ICFO Colloquium EUGENE POLZIK 'Measurements not bounded by the Heisenberg uncertainty principle'

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February 26, 2016

Friday, February 26, 12:00, ICFO Auditorium

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Professor of physics at the Niels Bohr Institute, University of Copenhagen and Head of QUANTOP laboratory

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Eugene Polzik is a professor of physics at the Niels Bohr Institute at the University of Copenhagen and Head of QUANTOP laboratory. His research interests are centered around quantum physics of matter and light and quantum information technologies. Among the results he has achieved are demonstrations of the quantum teleportation between material objects, a quantum memory for light, an optical detection of radio waves using a nanomechanical oscillator, a quantum optical interface with a one dimensional atomic crystal, and quantum trajectories without quantum uncertainties. Dr. Polzik is Distinguished

Invited Professor at the Institute for Photonic Sciences in Barcelona. He is a Member of the Royal Danish Academy of Sciences, a Fellow of the American Physical Society and a Fellow of the Optical Society of America. He is a recipient of the Gordon Moore Distinguished Scholar award, the Scientific American Research Leadership award, the European Research Council Advanced Grant award and the Danish Association of Academics award.
Measurements of one quadrature of an oscillator with precision beyond its vacuum state uncertainty have occupied a central place in quantum physics for decades. We have recently reported the first experimental implementation of such measurement with a magnetic oscillator. However, a much more intriguing goal is to trace an oscillator trajectory with the precision beyond the vacuum state uncertainty in both position and momentum, a feat naively assumed not possible due to the Heisenberg uncertainty principle. We have demonstrated that such measurement is possible if the oscillator is entangled with a quantum reference oscillator characterized by an effective negative mass. Progress towards such a measurement involving a macroscopic mechanical oscillator will be reported. The key element is the cancellation of the back action of the measurement on the composite system of two oscillators. Applications include measurements of e.-m. fields, accelleration, force and time with practically unlimited accuracy. In a more general sense, this approach leads to trajectories without quantum uncertainties and to achieving new fundamental bounds on the measurement precision.

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