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Scalable Quantum Computation using Two Atomic Species in Independent Optical Lattices ARJUN SHARMA, Department of Physics and James Franck Institute, University of Chicago, KARA LAMB, PETER SCHERPELZ, ANDREAS KLINGER, SKYLER DEGENKOLB, KATHY-ANNE BRICKMAN, NATHAN GEMELKE, CHENG CHIN — We confine bosonic ^{133}Cs and fermionic ^{6}Li atoms in a dipole trap to evaporatively cool and study the interspecies collision properties as a first step toward quantum information processing. Ultimately, each species will be confined by an independent optical lattice. Cooling the Li atoms into a degenerate band-insulator will allow uniform loading of 1atom/site. These Li atoms will act as quantum bits (qubits). Cs atoms will have a lower filling ratio of 1atom/100sites and will act as messengers to carry entanglement among the qubits. We present a novel technique to create commensurate lattices at 680nm for Li and 1064nm for Cs. One laser beam at each color is split into multiple beams by a diffractive optical element and recombined at the atoms to create independent triangular optical lattices. By relatively translating the two lattices using electro-optic modulators, the Cs messenger atoms can be translated to any Li qubit to perform entangling operations.

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