Abstract for an Invited Paper
for the MAR09 Meeting of
The American Physical Society

Decoherence mechanisms for electron and hole spins in quantum dots
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One major obstacle to the realization of electron-spin qubits is decoherence with a random environment. While relaxation ($T_1$) processes are dominated in these systems by spin-orbit coupling and phonon emission, much faster dephasing processes are determined by coupling to an uncontrolled environment of nuclear spins. I will review work on electron-spin decoherence due to nuclear spins [1] and how to control this decoherence through a sequence of measurements performed on the nuclear-spin system [2,3]. This talk will then focus on coherence properties of hole, rather than electron spins. Remarkably, in contrast to statements frequently made in the literature, we have found that the coupling of hole spins to nuclei can be appreciable [4] (comparable to that for electrons). However, in a two-dimensional quantum dot, the hole-nuclear spin coupling takes on an Ising-like form, which may allow for substantially longer coherence times than for electron spins.