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Magnetic Fluctuations and Superconductivity in Skutterudite Compounds

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In order to get an insight into the mechanism of superconductivity in filled skutterudite compounds, we investigate magnetic properties of f^n-electron systems from a microscopic viewpoint. By using the numerical renormalization group method, we evaluate the magnetic susceptibility of f electron based on the Anderson model, which is composed of the conduction electron, hybridization between conduction and f electrons, and local f-electron terms. Note that the f-electron term includes Coulomb interactions, spin-orbit coupling, and crystalline electric field potential for $T_{\rm h}$ symmetry.

When Γ_1 is the local ground state and $\Gamma_4^{(2)}$ is the excited state with small excitation energy, the Curie-law behavior in the magnetic susceptibility is found to appear even for the f^2-system. Thus, there may occur anisotropic Cooper-pairs mediated by the magnetic fluctuations in the f^2-electron system with Γ_1 ground state. In order to pursue such a possibility, we evaluate superconducting pair susceptibility of an orbital-degenerate Hubbard model constructed based on a j-j coupling scheme. Then, we find that the pair susceptibility is significantly enhanced when the energy difference between Γ_1 ground and Γ_4 excited states is small. We also discuss the change of the pairing symmetry when magnetic field is applied.