Abstract Submitted
for the DAMOP07 Meeting of
The American Physical Society

Entangling Neutral Atoms with Symmetrization-Dependent Dynamics NATHAN BABCOCK, RENÉ STOCK, Institute for Quantum Information Science, University of Calgary, MARK RAIZEN, Center for Nonlinear Dynamics and Department of Physics, University of Texas, Austin, BARRY SANDERS, Institute for Quantum Information Science, University of Calgary — Trapped neutral atoms provide a promising medium in which to perform quantum computations since they have long decoherence times and can easily be interfaced with light for single-qubit operations and measurements. Despite these advantages, reliable methods for entangling and transporting atomic qubits must be devised before practical atomic quantum information processing devices can be realized. We propose a method for entangling a pair of indistinguishable neutral atoms stored in separated optical dipole traps. We model this trapping potential in one dimension as a pair of Gaussian wells that can be brought together for atoms to interact. The dynamics of this process depend on the symmetrization parameters of the initial state, and by choosing the correct interaction time a controlled-phase gate can be designed. Adiabatic separation guarantees that the atoms end up in opposite traps. We provide both adiabatic and time-dependent numerical simulations of the entangling process. Additionally, we consider a novel method for creating entangled qubits via selective excitation of atoms in such optical dipole traps.

Nathan Babcock
Institute for Quantum Information Science, University of Calgary

Date submitted: 02 Feb 2007 Electronic form version 1.4