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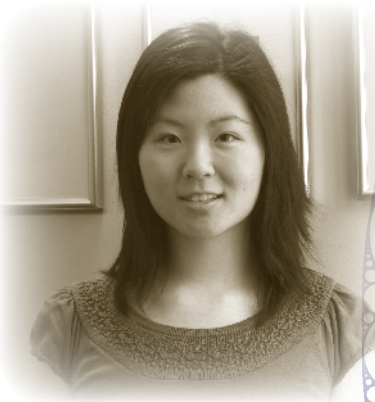
# Mathematics NEWS

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# DEPARTMENT OF MATHEMATICS NEWS

## MESSAGE FROM THE CHAIR

This is my eleventh and final year as chair, and the last time I write this newsletter column. Despite some bumps along the road and the financial turbulence of the past four years, it has been a thrill to serve in this role. In particular, it has been exciting to witness the growth of our programs, and to work with all of the groups that make up our department.

In the past dozen years, the total number of majors in our undergraduate programs has grown from under 250 to over 800. As you will see on page 15, over 250 students earned their Bachelor's degrees in the Math and ACMS programs in 2012, up from around 100 a decade ago. The students in these programs continue to impress with their achievements. A case in point is Jane Hung who added the Dean's Medal to her list of honors this spring, the eighth Math student to be so recognized in the past ten years; you can read about Jane's multidisciplinary achievements on page 4.

Our graduate program has also grown, though to a more modest extent. We now have over 100 graduate students. As I have explained in past newsletters, graduate students are the next generation of mathematical scientists. The typical PhD in mathematics takes five to six years to complete, and during this time the graduate students contribute to every aspect of the Department's mission: They serve as TAs in undergraduate courses, participate in outreach activities and, as they make progress in our program, they become active researchers. The recruitment and support of graduate students is critical to our department. As you will read in the following pages, we are very proud of the achievements of our current and former PhD students, and we continue to invest in our graduate program in every way to maintain our excellence in this area.

We have twelve excellent recent PhDs in postdoctoral positions this year, including four who hold prestigious NSF Postdoctoral Research Fellowships or NSF RTG postdocs.

The Department is fortunate to have dedicated staff who facilitate our work on a daily basis. I am particularly grateful to three: Brooke Miller, our Student Services Direc-

tor; Mike Munz, who recently moved from the position of Assistant to the Chair to that of Department Administrator; and Mary Sheetz, our former Administrator who retired after 27 years of stellar service to the Department. While we miss Mary, we are happy to know that she will be having lots of fun in her retirement as she devotes more time to her family and to her hobbies.

It has been a pleasure to get to know alumni and friends who have been steadfast in their support of the work of the Department.

Everything we do rests on the efforts of the Department's faculty. The size of our tenure-track faculty has diminished in the past four years, even while the responsibilities of the Department have grown in every avenue of its mission, including teaching, undergraduate and graduate education, postdoctoral mentoring and research. I cannot find the words to express my appreciation of my faculty colleagues and their commitment. It has been a pleasure to collaborate with them in my role as chair and to get to know them in ways that would not have been possible otherwise.
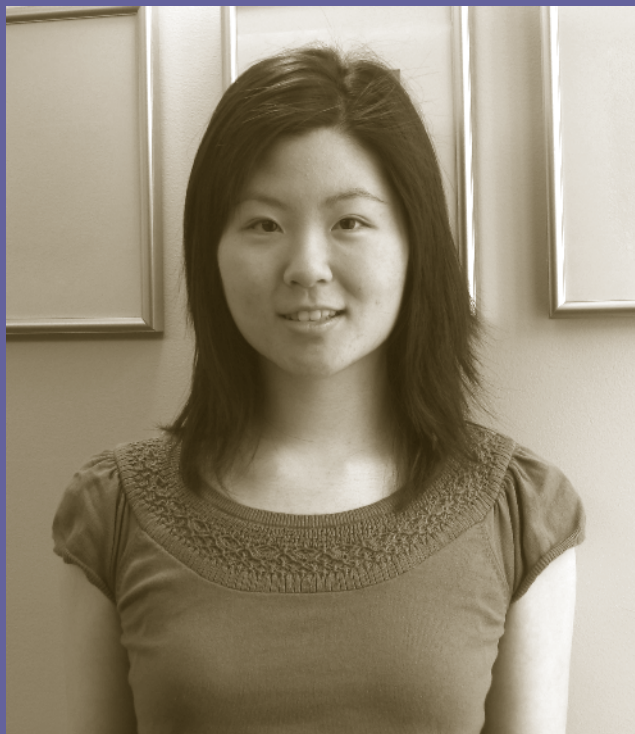
– SELIM TUNCEL

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**Pictured (front cover):**

*Top:* Jane Hung (see article, page 4), Andy Loveless (see article, page 6)

*Middle:* Jim Morrow (see article, page 7), Tatiana Toro (see article, page 8)

*Bottom:* Dylan Wilson, Sylvester Erikkson-Bique, Milda Zizyte (see article, page 10)

JANE HUNG
ARTS & SCIENCES DEAN'S MEDALIST
UW JUNIOR MEDALIST
GOLDWATER SCHOLAR
MARY BOAS SCHOLAR
MARY GATES RESEARCH SCHOLAR
NASA SPACE GRANT SCHOLAR

## Featured Graduate: Jane Hung

Last June, Jane Hung graduated *summa cum laude* from the University of Washington, earning two Bachelor of Science degrees: one in Mathematics (with honors), and another in Physics. This autumn, Jane is profiled here as our featured graduate.

Jane began her undergraduate career at the UW in 2008 at the age of 16 as one of 35 UW Academy students admitted early from Washington State high schools. Even before this, one of Jane's first connections to the Department of Mathematics was as a high school student. She participated in a departmental program for talented high school students, the Summer Institute for Mathematics at the University of Washington (SIMUW). The program is highly selective; only the very best high school students from Washington, British Columbia, Oregon, Idaho, and Alaska are admitted, making Jane's participation an early indicator of her abilities.

As Mathematics touches many scientific fields, so too does Jane's talent. In the summer of 2008, her high school record and strong interest in physics and chemistry earned her the opportunity to work on computational research via a High School Science Booster program begun by Professor Charles Campbell in the Department of Chemistry. Through this, Jane collaborated with Department of Chemistry Professor Xiaosong Li, whose research focuses on studies of molecular reactions and designs of new materials with confined functionalities, such as solar cells and quantum information storages. This material, which involves quantum mechanics, can often be very challenging to even a senior undergraduate. During that time, Jane was also the recipient of a NASA Space Grant Scholarship, a Summer Undergraduate Research Program (SURP) fellowship, and presented the results of her summer research at the SURP symposium.

Jane's exposure to advanced research led her to continue this work across her undergraduate career. Based on work in Professor Li's lab, Jane is the lead author on a paper published in the peer-reviewed *Journal of Physical Chemistry* titled "Rational Design using Dewar's Rules for Enhancing the First Hyperpolarizability of Nonlinear Optical Chromophores," and is the co-author of two additional published papers.

The start of Jane's freshman year also continued her strong progress along the path of mathematics. She was enrolled

in the Department's first year honors math course (Math 134/5/6), a highly rigorous course sequence into which only exceptionally strong students are admitted. In spring quarter, students do a group project in linear algebra. While most students choose from a list of projects proposed by the instructor, Jane instead designed a project that built upon her chemistry research. In this project, her team developed a Markov chain model for an electron moving in a nanotube under the influence of an electrostatic field.

Jane continued to achieve as she progressed along her undergraduate path. She was enrolled in another Mathematics honors sequence, this time Honors Advanced Calculus (Math 334/5/6). She participated in the Mathematical Contest in Modeling (MCM) and, with her team, won Meritorious designation, which put her team in the top 16% of more than 2,000 international teams. Jane also served as an undergraduate teaching assistant for a course in discrete mathematical modeling, taught by Tom Duchamp. This requires a background in mathematical modeling, and strong skills in not just mathematics, but computation and writing. On the basis of her undergraduate coursework and her MCM performance, Jane was selected, and did an excellent job. Says Duchamp, "She was ideally suited to the task."

Jane has been recognized for her talent and achievements throughout her undergraduate career in ways both numerous and distinguished. In addition to the accolades already mentioned, Jane has earned a Mary Gates Research Scholarship, a Mary Boas Scholarship for outstanding achievement as a woman in physics, a Barry M. Goldwater Scholarship, the UW Junior Medal, and the UW Dean's Medal.

Jane's senior thesis in Mathematics, titled "Energy Optimization of a Diatomic System," was written under the supervision of James Morrow and led to Jane earning her Mathematics degree with honors.

Says Morrow regarding Jane's thesis, "Jane came to me with a math problem related to her chemistry lab work. It was a non-trivial optimization problem and was very difficult to solve. Jane had to reformulate the problem and then modify existing algorithms to get a solution. She worked hard right up to the end of the year to get it right. The result was a very precise and satisfying solution."

Jane now studies at M.I.T., pursuing her PhD in chemical engineering. It is clear to us that, whatever career path she chooses, Jane is on her way to amazing achievements. We at the Department of Mathematics wish her the very best.

## Undergraduate Scholarships in Mathematics

**Jack Conger** has been selected as this year's recipient of the Mathematics Undergraduate Endowed Scholarship. This scholarship is renewable up to four years with satisfactory progress. Jack is an incoming freshman who is currently taking honors calculus. The Mathematics Undergraduate Endowed Scholarship also supports Brandon Saxberg (2011 recipient) and Matthew Heid (2010 recipient) as they continue their studies at UW.

**Valerie Sauer** is the recipient of the 2012-2013 Thomas Bleakney Endowed Scholarship in Mathematics. This is Valerie's first quarter at UW after transferring from Idaho.

Currently a junior, Valerie plans to become a math teacher, and will be working toward a Bachelor of Arts (teacher prep) degree.

**Garrett Kuwada** is the recipient of the 2012-2013 John and Kathy Connors Foundation Endowed Scholarship, which is renewable up to four years with satisfactory progress. This scholarship supports entering freshman students in the Educational Opportunity Program (EOP) who wish to pursue majors in the Department of Mathematics.

## Andy Loveless Receives UW Distinguished Teaching Award

Andy Loveless was one of seven UW faculty selected to receive the 2012 Distinguished Teaching Award, the University's highest honor for teaching.

The award is given to individuals who show "a mastery of their subject matter, intellectual rigor and a passion for teaching." This is the fourth time that a member of the Mathematics Department has received the award: Professor David Collingwood won in 1999, Professor Ronald Irving in 2001, and Professor Jim Morrow in 2003.

Together with three other Senior Lecturers, Andy is responsible for the teaching of the Department's precalculus and calculus courses for business, Math 111 and Math 112, as well as the precalculus course Math 120 that leads into the Math 124/125/126 calculus sequence for science and engineering students. Successful teaching of Math 111/112/120 presents a number of challenges. The instructor has to work hard to engage and encourage the students. In particular, the relevance of the mathematical material to the students' goals needs to be brought out. In Math 111/112, this requires the instructor and the TAs to be familiar with business terminology and the applications of mathematics to business. As the typical Math TA does not have this background, it becomes part of the instructor's responsibility to ensure the effectiveness of the TAs by holding weekly training sessions that discuss upcoming material including business concepts and terminology. An additional challenge is class size: Math 111/112/120 remain among our largest classes at 160 or 200 students. It is not unusual for Andy or the other Senior Lecturers to teach 500 students in a quarter.

Andy's approach to teaching is driven by his belief that all of his students can be good math students. Their misconceptions about their math abilities and general lack of confidence are the first hurdles he strives to get his students to overcome. If they are deficient in a certain area, he will include a quick class review and post a review sheet. Most students have just forgotten some mathematical details from high school, and by anticipating these issues Andy is able to fill the holes in their backgrounds. A central feature of his teaching is finding second, third, fourth, and fifth ways to explain the material from a slightly different perspective. Students understand in different ways, and sometimes an alternative explanation is the key to a breakthrough in insight. Andy's belief that every student can learn the topic keeps him searching for the right approach to make the topic click for each student.

The success of Andy's teaching is reflected in the stellar student evaluations that his courses receive. The numerical ratings consistently lie at the top of the University's 5-point scale. The numbers would be extraordinary for any set of courses, let alone those that present the instructor with the set of challenges that Math 111/112/120 do. His students' enthusiastic endorsement is also reflected in the letters they wrote to support his nomination for the Distinguished Teaching Award. To quote just one student's comments: "Andy made his class accessible to all of his students. He made lectures clear and allowed the students to ask questions and give their input to problems... He has the ability to take calculus, which is a foreign language to most, and make it easy and fun.... Basically, he is one of the best professors I have had on campus and anyone would be lucky enough to take a class from him."

Walking by Andy's office, you will see that his door is always open and the chairs are always occupied. If students are struggling and cannot make office hours, Andy is available by email well into the evening. In this way, students know they are never more than an email away from help, and do not have to struggle alone. It requires an extreme amount of time and energy to uphold this devotion to teaching, but Andy loves his job and could not imagine teaching any other way. The Distinguished Teaching Award is indeed a fitting recognition of the considerable effort Andy tirelessly invests in his students' education.

## Jim Morrow Honored with Humphreys Award

*In August, it was announced that Jim Morrow was the recipient of the Gweneth Humphreys Award from the Association for Women in Mathematics (AWM). The following is an AWM press release.*

The Association for Women in Mathematics (AWM) will present the THIRD ANNUAL M. GWENETH HUMPHREYS AWARD to **James Morrow,** Professor of Mathematics at the University of Washington, at the Joint Mathematics Meetings in San Diego, CA in January 2013. This award is named for M. Gweneth Humphreys (1911–2006). Professor Humphreys graduated with honors in mathematics from the University of British Columbia in 1932, earning the prestigious Governor General's Gold Medal at graduation. After receiving her master's degree from Smith College in 1933, Humphreys earned her PhD at age 23 from the University of Chicago in 1935. She taught mathematics to women for her entire career, first at Mount St. Scholastica College, then for several years at Sophie Newcomb College, and finally for over thirty years at Randolph Macon Woman's College. This award, funded by contributions from her former students and colleagues at Randolph-Macon Woman's College, recognizes her commitment to and her profound influence on undergraduate students of mathematics.

Morrow's nomination letters describe Jim as a superb teacher. Annually he teaches the year-long Honors Advanced Calculus course at UW in which he teaches students how to approach and enjoy problem solving. He challenges the students with tough problems, but also provides motivation and enormous support to get them to discover the solutions.

He has an outstanding record of motivating women students to pursue advanced degrees and research careers in the mathematical sciences. He accomplishes this by encouraging the women, fostering their confidence, and by understanding and anticipating their needs as they follow their interests.

A mid-career shift in Jim's research program from complex geometry to discrete inverse problems fortuitously extended his already well-established influence on undergraduate women (and men), primarily through the NSF-funded REU he co-founded in 1988 at UW. Often described by the NSF as a model program, it has attracted a stellar group of students in its 24 years of existence. Included in this group are nearly 30 women who have gone on to do graduate work in the mathematical sciences, often at top-tier universities.

In support of Jim's nomination, several women expressed sentiments conveyed in the following excerpts:

"I am very grateful to Jim Morrow for the course my life has taken over the past several years. He saw potential in my application to his REU way back when I was a junior in college and I had not taken many advanced classes.... Like too many other mathematically talented women, I didn't really think about graduate school as a possibility; no one had suggested it to me.... Thanks to Jim, I did consider it, and now I am a successful student at a very good graduate school.

"I'm pretty sure that if it weren't for Jim, I never would have become a mathematician."

"Jim was the most influential professor in my undergraduate career.... His devotion to his students is unparalleled."

The AWM is proud to honor Dr. Jim Morrow for his outstanding achievements in inspiring undergraduate women to discover and pursue their passion for mathematics and guiding them through critical transitions in their mathematical education.

*The 2013 Joint Mathematics Meetings will be held January 9–12 in San Diego, CA. For further information on the Humphreys Award, including past winners, please visit www.awm-math.org.*

## Tatiana Toro: Robert & Elaine Phelps Professor

Robert R. Phelps received his BA in Mathematics from the University of California at Los Angeles in 1954 and his PhD from the University of Washington in 1958. After two years at the Institute for Advanced Study in Princeton, and two years on the faculty at the University of California at Berkeley, he joined the UW Mathematics Department in 1962. Phelps was a Visiting Professor at the University of Paris in 1969-70 and at University College London in 1977-78. He served as Chair of our department from 1978 to 1981. He retired in 1996 and was named Professor Emeritus.

Elaine F. Phelps received her BA in Slavic Languages and Literature from the University of California at Berkeley and her PhD in Linguistics from the University of Washington. Her non-linguistic efforts were devoted to liberal political activism supporting secular humanism in general and abortion rights in particular.

Together they initiated the Robert R. and Elaine F. Phelps Endowed Fund in 1999 and supplemented the fund with an additional contribution in 2007, bringing it to the level of an endowed professorship. Tatiana Toro has been selected this year as the next Robert and Elaine Phelps Endowed Professor of Mathematics, for a four-year term.

Tatiana Toro followed an unusual academic path prior to her graduate studies at Stanford. Born in Colombia, she received a classical French education at the *Lycée Français Louis Pasteur* in Bogota, followed by a year of college at the *Lycée Louis le Grand* in Paris. She returned to Bogota and entered the *Universidad Nacional de Colombia*, but a series of violent demonstrations led to the closure of the university for over a year. During this period of time she taught herself English as well as most of the curriculum required to graduate with a BS degree in Mathematics. Despite being able to attend classes for only three semesters, she was able to graduate by taking exams to validate her self-studies.

Toro attended graduate school at Stanford University, where she worked under the supervision of Leon Simon in the area of Geometric Measure Theory, a branch of mathematics motivated by the calculus of variations and geometric analysis. Her thesis work concerned a topic that would become a recurring theme of her research. The particular question assigned to her involved characterizing when a surface in three-dimensional space could be "parametrized," i.e. identified in a one-to-one manner with a subset of the Euclidean plane, by a map which keeps the distance between points approximately the same (what is known as a bi-Lipschitz map). The types of surfaces considered in Geometric Mea-

sure Theory defies our common notion of what surfaces look like, similar to how the perimeter of a snowflake stretches our standard image of a curved line. Such surfaces might arise as the solution of an energy-minimization problem, and are usually described by abstract properties instead of explicit descriptions.

Toro's thesis work presented a breakthrough in the field by showing that a natural class of graph-surfaces admitted bi-Lipschitz parametrizations. The result was highly non-intuitive, since the surfaces can change directions wildly, and there is not a clearly defined notion of tangent direction at every point. During her final year of graduate study, Toro's research was supported by an Alfred P. Sloan Doctoral Dissertation Fellowship.

In the years following graduation, Toro was a member of the Institute for Advanced Study in Princeton, and a Morrey Assistant Professor at the University of California, Berkeley. From Berkeley she moved to the University of Chicago where she was a Dickson Assistant Professor. There she began a long-lasting collaboration with Carlos Kenig. Toro came to the UW Math Department in 1996.

The question of whether a metric space (that is, an abstract space with a notion of distance between each pair of points) can be be identified as a subset of some (possibly infinite dimensional) Euclidean space is a flourishing area of research with applications in theoretical computer science. Toro has approached this problem from two very different angles. One approach studies whether mild geometric conditions ensure the existence of good parameterizations. Her

joint work in this direction with Guy David (of the University of Orsay, France) has produced mathematical snowballs, whose existence had been conjectured a few years earlier but not proven. Mathematical snowballs are three- and higher-dimensional objects which share the geometric properties of physical snowflakes. In particular, all curves along the surface of the snowballs have infinite length.

A different approach takes as its starting point consideration of how the volumes of balls in the metric space grow as their radius increases. Toro's work has shown that reasonable growth properties can be used to ensure the existence of good parametrizations. This work has brought to light a powerful set of tools introduced by David Preiss in the 1980s in one of the classical and deep papers of Geometric Measure Theory.

Following Chicago, Toro's area of expertise expanded to include parts of Harmonic Analysis and Partial Differential Equations. A joint research program with several collaborators has created an area of study at the interface of these fields with Geometric Measure Theory. Problems of focus include the regularity of solutions to partial differential equations on very rough domains, the study of free boundary regularity problems with rough boundary data, and the understanding of properties of harmonic measure in higher dimensions.

As an example of a problem in Geometric Measure Theory, consider a bounded domain $\Omega$ in $n$-dimensional Euclidean space. There is a canonical notion of harmonic measure $\omega_X$ on the boundary of $\Omega$ with pole at a given point $X$. The probabilistic interpretation if that for a subset $E$ of the boundary, $\omega_X(E)$ is the probability that a random walk starting at the point $X$ will first hit the boundary at a point in $E$ (see figure 1).

Remarkably, in dimension $n = 2$, under minor assumptions on the domain $\Omega$ the measure $\omega_X$ can be used to yield a full description of the boundary as the union of three sets $G$, $N$, and $S$. On $G$, the measure $\omega_X$ and the standard arclength measure on the boundary are comparable. The set $N$ satisfies $\omega_X(N) = 0$, and the set $S$ has arclength measure zero but $\omega_X(S)$ is not zero. This brief statement summarizes years of deep work by many of the leading researchers in the field. The pursuit of this understanding generated many new ideas over the years, which enhanced the development of Complex Analysis far beyond the scope of this one question.
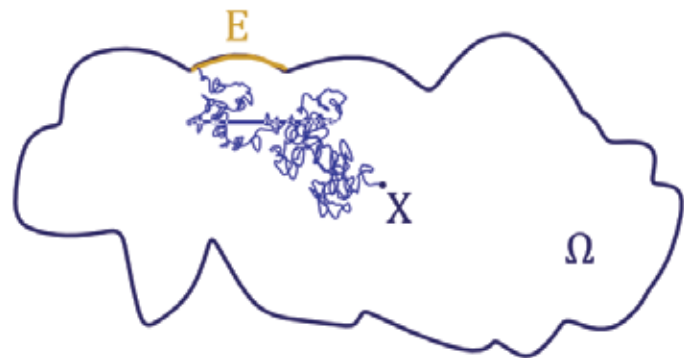


Figure 1

On the other hand, in the mid 1980s an example was constructed which showed that one of the key ingredients required to prove the above results was, in fact, false in three dimensions. As is often the case in mathematics, rather than closing a door this remarkable construction opened many new ones. The main question became, "What can be expected in higher dimensions?"

Much of Toro's work with Kenig and Preiss explores this question. Their work has provided some answers that disproved standing conjectures. They also introduced powerful tools from Geometric Measure Theory to the study of classical problems in Harmonic Analysis. Further understanding of this problem is being carried on by Toro's graduate student Matt Badger in a series of illuminative papers that explore new applications of these tools.

In addition to her research, Toro has served the mathematical profession as chair of the scientific review panel for the Pacific Institute for the Mathematical Sciences, member of the board of trustees of the Institute for Pure and Applied Mathematics, and editor of the *Proceedings of the AMS*, the *Journal of Potential Analysis*, and the *AMS University Lecture Series*. Her work has been recognized in the larger mathematical community in many ways. She has held an NSF Postdoctoral Research Fellowship as well as an Alfred P. Sloan Research Fellowship, and she was an invited speaker at the 2010 International Congress of Mathematicians.

## NSF Graduate Research Fellowships

The NSF Graduate Research Fellowship program, as described by the National Science Foundation, "helps ensure the vitality of the human resource base of science and engineering in the United States and reinforces its diversity." These prestigious, three-year grants support outstanding students pursuing graduate degrees in sciences, technology, engineering, and mathematics disciplines.

In 2011, the NSF named four students from the Department of Mathematics as NSF Graduate Fellows. In 2012, the Department was home to an additional three. Dylan Wilson and Milda Zizyte both received their undergraduate degrees in Mathematics last June from the UW, with Milda a double major in Mathematics and Computer Science. Sylvester Eriksson-Bique is currently a graduate student in our PhD program. What follows is a closer look at these three outstanding students.



Sylvester Eriksson-Bique



Dylan Wilson



Milda Zizyte

**Dylan Wilson** graduated from the University of Washington last June with a Bachelor of Science in Mathematics with College Honors, and with his team was a Meritorious Winner in the international Mathematical Contest in Modeling competition in 2009. Dylan is now pursuing a PhD at Northwestern University. His research interests lie in stable homotopy theory, especially its relationship to (derived) algebraic geometry. Dylan plans to continue to explore the mathematical landscape throughout his career, and intends to be in academia for the rest of his life.

Says Dylan of his time at UW, "Studying mathematics at UW was wonderful! There were always students and faculty eager and willing to talk about all sorts of topics."

**Milda Zizyte** graduated from the University of Washington last June as well. Milda earned two Bachelor of Science (*cum laude*) degrees: one in Computer Engineering and one in Mathematics. Also like Dylan, Milda was a competitor in the Mathematical Contest in Modeling, and was awarded Meritorious Winner with her team. In 2010, Milda participated in the Department's Research Experience for Undergraduates (REU) program. Her research led her to co-author a paper titled "Enumeration of Affine Permutations Avoiding Standard Permutations."

Milda is pursuing her PhD at Carnegie Mellon University.

**Sylvester Eriksson-Bique** joined the Department's graduate program this autumn after spending a year in the graduate program at the Courant Institute of Mathematical Sciences. Sylvester says he developed his interest in mathematics in high school, where he participated in mathematical contests and research competitions. At the University of Helsinki, his undergraduate work first focused on the history of religion, in which he wanted to understand the complex structure and redaction history of the Old Testament. This led him back to mathematics. Says Sylvester, "In my research on randomized algorithms and information retrieval, I realized that these problems are largely related to problems in computation and data mining, and provide a surprising application of mathematical methods."

Afterward, Sylvester decided to pursue research in mathematics instead of theology. Two of many research experiences include a Research Experience for Undergraduates (REU) program at North Carolina State University working on randomized algorithms for matrix applications with Ilse Ipsen, and collaborating with Valentine Polishchuk of the University of Helsinki regarding research applications in air traffic control, path planning, and optimization.

Currently, Sylvester is leaning toward research in probability and is enjoying his first quarter here. "The Department has extremely intelligent people who are friendly and do high quality research. I expect to have a good time completing my PhD."

## Graduate Student Awards for 2012–2013

**Academic Excellence Awards:**
Hao Chen
Sylvester Eriksson-Bique
Lorenzo Prelli

**Teaching Excellence Awards:**
Peter Caday
Courtney Kempton

**ARCS Foundation Fellows:**
Peter Caday
Alex McAvoy
Jonathan Swenson

**Z.W. Birnbaum Memorial Research Fellow:**
David Sprehn

**Gerald B. Folland Fellow:**
Alberto Chiecchio

**Ann Giles Fellow:**
Camil Aponte-Román

**McKibben and Merner Fellows:**
Christopher Aholt
Elliot Paquette
Tvrtko Tadic
Huy Tran

**Microsoft Scholars:**
Tim Carrell
Rebecca Hoberg
Stephen McKeown
James Pfeiffer
Lorenzo Prelli
Jose Alejandro Samper Casas
Pal Zsamboki

**NSF Graduate Fellows:**
Sylvester Eriksson-Bique
Cris Negron
Richard Robinson

**Robert & Elaine Phelps Fellow:**
Bharathwaj Palvannan

**John Rainwater Fellow:**
Cody Holdaway

**RTG Fellows:**
Joel Barnes
Alan Bartlett
Peter Caday
Gregory Drugan
Christopher Jordan-Squire
Courtney Kempton
Stephen Lewis
Stephen McKeown
Lee Patrolia
Matt Robinson
Justin Tittelfitz

**Tanzi-Egerton Fellow:**
Lindsay Erickson

**Tseng Fellow:**
Matthew Ward

**Top Scholar Awards:**
Christopher Fowler
Abdalla Nimer

## Matthew Badger Awarded NSF Postdoc

Former graduate student **Matthew Badger** was recently awarded a prestigious NSF Postdoctoral Fellowship. Matthew earned his PhD in 2011 under the supervision of Tatiana Toro (see article, page 8) and now studies geometric measure theory at Stony Brook University. He plans to use the fellowship to work with Chris Bishop and Raanan Schul at Stony Brook. His research will focus on questions at the interface of geometric measure theory and harmonic analysis.

## Running 'Circles' Around Math

In January, the UW Math Circle middle school outreach program, coordinated by Julia Pevtsova and supported by two grants from the NSF, was profiled in the College of Arts & Sciences publication, *Perspectives*. We thank *Perspectives* and Nancy Joseph for permission to include the article.

Julia Pevtsova and colleagues in the Department of Mathematics weren't sure what to expect when they organized an on-campus lecture for middle school students in 2010. After all, it was being held on a Sunday afternoon, on a math topic that was unfamiliar to most people. How many tweens and teens would give up their Sunday for math?

The reserved room filled up half an hour before the talk. The organizers quickly switched to a larger lecture hall but still ended up with a standing room only crowd. "It was clear there was a lot of interest," says Pevtsova, associate professor of mathematics.

With that vote of confidence, the Department decided to expand its offerings for middle schoolers, presenting three mathematics lectures annually, an annual math Olympiad, and weekly Math Circles that explore challenging math topics on an ongoing basis. All offerings are free.

The programs for middle school students grew out of an after-school math program offered by the Department at two Seattle elementary schools, Montlake and Stevens. Montlake fifth-graders urged then-UW graduate student Steve Klee, who led the sessions, to consider starting a similar program at their assigned middle school the following year. Klee obliged, but the middle school program never gained traction, so the Department decided to offer a program on the UW's Seattle campus instead.

"Middle school is an important age to show that math can be fun and that there's a lot you can do with it," says Pevtsova. "A lot of kids are really capable at math, but if they get one boring class, then another, they get lost and decide they're not good at it. This is especially true for girls, who will just start doing something else."

The UW Math Circle, explains Pevtsova, is modeled after its Russian namesake, started in Saint-Petersburg in the 1930s. The idea is simple: the person leading the group presents an intriguing math problem; participants must use logic and reasoning to come up with solutions.

"Our goal is not to bring up a generation of mathematicians per se," says Pevtsova. "The students are learning universal skills that can be used anywhere. It's about making connections and seeing the bigger problem."

Last year the Department began offering a weekly Math Circle for seventh graders; this year an eighth grade section was added. The groups are led by UW students—graduate student Chris Aholt and undergrads Kolya Malkin, Dylan Wilson, and Alex Vaschillo. "The instructors bring all this energy," says Pevtsova. "They're always looking for new problems, new topics, new ways to make it exciting. And I think they connect much better to younger people than faculty would."



UW graduate student Chris Aholt helps Math Circle participants work through a problem. *Photo: Jacob Lambert*

The instructors receive a small quarterly stipend thanks to National Science Foundation funding, but that nominal support is not what motivates them to lead a Math Circle. "The main reason that I do this is because I want the students to understand that math can be so much fun," says Aholt. "And it's not just the enjoyment that comes from having the best answer to a problem, or from really understanding why something is true. Rather, I think the best times come at that moment when you realize that your awesome solution is actually not optimal. There's nothing more exciting than finding out that something which you thought was difficult

Math Circle instructors (from left) Kolya Malkin, Alex Vaschillo, Dylan Wilson, and Chris Aholt. Photo: Jacob Lambert

and intricate and deep and beautiful is actually even more intricate and deep than you thought it was. Those are the things you're going to go home and talk about at dinner."

Some participants do, in fact, talk about Math Circle problems over dinner. As one parent wrote to Pevtsova, "I wanted to send a note of gratitude.... You have captured the fire in my child!"

To keep that fire alive, the instructors search for problems that will challenge and inspire without overwhelming. There's one problem that involves saving 100 pirates from cannibals ("Math problems are notoriously gruesome," says Aholt), and others that are less story-based. The key, says Malkin, is to find "the right balance of fun story problems

and theoretical problems...for them to get a grasp of the material without compromising their interest." Aholt has even used puzzle-type questions that software engineers are asked during job interviews. "It's a great boost of confidence to the students when we tell them that these are actual questions they ask people applying for jobs at Microsoft or Google!" he says.

Both sections have held "mathematical auctions" to encourage students to find the best solution to a problem, and have organized the students into teams for added motivation. The teams earn points for their solutions, with one team winning a prize at the end of the quarter. "In many cases, students are more driven by the competitive factor of winning the most points on a given day than they are interested in the prizes at the end of the quarter," says Vaschillo. "The point system gives the circle a healthy level of cooperative competition."

The Department has not yet decided whether it will add a ninth grade Math Circle next year. "If there is enough interest among the current eighth graders, we are likely to continue teaching them," says Pevtsova. Either way, the hope is that the lessons learned and the fire sparked through the Math Circle will inspire its participants for years to come.

"My experiences with such a program led me to an incredible interest in mathematics and a much deeper understanding of the beauty of math," says Vaschillo. "I hope that our Math Circle can similarly open doors for these students."

For more about the Department of Mathematics Math Circle program, visit www.math.washington.edu/~mathcircle/circle.

– NANCY JOSEPH



UW students Alex Vaschillo (far left) and Kolya Malkin lead a Math Circle.
Photo: Jacob Lambert

# MATHEMATICS NEWS

## Departmental Undergraduate Awards

The following undergraduate awards were presented to students during a ceremony last May. In addition to their award stipends, the students were presented with a book reflecting their mathematical interests, indicated in italics.

**Outstanding Graduating Bachelor of Science Major:**

Mark Bun – *The Code Book: The Science of Secrecy from Ancient Egypt to Quantum Cryptography* by Simon Singh

Jane Hung – *The Theory That Would Not Die: How Bayes' Rule Cracked the Enigma Code, Hunted Down Russian Submarines, and Emerged Triumphant from Two Centuries of Controversy* by Sharon McGrayne

Dylan Wilson – *Perfect Rigor: A Genius and the Mathematical Breakthrough of the Century* by Masha Gessen

Ian Zemke – *Pricing the Future: Finance, Physics, and the 300-year Journey to the Black-Scholes Equation* by George Szpiro

**Outstanding Graduating ACMS Major:**

Yuting Ma – *The Big Short: Inside the Doomsday Machine* by Michael Lewis

**Outstanding Graduating Bachelor of Arts Major:**

Morgan Eagar – *Journey Through Genius: The Great Theorems of Mathematics* by William Dunham

**Outstanding Student in Honors Calculus:**

Kolya Malkin (1st year) – *Euler: The Master of Us All* by William Dunham

Jerry Shao-Chieh Cheng (2nd year) – *The Man Who Loved Only Numbers: The Story of Paul Erdos and the Search for Mathematical Truth* by Paul Hoffman

**Award for Academic Excellence and K-12 Outreach:**

Natalie Hobson – *Winning Ways for Your Mathematical Plays, Vol. 1* by Elwyn R. Berlekamp, John H. Conway, and Richard K. Guy.

**Gullicksen Award for Outstanding Juniors in Mathematics:**

Jerry Li – *Godel, Escher, Bach: An Eternal Golden Braid* by Douglas R. Hofstadter

Grace Ingermanson – *Euler's Gem: The Polyhedron Formula and the Birth of Topology* by David S. Richeson

**Outstanding Putnam Score by a UW Student:**

Kolya Malkin – *Euler: The Master of Us All* by William Dunham

## Undergraduate Degrees 1995 – 2012



**Academic Year End**

■ Math Bachelor's degrees ■ ACMS Bachelor's degrees
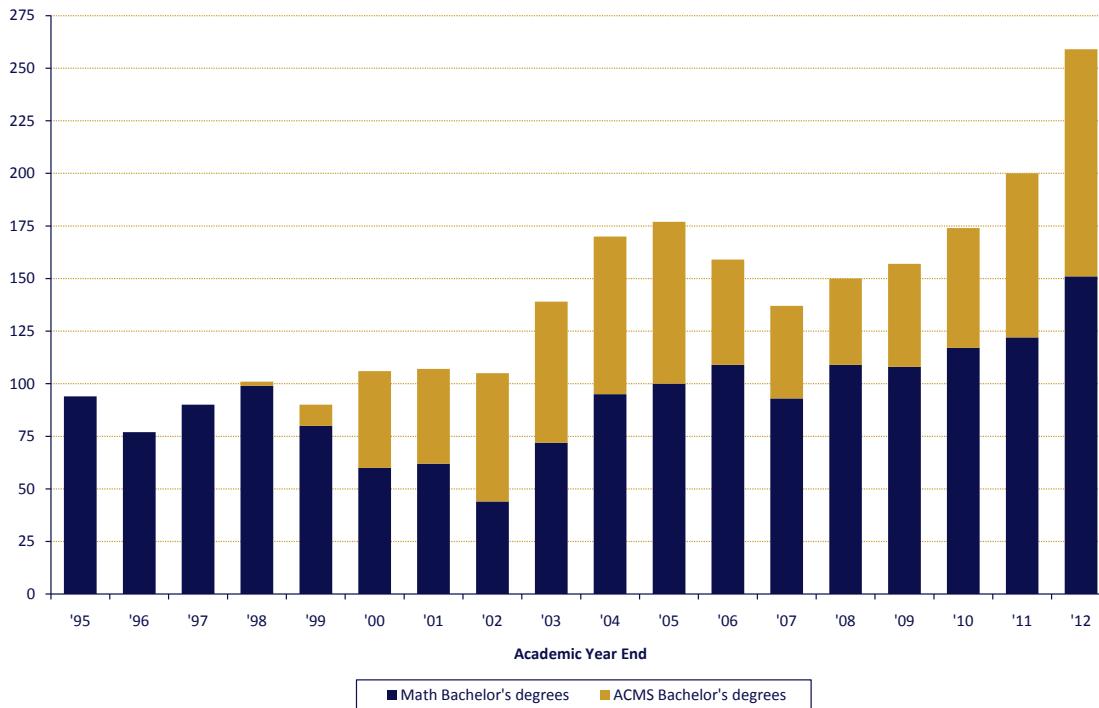
The total numbers of majors and degrees awarded in our programs continued to increase in 2012. The bar graph shows the number of Bachelor's degrees awarded in the Mathematics program and the joint Applied and Computational Mathematical Sciences program in each year since 1995.

## Matthew Kahle and Karl Schwede Receive Sloan Research Fellowships

Former UW Math Graduate students Matthew Kahle and Karl Schwede have each been awarded a Sloan Research Fellowship by the Alfred P. Sloan Foundation. The purpose of this award is "to stimulate fundamental research by early-career scientists and scholars of outstanding promise". Sloan Research Fellows are free to pursue whatever lines of inquiry are of the most compelling interest to them. The $50,000, two-year award may be used for equipment, professional travel, or any other activity directly related to the Fellow's research.

Matthew Kahle received his PhD in 2007 under the direction of Eric Babson and Christopher Hoffman. He is currently an assistant professor in mathematics at Ohio State University; prior to this position he was a postdoctoral fellow at Stanford University and a member of the School of Mathematics at the Institute for Advanced Study. Matthew's research interests include random topology, topological statistical mechanics, and combinatorics. His research is also supported by a DARPA Young Faculty Award.

Karl Schwede received his PhD in 2006 under Sándor Kovács. He is now assistant professor at Pennsylvania State University, following four years at the University of Michigan where he was a National Science Foundation Postdoctoral Fellow. Karl works in algebraic geometry and commutative algebra, with a focus on the study of algebraic singularities. His research interests also include number theory and computational commutative algebra.



Matthew Kahle



Karl Schwede

# FACULTY NEWS

## New Faculty

Eight new faculty members and postdoctoral fellows joined the Department in 2012-2013:

**Andrew Berget** (Acting Assistant Professor), PhD University of Minnesota, 2012. Berget studies combinatorics, algebra, and geometry.

**Mary Radcliffe** (Acting Assistant Professor), PhD UC San Diego, 2012. Radcliffe studies combinatorics and graph theory.

**Mario Micheli** (Acting Assistant Professor), PhD Brown University, 2008. Micheli, who will join us in the winter, studies differential geometry.

**Douglas Rizzolo** (RTG Postdoctoral Fellow), PhD UC Berkeley, 2012. Rizzolo studies probability theory and stochastic processes.

**François Monard** (Acting Assistant Professor), PhD Columbia University, 2012. Monard studies functional analysis.

**Brent Werness** (Acting Assistant Professor), PhD University of Chicago, 2012. Werness studies probability theory and stochastic processes.

**Lauri Oksansen** (Acting Assistant Professor), PhD University of Helsinki, 2012. Oksanen studies inverse problems for hyperbolic partial differential equations.

**Alexander Young** (RTG Postdoctoral Fellow), PhD UC San Diego, 2012. Young studies non-commutative rings and algebras.

## Mathematics Faculty Fellowships

The Mathematics Faculty Fellowships are intended for research faculty below the rank of professor, or professors who are less than fifteen years past the PhD, and recognize the importance and impact of research support for these colleagues.

The Department has selected **William Stein** (pictured, left) to be the 2012 recipient of this two-year award. Stein does research in number theory that involves elliptic curves and modular forms, motivated by the Birch and Swinnerton-Dyer conjecture. He is also involved in practical implementation of computer software for doing mathematics, including leading the Sage open source mathematical software project.

**Soumik Pal** (pictured, right), who was selected in 2011, continues as a Faculty Fellow this year.

## Gunther Uhlmann Elected to Washington State Academy of Sciences

**Gunther Uhlmann** was one of thirty-seven new members elected to the Washington State Academy of Sciences (WSAS). The induction took place in September at the fifth annual meeting of the WSAS at the Museum of Flight in Seattle, bringing the total number of active members to 185.

The Washington State Academy of Sciences provides expert scientific and engineering analysis to inform public policy-making, and works to increase the role and visibility of science in the State of Washington.

## Promotions and Retirements

**Isabella Novik** was promoted from Associate Professor to Professor.

**Soumik Pal** was promoted from Assistant Professor to Associate Professor with tenure.

**Jerry Folland** retired after thirty-nine years with the Department.

**M. Scott Osborne** retired after thirty-seven years with the Department.

# RECENT DEGREES

## Recent Degree Recipients

The following students completed their doctorates in Mathematics during the academic year 2011-2012.

**Nathaniel Blair-Stahn.** His advsior was Chris Hoffman, and his thesis title was "A Geometric Perspective on First-Passage Competition."

**Mauricio Duarte.** His advisor was Krzysztof Burdzy, and his thesis title was "Subelliptic Brownian Driven Processes Interacting with the Boundary Local Times, and Their Stationary Distribution." Mauricio is now a postdoc at *Centro de Modelamiento Matemático* in Santiago, Chile.

**Mark Hubenthal.** His advisor was Gunther Uhlmann, and his thesis title was "An Inverse Source Problem in Radiative Transfer." Mark is now a postdoc at the University of Jyväskylä in Finland.

**Sweta Suryanarayan.** Her advisor was Steve Mitchell, and her thesis title was "Local Cohomology at Generic Singularities of Schubert Varieties in Co-Minuscule Flag Varieties." Sweta is now an adjunct assistant professor at Lewis and Clark College.

**Joshua Tokle.** His advisor was Zhen-Qing Chen, and his thesis title was "Heat Kernel Estimates Related to the Fractional Laplacian." Joshua is now a Mathematical Statistician at the US Census Bureau.

**Wenhan Wang.** His advisor was Neal Koblitz, and his thesis title was "Isolated Curves for Hyperelliptic Curve Cryptography." Wenhan remains with the Department as a Part-time Lecturer.

**Luke Wolcott.** His advisor was John Palmieri, and his thesis title was "A Tensor-Triangulated Approach to the Derived Category of a Non-Noetherian Ring." Luke holds a postdoctoral position at the University of Western Ontario.

**Carto Wong.** His advisor was Steffen Rohde, and his thesis title was "Smoothness of Loewner Slits." Carto is headed for San Mateo, California to take up a position as a software engineer.

Below is a list of those who completed their work at the UW with a Master's degree in Mathematics, with each student's advisor listed in parenthesis:

**Allison Beckwith** (Solomyak)

**Guo Chen** (Hart Smith)

**Brian Donhauser** (Burke)

**Fabiana Ferracina** (Burke)

**Marzieh Nabi-Abdolyousefi** (Thomas)

**Michael Wojnowicz** (Burdzy)

### Bachelor's Degrees

259 Bachelor's degrees were awarded during the 2011-2012 academic year. 151 in Mathematics and 108 in ACMS.

The following is a list of our friends who have contributed to the Department between September 1, 2010, and October 15, 2012. Should you notice an error or omission in this list, please draw it to our attention by a telephone call or e-mail message to Rose Choi (206-543-1151 or rosechoi@math.washington.edu).

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Each year the Department receives gifts from its alumni and friends. These gifts are of immense value to us. They permit us to carry on important activities for our students and our scholarly work; for instance, they provide money for scholarships, fellowships, and prizes for our students. They help to support events like Mathday and the REU program. They support visits to our department by distinguished mathematicians from around the country and the world. They give the Department a much-needed element of flexibility to meet special needs as they arise. For these contributions we are truly thankful, and we hope to continue enjoying the support of our many alumni and friends. If you are thinking of making a gift to the Department, or remembering the Department in your will, we invite you to discuss the matter with Professor Selim Tuncel, the chair of the Department (206-543-1151 or chair@math.washington.edu), or Elizabeth Larsen of the Advancement Office in the College of Arts and Sciences (206-616-6553 or eblarsen@uw.edu). You can also visit our web site http://www.math.washington.edu and click on "Giving to Math."

## CONTACT INFORMATION

This newsletter is published annually for alumni and friends of Mathematics at the University of Washington.

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