Magnetic orderings in the Hubbard model with anisotropic spin-exchange interactions in the zero-bandwidth limit

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We discuss the phase diagrams and thermodynamics properties of the extended Hubbard models with anisotropic intersite spin-exchange interactions ($J_\perp$, $J_\parallel$) in the zero-bandwidth limit. The cases of ferromagnetic ($J_\alpha > 0$) and antiferromagnetic ($J_\alpha < 0$) exchange couplings are considered for arbitrary electron concentration ($0 < n < 2$). The analysis of these $U - J_\perp - J_\parallel$ models has been performed for d-dimensional hypercubic lattices by means of a variational approach which treats the U term exactly. Some rigorous results derived for $d = 1$ and $d = \infty$ cases are also presented. Depending on the interaction parameters and n the systems are found to exhibit several various phases with uniaxial and planar magnetic orderings as well as the phase separated states and the nonordered states. The effects of intersite Coulomb interactions and external fields on the phase diagrams are also concluded.

One shows that the systems considered can exhibit very interesting multicritical behaviors, including among others bicritical, tricritical, tertacritical and critical end points. The ground state phase diagrams of the zero-bandwidth model at half filling are compared with the corresponding diagrams derived recently for the case of finite bandwidth.
PACS numbers: 71.10.Fd, 75.10.-b, 75.30.Gw, 71.45.Lr, 74.20.-z

Subject category :

1. Strongly Correlated Electrons and High Temperature Superconductivity

Presentation mode :

poster

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