infty$, but $f(x)$ is well-defined for $x = \infty$. We can understand f as a *diffeomorphism* of \mathbb{RP}^1 . The transformations (3) with *real* coefficients form a group of projective symmetries of \mathbb{RP}^1 , which is $\mathrm{SL}(2, \mathbb{R})/\{\pm 1\}$. It follows that the Schwarzian is a *projective invariant*.

2. Given two diffeomorphisms f, g of \mathbb{RP}^1 , one has: $S(g \circ f) = S(g) \circ f + S(f)$, where the first summand is the action of f on a quadratic differential, $(u \circ f)(x) = u(f(x))(f'(x))^2$.

From discrete projective invariants to differential ones. The reader may be familiar with projective invariants; see F. Labourie's article [1]. Recall that a quadruple of points in \mathbb{P}^1 has a numerical invariant. Choose an affine coordinate that represents the points by four numbers t_1, t_2, t_3 , and t_4 ; the *cross-ratio*

$$[t_1, t_2, t_3, t_4] = \frac{(t_1 - t_3)(t_2 - t_4)}{(t_1 - t_2)(t_3 - t_4)}$$

is invariant under the projective transformations of the projective line. What is the relation of this discrete invariant to the Schwarzian?

Consider a diffeomorphism f of \mathbb{RP}^1 . The Schwarzian measures how f changes the cross-ratio of infinitesimally close points. Let t be a point in \mathbb{RP}^1 and v a tangent vector to \mathbb{RP}^1 at t . Extend v to a vector field in a vicinity of t and denote by ϕ_s the corresponding local flow. Consider four points: $t, t_1 = \phi_\varepsilon(t), t_2 = \phi_{2\varepsilon}(t), t_3 = \phi_{3\varepsilon}(t)$. The cross-ratio does not change in the first order in ε :

$$[f(t), f(t_1), f(t_2), f(t_3)] = [t, t_1, t_2, t_3] - 2\varepsilon^2 S(f)(t) + O(\varepsilon^3).$$

The coefficient of ε^2 depends on the diffeomorphism f , the point t , and the tangent vector v , but not on its extension to a vector field. It is

homogeneous of degree 2 in v , and therefore $S(f)$ is indeed a quadratic differential.

Schwarzian as a cocycle. Let G be a group acting on a vector space V , i.e., there is a homomorphism $\rho : G \rightarrow \mathrm{End}(V)$. A map $c : G \rightarrow V$ is a 1-cocycle on G with coefficients in V if

$$\tilde{\rho}_g : (v, \lambda) \mapsto (\rho_g v + \lambda c(g), \lambda)$$

is again a G -action on $V \oplus \mathbb{R}$. The cocycle c is *non-trivial* if this action is not isomorphic to that with $c = 0$. In this case, c defines a class of cohomology of G , the notion that plays a fundamental role in geometry, algebra, and topology.

Diffeomorphisms of \mathbb{RP}^1 form an infinite-dimensional group, $\mathrm{Diff}(\mathbb{RP}^1)$, which acts on all tensor fields on \mathbb{RP}^1 . Property 2 means precisely that the Schwarzian is a 1-cocycle with coefficients in the space of quadratic differentials $\mathcal{Q}_2(\mathbb{RP}^1)$. Moreover, one can prove uniqueness: *the Schwarzian is the only projectively invariant 1-cocycle on $\mathrm{Diff}(\mathbb{RP}^1)$* . This serves as a good intrinsic definition.

The algebra of vector fields, $\mathrm{Vect}(\mathbb{RP}^1)$, is the Lie algebra of the group $\mathrm{Diff}(\mathbb{RP}^1)$. Every differentiable map on $\mathrm{Diff}(\mathbb{RP}^1)$ corresponds to a map on $\mathrm{Vect}(\mathbb{RP}^1)$, its infinitesimal version. The infinitesimal version of the Schwarzian is easy to compute (substitute $f(x) = x + \varepsilon X(x)$ in (1) and differentiate with respect to ε at $\varepsilon = 0$): $s(X(x) d/dx) = X'''(x)(dx)^2$. This is a projectively invariant 1-cocycle on $\mathrm{Vect}(\mathbb{RP}^1)$ with coefficients in $\mathcal{Q}_2(\mathbb{RP}^1)$. Moreover, the invariant pairing between quadratic differentials and vector fields yields a 2-cocycle on $\mathrm{Vect}(\mathbb{RP}^1)$ with trivial coefficients:

$$\omega\left(X(x) \frac{d}{dx}, Y(x) \frac{d}{dx}\right) = \int_{\mathbb{RP}^1} X'''(x) Y(x) dx.$$

This is the Gelfand-Fuchs cocycle (1967); it defines a central extension of $\mathrm{Vect}(\mathbb{RP}^1)$ called the Virasoro algebra, perhaps the most famous infinite-dimensional Lie algebra, defined on the space $\mathrm{Vect}(\mathbb{RP}^1) \oplus \mathbb{R}$ by the commutator

$$[(X, \alpha), (Y, \beta)] = ([X, Y], \omega(X, Y)),$$

where $[X, Y]$ is the commutator of vector fields.

The Schwarzian contains complete information about the Gelfand-Fuchs cocycle; for instance, the 2-cocycle condition follows from Property 2. The relations between the Schwarzian and the Virasoro algebra were discovered, independently, by A. Kirillov and G. Segal (1980).

Multi-dimensional versions of the Schwarzian. Here is a “universal method” of discovering a multidimensional Schwarzian:

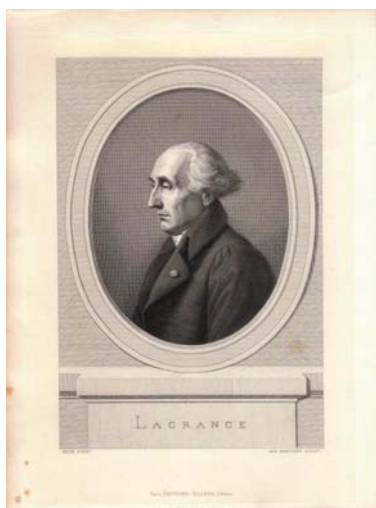
- choose a group of diffeomorphisms and a subgroup G that has a nice geometrical meaning,
- find a G -invariant 1-cocycle on the group of diffeomorphisms,
- (the most important step) check that no one did it before.

One of the most interesting multi-dimensional Schwarzians is that of Osgood and Stowe (1992). Consider a Riemannian surface (M, g) and the group $\text{Diff}_c(M)$ of all conformal transformations of M . The Riemann uniformization theorem implies that M is conformally flat. One can (locally) express the metric as $g = (1/F)\psi^*g_0$, where ψ is a conformal diffeomorphism of M , F is a smooth function, and g_0 is a metric of constant curvature. The conformal Schwarzian is given by

$$S(\psi) = \frac{\nabla dF}{F} - \frac{3}{2} \frac{dF \otimes dF}{F^2} + \frac{1}{4} \frac{g^{-1}(dF, dF)g}{F^2},$$

where ∇ is the covariant derivative corresponding to the Levi-Civita connection. This is a 1-cocycle on $\text{Diff}_c(M)$, invariant with respect to the (local) Möbius subgroup $\text{SO}(3, 1)$ associated to the metric g_0 . The construction also makes sense if $\dim M > 2$, but the conformal group is finite-dimensional in this case.

Lagrange and the Schwarzian Derivative



The name “Schwarzian derivative” was coined by Cayley, but he points out that Schwarz himself says that it occurs already, at least implicitly, in Lagrange’s essay on *cartes géographiques*. Felix Klein learned about Lagrange’s work through a private communication from Schwarz (noted in §III.5 of *Lectures on the Icosahedron*). It is not quite straightforward, however, in reading Lagrange, to see what he is doing, and it is not clear to what extent later mathematicians went to

the original work. Joseph Sylvester, in “Method of reciprocants” records that he tried to track down Lagrange’s use of the Schwarzian, but then only concludes that “There are two papers by Lagrange ... but I have not been able to discover the Schwarzian derivative in either one of them.” Even in modern times Lagrange’s role has been missed—for example, George Heine in an article in the recent book *Euler at 300: An Appreciation* says that Lagrange’s work had little influence on either mathematics or cartography.

Schwarz was, however, correct—Lagrange did introduce some version of the Schwarzian derivative $S(f)$, and for an interesting purpose. He considers the Earth as a general body of revolution, taking into account the known non-sphericity.

Among other generalizations, let us mention the “Lagrangian Schwarzian” modeled on symmetric matrices, Ovsienko (1989); a more general non-commutative Schwarzian of Retakh and Shander (1993); and various generalized Schwarzians with coefficients in the space of differential operators.

Last but not least, the Schwarzian derivative plays a key role in Teichmüller theory, namely, the Bers embedding of the Teichmüller space of a Riemann surface into an appropriate complex space. However, this vast topic deserves a separate treatment.

Further Reading

- [1] F. LABOURIE, What is...a cross-ratio?, *Notices* 55 (2008), No 10. (November), 1234–1235.
- [2] V. OVSIENKO and S. TABACHNIKOV, *Projective Differential Geometry Old and New. From the Schwarzian Derivative to the Cohomology of Diffeomorphism Groups*, Cambridge University Press, Cambridge, 2005.

He studies the maps given by a conformal mapping from a spherical region to the plane that takes all the meridians and all the parallels to arcs of circles (as does stereographic projection). This is equivalent to describing local conformal mappings $z \mapsto f(z)$ for which the image of each horizontal and each vertical line is a circular arc. He proves that the conditions on horizontals and verticals are equivalent and that both are equivalent, in contemporary notation, to the equation $\text{Im}S(f) = 0$. This implies in turn that $S(f) = \text{constant}$. He solves this equation and explicitly describes its solutions. The Schwarzian derivative $S(f)$ appears in his paper as ϕ''/ϕ where $\phi = 1/\sqrt{F}$, which excuses Sylvester to some extent for missing it.

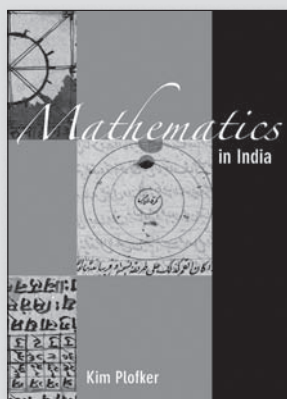
All this was found again much later, but apparently quite independently of Lagrange’s original work. What is sometimes called *Arnold’s Law* asserts, “Discoveries are rarely attributed to the correct person.” One might add to this (*Michael Berry’s Law*, prompted by the observation that the sequence of antecedents under the previous law seems endless: “Nothing is ever discovered for the first time.”

Lagrange’s article on *cartes géographiques* is in Volume IV of his collected works. This is not, unfortunately, available at <http://gallica.bnf.fr> as are Volumes II and VIII, but we have made a scan of it available at

<http://www.math.ubc.ca/~cass/cartes.pdf>.

It is this volume, incidentally, that contains as frontispiece the well known portrait of Lagrange reproduced here.

—Bill Casselman, Valentin Ovsienko,
and Sergei Tabachnikov

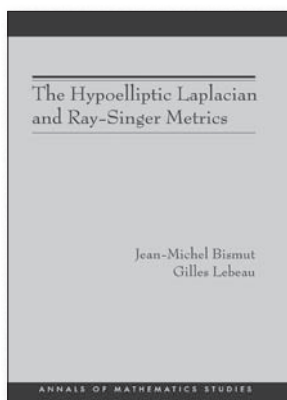


Mathematics in India

Kim Plofker

Based on extensive research in Sanskrit sources, *Mathematics in India* chronicles the development of mathematical techniques and texts in South Asia from antiquity to the early modern period. Kim Plofker reexamines the few facts about Indian mathematics that have become common knowledge—such as the Indian origin of Arabic numerals—and she sets them in a larger textual and cultural framework. The book details aspects of the subject that have been largely passed over in the past, including the relationships between Indian mathematics and astronomy, and their cross-fertilizations with Islamic scientific traditions.

Cloth \$39.50 978-0-691-12067-6 February



The Hypoelliptic Laplacian and Ray-Singer Metrics

Jean-Michel Bismut & Gilles Lebeau

This book presents the analytic foundations to the theory of the hypoelliptic Laplacian. The hypoelliptic Laplacian, a second-order operator acting on the cotangent bundle of a compact manifold, is supposed to interpolate between the classical Laplacian and the geodesic flow. Jean-Michel Bismut and Gilles Lebeau establish the basic functional analytic properties of this operator, which is also studied from the perspective of local index theory and analytic torsion.

Annals of Mathematics Studies

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The Structure of Affine Buildings

Richard M. Weiss

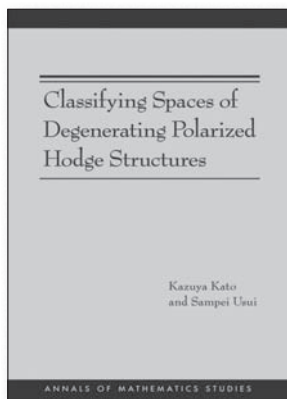
Richard Weiss gives a detailed presentation of the complete proof of the classification of Bruhat-Tits buildings first completed by Jacques Tits in 1986. The book includes numerous results about automorphisms, completions, and residues of these buildings. It also includes tables correlating the results in the locally finite case with the results of Tits's classification of absolutely simple algebraic groups defined over a local field. A companion to Weiss's *The Structure of Spherical Buildings*, *The Structure of Affine Buildings* is organized around the classification of spherical buildings and their root data as it is carried out in Tits and Weiss's *Moufang Polygons*.

Annals of Mathematics Studies

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Classifying Spaces of Degenerating Polarized Hodge Structures

Kazuya Kato & Sampei Usui

In 1970, Phillip Griffiths envisioned that points at infinity could be added to the classifying space D of polarized Hodge structures. In this book, Kazuya Kato and Sampei Usui realize this dream by creating a logarithmic Hodge theory. They use the logarithmic structures begun by Fontaine-Illusie to revive nilpotent orbits as a logarithmic Hodge structure.

Annals of Mathematics Studies

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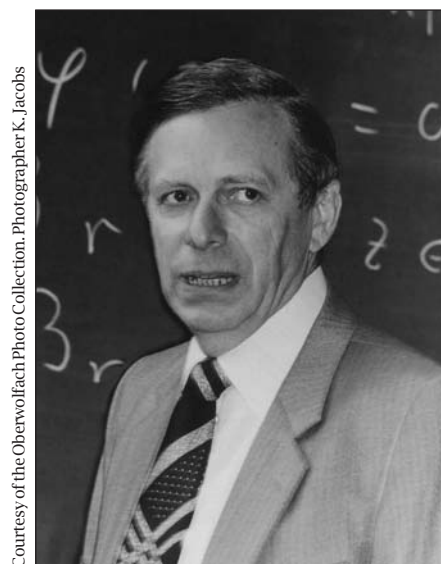


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Hans Grauert: Mathematiker Pur

Alan Huckleberry



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Hans Grauert in Utrecht (1980).

On April 25, 2008, on the occasion of the Gauß-Vorlesung in Bonn, Hans Grauert was presented the *Ehrenmitgliedschaft* of the Deutsche Mathematiker-Vereinigung (DMV, German Mathematical Society). Given the opportunity to describe even superficially the contributions of this most distinguished colleague, I was pleased when asked to write this article for the *Mitteilungen* of the DMV. Only a few months after that article appeared,¹ on September 15, 2008, Grauert was awarded the prestigious Cantor-Medaille of the DMV at its annual meeting, which took place in Erlangen. The inaugural Cantor-Medaille was awarded in 1990, on the occasion of the 100th anniversary of the founding of the DMV, to Karl Stein who, like Grauert, devoted most of his scientific life to the subject of several complex variables. The Medaille has been awarded on a regular basis since that time, being presented to J. Moser (1992), E. Heinz (1994), J. Tits (1996), V. Strassen (1999), Y. Manin (2002), F. Hirzebruch (2004), and H. Föllmer (2006).

It is *presumptuous* for a mere mortal to even attempt to write a laudation for Hans Grauert. The easy part is to construct a representative list of the various important stations of his life, and of his

accomplishments and honors, and to put them in a timeline. I have indeed integrated a rough outline of these data in this article, but to me this is just a small part of a story that I feel is very important.

Hans Grauert was born in Haren-Ems in 1930. At his retirement festival in Göttingen he recalled how he struggled with mathematics as a school-boy until a teacher told him it was acceptable to think abstractly, he didn't necessarily need deal with numbers. No more than fifteen years later he was introducing spaces without points, just structure!

After beginning his studies in the summer semester of 1949 in Mainz, Grauert transferred to Münster, starting in the winter semester of 1949–50. There he was integrated into an exciting, energized mathematical atmosphere with friends and teachers of all ages and experience. Among these was Reinhold Remmert, who would become his lifelong friend and main collaborator. The mathematics guru was Karl Stein. Heinrich Behnke was well connected to the outside mathematical world, in particular to H. Hopf and H. Cartan, and had a very good feeling for the important directions in complex analysis.

After a brief sojourn in Zürich, Grauert received his Dr. rer. nat. in Münster in 1954. Starting with his dissertation, Grauert contributed fundamental results that lie at the heart of a field of mathematics that was in an infantile state when he started and was at a refined and incredibly high level less than ten years later. Let us now think back to the time when he began his studies!

There were indeed the deep, perhaps mysterious ideas of Oka on the table. Stein understood these in his own way and was, for example, attempting to understand the role of topology in complex analysis, in particular for noncompact spaces. Hirzebruch had received his doctorate in 1950 in Münster and was on the path toward his

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¹ The present article, reprinted with the kind permission of the Deutsche Mathematiker-Vereinigung is a mildly modified version of the article by Huckleberry that appeared in the DMV *Mitteilungen*, volume 16, number 2, 2008.

fundamental book *Neue Topologische Methoden in der Algebraischen Geometrie*. The power of the developing Cartan-Serre theory cannot be underestimated. However, the foundations of what is now called *several complex variables* were simply not there!

The works of Grauert and Remmert, together with the input of Cartan and Serre (the positive impact of the Münster-Paris connection is well-documented), *are* these foundations. *Komplexe Räume* and *Bilder und Urbilder analytischer Garben* are two of numerous examples of their prolific joint work, which is basic for our subject.

Perhaps also because they have jointly written basic books on several complex variables, *Stein Theory* and *Coherent Analytic Sheaves*, one might tend to overlook their different viewpoints. One can see that in this beginning phase Remmert is interested in analytic sets, their continuations, their properties with respect to holomorphic and meromorphic maps.

Grauert seems to be guided by problems involving complex analytic objects on these sets. His *Oka Principle*, which in terms that certainly hide the true depth of this work, states that the category of holomorphic vector bundles on a Stein space is the same as the category of topological bundles, is a perfect example. The same is true of his solution to the *Levi Problem* where he constructs holomorphic functions with given polar data at the boundary of a domain by proving the finite-dimensionality of a certain obstruction space using a Fredholm theorem in a Fréchet context. His proof of the optimal version of *Theorem B* and his solution (with Docquier) of the Levi Problem for weakly pseudoconvex domains in Stein manifolds shows his deep understanding for approximation theorems of Runge type.

Shrinking coverings and understanding subtle properties involving restriction operators can be found at the top of the list of Grauert's important methods. The most complicated and perhaps most famous of his results where such arguments appear is his *direct image theorem*. Here one starts with a proper holomorphic map $F : X \rightarrow Y$ between complex spaces where one knows that the image $F(X)$ is an analytic subset of Y (Remmert's Theorem). Proving a theorem that is in a sense in another universe, Grauert shows that direct images of coherent sheaves on X are coherent on Y . One cannot think of working in global complex geometry without the availability of this result! To obtain some feeling for the order of magnitude of this work and for other interesting information we recommend reading Remmert's article in ([R]).

The last of the above-mentioned works appeared in 1960, but it is not at all clear to me when Grauert proved these theorems. It seems that at a certain point he understood *everything*, and it was just a matter of finding the time and energy



Courtesy of the Oberwolfach Photo Collection. Photographer K. Jacobs

H. Grauert, K. Stein, R. Remmert.

to write the papers. In any case he chose the Oka Principle as his *Habilitationsschrift* and around the time of completing his *Habilitation*, continuing the postwar tradition that opened the world to numerous outstanding young German mathematicians of that generation, Grauert left Münster for the Institute for Advanced Study, where he spent the winter semester of 1957–58. I know from direct discussions with others who were there at the time that the richness, depth and breadth of his ideas, which he presented both formally and informally, were nothing short of startling.

In 1959 Grauert became professor in Göttingen and remained in this position until becoming emeritus in 1996. Once he told me he didn't want to be away from Göttingen for more than two weeks. But in fact he did travel widely. For example, most likely due to the connection to Wilhelm Stoll, Grauert, Remmert, and Stein visited Notre Dame for extended periods. I know how important this was for that faculty and of course for me personally!

Grauert also invited distinguished foreign guests to Göttingen, among them Aldo Andreotti. In the winter semester of 1968–69 at Stanford I was introduced to Grauert's work in the lectures of Andreotti. Imagine being the only student in a course given by the most wonderful of lecturers discussing results of his friend and coworker that are even in hindsight some of the most beautiful in complex geometry. Their joint work was certainly one of the highlights: the Andreotti-Grauert theorems on finiteness and vanishing of cohomology for q -pseudoconvex manifolds, and their jewel "Algebraische Körper von automorphen Funktionen", where they show how to use pseudoconcavity to prove the finite-dimensionality of spaces of automorphic forms. However, what I remember most is Andreotti's explaining Grauert's elegant solution



DMV chairman Günter Ziegler presenting the Cantor-Medaille to Grauert's daughter Ulrike Peterzell, 2008.

of the Levi problem and applications to Kodaira-type vanishing and embedding theorems.

These last mentioned results are in a sense just snippets of Grauert's remarkable paper "Über Modifikationen und exzeptionelle analytische Mengen". There, answers to fundamental questions such as "When can you blow down a variety?" are given. Concepts such as plurisubharmonicity, bundle curvature and signature of intersection forms flow together. A new, important criterion for projective embeddings is proved. After reading this work, I was sure that this is the way mathematics should be!

On Grauert's research timeline we have now reached a point around 1963. Of course the ideas kept coming! There was a phase when he was thinking about parameter spaces of complex analytic objects (deformation theory). Here his two basic *Inventiones* papers should be mentioned ("Über die Deformation isolierter Singularitäten analytischer Mengen" (1972) and "Der Satz von Kuranishi für kompakte komplexe Räume" (1974)). At the time when he was concentrating on vector bundles (see for example his paper with Müllich, "Vektorbündel vom Rang 2 über dem n -dimensionalen komplex-projektiven Raum" (1975)), I remember a young mathematician asking him a general question about what would nowadays be the most important direction of research in mathematics. Typifying how Grauert focused: "Vector bundles on \mathbb{P}_3 !"

On the more analytic side there is the important work with his student Ramirez in the late 1960s and then with Lieb on integral kernel representations. The Grauert-Riemenschneider vanishing theorem ("Verschwindungssätze für analytische Kohomologiegruppen auf komplexen Räumen" (1970)) can also be regarded as being at home in complex analysis.

More recently Grauert turned back to his old interests in holomorphic and meromorphic equivalence relations. I remember he and Stein discussing these topics with great animation just a few years before Stein's passing. His most recent work in that direction appeared in 1987. Finally, one should not forget that *hyperbolicity* has been in the background for many years. One sees this in his work in 1965 with Reckziegel, his 1985 paper with Ulrike Peterzell, née Grauert, and in his final paper that was devoted to mathematics research "Jetmetriken und hyperbolische Geometrie" (1989).

At this point I could begin to be more precise about the details of Grauert's work. However, I hope that the above is sufficient for the interested bystander. For those whose appetites might have been whetted, Grauert should have the final word: Please take a look at his collected works ([G]) with its interesting annotations written by Yum-Tong Siu and Grauert himself.

As we all know, research is an extremely important part of our academic lives, but there are other aspects that must be emphasized. Here in Germany there is the classical notion of *Akademischer Lehrer*, which encompasses everything that a professor should be. Nowadays there seem to be new interpretations being propagated. Grants, research clusters, elite universities, etc., are the buzzwords. However, we don't need new words to describe Grauert's contributions. Let me expand on this.

His work in administration of science must be commended, in particular his involvement with projects of the Deutsche Forschungsgemeinschaft (German Science Foundation) and his role on editorial boards, for example in bringing the *Mathematische Annalen* back to its historic high standards. Nevertheless, when I think of Grauert I think of him *in* the science not above it. This includes his lectures, which may seem dry and minimal, sometimes even formal, but you should listen very carefully. There are always deep ideas that should be followed! From the undergraduate student in his *Funktionentheorie* course to the researcher being advised in a private conversation, every listener should take every word seriously. The same is true of his vast written work. The reader must take the time to understand what is meant by every sentence! This holds just as well for his research monographs as it does for his textbooks. While reading a Grauert-proof of Stokes' Theorem, you should keep in mind that he has seriously thought about it! These textbooks range from the basic

analysis sequence written with Fischer and Lieb to the new version of Grauert-Fritzsche where even new ideas in complex analysis are introduced.

Speaking of Grauert's minimality, I can't resist an anecdote. Whenever he lectures he carries the *Konzept* of the lecture with him on a three by five card. He will most often start his lecture writing *Let X be a complex space* ... on the board and meticulously checking his *Konzept* to make sure he got it right. Given that he and Remmert originally *defined* the notion of a complex space, this is a beautiful sight! Gossip has it that when giving a two-semester course on several complex variables he never changed the little piece of paper, but for the second semester did in fact turn it over!!

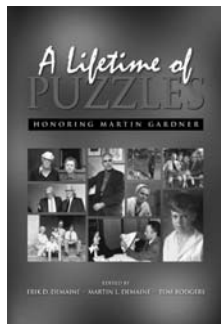
I have no idea how many students (*Diplom*, *Staatsexam*, *Promotion*) have done their work with Grauert. In any case it is a large number! We who are working in areas near their works see the strong positive influence of the master teacher, and I know that Grauert is proud of them all.

A researcher of the highest quality, a teacher at all levels with relevant fundamental new ideas always in the background, an author with a style where every word has a meaning, an important participant in and leader of academic societies, a cultured intellectual in the sense of Humboldt, and a very kind gentleman, Grauert personifies the true notion of *Akademischer Lehrer*.

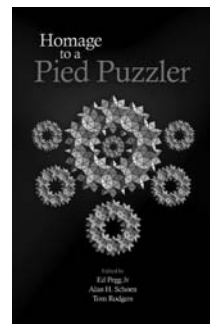
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 [R] R. REMMERT, *Mathematical Intelligencer* 17(2) (1995), 4-11.

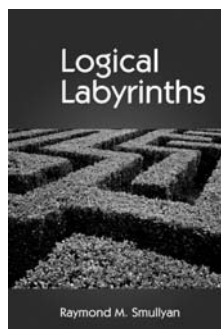
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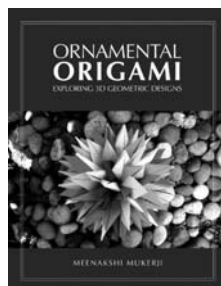
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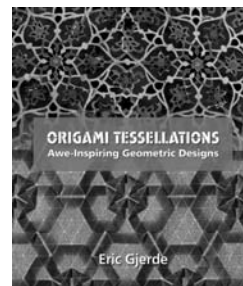
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A Celebration of Women in Mathematics at MIT

Margaret A. M. Murray

On Saturday and Sunday, April 12–13, 2008, the Department of Mathematics at the Massachusetts Institute of Technology held a Celebration of Women in Mathematics at MIT. The conference—co-sponsored by the MIT School of Science and the National Science Foundation—was instigated by Susan Landau, a 1983 Ph.D. alumna of the department, who asked mathematics department head Michael Sipser to organize a formal event to recognize MIT's role as a leading educator of women mathematicians. The organizing committee for the conference, headed up by Gigliola Staffilani and Katrin Wehrheim of the MIT math department, included Bonnie Berger—MIT professor of applied mathematics and a 1990 Ph.D. alumna in computer science—together with Susan Landau and three other MIT math alumnae: Lenore Blum (Ph.D. 1968), Ana Cannas da Silva (Ph.D. 1996), and Susan Colley (Ph.D. 1983).

The MIT celebration featured seven colloquium talks on topics in pure and applied mathematics, as well as two panels devoted to the mathematical lives of MIT women alumnae and faculty members: “Life Now: Becoming and Being a Mathematician”, and “Life Back Then: Graduates of the Sixties, Seventies, and Early Eighties”. In addition, alumnus Ken Fan (Ph.D. 1995) introduced Girls’ Angle, a math club for Cambridge-area middle-school girls, on Saturday afternoon; MIT President Susan Hockfield and School of Science Dean Marc Kastner hosted a buffet supper on Saturday evening.

Seeking broader historical context for the mathematical achievements of women at MIT, the conference organizers graciously invited me to give an hour talk at lunch on Sunday. I also agreed to cover the conference for the *Notices* as a participant-observer. Because my only connection

to MIT comes by way of MIT Press, my account interweaves historical elements from my presentation with my observations as both insider and outsider to the proceedings. Table 1 provides an alphabetical list of speakers and panelists. The full schedule of the conference, including slides and references, is now online at <http://www-math.mit.edu/womeninmath/schedule.html>.

Women in Mathematics: Doctorate Production at MIT (and elsewhere)

While the conference was ostensibly a celebration of *women in mathematics*, the proceedings largely focused upon women in mathematical *research*. Because the Ph.D. degree is effectively the professional certification for research mathematicians—and because most mathematical research is conducted by university mathematics faculty and their doctoral students—the conference celebrated the role of MIT as a producer of female mathematics Ph.D.’s.

But MIT’s leadership in Ph.D. production is a relatively recent phenomenon. Table 2 lists, in chronological order, the first Ph.D.’s awarded to women by each of the Top Ten departments—Berkeley, Caltech, Chicago, Columbia, Harvard, MIT, Michigan, NYU, Princeton, Stanford, and Yale.¹ Columbia was the first among *all* U.S. institutions to award a mathematics Ph.D. to a woman, when it recognized Winifred Edgerton in 1886.² Swept along in the tide of first-wave feminism, many other universities steadily followed suit.³ Among Top Ten departments both Chicago (46) and Yale (13) were leading producers of female mathematics Ph.D.’s prior to 1940 ([6], p. 18). All told, nine of the Top Ten departments—all but Princeton and Caltech—had awarded math Ph.D.’s to women by 1940.⁴

World War II was a turning point in the development of the American mathematical community. Mathematical research came to be seen as

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indispensable to national security, and a host of federal programs provided fuel for massive expansion of graduate programs in mathematics—above all the National Science Foundation, which began awarding fellowships in 1952. Paradoxically, however, the immediate result of this expansion was the virtual disappearance of women from mathematics doctoral programs in the 1950s ([14], pp. 21–46).

Table 3 lists the names, degree years, and advisers of the first nine women to earn Ph.D.'s in

mathematics from MIT. These are, in fact, *all* the women who earned MIT math Ph.D.'s prior to 1960. Domina Eberle Spencer, the third woman in the list, has been on the mathematics faculty at the University of Connecticut since 1950. At eighty-eight, Spencer was the oldest participant in the MIT celebration—seated front-and-center at each presentation with her chihuahua, Nikki, resting contentedly in her lap.⁵

One of the paradoxical effects of the postwar boom in mathematics was that institutions that

| Speaker | Highest Degree (in mathematics unless noted otherwise) | Current position | Title of Talk or Panel |
|---------------------|---|---|---|
| Sami Assaf | Ph.D., UC Berkeley, 2007 | Moore Instructor in Mathematics, MIT | <i>Life Now</i> |
| Bonnie Berger | Ph.D., MIT, 1990 (Computer Science) | Professor of Applied Mathematics, MIT | <i>Comparative Genomics: Sequence, Structure, and Networks</i> |
| Lenore Blum | Ph.D., MIT, 1968 | Distinguished Career Professor of Computer Science, Carnegie-Mellon University | <i>Computing Over the Reals: Where Turing Meets Newton; Life Back Then</i> |
| Anna Marie Bohmann | B.A., MIT, 2005 (Mathematics & Spanish); M.A., NYU, 2006 (Spanish) | Ph.D. Student, Mathematics, University of Chicago | <i>Life Now</i> |
| Ana Cannas da Silva | Ph.D., MIT, 1996 | Associate Professor of Mathematics, Universidade Técnica de Lisboa; Senior Lecturer in Mathematics, Princeton University | <i>Life Now</i> |
| Susan Colley | Ph.D., MIT, 1983 | Professor of Mathematics, Oberlin College | <i>Life Back Then</i> |
| Lenore Cowen | Ph.D., MIT, 1993 | Associate Professor of Computer Science, Tufts University | <i>Life Now</i> |
| Ioana Dumitriu | Ph.D., MIT, 2003 | Assistant Professor of Mathematics, University of Washington | <i>Matrix Computations: How Fast and Accurate Can They Be?</i> |
| Tara Holm | Ph.D., MIT, 2002 | Assistant Professor of Mathematics, Cornell University | <i>Dance of the Astonished Topologist, or How I Left Squares and Hexes for Math</i> |
| Susan Landau | Ph.D., MIT, 1996 | Distinguished Engineer, Sun Microsystems Laboratories | <i>Life Back Then</i> (moderator) |
| Nancy Lynch | Ph.D., MIT, 1972 | Professor of Computer Science, MIT | <i>Life Back Then</i> |
| Margaret Murray | Ph.D., Yale, 1983; M.F.A., Iowa, 2005 (Nonfiction Writing) | Development Division, ACT, Inc.; Adjunct Professor of Mathematics, University of Iowa | <i>Women Becoming Mathematicians: A Look Back (and a Look Forward)</i> |
| Ruth Nelson | B.A., MIT, 1963 | GTE Government Systems Corporation (retired) | <i>Life Back Then</i> |
| Ragni Piene | Ph.D., MIT, 1976 | Professor of Mathematics, University of Oslo | <i>Life Back Then</i> |
| Sarah Raynor | Ph.D., MIT, 2003 | Assistant Professor of Mathematics, Wake Forest University | <i>Life Now</i> |
| Linda Rothschild | Ph.D., MIT, 1970 | Professor of Mathematics, University of California at San Diego | <i>Real Geometric Objects that Live in Complex Manifolds; Life Back Then</i> |
| Brooke Shipley | Ph.D., MIT, 1995 | Professor of Mathematics, University of Illinois at Chicago | <i>Rings Up to Homotopy</i> |
| Katrin Wehrheim | Ph.D., ETH Zürich, 2002 | Assistant Professor of Mathematics, MIT | <i>Life Now</i> (moderator) |
| Lauren Williams | Ph.D., MIT, 2005 | Benjamin Peirce Assistant Professor of Mathematics, Harvard | <i>Combinatorics and Statistical Physics: A Story of Hopping Particles</i> |

Table 1. Speakers at the Celebration of Women in Mathematics at MIT.

| Year | Institution | Recipient |
|------|---------------------|--|
| 1886 | Columbia | Winifred Edgerton (Merrill) |
| 1895 | Yale | Charlotte Barnum |
| 1908 | Chicago | Mary Emily Sinclair |
| 1911 | Berkeley | Annie Dale Biddle |
| 1914 | Michigan | Suzan R. Benedict |
| 1917 | Harvard (Radcliffe) | Mary Curtis (Graustein) |
| 1928 | Stanford | Marie Weiss |
| 1930 | MIT | Dorothy Weeks |
| 1939 | NYU | Harriet Griffin |
| 1964 | Caltech | Lorraine Turnbull Foster |
| 1972 | Princeton | Marjorie Leiter Stein Deborah L. Goldsmith Susan Friedlander |

Table 2. Year first Ph.D. awarded to a woman in each of the Top Ten departments. Compiled and cross-checked from multiple sources, including *Bulletin and Notices of the AMS*, *ProQuest Dissertations & Theses*, *Mathematics Genealogy Project*, [3], [19].

had formerly been friendly to women became chilly, if not hostile, after 1945. The University of Chicago offers perhaps the most dramatic example of climate change ([14], pp. 26–27). But the post-Sputnik expansion of graduate funding—under Title IV of the National Defense Education Act (NDEA) of 1958—improved the situation for women. Statistics indicate that NDEA Title IV funding in the 1960s benefited larger numbers of women than had NSF funding a decade before ([21], pp. 76–79). Title IV funding, combined with second-wave feminism, led to a growing presence of graduate women in mathematics in the 1960s.

Just as the Nineteenth Amendment in 1920 was the culmination of American first-wave feminism, the signing of Title IX in 1972 was the culmination of American feminism’s second wave ([21], 361–382). Title IX of the Educational Amendments Act of 1972—which bans discrimination on the basis of sex in all educational institutions receiving federal funding—has had a revolutionary impact on the gender balance of American mathematical research. And in the Title IX era, MIT has been a leading provider of graduate mathematics education to women.

In the 1980s, for example, MIT led the Top Ten in overall percentage of math Ph.D.’s to women (15%), and led *all* U.S. departments in total numbers

(32) of female math Ph.D.’s [8]. From 1995–96 to 2002–03, MIT ranked fifth among all departments in total numbers of Ph.D.’s awarded to women in math: 37 out of 174 total, about 21%. Among the Top Ten departments only Berkeley ranked higher in total numbers (39), although it was lower in percent (16%).⁶

Women in Mathematics at MIT: Faculty Presence

But in terms of women on the graduate faculty, progress in the MIT math department is a much more recent development. According to departmental records for the period 1945–2007 [18], MIT’s mathematics faculty was all male until 1968, when the department hired its first woman C.L.E. Moore Instructor, Karen Uhlenbeck. While women held a handful of untenured faculty positions during the decade that followed, Michèle Vergne—affiliated with MIT during 1977–1988—was MIT’s first and only tenured woman in mathematics until 1999.

As a general matter, increases in women’s faculty presence generally lag behind increases in doctoral production ([11], 127–130). According to the most recent CBMS survey, women account for about 15% (1,651/11,332) of the tenured, doctoral mathematics faculty at U.S. colleges and universities, and about 30% (926/3,120) of those deemed “tenure-eligible” ([12], p. 96). By contrast, women’s representation among the tenured faculty at Top Ten institutions remains right around 5% [9]. But there have been clear signs of change in several Top Ten mathematics departments in recent years—including Michigan, Princeton, and MIT.

The revolution at MIT began in the summer of 1994, when biologist Nancy Hopkins joined with fifteen (of sixteen) other tenured women in the School of Science to petition then-Dean Robert Birgenau to establish a committee to investigate the status of women faculty at MIT. The committee, formed in 1995, included tenured women from every department in the school—*except* mathematics, which had no tenured women—and issued its final report in 1999 [4]. The report urged Dean Birgenau and then-President Charles M. Vest to improve conditions and ensure equity for both junior and senior women, and to increase women’s faculty presence in each of the six departments of the School of Science.⁷

The transformation of MIT’s mathematics faculty has been roughly concurrent with these developments. Bonnie Berger joined the department as an untenured assistant professor in 1992; she was tenured in 1999 and made full professor

| Name | Ph.D. Year | Dissertation Adviser |
|-------------------------|------------|----------------------|
| Dorothy Weeks | 1930 | Norbert Wiener |
| Martha Plass | 1939 | Dirk Struik |
| Domina Eberle Spencer | 1942 | Dirk Struik |
| Helen Beard | 1943 | Dirk Struik |
| Miriam Lipschütz-Yevick | 1948 | Witold Hurewicz |
| Violet Haas | 1951 | Norman Levinson |
| Phyllis Fox | 1954 | C. C. Lin |
| Evelyn Bender | 1954 | Irvin Cohen |

Table 3. Mathematics Ph.D.s awarded to women at MIT before 1960. Compiled and cross-checked from multiple sources, including *Bulletin* and *Notices* of the AMS, *ProQuest Dissertations & Theses*, *Mathematics Genealogy Project*.

in 2002. Gigliola Staffilani arrived as an associate professor in 2002, was tenured, and made full professor in 2006. Katrin Wehrheim arrived as a tenure-track assistant professor in 2005, and JuLee Kim arrived as a tenured associate professor in 2007. Women now account for 6.5% (3/46) of the tenured and 14.3% (1/7) of the tenure-eligible faculty. With the ascent of Susan Hockfield to MIT's presidency in 2004, many expect that these numbers and proportions will continue to rise.

Celebration—and Circumspection

The seven colloquium speakers were chosen—deliberately, I suspect—to represent three distinct academic generations. Lenore Blum and Linda Rothschild are veteran full professors, who completed their doctorates well after Sputnik but before Title IX. Bonnie Berger and Brooke Shipley are recent full professors, who earned Ph.D.'s roughly two decades *after* Title IX. Tara Holm, Ioana Dumitriu, and Lauren Williams are new assistant professors with twenty-first century doctorates; the ink had already dried on Title IX by the time they were born!

All seven speakers endeavored to communicate the excitement of research to a mathematically diverse audience; collectively, they illustrated the broad spectrum of women's work in pure and applied mathematics. Shipley and Rothschild gave classic colloquia, emphasizing internal connections among the disciplines of pure mathematics. Tara Holm took a step—or several—away from her pure-mathematical proclivities, joining with members of MIT's Tech Squares in a dynamic illustration of the topology of square dance. While Lauren Williams described how the problems of science inspire pure mathematics, Bonnie Berger emphasized how pure mathematics adapts to solve the problems of science. Finally, Ioana Dumitriu and Lenore Blum

explored the realm of computation—the inevitable meeting ground of theory and application.

When it came time for panel discussion, the organizers wisely chose to begin with the younger generation. The “Life Now” panelists told uplifting tales of early career success. The youngest panelist, Anna Marie Bohmann, is still working on her Ph.D.; she gave a brief but intriguing account of how she came to choose mathematics over Spanish as her academic specialty. Likewise, Sami Assaf had a dual major in mathematics and philosophy as an undergraduate at Notre Dame. These women exemplify a growing trend among a younger generation of scholars, drawn into the serious study of several disciplines at once [10]. Yet despite these Renaissance aspirations, the women of the “Life Now” panel seemed remarkably united in their desire for conventional careers in academic mathematics. All seemed to regard the conventional trajectory from Ph.D. to postdoc to tenure-track to tenure as both normative and desirable. Sami Assaf, Lenore Cowen, Ana Cannas da Silva, and Sarah Raynor told personal stories of the two-body problem, and of balancing marriage and childbearing with the timetables of promotion and tenure.

All this discussion of the “two-body problem” led to one of the more surprising moments of the conference. I asked the panelists if anyone would be willing to comment on the “one-body problem”: the potential isolation of being a single woman in a coupled-up academic world.⁸ This question led panel moderator Katrin Wehrheim, who had kept mum up until then about her own personal life, to come out as a single tenure-track faculty member—and to come out as lesbian, too. Wehrheim's revelation was greeted with lengthy applause. It seems that there's still something radical about coming out as a gay or lesbian mathematician—even in Massachusetts!

Despite themes common to both the panels, the “Life Back Then” panelists had generally grimmer tales to tell. Ruth Nelson, for example, worked on a Ph.D. in mathematics at MIT for four years in the 1960s before she was, in essence, ushered out of the program without so much as a master’s degree. Devastated, she left MIT convinced that she would never do mathematical research. Years later, however, with a corporate career well underway, Ruth Nelson published original research in computer science.

While Linda Rothschild, Lenore Blum, Susan Landau, and Nancy Lynch all managed to complete their Ph.D.’s at MIT, their subsequent careers have involved heroic feats of academic perigrination. The youngest of the old-time panelists, Susan Colley and Ragni Piene, have had rather more-settled careers, earning tenure in their first job post-Ph.D. All in all, the older generation of panelists, though content with their hard-won successes, seemed to counsel vigilance: Blum warned against “making important decisions naively”, while Lynch advised that a mathematician’s first allegiance is to research, rather than to any institution or local community.

In this respect, both panels seemed to buy into at least a modified version of what I have elsewhere described as “the myth of the mathematical life-course” ([14], pp. 15–18). Indeed, at one point Sami Assaf asked the heartfelt question, “What happens when life doesn’t conspire to help us?”

An Outsider’s Perspective: Problems and Prospects

The MIT Celebration of Women in Mathematics showed that MIT can be a wonderful place for women to prepare for a career in research mathematics. But the match between a doctoral student and his or her department varies from student to student, and I know some women Ph.D.’s from MIT whose experiences in the department were not wholly positive and whose later careers were not so stellar as those showcased at the conference. Even so, that the conference could bring together so many talented women who have earned MIT doctorates and successfully joined the professorial ranks is a clear indication that MIT is doing many things right.

But in the words of a recent National Research Council report, women have “entered academia in increasing numbers at a time when opportunities for obtaining more permanent and prestigious faculty positions [have] begun to decline” ([11], pp. 148–9). In some disciplines, the casualization of the academic workforce has reached crisis proportions [1]. To paraphrase Sami Assaf: what indeed, happens, when circumstances do not conspire to create the academic life we have envisioned?

I cannot help but respond to this question from my own perspective, as a Top Ten Ph.D. graduate

who has strayed far from the mythical course. For me, creating a life—mathematical and otherwise—has been an act of faith and a great work of the imagination. In another venue, in another time, I offered some advice to graduate students and new Ph.D.’s:

It is quite unlikely that you will lead the same kind of professional lives that your professors did. But this should not be reason for despair. You need always to remember that you have unusual training and skills. The world—*both inside and outside of mathematics*—is waiting for you, full of problems to be solved. ([5], p. 51)

Perhaps the best way for women to celebrate our achievements is to begin the work of envisioning the mathematical community of the future.

Notes

1. Top-ten rankings are issued periodically by the National Research Council and *U.S. News and World Report*. I offer the name *Top Ten* by analogy to the eleven-member Big Ten.

2. While Edgerton was the first woman to *receive* a U.S. mathematics Ph.D., she was not the first woman to actually *earn* one. That distinction goes to Christine Ladd-Franklin, student and collaborator of C. S. Peirce, who earned a Ph.D. at Johns Hopkins in 1882 but did not actually receive it until 1926 ([2], p. 133; [22], p. 123).

3. While women did not “officially” earn Ph.D.’s from Harvard until 1963, a Ph.D. from Radcliffe was a Harvard degree in all but name ([20], pp. 44, 169; [23]). Stanford’s appearance in the list is delayed until 1928, owing perhaps to peculiar circumstances which strictly limited women’s enrollment there until 1933 ([24], p. 59). Graduate programs in mathematics at MIT and NYU blossomed only in the 1930s, which explains their comparatively late entries in the table.

4. Caltech and Princeton were extremely slow to admit women to graduate study in any discipline ([21], p. 85; [16]; [25]). At Princeton, however, women held visiting memberships in the School of Mathematics at the Institute for Advanced Study throughout the 1930s [7]. For the early history of mathematics at Princeton, see [17].

5. Spencer’s adviser, Dirk Struik, is just one among many notable émigré mathematicians who were especially welcoming to female doctoral advisees during the pre-war years. He advised fully one-third of MIT’s pre-1960 women Ph.D.’s. For more on both Spencer and Struik, see [14].

6. In view of the fact that women received 26% of all mathematics doctorates during those years, however, all the Top Ten schools lagged behind the national average somewhat.

7. President Vest subsequently convened a meeting in 2001 at which MIT joined with eight other universities—Berkeley, Caltech, Harvard, Michigan, Penn, Princeton, Stanford, and Yale—in pledging to work toward creating a faculty “that reflects the diversity of the student body” [13]. All the Top Ten institutions were represented at the meeting—save Chicago, Columbia, and NYU.

8. At the 1993 Joint Mathematics Meetings in San Antonio, I was invited to speak on an AWM panel entitled, "Is Geography Destiny?" While the stated purpose was to discuss the effects of geography on academic careers in mathematics, I was the only panelist to speak on the topic assigned; everyone else talked about the employment problems that face a heterosexually-married couple of mathematicians. At the time of my appearance on the panel, I had recently come out as lesbian and entered into a long-term relationship with another woman after several years of singleness. None of this personal history is evident in the short essay I was asked to write in the aftermath of the panel [15].

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Noticed

The November 2008 issue of the *Notices* carried a study about the representation of females in high-level mathematics competitions. The study found that there are numerous girls who do well in such competitions but their participation is highly dependent on culture. In particular, United States girls participate in far fewer numbers than girls from some other countries. This article received widespread coverage in newspapers and magazines all over the world. A Reuters story was reprinted in many newspapers, and byline stories also appeared in the *Boston Globe*, the *Los Angeles Times*, *New Scientist*, the *New York Times*, *Newsweek*, *Science News*, and the *Neue Zürcher Zeitung*.

John Ewing Retires from the AMS

Allyn Jackson



Photograph by Tom Stio.

John Ewing

In 1996, when John Ewing had been AMS executive director for about a year, several Russian translation journals that the Society had been publishing pulled out and went to other publishers. This move, coming in the wake of the many upheavals in the Russian mathematical community after the fall of the Soviet Union, meant a US\$1.5 million loss in income for the AMS—a substantial chunk of the Society's budget, which was US\$20 million at the time. This episode was a stark reminder of how outside events could jeopardize the financial health of the AMS. Ewing rose to the challenge, working with the staff and the volunteer leadership to make cuts in nearly all areas of AMS operations. The AMS not only survived the immediate crisis—in fact, it never even dipped into the red that year—but is today in better fiscal shape than ever before in its history and is a model of financial health for a nonprofit professional society.

At the beginning of January 2009 Ewing will retire as executive director of the AMS to become president of Math for America, a project that aims to improve mathematics instruction in the nation's schools.¹ His tenure at the Society was marked by intelligent management of the many things the AMS did well and alacrity in tackling the challenges the Society faced. He also brought a deep belief in the value of the traditions developed over the Society's more than 100-year history and a vision for building on and diversifying them. Ewing leaves the AMS a stronger and more vibrant organization

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¹ See "New York City programs provide a model for National Teaching Corps", by Allyn Jackson, *Notices*, March 2007; and "Math for America and the Math Science Teaching Corps", by Irwin Kra, *Notices*, December 2006.

than when he started as executive director thirteen years ago. As former AMS president James G. Arthur of the University of Toronto put it, "Under his leadership the AMS has greatly enhanced its standing as a professional organization of which mathematicians everywhere can be proud."

When one asks those in the AMS leadership what Ewing's biggest accomplishment has been, many point to the financial health of the Society. After fiscal crises in the 1980s, the Board of Trustees established an "economic stabilization fund" of 75 percent of the operating budget, to enable the Society to weather tough financial times. Ewing worked hard to build this fund, which today has surpassed the target set by the trustees and now operates something like an endowment, providing income of over one million dollars each year that helps support AMS activities. The net assets of the AMS went from about US\$24 million in Ewing's first year with the Society, to nearly US\$80 million in 2007. "That really took great political skills on his part, because...there was often pressure to spend the money," Arthur noted. "Why should the AMS be accumulating money? That's just wrong,' people might think. But it's not wrong...It's extremely important that the activity that we mathematicians live for be protected and have reserves that can keep it vibrant. I think that's John's biggest accomplishment."

The primary means for improving the financial position has been careful investment in and cultivation of the Society's publication program. (Dues and registration fees for meetings account for only a small portion of the AMS budget; close to 80 percent comes from publications.) Ewing strengthened and expanded the publication program at a time of huge uncertainty about and upheaval in scholarly publishing. In 2002, with the retirement of AMS publisher Donald G. Babbitt, Ewing took on the role of publisher himself—on top of all of his other duties as executive director. In one sense, this was no surprise, as publishing is in Ewing's blood: His father was president of van Nostrand Reinhold publishing company from the late 1960s to the mid-1980s and a vice president of McGraw-Hill before that.

Ewing worked on improving the Society's twelve journals and building the book program, which now publishes about 100 titles per year. He was also deeply involved in the development of the Society's most important publication, the *Mathematical Reviews* database, which most mathematicians today access over the Internet using MathSciNet. When MathSciNet came online in 1996, some thought that it might become obsolete as search engines for the Web proliferated. In fact, just the opposite has happened. MathSciNet is nowadays an indispensable tool for mathematicians in everything they do, from carrying out research to checking on the publications of job applicants. Ewing made sure that investments and improvements in MathSciNet have been continually made, including the gargantuan task of keyboarding all reviews that were on paper only, going back to the first *Math Reviews* issue in 1940. He also realized that expanding access to MathSciNet would be crucial to its success, and under his watch the AMS developed a novel pricing scheme to reduce subscription rates for small institutions and for poor countries. As a result the number of institutions with access to MathSciNet has doubled in the past decade.

Ewing has over the years emerged as one of the world's leading experts in electronic publishing and digital archiving, and his knowledge and wisdom have greatly benefited the AMS. Amid all the fervent discussion over the past decade or so about the future of scholarly publishing, Ewing was sometimes criticized for being too conservative. "Certainly he has not rushed out to make things free, for the pretty sensible reason that he thought it would in the end cripple the ability to produce journals at all," said former AMS president David Eisenbud of the University of California, Berkeley. Other groups that did start free electronic journals are now coming to realize that they need some income to make the journals viable over the long term. "He is a tremendously respected voice in [electronic publishing technology]," said Eisenbud. "People didn't always like what he said, but I don't think anybody ever proved him wrong on an issue."

The AMS is in one sense a business—and Ewing knows how to run a business. "He seems to have more raw talent than CEOs of major American corporations," remarked Arthur. "He has all of the talents that would make him successful at running a much larger business than the AMS. But given his outlook and his idealism, this is probably not something he would seek." Indeed, Ewing's combination of business acumen and idealism have brought a healthy balance to the Society, so that, as its fiscal health grew, it never lost sight of its role as a nonprofit professional society dedicated to serving the mathematical community. The success of the AMS publication program has served

Some Reflections on John Ewing

Like many members of the mathematical community I have known John Ewing for a long time and have known of him for much longer. I knew of his distinguished contributions as a researcher and of his substantial skills as an editor and as an administrator. I had seen him in action as the deft and entertaining host of the AMS banquet at the Combined Membership Meetings.

But it was only in 1998, when we both began ten-year terms as members of the International Mathematical Union's then-new Committee on Electronic Information and Communication (CEIC, <http://www.ceic.math.ca>), that I had the privilege to get to know John well. We both finished our twice-extended terms this July. In the intervening time I learned a great deal from John and quite a lot about John. Let me touch on both.

John is an enormously hard-working man—this is not a secret—who wears his remarkable erudition and breadth of knowledge very lightly. He is patient, hard to ruffle, and even harder to alienate. The CEIC was formed with many passionate members; all knowledgeable about some bits of the puzzle. It had only one expert: John Ewing. John's patience and generosity in educating the rest of us about the many pitfalls and subtleties was extraordinary. His care in trying to distinguish his role as committee member from that as AMS executive director (which could have made him the eight-hundred pound gorilla on the committee) was remarkable.

After all, only John actually had to publish, manage, and communicate electronic information on a pretty large scale. The rest of us had opinions on everything and expertise on a subset—often a small subset. John was a "decider" who had expertise on everything and opinions (at least expressed) only on a subset. It is a measure of John's probity that over the decade we "opinionators" sometimes changed the opinions of the decider. It was the quality of its members and the remarkable give-and-take that made the CEIC a wonderful committee to work on.

I learned John did not especially like the social-public parts of his job—despite being extremely good at them. I learned he would often rather be home reading a good book than going to one more party. That said, John is definitely a beer man not a wine drinker, and has a large repository of subtle jokes. I also learned it was hard to find an area in which he was not knowledgeable, be it about matters legal, political, scientific, or cultural. This I discovered over many days and many nights in many cities, sometimes over dinner, sometimes in the very wee hours in taxi rides to distant airports. During the last ten years, I spent two as Canadian Mathematical Society president and consequently several as CMS observer to the AMS Council. This allowed me to confirm that John plays the same thoughtful and effective role outside the CEIC.

It is conventional to say that an individual is irreplaceable to an organization. John is irreplaceable to the AMS. It is luckily not the case that irreplaceable individuals cannot be replaced. John is off to master other challenges and we shall all be richer for that. I am eager to see the fruits of his ambitious new undertakings with Math for America. I am very proud to call John my friend.

—Jonathan Borwein, University of British Columbia

John Ewing and *Math Reviews*

John has been extremely successful at what is an almost impossible job, particularly for a hands-on perfectionist as John is. He has always seemed totally in command of all aspects of the AMS, usually knowing as much or more than the staff member with direct responsibility for a given aspect. Not only is he able to absorb large amounts of diverse and detailed information but with his acute intelligence he is able to use that knowledge constructively and imaginatively.

That John has been so successful is in part due to his control of the budget. His careful management and fiscal conservatism (at times a great frustration to staff!) led to many years of budget surpluses, which allowed new projects to be developed.

John arrived at the AMS when MathSciNet was well along in its development but hadn't been officially released. He has been instrumental in its growth since then, from all points of view—fiscal, technical, and mathematical. He pushed for investment in the database by digitizing the complete run of reviews from *Mathematical Reviews* from 1940 on and for the ongoing development of the citation database. He ensured that MathSciNet was available to mathematicians around the world by developing the database fee/consortium model of pricing, which at the same time has put the MR Database on sound financial footing. There is almost no aspect of MathSciNet, from what “author” means in a search to answering librarians’ concerns about usage statistics, in which John has not been actively involved. Finally, John has for the last few years served as an active MR reviewer. His reviews, mostly on topics of general interest, are always lucid and very well written; these models of a good review should be required reading for aspiring reviewers.

John visited MR regularly throughout his tenure. At these regular meetings, John discussed aspects of MR of current concern. Because he had learned so much about the workings of the MR office and the individual staff members, he was able to provide support and valuable, and often imaginative, suggestions to the executive editor to tackle problems.

John was an exacting boss. It was sometimes hard to live up to his example of hard work, imaginative management, intimate knowledge of one's sphere of responsibility, and high standards of integrity, but he inspired one to try.

John is one of the most intelligent and moral people I have ever met. It was an honor to work with him.

—Jane Kister, *MR Executive Editor, 1998–2004*

the community by providing a model of low-cost, high-quality publishing, thereby goading commercial publishers into keeping their own prices in check. The community has also benefited from the Society's author-friendly copyright policies, strongly supported by Ewing, which have pressured other publishers to follow suit.

The financial strength of the AMS makes possible everything the Society does—national and international meetings, the employment register, the annual survey, prizes, etc. Three important activities that have blossomed during Ewing's tenure are the Washington Office, the Public Awareness Office, and the Epsilon Fund. Samuel M. Rankin III,

who since 1991 had been AMS associate executive director at Society headquarters in Providence, was hired as director of the Washington Office in 1995, shortly after Ewing joined the AMS staff. The Washington Office today runs several programs, including the annual Congressional briefings in which mathematicians make presentations to members of Congress and their staffs; the Mass Media Fellowships, which bring math graduate students into media outlets for summer internships; and the Congressional Fellowships, in which mathematicians spend a year working on the staff of a member of Congress or a congressional committee.

But Ewing understood that the most important function of the Washington Office is to cultivate relationships with government and with other scientific societies, so that mathematics has a place at the table when decisions are made. “What I have valued most in working with John is that from the beginning he allowed me the time to find out how other scientific societies work in Washington and develop the DC operations around what I find useful,” Rankin said. “He has given me the freedom to form collaborations with other professional organizations and coalitions, which I believe helps enhance mathematics policy as well as science policy...John's supportive and decisive management style has allowed this to happen.”

The AMS leadership talked for years about the need to improve awareness and understanding of mathematics among the general public. Ewing came to realize that a focused effort would be needed to pursue this goal, and he spent a couple of years laying plans for the Public Awareness Office before it got off the ground in late 2000. The office is staffed by Mike Breen, a Ph.D. mathematician, and Annette Emerson, who previously was an AMS employee in the promotions department. Today the office bustles with activity, developing the popular “Mathematical Moments” program (a brainchild of Ewing), staging the wildly successful “Who Wants to Be a Mathematician?” game show for high-school students, preparing the monthly “Math in the Media” webpages, as well as issuing news releases and fielding inquiries from reporters and the general public. “The things the Public Awareness Office is doing are quite remarkable, especially considering the size of the operation,” Arthur remarked.

“The Epsilon Fund has been one of John's most cherished projects,” said Eisenbud. This fund was started to help support summer programs for mathematically talented high-school students. Many of them go on to pursue mathematics as a career, while the others carry with them through their lives a realistic sense of what the field is like. In the late 1990s, because funding sources at the National Science Foundation (NSF) had dried up, some of these programs were experiencing

financial difficulty. Ewing, together with the Board of Trustees, created the Epsilon Fund to provide small grants for these programs. An endowment was set up, with a target of a US\$2 million. Through the generosity of the AMS membership, this target has nearly been reached, and grants have been given for several years now. Ewing has also devoted much energy to many other fundraising efforts for the AMS, and recently he persuaded an anonymous donor to endow fully all of the AMS prizes. "This was a great feat that will benefit the Society for the rest of its life," remarked John B. Conway of George Washington University, a member of the AMS Board of Trustees.

Ewing has also been deeply involved in one of the Society's newest endeavors, Mathematics Research Communities (MRC). Created by Ewing, Eisenbud, and AMS associate executive director Ellen Maycock, the MRC program provides a structure for mathematicians just starting in their research careers, to help them build networks of peers and collaborators. The program, supported by the NSF, started in the summer of 2008 and featured three one-week summer conferences on specific mathematical areas (the number of conferences will increase to four in summer 2009). In addition, there will be special sessions at the Joint Mathematics Meetings, discussion networks by research topic, ongoing mentoring, and a longitudinal study of early career mathematicians. The MRC received an enthusiastic response from the young people who attended the 2008 summer conferences and has the potential to make a large difference in their future careers.

Of course, there are many others, volunteer members and staff, who share responsibility for the accomplishments mentioned here. Nevertheless Ewing was a major figure in making all of them happen. Moreover, he knows how to pick the right people. As Conway put it, "He has a trait that all of us doing any form of administration aspire to: choosing the right person for the right job and convincing them to fully dedicate their talents to carrying out their mission." Ewing has been an effective manager of the 200-plus staff of the AMS, and he has had excellent relations with the volunteer leadership. When he speaks at meetings of AMS committees, the Council, or the Board of Trustees, he commands great respect and trust for his insightful command of the issues. "But there is a kind of lightheartedness about John as well as the great gravity that he has as his public face," Eisenbud noted. Often Ewing emceed Society events, such as the banquets at the Joint Mathematics Meetings, and proved himself to be a delightful, witty host. "He did this with such care and love that he gave a warmth and family feeling to the events, and made them quite special," Eisenbud said.

The esteem in which Ewing is held extends beyond the AMS as well. "Right now relations be-

John Ewing and the *Notices*

John Ewing came to the AMS as executive director right after the *Notices* had been completely redesigned, in content and appearance, by a committee specially appointed for this task. His support and encouragement as the *Notices* went through this transition were crucial to its success. He has told me that people regularly ask him if he can publish this or that article in the *Notices*, and he has to explain that no, the *Notices* is an independent publication whose content is decided by the editor and editorial board. And—apart from official reports that appear in the *Notices* because it is the Society's journal of record—this really is how the *Notices* is run. John strongly supported the policy of the *Notices* being independent because he wanted it to be a lively, interesting publication and not just a house organ. Because of this independence, the *Notices* has occasionally done things that John really didn't like—and he let us know! But much more often he enthusiastically cheered us on, telling us how much our work is valued and inspiring us to do better. That he is himself such a talented and experienced writer and editor makes his appreciation all the more meaningful. There were a couple of episodes—including the time we stopped the presses because I forgot to include a world-famous mathematician in a faculty list, and the time one of my articles was plagiarized by a French magazine—when I was especially grateful for his support. His great sense of humor, intelligence, and charm made working with him a real pleasure. He will be very much missed—by the *Notices*, and by me.

—Allyn Jackson

tween the AMS and the other professional societies are very positive, and I think in large part it's due to the fact that other executive directors and the key people on their boards both like and respect John," said AMS secretary Robert Daverman of the University of Tennessee. In addition, Ewing has increased the international presence of the AMS, serving on committees of the International Mathematical Union and building ties between the Society and other mathematics organizations abroad through, for example, his strong support for AMS international meetings. "He has worked hard at the diplomatic aspects of his job," said AMS treasurer John Franks of Northwestern University.

John Ewing has strengthened the AMS so that it could diversify its activities to meet the needs of the mathematical community while also remaining true to its original purpose of helping mathematicians to connect, communicate, and support one another. "He captures the soul and the spirit of the Society," remarked AMS president James Glimm of Stony Brook University. "He has an acute view of the many different constituencies that make up its membership and the many different roles that it plays for them and in society. I think that panorama is probably unique among mathematicians I know...And he is certainly loved within the mathematical community."

What Is New in L^AT_EX?

I. Breaking Free

G. Grätzer

This is the first of a series of columns updating the mathematical community about some current developments in T_EX and T_EXing.

—Andy Magid

Jerry Seinfeld?

On this, we can all agree: L^AT_EX is the most important tool of a mathematician. So everybody wants to know: What is new in L^AT_EX?

In two words: *Not much*. Donald Knuth corrects obscure bugs in T_EX every few years, and 2008 was such a year (next: 2013). T_EX was updated from version 3.141592 to version 3.1415926. Chances are you have never come across any of the bugs exterminated this year...

L^AT_EX is supposed to be updated in December of every year. It was not updated last year, and in the years before, the changes were rather small. So L^AT_EX is extremely stable.

The AMS packages, which are so important for mathematical typesetting, are grouped under the name `amsmath`—not changed in eight years, and `amsc1s`—not changed in four years.

Is my series of articles like a Jerry Seinfeld episode: articles about nothing?

So why is it that any L^AT_EX expert you talk to is so excited about the changes that are taking place?

Looking Back

Donald E. Knuth's multivolume work, *The Art of Computer Programming* [4], caused its author a great deal of frustration because the proofs of the second edition of Volume 2 turned out to be so awful. To solve this problem, Knuth decided in 1978 to create his own typesetting language. The result is described in *The T_EXbook* [5]. We can

say that T_EX was designed by an American mathematician to be used in his own work, and then later “generalized” to be used by other American mathematicians also. T_EX had only one font family, Computer Modern, designed in Knuth's Metafont [7], based—indirectly—on the work of the great French font designers Didot (father and son), who published romantic novels in the early nineteenth century.

To work with T_EX, you need a platform. L^AT_EX, developed by Leslie Lamport [8] in the early 1980s, provided

- the use of logical units to separate the logical and the visual design of an article;
- automatic numbering, cross-referencing;
- bibliographic databases.

If you

- write in English (accents are difficult to type and the default hyphenation works only in English),
- use an American keyboard,
- do not need sophisticated mathematical typesetting of the type developed by the AMS,
- do not dislike the CM fonts,

then you had a very capable system as early as 1982.

What Is a Font?

When you work at your computer, a font is selected for you. When you hit a key, your keyboard transmits to the computer an 8-bit number (that is, an integer between 0 and 255). The computer looks up in a table what character corresponds to that number in the font used and displays the character on your monitor. The same way, when you print your document, that character is transformed into an “outline”, which will produce the required output on your printer or when viewing a pdf file. The output is produced using a set of tables, mapping the character into a “glyph” (the

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drawing), specifying sizes, ligatures, hinting (adjusting the glyph to the screen pixels), the spacing between the characters (kerning), and so on.

Until 1989 \TeX only accepted 128 numbers (0 to 127); Version 3 accepted all 256. This made it possible to extend \TeX to foreign languages. Johannes Braams' `babel` package (released soon after Version 3 became available) provided the framework.

What happens if you type a character not accepted by \TeX ? Type Grätzer György in a \TeX document. It will typeset as Grtzer Gyrgy. The accented characters will be omitted (and the `log` file will record it).

PostScript Fonts

By this time, the basic 35 Adobe Type 1 PostScript fonts became available on most laser printers. All computers came equipped with the appropriate files to utilize them. The New Font Selection Scheme, NFSS, of Frank Mittelbach and Rainer Schöpf, written in 1989, allows the easy integration of the PostScript fonts into \TeX .

A \TeX document class specifies three standard font families (see Section 5.6.2 of [3]):

- a roman (or serif or main) font family,
- a sans serif font family,
- a typewriter style font family.

For instance, the `times` package in the PSNFSS distribution makes Times-Roman the roman font family, Helvetica the sans serif font family, and Courier the typewriter style font family. In the `times` package these are named `ptm`, `phv`, and `pcr`, respectively.

In the preamble of your document, type `\usepackage{times}`

after the `\documentclass` line. Then Times becomes the roman, Helvetica the sans serif, and Courier the typewriter style document font family.

MathTime and Lucida

Looking at a mathematical article typeset with the Times text font, you may find that the Computer Modern math symbols look too thin. To more closely match Times and other PostScript fonts, Michael Spivak created the *MathTime* fonts (the most recent version is called *MathTime Pro 2*). You can purchase these fonts from Personal \TeX : <http://pctex.com/fonts.html>

If you do not like CM or Times fonts, you may want to consider the Lucida fonts designed by Bigelow & Holmes, with support for both mathematics and text. You can obtain the font set from the \TeX User Group (also from Personal \TeX): <http://tug.org/lucida>

Problems, Problems

When I get into trouble with \TeX , I turn to the \TeX on Mac OS X Mailing List, where experts help me out. A substantial part of the ongoing discussion is about fonts:

- How do I install ...
- Why does the installation not work ...

Different types of fonts in the three basic operating systems require differing—and nontrivial—installation processes, and the user is confused.

Font technology develops very fast; \TeX has always had a hard time catching up.

Apple Computer developed TrueType fonts in the late 1980s as a competitor to Adobe's Type 1 fonts. Adobe and Microsoft in 1996 introduced OpenType fonts, which in 2007 became ISO Standard ISO/IEC 14496-22. By 2005 there were more than 10,000 OpenType fonts.

And how many of these can we use natively in \TeX ? None.

Unicode

The problem is that a font does not contain enough room for the large number of characters we would need to typeset all languages (and also math!). It is easy to see that the 8-bit font tables are at the root of the problem. Unicode is supposed to fix this problem.

In 1988 Joe Becker published a draft proposal with a 64-bit font table: "Unicode is intended to address the need for a workable, reliable world text encoding ... to encompass the characters of all the world's living languages."

The Unicode standard in 1991 defined 16 "planes" (see [10]), each containing 65,534 characters. Plane 0 is the Basic Multilingual Plane and all the often-used characters from the vast majority of living languages can be found there.

But what good is Unicode for \TeX ?

X₃ \TeX

If instead of \TeX , you use X₃ \TeX , all your font problems go away. It is easy to switch from \TeX to X₃ \TeX . In WinEdt 6, the \TeX icon is a pull-down menu; select X₃ \TeX . In TeXShop, LaTeX is a pull-down menu; pull it down and choose XeLaTeX. The next time you typeset, you do it with X₃ \TeX .

X₃ \TeX is the brainchild of Jonathan Kew. It was introduced in 2004, and since 2007, it is included in the \TeX distributions \TeX Live and MiK \TeX . So you probably have it, even if you have never heard about it.

Now take your Hungarian (German) keyboard, and in a \TeX document type: Grätzer György (the Hungarian keyboard has all these keys) and X₃ \TeX will typeset this as

Grätzer György
(provided you use a font family, such as Lucida, that contains the characters ä and ö).

The real magic of \LaTeX is its handling of fonts. We illustrate some simple uses with a short sample article:

```
\documentclass{amsart}
\usepackage{amssymb,latexsym}
\usepackage{fontspec,xltxtra,xunicode}
\setmainfont[Mapping=tex-text]
  {Garamond Premier Pro}
\setmonofont[Scale=MatchLowercase]
  {Courier}
\defaultfontfeatures{Mapping=tex-text,
  Scale=MatchLowercase}
\setsansfont{Lucida Grande}
\newfontfamily{\Bic}{Bickham Script Pro}
\begin{document}
\title{Illustrating document fonts\and font switching}
\maketitle
This is set in Garamond Premier Pro,
the roman document font.---
```

```
\texttt{This is set in Courier, the
typewriter style document font.}
```

```
We set up a command, \verb+\Bic+,
for switching to Bickham Script Pro:\Bic This is Bickham Script Pro.}
\end{document}
```

In the preamble, we invoke the necessary packages and specify the three document fonts (you can pick any three system fonts installed on your computer). No more special installation for \LaTeX ! You no longer care whether the fonts are PostScript Type 1, or TrueType, or OpenType fonts; it just works.

The last command of the preamble sets up the font switching command, \Bic .

ILLUSTRATING DOCUMENT FONTS AND FONT SWITCHING

This is set in Garamond Premier Pro, the roman document font.—

This is set in Courier, the typewriter style document font.

We set up a command, \Bic , for switching to Bickham Script Pro:

This is Bickham Script Pro.

The typeset sample article.

\LaTeX accommodates all Latin alphabets, with all the accents, Cyrillic, Arabic, Chinese... It can print left-to-right or right-to-left, horizontal or vertical, as required by the language.

We have broken free from the \LaTeX font constraints.

For a technical description of \LaTeX , read Michel Goossens' *The \LaTeX Companion* [2]. To view a recent lecture by Jonathan Kew on "What is new in the \LaTeX world?" go to <http://river-valley.tv/conferences/bachotex2008/>

If you are curious about the commands, Mapping=tex-text (note how --- became an m-dash) and $\text{Scale=MatchLowercase}$ (adjusting the font size), look them up in the *fontspec* package documentation by Will Robertson [9].

A Warning

\LaTeX is easy to work with, because it uses standard 8-bit encoding for the characters. So if I write a paper on my Mac, send it to my coauthor, who works on a PC, and we submit it to a journal that uses Unix, there is no problem.

Mathematicians, as a rule, have no great need for fancy fonts, so there is little incentive to switch to \LaTeX . However, soon there will be Unicode math fonts to choose from, and then we should reevaluate the situation.

On the other hand, if you are a linguist, or want to work in non-European languages, switching to \LaTeX is a no-brainer.

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Weill Cornell Medical College in Qatar

Mathematics

MATHEMATICS

FACULTY POSITION

In a pioneering international initiative, the Weill Cornell Medical College (WCMC) established the Weill Cornell Medical College in Qatar (WCMC-Q) with the sponsorship of the Qatar Foundation for Education, Science and Community Development. WCMC-Q is located in Doha, Qatar, and in its seventh year of operation, its inaugural class having graduated with Cornell MD degrees in May 2008.

WCMC-Q seeks candidates for a full-time senior level faculty position to teach in Doha in the Pre-medical Program, with major responsibility for teaching mathematics to premedical students. The two-year Pre-medical Program is designed to prepare students for admission to the WCMC-Q Medical Program. Intensive and challenging, this two-year program has been specifically prepared for students in the Middle East. It provides them with instruction in subjects that comprise the pre-medical requirements of most medical colleges in the US.

The successful candidate will teach one course per semester at the level of college calculus and introductory statistics. In addition, he/she will participate in student academic advising, committee work, and the academic life of WCMC-Q. Research funding support is available and active participation in relevant research will be encouraged.

Qualifications include a Ph.D. in Mathematics, demonstrable teaching skills, and teaching experience at the college/university level. Candidates are expected to have experience in the American higher education system and must be willing to relocate to Doha, Qatar for the duration of the appointment. Academic rank and salary are commensurate with training and experience and are accompanied by an attractive foreign-service benefits package. Qualified applicants should submit a curriculum vitae and a letter of interest outlining their teaching and research experience to:

<http://job.qatar-med.cornell.edu> *

***Please select the appropriate position under the Academic options and indicate job # 08-wcmc-q-MT**

Cornell University is an equal opportunity, affirmative action educator and employer. Details regarding the WCMC-Q program and facilities can be accessed at: **www.qatar-med.cornell.edu**

The screening of applications will begin immediately and continue until suitable candidates are identified. Please note that due to the high volume of applications, only short-listed candidates will be contacted. Service is expected to begin in August 2009.

Short-listed candidates will be asked to provide names of three references.

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 2009 are:

Groups and their connections to geometry (A. Katok),

Complex analysis from a fluid dynamics perspective (A. Belmonte),

Explorations in convexity (S. Tabachnikov).

Applications for fall semester of 2009 are accepted now. Application deadline is 04/10/09.

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

Mathematics People

Venkatesh Awarded 2008 SASTRA Ramanujan Prize

AKSHAY VENKATESH of Stanford University has been awarded the 2008 SASTRA Ramanujan Prize. This annual prize is given for outstanding contributions to areas of mathematics influenced by the Indian 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 prize carries a cash award of US\$10,000.

The 2008 SASTRA Prize Citation reads as follows: “Akshay Venkatesh is awarded the 2008 SASTRA Ramanujan Prize for his phenomenal contributions to a wide variety of areas in mathematics, including number theory, automorphic forms, representation theory, locally symmetric spaces, and ergodic theory, by himself and in collaboration with several mathematicians. The prize recognizes the enormous influence his work has had, involving an interplay of number theoretic and analytic techniques. In particular, the prize recognizes his pathbreaking work on subconvexity of automorphic L -functions by himself and with Philippe Michel; his fundamental paper with Jordan Ellenberg in *Inventiones Mathematicae* (2007) on representing integral quadratic forms by quadratic forms—a problem having its roots in the work of Ramanujan; his work with Harald Helfgott in the *Journal of the American Mathematical Society* (2006) providing the first nontrivial upperbounds of 3-torsion in class groups of number fields; his seminal paper with Jordan Ellenberg in the *Annals of Mathematics* (2006) on bounds for the number of number fields with a bounded discriminant; his work with Elon Lindenstrauss on general Weyl laws, which establishes a conjecture of Sarnak; and his work with Lior Silberman establishing partial results towards a conjecture of Rudnick and Sarnak for higher rank arithmetic locally symmetric spaces. The prize also recognizes his recent work with Manfred Einsiedler, Elon Lindenstrauss, and Philippe Michel on Duke’s theorem for cubic fields, among others.”

Akshay Venkatesh was born in New Delhi in 1981 but was raised in Perth, Australia. He showed his brilliance in mathematics very early and was awarded the Woods Memorial Prize in 1997, when he finished his undergraduate studies at the University of Western Australia. He did his doctoral studies at Princeton under Peter Sarnak, completing his Ph.D. in 2002. He was C.L.E. Moore Instructor at the Massachusetts Institute of Technology for two years and was selected as a Clay Research Fellow in 2004. He served as associate professor at the Courant Institute of Mathematical Sciences at New York University and received the Salem Prize and a Packard Fellowship in 2007. He is now professor of mathematics at Stanford University.

The 2008 SASTRA Ramanujan Prize Committee consisted of Krishnaswami Alladi (chair), Manjul Bhargava, Bruce Berndt, Jonathan Borwein, Stephen Milne, Kannan Soundararajan, and Michel Waldschmidt. Previous winners of the SASTRA Ramanujan Prize are Manjul Bhargava and Kannan Soundararajan (2005), Terence Tao (2006), and Ben Green (2007).

—From a SASTRA Ramanujan Prize announcement

Hansen Awarded 2008 CME/MSRI Prize

LARS PETER HANSEN of the University of Chicago has been awarded the 2008 Prize in Innovative Quantitative Applications of the Chicago Mercantile Exchange (CME) Group and the Mathematical Sciences Research Institute (MSRI). The prize carries a cash award of US\$25,000 and a medal.

According to the prize citation, in the 1980s Hansen was “the leading contributor to the development and application of rigorous estimation and testing methods for financial data. His 1982 paper on generalized methods of moments fundamentally altered the way that empirical research is done in finance and macroeconomics. This new methodology led him, with Ken Singleton, to make one of the pioneering contributions to what became known as the ‘equity premium puzzle’. Hansen continues to be

a prolific researcher. He is part of a team investigating how long-run risk tradeoffs are encoded in asset prices. Hansen has also collaborated with others to develop models in which investors guard their investments against possible model misspecification, which they have shown are reflected in security market values and contribute to price dynamics."

Hansen is a member of the National Academy of Sciences and of the American Academy of Arts and Sciences, and is a fellow of the Econometric Society and of the American Finance Association. He has also held a Guggenheim Fellowship and a Sloan Fellowship. He received the 2006 Erwin Plein Nemmers Prize in Economics from Northwestern University, a Faculty Award for Excellence in graduate teaching from the University of Chicago, and the Frisch Medal from the Econometric Society.

The 2008 CME Group/MSRI Prize Selection Committee consisted of Leo Melamed (CME Group), Anat Admati (Stanford Graduate School of Business), Robert Bryant (Mathematical Sciences Research Institute), Darrell Duffie (Chair, Stanford University), John Gould (University of Chicago), Sanford Grossman (Quantitative Financial Strategies, Inc.), Stephen A. Ross (Massachusetts Institute of Technology Sloan School of Management), Jose A. Scheinkman (Princeton University), and Hugo Sonnenschein (University of Chicago). The previous recipients of the prize are Stephen A. Ross (2006) and David M. Kreps (2007).

The annual CME Group/MSRI Prize is awarded to an individual or a group to recognize originality and innovation in the use of mathematical, statistical, or computational methods for the study of the behavior of markets and, more broadly, of economics.

—From a CME Group announcement

Faltings Receives von Staudt Prize

The Otto und Edith Haupt-Stiftung of the Universität Erlangen-Nürnberg has presented the 2008 Karl Georg Christian von Staudt-Preis to GERD FALTINGS of the Max-Planck-Institut für Mathematik, Bonn. The prize was given at the annual meeting of the Deutsche Mathematiker-Vereinigung (German Mathematical Society) in September 2008 in Erlangen.

—DMV announcement

Burban and Oppermann Receive ICRA Awards

IGOR BURBAN of the University of Bonn and STEFFEN OPPERMANN of NTNU Trondheim, Norway, received awards from the International Conference on Representations of Algebras (ICRA) at its thirteenth conference in Sao Paulo, Brazil.

According to the prize citation, Burban was honored "for his work on derived categories of coherent sheaves and modules and their relation to the Yang-Baxter equation. He developed new techniques for explicit calculation in such derived categories of modules and coherent sheaves. His main results were obtained in terms of strings and bands, linking the topic to the representation theory of finite-dimensional algebras and matrix problems." Oppermann was recognized "for his highly original, inventive and influential work on representation dimension of finite-dimensional algebras. He has introduced completely new and far-reaching methods to determine lower bounds for representation dimension. He also applied his methods to obtain deep results in a broad variety of problems including representations of algebras, finite groups and coherent sheaves."

The series of conferences was established in 1974 to exchange results in the field of representations of finite-dimensional algebras. The next conference will be held in Tokyo, Japan, in 2010.

—From an ICRA announcement

NDSEG Fellowships Awarded

Fourteen young mathematicians have been awarded National Defense Science and Engineering Graduate (NDSEG) Fellowships by the Department of Defense (DoD). As a means of increasing the number of U.S. citizens trained in disciplines of military importance in science and engineering, DoD awards fellowships to individuals who have demonstrated ability and special aptitude for advanced training in science and engineering. The fellowships are sponsored by the United States Army, Navy, and Air Force.

The following are the names of the fellows in mathematics, their institutions, and the offices that awarded the fellowships: ALLISON BISHOP (University of Texas at Austin), Office of Naval Research (ONR); ELETTE BOYLE (Massachusetts Institute of Technology), Army Research Office (ARO); REX CHEUNG (Yale University), ARO; MICHAEL CHMUTOV (University of Michigan, Ann Arbor), Air Force Office of Scientific Research (AFOSR); ROSS KRAVITZ (University of Michigan, Ann Arbor), ARO; BRANDON LEVIN (Stanford University), ARO; ERIC MARBERG (Massachusetts Institute of Technology), ONR; JEFFREY MILLER (Brown University), AFOSR; JOHN PATE (University of Arizona), AFOSR; AARON SILBERSTEIN (Harvard University), AFOSR; CHARLES STAATS (University of Chicago), AFOSR; GEORGE TUCKER (Massachusetts Institute of Technology), High Performance Computing Modernization Program (HPCMP); GABRIEL ZAYAS-CABAN (Cornell University), ARO; JULIETTE ZERICK (University of California, Davis), ONR.

—From an NDSEG announcement

Masayoshi Nagata (1927–2008)

Masayoshi Nagata, professor emeritus of Kyoto University, passed away in Kyoto on August 27, 2008, at the age of 81. Nagata played outstanding roles, especially in the 1950s and 1960s, in the development of commutative algebra and algebraic geometry. Many of his contributions were through a result of producing crucial counterexamples. The most famous among them is a nonfinitely generated ring of invariants for a group acting on a polynomial ring, thereby negatively solving Hilbert's 14th problem in 1958. Another is a complete nonsingular 3-dimensional algebraic variety that cannot be embedded in any projective space.

His book *Local Rings*, published in 1962, remains one of the basic references in commutative algebra and algebraic geometry. "Pseudo-geometric rings", treated in the book, are now called "Nagata rings" and form an important class of Noetherian rings. This concept too resulted from his earlier examples of Noetherian rings not enjoying properties of those appearing in connection with algebraic varieties.

A series of papers in the late 1950s on algebraic geometry over Dedekind domains laid the foundation for later developments of algebraic geometry in terms of schemes. The concept of the Henselization of rings, developed in a series of papers in the 1950s, turned out to be fundamental for algebraic spaces and étale topology.

The completion of algebraic varieties—that is, embedding of algebraic varieties as open subvarieties of complete varieties—published in his paper in 1962, remains one of the basic techniques in algebraic geometry.

I. Shrestakov and U. Umirbaev finally confirmed in 2004 Nagata's conjecture of 1972 to the effect that a certain automorphism of the polynomial ring in three variables is not a composite of "elementary" ones. Recent increased interest in this topic is an indication of Nagata's lasting influence in commutative algebra and algebraic geometry.

Nagata was born on February 9, 1927, and graduated in 1950 from Nagoya Imperial University, where he was a student of Tadasi Nakayama. After serving as an assistant at Nagoya University, a lecturer, and then an assistant professor at Kyoto University, he was promoted to professor in February 1963 and held the position until his retirement on March 31, 1990.

He played quite active roles in the mathematical community in Japan by serving as a trustee of the Mathematical Society of Japan and as a member of the Science Council of Japan, among others.

At the International Mathematical Union he served as a member of the Executive Committee between 1975 and 1978 and as vice president from 1979 to 1982.

He was awarded the Chunichi Cultural Prize in 1961, the Matsunaga Prize in 1970, and the Japan Academy Prize in 1986. The Order of the Sacred Treasure, Gold and Silver Star was conferred on him in November 1998.

—Masaki Maruyama, Masayoshi Miyanishi, Shigefumi Mori, and Tadao Oda, on behalf of Nagata's students

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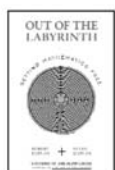


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Mathematics Faculty

The Farquhar College of Arts and Sciences seeks applications for the following faculty positions. Unless specifically noted otherwise, positions are full-time (9.5 month) and entail teaching the equivalent of 8 courses, participation in department and college committees and curriculum development, and strong commitment to student and community service and scholarship.

Candidates with a terminal degree are strongly preferred; faculty rank is dependent on terminal degree, college level teaching experience, and scholarship. Candidates with college-level teaching experience and a plan for active scholarship are preferred. Interest in or experience with teaching or developing online courses is a plus. Review of applications begins immediately; positions begin August 2009.

Duties include the instruction of mathematics and/or statistics. Candidates should exhibit a strong commitment to undergraduate teaching and research. Experience with online or computer-assisted instruction is a plus. Master's degree in relevant field required; terminal degree preferred.

With more than 120 full-time faculty members, 250 part time faculty members, and 2600 students, the Farquhar College of Arts and Sciences at Nova Southeastern University offers 21 undergraduate majors, 35 minors, and 5 certificate programs across four academic divisions, as well as a graduate program in writing. The College serves more than 5600 undergraduate students through general education, honors, and study abroad programs. Nova Southeastern University is the sixth largest not-for-profit university in the United States, serving more than 27,000 students. The university is located on 300 acres in Fort Lauderdale, Florida.

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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 2009. Please refer to the program announcement or contact the program director for more information.

December 15, 2008 (full proposal): Computational Mathematics

January 13, 2009 (full proposal): Mathematical Biology

January 22, 2009 (full proposal): Scientific Computing Research Environments for the Mathematical Sciences (SCREMS)

February 12, 2009 (full proposal): Interdisciplinary Training for Undergraduates in Biological and Mathematical Sciences (UBM)

February 16, 2009 (full proposal): Proactive Recruitment in Introductory Science and Mathematics (PRISM)

February 19, 2009 (full proposal): Interdisciplinary Grants in the Mathematical Sciences (IGMS)

February 27, 2009 (full proposal): Mathematical Science Research Institutes

June 2, 2009 (full proposal): University-Industry Cooperative Research Programs in the Mathematical Sciences

June 5, 2009 (full proposal): Research Experiences for Undergraduates (REU)

June 15, 2009 (full proposal): Workforce Program in the Mathematical Sciences

July 23, 2009 (full proposal): Faculty Early Career Development (CAREER) Program

August 21, 2009 (letter of intent): Focused Research Groups (FRG) in the Mathematical Sciences

August 27, 2009 (full proposal): Conferences, Workshops, and Special Meetings in the Mathematical Sciences

September 18, 2009 (full proposal): Focused Research Groups (FRG) in the Mathematical Sciences

October 6, 2009 (full proposal): Algebra, Number Theory and Combinatorics; Analysis; Foundations

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

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, 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 the 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 2009 is **January 15, 2009**. Further information about the fellowship program and application procedures is available online at <http://www.aaas.org/programs/education/MassMedia/>, or applicants may contact Stacey Pasco, Director, Mass Media Program, AAAS Mass Media Science and Engineering Fellows Program, 1200 New York Avenue, NW, Washington, DC 20005; telephone 202-326-6641; fax 202-371-9849; email: spasco@aaas.org. Further information is also available at <http://www.ams.org/government/massmediaaann.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 Washington Office

DARPA Mathematical Challenges

The Defense Advanced Research Projects Agency has issued a Broad Agency Announcement (BAA) soliciting innovative research proposals in the area of DARPA Mathematical Challenges, with the goal of dramatically revolutionizing mathematics and thereby strengthening the scientific and technological capabilities of the Department of Defense. Proposers are strongly encouraged to submit a white paper in advance of a full proposal. White papers can be submitted at any time up to **July 25, 2009**; full proposals can be submitted at any time up to **September 25, 2009**. Further information on DARPA-BAA08-65 is available at <https://www.fbo.gov/spg/ODA/DARPA/CMO/DARPA-BAA08-65/listing.html>.

—DARPA announcement

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 two hundred fellowships will be awarded in 2009.

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 2009. Fellows selected in spring 2009 must begin their fellowship tenure

in fall 2009. Fellowships are tenable only at U.S. institutions of higher education offering doctoral degrees in the scientific and engineering disciplines specified. Fellows will receive full tuition and a stipend for 12-month tenures. 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 5, 2009**. 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

National Academies Research Associateship Programs

The Policy and Global Affairs Division of the National Academies is sponsoring the 2009 Postdoctoral and Senior Research Associateship Programs. The programs are meant to provide opportunities for Ph.D., Sc.D., or M.D. scientists and engineers of unusual promise and ability to perform research at more than one hundred research laboratories throughout the United States and overseas.

Full-time associateships will be awarded for research in the fields of mathematics, chemistry, earth and atmospheric sciences, engineering, applied sciences, life sciences, space sciences, and physics. Most of the laboratories are open to both U.S. and non-U.S. nationals and to both recent doctoral recipients and senior investigators. The amount of the stipend depends on the sponsoring laboratory. Support is also provided for allowable relocation expenses and for limited professional travel during the period of the award.

Awards will be made four times during the year: in February, May, August, and November. The deadline for application materials to be postmarked or for electronic submissions for the February 2009 review is **February 15, 2009**. Materials for the May review are due **May 15, 2009**; for the August review, **August 15, 2009**; and for the November review, **November 15, 2009**.

For further information and application materials, see the National Academies website at <http://www7.nationalacademies.org/rap/> or contact Research Associateship Programs, National Research Council, Keck 568, 500 Fifth Street, NW, Washington, DC 20001; telephone 202-334-2760; fax 202-334-2759; email: rap@nas.edu.

—From an NRC announcement

Noether Lecture at ICM 2010

Emmy Noether was one of the great mathematicians of her time, someone who worked and struggled for what she loved and believed in. Her life and work remain a tremendous inspiration. The 2010 Emmy Noether Lecture will be presented as a plenary lecture at the International Congress of Mathematicians in August 2010 in Hyderabad to honor women who have made fundamental and sustained contributions to the mathematical sciences.

There have been Emmy Noether Lectures at four previous ICMs, and this will be the second time that the selection of the Emmy Noether Lecturer has been made formally by the International Mathematical Union. The IMU Executive Committee has established a committee of five, chaired by Cheryl Praeger (Australia), to select the 2010 Emmy Noether Lecturer. The committee will conduct their work over the next six to nine months, and suggestions for consideration by the committee may be sent to Cheryl Praeger at praeger@maths.uwa.edu.au.

—IMU announcement

2009 Fermat Prize for Mathematics Research

The Fermat Prize for Mathematics Research recognizes research in fields in which Pierre de Fermat made decisive contributions. These include statements of variational principles, foundations of probability and analytical geometry, and number theory. The prize carries a cash award of 20,000 euros (approximately US\$27,000). The prize is awarded every two years. The deadline for applications is **June 30, 2009**. Further information is available from Prix Fermat de Recherche en Mathématiques, Service Relations Publiques, Université Paul Sabatier, 31062 Toulouse Cedex 9, France, or at the website <http://www.math.ups-tlse.fr/Fermat/>.

—Jean-Marc Schlenker, Université Paul Sabatier

Plus Magazine New Writers Award

Plus, an Internet magazine that aims to introduce readers to the beauty and the practical applications of mathematics, is looking for science writers who can make mathematics lively and interesting for a general audience. The New Writers Award competition is open to new writers of any age and from any background who can explain a mathematical topic or application they think the world needs to know about. The winning entries will appear in the June 2009 issue of *Plus*, and the winners will receive an iPod, subscriptions to the journal *Nature*, and signed copies of popular math books by some of the best science writers today. The competition is open to secondary school and sixth-form students, university students (both

undergraduate and postgraduate), and the general public. The submission deadline is **March 31, 2009**. For further information, see the website <http://plus.maths.org/competition/>.

Plus is part of the Millennium Mathematics Project (MMP), a long-term national initiative based in Cambridge, United Kingdom. The MMP aims to help people of all ages and abilities share in the excitement of mathematics and understand the enormous range and importance of its applications to science and commerce.

—From a *Plus* announcement

Departments Again Coordinate Job Offer Deadlines

A group of mathematical sciences departments has adopted an agreement to coordinate deadlines for acceptance of postdoctoral job offers for jobs that begin in the fall of 2009. 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 two years or less past the Ph.D. The departments have agreed not to require these applicants to decide about a job offer before Monday, February 9, 2009. The NSF has already agreed that it will complete its review of applications by January 31, 2009, at the latest, and that all awardees of NSF postdoctoral fellowships will receive notification electronically by February 7, 2009. The list of participating departments, together with additional information, may be found on the Web at <http://www.ams.org/employment/postdoc-offers.html>.

—AMS Career Services announcement

News from the Fields Institute

Edward Bierstone, professor of mathematics at the University of Toronto, has been appointed as the new director of the institute, beginning July 2009. He succeeds Barbara Lee Keyfitz, who retired from the directorship to assume a professorship at the Ohio State University in Columbus, Ohio. The current deputy director, Juris Steprans, is acting director in the interim. Bierstone, a graduate of the University of Toronto who received his Ph.D. from Brandeis University, has made pathbreaking contributions in singularity theory, analytical geometry, and differential analysis.

The 2009 Winter/Spring thematic program at the Fields Institute will be o-Minimal Structures and Real Analytic Geometry. Two workshops will be held: o-Minimal Geometry, January 12–16, 2009; and Finiteness Problems in Dynamical Systems, June 22–26, 2009. See <http://www.fields.utoronto.ca/programs/scientific/08-09/o-minimal/>.

The Distinguished Lecture Series is tentatively scheduled for May 25–29, 2009. Jean-Christophe Yoccoz (Collège de France) will deliver the lecture series. See <http://www.fields.utoronto.ca/programs/scientific/> for information on activities at the institute. Future thematic programs include Quantum Computation (summer 2009), Foundations of Computational Mathematics (fall 2009), Quantitative Finance: Foundations and Applications (2010 winter/spring), Asymptotic Geometric Analysis (fall 2010), Dynamics and Transport in Disordered Systems (winter/spring 2011), Discrete Geometry and Applications (fall 2011), and Galois Representations (winter/spring 2012). Support for postdoctoral fellows is available; see <http://www.fields.utoronto.ca/proposals/postdoc.html>.

—Fields Institute announcement

Clay Mathematics Institute 2009 Summer School

The Clay Mathematics Institute (CMI) Summer School on Galois Representations will be held at the University of Hawaii at Manoa from June 15 to July 10, 2009. The school will focus on recent progress in the theory of Galois representations. Many advances on the algebraic side of number theory in the last 15 years (such as the solutions of the Shimura-Taniyama conjecture, Sato-Tate conjecture, and Serre's conjecture, as well as decisive progress on the Fontaine-Mazur conjecture and Main conjectures for modular forms) have relied in an essential way on improvements in the theory of Galois representations. The aim of the three main courses is to present an overview of many of the ideas and applications involved, aimed at advanced graduate students and postdocs with a strong background in number theory, Galois cohomology, and basic algebraic geometry. One course will focus entirely on local problems (p -adic representations of Galois groups of p -adic fields), a second course will have a more global flavor (Galois deformation theory and global applications), and a third (on L -values) will rely on the other two courses. The scientific committee consists of Brian Conrad, David Alexandre Ellwood, Mark Kisin, and Chris Skinner.

The Foundational Courses will be: *p -adic Hodge Theory* (Olivier Brinon, Brian Conrad), *Deformation of Galois Representations and Modular Forms* (Jacques Tilouine, Mark Kisin), *Iwasawa Theory and Automorphic Applications* (Joel Bellaïche, Chris Skinner).

Financial Support: Graduate students and postdoctoral fellows who are within five years of receipt of their Ph.D.'s can apply for financial support. Support is decided on a competitive basis and may include accommodation plus funds towards the cost of economy travel.

The deadline for applications is **February 15, 2009**. More information and an online application form can be found at <http://www.claymath.org/summerschool>.

—Clay Mathematics Institute Announcement

News from the Mathematical Biosciences Institute

The Mathematical Biosciences Institute (MBI) at The Ohio State University is accepting applications for Early Career Visitor and postdoctoral positions. The Early Career Visitor term runs during the 2009–2010 Year on Molecular Interactions within the Cell: Network, Scale, and Complexity. Early Career Visitors are hired for up to a one-year term. They are engaged in the integrated program of tutorials, working seminars, and workshops tied to the scientific theme of the year and are expected to interact with local and visiting researchers. Early Career Visiting positions are aimed at nontenured scientists who currently have continuing employment.

Postdoctoral positions will start in September 2009. Postdoctoral fellows are immersed in the topics of the MBI's emphasis year programs. They will engage in an integrated program of tutorials, working seminars or journal clubs, workshops, and interactions with local and visiting mentors. These activities are geared toward providing the tools to pursue an independent research program with an emphasis on collaborative research in the mathematical biosciences. MBI-facilitated activities for postdoctoral fellows are tailored to the needs of each young scientist. The program provides training in bioscience fundamentals to the mathematically oriented fellow, as well as mathematical fundamentals to the bioscience-oriented fellow. The postdoctoral program includes both regular postdoctoral fellows and sponsored postdoctoral fellows.

The deadline for applications for either program is **January 18, 2009**. For more information and to apply, see the website <http://mbi.osu.edu> or call 614-292-3648.

—MBI announcement

Inside the AMS

AMS Current Events Bulletin

The Joint Mathematics Meetings in Washington DC in January 2009 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 of the University of California, 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; written versions of the talks are prepared beforehand and distributed at the session. There are some novel features also. 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, after which 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 at the Washington Joint Meetings, the names of the speakers and their lecture titles are as follows:

MATTHEW JAMES EMERTON, Northwestern University, *Topology, representation theory, and arithmetic: Three-manifolds and the Langlands program*.

OLGA V. HOLTZ, University of California, Berkeley, and Technische Universität Berlin, *Compressive sensing: A paradigm shift in signal processing*.

MICHAEL HUTCHINGS, University of California, Berkeley, *From Seiberg-Witten theory to closed orbits of vector fields: Taubes’s proof of the Weinstein conjecture*.

FRANK SOTTILE, Texas A&M University, *Frontiers of reality in Schubert calculus*.

The session will take place on Wednesday, January 7, 2009, 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 Lecture

The Erdős Memorial Lecture is an annual invited address named for the prolific mathematician Paul Erdős (1913–1996). The lectures are supported by a fund created by Andrew Beal, a Dallas banker and mathematics enthusiast. The Beal Prize Fund, now US\$100,000, is being held by the AMS until it is awarded for a correct solution to the Beal Conjecture (see <http://www.math.unt.edu/~mauldin/beal.html>). At Beal’s request, the interest from the fund is used to support the Erdős Memorial Lecture.

The Erdős Memorial Lecturer for 2008 was William Timothy Gowers of the University of Cambridge. He delivered a lecture titled “Decomposing bounded functions” at the Spring Eastern Section Meeting at the Courant Institute of Mathematical Sciences, New York University, in March 2008.

—AMS announcement

From the AMS Public Awareness Office

Activities managed by the AMS Public Awareness Office at the 2009 Joint Mathematics Meetings in Washington DC include:

• **JMM Blog.** Adriana Salerno, a mathematics graduate student at the University of Texas at Austin, records her summaries of events at the 2009 meeting on the JMM Blog. Salerno is a past AMS-AAAS Media Fellow, working for ten weeks as a reporter for Voice of America, and she is a regular contributor to the AMS’s Math Digest (<http://www.ams.org/mathmedia/mathdigest/>). Read Adriana’s impressions of JMM 2009 and contribute some of your own at <http://www.ams.org/blog/jmm2009/>.

• **JMM Press Room.** Here is where journalists meet to write articles, interview speakers, connect with colleagues, review news releases about the Joint Mathematics Meetings and prize winners, and pick up fact sheets from participating organizations.

• **Meet the *Notices* Editors.** An informal event on Tuesday, January 6, 11:00 a.m. to 1:00 p.m. in the AMS exhibit area. If you are attending the Joint Mathematics Meetings, you are invited to stop by to meet the editors who bring you *Notices* each month, find out more about *Notices* and how it is produced, give your feedback, talk about what you would like to see in *Notices*, get information on how to submit articles, and pick up a free poster featuring *Notices* covers.

• **Who Wants to Be a Mathematician?** The game for local high school math students is Wednesday, January 7, 10:00 a.m. to 11:00 a.m. in the Marriott Ballroom Salon 3, Lobby Level, Marriott Wardman Park Hotel. The AMS special presentation, organized by Michael A. Breen, AMS Public Awareness Officer, and William T. Butterworth, DePaul University, is open to the public, and mathematicians are invited to attend.

—Annette Emerson and Mike Breen
AMS Public Awareness Officers
paoffice@ams.org

AMS Hosts Congressional Briefing: Can Mathematics Cure Leukemia?

Doron Levy, an associate professor of mathematics at the University of Maryland, College Park, and at the Center for Scientific Computation and Mathematical Modeling, delivered an address to congressional representatives at a Capitol Hill briefing in which he presented his recent work on leukemia. The briefing was sponsored by the AMS.

Levy discussed a particular type of leukemia, known as Chronic Myelogenous Leukemia (CML). He noted that new drug therapies are able to keep most patients in remission, but ultimately do not cure the disease. Levy then described his joint work with Peter Lee, M.D., from Stanford University Medical School, and his former student Peter Kim (now at the University of Utah) in which they focused on the role of the immune response to CML. By combining mathematical modeling with new experimental data, they propose a new low-risk clinical approach to enhancing the effect of drug therapy, possibly leading to a cure for the disease.

Previous AMS Congressional Lunch Briefings have covered the following topics:

November 2007: Mathematics of Ice to Aid Global Warming Forecasts, presented by Ken Golden, professor of mathematics at the University of Utah.

November 2006: The Necessity of Mathematics: From Google to Counterterrorism to Sudoku, presented by Amy Langville, professor of mathematics at the College of Charleston.

November 2005: From Katrina Forward: How Mathematics Helps Predict Storm Surges, presented by Clint Dawson, professor at the University of Texas and a member of the Center for Subsurface Modeling in the Institute for Computational Engineering and Sciences; and Joannes Westerink, associate professor of civil engineering and geological sciences at the University of Notre Dame.

September 2004: Homeland Security: What Can Mathematics Do?, presented by Fred S. Roberts, professor of mathematics and director of the Center for Discrete Mathematics and Theoretical Computer Science (DIMACS) at Rutgers University.

July 2003: Mathematics Is Biology's Next Microscope, Only Better; Biology Is Mathematics' Next Physics, Only Better, presented by Joel E. Cohen, Laboratory of Populations, Rockefeller and Columbia Universities.

February 2002: Mathematics, Patterns and Homeland Security, presented by Ingrid Daubechies, Princeton University.

July 2001: Adding It Up: Helping Children Learn Mathematics, a briefing on this National Research Council Report, presented by Deborah Loewenberg Ball and Hyman Bass, University of Michigan, and by Roger Howe, Yale University.

Other previous briefings include: What Does Water Know about Mathematics, by Mary Fannett Wheeler, University of Texas at Austin; Calculating the Secrets of Life: Mathematics in Medicine, by DeWitt Sumners, Florida State University; Eavesdropping on the Internet: Mathematics and Policy, by Carl Pomerance, University of Georgia; and Mathematical Transcriptions of the Real World: Fingerprints, Magnetic Resonance and Video, by Ronald Coifman, Yale University.

—Anita L. Benjamin, AMS Washington Office

Deaths of AMS Members

ALFRED AEPPLI, professor emeritus, University of Minnesota, died on September 14, 2008. Born on November 8, 1928, he was a member of the Society for 48 years.

ROMAE J. CORMIER, retired associate professor, Northern Illinois University, died on July 24, 2008. Born on May 17, 1928, he was a member of the Society for 50 years.

ANDREW M. GLEASON, former president of the AMS, and professor emeritus from Harvard University, died on October 17, 2008. Born on November 4, 1921, he was a member of the Society for 67 years.

GEORGE R. GREAVES, Cardiff University, died on August 24, 2008. Born on June 3, 1941, he was a member of the Society for 24 years.

JACK L. HURSCH, from Tallahassee, FL, died on August 11, 2008. Born on September 8, 1930, he was a member of the Society for 35 years.

HORST F. NIEMEYER, professor, Rheinisch-Westfälische Technische Hochschule Aachen, Germany, died on October 31, 2007. Born on June 30, 1931, he was a member of the Society for 43 years.

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 15, 2008: Applications for AMS Epsilon Fund grants. See <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`.

January 5, 2009: Applications for NDSEG Fellowships. See "Mathematics Opportunities" in this issue.

January 10, 2009: Applications for AAUW Educational Foundation Fellowships and Grants. See http://www.aauw.org/fga/fellowships_grants/selected.cfm or contact the AAUW Educational Foundation, Selected Professions Fellowships,

Where to Find It

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

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Dept. 60, 301 ACT Drive, Iowa City, IA 52243-4030; telephone: 319-337-1716, ext. 60; email: aauw@act.org.

January 15, 2009: Applications for Jefferson Science Program at U.S. Department of State. See <http://www7.nationalacademies.org/jefferson/>; telephone: 202-334-2643; email: jssf@nas.edu.

January 15, 2009: Applications for AMS-AAAS Mass Media Summer Fellowships. See <http://www.aaas.org/programs/education/Mass-Media/>; 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. Also see <http://www.ams.org/government/massmediaann.html> or contact the AMS Washington Office, 1527 Eighteenth Street, NW, Washington, DC 20036; telephone: 202-588-1100; fax: 202-588-1853; email: amsdc@ams.org.

January 18, 2009: Applications for Mathematical Biosciences Institute (MBI) Early Career Visitor and post-doctoral positions. See "Mathematics Opportunities" in this issue.

January 22, 2009: Proposals for NSF Scientific Computing Research Environments for the Mathematical Sciences (SCREMS). See http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5616.

January 31, 2009: Applications for AMS-AAAS 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, 2009: Applications for AWM Travel Grants. See <http://www.awm-math.org/travelgrants.html>; telephone: 703-934-0163; email: awm@awm-math.edu. The postal address is: Association for Women in Mathematics, 11240 Waples Mill Road, Suite 200, Fairfax, VA 22030.

February 13, 2009: Applications for Math for America Foundation (MfA) Fellowship Program for New York City and Los Angeles. See <http://www.mathforamerica.org/>.

February 15, 2009: Applications for National Academies Research Associateship Programs. See "Mathematics Opportunities" in this issue.

February 15, 2009: Nominations for Clay Liff Program for summer 2009. See <http://claymath.org/fas/liftoff>; telephone: 617-995-2600.

February 27, 2009: Submissions for Association for Women in Mathematics (AWM) essay contest. See <http://www.awm-math.org/biographies/contest.html>.

February 27, 2009: Proposals for DMS New Institute Competition. See http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5302.

March 1, 2009: Applications for the June program of the Christine Mirzayan Science and Technology Policy Graduate Fellowship Program of the National Academies. 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.

March 2, 2009: Applications for EDGE Summer Program. See http://www.edgeforwomen.org/?page_id=5.

March 31, 2009: Submissions for *Plus* Magazine New Writers Award. See "Mathematics Opportunities" in this issue.

April 15, 2009: Applications for fall 2009 semester of Math in Moscow. See <http://www.mccme.ru/mathin-moscow> or write to: Math in Moscow, P.O. Box 524, Wynnwood, PA 19096; fax: +7095-291-65-01; email: mim@mccme.ru. For information on AMS scholarships see <http://www.ams.org/outreach/mimoscow.html> or write to: Math in Moscow Program, Membership and Programs Department, American Mathematical Society, 201 Charles Street, Providence RI 02904-2294; email: student-serv@ams.org.

May 8, 2009: Applications for AWM Travel Grants. See <http://www.awm-math.org/travelgrants.html>; telephone: 703-934-0163; email: awm@awm-math.edu. The postal address is:

Association for Women in Mathematics, 11240 Waples Mill Road, Suite 200, Fairfax, VA 22030.

May 15, 2009: Applications for National Academies Research Associateship Programs. See "Mathematics Opportunities" in this issue.

June 1, 2009: Applications for the September program of the Christine Mirzayan Science and Technology Policy Graduate Fellowship Program of the National Academies. 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 1, 2009: Applications for the Math for America Foundation (MfA) Fellowship Program in San Diego. See <http://www.mathforamerica.org/>.

June 2, 2009: Proposals for NSF's Enhancing the Mathematical Sciences Workforce in the Twenty-First Century program. See http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf05595.

June 30, 2009: Applications for Fermat Prize for Mathematics Research. See "Mathematics Opportunities" in this issue.

August 15, 2009: Applications for National Academies Research Associateship Programs. See "Mathematics Opportunities" in this issue.

October 1, 2009: Applications for AWM Travel Grants. See <http://www.awm-math.org/travelgrants.html>; telephone: 703-934-0163; email: awm@awm-math.edu. The postal address is: Association for Women in Mathematics, 11240 Waples Mill Road, Suite 200, Fairfax, VA 22030.

November 1, 2009: Applications for the January program of the Christine Mirzayan Science and Technology Policy Graduate Fellowship Program of the National Academies. 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.

November 15, 2009: Applications for National Academies Research Associateship Programs. 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 (Consultant)
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 (Consultant)
President Emeritus
Texas A&M University

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

G. Wayne Clough
Secretary
Smithsonian Institution

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

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

Patricia D. Galloway (Vice Chair)
Chief Executive Officer
Nielsen-Wurster Group, Inc.
Seattle, Washington

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

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

Karl Hess (Consultant)
Swanlund Chair
Advanced Study Professor Emeritus
University of Illinois

Elizabeth Hoffman (Consultant)
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 (Consultant)
Professor of Biochemistry and Thomas Jefferson Fellow
University of Missouri

Arthur K. Reilly
Senior Director
Cisco Systems, Inc.

Jon C. Strauss
President Emeritus
Harvey Mudd College

Kathryn D. Sullivan
Director
Battelle Center for Mathematics and Science Education Policy
John Glenn School of Public Affairs
Ohio State University

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 (Consultant)
Vice President and Program Director
Arizona Transition Years Teacher and Curriculum Initiatives
Helios Education Foundation
Phoenix, Arizona

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

Craig R. Robinson
Executive Officer and Acting Office Director
National Science Board

The contact information for the Board is: National Science Board, National Science Foundation, 4201 Wilson Boulevard, Room 1225N, Arlington, VA 22230; telephone 703-292-7000; 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.

An Abundance of Katherines, by John Green. Dutton Juvenile Books, September 2006. ISBN-13: 978-0-5254-7688-7. (Reviewed October 2008.)

Amongst Mathematicians: Teaching and Learning Mathematics at University Level, by Elena Nardi. Springer, November 2007. ISBN-13: 978-0-387-37141-2.

The Archimedes Codex, by Reviel Netz and William Noel. Weidenfeld and Nicolson, May 2007. ISBN-13: 978-0-29764-547-4. (Reviewed September 2008.)

The Book of Numbers: The Secret of Numbers and How They Changed the World, by Peter J. Bentley. Firefly Books, February 2008. ISBN-13: 978-15540-736-10.

The Cat in Numberland, by Ivar Ekeland. Cricket Books, April 2006. ISBN-13: 978-0-812-62744-2. (Reviewed in this issue.)

A Certain Ambiguity: A Mathematical Novel, by Gaurav Suri and Hartosh Singh Bal. Princeton University Press, June 2007. ISBN-13: 978-0-6911-2709-5. (Reviewed February 2008.)

Digital Dice, by Paul J. Nahin. Princeton University Press, March 2008. ISBN-13: 978-06911-269-82.

Dimensions, by Jos Leys, Etienne Ghys, and Aurélien Alvarez. DVD, 117 minutes. Available at <http://www.dimensions-math.org>.

Discovering Patterns in Mathematics and Poetry, by Marcia Birken and Anne C. Coon. Rodopi, February 2008. ISBN-13: 978-9-0420-2370-3.

Does Measurement Measure Up?: How Numbers Reveal and Conceal the Truth, by John Henshaw. Johns

Hopkins University Press, March 2006. ISBN-13: 978-0-8018-8375-0.

Einstein's Mistakes: The Human Failings of Genius, by Hans C. Ohanian. W. W. Norton, September 2008. ISBN-13: 978-0393062939.

Euclidean and Non-Euclidean Geometries: Development and History, fourth revised and expanded edition, by Marvin Jay Greenberg. W. H. Freeman, September 2007. ISBN-13: 978-0-7167-9948-1.

Fighting Terror Online: the Convergence of Security, Technology and the Law, by Martin Charles Golumbic. Springer, 2008. ISBN: 978-0-387-73577-1.

**Five-Minute Mathematics*, by Ehrhard Behrends (translated by David Kramer). AMS, May 2008. ISBN-13: 978-08218-434-82.

Fly Me to the Moon: An Insider's Guide to the New Science of Space Travel, by Edward Belbruno. Princeton University Press, January 2007. ISBN-13: 978-0-6911-2822-1. (Reviewed April 2008.)

GeekSpeak: How Life + Mathematics = Happiness, by Graham Tattersall. Collins, September 2008. ISBN-13: 978-00616-292-42.

Geometric Folding Algorithms: Linkages, Origami, Polyhedra, by Erik D. Demaine and Joseph O'Rourke. Cambridge University Press, July 2007. ISBN-13: 978-05218-57574.

The Golden Section: Nature's Greatest Secret (Wooden Books), by Scott Olsen. Walker and Company, October 2006. ISBN-13: 978-08027-153-95.

Group Theory in the Bedroom, and Other Mathematical Diversions, by Brian Hayes. Hill and Wang, April 2008. ISBN-13: 978-0-8090-5219-6.

Guesstimation: Solving the World's Problems on the Back of a Cocktail Napkin, by Lawrence Weinstein and John A. Adam. Princeton University Press, April 2008. ISBN-13: 978-0-6911-2949-5.

Hexaflexagons, Probability Paradoxes, and the Tower of Hanoi: Martin Gardner's First Book of Mathematical Puzzles and Games, by Martin Gardner. Cambridge University Press, September 2008. ISBN-13: 978-0-521-73525-4.

A History of Abstract Algebra, by Israel Kleiner. Birkhäuser, October 2007. ISBN-13: 978-0-8176-4684-4.

How Round Is Your Circle, by John Bryant and Chris Sangwin. Princeton University Press, January 2008. ISBN-13: 978-0-6911-3118-4.

Impossible?: Surprising Solutions to Counterintuitive Conundrums, by Julian Havil. Princeton University Press, April 2008. ISBN-13: 978-0-6911-3131-3.

The Indian Clerk, by David Leavitt. Bloomsbury USA, September 2007. ISBN-13: 978-15969-1040-9. (Reviewed September 2008.)

Irreligion: A Mathematician Explains Why the Arguments for God Just Don't Add Up, by John Allen Paulos. Hill and Wang, December 2007. ISBN-13: 978-0-8090-591-95. (Reviewed August 2008.)

**Is God a Mathematician?* by Mario Livio. Simon & Schuster, January 2009. ISBN-13: 978-07432-940-58.

Kiss My Math: Showing Pre-Algebra Who's Boss, by Danica McKellar. Hudson Street Press, August 2008. ISBN-13: 978-1594630491.

The Last Theorem, by Arthur C. Clarke and Frederik Pohl. Del Rey, August 2008. ISBN-13: 978-0345470218.

The Legacy of Mario Pieri in Geometry and Arithmetic, by Elena Anne Marchisotto and James T. Smith. Birkhäuser, May 2007. ISBN-13: 978-0-8176-3210-6.

Leonhard Euler, A Man to Be Reckoned With, by Andreas K. Heyne and Alice K. Heyne. Birkhäuser, 2007. ISBN-13: 978-3-7643-8332-9. (Reviewed March 2008.)

Logic's Lost Genius: The Life of Gerhard Gentzen, by Eckart Menzler-Trott, Craig Smorynski (translator), Edward R. Griffor (translator). AMS-LMS, November 2007. ISBN-13: 978-0-8218-3550-0.

Making Mathematics Work with Needlework: Ten Papers and Ten Projects, edited by Sarah-Marie Belcastro and Carolyn Yackel. A K Peters, September 2007. ISBN-13: 978-1-5688-1331-8.

**The Map of My Life*, by Goro Shimura. Springer, September 2008. ISBN-13: 978-03877-971-44.

Mathematical Mind-Benders, by Peter Winkler. A K Peters, August 2007. ISBN-13: 978-1-5688-1336-3.

Mathematical Omnibus: Thirty Lectures on Classic Mathematics, by Dmitry Fuchs and Serge Tabachnikov. AMS, October 2007. ISBN-13: 978-

08218-431-61. (Reviewed December 2008).

The Mathematician's Brain, by David Ruelle. Princeton University Press, July 2007. ISBN-13 978-0-691-12982-2. (Reviewed November 2008.)

Mathematics and Democracy: Designing Better Voting and Fair-Division Procedures, by Steven J. Brams. Princeton University Press, December 2007. ISBN-13: 978-0691-1332-01.

Mathematics at Berkeley: A History, by Calvin C. Moore. A K Peters, February 2007. ISBN-13: 978-1-5688-1302-8. (Reviewed November 2008.)

**Mathematics in Ancient Iraq: A Social History*, by Eleanor Robson. Princeton University Press, August 2008. ISBN-13: 978-06910-918-22.

The Mathematics of Egypt, Mesopotamia, China, India, and Islam: A Sourcebook, by Victor J. Katz et al. Princeton University Press, July 2007. ISBN-13: 978-0-6911-2745-3.

Measuring the World, by Daniel Kehlmann. Pantheon, November 2006. ISBN 0-375-42446-6. (Reviewed June/July 2008.)

More Mathematical Astronomy Morsels, by Jean Meeus. Willmann-Bell, 2002. ISBN 0-943396743.

More Sex Is Safer Sex: The Unconventional Wisdom of Economics, by Steven E. Landsburg. Free Press, April 2007. ISBN-13: 978-1-416-53221-7. (Reviewed June/July 2008.)

Number Story: From Counting to Cryptography, by Peter M. Higgins. Springer, February 2008. ISBN-13: 978-1-8480-0000-1

One to Nine: The Inner Life of Numbers, by Andrew Hodges. W. W. Norton, May 2008. ISBN-13: 978-03930-664-18.

Origami, Eleusis, and the Soma Cube: Martin Gardner's Mathematical Diversions, by Martin Gardner. Cambridge University Press, September 2008. ISBN-13: 978-0-521-73524-7.

A Passion for Discovery, by Peter Freund. World Scientific, August 2007. ISBN-13: 978-9-8127-7214-5.

Perfect Figures: The Lore of Numbers and How We Learned to Count, by Bunny Crumpacker. Thomas Dunne Books, August 2007. ISBN-13: 978-0-3123-6005-4.

The Presidential Election Game, by Steven J. Brams. A K Peters, December 2007. ISBN-13: 978-1-5688-1348-6.

The Princeton Companion of Mathematics, edited by Timothy Gowers (June Barrow-Green and Imre Leader, associate editors). Princeton University Press, November 2008. ISBN-13: 978-06911-188-02.

The Probability of God: A Simple Calculation That Proves the Ultimate Truth, by Stephen D. Unwin. Three Rivers Press, October 2004. ISBN-13: 978-1-4000-5478-7. (Reviewed February 2008.)

Professor Stewart's Cabinet of Mathematical Curiosities, by Ian Stewart. Basic Books, December 2008. ISBN-13: 978-0-465-01302-9.

Pursuit of Genius: Flexner, Einstein, and the Early Faculty at the Institute for Advanced Study, by Steve Batterson. A K Peters, June 2006. ISBN 1-56881-259-0. (Reviewed August 2008.)

Pythagorean Crimes, by Tefcros Michalides. Parmenides Publishing, September 2008. ISBN-13: 978-19309-722-78. (Reviewed in this issue.)

Random Curves: Journeys of a Mathematician, by Neal Koblitz. Springer, December 2007. ISBN-13: 978-3-5407-4077-3.

Reminiscences of a Statistician: The Company I Kept, by Erich Lehmann. Springer, November 2007. ISBN-13: 978-0-387-71596-4.

Roots to Research: A Vertical Development of Mathematical Problems, by Judith D. Sally and Paul J. Sally Jr. AMS, November 2007. ISBN-13: 978-08218-440-38. (Reviewed December 2008.)

Sacred Mathematics: Japanese Temple Geometry, by Fukagawa Hidetoshi and Tony Rothman. Princeton University Press, July 2008. ISBN-13: 978-0-6911-2745-3.

Super Crunchers: Why Thinking-by-Numbers Is the New Way to Be Smart, by Ian Ayres. Bantam, August 2007. ISBN-13: 978-0-5538-0540-6.

Superior Beings: If They Exist, How Would We Know? Game-Theoretic Implications of Omnipotence, Omniscience, Immortality, and Incomprehensibility, by Steven Brams. Springer, second edition, November 2007. ISBN-13: 978-0-387-48065-7. (Reviewed February 2008.)

The Symmetries of Things, by John H. Conway, Heidi Burgiel, and Chaim Goodman-Strauss. A K Peters, May 2008. ISBN-13: 978-1-5688-1220-5.

Symmetry: A Journey into the Patterns of Nature, by Marcus du Sautoy. Harper, March 2008. ISBN-13: 978-0-0607-8940-4.

Symmetry: The Ordering Principle (Wooden Books), by David Wade. Walker and Company, October 2006. ISBN-13: 978-08027-153-88.

Tools of American Math Teaching, 1800-2000, by Peggy Aldrich Kidwell, Amy Ackerman-Hastings, and David Lindsay Roberts. Johns Hopkins University Press, July 2008. ISBN-13: 978-0801888144.

The Unfinished Game: Pascal, Fermat, and the Seventeenth-Century Letter That Made the World Modern, by Keith Devlin. Basic Books, September 2008. ISBN-13: 978-0-4650-0910-7.

Unknown Quantity: A Real and Imaginary History of Algebra, by John Derbyshire. Joseph Henry Press, May 2006. ISBN 0-309-09657-X. (Reviewed May 2008.)

Useless Arithmetic: Why Environmental Scientists Can't Predict the Future, by Orrin Pilkey and Linda Pilkey-Jarvis. Columbia University Press, February 2007. ISBN 0-231-13212-3. (Reviewed April 2008.)

The Volterra Chronicles: The Life and Times of an Extraordinary Mathematician, by Judith R. Goodstein. AMS, February 2007. ISBN-13: 978-0-8218-3969-0. (Reviewed March 2008.)

The Wraparound Universe, by Jean-Pierre Luminet. A K Peters, March 2008. ISBN 978-15688-130-97. (Reviewed December 2008.)

Zeno's Paradox: Unraveling the Ancient Mystery behind the Science of Space and Time, by Joseph Mazur. Plume, March 2008 (reprint edition). ISBN-13: 978-0-4522-8917-8.

Mathematics Calendar

January 2009

* 5–February 6 **Progress in Stein's Method**, Institute for Mathematical Sciences National University of Singapore, Singapore.

Description: In view of the breadth and diversity of these and other recent advances, the time is now ripe to hold a further program, with the aim of bringing together the people actively involved in the area, and of cementing and further promoting the development of the field. In addition to the general scientific aim, program is also designed to develop research in Stein's method in Southeast Asia, where there is a growing interest in the method. It also aims, by way of a series of tutorial lectures, to encourage more young mathematicians to undertake research in the field.

Information: <http://www.ims.nus.edu.sg/Programs/stein09/index.htm>; email: imscec@nus.edu.sg.

* 25–30 **"First Winter School at IMDEA on PDE's and Inequalities"**, IMDEA Matematicas, C-IX, UAM, Campus Cantoblanco, (28049) Madrid, Spain.

Description: A Winter School on PDEs and Inequalities with Courses by Almut Burchard (Toronto); Frank Duzaar (Erlangen); Nicola Fusco (Naples). Invited lectures and short talks.

Information: For more information and registration; visit: <http://www-dimat.unipv.it/~pratelli/pde2009>; <http://mate.dm.uba.ar/~jrossi/pde2009>; or you may contact: xemailpde2009@imdea.org.

February 2009

* 19–20 **Ph.D's in Logic**, Department of Pure Mathematics and Computer Algebra, Ghent University, Building S22, Krijgslaan 281, 9000 Gent, Belgium.

Description: The aim of the colloquium is to bring together young researchers in the field of logic. During these two days there will be 6 tutorials in total, 3 about mathematical and 3 about philosophical logic. In addition, Ph.D. students and postdocs in mathematical or philosophical logic are invited to give a presentation. In combination with the planned social activity this will hopefully lead to a better overview of the current research in logic and even joint work. Of course, everyone is invited to attend the tutorials and contributed talks! Tutorials in mathematical logic: Raf Cluckers (K.U. Leuven), Benedikt Löwe (University of Amsterdam), Françoise Point (Mons-Hainaut University). Tutorials in philosophical logic: Reinhard Muskens (Tilburg University), Karl-Georg Niebergall (HU Berlin), Jean Paul Van Bendegem (Vrije Universiteit Brussel).

Information: <http://www.phdsinlogic.ugent.be>.

March 2009

* 22–28 **Talbot Workshop 2009: Fukaya Categories**, Nags Head, North Carolina.

Description: Workshop focused on the construction of the Fukaya category associated to a symplectic manifold and the geometric structure it encodes. Specifically, topics developed will include A-infinity categories, Lagrangian Floer (co)-homology and its obstructions, the Fukaya and derived Fukaya categories, and applications to questions in symplectic geometry and the Homological Mirror Symmetry conjecture. Discussions will have an expository character and will be aimed at graduate students and junior faculty interested in this area.

Information: <http://math.mit.edu/talbot>; email: gwilliam@math.northwestern.edu.

* 25–26 **Illinois Number Theory Celebration**, University of Illinois at Urbana-Champaign, Urbana, Illinois.

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 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. 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/>.

Description: This meeting will celebrate the 90th birthday of Paul Bateman and the 70th birthday of Bruce Berndt. Speakers include: George Andrews, Richard Askey, Heng-Huat Chan, Youn-Seo Choi, Brian Conrey, Ron Evans, Marvin Knopp, Hugh Montgomery, Wolfgang Schmidt, Robert Vaughan, and Ae Ja Yee. A banquet honoring Bruce and Paul will be held the evening of March 25, and the evening of March 26 will be dedicated to the memory of Paul Erdos, with reminiscences of Erdos at Illinois and a showing of the film "N is a Number".

Information: <http://www.math.uiuc.edu/intc2009/>;

April 2009

- * 2-4 **International Conference on Multimedia Computing and Systems (ICMCS'09)**, Polydisciplinary Faculty of Ouarzazate, Morocco.

Description: ICMCS'09 is organized with the objective of bringing together researchers, developers, and practitioners from academia and industry working in all facets of multimedia, content authoring, processor technology, and systems design.

Information: <http://www.icmcs09.org>; email: bouzahir@ensa-agadir.ac.ma.

- * 6-9 **BMC 2009/IMS This is a joint meeting of the 61st British Mathematical Colloquium and the 22nd annual meeting of the Irish Mathematical Society**, National University of Ireland, Galway, Ireland.

Description: This is the annual forum in the UK at which leading mathematicians present their work to a general mathematical audience. The 2009 BMC is being held for the first time outside the UK, in Galway, Ireland!

Plenary Speakers: David Eisenbud (Berkeley), Ben Green (Cambridge), Ron Graham (San Diego), Rostislav Grigorchuk (Texas A&M) and Frances Kirwan (Oxford), together with twelve Morning Speakers. A Public Lecture will be held by Tom Koerner (Cambridge). There will be a Special Session on Computational Algebra led by Eamonn O'Brien (Auckland) and Goetz Pfeiffer (Galway) and a Special Session on Analysis led by David Preiss (Warwick), Sean Dineen (Dublin) and Ray Ryan (Galway). There will be opportunities to present talks at various splinter groups.

Information: <http://www.maths.nuigalway.ie/bmc2009/>; email: James.Ward@nuigalway.ie.

- * 19-May 2 **Spring School on Fluid Mechanics and Geophysics of Environmental Hazards**, Institute for Mathematical Sciences, National University of Singapore, Singapore.

Description: This School is intended to focus on fluid mechanical aspects, and is aimed at students who have already graduated in mathematics, physics or engineering, and who wish to undertake research in this broad area. It is intended to bring students rapidly to current research frontiers in the fluid mechanics of environmental hazards. The School will start with introductory and motivational lectures on the fundamentals of geophysical fluid dynamics, and on geophysical hazard and risk in atmosphere and ocean contexts, and will then focus on four specific environmental hazards: typhoons and tropical cyclones; monsoons and flooding; tsunamis; pollution of atmosphere, ocean and the urban environment.

Information: <http://ims.nus.edu.sg/Programs/09fluidss/index.htm>; email: imsec@nus.edu.sg.

- * 28-30 **CMIS2009 5th Contact Mechanics International Symposium**, Technical University of Crete, Chania, Crete, Greece.

Description: Previous contact mechanics symposia of this series have been organized in Lausanne, Switzerland, 1992, Carry Le Rouet, France, 1994, Praia da Consolacao, Portugal, 2001 and Hannover, Germany 2006.

Information: <http://www.cmis2009.tuc.gr>; email: gestavr@dpem.tuc.gr.

May 2009

- * 27-30 **17th biennial conference of the Association of Christians in the Mathematical Sciences**, Wheaton College, Wheaton, Illinois.

Main speaker: David Bressoud (Macalester College) is the main speaker and will present two talks.

Other invited speakers: James Sellers (Penn State University) and James Bradley (John Templeton Foundation).

Abstracts: Of contributed papers will be accepted for consideration until January 31, 2009.

Organizer: Terry Perciante (Terry.Perciante@wheaton.edu).

Information: <http://www.acmsonline.org>; email: Robert.L.Brabenec@wheaton.edu.

June 2009

- * 1-3 **Second Global Conference on Power Control and Optimization (PCO-2009)**, Bali, Indonesia.

Description: The main objective of PCO-09 is to provide a platform for researchers, engineers, practitioners and academicians as well as industrial professionals to present their research results and development activities. This conference, as part of discussing the results, ensures to provide opportunities for delegates to exchange new innovative ideas and application experiences face to face, and to provide a platform where possible entrepreneurs can think of new ventures, or generate research contacts and find global partners for future collaboration.

Deadlines: Paper Submission: 01/02/09. Formal acceptance: (letter with peer review) 01/03/09. Camera Ready Paper: 04/15/09. For paper submission via e-mail: icpco.20@gmail.com. All correspondence should be addressed to the conference secretariat: Chairman Professor Dr. Nader Barsoum, Malaysia; Conference Secretary Pandian Vasant, Malaysia; email: icpco.20@gmail.com; <http://www.engedu2.net>.

- * 1-5 **Geometry & Topology at Muenster 2009**, University of Muenster, Muenster, Germany.

Description: The conference will represent a wide variety of topics of current interest in the topology of manifolds, homotopy theory, geometric group theory, low-dimensional topology, symplectic geometry, and non-commutative geometry.

Organizers: Wolfgang Lück (Münster), Ian Hambleton (McMaster), Erik Pedersen (Copenhagen).

Information: <http://www.math.ku.dk/~erik/muenster/>; email: hambleton@mcmaster.ca.

- * 1-28 **Statistical Genomics**, Institute for Mathematical Sciences, National University of Singapore, Singapore.

Description: The new era of genomic studies has created great opportunities and also posed enormous challenges. To face up the challenges in synergy, it is of great interest to gather together prominent geneticists, statistical geneticists and the like to exchange their views and ideas on the ongoing and future development of genomic studies. The program will provide a platform for them to argue, to debate, and to interact with each other. The program will also provide an opportunity for young researchers and graduate students to learn directly from the authorities of the field and to get inspired for their further research. The program will consist of two workshops, one on Gene Mapping and the other on Genomic Profiling, and a graduate summer school.

Information: <http://ims.nus.edu.sg/Programs/genomics09/index.htm>.

- * 8-11 **25th Nordic and 1st British-Nordic congress of Mathematicians**, University of Oslo, Oslo, Norway.

Description: This is a general mathematical congress arranged by the mathematical societies of Denmark, Finland, Iceland, Norway and Sweden as well as London Mathematical Society and Edinburgh Mathematical Society.

Speakers: There will be 11 main speakers at the congress each giving 50 minutes talks in the morning sessions. In addition there will be 7 parallel special sessions each afternoon. The main speakers and the programs of the special sessions are announced here: <http://www.math.uio.no/2009/scientific/>. Also mathematicians outside Britain and the Nordic countries are welcome to attend

Information: <http://www.math.uio.no/2009/>; email: brat-teli@math.uio.no.

- * 8-19 **Recent Developments in Dynamic Equations on Time Scales**, University of Wyoming, Laramie, Wyoming.

Description: We will be concerned with a so-called dynamic equation on a time scale (a time scale is just a closed subset of the real numbers). If the time scale is the set of real numbers, then the dynamic equation is a differential equation, while if the time scale is the integers, then the dynamic equation is a difference equation. Hence our

study will be a unification and generalization of these two areas of mathematics. No previous knowledge of time scales will be assumed, but we will particularly be interested in new developments and applications of this area of research. Anyone interested in either differential equations or difference equations will be interested in this 2009 Rocky Mountain Mathematics Consortium Conference.

Speakers: Martin Bohner, Missouri University of Science and Technology, Allan Peterson, University of Nebraska-Lincoln, Chris Ahrendt, University of Nebraska-Lincoln

Sponsors: Rocky Mountain Mathematics Consortium. IMA and NSF Funding possible.

Deadline: For applications/abstracts of talks: April 1, 2009.

Information: A. Duane Porter; adporter@uwyo.edu, Department of Mathematics, University of Wyoming, Laramie, WY 82071. For information about Laramie, <http://www.laramie.org/>.

* 21-27 **2nd Mile High Conference on Nonassociative Mathematics**, University of Denver, Denver, Colorado.

Description: This is an international conference on loops, quasigroups, latin squares, nonassociative algebras, applications of non-associative algebras to physics, and other aspects of nonassociative mathematics.

Main Speakers: Murray Bremner (University of Saskatchewan, Canada); Diane Donovan (University of Queensland, Australia); Richard M. Green (University of Colorado, USA); Ling Long (Iowa State University, USA); Shahn Majid (Queen Mary, UK); Gabor P. Nagy (University of Szeged, Hungary); J. D. Phillips (Wabash College, USA); Ivan Shestakov (University of Sao Paulo, Brazil).

Program and Organizing Committee: Piroska Csorgo (Eotvos Lorand University); Kenneth W. Johnson (Penn State Abington); Michael K. Kinyon (University of Denver); G. Eric Moorhouse (University of Wyoming); Jonathan D. H. Smith (Iowa State University); Petr Vojtechovsky (University of Denver).

Information: Contact: milehigh@math.du.edu; <http://www.math.du.edu/milehigh/>.

* 23-26 **The 33rd Summer Symposium in Real Analysis**, Southeastern Oklahoma State University, Durant, Oklahoma.

Description: This conference, jointly sponsored by the host institutions and the Real Analysis Exchange has been held annually since 1978, twice in 1982, and is considered to be the premier conference of its type by members of the real analysis community.

Main Speakers: This years main speakers include Udayan Darji (University of Louisville), Steve Jackson (North Texas University) and Marton Elekes (Eotvos Lorand University, Budapest).

Information: <http://www.stolaf.edu/people/analysis>; email: humke@stolaf.edu.

* 28-July 25 **UA VIGRE: Arizona Summer Program 2009**, University of Arizona, Tucson, Arizona.

Description: The 2009 Arizona Summer Program will be an exciting 4-week research experience for undergraduates in Computational Photonics. There will be a number of lectures given by experts covering computational, mathematical, physical and engineering aspects of the subject accompanied by hands-on computational research experience. Our aim is to expose the role of mathematics in the emerging field of nano-optics, and to provide qualified undergraduates with research experience that promotes learning skills necessary for success in graduate school and in industrial R&D environments. Students will work on their projects related to the ongoing research at the Arizona Center for Mathematical Sciences (Prof. J.V. Moloney, Director, see <http://www.acms.arizona.edu>), and R&D division of the Raytheon Corporation (Dr. P. Kano, senior scientist) in the area of Computational Photonics.

Information: <http://math.arizona.edu/~brio/Class/Summer09Info.html>; email: brio@math.arizona.edu.

July 2009

* 1-August 31 **Mathematical Theory and Numerical Methods for Computational Materials Simulation and Design**, Institute for Mathematical Sciences, National University of Singapore, Singapore.

Description: This two-month program will provide a forum for experts from interdisciplinary fields to discuss the various issues and challenges facing the community. It will bring leading international applied and pure mathematicians, physicists, materials scientists and

computational scientists together to review, develop and promote interdisciplinary researches on problems at the interface between mathematics and materials sciences. It will provide a forum to highlight the progress in a broad range of topics, within a coherent theme and with greater emphasis on the mathematical theory and numerical methods for computational materials simulation and design. The program activities will consist of two workshops, a summer school, public lectures, working seminars and collaborative research.

Information: <http://ims.nus.edu.sg/Programs/09mattheory/index.htm>; email: imscec@nus.edu.sg.

* 6-11 **Conference on Algebraic Topology CAT'09**, University of Warsaw, Warsaw, Poland.

Description: CAT'09 will be the seventh in a series of quadrennial conferences on algebraic topology organized in Poland since 1985. The aim of the conference is to bring together mathematicians working in different areas of algebraic and geometric topology. The conference will be devoted to a wide spectrum of research in the areas of homotopy theory, topology of manifolds, geometric group theory and homotopy in algebraic geometry. The program will emphasize applications and connections between various fields and is intended to promote exchanges of ideas among mathematicians working in different areas related to algebraic topology.

Information: <http://www.mimuw.edu.pl/~cat09/>; email: cat09@mimuw.edu.pl.

* 13-16 **MULTICONF-09**, Orlando, Florida.

Description: The 2009 Multi Conference in Computer Science, Information Technology and Control systems and Computational Science and Computer Engineering (MULTICONF-09) will be held July 13-16 2009. We invite draft paper submissions. The event consists of ten different international conferences. We invite draft paper submissions. The event consists of ten different international conferences.

Information: For more details please visit: <http://www.PromoteResearch.org>; email: jeedward@yahoo.com.

* 13-17 **Permutation Patterns 2009**, Dipartimento di Sistemi e Informatica, Università di Firenze, Firenze, Italy.

Description: The topic of the conference is the study of patterns in permutations and words. Conference themes include (but are not limited to) enumeration questions, excluded pattern questions, study of the involvement order, algorithms for computing with permutation patterns, applications and generalizations of permutation patterns, and others.

Information: <http://www.dsi.unifi.it/~PP2009/>; email: ferrari@dsi.unifi.it.

* 13-18 **7th International ISAAC Congress**, Imperial College, London, United Kingdom.

Description: The ISAAC congress is a major international conference in analysis, its applications and computation. The primary goal of the congress is to bring together mathematicians working in these fields to discuss the latest progress in the area. The congress will consist of around 20 sessions devoted to different subjects in real, complex, harmonic, spectral and stochastic analysis, linear and non-linear partial differential equations of different types and their computational and applicational aspects. The International Society for Analysis, its Applications and Computation (ISAAC) has been organising the International ISAAC Congress biannually since 1997. The previous congresses took place in the USA (Delaware 1997), Japan (Fukuoka 1999), Germany (Berlin 2001), Canada (Toronto 2003), Italy (Catania 2005) and Turkey (Ankara 2007).

Information: <http://www.isaac2009.org>; email: j.wirth@imperial.ac.uk.

* 20-31 **2009 ESSLI Student Session**, Bordeaux, France.

Description: The 2009 ESSLI Student Session will take place from July 20 to July 31 in Bordeaux, France, as part of the annual European Summer School in logic, language, and computation. We hereby invite paper submissions from students in the areas of logic and computation, logic and language, and language and computation for presentation in the oral session or in the poster session. All submissions will be reviewed by three experts in the field, and those selected for presentation will be published in the proceedings. The Student Session is an excellent venue to present work in progress, and also to gain experience presenting one's research to a wide audience. As in previous years, Springer is offering 500 Euro in textbooks for the best

paper award, and 250 Euro in textbooks to each of two runners-up. The deadline for submission is February 1, 2009. For more details, please see the full call for papers: <http://www.stanford.edu/~icard/esslli/call>.

Information: <http://www.stanford.edu/~icard/esslli/>; email: icard@stanford.edu.

August 2009

- * 3-8 **XVI International Congress on Mathematical Physics (ICMP09)**, Clarion Congress Hotel Prague, Prague, Czech Republic.

Description: Following the tradition formed over several decades, the triennial congresses of the International Association of Mathematical Physics are the largest mathematical-physics conventions. The ICMP09 will be a major event: New results in the field and future challenges will be discussed, illustrating the richness and vitality of this branch of science. Registration will be open from the beginning of 2009. We hope that you will be able to attend and contribute to the success of the meeting. Please indicate your interest by pre-registering on the conference web-site at <http://www.icmp09.com/indication-of-interest>. A Young Researcher Symposium will be held from July 31-August 1, 2009.

Information: <http://www.icmp09.com>.

- * 10-14 **Topological complexity of random sets**, American Institute of Mathematics, Palo Alto, California.

Description: This workshop, sponsored by AIM and the NSF, will be devoted to the developing field of random maps between manifolds and their geometric properties.

Information: <http://www.aimath.org/ARCC/workshops/randomsets.html>; email: ebasor@aimath.org.

- * 12-14 **18th USENIX Security Symposium**, Le Centre Sheraton Hotel Montreal, 1201 Boulevard Rene-Levesque, West Montreal, Quebec H3B 2L7 Canada.

Description: The USENIX Security Symposium brings together researchers, practitioners, system administrators, system programmers, and others interested in the latest advances in the security of computer systems and networks.

Information: <http://www.usenix.org/events/sec09/>.

- * 27-29 **Ukrainian Mathematical Congress 2009 (Dedicated to the Centennial of Nikolai N. Bogoliubov)**, Institute of Mathematics of NASU, Kiev (Kyiv), Ukraine.

Sessions: Algebra and Number Theory; Dynamical Systems; Differential Equations and Nonlinear Oscillations; Complex Analysis and Potential Theory; Mathematical Physics; Statistical Mechanics and Quantum Field Theory; Functional Analysis; Numerical Mathematics and Mathematical Problems of Mechanics; Probability Theory and Mathematical Statistics; Approximation Theory and Harmonic Analysis; Topology and Geometry; Applied Mathematical Problems.

Information: <http://www.imath.kiev.ua/~congress2009/en/>; email: congress2009@imath.kiev.ua.

- * 30-September 4 **Algebraic Groups and Invariant Theory**, Centro Stefano Francini, Ascona, Switzerland.

Description: The main focus is on recent developments in the theory of semisimple algebraic groups and their Lie algebras.

Topics: W-algebras, invariants of subalgebras, nilpotent orbits, geometric representation theory.

Short courses: V. Ginzburg, A. Joseph, A. Premet.

Organizing Committee: K. Baur (ETH Zurich), A. Premet (Manchester), D. Testerman (EPFL Lausanne)

Plenary speakers to include: Donkin, Duflo, Fauquant-Millet, Kac, Kleshchev, Kostant, Kraft, Littellmann, McNinch, Serre, Vilonen, Walach.

Financial support: Some financial support is available for young participants and eastern European participants.

Information: <http://www.math.ethz.ch/~baur/AGIT/>; email: donna.testerman@epfl.ch.

September 2009

- * 4-9 **2nd Dolomites Workshop on Constructive Approximation and Applications (DWCAA09)**, Alba di Canazei, Trento, Italy.

Description: DWCAA09 proposes 8 main invited lectures, 4 sessions of contributed talks and a poster session.

Keynote speakers: C. de Boer (Madison, USA); N. Dyn (Tel-Aviv, IL); G. Meurant (Paris, F); R. Schaback (Goettingen, D); I.H. Sloan (Sydney, AU); N. Trefethen (Oxford, UK); H. Wendland (Brighton, UK); Y. Xu (Eugene OR, USA).

Information: <http://www.math.unipd.it/~dwcaa09>; email: marcov@math.unipd.it.

- * 8-December 11 **Long Program: Combinatorics: Methods and Applications in Mathematics and Computer Science**, Institute for Pure and Applied Mathematics (IPAM), UCLA, Los Angeles, California.

Overview: Combinatorics studies discrete objects and their properties. This program will focus specifically on several major research topics in modern Discrete Mathematics and puts an emphasis on the exchange of ideas, approaches and techniques between various areas of Discrete Mathematics and Computer Science and on the identification of new tools from other areas of mathematics which can be used to solve combinatorial problems.

Organizing Committee: Noga Alon, Gil Kalai, Janos Pach, Vera Sos, Angelika Steger, Benjamin Sudakov, Terence Tao.

Application/Registration: An application and registration form is available at <http://www.ipam.ucla.edu/programs/cma2009>. Applications received by July 27, 2009 will receive fullest consideration. Encouraging the careers of women and minority mathematicians and scientists is an important component of IPAM's mission and we welcome their applications. You may also register and attend without IPAM funding.

Information: <http://www.ipam.ucla.edu/programs/cma2009/>; email: sbeggs@ipam.ucla.edu.

- * 9-16 **Combinatorics: Methods and Applications in Mathematics and Computer Science, Tutorials**, Institute for Pure and Applied Mathematics (IPAM), UCLA, Los Angeles, California.

Overview: Tutorials provide an introduction to several major research topics in modern discrete mathematics, including probabilistic methods, extremal problems for graphs and set systems, Ramsey theory, additive number theory, combinatorial geometry, discrete harmonic analysis and more.

Goal: The goal is to familiarize the prospective participants with the techniques which were developed in Combinatorics in the last few decades. Registration for tutorials is free.

Organizing Committee: Noga Alon, Gil Kalai, Janos Pach, Vera Sos, Angelika Steger, Benjamin Sudakov, Terence Tao.

Application/Registration: An application and registration form is available at: <http://www.ipam.ucla.edu/programs/cmatut>. Applications received by July 29, 2009 will receive fullest consideration. Encouraging the careers of women and minority mathematicians and scientists is an important component of IPAM's mission and we welcome their applications. You may also simply register and attend without IPAM funding.

- * 10-12 **Quantum topology and Chern-Simons theory**, Institut de Recherche Mathématique Avancée, Université de Strasbourg, 7 rue René Descartes, Strasbourg, France.

Description: The meeting is No. 84 in the series "Encounter Between Mathematicians and Theoretical Physicists". The focus is on quantum topology and Chern-Simons theory. There will be survey lectures and specialized talks.

Invited speakers: A. Alekseev (Geneva), J. E. Andersen (Aarhus), F. Costantino (Strasbourg), V. Fock (Strasbourg), S. Garoufalidis (Georgia Tech), R. Kashaev (Genève), G. Masbaum (Paris 7), K. Noui (Tours), N. Reshetikhin (Amsterdam), B. Schroers (Edinburgh), Teschner (Hamburg), G. Thompson (Trieste).

Organization and information: Gwenael Massuyeau and Athanase Papadopoulos; email: massuyeau@math.u-strasbg.fr; papadopoulos@math.u-strasbg.fr.

Information: <http://www-irma.u-strasbg.fr/article744.html>; email: papadopoulos@math.u-strasbg.fr.

November 2009

- * 1-December 31 **Financial Mathematics**, Institute for Mathematical Sciences, National University of Singapore, Singapore.

Description: This program will be focusing on, but not limited to, the following three areas: 1) the pricing and hedging of environmental and energy-related financial derivatives; 2) risk and robust optimization; 3) optimal stopping and singular stochastic control problems in finance.

—Save the Date—

CLAY RESEARCH Conference

May 4–5, 2009

Cambridge, MA

[venue to be announced]

The Clay Mathematics Institute's annual conference featuring eight lectures on recent research developments and presentation of the Clay Research Awards.

Confirmed speakers

Heisuke Hironaka
Dinakar Ramakrishnan
Kannan Soundararajan

To preview lecture videos and program information from previous conferences and the full 2009 program (tba), see

www.claymath.org/researchconference

These areas form the substance of 3 workshops in the two-month long program. The workshops are intended for researchers working in the specific areas to congregate, cross-pollinate ideas, exchange knowledge, and together advance the mathematical frontiers in publishing and disseminating rigorous pieces of scholastic work.

Information: <http://ims.nus.edu.sg/Programs/financialm09/index.htm>; email: imscec@nus.edu.sg.

*2–6 **Combinatorics: Topics in Graphs and Hypergraphs**, Institute for Pure and Applied Mathematics (IPAM), UCLA, Los Angeles, California.

Overview: The workshop will focus on several research directions in modern graph and hypergraph theory including Ramsey theory, extremal problems for graphs and hypergraphs and in particular Turan-type questions, extremal set theory and its applications to information theory, computer science and coding theory, algebraic methods in extremal combinatorics, Szemerédi's regularity lemma for graphs and hypergraphs and its application to number theory and property testing.

Organizing Committee: Penny Haxell, Dhruv Mubayi, Vera Sos, Benjamin Sudakov, Jacques Verstraëte

Application/Registration: An application and registration form is available at: <http://www.ipam.ucla.edu/programs/cmaws3/>. Applications received by Sept. 21, 2009 will receive fullest consideration. Encouraging the careers of women and minority mathematicians and scientists is an important component of IPAM's mission and we welcome their applications. You may also register and attend without IPAM funding.

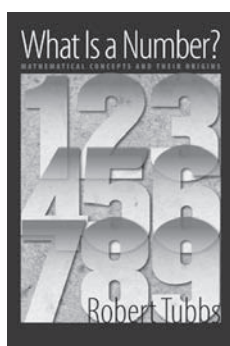
Information: <http://www.ipam.ucla.edu/programs/cmaws3/>; email: sbeggs@ipam.ucla.edu.

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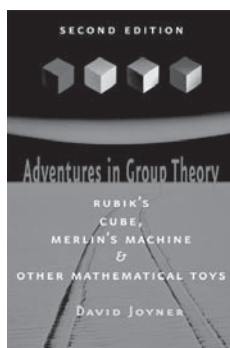
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AMERICAN MATHEMATICAL SOCIETY



2009 Spring AMS Sectional Meetings

March 27–29, 2009 (Friday–Sunday)
University of Illinois at Urbana-Champaign, Urbana, IL
(2009 Spring Central Section Meeting)

April 4–5, 2009 (Saturday–Sunday)
North Carolina State University, Raleigh, NC
(2009 Spring Southeastern Section Meeting)

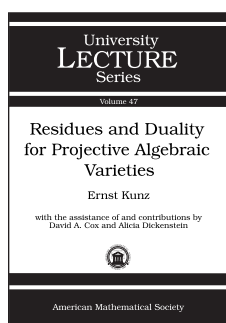
April 25–26, 2009 (Saturday–Sunday)
Worcester Polytechnic Institute, Worcester, MA
(2009 Spring Eastern Section Meeting)

April 25–26, 2009 (Saturday–Sunday)
San Francisco State University, San Francisco, CA
(2009 Spring Western Section Meeting)

New Publications Offered by the AMS

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Algebra and Algebraic Geometry



Residues and Duality for Projective Algebraic Varieties

Ernst Kunz, *University of Regensburg, Germany*
with the assistance of and
contributions by David A. Cox,
Amherst College, MA, and Alicia
Dickenstein, *University of Buenos
Aires, Argentina*

This book, which grew out of lectures by E. Kunz for students with a background in algebra and algebraic geometry, develops local and global duality theory in the special case of (possibly singular) algebraic varieties over algebraically closed base fields. It describes duality and residue theorems in terms of Kähler differential forms and their residues. The properties of residues are introduced via local cohomology. Special emphasis is given to the relation between residues to classical results of algebraic geometry and their generalizations. The contribution by A. Dickenstein gives applications of residues and duality to polynomial solutions of constant coefficient partial differential equations and to problems in interpolation and ideal membership. D. A. Cox explains toric residues and relates them to the earlier text.

The book is intended as an introduction to more advanced treatments and further applications of the subject, to which numerous bibliographical hints are given.

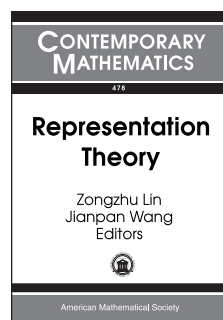
This item will also be of interest to those working in analysis.

Contents: Local cohomology functors; Local cohomology of noetherian affine schemes; Čech cohomology; Koszul complexes and local cohomology; Residues and local cohomology for power series rings; The cohomology of projective schemes; Duality and residue theorems for projective space; Traces, complementary modules, and differentials; The sheaf of regular differential forms on

an algebraic variety; Residues for algebraic varieties. Local duality; Duality and residue theorems for projective varieties; Complete duality; Applications of residues and duality; Toric residues; Bibliography; Index.

University Lecture Series, Volume 47

December 2008, 158 pages, Softcover, ISBN: 978-0-8218-4760-2, LC 2008038860, 2000 *Mathematics Subject Classification*: 14Fxx, 14F10, 14B15; 32A27, 14M10, 14M25, **AMS members US\$31**, List US\$39, Order code ULECT/47



Representation Theory

Zongzhu Lin, *Kansas State University, Manhattan, KS*, and
Jianpan Wang, *East China Normal University, Shanghai, People's Republic of China*,
Editors

Articles in this volume cover topics related to representation theory of various algebraic objects such as algebraic groups, quantum groups, Lie algebras, (finite- and infinite-dimensional) finite groups, and quivers. Collected in one book, these articles show deep relations between all these aspects of representation theory, as well as the diversity of algebraic, geometric, topological, and categorical techniques used in studying representations.

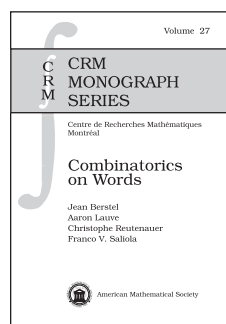
Contents: H. H. Andersen, Sum formulas and Ext-groups; S. Doty, Schur-Weyl duality in positive characteristic; A. Francis and W. Wang, The centers of Iwahori-Hecke algebras are filtered; **University of Georgia Vigre Algebra Group**, On Kostant's theorem for Lie algebra cohomology; X. He, G -stable pieces and partial flag varieties; L. Ji, Steinberg representations and duality properties of arithmetic groups, mapping class groups, and outer automorphism groups of free groups; S. Kumar, G. Lusztig, and D. Prasad, Characters of simplylaced nonconnected groups versus characters of nonsimplylaced connected groups; G. Liu, Classification of finite-dimensional basic Hopf algebras according to their representation type; G. Lusztig, Twelve bridges from a reductive group to its Langlands dual; B. J. Parshall and

L. L. Scott, Some new highest weight categories; **I. Pop** and **A. Stolin**, Classification of quasi-trigonometric solutions of the classical Yang-Baxter equation; **C. M. Ringel**, The relevance and the ubiquity of Prüfer modules; **A. Savage**, Quivers and the Euclidean group; **S. Shang** and **Y. Gao**, \mathfrak{su}_2 -Lie admissible algebras and Steinberg unitary Lie algebras; **T. Shoji**, Lusztig's conjecture for finite classical groups with even characteristic; **Y. Su**, A survey on quasifinite representations of Weyl type Lie algebras; **N. Xi**, Maximal and primitive elements in baby Verma modules for type B_2 ; **Y.-F. Yao** and **B. Shu**, Irreducible representations of the special algebras in prime characteristic.

Contemporary Mathematics, Volume 478

February 2009, 295 pages, Softcover, ISBN: 978-0-8218-4555-4, LC 2008034291, 2000 *Mathematics Subject Classification*: 16Gxx, 17Bxx, 20Cxx, 20Gxx; 17B10, 17B20, 17B37, 17B45, 17B56, 20G05, 20G10, 20G42, 20C05, 20C08, 20C30, **AMS members US\$71**, List US\$89, Order code CONM/478

Applications



Combinatorics on Words

Christoffel Words and Repetitions in Words

Jean Berstel, *Université de Marne-la-Vallée, France*, **Aaron Lauve**, *Texas A&M University, College Station, TX*, and **Christophe Reutenauer** and **Franco V. Saliola**, *Université du Québec à Montréal, QC, Canada*

The two parts of this text are based on two series of lectures delivered by Jean Berstel and Christophe Reutenauer in March 2007 at the Centre de Recherches Mathématiques, Montréal, Canada. Part I represents the first modern and comprehensive exposition of the theory of Christoffel words. Part II presents numerous combinatorial and algorithmic aspects of repetition-free words stemming from the work of Axel Thue—a pioneer in the theory of combinatorics on words.

A beginner to the theory of combinatorics on words will be motivated by the numerous examples, and the large variety of exercises, which make the book unique at this level of exposition. The clean and streamlined exposition and the extensive bibliography will also be appreciated. After reading this book, beginners should be ready to read modern research papers in this rapidly growing field and contribute their own research to its development.

Experienced readers will be interested in the finitary approach to Sturmian words that Christoffel words offer, as well as the novel geometric and algebraic approach chosen for their exposition. They will also appreciate the historical presentation of the Thue–Morse word and its applications and the novel results on Abelian repetition-free words.

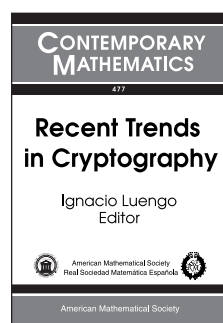
This item will also be of interest to those working in analysis and number theory.

Titles in this series are co-published with the Centre de Recherches Mathématiques.

Contents: *Part I. Christoffel words:* Christoffel words; Christoffel morphisms; Standard factorization; Palindromization; Primitive elements in the free group F_2 ; Characterizations; Continued fractions; The theory of Markoff numbers; *Part II. Repetitions in words:* The Thue–Morse word; Combinatorics of the Thue–Morse word; Square-free words; Squares in words; Repetitions and patterns; Bibliography; Index.

CRM Monograph Series, Volume 27

January 2009, 147 pages, Hardcover, ISBN: 978-0-8218-4480-9, LC 2008036669, 2000 *Mathematics Subject Classification*: 68R15; 37B10, 11J70, 68W40, **AMS members US\$41**, List US\$51, Order code CRMM/27



Recent Trends in Cryptography

Ignacio Luengo, *Universidad Complutense de Madrid, Spain*, Editor

This volume contains articles representing the courses given at the 2005 RSME Santaló Summer School on “Recent Trends in Cryptography”. The main goal of the Summer School was to present some

of the recent mathematical methods used in cryptography and cryptanalysis. The School was oriented to graduate and doctoral students, as well as recent doctorates. The material is presented in an expository manner with many examples and references.

The topics in this volume cover some of the most interesting new developments in public key and symmetric key cryptography, such as pairing based cryptography and lattice based cryptanalysis.

This item will also be of interest to those working in number theory.

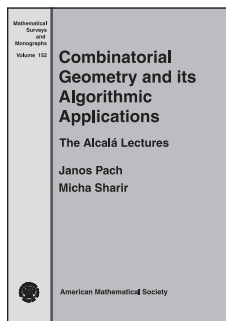
This book is copublished by the Real Sociedad Matemática Española and the American Mathematical Society.

Contents: **A. Fúster-Sabater**, Cellular automata in stream ciphers; **T. Hellese**, Linear and nonlinear sequences and applications to stream ciphers; **A. Menezes**, An introduction to pairing-based cryptography; **P. Q. Nguyen**, Public-key cryptanalysis; **I. E. Shparlinski**, Pseudorandom number generators from elliptic curves.

Contemporary Mathematics, Volume 477

February 2009, 141 pages, Softcover, ISBN: 978-0-8218-3984-3, LC 2008033089, 2000 *Mathematics Subject Classification*: 94Axx, 94A60, 94A62, 11T71, 14G50, 68P25, 14H52, **AMS members US\$39**, List US\$49, Order code CONM/477

Discrete Mathematics and Combinatorics



Combinatorial Geometry and Its Algorithmic Applications

The Alcalá Lectures

János Pach, *Courant Institute of Mathematical Sciences, New York, NY*, and Micha Sharir, *Tel Aviv University, Israel*

Based on a lecture series given by the authors at a satellite meeting of the 2006 International Congress of Mathematicians and on many articles written by them and their collaborators, this volume provides a comprehensive up-to-date survey of several core areas of combinatorial geometry. It describes the beginnings of the subject, going back to the nineteenth century (if not to Euclid), and explains why counting incidences and estimating the combinatorial complexity of various arrangements of geometric objects became the theoretical backbone of computational geometry in the 1980s and 1990s. The combinatorial techniques outlined in this book have found applications in many areas of computer science from graph drawing through hidden surface removal and motion planning to frequency allocation in cellular networks.

Combinatorial Geometry and Its Algorithmic Applications is intended as a source book for professional mathematicians and computer scientists as well as for graduate students interested in combinatorics and geometry. Most chapters start with an attractive, simply formulated, but often difficult and only partially answered mathematical question, and describes the most efficient techniques developed for its solution. The text includes many challenging open problems, figures, and an extensive bibliography.

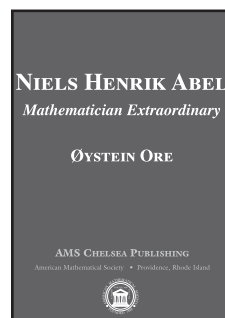
This item will also be of interest to those working in applications.

Contents: Sylvester-Gallai problem: The beginnings of combinatorial geometry; Arrangements of surfaces: Evolution of the basic theory; Davenport-Schinzel sequences: The inverse Ackermann function in geometry; Incidences and their relatives: From Szemerédi and Trotter to cutting lenses; Crossing numbers of graphs: Graph drawing and its applications; Extremal combinatorics: Repeated patterns and pattern recognition; Lines in space: From ray shooting to geometric transversals; Geometric coloring problems: Sphere packings and frequency allocation; From Sam Loyd and László Fejes Tóth: The 15 puzzle and motion planning; Bibliography; Index.

Mathematical Surveys and Monographs, Volume 152

January 2009, 235 pages, Hardcover, ISBN: 978-0-8218-4691-9, LC 2008038876, 2000 *Mathematics Subject Classification*: 05C35, 05C62, 52C10, 52C30, 52C35, 52C45, 68Q25, 68R05, 68W05, 68W20, **AMS members US\$60**, List US\$75, Order code SURV/152

General and Interdisciplinary



Niels Henrik Abel

Mathematician
Extraordinary

Øystein Ore

This is a story of more than a century ago, about a circle of young scientists, and in particular one among them, a mathematician, Niels Henrik Abel. He is well known to any mathematician of today; indeed, few men have their

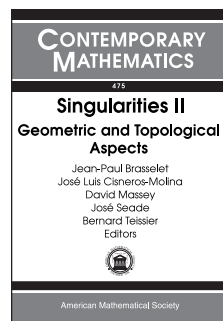
name associated with so many results and concepts in modern mathematics. This, however, is not the main concern in this book. It is rather the simple story of a scientist, his family and friends, his hopes and sorrows, his triumphs and tragedies. Many great lives, rich in outer events, have inspired biographers. But the profound humanity of a searching soul may provide the background for an equally arresting chronicle—the heart-warming tale of a young man who set out from a little Norwegian town to explore the world of science.

Contents: Family and childhood; At the university; Journey to the continent; The return; Epilogue; Bibliography; Index of names.

AMS Chelsea Publishing, Volume 274

October 2008, 277 pages, Hardcover, ISBN: 978-0-8218-4644-5, LC 73-14693, 2000 *Mathematics Subject Classification*: 01A70, 01A55, **AMS members US\$44**, List US\$49, Order code CHEL/274.H

Geometry and Topology



Singularities II

Geometric and Topological
Aspects

Jean-Paul Brasselet, *Institut de Mathématiques de Luminy-CNRS, Marseille, France*, José Luis Cisneros-Molina, *Universidad Nacional Autónoma de México, Cuernavaca, Mexico*, David Massey, *Northeastern University,*

Boston, MA, José Seade, *Universidad Nacional Autónoma de México, Cuernavaca, Mexico*, and Bernard Teissier, *Institut Mathématique de Jussieu-CNRS, Paris, France*, Editors

This is the second part of the proceedings of the “School and Workshop on the Geometry and Topology of Singularities”, held in Cuernavaca, Mexico, from January 8 to 26 of 2007, in celebration of the 60th Birthday of Lê Dũng Tráng.

This volume contains fourteen cutting-edge research articles on geometric and topological aspects of singularities of spaces and

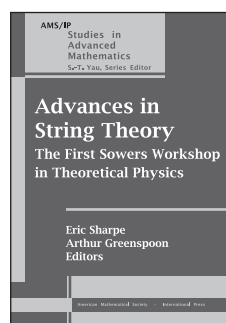
maps. By reading this volume, and the accompanying volume on algebraic and analytic aspects of singularities, the reader should gain an appreciation for the depth, breadth, and beauty of the subject and also find a rich source of questions and problems for future study.

Contents: S. Altinok and M. Bhupal, Minimal page-genus of Milnor open books on links of rational surface singularities; D. Chéniot, Homotopical variation; J. L. Cisneros-Molina, Join theorem for polar weighted homogeneous singularities; H. H. Vui and N. T. Thang, On the topology of polynomial functions on algebraic surfaces in \mathbb{C}^n ; H. A. Hamm, On theorems of Zariski-Lefschetz type; L. Hernández de la Cruz and S. López de Medrano, Some families of isolated singularities; D. Kerner, On the collisions of singular points of complex algebraic plane curves; L. Meersseman and A. Verjovsky, Sur les variétés LV-M; F. Michel, Jacobian curves for normal complex surfaces; M. Oka, Geometry of pencil of plane curves via Taylor expansions; P. Popescu-Pampu, On the cohomology rings of holomorphically fillable manifolds; R. N. Araújo dos Santos, Uniform (m)-condition and strong Milnor fibrations; M. Shubladze, On the topology of hyperplane singularities of finite codimension; C. Weber, On the topology of singularities.

Contemporary Mathematics, Volume 475

December 2008, 251 pages, Softcover, ISBN: 978-0-8218-4717-6, LC 2008028179, 2000 *Mathematics Subject Classification*: 14B05, 14E15, 14J17, 32Sxx, 34M35, 35A20, **AMS members US\$63**, List US\$79, Order code CONM/475

Mathematical Physics



Advances in String Theory

The First Sowers Workshop in Theoretical Physics

Eric Sharpe, *Virginia Polytechnic Institute & State University, Blacksburg, VA*, and **Arthur Greenspoon**, *American Mathematical Society, Ann Arbor, MI*, Editors

Over the past decade string theory has had an increasing impact on many areas of physics: high energy and hadronic physics, gravitation and cosmology, mathematical physics and even condensed matter physics. The impact has been through many major conceptual and methodological developments in quantum field theory in the past fifteen years. In addition, string theory has exerted a dramatic influence on developments in contemporary mathematics, including Gromov-Witten theory, mirror symmetry in complex and symplectic geometry, and important ramifications in enumerative geometry.

This volume is derived from a conference of younger leading practitioners around the common theme: "What is string theory?" The talks covered major current topics, both mathematical and physical, related to string theory.

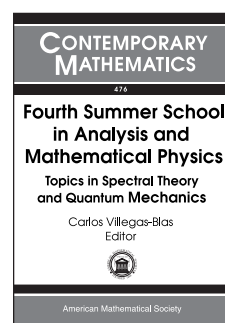
This item will also be of interest to those working in algebra and algebraic geometry.

Titles in this series are co-published with International Press, Cambridge, MA.

Contents: O. J. Ganor, Puff field theory; R. G. Leigh, T.-P. Choy, and P. Phillips, Mottness and strong coupling; A. C. Petkou, Holographic aspects of generalized electric-magnetic dualities; S. R. Das, Null and spacelike singularities and gauge-gravity duality; K. R. Dienes, M. Lennek, D. Sénéchal, and V. Wasnik, Is SUSY natural?; N. Kaloper, Brane induced gravity: Codimension-2; A. Hamilton, D. Kabat, G. Lifschytz, and D. A. Lowe, Local bulk operators in AdS/CFT and the fate of the BTZ singularity; L.-S. Tseng, Heterotic geometry and fluxes; L. Freidel, R. G. Leigh, D. Minic, and A. Yelnikov, On the spectrum of pure Yang-Mills theory; V. Balasubramanian, J. de Boer, S. El-Showk, and I. Messamah, Resolving black hole microstates; A. Tomasiello, Geometry of supersymmetric type II solutions; F. Larsen, Resolving gravitational singularities; E. Sharpe, Recent developments in heterotic compactifications; V. Braun, M. Kreuzer, B. A. Ovrut, and E. Scheidegger, Worldsheet instantons and torsion curves.

AMS/IP Studies in Advanced Mathematics, Volume 44

December 2008, 244 pages, Softcover, ISBN: 978-0-8218-4764-0, LC 2008039170, 2000 *Mathematics Subject Classification*: 81T30, 83E30, **AMS members US\$52**, List US\$65, Order code AMSIP/44



Fourth Summer School in Analysis and Mathematical Physics

Topics in Spectral Theory and Quantum Mechanics

Carlos Villegas-Blas, *Universidad Nacional Autónoma de México, Mexico*, Editor

This book consists of three expository articles written by outstanding researchers in mathematical physics: Rafael Benguria, Peter Hislop, and Elliott Lieb. The articles are based on their lectures at the Fourth Summer School in Analysis and Mathematical Physics, held at the Institute of Mathematics, Universidad Nacional Autónoma de México, Cuernavaca in May 2005.

The main goal of the articles is to link the basic knowledge of a graduate student in Mathematics with three current research topics in Mathematical Physics: Isoperimetric inequalities for eigenvalues of the Laplace Operator, Random Schrödinger Operators, and Stability of Matter, respectively.

These well written articles will guide and introduce the reader to current research topics and will also provide information on recent progress in some areas of Mathematical Physics.

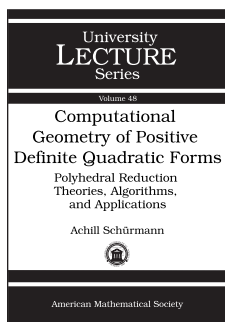
This book is co-published with Sociedad Matematica Mexicana.

Contents: R. D. Benguria and H. Linde, Isoperimetric inequalities for eigenvalues of the Laplace operator; P. D. Hislop, Lectures on random Schrödinger operators; E. H. Lieb, Quantum mechanics, the stability of matter and quantum electrodynamics.

Contemporary Mathematics, Volume 476

December 2008, 148 pages, Softcover, ISBN: 978-0-8218-4064-1, LC 2008028976, 2000 *Mathematics Subject Classification*: 81-02, 82D30, 35P05, 81Q99, **AMS members US\$39**, List US\$49, Order code CONM/476

Number Theory



Computational Geometry of Positive Definite Quadratic Forms

Polyhedral Reduction
Theories, Algorithms, and
Applications

Achill Schürmann, *Otto-von-Guericke Universität Magdeburg, Germany*

Starting from classical arithmetical questions on quadratic forms, this book takes the reader step by step through the connections with lattice sphere packing and covering problems. As a model for polyhedral reduction theories of positive definite quadratic forms, Minkowski's classical theory is presented, including an application to multidimensional continued fraction expansions. The reduction theories of Voronoi are described in great detail, including full proofs, new views, and generalizations that cannot be found elsewhere. Based on Voronoi's second reduction theory, the local analysis of sphere coverings and several of its applications are presented. These include the classification of totally real thin number fields, connections to the Minkowski conjecture, and the discovery of new, sometimes surprising, properties of exceptional structures such as the Leech lattice or the root lattices.

Throughout this book, special attention is paid to algorithms and computability, allowing computer-assisted treatments. Although dealing with relatively classical topics that have been worked on extensively by numerous authors, this book is exemplary in showing how computers may help to gain new insights.

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

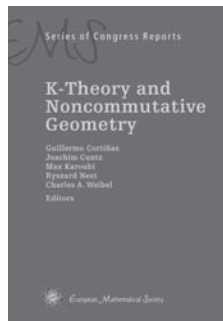
Contents: From quadratic forms to sphere packings and coverings; Minkowski reduction; Voronoi I; Voronoi II; Local analysis of coverings and applications; Polyhedral representation conversion under symmetries; Possible future projects; Bibliography; Index; Notations.

University Lecture Series, Volume 48

January 2009, approximately 162 pages, Softcover, ISBN: 978-0-8218-4735-0, LC 2008042435, 2000 *Mathematics Subject Classification*: 11-02, 52-02, 11Hxx, 52Bxx, 52Cxx, 90Cxx, 20H05; 11J70, 11R80, 20B25, 20H05, **AMS members US\$31**, List US\$39, Order code ULECT/48

New AMS-Distributed Publications

Algebra and Algebraic Geometry



K-Theory and Noncommutative Geometry

Guillermo Cortiñas, *University of Buenos Aires, Argentina*,
Joachim Cuntz, *University of Münster, Münster, Germany*, Max
Karoubi, *Université Paris VII, France*, Ryszard Nest, *University of Copenhagen, Denmark*,

and Charles A. Weibel, *Rutgers University, New Brunswick, NJ*, Editors

Since its inception 50 years ago, K-theory has been a tool for understanding a wide-ranging family of mathematical structures and their invariants: topological spaces, rings, algebraic varieties and operator algebras are the dominant examples. The invariants range from characteristic classes in cohomology, determinants of matrices, Chow groups of varieties, as well as traces and indices of elliptic operators. Thus K-theory is notable for its connections with other branches of mathematics.

Noncommutative geometry develops tools which allow one to think of noncommutative algebras in the same footing as commutative ones: as algebras of functions on (noncommutative) spaces. The algebras in question come from problems in various areas of mathematics and mathematical physics; typical examples include algebras of pseudodifferential operators, group algebras, and other algebras arising from quantum field theory.

To study noncommutative geometric problems one considers invariants of the relevant noncommutative algebras. These invariants include algebraic and topological K-theory, and also cyclic homology, discovered independently by Alain Connes and Boris Tsygan, which can be regarded both as a noncommutative version of de Rham cohomology and as an additive version of K-theory. There are primary and secondary Chern characters which pass from K-theory to cyclic homology. These characters are relevant both to noncommutative and commutative problems and have applications ranging from index theorems to the detection of singularities of commutative algebraic varieties.

The contributions to this volume represent this range of connections between K-theory, noncommutative geometry, and other branches of mathematics.

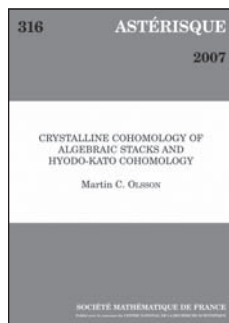
This item will also be of interest to those working in analysis.

A publication of the European Mathematical Society (EMS). Distributed within the Americas by the American Mathematical Society.

Contents: R. Meyer, Categorical aspects of bivariant K-theory; A. Bartels, S. Echterhoff, and W. Lück, Inheritance of isomorphism conjectures under colimits; H. Emerson and R. Meyer, Coarse and equivariant co-assembly maps; F. Muro and A. Tonks, On K_1 of a Waldhausen category; M. Karoubi, Twisted K-theory—old and new; C. Voigt, Equivariant cyclic homology for quantum groups; P. C. Rouse, A Schwartz type algebra for the tangent groupoid; J. Cuntz, C^* -algebras associated with the $ax + b$ -semigroup over \mathbb{N} ; W. Werner, On a class of Hilbert C^* -manifolds; U. Bunke, T. Schick, M. Spitzweck, and A. Thom, Duality for topological abelian group stacks and T -duality; P. Bressler, A. Gorokhovsky, R. Nest, and B. Tsygan, Deformations of gerbes on smooth manifolds; G. Garkusha and M. Prest, Torsion classes of finite type and spectra; T. Geisser, Parshin's conjecture revisited; C. Weibel, Axioms for the norm residue isomorphism; List of contributors; List of participants.

EMS Series of Congress Reports, Volume 2

October 2008, 454 pages, Hardcover, ISBN: 978-3-03719-060-9, 2000 *Mathematics Subject Classification*: 19-06, 58-06, 14A22, 14Fxx, 46Lxx, 53D55, 58Bxx, AMS members US\$99, List US\$124, Order code EMSSCR/2



Crystalline Cohomology of Algebraic Stacks and Hyodo-Kato Cohomology

Martin C. Olsson, *University of California, Berkeley, CA*

In this text the author uses stack-theoretic techniques to study the crystalline

structure on the de Rham cohomology of a proper smooth scheme over a p -adic field and applications to p -adic Hodge theory. He develops a general theory of crystalline cohomology and de Rham-Witt complexes for algebraic stacks and applies it to the construction and study of the (φ, N, G) -structure on de Rham cohomology. Using the stack-theoretic point of view instead of log geometry, he develops the ingredients needed to prove the C_{st} -conjecture using the method of Fontaine, Messing, Hyodo, Kato, and Tsuji, except for the key computation of p -adic vanishing cycles. He also generalizes the construction of the monodromy operator to schemes with more general types of reduction than semistable and proves new results about tameness of the action of Galois on cohomology.

A publication of the Société Mathématique de France, Marseilles (SMF), distributed by the AMS in the U.S., Canada, and Mexico. Orders from other countries should be sent to the SMF. Members of the SMF receive a 30% discount from list.

Contents: Introduction; Divided power structures on stacks and the crystalline topos; Crystals and differential calculus on stacks; The Cartier isomorphism and applications; De Rham-Witt theory; The abstract Hyodo-Kato isomorphism; The (φ, N, G) -structure on de Rham cohomology; A variant construction of the (φ, N, G) -structure; Comparison with syntomic cohomology; Comparison

with log geometry in the sense of Fontaine and Illusie; Bibliography; Index of notation; Index of terminology.

Astérisque, Number 316

September 2008, 412 pages, Softcover, ISBN: 978-2-85629-249-5, 2000 *Mathematics Subject Classification*: 14F20, 14F30, 14G20, 11G25, **Individual member US\$119**, List US\$132, Order code AST/316



Trends in Representation Theory of Algebras and Related Topics

Andrzej Skowroński, *Nicholas Copernicus University, Torun, Poland*, Editor

This book is concerned with recent trends in the representation theory of algebras

and its exciting interaction with geometry, topology, commutative algebra, Lie algebras, quantum groups, homological algebra, invariant theory, combinatorics, model theory and theoretical physics. The collection of articles, written by leading researchers in the field, is conceived as a sort of handbook providing easy access to the present state of knowledge and stimulating further development.

The topics under discussion include diagram algebras, Brauer algebras, cellular algebras, quasi-hereditary algebras, Hall algebras, Hecke algebras, symplectic reflection algebras, Cherednik algebras, Kashiwara crystals, Fock spaces, preprojective algebras, cluster algebras, rank varieties, varieties of algebras and modules, moduli of representations of quivers, semi-invariants of quivers, Cohen-Macaulay modules, singularities, coherent sheaves, derived categories, spectral representation theory, Coxeter polynomials, Auslander-Reiten theory, Calabi-Yau triangulated categories, Poincaré duality spaces, selfinjective algebras, periodic algebras, stable module categories, Hochschild cohomologies, deformations of algebras, Galois coverings of algebras, tilting theory, algebras of small homological dimensions, representation types of algebras, and model theory.

This book consists of fifteen self-contained expository survey articles and is addressed to researchers and graduate students in algebra as well as a broader mathematical community. They contain a large number of open problems and give new perspectives for research in the field.

A publication of the European Mathematical Society (EMS). Distributed within the Americas by the American Mathematical Society.

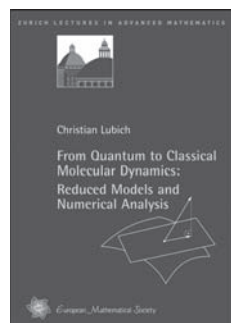
Contents: S. Ariki, Finite dimensional Hecke algebras; G. Bobiński, C. Riedtmann, and A. Skowroński, Semi-invariants of quivers and their zero sets; I. Burban and Y. Drozd, Maximal Cohen-Macaulay modules over surface singularities; J. F. Carlson, Rank varieties; K. Erdmann and A. Skowroński, Periodic algebras; C. Geiss, B. Leclerc, and J. Schröer, Preprojective algebras and cluster algebras; I. G. Gordon, Symplectic reflection algebras; O. Iyama, Auslander-Reiten theory revisited; P. Jørgensen, Calabi-Yau categories and Poincaré duality spaces; S. Kasjan, Representation types of algebras from the model theory point of view; B. Keller, Calabi-Yau triangulated categories; S. Koenig, A panorama of diagram algebras; H. Lenzing and J. A. de la Peña, Spectral analysis

of finite dimensional algebras and singularities; **M. Reineke**, Moduli of representations of quivers; **A. Skowroński** and **K. Yamagata**, Selfinjective algebras of quasitilted type; List of contributors.

EMS Series of Congress Reports, Volume 1

September 2008, 722 pages, Hardcover, ISBN: 978-3-03719-062-3, 2000 *Mathematics Subject Classification*: 16-02, 16Gxx, 03Cxx, 05Exx, 13Axx, 13Cxx, 13Hxx, 14Lxx, 14Mxx, 16Dxx, 16Exx, 16Sxx, 17Bxx, 18Exx, 18Gxx, 20Cxx, 20Gxx, 20Jxx, 32Sxx, 55Pxx, 57Mxx, 81Rxx, **AMS members US\$110**, List US\$138, Order code EMSSCR/1

Discrete Mathematics and Combinatorics



From Quantum to Classical Molecular Dynamics: Reduced Models and Numerical Analysis

Christian Lubich, *University of Tübingen, Germany*

Quantum dynamics of molecules poses a variety of computational challenges that are presently at the forefront of research efforts in numerical analysis in a number of application areas: high-dimensional partial differential equations, multiple scales, highly oscillatory solutions, and geometric structures such as symplecticity and reversibility that are favourably preserved in discretizations.

This text addresses such problems in quantum mechanics from the viewpoint of numerical analysis, illustrating them to a large extent on intermediate models between the Schrödinger equation of full many-body quantum dynamics and the Newtonian equations of classical molecular dynamics. The fruitful interplay between quantum dynamics and numerical analysis is emphasized.

A publication of the European Mathematical Society (EMS). Distributed within the Americas by the American Mathematical Society.

Contents: Quantum vs. classical dynamics; Reduced models via variational approximation; Numerical methods for the time-dependent Schrödinger equation; Numerical methods for non-linear reduced models; Semi-classical dynamics using Hagedorn wave packets; Bibliography.

Zurich Lectures in Advanced Mathematics, Volume 12

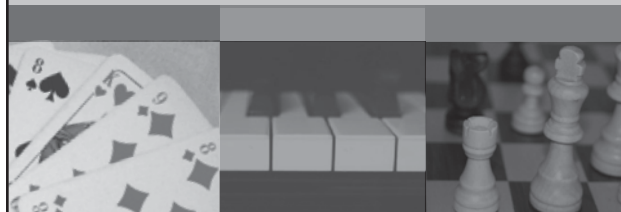
September 2008, 156 pages, Softcover, ISBN: 978-3-03719-067-8, 2000 *Mathematics Subject Classification*: 65M70, 65Z05, 81-08, **AMS members US\$31**, List US\$39, Order code EMSZLEC/12

AMERICAN MATHEMATICAL SOCIETY



How much math can you cover in five minutes?

Quite a bit, if you have a good guide.



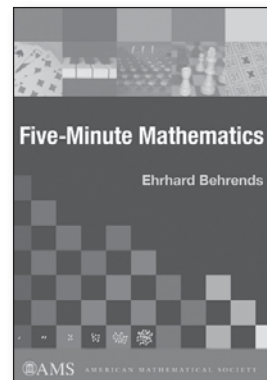
Five-Minute Mathematics

Ehrhard Behrends

Freie Universität Berlin, Germany

This collection of one hundred short essays offers a tour through contemporary and everyday mathematics that is both entertaining and enlightening.

Translated by
David Kramer



2008; 380 pp; softcover; ISBN: 978-0-8218-4348-2; List Price: US\$35; Member Price: US\$28; Order Code: MBK/53

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CALIFORNIA

UNIVERSITY OF CALIFORNIA, RIVERSIDE Department of Mathematics F. Burton Jones Chair

Applications and nominations are invited for the F. Burton Jones Chair in Pure Mathematics. The appointee will be a person of great distinction, with an international reputation for outstanding research. This prestigious chair was established with the generous endowment by the late emeritus professor, F. Burton Jones.

The holder of the Jones Chair will be expected to play a leading role in the department's research and teaching programs, especially at the graduate level. It is hoped to have the position filled by July 1, 2009.

It is expected that the appointment will be with tenure at the rank of full professor and that the appointee will perform all the duties thereof. Established criteria of the University of California determine rank and salary.

Initial review of applications will begin on December 1, 2008, and will continue until the position is filled.

Curriculum vitae, publication lists, and the names of at least five references are required.

Please send candidate information or any nominations to:

Search Committee
F. Burton Jones Chair
Department of Mathematics
University of California, Riverside

900 University Ave.
Riverside, CA 92521

The University of California, Riverside is an Affirmative Action/Equal Opportunity Employer.

000014

UNIVERSITY OF SOUTHERN CALIFORNIA Department of Mathematics

The University of Southern California Department of Mathematics seeks to fill the following three positions. The start date for all three positions is August 2009.

Tenure-Track Assistant Professorship. Subject area: open. Candidates should have demonstrated excellence in research and a strong commitment to graduate and undergraduate education.

Busemann Assistant Professorship. Subject area: geometry and/or topology. Candidates should demonstrate great promise in research in geometry/topology and evidence of strong teaching. This is a three-year non-tenure-track appointment with a three-course-per-year teaching load.

Assistant Professor Non-Tenure-Track. Subject area: any field of mathematics of interest to senior members of the department. Candidates should demonstrate great promise in research and evidence of strong teaching. This is a three-year non-tenure-track appointment with a four-course-per-year teaching load.

To apply, please submit the following materials: letter of application and curriculum vitae, including your email address, telephone and fax numbers, pref-

erably with the standardized AMS Cover Sheet. Candidates should also arrange for at least three letters of recommendation to be sent, one of which addresses teaching skills. Applications through MathJobs at <http://www.mathjobs.org> are preferred. Otherwise, all materials should be mailed to:

Search Committee
Department of Mathematics
College of Letters Arts and Sciences
University of Southern California
3620 Vermont Avenue, KAP 108
Los Angeles, CA 90089-2532.

Review of applications will begin November 15, 2008, and will continue until the positions are filled. Additional information about the USC Department of Mathematics can be found at our website <http://www.usc.edu/schools/college/mathematics>. USC strongly values diversity and is committed to equal opportunity in employment. Women and men and members of all racial and ethnic groups are encouraged to apply.

000147

FLORIDA

FLORIDA INTERNATIONAL UNIVERSITY Department of Mathematics

The Department of Mathematics at Florida International University invites applications for one position at open rank to build the research strength of the department and to provide leadership in building towards a Ph.D. program. The field for the

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 2009 rate is \$110 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 2009 issue–November 26, 2008; March 2009 issue–December 29, 2008; April 2009

issue–January 29, 2009; May 2009–February 27, 2009; June/July 2009 issue–April 28, 2009; August 2009 issue–May 28, 2009.

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. may not be legally bound to conform to these or similar requirements. Details may be found on page 1041 (volume 55).

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 classes@ams.org. AMS location for express delivery packages is 201 Charles Street, Providence, Rhode Island 02904. Advertisers will be billed upon publication.

position is open. Duties will include mathematical research, teaching, and service. Qualifications include Ph.D. in mathematics and outstanding record in research and teaching. Established record of funded research and successful Ph.D. students is a plus. FIU is a public university with over 37,000 students, <http://www.fiu.edu>. To apply, send an application letter, a vita, and names and contact information for at least three referees to: Recruitment Committee, Department of Mathematics, Florida International University, Miami, FL 33199. A member of the State University System, FIU is an EE/EO/EA Employer and Institution. Review of applications will start on February 1, 2009, and will continue until the position is filled. For more information, visit the department's website at <http://w3.fiu.edu/~math>.

000003

ILLINOIS

NORTHWESTERN UNIVERSITY Department of Mathematics Boas Assistant Professor

Applications are solicited for up to three Ralph Boas assistant professorships of three years each starting September 2009. These are non-tenure-track positions with a teaching load of four quarter courses per year. We invite applications from qualified mathematicians in all fields.

Applications should be made electronically at: <http://www.mathjobs.org> and should include (1) the American Mathematical Society Cover Sheet for Academic Employment, (2) a curriculum vitae, (3) a research statement, and (4) three letters of recommendation, one of which discusses the candidate's teaching qualifications. Inquiries may be sent to: boas@math.northwestern.edu.

The review process starts December 1, 2008. Northwestern University is committed to fostering a diverse faculty; women and minority candidates are especially encouraged to apply. AA/EOE.

000008

NORTHWESTERN UNIVERSITY Department of Mathematics Boas Assistant Professor

Applications are invited for anticipated tenured or tenure-track positions starting September 2009. Priority will be given to exceptionally promising research mathematicians. We invite applications from qualified mathematicians in all fields.

Applications should be made electronically at <http://www.mathjobs.org> and should include (1) the American Mathematical Society Cover Sheet for Academic Employment, (2) a curriculum vitae, (3) a research statement, and (4) three letters of recommendation, one of which discusses the candidate's teaching qualifications.

Inquiries may be sent to: boas@math.northwestern.edu.

The review process starts December 1, 2008. Northwestern University is committed to fostering a diverse faculty; women and minority candidates are especially encouraged to apply. AA/EOE.

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 2009. See website: <http://www.usna.edu/MathDept/website/employment.html> for full information. Tel: 410-293-6701; Fax: 410-293-4883; email: chm@usna.edu. The United States Naval Academy is an Affirmative Action/Equal Employment Opportunity Employer and provides reasonable accommodations to applicants with disabilities.

000007

MICHIGAN

NORTHERN MICHIGAN UNIVERSITY Mathematics/Computer Science/ Mathematics Education

POSITION TYPE: Department Head, Tenured, Full Professor

DEPARTMENT: Mathematics and Computer Science

DESCRIPTION/REQUIREMENTS: Visit HigherEdJobs.Com or call (906) 227-2020

ANNUAL SALARY: Competitive

APPLICATION DEADLINE: Screening will begin December 15, 2008, and continue until the position is filled.

NMU is an AA/EOE.

000006

MISSISSIPPI

UNIVERSITY OF MISSISSIPPI Department of Mathematics

The department of mathematics seeks to fill one tenure-track assistant professor position by August 2009. All candidates should have a Ph.D. by May 2009 (in mathematics or statistics) and outstanding potential in both research and teaching. We seek candidates whose research interests enhance and complement the existing strengths of the department. The successful applicant will teach 6 hours per week and is expected to conduct a vigor-

ous research program. Applicants should complete the application form, cover letter, and CV online at: <http://jobs.olemiss.edu>. Three letters of recommendation concerning research and at least one concerning teaching, and the applicant's statement on research and teaching must be sent to:

University of Mississippi
Department of Mathematics
Chair of the Search Committee
305 Hume Hall
University, MS 38677, USA

The letters must be submitted directly by the referees. Inquiries about the position may be sent to: mdepart@olemiss.edu.

Screening of applications will begin immediately and will continue until the position is filled. For information about the department and the university see <http://www.olemiss.edu>.

The University of Mississippi is an EEO/AA/Title VI/Title IX/Section 504/ADA/ADEA employer.

000010

NEW MEXICO

UNIVERSITY OF NEW MEXICO Department of Mathematics and Statistics

The Department of Mathematics and Statistics at the University of New Mexico invites applications for a full-time, probationary position leading to a tenure decision at the rank of assistant professor. The department expects to hire a specialist in computational and applied mathematics with a Ph.D. in applied mathematics or a field with a strong mathematical emphasis. For best consideration send application letter, vitae, teaching/research statement, and three reference letters by January 7, 2009, to Applied Math Hiring Committee, Dept. Math. and Stat., MSC03 2150, 1 University of New Mexico, Albuquerque, NM 87131; or submit all but references electronically. The position will remain open until filled. Complete information regarding the posting is located at: <http://www.math.unm.edu/hiring/AMa.php>. UNM's confidentiality policy ("Recruitment and Hiring", Policy #3210), which includes information about public disclosure of documents submitted by applicants, is located at <http://www.unm.edu/~ubppm>. University of New Mexico is an EEO/AA employer.

000013

NORTH CAROLINA

WAKE FOREST UNIVERSITY Department of Mathematics

Applications are invited for two tenure-track positions in mathematics at the assistant professor level beginning August 2009. We seek highly qualified candidates

who have a commitment to excellence in both teaching and research. A Ph.D. in mathematics or a related area is required. Candidates with research interests in number theory, combinatorics, or algebra will receive first consideration. The department has 20 members and offers both a B.A. and a B.S. in mathematics, with an optional concentration in statistics, and a B.S. in each of mathematical business and mathematical economics. The department has a graduate program offering an M.A. in mathematics. A complete application will include a letter of application, curriculum vitae, teaching statement, research statement, graduate transcripts, and three letters of recommendation. Applicants are encouraged to post materials electronically at: <http://www.mathjobs.org>. Hard copy can be sent to Stephen Robinson, Wake Forest University, Department of Mathematics, P.O. Box 7388, Winston-Salem, NC 27109. (sbr@wfu.edu, <http://www.math.wfu.edu>). AA/EO Employer.

000093

OHIO

OHIO WESLEYAN UNIVERSITY Department of Mathematics and Computer Science

Applications are invited for a tenure-track assistant professor position in mathematics to begin in August 2009.

A Ph.D. in mathematics is required with a strong preference for specialization in discrete mathematics or algebra. We seek a new staff member wishing to teach a broad range of undergraduate mathematics courses and to work closely with undergraduates in and out of the classroom. Also important are interest in directing student research projects and developing new courses and activities to enhance the mathematics program. Professional activity and departmental service are expected. The teaching load is three courses each semester. Ohio Wesleyan University is a selective, undergraduate-only liberal arts and sciences institution of 1,850 students located in Delaware, Ohio, a community of 21,000 located 20 miles north of Columbus, Ohio (the state capital, having a population of over 1,000,000). Please send a letter of application, a statement of teaching and research interests, CV, transcripts (both graduate and undergraduate), and three letters of recommendation to: Professor Jeffrey Nunemacher, Department of Mathematics and Computer Science, Ohio Wesleyan University, 61 S. Sandusky Street, Delaware, OH 43015. To ensure full consideration, applications should be received by January 26, 2009. Further information can be found at: <http://math.owu.edu>. The university is strongly committed to diversity and encourages all interested parties, including women and minorities, to apply.

000005

PENNSYLVANIA

UNIVERSITY OF PITTSBURGH Department of Mathematics

The Department of Mathematics at the University of Pittsburgh invites applications for a postdoctoral appointment starting the fall term 2009. The appointment is renewable annually to a maximum of three years. The position is funded jointly by the University of Pittsburgh and a new NSF Research Training Group (RTG) grant on complex biological systems across multiple space and time scales, see <http://www.math.pitt.edu/~cbsg/>.

The research areas covered by the RTG include (i) the development and analysis of mathematical models and computational algorithms for solving spatio-temporal problems arising in biology and (ii) the applications of these and other methods to problems arising in inflammation and neuroscience.

To be successful, a candidate must demonstrate excellence in research and must also have strong commitment to excellence in teaching at both the undergraduate and graduate levels. Candidates should be willing to work closely with experimentalists and clinicians.

All applications must include the following: (1) a curriculum vita, (2) a personal statement addressing their research agenda, (3) a statement of teaching philosophy, (4) a completed AMS Standard Cover Sheet form and (5) at least three letters of recommendation. Applications should be submitted electronically through <http://www.mathjobs.org>. If the candidate is unable to submit electronically, materials may be sent to: Postdoctoral Search Committee in Complex Biological Systems, Department of Mathematics, University of Pittsburgh, Pittsburgh, PA 15260. Review of completed files will begin on January 10, 2009, and continue until the position is filled.

The University of Pittsburgh is an Affirmative Action, Equal Opportunity Employer. Women and members of minority groups underrepresented in academia are especially encouraged to apply. NSF restrictions require that eligible candidates must be U.S. citizens or permanent residents.

000136

TEXAS

SOUTHERN METHODIST UNIVERSITY Clements Chair of Mathematics

Applications are invited for the Clements Chair of Mathematics to begin in the fall semester of 2009. Preference will be given to senior scholars with outstanding records of research who also have a strong commitment to teaching including an established history of advising Ph.D. theses. Applicants in all areas of applied and

computational mathematics are encouraged. The Department of Mathematics, which offers an active doctoral program in applied and computational mathematics, is in an exciting period of transition having hired four faculty last year. Visit <http://www.smu.edu/math> for more information about the department.

To apply, send a letter of application with a curriculum vitae, a list of publications, research and teaching statements, and the names of three references (references will not be contacted before receiving approval of the candidate) to: The Faculty Search Committee, Department of Mathematics, Southern Methodist University, P.O. Box 750156, Dallas, Texas, 75275-0156. The Search Committee can be contacted by sending email to math-search@mail.smu.edu. (Tel: 214-768-2452; Fax: 214-768-2355).

To ensure full consideration for the position, the application must be received by January 9, 2009, but the committee will continue to accept applications until the position is filled. The committee will notify applicants of its employment decision after the position is filled.

SMU, a private university with an engineering school, is situated in a quiet residential section of Dallas. Dallas is home to the University of Texas Southwestern Medical Center and its new Systems Biology Center.

SMU will not discriminate on the basis of race, color, religion, national origin, sex, age, disability or veteran status. SMU is also committed to nondiscrimination on the basis of sexual orientation.

000140

BRAZIL

INSTITUTE FOR PURE AND APPLIED MATHEMATICS (IMPA) Department of Mathematics

The Institute for Pure and Applied Mathematics (IMPA) invites applications for two tenure-track positions in any field of mathematics. IMPA, located in Rio de Janeiro, Brazil, is widely recognized as one of the leading mathematical research centers worldwide. Its main goal is the generation of high-level mathematical research. It also offers graduate level programs at the Ph.D. and MSc. level. Currently, its faculty includes specialists in real and complex dynamical systems, analysis, algebra, geometry, probability, fluid dynamics, optimization, mathematical economics and computer graphics. Applications should be sent to: opening@impa.br until June 30, 2009. Further inquiries should be addressed to the same email address. For information on application submissions, see http://www.impa.br/opencms/pt/pesquisa/concurso_pesq/opening.html.

000004

COLOMBIA

UNIVERSIDAD DE LOS ANDES
Department of Mathematics
Faculty and visiting positions 2009

The Department of Mathematics invites applications for positions at the tenure-track assistant professor level and visiting professor to begin in August 2009. All areas of pure and applied mathematics will be considered but preference will be given to analysis, algebra, differential and algebraic geometry, mathematical physics, probability and statistics. Applicants are required to have a Ph.D. in mathematical sciences and be able to develop a significant research program. A strong commitment to undergraduate and graduate teaching is also required. Duties include courses for undergraduate students in natural sciences, engineering and economics, graduate courses in mathematics, and the eventual supervising of undergraduate, master, or Ph.D. theses. The department offers internationally competitive salaries with start-up grants for research. Proficiency in Spanish is desirable. Please send an AMS standard cover sheet, curriculum vitae, research plan, teaching statement, and three letters of recommendation to:

Faculty Hiring
 Department of Mathematics
 Universidad de los Andes
 A.A. 4976
 Bogotá, Colombia

Electronic submission can also be sent to: matema@uniandes.edu.co. Applicants interested in any further information regarding the Mathematics Department at Los Andes please visit the website: <http://matematicas.uniandes.edu.co/>. Preference will be given to applicants whose applications are submitted by February 11, 2009. Review of applications will continue until positions are filled.

000012

PORTUGAL

INSTITUTO SUPERIOR TÉCNICO
Department of Mathematics
Postdoctoral Positions

The Center for Mathematical Analysis, Geometry, and Dynamical Systems of the Department of Mathematics of Instituto Superior Técnico, Lisbon, Portugal, invites applications for postdoctoral positions for research in mathematics, subject to budgetary approval. Positions are for one year, with the possibility of extension for a second year upon mutual agreement. Selected candidates will be able to take up their position between September 1, 2009, and January 1, 2010.

Applicants should have a Ph.D. in mathematics, or in a related area relevant to the scientific interests of the faculty of the Center, preferably obtained after

December 31, 2006. They must show very strong research promise in one of the areas in which the mathematics faculty of the center is currently active. There are no teaching duties associated with these positions.

Applicants should send a curriculum vitae; reprints, preprints, and/or dissertation abstract; description of research project (of no more than 1,000 words); and ask that three letters of reference are sent directly to the director at the above address.

To insure full consideration, complete application packages should be received by January 15, 2009. Additional information about the Center and the positions is available at: <http://www.math.ist.utl.pt/cam/>.

000011

UNIVERSITY OF COIMBRA
Center for Mathematics (CMUC)

The Centre for Mathematics of the University of Coimbra (CMUC) invites applications for one-year postdoctoral research positions, beginning September 2009. The corresponding salary is €1495 per month (tax free).

Applicants should have a Ph.D. in mathematics (preferably obtained after December 31, 2006) and a good command of English. They must show considerable promise in one of the areas of research in which the members of CMUC are currently active. For more information visit <http://www.mat.uc.pt/~cmuc>.

The deadline for applications is January 31, 2009.

000001

TAIWAN

ACADEMIA SINICA
Institute of Mathematics
Taiwan, R.O.C.

The Institute of Mathematics, Academia Sinica, is entrusted to promote mathematical research. The institute strives to become a national center of mathematical sciences in Taiwan, as well as an international mathematical institute. Mathematical researchers are welcome to apply for regular positions as well as 2009-2010 postdoctoral positions. Application for regular (resp. postdoctoral) positions completed by Jan. 15, 2009 (resp. May 31, 2009) will be given full consideration. Interested applicants should have the following materials

1. curriculum vitae
2. doctoral degree certificate
3. description of research
4. copies of representative publications
5. three letters of reference

either sent to:

The Chairman
 The Hiring Committee
 Institute of Mathematics
 Academia Sinica
 Nankang 11529,
 Taipei, Taiwan

or input to the site: <http://www.math.sinica.edu.tw/applicant>. For any questions on applications, please contact personnel@math.sinica.edu.tw. For general information about the Inst., please see <http://www.math.sinica.edu.tw>.

000002

Co-Sponsored Conferences

AAAS Meeting in Chicago Features Mathematics and Applications

The 2009 Annual Meeting of the American Association for the Advancement of Science will be February 12–16, in Chicago, IL. The theme of this year's meeting is "Our Planet and Its Life: Origins and Futures", which is a nod to the fact that 2009 is the 200th anniversary of the birth of Charles Darwin, and the 150th anniversary of the publication of *On the Origin of Species by Means of Natural Selection*. Many of the symposia sponsored by Section A (Mathematics) are interdisciplinary sessions that fit this theme.

The Annual Meeting is organized into symposia which have three or more speakers, and often a discussant who reflects on the talks that are given. Section A is sponsoring six symposia this year, featuring outstanding expository talks by prominent mathematicians. The six symposia sponsored by Section A this year are:

- The Mathematical Twists and Turns of Data Sets (organized by Robert Ghrist, University of Illinois, Urbana-Champaign)
- Games People Play: Challenges of Applying Mathematics and Computers to Games (organized by Bob Hearn, Dartmouth College)
- Climate and Disease: Quantitative Insights and Interdisciplinary Challenges (organized by Mercedes Pasqual, University of Michigan)
- Green, Gene, Growing Machines: The Evolutionary Shaping of Plant Form (organized by David Baum, University of Wisconsin)
- Mathematical Biology, the New Frontier: Educating the Next Generation (organized by Bonnie Shulman, Bates College)
- Mathematics of Origami: From the Joys of Recreation to the Frontiers of Research (organized by Edward Aboufadel, Grand Valley State, and Patsy Wang-Iverson, The Gabriella and Paul Rosenbaum Foundation)

Other symposia that will be of interest to the mathematical community include:

- New Computing Platforms for Data-Intensive Science
- A New Kind of Scientist: Professional Master's Education and U.S. Competitiveness
- Artificial Cells: Models of the Simplest Life
- The Grid, the Cloud, Sensor Nets, and the Future of Computing
- Big, Small, and Everything in Between: Simulating Our World Using Scientific Computing
- Providing Scientific Advice to the U.S. Congress: Is a New Paradigm Needed?
- The Evolution of Knowledge Production: Exploring

Creativity, Innovation, and Networks

- Earth's History and Future Revealed at the Frontier of Scientific Computing
- K–12 Engineering Education in the United States
- Inquiry or Direct? Research-Based Practices in Science Education
- Interdisciplinary Approaches to the Study of Large-Scale Human Networks
- The Science of Kissing

The above symposia are only a few of the nearly 200 AAAS program offerings in the physical, life, social, and biological sciences. For further information, including the schedule of talks, go to www.aaas.org/meetings.

AAAS annual meetings are the showcases of American science, and they encourage participation by mathematicians and mathematics educators. Section A acknowledges the generous contributions of AMS and MAA 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 mathematics and the brain, quantum information theory, the changing nature of mathematical proof, and the mathematical analysis of the performance of baseball players.

The 2010 meeting will be February 18–22 in San Diego. 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 Chicago on Friday, February 13, 2009, at 7:45 p.m., 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 2008 to February 2009:

Chair: William Jaco (Oklahoma State University)

Chair-Elect: Keith Devlin (Stanford University)

Retiring Chair: Carl Pomerance (Dartmouth College)

Secretary: Edward Aboufadel (Grand Valley State University)

Members at Large:

Mary Beth Ruskai (Tufts University)

David Isaacson (Rensselaer Polytechnic Institute)

Claudia Neuhauser (University of Minnesota)

Warren Page (City University of New York)

—Edward Aboufadel, Secretary of Section A of the AAAS

Call for Organizers 2010 MRC Conferences

The American Mathematical Society invites individuals and groups of individuals to serve as organizers of summer conferences of the Mathematics Research Communities program to be held in Snowbird, Utah, in the summer of 2010.

About the Mathematics Research Communities Program

Mathematics Research Communities (MRC), a newly-established program of the American Mathematical Society (AMS), nurtures early-career mathematicians—those who are close to finishing their doctorates or have recently finished—and provides them with opportunities to build social and collaborative networks through which they can inspire and sustain each other in their work. The structured program is designed to engage and guide all participants as they start their careers. The program includes one-week summer conferences for each topic; Special Sessions at the national meeting; discussion networks by research topic; ongoing mentoring; and a longitudinal study of early career mathematicians. Those accepted into this program will be fully supported for the summer conference, and will be partially supported for their participation in the following Joint Mathematics Meetings. The summer conferences of the MRC are held in the breathtaking mountain setting of the Snowbird Resort, Utah, where participants can enjoy the natural beauty and a collegial atmosphere. The MRC program is open to individuals who are U.S. citizens as well as to those who are affiliated with U.S. institutions. Women and underrepresented minorities are especially encouraged to participate.

The Division of Meetings and Professional Services of the AMS coordinates the Mathematics Research Communities program, and supports organizers throughout the entire program. Questions about the overall MRC program should be addressed to Ellen J. Maycock, Associate Executive Director, at ejm@ams.org or 401-455-4101.

Summer Conferences

The American Mathematical Society's Meetings and Conferences staff members arrange all the logistics of the summer conferences for the Mathematics Research Com-

munities program. This administrative support allows organizers to focus almost exclusively on providing a high-quality scientific program and enables both organizers and participants to concentrate on the conference and take advantage of the services, venue, and surrounding attractions. The AMS Meetings and Conferences Department provides general information and details online at <http://www.ams.org/amsmtg/mrc.html>.

The program pays for air transportation for all organizers and participants, as well as room and board for the stay at Snowbird and transportation by van from the Salt Lake City airport to the resort and back. Each organizer receives a stipend of US\$3,000. Additionally, each organizing committee has the option of hiring a graduate student to assist with work before and during the conference, for a stipend of US\$3,000. Young mathematicians apply to be participants in the MRC program by March 1, 2010. The organizers of each summer conference choose among these applicants during the month of March 2010, paying special attention to creating a diverse group of participants. Although the main emphasis of the summer conferences is the scientific program, it is important for the organizers to spend time with participants discussing professional development topics, such as the job search, writing grant proposals, giving talks, and other activities.

How To Apply

Members of the MRC Advisory Board and AMS staff members are pleased to provide guidance on the preparation of proposals. Core funding for the MRC program is provided by a grant from the National Science Foundation.

Proposals

The MRC Advisory Board encourages individuals to submit inquiries to ensure sufficient time for feedback. Proposals need to include the following information:

- (1) Organizing Committee members, with names and addresses (4–5 for a 40-participant conference, 2–3 for a 20-participant conference);
- (2) Scientific narrative addressing the focus, importance and timeliness of the topic, no more than 5 pages long;

About the Cover

Mains'l and spinnaker

This month's cover accompanies the article on mathematical modeling in this issue by Alfio Quarteroni. The image was produced by Nicola Parolini, assistant to Quarteroni, who writes, "The image shows two layers of streamlines at different heights around a gennaker (a gennaker is a modern hybrid between a spinnaker and a genoa) and a main sail of an America's Cup boat. They were computed based on the velocity obtained by the solution of the Reynolds-Averaged Navier-Stokes equations (using the software Ansys CFX) which model the air flow around deformable membranes representing the sails. The computational grid had about 15 million elements (tetrahedra) and was built using the mesh generation software Ansys IcemCFD.

"The main objective of this analysis was the maximization of the total driving force as a function of sail trimming by solving the fluid-structure interaction analysis on sails. The simulation converged in 5 coupling iterations, when the difference of forces on both sails with respect to the previous coupling has been found to be less than 0.5%. Each coupling iteration took about 2 hours, running in parallel over 62 processors. The picture highlights the flow structures and the wakes around the sails given one particular set of trimmings among several different possible sailing configurations. The large separation occurring at the gennaker's leading edge reveals that this configuration is not optimal and suggests pulling in the gennaker sheet (that is the cable attached to the gennaker leech-foot corner) which governs the gennaker's angle of attack."

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



(3) Organization of the week of the summer conference.

Preparation and submission guidelines are available at <http://www.ams.org/amsmtgs/mrc-proposals.html>. The current MRC Advisory Board members are listed at <http://www.ams.org/amsmtgs/mrc-contact.html>.

Send inquiries and proposals to:

Mathematics Research Communities
American Mathematical Society
by email: mrc2010@ams.org
by mail: 201 Charles Street, Providence, RI 02904
by fax: 401-455-4004

Deadlines for 2010 MRCs

Intent to submit proposal: **March 2, 2009**

Proposals: **April 1, 2009**

All individuals who submit proposals will be notified of the decisions before August 3, 2009.

About Snowbird Resort

Situated in a beautiful, breathtaking mountain setting, Snowbird Resort provides an extraordinary environment for the MRC program. The atmosphere is comparable to the collegial gatherings at Oberwolfach and other conferences that combine peaceful natural ambience with stimulating meetings. MRC participants have access to a range of activities such as a tram ride to the top of the mountain, walking and hiking trails in the surrounding mountains, and swimming in heated outdoor pools. Participants also enjoy the simpler pleasures of convening on the patios at the resort to read, work, and socialize. At the conclusion of the day's program colleagues may enjoy informal gatherings to network and continue discussion of the day's sessions over refreshments. Within a half hour of the University of Utah, Snowbird is easily accessible from the Salt Lake City International Airport. For more information about Snowbird Resort, see <http://www.snowbird.com>.

For myself and many others in mathematics, mentoring strong, eager students in small groups is one of the most rewarding things we do. Imagine the opportunity to choose a group of advanced graduate students and beginning post-docs in your field, from around the country, and spend an intense week getting to know them and helping them learn some new and valuable elements of your field.

—David Eisenbud, Chair, MRC Advisory Board

—Ellen J. Maycock
Associate Executive Director
Meetings and Professional Services

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 199 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 199. 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".

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 and a laptop projector 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.

Shanghai, People's Republic of China

Fudan University

December 17–21, 2008

Wednesday – Sunday

Meeting #1045

First Joint International Meeting Between the AMS and the Shanghai Mathematical Society

Associate secretary: Susan J. Friedlander

Announcement issue of *Notices*: June 2008

Program first available on AMS website: Not applicable

Program issue of electronic *Notices*: Not applicable

Issue of *Abstracts*: Not applicable

Deadlines

For organizers: Expired

For consideration of contributed papers in Special Sessions: To be announced

For abstracts: Expired

The scientific information listed below may be dated. For the latest information, see www.ams.org/amsmtg/internmtgs.html.

Invited Addresses

Robert J. Bryant, University of California Berkeley, *Title to be announced.*

L. Craig Evans, University of California Berkeley, *Title to be announced.*

Zhi-Ming Ma, Chinese Academy of Sciences, *Title to be announced.*

Richard Schoen, Stanford University, *Title to be announced.*

Xiaoping Yuan, Fudan University, *Title to be announced.*

Weiping Zhang, Chern Institute, *Title to be announced.*

Special Sessions

Biomathematics: Newly Developed Applied Mathematics and New Mathematics Arising from Biosciences, **Banghe Li**, Chinese Academy of Sciences, **Reinhard C. Laubenbacher**, Virginia Bioinformatics Institute, and **Jianjun Paul Tian**, College of William and Mary.

Combinatorics and Discrete Dynamical Systems, **Reinhard C. Laubenbacher**, Virginia Bioinformatics Institute, **Klaus Sutner**, Carnegie Mellon University, and **Yaokun Wu**, Shanghai Jiao Tong University.

Differential Geometry and Its Applications, **Jianguo Cao**, University of Notre Dame, and **Yu Xin Dong**, Fudan University.

Dynamical Systems Arising in Ecology and Biology, **Qishao Lu**, Beijing University of Aeronautics & Astronautics, and **Zhaosheng Feng**, University of Texas-Pan American.

Elliptic and Parabolic Nonlinear Partial Differential Equations, **Changfeng Gui**, University of Connecticut, and **Feng Zhou**, East China Normal University.

Harmonic Analysis and Partial Differential Equations with Applications, **Yong Ding**, Beijing Normal University, **Guo-Zhen Lu**, Wayne State University, and **Shanzhen Lu**, Beijing Normal University.

Integrable System and Its Applications, **En-Gui Fan**, Fudan University, **Sen-Yue Lou**, Shanghai Jiao Tong University and Ningbo University, and **Zhi-Jun Qiao**, University of Texas-Pan American.

Integral and Convex Geometric Analysis, **Deane Yang**, Polytechnic University, and **Jiazu Zhou**, Southwest University.

Lie Algebras, Vertex Operator Algebras and Related Topics, **Hu Nai Hong**, East China Normal University, and **Yi-Zhi Huang**, Rutgers University.

Nonlinear Systems of Conservation Laws and Related Topics, **Gui-Qiang Chen**, Northwestern University, and **Shuxing Chen** and **Yi Zhou**, Fudan University.

Optimization and Its Application, **Shu-Cherng Fang**, North Carolina State University, and **Xuexiang Huang**, Fudan University.

Quantum Algebras and Related Topics, **Naihuan N. Jing**, North Carolina State University, **Quanshui Wu**, Fudan University, and **James J. Zhang**, University of Washington.

Recent Developments in Nonlinear Dispersive Wave Theory, **Jerry Bona**, University of Illinois at Chicago, **Bo Ling Guo**, Institute of Applied Physics and Computational Mathematics, **Shu Ming Sun**, Virginia Polytech Institute and State University, and **Bingyu Zhang**, University of Cincinnati.

Representation of Algebras and Groups, **Birge K. Huisgen-Zimmermann**, University of California Santa Barbara, **Jie Xiao**, Tsinghua University, **Jiping Zhang**, Beijing University, and **Pu Zhang**, Shanghai Jiao Tong University.

Several Complex Variables and Applications, **Siqi Fu**, Rutgers University, **Min Ru**, University of Houston, and **Zhihua Chen**, Tongji University.

Several Topics in Banach Space Theory, **Gerard J. Buskes** and **Qingying Bu**, University of Mississippi, and **Lixin Cheng**, Xiamen University.

Stochastic Analysis and Its Application, **Jiangang Ying**, Fudan University, and **Zhenqing Chen**, University of Washington.

Topics in Partial Differential Equations and Mathematical Control Theory, **Xiaojun Huang**, Rutgers University, **Gengsheng Wang**, Wuhan University of China, and **Stephen S.-T. Yau**, University of Illinois at Chicago.

Washington, District of Columbia

Marriott Wardman Park Hotel and Omni Shoreham Hotel

January 5–8, 2009

Monday – Thursday

Meeting #1046

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: Bernard Russo

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: Expired

For consideration of contributed papers in Special Sessions: Expired

For abstracts: Expired

Program Updates

AMS Sessions

The title, description, and panelists for the Committee on Education Panel Discussion on Thursday at 8:30 a.m. are **The Future of School Mathematics Education**, organized and moderated by **William G. McCallum**, University of Arizona, with panelists **Scott J. Baldridge**, Louisiana State University; **Daniel Chazan**, University of Maryland; **Solomon A. Garfunkel**, COMAP; and **Kristin Umland**, University of New Mexico. Two recent conferences in the fall of 2008 addressed the issue of improving school mathematics education. One of these, about the future of high school mathematics, was cosponsored by the University of Maryland's Center for Mathematics Education and Math is More and one, in response to the National Mathematics Advisory Panel report, was cosponsored by CBMS and the U.S. Department of Education. The four panelists, two from each conference, will relate the results of those conferences and discuss the different directions we can and should take.

MAA Sessions

Reunion of College Algebra Workshops Participants, Tuesday, 6:00 p.m.–8:00 p.m., organized by **Donald B.**

Small, U.S. Military Academy, and **William E. Haver**, Virginia Commonwealth University. Participants from College Algebra Workshops (PREP, HBCUs, MAA's, etc.) will discuss their efforts to refocus college algebra courses based on their workshop experiences. Topics are expected to include visions, realities, efforts that worked, efforts that did not work, reflections on project work, hurdles encountered, suggestions on how to build support for change, etc. The session will also include discussions and exchanges of class activities, exercises, writing assignments, and tests.

The **Minority Chairs Breakfast Meeting** is now scheduled for Thursday, 7:00 a.m.–8:45 a.m.

Special Interest Groups of the MAA

SIGMAA on Mathematical and Computational Biology Business Meeting, Tuesday, 6:00 p.m.–7:00 p.m.

Other Organizations

The **Clayton-Woodard Lecture** at 1:00 p.m. on Saturday will be given by **Earl Barnes**, Morgan State University, on *The Hoffman-Wielandt inequality revisited*.

The **Cox-Talbot Lecture** will be given during the banquet at 7:30 p.m. on Friday by **Leon Woodson**, Morgan State University, on *State of a M.A.D. Union*.

Social Events

Early Music Sing, Wednesday, 7:00 p.m.–9:00 p.m. All JMM participants who enjoy a cappella singing of madrigals, motets, and similar art-music choral works of the Renaissance are invited to join us for informal sight-reading and practice of several classic pieces. (No auditions or solo singing required, but we do run through the parts fairly quickly and sing in other languages besides English.) If you are interested in participating, and especially if you would be interested in taking a turn at conducting during the Sing, please get in touch with one of the organizers, **John McCleary** or **Kim Plofker** (mccleary@vassar.edu, plofkerk@union.edu), so that we can provide enough copies of the sheet music. We hope to see you there!

Urbana, Illinois

University of Illinois at Urbana-Champaign

March 27–29, 2009

Friday – Sunday

Meeting #1047

Central Section

Associate secretary: Susan J. Friedlander

Announcement issue of *Notices*: January

Program first available on AMS website: February 12, 2009

Program issue of electronic *Notices*: March

Issue of *Abstracts*: Volume 30, Number 2

Deadlines

For organizers: Expired

For consideration of contributed papers in Special Sessions: Expired

For abstracts: February 3, 2009

The scientific information listed below may be dated. For the latest information, see www.ams.org/amsmtg/sectional.html.

Invited Addresses

Jeffrey C. Lagarias, University of Michigan, *From Apollonian circle packings to Fibonacci Numbers* (Erdős Memorial Lecture).

Jacob Lurie, Massachusetts Institute of Technology, *On topological quantum field theories*.

Gilles Pisier, Texas A&M University, *Title to be announced*.

Akshay Venkatesh, New York University-Courant Institute, *Title to be announced*.

Special Sessions

Algebra, Geometry and Combinatorics (Code: SS 10A), **Rinat Kedem**, University of Illinois at Urbana-Champaign, and **Alexander T. Yong**, University of Minnesota.

Algebraic Methods in Statistics and Probability (Code: SS 3A), **Marlos A. G. Viana**, University of Illinois at Chicago.

Complex Dynamics and Value Distribution (Code: SS 11A), **Aimo Hinkkanen** and **Joseph B. Miles**, University of Illinois at Urbana-Champaign.

Concrete Aspects of Real Positive Polynomials (Code: SS 20A), **Victoria Powers**, Emory University, and **Bruce Reznick**, University of Illinois at Urbana-Champaign.

Differential Geometry and Its Applications (Code: SS 16A), **Stephanie B. Alexander**, University of Illinois at Urbana-Champaign, and **Jianguo Cao**, University of Notre Dame.

Geometric Function Theory and Analysis on Metric Spaces (Code: SS 6A), **Sergiy Merenkov**, **Jeremy Taylor Tyson**, and **Jang-Mei Wu**, University of Illinois at Urbana-Champaign.

Geometric Group Theory (Code: SS 2A), **Sergei V. Ivanov**, **Ilya Kapovich**, **Igor Mineyev**, and **Paul E. Schupp**, University of Illinois at Urbana-Champaign.

Graph Theory (Code: SS 4A), **Alexander V. Kostochka** and **Douglas B. West**, University of Illinois at Urbana-Champaign.

Holomorphic and CR Mappings (Code: SS 9A), **John P. D'Angelo**, **Jiri Lebl**, and **Alex Tumanov**, University of Illinois at Urbana-Champaign.

Hyperbolic Geometry and Teichmüller Theory (Code: SS 18A), **Jason DeBlois**, University of Illinois at Chicago, **Richard P. Kent IV**, Brown University, and **Christopher J. Leininger**, University of Illinois at Urbana-Champaign.

Local and Homological Methods in Commutative Algebra (Code: SS 13A), **Florian Enescu**, Georgia State University, and **Sandra Spiroff**, University of Mississippi.

Mathematical Visualization (Code: SS 7A), **George K. Francis**, University of Illinois at Urbana-Champaign, **Louis H. Kauffman**, University of Illinois at Chicago, **Dennis Martin Roseman**, University of Iowa, and **Andrew J. Hanson**, Indiana University.

Nonlinear Partial Differential Equations and Applications (Code: SS 21A), **Igor Kukavica**, University of Southern California, and **Anna L. Mazzucato**, Pennsylvania State University.

Number Theory in the Spirit of Erdős (Code: SS 14A), **Kevin Ford** and **A. J. Hildebrand**, University of Illinois at Urbana-Champaign.

Operator Algebras and Operator Spaces (Code: SS 8A), **Zhong-Jin Ruan**, **Florin P. Boca**, and **Marius Junge**, University of Illinois at Urbana-Champaign.

Probabilistic and Extremal Combinatorics (Code: SS 5A), **Jozsef Balogh** and **Zoltan Furedi**, University of Illinois at Urbana-Champaign.

The Interface Between Number Theory and Dynamical Systems (Code: SS 17A), **Florin Boca**, University of Illinois at Urbana-Champaign, **Jeffrey Lagarias**, University of Michigan, and **Kenneth Stolarsky**, University of Illinois at Urbana-Champaign.

The Logic and Combinatorics of Algebraic Structures. (Code: SS 22A), **John Snow**, Concordia University, and **Jeremy Alm**, Illinois College.

Time, Scale, and Frequency Methods in Harmonic Analysis (Code: SS 15A), **Richard S. Laugesen**, University of Illinois at Urbana-Champaign, and **Darrin M. Speegle**, St. Louis University.

Topological Dynamics and Ergodic Theory (Code: SS 19A), **Alica Miller**, University of Louisville, and **Joseph Rosenblatt**, University of Illinois at Urbana-Champaign.

Topological Field Theories, Representation Theory, and Algebraic Geometry (Code: SS 12A), **Thomas Nevins**, University of Illinois at Urbana-Champaign, and **David Ben-Zvi**, University of Texas at Austin.

q-Series and Partitions (Code: SS 1A), **Bruce Berndt**, University of Illinois at Urbana-Champaign, and **Ae Ja Yee**, Pennsylvania State University.

Accommodations

Participants should make their own arrangements directly with the hotel of their choice and state that they will be attending the “AMS” or “American Mathematical Society meeting” or “AMS meeting”. The AMS is not responsible for rate changes or for the quality of the accommodations.

Illini Union Hotel, Illini Union, 1401 W. Green Street, Urbana, IL 61801; 217-333-1241. Rates start at US\$90 per night. This hotel is in a building right next door to the Math Department. Continental breakfast is included. The **deadline for reservations is March 27, 2009**.

Hampton Inn, 1200 W. University Ave., Urbana, IL 61801; 217-337-1100. Rates start at US\$89 per night. The hotel is approximately a 15-minute walk to the Math Department. Cooked breakfast is included. The **deadline for reservations is February 28, 2009**.

Historic Lincoln Hotel, 209 S. Broadway, Urbana, IL 61801; 217-384-8800. Rates start at US\$80 per night. The hotel is about a 20-minute walk (about 1 mile) from the Math Department and there is also bus service. The **deadline for reservations is February 26, 2009**.

The following three hotels are located next to one another and are approximately 2 miles from the math department. There is public bus service between the hotels and

the math department on Friday (all day); Saturday morning (limited), afternoon and evening; Sunday afternoon.

The UIUC math department will provide additional shuttle service from these three hotels to the AMS meeting on Saturday and Sunday mornings. All three hotels have free shuttle service to the Champaign airport and to the train station.

Hawthorn Suites, 101 Trade Center Drive, Champaign, IL 61820; 217-395-3400. Rates start at US\$92.99. Breakfast is included. **Deadline for reservations is March 27, 2009**.

Homewood Suites, 1417 S. Neil, Champaign, IL 61820; 217-352-9960. Rates start at US\$119. Breakfast is included. **Deadline for reservations is February 27, 2009**.

Hilton Garden Inn, 1501 S. Neil, Champaign, IL 61820; 217-352-9970. Rates start at US\$129 per night. **Deadline for reservations is February 25, 2009**.

Food Service

The university will be officially closed during the time of the meeting due to Spring Break. A list of restaurants will be available at the registration desk. A large number of restaurants and coffee shops are located on Green Street, immediately to the west of Altgeld Hall. A number of (mostly fast food) dining places are available in the basement of the Illini Union. A selected list of restaurants and lunch places in and near campus is available at <http://www.visitchampaigncounty.org/locals/index.php?category=94>

Local Information

All the talks will take place in two buildings: Altgeld Hall (the main UIUC math department building) and Noyes Lab. The 50-minute Invited Addresses will be in Altgeld Hall, Room 314. Both Altgeld Hall and Noyes Lab are located next to the Illini Union. A UIUC campus map is available at <http://illinois.edu/ricker/CampusMap>.

Please visit the webpage maintained by the UIUC Mathematics Department for more local information relating to the meeting: <http://www.math.uiuc.edu/ams09>.

Other Activities

Book Sales: Stop by the on-site AMS Bookstore and review the newest titles from the AMS, enjoy up to 25% off all AMS publications, or take home an AMS t-shirt! Complimentary coffee will be served courtesy of AMS Membership Services. The AMS Book Exhibit will take place in the Math Library located on the 2nd floor of Altgeld 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

On Saturday and Sunday the parking in university parking garages and university parking lots is free (unless the signs indicate otherwise). On Sunday most of the street parking, including university and city parking meters, is free (unless the signs indicate otherwise; note that

short-term red parking meters are never free). There is a university parking garage (lot C7) about one block west of Altgeld Hall at the corner of John Street and 6th street. Additional nearby university parking garages are at the corner of Daniel and Fifth (lot C10), about two blocks west and two blocks south of Altgeld; and the Krannert Center Parking Garage (lot D5), at the corner of Goodwin Avenue and Illinois Street.

Lots C7 and C10 are shown in the map http://www.parking.uiuc.edu/campus_map/map2-3.html (Altgeld Hall is building no. 26 and Illini Union is building no. 23 in this map) and lot D5 is shown in the map http://www.parking.uiuc.edu/campus_map/map2-4.html. The main campus parking map is available at http://www.parking.uiuc.edu/campus_map/.

The parking garages C7 and C10 have, at their top, a number of 6-hour parking meters that can be used on Friday afternoon.

For Friday parking we recommend the commercial parking lot on Green Street a little over one block west of Altgeld Hall. The entrance to the parking lot is from Green Street (north side), next to the Legends Bar.

Registration and Meeting Information

The registration desk will be located on the third floor of Altgeld Hall in the math department Common Room (Room 321) and will be open from noon to 4:00 p.m. on Friday and 7:30 a.m. to 4:00 p.m. on Saturday; it will not be open Sunday, March 29. Talks will take place in Altgeld Hall and Noyes Lab.

Registration fees: (payable on-site only) US\$40 for AMS or CMS members; US\$60 for nonmembers; US\$5 for students, unemployed mathematicians, and emeritus members. Fees are payable by cash, check, VISA, MasterCard, Discover, or American Express.

Social Event

The UIUC department of mathematics will host a reception for the AMS meeting participants on Saturday, March 28, 6:15 p.m. to 8:00 p.m. in the South Lounge of Illini Union. Light snacks, refreshments, and wine will be served.

Travel

By Air: Willard Airport (CMI) is located in Champaign county on Route 45 about 6 miles south of campus. Owned and operated by the University of Illinois, the airport is currently served by two carriers, American Eagle (an affiliate of American Airlines) and Northwest Airlink (an affiliate of Northwest airlines). American Airlines has direct flights between Champaign and Chicago O'Hare (ORD) and between Champaign and Dallas Fort Worth (DFW). Northwest has direct flights between Champaign and Detroit (DTW). Taxi service from the Champaign airport to the campus is approximately US\$8–\$14 per person. LEX Express (217-352-6682) runs regular taxi shuttle service from the Champaign airport to town and they usually have a representative available at the airport. Other taxi companies servicing the Champaign airport can be reached at: 217-355-1328, 217-355-3553, 217-367-0000.

Other regional airports served by shuttles to the university campus include Midway airport (MDW) and O'Hare airport (ORD) in Chicago; Central Illinois Regional Airport (BMI) in Bloomington, Illinois; and the Indianapolis Airport (IND). It takes about 2.5–3 hours by car to get from the Chicago area airports to Champaign. The BMI airport is about 50 miles away from Champaign. Plane tickets to BMI are often cheaper and more airlines fly there. The Indianapolis airport is a little closer than the Chicago airports and traffic between Indianapolis and Champaign is usually better.

The Illini Shuttle (<http://www.illinishuttle.com/>) runs buses from the Chicago airports to campus, and the LEX shuttle (<http://www.lincolnlndexpress.com/>) runs buses from the Chicago airports, the Bloomington airport, and the Indianapolis airport. Please make advance reservations when using these shuttle services. When using the LEX shuttle online reservation site, note that the stop right next to the Illini Union and the math department is called "U of I Follets".

Driving: Altgeld Hall is on the southeast corner at the intersection of Green and Wright Streets. The directions below will get you to this intersection. There is a campus map available at <http://illinois.edu/ricker/CampusMap>.

Northbound on I-57 (from Effingham): Exit east at exit 235A onto University Avenue. Continue east for several miles, under the railroad tracks, to 6th Street. Turn right on 6th Street and continue south to Green Street or (one block later) John Street. Altgeld Hall is just one block east of the intersection of 6th and John.

Northbound on I-57 (alternative): Exit east onto University Avenue where eastbound I-72 terminates, go east two miles, turn right onto Neil Street (traffic signal), go south 0.25 miles, turn left onto Green Street (traffic signal), go east seven blocks to Wright Street. (Warning: University Avenue is one-way eastbound in this area, so on the return trip take Church Street, which is two blocks further north.)

Southbound on I-57 (from Chicago): Take exit 235A and proceed as above.

Eastbound on I-72 (from Decatur and Springfield): Continue into Champaign onto University Avenue, go east two miles, turn right onto Neil Street, go south 0.25 miles, turn left onto Green Street (traffic signal), go east seven blocks to Wright Street. (Warning: University Avenue is one-way eastbound in this area, so on the return trip take Church Street, which is two blocks further north.)

Eastbound on I-74 (from Normal, Bloomington, and Peoria): Exit south at Prospect Street (first exit in Champaign), go south two miles, turn left on Green Street (traffic signal), go east to 6th Street.

Westbound on I-74 (from Indianapolis): Exit south on Lincoln Avenue to Green Street and turn right on Green Street (traffic signal), go west 0.5 mile to Wright Street.

Local Transportation: The Champaign-Urbana MTD runs a regular public bus service in the area. A detailed bus schedule and bus maps are available at <http://www.cumtd.com/>.

Note that the service on weekends and in the evenings is reduced. During the day on Friday bus no. 10 (Gold) can be used for transportation between Illini Union and the three hotels near the intersection of Kirby Avenue and Neil Street (Hawthorn Suites, Homewood Suites, and Hilton Garden Inn). On Friday evening as well as at all times on Saturday and Sunday bus no. 100 (Yellow) can be used for the same purpose. Note that the routes of the buses no. 10 and no. 100 are a little different. The Saturday daytime map and schedule for bus no. 100 (northbound, to campus) are available at <http://www.cumtd.com/routeschedules/ByRoute.aspx?routeID=35&routegroupID=11> and the corresponding Sunday daytime info is available at <http://www.cumtd.com/routeschedules/ByRoute.aspx?routeID=35&routegroupID=5>. The bus stop for bus no. 100 nearest to the three hotels mentioned above is stop (K) in the schedule, at the corner of Kirby and State. The bus stop next to the math department is stop (N), at the corner of Green and Wright.

The Friday daytime eastbound (towards campus) map and schedule for bus no. 10 is available at <http://www.cumtd.com/routeschedules/ByRoute.aspx?routeID=21&routegroupID=1>. The nearest stop to the three hotels mentioned above is at the corner of Neil and Kirby.

On Saturday and Sunday mornings the university will provide additional free shuttle bus service from the Hilton Garden Inn to the AMS meeting location.

It is also expected (but not yet definite) that the ZIPCAR service will start operating in the Champaign-Urbana area in the spring 2009 semester. Check for details at <http://www.zipcar.com> after January 2009.

Car Rental: Avis is the official car rental company for the sectional meeting in Urbana. All rates include unlimited free mileage. Weekend daily rates are available from noon Thursday to Monday at 11:59 p.m. 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. For the best available rate and to make a reservation please call Avis at 800-331-1600 or go online at <http://www.avis.com>. Please use the AMS meeting **Avis Discount Number J098887**.

Weather

In late March, the average high temperature is about 55° and low is approximately 35°. For local UIUC weather, visit <http://www.atmos.uiuc.edu/weather/>.

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 wsd@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.

Raleigh, North Carolina

North Carolina State University

April 4-5, 2009

Saturday - Sunday

Meeting #1048

Southeastern Section

Associate secretary: Matthew Miller

Announcement issue of *Notices*: January 2009

Program first available on AMS website: February 19, 2009

Program issue of electronic *Notices*: April 2009

Issue of *Abstracts*: Volume 30, Number 2

Deadlines

For organizers: Expired

For consideration of contributed papers in Special Sessions: December 16, 2008

For abstracts: February 10, 2009

The scientific information listed below may be dated. For the latest information, see www.ams.org/amsmtgs/sectional.html.

Invited Addresses

Nathan Dunfield, University of Illinois at Urbana-Champaign, *Surfaces in finite covers of 3-manifolds: The virtual Haken conjecture*.

Reinhard C. Laubenbacher, Virginia Bioinformatics Institute, *Algebraic models in systems biology*.

Jonathan C. Mattingly, Duke University, *Stochastically forced fluid equations: Transfer between scales and ergodicity*.

Raman Parimala, Emory University, *Arithmetic of linear algebraic groups over 2-dimensional geometric fields*.

Special Sessions

Advancements in Turbulent Flow Modeling and Computation (Code: SS 8A), **Leo G. Rebholz**, Clemson University, and **Traian Iliescu**, Virginia Polytechnic Institute and State University.

Algebraic Groups and Symmetric Spaces (Code: SS 19A), **Stacy Beun**, Cabrini College, and **Aloysius Helminck**, North Carolina State University.

Applications of Algebraic and Geometric Combinatorics (Code: SS 2A), **Seth M. Sullivant**, Harvard University, and **Carla D. Savage**, North Carolina State University.

Applications of Dynamical Systems to Problems in Biology (Code: SS 16A), **John E. Franke** and **James F. Selgrade**, North Carolina State University.

Brauer Groups, Quadratic Forms, Algebraic Groups, and Lie Algebras (Code: SS 12A), **Eric S. Brussel** and **Skip Garibaldi**, Emory University.

Commutative Rings and Monoids (Code: SS 17A), **Scott T. Chapman**, Sam Houston State University, and **James B. Coykendall**, North Dakota State University.

Computational Methods in Lie Theory (Code: SS 10A), **Eric Sommers**, University of Massachusetts, Amherst, and **Molly Fenn**, North Carolina State University.

Deferred Correction Methods and their Applications (Code: SS 20A), **Elizabeth L. Bouzarth** and **Anita T. Layton**, Duke University.

Enumerative Geometry and Related Topics (Code: SS 7A), **Richard L. Rimanyi**, University of North Carolina, Chapel Hill, and **Leonardo C. Mihai**, Duke University.

Galois Module Theory and Hopf Algebras (Code: SS 13A), **Robert G. Underwood**, Auburn University Montgomery, and **James E. Carter**, College of Charleston.

Geometry of Differential Equations (Code: SS 9A), **Thomas A. Ivey**, College of Charleston, and **Irina A. Kogan**, North Carolina State University.

Homotopical Algebra with Applications to Mathematical Physics (Code: SS 3A), **Thomas J. Lada**, North Carolina State University, and **Jim Stasheff**, University of North Carolina, Chapel Hill.

Kac-Moody Algebras, Vertex Algebras, Quantum Groups, and Applications (Code: SS 1A), **Bojko N. Bakalov**, **Kailash C. Misra**, and **Naihuan N. Jing**, North Carolina State University.

Low-Dimensional Topology and Geometry (Code: SS 4A), **Nathan M. Dunfield**, University of Illinois at Urbana-Champaign, **John B. Etnyre**, Georgia Institute of Technology, and **Lenhard Ng**, Duke University.

Mathematical Progress and Challenges for Biological Materials (Code: SS 18A), **Mansoor A. Haider**, North Carolina State University, and **Gregory Forest**, University of North Carolina, Chapel Hill.

Mathematics of Immunology and Infectious Diseases (Code: SS 14A), **Stanca M. Ciupe**, Duke University.

Nonlinear Dynamics and Control (Code: SS 11A), **Anthony M. Bloch**, University of Michigan, Ann Arbor, and **Dmitry Zenkov**, North Carolina State University.

Numerical Solution of Partial Differential Equations and Applications (Code: SS 15A), **Alina Chertock** and **Zhilin Li**, North Carolina State University.

Recent Advances in Symbolic Algebra and Analysis (Code: SS 5A), **Michael F. Singer** and **Agnes Szanto**, North Carolina State University.

Rings, Algebras, and Varieties in Combinatorics (Code: SS 6A), **Patricia Hersh**, North Carolina State University, **Christian Lenart**, SUNY Albany, and **Nathan Reading**, North Carolina State University.

Stochastic Dynamics (Code: SS 21A), **Yuri Bakhtin**, Georgia Institute of Technology, and **Scott McKinley** and **Jonathan C. Mattingly**, Duke University.

The Mathematics of Biochemical Reaction Networks (Code: SS 22A), **Anne Shiu**, University of California Berkeley, **Manoj Gopalkrishnan**, University of Southern California, and **Gheorghe Craciun**, University of Wisconsin-Madison.

Special Presentation

The American Mathematical Society sponsors a series of public lectures in mathematics entitled the **AMS Einstein Public Lecture in Mathematics**. The lectures began in 2005 to celebrate the one-hundredth anniversary of Einstein's *annus mirabilis*. The Department of Mathematics at North Carolina State University is honored that the AMS has chosen this meeting for the 2009 public lecture. The talk will be given by **Michael S. Waterman**, University of Southern California, on Saturday, April 4. The title of the talk is *Reading DNA sequences: Twenty-first century technology with eighteenth century mathematics*. The exact timing and location on campus will be announced at a later date. The public is cordially invited to attend.

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 North Carolina State University. Rooms have been blocked in the Holiday Inn and The Velvet Cloak Inn which are within walking distance of campus. The AMS is not responsible for rate changes or for the quality of the accommodations. Rates quoted do not include taxes (current tax rate is 12.75%). Hotels have varying cancellation or early checkout penalties; be sure to ask for details when making your reservation.

Holiday Inn-Brownstone Hotel, 1707 Hillsborough St., Raleigh, NC 27605; 919-828-0811; 800-331-7919; 919-834-0904 (fax); US\$79/single or double (**ask for NCSU/AMS meeting rate**); rates include complimentary high speed Internet, 24-hour fitness center, and seasonal outdoor pool. Ledo Pizza and Pasta is a full service restaurant and bar on site. Property is within walking distance to meeting. **The deadline for reservations is March 5, 2009.** For further information please visit <http://www.brownstonehotel.com>. Please be sure to inquire about cancellation or early checkout penalties when making your reservation.

The Velvet Cloak Inn, 1505 Hillsborough St., Raleigh, NC 27605; 919-828-0333; 919-828-2656 (fax); US\$69/single or double (**ask for NCSU/AMS meeting rate**); within walking distance to meeting. Bar/lounge on site, as well as indoor heated pool. **The deadline for reservations is March 5, 2009.** For further information please visit <http://www.thevelvetcloak.com>. Please be sure to inquire about cancellation or early checkout penalties when making your reservation.

Clarion Hotel, 320 Hillsborough St., Raleigh, NC 27603; 919-832-0501; US\$94/single or double (**ask for NCSU rate**); located approximately three miles east of campus. For further information please visit <http://www.clarionhotel.com>.

Ramada Inn Blue Ridge, 1520 Blue Ridge Rd., Raleigh, NC 27607; 919-832-4100; 800-272-6232 (**ask for NCSU rate**); located approximately three miles west of campus. For further information please visit <http://blueridge.pmcproperties.com>.

Food Service

There are a number of restaurants adjacent to the campus. A list of these restaurants will be available at the registration desk at the meeting. The student dining halls are located at Fountain Dining Hall (Bldg. 82 on Central Campus) and Clark Dining Hall (Bldg. 106 on Central Campus) and are open on Saturday and Sunday, 10:30 a.m.–8:00 p.m.

Local Information/Campus Map

Please visit the website maintained by the Department of Mathematics at <http://www.math.ncsu.edu/> and North Carolina State University website at <http://www.ncsu.edu>. A campus map is found at http://www.ncsu.edu/campus_map/.

Other Activities

Book Sales: Stop by the onsite AMS Bookstore and review the newest titles from the AMS and enjoy up to 25% off all AMS publications, or take home an AMS t-shirt! 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

The nearest parking areas can be found on Founders Drive, Lampe Drive, and Stinson Drive. Visitors may park on campus (except in fire lanes and no parking areas) on Saturday and Sunday at no charge. Please refer to the Web address http://www.ncsu.edu/campus_map/north.htm for these street locations.

For parking Monday–Friday, visitors may purchase daily permits for US\$2 per day at the Visitor Information Centers (Main Campus–Stinson Drive). The Main Campus Visitor Booth will issue visitor permits and a map to direct visitors to the Coliseum Parking Deck between Dunn and Cates Avenues if you need to be on campus during these days.

Registration and Meeting Information

The registration desk will be located in Riddick Hall (2401 Stinson Dr., Bldg 39 on campus map) and will be open 7:30 a.m. to 4:00 p.m. on Saturday, and 8:00 a.m. to noon on Sunday. Please refer to http://www.ncsu.edu/campus_map/north.htm for building locations. Registration 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.

Travel

By Air: The Raleigh–Durham International Airport (RDU), 2400 W. Terminal Blvd., Morrisville, NC, is about twelve miles northwest of the meeting site on campus and is served by most major airlines. A one-way taxi fare to campus from the airport is about \$30; limo service is about US\$55 per trip at the time this announcement went to press. There is no regularly scheduled shuttle service. Please refer to <http://www.rdu.com/groundtrans/groundtrans.htm> for names/contact information and rates.

Driving: Take I-40 East to exit 289 (Raleigh North and East), which becomes Wade Avenue. At third traffic light make right on Faircloth Street, then at first traffic light make left on Hillsborough Street. NCSU will be directly ahead on the right. The Holiday Inn–Brownstone and The Velvet Cloak Inn are less than one mile from NCSU entrance.

Train: There is an AMTRAK station a short taxi ride from campus. See <http://www.amtrak.com> for schedules and pricing information.

Car Rental

Avis Rent A Car is the official car rental company for the meeting. Depending on variables such as location, length of rental, and size of vehicle, Avis will offer participants the best available rate which can range from 5%–25% discount off regular rates. Participants must use the assigned Meeting Avis Discount Number (**J098887**) and meet Avis rate requirements to receive the discount. (Rate discounts are available at all corporate and participating licensee locations.) Reservations can be made by calling 800-331-1600 or online at <http://www.avis.com>.

All car rentals include unlimited free mileage and are available to renters 25 years and older. Renters must also meet Avis's driver and credit requirements. Return to the same rental location or additional surcharges may apply. Rates do not include any state or local surcharges, tax, optional coverages, or gas refueling charges.

Weather

Temperatures vary from 65° to 75°F in April with night lows dipping to upper 50's. For the most up-to-date weather information visit <http://www.wral.com/weather/>.

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.

Worcester, Massachusetts

Worcester Polytechnic Institute

April 25–26, 2009

Saturday – Sunday

Meeting #1050

Eastern Section

Associate secretary: Steven H. Weintraub

Announcement issue of *Notices*: February 2009

Program first available on AMS website: March 12, 2009

Program issue of electronic *Notices*: April 2009

Issue of *Abstracts*: Volume 30, Number 3

Deadlines

For organizers: Expired

For consideration of contributed papers in Special Sessions: January 6, 2009

For abstracts: March 3, 2009

The scientific information listed below may be dated. For the latest information, see www.ams.org/amsmtgs/sectional.html.

Invited Addresses

Octav Cornea, Université de Montréal, *Title to be announced.*

Fengbo Hang, Courant Institute of New York University, *Title to be announced.*

Umberto Mosco, Worcester Polytechnic Institute, *Title to be announced.*

Kevin Whyte, University of Illinois at Chicago, *Title to be announced.*

Special Sessions

Algebraic Graph Theory, Association Schemes, and Related Topics (Code: SS 8A), **William J. Martin**, Worcester Polytechnic Institute, and **Sylvia A. Hobart**, University of Wyoming.

Analysis of Weakly Differentiable Maps with Constraints and Applications (Code: SS 11A), **Fengbo Hang**, Courant Institute, New York University, and **Mohammad Reza Pakzad**, University of Pittsburgh.

Discrete Geometry and Combinatorics (Code: SS 5A), **Egon Schulte**, Northeastern University, and **Brigitte Servatius**, Worcester Polytechnic Institute.

Effective Dynamics and Interactions of Localized Structures in Schrodinger Type Equations (Code: SS 10A), **Fridolin Ting**, Lakehead University.

Number Theory (Code: SS 4A), **John T. Cullinan**, Bard College, and **Siman Wong**, University of Massachusetts, Amherst.

Quasi-Static and Dynamic Evolution in Fracture Mechanics (Code: SS 6A), **Christopher J. Larsen**, Worcester Polytechnic Institute.

Real and Complex Dynamics of Rational Difference Equations with Applications (Code: SS 9A), **M. R. S. Kulev** and **Orlando Merino**, University of Rhode Island.

Scaling, Irregularities, and Partial Differential Equations (Code: SS 7A), **Umberto Mosco** and **Bogdan M. Vernescu**, Worcester Polytechnic Institute.

Symplectic and Contact Topology (Code: SS 1A), **Peter Albers**, Purdue University/ETH Zurich, and **Basak Gurel**, Vanderbilt University.

The Mathematics of Climate Change (Code: SS 3A), **Catherine A. Roberts** and **Gareth E. Roberts**, College of the Holy Cross, and **Mary Lou Zeeman**, Bowdoin College.

Topological Robotics (Code: SS 2A), **Li Han** and **Lee N. Rudolph**, Clark University.

San Francisco, California

San Francisco State University

April 25–26, 2009

Saturday – Sunday

Meeting #1049

Western Section

Associate secretary: Michel L. Lapidus

Announcement issue of *Notices*: February 2009

Program first available on AMS website: March 12, 2009

Program issue of electronic *Notices*: April 2009

Issue of *Abstracts*: Volume 30, Number 3

Deadlines

For organizers: Expired

For consideration of contributed papers in Special Sessions: January 6, 2009

For abstracts: March 3, 2009

The scientific information listed below may be dated. For the latest information, see www.ams.org/amsmtgsectional.html.

Invited Addresses

Yehuda Shalom, University of California Los Angeles, *Title to be announced.*

Roman Vershynin, University of California Davis, *Title to be announced.*

Karen Vogtmann, Cornell University, *Title to be announced.*

Efim Zelmanov, University of California Los Angeles, *Title to be announced.*

Special Sessions

Advances in the Theory of Integer Linear Optimization and its Extensions (Code: SS 7A), **Matthias Koeppe** and **Peter Malkin**, University of California Davis.

Algebra and Number Theory with Polyhedra (Code: SS 11A), **Matthias Beck**, San Francisco State University, and **Christian Haase**, Freie Universität Berlin.

Applications of Knot Theory to the Entanglement of Biopolymers (Code: SS 10A), **Javier Arsuaga**, San Francisco State University, **Kenneth Millett**, University of California Santa Barbara, and **Mariel Vazquez**, San Francisco State University.

Aspects of Differential Geometry (Code: SS 9A), **David Bao**, San Francisco State University, and **Lei Ni**, University of California San Diego.

Banach Algebras, Topological Algebras and Abstract Harmonic Analysis (Code: SS 1A), **Thomas V. Tonev**, University of Montana-Missoula, and **Fereidoun Ghahramani**, University of Manitoba.

Concentration Inequalities (Code: SS 3A), **Sourav Chatterjee**, University of California Berkeley, and **Roman Vershynin**, University of California Davis.

Geometry and Topology of Orbifolds (Code: SS 6A), **Elizabeth Stanhope**, Lewis & Clark University, and **Joseph E. Borzellino**, California State University San Luis Obispo.

Lie Group Actions, Teichmüller Flows and Number Theory (Code: SS 12A), **Jayadev Athreya**, Yale University, **Yitwah Cheung**, San Francisco State University, and **Anton Zorich**, Rennes University.

Matroids in Algebra and Geometry (Code: SS 8A), **Federico Ardila**, San Francisco State University, and **Lauren Williams**, Harvard University.

Nonlinear Dispersive Equations (Code: SS 4A), **Sebastian Herr**, University of California Berkeley, and **Jeremy L. Marzuola**, Columbia University.

Nonlinear Partial Differential Equations (Code: SS 13A), **Igor Kukavica**, **Amjad Tuffaha**, and **Mohammed Ziane**, University of Southern California.

Recent Progress in Geometric Group Theory (Code: SS 2A), **Seonhee Lim** and **Anne Thomas**, Cornell University.

Waco, Texas

Baylor University

October 16–18, 2009

Friday – Sunday

Meeting #1051

Central Section

Associate secretary: Susan J. Friedlander

Announcement issue of *Notices*: August 2009

Program first available on AMS website: September 3, 2009

Program issue of electronic *Notices*: October 2009

Issue of *Abstracts*: Volume 30, Number 4

Deadlines

For organizers: March 17, 2009

For consideration of contributed papers in Special Sessions: June 30, 2009

For abstracts: August 25, 2009

*The scientific information listed below may be dated.
For the latest information, see www.ams.org/amsmtgs/sectional.html.*

Invited Addresses

David Ben-Zvi, University of Texas at Austin, *Title to be announced.*

Alexander A. Kiselev, University of Wisconsin, *Title to be announced.*

Michael C. Reed, Duke University, *Title to be announced.*

Igor Rodnianski, Princeton University, *Title to be announced.*

Special Sessions

Commutative Algebra: Module and Ideal Theory (Code: SS 4A), **Lars W. Christensen**, Texas Tech University, **Louiza Fouli**, University of Texas at Austin, and **David Jorgensen**, University of Texas at Arlington.

Dynamic Equations on Time Scales: Analysis and Applications (Code: SS 1A), **John M. Davis**, **Ian A. Gravagne**, and **Robert J. Marks**, Baylor University.

Lie Groups, Lie Algebras, and Representations (Code: SS 6A), **Markus Hunziker**, **Mark Sepanski**, and **Ronald Stanke**, Baylor University.

Mathematical Models of Neuronal and Metabolic Mechanisms (Code: SS 3A), **Janet Best**, Ohio State University, and **Michael Reed**, Duke University.

Numerical Solutions of Singular or Perturbed Partial Differential Equation Problems with Applications (Code: SS 2A), **Peter Moore**, Southern Methodist University, and **Qin Sheng**, Baylor University.

Topological Methods for Boundary Value Problems for Ordinary Differential Equations (Code: SS 5A), **Richard Avery**, Dakota State University, **Paul W. Eloe**, University of Dayton, and **Johnny Henderson**, Baylor University.

University Park, Pennsylvania

Pennsylvania State University

October 24–25, 2009

Saturday – Sunday

Meeting #1052

Eastern Section

Associate secretary: Steven H. Weintraub

Announcement issue of *Notices*: August 2009

Program first available on AMS website: September 10, 2009

Program issue of electronic *Notices*: October 2009

Issue of *Abstracts*: Volume 30, Number 4

Deadlines

For organizers: March 24, 2009

For consideration of contributed papers in Special Sessions: July 7, 2009

For abstracts: September 1, 2009

*The scientific information listed below may be dated.
For the latest information, see www.ams.org/amsmtgs/sectional.html.*

Invited Addresses

Michael K. H. Kiessling, Rutgers University, *Title to be announced.*

Kevin R. Payne, Università degli di Milano, *Title to be announced.*

Laurent Saloff-Coste, Cornell University, *Title to be announced.*

Robert C. Vaughan, Penn State University, *Title to be announced.*

Boca Raton, Florida

Florida Atlantic University

October 30 – November 1, 2009

Friday – Sunday

Meeting #1053

Southeastern Section

Associate secretary: Matthew Miller

Announcement issue of *Notices*: August 2009

Program first available on AMS website: September 17, 2009

Program issue of electronic *Notices*: October 2009

Issue of *Abstracts*: Volume 30, Number 4

Deadlines

For organizers: March 30, 2009

For consideration of contributed papers in Special Sessions: July 14, 2009

For abstracts: September 8, 2009

*The scientific information listed below may be dated.
For the latest information, see www.ams.org/amsmtgs/sectional.html.*

Invited Addresses

Spyros Alexakis, Princeton University, *Title to be announced.*

Kai-Uwe Bux, University of Virginia, *Title to be announced.*

Dino J. Lorenzini, University of Georgia, *Title to be announced.*

Eduardo D. Sontag, Rutgers University, *Title to be announced.*

Special Sessions

Commutative Ring Theory (Code: SS 3A), **Alan Loper**, Ohio State University, and **Lee C. Klingler**, Florida Atlantic University.

Concentration, Functional Inequalities, and Isoperimetry (Code: SS 2A), **Mario Milman**, Florida Atlantic University, **Christian Houdre**, Georgia Institute of Technology, and **Emanuel Milman**, Institute for Advanced Study.

Constructive Mathematics (Code: SS 1A), **Robert Lubar-sky**, **Fred Richman**, and **Martin Solomon**, Florida Atlantic University.

Riverside, California

University of California

November 7–8, 2009

Saturday – Sunday

Meeting #1054

Western Section

Associate secretary: Michel L. Lapidus

Announcement issue of *Notices*: September 2009

Program first available on AMS website: September 24, 2009

Program issue of electronic *Notices*: November 2009

Issue of *Abstracts*: Volume 30, Number 4

Deadlines

For organizers: April 6, 2009

For consideration of contributed papers in Special Sessions: July 21, 2009

For abstracts: September 15, 2009

The scientific information listed below may be dated. For the latest information, see www.ams.org/amsmtg/sectional.html.

Invited Addresses

Christopher Hacon, University of Utah, *Title to be announced.*

Birge Huisgen-Zimmerman, University of California Santa Barbara, *Title to be announced.*

Jun Li, Stanford University, *Title to be announced.*

Joseph Teran, University of California Los Angeles, *Title to be announced.*

Special Sessions

Algebraic Geometry (Code: SS 1A), **Christopher Hacon**, University of Utah, and **Ziv Ran**, University of California Riverside.

Fluid Mechanics (Code: SS 5A), **James Kelliher** and **Qi Zhang**, University of California Riverside.

History and Philosophy of Mathematics (Code: SS 4A), **Shawnee L. McMurrin**, California State University San Bernardino, and **James J. Tattersall**, Providence College.

Noncommutative Geometry (Code: SS 2A), **Vasiliy Dolgushev** and **Wee Liang Gan**, University of California Riverside.

Representation Theory (Code: SS 3A), **Vyjayanthi Chari**, **Wee Liang Gan**, and **Jacob Greenstein**, University of California Riverside.

San Francisco, California

Moscone Center West and the San Francisco Marriott

January 13–16, 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

Lexington, Kentucky

University of Kentucky

March 27–28, 2010

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: August 28, 2009

For consideration of contributed papers in Special Sessions: To be announced

For abstracts: To be announced

St. Paul, Minnesota

Macalester College

April 10–11, 2010

Saturday – 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 10, 2009

For consideration of contributed papers in Special Sessions: To be announced

For abstracts: To be announced

Albuquerque, New Mexico

University of New Mexico

April 17–18, 2010

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 17, 2009

For consideration of contributed papers in Special Sessions: To be announced

For abstracts: To be announced

Hoboken, New Jersey

New Jersey Institute of Technology

May 22–23, 2010

Saturday – Sunday

Eastern Section

Associate secretary: Steven H. Weintraub

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: November 23, 2009

For consideration of contributed papers in Special Sessions: To be announced

For abstracts: To be announced

Berkeley, California

University of California Berkeley

June 2–5, 2010

Wednesday – Saturday

Eighth Joint International Meeting of the AMS and the Sociedad Matemática Mexicana.

Associate secretary: Susan J. Friedlander

Announcement issue of *Notices*: February 2010

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

Notre Dame, Indiana

Notre Dame University

September 18–19, 2010

Saturday – 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: February 19, 2010

For consideration of contributed papers in Special Sessions: To be announced

For abstracts: To be announced

Los Angeles, California

University of California Los Angeles

October 9–10, 2010

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 10, 2010

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: Steven H. Weintraub

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

Statesboro, Georgia

Georgia Southern University

March 12–13, 2011

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: August 12, 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: Susan J. Friedlander

Announcement issue of *Notices*: October 2012

Program first available on AMS website: November 1, 2012

Program issue of electronic *Notices*: January 2012

Issue of *Abstracts*: Volume 34, Issue 1

Deadlines

For organizers: April 1, 2012

For consideration of contributed papers in Special Sessions: To be announced

For abstracts: To be announced

Baltimore, Maryland

Baltimore Convention Center

January 15–18, 2014

Wednesday – Saturday

Joint Mathematics Meetings, including the 120th Annual Meeting of the AMS, 97th 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, with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).

Associate secretary: Matthew Miller

Announcement issue of *Notices*: October 2013

Program first available on AMS website: November 1, 2013

Program issue of electronic *Notices*: January 2013

Issue of *Abstracts*: Volume 35, Issue 1

Deadlines

For organizers: April 1, 2013

For consideration of contributed papers in Special Sessions: To be announced

For abstracts: To be announced

San Antonio, Texas

Henry B. Gonzalez Convention Center and Grand Hyatt San Antonio

January 10–13, 2015

Saturday – Tuesday

Joint Mathematics Meetings, including the 121st Annual Meeting of the AMS, 98th 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, with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).

Associate secretary: Steven H. Weintraub

Announcement issue of *Notices*: October 2014

Program first available on AMS website: To be announced

Program issue of electronic *Notices*: January 2015

Issue of *Abstracts*: To be announced

Deadlines

For organizers: April 1, 2014

For consideration of contributed papers in Special Sessions: To be announced

For abstracts: To be announced

Presenters of Papers

Washington, District of Columbia; January 5–8, 2009

Numbers following the name indicate the speaker's position on the program.

*◊ Joint 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*

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| ► Jafarov, E. E. | 1931 | Kelly, B. P. | 1596 | * Kou, S. | 1508 | Lewis, H. A. | 157 |
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| Yarema, C. H. | 1106 | | |

Program of the Sessions

Washington, District of Columbia, January 5–8, 2009

Saturday, January 3

AMS Short Course on Quantum Computation and Quantum Information (Part I)

8:00 AM – 5:00 PM

Organizer: **Samuel J. Lomonaco**, University of Maryland Baltimore County

- 8:00AM Registration.
- 9:00AM *A Rosetta Stone for quantum computing.*
(1) **Samuel Lomonaco**, University of Maryland Baltimore County
- 10:15AM Break.
- 10:45AM *Quantum algorithms.*
(2) **Peter Shor**, Massachusetts Institute of Technology
- 2:00PM *Concentration of measure effects in quantum information.*
(3) **Patrick Hayden**, McGill University
- 3:15PM Break.
- 3:45PM *Quantum error correction and fault tolerance.*
(4) **Daniel Gottesman**, Perimeter Institute

MAA Short Course on Data Mining and New Trends in Teaching Statistics (Part I)

8:00 AM – 4:00 PM

Organizer: **Richard D. De Veaux**, Williams College

- 8:00AM Registration
- 9:00AM *Math is music—statistics is literature. What are the challenges of teaching statistics, and why is it different from mathematics?*
(5) **Richard D. De Veaux**, Williams College
- 10:30AM Break.
- 10:45AM *What does the introductory course look like in 2009? How technology has changed what we do in introductory statistics for the non-math/science student.*
(6) **Richard D. De Veaux**, Williams College

- 1:00PM *What does the math-based introductory course look like in 2009? How do we merge mathematical concepts into the introductory course for the math/science student? How does statistical programming fit in?*
(7) **Richard D. De Veaux**, Williams College
- 2:30PM Break.
- 2:45PM *Introduction to modeling. Regression and ANOVA.*
(8) **Richard D. De Veaux**, Williams College

Sunday, January 4

AMS Department Chairs Workshop

8:00 AM – 6:30 PM

MAA Board of Governors

8:00 AM – 6:00 PM

MAA Ancillary Workshop

8:30 AM – 5:00 PM

Teaching introductory data analysis through modeling.

Presenter: **Daniel Kaplan**, Macalester College

AMS Short Course on Quantum Computation and Quantum Information (Part II)

9:00 AM – 5:00 PM

Organizer: **Samuel J. Lomonaco**, University of Maryland Baltimore County

- 9:00AM *Riemannian geometry of quantum computation.*
(9) **Howard Brandt**, U. S. Army Research Laboratory
- 10:15AM Break.
- 10:45AM *Topology and quantum computing.*
(10) **Louis H. Kauffman**, University of Illinois at Chicago

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 30, Issue 1 of *Abstracts of papers presented to the American Mathematical Society*, ordered according to the numbers in parentheses following the listings.

- 2:00PM *Quantum knots and mosaics.*
 (11) **Samuel Lomonaco**, University of Maryland
 Baltimore County
- 3:15PM Break.
- 3:45PM Panel Discussion: The Grand Mathematical
 Challenge for Quantum Computation and Quantum
 Information.

MAA Short Course on Data Mining and New Trends in Teaching Statistics (Part II)

9:00 AM – 4:00 PM

- Organizer: **Richard D. De Veaux**, Williams College
- 9:00AM *Introduction to data mining, Part I: What is data*
 (12) *mining? How does it differ from statistics? What are*
the problems and techniques in data mining?
Richard D. De Veaux, Williams College
- 10:30AM Break.
- 10:45AM *Introduction to data mining, Part II: Five lessons*
 (13) *learned from data mining.*
Richard D. De Veaux, Williams College
- 1:00PM *Introduction to data mining, Part III: The methods*
 (14) *and algorithms of data mining.*
Richard D. De Veaux, Williams College
- 2:30PM Break.
- 2:45PM *Introduction to data mining, Part IV: Practical data*
 (15) *mining: Case studies.*
Richard D. De Veaux, Williams College

AMS Council

1:30 PM – 10:00 PM

Joint Meetings Registration

3:00 PM – 7:00 PM

Monday, January 5

Joint Meetings Registration

7:30 AM – 4:00 PM

AMS-MAA-SIAM Special Session on Research in Mathematics by Undergraduates, I

8:00 AM – 10:50 AM

- Organizers: **Darren A. Narayan**, Rochester
 Institute of Technology
Jacqueline A. Jensen, Sam Houston
 State University
Carl V. Lutzer, Rochester Institute of
 Technology
Vadim Ponomarenko, San Diego State
 University
Tamas Wiandt, Rochester Institute of
 Technology
- 8:00AM *Frames: Surgeries, dilation, and robustness.*
 ► (16) Preliminary report.
Jennifer L. Wolfe*, **Rachael L. Tomasino**, **Eileen L.**
Radzwion and **Sara P. Rimer**, Central Michigan
 University (1046-15-90)
- 8:30AM *The minimum semidefinite rank of a graph.*
 ► (17) **Taiji Tsutsui***, Hiram College, Hiram OH, and
Rachel Ellen Cranfill, Harvey Mudd College
 (1046-15-91)

- 9:00AM *A numerical and analytical study of modeling*
 ► (18) *techniques for microstructure evolution.*
M. R. Atkins, George Mason University
 (1046-35-103)
- 9:30AM *Understanding and predicting materials properties*
 ► (19) *from phase-field simulations.* Preliminary report.
Thomas Dean Stephens, George Mason University
 (1046-35-101)
- 10:00AM *Vector invariants of elementary Abelian p -Groups.*
 ► (20) Preliminary report.
Aaron B. Adcock, Texas Tech University, Lubbock
 TX (1046-13-22)
- 10:30AM *Mathematical modeling, analysis and computation*
 ► (21) *of a fluid-structure interaction problem with*
applications. Preliminary report.
Sarah Minerva Venuti*, **Kevin Kelbaugh** and
Padmanabhan Seshayer, George Mason University
 (1046-65-66)

AMS Special Session on Recent Trends in Coding Theory, I

8:00 AM – 10:50 AM

- Organizers: **Gretchen L. Matthews**, Clemson
 University
Judy L. Walker, University of Nebraska
- 8:00AM *Generalizing binary quadratic residue codes.*
 (22) **P. Charters**, University of Texas at Austin
 (1046-11-645)
- 8:25AM *Locally decodable codes.*
 (23) **Sergey Yekhanin**, Microsoft Research
 (1046-68-951)
- 8:50AM *Iterative subspace pursuit decoding of weighted*
 (24) *euclidean superimposed codes.*
Wei Dai* and **Olgica Milenkovic**, University of
 Illinois at Urbana-Champaign (1046-68-1510)
- 9:15AM *On algebraic constructions of codes for random*
 ► (25) *linear network coding.*
Felice Manganiello*, **Elisa Gorla** and **Joachim**
Rosenthal, Zurich University (1046-94-854)
- 9:40AM *Further analysis of codes based on permutations.*
 (26) **Christine A. Kelley**, University of Nebraska-Lincoln
 (1046-94-1960)
- 10:05AM *Coding theory and Pseudorandomness.*
 (27) **Venkatesan Guruswami**, University of Washington
 & Carnegie Mellon University (1046-05-1085)

AMS Special Session on Representation Theory of Lie Algebras and Algebraic Groups, I

8:00 AM – 10:50 AM

- Organizers: **David G. Taylor**, Roanoke College
Terrell L. Hodge, Western Michigan
 University
Daniel K. Nakano, University of
 Georgia
- 8:00AM *Killing forms of Lie algebras.*
 (28) **Audrey Malagon**, Emory University (1046-17-72)
- 8:30AM *Freudenthal triple systems by root system methods.*
 (29) **Fred W. Helenius**, Emory University (1046-17-80)
- 9:00AM *Filtrations of Weyl modules.* Preliminary report.
 (30) **Brian Parshall**, University of Virginia
 (1046-20-1137)
- 9:30AM *Cohomology of algebraic, quantum, and finite*
 (31) *groups.*
Leonard L. Scott, The University of Virginia
 (1046-20-1149)

- 10:00AM *Cohomology of finite-dimensional quantized enveloping algebras: The mixed case.*
(32) **Christopher M. Drupieski**, University of Virginia (1046-20-1224)
- 10:30AM *Combinatorics of crystal bases for certain Demazure modules.*
(33) **Julie C. Beier**, Mercer University (1046-17-445)

AMS Special Session on Nonlinear Partial Differential Equations and Applications, I

8:00 AM – 10:50 AM

Organizers: **Gui-Qiang G. Chen**, Northwestern University
Cleopatra C. Christoforou, University of Houston

- 8:00AM *Compensated compactness and the multi-dimensional Euler equations.*
(34) **James Glimm**, State University of New York at Stony Brook (1046-35-257)
- 8:30AM *On the dynamics of multicomponent reactive flows.*
(35) **Konstantina Trivisa**, University of Maryland (1046-35-1186)
- 9:00AM *Instantaneous boundary tangency and cusp formation in two-dimensional fluid flows.*
▶ (36) **Misha Perepelitsa***, Vanderbilt University, and **David Hoff**, Indiana University (1046-35-636)
- 9:30AM *On shock-free periodic solutions for the Euler equations.*
(37) **Robin C. Young***, University of Massachusetts, Amherst, and **J. Blake Temple**, University of California, Davis (1046-35-1619)
- 10:00AM *Stability of Newtonian rotating white dwarf stars.*
(38) **Tao Luo***, Georgetown University, and **Joel Smoller**, University of Michigan, Ann Arbor (1046-35-677)
- 10:30AM *Local well-posedness of a dispersive Navier-Stokes system.*
(39) **C. David Levermore*** and **Weiran Sun**, University of Maryland, College Park (1046-35-1209)

AMS Special Session on Stochastic, Large-Scale, and Hybrid Systems with Applications, I

8:00 AM – 10:50 AM

Organizers: **Aghalaya S. Vatsala**, University of Louisiana at Lafayette
G. S. Ladde, University of South Florida
K. Ramachandran, University of South Florida

- 8:00AM *Numerical solution of hybrid fractional differential equations.* Preliminary report.
(40) **S. Pederson** and **M. Sambandham***, Morehouse College (1046-65-435)
- 8:30AM *On periodic solutions of quasilinear differential equations with piecewise constant argument of generalized type in critical case.*
(41) **Cemil Buyukadali***, Middle East Technical University, and **Marat Akhmet**, Middle East Technical University (1046-34-850)
- 9:00AM *Existence of solutions for systems of differential equations with impulses with application to ecological models.*
(42) **Ianna H. West**, Nicholls State University (1046-34-1152)
- 9:30AM *On random network dynamics.* Preliminary report.
(43) **Andrzej Korzeniowski**, The University of Texas at Arlington (1046-60-1277)

- 10:00AM *Cooperative/competitive dynamics in social networks.* Preliminary report.
(44) **Jagdish Chandra***, The George Washington University, and **G. S. Ladde**, University of South Florida (1046-34-472)
- 10:30AM *Fractional differential and integral equations of Riemann-Liouville versus Caputo type.* Preliminary report.
(45) **Aghalaya S. Vatsala**, University of Louisiana at Lafayette (1046-34-490)

AMS Special Session on Experimental Mathematics, I

8:00 AM – 10:50 AM

Organizers: **Tewodros Amdeberhan**, Tulane University
Luis A. Medina, Tulane University
Victor H. Moll, Tulane University

- 8:00AM *Towards a classification of periodic orbits of particular fractal billiards.*
▶ (46) **Michel L. Lapidus** and **Robert G. Niemeyer***, University of California, Riverside (1046-37-945)
- 8:30AM *Towards a proof of the q -TSPP conjecture.*
▶ (47) **Christoph Koutschan**, RISC, Johannes Kepler University, Linz, Austria (1046-05-1749)
- 9:00AM *Some divisibility properties for Stirling numbers of the second kind.* Preliminary report.
▶ (48) **O-Yeat Chan***, Dalhousie University, and **Dante Manna**, Virginia Wesleyan College (1046-11-1271)
- 9:30AM *Experimentation at the frontier of reality in Schubert calculus.* Preliminary report.
(49) **Frank Sottile**, Texas A&M University (1046-14-1705)
- 10:00AM *Enumeration schemes for barred permutation patterns.* Preliminary report.
(50) **Lara K. Pudwell**, Valparaiso University (1046-05-936)
- 10:30AM *Grid graphs, Gorenstein polytopes, and domino stackings.*
▶ (51) **Matthias Beck***, San Francisco State University, **Christian Haase**, Freie Universität Berlin, and **Steven Sam**, MIT (1046-05-837)

AMS Special Session on Heavy-Tailed Behavior: Theory and Applications

8:00 AM – 10:50 AM

Organizers: **Thomas B. Fowler**, Noblis Incorporated
Marty Fischer, Noblis Incorporated
Denise Masi, Noblis Incorporated
John F. Shortle, George Mason University

- 8:00AM *Lévy stable laws.*
(52) **John P. Nolan**, American University (1046-60-1157)
- 8:35AM *Approximations for the waiting time distribution in an M/G/1 queue with heavy tails.*
(53) **Mariana Olvera-Cravioto***, Columbia University, and **Peter W. Glynn**, Stanford University (1046-60-587)
- 9:10AM *Emergence of heavy-tailed behavior and the failure of the central limit theorem due to hypercorrelation.*
▶ (54) **Thomas B. Fowler**, Noblis, Incorporated (1046-60-560)

- 9:45AM (55) *Simulation techniques and numerical methods for analyzing systems with heavy-tailed distributions.*
John F. Shortle*, George Mason University, **Martin J. Fischer** and **Denise M. B. Masi**, Noblis, Inc. (1046-90-819)
- 10:20AM (56) *Constructing a risk map for pyroclastic flows: Using simulations and data to predict rare events.*
Elaine T. Spiller, Marquette University (1046-86-1659)

AMS Special Session on Von Neumann Algebras, I

8:00 AM – 10:45 AM

Organizers: **Pinhas Grossman**, Vanderbilt University
Remus Nicoara, University of Tennessee

- 8:00AM (57) *Ergodic subequivalence relations induced by a Bernoulli action.*
Ionut Chifan*, UCLA, and **Adrian Ioana**, California Institute of Technology (1046-37-1285)
- 8:30AM (58) *Non-existence of certain finite depth subfactors.*
Marta Asaeda*, Univ of California, Riverside, and **Seidai Yasuda**, RIMS, Kyoto (1046-47-1190)
- 9:00AM (59) *Automorphisms of planar algebras.* Preliminary report.
Richard D. Burstein, University of Ottawa (1046-47-1763)
- 9:30AM (60) *Planar algebra of group-type subfactors.*
Shamindra Kumar Ghosh, Vanderbilt University (1046-47-2043)
- 10:00AM (61) *The free product of planar algebras.*
Dietmar Bisch, Vanderbilt University (1046-46-243)

AMS Special Session on Mathematics of Computation, I

8:00 AM – 10:50 AM

Organizers: **Susanne C. Brenner**, Louisiana State University
Chi-Wang Shu, Brown University

- 8:00AM (62) *Analysis of a local discontinuous Galerkin method for fourth-order time-dependent problems.*
Bo Dong* and **Chi-Wang Shu**, Brown University (1046-65-732)
- 8:30AM (63) *Superconvergence of discontinuous Galerkin finite element solutions for time-dependent problems.*
Yingda Cheng*, University of Texas at Austin, and **Chi-Wang Shu**, Brown University (1046-65-1060)
- 9:00AM (64) *A C^0 interior penalty approximation of the Cahn-Hilliard equation in phase separation.*
Susanne C. Brenner, **Thirupathi Gudi*** and **Li-yeng Sung**, Louisiana State University (1046-65-1861)
- 9:30AM (65) *New finite element methods for fourth order curl equations.*
Qiya Hu, LSEC, Chinese Academy of Sciences, **Jinchao Xu** and **Bin Zheng***, Penn State University (1046-65-1656)
- 10:00AM (66) *Multigrid solvers for a class of discontinuous Galerkin methods on graded meshes.*
Jintao Cui, Louisiana State University (1046-35-815)
- 10:30AM (67) *Evaluating options whose payoffs depend on continuously monitored asset prices.*
Fred J. Hickernell, Illinois Institute of Technology, Chicago, IL (1046-65-83)

AMS Special Session on Difference Equations, I

8:00 AM – 10:50 AM

Organizer: **Michael Radin**, Rochester Institute of Technology

- 8:00AM (68) *Open problems and conjectures in difference equations.* Preliminary report.
Gerasimos E. Ladas, University of Rhode Island (1046-39-171)
- 8:30AM (69) *Local asymptotic stability and difference equations of arbitrary finite order.*
John W. Cain, Virginia Commonwealth University (1046-39-87)
- 9:00AM (70) *On Riccati difference equations with periodic coefficients.*
E. A. Grove, **Y. Kostrov***, **G. Ladas**, University of Rhode Island, and **S. Schlutz**, Providence College (1046-39-646)
- 9:30AM (71) *Analyzing and comparing the boundedness nature of the positive solutions of two autonomous and two non-autonomous rational difference equations.* Preliminary report.
Edward A. Grove, University of Rhode Island (1046-39-640)
- 10:00AM (72) *Dynamics of certain periodic nonlinear delay difference equations.*
V. L. Kocic, Xavier University of Louisiana (1046-39-571)
- 10:30AM (73) *On reduction of order of difference equations.*
H. Sedaghat, Virginia Commonwealth University (1046-39-153)

AMS Special Session on Automorphic and Modular Forms in Number Theory, I

8:00 AM – 10:50 AM

Organizers: **Ken Ono**, University of Wisconsin-Madison
Amanda Folsom, University of Wisconsin-Madison
Sharon A. Garthwaite, Bucknell University

- 8:00AM (74) *Rank-crank type PDE and non-holomorphic Jacobi forms.* Preliminary report.
Kathrin Bringmann, Universitaet Koeln (1046-11-1251)
- 8:30AM (75) *Overpartitions and class numbers of binary quadratic forms.*
Jeremy Lovejoy*, CNRS, LIAFA, Universite Paris 7, and **Kathrin Bringmann**, University of Cologne (1046-11-1196)
- 9:00AM (76) *Recent work on Maass and modular forms.*
Matt Boylan, University of South Carolina (1046-11-1909)
- 9:30AM (77) *The unbounded denominator property of noncongruence modular forms.*
Chris A. Kurth and **Ling Long***, Iowa State University (1046-11-391)
- 10:00AM (78) *Jacobi forms over complex quadratic fields via the cubic Casimir operators.* Preliminary report.
Olav K. Richter*, University of North Texas & RWTH Aachen University (Germany), **Kathrin Bringmann**, University of Cologne (Germany), and **Charles H. Conley**, University of North Texas (1046-11-423)
- 10:30AM (79) *Gaussian hypergeometric functions.*
Robert Osburn, University College Dublin (1046-11-1635)

AMS Special Session on Topological Methods in Applied Mathematics, I

8:00 AM – 10:50 AM

Organizer: **Yongwu Rong**, George Washington University

- 8:00AM (80) *Dynamical systems over graphs: The relationship between graph topology and dynamics.*
Reinhard C. Laubenbacher*, **Abdul S. Jarrah**, Virginia Bioinformatics Institute, and **Alan Veliz-Cuba**, Virginia Polytechnic Institute and State University (1046-37-1326)
- 8:30AM (81) *Knot theoretical methods for RNA-template guided DNA recombinations.*
Angela Angeleska, **Natasa Jonoska**, and **Masahico Saito***, University of South Florida (1046-57-521)
- 9:00AM (82) *Strategies for DNA recombination using assembly graphs.*
A. Angeleska*, **N. Jonoska** and **M. Saito**, University of South Florida (1046-00-652)
- 9:30AM (83) *A transition polynomial for signed Feynman diagrams.* Preliminary report.
Kerry Luse*, Trinity (Washington) University, and **Yongwu Rong**, The George Washington University (1046-57-1385)
- 10:00AM (84) *Computation of the Alexander-Conway polynomial on the chord diagrams of singular knots.*
Sana Raoof, Harvard College (1046-92-1145)
- 10:30AM (85) *A fast algorithm for homology groups in 3D cubical space.*
Li Chen*, University of the District of Columbia, and **Yongwu Rong**, George Washington University (1046-57-1203)

AMS Special Session on the Role of Generalized Maximal Monotonicity Frameworks in Optimization and Control Theory with Applications, I

8:00 AM – 10:50 AM

Organizer: **Ram U. Verma**, International Publications

- 8:00AM (86) *Kalman filtering of measure driven processes in Hilbert space.*
N. U. Ahmed, SITE, University of Ottawa (1046-93-285)
- 9:00AM (87) *Optimal impulse control in currency markets when interventions affect rates.*
Alec N. Kercheval*, Florida State University, and **Juan F. Moreno**, State of Wisconsin Investment Board (1046-49-689)
- 10:00AM (88) *Global stabilization of nonlinear switched time-delay systems via matrix inequalities.* Preliminary report.
Vu Ngoc Phat, Institute of Mathematics, Hanoi, Vietnam (1046-93-463)
- 10:30AM (89) *Subgradients of marginal functions in parametric optimization.*
Boris Mordukhovich, Wayne State University, and **Nguyen Mau Nam***, University of Texas-Pan American (1046-49-35)

AMS Session on Biology, I

8:00 AM – 10:55 AM

- 8:00AM (90) *Mathematical model to quantify the impact of the recovery rate on the dynamics and transmission of malaria in a changing population: Case of Cameroon.*
Miranda Ijang Teboh-Ewungkem, Lafayette College (1046-92-714)
- 8:15AM (91) *The effect of temperature on transient population dynamics: A case study using the pea aphid (*Acyrtosiphon pisum*).* Preliminary report.
Joan P. Lubben*, **Brigitte Tenhumberg**, and **Richard Rebarber**, University of Nebraska-Lincoln (1046-92-1053)
- 8:30AM (92) *Circular splicing language and maximal prefix code.* Preliminary report.
Tilahun Abay Muche, University of South Florida (1046-92-1100)
- 8:45AM (93) *The mating game: A game theoretic analysis of the mating sign behavior in the honeybee.*
M. Wilhelm*, **J. Rychtar**, **O. Rueppell**, and **M. Chhetri**, UNCG (1046-92-1269)
- 9:00AM (94) *Effect of the abiotic environment on preening in glaucous-winged gulls (*Larus glaucescens*), Part I.*
Lynelle M. Weldon, **Shandelle M. Henson**, **James L. Hayward**, **Libby C. Megna***, Andrews University, and **Joseph G. Galusha**, Walla Walla University (1046-92-821)
- 9:15AM (95) *Effect of the abiotic environment on preening in glaucous-winged gulls (*Larus glaucescens*), Part II.*
Lynelle M. Weldon*, **Shandelle M. Henson**, **James L. Hayward**, **Libby C. Megna**, Andrews University, and **Joseph G. Galusha**, Walla Walla University (1046-92-823)
- 9:30AM Break
- 9:45AM (96) *The modeling of retinal ganglion cell (RGC) axons and its convexity properties.* Preliminary report.
Kai-Bin Fu, Texas A&M University (1046-92-1335)
- 10:00AM (97) *Dynamical behavior of a one-island, selection-migration model with partial dominance.* Preliminary report.
Jordan West Bostic*, North Carolina State University, **James H. Roberds**, USDA Forest Service, Southern Research Station, and **James F. Selgrade**, North Carolina State University (1046-92-1338)
- 10:15AM (98) *Kullback-Leibler Markov Chain Monte Carlo – A new algorithm for finite mixture analysis and its application to gene expression data.*
Tatiana Valerievna Tatarinova*, Loyola Marymount University, and **Alan Schumitzky**, University of Southern California (1046-92-1421)
- 10:30AM (99) *Radio-telemetry under malfunctioning receivers.*
Channa N. Navaratna*, Indiana University of Pennsylvania, and **Menaka B. Navaratna**, Florida Gulf Coast University (1046-92-1428)
- 10:45AM (100) *Nonlinear dynamics of a simple microvascular network.* Preliminary report.
David Gardner, **Yiyang Li** and **Benjamin Small***, Franklin W. Olin College of Engineering (1046-00-1672)

AMS Session on Operator Theory

8:00 AM – 10:55 AM

- 8:00AM (101) *Group Bundle Duality.*
Geoff R. Goehle, Dartmouth College (1046-47-566)
- 8:15AM (102) *Vertex operator algebras and integrable system.*
Shr-Jing Chen, Rutgers University (1046-47-241)

- 8:30AM (103) *Uncertainty principles from representations of Lie groups.*
Jens Gerlach Christensen, Louisiana State University (1046-47-1643)
- 8:45AM (104) *Lacunary orbits for multiplication operators in $C[0, 1]$ and $L_p[0, 1]$, $1 \leq p < \infty$.*
Aderaw Workneh Fenta, Arkansas State University (1046-46-1570)
- 9:00AM (105) *Hermitian weighted composition operators on weighted Hardy spaces.*
Carl C. Cowen, Indiana University – Purdue University, Indianapolis, **Gajath Gunatillake***, American university of Sharjah, and **Eungil Ko**, Ewha Women's University, Seoul, Korea (1046-47-207)
- 9:15AM (106) *Irregularity of orbits of operators.* Preliminary report.
Gabriel T. Prajitura, SUNY Brockport (1046-47-1055)
- 9:30AM Break
- 9:45AM (107) *n-contractivity and k-hyponormality of some Bergman-like weighted shifts.* Preliminary report.
Gregory Adams and **George R. Exner***, Bucknell University (1046-47-1448)
- 10:00AM (108) *On the numerical range of a class of composition operators on H^2 .* Preliminary report.
William M. Higdon, University of Indianapolis (1046-47-462)
- 10:15AM (109) *On the index solvability for variational inequalities with (S)-mappings.*
Dan D. Pascali, Courant Institute, New York University (1046-47-846)
- 10:30AM (110) *Inequalities and operator means.*
Mohammad Khadivi* and **Mokhtar Aouina**, Jackson State University (1046-47-922)
- 10:45AM (111) *A refined Luecking's theorem and finite-rank products of Toeplitz operators on the Bergman space.*
Trieu L. Le, University of Waterloo (1046-47-1170)

AMS Session on Differential Geometry

8:00 AM – 10:55 AM

- 8:00AM (112) *On the volume of meromorphic vector fields on Riemann surfaces.* Preliminary report.
Amine Fawaz, The University of Texas of the Permian Basin (1046-53-201)
- 8:15AM (113) *The topology of low-dimensional cohomogeneity one manifolds.* Preliminary report.
Corey A. Hoelscher*, Rutgers University, and **Shari Ultman**, Oregon State University (1046-53-673)
- 8:30AM (114) *On the classification of low-dimensional fixed point homogeneous Riemannian manifolds with nonnegative sectional curvature.* Preliminary report.
Fernando Galaz-Garcia, University of Maryland, College Park (1046-53-1098)
- 8:45AM (115) *The higher flows of harmonic maps.*
Michael S. Gagliardo, Jacksonville University (1046-53-1315)
- 9:00AM (116) *A convexity theorem for the real part of a Borel invariant subvariety.*
Timothy E. Goldberg, Cornell University (1046-53-1148)
- 9:15AM (117) *Isoperimetric balls in cones over tori.*
Frank Morgan, Williams College (1046-53-583)
- 9:30AM Break

- 9:45AM (118) *Folded toric four-manifolds.* Preliminary report.
Christopher R. Lee, University of Illinois at Urbana-Champaign (1046-53-1802)
- 10:00AM (119) *Connections and parallel transport.* Preliminary report.
Florin Dumitrescu, Pennsylvania State University (1046-53-1117)
- 10:15AM (120) *Connected components of strata of quadratic differentials over Teichmüller space.*
Katharine Walker, University of Michigan (1046-53-1827)
- 10:30AM (121) *Some CR-submanifolds of low Chen-type in complex space forms.* Preliminary report.
Ivko Dimitric, Pennsylvania State University Fayette (1046-53-2028)
- 10:45AM (122) *Screw-motion invariant minimal surfaces.*
Michelle E. Hackman, Indiana University (1046-53-217)

AMS Session on Quantum Theory and Fluid Mechanics

8:00 AM – 10:55 AM

- 8:00AM (123) *Linear instability criteria for Euler's equation: Two classes of perturbations.* Preliminary report.
Elizabeth Thoren, The University of Texas at Austin (1046-76-322)
- 8:15AM (124) *A hybrid particle-continuum (DSMC-SPDE) algorithm for dense fluid flows.*
Aleksandar Donev*, Lawrence Livermore National Laboratory, **Alejandro L. Garcia**, Dept. Physics & Astronomy, San Jose State Univ., and **Berni J. Alder**, Lawrence Livermore National Laboratory (1046-76-1402)
- 8:30AM (125) *Human tear film dynamics with an overset grid method.*
Kara L. Maki*, **Richard J. Braun**, University of Delaware, **William D. Henshaw**, Lawrence Livermore National Laboratory, and **P. Ewen King-Smith**, The Ohio State University (1046-76-1581)
- 8:45AM (126) *Dynamics of edge-flames in micro-channels.* Preliminary report.
Joanna A. Bieri, Northwestern University (1046-76-1824)
- 9:00AM (127) *Unstable internal waves.*
Roxana Tiron*, **Roberto Camassa**, University of North Carolina at Chapel Hill, **Ann Almgren**, LBL Laboratories, Berkeley, and **Amber Sallerson**, University of North Carolina at Chapel Hill (1046-76-1964)
- 9:15AM (128) *Falling spheres in stratified fluids.*
Roberto Camassa, **Joyce T. Lin*** and **Richard M. McLaughlin**, University of North Carolina at Chapel Hill (1046-76-1597)
- 9:30AM Break
- 9:45AM (129) *Vacuum and bound state calculations in point form quantum field theory.*
Kevin C. Murphy, The University of Iowa (1046-81-1724)
- 10:00AM (130) *Lieb-Robinson bound on the anharmonic lattice.*
Hillel M. Raz, University of California Davis (1046-81-1870)
- 10:15AM (131) *Differential geometry on a renormalization bundle.*
Susama Agarwala, Johns Hopkins University (1046-81-270)
- 10:30AM (132) *Quantum traces in quantum Teichmüller Theory.* Preliminary report.
Christopher Scott Hiatt, The University of Texas of the Permian Basin (1046-81-556)

- 10:45AM *Multipart quantum states with nearly maximal stabilizer.*
 ▶ (133) **Stephanie A. Blanda**, Lebanon Valley College (1046-81-808)

MAA Session on Mathematics and the Arts, I

8:00 AM – 10:55 AM

Organizer: **Douglas E. Norton**, Villanova University

- 8:00AM *How a medieval troubadour became a mathematical figure.* Preliminary report.
 ▶ (134) **Michael P. Saclolo**, St. Edward's University (1046-J1-1997)
- 8:20AM *Mathematics of salsa dancing.*
 ▶ (135) **Christine von Renesse** and **Volker Ecke***, Westfield State College (1046-J1-431)
- 8:40AM *Modeling voice-leading in music: The special role of the bass voice.* Preliminary report.
 ▶ (136) **James R. Hughes*** and **Brandon Metz**, Elizabethtown College (1046-J1-1754)
- 9:00AM *Using music to demonstrate group theory.* Preliminary report.
 ▶ (137) **Vicky Williams Klima**, Appalachian State University (1046-J1-818)
- 9:20AM *A mathematics & music course for liberal arts majors.*
 ▶ (138) **Kurt E. Ludwick**, Salisbury University (1046-J1-1926)
- 9:40AM *The MAA Curriculum Foundations Project: A report from the workshop on mathematics and the arts and implications for the undergraduate mathematics curriculum.*
 ▶ (139) **Susan L. Ganter***, Clemson University, **Joanne Caniglia**, Kent State University, and **William Haver**, Virginia Commonwealth University (1046-J1-585)
- 10:00AM *Which Edgar Allan Poe story is his most quintessential? A word analysis using Galois lattices of formal concepts.*
 ▶ (140) **Roger Bilisoly**, Central Connecticut State University (1046-J1-672)
- 10:20AM *The calculus of the Quinto Acuto and gothic architecture.*
 ▶ (141) **Mike Huber**, Muhlenberg College (1046-J1-194)
- 10:40AM *Art from the margins: Questions raised by artistic patterns illustrating FLT.*
 ▶ (142) **Stephen H. Harnish**, Bluffton University (1046-J1-2018)

MAA General Contributed Paper Session, I

8:00 AM – 10:55 AM

Organizer: **Sarah L. Mabrouk**, Framingham State College

Moderators: **Timothy Redl**, University of Houston-Downtown
Robert D. Poodiak, Norwich University
Michael J. Caulfield, Gannon University
Jennifer Wagner, Washburn University

- 8:00AM *Lobb's generalization of Catalan's parenthesization problem.*
 ▶ (143) **Thomas Koshy**, Framingham State College (1046-Z1-620)
- 8:15AM *Verifying Huppert's Conjecture for ${}^2G_2(q^2)$.*
 (144) **Thomas Philip Wakefield**, Slippery Rock University (1046-Z1-466)

- 8:30AM *An interdisciplinary project for statistics and physics.* Preliminary report.
 ▶ (145) **Josh W. Helms*** and **Rodney Sturdivant**, United States Military Academy (1046-Z1-1356)
- 8:45AM *Evaluating communication skills in a modern algebra course.* Preliminary report.
 ▶ (146) **Jennifer D. Wagner**, Washburn University (1046-Z1-228)
- 9:00AM *Discontinuous open maps from \mathbb{R}^n onto \mathbb{R}^n .*
 (147) **William Goldbloom Bloch**, Wheaton College (1046-Z1-1218)
- 9:15AM *Apportioning seats in the U.S. House of Representatives.*
 ▶ (148) **Michael J. Caulfield**, Gannon University (1046-Z1-347)
- 9:30AM *Development and analysis of a new course in computational mathematics with MATLAB at the University of Houston-Downtown.*
 ▶ (149) **Timothy A. Redl**, University of Houston-Downtown (1046-Z1-1083)
- 9:45AM *The power of five.*
 ▶ (150) **Robert D. Poodiak**, Norwich University (1046-Z1-1834)
- 10:00AM *Which is better: Homework or quizzes?* Preliminary report.
 ▶ (151) **Edwin P. Herman**, University of Wisconsin, Stevens Point (1046-Z1-1370)
- 10:15AM *Loop decompositions of circulations in strongly connected digraphs.* Preliminary report.
 ▶ (152) **Michael J. Adams*** and **Jonathan D. Vollmer**, Truman State University (1046-Z1-776)
- 10:30AM *Universal cycles of classes of restricted words.*
 ▶ (153) **Arielle M. Leitner***, California State University, Chico, and **Anant Godbole**, East Tennessee State University (1046-Z1-529)
- 10:45AM *Discriminating graphs of third degree polynomial functions.*
 ▶ (154) **Lucio M.G. Prado***, BMCC - The City University of New York, and **Abdramane Serme**, BMCC- The City University of New York (1046-Z1-1449)

MAA General Contributed Paper Session, II

8:00 AM – 10:40 AM

Organizer: **Sarah L. Mabrouk**, Framingham State College

Moderators: **Rachel Schwell**, Central Connecticut State University
David Hammond, Ecole Polytechnique Federale de Lausanne
Thomas Lominac, Virginia Military Institute

- 8:00AM *Developing modern algebra and perspectives on the nature of mathematics in Victorian England.*
 ▶ (155) **Richard H. Stout**, Gordon College (1046-Z1-1733)
- 8:15AM *Testing the effects of predictors data generated by non-identity link functions of the single-index model: A Monte Carlo approach.*
 (156) **Rebecca S. Patterson**, University of Louisville, and **Larry Wayne Lewis***, Spalding University (1046-Z1-924)
- 8:30AM *Math mistakes that make the news.* Preliminary report.
 ▶ (157) **Heather A. Lewis**, Nazareth College (1046-Z1-1573)
- 8:45AM *Foundations of mathematics, Survivor!*
 ▶ (158) **Deborah A. Koslover**, University of Texas at Tyler (1046-Z1-1775)

- 9:00AM *Using online discussions in an introductory/intermediate algebra course.*
 ► (159) **Sarah L. Mabrouk**, Framingham State College (1046-Z1-2051)
- 9:15AM *Wavelets on graphs via spectral graph theory.*
 (160) **David K. Hammond***, **Pierre Vanderghynst**, Ecole Polytechnique Federale de Lausanne, and **Remi Gribonval**, IRISA-INRIA Rennes (1046-Z1-1237)
- 9:30AM *Incorporating mathematics into a study abroad experience.*
 (161) **Ellen Mir**, Elon University (1046-Z1-335)
- 9:45AM *The modified Moore method versus the traditional one: A case study.* Preliminary report.
 ► (162) **Mahmoud Yousef***, **Shing S. So** and **David Ewing**, University of Central Missouri (1046-Z1-1279)
- 10:00AM *A research project for a beginning mathematics student.*
 ► (163) **Anthony D. Berard, Jr.**, King's College (1046-Z1-601)
- 10:15AM *Elementary central limit theorems via mathematical induction.*
 ► (164) **Mark H. Inlow**, Rose-Hulman Institute of Technology (1046-Z1-1165)
- 10:30AM *Bite-sized exams: A tale of two pre-calcs.*
 (165) **Rachel Schwell**, Central Connecticut State University (1046-Z1-1722)

SIAM Minisymposium on Mathematical Modeling of Natural Resources, I

8:00 AM – 10:50 AM

Organizer: **Catherine A. Roberts**, College of the Holy Cross

- 8:00AM *A multi-species model for bacterial biofilms used in waste water treatment.*
 (166) **David L. Chopp**, Northwestern University (1046-92-509)
- 8:30AM *Metapopulation models in tick-borne disease transmission modeling.*
 (167) **Holly D. Gaff***, Old Dominion University, and **Elsa Schaefer**, Marymount University (1046-92-357)
- 9:00AM *The persistence of ranavirus in salamanders with ephemeral larval habitats.* Preliminary report.
 (168) **Horst R. Thieme*** and **Thanate Dhirasakdanon**, Arizona State University (1046-92-505)
- 9:30AM *Deterministic and stochastic juvenile-adult models with application to amphibians.*
 (169) **Azmy S. Ackleh***, **Keng Deng** and **Qihua Huang**, University of Louisiana at Lafayette (1046-92-554)
- 10:00AM *Modeling "stay/flee" conflict situations in animal behavior: Poisson regression and differential equations.* Preliminary report.
 ► (170) **Shandelle M. Henson***, Andrews University, and **James L. Hayward**, Andrews University (1046-92-502)
- 10:30AM *Evolutionary reversals in competitive interactions: Experimental occurrences and model explanations using Darwinian dynamics.* Preliminary report.
 ► (171) **J. M. Cushing***, **Rosalyn Rael**, University of Arizona, **Thomas L. Vincent**, University of Arizona, and **R. F. Costantino**, University of Arizona (1046-92-510)

Employment Center

8:00 AM – 7:00 PM

AMS Session on Algebraic and Analytic Geometry

8:15 AM – 10:55 AM

- 8:15AM *Algebraic density property of homogeneous spaces.*
 (172) **Fabrizio Donzelli*** and **Shulim Kaliman**, University of Miami, Coral Gables, Florida (1046-14-1121)
- 8:30AM *On 3-dimensional tiling.* Preliminary report.
 ► (173) **Injun Song***, **Eu Kyum Kim** and **Hum Kum**, Korea Advanced Institute of Science and Technology (1046-14-1617)
- 8:45AM *Structure of Riemann-Roch G -modules for $\mathcal{Y}^m = x^p - x$ over $GF(p)$.*
 (174) **Darren Glass**, Gettysburg College, **W. David Joyner*** and **Amy Ksir**, US Naval Academy (1046-14-1756)
- 9:00AM *Group operation on the Jacobian of singular hyperelliptic curves.* Preliminary report.
 (175) **Enver Ozdemir**, University Of Maryland, College Park (1046-14-1494)
- 9:15AM *Prym varieties of trigonal curves.*
 (176) **Yuri Zarhin**, Pennsylvania State University (1046-14-1522)
- 9:30AM Break
- 9:45AM *A linear algebraic proof of Demailly and Skoda's theorem.*
 ► (177) **Yisha Peng**, Zhejiang University (1046-14-1179)
- 10:00AM *Theta functions for small genus curves with automorphisms.*
 (178) **G. Sujeeva Wijesiri**, Oakland University (1046-14-991)
- 10:15AM *Degree even coverings of elliptic curves by genus 2 curves.*
 (179) **Nejme Gjika***, University of Vlora, Albania, and **Miftar Ramosaco**, University of Vlora, Albania. (1046-14-695)
- 10:30AM *Determining equations of families of cyclic curves.*
 (180) **Rakinawasan Sanjeewa**, Oakland University (1046-14-857)
- 10:45AM *Computing fundamental units in bicyclic biquadratic global fields.*
 (181) **Qingquan Wu**, University of Calgary (1046-11-1030)

AMS Session on History

8:15 AM – 10:55 AM

- 8:15AM *How history of mathematics can help education of mathematics.* Preliminary report.
 ► (182) **Saeed Seyed Agha**, I.H.University (1046-01-27)
- 8:30AM *Al-Risala al-Muhitiyya II ("The treatise on the circumference").*
 (183) **Mohammad K. Azarian**, University of Evansville (1046-01-649)
- 8:45AM *Mathematician or physician?* Preliminary report.
 ► (184) **Mohammad Moazzam**, Salisbury University (1046-01-1270)
- 9:00AM *Ioannis Carandinos and the Ionian Academy.* Preliminary report.
 ► (185) **Christine Phili**, National Technical University Athens (1046-01-1566)
- 9:15AM *Determining the determinant: The early years.*
 (186) **Daniel E. Otero**, Xavier University (1046-01-1693)
- 9:30AM *Connections between the genesis of mathematics and writing in ancient Mesopotamia in 3100 B.C. and the neuroscience of learning mathematics today.* Preliminary report.
 ► (187) **Alexander G. Atwood**, SUNY Suffolk County Community College (1046-01-2003)

- 9:45AM *Boole and Hamilton: An unanswered question.*
 ▶ (188) Preliminary report.
Charlotte K. Simmons, University of Central Oklahoma (1046-01-1574)
- 10:00AM *A history of college algebra in the United States during the Nineteenth Century.*
 ▶ (189) **Jeff A. Suzuki**, Brooklyn College (1046-01-753)
- 10:15AM *Webster's "Arithmetick in Epitome" and other eighteenth century English arithmetic books.*
 ▶ (190) **Andrew B. Perry**, Springfield College (1046-01-1750)
- 10:30AM *Landmarks and trails in the development of differential calculus in normed and function spaces.*
 ▶ (191) **M. Zuhair Nashed**, University of Central Florida (1046-01-1918)
- 10:45AM *A new look at the convergence of a famous sequence.* Preliminary report.
 ▶ (192) **Mihaela Dobrescu**, Christopher Newport University (1046-40-1825)

Rebecca Walker, Grand Valley State University

MAA Minicourse #1: Part A

9:00 AM – 11:00 AM

Discrete models in biology and simulations.

Organizers: **Saber N. Elaydi**, Trinity University
Huseyin Kocak, University of Miami
David Ribble, Trinity University

MAA Minicourse #6: Part A

9:00 AM – 11:00 AM

Teaching with clickers and classroom voting.

Organizers: **Derek Bruff**, Vanderbilt University
Kelly Cline, Carroll College
Mark Parker, Carroll College
Holly Zullo, Carroll College

AMS Special Session on The Mathematics of Information and Knowledge, I

9:00 AM – 10:45 AM

Organizers: **Ronald R. Coifman**, Yale University
James G. Glimm, SUNY at Stony Brook
Peter W. Jones, Yale University
Stephen Smale, Toyota Institute

- 9:00AM *Scales and geometry in data sets.*
 (193) **Peter W. Jones**, Yale University (1046-65-1292)
- 10:00AM *Homological methods for the study of data sets.*
 (194) **Shmuel Weinberger**, University of Chicago (1046-55-2129)

AMS Special Session on Group Actions on Homogeneous Spaces and Applications, I

9:00 AM – 10:40 AM

Organizers: **Dmitry Y. Kleinbock**, Brandeis University
Gregory A. Margulis, Yale University
Hee Oh, Brown University

- 9:00AM *The generic points for the horocycle flow on \mathbb{Z}^d covers.*
 (195) **Omri Sarig***, The Pennsylvania State University, and **B. Schapira**, Universite Picardie Jules Verne (1046-37-245)
- 10:00AM *Volume entropy and measure of maximal entropy of hyperbolic buildings.* Preliminary report.
 (196) **Francois Ledrappier**, University of Notre Dame, and **Seonhee Lim***, Cornell University (1046-37-1544)

MAA Minicourse #11: Part A

9:00 AM – 11:00 AM

Planning and teaching mathematics capstone courses for preservice secondary school teachers.

Organizers: **Edward F. Aboufadel**, Grand Valley State University
Richard Hill, Michigan State University
Bruce E. Sagan, Michigan State University
Sharon Senk, Michigan State University
Natasha M. Speer, Michigan State University

AMS Session on Analysis

9:00 AM – 10:55 AM

- 9:00AM *A generalization of the mean value theorem for integrals.* Preliminary report.
 (197) **Nasser Dastrange**, Buena Vista University (1046-26-654)
- 9:15AM *Error terms for Steffensen's, Young's, and Chebychev's Inequalities.*
 ▶ (198) **Peter R. Mercer**, Buffalo State College (1046-26-1265)
- 9:30AM *Iterations of Darboux Functions.*
 (199) **Kandasamy Muthuvel**, University of Wisconsin-Oshkosh (1046-26-1499)
- 9:45AM *A generalization of an unpublished theorem of Wiener.*
 ▶ (200) **J. Marshall Ash***, DePaul University, **Sergey Tikhonov**, Scuola Normale Superiore, and **James Tung**, DePaul University (1046-42-2118)
- 10:00AM *Radon-Nikodym Theorem for hyper-measures.*
 (201) **Mark Burgin**, University of California, Los Angeles, **Dongxin (Tony) Chen*** and **Alan Krinik**, California State Polytechnic University, Pomona (1046-28-1563)
- 10:15AM *Large time heat kernel asymptotics for Riemannian polytopal complexes and finitely generated groups of isometries.* Preliminary report.
 (202) **Melanie Anne Pivarski**, Texas A&M University (1046-58-1804)
- 10:30AM *Idempotent probability measures on a locally compact semihypergroups.*
 (203) **Norbert N. Youmbi**, Saint Francis University (1046-43-879)
- 10:45AM *Extensions to the theory of local regularization for solving linear Volterra inverse problems.* Preliminary report.
 (204) **Cara D. Brooks***, Rose-Hulman Institute of Technology, and **Patricia K. Lamm**, Michigan State University (1046-45-1484)

AMS Session on Topological Groups

9:00 AM – 10:40 AM

- 9:00AM *Pro-p groups of rank 3 and the question of Iwasawa.*
 (205) **Ilir Snopce**, Binghamton University (1046-22-1303)

- 9:15AM (206) *Caratheodory approach in Haar measure.*
Preliminary report.
Amir A. Maleki, Howard University (1046-22-1343)
- 9:30AM (207) *On maximal ideals of compact connected mobs.*
Preliminary report.
Phoebe Ho McLaughlin*, **Shing S. So**, University of Central Missouri, and **Haohao Wang**, Southeast Missouri State University (1046-22-1766)
- 9:45AM (208) *Infinite towers of cocompact lattices in Kac-Moody groups.* Preliminary report.
Lisa Carbone and **Leigh Cobbs***, Rutgers University (1046-22-1130)
- 10:00AM (209) *Decompositions of various compact symmetric spaces.*
Robyn Brooks, Trinity University, **Derek Habermas**, State University of New York at Potsdam, **Karol Koziol***, New York University, and **Kirsten Trickey**, Clarkson University (1046-22-1525)
- 10:15AM (210) *Equivariant degenerations of spherical modules for groups of type A.* Preliminary report.
Stavros Papadakis, CAMGSD, Insituto Superior Tecnico, and **Bart Van Steirteghem***, Medgar Evers College (CUNY) (1046-22-1865)
- 10:30AM (211) *Topologies that are defined by forcing sequences of real numbers to converge to zero.* Preliminary report.
Jon W. Short*, Sam Houston State University, and **T. Christine Stevens**, Saint Louis University (1046-22-1994)

MAA Career Fair

9:00 AM – 11:00 AM

All students in the process of earning Bachelor's, Master's, or Ph.D. degrees are invited to participate.

Organizer: **Robert W. Vallin**, MAA

MAA-Young Mathematicians' Network Panel Discussion

9:00 AM – 10:20 AM

Finding your n^{th} job (for n greater than or equal to 2).

Organizers: **Joshua D. Laison**, Willamette University
Aaron Luttmann, Clarkson University
Raluca M. Gera, Naval Post Graduate School

MAA Special Presentation

9:00 AM – 10:20 AM

National Science Foundation programs supporting learning and teaching in the mathematical sciences.

Organizers: **Henry Warchall**, NSF/DMS
Karen A. Marrongelle, NSF/DRL
Daniel P. Maki, NSF/DUE
Ginger H. Rowell, NSF/DUE
Elizabeth J. Teles, NSF/DUE
Lee L. Zia, NSF/DUE

Student Hospitality Center

9:00 AM – 5:00 PM

MAA Special Presentation

9:30 AM – 10:30 AM

ICME-11 in retrospect.

Organizers: **Martha J. Siegel**, Towson University
William G. McCallum, University of Arizona

MAA Department Liaisons Meeting

9:30 AM – 11:00 AM

AMS Invited Address

10:05 AM – 10:55 AM

- (212) *Advances in advancing interfaces: Building semiconductors, inkjet plotters, medical scanners, and robotic devices.*
James Sethian, University of California, Berkeley (1046-35-09)

AMS-MAA Invited Address

11:10 AM – NOON

- (213) *Stability, consistency, and convergence: Modern variations on a classical theme.*
Douglas N. Arnold, University of Minnesota, Minneapolis (1046-65-14)

Exhibits and Book Sales

12:15 PM – 5:30 PM

Come to the Grand Opening at 12:15!

AMS Colloquium Lectures: Lecture I

1:00 PM – 2:00 PM

- (214) *Homogeneous dynamics and number theory I.*
Gregory Margulis, Yale University (1046-37-02)

MAA Invited Address

2:15 PM – 3:05 PM

- (215) *Perfect graphs—Structure and recognition.*
Maria Chudnovsky, Columbia University (1046-A0-11)

AMS-MAA-SIAM Special Session on Research in Mathematics by Undergraduates, II

2:15 PM – 6:30 PM

Organizers: **Darren A. Narayan**, Rochester Institute of Technology
Jacqueline A. Jensen, Sam Houston State University
Carl V. Lutzer, Rochester Institute of Technology
Vadim Ponomarenko, San Diego State University
Tamas Wiandt, Rochester Institute of Technology

- 2:15PM (216) *Spectrally accurate initial data for numerical relativity.*
Nicholas Battista* and **Anthony Harkin**, Rochester Institute of Technology (1046-35-944)

- 2:45PM *A network theoretic approach to hyperspectral image classification.*
 ▶ (217) **Ryan Lewis*** and **Anthony Harkin**, Rochester Institute of Technology (1046-91-1115)
- 3:15PM *Matrix number theory: Factorization in integral matrix semigroups.* Preliminary report.
 ▶ (218) **David Hannasch***, University of Nevada, Las Vegas, **Rene Ardila**, City College of New York, **Audra Kosh**, University of California, Santa Barbara, **Hannah McCarthy**, Lawrence University, **Ryan Rosenbaum**, **Donald Adams** and **Vadim Ponomarenko**, San Diego State University (1046-11-349)
- 3:45PM *Class number indivisibility in function fields.*
 ▶ (219) **Michael Daub**, Berkeley, **Jackie Lang***, Bryn Mawr, **Mona Merling**, Bard College, **Natee Pitiwan**, **Allison Pacelli**, Williams College, and **Michael Rosen**, Brown University (1046-11-1092)
- 4:15PM *The soap bubble problem on the sphere.* Preliminary report.
 ▶ (220) **Edward Souder Newkirk**, Williams College (1046-51-826)
- 4:45PM *The hitting time for a sequence pattern in a Markov chain.* Preliminary report.
 ▶ (221) **Shiliang Cui*** and **Evan Fisher**, Lafayette College (1046-60-517)
- 5:15PM *Classifying the simplices of the 4-dimensional cube.*
 ▶ (222) **Natalie Durgin***, **Helen Highberger**, **Jacob Scott** and **Francis Edward Su**, Harvey Mudd College (1046-52-157)
- 5:45PM *The strong symmetric genus of small generalized symmetric groups.*
 ▶ (223) **Michael A. Ginter**, **Susannah E. Johnson**, and **James E. McNamara***, Grove City College (1046-20-36)
- 6:10PM Discussion.

AMS-ASL Special Session on Logic and Dynamical Systems, I

2:15 PM – 6:10 PM

Organizer: **Stephen G. Simpson**, Pennsylvania State University

- 2:15PM *Symbolic dynamics and degrees of unsolvability.*
 (224) **Stephen G. Simpson**, Pennsylvania State University (1046-03-292)
- 2:35PM *Complex dynamics and Turing degrees.* Preliminary report.
 (225) **C. T. Chong**, National University of Singapore (1046-03-1162)
- 2:55PM *Using orbit equivalence as a model for ergodic systems.*
 (226) **Daniel J. Rudolph**, Colorado State University (1046-37-705)
- 3:15PM *Decidability of countable closed subshifts.*
 ▶ (227) Preliminary report. **Douglas Cenzer*** and **S. Ali Dashti**, University of Florida (1046-03-710)
- 3:35PM *Generic isometries and measure-preserving homeomorphisms are conjugate to their powers.*
 (228) **Christian Rosendal**, University of Illinois at Chicago (1046-03-716)
- 3:55PM *The classification problem for separable von Neumann factors.*
 ▶ (229) **Asger Törnquist**, University of Toronto (1046-03-724)

- 4:15PM *Computable dynamics of real functions.* Preliminary report.
 ▶ (230) **S. Ali Dashti*** and **Douglas Cenzer**, University of Florida (1046-03-786)
- 4:35PM *Bernoulli actions of property (τ) groups.* Preliminary report.
 (231) **Scott Schneider**, Rutgers University (1046-03-976)
- 4:55PM *Matrix models for discrete and topological groups.*
 (232) **Vladimir G. Pestov**, University of Ottawa, Ontario, Canada (1046-03-1104)
- 5:15PM *Computability in ergodic theory.*
 (233) **Jeremy Avigad**, Carnegie Mellon University (1046-03-1123)
- 5:35PM *Proof mining in topological dynamics.*
 (234) **Philipp Gerhardy**, Universitetet i Oslo (1046-03-1219)
- 5:55PM *The isomorphism problem for subshifts.*
 (235) **John D. Clemens**, Penn State University (1046-03-1523)

AMS Special Session on Convex and Discrete Geometry, I

2:15 PM – 6:05 PM

Organizers: **Włodzimierz Kuperberg**, Auburn University
Valeriu Soltan, George Mason University

- 2:15PM *General affine surface areas.*
 (236) **Monika Ludwig**, Polytechnic Institute of New York University (1046-52-1252)
- 2:45PM *Finite sets as complements of finite unions of convex sets.*
 (237) **Jim Lawrence** and **Walter Morris***, George Mason University (1046-52-643)
- 3:15PM *Generalized averages of section and projection functions.* Preliminary report.
 (238) **Paul R. Goodey**, University of Oklahoma, and **Wolfgang Weil***, University of Karlsruhe (1046-52-586)
- 3:45PM *On orthogonal chords in Minkowski spaces.*
 ▶ (239) Preliminary report. **Javier Alonso**, University of Extremadura, Spain, **Horst Martini**, University of Technology Chemnitz, Germany, and **Zokhrab Mustafaev***, University of Houston-Clear Lake (1046-52-192)
- 4:15PM *Special convex sets in normed linear spaces.*
 (240) **Horst Martini**, University of Technology, Chemnitz, Germany (1046-52-151)
- 4:45PM *Outer linear measure of connected sets via Steiner trees.*
 (241) **Konrad J. Swanepoel**, Chemnitz University of Technology (1046-28-119)
- 5:15PM *Convex polytopes with abelian vertex-transitive symmetry.* Preliminary report.
 ▶ (242) **Jim Lawrence**, George Mason University (1046-52-1257)
- 5:45PM *Class preserving dissections of convex polygons.*
 ▶ (243) Preliminary report. **Dan Ismailescu**, Hofstra University (1046-52-1692)

AMS Special Session on Recent Trends in Coding Theory, II

2:15 PM – 6:50 PM

Organizers: **Gretchen L. Matthews**, Clemson University
Judy L. Walker, University of Nebraska

- 2:15PM *On decoding multipoint algebraic geometry codes.*
(244) **Nathan Drake**, Clemson University (1046-14-1768)
- 2:40PM *Efficient list decoding of explicit codes with optimal redundancy.*
(245) **Atri Rudra**, University at Buffalo, The State University of New York (1046-68-464)
- 3:05PM *Trellis pseudocodewords.*
(246) **Deanna Dreher**, University of Nebraska (1046-94-1612)
- 3:30PM *LDPC codes and Ramanujan graphs.*
▶ (247) **Chenyang Wang**, Penn. State Univ. (1046-15-1807)
- 3:55PM *On right-regular graphs for cascaded LDPC codes.*
(248) **Abigail G. Mitchell**, University of Zürich (1046-94-2012)
- 4:20PM *Golay, Heisenberg and Weyl. Preliminary report.*
(249) **Robert Calderbank**, Princeton University (1046-94-465)
- 5:15PM *On the growth rate of the weight distribution of irregular doubly-generalized LDPC codes.*
(250) **Mark F. Flanagan***, University of Zurich, Switzerland, **Enrico Paolini**, University of Bologna, Italy, **Marco Chiani**, DEIS, University of Bologna, Italy, and **Marc P.C. Fossorier**, ETIS ENSEA / UCP / CNRS UMR-8051, Cergy Pontoise, France (1046-94-841)
- 5:40PM *Enumerating pseudo-codewords in fundamental cones.*
▶ (251) **Min Lu**, University Park, PA (1046-94-1490)
- 6:05PM *Extrinsic tree decoding of LDPC codes.*
(252) **Eric Thomas Psota**, University of Nebraska-Lincoln (1046-94-1540)
- 6:30PM *Polytope representations for linear-programming decoding of nonbinary linear codes.*
(253) **Mark F. Flanagan**, Universitat Zurich, **Vitaly Skachek***, Claude Shannon Institute, University College Dublin, **Eimear Byrne** and **Marcus Greferath**, University College Dublin (1046-94-685)

AMS Special Session on Nonlinear Partial Differential Equations and Applications, II

2:15 PM – 6:05 PM

Organizers: **Gui-Qiang G. Chen**, Northwestern University
Cleopatra C. Christoforou, University of Houston

- 2:15PM *Self-Similar multidimensional conservation laws: An excursion into linear equations.*
(254) **Nedyu I. Popivanov**, Sofia University, and **Barbara Lee Keyfitz***, Fields Institute and the Ohio State University (1046-35-424)
- 2:45PM *Transonic flows past wedges governed by full Euler equations.*
(255) **G.-Q. Chen**, Northwestern University, **J. Chen***, University of Houston, and **M. Feldman**, University of Wisconsin, Madison (1046-35-555)
- 3:15PM *Mixed type problems and semi-hyperbolic waves in two-dimensional compressible Euler systems.*
(256) **Yuxi Zheng**, Penn State (1046-35-516)
- 3:45PM *Transonic shocks of multi-dimensional compressible flow through divergent nozzles with arbitrary cross-sections.*
(257) **Myoungjean Bae*** and **Mikhail Feldman**, University of Wisconsin-Madison (1046-35-411)
- 4:15PM *Optimal transport for the system of isentropic Euler equations.*
(258) **Michael Westdickenberg**, Georgia Institute of Technology (1046-35-641)

- 4:45PM *On the structure of solutions of multidimensional systems of conservation laws.*
(259) **Monica Torres**, Purdue University (1046-35-669)
- 5:15PM *Large-data solution of the Cauchy problem for a model system for singular shocks.*
(260) **Michael Sever**, The Hebrew University of Jerusalem (1046-35-174)
- 5:45PM *Shock reflection, free boundary problems, and degenerate elliptic equations.*
(261) **Gui-Qiang Chen**, Northwestern University, and **Mikhail Feldman***, University of Wisconsin-Madison (1046-35-663)

AMS Special Session on Recent Advances in Mathematical Modeling in Medicine

2:15 PM – 6:05 PM

Organizers: **David Chan**, Virginia Commonwealth University
John W. Cain, Virginia Commonwealth University
Rebecca A. Segal, Virginia Commonwealth University

- 2:15PM *Oscillations of calcium, metabolism, and insulin secretion in pancreatic beta-cells.*
▶ (262) **Arthur S. Sherman**, National Institutes of Health (1046-34-863)
- 2:45PM *Statistical geometry of pancreatic islets.*
▶ (263) **Harold M. Hastings***, Hofstra University, and **Bruce S. Schneider**, Office of Cellular, Tissue, and Gene Therapies (1046-92-1728)
- 3:15PM *Tubuloglomerular feedback signal transduction in a compliant thick ascending limb.*
(264) **Anita T. Layton**, Duke University (1046-92-438)
- 3:45PM *A methodology for performing global uncertainty and sensitivity analysis in systems biology.*
(265) **Simeone Marino***, **Ian B. Hogue**, **Christian J. Ray** and **Denise E. Kirschner**, University of Michigan Medical School (1046-34-1639)
- 4:15PM *Mathematical modeling in nasal drug delivery and surgery. Preliminary report.*
▶ (266) **J. S. Kimbell***, **J. D. Schroeter** and **G. J. M. Garcia**, The Hamner Institutes for Health Sciences (1046-92-1940)
- 4:45PM *Mathematical modeling of blood-flow interaction with deformable arterial wall with applications in medicine. Preliminary report.*
▶ (267) **Javed I. Siddique***, **Daniel M. Anderson** and **Padmanabhan Seshaiyer**, George Mason University (1046-65-76)
- 5:15PM *Optimal control model for cancer chemotherapy subject to drug resistance.*
(268) **Daniel L. Kern**, University of Nevada, Las Vegas (1046-92-1815)
- 5:45PM *Optimal intervention strategies for a cholera outbreak.*
(269) **Rachael L. Miller***, **Suzanne Lenhart**, University of Tennessee, and **Elsa Schaefer**, Marymount University (1046-34-409)

AMS Special Session on Stochastic, Large-Scale, and Hybrid Systems with Applications, II

2:15 PM – 5:35 PM

Organizers: **Aghalaya S. Vatsala**, University of Louisiana at Lafayette
G. S. Ladde, University of South Florida

K. Ramachandran, University of South Florida

- 2:15PM ▶ (270) *Perturbation of a gradient temperature field due to the presence of two spheres*. Preliminary report. **Abhinandan Chowdhury**, University of Louisiana at Lafayette (1046-35-1305)
- 2:45PM (271) *Nonlinear stochastic modeling and statistic analysis*. Preliminary report. **Ling Wu*** and **Gangaram S. Ladde**, University of South Florida (1046-60-1254)
- 3:15PM (272) *Behrens Fisher's distribution for selecting genes and its application in cancer classification*. **Nabin K. Shrestha*** and **K. M. Ramachandran**, University of South Florida (1046-62-1572)
- 3:45PM (273) *Hybrid dynamic inequalities under random perturbations and applications*. Preliminary report. **Gangaram S. Ladde**, University of South Florida (1046-93-1307)
- 4:15PM (274) *Generalized quasilinearization for differential equations with causal operators*. Preliminary report. **Farzana A. McRae***, The Catholic University of America, **J. Vasundhara Devi**, GVP Institute for Advanced Studies, Visakhapatnam, India, and **Zahia Drici**, Illinois Wesleyan University (1046-34-1853)
- 4:45PM (275) *Fixed-point theorems for differential equations with causal operators*. Preliminary report. **Zahia Drici***, Illinois Wesleyan University, **Farzana A. McRae**, The Catholic University of America, and **Vasundhara J. Devi**, G.V.P. Institute for Advanced Studies, Visakhapatnam, India (1046-34-1700)
- 5:15PM (276) *A multi-time-scale analysis of biochemical reaction networks*. **Chang Hyeong Lee**, Worcester Polytechnic Institute (1046-92-1968)

AMS Special Session on Experimental Mathematics, II

2:15 PM – 5:35 PM

Organizers: **Tewodros Amdeberhan**, Tulane University
Luis A. Medina, Tulane University
Victor H. Moll, Tulane University

- 2:15PM ▶ (277) *On the greatest common divisor of $a^n - 1$ and $b^n - 1$* . Preliminary report. **Joseph H. Silverman**, Brown University (1046-11-361)
- 2:45PM ▶ (278) *Algorithmic proofs for special function identities*. **Flavia Stan**, RISC, Johannes Kepler University, Linz, Austria (1046-33-1638)
- 3:15PM ▶ (279) *Isodiametric problems for equilateral polygons*. **Michael J. Mossinghoff**, University of South Carolina and Davidson College (1046-52-1511)
- 3:45PM Break
- 4:15PM (280) *New formulas for Euler log-trigonometric integrals*. Preliminary report. **Olivier Oloa**, University of Versailles (1046-33-1183)
- 4:45PM (281) *Asymptotics and zeros for polynomials from combinatorics*. **Robert P. Boyer***, Drexel University, and **William M. Y. Goh**, University of Science and Technology of China (1046-05-276)
- 5:15PM ▶ (282) *Asymptotics of Bernoulli, Euler, and Strod polynomials*. **Timothy B. Flowers*** and **Neil J. Calkin**, Clemson University (1046-33-404)

AMS Special Session on Algebraic Structures in Knot Theory

2:15 PM – 5:55 PM

Organizers: **Sam Nelson**, Claremont McKenna College
Alissa S. Crans, Loyola Marymount University

- 2:15PM (283) *Set-theoretic Yang-Baxter operators and their deformations*. **Michael Eisermann**, Institut Fourier, Université Grenoble (1046-57-960)
- 3:15PM (284) *Embedded Khovanov homology and skein modules of three manifolds*. **Charles Frohman**, The University of Iowa (1046-57-131)
- 4:15PM (285) *Oriented state sums for the Jones polynomial*. **Louis H. Kauffman**, University of Illinois at Chicago (1046-57-839)
- 5:15PM (286) *Twisted Blanchfield pairings*. **Jonathan A. Hillman**, The University of Sydney, **Daniel S. Silver*** and **Susan G. Williams**, University of South Alabama (1046-57-626)

AMS Special Session on Nonsmooth Analysis in Inverse and Variational Problems, I

2:15 PM – 6:10 PM

Organizers: **M. Zuhair Nashed**, University of Central Florida
Otmar Scherzer, University of Innsbruck

- 2:15PM (287) *Missing data recovery by tight-frame algorithms with flexible wavelet shrinkage*. **Raymond H. Chan**, The Chinese University of Hong Kong (1046-65-959)
- 2:45PM (288) *Finite volume scheme for the nonlinear tensor anisotropic diffusion*. **Olga Drblikova**, **Angela Handlovicova***, and **Karol Mikula**, Slovak University of Technology, Bratislava, Slovakia (1046-65-987)
- 3:15PM (289) *On singularity reconstruction in thermoacoustic tomography*. Preliminary report. **Yulia Hristova**, **Peter Kuchment***, and **Linh Viet Nguyen**, Texas A&M University (1046-35-926)
- 3:45PM (290) *Convergence rates in regularization when the solutions are nonsmooth with respect to forward operators*. **Bernd Hofmann**, Chemnitz University of Technology, Chemnitz/Germany (1046-47-154)
- 4:15PM ▶ (291) *Minimum-variance pseudo-unbiased reduced-rank estimator and its applications*. **Isao Yamada*** and **Tomasz Piotrowski**, Tokyo Institute of Technology (1046-41-1541)
- 4:45PM (292) *On weakly bounded noise in ill-posed, non-quadratic minimization problems*. Preliminary report. **P. P. B. Eggermont***, University of Delaware, and **M. Z. Nashed**, University of Central Florida (1046-47-985)
- 5:15PM ▶ (293) *Regularization of quasi variational inequalities*. **Akhtar A. Khan*** and **Baasansuren Jadamba**, Rochester Institute of Technology (1046-49-1066)
- 5:45PM (294) *The derivation of a heterogeneous plate theory from nonlinear elasticity*. **Cristina Popovici**, North Dakota State University (1046-49-98)

AMS Special Session on Difference Equations, II

2:15 PM – 6:05 PM

Organizer: **Michael Radin**, Rochester Institute of Technology

- 2:15PM (295) *Global behavior of solutions to $x_{n+1} = \frac{\alpha + \beta x_n + \gamma x_{n-1}}{A + B x_n + C x_{n-1}}$ with non-negative parameters when prime period-two solutions exist.*
Sukanya Basu* and **Orlando Merino**, University of Rhode Island (1046-39-219)
- 2:45PM (296) *Positive solutions for systems of three-point nonlinear discrete boundary value problems.*
Johnny Henderson*, Baylor University, **Sotiris K. Ntouyas** and **Ioannis K. Purnaras**, University of Ioannina (1046-39-30)
- 3:15PM (297) *Adiabatic invariants for 2D linear dynamic systems on time scales. Preliminary report.*
Gro Hovhannisyan, Kent State University (1046-34-291)
- 3:45PM (298) *A bimodal system. Preliminary report.*
Candace Marie Kent* and **Hassan Sedaghat**, Virginia Commonwealth University (1046-39-605)
- 4:15PM (299) *Trends and oscillations in the dynamics of linear vs. non-linear difference equation models describing populations. Preliminary report.*
Tamara E. Awerbuch-Friedlander, Harvard School of Public Health (1046-92-1551)
- 4:45PM (300) *Modeling HIV outbreaks: The male to female prevalence ratio in the core population.*
James A. Yorke, Univ. of Maryland (1046-34-933)
- 5:15PM (301) *Dynamic classification of escape time Sierpinski curve Julia sets.*
Robert L. Devaney, Boston University (1046-37-324)
- 5:45PM (302) *The complex dynamics of singularly perturbed rational maps.*
Elizabeth D. Russell, Boston University (1046-37-631)

AMS Special Session on The Mathematics of Information and Knowledge, II

2:15 PM – 6:15 PM

Organizers: **Ronald R. Coifman**, Yale University
James G. Glimm, SUNY at Stony Brook
Peter W. Jones, Yale University
Stephen Smale, Toyota Institute

- 2:15PM (303) *Phase transition phenomenon in sparse approximation.*
Jared Tanner*, University of Edinburgh, and **David L. Donoho**, Stanford University (1046-52-2082)
- 3:15PM (304) *Accelerated computational methods for fluid and plasma dynamics.*
Russel E. Caflisch, IPAM, UCLA (1046-76-1789)
- 4:15PM (305) *Structure determination through eigenvectors of sparse operators.*
Amit Singer, Princeton University (1046-92-2130)
- 5:00PM Discussion

AMS Special Session on Group Actions on Homogeneous Spaces and Applications, II

2:15 PM – 5:55 PM

Organizers: **Dmitry Y. Kleinbock**, Brandeis University
Gregory A. Margulis, Yale University
Hee Oh, Brown University

- 2:15PM (306) *Weakly commensurable arithmetic groups, with applications to locally symmetric spaces.*
Andrei Rapinchuk, University of Virginia (1046-22-148)
- 4:15PM (307) *Locally symmetric subspaces of locally symmetric spaces.*
Vladimir Chernousov, University of Alberta, Canada, **Lucy Lifschitz**, University of Oklahoma, and **Dave Witte Morris***, University of Lethbridge, Canada (1046-22-1366)
- 5:15PM (308) *On compact Clifford-Klein forms of $SL_{n-2}(\mathbb{R}) \backslash SL_n(\mathbb{R})$. Preliminary report.*
David Constantine, University of Michigan (1046-37-704)

AMS Special Session on Tracking Moving Interfaces in Complex Phenomena, I

2:15 PM – 6:00 PM

Organizer: **James A. Sethian**, University of California Berkeley

- 2:15PM (309) *Simulating 3D fatigue crack growth.*
David Chopp, Northwestern University (1046-35-1097)
- 3:15PM (310) *Causality, dimensionality, efficiency.*
Alex Vladimirovsky, Cornell University (1046-35-1102)
- 4:15PM (311) *Regularized Stokeslets and other elements with applications to biological flows.*
Ricardo Cortez, Tulane University (1046-35-1105)
- 5:15PM (312) *Coupling cut cell methods and level set methods in cellular signaling.*
David Adalsteinsson, Univ. North Carolina, Chapel Hill (1046-35-1106)

MAA Minicourse #12: Part A

2:15 PM – 4:15 PM

SNAP Math Fairs in elementary education.
Organizers: **Andrew C.-F. Liu**, University of Alberta
Tanya Thompson, ThinkFun, Inc.

MAA Minicourse #2: Part A

2:15 PM – 4:15 PM

Using GeoGebra to create activities and applets for visualization and exploration.
Organizer: **Michael K. May**, Saint Louis University

MAA Minicourse #7: Part A

2:15 PM – 4:15 PM

A Game Theory path to quantitative literacy.
Organizers: **David L. Housman**, Goshen College
Richard A. Gillman, Valparaiso University

AMS Session on Combinatorics, I

2:15 PM – 6:10 PM

- 2:15PM (313) *The Biplanar crossing number of $C_k \times C_l \times C_{2m} \times P_n$. Preliminary report.*
Joshua K. Lambert, North Dakota State University (1046-05-81)

- 2:30PM
▶ (314) *Fully orientability of graphs with at most one dependent arc.*
Hsin-Hao Lai, **Ko-Wei Lih***, Academia Sinica, and **Li-Da Tong**, National Sun Yat-sen University (1046-05-223)
- 2:45PM
▶ (315) *Tiling bijections via finite automata.*
Katherine P. Benedetto, Univ. of North Carolina, Chapel Hill, and **Nicholas A. Loehr***, Virginia Tech (1046-05-376)
- 3:00PM
▶ (316) *The r -reduced cutting numbers of cycles, sequences of cycles and graphs.* Preliminary report.
Brad Bailey*, **Dianna Spence**, and **John Holliday**, North Georgia College & State University (1046-05-446)
- 3:15PM
▶ (317) *Progress on the skew Hadamard difference set existence problem.*
Carlos Harold Salazar-Lazaro, Caltech (1046-05-495)
- 3:30PM
(318) *Some combinatorial problems over finite Euclidean and non-Euclidean graphs.*
Anh Vinh Le, Harvard University (1046-05-532)
- 3:45PM
▶ (319) *Random difference graphs and their properties.*
Elizabeth Perez Reilly* and **Edward R. Scheinerman**, The Johns Hopkins University (1046-05-721)
- 4:00PM
(320) *Forcing faces in plane bipartite graphs.*
Zhongyuan Che*, Penn State University, Beaver Campus, and **Zhibo Chen**, Penn State University, McKeesport Campus (1046-05-1048)
- 4:15PM
▶ (321) *Pattern avoidance in binary trees.*
Eric S. Rowland, Rutgers University (1046-05-546)
- 4:30PM
(322) *Other critical exponents in coordinate percolation.* Preliminary report.
Elizabeth Moseman, US Military Academy, West Point (1046-05-588)
- 4:45PM
▶ (323) *On sums of permutations and sequences with distinct terms.* Preliminary report.
D. Jacob Wildstrom, University of Louisville (1046-05-593)
- 5:00PM
(324) *Graph model for pattern recognition in text.*
Qin Wu*, **Cun-Quan Zhang** and **Eddie Fuller**, West Virginia University (1046-05-734)
- 5:15PM
▶ (325) *Minimum cycle bases of direct products of complete graphs.*
Zachary Bradshaw, Virginia Commonwealth University (1046-05-737)
- 5:30PM
(326) *A forest formula for the antipode in incidence Hopf algebras.*
Hillary Einziger, The George Washington University (1046-05-746)
- 5:45PM
▶ (327) *The clique number of $\Gamma(\mathbb{Z}_{p^n}(\alpha))$.*
Omar A. AbuGhneim*, Jordan University, **Emad E. AbdAlJawad**, Al-Zaytoonah Private University, and **Hasan Al-Ezeh**, Jordan University (1046-05-763)
- 6:00PM
(328) *Paley partial difference sets in groups with order not a prime power.*
John Bowen Polhill, Bloomsburg University of Pennsylvania (1046-05-794)

AMS Session on Functional Analysis and Operator Algebras

2:15 PM – 5:55 PM

- 2:15PM
(329) *Generalizations of triangular algebras.*
Mohan Ravichandran, University of New Hampshire (1046-47-1917)

- 2:30PM
(330) *The projective unitary group is algebraically determined polish group.*
Alexandru Gabriel Atim*, University of South Carolina Lancaster, and **Robert R. Kallman**, University of North Texas (1046-46-1678)
- 2:45PM
(331) *Proper actions of groupoids on C^* -algebras.* Preliminary report.
Jonathan Henry Brown, Dartmouth College (1046-47-244)
- 3:00PM
(332) *Quasi-multipliers and algebrizations of operator spaces.*
Masayoshi Kaneda, The University of Mississippi (1046-46-2044)
- 3:15PM
(333) *On projective rigidity of Banach spaces.*
Matthew Neal, Denison University, and **Bernard Russo***, University of California Irvine (1046-46-1930)
- 3:30PM
(334) *Non-commutative majorant ergodic theorem for sub-sequences.*
Genady Ya Grabarnik* and **Larisa Shwartz**, IBM TJ Watson Research Center (1046-46-1611)
- 3:45PM
(335) *Constructive representation of the Feynman operator calculus in Banach spaces.*
Woodford W. Zachary* and **Tepper L. Gill**, Howard University (1046-46-437)
- 4:00PM
Break
- 4:15PM
(336) *Shifts on product spaces $E \times F$.* Preliminary report.
Minakshisundaram Rajagopalan, Tennessee State University (1046-46-307)
- 4:30PM
(337) *Smooth and extreme points in Marcinkiewicz function spaces.*
Anna Kamińska and **Anca M. Parrish***, University of Memphis (1046-46-835)
- 4:45PM
(338) *The Corona Theorem for infinitely many functions on the multiplier algebra of the weighted Dirichlet spaces.*
Berhanu T. Kidane* and **Tavan T. Trent**, The University of Alabama (1046-46-149)
- 5:00PM
(339) *Geometric properties inherited by ordered tensor products.* Preliminary report.
Michelle R. Craddock, University of Mississippi (1046-46-1364)
- 5:15PM
(340) *On the sum of superoptimal singular values.* Preliminary report.
Alberto A. Condori, Michigan State University (1046-46-1140)
- 5:30PM
(341) *Partial unconditionality on a regular array in a Banach space.* Preliminary report.
Frank Sanacory, SUNY - College at Old Westbury (1046-46-1988)
- 5:45PM
(342) *Norm-linear operators between uniform algebras.*
Rebekah B. Yates, University of Montana (1046-46-294)

AMS Session on Associative and Non-Associative Rings and Algebras

2:15 PM – 5:40 PM

- 2:15PM
(343) *A domain test for Lie color algebras.*
Kenneth L. Price, University of Wisconsin Oshkosh (1046-16-943)
- 2:30PM
(344) *Nonsplit module extensions over a non-noetherian ring.* Preliminary report.
Linhong Wang, Southeastern Louisiana University (1046-16-1084)
- 2:45PM
(345) *Square-free rings and their automorphism group.*
Martin W. Montgomery, Piedmont College (1046-16-1091)

- 3:00PM *An isomorphism between the fusion algebras of V_L^+ and type $D^{(1)}$ level 2.*
(346) **Michael Cuntz**, Universität Kaiserslautern, and **Christopher Goff***, University of the Pacific (1046-16-1202)
- 3:15PM *A characterization of certain morphic trivial extensions.*
(347) **Alexander J. Diesl***, Bowling Green State University, **Thomas J. Dorsey**, Center for Communications Research, and **Warren Wm. McGovern**, Bowling Green State University (1046-16-1602)
- 3:30PM Break
- 3:45PM *The Yoneda algebra of a monomial \mathcal{K}_2 algebra.*
(348) **Christopher Phan***, University of Oregon, **Thomas Cassidy**, Bucknell University, and **Brad Shelton**, University of Oregon (1046-16-1855)
- 4:00PM *Representation theory of finite W -algebras and twisted Yangians.* Preliminary report.
(349) **Jonathan Scott Brown**, University of Oregon (1046-16-1877)
- 4:15PM *Strongly clean matrix rings.*
(350) **Thomas J. Dorsey***, Center for Communications Research - La Jolla, and **Alexander J. Diesl**, Bowling Green State University (1046-16-2001)
- 4:30PM *Seven dimensional Lie algebras with a four-dimensional nilradical.* Preliminary report.
(351) **Firas Y. Hindeleh***, Grand Valley State University, and **Gerard Thompson**, The University of Toledo (1046-22-334)
- 4:45PM *Noncommutative linear algebra and primitive ideals.*
(352) **Victor Protsak**, Cornell University (1046-17-70)
- 5:00PM *Simple and nearly simple deep matrix algebras.*
(353) **Chris Kennedy**, Christopher Newport University (1046-17-871)
- 5:15PM *4-Dimensional non-associative division algebras.*
(354) **John Massman**, Rose-Hulman Institute of Technology (1046-17-1334)
- 5:30PM *Intersection matrix algebras.* Preliminary report.
(355) **Sandeep Bhargava**, University of Windsor (1046-17-1546)
- 3:45PM *Explicit constructions of infinite families of MSTD sets.*
► (362) **Daniel C. Scheinerman***, Brown University, and **Steven J. Miller**, Williams College (1046-11-761)
- 4:00PM *Hilbert 90 for finite Abelian extensions.*
(363) **Andrew Schultz**, University of Illinois at Urbana-Champaign (1046-12-623)
- 4:15PM *Convergence of singular series for a pair of quadratic forms.*
(364) **Thomas J. Wright**, Johns Hopkins University (1046-11-725)
- 4:30PM *On uniform bounds for rational points on rational curves and thin sets.* Preliminary report.
(365) **Patrick X. Rault**, SUNY Geneseo (1046-11-624)
- 4:45PM *Orthogonal polynomials and ranks of abelian varieties.* Preliminary report.
(366) **John Cullinan***, Bard College, and **Farshid Hajir**, University of Massachusetts (1046-11-707)
- 5:00PM *On the cyclotomic Littlewood polynomials.*
(367) **Yi Sun**, Harvard University (1046-11-762)
- 5:15PM *On integers n that divide $\phi(n) + \sigma(n)$.*
(368) **Kelley Harris**, Harvard University (1046-11-811)
- 5:30PM *Happy numbers and semihappy numbers.*
► (369) **Helen G. Grundman**, Bryn Mawr College (1046-11-980)
- 5:45PM *Stable reduction of $X_0(625)$, with implications.*
(370) **Ken McMurdy**, Ramapo College of New Jersey (1046-11-974)

MAA Session on Building Diversity in Advanced Mathematics: Models that Work

2:15 PM – 4:15 PM

Organizers: **Patricia L. Hale**, California State Polytechnic University Pomona
Abbe Herzig, University at Albany

- 2:15PM *Evaluating STEM intervention programs.*
► (371) **Debbie Gochenaur**, Elizabethtown College (1046-B1-1108)
- 2:40PM *Factors impacting the pursuit of mathematics for female Ph.D. students.*
► (372) **Y. Kathy Lin**, Rutgers University (1046-B1-957)
- 3:05PM *Effecting systemic change in the university: Five-year results from the NSF Houston-Louis Stokes Alliance for Minority Participation.*
(373) **Martin V. Bonsangue***, California State University, Fullerton, and **David E. Drew**, The Claremont Graduate University (1046-B1-1708)
- 3:30PM *Modular delivery and peer-led team-learning for precalculus.* Preliminary report.
► (374) **Helmut Knaust*** and **Emil D. Schwab**, The University of Texas at El Paso (1046-B1-1913)
- 3:55PM *The implementation and impact of an ADVANCE IT grant at a primarily undergraduate institution.* Preliminary report.
► (375) **Patricia L. Hale**, California State Polytechnic University, Pomona (1046-B1-1787)

MAA Session on Cryptology for Undergraduates

2:15 PM – 6:10 PM

Organizers: **Chris Christensen**, Northern Kentucky University
Robert E. Lewand, Goucher College

- 2:15PM *Teaching the group theory of permutation ciphers.*
► (376) Preliminary report.
Joshua Brandon Holden, Rose-Hulman Institute of Technology (1046-D1-1479)

AMS Session on Number Theory, I

2:15 PM – 5:55 PM

- 2:15PM *p -adic properties of Stirling numbers.*
(356) **Ana Berrizbeitia***, University of Texas at Austin, **Alexander Moll**, Columbia University, and **Laine Noble**, Tulane University (1046-11-60)
- 2:30PM *The non-Archimedean metric Mahler measure.*
(357) **Paul Fili**, University of Texas at Austin, and **Charles L. Samuels***, Max-Planck-Institut für Mathematik (1046-11-216)
- 2:45PM *Rational points and hypergeometric functions.*
(358) **Adriana Julia Salerno**, University of Texas at Austin (1046-11-311)
- 3:00PM *Mahler's order functions and p -adic algebraic approximation.*
(359) **Brian C. Dietel**, Oregon State University (1046-11-453)
- 3:15PM *On the iteration of a function related to Euler's ϕ -function.* Preliminary report.
► (360) **Joshua Harrington*** and **Lenny Jones**, Shippensburg University (1046-11-573)
- 3:30PM *Polynomials built using Lucas sequence pairs.*
► (361) Preliminary report.
Donald Mills, Wittenberg University (1046-11-579)

- 2:35PM (377) *Finding irreducible polynomials using Miller Rabin type tests.*
Jeffrey A. Ehme, Spelman College (1046-D1-1613)
- 2:55PM (378) *The Vigenere Cipher: A historical cipher with a modern day application.* Preliminary report.
Tamara B. Veenstra, University of Redlands (1046-D1-1127)
- 3:15PM (379) *The ElGamal Cryptosystem on the TI-83.* Preliminary report.
Blake Rice, N/A, **Neil Sigmon**, Radford University, and **Bill Yankosky***, North Carolina Wesleyan College (1046-D1-41)
- 3:35PM (380) *Quantum computing for undergraduates.*
Thomas R. Hagedorn, The College of New Jersey (1046-D1-1645)
- 3:55PM (381) *The Venona Project.*
Maryam Vulis, Fordham University (1046-D1-2016)
- 4:15PM (382) *An introduction to algebraic cryptanalysis.*
Amber M. Rogers, Northern Kentucky University (1046-D1-717)
- 4:35PM (383) *Arithmetic in the field F_{28} as used in the Advanced Encryption Standard.*
Eric West, Benedictine College (1046-D1-2060)
- 4:55PM (384) *An interactive demonstration of the Navajo Code of World War II.* Preliminary report.
Neil P. Sigmon* and **Jonathan D. Dixon**, Radford University (1046-D1-1363)
- 5:15PM (385) *Cryptology as first-year seminar: Challenges and rewards.*
Alan Koch, Agnes Scott College (1046-D1-170)
- 5:35PM (386) *Explorations of elliptic curves in undergraduate cryptography with minimal student background through the use of Maple worksheets.*
Mike May, Saint Louis University (1046-D1-230)
- 5:55PM (387) *Investigations with private-key ciphers.* Preliminary report.
Annela R Kelly, Roger Williams University (1046-D1-1859)

MAA Session on Environmental Mathematics

2:15 PM – 4:15 PM

Organizers: **Karen Bolinger**, Clarion University
Ben A. Fusaro, Florida State University

- 2:20PM (388) *A curriculum module for modeling bioaccumulation, biomagnification, and elimination of toxins.* Preliminary report.
Frederick A. Adkins, Indiana University of Pennsylvania (1046-G1-1881)
- 2:40PM (389) *Starting in your own backyard: Looking at local environmental risks in a mathematical modeling class.*
Jennifer A. Gorman, Gannon University (1046-G1-1537)
- 3:00PM (390) *Teaching applied calculus through environmental modeling.*
Rachel M. Dunwell* and **Christopher W. Seaton**, Rhodes College (1046-G1-1423)
- 3:20PM (391) *Quantitative and citizen literacy through key environmental issues of our time.* Preliminary report.
Harel Barzilai, Salisbury University (1046-G1-958)
- 3:40PM (392) *Weatherquakes, earthquakes, mathematics and climate change.*
Martin E. Walter, University of Colorado, Boulder (1046-G1-432)

- 4:00PM (393) *Modelphobia - How does it arise; What can we do about it?*
Ben Fusaro, Florida State University (1046-G1-2058)

MAA Session on Operations Research in the Undergraduate Classroom

2:15 PM – 5:00 PM

Organizers: **Gerald Kobylski**, U.S. Military Academy
Josh Helms, U.S. Military Academy
William Fox, Naval Post Graduate School

- 2:15PM (394) *Using interactive pedagogies to teach operations research.* Preliminary report.
Ronald M. Brzenk, Hartwick College, Oneonta NY 13820 (1046-P1-401)
- 2:45PM (395) *Mathematical methods of operations research.*
Morteza Shafii-Mousavi, Indiana University South Bend (1046-P1-63)
- 3:20PM (396) *Recursive formulae for steady state distribution of a certain class of Markov process.*
Mark Evans, **Lilinoe Harbottle**, **Ken Shun**, and **Alan Krinik***, California State Polytechnic University, Pomona (1046-P1-1562)
- 3:55PM (397) *Data envelopment analysis in operations research.*
William C. Bauldry, Appalachian State University (1046-P1-21)
- 4:25PM (398) *The "Artist Guild" Strike: An example of game theory.*
William P. Fox, Naval Postgraduate School (1046-P1-1225)

MAA Session on Performing Mathematics

2:15 PM – 5:40 PM

Organizers: **Timothy P. Chartier**, Davidson College
Karl Schaffer, De Anza College

- 2:15PM (399) *Möbius and Grassmann on musical tuning systems.*
Leon Harkleroad, Wilton, ME (1046-Q1-849)
- 2:45PM (400) *Juggling sequences with number theory—"A tale of two kingdoms".*
Stephen H. Harnish, Bluffton University (1046-Q1-2009)
- 3:15PM (401) *Laban's choreutics and polyhedra.*
Sarah-Marie Belcastro, Sarah Lawrence College / HCSSiM (1046-Q1-1627)
- 3:45PM (402) *Dance and mathematics: A survey.* Preliminary report.
Karl Schaffer, De Anza College and Dr. Schaffer and Mr. Stern Dance Ensemble (1046-Q1-1515)
- 4:15PM (403) *Using mime to see the remainder.*
Tim Chartier, Davidson College (1046-Q1-885)
- 4:45PM (404) *Magic from a distance.*
John M. Harris, Furman University (1046-Q1-864)
- 5:15PM (405) *Six fibs and videotape.*
Colm Mulcahy*, Spelman College, and **Tim Chartier**, Davidson College (1046-Q1-2034)

MAA Session on Productive Roles for Math Faculty in the Professional Development of K-12 Teachers, I

2:15 PM – 6:10 PM

Organizers: **Dale R. Oliver**, Humboldt State University

Elizabeth Burroughs, Montana State University

- 2:15PM ▶ (406) *Mathematics content knowledge and classroom practice in middle school.* Preliminary report. **Julie A. Belock**, Salem State College (1046-R1-754)
- 2:35PM ▶ (407) *An update of a professional development project focused on preparing students for algebra.* Preliminary report. **Matthew J. Haines***, **Tracy Bibelnicks**, and **Linda Stevens**, Augsburg College (1046-R1-2076)
- 2:55PM ▶ (408) *Math faculty as partners in team teaching a non-Euclidean geometry course for K-12 teachers.* **Maria G. Fung***, Worcester State College, **Tevis Dray**, Oregon State University, **Dave Damcke**, University of Portland, **Dianne Hart** and **Dianne Riverstone**, Oregon State University (1046-R1-1559)
- 3:15PM (409) *In-service teachers' proof schemes in transition.* **Evan Fuller***, **Osvaldo Soto**, **Guerushon Harel**, and **Alfred Manaster**, UC San Diego (1046-R1-950)
- 3:35PM ▶ (410) *Brazos Valley Math Teachers' Circle: Formation and activities.* Preliminary report. **Philip B. Yasskin**, Texas A&M University (1046-R1-589)
- 3:55PM (411) *Supporting mathematics teachers to increase retention through professional development: Overview, models and research.* **David Fischman**, California State University, San Bernardino (1046-R1-550)
- 4:15PM ▶ (412) *Contributing to the professional development of K-12 mathematics teachers.* **Katherine J. Mawhinney**, Appalachian State University (1046-R1-1295)
- 4:35PM ▶ (413) *Creating active learning environments with improved student/teacher relationships and state assessment scores.* **Juli D'Ann Ratheal**, The University of Texas of the Permian Basin (1046-R1-621)
- 4:55PM ▶ (414) *Teaching for understanding through a professional development partnership.* **Jennifer J. Kosiak*** and **Jon Hasenbank**, University of Wisconsin - La Crosse (1046-R1-1310)
- 5:15PM ▶ (415) *Mathematicians vs. future K-8 teachers: Is real communication possible? Is deep learning achievable?* **Betsy Darken**, University of Tennessee at Chattanooga (1046-R1-812)
- 5:35PM ▶ (416) *"If only I had known then what I know now": A look back at six years of professional development programs.* **Linda Braddy**, East Central University (1046-R1-486)
- 5:55PM ▶ (417) *The Kentucky Center for Mathematics.* **Kirsten Fleming**, Kentucky Center for Mathematics at Northern Kentucky University (1046-R1-181)

MAA Invited Paper Session on Mathematical Sociology

2:15 PM – 4:10 PM

Organizer: **Barbara F. Meeker**, University of Maryland, College Park

Moderator: **Joseph Auslander**, University of Maryland, College Park

- 2:15PM (418) *A particle system that mimics empirical income dynamics.* **John Angle**, Inequality Process Institute (1046-A1-892)

2:45PM (419) *Network implications of social exchange: An overview.*

Phillip Bonacich, University of California, Los Angeles (1046-A1-887)

3:15PM (420) *Exploring polarization: The effects of general inequality and subgroup relative size on distance between subgroups and dispersion within subgroups.*

Guillermina Jasso, New York University (1046-A1-893)

3:45PM (421) *Mathematical models of talking in discussion groups.*

Barbara F. Meeker, University of Maryland College Park (1046-A1-895)

SIAM Minisymposium on Mathematical Modeling of Natural Resources, II

2:15 PM – 5:35 PM

Organizer: **Catherine A. Roberts**, College of the Holy Cross

2:15PM ▶ (422) *Spatial optimal control in fishery models.*

Suzanne Lenhart, University of Tennessee (1046-92-485)

2:45PM (423) *Liapunov exponents and persistence in some discrete dynamical systems.* Preliminary report.

Paul Leonard Salceanu* and **Hal L. Smith**, Arizona State University (1046-37-460)

3:15PM (424) *Economics of harvesting age-structured fish populations.*

Olli Ilari Tahvonen, Finnish Forest Research Institute (1046-92-344)

3:45PM (425) *Fish biomass structure at pristine coral reefs and degradation by fishing.* Preliminary report.

Howard Weiss, Georgia Tech (1046-92-614)

4:15PM (426) *A comparison of the distributions of two stochastic models for metapopulation models.*

Amy J. Ekanayake* and **Linda J.S. Allen**, Texas Tech University (1046-92-625)

4:45PM ▶ (427) *Models of disease dispersal for populations with overlapping and non-overlapping discrete populations.* Preliminary report.

Carlos Castillo-Chavez*, Arizona State University, **Karen Rios-Soto**, Universidad de Puerto Rico, Mayaguez, and **Kailash Patidar**, Arizona State University (1046-92-1942)

5:15PM ▶ (428) *Decentralized multinational management of a highly migratory marine fish stock.*

Robert W. McKelvey, University of Montana (1046-91-630)

MAA-Young Mathematicians' Network Panel Discussion

2:15 PM – 3:35 PM

Graduate school: Choosing one, getting in, staying in.

Organizers: **Kirsti Meyer**, Wisconsin Lutheran College

Vanessa Garcia, Texas State University-San Marcos

Alan Alewine, McKendree University

MAA-Project NExT Panel Discussion

2:15 PM – 3:30 PM

The art of test-making and alternative assessments.

Organizers: **Suzanne Caulk**, Regis University

Panelists: **Gertrud L. Kraut**, Southern Virginia University
Laurie Lenz, Marymount University
Beth Schaubroeck, U. S. Air Force Academy
David M. Bressoud, Macalester College
Richard J. Cleary, Bentley College
Gary Hagerty, Black Hills State University
Barbara E. Reynolds, Cardinal Stritch University

MAA Project NExT-Young Mathematicians' Network Poster Session

2:15 PM – 4:15 PM

Organizers: **Michael C. Axtell**, Wabash College
Kevin E. Charlwood, Washburn University

AWM Panel Discussion

2:15 PM – 3:40 PM

What and where will the jobs be? Trends in mathematics and in employment.

Moderator: **Cathy B. Kessel**, Mathematics Education Consultant

Panelists: **Deanna Egelston**, National Security Agency
Ellen E. Kirkman, Wake Forest University
Sandy Landsberg, U. S. Department of Energy
Mary E. Morley, Ocean County College

MAA Section Officers

2:30 PM – 5:00 PM

MAA Invited Address

3:20 PM – 4:10 PM

(429) *Integral Appollonian packings and thin orbits.*
Peter Sarnak, Princeton University (1046-A0-12)

MAA General Contributed Paper Session, III

3:45 PM – 6:10 PM

Organizer: **Sarah L. Mabrouk**, Framingham State College
Moderators: **Cathy W. Carter**, Christian Brothers University
Heather Lewis, Nazareth College
Vonda K. Walsh, Virginia Military Institute

3:45PM ▶ (430) *Solution matching for a second order boundary value problem on a time scale.*
Aprillya Lanz*, Virginia Military Institute, and **Ana Tameru**, Alabama State University (1046-Z1-1852)

4:00PM ▶ (431) *How precise is your calibration? Multiple linear regression and prediction error in Excel.* Preliminary report.
Terje Hoim*, **Eugene Belogay** and **Eugene T. Smith**, Wilkes Honors College, FAU (1046-Z1-2109)

4:15PM ▶ (432) *Calculating the void fraction of carbon foam using a tetrahedron model.* Preliminary report.
Rika Paul*, **Rohini Mankee**, **G. Dale Wesson** and **Desmond Stephens**, Florida A&M University (1046-Z1-2116)

4:30PM ▶ (433) *Statistical significance of ranking paradoxes.* Preliminary report.
Raymond N. Greenwell, Hofstra University (1046-Z1-111)

4:45PM (434) *Historical resources for multivariable calculus and differential geometry.*
Sarah J. Greenwald* and **Gregory Rhoads**, Appalachian State University (1046-Z1-150)

5:00PM ▶ (435) *Posing and pursuing one's own questions: Comparing experiences of graduate students in math education and mathematics.* Preliminary report.
Juliana V. Belding*, Harvard University, and **Eden M. Badertscher**, Institute For Learning, University of Pittsburgh (1046-Z1-1776)

5:15PM ▶ (436) *Methods of estimating inbreeding coefficients by jointly estimating allele frequencies and accounting for the presence of null alleles.*
Daisy L. Phillips*, **Nathan W. Hall**, Western Washington University, **Laina Mercer**, University of Washington, and **Amy D. Anderson**, Western Washington University (1046-Z1-1415)

5:30PM ▶ (437) *A simulation study comparing methods of estimating inbreeding coefficients.*
Nathan W. Hall*, **Daisy L. Phillips**, Western Washington University, **Laina Mercer**, University of Washington, and **Amy D. Anderson**, Western Washington University (1046-Z1-1411)

5:45PM ▶ (438) *Mathematics immersion for freshman engineers (MIFE).*
Pascal Bedrossian and **Cathy W. Carter***, Christian Brothers University (1046-Z1-1324)

6:00PM ▶ (439) *Continual compounding of a conventional mortgage.*
William M. Wagner, Wagner Machine Works (1046-Z1-167)

AWM Business Meeting

3:45 PM – 4:15 PM

MAA CUPM Subcommittee on Research by Undergraduates Panel Discussion

3:50 PM – 5:10 PM

Starting and maintaining an academic year undergraduate research program.

Organizers: **Michael J. Dorff**, Brigham Young University
Zsuzsanna Szaniszló, Valparaiso University

Panelists: **Sarah Spence Adams**, Franklin W. Olin College of Engineering
Rebecca Garcia, Sam Houston State University
Richard A. Gillman, Valparaiso University
Darren A. Narayan, Rochester Institute of Technology
Daniel J. Schaal, South Dakota State University

Reception for Undergraduate Students and Math Club Advisors

4:00 PM – 5:00 PM

MAA Committee on Graduate Students-Young Mathematicians' Network Panel Discussion

4:30 PM – 5:40 PM

How to apply for jobs.

Organizer: **David C. Manderscheid**, University of Nebraska

Panelists: **Sharon M. Clarke**, Pepperdine University
James H. Freeman, Cornell College
David C. Manderscheid

SIGMAA on Environmental Mathematics Guest Lecture and Business Meeting

5:30 PM – 7:30 PM

SIGMAA on the History of Mathematics Business Meeting and Reception

5:30 PM – 6:30 PM

SIGMAA on the Philosophy of Mathematics Business Meeting and Reception

5:30 PM – 6:30 PM

Reception for Graduate Students and First-Time Participants

5:30 PM – 6:30 PM

MAA Special Dramatic Presentation

6:00 PM – 7:00 PM

The CNN United States of Mathematics Presidential Debate.

Presenters: **Colin C. Adams**, Williams College
Thomas Garrity, Williams College

SIGMAA on the History of Mathematics and SIGMAA on the Philosophy of Mathematics Guest Lecture

6:30 PM – 7:30 PM

(440) *The role of the untrue in mathematics.*
Chandler Davis, University of Toronto

AMS Josiah Willard Gibbs Lecture

8:30 PM – 9:30 PM

► (441) *Integrable systems: A modern view.*
Percy Deift, Courant Institute-New York University (1046-00-01)

Tuesday, January 6

Joint Meetings Registration

7:30 AM – 4:00 PM

AMS-MAA-MER Special Session on Mathematics and Education Reform, I

8:00 AM – 11:50 AM

Organizers: **William H. Barker**, Bowdoin College
William G. McCallum, University of Arizona
Bonnie S. Saunders, University of Illinois at Chicago

- 8:00AM (442) *Understanding, abstracting, and building upon students' mathematical reasoning: A new course for prospective elementary and middle school teachers.* Preliminary report.
Guadalupe I. Lozano, University of New Mexico (1046-97-1846)
- 8:30AM (443) *Creating regional networks of elementary and middle school teachers through professional development.*
Jonathan Rogness* and **Harvey B. Keynes**, University of Minnesota (1046-97-701)
- 9:00AM (444) *The impact of challenging mathematics courses on middle school teachers.* Preliminary report.
Bernadette Mullins*, Birmingham-Southern College, **John Mayer**, **Tommy Smith**, University of Alabama at Birmingham, and **Rachel Cochran**, Center for Educational Accountability (1046-97-1481)
- 9:30AM (445) *Changing K-16 Classroom Practice.* Preliminary report.
Rachel Cochran, **John Mayer***, University of Alabama at Birmingham, and **Bernadette Mullins**, Birmingham Southern College (1046-97-594)
- 10:00AM (446) *Math in the Middle Institute Partnership.* Preliminary report.
W. James Lewis, University of Nebraska-Lincoln (1046-97-990)
- 10:30AM (447) *The work of the Institute for Mathematics and Education in developing partnerships between mathematicians, educators, and teachers.*
William G. McCallum, The University of Arizona (1046-97-2077)
- 11:00AM (448) *MIME at IM&E: Professional development for mathematicians in mathematics education.*
Deborah Loewenberg Ball* and **Hyman Bass**, University of Michigan (1046-97-2075)
- 11:30AM (449) *A review of NSF-supported research and development on instructional innovations in undergraduate mathematics education.* Preliminary report.
Karen A. Marrongelle* and **Larry Suter**, National Science Foundation (1046-97-1401)

AMS-SIAM Special Session on Asymptotic Methods in Analysis with Applications, I

8:00 AM – 11:20 AM

Organizers: **Diego Dominici**, SUNY New Paltz
Peter A. McCoy, U.S. Naval Academy

- 8:00AM (450) *Asymptotic formulae for eigenvalues and eigenfunctions of q -Sturm-Liouville problems.*
Mahmoud H. Annaby* and **Zeinab S. Mansour**, Cairo University (1046-41-1887)
- 8:30AM (451) *A finite family of q -orthogonal polynomials.*
Jemal E. Giske*, Western Kentucky University, and **Mourad Ismail**, University of Central Florida (1046-33-140)

- 9:00AM *Characterizations of continuous and discrete*
(452) *q*-ultraspherical polynomials.
Mourad E. H. Ismail*, University of Central Florida,
and **Josef Obermaier**, Helmholtz Zentrum
München (1046-33-658)
- 9:30AM *A quick distributional way to the prime number*
(453) *theorem.*
Jasson Vindas* and **Ricardo Estrada**, Louisiana
State University (1046-11-992)
- 10:00AM *Another look at the Stirling series.*
► (454) **Valerio De Angelis**, Xavier University of Louisiana
(1046-41-1679)
- 10:30AM *Some linear statistics of random Hermitean*
(455) *matrices that are Painlevé functions.*
Yang Chen, Imperial College London (1046-41-971)
- 11:00AM *Global asymptotic analysis of the Painlevé*
(456) *transcendents. The Riemann-Hilbert approach.*
Alexander Its, Indiana University-Purdue University
Indianapolis (1046-41-1304)

AMS-ASL Special Session on Logic and Dynamical Systems, II

8:00 AM – 11:55 AM

Organizer: **Stephen G. Simpson**, Pennsylvania
State University

- 8:00AM *Models for measure preserving transformations.*
(457) **Matthew D. Foreman**, UC Irvine (1046-28-414)
- 8:20AM *A coloring property for countable groups.*
► (458) **Su Gao***, **Steve Jackson**, and **Brandon Seward**,
University of North Texas (1046-37-454)
- 8:40AM *Fixed-point aperiodic tilings.*
(459) **Bruno Durand**, LIF Marseille, CNRS, University
Aix-Marseille (France), **Andrei Romashchenko**, LIF
Marseille, CNRS, University Aix-Marseille (France)
and IITP RAS, Moscow (Russia), and **Alexander
Shen***, LIF Marseille, CNRS, University Aix-Marseille
(France) (1046-03-498)
- 9:00AM \mathbb{Z}^d -actions on the Cantor set: Approximation, Rohlin
(460) *properties and recursion theory.*
Michael Hochman, Princeton University
(1046-37-656)
- 9:20AM *Recursive and algorithmic aspects of growth*
(461) *complexity for multidimensional SFTs.*
Tom Meyerovitch, Tel Aviv University
(1046-37-764)
- 9:40AM *Random closed sets viewed as random recursions.*
(462) **R. Daniel Mauldin*** and **Alexander P. McLinden**,
University of North Texas (1046-37-785)
- 10:00AM *A compactness theorem for markers and group*
(463) *colorings.* Preliminary report.
Steve C. Jackson*, **Su Gao** and **Brandon Seward**,
University of North Texas (1046-03-1348)
- 10:20AM *Two notes on subshifts.*
(464) **Joseph S. Miller**, University of Wisconsin-Madison
(1046-03-1128)
- 10:40AM *Mortality and periodicity of dynamical systems.*
(465) **Jarkko Kari**, University of Turku, Finland
(1046-37-1568)
- 11:00AM *Computability and complexity of Julia sets.*
(466) **Mark Braverman**, Microsoft Research, New England
(1046-37-637)
- 11:20AM *Equivalence relations with infinitely many ends and*
► (467) *percolation.*
Inessa Epstein*, California Institute of Technology,
and **Greg Hjorth**, University of Melbourne, Australia
(1046-03-1669)

- 11:40AM *A Ramsey theorem and dynamics.*
(468) **Slawomir Solecki**, University of Illinois
(1046-05-2024)

AMS Special Session on Mathematical Models of Biological Structures and Function

8:00 AM – 11:50 AM

Organizers: **Chandrajit Bajaj**, University of Texas
at Austin
Andrew K. Gillette, University of
Texas at Austin

- 8:00AM *Applications of the Hodge decomposition to*
(469) *biological structure and function modeling.*
Preliminary report.
Andrew Gillette* and **Chandrajit Bajaj**, University
of Texas at Austin (1046-92-1079)
- 8:30AM *Hidden symmetries in virus architecture and their*
► (470) *implications on virus assembly.*
Thomas Keef* and **Reidun Twarock**, University of
York (1046-92-317)
- 9:00AM *Molecular solvation models and minimal surfaces.*
(471) **Chandrajit Bajaj***, University of Texas at Austin,
Guoliang Xu, Chinese Academy of Sciences, and
Qin Zhang, University of Texas at Austin
(1046-92-1080)
- 9:30AM *Fast protein dynamics simulations: Dominant*
(472) *pathways for protein conformational transitions.*
Patrice Koehl*, University of California, Davis, **Joel
Franklin**, Reed College, **Seb Doniach**, Stanford
University, and **Marc Delarue**, Institut Pasteur,
Paris, France (1046-65-948)
- 10:00AM *Multi-scale Morse theory for scientific data analysis.*
► (473) Preliminary report.
Valerio Pascucci, University of Utah (1046-68-474)
- 10:30AM *A model of cellular motility: Focusing on the “feet”*
► (474) *of the cell.*
Hannah L. Callender*, Institute for Mathematics
and its Applications, and **Hans G. Othmer**,
University of Minnesota (1046-92-919)
- 11:00AM *Numerical simulation of fluid membranes in*
(475) *Stokesian flow.*
Veerapaneni Shraavan, **Denis Gueyffier**, Courant
Institute of Mathematical Sciences, New York
University, **George Biros**, Georgia Institute of
Technology, and **Denis Zorin***, Courant Institute of
Mathematical Sciences, New York University
(1046-74-1857)
- 11:30AM *Multiscale modeling of rare events with applications*
(476) *in biology.*
Bjorn Engquist, University of Texas at Austin
(1046-65-1904)

AMS Special Session on Noncommutative Algebra, I

8:00 AM – 11:50 AM

Organizers: **Greg Marks**, St. Louis University
Ashish K. Srivastava, St. Louis
University

- 8:00AM *Essential dimension of central simple algebras.*
(477) **Zinovy Reichstein**, University of British Columbia
(1046-16-1359)
- 8:30AM *Quaternion algebras and their subfields.*
(478) **David J. Saltman**, Center for Communications
Research, Princeton NJ (1046-16-1863)

- 9:00AM (479) *Properties of injective hulls of a ring having a compatible ring structure.* Preliminary report.
Gary F. Birkenmeier, University of Louisiana at Lafayette, **Barbara L. Osofsky***, Rutgers, The State University of New Jersey, **Jae Keol Park**, Busan National University, Korea, and **S. Tariq Rizvi**, Ohio State University, Lima (1046-16-420)
- 9:30AM (480) *On Σ - q rings.*
S. K. Jain*, Ohio University, Athens **Surjeet Singh**, Panjab University, India, and **Ashish K. Srivastava**, St. Louis University (1046-16-419)
- 10:00AM (481) *Skew generalized power series rings.*
Ryszard Mazurek, Bialystok Technical University, (1046-16-1192)
- 10:30AM (482) *Quasi-duo skew polynomial rings and graded rings.*
Andre G. Leroy, Université d'Artois (1046-17-1045)
- 11:00AM (483) *On Noetherian skew power series rings.* Preliminary report.
Edward S. Letzter, Temple University (1046-16-1021)
- 11:30AM (484) *An inner automorphism is only an inner automorphism, but an inner endomorphism can be something strange.*
George M. Bergman, University of California, Berkeley (1046-16-259)

AMS Special Session on Mathematics of Computation, II

8:00 AM – 11:50 AM

Organizers: **Susanne C. Brenner**, Louisiana State University
Chi-Wang Shu, Brown University

- 8:00AM (485) *Dynamic defect morphology of sheared nematic polymers.*
X. Yang*, University of North Carolina at Chapel Hill, **Gregory M Forest**, University of North Carolina at Chapel Hill, **William M. Mullins**, University of North Carolina at Chapel Hill, and **Qi Wang**, University of South Carolina (1046-65-1662)
- 8:30AM (486) *Computation of spatial dynamics in systems biology.*
Ching-Shan Chou, UC Irvine (1046-65-1956)
- 9:00AM (487) *Application of inexact and truncated Krylov subspace methods to the solution of parabolic control problems.* Preliminary report.
Daniel B. Szyld, Temple University (1046-65-767)
- 9:30AM (488) *New efficient sparse space-time algorithms for superparameterization on mesoscales.*
Yulong Xing*, **Andrew J. Majda**, Courant Institute of Mathematical Sciences, New York University, and **Wojciech W. Grabowski**, National Center for Atmospheric Research (NCAR) (1046-65-1531)
- 10:00AM (489) *Finite element approximations of fully nonlinear second order PDEs.*
Michael Neilan, University of Tennessee, Knoxville (1046-65-402)
- 10:30AM (490) *A new spectral-Galerkin method for high-dimensional PDEs.*
Jie Shen, Purdue University (1046-65-1047)
- 11:00AM (491) *Computational methods for fluid-structure interaction problems.*
Padmanabhan Seshaiyer*, George Mason University, **Eugenio Aulisa**, Texas Tech University, and **Sandro Manservigi**, University of Bologna, Italy (1046-65-97)

- 11:30AM (492) *Generalized prolate spheroidal wave functions and spectral methods on quasi-uniform grids.*
Li-Lian Wang, Nanyang Technological University, Singapore (1046-65-1206)

AMS Special Session on Infinite Dimensional Analysis, Path Integrals and Related Fields

8:00 AM – 11:50 AM

Organizers: **Tepper L. Gill**, Howard University
Lance W. Nielsen, Creighton University
Woodford W. Zachary, Howard University

- 8:00AM (493) *Disentangling in Feynman's operational calculi for non-commuting operators.*
Gerald W. Johnson, University of Nebraska-Lincoln (1046-46-782)
- 8:30AM (494) *Convolution products, integral transforms and inverse integral transforms of functionals in $L_2(C_0[0, T])$.*
Seung Jun Chang, **Hyun Soo Chung**, Dankook University, Korea, and **David Skoug***, University of Nebraska-Lincoln (1046-28-670)
- 9:00AM (495) *Stochastic Feynman integral: Perspectives from fractional stochastic calculus.* Preliminary report.
Anna Amirdjanova, University of Michigan (1046-44-1497)
- 9:30AM (496) *Phase space Feynman path integrals via piecewise bicharacteristic paths and their semiclassical approximations.*
Naoto Kumano-go, Kogakuin University (1046-46-468)
- 10:00AM (497) *On the holonomy of the Coulomb Connection over manifolds with boundary.*
William E. Gryc, Morehouse College (1046-58-827)
- 10:30AM (498) *A weak Hilbert space not isomorphic its subspaces.*
Kevin James Beanland*, Virginia Commonwealth University, **Spiros Argyros** and **Haris Raikoftsalis**, National Technical University of Athens, Greece (1046-46-599)
- 11:00AM (499) *Nonrenormalizability tamed!*
John R. Klauder, University of Florida (1046-81-255)
- 11:30AM (500) *The power of functional integration.*
Cecile M. DeWitt-Morette, University of Texas at Austin (1046-46-178)

AMS Special Session on Computational Algebraic and Analytic Geometry for Low-dimensional Varieties, I

8:00 AM – 11:50 AM

Organizers: **Mika K. Seppälä**, Florida State University
Tanush Shaska, Oakland University
Emil J. Volcheck, Association for Computing Machinery

- 8:00AM (501) *Generators of the ideal of an algebraic space curve.*
Elisabetta Fortuna, **Patrizia Gianni**, Università di Pisa, and **Barry Trager***, IBM Research (1046-14-1921)
- 8:30AM (502) *Khovanskii-Rolle continuation for real solutions.* Preliminary report.
Dan Bates, Colorado State University, and **Frank Sottile***, Texas A&M University (1046-14-1272)

- 9:00AM *Polyhedral methods to find common factors of algebraic plane curves.* Preliminary report.
 ▶ (503) **Danko Adrovic**, University of Illinois at Chicago, and **Jan Verschelde***, University of Illinois at Chicago (1046-65-1885)
- 9:30AM *OpenMath library for computing on Riemann Surfaces.*
 ▶ (504) **Yuri Lebedev*** and **Mika Seppala**, Florida State University (1046-14-633)
- 10:00AM *Explicit models for Siegel modular varieties.*
 (505) **Reinier Broker*** and **Kristin Lauter**, Microsoft Research (1046-14-429)
- 10:30AM *Arithmetic aspects of a cubic function field in characteristic three.*
 (506) **Jonathan Webster**, University of Calgary (1046-11-1720)
- 11:00AM *Tabulation of cubic function fields via reduction.*
 (507) **Pieter Rozenhart*** and **Renate Scheidler**, University of Calgary (1046-11-1642)
- 11:30AM *Abelian manifolds of arbitrary genus with complex multiplication.* Preliminary report.
 (508) **Harvey Cohn**, IDA, Center for Communications Research (1046-14-889)

AMS Special Session on Automorphic and Modular Forms in Number Theory, II

8:00 AM – 11:50 AM

Organizers: **Ken Ono**, University of Wisconsin-Madison
Amanda Folsom, University of Wisconsin-Madison
Sharon A. Garthwaite, Bucknell University

- 8:00AM *Indefinite theta functions.*
 (509) **Sander Zwegers**, University College Dublin (1046-11-501)
- 8:30AM *Number theoretic properties of generating functions related to Dyson's rank for partitions into distinct parts.*
 (510) **Maria J. Monks**, Massachusetts Institute of Technology (1046-11-398)
- 9:00AM *On singular values of Maass forms.*
 (511) **Paul Jenkins**, Brigham Young University (1046-11-1778)
- 9:30AM *Mock Jacobi forms and the $1\psi_1$ summation formula.*
 (512) **Soon-Yi Kang**, Korea Advanced Institute for Science and Technology (1046-11-777)
- 10:00AM *Explicit computations of Hecke operators on automorphic forms.*
 (513) **Lloyd J. Kilford**, University of Bristol (1046-11-28)
- 10:30AM *Congruences for level four cusp forms.*
 (514) **Scott Ahlgren**, University of Illinois at Urbana-Champaign, **Dohoon Choi**, Korea Aerospace University, and **Jeremy Rouse***, University of Illinois at Urbana-Champaign (1046-11-1223)
- 11:00AM *Value distribution of automorphic L-functions.*
 (515) **Qiao Zhang**, Texas Christian University (1046-11-1323)
- 11:30AM *Experiments with Siegel modular forms.*
 (516) **Nathan C. Ryan***, **Lauren Grainer**, **Kevin McGoldrick**, **Sharon Anne Garthwaite**, Bucknell University, **Cris Poor**, Fordham University, **David W. Farmer**, American Institute of Mathematics, **David S. Yuen**, Lake Forest College, and **Ralf Schmidt**, University of Oklahoma (1046-11-265)

AMS Special Session on Categorification and Link Homology, I

8:00 AM – 11:50 AM

Organizers: **Aaron Lauda**, Columbia University
Mikhail Khovanov, Columbia University

- 8:00AM *Construction of H-thick knots in Khovanov homology.* Preliminary report.
 (517) **Andrew W. Elliott**, Rice University (1046-55-617)
- 8:25AM *Functoriality for the su_3 Khovanov homology.* Preliminary report.
 (518) **David A. Clark**, Randolph-Macon College (1046-57-602)
- 8:50AM *Twin TQFTs and Frobenius algebras.*
 (519) **Carmen L. Caprau**, California State University, Fresno (1046-57-1025)
- 9:15AM *Equivariant $sl(n)$ -link homology.*
 (520) **Daniel Krasner**, Columbia University (1046-81-615)
- 9:40AM *The 2-point and 4-point Khovanov categories.*
 (521) **Scott Morrison***, Microsoft Station Q, **Clark David**, Randolph-Macon College, and **Kevin Walker**, Microsoft Station Q (1046-54-955)
- 10:00AM Break
- 10:15AM *Transverse knots and knot homologies.*
 (522) **Lenny Ng**, Duke University (1046-57-622)
- 10:40AM *Involutions on 3-manifolds and Khovanov homology.*
 (523) **Liam Watson**, Universite du Quebec a Montreal (1046-57-969)
- 11:05AM *Patterns in odd Khovanov homology.* Preliminary report.
 (524) **Alexander N. Shumakovitch**, The George Washington University (1046-57-2050)
- 11:30AM *Link homologies via instanton counting.*
 (525) **S. Gukov**, Cal Tech (1046-54-2085)

AMS Special Session on Tracking Moving Interfaces in Complex Phenomena, II

8:00 AM – 11:45 AM

Organizer: **James A. Sethian**, University of California Berkeley

- 8:00AM *Exact subgrid interface correction (ESIC) schemes for elliptic interface problems.*
 (526) **Jae-Seok Huh**, California Institute of Technology (1046-35-1284)
- 9:00AM *How to make the most out of level sets for geodynamical modeling.*
 (527) **Jenny Suckale***, Massachusetts Institute of Technology, **J. C. Nave**, Massachusetts Institute of Technology, and **B. H. Hager**, Massachusetts Institute of Technology (1046-35-1296)
- 10:00AM *Front propagation in three scale media.*
 (528) **Adam Oberman**, Simon Fraser University (1046-35-1306)
- 11:00AM *A finite element method for implicit interface problems.*
 (529) **August Johansson**, Umea University (1046-35-1374)

AMS Special Session on Teichmüller Theory and Low-Dimensional Topology, I

8:00 AM – 11:20 AM

Organizers: **Richard P. Kent**, Brown University
Madlena Tomova, University of Iowa

- 8:00AM (530) *Surface subgroups of doubles of free groups.*
Cameron McA. Gordon* and **Henry Wilton**, University of Texas at Austin (1046-57-675)
- 8:30AM (531) *Finiteness theorems for hyperbolic 3-manifolds.*
Ian Biringer*, University of Chicago, and **Juan Souto**, University of Michigan (1046-51-310)
- 9:00AM (532) *Natural volumes on character varieties of three-manifolds.*
Charles Frohman*, The University of Iowa, and **Kania-Bartoszyńska**, National Science Foundation (1046-57-130)
- 9:30AM (533) *The local topology of deformation spaces of Kleinian surface groups.*
Aaron D. Magid, University of Michigan (1046-51-281)
- 10:00AM (534) *Reducible and toroidal Dehn filling with distance 3.*
Sungmo Kang, The University of Texas at Austin (1046-57-56)
- 10:30AM (535) *Complex projective structures with Schottky holonomy.*
Shinpei Baba, UC Davis (1046-51-368)
- 11:00AM (536) *Heegaard surfaces and the distance of amalgamation.*
Tao Li, Boston College (1046-57-202)

MAA Minicourse #3: Part A

8:00 AM – 10:00 AM

Educating about the state of the planet and sustainability while enhancing calculus.

Organizer: **Thomas J. Pfaff**, Ithaca College

MAA Minicourse #8: Part A

8:00 AM – 10:00 AM

Taking symbols seriously: Teaching form and function in college algebra.

Organizers: **Deborah Hughes Hallett**, University of Arizona and Harvard University
Patti Frazer Lock, St. Lawrence University
William G. McCallum, University of Arizona
Patricia D. Shure, University of Michigan

AMS Session on Geometry

8:00 AM – 11:40 AM

- 8:00AM (537) *Upper bound for the length of an n^{th} -shortest closed geodesic in a hyperbolic knot complement in S^3 .*
Sreekrishna Palaparthi, SUNY University at Buffalo (1046-51-231)
- 8:15AM (538) *A categorification of the Burau representation using contact geometry. Preliminary report.*
Sandra E. Ritz, University of Southern California (1046-51-290)
- 8:30AM (539) *Integer sequences from polygonal chains in the geometry of compact sets.*
Schlicker Steven, Grand Valley State University (1046-51-321)
- 8:45AM (540) *Two neat results in elementary geometry.*
R. KillGrove*, Vista, CA, **L. Taylor**, CSUB, and **D. Koster**, UWLC (1046-51-756)

- 9:00AM (541) *An index formula related to a conjecture of Loewner.*
Steven E. Broad, University of Notre Dame (1046-51-856)
- 9:15AM (542) *Tiling the plane with squares.*
Alison McDonough*, **Amanda Cangelosi**, **Alethea Tschetterwood**, **Alexandra Berkoff**, and **Amy Wesolowski**, Smith College (1046-51-998)
- 9:30AM (543) *Flat flocks and generalized j -planes.*
Oscar Vega, California State University, Fresno (1046-51-1013)
- 9:45AM Break
- 10:00AM (544) *Which sets are resilient to erosion?*
Wesley Pegden, Rutgers University (New Brunswick) (1046-52-77)
- 10:15AM (545) *Ellipses inscribed in, and circumscribed about, convex quadrilaterals.*
Alan Horwitz, Penn State University/Brandywine Campus (1046-51-1709)
- 10:30AM (546) *7-Point bundle forms in Laguerre planes.*
Robert D. Knight, Ohio University-Chillicothe (1046-51-2014)
- 10:45AM (547) *Squaring and not squaring one or more planes.*
James M. Henle*, Clark Science Center, Smith College, and **Frederick V. Henle**, athenahealth, Inc. (1046-52-838)
- 11:00AM (548) *Unfolding convex polyhedra.*
Emma Schlatter*, **Jessica Peterson**, **Sarah Rathnam**, and **Emily Gunawan**, Smith College (1046-52-999)
- 11:15AM (549) *Nonconvex polygons and deformations of associahedra.*
Satyan Devadoss, **Rahul Shah**, Williams College, **Xuanheng Shao**, MIT, and **Ezra M. Winston***, Bard College (1046-52-1955)
- 11:30AM (550) *Supergaussian directions and the Hyperplane Conjecture.*
Grigorios Paouris, Texas A&M University (1046-52-2073)

AMS Session on Probability

8:00 AM – 11:55 AM

- 8:00AM (551) *A strictly stationary, N -tuplewise independent counterexample to the central limit theorem.*
Richard C. Bradley*, Indiana University, and **Alexander R. Pruss**, Baylor University (1046-60-146)
- 8:15AM (552) *Stationary solutions for one-dimensional stochastic delay differential equations with reflection.*
Michael S. Kinnally* and **Ruth J. Williams**, University of California San Diego (1046-60-455)
- 8:30AM (553) *Large deviations for ergodic processes in split spaces.*
Adina Oprisan* and **Andrzej Korzeniowski**, The University of Texas at Arlington (1046-60-545)
- 8:45AM (554) *Complex Itô formulas.*
Mylan Redfern, Valdosta State University (1046-60-584)
- 9:00AM (555) *Transforming renewal processes for simulation of nonstationary point processes.*
Ira Gerhardt* and **Barry L. Nelson**, Northwestern University, (1046-60-604)
- 9:15AM (556) *Is the distribution exponential when the record median equals the record midrange, on average?*
George P. Yanev, The University of Texas - Pan American (1046-60-745)

- 9:30AM *A single-server poison queueing system with splitting and delayed batched feedback (Case $k = N = 1$).*
(557) **Aliakbar Montazer Haghighi***, Prairie View A&M University, **Stefanka S. Chukova**, Victoria University of Wellington, and **Dimitar P. Mishev**, Prairie View A&M University (1046-60-833)
- 9:45AM *Expected time to see flat path of α stable process.*
(558) **Sarah Bryant**, Purdue University (1046-60-1171)
- 10:00AM Break
- 10:15AM *Coalescence time for a nonuniform allocation process with applications to biology and computer science.*
► (559) **John K. McSweeney**, Ohio State University (1046-60-1330)
- 10:30AM *Existence of almost periodic solutions to some functional integro-differential stochastic evolution equations.*
(560) **Paul H. Bezandry**, Howard University (1046-60-1293)
- 10:45AM *Intersection exponents for biased random walks on discrete cylinders.*
(561) **Brigitta K. Vermesi**, University of Rochester (1046-60-1317)
- 11:00AM *Stochastic limiting averages of zero-one sequences.*
(562) **Ryan S. Gantner**, Saint John Fisher College (1046-60-1325)
- 11:15AM *On certain sequences of dependent random variables.*
► (563) **Stephanie Sapp***, Johns Hopkins University, and **Amol Kapila**, Brown University (1046-60-1367)
- 11:30AM *No feedback card guessing for top to random shuffles. Preliminary report.*
(564) **Lerna Pehlivan**, University of Southern California (1046-60-1469)
- 11:45AM *Generalized spaces of random variables.*
(565) **Mark Burgin**, University of California, Los Angeles, and **Alan Krinik***, California State Polytechnic University, Pomona (1046-60-1501)

AMS Session on Algebraic and General Topology

8:00 AM – 11:55 AM

- 8:00AM *Gorenstein model structures and generalized derived categories.*
(566) **James R. Gillespie**, Penn State Greater Allegheny (1046-55-160)
- 8:15AM *Recovering topology of a camera network coverage. Preliminary report.*
► (567) **Edgar J. Lobaton**, UC Berkeley (1046-55-1008)
- 8:30AM *Homotopy invariants for one-dimensional and planar spaces.*
► (568) **Mark H. Meilstrup*** and **Gregory R. Conner**, Brigham Young University (1046-55-1697)
- 8:45AM *The cohomology of $PSL(3, p)$, p an odd prime. Preliminary report.*
(569) **Jane H. Long**, Stephen F. Austin State University (1046-55-1734)
- 9:00AM *A (co-)homology invariant of topological manifolds and its interface with boundary value problems in Riemannian geometry. Preliminary report.*
(570) **Adeniran Adeboye**, Howard University (1046-55-2033)
- 9:15AM *A projective version of the Poincaré polyhedron theorem. Preliminary report.*
(571) **Benjamin J. Benoy**, University of Redlands (1046-54-93)
- 9:30AM *Categorified bundles and classifying spaces.*
(572) **Weiwei Pan**, Wesleyan University (1046-55-177)

- 9:45AM *A 32 dimensional manifold which is a rational analog of the projective plane. Preliminary report.*
(573) **Zhixu Su**, Indiana University (1046-57-309)
- 10:00AM *A new cardinality bound on homogeneous topological spaces via the Erdős-Rado theorem.*
(574) **Nathan A. Carlson***, University of Arizona, and **Guit-Jan Ridderbos**, Vrije Universiteit (1046-54-215)
- 10:15AM *Non-uniform thickness of smooth knots.*
(575) **Kim J. Huerter**, University of Iowa (1046-54-305)
- 10:30AM *An open $C^*(D)$ -filter process of compactifications and generalized Stone-Weierstrass theorems.*
(576) **Hueytzen J. Wu***, Texas A&M University-Kingsville, and **Wan-Hong Wu**, University of Texas-Health Science Center (1046-54-575)
- 10:45AM *Finite image braid group representations from the Yang Baxter Equation.*
► (577) **Jennifer M. Franko**, The University of Scranton (1046-54-1247)
- 11:00AM *Some extensions of semi-closure spaces. Preliminary report.*
► (578) **Shing S. So**, University of Central Missouri (1046-54-1273)
- 11:15AM *Fixed point theorems for n -continuous L^* -operators. Preliminary report.*
(579) **Wladyslaw Kulpa**, Card. S. Wyszynski University, and **Andrzej Szymanski***, Slippery Rock University (1046-54-1444)
- 11:30AM *The lattice of locally convex topologies on an ordered set. Preliminary report.*
(580) **Frederic Mynard**, Georgia Southern University, and **Tom Richmond***, Western Kentucky University (1046-54-1528)
- 11:45AM *A math classic: The tale of three links.*
► (581) **Samuel Jacob Behrend**, Denison University (1046-54-1711)

AMS Session on Analytic Function Theory

8:00 AM – 11:40 AM

- 8:00AM *On analytic multivalent functions. Preliminary report.*
► (582) **Rosihan M. Ali**, Universiti Sains Malaysia (1046-30-133)
- 8:15AM *Characterizing compact composition operators on the Hardy-Simironov spaces. Preliminary report.*
(583) **Abebaw Tadesse**, Langston University (1046-30-145)
- 8:30AM *An identical function theorem for functions of slow growth in the disk. Preliminary report.*
(584) **Paul A. Gunsul**, Northern Illinois University (1046-30-494)
- 8:45AM *Weak subordination for convex univalent harmonic functions.*
(585) **Stacey Muir**, University of Scranton (1046-30-912)
- 9:00AM *The MacLane class and complex differential equations in the unit disk. Preliminary report.*
(586) **Kari Fowler***, The University of Tampa, and **Linda Sons**, Northern Illinois University (1046-30-946)
- 9:15AM *Continuity of extremal elements in uniformly convex spaces and Ryabykh's theorem.*
(587) **Tim Ferguson**, University of Michigan, Ann Arbor (1046-30-968)
- 9:30AM *L^p -bounded point evaluations and uniform rational approximation. Preliminary report.*
(588) **Erin Rita Militzer**, University of Kentucky (1046-30-187)
- 9:45AM Break

- 10:00AM *Clunie type theorems for annuli.*
(589) **Mark E. Lund**, Northern Illinois University (1046-30-1442)
- 10:15AM *An effective proof of the fundamental theorem of algebra via Sturm chains.*
► (590) **Michael Eisermann**, Institut Fourier, Université Grenoble (1046-30-981)
- 10:30AM *A value distribution result for functions of small growth in the unit disk.* Preliminary report.
(591) **Jonathan Meshes**, Northern Illinois University (1046-30-1309)
- 10:45AM *A sufficient condition for equality of hyperbolic metric and generalized Kobayashi metric.*
(592) **Kourosh Tavakoli**, Fordham University (1046-30-1691)
- 11:00AM *Extension of convex mappings of order α of the unit disk in \mathbb{C} to convex mappings of the unit ball in \mathbb{C}^n .* Preliminary report.
(593) **Jerry R. Muir Jr.**, University of Scranton (1046-32-901)
- 11:15AM *Sums of products of real globally subanalytic functions and their logarithms are stable under integration.*
(594) **Daniel J. Miller***, Emporia State University, and **Raf Cluckers**, Katholieke Universiteit Leuven (1046-32-1809)
- 11:30AM *p -Capacity formulas for Z^n and T_d .*
(595) **Lucio M. G. Prado**, BMCC - The City University of New York (1046-31-1467)

AMS Session on Combinatorics, II

8:00 AM – 11:55 AM

- 8:00AM *Matching extendability in the hypercube.*
(596) Preliminary report.
Jennifer R. Vandenbussche*, Southern Polytechnic State University, and **Douglas B. West** (1046-05-333)
- 8:15AM *Bounded number of components of 2-factors in line graphs.*
(597) **Hong-Jian Lai**, West Virginia University, **Liming Xiong**, Beijing Institute of Technology, and **Huiya Yan***, West Virginia University (1046-05-481)
- 8:30AM *Combinatorics on border correlations of partial words.*
► (598) **F. Blanchet-Sadri**, University of North Carolina, Greensboro, **M. Cordier**, Kent State University, and **R. Kirsch***, University of Maryland (1046-05-831)
- 8:45AM *R -parametric chains.*
(599) **Anne C. Sinko**, Oberlin College (1046-05-979)
- 9:00AM *Elementary techniques for Erdos-Ko-Rado-like theorems.*
► (600) **Bill Kay***, University of South Carolina, and **Greg Brockman**, Harvard University (1046-05-1065)
- 9:15AM *Error-correction coding using combinatorial representation matrices.*
► (601) **Li Chen**, University of the District of Columbia (1046-05-1212)
- 9:30AM *Semantic paradoxes and graph dynamical systems.* Preliminary report.
► (602) **Matthew Macauley***, Clemson University, **Brian Rabern**, Australian National University, and **Landon Rabern**, Boulder, CO (1046-05-1069)
- 9:45AM Break
- 10:00AM *Growth of sumsets and polytopes.*
► (603) **Jaewoo Lee**, Borough of Manhattan Community College (CUNY) (1046-05-1521)

- 10:15AM *Generalized dice: An investigation of dice families.* Preliminary report.
► (604) **William M. Ella***, University of Mary Washington, **Michael L. Follett**, Lafayette College, **Chelsey A. Cooley**, North Carolina State University, **Eric A. Gilson**, University of Rochester, and **Lorenzo Traldi**, Lafayette College (1046-05-1506)
- 10:30AM *On decomposing complete graphs of odd order into Hamilton cycles and fixed length cycles.*
(605) **Jeffrey A. Mudrock***, University of Illinois at Urbana-Champaign, **Saad El-Zanati**, Illinois State University, **Kyle King**, University of Illinois at Urbana-Champaign, and **Josephine Witkowski**, Illinois State University (1046-05-1558)
- 10:45AM *Fulkerson coloring of some families of snarks.*
► (606) **Xiaofeng Wang**, West Virginia University (1046-05-1658)
- 11:00AM *An injective proof of strong q -Log-convexity for Bell polynomials.*
► (607) **Sebastian H. Moore***, **Sonia Gilbukh** and **Lynne M. Butler**, Haverford College (1046-05-1723)
- 11:15AM *Minimal triangulations of contractible spaces and random collapsing of n -simplices.* Preliminary report.
► (608) **Katherine D. Crowley**, Washington and Lee University, **Abigail Ebin**, Yale University, and **Bena M. Tshishiku***, Washington and Lee University (1046-05-1842)
- 11:30AM *Dominating cartesian products of Petersen and Grötzsch graphs.*
(609) **Robert R. Rubalcaba***, United States Department of Defense, and **Peter J. Slater**, University of Alabama in Huntsville (1046-05-2000)
- 11:45AM *On an exact formula for the coefficients of Han's generating function.*
► (610) **Ameya A. Velingker**, Harvard University (1046-05-2002)

AMS Session on Partial Differential Equations, I

8:00 AM – 11:55 AM

- 8:00AM *Classes of infinite semipositone systems.*
(611) **Eun Kyoung Lee**, Pusan National University, **Ratnasingham Shivaji** and **Jinglong Ye***, Mississippi State University (1046-35-54)
- 8:15AM *Poroelectricity.*
(612) **Chadia Affane Aji***, Tuskegee University, and **A. J. Meir**, Auburn University (1046-35-206)
- 8:30AM *Existence of solutions to semi-linear elliptic differential equations: Approximation and verification.*
(613) **Lisa Termine Hollman**, Trinity College (1046-35-226)
- 8:45AM *Loss of compactness for nonlinear elliptic PDE's.*
(614) **Florin Catrina**, St. John's University (1046-35-491)
- 9:00AM *A study on the solution of complex KdV-Burgers equation.* Preliminary report.
► (615) **Netra P. Khanal***, **Jiahong Wu**, Oklahoma State University, **Bingyu Zhang**, University of Cincinnati, and **Juan-Ming Yuan**, Providence University in Taiwan (1046-35-537)
- 9:15AM *The physical model of a variational nonlinear wave equation.*
(616) **Taewan Park**, Millersville University (1046-35-1851)

- 9:30AM (617) *Critical exponents for semilinear wave equations with space-time dependent potential.* Preliminary report.
Maisa M. Khader, University of Tennessee (1046-35-269)
- 9:45AM Break
- 10:00AM (618) *Observation based PDE models for stochastic production systems.* Preliminary report.
Ali Kemal Unver, Arizona State University (1046-35-1699)
- 10:15AM (619) *An accurate Riemann solver for Euler equation with phase change.*
Chunguang Chen* and **Harumi Hattori**, West Virginia University (1046-35-709)
- 10:30AM (620) *Dafermos regularization of a modified kdv Burgers equation.* Preliminary report.
Monique R. Taylor, North Carolina State University (1046-35-733)
- 10:45AM (621) *A new variational principle for Hamiltonian PDEs with nonlinear boundary conditions.*
Abbas Momeni, Queen's University (1046-35-783)
- 11:00AM (622) *Traveling wave solutions for a nonlinear equation which appears in fluid dynamics.* Preliminary report.
Sridevi Pudipeddi, Augsburg College (1046-35-908)
- 11:15AM (623) *Soliton solutions to the nonlinear Schrödinger equation.*
Samuel Rivera, University of Texas at Arlington (1046-35-970)
- 11:30AM (624) *Elliptic equations with BMO coefficients with singularity in Reifenberg flat domains.* Preliminary report.
Ko Woon Um, University of Iowa (1046-35-1096)
- 11:45AM (625) *Non-Fickian delay reaction-diffusion equations: Theoretical and numerical study.*
Joao Ricardo Branco*, Coimbra Institute of Engineering, **Jose Augusto Ferreira**, University of Coimbra, and **Pascoal Martins Silva**, Coimbra Institute of Engineering (1046-35-1703)

MAA Session on Mathematics and Sports, I

8:00 AM – 11:55 AM

Organizer: **Howard L. Penn**, U.S. Naval Academy

- 8:00AM (626) *Jump shot mathematics.* Preliminary report.
Howard Penn, U.S. Naval Academy (1046-N1-1582)
- 8:20AM (627) *Fixed points and free throws.*
C. W. Groetsch, The Citadel (1046-N1-128)
- 8:40AM (628) *Take a good look, using mathematics.* Preliminary report.
Jacqueline Brannon Giles, HCC Central College, Houston, Texas (1046-N1-39)
- 9:00AM (629) *How fair are BCS ratings? Analysis of Colley methods for sports ranking.*
Erich Kreutzer, Davidson College (1046-N1-1217)
- 9:20AM (630) *Football rankings using linear algebra.* Preliminary report.
R. Drew Pasteur, The College of Wooster (1046-N1-1477)
- 9:40AM (631) *The Superbowl box pool.*
Michael A. Jones, Mathematical Reviews (1046-N1-1991)
- 10:00AM (632) *Hitting golf balls and tee balls as far as possible.* Preliminary report.
Robert Kantrowitz*, Hamilton College, and **Michael M. Neumann**, Mississippi State University (1046-N1-702)

- 10:20AM (633) *G. H. Hardy's golfing adventure.* Preliminary report.
Roland Minton, Roanoke College (1046-N1-1236)
- 10:40AM (634) *Mission impossible - Hitting .400 for a season.*
Stanley Rothman, Quinnipiac University (1046-N1-53)
- 11:00AM (635) *Major League Baseball meets Facebook: Modeling trades using social network theory.*
David J. Hunter, Westmont College (1046-N1-1548)
- 11:20AM (636) *A Markov chain model of baseball.*
Eric W. Kuennen, University of Wisconsin Oshkosh (1046-N1-1731)
- 11:40AM (637) *Modeling cumulative home run frequencies and the recent home run explosion.*
Mike Huber*, Muhlenberg College, **Gabriel Costa**, United States Military Academy, **John Saccoman**, Seton Hall University, and **Brandon Stern-Charles**, Muhlenberg College (1046-N1-210)

MAA Session on Teaching Calculus in High School: Ideas that Work

8:00 AM – 11:55 AM

Organizers: **Dan Teague**, North Carolina School of Science and Mathematics

John F. Mahoney, Benjamin Banneker Academic High School

- 8:00AM (638) *Developing an interest in the conceptual meaning of calculus.* Preliminary report.
Carlos R. Bovell, Northern Burlington County Regional High School (1046-X1-69)
- 8:20AM (639) *The Aha! experience in AP calculus: Projects designed for a stimulating journey on a road of discovery.* Preliminary report.
Gail Kaplan, Towson University (1046-X1-359)
- 8:40AM (640) *Numerical integration before antidifferentiation.*
Doug Kuhlmann, Phillips Academy Andover, MA (1046-X1-1927)
- 9:00AM (641) *Teaching calculus course using creative hands-on activities.* Preliminary report.
Ryo Ohashi, King's College (1046-X1-544)
- 9:20AM (642) *A substitute for the U-substitution.*
Queen W. Harris, Georgia Perimeter College (1046-X1-915)
- 9:40AM (643) *The Clemson Calculus Challenge: A calculus competition for high school students.* Preliminary report.
P. M. Dearing and **Shari Prevost***, Clemson University (1046-X1-1214)
- 10:00AM (644) *Let them eat cake: An introduction to volumes by cross section.*
H. Smith Risser, Montana Tech (1046-X1-476)
- 10:20AM (645) *Metaphors that work, calculus and the real world.*
Aldo Maldonado, Park University (1046-X1-1333)
- 10:40AM (646) *Modeling the spread of a disease.*
Mary Ann Connors, Westfield State College (1046-X1-1235)
- 11:00AM (647) *Written papers and oral examinations to deepen students understanding of calculus.*
Christine M. Malone* and **Marie B. Copeland**, Macomb Mathematics Science Technology Center (1046-X1-1590)
- 11:20AM (648) *Introducing series using error.*
Mark Howell, Gonzaga College High School, Washington, DC (1046-X1-967)
- 11:40AM (649) *Teaching series convergence effectively.*
Robert Sachs, George Mason University (1046-X1-1883)

MAA Session on Undergraduate Mathematical Biology, I

8:00 AM – 11:45 AM

Organizers: **Timothy D. Comar**, Benedictine University
Raina Robeva, Sweet Briar College
Eric S. Marland, Appalachian State University

- 8:00AM (650) *Modeling logistic growth and extinction.*
Sheldon P. Gordon, Farmingdale State College (1046-Y1-176)
- 8:25AM (651) *BioCalculus: First steps at a small liberal arts college.*
Margaret M. Sullivan, College of Notre Dame of Maryland, Baltimore (1046-Y1-1275)
- 8:55AM (652) *Activities designed to prepare undergraduates for research in mathematical biology.*
Timothy D. Comar, Benedictine University (1046-Y1-1234)
- 9:20AM (653) *Translating the principles of BIO2010 into practice.*
Kelly E. Matthews*, **Merrilyn Goos** and **Peter Adams**, University of Queensland (1046-Y1-1567)
- 9:45AM (654) *Active learning in the symbiosis project.*
Jeff R. Knisley, East Tennessee State University (1046-Y1-1606)
- 10:10AM (655) *UBM-research and education program in biology and ecology.* Preliminary report.
S. Koksai, Florida Institute of Technology (1046-Y1-2010)
- 10:35AM (656) *Training undergraduates in mathematical biology using research with faculty.*
E. Miller Jason, Truman State University (1046-Y1-1987)
- 11:00AM (657) *The standard genetic code and equivalence classes.*
Brian Hopkins, Saint Peter's College (1046-Y1-548)
- 11:25AM (658) *Bioinformatics on the cheap.*
Jennifer R. Galovich, St. John's University/College of St. Benedict (1046-Y1-289)

MAA General Contributed Paper Session, IV

8:00 AM – 11:55 AM

Organizer: **Sarah L. Mabrouk**, Framingham State College

Moderators: **Anthony D. Berard Jr.**, King's College
Louise M. Berard, Wilkes University
Mahmoud Yousef, University of Central Missouri
Richard Stout, Gordon College

- 8:00AM (659) *Teaching calculus through experimentation and empiricism.* Preliminary report.
Travis Kowalski, South Dakota School of Mines and Technology (1046-Z1-2107)
- 8:15AM (660) *Online homework delivery in an introductory statistics course.* Preliminary report.
Leyla Batakci* and **Keri A. Speicher**, Elizabethtown College (1046-Z1-1969)
- 8:30AM (661) *A simple geometer's Sketchpad sketch for exploring ideas of function.*
Ian Whitacre, San Diego State University (1046-Z1-1958)
- 8:45AM (662) *Mathematica laboratory assignments inspired by the history of mathematics.* Preliminary report.
Gabriela R. Sanchis, Elizabethtown College (1046-Z1-1892)

- 9:00AM (663) *Enhance rigor in college geometry with technologies of Sketchpad, Cabri, or Cinderella.*
Subhash C. Saxena, Coastal Carolina University (1046-Z1-1770)
- 9:15AM (664) *The advanced mathematics program at the United States Military Academy: Exposing students to technology through a rigorous mathematics curriculum.* Preliminary report.
Randy Boucher*, **Janet Braunstein**, and **Donald Outing**, U.S. Military Academy (1046-Z1-1729)
- 9:30AM (665) *Strategies for effective use of online homework in calculus.*
Jenna P. Carpenter, Louisiana Tech University (1046-Z1-806)
- 9:45AM (666) *Using personal response systems (clickers) for pre-service teacher candidates in elementary content and secondary methods courses.* Preliminary report.
Janet A. White* and **Travis K. Miller**, Millersville University of PA (1046-Z1-703)
- 10:00AM (667) *A data gathering demo using Three Stooges films.*
Robert L. Davidson and **Robert B. Gardner***, East Tennessee State University (1046-Z1-484)
- 10:15AM (668) *Using a personal response system.* preliminary report.
John Hawkins and **T. Bruce McLean***, Georgia Southern University (1046-Z1-449)
- 10:30AM (669) *Illustrating algorithms for computing computer graphics.* Preliminary report.
Paul Raymond Bouthellier, University of Pittsburgh-Titusville (1046-Z1-236)
- 10:45AM (670) *Discovering the derivative and its meaning with the graphing calculator.*
Murray H. Siegel, Central Arizona College (1046-Z1-165)
- 11:00AM (671) *Integrating college algebra with modularity and technology (iCAM&T): A first year follow-up.* Preliminary report.
A. Dale Magoun*, **A. Serpil Saydam**, **Charlotte H. Owens**, **Elizabeth T. Smith** and **Stephen Richters**, The University of Louisiana at Monroe, LA (1046-Z1-112)
- 11:15AM (672) *Incorporating software into college algebra: Who wins? We all do, if...*
Michelle R. DeDeo, Univ. of North Florida (1046-Z1-79)
- 11:30AM (673) *Spreadsheet modeling and applications.*
Morteza Shafii-Mousavi, Indiana University South Bend (1046-Z1-67)
- 11:45AM (674) *Fluid-structure interaction mathematical models for studying biological systems.* Preliminary report.
Kevin Yorke Kelbaugh*, **Minerva Venuti**, and **Padmanabhan Seshaiyer**, George Mason University (1046-Z1-65)

SIAM Minisymposium on Mathematical and Computational Challenges in Global Climate and Energy Processes

8:00 AM – 10:55 AM

- Organizer: **Margot Gerritsen**, Stanford University
- 8:00AM (675) *Performance prediction of thermal recovery processes, or how we can produce heavy oil in an environmentally friendly way.*
Margot Gerritsen*, **J. V. Iambers** and **Z. Zhu**, Stanford University (1046-35-2013)
- 9:00AM (676) *Marine energy technology: Riding the current.*
Yin Lu Young*, Princeton University, and **Margot Gerritsen**, Stanford University (1046-65-2115)

- 9:30AM (677) *Climate response through fluctuation-dissipation: A new algorithm for low-frequency dynamics.*
Rafail V. Abramov*, University of Illinois at Chicago, and **Andrew J. Majda**, Courant Institute of Mathematical Sciences (1046-86-2111)
- 10:30AM (678) *Detection and correction of forecast bias due to parameter and initial condition errors.*
S. Lakshmivarahan, University of Oklahoma, and **S. Crowell***, University of Oklahoma (1046-37-2102)

Employment Center

8:00 AM – 7:00 PM

MAA Session on Demos and Strategies with Technology that Enhance Teaching and Learning Mathematics, I

8:20 AM – 11:35 AM

Organizers: **David R. Hill**, Temple University
Scott Greenleaf, University of New England
Mary L. Platt, Salem State College
Lila F. Roberts, Georgia College & State University

- 8:20AM (679) *Pen-technology and evolving Web-based instruction tools in freshman calculus.*
Marilyn Reba, Clemson University (1046-E1-1169)
- 8:40AM (680) *All you add is Webassign and Maple.* Preliminary report.
Denise J. LeGrand, University of Arkansas at Little Rock (1046-E1-897)
- 9:00AM (681) *Auditory graphs in Excel for calculus.*
Steven Hetzler* and **Robert Tardiff**, Salisbury University (1046-E1-793)
- 9:20AM (682) *Interactive, data-driven and technology-enhanced approach for probability and statistics education.*
Ivo D. Dinov, University of California, Los Angeles (1046-E1-26)
- 9:40AM (683) *Dynamic visualization tools for multivariable calculus.* Preliminary report.
Paul Seeburger, Monroe Community College (1046-E1-911)
- 10:00AM (684) *Developing a video tutorial library to service upper level MSE courses.* Preliminary report.
Christopher M. Smith*, **Frank Wattenberg**, **Josh W. Helms** and **Rodney Sturdivant**, United States Military Academy (1046-E1-1354)
- 10:20AM (685) *ProofBuilder, a tool for showing students how to construct basic proofs.* Preliminary report.
Hugh W. McGuire, Grand Valley State University (1046-E1-1399)
- 10:40AM (686) *Using 3-dimensional bifurcation diagrams to enhance student learning.*
Itai Seggev, Knox College (1046-E1-1695)
- 11:00AM (687) *On the combined use of algebra and technology in the study of a family of sequences.* Preliminary report.
Sandra Schroeder* and **Mihai Caragiu**, Ohio Northern University (1046-E1-1715)
- 11:20AM (688) *Conjecturing the sum of an infinite series: CAS Lab exercise in calculus I.*
Bill Marion, Valparaiso University (1046-E1-24)

MAA Invited Address

9:00 AM – 9:50 AM

- (689) *Stacking bricks and stoning crows.*
Peter Winkler, Dartmouth College (1046-A0-15)

AMS Special Session on The Mathematics of Information and Knowledge, III

9:00 AM – 11:45 AM

Organizers: **Ronald R. Coifman**, Yale University
James G. Glimm, SUNY at Stony Brook
Peter W. Jones, Yale University
Stephen Smale, Toyota Institute

- 9:00AM (690) *Topological sensing: Doing more with less in sensor networks via topological data.*
Robert Ghrist*, University of Pennsylvania, and **Yuliy Baryshnikov**, Bell Labs (1046-94-1796)
- 10:00AM (691) *Google and the Vapnik-Chervonenkis dimension.*
Stuart Geman, Brown University (1046-60-2126)
- 11:00AM (692) *Internet topology inference.*
Paul Barford, University of Wisconsin-Madison (1046-68-2132)

AMS Special Session on Group Actions on Homogeneous Spaces and Applications, III

9:00 AM – 11:40 AM

Organizers: **Dmitry Y. Kleinbock**, Brandeis University
Gregory A. Margulis, Yale University
Hee Oh, Brown University

- 9:00AM (693) *Orbital counting for thin groups and the affine linear sieve.*
Alex V. Kontorovich* and **Hee Oh**, Brown University (1046-11-252)
- 10:00AM (694) *Invariant subsets and stationary probabilities on homogeneous spaces.*
Yves Benoist*, Universite Paris-Sud, and **Jean-Francois Quint**, Universite Paris-Nord (1046-37-770)
- 11:00AM (695) *Higher rank Anosov actions on tori.*
David M. Fisher, Indiana University, **Boris V. Kalinin**, University of South Alabama, and **Ralf J. Spatzier***, University of Michigan (1046-37-792)

MAA Minicourse #13: 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

9:00 AM – 11:55 AM

Organizers: **David M. Strong**, Pepperdine University
Gil Strang, Massachusetts Institute of Technology
David C. Lay, University of Maryland

- 9:00AM (696) *Using linear algebra for image processing.* Preliminary report.
Paul Raymond Bouthellier, University of Pittsburgh-Titusville (1046-I1-233)

- 9:20AM *Geometric representations of a 4x4 determinant.*
 ▶ (697) Preliminary report.
Dean J. Caffentzis, New Port Richey, FL
 (1046-I1-751)
- 9:40AM *Using the discrete wavelet transform to illustrate concepts from linear algebra.*
 ▶ (698) **Patrick J. Van Fleet**, University of St. Thomas
 (1046-I1-450)
- 10:00AM *Algorithms for multivariable polynomial interpolation.*
 ▶ (699) **Richard D. Neidinger**, Davidson College
 (1046-I1-1637)
- 10:20AM *The Moore-Penrose inverse of a vector: Coping with a sometimes tricky case differentiation.*
 ▶ (700) **Karsten K. Schmidt**, Schmalkalden University of Applied Sciences, Germany (1046-I1-497)
- 10:40AM *Teach ill-conditioning to introductory linear algebra students in a single lecture!*
 ▶ (701) **Jeffrey Stuart**, Pacific Lutheran University
 (1046-I1-2078)
- 11:00AM *The linear package and its integration into an undergraduate linear algebra course.*
 ▶ (702) **Don Spickler**, Salisbury University (1046-I1-1430)
- 11:20AM *Getting your hands dirty in linear algebra.*
 (703) **Murphy Waggoner**, Simpson College
 (1046-I1-1440)
- 11:40AM *Using projects and oral reports in the first linear algebra course.* Preliminary report.
 ▶ (704) **Stephen Hilbert**, Ithaca College, Ithaca NY
 (1046-I1-2023)

MAA Session on Mathematics of Games and Puzzles, I

9:00 AM – 11:55 AM

Organizer: **Laura A. Taalman**, James Madison University

- 9:00AM *La Loubere magic squares.*
 ▶ (705) **James Z. Klingensmith*** and **Roman Wong**, Washington and Jefferson College (1046-L1-801)
- 9:20AM *Magic tortoise puzzles.* Preliminary report.
 ▶ (706) **Heakyung Lee**, Winthrop University (1046-L1-374)
- 9:40AM *Leapin' lizards! It's mathematics!*
 (707) **Doug Ensley**, Shippensburg University
 (1046-L1-1993)
- 10:00AM *On determining paint by numbers puzzles with non-unique solutions.* Preliminary report.
 (708) **Ryan Mullen**, Sacred Heart University
 (1046-L1-507)
- 10:20AM *The alarm-off puzzle.*
 ▶ (709) **Roman Wong***, **Shunika Hamilton** and **Sarah Charley**, Washington and Jefferson College
 (1046-L1-619)
- 10:40AM *Should you take the bet? A problem from Marilyn Vos Savant.*
 ▶ (710) **Daniel Schaal**, South Dakota State University
 (1046-L1-1840)
- 11:00AM *Using game theory to get a date: Strategy selection for two (or more) suitors.*
 ▶ (711) **Darryl K. Nester**, Bluffton University
 (1046-L1-1836)
- 11:20AM *Be rational! An examination of player motives and utility.* Preliminary report.
 ▶ (712) **Charles Andrew Tannouri**, Johns Hopkins University (1046-L1-2049)
- 11:40AM *Elementary Farkle strategy: Have you farkled lately?*
 ▶ (713) **Donald E. Hooley**, Bluffton University
 (1046-L1-891)

MAA-Young Mathematicians' Network Panel Discussion

9:00 AM – 10:20 AM

Career options for undergraduate mathematics majors.

Organizers: **Vanessa Garcia**, Texas State University-San Marcos
Dov N. Chelst, ICMA

MAA Panel Discussion

9:00 AM – 10:20 AM

Multidisciplinary projects that hook those not usually interested in mathematics.

Organizers: **Alex J. Heidenberg**, U.S. Military Academy
Gerald C. Kobylski, U.S. Military Academy

Panelists: **Laurie J. Heyer**, Davidson College
Shawnee L. McMurrin, California State University, San Bernardino
Michael Huber, Muhlenberg College
Barbra S. Melendez, U. S. Military Academy

MAA Committee on the Profession Special Presentation

9:00 AM – 10:20 AM

Session for chairs.

Organizers: **Daniel P. Maki**, Indiana University
Cahterine M. Murphy, Purdue University Calumet

Presenter: **Susan C. Geller**, Texas A&M University

MAA Committee on the Participation of Women/Women and Mathematics Network Poster Session

9:00 AM – 11:00 AM

Mathematical outreach programs for underrepresented populations.

Organizer: **Elizabeth G. Yanik**, Emporia State University

Student Hospitality Center

9:00 AM – 5:00 PM

Exhibits and Book Sales

9:30 AM – 5:30 PM

SIGMAA Officers Meeting

10:00 AM – 11:30 AM

Chair: **Amy Shell-Gellasch**, Pacific Lutheran University

AWM Emmy Noether Lecture

10:05 AM – 10:55 AM

- (714) *The geometry of graphs.*
Fan Chung Graham, University of California San Diego

MAA Minicourse #4: Part A

10:30 AM – 12:30 PM

An introduction to the mathematics of modern cryptography.

Organizers: **Jeffrey Ehme**, Spelman College
Colm A. Mulcahy, Spelman College

MAA Minicourse #9: Part A

10:30 AM – 12:30 PM

Beyond formulas and algorithms: Teaching a conceptual/thematic single variable calculus course.

Organizer: **Shahriar Shahriari**, Pomona College

SIGMAA on the History of Mathematics and SIGMAA on the Philosophy of Mathematics Panel Discussion

10:45 AM – 12:05 PM

The intersection of the history and philosophy of mathematics.

Organizers: **Bonnie Gold**, Monmouth University
Amy Shell-Gellasch, Pacific Lutheran University

Panelists: **Thomas L. Drucker**, University of Wisconsin-Whitewater
Kenneth L. Manders, University of Pittsburgh
Daniel C. Sloughier, Furman University

MAA Workshop

10:45 AM – 12:05 PM

Proposal writing for grant applications to the NSF Division of Undergraduate Education.

Organizers: **Daniel P. Maki**, NSF
Ginger H. Rowell, NSF
Elizabeth J. Teles, NSF
Lee L. Zia, NSF

MAA Committee on Technology in Mathematics Education Panel Discussion

10:45 AM – 12:05 PM

Picture this! Geometry software.

Organizers: **Mary L. Platt**, Salem State College
Marina Vulis, University of New Haven
Lawrence Moore, Duke University

Moderators: **Mary L. Platt**
Marina Vulis

Panelists: **Michael D. Hvidsten**, Gustavus Adolphus College
David Fowler, University of Nebraska-Lincoln
Jon Choate, Groton School
David Austin, Grand Valley State University

SIAM Invited Address

11:10 AM – NOON

(715) *Mathematics of sea ice to help predict climate change.*

Kenneth M. Golden, University of Utah
(1046-86-122)

AMS Colloquium Lectures: Lecture II

1:00 PM – 2:00 PM

(716) *Homogeneous dynamics and number theory II.*
Gregory Margulis, Yale University (1046-37-03)

AMS-MAA-SIAM Special Session on Research in Mathematics by Undergraduates, III

1:00 PM – 4:20 PM

Organizers: **Darren A. Narayan**, Rochester Institute of Technology
Jacqueline A. Jensen, Sam Houston State University
Carl V. Lutzer, Rochester Institute of Technology
Vadim Ponomarenko, San Diego State University
Tamas Wiandt, Rochester Institute of Technology

1:00PM *Morgan Prize talk.*

1:30PM *On the realizability of certain graphs as Delaunay Tessellations.*
▶ (717) **Nicholas L. Michaud***, **Liz Anet**, **Adam Chodoff** and **Viriya Ratanasangpunth**, Bard College
(1046-51-527)

2:00PM *Local edge detection with wavelet coefficients.*
▶ (718) **Taylor Edward Burmeister**, Haverford College
(1046-43-86)

2:30PM *Modeling the dynamics of feed-forward biological networks.*
▶ (719) **Lauren E. Pace***, **John W. Cain** and **Dewey T. Taylor**, Virginia Commonwealth University
(1046-92-89)

3:00PM *Examining the evolution of molecular gas in the interstellar medium: The case of the singular ordinary differential equations.* Preliminary report.
▶ (720) **Benjamin Baxter*** and **Lisa J. Holden**, Northern Kentucky University (1046-34-104)

3:30PM *Numerical evidence on the uniform distribution of power residues for elliptic curves.*
▶ (721) **Jeffrey Hatley***, The College of New Jersey, and **Amanda Hittson**, Bryn Mawr College (1046-11-115)

4:00PM *An upper bound for the number of graceful labelings of a path with n edges.*
▶ (722) **Sylvia R. Naples**, Bard College (1046-00-301)

AMS-MAA-MER Special Session on Mathematics and Education Reform, II

1:00 PM – 4:10 PM

Organizers: **William H. Barker**, Bowdoin College
William G. McCallum, University of Arizona
Bonnie S. Saunders, University of Illinois at Chicago

- 1:00PM *Undesirable habits of mind of pre-service teachers: Strategies for addressing them.*
(723) **Kien H. Lim**, University of Texas at El Paso (1046-97-1675)
- 1:30PM *Mathematical habits of mind and the language-learning brain: Mathematics as a second language.*
(724) **Paul Goldenberg**, Educational Development Center (1046-97-2113)
- 2:00PM *Algebraic reasoning in 3D, using principles of linearity and symmetry.*
(725) **Hyman Bass**, University of Michigan (1046-97-1906)
- 2:30PM *Habits of mind for proving.*
▶ (726) **Annie Selden*** and **John Selden**, New Mexico State University (1046-97-684)
- 3:00PM *Classroom norms and habits of mind.*
▶ (727) **Chris Rasmussen**, San Diego State University (1046-97-1774)
- 3:30PM *Panel: Helping students develop mathematical habits of mind.*
▶ (728) **Kristin A. Camenga***, Houghton College, and **Kien H. Lim**, University of Texas at El Paso (1046-97-1111)

AMS-MAA Special Session on The Scholarship of Teaching and Learning, I

1:00 PM – 4:20 PM

Organizers: **Curtis D. Bennett**, Loyola Marymount University
Jacqueline M. Dewar, Loyola Marymount University

- 1:00PM *Using video case-studies to enhance both teaching and learning in a transition course.* Preliminary report.
▶ (729) **James Sandefur***, Georgetown University, **Connie M. Campbell**, Millsaps College, **Kay Somers**, Moravian College, **Manya Raman**, Umeå University, and **Geoffrey D. Birky**, Georgetown University (1046-97-853)
- 1:30PM *Making the most of pre-class reading assignments in statistics.*
▶ (730) **Derek Bruff**, Vanderbilt University (1046-97-1657)
- 2:00PM *Questions you might want answered using data from the registrar.*
▶ (731) **Jack Bookman**, Duke University (1046-97-1739)
- 2:30PM *Collaborative concept mapping in calculus.*
▶ (732) **David E. Meel**, Bowling Green State University (1046-97-847)
- 3:00PM *Paperless Internet-based calculus across all levels, updated.*
▶ (733) **Thomas F. Banchoff**, Brown University (1046-00-972)
- 3:30PM *What makes effective online feedback in college algebra?* Preliminary report.
▶ (734) **Andrew G. Bennett**, Kansas State University (1046-97-1758)
- 4:00PM *Comparing methods of instruction in intermediate algebra for college students, round 2.* Preliminary report.
▶ (735) **Susan Elaine Thompson**, Otterbein College (1046-97-664)

AMS-SIAM Special Session on Asymptotic Methods in Analysis with Applications, II

1:00 PM – 4:20 PM

Organizers: **Diego Dominici**, SUNY New Paltz
Peter A. McCoy, U.S. Naval Academy

- 1:00PM *Asymptotic behavior of solutions of a class of non-linear difference equations.* Preliminary report.
▶ (736) **Faruk F. Abi-Khuzam**, American University of Beirut (1046-39-975)
- 1:30PM *Asymptotics of the p -adic valuations of solutions of linear recurrences.*
(737) **Tewodros Amdeberhan**, Tulane University, **Luis A. Medina**, Rutgers University, and **Victor H. Moll***, Tulane University (1046-11-1158)
- 2:00PM *Stochastic epidemic model reduction: A normal form approach.* Preliminary report.
(738) **Eric Forgoston***, Naval Research Laboratory, **Lora Billings**, Montclair State University, and **Ira B. Schwartz**, Naval Research Laboratory (1046-37-612)
- 2:30PM *Fluid limits, diffusion limits, and event horizons for the response times of processor sharing queues with time varying rates.*
(739) **William A. Massey**, Princeton University (1046-41-747)
- 3:00PM *Mathematical analysis of double-walled carbon nanotube model.*
(740) **Marianna A. Shubov*** and **Miriam Rojas-Arenaza**, University of New Hampshire (1046-35-1118)
- 3:30PM *Pulse propagation in a debye material with static conductivity: The search for a uniform expansion.* Preliminary report.
(741) **Natalie A. Cartwright***, State University of New York at New Paltz, and **Kurt E. Oughstun**, University of Vermont (1046-78-852)
- 4:00PM *The Riesz energy of the N -th roots of unity: An asymptotic expansion for large N .*
(742) **Edward B. Saff***, Vanderbilt University, **Johann S. Brauchart**, Graz University of Technology, and **Douglas Hardin**, Vanderbilt University (1046-41-2128)

AMS-ASL Special Session on Model Theoretic Methods in Finite Combinatorics, I

1:00 PM – 4:20 PM

Organizers: **Martin Grohe**, Humboldt University
Johann A. Makowsky, Technion Israel Institute of Technology

- 1:00PM Discussion
- 1:30PM *Symmetrized Ramsey theorems for graphs and for countably categorical structures.* Preliminary report.
(743) **Menachem Kojman**, Ben Gurion University, Bersheva, Israel (1046-05-342)
- 2:00PM *Universal graphs with forbidden subgraphs.* Preliminary report.
(744) **Gregory L. Cherlin**, Rutgers University, New Brunswick, NJ (1046-03-366)
- 2:30PM *Partition theorems and permutation groups.* Preliminary report.
(745) **Andreas Blass**, University of Michigan (1046-03-471)
- 3:00PM *A geometric zero-One law.*
▶ (746) **Robert Gilman**, Stevens Institute of Technology, **Yuri Gurevich**, Microsoft Research, and **Alexei Myasnikov***, McGill University (1046-05-373)

- 3:30PM *Laplace transforms and zero-one laws*. Preliminary report. (747)
Jason P. Bell, Simon Fraser University (1046-05-448)
- 4:00PM *The Specker-Blatter theorem revisited*. Preliminary report. (748)
Eldar Fischer* and **Johann A. Makowsky**, Technion - Israel Institute of Technology, Haifa, Israel (1046-05-343)

AMS Special Session on Convex and Discrete Geometry, II

1:00 PM – 4:20 PM

Organizers: **Włodzimierz Kuperberg**, Auburn University
Valeriu Soltan, George Mason University

- 1:00PM *Blocking numbers for l_p balls in three dimensions*. Preliminary report. (749)
David G. Larman, University College London (1046-52-576)
- 1:30PM *On the Hadwiger numbers of topological disks*. (750)
Zsolt Langi, Budapest University of Technology, Budapest, Hungary (1046-52-608)
- 2:00PM *On partial coverings of convex bodies by planks*. (751)
Károly Bezdek, University of Calgary (1046-52-1527)
- 2:30PM *Extremal coin graphs in the Euclidean plane*. Preliminary report. (752)
Geir Agnarsson and **Jill Bigley Dunham***, George Mason University (1046-05-371)
- 3:00PM *Shortest path among circles*. Preliminary report. (753)
Gábor Fejes Tóth, Rényi Institute, Budapest (1046-52-1143)
- 3:30PM *On covering a convex set with its smaller copies*. (754)
Marton Naszodi, University of Alberta (1046-52-1767)
- 4:00PM *On a new proof of the Malfatti's problem*. (755)
Andras Bezdek*, Auburn Univ and Renyi Inst. of the Hungarian Acad. of Sci., Budapest, Hungary, **Jan P. Boronski**, Auburn University, **Wesley Brown**, **Braxton Carrigan** and **Matt Noble**, Auburn University, Auburn, AL (1046-52-1395)

AMS Special Session on Von Neumann Algebras, II

1:00 PM – 4:20 PM

Organizers: **Pinhas Grossman**, Vanderbilt University
Remus Nicoara, University of Tennessee

- 1:00PM Discussion
- 1:30PM *On the conditionally free analogue of the S -transform*. (756)
Mihai Popa, Indiana University at Bloomington (1046-47-336)
- 2:00PM *Binary shifts of higher commutant index*. Preliminary report. (757)
Geoffrey L. Price, United States Naval Academy (1046-46-467)
- 2:30PM *Multipliers and extreme points of operator spaces*. (758)
Masayoshi Kaneda, The University of Mississippi (1046-46-1388)
- 3:00PM *Normalizers of subalgebras of II_1 factors*. (759)
Alan D. Wiggins, Vanderbilt University (1046-46-1280)

- 3:30PM *A modified version of free orbit-dimension of von Neumann algebras*. (760)
Weihua Li* and **Don Hadwin**, University of New Hampshire (1046-46-370)
- 4:00PM *Structure results for normalizers of II_1 factors*. (761)
Jan Cameron, Texas A&M University (1046-47-1313)

AMS Special Session on Noncommutative Algebra, II

1:00 PM – 3:50 PM

Organizers: **Greg Marks**, St. Louis University
Ashish K. Srivastava, St. Louis University

- 1:00PM *Hopf algebras of low GK-dimension*. (762)
James J. Zhang, University of Washington (1046-16-204)
- 1:30PM *Centralizers in domains of low Gelfand-Kirillov dimension*. Preliminary report. (763)
Jason P. Bell, Simon Fraser University (1046-16-451)
- 2:00PM *Homology of a ring*. (764)
Ivo Herzog, Yonsei University (Seoul, South Korea) and Ohio State University at Lima (1046-16-1418)
- 2:30PM *Nichols algebras in positive characteristic*. (765)
Aaron Lauve and **Sarah Witherspoon***, Texas A&M University (1046-16-2035)
- 3:00PM *Von-Neumann-algebra-like rings and the answer to a S. K. Berberian's question*. (766)
Lia Vaš, University of the Sciences in Philadelphia (1046-16-994)
- 3:30PM *Big projective modules over Noetherian semilocal rings*. (767)
Dolors Herbera*, Universitat Autònoma de Barcelona, and **Pavel Prihoda**, Charles University, Prague (1046-16-1580)

AMS Special Session on Computational Algebraic and Analytic Geometry for Low-dimensional Varieties, II

1:00 PM – 4:20 PM

Organizers: **Mika K. Seppälä**, Florida State University
Tanush Shaska, Oakland University
Emil J. Volcheck, Association for Computing Machinery

- 1:00PM *Palindromes and discreteness algorithms*. (768)
Jane Gilman*, Rutgers University, Newark, and **Linda Keen**, Lehman College, CUNY (1046-20-682)
- 1:30PM *On the maximal order of an automorphism of a trigonal Riemann surface*. (769)
Milagros Izquierdo*, Linköping University, and **Antonio F. Costa**, UNED (1046-14-405)
- 2:00PM *WIT: A structured and comprehensive package for computations in intersection theory*. (770)
Sebastian Xambó-Descamps, Universitat Politècnica de Catalunya (1046-14-1435)
- 2:30PM *Riemann surfaces via circle packing*. (771)
G. Brock Williams, Texas Tech University (1046-30-1803)
- 3:00PM *Hyperbolic polygons, Fuchsian groups and Helling Matrices*. (772)
K.-D. Semmler, EPF Lausanne (1046-53-1585)
- 3:30PM *Thetanulls of curves with automorphisms*. (773)
Emma Previato*, Boston University, and **T. Shaska**, Oakland University (1046-14-800)

- 4:00PM *Graphical representation of the Birman-Series set on hyperbolic surfaces.* Preliminary report.
(774) **Peter Buser*** and **Hugo Parlier**, École Polytechnique Fédérale Lausanne (EPFL) (1046-53-1093)

AMS Special Session on Harmonic Analysis, I

1:00 PM – 4:20 PM

Organizers: **Paul A. Hagelstein**, Baylor University
Alexander M. Stokolos, DePaul University

- 1:00PM *Bellman function in non-local settings.* Preliminary report.
(775) **Leonid Slavin**, University of Missouri-Columbia (1046-42-1177)
- 1:30PM *Smooth functions associated with wavelet sets on \mathbb{R}^d , $d \geq 1$, and frame bound gaps.*
(776) **John J. Benedetto** and **Emily J. King***, University of Maryland, College Park (1046-43-1532)
- 2:00PM *Growth properties of Fourier transforms via moduli of continuity.*
(777) **William O. Bray**, University of Maine (1046-42-68)
- 2:30PM *Weighted inequalities for multilinear fractional integral operators.*
(778) **Kabe A. Moen**, University of Kansas (1046-42-1064)
- 3:00PM *A sharp inequality for the Strichartz norm.* Preliminary report.
(779) **Emanuel Carneiro**, University of Texas at Austin (1046-42-743)
- 3:30PM *Besov-Lebesgue mapping properties for bilinear operators.* Preliminary report.
(780) **Diego Maldonado** and **Virginia Naibo***, Kansas State University (1046-42-511)
- 4:00PM *Pointwise convergence of Fourier series of the indicator of a ball in Euclidean space, following Kuratsubo.*
(781) **Mark A. Pinsky**, Northwestern University (1046-42-163)

AMS Special Session on the Mathematics of Information and Knowledge, IV

1:00 PM – 4:20 PM

Organizers: **Ronald R. Coifman**, Yale University
James G. Glimm, SUNY at Stony Brook
Peter W. Jones, Yale University
Stephen Smale, Toyota Institute

- 1:00PM *Hodge theory for singular spaces.*
(782) **Steve Smale***, Toyota Technological Institute, and **Nat Smale**, University of Utah (1046-60-1222)
- 2:00PM *Harmonic and multiscale analysis on low-dimensional data sets in high-dimensions.*
(783) **Mauro Maggioni**, Duke University (1046-60-1685)
- 3:00PM *Fast matrix computations via randomized sampling.*
(784) **Gunnar Martinsson**, University of Colorado at Boulder (1046-60-2131)
- 3:45PM Discussion

AMS Special Session on Topological Methods in Applied Mathematics, II

1:00 PM – 4:20 PM

Organizer: **Yongwu Rong**, George Washington University

- 1:00PM *Topology and data.*
(785) **Gunnar Carlsson**, Stanford University (1046-68-1631)
- 1:30PM *Estimating the topology of functions on manifolds from noisy samples.*
(786) **Peter Bubenik***, Cleveland State University, **Gunnar Carlsson**, Stanford University, **Peter T. Kim** and **Zhiming Luo**, University of Guelph (1046-55-916)
- 2:00PM *Homology computations for random nodal domains.*
(787) **Thomas Wanner**, George Mason University (1046-55-459)
- 2:30PM *Euler characteristic, integration, and definable functions.* Preliminary report.
(788) **Yuliy Baryshnikov**, Bell Labs, and **Robert Christ***, University of Pennsylvania (1046-55-479)
- 3:00PM *Counting objects in dense sensor networks: A topological integral transform.* Preliminary report.
(789) **Yuliy Baryshnikov**, Bell Laboratories (1046-55-1554)
- 3:30PM *Discrete curvature flows and their applications, I.*
(790) **Feng Luo***, Rutgers University, and **David Gu**, SUNY at Stony Brook (1046-52-1939)
- 4:00PM *Discrete curvature flows and their applications, II.* Preliminary report.
(791) **David Gu***, SUNY at Stony Brook, and **Feng Luo**, Rutgers University (1046-97-2091)

AMS Special Session on Teichmüller Theory and Low-Dimensional Topology, II

1:00 PM – 4:20 PM

Organizers: **Richard P. Kent**, Brown University
Madlena Tomova, Rice University

- 1:00PM *A normal surface calculus for Heegaard splittings.*
(792) **Jesse E. Johnson**, Yale University (1046-57-825)
- 1:30PM *Asymptotics of Weil-Petersson geodesics.*
(793) **J. Brock***, Brown University, **H. Masur**, University of Chicago, and **Y. Minsky**, Yale University (1046-51-1311)
- 2:00PM *Uniform uniform exponential growth of subgroups of the mapping class group.*
(794) **Johanna Mangahas**, University of Michigan (1046-51-362)
- 2:30PM *Topological index theory for isotopy classes of surfaces.*
(795) **David C. Bachman**, Pitzer College (1046-57-139)
- 3:00PM *A compactification for the space of singular Euclidean metrics on a surface.*
(796) **Kasra Rafi***, University of Oklahoma, **Moon Duchin**, University of Michigan, and **Christopher Leininger**, UIUC (1046-51-188)
- 3:30PM *Surgery on a knot in $(\text{surface}) \times (I)$.*
(797) **Martin Scharlemann**, UCSB, and **Abigail Thompson***, UC Davis (1046-57-932)
- 4:00PM *Geometry of splittings and models.*
(798) **Hossein Namazi**, University of Texas at Austin (1046-57-390)

MAA Minicourse #10: Part A

1:00 PM – 3:00 PM

The ubiquitous Catalan numbers and their applications.

Organizer: **Thomas Koshy**, Framingham State College

MAA Minicourse #14: Part A

1:00 PM – 3:00 PM

Teaching a course in the history of mathematics.

Organizers: **V. Frederick Rickey**, U.S. Military Academy
Victor J. Katz, University of the District of Columbia

MAA Minicourse #5: Part A

1:00 PM – 3:00 PM

Developing departmental self-studies.

Organizers: **Donna L. Beers**, Simmons College
Richard A. Gillman, Valparaiso University

AMS Session on Partial Differential Equations, II

1:00 PM – 3:55 PM

- 1:00PM (799) *Thermal blow-up in a subdiffusive medium.*
W. E. Olmstead, Northwestern University, and
Catherine A. Roberts*, College of the Holy Cross (1046-35-706)
- ▶ 1:15PM (800) *Accurate resolution of a nonlinear PDE with corner singularities.* Preliminary report.
Qingshan Chen*, Indiana University at Bloomington, and **Roger Temam**, Indiana University (1046-35-1492)
- 1:30PM (801) *A model for particle size segregation in granular flow under nonuniform shear.*
Karen Daniels, **Lindsay B.H. May***, North Carolina State University, **Kasey Phillips**, University of Cambridge, and **Michael Shearer**, North Carolina State University (1046-35-1694)
- 1:45PM (802) *Minimizers of the Lawrence-Doniach model for superconductors under weak coupling and a parallel or slightly tilted field.* Preliminary report.
Patricia E. Bauman and **Zhenqiu Xie***, Purdue University (1046-35-1850)
- 2:00PM (803) *The unique determination of an acoustic speed from thermoacoustic tomography data.*
Kyle S. Hickmann, Oregon State University (1046-35-1925)
- 2:15PM (804) *Propagation of solitons under colored noise.* Preliminary report.
Russell L. Herman, University of North Carolina Wilmington (1046-35-1966)
- 2:30PM (805) *Complete integrability in Burgers turbulence.* Preliminary report.
Ravi Srinivasan, Brown University (1046-35-2065)
- 2:45PM (806) *Using distinguish-ability criteria to optimally design sources in optical tomography.*
Taufiqar Khan, Clemson University, **Peter Maass**, University of Bremen, Germany, and **Bonnie McAdoo***, Clemson University (1046-35-1979)
- 3:00PM (807) *Nodal and multiple constant sign solutions for the p -Laplacian.* Preliminary report.
Michael E. Filippakis*, National Technical University of Athens, **Ravi P. Agarwal**, Florida Institute of Technology, **Donal O'Regan**, National University of Ireland, and **Nikolaos S. Papageorgiou**, National Technical University of Athens (1046-35-2127)
- ▶ 3:15PM (808) *Immiscible two-phase flow through porous media: A case of uniqueness of a solution.* Preliminary report.
Koffi B. Fadimba, University of South Carolina Aiken (1046-35-1453)

- 3:30PM (809) *Homogenization of time-harmonic acoustics of bone: The diphasic case.*
Ana Vasilic*, University of Delaware, **Ming Fang**, Norfolk State University, and **Robert P. Gilbert**, University of Delaware (1046-35-1828)
- 3:45PM (810) *An optimal order error estimate of a linear finite element method for smooth solutions of 2D systems of conservation laws.*
Xiaomei Ji, Stony Brook University. (1046-00-1650)

AMS Session on Biology, II

1:00 PM – 3:25 PM

- ▶ 1:00PM (811) *Gene dispersal in an insect pollinated tree species.* Preliminary report.
David M. Chan*, **Rodney J. Dyer**, **Erich Foster**, **Alex Feild** and **April McFarland**, VCU (1046-92-74)
- ▶ 1:15PM (812) *The estimation of the effective reproductive number from disease outbreak data.*
Ariel Cintron-Arias, North Carolina State University (1046-92-162)
- 1:30PM (813) *3D In vivo MRI-Based FSI models for human carotid atherosclerotic plaques and patient-specific plaque progression growth functions with validation.*
Zijie Liao, **Xueying Huang***, Worcester Polytechnic Institute, **Chun Yang**, Beijing Normal University, and **Dalin Tang**, Worcester Polytechnic Institute (1046-92-253)
- 1:45PM (814) *Linkage analysis for categorical traits on complex pedigrees.*
Abra Brisbin*, Center for Applied Mathematics, Cornell University, **Jason Mezey** and **Carlos Bustamante**, Cornell University (1046-92-264)
- ▶ 2:00PM (815) *Computational mutagenesis for analysis of protein functional changes upon mutation.* Preliminary report.
Majid Masso, George Mason University (1046-92-78)
- 2:15PM (816) *The analysis of a nonlinear adaptive elastic plate under loading with numerical simulations of its displacement and growth under various boundary conditions.*
Robert J. Ronkese, United States Military Academy (1046-92-389)
- ▶ 2:30PM (817) *A general method to derive a Boolean model from a continuous model for gene regulatory networks.*
Franziska B. Hinkelmann, Virginia Tech (1046-92-306)
- 2:45PM (818) *Study on critical stress in atherosclerotic carotid artery using In vivo MRI-based 3D multi-physics models with fluid-structure interactions.*
Zhongzhao Teng*, **Xueying Huang**, **Zijie Liao** and **Dalin Tang**, Worcester Polytechnic Institute (1046-92-417)
- ▶ 3:00PM (819) *A gender structured model with single-biased separation rate.* Preliminary report.
Daniel Maxin, Valparaiso University (1046-92-469)
- ▶ 3:15PM (820) *A modified Mitchell-Schaeffer model of cardiac action potential which incorporates caveolae-associated ionic currents.* Preliminary report.
Ian Besse*, **Colleen Mitchell**, University of Iowa, and **Erwin Shibata**, University of Iowa (1046-92-518)

AMS Session on Dynamical Systems and Ergodic Theory, I

1:00 PM – 3:55 PM

- 1:00PM (821) *Decay of correlations of nonuniform geodesic flows.*
Preliminary report.
Hongkun Zhang, University of Massachusetts-Amherst (1046-37-52)
- 1:15PM (822) *All bounded type Siegel disks of rational maps are quasi-disks.*
Gaofei Zhang, Nanjing University (1046-37-136)
- 1:30PM (823) *Endomorphisms of various substitution systems.*
Preliminary report.
Jeanette Olli, University of North Carolina at Chapel Hill (1046-37-280)
- 1:45PM (824) *A dynamical study of a cellular automata model of the spread of HIV in a lymph node.*
Emily G. Burkhead*, Meredith College, **Jane M. Hawkins**, University of North Carolina at Chapel Hill, and **Donna K. Molinek**, Davidson College (1046-37-314)
- 2:00PM (825) *Measurable time-restricted sensitivity.* Preliminary report.
Domenico Aiello, Williams College, **Hansheng Diao**, Massachusetts Institute of Technology, **Zhou Fan**, Harvard College, **Daniel O. King**, Williams College, **Jessica Lin***, Courant Institute of Mathematical Sciences, and **Cesar E. Silva**, Williams College (1046-37-953)
- 2:15PM (826) *Pinching deformations of rational maps.*
Robert W. O'Connell, Indiana University-Bloomington (1046-37-428)
- 2:30PM (827) *Minimal measures for Lagrangian systems on 2-manifold.* Preliminary report.
Fang Wang, Northwestern University (1046-37-1099)
- 2:45PM (828) *A cellular model for spatial population dynamics.*
James T. Long*, Moravian College, **Chu Yue (Stella) Dong**, Polytechnic Institute of New York University, **Corey Staten**, Ohio State University, **Rytis Umbrasas** and **Clifford A. Reiter**, Lafayette College (1046-37-1001)
- 3:00PM (829) *An approach at the binomial transformation problem.* Preliminary report.
Andy Q. Yingst*, University of South Carolina Lancaster, and **R. Daniel Mauldin**, University of North Texas (1046-37-1094)
- 3:15PM (830) *Reducibility of skew-product systems with Brjuno base flows.*
Sasa Kocic, University of Toronto (1046-37-1132)
- 3:30PM (831) *The dynamics of nonlinear tent-like maps.*
Oumarou Njoya* and **Zach Flres**, Michigan State University (1046-37-1141)
- 3:45PM (832) *On the road to a classification of attractors of injective iterated function systems in \mathbb{R}^1 .*
Jason E. Snyder* and **Mariusz Urbanski**, University of North Texas (1046-37-1316)

AMS Session on Number Theory, II

1:00 PM – 3:55 PM

- 1:00PM (833) *Bounding the coefficients of $\Phi_{pqr}(x)$.*
Brian Lawrence, California Institute of Technology (1046-11-1150)
- 1:15PM (834) *Membership in an ideal in the group ring, $\mathbb{Z}[GL_3(\mathbb{Z})]$.*
Becky E. Hall, Wesleyan University (1046-11-1349)

- 1:30PM (835) *More results on "sum of cubes equal to square of sums".*
Paul A. Loomis, Bloomsburg University (1046-11-1382)
- 1:45PM (836) *Finding square roots of p -adic numbers.*
William D. Taylor, University of Nevada, Reno (1046-11-1446)
- 2:00PM (837) *Composites with large sets of strong liars.* Preliminary report.
Andrew Shallue*, University of Calgary, and **Eric Bach**, University of Wisconsin-Madison (1046-11-1459)
- 2:15PM (838) *On a conjecture regarding the coefficients of cyclotomic polynomials.*
Sherry Gong, Harvard University (1046-11-1518)
- 2:30PM (839) *Modular forms for some noncongruence subgroups of $SL_2(\mathbb{Z})$.*
Chris A. Kurth, Iowa State University (1046-11-1817)
- 2:45PM (840) *Groups of linear functions on $\mathbb{Z}n$.*
Tue Ngoc Ly, University of South Florida (1046-11-1530)
- 3:00PM (841) *Computation of Jacobsthal's Function $h(n)$ for $n < 50$.*
Thomas R. Hagedorn, The College of New Jersey (1046-11-1633)
- 3:15PM (842) *Distribution of integers with smooth square free parts.*
Chaogui Zhang, Marywood University (1046-11-1794)
- 3:30PM (843) *Waring's number in a finite field.* Preliminary report.
James Arthur Cipra, Kansas State University (1046-11-1944)
- 3:45PM (844) *On prime factors of $A^n \pm 1$.* Preliminary report.
John H. Jaroma, Ave Maria University (1046-11-873)

MAA Session on Demos and Strategies with Technology that Enhance Teaching and Learning Mathematics, II

1:00 PM – 3:15 PM

- Organizers: **David R. Hill**, Temple University
Scott Greenleaf, University of New England
Mary L. Platt, Salem State College
Lila F. Roberts, Georgia College & State University
- 1:00PM (845) *Math in your hands: The use of tablet PCs and computer algebra systems in a calculus classroom.*
Joshua Brandon Holden, Rose-Hulman Institute of Technology (1046-E1-1480)
- 1:20PM (846) *Using tablet PCs and the ubiquitous presenter to engage students and enhance the learning experience in service courses.* Preliminary report.
Shems I. Alhaddad*, University of South Carolina Lancaster, and **Greg Thomas**, Waldorf College (1046-E1-1439)
- 1:40PM (847) *My first semester using 'clickers' for rapid feedback: The good, the bad, and the ugly.*
Dexter C. Whittinghill, Rowan University, Glassboro, NJ (1046-E1-1673)
- 2:00PM (848) *Turning point technology: Using personal response systems to stimulate class participation.* Preliminary report.
Kimberly J. Presser, Shippensburg University (1046-E1-422)

- 2:20PM *Effective teaching and learning with the right web-based resources.*
 ► (849) **Douglas B. Meade***, University of South Carolina, and **Philip B. Yasskin**, Texas A&M University (1046-E1-650)
- 2:40PM *A powerful, easy-to-use computer algebra alternative that students love, but (most) teachers have not yet discovered!*
 ► (850) **Anand L. Pardhanani**, Earlham College (1046-E1-600)
- 3:00PM *Integrating engineering technology into the teaching of mathematics.*
 ► (851) **Mary Ann Connors**, Westfield State College (1046-E1-198)

MAA Session on Mathematics and Sports, II

1:00 PM – 3:15 PM

- Organizer: **Howard L. Penn**, U.S. Naval Academy
- 1:00PM *SiSSYS: A senior capstone course based on statistics in sports.*
 ► (852) **Robin H. Lock***, **Michael E. Schuckers**, and **Travis Atkinson**, St. Lawrence University (1046-N1-2020)
- 1:20PM *Traditional introductory statistics restricted to sports.*
 ► (853) **Andrew B. Perry**, Springfield College (1046-N1-1773)
- 1:40PM *The effects of wind and altitude on 400-m sprint performances with various IAAF track geometries.*
 ► (854) **Michael Frantz***, University of La Verne, and **Vanessa Alday**, California State University, Fullerton (1046-N1-1882)
- 2:00PM *Walking or running in the rain: Myth busted?*
 ► (855) Preliminary report.
Eugene Belogay, Wilkes Honors College, Florida Atlantic University (1046-N1-1931)
- 2:20PM *Mathematics of the Olympics: From the ancient Greeks to the present.*
 ► (856) **Elizabeth C. Rogers**, Piedmont College (1046-N1-2062)
- 2:40PM *How expert swing dancers exploit physics.*
 ► (857) Preliminary report.
Megan Elise Selbach-Allen*, **Sommer E. Gentry** and **Kevin L. McIlhany**, United States Naval Academy (1046-N1-1894)
- 3:00PM *Mathematics and collegiate wrestling tournaments.*
 ► (858) **T. S. Michael**, United States Naval Academy (1046-N1-613)

MAA Session on Research on the Teaching and Learning of Undergraduate Mathematics, I

1:00 PM – 4:05 PM

- Organizers: **Keith H. Weber**, Rutgers University
Michelle J. Zandieh, Arizona State University
Karen A. Marrongelle, Portland State University
- 1:00PM *A multiage examination of students' approaches to mathematical induction tasks.*
 (859) **Stacy A. Brown**, Pitzer College (1046-U1-1771)
- 1:35PM *Bringing a formative approach to definitions in undergraduate real analysis: Theoretical considerations and preliminary results.* Preliminary report.
 ► (860) **Paul C. Dawkins**, University of Texas at Arlington (1046-U1-1871)

- 2:00PM *An investigation of students' problem solving abilities: Where's the quantity?*
 ► (861) **Kevin C. Moore**, Arizona State University (1046-U1-1471)
- 2:25PM *Expert vs. novice understanding of convergence of Taylor series.* Preliminary report.
 ► (862) **Jason Howard Martin**, University of Oklahoma (1046-U1-1716)
- 2:50PM *Measuring Mathematical Sophistication.*
 ► (863) **Eric W. Kuennen***, **Jennifer E. Szydluk**, University of Wisconsin Oshkosh, and **Carol E. Seaman**, University of North Carolina Greensboro (1046-U1-1760)
- 3:20PM *Students' mental models and success on a calculus word problem.*
 (864) **Dale J. Winter***, Carnegie Mellon University, and **Matthew E. DeLong**, Taylor University (1046-U1-564)
- 3:45PM *A two semester study of interactions in multi-section undergraduate mathematics classes.* Preliminary report.
 ► (865) **Jessica M. Deshler**, West Virginia University (1046-U1-1414)

MAA Session on Undergraduate Mathematical Biology, II

1:00 PM – 2:40 PM

- Organizers: **Timothy D. Comar**, Benedictine University
Raina Robeva, Sweet Briar College
Eric S. Marland, Appalachian State University
- 1:00PM *Sensitivity analysis and parameter identification in undergraduate mathematical modeling.*
 ► (866) **Steven M. Deckelman**, University of Wisconsin-Stout (1046-Y1-1014)
- 1:25PM *Materials for analyzing sensitivity using the partial rank correlation coefficient.* Preliminary report.
 ► (867) **J. K. Denny**, Mercer University (1046-Y1-2041)
- 1:55PM *Secret diffusion lessons of the sea monkeys and other math bio projects for undergraduates.*
 (868) **Brynja R. Kohler***, **Rebecca J. Atkins**, **James Haefner**, and **James Powell**, Utah State University (1046-Y1-993)
- 2:20PM *What's math have to do with history: A biological application to matrices and difference equations.*
 ► (869) **Robert E. Burks Jr.**, United States Military Academy (1046-Y1-1742)

MAA Session on Wavelets for Undergraduates

1:00 PM – 4:15 PM

- Organizers: **Catherine Beneteau**, University of South Florida
Caroline Haddad, SUNY Geneseo
David Ruch, Metropolitan State College of Denver
Patrick Van Fleet, University of St. Thomas
- 1:00PM *An image compression introduction to wavelets.*
 ► (870) **Colm Mulcahy**, Spelman College (1046-YY-1962)
- 1:25PM *Zooming in on a transformed image: A project for students.*
 (871) **Caroline N. Haddad***, State University of NY College at Geneseo, **Dawit Haile**, Virginia State University, and **Helmut Knaust**, The University of Texas at El Paso (1046-YY-1365)

- 1:50PM Wavelet packets and applications. Preliminary report.
▶ (872) **Bruce Atwood**, Beloit College, **Raouf Boules**, Towson University, and **Patrick Van Fleet***, University of St. Thomas (1046-YY-1920)
- 2:15PM A student project on lifting algorithms for wavelet transformations.
▶ (873) **Catherine Beneteau***, University of South Florida, **Kristin Pfabe**, Nebraska Wesleyan University, and **Karen Shuman**, Grinnell College (1046-YY-1698)
- 2:40PM A student project on matrix completion for discrete wavelet transformations. Preliminary report.
▶ (874) **Roger Zarnowski***, San Angelo State University, **Tatyana Sorokina**, Towson State University, and **David K. Ruch**, Metropolitan State College of Denver (1046-YY-1690)
- 3:05PM A student summer research project on image segmentation using wavelet methods and matrix completion.
▶ (875) **David K. Ruch**, Metropolitan State College of Denver (1046-YY-1696)
- 3:30PM Wavelets in vocal identification of great horned owls (Part I). Preliminary report.
▶ (876) **Katherine L. McCaffrey***, University of St. Thomas, and **Nicole F. Kingsley**, SUNY Geneseo (1046-YY-1362)
- 3:55PM Wavelets in vocal identification of great horned owls (Part II). Preliminary report.
▶ (877) **Nicole F. Kingsley***, State University of New York at Geneseo, and **Katherine L. McCaffrey**, University of St. Thomas (1046-YY-1441)
- 2:15PM Basic mathematical skills and success in introductory level statistics.
▶ (883) **M. Leigh Lunsford** and **Phillip Poplin***, Longwood University (1046-Z1-1740)
- 2:30PM Effect of WeBWork on student performance in calculus II. Preliminary report.
▶ (884) **Christopher C. Leary*** and **Aaron Heap**, SUNY Geneseo (1046-Z1-1683)
- 2:45PM The role of an inquiry-based classroom in undergraduate mathematics. Preliminary report.
▶ (885) **Nancy Donaldson**, **Maired Greene**, Rockhurst University, **Volker Ecke** and **Christine VonRenesse***, Westfield State College (1046-Z1-1660)
- 3:00PM A comparative study of online and traditional classroom learning of college algebra for non-traditional students in non-traditional higher education programs. Preliminary report.
▶ (886) **Michael Miner***, American Public University System, and **Darcel Ford**, Strayer University (1046-Z1-1465)
- 3:15PM A summary of research about perspectives on knowledge with implications for undergraduate mathematics education.
(887) **Katherine Safford-Ramus**, Saint Peter's College (1046-Z1-1267)
- 3:30PM Project based distance delivered elementary statistics. Preliminary report.
▶ (888) **Joseph B. Liddle**, **Colleen Ianuzzi*** and **Chris Hay-Jahans**, University of Alaska Southeast (1046-Z1-1070)
- 3:45PM Extended Newton-Leibnitz Theorem.
(889) **Zengxiang Tong**, Otterbein College (1046-Z1-1004)

MAA General Contributed Paper Session, V

1:00 PM – 3:55 PM

Organizer: **Sarah L. Mabrouk**, Framingham State College

Moderators: **Edwin Herman**, University of Wisconsin

Ana M. Tameru, Alabama State University

Aprillya Lanz, Virginia Military Institute

Deborah Koslover, University of Texas at Tyler

- 1:00PM The promises of clinical instructological research.
▶ (878) **Clyde L. Greeno**, MAEI Mathematics Institute (1046-Z1-1174)
- 1:15PM Teaching infinite series: A study on students' conceptual and procedural understanding of infinite series in calculus.
▶ (879) **Brian J. Lindaman**, University of Minnesota, IT Center for Educational Programs (1046-Z1-2053)
- 1:30PM How was that picture helpful? Using online tablet-PC software and corrective self-explanation to increase student conceptual understanding in applied pre-calculus. Preliminary report.
▶ (880) **Aaron Wangberg**, Winona State University (1046-Z1-2011)
- 1:45PM Evaluating the success of a calculus placement test: Aligning the basis for placement and the basis for assessment. Preliminary report.
▶ (881) **Carrie Muir**, University of Colorado, Boulder (1046-Z1-1933)
- 2:00PM Role of mathematical definitions in proof: A case of prospective mathematics teachers. Preliminary report.
(882) **Nermin Bayazit**, Florida State University (1046-Z1-1952)

SIAM Minisymposium on Graph Theory, I

1:00 PM – 3:55 PM

Organizer: **Stephen G. Hartke**, University of Nebraska-Lincoln

- 1:00PM Random threshold graphs.
(890) **Elizabeth Reilly** and **Edward R. Scheinerman***, Johns Hopkins University (1046-05-354)
- 1:30PM Large induced trees in K_r -free graphs.
(891) **Jacob Fox***, **Po-Shen Loh**, Princeton University, and **Benny Sudakov**, UCLA (1046-05-533)
- 2:00PM Some observations on sorting pairs in bins. Preliminary report.
▶ (892) **Andre E. Kezdy*** and **Adam Jobson**, University of Louisville (1046-05-1250)
- 2:30PM An approximate version of Hadwiger's conjecture for claw-free graphs.
(893) **Alexandra Ovetsky Fradkin***, Princeton University, and **Maria Chudnovsky**, Columbia University (1046-05-530)
- 3:00PM The distinguishing chromatic number.
▶ (894) **Karen L. Collins**, Wesleyan University (1046-05-1539)
- 3:30PM Entire $(\Delta + 4)$ -choosability of planar graphs with $\Delta \geq 8$.
▶ (895) **Daniel W. Cranston***, Center for Discrete Mathematics and Theoretical Computer Science, Rutgers, and **David Lapayowker**, Harvey Mudd College (1046-05-514)

MAA Panel Discussion

1:00 PM – 2:20 PM

Using open-source software for undergraduate courses.

Organizers: **Karl-Dieter Crisman**, Gordon College
Marshall E. Hampton, University of Minnesota, Duluth

Panelists: **David Joyner**, U. S. Naval Academy
John A. Verzani, CUNY
Michael E. Gage, University of Rochester
David Joyner
Robert Miller, University of Washington

MAA Committee on Graduate Students Panel Discussion

1:00 PM – 2:20 PM

Teaching postdocs: A journey from graduate school to a position in the world of mathematics.

Organizers: **Stephen M. Gagola, III**, University of Arizona
Feryal Alayont, Grand Valley State University

Panelists: **Taliesin Sutton**, University of Arizona
Andrew G. Bennett, Kansas State University
Nathan A. Carlson, University of Arizona
Steven J. Schlicker, Grand Valley State University
Matt Salomone, Bates College

MAA CUPM Subcommittee on Research by Undergraduates-Project NExT Panel Discussion

1:00 PM – 2:20 PM

Preparing students to communicate mathematics.

Organizer: **Lewis D. Ludwig**, Denison University

Panelists: **Joseph A. Gallian**, University of Minnesota-Duluth
Darren A. Narayan, Rochester Institute of Technology
Michael E. Orrison, Harvey Mudd College

MAA-Project NExT Panel Discussion

1:00 PM – 2:15 PM

Establishing your identity as a post-tenure professor.

Organizers: **Linda Braddy**, East Central University
Sharon M. Frechette, College of the Holy Cross
Jennifer McCloud-Mann, University of Texas at Tyler

Panelists: **Colin L. Adams**, Williams College
Jaimie Hebert, Sam Houston State University
Catherine A. Roberts, College of the Holy Cross
Charlotte K. Simmons, University of Central Oklahoma

Judy L. Walker, University of Nebraska-Lincoln

Summer Program for Women in Mathematics (SPWM) Reunion

1:00 PM – 4:00 PM

Organizer: **Murli M. Gupta**

MAA Session on Mathematics of Games and Puzzles, II

1:40 PM – 4:15 PM

Organizer: **Laura A. Taalman**, James Madison University

- 1:40PM **Meet Colonel Blotto.**
► (896) **Andrew G. Niedermaier**, University of California - San Diego (1046-L1-330)
- 2:00PM **Two-dimensional abstract games.**
► (897) **Matthew M. Burke**, George Washington University (1046-L1-1135)
- 2:20PM **Rubik's Cubes in the classroom: How a puzzle of logic, patterns, and algorithms can build confidence in mathematics.**
► (898) **Eric W. Drake*** and **Robert E. Burks Jr.**, The United States Military Academy (1046-L1-740)
- 2:40PM **Using the pile splitting puzzle to enhance student learning of mathematics.**
► (899) **Bill Marion**, Valparaiso University (1046-L1-23)
- 3:00PM **Discussion**
- 3:20PM **Chomp, chomp, bechewy chomp: Research with undergraduates.** Preliminary report.
► (900) **Alex Meadows**, St. Mary's College of Maryland (1046-L1-1989)
- 3:40PM **Counting the mathematical faces of all regular flexagons.** Preliminary report.
► (901) **Homeira Pajooesh**, City University of New York, **T. Bruce McLean***, Georgia Southern University, **Thomas Anderson**, Emory University, **Chasen Smith**, **Emil Iacob**, and **John Nelson**, Georgia Southern University (1046-L1-412)
- 4:00PM **You gotta know how to fold 'em.**
► (902) **Thomas C. Hull**, Western New England College (1046-L1-1378)

AMS Special Session on Group Actions on Homogeneous Spaces and Applications, IV

2:00 PM – 4:10 PM

Organizers: **Dmitry Y. Kleinbock**, Brandeis University
Gregory A. Margulis, Yale University
Hee Oh, Brown University

- 2:00PM **Expanding translates of curves and Dirichlet-Minkowski theorem on linear forms.**
(903) **Nimish A. Shah**, Yale University and Tata Institute (1046-11-1526)
- 3:00PM **Metric Diophantine approximation for systems of linear forms via homogeneous dynamics.** Preliminary report.
(904) **Dmitry Kleinbock***, Brandeis University, **Gregory Margulis**, Yale University, and **Junbo Wang**, Brandeis University (1046-11-1867)
- 3:30PM **Logarithm laws for horocycles and diophantine approximation.**
(905) **Jayadev Siddhanta Athreya*** and **Grigory Margulis**, Yale University (1046-37-254)

**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 (906) *WeBWork, a Web-based interactive homework system.*
Arnold Pitzer*, Michael Gage, and Vicki Roth, University of Rochester
- 2:00PM (907) *Quantitative reasoning in the contemporary world.*
Bernie Madison*, University of Arkansas, **Caren Diefenderfer**, Hollins University, **Stuart Boersma**, Central Washington University, and **Shannon Dingman**, University of Arkansas
- 2:00PM (908) *Mathematics across the curriculum.*
Carol Hay* and **Jessie Klein**, Middlesex Community College
- 2:00PM (909) *A Phase II expansion of the development of a multidisciplinary course on wavelets and applications.*
Caroline Haddad*, State University of New York College at Geneseo, **Catherine Beneteau**, University of South Florida, **David Ruch**, Metropolitan State College of Denver, and **Patrick Van Fleet**, University of St. Thomas
- 2:00PM (910) *Biocalculus: Text development, dialog, and assessment.*
Timothy Comar*, Lisa Townsley and **Brenda Alberico**, Benedictine University
- 2:00PM (911) *Real world STEM application modules.*
Darren Narayan*, William Basener and **Moises Sudit**, Rochester Institute of Technology
- 2:00PM (912) *Math images.*
Gene Klotz*, Swarthmore College and the Math Forum, and **Stephen Maurer**, Swarthmore College
- 2:00PM (913) *The National Curve Bank.*
Shirley Gray*, California State University, Los Angeles, **Mary Kay Abbey**, Montgomery College, and **Chris Caldwell**, University of Tennessee at Martin
- 2:00PM (914) *A biomathematical learning enhancement network for diversity (BLEND).*
Gregory Goins*, Mingxiang Chen, Dinitra White, Thomas Redd, Dominic Clemence, Mary Smith, and Vinaya Kelkar, North Carolina A&T State University
- 2:00PM (915) *Research-based video for teaching undergraduate proof.*
James Sandefur*, Geoffrey Birky, Georgetown University, **Connie Campbell**, Millsaps College, **Kay Somers**, Moravian College, and **Manya Sundstrom**, Umea University
- 2:00PM (916) *Learning discrete mathematics and computer science via primary historical sources.*
Jerry Lodder* and **David Pengelley**, New Mexico State University
- 2:00PM (917) *The MAA Online Book Project.*
Lawrence Moore* and **David Smith**, Duke University
- 2:00PM (918) *MathDL: The MAA Mathematical Sciences Digital Library.*
Lawrence Moore*, Duke University, and **Roseanne Brown**, Mathematical Association of America
- 2:00PM (919) *Biology and mathematics in population studies (BioMaPS).*
K. Renee Fister, Maeve McCarthy*, Terry Derting, Christopher Mecklin and, Howard Whiteman, Murray State University
- 2:00PM (920) *Experimental mathematics.*
Marc Chamberland, Grinnell College
- 2:00PM (921) *The PascGalois Project: Visualizing abstract mathematics.*
Michael Bardzell*, Kathleen Shannon, and **Donald Spickler**, Salisbury University
- 2:00PM (922) *Undergraduate research projects in complex analysis with accompanying applets.*
Michael Dorff*, Brigham Young University, **Jim Rolf**, U.S. Air Force Academy, **Rich Stankewitz**, Ball State University, **Ken Stephenson**, University of Tennessee, **Mike Brilleslyper**, U.S. Air Force Academy, **Dov Chelst**, ICMA, **Jane McDougall**, Colorado College, and **Beth Schaubroeck**, U.S. Air Force Academy
- 2:00PM (923) *Renewal of college algebra.*
Norma Agras*, Miami Dade College, and **J. Michael Pearson**, Mathematical Association of America
- 2:00PM (924) *Maplets for calculus, tutoring without the tutor.*
Philip Yasskin*, Texas A&M University, and **Douglas Meade**, University of South Carolina
- 2:00PM (925) *Integrating field trips into calculus courses.*
Despina Prapavessi*, Karen Edwards, and **Sam Needham**, Diablo Valley College
- 2:00PM (926) *Center for Women in Mathematics at Smith College.*
Ruth Haas* and **James Henle**, Smith College
- 2:00PM (927) *Long Beach Project in Geometry and Symmetry.*
Scott Crass, California State University, Long Beach
- 2:00PM (928) *Dynamic visualization tools for multivariable calculus.*
Paul Seeburger, Monroe Community College
- 2:00PM (929) *Proofs, functions, & computations: A web-based course as a laboratory for enhanced teaching and learning in logic, mathematics and computer science.*
Wilfried Sieg* and **Alex Smith**, Carnegie Mellon University
- 2:00PM (930) *Contemporary college algebra & the HBCU retreat and follow-on program.*
Don Small*, U.S. Military Academy, and **Laurette Foster**, Prairie View A&M University
- 2:00PM (931) *Sonification for calculus instruction.*
Steven Hetzler* and **Robert Tardiff**, Salisbury University
- 2:00PM (932) *Classroom response systems in statistics courses.*
Teri Murphy*, Curtis McKnight, Michael Richman, and **Robert Terry**, University of Oklahoma
- 2:00PM (933) *Elementary mathematics for teachers.*
Scott Baldridge, Louisiana State University, and **Thomas Parker***, Michigan State University
- 2:00PM (934) *PREP: Professional Enhancement Program.*
J. Michael Pearson, Mathematical Association of America, **Nancy Baxter Hastings**, Dickinson College, **Nathaniel Dean**, Texas State University, San Marcos, **Virginia Buchanan**, Hiram College, and **Jon Scott***, Montgomery College
- 2:00PM (935) *MathQuest: Math questions to engage students.*
Holly Zullo*, Kelly Cline, and **Mark Parker**, Carroll College
- 2:00PM (936) *Beyond Crossroads Workshops.*
Rikki Blair, American Mathematical Association of Two-Year Colleges, and **Robert Farinelli***, College of Southern Maryland
- 2:00PM (937) *Paradigms in physics: Multiple entry points.*
Corinne Manogue, Tevian Dray, **Barbara Edwards**, David McIntyre, Emily van Zee, Oregon State University, and **Aaron Wangberg***, Winona State University

- 2:00PM (938) *Preparing at-risk students for CS1 and calculus.*
John Lusth, University of Alabama Tuscaloosa
- 2:00PM (939) *College algebra in context: A learner-centered approach incorporating data-driven activities related to social issues.*
Michael Catalano, Dakota Wesleyan University
- 2:00PM (940) *SyBR-U: Synthetic biology research for undergraduates.*
Laurie Heyer*, Davidson College, **Jeffrey Poet**, Missouri Western State University, **A. Malcolm Campbell**, Davidson College, and **Todd Eckdahl**, Missouri Western State University
- 2:00PM (941) *Mathematics across the community college curriculum: A national quantitative literacy initiative.*
Jim Roznowski*, Delta College, and **Christie Gilliland**, Green River Community College
- 2:00PM (942) *Math biology research at UNCG.*
Jan Rychtar*, **M. Chhetri**, **S. Gupta**, **D. Remington**, **O. Rueppell**, and **M. Crowe**, University of North Carolina Greensboro
- 2:00PM (943) *Supplying undergraduate biology and mathematics education and research group experiences to students at the University of Michigan.*
Patrick Nelson*, **John Schiefelbein**, and **Trachette Jackson**, University of Michigan
- 2:00PM (944) *Understanding the formation of the arabidopsis root epidermis through an intimate collaboration between modeling and experiment.*
Luay Almassalha, **Asha Radhamohan**, **Andrew Cheng**, **David Gammack**, **Stephen Gao**, **Patrick Nelson**, **Yana Panciera**, and **John Schiefelbein***, University of Michigan
- 2:00PM (945) *Dynamic analysis of bactericidal activity in patients with severe sepsis.*
Moli Yin, **Alex Jacobsen**, **Nick Streicher**, **Patrick Nelson**, and **John Younger***, University of Michigan
- 2:00PM (946) *The next step: Integrating STEM learning communities.*
Jason Miller, Truman State University
- 2:00PM (947) *Research-focused Learning Communities in Mathematical Biology.*
Jason Miller*, **Jon Beck**, **Michael Kelrick**, and **Laura Rechav-Fielden**, Truman State University
- 2:00PM (948) *Discrete mathematics in computing education.*
David Klappholz, Stevens Institute of Technology
- 2:00PM (949) *Appropriately using WeBWork, WebAssign and Maple in calculus I and II. Preliminary report.*
Jeffrey Stuart*, **Bryan Dorner**, **Daniel Heath**, and **Jessica Sklar**, Pacific Lutheran University
- 2:00PM (950) *Research and education program in biology and ecology.*
Semen Koksai*, **Jan Varada**, **Adam Hernandez**, **Robert van Woesik**, **David Carroll**, **Richard Sinden**, and **Jewgeni Dshalalow**, Florida Institute of Technology
- 2:00PM (951) *A model teacher-scholar program in secondary mathematics.*
Saad El-Zanati, **David Barker**, **Cynthia Langrall**, **Sharon McCrone**, and **Wendy O'Hanlon***, Illinois State University
- 2:00PM (952) *REU Site: Mathematics research experience for pre-service and for in-service teachers.*
Saad El-Zanati, **David Barker***, **Cynthia Langrall**, **Sharon McCrone**, and **Wendy O'Hanlon**, Illinois State University

AMS Invited Address

2:15 PM – 3:05 PM

- (953) *Unearthing the visions of a master: The web of Ramanujan's mock theta functions.*
Ken Ono, University of Wisconsin-Madison (1046-11-07)

AMS Committee on the Profession Panel Discussion

2:30 PM – 4:00 PM

What I wish I had known or studied before going to graduate school.

- Moderator: **Craig L. Huneke**, University of Kansas
Panelists: **Raegen Higgins**, Texas Tech University
Manoj Kummini, Purdue University
Aaron D. Magid, University of Michigan
Marion Moore, University of California Davis
Andrew Niedermaier, University of California San Diego
Roger A. Wiegand, University of Nebraska-Lincoln

SIGMAA on Statistics Education and ASA-MAA Joint Committee on Statistics Panel Discussion

2:30 PM – 3:50 PM

Hiring, tenuring, and promoting statisticians in a mathematics or mathematical sciences department.

- Organizers: **Patricia B. Humphrey**, Georgia Southern University
Chris J. Lacke, Rowan University
Michael A. Posner, Villanova University
Robin H. Lock, St. Lawrence University
Moderator: **Carolyn K. Cuff**, Westminster College
Panelists: **Patti Frazer Lock**, St. Lawrence University
Douglas E. Norton, Villanova University
Lila F. Roberts, Georgia College & State University and Clayton State University

MAA Committee on the Teaching of Undergraduate Mathematics Panel Discussion

2:30 PM – 3:50 PM

Online homework systems: A pedagogical prospective.

- Organizers: **Ellen E. Kirkman**, Wake Forest University
Cheryl Miner, Nebraska Wesleyan University
Panelists: **Andrew G. Bennett**, Kansas State University
Ellen E. Kirkman
P. Gavin LaRose, University of Michigan

MAA Special Film Presentation

3:00 PM – 4:00 PM

The story of maths (Part I).

Presenter: **Robin Wilson**, The Open University

AMS Invited Address

3:20 PM – 4:10 PM

(954) *Categorification of quantum groups and link invariants.*

Mikhail Khovanov, Columbia University
(1046-81-08)

Joint Prize Session

4:25 PM – 5:25 PM

Joint Prize Session Reception

5:30 PM – 6:30 PM

SIGMAA on Quantitative Literacy Business Meeting

5:45 PM – 7:15 PM

SIGMAA on Statistics Education Business Meeting

5:45 PM – 7:15 PM

Web SIGMAA Business Meeting and Reception

5:45 PM – 7:15 PM

MAA Two-Year College Reception

5:45 PM – 7:30 PM

MAA Reunion of College Algebra Workshops Participants

6:00 PM – 8:00 PM

Organizers: **Donald B. Small**, U. S. Military Academy
William E. Haver, Virginia Commonwealth University

SIGMAA on Mathematical and Computational Biology Business Meeting and Reception

6:00 PM – 7:00 PM

SIGMAA on Research in Undergraduate Mathematics Education Business Meeting

6:00 PM – 7:30 PM

MAA Special Dramatic Presentation

6:00 PM – 7:30 PM

Lewis Carroll in Numberland

Presenter: **Robin Wilson**, The Open University

SIGMAA on Mathematics and the Arts Business Meeting

7:00 PM – 8:00 PM

Young Mathematicians' Network Town Meeting

7:30 PM – 8:30 PM

Organizer: **Sarah Ann Stewart**, Belmont University

Moderator: **Joshua D. Laison**, Willamette University

Wednesday, January 7

Joint Meetings Registration

7:30 AM – 4:00 PM

AMS Special Session on Continued Fractions, I

7:30 AM – 10:50 AM

Organizers: **James G. McLaughlin**, West Chester University

Nancy J. Wyshinski, Trinity College

7:30AM *Some of Ramanujan's continued fraction identities - How and why.*

► (955) **Lisa Lorentzen**, Norwegian University of Science and Technology (1046-40-1049)

8:00AM *Vertical symmetries in continued fraction periods.*

► (956) Preliminary report.
Richard K. Guy*, The University of Calgary, **Kell Cheng**, Hong Kong Institute of Education, and **Renate Scheidler**, The University of Calgary (1046-11-1264)

8:30AM *Some relations between orthogonal L-polynomials and orthogonal polynomials.*

(957) **A. Sri Ranga***, **Regina da Silva Lamblém**, and **Heron Martins Felix**, Universidade Estadual Paulista (1046-33-1328)

9:00AM *On a thermodynamic classification for real numbers.* Preliminary report.

► (958) **Thomas Garrity**, Williams College (1046-11-858)

9:30AM *Polynomials that take small values at an algebraic integer.* Preliminary report.

► (959) **Doug Hensley**, Texas A&M University (1046-11-1738)

10:00AM *Quadratics, continued fractions and divided cells.*

(960) Preliminary report.
Richard T. Bumby*, Rutgers, the State University of New Jersey, and **Mary E. Flahive**, Oregon State University (1046-11-832)

10:30AM *Applying the divided cell algorithm.* Preliminary report.

(961) **Mary E. Flahive***, Oregon State University, and **Richard T. Bumby**, Rutgers, the State University of New Jersey (1046-11-750)

ASL Invited Address

8:00 AM – 8:50 AM

(962) *Jet spaces and the Zilber dichotomy.*
Rahim Moosa, University of Waterloo
(1046-03-107)

AMS-MAA-SIAM Special Session on Research in Mathematics by Undergraduates, IV

8:00 AM – 10:50 AM

Organizers: **Darren A. Narayan**, Rochester Institute of Technology

Jacqueline A. Jensen, Sam Houston State University
Carl V. Lutzer, Rochester Institute of Technology
Vadim Ponomarenko, San Diego State University
Tamas Wiandt, Rochester Institute of Technology

- 8:00AM ▶ (963) *Least perimeter partitions of the sphere into equal areas.*
Max D. Engelstein, Yale University (1046-51-611)
- 8:25AM ▶ (964) *Coloring graphs.* Preliminary report.
Nora Youngs*, **Carolyn Gardner**, **Marissa Neal**, **Yoshi Merrybird**, and **Agnieszka Rec**, Smith College (1046-05-997)
- 8:50AM ▶ (965) *Maximally non-matching covered graphs.*
Timothy B. Muller* and **Kimberly Jordan Burch**, Indiana University of Pennsylvania (1046-05-475)
- 9:15AM ▶ (966) *Vector coloring.*
Gerald S. Haynes, Central Michigan University (1046-05-84)
- 9:40AM ▶ (967) *The relaxed coloring game on certain classes of trees.* Preliminary report.
Lynnette Snyder, Simpson College (1046-05-159)
- 10:05AM ▶ (968) *A tree with maximum degree three and game chromatic number four.* Preliminary report.
Victor O. Larsen, Middlebury College (1046-05-155)
- 10:30AM ▶ (969) *Multilevel and multidimensional Hadamard matrices.*
Matthew Crawford*, **Caitlin Greeley**, **Bryce Lee**, Franklin W. Olin College of Engineering, **Mathav Kishore Murugan**, Indian Institute of Technology Kharagpur, and **Sarah Spence Adams**, Franklin W. Olin College of Engineering (1046-05-859)

AMS-MAA-MER Special Session on Mathematics and Education Reform, III

8:00 AM – 10:50 AM

Organizers: **William H. Barker**, Bowdoin College
William G. McCallum, University of Arizona
Bonnie S. Saunders, University of Illinois at Chicago

- 8:00AM ▶ (970) *Math as exploration.* Preliminary report.
Scott Crass, CSU, Long Beach (1046-97-876)
- 8:30AM ▶ (971) *Geometry is natural.* Preliminary report.
David W. Henderson, Cornell University (1046-51-963)
- 9:00AM ▶ (972) *Discrete, combinatorial, and computational geometry for undergraduates.*
Joseph Malkevitch, York College (CUNY) (1046-97-848)
- 9:30AM ▶ (973) *A course in axiomatic geometry.*
Gerard A. Venema, Calvin College, MAA (1046-97-1598)
- 10:00AM ▶ (974) *Teaching the Erlanger Program.*
Roger Howe*, Yale University, and **William Barker**, Bowdoin College (1046-51-1534)
- 10:30AM ▶ (975) *Panel on teaching undergraduate geometry: Choices in philosophy, content, and pedagogy.*
William Barker, Bowdoin College (1046-97-1874)

AMS-MAA Special Session on History of Mathematics, I

8:00 AM – 10:55 AM

Organizers: **Joseph W. Dauben**, Lehman College

Karen H. Parshall, University of Virginia
Patti Hunter, Westmont College
Deborah Kent, Hillsdale College

- 8:00AM ▶ (976) *Mathematics in medieval India: The Bījagaṇita of Jñānarāja.*
Toke Lindegaard Knudsen, SUNY Oneonta (1046-01-739)
- 8:30AM ▶ (977) *Trigonometry on the edge: Interpolation in ancient and medieval astronomy.*
Glen R. Van Brummelen, Quest University (1046-01-299)
- 9:00AM ▶ (978) *A medieval Muslim mathematician looks at Indian arithmetic: Al-Biruni's treatise on Sanskrit rules of proportion.*
Kim Plofker, Union College (1046-01-690)
- 9:30AM ▶ (979) *The early years of Gresham College, London.*
Robin Wilson, The Open University, UK (1046-01-609)
- 10:00AM ▶ (980) *Leibniz and the two problems of Méré.*
Maria Sol de Mora, University of the Basque Country UPV/EHU (1046-01-345)
- 10:30AM ▶ (981) *The prehistory of the Cauchy-Riemann equations.* Preliminary report.
Craig Fraser, University of Toronto (1046-01-367)

AMS-MAA Special Session on The Scholarship of Teaching and Learning, II

8:00 AM – 10:50 AM

Organizers: **Curtis D. Bennett**, Loyola Marymount University
Jacqueline M. Dewar, Loyola Marymount University

- 8:00AM ▶ (982) *Teaching math majors how to teach.*
Yvonne Lai*, University of Michigan, Ann Harbor, **Hillel M. Raz** and **Marion Moore**, University of California Davis (1046-97-1880)
- 8:30AM ▶ (983) *Teacher-scholars: Research experiences for pre-service and in-service secondary mathematics teachers.* Preliminary report.
David Barker and **Saad I. El-Zanati***, Illinois State University (1046-97-1553)
- 9:00AM ▶ (984) *Teaching students to be life-long learners of mathematics: Algebra I and Mathematics for Mathematics Education doctoral students.*
Daniel I. Chazan, University of Maryland, Center for Mathematics Education (1046-97-1249)
- 9:30AM ▶ (985) *Mathematics + SENCER = Student Learning.*
Mariah Birgen, Wartburg College (1046-97-938)
- 10:00AM ▶ (986) *Teaching introductory statistics with community based group projects and assessing with the SENCER-SALG.*
Cindy C. Kaus, Metropolitan State University, Saint Paul, MN (1046-97-789)
- 10:30AM ▶ (987) *Mathematical and statistical reasoning in compelling contexts.*
David L. Ferguson, Stony Brook University (1046-97-1431)

AMS Special Session on Representation Theory of Lie Algebras and Algebraic Groups, II

8:00 AM – 10:50 AM

Organizers: **David G. Taylor**, Roanoke College
Terrell L. Hodge, Western Michigan University

Daniel K. Nakano, University of Georgia

- 8:00AM (988) *Induced modules for Affine Kac-Moody algebras.* Preliminary report. **Vyacheslav Futorny*** and **Iryna Kashuba**, University of Sao Paulo (1046-17-523)
- 8:30AM (989) *Type Q Lie superalgebras and degenerate affine Sergeev algebras.* **David Hill***, University of California, Berkeley, **Jon Kujawa**, University of Oklahoma, and **Josh Sussan**, University of California, Berkeley (1046-20-92)
- 9:00AM (990) *Representations of Lie superalgebras in prime characteristic.* **Lei Zhao*** and **Weiqiang Wang**, University of Virginia (1046-17-798)
- 9:30AM (991) *Motzkin algebras and $sl(2)$.* **Georgia Benkart***, University of Wisconsin-Madison, and **Tom Halverson**, Macalester College (1046-05-820)
- 10:00AM (992) *Normality of enhanced nilpotent orbit closures.* Preliminary report. **Benjamin F. Jones**, University of Georgia (1046-22-1233)
- 10:30AM (993) *Cohomology and support varieties for Cartan Lie superalgebras.* **Irfan Bagci**, The University of Georgia (1046-17-952)

AMS Special Session on Homotopy Theory and Higher Categories, I

8:00 AM – 10:50 AM

Organizers: **Thomas M. Fiore**, University of Chicago
Mark W. Johnson, Penn State Altoona
James M. Turner, Calvin College
W. Stephen Wilson, Johns Hopkins University
Donald Yau, Ohio State University at Newark

- 8:00AM (994) *Stable splitting of generalized moment-angle complexes.* **A. Bahri**, Rider University, **M. Bendersky***, Hunter College, **F. Cohen**, University of Rochester, and **S. Gitler**, Cinvestav (1046-55-655)
- 8:30AM (995) *Connective K -theory of certain symmetric groups.* **Son P. Nguyen**, Wayne State University (1046-55-158)
- 9:00AM (996) *The $RO(G)$ -graded Serre spectral sequence.* **William C. Kronholm**, Swarthmore College (1046-55-563)
- 9:30AM (997) *Some properties of the ν_1 -periodic spectra associated to exceptional Lie groups.* **Xiaoxue H. Li**, Emory & Henry College (1046-55-135)
- 10:00AM (998) *New developments in the topology of representation spaces.* **Daniel A. Ramras**, Vanderbilt University (1046-55-807)
- 10:30AM (999) *Differentials in homotopy fixed point spectral sequences.* **Michael A. Hill***, University of Virginia, **Michael J. Hopkins**, Harvard University, and **Douglas C. Ravenel**, University of Rochester (1046-55-1595)

AMS Special Session on Financial Mathematics, I

8:00 AM – 10:50 AM

- Organizers: **Erhan Bayraktar**, University of Michigan
Tim Siu-Tang Leung, Johns Hopkins University
Birgit Rudloff, Princeton University
- 8:00AM (1000) *Portfolio choice under space-time monotone performance criteria.* **Thaleia Zariphopoulou***, The University of Texas at Austin, and **Marek Musiela**, BNP Paribas, London (1046-35-2087)
- 9:00AM (1001) *Utility maximization under risk constraints.* **Birgit Rudloff***, Princeton University, **Joern Sass**, RICAM, and **Ralf Wunderlich**, Zwickau University of Applied Sciences (1046-60-1743)
- 9:30AM (1002) *A note on the existence of the power investor's optimizer.* **Kasper Larsen**, Carnegie Mellon University (1046-91-512)
- 10:00AM (1003) *Incorporating risk aversion and model uncertainty into structural models of default.* **Sebastian Jaimungal*** and **Georg Sigloch**, University of Toronto (1046-60-1210)
- 10:30AM Discussion

AMS Special Session on Dynamical Systems and Differential Equations: Theory and Applications, I

8:00 AM – 10:50 AM

- Organizers: **Annalisa Crannell**, Franklin & Marshall College
Suzanne Sindi, Brown University
- 8:00AM (1004) *Quasicontinuous functions in dynamical systems.* **Annalisa Crannell**, Franklin & Marshall College (1046-37-116)
- 8:30AM (1005) *Some results in metric trees.* **Asuman G. Aksoy**, Claremont McKenna College (1046-47-37)
- 9:00AM (1006) *Global stability with Dulac functions.* **Marc Chamberland**, Grinnell College (1046-34-713)
- 9:30AM (1007) *On the dynamics and control of drinking: The role of control theory in combating relapse and other factors.* **Carlos Castillo-Chavez***, Arizona State University, **Eunok Jung**, and **Sunmi Lee**, Konkuk University (1046-92-1934)
- 10:00AM (1008) *Solution sets for differential equations.* **Jerrold Bebernes**, University of Colorado-Boulder (1046-35-872)
- 10:30AM (1009) *Periodic difference equations with Allee effects: Applications to economics and biology.* Preliminary report. **Saber N. Elaydi**, Trinity University (1046-39-1864)

AMS Special Session on Harmonic Analysis, II

8:00 AM – 10:50 AM

- Organizers: **Paul A. Hagelstein**, Baylor University
Alexander M. Stokolos, DePaul University
- 8:00AM (1010) *Almost everywhere convergence of a case of weighted averages.* Preliminary report. **Anna K. Savvopoulou*** and **Karin Reinhold**, SUNY Albany (1046-37-526)

- 8:30AM (1011) *The regularity problem for the Lamé system of elastostatics on curvilinear polygons in two dimensions.* Preliminary report.
Katharine Ott*, University of Kentucky, **Irinia Mitrea**, University of Virginia, and **Warwick Tucker**, University of Bergen (1046-35-773)
- 9:00AM (1012) *Geometric configurations in Euclidean space and restriction theory.*
Alex Iosevich, University of Missouri (1046-42-2096)
- 9:30AM (1013) *Maximal multipliers in L^p .*
Ciprian Demeter, Indiana University, Bloomington (1046-42-1290)
- 10:00AM (1014) *Critical integrability exponent associated to multivariate polynomials.*
Tristan Collins and **Malabika Pramanik***, University of British Columbia, Vancouver (1046-42-1120)
- 10:30AM (1015) *Sharp weighted bounds for fractional operators.*
Kabe Moen, University of Kansas, Lawrence, Kansas, **Carlos Pérez**, University of Seville, Spain, and **Rodolfo H. Torres***, University of Kansas, Lawrence (1046-42-934)

AMS Special Session on Automorphic and Modular Forms in Number Theory, III

8:00 AM – 10:50 AM

Organizers: **Ken Ono**, University of Wisconsin-Madison
Amanda Folsom, University of Wisconsin-Madison
Sharon A. Garthwaite, Bucknell University

- 8:00AM Discussion
- 8:30AM (1016) *Holomorphic parts of weak harmonic Maass forms and Eichler cohomology.*
Pavel Guerzhoy, University of Hawaii at Manoa (1046-11-1175)
- 9:00AM (1017) *Traces of Hecke operators in level 1 and Gaussian hypergeometric functions.*
Jenny G. Fuselier, United States Military Academy (1046-11-878)
- 9:30AM (1018) *Non-harmonic weak Maass forms and arithmetic geometry.* Preliminary report.
Riad Masri* and **Amanda Folsom**, University of Wisconsin-Madison (1046-11-804)
- 10:00AM (1019) *A p -adic supercongruence conjecture of Van Hamme.*
Eric Mortenson, Pennsylvania State University (1046-11-2030)
- 10:30AM (1020) *The second moment of quadratic twists of a modular L -function.*
Matthew P. Young*, Texas A&M University, and **K. Soundararajan**, Stanford University (1046-11-781)

AMS Special Session on Computational Algebra and Convexity, I

8:00 AM – 10:50 AM

Organizers: **Dan Bates**, Colorado State University
Tsung-Lin Lee, Michigan State University
Sonja Petrovic, University of Illinois at Chicago
Zach Teitler, Texas A&M University

- 8:00AM (1021) *How to draw tropical planes.*
Sven Hermann, TU Darmstadt, **Anders Jensen**, U Göttingen, **Michael Joswig**, TU Darmstadt, and **Bernd Sturmfels***, UC Berkeley (1046-05-394)
- 8:30AM (1022) *Tropical implicitization and mixed fiber polytopes.*
Bernd Sturmfels, University of California, Berkeley, and **Josephine Yu***, Massachusetts Institute of Technology (1046-13-1502)
- 9:00AM (1023) *A tropical approach to rational curves on general hypersurfaces in \mathbb{P}^3 .*
Tristram C. Bogart, Queen's University (1046-14-1410)
- 9:30AM (1024) *Experimentation at the frontier of reality in Schubert calculus.* Preliminary report.
Frank Sottile, Texas A&M University (1046-14-578)
- 10:00AM (1025) *Geometrical aspects of control points for toric patches.* Preliminary report.
Luis D. Garcia-Puente*, Sam Houston State University, and **Frank Sottile**, Texas A&M University (1046-14-332)
- 10:30AM (1026) *Asymptotic regularity: Are we almost at infinity yet?* Preliminary report.
David Eisenbud*, University of California, Berkeley, and **Bernd Ulrich**, Purdue University (1046-14-524)

AMS Session on Numerical Analysis, I

8:00 AM – 10:55 AM

- 8:00AM (1027) *Constraint preconditioning for nonsymmetric indefinite linear systems.*
Liying Sun, Guangdong Education Institute (1046-65-32)
- 8:15AM (1028) *A numerical method for fast integration.* Preliminary report.
Natasha A. Cayco Gajic*, Caltech, **Nathan Kallus**, UC Berkeley, and **Jessica L. Stigile**, Washington University (1046-65-57)
- 8:30AM (1029) *Numerical solutions of boundary inverse problems for the Laplace equation.*
Weifu Fang, Wright State University, and **Suxing Zeng***, West Virginia University (1046-65-132)
- 8:45AM (1030) *Application of splitting techniques in numerical models for a hydrostatic atmosphere.*
Andrei Bourchtein* and **Ludmila Bourchtein**, Pelotas State University (1046-65-189)
- 9:00AM (1031) *Adaptive quad-tree surface representation for 3-D vortex rings motion and collision.*
Leon Kaganovskiy*, New College of Florida, **Robert Krasny**, University of Michigan, and **Feng Hualong**, Huaihai Institute of Technology, Lianyungang, China (1046-65-73)
- 9:15AM Break
- 9:30AM (1032) *Optimal kernel via an estimate to the eigenvalues of kernel matrices.*
Guohui Song, Syracuse University (1046-65-896)
- 9:45AM (1033) *A system of bilinear immersed finite elements.*
Xiaoming He*, **Tao Lin**, Virginia Tech, and **Yanping Lin**, University of Alberta (1046-65-795)
- 10:00AM (1034) *GMRES algorithm in the meshless generalized finite difference method for human carotid atherosclerotic plaque progression simulation.* Preliminary report.
Peng Ni*, **Homer Walker**, Worcester Polytechnic Institute, **Chun Yang**, Beijing Normal University, and **Dalin Tang**, Worcester Polytechnic Institute (1046-65-352)

- 10:15AM *Convergence analysis of mixed LDG methods applied to 2-D singularly perturbed problems.*
(1035) **Zhimin Zhang** and **Huiqing Zhu***, Wayne State University (1046-65-353)
- 10:30AM *Spline wavelets, finite element wavelets, and wavelets with composite dilation.* Preliminary report.
(1036) **Tian-Xiao He**, Illinois Wesleyan University (1046-65-1000)
- 10:45AM *Mathematical modeling and numerical simulations of cell signaling pathways.*
(1037) **Xinfeng Liu***, **Nie Qing**, University of California at Irvine, and **Lee Bardwell**, UC Irvine (1046-65-1320)

AMS Session on Commutative Rings and Algebras

8:00 AM – 10:55 AM

- 8:00AM *The core of points and the Cayley-Bacharach Property.*
(1038) **Louiza Fouli***, University of Texas, Austin, **Claudia Polini**, University of Notre Dame, and **Bernd Ulrich**, Purdue University (1046-13-271)
- 8:15AM *The local case sub-algorithm for Suslin's stability theorem.* Preliminary report.
(1039) **Cynthia J. Woodburn**, Pittsburg State University (1046-13-1075)
- 8:30AM *The Gorenstein property for coherent rings.*
(1040) **Livia Hummel***, University of Indianapolis, and **Thomas Marley**, University of Nebraska-Lincoln (1046-13-1197)
- 8:45AM *Uniqueness of minimal acyclic complexes.* Preliminary report.
(1041) **Meri T. Florence**, TX (1046-13-1319)
- 9:00AM *Negligibility of automorphisms of polynomial rings and other mathematical structures.* Preliminary report.
(1042) **Mowaffaq Hajja**, Yarmouk University (1046-13-1327)
- 9:15AM *The core of monomial ideals in $K[x, y]$.*
▶ (1043) **Bonnie B. Smith**, University of Notre Dame (1046-13-297)
- 9:30AM *Zero-sum sequence designs.* Preliminary report.
(1044) **Michael A. Freeze**, University of North Carolina Wilmington (1046-13-1914)
- 9:45AM *Generalized Gröbner basis method for computing multivariate Hilbert polynomials.*
(1045) **Alexander B. Levin**, The Catholic University of America (1046-13-787)
- 10:00AM *Square-free monomial ideals associated to Ferrers graphs.*
(1046) **Rachelle Renee Bouchat**, Slippery Rock University (1046-13-1493)
- 10:15AM *Goto numbers in a numerical semigroup ring.*
(1047) **Lance Bryant**, Purdue University (1046-13-1557)
- 10:30AM *Initial algebra of multiplicative invariants.*
(1048) **Mohammed S. Tesemma**, Spelman College (1046-13-1810)
- 10:45AM *Existence of totally reflexive modules.* Preliminary report.
(1049) **Kristen A. Beck**, The University of Texas at Arlington (1046-13-1829)

AMS Session on Linear Algebra and Matrix Theory

8:00 AM – 10:55 AM

- 8:00AM *Chordal supergraphs and minimum semidefinite rank.*
(1050) **Lon H. Mitchell**, Virginia Commonwealth University (1046-15-85)

- 8:15AM *The skew spectrum of an oriented tree.* Preliminary report.
▶ (1051) **Wasin So**, San Jose State University (1046-15-200)
- 8:30AM *GCD and LCM matrices on factor closed sets defined over principal ideal domains.*
▶ (1052) **Abdel Nasser El-Kassar***, **Samer S. Habre**, Lebanese American University, and **Yehia Awad**, Lebanese International University (1046-15-440)
- 8:45AM *Minimum rank of looped graphs with cut vertices.*
(1053) **Rana Mikkelsen**, Iowa State University (1046-15-1403)
- 9:00AM *Traces of matrix products.* Preliminary report.
▶ (1054) **John R. Greene**, University of Minnesota Duluth (1046-15-1404)
- 9:15AM *An associative multiplication for multidimensional matrices.* Preliminary report.
▶ (1055) **Paul A. Sundheim**, University of Wisconsin (1046-15-141)
- 9:30AM *A higher-order generalization of the matrix SVD as a product of higher-order tensors.* Preliminary report.
▶ (1056) **Carla D. Martin***, James Madison University, **Misha E. Kilmer**, Tufts University, and **Lisa Perrone**, Hawaii Pacific University (1046-15-1520)
- 9:45AM *Complex spectrally arbitrary zero-nonzero patterns whose Jacobian is zero at every nilpotent realization.*
(1057) **Amy Ann Yielding*** and **Judith J. McDonald**, Washington State University (1046-15-1409)
- 10:00AM *Diagonal and D convergence of matrices.*
(1058) **Olga Pryporova**, Iowa State University (1046-15-1455)
- 10:15AM *Roots of polynomials and linear programming.* Preliminary report.
(1059) **Carla Fidalgo***, Coimbra Institute of Engineering, Portugal, and **Alexander Kovacec**, University of Coimbra (1046-15-1746)
- 10:30AM *Linear maps preserving diagonalizability on the space of upper triangular matrices.* Preliminary report.
(1060) **A. A. Jafarian**, University of New Haven (1046-15-1831)
- 10:45AM *On the structure of some classes of invariant kernels.* Preliminary report.
(1061) **Troy Banks**, Salisbury University (1046-15-1998)

AMS Session on Partial Differential Equations, III

8:00 AM – 10:55 AM

- 8:00AM *Local fields in nonlinear power law materials.*
(1062) **Silvia Jimenez*** and **Robert Lipton**, Louisiana State University (1046-35-203)
- 8:15AM *Differential forms with mixed boundary conditions.*
(1063) **Tunde Jakab***, **Irina Mitrea**, University of Virginia, and **Marius Mitrea**, University of Missouri-Columbia (1046-35-209)
- 8:30AM *Modeling and computation of buoyant flow during alloy solidification.* Preliminary report.
(1064) **Dambaru Bhatta***, The University of Texas-Pan American, **M. Mallikarjunaiah** and **Daniel Riahi**, The University of Texas-Pan American (1046-35-581)
- 8:45AM *On the uniqueness of invariant measures for the stochastic infinite Darcy-Prandtl number model.*
(1065) **Rana Durga Parshad*** and **Xiaoming Wang**, Florida State University (1046-35-693)

- 9:00AM (1066) *A global existence theorem for the Navier-Stokes equations.*
Guy Bernard, Midwestern State University (1046-35-729)
- 9:15AM (1067) *Precise estimates for the subelliptic heat kernel on H -type groups.*
Nathaniel Eldredge, University of California, San Diego (1046-35-439)
- 9:30AM Break
- 9:45AM (1068) *A uniqueness result for equations modeling the flow of a viscous, barotropic fluid under periodic boundary conditions.* Preliminary report.
Diane Denny, Texas A&M University-Corpus Christi (1046-35-1129)
- 10:00AM (1069) *Nonlinear boundary value problem of the meniscus for the terrestrial dewetted Bridgman crystal growth technique.*
Liliana Braescu, West University of Timisoara, Romania (1046-35-771)
- 10:15AM (1070) *A lower bound for principal eigenvalues in parabola-shaped regions.*
Zhiren Jin, Wichita State University (1046-35-828)
- 10:30AM (1071) *Explicit construction of a robust family of compact inertial manifolds.*
Joseph L. Shomberg, Providence College (1046-35-1005)
- 10:45AM (1072) *First order compatibility of the cubic Schrodinger equation.*
Daniel J. Arrigo*, **David A. Ekrut** and **Jackson R. Fliess**, University of Central Arkansas (1046-35-1109)

AMS Session on Dynamical Systems and Ergodic Theory, II

8:00 AM – 10:55 AM

- 8:00AM (1073) *Symbolic dynamics for topological hyperbolic maps.*
David Richeson, Dickinson College, and **Jim Wiseman***, Agnes Scott College (1046-37-1361)
- 8:15AM (1074) *Long time error estimate using contraction properties of the Huxley's equation.*
Champikey Attanayake, Miami University (1046-37-1594)
- 8:30AM (1075) *Centralizers in the interval exchange group.*
Christopher F. Novak, University of Michigan-Dearborn (1046-37-1665)
- 8:45AM (1076) *A chaotic day at the beach.* Preliminary report.
L. Loizou*, **M. Dankwa**, **J. Herbut-Hewell**, and **J. C. Ortega**, James Madison (1046-37-1821)
- 9:00AM (1077) *The generalized Gauss transformation.*
Santanu Chakraborty, University of Texas - Pan American (1046-37-1886)
- 9:15AM (1078) *Fixed point shifts of inert involutions.*
Nicholas E. Long, Stephen F. Austin State University (1046-37-1664)
- 9:30AM (1079) *Imaginary circle inversions and Sierpinski carpets.* Preliminary report.
Daniel M. Look, Williams College (1046-37-1389)
- 9:45AM (1080) *Configuration spaces in phyllotaxis.* Preliminary report.
Cordelia McGehee*, **Christophe Golé**, **Gillian Riggs**, Smith College, and **Samantha Oestreicher**, University of Minnesota (1046-37-1937)
- 10:00AM (1081) *Pointwise convergence of ergodic averages in Orlicz spaces.*
Andrew J. N. Parrish, University of Memphis (1046-37-1983)

- 10:15AM (1082) *On the dynamics of non-linear tent-maps.* Preliminary report.
Zachary Flores* and **Oumarou Njoya**, Michigan State University (1046-37-1992)
- 10:30AM (1083) *Scaling law for a global bifurcation.*
Cecilia I. Gonzalez Tokman* and **Brian R. Hunt**, University of Maryland (1046-37-2029)
- 10:45AM (1084) *Nonsmoothable locally indicable group actions on the interval.*
Danny Calegari, California Institute of Technology (1046-37-2080)

MAA Session on Mathematics Experiences in Business, Industry, and Government

8:00 AM – 10:55 AM

- Organizers: **Philip Gustafson**, Mesa State College
Michael Monticino, University of North Texas
- 8:00AM (1085) *The Doppler Effect in radar as a source of mathematics.*
John E. Gray, U. S. Navy (1046-M1-1671)
- 8:15AM (1086) *Mathematical surface modeling problems in industry.*
Edmond Nadler, Eastern Michigan University (1046-M1-1556)
- 8:30AM (1087) *Dynamical systems modeling for Iraq.* Preliminary report.
William P. Fox, Naval Postgraduate School (1046-M1-1230)
- 8:45AM (1088) *Automated torpedo classification and alerting using Bayesian methods.*
Joni E. Baker*, **C. Allen Butler**, **W. Reynolds Monach**, and **Thomas R. McSherry**, Daniel H. Wagner Associates (1046-M1-1805)
- 9:00AM (1089) *Least cost check routing.* Preliminary report.
Michael G. Monticino, University of North Texas (1046-M1-559)
- 9:15AM (1090) *Using mathematics in industry.*
James P. Ochoa, Metron, Inc. (1046-M1-1487)
- 9:30AM (1091) *A short B.I.G. introduction to Sage.*
David Joyner, U.S. Naval Academy (1046-M1-757)
- 9:45AM (1092) *A mathematical consideration of the rule of three.* Preliminary report.
Paul H. Schuette, FDA (1046-M1-973)
- 10:00AM (1093) *Reliability as a field in aerospace: A NASA application.*
Richard D. Jarvinen, Winona State University (1046-M1-667)
- 10:15AM (1094) *A measure of inter-rater reliability when one rater is rating on a continuous scale.*
James H. Fife, Educational Testing Service (1046-M1-1682)
- 10:30AM (1095) *Effective use of controls in the clinical laboratory: Analysis of traditional and new algorithms.*
George V. Woodrow III, River Vale, New Jersey (1046-M1-443)
- 10:45AM (1096) *Determining an optimal search area for a serial criminal.*
Mike P. O'Leary, Towson University (1046-M1-1312)

MAA Session on Mathlets for Teaching and Learning Mathematics

8:00 AM – 10:55 AM

Organizers: **Thomas E. Leathrum**, Jacksonville State University

David M. Strong, Pepperdine University

Joe Yanik, Emporia University

- 8:00AM ▶ (1097) *How fit is your model? Interactive data fitting in Excel.* Preliminary report.
Eugene Belogay, Wilkes Honors College, Florida Atlantic University (1046-O1-1876)
- 8:20AM ▶ (1098) *Statlets: Statistics applets and activities.*
Kady Schneider, Utah State University (1046-O1-1819)
- 8:40AM ▶ (1099) *Mathlets for continuous and discrete dynamical systems.* Preliminary report.
Robert J. Decker, University of Hartford (1046-O1-1153)
- 9:00AM ▶ (1100) *Making calculus come alive with dynamic visualization tools.* Preliminary report.
Paul Seeburger, Monroe Community College (1046-O1-913)
- 9:20AM ▶ (1101) *Java mathlets with Blaise.* Preliminary report.
Elisha Peterson, United States Military Academy (1046-O1-1377)
- 9:40AM ▶ (1102) *Fractal applets in Flash.*
Daniel Gries, Hamilton College (1046-O1-487)
- 10:00AM ▶ (1103) *Toy proofs.* Preliminary report.
Kenneth G. Monks*, University of Scranton, and **Nathan C. Carter**, Bentley College (1046-O1-1261)
- 10:20AM ▶ (1104) *A Flash application illustrating Napier's bones.*
Michael J. Caulfield, Gannon University (1046-O1-346)
- 10:40AM ▶ (1105) *A maplet for encoding, decoding, and correcting errors in Golay codes.* Preliminary report.
Rick Klima, Appalachian State University (1046-O1-392)

MAA Session on Productive Roles for Math Faculty in the Professional Development of K-12 Teachers, II

8:00 AM – 10:55 AM

Organizers: **Dale R. Oliver**, Humboldt State University
Elizabeth Burroughs, Montana State University

- 8:00AM ▶ (1106) *Japanese lesson study: A process to build and foster communities of practice dedicated to the professional development of mathematics teachers.*
Connie H. Yarema* and **Cheryl D. Schwiethale**, Abilene Christian University (1046-R1-44)
- 8:20AM (1107) *A lesson study approach to developing productive dialogue between university mathematics faculty and high school teachers.* Preliminary report.
Randall E. Groth* and **Jennifer A. Bergner**, Salisbury University (1046-R1-1984)
- 8:40AM ▶ (1108) *Using lesson study to enhance content knowledge and use of inquiry in middle school classrooms.*
Elizabeth A. Burroughs, Montana State University (1046-R1-456)
- 9:00AM (1109) *The role of mathematics faculty in supporting teachers to increase retention: A constructivist model.*
Terran D. Felter*, California State University, Bakersfield, and **Axelle P. Faughn**, Western Carolina University (1046-R1-1730)
- 9:20AM (1110) *Middle school teachers connecting content and student thinking.*
Brian J. Lindaman*, University of Minnesota, and **Terry Wyberg**, University of Minnesota d Instruction (1046-R1-2064)

- 9:40AM ▶ (1111) *Mathematical inquiry in the elementary classroom after teacher participation in professional development.*
Heather R. Mathison, Montana State University (1046-R1-1003)
- 10:00AM ▶ (1112) *Sustained professional development in urban and suburban middle schools: Is it effective?*
Cathy S. Liebars, The College of New Jersey (1046-R1-869)
- 10:20AM ▶ (1113) *A program of courses to prepare highly qualified teachers of middle school mathematics.*
Marie P. Sheckels* and **Debra Hydorn**, University of Mary Washington (1046-R1-1798)
- 10:40AM (1114) *Connecting higher education mathematics faculty to K-12 Mathematics Teachers.*
Kathryn Ernie*, University of Wisconsin-River Falls, and **Erick B. Hofacker**, University of Wisconsin - River Falls (1046-R1-1476)

MAA Session on Quantitative Literacy Across the Curriculum

8:00 AM – 10:35 AM

Organizers: **Kimberly M. Vincent**, Washington State University
Cinnamon Hillyard, University of Washington

- 8:00AM ▶ (1115) *Making quantitative reasoning central to a precalculus course.*
Cinnamon Hillyard* and **Nicole Hoover**, University of Washington Bothell (1046-T1-1599)
- 8:20AM ▶ (1116) *QL from a service division perspective.*
Gary T. Franchy, Davenport University (1046-T1-2057)
- 8:40AM (1117) *Mathematics and democracy.*
Kira Hamman, Pennsylvania State University, Mont Alto (1046-T1-1744)
- 9:00AM ▶ (1118) *Using media article to drive a QL course.* Preliminary report.
Stuart Boersma*, Central Washington University, **Caren L Diefenderfer**, Hollins University, and **Bernard L Madison**, University of Arkansas (1046-T1-1299)
- 9:20AM ▶ (1119) *Medical accuracy: Content for a quantitative literacy course.*
Stuart Boersma* and **Teri Willard**, Central Washington University (1046-T1-570)
- 9:40AM (1120) *Building the mathematical and computational skills of science students: What we are doing, what students think, and how it is working.*
Kelly E. Matthews*, **Merrilyn Goos** and **Peter Adams**, University of Queensland (1046-T1-1565)
- 10:00AM ▶ (1121) *Toward a numerate culture: A quantitative literacy project.* Preliminary report.
D. Scott Dillery, Lindsey Wilson College (1046-T1-1464)
- 10:20AM ▶ (1122) *Incorporating quantitative literacy into the research writing classroom.* Preliminary report.
Kimberly M. Vincent, Washington State University (1046-T1-2069)

MAA General Contributed Paper Session, VI

8:00 AM – 10:55 AM

Organizer: **Sarah L. Mabrouk**, Framingham State College
Moderators: **Katrina Palmer**, Appalachian State University

Joyati Debnath, Winona State University

Hurlee Gonchigdanzan, University of Wisconsin Stevens Point

Jason Moliterno, Sacred Heart University

8:00AM (1123) *Facing up to the realities of quantitative illiteracy: Do you know what your students Do NOT Know about “Basic” mathematics?*

Betsy Darken, University of Tennessee at Chattanooga (1046-Z1-817)

8:15AM (1124) *Limit theorems for the product of partial sums.* Preliminary report.

Hurlee Gonchigdanzan, University of Wisconsin - Stevens Point (1046-Z1-168)

8:30AM (1125) *Zero product sequences in commutative rings.* Preliminary report.

Shane P. Redmond, Eastern Kentucky University (1046-Z1-1843)

8:45AM (1126) *What is a mathematical theory?*

► (1126) **James R. Henderson**, University of Pittsburgh-Titusville (1046-Z1-46)

9:00AM (1127) *Exploring Goldbach’s Conjecture via CAS (computer algebra system) technology.* Preliminary report.

Jay L. Schiffman, Rowan University (1046-Z1-248)

9:15AM (1128) *Enumerating graphs to conveniently produce adjacency matrices using Maple or Mathematica.*

► (1128) **Jason J. Moliterno**, Sacred Heart University (1046-Z1-784)

9:30AM (1129) *Teaching differential equations on-line: The challenges and changes.*

► (1129) **Katrina Palmer**, NC (1046-Z1-444)

9:45AM (1130) *Teaching introductory differential equations courses through real-life case studies.*

► (1130) **Anand L. Pardhanani**, Earlham College (1046-Z1-1119)

10:00AM (1131) *The positive influence generation (our college students).* Preliminary report.

► (1131) **John F. Loase**, Concordia College (1046-Z1-19)

10:15AM (1132) *Math in your dorm room - from calculus to number theory - with Sage.* Preliminary report.

► (1132) **Karl-Dieter Crisman**, Gordon College (1046-Z1-1604)

10:30AM (1133) *Characterization of compactness in classical Banach Spaces.*

► (1133) **Julius N. Esunge**, Louisiana State University, Baton Rouge, LA (1046-Z1-1725)

10:45AM (1134) *Lessons learned from a calculus redesign project.*

► (1134) **Jennifer C. McCloud-Mann**, University of Texas at Tyler (1046-Z1-2104)

SIAM Minisymposium on Graph Theory, II

8:00 AM – 10:55 AM

Organizer: **Stephen G. Hartke**, University of Nebraska-Lincoln

8:00AM (1135) *Some results on graph linkage.* Preliminary report.

► (1135) **Mark Ellingham**, **Michael Plummer**, Vanderbilt University, and **Gexin Yu***, College of William and Mary (1046-05-1376)

8:30AM (1136) *The number of cliques in graphs of given order and size.*

► (1136) **Vladimir Nikiforov**, University of Memphis, TN (1046-05-1889)

9:00AM (1137) *On A_4 -balanced graphs.*

► (1137) **Michael D. Barrus*** and **Douglas B. West**, University of Illinois (1046-05-880)

9:30AM (1138) *Structure of bipartite probe interval graphs.*

David E. Brown, Utah State University, **Arthur H. Busch**, University of Dayton, and **Garth Isaak***, Lehigh University (1046-05-1543)

10:00AM (1139) *Reconstructing a graph from its vertex-edge incidence graph.*

► (1139) **Stephen Hartke**, University of Nebraska - Lincoln, and **Geir Helleloid***, University of Texas at Austin (1046-05-874)

10:30AM (1140) *Entropy inequalities.*

Jonathan Cutler*, Montclair State University, and **A. J. Radcliffe**, University of Nebraska-Lincoln (1046-05-1294)

PME Council

8:00 AM – 11:00 AM

Employment Center

8:00 AM – 7:00 PM

AMS Special Session on Discrete Dynamical Systems in Periodic Environments, I

8:30 AM – 10:50 AM

Organizers: **M. R. S. Kulenović**, University of Rhode Island

Orlando Merino, University of Rhode Island

Abdul-Aziz Yakubu, Howard University

8:30AM (1141) *Population models with asymptotically constant or periodic solutions.* Preliminary report.

Youssef Naim Raffoul, University of Dayton (1046-39-212)

9:00AM (1142) *On the dynamics of $x_{n+1} = p_n + \frac{x_{n-1}}{x_{n-2}}$, $n = 0, 1, \dots$ with a period-2 and period-3 coefficient.*

Senada Kalabusic*, University of Sarajevo, Bosnia and Herzegovina, and **Nurkanovic Mehmed**, University of Tuzla, Bosnia and Herzegovina (1046-39-1601)

9:30AM (1143) *Dynamics of the Leslie-Gower model with periodic coefficients.*

Orlando Merino* and **Sukanya Basu**, University of Rhode Island (1046-39-928)

10:00AM (1144) *The effect of periodization of parameters in some monotone difference equations.* Preliminary report.

Ann Brett, University of Rhode Island (1046-39-1579)

10:30AM (1145) *Stability of the Gumowski-Mira equation with period-two coefficient.*

M. R. S. Kulenovic, University of Rhode Island (1046-39-1576)

AMS Special Session on Algebraic Cryptography and Generic Complexity, I

8:30 AM – 10:45 AM

Organizers: **Vladimir Shpilrain**, The City College of New York

Yesem Kurt, Randolph College

8:30AM (1146) *Thompson’s group F has no generic subgroups.*

Sean Cleary*, The City College of New York and the CUNY Graduate Center, **Murray Elder**, University of Queensland, Brisbane, Australia, **Andrew Rechnitzer**, University of British Columbia, and **Jennifer Taback**, Bowdoin College (1046-20-129)

- 9:00AM *Average-case vs. generic-case complexity of lattice problems.* Preliminary report.
(1147) **Antonio R. Nicolosi**, Stevens Institute of Technology (1046-68-1973)
- 9:30AM *A gateway to group based cryptography.* Preliminary report.
(1148) **Delaram Kahrobaei***, CUNY Graduate Center and City Tech, and **Michael Anshel**, CUNY Graduate Center and City College of New York (1046-68-735)
- 10:00AM *Mathematics of Commutator Key Exchange.*
► (1149) Preliminary report.
Alexei Miasnikov, McGill University (1046-20-1948)

AMS-MAA Grad School Fair

8:30 AM – 10:30 AM

Undergrads! Take this opportunity to meet representatives from mathematical sciences graduate programs.

MAA Invited Address

9:00 AM – 9:50 AM

- (1150) *Making math out of style.*
Daniel N. Rockmore, Dartmouth College (1046-A0-13)

ASL Invited Address

9:00 AM – 9:50 AM

- (1151) *Descriptive set theory and the classification of separable Banach spaces.*
Christian Rosendal, University of Illinois at Chicago (1046-03-108)

MAA Minicourse #11: Part B

9:00 AM – 11:00 AM

Planning and teaching mathematics capstone courses for preservice secondary school teachers.

Organizers: **Edward F. Aboufadel**, Grand Valley State University
Richard Hill, Michigan State University
Bruce E. Sagan, Michigan State University
Sharon Senk, Michigan State University
Natasha M. Speer, Michigan State University
Rebecca Walker, Grand Valley State University

MAA Minicourse #1: Part B

9:00 AM – 11:00 AM

Discrete models in biology and simulations.

Organizers: **Saber N. Elaydi**, Trinity University
Huseyin Kocak, University of Miami
David Ribble, Trinity University

MAA Minicourse #6: Part B

9:00 AM – 11:00 AM

Teaching with clickers and classroom voting.

Organizers: **Derek Bruff**, Vanderbilt University
Kelly Cline, Carroll College

Mark Parker, Carroll College
Holly Zullo, Carroll College

MAA Session on Statistics in K-12 Education: How Will It Affect Statistics at the College Level?

9:00 AM – 10:35 AM

Organizers: **Patricia B. Humphrey**, Georgia Southern University
Robin H. Lock, St. Lawrence University

- 9:00AM *They took AP, but didn't pass. Now what?* Preliminary report.
► (1152) **Patricia Humphrey**, Georgia Southern University (1046-V1-1649)
- 9:20AM *Preparing pre-service secondary math teachers to teach statistics.*
► (1153) **Kady Schneider*** and **Brynja Kohler**, Utah State University (1046-V1-1830)
- 9:40AM *Wikis, forums, and group assignments: Building a learning community over the Internet.* Preliminary report.
► (1154) **Lothar A. Dohse**, UNC - Asheville (1046-V1-1854)
- 10:00AM *Achieving statistical literacy in elementary school using current popular curricula.*
► (1155) **Anna E. Bargagliotti**, University of Memphis (1046-V1-195)
- 10:20AM *The American Statistical Association's Meeting Within a Meeting (MWM) Workshop and follow-up activities for K-12 mathematics and science teachers: An example K-12 statistics education outreach program*
► (1156) **Rebecca A. Nichols**, **Martha B. Aliaga**, American Statistical Association, and **Katherine T. Halvorsen***, Smith College (1046-V1-1792)

SIGMAA on Environmental Mathematics Panel Discussion

9:00 AM – 10:20 AM

Environmental mathematics: Getting it in the curriculum.

Organizers: **Karen D. Bolinger**, Clarion State University
Ben A. Fusaro, Florida State University
Moderator: **Lee Seitelman**, United Technologies
Panelists: **Charles R. Hadlock**, Bentley College
Martin E. Walter, University of Colorado at Boulder
Ben A. Fusaro

MAA-NCTM Committee on Mutual Concerns-MAA Committee on Articulation and Placement Panel Discussion

9:00 AM – 10:20 AM

Placement testing: Is it working?

Organizers: **Jerry F. Dwyer**, Texas Tech University
Susan L. Forman, Bronx Community College, CUNY
Panelists: **Bernard L. Madison**, University of Arkansas
Dan Miller, Millikin University
Kent Pearce, Millikin University
Judy E. Ackerman, Montgomery College

Student Hospitality Center

9:00 AM – 5:00 PM

AMS Special Session on Asymptotic Geometric Analysis, I

9:30 AM – 10:50 AM

Organizers: **Alexander E. Litvak**, University of Alberta
Dmitry Ryabogin, Kent State University
Artem Zvavitch, Kent State University

- 9:30AM (1157) *Projecting L_∞ onto classical spaces.*
Hermann Koenig, University of Kiel, Germany, and
Nicole Tomczak-Jaegermann*, University of Alberta (1046-46-1491)
- 10:00AM (1158) *Auerbach bases and minimal-volume sufficient enlargements for normed spaces.* Preliminary report.
Mikhail I. Ostrovskii, St. John's University (1046-46-492)
- 10:30AM (1159) *Convex geometry, Sobolev inequalities, and information theory.* Preliminary report.
Erwin Lutwak, **Deane Yang*** and **Gaoyong Zhang**, Polytechnic Institute of NYU (1046-52-2008)

Exhibits and Book Sales

9:30 AM – 5:30 PM

ASL Invited Address

10:00 AM – 10:50 AM

- (1160) *Orbit equivalence and ergodic actions of countable groups.*
Inessa Epstein, California Institute of Technology (1046-03-661)

AMS Special Presentation

10:00 AM – 11:00 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

- (1161) *Nonlinear problems involving integral diffusions.*
Luis A. Caffarelli, University of Texas at Austin (1046-35-06)

AMS-MAA Invited Address

11:10 AM – NOON

- (1162) *Geometry of surfaces, laminations, and dynamics over the moduli space of Riemann surfaces.*
Maryam Mirzakhani, Princeton University (1046-51-34)

AMS Colloquium Lectures: Lecture III

1:00 PM – 2:00 PM

- (1163) *Homogeneous dynamics and number theory III.*
Gregory Margulis, Yale University (1046-37-04)

MAA Lecture for Students

1:00 PM – 1:50 PM

- (1164) *Some elementary problems that remain unsolved.*
Nathaniel Dean, Texas State University-San Marcos

AMS Current Events Bulletin

1:00 PM – 4:45 PM

- Organizer: **David Eisenbud**, University of California Berkeley
- 1:00PM (1165) *Topology, representation theory, and arithmetic: Three-manifolds and the Langlands program.*
Matthew James Emerton, Northwestern University (1046-11-1560)
- 2:00PM (1166) *Compressive sensing: A paradigm shift in signal processing.*
Olga V. Holtz, University of California-Berkeley and Technische Universitaet Berlin (1046-94-2067)
- 3:00PM (1167) *From Seiberg-Witten theory to closed orbits of vector fields: Taubes's proof of the Weinstein conjecture.*
Michael Hutchings, UC Berkeley (1046-53-1445)
- 4:00PM (1168) *Frontiers of reality in Schubert calculus.*
Frank Sottile, Texas A&M University (1046-14-679)

AMS-MAA Special Session on History of Mathematics, II

1:00 PM – 5:55 PM

Organizers: **Joseph W. Dauben**, Lehman College
Karen H. Parshall, University of Virginia
Patti Hunter, Westmont College
Deborah Kent, Hillsdale College

- 1:00PM (1169) *The mathematics in Newton's Principia Mathematica.*
George E. Smith, Tufts University; Stanford University (Spring '09) (1046-01-1437)
- 2:00PM (1170) *Mrs. Bean's Young Ladies: Mathematics education in early modern england.*
Kathryn James, Beinecke Library, Yale University (1046-01-356)
- 2:30PM (1171) *Insights into Cayley's work on the quintic.*
Steven H. Weintraub, Lehigh University (1046-01-33)
- 3:00PM (1172) *What is at stake in Weierstrass' criticism of Riemann's function theory?*
Renaud G. Chorlay, Universite Denis Diderot (Paris 7) (1046-01-525)
- 3:30PM (1173) *Computing devices, mathematics education and mathematics - Sexton's Omnimeter in its time.*
Peggy Aldrich Kidwell, National Museum of American History, Smithsonian Institution (1046-01-287)
- 4:00PM (1174) *Did geometry need saving from Bourbaki?* Preliminary report.
Thomas Drucker, University of Wisconsin-Whitewater (1046-01-282)
- 4:30PM (1175) *The Polish-American mathematician Joseph Perott.* Preliminary report.
Roger L. Cooke, University of Vermont (1046-01-384)

- 5:00PM *Grading the greats: What G. Castelnuovo and F. Severi thought of one another in the 1930s.*
(1176) Preliminary report.
Donald G. Babbitt, UCLA, and **Judith R. Goodstein***, Institute Archives, California Institute of Technology (1046-01-378)
- 5:30PM *Hilbert and the origin myth of modern mathematics.*
► (1177) **Colin McLarty**, Case Western Reserve University (1046-01-802)

AMS-ASL Special Session on Model Theoretic Methods in Finite Combinatorics, II

1:00 PM – 5:50 PM

Organizers: **Martin Grohe**, Humboldt University
Johann A. Makowsky, Technion Israel Institute of Technology

- 1:00PM *Why is the chromatic polynomial a polynomial? A model theoretic interpretation.*
► (1178) **Tomer Kotek***, **Johann A. Makowsky**, Technion-Israel Institute of Technology, and **Boris Zilber**, Oxford University, Great Britain (1046-03-393)
- 1:30PM *Towards a theory of graph polynomials.* Preliminary report.
► (1179) **Johann A. Makowsky**, Computer Science, Technion-Israel Institute of Technology (1046-03-338)
- 2:00PM *Nonstandard methods in hypergraph theory.* Preliminary report.
(1180) **Gabor Elek**, The Alfred Renyi Mathematical Institute of the Hungarian Academy of Sciences, Budapest, and **Balasz Szegedy***, University of Toronto (1046-05-339)
- 2:30PM *Homomorphism universal structures.*
► (1181) **Jan Hubicka**, Charles University Prague, Czech Republic, and **Jaroslav Nesetril***, Charles University Prague (1046-05-341)
- 3:00PM *On the monadic second-order transduction hierarchy.*
(1182) **Achim Blumensath***, and **Bruno Courcelle**, Universite Bordeaux 1, LaBRI (1046-03-118)
- 3:30PM *Ramsey Theory and constraint propagation heuristics.* Preliminary report.
► (1183) **Albert Atserias**, Universitat Politècnica de Catalunya, Barcelona, Spain (1046-05-496)
- 4:00PM *Algorithmic meta-theorems.*
(1184) **Stephan Kreutzer**, University of Oxford (1046-05-340)
- 4:30PM *Counting constraint satisfaction problems.*
► (1185) **Andrei A. Bulatov**, Simon Fraser University (1046-05-377)
- 5:00PM *k-Clique requires $k/4$ variables.*
► (1186) **Benjamin Rossman**, Massachusetts Institute of Technology (1046-68-387)
- 5:30PM Discussion

AMS Special Session on Commutative Rings, I

1:00 PM – 5:50 PM

Organizers: **Jay A. Shapiro**, George Mason University
David E. Dobbs, University of Tennessee, Knoxville
Shane P. Redmond, Eastern Kentucky University
Joe A. Stickles, Millikin University

- 1:00PM *Finitely generated monoids of fractional ideals.*
(1187) **Daniel D. Anderson*** and **Sangmin Chun**, University of Iowa (1046-13-425)
- 1:30PM *Nonunique factorization in integral domains.* Preliminary report.
(1188) **David F. Anderson***, University of Tennessee, and **D. D. Anderson**, University of Iowa (1046-13-930)
- 2:00PM *The annihilator condition for finite commutative rings.* Preliminary report.
(1189) **John D. LaGrange**, Indiana University Southeast (1046-13-1229)
- 2:30PM *On the maximal cardinality of chains of intermediate rings.* Preliminary report.
(1190) **D. E. Dobbs**, University of Tennessee, Knoxville, **Gabriel Picavet**, Laboratoire de Mathématique, Université Blaise Pascal, and **Martine Picavet-L'Hermite***, Université Blaise Pascal, France (1046-13-855)
- 3:00PM *Ranks of indecomposable torsion-free modules and a Krull-Schmidt theorem.*
(1191) **Nicholas R. Baeth***, University of Central Missouri, and **Melissa R. Luckas**, University of Nebraska-Lincoln (1046-13-813)
- 3:30PM *Semigroups of torsion-free modules.* Preliminary report.
(1192) **Roger Wiegand**, University of Nebraska (1046-13-814)
- 4:00PM *Splitting sets and weakly Matlis domains.* Preliminary report.
(1193) **Muhammad Zafrullah**, Idaho State University (1046-13-1344)
- 4:30PM *Atomicity of certain pullback constructions.*
(1194) **Jason Greene Boynton** and **Jim Coykendall***, North Dakota State University (1046-13-939)
- 5:00PM *Generally t -linkative domains.* Preliminary report.
(1195) **Thomas G. Lucas**, University of North Carolina Charlotte (1046-13-1133)
- 5:30PM *Special sequences for local domains.* Preliminary report.
(1196) **S. B. Mulay**, University of Tennessee, Knoxville (1046-13-1332)

AMS Special Session on Mathematics and Mathematics Education in Fiber Arts

1:00 PM – 5:50 PM

- Organizers: **Sarah-Marie Belcastro**, The Hampshire College Summer Studies in Mathematics
Carolyn A. Yackel, Mercer University
- 1:00PM *Temari math and geometry on the sphere.*
► (1197) Preliminary report.
Carolyn Yackel, Mercer University (1046-20-1195)
- 1:30PM *Visualizing groups and subgroups in counted cross stitch.*
► (1198) **Mary D. Shepherd**, Northwest Missouri State University (1046-20-903)
- 2:00PM *Diaper pattern in needlepoint.*
► (1199) **Diane L. Herrmann**, University of Chicago (1046-00-899)
- 2:30PM *Semiregular tessellations.*
► (1200) **Irena Swanson**, Reed College (1046-52-674)
- 3:00PM Mathematical Fiber Arts Exhibit
- 3:30PM *Don't blow a gasket!*
► (1201) **Ted Ashton**, Linthicum Heights, MD (1046-00-760)
- 4:00PM *Exploring two-dimensional manifolds with crochet hook.*
► (1202) **Daina Taimina**, Cornell University (1046-97-962)

- 4:30PM *Braids, cables, and cells: An intersection of mathematics, computer science, and fiber arts.*
 ▶ (1203) Preliminary report.
Joshua Brandon Holden, Rose-Hulman Institute of Technology (1046-37-82)
- 5:00PM *Braid words in generalized helix stripe patterns.*
 ▶ (1204) **Sarah-Marie Belcastro**, Sarah Lawrence College / HCSSiM (1046-54-1626)
- 5:30PM *Calculating patterns for knitted surfaces.*
 (1205) **Amy F. Szczepański**, University of Tennessee, Knoxville (1046-00-1046)

AMS Special Session on Conformal Geometry, Twistor Theory, and Integrable Systems

1:00 PM – 5:50 PM

Organizers: **Dana Mihai**, Carnegie Mellon University

George Sparling, University of Pittsburgh

- 1:00PM *Twistors and 2T-physics as unifiers of 1T-physics systems.*
 (1206) **Itzhak Bars**, University of Southern California (1046-81-1735)
- 2:00PM *Geometric Interpretation of elliptic integrable systems associated to k-symmetric spaces.*
 (1207) **Idrisse Khemar**, T.U. Munich (1046-53-1189)
- 3:00PM *The Penrose process and the wave equation in Kerr geometry.*
 (1208) **Niky Kamran**, McGill University (1046-83-1727)
- 4:00PM *New ideas in space-time: Cartan's ODE's, parabolic geometry and conformal structures.*
 (1209) **George Sparling**, University of Pittsburgh (1046-83-1151)
- 5:00PM *On unveiled relations between twistor and quantum Hall effect.* Preliminary report.
 (1210) **Hasebe Kazuki**, Takuma National College of Technology (1046-51-1031)
- 5:30PM *Fierz identities for real Clifford algebras.*
 ▶ (1211) **Eric Korman**, University of Pittsburgh (1046-83-1156)

AMS Special Session on Discrete Dynamical Systems in Periodic Environments, II

1:00 PM – 5:50 PM

Organizers: **M. R. S. Kulenović**, University of Rhode Island

Orlando Merino, University of Rhode Island

Abdul-Aziz Yakubu, Howard University

- 1:00PM *Semigroups of maps and periodic difference equations.*
 (1212) **Robert J. Sacker**, University of Southern California (1046-37-1419)
- 1:30PM *Why period-doubling cascades occur.* Preliminary report.
 (1213) **James A. Yorke**, Univ. of Maryland (1046-37-927)
- 2:00PM *Unimodal periodic models with Allee effects.*
 ▶ (1214) Preliminary report.
Saber N. Elaydi, Trinity University (1046-39-1755)
- 2:30PM *Two species competition in a periodic environment.*
 (1215) Preliminary report.
J. M. Cushing, University of Arizona (1046-39-668)

- 3:00PM *S-I-S epidemic models with disease induced mortality in periodic environments.* Preliminary report.
 (1216) **John E. Franke***, North Carolina State University, and **Abdul-Aziz Yakubu**, Howard University (1046-37-1256)
- 3:30PM *Periodic versus constant harvesting of discretely reproducing fish populations.*
 ▶ (1217) **Abdul-Aziz Yakubu***, Howard University, and **Michael Fogarty**, National Marine Fisheries Service (1046-92-1215)
- 4:00PM *Attractors for a periodic, discrete selection-migration model with partial dominance.* Preliminary report.
 (1218) **James F. Selgrade***, Jordan West Bostic, North Carolina State University, and **James H. Roberds**, USDA Forest Service (1046-92-890)
- 4:30PM *Impact of harvesting in a discrete-time predator-prey model.*
 (1219) **Shari Wiley***, **Abdul-Aziz Yakubu**, Howard University, and **Michael Fogarty**, National Oceanic and Atmospheric Administration (1046-37-1748)
- 5:00PM *Dynamics of a discrete-time lottery model and its approximation by ODEs.* Preliminary report.
 (1220) **Ryusuke Kon**, Kyushu University (1046-92-1584)
- 5:30PM *On a property of plane curves.* Preliminary report.
 ▶ (1221) **Mohammad Javaheri**, Trinity College (1046-37-582)

AMS Special Session on Homotopy Theory and Higher Categories, II

1:00 PM – 5:50 PM

Organizers: **Thomas M. Fiore**, University of Chicago

Mark W. Johnson, Penn State Altoona

James M. Turner, Calvin College

W. Stephen Wilson, Johns Hopkins University

Donald Yau, Ohio State University at Newark

- 1:00PM *Classifying spaces for topological 2-groups.*
 (1222) **John C. Baez**, U. C. Riverside (1046-55-597)
- 1:30PM *Morita theory and Azumaya objects in bicategorical contexts.*
 (1223) **Niles Johnson**, University of Chicago (1046-18-1466)
- 2:00PM *Permutative and bipermutative categories revisited.*
 (1224) **J. Peter May**, University of Chicago (1046-55-416)
- 2:30PM *Limits, derived functors, and homotopical category theory.*
 (1225) **Michael A. Shulman**, University of Chicago (1046-18-395)
- 3:00PM *Homotopical versions of Hall algebras.* Preliminary report.
 (1226) **Julie Bergner**, University of California, Riverside (1046-55-355)
- 3:30PM *Some Ext groups in motivic cohomology theory.*
 (1227) **Armira Shkembri**, Wayne State University (1046-55-799)
- 4:00PM *Some remarks on 2-completed motivic homotopy theory and the motivic J-homomorphism.*
 (1228) **Kyle M. Ormsby**, University of Michigan (1046-55-55)
- 4:30PM *Generating spaces for S(n)-acyclics.* Preliminary report.
 (1229) **Aaron C. Leeman**, University of Oregon (1046-55-1893)

- 5:00PM *Completion of real Johnson-Wilson theory $E(n)$ yields fixed points of Morava E -theory.*
(1230) **Maia Averett**, Mills College (1046-55-1513)
- 5:30PM *Extensions of motives and cell bundles.*
(1231) **Jack Morava**, Johns Hopkins University (1046-55-2092)

AMS Special Session on Algebraic Cryptography and Generic Complexity, II

1:00 PM – 5:50 PM

Organizers: **Vladimir Shpilrain**, The City College of New York

Yesem Kurt, Randolph College

- 1:00PM *Public-Key cryptography from a (theoretical) cryptographer's perspective.*
► (1232) **Jonathan Katz**, University of Maryland (1046-68-860)
- 2:00PM *Group theory in authenticated key establishment: What assumption(s) Do We Make?*
(1233) **Rainer Steinwandt**, Florida Atlantic University (1046-94-1447)
- 2:30PM *Bilinear groups and algebraic cryptography.*
(1234) Preliminary report.
Nelly Fazio, City University of New York (1046-68-1974)
- 3:00PM *An identification scheme for one-time private key systems (OTPK). Preliminary report.*
► (1235) **Yesem Kurt**, Randolph College (1046-94-1517)
- 3:30PM *Cryptanalysis of the shifted conjugacy authentication protocol.*
(1236) **Alexander V. Ushakov***, Stevens Institute of Technology, and **Jonathan Longrigg**, University of Newcastle (1046-68-1496)
- 4:00PM *Challenge response password security using combinatorial group theory. Preliminary report.*
(1237) **Gilbert Baumslag**, City College of CUNY, **Benjamin Fine***, Fairfield University, and **Douglas Troeger**, City College of CUNY (1046-20-1006)
- 4:30PM *Authentication schemes.*
► (1238) **Dima Grigoriev**, Institut de Recherche Mathématique, Campus de Beaulieu, Rennes, France, and **Vladimir Shpilrain***, City College of New York (1046-94-503)
- 5:00PM Discussion

AMS Special Session on Asymptotic Geometric Analysis, II

1:00 PM – 4:50 PM

Organizers: **Alexander E. Litvak**, University of Alberta

Dmitry Ryabogin, Kent State University

Artem Zvavitch, Kent State University

- 1:00PM *Variational formulas for the isotropic constant.*
(1239) Preliminary report.
Ralph Howard, University of South Carolina (1046-53-1898)
- 1:30PM *Remark on isotropic constant of projections of convex bodies.*
(1240) **David Alonso-Gutiérrez**, **Jesús Bastero**, **Julio Bernués**, University of Zaragoza, Spain, and **Paweł Wolff***, Case Western Reserve University (1046-52-1772)

- 2:00PM *Local and Equatorial characterization of unit balls of subspaces of L_p , $p > 0$ and properties of the generalized cosine transform.*
(1241) **Jeffrey Schlaerth**, Kent State University (1046-52-2006)

- 2:30PM *Erdélyi-Kober integrals on the cone of positive definite matrices and Radon transforms on Grassmann manifolds.*
(1242) **Elena Ournycheva**, University of Pittsburgh at Bradford (1046-44-1483)

- 3:00PM *Intersection bodies with lower dimensional faces and Lonke's barrel zonoid. Preliminary report.*
► (1243) **Maria de los Angeles Alfonseca***, North Dakota State University, **Dmitry Ryabogin** and **Artem Zvavitch**, Kent State University (1046-52-902)

- 3:30PM *Quaternionic Busemann-Petty problem.*
(1244) **Boris Rubin**, Louisiana State University (1046-52-1393)

- 4:00PM *On embeddings of normed spaces in L_{-k} .*
(1245) **Vladyslav Yaskin**, University of Alberta (1046-46-1823)

- 4:30PM *Algorithmic approximation of convex polytopes by simpler convex polytopes.*
(1246) **Shlomo Reisner**, University of Haifa, Israel (1046-52-1564)

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 *Infinite dimensional duality and applications to equilibrium problems. Preliminary report.*
► (1247) **Patrizia Daniele***, University of Catania, Italy, **Sofia Giuffrè***, D.I.M.E.T. Mediterranean University, Italy, and **Antonino Maugeri**, University of Catania, Italy (1046-46-2083)
- 1:30PM *Inverse potential theory on the sphere.*
(1248) **Willi Freeden**, Geomathematics Group, TU Kaiserslautern, Germany (1046-86-1185)
- 2:00PM *On some mathematical aspects of the ill-posed determination of the Earth's interior.*
(1249) **Volker Michel**, University of Siegen, Germany (1046-45-426)
- 2:30PM *Sparse regularization with l - q penalty term.*
(1250) **Otmar Scherzer**, University Innsbruck (1046-49-1182)
- 3:00PM *Adaptive kernel methods using the balancing principle.*
(1251) **Sergei V. Pereverzev**, Johann Radon Institute For Computational and Applied Mathematics, Austrian Academy of Sciences (1046-65-610)
- 3:30PM *Tikhonov regularization methods with general data-fit term. Preliminary report.*
(1252) **Christiane Poeschl**, University of Innsbruck (1046-00-768)
- 4:00PM *Current density-based electrical impedance tomography.*
(1253) **Adrian Nachman**, University of Toronto, **Alexandru Tamasan***, University of Central Florida, and **Alexandre Timonov**, University of South Carolina Upstate (1046-35-1408)

- 4:30PM (1254) *Nonsmooth analysis in infinite dimensions with applications to stability of variational systems.*
Mordukhovich Boris, Wayne State University, and **Nguyen Mau Nam***, University of Texas-Pan American (1046-49-51)
- 5:00PM (1255) *A hierarchy of differential approximations for nonsmooth operators and variational problems.* Preliminary report.
M. Zuhair Nashed, University of Central Florida (1046-46-1899)
- 5:30PM (1256) *A nonsmooth feedback solution for a class of quantum control problems.*
Qin Zhang* and **Kazufumi Ito**, North Carolina State University (1046-49-458)

AMS Special Session on Categorification and Link Homology, II

1:00 PM – 5:50 PM

- Organizers: **Aaron Lauda**, Columbia University
Mikhail Khovanov, Columbia University
- 1:00PM (1257) *A categorification of quantum tangle invariants via quiver varieties.* Preliminary report.
Ben Webster, Massachusetts Institute of Technology (1046-18-1244)
- 1:25PM (1258) *The 1,2-coloured HOMFLY-PT link homology.*
M. Mackaay*, Universidade do Algarve, **M. Stosic**, Instituto Superior Técnico, and **P. Vaz**, Universidade do Algarve (1046-18-607)
- 1:50PM (1259) *Towards a geometric categorification of the coloured Reshetikhin-Turaev $sl(m)$ knot invariants.*
Sabin Cautis, Rice University/MSRI (1046-14-1164)
- 2:15PM (1260) *How to categorify dynamical zeta functions.* Preliminary report.
Alexander Fel'shtyn, University of Szczecin and Boise State University (1046-57-1010)
- 2:40PM (1261) *Gram determinants of planar states and Lagrangian tangles.*
Jozef H. Przytycki, George Washington University (1046-57-1710)
- 3:05PM (1262) *Crossingless matchings and the Springer representation.*
Heather M. Russell* and **Julianna S. Tymoczko**, University of Iowa (1046-57-1373)
- 3:30PM (1263) *Plane diagrammatics and categorification.* Preliminary report.
Radmila Sazdanovic*, The George Washington University, and **Mikhail Khovanov**, Columbia University (1046-16-1241)
- 3:55PM (1264) *Sheaves of modules over posets and Khovanov homology.*
Paul R. Turner*, Heriot-Watt University/ Université de Fribourg, and **Brent J. Everitt**, University of York (1046-57-638)
- 4:20PM Discussion
- 4:45PM (1265) *Every modular category is the category of modules over an algebra.*
Hendryk Pfeiffer, The University of British Columbia (1046-20-1762)
- 5:10PM (1266) *Groupoidification.*
John C. Baez, University of California, Riverside (1046-18-596)
- 5:35PM (1267) *A categorification of Hecke algebras.*
Alexander E. Hoffnung, University of California, Riverside (1046-18-1057)

AMS Special Session on the Role of Generalized Maximal Monotonicity Frameworks in Optimization and Control Theory with Applications, II

1:00 PM – 5:20 PM

- Organizer: **Ram U. Verma**, International Publications
- 1:00PM (1268) *Optimality conditions and efficiency in solving nonsmooth multiobjective programming problems.*
S. K. Mishra, Banaras Hindu University, **R. N. Mohapatra***, University of Central Florida, and **Vinay Singh**, Banaras Hindu University (1046-49-2017)
- 2:00PM (1269) *Fixed point iterations.* Preliminary report.
B. E. Rhoades, Indiana University, Bloomington, IN (1046-47-229)
- 3:00PM (1270) *Hybrid over-relaxed proximal point procedure and generalized Yosida regularization for first-order evolution inclusions.*
Ram U. Verma, International Publications (USA) (1046-49-791)
- 4:00PM (1271) *Representability of monotone operators.*
M. D. Voisei, Towson University (1046-46-442)
- 5:00PM (1272) *Input identification to linear differential systems.*
Gheorghe Morosanu, Central European University, Budapest, Hungary (1046-93-452)

AMS Special Session on Computational Algebra and Convexity, II

1:00 PM – 5:50 PM

- Organizers: **Dan Bates**, Colorado State University
Tsung-Lin Lee, Michigan State University
Sonja Petrovic, University of Illinois at Chicago
Zach Teitler, Texas A&M University
- 1:00PM (1273) *Diagonal ideals of determinantal rings.*
Kuei-Nuan Lin, Purdue University (1046-13-1207)
- 1:30PM (1274) *Finite atomic lattices and resolutions of associated monomial ideals.* Preliminary report.
Sonja Mapes, Columbia University (1046-13-982)
- 2:00PM (1275) *A numerical local dimension test for algebraic sets.*
Andrew Sommese, University of Notre Dame (1046-65-687)
- 2:30PM (1276) *Partial decomposition of radical ideals through numerical homotopy and lattice basis reduction.*
Dan Bates, Colorado State University, **Jon Hauenstein**, University of Notre Dame, **Tim McCoy**, Colorado State University, **Andrew Sommese**, University of Notre Dame, and **Christopher Peterson***, Colorado State University (1046-14-1451)
- 3:00PM (1277) *Numerical primary decomposition.*
Anton Leykin, University of Illinois at Chicago (1046-14-520)
- 3:30PM (1278) *On numerical-symbolic exact irreducible decomposition of cyclic-12.*
Rostam Sabeti* and **Tien-Yien Li**, Michigan State University (1046-65-577)
- 4:00PM (1279) *Computational algebraic geometry for mechanism synthesis.*
Hai-Jun Su, University of Maryland, Baltimore County (1046-14-1124)
- 4:30PM (1280) *F, G, H, I bases for polynomial rings and their relations.*
Wenyuan Wu, Michigan State University (1046-13-421)

- 5:00PM *Estimates for orders of derivatives in differential Nullstellensatz.*
(1281) **Oleg Golubitsky**, University of Western Ontario, **Marina Kondratieva**, Moscow State University, **Alexey Ovchinnikov***, University of Illinois at Chicago, and **Agnes Szanto**, North Carolina State University (1046-13-99)
- 5:30PM *p-adic Descartes' bounds.*
(1282) **Ashraf A. Ibrahim**, Texas A&M University (1046-14-315)

AMS Session on Mathematics Education

1:00 PM – 3:55 PM

- 1:00PM *Instructor resources for elementary mathematics for teachers.* Preliminary report.
► (1283) **Scott J. Baldridge***, Louisiana State University, and **Thomas H. Parker**, Michigan State University (1046-97-2072)
- 1:15PM *Integrated, multidisciplinary and technology-enhanced science education: The next frontier.*
► (1284) **Ivo D. Dinov*** and **Nicolas Christou**, University of California, Los Angeles (1046-97-25)
- 1:30PM *Inquiry-based learning: An educational reform based upon content-centred teaching.*
► (1285) **M. Padraig McLoughlin**, Kutztown University of Pennsylvania (1046-97-644)
- 1:45PM *What do MD & VA teachers believe about mathematics and what do they know about mathematics history?*
► (1286) **Danielle M. Goodwin**, Vincennes University (1046-97-755)
- 2:00PM *The hybrid mathematics class: The best of both worlds, or No Man's Land?*
► (1287) **Catherine A. Matos*** and **Mary Hudachek-Buswell**, Clayton State University (1046-97-1489)
- 2:15PM *Bluma's Method: A different way to solve quadratics.* Preliminary report.
► (1288) **Richard Millman**, Georgia Institute of Technology, and **Eric L. Clark***, University of Kentucky (1046-97-75)
- 2:30PM *How redesigning freshman classes can impact a whole department.*
► (1289) **Tristan M. Denley**, University of Mississippi (1046-97-1495)
- 2:45PM *A constructivist theory of teaching mathematics: From concept to context.*
► (1290) **Wendy Hageman Smith**, Longwood University (1046-97-1550)
- 3:00PM *Refocused algebra versus POGIL: Chemistry's solution and what mathematics can derive from it.*
► (1291) **Robert E. Wieman**, Virginia State University (1046-97-1561)
- 3:15PM *What will students do for 1 point in the land of no bonus?* Preliminary report.
► (1292) **Robin Leigh Blankenship**, Morehead State University (1046-97-2090)
- 3:30PM *Problems encountered in trying to collaborate with mathematicians in the Third World.*
► (1293) **Melvin Henriksen**, Harvey Mudd College (1046-00-940)
- 3:45PM *Building a high-performing mathematics program in the City of Baker using the Singapore mathematics curriculum.* Preliminary report.
► (1294) **Scott J. Baldridge***, Louisiana State University, and **Johnette Winfrey**, The City of Baker School System (1046-97-2036)

AMS Session on Financial Mathematics

1:00 PM – 4:40 PM

- 1:00PM *Volatility models of the yield curve.*
(1295) **Victor Goodman**, Indiana University (1046-90-48)
- 1:15PM *Stochastic optimization for portfolio selection problem with mean absolute negative deviation measure.*
(1296) **Anton Abdulbasah Kamil***, **Adli Mustafa** and **Khilipah Ibrahim**, Universiti Sains Malaysia (1046-90-381)
- 1:30PM *Option pricing in the presence of random arbitrage return.*
(1297) **Jungmin Choi***, Florida State University, and **Max Gunzburger**, Florida State University (1046-90-1288)
- 1:45PM *On the convergence of adaptive stochastic search methods for continuous global optimization.*
(1298) **Rommel G. Regis**, Saint Joseph's University (1046-90-1976)
- 2:00PM *Sensitivity analysis of asset flow differential equations and a new volatility approach.*
(1299) **Ahmet Duran**, University of Michigan-Ann Arbor (1046-91-94)
- 2:15PM *Stable trading strategy involving several options.*
(1300) **Anirban Dutta*** and **Qiji J. Zhu**, Western Michigan University (1046-91-1095)
- 2:30PM *A Turán type inequality for the Kummer function arising in finance. Part I: The application.*
(1301) **Roger W. Barnard**, Texas Tech University, **Michael B. Gordy***, Senior Economist, Federal Reserve Board, and **Kendall C. Richards**, Southwestern University (1046-91-182)
- 2:45PM Break
- 3:00PM *A Turán type inequality for the Kummer function arising in finance. Part II: The verification.*
(1302) **Roger W. Barnard**, Texas Tech University, **Michael B. Gordy**, Federal Reserve Board, and **Kendall C. Richards***, Southwestern University (1046-33-183)
- 3:15PM *Portfolio optimization under subadditive transaction cost.*
(1303) **Qingshuo Song**, University of Southern California (1046-60-61)
- 3:30PM *On moment conditions for Girsanov Theorem.*
(1304) **See Keong Lee**, Universiti Sains Malaysia (1046-60-558)
- 3:45PM *A Markov state model for wake-sleep transitions.*
► (1305) **Badal Joshi*** and **Janet Best**, Ohio State University (1046-60-1835)
- 4:00PM *An exact Malliavin weight for variance gamma and normal inverse Gaussian processes: Sensitivity analysis of European style options.* Preliminary report.
(1306) **Dervis Bayazit*** and **Craig A. Nolder**, Florida State University (1046-60-1860)
- 4:15PM *American option pricing under stochastic volatility.*
► (1307) **Hari P. Adhikari**, University of South Florida (1046-00-1413)
- 4:30PM *Possible evolutions of financial markets in a Keynesian economy.*
(1308) **James M. Haley**, Point Park University, Economics (1046-97-1919)

AMS Session on Number Theory, III

1:00 PM – 5:10 PM

- 1:00PM *An identity involving generalized Fibonacci numbers.*
(1309) **Curtis N. Cooper**, University of Central Missouri (1046-11-1706)
- 1:15PM *Chebyshev's bias in function fields.*
(1310) **Byungchul Cha**, Muhlenberg College (1046-11-42)
- 1:30PM *A Hecke correspondence theorem for automorphic integrals with symmetric rational period functions on the Hecke groups.*
(1311) **Wendell Ressler**, Franklin & Marshall College (1046-11-49)
- 1:45PM *New lower bounds for the Ihara function $A(q)$.*
(1312) **Laura L. Hall-Seelig**, University of Massachusetts, Amherst (1046-11-283)
- 2:00PM *On the frequency of anomalous primes for elliptic curves.* Preliminary report.
(1313) **Penny C. Ridgill**, University of Massachusetts (1046-11-308)
- 2:15PM *Characterizing limits of analytic continued fractions.* Preliminary report.
(1314) **Kristen J. Campbell**, Northern Illinois University (1046-11-316)
- 2:30PM *Brauer-Manin obstructions and Sha of genus-2 jacobians.*
(1315) **Patrick Corn**, St. Mary's College of Maryland (1046-11-1329)
- 2:45PM *Maximal subbundles in coding theory.*
(1316) **Emma Previato***, Boston University, and **Drue Coles**, Bloomsburg University (1046-11-1007)
- 3:00PM Break
- 3:15PM *Characteristic classes and root numbers for motives associated to GO_n .* Preliminary report.
(1317) **Asher N. Auel**, University of Pennsylvania (1046-11-1655)
- 3:30PM *The search for base-2 Fibonacci pseudoprimes.*
► (1318) **Dominic W. Klyve**, Carthage College (1046-11-1391)
- 3:45PM *A note on disjoint covering systems of congruences: Variations on a 2002 AIME problem.*
► (1319) **John W. Hoffman**, **W. Ryan Livingston** and **Jared M. Ruiz***, Youngstown State University (1046-11-1549)
- 4:00PM *Eichler cohomology theorem for small weights.*
(1320) **M. Knopp** and **H. Mawi***, Temple University (1046-11-1751)
- 4:15PM *On some fundamental properties and applications of continued fractions to coding theory.* Preliminary report.
► (1321) **Ahlam E. Tannouri*** and **Sam F. Tannouri**, Morgan State University (1046-11-2048)
- 4:30PM *On integer polynomials that are small at a given cubic irrational.*
(1322) **Kiryl I. Tsishchanka**, DePaul University (1046-11-2071)
- 4:45PM *Weyl group multiple Dirichlet series for type C.* Preliminary report.
(1323) **Jennifer Beineke***, Western New England College, **Ben Brubaker**, MIT, and **Sharon Frechette**, College of the Holy Cross (1046-11-1954)
- 5:00PM *A refinement of Stark's Conjecture over complex cubic number fields.*
(1324) **Tian Ren***, Queensborough Community College, The City University of New York, and **Robert Szezech**, Rutgers University - Newark (1046-11-1144)

MAA Session on College Algebra: Focusing on Conceptual Understanding, Real-World Data, and Mathematical Modeling, I

1:00 PM – 5:55 PM

- Organizers: **Florence S. Gordon**, New York Institute of Technology
Laurette B. Foster, Prairie View A&M University
Yajun Yang, Farmingdale State College
Ray E. Collings, Georgia Perimeter College
- 1:00PM *A data-based project to enhance the teaching of functions in college algebra.*
► (1325) **Murray H. Siegel**, Central Arizona College (1046-C1-164)
- 1:20PM *Revitalizing college algebra: A success story.* Preliminary report.
(1326) **Kimberly Muller**, Lake Superior State University (1046-C1-29)
- 1:40PM *Infusing real-life opportunities, questions, and concepts into the mathematics curriculum.*
(1327) **Erick B. Hofacker***, University of Wisconsin-River Falls, and **Kathryn Ernie**, University of Wisconsin - River Falls (1046-C1-1478)
- 2:00PM *Getting students to DIGMath: Dynamic interactive graphics in college algebra.*
► (1328) **Sheldon P. Gordon**, Farmingdale State College (1046-C1-175)
- 2:20PM *Technology driven investigations for intermediate algebra for business majors.*
► (1329) **Wendiann R. Sethi**, Seton Hall University (1046-C1-1879)
- 2:40PM *Three interesting projects for college algebra.*
(1330) **Rich West**, Francis Marion University (1046-C1-1641)
- 3:00PM *A math teacher sees the light: Photonics labs in an algebra class.* Preliminary report.
► (1331) **June I. Decker**, Three Rivers Community College (1046-C1-1136)
- 3:20PM *Make COLLEGE algebra more meaningful for non-calculus-bound majors.*
(1332) **Xuhui Li**, California State University - Long Beach (1046-C1-1941)
- 3:40PM *Social science applications in an applied college algebra course.*
► (1333) **Lisa S. Yocco**, Georgia Southern University (1046-C1-319)
- 4:00PM *Making first year mathematics more relevant to science students: Connecting mathematics and science courses.* Preliminary report.
► (1334) **Jose H. Giraldo**, Texas A&M University-Corpus Christi (1046-C1-2027)
- 4:20PM *How mathematics can contribute to solving the problems facing the world; Building civic engagement into mathematics courses as a way to motivate and inspire students.*
► (1335) **Victor J. Donnay**, Bryn Mawr College (1046-C1-1681)
- 4:40PM *College algebra in context: A learner-centered approach incorporating data-driven activities related to social issues.*
► (1336) **Michael T. Catalano**, Dakota Wesleyan University (1046-C1-1816)
- 5:00PM *Focusing on algebraic understanding using a student-centered questioning framework.*
(1337) **Jennifer J. Kosiak*** and **Jon Hasenbank**, University of Wisconsin - La Crosse (1046-C1-1417)

- 5:20PM *Mathematical readiness of incoming college freshmen.*
(1338) **Marko Kranjc**, Western Illinois University (1046-C1-723)
- 5:40PM *News ways to compare NFL players, using model building.*
▶ (1339) **Jacqueline Brannon Giles**, HCC Central College, Houston, Texas (1046-C1-180)

MAA Session on Statistics Resources on the Web

1:00 PM – 4:00 PM

Organizers: **Dorothy W. Anway**, University of Wisconsin, Superior
Patricia B. Humphrey, Georgia Southern University
Christopher J. Lacke, Rowan University

- 1:00PM *Statistics resources in a "Math for Practical Arts" course.*
▶ (1340) **Mary R. Parker***, Austin Community College, and **Hunter D. Ellinger**, Exemplar Technologies (1046-W1-1646)
- 1:20PM *The challenges and benefits of using e-books and Web companion sites to organize statistics resources on the Web for statistics education.*
(1341) **Deborah Lurie**, Saint Joseph's University (1046-W1-1462)
- 1:40PM *Utilizing Web-based statistical resources in teaching nontraditional undergraduate students in online learning environments.* Preliminary report.
▶ (1342) **Michael Miner***, American Public University System, and **Darcel Ford**, Strayer University (1046-W1-1482)
- 2:00PM *A collection of resources for use in teaching statistics, including assessments, group activities, in and out of class calculator simulations, and several applets to demonstrate statistical concepts.*
▶ (1343) **Rob Eby**, Blinn College - Bryan Campus (1046-W1-1686)
- 2:20PM *Two applets for teaching IID sampling, sampling distributions, and the central limit theorem.*
▶ (1344) **Mark H. Inlow**, Rose-Hulman Institute of Technology (1046-W1-1172)
- 2:40PM *Interactive tools for exploring the standard normal curve and more.*
▶ (1345) **Susan M. Barton**, WVU Tech (1046-W1-1357)
- 3:00PM *Should statistics tables be banned from the curriculum?*
(1346) **Robin H. Lock**, St. Lawrence University (1046-W1-2031)
- 3:15PM Discussion

MAA Session on Assessment of Student Learning in Undergraduate Mathematics

1:00 PM – 5:55 PM

Organizers: **William O. Martin**, North Dakota State University
Bernard L. Madison, University of Arkansas

- 1:00PM *"Pair-Quizzes": An instructional and an evaluative tool in mathematics classes.* Preliminary report.
▶ (1347) **Harrison W. Straley*** and **Lauren Dupee**, Wheaton College (1046-A5-137)

- 1:20PM *Students' understanding of slope and direction fields in a non-traditional differential equations class.*
▶ (1348) **Samer S. Habre**, Lebanese American University (1046-A5-173)
- 1:40PM *Designing benchmarks for assessing undergraduate students' mathematics performances in general education.* Preliminary report.
▶ (1349) **Xuhui Li**, California State University Long Beach (1046-A5-379)
- 2:00PM *Outcomes based assessment of student learning in mathematics.* Preliminary report.
▶ (1350) **Ronald M. Brzenk**, Hartwick College (1046-A5-400)
- 2:20PM *An examination of the Mathematics and Technology Attitude Scale (MTAS): Implication to assessment of undergraduate mathematics.*
▶ (1351) **Jerry Obiekwe**, The University of Akron-Wayne College (1046-A5-1067)
- 2:40PM *Basic skills exam in college algebra.*
▶ (1352) **Karla Marie Childs**, Pittsburg State University (1046-A5-1131)
- 3:00PM *Calculus assessment: Then and now.* Preliminary report.
▶ (1353) **Sarah V. Cook**, Washburn University (1046-A5-1347)
- 3:20PM *Assessment across the curriculum; Varying strategies for varying situations.*
▶ (1354) **J. Winston Crawley*** and **James E. Hamblin**, Shippensburg University of Pennsylvania (1046-A5-1346)
- 3:40PM *Evolution of a capstone course for prospective high school mathematics teachers.* Preliminary report.
(1355) **Michael D. Bice**, California State University, Stanislaus (1046-A5-1884)
- 4:00PM *Challenges of assessing mathematics content courses designed specifically for middle childhood education majors.* Preliminary report.
▶ (1356) **Joy Moore**, Xavier University (1046-A5-1875)
- 4:20PM *Assessment working instead of working for assessment.* Preliminary report.
(1357) **Heather Coughlin**, California State University, Stanislaus (1046-A5-1848)
- 4:40PM *Assessing quantitative literacy using a wide range of news stories.* Preliminary report.
▶ (1358) **Milo Schield**, W. M. Keck Statistical Literacy Project (1046-A5-1820)
- 5:00PM *A control versus treatment evaluation of the chemistry in calculus project at William and Mary.*
(1359) **George Rublein**, College of William and Mary (1046-A5-1806)
- 5:20PM *Assessment of the undergraduate mathematics program.*
▶ (1360) **Melvin A. Nyman*** and **Robert Molina**, Alma College (1046-A5-1759)
- 5:40PM *Portfolio assessment of general education mathematics.* Preliminary report.
(1361) **Rich West**, Francis Marion University (1046-A5-1615)

MAA General Contributed Paper Session, VII

1:00 PM – 5:55 PM

- Organizer: **Sarah L. Mabrouk**, Framingham State College
- Moderators: **Thomas Philip Wakefield**, Slippery Rock University
Larry Lewis, Spalding University

Kyle Riley, South Dakota School of Mines & Technology

Jim Fulmer, University of Arkansas at Little Rock

- 1:00PM ► (1362) *10 questions about numbers: A college algebra writing assignment.* Preliminary report.
Elliott S. Elliott, University of Tennessee at Martin (1046-Z1-1114)
- 1:15PM ► (1363) *Why is one usually first? Preliminary report.*
Sandra J. Schroeder, Ohio Northern University (1046-Z1-1138)
- 1:30PM ► (1364) *Are you in or out? Mathematical lessons from fashion design.*
Jeff A. Suzuki, Brooklyn College (1046-Z1-536)
- 1:45PM ► (1365) *The continuous birthday problem.*
Dale K. Hathaway, Olivet Nazarene University (1046-Z1-918)
- 2:00PM ► (1366) *Discovering Bernoulli number identities via Euler-Maclaurin summation.* Preliminary report.
Hieu D. Nguyen, Rowan University (1046-Z1-406)
- 2:15PM (1367) *The role of external consultants as part of a departmental self study.*
Kyle L. Riley, SD School of Mines & Technology (1046-Z1-147)
- 2:30PM ► (1368) *Reconstructing graphs given only a few marked cards.*
Michael D. Barrus* and **Douglas B. West**, University of Illinois (1046-Z1-978)
- 2:45PM (1369) *Promoting responsibility and cooperation through the use of discussion boards.*
Janet L. Braunstein, United States Military Academy at West Point (1046-Z1-1516)
- 3:00PM ► (1370) *Visualizing continuity and differentiability of functions of two variables.*
Tom McMillan and **Jim Fulmer***, University of Arkansas at Little Rock (1046-Z1-1895)
- 3:15PM ► (1371) *The natural role of lower-division sequences and series as a pre-bridge course.*
Scott F. Beaver, Western Oregon University (1046-Z1-937)
- 3:30PM ► (1372) *Studying affect in undergraduate mathematics: Efforts to clarify students' experiences of learning mathematics.* Preliminary report.
Marja-Liisa Hassi*, University of Colorado at Boulder, and **Sandra Laursen**, University of Colorado at Boulder (1046-Z1-810)
- 3:45PM ► (1373) *Teacher versus student motivation: Who wins the game? Preliminary report.*
Laura J. Schmidt, University of Wisconsin-Stout (1046-Z1-772)
- 4:00PM ► (1374) *Pre/post tests for undergraduate mathematics.* Preliminary report.
Jacob Sloujitel, Globe Institute of Technology (1046-Z1-592)
- 4:15PM ► (1375) *Geometry: The hardest course? Preliminary report.*
H. A. Dye, McKendree University (1046-Z1-388)
- 4:30PM ► (1376) *An examination of the social class backgrounds of California's mathematics professors.*
Chris Pavone, **Sophy Huck**, California State University, Chico, **Megan K O'Connor**, Western Michigan University, **Carol A Wilson***, California State University, Sacramento, and **Elizabeth Zapata**, California State University, Chico (1046-Z1-386)
- 4:45PM ► (1377) *Traditional vs. online homework in college algebra.*
Kimberly Jordan Burch* and **Yu-Ju Kuo**, Indiana University of Pennsylvania (1046-Z1-375)

- 5:00PM ► (1378) *The role of the sampling distribution in student learning of inferential statistics.*
Barbara Bennie, University of Wisconsin - La Crosse (1046-Z1-372)
- 5:15PM ► (1379) *Elementary statistics: To lecture or not to lecture? That is the question.*
Pamela K. Wovchko, West Virginia Wesleyan College (1046-Z1-239)
- 5:30PM ► (1380) *Teaching technology to first year students.* Preliminary report.
Luz M. DeAlba, Drake University (1046-Z1-399)
- 5:45PM ► (1381) *The Kean STEM Scholarship Program: Successes in recruitment and retention of math and science majors.*
Pablo Zafra, **Louis M. Beaugris*** and **Kikombo Ngoy**, Kean University (1046-Z1-1514)

MAA General Contributed Paper Session, VIII

1:00 PM – 3:10 PM

- Organizer: **Sarah L. Mabrouk**, Framingham State College
- Moderators: **William Goldbloom Bloch**, Wheaton College
James Henderson, University of Pittsburgh-Titusville
- 1:00PM ► (1382) *Stabilizing vibrating beams with point-load damping.* Preliminary report.
Richard J. Marchand*, Slippery Rock University, and **Timothy J. McDevitt**, Elizabethtown College (1046-Z1-1452)
 - 1:15PM ► (1383) *Duplication, trisection, and quadrature by cheating.*
Charlie Smith, Park University (1046-Z1-1263)
 - 1:30PM ► (1384) *Digital signal processing in the service of mathematics courses.*
Mohamed Allali, Chapman University (1046-Z1-1110)
 - 1:45PM (1385) *Waring's problem in number fields.* Preliminary report.
Ala' Jamil Alnaser, Kansas State University (1046-Z1-1454)
 - 2:00PM ► (1386) *Ghosts of departed errors: Berkeley's mathematical objections to the calculus of Newton and Leibniz.*
Eugene C. Boman, Penn State, Harrisburg campus (1046-Z1-1676)
 - 2:15PM ► (1387) *Estimating relatedness using Markov Chain Monte Carlo techniques.*
Jennifer K. Angelosante* and **Amy Anderson**, Western Washington University (1046-Z1-1869)
 - 2:30PM ► (1388) *Arbitrary roughness.*
Elijah Miguel Allen, Armstrong Atlantic State University (1046-Z1-1891)
 - 2:45PM ► (1389) *The evolution of cooperation on random networks.*
Stephen Devlin*, University of San Francisco, and **Thomas Treloar**, Hillsdale College (1046-Z1-2079)
 - 3:00PM (1390) *Toughness extended to infinite graphs.*
Kevin K. Ferland, Bloomsburg University of PA (1046-Z1-2097)

MAA General Contributed Paper Session, IX

1:00 PM – 2:55 PM

- Organizer: **Sarah L. Mabrouk**, Framingham State College
- Moderators: **Jose Maria Menendez**, University of Arizona
Anand L. Pardhanani, Earlham College

- 1:00PM *Mathematics from work and home: Lessons learned.*
(1391) **José María Menéndez**, The University of Arizona (1046-Z1-875)
- 1:15PM *Optimizing data returned by pop up satellite tags.*
▶ (1392) Preliminary report.
Joseph B. Liddle*, University of Alaska Southeast, and **Michael Musyl**, University of Hawaii (1046-Z1-1068)
- 1:30PM *Mathematical models for call options on stocks.*
▶ (1393) **Nicole Stawasz**, King's College (1046-Z1-923)
- 1:45PM *Examples of embedded minimal spheres without area bounds.*
▶ (1394) **Joel I. Kramer**, The Johns Hopkins University (1046-Z1-726)
- 2:00PM *Partial fraction decomposition extensions.*
▶ (1395) Preliminary report.
Kevin E. Charwood, Washburn University (1046-Z1-561)
- 2:15PM *Models of undergraduate computational science curricula.*
(1396) **Ignatios Vakalis**, Computer Science Department (1046-Z1-508)
- 2:30PM *Chances of a cruise ship birthday match.*
▶ (1397) **David T. Atkinson**, Olivet Nazarene University (1046-Z1-909)
- 2:45PM *Synthetic mathematical thought.*
▶ (1398) **Timothy G. Hall**, PQI Consulting (1046-Z1-172)
- 2:00PM *Sea ice modeling in the GCM context.*
▶ (1405) **Elizabeth C. Hunke**, Los Alamos National Laboratory (1046-86-1242)
- 2:30PM *Sunlight, water, and ice: The sea ice-albedo feedback in a changing climate.*
▶ (1406) **Donald K. Perovich**, ERDC - Cold Regions Research and Engineering Laboratory (1046-86-1056)
- 3:00PM *Sea ice thickness and kinematics.*
(1407) **Ron Kwok**, CA (1046-86-1424)
- 3:30PM *Sea ice: Fracture and frictional sliding on small and large scales.*
(1408) **Erland M. Schulson**, Dartmouth College (1046-00-941)
- 4:00PM *Modeling sea-ice mechanics.*
(1409) **Deborah Sulsky***, **Kara Peterson**, University of New Mexico, **Giang Nguyen**, University of Sydney, and **Howard Schreyer**, University of New Mexico (1046-86-900)
- 4:30PM *An optimization approach to modeling sea-ice dynamics.*
▶ (1410) **Esteban G. Tabak***, Courant Institute of Math. Science, New York University, and **Helga S. Huntley**, University of Delaware, College of Marine & Earth Science (1046-76-1687)
- 5:00PM *Climate change and the peculiar Antarctic ocean.*
▶ (1411) **Thorsten Markus**, NASA Goddard Space Flight Center (1046-00-1227)

MAA Invited Paper Session on the Beauty and Power of Number Theory

1:00 PM – 2:55 PM

Organizers: **Thomas Koshy**, Framingham State College
Thomas Moore, Bridgewater State College

- 1:00PM *Hooks and infinite product power series.*
▶ (1399) **Ken Ono**, U. Wisconsin, Madison (1046-A2-694)
- 1:30PM *Sociable numbers: New developments on an ancient problem.*
▶ (1400) **Mitsuo Kobayashi**, Dartmouth College, **Paul Pollack**, University of Illinois at Urbana-Champaign, and **Carl Pomerance***, Dartmouth College (1046-A2-712)
- 2:00PM *Undecidability in number theory.*
(1401) **Kirsten Eisentraeger**, The Pennsylvania State University (1046-A2-727)
- 2:30PM *Surprises from Ramanujan's Lost Notebook.*
▶ (1402) **George E. Andrews**, The Pennsylvania State University (1046-A2-697)

SIAM Minisymposium on Polar Climate Modeling

1:00 PM – 5:25 PM

Organizers: **Kenneth M. Golden**, University of Utah
David M. Holland, Courant Institute of Mathematical Sciences-NYU
Moderator: **Deborah L. Sulsky**, University of New Mexico

- 1:00PM *Observations and modeling of ice sheet - Ocean interaction.* Preliminary report.
▶ (1403) **David M. Holland**, Courant Institute of Mathematical Sciences (1046-76-748)
- 1:30PM *Polar ice sheets: Observations and models.*
(1404) **Kenneth Jezek**, The Ohio State University (1046-00-1301)

NAM Granville-Brown-Haynes Session of Presentations by Recent Doctoral Recipients in the Mathematical Sciences

1:00 PM – 2:55 PM

- 1:00PM *Maximal groups in the Stone-Cech Compactification the free semigroup.*
▶ (1412) **Lakeshia R. Legette**, Johnson C. Smith University (1046-54-1139)
- 1:30PM *Development of an unsplit, time dependent, three dimensional elastic perfectly matched layer for elasto-dynamic analyses.*
(1413) **Anthony N. Johnson**, United States Military Academy (1046-35-775)
- 2:00PM *Prime ideals in low-dimensional mixed polynomial/power series rings.* Preliminary report.
(1414) **Christina Eubanks-Turner***, University of Louisiana at Lafayette, **Melissa Luckas**, Madison, Wisconsin, and **Serpil Saydam**, University of Louisiana at Monroe (1046-13-348)
- 2:30PM *Oscillation theory of dynamic equations on time scales.* Preliminary report.
(1415) **Raegan J Higgins**, Texas Tech University (1046-39-249)

MAA Panel Discussion

1:00 PM – 2:20 PM

Refocusing the courses below calculus: The view from the Dean's office.

Organizer: **Sheldon P. Gordon**, Farmingdale State College

Panelists: **Bruce C. Crauder**, Oklahoma State University
Judi H. Morrel, Butler University
Rhonda Mandel, SUNY Oswego
Reggie K. U. Luke, Middlesex County College

MAA Panel Discussion

1:00 PM – 2:20 PM

Power of three: How the public, private, and academic sector need to work together to restore education in America.

Organizer: **Jim Whaley**, Siemens Foundation

AMS Session on Ordinary Differential Equations

1:15 PM – 6:10 PM

- 1:15PM Multiplicity of positive solutions for an even-order nonhomogeneous boundary value problem.
(1416) **Britney Hopkins**, Baylor University (1046-34-40)
- 1:30PM Basic results and stability criteria for set valued differential equations on time scales.
(1417) **S. Sivasundaram**, Embry Riddle Aeronautical University (1046-34-547)
- 1:45PM A numerical solution for a nonlinear integro-differential equation in a population model.
(1418) **Mohsen Razzaghi**, Mississippi State University (1046-34-657)
- 2:00PM A mass, a spring, and a string.
(1419) **Don Hinton**, University of Tennessee, and **Maeve L. McCarthy***, Murray State University (1046-34-698)
- 2:15PM Stability of perturbed almost periodic ordinary differential equations. Preliminary report.
(1420) **Zhivko S. Athanassov**, Bulgarian Academy of Sciences (1046-34-840)
- 2:30PM Poisson stability and chaos of relay systems.
(1421) **Marat Akhmet**, Middle East Technical University (1046-34-845)
- 2:45PM A periodically forced, cubic-like, single neuron equation with multiple attractors.
(1422) **Robert J. Decker*** and **V. W. Noonburg**, University of Hartford (1046-34-984)
- 3:00PM Regular bursting emerging from synaptically coupled elliptic bursters. Preliminary report.
► (1423) **Jianzhong Su** and **Humberto Perez***, University of Texas at Arlington (1046-34-1074)
- 3:15PM The ultimate N-Body algorithm: Parameter-free, adaptive, and parallel.
(1424) **C. David Pruett***, James Madison University, and **William H. Ingham**, James Madison University (1046-34-949)
- 3:30PM Break
- 3:45PM Existence and uniqueness of traveling waves in a class of unidirectional lattice differential equations.
(1425) **Aaron Hoffman**, Boston University, and **Benjamin Kennedy***, Gettysburg College (1046-34-790)
- 4:00PM On singular solutions of Clairaut-type differential equations. Preliminary report.
(1426) **M. Affouf**, Kean University (1046-34-1161)
- 4:15PM Uniqueness implies existence and uniqueness conditions for a Class of $(k + j)$ -point boundary value problems for n th order differential equations.
(1427) **Paul W. Elie***, University of Dayton, and **Johnny Henderson**, Baylor University (1046-34-1253)
- 4:30PM On the Aizerman problem for second-order systems with multiple delays.
(1428) **Dmitry Altshuller**, Crane Aerospace & Electronics (1046-34-1258)
- 4:45PM An application of the left-definite spectral theory to the Jacobi differential equation for non-classical parameters.
(1429) **Andrea Bruder**, Baylor University (1046-34-1355)

- 5:00PM Existence of bounded monotonic solutions of second order differential equations. Preliminary report.
(1430) **Lianwen Wang** and **Rhonda McKee***, University of Central Missouri (1046-34-1425)
- 5:15PM Uniqueness implies existence for nonlinear focal-like boundary value problems.
(1431) **Jeffrey A. Ehme***, Spelman College, and **Aprillya Lanz**, Virginia Military Institute (1046-34-1628)
- 5:30PM Continuity and boundedness of solutions of differential equations without bounded assumption on nonlinear functions.
► (1432) **Brittney N. Hinds**, University of Central Missouri (1046-34-1769)
- 5:45PM Circuit approach to modeling neurons: New dynamical structures and chaotic behavior.
► (1433) **Tyler Y. Takeshita***, University of Northern Colorado, and **Adrienne Amador**, Kenyon College (1046-34-1922)
- 6:00PM Newton-like methods for convex-concave functions via the method of generalized quasilinearization. Preliminary report.
► (1434) **Cesar Martinez Garza**, Pennsylvania State University - Berks Campus (1046-34-2039)

ASL Contributed Paper Session

2:00 PM – 4:50 PM

- 2:00PM The MP axiom of intensionality: Connecting types and sets.
(1435) **Sandro Skansi**, University of Zagreb
- 2:30PM Some theories concerning deontic implications of proof for belief.
(1436) **Billy Joe Lucas**, Manhattanville College
- 3:00PM Canonicity in symmetric generalized Galois Logics.
(1437) **Katalin Bimbo***, University of Alberta, and **J. Michael Dunn**, Indiana University
- 3:30PM Non-isomorphic automorphism groups of short recursively saturated models of PA.
(1438) **Erez Shochat**, St. Francis College
- 4:00PM Automorphisms of certain filters of $\mathcal{L}^*(V_\infty)$.
(1439) **Rumen D. Dimitrov**, Western Illinois University
- 4:30PM Coding Turing degrees in geometric objects.
(1440) **W. Calvert***, Murray State University, **V.S. Harizanov**, The George Washington University, and **A. Shlapentokh**, East Carolina University

MAA Minicourse #12: Part B

2:15 PM – 4:15 PM

SNAP Math Fairs in elementary education.
Organizers: **Andrew C.-F. Liu**, University of Alberta
Tanya Thompson, ThinkFun, Inc.

MAA Minicourse #2: Part B

2:15 PM – 4:15 PM

Using GeoGebra to create activities and applets for visualization and exploration.
Organizer: **Michael K. May**, Saint Louis University

MAA Minicourse #7: Part B

2:15 PM – 4:15 PM

A Game Theory path to quantitative literacy.
Organizers: **David L. Housman**, Goshen College
Richard A. Gillman, Valparaiso University

RMMC Board of Directors

2:15 PM – 4:10 PM

MAA Presentations by Teaching Awards Recipients

2:30 PM – 4:00 PM

Organizer: **Martha J. Siegel**, Towson University
Moderator: **Joseph A. Gallian**, University of Minnesota-Duluth

- (1441) *From groups to graphics: Stories of undergraduate research in visualizing abstract mathematics.*
Michael J. Bardzell, Salisbury University (1046-A0-220)
- (1442) *My teaching philosophy and the development of keystone method: A synergistic model for teaching and learning.*
M. Vali Siadat, Richard J. Daley College (1046-A0-221)
- (1443) *How to beat the lecture/textbook trap! An active classroom via advance student reading and writing.*
David J. Pengelley, New Mexico State University (1046-A0-222)

AMS Committee on Science Policy Presentation

2:30 PM – 4:00 PM

Future federal science and technology budgets.
Presenter: **Kei Koizumi**, AAAS

MAA Panel Discussion

2:30 PM – 3:50 PM

From the trenches: Middle school teachers look at their training.

Organizers: **Florence D. Fasanelli**, AAAS
George M. Rosenstein, Franklin & Marshall College

Moderator: **Hyman Bass**, University of Michigan, Ann Arbor

Panelists: **Beth Cole**, St. Patrick Episcopal School
Michelle Johncock, Edmund Burke School
Brieta Dougherty-Brill, Maya Angelou Public Charter School
Marcia Cole, Clark Elementary School

MAA Special Film Presentation

3:00 PM – 4:00 PM

The story of maths (Part II).
Presenter: **Robin Wilson**, The Open University

MAA Open House

3:00 PM – 6:00 PM

Come see the MAA Dolciani Mathematical Center, the Halmos Carriage House, and the River of Bricks; shuttle service available from the Marriott's 24th St. entrance.

MAA Session on Research on the Teaching and Learning of Undergraduate Mathematics, II

3:15 PM – 5:00 PM

Organizers: **Keith H. Weber**, Rutgers University

Michelle J. Zandieh, Arizona State University

Karen A. Marrongelle, Portland State University

- 3:15PM (1444) *Students' reasoning about the concept of limit in the context of reinventing the formal definition.*
Craig A. Swinyard, University of Portland (1046-U1-1916)
- 3:50PM (1445) *Addressing student difficulties with negating mathematical statements and translating statements from English to symbolic form.* Preliminary report.
Bonnie Gold, Monmouth University (1046-U1-504)
- 4:15PM (1446) *Using a model-eliciting activity to teach exponential growth: An investigation of student conceptions and affect.*
Stacey A. Bowling, Arizona State University (1046-U1-1443)
- 4:40PM (1447) *Designing and assessing hands-on statistics activities: The central limit theorem and hypothesis testing.* Preliminary report.
Aaron D. Weinberg* and **Thomas J. Pfaff**, Ithaca College (1046-U1-1289)

MAA Poster Session on Research by Undergraduate Students

4:00 PM – 5:30 PM

Organizer: **Diana M. Thomas**, Montclair State University

AMS Session on Behavioral Sciences

4:15 PM – 5:40 PM

- 4:15PM (1448) *Studying voting paradoxes through representation theory.*
Gregory Minton, New York, NY (1046-91-1603)
- 4:30PM (1449) *Dice voting: A deterministic method for aggregating pairwise preferences.* Preliminary report.
Eric A. Gilson*, University of Rochester, **Chelsey A. Cooley**, North Carolina State University, **William M. Ella**, University of Mary Washington, **Micheal L. Follett** and **Lorenzo Traldi**, Lafayette College (1046-91-1485)
- 4:45PM (1450) *Clubs, beliefs, and entrapment.*
Scott Duke Kominers, Harvard University (1046-91-1432)
- 5:00PM (1451) *Uncertainty quantification: Improved stochastic finite element approach.*
Oleg Roderick*, Argonne National Laboratory / Portland State University, **Mihai Anitescu** and **Paul Fischer**, Argonne National Laboratory (1046-90-666)
- 5:15PM (1452) *Rational behavior in response to pandemic influenza, and consequences for control.* Preliminary report.
Timothy C. Reluga, Pennsylvania State University (1046-91-1547)
- 5:30PM (1453) *An optimal strategy for energy allocation in a multiple resource environment.* Preliminary report.
Anthony Tongen*, **D. Brian Walton**, **Deena Hannoun** and **Leslie Hindman**, James Madison University (1046-91-1791)

AMS Special Presentation on Congressional Fellowships

4:30 PM – 6:30 PM

Organizer: **Samuel M. Rankin III**, AMS

SIGMAA on Business, Industry, and Government Guest Lecture

5:00 PM – 6:00 PM

(1454) *Calculus in orbit.*
Dan Kalman, American University

MAA Information Session

5:00 PM – 7:00 PM

Actuarial education; cosponsored by ACTEX, CAS, and SOA.

Organizers: **Robert E. Buck**, Slippery Rock University
Bettye Anne Case, Florida State University
Kevin E. Charlwood, Washburn University
Steve P. Paris, Florida State University
 Panelists: **James W. Daniel**, University of Texas at Austin
Ken Guthrie, Society of Actuaries
Bryan Hearsey, Lebanon Valley College
Emily Kessler, Society of Actuaries
Hwa Chi Liang, Washburn University

SIGMAA on Circles Business Meeting

6:00 PM – 7:00 PM

Mathematical Reviews Reception

6:00 PM – 7:00 PM

BIG SIGMAA RECEPTION

6:15 PM – 7:15 PM

AMS Special Film Presentation

7:00 PM – 8:30 PM

Wolfgang Doeblin—A mathematician rediscovered.

SIGMAA on Mathematics and the Arts Special Presentation

7:00 PM – 9:00 PM

Mathematics and love: A poetry reading.

Organizer: **JoAnne Growney**, Silver Spring, MD
 Moderator: **Sarah Glaz**, University of Connecticut
 Presenters: **Karren LaLonde Alenier**, Chevy Chase, MD
Judith Baumel, Adelphi University
Marion Deutsche Cohen, Arcadia University
Jennifer Crow, West Falls, NY
Kathryn DeZur, SUNY Technical College at Delhi
Sarah Glaz
Emily Grosholz, Pennsylvania State University
JoAnne Growney
Bob Grumman, Port Charlotte, FL
Israel Lewis, Silver Spring, MD

Kaz Maslanka, D3 Technologies
Wilmer Mills, University of North Carolina
Wendy Mnookin, Emerson College
Kyoko Mori, George Mason University
Deanna Nikaido, Baltimore, MD
Becky Dennison Sakellariou, Kifissia, GR
Elizabeth Anne Socolow, Evergreen Forum
John Vieira, Potomac, MD
Ellen Wehle, West Chester University

NAM Cox-Talbot Address

7:30 PM – 8:30 PM

(1455) *State of a M.A.D. Union.*
Leon Woodson, Morgan State University

MAA-Project NExT Reception

8:30 PM – 10:30 PM

All Project NExT Fellows, consultants, and other friends of Project NExT are invited.

Thursday, January 8

MAA Minority Chairs Breakfast Meeting

7:00 AM – 8:45 AM

Joint Meetings Registration

7:30 AM – 2:00 PM

AMS Special Session on Nonlinear Evolution Equations and Their Applications, I

7:30 AM – 10:55 AM

Organizers: **Gaston N'Guerekata**, Morgan State University
Alexander A. Pankov, Morgan State University
Guoping Zhang, Morgan State University
Xuming Xie, Morgan State University
Zhijun Qiao, University of Texas Pan American

7:30AM *Stability of a combustion front.*
 (1456) **Yuri Latushkin**, University of Missouri (1046-35-2125)
 8:30AM *Standing wave of the discrete nonlinear Schroedinger equations with growing potentials.*
 (1457) Preliminary report.
Guoping Zhang* and **Alexander Pankov**, Morgan State University (1046-39-722)
 9:00AM *Bilinear equations, integrable semi-discretization, and novel numerical computations of the Camassa-Holm equation.*
 (1458) **Bao-Feng Feng***, The University of Texas-Pan American, **Yasuhiro Ohta**, Kobe University, Japan, and **Ken-ichi Maruno**, The University of Texas-Pan American (1046-35-1426)

- 9:30AM *On a method of resolution of controllability problems for a semilinear heat equation: Application to the sentinels.*
(1459) **Gisele Massengo Mophou***, Université des Antilles et de la Guyanne (Campus de Fouillol), and **Ousseynou Nakoulima**, Université des Antilles et de la Guyane (Campus de Fouillol) (1046-93-961)
- 10:00AM *Stepanov-like almost automorphy and monotone evolution equations.*
(1460) **Gaston M. N'Guerekata*** and **Alexander Pankov**, Morgan State University (1046-35-842)
- 10:30AM *Traveling wave solutions for a modified Fisher PDE having square-root and linear reaction terms.*
(1461) **Ronald E. Mickens**, Clark Atlanta University (1046-35-126)

- 9:00AM *Drawing diagrams and making arguments in Greek mathematics.*
▶ (1470) **Nathan Sidoli**, Osaka Prefecture University (1046-01-557)
- 9:30AM *Ptolemy's indisputable mathematical tools.*
(1471) **Jacqueline Fekete**, IHPST, University of Toronto (1046-01-719)
- 10:00AM *From proofs to Suanli (mathematical principles) in Late Imperial China.*
▶ (1472) **Jiang-Ping Jeff Chen**, St. Cloud State University (1046-01-238)
- 10:30AM *George Sarton (1884-1956) and Chinese mathematics.* Preliminary report.
▶ (1473) **Yibao Xu**, BMCC, CUNY (1046-01-242)

AMS Special Session on Continued Fractions, II

7:30 AM – 10:50 AM

Organizers: **James G. McLaughlin**, West Chester University
Nancy J. Wyshinski, Trinity College

- 7:30AM *Some types of multi-dimensional continued fractions.* Preliminary report.
▶ (1462) **Khrystyna Kuchmins'ka**, Pidstryhach Institute of Applied Problems of Mechanics and Mathematics of NAS of Ukraine (1046-40-606)
- 8:30AM *Sequential closures of continued fractions.* Preliminary report.
(1463) **Douglas Bowman**, Northern Illinois University (1046-40-1793)
- 9:00AM *Classifying sequential closures of q -continued fractions.* Preliminary report.
(1464) **D. Bowman** and **K. J. Campbell***, Northern Illinois University (1046-11-598)
- 9:30AM *Nearest square continued fractions, and related results.*
▶ (1465) **Keith R. Matthews**, Univ. Of Queensland, Brisbane, and Australian Nat'l Univ., Canberra, **John P. Robertson***, Actuarial and Economic Services Division, National Council on Compensation Insurance, Boca Raton, FL, and **Jim White**, Australian National University, Canberra (1046-11-418)
- 10:00AM *Polynomial continued fractions and iterated function systems.* Preliminary report.
▶ (1466) **Eugen Andrei Ghenciu**, University of Alaska Fairbanks (1046-11-142)
- 10:30AM *Some new families of Tasoevian and Hurwitzian continued fractions.*
(1467) **James G. McLaughlin**, West Chester University, PA (1046-11-127)

AMS-MAA Special Session on History of Mathematics, III

8:00 AM – 10:55 AM

Organizers: **Joseph W. Dauben**, Lehman College
Karen H. Parshall, University of Virginia
Patti Hunter, Westmont College
Deborah Kent, Hillsdale College

- 8:00AM *On the history of algebra.* Preliminary report.
▶ (1468) **Victor J. Katz**, University of the District of Columbia (1046-01-447)
- 8:30AM *The problem of word problems.* Preliminary report.
(1469) **Duncan J. Melville**, St. Lawrence University (1046-01-639)

AMS-MAA Special Session on Inquiry-Based Learning, I

8:00 AM – 10:45 AM

Organizers: **William B. Jacob**, University of California Santa Barbara
Paul J. Sally, University of Chicago
Ralf J. Spatzier, University of Michigan
Michael Starbird, University of Texas at Austin

- 8:00AM *IBL analysis at The University of Texas.* Preliminary report.
(1474) **Edward Odell**, The University of Texas at Austin (1046-97-1259)
- 8:30AM *Inquiry about inquiry: Use of case studies to develop mathematical ideas in courses for pre-service teachers.*
(1475) **Bill Jacob**, University of California, Santa Barbara (1046-97-779)
- 9:00AM *Inquiry-based learning opportunities for secondary teachers and students.*
(1476) **Bret Benesh**, College of Saint Benedict, **Andrew Engelward**, Harvard University, **Thomas W. Judson***, Stephen F. Austin University, and **Matthew Leingang**, New York University (1046-97-489)
- 9:30AM *Outreach IBL at the University of Chicago.*
(1477) **Paul J. Sally**, University of Chicago (1046-97-1380)
- 10:00AM Discussion

AMS Special Session on Function Theoretic Operator Theory, I

8:00 AM – 10:50 AM

Organizers: **John B. Conway**, George Washington University
Sherwin Kouckekian, University of South Florida
William T. Ross, University of Richmond

- 8:00AM *Nehari's problem and matrix A_2 .*
(1478) **Alexander L. Volberg***, Michigan State University, University of Edinburgh, and **Peter Yuditskii**, Univ. of Linz, Austria, MSU (1046-30-457)
- 8:30AM *Toeplitz kernels and Polya sets.*
(1479) **Alexei Poltoratski**, Texas A&M University (1046-30-320)
- 9:00AM *Asymptotics of polynomials orthogonal over planar regions with analytic boundary.* Preliminary report.
(1480) **Erwin Miña-Díaz***, University of Mississippi, and **Peter Draznev**, Indiana-Purdue University Fort Wayne (1046-30-651)

- 9:30AM (1481) *Toeplitz-Composition algebras with several generators.*
Tom Kriete, Barbara MacCluer, University of Virginia, and **Jennifer Moorhouse***, Colgate University (1046-46-1433)
- 10:00AM (1482) *Multiplication operators on the Bloch space of a bounded homogeneous domain.* Preliminary report.
Robert F. Allen, George Mason University (1046-47-567)
- 10:30AM (1483) *Hypercyclic operators with a prescribed spectrum.* Preliminary report.
Nathan S. Feldman, Washington & Lee University (1046-47-914)

AMS Special Session on Commutative Rings, II

8:00 AM – 10:50 AM

Organizers: **Jay A. Shapiro**, George Mason University
David E. Dobbs, University of Tennessee, Knoxville
Shane P. Redmond, Eastern Kentucky University
Joe A. Stickles, Millikin University

- 8:00AM (1484) *Kronecker function rings of transcendental field extensions.*
Olivier Kwegna Heubo, New Mexico State University (1046-13-237)
- 8:30AM (1485) *Compact metric spaces and Prufer domains of polynomials.* Preliminary report.
K. Alan Loper*, Ohio State University - Newark, and **Francesca Tartarone**, University of Rome III (1046-13-1375)
- 9:00AM (1486) *Prufer domains with Clifford class semigroup.*
Warren Wm. McGovern, Bowling Green State University (1046-13-1238)
- 9:30AM (1487) *Straight rings, II.* Preliminary report.
Gabriel Picavet*, Université Blaise Pascal, and **D. E. Dobbs**, University of Tennessee, Knoxville (1046-13-851)
- 10:00AM (1488) *Gaussian properties of group rings.* Preliminary report.
Sarah Glaz, University of Connecticut (1046-13-1291)
- 10:30AM (1489) *Finitistic projective and flat dimensions of commutative rings.*
Silvana Bazzoni, Padova University, Italy (1046-13-1204)

AMS Special Session on SAGE and Mathematical Research Using Open Source Software, I

8:00 AM – 10:50 AM

Organizers: **David Saunders**, University of Delaware
David Harvey, Harvard University
David Joyner, U.S. Naval Academy

- 8:00AM (1490) *Undergraduate research in the mathematics of voting and choice using Sage.* Preliminary report.
Karl-Dieter Crisman, Gordon College (1046-91-102)
- 8:30AM (1491) *Sage in an early-graduate research course investigating the minimum rank problem.*
Jason Grout, Iowa State University (1046-15-1841)
- 9:00AM (1492) *zn.poly: A library for polynomial arithmetic.* Preliminary report.
David M. Harvey, New York University (1046-11-1822)

- 9:30AM (1493) *Fast multiplication with low space complexity.* Preliminary report.
Daniel S. Roche, University of Waterloo (1046-68-1837)
- 10:00AM (1494) *Solutions, bounds, and finiteness of polynomial systems in Sage.*
Marshall Hampton, University of Minnesota, Duluth (1046-13-20)
- 10:30AM (1495) *Rump's model problem and the computer search for records in number theory.* Preliminary report.
Erich Kaltofen, North Carolina State University (1046-11-2094)

AMS Special Session on Homotopy Theory and Higher Categories, III

8:00 AM – 10:50 AM

Organizers: **Thomas M. Fiore**, University of Chicago
Mark W. Johnson, Penn State Altoona
James M. Turner, Calvin College
W. Stephen Wilson, Johns Hopkins University
Donald Yau, Ohio State University at Newark

- 8:00AM (1496) *The homotopy theory of n-fold categories.*
Thomas M. Fiore*, University of Chicago, **Simona Paoli**, University of Haifa, and **Dorette Pronk**, Dalhousie University (1046-55-156)
- 8:30AM (1497) *Defining the units of equivariant ring spectra.*
Rekha Santhanam, Johns Hopkins University (1046-55-1248)
- 9:00AM (1498) *Orientations and p-adic Analysis.*
Barry John Walker, Northwestern University (1046-55-2105)
- 9:30AM (1499) *Level structures, Igusa tower and topological modular forms.*
Valentina Joukhovitski, University of Michigan (1046-55-1845)
- 10:00AM (1500) *The homology of topological modular forms.*
Paul Thomas Pearson, University of Rochester (1046-55-1436)
- 10:30AM (1501) *Unstable module presentations for the cohomology of real projective spaces.*
David Pengelley* and **Frank Williams**, New Mexico State University (1046-55-279)

AMS Special Session on Spectra of Matrix Patterns and Applications to Dynamical Systems, I

8:00 AM – 10:50 AM

Organizers: **Bryan L. Shader**, University of Wyoming
Luz M. DeAlba, Drake University
Leslie Hogben, Iowa State University
In-Jae Kim, Minnesota State University

- 8:00AM (1502) *Spectra of matrix patterns.*
Leslie Hogben, Iowa State University & American Institute of Mathematics (1046-15-671)
- 8:30AM (1503) *Spectra of matrices applied to dynamical models of infectious disease.*
Pauline van den Driessche, University of Victoria, Canada (1046-15-568)
- 9:00AM (1504) *Spectral properties of nonnegative and eventually nonnegative matrices.*
Judith J. McDonald, Washington State University (1046-15-1339)

- 9:30AM *Should I stay or should I go? On the evolution of dispersal.*
 ▶ (1505) **Sebastian J. Schreiber**, University of California, Davis (1046-92-434)
- 10:00AM *Eigenvalues and the scrambling index for stochastic matrices.*
 (1506) **Mahmud Akelbek**, Weber State University, and **Steve Kirkland***, University of Regina (1046-15-1029)
- 10:30AM *Low rank perturbations and inertias of full symmetric sign patterns.*
 ▶ (1507) **Charles Waters** and **In-Jae Kim***, Minnesota State University, Mankato (1046-15-541)

AMS Special Session on Financial Mathematics, II

8:00 AM – 10:50 AM

Organizers: **Erhan Bayraktar**, University of Michigan
Tim Siu-Tang Leung, Johns Hopkins University
Birgit Rudloff, Princeton University

- 8:00AM *The recent financial turmoil and related research problems.*
 ▶ (1508) **Steven Kou**, Columbia University (1046-91-744)
- 8:30AM *Stability and equilibria of financial markets.*
 (1509) Preliminary report.
Gordan Zitkovic, University of Texas at Austin (1046-91-759)
- 9:00AM *Stock market insider trading in continuous time with imperfect dynamic information.*
 (1510) **Albina Danilova**, Carnegie Mellon University (1046-91-1297)
- 9:30AM *A Markov model for the dynamics of a limit order book.*
 (1511) **Sasha F. Stoikov***, Cornell, **Rama Cont** and **Rishi Talreja**, Columbia (1046-90-1450)
- 10:00AM *No arbitrage conditions for simple trading strategies.*
 (1512) **Hasanjan Sayit***, Worcester Polytechnic Institute., and **Erhan Bayraktar**, University of Michigan (1046-60-778)
- 10:30AM *A note on admissible strategies for general stochastic processes and applications.* Preliminary report.
 (1513) **Sara Biagini**, Università di Perugia, and **Mihai Sirbu***, University of Texas at Austin (1046-60-1427)

AMS Special Session on Dynamical Systems and Differential Equations: Theory and Applications, II

8:00 AM – 10:50 AM

Organizers: **Annalisa Crannell**, Franklin & Marshall College
Suzanne Sindi, Brown University

- 8:00AM *An extension of the notion of zero-epi maps to the context of topological spaces.*
 (1514) **Alfonso Vignoli**, Seconda Università di Roma -Tor Vergata (1046-37-1651)
- 8:30AM *The minimal period problem of Mario Martelli.*
 (1515) **Diana M. Thomas**, Montclair State University (1046-34-1587)
- 9:00AM *Multiple limit cycles in the standard model of three species competition for three essential resources.*
 ▶ (1516) **Steve Baer**, Arizona State University, **Bingtuan Li**, University of Louisville, and **Hal L. Smith***, Arizona State University (1046-34-477)

- 9:30AM *Modeling the evolution of repetitive sequence in DNA.*
 ▶ (1517) **Suzanne S. Sindi**, Brown University (1046-34-551)
- 10:00AM *Globally stable equilibria.*
 (1518) **Basilio Messano**, University of Napoli (1046-37-711)
- 10:30AM *On the longitudinal librations of hyperion.*
 (1519) **Mario Umberto Martelli**, Claremont Graduate University (1046-34-634)

AMS Special Session on Orderings in Logic and Topology, I

8:00 AM – 10:50 AM

Organizers: **Valentina S. Harizanov**, George Washington University
Jozef H. Przytycki, George Washington University

- 8:30AM *Topology of spaces of orderings of groups.*
 ▶ (1520) Preliminary report.
Adam S. Sikora, SUNY Buffalo (1046-06-1077)
- 9:30AM *The Conrad property for left orderings on groups from a topological and a dynamical viewpoint.*
 (1521) **Andres Navas**, University of Santiago, Chile (1046-06-662)
- 10:30AM *Left ordered and discretely ordered groups.*
 (1522) **Peter A. Linnell**, Virginia Tech (1046-20-1073)

AMS Special Session on Scientific Computing and Advanced Computation, I

8:00 AM – 10:50 AM

Organizers: **Edward Castillo Jr.**, University of California Irvine
James M. Rath, University of Texas at Austin
Sarah A. Williams, University of California Davis

- 8:00AM *Asynchronous event-driven particle algorithms in computational materials science.*
 (1523) **Aleksandar Donev**, Lawrence Livermore National Laboratory (1046-68-1397)
- 8:30AM *A noisy adiabatic theorem and implications for quantum computing.*
 ▶ (1524) **Dianne P. O'Leary**, University of Maryland (1046-65-569)
- 9:00AM *The mathematics of scientific software automation.*
 (1525) **L. Ridgway Scott**, University of Chicago (1046-65-1205)
- 9:30AM *Computational optimization: Insights & questions.*
 ▶ (1526) **Stephen G. Nash**, George Mason University (1046-49-1228)
- 10:00AM *Experiences in computational science and the Department of Scientific Computing at FSU.*
 ▶ (1527) **Max Gunzburger**, Florida State University (1046-65-2117)
- 10:30AM *Scientific computing at Stony Brook University.*
 ▶ (1528) **James Glimm**, Stony Brook University (1046-76-1216)

AMS Session on Algebraic Geometry and K-Theory

8:00 AM – 10:55 AM

- 8:00AM *Differential Tannakian categories.*
 (1529) **Alexey Ovchinnikov**, University of Illinois at Chicago (1046-14-100)

- 8:15AM *Motivic zeta-functions for curves with group actions.*
(1530) **Justin D. Mazur**, Indiana University (1046-14-515)
- 8:30AM *On splice quotients of the form $\{z^n = f(x, y)\}$.*
(1531) **Elizabeth A. Sell**, Millersville University (1046-14-169)
- 8:45AM *K3 surfaces and modular parametrizations.*
(1532) **Ursula A. Whitcher**, University of Washington (1046-14-312)
- 9:00AM *Translation covers among triangular billiards surfaces.* Preliminary report.
► (1533) **Jason P. Schmurr**, Oregon State University (1046-14-535)
- 9:15AM *Birational geometry of the moduli space of curves with marked points.*
(1534) **David Jensen**, University of Texas at Austin (1046-14-996)
- 9:30AM Break
- 9:45AM *Weighted homogeneous polynomials and the Jacobian in two variables.* Preliminary report.
► (1535) **James Price**, Purdue University (1046-14-935)
- 10:00AM *Bounded category of an exact category.*
(1536) **Seshendra Pallekonda**, King's College (1046-19-700)
- 10:15AM *Localization formulae in odd K-theory.* Preliminary report.
(1537) **Florentiu Daniel Cibotaru**, University of Notre Dame (1046-19-1134)
- 10:30AM *Solving polynomial systems on a parallel computer with PHCpack and PHClab.*
(1538) **Yun Guan*** and **Jan Verschelde**, University of Illinois at Chicago (1046-14-1873)
- 10:45AM *Some syzygies of the generators of the ideal of a border basis scheme.* Preliminary report.
(1539) **Mark E. Huibregtse**, Skidmore College (1046-14-1239)

AMS Session on Combinatorics, III

8:00 AM – 10:55 AM

- 8:00AM *Reduced decompositions with few repetitions and permutation patterns.*
(1540) **Daniel Daly**, University of Denver (1046-05-836)
- 8:15AM *Subsets of finite groups exhibiting additive regularity.*
(1541) **Todd M. Gutekunst**, King's College (1046-05-888)
- 8:30AM *On the Erdos- Sos and Komlos Sos Conjecture for graphs without a $K(2, s)$.*
► (1542) **Suman Balasubramanian*** and **Edward Dobson**, Mississippi State University (1046-05-986)
- 8:45AM *The critical independence number of a graph and an independence decomposition.*
► (1543) **Craig Larson**, Virginia Commonwealth University (1046-05-1042)
- 9:00AM *Extremal functions of forbidden double permutation matrices.*
(1544) **Jesse T. Geneson**, Harvard University (1046-05-829)
- 9:15AM Break.
- 9:30AM *Secondary domination graphs of tournaments.*
(1545) **Kim A.S. Factor**, Marquette University, and **Larry J. Langley***, University of the Pacific (1046-05-868)
- 9:45AM *Extending generating functions to $S_k \wr S_n$.*
► (1546) **Andrew G. Niedermaier**, University of California - San Diego (1046-05-816)
- 10:00AM *The Hall-Paige conjecture in non-associative contexts.*
► (1547) **Kyle Pula**, University of Denver (1046-05-1168)

- 10:15AM *Non-embeddable quasi-residual Menon designs.*
► (1548) **Tariq A. Alraqad***, Northern State University, and **Mohan Shrikhande**, Central Michigan University (1046-05-1184)
- 10:30AM *Enumerating Rook paths and Queen paths.* Preliminary report.
► (1549) **Martin J. Erickson**, Truman State University (1046-05-1220)
- 10:45AM *The rainbow index of a graph.*
► (1550) **Futaba Okamoto***, University of Wisconsin - La Crosse, **Gary Chartrand** and **Ping Zhang**, Western Michigan University (1046-05-1226)

AMS Session on Manifolds and Cell Complexes

8:00 AM – 10:55 AM

- 8:00AM *Dean knots.*
(1551) **Brandy J. Guntel**, The University of Texas at Austin (1046-57-64)
- 8:15AM *Surgery equivalence invariants of generalized colored knots.*
(1552) **Steven D. Wallace**, Macon State College (1046-57-552)
- 8:30AM *Circular thin position for knots.*
► (1553) **Manjarrez-Gutierrez Fabiola**, UC Davis (1046-57-1282)
- 8:45AM *The bridge number of knots and links which differ from a split link by a rational tangle replacement.*
(1554) **Scott A. Taylor**, Colby College (1046-57-1340)
- 9:00AM *The growth of the quantum hyperbolic invariants of the figure eight knot.* Preliminary report.
(1555) **Heather M. Molle**, The University of Iowa (1046-57-1702)
- 9:15AM *On knot Floer homology of satellite $(1, 1)$ knots.*
(1556) **Philip J. P. Ording**, Medgar Evers College, CUNY (1046-57-676)
- 9:30AM *Three manifold cobordisms and homotopy Lie algebras.*
(1557) **Benjamin J. Cooper**, University of California, San Diego (1046-57-1470)
- 9:45AM *High distance knots in 3-manifolds.*
(1558) **Marion Moore*** and **Matt Rathbun**, University of California at Davis (1046-57-1872)
- 10:00AM *Relative critical sets: Structure and application.*
► (1559) **Jason E. Miller**, Truman State University (1046-57-1950)
- 10:15AM *Pictures of the second homotopy module of a two-complex.* Preliminary report.
(1560) **Katherine S. Byler Kelm**, California State University, Fresno (1046-57-1764)
- 10:30AM *The space of regular polygons.*
► (1561) **Angela L. Pile**, Lock Haven University of Pennsylvania (1046-57-616)
- 10:45AM *Cohomology of cohomogeneity-one manifolds.*
(1562) **Shari K. Ultman**, Oregon State University (1046-57-286)

MAA Session on College Algebra: Focusing on Conceptual Understanding, Real-World Data, and Mathematical Modeling, II

8:00 AM – 10:55 AM

- Organizers: **Florence S. Gordon**, New York Institute of Technology
Laurette B. Foster, Prairie View A&M University
Yajun Yang, Farmingdale State College

Ray E. Collings, Georgia Perimeter College

- 8:00AM (1563) *Engaging precalculus students in the complete process of mathematical modeling.*
Paula Shorter*, **Mairead Greene** and **Zdenka Guadarrama**, Rockhurst University (1046-C1-1878)
- 8:20AM (1564) *Involving students in conceptual learning in college algebra and pre-calculus.*
Joyati Debnath, Winona State University (1046-C1-1146)
- 8:40AM (1565) *Elementary modeling across the two-year college curriculum.*
Alice Eiko Pierce* and **Ray E. Collings**, Georgia Perimeter College (1046-C1-1745)
- 9:00AM (1566) *Teaching modeling college algebra for 2000 students: Garnering support from faculty and administrators.*
Bill Haver* and **Kim Shannon**, Virginia Commonwealth University (1046-C1-1858)
- 9:20AM (1567) *Teaching modeling college algebra for 2000 students: Providing professional development and course materials for instructors.*
Ed Eades* and **Bill Haver**, Virginia Commonwealth University (1046-C1-1862)
- 9:40AM (1568) *Changing the culture: Professional development for an activity-based modeling approach to teaching college algebra.*
Barbara E. Edwards, Oregon State University, Corvallis, OR (1046-C1-1808)
- 10:00AM (1569) *Students' conceptual understanding and attitudes in an activity-based modeling approach to teaching college algebra.*
Stephanie Bowers*, **Barbara E. Edwards**, **Charisse Hake**, **Gulden Karakok** and **Ching-chia Ko**, Oregon State University (1046-C1-1800)
- 10:20AM (1570) *Implementation of refocused college algebra at Howard University.*
J. F. McGowan, Howard University (1046-C1-1276)
- 10:40AM (1571) *"I'd rather be approximately right than precisely wrong": Moving beyond mathematicians' natural obsession with the exact in college algebra.* Preliminary report.
Suzanne I. Dorée, Augsburg College (Minneapolis, MN) (1046-C1-408)

MAA Session on Developmental Mathematics Education: Helping Under-Prepared Students Transition to College-Level Mathematics

8:00 AM – 10:55 AM

Organizers: **J. Winston Crawley**, Shippensburg University

Kimberly Presser, Shippensburg University

- 8:00AM (1572) *Building bridges to college mathematics.* Preliminary report.
Dora Cardenas Ahmadi, Morehead State University (1046-F1-1167)
- 8:20AM (1573) *"Rock Math" - Helping under-prepared students make the transition to college mathematics.*
Robert E. Burks Jr., United States Military Academy (1046-F1-1199)
- 8:40AM (1574) *Females in mathematics: Why aren't they persisting? And what can we do to encourage them to stay?* Preliminary report.
Carla V. Gerberry, Purdue University (1046-F1-686)

- 9:00AM (1575) *Combination of formative and summative assessment instruments in elementary algebra classes at the college.* Preliminary report.
Eugenia V. Peterson and **M. Vali Siadat***, Richard J. Daley College (1046-F1-358)
- 9:20AM (1576) *Some thoughts from teaching math for business course.*
Yun Lu, Kutztown University of Pennsylvania (1046-F1-830)
- 9:40AM (1577) *RASM reconstruction of the developmental mathematics program.*
Clyde L. Greeno, MALEI Mathematics Institute (1046-F1-1178)
- 10:00AM (1578) *Statistics: The key to college success for educationally under-prepared students.* Preliminary report.
John F. Loase, Concordia College (1046-F1-18)
- 10:20AM (1579) *Integration of the Keystone Methodology with computer technology.*
Cyrill Oseledets, **Vali Siadat** and **Ming-Jer Wang***, Richard J. Daley College (1046-F1-921)
- 10:40AM (1580) *Successfully transitioning under-prepared first-year pre-calculus students.*
Joy Moore, Xavier University (1046-F1-1302)

MAA Session on Mathematics and the Arts, II

8:00 AM – 10:55 AM

Organizer: **Douglas E. Norton**, Villanova University

- 8:00AM (1581) *Mathematical photo scavenger hunt.*
Dale K. Hathaway, Olivet Nazarene University (1046-J1-920)
- 8:20AM (1582) *On the beauty of mathematics.*
Olya V. Sahakyan, Armenian State Pedagogical University after Kh. Abovyan (1046-J1-1180)
- 8:40AM (1583) *Cracking open the books: Encouraging undergraduates to interact with mathematic(al) texts.* Preliminary report.
Jeffrey P. Smith, Otterbein College (1046-J1-45)
- 9:00AM (1584) *Newton and Fibonacci: Estimating The Golden Ratio.*
Michelle Y. Penner, Central Virginia Community College (1046-J1-1707)
- 9:20AM (1585) *Mathematics of southern Appalachian folk pottery.*
Michelle Krolkowski* and **Elizabeth C Rogers**, Piedmont College (1046-J1-2021)
- 9:40AM (1586) *Recreating a decagonal star polygon design.*
B. Lynn Bodner, Monmouth University (1046-J1-461)
- 10:00AM (1587) *On Ricochet compositions for N-gons.* Preliminary report.
Gary R. Greenfield, University of Richmond (1046-J1-407)
- 10:20AM (1588) *A brief study of designs on the surfaces of some swing-hinged dissections.*
Reza Sarhangi, Towson University (1046-J1-436)
- 10:40AM (1589) *The symmetry of M.C. Escher's Circle Limit IV pattern and related patterns.* Preliminary report.
Douglas Dunham, University of Minnesota Duluth (1046-J1-1965)

MAA Session on Promoting Deep Learning for Mathematics Majors through Experiential Learning, Writing, and Reflection, I

8:00 AM – 10:55 AM

Organizers: **Murphy Waggoner**, Simpson College
Chuck Straley, Wheaton College

- 8:00AM *Semi inquiry-based learning in undergraduate real analysis*. Preliminary report.
 ► (1590) **Jialing Dai**, The University of the Pacific (1046-S1-2070)
- 8:20AM *How to stop a British ship: Projectile motion, the Revolutionary War, and West Point*.
 ► (1591) **Doug M. Fletcher***, United States Military Academy, West Point, and **Gary Kramlich**, 82d Airborne Division, Fort Bragg, NC (1046-S1-1578)
- 8:40AM *Inquiry-based learning in a discrete mathematics with graph theory course*. Preliminary report.
 (1592) **Feryal Alayont**, Grand Valley State University (1046-S1-1900)
- 9:00AM *Discussion and revisiting of calculus concepts to gain understanding of main concepts*. Preliminary report.
 ► (1593) **Jose H. Giraldo**, Texas A&M University-Corpus Christi (1046-S1-2045)
- 9:20AM *Calculus field trips*.
 (1594) **Despina Prapavessi***, **Karen Edwards** and **C. Samuel Needham**, Diablo Valley College (1046-S1-482)
- 9:40AM *Midwest Math-in: 24 hours of math*.
 ► (1595) **Benjamin J. Galluzzo**, University of Iowa (1046-S1-1524)
- 10:00AM *Escalating writing assignments in calculus 1*.
 ► (1596) **Brian P. Kelly**, Bryant University (1046-S1-1747)
- 10:20AM *Developing future secondary teachers' mathematics knowledge (for teaching) with student presentations*. Preliminary report.
 ► (1597) **Erica L. Johnson**, St. John Fisher College (1046-S1-1905)
- 10:40AM *Implementing SENCER ideals into an introductory statistics course*. Preliminary report.
 ► (1598) **Katarzyna Potocka**, Ramapo College of New Jersey (1046-S1-528)

MAA General Contributed Paper Session, X

8:00 AM – 10:55 AM

Organizer: **Sarah L. Mabrouk**, Framingham State College

Moderators: **Lawrence D'Antonio**, Ramapo College of New Jersey
Stephen Szydluk, University of Wisconsin-Oshkosh
Stan VerNooy, College of Southern Nevada
Carlos Bovell, Mercer Community College

- 8:00AM *A few new approaches to teach remedial math in the college*. Preliminary report.
 ► (1599) **Haishen Yao**, CUNY Queensborough Community College (1046-Z1-1689)
- 8:15AM *Bilingual and English language learners understanding and solving mathematics problems*. Preliminary report.
 ► (1600) **Heather Cavell**, **Liana Dawson**, **Kathleen Ross** and **Belin Tsinnajinnie***, University of Arizona (1046-Z1-1779)
- 8:30AM *Coordinating tutoring with the calculus I classroom*. Preliminary report.
 ► (1601) **Sharon S. Emerson-Stonnell*** and **Robert D. Markey**, Longwood University (1046-Z1-844)
- 8:45AM *Engagement across the disciplines*. Preliminary report.
 ► (1602) **Laura J. Schmidt*** and **Eileen M. Zito**, University of Wisconsin-Stout (1046-Z1-741)

- 9:00AM *What is mathematics and what kind of answers will satisfy this question?*
 ► (1603) **Carlos R. Bovell**, Northern Burlington County Regional High School (1046-Z1-71)
- 9:15AM *What if your precalculus student asks a good question?*
 ► (1604) **Stan VerNooy**, College of Southern Nevada (1046-Z1-1063)
- 9:30AM *The WiVaM Consortium REU-RET*. Preliminary report.
 ► (1605) **Colin L Starr*** and **Inga Johnson**, Willamette University (1046-Z1-870)
- 9:45AM *Is mathematics an exact science?*
 ► (1606) **Lawrence A. D'Antonio**, Ramapo College of New Jersey (1046-Z1-403)
- 10:00AM *A moment of truth: Teaching an honors seminar course*.
 ► (1607) **Stephen D. Szydluk**, University of Wisconsin-Oshkosh (1046-Z1-1688)
- 10:15AM *Tiings, compositions, and generalizations*.
 ► (1608) **Ralph P. Grimaldi**, Rose-Hulman Institute of Technology (1046-Z1-904)
- 10:30AM *Making effective use of the uniform distribution in an introductory probability theory course*.
 ► (1609) **Paul S. Rossi**, College of Saint Elizabeth (1046-Z1-1300)
- 10:45AM *Problems in combining rational expressions and factorization of a special kind of quadratic trinomial*.
 (1610) **Bernardo Rivera Marquez**, Ateneo de Naga University (1046-Z1-1187)

SIAM Minisymposium on the Mathematics of Energy Conversion

8:00 AM – 10:55 AM

Organizer: **Keith Promislow**, Michigan State University

- 8:00AM *Intercalation dynamics in rechargeable batteries*.
 (1611) **Martin Z. Bazant**, Stanford University (1046-00-1142)
- 8:30AM *Non-linear dynamics of transport and mechanical properties in PEM fuel cells*.
 (1612) **Jay Benziger**, Princeton University (1046-74-1243)
- 9:00AM *Proton conduction in polymer electrolyte membranes*.
 (1613) **Keith S. Promislow**, Michigan State University (1046-70-881)
- 9:30AM *Existence of positive solutions to a nonlinear PDE system, modeling fuel cell dynamics near a triple phase boundary*.
 (1614) **Arian Novruzzi***, University of Ottawa, and **Al-Arydah Mo'Tassem**, University of Ottawa (1046-35-1416)
- 10:00AM *Simulation of microstructures in energy conversion systems*.
 (1615) **Katsuyo Thornton**, University of Michigan (1046-80-1529)
- 10:30AM *Gamma convergence for functionalized energies*. Preliminary report.
 (1616) **Yang Li*** and **Keith S. Promislow**, Michigan State University (1046-35-1982)

ASL Invited Addresses and Contributed Paper Sessions

8:00 AM – 5:30 PM

AWM Workshop

8:20 AM – 4:30 PM

This session has several parts that will be listed separately by time in this program. All presentations are open to all JMM participants.

AMS Session on Approximations and Expansions

8:30 AM – 10:55 AM

- 8:30AM (1617) *Functions with strongly unique best approximates are dense in vector valued approximation.*
Martin Bartelt*, Christopher Newport University, and **John Swetits**, Old Dominion University (1046-41-331)
- 8:45AM (1618) *Statistical learning methods for uniform approximation bounds in multiresolution spaces.*
Mark A. Kon, Boston University, and **Louise A. Raphael***, Howard University (1046-41-473)
- 9:00AM (1619) *On smoothness of nonlinear subdivision schemes.*
Esfandiar Nava-Yazdani, Drexel University (1046-41-803)
- 9:15AM (1620) *A generalization of a result of G. Pólya and its application to a continuous extension of the de la Vallée Poussin means.*
Alfred S. Cavaretta and **Terence G. Hanchin***, Kent State University (1046-41-1246)
- 9:30AM (1621) *Statistical approximation for stochastic processes.*
George A. Anastassiou*, University of Memphis, **Oktay Duman**, TOBB Economics and Technology University, and **Esra Erkus-Duman**, Gazi University (1046-41-58)
- 9:45AM Break
- 10:00AM (1622) *Vector field decomposition on the sphere using radial basis functions.*
Edward J. Fuselier*, United States Military Academy, and **Grady B. Wright**, Boise State University (1046-41-572)
- 10:15AM (1623) *A context for sylvester's theorem on sums of shifted monomial powers.* Preliminary report.
Alfred S. Cavaretta* and **Terence Hanchin**, Kent State University (1046-41-1318)
- 10:30AM (1624) *Approximating Bessel functions of the first kind using super-Gaussians.*
Patricia Mellodge* and **S. S. Townsend**, University of Hartford (1046-41-1474)
- 10:45AM (1625) *Applying expansion techniques of multivariate expansion base method and extended Hensel construction to cryptography.* Preliminary report.
Maki Iwami, Osaka University of Economics and Law (1046-41-2040)

AMS Session on Mechanics

8:30 AM – 10:55 AM

- 8:30AM (1626) *A family of orbits in the Newtonian three-body problem.*
► **Elizabeth A. Zollinger**, Hiram College (1046-70-256)
- 8:45AM (1627) *Explicit symplectic integration of compact lie Poisson systems.*
Steven Benzel, Berry College (1046-70-1274)
- 9:00AM (1628) *Three-dimensional equilibrium crystal shapes with corner energy regularization.*
Antonio Mastroberardino*, Penn State Erie, and **Brian J. Spencer**, University at Buffalo (1046-70-1429)

- 9:15AM (1629) *Quadrature-rule type approximations to the quasicontinuum method.*
Yanzhi Zhang* and **Max Gunzburger**, Florida State University (1046-74-225)
- 9:30AM (1630) *A 3-D nonlinear anisotropic elastodynamic model for rapid enlargement of intracranial saccular aneurysms.* Preliminary report.
Janet Chen Daniel, **Anthony Tongen**, **Paul G. Warne** and **Debra Polignone Warne***, James Madison University (1046-74-1314)
- 9:45AM Break
- 10:00AM (1631) *Relaxed matching for stabilization of mechanical systems.*
David A. Long*, North Carolina State University, **Anthony M. Bloch**, University of Michigan, **Jerrold E. Marsden**, California Institute of Technology, and **Dmitry V. Zenkov**, North Carolina State University (1046-70-549)
- 10:15AM (1632) *Stability results for a multilayer Mead-Markus beam.*
Aaron A. Allen* and **Scott W. Hansen**, Iowa State University (1046-74-809)
- 10:30AM (1633) *Numerical results for energy decay in thermoelastic beams.* Preliminary report.
Tim McDevitt, Elizabethtown College (1046-74-1714)
- 10:45AM (1634) *F dot ds...simple calculus, deep physics.* Preliminary report.
► **Lawrence S. Braden**, St. Paul's School (1046-01-166)

AMS Session on Logic and Computer Science

8:30 AM – 10:55 AM

- 8:30AM (1635) *Convergence with a fixed regulator in residuated lattices.*
Lavinia Corina Ciungu, State University of New York at Buffalo (1046-03-337)
- 8:45AM (1636) *Reducts of generalized random bipartite graph.*
Yun Lu, Kutztown University of Pennsylvania (1046-03-824)
- 9:00AM (1637) *Separating the degree spectra of structures.*
Tyler J. Markkanen, University of Connecticut (1046-03-1799)
- 9:15AM (1638) *Investigating KeeLoq.*
► **Amber M. Rogers***, Northern Kentucky University, and **Brad Fox**, Transylvania University (1046-68-718)
- 9:30AM (1639) *Computable dimension of ordered fields.*
Oscar Levin, University of Connecticut (1046-03-1337)
- 9:45AM Break
- 10:00AM (1640) *Reverse mathematics of theorems involving the coloring number of graphs.*
Matthew A. Jura, University of Connecticut (1046-03-1677)
- 10:15AM (1641) *The inverse fixed point theorem and image encoding.* Preliminary report.
Chokri Cherif* and **Avraham Goldstein**, BMCC/City University of New York (1046-68-1023)
- 10:30AM (1642) *Can you hear me now?* Preliminary report.
► **Le Gui**, University of Iowa (1046-94-274)
- 10:45AM (1643) *Infinite families of recursive formulas generating power moments of Kloosterman sums: Symplectic case.*
Dae San Kim, Sogang University (1046-94-1176)

AWM Workshop: Research Presentations by Recent Ph.D.'s, I

8:30 AM – 10:20 AM

- 8:30AM (1644) *On the Casimir fields of $q(n)^{(1)}$. Preliminary report.*
Jennifer D. Berg, Fitchburg State College (1046-22-263)
- 9:00AM (1645) *Elliptic curves of large rank in towers of function fields.*
Lisa A. Berger, Stony Brook University (1046-11-288)
- 9:30AM (1646) *Sobolev estimates for the Green potential associated with the Robin-Laplacian.*
Tunde Jakab*, **Irina Mitrea**, University of Virginia, and **Marius Mitrea**, University of Missouri-Columbia (1046-35-208)
- 10:00AM (1647) *Ray class groups.*
Jing Long Hoelscher, University of Arizona (1046-11-258)

AMS Committee on Education Panel Discussion

8:30 AM – 10:00 AM

- The future of school mathematics education.*
 Moderator: **William G. McCallum**, University of Arizona
- Panelists: **Scott J. Baldridge**, Louisiana State University
Daniel Chazan, University of Maryland
Solomon A. Garfunkel, COMAP
Kristin Umland, University of New Mexico

AMS Invited Address

9:00 AM – 9:50 AM

- (1648) *On Nash, Brouwer, and other nonconstructive proofs.*
Christos Papadimitriou, University of California Berkeley

ASL Invited Address

9:00 AM – 9:50 AM

- (1649) *Computable structure theory.*
Barbara Csima, University of Waterloo (1046-03-105)

AMS Special Session on New Connections Between Topology, Combinatorics, and Physics, I

9:00 AM – 10:45 AM

- Organizers: **Paul Fendley**, University of Virginia
Slava Krushkal, University of Virginia
- 9:00AM (1650) *Diagrammatics of biadjoint functors and beyond.*
Mikhail Khovanov, Columbia University (1046-18-738)
- 10:00AM (1651) *Self-duality and generalized differential cohomology.*
Gregory W. Moore, Rutgers University (1046-81-931)

MAA Minicourse #13: Part B

9:00 AM – 11:00 AM

- Directing undergraduate research.*
 Organizer: **Aparna W. Higgins**, University of Dayton

MAA Minicourse #3: Part B

9:00 AM – 11:00 AM

- Educating about the state of the planet and sustainability while enhancing calculus.*
 Organizer: **Thomas J. Pfaff**, Ithaca College

MAA Minicourse #8: Part B

9:00 AM – 11:00 AM

- Taking symbols seriously: Teaching form and function in college algebra.*
 Organizers: **Deborah Hughes Hallett**, University of Arizona and Harvard University
Patti Frazer Lock, St. Lawrence University
William G. McCallum, University of Arizona
Patricia D. Shure, University of Michigan

AMS Session on Calculus of Variations and Control

9:00 AM – 10:55 AM

- 9:00AM (1652) *Finding explicitly the value function for an optimal control problem.*
Jesus A. Pascal, American University of Nigeria (1046-49-683)
- 9:15AM (1653) *Optimal quadrature formulae related to solutions of initial boundary value problems.*
Anna S. Bulanova*, University of Alaska, Fairbanks, **Sergei A. Avdonin**, University of Alaska, Fairbanks, and **Dmitri A. Ovsyannikov**, Saint Petersburg State University (1046-49-2063)
- 9:30AM (1654) *Convexity in Hamilton-Jacobi theory with measurable dependent time.*
Lingyan Huang, Louisiana State University (1046-49-2103)
- 9:45AM (1655) *Variational characterizations of the yield set of a polycrystal: Some model cases.*
Marian Bocea, North Dakota State University (1046-49-96)
- 10:00AM (1656) *Multiobjective optimization and nonlinear programming.*
Qingxia Li* and **Peter Wolenski**, Louisiana State University (1046-49-2099)
- 10:15AM (1657) *A distribution approach to (bi)simulation relations for nonlinear control systems. Preliminary report.*
Laura Munteanu, The State University of New York, College at Oneonta (1046-93-1160)
- 10:30AM (1658) *Controlling the motion of charged particles in a vacuum electromagnetic field from boundary.*
Luis R. Suazo*, University of Central Arkansas, and **Weijiu Liu**, University Of Central Arkansas (1046-93-1438)
- 10:45AM (1659) *Tracking control of nonlinear systems with uncertainties in the presence of hysteresis and saturation.*
Dinesh B. Ekanayake* and **Ram V. Iyer**, Texas Tech University (1046-93-2046)

MAA Session on Research on the Teaching and Learning of Undergraduate Mathematics, III

9:00 AM – 10:45 AM

Organizers: **Keith H. Weber**, Rutgers University
Michelle J. Zandieh, Arizona State University
Karen A. Marrongelle, Portland State University

9:00AM (1660) *Dialogical engagement in two interactive mathematics lessons.*

Vilma Mesa* and **Peichin Chang**, University of Michigan-Ann Arbor (1046-U1-1390)

9:35AM (1661) *An analysis of college mathematics placement policies for students with high school calculus experience.*

Theresa A. Laurent, St Louis College of Pharmacy (1046-U1-227)

10:00AM (1662) *Ascertaining the professional development needs of graduate mathematics teaching assistants. Preliminary report.*

Jason K. Belnap, Brigham Young University (1046-U1-1897)

10:25AM (1663) *Instructor responses to prior knowledge errors within a calculus I course. Preliminary report.*

Jana R. Talley, University of Oklahoma (1046-U1-531)

SIGMAA on Statistics Education Panel Discussion

9:00 AM – 10:20 AM

Technology in statistics education.

Organizers: **Patricia B. Humphrey**, Georgia Southern University
Chris J. Lacke, Rowan University
Michael A. Posner, Villanova University

Moderator: **Michael A. Posner**

Panelists: **Patricia B. Humphrey**
John D. McKenzie, Babson College
Paul L. Myers, Woodward Academy
Chris J. Lacke

NAM Panel Discussion

9:00 AM – 10:00 AM

Title to be announced.

Exhibits and Book Sales

9:00 AM – NOON

Student Hospitality Center

9:00 AM – 2:00 PM

Employment Center

9:00 AM – NOON

MAA-Project NExT Panel Discussion

9:30 AM – 10:45 AM

Designing and teaching a geometry course for preservice secondary mathematics teachers.

Organizers: **James E. Hamblin**, Shippensburg University

William O. Martin, North Dakota State University

Todd D. Oberg, Illinois College

Panelists: **William E. Fenton**, Bellarmine University

Angela M. Hodge, North Dakota State University

Barbara E. Reynolds, Cardinal Stritch University

Thomas Q. Sibley, St. John's University

ASL Invited Address

10:00 AM – 10:50 AM

(1664) *Set theoretic methods in model theory.*

Jouko Väänänen, University of Amsterdam, ILLC (1046-03-110)

NAM Business Meeting

10:00 AM – 10:55 AM

MAA Invited Address

10:05 AM – 10:55 AM

(1665) *Geometreks.*

Ivars Peterson, MAA (1046-A0-10)

AWM Workshop: Poster Session with Presentations from Women Graduate Students

10:30 AM – 11:00 AM

10:30AM (1666) *Planar algebras and knots. Preliminary report.*

Emily Peters*, University of California, Berkeley,
Scott Morrison, Microsoft, Station Q, and **Noah Snyder**, University of California, Berkeley (1046-57-197)

10:30AM (1667) *Embedded minimal surfaces with finite topology. Preliminary report.*

Christine Breiner, Johns Hopkins University (1046-53-211)

10:30AM (1668) *Bockstein basis and resolution theorems in extension theory.*

Vera Tonic, University of Oklahoma (1046-54-213)

10:30AM (1669) *State complexes and special cube complexes.*

Valerie J. Peterson, University of Illinois at Urbana-Champaign (1046-55-214)

10:30AM (1670) *Noise tolerant planar curve matching using invariants.*

Kathleen M. Iwancio, North Carolina State University (1046-14-232)

10:30AM (1671) *Reconstructing free surfaces for a flow of ideal fluid around supercavitating wedges.*

Yuri Antipov and **Anna Zemlyanova***, Louisiana State University (1046-76-235)

10:30AM (1672) *Some results on approximate liftings.*

Weihua Li* and **Don Hadwin**, University of New Hampshire (1046-46-246)

10:30AM (1673) *Prior knowledge and calculus performance.*

Jana R. Talley, University of Oklahoma (1046-97-250)

10:30AM (1674) *An uncoupled EMP formulation of a Bianchi I scalar field cosmology.*

Jennie D'Ambroise, University of Massachusetts Amherst (1046-83-261)

- 10:30AM (1675) *Yang Mills functional on a deformed Heisenberg C^* -algebra.*
Sooran Kang, University of Colorado, at Boulder (1046-53-267)
- 10:30AM (1676) *Weighted L^2 estimates for dissipative nonlinear wave equations with space-time dependent potential.*
Maisa M. Khader, University of Tennessee (1046-35-268)
- 10:30AM (1677) *The effect of diffusion on calcium oscillations.*
 Preliminary report.
Nessy Tania* and **James P. Keener**, University of Utah (1046-92-273)
- 10:30AM (1678) *A new approach to killing forms.*
Audrey Malagon, Emory University (1046-17-296)
- 10:30AM (1679) *A geometric and combinatorial construction of the Springer representation.*
Heather M. Russell* and **Julianna S. Tymoczko**, University of Iowa (1046-57-304)
- 10:30AM (1680) *Homogenizing the acoustics of cancellous bone.*
Ana Vasilic, University of Delaware (1046-35-325)
- 10:30AM (1681) *The mechanics and dynamics of DNA as an elastic rod.*
Eva M. Strawbridge, University of California, Davis (1046-92-326)

MAA Business Meeting

11:10 AM – 11:40 AM

Organizer: **Martha J. Siegel**, Towson University
 Moderator: **Joseph A. Gallian**, University of Minnesota-Duluth

AMS Business Meeting

11:45 AM – 12:15 PM

Luncheon in Honor of Retiring MAA Associate Secretary James Tattersall

12:15 PM – 2:00 PM

NAM Claytor-Woodard Lecture

1:00 PM – 1:50 PM

- (1682) *The Hoffman-Wielandt inequality revisited.*
Earl R. Barnes, Morgan State University

ASL Invited Address

1:00 PM – 1:50 PM

- (1683) *Can we make the Second Incompleteness Theorem coordinate free?*
Albert Visser, Utrecht University (1046-03-109)

AMS-MAA Special Session on History of Mathematics, IV

1:00 PM – 5:55 PM

Organizers: **Joseph W. Dauben**, Lehman College
Karen H. Parshall, University of Virginia
Patti Hunter, Westmont College
Deborah Kent, Hillsdale College

- 1:00PM (1684) *Saving the phenomena: Limits from Maclaurin to Cauchy.* Preliminary report.
Robert E. Bradley, Adelphi University (1046-01-720)
- 1:30PM (1685) *Euler, Lagrange and Cauchy: Three perspectives on the “Euler Identity”.*
C. Edward Sandifer, Western Connecticut State University (1046-01-769)
- 2:00PM (1686) *Andrew Ellicott: Mathematician, surveyor, teacher.* Preliminary report.
Florence D. Fasanelli, AAAS (1046-01-413)
- 2:30PM (1687) *Edwin Abbott and the mathematics of Flatland.*
William Lindgren*, Slippery Rock University, and **Joan Richards**, Brown University (1046-01-696)
- 3:00PM (1688) *Elliptic functions via invariant theory: Cayley’s partial anticipation of the Weierstrass \wp -function.*
Adrian Rice, Randolph-Macon College (1046-01-369)
- 3:30PM (1689) *Teacher and mentor: Gösta Mittag-Leffler’s influence on the Swedish mathematical community through his role as professor at Stockholm’s högskola.* Preliminary report.
Laura E. Turner, University of Aarhus (1046-01-688)
- 4:00PM (1690) *What led Ronald Fisher to the concept of randomization? A re-examination.* Preliminary report.
Nancy S. Hall, University of Delaware (1046-01-538)
- 4:30PM (1691) *Integral equations: a “Revolution” in mathematics in the early 20th Century?*
William T. Archibald*, Simon Fraser University, and **Rossana Tazzioli**, Université de Lille I, Lille, France (1046-01-506)
- 5:00PM (1692) *The center problem in complex dynamics, 1913–1942.* Preliminary report.
Daniel S. Alexander, Drake University (1046-01-1126)
- 5:30PM (1693) *The real inventor of the computer.* Preliminary report.
Sanford L. Segal, University of Rochester (1046-01-562)

AMS-MAA Special Session on Inquiry-Based Learning, II

1:00 PM – 5:50 PM

Organizers: **William B. Jacob**, University of California Santa Barbara
Paul J. Sally, University of Chicago
Ralf J. Spatzier, University of Michigan
Michael Starbird, University of Texas at Austin

- 1:00PM (1694) *Inquiry based learning at University of Michigan.* Preliminary report.
Ralf J. Spatzier, University of Michigan (1046-97-1002)
- 1:30PM (1695) *Two very different inquiry based learning courses at the University of Michigan.*
Morton Brown, University of Michigan (1046-97-513)
- 2:00PM (1696) *Upper-level undergraduate IBL mathematics classes at the University of Chicago.*
John D. Boller, University of Chicago (1046-97-728)
- 2:30PM (1697) *Real Analysis—an inquiry-based approach.*
Carol S. Schumacher, Kenyon College (1046-97-642)

- 3:00PM *Restraint and coverage: A characterization of instructor change.*
(1698) **Stan T. Yoshinobu**, Cal State Dominguez Hills (1046-97-1341)
- 3:30PM *Student-to-student discussions: The roles of the instructor and students in discussions in an inquiry-oriented transition to proof course.*
▶ (1699) **Stephanie R. Nichols**, Anoka-Ramsey Community College (1046-97-1545)
- 4:00PM *Inquiring about inquiry: Progress on research and evaluation studies of Inquiry-Based Learning in undergraduate mathematics at four campuses.*
▶ (1700) **Sandra L. Laursen*** and **Marja-Liisa Hassi**, University of Colorado, Boulder (1046-97-742)
- 4:30PM *Incorporating Inquiry-Based Learning in the calculus sequence: A most challenging endeavour.*
(1701) **M. Pdraig McLoughlin**, Kutztown University of Pennsylvania (1046-97-553)
- 5:00PM *IBL in freshman calculus at the University of Chicago.*
(1702) **Diane Herrmann**, University of Chicago (1046-97-730)
- 5:30PM *Guided discovery: Teaching mathematics/transforming lives.* Preliminary report.
▶ (1703) **Michael Starbird**, The University of Texas at Austin (1046-97-627)

AMS Special Session on Function Theoretic Operator Theory, II

1:00 PM – 5:50 PM

Organizers: **John B. Conway**, George Washington University

Sherwin Kouckekian, University of South Florida

William T. Ross, University of Richmond

- 1:00PM *"Fingerprints" of the two dimensional shapes and lemniscates.* Preliminary report.
▶ (1704) **Peter Ebenfelt**, UCSD La Jolla, **Dima Khavinson***, University of South Florida, and **Harold S. Shapiro**, Royal Institute of Technology Stockholm (1046-30-134)
- 1:30PM *One to one compressions of composition operators and the Klein-Gordon equation.* Preliminary report.
(1705) **Hakan Hedenmalm**, Royal Institute of Technology, Sweden, and **Alfonso Montes-Rodriguez***, Universidad de Sevilla (1046-47-731)
- 2:00PM *Examples in Bergman and Hardy Spaces.*
(1706) **John R. Akeroyd**, University of Arkansas (1046-30-351)
- 2:30PM *Multiplicative isometries and isometric zero-divisors.*
(1707) **Alexandru Aleman**, Lund University, **Peter L. Duren**, **Maria J. Martin***, University of Michigan, and **Dragan Vukotic**, Universidad Autonoma de Madrid (1046-30-653)
- 3:00PM *On some bilinear symmetric forms and meromorphic continuation of analytic functions.*
▶ (1708) Preliminary report.
Vasiliy A. Prokhorov*, University of South Alabama, and **Dmitri V. Prokhorov**, University of South Florida (1046-41-595)

- 3:30PM *Zeros of certain kernel functions in the Fock space.* Preliminary report.
(1709) **Catherine Beneteau***, University of South Florida, **Brent Carswell**, Allegheny College, and **Sherwin Kouckekian**, University of South Florida (1046-30-1052)
- 4:00PM *Invariant subspaces and composition operators.*
(1710) **Manuel Ponce-Escudero***, **Alfonso Montes-Rodriguez**, Universidad de Sevilla, and **Stanislav Shkarin**, Queen's University Belfast (1046-47-1753)
- 4:30PM *Weighted composition operators on the Bloch space in \mathbb{C}^n .*
(1711) **Robert F. Allen** and **Flavia Colonna***, George Mason University (1046-47-660)
- 5:00PM *Compact approximation of integral operators with applications to composition operators.*
(1712) **Pekka J. Nieminen**, University of Helsinki (1046-47-1577)
- 5:30PM *Extremals for the families of commuting spherical contractions and their adjoints.* Preliminary report.
(1713) **Stefan Richter*** and **Carl Sundberg**, University of Tennessee (1046-47-884)

AMS Special Session on Complex Dynamics and Complex Function Theory

1:00 PM – 5:50 PM

Organizers: **Stephanie Edwards**, Hope College
Rich L. Stankewitz, Ball State University

- 1:00PM *Boundaries of bounded Fatou components of quadratic maps.*
(1714) **Ross Flek**, Graduate Center, CUNY, and **Linda Keen***, Graduate Center and Lehman College, CUNY (1046-30-882)
- 1:30PM *A generalized version of the McMullen domain.*
(1715) **Elizabeth D. Russell**, Boston University (1046-37-632)
- 2:00PM *Singular perturbations of complex polynomials.*
▶ (1716) **Sebastian M. Marotta**, University of the Pacific (1046-37-635)
- 2:30PM *Holomorphic motions and Hénon maps.*
(1717) **Philip P. Mummert**, Taylor University (1046-30-1463)
- 3:00PM *Approximable quasidisks.*
(1718) **Ngin-Tee Koh**, University of Illinois at Urbana-Champaign (1046-30-681)
- 3:30PM *Convex combinations of harmonic mappings.*
▶ (1719) **Michael Dorff*** and **Magdalena Woloszkiewicz**, Brigham Young University (1046-30-113)
- 4:00PM *Discrete conformal flows in circle packing.* Preliminary report.
(1720) **Ken Stephenson***, University of Tennessee, Knoxville, **Elias Wegert** and **David Bauer**, University of Freiberg, Germany (1046-30-350)
- 4:30PM *Multiplier sequences for generalized Laguerre bases.* Preliminary report.
(1721) **Tamas Forgacs**, California State University, Fresno, and **Andrzej Piotrowski***, University of Alaska Southeast (1046-30-565)
- 5:00PM *Behavior of $\int \exp(rz - b(r)) dr$ for smooth b : Connections with the Szegő projection operator.*
(1722) **Jennifer Halfpap**, University of Montana (1046-32-1713)
- 5:30PM *Weighted homogeneous pluripotential theory.*
(1723) **Malgorzata S. Stawiska***, University of Kansas, and **Maritza M. Branker**, Niagara University (1046-32-191)

AMS Special Session on Commutative Rings, III

1:00 PM – 5:50 PM

Organizers: **Jay A. Shapiro**, George Mason University
David E. Dobbs, University of Tennessee, Knoxville
Shane P. Redmond, Eastern Kentucky University
Joe A. Stickles, Millikin University

- 1:00PM (1724) *Derivations, formal fibers and bad Noetherian rings*. Preliminary report.
Bruce M. Olberding, New Mexico State University (1046-13-603)
- 1:30PM (1725) *On the t -spectrum of a Noetherian domain*. Preliminary report.
Evan Houston*, University of North Carolina at Charlotte, and **Abdeslam Mimouni**, King Fahd University of Petroleum & Minerals (1046-13-1308)
- 2:00PM (1726) *Seminormality and weak normality*.
Marie A. Vitulli, University of Oregon (1046-13-410)
- 2:30PM (1727) *On n -absorbing ideals of commutative rings*. Preliminary report.
David F. Anderson, The University of Tennessee, Knoxville, and **Ayman R. Badawi***, American University Of Sharjah, United Arab Emirates (1046-13-478)
- 3:00PM (1728) *Some characterizations of generalized GCD domains*.
Hwankoo Kim, Hoseo University, Korea (1046-13-179)
- 3:30PM (1729) *Krull-dimension of a power series ring over a nonSFT-domain*.
Byung Gyun Kang* and **Phan Thanh Toan**, Pohang University of Science and Technology (1046-13-1636)
- 4:00PM (1730) *Elasticity of Krull domains with infinite class groups*. Preliminary report.
Benjamin R. Lynch, University of Tennessee (1046-13-1255)
- 4:30PM (1731) *Block diagonalization and 2-unit sums of matrices over Prüfer domains*. Preliminary report.
Peter Vamos, University of Exeter, and **Sylvia Wiegand***, University of Nebraska (1046-13-862)
- 5:00PM (1732) *Cut vertices and zero-divisor graphs*. Preliminary report.
M. Axtell*, University of St. Thomas, and **J. Stickles**, Millikin University (1046-13-1345)
- 5:30PM (1733) *Generalized Boolean rings, idealizations, and zero-divisor graphs*. Preliminary report.
Ryan E. Clark, University of Tennessee Knoxville (1046-13-1266)

AMS Special Session on New Connections Between Topology, Combinatorics, and Physics, II

1:00 PM – 5:45 PM

Organizers: **Paul Fendley**, University of Virginia
Slava Krushkal, University of Virginia

- 1:00PM (1734) *Certain enumeration problems in 2-dimensional topology*.
Vladimir Turaev, Indiana University (1046-57-293)
- 2:00PM (1735) *Quantum noise and the entanglement entropy of fermions*.
Israel Klich, University of Virginia (1046-81-1509)
- 3:00PM (1736) *Blob homology*.
Scott Morrison, Microsoft Station Q (1046-57-925)

- 4:00PM (1737) *Quantum Hall wavefunctions and topological quantum field theories*.
Nicholas Read, Yale University (1046-81-736)
- 5:00PM (1738) *Invariants of links with flat connections in the complement*.
Nicolai Reshetikhin, University of California, Berkeley (1046-57-1026)

AMS Special Session on Geometry, Algebra, and Topology of Character Varieties

1:00 PM – 5:50 PM

Organizers: **Sean Lawton**, Instituto Superior Tecnico
Elisha Peterson, United States Military Academy

- 1:00PM (1739) *Metabelian $SL(n, \mathbb{C})$ representations of knot groups*.
Hans U. Boden*, McMaster University, and **Stefan Friedl**, University of Warwick (1046-57-1240)
- 1:30PM (1740) *Characteristic subsurfaces, character varieties and Dehn fillings*.
Marc Culler*, University of Illinois at Chicago, **Steve Boyer**, Université du Québec à Montréal, **Peter B. Shalen**, University of Illinois at Chicago, and **Xingru Zhang**, State University of New York at Buffalo (1046-57-1507)
- 2:00PM (1741) *3-manifolds whose character varieties are not Lagrangian*. Preliminary report.
S. Adam Sikora, SUNY Buffalo (1046-53-1081)
- 2:30PM (1742) *Bers slices are Zariski dense*.
David Dumas*, University of Illinois at Chicago, and **Richard P. Kent**, Brown University (1046-30-1260)
- 3:00PM (1743) *Deformations of maximal representations in the real symplectic group*. Preliminary report.
Steven Bradlow, University of Illinois, **Oscar Garcia-Prada**, CSIC, Madrid, and **Peter Gothen***, Centro de Matematica da Universidade do Porto (1046-14-441)
- 3:30PM (1744) *Ergodicity of subgroups of mapping class groups on $SU(2)$ -character varieties*.
William M. Goldman*, University of Maryland, and **Eugene Z. Xia**, National Center for Theoretical Science (South), National Cheng-Kung University (1046-57-1191)
- 4:00PM (1745) *Dynamics of the modular group action on certain character varieties of the two generator free group*.
William M. Goldman, University of Maryland College Park, **Greg McShane**, Laboratoire Emile Picard Université Paris Paul Sabatier, France, **George Stantchev**, Center for Scientific Computation and Mathematical Modelling, University of Maryland College Park, and **Ser P. Tan***, National University of Singapore (1046-57-752)
- 4:30PM (1746) *Cohomology of $SL(2, \mathbb{C})$ character varieties of surface groups and the action of the Torelli group*.
Georgios D. Daskalopoulos, Brown University, and **Richard A. Wentworth***, Johns Hopkins University and the University of Maryland (1046-32-1208)
- 5:00PM (1747) *The topology of the moduli of free group representations*.
Sean Lawton*, University of Maryland, and **Carlos Florentino**, Instituto Superior Tecnico (1046-14-749)
- 5:30PM (1748) *Trace diagram recurrences and central functions of $SL(2, \mathbb{C})$ -character varieties*. Preliminary report.
Elisha Peterson*, United States Military Academy (West Point), and **Sean Lawton**, Instituto Superior Técnico (1046-14-1394)

AMS Special Session on SAGE and Mathematical Research Using Open Source Software, II

1:00 PM – 4:50 PM

Organizers: **David Saunders**, University of Delaware
David Harvey, Harvard University
David Joyner, U.S. Naval Academy

- 1:00PM *Siegel modular forms in Sage.*
 (1749) **Craig Citro**, University of California – Los Angeles, **Alexandru Ghitza**, University of Melbourne, **Nathan C. Ryan***, Bucknell University, and **Nils-Peter Skoruppa**, Universität Siegen (1046-11-266)
- 1:30PM *Nilpotent orbits associated to Coxeter cells.*
 (1750) **Steven Glenn Jackson** and **Alfred G. Noël***, University of Massachusetts Boston (1046-22-272)
- 2:00PM *Coding theory and combinatorics in Sage.*
 (1751) **David Joyner***, U.S. Naval Academy, and **Robert Miller**, University of Washington, Seattle (1046-05-758)
- 2:30PM *Numerical analysis tools for LLL lattice basis reduction.* Preliminary report.
 ► (1752) **Gilles Villard**, CNRS, University of Lyon, France (1046-68-1571)
- 3:00PM Break
- 3:30PM *Ultra-sparse matrix reduction to reduced Row-Echelon form for matrices over $GF(2)$.*
 (1753) **Gregory V. Bard***, Fordham University, and **Robert Miller**, The University of Washington (1046-15-1959)
- 4:00PM *Modular ranks of the adjacency matrices of strongly regular graphs arising from semifields.*
 ► (1754) **Qing Xiang**, University of Delaware (1046-05-1752)
- 4:30PM *On matrix rank modulo small primes.* Preliminary report.
 (1755) **B. David Saunders**, University of Delaware (1046-15-2007)

AMS Special Session on Group Actions on Curves

1:00 PM – 5:50 PM

Organizers: **Darren Glass**, Gettysburg College
Amy E. Ksir, United States Naval Academy

- 1:00PM *Fields of moduli of three point covers.*
 (1756) **Andrew S. Obus**, University of Pennsylvania (1046-14-199)
- 1:30PM *Cartier operator on Kummer covers of the projective line.*
 (1757) **Arsen Elkin**, Colorado State University (1046-14-1009)
- 2:00PM *Abelian formulas for cyclic curves.*
 (1758) **Emma Previato***, Boston University, and **Shigeki Matsutani**, Sagami-hara, Japan (1046-14-1062)
- 2:30PM *Admissible group actions on curves.* Preliminary report.
 (1759) **David Harbater***, University of Pennsylvania, **Julia Hartmann**, RWTH Aachen, and **Daniel Krashen**, University of Georgia (1046-16-1155)
- 3:00PM *Minimal-genus G -actions.* Preliminary report.
 (1760) **Robert Guralnick**, University of Southern California, and **Michael Zieve***, Rutgers University (1046-14-433)
- 3:30PM *Katz Gabber covers of curves with extra automorphisms.* Preliminary report.
 (1761) **Ted Chinburg***, University of Pennsylvania, **Frauke M. Bleher**, University of Iowa, and **Peter Symonds**, University of Manchester (1046-14-247)

- 4:00PM *Bounding the number of group actions on a surface of fixed genus.* Preliminary report.
 (1762) **Aaron D. Wootton***, University of Portland, and **J. W. Anderson**, University of Southampton (1046-14-519)
- 4:30PM *Decomposing Jacobian varieties using automorphism groups.*
 (1763) **Jennifer Paulhus**, Kansas State University (1046-11-1159)
- 5:00PM *Automorphism groups of cyclic curves defined over finite fields of any characteristics.*
 (1764) **Rakinawasan Sanjeewa*** and **Tanush Shaska**, Oakland University (1046-14-275)
- 5:30PM *Class numbers of function fields.* Preliminary report.
 (1765) **Jing Long Hoelscher**, University of Arizona (1046-11-995)

AMS Special Session on Nonlinear Evolution Equations and Their Applications, II

1:00 PM – 6:50 PM

Organizers: **Gaston N'Guerekata**, Morgan State University

Alexander A. Pankov, Morgan State University

Guoping Zhang, Morgan State University

Xuming Xie, Morgan State University

Zhijun Qiao, University of Texas Pan American

- 1:00PM *Well-posedness in Sobolev space of an unsteady crystal growth problem.* Preliminary report.
 (1766) **Xuming Xie**, Morgan State University (1046-35-383)
- 1:30PM *Optical solitons with time-dependent dispersion, nonlinearity and attenuation.*
 (1767) **Anjan Biswas**, Delaware State University (1046-78-295)
- 2:00PM *Nonlinear dynamical phenomena in mesoscale modeling of polycrystals.*
 (1768) **Maria Emelianenko***, George Mason University, **David Kinderlehrer**, Carnegie Mellon University, and **Dmitry Golovaty**, University of Akron (1046-60-1912)
- 2:30PM *A numerical study of optical soliton-like structures resulting from the nonlinear Schrödinger equation with square-root law nonlinearity.*
 ► (1769) **Dawn Alisha Lott*** and **Anjan Biswas**, Delaware State University (1046-78-318)
- 3:00PM *Peakon Equations.*
 (1770) **Zhijun George Qiao** and **X Li***, UTPA (1046-35-542)
- 3:30PM *Pseudo almost automorphic solutions to the N -dimensional heat equation with S^p -pseudo almost automorphic coefficients.* Preliminary report.
 (1771) **Toka Diagana**, Howard University (1046-34-1915)
- 4:00PM *Rigidity of Landau's solutions to the Navier-Stokes equations.*
 (1772) **Hongjie Dong**, Brown University (1046-35-123)
- 4:30PM *Dynamics of super-Gaussian optical solitons by collective variables method.*
 (1773) **Patrice Green***, **Dawn Lott** and **Anjan Biswas**, Delaware State University (1046-78-300)
- 5:00PM *Soliton perturbation theory for the phi-four equation.*
 (1774) **Ryan Sassaman*** and **Anjan Biswas**, Delaware State University (1046-35-298)

- 5:30PM *Quenching phenomena due to a concentrated nonlinear source in \mathbb{R}^N .*
(1775) **Patcharin Tragoonsirisak**, University of Louisiana at Lafayette (1046-35-62)
- 6:00PM *$C^{(n)}$ -almost automorphic solutions of some nonautonomous differential equations.*
(1776) **Valerie N. Nelson***, **Gaston M. N'Guerekata**, Morgan State University, and **Khalil Ezzinbi**, Université Cadi Ayyad, Faculté des Sciences Semlalia (1046-34-910)
- 6:25PM *Spherical averaged endpoint Strichartz estimate for the two-dimensional Schrödinger equation with inverse square potential.*
(1777) **I-Kun Chen**, University of Maryland, College Park (1046-35-591)

AMS Special Session on Spectra of Matrix Patterns and Applications to Dynamical Systems, II

1:00 PM – 5:50 PM

Organizers: **Bryan L. Shader**, University of Wyoming
Luz M. DeAlba, Drake University
Leslie Hogben, Iowa State University
In-Jae Kim, Minnesota State University

- 1:00PM *Spectrally arbitrary patterns over finite fields.*
(1778) **Elizabeth J. Bodine**, Washington State University (1046-15-1342)
- 1:30PM *Potentially nilpotent full sign patterns.*
► (1779) **I.-J. Kim**, Minnesota State University, Mankato, **D. D. Olesky**, University of Victoria, **B. L. Shader**, University of Wyoming, **P. van den Driessche**, University of Victoria, **H. van der Holst**, Eindhoven University of Technology, and **K. N. Vander Meulen***, Redeemer University College (1046-15-628)
- 2:00PM *Minimum rank of various matrix patterns.*
► (1780) Preliminary report.
Shaun M. Fallat, University of Regina (1046-15-1268)
- 2:30PM *Minimum rank of graph powers.* Preliminary report.
► (1781) **Richard Brualdi**, **Louis Deaett**, University of Wisconsin, Madison, **Luz DeAlba**, Drake University, **Jason Grout***, Iowa State University, **In-Jae Kim**, Minnesota State University, Mankato, **Steve Kirkland**, University of Regina, **Raphael Loewy**, Technion-Israel Institute of Technology, **Judith McDonald**, Washington State University, **Pauline van den Driessche**, University of Victoria, and **Amy Yielding**, Washington State University (1046-15-1422)
- 3:00PM *Minimum rank of skew-symmetric matrices described by a graph.*
► (1782) **Colin Garnett**, University of Wyoming (1046-15-1903)
- 3:30PM *Discovery of principles of nature from mathematical modeling of DNA microarray data: Computational prediction and experimental verification.*
(1783) **Orly Alter**, University of Texas at Austin (1046-15-766)
- 4:00PM *On m -convertible matrices.* Preliminary report.
(1784) **Adam H. Berliner**, University of Wisconsin - Madison (1046-15-708)
- 4:30PM *Graph-theoretic criteria for injectivity and unique equilibria in biochemical reaction networks.*
(1785) **Gheorghe Craciun**, University of Wisconsin-Madison (1046-37-788)

- 5:00PM *Signed domination number of a matrix.* Preliminary report.
► (1786) **Adam Berliner**, **Richard A. Brualdi***, **Louis Deaett**, **Kathleen P. Kiernan**, **Seth Myer** and **Michael Schroeder**, University of Wisconsin - Madison (1046-05-574)
- 5:30PM Problem Session

AMS Special Session on Financial Mathematics, III

1:00 PM – 5:50 PM

Organizers: **Erhan Bayraktar**, University of Michigan
Tim Siu-Tang Leung, Johns Hopkins University
Birgit Rudloff, Princeton University

- 1:00PM *Smooth fit principle for impulse control of multi-dimensional diffusion processes.*
(1787) **Xin Guo***, UC Berkeley, and **Guoliang Wu**, UC Berkeley (1046-49-1505)
- 1:30PM *Regularity of the American put price in exponential Lévy models.*
(1788) **Erhan Bayraktar** and **Hao Xing***, University of Michigan (1046-60-1287)
- 2:00PM *Formulas for stopped diffusion processes with stopping times based on drawdowns and drawups.*
(1789) **Libor Pospisil**, **Jan Vecer**, Columbia University, and **Olympia Hadjiladis***, Brooklyn College, C.U.N.Y. (1046-60-1475)
- 2:30PM *Exponential hedging with optimal stopping and static-dynamic hedging.*
(1790) **Tim S. T. Leung**, Johns Hopkins University (1046-60-2042)
- 3:00PM *Volatility derivatives on time-changed Levy processes.*
(1791) **Roger Lee***, University of Chicago, and **Peter Carr**, Bloomberg LP and NYU Courant Institute (1046-60-2032)
- 3:30PM *A stochastic volatility alternative to SABR.*
(1792) **Chris Rogers**, University of Cambridge, and **Luitgard Veraart***, University of Karlsruhe (1046-60-1107)
- 4:00PM *A Hilbert transform approach to options pricing.*
(1793) **Liming Feng**, University of Illinois at Urbana-Champaign (1046-00-1232)
- 4:30PM *Time changed Markov processes in unified credit-equity modeling.*
(1794) **Rafael Mendoza***, **Vadim Linetsky**, Northwestern University, and **Peter Carr**, New York University, Courant Institute (1046-60-365)
- 5:00PM *An information reduction model for credit risk based on level crossings of a diffusion.*
(1795) **A. Deniz Sezer**, University of Calgary (1046-60-907)
- 5:30PM *Credit portfolio optimization.* Preliminary report.
(1796) **Jack Kim*** and **Kay Giesecke**, Stanford University (1046-60-1193)

AMS Special Session on The Redistricting Problem

1:00 PM – 6:50 PM

Organizers: **Daniel Goroff**, Harvey Mudd College
Daniel Ullman, George Washington University

- 1:00PM *The mathematical redistricting problem.*
► (1797) Preliminary report.
Daniel H. Ullman, The George Washington University (1046-91-917)

- 1:20PM (1798) *The law and policy of redistricting.* Preliminary report.
Richard Pildes, NYU School of Law (1046-00-1412)
- 1:40PM (1799) *A proposal for redistricting reform: A model state constitutional amendment.*
► **Sam Hirsch**, Jenner & Block LLP (1046-91-1674)
- 2:10PM (1800) *The promises and perils of optimal redistricting.*
► **Micah Altman**, Institute for Quantitative Social Science, Harvard University (1046-90-1592)
- 2:30PM (1801) *The redistricting problem: Second-order bias.* Preliminary report.
► **Michael P. McDonald**, George Mason University (1046-91-1498)
- 3:00PM (1802) *Lessons from a court-appointed nonpartisan redistricter.*
Nathaniel Alfred Persily, Columbia University (1046-00-796)
- 3:20PM (1803) *Partisan fairness in districting.* Preliminary report.
► **Andrew Gelman***, Columbia Univ, and **David Epstein**, Columbia Univ (1046-91-834)
- 3:40PM (1804) *Empirical consequences of redistricting in the U.S.*
James M. Snyder, Massachusetts Institute of Technology (1046-91-2101)
- 4:20PM (1805) *A fair division solution to the problem of redistricting.*
► **Zeph Landau***, University of California, Berkeley, **Ilona Yershov** and **Oneil Reid**, City College of New York (1046-91-680)
- 4:40PM (1806) *A measure of bizarreness.*
Christopher P. Chambers and **Alan D. Miller***, California Institute of Technology (1046-91-1166)
- 5:00PM (1807) *A new approach to measuring the racial impact of redistricting.*
Jonathan N. Katz*, California Institute of Technology, **Andrew Gelman**, Columbia University, and **Gary King**, Harvard University (1046-91-947)
- 5:30PM (1808) *Drivers of redistricting trends.* Preliminary report.
► **Michael S. Teitelbaum**, Alfred P. Sloan Foundation (1046-00-1353)
- 5:50PM (1809) *Will contiguous redistricting create competitive races for legislative elections?*
Richard B. Freeman, Harvard University (1046-05-1653)
- 6:10PM (1810) *Reflections upon almost 30 years involvement with redistricting.*
► **Charles R. Hampton**, The College of Wooster and Calvin College (1046-00-1372)
- 6:30PM (1811) *Continuing discussion of the redistricting problem.*
► Preliminary report.
Daniel L. Goroff, Harvey Mudd College (1046-91-1888)

AMS Special Session on Orderings in Logic and Topology, II

1:00 PM – 5:50 PM

Organizers: **Valentina S. Harizanov**, George Washington University
Jozef H. Przytycki, George Washington University

- 1:00PM (1812) *Non-right-orderable 3-manifold groups.*
Rachel Roberts* and **John Shareshian**, Washington University in St Louis (1046-57-1765)
- 1:30PM (1813) *Computability theoretic aspects of ordered groups.*
David Reed Solomon, University of Connecticut (1046-03-1298)
- 2:00PM Discussion

- 2:30PM (1814) *Real computability and manifolds.* Preliminary report.
Wesley Calvert, Murray State University, and **Russell Miller***, Queens College & The Graduate Center, C.U.N.Y. (1046-03-1667)
- 3:00PM (1815) *A geometrical approach to the braid conjugacy problem.* Preliminary report.
Ivan A. Dynnikov, Moscow State University (1046-57-2121)
- 3:30PM (1816) *Countable groups and their orderings.*
Jennifer Chubb, George Washington University (1046-03-1054)
- 4:00PM (1817) *Palindromes and orderings in Artin groups.*
► **Florian L. Deloup**, Institut de Mathématiques, Université de Toulouse III, France (1046-20-1844)
- 4:30PM (1818) *Compactness of the space of left orders.*
► **Mieczysław K. Dabkowski***, **Malgorzata A. Dabkowska**, UTD, **Valentina S. Harizanov**, **Jozef H. Przytycki** and **Michael A. Veve**, GWU (1046-54-2061)
- 5:00PM (1819) *Limit points in the space of left orderings of a group.* Preliminary report.
Adam J. Clay* and **Dale P. O. Rolfsen**, University of British Columbia (1046-06-942)
- 5:30PM (1820) *Pseudotrees under the interval topology.* Preliminary report.
Jennifer Anne Brown, California State University, Channel Islands (1046-06-2095)

AMS Special Session on Scientific Computing and Advanced Computation, II

1:00 PM – 5:50 PM

Organizers: **Edward Castillo Jr.**, University of California Irvine
James M. Rath, University of Texas at Austin
Sarah A. Williams, University of California Davis

- 1:00PM Networking Meet & Greet for Scientific Computing Community
- 2:00PM Discussion
- 2:30PM (1821) *Computational methods in coastal engineering.*
Jerry L. Bona, University of Illinois at Chicago (1046-86-1620)
- 3:00PM (1822) *Low mach number modeling of type Ia supernovae.* Preliminary report.
► **Ann S. Almgren***, **John B. Bell**, **Andy J. Nonaka**, Lawrence Berkeley National Laboratory, and **Mike Zingale**, Stony Brook University (1046-85-1795)
- 3:30PM (1823) *Numerical methods and software for hazardous free-surface geophysical flows.*
► **David L. George**, USGS Cascades Volcano Observatory (1046-65-877)
- 4:00PM (1824) *Linear algebra challenges in parallel circuit simulation.*
Erik G. Boman, **David M. Day**, **Robert J. Hoekstra** and **Heidi K. Thornquist***, Sandia National Laboratories (1046-15-1902)
- 4:30PM (1825) *Scalable solution methods via optimal control reformulation.*
Denis Ridzal* and **Pavel Bochev**, Sandia National Labs (1046-49-1923)
- 5:00PM (1826) *Generalized finite element methods, meshless methods, and quadrature.*
► **John E. Osborn**, University of Maryland at College Park (1046-65-906)

- 5:30PM (1827) *Goal-oriented error estimation and multilevel preconditioning for the Poisson-Boltzmann equation.*
Stephen D. Bond*, University of Illinois at Urbana-Champaign, **Burak Aksoylu**, Louisiana State University, **Eric C. Cyr**, University of Illinois at Urbana-Champaign, and **Michael J. Holst**, University of California at San Diego (1046-65-1472)

MAA Minicourse #14: Part B

1:00 PM – 3:00 PM

Teaching a course in the history of mathematics.

Organizers: **V. Frederick Rickey**, U.S. Military Academy

Victor J. Katz, University of the District of Columbia

MAA Minicourse #4: Part B

1:00 PM – 3:00 PM

An introduction to the mathematics of modern cryptography.

Organizers: **Jeffrey Ehme**, Spelman College
Colm A. Mulcahy, Spelman College

MAA Minicourse #9: Part B

1:00 PM – 3:00 PM

Beyond formulas and algorithms: Teaching a conceptual/thematic single variable calculus course.

Organizer: **Shahriar Shahriari**, Pomona College

AMS Session on Numerical Analysis, II

1:00 PM – 3:40 PM

- 1:00PM (1828) *The Schur aggregation and ill conditioned linear system.*
Abdramane Serme*, BMCC - The City University of New York, and **Lucio M.G. Prado**, BMCC- The City University of New York (1046-65-1460)
- 1:15PM (1829) *Jacobi-Gauss quadrature and near-optimal Lebesgue constants.* Preliminary report.
Akil Narayan, Brown University (1046-65-1588)
- 1:30PM (1830) *A numerical method for constrained dynamic problems.* Preliminary report.
Jin Wang* and **Gene Hou**, Old Dominion University (1046-65-1609)
- 1:45PM (1831) *A new spectral-element method in polar and spherical geometries.* Preliminary report.
Yuen-Yick Kwan*, Tulane University, and **Jie Shen**, Purdue University (1046-65-1868)
- 2:00PM (1832) *On the stability of a numerical scheme for a system of ordinary differential equations with a large skew-symmetric component.* Preliminary report.
Katharine F. Gurski*, Howard University, and **Stephen O'Sullivan**, University College Dublin (1046-65-1351)
- 2:15PM Break
- 2:30PM (1833) *Approximation by bivariate linear splines for adaptive mesh generation.*
Edmond Nadler, Eastern Michigan University (1046-65-1555)

- 2:45PM (1834) *Higher order convergence of an SDG method for scalar conservation laws.* Preliminary report.
Yangsuk Ko, California State University, Bakersfield (1046-65-1910)
- 3:00PM (1835) *Developing 3rd, 4th and 5th order difference techniques on a singular perturbation problem and their stability comparison.* Preliminary report.
F. Olcay Ilcasu*, Rowan University, **David H. Schultz**, UW-Milwaukee, and **Bakhadirzhon Siddikov**, Ferris State University (1046-65-1935)
- 3:15PM (1836) *A fast inversion algorithm for linearized diffuse optical tomography with large data sets.* Preliminary report.
Gunay Dogan*, NIST, and **George Biros**, Georgia Tech (1046-65-2025)
- 3:30PM (1837) *On the orthogonal expansion of functions on the cylinder.*
Jeremy Wade, University of Oregon (1046-65-2047)

AMS Session on Combinatorics, IV

1:00 PM – 5:25 PM

- 1:00PM (1838) *On Seymour's second neighborhood conjecture.*
James N. Brantner, Erskine College (1046-05-1278)
- 1:15PM (1839) *Structure and randomness in additive combinatorics.*
Philip Matchett Wood*, **Linh Tran**, and **Van Vu**, Rutgers University (1046-05-1281)
- 1:30PM (1840) *The diameter of random spanning trees in a given graph.*
Fan Chung, **Paul K. Horn***, UC San Diego, and **Linyuan Lu**, University of South Carolina (1046-05-1400)
- 1:45PM (1841) *Towards a general tree decomposition theory for matroids.*
Jeremy M. Aikin* and **James Oxley**, Louisiana State University (1046-05-1406)
- 2:00PM (1842) *Universal cycles on simple graphs.*
Emma E. Snively*, Rose-Hulman Institute of Technology, **Bill Kay**, University of South Carolina, and **Greg Brockman**, Harvard College (1046-05-1457)
- 2:15PM (1843) *The Gale-Berlekamp switching game.* Preliminary report.
Garry S. Bowlin, Binghamton University (1046-05-1610)
- 2:30PM (1844) *On γ -labeling almost-bipartite 2-regular graphs.*
Ryan Bunge*, **Saad El-Zanati** and **Charles Vanden Eynden**, Illinois State University (1046-05-1712)
- 2:45PM (1845) *Elements of finite order in the Riordan group.*
Marshall M. Cohen, Morgan State University (1046-05-1782)
- 3:00PM (1846) *Enumeration of the distinct shuffles of permutations.* Preliminary report.
Camillia Smith, Department of Mathematics (1046-05-1352)
- 3:15PM Break
- 3:30PM (1847) *Haar graphs for groups that are non-cyclic.* Preliminary report.
Charlie A. McIntosh, Wesleyan University (1046-05-2019)
- 3:45PM (1848) *Further results on labeling the r -path with a condition at distance two.*
John P. Georges, **David W. Mauro***, Trinity College, and **Yan Wang**, Millsaps College (1046-05-1811)

- 4:00PM *Selectivity Schur numbers for a finite number of colors.*
 ▶ (1849) **Daniel Schaal***, South Dakota State University, **Mike Bergwell**, Southeast Technical Institute, and **Scott Jones**, Milliman Inc. (1046-05-1812)
- 4:15PM *A deletion-contraction theorem for internally 4-connected graphs.*
 ▶ (1850) **Carolyn B. Chun***, **James Oxley**, Louisiana State University, and **Dillon Mayhew**, Victoria University of Wellington (1046-05-1946)
- 4:30PM *Isomorphic components of direct products of bipartite graphs.*
 ▶ (1851) **Richard Hammack**, Virginia Commonwealth University (1046-05-2084)
- 4:45PM *The incidence game chromatic number.*
 ▶ (1852) **John Y. Kim**, MIT (1046-05-2119)
- 5:00PM *Binary rank and path invariance for reductions of signed graphs.*
 ▶ (1853) **Nathan K. Pflueger**, Stanford University (1046-05-2120)
- 5:15PM *Super-exponential families of nonisomorphic matroids having the same Tutte polynomial.*
 (1854) **Ken Shoda**, The George Washington University (1046-05-1262)

AMS Session on Statistics and Probability

1:00 PM – 5:55 PM

- 1:00PM *On anticipating linear stochastic differential equations.*
 (1855) **Julius N. Esunge*** and **Hui-Hsiung Kuo**, Louisiana State University, Baton Rouge, LA (1046-60-1721)
- 1:15PM *Time discretization of Markov chains: Kick it up a notch.* Preliminary report.
 ▶ (1856) **Bogdan Doytchinov**, Elizabethtown College (1046-60-1790)
- 1:30PM *Evolution systems of measures for non-autonomous stochastic differential equations with Lévy noise.*
 (1857) **Robert D. Wooster**, University of Connecticut (1046-60-1938)
- 1:45PM *On mean advantage over inferiors ordering and weighted distributions.*
 (1858) **Broderick Oluyede***, Georgia Southern University, and **Norou Diawara**, Old Dominion University (1046-62-483)
- 2:00PM *Measurement errors in the generalized Poisson-Poisson regression model.* Preliminary report.
 ▶ (1859) **Mavis Pararai**, Indiana University of Pennsylvania (1046-62-125)
- 2:15PM *Tests for the equality of the means in the analysis of clustered count data.*
 ▶ (1860) **K. K. Saha**, Central Connecticut State University (1046-62-580)
- 2:30PM *All-pairwise comparisons for populations with unequal error variances.* Preliminary report.
 (1861) **Hong Li**, Bowling Green State University (1046-62-629)
- 2:45PM *Image reconstruction in multi-channel model under Gaussian noise.*
 (1862) **Veera Holdai***, Wayne State University/Salisbury University, and **Alexander Korostelev**, Wayne State University (1046-62-699)
- 3:00PM *A spectral look at the serial test of randomness.*
 ▶ (1863) Preliminary report. **Abbas M. Alhakim**, Clarkson University (1046-62-797)
- 3:15PM Break

- 3:30PM *A hypothesis test for evaluating the spectral purity of fuzzy clusters.*
 (1864) **Rhonda D. Phillips***, **Layne T. Watson** and **Randolph H. Wynne**, Virginia Tech (1046-60-1591)
- 3:45PM *The generalized MLE with interval-censored and masked competing risks data.*
 (1865) **Jiaping Wang***, **Qiqing Yu**, SUNY at Binghamton, and **George George Y. C. Wong**, Strang Cancer Prevention Center (1046-62-977)
- 4:00PM *Spatial analysis of archaeological sites associated with subsistence resources in coastal south central Alaska.* Preliminary report.
 ▶ (1866) **Joseph B. Liddle***, University of Alaska Southeast, **Aron Crowell**, Arctic Studies Center, Smithsonian Institution, Anchorage, and **Mark Matson**, Matanuska-Susitna Borough, Palmer, Alaska (1046-62-1061)
- 4:15PM *On the two-sided power distribution.*
 ▶ (1867) **Amol Kapila***, Brown University, and **Stephanie Sapp**, Johns Hopkins University (1046-62-1198)
- 4:30PM *Statistical analysis of aggregated, spatiotemporally clustered proportions.* Preliminary report.
 (1868) **Boubakari Ibrahimou**, University of South Florida (1046-62-1245)
- 4:45PM *Rainflow cycles counting method to assess time series models for terrain profiles.*
 (1869) **Jinfeng Wei***, Maryville University of St. Louis, and **T.C. Sun**, Wayne State University (1046-62-1519)
- 5:00PM *Proving the 100 Swiss Francs conjecture.*
 (1870) **Mingfu Zhu***, **Shuhong Gao**, Clemson University, and **Guangran Jiang**, Zhejiang University (1046-62-1535)
- 5:15PM *Omnibus sequences.*
 ▶ (1871) **Greg Brockman***, Harvard College, and **Sunil Abraham**, The University of Oxford (1046-62-1542)
- 5:30PM *Nonparametric statistics applied on simulated data and some Gene Expression data.* Preliminary report.
 ▶ (1872) **Akram M. Almohalwas**, Central Michigan University (1046-62-1783)
- 5:45PM *A computational model for functional mapping of genes that regulate HIV drug therapy and virus load.*
 (1873) **William W. Hager**, University of Florida Gainesville, **Jiangtao Luo***, University of Florida, Gainesville, and **Rongling Wu**, University of Florida, Gainesville (1046-62-1901)

AMS Session on Group Theory

1:00 PM – 5:25 PM

- 1:00PM *Residual solvability of one-relator groups.*
 (1874) **Delaram Kahrobaei**, City University of New York (1046-20-124)
- 1:15PM *New classification of 2-generated p -groups of class 2.*
 (1875) **Arturo Magidin***, University of Louisiana at Lafayette, **Robert F. Morse**, University of Evansville, and **Azhana Ahmad**, Universiti Teknologi Malaysia (1046-20-218)
- 1:30PM *Hyperbolic groups which fiber in infinitely many ways.*
 (1876) **Taralee Mecham*** and **Antara Mukherjee**, University of Oklahoma (1046-20-262)
- 1:45PM *Cartesian products of sets satisfying the central sets theorem.*
 (1877) **Neil Hindman***, Howard University, and **Dona Strauss**, University of Leeds (1046-20-364)

- 2:00PM *The probability that a product of n group elements is equal to a rearrangement of itself.*
(1878) **Thomas Langley***, Rose-Hulman Institute of Technology, **David Levitt**, Carnegie Mellon University, and **Joseph Rower**, California Lutheran University (1046-20-397)
- 2:15PM *Singleton doubly-twisted conjugacy classes in free groups.*
(1879) **P. Christopher Staecker**, Messiah College (1046-20-648)
- 2:30PM *The structure of finite groups with conditions on fixed-point-free automorphisms.*
► (1880) **Gary L. Walls**, Southeastern Louisiana University (1046-20-865)
- 2:45PM *On n -Scorza groups.* Preliminary report.
► (1881) **Luise-Charlotte Kappe**, State University of New York at Binghamton (1046-20-866)
- 3:00PM Break
- 3:15PM *The point-pushing subgroup of the punctured mapping class group is not realizable by diffeomorphisms.*
(1882) **Mladen Bestvina**, University of Utah, **Thomas Church***, University of Chicago, and **Juan Souto**, University of Michigan (1046-20-1928)
- 3:30PM *The development of Sylow p -subloops in finite Moufang loops.*
(1883) **Stephen M. Gagola III**, The University of Arizona (1046-20-2055)
- 3:45PM *Characterizing subgroups satisfying the strong Frattini argument in a direct product.*
(1884) **Joseph Evan**, King's College (1046-20-929)
- 4:00PM *A note on irreducible, infinite Coxeter groups.*
► (1885) **Dongwen Qi**, Georgia Southwestern State University (1046-20-1089)
- 4:15PM *Quasi-multiplicative bases for the center of the Iwahori-Hecke algebra of Type A_n .* Preliminary report.
(1886) **Andrew Francis**, University of Western Sydney, and **Lenny Jones***, Shippensburg University (1046-20-1211)
- 4:30PM *On an algorithm for low dimensional group homology.* Preliminary report.
(1887) **Josh Roberts**, University of Kentucky (1046-20-1321)
- 4:45PM *Centers of cyclotomic Sergeev superalgebras.*
(1888) **Oliver Ruff**, University of Toledo (1046-20-1336)
- 5:00PM *On the covering number of small alternating groups.*
(1889) **Luise-Charlotte Kappe**, State University of New York at Binghamton, and **Joanne L Redden***, Elmira College (1046-20-1504)
- 5:15PM *IA-automorphisms of center by metabelian groups.* Preliminary report.
(1890) **Margaret H. Dean***, **Marcos Zyman**, Borough of Manhattan Community College / CUNY, and **Katalin A. Bencsáth**, Manhattan College (1046-20-1670)

AMS Session on Difference and Functional Equations

1:00 PM – 4:40 PM

- 1:00PM *Oscillation of sublinear Emden-Fowler dynamic equations on time scales.*
► (1891) **Allan C. Peterson***, **Lynn H. Erbe**, University of Nebraska-Lincoln, and **Baoguo Jia**, University of Nebraska-Lincoln (1046-39-805)
- 1:15PM *The dynamic Lyapunov Equation on time scales.* Preliminary report.
(1892) **Alice A. Ramos**, Baylor University, Waco, TX (1046-39-1360)

- 1:30PM *Homoclinic orbits for a $2n^{\text{th}}$ order nonlinear difference equation.*
(1893) **Heidi Berger**, Simpson College (1046-39-1461)
- 1:45PM *Adaptive control in the Nabla Setting.*
(1894) **Billy J. Jackson**, Valdosta State University (1046-39-1473)
- 2:00PM *Nonhyperbolic dynamics for competitive systems in the plane and global period-doubling bifurcations.*
(1895) **Senada Kalabusic**, University of Sarajevo, Bosnia and Herzegovina (1046-39-1575)
- 2:15PM *The use of formative assessment in university level mathematics courses.*
► (1896) **Judith C. Stull**, Temple University (1046-39-1593)
- 2:30PM *Symmetric functions and difference equations with asymptotically periodic solutions.*
(1897) **Richard T. Guy*** and **Kenneth S. Berenhaut**, Wake Forest University (1046-39-1963)
- 2:45PM Break
- 3:00PM *Morphing Lord Brouncker's continued fraction for π into the product of Wallis.*
► (1898) **Thomas J. Osler**, Rowan University (1046-40-522)
- 3:15PM *Weakly nonlinear boundary value problems on time scales.*
(1899) **Rebecca Burton Kalhorn*** and **Jesus Rodriguez**, North Carolina State University (1046-39-1781)
- 3:30PM *Equations of convolution type with monotone coefficients.*
(1900) **Kenneth S. Berenhaut** and **Nathaniel G. Vish***, Wake Forest University (1046-39-1890)
- 3:45PM *Some conditions for convergence and subsequential convergence of regularly generated sequences.*
► (1901) **Ibrahim Canak*** and **Umit Totur**, Adnan Menderes University (1046-40-534)
- 4:00PM *Treating power series through topological concepts.*
► (1902) **Mokhtar Aouina*** and **Mohammad Khadivi**, Jackson State University (1046-40-905)
- 4:15PM *Reverse sharp inequalities for the sequence-to-function Hausdorff transformation.* Preliminary report.
► (1903) **Constantine Georgakis**, DePaul University (1046-40-1975)
- 4:30PM *Sequence design in wireless communication.*
► (1904) **Corneliu Alexandru Bodea***, **Matthew F. Der**, **Calina Anamaria Copos** and **David O'Neal**, University of Richmond (1046-40-2037)

AMS Session on Fields, Polynomials, Homological Algebra

1:00 PM – 5:10 PM

- 1:00PM *Order in the conjugacy poset of a reductive monoid.* Preliminary report.
(1905) **Ryan K. Therkelsen**, North Carolina State University (1046-06-121)
- 1:15PM *MV-pairs.*
(1906) **Elena Vinceková*** and **Silvia Pulmannová**, Mathematical Institute, Slovak Academy of Sciences, Bratislava, Slovakia (1046-06-774)
- 1:30PM *A topology on lattice ordered groups.* Preliminary report.
(1907) **Homeira Pajoohesh**, Medgar Evers College, CUNY (1046-06-1071)
- 1:45PM *Natural poset extensions of the lattice of integer partitions.* Preliminary report.
(1908) **Michael E. Detlefsen**, Slippery Rock University (1046-06-1630)

- 2:00PM *Some result in lattices.*
(1909) **Omid Ghayour***, **Mehrdad Namdari**, Shahid Chamran University, and **M. Motamedi**, Chamran University (1046-06-1777)
- 2:15PM *A topology on the Galois group.*
(1910) **Jorge Maciel**, BMCC-The City University of New York (1046-12-193)
- 2:30PM *Commutative semifields via Dembowski-Ostrom polynomials.*
(1911) **Pamela Kosick*** and **Robert S. Coulter**, University of Delaware (1046-12-278)
- 2:45PM *square-vinegar signature scheme.*
► (1912) **Crystal Clough**, University of Cincinnati (1046-12-284)
- 3:00PM *ESSENCE: A family of cryptographic hashing algorithms.*
(1913) **Jason Worth Martin**, James Madison University (1046-08-1990)
- 3:15PM *Rational and irrational series over the free group.*
(1914) **Aaron Lauve***, Texas A&M University, and **Christophe Reutenauer**, University of Quebec at Montreal (1046-12-2066)
- 3:30PM *The limits of the attack on SFLASH.*
(1915) **Daniel C. Smith**, Indiana University (1046-12-1387)
- 3:45PM Break
- 4:00PM *On certain towers of extensions by antiderivatives.*
(1916) Preliminary report.
V. Ravi Srinivasan, University of Oklahoma (1046-12-898)
- 4:15PM *Hilbert's seventeenth problem in valued fields.*
(1917) **Laurel Miller-Sims**, McMaster University (1046-12-1832)
- 4:30PM *Solving an intellectual property problem via a system of polynomial equations over GF(2).*
► (1918) Preliminary report.
Gregory V. Bard, Fordham University (1046-12-1953)
- 4:45PM *Further remarks on fibration and cofibration in module theory.*
(1919) **C. Joanna Su**, Providence College (1046-18-1839)
- 5:00PM *Homology of a chain complex over p -complete abelian groups.* Preliminary report.
(1920) **Ruth E. Vanderpool**, University of Oregon (1046-18-2112)
- 2:15PM *Four-order acousto-optic diffraction for Bragg incident light.*
► (1926) **Deborah A. Koslover*** and **Ron Pieper**, University of Texas at Tyler (1046-78-1704)
- 2:30PM Break
- 2:45PM *A new family of periodic orbits with singularities in the 2D n -body problem.*
► (1927) **Skyler C. Simmons***, **Duokui Yan** and **Tiancheng Ouyang**, Brigham Young University (1046-85-1818)
- 3:00PM *Type Ia Supernova Luminosity Data and the LTB Model: A well-posedness problem.* Preliminary report.
(1928) **Christopher J. Winfield**, UW-Oshkosh (1046-85-1012)
- 3:15PM *Long's equation in terrain following coordinates.*
(1929) **Mayer Humi**, Worcester Polytechnic Institute (WPI) (1046-86-144)
- 3:30PM *An algorithm for seismic imaging and amplitude correction derived from scattering theory.*
► (1930) **Bogdan G. Nita**, Montclair State University (1046-86-382)
- 3:45PM *Inverse problem of heat conduction, reconstruction of the temperature profile.*
(1931) **Elchin E. Jafarov***, **Dmitry J. Nicolsky**, **Victor S. Mikhaylov** and **Vladimir E. Romanovsky**, Univ Alaska Fairbanks (1046-86-1569)
- 4:00PM *Parameter determination for subsurface fluid flow modeling.* Preliminary report.
(1932) **Benjamin J. Galluzzo**, University of Iowa (1046-86-2074)

MAA Session on Guided Discovery in Mathematics Education

1:00 PM – 5:40 PM

Organizer: **Jerome S. Epstein**, Polytechnic University

- 1:00PM Introduction, Jerome Epstein
- 1:05PM *Using "real world problems" to guide mathematics learning: Challenges in instructional practice and research.*
► (1933) **Joan Ferrini-Mundy*** and **Karen Marrongelle**, National Science Foundation (1046-H1-1949)
- 1:40PM Discussion
- 2:15PM *The calculus concept inventory – New data. Correlation with teaching methodology.*
► (1934) **Jerome Epstein**, The STEM Center for Research in Educational Assessment and Teaching Enhancement (1046-H1-1458)
- 2:40PM *Guided inquiry and mathematical sophistication.*
► (1935) preliminary report.
Jennifer Earles Szydluk*, University of Wisconsin Oshkosh, and **Carol E. Seaman**, University of North Carolina at Greensboro (1046-H1-780)
- 3:00PM *An electronic classroom model for mathematics content courses: Influences on K-12 classroom teaching.*
► (1936) **Brooke Evans*** and **Patricia McKenna**, Metropolitan State College of Denver (1046-H1-954)
- 3:20PM *Teaching number theory: A deductive inquiry approach.*
► (1937) **Shlomo Libeskind**, University of Oregon (1046-H1-1112)
- 3:35PM Break
- 3:45PM *Embedded assessments of discovery-based learning.*
(1938) **Susan D. Nickerson*** and **Cassandra Brown**, San Diego State University (1046-H1-1957)

AMS Session on Mathematical Physics

1:00 PM – 4:10 PM

- 1:00PM *Spatial bounds on the effective complex permittivity for time-harmonic waves in random media.*
(1921) **Lyubima Boteva Simeonova*** and **David C. Dobson**, University of Utah (1046-78-260)
- 1:15PM *Calculation of the EM fields for scattering from large cavities.*
(1922) **Weiwei Zhang**, King's College (1046-78-1154)
- 1:30PM *Existence and uniqueness of the critical wave number for the asymmetric planar Bénard problem.* Preliminary report.
(1923) **Matthew Glomski**, Marist College (1046-80-1866)
- 1:45PM *Quantum non-singularity of spacetimes with higher order diverging differential curvature invariants.*
(1924) **Deborah A. Konkowski***, U.S. Naval Academy, and **Thomas M. Helliwell**, Harvey Mudd College (1046-83-1833)
- 2:00PM *Collinear four-body problem.*
(1925) **Tiancheng Ouyang** and **Duokui Yan***, Provo, UT (1046-85-1188)

- 4:05PM *Assessing The effectiveness of inquiry-oriented teaching in the context of TA professional development.* Preliminary report.
 ▶ (1939) **Ian Whitacre*** and **Susan D. Nickerson**, San Diego State University (1046-H1-1943)
- 4:25PM *Teaching calculus coherently.* Preliminary report.
 ▶ (1940) **Tevian Dray**, Oregon State University (1046-H1-1780)
- 4:45PM *Student proof scheme development in an introductory proof course.* Preliminary report.
 (1941) **Todd CadwalladerOlsker*** and **Nicole Engelke**, California State University, Fullerton (1046-H1-1761)
- 5:05PM *Guided discovery in a discrete mathematics course for middle school teachers.* Preliminary report.
 (1942) **Reva Kasman**, Salem State College (1046-H1-1350)
- 5:25PM *Comparisons of guided discovery and problem based learning.*
 ▶ (1943) **Marie P. Sheckels**, University of Mary Washington (1046-H1-1331)

MAA Session on Mathematics and the Arts, III

1:00 PM – 5:35 PM

Organizer: **Douglas E. Norton**, Villanova University

- 1:00PM *The Four R's in math education: Reading, WRiting, ARithmetic, and Rhyme.*
 ▶ (1944) **Karen D. Ivy**, New Jersey City University (1046-J1-983)
- 1:20PM *Potential literature and group theoretical poetry.*
 ▶ (1945) Preliminary report.
Patrick Bahls, University of North Carolina, Asheville (1046-J1-1600)
- 1:40PM *Playing with poetry: Using mathematics to discover new verses.*
 (1946) **JoAnne Growney**, Silver Spring, MD (emerita professor Bloomsburg University, PA) (1046-J1-470)
- 2:00PM *Fractal gardens.* Preliminary report.
 ▶ (1947) **Anne M. Burns**, Long Island University, C.W. Post Campus (1046-J1-328)
- 2:20PM *Weaving mathematics.*
 ▶ (1948) **Susan McBurney**, Western Springs, Illinois (1046-J1-327)
- 2:40PM *Cut my cote: When geometry met fashion.*
 ▶ (1949) **Jeff A. Suzuki**, Brooklyn College (1046-J1-540)
- 3:00PM *Symmetry groups of Chokwe Sona drawings.*
 ▶ (1950) Preliminary report.
Darrah P. Chavey, Beloit College, Beloit, Wisc. (1046-J1-1908)
- 3:20PM *Modeling heraldry using shape grammars.*
 ▶ (1951) Preliminary report.
Barbara Ashton, Borough of Manhattan Community Collge, CUNY (1046-J1-1596)
- 3:40PM *Group theory art.* Preliminary report.
 ▶ (1952) **Hayden Harker**, Vassar College (1046-J1-715)
- 4:00PM *How long was Vermeer's studio?* Preliminary report.
 ▶ (1953) **Helmer Aslaksen*** and **Aditya Liviandi**, National University of Singapore (1046-J1-1050)
- 4:20PM *The golden ratio in the arts: A skeptic's inquiry.*
 ▶ (1954) **John F. Putz**, Alma College (1046-J1-1396)
- 4:40PM *Albrecht Dürer's trochoidal woodcuts.*
 ▶ (1955) **Andrew J. Simoson**, King College (1046-J1-190)
- 5:00PM *Complex visualizations and sculpture: An interdisciplinary project for undergraduates.*
 ▶ (1956) Preliminary report.
Zdenka Guadarrama, Rockhurst University (1046-J1-2068)

- 5:20PM *Parameters, patterns, and the phase plane.*
 ▶ (1957) Preliminary report.
Douglas E. Norton, Villanova University (1046-J1-1680)

MAA Session on Promoting Deep Learning for Mathematics Majors through Experiential Learning, Writing, and Reflection, II

1:00 PM – 3:55 PM

Organizers: **Murphy Waggoner**, Simpson College
Chuck Straley, Wheaton College

- 1:00PM *Deepening mathematical concepts through presentations and writing research findings.*
 (1958) **Joyati Debnath**, Winona State University (1046-S1-1147)
- 1:20PM *Using discussion boards to enhance understanding in mathematics courses.* Preliminary report.
 ▶ (1959) **Edwin P. Herman**, University of Wisconsin, Stevens Point (1046-S1-1488)
- 1:40PM *Using peer reviews in proof-based mathematics courses.*
 (1960) **Ryan J. Zerr*** and **Jessica M. Zerr**, University of North Dakota (1046-S1-692)
- 2:00PM *Thoughts on a modified moore method course in undergraduate analysis.* Preliminary report.
 (1961) **Alex Meadows**, St. Mary's College of Maryland (1046-S1-1972)
- 2:20PM *The role of an inquiry-based classroom in promoting deep learning for mathematics majors: A case study.*
 (1962) **Mairead Greene**, Rockhurst University (1046-S1-1986)
- 2:40PM *Writing in undergraduate mathematics: From special topics course to an integrated approach.*
 ▶ (1963) **Jeffrey W. Clark**, Elon University (1046-S1-161)
- 3:00PM *Does service-learning make sense when I hate math?*
 (1964) **Rachelle M. Ankney**, North Park University (1046-S1-1719)
- 3:20PM *Learning through generalization: Using first semester calculus concepts to teach multivariable calculus.* Preliminary report.
 ▶ (1965) **Thomas W. Milligan**, University of Central Oklahoma (1046-S1-1420)
- 3:40PM *Why should I take statistics? - Let's "talk".*
 ▶ (1966) **Sarah L. Mabrouk**, Framingham State College (1046-S1-1173)

MAA General Contributed Paper Session, XI

1:00 PM – 5:25 PM

Organizer: **Sarah L. Mabrouk**, Framingham State College

Moderators: **Thomas B. Fox**, University of Houston-Clear Lake
Jay L. Schiffman, Rowan University
Russell Blyth, Saint Louis University
Ximena Catepillan, Millersville University

- 1:00PM *Problem-centered learning in mathematics education.*
 ▶ (1967) **Tracey Keck**, WSSU (1046-Z1-2038)
- 1:15PM *Which solution or proof is better and why?*
 ▶ (1968) **Shlomo Libeskind**, University of Oregon (1046-Z1-1101)

- 1:30PM *Circular insights into geometry.*
 ► (1969) **Jeffery T. McLean**, University of St. Thomas (1046-Z1-1583)
- 1:45PM *A project-oriented undergraduate course in discrete geometry.*
 (1970) **Bill Wood**, Hendrix College (1046-Z1-1508)
- 2:00PM *The Sheffer B-type 1 orthogonal polynomial sequences.* Preliminary report.
 ► (1971) **Daniel Joseph Galiffa**, University of Central Florida (1046-Z1-1116)
- 2:15PM *Examining the box topology on the Cartesian product of connected spaces.* Preliminary report.
 ► (1972) **Jeremy D. Hauze**, Kings College (1046-Z1-886)
- 2:30PM *Ancient Inca mathematics.* Preliminary report.
 ► (1973) **Ximena Catepillan***, Millersville University of Pennsylvania, and **Waclaw Szymanski**, West Chester University of Pennsylvania (1046-Z1-1801)
- 2:45PM *Recent developments in derivative-free optimization.* Preliminary report.
 ► (1974) **Rommel G. Regis**, Saint Joseph's University (1046-Z1-2054)
- 3:00PM *Discovering theorems in abstract algebra using GAP.*
 (1975) **Russell D. Blyth*** and **Julianne G. Rainbolt**, Saint Louis University (1046-Z1-1978)
- 3:15PM *Developing conceptual underpinnings of the derivative in courses before calculus.*
 ► (1976) **Thomas B. Fox**, University of Houston-Clear Lake (1046-Z1-2015)
- 3:30PM *Do the ends justify the lengths? Actin polymer length distribution.*
 ► (1977) **Csilla Szabo*** and **Donald Drew**, Rensselaer Polytechnic Institute (1046-Z1-2056)
- 3:45PM *Group work: Motivation, challenges, and how to make it work.* Preliminary report.
 ► (1978) **Theresa Lynn Jeevanjee**, Fontbonne University (1046-Z1-1468)
- 4:00PM *Retention programs for women in STEM fields with a significant mathematical emphasis.* Preliminary report.
 ► (1979) **Elizabeth K. Mauch**, Bloomsburg University of Pennsylvania (1046-Z1-493)
- 4:15PM *Multipliers for the lower central series of strictly upper triangular matrices.*
 (1980) **Louis A. Levy**, North Carolina State University (1046-Z1-43)
- 4:30PM *Generalizations of Varignon's and Steiner's theorems to simplexes using set partitions.*
 ► (1981) **John D. Pesek**, University of Delaware (1046-Z1-2004)
- 4:45PM *A geometric complexity problem in a length space.*
 (1982) **David W. Shoenthal**, Longwood University (1046-Z1-1072)
- 5:00PM *A cunning trap must be set!*
 ► (1983) **Maria C. Walpole**, Kings College (1046-Z1-1456)
- 5:15PM *Group presentations, Cayley graphs, & Markov processes.* Preliminary report.
 ► (1984) **Peter T. Olszewski**, City University of New York (1046-Z1-184)

SIAM Education Minisymposium: Professional Development and Career Choices for Students

1:00 PM – 4:25 PM

Organizer: **William L. Briggs**, University of Colorado at Denver

- 1:00PM *Good choices for great careers in the mathematical sciences.*
 ► (1985) **Mac Hyman**, Los Alamos National Laboratory (1046-00-1736)
- 2:00PM *Career preparation of mathematics and statistics students through interdisciplinary research and consulting.*
 ► (1986) **Matthias K. Gobbert*** and **Nagaraj K. Neerchal**, University of Maryland, Baltimore County (1046-97-618)
- 2:30PM *Opportunities in mathematics at the National Institutes of Health.*
 ► (1987) **Arthur S. Sherman**, National Institutes of Health (1046-00-867)
- 3:00PM *How to thrive as a mathematician at a small college.*
 (1988) **Kurt M. Bryan**, Rose-Hulman Institute of Technology (1046-00-1125)
- 3:30PM *Job opportunities for mathematics students in the Navy labs.*
 ► (1989) **Angela Mejeur**, Naval Surface Warfare Center, Dahlgren Division (1046-97-1221)
- 4:00PM *Being applied in a pure world.*
 ► (1990) **Keith E. Howard**, Mercer University (1046-37-1322)

MAA Panel Discussion

1:00 PM – 2:20 PM

Beyond T.A. training: Calculus curriculum development by graduate teaching assistants.
 Organizers: **Timothy Lucas**, Pepperdine University
Joseph A. Spivey, Wofford College
 Moderator: **Joseph A. Spivey**
 Panelists: **Jack Bookman**, Duke University
Paul L. Bendich, Pennsylvania State University
Abraham D. Smith, Duke University
Rann Bar-On, Duke University
Timothy Lucas

MAA Special Presentation

1:00 PM – 3:00 PM

Math Club in a box.
 Organizers: **Kay B. Somers**, Moravian College
Elizabeth Mayfield, Hood College

AWM Workshop Panel Discussion

1:00 PM – 2:00 PM

What is the right job for me?
 Moderator: **Gail D. L. Ratcliff**, East Carolina University
 Panelists: **Deanna Haunsperger**, Carleton College
Magnhild Lien, California State University Northridge
David C. Manderscheid, University of Nebraska-Lincoln
Carol S. Wood, Wesleyan University

AMS Session on Biology, III

1:15 PM – 4:55 PM

- 1:15PM *Bifurcations in an SEIQR model for childhood diseases.*
► (1991) **David J. Gerberry**, Purdue University (1046-92-1486)
- 1:30PM *Average distance and the Cantor Set.*
► (1992) **Christopher C. Leary**, SUNY Geneseo (1046-92-1668)
- 1:45PM *An integral projection model analysis for an endangered plant.*
► (1993) **Joseph Briggs**, North Carolina State University, **Kathryn Dabbs***, University of Tennessee, Knoxville, and **Daniel Riser-Espinoza**, Swarthmore College (1046-92-1701)
- 2:00PM *Predicting viscoelastic properties of the arterial wall.*
(1994) **Kasey Crompton**, University of South Carolina, **Andrew Davis**, Clarkson University, **Satoru Ito***, NC State University, **Amanda Olsen**, LaGrange College, **Gregory Morton**, Morehouse College, **Daniela Valdez** and **Mette Olufsen**, NC State University (1046-92-1717)
- 2:15PM *A mathematical model of erythropoiesis subject to malaria infection.*
(1995) **Jeremy J. Thibodeaux**, University of Central Oklahoma (1046-92-1718)
- 2:30PM *A mathematical model for the nociceptive withdrawal response of rats.*
► (1996) **Deena M. Hannoun***, **Joseph Schutte**, **Anthony Tongen** and **Corey Cleland**, James Madison University (1046-92-1726)
- 2:45PM *Exploring male dimorphism in the dung beetle using a discrete-time stochastic population model.*
► (1997) Preliminary report.
D. Brian Walton*, **Anthony Tongen**, James Madison University, **Phillip Andreae**, Emory University, **Adam Falk**, Grand Valley State University, **Sarah Mecholsky**, Agnes Scott College, and **Theresa Klinkhammer**, Saint Mary's College (1046-92-1847)
- 3:00PM Break
- 3:15PM *Modeling microRNA targets via clustering of mRNA microarray data.* Preliminary report.
► (1998) **Frederick A. Adkins**, Indiana University of Pennsylvania (1046-92-1896)
- 3:30PM *Mathematical models of kleptoparasiting behavior.*
► (1999) **Jan Rychtar***, The University of North Carolina at Greensboro, and **Mark Broom**, University of Sussex, UK (1046-92-1757)
- 3:45PM *On the forest transient dynamics in the perfect plasticity approximation model.* Preliminary report.
(2000) **Nikolay S. Strigul**, Stevens Institute of Technology (1046-92-1947)
- 4:00PM *Modeling frequency-dependent selection in a population of fish.*
(2001) **Sheree L. Arpin***, Framingham State College, and **J. M. Cushing**, University of Arizona (1046-92-1995)
- 4:15PM *Extracting information from genotype data of closely related individuals.* Preliminary report.
► (2002) **Giulio Genovese**, Dartmouth College (1046-92-2026)
- 4:30PM *Horizontal gene transfer of kinetic network in aquifer media.* Preliminary report.
(2003) **Mahbubur M. Rahman**, University of North Florida (1046-92-2098)

- 4:45PM *Interaction of tumor with its microenvironment: A mathematical model.*
► (2004) **Yangjin Kim***, **Avner Friedman**, Mathematical Biosciences Institute, Ohio State University, **Julie Wallace**, **Fu Li** and **Michael Ostrowski**, Human Cancer Genetics, Ohio State University (1046-92-2114)

ASL Contributed Paper Session

2:30 PM – 5:20 PM

- 2:30PM *Ramsey-like cardinals.*
(2005) **Victoria Gitman**, New York City College of Technology
- 3:00PM *Set-theoretic geology.*
(2006) **Jonas Reitz**, The New York City College of Technology
- 3:30PM *van Lambalgen's Theorem and weaker randomness notions.*
(2007) **Johanna N.Y. Franklin**, National University of Singapore
- 4:00PM *Random closed sets and probability.*
(2008) **Logan Axon**, University of Notre Dame
- 4:30PM *Reducts of the generalized random bipartite graph.*
(2009) **Yun Lu**, Kutztown University of PA
- 5:00PM *The strength of the polarized Ramsey's Theorem.*
(2010) **Jeffrey L. Hirst***, Appalachian State University, and **Damir D. Dzharfarov**, University of Chicago

AWM Workshop: Research Presentations by Recent Ph.D.'s, II

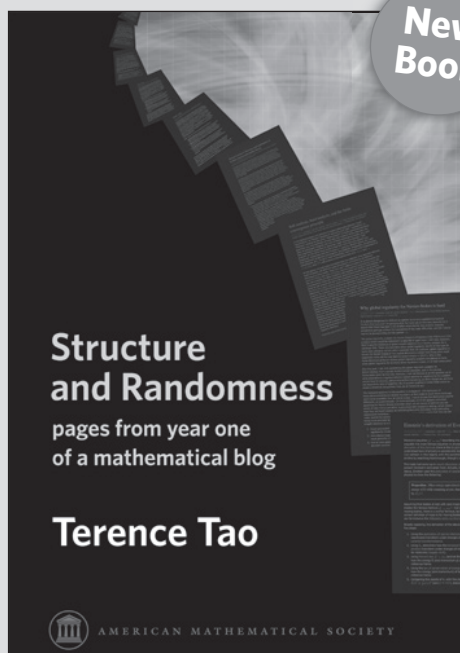
2:30 PM – 4:20 PM

- 2:30PM *Evaluation of rotavirus models with coinfection and vaccination.*
► (2011) **Omayra Y. Ortega**, Arizona State University (1046-34-59)
- 3:00PM *An introduction to enumeration schemes.*
► (2012) **Lara K. Pudwell**, Valparaiso University (1046-05-240)
- 3:30PM *Counting paths in digraphs.*
(2013) **Blair D. Sullivan**, Oak Ridge National Laboratory (1046-05-277)
- 4:00PM *The centers of spin hyperoctahedral group algebras.*
(2014) **Jill E. Tysse**, Hood College (1046-20-185)

MAA Panel Discussion

2:30 PM – 3:50 PM

- Mathematics and public policy.*
Organizer: **Philippe M. Tondeur**, University of Illinois at Urbana-Champaign
- Chair: **Philippe Tondeur**
- Panelists: **Vernon J. Ehlers**, U. S. Congressman, Michigan
Jerry McNeerney, U. S. Congressman, California
Douglas N. Arnold, University of Minnesota
Daniel Ullman, George Washington University



Structure and Randomness

pages from year one
of a mathematical blog

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

This collection of articles from Tao's research blog captures the insight, the inquisitiveness and even the playfulness of a great mathematician at the height of his influence. His contributions in diverse areas of mathematics allow him to establish connections between seemingly disparate subjects. An informal approach to the writing focuses on general ideas rather than detailed techniques.

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Program of the Sessions

MAA Minicourse #10: Part B

3:30 PM – 5:30 PM

The ubiquitous Catalan numbers and their applications.

Organizer: **Thomas Koshy**, Framingham State College

MAA Minicourse #5: Part B

3:30 PM – 5:30 PM

Developing departmental self-studies.

Organizers: **Donna L. Beers**, Simmons College
Richard A. Gillman, Valparaiso University

AMS-MAA-SIAM Gerald and Judith Porter Public Lecture

6:00 PM – 7:00 PM

(2015) *The story of a mathematical friendship.*

Steven Strogatz, Cornell University (1046-00-1405)

AMS-MAA-SIAM Joint Reception

7:00 PM – 7:45 PM

AMS Banquet

7:45 PM – 10:00 PM

Bernard Russo
AMS Associate Secretary
Irvine, California

James J. Tattersall
MAA Associate Secretary
Providence, Rhode Island

Meetings and Conferences of the AMS

Associate Secretaries of the AMS

Western Section: Michel L. Lapidus, Department of Mathematics, University of California, Surge Bldg., 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 (until January 31, 2009), Department of Mathematics, Polytechnic University, Brooklyn, NY 11201-2990; e-mail: lsibner@duke.poly.edu; telephone: 718-260-3505. **Steven H. Weintraub** (after January 31, 2009), Department of Mathematics, Lehigh University, Bethlehem, PA 18105-3174; e-mail: steve.weintraub@lehigh.edu; telephone: 610-758-3717.

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.

2009 Washington, DC, Meeting: Bernard Russo, Department of Mathematics, University of California, Irvine, CA 92697-3875, e-mail: brusso@math.uci.edu; telephone: 949-824-5505.

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:

2008

| | | |
|----------------|--------------------------------------|-------|
| December 17-21 | Shanghai, People's Republic of China | p. 90 |
|----------------|--------------------------------------|-------|

2009

| | | |
|----------------|-------------------------------|--------|
| January 5-8 | Washington, DC Annual Meeting | p. 91 |
| March 27-29 | Urbana, Illinois | p. 92 |
| April 4-5 | Raleigh, North Carolina | p. 95 |
| April 25-26 | Worcester, Massachusetts | p. 98 |
| April 25-26 | San Francisco, California | p. 99 |
| Oct. 16-18 | Waco, Texas | p. 99 |
| Oct. 24-25 | University Park, Pennsylvania | p. 100 |
| Oct. 30-Nov. 1 | Boca Raton, Florida | p. 100 |
| Nov. 7-8 | Riverside, California | p. 101 |

2010

| | | |
|---------------|--|--------|
| January 13-16 | San Francisco, California Annual Meeting | p. 101 |
| March 27-28 | Lexington, Kentucky | p. 101 |
| April 10-11 | St. Paul, Minnesota | p. 102 |
| April 17-18 | Albuquerque, New Mexico | p. 102 |
| May 22-23 | Hoboken, New Jersey | p. 102 |
| June 2-5 | Berkeley, California | p. 102 |

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|-----------------|-------------------------|--------|
| September 18-19 | Notre Dame, Indiana | p. 102 |
| October 9-10 | Los Angeles, California | p. 103 |

2011

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|-------------|---------------------------------------|--------|
| January 5-8 | New Orleans, Louisiana Annual Meeting | p. 103 |
| March 12-13 | Statesboro, Georgia | p. 103 |

2012

| | | |
|-------------|--------------------------------------|--------|
| January 4-7 | Boston, Massachusetts Annual Meeting | p. 103 |
|-------------|--------------------------------------|--------|

2013

| | | |
|--------------|--------------------------------------|--------|
| January 9-12 | San Diego, California Annual Meeting | p. 104 |
|--------------|--------------------------------------|--------|

2014

| | | |
|---------------|------------------------------------|--------|
| January 15-18 | Baltimore, Maryland Annual Meeting | p. 104 |
|---------------|------------------------------------|--------|

2015

| | | |
|---------------|-----------------------------------|--------|
| January 10-13 | San Antonio, Texas Annual Meeting | p. 104 |
|---------------|-----------------------------------|--------|

Important Information Regarding AMS Meetings

Potential organizers, speakers, and hosts should refer to page 89 in the January 2009 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.)

Co-sponsored conferences:

February 12-16, 2009: AAAS Meeting in Chicago, IL (see page 86 for more information).

June 13-July 3, 2009: Mathematics Research Communities, Snowbird, UT (see www.ams.org/amsmtgs/mrc.html for more information).

Start the New Year off Right with New Titles from Cambridge!

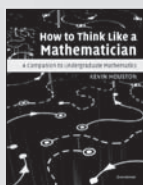
Forthcoming...

How to Think Like a Mathematician

A Companion to Undergraduate Mathematics

Kevin Houston

\$85.00: Hb: 978-0-521-89546-0
\$34.99: Pb: 978-0-521-71978-0:
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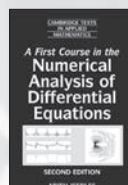
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Forthcoming...

Analytic Number Theory

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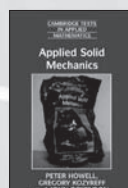
Peter Howell

Gregory Kozyreff

John Ockendon

Cambridge Texts in Applied Mathematics

\$140.00: Hb: 978-0-521-85489-4
\$60.00: Pb: 978-0-521-67109-5:
464 pp.



Leibniz

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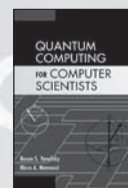


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Noson S. Yanofsky

Mirco A. Mannucci

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368 pp.



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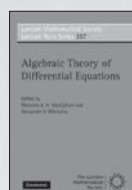
Edited by

Malcolm A. H. MacCallum

Alexander V. Mikhailov

London Mathematical Society Lecture Note Series

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248 pp.



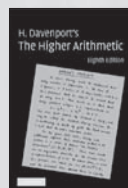
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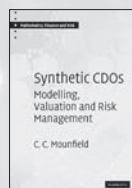
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Finance and Risk

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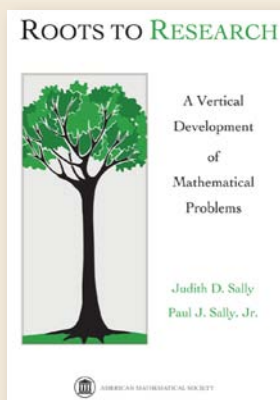
Prices subject to change.

Attending the **Joint Mathematics Meeting?**

Stop by the **Cambridge booth #210** for 20% off all titles on display!



Notable Titles from the AMS



Roots to Research A Vertical Development of Mathematical Problems

Judith D. Sally, *Northwestern University, Evanston, IL*, and **Paul J. Sally, Jr.**, *University of Chicago, IL*

Many references are given but the book is largely self-contained. The authors

have done a remarkable job of giving a seamless presentation of material at very different levels of difficulty. Teachers and students will appreciate this book both for the information it contains and as a model of expository writing.

—**Mathematical Reviews**

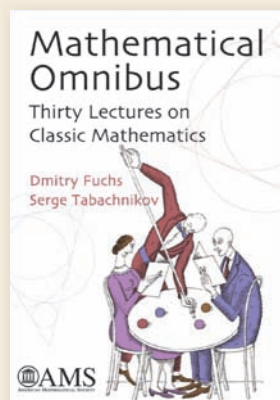
Certain contemporary mathematical problems have captivated the field because their study originates in the elementary school curriculum and proceeds through the high school, college and university levels. This book traces the full range of mathematics needed to understand the emergence of five such problems: The Four Numbers Problem, Rational Right Triangles, Lattice Point Geometry, Rational Approximation, and Dissection.

The five problems are discussed in five separate chapters, each beginning with the elementary mathematics involved at the source of the problem. For four of the problems, the discussion proceeds to an examination of important results in contemporary research. For example, the chapter on Lattice Point Geometry traces the path of study from the properties of lattice polygons in the early grades to the study of Minkowski's theorem on lattice points in convex regions and Ehrhart's theorem at the university level.

The discussion of the full range of mathematics for these five problems makes this book ideal for students and teachers at all levels, as well as for working mathematicians who are curious about results in fields other than their own. Students who begin reading the book in high school can return to it as their experience allows them to delve into more advanced aspects of the problems.

In its coverage of all levels of mathematics pertinent to the understanding of these five problems, this book offers unprecedented depth in its presentation of these important mathematical topics.

2007; 338 pages; Hardcover; ISBN: 978-0-8218-4403-8; List US\$49; AMS members US\$39; Order code MBK/48



Mathematical Omnibus

Thirty Lectures on Classic Mathematics

Dmitry Fuchs, *University of California, Davis, CA*, and **Serge Tabachnikov**, *Pennsylvania State University, University Park, PA*

This is an enjoyable book with suggested uses ranging from a text for an undergraduate Honors Mathematics

Seminar to a coffee table book. It is appropriate for either. It could also be used as a starting point for undergraduate research topics or a place to find a short undergraduate seminar talk. This is a wonderful book that is not only fun to read, but gives the reader new ideas to think about.

—**MAA Reviews**

The 30 lectures on diverse subjects that make up this highly rewarding book were selected to reflect mathematics' beauty and unity. Brought together in this way, the lectures convey a broad sense of the mathematical landscape, and will inspire advanced thought in readers already interested in mathematics.

Each lecture can be read independently of the others, although readers will find some recurring themes throughout the book. The reader who is curious about mathematical topics will be engaged with a question at the start of each lecture. The subjects included in this book are accessible in that they will strike readers as ones they could have theorized about.

Questions answered in the lectures include: "Can a Number Be Approximately Rational?", "How Many Roots Does a Polynomial Have?", and "Can One Make a Tetrahedron Out of a Cube?" Mathematics judged over time to be the highest-quality of its kind is the focus in the selected lectures. Each lecture resembles its own novel in a collection of like-minded works. The book also features about 200 exercises, many with solutions provided, and is lavishly illustrated.

While the book will challenge the reader in following the details of all arguments presented, it also will reward in filling the reader with awe over the harmony of the subject. Each lecture leads to discoveries that demonstrate that the subject merited the reader's curiosity. This will leave the reader seeking to learn more about these compelling subjects.

2007; 463 pages; Hardcover; ISBN: 978-0-8218-4316-1; List US\$59; AMS members US\$47; Order code MBK/46

**Read a review of both books at www.ams.org/notices/200811/tx081101415p.pdf
or page 1415 in the December 2008 issue of *Notices of the AMS***

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Stochastic Control of Hereditary Systems and Applications

M. Chang, U.S. Army Research

Office, Durham, NC, USA

This research monograph develops the Hamilton-Jacobi-Bellman theory, a very active research area. It is intended for researchers and advanced graduate students who have special interest in optimal control theory and applications of stochastic hereditary systems.

2008. XVIII, 406 p. (Stochastic Modelling and Its Applications, Volume 59) Hardcover ISBN 978-0-387-75805-3 ► **\$79.95**



Implementing Models in Quantitative Finance: Methods and Cases

G. Fusai, Università del Piemonte Orientale, Novara, Italy; A. Roncoroni, ESSEC Graduate Business School, Cergy Pontoise, France

This book puts numerical methods in action for the purpose of solving practical problems in quantitative finance. It fills a gap in the current published literature by delivering a case-study collection together with a self-contained course on major numerical methods developed and used by the finance industry.

2008. XXIII, 608 p. 150 illus., 5 in color. (Springer Finance) Hardcover ISBN 978-3-540-22348-1 ► **\$79.95**



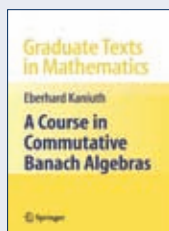
Twentieth Anniversary Volume: Discrete & Computational Geometry

J. E. Goodman,

City College, CUNY, NY, USA; J. Pach, R. Pollack, Courant Institute, NYU, NY, USA (Eds.)

This commemorative book contains twenty-eight major articles that present a comprehensive picture of the current state of discrete and computational geometry. Many of the articles solve long-outstanding problems in the field.

2009. XVIII, 635 p. 212 illus. Softcover ISBN 978-0-387-87362-6 ► **\$89.95**



A Course in Commutative Banach Algebras

E. Kaniuth, Paderborn University,

Paderborn, Germany

This book provides a thorough and self-contained introduction to the theory of commutative Banach algebras, aimed at graduate students with a basic knowledge of functional analysis, topology, complex analysis, measure theory, and group theory. At the core of this text are the chapters on Gelfand's theory, regularity and spectral synthesis. Special emphasis is placed on applications in abstract harmonic analysis and on treating many special classes of commutative Banach algebras.

2009. XII, 353 p. (Graduate Texts in Mathematics, Volume 246) Hardcover ISBN 978-0-387-72475-1 ► **\$69.95**

Handbook of Optimization in Medicine

P. Pardalos, H. E. Romeijn, University of Florida, Gainesville, Florida, U.S.A. (Eds.)

This book is devoted to examining the dramatic increase in the application of effective optimization techniques to the delivery of health care. The articles, written by experts from the areas of operations research, computer science, and medicine, focus on models and algorithms that have led to more efficient and sophisticated treatments of patients.

2009. Approx. 456 p. 129 illus. (Springer Optimization and Its Applications, Volume 26) Hardcover ISBN 978-0-387-09769-5 ► **\$149.00**



The Unreal Life of Oscar Zariski

C. Parikh, Brookline, MA, USA

From the Reviews ► *The author has written an attractive book that recreates one of the great mathematical personalities of our century. Both mathematicians and nonspecialists will enjoy it.* ► **Doru Stefanescu**, Mathematical Reviews

2009. Approx. 265 p. 46 illus. Softcover ISBN 978-0-387-09429-8 ► **\$39.95**

Subdivision Surfaces

J. Peters, University of Florida, Gainesville, FL, USA; U. Reif, TU Darmstadt, Germany

2008. XVI, 204 p. 52 illus., 8 in color. (Geometry and Computing, Volume 3) Hardcover ISBN 978-3-540-76405-2 ► **\$69.95**

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