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Dynamical simulation of a two-electron spin qubit based on hyperfine interaction[1] MIGUEL ANGEL RODRIGUEZ-MORENO, Centro de Investigaciones en Semiconductores ICUAP, LILIA MEZA-MONTES, Instituto de Fisica BUAP, DAVID HERNANDEZ DE LA LUZ, Centro de Investigaciones en Semiconductores ICUAP — The interaction with the nuclear field is one of the main sources of decoherence in solid state quantum bits. However, recently it has been shown that hyperfine interaction can also be used to manipulate the spin state of electrons in double quantum dots. In this work, we simulate numerically the dynamics of a spin-based quantum bit consisting of two electrons confined in a double quantum dot, including the interaction with a random nuclear field. The two electron wavefunction is built using an antisymmetric function expansion and the total hamiltonian is discretized spatially using finite differences. For the dynamic simulation, an exponential approximation of the time propagator is used. In order to model the hyperfine interaction, a normally-distributed random magnetic field is assigned to each simulation grid point. The dynamics of the system is calculated by averaging over an ensemble of quantum dots. It is shown how the hyperfine field can be used to drive transitions between singlet and triplet states, an effect that has already been found experimentally. Particularly, it is shown how these transitions can be controlled using an applied electric field, thus allowing for the realization of a two-electron quantum gate.

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