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Surface code with decoherence: An analysis of three superconducting architectures[1] JOYDIP GHOSH, University of Georgia, AUSTIN G. FOWLER, The University of Melbourne, MICHAEL R. GELLER, University of Georgia — We consider a realistic, multi-parameter error model and develop a methodology to connect logical error rates of a surface code architecture with single qubit coherence time (T1 or T2) for any realistic set of intrinsic parameters, such as state preparation, gate, and readout errors. The amplitude and phase damping are mapped to a diagonal Pauli "depolarization" channel via the Pauli twirl approximation. Three existing superconducting architectures are chosen and a numerical Monte Carlo simulation is performed to obtain the logical error rates. A leading order analytic model is also constructed that estimates the scaling behavior of logical error rates below threshold for small distances. Our results suggest that large-scale fault-tolerant quantum computation should be possible with existing state-of-the-art superconducting devices.

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Joydip Ghosh
University of Georgia

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