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Changing topology by knotting in the three-dimensional Toric Code ANDREJ MESAROS, Department of Physics, Boston College, Chestnut Hill, MA 02467, USA, YONG BAEK KIM, Department of Physics, University of Toronto, Toronto, Ontario M5S 1A7, Canada, YING RAN, Department of Physics, Boston College, Chestnut Hill, MA 02467, USA — A novel way to study the ground state degeneracy (GSD) of topological matter is through lattice dislocations: When a second copy of a lattice model is introduced through translation by half a lattice constant ($|\vec{b}| = a/2$), then a lattice dislocation with Burgers vector $\vec{b}$ locally smoothly connects the two model copies. Such dislocations are "genon" defects, effectively changing the topology of lattice. In three dimensions (3d), dislocations are closed loops that can be linked and knotted, leading to complex three dimensional manifolds on which the topological theory is defined. We give an analytical construction, supported by exact numerical calculations, for the dependence of GSD on dislocations of such a doubled version of the exactly solvable Kitaev's Toric Code (having Z_2 topological order) in both 2d and 3d. Surprisingly, we find that GSD of the 3d model depends only on the total number of dislocation loops, no matter their linking or knotting. The analytical proof is extended to Z_n generalizations of the model. Additionally, we consider the phase in which dislocations become dynamical through proliferation of double dislocations ($2\vec{b}$) in 2d: the resulting gauge theory is non-Abelian, in the special case of Z_2 Toric Code it is D_4.

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