Abstract Submitted
for the DAMOP13 Meeting of
The American Physical Society

Scalable Techniques with Trapped Ion Quantum Information Processing[1] RYAN BOWLER, JOHN GAEBLER, TING REI TAN, YIHENG LIN, National Institute of Standards and Technology, DAVID HANNEKE, Amherst College, JOHN JOST, Ecole Polytechnique Federale de Lausanne, JONATHAN HOME, ETH Zurich, ADAM MEIER, EMANUEL KNILL, DIETRICH LEIBFRIED, DAVID WINELAND, National Institute of Standards and Technology — We report progress towards combining all the building blocks required for scalable quantum information processing using trapped atomic ions. Included elements are qubits with long coherence times, a laser-induced universal gate, motional state initialization using a second ion species, and information transport. Our techniques include the use of a multiple electrode segmented trap, wherein information transport is achieved through the transport of ions between spatially distinct locations. While experiment timescales had previously been dominated by ion transport and re-initialization of motional states, we have achieved diabatic transport of ions on timescales comparable to quantum logic with low motional excitations [1]. We have also achieved rapid sympathetic ground state cooling with use of an electromagnetically-induced transparency cooling scheme [2]. In addition, we have demonstrated a method to efficiently measure gate fidelity in a scalable way involving multiple qubits and randomized benchmarking [3]. [1] R. Bowler *et. al.* Phys. Rev. Lett. **109**, 080502 (2012) [2] Y. Lin *et. al.* arXiv:1211.6647 [3] J. P. Gaebler *et. al.* Phys. Rev. Lett. **108**, 260503 (2012)

[1]Supported by IARPA, ARO contract no. EAO139840, ONR, and the NIST Quantum Information Program.

Ryan Bowler
National Institute of Standards and Technology

Date submitted: 24 Jan 2013 Electronic form version 1.4