ICFO

ICFO Colloquium KIP THORNE 'Geometrodynamics, and Quantum Nondemolition Techniques for LIGO'

KIP THORNE

May 26, 2017

Friday, May 26, 12:00, 2017. ICFO Auditorium

KIP THORNE

Professor of Theoretical Physics; Emeritus

California Institute of Technology (Caltech)$$Kip Thorne is the Feynman Professor of Theoretical Physics, Emeritus, at the California Institute of Technology (Caltech). He received his BS from Caltech in 1962 and his PhD from Princeton in 1965, then returned to Caltech as a postdoctoral fellow (1966), an associate professor (1967), a full professor (1970), and the Feynman Professor of Theoretical Physics (1991). Thorne?s research has focused on Einstein?s general theory of relativity and on astrophysics, with emphasis on relativistic stars, black holes and especially gravitational waves. He was cofounder (with R. Weiss and R.W.P. Drever) of the LIGO (Laser Interferometer Gravitational Wave Observatory) Project, which made the breakthrough discovery of gravitational waves arriving at Earth from the distant universe on September 14, 2015.

In 2009 Thorne stepped down from his professorship to ramp up a new career at the interface between art and science, including the movie Interstellar (which sprang from a Treatment he co-authored, and for which he was Executive Producer); multimedia performances with composer Hans Zimmer and visual effects guru Paul Franklin; and a forthcoming book of his poetry and of paintings by artist Lia Halloran.

Thorne will describe two unusual research programs that he and his research group have pursued. Both are connected to LIGO, the Laser Interferomter Gravitational Wave Observatory.

GEOMETRODYNAMICS: The nonlinear dynamics of curved spacetime (the "spacetime storm") created by the black-hole collisions that LIGO has observed. This dynamics entails physical structures called "tidal tendices" and "frame-drag vortices" that (i) are made from curved spacetime, (ii) are attached to the colliding black holes, and (iii) interact in remarkable ways, giving rise to the gravitational waves that LIGO detects and monitors.

QUANTUM NONDEMOLITION (QND) TECHNIQUES: The set of techniques that may soon be used in LIGO, to circumvent the Heisenberg uncertainty principle as applied to LIGO?s 40 kg mirrors. The uncertainty principle dictates that, by monitoring the separations of the mirrors? centers of mass, the LIGO instrumentation creates unpredictable quantum fluctuations of the mirrors? relative momenta, fluctuations large enough to hide the subsequent influence of gravitational waves. Late this year, the first of a set of QND techniques, to prevent these quantum fluctuations from "demolishing" the gravitational-wave signal, will be installed in LIGO. This first QND technique is the injection of squeezed vacuum into LIGO?s output port.

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