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Two-electron-spin dephasing due to hyperfine interaction in a GaAs double dot JO-TZU HUNG, Department of Physics, University at Buffalo, SUNY, LUKASZ CYWINSKI, Institute of Physics, Polish Academy of Sciences, XUEDONG HU, Department of Physics, University at Buffalo, SUNY, SANKAR DAS SARMA, Department of Physics, University of Maryland — We study hyperfine interaction induced pure dephasing of two electron spin states in a GaAs double quantum dot. We construct the effective pure dephasing Hamiltonian for the two electron spins, and apply the ring-diagram theory [1] to calculate the decoherence function of the double dot two-spin system. With a finite exchange coupling, singlet and triplet states are the electron spin eigenstates, and we focus on the dephasing between the singlet state S and the unpolarized triplet state T_0. We find that the effective Overhauser fields for these two states are suppressed because of their state symmetries, leading to weaker effective coupling between the nuclear spins. On the other hand, the weaker Overhauser field also allows more nuclear spins to flip-flop with each other. We show that these competing effects lead to interesting two-spin decoherence dynamics. We calculate the coherence decay as functions of the external field, the exchange splitting, and the quantum dot size, and compare our results with those for a single spin and for two uncorrelated spins. [1] L. Cywinski, W. Witzel, and S. Das Sarma, Phys. Rev. B 79, 245314 (2009).

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