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Chiral spin liquids in the Kagome lattice

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Spin liquids are exquisite states of matter which host fractionalized excitations of spin and show no long-range magnetic order even at zero temperature due to quantum fluctuations. They've been extensively studied using fractionalized representations of the spin degrees of freedom in the so-called parton construction – such as the Abrikosov fermions, Schwinger bosons or Majorana fermions – in conjunction with the Gutzwiller projection which imposes the no double occupancy constraint at each site to correctly describe the physical Hilbert space. (1) Using Mean Field Theories (MFT), this constraint is imposed on average sense, and numerical techniques, such as the Variational Monte Carlo (VMC), are required to impose this condition exactly at each site. In this framework, the VMC is a powerful tool to indicate which MFT ansatz is favored energetically to represent the spin liquid state based on the variational principle and the specific spin fractionalized representation. We employed this approach to investigate a putative chiral spin liquid state in the Kagome lattice using the Abrikosov representation to decompose the spin into spinons: neutral spin-1/2 fermionic quasiparticles. This work was done having the Jd-Jx Kagome Lattice model in mind, a minimal model inspired by the material Kapellasite (2), a polymorphous structure of Herbertsmithite, with Heisenberg interactions in the diagonals of the hexagons and staggered chiral interactions in the triangles of the Kagome Lattice. Our VMC results favor a gapless chiral spin liquid with staggered half pi flux over the triangles and zero flux on the hexagons in the region with |Jd/Jx|>0. (3) We also investigated the stability of this spin-liquid state with respect to ordered phases known to occur in the model.

Palavras-chave: Chiral spin liquids. Parton construction. Variational Monte Carlo.

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