Decoherence and relaxation of topological states in extended quantum Ising models

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We study the decoherence and the relaxation dynamics of topological states in an extended class of quantum Ising chains which can present a degenerate ground state subspace.

The leading interaction of the spins with the environment is assumed to be the local fluctuations of the transverse magnetic field. By deriving the Lindblad equation using the many-body states, we investigate the relation between decoherence, energy relaxation and topology. In particular, in the topological phase and at low temperature, we analyze the dephasing rates between the different degenerate ground states. We derive a formula for the dephasing rate, in a given parity subspace, that incorporate two Majorana zero modes. We show that the topology also affects the relaxation dynamics of excited states. Here we found that a "secondary gap" (which appears for topological number g=2) determines the relaxation behavior of the excited states and the resulting occupation imbalance of the ground states in a given parity subspace.

[1] H. Weisbrich, W. Belzig, G. Rastelli, SciPost Phys. 6, 037 (2019).