Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Micro-resonators coupled to atoms in an optical lattice ANDREW GERACI, JOHN KITCHING, NIST, Boulder, CO — Recently there has been a convergence of ideas between the fields of solid-state and atomic physics – examples range from using atoms for quantum simulation of condensed-matter Hamiltonians to physically coupling atoms with solid-state devices such as micro-resonators. In this talk, we discuss an experimental proposal involving an array of cooled micro-cantilevers coupled to a sample of ultracold atoms trapped near a microfabricated surface [1]. The cantilevers allow individual lattice site addressing for atomic state control and readout, and potentially may be useful in optical lattice quantum computation schemes. Assuming resonators can be cooled to their vibrational ground state, we describe the implementation of a two-qubit controlled-NOT gate with atomic internal states and the motional states of the resonators, along with a protocol for entangling two or more cantilevers on the atom chip using the trapped atoms as an intermediary. Although similar experiments could be carried out with magnetic microchip traps, the optical confinement scheme we consider may exhibit reduced near-field magnetic noise and decoherence. Prospects for using this system for tests of quantum mechanics at macroscopic scales or quantum information processing will be discussed.

[1] A. Geraci and J. Kitching, Phys. Rev. A 80, 032317 (2009)

Andrew Geraci
NIST, Boulder, CO

Date submitted: 16 Nov 2009 Electronic form version 1.4