Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Master equation approach to the central spin decoherence problem[1] EDWIN BARNES, Condensed Matter Theory Center, Dept. of Physics, University of Maryland, LUKASZ CYWINSKI, Institute of Physics, Polish Academy of Sciences, SANKAR DAS SARMA, Condensed Matter Theory Center, Dept. of Physics, University of Maryland — The electron-nuclear hyperfine interaction is the leading source of decoherence for electron spin qubits in III-V semiconductor quantum dots. For sufficiently low external B-field, the dynamics is purely hyperfine-induced. Generalized master equations embody an attractive approach to this problem due to strong analytical control, but so far they have only been applied in the case of high magnetic fields where a standard perturbative treatment is reliable. In the low field regime where pure hyperfine effects are measurable, this standard treatment breaks down. We show how to overcome this problem by first arguing that the detailed shape of the electron wavefunction is irrelevant for the electron spin decoherence at low B-fields. We then employ a powerful technique involving so-called correlated projection operators to vastly improve the convergence of the perturbative master equation approach by taking advantage of the symmetries that arise when the electron wavefunction is coarse-grained. This brings the low B-field regime into the scope of the master equation description, paving the way for the development of a well-controlled theory of pure hyperfine decoherence that is relevant for current experiments. [E. Barnes, L. Cywinski, S. Das Sarma, Phys. Rev. B 84, 155315 (2011)]

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[1] Work supported by LPS-CMTC, CNAM, and IARPA

Date submitted: 10 Nov 2011 Electronic form version 1.4