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Resilience of topological error-correction codes to concurrent qubit and measurement errors RUBEN S. ANDRIST, Department of Physics, ETH Zurich, HECTOR BOMBIN, Perimeter Institute for Theoretical Physics, MIGUEL ANGEL MARTIN-DELGADO, Departamento de Fisica, Universidad Complutense, HELMUT G. KATZGRABER, Department of Physics and Astronomy, Texas A&M University and ETH Zurich — Topologically-protected quantum computing schemes avert decoherence by storing quantum information in nonlocal degrees of freedom while actively correcting for local errors. To date, the effects of individual error sources, such as, for example, bit flips, phase flips, or measurement errors have been studied. A more realistic assessment of the error stability is given by studying the combination of different error sources, such as bit flips and measurement errors. So far this has only been accomplished under the assumption that both bit-flip and measurement errors occur with the same probability [New J. Phys. 13, 083006 (2011)]. Here we study in detail the interplay between bit-flip and measurement errors, and analyze the resilience of topological error-correction codes to concurrent, nonsymetric bit flips and measurement errors. The error threshold is determined by mapping the problem onto classical, disordered lattice gauge theories, that are investigated using large-scale Monte Carlo simulations and improved estimators for systems with local gauge symmetries.

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