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Dynamic Nuclear Polarization in Double Quantum Dots

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We theoretically investigate the controlled dynamic polarization of lattice nuclear spins in GaAs double quantum dots containing two electrons.¹ Three regimes of long-term dynamics are identified, including the build up of a large difference in the Overhauser fields across the dots, the saturation of the nuclear polarization process associated with formation of so-called “dark states,” and the elimination of the difference field. We show that in the case of unequal dots, build up of difference fields generally accompanies the nuclear polarization process, whereas for nearly identical dots, build up of difference fields competes with polarization saturation in dark states. The elimination of the difference field does not, in general, correspond to a stable steady state of the polarization process.

¹M. Gullans, et. al., Phys. Rev. Lett. 104, 226807 (2010).