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Quantum error thresholds for gauge-redundant digitizations of lattice field theories

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In the quantum simulation of lattice gauge theories, gauge symmetry can be either fixed or encoded as a redundancy of the Hilbert space. While gauge-fixing reduces the number of qubits, keeping the gauge redundancy can provide code space to mitigate and correct quantum errors by checking and restoring Gauss's law. In this work, we consider the correctable errors for generic finite gauge groups and design the quantum circuits to detect and correct them. We calculate the error thresholds below which the gauge-redundant digitization with Gauss's law error correction has better fidelity than the gauge-fixed digitization. The results provide guidance for fault-tolerant quantum simulations of lattice gauge theories.

Mini Symposia (Invited Talks Only)

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