Abstract Submitted
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Predicting the valley physics of silicon quantum dots directly from a device layout[1] JOHN KING GAMBLE, Sandia National Laboratories, PATRICK HARVEY-COLLARD, Sandia National Laboratories and Université de Sherbrooke, N. TOBIAS JACOBSON, ANDREW D. BACEWSKI, ERIK NIELSEN, INÈS MONTAÑO, MARTIN RUDOLPH, MALCOLM S. CARROLL, RICHARD P. MULLER, Sandia National Laboratories — Qubits made from electrostatically-defined quantum dots in Si-based systems are excellent candidates for quantum information processing applications. However, the multi-valley structure of silicon's band structure provides additional challenges for the few-electron physics critical to qubit manipulation. Here, we present a theory for valley physics that is predictive, in that we take as input the real physical device geometry and experimental voltage operation schedule, and with minimal approximation compute the resulting valley physics. We present both effective mass theory and atomistic tight-binding calculations for two distinct metal-oxide-semiconductor (MOS) quantum dot systems, directly comparing them to experimental measurements of the valley splitting. We conclude by assessing these detailed simulations utility for engineering desired valley physics in future devices. Sandia is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the US Department of Energy's National Nuclear Security Administration under Contract No. DE-AC04-94AL85000.

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