The Crafoord Prizes in Mathematics and Astronomy 2016

The Royal Swedish Academy of Sciences has decided to award the 2016 Crafoord Prize in Mathematics to

Yakov Eliashberg

Stanford University, Stanford, California, USA

"for the development of contact and symplectic topology and groundbreaking discoveries of rigidity and flexibility phenomena."

and the 2016 Crafoord Prize in Astronomy to

Roy Kerr

University of Canterbury, Christchurch, New Zealand

Roger Blandford

Stanford University, CA, USA

"for fundamental work concerning rotating black holes and their astrophysical consequences"

The Crafoord Prize in Mathematics

Yakov Eliashberg is one of the leading mathematicians of our time. For more than thirty years he has helped to shape and research a field of mathematics known as symplectic geometry, and one of its branches in particular – symplectic topology.

Yakov Eliashberg has solved many of the most important problems in the field and found new and surprising results. He has further developed the techniques he used in contact geometry, a twin theory to symplectic geometry. While symplectic geometry deals with spaces with two, four, or other even dimensions, contact theory describes spaces with odd dimensions. Both theories are closely related to current developments in modern physics, such as string theory and quantum field theory.

Symplectic geometry's link to physics has old roots. For example, it describes the geometry of a space in a mechanical system, the space phase. For a moving object, its trajectory is determined each moment by its position and velocity. Together, they determine a surface element that is the basic structure of symplectic geometry. The geometry describes the directions in which the system can develop; it describes movement. Physics becomes geometry.

One of Yakov Eliashberg's first and perhaps most surprising results was the discovery that there are regions where symplectic geometry is rigid and other regions where it is completely flexible. But where the boundary is between the flexible and the rigid regions, and how it can be described mathematically, is still a question that is awaiting an answer.

Yakov Eliashberg, born 1946 in S:t Petersburg, Russia, Ph.D. at Leningrad State University 1972. Herald L. and Caroline L. Ritch Professor of mathematics at Stanford University, CA, USA.

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KUNGL. VETENSKAPS-AKADEMIEN
THE ROYAL SWEDISH ACADEMY OF SCIENCES

The Crafoord Prize in Astronomy

Black holes are the origin of the universe's most powerful light, with rays that can stretch many thousands of light years out into space. Roger Blandford's theoretical work deals with the violent processes behind this strong radiation. Roy Kerr created one of the most important tools in modern astrophysics and cosmology early in his career, when he discovered a mathematical description of rotating black holes before anyone had even seen them.

Black holes are the strangest result of the general theory of relativity. When Albert Einstein finally presented his theory, in November 1915, he described gravity as a geometric property of space and time, spacetime. All massive space objects bend spacetime; they create a pit into which smaller objects can fall. The greater the mass, the deeper the pit. The mass of a black hole is so great that nothing that ends up in there can escape, not even light.

It took until 1963 for someone to solve Einstein's equations for black holes that could possibly be found in the universe – rotating black holes – and it was mathematician Roy Kerr who succeeded. At about the same time, astronomers discovered galaxies that emitted light that was so strong it outshone several hundred ordinary galaxies. They were named quasars. Nothing other than a black hole could give the quasars their luminosity.

So how is the strong light of rotating black holes created? This question was answered by Roger Blandford in 1977. Ever since, he has refined and made more realistic models of how gas surrounding a black hole flows towards it, is heated up and transforms some of its gravitational energy to radiation. At the same time, electrically charged particles are sent millions of kilometres into space in the form of powerful jets. The source of all of this power is the rotational energy of the massive black hole.

Roy Kerr, born 1934 in Kurow, New Zeeland. Ph.D. 1959 at University of Cambridge, Great Britain. Emeritus Professor at University of Canterbury, New Zeeland.

www.phys.canterbury.ac.nz/people/kerr.shtml

Roger Blandford, born 1949 in Grantham, Great Britain. Ph.D. 1974 at University of Cambridge, Great Brittan. Luke Blossom Professor in the School of Humanities and Sciences, Stanford University, CA, USA.

https://physics.stanford.edu/people/faculty/roger-blandford

Prize amount: 6 million Swedish krona per prize. The Crafoord Prize in Astronomy is shared equally between the Laureates.
Prize award ceremony: is to be held at the Royal Swedish Academy of Sciences on 26 May 2015, in the presence of Their Majesties the King and Queen of Sweden.
Crafoord Days 24–26 may 2016 in Stockholm and Lund: Prize Lecture, Tuesday 24 May, Lund University, Lund.
Prize symposium, Wednesday 25 May, Stockholm registration at http://kva.se/kalendarium.
Prize ceremony, Thursday 26 May, Beijer hall, the Royal Swedish Academy of Sciences, Stockholm.
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