Math Times

New Illinois Geometry Lab provides exciting opportunities for undergraduate research, community outreach

In Spring 2012, Assistant Professor Jayadev Athreya and Ph.D. student Anton Lukyanenko founded the Illinois Geometry Lab (IGL). Inspired by the Illinois tradition of work in Geometry and Visualization, the IGL is a community of undergraduate students, graduate students, faculty, and staff working on research involving visualization of mathematics. It is an exciting new platform both for undergraduate research and for community outreach.

The IGL recruits faculty and staff to propose research and visualization projects, graduate students to help lead the projects, and undergraduate students to participate and implement the projects, working closely with their graduate and faculty mentors.

In its initial semester, there were 8 projects, involving 7 faculty, 1 staff member, 8 graduate students, and a total of 18 undergraduate students. Projects included visualizing deSitter space (crucial to understanding modern notions of space-time); studying the relationship between music theory and geometry; understanding how one can 'deform' fractals arising from iterated function systems; and cataloging and studying the history of the Altgeld Model Collection. Some of the extraordinary images they produced are shown in the images accompanying this article; full details of the projects are available at the IGL website (www.math.illinois.edu/igl). At the end of the spring 2012 semester, the IGL held an open house, giving the enti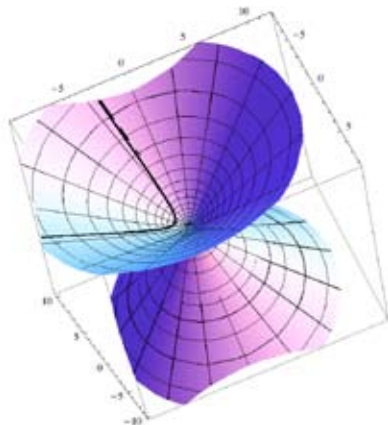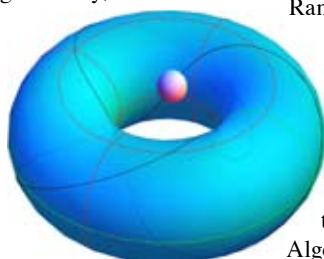re Illinois mathematics community the opportunity to see the videos, interactive tools, and images that the students had produced.

The IGL is also a great platform for introducing middle school and high school students to mathematics research. A class from Countryside Middle School made a field trip to the IGL in January. Using a laser paper-cutter, the lab prepared cardstock shapes that the visiting class could fold into various polyhedra. They had been studying measurement, so the lab explored concepts of volume by pouring rice into some of the polyhedra. The students also counted the Vertices, Edges, and Faces of the polyhedra, and discovered Euler's formula V - E + F = 2. Their visit was capped off by a tour of the library, and finally, a climb into the bell tower. A class from Rantoul High School made a similar field trip later in the spring. Other visits, both from and to schools, were held during the fall semester.

The lab has already received some external publicity. A *Scientific American* web article and slide show on Geometry Labs featured the IGL alongside the Experimental Geometry Lab at the University of Maryland and the Experimental Algebra and Geometry Lab (EAGL) at Texas Pan-American. The lab is now in its second full semester, and is growing fast, with 29 undergraduate students, 11 graduate students, and 10 faculty and staff involved in 11 projects. Current projects were on display at the IGL open house during the math department's homecoming party in October.

To learn more about IGL, visit their website at www.math.illinois.edu/igl/.

In this issue:

Ph.D. alumni reunion planned for March 2013

The department is organizing its first-ever reunion for our Ph.D. alumni to be held on campus on Saturday, March 2, 2013. We expect to have related activities on Friday, March 1, 2013 involving alumni and current graduate students. Ph.D. alums, please mark your calendars and prepare to reconnect with your former classmates and teachers, and stay tuned for more information!

The evolving details of the alumni reunion will be posted on the web at www.math.illinois.edu/reunion/. If you might be interested in attending the reunion, please pre-register by completing the form on the alumni reunion webpage.

From the department chair

It is an exciting and challenging time to be a great mathematics department at a great public university. The demand for mathematics and mathematicians has never been greater. We see this in our enrollment, which is at an all-time high, up more than 13 percent in just the last five years. We also see it in the mathematical challenges raised by scientific and technological advances in a rapidly changing world. The job of a great math department is to bring together the best faculty and the most promising students, and provide them with world-class facilities to address the mathematical challenges our time.

Our faculty, students, and alumni are making important contributions to this work. In this *Math Times*, you can read about Ph.D. alum Bill Taber's work at NASA helping to land the Curiosity rover on Mars and Prof. Marius Junge's boundary-shattering interdisciplinary work in quantum information theory.

Perhaps our most important charge is to prepare the mathematical workforce of the future. In the present landscape, our work is colored by the changing funding of public higher education and by rapidly developing technology. The hardship of increased tuition brings welcome focus on the importance of excellence in undergraduate instruction. Creative use of technology offers the possibility of enhancing instruction, but we are still learning how to use it most effectively, to put faculty in contact with students at the moment when it can most make a difference.

We have many exciting on-going projects to enhance instruction. In the last few years we have introduced collaborative active learning in our first-year calculus courses on an unprecedented scale: students work together on problems rather than watching an instructor work at a blackboard. In the Spring 2012 issue of the *Math Times*, Prof. Zoi Rapti reported on the BioMath project. This NSF-funded initiative brings together faculty from biology and mathematics to lead project-based research classes for undergraduates. In this issue, Prof. Jayadev Athreya describes the new Illinois Geometry Lab (IGL). IGL is enabling an unprecedented number of undergraduate students to get involved in research with faculty and graduate students. The ability to provide opportunities like these for our students is a great strength of the University of Illinois and of our department.

It was a pleasure to meet many of you at this year's Homecoming party. We had the unique opportunity to be photographed taking the place of Alma Mater (see pg. 11). The Alma Mater sculpture should be back next year, and I hope many of you will join us at next year's homecoming party.

Matthew Ando
Chair, Department of Mathematics

Alumnus Profile: William Taber

by Jim Dey

Since he was a young man, Bill Taber's interests have included math and the moon. In fact, the first book he ever recalls reading was about the solar system.

Later, when Taber was a sophomore at Rochester Community High School near Springfield, he fell in love with mathematics to the point that he not only majored in it at Eastern Illinois University in Charleston, but got his doctorate in the subject in 1980 from the University of Illinois at Urbana-Champaign

On August 6 of this year, in a merger of those two interests, Taber became part of history when he and his associates at the National Aeronautics & Space Administration's Jet Propulsion Laboratory landed Curiosity, a car-sized robotic rover, on Mars.

For Taber, the safe landing of Curiosity is just one of a number of highlights he's enjoyed during his 29 years at the Pasadena, California-based JPL, a career he said would have been "impossible without my experience at the UI."

"I learned an incredible amount there. Everything was interesting," he said.

Taber recalled that he decided as a graduate student to concentrate in differential geometry, a marriage of calculus and geometry, after hearing a guest lecture on the subject by UI Professor Stephanie Alexander. She later became his doctoral thesis advisor, and he remembers her with fondness.

In the wake of his celebration of Curiosity's successful landing, Taber wrote Alexander, now an emeritus professor, to tell her that "I would be remiss if I did not say to you that you played a role in this historic moment as well."

"You helped make this journey possible for me," he wrote Alexander.

One of three sons born to Nelson and Phyllis Taber, the 58-year-old Taber, a resident of Upland, Calif., recalls that he became fascinated with mathematics because it explained so much about life.

"You could discover things about the world through geometry alone," he said.

He found the fact that 180 degrees is the sum of any triangle to be revelatory.

"The fact that you could prove it was amazing to me," he recalled. "For a teenage boy, it was like being given the keys to the universe. I was hooked from then on."

Taber said he pursued mathematics "for the love of it." Only later did he discover that a "nice side effect" of his education were life-changing professional opportunities.

"It opened up a lot of doors for me," he said.

One of the biggest was at JPL, which came about in an unusual way. Taber was working for Hughes Aircraft in California when he spotted an advertisement for a job fair at JPL. He went to see what was available and soon went to work there.

"It was just one of the things that fell into my lap," he said. "Not many people get someplace like here by looking at an ad in the newspaper. But I am one of them."

Taber has been a technical group supervisor for mission design and navigation software at JPL since 2002. He supervises a group of 12 physicists, mathematicians, aeronautical engineers and computer scientists.

"We write the software that is used to design and navigate all the deep space missions," he said, defining deep space as "anything that is beyond the moon."

The staff at JPL has a lot on its plate, including missions to orbit Saturn, sending the Juno spacecraft to Jupiter, and the Spitzer Space Telescope.

But it was the landing of Curiosity on Mars that has drawn the attention of the world, and Taber said it has the potential to change the entire concept of life in the solar system. The rover's goals include conducting a number of scientific investigations to determine whether Mars is or ever was a place where life could exist. Scientists already have discovered signs that water once was present.

Taber said that if Curiosity provides evidence that there once was life on Mars "it would be one of those watershed moments in human history."

Back on Earth, Taber lives with his wife, Susan, a UI graduate in political science who works for an investment company. They have two grown sons, one in law school at the University of Arizona and the other working at Apple Computers in Boulder, Colorado.

A few years ago, thinking it would improve his management skills, he returned to graduate school to gets a Master's degree in business administration.

Taber's main hobby is cycling, and he estimates that he rides 150-200 miles per week. A long-distance runner in high school, Taber said he found some years ago that there was something missing in his life, and he decided that it was physical activity. He said cycling fills that void, and it allows him to be "a kid again."

"It's just me, the wind and the road," he said. "Cycling gives joy to my muscles."

Although his parents are still living, Taber has no family left in Illinois. So other than a job recruiting trip several years back, he hasn't been back to the UI. But Taber he said he'd love to return and deliver a lecture on the Curiosity's landing to mathematics department students.

Jim Dey is an editorial writer and columnist for The News-Gazette in Champaign-Urbana.

RESEARCH HIGHLIGHT

Connections between the theory of operator spaces and quantum information theory

A combination of lucky coincidences led to surprising connections between the theory of Operator Spaces and Quantum Information Theory (QIT). While serving as an external evaluator for a Ph.D. defense in Madrid, Spain, Professor Marius Junge was asked a question on tensor norms by two young researchers from the University of Complutense. Being a specialist in tensor norms Professor Junge could indeed answer some of their questions. One of these young researchers, David Pérez García, now a Professor at the University of Complutense, made a career change and started working at the Max-Planck Institute in Munich on QIT. Two years later, Professor Junge received an e-mail from David Pérez informing him that the estimates for tensors discussed earlier solved a twenty-year-old problem on Bell inequalities for three parties. This was the starting point for research at the intersection of Operator Algebras and QIT. More recently the groups around Perez and Junge discovered that a counterexample to a fundamental problem in QIT, the Tsirelson problem on quantum probabilities, also provides a counterexample for one of the famous open problems in Operator Algebras, the so-called Connes' embedding problem. There were some attempts to decide the Tsirelson problem with the help of a computer. Since the Connes' embedding problem resisted all attempts of solution for many years, and the two problems are so closely connected, the idea of solving either problem with a computer-assisted proof is daunting, and probably unsuccessful.
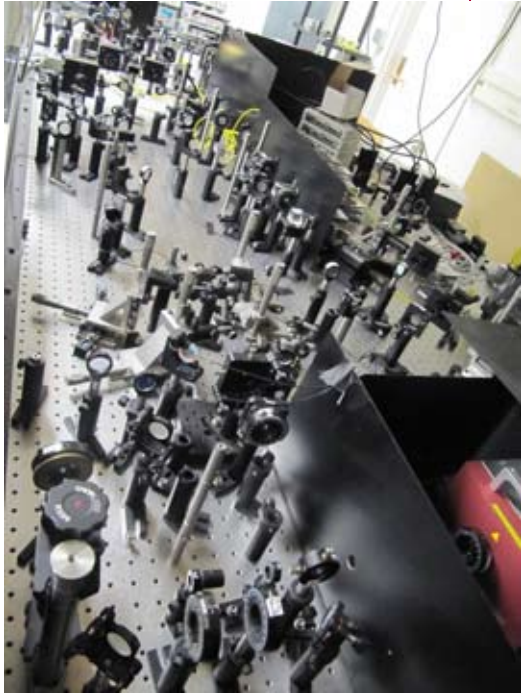
In 1935 Einstein, Podolsky and Rosen criticized the newly discovered theory of Quantum Mechanics because it had non-local features. They observed that if two photons emanate from a source at the same time one can make an experiment, based on the spin of these photons, which is in violation with any classical theory. More precisely, they discovered that no theory based on possibly unknown hidden variables could describe the outcomes observed by Alice and Bob each receiving their photon simultaneously. Of course such a paradox shook the foundations of physics at that time. In 1964 John S. Bell simplified and clarified the argument by Einstein, Rosen and Podolsky. If the largest possible value of a classical experiment is normalized to be one, then the photon experiment gives the value $\sqrt{2}$. The picture at left is from a 'loop hole free' experiment measuring this value $\sqrt{2}$, performed by the Kwiat group at the University of Illinois, and confirming with very high probability that quantum mechanical experiments are non-local (i.e. non-classical). Non-locality is also the source of teleportation, more precisely teleportation of information, not particles.

A closer look at Bell's inequality reveals that it is about correlations, that means Alice and Bob make measurements with possible outcome +1 or -1 on their photon. Around 1980 Tsirelson discovered that Bell's inequality is closely connected to work of Grothendieck from 1953. Before becoming a superstar in algebraic geometry, Grothendieck studied tensor norms and proved his famous "fundamental inequality." According to Tsirelson, Grothendieck's inequality implies that for two parties with correlations and normalized classical value 1, the violation of Bell inequality can never exceed a constant K_G whose precise value is still unknown, although it is known that $K_G \leq 1.78$. This should be compared with the value $\sqrt{2} \approx 1.41$ from the photon experiment.

Surprisingly enough Grothendieck's inequality does not rule out stronger violations if measurements with more than two answers, or more than two parties, are concerned. Professor Junge and his collaborators were able to show that in both cases very large violations can be obtained if one is able to use many photons, complicated measurements, and large Hilbert space dimensions. Operations on Hilbert spaces are crucial in the mathematical description of quantum mechanics. Nowadays, large violations are considered a resource for exploiting the advantages of quantum mechanics in Quantum Information Theory. They also serve to show robustness of certain non-local states. Very recently, computer scientists working with H. Buhrmann improved on the original estimates of Junge and his collaborators and discovered a striking connection to communication complexity.

Professor Junge also collaborates with Y. Bresler and his former student, Kiryung Lee, from the department of electrical and computer engineering at Illinois on problems in compressed sensing.

Marius Junge

Marius Junge is a Professor in the Department of Mathematics at the University of Illinois at Urbana-Champaign. He received his Ph.D. in 1991 at the University of Kiel, Germany, under the direction of Professor Herman König. In 1996 he obtained the Habilitation in Kiel, a second doctorate for university professors. He joined the faculty at the University of Illinois in 1999. Junge has received continuous funding from NSF since 2000. In 2011 Junge was appointed a J.L. Doob Scholar by the Department of Mathematics, he was named a 2011-2014 Richard and Margaret Romano Professorial Scholar in the College of LAS, and he has served as a mentor for eight postdoctoral faculty. Alongside with C. Feffermann, N. Hitchin and V. Ginzborg, he is the leader of a laboratory at the ICMAT in Madrid, Spain. His research interests include operator algebras, quantum probability, noncommutative harmonic analysis and quantum information theory. For more information see http://www.math.illinois.edu/~mjunge/.

Rui Loja Fernandes

Rui Loja Fernandes
Lois M. Lackner Professor in Mathematics
Ph.D. 1994, University of Minnesota

Rui Loja Fernandes joined the mathematics faculty at Illinois in September 2012. Before coming to Illinois, he was a Professor and Head of the Department of Mathematics at Instituto Superior Técnico, Lisbon. In 1994, he obtained his Ph.D. in mathematics at the University of Minnesota under the direction of Peter Olver. His current research interests include Poisson geometry, integrable systems and Lie theory. Together with Marius Crainic, he found a solution of the long-standing problem of integrability of Lie algebroids to Lie groupoids. He was a recipient of the Best Thesis Award of the University of Minnesota for his Ph.D. thesis and of the Calouste Gulbenkian Foundation Award for the Basic Sciences in 2001. In 2006, he became a corresponding member of the Lisbon Academy of Sciences and he joined the Executive Committee of European Mathematical Society in January 2011. He is currently the Editor-in-Chief of *Portugaliae Mathematica*, a journal published by the EMS Publishing House. He is married to a lawyer and has three children.

Philippe Di Francesco

Philippe Di Francesco
Morris and Gertrude Fine Distinguished Professor of Mathematics
Ph.D. 1989, Université Paris 6

Philippe Di Francesco will join the mathematics faculty at Illinois in Spring 2013. He received his Ph.D. in Theoretical Physics (1989) from Université Paris 6 and is a graduate from Ecole Polytechnique and Ecole des Mines de Paris. He also holds an Habilitation à Diriger des Recherches in Mathematics from Université Paris 7. He joined the Institut de Physique Théorique du Commissariat à l'Energie Atomique in Saclay, France, after his thesis. He held a postdoctoral position in Theoretical Physics at Princeton University (1989-1991) and was a Professor of Mathematics at the University of North Carolina, Chapel Hill (1996-2000). He has also held visiting positions at the University of Illinois at Urbana-Champaign, University of Michigan, Ann Arbor, and MSRI. His areas of specialization are enumerative and algebraic combinatorics, integrable models of statistical physics and more broadly physical mathematics.

Endowed professorships bring new faculty to Illinois

Two prominent mathematicians are joining the Illinois mathematics faculty in newly-created endowed professorships. These endowed positions represent an extraordinary opportunity to advance the department, and we are very grateful to Dr. Lois Lackner and to Dr. Ken and Mrs. Rebecca Fine for making them possible.

Rui Loja Fernandes is the Lois M. Lackner Professor in Mathematics. He comes to Illinois from the Department of Mathematics at Instituto Superior Técnico, Lisbon, where he was Department Head. Fernandes's recent research on Poisson geometry, integrable systems and Lie theory has led to ground-breaking publications in *Inventiones Mathematicae* and the *Annals of Mathematics*.

The Lois M. Lackner Professorship in Mathematics was created in 2011 through a generous gift from University of Illinois alumna Dr. Lois M. Lackner. In 2007, Dr. Lackner made another significant gift to the department by creating the Lois M. Lackner Fund for Female Students in Mathematics. This fund has provided scholarships and fellowships to deserving students, giving preference to female students of Czechoslovakian descent. Dr. Lackner holds three degrees from the University of Illinois: B.S. in the Teaching of Mathematics (1957), M.S. in the Teaching of Mathematics (1958), and Ph.D. in Education (1968).

Philippe Di Francesco will be the Morris and Gertrude Fine Distinguished Professor of Mathematics. Previously he held a research position at the Institut de Physique Théorique du Commissariat à l'Energie Atomique in Saclay, France. He has published over 100 papers in enumerative and algebraic combinatorics, integrable models of statistical physics and, more broadly, physical mathematics.

Dr. Kenneth B. Fine's career included 30 years of executive, management and engineering experience in the semiconductor and computer industries. Prior to retiring in 1997, Ken spent 14 years with Intel Corporation. Dr. Fine served on the Mathematics Development Advisory Board for 2010-2012. He received his B.S. (with highest distinction), M.S. and Ph.D. degrees in mathematics from the University of Illinois and also holds an honoary DBA from Eastern Michigan University.

An Investiture Ceremony will be held in February 2013 to recognize Professors Fernandes and Di Francesco and to honor the donors of these endowed professorships.

NEW FACULTY

Runhuan Feng
Assistant Professor
Ph.D. 2008, University of Waterloo, Canada

Runhuan Feng obtained his doctorate from the University of Waterloo, Canada, under the direction of Professors Jun Cai and Gordon E Willmot. Prior to joining the department, he worked at the University of Wisconsin-Milwaukee as an assistant professor. His research interest lies in actuarial/financial mathematics, applied probability and analysis.
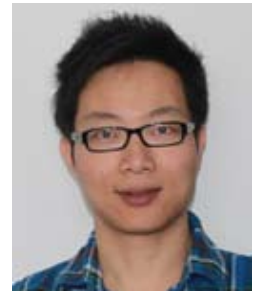
Runhuan Feng

Philipp Hieronymi
Assistant Professor
Dphil 2008, University of Oxford

Philipp Hieronymi received his DPhil from the University of Oxford in 2008 under the supervision of Alex Wilkie. He was a 2010-2013 J. L. Doob Research Assistant Professor before taking the position as Assistant Professor here at Illinois. Before coming to Illinois, he spent a year as a DAAD fellow at the Fields Institute and McMaster University. His research in logic focuses on ordered structures and their potential applications in analysis and geometry.

Philipp Hieronymi

Michael Brannan
J.L. Doob Research Assistant Professor
Ph.D. 2012, Queen's University

Michael Brannan grew up in the town of Saint Catharines, Ontario, Canada, and completed his Ph.D. in 2012 at Queen's University, Kingston, under the supervision of James Mingo and Roland Speicher. His research interests include operator algebras, quantum groups, non-commutative harmonic analysis, and free probability. Michael lives in Champaign with his wife Janina. In his free time, he enjoys running, playing drums and baking.

Michael Brannan

Francesco Cellarosi
J.L. Doob Research Assistant Professor
Ph.D. 2011, Princeton University

Francesco Cellarosi grew up in Italy, and obtained his undergraduate degree in mathematics in 2006 from the Universita' di Bologna. He then moved to the United States, where he received his Ph.D. from Princeton University in 2011 under the supervision of Yakov G. Sinai. Recently, he spent one year between the Institute for Advanced Study in Princeton and at the Mathematical Sciences Research Institute in Berkeley, CA. His research focuses on the interplay between dynamical systems, number theory, and probability theory.

Francesco Cellarosi

Ali S. Kavruk
J.L. Doob Research Assistant Professor
Ph.D. 2010, University of Houston

Ali Kavruk completed his Ph.D. at the University of Houston and continued his research as a postdoctoral fellow for a year before joining our department. His doctoral dissertation focuses on tensor products on the algebra of operators with various applications in functional analysis as well as mathematical physics. He has conducted several research projects with mathematicians from the United States, Canada and Europe. His current research interests mainly focus on Quantum Information Theory on both the theoretical and experimental level. He says Illinois is a perfect environment for research and interacting with other scholars and students. His personal interests and hobbies include soccer and music.
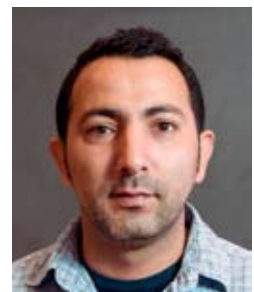
Ali Kavruk

Derrick Stolee

J.L. Doob Research Assistant Professor
Ph.D. 2012, University of Nebraska–Lincoln

Derrick Stolee received his Ph.D. in Mathematics and Computer Science from the University of Nebraska–Lincoln under the supervision of Stephen G. Hartke and Vinod Variyam. He works in graph theory and combinatorics and specializes in computational methods. In his free time he enjoys trailrunning and collecting records.

Derrick Stolee

Armin Straub

J.L. Doob Research Assistant Professor
Ph.D. 2012, Tulane University

Armin Straub is originally from Heusenstamm, Germany, but spent five years in New Orleans at Tulane University, completing his Ph.D. in 2012 under the direction of Victor Moll. A semester and two summers of that time he spent at Newcastle University working with Jonathan Borwein. Armin's research has a focus on the many aspects of special functions, especially hypergeometric and modular ones, and he enjoys working on problems highlighting their connections to number theory, combinatorics and computer algebra. During the year of 2013 he will visit the Max Planck Institute for Mathematics in Bonn before returning to Illinois for the Spring 2014 semester.

Armin Straub

Bogdan Udrea

J.L. Doob Research Assistant Professor
Ph.D. 2012, University of Iowa

Bogdan Udrea received his Ph.D. in 2012 from the University of Iowa, under the joint supervision of Paul Muhly and Ionut Chifan. His thesis contains some results about structural properties of type II_1 factors coming from actions of direct products of hyperbolic groups. His research interests include classification and structural theory of von Neumann algebras, particularly those coming from group actions on measure spaces, C^*-algebras theory and ergodic theory.


Bogdan Udrea

Jordan Watts

J. J. Uhl Research Assistant Professor
Ph.D. 2012, University of Toronto

Jordan Watts was born and raised on Prince Edward Island, the smallest province of Canada. He then moved out west to Calgary, Alberta and completed a BSc and MSc there. He then moved to Toronto, Ontario, Canada where he completed his Ph.D. under the supervision of Yael Karshon. His research interests include symplectic geometry and so-called "smootheology." In particular, in his most recent research, he tries to answer the question, "What does it mean to be smooth?" and applies the resulting theory to spaces related to Lie group and Hamiltonian group actions.
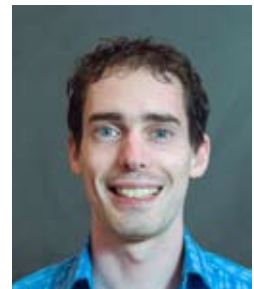
Jordan Watts

Ben Wyser

J.L. Doob Research Assistant Professor
Ph.D. 2012, University of Georgia

Ben Wyser received his Ph.D. in mathematics from the University of Georgia in 2012 under the direction of William Graham. His research interests are primarily in algebraic groups and the geometry and combinatorics of homogeneous spaces, flag varieties and symmetric spaces in particular. Originally from Mississippi, Wyser spent three years as a computer programmer in Arkansas before moving to Georgia for graduate school. He has been married to his wife Crystal for 9 years, and has two daughters, Avery (4) and Carsyn (15 months).

Ben Wyser

DEPARTMENT NEWS

Faculty Achievements

Yong named Helen Corley Petit Scholar

Associate Professor Alexander Yong (Ph.D. 2003, Michigan) has been named a 2012-2013 LAS Helen Corley Petit Scholar. Helen Corley Petit, an alumna of the College of LAS who passed away in 2002, provided an endowment for the development of the scholarship and teaching of young faculty members in the College. This is a very competitive and prestigious award. Yong works in algebraic combinatorics with a focus on the interplay with Lie theory and algebraic geometry. During his appointment, he will work with students and a postdoc to develop methods to study natural subvarieties of the Grassmannian and flag manifolds. By geometric degeneration, these subvarieties are broken into pieces which can be analyzed combinatorially. Consequently, one recovers information about the singularity problems of the initial object.

Bronski and Dunfield named Simons Fellows

Professor Jared Bronski and Associate Professor Nathan Dunfield have been named Simons Fellows in Mathematics. Bronski (Ph.D. 1994, Princeton) has research interests in nonlinear wave propagation, stability and eigenvalue problems. Dunfield (Ph.D. 1999, Univ. of Chicago) has research interests in the topology and geometry of 3-manifolds. The mission of the Simons Foundation is to advance the frontiers of research in mathematics and the basic sciences by sponsoring a range of programs that aim to promote a deeper understanding of our world. Simons Fellowships are awarded based on the applicant's scientific accomplishment and on the potential scientific impact of their work. No more than 40 fellowships are awarded each year.

Hur named Sloan Research Fellow

Assistant Professor Vera Hur (Ph.D. 2006, Brown University) has been named a 2012 Sloan Research Fellow. Her research focuses on the analysis of nonlinear partial differential equations which arise in physical contexts. In particular, she has interests in the surface water wave problem and related moving boundary problems. The Sloan Research Fellowships were established by the Alfred P. Sloan Foundation in 1955 to recognize the achievements of outstanding young scholars in science, mathematics, economics and computer science. Selection procedures for the Sloan Research Fellowships are designed to identify those who show the most outstanding promise of making fundamental contributions to new knowledge.

Gorvett elected to CAS Board and SOA Council

Associate Professor Rick Gorvett has been elected to the Board of Directors of the Casualty Actuarial Society and to the Governing Council, Education and Research Section, of the Society of Actuaries. Gorvett is the Director of the Actuarial Science Program at Illinois and he is the State Farm Companies Foundation Scholar in Actuarial Science. From its inception the Casualty Actuarial Society has grown in scientific and related contributions to all lines of insurance other than life, including automobile, fire, homeowners, commercial multiple peril, and others. The Society's governing body is the 18-member Board of Directors, four of whom are elected annually to the board for three-year terms. The Society of Actuaries (SOA) is an educational, research and professional organization dedicated to serving the public and Society members. The SOA's vision is for actuaries to be the leading professionals in the measurement and management of risk.

New Associate Chair for Faculty position created

This fall, the Department of Mathematics created a new position, the Associate Chair for Faculty. As the name suggests, the aim is to provide support for faculty, with a special focus on pre-tenure, postdoctoral and visiting faculty. The Associate Chair for Faculty will also work closely with the Mathematics Business Office to increase external funding, both of individual and large infrastructure grants, and assist the Department Chair on personnel issues.

Hal Schenck

The new Associate Chair for Faculty is Hal Schenck. Schenck received his Ph.D. (and a College of Arts & Sciences Distinguished Teaching Award) from Cornell in 1997, did postdoctoral work at Harvard and Northeastern, and was a professor at Texas A&M before joining the Illinois faculty in 2007. His research areas are commutative algebra and algebraic geometry, with a focus on applied and computational aspects. He enjoys working with graduate students and postdocs, and has recently run summer schools at Snowbird, MSRI, and Cortona. He especially looks forward to being closely involved in the mentoring of new members of the department.

Uhl postdoctoral positions

The J.J. Uhl Research Assistant Professor postdoctoral positions were established in 2011 by the Department of Mathematics at Illinois in honor of the late J. Jerry Uhl. Uhl joined the mathematics faculty at Illinois in 1968, retiring in 2008. Uhl was one of the world's leading Banach spacers, writing two books: *Vector Measures* with Joe Diestel and *The Mathematics of Non-linear Programming* with Tony Peressini and Francis Sullivan. Uhl was a leading developer of the groundbreaking Calculus&*Mathematica* program. For his contributions to teaching with the use of *Mathematica*, he was given the AMOCO Award for Innovation in Undergraduate Education in 1996, the Mathematical Association of America award for distinguished teaching in 1998, and a Pioneer Award from Wolfram Research in Champaign, IL, in 2008. Uhl passed away in 2010. In recognition of Jerry Uhl's contributions to education, part of the Uhl Research Assistant Professors' teaching will involve work with the math department's programs in online or technology-assisted education.

The department hired the first two J.J. Uhl Research Assistant Professors in 2012. Jordan Watts (Ph.D. 2012, University of Toronto) joined the department in fall 2012. His research interests include symplectic geometry and so-called "smootheology." Janna Lierl (Ph.D. 2012, Cornell), currently at the Hausdorff Center for Mathematics in Bonn, Germany, will join the department in fall 2013. Her research interests are in probability theory and stochastic processes.

First GEAR Retreats held at Urbana-Champaign campus

Not even triple-digit temperatures could dampen the enthusiasm of the participants last summer when the Department of Mathematics at Illinois hosted two retreats for over 100 members of the GEometric structures And Representation varieties (GEAR) Network.

Participants at the GEAR Retreat 2012 gathered on the steps of Altgeld Hall.

Created in September 2011 with a five-year, $2.2M grant from the National Science Foundation, the GEAR network is centered at the University of Illinois under the direction of Steve Bradlow. The network has two other main hubs at the University of Maryland (directed by William Goldman, Richard Wentworth, and Anna Wienhard) and Stanford University (Steve Kerckhoff) and additional nodes at nearly 50 locations in the U.S., Canada, Europe, India, and Singapore. The network links together a diverse group of mathematicians with common research interests in the interplay between the topology of low-dimensional spaces and the geometric structures that can be built on them.

The main GEAR Retreat this past summer brought network members together in one place to explore their common interests and to discuss the network's agenda for the coming years. This was preceded by a two-week Junior Retreat for graduate students and postdocs in the network.

Reflecting the broad range of interests represented in the GEAR network, both Retreats were structured around five themes: Dynamics on Moduli Spaces, Geometric Structures and Teichmüller Spaces, Higgs Bundles, Hyperbolic 3-manifolds, and Special Representations.

Designed to build bridges between the different interest groups, the Retreat program included broad survey talks as well as activities such as an Everything You Want To Know (EYWTK) question-and-answer session, and a panel discussion. The EYWTK session gave an opportunity for those with expertise in one area to pick the brains of the experts in other areas. The panel discussion focused on the best ways to exploit the resources of the network and also on the mathematical agenda for the coming years.

Junior Retreat mini-courses in all the main theme areas prepared graduate students and postdocs for the Retreat. Each mini-course included four hours of problem sessions which exit surveys showed were among the most popular features of the Junior Retreat. Other popular features included a Mathematical "Speed Dating" session at which participants got to find out about each other's (research) passions, and a trip to the Champaign County Fair that by all accounts changed the way the non-U.S. visitors think of deep-fried foods.

With the help of the Online & Continuing Education/ATLAS Digital Media group on campus, all Retreat talks were live-streamed over the web and recorded. The live-streaming website included an interactive comment section where viewers could submit questions or comments in real time. The recorded talks are permanently available on the GEAR website at gear.math.illinois.edu. Some of the talks have already been viewed over 600 times.

The local organizers for the Retreats, Chris Leininger, Jayadev Athreya and Spencer Dowdall, were enthusiastically assisted by graduate students Caglar Uyanik and Rasimate Maungchang, and the staff of the mathematics department.

The next GEAR Retreat will be hosted by the University of Maryland hub in 2014.

The prize winning entries in the Champaign County Best Bundle competition apparently included one with visiting GEAR Retreat members as fibers.

DEPARTMENT NEWS

IMSE symposium showcases interdisciplinary research

The Initiative for Mathematical Sciences and Engineering (IMSE) announced itself to the national community of researchers at its kickoff symposium, Critical Challenges at the Interface of Mathematics and Engineering, held on the U of I campus on September 17-18, 2012. Leaders from academia, industry, and government were invited.
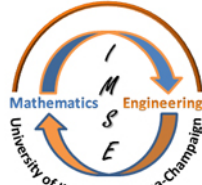
The purposes of the symposium were to bring interdisciplinary leaders to campus, to showcase the interdisciplinary research underway in the Department of Mathematics and the College of Engineering on our campus, to conduct sessions on critical research areas, and to work to define the national agenda for the collaboration of mathematics and engineering.

The program featured plenary talks by François Baccelli of the University of Texas, Austin, and Gunnar Carlsson of Stanford University, in addition to 23 other talks delivered in parallel sessions on Computing, Risks and Decisions, Networked Systems, and Stochastic Dynamical Systems. There was a stimulating panel discussion on Prospects for the Future of Mathematics and Engineering, with panelists Yuliy Baryshnikov from the Departments of Mathematics and ECE and Narayan Aluru, Director of Computational Science and Engineering from our campus, together with Ahmed Sameh from Purdue University and Jonathan Mattingly from Duke University.

IMSE is working to secure grant funding and to develop new corporate partnerships in support of our goal of becoming a national center for the interaction of mathematics and engineering.

For more information, please contact IMSE Director Sheldon Katz at katz@math.uiuc.edu and visit the IMSE website at https://imse.math.illinois.edu/.

Illinois math reception to be held at joint math meetings

The 2013 Joint Mathematics Meetings will be held January 9-12, 2013, in San Diego, CA. The Department of Mathematics at the University of Illinois at Urbana-Champaign will host a reception from 5:30 p.m. to 7:30 p.m. on Friday, January 11, 2013, in the Solana Room, located on the Level One of the San Diego Marriott Marquis and Marina.

Everyone ever connected with the department is encouraged to get together for conversation and to hear about mathematics at the University of Illinois.

Midwest number theory conference doubles attendance

On the weekend of October 12-14, the Department of Mathematics hosted the ninth Midwest Number Theory Day and Midwest Number Theory Conference for Graduate Students. The conference attracted over 80 graduate students in number theory and more than 100 participants overall, which was double the number at the last number theory meeting held at the University of Wisconsin. On Friday, six distinguished number theorists gave hour talks. These speakers included Ae Ja Yee (Penn State) and Paul Pollack (University of Georgia) who were once postdocs at Illinois. The remaining four were Amanda Folsom (Yale), William Banks (University of Missouri), Jordan Ellenberg (University of Wisconsin), and Jayce Getz (Duke). On Saturday and Sunday, there were thirty-seven 20-minute talks given by graduate students and recent Ph.Ds. This event was organized by current Illinois graduate students in Number Theory: M.Tip Phaovibul, Jennifer Lansing, and Joseph Vandehey, with guidance from Professor Bruce Berndt. The conference was supported by the NSF, the Number Theory Foundation and the Illinois Department of Mathematics.

AWM local chapter providing support for women in math

During the fall of 2010 a small group of female graduate students started the department's first local chapter of the Association for Women in Mathematics (AWM). The organization has been steadily growing, and is helping to recruit and support women graduate students at Illinois.

Part of the mission of the AWM is to provide a relaxed, supportive and stress-free environment in which women graduate students, advanced undergraduate students, postdocs and faculty in the department can interact.

So far this academic year they have hosted a Welcome Back BBQ for women in the department, organized local seminar talks, put on a Job Application Workshop, and organized an outing to Curtis Orchard. There are many more plans in the works for the rest of the year, including applying for a grant from the AWM for the department's first Sonia Kovalevsky High School Math Day for Girls. To learn more about AWM activities, visit their website at http://www.math.illinois.edu/awm/.

Members of the AWM local chapter visit Curtis Orchard in Champaign, IL.

NASA awards 5-year research grant to Illinois team to study origin and evolution of life

A University of Illinois research team was recently awarded a five-year grant totaling $8 million and will join the NASA Astrobiology Institute (NAI). The initiative is headed by Nigel Goldenfeld, Swanlund Professor of Physics and leader of the Biocomplexity research theme at the Institute for Genomic Biology (IGB), and one of the co-Investigators is Lee DeVille, Assistant Professor of Mathematics. The research team also has a significant experimental component and includes investigators in the fields of microbiology, geobiology, computational chemistry, genomics, and physics. Co-investigators on the research team include Elbert Branscomb, Isaac Cann, Bruce Fouke, Rod Mackie, Gary Olsen, Zan Luthey-Schulten, Charles Werth, Rachel Whitaker, and Carl Woese from Illinois, Scott Dawson from the University of California–Davis, and Philip Hastings and Susan Rosenberg from Baylor College of Medicine.

The main purpose of this grant is to study the origin and evolution of life by seeking to define and characterize the principles of "universal biology" (UB)—the identification of the universal principles that underlie the origins of life. UB can and does mean many things in differing contexts, but from a mathematical point of view, it can be thought of as the search for the most parsimonious logical and/or computational structure that can allow for evolution of complex self-replicating agents with a view towards explaining the open-ended growth of complexity that is ubiquitously observed in living organisms and ecosystems. One particular focus will be the mathematical basis for the emergence of evolvable dynamical processes that are capable of instantiation in molecular biochemistry and fundamentally reliant on collective effects. The study of these issues leads naturally into many questions in dynamical systems, stochastic processes, and computational complexity.

From the standpoint of mathematics and potential impacts on the natural sciences, this is a wonderful opportunity to probe some of the deepest and most tantalizing questions in theoretical biology. The ability of life to arise spontaneously and evolve structures of indescribable complexity is known; we can and do observe the results of such events. But the question remains: is the emergence of life and its concomitant complexity a rare event, or an inevitable one? Does any sufficiently rich ecosystem lead inevitably to explosions in complexity? Knowing the answers to these questions will go a long way towards telling us whether and how we can expect to find life on other planets; it will also give significant insight into the detailed workings of the one example we do know.

Grads reconnect at homecoming 2012

Department of Mathematics alumni, faculty, and students enjoyed Homecoming 2012 held in front of Altgeld Hall on a crisp fall day under partly sunny skies. With the Alma Mater sculpture temporarily away undergoing restoration, guests gathered on and around the sculpture base for a group photo (at right).

Please plan to join us next year! Mark your calendars for Homecoming 2013 which will be held Saturday, October 26, 2013. Event details will be posted on the web at math.illinois.edu/homecoming/ or visit us on Facebook (Illinois Department of Mathematics).

GRADUATE PROGRAM NEWS

Report from the Graduate Program

"Students must learn that mathematics is the most human of endeavors. Flesh and blood representatives of their own species engaged in a centuries long creative struggle to uncover and to erect this magnificent edifice. And the struggle goes on today."
—J. D. Philips, Mathematics as an Aesthetic Discipline.

Research Experience for Graduate Students (REGS). Students and faculty both enjoy the collaborative research environment of our summer REGS program. Forty incoming and continuing graduate students worked with faculty mentors on group and individual projects, tackling theoretical and computational challenges and learning early about the struggles and joys of research. Group projects in Applied Dynamics and Topology, Combinatorics, and Cluster Algebras and Integrable Systems, were complemented by smaller teams in Analytic Number Theory, Symplectic Geometry, and many more fields across the spectrum of mathematics. Every year the REGS students write numerous research papers based on their summer research. We honored some of the best projects at REGS Day 2012 (see article on page 13).

Recent Graduates. The value of an Illinois degree is confirmed by the robust success of our graduates in the job market. Of the 20 students who graduated with a Ph.D. last spring and summer, 18 are known to be employed full-time in suitable positions. Postdoctoral research and teaching positions account for half that number, including graduates who have won positions at the Institute for Advanced Study, UCLA, the University of Copenhagen, University of Pennsylvania, and other top-ranked schools. We are proud of the contributions all our graduates make to the teaching and development of mathematics.

New Student Orientation. A lively crop of 29 new students entered the Ph.D. program this Fall, with students coming from the U.S., China, South Korea, Thailand, Armenia, Greece, Kenya and India. We eased their entry to the university with a multi-day orientation program that outlined what they can expect in this first year, and provided training and resources for those students holding teaching assistantships. The concluding cook-out at George and Bettina Francis's house was a good chance to start making friends among fellow students. These bonds across the world are a vital part of our culture as a department.

The past, and future challenges. I am grateful to my predecessor, Randy McCarthy, who generously shared his advice during the transition period. Randy launched some exciting initiatives during his three years as Director of Graduate Studies, such as an expanded effort to recruit graduate students from traditionally under-represented groups. You will hear more about that effort in the next issue!

Yet we face challenges to sustain our excellence. A direct result of ever-decreasing funding from the State of Illinois is that our department cannot match the fellowship (non-teaching)

Laugesen named Director of Graduate Studies

Richard Laugesen (Ph.D. Washington University, St. Louis, 1993) was named Director of Graduate Studies this fall. He grew up in New Zealand (not on a sheep farm, although a sheep lived on an empty lot down the street). Laugesen says, "Encountering real analysis at university changed my understanding of what it means to "know" a statement was true, and led eventually to graduate school at Washington University in St. Louis."

Richard Laugesen

Then professors Don Burkholder, Jang-Mei Wu and Aimo Hinkkanen invited Laugesen to give a talk at Illinois while he was still a student. After postdoctoral positions at Michigan and the Institute for Advanced Study, Laugesen was hired by the Department of Mathematics at Illinois as an assistant professor in 1997. "I've been happily teaching and conducting research in Altgeld Hall ever since, except for weekends spent with my wife and two children in the State Streets neighborhood of Urbana," Laugesen said.

support offered to graduate students by private universities. Our competitors routinely offer their incoming students a full year of fellowship before teaching duties commence, and then another year on fellowship to assist with dissertation completion.

To match those kind of offers to the best incoming students, we must raise private funds. Fellowship support makes a huge difference to students. If this opportunity for giving appeals to you please contact me, Matthew Ando, Chair of the Department of Mathematics (mando@illinois.edu), or Patrick Hayes, Senior Director LAS Advancement (pbhayes@illinois.edu; 217-333-7108).

Where to find me. Please stop by my office, 259 Altgeld Hall, so I can introduce myself whenever you pass through town. I'd like to hear how your mathematical training shaped your life experiences. And if you know of career opportunities in industry, government or academia for our smart and dedicated Masters and Ph.D. graduates, please drop me a line and let's talk!

Richard S. Laugesen
Director of Graduate Studies
259 Altgeld Hall
E-mail: Laugesen@illinois.edu
Tel. (217) 333-3354

REGS dissertation completion fellowship and research assistantships awarded

Anton Lukyanenko has been chosen for an MCTP funded dissertation completion fellowship for the academic year 2012-2013. Anton was born in Leningrad (now St. Petersburg) in 1984 and moved to the United States in 1995. He received B.S. (2007) and M.A. (2008) degrees from the University of Maryland. His master's thesis considered projective deformations of triangle tilings. Anton's primary research interests lie in Complex Hyperbolic Spaces, from the point of view of Geometric Group Theory. His interests include geometric aspects of the Heisenberg group. He has already published two papers (one joint with Professor Ilya Kapovich) and submitted a third (joint with several authors) on related topics. Anton's advisor is Jeremy Tyson. Anton also co-founded, with Professor Jayadev Athreya, the Illinois Geometry Laboratory (see this issue's cover story).

The MCTP grant which supports REGS will also be providing new research funding for Spring 2013. Six graduate students have been selected for REGS Research Assistantships. The students (with adviser in parentheses) are Brian Benson (Nathan Dunfield), Noel DeJarnette (Jeremy Tyson), Daniel Hockensmith (Eugene Lerman), Mee-Seong Im (Tom Nevins), Brian Ray (Ilya Kapovich), Matthew Yancey (Alexandr Kostochka).

Join us on LinkedIn

Please join us on the Illinois Department of Mathematics Networking Group on LinkedIn, the world's largest professional network. The purpose of this group is to connect our alumni, students, faculty, and friends with the department and with each other. We encourage you to initiate and actively participate in the group's discussions. In addition, we will periodically broadcast news from the department. We hope to renew old Illinois mathematics connections as we also create new ones.

If you are already a member of LinkedIn, simply select "Illinois Department of Mathematics Networking" from the list of groups on the LinkedIn groups tab and then click on the "join group" button. If you are not a member of LinkedIn, you will need to join LinkedIn before you can join the group. You can sign up for LinkedIn at https://www.linkedin.com/reg/join.

We look forward to your participation in the Illinois Department of Mathematics Networking Group!

Students present summer research at REGS Day 2012

REGS Day 2012 was held Wednesday, October 17, 2012. Three students presented work from their summer research projects. A pizza party and awards presentation followed. Because 2012 is an Olympic year, the original plan was to award gold, silver, and bronze medals. The speakers were so good that we instead awarded one gold and two silver medals. Nickolas Andersen received the Gold medal; Erin Compaan and Xiumin Du each received a Silver medal.

Andersen, who worked with Scott Ahlgren, established infinitely many congruences modulo 3, 5, and powers of 2 for the overpartition function and two smallest parts functions.
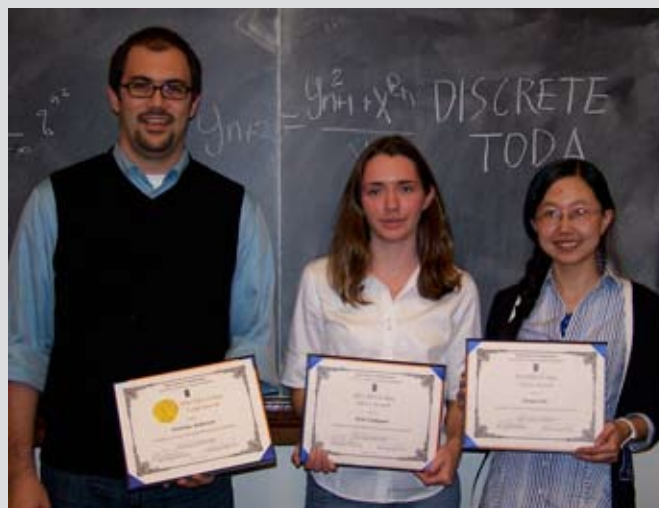
REGS Day medalists (from left) Nickolas Andersen, Erin Compaan, and Xiumin Du.

Compaan and Du worked with the cluster algebra group run by Maarten Bergvelt and Rinat Kedem. Compaan showed that certain sequences arising in cluster algebras exhibit conserved quantities and their generating functions can be expressed in closed form. Du established a relationship between tri-diagonal Lax matrices for Toda lattices and Ar Q-systems. She used orthogonal polynomials to prove a relation for discrete evolution.

The MCTP grant will continue to support REGS through Summer 2013. For more information about REGS, visit the REGS website at www.math.illinois.edu/REGS/.

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Please consider the Department of Mathematics in your estate planning. These deferred gifts can provide an easy way to make a truly significant and lasting contribution to the department. If you would like to discuss giving opportunities, please contact Sheldon Katz, Mathematics Development Committee Chair, at (217) 265-6258, or Patrick Hayes, Senior Director of Development, at (217) 333-7108.

Renming Song becomes *IJM* Editor-in-Chief

Since May 2007, Phil Griffith has served as Editor-in-Chief of the *Illinois Journal of Mathematics*. Under his leadership, significant changes have taken place in *IJM* operations, notably the outsourcing of copy editing and typesetting production services to VTEX/Mattson Publishing Services, Baltimore, MD, which has been a successful venture and partnership for *IJM*. A monograph series, started a few years ago to honor retired University of Illinois mathematics faculty, has been continued under Phil's direction with the latest book in the series celebrating the distinguished career of Don Burkholder. *IJM* participation in Project Euclid, an electronic hosting site for scientific journals, has been an important mission during Phil's tenure, with back issues of *IJM* since its inception in 1955 being archived at no cost to the journal and available electronically to subscribers. Marius Dadarlat at Purdue and Gigliola Staffilani at MIT have been welcomed to the Editorial Board, representing an ongoing effort to maintain high editorial standards for the journal. For these and other initiatives carried out during his time as Editor-in-Chief we would like to thank Phil Griffith for his service.

Renming Song, Professor, University of Illinois at Urbana-Champaign, has agreed to take over as *IJM* Editor-in-Chief, assuming the responsibilities and challenges associated with scholarly publications in today's academic environment. Renming received his Ph.D. from the University of Florida in 1993 and he joined the mathematics faculty at Illinois in 1997. His research interests are in stochastic analysis, Markov processes, mathematical physics, and mathematical finance.

For more information about the *Illinois Journal of Mathematics, visit the IJM* website at http://ijm.math.illinois.edu/.