Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Asymmetric absorption and emission of energy by a macroscopic mechanical oscillator in a microwave circuit optomechanical system JENNIFER HARLOW, TAUNO PALOMAKI, JOSEPH KERCKHOFF, JILA, University of Colorado and NIST, JOHN TEUFEL, RAYMOND SIMMONDS, NIST Boulder, KONRAD LEHNERT, JILA, University of Colorado and NIST — We measure the asymmetry in rates for emission and absorption of mechanical energy in an electromechanical system composed of a macroscopic suspended membrane coupled to a high-Q, superconducting microwave resonant circuit. This asymmetry is inherently quantum mechanical because it arises from the inability to annihilate the mechanical ground state. As such, it is only appreciable when the average mechanical occupancy approaches one. This measurement is now possible due to the recent achievement of ground state cooling of macroscopic mechanical oscillators [1,2]. Crucially, we measure the thermal cavity photon occupancy and account for it in our analysis. Failure to correctly account for the interference of these thermal photons with the mechanical signal can lead to a misinterpretation of the data and an overestimate of the emission/absorption asymmetry.

[1] J. D. Teufel, T. Donner, Dale Li, J. W. Harlow, M. S. Allman, K. Cicak, A. J. Sirois, J. D. Whittaker, K. W. Lehnert, R. W. Simmonds, "Sideband Cooling Micromechanical Motion to the Quantum Ground State," Nature, 475, 359363 (2011).
[2] Jasper Chan, et al, "Laser cooling of a nanomechanical oscillator into its quantum ground state," Nature, 478, 89-92 (2011).

Jennifer Harlow
JILA, University of Colorado and NIST

Date submitted: 19 Dec 2011 Electronic form version 1.4