Dissipative Symmetry-protected topological order induced by Z_2 x Z_2 generators

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Abstract

Topological phases of matter[1] have emerged last decades as an important research area in condensed matter physics owing to further paradigms on the classification of novel quantum phases of matter beyond the Landau-Ginzburg-Wilson theory. Also, the interplay of quantum physics and the environment opens the possibilities to interesting physics phenomena, where the role of dissipation on the topological order is important given the possibilities of applications in material science[2] and topological quantum computing[3]. In this work, we implement a tensor networks [4,5] algorithm to investigate the effects of dissipation on the symmetry-protected topological order. We've considered the Affleck-Kennedy-Tasaki-Lieb spin model coupled with an environment where the Lindbladian master equation describes dissipative dynamics. We numerically solve the Lindbladian master equation by adapting the infinite time-evolving block decimation method for mixed states [5]. We demonstrate that, for jump-operators described by the Z_2xZ_2 group generator elements we obtained a non-equilibrium steady state with typical properties of a symmetry-protected topological order[6]. We also bring counter-examples with jump operators as geral spin rotations are given, where no fingerprints of symmetry-protected topological order are observed.

References

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Figures

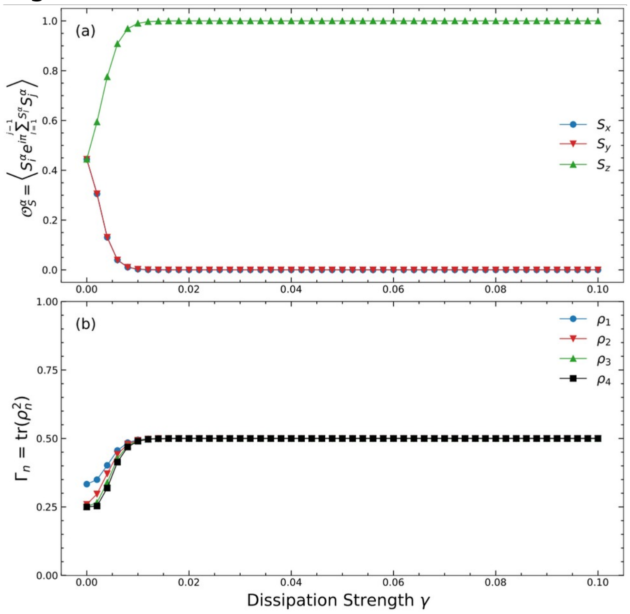

Figure 1: String Order parameter(a) and Purity(b) of the non-equilibrium steady state. In that case, the jump-operators are described by Z_2xZ_2 group generators.

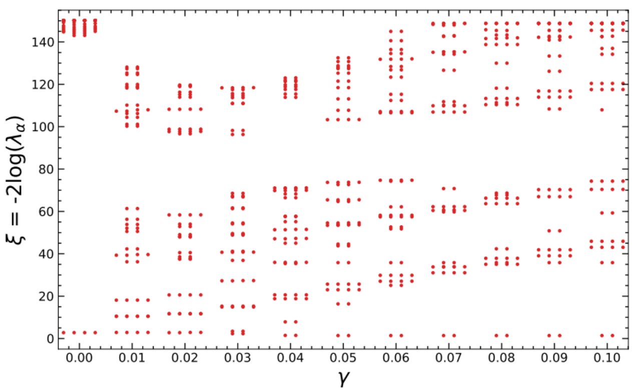

Figure 2: The Entanglement Spectrum of the non-equilibrium steady state. The typical degeneracy is a robust fingerprint of a symmetry-protected topological phase.