

# 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.

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