One-dimensional p-wave superconductivity with long-range hopping and pairing

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Abstract

In this paper, we have considered the extended version of the Kitaev model in one dimension, i.e., a long-range p-wave superconducting wire. In the long-range Kitaev chain, the superconducting hopping and pairing terms in the Hamiltonian decay, independently, in a power-law fashion $1/l^x$, where l is the distance between the two sites and x is some positive constant. We have studied the appearance of Majorana zero-energy edge modes and also, massive Dirac edge modes by exact diagonalization, as well as analytical computations. Exact diagonalization indicates the existence of both kinds of massless and massive edge modes in the energy spectrum. Furthermore, we obtain the phase diagram and the topological phase transitions by calculating the winding number, which is the topological invariant.

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