MAR08-2007-007273

Abstract for an Invited Paper
for the MAR08 Meeting of
the American Physical Society

Strong dispersive coupling between a micromechanical oscillator and a high finesse optical cavity.

JACK HARRIS, Departments of Physics and Applied Physics, Yale University, New Haven, CT

Very sensitive mechanical detectors spanning roughly seventeen orders of magnitude in size are rapidly approaching a regime in which either the mechanical device itself or its readout should demonstrate quantum behavior. One of the main technical barriers to actually reaching this regime has been the difficulty of integrating ultrasensitive micromechanical devices with high-finesse optical cavities. Recently we have developed a robust means for addressing this issue, and have integrated a 50 nm-thick membrane (with a quality factor $>$ 1,000,000) into an optical cavity with a finesse $\sim$ 20,000. Although the membrane is nearly transparent, it couples to the optical cavity dispersively. This coupling is strong enough to laser-cool the membrane from room temperature to 7 mK. In addition, the dispersive nature of the optomechanical coupling allows us to realize a sensitive "displacement squared" readout of the membrane. Such a readout is a crucial requirement for measuring quantum jumps in a mechanical oscillator. We will describe these results, as well as our progress towards observing quantum effects in this system.