College of Science and Technology

MATHEMATICS

UPDATE SPRING 2017

TEMPLE UNIVERSITY

Chair's Message

Last July 1 marked the beginning of a challenging and exciting time for me as I assumed the role of department chair. While this entailed reprioritizing my life as I knew it, since then I have had the privilege to get to know and work more closely with our extraordinary faculty and staff.

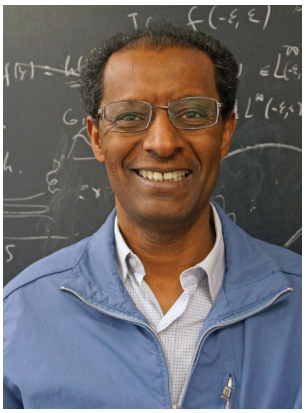
Hiring new faculty; experiencing the energy of Wachman Hall's sixth floor during the peak hours of our new tutoring center; benefiting from the effectiveness of our staff; and seeing our graduate and undergraduate students professionally grow and achieve what just yesterday seemed impossible have all been extremely rewarding. Our world-class faculty have earned many incredible research accolades, including an American Mathematical Society Fellowship, a Fulbright, a Sloan, new grants, new books and prestigious invited lectures. Together, our department achieved so much already and there will be more accomplishments in the years ahead.

After a fruitful Numerical Analysis Day this past fall, the department hosted spring and summer events, including Sonia Kovalevsky Mathematics Day and the Philadelphia Undergraduate Mathematics Conference Series. In June, the department will host the Graduate Student Conference in Algebra, Geometry and Topology. These professional events transform lives, and I am very grateful for everyone's commitment to make each of them successful.

Our achievements were also made possible by department's alumni and friends who support our efforts. Thank you.

Irina Mitrea
Professor and Chair

Shiferaw Berhanu: Crossroads of complex analysis and partial differential equations



Professor Shiferaw Berhanu is a world-class expert in the theory of systems of complex vector fields, an area which is at the crossroads of complex analysis and partial differential equations.

Recently, in collaboration with Ming Xiao, a J. L. Doob Assistant Professor of Mathematics at the University of Illinois at Urbana-Champaign, he settled an important 20-year-old conjecture regarding Cauchy-Riemann mappings between Cauchy-Riemann manifolds of differing dimensions. The results and methods of this work have been used by researchers in settling other longstanding conjectures in several complex variables and complex geometry.

Berhanu, the department's director of graduate studies, has a dynamic research record of 47 papers published in top mathematical journals. In 2008, he was a co-author of the research monograph An Introduction to Involutive Structures, published by Cambridge University Press. In addition, his research has been supported by back-to-back National Science Foundation grants.

His groundbreaking research in complex analysis and partial differential equations was recognized nationally by his election into the 2016 class of the Fellows of the American Mathematical Society. In 2014, Berhanu was elected as an Associate Fellow of the Ethiopian Academy of Sciences in recognition of both his pioneering research work and tremendous efforts in supporting mathematical research and education in Ethiopia.

In addition to his NSF grants, Berhanu has also secured substantial funding from eight other funding agencies. These include the Centre National de la Recherche Scientifique, the French National Research Agency, the International Mathematics Union and the International Centre for Theoretical Physics, all of which have supported conferences he has organized around the world.

Support Mathematics and CST

You can contribute to the continued success of CST and the Department of Mathematics by supporting scholarships, undergraduate research, faculty endowment and innovative programs. Make your gift at *giving.temple.edu/givetocst* .

STUDENT ACHIEVEMENT

Students earn prestigious awards and scholarships

DEPARTMENT OF MATHEMATICS

Christopher W. Copple Award for Excellence in the Field of Mathematics
Kyle Nardi, Mathematics (2016)

David Tepper, CST '64, and Elaine Kowalewski Scholarship in Mathematics
Alexandra Jones, Mathematics (2017)

Excellence in Service by a Graduate Student
Thomas Ng, Mathematics (2016)
William Worden, Mathematics (2016)

Francis James and Helen C. Sholomskas Award for Outstanding Students
Dong Bin Choi, Mathematics and Computer Science (2017)
Jordan Cregger, Mathematics (2017)
Fiona Galzarano, Mathematics (2017)
Louis Graup, Applied Mathematics (2016)
Daniel Jackson, Applied Mathematics (2016)

Phyllis Zayon Steinberg Memorial Award in Mathematics
Andrew Higgins, Applied Mathematics (2017)
Patrick Wynne, Mathematics (2016)

Sholomskas Progress to Excellence Scholarship
Dong Bin Choi, Mathematics and Computer Science (2017)
Jordan Clever, Mathematics (2017)
Mckenzie Cunningham, Mathematics and Computer Science (2017)
Hoa Huynh, Mathematics (2017)
Joseph Norkin, Mathematics and Computer Science (2017)

The Orin N. Chein Most Promising Mathematics Major Award
Aidan Lorenz, Mathematics and Physics (2017)
Dong Bin Choi, Computer Science (2016)

Undergraduate Student Departmental Service Award
Leah Rosenbloom, Mathematics (2016)

COLLEGE-WIDE AWARDS

College of Science and Technology Alumni Endowed Scholarship
Mathew Wynne, Mathematics (2017)

Computer and Information Sciences Department Award for Outstanding Achievement
Bryan Berman, Mathematics and Computer Science with Teaching (2016)

Dean's Award for Outstanding Teaching Assistant
Hussein Awala, Mathematics (2017)

Donald and Annette Baird Family Award
Elliot Bickel, Mathematics with Teaching (2017)
Emily Wetzel-Ulrich, Mathematics with Teaching (2016)

Dr. Muriel Apfelberg Brownstein Science and Math Education Endowed Scholarship
Margaret King, Mathematics with Teaching (2017)

Louis Stokes Alliance for Minority Participation Award for Academic Achievement
Mckenzie Cunningham, Mathematics and Computer Science (2017)

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One of the top three undergraduate majors in mathematics at Temple, Philadelphia native Fiona Galzarano, a Presidential Scholar and winner of the 2015 Most Promising Mathematics Major Award, has engaged in extensive undergraduate research.

As part of the CST's Undergraduate Research Program, the computer science and Spanish minor tested an intelligent reasoning system under Associate Professor **Pei Wang** of the Department of Computer & Information Sciences.

At the 2015 Cornell University Summer Program for Undergraduate Research, she analyzed Apollonian gaskets with Professor Robert Strichartz; presented their results at a March 2016 American Mathematical Society meeting; and is working with him on a related paper.

Finally, Galzarano's work last summer as an applied mathematics intern with the Department of Defense in Maryland has resulted in a full-time job following graduation assisting the government with cyber security.

"Beyond specific formal proofs, Temple has given me the intuition to be able to figure out stuff on my own," says the vice president of Temple's Association for Women in Mathematics chapter. "The job's mostly computer science, but it will be 'mathy' computer science."

PhD Student Zach Cline envisions teaching math at liberal arts university

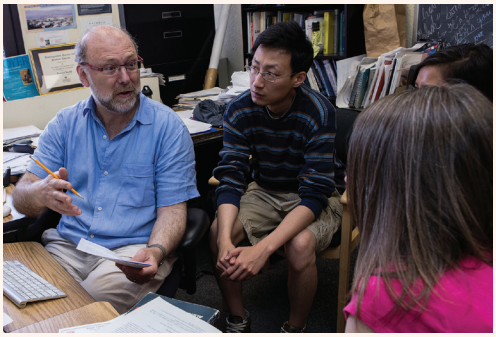
Zach Cline earned his bachelor's degree in mathematics from the Templeton Honors College of Eastern University in Pennsylvania in 2013. When he earns his PhD—probably in 2019—he hopes to return to that milieu as a professor at a small liberal arts institution.

"Math requires students to think qualitatively and logically, which is different from the critical thinking that subjects such as philosophy require," Cline says. "I want to teach them to see the beauty of math."

Cline, whose first research paper is focusing on Hopf algebras, attended and helped with Temple's Graduate Student Conference in Algebra, Geometry, and Topology last April and has traveled to several mathematical conferences/workshops in Denver and Seattle.

At Temple, Cline has gained what he calls "mathematical maturity."

"There are certain concepts or ways of proving things that mathematicians take for granted when explaining something to another mathematician, and learning those things enables you to better understand other mathematicians' work," he says. "Your brain gets quicker and you don't have to go through the proofs as slowly."



Daniel Szyld elected **AMS** and **SIAM fellow**

Professor Daniel Szyld has been elected to the 2017 Class of Fellows of the American Mathematical Society (AMS) and to the 2017 Class of Fellows of the Society for Industrial and Applied Mathematics (SIAM). The honors recognize his contributions to numerical and applied linear algebra and his exemplary research and service to the community.

Szyld is Temple University's first SIAM Fellow. Along with Professors Shiferaw Berhanu, Irina Mitrea and Igor Rivin, Szyld is the fourth Temple mathematics professor to become an AMS fellow in the past three years.

Graduate student talks, poster presentations and dissertation completion grants

Kathryn Lund delivered lectures at the 20th International Linear Algebra Society (ILAS) Conference 2016 in Belgium and at the 88th Gesellschaft für Angewandte Mathematik und Mechanik Annual Meeting 2017 in Germany. She also will present a poster at the Householder Symposium XX on Numerical Linear Algebra at Virginia Tech.

José Garay delivered poster presentations at the 2016 Mid-Atlantic Numerical Analysis day at Temple and the DD XXIV, International Conference on Domain Decomposition Methods at the University of Bergen, Norway.

Hussein Awala attended the Summer Graduate School: Harmonic Analysis and Elliptic Equations on Real Euclidean Spaces and on Rough Sets at MSRI, Berkeley, California; and presented lectures at the 2016 Prairie Analysis Seminar at the University of Kansas; 17th International Symposium on Scientific Computing, Computer Arithmetics and Verified Numerics at Sweden's Upsalla University; and the 2017 Joint Mathematical Meeting in Atlanta.

In addition, fall 2016 doctoral dissertation completion grant recipients were awarded to **Hussein Awala, Dianbin Bao, Adam Jacoby, Michael Ratner** and **Geoffrey Schneider**

FUNDED MATHEMATICS DEPARTMENT RESEARCH

Shiferaw Berhanu
- PI, The Regularity of Cauchy-Riemann Mappings and Solutions of Systems of Nonlinear Partial Differential Equations, *NSF (2016-19)*

Vasily Dolgushev
- PI, Questions on Algebraic Operads and Related Structures, *NSF (2015-18)*

David Futer
- Connections in Low-Dimensional Topology, *NSF (2014-17)*

Yury Grabovsky
- Linear and non-linear elasticity: Study of exact relations and instabilities, *NSF (2014-17)*

Cristian Gutiérrez
- Monge–Ampère-Type Equations and Geometric Optics, *NSF (2016-19)*

Isaac Klapper
- PI, Connecting Omics to Physical and Chemical Environment in Community Microbial Ecology, *NSF (2015-18)*
- Co-PI, Spatiotemporal Distribution of Oxygen in Biofilm Infections, *NIH (2013-17)*

Irina Mitrea
- PI, Geometric Measure Theory and Higher Order Elliptic Problems, *Simons Foundation (2014-19)*

Brian Rider
- PI, Limit laws arising in random matrix theory, *NSF (2014-17)*

Benjamin Seibold
- PI, CPS: Synergy: Collaborative Research: Control of vehicular traffic flow via low density autonomous vehicles, *NSF (2015-17)*

Matthew Stover
- PI, Geometry and arithmetic of locally symmetric spaces, *NSF (2013-17)*

Daniel Szyld
- PI, Multiple Preconditioning for Saddle-Point and other Problems, *NSF (2014-17)*
- PI, Asynchronous Iterative Solvers for Extreme-Scale Computing, *DOE (2016-19)*

Chelsea Walton
- PI, Noncommutative Algebraic Geometry and Noncommutative Invariant Theory, *NSF (2014-17)*

CONFERENCE GRANTS

David Futer, PI, and Chelsea Walton, Co-PI
- Graduate Student Conference in Algebra, Geometry and Topology, *NSF (2016-17)*

Brian Rider, PI
- Thematic Semester on Probabilistic Methods in Geometry, Topology and Mathematical Physics, *NSF (2016-18)*

Chelsea Walton, PI, and Vasily Dolgushev, Co-PI
- Kirkman & Lorenz: Algebra Extravaganza, *NSF (2017-18).*

Faculty notes

Assistant Professor of Instruction Jose Giménez received the 2017 Provost's Award for Teaching Excellence in General Education.

Professor Maria Lorenz's service to the department and university was recognized through CST's Outstanding Faculty Service Award and Temple's Lindback Award for Distinguished Teaching.

Professor Martin Lorenz received a 2017 Summer Research Award and a 2017 University Grant-in-Aid Award in support of his book project on representation theory.

Professor Irina Mitrea was elected to serve a three-year term through 2020 on the AMS Council.

Professor Brian Rider received a spring 2018 Fulbright U.S. Scholar award to study at the National Autonomous University of Mexico in Mexico City.

Professor Benjamin Seibold's effective mentoring of students and postdocs earned him the Dean's Distinguished Excellence in Mentoring Award.

Professor Chelsea Walton received a Sloan Fellowship in Mathematics, Temple's first recipient since 1989. In Oct. 2016, she delivered an invited address at the AMS Fall Western Sectional Meeting in Denver.

Non-tenure track faculty members **Doreen Wald** and **Xingting Wang** and adjunct faculty members **Ray Favocci** and **Ben Spiro** won 2016 Departmental Excellence in Teaching Awards.

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Conference in Italy celebrates Cristian Gutiérrez

A two-day meeting on the occasion of Professor Cristian Gutiérrez's 65th birthday was hosted by the Accademia delle Scienze dell'Istituto di Bologna in Bologna, Italy last June. The meeting was in honor of Gutierrez' contributions to the study of linear and nonlinear partial differential equations. The conference also celebrated his election as an Accademico Corrispondente Straniero of the Accademia delle Scienze.

Department conference to honor Martin Lorenz and Wake Forest's Ellen Kirkman

The Mathematics Department is hosting a five-day conference honoring Professor Martin Lorenz and Professor Ellen Kirkman, Wake Forest University, July 24-28, 2017. The conference is devoted to the recent research on the interplay between noncommutative algebra with invariant theory, representation theory and algebraic geometry. Conference organizers are professors Chelsea Walton, Ed Letzter and Vasily Dolgushev.

K-12 outreach

The department hosted its fifth annual Sonia Kovalevsky Day on April 16, 2016. Fifty middle-school girls from the Philadelphia area and beyond learned about code breaking, deceptive data, the golden ratio and the mathematics of pizza. The instructors were Sogol Baharlou (Engineering), and mathematics students and faculty Brian Filips, Fiona Galzarano, Beca Lufi, Kathryn-Lund Nguyen and Sarah Roden. The teaching assistants were Ramya Ailavajhala (Engineering), Mei Rose Connor (high school student), and mathematics graduate students Joshua Finkelstein, Sowmya Srinivasan, William Worden and Yilin Wu. Assistant Professor Meredith Hegg gave the opening remarks. The event was organized by Professors Maria Lorenz and Irina Mitrea.

Student awards and scholarships

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Natan Luehrmann-Cowen Memorial Award
Jason Loux, Mathematics and Computer Science (2017)

Robert A. Figlin Family Research Award
Aidan Lorenz, Mathematics and Physics (2017)
Sujay Rajkumar, Mathematics (2017)

Outstanding Research Award in Mathematics
Farhan Abdedin, Mathematics (2017)
Hussein Awala, Mathematics (2017)

UNDERGRADUATE STUDENT ACHIEVEMENTS

Undergraduate Research Projects

- **Dong Bin Choi:** with Professor Chelsea Walton on Noether's Bound for Noncommutative Algebras
- **Alexandra Jones:** in Biology Professor Rob Kulathinal's Computational Genomics Lab
- **Sujay Rajkumar:** in the Genomics and Evolutionary Medicine Lab

Summer Internships

- **Fiona Galzarano:** as an applied mathematician with the Department of Defense
- **Sabrina Harris:** for the GSK Science in the Summer Program at the Franklin Institute
- **Katherine Wang:** with Youth Engineering and Science Camps

Study Abroad

- **Josh Lloret:** 2016 Spring Semester of Mathematics in Hamburg, Germany
- **Aidan Lorenz:** 2016 Budapest Semester in Math Summer Program

Books by faculty

Composite Material: Mathematical theory and exact relations
Yury Grabovsky (Institute of Physics Publishing, 2016)

Introduction to Calculus and Classical Analysis (4th edition)
Omar Hijab (Springer, 2016)

The Monge-Ampère Equation (2nd edition)
Cristian Gutiérrez (Springer's Birkhäuser Mathematics series, 2016)

The Hodge Laplacian: Boundary value problems on Riemannian manifolds
Irina Mitrea in collaboration with D. Mitrea, M. Mitrea and M. Taylor (DeGruyter's Studies in Mathematics series, 2016)