Abstract Submitted
for the MAR07 Meeting of
The American Physical Society

Cooling of a micro-mechanical oscillator using radiation pressure induced dynamical back-action ALBERT SCHLIESSER, NIMA NOOSHI, PASCAL DEL'HAYE, Max-Planck-Institute of Quantum Optics, 85748 Garching, Germany, KERRY VAHALA, Caltech Department of Applied Physics, Pasadena, CA 91125 USA, TOBIAS KIPPENBERG, Max-Planck-Institute of Quantum Optics, 85748 Garching, Germany — For more than three decades, dynamical backaction in the form of radiation pressure has been predicted to give rise to intricate coupled dynamics of the optical modes of a high-finesse cavity and the mechanical modes of its boundaries. In particular, if the mechanical oscillation period is comparable to the cavity's photon lifetime, and the cavity is pumped with a red-detuned laser, the Brownian motion of the mechanical mode can be reduced, corresponding to an effective temperature reduction or cooling. We have recently succeeded in an experimental demonstration of this phenomena, and exploited dynamical back-action to cool the radial breathing mode of a toroidal silica microcavity from room temperature to 11 K. Working with distinctively high mechanical frequencies (50 MHz) we can provide strong evidence for a virtually pure radiation-pressure effect. We further introduce a theoretical model to quantitatively predict the light-induced modifications in the mechanical oscillator's properties over a wide range of experimental parameters. These achievements constitute an important step towards ground-state cooling of a micromechanical oscillator.

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Date submitted: 20 Nov 2006 Electronic form version 1.4