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Robust Topological and Holographic Degeneracies of Classical Systems SEYYED MOHAMMAD SADEGH VAEZI, ZOHAR NUSSINOV, Washington University in St.Louis, GERARDO ORTIZ, Indiana University, Bloomington
— We challenge the hypothesis that the ground states of a physical system whose degeneracy depends on topology must necessarily realize topological quantum order and display non-local entanglement. To this end, we introduce and study a classical rendition of the Toric Code model embedded on Riemann surfaces of different genus numbers. We find that the minimal ground state degeneracy (and those of all levels) depends on the topology of the embedding surface alone. As the ground states of this classical system may be distinguished by local measurements, a characteristic of Landau orders, this example illustrates that topological degeneracy is not a sufficient condition for topological quantum order. This conclusion is generic and, as shown, it applies to many other models. We also demonstrate that in certain lattice realizations of these models, and other theories, one can find a ground state entropy that is "holographic", i.e., extensive in the system's boundary.

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