Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Experimental Implementation of High-Fidelity Single-Qubit Gates for Two-Electron Spin Qubits in GaAs[1] PASCAL CERFONTAINE, TIM BOTZEM, HENDRIK BLUHM, Department of Physics, RWTH Aachen University, D-52074 Aachen, Germany — High fidelity gate operations for manipulating individual and multiple qubits in the presence of decoherence are a prerequisite for fault-tolerant quantum information processing. However, the control methods used in earlier experiments on GaAs two-electron spin qubits are based on unrealistic approximations which preclude reaching the required fidelities. An attractive remedy is to use control pulses found in numerical simulations that minimize the infidelity from decoherence and take the experimentally important imperfections and constraints into account [1]. We show that the experimental implementation of these numerically optimized control pulses is possible by using a self-consistent calibration routine we proposed earlier [1]. In our experiment this calibration routine succeeds in removing systematic gate errors to a high degree without increasing the pulses' decoherence. We extract the Bloch sphere trajectories of the resulting gate sequences using self-consistent state tomography and find good agreement with the theoretically predicted trajectories. Furthermore, we prepare different states using these gates and determine their fidelities.

[1] P. Cerfontaine, T. Botzem, D. P. DiVincenzo, and H. Bluhm, Physical Review Letters **113**(15), 2014.

[1]Alfried Krupp von Bohlen und Halbach - Foundation, Deutsche Telekom Foundation

Pascal Cerfontaine
Department of Physics, RWTH Aachen University, D-52074 Aachen, Germany

Date submitted: 14 Nov 2014 Electronic form version 1.4