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Shuttling electrons on and off As donor atoms in silicon A.M. TYRYSHKIN, S.A. LYON, Princeton University, C.C. LO, R. LO NARDO, J.J.L. MORTON, University College London, S. SIMMONS, University of Oxford, C.D. WEIS, T. SCHENKEL, Lawrence Berkeley National Laboratory, J. BOKOR, University of California Berkeley, J. MEIJER, D. ROGALLA, Ruhr-Universitat Bochum
— Hybrid quantum devices where electron spins are used for state initialization, fast manipulation, long range entanglement and detection, while nuclear spins are used for long term storage promise revolutionary advantages. Here we report our first experiments using a silicon-based device that utilizes electron and nuclear spins of arsenic donors. The device is a large-area, parallel-plate capacitor fabricated on a silicon-on-insulator (SOI) wafer where the SOI layer is implanted with arsenic donors, and a back gate is formed in the silicon below the buried oxide by a high-energy boron implantation. The electrons can be controllably stripped from the donors and then reintroduced to the ionized donors by applying appropriate gate voltages. We use ensemble ESR experiments (X-band, magnetic field of 0.35 T) to track the occupancy of the donors during these operations. Pulsed ESR is used to characterize the spin state of the donor electrons and the effect of applied electric fields below the ionization threshold. The spin state of the arsenic nuclei, and the effect of electron removal and reintroduction on the nuclear state is expected to be observable in pulsed ENDOR experiments. The work is funded by LPS and NSF-MWN.

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