The University of Texas at Austin
Department of Physics
College of Natural Sciences

Colloquium

Wednesday, September 21, 2022

John Archibald Wheeler Lecture Hall

PMA 4.102, 4:00pm

Levitated optomechanics and Casimir effects

Prof. Tongcang Li

Purdue University

Abstract

Optical tweezers provide a non-contact method to manipulate microscopic objects and have many potential applications in precision measurements. Recently, we developed an optically levitated Cavendish torsion balance for quantum-limited torque and force sensing [*Phys. Rev. Lett.*, 121, 033603 (2018)]. We have optically levitated nanoparticles in a vacuum and driven them to rotate up to 300 billion rpm (5 GHz). Using a levitated nanoparticle in a vacuum, we demonstrated ultrasensitive torque detection with a sensitivity several orders higher than the former record [*Nature Nanotechnology* 15, 89 (2020)]. This system will be promising for studying quantum friction, Casimir torque, and gravity at short distances. We have also proposed and demonstrated a scheme to achieve strong coupling between multiple micromechanical oscillators with quantum vacuum fluctuations, i.e., Casimir effects. Quantum field theory predicts random fluctuations everywhere in a vacuum due to the zero-point energy. We have achieved non-reciprocal energy transfer between two mechanical resonators with quantum vacuum fluctuations [*Nature Nanotechnology* 17, 148 (2022)], and measured the Casimir force between three objects for the first time.