MANY-BODY MAJORANA-LIKE ZERO MODES WITHOUT GAUGE SYMMETRY BREAKING

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Topological superconductors represent one of the key hosts of Majorana-based topological quantum computing. Typical scenarios for one-dimensional (1D) topological superconductivity assume a broken gauge symmetry associated to a superconducting state. However, no interacting 1D many-body system is known to spontaneously break gauge symmetries. Here, we show that zero modes emerge in a many-body system without gauge symmetry breaking and in the absence of superconducting order [1]. In particular, we demonstrate that Majorana zero modes of the symmetry-broken superconducting state are continuously connected to these zero-mode excitations, demonstrating that zero-bias anomalies may emerge in the absence of gauge symmetry breaking. We demonstrate that these many-body zero modes share the robustness features of the Majorana zero modes of symmetry-broken topological superconductors. We further show that the interface between the interacting model and a 1D topological superconductor does not support Majorana modes. We introduce a bosonization formalism to analyze these excitations and show that a ground state analogous to a topological superconducting state can be analytically found in a certain limit. Our results demonstrate that robust Majorana-like zero modes may appear in a many-body systems without gauge symmetry breaking, thus introducing a family of protected excitations with no single-particle analogues.

Ref:

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