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Experimental Progress Towards Scalable Quantum Computation using Dual Atomic Species in Optical Lattices 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, KATHY-ANNE BRICKMAN, NATHAN GEMELKE, CHENG CHIN, Department of Physics and The James Franck Institute, The University of Chicago — We propose a new method for implementing quantum entaglement with neutral atoms. In our scheme, ultracold fermionic lithium atoms (^{6}Li) and bosonic cesium atoms (^{133}Cs) will be loaded into two independent optical lattices. The Cs lattice will be sparsely filled (1atom/1000sites) relative to uniformly filled Li lattice. Each lattice frequency is carefully chosen so that one specie's lattice does not influence the other species. Precise phase control with electro-optic modulators will enable translation of the Cs lattice so that a single Cs atom can interact with any Li atom. Through this interaction, and transportation of the Cs atoms among the Li atoms, entanglement of distant Li atoms may be realized. We are fabricating a vacuum system with two chambers. Each atomic species will be Bose-condensed in its own chamber. The Li atoms will then be transported to the Cs chamber. Initial experiments will conduct the first studies into the cold collision properties between Li and Cs quantum gases. The results will allow us to determine the best strategy to implement the above entangling operations.

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