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Modeling quantum noise for efficient testing of fault-tolerant circuits EASWAR MAGESAN, Massachusetts Institute of Technology, DANIEL PUZZUOLI, CHRISTOPHER E. GRANADE, DAVID G. CORY, University of Waterloo-Institute for Quantum Computing — Simulating fault-tolerant properties of quantum circuits is important for the design of large-scale quantum information processors. For general circuits and noise models, these simulations quickly become intractable in the size of the encoded circuit. We introduce methods for approximating a noise process by one which allows for efficient Monte Carlo simulation of properties of encoded circuits. The approximations are as close to the original process as possible without overestimating their ability to preserve quantum information, a key property for obtaining more honest estimates of threshold values. We numerically illustrate the method with physically relevant noise models.

Easwar Magesan
Massachusetts Institute of Technology

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