Abstract Submitted
for the DAMOP11 Meeting of
The American Physical Society

Ion-photon networks for scalable quantum computing SUSAN CLARK, DAVID HAYES, DAVID HUCUL, SHANTANU DEBNATH, QUDSIA QURAISHI, STEVEN OLMSCHENK, DZMITRY MATSUKEVICH, PETER MAUNZ, CHRISTOPHER MONROE, Joint Quantum Institute, University of Maryland Department of Physics and National Institute of Standards and Technology, College Park, Maryland 20742 — Trapped ions connected by photons are a promising avenue for large-scale quantum computing and quantum information transfer. Previous experiments with photonically connected, distant, trapped ions establish ion entanglement and teleportation. Here, we report advances toward combining these photonic gates between distant ions with Coulombic gates between nearby ions in order to demonstrate a scalable quantum network. Specifically, we show individual optical addressing of single ions, allowing for photonic entanglement to be performed separately from Coulombic gates. Additionally, we move from a four rod trap to a segmented blade-type trap to more easily hold a larger number of ions. Finally, we implement a more robust method of ion entanglement that lessens dephasing due to rf trap noise. These improvements are important steps to the realization of a scalable ion-photon network. This work was supported by grants from the U.S. Army Research Office with funding from IARPA, the DARPA OLE program, and the MURI program; the NSF PIF Program; the NSF Physics Frontier Center at JQI; the European Commission AQUTE program.

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Date submitted: 04 Feb 2011 Electronic form version 1.4