Department of Mathematics
University of Wisconsin

Van Vleck Notes 2006

From the Editor...

Being part of a public, underfunded university, the Department of Mathematics depends critically on private giving to support many of its activities: scholarships and awards for both undergraduate and graduate students, distinguished lecture series, travel for graduate students to conferences, and many other activities that are important for faculty and students. The current list of targeted funds, many of which began with a substantial private gift, is given at the end of this newsletter along with instructions on how to make a contribution. Included on this list is the Department's General Fund, an unrestricted fund that is used to finance a variety of programs and activities that could not be funded otherwise. The list of our funds, along with a short bio of people for whom they are named, can be found on our webpage http://www.math.wisc.edu by clicking on *Giving to Mathematics*. And now you can now make a gift online. We welcome, and are grateful for, contributions to any of our funds.

Those of you who have spent some time in Madison recently and maybe attended a lecture in B239 won't be surprised to hear us say that one of the Department's most pressing needs for Van Vleck Hall is a modern lecture room seating 100-125 people that could be used as a colloquium room and as a classroom for our lecture-classes of about 100 students. We have often thought that so much of the concrete on the plaza level surrounding Van Vleck Hall (and over the classrooms on the B-levels) is wasted, and wouldn't it be wonderful if on this under-utilized space a new wing could be built containing such a modern lecture room. Unfortunately, it does not appear that such an addition is a high priority for campus officials at this time. But the need is great.

There may be no construction on Van Vleck Hall, but there is much construction going forward on campus and in downtown Madison. University Square will be closed soon to make way for new university buildings and dormitories (that landmark Italian restaurant—I am sure you know which one I mean—has already moved out and has reopened closer to the capital square). The campus has a new master plan that will change considerably the appearance of many parts of campus in the next ten to fifteen years. Camp Randall (the football stadium) has a new appearance with many additional seats added. There is a new sculpture "Hail's Nails" at the corner of Breese Terrace and Regent Street that has aroused some controversy.

In downtown Madison, the new Overture Center off of State Street is now nearly complete. The Madison Symphony's home is now located there in Overture Hall, the Wisconsin Chamber Orchestra is in the refurbished Capital Theater within the Overture Center, and the Madison Repertory Theater has recently opened its first production in its new quarters in the Overture Center. It's a fabulous center, made possible by private gift giving. Condominium construction in and around downtown Madison is proceeding at a phenomenal rate, as are apartment buildings intended primarily for students. If you haven't been back to Madison recently, you won't recognize the area around West Gorham, Bassett Street, and University Avenue.

Come and have a look for yourself and see what's going on. We would love to see you in Madison. The view from our 9th floor conference room is as wonderful as ever. ... **RAB**

From the Chair...

I am happy to introduce myself to you as the new Chair, and grateful to all of my colleagues for guiding me through these first challenging and exciting months. Among those are the former Chairs Richard Brualdi, Tom Kurtz, Alex Nagel, and especially my predecessor David Griffeath. David successfully navigated the department through a difficult period of budget cuts, and still managed to strengthen the department by hiring many exceptional faculty and staff. In the following pages you will read about two new assistant professors: James Rossmanith (numerical analysis, PhD University of Washington, Seattle) and Gheorghe Craciun (mathematical biochemistry, PhD Ohio State University). You will also be introduced to seven new Van Vleck Assistant Professors, Jun Chen (PDE, PhD Northwestern University), Rafe Jones (number theory, PhD Brown University), Aobing Li (PDE, PhD Rutgers University), Han Peters (complex dynamical systems, PhD University of Nijmegen, The Netherlands), Roman Shterenberg (mathematical physics, PhD St. Petersburg State University), Craig Westerland (homotopy theory, PhD University of Michigan) and Ke Zhu (symplectic geometry and Riemannian geometry, PhD Stanford University). Vicky Whelan has become our new Department Administrator and brings with her a wealth of experience and knowledge about the University in general, and about budget issues in particular. John Heim joins our computer staff, bringing expertise in Linux and Windows environments, and in database management. We were also successful in recruiting two outstanding geometers, both of whom will join the faculty in fall 2006: assistant professor Sean Paul (PhD Princeton University) and associate professor Jeff Viaclovsky (PhD Princeton University). Both will be featured in next year's newsletter.

As is often the case amongst our highly distinguished and decorated faculty, several members have been recognized with prestigious awards this year. Ken Ono was selected to receive the NSF Director's Award for Distinguished Teaching Scholars. Paul Rabinowitz was chosen for the UW Hilldale Award honoring lifetime achievement in the Physical Sciences. Yong-Geun Oh will give an invited lecture at the 2006 ICM meeting in Madrid. Serguei Denissov and Julie Mitchell are the amongst the latest recipients of Alfred P. Sloan Fellowships. I invite you to read more about these and other awards given to our faculty, staff, graduate students and undergraduate students in the pages that follow.

You have already heard from the Editor about our need for private donations, and I would only like to add one more telling fact: last year we supplemented TA salaries with over $60,000 from our UW Foundation funds, in order to remain competitive with other institutions and to recruit the high quality graduate students who are so vital to the research life of the department.

I would be pleased to meet you in person, and we welcome you to stop by Van Vleck on your next trip to Madison to visit with old and new colleagues and friends. Please also keep in mind the next Wisconsin Reunion of Alumni and Friends will be held during the Joint Mathematics Meetings in New Orleans, January 5-8, 2007. Best Wishes for the coming year!

Sincerely,
Leslie Smith, Chair
Department of Mathematics

New Faculty

Two new faculty members joined the Department of Mathematics. They are **Gheorghe Craciun** and **James Rossmanith**. Gheorghe was hired within the Molecular Biometry program, one of the clusters of the interdisciplinary strategic hiring initiative of the university to maintain research preeminence and to develop programs in emerging areas of knowledge. The hiring for this cluster, for which Paul Milewski, Tom Kurtz, and Julie Mitchell played crucial roles, is now complete and Gheorghe joins Julie Mitchell of our department who was hired in 2004 for that cluster. James Rossmanith was hired to solidify our important program in scientific computing and numerical analysis.

Gheorghe Craciun has been appointed as Assistant Professor with a 75% time appointment in the Department of Mathematics (College of Letters and Science) and a 25% time appointment in the Department of Biomolecular Chemistry (School of Medicine). Gheorghe did his undergraduate work at the University of Bucharest in Romania, and received the PhD in Applied Mathematics from the Ohio State University in 2002. The title of his dissertation, written under the supervision of Martin Feinberg of the Mathematics and Chemical Engineering Departments, is *Systems of nonlinear equations deriving from complex chemical reaction networks*. While a graduate student at Ohio State, Gheorghe was a member of the group *Efficient Visualization and Interrogations of Terascale Datasets* and he worked on designing feature-preserving wavelets and filter banks for visualization of large computational datasets. From 2002 to 2005 he was a postdoctoral researcher at the Mathematical Biosciences Institute (MBI) of the Ohio State University where his mathematics mentor was the Director of MBI, Avner Friedman. Some of the projects that he worked on at MBI were understanding bistability of complex biochemical reaction networks, mathematical models for cell cycle and apoptosis, databases and computational approaches for modeling gene regulatory networks, mathematical models for axonal transport of neurofilaments along microtubules, and inverse problems in neuronal cable theory.

James Rossmanith has been appointed as an Assistant Professor in the Department of Mathematics. James received the PhD in Applied Mathematics from the University of Washington in Seattle with a thesis, supervised by Randall LeVeque, titled *A wave propagation method with constrained transport for ideal and shallow water MHD*. He spent three years as a VIGRE Assistant Professor at the University of Michigan before joining us in Madison in 2005. While at Michigan he mentored an undergraduate student in the Research Experiences for Undergraduates program. James's research interests are interdisciplinary in nature and are focused on the development and analysis of numerical methods for hyperbolic conservation laws, with particular interest in wave propagation methods on locally Cartesian grids and in hybrid finite-volume/finite-element methods on unstructured grids. He also works on applying these methods to astrophysical fluid dynamics, a field that contains elements of gas dynamics, plasma physics, and general relativity.

Three Associate Professors Promoted to Professor

Xiuxiong Chen, Alexander Kiselev, and Timo Seppalainen have all been promoted to (full) professor in the Department of Mathematics.

Xiuxiong Chen received the PhD from the University of Pennsylvania in 1994. Following an instructorship at McMaster University (Canada) from 1994 to 1996, and an NSF postdoctoral fellowship at Stanford from 1996 to 1998, he joined our faculty as an Assistant Professor. He was promoted to Associate Professor in 2002. Xiuxiong is internationally recognized for his work in complex geometry, a relatively new subject which lies at the intersection of the fields of differential geometry, several complex variables, and nonlinear partial differential equations. His achievements in the revolutionary program in complex geometry initiated by Simon Donaldson were recognized in 2002 by the highly coveted honor of being invited to address the International Congress of Mathematicians in Beijing. Recently, with collaborators, Xiuxiong has made important contributions to complex geometry, including classifying extremal metrics, showing that the space of Kähler metrics is geodesically convex, finding geodesics in this space, obtaining partial regularity theorems, and introducing important functionals and flows.

Alexander Kiselev received the PhD in mathematics from the California Institute of Technology in 1996. Following a postdoctoral fellowship year at the Mathematical Sciences Research Institute, he was an L.E. Dickson Instructor at the University of Chicago from 1997 to 1999, and then was appointed as an Assistant Professor at Chicago. He joined our faculty as an Associate Professor in 2002. Alexander (Sasha) has made deep and important contributions to two separate areas of mathematics: the spectral theory of Schrödinger operators, and the theory of reaction-diffusion equations. In one of his breakthrough papers he solved a problem that Barry Simon (Sasha's thesis advisor) listed in a millennial list that he produced for the 2000 IAMP Congress. Sasha's research and teaching contributions were recognized by the NSF with a five-year (2002-07) NSF CAREER research grant. He provides an important link in the department between the analysis and applied mathematics groups. Sasha has also developed an advanced undergraduate course on mathematical biology.

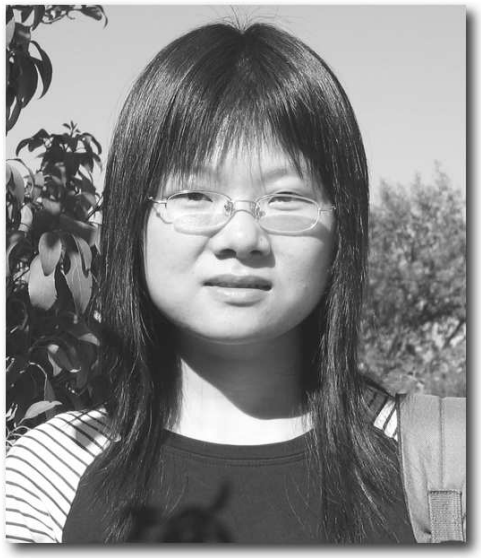
Timo Seppäläinen received the PhD from the University of Minnesota in 1991. Following a two-year instructorship at the Ohio State University, one-year postdoctoral fellowships at the Institute for Mathematics and its Applications and the Mittag-Leffler Institute, and five years as an Assistant, then Associate, Professor at Iowa State University, he came to Madison in 2001 as an Associate Professor. Timo's research focuses on complex interacting random systems, an area at the interface between probability theory and statistical physics. This includes his elegant coupling connection between the simple exclusion process and the classical variation formula for the solution of the Hamilton-Jacobi equation and his results connecting fluctuations of the exclusion process with the subdiffusive power law exponent $1/3$ and (non-Gaussian) Tracy-Widom distribution of random matrix theory. In addition, Timo has made very significant contributions to random walks in a random environment, a currently very hot and difficult topic in probability theory. For the last couple of years, Timo has very successfully chaired one of the most important committees in the department, the Graduate Admissions Committee.

Van Vleck Visiting Assistant Professors

Seven new PhDs began postdoctoral appointments this year as Van Vleck Visiting Assistant Professors. They are **Jun Chen, Rafe Jones, Aobing Li, Han Peters, Roman Shterenberg, Craig Westerland,** and **Ke Zhu**.

Jun Chen received the PhD from Northwestern University in 2005 with a thesis titled *Multidimensional transonic shocks of full Euler equations* and supervised by Gui-Qiang Chen. His research interests include nonlinear partial differential equations and their applications, inverse problems, and related numerical analysis. Jun's appointment is partially funded through an NSF Focused Research Grant under the supervision of Mikhail Feldman.

Rafe Jones received the PhD from Brown University in 2005 under Joseph Silverman. The title of his thesis is *Galois martingales and the density of the p-adic hyperbolic Mandelbrot set*. Rafe is also a VIGRE postdoctoral fellow and is participating in the department's VIGRE activities. His research interests are in dynamics, algebraic number theory, Galois theory, and probability. While a graduate student at Brown, Rafe received the MAA's Allendoerfer Prize for Mathematical Exposition for his paper *A postmodern view of fractions and the reciprocals of Fermat primes*. His academic mentor in Madison is Nigel Boston.



Aobing Li received the PhD from Rutgers University in 2004 and spent the following year on a postdoctoral appointment at the Institute for Advanced Study at Princeton University. Her research interests are in nonlinear partial differential equations, geometric analysis, and conformal geometry. Her thesis *On some conformally invariant fully nonlinear equations* was supervised at Rutgers by Yanyan Li.

Han Peters received the PhD from the University of Michigan in 2005 working with John Erik Fornaess. His research field is several complex variables and complex dynamical systems, and his thesis was concerned with non-autonomous dynamics, that is, questions related to compositions of different maps instead of iterations of a single map. As an undergraduate at the University of Nijmegen in The Netherlands, Han worked as a teaching assistant.

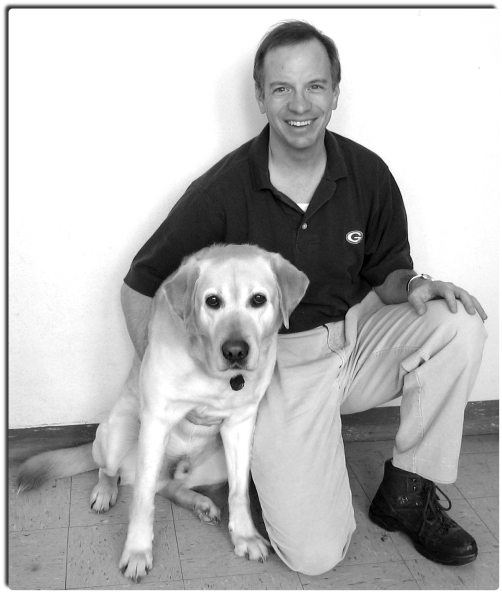
Roman Shterenberg received the PhD from St. Petersburg State University in Russia in 2003 where his advisor was M. Berman. He held a postdoctoral position at KTH in Stockholm and a research position at St. Petersburg before coming to Madison. Roman's scientific interests are in spectral theory and mathematical physics, Schrödinger operators, scattering theory and inverse problems. His postdoctoral appointment in Madison is being partially funded by research funds of Professors Alexandru Ionescu and Alexander Kiselev.

Craig Westerland received the PhD from the University of Michigan in 2004 and then spent one year on a postdoctoral appointment at the Institute for Advanced Study at Princeton University. His thesis at Michigan, *Stable splittings of configurations of surfaces and related mapping spaces*, was supervised by Igor Kriz. Craig is interested in how geometry informs stable homotopy theory and the homotopy theory of configurations and mapping spaces, including connections with modular forms and Dieudonné modules. He is also a VIGRE postdoctoral fellow.

Ke Zhu received the PhD from Stanford University in 2004 working with Yakov Eliashberg. He spent the 2004-05 academic year participating in the program *The geometry of string theory* at the Fields Institute in Toronto. Ke's thesis title is *Degeneration of J-holomorphic discs and Legendrian contact homology*. His research interests include both symplectic geometry and Riemannian geometry. Yong-Geun Oh serves as his mentor in Madison.

Continuing as Van Vleck Visiting Assistant Professors this year are **Marton Balazs, Kathrin Bringmann, Jason Swanson, Lijing Wang,** and **Andrej Zlatos**.

Staff News



John Heim has been hired as a computer specialist in the Department of Mathematics with the formal title of Information Processing Consultant. John holds a B.S. degree from UW-Stevens Point with a double major in mathematics and computer science. His previous work experience has been quite varied. From 1983 to 1990 he worked as a programmer and analyst for Delphi Systems, E.W. Miller Company, and Merge Technologies, all in Milwaukee. In 1990 he took a job as Information Processing Consultant with UW-Madison's Division of Information Technology (DoIT) and then became DoIT's Web Services Coordinator. Since taking his position in the Department of Mathematics on April 1, 2005, John has worked on several projects dealing with installing Windows XP and Windows applications and installing Linux. Using his expertise on web services that he developed while working at DoIT, John has implemented our Graduate Application web application. This web page allows members of the graduate admission committee to easily view and sort the approximately 400 graduate student applications we have been receiving yearly.

Victoria (Vicky) Whelan is the Department's new administrator. Vicky brings a wealth of experience in the university to the job: Accountant Assistant (Physics Dept.), Business Manager Assistant (School of Education), Business Office Manager (School of Music), Payroll & Benefits Specialist (Mathematics Dept.). Vicky is very knowledgeable about the university and is a great asset to our chair, faculty, and staff. If she doesn't know something (and that's rare), she knows where and how to find out about it. Vicky is a bundle of energy both on and off campus. Among her passions are music, bicycling, good food, and traveling.

Vicky Whelan on the right with retired support staff Diane Reppert and Sherry Lange

Dorothy Churchwell Retires from the Math Tutorial Program

Dorothy Churchwell started working with the Math Tutorial Program (MTP) in 1981 and retired at the end of the 2003 fall semester with the title Faculty Associate Emerita. For thirteen years, she was an important member of the MTP staff, working with sensitivity and expertise in helping academically at-risk students improve their mathematical skills. Her working relations with students and the other members of the MTP were uniformly excellent. In addition to teaching tutorial sections for the mathematics courses served by the MTP, Dorothy also prepared instructional material for courses from algebra and trigonometry to calculus, and developed and offered calculus review workshops during the first week of classes each semester. She also taught the developmental class on mathematical skills and coordinated and taught the course on intermediate algebra.

Sabbaticals in 2006-07

Four faculty members have been awarded sabbatical leaves for the 2006-07 academic year.

Xianghong Gong will be on sabbatical during the fall of 2006. He plans extended visits at the University of Chicago and Nanjing University working with collaborators on classification of real sub-manifolds in complex space and dynamical systems theory. In China, he also plans to document similarities and differences in approaches to teaching undergraduate calculus.

Shi Jin will be on sabbatical leave for the full 2006-07 academic year. He will spend 6 months as a Pauli Fellow at the Wolfgang Pauli Institute of the University of Vienna, organizing a thematic program on numerical partial differential equations. Shi also plans visits to the Université Paul Sabbatier-Toulouse in France, Tsinghua University in China, and Stanford University working with collaborators on numerical methods for coupled kinetic and hydrodynamic systems, and on wave propagation in random media.

Robert Wilson will be on sabbatical leave during the fall of 2006 and will be based in Madison during that time. Bob has a supervisory role in our pre-service courses for future K-12 teachers and in our calculus sequence, and is also involved in outreach activities for area middle-school teachers. With his primary interest in mathematics education, he plans to investigate how cultural background influences student success in mathematics, at both the K-12 and college levels.

Tonghai Yang will be on sabbatical leave for the full 2006-07 academic year. Tonghai is a participant in an NSF Focused Research Grant in number theory and will be working with research groups at Columbia University and the University of Maryland on this grant. He also plans to work on a text on the Arakelov theory of modular forms during this period, and to prepare individual research projects for undergraduates to be used within the department's VIGRE program.

Honors and Awards

Gloria Mari Beffa Wins L&S Mid-Career Award

Dr. Gloria Mari Beffa has been selected to receive a Mid-Career Award from the College of Letters and Science. This award recognizes individuals who demonstrate outstanding performance in their position, show substantial promise of continuing contributions, and demonstrate a high degree of professionalism. Since 2002 Gloria has been the Undergraduate Advisor in the Department of Mathematics, supervising with dedication and skill the undergraduate mathematics program. She also was for several years our Honors Coordinator.

Gloria received the PhD from the University of Minnesota in 1991. She spent one year as a postdoctoral fellow at UC-Davis before taking up a Van Vleck Visiting Assistant Professorship in 1993. Dr. Mari Beffa's broad research area is symplectic geometry, and she is an expert on the geometry of Hamiltonian structures associated with curve flows in homogeneous spaces and integrable equations. Gloria has been on leave this year at the Vrij Universiteit in Amsterdam.

Ken Ono receives NSF Director's Award for Distinguished Teaching Scholars

Nominated by Dean Gary Sandefur of the College of Letters and Science, and by mathematicians George Andrews of the Pennsylvania State University and Barry Mazur of Harvard University, **Ken Ono** has received the NSF Director's Award for Distinguished Teaching Scholars. The Directors Award is the highest honor bestowed by the NSF for excellence in both teaching and research in STEM (Science, Technology, Engineering, and Mathematics) research areas. According to NSF director, Arden L. Bement Jr., "The awards are NSF's recognition of accomplishments by scientists and engineers whose roles as educators and mentors are considered as important as their groundbreaking results in research." Ken is one of only four mathematicians to ever win the award. The prize comes with a grant of $305,000 and a nice sculpture which now has a prominent place in Ken's office in Van Vleck Hall.

Ken, who is Solle P. and Margaret Manasse Professor of Letters and Science, has been a member of the mathematics faculty since 1999 and has won numerous awards. Ken is well-known for solving the 80-year-old problem of the "Ramanujan congruences," which describe a series of patterns for certain partition numbers. He has done important work in the areas of modular forms, elliptic curves and L-series.

The awards ceremony, at which Ken was accompanied by his wife Erika, was held on June 21, 2005, at the National Academy of Sciences in Washington, D.C. On June 22, a forum on the topic of "Broader Impacts" was held at the National Science Foundation in which Ken participated.

Ken intends to use the grant on gifted students at all levels who want to pursue research in mathematics. Specifically, he intends to run an annual eight-week summer institute that will recruit top math students from around the country. He will also participate in "outreach site visits" to middle schools and high schools around the country in collaboration with the American Mathematical Society and Science Service. In addition to hands-on classroom activities, site visits will feature a game show loosely based on the TV program "Who Wants to Be a Millionaire?" Students will compete for prizes and scholarships, with local winners meeting for a year-end standoff at the "Tournament of Champions."

Yong-Geun Oh to be ICM Lecturer

The International Congress of Mathematicians (ICM) will be held from August 22 to 30, 2006 in Madrid, Spain. The ICM is the most celebrated mathematics meeting in the world and has taken place every four years since 1897. A major scientific event, the ICM is attended by mathematicians from all over the world, demonstrating the crucial role played by mathematics in science and society. Being invited to give a lecture at the ICM is a very prestigious honor, and our colleague **Yong-Geun Oh** has been invited to give a lecture in the geometry section at ICM-2006. Yong Geun's research primarily concerns symplectic geometry and mirror symmetry, with special emphasis on Floer theory.

Paul Rabinowitz Receives Hilldale Award

Paul Rabinowitz, Vilas Professor of Mathematics, received the Hilldale Award in the Physical Sciences for 2004-2005. This is one of the highest honors bestowed by our university in recognition of lifetime achievement. A reception for the Hilldale Award honorees in each of the four divisions was held at the home of Chancellor John Wiley.

Paul is well-known to readers of this newsletter. His contributions to nonlinear analysis have been recognized by election to the National Academy of Sciences in 1998 and the Birkhoff Prize in Applied Mathematics, awarded to him in 1998 by the American Mathematical Society and the Society of Industrial and Applied Mathematics.

Paul receiving Award

Paul and Birgit Rabinowitz

Leslie Smith and Nigel Boston win Vilas Associates Award

The UW-Madison Graduate School has named **Leslie Smith** a Vilas Associate for the years 2005-07 and **Nigel Boston** a Vilas Associate for the years 2006-08. This award provides summer research support for two years and a flexible research fund for scholarly activities.

Leslie Smith received the PhD in applied mathematics from MIT in 1988. She has been on the UW-Madison faculty since 1997, holding now a three-quarter time position in Mathematics and a one-quarter time position in Engineering Physics. Currently, her research is focused on geophysical fluid dynamics and dispersive wave systems, and her other interests include statistical physics, turbulence and stability theory. Leslie was on sabbatical during the 2004-05 academic year working at the Los Alamos National Laboratories. Since last summer she has been the Chair of the Department of Mathematics.

Nigel Boston received the PhD from Harvard University in 1987. After many years at the University of Illinois, he came to UW-Madison as part of the computational sciences cluster of UW-Madison's strategic hiring initiative. Nigel holds a joint appointment in Mathematics and Electrical & Computer Engineering. His research interest are many, including algebraic number theory, group theory, coding theory and applications, cryptography, and computer algebra systems. Last year this newsletter contained an article concerning the team project Nigel is working on to build a face recognition system and to investigate a common foundation between face recognition and cryptanalysis.

Two Faculty Awarded Sloan Fellowships

Assistant Professors **Serguei Denissov** and **Julie Mitchell** have been awarded prestigious Alfred P. Sloan Fellowships. These extremely competitive awards, recognizing past research accomplishments and future potential, are given only to the best young scientists in the country.

Serguei Denissov, who received the PhD from Moscow State University in 1999, joined our department in the fall of 2005 after finishing an Olga Taussky-John Todd instructorship at the California Institute of Technology. His research areas are mathematical physics (spectral properties of Schrödinger operators) and mathematical analysis in general. More information about Serguei can be found in last year's newsletter.

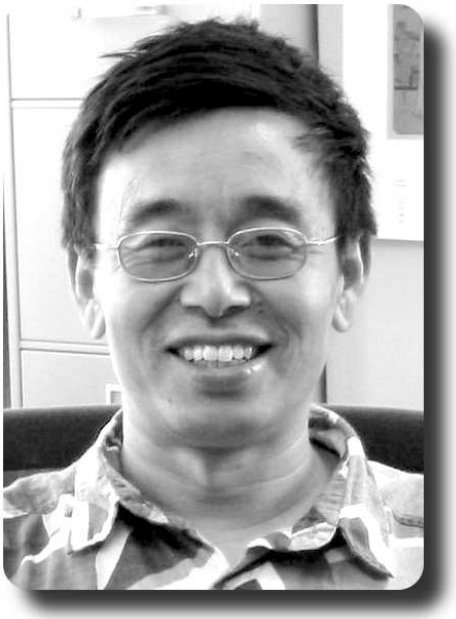
Julie Mitchell, who holds a joint appointment in the Biochemistry Department, is also Director of the new BACTER Institute about which there was an article in last year's newsletter. Before joining our department in 2003 as part of the university's cluster on Molecular Biometry. She was an Assistant Principal Scientist at the San Diego Supercomputer Center. Dr. Mitchell uses mathematics to study protein interactions. At the level of structure, how molecules bend depends on their geometry and electrostatic properties. Once one considers networks of interactions that drive physiology, nonlinear systems theory can predict time-dependent behavior.

Georgia Benkart and Yongbin Ruan Named E.B. Van Vleck Professors

Effective with the fall semester of the 2005-06 academic year, the Department of Mathematics has named **Georgia Benkart** and **Yongbin Ruan** as E.B. Van Vleck Professors of Mathematics.

Georgia Benkart received the PhD from Yale University in 1974. She was C.C. MacDuffee Instructor at UW-Madison from 1974 to 1976 before being appointed Assistant Professor in 1976. Georgia is an expert of the highest international standing on Lie algebras, their representation theory and combinatorial connections. Her contributions have been unusually broad: classification of modular Lie algebras, Kac-Moody algebras (of importance in physics), Lie superalgebras, the combinatorics of tableaux and its connection with Lie algebras, algebraic combinatorics, and quantum groups and superalgebras. Her 1996 paper in *Inventiones Math.*, with E. Zelmanov, was the beginning of an extensive study of a new class of Lie algebras generalizing the classical semisimple Lie algebras and the Kac-Moody Lie algebras. With collaborators, Georgia has completed the classification of these so-called root system Lie algebras, including a very long Memoir published by the American Mathematical Society (AMS) in 2002. Her distinguished research was recognized by UW-Madison with a WARF Mid-Career Award in 1996.

In addition to outstanding research, Georgia is recognized nationally and internationally for her remarkable lecturing and expository skills. In 1987 Georgia's teaching accomplishments were recognized with a Distinguished Teaching Award from UW-Madison. Since 2000 she has given more than fifty outside lectures all over the world. Georgia was the prestigious Pólya Lecturer of the Mathematical Association of America (MAA) for 2000-02. In 2005 she gave an AMS-MAA invited lecture at the annual AMS-MAA meetings in Atlanta. In addition, Benkart has given many prized lecture series at colleges and universities throughout the country.



Yongbin Ruan received the PhD from the University of California-Berkeley in 1991, and after short stays at Michigan State and at the University of Utah, he joined the UW-Madison Department of Mathematics faculty in 1995. Yongbin works in topology and differential geometry, fundamental and classical subjects in mathematics. A distinguishing feature of his work is its understanding of physics and how it can shed light on apparently unrelated subjects in pure mathematics. Yongbin has been remarkably effective in extracting mathematically relevant ideas from the work of physicists and then substantially developing them. He was one of the developers of quantum cohomology, now a broad and popular field in algebraic and symplectic geometry. Yongbin gave the first rigorous definition of the Gromov-Witten invariants which have major implications in both enumerative algebraic geometry and physics. He also invented orbifold cohomology, a theory based on ideas arising from string theory.

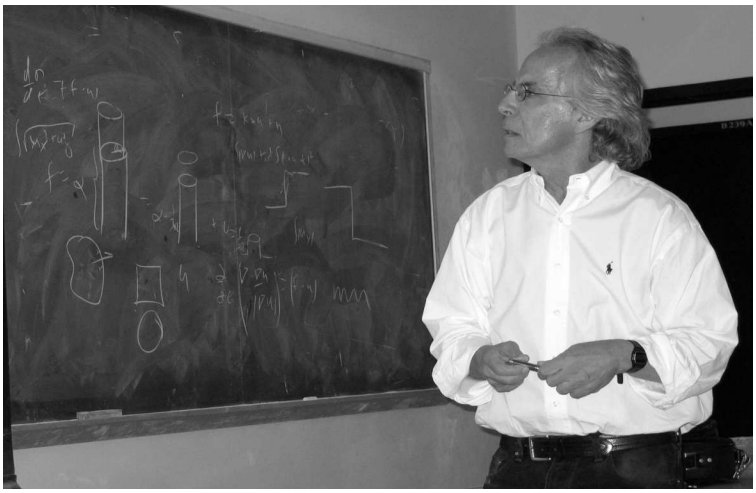
Yongbin's distinguished record has been recognized by an Alfred P. Sloan Research Fellowship (1995), an invitation to deliver a lecture at the International Congress of Mathematicians (ICM) in 1998, an invitation to serve on the 2002 ICM Selection Committee for speakers in the topology/geometry section, and a Vilas Associate Award. In the fall of 2004 he served as Ordway Professor of Mathematics at the University of Minnesota. Yongbin has also been honored by China with the Distinguished Overseas Young Scientist Award, 2000-03.

Regrettably, Yongbin resigned from UW-Madison at the end of the 2005-06 fall semester to take a position at the University of Michigan.

Special Lectures

10th Wolfgang Wasow Memorial Lecture

The 10th Wolfgang Wasow Lecture was given on October 21, 2005 by **Stanley Osher**, Professor of Mathematics and Director of Applied Mathematics at the University of California, Los Angeles and also Director of Special Projects at the Institute for Pure and Applied Mathematics (IPAM). The title of his lecture was *Mathematics in the real world and the fake world.*



Professor Osher discussed data centric computing and a new approach to image science and free boundary problems in nature, exemplified by the level set method for capturing moving fronts, which was introduced in 1987 by Osher and Sethian. As Professor Osher said, this has proven to be "phenomenally successful as a numerical device." He said that typing in "Level Set Methods" on Google's search engine gives roughly 90,000 responses. Applications discussed by Professor Osher in his lecture (and video displays) ranged from capturing multiphase fluid dynamical flows, to special effects in Hollywood, to visualization, image processing, control, epitaxial growth, and computer vision. He gave a quick overview of the numerical technology, its relation with the field of PDE-based imaging science, and some applications. In keeping with his title, Professor Osher said "the real world is exemplified by image analysis and the fake world is exemplified by computer graphics."

Announcing

2006 Wasow Memorial Lecture

Elias Stein

Department of Mathematics

Princeton University

Fall 2006

10th LAA Lecture

On March 14, 2005, **David Donoho**, the Anne T. and Robert M. Bass Professor of Humanities and Sciences and Professor of Statistics at Stanford University, gave the 10th annual LAA Lecture on *More Unknowns than Equations? Bring it on!* Professor Donoho challenged his audience with: "Everything you were taught about underdetermined systems of linear equations is wrong..." and then went on to say that "that's too strong but you have been taught things in undergraduate linear algebra which, if you are an engineer or scientist, may be holding you back. The main one is that if you have more unknowns than equations, you're lost. Don't believe it."

Professor Donoho went on to list two problems in the information sciences where "researchers are currently confounding expectations by turning linear algebra upside down":

(a) An imaging system can produce an accurate N-pixel image using only $N^{1/4}\log^3(N)$ (specially chosen) samples to reconstruct it, far fewer than the N pixel samples you might have naively thought.

(b) It is possible to transmit a signal without mistakes, despite jamming by an arbitrarily clever opponent, if the opponent's jamming only interferes less than 1/2 the time – even if the opponent's jamming can be arbitrarily more powerful and is entirely malicious.

He continued that "mathematically, what's going on is a recent explosion of interest in finding the sparsest solution to certain systems of underdetermined linear equations. This problem is known to be NP-hard in general, and hence the problem sounds intractable.

"Surprisingly, in some particular cases, it has been found that one can find the sparsest solution by l^1 minimization, which is a convex optimization problem and so tractable. Many researchers are now actively working to explain and exploit this phenomenon. It's responsible for the examples given above."

Professor Donoho discussed this curious behavior of l^1 minimization and connected it with some deep mathematics – Banach space, geometry, and geometry of convex polytopes.

Announcing

2006 LAA Lecture

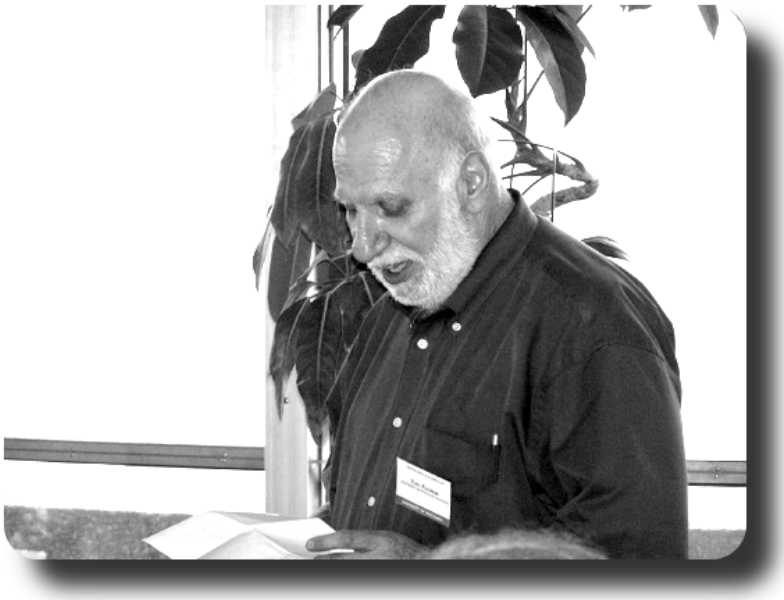
Ron DeVore
Department of Mathematics
University of South Carolina
April 28, 2006

Last year's newsletter contained a short bio of Barry Mazur who was the 2004-05 Hilldale Lecturer in the Physical Sciences. We would like to expand on certain statements presented in the newsletter concerning the Schoenflies Conjecture.

Using a minimum of technical machinery, Barry Mazur broke open the field of topological manifolds with a startling proof of the Schoenflies Conjecture under a smoothness assumption. Later, inspired by his success in proving such an important result while using little technical machinery, Morton Brown [PhD, 1958, R.H. Bing] gave a short complete proof by an entirely different method. Barry and Mort shared the fourth (1966) Veblen Prize for their work.

Conference News

Conference Celebrates Don Passman's 65th Birthday



A conference *Groups, Rings & Algebras* was held in Madison on June 10-12, 2005 in celebration of **Don Passman's 65th birthday** and his many contributions to mathematics. The conference was organized by William Chinn [PhD 1985, D. Passman], Jim Osterburg, and Declan Quinn [PhD 1985, D. Passman]. There were nine one-hour invited talks given by prominent algebraists. many of whom are co-authors of Don: Yuri Bahturin, Ed Formanek, Marty Isaacs, Martin Lorenz, Susan Montgomery, Toby Stafford, Lance Small, Alexander Zalesskii, and Efim Zelmanov. In addition, there were almost thirty shorter talks. Aside from the USA, there were participants from England, Italy, Israel, Belgium, Russia, Brazil, India, Taiwan and Canada. The conference was partially supported by the National Security Agency and the Department of Mathematics.

There was a dessert party at the Passman house on Friday evening, June 10 and a banquet on the 9th floor of Van Vleck on Saturday evening, celebrating Don's magnificent career. Additional Conference information and photos and Don's after-dinner speech are available linked though Don's web page (http://www.math.wisc.edu/~passman).

Conference on Groups, Rings & Algebras

BrualdiFest Conference and Celebration

A two-day conference titled *Brualdi-Fest: Linear Algebra, Graph Theory and Combinatorics*, was held April 30 to May 1 in honor of **Richard Brualdi** and his numerous contributions to mathematics. Richard Wilson (CalTech) gave the keynote address, "Revisiting the (t, k)-Subset Inclusion Matrices". There were 21 other technical papers ranging widely over combinatorics and linear algebra.

Richard's 32 PhD students were especially invited to take part, almost half of them were in attendance, and many were on the conference program. Also presenting talks were colleagues Jim Propp and Paul Terwilliger. There were over 50 participants, including Richard's three present students.

In a session devoted to his students' reflections on Richard's influence on them, in addition to his role as mathematical mentor there were frequent mentions of Richard's high energy and continual availability, no matter what the weather or the time of day, etc.

Richard and Mona accomplished the amazing feat of having the entire conference population over to their house for a delightful dinner evening!

Rick and Kathy Wilson have a marvelous conference web page
http://www.oldflutes.com/Kathy&Rick/brualdi.htm
with pictures, sketches, and comments.

The Official Conference Shirt

The conference was held at the Pyle center in Madison and organized by John Goldwasser (West Virginia University) (Richard's 7^{th} student), Hans Schneider (UW-Madison), Bryan Shader (Univ. of Wyoming) (Richard's 15^{th} student), and Bob Wilson (UW-Madison).

Richard with his Students

International Conference on Complex Analysis

Jean-Pierre Rosay, Patrick Ahern, Alexander Nagel

An International Conference on Complex Analysis was held in Madison from March 16–19, 2006 honoring **Patrick Ahern**, **Alexander Nagel**, and **Jean-Pierre Rosay** for their many seminal contributions to the field. The organizers of the conference were Andreas Seeger, Xianghong Gong, Steve Wainger, and our former colleague Franz Forstneric. The conference opened with a lecture by Lee Stout [PhD 1964, W. Rudin] of the University of Washington with the title *The complex analysis of Pat Ahern, Alex Nagel, and Jean-Pierre Rosay*. Lee was given an impossible task by the organizers — to describe in 60 minutes the work on complex analysis done by these three distinguished contributors to complex analysis over a combined total of about 100 years — but he did an admirable job. The other invited speakers were: M. Salah Baouendi (UC - San Diego), Joaquim Bruna (Autonomous U. of Barcelona), Michael Christ (UC - Berkeley), John P. D'Angelo (UI - Urbana-Champaign), Sergey Ivashkovich (U. Lille), Laszlo Lempert (Purdue U), Jeffery McNeal (Ohio State U.), Detlef Mller (Christian-Albrechts U., Kiel), Joaquim Ortega (U. Barcelona), Evgeny A. Poletsky (Syracuse U.), Fulvio Ricci (Scuola Normale Superiore, Pisa), Linda Preiss Rothschild (UC - San Diego), Mei-Chi Shaw (U. Notre Dame), Berit Stensones (U. M. - Ann Arbor), Elias M. Stein (Princeton U.), Dror Varolin (SUNY - Stony Brook) [PhD 1997, F. Forstneric], and Sidney M. Webster (U. Chicago).

On Saturday evening, March 18, there was a banquet in celebration of the event. The dinner. catered by the UW Memorial Union, included their famous fudge-bottom pie. The after-dinner festivities, emcee'd by Steve Wainger, included talks by Salah Baouendi, Elias Stein, and Laszlo Lempert. Salah described how, as chair at Purdue, he tried to get Jean-Pierre Rosay to take a permanent job but was outfoxed by UW-Madison and Walter Rudin. He also mentioned that when he invited Jean-Pierre to visit San Diego, Jean-Pierre said he wouldn't come until April, so as not to miss any snow (Jean-Pierre is a *very* eager cross-country skier). Eli described his many years of collaboration with Alex and Alex's "decommission" as associate dean, at which Eli was present, where Dean Phil Certain cut Alex's tie to signify his duty in the College of Letters and Science was over. Laszlo talked about his connections with Pat Ahern, and also with Alex and Jean-Pierre.

In his response Jean-Pierre thanked Walter Rudin who was instrumental in bringing him to Madison and described the wonderful atmosphere and quality of life at UW-Madison. Alex thanked the department for the wonderful 36 years he has spent so far at UW-Madison, and the three people who mentored him early in his career — Walter Rudin, Steve Wainger, and Elias Stein. (Alex's daughters, their companions, and his brother attended the dinner.) To finish the evening Steve related how important it is to him to have Pat, Alex, and Jean-Pierre as mathematical friends. He also said that the conference was also celebrating complex analysis at Wisconsin, something that would have been impossible without Walter Rudin. He also thanked Walter and Mary Ellen Rudin for making our mathematics department such a wonderful place to be.

International Conference on Complex Analysis

FRG Workshop on Multi-dimensional Hyperbolic Conservation Laws

On June 8-12, 2005 a workshop on multi-dimensional hyperbolic conservation laws was held in Madison organized by **Marshall Slemrod**. The workshop was sponsored by the National Science Foundation through their Focused Research Grant program. There were 28 talks spread over four days, including talks by locals Thanos Tzavaras, Misha Feldman, and Shi Jin. In addition to participants from the USA, there were participants from China, Hong Kong, Korea, and France. Everyone was housed and fed in the Friederick Center on campus allowing for intensive conversations and collaboration during the workshop.

Annual Wisconsin Reunion and Reception

At the national math meetings in San Antonio, January 2006, we had our annual reunion for those with some UW–Madison math connection. The UW–Madison math community is a large and loyal group! About a hundred people took part, ranging from retirees to a future generation of mathematicians just a few years old. Here are some pictures from the reunion:

Student and Instructional News

Mathematics Talent Search Honors Day

back: Adam Helgren, Jacob Mauermann, Jason Malinowski, Tim Black, Nick Wage
front: Andrew Bolanowski, Laura Luo, Math Dept. Staff Sharon Paulson, Mary Zhang, Ben Holzer

The UW mathematics, engineering and science talent search, now in its fifth decade, continues to grow in many ways. The overall winner now receives a $24,000 scholarship to attend UW-Madison. In addition to participation by middle and high school students from across Wisconsin, we now have entrants coming from other states and foreign countries. Schools in Bulgaria are using the challenge problems, as are various Asian countries. In California a satellite contest has started that uses the Wisconsin problems but runs its own competition.

Out of the over one hundred students who participated in the talent search in 2004-2005, sixteen were invited to our annual Talent Search Honors Day on May 5, 2005. Timothy Black of Madison Memorial High School was announced as the winner of the four-year Van Vleck scholarship. The program for the Honors Day included a talk by Professor William Sethares entitled "Beat Tracking of Musical Performances using Low-Level Audio Features" and a talk by Professor Nigel Boston entitled "Fermat's Last Theorem".

Lev Borisov and Jordan Ellenberg now assist Martin Isaacs and Don Passman in producing the problem sets. Here are two problems from 2005:

(1) Let a be an odd positive integer and suppose that the equation $x^2 - y^2 = a$ has exactly one solution in positive integers x and y. Prove that either a is a prime number or it is the square of a prime number.

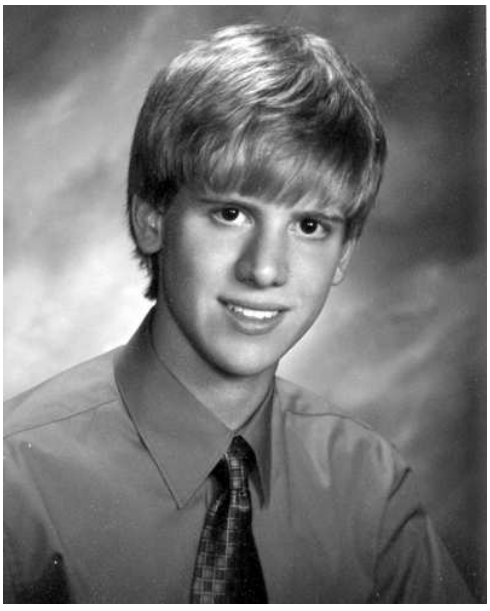
(2) Let us say that a diagonal of a pentagon is "good" if it is parallel to one of the sides of the pentagon. Show that if four of the five diagonals of a pentagon are good, then the fifth diagonal is also good.

For the solutions to these problems, and more about the Talent Search, see:
http://www.math.wisc.edu/~talent/honors.html .

REU in Number Theory

Last summer Ken Ono ran an REU in Number Theory with his graduate students Sharon Garthwaite, Karl Mahlburg, and Jeremy Rouse. Thanks to NSF VIGRE funding, they were able to support the research of a number of bright undergraduates, and one high school student. The students investigated characters arising in Moonshine, conjectures about p-adic modular forms, and the Ramsey properties of generalized Paley graphs. The students proved a number of theorems which have resulted in three publication. Zajj Daugherty wrote a paper on characters arising in a paper which has been accepted for publication in *Integers*. Po-Ru Loh and Rob Rhoades wrote a comprehensive paper on p-adic modular forms which has been accepted for publication in the *International Journal of Number Theory*. Nicholas Wage, a high school student in Appleton, Wisconsin, wrote a beautiful paper on the Ramsey properties of generalized Paley graphs. His project, which was inspired by a classic conjecture of Erdös, has been accepted for publication in *Integers*, and it is his high school science fair project. Read more about Nick below.

Appleton Student Wins in Intel Talent Search



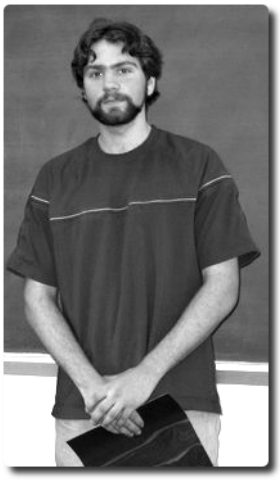
Nicholas Wage, a 17-year-old Appleton East High School senior and the winner of the 2003 Wisconsin Mathematics Talent Search, won fourth place (out of thousands of submissions) in this year's Intel Talent Search with a project based on the work he did at the 2005 Research Experiences for Undergraduates (REU) program at UW-Madison under the supervision of Prof. Ken Ono.

Nick's research concerned Paley graphs and generalized Paley graphs. Given a prime $p \equiv 1 \pmod 4$, we obtain a Paley graph by taking as vertices the integers $0, 1, ..., p-1$ with an edge between x and y exactly when $x - y$ is a (non-zero) square mod p. Nick found an asymptotic formula (as p increases) for the number of complete subgraphs of a fixed size, and showed that this agrees with a formula that Paul Erdös (wrongly) conjectured to hold for all graphs. For the case where $p \equiv 3 \pmod 4$, Nick found an asymptotic formula for the number of three-cycles in the directed graph in which the vertices are $0, 1, ..., p-1$ with a directed edge from x to y exactly when $y - x$ is a square mod p. His proofs used results from number theory, including Weil's Riemann hypothesis for finite fields. Nick's paper on his results has been accepted for publication in the journal *Integers*.

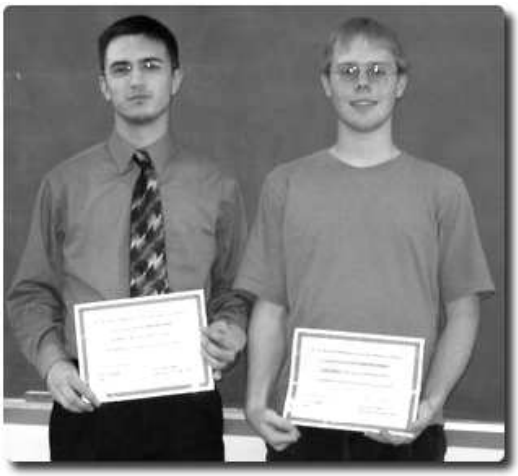
Nick will participate again in the Wisconsin REU run by Ken Ono this summer.

Some Photos of Undergraduate Scholarship Winners

Undergraduate Advisor Gloria Mari Beffa, Brian Hickmann, Blake Charvat, Konstantin Davydov



Jesse Beder



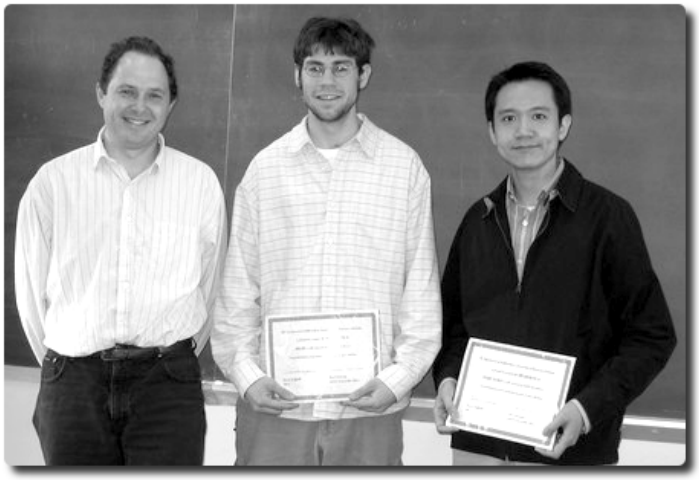
Erick Butzlaff, Gordon Stephenson

Kristin Lewis

Isaac Schwabacher, Chad Koch

Sam Lachterman, Manuela Mazzocco

Christopher Yu, Shane Squires



Paul Milewski, Jeffrey Noel, Christopher Yu

Undergraduate Scholarship Awards

At our annual Student Awards Ceremony held on May 4, 2005, a number of undergraduates were recognized with scholarship awards.

Leadership Prizes in AMEP ($500), awarded to outstanding students pursuing a degree in Applied Math, Engineering, and Physics with demonstrated leadership and superior academic record, went to:

Christopher Yu: Currently a senior. He is a returning student, having worked for seven years as an investment manager in Hong Kong. See below (under Frank Cady Scholarships).

Jeffrey Noel: Participated in a variety of research projects while an undergraduate and co-authored two papers on mathematical ecology. Now pursuing a doctorate in physics at UCSD.

Prof. Linnaeus Wayland Dowling Scholarships ($400), for students majoring in Mathematics, went to:

Konstantin Davydov: A double major in Computer Science and Math, now doing graduate work in Computer Science at Stanford.

John Bethencourt: A triple major in Computer Engineering, Computer Science and Math, now doing graduate work in Computer Science at Carnegie Mellon.

Blake Charvat: A double major in Math and Statistics who got As in our toughest courses.

Yael Peled: A straight A student and an athlete. After finishing her double major in Mathematics and CS, she went to work for Microsoft in Seattle.

Brian Hickmann: A junior straight-A student from Sheboygan. A double major in Computer Science and Math.

A David Lawrence Young Memorial Scholarship ($400), for a student showing promise early in his/her career, went to:

Jesse Beder: He is an undergraduate student who has only taken graduate courses in Madison. A past winner of the Talent Search, he has a great future.

R. Creighton Buck Scholarships ($350), for students demonstrating outstanding creativity in mathematics, went to:

Gordon Stephenson: A double major in Math and Atmospheric and Oceanic Sciences who took 5XX-level courses while still in high school. During his junior year, he did research with Gloria Mari Beffa and he is now following up on that by writing a paper with Shane Squires on moving frames in Lorentzian and Galilean manifolds. In Fall 2005 Gordon did an internship at NASA, applying differential geometry to some problems related to black holes.

Erick Butzlaff: A double major in Math and Physics and a sophomore, who did work with Alex Kiselev in the CURL program. He designed a project on traffic flow and did preliminary work on the project with Profs. Alexander Kiselev and David Griffeath.

An Irma L. Newman Scholarship ($600), for an outstanding major, went to:

Kristin Lewis: A triple major in Math/Astronomy/Physics, with Honors in the major in Physics. A straight A student in Math. She went on to graduate school in Physics at Michigan in the Fall.

Violet Higgitt Frank Scholarships ($800), for students majoring in Mathematics, went to:

Chad Koch: This is the second time Chad gets this award; moreover, last year he was the recipient of the Ingraham prize. A past winner of the Talent Search, he is a double major in CS and Math, pursuing Honors in the major in Math and currently working on a certificate in Business.

Isaac Schwabacher: An Honors students in Math and a member of the UW Choir, a sophomore who has already taken 10 courses at the 5XX-level, most of them for Honors. He was recipient of the Young award last year.

Mark Ingraham Scholarships ($1000), for the best Math majors, went to:

Manuela Mazzocco: A senior who received the Cady Scholarship last year. A double major Economics and Math, Honors in the major in Math. Highly praised by her teachers, she is an A-student nominated for several awards in Letters & Science. She has written a senior thesis under the supervision of Arun Ram entitled The Radicals of the Temperley-Lieb Algebra. She is taking the year off to have her first child and plans to return to graduate school in Math.

Samuel Lachterman: A student working on an Honors degree in Mathematics and a straight A student. He is a junior who entered the University at Calculus 3 level and who completed the Honors degree in his junior year. He has been working with Ken Ono for over a year and has co-written a paper accepted for publication in the Ramanujan Journal with two other students. He is writing his senior thesis under the supervision of Prof. Ono on explicit Ramanujan-type partition congruences, with support from an Honors grant from the School of Letters and Sciences (1 of around 17 awarded by L&S). He attended the MASS program in Penn State in Fall.

Frank Cady Scholarships ($3000), for outstanding and financially needy juniors and seniors with plans to continue their study of mathematics beyond college, went to:

Shane Squires: A junior double-majoring in Math and Physics and an A student. He is one of the very few students in Letters & Science who is working on a comprehensive Honors degree, a degree with Honors in Math and Honors in breadth requirements. Apart from Math and Physics, he has taken Honors courses in chemistry, anthropology, Indian civilizations, etc. He entered at

the Calculus 3 level, and in his junior year had already almost completed his degrees. He did work on a research project with Gloria Mari Beffa during his junior year (see the article on Undergraduate Research in Van Vleck Notes 2006) and over the summer started writing a senior thesis on integrable geometric nonlinear PDEs in Lorentzian manifolds under the supervision of Gloria Mari Beffa and with an Honors grant from Letters & Science (1 of around 17 awarded by L&S). He has been completely self-supported economically since high school and has held several jobs while pursuing his studies. This is the second year he receives the Cady Scholarship. He wishes to go to graduate school in Math/Physics next year.

Christopher Yu: A student from Hong-Kong who has also received the AMEP leadership award this year. He wants to pursue graduate studies in Financial Mathematics. He is a double major in Math and Statistics and a stellar student. He has been self-supported since 1996 and has recently quit his job to dedicate himself to studying.

Undergraduates Win Goldwater Scholarship

Dan Chavez and **Erin Conrad**, UW-Madison undergraduates, have won prestigious Barry M. Goldwater Scholarships, which provide $7,500/year to support undergraduate study in mathematics, engineering or the natural sciences. They are two of 323 (out of a pool this year of 1,081 nominees) undergraduate sophomore and junior students in the United States receiving an award this year on the basis of academic achievement and potential for a successful research career. Dan is majoring in Mathematics and Atmospheric and Oceanic Sciences (AOS); additionally, he has been doing research in AOS Professor Michael Morgan's laboratory. After pursuing a PhD in atmospheric science and a professorship at a major research university, Dan has an ambitious career goal: to become Director of the National Hurricane Center. Erin is majoring in mathematics and physics; she has been working on a research project in quantum computing in the Physics Department.

Puzzles and Games Collection

This year saw a new addition to our department's growing supply of puzzles and games: the "All Five Puzzle" designed and hand-made by physicist Wayne Daniel. This sliding-block puzzle is five puzzles in one, with a different puzzle for each Platonic solid. The puzzles are nested one inside another, as in Kepler's model of the solar system. The All Five Puzzle and other puzzles and games (whose purchase was made possible by a games and puzzles fund generously endowed by Oliver Eng, Ph.D. 1996) are kept in an unlocked cabinet in the faculty and graduate student lounge on the 9th floor of Van Vleck. Also included in the collection is a Zometools polyhedral construction kit and a kit for constructing Penrose tilings. Undergraduates, visiting alums, and others interested in playing with the games, puzzles, and kits should contact propp@math.wisc.edu.

Undergraduate Research

A **CURL (Collaborative Undergraduate Research Lab)** is an undergraduate research lab that is usually linked to a concurrent special topics class. The course is taken for credit, and those who are in the lab are paid for their efforts. The lab is a gathering of undergraduate students, graduate students, and faculty engaged in exploring mathematical phenomena of all kinds, focussing on genuine research questions that are accessible to undergraduates. Our CURL program is supported by the department's five-year VIGRE grant from the National Science Foundation.

In last year's CURL on mathematical biology, Profs. Sasha Kiselev, Paul Milewski and Julie Mitchell did work with six undergraduates, studying a variety of mathematical models, such as the life-cycle of cicadas. Three of these students (David Andrzejewski, Erick Butzlaff and Lam Raga Markely) are co-authors (with Prof. Kiselev) on a paper on reaction-diffusion equations that has been accepted at Communications in Mathematical Sciences. This paper studies the influence of shear flow on reaction rate, simplifying earlier proofs and giving improved bounds. Additionally, Lam Raga Markely is co-authoring a paper with Prof. Milewski explaining the prime periodicity of cicada emergences as an evolutionary response to periodic predator populations.

Newly arrived assistant Professor Jordan Ellenberg ran a CURL in computational algebraic number theory in Fall 2005, focussing on counting number fields of low degree. After implementing existing number-theoretic algorithms in Magma and in C and obtaining data from the programs they had written, the students applied statistical tests to the data, both to confirm existing conjectures and to formulate new ones. The students arrived at a precise (and new) conjecture for an asymptotic main term for the number of cubic fields with bounded multidiscriminant (earlier researchers had conjectured a growth rate but had made no prediction for the constant). Undergraduates George Foster, William Unboh, and Jared White did research under Ellenberg's supervision.

Prof. Amir Assadi is currently running a CURL at the interface between mathematics, scientific computation, and biology, on the theme of mathematical modeling of biological intelligence. After leading the students through such topics as symmetry, randomness, approximation, and optimization, Prof. Assadi will help the students to choose individual projects, to write "research proposals" of the sort that are sent to Federal funding agencies, and to conduct research under his supervision. At press time, his group includes 16 students. Details can be found at https://mywebspace.wisc.edu/ahassadi/web/CURL_Spring2006.htm .

On the non-CURL front, Prof. Ken Ono ran an intensive summer program for undergraduates, entitled "Modular forms and q-series", with support from the department's VIGRE grant. Led by Ken Ono and by graduate fellows Karl Mahlburg and Jeremy Rouse, UW students Sam Lachterman and Brendan Younger and five non-UW students (one of whom, Appleton high school student Nick Wage, went on to win fourth place nationally in the Intel Science Talent Search in March 2006 with research applying number theory to combinatorics) spent seven weeks learning number theory and conducting supervised research. So far, three papers have been accepted for publication written by these students, based on work they did in the REU program. See http://www.math.wisc.edu/~ono/reu05.html for more details. Sam Lachterman has continued to do research under the supervision of Prof. Ono, and is writing up this work in the form of an honors thesis on Ramanujan-type congruences satisfied by Euler's partition function.

Other UW faculty members supervised undergraduate research on an individual basis, often with support from VIGRE.

Dr. Gloria Mari-Beffa supervised three students (Shane Squires, Gordon Stephenson and Shane McMahon) in a project on moving frames in Lorentzian and Galilean geometries. Squires continued this work in the form of an Honors thesis on geometric Poisson brackets in Lorentzian geometry, and will be starting graduate school in Fall 2006.

Prof. Amir Assadi supervised Liz Drilla, who won a Hilldale Award for a project applying dynamical systems theory to foreign currency exchange rates; Brenton McMenamin, who has published papers and given presentations on facial recognition and magnetoencephalography; Michael Behrman, whose paper on applying neural networks to pain diagnosis has been accepted for publication; and Kyle Handley. Drilla has been accepted into a masters program in public policy, and Behrman plans to attend graduate school after he finishes serving in the Peace Corps in Gambia.

Twenty-Two PhDs Awarded in 2005

Twenty-two mathematics PhDs were awarded by UW-Madison in calendar year 2005. Recipients, thesis advisors, current positions, and thesis titles are listed below.

Benesh, Bret (Advisor: Nigel Boston) Preceptor in Mathematics, Harvard University. *Counting generators in finite groups that are generated by two subgroups of prime power order.*

Bisgard, James (Advisor: Paul Rabinowitz) Central Washington Univ. *Homoclinic and heteroclinic orbits for Hamiltonian systems.*

Carracino, Christine (Advisor: Alex Nagel) Assistant Professor of Mathematics, Richard Stockton College of New Jersey. *Estimates for the Szego kernel on a non-pseudoconvex domain.*

Charalambides, Marios (Advisor: Fabian Waleffe) Lecturer in Mathematics, Frederick Institute of Technology in Cyprus. *Stable spectral methods with no spurious eigenvalues.*

Chatterjee, Rohit (Advisor: Ken Ono) Interactive Brokers, Greenwich, Connecticut. *On class polynomials and supersingular j-invariants.*

Cossey, James (JP) (Advisor: Marty Isaacs) Postdoc at University of Arizona. *Generalizations of the Fong-Swan theorem.*

Davis, Joshua (Advisor: Eleny Ionel) Duke University Mathematics Department. *Degenerate relative Gromov-Witten invariants and symplectic sums.*

de la Vega, Ramiro (Advisor: Ken Kunen) Assistant Professor at Universidad de los Andes, in Colombia. *Homogeneity properties on compact spaces.*

Dwyer, Chris (Advisor: Alejandro Adem) Postdoc at SUNY-Binghamton. *Twisted equivariant K-theory for proper actions of discrete groups.*

Halfpap, Jennifer (Advisor: Alex Nagel) Assistant Professor, University of Montana. *Contributions to the theory of the holomorphic extension of CR functions.*

Jenkins, Michael (Adrian) (Advisor: Xianghong Gong) Research Assistant Professor, Purdue University. *Equivalences of holomorphic mappings in one and several complex variables.*

Kent, Thomas (Advisor: Steffen Lempp) Brigham Young University, 2005-2006, and then Marie Curie Fellowship to visit University of Siena, Italy, for 2 years. *Decidability and definability in the Σ^0_2-enumeration degrees.*

Lo, Darren (Advisor: Marty Isaacs) Medtronic, Inc., Minneapolis. *Several results on relativized character degrees.*

McQuistan, Michael (Advisor: Marty Isaacs) National Security Agency. *Relativized character degree problems.*

Raich, Andrew (Advisor: Alex Nagel) Postdoc, Texas A&M University. *Heat equations in $\mathbb{R} \times \mathbb{C}$.*

Ramsamooj, Neil (Advisor: Eleny Ionel) University of West Indies. *Gromov-Witten invariants of a $K3$ fibration.*

Rushton, Joshua (Advisor: Jim Kuelbs) Postdoc at Cornell University. *Small-ball estimates and accompanying LIL for α-stable and related processes.*

Stefansson, Halldor Narfi (Advisor: Amos Ron) The Mathworks Inc., Boston. *The structure of sparse representations of images using tight frames.*

Swisher, Holly (Advisor: Ken Ono) Ross Assistant Professor, Ohio State University (2005-2006), Assistant Professor, Oregon State University (2006-). *Asymptotics and congruence properties for Stanley's partition function, and a note on a theorem of Koike.*

Temple, Kathryn (Advisor: Tom Kurtz) Assistant Professor, Central Washington University Department of Mathematics. *Particle representations for measure-valued processes with interactions and exit measures.*

Weinberg, Aaron (Advisor: Bob Wilson) Assistant Professor of Mathematics at Ithaca College. *A framework for analyzing objects in mathematical discourse.*

Wiesner, Emilie (Advisor: Arun Ram) Franklin Fellow at the University of Georgia. *Translation functors and the Shapovalov determinant.*

New Graduate Students in the Fall of 2005

Again in 2005 we had a large group of excellent students entering the mathematics graduate program. The names and undergraduate institutions of the 34 new students are:

ALSTON, Garrett	University of Chicago
ANDREWS, Ulysses	Princeton University
BOONKASAME, Anakewit	California State University, Los Angeles
BROWN, George	Brandeis University
CARLSON, Carl	St. Olaf College
CASE, Seth	University of Illinois, Urbana–Champaign
CHEMOTTI, Frank	Davidson College
CHURCH, Michael	Carleton College
COLVIN, Julien	Haverford College
DAUGHERTY, Zajj	Harvey Mudd College
DAVIS, Matthew	Ball State University
GUETTES, Sabrina	Rheinische Friedrich-Wilhelms University – Bonn
GUO, Jingwei	China University of Science and Technology
HAACK, Jeffrey	University of Wisconsin – Madison
HAZELLIEF, Blythe	University of Florida – Gainesville
HEUMANN, Jay	Columbia University
HRUSKA, Stephen	Wheaton College
JORSTAD, Anne	Cornell University
LEE, Hwan	Korea Advanced Institute of Science and Technology – Taejon
LIEN, Tseching	Pomona College
LIN, Hao	Zhejiang University
MANTILLA-SOLER, Guillermo	University of Los Andes – Bogota
MORAN, Melinda	University of Notre Dame
OZMAN, Ekin	Bilkent University – Ankara
PRETEL, Gabriel	University of California – Berkeley
RHOADES, Robert	Bucknell University
RUIZ, Melanie	University of California – Santa Barbara
SCHROEDER, Michael	University of Florida – Gainesville
SOLOMOU, Loizos	University of Cyprus
TU, Junwu	Nanjing University
VAN ESSEN, Anton	University of Canterbury – Christchurch
WOODBURY, Michael	University of Utah
YANG, Xu	Tsinghua University – Beijing
ZHAO, Luanlei	Shandong University – Ji'nan

Major Discovery by a Graduate Student

Karl Mahlburg, a graduate student of Ken Ono, has made a major discovery in the theory of partitions of numbers that has been characterized by Freeman Dyson as "beautiful and totally unexpected." His result goes back to Ramanujan's work on congruences of partitions modulo the primes 5, 7, and 11. It was conjectured by Dyson, and later proved by A.O.L. Atkin and H.P.F. Swinnerton-Dyer, that the congruences modulo 5 and 7 could be explained by a quantity known as the *rank* of a partition. The rank failed to explain the congruences modulo 11, and Dyson postulated the existence of a *crank* that could explain the congruences modulo all three primes. George Andrews and Frank Garvan discovered a crank function which led to an explanation of all these congruences. In 2000, Ken Ono discovered that Ramanujan's congruences were just the tip of the iceberg; he found that there were congruences for the partition function for all primes greater than 3. What Karl Mahlburg has done is to show that the crank also explains all of Ono's partition congruences thus providing a combinatorial proof of them. This accomplishment now gives a more complete understanding and explanation of the partition congruences.

Karl's summary of his work appears in his paper "Partition congruences and the Andrews-Garvan-Dyson crank," published in the Proceedings of the National Academy of Sciences (PNAS) 102 (2005). PNAS has established an annual award that recognizes published papers of outstanding scientific excellence and originality. Karl Mahlburg has been selected to receive the first PNAS Paper of the Year Prize for this article. He will receive the award certificate at the PNAS Editorial Board Meeting on Sunday morning, April 23, 2006 in Washington, DC. His name will be included in the National Academy of Sciences awards ceremony program and it will be announced during the Sunday afternoon ceremony.

Mahlburg's accomplishments have been reported in numerous publications including: "Pieces of Numbers," Science News, June 18, 2005; "Fascination in Summation," On Wisconsin Magazine, Summer 2005; " 'Cranky' Proof Reveals Hidden Regularities," Science, April 1, 2005; "Classic maths puzzle cracked at last," New Scientist, March 21, 2005; and "UW-Madison grad student makes math history," Wisconsin State Journal, March 18, 2005.

Karl gave a plenary Address at the SASTRA International Conference this past December in Kumbakonan, Ramanujan's birthplace, where the SASTRA Prize was jointly awarded to M. Bhargava and K. Soundararajan. In the fall he will be a Moore Instructor at MIT.

Graduate Award Photos

Ahyoung Kim, Sigurd Angenent, Benjamin Newton, Marios Charalambides, Jodi Supanich, John Neely

Johann Leida, Holly Swisher, Karl Mahlburg

Youngmi Hur

Awards to Graduate Students

The annual student awards ceremony was held on May 4, 2005 with many graduate students honored for their teaching and research accomplishments.

The **2004-05 Departmental Teaching Awards** were presented to eight of our graduate students: **Asher Kach**, **John Neely**, **Jodi Supanich**, **Ahyoung Kim**, **Marios Charalambides**, **Jeremy Lanig**, **Liming Lin**, and **Benjamin Newton**.

In mathematical research for their theses, our graduate students make important contributions to the development and application of mathematics. Three graduate students were recognized for especially significant research contributions by being awarded **Excellence in Mathematical Research Awards**.

Johann Leida, working with Yongbin Ruan and Alejandro Adem, was recognized for his work on equivariant homotopy theory and orbifold homotopy theory. Johann expects to receive the PhD this year.

Holly Swisher, working with Ken Ono, was recognized for her work in number theory, specifically the analytic and arithmetic properties of modular forms, where in particular, she solved a conjecture of work on p-adic analysis. Holly is currently a postdoc at Ohio State.

Karl Mahlburg, also working with Ken Ono, was recognized for his work in number theory, specifically partition theory, where he succeeded in describing the crank function for partition congruences, resolving a long-standing and difficult problem. Karl expects to receive the PhD in 2006. For more on Karl see page 29.

The **Elizabeth Hirschfelder Scholarship**, awarded to one or more graduate women who are making excellent progress toward the PhD, was given to **Youngmi Hur**, who is working with Amos Ron. Youngmi already has made important contributions to wavelet representations for high dimensional data, discovering an innovative approach for dealing with such problems. Youngmi expects to receive the PhD in 2006.

Other News

Steve Bauman has joined the Ombuds Office for Faculty and Staff this year. The primary role of this office is to provide an informal, confidential, and impartial means for resolving conflict within the university. There are four ombuds in this office who work part time and share duties. In his retirement, Steve continues to be involved with student life, serving as a faculty fellow in the Bradley Residential Learning Community on campus.

Nigel Boston is now the Director of the new UW Wireless and Sensor Networks (WiSeNet) Consortium. There will be some events this semester introducing this new consortium to the UW community. Nigel will be giving a plenary talk at the Algorithmic Number Theory Symposium (ANTS) VII in Berlin this summer. In addition, he is organizing meetings at Oberwolfach (on pro-p groups) and Vancouver (coding theory).

Xiuxiong Chen has been invited to give a talk on recent developments in his specialty in geometry at the International Summer School in Several Complex Variables that will take place in June 19-23, 2006 at the Beskidy mountains resort of Szczyrk. The summer school is being organized by the Institute of Mathematics of the Jagiellonian University. Xiuxiong is also invited as a plenary speaker for an ICM satellite conference in Germany this coming summer.

Jordan Ellenberg was an organizer (together with graduate students Jackie Anderson, Sharon Garthwaite, and Jeremy Rouse) of the 3rd annual Graduate Student Conference in Number Theory, which brought about 40 graduate students from around the Midwest and beyond to Madison on November 5 and 6, 2005. He was was also an organizer with **Nigel Boston** and **Tonghai Yang** of the Midwest Number Theory Day, which UW-Madison hosted on November 4, 2005. Jordan used his recently awarded NSF-CAREER grant to fund the Graduate Student Conference and to fund an enrichment program he is running at Memorial High School. For the upcoming *Princeton Companion to Mathematics*, being edited by Tim Gowers, he wrote the article on "Arithmetic Geometry."

Shi Jin spent the spring semester of 2005 at the Institute for Mathematics and its Applications (IMA) at the University of Minnesota as a New Directions Visiting Professor. According to the records of ISI Web of Knowledge, Shi is ranked in the top 90, among all mathematicians and statisticians, for the number of citations of articles published in mathematics and statistics journals from 1995 to 2004.

Tom Kurtz was elected in 2005 to the American Academy of Arts & Sciences. Tom is also the president of the Institute of Mathematical Statistics.

Steffen Lempp spent a month at a workshop on "Computational Prospects of Infinity" at the National University of Singapore this past summer with about 50 of the major people in his field. Steffen reports that he is getting increasingly involved with issues of mathematics education. With **David Griffeath**, he co-chairs a committee on "middle school pre-service" trying to determine what mathematics middle school mathematics teachers should know in addition to the mathematics courses for the elementary school program. This is a joint committee with the Department of Curriculum and Instruction of UW-Madison's School of Education and the Madison school district.

Ken Ono gave several special lectures this past year: the Winifred Asprey Lectures at Vassar College, a Distinguished Lecture Series at the University of Iowa, and an invited lecture at the Gauss-Dirichlet Conference in Gottingen, Germany.

Donald Passman was on his first-ever sabbatical in the fall of 2005. He spent two months in England visiting the University of East Anglia, the University of Leicester, Royal Holloway University of London, and the Government Communications Headquarters (the British analogue of the National Security Agency). Don also spent one month in San Diego (December) visiting the Center for Communications Research (CCR-LaJolla).

Fabian Waleffe will be giving several prestigious lectures this spring. He is an invited speaker at the general meeting of the American Physical Society in Baltimore, March 13-17, 2006; an invited speaker at the workshop on "Nonlinearities - from Turbulent to Magic" at the Niels Bohr Institute, Copenhagen, Denmark, May 17-20, 2006; and the keynote lecturer at the conference on "Turbulence and Interactions," Porquerolles, France, May 29-June 2, 2006.

The book *Modular forms and special cycles on Shimura curves* written by **Tonghai Yang** with Stephen Kudla and Michael Rapoport has been accepted for publication for the "Annals of Mathematics Series" and will be published this year.

Alumni News and Comments

http://math.wisc.edu/directories/alumni.html

Emre Alkan [PhD 2003, K. Ono] has been a Doob Assistant Professor at the University of Illinois and will start a permanent professorship at Koc University in Istanbul, his hometown in Turkey.

Matt Boylan [PhD 2002, K. Ono] is now a Palmetto Professor of Mathematics at the University of South Carolina. This is an endowed tenure track assistant professorship.

Tom Kent [PhD 2005, S. Lempp] has been awarded a Marie Curie Fellowship funded by the European Union to work with Professor Andrea Sorbi of the University of Siena, Italy, for two years.

Xiantao Li [PhD 2002, Shi Jin] is now a tenure-track assistant professor at the Pennsylvania State University. After receiving his PhD Xiantao spent two years as a postdoctoral fellow at Princeton University and and one year at the IMA at the University of Minnesota.

Yiming Long [PhD 1987, P. Rabinowitz], Yangzi River Professor at the Nankai Institute of Mathematics in China, has won the 2004 Third World Academy of Science (TWAS) Prize in Mathematics. The TWAS prizes, awarded in eight fields of scientific research, carry a cash award of $10,000 and were announced at the opening session of the TWAS 15th General Meeting on 23 November 2004, at the Academy's headquarters in Trieste, Italy. Yimin was cited for his "fundamental contributions to Hamiltonian dynamics, in particular for establishing the index iteration theory for symplectic paths and deep studies on periodic solution orbits of Hamiltonian systems."

Jenny Quinn [PhD 1993, R. Brualdi] is now the Executive Director of the Association for Women in Mathematics (AWM). Her duties include generating new membership, grant reporting, facilitating committee rotation and volunteer efforts, and carrying out new initiatives. Jenny is co-author, with Arthur Benjamin, of *Proofs that Really Count*, published by the MAA in 2003 and is also co-editor (with Benjamin) of *Math Horizons*. At the Joint Math Meeting in San Antonio in January of this year, Jenny and Arthur were awarded the MAA Beckenback Book Prize for their book. Jenny does her work out of her office at the University of Puget Sound, in Tacoma, Washington.

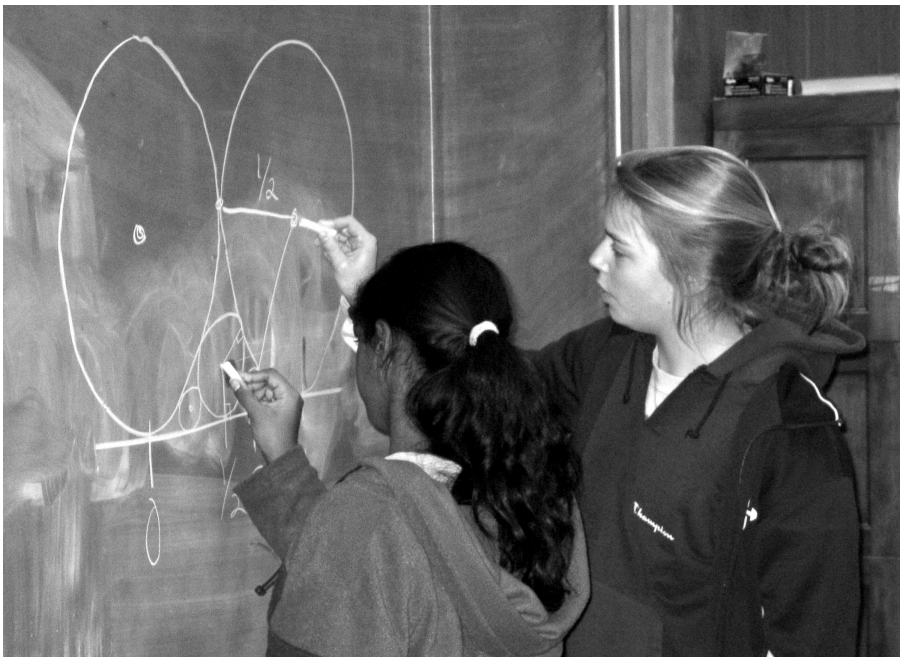
Holly Swisher [PhD 2005, K. Ono] is presently in her first year as a Ross Assistant Professor at Ohio State University. She has also accepted a tenure track assistant professorship at Oregon State University which she will begin after she completes her appointment at Ohio State.

Michael Wage [PhD 1976, M. Rudin] is coach of a Mathcounts team (6th through 8th graders) from Appleton that took first place at the State of Wisconsin competition this year. As a result, Mike will be the coach of the top four placers in the state who will compete for Wisconsin at the national competition in Arlington in May. Mike is a practicing ophthalmologist in Appleton.

Outreach Activities

UW-Madison and the Madison school district (and some other regional school districts) have a program, developed with Title II funding, connecting faculty with teachers and organized around materials used in real school classrooms. Classes for middle school teachers are continuing, and a follow-on program is being developed for work with elementary teachers. The classes (in Algebra, Probability, Geometry, Proportional Reasoning, and Measurement) have been successful in two directions: teachers' content knowledge has improved, as measured on pre- and post-tests, and our faculty have become more familiar with content and practices actually in use in middle school.

Assisted by funding from the department's VIGRE grant, a program addressing Vertical Integration and the pipeline for future mathematicians in a local way was started last year. Local high school women come to the department for evening sessions working in groups with faculty, graduate students, and undergraduates. The first year they worked on three projects in chaos and complexity, fractals, and combinatorics, which introduced the students (ranging from sophomores to seniors) to more advanced ideas such as ordinary differential equations as well as to ways of thinking mathematically. An additional, geometric, project was added last fall. Work is under way to expand the program to involve additional schools and more students. For more information, see http://www.math.wisc.edu/VIGRE/Outreach_Women_Summary-2006.html .



For the last couple of years the math department has had a monthly series of programs for regional high school students. Initiated by graduate students and supported by the department, most of the programs have been talks given by graduate students on their own mathematical work or on hot subjects in mathematics, with pizza or other refreshments. Other sessions have had panel discussions, e.g. on what kinds of jobs a student could look forward to based on a degree in mathematics.

Meanwhile, the Wisconsin Emerging Scholars (WES) mentoring program has been started under the stewardship of Concha Gomez. The mentoring program is being funded by the Wallace J. Hilliard Fund, an endowment established by the Hilliard Family Foundation in Green Bay to support undergraduate students in the Wisconsin Emerging Scholars program. (The fund has also been used to send WES students and Student Assistants to scientific conferences like the SACNAS National Conference and the Nebraska Conference for Undergraduate Women in Mathematics.)

The WES mentoring program is at Lincoln Elementary School on Madison's south side. The two mentors, Oluwatosin Alabi (from Minneapolis) and Sasha Cai Lesher-Perez (from Madison), are both sophomores and former WES students who have completed our calculus sequence. Sasha Cai is a math and biomedical engineering double major, and Oluwatosin is considering majoring in actuarial science. The two groups meet once a week for an hour to work on fun, engaging mathematics activities. The activities may be related to work in their mathematics course, or may provide a glimpse into topics they haven't covered yet. At the end of the semester-long program, the students are taken on a tour of some part of the UW-Madison campus and treated to pizza with their mentors.

The goal of the program is to keep these talented students interested in math and science by introducing them to successful role models and showing them how interesting and relevant math can be. When asked what she liked about the mentoring program, one Lincoln student replied that "it makes math class a lot more fun!" For more about WES, see http://www.math.wisc.edu/~wes/ .

In Memoriam

Benjamin Noble died on January 5, 2006 in England at age 83. Ben received the degree of D.Sc. from Aberdeen University in Scotland and was a Fellow of the Royal Society of Edinburgh. After two years as a member of the Mathematics Research Center (MRC), in 1964 he became a permanent member of (MRC) and Professor of Mathematics and Computer Sciences. He was appointed Director of MRC in 1975 and retired from the University in 1985. His research interests were in linear algebra/matrix theory, numerical analysis, variational methods, integral equations, and elasticity. He wrote four books, including the well-known textbook *Applied Linear Algebra* (Prentice-Hall, 1969), revised in 1977 with Jim Daniel. Ben had a distinguished career in research and teaching at Wisconsin for 23 years.

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