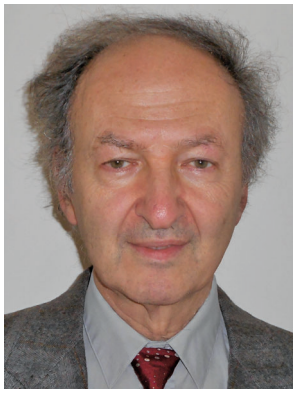
George Lusztig Awarded 2022 Wolf Prize

The Wolf Foundation Prize in Mathematics for 2022 has been awarded to **George Lusztig** of the Massachusetts Institute of Technology for "groundbreaking contributions to representation theory and related areas."


George Lusztig

Citation

George Lusztig is a Romanian American mathematician who works on geometric finite reductive groups, representation theory, and algebraic groups. Lusztig's work is characterized by a very high degree of originality, an enormous breadth of subject matter, remarkable technical virtuosity, and great profundity in getting to the heart of the problems involved. Lusztig's groundbreaking contributions mark him as one of the great mathematicians of our time.

Lusztig is known for his work on representation theory, in particular for the objects closely related to algebraic groups, such as finite reductive groups, Hecke algebras, P-adic groups, quantum groups, and Weyl groups. He essentially paved the way for modern representation theory. This has included fundamental new concepts, including the character sheaves, the Deligne–Lusztig varieties, and the Kazhdan–Lusztig polynomials.

Lusztig's first breakthrough came with Deligne around 1975, with the construction of Deligne–Lusztig representations. He then obtained a complete description of the irreducible representations of reductive groups over finite fields. Lusztig's description of the character table of a finite reductive group rates as one of the most extraordinary achievements of a single mathematician in the twentieth century. To achieve his goal, he developed a panoply of techniques which are in use today by hundreds of mathematicians. The highlights include the use of étale cohomology, the role played by the dual group, the use of intersection cohomology, and the ensuing theory of character sheaves, almost characters, and the noncommutative Fourier transform.

In 1979 Kazhdan and Lusztig defined the Kazhdan–Lusztig basis of the Hecke algebra of a Coxeter group and stated the Kazhdan–Lusztig conjecture. The Kazhdan–Lusztig conjecture led directly to the Beilinson–Bernstein localization theorem, which, four decades later, remains our most powerful tool for understanding representations of reductive Lie algebras. Lusztig's work with Vogan then introduced a variant of the Kazhdan–Lusztig algorithm to produce Lusztig–Vogan polynomials. These polynomials are fundamental to our understanding of real reductive groups and their unitary representations.

In the 1990s, Lusztig made seminal contributions to the theory of quantum groups. His contributions include the introduction of the canonical basis; the introduction of the Lusztig form (which allows specialization to a root of unity and connections to modular representations); the quantum Frobenius and a small quantum group; and connections to the representation theory of affine Lie algebras. Lusztig's theory of the canonical basis (and Kashiwara's parallel theory of crystal bases) has led to deep results in combinatorics and representation theory. Recently there has been significant progress in representation theory and low-dimensional topology via "categorification"; the roots of this work go back to Lusztig's geometric categorification of quantum groups via perverse sheaves on quiver moduli.

Biographical Sketch

George Lusztig received his PhD from Princeton University in 1971 under the direction of Michael Atiyah and William Browder. As a high school student, he represented Romania in the International Mathematical Olympiads of 1962 and 1963, winning a silver medal each year. He held a professorship appointment at the University of Warwick from 1974 to 1977. He joined the mathematics faculty at MIT in 1978 and served as Norbert Wiener Professor

from 1999 to 2009. He is currently Abdun-Nur Professor of Mathematics. His honors include the Berwick Prize of the London Mathematical Society (1977), the AMS Cole Prize in Algebra (1985), the Brouwer Medal of the Dutch Mathematical Society (1999), and the AMS Leroy P. Steele Prize for Lifetime Achievement (2008). He was awarded the Shaw Prize in Mathematical Sciences in 2014. He held Simons Foundation Fellowships in 2014 and 2021. He is a Fellow of the Royal Society and of the American Academy of Arts and Sciences and a member of the National Academy of Sciences.

About the Prize

The Wolf Prize carries a cash award of US$100,000. The science prizes are given annually in the areas of agriculture, chemistry, mathematics, medicine, and physics. Laureates receive their awards from the President of the State of Israel in a special ceremony at the Knesset Building (Israel's Parliament) in Jerusalem. The list of previous recipients of the Wolf Prize in Mathematics is available on the website of the Wolf Foundation, `www.wolffund.org.il`.

Credits

Photo of George Lusztig is courtesy of Gongqin Li.