Abstract Submitted
for the MAR05 Meeting of
The American Physical Society

Fidelity of spin ensemble memory for mesoscopic quantum bits
V.V. DOBROVITSKI, Ames Laboratory, Iowa State University, Ames, IA 50014, J.M. TAYLOR, M.D. LUKIN, Department of Physics, Harvard University, Cambridge, MA 02138 — Development of techniques for coherently manipulating electron spins in quantum dots is important for future applications in spintronics and in quantum information processing. In this work we study the quantum memory protocol suggested recently [1] for storage and retrieval of the electron spin states in the lattice nuclear spins. We report detailed studies of this technique in the presence of imperfections, such as the incomplete polarization of the nuclear spins and the spread in the hyperfine couplings between the electron and the nuclei. We numerically simulate the memory protocol by solving the time-dependent Schrödinger equation for the system comprising the electron spin and the bath spins [2]. We find that the memory operation is robust with respect to these relalistic imperfections and that high fidelity operation is possible with realistic values of nuclear spin polarization. This work was supported by the NSA, ARDA and ARO.
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Date submitted: 06 Dec 2004 Electronic form version 1.4