MAR11-2010-003478

Abstract for an Invited Paper
for the MAR11 Meeting of
the American Physical Society

Excited-State Spin Manipulation and Intrinsic Nuclear Spin Memory using Single Nitrogen-Vacancy Centers in Diamond[1]

GREGORY FUCHS[2], Center for Spintronics and Quantum Computation, University of California, Santa Barbara

Nitrogen vacancy (NV) center spins in diamond have emerged as a promising solid-state system for quantum information processing and precision metrology at room temperature. Understanding and developing the built-in resources of this defect center for quantum logic and memory is critical to achieving these goals. In the first case, we use nanosecond duration microwave manipulation to study the electronic spin of single NV centers in their orbital excited-state (ES) [1]. We demonstrate ES Rabi oscillations and use multi-pulse resonant control to differentiate between phonon-induced dephasing, orbital relaxation, and coherent electron-nuclear interactions. A second resource, the nuclear spin of the intrinsic nitrogen atom, may be an ideal candidate for a quantum memory due to both the long coherence of nuclear spins and their deterministic presence. We investigate coherent swaps between the NV center electronic spin state and the nuclear spin state of nitrogen using Landau-Zener transitions performed outside the asymptotic regime [2]. The swap gates are generated using lithographically fabricated waveguides that form a high-bandwidth, two-axis vector magnet on the diamond substrate. These experiments provide tools for coherently manipulating and storing quantum information in a scalable solid-state system at room temperature.

[1] G. D. Fuchs, V. V. Dobrovitski, D. M. Toyli, F. J. Heremans, C. D. Weis, T. Schenkel, and D.D. Awschalom, *Nat. Phys.* **6**, 668 (2010).
[2] G. D. Fuchs, G. Burkard, P. Klimov, and D. D. Awschalom, *in preparation.*

[1]We gratefully acknowledge support from AFOSR, ARO, and DARPA.

[2]In collaboration with V. V. Dobrovitski, G. Burkard, D. M. Toyli, F. J. Heremans, P. Klimov, and D. D. Awschalom