Luis Caffarelli Awarded Shaw Prize

The Shaw Foundation has announced the awarding of the 2018 Shaw Prize in Mathematical Sciences to LUIS CAFFARELLI of the University of Texas at Austin “for his groundbreaking work on partial differential equations, including creating a theory of regularity for nonlinear equations such as the Monge–Ampère equation, and free-boundary problems such as the obstacle problem, work that has influenced a whole generation of researchers in the field.”

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The Shaw Foundation’s statement reads: “Partial differential equations are fundamental to large parts of mathematics, physics, and indeed all the sciences. They are used to model heat flow, fluid motion, electromagnetic waves, quantum mechanics, the shape of soap bubbles, and innumerable other physical phenomena.”

“A few very simple equations can be solved explicitly—that is, one can find an exact formula for their solutions—but this is very much the exception rather than the rule. Instead, one has to be content with being able to show that solutions exist, and with being able to say something about how they behave.”

“A very important example of this is the Navier–Stokes equation, which describes the motion of a viscous fluid. It is not known whether, given appropriate initial conditions, there must be a solution to the Navier–Stokes equation that remains well-behaved forever, or whether singularities will necessarily develop. To put it more graphically, if you stir a bucket of water, is there a danger that a week later it will blow up? Probably not, but nobody knows how to prove this, and it is one of the major unsolved problems of mathematics.”

“Although it is not known how to solve the Navier–Stokes equations, one can find so-called ‘weak solutions,’ which are abstract objects that solve the equations, but not in quite the sense one wants. If one could show that these solutions were ‘regular,’ then the Navier–Stokes problem would be solved. A famous result of Caffarelli, Kohn, and Nirenberg is the closest anybody has come to that: it shows that weak solutions exist that are regular except on a set of singularities that has to be very small, in a precise mathematical sense.”

“Another area in which Caffarelli has created a new and highly influential theory is obstacle problems. Here one would like to know the shape that will be taken by an elastic membrane with a given boundary if it has to lie above a certain obstacle. The shape taken will be the one that minimizes its energy, but the important questions concern how well-behaved, or ‘regular,’ a solution of this kind will be. As with all important problems in partial differential equations, this one arises in many contexts, including fluid filtration in porous media, and financial mathematics.”

“In general, because one does not usually have explicit formulae for solutions to partial differential equations, the analysis of their properties is very hard, and depends on extremely delicate estimates. Caffarelli is a master at this, frequently coming up with arguments that have left other researchers wondering how he could possibly have thought of them. He continues to work at the forefront of the field and has had a huge influence, both through his own work and that of his doctoral students, many of whom have themselves become extremely distinguished mathematicians. In a way that few mathematicians achieve even once, he has repeatedly created important areas almost from scratch that are extremely active to this day.”

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Biographical Sketch

Luis A. Caffarelli was born in Buenos Aires, Argentina, in 1948. He received his PhD in mathematics in 1972 from the University of Buenos Aires. He joined the University of Minnesota, where he held the positions of postdoctoral fellow (1973–1974), assistant professor (1975–1977), associate professor (1977–1979), and professor (1979–1983). He was professor at the Courant Institute of Mathematical Sciences, New York University, from 1980 to 1982, at the University of Chicago from 1983 to 1986, at the Institute for Advanced Study in Princeton from 1986 to 1996, and at the Courant Institute, New York University, from 1994 to 1997. His awards and honors include the Bôcher Memorial Prize (1984), the Rolf Schock Prize (2005), the Steele Prize for Lifetime Achievement (2009), and the Wolf Prize (with Michael Aschbacher, 2012). He is a Fellow of the AMS, SIAM, and the American Academy of Arts and Sciences and a member of the National Academy of Sciences and the Pontifical Academy of Sciences.

About the Prize

The Shaw Prize is an international award established to honor individuals who are currently active in their respective fields and who have achieved distinguished and significant advances, who have made outstanding contributions in culture and the arts, or who have achieved excellence in other domains. The award is dedicated to furthering societal progress, enhancing quality of life, and enriching humanity’s spiritual civilization. Preference is given to individuals whose significant work was recently achieved.

The Shaw Prize consists of three annual awards: the Prize in Astronomy, the Prize in Science and Medicine, and the Prize in Mathematical Sciences. Established under the auspices of Run Run Shaw in November 2002, the prize is managed and administered by the Shaw Prize Foundation based in Hong Kong. The prize carries a cash award of US$1,200,000.

Previous recipients of the Shaw Prize in Mathematical Sciences are:

- János Kollár and Claire Voisin (2017)
- Nigel J. Hitchin (2016)
- Gerd Faltings and Henryk Iwaniec (2015)
- George Lusztig (2014)
- David L. Donoho (2013)
- Maxim Kontsevich (2012)
- Demetrios Christodoulou and Richard S. Hamilton (2011)
- Jean Bourgain (2010)
- Vladimir Arnold and Ludvig Faddeev (2008)
- David Mumford and Wen-Tsun Wu (2006)
- Andrew Wiles (2005)
- Shihing-Shen Chern (2004)

—Shaw Foundation announcement