Final Essay Proposal

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March 12, 2023

Contents

The following content is generate by ChatGPT. The main gist of my final presentation is to extend/give an example of our learning on topological invariants. This is achieved by discussion of emergence of Majorana zero modes in superconducting systems. Specifically, the 1D toy model that is presented in this paper.

The emergence of Majorana fermions in superconducting systems is related to the concept of a topological invariant or topological number. A topological invariant is a quantity that characterizes the topological properties of a system and remains unchanged even under small perturbations. In the case of Majorana fermions, their existence is tied to a topological invariant known as the Chern number or the topological index.

In 1D superconducting systems, the emergence of Majorana fermions is related to the topological invariant known as the winding number, which characterizes the topological properties of the system. The winding number describes how many times the superconducting phase changes around the wire, and it is related to the number of Majorana fermions that can emerge at the ends of the wire. Specifically, the number of Majorana fermions is equal to the absolute value of the winding number.

In 2D superconducting systems, the emergence of Majorana fermions is related to the topological invariant known as the Chern number, which characterizes the topological properties of the system in terms of the curvature of the energy bands. The Chern number is related to the number of Majorana fermions that can form at the edge of the superconductor, and specifically, the number of Majorana modes is equal to the absolute value of the Chern number.

The existence of Majorana fermions in superconducting systems is therefore closely tied to the topological properties of the system, as described by

topological invariants such as the winding number and the Chern number. These topological invariants provide a robust and quantitative way to characterize the presence and properties of Majorana fermions in these systems.