

Logical T for The Toric Code Has to Have Non Trivial Depth.

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Abstract

In this work we study the depth of logical T gate of the CSS quantum error correction codes. In particular we shown that for the Toric code the depth of logical T can not be trivial.

$$\| |1\rangle - T |1\rangle \|_2^2 = \| |1\rangle - e^{i\frac{\pi}{4}} |1\rangle \|_2^2 = 2 \left(1 - \cos\left(\frac{\pi}{4}\right) \right) = 2 - \sqrt{2}$$