THE KAVLI PRIZE

THE KAVLI PRIZE IN ASTROPHYSICS 2016

The Norwegian Academy of Science and Letters has decided to award the Kavli Prize in Astrophysics for 2016 to

RONALD W.P. DREVER
California Institute of Technology, USA

KIP S. THORNE
California Institute of Technology, USA

RAINER WEISS
Massachusetts Institute of Technology, USA

"for the direct detection of gravitational waves"

On September 14, 2015, the Laser Interferometer Gravitational Wave Observatory (LIGO) registered a pulse of gravitational radiation emitted by the inspiralling and coalescence of two black holes. This detection has, in a single stroke and for the first time, validated Einstein's theory of general relativity for very strong fields, established the nature of gravitational waves, demonstrated the existence of black holes with masses 30 times that of our sun, and opened a new window on the universe.

Gravitational radiation was predicted 100 years ago by Albert Einstein, shortly after he developed the theory of gravity known as general relativity. Gravitational waves consist of almost unimaginably tiny ripples in the very fabric of four-dimensional space-time that emanate from rapidly moving masses and propagate at the speed of light, in analogy to ripples spreading on the surface of a placid pond. Emission of gravitational radiation was inferred from the measured orbital decay of a single binary pulsar some 30 years ago. But the direct measurement of the tiny space-time ripples required the sustained vision and experimental ingenuity of Drever, Thorne and Weiss, spanning most of the last 50 years, as individual scientists and later as intellectual leaders of a team of hundreds of scientists and engineers.

When a gravitational wave passes through Earth it distorts space, alternately stretching it in one direction and compressing it at right angles. LIGO consists of two perpendicular arms, each 4 km long, which respond to this distortion, changing in length by a tiny fraction of the diameter of a proton. Measuring such displacements, billions of times smaller than vibrations produced naturally in the environment, is the astonishing technical feat that LIGO has accomplished. To distinguish the passage of a gravitational wave from local disturbances, LIGO deploys two identical interferometers, one in Washington State and the other in Louisiana. At the moment the gravitational wave hit the Earth, the two instruments registered identical signals, separated only by the time required for the wave to traverse the distance between them.

The tiny effect that gravitational waves have on space led many scientists to believe they would be undetectable. A breakthrough was achieved in 1972, when Weiss worked out the basic interferometer concept that eventually became LIGO. Weiss provided technical leadership and devoted his extraordinary experimental acumen over the next decades, contributing to every aspect of the final apparatus.

Thorne had, since the 1960s, been evaluating how extreme events in the universe, such as colliding black holes and neutron stars, would generate gravitational radiation. In 1975 Thorne and Weiss began discussions of how to build Weiss' interferometer. Thorne provided scientific leadership and the vision that led to the establishment of LIGO. He also initiated a successful programme of numerical

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See also:

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The Kavli Foundation
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computations of the expected waveforms necessary to extract astrophysical parameters from the detected signals.

Drever joined Thorne and Weiss in 1979 as a third co-founder of the project. Drever applied his extraordinary experimental genius to perfecting the design and operation of interferometers. He devised methods for increasing the efficiency and power of the optical systems at the heart of LIGO. His insights led to major improvements in LIGO's capability that were essential in achieving the required sensitivity.

The detection of gravitational waves is an achievement for which hundreds of scientists, engineers and technicians around the world share credit. Drever, Thorne and Weiss stand out: their ingenuity, inspiration, intellectual leadership and tenacity were the driving force behind this epic discovery.