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High fidelity gates in quantum dot spin qubits[1] MARK FRIESEN, TECK SENG KOH, S. N. COPPERSMITH, University of Wisconsin - Madison — A variety of logical qubits and quantum gates have been proposed for quantum computer architectures using top-gated quantum dots. Despite their differences, we show that many combinations of qubits and gates can be evaluated on an equal footing by optimizing the gating protocols for maximum fidelity. Here, we evaluate single-qubit gate operations for two types of logical-qubits: singlet-triplet qubits and quantum dot hybrid qubits. In both cases, transitions between the qubit states are controlled by the exchange interaction between the dots, which in turn depends on the tunnel coupling and the detuning. We compute the fidelities for three exchange gate protocols: a dc pulsed gate, an ac resonant gate, and stimulated Raman adiabatic passage (STIRAP). Remarkably, we find that the optimized fidelities for all three gates follow a simple scaling law; the maximum fidelity depends only on the range of parameters that can be achieved experimentally. We show that a singlet-triplet qubit can be pulse-gated with significantly higher fidelity than a hybrid qubit, and that the highest overall fidelity should be achieved in a hybrid qubit using a STIRAP gating protocol.

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