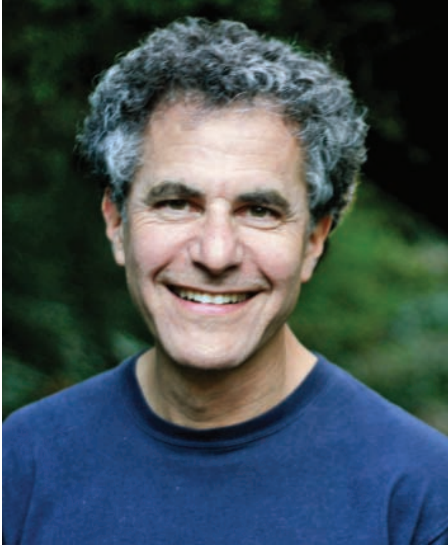


Integral

NEWS FROM THE MATHEMATICS DEPARTMENT AT MIT



Dear Friends,

Thank you!

With the wonderful generosity of our alumni and friends, we have successfully completed our first-ever capital campaign and exceeded our goal of 15 million dollars. This unprecedented achievement is already having profound benefits for our department. This year for the first time in memory, all 23 incoming graduate students will be supported by fellowships, thereby giving them complete freedom to think and study during their critical first year here. We've gained appreciation for our efforts from the MIT administration, translating into greater flexibility in our hiring and other activities. All of us are very grateful to you.

Now, as the fall term gets under way, we are delighted to welcome three new faculty: Bjorn Poonen, Scott Sheffield, and Lie Wang (pictures and bios on page 2). With Bjorn, we are elated to have a senior number theorist for the first time in twenty years. Scott is a senior probability theorist, who puts us in the forefront of recent developments in that key field. Lie covers statistics, so important for our students these days. By attracting these three accomplished mathematicians, we have taken a big step toward strengthening our department by building in critical areas, in advance of the retirement of a large number of

older faculty. This renewal process is only just beginning. Five years from now, our department will look very different.

The success of last spring's conference celebrating the many women mathematics PhDs who studied at MIT points to one difference we can look forward to—women will continue to play greater roles in our department and throughout MIT. Years ago, women were strongly discouraged from entering mathematics; only a few managed to overcome the obstacles they encountered. So imagine my pleasure when one of our PhDs from 1942—a woman—walked into my office last fall and introduced herself, saying that she had been inspired to reconnect with our department after reading *Integral*. Domina Eberle Spencer's fascinating story appears on page 4, next to a report on our recent conference for women in mathematics.

Speaking of stories, we've recently finished a history of the department, focusing on the 1950s and 1960s, as told by many of us who were here at that time. It will appear as *Recountings: Conversations with MIT Mathematicians*, published by AK Peters. See excerpts and links to purchase the book on our newly refurbished website math.mit.edu. (Use discount code INTEGRAL at publisher's website!)

For the coming year, Étienne Ghys and Robert Schapire will give the Simons Lectures, and we'll be celebrating Is Singer's 85th birthday with a conference in his honor, both events taking place in the spring. Our recruitment effort will continue with the same vigor that we've had for the past several years. The success of our recently-completed landmark fundraising project has inspired us to try to attract support for new objectives, now that our earlier goals have been met. These new objectives include establishing additional fellowships for women to carry on the progress we've made at bringing them into the field. We'll also work to obtain support for our outstanding RSI and SPUR summer programs for high-school and undergraduate students, as described on page 5. And finally, we'd like to develop a fund for visitors, because mathematics thrives from the cross-fertilization of individuals coming together from different places.

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That brings me to the last news I want to share with you before I sign off. We are beginning to envision a renovation of Building 2 as a part of MIT's overall restoration of the main group (the MIT Bosworth Building). The project is certainly a way off—for one thing, we will have to raise the necessary funds—but it's on our radar screen and we're starting to dream.

In the near term, we're considering renovating the 2-190 lecture hall into office space to relieve overcrowding. One possibility would involve turning the lecture hall into open/shared office space for first-year graduate students. This new environment would promote a sense of community within the entering group, but it might diminish contact between the new students and the older, more experienced students. If you have any thoughts on the advisability of this plan (or anything else, for that matter) please drop us a line at dept@math.mit.edu and let us know your suggestions and ideas.

Michael Sipser
Department Head

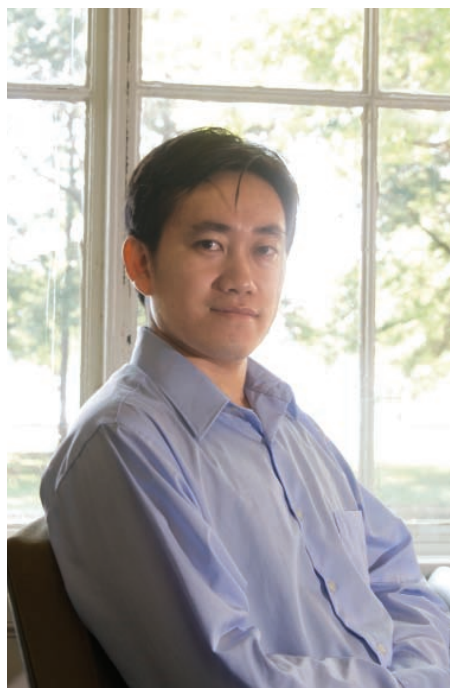
Mathematics welcomes three new faculty



Bjorn Poonen, Professor of Mathematics, comes to MIT from the University of California at Berkeley. His research focuses on number theory and algebraic geometry. He was a Putnam Fellow four times as an undergraduate, one of only seven individuals to earn that distinction in the 70-year history of the competition. He received his PhD from the University of California at Berkeley in 1994.



Scott Sheffield, Professor of Mathematics, comes to us from NYU's Courant Institute and the Institute for Advanced Study. He earned his PhD from Stanford University in 2003 and last year received a Sloan Research Fellowship and an NSF CAREER Award. His research includes probability, mathematical physics, and game theory.



Lie Wang, Assistant Professor, brings his expertise in statistics to the department. Coming to MIT from the Wharton School at the University of Pennsylvania, where he received his PhD in 2008, Lie specializes in nonparametric function estimation, high dimensional sparse regression, semi-parametric models, and functional data analysis.



Peter Shor



Tom Leighton



James McKernan



George Lusztig

Awards and achievements

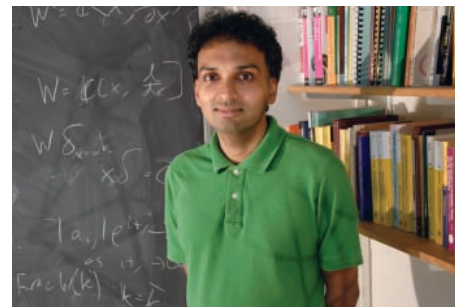
Peter Shor shared the 2007 INFORMS Computing Society Prize with co-authors for his work on the paper “On the Sum-of-Squares Algorithm for Bin Packing,” published in the *Journal of the ACM*. He also appeared in the NOVA episode “Absolute Zero” in January. **George Lusztig** was honored with the 2008 Steele Prize for Lifetime Achievement, presented by the American Mathematical Society for having “entirely reshaped representation theory, and in the process, changed much of mathematics.” **Tobias Colding** was elected Fellow of the American Academy of Arts and Sciences, and **Tom Leighton** was elected Member of the National Academy of Sciences. **James McKernan** received a Clay Research Award for his work with Christopher Hacon on birational geometry of algebraic varieties in dimensions greater than three. **Kiran Kedlaya** was awarded a Presidential Early Career Award for Scientists and Engineers [PECASE] by the National Science Foundation. In February, he finished 9th in the American Crossword Puzzle Tournament.

Undergraduates **Anand Deopurkar '08** and **Galyna Dobrovolska '08** shared the Bucseala Award for Distinguished Scholastic Achievement in Mathematics, awarded by the MIT Mathematics Department. Galyna is also the co-winner of the 2008 Alice T. Schafer Prize for Excellence in Mathematics by an Undergraduate Woman. Graduate students **Denis Chebikin** and **Aaron Tievsky** were recognized for their excellence in teaching with the Charles and Holly Housman award. The Charles and Jennifer Johnson Prize was awarded to **Ruochuan Liu** and **Ting Xue** for their outstanding published research papers. **Markéta Havlíčková** and **Yanir Rubinstein** were named 2008 Clay Liftoff Fellows by the Clay Mathematics Institute. Staff member **Tony Pelletier** won an MIT Excellence Award in the category of Fostering Community.



Left to right: Charles and Holly Housman stand with Housman Awardees Aaron Tievsky and Denis Chebikin with Michael Sipser.

Junior Faculty named to chairs



Kiran Kedlaya

Associate Professor Kiran Kedlaya was appointed the Cecil and Ida Green Career Development Associate Professor of Mathematics. Kiran is a world renowned expert on p -adic analysis, which brings the tools of real and complex analysis to problems in number theory, with applications in cryptography and coding theory. He has been coaching department undergraduates in preparation for the Putnam competition. Kiran received a PhD from MIT in 2000.



Jonathan Kelner

Assistant Professor Jonathan Kelner was appointed the KDD (Kokusai Denshin Denwa) Career Development Assistant Professor of Applied Mathematics. Jon is a rising superstar in theoretical computer science with numerous accomplishments already, including work on spectral graph theory and on the simplex algorithm. A spectacular teacher, he offered an innovative and well-attended class last year, “An Algorithmist’s Toolkit.” Jon received a PhD from MIT in 2006.

A life in full color



Domina Eberle Spencer is one of the Technicolor icons that made the MIT Mathematics Department such a remarkable place in the mid 20th century. A revolutionary thinker and indomitable intellectual explorer, the 88-year-old Spencer is the author of 8 books and more than 300 papers. A Professor of Mathematics at the University of Connecticut for the last half century, she has also taught at American University, Tufts, and Brown University.

Spencer came to MIT as a high school student in a summer program and stayed on to earn three degrees, her SB in Physics in 1939, SM in Mathematics in 1940, and PhD in Mathematics in 1942. A lifelong pacifist, she was nevertheless unafraid of confrontation if principle dictated. At the age of 15, she found herself in the center of a contretemps—on the Charles River. Participating in the annual sailboat races, she challenged the tactics of a competitor, only to discover the offending sailor was none other than MIT President Karl Taylor Compton. Spencer did not back down when she realized the identity of her opponent. She pleaded her case but lost the challenge.

Spencer was the friend, student, and colleague of a cluster of faculty who attracted the spotlight at the mid-century—Norbert Wiener, for example, one of the world's best known absent-minded professors. Wiener brought his friend Dutch mathematician Dirk Struik to MIT in 1926. Struik became one of Spencer's closest friends—and one of the reasons she pursued mathematics instead of physics. She helped him celebrate his final birthday in 2000. He was 106.

Domina Spencer married another MIT legend, Parry Moon, an electrical engineer and assistant to Vannevar Bush. Working in Bush's laboratory, Moon sustained serious injuries in an experiment designed to disprove Einstein's theory of relativity. Spencer says that Moon was assumed to be beyond help when the ambulance arrived at St. Elizabeth's Hospital, until the head of the EE Department D. C. Jackson arrived on the scene and pleaded with doctors to try and salvage "the brightest young man at MIT." Moon survived, although he was badly scarred and had lost 70% of his sight. He died a half century later in 1988 at the age of 90.

Spencer and Moon enjoyed a dynamic personal and professional partnership in which they merged their interests to develop the theory of holors, a generalization of tensors. They also produced landmark research in the engineering of illumination, work that culminated in the development of luminous ceilings. In fact, Spencer designed a luminous ceiling for her own office at the University of Connecticut. The ceiling embeds light within a painted history of her vibrant career.

Women in Mathematics: A Celebration



Many of the gifted young mathematicians of our age converged at the Women in Mathematics Conference April 12–13 at the MIT Stata Center. The two-day event celebrated the generations of women with PhDs who studied at MIT at some point in their careers. Featured guest speakers presented topics as varied as "Matrix Computations: How Fast and Accurate Can They Be" (Ioana Dumitriu PhD '03) and "Dance of the Astonished Topologist...or How I Left Squares and Hexes for Math" (Tara Holm PhD '02). Holm was assisted in her monodromy presentation by 16 members of the MIT square dancing club—The Tech Squares.

The 140 attendees from the United States, Canada, and Europe were primarily graduate students, but were joined in celebration by 40 or so established mathematicians young and old—including 88-year-old Domina Eberle Spencer, the third woman to earn her PhD in mathematics from MIT. (See companion article.)

Spencer was not the only attendee to bring a historical perspective to the proceedings. Margaret Murray, who has written extensively on women in mathematics, presented a colorful slideshow on the subject. Another discussion explored "Life Back Then: Graduates of the Sixties, Seventies, and Early Eighties." That lively panel included distinguished alumnae Lenore Blum (CMU), Susan Colley (Oberlin), Ruth Nelson (retired GTE), Ragni Piene (CMA, Oslo), and Linda Rothschild (UCSD).

MIT President Susan Hockfield and Marc Kastner, Dean of Science, spoke to the group over dinner, one of many events that provided an opportunity for socializing and community-building.

A panel of recent alumni offered advice on getting into graduate school and breaking into the field. Professor Gigliola Staffilani, faculty organizer of the event along with Assistant Professor Katrin Wehrheim, observed that the number of women who pursue academic careers in mathematics is growing. The MIT Mathematics Department is a case study in the changing genderscape of mathematics, says Staffilani, pointing to the four women on the department's faculty. She also notes that 22% of all MIT graduate students studying mathematics are women, placing the Institute among the top of leading research institutions.

SPUR & RSI

Students collaborate on problem-solving



Every summer MIT hosts a six-week mathematical research extravaganza for budding student researchers. More than two dozen undergraduate and high-school students team up with MIT Department of Mathematics graduate students to solve open-ended mathematical problems.

“The scale is mind-boggling,” notes Professor David Jerison. “Each student is presented with his or her own individual problem. Grad students and a few new PhDs, with a little help from faculty advisors, are supervising 33 different research projects this summer!”

This math blast is actually the combination of two programs—the 12-year-old Summer Program in Undergraduate Research (SPUR) for undergraduates and the 25-year-old Research Science Institute (RSI) for high-school students.

RSI, designed to provide challenging research opportunities to some of the world’s most gifted high-school science students, is sponsored by the Center for Excellence in Education in McLean, Virginia. The program fields a thousand applications every year for 80 coveted slots. Fifty participants are chosen from the United States, 30 from abroad. MIT houses all RSI students, each pursuing a specific research interest at MIT or in the Boston area. Almost a third of all RSI students this year chose to participate in the Department of Mathematics’ popular research experience.

“The goal for participants of the summer programs is not to find complete solutions,” says Jerison, “but to develop an aptitude for research—and for communicating that research.” The SPUR/RSI experience also builds the teaching and mentoring skills of the 18 or so graduate students who work with the participants of the two programs. Each is charged with devising a problem specifically for his or her mentee(s), then meets daily with the students to offer guidance and support.

At the end of the six weeks, the best student-mentor team or teams in SPUR are awarded the Rogers Prize in honor of the program’s founder Professor Hartley Rogers, who considers SPUR a powerful symbol of MIT’s recognition of “research experience as a fundamental feature of its educational program in mathematics.” Indeed, three of the undergraduates in 2007 SPUR were able to submit papers based on their work to research journals.

While Jerison is quick to point out that this summer research experience is not about competition, many alumni of RSI in mathematics have gone on to win major contests (see box at left).

Not surprisingly, the summer programs are costly to run. We are grateful to the Lord Foundation, which provided a \$66,000 grant this year to support them.

Staffilani spent her high school years on a farm in coastal Italy studying in a science-oriented school. “I never felt that I couldn’t do higher mathematics because I was a girl,” she remembers. “Quite the opposite. There, girls were expected to perform better than boys, thanks to their general strength, passion, and dedication. When I arrived in the USA as a graduate student, I was surprised to realize that here there is a sense that women just don’t have the same brainpower. Thanks to my education, this more or less subtle mindset didn’t really affect me deeply, but many other women didn’t have my luck. If during our meeting we were able to convince at least one of the participants (man or woman!) that women can do math as well as men, then the conference was a success.”

When measured in these terms, Wehrheim believes the conference did achieve its goals. She says she caught herself scanning the faces of the audience more and more frequently because of the joy she saw reflected there. “These women were transfixed by the speakers. They came here for serious math, and they were enjoying every minute of it.”

But perhaps one of the graduate student attendees best summed up the event’s unique culture. “It was all a blast!”

The idea for the conference came from alumna Susan Landau, PhD ’83, Distinguished Engineer at Sun Microsystems, where she examines the interplay between security and public policy. Landau is the recipient of the 2008 Women of Vision Social Impact Award. She served on the event’s organizing committee.

Wehrheim and Staffilani hope that Landau’s idea has launched a tradition. They’d like to see a Women in Mathematics Conference at MIT every five years.

Note: Our apologies if you did not receive an invitation to the Women in Mathematics Conference. A mailing list glitch omitted some addressees. We’ll be sure you are invited to the next one!

RSI Stars

2007–08 competitions

Sana Raouf won \$60K in a three-way tie for first place in the 2008 Intel International Science and Engineering Fair (Intel ISEF).

RSI 2007 students Benjamin Dozier and Qiaochu Yuan were named finalists (top 40; prize \$5K) in the Intel Talent Search. Ten of the semifinalists (top 300, prize \$1K) were RSI math students.

2006–07 competitions

Dmitry Vaintrob used his RSI mathematics project to win the grand prize (\$100K) in the 2006–07 Siemens Competition.

Mathematician as Entrepreneur Meet Ray Sidney, PhD '95

Photo by Marc Longwood



When Google went public, Ray Sidney's life changed forever. He had joined the company as a software engineer in 1999—one of Google's earliest employees—and retired in 2004, having learned a lesson or two from the company that wrote the book on entrepreneurship. "It was nothing short of a life-changing event," he says now.

Indeed, after retiring, Sidney picked up, moved to Tahoe, invested in some land in Douglas County, and started Big George Ventures, a company that builds eco-friendly housing. "Our flagship development is called Georgetown Village and so far consists only of dirt, sagebrush, and rabbit," Sidney jokes, "which makes it very eco-friendly." But Google started with the metaphorical equivalent of a bit of dirt and sagebrush, too. Sidney and his partner plan to build 600+ houses leaving as much land untouched as they can.

This green living enterprise is not the path Sidney envisioned when he launched his mathematics career. The son of a mathematician, he spent his childhood in Storrs, Connecticut, earned his undergraduate degree from Harvard, then went on to MIT for graduate school. "While I was at

Harvard, I spent a lot of time taking classes and just hanging out at MIT," he remembers. "When it came time to pick a grad school, I looked at how strong the MIT Mathematics Department was in the areas that particularly interested me. I thought about how much I had enjoyed the time I spent at MIT, and the decision was easy."

Sidney has stayed connected to the Mathematics Department and recently bestowed a \$308,000 gift in support of the Math Special Needs Fund. Sidney understands the impact and importance of giving back—and he realized that by supporting the Special Needs Fund, the department would have the flexibility to address its most pressing needs. When Sidney learned that the department just surpassed its first ever capital campaign to support graduate students and faculty recruitment—and that his gift was part of it—he was thrilled.

Sidney encourages other alumni to lend their support. "Think about what MIT means to you and how important your experiences there were to your life. Think about how you can best assist what a research university like MIT might call the next generation of innovators."

Donor's Corner



Left to Right: Bill Poduska, Michael Sipser, John Reed, Marc Kastner

Campaign for Math — Results Are In!

The Mathematics Department finished its first ever campaign with \$16,684,573, surpassing its \$15M goal. In April 2006, we launched the "Campaign for Math" to raise much needed funds to support graduate students and faculty recruitment. This support will allow us to keep the department at the top of its field. We will be able to attract the very best students by offering more graduate fellowships, and more endowed chairs will help us find, attract, and retain the best mathematicians in the world.

A Special Thanks

We could not have accomplished this goal without the generosity of our alumni and friends. On behalf of the Institute and the department, we'd like to thank all donors who made a gift to the "Campaign for Math" from April 2006—April 2008. And in particular, we'd like to thank and recognize John and Cynthia Reed for making their \$6M lead gift to help inspire others—and all our leadership donors who made a gift of \$50K or higher.

Leadership Donors

Anonymous
Elwyn Berlekamp
Douglas Ell
Robert E. Collins Trust
David desJardins
Charles and Jennifer Johnson
David and Helen Leighton
Tom Leighton and Bonnie Berger
Liberty Mutual Foundation
Diko Mihov
Louis Odette and Ellen Gaffney
John and Cynthia Reed
Ray Sidney
Marilyn and Jim Simons
Michael Speciner
Sam Wagstaff

Odds and ends

Pedro Reis and Tearing Tape



Perhaps you have tried to peel a fresh tomato or encountered scotch tape that won't peel off the roll in a straight line, instead producing a multitude of useless triangular scraps.

Inspired by these experiences, an international collaboration (Benoît Roman from ESPCI, Paris; Eugenio Hamm and Enrique Cerda from Universidad de Santiago de Chile; and Pedro Reis from the Applied Mathematics Laboratory, MIT) has shown why the detached films have perfect triangular shapes with a well-defined vertex angle. This is a signature of the conversion of bending energy into surface energy of fracture and adhesion.

Similar geometries are observed when peeling ultra thin films grown or deposited on a solid substrate, for example, in electronics. Another instance of this mode of tearing is common to eye surgeons when peeling the thin layer of tissue attached to the retina during surgical procedures.

The resulting triangular shapes of the tear encode the mechanical parameters related to these three forms of energy and can be used as a method for the mechanical characterization of thin adhesive films.



Pedro Reis

John Bush and Shorebirds in Science



Photo courtesy of Robert Lewis

Professor John Bush and collaborators Manu Prakash (a graduate student in MIT's Center for Bits and Atoms) and David Quéré (a visiting professor in spring 2006 from ESPCI, Paris) recently brought to light a subtle feeding mechanism employed by a class of shorebirds. The birds swim in a tight circle, drawing their prey, millimetric crustaceans, to the surface just as tea leaves are swept to the surface of a swirling tea cup. By pecking the surface, the birds capture their prey inside millimetric droplets on their beak tips. Subsequently, by opening and closing their beaks in a tweezing motion, the birds draw the droplets and their prey mouthwards in a ratcheting fashion.

A combined theoretical and experimental investigation made clear the critical role of surface tension and the beak's wetting properties on this mode of feeding, thus highlighting the sensitivity of this class of birds to chemical spills. Moreover, it suggests new directions for discrete fluid transport in microfluidic devices. Their study was reported in the May 16 issue of *Science* magazine, where a "Perspectives" piece by Professor Mark Denny of Stanford University highlights Professor Bush's recent work.

Events

Recent Birthday Conferences

Victor Kac — *Symmetries in Mathematics and Physics: a conference in honor of Victor Kac's 65th birthday*, June 22–28, 2008, at Palazzone della Scuola Normale Superiore, Cortona, Italy.

Haynes Miller — *Homotopical Group Theory and Topological Algebraic Geometry*, in honor of Miller's 60th birthday, June 23–27, 2008, in Bonn, Germany.

Bert Kostant — *Lie Theory and Geometry: the Mathematical Legacy of Bertram Kostant*, in honor of his 80th birthday, May 19–24, 2008, at Pacific Institute for the Mathematical Sciences, Vancouver, British Columbia.

Upcoming

Is Singer — 85th birthday celebration, May 22–24, 2009 at MIT, Harvard, and the Academy of Sciences. Check the Department of Mathematics website in upcoming months for details.

New Book Chronicles Mathematics Department History

A history of the MIT Mathematics Department will be published this winter by AK Peters. The department's colorful story will be illustrated by the reminiscences of a dozen or so faculty from the 1950s and 60s along with photographs from that period. Check the department's website for further information: math.mit.edu/news/recountings.html

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