## Abstract Submitted for the DAMOP08 Meeting of The American Physical Society

Scalable Quantum Information Processing Based on Two Ultracold Atomic Species in Optical Lattices with Single Site Addressability KATHY-ANNE BRICKMAN, ARJUN SHARMA, SCOTT WAITUKAITIS, Department of Physics and The James Franck Institute, The University of Chicago, DANIEL RIVAS, Department of Physics (FCFM), Universidad de Chile, NATHAN GEMELKE, CHENG CHIN, Department of Physics and The James Franck Institute, The University of Chicago — We propose a new scheme for quantum information processing that utilizes two different atomic species held in two independently controlled optical lattices. One uniformly filled lattice holds fermionic Li atoms that act as quantum bits (qubits) in the system. The second less densely populated lattice (1atom/1000sites) holds bosonic Cs-133 atoms that will mediate entanglement among the qubit atoms. By controlling the relative phase between the lattices, the Cs atoms can be transported to interact with any Li atom in the lattice. In this way, the Cs atoms become messengers among the Li atoms. By using these auxiliary "messenger" atoms, each Li qubit can be individually addressed and any of the Li atoms in the lattice can be entangled through controlled collisions with the Cs atoms. This system is inherently scalable since the qubit lattice can contain 1000 atoms in a small volume ( $\sim 5\mu \text{m}^3$ ).

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