Abstract Submitted
for the DAMOP10 Meeting of
The American Physical Society

Near field quantum control of trapped ions[1] CHRISTIAN OSPELKAUS, KENTON R. BROWN, JASON M. AMINI[2], DIETRICH LEIBFRIED, DAVID J. WINELAND, National Institute of Standards and Technology; 325 Broadway; Boulder, CO 80305 — We report the near-field manipulation of trapped-ion qubits using oscillating magnetic fields produced by currents in a microfabricated surface-electrode trap. We trap $^{25}Mg^{+}$ ions at a distance of 30 μm from a planar gold surface. On a first-order magnetic-field insensitive hyperfine transition at 21.3 mT, we observe π times for single-qubit rotations of less than 20 ns, nine orders of magnitude faster than the coherence time observed on similar transitions. The small distance of the ion from the surface leads to the presence of a sizeable gradient of the oscillating magnetic field, which is used to drive motional sideband transitions. For this purpose, it is desirable to produce an oscillating magnetic field gradient and a zero magnetic field at the mean ion position. We describe a technique to achieve this configuration and report the observation of motional sideband transitions on one-ion and two-ion normal modes driven by microwave fields. We also discuss steps towards the realization of a two-qubit entangling logic gate.

[1]Supported by IARPA, DARPA, NSA, ONR, and the NIST Quantum Information Program.
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Date submitted: 22 Jan 2010 Electronic form version 1.4