Quantum optomechanics with single photons

Abstract:

Quantum optomechanics uses the radiation-pressure interaction and the tools of quantum optics to manipulate the motion of mechanical resonators at a quantum level. The field is currently receiving a surge of interest for its potential to contribute to both fundamental and applied science with current research directions including table-top tests of quantum gravity and the development of high-precision weak-force sensors. This talk will describe two recently developed techniques for quantum state engineering of mechanical motion by heralding with single photon counters. Firstly, a technique to perform single phonon addition and subtraction to a mechanical degree of freedom will be described [1]. An interesting feature of this protocol is that the addition and subtraction operations can be performed in a coherent superposition allowing for continuous-variable quantum state orthogonalization. Secondly, recent experimental work observing mechanical interference fringes will be described [2]. This second approach allows the wave-like behaviour of mechanical oscillators to be probed and brings the generation of macroscopic superposition states within reach of current technology.