Abstract Submitted
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Spin exchange in a double-well optical lattice for a $\sqrt{SWAP}$ gate PATRICIA LEE, NIST, MARCO ANDERLINI, BENJAMIN BROWN, JENNIFER SEBBY-STRABLEY, WILLIAM PHILLIPS, TREY PORTO — We report the observation of coherent spin-exchange between pairs of atoms in a double-well optical lattice, from which a $\sqrt{SWAP}$ gate can be constructed. First, we perform qubit rotations selectively to atoms in either side of the double well to prepare pairs of qubits in the initial state. Each pair of neighboring atoms are then brought together in a single well and entangled through controlled coherent collisions. The "exchange blockade" arising from the symmetry of identical particles results in $\sqrt{SWAP}$, a universal two-qubit entangling gate. These demonstrations provide important tools for quantum information processing and simulation of condensed matter systems. We will also discuss how they can be extended to a scalable system for quantum computation.

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