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LeRoy Apker Award Lecture: Coherent control of a semiconductor charge qubit[1]

YULIYA DOVZHENKO, Department of Physics, Princeton University, New Jersey, 08544

A charge qubit is formed in a GaAs double quantum dot containing one electron. The two basis states of the qubit correspond to the electron residing in either the left or the right dot. In order to drive coherent rotations of the qubit state, 100 ps timescale voltage pulses are applied to the depletion gates forming the double dot. The resulting charge state is detected by a nearby quantum point contact charge sensor. In contrast with previous work, where a single non-adiabatic pulse was applied for quantum control,[2] we apply multiple pulses working towards dynamic decoupling.[3] Data for Ramsey and charge echo pulse sequences are obtained and compared with numerical simulations of the charge qubit evolution.[4] Coherent multi-pulse control of a semiconductor charge qubit demonstrated in this experiment is an essential requirement for future work in understanding charge noise in semiconductor qubits and improving the fidelity of spin qubit operations.

[1]In collaboration with J. Stehlik, K. D. Petersson, and J. R. Petta. Supported by the Sloan and Packard Foundations, DARPA, and the NSF.

[2]K. D. Petersson *et al.*, Phys. Rev. Lett. **105**, 246804 (2010).
[3]L. Viola *et al.*, Phys. Rev. Lett. **82**, 2417 (1999).
[4]Y. Dovzhenko *et al.*, Phys. Rev. B **84**, 161302(R) (2011).