Interplay between magnetic and charge orders in the system of localized fermions on a geometrically-frustrated lattice with Ising-like interactions

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A generalized fermionic lattice gas model in the form of the extended Hubbard model with intersite Ising-like interactions (between nearest neighbors, both antiferromagnetic and ferromagnetic) at the atomic limit on the triangular lattice is studied [1-5]. The Hamiltonian of the system consists of the following terms: nearest-neighbor Ising-like magnetic J interactions and onsite Coulomb U interactions. The model is investigated for both signs of J, arbitrary U interaction, and arbitrary chemical potential μ (or, equivalently, arbitrary particle concentration n) using two complementary methods: (i) Monte Carlo simulations in the grand canonical ensemble [1,3-5] and (ii) the variational method within the mean-field decoupling of the intersite term and exact treatment of the onsite interaction [2,3]. Both methods yield the exact ground-state phase diagram as a function of μ [1,2]. For antiferromagnetic coupling, a nontrivial ordered phase with coexistence of metamagnetic and charge ordering is found. The finite-temperature phase diagram is complex, with phase transitions between the ordered and nonordered phases being of first as well as second order (i.e., discontinuous and continuous, respectively), depending on the model parameters. The results are contrasted with the findings for the two-dimensional square lattice [3–5].

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