Abstract Submitted
for the DAMOP13 Meeting of
The American Physical Society

Atom-mediated optical cooling of a mechanical resonator[1]

COLLIN REYNOLDS, Cornell University, SRIVATSAN CHAKRAM, Cornell University, BELINDA PANG, KEITH SCHWAB, California Institute of Technology, MUKUND VENGALATTORE, Cornell University — We present our experimental progress toward the realization of a hybrid quantum system consisting of a high-Q mechanical oscillator coupled to ultracold ^{87}Rb atoms. We observe quality factors and ω-Q products as high as 3×10^7 and 6×10^{13} respectively for stoichiometric silicon nitride membranes [1,2] at room temperature, putting us in a regime to achieve quantum ground-state cooling[3]. A novel sympathetic cooling scheme is presented which relies on coupling internal states of ^{87}Rb atoms to the mechanical motion of the resonator via a non-degenerate two-photon Raman process. Proof-of-principle experiments give projected cooling rates of 10^{12} phonons/s, leading to the possibility of atom-mediated cooling from room temperature down to the quantum ground state. Our scheme does not rely on the optomechanical system being in the "good cavity" regime, thereby enabling the optical cooling of mechanical resonators with low quality factors and poor optical properties such as graphene nanoresonators.

[1] B. M. Zwickl *et al*, Appl. Phys. Lett. **92**, 103125 (2008);
[2] D. J. Wilson *et al*, Phys. Rev. Lett. **103**, 207204 (2009);
[3] F. Marquardt *et al*, Phys. Rev. Lett. **99**, 09390

[1]This work is supported by the DARPA QuASAR program through a grant from the ARO.

Collin Reynolds
Cornell University

Date submitted: 24 Jan 2013 Electronic form version 1.4