

Abstract Submitted
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High-Fidelity Entangling Gates for Two-Electron Spin Qubits¹

PASCAL CERFONTAINE, JARA-Institute for Quantum Information, RWTH Aachen Univ., SEBASTIAN MEHL, DAVID P. DIVINCENZO, Peter Grünberg Institute (PGI-2), Forschungszentrum Jülich, HENDRIK BLUHM, JARA-Institute for Quantum Information, RWTH Aachen Univ. — High fidelity gate operations for manipulating individual and multiple qubits are a prerequisite for fault-tolerant quantum information processing. Recently, we have shown that single-qubit gates for singlet-triplet qubits in GaAs can be pulse-engineered to reduce systematic errors and mitigate magnetic field fluctuations from the abundant nuclear spins, leading to experimentally demonstrated gate fidelities of 98.5% [1]. We expect that a similar approach will be successful for two-qubit gates. We now describe short gating sequences for exchange-based two-qubit gates, showing that gate infidelities below 0.1% can be reached in realistic quantum dot setups [2]. Additionally, we perform numerical pulse optimization to fully take the experimentally important imperfections into account, minimizing systematic errors and noise sensitivity. Since transferring the optimal control pulses to an experimental setting will inevitably incur systematic errors, we discuss how these errors can be calibrated on the experiment. [1] P. Cerfontaine, T. Botzem, D. Schuh, D. Bougeard, H. Bluhm, in preparation. [2] S. Mehl, H. Bluhm, D. P. DiVincenzo, PRB 90 (2014).

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