Abstract Submitted
for the DAMOP12 Meeting of
The American Physical Society

Coherent detection of mechanical motion with a single spin qubit

SHIMON KOLKOWITZ, QUIRIN UNTERREITHMEIER, Harvard University, ANIA JAYICH, UC Santa Barbara, STEVEN BENNETT, Harvard University, PETER RABL, nstitute for Quantum Optics and Quantum Information of the Austrian Academy of Science, JACK HARRIS, Yale University, MIKHAIL LUKIN, Harvard University — Mechanical systems can be influenced by a wide variety of extremely small forces, ranging from gravitational to optical, electrical, and magnetic. When mechanical resonators are scaled down to nanometer-scale dimensions, these forces can be harnessed to enable coupling to individual quantum systems. We present results showing that the coherent evolution of a single electronic spin associated with a Nitrogen Vacancy (NV) center in diamond can be coupled to the motion of a magnetized mechanical resonator. Specifically we use coherent manipulation of the spin to sense the driven and Brownian motion of the resonator under ambient conditions at a precision of 5 picometers. We discuss potential future applications of this technique including the detection of the zero-point fluctuations of a mechanical resonator, the realization of strong spin-phonon coupling at a single quantum level, and the implementation of quantum spin transducers.

Shimon Kolkowitz
Harvard University

Date submitted: 30 Jan 2012 Electronic form version 1.4