MAR13-2012-004761

Abstract for an Invited Paper
for the MAR13 Meeting of
the American Physical Society

Entanglement of Singlet-Triplet Qubits

MICHAEL SHULMAN, Harvard University

Spins in semiconductor quantum dots are promising candidates for the building blocks of a quantum information processor due to their potential for miniaturization and scalability. Singlet-triplet (S-T0) qubits, a certain type of spin qubit, store information in the joint spin state of two electrons. However, these qubits' weak interaction with the environment, which leads to their long coherence times, makes two-qubit operations challenging. We perform the first two-qubit operation between two S-T0qubits, exploiting the capacitive coupling between two adjacent qubits to generate a CPHASE gate. In order to combat low frequency noise we use a dynamically decoupled sequence that maintains the two-qubit coupling while decoupling each qubit from its fluctuating environment. Using state tomography we show that the two-qubit operation has the intended effect on the state of the qubits, and we provide definitive proof of entanglement by extracting a concurrence of 0.44 and a Bell state fidelity of 0.72. This two-qubit interaction lends itself to easily implemented improvements, which promise to generate higher fidelity entangled states that can be the basis for establishing a scalable architecture for quantum information processing.