Abstract Submitted
for the DAMOP05 Meeting of
The American Physical Society

"T"-junction and multizone ion traps for scalable quantum computation W.K. HENSINGER, D. STICK, M. ACTON, K.-A. BRICKMAN, D. HUCUL, R. KOHN, J. BURRESS, J.A. RABCHUK, L. DESLAURIERS, P.J. LEE, P.C. HALJAN, M. MADSEN, K. SCHWAB, C. MONROE, FOCUS Center and Department of Physics, University of Michigan, Laboratory for Physical Sciences, University of Maryland, Western Illinois University — Trapping and shuttling trapped ions in complex multizone trap structures is critical for scaling the trapped ion quantum computer. We have demonstrated a 10-zone linear ion trap consisting of 49 electrodes in a three-layer geometry, and have shuttled cold Cd^+ ions between several zones. This trap features a "T"-junction that should allow shuttling around a corner, possibly enabling the controlled swapping of ion positions within a linear crystal. This trap topology may be a fundamental building block towards implementing complex entanglement algorithms on an ion trap quantum computer. We will discuss several nontrivial aspects regarding the trapping region near the junction. We will also report progress on the operation of micron-scale planar ion traps fabricated from epitaxially-grown GaAs/AlGaAs layers and shaped with chemical and dry etching techniques. Development of this fabrication process may allow scaling elementary ion trap quantum processors to a large number of qubits. This work is supported by the U.S. National Security Agency and the Advanced Research and Development Activity under Army Research Office contract, and the National Science Foundation ITR Program.

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Date submitted: 28 Jan 2005 Electronic form version 1.4