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Progress Towards Scalable Quantum Manipulation using Two Atomic Species in Independent Optical Lattices KARA LAMB, ARJUN SHARMA, PETER SCHERPELZ, KATHY-ANNE BRICKMAN SODERBERG, NATHAN GEMELKE, CHENG CHIN, The Department of Physics and The James Franck Institute, The University of Chicago — Advances in quantum information and quantum simulation require novel experimental techniques to provide precise control at the quantum level. One bosonic and one fermionic species of ultra-cold neutral atoms, trapped in overlapping, independently controlled optical lattices offers a promising system for such manipulations. After initial cooling, Pauli exclusion allows fermionic ^{6}Li to be loaded with high fidelity unit occupancy into one lattice. Bosonic ^{133}Cs atoms can be loaded with much lower occupancy into a second lattice to act as messenger atoms. By relative translation of the lattices using an electro-optic modulator array, the atomic wavefunctions of a Cs and any given Li atom can be overlapped and entangled through a molecular state. Scalability is inherent since a single Cs atom can be moved between any two distant Li atoms. Our initial studies will focus on interspecies collision properties, which will guide strategies to implement entangling operations.

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