MATHEMATICS + BERKELEY

Newsletter of the Department of Mathematics at the University of California, Berkeley

FALL 2012

MESSAGE FROM THE CHAIRS

A TIME OF RENEWAL

Dear Friends,

It is an exciting time for the Department of Mathematics, and we have a lot of news to share with you. Restarting the regular publication of this newsletter (the previous one was published over three years ago) is just one of the many new strategic initiatives taking place in the department.

New People

The department is first and foremost a community of people, and this community is evolving at a rapid pace. This fall we are excited to welcome three new faculty members whose arrival will bolster our research leadership in several areas of mathematics: Associate Professor Antonio Montalbán (mathematical logic), Professor David Nadler (geometry and representation theory), and Assistant Professor Xinyi Yuan (number theory). You will find their profiles on page 2. The renewal of our faculty will continue this year, with up to three faculty positions to be filled. We are also looking forward to the new opportunities offered by the arrival on campus of the Simons Institute for the Theory of Computing, which will invigorate research at the interface of mathematics and computer science.

Meanwhile we were sad to bid farewell to Barbara Peavy, who was the Director of Student Services for many years until her retirement this June. Although we will miss her enormously, we are very pleased to have been able to recruit Rebecca Pauling, from the Berkeley/UCSF Bioengineering program.

Chair Arthur Ogus

Co-Chair Denis Auroux

Changes to the department's leadership also include two new vice chairs: Professor Bernd Sturmfels is now Vice Chair for Faculty Affairs, and Professor Martin Olsson is our new Vice Chair for Graduate Affairs. Professor Ken Ribet continues as Vice Chair for Development, and Professors Michael Hutchings and James Sethian continue to share the duties of Vice Chair for Undergraduate Affairs.

Renovated Facilities

Perhaps the most visible sign of change in the department is the recently completed renovation of our common room, 1015 Evans. The common room serves as the main space for social interactions among the entire Berkeley math community, both during scheduled events such as the departmental teas and in the form of spontaneous, chance encounters. See the article and photos of the new common room on page 12, and please stop by next time you happen to be in Evans Hall! The next key project in the renewal of our physical spaces concerns the ninth floor of Evans Hall. We are planning to renovate the ninth floor courtyard in the near future and, if funds can be secured for that purpose, turn the adjacent mail room into a graduate student lounge.

New courses

It is often said that the basic curriculum in undergraduate mathematics has hardly changed in the last hundred years, but this is not true at Berkeley! We are inaugurating a major new addition to our lower-division courses: Math 10, Methods of Mathematics. This year-long sequence offers a fresh perspective on twenty-first century mathematics to students who intend to major in the life sciences by combining elements of calculus, statistics and discrete mathematics. The course was first taught as a pilot project by Professor Lior Pachter during the last academic year; you will find his report on page 7. This initiative comes on the heels of the recent updating of our upper division offerings, which saw the creation of new courses in mathematical biology, wavelets and signal processing, and cryptography.

Thanks

Many of the seeds for these new initiatives were planted by the dedicated stewardship of the previous chairs, Professors Hugh Woodin and Ted Slaman. Let us take this opportunity to thank

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them for their service to the department. We would also like to thank all of the department staff led by Mary Pepple for the innumerable contributions they make to the life of our department day after day.

Finally, we would like to thank all those of you who have supported the Berkeley Math Department over the past years, and those who may be thinking of doing so in the future (see page 11). In these times when the State of California is cutting back on its support to our University, and when our limited resources are placing us at risk of falling behind our better-funded private peers, contributions by alumni and other friends are essential as we work hard to maintain our standing as the top mathematics department in a public institution worldwide.

Please Stay In Touch

We hope you will keep in contact with us. Please visit our new website (see page 9). We hope you will attend some of the events listed there. We also hope you will send us your e-mail address so we can stay in touch with you and send you future issues of this annual newsletter. Please send your contact information to: newsletter@math.berkeley.edu. We look forward to hearing from you.

Arthur Ogus, Chair
Denis Auroux, Co-Chair for Strategic Planning

Professor Ogus (PhD Harvard 1972) has been a member of the department faculty since 1974. His research area is algebraic geometry. Professor Auroux (PhD Ecole Polytechnique 1999) joined the department in 2009. His research is in symplectic geometry. They became respectively Department Chair and Co-Chair for Strategic Planning in Fall 2011.

NEW FACULTY

Antonio Montalbán

Associate Professor Antonio Montalbán comes to Berkeley from the University of Chicago, where he joined the faculty in 2007. Montalbán's research area is mathematical logic, and more specifically computability theory. His work studies the complexity of mathematical objects, constructions, statements and proofs. After undergraduate studies in his native Uruguay, Montalbán obtained his PhD at Cornell University in 2005 as a student of Richard Shore; his dissertation was awarded the 2005 Sacks Prize. His more recent work earned him an AMS Centennial Fellowship in 2009 and a Packard Fellowship in 2010.

David Nadler

Professor David Nadler joins our department from Northwestern University, where he began his faculty career in 2005. Nadler's research is very broad, ranging from topology to representation theory and mathematical physics. His work illuminates central questions of modern mathematics such as the geometric Langlands program and the homological mirror symmetry conjecture. Nadler obtained his PhD from Princeton University in 2001 as a student of Robert McPherson; he was the recipient of a Sloan Fellowship in 2007.

Xinyi Yuan

Assistant Professor Xinyi Yuan comes to our department from Princeton University. Yuan is an expert in number theory, and more specifically Arakelov geometry, Shimura varieties and automorphic forms. His work studies arithmetic intersection theory, algebraic dynamics, and special values of L-functions. Yuan obtained his PhD from Columbia University in 2008 under the supervision of Shou-Wu Zhang. He was awarded a prestigious three-year Clay Research Fellowship in 2008.

FAREWELLS AND WELCOMES

Ladder Faculty

Even as we welcome three new members of the ladder faculty, Associate Professor Antonio Montalbán, Professor David Nadler, and Assistant Professor Xinyi Yuan (see their profiles on page 2), we must also bid farewell to several of our esteemed colleagues:

Professor Marina Ratner retired in July 2011; Professor Don Sarason retired in January 2012; and Professor John Neu retired in July 2012. Professor in Residence Emeritus Grigory Barenblatt will be leaving the department in November 2012. These colleagues have made many remarkable contributions to the field of Mathematics and to the Department, and we wish them well.

We are very saddened by the deaths of our former colleagues Professors Emeriti William B. Arveson, William G. Bade, and Shoshichi Kobayashi (see *In Memoriam*, page 4). The mathematical community also mourns the loss of William Thurston, who was our colleague from 1991 to 1996.

Staff

There were two departures among the department staff in the past year: Barbara Peavy, our Director of Student Services, retired in June 2012, while Lynn Greene left the department in August 2012 for a position in the Operational Excellence Program.

On the other hand, we are very happy to welcome Rebecca Pauling as our new Director of Student Services. Rebecca was previously an administrator for the joint Berkeley/UCSF graduate program in Bioengineering.

Rebecca Pauling

Prof. Marina Ratner

Prof. John Neu

Prof. Don Sarason

Barbara Peavy

New Visitors and Postdocs

The department welcomed a number of new postdoctoral fellows this fall:

Florian Block (Combinatorics), PhD University of Michigan 2011, Humboldt Foundation Postdoctoral Fellow.

Atoshi Chowdhury (Algebraic Geometry), PhD Stanford 2012, RTG Postdoctoral Fellow.

Damir Dzhafarov (Mathematical Logic), PhD University of Chicago 2011, NSF Postdoctoral Fellow.

James Freitag (Model Theory), PhD University of Illinois at Chicago 2012, NSF Postdoctoral Fellow.

Noah Giansiracusa (Algebraic Geometry), PhD Brown University 2011, NSF Postdoctoral Fellow.

Matthew Gill (Differential Geometry), PhD UC San Diego 2012, RTG Postdoctoral Fellow.

Max Glick (Algebraic Combinatorics), PhD University of Michigan 2012, RTG Postdoctoral Fellow.

Owen Gwilliam (Quantum Field Theory), PhD Northwestern 2012, NSF Postdoctoral Fellow.

Eliana Hechter (Statistical Genetics), DPhil Oxford 2011, Postdoctoral Fellow, Laboratory for Mathematical and Computational Biology.

David Li-Bland (Symplectic Geometry), PhD University of Toronto 2012, NSF Postdoctoral Fellow.

Anatoly Preygel (Algebraic Topology), PhD MIT 2012, NSF Postdoctoral Fellow.

Steven Sam (Commutative Algebra), PhD MIT 2012, Miller Research Fellow.

Ted Stadnik (Geometric Representation Theory), PhD Northwestern 2012, RTG Postdoctoral Fellow.

We are also hosting a number of distinguished Visiting Scholars, including Federico Ardila, Jean Bourgain, Mei-Chu Chang, Alberto Ibort, Franz Luef, Mariya Soskova and Masaru Tanaka. Finally, Dylan Thurston is this year's Chancellor's Visiting Professor.

Damir Dzhafarov

Noah Giansiracusa

Matthew Gill

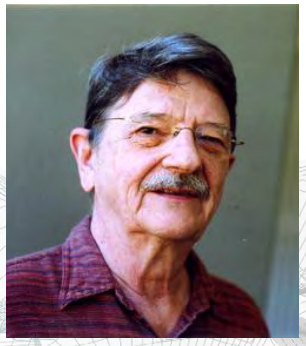
Eliana Hechter

David Li-Bland

Steven Sam

IN MEMORIAM

William B. Arveson (1934-2011)



We are very saddened by the death of our colleague Professor William B. Arveson on November 15, 2011, due to complications of surgery. Professor Arveson joined our department faculty in 1968. He had done his undergraduate studies at Cal Tech, and his graduate studies at UCLA, where he obtained his PhD in 1964 under Henry Dye. He soon came to be recognized as one of the world's leading research mathematicians studying algebras of operators on Hilbert spaces and their applications, especially to quantum physics.

Professor Arveson remained fully active in research up to the time of his death. He strongly inspired and influenced many other researchers, and in particular, the 29 doctoral students who wrote their doctoral dissertations under his guidance.

William G. Bade (1924-2012)

We sadly report the death of our colleague Professor William G. Bade, who died on August 10, 2012, at the age of 88. Professor Bade received his PhD in 1951 at UCLA under Angus Taylor. He then spent three years at Yale, where he met Philip C. Curtis, Jr; the two became close friends and longtime mathematical collaborators.

Professor Bade joined the Berkeley faculty in 1955. He and Curtis were prominent contributors to the subject of Banach algebras, which was rapidly expanding at the time. Notably, they pioneered the study of radical Banach algebras, an infinite-dimensional generalization of rings of nilpotent matrices. Professor Bade directed 24 successful doctoral dissertations, and many of his students made significant advances in the field he and Curtis had originated.

Professor Bade served for many years as our Vice Chair for Graduate Affairs. His devotion to our graduate students went far beyond the call of duty. He viewed his role not merely as a mathematical advisor but also as a personal friend.

Professor Bade retired in 1991. He is survived by his wife of 60 years, Elly, by six children, and by five grandchildren.

Shoshichi Kobayashi (1932-2012)

We were very sad to learn the death of our colleague Professor Shoshichi Kobayashi on August 29, 2012, at the age of 80. Professor Kobayashi joined our department faculty in 1962. He had done his undergraduate studies at the University of Tokyo, and obtained his PhD from the University of Washington, Seattle in 1956.

Professor Kobayashi was one of the most important contributors to the field of differential geometry in the second half of the twentieth century. His early work concerned the theory of connections; another major interest of his was the relation of curvature to topology, in particular on Kähler manifolds. The majority of his career, though, was devoted to complex geometry. Notions such as the Kobayashi pseudodistance and Kobayashi hyperbolicity have become indispensible tools for the study of mappings of complex manifolds.

Several of Professor Kobayashi's books are now standard references in differential and complex geometry, among them his two-volume treatise with Katsumi Nomizu entitled "Foundations of Differential Geometry" from which generations of students and other scholars have learned the essentials of the subject.

Professor Kobayashi served as Chair of the Department of Mathematics from 1978 to 1981, a time during which he stood up to the administration to preserve the department's space in Evans Hall. His legacy also includes the 35 PhD students whose dissertations he supervised at Berkeley.

For donations in memory of our colleagues, please see http://math.berkeley.edu/about/donate

AWARDS AND HONORS

Faculty and Staff Honors

- Professors Ian Agol, Ted Slaman and Daniel Tataru were awarded Simons Sabbatical Fellowships by the Simons Foundation;
- Professor Bernd Sturmfels was a recipient of the Sarlo Distinguished Graduate Student Mentoring Award;
- Professor Alan Schoenfeld was awarded the Felix Klein Medal for Lifetime Achievement by the International Commission on Mathematics Instruction;
- Professor James Sethian and his student Robert Saye were awarded the Cozzarelli Prize by the National Academy of Sciences for their paper "*The Voronoi Implicit Interface Method for computing multiphase physics*";
- Professors James Demmel and Olga Holtz received the Best Paper award from the SIAM group on Linear Algebra for their work "*Minimizing Communications in Numerical Linear Algebra*";
- Assistant Professor Lauren Williams received the Hellman Family Faculty Fund Award;
- Professor Lior Pachter was the recipient of the first Raymond and Beverly Sackler Chair in Computational Biology, while Professor James Sethian holds the James H. Simons Chair in Mathematics;
- Professor Denis Auroux and Visiting Professor Zvezdelina Stankova were included in The Princeton Review's Best 300 Professors list;
- Professor Ian Agol was awarded the 2012 Senior Berwick Prize by the London Mathematical Society;
- Department Manager Mary Pepple won the Chancellor's Outstanding Staff Award;

Newly promoted faculty members: from left to right, Profs. Ian Agol, Michael Hutchings, and Jon Wilkening

- SPOT Awards for Outstanding Performance were awarded to our staff members Mike Kim, Kim Oyler, Kathy Santos, and Barb Waller.

Faculty Promotions

- Ian Agol and Michael Hutchings were promoted from Associate Professor to Professor;
- Jon Wilkening was promoted from Assistant Professor to Associate Professor.

Graduate Student Honors

- The Herb Alexander Prize for an outstanding dissertation in pure mathematics was awarded to Yi Liu.
- The Bernard Friedman Memorial Prize in Applied Mathematics was awarded to Darsh Ranjan and Thomas Vidick.
- The Kenneth Ribet & Lisa Goldberg Award in Algebra was awarded to Morgan Brown.
- Rob Bayer and Ivan Ventura were awarded the Nikki Kose Memorial Teaching Prize.
- Adam Boocher, Andrew Critch, Noah Forman, Daniel Greengard, Vinicius Gripp, Alex Kruckman, James McIvor, Felipe Rincon and Peyam Tabrizian were 2011-2012 recipients of Outstanding Graduate Student Instructor Awards.
- Boaz Haberman, Alexander Shapiro and Qiaochu Yuan were awarded NSF Graduate Research Fellowships.
- Recent PhDs Melody Chan, Andrew Marks, Douglas Rizzolo and Cynthia Vinzant received NSF Postdoctoral Research Fellowships. Andrew Marks was also awarded a Turing Research Scholarship by the John Templeton Foundation.

Undergraduate Honors

- The 2011-2012 Departmental Citation was awarded to Class of 2012 Valedictorian Bharath Ramsundar.

Class of 2012 Valedictorian Bharath Ramsundar

- Sophomore Shiyu Li received a Honorable Mention for her performance in the 2011 Putnam Competition.
- Tyler Arant, Dominic Culver, Julian Landaw, Milashini Nambiar, Matthew Nichols, Bharath Ramsundar, Yohei Rosen and Zhixin Zhou were awarded the Dorothea Klumpke Roberts Prize in Mathematics in recognition of their truly exceptional scholarship.
- Brendan Bulik-Sullivan, Kelli-Jean Chun, Kabalan Gaspard, Donald Hsu, Pawarit Kreepok, Huamin Li, Danielle Maddix, Daniel Smith, River Snively and Hairan Zhu were awarded the Percy Lionel Davis Award for Excellence in Scholarship in Mathematics.

GRADUATE PROGRAM NEWS

Prof. Martin Olsson, Vice Chair for Graduate Affairs

Our graduate program remains one of the top rated graduate programs worldwide (in the most recent US News ranking of math graduate programs we tied for second place), and *the* top graduate program among public universities in the United States. The excellence, energy, and creativity of our graduate students is felt throughout the research and teaching missions of the department.

This past year we welcomed 31 new students to our PhD program. These new students were selected from an extraordinarily talented group of applications, and include some of the most promising young mathematicians both domestic and international. Among the entering cohort, 14 were international students, with 10 foreign countries represented.

Last year we awarded 31 PhDs and 7 Masters degrees. Many of these degree recipients went on to academic postdoc positions in mathematics, including prestigious positions at many of the top institutions around the world. We also saw several of our graduate students take their mathematical skills into industry positions.

Prof. Lauren Williams hosted a dinner to welcome new graduate students. From left to right: Prof. Michael Hutchings, Dr. Florian Block, Prof. Lauren Williams, and first-year PhD students Patrick Wilson, Qiao Zhou, and Grace Liu.

Our graduate students have won numerous awards and fellowships; at last year's commencement ceremony we also honored several students with departmental prizes. (see *Awards and Honors*, page 5).

Congratulations to our students who received their PhDs this past academic year!

Tonci Antunovic, "Two Probabilistic Models of Competition," under Yuval Peres and Sourav Chatterjee. Tonci is now a Hedrick Assistant Professor at UCLA.

Rob Bayer, "Lowness For Computational Speed," under Theodore Slaman. Rob is now attending medical school at the Mayo Clinic.

Morgan Brown, "Cox Rings and Partial Amplitude," under David Eisenbud. Morgan is now an RTG Postdoc at the University of Michigan.

Melody Chan, "Tropical Curves and Metric Graphs," under Bernd Sturmfels. Melody is now an NSF Postdoc at Harvard University.

Yann-Shin A. Chen, "Impulse Control and Optimal Stopping," under Craig Evans and Xin Guo. Yann-Shin is now a Quantitative Researcher at Citadel Securities.

Ka Lun Choi, "Constructing a Broken Lefschetz Fibration with a Spun or Twist-Spun Knot Fiber," under Rob Kirby.

Jeffrey Doker, "Geometry of Generalized Permutohedra," under Federico Ardila and Matthias Beck. Jeffrey now works for Bloomberg Sports in New York.

Anton Geraschenko, "Toric Stacks," under Vera Serganova. Anton is now a Bateman Instructor at Caltech.

Matthias Goerner, "Visualizing Regular Tessellations: Principal Congruence Links and Equivariant Morphisms from Surfaces to 3-Manifolds," under Peter Teichner and Ian Agol. Matthias is now a Postdoc at the University of Maryland.

Erica Isaacson, "Some Periodic Solutions of the Two-Dimensional Stokes-Oldroyd-B System With Stress Diffusion," under Jon Wilkening. Erica is now an Adjunct Lecturer at Indiana University.

Benoît Jubin, "The Tangent Functor Monad and Foliations," under Alan Weinstein. Benoît is now a Postdoc at the University of Luxembourg.

Aaron Kleinman, "Combinatorial Phylogenetics of Reconstruction Algorithms," under Lior Pachter. Aaron is now a Postdoc in Computational Biology.

Chul-hee Lee, "Algebraic Structures in Modular q-Hypergeometric Series," under Richard Borcherds. Chul-hee is now a Postdoc at the Max Planck Institute for Mathematics.

Baoping Liu, "Low Regularity Solutions of Korteweg-de Vries and Chern-Simons-Schrödinger Equations," under Daniel Tataru. Baoping is now a Dickson Instructor at the University of Chicago.

Yi Liu, "Nonzero Degree Maps Between Three Dimensional Manifolds," under Ian Agol. Yi is now a Taussky-Todd Instructor at Caltech.

Andrew Marks, "Recursion Theory and Countable Borel Equivalence Relations," under Theodore Slaman. Andrew is now an NSF Postdoc at Caltech.

Diogo Oliveira e Silva, "Oscillatory Integrals and Extremal Problems in Harmonic Analysis," under Michael Christ. Diogo is now a Postdoc at the University of Bonn.

David Penneys, "Planar Structure for Inclusions of Finite von Neumann Algebras," under Vaughan Jones. David is now a Postdoc at the University of Toronto.

Daniel Pomerleano, "Curved String Topology and Tangential Fukaya Categories," under Constantin Teleman. Daniel is now a Postdoc at IPMU.

René Quilodrán, "On Extremizers for Adjoint Fourier Restriction Inequalities and a Result in Incidence Geometry," under Michael Christ.

Alex Rennet, "Ultraproducts of O-Minimal Structures," under Thomas Scanlon. Alex is now a Postdoc at the University of Toronto.

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2011-2012 PHDS, *continued from page 6*

Felipe Rincón, "Tropical Linear Spaces and Applications," under Olga Holtz and Bernd Sturmfels. Felipe is now a Postdoc at the University of Warwick.

Douglas Rizzolo, "Scaling Limits of Random Trees," under James Pitman. Douglas is now an NSF Postdoc at University of Washington.

George Schaeffer, "The Hecke Stability Method and Ethereal Forms," under Akshay Venkatesh and Ken Ribet. George is now an RTG Postdoc at UCLA.

William Slofstra, "Strong Macdonald Theory and the Brylinski Filtration for Affine Lie Algebras," under Constantin Teleman. William is now a Krener Assistant Professor at UC Davis.

Hung Tran, "Some New Methods For Hamilton-Jacobi Type Nonlinear PDE," under Craig Evans. Hung is now a Postdoc at the University of Chicago.

Ivan Ventura, "Applications of Semiclassical Analysis to Partial Differential Equations," under Maciej Zworski. Ivan is now a Postdoc at the University of Arizona.

Alan Wilder, "Smooth Field Theories and Homotopy Field Theories," under Peter Teichner. Alan now works at Credit Suisse in New York.

Junjie Zhou, "Essays on Microeconomics," under Chris Shannon. Junjie is now an Assistant Professor at Shanghai University.

UNDERGRADUATE EDUCATION

A NEW MATH COURSE For First Year Students Planning To Major in the Biological Sciences

Prof. Lior Pachter

In a prescient opinion piece titled "Mathematics Is Biology's Next Microscope, Only Better; Biology Is Mathematics' Next Physics, Only Better" (PLoS Biology 2004), mathematical biologist Joel Cohen argued that mathematics must be the foundation for tackling fundamental questions in biology, and that conversely biology questions can inspire new mathematics. Part of the basis for these claims was the observation that biology was becoming more "quantitative" than it had been in the past. He highlighted large data collection efforts, enabled by cheap DNA sequencing and the adaptation of semiconductor technology to biology that were transforming molecular biology by probing cells at unprecedented detail, and were necessitating the need for simplifying and predictive mathematical models. Around the same time, a National Research Council committee on Undergraduate Biology Education to Prepare Research Scientists for the 21st Century published a book with its findings in 2003 with the primary recommendation that "Given the profound changes in the nature of biology and how biological research is performed and communicated, each institution of higher education should reexamine its current courses and teaching approaches to see if they meet the needs of todays undergraduate biology students."

In our own university, it was becoming clear to our colleagues in the biological sciences that course offerings in their departments needed to be revamped so that students would be learning about the new technologies affecting biology, while being trained in the tools needed to utilize them for discovery. With a vision and determination to institute the needed changes, our Dean Mark Richards and former Dean of Biological Sciences Mark Schlissel convened a meeting in the summer of 2008 with the chairs of the mathematics and statistics departments, as well as interested parties in our biology departments, to discuss specific recommendations for the increased use of mathematics, probability and statistics in biology courses. One outcome of the meeting was an agreement that a prerequisite to increasing the mathematical content of biology courses was an understanding of the current mathematical training of our biology majors. With the help of several colleagues and staff members (special thanks to Barbara Peavy and Jennifer Sixt Pinney), I began to collect data to address this question, and discovered a complex tangle of math requirements by different majors. Surprisingly, despite our offering Math 16 (math for the social and biological sciences), many biology students were taking Math 1 (for the physical sciences) while some majors were requiring very little math altogether, allowing their students to pass through the math requirement with high school coursework. There were also glaring omissions in training: for example many students were proceeding through their biology majors without any training in discrete mathematics, which has become an essential framework for evolution and genetics, and without basic knowledge of the statistics required for data analysis.

I resolved to work with colleagues in mathematics, statistics and biology to rethink appropriate math training for our biology students and the result, thanks to the collective wisdom of many colleagues, the support of our Dean and Vice Provost Cathy Koshland, help from the Physical Sciences Oncology Center and the hard work of graduate students who helped to develop material, is a new year-long course, called Math 10 (Methods of Mathematics: Calculus, Statistics, and Combinatorics). Unlike attempts at other universities to introduce "Calculus for Biology" courses, our curriculum goes beyond adding examples from biology to existing coursework. Instead, Math 10 focuses on important ideas from the mathematical sciences that are now relevant for biology and medicine, thus empowering our students and preparing them for more math in their biology courses, and also more math and statistics courses in their future.

I taught a pilot version of the course last year and this year a larger cohort is being taught by Bernd Sturmfels and Craig Evans in preparation for a full launch. I am pleased to announce that initially the Molecular and Cell Biology and Integrative Biology departments will require the

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THE BERKELEY MATH CIRCLE

Where Youngsters Fall in Love with Math

Prof. Zvezdelina Stankova, BMC Director

The Berkeley Math Circle (BMC) is a familiar sight on Tuesday evenings in the Math Department: the Department has generously hosted and been actively involved in the organization of the BMC ever since its inception in 1998.

Over the last 14 years, the circle has grown from 50 mostly high school students, learning in a single room, to 250 students in all grades 1-12, split into 7 groups at 5 levels, ranging from BMC-Elementary I (for 1st-2nd graders) to BMC-Advanced (for 9th–12th graders). However, students can elect to move up to a higher level than that suggested for their age or grade, depending on previous experience with math circles and/or contests, mathematical maturity, knowledge, and skills. This year a dozen BMC-Elementary/Beginner students switched to the BMC-Intermediate and even BMC-Advanced levels: we welcome such shifts, as long as they are initiated by the students who must feel comfortable, yet challenged enough at the new level.

Laura Pierson, a 6th grade math circler, should have been by age in BMC-Beginners; yet by talent, skills, and motivation she is one of the leading BMC-Advanced students. Last March, Laura was awarded the grand prize at the Bay Area Mathematical Olympiad (up to grade 8) with a perfect score, and having left the competition at half-time! She qualified for the USA Junior Math Olympiad (up to grade 10), which she also won on her first participation. Laura was the first ever 6th grade participant at MOSP, the summer training of the US team for the International Math Olympiads. Continuing to make history, she qualified (again as the youngest student ever) on the US team for China's Girls' Math Olympiad, where she received a silver medal in August 2012. Undoubtedly, a new (female!) math star is rising, as was apparent from the moment she stepped into the BMC-Beginners circle two years ago. The Circle helped her identify and develop her talent, exposed her to topics and ideas that she had never known existed, and nurtured her love for mathematics.

Winners of Contest 8 and BMC Staff, MSRI, May 8 2012. Front row: Charlotte Peale (2nd prize, Beginners, 7th grade), Robert Washbourne (3rd prize, Beginners, 5th grade), Arav Karighattam (1st prize, Beginners, 3rd grade), Laura Pierson (1st prize, Advanced, 6th grade). Back row: Zvezdelina Stankova (BMC Director), Evan Chen (Contest Coordinator, 10th grade), Brian Burns (2nd prize, Advanced, 10th grade), Daniel Blank (3rd prize, Advanced, 8th grade).

Laura's is not the only exceptional story at BMC. All circlers are exceptional in their own way – whether by their mathematical aptitude, or by the interest they have taken in math so early in life, or by their determination to travel from as far away as San Jose or Sacramento to the Circle every Tuesday evening. These young students have thereby put their passion for mathematics (at least once a week) above the abundance of other after-school activities available to them.

The biggest strength of BMC resides in its instructors. We are extremely proud of the diversity of our instructors: they have a variety of professional backgrounds and experiences, ranging from current math circlers to school teachers and professionals from outside-of-academia fields, and about 30% of them are women. Of course, the majority are mathematics professors, while graduate students from a number of math and science disciplines comprise more than a quarter of the instructor pool. Needless to say, UC Berkeley faculty, students, and alumni tremendously contribute to the success of the circle every year. The complete list is too long to print here, but includes such distinguished names as:

Aaron Kleinman, Alexander Givental, Alexandre Chorin, Andrew Dudzik, Austin Shapiro, Bernd Sturmfels, Bernt Wahl, Bjorn Poonen, Claudiu Raicu, Dan-Andrei Geba, Elena Fuchs, Elwyn Berlekamp, Eugene Mukhin, Grigor Sargsyan, Helmer Aslaksen, Igor Ganichev, Ilya Zakharevich, Ioana Dumitriu, Ivan Matic, James Propp, John Schulman, Keith Conrad, Kiran Kedlaya, Lilit Martirosyan, Maksim Maydanskiy, Michael Pejic, Miklos Racz, Mira Bernstein, Ngoc Tran, Olga Holtz, Paul Zeitz, Quan Lam, Robert Bryant, Robin Hartshorne, Serge Lang, Valentin Tonita, Vera Serganova, Yael Degany, and Zack Judson.

In addition to our returning veteran instructors, in the upcoming 2012-2013 year we are welcoming several new UC Berkeley and MSRI instructors to the Circle: Alex Zorn, Alexander Shapiro, and Richard Borcherds (UC Berkeley); Anna Felikson, Claudio Procesi, Frank Sottile, Gregg Musiker, Kaisa Taipale, and Karin Baur (MSRI).

Two important social highlights are the New Year and End-of-the-Year parties, hosted by MSRI for the past several years. Besides a joint session for the BMC-Upper groups (5th-12th grades) in the Simons Auditorium, these feature food brought by the BMC parents and an awards

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The elementary school students (1st-4th grades) at MSRI, with their regular session leaders Laura Givental, Elena Blanter, Ilya Zakharevich, Vera Serganova, and Sergei Ovchinnikov.

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ceremony for the best Monthly Contest papers.

What kind of problems do students tackle at the Circle and in the monthly contests? Here are two sample contest problems (by Evan O'Dorney) for your enjoyment:

Monthly Contest 1 (2012), Problem 7.
Let $n > 1$ be an integer. Three complex numbers have the property that their sum is 0 and the sum of their n^{th} powers is also 0. Prove that two of the three numbers have the same absolute value.

Monthly Contest 8 (2012), Problem 7.
In the triangle ABC, the angle at A is 60°. Let E and F be points on the extensions of AB and AC such that BE=CF=BC. The circumcircle of the triangle ACE intersects EF in K (different from E). Prove that K lies on the bisector of the angle BAC.

If you are interested in reading more about the Circle, finding solutions to the above problems, or browsing through 14 years of Circle materials, please visit the Berkeley Math Circle website at

http://mathcircle.berkeley.edu

Zvezdelina Stankova is a Professor at Mills College, a Visiting Professor of Mathematics at UC Berkeley, and the Director of the Berkeley Math Circle.

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course, and it is under consideration by many other biology majors (and even psychology). UC Berkeley has always been a leader in "quantitative biology," but we are now also providing the necessary training for the next generation of biologists who will be using "mathematical microscopes."

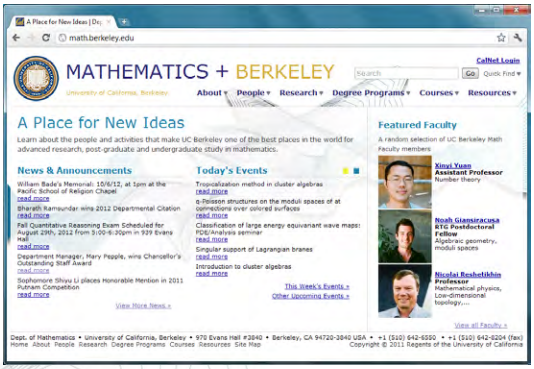
Lior Pachter is a Professor of Molecular and Cell Biology, Mathematics, and Computer Science. Professor Pachter holds the Raymond and Beverly Sackler Chair in Computational Biology. He is also the director of the Center for Computational Biology at UC Berkeley.

ALSO IN THE NEWS

New Department Website

The department's website underwent a much needed redesign last fall. The new site went live last November. Please visit us online at

http://math.berkeley.edu



The new department website.

Distinguished Lectures

Like every year, the department welcomed several distinguished speakers for its named lecture series:

- The 2011 Serge Lang Undergraduate Lecture was given on December 1st, 2011 by Jordan Ellenberg of the University of Wisconsin, on *"Set – A Laboratory in Combinatorics, Geometry, and Harmonic Analysis Pretending to be a Card Game."*
- The 2012 DiPerna Lecture was given by Emmanuel Candes of Stanford University on January 26th, 2012. The title of his talk was *"Exact Phase Retrieval via Convex Programming."*
- The 2012 Alfred Tarski Lectures were given by Per Martin-Löf, Emeritus Professor of Logic at Stockholm University, on February 21st, 22nd, and 24th. His three lectures were entitled *"Assertion and Inference," "Propositions, Truth and Consequence,"* and *"Tarski's Metamathematical Reconstruction of the Notions of Truth and Logical Consequence."*
- The 2011-2012 Bowen Lectures were given by Fields Medalist Cédric Villani of Université Lyon 1 and Institut Henri Poincaré on February 27th, 28th and 29th, 2012, about *"Many Particle Systems and Plasma Physics."*
- The 2012 Chern Lectures were given by Shiing-Shen Chern Visiting Professor and Fields Medalist Jean Bourgain, of the Institute for Advanced Studies, on April 10th, 12th, 17th and 19th, on the topic of *"Group expansion, spectral gaps and applications."*

Chern Visiting Professor Jean Bourgain

- The 2012-2013 Bowen Lectures were given by Benedict Gross of Harvard University on October 9th, 10th and 11th, 2012; his lectures were entitled *"On the arithmetic of hyperelliptic curves."*

Prof. Jordan Ellenberg delivers the 2011 Serge Lang Undergraduate Lecture.

Simons Institute

We were thrilled to learn on May 1st that Berkeley won the competition to host the new Simons Institute for the Theory of Computing, funded by a $60 million award from the Simons Foundation. The new institute, to be housed on campus in Calvin Hall and directed by University Professor Richard Karp, will explore the mathematical foundations of computer science and extend them to tackle challenges in a variety of fields. The institute will host its first scientific programs in 2013, and several of our faculty members are already slated to participate actively.

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Shanghai Rankings

According to the 2012 Academic Ranking of World Universities in Mathematics recently published by Shanghai Jiao Tong University, the UC Berkeley math department occupies the third place worldwide, just behind Princeton and Harvard. Cambridge and Stanford round out the top five.

2012 Commencement

The Department of Mathematics' 2012 Commencement Ceremony took place on May 14th in Zellerbach Auditorium. This year's commencement speaker was Emeritus Professor Freeman Dyson of the Institute for Advanced Studies. The ceremony saw over 200 mathematics and applied mathematics majors receive undergraduate degrees, while nearly 40 graduate students received Masters and PhDs; a number of departmental prizes (both graduate and undergraduate) were also awarded during the ceremony.

Prof. Freeman Dyson delivers the 2012 Mathematics Commencement Address.

From left to right: Ricardo Cortez, Ivelisse Rubio, Herbert Medina, Duane Cooper, and Suzanne Weeks. Photo credit: Duane Cooper

ALUMNI BROADEN PARTICIPATION IN MATHEMATICS

Dr. Colette Patt

Ricardo Cortez, UC Berkeley PhD (1995) and Pendergraft William Larkin Duren Professor of Mathematics at Tulane University, is the 2012 winner of the Blackwell-Tapia prize. According to the organizers, the prize recognizes a mathematical scientist who has contributed significantly to research in his or her field of expertise and who has served as a role model for mathematical scientists and students from underrepresented minority (URM) groups or has contributed in other significant ways to addressing the problem of the underrepresentation of minorities in mathematics. Cortez is internationally regarded as a leading researcher in fluid dynamics and mathematical modeling. He has also been a leader in undergraduate mentoring and the development of training opportunities for underrepresented minority students in the mathematical sciences. Cortez will be the guest of honor at the Seventh Blackwell-Tapia Conference on November 9-10, 2012.

Cortez shines in a constellation of Berkeley alumni who are dedicated not only to advancing ideas in mathematics, but also to broadening access to mathematics for minorities and women. Graduate student engagement in social issues is intrinsic to UC Berkeley's history and often is a valued aspect of the student experience at Cal. It also can help shape professional values and networks— as it did in Cortez's history of working to diversify the scientific community.

Cortez became a founding director, at MSRI Director David Eisenbud's request, of the Mathematical Sciences Research Institute Undergraduate Program (MSRI-UP) after he spoke at MSRI in 2006 about the impact of summer research experiences on increasing the participation of URMs in mathematics. Cortez called on four colleagues, including two UC Berkeley alumni, to establish the first research program for undergraduates affiliated with a prestigious national mathematics research institute: Herbert Medina (Berkeley PhD, 1992); Duane Cooper (Berkeley PhD, 1993); Ivelisse Rubio; and Suzanne Weeks. MSRI-UP's structure and focus evolved from two similar programs designed to increase URM participation in mathematics, both co-founded by Medina: one at Cornell (with Carlos Castillo-Chavez), and one at University of Puerto Rico, Humacao (with Ivelisse Rubio).

The idea for these programs, in turn, can be credited to the Berkeley Summer Mathematics Institute (BSMI), started by Leon Henkin and Uri Treisman. BSMI was one of the first programs in the country, if not the first, established specifically to inspire URM students to go into advanced careers in mathematics by engaging undergraduates in a summer of rigorous research in the context of a welcoming community of like-minded mathematicians. MSRI-UP co-directors Medina and Cooper were among those in the first small cohort of graduate students to teach in the BSMI. Cortez joined them as a graduate student instructor in a later cohort.

These programs are important to increasing diversity in the mathematics community. In MSRI-UP Cortez and his co-directors look for untapped mathematical talent within the U.S. Black, Latino and Native American communities. From 2007 to 2011, 81 undergraduates have participated in the MSRI-UP program, organized into teams. Each team has presented its research at the annual meeting of the Society for the Advancement of Chicanos and Native Americans in Science, and at least 25 students have presented their work at the Joint Mathematics Meetings.

Dr. Colette Patt received her PhD in Social and Cultural Studies in Education at UC Berkeley in 1995. She is the Director of the Science Diversity Office in the College of Letters & Sciences and of the Berkeley Edge Program.

DEPARTMENT OF MATHEMATICS,
UNIVERSITY OF CALIFORNIA AT
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The Department of Mathematics wishes to thank all alumni, parents, students, faculty, staff and friends who support the Department.

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A Note on Strategic Priorities

The Department of Mathematics is working hard to maintain its excellence in all aspects of research and education and to bridge the resource gap that separates us from our better-funded private peers. For this we rely crucially on donations from alumni and friends of the Department. Here are some of the department's top current strategic priorities:

- **Graduate Student Fellowships** are vitally needed to enable the department to make competitive, attractive offers to the very strongest applicants to our graduate program, who are otherwise often lured by our private peers with offers of higher stipends and lower teaching loads.

Note: UC Berkeley is currently offering (through calendar year 2013) a Graduate Student Support matching program for major gifts made to endow graduate student support funds.

- **Endowed Faculty Chairs** are needed in order to improve the department's ability to make competitive offers for the recruitment and retention of world-class faculty.
- **Capital Improvements** such as the renovation of the ninth floor patio and the creation of a graduate student lounge in the adjacent space: the campus is providing funds for the structural repairs but we need to raise the funds for the completion of the project (see article on page 12).
- **Research Visitor Funds** would make it easier to invite high-profile visitors to visit Berkeley to deliver lectures in our department or collaborate with our faculty. These intellectual exchanges are of tremendous value to our research and education.

Funding for these departmental priorities will enable us to meet the challenges and respond to the many opportunities for Mathematics at UC Berkeley. Knowing how important these priorities are, we have also committed to the additional goal of strengthening and expanding our fund development efforts.

We invite you to join us in keeping UC Berkeley Mathematics strong through your gifts to the department. All donations, large or small, are greatly valued. You may choose whether to direct your gift toward a specific goal of your choice or to have your donation used at the department's discretion.

We also take this opportunity to mention the 2012-13 New Alumni Challenge. Thanks to the generosity of a group of donors who are funding this challenge, a dollar-for-dollar match is available for donations made by our newest group of alumni from the classes of 2008-12 and this year's graduating class of 2013. Even small donations go a long way: for example, a $50 donation becomes a $100 gift to the Math department. Don't miss this opportunity to double your gift in support of Math and to join the ranks of those who are helping us maintain our excellence and our world-class research and education programs.

For further information, please contact Prof. Ken Ribet, Vice Chair for Development, e-mail: ribet@math.berkeley.edu

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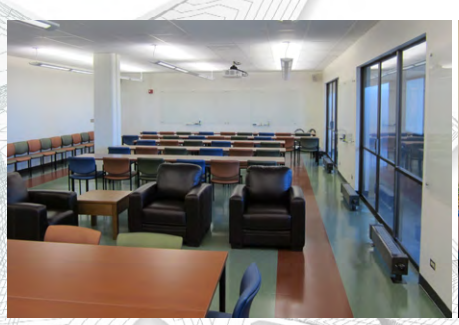
MATHEMATICS + BERKELEY

FALL 2012 NEWSLETTER


Left: Prof. Ken Ribet, Prof. Arthur Ogus, and Dean Mark Richards in the newly renovated common room; Right: undergraduates studying in 1015 Evans.

DEPARTMENT NEWS

FACILITIES UPDATE

The department has been pursuing a number of capital improvement projects to support its core missions in education and research. A number of our seminar rooms have been renovated in the recent past, and we are now turning our attention to the common spaces that make fruitful interactions among the math community possible. Two projects, one recently completed and one planned for the near future, are part of our broader goal of rehabilitating the department's most valuable spaces and turning them into functional and welcoming interaction areas for the math community at large, and for students in particular.

Common Room

We are very pleased to announce the recent completion of a major and long overdue renovation of the department's common room, 1015 Evans. The common room serves multiple roles: it is our main general-purpose interaction space, a study space for students, a social space for departmental events, and on occasion a meeting space. Its stained carpeting and tired furniture were increasingly hard to ignore, reducing the value of the space and offering a poor image of the department to our visitors.

The $250, 000 renovation project was completed over this past summer, in no small part thanks to the generosity of our colleague Professor James Sethian. The many improvements to the room include new flooring, lighting, furniture, A/V equipment and glass dry-erase boards in the main interaction space, as well as technical updates to HVAC, electrical, and plumbing systems. The small north section of the room, which did not integrate well with the rest of the space, has been split off and turned into a faculty lounge area. The main room remains accessible to graduate and undergraduate students as it has been in the past.

The project was overseen by Department Manager Mary Pepple and Building Coordinator Kathy Santos together with L&S Facilities Managers Brian Joseph and Ruben Mejia, with additional input into a number of design choices (furniture, equipment, color scheme, materials,...) provided by a departmental task force led by Professor James Sethian. We thank them all for their time and efforts.

Ninth Floor Patio

The outdoor patio area on the ninth floor of Evans Hall has fallen into disrepair and is currently not being used to its full potential. The empty fountain, which was drained in 2005 due to leaks, has been an eyesore to the math community ever since.

Funds from Campus Capital Projects will allow us to demolish the concrete patio, repair and reseal the faulty roof membrane under it, and install a paver system. This costly project will provide a sound basis for our efforts to improve the patio.

We envision that a thoughtful redesign of the patio area, accounting for traffic flow, light, noise, and weather mitigation, and the addition of suitable furniture and architectural improvements will turn the patio into a welcoming area where faculty, students, and staff can socialize during lunch breaks, and where students can work in small groups.

Following the renovation of the patio, our next project, pending the availability of department funds and the success of future fundraising efforts, will be to create a graduate student study lounge in the space currently occupied by the departmental mail room adjacent to the patio. The existing mail slots will be moved to the copy room. A study lounge with natural light has been one of our graduate students' top requests. Creating such a space next to a renovated patio will greatly improve student quality of life and make our graduate program more attractive to prospective students.