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Fermionic mean field theory for arbitrary spin and Spin-1 algebraic spin liquid on triangle lattice ZHENG-XIN LIU, Department of Physics, Hong Kong University of Science and technology, YI ZHOU, Department of Physics, The University of Hong Kong, TAI-KAI NG, Department of Physics, Hong Kong University of Science and technology — We generalized the fermionic representation for Heisenberg model with spin-1/2 to arbitrary spin. The particle-hole symmetry for spin-1/2 Hilbert space is absent for $S \geq 1$. We find a Lagrangian for Heisenberg model with spin-1 or spin-3/2 with restored particle-hole symmetry and study the corresponding mean fields. The excitation spectrum is gapped for the former and gapless for the latter, which is consistent with Haldane's conjecture. We also study the magnetic insulator $NiGa_2S_4$ by applying the fermionic mean field theory to the spin-1 J_1-J_3-K model $H = \sum_{\langle i,j\rangle} \left[J_1 \mathbf{S_i} \cdot \mathbf{S_j} + \mathbf{K}(\mathbf{S_i} \cdot \mathbf{S_j})^\mathbf{2}\right] + J_3 \sum_{[i,j']} \mathbf{S_i} \cdot \mathbf{S_{j'}}$. We find two spin liquid solutions with gapless spinon excitations, which has never been discussed in literature to our knowledge. We assume that the ground state is in one of these spin liquid phases, then the gapless excitation spectrum explains the T^2 law of the specific heat at low temperature. The susceptibility calculated from the mean field theory is linear in T at low temperature. We attribute the experimentally observed nonzero susceptibility at zero temperature and the partially spin freezing below T_f to the defects such as impurities or surface effects.

Zheng-Xin Liu
Hong Kong University of Science and technology

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