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Mean-field interaction effects on the topological phases of Kagome-graphene systems

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Abstract

The improving ability to synthesize new materials has intensified the interest in describing properties of systems modeled by more complex lattices. The 2D super-honeycomb lattices, including the Kagomé-graphene lattice, have been explored recently in metallic organic frameworks. They have been revealed as an essential route to achieving localized electronic responses, manifested as flat bands in their electronic structure with topological insulating behavior. Therefore, a natural inquiry for these systems is a complete analysis of their topological phases in the presence of electronic correlation effects. In this work, we use the tight-binding model to reveal a careful analysis of the impact of the electron-electron correlation effects via Hubbard mean-field approximation on the topological phases of Kagomé-graphene lattices. The spin conductivity phase's diagrams describe metallic, trivial Mott insulator and topological insulating behaviors, considering different intrinsic spin-orbit couplings, Hubbard mean-field intra-site energy intensities, and electronic occupations. This study can contribute to advances in tunable nanostructured devices prospection with relevant application potential in spintronics and transport responses.

Figure

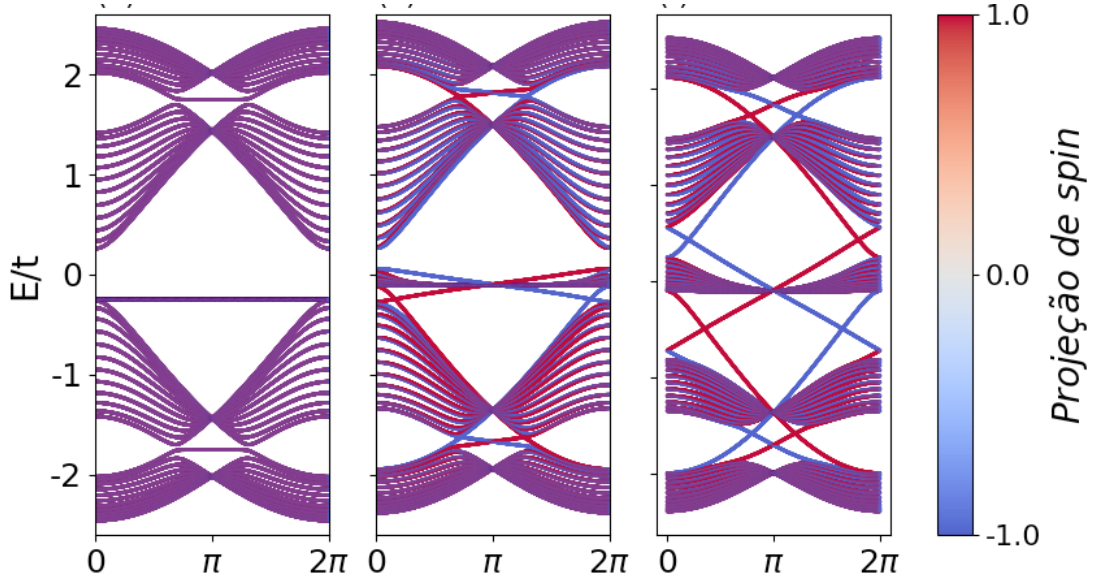

Figure 1: Electronic structures of a Kagome-graphene nanoribbon (50-KGNR) with zero spin-orbit and e-e correlations (left panel), spin-orbit equal to 0.05t and e-e correlation 0.2t (middle) and both spin-orbit coupling and e-e correlation equal to 0.2t (right panel).