Massachusetts Institute of Technology

Autumn 2006
Volume 1

IntegraL

NEWS FROM THE MATHEMATICS DEPARTMENT AT MIT

Inside

Dear Friends,

I am pleased to introduce *Integral*, the newsletter from MIT's Mathematics Department. *Integral* will bring you news of our faculty, alumni, staff, and students, as well as updates on recent developments of note. Our plan is for *Integral* to announce what is new, celebrate our achievements, define our challenges, and bring together our mathematical community. *Integral* will be available in hardcopy and on the web at http://math.mit.edu. Looking over the alumni of our department, I see a remarkable group of people. Many have gone on to distinguished careers in mathematics and other fields in academia and business. We're proud of you! Now you can stay in touch with us through *Integral*. Tell us what you've been up to and give us stories about your time at MIT. Your suggestions on ways to improve the department are also welcome. Let us know what you'd like to see in future issues of our newsletter. Do you like the title? If not, please suggest something better! To steal a phrase from Paul Erdös, "Our minds are open."

Among Our Faculty

MIT is an extraordinary place, and mathematics is central to nearly everything the Institute does. Here's an interesting statistic: Among the MIT faculty outside the Mathematics Department, 13 hold degrees from our department, including the current head of Electrical Engineering and Computer Science (EECS), a former MIT provost, and a Nobel Prize winner in biology.

Highest Honors

The Abel Prize for research in mathematics was established by Norway about three years ago, although it had been conceived a century earlier. Similar in many respects to a Nobel Prize, the Abel Prize is still relatively unknown. We need to work on raising public awareness of this major award in our field. At MIT, we're most fortunate to have a faculty member who is one of these rare creatures, an Abel Laureate: Isadore Singer. "Is" holds the position of Institute Professor, one of the very highest honors that MIT bestows upon its faculty, and in March he gave the 2006 Killian Lecture.

Simons Lectures

Our Simons Lecture Series has been running annually for five years, bringing in distinguished speakers, such as Laurent Lafforgue, Peter Shor, Robert MacPherson, Wendelin Werner, Grigory Perelman, Nigel Hitchin, and Noga Alon. This year, we were privileged to hear speakers Akshay Venkatesh and Yves Couder. In 2007, we will hear from David Donoho and Terry Tao.

Off the Infinite Corridor

A few other happenings are worth mentioning. We've completed a renovation of the second-floor common room. It now has three enormous blackboards, a new kitchen, comfortable furniture, and boardgames. We've also renovated the third-floor applied math laboratory, where John Bush and Martin Bazant conduct experiments on how to walk on water and other miracles.

Reaching Out

David Jerison is taking over RSI (Research Science Institute) and SPUR (Summer Program for Undergraduate Research) from Hartley Rogers, who has been running them for many years. These wonderful programs match our graduate students with high-school students and MIT undergraduates for an intensive summer research experience. This year, two students, Kimberly Scott and Yi Sun, ranked among the top-10 winners in the Intel Science Talent Search for their work in the RSI program, summer 2005. To transmit excitement about mathematics, we've recently developed a pilot program called "ProveIt," which joins MIT undergraduates with Cambridge-area middle-school and high-school students.

Moving Forward

Our department is entering a critical period. Over the next few years, we will be recruiting new faculty most actively. The choices we make now about faculty hiring and research direction will determine the character of our department for a generation. If you have thoughts on the future of mathematics at MIT, we're eager for your advice and help. Please email me directly at sipser@math.mit.edu. I hope to hear from many of you.

Michael Sipser
Department Head

Faculty News

Steven Johnson

Roman Bezrukavnikov

Igor Pak

New Faculty

Roman Bezrukavnikov joined our department as a Professor of Mathematics in September 2005 from Northwestern University. He is a specialist in geometric representation theory.

Toby Colding joined us in January 2005 as a Professor of Mathematics from the Courant Institute. Toby's field is differential geometry with a concentration on Riemannian geometry.

Mark Behrens joined the mathematics faculty as Assistant Professor of Mathematics in September 2005. Mark's field is algebraic topology

In September of 2006, **Benjamin Brubaker**, who works in analytic number theory, joined us as an Assistant Professor of Mathematics.

Steven Johnson joined us an Assistant Professor of Applied Mathematics in September 2004. Steven's field is computational science and numerical analysis.

Eric Lauga, who specializes in fluid dynamics, joined us as an Assistant Professor of Applied Mathematics in September 2006.

Katrin Wehrheim joined our department as an Assistant Professor of Mathematics in September 2005. Katrin's focus is on symplectic geometry and low-dimensional topology.

Promotions

Pavel Etingof and **Gigliola Staffilani** have been promoted to Professor. **Denis Auroux** and **John Bush** received tenure. **Igor Pak**, **Dmitry Panchenko**, **Alexander Postnikov**, and **Jeff Viaclovsky** have been promoted to Associate Professor.

Gigliola Staffilani,
Tomasz Mrowka,
and their two children
Mario and Sofia

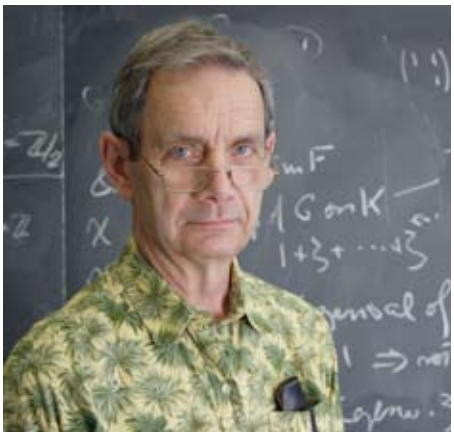
Toby Colding

Pavel Etingof

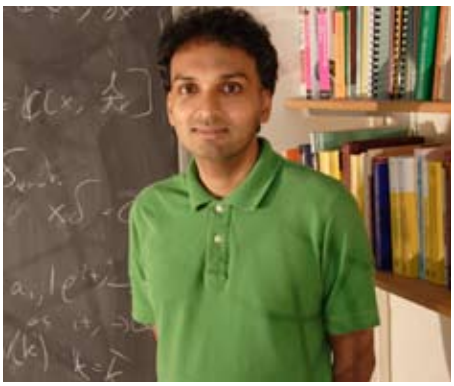
Katrin Wehrheim

Denis Auroux

Awards and Achievements



Mike Artin



Kiran Kedlaya

Tom Leighton

Mike Artin received the Harvard University Graduate School of Arts and Sciences Centennial Medal for being "an architect of the modern approach to algebraic geometry." **Denis Auroux**, **Kiran Kedlaya**, and **Jason Starr** received Alfred P. Sloan Research Fellowships. **Toby Colding** was elected as a foreign member of the Royal Danish Academy of Science and Letters, and named Honorary Professor by the University of Copenhagen. **Alan Edelman** and **Gil Strang** received the Ford Award of the Mathematical Association of America for their paper, "Pascal Matrices." **Daniel Freedman** is a co-winner of the 2006 Heineman Prize for Mathematical Physics, for his original paper on the theory of supergravity published in 1976. **Tom Leighton** was made a Trustee of the American Academy of Arts & Sciences. **George Lusztig** was named an Honorary Member of the Mathematics Institute of the Romanian Academy. **Richard Stanley** was chosen to be a 2004 Clay Senior Scholar by the Clay Mathematics Institute. **Gilbert Strang** was honored with the John von Neumann Medal of the United States Association for Computational Mechanics. **Santosh Vempala** was selected for a John Simon Guggenheim Foundation Fellowship for his work on algorithmic convex geometry.

A number of our faculty have been selected by their colleagues here at MIT for departmental and institute distinctions. In August 2000, Alan Mendelson of Axiom Venture Partners established the Edmund F. Kelly Research Award, in recognition of a junior faculty member doing fundamental or innovative applied mathematical research. In 2003, **John Bush** was selected as its first recipient. This year, **Alexander Postnikov** received the award for work in algebraic combinatorics. For his work on combinatorial algorithms, **Michel Goemans** was selected to be the next Robert E. Collins Distinguished Scholar, supported by the Robert E. Collins Professorship Fund. He also received the School of Science Dean's Educational & Student Advising Award. **Haynes Miller** was selected as a 2005 Margaret MacVicar Faculty Fellow for his outstanding teaching and leadership in the design of core mathematics subjects. Haynes was also awarded the Graduate Council Teaching Award by the School of Science. **Denis Auroux** received the School of Science teaching award.

Jason Starr

Gil Strang

Richard Stanley

Michel Goemans

$15 Million Campaign for Math Announced

Left: Marc Kastner, Jim Simons, and Mike Sipser.

The Campaign for Math

The Mathematics Department at MIT is embarking on a $15 million campaign to raise funds for faculty recruitment and retention and for supporting our graduate students.

Last January, our long-time friend and benefactor Jim Simons graciously hosted a dinner for MIT Math and Physics alumni at his home in New York City. The party was great fun, and allowed alumni old and new to reconnect with each other and with MIT. From the event's excellent turnout and the comments of those attending, we realized that our department enjoys a tremendous depth of positive feeling and support among our alumni. The idea for a campaign was born.

The department's visiting committee met later that spring and gave its blessing to the concept of a campaign for math. The committee's chair John Reed helped us to formulate the campaign scope, and together we designed its plan. We felt that $15 million would meet the department's need for endowed chairs and graduate fellowships, and would be attainable by the campaign's end in the spring of 2008. In the first major development of the campaign, John and his wife Cynthia stunned us all by offering to make a leadership gift of $6 million. To encourage others to follow his example, their gift is offered as a one-for-one match for the duration of the campaign.

Why Now?

Our greatest challenge is faculty renewal. Nearly 40 percent of our tenured math faculty members are over the age of 65 and nearing retirement. Other mathematics departments across the country have similar age distributions. Intense competition for top mathematicians to replace retiring faculty is already evident. In the past few years alone, we lost a significant number of our top faculty to other departments. We simply have to act aggressively to retain our people and to recruit others.

Support for Faculty

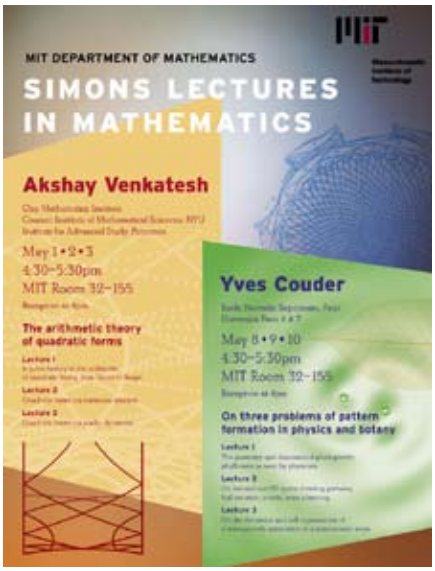
Named professorships through endowed chairs are one way to make this happen. If MIT Math is to stay at the top, we must find, attract, and retain the most promising and accomplished mathematicians worldwide. The department must be able to match—or exceed—offers from other schools. An endowed chair is a visible way to recognize and reward outstanding researchers and educators. It is one of the most lasting and significant gifts a donor can make to MIT. Simply put, an endowed chair accomplishes two things: It provides a permanent legacy to honor scholarship, teaching, and research for the chair holders, and it reflects the benefactor's abiding commitment to MIT.

Support for Graduate Students

In order to ensure that our program continues to attract the very best students, we must offer graduate fellowships. Currently, only 60 percent of our incoming graduate students receive fellowships, due to the limited number we have available. By contrast, most other top mathematics departments offer nearly all incoming graduate students a first-year fellowship or equivalent. Graduate students need fellowships during their first year because it gives them a chance to complete coursework, begin research, and become accustomed to a new environment, free of the added responsibility to teach or grade papers.

With its distinguished, award-winning faculty and brilliant students, the Mathematics Department remains a cornerstone of MIT. Clearly, we want to make certain that we have the resources to build on our past. It is worth repeating that now is a crucial time for mathematics at MIT, as we are making decisions about faculty and research that will shape the future of this department. Our friends and alumni play a vital role in ensuring the continued greatness of this department. Our goal is to expand the number of opportunities for our alumni and friends to become involved in our enterprise.

Meet Diko Mihov



Leverage Your Contribution
John and Cynthia Reed will match your gift, doubling its impact. Join them to ensure that our department's future is as memorable as its past. For more information and/or to make a gift to the Math Department, please contact Elizabeth Chadis at echadis@mit.edu or call 617-452-2807.

In his native Bulgaria, Diko Mihov showed enough promise to make the Olympiad Mathematics team. At age 16, he took home the gold—making good on that promise—and he's still at it.

In 1996, Diko earned a PhD in Mathematics from MIT. Here is what he has to say about it: "My experience was not all that different from that of any other student. I was exclusively focused on my work and research." He adds, "What does stand out is the help I received from my advisor. The person at MIT who influenced me most was David Vogan, an extraordinary person and terrific teacher."

According to David Vogan, "Diko was fantastically quick, always learning whatever he needed to by reading on his own. He was usually several jumps ahead of me in his work." Vogan continues, "Diko was always extremely good at teaching, as gentle and careful of his students as he was harsh and demanding of himself."

During Diko's last year at MIT, he began to look around and wonder about opportunities outside of academia. He considered Wall Street and gradually started, as he put it: "the finance thing," where he learned that mathematics and finance have more similarities than differences. Both proved to be exciting, satisfying fields requiring a mix of quantitative and creative skills along with the ability to communicate—the same talents and skills he polished at MIT.

In 1997, Diko joined the D.E. Shaw group, a specialized investment and technology firm focused on the intersection between technology and finance. Today, Diko is one of the firm's managing directors. When asked what prompted his recent $250,000 pledge toward MIT graduate fellowships for students from Bulgaria, Diko says, "It's simple, my PhD led to a career that allows me to give back to mathematics, so I do it."

Diko's commitment to giving back is not limited to MIT. When he learned that Bulgaria's programs for talented children—the kind he had benefited from—could not find funding due to the changing economic climate, he established the American Foundation for Bulgaria (www.afbulgaria.org). To date, the foundation has awarded hundreds of merit-based scholarships to deserving Bulgarian students. When asked about his foundation work, Diko remarks simply, "It is rewarding."

David Vogan remembers when Diko began at D.E. Shaw and says, "Immediately, Diko said what he liked most about the job was the people: 'very smart and really nice.' Diko didn't think that was automatic in the investment banking world." Continues Vogan, "Diko was always strongly appreciative of his parents and their support."

Vogan wondered how Diko's parents reacted to his career, so we asked. Diko confides, "They are thrilled." So are we. In his role at D.E. Shaw, in founding the American Foundation for Bulgaria, and in his generous gift to the Mathematics Department, Diko is always investing in a future that puts a great deal of store in the past.

Above: Diko Mihov

Left: At the dinner hosted by Jim Simons, Diko Mihov first became aware of the Math Department's need for support.

MIT Scores Brilliantly in Recent Putnam Competition

This past year witnessed another outstanding performance by MIT undergraduates in the William Lowell Putnam Mathematics competition. Among the 75 listed top scorers in the competition this year, 23 attend MIT, nearly one-third. This number of students receiving Honorable Mention or higher appears to be an all-time record for a single institution and amply demonstrates the tremendous depth of mathematical talent across our undergraduates. By comparison, the institution with the second-highest number of scorers at this level this year had only eight, and also happens to be in Cambridge. A total of 107 MIT undergraduates participated in the competition this year.

For the second consecutive year, three MIT students were designated Putnam Fellows for scoring among the top-six individuals. The new Putnam Fellows are junior Daniel Kane and sophomores Oleg Golberg and Matthew Ince. We look forward to having their extraordinary talent with us for at least another year.

The MIT Putnam team, composed of three students chosen by the Math Department, placed fourth in the team competition this year, following two years of first-place wins. The 2005 team members were senior Vladimir Barzov and juniors Daniel Kane and Timothy Abbott.

The annual competition, inaugurated in 1938, traditionally takes place on the first Saturday in December. Students from universities in the United States and Canada tackle 12 problems worth 10 points apiece in two three-hour sessions. The test is so difficult that many of the tests are returned to Putnam graders blank. The maximum possible score is 120 points. The median score among all participants is 1 point.

We thank Professors Hartley Rogers and Richard Stanley for their work over many years with MIT undergraduates who participate in the Putnam. This year, the venerable Rogers and Stanley coaching combination was enhanced with the able assistance of Assistant Professor Kiran Kedlaya.

Professor Gerald Sacks Retires from MIT

On May 25, 2006, the Mathematics Department hosted a retirement luncheon for Professor Gerald Sacks at the MIT Faculty Club. They were joined by members of his family, invited guests, department faculty, and four of his graduate students. Following the meal, Professor Hartley Rogers reminisced about Gerald's research and academic career. Professor Akihiro Kanamori (Boston University) also spoke about Gerald's research, and Professor Sacks' wife, Maggie, talked about his mathematical life at home. Following the talks, graduate students Nate Ackerman, Alice Chan, Cameron Freer (Harvard), and Christina Goddard presented Gerald with a CD they had assembled of all his publications and his students' available theses. Professor Sacks then offered some farewell remarks.

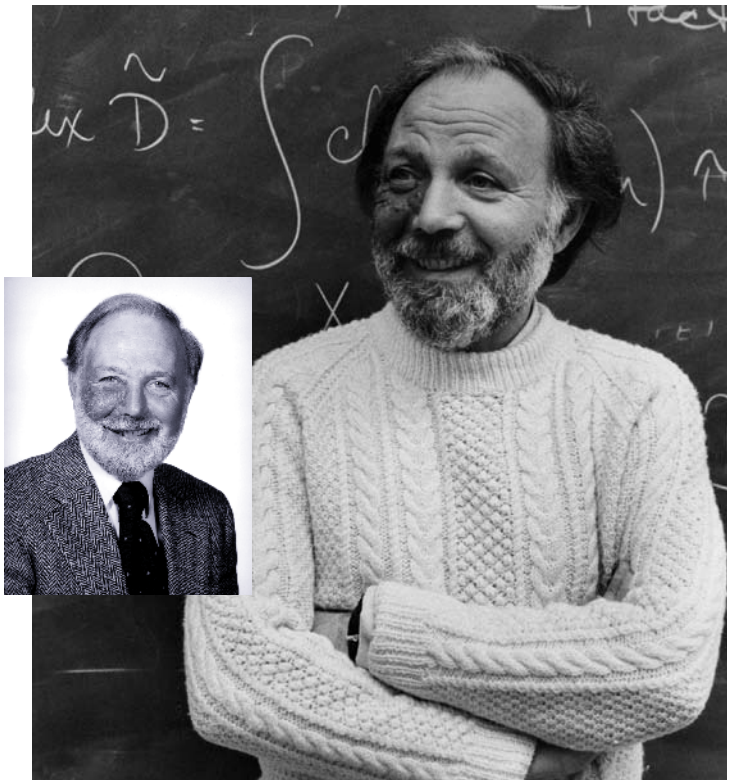
A major figure in mathematical logic, Professor Sacks' contributions impact the cornerstone of modern mathematics. Many of his contributions were in recursion theory, a precursor of today's computer science.

During the 1960s and 1970s, MIT became the premier center for logic worldwide under the stewardships of Hartley Rogers and Gerald Sacks. Twenty-nine students earned PhDs under Gerald's supervision, with a remarkably high percentage now professors at major research institutions.

In 1994, the Sacks Prize was established by admiring colleagues in honor of Professor Sacks' research and for his unique success as a graduate advisor. The Prize has since been awarded annually to the most outstanding doctoral dissertation in mathematical logic. In 1999, the Prize came under the auspices of the Association for Symbolic Logic, which administers the fund and selects the recipient through a committee.

Professor Sacks continues as a member of the Harvard faculty, where he is heavily engaged in research, conference organization, and graduate student supervision. Three of his students earned PhDs last spring.

Abel Laureate Wins MIT's Killian Award



Isadore M. Singer

Established in 1971 as a tribute to James Rhyne Killian, the Killian Award recognizes extraordinary professional accomplishment by an MIT faculty member. Isadore Singer was selected to be the Killian Award winner for 2005–06. Born in 1924 in Detroit, Professor Singer earned an undergraduate degree from the University of Michigan in 1944. After earning a PhD from the University of Chicago in 1950, he joined the faculty at MIT. Singer has spent most of his professional life at MIT, where he is currently an Institute Professor. In 2005, the Norwegian Academy of Science and Letters awarded the Abel Prize to Isadore M. Singer, Massachusetts Institute of Technology, and Sir Michael Francis Atiyah, University of Edinburgh, "for their discovery and proof of the index theorem, bringing together topology, geometry, and analysis, and their outstanding role in building new bridges between mathematics and theoretical physics."

ABEL PRISEN

The Abel Prize

In 2001, the Norwegian government announced the creation of the Abel Prize, named after the brilliant Norwegian mathematician Niels Henrik Abel (1802–1829), in commemoration of the 200th anniversary of his birth. The Abel Prize had been proposed in 1902, but the idea was abandoned when the union between the kingdoms of Sweden and Norway was disbanded. The Abel Prize is now awarded annually.

Richard Melrose Appointed to Simons Chair

Richard Melrose

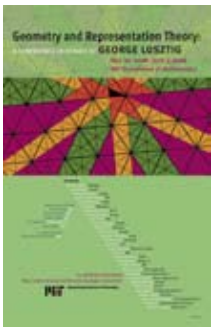
Professor Richard Melrose was appointed as chair holder of the Simons Mathematics Professorship beginning July 1, 2006.

Professor David Vogan had this to say about Richard's extraordinary contributions, "Richard Melrose is the heart of the Math Department's program in analysis: the general study of differential equations and their solutions. The department's beginnings as a serious research department came with Norbert Wiener; Richard's earliest work on wave front sets and propagation of singularities is very much in the spirit of Wiener.

"The next great monument in the history of analysis at MIT was the proof of the index theorem by Sir Michael Francis Atiyah and Isadore M. Singer in 1963. Richard's work has focused on questions related to the index theorem; roughly speaking, the relationship between solutions of differential equations on a manifold and the topology of the manifold. Richard Melrose has been doing mathematics at MIT for 30 years, and MIT is a much stronger place for his presence."

Richard Melrose holds a BS degree from the University of Tasmania, and a PhD from the University of Cambridge. He began his career at MIT as an Associate Professor in 1976. Professor Melrose received the Bôcher Prize in 1984. He is a member of the American Academy of Arts & Sciences and a member of the Scientific Advisory Board of the Clay Mathematics Institute.

Lusztig's Birthday Celebrated with Conference



From May 30 to June 3, 2006, the Mathematics Department hosted a conference on the occasion of Professor George Lusztig's 60th birthday: *Geometry and Representation Theory: A Conference in Honor of George Lusztig*.

The conference (http://math.mit.edu/conferences/lusztig60/index.html) featured lectures by 27 leading mathematicians on a wide range of topics—from representation theory and number theory to index theorems and differential geometry—reflecting the great breadth of Professor Lusztig's work. The conference attracted an international audience, with participation intense throughout its five days. On the evening of the second day, a banquet took place at the Royal East restaurant, during which Professor Singer reflected on Professor Lusztig's 35-year research career.

A 1971 graduate of Princeton University, George Lusztig was appointed professor at the University of Warwick by 1974, and had received the Junior Berwick Prize from the London Mathematical Society in 1977. He joined the MIT Mathematics faculty in 1978. His research throughout the 1970s and 1980s, partly in joint work with Pierre Deligne and David Kazhdan, brought geometric techniques and perspectives to bear on algebraic problems in finite Chevalley, p-adic, real reductive, and quantum groups. Lusztig's work transformed all these subjects, and continues to shape their development today.

In 1983, Professor Lusztig was elected a Fellow of the Royal Society; and in 1985, he received the American Mathematical Society's Frank Nelson Cole Prize in Algebra, "for his fundamental work on the representation theory of finite groups of Lie type." He was elected a Fellow of the American Academy of Arts & Sciences in 1991 and a Member of the National Academy of Sciences in 1992. Among other distinctions, Professor Lusztig was awarded the Brouwer Medal by the Dutch Mathematical Society and the Dutch Academy of Science, which is awarded every three years in a different area of mathematics (that year for algebra, including algebraic K-theory). Since 1999, Professor Lusztig has been appointed the Norbert Wiener Professor of Mathematics at MIT.

Here and Now

This space is reserved for our former students. It's fair to say we are an interesting bunch with a wealth of stories to tell. It's also fair to say we don't tell them. This is a place where we can begin to do that. What have you been up to? Maybe you have a math problem you'd like to share. Whether you are a member of the Class of 2001 or 1950, we'd like to hear from you. Email us at integral@math.mit.edu with an update!

Making the Past History

We're in the process of assembling a history of our illustrious and colorful department: the individuals, the mathematics, and the stories. History, it turns out, is personal. In short, we want to document your experience. Send us an anecdote about the time you spent within these halls. Old photographs are especially welcome. Help us paint a picture of the past. In return, we'll provide you with a bit of news and a way to keep in touch.

Send an email to integral@math.mit.edu.

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