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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.

[1] W. A. Coish, J. Fischer and D. Loss, Phys. Rev. B 77, 125329 (2008)
[2] D. Klauser, W. A. Coish, and D. Loss, Phys. Rev. B 73, 205302 (2006)
[3] D. Klauser, W. A. Coish, and D. Loss, Phys. Rev. B 78, 205301 (2008)
[4] J. Fischer, W. A. Coish, D. V. Bulaev, and D. Loss, Phys. Rev. B 78, 155329 (2008)