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Dynamic nuclear polarization of nitrogen-vacancy centers in diamond

WEN-HUI HU, Beijing Computational Science Research Center, NAN ZHAO
COLLABORATION — Single nitrogen-vacancy (NV) centers in diamond triggered
the research for wild applications in quantum information processing and quantum
metrology. One of the most important advantages of the NV centers is the long
coherence time of the center electron spins. Dynamic nuclear polarization (DNP)
has been introduced as an efficient method to protect the spin coherence. The co-
herence time $T_2^*$ should have been prolonged of two orders theoretically, nevertheless
less than one order in experiments. In this work, we theoretically study the DNP
process in a high-purity diamond, where the dipole-dipole hyperfine interaction be-
tween the center electron spins and the bath $^{13}$C nuclear spins is dominant. The
simulations show that the saturated polarization of the nuclear bath depends on
the spin-lock period and the efficiency of the initialization laser, accompanied with
the magnitude of the external magnetic field. The polarization saturation comes
from the capability of the polarization transfer and the equilibrium of probability
distribution between the polarized and unpolarized states.

Wen-Hui Hu
Beijing Computational Science Research Center

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