Abstract Submitted
for the MAR08 Meeting of
The American Physical Society

Microwave Cavity Quantum Electrodynamics in a Molecular Ion Trap DAVID SCHUSTER, Yale University and MIT, PAUL ANTOHI, GLEB AKSELROD, ZILIANG LIN, ISAAC CHUANG, MIT, DAVID DEMILLE, ROBERT SCHOELKOPF, Yale University — It has been proposed to use the rotational states of trapped neutral molecules inside of an on-chip superconducting microwave resonator for cavity quantum electrodynamics and quantum information processing. We investigate the potential of molecular ions, which have several properties that might be advantageous over neutral molecules. Ions can be loaded into deep RF traps which do not require ultra-stable lasers and trap independent of their rotational state. They can be cooled by both cryogenic buffer gas and sympathetic laser cooling with atomic ions. Further, the ion charge screens electric fields felt by the rotational dipole reducing dephasing due to trapping or spurious fields. In addition, this property should allow one to create stable ensembles of ions which could be used as a quantum memory. As with neutral proposals such a system could be both interrogated and manipulated with microwave fields. Finally, the system represents a high precision spectroscopy tool for studying microwave transitions of single molecules.

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Date submitted: 27 Nov 2007 Electronic form version 1.4