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Dynamical nuclear spin polarization and the Zamboni effect in gated double quantum dots[1] GUY RAMON, XUEDONG HU, Department of Physics, University of Buffalo, SUNY — The hyperfine interaction between electron spins confined in semiconductor quantum dots and the surrounding nuclear spins is one of the main sources for electron spin decoherence in low temperature GaAs quantum dots. We have investigated theoretically the dynamics of a system of two electrons and nuclear spin baths subject to the hyperfine interaction in a gated double dot system. It is shown that the hyperfine interaction can mediate a dynamical nuclear polarization by utilizing the degeneracy point between the two-electron singlet and polarized triplet states. Most importantly, we demonstrate that a small polarization (0.3%) is sufficient to enhance the singlet decay time by two orders of magnitude, in contrast with the single dot case, where nearly complete nuclear polarization is required to improve spin coherence time significantly. This enhancement is attributed to an equilibration process between the nuclear reservoirs in the two dots, mediated by the hyperfine interaction, an effect we have dubbed as the nuclear Zamboni effect. We explore other strategies to facilitate this effect and show that while equilibration of the two nuclear configurations is obtained, the singlet decay times are only modestly enhanced due to broadening of the nuclear spin distribution.

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