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Investigating the positively charged nitrogen-vacancy center in diamond as a long lived quantum memory MATTHIAS PFENDER, NABEEL ASLAM, SINA BURK, HELMUT FEDDER, PHILIPP NEUMANN, 3rd Institute of Physics, University of Stuttgart, PATRICK SIMON, JOS A. GARRIDO, Walter Schottky Institut, Technische Universitt Mnchen, JRG WRACHTRUP, 3rd Institute of Physics, University of Stuttgart, 3RD INSTITUTE OF PHYSICS, UNIVERSITY OF STUTTGART TEAM, WALTER SCHOTTKY INSTITUT, TECHNISCHE UNIVERSITT MNCHEN TEAM — The nitrogen-vacancy (NV) defect in diamond is one of the major candidates for a solid-state quantum processor. Its electron spin is readout and initialized optically. Proximal nuclear spins (e.g. ^{14}N, ^{15}N, ^{13}C) serve as inherently robust qubits, their readout is facilitated via the electron spin in a QND measurement and they exhibit T_1 lifetimes of several minutes. However, for strongly coupled nuclear spins, the coherence time is limited by the electron spin's T_1 lifetime (5ms @ roomtemperature). In Si:P, this obstacle is overcome by ionizing the P donor into a spinless charge-state. In this work, we employ in-plane gate structures on the diamond surface for deterministic charge state switching of near-surface NVs from NV^- over NV^0 to NV^+, while investigating the electron spin properties using the nitrogen nuclear spin as a probe. The positive charge state happens to have no unpaired electrons, therefore the nuclear spin coherence time is prolonged beyond the 5ms-limit imposed by the NV^- electron spin. Proper charge state control removes an important roadblock for achieving minute-long coherence times at room-temperature and deterministic quantum system initialization.

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