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Nuclear-driven electron spin rotations in a coupled silicon quantum dot and single donor system PATRICK HARVEY-COLLARD, Univ of Sherbrooke, NOAH TOBIAS JACOBSON, MARTIN RUDOLPH, GREGORY A. TEN EYCK, JOEL R. WENDT, TAMMY PLUYM, MICHAEL P. LILLY, Sandia National Laboratories, MICHEL PIORO-LADRIRE, Univ of Sherbrooke, MALCOLM S. CARROLL, Sandia National Laboratories — Single donors in silicon are very good qubits. However, a central challenge is to couple them to one another. To achieve this, many proposals rely on using a nearby quantum dot (QD) to mediate an interaction. In this work, we demonstrate the coherent coupling of electron spins between a single ^{31}P donor and an enriched ^{28}Si metal-oxide-semiconductor few-electron QD. We show that the electron-nuclear spin interaction can drive coherent rotations between singlet and triplet electron spin states. Moreover, we are able to tune electrically the exchange interaction between the QD and donor electrons. The combination of single-nucleus-driven rotations and voltage-tunable exchange provides all elements for future all-electrical control of a spin qubit, and requires only a single dot and no additional magnetic field gradients. 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 managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. DOE's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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