

The Quaternion

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The Newsletter of the Department of Mathematics and Statistics



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The Quaternion is an annual publication of the USF Department of Mathematics and Statistics, which can be visited on the web at <http://www.math.usf.edu/>. Our e-mail address is mathdept@math.usf.edu, our snail-mail address is Department of Mathematics and Statistics, University of South Florida, 4202 E. Fowler Ave., PHY114, Tampa, FL 33620. Our phone number is (813) 974-2643, and our fax number is (813) 974-2700.

The Zen of Math Education

“Where have all the science majors gone?” asked CNN last summer, noting that for each new Ph.D. in the physical sciences, America graduates eighteen lawyers and fifty MBAs. CNN also noticed that it isn’t just high-tech industries that are asking this question, as the need for high-tech employees is becoming widespread.

The issue is becoming critical. In 2008, nearly 60 % of all U.S. workers with STEM (Science / Technology /Engineering /Mathematics) degrees were at least forty-five years old. Maintaining America’s economic position in the global economy means answering the question and doing something about it.

Part of the answer is preparation (17 % of high school seniors surveyed were *both* interested in STEM subjects, *and* showed the requisite proficiency in mathematics). Part of the answer is attrition in college: half the students entering college intent on studying a STEM subject get a degree on a STEM subject.

Mathematics is central to this challenge, and mathematics education has always been difficult. When Alexander the Great asked his mathematics tutor Menaechmus if there was a shortcut to learning geometry, Menaechmus replied, “There is no royal road to geometry.” Geometry education in Europe over the last thousand years has swung between strict rigor with high failure rates, and relaxed rigor with higher success rates and lower proficiency. One of the greatest challenges of mathematics has been how to teach it.

At USF, the Department of Mathematics & Statistics is participating in several initiatives, based on two bits of folklore supported by recent discoveries in cognitive science. One is that learning is not passive – one does not really *teach* a student so much as provide opportunities, guidance, and incentives to learn. The other is that students will learn more effectively about things that they become engaged in. State and federal agencies have provided USF with grants to launch pilot teaching programs built around these principles.

Among the many initiatives at USF are the *Mathematics Umbrella Group* program launched by **Arcadii Grinshpan**; this program was aimed at reducing the combined drop/fail rate in first-year calculus (a national problem: CNN described calculus as “the STEM killer”) by having students work on substantial projects, thus providing them with experience in problem solving in projects (see the 2006 *Quaternion* for more on the MUG).

Another initiative was the peer leading program developed by **Jennifer Lewis** of the Chemistry Department; Lewis employed the Process Oriented Guided Inquiry Learning (POGIL) regime that was launched by chemistry departments in the 1990s to address their lower division drop/fail rates (!). In POGIL classes, students work in groups, and then in labs, assisted by undergraduate “peer leaders” – who thus get an opportunity to learn their own subject in greater depth, as any teacher can attest, the most effective way to learn a subject is to teach it.

In both initiatives, the curriculum is “discovery-based”, i.e., the materials are designed so that students work out for themselves what they are supposed to learn. Discovery-based learning requires more labor-intensive teaching efforts, but may result in better retention and the development of broader problem-solving skills.

The National Science Foundation launched a STEM Talent Expansion Program (STEP) offering grants for STEM education initiatives. **Kandethody Ramachandran** led a group extending these two initiatives, together with the *STEM-Mart* lab housed in the Tutoring Center, to reorganize critical mathematics and chemistry gatekeeping courses. The team, consisting of Ramachandran, Grinshpan, and **Catherine Bénéteau, Scott Campbell** of the Chemical Engineering Department, and **Gordon Fox** of the Integrative Biology Department, was awarded nearly \$ 1.6 million dollars for these pilot projects, which includes using undergraduate peer leaders in a STEM-Mart lab, housed in the Tutoring Center.

USF is also participating in an initiative to improve the pre-college preparation of its students. The Partnership to Rejuvenate and Optimize Mathematics and Science Education (Florida PROMISE) is a pilot

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program to provide supplementary classes for STEM high school teachers. One of the impulses is the Next Generation Sunshine State Standards (NGSSS), which includes a major revision of elementary and secondary mathematics education in Florida.

* Previously, mathematics education was a bit like a helix, with students revisiting a vast span of mathematics, but at a slightly more intense level, each year. The result was a mandate for nearly ninety major topics each year, or nearly one every other day.

* The new standards entail a cumulative sequence of levels, perhaps three major ideas for each grade level, with about eighteen benchmarks for each grade. This allows teachers to focus their attention on a smaller number of subjects that students can then learn more thoroughly.

Colleges and universities across the state are involved with Florida PROMISE, which is funded by the U.S. Department of Education via the Florida Department of Education, and led by **Gladis Kersaint** of the USF Mathematics Education program. USF faculty teaching these workshops for high school teachers are **Catherine Bénéteau**, **Fernando Burgos**, **Mohamed Elhamedi**, **Dima Khavinson**, **Milé Krajčevski**, **Brendan Nagle**, and **Denisse Thompson**.

In addition, the NSF awarded a \$1.2 million Robert Noyce STEM grant to a team from the Colleges of Education and Arts and Sciences to develop an accelerated one-year Master's of Arts in Teaching program. This program is for individuals who already hold a bachelor's degree in a STEM field, and will support "change-of-career" individuals as well as recent graduates having no prior experience in education. The team is led by Gladis Kersaint, with **Allan Feldman** of the USF Science Education program, **Jeffrey Ryan** of Geology, and Milé Krajčevski.

TRANSITIONS



Remembering You-Feng Lin

You-Feng Lin was one of the first mathematicians to arrive at USF, in 1964. He and his wife, Shwu-Yeng (Yoshi) Lin, had studied under the topologist Alexander Wallace before arriving at USF with freshly minted Ph.D.s.

Higher education was expanding across the country, and the University of South Florida was part of that expansion. The university was only four years old, the first Florida university to be fully air conditioned. Professor Lin was hired one year after USF graduated its first students and one year before it was first accredited by the Southern Association of Colleges and Schools.

USF's first doctoral program – in astronomy – was approved in 1975; two years later, USF awarded a Ph.D. to one of Professor Lin's students. Eight USF presidents served during Professor Lin's tenure.

You-Feng Lin was born in Taiwan in 1932, and came to the United States in 1959 on an NSF fellowship after receiving a bachelors' degree from National Taiwan Normal University. He went to Tulane University with his wife, and graduated in 1964 after writing a thesis on topological semigroups.

He kept his feet wet doing research, but his primary focus was in teaching. He co-authored two books, one on *Intermediate Algebra* with Marcus McWaters, and one on *Set Theory* with his wife. After three decades helping build the mathematics program, he retired in 1994.

He died July 14, 2010, and was survived by his wife of fifty years, his three sons Luke, Halbert, Winston, and their families, including two grandchildren. Donations in his memory may be made to the Alzheimer's Association, 9365 U.S. Highway 19N, Suite B, Pinellas Park, FL 33782.

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Faculty News

We are happy to welcome two new members to the USF Mathematics & Statistics Department.

Razvan Teodorescu joined the department of Mathematics and Statistics at USF as an Assistant Professor of Mathematics. Dr. Teodorescu (a native Iasi, Romania), did his undergraduate studies at Ecole Polytechnique in Paris (France) and at “Al. I. Cuza” University in Iasi, majoring in Physics and Mathematics. In 1999, he began his Ph.D. studies in mathematical physics at the University of Chicago, working with Paul Wiegmann on random matrix theory, algebraic geometry, and systems of integrable differential equations. In 2004, upon graduating and receiving his Ph.D. in theoretical physics, he accepted a postdoctoral research fellowship at Columbia University in New York. In 2006 he won a prestigious competition and DOE grant for Director’s postdoctoral fellows at Los Alamos National Laboratory, where he worked in the Theoretical Division until his departure to USF in 2009. Dr. Teodorescu was awarded the Leading Young Researcher Award by the Centre for Mathematical Research at the University of Montreal in 2008, and was nominated for the Outstanding Young Researcher Award, given by the Computational Methods and Function Theory Journal in 2009.

Rebecca Wooten joined the Department of Mathematics and Statistics at USF as an Assistant Professor of Statistics. Dr. Wooten was born and raised in Tampa, Florida. She received her MA/BA in 1996 from USF in Mathematics and in 2006, earned her Ph.D. in Statistics. She works in applied Statistics with emphasis on environmental studies: hurricanes, lightning, red tide, volcanic ashfall, etc. Dr. Wooten is the academic coordinator for the Urban Scholars Outreach Program (USOP) and the Dr. A.N.V. Rao Gurukulam Program (RGP), two organizations which offer free educational assistance to the local community. She is also the founder of *The Pedagogue*, a free online tutoring network.

Other Faculty News

Arthur Danielyan presented a solution to an approximation problem of Lawrence Zalcman at invited addresses at the International Conference on Complex Analysis and Dynamical Systems IV in Israel, the 26th Southeastern Analysis Meeting at Georgia Tech, and the Conference on Complex Analysis at Urbana-Champaign.

Masahico Saito and **Nataša Jonoska** were awarded a grant from the National Science Foundation and the National Institutes of Health on “Summer Research Opportunities for Undergraduates (Graphs for DNA Assembly)”.

Center for Mathematical Services

The Center for Mathematical Services (CMS) conducted a summer program for gifted and high ability students from junior high and high schools in the Tampa Bay area from June 14 to July 23, 2010. The program was divided into two levels. Level I was for students entering grades 8 - 10, and Level II was for students entering grades 11 and 12. This year, Level I students were also given practice SAT tests besides Finite Math and Computer Science. Level II students studied Calculus or Linear algebra, and Computer Science, and earned dual credits. Two outstanding High School students were awarded stipends of \$650 each to participate in a research program through a grant from the Academy of Applied Science with **J. S. Ratti** (PI): Sylvan O'Sullivan worked with **Stephen Suen** and Manuel Thornberry worked with **Gangaram Ladde** on their projects. We had a rewarding summer and look forward to an even better program in Summer 2011.

Gravity as Illusionist: the Nagle Lecture

When Einstein realized that a star might act somewhat as a lens, explained Nagle Lecturer **Arlie Petters**, he didn't like the idea and didn't think it would happen. But as Petters explained to a packed hall of students, faculty, and members of the community, astronomers have found many stars – and other masses – that behave somewhat like lenses, even creating multiple images of more distant objects.

Arlie Petters is the Benjamin Powell Professor / Professor of Mathematics, Physics, and Business Administration at Duke University. He delivered the Nagle Lecture on *Einstein, Higher Dimensions, and Black Holes* on April 1.

One reason why scientists accepted Einstein's theory of general relativity was that in the 1919 solar eclipse, the stars almost but not quite behind the Sun had their images displaced by angles Einstein predicted, because the light from those distant stars had been bent by the Sun's gravity before reaching the Earth.

Gravitational lensing is more subtle. In 1936, Einstein worked out a scenario by which a gravitational field could generate two images of the same object – or even a ring of images apparently circling the mass at the center of the lensing field – and since then, many such multiple images of single objects have been observed.

Petters proposed one theory involving gravitational lensing. The *Braneworld* theory proposes that the observable universe is one of many parallel “branes” (short for “membrane”). This theory makes predictions about black holes and dark matter, and since both black holes and dark matter generate gravitational fields, lensing could be used to test the theory.

The Nagle Lecture Series was established in honor of the late R. Kent Nagle, a mathematician deeply interested in mathematics in itself, in education, and in society. In this spirit, the NLS invites world renowned scholars to speak on mathematics in lectures designed for the general public. This lecture was accompanied by a *Gravitational Lensing Workshop* organized by **Dima Khavinson** and **Razvan Teodorescu**, whose announcement noted that research in gravitational lensing, lying in the intersection of mathematics, general relativity and astrophysics, has led to new work in complex analysis.

Student News

During the last year, we awarded 41 Bachelor's of Arts degrees to: Kyle Anderson, Anie Atanacio, Cheriece Barry, Frederick Bartelt, Allison Brewer, Scott Brown, Penny Bryan, Clea Cidri, Ingrid Cotton, Tyson Dilorenzo (cum laude) (honors), Lauren Fertig (magna cum laude), Jeannie Gardner (magna cum laude) (honors), Luke Gittens, David Hiller, Michael Hopkins, Thomas Ivan (cum laude), Tiffany Jackson, Russell Kirk, Rawad Koteiche, Jessica Lawson, Tiffany Lee, Julie Manuel (cum laude) (honors), Karen Michalski, Wanda Miller, Michelle Miracle (magna cum laude), Nicholas Orletsky, Arbin Rai, Nick Reithmaier, Criston Schellenger, Stephen Shelton, John Short, Armando Signorini, Katya Tipps, Carl Toussaint, Matthew Turner (honors), Linda Vu, Athena White (magna cum laude) (honors), Matthew Wiseman (summa cum laude), and Dannie Young.

We also awarded sixteen Masters of Arts degrees to: Helen Barclay, Dimitrios E. Begetis, Howard Vorder Bruegge, Yiu Ming Chan, Dewey Estep, Eric Jan D. DeNooyer (*Statistical Idealities and Expected Realities in the Wavelet Techniques Used for Denoising* under Catherine Bénéteau), Dahomey O. Kadera, Sampath Kalluri, Shoaib A. Khan (*A Hypergraph Regularity Method for Linear Hypergraphs* under Brendan Nagle), Venkateswara Mudunuru, Fernando Neranga, Diana M. Prieto, Sabina Sadou, Jessica Sobkowiak (*Some Combinatorial Structures Constructed from Modular Leonard Triples* under Brian Curtin), Christopher Sze (*Certain Diagonal Equations over Finite Fields* under Xiang-Dong Hou), Ekaterina A. Vorotnikova, and Junshun Zhang.

And we awarded six Doctorates of Philosophy to: Angela Angeleska (*Combinatorial Models for DNA Rearrangements in Ciliates* under Nataša Jonoska and Masahiko Saito), Elliot M. Findley (*Fine Asymptotics of Christoffel Functions and Universality for Szego Weights in the Complex Plane* under Vilmos Totik), O'Neil L. Lynch (*Mixture Distributions with Application to Microarray Data Analysis* under Chris P. Tsokos), Nabin K. Manandhar (*Statistical Learning And Behrens Fisher Distribution Methods For Heteroscedastic Data in Microarray Analysis* under Kandethody Ramachandran), Kevin P. Wagner (*A Generalized Acceptance Urn Model* under Stephen Suen), and Ling Wu (*Stochastic Modeling and Statistical Analysis* under Gangaram Ladde).

PME and Math Club News

Florida Epsilon, the USF Chapter of Pi Mu Epsilon, the Mathematics Honor Society, inducted thirteen new members at its forty-fourth annual Induction Banquet and Ceremony on April 30. The new inductees were Charleen Baron (Business), Mary Billington (Math), Christeen Bisnath (Math), Kristen Childers (Math), Gregory Churchill (Math), Nicole Dalzell (Math), Mark Diba (Math Ed), Justin Doromal (Math), Michael Kotarinos (Stat), Nicholas Laurita (Physics), Natalie Palesh (Math Ed), Nicolas Torres (Engineering), and Patrick Ware (Physics). The Banquet's Featured Speaker was **Razvan Teodorescu**, who gave a presentation on *Complexity, Disorder, and Life in General*. Graduating seniors Lauren Fertig (Math) and Julie Manuel (Math & Stat double-major) were co-winners of the 2010 Florida Epsilon Outstanding Scholar Award, and presented with plaques. Michelle Krause (Math), President of our PME Chapter, was Master of Ceremonies, aided by Vice-president Besjana Zeqo (Math).

The USF Student Chapter of the MAA (the USF Math Club) was led this year by Julie Manuel (President, Math), Michael Glidden (VP, Physics), and Ingrid Cotton (Treasurer, Math). Highlights of student presentations during the year-long biweekly math club meetings included *Amalthea REU, A Summer Research Experience* and *Mathematics in the Real World, An Undergraduate Thesis*, both by Julie Manuel; *Cardano: How I did It* by David Hiller (Math); *Can We Hear The String Equation?* by Erik Lundberg (Math); and the performance of mathematician Colin Adams' short plays *Happiness is a Warm Theorem*, and *Immortality* by The Abstract Players, a group of USF undergraduate students with interest in both acting and math.

Two teams of USF undergraduate students participated in the 2010 modeling contests. Coached by **Brian Curtin**, a team of Michael Kotarinos (Stat), Alexander Henry (Physics) and Dustin Tracy (Business) researched the problem called *The Pacific Ocean Garbage Patch*, and was recognized in the Interdisciplinary Modeling Contest (ICM) as a Meritorious Winner. A second team coached by **Mohamed Elhamdadi** of Timothy Yeatman (Math), Chris Lizardi and Kitoxtansoma Bradley (Math) attacked the *Criminal Profiling* problem, and was recognized by the Mathematical Modeling Contest (MCM) as a Successful Participant. Their findings and conclusions were reported to the MCM, and presented to the USF math community on the March 19 math club meeting.

Math club members organized a Walk-a-Thon at Lettuce Lake Park on November 7 to remember Dane Harmon (Math/08), a well-liked past math club president who died in August, 2009, in a traffic accident. Donations totaling \$ 835.00 were raised toward the Harmon Memorial Fund. Dane will be sorely missed by his friends at USF.

The top problem solvers during the year-long contest *The Math Problem of the Month* were Thu Nguyen, and Nick Laurita, both Physics students. They correctly solved most of the nine math problems posted by **Milé Krajčevski**, sponsor of the event.

As it is now customary, contingents of ten to twelve undergraduate math club members (mainly math majors) traveled to the Suncoast Regional Mathematical Association of America (MAA) Meeting (this year at Polk State College in Lakeland), and the MAA Florida Section Meeting (this year at Santa Fe College in Gainesville). Joy D'Andrea, a math graduate student, delivered a presentation on *Describing some Polyhedra and their Symmetry Groups*.

Math Club members earned a \$350.00 grant from WH Freeman Publishers for reviewing two chapters of the new book *Discovering Statistics*, by Dan Larose. Book reviewers were Michelle Krause (Math, team leader), Donald Dahl (Math), Michael Glidden (Phy), and David Hiller (Math). The money was used to buy pizza for math club meetings.

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We'd Like to Hear from YOU!

The Department of Mathematics & Statistics would like to hear from alumni, friends, collaborators, members of the community, and fellow explorers of and guides to the world of mathematics and statistics. Contact us at: 974-2643, or fax 974-2700. E-mail mathdept@math.usf.edu. We have a web-page at <http://www.math.usf.edu/>. Snail-mail address is Department of Mathematics & Statistics, University of South Florida, 4202 E. Fowler Ave., PHY114, Tampa, FL 33620.

Appeal for funds

We are a growing department in a new university, and we strive to develop new programs to meet the needs and provide opportunities for our students and our community to fulfill their aspirations. With all due respect to Benjamin Franklin, many of the best things in education and scholarship cost money. We would appreciate any assistance we can get from alumni and the community. Feel free to contact our chair, Marcus McWaters, at the above address for details.