

*Duke University
Math News
May 12, 2011*



• ◆ • *SPRING 2011 EDITION* • ◆ •

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Events

Triangle Lectures in Combinatorics

The Spring 2011 Triangle Lectures in Combinatorics (TLC) were held on April 9 at NCSU in Raleigh, NC. TLC is a new series of one-day combinatorial workshops, funded by the NSF, that rotates among the universities in the Research Triangle. The TLC steering committee consists of Patricia Hersh (NCSU), Ezra Miller (Duke), Scott Provan (UNC Chapel Hill), and Nathan Reading (NCSU).

The main speakers this spring were:

- John Stembridge (Michigan), *A finiteness theorem for W -graphs*
- Prakash Belkale (UNC Chapel Hill), *Combinatorial questions related to the Hermitian eigenvalue problem*
- Stephanie van Willigenburg (UBC), *Quasisymmetric refinements of Schur functions*
- Victor Reiner (Minnesota), *P -partitions revisited*

On September 25, 2010, the TLC was held at Duke and the speakers were Alexander Barvinok (University of Michigan), Anne Shiu (Duke), Sami Assaf (MIT), and Persi Diaconis (Stanford).

Undergraduate News

DUMU

The Duke University Math Union sponsors a number of events throughout the year for all undergraduates with an interest in mathematics. This includes several social get togethers, math talks, and the Duke Math Meet. The semester ended with a Games night on Friday April 22.

Special thanks and best wishes to graduating DUMU officers Alan Guo and Yiwen Zhu.

Duke Math Meet

Nearly 300 high school students visited Duke on Saturday November 14 for the annual Duke Math Meet. Duke students create and grade the problems. The team contest was won by Walton HS in Marietta Georgia with Thomas Jefferson HS in Virginia, two teams from AAST magnet school in New Jersey and the Columbia Math Circle in South Carolina rounding out the top five. Individual honors go to Calvin Deng from Enloe in Raleigh, Tom Lu from Guilford, and Ben Gunby from Georgetown Day School in DC. Each of the winners was awarded a beautiful glass Klein bottle.

Over 40 Duke students volunteered their time and effort to help with this event. Special thanks goes to Siyang Chen, Veronica Ciocanel, Alan Guo, Misha Lavrov, Yingyi Shen, TongTong Zhan, Yiwen Zhu, and especially to Vivek Bhattacharya and Joe Keefer for their hard work in making the meet a success.

Putnam Competition

The team of Misha Lavrov, Vivek Bhattacharya and Alan Guo finished 9th among 546 colleges and universities in the 71st annual W.L Putnam Competition. Misha was 27th in the contest and Vivek ranked in the top 3% of the 4296 participants. Other Duke students among the top 500 participants were Michael Banaszek, Adrian Chan, Siyang Chen, Alan Guo, Thames SaeSue and Joe Keefer.

Of the 25 participants from Duke, all but four finished among the top 40%. The Duke Putnam team has finished among the top ten each year since 1995.

Mathematics Contest in Modeling

For 96 hours last February, 2775 teams of three undergraduates from countries around the world struggled to derive a solution to one of two open-ended modeling problems in the 2011 Mathematical Contest in Modeling.

For one of the problems, teams designed a more efficient "halfpipe" to maximize the vertical lift of snowboarders. The other required an efficient arrangement of VHF repeaters to accommodate 1000 simultaneous users within a circular region of radius 40 miles.

The team of Vivek Bhattacharya, Alan Guo and Misha Lavrov was designated as a Finalist - among the top 1% of all teams. In their 36 page paper, they developed algorithms to achieve total radio coverage and multi-way communication in a circular region using the disk covering method. Misha, Alan, and Vivek also constituted the Duke Putnam team that finished among the top 10 last December.

Meritorious Awards (top 13%) went to the team of Philip Pham, Robert Won and Elizabeth Liang and to the team of HyungJu (Danniel) Jeon, So Youn Lee and Kyu Won Choi.

Each of these three teams submitted solutions to the VHF repeater problem.

A fourth Duke team competed successfully with their design of a half-pipe.

In this contest, 8 of the 2775 teams were designated as Outstanding, 23 as Finalists, 353 as Meritorious and 842 as Honorable Mention. Another 735 teams competed in the related Interdisciplinary Contest in Modeling on a problem involving electric vehicles. More details at <http://www.comap.com/undergraduate/contests/mcm/contests/2010/results/>.

Menger Prize

The Menger Award is given to the three highest ranking students on the Putnam Competition. Winners this year were Misha Lavrov, Vivek Bhattacharya and Siyang Chen.

Eva Menger-Hammond donated a fund to Duke in honor of her father, Karl Menger, a prolific Austrian mathematician who lived from 1901 to 1985. See <http://www.math.duke.edu/news/awards/menger/index.html> for more information and past winners.

Julia Dale Prize

Alan Guo and Misha Lavrov have been awarded the Julia Dale prize for excellence in mathematics. Each of these students has excelled in higher mathematics courses and math competitions. They have

been major contributors to the Duke Math Meet and other activities sponsored by DUMU.

Alan has been named Duke Faculty Scholar. He is the author or coauthor of four research papers three of which have already been published. His senior thesis on combinatorial games was deemed worthy of Graduation with Highest Distinction. In the fall, Alan will pursue a doctorate in Electrical Engineering and Computer Science at MIT on an NSF Graduate Scholarship.

Misha came to Duke from Enloe HS in Raleigh as the North Carolina Math Scholar. As co-assistant in the Problem Solving Seminar in fall 2010, he gave short lectures each week to the students to help them prepare for the Putnam and other math competitions. His senior thesis on knot theory has qualified him for Graduation with High Distinction. In the fall, Misha will pursue a doctorate in the interdisciplinary program Algorithms, Combinatorics and Optimization at Carnegie Mellon University.

The Freshman Julia Dale award for the outstanding first year students in mathematics courses has been awarded to Joseph Graves, Daniel Stern and Youngjik Yang.

For more information about Julia Dale and a list of previous winners, see <http://www.math.duke.edu/news/awards/dale/index.html>

Duke Faculty Scholarship

Congratulations to Alan Guo, one of three Faculty Scholars for 2010-11. This is the highest honor that the Duke faculty can bestow on undergraduates. Alan is the fourteenth math major named as faculty scholar since 1990. See <http://academiccouncil.duke.edu/faculty-scholars/history>

Goldwater Fellow

Vivek Bhattacharya was the sole Goldwater Fellow from Duke this year. Although a double major in Economics and Physics, Vivek has been an active force in the math department throughout his years at Duke and currently serves as vice president of DUMU. For the past two years, Vivek helped coordinate the Duke Math Meet. He has ranked high on the Virginia Tech Math Contest and the Putnam

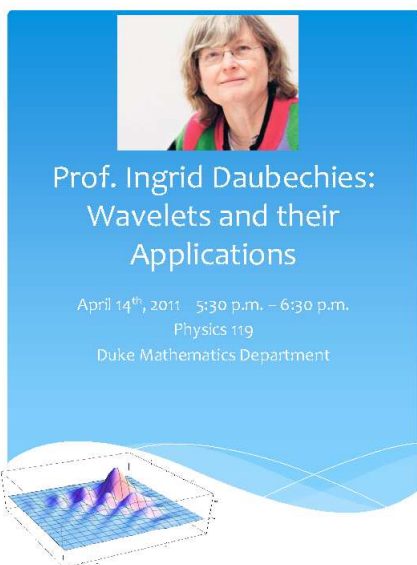
competition, and was on two Finalists teams in the Math Contest in Modeling.

Undergraduate Lecture Series

On Thursday, April 14th, Ingrid Daubechies, James B. Duke Professor of Mathematics and National Academy of Science Fellow, gave a talk to DUMU on her research in wavelets. Math majors and others packed Math-Physics Room 119 to hear Professor Daubechies outline her theory and illustrate it with delightful applications to photo rendering and art restoration. DUMU officers Vivek Bhattacharya, Alan Guo, Yiwen Zhu and others continued their discussion with Professor Daubechies at dinner after the talk.

DUMU, which sponsored this event, would like to thank Professor Daubechies for lending her time to this wonderful event and hope that she has had a great first year as a Duke Professor.

More about Daubechies and her contributions is in the Faculty News section of this paper.



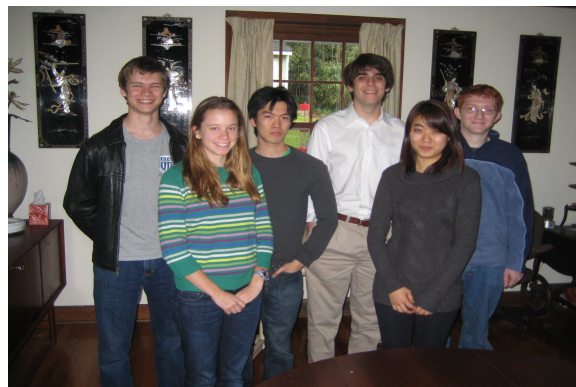
Undergraduate Research Programs

Through various grants, the Duke Math Department is able to provide stipends for summer research in mathematics or mathematical biology to a select group of Duke students.

Now in its twelfth year, the PRUV program has already supported 70 students. The following math majors have been accepted into the PRUV Fellow

program for the summer of 2011. Each of them will work intensively for six weeks with a faculty mentor on a project leading to a senior thesis.

- Ben Bellis -Mentor - Mark Stern
- Adrian Chan -Mentor - Jake Bouvrie
- Kyu Won Choi - Mentor - Arlie Petters
- Jim Mallernee - Mentor - Mark Iwen
- Leslie Morrison - Mentor - Les Saper
- Daniel Thielman - Mentor - Anne Shui



REU in Math Biology

Nine Duke students will participate in an intensive research experience in Mathematical Biology during the first summer term of 2011. They will receive a stipend thanks to a large Research Training Grant from the National Science Foundation and from other sources. The faculty mentors for the research projects are Rick Durrett, Anita Layton, Harold Layton, Karin Leiderman, Jonathan Mattingly, Jim Nolen, and Michael Reed. Graduate students Jack Enyeart, Miles Crosskey, Sean Lawley, and Tiffany Kolba will also assist.

The students for the summer 2011 program and their majors or intended majors are as follows:

- Yifei Chen, sophomore, biophysics
- Veronica Ciocanel, junior, mathematics
- Natalie Dorrow, junior, mathematics

- Zach Miller, sophomore, biomedical engineering
- Anirud Mohan, freshman, biomedical engineering,
- Scott Rich, junior, mathematics,
- Angelica Schwartz, freshman, computer science
- Sheryan Sen, junior, mathematics and physics,
- Angela Woods, freshman, biomedical engineering

Graduation with Distinction in Mathematics

A record nine math majors will graduate with distinction this May.

- Kaitlin Daniels - *Noise driven transitions between stable equilibria in stochastic dynamical systems* - mentor Avanti Athreya
- Alan Guo - *Lattice point methods for combinatorial games* - mentor Ezra Miller
- Nils Hultgren - *Centrality and network analysis* - mentor Ivan Matic
- Hans Kist - *Estimating carbon sequestration potential in the boreal forests* - mentor David Kraines
- Misha Lavrov - *Invariants of the Legendrian links in the solid torus* - mentor Dan Rutherford
- Philip Pham - *Tubuloglomerular Feedback Signal Transduction in the Loop of Henle* - mentor Anita Layton
- Thames Sae Sue - *A simple cardiac model exhibiting stationary discordant alternans* - mentor David Schaeffer
- Max Tabachnik - *Strategy and Effectiveness: An analysis of preferential ballot voting methods* - mentor Hugh Bray
- Bo Waggoner - *A model of the foot and ankle in running* - mentor Elizabeth Bouzarth

Duke Math Shirt

The 2011 Duke Math shirt design is based on the Ulam spiral, Mathematician Stanislaw Ulam popularized this pattern to exhibit visual relationships among prime numbers. Thanks to Siyang Chen and others in DUMU for this representation leading to the prime 2011. See http://en.wikipedia.org/wiki/Ulam_spiral.

Graduate Student News

Graduating Ph.D. Students 2010-2011

Congratulations to the following graduate students who will receive their Ph.D. in mathematics this May.

- Amir Aazami
Thesis: *The geometry of gravitational lensing: magnification invariants and Kerr black holes*
Advisor: Arlie Petters
- Matthew Bowen
Thesis: *A spectral deferred correction method for computing the cardiac two-current model*
Advisor: David Schaeffer
- Oliver Gjoneski
Thesis: *Multi-variable period polynomials associated to cusp forms*
Advisor: Leslie Saper
- Aubrey HB
Thesis: *Persistent cohomology*
Advisor: John Harer
- M. George Lam
Thesis: *The graph cases of the Riemannian positive mass and Penrose inequalities in all dimensions*
Advisor: Hubert Bray
- Anna V. Little
Thesis: *Estimating the intrinsic dimension of high-dimensional data sets: A multiscale, geometric approach*
Advisor: Mauro Maggioni
- Alberto Tegua
Thesis: *Stochastic gravitational lensing*
Advisor: Arlie Petters

Faculty News

Ingrid Daubechies joined the department this January as James B. Duke Professor of Mathematics. She received her Ph.D. in theoretical physics in 1980 in her native Belgium and was appointed professor at Princeton in 1994. She is the author or co-author of about 150 papers. Her many awards include being named a MacArthur Fellow in 1992 and election to the American Academy of Arts and Sciences in 1993 and to the National Academy of Sciences in 1998. In April, 2011, the Franklin Institute presented Daubechies with the Benjamin Franklin Medal in Electrical Engineering for fundamental discoveries in the field of compact representations of data, leading to efficient image compression as used in digital photography. Daubechies is currently serving as president of the International Mathematical Union.

The following summary of her research has been adapted from <http://www.ams.org/profession/prizes-awards/ams-prizes/satter-prize>

Ingrid Daubechies is known for her deep and beautiful analysis of wavelets and their applications. Her work is a permanent contribution not only to mathematics but to science and engineering. Daubechies' best-known achievement is her construction of compactly supported wavelets in the late 1980s. After this construction, she continued their development on the theoretical level and to applications in physics and signal processing. Her discovery with Jaffard and Journé of orthonormal Wilson bases provided the first clues to the existence of cosine packet libraries of orthonormal bases as well as Gaussian bases. These are now standard tools in time frequency analysis as well as in the numerical analysis of partial differential equations. Her work with A. Cohen on biorthogonal wavelet bases provided a more flexible approach to the use of wavelets in image compression algorithms. Biorthogonal basis functions are currently the most common wavelets used in standard compression. While continuing to push forward wavelet analysis, Daubechies has also made important contributions in other related areas. Of particular note are her work with Klauder on path integration and an inequality that has been used in virtually every discussion on semi-classical approximations to relativistic quantum mechanics

since its derivation.

Ann S. Tunstall

From 1967 until 1994, Ann Tunstall helped manage the Mathematics Department with grace and warmth. She has served six chairmen and numerous faculty as Administrative Assistant for most of that time.

She passed away on March 21, 2011, after a long illness. Ann is survived by two daughters, two sons, eight grandchildren, eleven great grandchildren, and by all the members of the Duke math department.

Math Degree Candidates, Academic Year 2010–11

First Majors

Ms. Suzanne Bay
 Mr. Cameron Taylor Bloomer
 Mr. David John Bronfman
 Ms. Lauren Elizabeth Christenbury
 Ms. Maria Motto Cimino
 Mr. Daniel James Emanuel Curtis
 Ms. Kaitlin Marie Daniels
 Mr. Yang Ding
 Mr. Max Howard Golden
 Mr. Kelvin Gu
 Mr. Alan Xinyu Guo
 Mr. Samuel Blackwell Heroy
 Mr. Nils Roland Hultgren
 Mr. Kevin Joseph Kupiec
 Mr. Mikhail Petrovich Lavrov
 Mr. Charles Bopes Lee III
 Ms. Pam Liu
 Ms. Anne Lo Peterson
 Mr. Philip Minh Pham
 Mr. Tanawit Sae Sue
 Mr. Andrew Patrick Schwert
 Mr. Maksim Albert Tabachnik
 Mr. Jamal Timsah
 Ms. Heather Darling Wiese
 Mr. Chase Alexander Wilson
 Mr. Joshua Thomas Wilson
 Mr. Robert Jeffrey Won

Second Majors

Mr. Christopher James Carlon
 Ms. Megan Elizabeth Heysham
 Ms. Corinne Elizabeth Horn
 Mr. Hyung Ju Jeon
 Mr. Hans Friedrich Kist
 Mr. George Christopher Leef
 Mr. Karna Mital
 Mr. Eugene Yong Park
 Mr. Siyuan Sun
 Mr. Antony Jacob Thomas
 Ms. Rebecca Versteeg
 Mr. David Graham White
 Ms. Nina L. Wu
 Mr. Peter Boyuan Yao
 Ms. Ruijia Zhou

Minors

Ms. Chelsea Laine Arrington
 Ms. Rachel Leah Belzer
 Mr. Joav Birjiniuk
 Ms. Rachel Alice Blum
 Mr. William Zachary Corse
 Ms. Chen Ding
 Mr. Morgan Douglas Brothers Fox
 Mr. Varun Anand Gumaste
 Ms. Heather Marie Hill
 Mr. Matthew Harris Jacobson
 Mr. Joshua Terry Lund
 Mr. Lakshya Madhok
 Mr. Michael Juhn Uh Seo
 Ms. Christine Nicole Smith
 Mr. Patrick Kelvin Wang
 Mr. Craig Ian White
 Mr. Tony Tian-Yi Zhang

Master of Arts

Mr. Kevin Anthony Kordek
 Mr. Sean David Lawley
 Ms. Elizabeth Anne Munch
 Ms. Hwa Yeon Ryu

Ph.D.

Dr. Amir Babak Aazami
 Dr. Matthew Michael Bowen
 Dr. Oliver Gjoneski
 Dr. Aubrey Rae HB
 Dr. Michael Joseph Jenista
 Dr. Mau-Kwong George Lam
 Dr. Anna Victoria Little
 Dr. Arya Roy
 Dr. Alberto Mokak Tegua
 Dr. Andrea Cheresse Watkins
 Dr. Jason Robert Wilson

Duke Math News

The *Duke Math News* is published several times a year and is distributed to those in the Duke mathematics community. For previous editions and other news, see <http://www.math.duke.edu/news/>. We welcome items of interest for our next issue. Send them to dept@math.duke.edu or dkrain@duke.edu

To read about other news, honors and events concerning mathematics at Duke, visit <http://www.math.duke.edu/news/>. The on-line calendar at <http://www.math.duke.edu/mcal> lists both regular and special seminars and colloquia for the upcoming weeks. The department maintains video archives of talks, lecture series and special conferences at Duke, many of which are available, on-line. See <http://www.math.duke.edu/computing/broadcast.html> for more information.

—David Kraines, *DMN Faculty Sponsor*

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