Abstract Submitted
for the MAR05 Meeting of
The American Physical Society

Controlling decoherence due to nuclear spins in III-V compounds: Which price do we pay? ROGERIO DE SOUSA, NEIL SHENVI, K. BIRGITTA WHALEY, Dept. of Chemistry, University of California, Berkeley — Nuclear spins of the host lattice are the dominant source of decoherence in semiconductor donor and quantum dot spin qubits. There are two channels for nuclear induced decoherence: (1) Loss of visibility arising from the non-secular hyperfine coupling; (2) Spectral diffusion arising from the combined effect of inter-nuclear dipolar coupling and the secular hyperfine term. We performed numerical calculations to show that application of a moderate static magnetic field (~ 2 Tesla) is enough to suppress mechanism (1) within the 10^{-4} criteria of quantum error correction. On the other hand a much greater overhead is required to control mechanism (2). We consider the Carr-Purcell-Meiboom-Gill sequence as a means to control (2) and provide a realistic assessment of the required overhead in number of qubit π-pulses. We show that the required rate of π-pulsing is proportional to the nuclear spin quantum number squared, showing that robust coherent manipulation in the large spin environments characteristic of the III-V compounds is possible without resorting to nuclear spin polarization.

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Date submitted: 21 Mar 2013 Electronic form version 1.4