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Microwave Controlled Transport and Collisions of Cs Atoms in an Optical Lattice JAE HOON LEE, WORAWARONG RAKREUNGDET, ENRIQUE MONTANO, University of Arizona, BRIAN MISCHUCK, IVAN DEUTSCH, University of New Mexico, POUL JESSEN, University of Arizona —
Quantum information processing with atomic qubits in optical lattices requires two-qubit entangling operations that can be implemented by e.g. controlled pairwise collisions. As a step in this direction we are working on an experiment that uses microwave transitions to control the motion of Cs atoms between the sites of an anti-ferromagnetic lattice. In Cs the relevant ground state scattering length is large enough for a pair of atoms at neighboring spin-up/down sites to be bound together in a long range molecular state whose energy can be shifted by a large amount relative to isolated, non-interacting atoms. In principle this shift can be used as the basis for a quantum phase gate. We are currently attempting to observe distinct lines in the microwave spectrum corresponding to excitation of this molecular state.

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