Mathematics People

Weiss, Barish, and Thorne Awarded Nobel Prize in Physics

Rainer Weiss

Kip S. Thorne

The Royal Swedish Academy of Sciences has awarded the 2017 Nobel Prize in Physics to Rainer Weiss, Barry C. Barish, and Kip S. Thorne, all of the LIGO/Virgo Collaboration, for their "decisive contributions to the LIGO detector and the observation of gravitational waves." Weiss receives one-half of the prize; Barish and Thorne share one-half.

According to the prize citation, "LIGO, the Laser Interferometer Gravitational-Wave Observatory, is a collaborative project with over one thousand researchers from more than twenty countries. Together, they have realized a vision that is almost fifty years old. The 2017 Nobel Laureates have, with their enthusiasm and determination, each been invaluable to the success of LIGO. Pioneers Rainer Weiss and Kip S. Thorne, together with Barry C. Barish, the scientist and leader who brought the project to completion, ensured that four decades of effort led to gravitational waves finally being observed.

"Gravitational waves spread at the speed of light, filling the universe, as Albert Einstein described in his general theory of relativity. They are always created when a mass accelerates, like when an ice-skater pirouettes or a pair of black holes rotate around each other. Einstein was convinced it would never be possible to measure them. The LIGO project's achievement was using a pair of gigantic laser interferometers to measure a change thousands of times smaller than an atomic nucleus, as the gravitational wave passed the Earth."

Lydia Bieri of the University of Michigan provided the *Notices* with the following statement about the prizewinners, their work, and the LIGO project:

"In 1972, Rainer Weiss wrote down in an MIT report his ideas for building a laser interferometer that could detect gravitational waves. He had thought this through carefully and described in detail the physics and design of such an instrument. This is typically called the 'birth of LIGO.' Rai Weiss's vision, his incredible insights into the science and challenges of building such an instrument were absolutely crucial to make out of his original idea the successful experiment that LIGO has become.

"Kip Thorne has done a wealth of theoretical work in general relativity and astrophysics, in particular connected with gravitational waves. In 1975, a meeting between Rainer Weiss and Kip Thorne from Caltech marked the beginning of the complicated endeavors to build a gravitational wave detector. Rai Weiss's incredible insights into the science and challenges of building such an instrument combined with Kip Thorne's theoretical expertise with gravitational waves, as well as his broad connectedness with several areas of physics and funding agencies, set the path toward a larger collaboration. Building such an instrument requires an enormous expertise in many areas of physics, astrophysics, mathematics, and engineering. Thus many more people needed to be hired.

"Kip Thorne at Caltech created a gravitational-wave research group and hired Ron Drever from Glasgow University. Very sadly, Drever passed away in early 2017. Ron Drever was most crucial to improving the laser technique required by such a detector.

"The group consisting of Rai Weiss, Ron Drever, and Kip Thorne was called the 'LIGO triumvirate.'

"In 1989 LIGO was funded by NSF, and in 1994 construction began for the two detectors of LIGO.

"In 1994, Barry Barish joined Rai, Kip, and Ron. Barry became LIGO principal investigator that year. Barry Barish was the person who transformed the project from a small group into a large team that was required in order to construct such an experiment and lead it to success. Barry Barish's knowledge on building and managing such a huge project paired with his vision and ability to realize science led to the construction of the instruments and to the creation of the LIGO Scientific Collaboration. He was also crucial in making the successful proposal for building Advanced LIGO, which has observed gravitational waves several times already.

"Rai Weiss, Kip Thorne, Ron Drever, and Barry Barish were all absolutely crucial to make LIGO a success. Each one of them contributed in extraordinary ways."

Rainer Weiss was born in Berlin, Germany, and received his PhD in 1962 from the Massachusetts Institute of Technology, where he is currently professor of physics. Barry Barish was born in Omaha, Nebraska, and received his PhD in 1962 from the University of California. He is Linde Professor of Physics at the California Institute of Technology. Kip Thorne was born in Logan, Utah, and received his PhD in 1965 from Princeton University. He is Feynman Professor of Theoretical Physics at the California Institute of Technology.

— From a Nobel Prize announcement

EDITOR'S NOTE. The August 2017 issue of the *Notices* features the articles "How the Green Light Was Given for Gravitational Wave Search" by C. Denson Hill and Paweł Nurowski and "Gravitational Waves and Their Mathematics" by Lydia Bieri, David Garfinkle, and Nicolas Yunes.

Viazovska Awarded SASTRA Ramanujan Prize

Maryna Viazovska

MARYNA VIAZOVSKA of the Swiss Federal Institute of Technology, Lausanne, has been awarded the 2017 SASTRA Ramanujan Prize. She is "an extraordinarily gifted mathematician who has made deep contributions to several fundamental problems in number theory."

The prize citation reads: "Maryna Viazovska is awarded the 2017 SASTRA Ramanujan Prize for her stunning and elegant resolution of the celebrated sphere-packing problem in dimension 8, the proof of which appeared in her paper in the *Annals of Mathematics* (2017), and for her joint 2017 paper in the *Annals of Mathematics* with Henry Cohn, Abhinav Kumar, Stephen D. Miller, and Danylo Radchenko, which resolves the sphere-packing problem in dimension 24 by building on her ideas in dimension 8. The prize also recognizes her outstanding PhD thesis of 2013 at the University of Bonn in which she resolved significant cases of the Gross-Zagier Conjecture and her work prior to her PhD with A. Bodarenko and D. Radchenko resolving a long-standing conjecture of Korevaar and Meyers on spherical designs, that appeared in the *Annals of Mathematics* in 2013. The prize notes that the modular forms techniques developed by Viazovska will have a significant future impact in discrete geometry, analytic number theory, and harmonic analysis. The award of the 2017 SASTRA Ramanujan Prize to Maryna Viazovska is in keeping with the tradition of recognizing the spectacular contributions by the most brilliant young mathematicians."

Viazovska was born in Kiev, Ukraine, in 1984. She received her PhD from the University of Bonn in 2013 under the direction of Don Zagier. She has received several awards and recognitions, such as the Salem Prize (2016), the European Prize in Combinatorics (2017), and the Clay Research Award (2017).

The SASTRA Ramanujan Prize was established in 2005 and is awarded annually for outstanding contributions by young mathematicians to areas influenced by the genius Srinivasa Ramanujan. The age limit for the prize has been set at 32 because Ramanujan achieved so much in his brief life of 32 years. The prize will be awarded in December, 2017, at the International Conference on Number Theory at SASTRA University in Kumbakonam (Ramanujan's hometown) where the prize has been given annually.

The prize committee for the 2017 SASTRA Ramanujan Prize consisted of:
- Krishnaswami Alladi, chair
- Andrew Granville
- Winfried Kohnen
- Philippe Michel
- Peter Sarnak
- Michael Schlosser
- Gisbert Wustholz

Previous winners of the SASTRA Ramanujan Prize are:
- Manjul Bhargava and Kannan Soundararajan (two full prizes), 2005
- Terence Tao, 2006
- Ben Green, 2007
- Akshay Venkatesh, 2008
- Kathrin Bringmann, 2009
- Wei Zhang, 2010
- Roman Holowinsky, 2011
- Zhiwei Yun, 2012
- Peter Scholze, 2013
- James Maynard, 2014
- Jacob Tsimerman, 2015
- Kaisa Matomaki and Maksym Radziwill (shared), 2016

—Krishnaswami Alladi, University of Florida

EDITOR'S NOTE. A feature article on Viazovska's work appears in the February 2017 issue of *Notices*.

NEWS

Venkatesh Awarded Ostrowski Prize

Akshay Venkatesh

Akshay Venkatesh of Stanford University has been awarded the Ostrowski Prize for 2017 "for his groundbreaking work in number theory, the theory of automorphic forms and representation theory, homogeneous dynamics, and arithmetic geometry." The prize carries a cash award of 100,000 Swiss francs (approximately US$102,000).

The prize citation reads as follows: "Venkatesh is notable for his originality and his ability to synthesize between different fields, bringing conceptually new tools to bear against long-standing problems with striking consequences. This not only advances the state of our knowledge, but plants the seed of further progress by exploring and highlighting previously unexplored connections between different mathematical fields.

"Among his notable results are his work on subconvex estimates for *L*-functions, in part joint with Philippe Michel, where a unified treatment of all previous subconvex estimates for *GL_2* forms is given and new important cases of subconvexity are established by exploiting the link between subconvex estimates and effective equidistribution. Along the way, Venkatesh also proved significant new results regarding sparse equidistribution questions in homogeneous dynamics. This theme of effective equidistribution results and its connection with analytic number theory is further explored in his work with Einsiedler, Margulis, and Mohammadi on effective equidistribution for periodic orbits of semisimple groups, where, in particular, the effective approach allows Vankatesh and his collaborators to prove new equidistribution results that are not approachable even qualitatively by previous techniques.

"The fruitful interaction between a wide range of number theoretic and dynamical techniques are also displayed in his work with Einsiedler, Lindenstrauss, and Michel on a cubic analogue of Duke's well-known results on equidistribution of *CM*-points and in his work with Ellenberg about the very classical problem of the local-to-global principle for representing quadratic forms by a given quadratic form in more variables, dramatically reducing the co-dimension needed for a local-to-global result to hold.

"Recently, another unexpected connection between mathematical fields was explored by Venkatesh in collaborations with Bergeron and Calegari in the study of the diffcult problem of counting torsion classes in the cohomology of arithmetic varieties, where analytic tools from differential geometry and specifically analytic torsion are employed."

Akshay Venkatesh received his PhD in mathematics in 2002 from Princeton University under Peter Sarnak. He has held positions at the University of Western Australia, the Massachusetts Institute of Technology, and Courant Institute of Mathematical Sciences. His honors include the Salem Prize (2007), a Packard Fellowship (2007), the SASTRA Ramanujan Prize (2008), and the Infosys Prize (2016).

The Ostrowski Foundation was created by Alexander Ostrowski, for many years a professor at the University of Basel. He left his entire estate to the foundation and stipulated that the income should provide a prize for outstanding recent achievements in pure mathematics and the foundations of numerical mathematics. The prize is generally awarded every two years.

—From an Ostrowski Foundation announcement

Candès Awarded MacArthur Fellowship

Emmanuel Candès

Emmanuel Candès of Stanford University has been awarded a MacArthur Fellowship, popularly known as a "genius grant," for 2017. According to the prize citation, "Emmanuel Candès is a mathematician and statistician known for developing a unified framework for addressing a range of problems in engineering and computer science, most notably compressed sensing. Compressed sensing is a technique for efficiently reconstructing or acquiring signals that make up sounds and images. Candès's research focuses on reconstructing high-resolution images from small numbers of random measurements, as well as recovering the missing entries in massive data tables.

"Using an approach that draws on concepts from linear algebra and L^1 minimization (a concept of high-dimensional geometry), Candès and colleagues were able to reconstruct high-resolution signals from sparse measurements under specified conditions. In diagnostic healthcare, for example, reducing the number of measurements needed to create high-resolution MRI scans shortens the amount of time patients must remain still in the scanner, an outcome with particularly beneficial implications for children. The ability to process and/or reconstruct audio, visual, and wireless signals from limited data has also led to significant refinements in digital photography, radar imaging, and wireless communications. Candès has expanded this work to address problems in low-rank matrix completion, devising statistical estimation methods for inferring missing entries in data arrays. (This is analogous to trying to identify a customer's movie preferences from the partial movie ratings that the user has provided.) His framework holds promise for phase retrieval, a problem arising in many applications such as crystallography, diffraction imaging (X-ray), and astronomical instrumentation.

"Candès's work at the interface of applied and theoretical mathematics is generating new lines of research in information theory as well as laying the groundwork for improvements in many devices that make use of signal and image processing methods."

Emmanuel Candès received his PhD in 1998 from Stanford University. He was a member of the faculty of Stanford University (1998–2000) and at the California Institute of Technology (2000–2009), before returning to Stanford. His awards and honors include a Sloan Research Fellowship (2001), the Popov Prize (2001), the Wilkinson Prize in Numerical Analysis and Scientific Computing (2005), the Alan T. Waterman Award of the National Science Foundation (2006), the Polya Prize (2010), the Collatz Prize (2011), the Lagrange Prize in Continuous Optimization (2012), the Dannie Heineman Prize (2013), and the 2015 AMS–SIAM George David Birkhoff Prize in Applied Mathematics. He gave the 2011 Erdős Memorial Lecture. He is a member of the AMS and serves on the editorial board for the *Bulletin of the AMS*.

The MacArthur Fellows Program is intended to encourage people of outstanding talent to pursue their own creative, intellectual, and professional inclinations. Each fellowship awards a stipend of US$625,000 to the recipient.

—From a MacArthur Fellowship Program announcement

Schoen Awarded Lobachevsky Prize

Richard M. Schoen

Richard M. Schoen of the University of California Irvine has been awarded the 2017 Lobachevsky Medal and Prize for Outstanding Work in Geometry and Its Applications. The prize carries a cash award of US$75,000. He was honored for his work in differential geometry. According to the prize citation, "he holds fundamental theorems on positive energy in the general theory of relativity, he obtained a complete solution of the famous Yamabe problem on compact manifolds. He also made a fundamental contribution to the theory of regularity of minimal surfaces and harmonic maps."

Schoen was born in Celina, Ohio, and received his PhD in 1977 from Stanford University. His honors include a MacArthur Fellowship (1983), the Bôcher Memorial Prize (1989), the Wolf Prize (2017), the Heinz Hopf Prize (2017), and the Rolf Schock Prize (2017). He tells the *Notices*: "I grew up as the tenth child in a family of thirteen children, eight girls and five boys. We lived in rural Ohio and there were no relatives in previous generations who were educated beyond high school. I was lucky to arrive as a PhD student at Stanford in the early 1970s at a time when nonlinear methods in PDE had been rapidly developing. With my advisors Leon Simon and Shing-Tung Yau we advanced an area of mathematics which was a synthesis of nonlinear PDE with differential geometry, a field which is now called geometric analysis. I think my rural midwestern background has helped me to keep my personal and professional lives in a healthy balance."

—Elaine Kehoe

Ros-Oton Awarded Rubio de Francia Prize

Xavier Ros-Oton

Xavier Ros-Oton of the Universität Zürich has been awarded the 2016 Rubio de Francia Prize of the Royal Spanish Mathematical Society (RSME). According to the prize citation, he was recognized "for contributions to analysis and partial differential equations, including his work on regularity of stable solutions up to dimension seven in domains of double revolution (with X. Cabré), important contributions to boundary regularity for fully nonlinear integro-differential equations (with J. Serra) and to the obstacle problem for integro-differential operators (with L. Caffarelli and J. Serra), and obtaining a Pohozaev type identity for the fractional Laplacian (with J. Serra)." He received his PhD in 2014 from the Universitat Politècnica de Catalunya and served as R. H. Bing Instructor at the University of Texas at Austin from 2014 to 2017 before joining the University of Zurich. In 2017 he was awarded the Antonio Valle Prize from the Spanish Society of Applied Mathematics, given to the best researcher under thirty-four years of age. At age twenty-nine, he was the youngest recipient of the award. Ros-Oton tells the *Notices*: "I grew up in Barcelona, and lived always there until I finished my PhD in mathematics. After that, I moved to Austin, where I found a really nice city with an even warmer weather than in Barcelona. Very recently I moved to Zurich, so now I will have to get used to cold winters and to see snow in my city! I'm looking forward to trekking and exploring the mountains nearby." The prize honors the memory of renowned Spanish analyst J. L. Rubio de Francia (1949–1988). The RSME awards the prize annually to a mathematician from Spain or who has received a PhD from a university in Spain and who is at most thirty-two years of age. The prize is awarded for high-caliber contributions to any area of pure or applied mathematics.

—From a Royal Spanish Mathematical Society announcement

Pardon Awarded 2017 Packard Fellowship

John V. Pardon

John V. Pardon of Princeton University has been awarded a Packard Fellowship by the David and Lucile Packard Foundation. The Fellowship provides a grant of US$875,000 over five years to allow the recipient to pursue his or her research. Pardon's research explores problems in geometry and topology and related fields. Although topological problems are insensitive to the geometry of objects in question, geometric structures often play an unexpected role in the answer to topological questions. Pardon received his PhD in 2015 from Stanford University. He was awarded the AMS Morgan Prize in 2012 and the NSF Waterman Award in 2017. He is an AMS member.

—From a Packard Foundation announcement

2017 CAV Award

Parosh Abdulla

Alain Finkel

The 2017 CAV Award for fundamental contributions to the field of computer-aided verification has been awarded to Parosh Abdulla, Uppsala University; Alain Finkel, Ecole Normale Supérieure de Cachan, Bengt Jonsson, Uppsala University, and Philippe Schnoebelen, CNRS and ENS de Cachan, "for the development of general mathematical structures leading to general decidability results for the verification of infinite-state transition systems." The award carries a cash prize of US$10,000, shared equally among the recipients.

According to the prize citation, the recipients "showed how the abstract notion of a well-quasi-order can be used to identify a large class of infinite-state transition systems with important decidability properties." The principles espoused in their work "were shown to be applicable to an impressively large number of formalisms. Equally important, well-quasi-orders also have been at the heart of many practical contributions that target, among others, the automatic verification of multi-threaded programs and parametric systems."

Jonsson is an educated concert pianist and enjoys "the very Swedish sport of orienteering." Schnoebelen tells the *Notices*: "I am a puzzle enthusiast and started the Retrograde Analysis Corner (now at `www.janko.at/Retros/index.htm`) at some time around 1995, several years before wikis and blogs became fashionable. One of the few problems I composed is at `www.janko.at/Retros/Probleemblad/N1996-05.htm`: It is a chess position that must be reached in a legal game lasting 15 moves, where White and Black cooperate to reach the position. Solving such 'proof game' problems is like solving the *NYT* Sunday crossword: at first we only get parts of the solution, but these help finding other parts, then other parts, until some hidden Easter Egg is revealed and we finish the puzzle in some unusual state of exhilaration."

Bengt Jonsson

Philippe Schnoebelen

—From a CAV Award announcement

Kimsey Awarded Clifford Prize

David Kimsey

David Kimsey of Newcastle University has been awarded the third W. K. Clifford Prize "for his outstanding mathematical research achievements in the field of quaternionic analysis with applications in quantum mechanics." Kimsey received his PhD from Drexel University under H. Woerdeman. He later became interested in quaternionic analysis. The prize citation reads in part: "Spectral theory for normal operators on a quaternionic Hilbert space is a delicate and technical subject due to the noncommutativity of the quaternions. In particular, the proper notion of spectrum is not immediately obvious and turns out to be given by the recently discovered *S*-spectrum. Based on this notion, David Kimsey (in collaboration with Alpay and Colombo) produced a completely rigorous analogue of the spectral theorem for bounded and unbounded normal operators on a quaternionic Hilbert space. This spectral theorem is a crucial tool to formulate the axioms of quaternionic quantum mechanics and as such closed a problem formulated by Birkhoff and von Neumann in 1936." Kimsey also "initiated the study of moment problems, free analysis and interpolation in the context of quaternions."

—Hendrik De Bie, University of Ghent

AWM Inaugural Fellows Chosen

The Executive Committee of the Association for Women in Mathematics (AWM) has established the AWM Fellows Program to recognize individuals who have demonstrated a sustained commitment to the support and advancement of women in the mathematical sciences, consistent with the AWM mission: "to encourage women and girls to study and to have active careers in the mathematical sciences, and to promote equal opportunity and the equal treatment of women and girls in the mathematical sciences."

The Inaugural Class of AWM Fellows has been chosen from living members of the following groups: past presidents of the AWM, AWM Lifetime Service Award winners, and AWM Humphreys Award winners. Additionally, each Fellow of the Inaugural Class is at least twenty-five years beyond her or his terminal degree and has been a member of AWM for at least ten years.

The inaugural fellows are:

- Georgia Benkart, University of Wisconsin, Madison
- Lenore Blum, Carnegie Mellon University
- Bettye Anne Case, Florida State University
- Ruth Charney, Brandeis University
- Carolyn Gordon, Dartmouth College
- Mary W. Gray, American University
- Helen G. Grundman, AMS and Bryn Mawr College
- Ruth Haas, University of Hawaii at Manoa
- Deanna Haunsperger, Carleton College
- Rhonda J. Hughes, Bryn Mawr College
- Linda Keen, City University of New York, Lehman College and the Graduate Center
- Cathy Kessel, senior editor, *Illustrative Mathematics*
- Barbara Keyfitz, Ohio State University, Columbus
- Kristin Lauter, Microsoft Research
- Suzanne Lenhart, University of Tennessee, Knoxville
- Jill P. Mesirov, University of California San Diego
- James Morrow, University of Washington
- Jill Pipher, Brown University
- Judith Roitman, University of Kansas
- Linda P. Rothschild, University of California San Diego
- Bhama Srinivasan, University of Illinois at Chicago
- Jean E. Taylor, Rutgers University and New York University, Courant Institute
- Chuu-Lian Terng, University of California Irvine
- Sylvia M. Wiegand, University of Nebraska—Lincoln
- Carol Wood, Wesleyan University

—From an AWM announcement

Sims Awarded Australian Mathematical Society Medal

Aidan Sims of the University of Wollongong has been awarded the Australian Mathematical Society Medal for 2016 for his work in functional analysis, specifically in operator algebras and their applications in related fields. The Medal is awarded to a member of the Society under the age of forty years for distinguished research in the mathematical sciences. A significant portion of the research work should have been carried out in Australia.

—Australian Mathematical Society announcement

2017 Golden Goose Award Given

Lotfi A. Zadeh of the University of California Berkeley has been named a recipient of the 2017 Golden Goose Award for his work on fuzzy logic. In the early 1960s he recognized the need to translate fuzzy human concepts into concrete instructions for computers, and in 1965 he published the article "Fuzzy Sets." Today "fuzzy math" or "fuzzy logic" is the basis for many important innovations such as devices that understand human speech. It is used in industrial processes, medical diagnosis, home appliances, economics research, fraud detection, and consumer electronics. Zadeh passed away in 2017. The Golden Goose Award recognizes federally funded basic research that has had unexpected and significant societal impact even if the original research sounded obscure.

—From a Golden Goose Award announcement

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