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Periodic Boundary Condition of Partons in the Kitaev Model

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The Kitaev honeycomb model is an exactly solvable model that hosts a quantum spin liquid ground state, a novel phase of matter characterized by non-trivial many-body entanglement. This phase exhibits phenomena such as excitations with fractional statistics and topological features. Parton construction can decouple the up and down spin sectors of the Kitaev honeycomb model, leading to the convenience of theoretical analysis. Many literatures, including Kitaev's original work, analyze the model with infinite lattice sites, but investigating finite-size systems is necessary for both numerical studies and computing physical quantities for experiments. However, when doing so, some issues related to the periodic boundary condition arise due to the emergent gauge redundancy. In this research, we investigate the periodic boundary condition of partons in the Kitaev honeycomb model. The result turns out that the parton solution highly depends on the type of periodic boundary condition we chose. This research may help us to understand more about the properties of the parton technique, especially its application to the analysis of quantum spin liquids.

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