Abstract Template

Magnetism and superconductivity in the t-J model of $La_3Ni_2O_7$ under multiband Gutzwiller approximation

(Session number, Oral)

Fa Wang[1,2]

[1]Internatioal Center for Quantum Materials, School of Physics, Peking University, Beijing 100871, China

[2]Collaborative Innovation Center of Quantum Matter, Beijing 100871, China

The recent discovery of possible high temperature superconductivity in single crystals of $La_3Ni_2O_7$ under pressure renews the interest in research on nickelates. The DFT calculations reveal that both d_{z2} and d_{x2-y2} orbitals are active, which suggests a minimal two-orbital model to capture the low-energy physics of this system. In this work, we study a bilayer two-orbital t – J model within multiband Gutzwiller approximation, and discuss the magnetism as well as the superconductivity over a wide range of the hole doping. Owing to the inter-orbital super-exchange process between d_{z2} and d_{x2-y2} orbitals, the induced ferromagnetic coupling within layers competes with the conventional antiferromagnetic coupling, and leads to complicated hole doping dependence for the magnetic properties in the system. With increasing hole doping, the system transfers to A-AFM state from the starting G-AFM state. We also find the inter-layer superconducting pairing of d_{x2-y2} orbitals dominates due to the large hopping parameter of d_{z2} along the vertical inter-layer bonds and significant Hund's coupling between these orbitals. Meanwhile, the G-AFM state and superconductivity state can coexist in the low hole doping regime. Our results highlight the importance of the interplay between magnetism and superconductivity in theoretical models for nickelate superconductors.