Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Suppression of Dephasing using Real Time Environmental Monitoring MICHAEL SHULMAN, SHANNON HARVEY, JOHN NICHOL, Harvard University, VLADIMIR UMANSKY, Weizmann Institute of Science, AMIR YACOBY, Harvard University — Electron spins in semiconductor quantum dots are promising candidates for the building blocks of a quantum information processor due to their potential for scalability and miniaturization. However, interactions between the electrons and a fluctuating nuclear bath cause these qubits to dephase in tens of nanoseconds. These ill effects can be partially mitigated by nuclear programming or dynamical decoupling; however, these techniques are limited by nuclear pumping efficiency and the complexity of decoupled sequences. Here we present a new scheme that stabilizes the qubit by exploiting the slow nuclear dynamics. The qubit measures the size of the nuclear splitting, which is used in real time to feed back on the control of the qubit. We employ this technique on a singlet-triplet qubit operated in the rotating frame in a regime where it is sensitive to fluctuating nuclear magnetic fields, and we show that this feedback increases qubit coherence times. This feedback is distinct from schemes that constantly monitor a qubit through weak measurement and can improve arbitrary qubit operations in all qubits that suffer dephasing from slow environmental fluctuations, including all spin qubits.

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Date submitted: 14 Nov 2013 Electronic form version 1.4