

School of Mathematics

Newsletter Volume 19, Spring 2013



Head Lines Peter Olver



Head Lines	1
Peter Olver	
Welcome to New Faculty	3
Benjamin Brubaker Dmitri Bilyk Kai-Wen Lan Arnab Sen Mike Weimerskirch	
Featured Colleagues	4
William Messing Dennis Stanton	
Symposia	6
Riviere Fabes Symposium Conference in Honor of Peter Olver 2012 Yamabe Symposium CSE Distinguished Women Scientist and Engineers Program	
Remembering Former Colleagues	7
James Serrin	
Awards and Recognition	7
Retirements	8
Harvey Keynes Dennis White	
MathCEP	9
MCIM	9
MCFAM	9
Math Library	10
IMA	10
Undergraduate Program	10
Graduate Program	11
Graduate Student Fellowship Awards Ph.D. Graduating Students	
Contacting Us	12

The older one gets the quicker time appears to pass by. And so I already find I am in the final year of my five year term as department head. I must say that it has been an incredible honor to have been given the opportunity to head such an outstanding, innovative, and remarkably active mathematics program over the past half decade. While my colleagues and Dean Crouch have just convinced me to sign on for a second term, this is nevertheless a good time to reflect on developments so far and the current trajectory of the department. While there are a few aspects requiring concern, our overall outlook, even in such difficult times, is decidedly positive, and I remain extremely optimistic about the future of mathematics at the University of Minnesota.

The first item on my list is the ongoing rejuvenation of the department through the recruitment of new faculty. After a slow start, over the last 4 years we have brought in 12 exceptional young tenure track and tenured professors. This includes an additional two tenure track assistant professors hired this year: Christine Berkesch, who specializes in combinatorics and algebraic geometry, from Duke University, while Yu-jong Tzeng, currently at Harvard University, is in algebraic and enumerative geometry. Both are superb additions to our department. Their arrival will increase the total number of women faculty to 6, which, while still lower than where I would like to be, is a welcome step in the right direction. In his role as Associate Head of the Department, Arnd Scheel has done an exemplary job facilitating the, at times, challenging hiring process. (Arnd also adeptly chairs the tenure and promotion committees, which evaluate assistant and associate professors' suitability for moving up in rank.) This year we also hired 9 new postdocs, whose wide ranging interests include probability, climate modeling, numerical analysis, combinatorics, and differential geometry.

In recognition of their influential, highly cited research contributions throughout mathematics, our faculty have been honored with many prestigious awards, while research grant funding has significantly increased in recent years. Over the past year: Tyler Lawson was promoted to the rank of Associate Professor with tenure. Hoai-Minh Nguyen and Pavlo Pylyavskyy are recipients of Sloan Research Fellowships. Jasmine Foo is the recipient of a McKnight Land-Grant Professor. Anar Akhmedov has received the Guillermo E. Borja Award. Eleven current faculty (Doug Arnold, Carme Calderer, Dennis Hejhal, Albert Marden, Andrew Odlyzko, Peter Olver, Victor Reiner, Mikhail Safonov, Fadil Santosa, George Sell, Dennis Stanton), and three emeriti (Don Aronson, Robert Ellis, Hans Weinberger) were named members of the Inaugural Class of Fellows of the American Mathematical Society. Hans Othmer was named a Fellow of the Society for Industrial and Applied Mathematics (SIAM). Svitlana Mayboroda is the first recipient of the AWM-Sadosky Research Prize in Analysis. Emeritus Professor Willard Miller, Jr., and former Ph.D. student Sarah Post (now at the University of Hawaii) were awarded a 2012 Journal of Physics A Best Paper Prize. Sadly, Emeritus Regents Professor Jim Serrin, one of the giants of modern analysis, passed away last August and will be sorely missed by all; an obituary outlining his career and remarkable accomplishments appears later in this issue.

I am particularly proud of the ongoing improvements to our graduate program. Dick McGehee continues to serve as an outstanding Director of Graduate Studies, and his hard work and dedication is paying ample dividends. We now have an exceptionally diverse graduate student body. Indeed, other department chairs have asked me how we are able to attract such a high percentage of females, as well as increasing numbers from underrepresented groups. The secret is to foster a vibrant and welcoming community among the students, recruit aggressively, and develop pipelines so that students in residence attract and mentor the new arrivals. Moreover, we are at an all-time high for graduate fellowships; next year we will have 7 NSF fellows, 7 CSE fellows, and 2 DoD fellows! A recent innovation is the introduction of a new required course, Math 8001 Preparation for College Teaching, run by Bryan Mosher and Jon Rogness, that prepares graduate students for their teaching duties and other aspects of the profession, including research, jobs, grants, ethics, and so on.

Bryan Mosher continues as our hard-working Director of Undergraduate Studies, now ably assisted by Mike Weimerskirch who started this year as Lower Division Math Coordinator. Despite the stresses of the continuing increase in student demand for our courses, particularly those at the advanced undergraduate level, Bryan, Mike, and the staff in the Undergraduate Office are doing an outstanding job keeping the program on an even keel. The integration of the extension classes into our regular offerings went without a hitch. Of especial note is a new introductory course, Math 1241, geared to undergraduate biology majors, which has been developed in consultation with representatives from the College of Biological Sciences, and now taught by

Duane Nykamp. The impending tsunami in online instruction, including videotaping lectures and supplementary materials, flipping the classroom, and Massively Open Online Courses (MOOCs) has not gone unnoticed here, and several initiatives, including the aforementioned Math 1241, are under active discussion.

Another notable development during my tenure has been the creation of the Minnesota Center for Financial and Actuarial Mathematics (MCFAM) that both reinvigorated our undergraduate actuarial program by combining with our increasingly successful Masters of Financial Mathematics program. The rapid growth and development of the MCFAM programs, thanks to the expert and innovative stewardship of its Directors Rina Ashkenazi and Laurie Derechin, has resulted in wide-ranging recognition, both locally and nationally, of its increasing impact in the financial and actuarial industry.

Another significant development was the successful re-incorporation of our Center for Education Programs (MathCEP) and subsequent administrative transition as its indefatigable founder, Harvey Keynes, who is retiring this year, passed the baton to its current Director, Jon Rogness. The MathCEP programs, particularly UMTYMP, are well recognized throughout the Twin Cities area and beyond. Similarly, Dan Spirn continues to ably direct our Center for Industrial Mathematics (MCIM) and its programs, connecting students and faculty with local and national industries.

Underpinning it all, and without whom nothing would be possible, is our amazing staff. From scheduling classes, managing grants and reimbursements, handling students in all capacities, writing memos and letters, preparing and duplicating exams, quickly solving problems as they arise, and on and on, the staff form the bedrock of the department, and the oil that makes all the component parts run smoothly and (usually) quietly.

Finally, last May I was deeply honored by a conference held here for my sixtieth birthday. (We won't discuss the downside of it all making me feel old!) Over 100 attendees included many current and former students, colleagues, collaborators, close friends, and new acquaintances. I was particularly grateful that almost all of my family, including my wife Cheri, children Pari, Sheehan and Noreen, Pari's fiancée, now husband, Rowan, as well as my father Frank and his wife Claire (sadly my mother Grace passed away in 1980) and my sister Sally and her husband Neal were able to attend. I thoroughly enjoyed the splendid and wide-ranging lectures delivered by leading researchers in the many areas near and dear to me. The conference highlight was the banquet and many speeches, stories, photos, and jokes (not all at my expense). All in all, an overwhelming experience, and one that I will never forget!

While finishing this piece, I received the very sad news that my father, Frank W.J. Olver, a celebrated mathematician and leader in the field of asymptotics and special functions, passed away on April 23, 2013. His death leaves a great void, both personally and mathematically, that can never be filled

Thanks as always for your continued interest in and support of the School of Mathematics. If you have any comments, questions, or suggestions, please don't hesitate to stop by, call, or send me email.

Mathematically yours,
Peter Olver

Welcome to New Faculty

Benjamin Brubaker

Ben Brubaker joined the School of Mathematics as an Associate Professor in the fall of 2012. He received his Ph.D. in 2003 from Brown University under the direction of Professor Jeffrey Hoffstein. He spent three years as a Szegő assistant professor at Stanford University before taking a position at MIT. During his six years at MIT, Professor Brubaker was an Assistant and then Associate Professor, and held a Cecil and Ida B. Green career development chair. In 2008, he was awarded a Career Grant from the National Science Foundation. His primary research



interests are in automorphic forms and representation theory, where he studies discrete analogs of solutions to important classes of differential equations.

Professor Brubaker received his undergraduate degree from Amherst College, where he graduated Summa Cum Laude in 1998. Originally, he had intended to be a double major in French literature and physics, but kept getting drawn in by the gradually unfolding mysteries of his mathematics courses (and realized that great French novels are better enjoyed when they aren't your vocation). When asked about his choice of number theory as a specialization, Prof. Brubaker gives two reasons: "I like that number theory is defined by the questions it asks and not by means necessary to answer them. So number theory borrows tools from all subjects in mathematics, which means you get to interact with many different colleagues." And second: "A very wise undergraduate professor told me to pick your advisor in graduate school, not your subject area. It just so happened that the best fit for me as an advisor was a number theorist."

Dmitri Bilyk

As an undergraduate, between 1996 and 2001, Dmitri Bilyk studied at the Kharkiv National University in Kharkiv, Ukraine, where he obtained an M.Sc. in Mathematics and became interested in functional analysis. In 2001 he entered graduate school at the University of Missouri in Columbia, MO. There he started working in harmonic analysis and wrote a thesis with the title 'Distributional estimates for multilinear operators' under the advisement of Loukas Grafakos, which he defended in 2005. From 2005 to 2008 Bilyk held a postdoctoral position at the Georgia Institute of Technology. In the spring of 2008 he spent a semester as a visiting fellow at the Fields Institute in Toronto, ON. During the academic year 2008-2009 Dmitri was a visiting researcher at the Institute for Advanced Study in Princeton, NJ. After that, in 2009, he joined the faculty of the Department of Mathematics at the



University of South Carolina and in 2012 he joined the School of Mathematics of the University of Minnesota as a tenured Associate Professor.

Kai-Wen Lan

Kai-Wen Lan was born in Taipei, Taiwan in 1979 and grew up there. His family is from Peng-Hu, a beautiful archipelago sitting in the middle of the Taiwan Strait. They work in the business of shipping and tourism, and mathematical research was (and probably still is) an alien notion to them. Nevertheless, they have been open-minded and supportive of Kai-Wen's career decisions.

He began his undergraduate study at the National Taiwan



University in 1995, and obtained his B. S. and M. S. degrees in mathematics in 1999 and 2001, respectively. During these years, he tried all kinds of mathematical topics available to him: at least for a year, he thought he would be doing either differential geometry or abstract algebra. In the end, he was most attracted by algebraic number theory and arithmetic algebraic geometry, because he found it mesmerizing that the symmetry of manifolds and the

symmetry of algebraic numbers can be at all related.

After finishing his military service in 2003, he went to Harvard University for his Ph. D. degree, and worked under the supervision of Richard Taylor. It was a very exciting environment for him, with many energetic and inspiring people around. In retrospect, he believes that he learned no less from the fellow graduate students than from the faculty members, during numerous hours of student seminars and late nights. He graduated in 2008 and was awarded a Clay Liftoff Fellowship that summer. His thesis carried out a uniform construction of good compactifications over integers for a large class of Shimura varieties, which supplied the logical foundation for several exciting recent developments in algebraic number theory. He continued this work, at the same time expanding his interests, as a Veblen Research Instructor at Princeton University from 2008 to 2011

Arnab Sen

Arnab grew up in a small town near Kolkata in India. In 2001, he got admission in the bachelor of statistics program at Indian Statistical Institute, Kolkata through a very competitive entrance exam. He obtained his bachelor degree in 2004 and joined the master's program in statistics with an emphasis on mathematical statistics and probability at the same institute. In the final year of his master's program he did a project on random matrix theory under the direction of Arup Bose. This turned out to be a key turning point of his academic career. Suddenly the theory of probability became much more appealing to him than statistics.



He came to the US in 2006 to start his PhD in University of California at Berkeley. He was awarded a Loève Fellowship at Berkeley. There he found a very stimulating environment to do

research in probability. He started working with two advisors - Steve Evans and Elchanan Mossel. Having two advisors with contrasting research interests gave him a unique opportunity to explore and work in different areas of probability including coalescing particle systems, random matrices and discrete harmonic analysis. His thesis includes a chapter from each of these three topics. With his collaborators, he was also involved in a project where they studied certain stochastic differential equations arising from population biology. He was awarded the PhD in 2010.

He did a postdoc at Cambridge University in England from 2010 to 2012. Nathanael Berestycki was his postdoctoral supervisor at Cambridge. With him and Christophe Garban, he started investigating the noise sensitivity properties of certain coalescing particle systems. During his postdoctoral years, he also begun collaborating with Balint Virag on random matrices and random graphs including some questions related to random Schrodinger operators and still continues to do so. Arnab arrived in Minnesota in Fall 2012.

Mike Weimerskirch

Mike Weimerskirch earned his Bachelor's Degree from Northwestern University in 1985 and his Ph.D. from the University of Minnesota in 2007. In between, he taught in high schools in the Twin Cities area. He worked with Bert Fristedt for his thesis in Combinatorial Game Theory and continues to conduct research in that area. He is also interested in probability theory and its application to ranking sports teams, and has appeared occasionally on NPR talking about math and sports. After graduating in 2007, Mike held Visiting Assistant Professor positions at St. Olaf, Macalester and Augsburg before returning to the U of M this fall as a faculty member.



Featured Colleagues

William Messing

Our colleague, Bill Messing, was born in the garden spot of America: Brooklyn, New York. His father was a dentist, and his mother was an elementary school teacher. She came of age during the Spanish Civil War, and it is under her influence that Bill became fond of left wing political music including 'The East Is Red', 'The Ballad Of Ho Chi Minh', and 'Freiheit'.



Bill became interested in mathematics and girls when he stopped being interested in sports, at about the age of thirteen. Part of his early mathematical education came from Sunrise Semester, a 6am television program, where John Kelley, the Berkeley topologist, lectured on modern algebra. This is how Bill learned about groups, rings and fields. His willingness to get up this early convinced his parents that he was serious about mathematics.

Bill attended the Samuel J. Tilden High School together with Steve Sperber. They were both on the mathematics team, which meant they would meet four days a week to practice, and then compete against other high schools on Fridays. When the time came to decide on what to do after high school graduation, his extended family, which had four dentists, decided that he lacked the needed manual dexterity and Bill was discouraged from pursuing dentistry, something he had zero interest in. He decided that he wanted to be a mathematician. Bill attended Brooklyn College, which was free, except for a four dollar per semester fee entitling one to use the Student Union building. In fact he was paid \$600 a year, thanks to winning a Regents Scholarship. He remembers this time as idyllic, and says he enjoyed the company of several other future mathematicians, such as Steve Sperber, Jay Goldman, Larry Smith, William Kantor, and Robert Kaufman, and had wonderful teachers such as George Booth and Moses Richardson.

While in graduate school at Princeton, Bill first thought he would do topology. However, there were no standard courses, and in his first semester, the only course offering in the area was a topics course on non-simply connected surgery aimed at faculty rather than first year graduate students. Bill was also very interested in algebraic geometry and decided to study this subject instead.

He ended up talking often with Princeton professors Nick Katz and Bernard Dwork, and was greatly encouraged and influenced by the magnificent figure of Grothendieck. Bill considers himself to be very lucky that the Princeton mathematics library was so good and that it included the SGA seminars, which were not well circulated outside of Paris at the time. Bill first met Grothendieck in September 1966 when the latter gave a series of lectures at Haverford ranging from basics of algebraic geometry to his thoughts concerning crystalline cohomology. A 1970 summer school at University of Montreal, where Grothendieck, Nagata, and Artin lectured, was also especially influential, leading to his eventual thesis problem.

In addition to Grothendieck, some of the mathematicians that have influenced Bill are Artin, Katz, Mazur, Quillen, Serre and Tate. He was also inspired by Grothendieck's students from that time period, Illusie, Berthelot, Raynaud, and Deligne, with all of whom Bill remains close. Bill considers working with Grothendieck one of the great experiences of his life, and he was especially impressed with Grothendieck's ability, in marvelous fashion, to see how things would go and what he would do, over a fourteen year period, as described in his 1958 ICM lecture. Bill also has a deep appreciation of Grothendieck's whole approach to mathematics. To quote Bill and a beautiful metaphor of Grothendieck's, 'He saw very very deeply how to approach understanding mathematics, and his idea was you don't try to use a sledgehammer to crack a problem, you treat it like it is some hard nut whose shell you can't break. So what you do,' as Grothendieck wrote in *Recoltes et Semailles*, 'is you bury it in the snow and when it has been there for three months, Spring has come, the shell has softened, so you can simply open it with your fingers.' The idea was that in mathematics, if you find that right way to understand, everything becomes simple and natural and easy."

Among Bill's best work is his paper with Katz in *Inventiones* on consequences of the Riemann hypothesis for varieties over finite fields. He is also proud of his work with Fontaine on p -adic

Hodge theory, and of his work on crystalline Dieudonné theory with Berthelot and Breen. He is very optimistic about the future of mathematics, thinking that we will never run out of good questions to explore.

In his career, Bill was employed by the IHES, MIT, UC Irvine and finally by the University of Minnesota. He plans to stay here and hopes to produce interesting mathematics for many more decades.

Dennis Stanton

Dennis Stanton was born near Des Moines, Iowa, a locale he describes as Minnesota without Minneapolis. His hometown is a thriving suburb now but was in the initial stages of suburbia when he was growing up. His father worked on the railroad and his mother was a housewife turned bus driver. Dennis was the second of six children, and their family also had a number of cats and dogs. He says that he was a cat person



from a young age, but his affinity toward felines might also be related to his scar with the uncanny shape of a dog's mouth.

Although Dennis is now an avid golfer, baseball fan and aficionado of classical music, ballet, and cinema, growing up his main interests were mathematics and baseball. By the time Dennis could do arithmetic (at around 3 or 4 years old) he had decided he was interested in mathematics. This was also the same time he became interested in baseball. Despite his love of baseball, by high school he knew he wanted to become a mathematician or physicist, although Dennis cannot point to a specific event that piqued his interest.

Dennis began at Iowa State as a physics major but quickly gravitated away from the formulaic problems of his physics courses and towards mathematics instead. One of his favorite courses as an undergraduate was an analysis course. In a Moore-style-taught topology course Dennis was introduced to the long line and other pathological topologies. He has had a more than healthy skepticism of set theory since then.

After graduating in three years, Dennis began graduate school at University of Wisconsin, Madison. When he began, Dennis thought he would do functional analysis, but after taking a special functions course from Dick Askey he found this much more exciting. Askey was a very generous adviser and would encourage Dennis to read things beyond his own scope of interests. Askey had the ability to know intuitively that there were going to be theorems 'there', which is all you can really ask from your adviser, according to Dennis. Louis Solomon, a group theorist, also co-advised Dennis and he spoke frequently with Georgia Benkart, who had recently arrived as a new professor at Madison. Dennis' thesis had combinatorics in it even back then: enumeration over finite fields with

connections to special functions such as hypergeometric series.

Most of his memorable stories from college revolve around his spartan living conditions in a trailer a few miles away from campus. Dennis does not recall any parties from those days. In graduate school on the other hand, there was a rather memorable party in his honor. Among other occurrences, Dennis remembers a stripper who did not do any stripping, but instead played chess with some of the other party guests. You will have to ask him for the full story.

Dennis took a one year position at Rutgers after graduation. While there was no enumerative combinatorics there at the time, Dennis was exposed to it through an AMS session. A year later Dennis became a Moore instructor at MIT where he shared an office with Ira Gessel. Jeff Kahn and Joe Kung were also postdocs at the time. He found such a concentration of combinatorialists to be quite exciting. In addition, there were a number of graduate students with similar interests: Bruce Sagan, Paul Edelman, Michael Saks, and Bob Proctor. They were very kind, and Dennis has vivid memories of learning from the postdocs and students. For example, he recalls Michael Saks initiating him in the art of Hall's Marriage Theorem.

In 1980, Dennis joined the Minnesota faculty, which already included combinatorialists Dennis White, Jay Goldman and Jim Joichi. Having reached critical mass, a weekly combinatorics seminar was born. Dennis' early work here continued the study of algebraic graph theory related to his thesis work, but in time he became more and more interested in enumeration. Eventually it led to the discovery of the cyclic sieving phenomenon, jointly with Vic Reiner and Dennis White. Dennis considers it to be one of his top mathematical achievements. It started with an investigation of certain congruences related to the partition function. This led to an observation on q -binomial coefficients, and eventually to further examples of this phenomenon. Dennis is also particularly proud of his work on Cranks with Dongsu Kim and Frank Garvin, a new statistic that they defined to combinatorially prove Ramanujan's congruences for certain moduli.

In addition to being known for his mathematical prowess, for many years Dennis was also known as a April Fools' prankster. His very first prank involved a fake letter from Richard Stanley on MIT stationery offering Dennis a job. Dennis brought it into the office of the chairman at that time, Willard Miller, and said, "Willard, look at this letter I got today in the mail!" Willard was a little surprised and worried. When Dennis pointed out the date of the letter, Willard was relieved and quite enjoyed the joke. Another memorable joke was Dennis' April 1, 1994 memo that the University would start requiring sign-in sheets. Eventually, his pranking met with an end after one unfortunate prank, which is another story you'll have to ask him about yourself.

Dennis has seen a long span of the department's life, and has observed that the department is much less fractured today than it used to be, and that people are more agreeable. He has noticed other changes, including an increased use of computers, a greater number of conferences, more activity among the graduate students, and greater ease and availability of communication between researchers. Dennis thinks that many great questions remain unanswered, especially in number theory, and looks forward to many more years of mathematical research.

Symposia

Riviere-Fabes Symposium

The 15th Rivière-Fabes Symposium on Analysis and PDE was held April 20-22, 2012, at the School of Mathematics, University of Minnesota. The two-hour speakers were Panagiotis Souganidis (University of Chicago) and Antonio Córdoba (Universidad Autónoma de Madrid) and one-hour talks were given by Thomas Alazard (Ecole Normale Supérieure), Giuseppe Mingione (Università degli Studi di Parma), Gabriella Tarantello (Università di Roma 'Tor Vergata') and Rachel Ward (University of Texas at Austin). The Symposium was sponsored by the NSF, the Rivière-Fabes Fund at the University of Minnesota, and the IMA through their Participating Institution Conference Program. For more detailed information, see the website: http://www.math.umn.edu/conferences/riv_fabes_12/

Meeting in Honor of Peter Olver

The conference 'Symmetries of Differential Equations: Frames, Invariants and Applications' was held May 17-19, 2012, hosted by the School of Mathematics. It was organized in recognition of Peter Olver's sixtieth birthday, and centered around the areas of mathematics to which he has contributed, particularly symmetries of differential equations and variational problems, moving frames for Lie groups and Lie pseudo-groups, invariant theory, solitons and applications of these methods. The conference was about five months late, but no one seemed to care!

Peter's work has had an amazing impact on the mathematical world: he has had so far at least 20 Ph.D. students, 16 postdocs and long term visitors, 62 collaborators, written 4 books with another on the way, and has 130 published research papers and many other publications to his name. This prolific activity was reflected in the program of the meeting in which 28 talks were given over 3 days and in the list of the approximately 100 participants. The schedule can still be found online at <http://math.umn.edu/conferences/olver/> together with slides of the talks and recordings of some of the sessions.

The banquet was a highlight of the meeting. It was very well attended, and three generations of mathematicians in the Olver family were present: father Frank, Peter and his wife Chehrzad Shakiban and son Sheehan. Cheri recounted the circumstances of their 1976 union. They both had the same advisor, the famous Harvard mathematician Garrett Birkhoff and he was the matchmaker. Other graduate students in the department were dubious and organized a pool on how long the marriage would last. Cheri chose one year! Another personal reminiscence was shared by Yvette Kosmann-Schwarzbach, who read an excerpt from a 1984 letter from Peter that gave us some insight into the development of a mathematician: "Sheehan is now 1 year old, and an unbelievable amount of trouble. He gets into everything!."

The meeting was supported by the National Science Foundation, the Institute for Mathematics and its Applications and the College of Science and Engineering. In connection with the meeting and birthday celebration a special issue of the online journal SIGMA will be published and there is also a special issue of the journal Foundations of Computational Mathematics.

Fall 2012 Yamabe Symposium

The sixth Yamabe Memorial Symposium took place from Friday to Sunday, October 5-7, 2012.

2012 marked the 50 year anniversary after the first Yamabe Memorial Lecture was delivered. The Yamabe Lecture was initiated jointly with Northwestern to commemorate the early passing of the brilliant Japanese mathematician Hidehiko Yamabe, who once was a faculty member at University of Minnesota and Northwestern University. The Yamabe Symposium, started in 2002 and held every two years at University of Minnesota, is an enhancement of the Yamabe Lecture tradition. To mark this special occasion, President of the Mathematical Society of Japan, Professor Yoichi Miyaoka from Tokyo University wrote a letter to the organizers and the participants. This letter was read by Professor Mikio Furuta from University of Tokyo during the Symposium.

The theme of the Yamabe Symposium this year was Geometric Analysis, an area Yamabe worked in during his last years and in which made a lasting impact. Each of the following mathematicians gave a one-hour talk: Huaidong Cao (Lehigh University), Jean-Pierre Demailly (University of Grenoble), Benson Farb (University of Chicago), Robert Hardt (Rice University), Misha Kapovich (UC Davis), Conan Leung (Chinese University of Hong Kong), Natasa Sesum (Rutgers University), Ben Weinkove (UCSD/Northwestern).

The conference was well attended, with over 70 registered participants. A majority of them were graduate students and young researchers. In total, in addition to the eight speakers, 30 out-of-town participants were partially supported for their expenses, thanks to the funds made available by the National Science Foundation. Speaker expenses were also partially covered by funds from the Yamabe Foundation, which was made possible by a generous anonymous contribution. Funds for participant support were awarded competitively, based on the curriculum vitae and, in the case of young researchers, a letter of recommendation. Women and minorities were especially encouraged to apply.

There was a notably high degree of interaction among the speakers, organizers and other participants during the coffee breaks and the Saturday banquet. Discussions were mainly (but not exclusively!) of a mathematical nature. For graduate students and postdocs, these contacts may be used to great advantage in the future.

Further information including the schedule of the conference, titles and abstracts of talks, and the list of participants is available on the website <http://www.math.umn.edu/yamabe>.

CSE Distinguished Women Scientist and Engineers Program

Prof. Anna Mazzucato, from Pennsylvania State University, visited the Department March 6-8, 2013 for the CSE Distinguished Women Scientist and Engineers program. During her stay she gave a Colloquium talk on "Incompressible Fluid Flows at High Reynolds Numbers" and a PDE Seminar talk on "Asymptotic expansions for the displacement in elastic media with small inclusions". On Friday, the Undergraduate and Graduate Women in Mathematics Coordinators, Christina Laughlin and Maggie Ewing, helped organize a Q&A session with students where Professor Mazzucato spoke and answered questions about her career path and issues specific to women in math. This was

followed by a brunch for undergraduate, graduate, and faculty women in math to continue the conversation. All in all it was a very successful visit.

Remembering Former Colleagues

James Serrin

Regents Professor Emeritus James Serrin passed away on Aug. 23, 2012 at age 85. Born Nov. 1, 1926 in Chicago, Ill., Jim received his BA degree from Western Michigan College in 1947 and his Ph.D. in mathematics from Indiana University under David Gilbarg in 1951. Following appointments in Princeton and MIT, he was in the School of Mathematics from 1954 until his retirement in 1995. During this time, he served as Head of the School of Mathematics from 1964-65, and was named Regents Professor of Mathematics in 1969.



Jim is well known for his many fundamental contributions to nonlinear analysis, partial differential equations, fluid mechanics, continuum mechanics, and thermodynamics. Among his many honors, he was awarded the G.D. Birkhoff Prize in Applied Mathematics from the American Mathematical Society in 1973. He served on the Council of the American Mathematical Society from 1972-74. In 1979, he received the Distinguished Alumni Award from Indiana University, and the following year, he was elected a fellow of the American Association for the Advancement of Science and a member of the National Academy of Sciences. He also was a foreign member of the Finnish Academy of Sciences, and received honorary doctorates from the Universities of Sussex, Ferrara, and Padova.

Jim is survived by his beloved wife of nearly 60 years, Barbara, his three daughters, Martha Stack, Elizabeth Conley, and Janet Sucha and four grandchildren. On September 21, 2012, a Memorial Service for Jim was held in Vincent Hall Library and attended by his family and many of his colleagues and friends. On November 14-16, 2013, the 51st meeting of the Society for Natural Philosophy will be held at the University of Minnesota, with the theme "Mathematics and Mechanics in the Physical Sciences: A Tribute to James Serrin". It will bring together researchers of international and national stature as well as recent Ph.D.'s and graduate students who either share the common experience of having been immensely influenced by Jim's teachings, writings, and other scientific activities or deeply value the dialogue and interaction between mathematics and mechanics.

Awards and Recognition

AMS Fellows

Eleven current faculty (Doug Arnold, Carme Calderer, Dennis Hejhal, Albert Marden, Andrew Odlyzko, Peter Olver, Victor Reiner, Mikhail Safonov, Fadil Santosa, George Sell, Dennis Stanton), and three emeriti (Don Aronson, Robert Ellis, Hans Weinberger) were named members of the Inaugural Class of Fellows of the American Mathematical Society.

Anar Akhmedov

Anar Akhmedov has received the Guillermo E. Borja Award. The award is given by the College of Science and Engineering, and recognizes exceptional research and scholarly accomplishments by a candidate for tenure during the probationary period.

Jasmine Foo

Jasmine Foo has been awarded a McKnight Land-Grant Professorship during 2013-15. This University of Minnesota award is in recognition of a junior faculty member's outstanding contributions to research and potential for future achievements. Jasmine's research project is in mathematical biology and has the title, 'Mathematics of cancer evolution'.

Svitlana Mayboroda

Svitlana Mayboroda has been named as the first recipient of the AWM-Sadosky Research Prize in Analysis. The prize is awarded by the Association for Women in Mathematics (AWM) to highlight to the community outstanding contributions by women in the field and to advance the careers of the prize recipients.

Hoai-Minh Nguyen and Pavlo Pylyavskyy

Hoai-Minh Nguyen and Pavlo Pylyavskyy are recipients of Sloan Research Fellowships. These two-year fellowships are awarded to support the research of recent Ph.D.s in tenure-track positions, in recognition of their distinguished performance and unique potential.

Hans Othmer

Hans Othmer has been named a Fellow of the Society for Industrial and Applied Mathematics (SIAM). His citation reads, 'For contributions to mathematical biology, in particular the theory of pattern formation in biological systems.'

Maxwell Shinn

Maxwell Shinn has been named a 2013 Barry M. Goldwater Scholar. Max is a sophomore majoring in neuroscience and mathematics. He has been involved in research under Professors Duane Nykamp of the School of Mathematics, Philip Zelazo of the Institute for Child Development and Professor Clarence Lehman of the Department of Ecology, Evolution, and Behavior. He also holds an AXA Achievement Scholarship and a University of Minnesota Presidential Scholarship.

Retirements

Harvey Keynes

Harvey Keynes retires this year. He joined the Mathematics Department in 1968, at first on a visiting position, and then a year later as Assistant Professor. Prior to this he had obtained his Ph.D. in 1966 at Wesleyan University in topological dynamics and he was on a postdoc for 2 years at UC Santa Barbara. He continued his work on dynamical systems with Bob Ellis, and later with Harry Furstenberg and Len Shapiro, and during the 1970s and early 1980s three students obtained their Ph.D. under his supervision. At the same time Harvey was promoted, becoming Full Professor in 1979.



An opportunity arose at the end of the 1970s which was to shape Harvey's career. During those years there was a program for talented middle and high school students, run by Wayne Roberts at Macalester College, in which the students were taught courses in algebra, geometry and mathematical analysis. It was felt that a calculus course was needed and the idea was that the University of Minnesota could provide this. More than this happened: together with Jay Goldman, and with the encouragement of Willard Miller who was department head at the time, Harvey started the University of Minnesota Talented Youth Mathematical Project, known universally as UMTYMP ('um-tee-ump'). The first year of high school calculus students entered this program in 1980 and it was they who thought of the name of the program. One of Harvey's goals was to provide these particularly talented students with an atmosphere where it is OK to think of mathematics and science in a serious way. The program continues to this day and, according to Harvey, it has flourished in part because the curriculum taught is determined by the University of Minnesota, and not from any prescribed notions from outside.

Harvey went to Washington D.C. during the year 1982-83 to spend a year as NSF program director in Modern Analysis. He then returned to Minnesota to initiate further programs in mathematics education, aimed at teachers as well as students. Between September 1985 and July 1988 he started the NSF Teacher Renewal Project, which involved around 100 teachers in a residential summer program. Another such program started at the same time in collaboration with Lynn Steen was Minnesota Mathematics Mobilization, which provided support for teachers through a variety of activities. There were other such initiatives, addressing various concerns, and in recognition of all this Harvey was the 1992 recipient of the AMS Award for Distinguished Public Service 'for his multifaceted efforts to revitalize mathematics education, especially for young people'. His legacy is MathCEP, whose many programs can be found listed on the departmental web site.

In retirement Harvey looks forward to developing further new projects, but their exact nature is not clear to him yet.

He plans to find new ways to provide support for teachers, and is concerned for members of society who do not have an easy time, including those who are incarcerated. He may also do some fishing. We wish him continued success!

Dennis White

Dennis White retires this year after a period of phased retirement.



He joined the mathematics department in 1973 after obtaining his Ph.D. under Gill Williamson at UC San Diego. He did early work in Polya's theory of enumeration under group action, leading him to later work on unimodality, bijective studies of tableaux and characters of the symmetric group. His oft cited results with Goldman and Joichi on the theory of rook placements are among the gems of Minnesota combinatorics. Dennis's investigations on sign-balance and cyclic actions led him to an important conjecture on tableaux, that inspired recent deep threads in geometry and representation theory. During his time at Minnesota Dennis has been a mainstay of the combinatorics group; he has supervised the Ph.D.s of five students, and by his estimate has taught over 6,000 undergraduates!

On November 30, 2012 Dennis gave a memorable talk in the combinatorics seminar, in which he recalled the development of combinatorics at Minnesota during his career, as well as many other things. His topics ranged from history lessons about the people of influence at the university - the heads of department, the presidents, the deans - through a selection of photos of socially and culturally significant icons, to a discussion of the mathematics which has engaged him and to which he has contributed over his career. The whole talk was remarkable for the photographs presented of just about everyone and everything he mentioned, including faculty in our department, officials in the university, his students, visitors and postdocs over the years and of course of himself and his wife, Joan. We will remember the sense of humor which he displayed, and how startling it can be to see how appearances change over the years.

Dennis recalled that when he arrived at Minnesota the people already doing combinatorics were Jay Goldman and James Joichi. Over the years there have been arrivals and departures, including those of Dennis Stanton, Paul Edelman, Vic Reiner, and then Ezra Miller, Igor Pak and Andrew Odlyzko, followed more recently by Pasha Pylyavskyy and Gregg Musiker. Combinatorics has seen growth during his career, and Dennis retires at a time when the group of people in this area could hardly be more lively.

Away from the department Dennis has an evident love of the outdoors and hiking, and he happens to be a Minnesota Master Gardener, interests that will remain with him during the coming years.

School of Mathematics Center for Educational Programs (MathCEP)

This last year has been a time of growth and transition for MathCEP. The University of Minnesota Talented Youth Math Program (UMTYMP) continues to have record numbers of student participants on the Twin Cities campus, but we have also been hard at work to open 'satellite' UMTYMP sites around the state. This spring we ran entrance exams in Rochester and Willmar, and have our sights set on other locations around Minnesota for next year. We are optimistic that UMTYMP can become a statewide program, as was the case in the past.



Much of the teaching at UMTYMP is done by postdocs, and we welcome two new ones this year: Jane Butterfield (Illinois) and David Clark (Michigan Tech). Both were accepted into the highly selective Project NExT professional development program for new PhDs, run by the Mathematical Association of America (MAA), and have already had a large positive influence on our curriculum and program structure. We were also fortunate to be written into a grant by our combinatorics group, with the result that their RTG postdoc, Joel Lewis (MIT) taught an Advanced Topics course in combinatorics for students who have finished UMTYMP but are still in high school.

As part of our emphasis to involve UMTYMP students in mathematical activities beyond the classroom, Butterfield and Clark have been working with five high school students on three different undergraduate research projects. The students are presenting their work this month at the Pi Mu Epsilon conference at St. John's University and the MAA's North Central Section Spring 2013 meeting. In addition, the Fall 2012 volume of the Rose Hulman Undergraduate Mathematics Journal includes a paper written by Rob Siliciano, an UMTYMP alum now at Princeton, which describes a project he worked on with Jonathan Rogness, MathCEP's director. In addition to the research activities, UMTYMP alumni Isaac Garfinkle and Stephen Jacobs worked with Butterfield and Rogness to build a Zome model of a 120-cell at the Fall 2012 Math & Science Family Fun Fair.

Two students joined the Masters in Mathematics with an Emphasis in Mathematics Education program this year: Scott Flancher and Nikki Ness. Lauren Weum and Alex Fisher will complete the degree this summer. Although the program was initially designed for future high school mathematics teachers, recent graduates have often taken jobs at local community colleges. With this in mind, we have been working with local two-year colleges to develop a new track within the program for students who are interested in that career path.

Our enrichment and teacher professional development programs continue to be strong, with nearly 400 students

and a few dozen teachers participating throughout the year. The new postdocs have created new curriculum in graph theory, coding theory, and other areas for use with both students and teachers; we have also been working with the Will Steger Foundation and the Center for Energy and Environment to develop an enrichment module combining geometric concepts with the mathematics of energy efficiency.

Minnesota Center for Industrial Mathematics (MCIM)

The aim of the Minnesota Center for Industrial Mathematics (MCIM) is to develop and maintain the department's ties to mathematicians and researchers working in industry and at national laboratories.

The centerpiece of the MCIM is the joint IMA/MCIM Industrial Problems Seminar. This seminar series is designed to give students, postdoctoral fellows and faculty members contact with the types of mathematical challenges that arise at companies and labs. This year the seminar hosted a wide range of speakers including Tuhin Sahai (United Technologies Research Center), Thomas Grandine (Boeing Corporation), Deepa Mahajan (Boston Scientific), Mostafa Fatemi (Mayo Clinic Translation Research), Laurent White (Exxon-Mobil), Aleksandar Zatezalo (Scientific Systems Company, Inc.), and Andrew Stein (Novartis Institute for Biomedical Research). Among the many themes arising in the lecture series were the need for robust mathematical techniques to reduce the complexity of large, interconnected systems, the development of sophisticated numerics to help in design and prediction, and the use of modeling to predict complex systems.

Along with bringing in leading researchers working in industry, MCIM aims to match graduate students with summer internships at leading companies. This year several graduate students applied for such opportunities, and so far three of them have been selected for internships at Schlumberger Doll Research, Motorola Corporation and St. Jude Medical.

Minnesota Center for Financial & Actuarial Mathematics (MCFAM)

During the current academic year the number of MCFAM students has increased to 306, up from 280 last year. The increase is due entirely to the continued growth of the Actuarial student body. We have a total of 216 Actuarial Majors, up 13.6% versus a year ago. However the increase in actuarial students has slowed after a 35% increase in 2012. The MFM student body has stayed steady at 90 students.

The Actuarial curriculum now offers the writing intensive, actuarial problem solving course Math 4067W both in the fall and spring semesters due to high demand from both students and practitioners. This year participating actuaries were from Ameriprise, Allianz, Travelers, Mercer and Gross Consulting. MCFAM again collaborated with a variety of firms that supported student projects.

2012-13 was a successful year for the MCFAM Distinguished Lecture Series. The fall lecturers were Peter Carr, from Courant Institute of Mathematics/NYU and Morgan Stanley, and Jay Vadeloo, from the University of Connecticut and Towers Watson. In the spring MCFAM brought in Steve Shreve, the Orion Hoch Professor of Mathematics at Carnegie Mellon University and Ian Duncan from the University of California-Santa Barbara, School of Healthcare at Georgetown University and VP of Research at Walgreens.

Placement trends in both the MFM and the Actuarial programs remain strong. The 2011 MFM class has a 95% placement status and the May 2012 class is at 82% not even a year after graduation. In the larger more difficult to reach Actuarial graduating class for 2012, we have identified that at least 57% of our alumni have positions in business and actuarial roles or are in top US finance and economics Master programs. There is already a 30% placement rate in full time jobs, internships or graduate programs for the 56 actuarial students graduating in the spring and summer of 2013 and a 13% placement rate for the 31 MFM students graduating May 2013.

Math Library News

Visiting Professor Frank Farris's mathematical art was featured in an exhibit co-sponsored by the Libraries and the School of Mathematics. On December 6, 2012, he gave a public talk to open "Seeing Symmetry" in Walter Library, introducing translational, mirror, p4g and other symmetries to a general audience (including kids!). Some of the ideas behind the images were presented in his November 2012 Notices article (<http://www.ams.org/notices/201210/rx121001386p.pdf>). Originally produced at Carleton College, the exhibit moved on to the University of St. Thomas after its three-month run at the University of Minnesota. Two other Mathematics Library exhibits showcased the Mathematics of Planet Earth Year 2013, including Professor Richard McGehee's work on sea ice, "A Paleoclimate Model of Ice-Albedo Feedback," and the connections between music and mathematics learning--with a photo of a math grad student string trio playing at last year's holiday party.

In the wake of the Elsevier boycott started by mathematicians last year, authors and policy-makers continue efforts to increase the availability of research results and publications. Professors Doug Arnold and Peter Olver are on the editorial board of the new open-access, peer-reviewed journals Forum of Mathematics, Pi and Forum of Mathematics, Sigma, through Cambridge University Press. Another start-up project, Episciences-Math, plans a different open-access model coupling the arXiv with a peer review process. A significant government move in March 2013 was the Office of Science & Technology Policy's announcement of mandatory open access to research funded by most federal agencies; this is a substantial expansion of the NIH's 2008 Public Access Policy and anticipates the pending Fair Access to Science and Technology Research Act (FASTR). NSF already requires data management plans for grant proposals, encouraging but not mandating that the research data be shared as well;

principal investigators can find support in developing such plans through data management workshops, a data management plan checklist, and other resources at <https://www.lib.umn.edu/datamanagement>. This is one way the Libraries facilitate research sharing, along with ongoing support for innovative improvements in the in the scholarly publishing landscape.

IMA News

The IMA's Thematic Year on "Infinite Dimensional and Stochastic Dynamical Systems and Their Applications" will conclude in June with the final Joint U.S.-Japan Conference for Young Researchers on Interactions among Localized Patterns in Dissipative Systems. This has been a very exciting year with many long-term visitors; several are here for a return visit. We are now gearing up for a busy summer which will include an REU, a summer school for graduate students, a two-week short course on statistics and machine learning, a week-long outreach program for high-school students, and the popular Mathematical Modeling in Industry workshop.

In the Fall, we will launch the new thematic program on "Scientific and Engineering Applications of Algebraic Topology". This exciting program will focus on new applications of topological techniques in disparate areas such as data analysis, computational biology, communication and networks. The IMA will gather topologists, computational geometers, networks experts, statisticians, biologists, and other application domain specialists who are critical to the further development and implementation of the methods, allowing for progress in a number of different directions.

The Third Abel Conference, in honor of Endre Szemerédi, took place in November 2012. This conferences series, which celebrates the work of the Abel laureate, is a collaboration between the IMA and the Norwegian Academy of Science and Letters. Szemerédi received the Abel Prize in 2012 for his fundamental contributions to discrete mathematics and theoretical computer science.

Finally, we note that Fadil Santosa is planning to step down as director of the IMA. The IMA Board of Governors and the University of Minnesota have begun the search for a new Director for an appointment beginning July 2015.

Undergraduate Program

From the Director of Undergraduate Studies

More than 600 undergraduates are pursuing mathematics degrees through the College of Science and Engineering and the College of Liberal Arts. We have added advisers to respond to increased demand: Professor Mike Weimerskirch, our lower-division coordinator; Aileen Lyle, an actuary from the industry; and Doreen Vescelius, a recent graduate of our major program with actuarial specialization.

Our new Mathematical Biology specializations emphasizing Genomics and Physiology have been fully approved by the Board of Regents and are available to students.

Sophomore Math and Neuroscience major Maxwell Shinn has been named a 2013 Barry M. Goldwater Scholar.

Teaching assistants Alanna Hoyer-Leitzel, Erin Manlove, and Nicholas Switala won the inaugural Outstanding Teaching Assistant Award for 2011-12. Students in mathematics courses submitted more than 450 nominations in support of their TAs.

Graduate Program

Graduate Student Fellowship Awards

Richard McGehee, Director of Graduate Studies in Mathematics and The Graduate School congratulates the following graduate students who received fellowships.

Jonathan Hahn, 2012 College of Science and Engineering (CSE) Graduate Fellowship, Tyler Lawson, advisor.

Katie Heaps, 2012 College of Science and Engineering (CSE) Graduate Fellowship, Peter Olver, advisor.

Danika Lindsay, 2012 National Science Foundation (NSF) Graduate Research Fellowship Program (GRFP) Fellowship, Paul Garrett, advisor.

Gang Liu, Doctoral Dissertation Fellowship, *Manifolds with Ricci Curvature Lower Bound*, Jiaping Wang, advisor.

Jeffrey Moulton, Science, Mathematics & Research for Transformation (SMART) Scholarship, Duane Nykamp, advisor.

Ph.D. Graduating Students

Richard McGehee, Director of Graduate Studies in Mathematics and The Graduate School congratulate our recent graduating Ph.D. students (February, 2012 to February, 2013).

Patrick Byrnes, *Structural aspects of differential posets*, Victor Reiner, advisor, Mathematics Instructor, Century College, White Bear Lake, MN.

Hyun Soo Doh, *Error Estimates for Finite Difference Solutions of Second-Order Elliptic Equations in Discrete Sobolev Spaces*, Nicolai Krylov, advisor, Postdoc/Student, Financial Economics (SSD), The University of Chicago, Booth School of Business, Chicago, IL.

Xiaoqin Guo, *Diffusivity and Ballistic Behavior of Random Walk in Random Environment*, Ofer Zeitouni, advisor, Postdoc, Technical University of Munich, Munich, Germany.

Varunyu Khamviwath, *Directional Sensing and Actin Dynamics in Dictyostelium Discoideum Amoebae*, Hans Othmer, advisor, Postdoc, NCTS Math Division, National Tsing Hua University, Hsinchu, Taiwan.

Jeonghun Lee, *Mixed methods with weak symmetry for time dependent problems of elasticity and viscoelasticity*, Douglas Arnold, advisor, Postdoctoral Research, Department of Mathematics and Systems Analysis, Aalto University, Helsinki, Finland.

Hui Li, Topics in The Mathematical Theory of Nonlinear Elasticity, Marta Lewicka, advisor; Graduate Student, Pennsylvania State University, University Park, PA.

Liping Li, *A generalized Koszul theory and its applications in representation theory*, Peter Webb, advisor; Visiting Assistant Professor, University of California Riverside, Department of Mathematics, Riverside, CA.

Xingjie (Helen) Li, *The Development and Analysis of Atomistic-to-Continuum Coupling Methods*, Mitchell Luskin, advisor; Prager Assistant Professor, Brown University, Division of Applied Mathematics, Providence, RI.

Vishal Saraswat, *Anonymity and Privacy in Public Key Cryptography*, Andrew Odlyzko, advisor; Assistant Professor, C.R. Rao Advanced Institute of Mathematics, Statistics and Computer Science (AIMSCS), Gachibowli, Hyderabad, India.

Ke Shi, *Devising superconvergent HDG methods for partial differential equations*, Bernardo Cockburn, advisor; Visiting Assistant Professor, Texas A & M University, Department of Mathematics, College Station, TX.

Hsi-Wei Shih, Some results on scattering for log-subcritical and log-supercritical nonlinear wave equations, Markus Keel, advisor; Research Associate, University of Minnesota, School of Mathematics, Minneapolis, MN.

Brian Van Koten, Development and Analysis of the Blended Energy-Based Quasicontinuum Method, Mitchell Luskin, advisor; RTG Assistant Adjunct Professor, University of California - Los Angeles, Los Angeles, CA.

Qixuan Wang, Modeling of Amoeboid Swimming at Low Reynolds Number, Hans Othmer, advisor; Visiting Assistant Professor, University of California-Irvine, Department of Mathematics, Irvine, CA.

Teng Wang, *Filtering partially observable diffusions up to the exit time from a domain*, Nicolai Krylov, advisor; Quantitative Research, Worldquant.

Yi Wang, *Robust Hybrid Linear Modeling and its Applications*, Gilad Lerman, advisor; Postdoc, Statistical and Applied Mathematical Sciences Institute (SAMSI), Research Triangle Park, NC.

Weiwei Wu, *Lagrangian spheres, symplectic surfaces and the symplectic mapping class group*, Tian-Jun Li, advisor; Postdoctoral Research Associate, Michigan State University, Department of Mathematics, East Lansing, MI.

Wujun Zhang, *Convergence of adaptive hybridizable discontinuous Galerkin methods for second-order elliptic equations*, Bernardo Cockburn, advisor; Faculty Research Associate, University of Maryland, Department of Mathematics, College Park, MD.

Yi Zhang, *Local Cohomology Modules Over Polynomial Rings Of Prime Characteristic*, Gennady Lyubeznik, advisor; Postdoc, Purdue University, Department of Mathematics, West Lafayette, IN - Fall, 2012, Postdoc, Mathematical Sciences Research Institute (MSRI), Berkeley, CA - Spring, 2013.

Liqiong Zhao, *Synchronization on Second Order Networks*, Duane Nykamp, advisor.

Wei Zhou, *On the interior regularity for degenerate elliptic equation*, Nicolai Krylov, advisor; Postdoc, University of Minnesota, School of Mathematics, Minneapolis, MN.

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<p>The Newsletter Committee is composed of Peter Webb (Chair), Bonny Fleming, Gregg Musiker, Peter Olver, Pavlo Pylyavskyy, Harry Singh.</p>
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