Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Quantum information processing using quasiclassical electromagnetic interactions between qubits and electrical resonators[1] ANDREW KERMAN, MIT Lincoln Laboratory — Electrical resonators are widely used in quantum information processing with any qubits that are manipulated via electromagnetic interactions. In most cases they are engineered to interact with qubits via real or virtual exchange of (typically microwave) photons, and the resonator must therefore have both a high quality factor and strong quantum fluctuations, corresponding to the strong-coupling limit of cavity QED. Although great strides in the control of quantum information have been made using this so-called "circuit QED" architecture, it also comes with some important disadvantages. In this talk, we discuss a new paradigm for coupling qubits electromagnetically via resonators, in which the qubits do not exchange photons with the resonator, but instead exert quasi-classical, effective "forces" on it. We show how this type of interaction is similar to that induced between the internal state of a trapped atomic ion and its center-of-mass motion by the photon recoil momentum, and that the resulting entangling operations are insensitive both to the state of the resonator and to its quality factor. The methods we describe are applicable to a variety of qubit-resonator systems, including superconducting and semiconducting solid-state qubits, and trapped molecular ions.

[1]This work is sponsored by the ASDR&E under Air Force Contract #FA8721-05-C-0002. Opinions, interpretations, recommendations and conclusions are those of the authors and are not necessarily endorsed by the United States Government.

Andrew Kerman
MIT Lincoln Laboratory

Date submitted: 19 Nov 2012

Electronic form version 1.4