Field:

Physics/Astrophysics/Astronomy

Session Topic:

Quantum Effects of Motion

Speaker:

Jack HARRIS, Yale University

The laws of quantum mechanics describe a world that is very different from our everyday experience. According to quantum mechanics, objects may be in multiple places at once, they may pass effortlessly through barriers, and they may influence each other across vast distances via an effect that Albert Einstein called "spooky action at a distance".

Although physicists believe the laws of quantum mechanics provide our most fundamental description of the universe, the exotic effects described above do not appear in our daily lives. This is a shame, since it is predicted that, for a wide range of tasks in computing and communications, machines that take advantage of these quantum effects can vastly outperform machines that do not. In addition, it is a point of intellectual curiosity to wonder whether macroscopic objects can be induced to exhibit quantum effects.

As a practical matter quantum effects are most readily observed in the behavior of small particles, and perhaps most readily in the behavior of photons. I will describe our work in the field of optomechanics, where we are exploring how to couple photons to the motion of macroscopic objects in ways that allow the quantum properties of the photons to be transferred to motion of the macroscopic object. Our goals are to better understand how our apparently classical macroscopic world emerges from fundamentally quantum components, how to coax quantum behavior from surprisingly large objects, and how to exploit this macroscopic quantum behavior to improve the performance of measurement, communication, and computing technologies.