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**Logical error rates and resource overheads of non-transversal, magic-less gates** RYUJI TAKAGI, THEODORE J. YODER, ISAAC L. CHUANG, Massachusetts Institute of Technology — A non-transversal gate is required for a quantum error correcting code to perform universal computation. Gate teleportation using magic states is one way to perform the necessary operation, albeit with large overhead. Several constructions of logical gates have been proposed without magic states, but little work has been done to evaluate logical error rates and resource overheads of the gates, and compare them to magic states. In this work, we calculate logical error rates of controlled-controlled-$Z$ (CCZ) gates on 5-qubit code and 7-qubit code implemented with the recently proposed pieceably fault-tolerant construction, which uses neither magic states nor additional ancilla qubits other than those used for error correction. Alongside transversal gates on these codes, CCZ is enough for universal computation. We also calculate the error rate of performing CCZ by state injection. Despite being much more costly in terms of space and time, state injection is no less error-prone than pieceable constructions. Our result also serves as motivation to investigate different choices of universal gate sets other than the conventional one, Clifford gates + $T$ gate.

Ryuji Takagi
Massachusetts Institute of Technology

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