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Perturbing the Kitaev spin liquid with disorder

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The Kitaev honeycomb model provides a paradigmatic example of exactly solvable quantum spin liquid (QSL), in which the spin degrees of freedom fractionalize into itinerant Majorana fermions coupled to a static background of Z_2 gauge fluxes. (1) This model has attracted significant attention in recent years due to the possibility of its experimental realization in some spin-orbit Mott insulators. Amongst the various candidates to host the Kitaev spin liquid phase, the iridate compound H_3LiIr_2O_6 has a prominent role due to the absence of long-range magnetic order in low temperatures, which is a distinct feature of a QSL state. (2) Another important aspect observed in this material is the presence of magnetic disorder, which may induce a distinct thermodynamic behavior in comparison to the clean model. (2-3) Motivated by this experimental scenario, we consider the Kitaev honeycomb model in the presence of an external magnetic field, where the system behaves as a gapped topological QSL, hosting chiral edge states labeled by a topological number. In addition to the field, we also consider a relevant perturbation coming from the non-Kitaev interactions which gives rise to possible different static flux configurations in the ground state and, therefore, preserves the model's exact solvability. Our aim is to study the effects of bond-disorder and vacancies in this extended model, using the spectrum obtained via exact diagonalization. The robustness of the chiral edge states in the presence of disorder is investigated using the Bott index formula, a real space topological index equivalent to the Chern number, complemented by an analysis of the spectrum statistics.

Palavras-chave: Spin-Liquid. Disorder. Topology.

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