Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Precise Measurement of Nuclear Magnetic Fields with Gallium Arsenide Spin Qubits SHANNON HARVEY, MICHAEL SHULMAN , JOHN NICHOL , Harvard University, VLADIMIR UMANSKY, Weizmann Institute of Science, AMIR YACOBY, Harvard University — Qubits that can be easily initialized and read out hold promise both for metrology and for quantum information processing. In particular, spin qubits in semiconductor quantum dots are able probe their rich magnetic and electric environment and study spin and charge dynamics in semiconductors. In this talk, we present measurements using a singlet-triplet (S-T_0) qubit in a gallium arsenide double quantum dot to measure the nuclear magnetic field gradient surrounding it. This nuclear bath has slow dynamics compared to the timescale of qubit operations and measurement, so precise sensing of nuclear fields can be done with repeated projective measurement. We compare three techniques for rapidly estimating the nuclear gradient, and verify it to within 1 MHz in 800 us of real time for the best performing scheme. This level of precision offers the prospect of performing real-time monitoring of the nuclear gradient, which could both yield insight into quantum many-body problems such as nuclear spin diffusion and be used to drive the qubit adaptively in a way that is insensitive to nuclear noise.

Shannon Harvey
Harvard University

Date submitted: 15 Nov 2013 Electronic form version 1.4