ATELIER SUR L'INFORMATION QUANTIQUE ET LA PHYSIQUE STATISTIQUE
18–21 OCTOBRE 2011

WORKSHOP ON QUANTUM INFORMATION IN QUANTUM MANY-BODY PHYSICS
OCTOBER 18–21, 2011

Local equivalence of topological order : Kitaev's code and color codes

Guillaume Duclos-Cianci *
Guillaume.Duclos-Cianci@USherbrooke.ca

We demonstrate that distinct topological codes can be mapped onto each other by local transformations. The existence of such a local mapping can be interpreted as saying that these codes belong to the same topological phase. When used as quantum error correcting codes, the local mapping also enables us to use any decoding algorithm suitable for one of these codes to decode other codes in the same topological phase. We illustrate this idea with the topological color code and the topological subsystem color code that are found to be locally equivalent to two copies of Kitaev's toric code. We are therefore able to decode these two codes that had no previously known efficient decoding algorithm, and find error thresholds comparable to previously estimated optimal values. These local mappings could have additional use for fault-tolerant quantum computation. In particular, one could in principle take advantage of the features (transversal gates, topological gates, etc.) of all the codes that are locally equivalent by switching between them during the computation in a fault-tolerant fashion.

*Département de physique, Université de Sherbrooke, 2500, boul. de l'Université, Sherbrooke, QC J1K 2R1, CANADA.