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Few electron quantum dot coupling to donor implanted electron spins MARTIN RUDOLPH, PATRICK HARVEY-COLLARD, ERIK NEILSON, JOHN GAMBLE, RICHARD MULLER, TOBY JACOBSON, GREG TEN-EYCK, JOEL WENDT, TAMMY PLUYM, MICHAEL LILLY, MALCOLM CARROLL, Sandia National Laboratory — Donor-based Si qubits are receiving increased interest because of recent demonstrations of high fidelity electron or nuclear spin qubits and their coupling. Quantum dot (QD) mediated interactions between donors are of interest for future coupling of two donors. We present experiment and modeling of a polysilicon/Si MOS QD, charge-sensed by a neighboring many electron QD, capable of coupling to one or two donor implanted electron spins (D) while tuned to the few electron regime. The unique design employs two neighboring gated wire FETs and self-aligned implants, which supports many configurations of implanted donors. We can access the (0,1)⇔(1,0) transition between the D and QD, as well as the resonance condition between the few electron QD and two donors ((0,N,1)⇔(0,N+1,0)⇔(1,N,0)). We characterize capacitances and tunnel rate behavior combined with semi-classical and full configuration interaction simulations to study the energy landscape and kinetics of D-QD transitions. This work was performed, in part, at the Center for Integrated Nanotechnologies, a U.S. DOE, Office of Basic Energy Sciences user facility. The work was supported by the Sandia National Laboratories Directed Research and Development Program. Sandia National Laboratories is a multi-program laboratory operated by Sandia Corporation, a Lockheed-Martin Company, for the U. S. Department of Energy under Contract No. DE-AC04-94AL85000.

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