Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Measurement-free implementations of small-scale surface codes for quantum dot qubits[1] H. EKMEL ERCAN, JOYDIP GHOSH, DANIEL CROW, VICKRAM N. PREMAKUMAR, ROBERT JOYNT, MARK FRIESEN, S. N. COPPERSMITH, University of Wisconsin-Madison — Quantum error correction schemes and their corresponding error thresholds depend sensitively on the physical implementation of the qubits. For example, in quantum dot spin qubits, readout can be much slower than gate operations; however qubit reset—without readout—can be fast, via tunneling to a reservoir. Conventional surface code implementations rely heavily on syndrome measurements, and could therefore be challenging for quantum dots. Here, we propose small-scale surface code implementations for which syndrome measurements are replaced by a combination of Toffoli gates and qubit reset. For quantum dot qubits, this enables much faster error correction than measurement-based schemes, but requires additional ancilla qubits and non-nearest-neighbor interactions. We have performed numerical simulations of two different coding schemes, obtaining error thresholds on the order of 10^{-3} for a 1D architecture that only corrects bit-flip errors, and 10^{-5} for a 2D architecture that corrects bit- and phase-flip errors.

[1]This work was supported in part by ONR (N00014-15-1-0029) and ARO (W911NF-12-0607).

H. Ekmel Ercan
University of Wisconsin-Madison

Date submitted: 11 Nov 2016 Electronic form version 1.4