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Nuclear spin dynamics and spin orbit effects in Landau-Zener sweep correlations at the S-T_+ Transition CHRISTIAN DICKEL, Kavli Institute of Nanoscience, Delft University of Technology, SANDRA FOLETTI, AMIR YACOBY, Department of Physics, Harvard University, DIANA MAHALU, VLADIMIR UMANSKY, Department of Condensed Matter Physics, Weizmann Institute of Science, HENDRIK BLUHM, 2nd Institute of Physics C, RWTH Aachen University — In GaAs-based double quantum dot spin qubits, nuclear spins have been used for qubit control, but are also an important source of decoherence. The S and T_+ levels exhibit a small avoided crossing as a function of detuning. It has been used for S-T_+ qubit control and for dynamic nuclear polarization (DNP). The transition matrix element contains the nuclear Overhauser fields perpendicular to the external B-field and spin-orbit coupling. We show, both theoretically and experimentally, that nuclear spin dynamics can be seen in the temporal correlation of single-shot measurements after Landau-Zener sweeps across this transition. A semi-classical model of the nuclear spins is sufficient. The dynamics consist of the relative Larmor precession of the three GaAs nuclear spin species in the external B-field and dephasing of the oscillations due to local field fluctuations. Theoretically, it is expected that the absolute Larmor precessions also become visible in the presence of spin-orbit coupling. This can be used to qualitatively and quantitatively observe spin-orbit coupling and to distinguish it from the nuclear spin contribution. Understanding these dynamics is relevant for the fidelity of S-T_+ qubit operations and the effectiveness of DNP.

Christian Dickel
Kavli Institute of Nanoscience, Delft University of Technology

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