Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Efficiently simulable approximations to realistic incoherent and coherent errors and their application to threshold estimation MAURICIO GUTIERREZ, KENNETH BROWN, Georgia Institute of Technology — Classical simulations of noisy stabilizer circuits are often used to estimate the threshold of a quantum error-correcting code (QECC). It is not completely clear how sensitive a code's threshold is to the error model, and whether or not a Pauli channel (PC) is a good approximation for realistic non-stabilizer errors. Within the stabilizer formalism, it has been shown that for a single qubit more accurate approximations can be obtained by expanding the PC. We now examine the feasibility of employing these error approximations at the single-qubit level to obtain better estimates of a QECC's threshold. We calculate the level-1 pseudo-threshold for the Steane [[7,1,3]] code for several error models. At the logical level, the Pauli twirled channel (PTC) provides an extremely accurate approximation for incoherent channels. However, for coherent channels, the PTC severely underestimates the magnitude of the error. By computing the effective 1-qubit process matrix for the whole circuit at low error rates, it becomes clear that this behavior is due to the stronger persistence of off-diagonal entries in the coherent channels. Therefore, if the main source of error in the quantum system is coherent, reliable stabilizer simulations should employ expanded Clifford channels.

Mauricio Gutierrez
Georgia Institute of Technology

Date submitted: 06 Nov 2015 Electronic form version 1.4