Kip S. Thorne

Kip S. Thorne (BS '62), the Richard P. Feynman Professor of Theoretical Physics, Emeritus, and recipient of the 2017 Nobel Prize in Physics, is one of the world's leading experts on the astrophysical implications of Albert Einstein's general theory of relativity. His research has provided a deeper theoretical understanding of extreme cosmic objects, such as black holes, and how they warp space and time. He is co-founder of the Laser Interferometer Gravitational-wave Observatory (LIGO), along with the late Ronald W. P. Drever of Caltech and MIT's Rainer Weiss.

On September 14, 2015, LIGO made the first-ever observation of ripples in the fabric of space and time, called gravitational waves. These waves were generated by the collision of two black holes in the distant universe and travelled for 1.3 billion years to reach Earth. LIGO consists of two L-shaped instruments called interferometers—one in Hanford, Washington, and the other in Livingston, Louisiana—each with two 4-kilometer-long arms designed to register the infinitesimally small changes to space and time caused by passing gravitational waves.

Thorne was born on June 1, 1940, in Logan, Utah. He received his bachelor's degree in physics from Caltech in 1962 and his PhD in physics from Princeton University in 1965.

Thorne joined the Caltech faculty as an associate professor of theoretical physics in 1967, and became a full professor in 1970 and Caltech's William R. Kenan, Jr., Professor in 1981. He was named the Richard P. Feynman Professor of Theoretical Physics in 1991 and Feynman Professor, Emeritus, in 2009.

In the late 1960s, Thorne initiated theoretical studies that would underpin LIGO. He set up a research group at Caltech to improve the theory of gravitational waves and estimate the details and strengths of the waves that would be produced by objects in our universe such as black holes, neutron stars, and supernovas. In 1972, with his student Bill Press (MS '71, PhD '73), Thorne published the first of many articles that would appear over the course of three decades, summarizing all that was known about the sources of gravitational waves and formulating an evolving vision for the future of gravitational-wave astronomy.

In 1975, Thorne and Weiss initiated discussions that would lead them, with Drever, to create LIGO. From the 1970s through the 2000s, Thorne and his postdocs and students provided theoretical support for LIGO. This included analyzing potential sources of gravitational waves; laying foundations for searching for those waves in LIGO's noisy data; analyzing noises that could mask the gravitational-wave signals; and devising ways to deal with the noises. Thorne's group, in collaboration with a Russian group led by the late Vladimir Braginsky of Moscow State University, showed that, with LIGO, scientists would see for the first time ever human-sized objects (LIGO's mirrors) exhibiting quantum mechanical fluctuations. They devised so-called quantum-nondemolition techniques to prevent those fluctuations from destroying LIGO's gravitational-wave signals before they could be seen.

In 2004, with Saul Teukolsky (PhD '73), who was then at Cornell University and is now jointly the Robinson Professor of Theoretical Astrophysics at Caltech and Hans A. Bethe Professor of Physics and Astrophysics at Cornell, Thorne founded the SXS (Simulating eXtreme Spacetimes) project, to simulate on supercomputers the sources of gravitational waves that could be detected by LIGO. The SXS simulations became a crucial underpinning for extracting information from LIGO's first observed gravitational-wave signals.

Among other research, Thorne has investigated the spin rates of black holes. In 1974, he deduced that a black hole orbited by a stellar companion can be spun up to 0.998 percent of the maximum spin allowed by general relativity, but never any faster. In 1985, with James Hartle (PhD '64) of UC Santa Barbara, he derived the laws of motion and precession of black holes and other bodies that have ultrastrong gravity. In 1976, he and then-Caltech postdoctoral fellow Anna Żytkow, now at the Institute of Astronomy of the University of Cambridge, predicted the existence of red supergiant stars with neutron-star cores.

He has been a mentor to 52 PhD physicists, many of whom have gone on to become world leaders in their fields.

Thorne served as an executive producer and science adviser for the 2014 film *Interstellar*, directed by Christopher Nolan. He published a book, *The Science of Interstellar*, to detail the real science embedded in the film, and was awarded the National Space Society's Space Pioneer Award for Mass Media for his role in the film's production and in ensuring its scientific accuracy.

He coauthored the textbook *Gravitation Theory and Gravitational Collapse* in 1965; *Gravitation* in 1973; and *Black Holes: The Membrane Paradigm* in 1986. On October 11, 2017, he will publish the textbook *Modern Classical Physics,* coauthored with Roger Blandford. He was the sole author of *Black Holes and Time Warps: Einstein's Outrageous Legacy*, published in 1994.

Thorne is a member of the National Academy of Sciences, the Russian Academy of Sciences, and the American Philosophical Society, and is a fellow of the American Physical Society and the American Academy of Arts and Sciences. He holds honorary degrees from the University of Chicago, the University of Glasgow, Moscow State University, Universitat Politècnica de Catalunya, Utah State University, Claremont Graduate University, and Illinois College.

In 2016, together with Drever and Weiss, Thorne won the Kavli Prize in Astrophysics, the Shaw Prize in Astronomy, the Gruber Foundation Cosmology Prize, and the Special Breakthrough Prize in Fundamental Physics. In 2017, together with former LIGO director Barry C. Barish, Weiss, and the entire LIGO Scientific Collaboration (LSC), he won the Princess of Asturias Award for Technical and Scientific Research. With Weiss and Barish, he also won the 2017 European Physical Society's Giuseppe and Vanna Cocconi Prize and the 2017 Fudan University's Fudan-Zhongzhi Science Award. Additionally, Thorne has been awarded the Lilienfeld Prize of the American Physical Society, the Karl Schwarzschild Medal of the German Astronomical Society, and UNESCO's Niels Bohr Gold Medal.