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Local disentanglers for the equivalence of two-dimensional topological quantum codes

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Abstract
Studying equivalence classes under local unitary transformations is one of the most important approaches for the classification of topological quantum states. It has specially attracted much attention for topological quantum codes due to their application in quantum computing. In particular, It has been shown that each D dimensional color code is local unitary equivalence to many copies of D dimensional toric codes. In this paper, we consider such transformations for two- dimensional (2D) topological codes by introducing GHZ disentanglers. We apply the above disentanglers on qubits corresponding to one particular color in the color code defined on a three-colorable honeycomb lattice. Then, we show that it leads to disentangling other colors because the initial color code is converted to two copies of the triangular toric codes. Furtheremore we extend the above transformations for color codes on different three-colorable lattices. We show that by applying GHZ disentanglers corresponding to one particular color, the color code is converted to two toric codes defined on dual lattices corresponding to other colors. This result is also useful for comparing color codes on different lattices regarding the difference between their dual lattices.

Keywords: local transformations, topological equivalence classes, color code, toric code, topological phase

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