Calendar of AMS Meetings and Conferences

This calendar lists all meetings and conferences approved prior to the date this issue went to press. The summer and annual meetings are joint meetings with the Mathematical Association of America.

Abstracts of papers presented at a meeting of the Society are published in the journal Abstracts of papers presented to the American Mathematical Society in the issue corresponding to that of the Notices which contains the program of the meeting, insofar as is possible. Instructions for submission of abstracts can be found in the January 1993 issue of the Notices on page 46. Abstracts of papers to be presented at the meeting must be received at the headquarters of the Society in Providence, Rhode Island, on or before the deadline given below for the meeting. Note that the deadline for abstracts for consideration for presentation at special sessions is usually three weeks earlier than that specified below.

Meetings

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* Please refer to page 239 for listing of special sessions.
† Please refer to the Table of Contents for further information.

Conferences


June 11–July 6, 1994: Joint Summer Research Conferences in the Mathematical Sciences, Mt. Holyoke College, South Hadley, Massachusetts.


Other Events Cosponsored by the Society

May 5–8, 1994: MER Network Workshop, University of Texas at Austin, Austin, Texas.

Deadlines

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* Please contact AMS Advertising Department for an Advertising Rate Card for display advertising deadlines.
** For material to appear in the Mathematical Sciences Meetings and Conferences section.

ICM-94 ABSTRACT DEADLINE: The deadline for abstracts for short communications to be presented at ICM-94, August 3–11, in Zurich is April 15, 1994. Readers should be aware that the Second Announcement contains detailed instructions for the preparation of abstracts and a sample abstract; abstracts not in the proper form will not be accepted. Much of the Second Announcement (including instructions on the preparation of abstracts) will appear in the April 1994 issue of the Notices. Copies of the Second Announcement are available by writing to: International Congress of Mathematicians, ETH Zentrum, CH-8092 Zurich; telephone: +41-1-632-52-30; fax: +41-1-252-91-84; e-mail: icm94@math.ethz.ch.
ARTICLES

182 Martin D. Kruskal Receives National Medal of Science
Martin Kruskal of Rutgers University has received the National Medal of Science, the nation's highest distinction for scientific achievement. In this article, Mark Ablowitz, John Greene, and Harvey Segur pay tribute to Kruskal's accomplishments.

185 Update on Fermat's Last Theorem
In early December, Andrew Wiles acknowledged what many in touch with the rumor mill already knew: There is a gap in his proof of Fermat's Last Theorem. Allyn Jackson provides some background on the general nature of the gap and describes some of the public attention Wiles's work has drawn.

187 Fighting for Tenure
The Jenny Harrison Case Opens a Pandora's Box
In July of last year, Jenny Harrison was appointed to the Berkeley mathematics department as a full professor, after a long legal battle with the university. Allyn Jackson provides a history of the case and a look at some of the broader issues the case raises.

FEATURE COLUMNS

195 Computers and Mathematics Keith Devlin
Three software reviews make up this month's column. John Crow concentrates on Maple in the first of a two-installment comparison of Maple and Macsyma computer algebra systems. Next, Herb Holden reports on X(PLORE). Finally, Marvin Margolis takes a look at the mathematical graphics system MG.

202 Inside the AMS
During the Joint Mathematics Meetings in Cincinnati, the AMS Council passed a strongly worded resolution about recent doctorates and the job market. The resolution urges departments to offer new doctorates positions of at least two years duration, and denounces the hiring of Ph.D.s in part-time positions at substandard salaries as a way for institutions to ease financial pressures.
From the Executive Director . . .

THE NEW NOTICES

The Notices of the AMS is the most widely distributed publication communicating about mathematics, mathematicians, and the mathematical profession. The Notices is available to all AMS members as a benefit of membership, and it also has a number of institutional subscribers. In 1992, a special task force was constituted to review all membership publications and in particular to study and make recommendations as to whether the Notices was serving the membership as well as it could. That task force reported back to the Society and recommended an "enhanced" Notices, and the pieces are now in place to make this recommendation a reality. January 1995 will see the first issue of the new and enhanced Notices.

The most important feature of the new Notices will be a single individual with editorial authority and responsibility, the editor of the Notices. The Notices will remain the "journal of record" of the Society and therefore will communicate items of Society business as directed by the bylaws and by tradition. These will include reports of national and sectional meetings and business meetings, as well as reports of the secretary, treasurer, and executive director. However, the new Notices is expected to take on an individual flair and character that have heretofore been missing. The Notices will remain a principal vehicle of communication of the Society; but it will carry the voices and opinions of individual mathematicians, with the understanding that their views do not reflect official opinion of the AMS.

The task force recommended features that it believed would be important to the new Notices. It should include editorial pieces by the editor or by individuals selected by the editor and should have a lively section of "Letters to the Editor". It is expected to have succinct and pithy news about mathematics, science policy, and the profession. There should be regular features on mathematics education, applications of mathematics, and computers in mathematics. Information on meetings and the programs of AMS meetings should be available to all members through the Notices, as well as information on AMS activities.

But most importantly, the Notices should communicate a broad scientific and professional overview of contemporary mathematics to the diverse membership of the AMS. In particular, the new Notices is expected to communicate mathematics as a rich and living subject, with news on what has just happened or even what might be expected to happen in mathematics research, articles that describe the development and context of areas of research, and mathematical expositions that reaches out to a significant fraction of the AMS membership.

The AMS Council has appointed an editor who will present nominations of associate and contributing editors to the April Council. A production editor with magazine production experience has been brought on staff to oversee the production side of the Notices. Also, as might be expected, the new Notices will have a new and enhanced design, featuring a four-color cover. But most importantly, this new design will better serve readers, allowing them to easily find what they need in an issue. Standard content such as meeting information and programs will have a new design that forecasts great improvement.

There is a lot of anticipation and excitement, because this is a first for the AMS: having an individual as an editor with sole authority and responsibility for an AMS publication, an AMS membership publication. We should hear more from the new editor during this year, and we especially look forward to hearing from the new editor in the new Notices of the AMS.

William Jaco
Letters to the Editor

A Letter Concerning the Jenny Harrison Case

I am writing concerning the case of Jenny Harrison, who was recently appointed to the position of Full Professor at the Department of Mathematics at UC Berkeley by order of the Chancellor, without consulting the Mathematics Faculty, contrary to Berkeley's own rules concerning academic appointments. No doubt Chancellor Tien felt under tremendous pressure to act the way he did.

Over the past seven years, since Harrison's denial of tenure by the normal procedures of the Department and the Berkeley Campus, there has been an unprecedented propaganda campaign on her behalf as an alleged victim of "sex discrimination." I find it ironic that I, the sole tenured woman Professor in the Berkeley Math Department, was virtually completely ignored by the many newspaper and magazine articles because my opinion was and remains contrary to that of the Harrison lobby.

Let me make my position clear. Though sexism and racism still exist on our campuses -- and must be eradicated by every means -- the fact is that there was NO sex discrimination in the case of Jenny Harrison. She was denied tenure purely and simply because, though a good teacher, her research did not meet the very high standards of the Mathematics Department at Berkeley, the finest public university in the country.

As a result this campaign has gone virtually unanswered for seven years.

Being in the same broad area of mathematics as Harrison, I was able to read her papers and attend her talks knowledgeably. It is on this basis that I have been one of her most vocal critics. Her supporters have unscrupulously tried to intimidate me.

Having won, Harrison is now a "role model" on how to achieve one's goal, despite lacking the necessary qualifications. Sadly, her successful tactics send a message to the public and to university students that women faculty are hired primarily for their gender. This will only enhance cynicism and TRUE gender discrimination.

I believe that we, women in science, deserve far better; for in fact we are perfectly equipped to meet the same standards that men do. Though our numbers are still relatively small, we can do very well indeed without male enthusiasts who actually see us as inferior, and who "genuinely" try to "help" with Harrison-type lobbying.

I very much hope that people in our society will find the courage and integrity to speak their minds and stand up against a fear-instilling campaign (like Harrison's) no matter how "politically correct" it might seem.

Marina Ratner
University of California, Berkeley
(Received July 26, 1993)

Editor's Note: Professor Harrison was offered an opportunity to respond to Professor Ratner's letter or to ask someone else to respond. She asked Professor Morris Hirsch to respond on her behalf. His response follows.

The letter of my distinguished colleague Marina Ratner is representative of a small but extremely vocal group of Berkeley mathematicians who are opposed to Jenny Harrison's appointment. Unable to present any evidence supporting their views, they have resorted to unsupported allegations.

Ratner's claim that she was "virtually ignored" by the press is absurd. In fact the views of Harrison's critics have received widespread coverage. The Los Angeles Times Magazine of May 2 (readership: 1.8 million) quoted Ratner and four other members of the Math Department opposing Harrison, but only one supporter. The October 15 Science has extensive quotes from Ratner and others who share her views, as did the June 28, 1991 issue. In one sense, however, she is correct: The press has ignored her baseless claims of "manipulating the facts...intimidation...character assassination...a fear instilling campaign..." on the part of Harrison's supporters.

In the Harrison case there are three substantive issues which it is important to untangle:

1. Was Harrison subject to gender discrimination?
2. Was she worthy of tenure in 1986?
3. Is she worthy of tenure today?

(1) Was Harrison subject to gender discrimination? While acknowledging that "sexism and racism still exist on our campuses," Ratner asserts "there was no discrimination in the case of Jenny Harrison." How does she know this? She doesn't tell us, claiming only that Harrison's research was not good enough for Berkeley.

In fact, Harrison's legal case was based on hundreds of hours of sworn testimony by a score of witnesses, and thousands of pages of documents, including the personnel files of those Berkeley mathematicians who received

Letters to the Editor

Letters submitted for publication in the Notices are reviewed by the Editorial Committee. The Notices does not ordinarily publish complaints about reviews of books or articles, although rebuttals and correspondence concerning reviews in Bulletin of the American Mathematical Society will be considered for publication.

Letters should be typed and in legible form or they will be returned to the sender, possibly resulting in a delay of publication. All published letters must include the name of the author. Letters which have been, or may be, published elsewhere will be considered, but the Managing Editor of the Notices should be informed of this fact when the letter is submitted.

The committee reserves the right to edit letters.

Letters should be mailed to the Editor of the Notices, American Mathematical Society, P.O. Box 6248, Providence, RI 02940, or sent by e-mail to notices@ams.org, and will be acknowledged on receipt.
tenure during Harrison’s first appointment. For the courts, a sufficient basis for a finding of discrimination is to prove that men with comparable records were given tenure. It is revealing that for five years the University would not even discuss an out-of-court settlement with Harrison, but soon agreed to such discussion after seeing her evidence.

(2) Was Harrison worthy of tenure in 1986? This is a separate but related question: A negative answer does not imply there was no discrimination; nor does a positive answer imply there was discrimination. But if in fact the 1986 tenure review process was tainted by discrimination, then the fairness and hence the correctness of the denial of tenure are in question.

In 1986 I urged the Mathematics Department to grant Harrison tenure on the basis of the excellence of her research. The Department, severely divided, voted against tenure. The report of the 1993 review committee (see below), however, strongly suggests that tenure was justified in 1986.

(3) Is Harrison now worthy of tenure? Ratner’s negative opinion—“appointed only for her gender”—is contradicted by the recent review of Harrison’s career that was part of the settlement of the lawsuit. According to Science (the source of the following quotes and information), the seven members of the review committee contained five mathematicians, including two from Berkeley (I was not one); the committee obtained letters from ten other mathematicians. The seven reviewers first looked at Harrison’s early research, including “two notable results” completed before the departmental review in 1986, and several related papers which were finished later. They concluded that this work placed her “in the lower middle of the comparison group” of the nine men and one woman appointed to tenure since Harrison’s initial appointment in 1977. On this basis they recommended appointment to tenure. The reviewers then evaluated all her research to date and compared it to that of the ten tenure appointees. They found the quality of Harrison’s research to be “in many cases comparable and in some cases higher”. On this basis they recommended appointment as Full Professor. These findings were unanimous.

Contrary to Ratner’s opinion, this review was carried out in accordance with established, if unusual, University procedures; similar procedures had recently been used in settling two other gender discrimination cases at Berkeley. According to Science, Alberto Grünbaum (then Chair) consulted about a dozen members of the Math Department about the settlement—mostly Harrison’s critics. Harrison and Grünbaum agreed upon a list of 42 people. Provost Carol Christ, in consultation with the Academic Senate’s Budget Committee (which recommends action to the Chancellor on every tenure appointment and promotion), selected the seven reviewers from this list.

Science also quotes favorable assessments of Harrison’s latest work by Morton Brown, Robert Devaney, Dennis Sullivan and James Yorke. Readers can form their own opinion by reading Harrison’s Research Announcement in the October AMS Bulletin.

My views on the propriety of Harrison’s campaign were eloquently expressed by Melvin Rothenberg’s letter to Ratner, quoted in Science: “Much of the anger in your letter seems to flow from the fact that Harrison and her supporters waged a vigorous public and legal campaign to reverse a departmental decision. There are mathematicians who feel that such activity is improper and somehow unprofessional. I don’t agree. Such campaigns, while sometimes unpleasant and disruptive of academic tranquility, are a legitimate way of coming to grips with serious social issues. To characterize them generally as forms of intimidation or harassment is to deny the legitimacy of any forms of social protest”.

On one point, at least, Ratner and I agree: There is prejudice and discrimination against women in mathematics. Unfortunately, too many mathematicians deny its existence. Harrison’s successful struggle, by encouraging others to fight against unfair treatment, will hasten the day when a mathematician’s gender is as irrelevant as hair color.

Morris W. Hirsch
Mathematics Department
University of California
at Berkeley
Professor Emeritus and former Chair
(Received November 5, 1993)

A Questionable Proposal
Following the publication in the February 93 issue of the Notices of my article “Will Russian Mathematics Survive” I received from one very qualified American mathematician a letter saying:

“I read your article in the February 93 ‘Notices’. I would like to tell you that I have been working very hard to get Professor (**-the name of my former student-V.A.) a position here, although the University budget here is extremely tight... I have nominated both you and (*) as visitors. . . .

In order that I can deal with our administration people here more effectively, I hope that I can be nominated as a speaker in (**- the name of a very important mathematical forum). . . . I understand that you are on the Nominating Committee for (**). I hope that you will nominate me as a speaker. I believe that Professor (***) will agree with your nomination.”

The letter ends with an agreement of the author to implement into one of his forthcoming publications some suggestions that I had communicated to the author earlier and which he earlier was reluctant to implement.

I have omitted the long description of the mathematical results of the author of the letter, which are quite interesting.

The economical situation of Russian mathematicians is indeed disastrous. However most Russians are proud people and are not selling their opinions even for the bargain of an invitation to an USA university.

V.I. Arnold
Steklov Mathematical Institute
Moscow
(Received June 24, 1993)
Position:
The Trustees of the American Mathematical Society seek to find a suitable person to serve as the Executive Director of the Society when that position is vacated by the current incumbent, Dr. William Jaco, at some time in the first half of 1995. The precise starting date of employment is somewhat flexible, but would not be later than July 1, 1995.

Duties and terms of appointment:
The Executive Director is the principal executive officer of the Society and is responsible for the execution and administration of the policies of the Society as approved by the Board of Trustees and by the Council. The Executive Director is a full-time employee of the Society appointed by the Trustees and is responsible for the operation of the Society's offices in Providence and Pawtucket, RI; Ann Arbor, MI; and Washington, DC. The Executive Director is an ex-officio member of a number of policy committees of the Society and is often called upon to represent the Society in its dealings with other scientific and scholarly bodies.

The American Mathematical Society is the oldest scientific organization of mathematicians in the U.S. The Society's activities are mainly directed towards the promotion and dissemination of mathematical research and scholarship, broadly defined; the improvement of mathematical education at all levels; increasing the appreciation and awareness by the general public of the role played by mathematics in our society; and advancing the professional status of mathematicians. These aims are pursued mainly through an active program of publications, meetings, and conferences. The Society is a major publisher of mathematical books and journals, including Mathematical Reviews; organizer of numerous meetings and conferences each year; and is a leading provider of electronic information in the mathematical sciences. The Society has recently opened a Washington office to improve interaction with federal agencies.

The annual budget of the Society for the current year is $21 million. The major part of the budget is related to publications. Almost all operations (including the printing) of the publications program are done in-house by the Society. Most phases of the office operations and the publications program are computerized. There is a staff of over 250 in the four offices. The directors of five divisions report directly to the Executive Director.

The Executive Director serves at the pleasure of the Trustees. The terms of appointment, salary and benefits will be consistent with the nature and responsibilities of the position and will be determined by mutual agreement between the Trustees and the prospective appointee.

Qualifications:
Candidates for the office of Executive Director should have a Ph.D. (or equivalent) in mathematics, published research beyond the Ph.D., and significant administrative experience. Excellent communication skills are essential, and an interest in mathematical publication, fiscal management, and the utilization of modern technologies for these activities would be highly desirable.

Applications:
A search committee (chaired by Ramesh Gangolli) has been formed to seek and review applications. Persons who wish to be considered for the position or who wish to make a nomination of another individual should write, with appropriate supporting information, to:

Ramesh Gangolli
Department of Mathematics, GN-50
University of Washington
Seattle, WA 98195

The closing date for applications is May 31, 1994.
Martin D. Kruskal of Rutgers University was awarded the National Medal of Science, the nation’s highest honor for achievement in science. He received the medal “for influence as a leader in nonlinear science for more than two decades”. President Clinton presented the awards to eight scientists at a ceremony at the White House in late September.

Commentary on Kruskal’s Work
The following piece about Professor Kruskal’s work was prepared, at the request of the Notices, by Mark J. Ablowitz of the University of Colorado in Boulder, John Greene of General Atomics in San Diego, and Harvey Segur of the University of Colorado in Boulder. These three authors also prepared the biographical sketch that follows this commentary.

Martin D. Kruskal has made profound contributions in pure and applied mathematics. His research is remarkably diverse and includes seminal discoveries in the mathematics of plasma physics, relativity, asymptotic analysis and perturbation theory, surreal numbers, and differential equations. In his extensive studies of differential equations he has forever changed our understanding of nonlinear partial differential equations by the discovery of solitons and the analysis of their governing equations.

The study of theoretical plasma physics dominated Martin Kruskal’s early work. In this research (see for example references [1-4] below) he helped develop some of the basic principles of plasma physics, and found new exact solutions to the governing equations and novel mathematical methods to analyze the stability of plasma waves. In the 1950s there was a great deal of discussion regarding the nature of plasma oscillations. The linearized evolution equations possess a continuous spectrum, which prevents the use of standard normal-mode analysis. This raises many subtle questions about the nature of irreversibility in time-reversible systems, causality, and the physical meaning of singular eigenfunctions. The notion that there are nonlinear solutions of the governing equations that are more transparent than the linearized solutions is an important result in this context. The publication containing this revelation is known as the “BGK” (Bernstein-Greene-Kruskal) paper [1]. In a further important development arising from the study of plasma dynamics, Kruskal and Oberman introduced the “KO” principle for stability. The use of the invariants of the system presages much, if not most, of what is often referred to as the Arnol’d energy method.

In 1960 Kruskal published a paper [5] in which he concretely showed that in suitable coordinates, often termed “Kruskal coordinates” by relativists, apparent singularities in certain solutions (e.g., the Schwarzschild solution) of the equations of general relativity are in fact not singular away from the origin. These coordinates allow analysis in the neighborhood of a black hole to be carried out effectively.

A recurrent theme in Kruskal’s research has been the use and systematic development of asymptotic analysis and perturbation theory. He spelled out his ideas in his 1963 paper “Asymptotology” [6] in which he developed a set of principles that apply to problems in definite limiting cases.

An important application of Kruskal’s systematic use of asymptotic analysis was an approach to the understanding of what we would now call the chaotic nature of magnetic lines of force in a toroidal configuration. Since magnetic
lines are a characteristic of virtually any model of plasma physics, solutions of these equations cannot be understood without some conception of the magnetic geometry. In the pre-computer days of the 1950s he formulated the problem as one of understanding the unavoidable inaccuracy of asymptotic series for the approximate locations of the magnetic lines. In our computer age there are alternative ways to study chaos, but the value of such asymptotic analyses remains in providing analytical results that can be used to verify computational results.

In the course of his work on plasma physics, Kruskal illuminated the importance of asymptotic approximations as opposed to ad hoc approximations, and a number of significant results emerged, e.g., the analysis of the adiabatic invariance of the magnetic moment of a charged particle gyrating in a magnetic field. An adiabatic invariant is a formal constant in the asymptotic theory, but usually not in the exact problem. Kruskal, in various papers (see [7] for an historical perspective), represented the adiabatic invariant by an appropriate asymptotic series, which when truncated at any order, undergoes a change of smaller order than the last retained term. This shows that the actual change is small beyond all orders of the expansion.

Generalizations of the asymptotic studies in plasma physics led Kruskal to the understanding of solutions of Hamiltonian equations that display, in their time dependence, multiple scales that depend on the perturbation amplitude. In the paper on Hamiltonian systems with nearly periodic solutions [7] Kruskal systematically constructs new variables and recursively obtains better and better approximations to nearly periodic solutions.

The question of analyzing asymptotic solutions "beyond all orders" has been a strong motivation for much of his recent work on asymptotic expansions. Kruskal and Segur [8] analyzed a nonlinear ordinary differential equation arising in crystal growth and developed a method showing that small terms in the equations (e.g., surface tension) have a physically significant, though exponentially small, effect on the solution. This effect, which is beyond all orders, showed that many of the models of crystal growth were nonphysical. The method developed in their paper has since been used by numerous researchers in a variety of problems.

The issue of analyzing, in general, asymptotic series with terms beyond all orders has also been one of the motivations behind Kruskal's analysis and development of surreal numbers. Surreal numbers are an extension of the real number system that comprise both infinitely large (e.g., the ordinal numbers) and infinitesimal numbers. They were originally conceived and developed by John Conway over twenty years ago. Kruskal has given a direct and constructive way to generate the surreal numbers and has moved towards being able to use surreal numbers as fundamental entities in calculus. Anyone who discusses surreal numbers with Kruskal comes away appreciating his firm belief that they are beautiful, fundamental, and natural.

Perturbation theory also led Kruskal from the anharmonic lattice system of Fermi-Pasta-Ulam to the Korteweg-deVries (KdV) equation,

$$\frac{\partial u}{\partial t} + u \frac{\partial u}{\partial x} + \frac{\partial^3 u}{\partial x^3} = 0,$$

which arose first in 1895 in the context of long water waves of small amplitude. The KdV equation was known to possess special solitary wave solutions, namely steady travelling localized waves (e.g. a moving heap of water of invariant form). In what can only be characterized as a monumental contribution, Zabusky and Kruskal in 1965 [9] recognized that these solitary waves are extremely special. Upon collision, asymptotically in time, the solitary waves regain their amplitudes and speeds and only suffer a phase shift. Zabusky and Kruskal termed these particle-like waves "solitons", a term that is recognized throughout science today. This work was based upon numerical simulation of the KdV equation and was an outstanding early success of scientific computation.

Following the discovery of solitons was a series of far-reaching contributions that culminated in the "inverse scattering method" for solving the KdV equation [10, 11] as an initial-value problem on the line with rapidly decreasing initial data. If the KdV equation were the only such equation with solitons and solvable by inverse scattering, the contribution would have been important but limited in scope. However, the KdV equation is the prototype of a class of "integrable" infinite-dimensional Hamiltonian nonlinear equations that have many features in common, including solitons, infinitely many conserved quantities and related symmetries, Miura and Backlund transformations, special structure in the complex plane such as reductions to ordinary differential equations of Painlevé type, and linearizations by Lax pairs. Such integrable equations have applications in many areas of mathematics and physics, for example: group theory, numerical analysis, fluid dynamics, nonlinear optics, plasma physics, relativity, quantum field theory, and differential, algebraic, and symplectic geometry. The wide-ranging importance and usefulness of the KdV work is perhaps best appreciated by realizing that there have been an enormous number of papers and many textbooks written on various aspects of this subject. In short, this work created a field of study.

Differential equations and their solutions has also been a subject to which Kruskal returns over and over again. In a lovely example of concrete analysis, Clarkson and Kruskal [12] developed a direct method of obtaining special solutions of the Boussinesq equation of fluid dynamics. It turns out that their method yields a class of solutions that can not be found by classical similarity analysis. As such it has regenerated great interest in such similarity methods.

Even after discussing this list of important papers, we note that Kruskal's scientific influence has been augmented by significant unpublished work and the lasting influence on those people lucky enough to have worked with him. Their research often bears his imprint. In particular, they can attest to his dogged insistence on logical thinking, his desire for clear understanding of the basic concepts, and his emphasis on the usefulness of concrete examples.
Biographical Sketch

Martin Kruskal was born on September 28, 1925, in New York City. No doubt his childhood was stimulating; his brothers William (University of Chicago), and Joseph (AT&T Bell Laboratories) are both noted mathematicians. After completing high school at the Fieldston School in Riverdale, NY, he went to the University of Chicago and obtained a BS in mathematics. Fortunately, the Kruskal family lived in New Rochelle, NY, and one of their neighbors was Richard Courant, who was in the process of building an internationally acclaimed academic institute at New York University, now known as the Courant Institute of Mathematical Sciences. Kruskal decided to do his graduate work at this new institute and wrote his Ph.D. thesis on minimal surfaces with Courant as his advisor.

In 1951 Kruskal moved to Princeton and became one of the earliest employees of what is now called the Princeton Plasma Physics Laboratory. At that time it was called Project Matterhorn, and it was among the first places in the world to start research on the possibility of producing useful energy from controlled thermonuclear fusion. Plasma physics was in its infancy, and much of the work was security-classified. In 1956 he was promoted to Associate Head of the Theoretical Division of Project Matterhorn, a position he held until 1964. In 1959 he became a lecturer in astronomy at Princeton University and in 1961 was promoted to Professor of Astrophysical Sciences.

In 1959–1960 Kruskal was awarded a Senior Fellowship of the National Science Foundation, which he used at the Max Planck Institute for Physics and Astrophysics in Munich, Germany. In the winter of 1965–1966 he was the first long-term thermonuclear fusion exchange visitor to the then-USSR. In 1979 he led the US delegation for a binational Academy of Sciences workshop on Soliton Theory in Kiev, USSR, and from there went on to a five-month visit to the University of Nagoya and the Nagoya Plasma Institute. In recent years he has been invited to universities and research institutes around the world, including several trips to India and Australia.

From 1968–1988 Kruskal was director of the Program in Applied Mathematics at Princeton University, and in 1979 he was appointed Professor of Mathematics at Princeton. In 1989 he retired from Princeton, where he is now Professor Emeritus, and took the newly created position of the David Hilbert Professor of Mathematics at Rutgers University.

In 1980 Martin Kruskal was elected to the National Academy of Sciences and in 1983 to the American Academy of Arts and Sciences. He has numerous honors and prizes to his credit, including the AMS Gibbs Lectureship in 1979, the Dannie Heineman Prize in Mathematical Physics in 1983, the Potts Gold Medal of the Franklin Institute in 1986, the National Academy of Sciences Award in Applied Mathematics and Numerical Analysis in 1989, and now the 1993 National Medal of Science.

Martin Kruskal has been a long-time member of the American Mathematical Society. He is also a member of the Society for Industrial and Applied Mathematics and a former two-year member of its Board of Trustees, a member of the Mathematical Association of America, and a Fellow of the American Physical Society. He has also served on numerous governmental and external university committees, including the Mathematical Sciences Education Board of the National Research Council.

Martin Kruskal has written more than sixty published papers on a wide range of topics, some of which were described above. He has had a number of Ph.D. students, including Stephen Orszag, currently in the Program in Computational and Applied Mathematics at Princeton; Alfred Ramani at the Ecole Polytechnique in France; Nalini Joshi at the University of New South Wales in Australia; and Ji-Shan Hu at Hong Kong University of Science and Technology.

Finally we mention two of Martin Kruskal’s deep interests apart from mathematics: limericks and origami. For years, as director of the Program in Applied Mathematics at Princeton, he wrote an appropriate original limerick to appear on the announcement of the applied mathematics colloquium for each speaker. His interest in origami was motivated by his wife Laura, a world renowned creator and teacher of origami, and his mother, the late Lillian Oppenheimer, who founded the Origami Center of America. Lucky individuals who attend meetings with the Kruskals often receive their own original models!

Martin and Laura Kruskal have three children and six grandchildren, including a set of triplets.

References


Update on Proof of Fermat’s Last Theorem

Gap Appears in Proof but Experts
Laud Wiles’s Accomplishment

Last June was a heady time for mathematics, as e-mail messages streaked around the globe telling of Andrew Wiles’s announcement of a proof of Fermat’s Last Theorem. The Isaac Newton Institute in Cambridge, England, where Wiles made his announcement in a series of three lectures, was inundated with requests for interviews, photos, and explanations of the proof. Newspapers all over the world trumpeted the demise of this deceptively simple problem, which had stubbornly resisted the efforts of many. Unlike previous proofs that were announced and then quickly collapsed, Wiles’s proof had strong support from experts who understood the strategy of his proof.

Then, in early December, Wiles sent out an e-mail announcement confirming what those in touch with the rumor mill had already heard: there was a gap in the proof. As early as July, experts had been asking pointed questions about the part of the proof having to do with Wiles’s use of Euler systems, though at that time, no error had been discovered in the proof. Euler systems, which are sequences of elements in cohomology groups, were invented only recently by Viktor Kolyvagin. Despite the success of Kolyvagin and Karl Rubin in exploiting them in diverse situations, the general theory of Euler systems is only partially understood. The gap which has emerged concerns the Euler system constructed by Wiles in studying the Selmer-like group attached to the symmetric square representation associated with an elliptic curve. This construction generalizes, and was inspired by, work of Matthias Flach.

Vague rumors of a gap in the proof began to circulate widely during the fall, and gradually they became more precise and more persistent. Finally, on November 15, the rumors were acknowledged in a lecture by John Coates, who was Wiles’s thesis advisor. This lecture had been planned and announced weeks earlier; coincidentally, it was held in the same room at the Newton Institute as Wiles’s June lectures. Discussions of the mathematics that might be required to repair Wiles’s proof have been of a general nature, as his manuscript has not circulated publicly. The manuscript was submitted for publication to Inventiones Mathematicae through Barry Mazur of Harvard University, who is an editor of this journal. Mazur and a small group of referees have had access to the manuscript.

Through all of this, Andrew Wiles has avoided publicity, continuing to work quietly on his manuscript, correcting problems pointed out by the referees and trying to get it into a form suitable to circulate. Although invitations to speak poured in from all over the world, he did not give any further talks on this work. Finally on December 4 he sent out an e-mail message acknowledging the gap in the proof. The message said:

“In view of the speculation on the status of my work on the Taniyama-Shimura conjecture and Fermat’s Last Theorem I will give a brief account of the situation. During the review process a number of problems emerged, most of which have been resolved, but one in particular I have not yet settled. The key reduction of (most cases of) the Taniyama-Shimura conjecture to the calculation of the Selmer group is correct. However the final calculation of a precise upper bound for the Selmer group in the semistable case (of the symmetric square representation associated to a modular form) is not yet complete as it stands. I believe that I will be able to finish this in the near future using the ideas explained in my Cambridge lectures.

“The fact that a lot of work remains to be done on the manuscript makes it still unsuitable for release as a preprint. In my course in Princeton beginning in February I will give a full account of this work.”

—Andrew Wiles

At the Joint Mathematics Meetings in Cincinnati, Kenneth Ribet of the University of California at Berkeley gave a lecture about Wiles’s work. To understand this work, one has to know something about elliptic curves. Elliptic curves over the field of rational numbers are algebraic curves defined by equations like $y^2 = x(x-3)(x+3)$—that is, cubic polynomials in $x$ and $y$ with integral coefficients. Fixing a particular equation and choosing a prime number $p$, one can look at the number of points on the curve mod $p$, that is, the number $N_p$ of $x$ and $y$ mod $p$ that satisfy the equation, viewed as a congruence mod $p$. The elliptic curve is modular if $N_p$ varies with $p$ in a specific way: the various differences $p-N_p$ are required to be Fourier coefficients of a single modular form. The Taniyama-Shimura conjecture says that every elliptic curve is modular. Gerhard Frey pinpointed just the right elliptic curves that Ribet used in his 1986 proof that the Taniyama-Shimura conjecture...
implies Fermat. In his lecture Ribet stated that, before Wiles's work, the Taniyama-Shimura conjecture seemed completely out of reach. Wiles startled number theorists by reducing the Taniyama-Shimura conjecture for a given elliptic curve to a single numerical inequality. This, said Ribet, was a major feat that "shook all of number theory".

To add perspective to Wiles's work, Ribet noted that each elliptic curve gives rise to its "j-invariant", a rational number that can be calculated easily from a defining equation of the curve. Every rational number is the j-invariant of some elliptic curve. Further, two elliptic curves have the same j-invariant if and only if they are the same as Riemann surfaces. Finally, whether or not an elliptic curve is modular depends only upon its j-invariant. Thus the Taniyama-Shimura conjecture may be reformulated as the statement that all rational numbers are j-invariants of modular elliptic curves.

Until June, only finitely many rational numbers were known to be the j-invariants of modular elliptic curves. In his first Cambridge lecture, Wiles announced that he could prove the Taniyama-Shimura conjecture for a class of elliptic curves whose j-invariants form an infinite set. In his final lecture, Wiles announced that he could prove the Taniyama-Shimura conjecture for a second class of elliptic curves: those that are semistable. Since this second class contains the elliptic curves that Frey constructed in connection with Fermat, Wiles's achievement with the first class of elliptic curves was largely forgotten in the excitement over Fermat. The gap in Wiles's proof of Fermat affects only the second class of curves, not the first.

The news media has not given the gap in the proof the same kind of attention it gave Wiles's original announcement. The New York Times carried a front page story, complete with a picture of Fermat, the day after Wiles delivered his Cambridge lectures. But it wasn't until a week after Wiles's announcement of the gap in the proof that the Times ran a story, buried on page nine. The restraint of the media appears to be justified by confidence that the overall structure and strategy of the proof remain solid. In fact, no one has claimed that the gap cannot be filled; bridging it appears to be feasible. And, most important of all, Wiles's results, even without a complete proof of Fermat's Last Theorem, constitute a profound contribution to number theory. So while his achievement at this point has fallen short of Fermat's Last Theorem, it is already a major contribution.

In the months after Wiles's Cambridge lectures, the media showered him with attention unusual for a mathematician. He was named one of the "25 Most Intriguing People of 1993 by People magazine, along with Princess Diana, Michael Jackson, and President Clinton and his wife Hillary Rodham Clinton. Wiles turned down an offer by the Gap, the jeans company, to pose for an advertisement. However, rumors that movie actress Sharon Stone asked to meet him proved false (the rumor started because an obviously forged e-mail message, purportedly from Stone, was sent to him at the Newton Institute after his lectures there). Others whose work has been important in Wiles's results have also had their share of the limelight. Rumor has it that Gerhard Frey was stopped by a U.S. customs official in an airport, who asked, "Are you the same Frey who discovered the connection between Fermat and elliptic curves?"

The media has, in general, warmly greeted Wiles's outstanding work with admiration and appreciation. However, at least one piece provoked responses ranging from groans of disbelief to outraged letters. Marilyn Vos Savant, who is listed in the Guinness Book of World Records Hall of Fame for "Highest IQ", writes a column for the Sunday supplement Parade Magazine, which is included with newspapers across the nation. On November 21, 1993, her column was devoted to showing why Wiles's proof of Fermat's Last Theorem was incorrect.

In her column, she points out that the famous problem of "squaring the circle" has been proved to be impossible, so any "proof" of that fact can be assumed to be flawed. Her reasoning begins to falter when she implies that János Bolyai's squaring of the circle in hyperbolic geometry was mistaken, because "his hyperbolic proof would not work in Euclidean geometry." Saying that Wiles's proof is "based in hyperbolic geometry", she then applies the same logic to Wiles's work: "If we reject a hyperbolic method of squaring the circle, we should also reject a hyperbolic proof of Fermat's last theorem."

How did she get onto this? At the Cincinnati Meetings, Barry Mazur of Harvard University received the Chauvenet Prize of the Mathematical Association of America for his article "Number Theory as Gadfly", which, although written two years before Wiles's announcement, explains some of the number theory connected to Fermat's Last Theorem and Wiles's work. In his acceptance speech, Mazur said that the Harvard mathematics department had received a request from Vos Savant for information about the proof of Fermat, so he sent her a copy of the "Gadfly" paper. Vos Savant then took off and wrote not only her column but also a book about Fermat's Last Theorem, published by St. Martin's Press. Although in her book Vos Savant thanks Mazur, as well as Ribet and Karl Rubin, she never contacted Mazur after receiving the paper, and the other two say they have never had any contact with her. Mazur has written a letter to St. Martin's Press denouncing the book and disavowing any involvement in it.

Despite this episode, Fermat's Last Theorem has helped the public to better understand the nature of mathematics. Dwarfing public-awareness efforts to connect mathematics with "economic competitiveness" and "technology transfer", Fermat's Last Theorem reveals the innate fascination of mathematics as something everyone can appreciate.

Allyn Jackson
Fighting for Tenure

The Jenny Harrison Case Opens Pandora's Box of Issues About Tenure, Discrimination, and the Law

This article is intended to inform the mathematical sciences community about a tenure case in mathematics that has received international publicity and has been discussed widely in the community. Ordinarily, the Notices and the AMS would avoid discussion of individual tenure cases. In particular, the Society takes no stand on this case. However, the large amount of publicity and discussion about this case made it important that the Notices attempt to provide information about it to the community. In addition, the case raises broader issues about tenure reviews, grievance procedures, and dispute resolution that are of interest to the academic community.

On July 1, 1993, the University of California at Berkeley appointed Jenny Harrison to a full professorship in the Department of Mathematics. The action ended a legal battle between Harrison and the university, in which Harrison charged sex discrimination in the university's 1986 decision to deny her tenure. The mathematical community and the general public have, through various press accounts as well as the rumor mill, followed developments in the case over the past seven years. The decision to appoint Harrison was based on the recommendation of a review committee set up in confidential settlement negotiations between Harrison and the university. The hope was that the use of an outside committee would bring a fresh impartiality that would satisfy both sides. Although some in the department are happy about the outcome, and others are just relieved that the case has been resolved, a vocal minority has expressed strong criticism of Harrison's actions and of the review process.

Harrison and her supporters maintain that she was the victim of sex discrimination in the Berkeley department, which resulted in unfair treatment and a biased review of her tenure case. Her opponents say her claims of discrimination are groundless and have strongly criticized the procedure the university used in resolving the fight. Who is right and who is wrong? It is not an easy question.

History of the Case

Jenny Harrison received her Ph.D. in 1975 from the University of Warwick in England, where her adviser was the topologist Colin Rourke. Her thesis, Unsmoothable Diffeomorphisms, concerned a problem that was solved independently around that time by William Thurston and Charles Fefferman, both at Princeton University, who ceded priority to Harrison and did not publish the result. The question was whether every $C^r$ diffeomorphism of a manifold is topologically conjugate to a $C^{r+1}$ diffeomorphism; Harrison found a 2-dimensional counterexample (and others in higher dimensions in later papers). Her thesis work is considered to be very good by both her supporters and her opponents.

Harrison held positions at Princeton University and the Institute for Advanced Study before she went to Berkeley in 1977 on a Miller Fellowship, a prestigious postdoctoral position. In 1978, she accepted a tenure-track assistant professorship at Berkeley. A year later, she received an offer from Oxford University for a position at Somerville College and spent three years there, while still retaining her Berkeley post. On returning to Berkeley in 1982, she announced that she had found a $C^2$ counterexample to the Seifert Conjecture, providing an example of a twice-differentiable vector field on the three-sphere without a closed orbit. Her work extended a result of Paul Schweitzer, who in 1970 had found a $C^1$ counterexample. Harrison's work drew on new and delicate techniques from several fields and proved very difficult to write up for publication. A number of experts believed early on that the result was correct, but others maintained it was not. These factors contributed to the delay in publication, and the work was not generally believed to be correct until early 1986, when it was accepted for publication. Though there is some disagreement on the importance of this result, the consensus seems to be that it is a high-quality piece of work.

Harrison was denied tenure that year. In March, 1988, she filed a formal complaint with Berkeley's Privilege and Tenure Committee, a campus-wide committee of faculty from various disciplines which hears grievances about tenure reviews, among other things. This committee, after examining various charges of gender discrimination and mishandling of

Grievance about the Tenure Review

At Berkeley, tenure review is a complex, multi-step process. It starts with a review committee of about half a dozen faculty members from the department, which selects letters of evaluation from experts in the candidate's field and examines his or her papers and other background material. The candidate can suggest reviewers as well as request that certain individuals not be asked to write. After the letters are received, the candidate can obtain a summary of the information in the tenure file and can add material to the file in order to rebut information he or she considers unfair or incorrect.

The review committee votes on whether or not to recommend to the department that the candidate be given tenure and presents the result at a departmental meeting. After hearing

any other comments by the faculty, the department votes. In Harrison's case, the review committee's vote was four against and one for, with one abstention; a little over half the department participated in the departmental vote, with nineteen against, twelve for, and an unusually large number (seven) of abstentions.

The departmental vote is generally the deciding factor in a tenure case, but there are also a number of other stages of review, including the dean, the campus-wide Budget Committee, and an Ad Hoc Committee consisting of two members from the department who were not on the departmental committee, and three from outside the department. The chancellor makes the final decision on whether or not to grant tenure. At each step of the process, the decision went against Harrison.

Grievances with these procedures are heard by the Privilege and Tenure (P&T) Committee. Made up of faculty and functioning independently of the administration, P&T examines all kinds of complaints, from such matters as laboratory space being taken away, to discrimination cases like Harrison’s. P&T’s recommendations go to the chancellor, who nearly always accepts them. According to Berkeley provost Carol Christ, there have been many cases in which P&T ruled in favor of faculty members and “it’s not at all true that the committee [usually] rules against the faculty” and in favor of the university.

According to the current P&T Committee chair, Berkeley historian Richard Abrams (who was on the committee when Harrison’s grievance was reviewed), P&T is not charged with examining the substance of departmental tenure reviews, but only with finding out whether or not procedures were properly followed (this includes examining whether nonprofessional or nonacademic criteria entered into a decision about a case). Abrams says that because the procedures for deciding tenure are complex and have many steps, it often happens that faculty unwittingly break the rules. Such errors may or may not affect the outcome of a tenure decision. Abrams says P&T tries to “get to the heart of the matter” and judge whether mishandling occurred, and if so, whether it had any substantive effect on the case. By contrast, in a court of law, a technical infraction, such as when a police officer does not read the Miranda rights to a suspect, often means that a case gets thrown out of court.

The P&T Committee reviewed a number of complaints by Harrison about procedural mishandling of her tenure review and about gender bias in the mathematics department. After eighty hours of testimony from twenty-five witnesses, P&T found all the charges to be without substance or impossible to prove. Harrison’s opponents have pointed to the P&T report as the most exhaustive analysis of the case that’s been done, saying it “exonerated” the department. Harrison has said that, because she did not have access to university documents that would support her case—in particular, her own tenure file and those of the men who had recently been promoted to tenure—she could not present to P&T the information she believed was most crucial to her case. A few months before P&T began its hearings, the university administration did give Harrison a summary of her own tenure file, consisting of forty-seven...
pages of material that had been cut into about 250 pieces and scrambled in random order. The university lawyers and staff had open access to all university documents, confidential or not. Unlike in a court of law, subpoenas could not be issued, so those who did not wish to testify could simply not show up, regardless of the importance of their testimony.

The P&T Committee examined a range of procedural issues in Harrison's case, such as whether or not Harrison had had the opportunity to add material to her file, whether a letter had been missing from her file, and whether she had received an adequate summary of the conclusions of the tenure review committee's recommendation. One item that P&T investigated has since become quite famous. It involves a letter sent by then-chair John Addison, in which he asked for an evaluation of Harrison's work, adding that the Berkeley mathematics department aspires to become "the top center for mathematics research in the world." The letter was sent to only one individual, at the request of the campus-wide Ad Hoc Committee, after the department had already made its decision against granting Harrison tenure.

Harrison's side argued that the letter was unfair because "best in the world" standard was not invoked in solicitation letters for male candidates. Of all the issues it looked at, the P&T report devoted the shortest analysis to this one, saying, "We find no basis for a violation of Dr. Harrison's rights or privileges as a result of this statement in one letter, written to a friend of the Chair, in an attempt to be humorous." (Many mathematics departments, to avoid exactly this kind of difficulty, use a standard letter to solicit all evaluations. One chair of a research-oriented department was amazed to hear that Berkeley did not use a standard solicitation letter. "You're asking for trouble," he said to a Berkeley faculty member, who replied, "And we got it!")

P&T did find that a rule was broken in one instance: After the campus Ad Hoc Committee solicited three additional letters from external reviewers, Harrison was not informed of the contents of the letters. Although it found university rules about tenure evaluations were technically violated, P&T said, "We do not find that the violation warrants a reconsideration [of the tenure decision] nor that a plausible case can be made that it caused harm." After the P&T review ended, Harrison continued to maintain that this incident, and others deemed harmless by P&T, contributed to the negative outcome of her tenure review. In addition, much to the chagrin of her opponents, she continued to repeat the charge of gender discrimination, presenting much of the same evidence that P&T had examined and rejected.

The P&T report, submitted to the chancellor in September 1989, was confidential until it became part of the court record. The report is methodical, well reasoned, and quite persuasive. On the other hand, Harrison's frustration over her inability to secure important documents is understandable, as is her feeling that the whole process was an instance of the "little guy" fighting the big institution. When a grievant feels that such procedures do not function well, a court of law is the next logical step. But beyond disagreeing with the conclusions of the P&T Committee, Harrison called the entire process "Kafkaesque" and a "kangaroo court". Her critics have bridled at accusations that this trusted faculty committee was unfair.

Later on, when Harrison filed her lawsuit against the university, the Legal Defense Fund of the American Association of University Professors (AAUP) supported her case and made a contribution toward her legal expenses. The attorney at AAUP who dealt with her case no longer works there and could not be reached for comment. However, AAUP counsel Ann H. Franke is familiar with some aspects of Harrison's case. "The AAUP did make a small grant, occasioned by concern over some of the procedures used by the institution in reviewing allegations of discrimination," says Franke. The AAUP "is zealous in pursuit of adequate internal mechanisms" to handle grievances about discrimination, she says. When these mechanisms don't function adequately, AAUP will in some cases help grievants seek legal means of addressing their complaints. Franke makes it clear that the AAUP did not take a position on whether or not Harrison should have been granted tenure, but only supported Harrison's contention that the appeal mechanism within the university was inadequate for addressing her grievances. The Legal Advocacy Fund of the American Association of University Women, for similar reasons, also supported Harrison's case and contributed a grant toward her legal expenses.

A Position at Oxford

One bone of contention in the Harrison case has been her position at Oxford University. Harrison maintains that it was a regular, tenured faculty position and that Berkeley should have reviewed her work at the time of the offer and should have considered making her a tenured counteroffer. She also says that Berkeley made counteroffers to other assistant professors, even in cases in which those offers were from universities of considerably less stature than Berkeley or Oxford. Harrison's critics say that her Oxford position was not equivalent to a tenured professorship at Berkeley.

Indeed, it is not an easy matter to compare the two positions because the systems of academic appointments in the US and England differ markedly. In the US, the assumption is that one will rise in the ranks from assistant professor through the tenured positions of associate and full professor. In England, appointments are generally made to the positions of lecturer, senior lecturer, reader, or professor. Until the 1980s, these positions were tenured, sometimes after a probationary period, though there was no tenure review on the scale of what one finds in the US. In addition, unlike the "up or out" system in the US, in the English system there is no assumption that if, say, one is hired as a lecturer, one will rise through the ranks to the higher levels of senior lecturer, reader, and professor—indeed, such advancement happens only rarely, since the number of professorships is very limited.

Oxford University is a collegiate university, and the system of appointments there is somewhat different from that at other English universities. There are University Lecturers, Readers, and Professors. These appointments are made by the University, and individuals holding these positions have their primary teaching responsibilities within their departments,
not within a college. In mathematics, this means that they teach lecture courses in the Mathematical Institute (which is not an institute like, say, the Isaac Newton Institute in Cambridge, but is simply Oxford’s mathematics department). Such an appointment also entails a fellowship in one of the colleges, and the fellowship may or may not carry teaching responsibilities within the college.

In addition to those faculty holding such University positions are those members of the Mathematics Faculty who hold tutorial fellowships at one of the colleges. These college appointments are made by the college concerned, although representatives of the University mathematics faculty conduct the interviews and state which, if any, of the candidates are of an acceptable standard. Tutorial fellows are also appointed to a CUF (“Common University Fund”) Lecturership as an adjunct to the college position. The primary responsibilities, however, remain within the college (twelve hours per week of tutorial teaching is a typical load). A CUF Lecturership requires two hours per week of university-wide lectures in one of the three terms each year.

Harrison held a tutorial Fellowship at Somerville College and an associated CUF Lectureship. At the time Harrison was appointed in the late 1970s, there were two different tenure systems for the two positions. Fellowships at Somerville were not tenured, but had a five-year term. However, continuation of the fellowship, which required reelection by the other fellows, was routine. CUF Lecturerships were, like all University positions, initially for a five-year period. At the end of that period, there was a review by the University, leading in almost all cases to tenure. Again, this review was not on the scale of a tenure review in the US, and, in particular, did not involve solicitation of evaluation letters. Harrison was not at Oxford long enough to go through reelection to her fellowship or a review for tenure in the lecturership. Her position was therefore not, strictly speaking, tenured, but it was de facto tenured because the reelection and the review have virtually never resulted in a negative decision.

Standards for Tenure
As one of the top mathematics departments in the nation, if not in the world, Berkeley has extremely high standards. Considering that hires in recent years have included Fields Medalists William Thurston and Vaughan Jones, one might think that Harrison didn’t stand a chance. But if such “superstars” set the standard for tenure, the faculty of around sixty full professors would dwindle down to a small handful. Berkeley hires some, like Thurston and Jones, with tenure, but it also hires lesser-known but promising assistant professors and promotes them through the ranks. Harrison is the first assistant professor to have been denied tenure in approximately the past twenty-five years.

Harrison has said that her work compared well with that of eight so-called “comparables”—the men who were promoted from assistant to associate or full professor between 1978 and 1988. (Not considered a “comparable” is Marina Ratner, the one woman promoted to tenure in that period.) Who got tenure at what time is public knowledge, so it would be a simple matter to check who these individuals are. However, their names have been left out of press accounts and other writings about the Harrison case out of a feeling that these individuals are innocent bystanders to the controversy and it would be unfair to drag them into the fray. Harrison, who obtained their tenure files through a court action, has said that her qualifications place her squarely in the middle of this group.

In an article prepared after Harrison was appointed to the faculty this summer, Berkeley faculty member Rob Kirby argues that the standard relevant in the Harrison case is set by the group to whom Berkeley has made offers in geometry/topology. (He explains that for some purposes the department divides itself into five fields: algebra, analysis, applied mathematics, logic, and geometry/topology. Some faculty belong to more than one field.) Between 1972 and 1991, Berkeley made twelve offers for tenured and tenure-track positions in geometry/topology. The list of offers is indeed impressive, with Fields Medalists S.-T. Yau, William Thurston, and Michael Freedman, as well as others, such as I. M. Singer, generally considered to be of equal standing. Kirby also says that there are at least a dozen other geometers of equal quality to those on his list, including some women, to whom offers would have been made had they expressed sufficient interest.

Which “list”—Harrison’s or Kirby’s—is more relevant to the Harrison case? The basic yardstick for making tenure decisions at Berkeley is an assessment by experts in the field of the quality of the candidate’s work, as well as comparisons to others in the field who are at a similar stage in their careers. Letters that solicit recommendations for tenure decisions often explicitly ask for such comparisons. Harrison’s list of “comparables” does not really capture the process of tenure review at Berkeley because, although past tenure decisions do establish a general level of quality that tenure candidates must meet, the review does not include a systematic comparison of the candidate’s tenure file with the files of those who have gained tenure in the past. This is in part because doing so would involve comparing the candidate to current faculty members, and in part because making comparisons across fields is extremely difficult.

On the other hand, one might say that Kirby’s list amounts to asking, when a candidate comes up for tenure, whether there is anyone better out there whom Berkeley could hire; this is not part of the usual tenure review process either. Given that in a tenure review a candidate is compared with others in the field, one might conclude that Kirby’s list is more relevant than Harrison’s. However, Harrison says that Kirby erred in placing her in geometry/topology; she says she is in analysis. In addition, many of the people on Kirby’s list are more senior than Harrison, and most received offers at the full professor level. One of the reasons why Kirby’s and Harrison’s lists give different pictures is that Harrison is focusing on the tenure review, while Kirby (who believes Harrison should not

have been hired as an assistant professor in the first place) is focusing on hiring. The main significance of Harrison's list of “comparables” is that their tenure files would have formed the core evidence in a court trial. To prove discrimination, Harrison would have had to demonstrate that she was at least as strong as the weakest among the “comparables”.

Some in the department contend that the reason Harrison was denied tenure was that her work simply wasn’t good enough. “On purely mathematical grounds, it’s a 100% reasonable decision,” says Kirby. “There’s no way in the world that there should be claims of sexism in this case.” In his article, Kirby says that the letters of recommendation for Harrison’s tenure struck him as “on the whole, unremarkable, and clearly below the kind of letters I expect for a positive tenure vote.” Although Kirby believes Harrison has done some good work, he says that she had not accomplished enough by the time of her tenure review. He says that opinions about her work both within the department and outside it were divided and concludes, “such divided opinion is a long, long way from what it takes [to get tenure] at Berkeley.” Berkeley faculty member Marina Ratner states it more bluntly: “Her case was absolutely, clearly below all other cases considered by the department that I observed.”

Neither Harrison nor her supporters paint her as a world-class genius; she says she is a good, solid mathematician of Berkeley caliber, and they acknowledge that hers was not the strongest case for tenure that Berkeley has seen. What happened, Harrison has said, was that in the cases of the men who were granted tenure, their strengths were emphasized and weaknesses downplayed, while she was given the opposite treatment: her strengths were downplayed and her weaknesses emphasized. In addition, Harrison has said that reviewers who knew her work well supported her and that those who were against her were unfamiliar with it. According to Morris Hirsch, her strongest supporter in the department, “I think that if she had been a man, her case would have been prepared differently, a different case would have been presented to the department.” He says that even though sometimes doubts are expressed about the qualifications of male candidates, “it’s sort of shoulder-to-shoulder...there’s hardly ever an important split in the department.” But if a woman is perceived as being “not world class [then] all these doubts come out”, and she is treated very differently from men with similar qualifications.

The diverging opinions about the Harrison case point to the broader issue of how much tenure reviews involve subjective matters of taste and opinion. Dorothy Wallace, now a faculty member at Dartmouth College, spent some time at Berkeley as a visiting professor in the early 1980s. Although she does not have an opinion on the Harrison case, she believes the process of tenure review can be quite subjective. “We faculty members are asked to look at a candidate’s file in comparison with other young mathematicians we know in similar situations,” she comments. “We might be comparing the person with people who got tenure at Harvard, or were denied tenure at Harvard or who received or were denied tenure at Penn State, or whatever collection of mathematicians leaps to mind. We are not asked for any justification of our choice of pool. We are expected to be able to say that the candidate is at least as good as any of the people to whom we are comparing her (or him). We are never asked to justify this judgment, in fact we are never asked to define what constitutes ‘good’ or ‘as good as’...I am driving at the fact that the process itself is wide open to any sort of individual or group prejudice that could possibly exist.”

Charges of Discrimination

One of the aspects of this case that especially rankled Harrison’s detractors is the fact that Harrison has on numerous occasions characterized the Berkeley mathematics department as sexist (though she has also said that this charge pertains to only a few faculty). Her critics point out that the P&T Committee, which included two women faculty, found that Harrison’s allegations of sexism were not substantiated by the evidence presented to them. The evidence reviewed in the P&T report consisted primarily of statements indicating gender bias allegedly made by a number of Berkeley faculty members. P&T found that several of the charges boiled down to one person’s word against another’s and could not be corroborated by other evidence. In some cases, individuals who had allegedly made biased statements testified that their statements had been taken out of context and, after explaining the context, convinced P&T that the statements had not in fact been biased. “We are convinced that there was no connection between the decision to deny Dr. Harrison tenure and gender discrimination”, the Committee concluded. “We find it unfortunate that anyone who does not believe that she warrants tenure is biased, and that he or she could not have a legitimate reason for a negative view or position.”

However, even some who are sharply critical of Harrison’s actions believe that the Berkeley mathematics department does not have a good record with women. Lenore Blum, deputy director of the Mathematical Sciences Research Institute, has written a long article on the Harrison case. Blum is not a Harrison supporter, as her article makes clear. Nevertheless, Blum sees major problems regarding women and the Berkeley mathematics department. “Blanket denials that [the department] ever behaved badly towards women—or categorical statements that its actions have been exemplary—are just not true, nor are they widely believed outside Berkeley,” she writes.

As an example, Blum recounts an instance in the 1970s when the department, under pressure of affirmative action trends, invited women and minorities to apply for two tenure-track positions. “The trouble was, the Department had already offered the positions to two men,” Blum writes. “This charade was clearly unfair to the women and minorities who applied in good faith and were subsequently subjected to an evaluation which necessarily had to unearth flaws in their records.” She contends that Berkeley’s recent efforts to recruit more women are “not enough” and suggests that Berkeley should do more to nurture talented young women mathematicians, instead of...
only trying to hire from the very small pool of top senior women mathematicians. "There certainly is a pool of talent out there, if one cares to look," Blum writes.

Two famous stories involving women mathematicians have haunted the Berkeley mathematics department over the years. One involves Julia Robinson, who was an adjunct in the department when she was elected to the National Academy of Sciences in 1975. As the story goes, for many years the department had not given Robinson a regular position, citing hazy nepotism rules and her health, but then, when she was elected to the Academy, the department suddenly found a way around these difficulties and appointed her to full professor. Following Harrison's appointment, Berkeley's treatment of Robinson has been discussed anew, prompting Robinson's sister, the mathematical biographer Constance Reid, to write a letter to the editor of the San Francisco Chronicle. Because of health problems, "Julia never wanted and never applied for a regular teaching position at Berkeley," writes Reid. "The story that Julia Robinson was 'denied' a position at Berkeley has been widely circulated as an example of an alleged pattern of discrimination against women by the Berkeley mathematics department. The story is simply not true."

The other story concerns Marina Ratner, who for years has been the only tenured female faculty member in the Berkeley department since Robinson's death in 1985 (Alice Chang of the University of California at Los Angeles spent a short time at Berkeley in a tenured position in the late 1980s). Ratner was offered an assistant professorship in 1975. In a now-famous letter published around that time in the campus newspaper, the Daily Californian, Robin Kirby wrote that although Ratner was well qualified in research, he said that he thought there were several men who were better and that the department had no information on Ratner's teaching record "except that there is some evidence she does not speak English." (A later article on the controversy appeared in the Berkeley Daily Gazette carrying the ludicrous headline, "Can't speak English, but girl has $E = MC^2$ [sic].)

Ratner says that she was in Israel when she received the offer, and she knew nothing about any controversy. Asked what she thought of Kirby's letter, Ratner says, "I found absolutely nothing that was against me... The letter by Kirby [said] that the department hired a woman and she cannot speak English. And that was absolutely true, I could not speak a word of English." When she arrived in Berkeley, she says, the department arranged English classes for her. "What was written in that letter, in my view, said absolutely nothing that can be interpreted as implying that he was against women," she declares.

There have also been rumors of a controversy over the vote on Ratner's tenure. Ratner says she heard about the controversy, but did not know of any details. But anyway, she says, "everybody has the right to speak his thoughts... Even if there were some who were against, I find it perfectly normal, really, and I don't believe it was because I was a woman." Ratner says she believes that there is sexism in the mathematical community, but that it is mostly "subconscious". She also says there is discrimination on the Berkeley campus in that women are not advanced as quickly as men. But she believes there is no sex discrimination in the mathematics department and there was none in Harrison's case.

How can there be such differing views of the Berkeley mathematics department? As one observer put it, "sexism is a very individual thing, for the giver and the taker." In any case, it is clear that Berkeley has a reputation in the mathematics community for poor treatment of women faculty and students, and the department is certainly aware of this. There is some indication that, in recent years, the department has made efforts to take action when problems of harassment have arisen. In addition, the university has a newly formed committee (Harrison is a member of it) to look at ways to recruit and retain women in mathematics and the physical sciences.

In the Public Eye

Since its formation in January 1991, the Jenny Harrison Support Committee has accumulated members, put out a newsletter, compiled information about the case, and solicited donations to help defray Harrison's legal expenses. Headed by Charity Hirsch, the wife of Berkeley's Morris Hirsch, the Support Committee had a heavy-hitting lineup of honorary members, including California legislators, well-known mathematicians and scientists, and representatives of the American Association of University Women and the Association of Federal, County, State, and Municipal Employees. When Harrison was appointed to the Berkeley faculty last summer, the Support Committee held a press conference and issued a news release. In addition to publicity generated by the Support Committee, numerous articles, many of them favorable to Harrison, have been published in such diverse publications as the East Bay Express (a free weekly newspaper published in Berkeley), the Los Angeles Times, and Science magazine. In addition, Harrison gave speeches about her case in a number of forums, including before a panel of the U.S. Congress, which led to her appearance on the CNN television program, "Sonia Live".

Given popular perceptions that "women can't do mathematics" and the fact that there are so few women mathematicians in the nation's elite universities, it might seem unsurprising that Harrison's story received so much publicity. However, Harrison's critics contend that she and her supporters mounted a "propaganda campaign" and manipulated the facts of her case in order to gain public sympathy. For example, in her article, Lenore Blum describes what she sees as distortions, manipulation of facts, and intimidation carried out by Harrison and her supporters. In his article, Kirby accuses Harrison of carrying out a public campaign to paint the Berkeley mathematics department as sexist.

Asked by the Notices if she had a response to these charges, Harrison provided the following statement: "My supporters and I believe that the case got widespread press coverage because of its compelling evidence of discrimination in the important field of mathematics. This coverage brought the attention of the public not only to my situation but to the general one of many women in mathematics, especially
in the top research departments. As to the statements that
Blum opines, I do my best to ignore unsubstantiated ad
hominem attacks, and I anticipate the editors of the Notices
will have a fact checker review such assertions before taking
them seriously and publishing them. Regardless, I assume the
readers of the Notices will require evidence and discussion
from both sides before buying into what may amount to
vacuous gossip. I suggest that we move on to our research,
teaching, and service and encourage women of all ages to
pursue their mathematical interests."

Like other Harrison critics, Blum says that Harrison’s
“publicity campaign” contributed to the pressure on the
university to settle out of court. Saying that she believes the
university could have won a court case, Blum writes: “What
it probably could not have won, and of which the University
administration was ultimately aware, would be the larger
case in the public’s mind: why are there so few women
and minorities in the Math Department at Berkeley. The University
just didn’t want its track record in terms of women—and
minorities—examined under a public microscope”.

The Review Committee
In the spring of 1993, Harrison and the university arrived
at an agreement on a settlement involving the use of an
outside review committee of mathematicians that would make
a recommendation about her case. Officially, all details about
the review committee are secret: who the members were, how
many there were, their fields of expertise, what information
they were given, and what criteria they judged Harrison on.
The only information that has officially been released is that
the committee did not reopen Harrison’s 1986 tenure case, but
instead considered whether or not Harrison’s work up to 1993
qualified her for a tenured position at Berkeley. However,
some unofficial reports about the review have appeared in the
press.

A July 16, 1993 article in Science magazine reported that
the committee consisted of seven members, two of
them nonmathematicians, three of them mathematicians from
outside Berkeley, and two mathematicians from the Berkeley
department. A second article in the October 15, 1993 issue
of Science reported the following details about the review
committee. Two lists of possible committee members (for
a total of forty-two) were drawn up, one by Harrison and
one by then-chair of the department, Alberto Grunbaum.
The two lists were then submitted to Provost Carol Christ,
who, in consultation with the campus Budget Committee,
made the final selections for the review committee. Neither
Grunbaum nor Harrison knew who had been chosen to serve
on the review committee. The committee’s recommendation
was reported to the chancellor, who is the one who grants
tenure or not. The agreement was that, if the committee
recommended not appointing Harrison, and the chancellor
agreed with the decision, then she would have to drop her case
against the university. (Science did not report one further
detail about the agreement: If the review committee recommended
appointment, but the chancellor denied it, then Harrison would
be free to pursue her lawsuit.)

Science also reported that the review committee compared
the file of Harrison’s early work (as of 1987, which includes
her thesis results and her work on the C² Seifert Conjecture)
to the files of the nine men and one woman who had been
promoted to tenure since 1977, when Harrison first came
to Berkeley. The committee concluded that Harrison’s work
placed her in the middle of this comparison group. Science
reported that the committee then examined Harrison’s work
up to 1993 in order to decide at what level (associate or
full professor) the appointment should be made. According
to Science, the review committee was given eight letters of
recommendation, and later asked for and received two more
letters. Asked about the university’s position on the accuracy
of these reports, Christ said that the university has “no further
comment at this time.”

Reactions in the Department
After Harrison’s appointment to the department, inflammatory
e-mail circulated within the department, some of it decrying
the university’s handling of the matter, some of it accusing
Harrison of conducting a “propaganda campaign”, some of
it deploring the bad publicity for the department and for
mathematics. However, Harrison says that the vituperative
e-mail has been confined to a minority of the faculty and
that about two dozen faculty “warmly” welcomed her back
to the department. Much of the criticism was directed not so
much at Harrison herself but at the process used to resolve her
case. The use of an outside review committee is not unheard
of on the Berkeley campus; the same procedure was used to
resolve tenure disputes in Berkeley’s law school and in its art
history department. In each of those cases, a candidate who
was denied tenure was reinstated after the review. But the
mathematics department did not take much comfort in these
precedents. Many were unhappy that a new faculty member
was appointed not only without a departmental vote, but
also with no information presented to the department about
how the review was conducted. This put the department in
the position of having to rely on press accounts and its own
speculation about what the committee did. It was this aspect
of the case that brought out criticisms by many in the department
who had not voiced opinions about the Harrison case before.

A group of nine faculty sent a letter to the UC Berkeley
Academic Senate complaining about the procedure used.
“[T]he procedure used in appointing Dr. Harrison... was in
violation of virtually all of the regulations for making such
appointments,” the letter says. “We are not here questioning
the wisdom of [the decision to settle] but we do have very
strong objections to the procedure used in implementing it
which we feel has done substantial damage (A) to the Berkeley
mathematics department and (B) to the cause of due process
at Berkeley.” The letter does not ask the Senate to look into
reversing the decision, but only to consider issuing some kind
of statement or censure that would help to insure, as the letter
puts it, “that nothing like this will ever happen again on the
Berkeley campus.”

Some faculty maintain that, throughout the years of legal
wrangling between the university and Harrison, they bowed to
the university's wishes and kept their views on the case more or less to themselves. Although the university says it upholds the department's original 1986 decision and the conclusions of the P&T Committee, many in the department felt that the settlement made it appear that the mathematics department had done something wrong. On the other hand, given the set of choices the university was faced with—settling or going to court—most seem to agree with what Grunbaum told Science magazine, that settling was the "least undesirable path."

Christ says the 1986 decision to deny Harrison tenure was "supported by the chancellor and not altered." (This may seem paradoxical, but Christ points out that the two committees that reviewed Harrison's case for tenure in 1986 and in 1993 were looking at different sets of evidence, because the later review examined all of Harrison's work up to 1993.) Furthermore, says Christ, the P&T Committee "worked conscientiously and felt that the evidence did not sustain a complaint," and the university backs that conclusion. But if the university felt it had not wronged Harrison and that the denial of tenure had been just, why did it settle? "The motivation to settle is complex," Christ says. "The university felt it wasn't in its best interest to have a long, expensive, divisive trial. The university was also concerned about setting a precedent that tenure decisions would be made by a jury trial. And we felt it would create more divisiveness in the mathematics department."

The university's reluctance to turn a tenure case over to the courts is understandable. At the University of California at Irvine, a man who was an assistant professor in the mathematics department recently sued the university when he was denied tenure, saying that the mathematical judgment in his tenure case had been wrong. The case never came to a jury trial. A lower-court judge who reviewed the evidence said that one of the negative reviews of the candidate's work should be disregarded because the reviewer worked in probability theory, while the candidate worked in martingale theory. The judge was clearly unaware that martingale theory is a subfield of probability theory. The judge ruled that the man be reappointed to the department, as an assistant professor, and that his tenure case be reviewed again in two years' time.

**The AWM's Position**

Over the years, the membership of the Association for Women in Mathematics (AWM) has followed closely the Harrison case. Carol Wood of Wesleyan University says that, during her tenure as AWM president in 1991 and 1992, there were members who wanted AWM to take a stand on the case. "The AWM has an interest in seeing women succeed at the top levels of mathematics," says Wood, so Harrison's case came up, saying that the AWM would not take a position in a dispute between an individual and an institution.

What organizations like the AWM can do, she notes, is formulate general guidelines that may be of use in tenure disputes. Therefore, in February 1992, the AWM Executive Committee drafted a "Statement on Dispute Resolution", which was published in the May-June 1992 issue of the AWM Newsletter. "I was instructed by the AWM Executive Committee to take the document to Harrison and Berkeley and to make it available to other places where it might be helpful, which I did," says Wood. The statement outlines a procedure for forming an outside committee of mathematicians to review a disputed tenure case and says that such a route is preferable to resolving such cases in court.

The AWM Newsletter has over the years published a number of articles about the Harrison case. After Harrison was appointed to a tenured position last summer, the September-October 1993 issue of the Newsletter carried the triumphant press release of the Jenny Harrison Support Committee, and, a few pages later, a letter from Marina Ratner containing blistering criticisms of Harrison's actions over the years. Then, in the following issue, the Newsletter Editorial Board stated that they would publish no further comment on the Harrison case, saying "we intend not to discuss the personality or the intentions or the actions of individual colleagues, nor can we dissect and compare their mathematical abilities and accomplishments." "The very small number of women in the top mathematics departments has made the Jenny Harrison case extraordinarily visible," the statement goes on to say. "We should direct our endeavors to increase the number of worthy women mathematicians at the top level of the profession. Then, the right of women to do mathematics will no longer become confused with the discussion of personalities."

The AWM, now a powerful, respected organization in the mathematical community, is seen very differently today than when it began in the early 1970s. Will the Harrison case also look different in twenty years' time? "While the AWM is now widely accepted by the establishment, it nevertheless had its beginnings in confrontational politics," remarks Joan Birman of Columbia University. "I was there, I was beginning my career, and frankly I was embarrassed by the tactics of some of my unpleasantly aggressive women colleagues. I did not want and I was absolutely certain that I did not need their help. A natural (and very arrogant) corollary was that if they had to resort to such unattractive behavior it had to be because, if one took a good hard look, one would see that they did not have the goods. That was in 1973. With the wisdom of hindsight I am now forced to admit that things were not as they seemed, and that the women mathematicians who participated in confrontational politics in those days did a real service for the rest of us, probably at considerable pain to themselves. Of course, those days are past... or are they?"

Allyn Jackson
Part of my interest in reviewing these packages arose from discussions with friends who seemed to believe that there was little such software could not handle and from others who were somewhat more skeptical. Some looked at these packages as computerized tables of integrals, and others hoped to use them for assisting in proving conjectures in linear algebra. I wanted to find out for myself what sorts of things could be done and how easy it would be to do them.

In this first part I will discuss Maple, giving an overview on the types of things it can do and then providing a little more detail on its generic features. A second part will discuss my experience with Macsyma and will provide a comparison between the two packages. Some of the problems arising in the two packages will be described in Part II. Description of some of the specialized features is not in the scope of this review, but the interested reader might want to consult the cited references. I would like to have included Wolfram's Mathematica, but time constraints did not allow it, and, in any case, Mathematica has already been reviewed rather thoroughly.

Before starting, let me admit to a few biases in this review. First of all, I had only a slight interest in the graphical capabilities of these packages. Perhaps this is due to the fact that in the modeling work I do I often run into messy expressions that need to be manipulated, and visualization of results is the lesser of two headaches in these cases. Also, it seems that faster, more flexible packages are available for graphical purposes. Therefore, graphics get short shrift here. My second bias is that I elected to review this software on a SparcStation as opposed to a PC or Mac in order to allow the software to make free use of the memory (fast and virtual) that always seems to be insufficient on small machines—I've had similar programs hang under MS-Windows—so prospective users of these packages on smaller platforms ought to check carefully into memory requirements. Finally, I ought to admit that I myself was one of those skeptics mentioned above.

I should like to thank Gary Macheel and Dave Hinch of the Autonetics Electronic Systems Division for providing access to the Sun SparcStation used in this review.

Symbolic manipulation software shares with politicians that rather dubious distinction of being all things to all people. In this and a subsequent report, I would like to share my experiences reviewing Maple and Macsyma as installed on a Sun SparcStation with the hope of passing on a bit of the flavor and scope of these packages and to give an inkling of what a prospective user should and should not expect.

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was installed on a Sun SparcStation for this review. The full package took up 42 MB of hard disk. I should like to thank Ted Shapiro and Jon Oberholtzer of WMS for providing both the software and the technical assistance in the Maple evaluation.

1.1 Scope
Maple is a command-line interpreting package for mathematical calculations, both numeric and symbolic. Maple provides access to a wide range of special functions, to linear/vector algebra operations, to series manipulations and expansions, to integrators, and to a whole host of “equation solvers”, thereby allowing the user to work with, create, and manipulate numbers, matrices, series, equations, expressions, lists, or any of a number of other mathematical objects and data types. For example, the expression

\[ a := \text{series}(\exp(x), x=0) \]

causes the symbol a subsequently to be interpreted as a power series, which in turn may be manipulated. Similarly, by defining a variable odesys to be a system of ordinary differential equations, the user might make a call to the symbolic ODE solver dsolve, providing odesys as an argument, to have Maple try to discover the solution of the system.

Beyond straightforward manipulation of numbers and symbols, Maple provides the ability to solve linear and nonlinear systems of equations both numerically and symbolically. Polynomial roots are extracted exactly when possible over a user-specified field.

Standard calculus operations are represented. Functions may be differentiated and integrated symbolically—more on this later. There is the `limit` operator which returns the limit of a function as its argument tends to a specified value.

Practical approximation algorithms are represented in the ability of Maple to generate linear least-squares estimators (i.e., solving \( Ax = b \) for \( x \) in a least-squares sense for overdetermined \( A \)) and best rational \( L^\infty \) approximations to univariate functions on an interval using a form of the Remez algorithm. Padé approximants of power series can be computed. In addition to the functions initially loaded, Maple also has many special-purpose “packages” that can be loaded by the user. These are discussed in Section 1.3 below.

The Maple symbolic manipulation kernel, or at least a portion of it, is found in other commercial products such as Mathworks’ MATLAB and Mathsoft’s MathCAD.

1.2 Using Maple
The UNIX version tested has both windowed and non-windowed interfaces. The experience with Maple under the X windowing system was good but really no different per se than the standard version. Maple in its standard version is accessed from the operating system prompt by entering maple. A short notice appears with version and registration information, then the user is presented with the prompt `>`, which means Maple is waiting for input. For concreteness, here is a sample session that involves the evaluation of an integral; text following the `>` prompts is entered by the user:

```maple
> f := (x, y) -> 1 / (1 + y * \exp(x));
> \text{int}(f, x = 0..\text{infinity});
-ln(y) + \ln(1 + y)
> \text{subs}(y = 1, ");
1
> \text{quit};
```

The first of these lines defines the function of two real variables, \( f \), in a rather clean fashion: The function \( f \) is defined by (\( := \)), the mapping that sends the pair \((x, y)\) to \(1/(1+y\exp(x))\). With such input the user does not run into the problem of Maple thinking that \( f(u, v) \) is unknown because it was \( f(x, y) \) that was defined—this happened with older and bottom-of-the-line symbolic manipulation packages. The next line then integrates \( f \) with respect to \( x \) over \( 0 < x < \infty \).

Note that the first of these lines as entered by the user ends with a colon and the second with a semicolon. Each line entered in Maple (with a few exceptions) must end with either a colon or semicolon: semicolons cause the results of that line’s operation to be written to the screen, while colons suppress this output.

The next line substitutes unity for \( y \) into the results of the integration; and because the line is terminated with a semicolon, the computed result is written to the monitor. The double-quotes symbol stands for the result obtained at the last step (in this case, the integration over \( x \)), and two double-quotes (""") stands for the result prior to the last one. The command `quit` ends the session and returns the user to the operating system.

A few more notes on this example. First of all, the integration over \( x \) involves the symbol `infinity` which corresponds to \( +\infty \); several constants are an inherent part of the package, such as \( \pi \) (Pi), \( e \) (E), Euler’s constant \( \gamma \) (gamma), the imaginary unit \( i \) (I), and Catalan’s constant (Catalan). These are symbolic constants and may be evaluated to the desired precision when numerical results are required. A feature that could cause heartburn for some users is the fact that the Maple language is case-sensitive, so \( F \) would not be the same as \( f \). Likewise, a call to \( \text{EXP} \) would not be recognized as \( \exp \). In my experience though, the disadvantages of case-sensitivity dissipate rather quickly with use as a result of the flexibility in setting up variable and function names.

I would like now to describe the features available to the Maple user.

1.3 Maple Packages
Maple has a large number of operations available to the user, and it is fortunate WMS recognized that not every user will use all the built-in capabilities. One way to handle this is to sell only a bare-bones package and then offer at additional cost the add-ons wanted. I think there are drawbacks to this approach. In any case, WMS does not adopt this approach.

In order to conserve memory by limiting the number of operations available, Maple is composed of “packages”—sets of related operations and functions—which can be loaded as needed. The large collection of operations and
functions loaded at program start-up are augmented by loading the packages as required. For example, to introduce operations useful for certain number-theoretic investigations, the user would enter with (numtheory) to load the package numtheory containing these. Two of the packages I enjoyed playing with were linalg and liesymm. Following is a list of the packages available in Maple:

- combinat — Combinatorial functions (lists, partitions, permutations)
- DEtools — Operations on differential equations (plots, changes-of-variable)
- diffforms — Operations on differential forms (exterior derivatives, wedge products, simplification of forms)
- Gauss — Create "domains of computation" (used in the development of new Maple applications; cf [1-4])
- GaussInt — Operations on Gaussian integers
- geometry — 2d geometry operations (intersection tests; points, lines, circles, triangles; area)
- geom3d — 3d geometry operations (intersection tests; points, lines, spheres, tetrahedra; volumes; projections)
- GF — Arithmetic on Galois fields
- grobner — Operations for Gröbner bases
- group — Finite group operations and representations
- linalg — Linear algebra operations (eigenvalues, solving systems, vector and tensor analysis)
- logic — Operations on Boolean logic expressions
- networks — Construct graphs and networks, extract graph characteristics
- np — Newman-Penrose formalism
- numapprox — Compute numerical approximation (uniform rational, Chebyshev polynomial expansions)
- numtheory — Number-theoretic (mostly integer) operations and calculations
- orthopoly — Classical orthogonal polynomials
- padic — Working with p-adic numbers
- plots — Curve, surface, and contour plots
- powseries — Formal power series operations
- projgeom — Projective geometry operations with points, lines, tangents, intersections, harmonic conjugates
- simplex — Linear optimization by simplex methods
- stats — Statistical analysis and functions (pdf, cdf), random variate generators
- totorder — Define totally ordered (finite) sets, work with assumed relations

These packages have anywhere from a few functions (totorder) to around a hundred (linalg).

1.4 Integration, Differentiation, Limits

Maple provides the ability to evaluate definite integrals as was shown in the example above. Indefinite integration calls are made by leaving off the integration interval (e.g., replace \( x = 0 \) . infinity with \( x \)). Of course, not all attempts at evaluating an integral symbolically are successful. Definite integrals may be evaluated numerically simply by enclosing the integration call in the numerical evaluation call: \( \text{evalf} (\text{int}(f, x = 0..1)) \). It probably ought to be pointed out that failure of Maple to evaluate a symbolic integral does not indicate that a closed-form does not exist.

My experience with Maple is that it handles large classes of integrals rather nicely, especially those involving the elementary functions. For example, integration of a function like

\[
(t^5 \sin(20(t-1)) \exp(-t))
\]

poses no problem, though the results for integrals like these tend to get ugly rather quickly. I found Maple to be very good, reliable, and quick at problems involving the elementary functions, with answers returned (either successful or not) within a few seconds usually and within a minute almost always.

In addition to int introduced in the example above, there also are fourier, laplace, invlaplace, and mellin to compute those integral transforms. According to WMS, the symbolic integration techniques are Risch, integration-by-parts, and many others”. The Risch algorithm part explains at least a bit of the success with elementary function integrands; however, I am not sure what the “many others” are. For example, as a simple test, I attempted to symbolically integrate the Bessel function \( J_1 \); its antiderivative is \(-J_0\). Indefinite integration was unsuccessful, as was integration over \((0, \infty)\). However, the Laplace transform was computed correctly, and therefore the definite integral was obtained by setting the Laplace parameter to zero.

Maple also can perform differentiation (ordinary and partial) on internal functions or those set up by the user. I will admit right here that, at least going into this evaluation, I did not see this as anything really useful, since even I can differentiate. To some extent, this attitude is justified; however, the real benefit of Maple in performing differentiation (as well as other symbolic manipulations) is its ability to keep track of very messy expressions. This was driven home to me in a problem in which I needed to compute the second and third derivatives of what started out as a complicated function involving the Legendre polynomials and ratios of square roots of polynomials. The derivatives were messier by a few orders of magnitude; but as luck would have it, I needed only to evaluate this derivative at a single point. When I requested this, Maple found through its processing that the result I needed was in fact a very simple expression.

Maple provides, in addition, the function limit to evaluate univariate limits. It turned out to be not so impressive. Easy limits were handled, and perhaps this is an area of development for WMS.

1.5 Series Operations

Maple provides the user functions to obtain series expansions of functions and to manipulate series. A series here means, for the most part, a Taylor or Laurent series, possibly with attached logarithms and fractional powers. Expansion of a function is made by a call of the form \( \text{series}(f(x), x = 0) \) and is up to terms of the order given by the variable
Order which the user may vary at will; for example, setting Order := 23 will cause expansions of order twenty-three to be produced. There also is a function sum that is used to produce finite or infinite symbolic sums in which the user specifies the general term of the sequence. Such sums may be tested for being a hypergeometric function using an option of the simplify command. Series may be subjected to the usual arithmetic operations.

The numapprox package provides functions for computing Chebyshev power series expansions as well as Padé approximants.

1.6 Solving Equations

Maple has several equation-solving functions, but the focal point is the function solve. A call to solve is of the form solve(eqns, vars) where eqns is a collection of equations to be solved, and vars is a list of names of the unknowns to be solved for. Exact solutions are sought, and when none are found, recourse might be made to the numeric-solver fsolve. There are a number of solvers that the user ought to become familiar with:

dsolve—Solution of systems of ordinary differential equations; general solutions, initial and boundary value problems

fsolve—Numerical solution of a system of equations over the real (or optionally, complex) field

isolve—Numerical solution of a system of equations over the field of integers

msolve—Same as isolve, but modulo m, where m is specified by the user

rsolve—Solution of systems of recurrence relations; general solutions, initial and boundary value problems

The solvers can be either very fast or very slow. In the tests I ran, it seemed that either a solver came up with an answer within a minute, or it never did at all. In one instance of the latter, I was able to write, debug, and execute a FORTRAN code for solving a particular system of nonlinear equations while Maple was running and was able to obtain the answer in this way before Maple ended by giving up! The user does not provide fsolve with an initial estimate of the solution, which seems a little unfortunate. In the case just mentioned, I had a rather good a priori estimate of the solution; however, search intervals for the unknowns may be specified, and fsolve will report all zeros it finds within these bounds.

My experience is that when the Maple solvers work, they work very well. I was pleasantly surprised that solve found exact solutions to certain sets of algebraic equations that looked rather complicated, and it did so very quickly. It also was a little fun numerically solving the Bessel function equation $J_0(p) = p = 0$ with just a few key strokes.

The ODE solver dsolve handles systems of differential equations and obtains general solutions; initial or boundary value problems are solved by including this information in the dsolve call. Here is an example of how one might set up the system $x'(t) = -x(t) + ay(t), y'(t) = bx(t) - y(t)$ subject to the initial conditions $x(0) = 1, y(0) = 0$:

```maple
> eqns := diff(x(t), t) + x(t) = a * y(t),
> diff(y(t), t) = b * x(t) - y(t):
> fcns := \{x(t), y(t)\};
> Sol := dsolve({eqns, x(0) = 1, y(0) = 0}, fcns);
```

Here, the variable Sol is set to the solutions of the system, and can be subsequently used for further analysis.

A variety of options are available with dsolve, including solution by Laplace transform and series techniques and numerical solutions. As might be expected, linear ODEs (all orders) seemed to be the easiest for dsolve to handle; nonlinear ODEs are harder, but a few tests using equations I knew how to solve showed me that Maple performs well in this realm too. It is difficult to quantify dsolve's abilities. Running it against a set of benchmark problems is one way to assign a figure-of-merit, but even this can be misleading. To skirt the issue, I would say dsolve performed "very well" on a scale of poor-to-excellent. General solutions (implicit) of the nonlinear oscillator problems $y''(t) + (1 + (y')^2)y = 0$ for $n = 0, 1, 2, 4$ were found by dsolve much quicker than I could locate in tables (less than 15 s for Maple), and I still have not found the case $n = 4$ in tables. On the other hand, performance with linear equations was mixed: Solutions of Bessel's equation (in forms 9.1.1 and 9.1.49 of [1-5]) were found, but not for the nonhomogeneous equation. The homogeneous ODE for Legendre functions was not solved.

A package of related interest is DEtools, as mentioned in Section 1.3; this package includes solution plotting.

With respect to optimization tools, I could find only minimize and maximize which return minima and maxima of an expression. This function returns extrema, not the extremal points.

1.7 I/O

The most straightforward way of getting information into and out of Maple is by entering commands from the Maple prompt and reading the results off the monitor. Depending upon what is required, though, this is not always the most efficient way. Nor is it the most convenient when long or complicated commands are being used, so Maple allows the user to enter information via input files. One way of doing this is to issue a save command prior to leaving a previous session, then using a read command in a later session to read the saved information. Another way simply is to create an input file to be read by Maple. In my own case, I found it very convenient to (i) use my PC's editor to create the text file map.in of commands I wished Maple to execute, (ii) transfer the file to one of our local SparcStations, and then (iii) start up Maple and issue a read 'map.in' command to load and execute input file. A cleaner way of doing this is in a windowed environment where windows for both Maple and the text editor can be kept open.

Output from Maple can be in several forms. In addition to the monitor output, the user can request output to a file using

- save to retain expressions or the session,
- C or fortran to convert expressions to C or FORTRAN code,
- latex to convert expressions to L\LaTeX,
--- eqn to convert expressions for troff/eqn printing.
I have seen no errors in the translations obtained from C, fortran, and latex, but they almost always seem to need some touch-up work later since they are far from elegant.

Monitor output looks like the displayed items in a book except that all the symbols needed are constructed from standard keyboard characters. For example, fractions are displayed with the numerator over the denominator with the fraction bar constructed of hyphens; integrals look like this:

\[ \frac{\pi}{2} \int f(x) \cos(mx) \, dx. \]

This is standard for the widely available symbolic manipulation codes. It would be a nice touch, however, to build in a displayeqn function, called something such as displayeqn(eqn), that would \[ \TeX \] an equation eqn or expression and display its typeset version, perhaps in a secondary window. This would be useful for longer, more complicated displays that tend to get confusing.

Another kind of I/O, potentially the most useful, is communication with other languages. Standard Maple currently does not support this sort of interaction, but mention is made of this in Section 3.18 of [1-2].

1.8 Numerical Precision
A very handy feature for numerical work is the ease with which results can be obtained to different precisions. If a result is computed and more precision is needed, the user simply repeats his previous steps after resetting the Digits parameter. For example, the lines

```maple
> Digits := 250;
> evalf(exp(Pi));
```

will cause the first 250 significant digits of \( e^\pi \) to be written to the monitor. This variable precision can be used for checking results and probable errors. When one evaluates the integral of (1.1) over the interval (0, 1) to 5S with Maple, one obtains \( 0.10724 \times 10^7 \) and to 10S, one gets \(-102.9560130\); both of these incorrect results are products of catastrophic cancellation in the evaluation of the symbolic results. By increasing the number of significant digits to 30, 100, then 200, one sees the results settling down to \( 0.1879 \ldots \times 10^{-11} \). The upper bound for Digits is 500,000.

1.9 Getting Help
I found Maple’s on-line help very convenient. At the Maple prompt, entering ?item causes the program to display standardized information about the function, operation, package, and so on, called item. For example, to get help on the package padic, the user would enter ?padic, after which information on the package would appear, including examples and references to related topics. This is all very handy. In addition, when a request for help is made on a topic that does not exist in Maple, the program responds with a notice to this effect and then suggests a list of topics that the user might find appropriate. For example, ?bess causes the program to offer the list BesselI, BesselJ, BesselK, \ldots. Help and very good technical support are also available to the user from WMS via e-mail and telephone.

1.10 Programming Maple
Maple allows the user to write procedures (user-defined operations) using the built-in operations. Here is an example of a function I wrote (hilbeig) that returns the magnitude of the smallest eigenvalue of the \( n \times n \) Hilbert matrix:

```maple
hilbeig := proc(n)
  A := hilbert(n):
  eigenvals(A):
  eig := ["1:
  eigabs := map(abs, eig):
  min(op(eigabs))
end:
```

The subsequent call \( \rho := \text{hilbeig}(13) \) then sets \( \rho \) to the magnitude of the smallest eigenvalue of the \( 13 \times 13 \) Hilbert matrix. Here, hilbeig is the function name, proc indicates that a function is being defined with argument n, and end marks the end of the body of the function. A call to this function produces a matrix and a list of eigenvalues; the value of the function in this case is the last result obtained, namely, the output of \( \min(\text{op(eigabs)}) \).

Procedures may also include standard programming structures using Algol-like statements such as for and do-od for loops and if-while for conditionals.

1.11 Further Information
There is a great deal of literature supporting the Maple user. Along with the software, I received the books [1-1, 1-2, 1-3], a copy of the very handsome Maple Technical Newsletter, and references to other books of interest. There are many users of Maple interested in developing applications and using Maple as a teaching tool, as is evident from scanning the newsletter articles. Several universities provide on-line (ftp) access to Maple libraries and user groups.

Maple is available from Waterloo Maple Software. For further information contact WMS via electronic mail info@maplesoft.on.ca (Internet) or telephone at 519-747-2373. The company’s address is

Waterloo Maple Software
450 Phillip Street
Waterloo, Ontario
Canada N2L 5J2

Part 2 of this report will appear in the next issue of this column.

The statements and opinions expressed herein are those of the author and do not necessarily reflect those of Rockwell International Corporation.

References
**X(PLORE) Version 4.0 for DOS**

Reviewed by Herbert Holden*

X(PLORE) is an interactive environment for developing, exploring, and testing mathematical ideas on the IBM PC, with capabilities similar to Mathematica or Derive. It is the latest version of Calculus Calculator, a program which was reviewed in the September 1989 and January 1992 issues of the Notices.

Since the basic features of this software (the user interface, evaluation of mathematical expressions, graphing in 2-D and 3-D, differentiation, integration, solutions of systems of equations, and the built-in programming language) are described in previous reviews, I will restrict myself to the new features of X(PLORE). The user initiated Calculus Calculator by entering cc. X(PLORE) is initiated by entering xpl, and this product will henceforth be referred to by xpl.

My first concern with xpl was that perhaps cc had evolved into fatware (it hasn't) or that the user interface had changed (it didn't). The product consists of a 250-page wire-bound manual and a single 3-1/2" disk containing the following five uncompressed files which can be installed with a simple copy command.

- **xpl.hlp** 86k; **xpl.exe** 224k; **xpl.ovr** 303k; and two demo files, 15k for both.

This is a refreshing change from juggernaut applications consisting of hordes of compressed files to be resurrected via the malediction "install" which spawns subdirectories and files whose names and functions are generally unknown to the user. For a discussion of fatware see BYTE, April 1993.

The major new features are:

Matrix operations are now available. Matrices can be created by lists of elements, juxtaposition of existing conformable matrices, a formula for the $i$th element, or by spreadsheet-like editing. Arithmetic operations include the usual matrix arithmetic, as well as elementwise arithmetic, elementwise comparison, and elementwise logical bitwise operations. Functions are: transpose, conjugate, determinant, trace, rank, number of rows or columns, row reduced echelon form, LU and QR factorization, eigenvalues and eigenvectors, characteristic polynomial, condition number, inverse, and pseudo-inverse. The statistical operations Max, Min, Sum Product, Average, and StanDev can be applied to a matrix, and the rows of a matrix can be sorted by the entries in any given column.

The improvements to graphics are: graphing of vector fields and trajectories; graphing of curves in 3-D; graphing level curves; a zoom and unzoom feature; and a variety of cosmetic improvements to a graph such as axes, grid lines, ticmarks, labels, and onscreen editing.

The string-valued functions Date and Time have been added as well as the usual string operators and functions.

Variables can be deallocated with **forget**.

Infinite precision arithmetic is available.

Editing has been improved with cut-and-paste functions which can access ten text buffers.

xpl is still easy to learn. The manual is well written, and a complete survey of all the features is contained in the first 120 pages. The remainder of the manual is devoted to programming in the xpl language (pp. 121–138), technical notes (pp. 139–152), applications (pp. 153–217), two appendices on Commands and Error Messages, and the index.

xpl was designed by David Meredith at San Francisco State University and is published by Prentice Hall. The manual and disk retail for about $30. For network users, the manual alone is about $20, a rather modest price for a rather effective product.

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**MG Mathematical Graphics System**

Reviewed by Marvin S. Margolis*

**Introduction**

The MG Mathematical Graphics System creates and displays two- and three-dimensional mathematical graphics on an MS-DOS-based personal computer and produces high-quality PostScript output. The developers, R. B. Israel and R. A. Adams, Department of Mathematics, The University of British Columbia, Vancouver, B.C., Canada V6T 1Z2, primarily designed the relatively small program to assist authors to create graphs to include in TeX-typeset documents. It is available from MG Software, 4223 West Ninth Avenue, Vancouver, B.C., Canada V6R 2C6.

**System Requirements**

A system running MG must have:

- an IBM PC or compatible computer with 512K main memory and one floppy disk drive;
- PC- or MS-DOS version 2.0 or higher;
- a graphics adapter and monitor (CGA, MCGA, EGA, VGA, Hercules Monochrome Graphics Card, AT&T 400 line, IBM 8514 and 3270 PC are supported).

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To enhance MG’s performance, the authors recommend, but do not require, a:

- hard disk or second floppy drive;
- Microsoft or Logitech mouse or compatible pointing device;
- numeric coprocessor; if one is present, MG will automatically make use of it, with considerable increase in speed.

To incorporate MG output into a \TeX document and print requires:

- the \TeX program,
- a DVI to PostScript driver,
- a PostScript printer or typesetter.

A user must have a PostScript printer or typesetter to obtain a PostScript-printed version of an MG graph not involving \TeX. I tested the program on an IBM PS/1 486dx computer with an SVGA color monitor and a LaserJet IIIp printer. Since I do not have a Microsoft or Logitech mouse, I used the keyboard to operate the program. It worked well without a mouse.

**What Can MG DO?**

MG’s two-dimensional graphs can involve Cartesian, polar, or parametric curves, straight lines, and vectors, as well as parametric families of such items. The user can:

- vary axis positions, labels, scales, and markings;
- plot vector fields and trajectories of dynamical systems.

The three-dimensional graphs can involve Cartesian or parametric surfaces, lines, vectors, and three-dimensional parametric curves, and families of these. The user can:

- rule surfaces by arbitrary curve families;
- variably shade surfaces as though to illuminate them from a particular direction;
- arbitrarily position axes, scale and rotate them, or draw a three-dimensional bounding box.

In both two- and three-dimensional graphs, the user can draw curves and lines in various colors (on color monitors) and render them in various patterns (solid, dotted, dashed) and in arbitrary line widths in the PostScript file. He or she can:

- place dots (circles, filled or unfilled) with arbitrary radius and position;
- arbitrarily place free drawing, including lines, filled or unfilled polygonal lines and spline curves, and dots and labels;
- select horizontal and vertical label justification;
- include raw PostScript in the output file to produce special effects;
- select the level of gray shading of shaded regions.

**How Does MG Work in Practice?**

I installed MG without problems, and it worked exactly as the user manual said. A new user can give the program a simple trial and learn how to use its menus with an included quick tutorial. The company distributes MG with two example graphs, a two-dimensional polar, and a three-dimensional surface graph. I found the surface graph stunningly beautiful on a super VGA color monitor. Even before trying MG, I knew it was special. As a mathematical graphing program, it did not try to sell itself with a marketing brochure containing stunning graphs of mathematical figures.

I easily learned how to use the small program by working through the tutorial and user manual. Within two hours I felt competent to draw my own graphs with appropriate additional detail. Years after acquiring it, I am still learning Mathematica commands. Despite the many options MG offers for any one feature, the authors logically thought out, designed, and implemented them. The menu system’s flexibility exemplifies its clever design. The authors mitigate the usual menu inflexibility by taking advantage of a mouse, hot keys, an ability to configure MG, context-sensitive help, and many other features.

I know of two roughly competing mathematical publication-quality graphing alternatives to MG. PICTEX is an add-in set of macros for \TeX that eases graphing tasks. Since I have never used PICTEX, I cannot assess its usefulness. However, unlike PICTEX, MG is a stand-alone mathematical graphing program that one can use independently of \TeX. Secondly, programs like Mathematica produce excellent graphics and are capable of passing their output to \TeX in \TeX format.

**User Manual**

The company supplies a comprehensive user manual that is divided into nine short chapters. The authors drew the manual’s graphics using MG. The PostScript drawing of the sample file’s three-dimensional surface no longer stuns me, but gray shadings work well. I would be pleased to have the figure in a publications-quality document.

**Conclusions**

Since I first acquired \TeX, I wanted to buy a niche product like MG. The MG authors seemed to know exactly what I wanted. In the past, I used \TeX (or rather \LaTeX) to typeset a long document with many mathematical symbols and figures. \LaTeX handled mathematical symbols with ease. However, using \LaTeX to draw publication-quality mathematical graphs was a chore that brought back painful memories of a mechanical drafting class I once had to take. MG is significant because it makes drawing mathematical graphs suitable for publication a pleasure. It does so by allowing users to concentrate more on mathematical and less on drafting details.
Inside the AMS

A Statement on
Supportive Practices and Ethics
in the Employment of
Young Mathematicians

The Council of the American Mathematical Society, meeting in Cincinnati, Ohio, on 11 January 1994, passed the following resolution unanimously so as to speak in the name of the Society.

For several years now, there have been substantially fewer Ph.D.-level positions available in Mathematics than qualified applicants. (See, for example, the report of the AMS Task Force on Employment reviewed in the AMS Notices, October 1992, pp. 820–821, and the 1993 survey of new doctorates, AMS Notices, November 1993, p. 1164). The disparity between supply and demand has caused severe difficulties for some recent Ph.D.s. There is no indication that the situation will ease significantly in the near future.

It is incumbent on mathematics departments to make all their potential Ph.D.s aware of the realities of the job market and to encourage them to prepare for a broad range of jobs in the mathematical sciences.

The early post-Ph.D. years are crucial in career development. Employment practices should conform to this principle.

The systematic use of one-year appointments to fill regular teaching positions has the potential for exploitation of those holding such positions. Young mathematicians in one-year terminal positions with full teaching loads must, in addition to carrying out their duties and trying to establish their own scholarly program, begin again searching for a job almost immediately after settling in—a concentration of pressures which will almost certainly have adverse effects on professional growth and morale.

While some one-year positions are professionally beneficial, many others can be rationalized by institutions only on grounds of fiscal expediency or charity.

Employers should strenuously seek means to devise better situations for recent Ph.D.s. Whenever possible, positions should be offered for at least two years.

Although many institutions are under severe financial pressure, this should not be used as an excuse for exploitation. In particular, the practice of hiring unemployed Ph.D.s by the course, without integrating them into the scholarly life of the department, is seriously detrimental to the individuals and the profession.

The systematic hiring of unemployed Ph.D.s part-time at substandard salaries is reprehensible and exploitative. It demeans the profession. Such a practice undermines educational quality.
MAA Prizes Awarded in Cincinnati

During the Joint Mathematics Meetings in Cincinnati in January of this year, the Mathematical Association of America (MAA) awarded a number of prizes.

JAMES SUTHERLAND FRAME of Michigan State University received the Yueh-Gin Gung and Dr. Charles Y. Hu Award for Distinguished Service to Mathematics. The $4,000 prize is MAA's most prestigious award. Frame earned his B.S., M.S., and Ph.D. degrees at Harvard University. He served as head of the mathematics department at Michigan State from 1943 to 1960 and retired in 1977. Frame's main interest has always been students and their professional growth and success. Widely regarded as "Dr. Pi Mu Epsilon", he has personally installed more than fifty chapters of the national honorary society and served as president of PME for nine years and as secretary for three years. Receiving the award has "lifted my spirits to cloud nine," he said. "It is a high honor to be included with the previous winners of this award... [MAA's] increasing concern for the participation of students in national mathematical activity bodes well for the future of our profession."

STEVEN G. KRANTZ of Washington University received the Beckenbach Book Prize for his book Complex Analysis: The Geometric Viewpoint. Named for Edwin Beckenbach of the University of California at Los Angeles, a longtime leader in the publications program of the MAA, the $1,000 prize honors distinguished, innovative books published by the MAA. The prize committee noted, "This is a truly outstanding monograph, in which the author has given a readable account of some difficult mathematics."

BARRY MAZUR of Harvard University received the Chauvenet Prize for his paper, "Number Theory as Gadfly", American Mathematical Monthly, volume 98 (1991). The $1,000 prize recognizes an outstanding expository article by an MAA member. The paper describes the mathematics surrounding the Shimura-Taniyama-Weil Conjecture, which implies Fermat's Last Theorem and which was an important ingredient in the work of Andrew Wiles on the theorem. The prize committee said, "Few experts would have attempted to explain such formidable material to a general audience. The mathematical public is indebted to [Mazur] for making this exciting topic accessible."

Three Awards for Distinguished College or University Teaching of Mathematics were presented. These awards, each of $1,000, honor college or university teachers who have been widely recognized as extraordinarily successful and whose teaching effectiveness has been shown to have had an influence beyond their own institutions.
PAUL R. HALMOS of Santa Clara University was nominated for the teaching award by the Northern California Section of the MAA, which called him an “accomplished, energetic, widely respected, and well-disposed colleague... We are most pleased to exercise this opportunity to trumpet the extraordinary merit of this extraordinary teacher of mathematics.” Upon notification of the award, Halmos remarked: “Usually the only recognition you get for having tried to teach well is that a middle-aged former student drops in on you and says, ‘Gee whiz, Prof, I sure liked that course I took from you—I never really needed that stuff, but you made it, like, you know, kind of interesting.’ That’s all the more reason why this award means a lot to me.”

JUSTIN J. PRICE of Purdue University also received a teaching award. Price has taught a wide variety of courses, ranging from freshman to graduate courses, and from honors courses to those intended for mathematics education majors. He encourages his students to express mathematical ideas clearly and precisely in a grammatically correct and readable mixture of mathematical formalism and English. Upon notification of the award, Price said, “I have had many satisfactions in teaching: seeing a student’s eyes suddenly light up with understanding, imparting enthusiasm for the subject and desire to learn more, convincing future teachers that math is more than a collection of rules. But these were private rewards. To be cited publicly is truly wonderful.”

ALAN C. TUCKER of the State University of New York at Stony Brook, another teaching award recipient, has repeatedly been voted outstanding teacher in his department. In addition, he created programs to enable talented high school students to undertake independent mathematics projects under the supervision of university faculty. Upon notification of the award, Tucker said he was greatly honored, saying that he has been “lucky to have worked with delightful students and fellow faculty at my home institution and equally inspiring professional colleagues in the MAA and other professional activities. On top of that, I was blessed to have a wonderful wife and family. Whatever good I have done is a reflection of the good I see in others and the joy I have had working with them.”

Faculty Fellows Announced
President Bill Clinton named thirty young scientists and engineers as Presidential Faculty Fellows. These fellowships, among the most prestigious given by the federal government, provide recognition and support for young faculty who demonstrate excellence and promise in research and teaching. Each award carries a grant from the National Science Foundation of $100,000 per year for five years.

Among the Fellows were two in the mathematical sciences: CHUNG-CHIEH KUO of the Department of Electrical Engineering at the University of Southern California, and ROBIN A. PEMANTLE of the Department of Mathematics at the University of Wisconsin at Madison.

Fulbright Awards
The J. William Fulbright Foreign Scholarship Board and the United States Information Agency have made awards to graduate students, academics, professionals, and independent scholars to study or do research abroad during 1993-1994.

Following are the names of the graduate students in mathematics who received awards, their home institutions, and the countries in which they are studying: KATHLEEN FARRELL, Colgate University, Britain; DANIEL FRANKOSKI, University of Minnesota, Hungary; JOEL FRIEDMAN, Vassar College, Britain; JAMES MANN, Georgia Institute of Technology, Germany; JOEL MULLER, University of Oregon, Hungary; KATHLEEN SIMONIAN, University of Central Arkansas, Pakistan; and JOHN WEISENFELD, Washington University in St. Louis, Germany.

Following are the names of mathematics faculty receiving awards, their home institutions, and the countries in which they will use the awards: ROBERT B. BROOKS, University of Southern California, Israel; BORIS A. DATSHOVSKY, Temple University, Israel; REBECCA DER-SIMONIAN, National Institute of Child Health and Development, Armenia; MOHAMMED K. KHAN, University of Central Arkansas, Pakistan; CHARLES W. MULLINS, University of Central Arkansas, Ghana; PETER A. PERRY, University of Kentucky, Norway; RUBEN D. SCHWIEGER, Indiana Wesleyan University, Ghana; ANDREW VINCE, Uni-
The first Vasil A. Popov Prize will be awarded at the Eighth Texas International Conference on Approximation Theory to be held in January of 1995. The prize has been established in memory of Vasil A. Popov and his contributions to approximation theory and related areas of mathematics.

The prize will be awarded every three years for outstanding research contributions in fields related to Vasil Popov's work. Eligibility for this first prize is restricted to mathematicians who did not have their terminal degree on June 1, 1988. The winner of the prize will be asked to deliver a plenary lecture at the Texas conference.

The Selection Committee for the Vasil A. Popov prize consists of Charles Chui, Ronald A. DeVore, Paul Nevai, Allan Pinkus, Pencho Petrushev, and Edward Saff.

Nominations for the award should be sent by June 1, 1994 to: Professor Ronald A. DeVore, Chairman of the Selection Committee, Department of Mathematics, University of South Carolina, Columbia, South Carolina 29208. Nominations should include a brief description of the research related to the nomination. Other supporting material may also be submitted.

AAAS Seeks Information for Resource Directory

The American Association for the Advancement of Science Project on Science, Technology, and Disability invites scientists and engineers with disabilities to be included in the third edition of the Resource Directory of Scientists and Engineers with Disabilities. Potential candidates for the directory must hold, or be working towards, a degree in a scientific, engineering, or medical discipline, or currently be employed in a scientific field.

Funded by the National Science Foundation, the project's Resource Directory of Scientists and Engineers with Disabilities has assisted hundreds of individuals to enter and advance in scientific disciplines by helping to connect persons with disabilities and their families with professors, teachers, and counselors who can serve as role models and mentors. The directory lists scientists, mathematicians, and engineers from all parts of the country with their disciplines, degrees, and disabilities, including both professionals who were born with disabilities and those who acquired disabilities mid-career. Persons listed in the directory are also asked to consult for academia, government agencies, and industry, as well as serve on peer review panels and symposia. Since the passage of the Americans with Disabilities Act (ADA), the AAAS Resource Directory has become a valuable source of expertise.

To be included in the directory, or for more information, please contact Laurren Summers, Program Associate, or Patricia A. Thompson, Editorial Specialist, AAAS Project on Science, Technology, and Disability, AAAS, 1333 H Street, NW, Washington, DC 20005, or call 202-326-6645 (V/TDD). Information can also be sent via fax to 202-371-9849.

News from the Institute for Mathematics and its Applications

University of Minnesota

The IMA 1993–1994 academic year program Emerging Applications of Probability continues, with the guidance of the coordinators J. Michael Steele (chairman), David Aldous, Persi Diaconis, Rick Durrett, and Larry Shepp. Details concerning the spring segment of the program, Probability in Geo-systems, April 1–June 30, 1994, can be found in the December Notices.

From July 5–29, 1994, the IMA will present a summer program on Molecular Biology. The organizers are Michael Waterman, Terence P. Speed, Gene Myers, Jill P. Mesirov, Klaus Schulten, and De Witt Sumners.

The revolutionary progress in molecular biology within the last thirty years opens the way to full understanding of the structures of living organisms. This program touches upon several interdisciplinary areas and is driven by ever-growing computational power. The mathematical sciences accompany and support much of the progress achieved by computations as well as provide insight into geometric and topological properties of protein structures.

The program will bring together molecular biologists and mathematicians who have worked on protein sequencing, protein folding, molecular dynamics and the various mathematical, statistical and computational aspects involved in order to increase interaction and to discuss future directions.
Another goal is to bring young mathematicians (graduate students and recent Ph.D.s) into contact with this fast-growing field. We are particularly interested in attracting women and minorities.

The first two weeks of the program (Sequencing and Mapping, July 5–8; Genetic Linkage and Mapping, July 11–15) will deal with linear representations of genomic information: genetic and physical mapping and DNA sequencing. The last two weeks (Protein Structure and Dynamics, July 18–22; Topology and Geometry of DNA and RNA, July 25–29) will be devoted to numerical and analytic models for and simulations of the spatial structure of proteins, DNA and RNA. See the advertisement in this issue.

During August 1–19, 1994, the IMA will feature a new summer program for mathematics faculty, Mathematical Modeling for Instructors. The goal is to provide experience in the use of mathematical modeling to solve problems which come from industry and engineering for thirty-two college/university instructors of undergraduates so that they can incorporate their experience and newly acquired skills in either enrichment of existing math courses or development of new undergraduate courses in math modeling. The instructors will solve these problems in teams coached by tutors. The tutors are Donald Drew, Patrick Hagan, Ellis Cumberbatch, Gerald Young, David Ross, and Colin Please.

Applications are due by March 15. See the advertisement in the February Notices.

For more information about IMA activities, see the Meetings and Conferences section of this issue or contact the IMA (ima-staff@ima.umn.edu). Also, weekly IMA seminar schedules with titles and abstracts are available on Usenet: umn.math.dept and by fingerling seminar@ima.umn.edu. \TeX files for the Newsletter and the Update are available via anonymous ftp (at ftp.ima.umn.edu) or gopher (at gopher.ima.umn.edu).

Two Summer Programs at the Geometry Center

The Geometry Center in Minneapolis will host two programs this summer, one for undergraduate students and the other for high school and middle school teachers.

The Summer Institute for Research and Training in Computation, Visualization, and Mathematics for Undergraduates will be held June 13 to August 19, 1994. The program is aimed at students who have a strong and demonstrated interest in mathematics and computing and who would enjoy working in an intense environment with other students and researchers. Although intended for students currently enrolled in college, strong applications from graduating high school seniors and graduating college seniors may be considered. Students will use computing and graphics programs to investigate problems combining mathematics and visualization. Past student projects have focused on hyperbolic, Euclidean, and spherical geometries; fractals, chaos, and dynamical systems; differential geometry; group theory; mathematical exposition via visualization; and computer graphics. The program can accommodate up to twenty students. A scholarship of $2,000–$2,500 will be paid depending upon background, experience, and year in college. Dorm rooms and board are provided for each participant. No travel funds are available.

Students in the undergraduate program, together with thirty high school and middle school teachers, will participate in the two-week course, Geometry and the Imagination: Chance, to be held June 20 to July 1, 1994. The course looks at questions of probability and statistics currently reported in the news, such as the prevalence of HIV, whether electromagnetic fields cause cancer, and the reliability of election polls. The course begins with newspaper articles and moves on to journals such as Chance, Nature, Science, and Scientific American, as well as to readings on basic concepts in probability and statistics. Computer simulations and statistical packages are used to illustrate the relevant theoretical concepts. Teachers applying to the program can receive college credit, and a $35 registration fee will be charged.

For further information about these programs, contact The Geometry Center, 1300 South Second Street, Suite 500, Minneapolis, MN 55454; telephone 612-626-0888; fax 612-626-7131; e-mail admin@geom.umn.edu.
Funding Information
for the Mathematical Sciences

New Educational Initiative
at NSF
The National Science Foundation has announced a new initiative: Mathematical Sciences and Their Applications Throughout the Curriculum. Projects supported in the initiative are expected to lead to increased student understanding in the mathematical sciences and in student ability to apply the mathematical sciences in other disciplines.

The interdisciplinary character of the initiative is central and will require strong support across academic units and development by mathematical sciences faculty in partnership with faculty in other disciplines. Projects are also expected to have a pervasive impact on the mathematical sciences and the other departments involved, building on efforts, such as the calculus reform movement, to improve undergraduate education. In addition to changes in course content, projects should involve a full range of goals, such as improving student learning through alternative instructional practices, the effective use of computational technologies, and increasing the diversity of students who are attracted to and successful in disciplines requiring a foundation in the mathematical sciences.

Projects could involve the entire mathematical sciences curriculum or be more focused; for example, a project might involve the calculus curriculum, including courses that lead to and follow calculus, and its applications in other disciplines. Consideration of other segments of the curriculum is also encouraged.

This initiative replaces the NSF’s Calculus and Bridge to Calculus Program. Continuing the progress made in the area of calculus remains a high priority for NSF. Support for projects in calculus that do not have the interdisciplinary or other features expected in this initiative is available through the Course and Curriculum Program (which supports development of new curricula and large scale adaptation and implementation projects), the Instrumentation and Laboratory Improvement Program (matching funds for equipment), the Undergraduate Faculty Enhancement Program (workshops for faculty), and the Advanced Technological Education Program. All of these programs are described in the new Division of Undergraduate Education Program Announcement (NSF-93-164).

In the Mathematical Sciences and Their Applications Program, NSF expects initially to award ten to twenty planning grants of up to $50,000. It is expected that these planning grants will provide a basis for the preparation of comprehensive proposals that will lead to a few awards of up to $1 million per year for three to five years. Information about this new initiative is available in an addendum to NSF-93-164 and is available by calling 703-306-1669. The due date for proposals for planning grants is June 6, 1994, with full proposals due February 6, 1995.

NSF publications are available by sending e-mail to pubs@nsf.gov; be sure to specify your full mailing address and how many copies you need. Access to a wide range of NSF documents is available through STIS, the NSF’s online information service. For information on STIS, send a message to stisfly@nsf.gov.

NSF’s Academic Research Infrastructure Program
The Academic Research Infrastructure Program (ARI) of the National Science Foundation (NSF) is designed to improve the condition of research equipment and facilities in the nation’s academic institutions in all disciplines. In fiscal year 1994, separate competitions will be held for facilities modernization and instrumentation. This solicitation is for proposals for the support of instrumentation development and acquisition only. Proposals submitted in response to this program solicitation will be competing for about $55 million in fiscal 1994. The proposal success rate for the previous ARI competition was approximately 26%.

The purpose of the program is to improve research infrastructure through focused investment in the acquisition or development of major research instrumentation used for research and research training. The program also seeks to initiate instrumentation development partnerships between academia and industry.

The goals of the instrumentation component of the ARI Program are to:
• support the acquisition, through purchase or development, of major state-of-the-art research instrumentation;
• improve accessibility to and greater utilization of modern research instrumentation by scientists, engineers, and graduate and undergraduate students; and
• foster the development of the next generation of research instrumentation through partnerships between academic researchers and private sector instrument developers.
Funding Information

The program will assist in the acquisition or development and maintenance and technical support of major research instrumentation that is not usually available through other NSF programs. Proposals may be for a single instrument, a large system of instruments, or multiple instruments that are used to address a common problem. A list of assorted instruments without a common research theme will not be reviewed.

Awards for instrumentation will range from $100,000 to $2 million. Lesser amounts will be considered from proposals representative of undergraduate institutions or from mathematics, or the social, behavioral, or economic science communities. Proposals may be submitted by institutions of higher education, independent nonprofit research institutions, research museums, and legally incorporated consortia thereof. Computer systems or networks necessary for the purpose of carrying out research are acceptable. Proposals for computer networks as general purpose equipment will not be reviewed.

Matching or cost-sharing at the level between 30%–50% of total eligible project costs is required, with the 50% level being strongly encouraged. An institution may only submit two proposals in response to this solicitation. However, the institution may, in addition, be included as a member of a consortium that is submitting a separate proposal. Proposals must be received by 5:00 p.m. March 15, 1994.

The program announcement is NSF publication number NSF 93-172. For further information please contact: Office of Science and Technology Infrastructure, Academic Research Infrastructure, National Science Foundation, Room 1270, 4201 Wilson Boulevard, Arlington, VA 22230; telephone 703-306-1040; e-mail ari@nsf (Bitnet) or ari@nsf.gov (Internet).

NSF publications are available by sending e-mail to pubs@nsf.gov; be sure to specify your full mailing address and how many copies you need. Access to a wide range of NSF documents is available through STIS, the NSF's online information service. For information on STIS, send a message to stisfly@nsf.gov.

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HISTORY OF MATHEMATICS

Golden Years of Moscow Mathematics

Smilka Zdravkovska and Peter L. Duren, Editors

Volume 6

This volume contains articles on Soviet mathematical history, many of which are personal accounts by mathematicians who witnessed and contributed to the turbulent years of Moscow mathematics. In today's climate of glasnost, the stories can be told freely for the first time, with a candor uncharacteristic of the "historical" accounts published under the Soviet regime. The articles focus on mathematical developments in that era, the personal lives of Russian mathematicians, and political events that shaped the course of scientific work in the Soviet Union. An important feature is the inclusion of two articles on Kolmogorov, perhaps the greatest Russian mathematician of the twentieth century. The volume concludes with an annotated English bibliography and a Russian bibliography for further reading. This book appeals to mathematicians, historians, and anyone else interested in Soviet mathematical history. The History of Mathematics series is published jointly with the London Mathematical Society (LMS). *

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University of Kentucky, Lexington, Kentucky  
March 18–19, 1994  

Preliminary Program

The eight hundred and ninetieth meeting of the American Mathematical Society (AMS) will be held at the University of Kentucky, Lexington, Kentucky, on Friday and Saturday, March 18–19, 1994.

Invited Addresses

Jack Dongarra, Oak Ridge National Laboratory and University of Tennessee, Recent work in parallel algorithms for linear algebra.

David R. Morrison, Institute for Advanced Study, Mirror symmetry and the quantum moduli space of Calabi-Yau manifolds.

James E. McClure, Purdue University, Applications of Hochschild and Andre-Qui/len homology to homotopy theory.

George F. McNulty, University of South Carolina, Avoiding combinatorial patterns in strings of symbols.

Special Sessions

Infinite groups and group rings, James C. Beidleman and Donald B. Coleman, University of Kentucky.

Geometric group theory and metric geometry, Philip L. Bowers, Florida State University.

Partial differential equations and minimal smoothness conditions, Russell M. Brown and John L. Lewis, University of Kentucky, and Zhongwei Shen, Purdue University.

Graph theory, Karen L. Collins, Wesleyan University, and Ewa M. Kubicka, University of Louisville.

Collaborative learning in calculus and precalculus, Michael B. Freeman, University of Kentucky.

Inverse spectral problems: theory and computation, Peter D. Hislop and Peter Perry, University of Kentucky.

Homotopy theory, Mark A. Hovey, University of Kentucky, and James E. McClure.

Quantum algebraic geometry, David R. Morrison, Institute for Advanced Study.

Elliptic genera and elliptic cohomology, Serge Ochanine, University of Kentucky.

Mathematics of many-body quantum theory, M. Beth Ruskai, University of Massachusetts at Lowell.

The deadline for submission of abstracts for consideration in any of these sessions has expired.

There will also be sessions for contributed ten-minute papers. The deadline for submission of abstracts for these sessions has expired. Unfortunately, late papers cannot be accommodated.

Accommodations

Rooms have been blocked in the following hotels. An NCAA Regional Men's Basketball Tournament is scheduled in Lexington for the weekend of March 18, so participants are advised to make reservations early. Participants should make their own arrangements with the hotel of their choice. The AMS is not responsible for rate changes or the quality of the accommodations offered by these hotels/motels.


Lexington offers several rather good restaurants along with the usual assortment of fast food and chain diners. The University Student Center will also be open.

Parking

Free parking will be available on the campus within a five-minute walk from the meeting site. One of the lots is accessed from Rose Street and is behind Memorial Coliseum. The second, slightly closer, is off Virginia Avenue between South Limestone Street and the railroad tracks.

Registration

The meeting registration desk will be located in the main foyer on the ground floor of the Business and Economics Building, which is near the main gate on South Limestone Street, and will be open from 7:30 a.m. to 5:00 p.m. on Friday, March 18, and 7:30 a.m. to noon on Saturday, March 19.

The registration fees are $30 for members of the AMS, $45 for nonmembers, and $10 for emeritus members, students, or unemployed mathematicians.

Travel

The University of Kentucky campus is located approximately eight miles from Bluegrass Field, which services American, Delta, Northwest, TWA, United Airlines, and USAir.
Delta has been selected as the official airline for this meeting. The following benefits are available exclusively to mathematicians and their families attending the meeting: a savings of up to 10% off any published domestic fare (includes U.S., Canada, Bermuda, the Bahamas, Puerto Rico, and the U.S. Virgin Islands), subject to applicable fare restrictions. Call 1-800-241-6760 between 8:00 a.m. and 11:00 p.m. EST to contact Delta directly or call any licensed travel agent. Instruct the ticket agent to refer to file MO456 in order to qualify for the applicable discount.

Two major interstate highways intersect at Lexington: I-75 for persons arriving from the north or south and I-64 for those arriving from the east or west. Arrivals from the south should take the first Lexington exit, Athens/Lexington, at mile marker 104 on I-75 and enter Lexington on East Main. Persons arriving from the east should take I-75 South off I-64 and take exit #110, Winchester/Lexington. Those arriving from the north or west take exit #113, Paris/Lexington, and travel south on Broadway to the campus.

Weather
Weather in Lexington in mid-March is often pleasant. Temperatures should be moderate, but rain is likely. Mean high temperature is 53.7°F. The mean low temperature is 34.1°F. The average rainfall for March is 4.83 inches.
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### Program of the Sessions

The time limit for each contributed paper in the sessions is ten minutes. 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.

Abstracts of papers presented in the sessions at this meeting will be found in the March 1994 issue of *Abstracts of papers presented to the American Mathematical Society*, ordered according to the numbers in parentheses following the listings below.

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 (△) may be of interest to undergraduate students.

#### Friday, March 18

**Special Session on Infinite Groups and Group Rings, I**

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| 8:30 a.m.–10:50 a.m. | Using symbolic computer calculations to construct group representations.  
Thomas A. Fournelle, University of Wisconsin, Parkside (890-20-54)  
9:00 a.m. | Are dimension quotients $D_n(G)/\gamma_n(G)$ central?  
Narain D. Gupta, University of Manitoba (890-20-120)  
9:30 a.m. | Semisimplicity of crossed products.  
Derek J. S. Robinson*, University of Illinois, Urbana-Champaign, and Eli Aljadeff, Israel Institute of Technology, Israel (890-20-14)  
10:00 a.m. | Near commutativity conditions in groups.  
Luise-Charlotte Kappe*, State University of New York, Binghamton, and Michael Tomkinson, University of Glasgow, United Kingdom (890-20-35)  
10:30 a.m. | Some non-Specht multilinear commutator identities.  
C. Kanta Gupta, University of Manitoba (890-20-119) (Sponsored by Narain D. Gupta) |

**Special Session on Graph Theory, I**

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| 8:30 a.m.–10:50 a.m. | Alternating walks in partially 2-edge-colored graphs and optimal strength of graph labeling.  
André E. Kézdy and Chi Wang*, University of Louisville (890-05-48)  
9:00 a.m. | Chromatic difference sequences.  
Karen L. Collins, Wesleyan University (890-05-21)  
9:30 a.m. | On the ultimate normalized chromatic difference sequence of a graph.  
Huishan Zhou, Georgia State University (890-05-24) (Sponsored by Karen L. Collins)  
10:00 a.m. | The greatest common divisor index of a graph.  
Gary Chartrand, Saba Farokh, Western Michigan University, Wayne Goddard, University of Pittsburgh, Grzegorz Kubicki*, University of Louisville, and Christina M. Mynhardt, University of South Africa, Republic of South Africa (890-05-65) |

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<th>Time</th>
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| 10:30 a.m. | On $m$-chromatic factorizations of complete graphs.  
Gary Chartrand*, Western Michigan University, Héctor Hevia, Universidad Católica de Valparaíso, Chile, and Ortrud R. Oellermann, Brandon University (890-05-52) |

**Special Session on Collaborative Learning in Calculus and Precalculus, I**

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<th>Time</th>
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| 8:30 a.m.–10:50 p.m. | Collaborative learning—The cutting edge, and more fun for everybody.  
Uri Treisman, University of California, Berkeley (890-99-173)  
9:00 a.m. | Achieving a diverse graduating class.  
Ray Shiflett, California Polytechnic State University (890-98-25)  
9:30 a.m. | Long-term benefits of collaborative learning programs: A case study.  
Martin Vern Bonsangue, California State University, Fullerton (890-98-40)  
10:00 a.m. | Panel Discussion on Collaborative programs, Uri Treisman, Martin Bonsangue, and Ray Shiflett |

**Special Session on Homotopy Theory, I**

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<th>Time</th>
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| 8:30 a.m.–10:50 a.m. | $\beta_{\infty}$ module spectra over connective $K$-theory.  
Jerome J. Wolbert, University of Chicago (890-55-83)  
9:00 a.m. | A few remarks on Hopf algebra cohomology.  
John H. Palmieri, University of Wisconsin, Madison (890-55-137)  
9:30 a.m. | On torsion in the cohomology of certain mapping spaces.  
Nicholas J. Kuhn*, University of Virginia, and Mark Winstead, University of California at San Diego (890-55-90)  
10:00 a.m. | Topological Quillen homology. Preliminary report.  
Thomas Hunter*, Swarthmore College, and James McClure, Purdue University, West Lafayette (890-55-126)  
10:30 a.m. | Topological Hochschild homology of extensions of $\mathbb{Z}$ and $\mathbb{Z}/p$ by polynomials.  
Ayelet Lindenstrauss, University of Pennsylvania (890-55-122) |
Program of the Sessions

Special Session on Quantum Algebraic Geometry, I

8:30 a.m.–10:50 a.m.

8:30 a.m.  K3 surfaces with involution and mirror pairs of Calabi-Yau manifolds.
Ciprian Borcea, Rider College (890-14-39)

9:20 a.m.  Fibrations on Calabi-Yau threefolds. Preliminary report.
Antonella Grassi, University of Pennsylvania (890-14-93)

10:10 a.m.  Mirror symmetry for elliptic Calabi-Yau threefolds with constant J-invariant.
Mark W. Gross, Cornell University, Ithaca (890-14-144) (Sponsored by David R. Morrison)

Special Session on Mathematics of Many-Body Quantum Theory, I

8:45 a.m.–10:50 a.m.

8:45 a.m.  Introduction.

9:00 a.m.  Essential spectrum of an n-particle Hamiltonian in a magnetic field.
Gregorj Zhislin, Russian Academy of Sciences, Russia (890-81-57) (Sponsored by M. B. Ruskai)

9:30 a.m.  Limits on stability of positive molecular ions in a homogeneous magnetic field. Preliminary report.
Simeon Vugal'ter, Steklov Institute of Mathematics, Russia (890-81-58) (Sponsored by M. B. Ruskai)

10:00 a.m.  Binding of atoms and stability of molecules in Thomas-Fermi and Hartree models.
Isabelle Catto, University of Paris-Dauphine, France (890-81-115) (Sponsored by M. B. Ruskai)

10:30 a.m.  Rates of convergence for the Rayleigh-Ritz variational methods. Preliminary report.
Robert Nyden Hill, University of Delaware (890-81-75) (Sponsored by M. B. Ruskai)

Special Session on Geometric Group Theory and Metric Geometry, I

9:00 a.m.–10:50 a.m.

9:00 a.m.  Compactifying covers of 3-manifolds.
Mike L. Mihalik, Vanderbilt University (890-20-36)

9:40 a.m.  Tame combings and rewriting systems for groups.
Susan M. Hermiller*, University of Melbourne, Australia, and John Meier, Lafayette College (890-20-37)

10:20 a.m.  Normalizers in semihyperbolic groups. Preliminary report.
Juan M. Alonso, Stockholm University, Sweden (890-20-96)

Special Session on Partial Differential Equations and Minimal Smoothness Conditions, I

9:00 a.m.–10:50 a.m.

9:00 a.m.  The Cauchy problem for nonlinear parabolic equations of very fast diffusion type.
Panagiota Daskalopoulos*, University of Minnesota, Minneapolis, and Manuel Del Pino, University of Chicago (890-35-67)

9:30 a.m.  Regularity of A-harmonic function. Preliminary report.
Pekka J. Koskela, University of Michigan, Enrique Villamor, Florida International University, and Juan J. Manfredi*, University of Pittsburgh (890-30-149)

10:00 a.m.  Embedding theorems on various function spaces associated with degenerate vector fields and applications.
Guozhen Lu, Wright State University (890-46-79) (Sponsored by Michael Freeman)

10:30 a.m.  Isoperimetric and Sobolev inequalities for Carnot-Caratheodory metrics.
Nicola Garofalo, Purdue University, West Lafayette (890-35-172)

Invited Address

11:00 a.m.–11:50 a.m.

34 Recent work in parallel algorithms for linear algebra.
Jack Dongarra, University of Tennessee (890-99-167)

Invited Address

1:30 p.m.–2:20 p.m.

35 Mirror symmetry and the quantum moduli space of Calabi-Yau manifolds.
David R. Morrison, Duke University (890-14-154)

Special Session on Infinite Groups and Group Rings, II

2:30 p.m.–5:20 p.m.

2:30 p.m.  Computer generated results on the unit groups of modular group algebras.
Donald B. Coleman, University of Kentucky, and Robert Sandling*, University of Manchester, United Kingdom (890-16-62)

3:00 p.m.  Semiprimitivity of group algebras.
Donald S. Passman, University of Wisconsin, Madison (890-16-06)

3:30 p.m.  Building on a counter-example to a conjecture of Hans Zassenhaus. Preliminary report.
Peter Floodstrand Blanchard, University of Virginia (890-20-156)

4:00 p.m.  Constructing units in Z[G]. Preliminary report.
S. K. Sehgal, University of Alberta (890-16-16)

4:30 p.m.  Units of infinite order in certain group rings.
Gary Thompson, Virginia Commonwealth University (890-20-09)
### Program of the Sessions

#### Friday, March 18 (cont'd)

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>5:00 p.m.</td>
<td>On the unit conjecture and the support of units in group algebras.</td>
</tr>
<tr>
<td>(41)</td>
<td>Peter C. Pappas, Vassar College (890-99-170)</td>
</tr>
</tbody>
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**Special Session on Geometric Group Theory and Metric Geometry, II**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>2:30 p.m.-5:00 p.m.</td>
<td>Groups course quasi-isometric to $H^2 \times \mathbb{R}$.</td>
</tr>
<tr>
<td>(42)</td>
<td>Eleanor G. Rieffel, University of Southern California (890-22-81)</td>
</tr>
<tr>
<td>3:10 p.m.</td>
<td>Automatic structures on extensions of $F_1$ by $Z$.</td>
</tr>
<tr>
<td>(43)</td>
<td>Thomas Brady, Brigham Young University (890-20-80) (Sponsored by Philip L. Bowers)</td>
</tr>
<tr>
<td>3:50 p.m.</td>
<td>Constructing (semi) hyperbolic groups via cubical complexes.</td>
</tr>
<tr>
<td>(44)</td>
<td>John Meier, Lafayette College (890-20-41)</td>
</tr>
<tr>
<td>4:30 p.m.</td>
<td>Pseudo-Anosov diffeomorphisms with prescribed cubic expansions.</td>
</tr>
<tr>
<td>(45)</td>
<td>Richard W. Kenyon, Centre National de la Recherche Scientifique, France (890-20-42) (Sponsored by Philip L. Bowers)</td>
</tr>
</tbody>
</table>

**Special Session on Partial Differential Equations and Minimal Smoothness Conditions, II**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>2:30 p.m.-4:50 p.m.</td>
<td>Singular integrals and parabolic PDE.</td>
</tr>
<tr>
<td>(46)</td>
<td>Steve Hofmann, Wright State University (890-42-19)</td>
</tr>
<tr>
<td>3:00 p.m.</td>
<td>Boundary value problems for the Maxwell system.</td>
</tr>
<tr>
<td>(47)</td>
<td>Marius Mitrea, University of South Carolina, Columbia (890-35-33)</td>
</tr>
<tr>
<td>3:30 p.m.</td>
<td>Transmission problems in electromagnetism.</td>
</tr>
<tr>
<td>(48)</td>
<td>Preliminary report.</td>
</tr>
<tr>
<td>4:00 p.m.</td>
<td>Third derivative estimates for Dirichlet's problem in convex domains.</td>
</tr>
<tr>
<td>(49)</td>
<td>Stephen J. Fromm*, McMaster University, and David Jerison, Massachusetts Institute of Technology (890-35-97)</td>
</tr>
<tr>
<td>4:30 p.m.</td>
<td>Parabolic equations with coefficients in Morrey spaces.</td>
</tr>
<tr>
<td>(50)</td>
<td>Gary M. Lieberman, Iowa State University (890-35-145)</td>
</tr>
</tbody>
</table>

**Special Session on Graph Theory, II**

<table>
<thead>
<tr>
<th>Time</th>
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</thead>
<tbody>
<tr>
<td>2:30 p.m.-6:00 p.m.</td>
<td>Forbidden subgraphs and Hamiltonian properties.</td>
</tr>
<tr>
<td>(51)</td>
<td>Ralph Faudree*, Memphis State University, Zdenek Ryjáček, University of West Bohemia, Czech Federal Republic, and Ingo Schiermeyer, Technische Hochschule Aachen, Germany (890-95-77)</td>
</tr>
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<tr>
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<th>Event</th>
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<tbody>
<tr>
<td>3:00 p.m.</td>
<td>The transfer matrix method for counting cycles and paths on grid graphs. Preliminary report.</td>
</tr>
<tr>
<td>(52)</td>
<td>Y. H. Harris Kwong*, State University of New York, College at Fredonia, and D. G. Rogers, The University, Aberdeen, United Kingdom (890-95-63)</td>
</tr>
<tr>
<td>3:30 p.m.</td>
<td>Large enough rectangles can be tiled, but how large is &quot;enough&quot;? Preliminary report.</td>
</tr>
<tr>
<td>(53)</td>
<td>Darren A. Narayan, State University of New York, Binghamton, and Allen J. Schwenk*, Western Michigan University (890-05-50)</td>
</tr>
<tr>
<td>4:00 p.m.</td>
<td>Graph rigidity and connectivity.</td>
</tr>
<tr>
<td>(54)</td>
<td>D. S. Franzblau, Rutgers University, Piscataway (890-05-69)</td>
</tr>
<tr>
<td>4:30 p.m.</td>
<td>Extremal graphs for intersecting triangles.</td>
</tr>
<tr>
<td>(55)</td>
<td>P. Erdős, Hungarian Academy of Science, Hungary, Z. Füredi, University of Illinois, Urbana-Champaign, R. J. Gould* and D. S. Gunderson, Emory University (890-05-29)</td>
</tr>
<tr>
<td>5:00 p.m.</td>
<td>Problem session</td>
</tr>
</tbody>
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**Special Session on Collaborative Learning in Calculus and Precalculus, II**

<table>
<thead>
<tr>
<th>Time</th>
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<tbody>
<tr>
<td>2:30 p.m.-5:50 p.m.</td>
<td>Collaborative learning in calculus and precalculus.</td>
</tr>
<tr>
<td>(56)</td>
<td>Peter U. Georgakis, Santa Barbara City College (890-98-27)</td>
</tr>
<tr>
<td>3:00 p.m.</td>
<td>Discussion</td>
</tr>
<tr>
<td>3:30 p.m.</td>
<td>Mathematical collaborative learning at Shoreline Community College.</td>
</tr>
<tr>
<td>(57)</td>
<td>Carl Main, Shoreline Community College (890-98-114) (Sponsored by Michael Freeman)</td>
</tr>
<tr>
<td>4:00 p.m.</td>
<td>Discussion</td>
</tr>
<tr>
<td>4:30 p.m.</td>
<td>Unique university/high school collaboration increases mathematics access.</td>
</tr>
<tr>
<td>(58)</td>
<td>Roberta L. Dees, University of Illinois, Chicago (890-97-32)</td>
</tr>
<tr>
<td>5:00 p.m.</td>
<td>Panel Discussion on Collaborative workshops, Roberta Dees and Michael Freeman.</td>
</tr>
</tbody>
</table>

**Special Session on Inverse Spectral Problems: Theory and Computation, I**

<table>
<thead>
<tr>
<th>Time</th>
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<tbody>
<tr>
<td>2:30 p.m.-4:50 p.m.</td>
<td>Using eigenvalues to detect coefficient singularities.</td>
</tr>
<tr>
<td>(59)</td>
<td>Preliminary report.</td>
</tr>
<tr>
<td>3:00 p.m.</td>
<td>A finite difference algorithm for an inverse Sturm-Liouville problem.</td>
</tr>
<tr>
<td>(60)</td>
<td>Roger Knobel, University of Texas-Pan American, Richard Fabiano, Jr. and Bruce Lowe*, Texas A &amp; M University, College Station (890-34-11)</td>
</tr>
<tr>
<td>3:30 p.m.</td>
<td>Asymptotics for natural frequencies and mode shapes for vibrating, rectangular membranes.</td>
</tr>
<tr>
<td>(61)</td>
<td>Ole H. Hald, University of California, Berkeley, and Joyce R. McLaughlin*, Rensselaer Polytechnic Institute (890-35-151)</td>
</tr>
</tbody>
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NOTICES OF THE AMERICAN MATHEMATICAL SOCIETY
Program of the Sessions

Special Session on Homotopy Theory, II

2:30 p.m.–5:50 p.m.

2:30 p.m.  Local Dickson invariants.
          (64) Dan Arnon, Massachusetts Institute of Technology
                   (890-55-121)

3:00 p.m.  Algebraic elements of Pic., Preliminary report.
           (65) Mark Mahowald, Northwestern University, and Hal
                   Sadosky*, Johns Hopkins University (890-55-128)

3:30 p.m.  The cohomology of finite-dimensional Hopf algebras.
           (66) Anetta Bajer*, Pennsylvania State University, Reading, and Hal
                   Sadosky, Johns Hopkins University (890-55-135)

4:00 p.m.  Commutative algebra in equivariant stable homotopy
           theory.
           (67) J. P. May, University of Chicago (890-55-131)

4:30 p.m.  Looping Bousfield-Kan towers. Preliminary report.
           (68) James M. Turner, Massachusetts Institute of Technology
                   (890-55-61)

5:00 p.m.  THH of $A_\infty$ and $E_\infty$ ring spectra revisited. Preliminary
           report.
           (69) A. D. Elmendorf, Purdue University, Calumet Campus
                   (890-19-08)

5:30 p.m.  Hybrid spaces with interesting cohomology.
           (70) Kathryn Lesh, University of Toledo (890-55-138)

Special Session on Quantum Algebraic Geometry, II

2:30 p.m.–6:30 p.m.

2:30 p.m.  Mirror symmetry for hypersurfaces in weighted
           projective space and topological couplings.
           (71) Per Berglund*, Institute for Advanced Study, and
                   Sheldon Katz, Oklahoma State University (890-14-95)

3:20 p.m.  The nonlinear Kähler form in quantum geometry.
           (72) Paul S. Aspinwall, Institute for Advanced Study
                   (890-14-68) (Sponsored by David R. Morrison)

4:10 p.m.  Discussion

5:00 p.m.  On Weil-Petersson completions of moduli spaces of
           Calabi-Yau manifolds. Preliminary report.
           (73) Paul S. Green and Yoshikio Hayakawa*, University of
                   Maryland, College Park (890-14-84)

5:50 p.m.  Quantum cohomology and mirror symmetry for a
           hypersurface in a toric variety. Preliminary report.
           (74) M. Ronen Plessier, Institute for Advanced Study
                   (890-14-94) (Sponsored by David R. Morrison)

Special Session on Mathematics of Many-Body Quantum Theory, II

2:30 p.m.–5:20 p.m.

2:30 p.m.  Local properties of coulombic wave functions.
           (75) M. Hoffmann-Ostenhof*, University of Wien, Austria,
                   T. Hoffmann-Ostenhof, Vienna University, Austria,
                   and H. Stremnitzer, University of Wien, Austria
                   (890-81-98)

3:00 p.m.  Solutions of Schrödinger equations that decay
           superexponentially fast. Preliminary report.
           (76) Jaime Cruz, Universidad de las Americas, Mexico
                   (890-35-60) (Sponsored by M. B. Ruskai)

3:30 p.m.  Regularity properties of the zero set of solutions to
           Schrödinger equations.
           (77) T. Hoffmann-Ostenhof*, Vienna University, Austria, M.
                   Hoffmann-Ostenhof, University of Wien, Austria, and
                   N. Nadirashvili, Academy of Sciences of the USSR,
                   Moscow (890-35-82)

4:00 p.m.  Magnetic Lieb-Thirring inequalities.
           (78) László Erdős, Princeton University (890-81-07)

4:30 p.m.  Localization for the wave equation in random media.
           (79) Preliminary report.
           (80) J. M. Combes, University of Toulon, France, P. D.
                   Hislop, University of Kentucky, C. A. Shubin*,
                   California State University, Northridge, and A. Tip,
                   Instituut voor Atoom en Molecuulfysica, Netherlands
                   (890-80-163)

5:00 p.m.  Localisation of wave functions near a critical value of
           the energy.
           (81) Thierry Paul, University of Paris-Dauphine, France
                   (890-81-157) (Sponsored by M. B. Ruskai)

Saturday, March 19

Special Session on Collaborative Learning in Calculus and Precalculus, III

8:00 a.m.–10:50 a.m.

8:00 a.m.  An applied Treisman style calculus intervention at a
           coop university.
           (81) Maurice Gilmore, Northeastern University (890-98-23)

8:30 a.m.  Enrichment programs in calculus.
           (82) Joseph Egur, Sherwood Silliman* and Bhushan
                   Wadhwa, Cleveland State University (890-98-28)
                   (Sponsored by John J. Walsh)

9:00 a.m.  Discussion

9:30 a.m.  Potential impact that a collaborative learning program
           can have throughout campus.
           (83) Paul R. McCreary, University of Illinois, Urbana-Champaign
                   (890-98-76)

10:00 a.m. Wisconsin emerging scholars program.
           (84) Michael Bleicher, University of Wisconsin, Madison
                   (890-98-99)

10:30 a.m. Discussion
Program of the Sessions

Saturday, March 19  (cont’d)

General Session

8:00 a.m.–9:55 a.m.
8:00 a.m.  Five-fold loop spaces with trivial Dyer-Lashof and Browder operations.  Mark Foskey, University of California at San Diego, La Jolla (890-55-46)
8:15 a.m.  The mixed harmonious Ramsey number.  David Moser, Manchester College (890-05-107)
8:30 a.m.  A generalization of the Liouville’s theorem on elementary functions.  N. V. Rao, University of Toledo (890-12-87)
8:45 a.m.  Wave polynomials.  Allan Fryant*, Greensboro College, and M. K. Vemuri, University of Chicago (890-35-18)
9:00 a.m.  Manifold with the structure satisfying
(89)  $p^{K-1} - q^{K-1} = 0.
Lovejoy Das, Kent State University (890-53-110)
9:15 a.m.  Convergence problems for partially observed stochastic games.  Kandethody Ramachandran, University of South Florida (890-60-109)
9:30 a.m.  On the numerical stability of Volterra integral equations with several delays.  Baruch Cahlon, Oakland University (890-65-108)
9:45 a.m.  Preparing instructors for the collaborative learning environment.  Bradford J. Kline, University of Illinois, Urbana-Champaign (890-98-92)

Special Session on Infinite Groups and Group Rings, III

8:30 a.m.–10:50 a.m.
8:30 a.m.  The generalized Wielandt subgroup of a group.  James C. Beidleman, University of Kentucky, Martyn R. Dixon*, University of Alabama, and Derek J. S. Robinson, University of Illinois, Urbana-Champaign (890-20-02)
9:00 a.m.  A new characterization of totally projective groups.  Preliminary report.  Paul Hill, Auburn University, Auburn (890-20-47)
9:30 a.m.  On periodic products of groups.  Sergei Ivanov, University of Illinois, Urbana-Champaign (890-20-31) (Sponsored by Derek J. Robinson)
10:00 a.m.  Relation modules of infinite groups.  Martin J. Evans, University of Alabama (890-20-102)
10:30 a.m.  The isomorphism problem for cyclically pinched one-relator groups.  Gerhard Rosenberger, University of Dortmund, Germany (890-20-10)

Special Session on Graph Theory, III

8:30 a.m.–10:50 a.m.
8:30 a.m.  The median procedure on median graphs.  F. R. McMorris*, University of Louisville, Henry Martyn Mulder, Erasmus University, The Netherlands, and Fred S. Roberts, Rutgers University, New Brunswick (890-05-15)
9:00 a.m.  Venn diagrams and Venn graphs. Preliminary report.  Kiran B. Chilakamarri, Central State University, Peter Hamburger and Raymond E. Pippert*, Indiana University-Purdue University, Ft. Wayne (890-05-53)
10:00 a.m.  Using graph theory in statistics.  Terry McKee, Wright State University (890-05-03)
10:30 a.m.  Nonmonotonic logics-applications to graph theory. Preliminary report.  Miroslaw Truszczynski, University of Kentucky (890-05-30)

Special Session on Homotopy Theory, III

8:30 a.m.–10:50 a.m.
8:30 a.m.  Duality of Thom complexes.  Robert R. Bruner, Wayne State University (890-55-125)
9:00 a.m.  Complex oriented cohomology of covers of BU.  Neil Strickland, Massachusetts Institute of Technology (890-55-127) (Sponsored by Mark A. Hovey)
9:30 a.m.  Tate cohomology for arbitrary groups.  Guido Mislin, Eidgen Technische Hochschule, Switzerland (890-19-70)
10:00 a.m.  The $p^a$-K-theory of $\mathbb{D}^n_{n+1}$.  Lisa Langsetmo, Wayne State University (890-55-91)
10:30 a.m.  A generalization of Swan’s theorem. Preliminary report.  John R. Martino*, Western Michigan University, and Stewart B. Priddy, Northwestern University (890-55-123)

Special Session on Quantum Algebraic Geometry, III

8:30 a.m.–10:50 a.m.
8:30 a.m.  The mirror symmetry of $n$-folds with $K = 0$ may nevertheless be trivial.  Tristan Hübsch, Howard University (890-14-140) (Sponsored by David R. Morrison)
9:00 a.m.  Duality symmetries in string theory. Preliminary report.  Xenia C. de la Ossa, Institute for Advanced Study (890-14-147) (Sponsored by David R. Morrison)
10:10 a.m.  Less is more: On the moduli space of (0, 2) SCFTs.  Jacques Distler, Princeton University (890-14-160) (Sponsored by David R. Morrison)
# Program of the Sessions

## Special Session on Mathematics of Many-Body Quantum Theory, III

**8:30 a.m.—10:50 a.m.**

- **8:30 a.m.** Number theory, atoms and classical mechanics.  
  (111) Luis A. Seco, University of Toronto (890-81-38)
- **9:00 a.m.** Asymptotic completeness for N-particle long range systems in constant magnetic fields.  
  (112) Izabella Laba, University of Toronto (890-78-71)
- **9:30 a.m.** Geometric methods in inverse scattering theory.  
  (113) Preliminary report.  
  Ricardo Weder, IIMAS-UNAM, Mexico (890-35-74)
- **10:00 a.m.** Perturbation theory for the Schrödinger operator with a periodic potential.  
  (114) Yulia E. Karpeshina, Saint Petersburg State University, Russia (890-81-56)
- **10:30 a.m.** Segal-Bargmann transform in $L^p$ spaces.  
  (115) Stephen B. Sontz, University of Virginia (890-81-59)

## Special Session on Geometric Group Theory and Metric Geometry, III

**9:00 a.m.—10:50 a.m.**

- **9:00 a.m.** An ultra-pumping lemma with applications to negatively curved groups. Preliminary report.  
  (116) Kim Ruane, Florida State University (890-20-116)
- **9:40 a.m.** Infinite dimensional boundaries of negatively curved spaces.  
  (117) Eric Lewis Swenson, Michigan Tech University (890-20-171)
- **10:20 a.m.** Metrics on infinite dimensional groups.  
  (118) Conrad Plaut, University of Tennessee (890-28-89)

## Special Session on Partial Differential Equations and Minimal Smoothness Conditions, III

**9:00 a.m.—10:50 a.m.**

- **9:00 a.m.** Regularity of solutions to the Schrödinger equation. Preliminary report.  
  (119) Jiaping Zhong, University of Texas, Austin (890-35-112)
- **9:30 a.m.** Uniqueness in the Cauchy problems for higher order elliptic differential operators.  
  (120) Wensheng Wang, University of Chicago (890-35-66)  
  (Sponsored by Michael Freeman)
- **10:00 a.m.** Boundary uniqueness for solutions of parabolic equations in nonsmooth domains.  
  (121) Carlos E. Kenig, University of Chicago (890-35-166)
- **10:30 a.m.** Estimates for elliptic PDE in cones. Preliminary report.  
  (122) Gregory Verchota*, Syracuse University, and Jill C. Pipher, Brown University (890-35-150)

## Special Session on Inverse Spectral Problems: Theory and Computation, II

**9:00 a.m.—10:50 a.m.**

- **9:00 a.m.** On identification of nonlinear modal interactions in response dominated by linear behavior.  
  (123) Suzanne Weaver Smith, University of Kentucky (890-93-134)  
  (Sponsored by Peter A. Perry)
- **9:30 a.m.** Determining coefficients using multiple input sources.  
  (124) Bruce Lowe and William Rundell*, Texas A & M University, College Station (890-35-143)
- **10:00 a.m.** Mathematical foundations of the hole-drilling method for evaluation of residual stress. Preliminary report.  
  (125) Chi-Sing Man, University of Kentucky (890-73-146)
- **10:30 a.m.** Reconstruction of a general second order elliptic operator via incomplete boundary spectral data. Preliminary report.  
  (126) Alexander Katchalov, University of Kentucky (890-35-65)  
  (Sponsored by Yaroslav Kurylev)

## Invited Address

**11:00 a.m.—11:50 a.m.**

- **11:00 a.m.** Applications of Hochschild and André-Quillen homology to homotopy theory.  
  James E. McClure, Purdue University, West Lafayette (890-99-168)

## Invited Address

**1:30 p.m.—2:20 p.m.**

- **1:30 p.m.** Avoiding combinatorial patterns in strings of symbols.  
  George F. McNulty, University of South Carolina, Columbia (890-99-169)
### Saturday, March 19 (cont’d)

#### Special Session on Infinite Groups and Group Rings, IV

- **2:30 p.m.** - 4:50 p.m.  
  - **2:30 p.m.** Groups rich in finite quotients.  
    - **Venn Walter**, University of Illinois, Urbana-Champaign (890-20-12)  
  - **3:00 p.m.** Images of periodic linear groups.  
    - **Richard E. Phillips**, Michigan State University (890-20-01)  
  - **3:30 p.m.** The automorphism tower problem revisited.  
    - **Preliminary report.**  
    - **Simon Thomas**, Rutgers University, New Brunswick (890-20-04)  
  - **4:00 p.m.** Groups with few conjugacy classes of insoluble subgroups.  
    - **Howard Smith**, Bucknell University (890-20-05)  
  - **4:30 p.m.** $n$-free groups and the model theory of free groups.  
    - **Benjamin Fine**, Fairfield University, **Anthony Gaglione**, U. S. Naval Academy, **Gerhard Rosenberger**, University of Dortmund, Germany, and **Dennis Spellman**, Philadelphia, Pennsylvania (890-20-118)

#### Special Session on Geometric Group Theory and Metric Geometry, IV

- **2:30 p.m.** - 4:20 p.m.  
  - **2:30 p.m.** CAT(0) reflection manifolds.  
    - **F. D. Ancel**, University of Wisconsin, **M. Davis**, Ohio State University, Columbia, and **C. R. Guilbault**, University of Wisconsin, Milwaukee (890-53-132)  
  - **3:10 p.m.** CAT(0) 4-manifolds with a tame point are Euclidean.  
    - **Paul Thurston**, Cornell University, Ithaca (890-57-73)  
  - **3:50 p.m.** Cut points in the boundary of negatively curved groups.  
    - **Preliminary report.**  
    - **Philip L. Bowers**, Florida State University (890-20-117)

### Special Session on Partial Differential Equations and Minimal Smoothness Conditions, IV

- **2:30 p.m.** - 5:20 p.m.  
  - **2:30 p.m.** Variance of the lifetime of conditioned Brownian motion, and the heat kernel.  
    - **Burgess Davis**, Purdue University, West Lafayette (890-35-111)  
  - **3:00 p.m.** The $L^p$ Dirichlet problem for elliptic operators with nonsmooth coefficients.  
    - **Nancy Lim**, University of Chicago (890-35-100)

### Special Session on Collaborative Learning in Calculus and Precalculus, IV

- **2:30 p.m.** - 4:20 p.m.  
  - **2:30 p.m.** Initiating an intervention project for underrepresented students.  
    - **Preliminary report.**  
  - **3:00 p.m.** Panel Discussion on Funding for special projects, Bill Hawkins and Michael Freeman.
Program of the Sessions

Special Session on Inverse Spectral Problems: Theory and Computation, III

2:30 p.m.–5:00 p.m.

2:30 p.m. A boundary determination problem from the design of periodic diffractive structures. Preliminary report. David C. Dobson, Texas A & M University, College Station (890-35-103)

3:00 p.m. Some uniqueness theorems related to inverse spectral problems. Ziqi Sun, Wichita State University (890-35-20)

3:30 p.m. Energy theorems and bounds is linearized elasticity with residual stress. Preliminary report. F. George Abatt and Donald E. Carlson*, University of Illinois, Urbana-Champaign (890-73-13)

4:00 p.m. On the sensitivity of an identification technique in structural diagnostic problems. Cesare Davini, University of Udine, Italy (890-73-106) (Sponsored by David R. Morrison)

4:30 p.m. Inverse boundary problem for a general second order elliptic operator. Preliminary report. Yaroslav Kurylev, Purdue University, West Lafayette (890-34-64)

Special Session on Quantum Algebraic Geometry, IV

2:30 p.m.–6:30 p.m.

2:30 p.m. Theta functions of Calabi-Yau integrable systems. Preliminary report. Ron Donagi, University of Pennsylvania (890-14-148)

3:20 p.m. Calculation of Gromov-Witten invariants via excess intersection theory. Preliminary report. Sheldon Katz, Oklahoma State University, Stillwater (890-14-130)

4:10 p.m. Discussion

5:00 p.m. A mathematics theory of quantum cohomology. Yongbin Ruan*, University of Utah, and Gang Tian, Courant Institute of Mathematical Sciences, New York University (890-53-139)

5:50 p.m. Quantum field theory methods in counting holomorphic curves. Michael Bershadsky, Harvard University (890-14-141) (Sponsored by David R. Morrison)

Special Session on Elliptic Genera and Elliptic Cohomology, II

2:30 p.m.–4:20 p.m.

2:30 p.m. The fixed-point formula on loop spaces as an isogeny formula, and its relationship to the Tate curve. Preliminary report. Matthew Ando, University of Virginia (890-55-88)

3:00 p.m. The cobordism spectrum MO(8). Preliminary report. Mark Hovey*, University of Kentucky, and Doug Ravenel, University of Rochester (890-55-72)

3:30 p.m. Group actions and higher Dirac operators. Preliminary report. Tianjun Li, Brandeis University (890-57-164)

Special Session on Mathematics of Many-Body Quantum Theory, IV

2:30 p.m.–3:50 p.m.

2:30 p.m. On the existence of monotonic fronts for a class of physical problems described by the equation \(\lambda u'' + u' = f(u)\). Rafael D. Benguria* and M. Christina Depassier, Pontificia University Catolica, Chile (890-34-142)

3:00 p.m. On classical linear wave equations in pulsating bounded domains. P. Duclos*, Universite de Toulon et du Var, France, J. Dittrich and P. Šeba, Nuclear Physics Institute, Czech Federal Republic (890-81-155)

3:30 p.m. Effective masses and the inverse problem for the Hill operator. P. Kargaev, University of Saint Petersburg, Russia, and E. Korotyaev*, Saint Petersburg Electrotech Institute, Russia (890-81-153) (Sponsored by M. B. Ruskai)

Special Session on Homotopy Theory, IV

3:30 p.m.–5:50 p.m.

3:30 p.m. Postnikov towers of \(E_\infty\) ring spectra with an application to \(BP\). I. Kriz, Chicago University (890-55-22) (Sponsored by Mark A. Hovey)

4:00 p.m. An equivariant van Kampen spectral sequence. Michele Intermont, University of Notre Dame (890-55-17)

4:30 p.m. Some remarks on Shimomura and Yabe's calculation of \(\pi_i(L_2S^0)\). Preliminary report. Mark Mahowald, Northwestern University (890-57-78)

5:00 p.m. The \(I_2\)-localization of the fiber of the double suspension. Preliminary report. Robert D. Thompson, Hunter College, City University of New York (890-55-136)

5:30 p.m. Equivariant \(K\)-theory from a homotopy theoretic point of view. Preliminary report. Crichton Ogle*, Ohio State University, Columbus, Paul Baum and Nigel Higson, Pennsylvania State University, University Park (890-46-124) (Sponsored by Mark A. Hovey)

Robert J. Daverman Associate Secretary Knoxville, Tennessee
Kansas State University, Manhattan, Kansas  
March 25 – 26, 1994

Preliminary Program

The eight hundred and ninety-first meeting of the American Mathematical Society will be held at Kansas State University in Manhattan, Kansas, on Friday, March 25, and Saturday, March 26, 1994. All sessions will be held in Cardwell Hall and Waters Hall.

Invited Addresses

Marilyn Breen, University of Oklahoma, *Krasnosel'skii-type theorems in orthogonal polygons.*

Michael C. Cranston, University of Rochester, *On coupling in applications of probability to analysis.*

David M. Goss, Ohio State University, *Zeta functions of characteristic p arithmetic.*

Mei-Chi Shaw, University of Notre Dame, *Solvability and estimates for the tangential Cauchy-Riemann operators.*

Special Sessions

Harmonic analysis and probability, Andrew G. Bennett and Charles N. Moore, Kansas State University.

Groups and geometries, Andrew L. Chermak and Albert L. Delgado, Kansas State University.

Quantum topology, Louis Crane and David Yetter, Kansas State University.

Global fields, David M. Goss, Ohio State University; Michael I. Rosen, Brown University; and Dinesh Thaker, University of Arizona.

Special functions, Robert A. Gustafson, Texas A&M University.

Several complex variables and partial differential equations, A. Alexandrou Himonas, Institute of Advanced Study, and Mei-Chi Shaw.

Nonlinear topics and critical phenomena in partial differential equations, Lev Kapitanski and Lige Li, Kansas State University.

Representations of algebraic groups and quantum groups, Zongzhu Lin and David B. Surowski, Kansas State University.

Operator theory, Gabriel Nagy, Kansas State University, and Vladimir V. Peller, University of Hawaii.

Convergence problems in ergodic theory, Joseph M. Rosenblatt, Ohio State University.

Dynamical systems and fluid dynamics, Misha Vishik, University of Texas at Austin.

Computational mathematics and numerical analysis, Hu-nan Yang and Qisu Zou, Kansas State University.

The deadline for submission of abstracts for consideration in any of these sessions has expired.

There will also be sessions for contributed ten-minute papers. This deadline has also expired.

Accommodations

Rooms have been blocked for participants at the Ramada Inn, Best Western Continental Inn, and Days Inn. Participants should make their own arrangements directly with the hotel of their choice and request the AMS conference rate to obtain the rate listed. All rooms will be on a space-available basis after March 8, 1994.

Ramada Inn (0.2 mile to Cardwell Hall): 17th and Anderson Avenue, Manhattan, KS 66502. Telephone: 913-539-7531. Single $57 and Double $63.

Best Western (1.2 miles to Cardwell Hall): 100 Bluemont Avenue, Manhattan, KS 66502. Telephone: 800-452-5111 or 913-776-4771. Single or Double $54 ($4 each additional person).

Days Inn (1.7 miles to Cardwell Hall): 1501 Tuttle Creek Boulevard, Manhattan, KS 66502. Telephone: 800-325-2525 or 913-539-5391. Rooms are $50 (2 double beds, 1–4 people).

Other hotels/motels in the area are the Holiday Inn (1.8 miles to Cardwell Hall), tel: 913-539-5311; Super 8 Motel (1.6 miles to Cardwell Hall), tel: 913-537-8468 or (800) 800-8000; and Motel 6 (1.3 mile to Cardwell Hall), tel: 913-537-1022.

Registration

The registration desk will be located inside the main entrance to Cardwell Hall and will be open from 8:00 a.m. to 5:00 p.m. on Friday, March 25, and from 8:00 a.m. to noon on Saturday, March 26. The registration fees are $30 for members of the AMS, $45 for nonmembers, and $10 for emeritus members, students, or unemployed mathematicians.

Social Events

A cash bar reception will be held on Friday evening from 8:00 p.m. to 11:00 p.m. at the Ramada Inn located just south of the Kansas State campus.

Food Service

Restaurants are located in or adjacent to all area hotels and motels. Other restaurants, bars, and cafes abound in “Aggieville”, a commercial neighborhood located just south-east of the Kansas State campus. Breakfast and lunch will also be available on Friday at the K-State Union, which will be closed Saturday. Only coffee service will be provided at the meeting site.

Parking

Participants staying at the Ramada Inn will find it most convenient to park in the hotel lot and walk the 0.2 miles to Cardwell Hall. For participants staying in other accommo-
Meetings

dations or driving in for only one day, on-campus parking convenient to Cardwell Hall is available in lots accessible from Claffin Avenue and Denison Avenue. Participants may use any nonreserved faculty, student or general parking place. On Friday, parking permits, available at morning registration at the cost of $1, will be required. Arrangements have been made to allow participants to park, register, and return to place the permit in their car. Participants arriving after 11:00 a.m. on Friday should get a permit at the Visitors Information Booth located on 17th Street just north of Anderson Avenue near the K-State Union before parking. Permits are not required on Saturday.

Travel

USAir is the official airline for this meeting. The following benefits are available exclusively to mathematicians and their families attending the meeting: 10% discount off any published domestic fare with a seven-day advance purchase. Call USAir's Meetings and Convention Reservation Office at 1-800-334-8644 between 8:00 a.m. and 9:00 p.m. EST or call any licensed travel agent. Instruct the agent to refer to gold file #16950015 in order to qualify for the applicable discount.

Kansas State University campus is located in Manhattan, in the Flint Hills of eastern Kansas. Manhattan is 130 miles west of Kansas City, Missouri, and 140 miles west of the Kansas City International Airport. For travelers arriving by car, those coming from the east on Interstate 70 should take exit 313 (state highway K-177). Those coming from the west on Interstate 70 should take exit 303 (state highway K-18). In both cases, follow signs north to Manhattan and Kansas State University.

For travelers arriving by air, all flights into Manhattan originate in Kansas City, Missouri, and are operated by USAir Express. From cities served by USAir, the least expensive option is generally to fly USAir into Manhattan via Kansas City. For travelers using other airlines, it is generally less expensive to fly into Kansas City and use ground transport to Manhattan. The options from KCI to Manhattan (by ground) are to rent a car (driving time approximately 2.5 hours) or to use Travelers Express commercial van shuttle service (reserve in advance at 1-800-747-2524). Present fares for the van shuttle are $59.00 round trip ($57.00 for students) between the gate at KCI and your hotel or motel in Manhattan.

Weather

Midcontinental variations in the jet stream make late March weather in Manhattan highly variable, both with regard to temperature and precipitation. Participants are advised to check forecasts immediately before travelling.
Presenters of Papers

Numbers following the names indicate the speakers' positions on the program.

- Invited Lecturer
- Special Session Speaker
Program of the Sessions

The time limit for each contributed paper in the sessions is ten minutes. 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.

Abstracts of papers presented in the sessions at this meeting will be found in the March 1994 issue of Abstracts of papers presented to the American Mathematical Society, ordered according to the numbers in parentheses following the listings below.

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 may be of interest to undergraduate students.

### Friday, March 25

#### Special Session on Groups and Geometries, I

**9:00 a.m.–10:50 a.m.**

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00 a.m.</td>
<td>Representations of finite groups on cell complexes.</td>
<td>Michael Aschbacher, California Institute of Technology (891-20-50)</td>
</tr>
<tr>
<td>10:00 a.m.</td>
<td>Maximal 2-locals of the monster. Preliminary report.</td>
<td>Ulrich Meierfrankenfeld, Michigan State University (891-20-87)</td>
</tr>
<tr>
<td>10:30 a.m.</td>
<td>Embeddings of sporadic geometries. Preliminary report.</td>
<td>Stephen D. Smith, University of Illinois, Urbana-Champaign (891-20-16)</td>
</tr>
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</table>

#### Special Session on Special Functions, I

**9:00 a.m.–10:50 a.m.**

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<thead>
<tr>
<th>Time</th>
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<th>Authors</th>
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<tbody>
<tr>
<td>9:00 a.m.</td>
<td>Bessel functions on Jordan pairs.</td>
<td>Hongming Ding, St. Louis University (891-33-354)</td>
</tr>
<tr>
<td>9:30 a.m.</td>
<td>Intertwining for differential-difference operators.</td>
<td>Charles F. Dunkl, University of Virginia (891-33-69) (Sponsored by Robert A. Gustafson)</td>
</tr>
<tr>
<td>10:00 a.m.</td>
<td>Multidimensional special functions and representations of groups.</td>
<td>Alexander V. Rozenblyum, New York University, Courant Institute of Mathematical Sciences (891-33-190)</td>
</tr>
<tr>
<td>10:30 a.m.</td>
<td>Contiguous relations and continued fractions. Preliminary report.</td>
<td>David R. Masson, University of Toronto (891-33-145)</td>
</tr>
</tbody>
</table>

**Special Session on Representations of Algebraic Groups and Quantum Groups, I**

**9:00 a.m.–10:50 a.m.**

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<tr>
<th>Time</th>
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<tbody>
<tr>
<td>9:00 a.m.</td>
<td>Holomorphic orbifolds and the quantum double. Preliminary report.</td>
<td>Geoffrey Mason, Rutgers University, New Brunswick (891-20-25)</td>
</tr>
<tr>
<td>9:30 a.m.</td>
<td>Elliptic functions and orbifold theory.</td>
<td>Chongying Dong, University of California, Santa Cruz (891-17-141)</td>
</tr>
<tr>
<td>10:00 a.m.</td>
<td>An approach to tensor product theory for representations for a vertex operator algebra.</td>
<td>Haisheng Li, Rutgers University, New Brunswick (891-17-125)</td>
</tr>
<tr>
<td>10:30 a.m.</td>
<td>Z-algebra representations of quantum affine algebras.</td>
<td>Naihuan Jing, University of Kansas (891-17-195)</td>
</tr>
</tbody>
</table>

**Special Session on Operator Theory, I**

**9:00 a.m.–10:50 a.m.**

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Authors</th>
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<tbody>
<tr>
<td>9:00 a.m.</td>
<td>On unconditional bases of invariant subspaces of contractions with finite defects.</td>
<td>Sergei Treil, Michigan State University (891-47-25)</td>
</tr>
<tr>
<td>9:30 a.m.</td>
<td>A time-variant analogue of point evaluation of analytic functions.</td>
<td>Joseph A. Ball, Virginia Polytech Institute &amp; State University (891-47-20)</td>
</tr>
<tr>
<td>10:00 a.m.</td>
<td>A Kronecker theorem for higher order Hankel forms.</td>
<td>Richard Rochberg, Washington University (891-46-15)</td>
</tr>
<tr>
<td>10:30 a.m.</td>
<td>Integral representations of completely positive Hankel Toeplitz kernels acting in C* algebras.</td>
<td>Mischa Cotlar, Universidad Central de Venezuela, Caracas, Venezuela, and Cora Sadosky*, Howard University (891-47-32)</td>
</tr>
</tbody>
</table>

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### Program of the Sessions

**Friday, March 25 (cont'd)**

#### Special Session on Convergence Problems in Ergodic Theory, I

9:00 a.m.–10:50 a.m.

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<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Speaker(s)</th>
<th>Institution(s)</th>
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<tbody>
<tr>
<td>9:00 a.m.</td>
<td>Ergodic measures for the Pascal adic and ratio limit theorems for transient Markov chains. Preliminary report.</td>
<td>Karl Petersen, University of North Carolina, Chapel Hill</td>
<td>(891-28-81)</td>
</tr>
<tr>
<td>9:30 a.m.</td>
<td>Oriented local entropies for commuting automorphisms.</td>
<td>Vijay Chothi, Graham Everest and Thomas Ward*, University of East Anglia, Norwich, United Kingdom</td>
<td>(891-22-18)</td>
</tr>
<tr>
<td>9:30 a.m.</td>
<td>Calculation of the limit in the return times theorem for Dunford-Schwartz operators.</td>
<td>Peter O. Schwartz, Ohio State University, Columbus</td>
<td>(891-28-121)</td>
</tr>
<tr>
<td>10:00 a.m.</td>
<td>Parametric probability distribution function closures.</td>
<td>B. J. Bayly, University of Arizona (891-76-109)</td>
<td>(Sponsored by Misha Vishik)</td>
</tr>
<tr>
<td>10:00 a.m.</td>
<td>Symmetry and chaos: Patterns on average.</td>
<td>Martin Golubitsky, University of Houston, Downtown</td>
<td>(891-34-44)</td>
</tr>
</tbody>
</table>

#### Special Session on Global Fields, I

9:00 a.m.–10:50 a.m.

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<tr>
<th>Time</th>
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<tbody>
<tr>
<td>9:00 a.m.</td>
<td>The Mordell-Weil theorem for Drinfeld modules.</td>
<td>Bjorn Poonen, University of California, Berkeley</td>
<td>(891-11-38)</td>
</tr>
<tr>
<td>9:30 a.m.</td>
<td>A regulator for an Euler product associated to a rank one elliptic A-module.</td>
<td>Greg W. Anderson, University of Minnesota, Minneapolis</td>
<td>(891-11-93)</td>
</tr>
<tr>
<td>10:00 a.m.</td>
<td>Divisors of solitons and algebraic Hecke characters.</td>
<td>S. K. Sinha, University of Minnesota, Minneapolis</td>
<td>(891-35-14)</td>
</tr>
<tr>
<td>10:30 a.m.</td>
<td>Arithmetic of higher-dimensional function fields: The Goss zeta function.</td>
<td>Mikhail M. Kapranov, Northwestern University</td>
<td>(891-11-33)</td>
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</table>

#### Special Session on Several Complex Variables and Partial Differential Equations, I

9:00 a.m.–10:50 a.m.

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<tr>
<th>Time</th>
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<tbody>
<tr>
<td>9:00 a.m.</td>
<td>A counterexample to the differentiability of the Bergman kernel function.</td>
<td>So-Chin Chen, State University of New York, Albany</td>
<td>(891-32-68)</td>
</tr>
<tr>
<td>9:30 a.m.</td>
<td>A necessary condition for analytic hypoellipticity.</td>
<td>Michael Christ, University of California, Los Angeles</td>
<td>(891-35-133)</td>
</tr>
<tr>
<td>10:00 a.m.</td>
<td>Integrability of germs of Mizohata structures.</td>
<td>Abdelhamid Meziani, Florida International University</td>
<td>(891-32-116)</td>
</tr>
<tr>
<td>10:30 a.m.</td>
<td>Higher order caratheodory distances and $H^\infty$-modules.</td>
<td>Norberto Salinas, University of Kansas (891-32-99)</td>
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#### Special Session on Quantum Topology, I

9:20 a.m.–10:50 a.m.

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<tr>
<th>Time</th>
<th>Title</th>
<th>Speaker(s)</th>
<th>Institution(s)</th>
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<tbody>
<tr>
<td>9:20 a.m.</td>
<td>Finite-dimensional ribbon Hopf algebras and 3-manifold invariants. Preliminary report.</td>
<td>Louis H. Kauffman, University of Illinois at Chicago</td>
<td>(891-57-178)</td>
</tr>
<tr>
<td>10:10 a.m.</td>
<td>Invariants of plane algebraic curves and representations of the braid groups.</td>
<td>A. Libgober, University of Illinois at Chicago</td>
<td>(891-57-209)</td>
</tr>
</tbody>
</table>
### Program of the Sessions

**Special Session on Nonlinear Topics and Critical Phenomena in Partial Differential Equations, I**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session Details</th>
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</table>
| 9:30 a.m.–10:50 a.m. | **A reaction-diffusion problem with nonlinear absorption versus release through the boundary.** Qi-Xiao Ye, Beijing Institute of Technology, People's Republic of China (891-35-222)  
Positive steady-state solutions of a competing reaction-diffusion system with cross diffusion. W. H. Ruan, Purdue University, Calumet Campus (891-35-13)  
Discrete spectrum of the perturbed Dirac operator. M. Sh Birman, Saint Petersburg State University, Russia, and Arij Laptev*, Linkoping University, Sweden (891-35-206) |

**Special Session on Harmonic Analysis and Probability, I**

<table>
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<tr>
<th>Time</th>
<th>Session Details</th>
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| 10:00 a.m.–10:50 a.m. | Recurrence for Lacunary series. Charles Moore, Kansas State University (891-42-210)  

**Invited Address**

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<tr>
<th>Time</th>
<th>Session Details</th>
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<tbody>
<tr>
<td>11:00 a.m.–11:50 a.m.</td>
<td>Zeta functions of characteristic $p$ arithmetic. David M. Goss, Ohio State University, Columbus (891-11-92)</td>
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</table>

**Invited Address**

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<tr>
<th>Time</th>
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<tbody>
<tr>
<td>1:30 p.m.–2:20 p.m.</td>
<td>Solvability and estimates for the tangential Cauchy-Riemann operators. Mei-Chi Shaw, University of Notre Dame (891-32-135)</td>
</tr>
</tbody>
</table>

**Special Session on Nonlinear Topics and Critical Phenomena in Partial Differential Equations, II**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session Details</th>
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</table>
| 2:30 p.m.–5:20 p.m. | Nonlinearity, localization and chaos in solutions of partial differential equations. James Glimm, State University of New York, Stony Brook (891-35-08)  
Existence of global weak solutions to one-component Vlasov-Poisson and Fokker-Planck-Poisson systems in one space dimension with measures as initial data. Yuxi Zheng*, Indiana University, Bloomington, and Andrew Majda, Princeton University (891-35-130)  
Compensated compactness and the van Karman model for plates. Daniel Tataru, Northwestern University (891-35-162)  
Regularized Euler and Navier-Stokes equations for rotating fluids. A. Babin, Moscow Institute of Railway Transport Engineers, Russia, A. Mahalov* and B. Nicolaenko, Arizona State University (891-35-155)  
Jacobians associated with systems of vector fields satisfying Hormander's condition. Loukas Grafakos, Washington University (891-35-137)  
Global existence of some nonlinear wave equations in the finite Einstein energy space. Zhongfang Zhou, Michigan State University (891-35-221) |

**Special Session on Harmonic Analysis and Probability, II**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session Details</th>
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</table>
| 3:00 p.m.–5:50 p.m. | Bilinear Hilbert transform. Michael Lacey, Indiana University, Bloomington (891-42-200)  
Pointwise Fourier inversions and related Jacobi polynomial expansions. Mark Pinsky, Northwestern University (891-42-106)  
Uniqueness and approximate identities in $n$-dimensional trigonometric series. D. J. Grubb, Northern Illinois University (891-42-194) (Sponsored by Charles N. Moore)  
Packing measure analysis of harmonic measure. Elizabeth Ann Housworth, Purdue University, West Lafayette (891-30-89)  
Radial divergence in BMOA. David C. Ulrich, Oklahoma State University, Stillwater (891-32-78)  

**Special Session on Groups and Geometries, II**

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<thead>
<tr>
<th>Time</th>
<th>Session Details</th>
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</table>
| 3:00 p.m.–5:50 p.m. | Monodromy groups of coverings of the projective line. Preliminary report. Robert M. Guralnick, University of Southern California (891-20-165)  
On the maximality of irreducible cross characteristically embedded classical groups. Preliminary report. Kay Magaard, Wayne State University (891-20-88)  
On the maximality of symmetric and alternating groups in the classical groups. Preliminary report. William J. Husen, Wayne State University (891-20-53) |
Program of the Sessions

Friday, March 25  (cont’d)

<table>
<thead>
<tr>
<th>Time</th>
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<tbody>
<tr>
<td>4:30 p.m.</td>
<td>Basic conjugacy results for $G_2(\mathbb{C})$.</td>
</tr>
<tr>
<td>(61)</td>
<td>Robert L. Griess, Jr., University of Michigan, Ann Arbor (891-20-129)</td>
</tr>
<tr>
<td>5:00 p.m.</td>
<td>Fixed point ratios on buildings. Preliminary report.</td>
</tr>
<tr>
<td>(62)</td>
<td>Daniel Frohardt* and Kay Magaard, Wayne State University (891-51-52)</td>
</tr>
<tr>
<td>5:30 p.m.</td>
<td>Quillen’s complex and normal subgroups. Preliminary report.</td>
</tr>
<tr>
<td>(63)</td>
<td>Peter Webb, University of Minnesota, Minneapolis (891-20-199) (Sponsored by Alberto L. Delgado)</td>
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Special Session on Quantum Topology, II

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<tr>
<th>Time</th>
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<tbody>
<tr>
<td>3:00 p.m.</td>
<td>Discussion</td>
</tr>
<tr>
<td>3:30 p.m.</td>
<td>Isotopy classes of braid movies form a braided monoidal 2-category.</td>
</tr>
<tr>
<td>(64)</td>
<td>J. Scott Carter*, University of South Alabama, and Masahico Saito*</td>
</tr>
<tr>
<td></td>
<td>pillow, University of Texas, Austin (891-57-152)</td>
</tr>
<tr>
<td>4:40 p.m.</td>
<td>Some new aspects of 4-dimensional braid theory.</td>
</tr>
<tr>
<td>(65)</td>
<td>J. Scott Carter, University of South Alabama, and Masahico Saito*</td>
</tr>
<tr>
<td></td>
<td>pillow, University of Texas, Austin (891-57-151)</td>
</tr>
<tr>
<td>5:30 p.m.</td>
<td>Integral formulae for Drinfeld’s associator.</td>
</tr>
<tr>
<td>(66)</td>
<td>Xiao-Song Lin, Institute for Advanced Study (891-57-203)</td>
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</tbody>
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Special Session on Special Functions, II

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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</thead>
<tbody>
<tr>
<td>3:00 p.m.</td>
<td>Pearson equation and the beta integral on the $q$-linear lattice.</td>
</tr>
<tr>
<td>(67)</td>
<td>Mizanur Rahman*, Carleton University, and Sergei K. Suslov, Kurchatov</td>
</tr>
<tr>
<td></td>
<td>Institute of Atomic Energy, Moscow (891-33-29)</td>
</tr>
<tr>
<td>3:30 p.m.</td>
<td>$q$-extensions of Abel-Roth type identities.</td>
</tr>
<tr>
<td>(68)</td>
<td>Warren Johnson, Pennsylvania State University, University Park (891-05-118)</td>
</tr>
<tr>
<td>4:00 p.m.</td>
<td>The weighted logarithmic mean of several variables.</td>
</tr>
<tr>
<td>(69)</td>
<td>Preliminary report.</td>
</tr>
<tr>
<td></td>
<td>Edward Neuman, Southern Illinois University, Carbondale (891-33-45) (Sponsored by Mary H. Wright)</td>
</tr>
<tr>
<td>4:30 p.m.</td>
<td>The spectral properties of Askey-Wilson operator in weighted spaces.</td>
</tr>
<tr>
<td>(70)</td>
<td>Ruiming Zhang, University of Toronto, Canada (891-33-187)</td>
</tr>
</tbody>
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Special Session on Representations of Algebraic Groups and Quantum Groups, II

<table>
<thead>
<tr>
<th>Time</th>
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<tbody>
<tr>
<td>3:00 p.m.</td>
<td>Characters of generic irreducible representations of Lie superalgebras.</td>
</tr>
<tr>
<td>(71)</td>
<td>Preliminary report.</td>
</tr>
<tr>
<td></td>
<td>Ivan Penkov, University of California, Riverside (891-17-176)</td>
</tr>
<tr>
<td>3:30 p.m.</td>
<td>Discussion</td>
</tr>
<tr>
<td>4:00 p.m.</td>
<td>On the vanishing of extensions of modules over reduced enveloping algebras.</td>
</tr>
<tr>
<td>(72)</td>
<td>Jon F. Carlson, University of Georgia, Daniel K. Nakano, Northwestern University, and Karl M. Peters*; Loyola University of Chicago (891-17-55)</td>
</tr>
<tr>
<td>4:30 p.m.</td>
<td>The adjoint representation of quantized enveloping algebras. Preliminary report.</td>
</tr>
<tr>
<td>(73)</td>
<td>Chen Liu, University of Oregon (891-20-184)</td>
</tr>
<tr>
<td>5:00 p.m.</td>
<td>Modular representation theory for Lie algebras of Cartan type. Preliminary report.</td>
</tr>
<tr>
<td>(74)</td>
<td>Daniel Kan Nakano*, Northwestern University (891-20-31)</td>
</tr>
<tr>
<td>5:30 p.m.</td>
<td>Standard basis theorems for the classical groups and applications.</td>
</tr>
<tr>
<td>(75)</td>
<td>Mihalis Maitakis, University of Arkansas (891-20-185)</td>
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Special Session on Operator Theory, II

<table>
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<tr>
<th>Time</th>
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<tbody>
<tr>
<td>3:00 p.m.</td>
<td>Restriction of the Bergman shift to invariant subspaces.</td>
</tr>
<tr>
<td>(76)</td>
<td>Kehe Zhu, State University of New York, Albany (891-47-09)</td>
</tr>
<tr>
<td>3:30 p.m.</td>
<td>Schatten class Hankel operators on Bergman spaces.</td>
</tr>
<tr>
<td>(77)</td>
<td>Daniel H. Luecking, University of Arkansas, Fayetteville (891-47-26)</td>
</tr>
<tr>
<td>4:00 p.m.</td>
<td>Fredholmness of singular integral operators and related properties of Hunt-Muckenhoupt-Wheeden weights.</td>
</tr>
<tr>
<td>(78)</td>
<td>I. Gohberg, Tel Aviv University, Israel, N. Krupnik, Bar-Ilan University, Israel, and I. Spivkovsky*; College of William and Mary (891-47-41)</td>
</tr>
<tr>
<td>4:30 p.m.</td>
<td>Toeplitz operators on semi-simple Lie groups.</td>
</tr>
<tr>
<td>(79)</td>
<td>Preliminary report.</td>
</tr>
<tr>
<td></td>
<td>Harald Upmeier* and Yi Chu, University of Kansas (891-47-21)</td>
</tr>
<tr>
<td>5:00 p.m.</td>
<td>On the optimal $L^2$ solution of the Caratheodory-Schur interpolation problem.</td>
</tr>
<tr>
<td>(80)</td>
<td>Ciprian Foias*, Indiana University, Bloomington, A. E. Frazho, Purdue University, West Lafayette, and W. S. Li, Georgia Institute of Technology (891-15-10)</td>
</tr>
<tr>
<td>5:30 p.m.</td>
<td>Hilbert spaces of vector-valued holomorphic functions on symmetric tube domains.</td>
</tr>
<tr>
<td>(81)</td>
<td>Bent Orsted and Genkai Zhang*, Odense University, Denmark (891-32-23)</td>
</tr>
<tr>
<td>6:00 p.m.</td>
<td>Some norm operator inequalities of Hölder type.</td>
</tr>
<tr>
<td>(82)</td>
<td>Mary Beth Ruskai, University of Massachusetts, Lowell (891-47-156)</td>
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</tbody>
</table>
### Special Session on Convergence Problems in Ergodic Theory, II

**3:00 p.m.–5:20 p.m.**

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<tr>
<th>Time</th>
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<th>Speakers</th>
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<tbody>
<tr>
<td>3:00 p.m.</td>
<td>Convolution powers of spread-out probabilities.</td>
<td>Michael Lin*, Ben-Gurion University of the Negev, Israel, and Rainer Wittmann, University of Göttingen, Germany (891-22-225) (Sponsored by Joseph M. Rosenblatt)</td>
</tr>
<tr>
<td>3:30 p.m.</td>
<td>Singular spectral type of rank one transformations.</td>
<td>Ivo Klemes, McGill University, Canada, and Karin Reinhold*, State University of New York, Albany (891-28-171) (Sponsored by Joseph M. Rosenblatt)</td>
</tr>
<tr>
<td>4:00 p.m.</td>
<td>The convergence problems arising from harmonic analysis and ergodic theory.</td>
<td>Guodong Li* and Joseph Rosenblatt, Ohio State University, Columbus (891-40-138)</td>
</tr>
<tr>
<td>4:30 p.m.</td>
<td>Strongly approximately transitive actions of a semisimple Lie group and boundaries of random walks.</td>
<td>Wojciech Jaworski, Dalhousie University (891-28-172)</td>
</tr>
<tr>
<td>5:00 p.m.</td>
<td>Interval translation mappings.</td>
<td>Michael D. Boshernitzan, Rice University, and Isaac Kornfeld*, North Dakota State University (891-58-173)</td>
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</table>

### Special Session on Dynamical Systems and Fluid Dynamics, II

**3:00 p.m.–5:50 p.m.**

<table>
<thead>
<tr>
<th>Time</th>
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<th>Speakers</th>
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<tbody>
<tr>
<td>3:00 p.m.</td>
<td>Decompositions of vector fields and the equations for incompressible flow.</td>
<td>Giles Auchmuty, University of Houston, University Park (891-76-47)</td>
</tr>
<tr>
<td>3:30 p.m.</td>
<td>Stability and instability criteria for ideal fluids and MHD.</td>
<td>Susan Friedlander*, University of Illinois, Urbana-Champaign, and Mishra Vishik, University of Texas, Austin (891-76-39)</td>
</tr>
<tr>
<td>4:00 p.m.</td>
<td>Some analytical results for the Hele-Shaw problem.</td>
<td>M. Pugh, Courant Institute of Mathematical Sciences, New York University (891-35-84)</td>
</tr>
<tr>
<td>4:30 p.m.</td>
<td>Short wavelength instabilities of rotating fluid masses.</td>
<td>Norman Lebovitz, University of Chicago (891-76-28) (Sponsored by Mishra Vishik)</td>
</tr>
<tr>
<td>5:00 p.m.</td>
<td>Multipolar fluids of grade 3.</td>
<td>Jindrich Necas, Northern Illinois University (891-76-71) (Sponsored by Mishra Vishik)</td>
</tr>
<tr>
<td>5:30 p.m.</td>
<td>Large time behavior of solutions to the magneto-hydrodynamics equations.</td>
<td>M. E. Schonbek*, T. Schonbek, University of California, Santa Cruz, and E. Sull, University of Oxford, England (891-76-139)</td>
</tr>
</tbody>
</table>

### Special Session on Global Fields, II

**3:00 p.m.–5:20 p.m.**

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Speakers</th>
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</thead>
<tbody>
<tr>
<td>3:00 p.m.</td>
<td>Order of vanishing of the characteristic p zeta functions.</td>
<td>Dinesh S. Thakur, University of Arizona (891-11-148)</td>
</tr>
<tr>
<td>3:30 p.m.</td>
<td>On Drinfeld modules of Carlitz type. Preliminary report.</td>
<td>Ji-Nong Co, National Tsing Hua University, Taiwan (891-11-76) (Sponsored by Jing Yu)</td>
</tr>
<tr>
<td>4:00 p.m.</td>
<td>Average Lang-Trotter conjecture for Drinfeld modules.</td>
<td>Chantal David, Concordia University (891-11-61) (Sponsored by David Goss)</td>
</tr>
<tr>
<td>4:30 p.m.</td>
<td>Average values of L-series in cyclic extensions of F(7).</td>
<td>Michael Rosen, Brown University (891-11-177)</td>
</tr>
<tr>
<td>5:00 p.m.</td>
<td>A relative class number formula for global function fields.</td>
<td>Lihgshueh Shu, Ohio State University, Columbus (891-11-150)</td>
</tr>
</tbody>
</table>

### Special Session on Several Complex Variables and Partial Differential Equations, II

**3:00 p.m.–5:50 p.m.**

<table>
<thead>
<tr>
<th>Time</th>
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<tbody>
<tr>
<td>3:00 p.m.</td>
<td>On bounded point evaluation in C^n.</td>
<td>R. Michael Range*, State University of New York, Albany, and Michael I. Stessin, University of Pittsburgh (891-32-95)</td>
</tr>
<tr>
<td>3:30 p.m.</td>
<td>L^p and Hölder smoothing of the J-Neumann operator, and subellipticity.</td>
<td>Emil J. Straube, Texas A &amp; M University, College Station (891-32-123)</td>
</tr>
</tbody>
</table>
Program of the Sessions

Friday, March 25 (cont’d)

4:00 p.m. Kobayashi metric of the ellipsoids. (106)
Daowei Ma, Wichita State University (891-32-164)
4:30 p.m. \( L^p \) estimates of Cauchy-Riemann equations. (107)
Zhenhua Chen, Tennessee Technological University (891-35-126)
5:00 p.m. Type functions of \( CR \) manifolds. (109)
Roman Dwilewicz, University of Western Ontario (891-32-224) (Sponsored by Alexander A. Himonas)
5:30 p.m. \( W^{k,p} \)-estimates for \( \bar \partial \) on bounded convex domains in \( \mathbb{C}^2 \). (108)
Deyun Wu, University of Notre Dame (891-32-134)

General Session

3:00 p.m.–3:50 p.m.
3:00 p.m. \( k \)-maximal subgroups of classical groups. Preliminary report. (110)
Ralph Bremigan, Ball State University (891-20-77)
3:20 p.m. A removable singularities theorem for families of ruled surfaces. Preliminary report. (111)
Adam Harris, State University of New York, Stony Brook (891-32-58)
3:40 p.m. Parametrically excited surface waves. Preliminary report. (112)
Lawrence Turyn, Wright State University (891-35-27)

Saturday, March 26

Special Session on Harmonic Analysis and Probability, III

8:00 a.m.–10:50 a.m.
8:00 a.m. Pointwise convergence for the conjugate function on locally compact Abelian groups. Preliminary report. (113)
Nakhle H. Asmar* and Stephen J. Montgomery-Smith, University of Missouri, Columbia (891-43-73)
8:30 a.m. The Dirichlet problem for elliptic operators and preservation of weight classes. (114)
Nancy Lim, University of Chicago (891-42-95)
9:00 a.m. Towards an elementary, direct proof of the equivalence of \( A_\infty \) and Helson-Szego. Preliminary report. (115)
Caroline Sweezey, New Mexico State University, Las Cruces (891-42-113)
9:30 a.m. \( L^p - L^q \) weighted Bergman space inequalities. (116)
Richard Wheeden, Rutgers University, and J. M. Wilson*, University of Vermont (891-42-214) (Sponsored by Charles N. Moore)
10:00 a.m. On the size of lacunary series on small subsets of the circle. (117)
Roderigo Baruelos*, Purdue University, West Lafayette, and Tom Carroll, University College, Republic of Ireland (891-42-112)
10:30 a.m. Metropolis Markov chains on the symmetric group. (118)
Kenneth A. Ross* and Daming Xu, University of Oregon (891-43-43)

Special Session on Groups and Geometries, III

8:00 a.m.–10:50 a.m.
8:00 a.m. Some results on embeddings of geometries. (119)
Matt Barlow, University of Illinois at Chicago (891-20-196) (Sponsored by Alberto L. Delgado)
8:30 a.m. Regular collineation groups of finite projective planes. (120)
Preliminary report.
Chat Yin Ho, University of Florida (891-20-75) (Sponsored by Alberto L. Delgado)
9:00 a.m. Finite geometry and difference sets. (121)
Joel Ham, Colorado State University (891-51-197)
9:30 a.m. Diagonal forms for projective geometry incidence matrices and integral Hecke algebras. Preliminary report. (122)
Robert A. Liebler, Colorado State University (891-51-72)
10:00 a.m. Combinatorial constructions of some point-line geometries. (123)
Bruce Cooperstein, University of California, Santa Cruz (891-20-149)
10:30 a.m. Graphs which are locally Grassmann. Preliminary report. (124)
Vladimir I. Trofimov, Russian Academy of Sciences, Russia, and Richard M. Weiss*, Tufts University (891-20-64)

Special Session on Operator Theory, III

8:00 a.m.–10:50 a.m.
8:00 a.m. Separating vectors for dual algebras. (125)
David R. Larson*, Texas A & M University, College Station, and Warren R. Wogen, University of North Carolina, Chapel Hill (891-47-34)
8:30 a.m. Reflexivity of certain pairs of commuting isometries. (126)
Hari Bercovici, Indiana University, Bloomington (891-47-117)
9:00 a.m. Weighted shift asymptotically holomorphic functions. (127)
A. L. Volberg, Michigan State University (891-47-201) (Sponsored by Gabriel Nagy)
9:30 a.m. Carleson measures and subnormal operators on multiply connected domains. (128)
Robert F. Olin* and James Qiu, Virginia Polytechnic Institute & State University (891-47-22)
10:00 a.m. Factorization in Bergman spaces. (129)
Alexandru Aleman, Fern University, Germany, Stefan Richter, University of Tennessee, and Carl Sundberg*, University of Tennessee, Knoxville (891-47-218) (Sponsored by V. V. Peller)
10:30 a.m. Operator spaces and dilations. (130)
Vern I. Paulsen, University of Houston-University Park (891-47-206)
### Program of the Sessions

#### Special Session on Dynamical Systems and Fluid Dynamics, III

**8:00 a.m.–10:50 a.m.**

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<th>Time</th>
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<tbody>
<tr>
<td>8:00 a.m.</td>
<td>Spectral radius of matrix Ruelle operator and weighted composition operator. &lt;br&gt;Yuri Latushkin, University of Missouri, Columbia (891-47-36)</td>
</tr>
<tr>
<td>8:30 a.m.</td>
<td>Homoclinic points of $Z^d$ actions as mathematical images of defects in lattice dynamical systems. &lt;br&gt;Valya Afrimovich, Georgia Institute of Technology (891-39-82) (Sponsored by Misha Vishik)</td>
</tr>
<tr>
<td>9:00 a.m.</td>
<td>A geometric approach to regular perturbation theory. Preliminary report. &lt;br&gt;Carmen Chicone, University of Missouri, Columbia (891-58-36)</td>
</tr>
<tr>
<td>9:30 a.m.</td>
<td>Mathematical aspects of correlation dimension. &lt;br&gt;Ya Pesin* and A. Tempelman, Pennsylvania State University (891-76-183) (Sponsored by Misha Vishik)</td>
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</table>

#### Special Session on Several Complex Variables and Partial Differential Equations, III

**8:00 a.m.–10:50 a.m.**

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<tr>
<td>8:00 a.m.</td>
<td>A partial differential equation characterization of complex projective space up to biholomorphic isometry. &lt;br&gt;Karen Pinney Mortensen* and Robert Molzon, University of Kentucky (891-53-119)</td>
</tr>
<tr>
<td>8:30 a.m.</td>
<td>Holomorphic and unimodular geometry of surfaces. Preliminary report. &lt;br&gt;Sid Webster, University of Chicago (891-32-122)</td>
</tr>
<tr>
<td>9:00 a.m.</td>
<td>Algebraic approximation of analytic mappings. &lt;br&gt;Jean Pierre Demailly, University of Grenoble I, France, Laszlo Lempert*, Purdue University, West Lafayette, and Bernard Shiffman, Johns Hopkins University (891-32-157)</td>
</tr>
<tr>
<td>9:30 a.m.</td>
<td>Degenerate holomorphic mappings of real-analytic CR-manifolds. &lt;br&gt;Alexander V. Isaev, Australian National University, Australia (891-32-100) (Sponsored by Neil S. Trudinger)</td>
</tr>
<tr>
<td>10:00 a.m.</td>
<td>Quasiconformal homeomorphisms on CR 3-manifolds with symmetries. &lt;br&gt;Puqi Tang, Purdue University, West Lafayette (891-32-59)</td>
</tr>
<tr>
<td>10:30 a.m.</td>
<td>Analytic hypoellipticity for generalized Baouendi-Goulaouic operators. &lt;br&gt;Nicholas Hanges, Herbert H. Lehman College, City University of New York, and A. Alexandrou Himonas*, University of Notre Dame (891-32-202)</td>
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#### Special Session on Quantum Topology, III

**8:30 a.m.–10:50 a.m.**

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<tr>
<td>8:30 a.m.</td>
<td>The combinatorics of Yang-Baxter type equations. &lt;br&gt;Ruth J. Lawrence, University of Michigan, Ann Arbor (891-57-163) (Sponsored by David N. Yetter)</td>
</tr>
<tr>
<td>9:20 a.m.</td>
<td>On Kauffman's knot invariants arising from finite-dimensional Hopf algebras. Preliminary report. &lt;br&gt;David Radford, University of Illinois, Chicago (891-57-140)</td>
</tr>
<tr>
<td>10:10 a.m.</td>
<td>Topological constructions of quasitriangular Hopf algebras. &lt;br&gt;Kenneth J. Ferguson, University of Southern California (891-57-179)</td>
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</table>

#### Special Session on Representations of Algebraic Groups and Quantum Groups, III

**8:30 a.m.–10:50 a.m.**

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<tr>
<td>8:30 a.m.</td>
<td>Extensions of simple modules for semisimple algebraic groups in characteristic 2. Preliminary report. &lt;br&gt;Michael F. Dowd and Peter Sin*, University of Florida (891-20-90)</td>
</tr>
<tr>
<td>9:00 a.m.</td>
<td>Modules of dimension divisible by $p$. Preliminary report. &lt;br&gt;J. E. Humphreys, University of Massachusetts, Amherst (891-20-143)</td>
</tr>
<tr>
<td>9:30 a.m.</td>
<td>The first Cartan invariant of a finite group of Lie type for large $p$. &lt;br&gt;Cornelius Pillen, University of South Alabama (891-20-104) (Sponsored by Zongzhu Lin)</td>
</tr>
<tr>
<td>10:00 a.m.</td>
<td>Resolutions of representations. &lt;br&gt;S. R. Doty, Loyola University of Chicago (891-20-181)</td>
</tr>
<tr>
<td>10:30 a.m.</td>
<td>Discussion</td>
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#### Special Session on Convergence Problems in Ergodic Theory, III

**8:30 a.m.–10:50 a.m.**

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<tr>
<td>8:30 a.m.</td>
<td>The rate of entropy convergence. Preliminary report. &lt;br&gt;Frank Blume, University of North Carolina, Chapel Hill (891-28-97) (Sponsored by Karl E. Petersen)</td>
</tr>
<tr>
<td>9:00 a.m.</td>
<td>On maximal functions. Preliminary report. &lt;br&gt;Alexandra Bellow, Northwestern University (891-28-191)</td>
</tr>
<tr>
<td>9:30 a.m.</td>
<td>An example of compact extensions of Kronecker factors and skew products of irrational rotations with finite groups. &lt;br&gt;Qing Zhang, Clark College (891-28-205)</td>
</tr>
<tr>
<td>10:00 a.m.</td>
<td>The Banach principle in Riesz spaces. &lt;br&gt;Radu Zaharopol, State University of New York, Binghamton (891-47-168)</td>
</tr>
<tr>
<td>10:30 a.m.</td>
<td>Residual behavior of induced maps. &lt;br&gt;Andre del Junco, University of Toronto, and Daniel J. Rudolph*, University of Maryland, College Park (891-28-56)</td>
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## Saturday, March 26  (cont’d)

### Special Session on Global Fields, III

<table>
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<tr>
<td>8:30 a.m.</td>
<td>Diophantine approximation on Abelian varieties in characteristic p.</td>
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<td>José Felipe Voloch, University of Texas at Austin</td>
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<tr>
<td>9:00 a.m.</td>
<td>On a generalization of quasi-algebraic closure.</td>
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<td>Steven Sperber, University of Minnesota, Minneapolis</td>
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<tr>
<td>9:30 a.m.</td>
<td>Algebraic independence and $l$-modules.</td>
</tr>
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<td>Robert Tubbs, University of Colorado</td>
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<tr>
<td></td>
<td>(Sponsored by David M. Goss)</td>
</tr>
<tr>
<td>10:00 a.m.</td>
<td>A function field analogue of Serre’s conjecture.</td>
</tr>
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<td></td>
<td>Nigel Boston and David T. Ooe*, University of Illinois, Urbana-Champaign</td>
</tr>
<tr>
<td>10:30 a.m.</td>
<td>Group $\gamma$-modules for function fields.</td>
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<td>Yuichiro Taguchi, Institute for Advanced Study</td>
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### Special Session on Special Functions, III

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<tr>
<td>9:00 a.m.</td>
<td>A right inverse of the Askay-Wilson operator.</td>
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<tr>
<td></td>
<td>B. Malcolm Brown, University of Wales, United Kingdom, and Mourad E. H. Ismail*</td>
</tr>
<tr>
<td>9:30 a.m.</td>
<td>Basic hypergeometric functions as eigenfunctions and group invariants.</td>
</tr>
<tr>
<td></td>
<td>Douglas C. Bowman, Pennsylvania State University, University Park</td>
</tr>
<tr>
<td>10:00 a.m.</td>
<td>$A$, and $C_\gamma$ basic hypergeometric series and combinatorics.</td>
</tr>
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<td></td>
<td>Christian Krattenthaler, University of Vienna, Austria</td>
</tr>
<tr>
<td>10:30 a.m.</td>
<td>Some generalizations of the Farkas-Kra theta function identities.</td>
</tr>
<tr>
<td></td>
<td>Frank Garvan, University of Florida</td>
</tr>
</tbody>
</table>

### Special Session on Nonlinear Topics and Critical Phenomena in Partial Differential Equations, III

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
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</thead>
<tbody>
<tr>
<td>9:30 a.m.</td>
<td>Optimal $L^\infty$ decay for solutions to the wave equation with a potential.</td>
</tr>
<tr>
<td></td>
<td>R. Michael Beals, Rutgers University, New Brunswick</td>
</tr>
<tr>
<td>10:00 a.m.</td>
<td>Pointwise convergence of spherical means.</td>
</tr>
<tr>
<td></td>
<td>Andreas Seeger*, University of Wisconsin, Madison, Stephen Wainger and James Wright, University of Sussex, England</td>
</tr>
</tbody>
</table>

### Invited Address

<table>
<thead>
<tr>
<th>Time</th>
<th>Speaker</th>
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<tbody>
<tr>
<td>10:30 a.m.</td>
<td>Sharp constants in inequalities related to the Sobolev inequality.</td>
</tr>
<tr>
<td></td>
<td>Eric Carlen* and Michael Loss, Georgia Institute of Technology</td>
</tr>
</tbody>
</table>

### Invited Address

<table>
<thead>
<tr>
<th>Time</th>
<th>Speaker</th>
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<tbody>
<tr>
<td>11:00 a.m.</td>
<td>Krasnosel’skiĭ-type theorems in orthogonal polygons.</td>
</tr>
<tr>
<td></td>
<td>Marilyn Breen, University of Oklahoma</td>
</tr>
</tbody>
</table>

### Invited Address

<table>
<thead>
<tr>
<th>Time</th>
<th>Speaker</th>
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<tbody>
<tr>
<td>1:30 p.m.</td>
<td>On coupling in applications of probability to analysis.</td>
</tr>
<tr>
<td></td>
<td>Michael Cranston, University of Rochester</td>
</tr>
</tbody>
</table>

### Special Session on Nonlinear Topics and Critical Phenomena in Partial Differential Equations, IV

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
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</thead>
<tbody>
<tr>
<td>2:30 p.m.</td>
<td>Fujita exponents for heat equations with nonlinear boundary conditions.</td>
</tr>
<tr>
<td></td>
<td>Howard A. Levine*, Iowa State University, and Victor A. Galaktionov, Russian Academy of Science, USSR</td>
</tr>
<tr>
<td>3:00 p.m.</td>
<td>On microlocal smoothness and moments of solutions to Schrödinger’s equation.</td>
</tr>
<tr>
<td></td>
<td>Walter Craig, Brown University</td>
</tr>
<tr>
<td>3:30 p.m.</td>
<td>On some a priori estimates for the wave equation.</td>
</tr>
<tr>
<td></td>
<td>M. G. Grilakis, University of Michigan, Ann Arbor</td>
</tr>
<tr>
<td>4:00 p.m.</td>
<td>Finite energy solutions of the Yang-Mills equations in $R^4$.</td>
</tr>
<tr>
<td></td>
<td>Matei Machedon* and Sergiu Klainerman, Princeton University</td>
</tr>
<tr>
<td>4:30 p.m.</td>
<td>Wave maps and symmetry: Preliminary report.</td>
</tr>
<tr>
<td></td>
<td>A. Shadi Tahvildar-Zadeh, University of Michigan, Ann Arbor</td>
</tr>
<tr>
<td>5:00 p.m.</td>
<td>Inverse problems for nonlinear parabolic equations.</td>
</tr>
<tr>
<td></td>
<td>Victor Isakov, Wichita State University</td>
</tr>
</tbody>
</table>

### Special Session on Harmonic Analysis and Probability, IV

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
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</thead>
<tbody>
<tr>
<td>3:00 p.m.</td>
<td>Gibbs phenomenon for wavelets.</td>
</tr>
<tr>
<td></td>
<td>Susan Kelly, University of Wisconsin-La Crosse</td>
</tr>
<tr>
<td>3:30 p.m.</td>
<td>Dilation equations, quadratic variation, and absolute continuity.</td>
</tr>
<tr>
<td></td>
<td>Richard F. Gundy, Rutgers University, New Brunswick</td>
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</tbody>
</table>
### Program of the Sessions

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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</thead>
<tbody>
<tr>
<td>4:00 p.m.</td>
<td>Constrained decoupling.</td>
</tr>
<tr>
<td></td>
<td><a href="#">Victor H. de la Peña</a>, Columbia University (891-42-212) (Sponsored by Andrew G. Bennett)</td>
</tr>
<tr>
<td>4:30 p.m.</td>
<td>Differential subordinations for continuous time</td>
</tr>
<tr>
<td></td>
<td><a href="#">Martiangales and related sharp Martingale inequalities</a>.</td>
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<tr>
<td></td>
<td><a href="#">Gang Wang</a>, DePaul University (891-60-98)</td>
</tr>
<tr>
<td>5:00 p.m.</td>
<td>Reflected Brownian motion in a wedge with variable reflection.</td>
</tr>
<tr>
<td></td>
<td><a href="#">R. Dante DeBiasse</a>, Texas A &amp; M University, College Station (891-60-105)</td>
</tr>
<tr>
<td></td>
<td>Special Session on Groups and Geometries, IV</td>
</tr>
<tr>
<td>3:00 p.m.</td>
<td>Locally finite simple groups which are finitary.</td>
</tr>
<tr>
<td></td>
<td><a href="#">Jonathan I. Hall</a>, Michigan State University (891-20-120)</td>
</tr>
<tr>
<td>3:30 p.m.</td>
<td>Progress report on the revision of the classification of the finite simple groups.</td>
</tr>
<tr>
<td></td>
<td><a href="#">Ronald Solomon</a>, Ohio State University, Columbus (891-20-160)</td>
</tr>
<tr>
<td>4:00 p.m.</td>
<td>Quillen complex of the classical groups of Lie type.</td>
</tr>
<tr>
<td></td>
<td><a href="#">Koustuv M. Das</a>, California Institute of Technology (891-20-51)</td>
</tr>
<tr>
<td>4:30 p.m.</td>
<td>Rank two amalgams with a critical pair of distance one.</td>
</tr>
<tr>
<td></td>
<td><a href="#">John T. Zerger</a>, Kansas State University (891-20-159)</td>
</tr>
<tr>
<td>5:00 p.m.</td>
<td>Generalized $A_n - n$-gons and twin trees. Preliminary report.</td>
</tr>
<tr>
<td></td>
<td><a href="#">Curtis Bennett</a>, Bowling Green State University (891-20-86)</td>
</tr>
<tr>
<td>5:30 p.m.</td>
<td>Embeddings and automorphisms of geometries. Preliminary report.</td>
</tr>
<tr>
<td></td>
<td><a href="#">Peter M. Johnson</a>, Technical University Eindhoven, The Netherlands (891-51-66)</td>
</tr>
<tr>
<td></td>
<td>Special Session on Quantum Topology, IV</td>
</tr>
<tr>
<td>3:00 p.m.</td>
<td>Finite degree invariants and satellites.</td>
</tr>
<tr>
<td></td>
<td><a href="#">Stephen Sawin</a>, Massachusetts Institute of Technology (891-57-57)</td>
</tr>
<tr>
<td>3:50 p.m.</td>
<td>Higher algebraic structures in gauge theory.</td>
</tr>
<tr>
<td></td>
<td><a href="#">John C. Baez</a>, University of California, Riverside (891-57-216)</td>
</tr>
<tr>
<td>4:40 p.m.</td>
<td>$H_0(M^n)$ and its skein module quantizations.</td>
</tr>
<tr>
<td></td>
<td><a href="#">Józef H. Przytycki</a>, Odense University, Denmark (891-57-180)</td>
</tr>
<tr>
<td>5:30 p.m.</td>
<td>Extended loops: A new framework for quantizing gravity.</td>
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<td><a href="#">Jorge Pullin</a>, Pennsylvania State University, University Park (891-57-107) (Sponsored by Louis Crane)</td>
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### Special Session on Special Functions, IV

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>3:00 p.m.</td>
<td>Transformations of $U(n + 1)$ multiple basic hypergeometric series.</td>
</tr>
<tr>
<td></td>
<td><a href="#">Stephen C. Milne</a>, Ohio State University, Columbus (891-33-136)</td>
</tr>
<tr>
<td>3:30 p.m.</td>
<td>A simple proof of an Aomoto type extension of Gustafson’s Askey-Wilson $q$-Selberg integral. Preliminary report.</td>
</tr>
<tr>
<td></td>
<td><a href="#">Kevin W. J. Kadell</a>, Arizona State University (891-33-186)</td>
</tr>
<tr>
<td>4:00 p.m.</td>
<td>Rogers-Ramanujan identities for plane partitions.</td>
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<td></td>
<td><a href="#">Robert A. Gustafson</a>, Texas A &amp; M University (891-33-188)</td>
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</tbody>
</table>

### Special Session on Representations of Algebraic Groups and Quantum Groups, IV

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>3:00 p.m.</td>
<td>Kazhdan-Lusztig conjecture in Kac-Moody setting.</td>
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<tr>
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<td><a href="#">Luis Casian</a>, Ohio State University, Columbus (891-22-170)</td>
</tr>
<tr>
<td>3:30 p.m.</td>
<td>Total positivity in reductive groups. Preliminary report.</td>
</tr>
<tr>
<td></td>
<td><a href="#">G. Lusztig</a>, Massachusetts Institute of Technology (891-20-60)</td>
</tr>
<tr>
<td>4:00 p.m.</td>
<td>Kazhdan-Lusztig Theory. Preliminary report.</td>
</tr>
<tr>
<td></td>
<td><a href="#">V. Deodhar</a>, Indiana University, Bloomington (891-20-144)</td>
</tr>
<tr>
<td>4:30 p.m.</td>
<td>The homological dual of a highest weight category.</td>
</tr>
<tr>
<td></td>
<td><a href="#">E. T. Cline</a>, University of Oklahoma, <a href="#">Brian Parshall</a> and <a href="#">Leonard Scott</a>, University of Virginia (891-20-142)</td>
</tr>
<tr>
<td>5:00 p.m.</td>
<td>Koszul algebras and the Frobenius automorphism.</td>
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<td></td>
<td><a href="#">Brian Parshall</a> and <a href="#">Leonard Scott</a>, University of Virginia (891-20-124)</td>
</tr>
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### Special Session on Operator Theory, IV

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>3:00 p.m.</td>
<td>Cohomology and extensions of the Hilbert module $H^2$.</td>
</tr>
<tr>
<td></td>
<td><a href="#">Jon F. Carlson</a> and <a href="#">Douglas N. Clark</a>, University of Georgia (891-47-67)</td>
</tr>
<tr>
<td>3:30 p.m.</td>
<td>A matricial approach to the truncated complex moment problem.</td>
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<td><a href="#">Raúl E. Curto</a>, University of Iowa (891-47-19)</td>
</tr>
<tr>
<td>4:00 p.m.</td>
<td>Orthogonal complement to subalgebras of bounded operators.</td>
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<td><a href="#">Victor Lomonosov</a>, Kent State University (891-47-192)</td>
</tr>
<tr>
<td>4:30 p.m.</td>
<td>Analytic Besov spaces and invariant subspaces of Bergman spaces.</td>
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<td><a href="#">William T. Ross</a>, University of Richmond (891-47-24)</td>
</tr>
<tr>
<td>5:00 p.m.</td>
<td>Geometric models and compactness of composition operators.</td>
</tr>
<tr>
<td></td>
<td><a href="#">Wayne Smith</a>, University of Hawaii, <a href="#">Joel H. Shapiro</a>, Michigan State University, and <a href="#">David A. Stiegentz</a>, University of Hawaii (891-46-115)</td>
</tr>
</tbody>
</table>
Program of the Sessions

Saturday, March 26  (cont’d)

5:30 p.m.  Double crossproducts of discrete quantum groups.
           (203)  Preliminary report.
           Kevin Fitzgerald, University of Illinois,
                 Urbana-Champaign (891-45-226)

Special Session on Convergence
Problems in Ergodic Theory, IV

3:00 p.m.–5:50 p.m.
3:00 p.m.  On the connection between Beta compactifications
           and enveloping semigroups of subshifts. Preliminary report.
           Kenneth Berg, University of Maryland, College Park,
           David Gove and Kamel N. Haddad*, California State University,
                 Bakersfield (891-54-131)
3:30 p.m.  Coding techniques for non-singular maps. Preliminary report.
           Andrés del Junco, University of Toronto, Canada
                 (891-28-174)
4:00 p.m.  Square functions in ergodic theory.
           Roger L. Jones*, DePaul University, I. Ostrovskii,
                 Academy of Science of Ukraine, Ukraine, and
           Joseph Rosenblatt, Ohio State University, Columbus
                 (891-47-96)
4:30 p.m.  Asymptotic behavior of one-dimensional discrete
           velocity models in a slab.
           Christopher Bose*, Peter Grzegorczyk and
           Reinhard Illner, University of Victoria (891-28-207)
                 (Sponsored by Joseph M. Rosenblatt)
5:00 p.m.  Moving ergodic theorems for superadditive processes.
           Sebastian Ferrando, University of Toronto
                 (891-28-111)
5:30 p.m.  Multiple recurrence along polynomials and
           combinatorics.
           Vitaly Bergelson, Ohio State University, Columbus
                 (891-28-127)

Special Session on Dynamical
Systems and Fluid Dynamics, IV

3:00 p.m.–5:50 p.m.
3:00 p.m.  Topological transitions and singularities in nonlinear
           diffusion equations.
           Andrea L. Bertozzi*, Michael Brenner, Todd Dupont
           and Leo Kadanoff, University of Chicago (891-76-83)
3:30 p.m.  On the compressible Euler equations with geometrical
           structure. Preliminary report.
           Gui-qiang Chen, University of Chicago (891-35-85)
4:00 p.m.  Coordinate transformations and exterior calculus for
           weak solutions of nonlinear conservation laws.
           David H. Wagner, University of Houston, University
           Park (891-35-48)
4:30 p.m.  Central extensions of Lie algebras in hydrodynamical
           systems.
           Boris A. Khesin, Yale University (891-76-182)
                 (Sponsored by Misha Vishik)

5:00 p.m.  Hydrodynamic stability and diffeomorphism groups.
           (214)  Gerard Misiolek, State University of New York, Stony
                 Brook (891-58-65)
5:30 p.m.  Chaos in two-dimensional mappings. Preliminary report.
           Jian-Ying Zhou, Peking University, People’s Republic
                 of China (891-34-46)

Special Session on Computational
Mathematics and Numerical Analysis, III

3:00 p.m.–5:50 p.m.
3:00 p.m.  Discussion
3:30 p.m.  Solution of incompressible flows in complex
           geometries using overlapping grids. Preliminary report.
           Marc B. Reider, Los Alamos National Laboratory
                 (891-65-30)
4:00 p.m.  Large Eddy simulations with lattice Boltzmann
           algorithms. Preliminary report.
           James D. Sterling, California Institute of Technology
                 (891-65-102)  (Sponsored by Qisu Zou)
4:30 p.m.  Simulation of cavity flow by the lattice Boltzmann
           method.
           Shuling Hou*, Qisu Zou, Shi yi Chen, Gary D.
           Doolen, Los Alamos National Laboratory, and Allen
           C. Cogley, Kansas State University (891-65-11)
5:00 p.m.  Analytic solutions for stokes flow in the entrance
           region of a semi-infinite circular tube.
           Irwin S. Goldberg, Saint Mary’s University
                 (891-65-167)  (Sponsored by Qisu Zou)
5:30 p.m.  Discussion

Special Session on Global Fields, IV

3:00 p.m.–4:20 p.m.
3:00 p.m.  Modular parameterizations of elliptic curves over
           \( \mathbb{Q}(T) \).
           Ernst-Ulrich Gekeler, University of Saarlandes, Germany
                 (891-11-37)
3:30 p.m.  Computing elliptic curves over function fields using
           modular symbols. Preliminary report.
           Douglas E. Burke, University of Illinois, Chicago
                 (891-11-91)
4:00 p.m.  Discussion
           Andy R. Magid
           Associate Secretary
           Norman, Oklahoma
Polytechnic University, Brooklyn, New York
April 8–10, 1994

Second Announcement

The eight hundred and ninety-second meeting of the American Mathematical Society (AMS) will be held at Polytechnic University, Brooklyn, New York, on Friday, Saturday, and Sunday, April 8–10, 1994.

Invited Addresses
David Bayer, Columbia University, title to be announced.
Peter B. Kronheimer, Merton College, Embedded surfaces in 4-manifolds.
Debasis Mitra, AT&T Bell Labs, title to be announced.
Nicholai Reshetikhin, University of California, Berkeley, Quantum topology.

Special Sessions
Computational geometry, Boris Aronov, Polytechnic University.
Mathematical problems in molecular biology, Craig J. Benham, Mt. Sinai Medical Center.
Invariants of low dimensional manifolds, Joan S. Birman, Columbia University; Sylvain E. Cappell, NYU Courant Institute; and Edward Miller, Polytechnic University.
Geometric analysis, Jozef Dodziuk and Edgar A. Feldman, Graduate School and University Center, CUNY.
Combinatorial group theory and related topics, Benjamin Fine, Fairfield University; Anthony M. Gaglione, United States Naval Academy; and Kathryn Kuiken, Polytechnic University.
Theichmüller theory and dynamical systems, Frederick P. Gardiner and Yunping Jiang, Brooklyn College, CUNY.
Analytic number theory, Dorian Goldfeld, Columbia University.
Geometric convexity, Jacob E. Goodman and Erwin Lutwak, Polytechnic University.
Topological methods; topological measure theory, Pao-sheng Hsu, University of Maine, Orono, and L. Narisi, St. Johns University.
Partial differential equations, Yanyan Li, Rutgers University.
Discrete geometry, Janos Pach, New York University, and William Steiger, Rutgers University.
Gauge theory and applications, Robert J. Sibner, Brooklyn College, CUNY.
Models in telecommunications, Alan A. Weiss, AT&T Bell Labs.

The deadline for submission of abstracts for consideration in any of these sessions has expired. Unfortunately, late papers cannot be accommodated.

Accommodations
Rooms have been blocked in the following hotels. Participants should make their own arrangements with the hotel of their choice. The AMS is not responsible for rate changes or the quality of the accommodations offered by these hotels/motels. The deadline for reservations is March 17, 1994.

Barbizon Hotel: 140 East 63rd St., New York, NY 10021. Telephone: 800-223-1020 or 212-838-5700 (within New York only). Single $90 and double $95 (with queen bed $110).


Council
The Council of the Society will meet on Saturday, April 9, 1994, at the Barbizon Hotel, located at 140 East 63rd Street at Lexington Avenue, New York, New York 10021.

Open Forum
The AMS Committee on the Profession (CoProf) (M. Salah Baouendi, chair) will host an open forum on Saturday afternoon, April 9, on issues related to the employment of mathematicians. The main purpose of the forum is to foster dialog and seek input from the community of mathematical scientists on the role that the AMS can take in improving employment opportunities. Please refer to the February 1994 issue of the Notices for further information.

Other Events of Interest
Raoul Bott, Harvard University, will present the Magnus Lectures on Thursday, April 7, and Friday, April 8, at 4:00 p.m.

Registration
The registration fees are $30 for members of the AMS; $45 for nonmembers; and $10 for emeritus members, students, or unemployed mathematicians. There will also be a special one-day registration fee of $20.

Travel
American Airlines has been selected as the official airline for this meeting. The following benefits are available exclusively to mathematicians and their families attending the meeting: a savings of up to 10% off any published domestic fare (includes U.S., Canada, Bermuda, the Bahamas, Puerto Rico,
Meetings

and the U.S. Virgin Islands), subject to applicable fare restrictions. Seats are limited. Call 1-800-433-1790 between 8:00 a.m. and 11:00 p.m. EST to contact American directly or call any licensed travel agent. Instruct the ticket agent to refer to file NBR-S0144CE in order to qualify for the applicable discount (10 tickets must be sold).
University of Oregon, Eugene, Oregon
June 16–18, 1994
First Announcement

The eight hundred and ninety-third meeting of the American Mathematical Society (AMS) will be held at the University of Oregon, Eugene, Oregon, on Thursday, Friday, and Saturday, June 16–18, 1994. This meeting will be held in conjunction with a meeting of the Mathematical Association of America (MAA).

Invited Addresses
Stephen A. Mitchell, University of Washington, title to be announced.
Gustavo A. Ponce, University of California, Santa Barbara, Nonlinear dispersive equations.
Karen Parshall, University of Virginia, title to be announced.

Special Sessions
Rings and their representations, Frank W. Anderson, University of Oregon, and Kent R. Fuller, University of Iowa.
3-manifolds, Steven A. Bleiler, Portland State University.
Commutative algebra and probability groups, Frank R. Demeyer, Colorado State University, and Thomas M. McKenzie, Bradley University.
Simple C*-algebras, Chris Phillips, University of Oregon.
Undergraduate research, Robby Robson, Oregon State University.

Abstracts for consideration for these sessions should be submitted by the March 14, 1994 deadline.

There will also be sessions for contributed ten-minute papers. The deadline for submission of abstracts for these sessions is April 4, 1994.

Events of Other Organizations
The MAA program will feature Carl Pomerance, University of Georgia, who will give the MAA Polya Lecture. Doris Schattschneider, Moravian College and first vice-president of the MAA for 1994 and 1995, will be the other featured MAA Hour Speaker.

There will be two minicourses; the registration fees for each will be $20. James Tattersall, Providence College, will present a minicourse on the history of the first nine Lucasian professors at Cambridge, starting with Barrow and Newton, and proceeding through Woodhouse. Much of this material, which will include some of their mathematical accomplishments, will be useful in a modern classroom. Carl E. Swenson, Seattle University, is presenting a minicourse titled Using Mathematica to produce graphical classroom materials. The first presentation will be a presentation of techniques, samples, and ideas for classroom materials, including 3-D graphics, animation, and flipbooks. During the second session participants will create something for their own classroom. Mathematica experience will be helpful but not essential.

A panel discussion on Sensitivity and understanding of the job market will be moderated by Ken Ross, University of Oregon. The two-year college program will include a panel discussion on The baby and the bathwater problem, which will focus on what we throw out of algebra to make room for technological advances. There will be sessions of contributed papers. Presentations by students are especially solicited. For more information, contact Dick Koch, University of Oregon, Eugene, OR 97403-1222; e-mail: koch@math.uoregon.edu.

Accommodations
Rooms have been blocked in the following motels. Participants should make their own arrangements with the motel of their choice and ask for the “math conference rate”. All rates are subject to applicable taxes. Reservations must be made by May 20, 1994. There may be a Grateful Dead concert in Eugene that weekend, so very early reservations are advised. The first four motels listed are within a mile of the meeting site; the nearest, Best Western New Oregon Motel, is across the street. The Village Green is 15 miles south of Eugene.


Best Western New Oregon Motel: P.O. Box 18, 1655 Franklin Blvd., Eugene, OR 97440. Telephone: 503-683-3669. Single or double $60.50 (restaurants, outdoor heated pool, tennis courts).


Village Green: 725 Row River Road, Cottage Grove, OR 97424. Telephone: 503-942-2491 or 800-343-ROOM. Single or double $49 (restaurants, outdoor heated pool, tennis courts).

Dormitory housing on the University of Oregon campus will be available. Details will appear in the spring newsletter of the Pacific Northwest Section (MAA) and are available directly from Ken Ross at the University of Oregon (ross@bright.uoregon.edu). Limited housing with local Eugene students will be available to students attending the meeting; those interested should contact Lorna at hanes@euclid.uoregon.edu.
Meetings

Registration
The registration fees are $30 for members of the AMS, $20 for participants who are members of MAA, $45 for nonmembers, and $10 for emeritus members, students, or unemployed mathematicians.

Travel
American Airlines has been selected as the official airline for this meeting. The following benefits are available exclusively to mathematicians and their families attending the meeting: a savings of up to 10% off any published domestic fare (includes U.S., Canada, Bermuda, the Bahamas, Puerto Rico, and the U.S. Virgin Islands), subject to applicable fare restrictions (10 tickets must be sold). Call 800-433-1790 between 8:00 a.m. and 11:00 p.m. EST to contact American directly or call any licensed travel agent. Instruct the ticket agent to refer to file NBR-S0264CE to qualify for the applicable discount.

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800-321-4AMS (4267) or 401-455-4166
e-mail: eps@math.ams.org
The Minneapolis Mathfest will be held August 15–17, 1994 (Monday–Wednesday). The first full announcement of the meetings will appear in the April issues of the Notices and FOCUS. This preliminary announcement is made to encourage participation and to provide lead time for submission of abstracts for consideration for presentation in AMS special sessions or contributed paper sessions, and for the submission of papers for MAA contributed paper sessions.

AMS Special Sessions
A tentative list of special sessions for this meeting can be found in the Invited Addresses, Special Sessions, and Contributed Papers section of this issue.

Most of the papers to be presented at these special sessions will be by invitation; however, anyone contributing an abstract for the meeting who feels that his or her paper would be particularly appropriate for one of these sessions should indicate this on the abstract and should submit it by April 26, 1994, in order that it be considered for inclusion. If the paper cannot be accommodated in the special session requested, it will be automatically considered a ten-minute contributed paper unless proper notation has been made on the abstract form.

AMS Contributed Paper Sessions
There will be sessions of ten-minute contributed papers. Contributed papers will be grouped by related Mathematical Reviews subject classifications into sessions insofar as possible.

Submission Procedures for AMS Abstracts
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.

Abstracts should be prepared on the standard AMS form available from the AMS office in Providence or in departments of mathematics and should be sent to Abstracts, Meetings Department, AMS, P.O. Box 6887, Providence, RI 02940, so as to arrive by April 26 (see above) or no later than May 17, 1994. A charge of $16 is imposed for retyping abstracts that are not in camera-ready form. Unfortunately, late papers cannot be accepted.

Electronic submission of abstracts is available to those who use the TeX typesetting system. The electronic package of files may be requested from e-MATH via e-mail by following this procedure:

1. Type telnet e-math@math.ams.org
2. When asked for login, type e-math
3. When asked for password, type e-math
4. Type q to bypass welcome information and go directly to the Main Menu
5. In the Main Menu, select #10 for Gopher
6. In Gopher, select #11 for Meetings and Conferences
7. In Meetings and Conferences, select #3 for Abstracts

Users may also obtain the package on IBM or Macintosh diskettes, available free of charge by writing to Electronic Abstracts, AMS Meetings Department, P.O. Box 6887, Providence, RI 02940. When requesting the abstracts package, be sure to specify either the plain TeX, \MASTEXX, or the \LaTeXX package. Requests for general information concerning abstracts may be sent to abs-misc@math.ams.org.

MAA Contributed Paper Sessions
Contributed papers are being accepted on several topics in collegiate mathematics for presentation at the meeting. The organizers below are soliciting contributed papers pertinent to their session.

- Environmental mathematics, Ben Fusaro*, Department of Mathematics and Computer Science, Salisbury State University, Salisbury, MD 21801; e-mail e3fa@usna.navy.mil; phone 410-543-6470; fax 410-548-5597.

- Papers that deal with concepts or contents that can be used in introductory mathematics courses, such as precalculus, applied ("baby") calculus, and mathematics in culture are especially welcome. However, all undergraduate applications of mathematics to the environment are welcome.

- Innovative projects in first-year courses, Howard Lewis Penn*, Mathematics Department, U.S. Naval Academy, 572 Holloway Road, Annapolis, MD 21402-5002; e-mail hlp@usna.navy.mil; phone 410-267-3892; and Aaron I. Stucker, Washburn University.

This session, sponsored by the MAA Committee on Computers in Mathematics Education, will focus on innovative teaching approaches in first-year mathematics courses such as college algebra, trigonometry, precalculus, and finite mathematics. Projects that use technology are especially encouraged; however, other projects are also welcome.

- Recreational mathematics and computing, Charles D. Ashbacher*, DecisionMark Corp., 300 Second Ave. SE, Suite 300, Cedar Rapids, IA 52401; e-mail 71603.5220
Meetings

compuserve.com; phone 319-363-6235; fax 319-365-5694.

Mathematicians at all levels often engage in mathematical play, and the results are always interesting and occasionally revolutionary. This session will feature papers describing such play. Due to the broad spectrum of possibilities, no topic should be considered forbidden. Problems where a computer was used in the solution are particularly welcome. To make the results understandable to the widest possible audience, all programs should be written in a well-known language such as BASIC, FORTRAN, Pascal, or C.

- Winning women into mathematics, Marcelle Bessman*, 644 Geneva Place, Tampa, FL 33606; e-mail jtaylor@madonna.coedu.usf.edu; Miriam P. Cooney, Saint Mary's College, Indiana; and Gerald J. Porter, University of Pennsylvania, Philadelphia.

Papers on successful programs to recruit and retain women in mathematics are solicited. Submissions should include a description of the program, documentation of its success, discussion of its transferability to other institutions or groups, and available materials and resources for implementation.

Submission Procedures for MAA Contributed Papers

Presentations are normally limited to ten minutes, although selected contributors may be given up to twenty minutes. Individuals wishing to submit a paper for any of these sessions should note the following: The name(s) and address(es) of the author(s) and a one-page summary of the paper should be sent directly to the organizer of the session marked with an asterisk (*). The summary should enable the organizer(s) to evaluate the appropriateness of your paper for the selected session, so you should include as much detailed information as possible within the one-page limitation. Your summary should reach the designated organizer by Tuesday, April 26, 1994; the organizer will acknowledge receipt of all paper summaries. If the paper is accepted, you will receive a standardized MAA abstract form and further instructions.

Audio-Visual Equipment

Rooms where special sessions and contributed paper sessions will be held are equipped with one overhead projector and screen. Blackboards are available only in rooms where they currently exist and cannot be produced upon request. Speakers requiring additional equipment should contact the Audio-Visual Coordinator for the meetings at the AMS office in Providence at 401-455-4140, or by e-mail wsd@math.ams.org prior to June 1, 1994.

Requests for equipment made at the meeting most likely will not be satisfied because of budgetary restrictions.
Invited Addresses, Special Sessions, and Contributed Papers

Invited Addresses at AMS Meetings
The individuals listed below have accepted invitations to address the Society at the times and places indicated. For some meetings the list of speakers is incomplete. For full announcements or programs of meetings occurring prior to the first meeting listed below, see the table of contents in this issue. Invited addresses at Sectional Meetings are selected by the Section Program Committee, usually twelve to eighteen months in advance of a meeting. Members wishing to nominate candidates for invited addresses should send relevant information to the associate secretary for the section who will forward it to the Section Program Committee.

Minneapolis, MN, August 1994
George E. Andrews
(History of Mathematics Lecture)
Carole B. Lacampagne
(AMS-MAA)

Todd J. Arbogast
(AMS-MAA)
Cameron Gordon
(AMS-MAA)

Pierre Louis Lions
(Progress Lecturer)

Stillwater, OK, October 1994
V. Lakshmibai
David J. Wright

David E. Marker
Joel Zinn

October 1994 Meeting in Stillwater, Oklahoma
Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: Expired
Deadline for consideration: July 13, 1994

Efraim Armendariz, D. J. Lewis, Andy R. Magid, and Robert I. Zimmer, New doctoral work in mathematics
Ara S. Basmajian and Robert R. Miner, Complex hyperbolic geometry and discrete groups
Edward T. Cline, Representations of algebraic groups
Brian Conrey and William D. Duke, Number theory
Bruce C. Crauder and Zhenbo Qin, Algebraic geometry
Edward G. Dunne and Roger C. Zierau, Geometry and representations of Lie groups
Alan R. Elcrat, Fluid dynamics
Benny D. Evans, The evolving undergraduate mathematics curriculum
Vladimir Ezhov and Alan V. Noell, Several complex variables
Jerry A. Johnson, Technology in the classroom
Mark W. McConnell, Arithmetic groups and topology
Phillip E. Parker, Geometry and geodesics

Richmond, VA, November 1994
Loren D. Pitt
Doron Zeilberger

Cora S. Sadosky

November 1994 Meeting in Richmond, Virginia
Southeastern Section
Associate Secretary: Robert J. Daverman
Deadline for organizers: Expired
Deadline for consideration: July 13, 1994

Paul S. Bourdon and William T. Ross, Operator on Banach spaces of analytic functions

Hartford, CT, March 1995
Ben F. Logan
Kari Vilonen

Nina N. Uraltseva
Shouwu Zhang

March 1995 Meeting in Hartford, Connecticut
Eastern Section
Associate Secretary: Lesley M. Sibner
Deadline for organizers: June 3, 1994
Deadline for consideration: To be announced

Organizers and Topics of Special Sessions
The list below contains all the information about special sessions at meetings of the Society available at the time this issue of the Notices went to the printer.

August 1994 Mathfest in Minneapolis, Minnesota
Associate Secretary: Lesley M. Sibner
Deadline for organizers: April 26, 1994
Deadline for consideration: To be announced

George E. Andrews and Dennis W. Stanton, q-Series
Thomas Drucker, History of mathematical logic and theoretical computer science

Dennis M. Roseman, Computer graphics as a research tool in geometry and topology

January 1995 Meeting in San Francisco, California
Associate Secretary: Andy R. Magid
Deadline for organizers: April 2, 1994
Deadline for consideration: September 9, 1994

March 1995 Meeting in Orlando, Florida
Southeastern Section
Associate Secretary: Robert J. Daverman
Deadline for organizers: June 17, 1994
Deadline for consideration: To be announced
Meetings

Robert C. Brigham and Richard P. Vitray, Combinatorics and graph theory
John R. Cannon, Inverse and ill-posed problems
S. Roy Choudhury, Nonlinear dynamical systems, chaos, and turbulence
S. Roy Choudhury and Lokenath Debnath, Solitons and nonlinear waves
Xin Li and Ram N. Mohapatra, Approximation theory and special functions
Piotr Mikusinski, New trends in generalized functions
Ahmed I. Zayed, Sampling theory, wavelets, and signal processing

March 1995 Meeting in Chicago, Illinois
Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: June 24, 1994
Deadline for consideration: To be announced

August 1995 Mathfest in Burlington, Vermont
Associate Secretary: Robert J. Daverman
Deadline for organizers: November 4, 1994
Deadline for consideration: To be announced

October 1995 Meeting in Boston, Massachusetts
Eastern Section
Associate Secretary: Lesley M. Sibner
Deadline for organizers: January 6, 1995
Deadline for consideration: To be announced

November 1995 Meeting in Kent, Ohio
Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: February 4, 1995
Deadline for consideration: To be announced

January 1996 Meeting in Orlando, Florida
Associate Secretary: Lance W. Small
Deadline for organizers: April 12, 1995
Deadline for consideration: To be announced

March 1996 Meeting in Iowa City, Iowa
Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: June 22, 1995
Deadline for consideration: To be announced
Daniel D. Anderson, Commutative ring theory

April 1996 Meeting in Baton Rouge, Louisiana
Southeastern Section
Associate Secretary: Robert J. Daverman
Deadline for organizers: July 19, 1995
Deadline for consideration: To be announced

November 1996 Meeting in Columbia, Missouri
Central Section
Associate Secretary: Andy R. Magid
Deadline for organizers: February 1, 1996
Deadline for consideration: To be announced

January 1997 Meeting in San Diego, California
Associate Secretary: Lesley M. Sibner
Deadline for organizers: April 8, 1996
Deadline for consideration: To be announced

January 1998 Meeting in Baltimore, Maryland
Associate Secretary: Robert J. Daverman
Deadline for organizers: April 10, 1997
Deadline for consideration: To be announced

Information for Organizers
Potential organizers should refer to the January issue of the Notices for guidelines on organizing a session. Proposals for any of the meetings mentioned in the preceding section should be sent to the cognizant associate secretary by the deadline indicated. No special sessions can be approved too late to provide adequate advance notice to members who wish to participate.

Western Section
Lance W. Small, Associate Secretary
Department of Mathematics
University of California, San Diego
La Jolla, CA 92093
E-mail: g_small@math.ams.org
Telephone: 619-534-3590

Central Section
Andy R. Magid, Associate Secretary
Department of Mathematics
University of Oklahoma
601 Elm PHSC 423
Norman, OK 73019
E-mail: g_magid@math.ams.org
Telephone: 405-325-6711

Eastern Section
Lesley M. Sibner, Associate Secretary
Department of Mathematics
Polytechnic University
Brooklyn, NY 11201-2990
E-mail: g_sibner@math.ams.org
Telephone: 718-260-3505

Southeastern Section
Robert J. Daverman, Associate Secretary
Department of Mathematics
University of Tennessee
Knoxville, TN 37996-1300
E-mail: g_daverman@math.ams.org
Telephone: 615-974-6577

Other Information
General information for speakers and full instructions for submitting abstracts, as well as information on site selection for Sectional Meetings, can be found in the January issue of the Notices.
1994 Summer Seminar in Applied Mathematics

Dynamical systems and probabilistic methods for nonlinear waves

Mathematical Sciences Research Institute, Berkeley, California, June 20–July 1

The twenty-fourth AMS-SIAM Summer Seminar in Applied Mathematics will be held June 20–July 1, 1994, at the Mathematical Sciences Research Institute in Berkeley, California. The seminar will be sponsored by the American Mathematical Society, the Mathematical Sciences Research Institute, and the Society for Industrial and Applied Mathematics. It is anticipated that the seminar will be partially supported by grants from federal agencies. The proceedings of the seminar will be published by the American Mathematical Society in the Lectures in Applied Mathematics series.

Nonlinear waves provide a rich source of phenomena which are important to both mathematics and science. Scientifically, these include disturbances in the atmosphere and the oceans, the propagation of laser light in nonlinear optics, and waves in plasmas and fluids. Mathematically, nonlinear wave theory has unveiled the soliton: one of the most important discoveries in nonlinear partial differential equations (pde’s) during the last twenty-five years. In addition, results in nonlinear wave theory include rigorous descriptions of the scattering of localized solitary waves, detailed descriptions of the development of singularities for nonlinear pde’s, a thorough understanding of dissipative and dispersive mechanisms for the regularization of these singularities, and numerical observations (with theoretical interpretation) of temporally chaotic behavior in nonlinear dissipative waves.

From a mathematical perspective, many recent results about nonlinear waves belong to a relatively new area—infinite dimensional dynamical systems theory for pde’s. Soliton equations are completely integrable Hamiltonian systems in infinite dimensions. The stability and scattering of solitary waves naturally admit dynamical systems interpretations which play a central role in their resolution. The same can be said of the description of the development and behavior of singularities for nonlinear Schrödinger equations. Dynamical systems theory is central to any study of chaotic dispersive waves.

However, from a scientific perspective, these successes have been restricted to relatively simple situations involving one, a very few, or a regular array of solitary waves. To address issues of greater scientific relevance and complexity, it is likely that probabilistic methods for nonlinear pde’s are required. Nonlinear waves are beginning to provide an excellent testing ground for these methods. Natural questions concern the interaction of many solitary waves (coherent structures) with each other and with a random environment which itself could be fixed or evolving.

More specifically, the organizers note recent mathematical results in the equilibrium statistical mechanics of solitons, in the advection of a passive scalar via a random velocity field, in nonequilibrium statistical theories of both weak and strong turbulence, and in stochastic pde’s such as the randomly forced Burgers and nonlinear Schrödinger equations. Controlled numerical studies are beginning to appear which investigate the coexistence of random and nonlinear effects in waves, and which test the predictions of the more heuristic turbulence theories. These theories and numerical studies directly impact our knowledge of wind-driven waves in the ocean, of chaotic and turbulent behavior in plasmas, of the long-distance propagation of laser pulses in nonlinear fibers, and of idealized models of proteins and DNA, for example.

This research area, bringing probabilistic and dynamical systems methods to bear on pde’s, is very broad. Advances require that modern mathematical theories, together with computational and visualization methods, be developed and applied to appropriate and relevant scientific problems. Probabilistic and dynamical methods pose important technical problems in pde theory and unveil fascinating new phenomena. They constitute an important general area to expose to researchers who are just initiating their own programs.

The organizing committee consists of Percy Deift, Courant Institute for the Mathematical Sciences, New York University; Philip Holmes (co-chair), Cornell University; James M. Hyman, Los Alamos National Laboratories; C. David Levermore, University of Arizona; David W. McLaughlin (co-chair), Princeton University; Y. Sinai, Princeton University; and C. Eugene Wayne, Pennsylvania State University.

Expository series of lectures will be given by senior researchers including Peter S. Constantin, Walter L. Craig, Percy Deift, Charles Doering, Hermann Flaschka, Nancy J. Kopell, Dave Levermore, David W. McLaughlin, Alexander Mielke, Gene Wayne, and Steve Wiggins.

Those interested in attending the seminar should send the following information before March 15, 1994, to AMS-SIAM Summer Seminar Conference Coordinator, American Mathematical Society, P.O. Box 6887, Providence, R.I. 02940; e-mail: d1s@math.ams.org. Please type or print the following:

1. Full name and mailing address;
2. Telephone number and area code for office and home;
3. E-mail address if available;
4. Anticipated arrival and departure dates;
5. Your scientific background relevant to the topic of the seminar; please indicate if you are a student or if you received your Ph.D. on or after 7/1/88.
Meetings

6. Financial assistance requested (please estimate cost of travel); indicate if support is not required and if interested in attending even if support is not offered.

Special encouragement is extended to junior scientists to apply. A special pool of funds expected from federal agencies has been earmarked for this group. Other participants who wish to apply for a grant-in-aid should so indicate; however, funds available for the seminar are very limited, and individuals who can obtain support from other sources should do so. Graduate students who have completed at least one year of graduate school are encouraged to participate.

American Mathematical Society Translations, Series 2

Ordered Sets and Lattices II
Volume 152

This indispensable reference source contains a wealth of information on lattice theory. The book presents a survey of virtually everything published in the fields of partially ordered sets, semilattices, lattices, and Boolean algebras that was reviewed in Referativnyi Zhurnal Matematika from mid-1982 to the end of 1985. Of interest to mathematicians, as well as to philosophers and computer scientists in certain areas, this unique compendium is a must for any mathematical library.

1991 Mathematics Subject Classification: 06; 03, 08
ISBN 0-8218-7501-9, 247 pages (hardcover), November 1992
Individual member $77, List price $128, Institutional member $102
To order, please specify TRANS2/152NA

Singularity Theory and Some Problems of Functional Analysis
Volume 153
S. G. Gindikin, Editor

The papers in this volume include reviews of established areas as well as presentations of recent results in singularity theory. The authors have paid special attention to examples and discussion of results rather than burying the ideas in formalism, notation, and technical details. The aim is to introduce all mathematicians—as well as physicists, engineers, and other consumers of singularity theory—to the world of ideas and methods in this burgeoning area.

1991 Mathematics Subject Classification: 40, 51, 57, 58, 92; 12, 19, 28, 32, 35, 49, 60
ISBN 0-8218-7502-7, 199 pages (hardcover), November 1992
Individual member $61, List price $101, Institutional member $81
To order, please specify TRANS2/153NA

All prices subject to change. Free shipment by surface; for air delivery, please add $6.50 per title. Prepayment required. Order from: American Mathematical Society, P.O. Box 5904, Boston, MA 02205-5904, or call toll free 800-321-4AMS (321-4267) in the U.S. and Canada to charge with VISA or MasterCard. Residents of Canada, please include 7% GST.
1994

March 1994
7–11. Twenty-fifth Southeastern International Conference on Combinatorics, Graph Theory, and Computing. Florida Atlantic University, Boca Raton, FL. (Sep. 1993, p. 924)
18–19. Southeastern Section. University of Kentucky, Lexington, KY.

Mathematical Sciences Meetings and Conferences

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 or symposia devoted to specialized topics, as well as announcements of regularly scheduled meetings of national or international mathematical organizations. A complete listing of meetings of the Society, and of meetings sponsored by the Society, will be found inside the front cover.

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 each issue until it has been held and a reference will be given in parentheses to the month, year, and page of the issue in which the complete information appeared. Asterisks (*) mark those announcements containing new or revised information.

In general, announcements of meetings and conferences held in North America carry only date, title of meeting, place of meeting, names of speakers (or sometimes a general statement on the program), deadlines for abstracts or contributed papers, and source of further information. Meetings held outside the North American area may carry more detailed information. In any case, if there is any application deadline with respect to participation in the meeting, this fact should be noted. All communications on meetings and conferences in the mathematical sciences should be sent to the Editor of the Notices, care of the American Mathematical Society in Providence, or electronically to notices@ams.org.

Deadlines for entries in this section are listed on the inside front cover of each issue. 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 by six months prior to the scheduled date of the meeting.

Effective with the 1990 volume of the Notices, the complete list of Mathematical Sciences Meetings and Conferences will be published only in the September issue. In all other issues, only meetings and conferences for the twelve-month period following the month of that issue will appear. As new information is received for meetings and conferences that will occur later than the twelve-month period, it will be announced at the end of the listing in the next possible issue. That information will not be repeated until the date of the meeting or conference falls within the twelve-month period.

25–26. Central Section. Kansas State University, Manhattan, KS.

Information: W. Drady, AMS, P.O. Box 6887, Providence, RI 02940.

Meetings and Conferences

April 1994


5–7. First Annual Meeting of the Saudi Association for Mathematical Sciences, King Saud University, Riyadh, Saudi Arabia. (Jan. 1994, p. 51)

5–9. Workshop on Proof Theory, Complexity, Metamathematics, University of Technology, Vienna, Austria. (Feb. 1994, p. 137)


7–8. The First Magnus Lectures, Courant Institute of Mathematical Sciences (NYU) and Polytechnic University, NY. (Feb. 1994, p. 137)


8–10. Eastern Section, Polytechnic University, Brooklyn, NY.

Information: W. Drady, AMS, P.O. Box 6887, Providence, RI 02940.


11–22. Spring School and Workshop on String Theory, Gauge Theory, and Quantum Gravity, Trieste, Italy. (Jan. 1994, p. 52)


17–22. International Conference on New Trends in Computer Science I (NETCOMS I), University of Ibadan, Nigeria. (Please note date change from Nov. 1992, p. 1121)


26. Second Annual Workshop on I/O Parallel Computer Systems (to be held in conjunction with the International Parallel Processing Symposium-IPPS '94), Cancun, Mexico. (Dec. 1993, p. 1447)

26–30. International Conference on Logic and Algebra Dedicated to Roberto Magari on his 60th Birthday, Pontignano (Siena), Italy. (Jan. 1994, p. 52)

29–May 1. Fourth Midwest Geometry Conference, University of Iowa, Iowa City, IA. (Jan. 1994, p. 52)

May 1994


2–6. IMA Workshop on Image Models (and Their Speech Model Cousins), Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Jan. 1993, p. 64)


2–6. Variété et Contrôle, CIRM, Marseille, France. (Feb. 1994, p. 138)

2–6. Wavelet Analysis as a Tool for Geometric Synthesis and Analysis, University of Minnesota, Minneapolis, MN. (Nov. 1993, p. 1255)


3–10. Spring College on Quantum Phases, Trieste, Italy. (Jan. 1994, p. 53)


5–8. MER Network Workshop, University of Texas at Austin, Austin, Texas.

Information: W. Drady, AMS, P.O. Box 6887, Providence, RI 02940.
Meetings and Conferences


*7. Midwest Several Complex Variables Meeting, Purdue University, West Lafayette, IN.


Information: L. Lempert, electronic mail: lempert@math.purdue.edu.


Information: S. Joc, Dept. of Math. and Statistics, Univ. of Waikato, Private Bag 3105, Hamilton, New Zealand; e-mail: nzmc94@hoiho.math.waikato.ac.nz.


Invited Speakers: J. An (Auckland), F. Gehring (Michigan), D. James (Penn State), G. Lehrer (Sydney), M. Macbeath (St. Andrews), C. Maclachlan (Aberdeen), M. Newman (Canberra), A. Reid (Cambridge), and H. Rubinstein (Melbourne).

Information: M. Conder and G. Martin (organizers), Dept. of Math., Univ. of Auckland, Private Bag 92019, Auckland, New Zealand; fax: 0064-9-3737457; e-mail: conder@mat.auckuni.ac.nz.

16–20. IMA Workshop on Stochastic Models in Geosystems, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Jan. 1993, p. 64)

16–20. Géométrie Algébrique, CIRM, Marseille, France. (Jan. 1993, p. 64)

16–26. NATO–Advanced Study Institute on the Recent Developments in Approximation Theory, Wavelets, and Applications, Maratea, Italy. (Feb. 1994, p. 139)


Scientific Program: May 17: Fractals and stability (differential operators on fractal objects: the heat equation on a snowflake, deterministic chaos revisited) by J. Fleckinger (Toulouse I) and R. Caboz (Pau); Complex analysis, applications to number theory (extrapolation of a signal known on a small interval, extension of holomorphic functions, and Riemann hypothesis and prime numbers distribution) by A. Yger (Bordeaux I), P. Thomas (Toulouse III), and J.-M. Deshouilhers (Bordeaux II); May 18: Optimization problems and applications (variational analysis: a tour of the theory and its applications; marginal analysis and Lagrange multipliers: application to optimization problems; optimal control of systems governed by P.d.E; and differential games and Hamilton-Jacobi equations) by M. Théra (Limoges), J.-P. Pelnot (Pau), D. Aze (Perpignan), and R. Deville (Bordeaux I). Also presentation of fractals for a large audience (May 18). All lectures will be in French.

Information: B. Beauzamy, electronic mail: beauzamy@mathp7.jussieu.fr.


22–25. 24th International Symposium for Multiple-Valued Logic, Boston, MA. (Feb. 1994, p. 139)


23–27. Elliptic and Parabolic Methods in Geometry, University of Minnesota, Minneapolis, MN. (Nov. 1993, p. 1255)


26–29. ICANN ‘94 International Conference on Artificial Neural Networks, Sorrento Congress Center, near Naples, Italy. (Jul./Aug. 1993, p. 712)


30–June 3. Equations aux Derivees Partielles Stochastiques, CIRM, Marseille, France. (Feb. 1994, p. 139)


30–June 3. International Congress on Women Mathematicians, Moscow, Russia. (Jan. 1994, p. 54)

30–June 4. Problemes en Homotopie Rationnelle, Marseille, France. (Jan. 1994, p. 54)


31–June 3. IMA Minisymposium on Phase Transitions in Catalytic Surface Reaction Models, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Jan. 1993, p. 64)


June 1994

*First Workshop on Scientific Information concerning Education, Camaguey, Cuba.
Topics: Development policies and strategies of library networks within the educational sphere; the role of scientific information in forming and improving undergraduate and professional skills; editorial work as a bibliographic support for teaching; information acquisition and exchange with educational purposes; information services, their impact, evaluation, and retrieval; information-searching languages; and scientific information automation.

Call for Papers: Send abstracts of 250 words by February 1994 and papers by April 1994 to the address below.

Information: Lie: S.A. Vishal, Centro de Información Científico Técnica, Universidad de Camagüey, Carretera Circunvalación km 5 1/2, Camagüey, Cuba; telex: 031227; fax: 61126; e-mail: infoc@canai.cu. The admission fee is $50 (US).


2-5. Colloque tournant d’Analyse Harmonique, Université de Nancy, France.

Program: The conference is organized by the Dept. of Math., Univ. of Nancy, to honor P. Eymard on the occasion of his retirement and with the Colloque tournant d’Analyse Harmonique, a traditional meeting of French harmonic analysts.

Invited Speakers: P. Delorme (Marseille), J. Faraut (Paris VI), P. de la Harpe (Genève), S. Helgason (MIT), A. Hulanicki (Wrocław), A. Korányi (CUNY), R. Kunze (Univ. Georgia), H. Leptin (Bielefeld), N. Lohoué (Orsay), J.-P. Pier (Luxembourg), G. Schiffman (Strasbourg), J. Taylor (McGill), and N. Varopoulos (Paris VI).

Information: J.-P. Anker, J.-L. Clerc, Université de Nancy, Département de Mathématiques, B.P. 239, F-54506, Vandoeuvre-lès-Nancy Cedex, France; tel: (33) 83.91.21.42 or 49; fax: (33) 83.28.09.89; e-mail: anker or clerç@iecn.u-nancy.fr.


3-4. Praha-Chemnitz-Torun Algebra Symposium, Charles University, Faculty of Mathematics and Physics, Prague, Czech Republic. (Jan. 1994, p. 54)


6-10. Applied and Industrial Mathematics, University of Linköping, Linköping, Sweden. (Nov. 1993, p. 1256)

6-10. Formes Quadratiques et Groupes Algebriques Lineaires, Marseille, France. (Jan. 1994, p. 54)


7-11. AMS Symposium in Research Mathematics on Quantization and Nonlinear Wave Equations, Massachusetts Institute of Technology, Cambridge, MA.

Information: W.S. Drays, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.


Symposia Topics: Multivariate approximation theory, the uses of K-theory in operator algebras, combinatorics, differential geometrical aspects of partial differential equations.

Education Session: The transition from High School to University. Scientific program committee chair: Keith Taylor, Dept. of Math., Univ. of Saskatchewan, Saskatoon, Saskatchewan, Canada STN 0W0; tel: 306-966-6100; electronic mail: taylor@skmath.usask.ca.

Information: CMS Summer Meeting 1994, Canadian Mathematical Society, 577 King Edward, POB 450, Station A, Ottawa, Ontario, Canada KIN 6N5; tel: 613-565-2223; fax: 613-565-1539; electronic mail exsnces@acadvm1.uottawa.ca.


13-17. Advanced Topics in Mathematics and Theoretical Physics, CIRM, Marseille, France. (Feb. 1994, p. 140)

13-18. International Conference on Logic Planning, Santa Margherita Ligure, Italy. (Feb. 1994, p. 140)


Summer 1994. Summer Regional Centers–TRANSIT, Ohio State University, Columbus, OH. (Oct. 1992, p. 951)

13-17. IMA Workshop on Classical & Modern Branching Processes, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Jan. 1993, p. 64)

13-18. Thirty Years after Sharkovskii’s Theorem—New Perspectives, Murcia, Spain. (Dec. 1993, p. 1449)

16-18. Western Section, University of Oregon, Eugene, Oregon.

Information: W. Drady, AMS, P.O. Box 6887, Providence, RI 02940.

17-18. Conference in Honor of L.D. Berko­vitz, Purdue University, West Lafayette, IN. (Feb. 1994, p. 140)

18-19. IMS Workshop on Directions in Sequential Analysis, Chapel Hill, NC. (Jan. 1994, p. 55)


20-24. Probabilités Quantiques, CIRM, Marseille, France. (Jan. 1993, p. 64)

20-24. IMA Workshop on Mathematics in Manufacturing Logistics, Institute for Mathematics and its Applications, University of Min-
Meetings and Conferences


*20–30. Scale Invariance, Interfaces and Non-Equilibrium Dynamics, Isaac Newton Institute for Mathematical Sciences, Cambridge, UK.*

**Program:** The meeting will discuss and explore the recent theoretical advances in the study of complex structures in systems far from equilibrium.

**Organizing Committee:** M. Droz (Geneva), A. McKane (Manchester), J. Vannimenus (Paris), and D. Wolf (Duisburg).

**Lecturers:** B. Chopard (Geneva), Y. Couder (Paris), S. Edwards (Cambridge), P. Grassberger (Wuppertal), V. Hakim (Paris), H. Jaeger (Chicago), R. Julien (Montpellier), M. Kardar (MIT), J. Krug (Jülich), D. Wolf (Duisburg), and R. Zia (VPI, Blacksburg).

**Information:** Participation is by invitation only, and the closing date for applications is March 15, 1994. Contact: The Deputy Director, Newton Institute for Mathematical Sciences, 20 Clarkson Road, Cambridge CB3 0EH, UK; e-mail: i.newton@newton.cam.ac.uk. Limited financial support will be available for some participants.


**Information:** Donna Salter, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.

20–July 1. **Miniworkshop on Submicron Dynamics**, Trieste, Italy. (Jan. 1994, p. 55)


22–26. Eighteenth Symposium on Real Analysis, University of Virginia, Charlottesville, VA. (Dec. 1993, p. 1450)

23–July 1. International Conference on Abelian Groups and Modules, University of Padova, Padova, Italy. (Dec. 1993, p. 1450)


**Program:** Hosted by the Calculus Consortium, National Science Foundation, and John Wiley & Sons, Inc., a program of invited speakers, panels, and contributed papers should provide something of interest for everyone interested in the way calculus is taught. The scope is broad, there will be more emphasis on contributed papers and discussion and less on formal presentation this year. Two- and four-year college, university, and secondary school faculty are welcome. Panels are planned on the following topics: Reports on the Implementation of a Variety of Calculus Reform Settings, Calculus Around the World, Evaluation, and Assessment; The Changing Curriculum: Precalculus, Multivariate Calculus, Differential Equations and Linear Algebra; The Changing High School Curriculum and Its Implications for Calculus; The Future of Technology for Calculus; and Innovative Learning Environments.

**Program Committee:** D. Hughes Hallett (Harvard), W. Roberts (Macalester College), T. Tucker (Colgate College), S. Gordon (Suffolk C.C.), H. Keynes (Univ. of Minnesota), and M. Brown (Univ. of Michigan).

**Call for Papers:** Contributed papers are invited for the following sessions: Using Technology (Computers), Using Technology (Calculators), Linking Calculus to Other Courses (e.g., Precalculus, Linear Algebra, D.E.), Pedagogical Issues (e.g., Co-operative Learning, Writing, Projects), Politics of Reform (e.g., Funding, Dealing with Faculty/Administrators, Setting up Labs), Assessment/evaluation/Favorite Topics; and Special Topics. Sessions will be run in parallel with fifteen minutes allotted for each paper. Send title of the paper, category of your choice (from above), and a 25-word abstract to Karen or Joe Thrash, Mathematics, Univ. of Southern Mississippi, 730 East Beach Blvd., Longbeach, MS 39560; e-mail: calculus@bull.cc.usm.edu. Please include your mailing address in e-mail message. Deadline for submissions is April 1, 1994. **Information:** Ethan Goodman, John Wiley & Sons, Publishers, 605 Third Ave., New York, NY: 212-850-6711; e-mail: math@jwiley.com.


27–July 1. **Logique et Informatique**, CIRM, Marseille, France. (Feb. 1994, p. 141)


**July 1994**


**Local Organizing Committee:** R. Bartnik, I. Bokor, Y. Du, J. Hempel, C. Radford, and T. Qian.

**Invited Speakers:** B. Andrews (ANU and Stanford), A. Baierstein (Washington U., St. Louis), A. Beardon (Cambridge), A. Carey (Adelaide), N. Dancer (Sydney), P. Hilton (SUNY Binghamton), K. Horadam (RMIT), G. Martin (ANU and Auckland), W. Neumann (Melbourne), I. Rabin (Newcastle), C. Rogers (UNSW), M. Safonov (Minnesota), J. Shatah (Courant Inst.), R. Schoen (Stanford), and E. Zelmanov (Wisconsin).

**Call for Papers:** Participants are invited to present papers of 25 minutes duration on any area of mathematics. Students are particularly welcome and may compete for the B.H. Neumann Prize for the best student talk at the conference. Those who present papers are also eligible for up to $100 assistance with their travel and accommodation expenses. Application for this support should be lodged as soon as possible with the treasurer of the conference: J. Hempel; Mathematics, Statistics, and Computing Science; Univ. of New England; Armidale, NSW 2351, Australia. **Information:** I. Bokor, Dept. of Math., Statistics and Computing Science, Uni-

MARCH 1994, VOLUME 41, NUMBER 3 247
Meetings and Conferences

versity of New England, Armidale, NSW 2351, Australia; electronic mail: ams940
neumann.une.edu.au.

4-8. Arrangements d’Hyperplans, CIRM, Marseille, France. (Feb. 1994, p. 141)

4-8. International Conference on Computer
Aided Geometric Design (CAGD), Penang,
Malaysia. (Jul/Aug. 1993, p. 713)

4-8. Thirty-eighth Annual Meeting of the
Australian Mathematical Society, University
of New England in Armidale, Australia. (Oct.
1993, p. 1087)

4-12. Transcendental Methods in Algebraic
Geometry, Grand Hotel San Michele, Cetaro
(CS). (Feb. 1994, p. 141)

4-29. Miniworkshop on Quantum Phase
Transitions, Trieste, Italy. (Jan. 1994, p. 55)

5-9. Twenty-fourth National Conference
on Geometry and Topology (CNGT 24),
University of Timișoara, Romania. (Jul/Aug.
1993, p. 713)

5-22. Conference on Differential and Differ­
ence Equations and Recent Developments in
Population Biology, University of Wyoming,
Laramie, WY. (Nov. 1993, p. 1257)

5-29. IMA Summer Program on Molecular
Biology, Institute for Mathematics and its
Applications, University of Minnesota,
Minneapolis, MN. (Apr. 1993, p. 415)

9-14. Conference on Differential Geometry,
Katholieke Universiteit Leuven and Brussel
(Belgium). (Feb. 1994, p. 141)

*7-23. XXIVème Ecole D’été de Calcul des
Probabilités, Saint-Flour (Cantal), France.

INVITED SPEAKERS: M. Dobrushin (Rus­
sia), M. Gubinelli (Calif., USA), and M.
Ledoux (Toulouse, III).

INFORMATION: P. Bernard, Université Blaise
Pascal, Mathématiques Appliquées, F63177
Aubiere Cedex; tel: 73.40.70.52 or 73.40.
70.50; fax: 73.40.70.64; e-mail: bernard@ucmfa.univ-bpclermont.fr.

* 10-13. Second Conference on Mathemat­
ics and Computers in Sport, Gold Coast,
Queensland, Australia.

INFORMATION: N. de Mestre, School of
Information and Technology, Bond Uni­
versity, Gold Coast, QLD 4229, Australia.

10-16. Freie Randwertprobleme, Oberwo­
fach, Federal Republic of Germany. (Apr. 1993,
p. 415)

10-16. Euroconference: Combinatorial Geo­
metry, Anoegia, Crete, Greece. (Jan. 1994,
p. 56)

10-20. Third Sosnix Conference, Saratov,
Russia. (Feb. 1994, p. 142)

10-30. The Park City/Institute for Ad­
vanced Study Mathematics Institute, Park
City, Utah. (Jan. 1994, p. 56)

* 11-13. AEMC94–First Biennial Engineer­
ing Mathematics Conference, Melbourne,
Victoria, Australia.

INFORMATION: J. Steiner, Dept. of Math.,
Swinburne Univ. of Technology, Hawthorn,
Victoria 3122, Australia; e-mail: aemc940
swinv.edu.au.

11-14. First International Conference on
Temporal Logic, Gustav Stresemann Institut,
Bonn, Germany. (Feb. 1994, p. 142)

11-15. Analyse-non Standard, CIRM, Marc­
seille, France. (Feb. 1994, p. 142)

11-15. Fourteenth IMACS World Congress
on Computational and Applied Mathe­
matics, Georgia Institute of Technology, Atlanta,
GA. (Oct. 1992, p. 951)

11-15. The First International Derive Con­
ference, Plymouth, UK. (Dec. 1993, p. 1450)

* 11-16. International Workshop on Quan­
tum Communications and Measurement,
University of Nottingham, England.

PROGRAM: The conference will be devoted to
mathematical, physical, and interpreta­
tive problems of quantum noise and quan­
tum information in open systems and optical
communications. It will bring into contact
research workers in experimental and
engineering aspects of quantum optics and
communication systems with mathematicians
and physicists working in quantum
probability and measurement theory.

CONFERENCE TOPICS: Topics include math­
ematical foundations of quantum communica­
tions; quantum noise and output stochas­
tic processes; quantum measurement and
dynamical reduction theory; causality,
filtering, and control in quantum systems;
squeezed states and nonclassical light; new
quantum optical phenomena and effects;
proposed experiments for quantum
communication systems, and devices for quantum
communication systems.

INFORMATION: V.P. Belavkin, Math. Dept.,
Univ. of Nottingham, University Park,
Nottingham NG7 2RD; tel: 0602 514954;
fax: 0602 514951; electronic mail: qcm@ maths.nott.ac.uk.

11-22. SMS-NATO ASI: Topological Meth­
ods in Differential Equations and Inclusions,
Université de Montréal, Montréal, Canada.
(Dec. 1993, p. 1451)

12-15. Theoretical Models in Biological
Systems, Trieste, Italy. (Jan. 1994, p. 56)

14-18. LFCS’94: Logic at St. Petersburg,
a Symposium on Logical Foundations of
Computer Science, St. Petersburg, Russia.
(Jul/Aug. 1993, p. 714)

16-21. Fifth International Conference on
Logic Programming and Automated Rea­
soning (LPAR ’94), Kiev, Ukraine. (Feb. 1994,
p. 142)

17-23. Conférence Internationale de Topologie,
CIRM, Marseille, France. (Jan. 1993, p. 64)

17-23. Algebraische Zahlentheorie, Ober­
wolfgang, Federal Republic of Germany. (Apr.
1993, p. 415)

17-23. Workshop on Harmonic Analysis
and Elliptic Partial Differential Equations,
International Centre for Mathematical Sci­
ces, Edinburgh, Scotland. (Jul./Aug. 1993,
p. 714)

17-23. Euroconference: Actions of Lie
Groups and Discrete Subgroups on Mani­
folds, Anoegia, Crete, Greece. (Jan. 1994,
p. 56)

18-22. CIMNS International Colloquium
on Nonstandard Mathematics in Memory
of Abraham Robinson, Universities of Aveiro
and Beira Interior, Portugal. (Feb. 1994, p. 142)

18-22. Knots and 3-manifolds, CIRM, Lu­
mây, Marseille. (Feb. 1994, p. 142)

18-22. Sixth International Conference on
Fibonacci Numbers and Their Applications,
Washington State University, Pullman, WA.
(Jul./Aug. 1993, p. 714)

18-22. Conference Internationale de Topologie,
Marseille, France. (Jan. 1994, p. 56)

18-29. Fifth Workshop of Stochastic Anal­
ysis of Oslo-Silivri, Silivri, Istanbul, Turkey.
(Oct. 1993, p. 1087)

20-22. International Symposium on Sym­
bolic and Algebraic Computation, ISSAC
’94, St. Catherine’s College, Oxford, UK. (Jan.
1994, p. 56)

20-30. Third Souslin Conference, Saratov,
Russia. (Jul./Aug. 1993, p. 714)

21-30. 1994 ASL European Summer Meet­
ing (Logic Colloquium ’94), Université
d’Auvergne, Clermont-Ferrand, France. (Feb.
1994, p. 142)

24-30. Complex Geometry: Moduli Prob­
lems, Oberwolfach, Federal Republic of Ger­
many. (Apr. 1993, p. 415)

25-29. Représentation des Groupes Reduc­
tifs p-adiques, CIRM, Marseille, France. (Nov.
1992, p. 1122)

Diego, CA. (Sep. 1993, p. 927)

25-29. Conference on Evolution Equations,
University of Strathclyde, Glasgow, Scotland.
(Dec. 1993, p. 1451)

25-29. European Colloquium of Category
Theory (ECCT), Tours, France. (Jan. 1994,
p. 56)

* 25-30. Colloquium on Differential Geo­
mety, Mathematical Institute of the University
of Debrecen, Hungary.

PROGRAM: The scientific program is de­
voted to lectures given by participants and
invited lectures on various fields of dif­
fferential geometry, together with global
analytic and applications to mathematical physics.

**Organizing Committee:** S. Bácsó (Debrecen), L. Kozma (Debrecen, colloquium secretary), P.T. Nagy (Szeged), G. Soós (Budapest), J. Szenthe (Budapest, chair), and L. Tamássy (Debrecen, chair). Honorary chair is A. Rapcsák (Debrecen).

**Information:** L. Kozma, Dept. of Math., Univ. of Debrecen, H-4010 Debrecen Pf. 12, Hungary; fax: 36-52-310936; e-mail: difgeo@ukule.e51.bitnet.


27–August 1. **International Conference on Commutative Algebra (A Satellite Conference of ICM 94, Zürich)**, Universität Os­nabrück, Standort Vechta, Germany. (Dec. 1993, p. 1451)


31–August 4. **\LaTeX Users Group Annual Meeting**, University of California, Santa Barbara, CA. (Feb. 1994, p. 143)


**Meetings and Conferences**

**August 1994**

1–5. **Third World Congress on Computational Mechanics (WCCM III)**, Chiba, Japan. (May/June 1992, p. 497)


ADDITIONAL INFORMATION: In addition to the previously reported program, there will be an informal seminar "Lorentzian Geometry and Applications" for two days during ICM '94.

**Information:** K.B. Marathe, electronic mail: kbm@sci.brooklyncuny.edu or K.L. Duggal, yq@ucc.windsor.ca.


**Program:** The aim of the workshop is to stimulate contacts between analysts (mostly specialists in complex analysis) and geometers (specialists in differential geometry) and to investigate of topics of common interest: complex and almost complex structures, Hermitian and almost-Hermitian geometry, twistor methods, complex vector fields with singularities, complex analytic and differentiable spaces, real analytic Riemann manifolds, Kahler manifolds, Monge-ampere equations, and others. This year the workshop is dedicated to D. Pedoe (Minneapolis) and to the 60th birthday of K. Spallek (Bochum).

**Invited Speakers (TENTATIVE LIST):**


**Organizing Committee:**


**Information:**

K.B. Marathe, electronic mail: kbm@sci.brooklyncuny.edu or K.L. Duggal, yq@ucc.windsor.ca.


14–27. **NATO Advanced Study Institute on “Finite and Locally Finite Groups”**, Bosphorous University, Istanbul, Turkey. (Nov. 1993, p. 1257)

15–17. **Mathfest**, University of Minnesota, Minneapolis, MN (including the summer meetings of the AMS, AWM, MAA, and PME).

**Information:** H. Daly, AMS, P.O. Box 6887, Providence, RI 02940.


15–26. **Advanced Workshop on Algebraic Geometry**, International Centre for Theoretical Physics, Trieste, Italy. (July/Aug. 1993, p. 714)


**Organizers:** M. Aschbacher (Pasadena), W. Kantor (Eugene), and F.-G. Timmesfeld (Gießen).

**Information:** Mathematisches Forschungsinstitut Ober­wol­fach, Steffisburg, P.O. Box 1531, 79416 Gießen.

Meetings and Conferences


29–September 2. L'arithmetique des Courbes de Genre Deux, CIRM, Marseille, France. (Feb. 1994, p. 144)


Program: Organized on the occasion of the life jubilees of O. Axelsson and M. Zlámal, Modelling 94 will provide an interdisciplinary forum in which researchers in the field of mathematical modelling and computational mathematics can present results and exchange ideas and information. The program will include invited lectures, short communications, and posters.

Topics: Mathematical modelling and simulation in science and technology, computational methods for solutions of corresponding model problems (e.g. FEM, BEM, FDM, FVM, and analytical and algebraical methods), methods of numerical algebra and analysis; expert systems in science; and visualization techniques for pre- and post-processing.


Information: Organizing Committee, Modelling 94, Institute of Computer Science AS CR, Pod vodárenskou věží 2, 18221 Prague 8 – Liběchov, Czech Republic; phone: (+42 2) 66 05 32 80; fax: (+42 2) 85 85 789; e-mail: modelling94@uivt.cas.cz.

September 1994


Fall 1994. Workshop on Geometry of Non-compact Manifolds, Centre de Recherches Mathématiques, Université de Montréal. (Jan. 1994, p. 57)


5–9. IX Brazilian Meeting of Topology, Universidade Federal Fluminense, Instituto de Matematica, Niteroi, Rio de Janeiro, Brazil. (Jan. 1994, p. 57)

5–10. Analyse Numérique des Polynomes Orthogonaux, CIRM, Marseille, France. (Feb. 1994, p. 144)


19–23. IMA Workshop on Computational Wave Propagation, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Feb. 1994, p. 144)

19–23. 3ème Atelier International de Théorie des Ensembles, CIRM, Marseille, France. (Apr. 1993, p. 416)


26–29. Second International Conference on Theorem Provers in Circuit Design: Theory, Practice, and Experience, Bad Herrenalb (Blackforest), Germany. (Feb. 1994, p. 144)

26–30. Annual Conference of the European Association for Computer Science Logic (CSL '94), Kazimierz, Poland. (Feb. 1994, p. 144)

26–October 1. First International Workshop on Functional Analysis, Trier University, near Luxembourg, Germany. (Oct. 1993, p. 1088)


October 1994


11–13. IMA Tutorial on Waves, Multi-grid and Other Fast Algorithms (Multipole, FFT), and Their Use in Wave Propagation, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Feb. 1994, p. 145)


17–21. IMA Workshop on Waves, Multi-grid and Other Fast Algorithms (Multipole, FFT), and Their Use in Wave Propagation, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Feb. 1994, p. 145)


24–November 11. Fourth Autumn Course on Mathematical Ecology, Trieste, Italy. (Jan. 1994, p. 58)

* 26–29. Sixth IEEE Symposium on Parallel and Distributed Processing, Dallas, Texas.
Meetings and Conferences

December 1994


November 1994

2-4. Mathématique Informatique, CIRM, Marseille, France. (Feb. 1994, p. 145)

7-18. 2nd Workshop on Three-dimensional Modelling of Seismic Waves Generation, Propagation, and Their Inversion. Trieste, Italy. (Feb. 1994, p. 145)

9-10. IMA Tutorial on Waves in Random and Other Complex Media, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Feb. 1994, p. 145)

11-13. Southeastern Section, University of Richmond, Richmond, VA.

Information: W. Drady, AMS, P.O. Box 6887, Providence, RI 02940.


14-18. IMA Workshop on Waves in Random and Other Complex Media, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Feb. 1994, p. 145)


Program: This purpose of this symposium is to provide a forum for an exchange of ideas among experts in various areas of applied analysis. It also aims at disseminating information on recent advances made in these areas. Symposium topics include asymptotics, integral equations, perturbation methods, special functions, and wave propagation. There will be one-hour expository addresses, half-hour specialized talks, and contributed sessions.


Call for Papers: Titles and abstracts of contributed papers must be received by July 30, 1994. The abstracts should be typed double-spaced, not to exceed one page, and sent to one of the program organizers.

Program Organizers: R.M. Miura, Dept. of Math., U. of British Columbia, e-mail: miura@euro.n.math.ubc.ca; R.S.C. Wong, Dept. of Math., City Polytechnic of Hong Kong, electronic mail: mavong@cpkhxv.cphk.hk.

Information: Daniel Ho, Dept. of Math., City Polytechnic of Hong Kong, e-mail: madanie@cphkxv.cphk.hk.


Second International Conference on Numerical Methods for Votterra and Delay Equations (A conference to celebrate the 100th anniversary of Volterra's birth). Italy. (Mar. 1992, p. 251)
January 1995

4-7. Joint Mathematics Meetings, San Francisco, CA (including the annual meetings of the AMS, AWM, MAA, and NAM).

Information: H. Daly, AMS, P.O. Box 6887, Providence, RI 02940.

16-19. First Asian Computational Fluid Dynamics Conference, Hong Kong University of Science and Technology, Clear Water Bay, Hong Kong. (Jan. 1994, p. 58)

17-20. IMA Tutorial 1 on Inverse Problems in Wave Propagation, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Feb. 1994, p. 146)

March 1995

4-5. Eastern Section, Hartford, Connecticut.

Information: W.S. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.

6-17. IMA Workshop on Inverse Problems in Wave Propagation, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Feb. 1994, p. 146)

17-18. Southeastern Section, Orlando, Florida.

Information: W.S. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.

19-21. Southeastern Section, Baton Rouge, Louisiana.

Information: W.S. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.

The following new announcements will not be repeated until the criteria in the last paragraph in the box at the beginning of this section are met.

April 1995

4-6. IMA Tutorial on Singularities and Oscillations, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN.

Information: Institute for Mathematics and its Applications, University of Minnesota, 514 Vincent Hall, 206 Church St., SE, Minneapolis, MN 55455.

4-5. Eastern Section, Hartford, Connecticut.

Information: H. Daly, AMS, P.O. Box 6887, Providence, RI 02940.

6-17. IMA Workshop on Inverse Problems in Wave Propagation, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN. (Feb. 1994, p. 146)

April 1996

19-21. Southeastern Section, Baton Rouge, Louisiana.

Information: W.S. Drady, American Mathematical Society, P.O. Box 6887, Providence, RI 02940.

November 1995

3-4. Central Section, Kent State University, Kent, Ohio.

Information: W. Drady, AMS, P.O. Box 6887, Providence, RI 02940.

17-18. Southeastern Section, University of North Carolina, Greensboro, NC.

Information: W.S. Drady, AMS P.O. Box 6887, Providence, RI 02940.

January 1996

10-13. Joint Mathematics Meetings, Orlando, Florida (including the annual meetings of the AMS, AWM, MAA, and NAM).

Information: H. Daly, AMS, P.O. Box 6887, Providence, RI 02940.

March 1996

22-23. Central Section, University of Iowa, Iowa City, Iowa.

Information: W. Drady, AMS, P.O. Box 6887, Providence, RI 02940.

May 1995


16-18. IMA Tutorial on Quasiclassical Methods, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, MN.

Information: Institute for Mathematics and its Applications, University of Minnesota, 514 Vincent Hall, 206 Church St., SE, Minneapolis, MN 55455.

October 1995

7-8. Eastern Section, Northeastern University, Boston, Massachusetts.

Information: W. Drady, AMS, P.O. Box 6887, Providence, RI 02940.

November 1996

1-2. Central Section, University of Missouri at Columbia, Columbia, Missouri.

Information: W. Drady, AMS, P.O. Box 6887, Providence, RI 02940.

January 1997

10-13. Joint Mathematics Meetings, San Diego, California (including the annual meetings of the AMS, AWM, MAA, and NAM).

Information: H. Daly, AMS, P.O. Box 6887, Providence, RI 02940.
New Publications Offered by the AMS

CONTEMPORARY MATHEMATICS

Lie Algebras, Cohomology, and New Applications to Quantum Mechanics
Niky Kamran and Peter J. Olver, Editors
Volume 160

This volume is devoted to a range of important new ideas arising in the applications of Lie groups and Lie algebras to Schrödinger operators and associated quantum mechanical systems. In these applications, the group does not appear as a standard symmetry group, but rather as a "hidden" symmetry group whose representation theory can still be employed to analyze at least part of the spectrum of the operator. In light of the rapid developments in this subject, a Special Session was organized at the AMS meeting at Southwest Missouri State University in March 1992 in order to bring together, perhaps for the first time, mathematicians and physicists working in closely related areas. The contributions to this volume cover Lie group methods, Lie algebras and Lie algebra cohomology, representation theory, orthogonal polynomials, q-series, conformal field theory, quantum groups, scattering theory, classical invariant theory, and other topics. This volume, which contains a good balance of research and survey papers, presents a look at some of the current developments in this extraordinarily rich and vibrant area.

Contents

B. Abraham-Shrauner and A. Guo, Hidden symmetries of differential equations; Y. Alhassid, Algebraic methods in scattering; C. M. Bender, Exact solutions to operator differential equations; L. C. Biedenhorn, The algebra of tensor operators for the unitary groups; P. Feinsilver, Lie groups and probability; D. Flath, Coherent tensor operators; R. Floreanini and L. Vinet, $U_{q}(sl(2))$ and q-special functions; J. N. Ginocchio, The group representation matrix in quantum mechanical scattering; A. González-López, N. Kamran, and P. J. Olver, Quasi-exact solvability; P. E. T. Jorgensen, Quantization and deformation of Lie algebras; F. Iachello, Algebraic theory; D. J. Kaup, The time-dependent Schrödinger equation in multidimensional integrable evolution equations; E. G. Khmims, W. Miller, Jr., and S. Mukherjee, Models of q-algebra representations: Matrix elements of $U_{q}(su_{2})$; J. Palduc, Many-electron correlation problem and Lie algebras; M. A. Shifman, Quasi-exactly-solvable spectral problems and conformal field theory; A. Turbiner, Lie-algebras and linear operators with invariant subspaces.

CRM PROCEEDINGS & LECTURE NOTES

Elliptic Curves and Related Topics
Hershy Kisilevsky and M. Ram Murty, Editors
Volume 4

This book represents the proceedings of a workshop on elliptic curves held in St. Adele, Quebec, in February 1992. Containing both expository and research articles on the theory of elliptic curves, this collection covers a range of topics, from Langlands’s theory to the algebraic geometry of elliptic curves, and from Iwasawa theory to computational aspects of elliptic curves. This book is especially significant in that it covers topics comprising the main ingredients in Andrew Wiles’s recent result on Fermat’s Last Theorem.

Contents

G. Frey, Construction and arithmetical applications of modular forms of low weight; K. Rubin, More "main conjectures" for imaginary quadratic fields; J. E. Cremona, Periods of cusp forms and elliptic curves over imaginary quadratic fields; H. Darmon, Heegner points, Heegner cycles, and congruences; J. Gebel and H. G. Zimmer, Computing the Mordell-Weil group of an elliptic curve over $Q$; F. Q. Gouvea, Continuity properties of $p$-adic modular forms; R. Greenberg, Elliptic curves and $p$-adic deformations; J. Ind. Twisted tensor L-functions attached to Hilbert modular forms; L. Mai and M. Ram Murty, A note on quadratic twists of an elliptic curve; D. E. Rohrlich, Elliptic curves and the Weil-Deligne group; F. Shahidi, Symmetric power L-functions for $GL(2)$; Y. G. Zarhin, $l$-adic representations and Lie algebras.

1991 Mathematics Subject Classification: 11Fxx, 11Gxx; 11F12, 11F67, 11G05, 11G40
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Measure-Valued Processes, Stochastic Partial Differential Equations, and Interacting Systems

D. A. Dawson, Editor

The papers in this collection explore the connections between the rapidly developing fields of measure-valued processes, stochastic partial differential equations, and interacting particle systems, each of which has undergone profound development in recent years. Bringing together ideas and tools arising from these different sources, the papers include contributions to major directions of research in these fields, explore the interface between them, and describe newly developing research problems and methodologies. Several papers are devoted to different aspects of measure-valued branching processes (also called superprocesses). Some new classes of these processes are described, including branching in catalytic media, branching with change of mass, and multilevel branching. Sample path and spatial clumping properties of superprocesses are also studied. The papers on Fleming-Viot processes arising in population genetics include discussions of the role of genealogical structures and the application of the Dirichlet form methodology. Several papers are devoted to particle systems studied in statistical physics and to stochastic partial differential equations which arise as hydrodynamic limits of such systems. With overview articles on some of the important new developments in these areas, this book would be an ideal source for an advanced graduate course on superprocesses.

Contents


1991 Mathematics Subject Classification: 60B30, 60F60; 60G17, 60F15
ISBN 0-8218-6992-2, LC 93-4431, ISSN 1065-7339
214 pages (softcover), March 1994
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Combinatorial Rigidity

Jack Graver, Brigitte Servatius, and Herman Servatius

Volume 2

This book presents rigidity theory in a historical context. The combinatorial aspects of rigidity are isolated and framed in terms of a special class of matroids, which are a natural generalization of the connectivity matroid of a graph. This book includes an introduction to matroid theory and an extensive study of planar rigidity. The final chapter is devoted to higher-dimensional rigidity, highlighting the main open questions. Also included is an extensive annotated bibliography with over 150 entries. This book is aimed at graduate students and researchers in graph theory and combinatorics or in fields which apply the structural aspects of these subjects in architecture and engineering. Accessible to those who have had an introduction to graph theory at the senior or graduate level, this book is suitable for a graduate course in graph theory.

Contents

Overview; Infinestesimal rigidity; Matroid theory; Linear and planar rigidity; Rigidity in higher dimensions; References; Index.

1991 Mathematics Subject Classification: 05B35; 05C10
ISBN 0-8218-3801-6, LC 93-34431, ISSN 1065-7539
172 pages (hardcover), December 1993
Individual member $25, List price $41, Institutional member $33
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Proceedings of the Steklov Institute of Mathematics

Theory and Applications of Differentiable Functions of Several Variables. 14
S. M. Nikol'skii, Editor

Volume 194

This collection is the fourteenth in an ongoing series on differentiable functions of several variables, presenting recent contributions to a line of research begun by Sobolev in 1950. The papers study various spaces of differentiable functions of several real variables on domains of Euclidean space, their imbeddings, equivalent norms, weighted estimates of derivatives, and traces on sets. Several questions of approximation in function spaces on the line, on a hyperboloid, and on Lobachevsky space are studied. Investigations of bilinear approximations are applied to estimates of the singular numbers of integral operators and widths. The authors also examine the asymptotics of the spectrum of elliptic systems, as well as the Dirichlet variational problem for a degenerate elliptic operator. Finally,
a block method of solving Laplace’s equation for nonanalytic boundary conditions is developed.

Contents

P. M. Badzhrachariya and V. I. Burenkov, Necessary and sufficient conditions for continuity with respect to a nonlinear translation for various function spaces; O. V. Besov, Equivalent norms of the Sobolev-Liouville space on a domain; K. Kh. Boltmatov, A Tauberian method for studying spectral asymptotics of strongly degenerate elliptic systems; V. I. Burenkov, On the best constant in Hardy’s inequality with $0 < p < 1$ for monotone functions; E. A. Volkov, Approximate solution of Laplace’s equation by the block method on polygons under nonanalytic boundary conditions; M. A. Gabidzashvili, I. Z. Genebashvili, and V. M. Kokilashvili, Two-weight inequalities for generalized potentials; P. A. Zharov, On a two-weight inequality. Generalization of inequalities of Hardy and Poincaré; V. A. Ivanov, Precise results in the problem of the Bernstein-Nikol’skii inequality on compact symmetric Riemannian spaces of rank 1; P. I. Lizorkin, Direct and inverse theorems of approximation theory for functions on Lobachevsky space; G. G. Magaril-Il’yaev, On best approximation by splines of function classes on the line; G. A. Mamedov, On traces of functions from anisotropic Nikol’skii-Besov and Lizorkin-Triebel spaces on subsets of Euclidean space; N. V. Miroshin, The exterior Dirichlet variational problem for an elliptic operator with degeneration; Yu. S. Nikol’ski, Imbedding theorems for nonisotropic weighted spaces of differentiable functions on unbounded domains; I. V. Petrova, Approximation on a hyperbolid in the $L_2$-metric; V. N. Temlyakov, Bilinear approximation and related questions.

1991 Mathematics Subject Classification: 46E35, 35J70, 35A40, 26D10, 41A30, 41A15, 35J35
ISBN 0-8218-3152-6, ISSN 0081-5438
265 pages (softcover), March 1994

Individual member $105. List price $175. Institutional member $140
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A Proof of the $q$-Macdonald-Morris Conjecture for $BC_n$
Kevin W. J. Kadel

Macdonald and Morris gave a series of constant term $q$-conjectures associated with root systems. Selberg evaluated a multivariable beta type integral which plays an important role in the theory of constant term identities associated with root systems. Aomoto recently gave a simple and elegant proof of a generalization of Selberg’s integral. Kadel extended this proof to treat Askey’s conjectured $q$-Selberg integral, which was proved independently by Habsieger. This monograph uses a constant term formulation of Aomoto’s argument to treat the $q$-Macdonald-Morris conjecture for the root system $BC_n$. The $B_n$, $B_n^+$, and $D_n$ cases of the conjecture follow from the theorem for $BC_n$. Some of the details for $BC_n$ and $C_n$ are given. This illustrates the basic steps required to apply methods given here to the conjecture when the reduced irreducible root system $R$ does not have miniscule weight.

Contents

Introduction; Outline of the proof and summary; The simple roots and reflections of $B_n$ and $C_n$; The $q$-engine of our $q$-machine; Removing the denominators; The $q$-transportation theory for $BC_n$; Evaluation of the constant terms $A$, $E$, $K$, $F$, and $Z$; $q$-analogues of some functional equations; $q$-transportation theory revisited; A proof of Theorem 4; The parameter $v$; The $q$-Macdonald-Morris conjecture for $B_n$, $B_n^+$, $C_n$, $C_n^+$ and $D_n$. Conclusion.

1991 Mathematics Subject Classification: 17B20
ISBN 0-8218-2552-6, LC 93-48293, ISSN 0065-9266
80 pages (softcover), March 1994

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Behavior of Distant Maximal Geodesics in Finitely Connected Complete 2-dimensional Riemannian Manifolds
Takashi Shioya

Volume 108, Number 517

This monograph studies the topological shapes of geodesics outside a large compact set in a finitely connected, complete, and noncompact surface admitting total curvature. When the surface is homeomorphic to a plane, all such geodesics behave like those of a flat cone. In particular, the rotation numbers of the geodesics are controlled by the total curvature. Accessible to beginners in differential geometry, but also of interest to specialists, this monograph features many illustrations that enhance understanding of the main ideas.

Contents

Introduction; The semi-regular curves in a differentiable plane; Statement of main results and examples; Some applications of the Gauss-Bonnet theorem; Semi-regularity of distant geodesics; Almost regularity of distant geodesics; The visual diameter; Distant geodesics in a finitely connected manifold with finitely connected boundary; References.

1991 Mathematics Subject Classification: 53C22, 53C45
ISBN 0-8218-2578-X, LC 93-48484, ISSN 0065-9266
73 pages (softcover), March 1994

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Parabolic Anderson Problem and Intermittency
René A. Carmona and S. A. Molchanov

Volume 108, Number 518

This book is devoted to the analysis of the large time asymptotics of the solutions of the heat equation in a random time-dependent potential. The authors give complete results in the discrete case of the $d$-dimensional lattice when the potential is, at each site, a Brownian motion in time. The phenomenon of intermittency of the solutions is discussed.

Contents

Introduction; Existence and uniqueness problems; Moment Lyapunov exponents and intermittency; Almost sure Lyapunov exponents; Concluding remarks.

1991 Mathematics Subject Classification: 60H15, 60H25, 60F10, 60G15, 60K40
ISBN 0-8218-2577-1, LC 93-48271, ISSN 0065-9266
125 pages (softcover), March 1994

Individual member $20. List price $34. Institutional member $27
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MARCH 1994, VOLUME 41, NUMBER 3 255
Completely Prime Maximal Ideals and Quantization
William M. McGovern
Volume 108, Number 519
This monograph will appeal to graduate students and researchers interested in Lie algebras. McGovern classifies the completely prime maximal spectrum of the enveloping algebra of any classical semisimple Lie algebra. He also studies finite algebra extensions of completely prime primitive quotients of such enveloping algebras and computes their lengths as bimodules, characteristic cycles, and Goldie ranks in many cases. This work marks a major advance in the quantization program, which seeks to extend the methods of (commutative) algebraic geometry to the setting of enveloping algebras. While such an extension cannot be completely carried out, this work shows that many partial results are available.

Contents
Introduction; Preliminaries on nilpotent orbits and their covers; Induced Dixmier algebras and orbit data; Construction and basic properties of the algebras; Associated varieties and characteristic cycles; Goldie ranks; Applications to the quantization program; Exhaustion of the completely prime maximal spectrum; Examples; References.
1991 Mathematics Subject Classification: 17B35, 20G05, 22E47
ISBN 0-8218-2580-1, LC 93-48292, ISSN 0065-9266
67 pages (softcover), March 1994
Individual member $17, List price $29, Institutional member $23
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Elliptic Regularization and Partial Regularity for Motion by Mean Curvature
Tom Ilmanen
Volume 108, Number 520
This monograph considers (singular) surfaces moving by mean curvature, combining tools of geometric measure theory with "viscosity solution" techniques. Employing the geometrically natural concept of "elliptic regularization," Ilmanen establishes the existence of these surfaces. The groundbreaking work of Brakke, combined with the recently developed "level-set" approach, yields surfaces moving by mean curvature that are smooth almost everywhere. The methods developed here should form a foundation for further work in the field. This book is also noteworthy for its especially clear exposition and for an introductory chapter summarizing the key compactness theorems of geometric measure theory.

Contents
Introduction; Elliptic regularization; Partial regularity in codimension one; Appendix; References.
1991 Mathematics Subject Classification: 35, 53, 82
ISBN 0-8218-2582-8, LC 93-48272, ISSN 0065-9266
90 pages (softcover), March 1994
Individual member $19, List price $32, Institutional member $26
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Fermat's Last Theorem—The Theorem and its Proof: An Exploration of Issues and Ideas
In July 1993, just three weeks after Andrew Wiles's announcement of a proof of Fermat's Last Theorem, the Mathematical Sciences Research Institute hosted a special celebration in San Francisco. Combining mathematics, history, and music, the evening of public lectures was a great success. This videotape captures the celebratory mood of what has come to be known as the "Fermat Fest", with talks by five mathematicians, musical interludes, and a panel discussion. Accessible to a general audience and requiring no mathematical background, the videotape provides insight into the mathematics and the history of this famous problem. Accompanying the tape is a pamphlet in which some of the speakers present additional background material; also included are an article by Hendrik Lenstra on Pythagorean triples and one by Joe Buhler on the contributions of Sophie Germain. This closed-captioned tape is an excellent means for stimulating student interest in mathematics, as it presents some fascinating mathematical concepts while also revealing the human side of attempts to solve this famous problem. This tape is produced by MSRI and distributed by the AMS. Moderator: Will Hearst; Robert Oserman, Lenore Blum, Karl Rubin, Kenneth Ribet, John H. Conway; Panelists: Lenore Blum, John H. Conway, Lee Dembart, Kenneth Ribet; Musician: Morris Bobrow.
1991 Mathematics Subject Classification: 00, 01
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Mathematical Sciences Professional Directory

This annual directory provides a handy reference to various organizations in the mathematical sciences community. Listed in the directory are: officers and committee members of over thirty professional mathematical organizations (terms of office and other pertinent information are also provided in some cases); key mathematical sciences personnel of selected government agencies; academic departments in the mathematical sciences; mathematical units in nonacademic organizations; and alphabetic listings of colleges and universities. Current addresses, telephone numbers, and electronic addresses for individuals are listed in the directory when provided.

1991 Mathematics Subject Classification: 00
ISBN 0-8218-0183-X, ISSN 0737-4356
227 pages (softcover), March 1994
List price $50, Institutional member $40,
To order, please specify PRODIR/94N

Systèmes Cohérents et Structures de Niveau
Joseph LePotier
Number 214

Suppose X is an algebraic projective smooth variety. A d-dimensional coherent system on X is a pair (Γ,F), where F is a coherent algebraic sheaf on X whose support has dimension d, and Γ is a vector subspace of sections H^0(F). This book defines a natural notion of semistability for such pairs and constructs a projective variety which is a coarse moduli space for semistable coherent systems (Γ,F) such that the Hilbert polynomial P_F of the sheaf F is a fixed polynomial P. This construction is inspired by the work of C. Simpson.

Contents
Introduction; Le module de Simpson; L'espace de modules M_{m}(m^2 + 3m); Systèmes cohérents; Cosystèmes cohérents; Structures de niveau sur P^1; Le module de Trautmann; Appendices; Bibliographie.

1991 Mathematics Subject Classification: 14D20, 14F05
ISSN 0303-1179
143 pages (softcover), 1993
AMS or SMF member $16, List price $23,
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Topology and Its Applications
S. P. Novikov, Editor

This book contains the proceedings of an international topology conference held in the town of Zagulba, near Baku in the former Soviet Union, in October 1987. Sponsored by the Institute of Mathematics and Mechanics of Azerbaijan and the Steklov Mathematical Institute, the conference was organized by F. G. Maksudov and S. P. Novikov. About 400 mathematicians, including about 100 foreigners, attended the conference. This book covers aspects of general, algebraic, and low-dimensional topology.

1991 Mathematics Subject Classification: 58, 55, 57, 54
ISBN 0-8218-3151-8, 250 pages (softcover), November 1993
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Miscellaneous

Personals

C. Y. Chan, of the University of Southwestern Louisiana, was appointed as head of the Department of Mathematics at that institution effective October 1, 1993.

Deaths

John J. Andrews, of Harlingen, TX, died on November 5, 1993. He was born in January 1906, and was a member of the Society for 46 years.

Maher Wagdi Barsoum, of San Diego, CA, died on September 27, 1993. He was born on December 10, 1937, and was a member of the Society for 1 year.

Willie R. Callahan, of Newport News, VA, died on June 25, 1993. He was born on March 18, 1910, and was a member of the Society for 48 years.

Florica Campan, of Iasi, Romania, died on August 23, 1993. She was a member of the Society for 16 years.

Ralfe J. Clench, of Queen's University, Ontario, Canada, died on August 4, 1993. He was born on February 25, 1936, and was a member of the Society for 34 years.

Nelly E. Doll, of Eastern Michigan University, died on November 13, 1993. She was born on January 13, 1925, and was a member of the Society for 66 years.

Diego Bricio Hernandez, of CIMAT, Guanajuato, Mexico, died on November 25, 1993. He was born on November 13, 1945, and was a member of the Society for 10 years.

Carl Holton, of Tempe, AZ, died on. He was born on October 27, 1904, and was a member of the Society for 50 years.

Alston S. Householder, of Malibu, CA, a former president of SIAM, died on July 4, 1993. He was born on May 5, 1904, and was a member of the Society for 63 years.

Charles G. Lange, of the University of California at Los Angeles, died on June 25, 1993. He was born on March 30, 1942, and was a member of the Society for 25 years.

A. J. McConnell, Emeritus Fellow of Trinity College, Dublin, Ireland, died on August 24, 1993. He was born on November 18, 1903, and was a member of the Society for 64 years.

Edward C. Posner, of the California Institute of Technology, died on June 15, 1993. He was born on August 10, 1933, and was a member of the Society for 39 years.

Wolfgang R. Wasow, Professor Emeritus of the University of Wisconsin, died on September 11, 1993. He was born in July 1909, and was a member of the Society for 51 years.
TO: Screening Committee, Dept. of Mathematics for appointment as Associate Professor or CV. Must have earned doctorate, and Statistics, and offers degrees in both Math and Stat. qualifications. and/or stochastic differential equations and their seeking to maintain its heritage and identity or to apply, contact: Search Committee, position starting 9/94. Cal Poly Pomona is actively seeking to maintain its heritage and identity as a comprehensive center of education that serves a dynamic, multicultural region (with 58% ethnic minorities). For additional information or to apply, contact: Search Committee, Mathematics Dept., California State Polytechnic University, 3801 W. Temple Avenue, Pomona, CA 91758-4033. 909-869-3467. EOE/AA.

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Department of Mathematics and Statistics seeks chair. Must have earned doctorate, qualify for appointment as Associate Professor or Professor. Department has 27 full-time faculty and offers degrees in both Math and Stat. Send CV and three letters of reference by April 1, 1994 to: Screening Committee, Dept. of Mathematics and Statistics, FCS 3, University of South Alabama, Mobile, AL 36684. 205-460-6264. e-mail: dept@mathstat.usouthal.edu.

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UNIVERSITY OF CALIFORNIA

Riverside, California

Department of Mathematics

Applications are invited for one or more visiting assistant professor positions beginning September 1994. Applicants must show demonstrated or strong promise in research and teaching. The positions are open to applicants from all research areas in mathematics. The teaching load is six quarter-courses per year. Candidates must have received a Ph.D. degree by September 1994. Applicants should send their curriculum vitae, including their publication list, and have at least three letters of recommendation sent to Temporary Faculty Search Committee Attn: Danielle McQueen Department of Mathematics University of California, Riverside Riverside, CA 92521-0135 by Friday, April 15, 1994. UCR is an Affirmative Action/Equal Opportunity Employer.

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UNIVERSITY OF CONNECTICUT

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Assistant/Associate Professor

The Department of Mathematics invites applications for an anticipated, tenure-track position at the Assistant/Associate Professor level at the Hartford Campus effective September 1, 1994. The Hartford Campus is located in West Hartford, which is about thirty miles away from the main campus. UCONN-Hartford offers a two-year program but hopes to expand to a four-year program in Mathematics, and we are looking for a person who can take a leadership role in that transition. Requirements include a Ph.D. in mathematics, experience, and demonstrated talent in teaching both mathematics and statistics, and strong evidence of research capabilities. Salary commensurate with experience. Screening of applicants will begin March 15, 1994, and will continue until the position is filled. For full consideration, send resume and at least three letters of recommendation to Professor Jerome Neuwirth, Department of Mathematics, U-9, University of Connecticut, Storrs, CT 06269-3008. We encourage applications from under-represented groups, including minorities, women, and people with disabilities. (Search #4A229)

FLORIDA

UNIVERSITY OF MIAMI

Assistant/Associate Professor

The Department of Mathematics and Computer Science of the University of Miami may have two tenure-track positions in mathematics available for the fall of 1994. Candidates should have Ph.D.s in mathematics and should be outstanding in both teaching and research. Although these positions will probably be at the junior level, we will seriously consider any well-qualified applicants. To apply, please send your vita and three letters of recommendation to: Alan M. Zame, chairman Mathematics and Computer Science P.O. Box 249085 University of Miami Coral Gables, FL 33124-4250 The University of Miami is an equal opportunity affirmative action employer and a smoke/drug free workplace.

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Review of applications will begin in January 1994 and will continue until the position is filled. Candidates must be U.S. citizens or meet Immigration Reform Act criteria. Send letter of application, curriculum vitae, and names of references to:
MAINE

BATES COLLEGE
Lewiston, Maine
Department of Mathematics
Temporary Positions Announcement

The Mathematics Department at Bates College announces two full-time temporary positions, beginning fall 1994. The first position is for two years and the second is for one.

Each position requires teaching six courses during the academic year: two courses in the fall, three in the winter, and one during the Bates five-week “short-term.” The courses will range from calculus through junior and senior level major courses, and perhaps the opportunity to teach computer science courses.

The qualified applicant will have or be near completion of a Ph.D. in mathematics.

Special consideration will be given to those candidates expressing a desire to teach applied math, computer science, or a seminar with a strong writing component for first-year students. Furthermore, in all Bates College calculus sections, we are successfully using the curriculum developed by the Calculus Consortium at Harvard University; familiarity with its approach and philosophies and an overall interest in calculus reform is a plus.

Consideration of candidates will begin March 22, and will continue until the position is filled.

Located in central Maine, Bates College is a liberal arts college of 1500 students. The mathematics department has eight faculty members, and we graduate about 15 majors per year. Department members take teaching very seriously, while supporting a wide range of professional activities including research and publication.

Bates College values a diverse college community and seeks to assure Equal Opportunity through a continuing and effective Affirmative Action program. We welcome applications from women and minorities.

Interested persons should send a letter of application, current vita, and three letters of reference to:

Bates College, c/o Secretarial Services
9 Andrews Road, Lane Hall
Bates College
Lewiston, Maine 04240

NEW HAMPSHIRE

UNIVERSITY OF NEW HAMPSHIRE

The Department of Mathematics invites applications for a tenure-track (possibly senior) position in applied mathematics. The Institute for the Study of Earth, Oceans, and Space at UNH is a source of many interesting problems in applied mathematics (and funded) collaborative work is possible. It is possible that there will be a position in pure mathematics if funding becomes available. Strong commitment to teaching in both undergraduate and graduate courses is expected. The positions will begin in the fall semester of 1994. Review of applications will begin on April 1, 1994, but applications will be considered until the positions are filled.

Send resume, e-mail address if possible, and three letters of recommendation to Kenneth Appel, chair, Department of Mathematics, University of New Hampshire, Durham, NH 03824 (kla@orion.unh.edu). Hiring is contingent on eligibility to work in the U.S. Women and minorities are encouraged to apply. UNH is an AA/EEO employer.

WV Virginia

UNIVERSITY OF VIRGINIA

Newington, Virginia

Department of Mathematics
Temporary Faculty Positions Announcement

The Mathematics Department at the University of Virginia invites applications for three temporary faculty positions: one at the level of Lecturer, one at the level of Assistant Professor, and one at the level of Associate Professor. These positions are for the academic year 1994-95.

Applications: Please address applications to:

Chair, Department of Mathematics
University of Virginia
Charlottesville, Virginia 22903

Salary will be commensurate with qualifications.

Applications will be accepted until the positions are filled. The review of applications will begin on May 1, 1994. Women and minorities are encouraged to apply.

UNIVERSITY OF TENNESSEE

Knoxville, Tennessee

Department of Mathematics
Temporary Faculty Positions Announcement

The Mathematics Department at the University of Tennessee invites applications for three temporary faculty positions: one at the level of Lecturer, one at the level of Assistant Professor, and one at the level of Associate Professor. These positions are for the academic year 1994-95.

Applications: Please address applications to:

Chair, Department of Mathematics
University of Tennessee
Knoxville, Tennessee 37996

Salary will be commensurate with qualifications.

Applications will be accepted until the positions are filled. Women and minorities are encouraged to apply.

NEW YORK

CLARKSON UNIVERSITY

Department of Mathematics
Temporary Faculty Positions Announcement

The Department of Mathematics at Clarkson University invites applications for two temporary faculty positions. Minimum qualifications are: Ph.D. in mathematics or a closely related discipline, demonstrated excellence in both teaching and research, ability to communicate readily in English. The first position requires expertise in statistics and probability ability to provide leadership in undergraduate statistics and actuarial studies. The second position requires expertise in nonlinear waves and applied mathematics as well as a research area compatible with current faculty. Rank and salary are negotiable.

Applications including vita and names of three references must be received by March 1, 1994. Starting date is August 16, 1994. Applications should be submitted to Professor D. Powers, Department of Mathematics and Computer Science, Clarkson University, Potsdam, NY 13699-5815. Clarkson University is an equal opportunity/affirmative action employer. Women and minorities are urged to apply. (Pos. #554 and 556).

CLARKSON UNIVERSITY

Chair, Department of Mathematics and Computer Science

Clarkson University seeks applications and nominations for the chair of the Department of Mathematics and Computer Science. The department offers undergraduate and graduate degree programs in both mathematics and computer science and has responsibility for providing fundamental mathematics instruction to the University. The successful candidate is expected to be a strong leader in the area of faculty hiring and development in support of the University’s commitment to excellence in teaching and faculty scholarship. Clarkson is a technologically oriented university with 2,400 undergraduates and 350 graduate students majoring principally in engineering, science and management. The University is located in a small upstate New York town near the Adiron- deck Mountains with three other institutions of higher education within a ten mile radius. Candidates should submit a resume, statement of educational and leadership philosophy, and the names of at least three references to: Dr. A.
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Birkhäuser is very pleased to announce that Professor I.M. Gelfand of Rutgers University has agreed to assume the Chief Editorship of the journal previously known as *Selecta Mathematica Sovietica*, to be known beginning in 1994 as *Selecta Mathematica*. Professor David Kazhdan of Harvard University and Professor Robert D. MacPherson of the Massachusetts Institute of Technology have agreed to serve as Associate Editors, and an international editorial board is now being formed.

*Selecta Mathematica* is a peer reviewed journal addressed to a general audience of mathematicians. Any topic in pure and applied mathematics will be considered appropriate for review. The Journal is global in philosophy and flexible in its acceptance of individual style. The diversity of the editorial board will guarantee coexistence in the journal of a wide selection of pure and applied topics as well as the mathematical language in which the papers are created.

The following mathematicians have already accepted invitations to serve on the editorial board:

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Papers should be submitted in three copies, accompanied by a diskette when possible. All submitted papers will be reviewed by the Editorial Board. Submission of a paper to Selecta Mathematica is representation by the author that the same paper has not been submitted at the same time to another journal.
Institute for Mathematics and its Applications Summer Program, July 5-29, 1994

MOLECULAR BIOLOGY

Organizers: Michael Waterman (Chair), Jill P. Mesirov, Gene Myers, Klaus Schulten, Terence P. Speed, De Witt Sumners

The Rationale: The revolutionary progress in molecular biology within the last 30 years opens the way to full understanding of the structures of living organisms. This program touches upon several interdisciplinary areas and is driven by ever growing computational power. The mathematical sciences accompany and support much of the progress achieved by computations, as well as provide insight into geometric and topological properties of protein structures. The program will get together molecular biologists and mathematicians who have worked on protein sequencing, protein folding, molecular dynamics and the various mathematical, statistical and computational aspects involved, in order to increase interaction and to discuss future directions. Another goal is to bring young mathematicians (graduate students and recent Ph.D.s) into contact with this fast growing field.

The Program: Week 1: Sequencing and Mapping, July 5-8; Week 2: Genetic Linkage and Mapping, July 11-15; Week 3: Protein Structure and Dynamics, July 18-22; Week 4: Topology and Geometry of DNA and RNA, July 25-29. It is the intent of the coordinators to strike a 50%-50% balance between mathematics and biology in this program. Each weekly segment will feature several introductory and survey talks by senior researchers. There will be a larger number of invited technical talks and several sessions for contributed talks. Occasional discussion sessions will be organized, and informal interaction will be encouraged.

Participation and Support: There is a $100 registration fee. Some support will be available for researchers (including graduate students) who are, or wish to become, familiar with the subject. Women and minorities are especially encouraged to apply. Preference will be given to those who participate in the entire program. For details concerning support or participation write to Avner Friedman, Director, at the Institute for Mathematics & its Applications, University of Minnesota, 514 Vincent Hall, 206 Church Street S.E., Minneapolis, MN 55455. Application deadline is May 6, 1994.
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Jack Graver, Brigitte Servatius, and Herman Servatius
Volume 2

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Membership Categories

Please read the following to determine what membership category you are eligible for, and then indicate below the category for which you are applying.

For ordinary members whose annual professional income is below $45,000, the dues are $84; for those whose annual professional income is $45,000 or more, the dues are $112.

The CMS cooperative rate applies to ordinary members of the AMS who are also members of the Canadian Mathematical Society and reside outside of the U.S. For members whose annual professional income is $45,000 or less, the dues are $71; for those whose annual professional income is above $45,000, the dues are $95.

For a joint family membership, one member pays ordinary dues, based on his or her income; the other pays ordinary dues based on his or her income, less $20. (Only the member paying full dues will receive the Notices and the Bulletin as a privilege of membership, but both members will be accorded all other privileges of membership.)

Minimum dues for contributing members are $168.

For either students or unemployed individuals, dues are $28, and annual verification is required.

The annual dues for reciprocity members who reside outside the U.S. and Canada are $56. To be eligible for this classification, members must belong to one of those foreign societies with which the AMS has established a reciprocity agreement, and annual verification is required. Reciprocity members who reside in the U.S. or Canada must pay ordinary member dues ($84 or $112).

The annual dues for category-S members, those who reside in developing countries, are $16. Members can choose only one privilege journal. Please indicate your choice below.

Members can purchase a multi-year membership by paying their current dues rate for either two, three, four or five years. This option is not available to category-S, unemployed, or student members.

1994 Dues Schedule (January through December)

For any category of membership where more than one dues level is given, see the above for descriptions of Members' Categories.

Ordinary member .................................................. $84 $112
CMS Cooperative rate ........................................ $71 $95
Joint family member (full rate) ............................... $84 $112
Joint family member (reduced rate) ......................... $64 $92
Contributing member (minimum $168) .................. $168
Student member (please verify) .............................. $28
Unemployed member (please verify) ....................... $28
Reciprocity member (please verify) ....................... $56 $84 $112
Category-S member ........................................... $16
Multi-year membership ....................................... $ for years

1 Student Verification (sign below)
I am a full-time student at ........................................ to ................................ for ................................ years

2 Unemployed Verification (sign below) I am currently unemployed and actively seeking employment. My unemployment status is not a result of voluntary resignation or of retirement from my last position.

3 Reciprocity Membership Verification (sign below) I am currently a member of the society indicated on the right and am therefore eligible for reciprocity membership.

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- Allahabad Mathematical Society
- Asociaciön Matemática Española
- Australian Mathematical Society
- Berliner Mathematische Gesellschaft e.V.
- Calcutta Mathematical Society
- Croatian Mathematical Society
- Danske Matematikerkongress
- Deutsche Mathematiker-Vereinigung e.V.
- Edinburgh Mathematical Society
- Egyptian Mathematical Society
- Gesellschaft für Angewandte Mathematik und Mechanik
- Glasgow Mathematical Association
- Indian Mathematical Society
- Iranian Mathematical Society
- Irish Mathematical Society
- Israel Mathematical Union
- János Bolyai Mathematical Society
- Korean Mathematical Society
- London Mathematical Society
- Malaysian Mathematical Society
- Mathematical Society of Japan
- Mathematical Society of the Philippines
- Mathematical Society of the Republic of China
- Nepal Mathematical Society
- New Zealand Mathematical Society
- Nigerian Mathematical Society
- Nordisk Matematisk Forening
- Österreichische Mathematische Gesellschaft
- Polskie Towarzystwo Matematyczne
- Punjab Mathematical Society
- Ramanujan Mathematical Society
- Real Sociedad Matemática Española
- Sociedad Colombiana de Matemáticas
- Sociedad de Matemática de Chile
- Sociedad Matemática de la República Dominicana
- Sociedad Matemática Mexicana
- Sociedade Brasileira de Matemática
- Sociedade Brasileira de Matemática Aplicada e Computacional
- Sociedade Paranaense de Matemática
- Sociedade Portuguesa de Matemática
- Societat Catalana de Matemàtiques
- Société de Mathématiques Appliquées et Industrielles
- Société Mathématique de Belgique
- Société Mathématique de France
- Société Mathématique Suisse
- Southeast Asian Mathematical Society
- Suomen Matemaattinen Yhdistys
- Svenska Matematikersamfundet
- Union Matemática Argentina
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Journal mailing lists must be printed four to six weeks before the issue date. Therefore, in order to avoid disruption of service, members are requested to provide the required notice well in advance.

Besides mailing addresses for members, the Society's records contain information about members' positions and their employers (for publication in the Combined Membership List). In addition, the AMS maintains records of members' honors, awards, and information on Society service. Information of the latter kind appears regularly in Notices.

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HOMOLOGY THEORY
An Introduction to Algebraic Topology
This book is designed to be an introduction to some of the basic ideas in the field of algebraic topology. In particular, it is devoted to the foundations and applications of homology theory. The only prerequisite for the student is a basic knowledge of abelian groups and point set topology. The essentials of singular homology are given in the first chapter, along with some of the most important applications. In this way the student can quickly see the importance of the material. The successive topics include attaching spaces, finite CW complexes, the Eilenberg-Steenrod axioms, cohomology products, manifolds, Poincaré duality, and fixed point theory. Throughout the book the approach is as illustrative as possible, with numerous examples and diagrams. Extremes of generality are sacrificed when they are likely to obscure the essential concepts involved. The book is intended to be easily read by students as a textbook for a course or as a source for individual study. The second edition has been substantially revised. It includes a new chapter on covering spaces in addition to illustrating new exercises.

A.J. HAHN, University of Notre Dame, Notre Dame, IN
QUADRATIC ALGEBRAS, CLIFFORD ALGEBRAS, AND ARITHMETIC WITT GROUPS
This book introduces mathematicians to the large and dynamic area of algebras and forms over commutative rings. The book begins very elementary and progresses gradually in its degree of difficulty. Topics include the connection between quadratic algebras, Clifford algebras and quadratic forms. Brauer groups, the matrix theory of Clifford algebras over fields, and Witt groups of quadratic and symmetric bilinear forms. Some of the new results included by the author concern the representation of Clifford algebras, the structure of Arf algebra in the free case, connections between the group of isomorphic classes of finitely generated projectives of rank one and arithmetic results about the quadratic Witt group.

H. COHEN, University of Bordeaux, France
A COURSE IN COMPUTATIONAL ALGEBRAIC NUMBER THEORY
This book gives a comprehensive introduction to computational number theory, concentrating on practical aspects of the implementation of powerful algorithms. It contains descriptions of 148 algorithms which are fundamental for number theoretic calculations, in particular, for implementations related to algebraic number theory, elliptic curves, primality testing, lattices and factoring. A detailed description of each algorithm is given, allowing for immediate computer implementation. Many of the algorithms are new or appear here for the first time in book form. For each subject, a complete theoretical introduction and exercises are given.

L. CARLESON, Mathematics Institute, University of Bordeaux, France
REAL ANALYSIS, Measure Theory, Integration, and Hilbert Spaces
The book begins with a treatment of measure theory, using abstract notions of outer measure to motivate the construction of a measure. It then proceeds to investigate the Lebesgue integral, covering such topics as the monotone convergence theorem, Fatou's lemma, and the dominated convergence theorem. The second half of the book is devoted to the study of Hilbert space, with applications to Fourier series, Fourier and Laplace transforms, and Sobolev spaces.

A.J. HAHN, University of Notre Dame, Notre Dame, IN
GEOMETRY OF VOTING
Election and decision procedures do not behave as expected, since different tallying methods can radically change the outcomes. This book presents a unified geometric approach that explains many of the mysteries of voting systems. It introduces "profile coordinates" which allow one to see the set of possible voter preferences that support a given election outcome. In this manner, the likelihood of various conclusions can be compared, new flaws of widely accepted concepts (e.g., the Condorcet winner) become evident and extensions of other conclusions are immediate. Readers will also be interested in the simplified proof of Arrow's theorem which proves it is impossible to find a procedure that does what most people expect a voting method to do, and the geometric description of the Gibbard-Satterthwaite theorem which shows that all systems can be manipulated. Geometry is also applied to apportionment methods to uncover new explanations why such methods can create trouble, such as for the US apportionment of congressional seats.

H. COHEN, University of Bordeaux, France
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