Abstract Submitted
for the DAMOP09 Meeting of
The American Physical Society

**Fast quantum gates with hyperfine qubit states**[1] Q. QURAISHI, W. CAMPBELL, J. MIZRAHI, C. MONROE, Joint Quantum Institute and Dept. of Physics, Univ. of Maryland — Recent work in coherent transfer of atomic quantum states demonstrated the novel integration of ultrashort pulsed lasers with trapped ions [1]. Building on this work, we propose an experimental scheme whereby a sequence of optical pulses is used for quantum state manipulation. Specifically, we envisage trapping a single ytterbium ion in a linear trap and then, using a series of nonresonant optical pulses, we plan on individually addressing its hyperfine qubit state [2]. By controlling the timing, phases and intensities between successive pulses we can optimize the fidelity of the qubit gate. Given a 10 ps pulse duration laser, centered at 355 nm (14 nm from resonance at 369 nm) with 4 W average power, we expect two optical pulses to be sufficient to perform a single qubit rotation. Additionally, we expect that by using counter propagating pulses having well defined relative RF frequency shifts, we can impart controllable spin-dependent forces. These results are relevant for motional or temporal gates involving multiple ions. [1] S. Olmschenk, et. al., Science (2009). [2] J. J. Garcia-Ripoll, et. al., Phys. Rev. Lett. 91, 157901 (2003).

[1]This work supported by DARPA OLE Program under ARO contract, IARPA under ARO contract, NSF PIF, IC Postdoc Program, and the NSF Physics Frontier Center at JQI.

Qudsia Quraishi
Joint Quantum Institute and Dept. of Physics, Univ. of Maryland

Date submitted: 26 Jan 2009 Electronic form version 1.4