DAMOP08-2008-020087
Abstract for an Invited Paper
for the DAMOP08 Meeting of
the American Physical Society

Coupled Electronic and Nuclear Spin Quantum Registers in Diamond[1]

GURUDEV DUTT, University of Pittsburgh

Building scalable quantum information systems is a central challenge facing modern science. One promising approach is based on quantum registers composed of several quantum bits that are coupled together via optical channels. We discuss experiments that demonstrate addressing, preparation, and coherent control of individual nuclear spin qubits in the diamond lattice at room temperature. We have measured spin coherence times exceeding milliseconds, and observed coherent coupling to nearby electronic and nuclear spins. Robust initialization of a two-qubit register and transfer of arbitrary quantum states between electron and nuclear spin qubits has been achieved. Our results show that coherent operations are possible with individual solid-state qubits whose coherence properties approach those for isolated atoms and ions. The resulting electron-nuclear few-qubit registers can potentially serve as small processor nodes in a quantum network where the electron spins are coupled by optical photons to generate entanglement, and the nuclear spins serve as a resource for quantum memory and quantum logic operations.

[1]This work was carried out in collaboration with L. Childress, E. Togan, L. Jiang, J. Maze, A. S. Zibrov, F. Jelezko, P. R. Hemmer and M. D. Lukin, and supported in part by the NSF (CAREER & PIF), Army Research Office, Packard & Hertz Foundations.