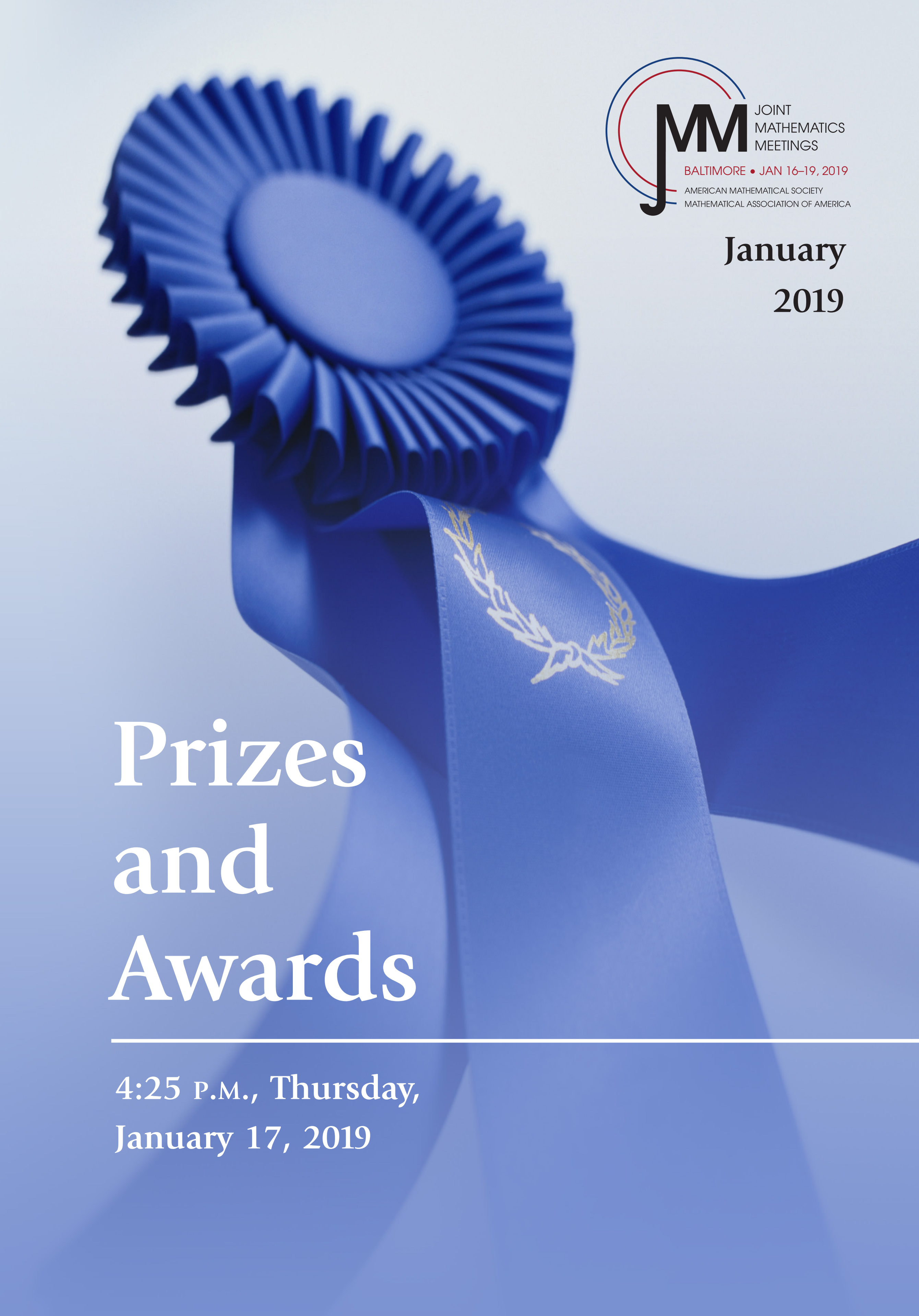

JOINT MATHEMATICS MEETINGS
BALTIMORE • JAN 16–19, 2019
AMERICAN MATHEMATICAL SOCIETY
MATHEMATICAL ASSOCIATION OF AMERICA

January 2019

Prizes and Awards

4:25 P.M., Thursday,
January 17, 2019

Program

Opening Remarks
Kenneth A. Ribet, American Mathematical Society

Chauvenet Prize
Mathematical Association of America

Euler Book Prize
Mathematical Association of America

The Deborah and Franklin Tepper Haimo Awards for Distinguished College or University Teaching of Mathematics
Mathematical Association of America

Yueh-Gin Gung and Dr. Charles Y. Hu Award for Distinguished Service to Mathematics
Mathematical Association of America

Louise Hay Award for Contribution to Mathematics Education
Association for Women in Mathematics

M. Gweneth Humphreys Award for Mentorship of Undergraduate Women in Mathematics
Association for Women in Mathematics

Joan & Joseph Birman Prize in Topology and Geometry
Association for Women in Mathematics

Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student
American Mathematical Society
Mathematical Association of America
Society for Industrial and Applied Mathematics

Communications Award
Joint Policy Board for Mathematics

Norbert Wiener Prize in Applied Mathematics
American Mathematical Society
Society for Industrial and Applied Mathematics

Levi L. Conant Prize
American Mathematical Society

E. H. Moore Research Article Prize
American Mathematical Society

Mary P. Dolciani Prize for Excellence in Research
American Mathematical Society

David P. Robbins Prize
American Mathematical Society

Oswald Veblen Prize in Geometry
American Mathematical Society

Ruth Lyttle Satter Prize in Mathematics
American Mathematical Society

Leroy P. Steele Prize for Seminal Contribution to Research
American Mathematical Society

Leroy P. Steele Prize for Mathematical Exposition
American Mathematical Society

Leroy P. Steele Prize for Lifetime Achievement
American Mathematical Society

Closing Remarks
Deanna Haunsperger, Mathematical Association of America

Chauvenet Prize

The Chauvenet Prize is awarded to the author of an outstanding expository article on a mathematical topic. First awarded in 1925, the Prize is named for William Chauvenet, a professor of mathematics at the United States Naval Academy. It was established through a gift in 1925 from J. L. Coolidge, then MAA President. Winners of the Chauvenet Prize are among the most distinguished of mathematical expositors.

Citation

Tom Leinster

"Rethinking Set Theory," *The American Mathematical Monthly*, **121** (2014), no. 5, 403–415.

Every mathematician knows that modern mathematics is an axiomatic system based on a theory of sets defined by the Zermelo–Fraenkel axioms plus the Axiom of Choice (ZFC). But how many of us can recite these axioms? Even after looking them up, are they in accord with our working understanding of sets? Or is the ZFC conception of sets necessarily nonintuitive as a result of having to rectify the difficulties of naive set theory discovered by Russell? In this paper, Tom Leinster tackles this issue with clarity and finesse.

In 1964, F. William Lawvere proposed a revolutionary alternative axiomatization. Presented in the language of topos theory, an esoteric branch of category theory, Lawvere's axioms languished unrecognized by the majority of mathematicians of the era. Leinster reformulates Lawvere's axioms with striking simplicity. By expanding the primitive terms of the axiomatization to include functions and the composition of functions, Leinster replaces the ZFC axioms with ten axioms that can be easily understood—and accepted—by any undergraduate math major.

Leinster issues a challenge: how many of us would be troubled to discover one day that ZFC is inconsistent? He speculates that most of us would be "unlikely to feel threatened by the inconsistency of axioms to which we never referred anyway." "Discovering an inconsistency in Lawvere's much more natural and intuitive axioms," Leinster conjectures, would be "devastating." Read the paper and judge for yourself!

Biographical Note

Tom Leinster studied in Oxford and Cambridge, doing a Ph.D. on higher category theory with Martin Hyland, followed by postdoctoral positions in Cambridge and Paris. He then made his home in Scotland, working at the University of Glasgow before moving to the University of Edinburgh, where he now is. He is also a member of Glasgow's Boyd Orr Centre for Population and Ecosystem Health. His interests lie mainly in applications of category theory, recently focusing on applications to geometry, analysis, and the quantification of biological diversity. He is the author of three books: *Higher Operads, Higher Categories* (2004), *Basic Category Theory* (2014), and *Entropy and Diversity: The Axiomatic Approach* (to appear). He has also written about the role played by mathematicians in the mass suspicionless surveillance of citizens by governments and is a contributor to the research blog The n-Category Café.

Response from Tom Leinster

I am very grateful, honoured and surprised to receive the Chauvenet Prize for "Rethinking set theory." The spark for this article was a talk given by Saunders Mac Lane close to the end of his life, in which he exhorted someone to write a short, elementary book on categorical set theory accessible to any mathematician. I'm afraid that at the time, I thought this sounded crazy: categorical set theory is usually seen as belonging to topos theory, a branch of category theory that can be intimidating even to category theorists. But years later, I discovered the work of the philosopher of mathematics Colin McLarty, who made it crystal clear that categorical axioms of set theory can be stated without even mentioning categories, let alone more sophisticated concepts. One of the paradoxes of modern mathematics is that we constantly refer to sets, yet very few of us can state accurately what we mean by the word. The categorical axioms come close to how mathematicians actually use sets in practice. Excited by this idea, I gave some seminars on it and started work on the paper. Feedback from audiences, and from discussions at the n-Category Café and MathOverflow helped to refine it. and I am grateful to all those who took part.

EULER BOOK PRIZE

THE Euler Book Prize is awarded annually to the author of an outstanding book about mathematics. The Prize is intended to recognize authors of exceptionally well-written books with a positive impact on the public's view of mathematics and to encourage the writing of such books. The Euler Prize, established in 2005, is given every year at a national meeting of the Association beginning in 2007, the 300th anniversary of the birth of Leonhard Euler. This award also honors Virginia and Paul Halmos, whose generosity made the award possible.

CITATION

Cathy O'Neil

Weapons of Math Destruction, Crown (2016)

Weapons of Math Destruction is a singularly important book especially at this current historical juncture. It is well-written, engaging, and tackles an important issue, "the dark side of data science," in a thoughtful way. O'Neil convincingly and passionately argues that math is not just for solving the world's problems; it is responsible also for fueling some of them. Her discussion of ethical issues and how mathematical models, data, and algorithms are used to manipulate society is important both socially and politically. Honestly confronting the harmful uses of mathematics, while at the same time promoting its benefits, will only enhance the public's perception of mathematics.

The book is exceptionally engaging, drawing on personal experience, professional expertise, and careful reporting. "As I survey the data economy, I see loads of emerging mathematical models that might be used for good and an equal number that have the potential to be great if they're not abused." She gives examples of helping families in shelters find permanent homes, finding sources of forced labor in supply chains, and identifying factors that predict child abuse in order to funnel resources toward at-risk families. She also suggests codes of ethics for those who develop mathematical models (much like the Hippocratic Oath for physicians), regulation, transparency, and auditing processes as being essential to limiting the damage of WMDs.

Biographical Note

Cathy O'Neil earned a Ph.D. in math from Harvard, was a postdoc at the MIT math department, and a professor at Barnard College where she published a number of research papers in arithmetic algebraic geometry. She then switched over to the private sector, working as a quant for the hedge fund D. E. Shaw in the middle of the credit crisis, and then for RiskMetrics, a risk software company that assesses risk for the holdings of hedge funds and banks. She left finance in 2011 and started working as a data scientist in the New York startup scene building models that predicted people's purchases and clicks. She wrote *Doing Data Science* in 2013 and launched the Lede Program in Data Journalism at Columbia in 2014. She is a regular contributor to Bloomberg View and wrote the book *Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy*. She recently founded ORCAA, an algorithmic auditing company.

Response from Cathy O'Neil

It's my honor to be recognized by the mathematical community (which I still consider my community!) for my recent nonacademic work. I've always seen math as, at its best, a force of clarity and honesty. Indeed my experience of doing mathematics research was rather unique in this world: a context in which we want to know the truth, we even thank others for pointing out our errors, and we are constantly and openly humbled with confusion and frustration. If you think about it, that's a rare thing. Too often people, through commercial or reputational incentives, tend to overstate their accomplishments, hide their mistakes or weaknesses, and gloss over negative consequences. This is especially true in the world of big data, and the long term negative side effects are just now being acknowledged if not yet measured or mitigated, from discriminatory hiring algorithms to a weakened democracy via social media editorializing algorithms. I'm glad I have been able to shine a spotlight on this urgent problem, and in particular to other mathematicians, because I truly believe that the trust that the public has in mathematics is at stake, and we need to defend that which deserves defending.

DEBORAH AND FRANKLIN TEPPER HAIMO AWARDS FOR DISTINGUISHED COLLEGE OR UNIVERSITY TEACHING OF MATHEMATICS

IN 1991, the Mathematical Association of America instituted the Deborah and Franklin Tepper Haimo Awards for Distinguished College or University Teaching of Mathematics to honor college or university teachers who have been widely recognized as extraordinarily successful and whose teaching effectiveness has been shown to have had influence beyond their own institutions. Deborah Tepper Haimo was president of the Association, 1991–1992.

CITATION

Suzanne Dorée

Dr. Suzanne Dorée is recognized for her exemplary teaching innovation and leadership, not only at Augsburg University, but also nationally through her work with the MAA, the Charles A. Dana Center, and numerous presentations and workshops on campuses throughout the U.S.

Su is an expert teacher of mathematics who goes to extraordinary lengths to help students at all levels to learn mathematics. On of Su's former students who now manages a large tech company wrote,"In the process of learning to cope with my mental health issues, I found that having a service dog accompany me to class was a key enabler.... Su was exceptionally supportive. Even though she is horribly allergic to dogs, she recognized that it was helping me and actively worked to create a way for me to have this accommodation."

Su takes great care in the design of classes, authentic assessments, and highly interactive classrooms, creating an environment where the students build routines that support a high-level of effort, time on task, and success. She can tell you why each assessment or portion of a lesson is part of the course and where in the course that concept is revisited or more fully developed.

She is exceptionally skilled in her interactions with students. She challenges students to rise to their ability through productive struggle and as an academic advisor she challenges them to reflect deeply on academic and career path choices. Su's enthusiasm for mathematics is infectious, and students get excited by the material. She shows them the joys of mathematics, its usefulness, its connections to other disciplines, and the opportunities that having a strong background in mathematics opens.

Su developed Augsburg's developmental algebra course, which focuses on learning exclusively through applied contexts (100% story problems) that are relevant to students lives, future studies, and roles as an engaged member of society. Students work actively on the material, building their own understanding of linear and exponential models. Several other colleges also use the materials, and Su has led multiple sessions at national meetings on teaching developmental mathematics.

Su also developed Augsburg's discrete mathematics course, which is both the school's introduction to discrete mathematics and also the "transitions" course to the ideas of mathematical logic, axioms, and proof writing. Su created all the materials for the class: textbook, homework, and daily cooperative learning activities.

Su is a gifted mentor to colleagues and other teachers. Within the department, she has created a culture where peer observation and conversations about teaching are the norm. As her nominator wrote, "As chair, Dr. Dorée would always invite faculty to observe her classroom teaching before sitting in on a faculty member's class for review. Especially for new faculty, seeing quality teaching helps one to imagine teaching possibilities. My colleagues were good teachers before coming to Augsburg but are better now, in part because of Dr. Dorée's influence. Each regularly implements teaching techniques that she introduced to them…Dr. Dorée's philosophy includes the idea that students learn mathematics by doing mathematics, and they learn mathematics better when they engage with others learning the mathematics."

At the national level, Su chaired the CRAFTY (Curriculum Renewal Across the First-Two Years) committee. She proposed, organized, coordinated, and assisted in rewrites of a series of articles in MAA FOCUS highlighting mathematics curriculum renewal projects throughout the US. Su spent her past sabbatical working with the Charles A. Dana Center at University of Texas–Austin on national curriculum reforms.

Su has also impacted teachers and students nationally through her many dozens of workshops and other presentations. She has given invited undergraduate plenary talks at campuses and conferences, published articles in *PRIMUS, Mathematics Magazine, MAA Focus*, and *MAA Notes*, with related talks at the Joint Mathematics Meetings, Project/Section NExT workshops, AMATYC, AAC&U/STEM, and IBL Conferences.

The MAA recognizes the great positive impact Dr. Suzanne Dorée has had on mathematics education at her own institution and across the country and is honored to present her with the Deborah and Franklin Tepper Haimo Award for Distinguished College or University Teaching of Mathematics.

Biographical Note

Suzanne Dorée is Professor of Mathematics and chair of the Department of Mathematics, Statistics, and Computer Science at Augsburg University in Minneapolis where she has taught since 1989. She earned her Ph.D. in Character Theory from the University of Wisconsin–Madison. Her research interests include curriculum and materials development and directing undergraduate research in combinatorics. She enjoys teaching mathematics at all levels using pedagogies that support active and inquiry-based learning. Dr. Dorée is active in the Mathematical Association of America, currently serving as Chair of the MAA Congress and Chair of the Council on Programs and Students. An avid gardener, cook, and designer, she appreciates the importance of getting her hands dirty, and not just in mathematics.

Response from Suzanne Dorée

I am humbled and grateful for this honor. Nobody learns to teach alone. Nudging me on have been my mathematics colleagues at Augsburg who literally support anything I do (be it good, bad, or ugly), a faculty rewards system at Augsburg that honors the Scholarship of Teaching and Learning, Augsburg's Disabilities Support staff who don't believe in the word "can't", my colleagues in the North Central Section and MAA nationally from whom I have often stolen (ahem, adapted) ideas and who challenge me to build a more inclusive classroom, my buddies from graduate school at Wisconsin (they know why), members of the Inquiry-Based Learning community, and my family. Most of all, thanks to the thousands of students these past years. Their creative approaches to learning mathematics, their unedited criticism and challenge, their often surprising enthusiasm for courses they didn't want to take, their patience tried by my many missteps, and their perpetually novel insights have humbled me and challenged everything I thought I knew about teaching and learning mathematics. They have inspired me time and time again and I am grateful that they have allowed me to make a difference in their lives. Thank you all.

CITATION

Carl Lee

Dr. Carl Lee of Central Michigan University (CMU) is recognized for his outstanding contributions to teaching and learning in the mathematical sciences and particularly in statistics. He is an innovative and engaging teacher and an inspired mentor.

Carl provides tireless mentoring and helps any student interested in mathematical sciences and applications. One of his former students, who came from a small village in a foreign country with a baccalaureate degree in English and Literature, wrote, “I struggled with what I should do, and started taking a variety of courses in different disciplines. It was the Statistics course I took in summer 2012 taught by Professor Lee that changed my career path, and I decided to pursue a quantitative related field. Quantitative subjects have never been a subject of my choice until taking Professor Lee’s class. He opened my eyes to the wonder of statistics and its powerful applications.”

Carl has successfully worked to develop and promote statistics programs at both undergraduate and graduate levels at CMU. He has developed and taught many different courses from introductory level to master’s and Ph.D. level courses. He helped design the undergraduate statistics and actuarial science program, initiated and developed a graduate certificate program in data mining, the MS in Applied Statistics and Analytics, and completely revised the Ph.D. program from Ph.D. in Mathematics with Concentration in Collegiate Teaching to Ph.D. in Mathematical Sciences with three different concentrations: in Pure Mathematics, Collegiate Mathematics Education, and Statistics. Among all faculty in the department, Carl has supervised (or co-supervised) the highest number of PhD dissertations and has also served on many Ph.D. dissertation committees within and outside the Department of Mathematics.

Carl is a pioneer among statistics educators. He developed the NSF-supported Real-Time Online Hands-on Activities Database, used by more than 100 instructors at more than 50 institutions. The idea is to host activities that allow students to mimic statistical practice of defining the problem, collecting data, cleaning, manipulating and analyzing data, and writing and presenting results. Carl co-developed an online SPSS Training Workshop website using a variety of movie clips to demonstrate how to use SPSS step by step in 1999 with several revisions since then. This site has been one of the most popular sites for SPSS online training.

Carl teaches statistics courses with active learning. In his undergraduate level courses, he uses a flipped classroom approach by requiring students to study the topic and pass an online quiz before coming to class. During the class, instead of lecturing, he engages students to participate and facilitates work in teams to solve real-world problems in an active learning environment. A former student wrote, “Throughout my experience, Dr. Lee drew connections between the material learned in class and its application in greater society thus giving it significance beyond the grade.”

In his senior and graduate level courses, Carl requires students to conduct semester-long team projects. Each team comes up with their own project, defines the purpose, identifies the data sources, collects, cleans and manipulates data from various data sources, analyzes the data, writes reports, and makes presentations in class and at the university annual student research exhibition.

Carl works with the SAS company to offer two SAS Professional Certification Exams each semester on the CMU campus that are among the best credentials for students in their job searching.

Carl is one of the founding members of the Consortium for the Advancement of Undergraduate Statistics Education (CAUSE) founded in 2003. He founded the Undergraduate Statistics Project Competition (USPROC) in 2006 and chaired the competition committee from 2006–13. This competition is now an important annual event sponsored by CAUSE and ASA. He also served as a member of the ASA/MAA Joint Committee on Undergraduate Statistics (2003–05) and was heavily involved with the 2000 ASA Undergraduate Statistics Education Initiatives (USEI) organized by the former ASA President, Professor Richard Scheaffer.

Carl's mentoring and leadership has helped other faculty throughout the U.S. One reference wrote, "My graduate school training was in probability theory and my first academic job was at a small liberal arts college. I had no experience teaching introductory statistics. I met Professor Lee at a statistics education conference in 1999 where he shared his experience of teaching introductory statistics using new and non-traditional approaches and introduced me to different ways of assessing student learning. With his mentorship, I was able to present and publish statistics education research papers and mentored several undergraduate research projects related to statistics education. I am currently a full professor at a research university. I credit my long time productive collaborations with Professor Lee for my successful transition from the small liberal arts school to Michigan State University."

The MAA recognizes the great positive impact of Dr. Carl Lee on mathematics students and colleagues at his own institution and across the country and is honored to present him with the Deborah and Franklin Tepper Haimo Award for Distinguished College or University Teaching of Mathematics.

Biographical Note

Carl Lee is a Professor of Statistics in the Department of Mathematics, Central Michigan University (CMU). He was raised in a small mountain village in southern Taiwan. It was a blessing for him to receive the opportunity to pursue his dream as a university professor in the United States. He is a Fellow of ASA, an elected member of the International Statistical Institute, and a recipient of the President Research Award by CMU. He received his Ph.D. in Statistics from Iowa State University. He has spent his entire career in the Department of Mathematics, CMU. Previously, he earned his bachelor's degree in Agronomy from National Taiwan University and an MA in Mathematics from the University of West Florida. Carl has published over 100 refereed articles in methodological statistics and statistics education. He is the co-founder and Co-Chief Editor of the *Journal of Statistical Distributions and Applications.* Most of his statistics education research are the result of reflecting his teaching and students' learning that has helped greatly to transform his teaching. Besides teaching and research activities, Carl is active in statistical consulting at university and beyond. He was in charge of university statistical consulting for ten years. He is a Dow Chemical Company certified Six Sigma Black Belt and continues to be involved with consulting projects beyond university.

Response from Carl Lee

I am very honored and humbled to receive the prestigious MAA Haimo award. It feels like a dream to be included among the many outstanding teachers. I am grateful to the Department of Mathematics at Central Michigan University for providing an environment that welcomes taking risks and experimenting with various active learning strategies in our classes. I would like to thank Professor En-Bing Lin, the former Mathematics Department Chair, for his nomination and thank my colleagues for their friendships and support of tolerating my 'crazy' teaching ideas. Thank you to the students who have helped me transform my teaching methods throughout 34 years of teaching. Being a university professor was my first and only career choice since college. I am very grateful and fortunate to have received so much help from professors and colleagues since college, especially inspiration and mentoring from Professor Lu-Zi Chang of National Taiwan University for his inspiration, my dissertation advisor, Professor Oscar Kempthorne, for his high standards and total trust of his students to conduct independent research, and Professor Richard Scheaffer, former ASA President, for his openness, mentoring and support for junior scholars. Last, but not the least, my wife, Ye-Fu, for her truly amazing support and tireless effort to take care of our family.

CITATION

Jennifer Switkes

Dr. Jennifer Switkes of California State Polytechnic University Pomona is recognized for bringing her educational core values of excellence, honor, integrity, love, and purpose to all students, and specifically to traditionally underserved students.

Dr. Switkes makes extensive use of projects in her courses and always includes some content that forces the students to address issues not specifically asked for. Students extend and apply the concepts and algorithms that have been learned in class to large-scale and hands-on problems. The inclusion of a research component allows the students to challenge themselves and gives them an opportunity to see how mathematical research can be conducted. As a former student describes her experience with Dr. Switkes' methods, "During this time we expanded a recently developed iterative numerical integration technique to higher dimensions, programmed the method in MATLAB, and used difference equations to derive closed-form formulas for specific examples. Working on this project with Dr. Switkes introduced me to the extensive community of mathematics by presenting our work at five undergraduate research conferences and publishing a paper in *The Mathematical Scientist.* This was my first research project, and it sent me on a trajectory to become a research intern at MIT and subsequently to be accepted to MIT's Ph.D. program."

Dr. Switkes has been officially designated as a teacher-scholar by the College of Science at Cal Poly Pomona. She has directed thirteen master's theses and twelve undergraduate research projects during the past thirteen years. Twelve research articles were published by Dr. Switkes and her student co-authors (nine of these articles were co-authored with undergraduates while three of her papers were written with graduate students). In addition to her own student undergraduate advisees, Dr. Switkes advises students on all types of questions such as grade issues, admissions, early start, curriculum, course equivalency, teacher preparation, mathematics placement, and more. Her academic service roles include Associate Chair, Scheduling Coordinator, and service on departmental committees such as Search Committee, Retention/Tenure/Promotion Committee, Lecturer Interview Committee, and others. Dr. Switkes not only teaches her students mathematics, but how to improve their study habits and grade performance, career information, what a mathematician does at professional conferences, how to write articles, and more.

Professor Switkes' teaching efforts in mathematics extend well beyond Cal Poly Pomona classrooms. She has a missionary dedication in her desire to volunteer to teach underserved student populations. A few years ago, she began teaching calculus at the California Rehabilitation Center in Norco, CA, through the Prison Education Project, a large-scale project founded and led by Cal Poly Pomona Political Science Professor Renford Reese. Serving with the Prison Education Project, Professor Switkes developed strategies to focus the students' attention on the big ideas of calculus, even though she didn't know if she would have the same students week after week.

One challenge in the calculus classes was that some of the inmates knew some calculus already while others had never seen it. She realized that it would be very unlikely that any of the students at the prison had learned graph theory before, leading to a graph theory class in which everyone, regardless of background, was starting at about the same level. She loved showing the inmates unsolved problems or recent work in graph theory. Her extraordinary experiences teaching graph theory in prison were described in the October/November 2016 issue of *MAA Focus.*

Dr. Switkes has a special affinity for Uganda, and she was happy to spend her Fall 2013 sabbatical there. There she taught a semester of differential equations to two large classes of students at Makerere University in Kampala. In 2015, she also continued her work in prisons by teaching in the Luzira Upper Prison in Uganda with the Prison Education Project. Dr. Switkes has since extended her prison work with the Prison Education Project by creating a Math/Science Forum at the California Rehabilitation Center, and she has invited STEM faculty from Cal Poly Pomona to give guest lectures there during several terms.

Her nominating MAA Section writes, "In 2012, Dr. Switkes obtained independent validation of her teaching methods and results when she received the 2012 College of Science Distinguished Teaching Award. In her wonderful Distinguished Teaching Award Seminar (October 18, 2012), Dr. Switkes gave an insight into her philosophy of teaching and some of the core values that characterize her educational vision....Her thoughts are profound and clearly reflect the considerations and planning of a seasoned educator who has given careful thought concerning what her goals are for her students and how to best achieve these objectives. In her seminar, Dr. Switkes skillfully demonstrated how she has developed and refined class projects into meaningful and enriching learning experiences. Dr. Switkes' success with class projects has influenced many of our junior faculty and lecturers to experiment with class projects as a way to encourage deeper student learning and as a natural gateway to undergraduate research experiences."

The MAA recognizes the great positive impact Dr. Jennifer Switkes has had on mathematics education at her own institution, regionally, and internationally and is honored to present her with the Deborah and Franklin Tepper Haimo Award for Distinguished College or University Teaching of Mathematics.

Biographical Note

Jennifer Switkes received a B.S. from Harvey Mudd College in 1994, an M.S. from Claremont Graduate University in 1996, and a Ph.D. from Claremont Graduate University in 2000. Her dissertation in mathematical biology was conducted with Dr. Michael Moody. After teaching briefly at Citrus College and at the University of Redlands, she joined the tenure-track faculty at California State Polytechnic University in 2001 and has been teaching there ever since. Her primary mathematical interests are in mathematical modeling and operations research. She is passionate about teaching, mentoring, and providing research experiences for first-generation and underrepresented college students. In recent years, she has volunteered extensively with the Prison Education Project, teaching mathematics and leading STEM faculty seminars at a prison in Southern California. She also is passionate about serving in Uganda, where she spent a sabbatical at Makerere University in Kampala, taught mathematics at a prison in Kampala, and has done a variety of other humanitarian work. In addition to her work at Cal Poly Pomona, she serves as a volunteer pastor at a church focusing on community service and mentoring of leaders. In her spare time, she loves hiking and camping.

Response from Jennifer Switkes

I am very honored to receive the MAA Haimo Award. I love what I do, teaching and mentoring students at California State Polytechnic University, Pomona. I have been at our university for over seventeen years, and still, I approach each new term with a sense of joy and amazement that I have the privilege of working and serving here. I feel blessed to teach and share life with our amazing, diverse, kind, and gifted community of undergraduate students, graduate students, staff, faculty, and administration. They make Cal Poly Pomona the incredible place that it is. I especially thank current department chair Dr. Berit Givens, along with recent department chairs Dr. Alan Krinik and Dr. Michael Green, and previous department chairs Dr. Barbara Shabell and Dr. Claudia Pinter-Lucke, for encouraging and empowering me every day of my career here. Thank you very much to the MAA for this recognition of my work and our work together.

Yueh-Gin Gung and Dr Charles Y. Hu Award for Distinguished Service to Mathematics

The Gung and Hu Award for Distinguished Service to Mathematics, first presented in 1990, is the endowed successor to the Association's Award for Distinguished Service to Mathematics, first presented in 1962. This award is intended to be the most prestigious award for service offered by the Association. It honors distinguished contributions to mathematics and mathematical education—in one particular aspect or many, and in a short period or over a career. The initial endowment was contributed by husband and wife, Dr. Charles Y. Hu and Yueh-Gin Gung. It is worth noting that Dr. Hu and Yueh-Gin Gung were not mathematicians, but rather a professor of geography at the University of Maryland and a librarian at the University of Chicago, respectively. They contributed generously to our discipline, writing, "We always have high regard and great respect for the intellectual agility and high quality of mind of mathematicians and consider mathematics as the most vital field of study in the technological age we are living in."

Citation

Dr. Philip Uri Treisman

The Gung and Hu Award for Distinguished Service to Mathematics is the most prestigious award for service offered by the Mathematical Association of America. It honors service to mathematics that has been widely recognized as extraordinarily successful, influencing the field of mathematics or mathematical education in a significant and positive way on a national scale.

The 2019 Gung and Hu Award award goes to Dr. Uri Treisman for his extraordinary leadership in strengthening mathematics and science education throughout the K-20 spectrum, supporting mathematics achievement and equity for historically disenfranchised groups, and promoting innovation, productive partnerships, and community service.

Uri completed his higher education in California, including a B.A. in mathematics, summa cum laude, from UCLA, and an MA in mathematics and an interdisciplinary Ph.D. from UC Berkeley under the direction of Leon Henkin. He taught at Swarthmore College as the E. M. Lang Visiting Professor of Mathematics and Social Change and provided senior leadership for the Professional Development Program (PDP) at UC Berkeley before joining the faculty at The University of

Texas at Austin (UT) as a professor of mathematics in 1991. He is currently a University Distinguished Teaching Professor, professor of mathematics, and professor of public affairs at UT. Uri also is the founder and the executive director of the University's Charles A. Dana Center for Mathematics and Science Education.

Although Uri's influence and leadership in mathematics education are far-reaching, he may be best known for his seminal research on factors that support high achievement for students historically disenfranchised in mathematics which earned him the 1987 Charles A. Dana Award for Pioneering Achievement in American Higher Education. Based upon his research, he and his collaborators created what is now commonly known as Emerging Scholars Programs to counter barriers to success he identified in his research. Emerging Scholars Programs have now been replicated and adapted at hundreds of institutions nationwide to focus on equity and high achievement in mathematics (e.g. calculus, precalculus, college algebra) and other sciences (e.g. chemistry, physics, biology). He was named a 1992 MacArthur Fellow to recognize his innovative work in improving postsecondary mathematics instruction, especially for ethnic minority students.

Uri has received numerous awards and recognition for his leadership and research efforts. In December 1999, he was named one of the outstanding leaders in higher education in the twentieth century by the magazine *Black Issues in Higher Education*. The next year, he received a Lifetime Achievement Award from the Center for the Study of Diversity in Teaching and Learning in Higher Education. He received the Founder's Award in 2004 from AVID (Advancement Via Individual Determination) for his role in helping to launch that organization as a national non-profit working to broaden participation of low-income and ethnic minority students in higher education. In 2006, the Harvard Foundation of Harvard University named him "2006 Scientist of the Year" for his notable achievements in mathematics and particularly for his efforts to advance minorities and women in the sciences. In 2015 and 2016, respectively, Uri was recognized by the National Council of Supervisors of Mathematics with the Kay Gilliland Equity Lecture Award and the Ross Taylor/Glenn Gilbert National Leadership Award. Also in 2016, he received the American Mathematical Association of Two-Year Colleges (AMATYC) Mathematics Excellence Award and the E^3 Alliance (Education Equals Change Alliance) Catalyst for Educational Change Award. This list is not exhaustive but gives a glimpse of the regard for Uri's work across a broad cross-section of American education.

From 1994 to 2004, Uri served as executive director of the Texas Statewide Systemic Initiative, a $15.8 million effort to reform science and mathematics education for all students in the state. The work encompassed reform of curriculum and assessment, changes in teacher professional development, and support for the implementation of the then newly adopted Texas Essential

Knowledge and Skills (TEKS) in mathematics and science. The Dana Center's leadership in the crafting of the TEKS, which was approved by the Texas State Board of Education in 1997, and the design of the extensive teacher professional development (e.g. Texas Teachers Empowered for Achievement in Mathematics and Science (TEXTEAMS) needed for implementation of the new standards is broadly credited for the sustained growth in student achievement over the following decade. In 2004, the Dana Center, working with Achieve, Inc., created the Urban Mathematics Leadership Network (UMLN), a network of six large school districts in six states working together to develop new approaches to challenging problems of urban math education. By 2008, the UMLN had grown to twenty-two districts serving almost half of all urban school children in the U.S. Uri worked to connect national networks in urban education including networks of chief academic officers (the Aspen Institute's CAO Network), directors of literacy (Aspen's Urban Literacy Leadership Network), and directors of mathematics (UMLN) to form the Urban District Leadership Network in 2010.

As a founding member of Transforming Post-Secondary Education in Mathematics (`tpsemath.org`) and as a representative of the American Mathematical Society to the American Association for the Advancement of Science, Uri is now working to increase the effectiveness and reach of grassroots mathematics education leaders and to support their efforts to improve STEM education at scale. As one of the principal architects of the multiple math pathways movement, Uri is engaged in a wide variety of efforts to modernize postsecondary gateway mathematics courses and to address systemic barriers to ethnic minority and rural student success in higher education. He played a central role in developing the Statway/Quantway projects and the Dana Center's Mathematics Pathways Initiative (`dcmathpathways.org`). With his Dana Center colleagues, he has helped organize and lead state postsecondary math task forces in a dozen states.

Over four decades, Uri has served on numerous advisory boards and steering committees focused on improving mathematics education in the US. He served three consecutive three-year terms as President of COMAP's Board of Directors. Most recently he has served on the leadership team for MAA's Common Vision 2025 project, which brought together leaders from five professional associations in the mathematical sciences—AMATYC, AMS, ASA, MAA, and SIAM—to collectively consider ways to improve undergraduate curricula and education in the mathematical sciences. He has also served as an advisory board member for MAA's Instructional Practices Guide project, which shares effective, evidence-based practices instructors can use to facilitate meaningful learning for students of mathematics, and on the Conference Board for the Mathematical Sciences (CBMS) Research Advisory group that aims to inform policy decisions that affect mathematics education.

Uri has served since 2013 as a Distinguished Senior Fellow at the Education Commission of the States, where he helps formulate guidance to state legislative and governance officials on matters related to STEM education. He served two terms on the Texas Governor's Commission on Volunteerism and Community Service, where he was an advocate for community-based efforts to improve the education of children living in challenging circumstances. He also serves as chair of Strong Start to Finish, a joint initiative of the Bill & Melinda Gates Foundation, the Kresge Foundation, and the Great Lakes Higher Education Guaranty Corporation that supports improvement at scale in postsecondary gateway mathematics instruction. He has served on the STEM working group of the President's Council of Advisors on Science and Technology, on the 21st-Century Commission on the Future of Community Colleges of the American Association of Community Colleges, and on the Commission on Mathematics and Science Education of the Carnegie Corporation of New York Institute for Advanced Study.

Uri not only serves at a national level but also continues a commitment to his own teaching at UT. Each fall, he teaches a freshman-level calculus class of 120 students and takes great effort to connect with students as a teacher and mentor despite the large class size. He "practices what he teaches" by effectively incorporating active learning methods, coupled with the appropriate challenge, in his teachings that are consistent with his advocacy and nationwide leadership work. In 2011, he received the Texas Exes Teaching Award and he has been a member of the Academy of Distinguished Teachers at UT since 2015. In 2016, he was named a Minnie Stevens Piper Professor, one of only ten professors in Texas selected each year for their superior teaching. In 2017, he received the prestigious UT System Regents' Outstanding Teaching Award. After over thirty years of teaching at the college level, Uri continues to be recognized as an outstanding teacher and mentor.

The breadth of Uri Treisman's reach as a leader and researcher in mathematics education spans K–12 education networks, community college networks, and organizations such as AMATYC, policy-making entities such as the Policy and Priorities Committee of the Education Commission of the States and National Center for Public Policy in Higher Education, the American Mathematical Society, and the Mathematical Association of America. His capacity to identify common goals among these groups and to help them capitalize on potential synergies is extraordinary and contributes to collective action around systemic change. The MAA is pleased to present the MAA's 2019 Yueh-Gin Gung and Dr. Charles Y. Hu Award for Distinguished Service to Mathematics to Uri Treisman.

Biographical Note

Dr. Philip Uri Treisman graduated from Erasmus Hall High School in Brooklyn in 1964 and then moved to Israel to join a kibbutz and become a farmer. An unhappy encounter with a pit viper ended that career trajectory and he returned to the U.S. in 1965. He attended several two- and four-year colleges in Southern California while working as a gardener, landscape designer, community organizer, and occasional auto mechanic. With the constant encouragement of a community college math teacher, Jack Stutesman, he transferred to UCLA. In 1969, he earned his baccalaureate degree, summa cum laude, and received the math department's Sherwood Prize. While pursuing his doctoral studies at Berkeley, his dissertation advisor, Leon Henkin, encouraged him to become involved in the work of the Special Opportunity Scholarship Committee of the Academic Senate, Berkeley Division, which was charged with increasing the participation of women and minorities in the wide range of academic disciplines in which they were underrepresented. Working initially as Henkin's apprentice on the Committee's projects shaped Uri's research and profession service commitments. He continued to work for the Committee after he completed his dissertation until 1990 when he became E. M. Lang Visiting Professor of Mathematics and Social Change at Swarthmore College. He has been at UT Austin since 1991. There, he is University Distinguished Teaching Professor, professor of mathematics, professor of public affairs, and director of the University's Charles A. Dana Center for Mathematics and Science Education.

Response from Dr. Philip Uri Treisman

There is no shortage of opportunities for humility for those who work in mathematics or mathematics education, but this award brings with it not only humility but wonderful memories and an opportunity to express the profound debt I owe to so many previous recipients. My teacher and mentor, Leon Henkin, received the award in 1990. Over the course of my career, I've been privileged to work on projects or serve on committees led by twenty of the twenty-eight subsequent recipients, of course, as a very junior member in the early years. They have been bright lights that have helped me navigate my career and shape my life as a teacher. I thank the award selection committee for the honor it has bestowed on me.

LOUISE HAY AWARD FOR CONTRIBUTION TO MATHEMATICS EDUCATION

THE Executive Committee of the Association for Women in Mathematics (AWM) established the Louise Hay Award for Contribution to Mathematics Education in 1990. The purpose of this award is to recognize outstanding achievements in any area of mathematics education, to be interpreted in the broadest possible sense. While Louise Hay was widely recognized for her contributions to mathematical logic and for her strong leadership as head of the Department of Mathematics, Statistics, and Computer Science at the University of Illinois at Chicago, her devotion to students and her lifelong commitment to nurturing the talent of young women and men secure her reputation as a consummate educator. The annual presentation of this award is intended to highlight the importance of mathematics education and to evoke the memory of all that Hay exemplified as a teacher, scholar, administrator, and human being.

CITATION

Jacqueline Dewar

The AWM presents the 2019 Louise Hay Award to Jacqueline Dewar of Loyola Marymount University in Los Angeles (LMU) in recognition of her many achievements as a professor, a leader in outreach, and a contributor to the scholarship of teaching and learning (SoTL). Her peers and students praise her as a teacher, mentor, and scholar.

With a Ph.D. in mathematics, she served LMU for forty years. She advocated for active learning, initiated a biomathematics program, and developed courses in computer literacy, the history of women in mathematics, and mathematics in civic engagement. Her mentoring continues past graduation: in one notable case she guided a career that moved from classroom teaching, into grants management, then to doctoral study and a post-secondary faculty position.

She shares her expertise in mathematics and teaching with students and teachers widely. In 1978 she was a cofounder of the Math Science Interchange in Los Angeles, which still provides an annual career day, “Expanding Your Horizons-LA”, for K–12 students and teachers. Thousands of girls and their teachers have attended these events. Dr. Dewar still leads workshops and trains other leaders. She was a major contributor to an NSF-funded collaboration among five four-year colleges and five community colleges to enhance preparation of mathematics and science teachers. This project's initiatives persist and have been replicated.

Dr. Dewar received the LMU President's Award for distinguished teaching and the MAA's Haimo Award. One indicator, among many, of scholarly leadership is her selection as co-editor of *Mathematics Education: A Spectrum of Work in Mathematical Sciences Departments*, published by Springer in 2016.

Response from Jacqueline Dewar

I feel very honored to receive the Louise Hay Award for Contribution to Mathematics Education. I never had the good fortune to meet Louise Hay in person, but I definitely recall reading her autobiographical essay—"How I became a mathematician (or how it was in the bad old days)"—when it first appeared in the September–October 1989 issue of *The Association for Women in Mathematics Newsletter*. Her life story and bravery touched and encouraged me then and did so again recently when I re-read her essay.

No one makes a contribution to something as complex as mathematics education all alone. Over my career I have benefitted from the collaboration and support of colleagues in many locations: at my home institution Loyola Marymount University and at nearby institutions, in the Association for Women in Mathematics, the Carnegie Scholars Program, and the Mathematical Association of America, and throughout the larger mathematics community. I want to thank my colleagues and my former students for the many things I learned from them. It has been a privilege to do work in mathematics education in their company.

M. GWENETH HUMPHREYS AWARD FOR MENTORSHIP OF UNDERGRADUATE WOMEN IN MATHEMATICS

THE award is named for M. Gweneth Humphreys (1911–2006). Professor Humphreys graduated with honors in mathematics from the University of British Columbia in 1932, earning the prestigious Governor General's Gold Medal at graduation. After receiving her master's degree from Smith College in 1933, Humphreys earned her Ph.D. at age twenty-three from the University of Chicago in 1935. She taught mathematics to women for her entire career, first at Mount St. Scholastica College, then for several years at Sophie Newcomb College, and finally for over thirty years at Randolph–Macon Woman's College. This award, funded by contributions from her former students and colleagues at Randolph–Macon Woman's College, recognizes her commitment to and her profound influence on undergraduate students of mathematics.

CITATION

Suzanne Weekes

The Association for Women in Mathematics is pleased to present its ninth annual M. Gweneth Humphreys Award to Professor Suzanne Weekes, a prominent applied mathematician at Worcester Polytechnic Institute (WPI) whose specialties include dynamic materials, numerical methods, and computational fluid dynamics. Weekes has served on the WPI faculty since 1998, where she's been a student favorite, supervising a long list of undergraduate (and a few graduate) research projects. This is only a small part of a truly impressive record of outreach and mentorship, including an unusually broad range of commitments outside of her home university. Notably, Weekes is a founding director and has offered a strong shaping hand in the deeply impactful MSRI-UP program, devoted to "cultivating heretofore untapped mathematical talent" with a focus on communities traditionally underrepresented in mathematics. Over her tenure at MSRI-UP, over eighty women, including more than fifty women of color, have passed through the program, with the majority continuing to graduate programs after college.

Current and former students had a range of moving tributes to offer: "Being randomly assigned to Professor Weekes as my academic adviser was most likely the best thing that could have ever happened to me here at WPI. Through her guidance and encouragement, I have discovered SIAM, traveled to my first mathematics conference, received a research grant, and will be presenting said research on an international scale. Because of her enthusiasm and belief in me, she has helped me achieve things I never thought were imaginable during my undergraduate career."

One student who writes of her struggles with self-doubt continues, "Although I had support and encouragement from various professors, none quite gave me the confidence and honest feedback like Prof. Weekes."

Another, musing on the importance of role models, notes: "I didn't even know that it mattered that I had no female mentors, until I really knew Suzy."

Finally, one student put it simply and powerfully: "Prof. Weekes was our champion."

For her exceptional track record of support, guidance, unvarnished feedback, and inspiration, the AWM proudly recognizes Suzanne L. Weekes.

Response from Suzanne Weekes

I am humbled and thrilled to receive the 2019 Humphreys Award from the AWM. Thank you to my colleague, Sarah Olson, who nominated me for the award and to my colleagues and students who wrote in support of my nomination. I am fortunate to have spent the majority of my faculty career at Worcester Polytechnic Institute, a university where undergraduate research projects and undergraduate advising are a central part of its academic plan. Also, through my work in our summer REU program and the Mathematical Sciences Research Institute Undergraduate Program (MSRI-UP), I have been able to work with students beyond my home institution.

It is a joy to do work with our young women and to help make sure that our community is a rich, welcoming, and healthy place for those who dwell with us and for those who are passing through. It is a privilege to help our students work toward their own professional goals, to give them work and life advice (solicited and unsolicited), and to see them go off on their own amazing journeys. Thank you to all of my students who have given me the honor of learning from you, growing with you, and walking part of the way with you.

Joan & Joseph Birman Research Prize in Topology and Geometry

The Executive Committee of the Association for Women in Mathematics established the AWM-Birman Research Prize in Topology and Geometry in 2013. First presented in 2015, this prize is awarded every other year. The purpose of the award is to highlight exceptional research in topology/geometry by a woman early in her career. The field will be broadly interpreted to include topology, geometry, geometric group theory, and related areas. Candidates should be women, based at U.S. institutions who are within 10 years of receiving their Ph.D. or having not yet received tenure, at the nomination deadline.

The AWM-Joan & Joseph Birman Research Prize in Topology and Geometry serves to highlight to the community outstanding contributions by women in the field and to advance the careers of the prize recipients. The award is made possible by a generous contribution from Joan Birman whose work has been in low dimensional topology and her husband Joseph who is a theoretical physicist whose specialty is applications of group theory to solid state physics.

Citation

Kathryn Mann

The 2019 Joan & Joseph Birman Research Prize in Topology and Geometry is awarded to Kathryn Mann for breakthrough work in the theory of dynamics of group actions on manifolds.

Mann uses a broad array of mathematical tools to obtain results at the juncture of topology, group theory, geometry, and dynamics, and she finds new connections between them. She has discovered new phenomena, built general theory, and has solved long-open problems. As an example, in a solo paper she introduced a new method to study the topology of the space of surface group representations in the space of orientation-preserving circle homeomorphisms and to prove a rigidity result about geometric such representations. Building on this paper, jointly with M. Wolff, Mann proved that conversely this rigidity property characterizes the geometric surface group actions on the circle. A leading expert describes this as one of the best results obtained in the area in the last couple of decades and another mathematician describes Mann as “that once-in-a-generation thinker who opens significant new directions for research.”

Kathryn Mann received her Ph.D. in 2014 from the University of Chicago. During 2014–2017, she was a Morrey Visiting Assistant Professor and an NSF postdoctoral fellow at the University of California at Berkeley. She now holds a Manning Assistant Professorship of Mathematics at Brown University.

Response from Kathryn Mann

I am very honored to be selected for the Birman research prize, and deeply grateful to Joan and Joseph Birman for their support in establishing the award with the AWM. I had the pleasure of meeting Joan last fall, after many years of knowing her work. I realize now how fortunate I was to "grow up" mathematically in a field in which Joan Birman was a household name.

I'd like to take this opportunity to thank the many mentors I have had—first and foremost my advisor Benson Farb, and the surrounding community at the University of Chicago. It was there that I first encountered the kind of questions in geometry and dynamics that continue to fascinate me. Though too many to list here, I am indebted to all those I have looked up to and who serve as a continuing source of inspiration: mentors, collaborators, and mathematical friends. I'm very grateful also to my current colleagues at Brown for giving me such a warm welcome and an immediate show of support.

American Mathematical Society
Mathematical Association of America
Society for Industrial and Applied Mathematics

Frank and Brennie Morgan Prize

The Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student recognizes and encourages outstanding mathematical research by undergraduate students. It was endowed by Mrs. Frank Morgan of Allentown, PA.

Citation

Ravi Jagadeesan

The recipient of the 2019 AMS-MAA-SIAM Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student is Ravi Jagadeesan of Harvard University. Jagadeesan was selected as the winner of the Prize for "[his] fundamental contributions across several topics in pure and applied mathematics, including algebraic geometry, statistical theory, mathematical economics, number theory, and combinatorics" from a pool with outstanding candidates that impressed the selection committee. His papers have been published or accepted for publication in journals such as *Proceedings of the London Mathematical Society*, *Electronic Journal of Combinatorics*, *Research in Number Theory*, *American Economic Journal: Microeconomics*, and *Games and Economic Behavior*. Additionally, he has presented three papers at the Association for Computing Machinery Conference on Economics and Computation.

Jagadeesan's research in mathematics began early, when he published combinatorics papers on pattern avoidance for permutations in the context of (i) alternating permutations and (ii) Young's diagrams and tableaux (joint with Nihal Gowravaram). Then, he went on to derive a new invariant for the action of the absolute Galois group of $\mathbb{Q}$ on the set of isomorphism classes of the so-called *dessins d'enfants* (children's drawings). In another paper, he gave a new proof of Serre's characterization of regular local rings (joint with Aaron Landesman). At Harvard, he has worked on the birational geometry of elliptic fibrations and its connections to the combinatorics of hyperplane arrangements. His resulting award-winning senior thesis and three related papers (joint with Mboyo Esole, Steven Jackson, Monica Kang, and Alfred Noël) lie at the interface of algebraic geometry, combinatorics, and string theory.

Jagadeesan's work in mathematical economics is in the fields of matching theory, market design, and public finance. In the view of his references, he brings deep mathematical insights and connections from multiple areas to the table.

His papers in matching theory (joint with Tamás Fleiner, Zsuzsanna Jankó, Scott Kominers, Ross Rheingans-Yoo, and Alex Teytelboym) leverage topological fixed-point theorems and ideas from general equilibrium to yield insights into the structure of equilibria in markets with frictions. His work in market design streamlined the analysis of proposed market-clearing mechanisms and clarified the role of key mathematical assumptions. His paper on optimal taxation with an endogenous growth rate is described as being an important contribution to theoretical public finance.

In addition to the above work, Jagadeesan has extended Ramsey theory via quasi-colorings to write a paper on causal statistical inference in the presence of an underlying graph or a network. Regarding this contribution, a reference letter writer states that they were most satisfied by Jagadeesan's "harnessing the beauty and power of mathematics to find structure in a messy real-world problem…making fundamental progress on an important problem of our times." Indeed, the committee members felt that this statement could be applied as well to much of Jagadeesan's work in economics and other areas. Case in point: he has used ideas from category theory to co-author a Python library, *Matriarch*, for biomaterials architecture (joint with Tristan Giesa, David Spivak, and Markus Buehler).

Biographical Note

Ravi Jagadeesan grew up in Naperville, IL. His interest in mathematics was inspired at a young age by his grandparents—all four of them mathematicians—and his parents—who are both computer scientists. He attended Phillips Exeter Academy in Exeter, NH for high school, where he had the opportunity to take advanced courses in mathematics and develop his problem solving skills. He graduated from Harvard with an A.B. *summa cum laude* in mathematics (with a minor in economics) and with an A.M. in statistics.

He had the opportunity to work in several different areas of pure and applied mathematics—including algebraic geometry, combinatorics, number theory, statistical theory, and mathematical economics—under a host of advisers. His first experience with mathematical research was during high school, when he was a student in the MIT math department's Program for Research in Mathematics, Engineering, and Science (PRIMES). He then became interested in exploring applied work, and spent summers working on research in applied mathematics at the Center for Excellence in Education's Research Science Institute (RSI) at MIT and as an Economic Design Fellow at the Harvard Center of Mathematical Sciences and Applications (CMSA). He is currently a student in

Harvard's Ph.D. program in Business Economics, where he is a National Science Foundation Graduate Research Fellow.

Jagadeesan earned a gold medal at the International Mathematical Olympiad in 2012 and was named a Putnam Fellow in 2014. He received Harvard's Jacob Wendell Scholarship Prize, and his senior thesis on "Crepant resolutions of $\mathbb{Q}$-factorial threefolds with compound Du Val singularities" was awarded the Thomas Temple Hoopes Prize.

Outside of mathematics and economics, he enjoys dancing and is a member of the Harvard Ballroom Dance Team.

Response from Ravi Jagadeesan

It is a great honor to receive the 2019 AMS-MAA-SIAM Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student. I would like to thank Mrs. Morgan, as well as the AMS, MAA, and SIAM, for establishing this prize and for recognizing me.

I would also like to thank my many mentors—Markus Buehler, Noam Elkies, Mboyo Esole, Pavel Etingof, Zuming Feng, John Geanakoplos, Tristan Giesa, Jerry Green, Joel Lewis, Akhil Mathew, Natesh Pillai, John Rickert, David Spivak, Stefanie Stantcheva, Alex Teytelboym, Alex Volfovsky, Shing-Tung Yau, and, especially, Scott Kominers—for their advice and support over the years.

I am grateful to the MIT Program for Research in Mathematics, Engineering and Science; the Research Science Institute; and the Harvard Center of Mathematical Sciences and Applications for providing excellent work environments.

I am also grateful for research and travel grants from Harvard Business School, the Harvard College Research Program, and the Harvard math department. Most of all, I would like to thank my family—including my wonderful grandparents, parents, and sister—for their love and support.

Citation

Evan Chen

Evan Chen is recognized with an Honorable Mention for the 2019 Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student. He has authored many papers in combinatorics and number theory, some as a single author and some in collaboration. He has papers accepted to *Proceedings of the AMS, Electronic Journal of Combinatorics, Research in Number Theory,* and the *International Journal of Number Theory.* In joint work, he proved an elliptic curve version of Linnik's Theorem. He answered an open question on balance constants of posets, and in joint work made progress on the long-studied problem of classification of Wilf-equivalence classes of patterns. He is currently a Ph.D. student at MIT, where he is supported by an NSF Graduate Fellowship.

Biographical Note

Evan Chen was born and raised in California, and completed his undergraduate degree in Cambridge, MA. He is currently pursuing a Ph.D. in mathematics at MIT, supported by an NSF fellowship.

Besides research, Evan is deeply involved in the training of the USA team for the International Math Olympiad (IMO), after having won a gold medal himself in high school. Among other roles, he is the assistant academic director for the USA's training camp and the coordinator for the USA team selection tests. He is also the current chief of staff for the Harvard-MIT math tournament and the author of a popular MAA-published book in competitive geometry. Outside of math and teaching, Evan enjoys board games and Korean pop dance.

Response from Evan Chen

It is a wonderful privilege to receive an Honorable Mention for the 2019 Frank and Brennie Morgan Prize. I would like to thank Mrs. Morgan and the AMS, MAA, and SIAM for their generosity and support of undergraduate research.

I would like to acknowledge and thank Joe Gallian and Ken Ono for their mentorship and support during my undergraduate years. The three summers I spent at these REU programs were immensely productive learning and research experiences, and contributed greatly to my development. I am also deeply grateful for their encouragement and advice.

I would also like to extend thanks to my professors and teachers from the past several years, with particular thanks to Zuming Feng, Po-Shen Loh, Zvezda Stankova, and Yan Zhang. Finally I would like to thank my family and friends for their constant care and support.

CITATION

Huy Tuan Pham

Huy Tuan Pham is recognized with an Honorable Mention for the 2019 Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student. He has jointly authored several papers in additive combinatorics. These papers comprise his undergraduate thesis, for which he won the Kennedy Thesis Prize at Stanford University. Two of his papers have been accepted to the *International Mathematical Research Notices* and *Discrete Analysis.* His work uses tools from combinatorics, number theory, and analysis to show that tower-type bounds are needed in some natural applications of Szemeredi's regularity method, including Green's generalization of Roth's theorem for popular difference. He is currently at the University of Cambridge supported by a Trinity Studentship, and will start his Ph.D. studies at Stanford this fall.

Biographical Note

Huy Tuan Pham was born and raised in Chi Minh City, Vietnam. After finishing high school at High School for the Gifted-Vietnam National University Ho Chi Minh City, he attended Stanford University, where he received a BS in Mathematics with Honors and a minor in Computer Science, and an MS in Statistics. He is now at Cambridge University pursuing Part III of the Mathematical Tripos, and will return to Stanford University for his Ph.D.

Huy's initial interest in combinatorics was developed during Olympiad trainings in Vietnam. Since his sophomore year, he has been working with Professor Jacob Fox on probabilistic and additive combinatorics. He plans to continue his study of combinatorics and probability in his Ph.D.

Response from Huy Tuan Pham

I am honored to receive the Honorable Mention for the 2019 Frank and Brennie Morgan Prize. I would like to thank Mrs. Frank Morgan and the AMS, MAA, and SIAM for sponsoring this meaningful award. I am extremely thankful to my advisor Jacob Fox for his help and support throughout my undergraduate years, which has shaped my passion and understanding of combinatorics. I am also grateful to Professor Yufei Zhao, who has given me useful advice throughout our collaboration. I am fortunate to have learned great mathematics from Stanford math professors, particularly Professors Amir Dembo, Persi Diaconis, Andrea Montanari, Lenya Ryzhik, Ravi Vakil, and Jan Vondrak. Last but not least, I would like to thank my family and friends for their support, especially to my friend Phan-Minh Nguyen, who has provided me with tremendous encouragement and insights through our endless conversations in mathematics and statistics.

COMMUNICATIONS AWARD

THE JOINT POLICY BOARD FOR MATHEMATICS (JPBM) established its Communications Award in 1988 to reward and encourage journalists and mathematicians who, on a sustained basis, bring mathematical ideas and information to nonmathematical audiences. The award recognizes a significant contribution or accumulated contributions to the public understanding of mathematics, and it is meant to reward lifetime achievement. JPBM represents the American Mathematical Society, the American Statistical Association, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics.

CITATION

Margot Lee Shetterly

The 2019 JPBM Communications Award is presented to Margot Lee Shetterly for her book and subsequent movie *Hidden Figures,* which opened science and mathematics to a new generation of women and people of color by bringing into the light the stories of the African-American women who made significant contributions to aeronautics and astronautics, and, ultimately, to America's victory in the Space Race.

Biographical Note

Margot Lee Shetterly is a writer, researcher, and entrepreneur. She is the author of *Hidden Figures: The American Dream and the Untold Story of the Black Women Mathematicians Who Helped Win the Space Race*, which was a top book of 2016 for both *TIME* and *Publisher's Weekly*, a *USA Today* bestseller, and a #1 *New York Times* bestseller. Shetterly is also the founder of the Human Computer Project, a digital archive of the stories of NASA's African-American "Human Computers" whose work tipped the balance in favor of the United States in WWII, the Cold War, and the Space Race. According to The *New York Times*, the 2007 film adaptation of her book introduces viewers to "real people you might wish you had known more about earlier… [who] can fill you with an outrage at the persistence of injustice and gratitude towards those who had the grit to stand up against it."

Response from Margot Lee Shetterly

Being awarded the Joint Policy Board for Mathematics Communications Award is a great honor, not just for me but for all of the women who worked as computers, mathematicians, math aides, data analysts, and engineers at the National Advisory Committee for Aeronautics (NACA) and the National Air and Space Administration (NASA) over the years. Though largely unheralded during their careers, these women provided the necessary calculations that fueled America's ascent into the Earth's atmosphere, and into space. It is my hope that they will serve as role models for current and future generations of women and men, and that they will remind us that the quest to understand the natural world is one of the most fundamental aspects of our shared humanity.

AMS-SIAM NORBERT WIENER PRIZE IN APPLIED MATHEMATICS

THE Wiener Prize is awarded for an outstanding contribution to applied mathematics in the highest and broadest sense. The American Mathematical Society and the Society for Industrial and Applied Mathematics award this prize jointly; the recipient must be a member of one of these societies. This prize was established in 1967 in honor of Professoor Norbert Wiener and was endowed by a fund from the Department of Mathematics of the Massachusetts Institute of Technology. The endowment was further supplemented by a generous donor.

CITATION

Marsha Berger

The 2019 Norbert Wiener Prize in Applied Mathematics is awarded to Marsha Berger for her fundamental contributions to Adaptive Mesh Refinement and to Cartesian mesh techniques for automating the simulation of compressible flows in complex geometry.

In solving partial differential equations, Adaptive Mesh Refinement (AMR) algorithms can improve the accuracy of a solution by locally and dynamically resolving complex features of a simulation. Marsha Berger is one of the inventors of AMR. The block-structured approach to AMR was introduced by Berger in her 1982 thesis, and from this, the Berger-Oliger algorithm and the Berger-Colella algorithm were developed by Berger, Joseph Oliger, and Phillip Colella. Berger provided the mathematical foundations, algorithms, and software that made it possible to solve many otherwise intractable simulation problems, including those related to blood flow, climate modeling, and galaxy simulation. Her mathematical contributions include local error estimators to identify where refinement is needed, stable and conservative grid interface conditions, and embedded boundary and cut-cell methods. She is part of the team that created Cart3D, a NASA code based on her AMR algorithms that is used extensively for aerodynamic simulations, and which was instrumental in understanding the Columbia Space Shuttle disaster. She also helped build GeoClaw, an open source software project for ocean-scale wave modeling. It is used to simulate tsunamis, debris flows, and dam breaks, among other applications.

Biographical Note

Marsha Berger received her Ph.D. in Computer Science from Stanford in 1982. She started as a postdoc at the Courant Institute of Mathematical Sciences at NYU, and is currently a Silver Professor in the computer science department, where she has been since 1985.

She is a frequent visitor to NASA Ames, where she has spent every summer since 1990, and several sabbaticals. Her honors include membership in the National Academy of Sciences, the National Academy of Engineering, and the American Academy of Arts and Science. She is a Fellow of the Society for Industrial and Applied Mathematics. Berger was a recipient of the Institute of Electrical and Electronics Engineers Fernbach Award, and was part of the team that won the 2002 Software of the Year Award from NASA for their Cart3D software.

Response from Marsha Berger

What a thrill to learn that I will be one of the recipients of the 2019 Norbert Wiener Prize! One of the main enjoyments I get from my research is developing tools to solve real problems in aerodynamics, tsunami modeling, etc. that others can use. This has been possible because of collaborators I have been fortunate to meet, starting with Phil Colella and Antony Jameson, and later Randy LeVeque and Michael Aftosmis, along with a number of postdocs.

I am particularly pleased that this kind of research is being recognized. The Adaptive Mesh Refinement (AMR) and Cartesian grid projects have both required the creation of new techniques in mathematics and computer science. They were decade-long efforts where I and my collaborators developed theory and algorithms, while paying attention to important practical aspects of their use in realistic geometries. Complicated algorithms have complicated implementations, and accuracy, robustness, and performance are all essential parts of the research.

CITATION

Arkadi Nemirovski

The 2019 Norbert Wiener Prize in Applied Mathematics is awarded to Arkadi Nemirovski for his fundamental contributions to high-dimensional optimization and for his discovery of key phenomena in the theory of signal estimation and recovery.

A powerful and original developer of the mathematics of high-dimensional optimization, Nemirovski, with D. Yudin, invented the ellipsoid method used by Leonid Khachiyan to show for the first time that linear programs can be solved in polynomial time. With Yurii Nesterov, he extended interior point methods in the style of Narendra Karmarkar to general nonlinear convex optimization. This foundational work established that a rich class of convex problems called semidefinite programs are solvable in polynomial time; semidefinite programs are nowadays routinely used to model concrete applied problems or to study deep problems in theoretical computational complexity. A third breakthrough, with Aharon Ben-Tal, was the invention of methods of robust optimization to address problems in which the solution may be very sensitive to problem data. Nemirovski also, and rather amazingly, made seminal contributions in mathematical statistics, establishing the optimal rates at which certain classes of nonparametric signals can be recovered from noisy data and investigating limits of performance for estimation of nonlinear functionals from noisy measurement. All in all, Nemirovski's contributions have become bedrock standards with tremendous theoretical and practical impact on the field of continuous optimization and beyond.

Biographical Note

Arkadi Nemirovski was born in 1947 in Moscow, Russia. He earned his Ph.D. (1974) from Moscow State University, under the supervision of Georgi Evgen'evich Shilov. His research areas are convex optimization (information-based complexity of convex optimization, design of efficient first order and interior point algorithms, robust optimization), and nonparametric statistics. He held research associate positions at the Moscow Research Institute for Automatic Equipment (1973–87) and the Central Economic Mathematical Institute of USSR/Russian Academy of Sciences (1987–93), and was professor at the Faculty of Industrial Engineering and Management, Technion, Israel (1993–2005). Since 2005, he holds a professorship at the H. Milton Stewart School of Industrial and Systems Engineering, Georgia Institute of Technology.

Arkadi Nemirovski was elected to the U.S. National Academy of Engineering (2017) and the American Academy of Arts and Sciences (2018); he is recipient of the Fulkerson Prize of the Mathematical Programming Society (MPS) and the AMS (1982, joint with L. Khachiyan and D. Yudin), the Dantzig Prize of MPS and SIAM (1991, joint with M. Grötschel), and the John von Neumann Theory Prize of the Institute for Operations Research and the Management Sciences (INFORMS) (2003, joint with M. Todd).

Response from Arkadi Nemirovski

I am deeply honored and grateful to receive the 2019 Norbert Wiener Prize in Applied Mathematics—a distinction I never dreamt of. As a student, I have been fortunate to be taught by brilliant mathematicians at the Mechanical and Mathematical Faculty of Moscow University, where I was mentored by Georgi Shilov. During my professional life, I had the honour and privilege to collaborate with outstanding colleagues, first and foremost, with Yuri Nesterov, Aharon Ben-Tal, and Anatoli Iouditski, to whom I am extremely grateful for their indispensable role in our joint research and for decades of friendship. I owe a lot to excellent working conditions I enjoyed at the Central Economic Mathematical Institute in Moscow, at Technion—the Israel Institute of Technology, and at Georgia Institute of Technology.

I always thought that the key word in “applied mathematics” is “mathematics”—even when all we need at the end of the day is a number, I believe that what matters most are rigorous results on how fast this number could be found and how accurate it is, which poses challenging and difficult mathematical problems. I am happy to observe how my research area—convex optimization—thrives due to the effort of new generations of researchers, and how rapidly extends the scope of its applications.

LEVI L. CONANT PRIZE

THIS prize was established in 2000 in honor of Levi L. Conant to recognize the best expository paper published in either the *Notices of the AMS* or the *Bulletin of the AMS* in the preceding five years. Levi L. Conant (1857–1916) was a mathematician who taught at Dakota School of Mines for three years and at Worcester Polytechnic Institute for twenty-five years. His will included a bequest to the AMS effective upon his wife's death, which occurred sixty years after his own demise.

CITATION

Alex Wright

The 2019 Levi L. Conant Prize is awarded to Alex Wright for his article "From rational billiards to dynamics on moduli spaces" published in 2016 in the *Bulletin (New Series) of the American Mathematical Society*.

In only sixteen pages, the article gives a panoramic view of the theory of translation surfaces and of the recent breakthrough by Alex Eskin, Maryam Mirzakhani, and Amir Mohammadi on the structure of the orbit closure of a translation surface. Wright's account combines brevity with clarity. It is a considerable feat: this active and highly technical research area comprises the work of many. The article gives non-specialists a good entry point and a guide to further reading.

The article starts with motivation from billiards inside planar polygons. The billiard dynamical system describes the motion of a particle in a domain, subject to specular reflections off the boundary. Many mechanical systems with elastic collisions, that is, collisions in which the energy and momentum are preserved, are described as billiard systems. Little is known about billiards in general polygons (for example, we still do not know whether every obtuse triangle has a periodic billiard trajectory!); the situation is considerably better understood when the angles of the polygon are π-rational, because of their relation to translation surfaces. A translation surface is a surface that is presented as a finite collection of planar polygons, glued together along pairings of parallel edges. Reflected copies of rational polygons are special examples of translation surfaces.

Through ample figures and examples, Wright gives a simple definition of translation surfaces and their moduli space, clearly explains the relation to rational billiards, and describes an action of the general linear group $GL(2, \mathbf{R})$ on the moduli space. He provides a brief survey of seminal work by Kerckhoff, Masur, Smillie, and Veech (in the 1980–90s), including the surprising result by Veech that billiards in a regular polygon share a familiar property with billiards in a square: in countably many directions, every billiard trajectory is periodic, but in every other direction, trajectories are equidistributed.

The second half of the article is devoted to the recent breakthrough by Eskin, Mirzakhani, and Mohammadi: *the closure of the $GL(2, \mathbf{R})$ orbit of a translation surface is always a manifold, defined locally by linear equations in (the standard) period coordinates.*

Wright outlines the proof and describes the relation of this theorem to other fundamental results, such as Ratner's orbit closure theorem and the high and low entropy methods of Einsiedler, Lindenstrauss, and Katok in homogeneous space dynamics. Wright also describes an intimate connection between moduli of translation surfaces and Teichmüller theory.

Several applications of the theorem are presented. For example, given a polygon and two points, x and y, inside it, the illumination problem asks whether there exists a billiard trajectory in the polygon from x to y. Recently Lelièvre, Monteil, and Weiss proved that if the polygon is rational, then for every x there are at most finitely many y not illuminated by x; this work relies heavily on the theorem of Eskin, Mirzakhani, and Mohammadi.

Over the years, a number of surveys of the theory of translation surfaces and related topics have appeared, from lengthy and detailed ones to short overviews of the subject. Wright's article is based on his talk in the "Current Events Bulletin" at the Joint Mathematics Meetings in January of 2015. It is a tribute to the work of Maryam Mirzakhani who passed away in 2017.

Biographical Note

Alex Wright received his BMath at the University of Waterloo in 2008 and his Ph.D. at the University of Chicago in 2014. He was then awarded a five year Clay Research Fellowship, which he held primarily at Stanford University. He is now at the University of Michigan. His research interests include Teichmüller theory, geometry, and dynamical systems, including special families of algebraic curves that arise in this context. He recently received the Michael Brin Dynamical Systems Prize for Young Mathematicians.

Response from Alex Wright

I'm honored to receive this recognition for my expository article on the breakthrough work of Eskin, Mirzakhani, and Mohammadi. This work lies in

Teichmüller dynamics, and yet it has remarkable connections to toy models in physics, other dynamical systems, ergodic theory on homogeneous spaces, and special families of algebraic curves. I am especially thankful to Alex Eskin and Maryam Mirzakhani for teaching me so much about the field. I'm also grateful to David Eisenbud for inviting me to speak on this topic at the Current Events Bulletin, and to Susan Friedlander for encouraging me to publish an article based on that talk.

E. H. Moore Research Article Prize

The Moore Prize is awarded for an outstanding research article to have appeared in one of the AMS primary research journals (namely, the *Journal of the AMS, Proceedings of the AMS, Transactions of the AMS, Memoirs of the AMS, Mathematics of Computation, Electronic Journal of Conformal Geometry and Dynamics,* and *Electronic Journal of Representation Theory*) during the six calendar years ending a full year before the meeting at which the prize is awarded. It was established in 2002 in honor of Eliakim Hastings Moore. Among other activities, Moore founded the Chicago branch of the American Mathematical Society, served as the Society's sixth President (1901–02), delivered the Colloquium Lectures in 1906, and founded and nurtured the *Transactions of the AMS.*

Citation

Ciprian Manolescu

The 2019 E. H. Moore Research Article Prize is awarded to the paper "Pin(2)-equivariant Seiberg-Witten Floer homology and the triangulation conjecture" by Ciprian Manolescu, published in the *Journal of the American Mathematical Society.*

This paper resolves the Triangulation Conjecture, showing that there are topological manifolds that do not admit a simplicial triangulation in each dimension greater than 4. This is achieved by introducing Pin(2)-equivariant Seiberg-Witten Floer homology to give homology cobordism invariants of oriented homology 3-spheres, including an integral lift of the Rokhlin invariant which is negated by taking the mirror image (reverse orientation). The new invariants are powerful enough to show that there does not exist a homology 3-sphere with Rokhlin invariant 1 which is homology cobordant to its mirror image. In turn, this implies the existence of non-triangulable manifolds in dimensions 5 and higher by the work of D. E. Galewski and R. J. Stern and of T. Matumoto (note that it was known before that 2- and 3-dimensional manifolds are triangulable, and there are 4-manifolds which do not admit a triangulation, thus resolving the triangulation question in all dimensions).

One expert referred to this as a "landmark article". Moreover, the techniques from the paper are already being applied to answer other questions in low-dimensional topology, for example regarding the homology cobordism groups, and inspired a related theory of involutive Heegaard Floer homology.

Biographical Note

Ciprian Manolescu was born in Romania in 1978. He received his B.A. in 2001 and his doctorate in 2004, both from Harvard University. After appointments at Princeton University, Columbia University, and the University of Cambridge, he joined the University of California, Los Angeles, where he is now a professor. He was previously awarded the Frank and Brennie Morgan Prize, a Clay Research Fellowship, and a European Mathematical Society Prize. In 2017 he became a Fellow of the American Mathematical Society, and in 2018 he gave an invited talk at the International Congress of Mathematicians.

Response from Ciprian Manolescu

I feel very honored to receive the E. H. Moore Research Article Prize from the AMS. The main result of the paper is the existence of non-triangulable manifolds in dimensions at least five. In principle a low dimensional topologist like me could have no hope of proving such a result. Luckily, in the 1970s, David Galewski, Ron Stern and Takao Matumoto managed to reduce this statement to a conjecture about the homology cobordism group in dimension three, and this is the conjecture I proved. They deserve more than half of the credit for the final theorem. I would like to thank my mentors Peter Kronheimer, Mike Hopkins, and Lars Hesselholt. With their help, during my student years at Harvard I developed a stable homotopy version of Seiberg-Witten Floer homology. I found a few applications for this construction back then, but the theory lay more or less dormant for the next decade. In 2012 I started thinking about homology cobordism, and I then realized that by incorporating an extra symmetry into my old construction I could get new information. The result was the article cited for this award. I am happy to see that, in the past few years, several young mathematicians have further developed the techniques from my paper to yield even more insight into homology cobordism. I would particularly like to acknowledge the contributions of Irving Dai, Kristen Hendricks, Jennifer Hom, Tye Lidman, Francesco Lin, Jianfeng Lin, Matt Stoffregen, Linh Truong, and Ian Zemke. It was a pleasure having some of them as collaborators and students. Finally, I want to thank my colleagues at UCLA for making the department a great place to do research.

AMS Mary P. Dolciani Prize for Excellence in Research

The AMS Mary P. Dolciani Prize for Excellence in Research recognizes a mathematician from a department that does not grant a Ph.D. who has an active research program in mathematics and a distinguished record of scholarship. It is funded by a grant from the Mary P. Dolciani Halloran Foundation. Mary P. Dolciani Halloran (1923–85) was a gifted mathematician, educator, and author. She devoted her life to developing excellence in mathematics education and was a leading author in the field of mathematical textbooks at the college and secondary school levels

Citation

Stephan Ramon Garcia

The Dolciani Prize is awarded to Stephan Ramon Garcia, W. M. Keck Distinguished Service Professor and Professor of Mathematics at Pomona College, for his outstanding record of research in operator theory, complex analysis, matrix theory, and number theory, for high quality scholarship with a diverse set of undergraduates, and for his service to the profession.

Garcia received his Ph.D. in Mathematics in 2003 from the University of California at Berkeley. He is the author of 89 research papers in several areas, including operator theory, linear algebra, complex analysis, mathematical physics, and number theory. His work has appeared in top research journals as well as top expository journals, and he has been the Principal Investigator on four NSF research grants. He has co-authored four books and is currently writing two more. Garcia has also co-authored over twenty-nine articles with undergraduates, with papers appearing in the *American Mathematical Monthly*, the *Notices of the American Mathematical Society, Proceedings of the American Mathematical Society*, and the *Journal of Number Theory*, among others. His paper "G. H. Hardy: Mathematical Biologist", written with a student, was included in the 2016 books series *The Best Writing on Mathematics*, published by Princeton University Press. Garcia currently serves as editor of the *Notices of the American Mathematical Society*, the *American Mathematical Monthly, Proceedings of the American Mathematical Society, Annals of Functional Analysis*, and the undergraduate research journal *Involve*. He serves on the Human Resources Board of the American Institute of Mathematics (AIM), whose goal is to foster diversity in the activities of AIM. He is also a member of the advisory board of REUF (Research Experiences for Undergraduate Faculty), an NSF-funded program for faculty who are interested in conducting research with underrepresented minority students, students with disabilities, and first-generation college students.

Garcia's research began with complex analysis and H^p spaces and now includes, among several other topics, operator theory on Hilbert spaces. One of his objectives is to develop models for various classes of operators. In a series of highly-cited papers published in *Transactions of the AMS* and the *Journal of Functional Analysis*, he and his co-authors pioneered the study of complex symmetric operators. Specifically, the theory behind linear transformations T that are "almost" self-adjoint by means of a conjugate-linear, isometric involution C; that is, $T = CT^*C$. Thus, the conjugation C works to express an operator in terms of its adjoint. These almost self-adjoint operators are called complex symmetric operators. Many unexpected, and highly non-normal, operators have been shown to be complex symmetric, as have several classes of familiar operators. Garcia and his colleagues have developed a structure theory for this important (and large) class of operators. They are currently developing the machinery to connect truncated Toeplitz operators and complex symmetric operators. They conjecture that every complex symmetric operator on a Hilbert space can be concretely represented in terms of truncated Toeplitz operators.

Garcia has also made significant contributions to number theory. His work in number theory has been primarily in four areas: geometric lattice theory, exponential sums, arithmetic quotient sets, and the behavior of the Euler totient near prime arguments. Exponential sums, such as Gauss sums, Kloosterman sums, Ramanujan sums and others are classical objects of study in analytic number theory. Garcia's novel approach was to view these sums from the standpoint of supercharacter theory. From this perspective, classical exponential sums can be viewed as orthogonal functions on certain abelian groups. Garcia and his co-authors (many of whom were undergraduate students) used this approach to visualize exponential sums, exhibiting some rather remarkable and visually stunning graphical features of these objects. An arithmetic quotient set is a set of fractions, a/b where a and b are elements of an infinite arithmetically-defined set. Garcia and his coauthors explored the relationship between the arithmetic properties of a set and the analytic properties of its corresponding quotient set, for example its density in the positive reals or in p-adic completions of the field of rational numbers. Concerning the Euler totient, one striking recent result of Garcia, his student Elvis Kahoro, and Florian Luca (subject to the Bateman-Horn conjecture) is that for an overwhelming majority of twin prime pairs $(p, p+2)$, the first prime p has more primitive roots than the second, $p+2$. Moreover, this is reversed for a small positive proportion of the twin primes.

Again, in these rich and deep subject areas, Garcia has been able to involve undergraduates in this work.

Biographical Note

Stephan Ramon Garcia is W. M. Keck Distinguished Service Professor and Professor of Mathematics at Pomona College. He earned his BA and Ph.D. in mathematics from UC Berkeley and was a postdoc at UC Santa Barbara. Since 2006, he has been on the faculty of Pomona College. He was recently elected a Fellow of the AMS (2019).

He is the author of over eighty-five research articles in operator theory, complex analysis, matrix analysis, number theory, discrete geometry, and other fields. Several dozen of these papers were coauthored with students, many of whom are from underrepresented groups in the mathematical sciences. Garcia has also written four books: *Introduction to Model Spaces and Their Operators* (with W. T. Ross and J. Mashreghi, Cambridge, 2016), *A Second Course in Linear Algebra* (with R. A. Horn, Cambridge, 2017), *Finite Blaschke Products and Their Connections* (with W. T. Ross and J. Mashreghi, Springer, 2018), and *100 Years of Math Milestones: The Pi Mu Epsilon Centennial Collection* (with S. J. Miller, AMS, forthcoming).

Garcia has received four NSF research grants as principal investigator and five teaching awards. He serves on the editorial boards of the *Notices of the American Mathematical Society* (2019–), *Proceedings of the American Mathematical Society* (2016–), *Involve* (2011–), *The American Mathematical Monthly* (2017–), and *Annals of Functional Analysis* (2013–). He has served on the Human Resources Board of the American Institute of Mathematics since 2008.

Response from Stephan Ramon Garcia

I am deeply honored to receive the inaugural Mary P. Dolciani Prize for Excellence in Research. Thanks go to the American Mathematical Society and the Mary P. Dolciani Halloran Foundation for initiating this award. Although I am the first recipient of this prize, there are many vibrant researchers at non-Ph.D. granting institutions who are also worthy. I look forward to celebrating the achievements of future prizewinners in the years to come.

This would not have been possible without the advice and support of my many colleagues in the profession and the members of my department. I owe a great deal of thanks to those mathematicians who mentored me during my formative years. My advisor, Donald Sarason, and my postdoctoral mentor, Mihai Putinar, are due special consideration. I also thank my innumerable coauthors, from whom I learned a great deal, and my many research students throughout the years. Finally, I wish to thank my wife, Gizem Karaali, and our children, Reyhan and Altay, for their constant support and affection.

David P. Robbins Prize

This prize was established in memory of David P. Robbins by members of his family. Robbins, who died in 2003, received his Ph.D. in 1970 from MIT. He was a long-time member of the Institute for Defense Analysis Center for Communication Research and a prolific mathematician whose work (much of it classified) was in discrete mathematics. The Prize is for a paper that reports on novel research in algebra, combinatorics, or discrete mathematics, has a significant experimental component, and is on a topic which is broadly accessible. The paper shall provide a simple statement of the problem and clear exposition of the work.

Citation

Roger Behrend, Ilse Fischer, and Matjaž Konvalinka

The David P. Robbins Prize is awarded to Roger Behrend, Ilse Fischer, and Matjaž Konvalinka for the paper “Diagonally and antidiagonally symmetric alternating sign matrices of odd order,” published in 2017 in *Advances in Mathematics*. In this work, Behrend, Fischer, and Konvalinka prove, after more than thirty years, the conjectured formula for the number of odd-order diagonally and antidiagonally symmetric alternating sign matrices, the last remaining of David Robbins’ conjectures on alternating sign matrices.

An alternating sign matrix (ASM) is a square matrix in which every entry is 0, 1, or -1, and along each row and column the non-zero entries alternate in sign and have a sum of 1. They were introduced by David Robbins and Howard Rumsey in work on a certain generalization of the determinant where these matrices surfaced naturally. Robbins, in the mid-1980s, initiated a program of counting symmetry classes of ASMs of a given size, and conjectured remarkably simple product formulae for most of these symmetry classes. The quote from his 1991 survey paper reads

“*These conjectures are of such compelling simplicity that it is hard to understand how any mathematician can bear the pain of living without understanding why they are true.*”

All had been proven by 2006, with the exception of the conjecture for diagonally and antidiagonally symmetric ASMs, which had resisted proof until the present paper.

The Robbins conjectures have led to the development of new methods of enumeration, as well as to the discovery of deep connections to statistical physics. The first breakthrough came in 1996, with the proof by Doron Zeilberger that $n \times n$ ASMs are equinumerous with totally symmetric, self-complementary plane partitions in a $2n \times 2n \times 2n$ box, for which George Andrews had derived a simple product formula. In the same year, Greg Kuperberg made the connection to statistical physics by deriving the same ASM enumeration from the Izergin-Korepin determinant for a partition function for the six-vertex model on a square grid with domain wall boundary conditions. Kuperberg subsequently used this approach to enumerate three other symmetry classes of ASMs, and the enumeration by Roger Behrend, Ilse Fischer, and Matjaž Konvalinka builds on his work.

The main technical tool introduced by Kuperberg is a set of determinant and Pfaffian formulae for ASM partition functions, and it is these formulae that explain why the enumeration formulae are products of small factors. Behrend, Fischer, and Konvalinka arrive at a partition function with a compact formula by introducing vertex weights depending on many parameters into the model. Through computational experiments, they were able to guess the form of the partition function, which of course depends fundamentally on the choice of weights. To arrive at the compact formula, they took advantage of the observation by Soichi Okada, and by Alexander Razumov and Yuri Stroganov, that partition functions associated with ASM enumeration can often be written in terms of determinants which are associated with characters of irreducible representations of classical groups. In this case the partition function turns out to be a sum of two determinants, and each determinant reduces at some point to a Schur function.

The David P. Robbins Prize is awarded to a novel research paper in algebra, combinatorics or discrete mathematics with a significant experimental component. This proof of the last remaining of David Robbins' conjectures on alternating sign matrices is a shining example. Not only is it a crowning achievement that makes use of deep methods developed by a community of researchers over more than twenty-five years, it is also a paper that makes new problems accessible.

Biographical Note

Roger Behrend was born in Melbourne, Australia. He studied mathematics and physics at the University of Melbourne and Imperial College London, receiving a Ph.D. in mathematical physics from the University of Melbourne in 1997. Between 1997 and 2000, he held postdoctoral positions at the Physics Institute of the University of Bonn and the C. N. Yang Institute for Theoretical Physics at Stony Brook University. He has worked in the School of Mathematics at Cardiff University since 2001, and held a visiting position in the Faculty of Mathematics at the University of Vienna during 2017–2018. His research throughout the past decade has been in combinatorics. Much of his spare time is spent listening to classical music.

Response from Roger Behrend

I feel deeply honored to receive the David P. Robbins Prize together with my collaborators Ilse Fischer and Matjaž Konvalinka. It is fitting that in the research recognized by this award, we proved a conjecture of Robbins himself, and that this conjecture involved alternating sign matrices, which were first encountered by David Robbins and Howard Rumsey.

I believe that our construction of a proof of Robbins' conjecture for the number of odd-order diagonally and antidiagonally symmetric alternating sign matrices lies some distance from both the beginning and the end of the overall story of alternating sign matrices. Looking back, the proof depended on a significant body of earlier work, including that of Mills, Robbins, Rumsey, Izergin, Korepin, Zeilberger, Kuperberg, Okada, Razumov, and Stroganov. Looking forward, there remain many intriguing mysteries still to be resolved. As an important example, bijective proofs are currently lacking for known equalities between numbers of alternating sign matrices and numbers of certain plane partitions.

I am thankful to my wife Rachael and to my colleagues, family, and friends for their support throughout my exploration of the fascinating world of alternating sign matrices.

Biographical Note

Ilse Fischer received her doctoral degree in 2000 from the University of Vienna under the direction of Christian Krattenthaler. After some years as a postdoctoral researcher at the University of Klagenfurt, she returned to a faculty position at the University of Vienna in 2004. In 2009 she was awarded the START prize of the Austrian Federal Ministry for Science, the most prestigious award for young researchers in Austria, and a 1.1 million euro research grant endowment. In 2017 she was promoted to full professor. Her research is devoted to enumerative and algebraic combinatorics, and its connections to statistical physics and other fields.

Response from Ilse Fischer

The idea of working on Robbins' last open conjecture on alternating sign matrices slowly manifested in my mind when I was writing a grant proposal about ten years ago, when I identified it as an ultimate, albeit unrealistic, goal. In the beginning I hardly dared spend much time on it, but every now and then I discussed it with other combinatorialists. Roger Behrend and Matjaž Konvalinka were obviously among them, but I also had a particularly fruitful exchange with Arvind Ayyer back in 2012, which led us to several conjectures on the enumeration of extreme diagonally and antidiagonally symmetric alternating sign matrices of odd order. About three years later, Arvind, Roger, and I were able to prove these conjectures, and to some extent also this work paved the way for the eventual proof of Robbins' conjecture. I feel deeply honored and moved to now receive, together with Matjaž and Roger, the David P. Robbins prize.

I would like to express my appreciation for the initiative to support mathematical research with an experimental component. Results discovered through experiment rather than intuition have the potential to be particularly surprising, and proving them can present a challenge because initially one may have no clue as to the reason why they are true. The area of enumerative combinatorics Robbins and several others originated serves as a good example: They introduced objects such as alternating sign matrices, plane partitions, and lozenge tilings, and while for most enumerations no explicit formula exists containing, say, only the basis arithmetic operations, certain enumerations of those objects are expressible by simple product formulas, which were usually discovered through computer experiments. Although all of Robbins' conjectures have now been proven, the proofs are complicated and we still lack thorough understanding just in what situations to expect a simple enumeration formula, nor are we able to explain phenomena such as the same enumeration formula appearing in the context of two very different combinatorial objects. Much of my past and current research has been driven by these questions.

Biographical Note

Matjaž Konvalinka was born in Ljubljana, Slovenia. He obtained his Bachelor's and Master's degrees at the University of Ljubljana, and his Ph.D. at the Massachusetts Institute of Technology in 2008 under Igor Pak. He held a postdoctoral position at Vanderbilt University until 2010, and has been a professor at the Faculty of Mathematics and Physics, University of Ljubljana since then. In 2012, he received a University award for excellent teaching and research. He mostly works in enumerative and algebraic combinatorics, and particularly enjoys bijective proofs, Schur functions, and tableaux combinatorics.

Response from Matjaž Konvalinka

I am deeply honored to be one of the recipients of the AMS David P. Robbins Prize. One of the reasons I love combinatorics is that many of its problems can be explained to a child, even when they are fiendishly hard to solve and inspire deep new tools and theorems. Problems involving alternating sign matrices are a prime example of this. Combinatorialists will forever be grateful to David Robbins and his coauthors for introducing them to the community and for the conjectures related to their enumeration.

I owe a debt of gratitude to many people. First and foremost I have to thank Ilse and Roger, my coauthors, both amazing mathematicians and people. They are truly worthy recipients of this prize. I am also deeply grateful to Marko Petkovšek

for my first combinatorics courses, to my Ph.D. advisor Igor Pak for everything he taught me and for always knowing what problems I will like, to Richard Stanley for his wonderful lectures, papers, and books, and to Sara Billey for being the best collaborator and friend one could imagine. My colleagues and students at the University of Ljubljana are a big part of why I enjoy my job. Many thanks also go to my husband Danijel and our daughter Ana, to the rest of my family, and to my friends, not least for seeming less surprised by this prize than I.

Oswald Veblen Prize in Geometry

The Oswald Veblen Prize in Geometry is made for a notable research work in geometry or topology that has appeared in the last six years. The work must be published in a recognized, peer-reviewed venue. This prize was established in 1961 in memory of Professor Oswald Veblen through a fund contributed by former students and colleagues. The fund was later doubled by the widow of Professor Veblen. An anonymous donor generously augmented the fund in 2008. In 2013, in honor of her late father, John L. Synge, who knew and admired Oswald Veblen, Cathleen Synge Morawetz and her husband, Herbert, substantially increased the endowment.

Citation

Xiuxiong Chen, Simon Donaldson, and Song Sun

The 2019 Oswald Veblen Prize in Geometry is awarded to Xiuxiong Chen, Simon Donaldson, and Song Sun for the three-part series entitled "Kähler-Einstein metrics on Fano manifolds, I, II and III" published in 2015 in the *Journal of the American Mathematical Society,* in which Chen, Donaldson, and Sun proved a remarkable nonlinear Fredholm alternative for the Kähler-Einstein equations on Fano manifolds. They show this fully nonlinear PDE can be solved if and only if a certain stability condition involving only finite-dimensional algebro-geometric data holds.

In 1982 Shing-Tung Yau received the Fields Medal in part for his 1978 proof of the so-called Calabi Conjecture. In particular Yau proved that if the first Chern class of a compact Kähler manifold vanishes (respectively, is negative), then it admits a Kähler-Einstein metric, i.e., there is a unique Kähler metric in the same class with vanishing (respectively, constant negative) Ricci curvature.

Yau later conjectured that a solution in the case of Fano manifolds, i.e., those with positive first Chern class, would necessarily involve an algebro-geometric notion of stability. Seminal work of Gang Tian and then Donaldson clarified and generalised this idea. The resulting conjecture—that a Fano manifold admits a Kähler-Einstein metric if and only if it is K-stable—became one of the most active topics in geometry. In 1997 Tian introduced the notion of K-stability used in the cited papers, and used this to demonstrate that there are Fano manifolds with trivial automorphism group which do not admit Kähler-Einstein metrics.

Proving this conjecture had long been understood to involve a vast combination of ideas from symplectic and complex geometry, infinite-dimensional Hamiltonian reduction, and geometric analysis. All methods involved some kind of continuity method; in 2011 Donaldson proposed one involving Kähler-Einstein metrics with cone singularities (published by Springer in *Essays in mathematics and its applications* in 2012).

One of the main technical obstacles was then how to control certain limits of sequences of Kähler metrics on Fano manifolds (equivalently, how to obtain the "partial C^0-estimate"). One can take the so-called Gromov-Hausdorff limit, but a priori this could be a metric space with no algebro-geometric description.

It was a huge breakthrough when, in 2012, Donaldson and Sun managed to use Bergman kernels to put the structure of a normal projective algebraic variety on the Gromov-Hausdorff limit of a noncollapsing sequence of polarized Kähler manifolds with bounded Ricci curvature (published in *Acta Mathematica* in 2014).

Chen, Donaldson, and Sun gave a complete solution of the conjecture for Fano manifolds a few months later. The announcement was published in *International Mathematics Research Notices* in 2014 and full proofs followed in "Kähler-Einstein metrics on Fano manifolds. I: Approximation of metrics with cone singularities", "Kähler-Einstein metrics on Fano manifolds. II: Limits with cone angle less than 2π", and "Kähler-Einstein metrics on Fano manifolds. III: Limits as cone angle approaches 2π and completion of the main proof", all published in 2015 in the *Journal of the AMS*.

As one nominator put it, "This is perhaps the biggest breakthrough in differential geometry since Perelman's work on the Poincaré conjecture. It is certainly the biggest result in Kähler geometry since Yau's solution of the Calabi conjecture thirty-five years earlier. It is already having a huge impact that will only grow with time."

Biographical Note

Xiuxiong Chen received his undergraduate degree in 1987 from the University of Science and Technology of China (USTC) and a master's degree from the graduate school of USTC and the Academia Sinica in 1989, supervised by JiaGui Peng in geometry and Weiyue Ding in analysis. He then moved to the University of Pennsylvania in 1989 for his doctoral degree under the supervision of E. Calabi. He held positions at McMaster University (1994–96), Stanford (1996–98), Princeton (1998–2002), and the University of Wisconsin-Madison (2002–09). Since 2009 he has been a professor of mathematics at Stony Brook University. He was an invited speaker at ICM 2002 in Beijing, a 2015 Fellow of the American Mathematical Society, and a 2016 Simons Fellow in mathematics. Over his career, he has supervised around twenty Ph.D. students in mathematics.

Biographical Note

Simon Donaldson received his undergraduate degree in 1978 from Cambridge University and moved to Oxford for his doctorate, supervised by Michael Atiyah and Nigel Hitchin. He held positions in Oxford and Stanford before moving to Imperial College, London in 1998. At present he is a permanent member of the Simons Center for Geometry and Physics, Stony Brook. Over his career he has supervised about forty-five doctoral students, many of whom are now leading figures in mathematical research. Donaldson was awarded a Fields Medal in 1986 for his work on gauge theory and four-dimensional manifolds, and has made contributions to several other branches of differential geometry. He was an invited speaker at ICM 1983, 1986, 1998, and 2018. He has held a number of editorial positions (including, currently, the *Journal of the AMS*), and served on a variety of committees, including the Executive Committee of the International Mathematical Union 1994–2002.

Biographical Note

Song Sun was born in 1987 in Huaining, Anhui province, China. He received a BS from the University of Science and Technology of China in 2006 and a Ph.D. from the University of Wisconsin–Madison in 2010, supervised by Xiuxiong Chen. He held a postdoctoral position at Imperial College London from 2010–13, and then became an assistant professor at Stony Brook University. In 2018, he joined the faculty at University of California, Berkeley. Sun received an Alfred P. Sloan Research Fellowship in 2014, and was an invited speaker at ICM 2018 in Rio de Janeiro.

Response from Xiuxiong Chen, Simon Donaldson, and Song Sun

It is a great honour to be awarded the 2019 Oswald Veblen Prize for our work on Kähler-Einstein metrics. Our work builds on that of many others. In 1954, Calabi proposed his vision of far-reaching existence theorems for canonical metrics on Kähler manifolds—a vast extension of the classical theory for Riemann surfaces. The foundation for this vision came from the developments of complex differential geometry over the preceding decades by Kähler, Hodge, Chern, and others. In its general formulation, involving "extremal" Kähler metrics, Calabi's problem remains to a large extent open, but in the case of Kähler-Einstein metrics the existence theory is now in a relatively satisfactory state. A crucial breakthrough by S-T Yau, which famously dealt with the cases of negative or zero first Chern class, was recognized in the 1981 Veblen Prize. Many mathematicians have contributed to the understanding of the remaining "positive" case over the four decades since Yau's work. We feel very fortunate and privileged to have had the opportunity to play a part in this long story.

Our cited work interweaves strands from several different fields. One is the theory of the complex Monge-Ampère equation, with estimates in the style going back to Calabi and Yau, but also with modern developments which extend the theory to singular varieties. Another is the convergence theory of Riemannian manifolds with Ricci curvature bounds: our work blends these ideas with complex geometry through the L^2 or “Hörmander” method. A third strand brings in the circle of ideas linking Geometric Invariant theory in algebraic geometry, and notions of “stability”, to symplectic geometry. In the few years following our cited work, several other proofs of the main result have appeared, but all sharing a similar diversity of techniques. This diversity is an intrinsic feature of the problem, which seeks a bridge between differential and algebraic geometry. While our work provides an answer to one long-standing question, these recent developments open up wonderful new vistas, for example in the study of moduli spaces and singularities, within this grand theme.

We are very glad to have this opportunity to thank our wives—Holly, Nora, and Jiajia—for their wonderful support, which was crucial for us in completing this work. Xiuxiong Chen wishes to take this opportunity to thank his advisor, E. Calabi, for his mathematical guidance and inspiration.

THE RUTH LYTTLE SATTER PRIZE IN MATHEMATICS

The Satter Prize was established in 1990 using funds donated by Joan S. Birman in memory of her sister, Ruth Lyttle Satter, to honor Satter's commitment to research and to encourage women in science. The prize is awarded every two years to recognize an outstanding contribution to mathematics research by a woman in the previous six years.

CITATION

Maryna Viazovska

The 2019 Ruth Lyttle Satter Prize in Mathematics is awarded to Maryna Viazovska of École Polytechnique Fédérale de Lausanne for her groundbreaking work in discrete geometry and her spectacular solution to the sphere-packing problem in dimension eight.

In his 1900 list of outstanding mathematical problems, David Hilbert asked, "How can one arrange most densely in space an infinite number of equal solids of a given form, e.g., spheres with given radii ...?" Viazovska's work is a major advance in addressing this question. Her 2017 paper in *Annals of Mathematics* shows that the E_8 root lattice is the densest sphere packing in eight dimensions. Shortly after this much heralded breakthrough, Dr. Viazovska, in collaboration with Henry Cohn, Abhinav Kumar, Stephen D. Miller, and Danylo Radchenko, adapted her methods to prove that the optimal sphere-packing density in dimension twenty-four is achieved by the Leech lattice. Prior to these results, the sphere-packing problem had not been solved beyond dimension three.

Maryna Viazovska's work has been described as "simply magical," "very beautiful," and "extremely unexpected." Her solution to the sphere-packing problem in dimension eight, while conceptually simple, has a deep structure based on certain functions that she explicitly constructs in terms of modular forms. It establishes a new, unanticipated connection between modular forms and discrete geometry.

Dr. Viazovska's earlier results on spherical designs are fundamental contributions to the topic. Her 2013 *Annals of Mathematics* paper with Andriy Bondarenko and Danylo Radchenko solved a conjecture of J. Korevaar and J. L. H. Meyers by showing for $N > C_d t^d$, where C_d is a positive constant depending only on d, that spherical t-designs with N points exist in the unit sphere S^d. Spherical designs have been essential tools of practical importance in the statistical design of experiments and in both combinatorics and geometry. Most recently, spherical t-designs have appeared in the guise of quantum t-designs with applications to quantum information theory and quantum computing.

Leroy P. Steele Prize for Seminal Contribution to Research

The Leroy P. Steele Prizes were established in 1970 in honor of George David Birkhoff, William Fogg Osgood, and William Caspar Graustein and are endowed under the terms of a bequest from Leroy P. Steele. Prizes are awarded in up to three categories. The following citation describes the award for Seminal Contribution to Research.

Citation

Haruzo Hida

The 2019 Leroy P. Steele Prize for Seminal Contribution to Research is awarded to Haruzo Hida of the University of California, Los Angeles for his highly original paper "Galois representations into $GL_2(\mathbb{Z}_0[[X]])$ attached to ordinary cusp forms", published in 1986 in *Inventiones Mathematicae.*

In this paper, Hida made the fundamental discovery that ordinary cusp forms occur in p-adic analytic families. J.-P. Serre had observed this for Eisenstein series, but there the situation is completely explicit. The methods and perspectives that Hida introduced have been used in the past three decades to solve fundamental problems in the theory of p-adic Galois representations and p-adic L-functions, and have led to progress on p-adic analogs of the conjecture of Birch and Swinnerton-Dyer. Hida families are now ubiquitous in the arithmetic theory of automorphic forms, and his research has changed the way we view the subject.

Biographical Note

Haruzo Hida is a distinguished professor of mathematics at UCLA. Born in 1952 in the beach resort town of Hamadera (presently, Sakai West-ward), Japan, he received an MA (1977) and Doctor of Science (1980) from Kyoto University. He did not have a thesis advisor. He held positions at Hokkaido University (Japan) from 1977–1987 up to associate professorship. He visited the Institute for Advanced Study for two years (1979–81), though he did not have a doctoral degree in 1979, and Institut des Hautes Études Scientifiques and Université de Paris Sud from 1984–86. Since 1987, he has held a full professorship at UCLA (and was promoted to distinguished professor in 1998).

Hida's main research interests lie in arithmetic geometry, both Archimedean and Henselian, through the automorphic approach (initiated by Erich Hecke). He was an invited speaker at the ICM in Berkeley (1986), a Guggenheim fellow (1991–92), a recipient of the Spring Prize from the Mathematical Society of Japan (1992), a Senior Scholar at the Clay Mathematics Institute (2010–11), an inaugural fellow of the American Mathematical Society (2012–), and a recipient of a Docteur Honoris Causa, Université de Paris XIII (2015). He is the author of seven research books and monographs on his own results.

Response from Haruzo Hida

It is a great honor (and also a big surprise) to receive the Leroy P. Steele Prize from the AMS. Why a surprise? The name of the town Hamadera appears (as "Takashi-no-Hama") in the sixth–eighth-century Japanese "Tan-ka/Chou-ka" poem anthology "Manyou-shu" (Ten thousand leaves), and by a tradition of the town, Hida was familiar with the ancient poems at an early age (as they are all written in Japanese phonetic symbols, so, easy to read). Starting with the poems, he enjoyed Japanese and Chinese classics. Chinese poems by a decadent Japanese Zen monk of the 15th century greatly impressed him; they could be interpreted (with a question mark) to suggest the purpose of one's life could be found only in an enjoyable pastime (or more precisely, a way to kill time), lasting until one's demise. From that time on, he tried in earnest to find such a way to kill time. He finally found one accidentally in the mid-70s and, after that, he became totally addicted to math. Therefore, he is hardly professional nor academic in his mathematical work and often creates his mathematics without tangible reference to contemporaries. It seems unfair that such a person be chosen for a prestigious AMS prize. Nevertheless, his work has found some deep applications. This hopefully legitimizes the award.

A seventeenth-century Japanese playwright told a Confucianist that creating a play is to walk the boundary of imaginary and real (or dream and truth) without stepping out off of the narrow path. When Hida in 1975 started to study (with Koji Doi) the relation between congruence and L-values, Doi told him that a Hecke eigenform appears to have siblings having eigenvalues (of Hecke operators) congruent modulo a (parent) prime with the eigenvalues of the initial form. While he was at IAS, Hida felt that pathwise connectedness of the Archimedean topology forces the core cuspidal spectrum of Hecke operators to be discrete; so, under a Henselian topology, totally disconnected, he imagined that the spectrum is prevalently continuous. After having gotten back to Japan in the fall of 1981, he started making progress in proving his guess and succeeded (partially) in getting a proof via arithmetic geometry by the end of January 1982. Since the result seemed too strong, he sought one more proof. He got another via Betti Ètale cohomology of modular curves within a couple of months. Afterwards, he sent out preprints to senior number theorists he encountered at Princeton. The second proof is in the paper published in 1986 for the award (and now there are more than two proofs).

Since Hida enjoys finding results independent of his fellow mathematicians, he himself did not make too much effort to find applications to classical questions posed by others, but a handful of excellent number theorists became interested in later years, and found good applications for his result.

Leroy P. Steele Prize for Mathematical Exposition

The Leroy P. Steele Prizes were established in 1970 in honor of George David Birkhoff, William Fogg Osgood, and William Caspar Graustein and are endowed under the terms of a bequest from Leroy P. Steele. Prizes are awarded in up to three categories. The following citation describes the award for Mathematical Exposition.

Citation

Philippe Flajolet, and Robert Sedgewick

The 2019 Steele Prize for Mathematical Exposition is awarded to Philippe Flajolet (posthumously) of INRIA and Robert Sedgewick of Princeton University, for their book *Analytic Combinatorics,* an authoritative and highly accessible compendium of its subject, which demonstrates the deep interface between combinatorial mathematics and classical analysis. It is a rare work, one that defines the relatively young subject in its title, mixing equal parts of complex analysis and combinatorial structure. The authors have combined their extraordinary analytical and expository skills to organize the entire subject into a well-developed and fascinating story. Its publication in 2009 was a major event, and as a result, analytic combinatorics is now a thriving subdiscipline of combinatorial and stochastic mathematics, as well as a key component of the analysis of algorithms.

Quoting Robin Pemantle's 2010 review of *Analytic Combinatorics,* published in *SIAM Review*, "This is one of those books that marks the emergence of a subfield." The book magically summarizes a vast amount of information. It identifies and expounds key techniques that have never been explained so well before, while consistently paying proper attention to the historical context. It features world-class graphics and typesetting, and a definitive bibliography. The book is largely self-contained and a pleasure to read—any mathematician can use it as the basis for teaching a course on analytic combinatorics as an undergraduate elective in mathematics.

Biographical Note

Philippe Flajolet (1948–2011) was an extraordinary French mathematician and computer scientist. He graduated from École Polytechnique in Paris in 1970, obtained a Ph.D. from Université Paris 7 with Maurice Nivat in 1973 and got a Doctorate in Sciences from the University of Paris at Orsay in 1979. He spent his career at the Institut National de Recherche en Informatique et en Automatique (INRIA) in Rocquencourt, France where he eventually led the ALGO research group, which produced numerous outstanding young scientists and attracted visiting researchers from all over the world.

He held numerous visiting positions, at Waterloo, Stanford, Princeton, Wien, Barcelona, IBM, and Bell Laboratories. He received several prizes, including the Grand Science Prize of UAP (1986), the Computer Science Prize of the French Academy of Sciences (1994), and the Silver Medal of CNRS (2004). He was elected a Corresponding Member (Junior Fellow) of the French Academy of Sciences in 1994, a Member of the Academia Europaea in 1995, and a Member (Fellow) of the French Academy of Sciences in 2003. He was made a knight of the Légion d'Honneur in 2010.

Flajolet's extensive and far-reaching research in mathematics and computer science spanned formal languages, computer algebra, combinatorics, number theory, and analysis, all oriented towards the study of algorithms and discrete structures. During his forty years of research, he contributed nearly 200 publications. An important proportion of these are foundational contributions, or represent uncommon breadth and depth. Highlights range from pioneering work in computer algebra in the 1980s, to theorems in asymptotic analysis in the 1990s that inspired decades of later research, to a probabilistic algorithm that is widely used in modern cloud computing. Much of his research laid the foundation for the development, with Sedgewick, of the subfield of mathematics that is now known as analytic combinatorics, a calculus for the study of discrete structures.

These research contributions will have impact for generations. Flajolet's approach to research, based on endless curiosity, discriminating taste, deep knowledge, relentless computational experimentation, broad interest, intellectual integrity, and genuine camaraderie, will serve as an inspiration to those who knew him for years to come.

Biographical Note

Robert Sedgewick is the William O. Baker Professor in the Department of Computer Science at Princeton University. Born in 1946 in Willimantic, Connecticut, he graduated from Brown University in 1968 and did his doctoral work with Donald E. Knuth at Stanford University, receiving his Ph.D. in 1975. After ten years on the faculty at Brown, he left to be the founding chair of

Princeton's Department of Computer Science in 1985. He served for twenty-six years as a member of the board of directors of Adobe Systems and has held visiting research positions at Xerox PARC, IDA, INRIA, and Bell Laboratories.

Sedgewick is the author of twenty books. He is best known for *Algorithms*, which has been a best-selling textbook since the early 1980s and is now in its fourth edition. His other current textbooks include *An Introduction to the Analysis of Algorithms and Analytic Combinatorics* (with Philippe Flajolet) and *Computer Science: An Interdisciplinary Approach* (with Kevin Wayne).

Beyond his work with Flajolet on analytic combinatorics, Sedgewick's research is characterized by a scientific approach to the study of algorithms and data structures, where careful implementations and appropriate mathematical models are validated by experimentation and then used to understand performance and develop improved versions. Many of his research results are expressed in his *Algorithms* books, and his implementations routinely serve as reference and are featured throughout our global computational infrastructure.

In recent years, Sedgewick has been a pioneer in developing modern approaches to disseminating knowledge, from introductory to graduate level. He has developed six massive open online courses (MOOCs) and published extensive online content on analysis of algorithms and analytic combinatorics and, with Kevin Wayne, algorithms and computer science. These materials have made it possible and convenient for millions of people around the world to teach and learn these subjects, particularly in regions where access to higher education is difficult.

Response from Robert Sedgewick

This award is thrilling and humbling for me, but also bittersweet, because Philippe is not here to share it. But all of us who were there vividly remember his excitement at our event in Paris on the occasion of his sixtieth birthday when we presented him with the first printed copy of *Analytic Combinatorics*. I keep the look on his face at that moment fresh in my mind, and know that the same look would grace us now.

Philippe and I (and many others) were students of the work of Don Knuth in the 1970s, and inspired by the idea that it was possible to develop precise information about the performance of computer programs through classical analysis. When we first began working together in 1980, our goal was just to organize models and methods that we could use to teach our students what they needed to know. As we traveled between Paris and Princeton, producing conference papers, journal articles, and INRIA research reports, we began to understand that something more general was at work, and *Analytic Combinatorics* began to emerge. It is particularly gratifying to see citations of the book by researchers in physics, chemistry, genomics, and many other fields of science, not just mathematicians and computer scientists.

Analyzing algorithms is challenging—at the outset, known results were often either excessively detailed or rough, questionably useful approximations. Thus, what fun it was to consider the idea that maybe (despite the formidable barrier of the Halting Problem) one could develop a black box that could take a program as input and produce as output an asymptotic estimate of its running time. How challenging it was to develop a rigorous calculus that takes us from simple formal descriptions of combinatorial objects through properties of generating functions in the complex plane to precise information about the objects. How exciting it was to build on this work to develop theorems of sweeping generality that encompass whole families of combinatorial classes. As Philippe said, developing new theorems like these "constitutes the very essence of analytic combinatorics." With a vibrant community of researchers working on developing and applying such theorems, I suspect and hope that the story of analytic combinatorics is just in its infancy.

I am particularly heartened by the statement in the citation that any mathematician could use our book to teach an undergraduate course on the subject. Having the broadest possible reach was indeed our hope when, with the support of our editor, we provided free access to the book on the web. For the past several years, I have been working hard to apply twenty-first-century tools to develop a unique resource for teaching this material. Anyone can now teach and learn *Analytic Combinatorics* using the studio-produced lecture videos, new problems with solutions, and other online content found at `http://ac.cs.princeton.edu`. Philippe, who always embraced technology, would be particularly pleased with the idea that it now makes analytic combinatorics accessible to large numbers of people around the world.

Leroy P. Steele Prize for Lifetime Achievement

The Leroy P. Steele Prizes were established in 1970 in honor of George David Birkhoff, William Fogg Osgood, and William Caspar Graustein and are endowed under the terms of a bequest from Leroy P. Steele. Prizes are awarded in up to three categories. The following citation describes the award for Lifetime Achievement.

Citation

Jeff Cheeger

The 2019 Steele Prize for Lifetime Achievement is awarded to Jeff Cheeger of the Courant Institute, NYU for his fundamental contributions to geometric analysis and their far-reaching influence on related areas of mathematics. For more than half a century, Jeff Cheeger has been a central figure in differential geometry and, more broadly, geometric analysis. His work on the profound and subtle effects of curvature on the topology and geometry of manifolds, often under very weak regularity conditions, has laid and continues to lay foundations for much of the progress in these areas ever since his 1967 dissertation.

His work, both alone and in collaboration with others, has yielded such spectacular results as the Soul and Splitting Theorems (with Detlef Gromoll) and the Compactness and Collapsing Theories (with Kenji Fukaya and Misha Gromov), which have been among the most important developments in geometry in the past three decades. These fundamental theories have had far-reaching consequences, for instance, playing an essential role in Perelman's resolution of the Poincaré conjecture. Cheeger's inequality bounding from below the first nonzero eigenvalue of the Laplacian in terms of a certain isoperimetric constant, known as Cheeger's constant, has had numerous applications, as has his work on the Hodge theory and spectral geometry of singular spaces, the structure theory of spaces with bounds on Ricci curvature, his resolution of the Ray-Singer Conjecture, the theory of differential characters (with James Simons), his work on differentiability of Lipschitz functions on metric measure spaces, and many others have been the fundamental tools that enabled major advances in geometry and analysis that continue to bear fruit and shape the field.

Biographical Note

Jeff Cheeger was born in Brooklyn New York in 1943. He graduated from Erasmus Hall High School in 1960 and from Harvard College in 1964. He received his Ph.D. from Princeton under Salomon Bochner and James Simons in 1967. After a year in Berkeley as an NSF Postdoctoral Fellow and a year at the University of Michigan as an Assistant Professor, he moved to Stony Brook where he remained for the next twenty years, rising to the rank of Distinguished Professor. Since 1989, he has been a member of the Courant Institute, NYU, where since 2003 he has been Silver Professor of Mathematics.

Cheeger has given invited addresses at the International Congress of Mathematicians in 1974 and 1986. He was awarded the Max Plank Research Prize of the Alexander von Humboldt Society in 1996, and the Veblen Prize of the AMS in 2001. He was elected to the National Academy of Sciences in 1997, the Finnish Academy of Science and Letters in 1998 and the American Academy of Arts and Sciences in 2006. He was elected a Fellow of the AMS in 2012.

Response from Jeff Cheeger

It is a great honor to have been awarded the Leroy P. Steele Prize for Lifetime Achievement. It is especially gratifying to have received an award for research done over my whole career and for which the citation includes work with a number of remarkable mathematicians, the interactions with whom have enriched my life. I would particularly like to thank my collaborators Paul Baum, Detlef Gromoll, Jim Simons, S.-T. Yau, Michael Taylor, Werner Muller, Robert Schrader, Misha Gromov, Jean-Michel Bismut, Mike Anderson, Gang Tian, Xiaochun Rong, Xianzhe Dai, Kenji Fukaya, Toby Colding, Bruce Kleiner, Assaf Naor and Aaron Naber. I would also like to acknowlege the influence of my friends Blaine Lawson, Dennis Sullivan and Is Singer.

I was introduced to mathematics by my father, Thomas Cheeger, a structural engineer. He could not have given me a better gift. My mother, Pauline, stressed to me the benefits of hard work.

In junior high school, I made a very good friend, Mel Hochster, with whom I could share my interest in mathematics. It was exciting and fun. When I was an undergraduate at Harvard, two professors, Shlomo Sternberg and Raul Bott, made a big impression. They introduced me to differential geometry and algebraic topology. Beyond that, they conveyed the feeling that being a mathematician was something like being a member of a special order, an order into which one could hope to one day be initiated. During my last year, I took a PDE course from Jim Simons. In graduate school at Princeton, along with my official advisor, Salomon Bochner, Jim became my teacher and then my friend. I owe him a lot.

I was very lucky to have found my way into differential geometry which, I have come to believe, was the right area for my particular turn of mind. When I started it was a bit out of fashion, underdeveloped, not overly competitive, but poised to take off. For me, this was ideal. Later, I learned some analysis, which opened up new vistas.

As reseachers, our job is to produce new mathematics. Still, looking back over a whole career, it is somewhat mind blowing to realize how little we understood when I began, as compared to what has since been discovered.

From the time I was young, I was struck by the fact that in mathematics, questions have a right or wrong answer. This has a consequence. With small exceptions, mathematicians tend to genuinely admire each other's achievements. Another thing. As mathematicians we have quite direct access to some of the most original minds of the past and of the present. From such people, if you keep your ears open, you can really learn something. Finally, we are lucky in that we get to think about what we want and to interact with brilliant young people. I feel very fortunate to have had a life in mathematics.

Summary of Awards

For MAA

- **Chauvenet Prize**: Tom Leinster
- **Euler Book Prize**: Cathy O'Neil
- **Deborah and Franklin Tepper Haimo Awards for Distinguished College or University Teaching of Mathematics**: Suzanne Dorée, Carl Lee, and Jennifer Switkes
- **Yueh-Gin Gung and Dr. Charles Y. Hu Award for Distinguished Service to Mathematics**: Dr. Philip Uri Treisman

For AWM

- **Louise Hay Award for Contribution to Mathematics Education**: Jacqueline Dewar
- **M. Gweneth Humphreys Award for Mentorship of Undergraduate Women in Mathematics**: Suzanne Weekes
- **Joan & Joseph Birman Prize in Topology and Geometry**: Kathryn Mann

For AMS-MAA-SIAM

- **Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student**: Ravi Jagadeesan; Honorable mention: Evan Chen and Huy Tuan Pham

For JPBM

- **Communications Award**: Margot Lee Shetterly

For AMS-SIAM

- **Norbert Wiener Prize in Applied Mathematics**: Marsha Berger and Arkadi Nemirovski

For AMS

- **Levi L. Conant Prize**: Alex Wright
- **E. H. Moore Research Article Prize**: Ciprian Manolescu
- **Mary P. Dolciani Prize for Excellence in Research**: Stephan Ramon Garcia
- **David P. Robbins Prize**: Roger Behrend, Ilse Fischer, Matjaž Konvalinka
- **Oswald Veblen Prize in Geometry**: Xiuxiong Chen, Simon Donaldson, and Song Sun
- **Ruth Lyttle Satter Prize in Mathematics**: Maryna Viazovska
- **Leroy P. Steele Prize for Seminal Contribution to Research**: Haruzo Hida
- **Leroy P. Steele Prize for Mathematical Exposition**: Philippe Flajolet and Robert Sedgewick
- **Leroy P. Steele Prize for Lifetime Achievement**: Jeff Cheeger

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