Welcome

Welcome to the Duke Mathematics Department for another exciting year.

Bill Pardon finished his term as Associate Chair this summer, and Les Saper has taken over as Associate Chair for the next few years. Bill Allard is continuing as Director of Undergraduate Studies, and Paul Aspinwall as Director of Graduate Studies. We all look forward to working with you.

A large number of new assistant professors and postdocs are joining us this year, bringing energy, exciting research, and enthusiastic teaching. Join me in welcoming them to the department. Be sure to take advantage of all the talents they bring to the program.

The department is losing two exceptional teachers this year. Margaret Hodel, who has played a major role in our calculus program, retired this summer after many years of service to the Department and to the University. Dick Hodel is retiring this spring. There are few Duke math majors who have not had the pleasure of taking a course from Professor Hodel. We wish them both a happy and exciting retirement.

Congratulations to Professor Robert Bryant, who was elected to the National Academy of Sciences this summer. Professor Bryant has taken a leave to become Director of the Mathematical Sciences Research Institute in Berkeley, California. We hope that his "deployment" is brief and that he can quickly rejoin us after providing this service to the mathematics community.

We welcome Tyffany Kittrell to our office staff. Tyffany is our new Administrative Secretary. She is taking over for Katherine Wilson, who was promoted to Accounting Specialist over the summer.

There are tentative plans to move the Mathematics Library out of Vesic. We must all help the administration ensure that our excellent research collection is not compromised in the transition.

Students who are considering a major in mathematics are encouraged to take the new sequence Math 104-105 rather than the traditional Math 103-104. This sequence introduces students first to linear algebra to be followed by an enhanced multivariable calculus course, a perspective that mathematically talented students should find more appealing and that should better prepare them for the more advanced courses.

Best wishes for an excellent year for all.

—Mark Stern, Chair

Undergraduate News

DUMU

DUMU is a student club devoted to organizing events and providing resources to undergraduates interested in mathematical activities. Throughout the year, we arrange for guest lecturers, organize dinners and ice cream socials, compete in sports events with the Society of Physics Students, and organize the Duke Math Meet, a contest for high school students throughout the Southeast. Contact DUMU president Kshipra Bhawalkar kub@duke.edu for more information and to be included on the DUMU mailing list.

Problem Solving Seminar

The Problem Solving Seminar (Math 149S) is a half credit course offered in the fall. Organized as a seminar, it aims to provide students with methods and techniques to solve challenging contest problems and write rigorous proofs. The course is designed both for incoming freshmen and veteran problem solvers who want to prepare themselves for math contests and to hang out with others who share such interests. This fall, Math 149S meets Monday evenings from 8:30 to 10:30 in Math-Physics 119, with pizza and refreshments provided.

Alumni Lecture

Paul Dreyer gave a talk to a large group of undergraduates and others on September 13 as part of the new Alumni Series of Undergraduate Mathematics Lectures. In his lecture, *How hard is it to defend*

the Roman Empire? Dreyer motivated a problem in graph theory with a discussion of Emperor Constantine's military strategies seventeen centuries ago. He demonstrated that the decision problem for Roman domination is NP complete. Dreyer and his wife entertained a group of DUMU students at dinner after the talk.

While a sophomore at Duke in 1993, Dreyer created DUMU and served as its first president. He founded the Duke Math Meet and invited regional high schools to attend. He persuaded the renowned Professor John Horton Conway to give one of the first in the series of lectures for undergraduates. After graduating *summa cum laude* as a Mathematics and History major, Dreyer attended Rutgers, receiving his Ph.D. in Combinatorics in 2000. He now works on government projects at RAND Corporation in Santa Monica.

Competitions

Several math contests for undergraduates will be held this fall. The Virginia Tech Math Contest takes place from 9 to 11:30 on Saturday October 27 and the Putnam Competition is held from 10 to 1 and 3 to 6 on Saturday December 1. Although no mathematics beyond a basic knowledge of calculus and linear algebra is assumed, creative insight and rigorous proofs are needed to do well. The contests are open to all undergraduates at Duke regardless of major.

In recent years, Duke has had significant success in these contests, capturing many of the top rankings on the Virginia Tech and frequently placing among top 3 teams in the Putnam Competition. If you are interested in taking them, or you want to learn more about them, contact Jason Ferguson at `jmf22@duke.edu` or Aaron Pollack at `ajp13@duke.edu`.

The Mathematics Contest in Modeling and its spin-off, the Interdisciplinary Contest in Modeling, are 96 hours contests offered in early February. Teams of three students work on an open-ended, real-life problem and produce a major research paper at the end of this four day competition. Over the past decade, Duke teams have often been among the winners. In 2006, fourteen of the 972 entries were designated as Outstanding, of

those three were from Duke. In 2007, sixteen of the 1222 teams received the Outstanding designation, of those four were from Duke. Outstanding papers have been published in the math journal UMAP. See `www.math.duke.edu/news/awards/` `competitions.html#modeling` for papers by previous Duke teams and for more information. Contact David Kraines at `dkrain@math.duke.edu` if you are interested in being a part of a team in February 2008.

High School Math Meet

Duke Math Meet is a day-long contest that DUMU organizes for high school students throughout the Southeast. Duke students compose and grade the problems, make arrangements for refreshments and present the awards. This ARML style event will be held on Saturday, November 17. Last year, the Meet attracted nearly 200 high school students from Virginia to Alabama. For more information see http://www.math.duke.edu/dumu/mathmeet/.You can assist in making this a fun event for all. Encourage your high school math teacher to send a team. Volunteer to help with registration or to act as a host.

Summer research opportunities

Now in its eighth year, the PRUV Fellow program offers stipends to math majors for mentored research leading to Graduation with Distinction in Mathematics. The following seniors completed their intensive research during the summer of 2006 and are in the process of writing their senior thesis: Michael Bauer with mentor Anne Catlla, Tirasan Khandhawit with mentor Fernando Schwartz, Charles Staats III with mentor Eric Katz, and Lingren Zhang with mentor Thomas Witelski. The current PRUV Fellows are Jason Ferguson with mentor Chad Schoen, Andy Ng with mentor John Harer, Aaron Pollack with mentor Richard Hain, Elliott Wolf with mentor Richard Hodel and Barry Wright III with mentor Hubert Bray. These students recently gave talks on their summer research results. For other information and an application, see http://www.math.duke.edu/vigre/pruv/ or con-

tact David Kraines at dkrain@math.duke.edu.

Many other opportunities are available for internships and for research in and the study of mathematics this summer. The National Science Foundation sponsors scores of Research Experiences for Undergraduates in Mathematics around the country. A listing of REU programs that were offered last summer is at http://www.ams.org/outreach/reu.html. This list should be updated in a few months. In recent years, dozens of Duke math majors and even a few freshmen have participated in REU programs.

Modeling Biological Systems

A new Undergraduate Certificate program, Modeling Biological Systems, has recently been approved by Trinity College. This program aims to provide rigorous biological, mathematical, and computational training and an intensive independent research experience for students with a strong background in mathematics and a serious interest in the life sciences. For their projects in the pilot program of the MBS Certificate, Morgan Brown and James Zou graduated last May with High Distinction.

Those sophomores and advanced freshmen who wish to pursue the MBS Certificate should take MBS 100S, an introduction to methods of modeling, to be taught by Professor Michael Reed this spring. In successive years, MBS 100S will be taught by professors in Biology, Computer Science and Statistics departments. For more details, see `www.genome.duke.edu/education/undergraduate/MBS/`.

Graduate Program News

Doctorates Graduated

This past summer, the following students received a Ph.D. in Mathematics.

Michael Nicholas' thesis, *A Third Order Numerical Method for 3D Doubly Periodic Electromagnetic Scattering Problems*, was written under the supervision of Tom Beale. Michael is a Postdoctoral Researcher at Tulane University.

Nicholas Robbins' thesis, *Negative Point Mass Singularities in General Relativity*, was written under the supervision of Hugh Bray. Nicholas is an Assistant Professor at St. Mary's College of Maryland.

New Graduate Students

Ten graduate students join our program this fall. With their undergraduate institution, they are:

- **Amir Aazami,** Physics graduate school at Duke

- **Alex Aguado,** Illinois State University

- **David Rose,** College of William and Mary; Tripos part III, Cambridge University

- **Shishi Luo,** University of Queensland, Australia

- **Esteban Chavez,** University of Louisville

- **Patrick Pacharm,** University of Paris VII (exchange student)

- **Alan Parry,** Utah State University

- **Timothy Rankin,** Davidson College

- **Arya Roy,** Physics graduate school at Duke

Graduate Students Create 41L

The Department's tradition of educational innovation continued with a twist this year. In early Spring 2007, a committee of graduate student instructors conducted a comprehensive review of the entire calculus curriculum.

As part of their report, they designed Math 41L for incoming freshmen with one semester of calculus AP credit. These students tend to excel in computation but can benefit from exposure to and guidance in formal rigor.

The new Math 41L should appeal to students who are interested both in theoretical mathematics and in applications to other disciplines.

In addition to traditional second semester calculus topics, this lab-based course will introduce students to continuous probability, Fourier series, and elementary differential equations with applications to engineering and the physical and biological sciences.

Unlike labs in Math 31L and 32L, which often focus on the analysis of scientific data, some new labs ask students to develop proofs from classical analysis. The committee hopes that this emphasis on rigor will attract more bright freshmen to the mathematics major.

This fall Tim Lucas is teaching a pilot version of 41L. In the spring of 2008 the course will be re-evaluated and compared to the other integral calculus courses, Math 32 and Math 32L.

The committee itself was an innovation. It arose from discussions among graduate student instructors during Fall 2006 about the current calculus courses. By December, the committee of nine of these instructors, all with significant teaching experience, was set to review the calculus curriculum as a whole.

Committee members interviewed math professors, including the architects of the existing calculus courses, and faculty in physics, chemistry, computer science, engineering, and economics. They analyzed statistics on the careers and performance of the undergraduate population.

This investigation led to an extensive commentary on the curriculum development process.

Abe Smith and Lewis Blake

Teaching Award

Paul Bendich is the recipient of the 2006-2007 L.P. and Barbara Smith Award for Excellence in Teaching. Paul will receive a check in the amount of $2500 for his outstanding contributions to teaching in our department. Paul graduated from Grinnell College in 2001 and taught at Borough of Manhattan Community College for two years. Since his arrival here in the fall of 2003, Paul has taught a variety of courses including lab and non-lab calculus, linear algebra, and differential equations for engineering students. As a member of the department's calculus committee, he was one of several graduate students who designed the new course, Math 41L.

Paul is working with Professor John Harer on the analysis of high-dimensional datasets using methods of algebraic topology. When asked what he'd like to be doing after Duke, Paul replied: "My original plan was to head straight for a liberal arts college. However, I've been greatly enjoying my research the last few years. So in the best of all possible worlds, I'd do a research postdoc that leads to a liberal arts job at a place where I could continue doing research, perhaps by enlisting the help of undergraduates. Ideally, I'd like to stay around the Triangle."

This teaching award was made possible by the generous contribution of Captain L.P. Smith and Barbara Smith. Capt. Smith came to Duke after his retirement in 1966 from a career as a pilot in the US Navy. After earning a masters degree at Duke, he became Supervisor of First-year Instruction in 1973. In 1982 Capt. Smith retired again, this time as an Assistant Professor in the Mathematics Department. At that time, he and his wife Barbara established a fund that has been used to recognize and reward graduate students, such as Paul, for their outstanding teaching.

Following his retirement from Duke, Capt. Smith moved to his summer home in New Mexico. Later, he moved to be near family in Washington State, where he lived until his death in 2006. The structure and organization which Capt. Smith brought to the first-year math program still bear his fingerprints today. It is with fondness and thankfulness that we recall his contributions to our department.

Lewis Blake

Faculty News

New Faculty

The following professors and research associates have joined the department this fall.

- **Benoit Charbonneau**, Visiting Assistant Professor comes to us from McGill and MIT. He works on differential geometry and global analysis.

- **Jer-Chin(Luke) Chuang**, Lecturing Fellow comes to us from Rice University. He works on combinatorial topology and geometry.

- **Laurent Demanet**, Research Associate comes to us from California Institute of Technology. He works on applied harmonic analysis and scientific computing.

- **Stefano Guerra**, Visiting Assistant Professor comes to us from University of Pennsylvania. He works on algebraic geometry and string theory.

- **Boumediene Hamzi**, Visiting Assistant Professor comes to us from UC Davis, University of Paris-Sud. He works on applied dynamical systems and control theory.

- **Matthias Heymann**, Assistant Research Professor comes to us from NYU. He works on probability and math biology.

- **Yoon Mo Jung**, Research Professor comes to us from Minnesota. He works on calculus of variations, wavelets and scientific computing.

- **Jian-Guo Liu**, Visiting Professor comes to us from Maryland and UCLA. He works on computational fluid dynamics.

- **Shahed Sharif**, Asssistant Research Professor comes to us from Berkeley via Niagara University. He works on arithmetic geometry and number theory.

- **Graham Wilks**, Visiting Professor comes to us from Keele University. He works on fluid dynamics.

NOVA Profile

The life and work of professor Arlie Petters was featured on the PBS series Nova on July 24, 2007. His renowned work on gravitational lensing and his contributions to advancing education in his native Belize were profiled. See www.pbs.org/wgbh/nova/sciencenow/3411/04.html.

Richard and Margaret Hodel Retire

After decades of dedicated service, two of the most popular teachers in the mathematics department, Richard and Margaret Hodel, are ending their regular classroom duties.

Shortly after receiving her Ph.D.from Duke, Margaret Hodel became an Instructor of Mathematics and continued until her retirement last May.

She taught various levels of calculus to overflowing classes for the next 33 years. The 3500 students who have benefited from her instruction may be topped only by the 4000 students that Dick Hodel has taught here since 1965.

After his retirement at the end of the Fall 2007 term, Dick Hodel expects to keep active in mathematics, writing papers and articles, and has plans to revise his Mathematical Logic book. He will resume his oversight of the MAT program, of which he is co-principal investigator on a major grant, once his daughter Katie graduates from the program.

We are grateful to the Hodels for their many years of devotion to their students.

Reminiscences of Richard E Hodel

After graduating from Davidson College in 1959, I began my graduate studies in mathematics at Duke. At that time the requirements for the Ph.D. included a reading knowledge of both French and German and a minor. I chose philosophy for my minor and the courses I took in symbolic logic and analytic philosophy served me well when I wrote my logic book in the 1990's. I was able to complete my degree in three years (spring of 1962), due in large part to the fact that I did not have any teaching duties as a graduate student.

I felt a certain pressure to finish my degree as soon as possible because, after four years of ROTC as an undergraduate, I had a commitment to serve for two years in the Army.(There was a draft in those days.) In January 1963 I reported to Fort Sill, Oklahoma, an artillery base, where I spent about half of my time writing computer programs. Secretary of Defense Robert McNamara was a former executive at Ford and a big fan of cost effectiveness studies.Roughly speaking, the choice of a weapon system was based on selecting the one whose cost per casualty was smallest. These studies required an enormous number of calculations, all of which had been done with the aid of an adding machine. Fortunately, there was a computer on the base, a Bendix G-15 with an internal memory of 2000 words that could do 2000 additions per second - quite impressive for the time! Since I had taken a programming course at Duke, I was able to write programs in machine language that would do calculations that were previously done la-

boriously by hand. The Army was so pleased that they gave me the Army Commendation Medal and invited me to re-enlist.

However, academic positions were easily available in those days and I received several offers, including one from Duke where I began teaching in the fall of 1965. One semester I had three different courses: a freshman calculus course with 30+ students, a graduate course in topology with 20+ students, and a computer programming course with 70+ students. Both statistics and computer science were part of the mathematics department at that time.

I especially enjoyed teaching Topology in 1968-69 because of a particularly bright and attractive graduate student. Just to get the record straight, my first date with Margaret was June 12 - after the course was over. But then things moved along quickly: we were engaged July 6 (her birthday) and married January 3, 1970. She started teaching here a few years later. I did not realize at the time that I had just made my most valuable contribution to the Duke mathematics department.

My first two research papers were in dimension theory: my Ph.D. thesis,written under the supervision of J.H. Roberts, a leading expert in this area, and a paper on metric-dependent dimension functions, an area of dimension theory that was actually discovered by Roberts and K. Nagami, a collaborator from Japan. Then I switched to metrization theory and generalized metrizable spaces. By 1972 I became interested in cardinal functions in topology. I was asked to write the lead article on cardinal functions in the Handbook of Set Theoretic Topology, published in 1984.

Advanced work in cardinal functions requires extensive knowledge of set theory, which in turn requires a strong background in logic. I have devoted a considerable amount of time to both subjects, and became so interested in logic that I eventually wrote a book on the subject, Introduction to Mathematical Logic.I am indebted to J.R. Shoenfield, a distinguished logician on the Duke faculty, whose courses in computability, model theory, and set theory greatly benefited me.

I now work in all of these areas. In 2003 I wrote two articles on metrization theory for the newly published Dictionary of Set-Theoretic Topology. My two most recent papers, published in 2006, involve car-

dinal functions and set theory.I am currently working on two papers: one that gives a characterization of intuitionistic and classical propositional logic and one that investigates the common part of logic, topology, linear algebra, and graph theory.

In my 42 years at Duke I have taught approximately 4000 students, including five Ph.D. students: Barry Lobb (Lynchberg College), Dwight House (Fayetteville State University), Art Charlesworth (U. Richmond), Ken Abernethy (Furman U.) and Tom Kramer (US government) and so far three graduation with distinction students: Robert Schneck (Ph.D. from Berkeley in Logic); Alex Brodie (systems programmer, Microsoft), and Luis von Ahn (Ph.D. in computer science at CMU, and a recent McArthur Fellow).

Reminiscences of Margaret J Hodel

When I graduated from Vassar College in 1963, the United States was in the throes of a space race with the Soviet Union, sparked by the launching of Sputnik I and II in 1957. To help make the U.S. more competitive in scientific pursuits, the NSF provided financial support for the preparation of pre-collegiate mathematics textbooks by the School Mathematics Study Group, a collection of university mathematicians and mathematics teachers.

Instead of going directly to graduate school, I decided to take a job teaching the "new math" to seventh and eighth graders at the American Community School in Athens. I learned that teaching was much harder than I expected and that university professors probably should not be writing textbooks for 12 year olds. After spending two years in Athens, I taught in Rome for three years in the newly founded St. Stephen's School, a boarding and day school for high school students of all nationalities. (Last year I taught a student who had just graduated from this school.)

In 1968, ready to become a student again, I chose Duke because Leonard Carlitz was on the faculty. Carlitz, an extraordinarily prolific mathematician, published over 770 research papers in number theory, finite field theory, combinatorics, special functions and the arithmetic of polynomials over a finite field. I become the 38th of his 44 students, working in combinatorics and benefiting from his advice and

friendship even after I completed my Ph.D. in 1972. Recently I learned that, thanks to Carlitz, my mathematical lineage includes Leibniz, Jacob and Johann Bernoulli, Euler, Lagrange, Poisson and Veblen.

Duke and Durham were much less developed forty years ago than they are today. Durham's only shopping center was a strip mall at Northgate. Route 15-501 to Chapel Hill was a country road with neither stoplights nor commercial establishments. There was no Bryan Center and no Duke Hospital North. Parking was free and easily available.

My instructors during my first two years included David Smith, Lang Moore, Joe Kitchen, and Seth Warner, all longtime friends who are now retired. But my favorite teacher was Dick Hodel, whom I married in January, 1970. We have two wonderful children, Katie, 24 and Richie, 27, neither of whom majored in math.

As a graduate student I was an instructor for math 31 and 32. Beginning in January, 1974 I have taught an average of two courses (31, 32, 33, 34, 41, 103, 104, and 124) each semester except for the one following our daughter's birth. Over this period of 34 years, I have probably had over 3500 different students in my classes. This number includes the former chairman of the chemistry department and a member of the law school faculty. While I cannot remember all of these students, some I'll never forget. For example, one student in math 103 stopped by my office near the end of the semester, opened up his gym bag, and presented me with a beautiful bouquet of red roses. I'm afraid I had to wonder if the present had anything to do with the fact that his grade going into the final was on the B+/A- line. A number of years later I decided he had earned the A- he received. In the Durham Herald-Sun I came upon an article he had written about a home in Raleigh. He described the roof as a hyperbolic paraboloid.

Duke Math News

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

To read about other news, honors and events concerning mathematics at Duke, visit `www.math.duke.edu/news/`. The on-line calendar at `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 `www.math.duke.edu/computing/broadcast.html` for more information.

—David Kraines, DMN Faculty Sponsor