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Towards ultra-high single-shot readout fidelity of an electron spin qubit through an enhanced latching mechanism PATRICK HARVEY-COLLARD, Univ of Sherbrooke, BENJAMIN DANJOU, McGill University, JASON DOMINGUEZ, GREGORY A. TEN EYCK, JOEL R. WENDT, TAMMY PLUYM, MICHAEL P. LILLY, Sandia National Laboratories, WILLIAM A. COISH, McGill University, MICHEL PIORO-LADRIRE, Univ of Sherbrooke, MALCOLM S. CARROLL, Sandia National Laboratories — The readout of semiconductor spin qubits relies on a spin-to-charge conversion that maps spin states to a transient charge state detected by a charge sensor. Readout fidelities currently lag behind qubit control fidelities and have become a significant bottleneck. In this work, we study an enhanced latching readout and directly compare the mechanisms and benefits with the conventional spin blockade readout. Using a silicon quantum dot coupled to a single donor atom, we demonstrate that the single shot signal lifetime and amplitude can be enhanced by at least factors of 10 and 5 respectively, potentially leading to $> 99.9\,\%$ fidelity. Finally, the enhanced latching readout functions with double quantum dot singlet-triplet qubits and also works when the charge sensor position is such that the conventional (2,0)-(1,1) charge signal would vanish. This work was performed, in part, at the Center for Integrated Nanotechnologies, an Office of Science User Facility operated for the U.S. Department of Energy (DOE) Office of Science. Sandia National Laboratories is a multi-program laboratory operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. DOE under contract DE-AC04-94AL85000.

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