Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Using spin fluctuations to reveal long hole spin lifetimes and hole-nuclear coupling in (In,Ga)As quantum dots[1] YAN LI, S.A. CROOKER, National High Magnetic Field Lab, Los Alamos National Lab, D. REUTER, A.D. WIECK, Ruhr-Universitat Bochum, D.R. YAKOVLEV, M. BAYER, Technische Universitat Dortmund — "Spin noise spectroscopy" is a recently-developed technique for passively measuring the spin dynamics of electrons and holes via their intrinsic random spin fluctuations. In accord with the fluctuation-dissipation theorem, the frequency spectra of this spin noise alone reveals spin dephasing times and Landé g-factors. Using these methods we measure hole spins confined in self-assembled (In,Ga)As/GaAs quantum dots (QDs). Owing to their p-type wavefunctions, holes experience much less hyperfine interaction with lattice nuclei as compared with confined electrons, leading in principle to long spin decoherence times which are favorable for potential qubit applications. We observe very long hole spin correlation times ($\sim$400 ns) in zero magnetic field, ultimately limited by dephasing from hole-nuclear hyperfine interactions. Suppressing this dephasing with small longitudinal fields ($<$ 100 G) directly reveals the hyperfine coupling strength, and unveils intrinsic hole spin relaxation times up to $\sim$5 μs. Importantly, the lineshape of the noise evolves from a Lorentzian to a power-law as the hole-nuclear dephasing is suppressed.

[1]We acknowledge support from LANL LDRD program.

Yan Li
National High Magnetic Field Lab, Los Alamos National Lab

Date submitted: 19 Dec 2011 Electronic form version 1.4