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Dynamical nuclear spin polarization in a double quantum dot[1]
GUY RAMON, CHANGXUE DENG, XUEDONG HU, Department of Physics, University of Buffalo, SUNY — The hyperfine interaction between an electron spin confined in a semiconductor quantum dot and the nuclear spins in the surrounding lattice has been identified as one of the main sources for decoherence in low temperature GaAs quantum dots. Recent experiments in gated double dot systems [1] have attempted to utilize the degeneracy point between the two-electron singlet and polarized triplet states to polarize the nuclear spins, thereby reducing their decoherence effects on the electron spins. Here we analyze the dynamics of the system of two electrons and a nuclear spin bath subject to the hyperfine interaction. We consider the effective spin Hamiltonian for the two-electron system, and represent the nuclear spins in the basis of their collective states. The nuclear polarization rates are evaluated for various initial conditions of the nuclear spin system, and optimal conditions for efficient polarization are discussed. [1] J. R. Petta, A. C. Johnson, J. M. Taylor, E. A. Laird, A. Yacoby, M. D. Lukin, C. M. Marcus, M. P. Hanson, A. C. Gossard, Science 309, 2180 (2005).

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Guy Ramon
Department of Physics, University of Buffalo, SUNY

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