

2022 Abel Prize

The Norwegian Academy of Science and Letters in Oslo, Norway, has awarded the 2022 Abel Prize to Dennis Parnell Sullivan, USA. Sullivan holds the Albert Einstein Chair at the City University of New York Graduate Center, New York, USA, and is a distinguished professor at Stony Brook University, New York. He will receive a cash award of 7.5 million Norwegian kroner (USD 854,000) and a citation as follows: ‘for his groundbreaking contributions to topology in its broadest sense, and in particular its algebraic, geometric and dynamical aspects.’ The award ceremony took place on 24 May in Oslo, the capital of Norway.

Sullivan was born in 1941 in Port Huron, Michigan, USA. Soon after, his family relocated to Houston. He enrolled in the chemical engineering programme at Rice University, Houston. During a calculus lecture at the University, his professor drew two figures – one was a circle and the other was more blobby like a kidney. The professor pointed out that one figure could be transformed into the other by stretching. This drew Sullivan’s interest to the field of topology, which is the study of qualitative properties of shapes. He switched his major from chemical engineering to mathematics in the second year of the BS programme. Sullivan received his Ph.D. degree in mathematics from Princeton University (1966) under the guidance of William Browder with his thesis titled, ‘Triangulating homotopy equivalences’. His work encompasses mathematical objects called manifolds, which are higher-dimensional counterparts of two-dimensional surfaces. In 1970, he published a set of notes entitled ‘Geometric topology: localization, periodicity and Galois symmetry’, which are still widely used.

According to Hans Munthe-Kaas, Chair of the International Abel Prize Committee, ‘Dennis P. Sullivan has repeatedly changed the landscape of topology by introducing new concepts, proving landmark theorems, answering old conjectures and formulating new problems that have driven the field

forwards. Sullivan has moved from area to area, seemingly effortlessly, using algebraic, analytic and geometric ideas like a true virtuoso.’ His doctoral advisor, Browder, is one of the pioneers of the so called ‘surgery theory’ method for classifying high-dimensional manifolds. Sullivan was one of the leading proponents of the surgical theory. He contributed significantly to the ‘Hauptvermutung’, which deals with the different ways of triangulating space. By developing the notions of localization and completion in homotopy theory he proved the Adams conjecture, which was also proved independently by Daniel Quillen using a different approach^{1–3}.

In the 1980s, Sullivan’s focus switched to dynamical systems, an area typically considered unrelated to algebraic topology. The computational works pointed to the frequent occurrences of certain numbers (now known as the Feigenbaum constants) across diverse types of dynamical systems. Sullivan explained phenomenon and proved the universality law for a period-doubling for a large class of dynamical systems. In 1985, he proved that rational maps do not have wandering domains, a landmark result in dynamical systems⁴. With Moira Chas, Sullivan established the field of string topology. This new field has been employed in proposals to construct topological quantum field theories in mathematical physics⁵.

Sullivan is a recipient of many awards, including the Veblen Prize in Geometry (1971), Prix Élie Cartan of the French Academy of Sciences (1981), King Faisal International Prize for Science (1994), Leroy P. Steele Prize by the American Mathematical Society (2006), Wolf Prize (2010) and Balzan Prize (2014). He is a regular visitor to India and has given seminars at various locations across the country. For instance, he gave the ‘First Subhashis Nag Memorial Endowment Lecture’ in December 2002 (<https://www.imsc.res.in/>). Nag (1955–98) is well known for his work on the Teichmüller spaces⁶. Sullivan’s doctoral students

from India include Somnath Basu, Aradhana Kumari and Chandrika Sadanand.

The Abel Prize was instituted in 2001 in honour of the Norwegian mathematician Niels Henrik Abel (1802–29). Along with the Fields Medal (first given in 1936), the Abel Prize is considered to be the highest award in mathematics. The inaugural prize was given to Jean-Pierre Serre in 2003. Among the 25 recipients, Karen Keskulla Uhlenbeck is the only woman laureate who received the honour unshared in 2019. Sathamangalam Ranga Iyengar Srinivasa Varadhan is the only recipient of Indian (and Asian) origin to have won the prize (unshared in 2007)⁷. Six of the 25 Abel laureates are Fields medalists (Jean-Pierre Serre, Michael Francis Atiyah, John Griggs Thompson, John Willard Milnor, Pierre Deligne and Grigory Aleksandrovich Margulis). The deadline for nomination to the Abel Prize is 15 September each year (<https://www.abelprize.no/>).

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