Abstract Submitted
for the DAMOP06 Meeting of
The American Physical Society

Quantum logic in Group-II neutral atoms via nuclear-exchange interactions DAVID HAYES, IVAN DEUTSCH, UNM, PAUL JULIENNE, NIST — The spin exchange-interaction provides a means of producing an entangling quantum-logic gate, the square-root of SWAP, at the heart protocols employing single electron quantum dots. This is typically accompanied by strong Coulomb interactions and commensurate decoherence due to strong coupling of charge degrees of freedom to the noisy environment. We propose a protocol utilizing a *nuclear-exchange* interaction that occurs through ultra-cold collisions of identical spin $1/2$ Group-II *neutral* atoms. A natural advantage is gained by storing the quantum information in nuclear spin states with long coherence times. Unlike NMR protocols based on weak magnetic dipole-dipole interaction, the nuclear exchange interaction stems from strong s-wave scattering of electrons. Nuclear exchange is ensured by the Fermi symmetry of the overall wave function. We have studied this protocol in the context of ^{171}Yb atoms trapped in far-off resonance optical dipole traps. Using numerical analysis, we show that high-fidelity operation is possible through controlled collisions in varied double-well trapping potentials.

David Hayes
UNM

Date submitted: 01 Feb 2006 Electronic form version 1.4