Nominations for President

Nomination of Jill C. Pipher

by Peter W. Jones and Carlos E. Kenig

It is a pleasure and a distinct honor to nominate Jill Pipher for the Presidency of the AMS. We have both known Jill for more than 30 years. Over the course of her distinguished career, Jill has made fundamental contributions to harmonic analysis and partial differential equations and has also done groundbreaking work in cryptography. Jill has served our profession in a variety of ways and she has a remarkable record of service to our community. Jill has great leadership abilities that she has demonstrated over the years in a number of ways. Her leadership style combines vision, dedication, determination, careful thought, and a true commitment to diversity in all its forms. We are convinced that Jill would be an outstanding choice for President of the American Mathematical Society.

Jill's Background

Jill obtained her BA degree at UCLA in 1979. She completed her PhD, also at UCLA, in 1985, under the direction of John Garnett. In the period 1985–1990 she was an L. E. Dickson Instructor and then an Assistant Professor at the University of Chicago. Jill moved to Brown University in 1990, as Associate Professor, where she has remained ever since. Since 2013 she is the Elisha Benjamin Andrews Professor of Mathematics. In addition to her academic work, Jill was, in 1999, a co-founder of NTRU, Inc., a company founded to commercialize the first secure and practical public key cryptosystem, which Jill developed with J. Hoffstein and J. Silverman. The company was sold in 2009 to Security Innovation, Inc., a privately held company.

Jill has served in a number of administrative positions. Here are some highlights: she served as chair of the Department of Mathematics at Brown, 2005–2008, as President of the Association for Women in Mathematics (AWM) 2011–2013, as Founding Director of the National Science Foundation (NSF) Institute for Computational and Experimental Research in Mathematics (ICERM) at Brown 2010–2016, and she will serve as Vice President for Research at Brown, starting in July 2017. In addition, Jill has served on numerous committees and advisory boards.

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Jill has been widely recognized for her scientific achievements. She received an NSF Postdoctoral Fellowship (1987–1990), an Alfred P. Sloan Fellowship (1989–1993), and a Presidential Young Investigator Award (1990–1995). In 2012, Jill was elected Fellow of the AMS, in its Inaugural Class, and in 2014 she was an invited speaker at the International Congress of Mathematicians, Seoul, Korea. In 2015 she was elected as Fellow of the American Academy of Arts and Sciences.

Jill has delivered many invited and distinguished lectures all over the world and has organized or co-organized many workshops, conferences and programs.

Jill's Mathematics

We now turn to some of the highlights of Jill's research.

On harmonic analysis

The modern theory of harmonic analysis in several variables had its beginnings in the pioneering work of A. Calderon and A. Zygmund and their school, in the second half of the 20th century. In this work, the basic object of study was the analysis of operators (such as singular integrals, maximal functions, and multipliers) that behaved in a natural way with respect to the dilations and translations in the ambient space. The dilations considered in the initial works were isotropic, of the same magnitude in each separate variable. Later on, anisotropic dilations were also considered, but still depending on a single parameter. The resulting body of works is one of the bedrocks of modern analysis, with myriad fundamental applications to partial differential equations, complex analysis, analysis on Lie groups, geometry, probability, theory, operator theory, and other areas of mathematics. In the late 1970s and early 1980s, in works of Malliavin–Malliavin, Gundy–Stein, A. Chang and R. Fefferman, a study of the case of independent dilations in each variable (or subgroup of variables) was initiated, in what we now call the "multi-parameter theory." (This was preceded by a pioneering work in the 1930s by Jessen–Marcinkiewicz–Zygmund, on the so called "strong maximal function," which remained isolated for decades.) It is against this backdrop that Jill's deep contributions to the multi-parameter theory should be placed. In her dissertation, Jill extended an important covering lemma of Journe's from the case of two parameters, to the general multi-parameter case, in a breakthrough. In an important paper with R. Fefferman (1997), Jill developed sharp weighted norm inequalities for multi-parameter operators, a work which has led to surprising developments in several aspects of harmonic analysis. In a noteworthy series of works, Jill (and collaborators) pioneered a multi-parameter theory of multi-linear operators. For instance, with Muscalu, Thiele, and Tao (2004, 2006) Jill developed a multi-parameter theory of paraproducts. The one-parameter case was introduced by Coifman–Meyer in their groundbreaking development of the multi-linear Calderon–Zygmund theory, which was motivated by important applications to complex analysis, operator theory and partial differential equations. The resulting multi-parameter theory is extremely intricate and also very useful. It is essential for the development of multi-parameter Leibniz rules for fractional differentiation, which are used for instance, in the analysis of some nonlinear dispersive equations.

On partial differential equations

The theory of linear partial differential equations under minimal regularity on the coefficients and on the boundaries of the domains involved, was developed because of its intrinsic interest and also with an eye towards applications to nonlinear partial differential equations. The fundamental works of E. De Giorgi, J. Nash and J. Moser in the late 1950s and early 1960s greatly advance this program, for example yielding the solution of Hilbert's 19th problem, independently by De Giorgi and Nash. In the early 1960s, A. Calderon, motivated by these works and his own works on algebras of singular integral operators, envisioned a research program, one of whose ultimate goals was to develop a theory of elliptic boundary value problems on Lipschitz domains, which would be the analog of the theory of Agmon–Douglis–Nirenberg, and Calderon himself, developed in the late 50's, and which was set in regular domains. Progress in this program has been slow and difficult, but a number of breakthrough results were obtained for the case of second order constant coefficient elliptic equations on Lipschitz and C1 domains, by Dahlberg, Fabes–Jodeit–Riviere, Jerison–Kenig, A. Calderon, Dahlberg-Kenig and others in the late 1970s and early 1980s. For higher order constant coefficient elliptic equations, very few results were available. In the early to mid 1990s, Jill (in collaboration with G. Verchota) pioneered the systematic study of the Dirichlet and regularity problems for constant coefficient higher order elliptic operators, with data in Lebesgue spaces, on Lipschitz domains. These works revealed intriguing differences with the well-understood second order case. The culmination of these works is a by now classical paper of Jill and Verchota from 1995, in which they established the unique solvability of the Dirichlet (and regularity) problems with square integrable data, on bounded Lipschitz domains, for arbitrary order homogeneous constant coefficient elliptic operators, thus establishing a long-standing conjecture in the field. These works have stimulated a lot of further research, which is still ongoing, since many fascinating open problems remain in this area. Jill has also made (and continues to make) important contributions to the study of the Dirichlet, regularity and Neumann problems for second order elliptic operators in divergence form, under sharp regularity assumptions on the coefficients. Noteworthy recent contributions are in joint works with Hofmann, Kenig, and Mayboroda (2015), where Jill established, for coefficients that need not be symmetric, optimal results on the solvability of the problems mentioned above, with data in Lebesgue spaces. The new methods developed in these works are expected to have a wide range of applicability.

On cryptography

Jill's work on cryptography started in a paper with J. Hoffstein and J. Silverman, in which they describe NTRU, the first secure and practical cryptosystem based on hard lattice problems. This work has spawned a veritable industry of research on lattice-based cryptography, which has recently taken on added importance due to its use by Gentry to construct the first fully homomorphic cryptosystem, and to the fact that NTRU and subsequent lattice-based cryptosystems appear to be secure against attack by quantum computers, as opposed to all earlier systems. Jill continues to be actively involved in this field, in which she has cofounded a company to commercialize a new cryptosystem, published a number of papers, holds four patents, and has written an undergraduate textbook (all with co-authors).

In addition to the intense research work just outlined, Jill has over the years also been very actively involved in the mentoring and training of graduate students and postdocs.

Jill and ICERM (the NSF Institute for Computational and Experimental Research in Mathematics)

Jill played an amazing leadership role in the conception and creation of ICERM, the Institute for Computational and Experimental Research in Mathematics, an NSF-funded research institute at Brown University, of which she was the founding director (2010–2016). Jill conceived the scientific concept of the institute and wrote the proposal to NSF. A key role in the securing of the NSF funding for the institute was played by the commitment by Brown University to build the facilities for the institute. This was a big investment in mathematics by Brown. To obtain this commitment, Jill needed to forcefully and persuasively present the case, to the university's administration, of the importance of mathematics for the university.

Jill was deeply involved in every aspect of the creation of ICERM, from putting together an excellent board of trustees for general oversight, and an outstanding scientific advisory board to advise on the launching of great programs, to ensuring that postdocs and visitors had successful and enjoyable experiences, and always making diversity in all its forms a priority for the institute. During Jill's tenure ICERM became a world-renowned institute. Finally, before stepping down as director, Jill made a forceful case to Brown's administration to make the institute a priority in their fundraising, to help secure its funding going forward.

Conclusion

Jill Pipher has demonstrated outstanding leadership qualities through her excellent work as chair of the Department of Mathematics at Brown and president of the AWM. She has also made a number of important scientific contributions to harmonic analysis, partial differential equations and cryptography. As founding director of ICERM, Jill has shown great vision, and has demonstrated a leadership style that encompasses careful thoughtfulness and true dedication to diversity and inclusion. In making ICERM a reality, Jill has shown herself to be an incredibly effective advocate for mathematics. We feel very strongly that these great attributes would serve very well the AMS and the whole mathematical community, should Jill be elected to the Presidency of the AMS.

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Nomination of Ruth J. Williams

by Persi Diaconis and S. R. Srinivasa Varadhan

Ruth Williams is an excellent choice to be President of the American Mathematical Society (AMS). She is a superb probabilist and analyst who has developed both healthy abstract theories and really useful applications. Ruth was president of the Institute of Mathematical Statistics, an active editor of journals, and a very successful organizer of dozens of large meetings. Ruth is well known as someone who gets things done in a positive, responsible way. With storm clouds on the national horizon, having an effective leader with a "can do" spirit as well as being a world-class mathematician is crucial to the AMS.

To begin at the beginning, Ruth had her undergraduate and master's level education in Melbourne, Australia. She had a spectacular start, winning many prizes at the University of Melbourne in mathematics, pure and applied, as well as physics and chemistry. Her first publications (in n-person game theory) stem from this period.

She then went to Stanford University to pursue a doctorate in mathematics under Kai Lai Chung. Her thesis problem started in queueing theory but evolved into delicate infinite-dimensional analysis and novel high-dimensional convex geometry. In simple cases, a queue can be described by specifying an arrival process, for instance, a Poisson process, an internal structure — for instance, there are k servers and arrivals join the shortest line — and a distribution of service times. As customers arrive, queue lengths build up and deplete, and one is interested in long-time stationary behavior, the emergence of blow-ups, and the effect of the design on these. A useful limiting approximation, the heavy traffic limit, has arrival and service rates large but approximately equal. Then a suitably scaled vector of queue lengths behaves like an n-dimensional diffusion process reflecting off the boundaries of a convex polyhedra. Understanding the heavy traffic limits of complex queuing networks with a large number of interconnected nodes with feedback; i.e., when, after service, the client can go back for service at another node, has an important role in the study of complex computer networks.

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S. R. Srinivasa Varadhan, Professor of Mathematics and the Frank-Jay Gould Professor of Science, Courant Institute.

Ruth's thesis treated the case of diffusion in a two-dimensional wedge. This is Brownian motion with a drift towards zero inside the wedge with constant oblique reflections on the two lines bounding the wedge. The existence of the limit and its long-term behavior were established and studied in detail. Later technical advances established conditions on the reflection rules so that the diffusion is a semi-martingale; a detailed study was later made for symmetric diffusions. In work with Maury Bramson, Ruth developed a method for reducing the dimension of the space in which the approximation has to be established.

Ruth has continued to work on both mathematical and applied aspects of queueing theory. In a system where each processor is shared among many jobs, perhaps unequally, the analysis requires keeping track of the amount of service still needed for each job. The information can be coded into a measure and this can be used to study the limits both fluid (law of large numbers) and diffusive (fluctuation). Some of this work, with Amber Puha, received the Best Publication in Applied Probability Award from the Applied Probability Society of the Institute for Operations Research and the Management Sciences. She discussed this work at the International Congress of Mathematicians (ICM) in Berlin and it is cited in her INFORMS John von Neumann Theory Prize.

Ruth seems to have investigated every part of queueing theory, from the most esoteric measurability issues to long-term collaborations with applied researchers working on stochastic control of stochastic networks. She has been fundamental in finding how to implement the optimal procedures obtained for the heavy traffic limit on an actual queueing network. While the answer to the question in full generality is still open, Ruth has solved a variety of cases for networks with specific protocols.

Other longstanding interests, with many publications, are financial mathematics, chemical reaction networks, and biology—in particular crosstalk in gene networks. In these areas, Ruth mixes mathematical clarity and rigor with hands-on knowledge of the science underlying the application. In this age of increasing specialization, it is refreshing to witness Ruth's immersive grasp of dynamical systems, game theory, PDEs, control theory, and functional analysis all coming together.

Clearly, Ruth Williams is a distinguished probabilist. She is a member of the US National Academy of Sciences, an ICM speaker and von Neumann Prize winner. In addition, she has years of experience in service to the community. The Institute of Mathematical Statistics (IMS) is a large international organization very much akin to the AMS. Ruth served three years as IMS president (incoming, current, and past). Her two AMS nominators have both done this job and attest to the good judgment and patience Ruth brought to it. She has served on innumerable committees, like selection, advisory, and organizing. She has infinite energy, getting things done in an innovative, fair, and calm way. We both believe that, if elected, she will make an excellent President of the American Mathematical Society, and she deserves your vote.