Exact ground states of an interacting Kitaev/Majorana chain

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We consider a system of interacting spinless fermions on an open chain. In the absence of interactions, the model describing the system reduces to the celebrated Kitaev/Majorana chain[1], in which zero-energy edge modes occur in a phase with topological order. We will demonstrate that the exact ground states can be obtained analytically even in the presence of interactions when the chemical potential is tuned to a particular function of the other parameters. The ground states obtained are two-fold degenerate and differ in fermion parity, as is the case with the Kitaev/Majorana chain in a topological phase. We will prove that the ground state is unique in each fermion parity sector. We will also prove rigorously the existence of an energy gap using a slight modification of Knabe's method [2,3]. The results clearly show that the topological phase in the non-interacting limit is adiabatically connected to the phase of the interacting model without gap closing, suggesting the presence of Majorana edge zero modes.

References

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