Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

Robust benchmarking of quantum processes EASWAR MAGESAN, JAY GAMBETTA, JOSEPH EMERSON, Institute for Quantum Computing, University of Waterloo — Fault-tolerant threshold theorems show that as long as the noise affecting a quantum system is below some threshold, reliable quantum computation can take place. As a result, methods for noise characterization are of great interest in quantum information theory. Unfortunately, methods for complete noise characterization scale exponentially in the number of qubits comprising the system. This non-scalability highlights the importance of developing mathematical methods for scalable partial characterization of the noise affecting a quantum system. We discuss a randomized benchmarking protocol that provides fitting models for the fidelity decay of the noisy gates used in quantum information processing. We show that when the average variation of the noise is not too large the first order model gives a robust estimate of both the average error affecting the gate set and the gate-dependence of the noise. We also show that the protocol is scalable in the number of qubits comprising the system. The protocol allows the noise to be both time and gate-dependent, and takes into account state preparation and measurement errors.

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Date submitted: 19 Nov 2010 Electronic form version 1.4