

凝縮系物理学ゼミナール

Condensed Matter Seminar

Location: Zoom Online seminar

Date: 13:30-15:00, Wednesday, 13 May 2020

“Electronic state and Superconductivity in UTe₂”

Speaker:

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Abstract:

Recently discovered heavy fermion superconductor UTe₂ [1], as a member of the ferromagnetic superconductors, provides a new platform to study the spin-triplet superconductivity. The spin-triplet state in UTe₂ is manifested by various experimental results: large upper critical field H_{c2} along the three principal axes [1, 2], reentrant superconductivity under magnetic field along b axis [3], and the Knight shift measurement in superconducting state [4].

In this talk, we study the electronic state and topological superconductivity in UTe₂. Theoretically, a band structure has been investigated for UTe₂ from first principles calculation [2]. However, previously obtained result shows an insulating state, incompatible with superconducting instability. To solve this program, we perform a GGA+ U calculation and find the insulator-metal transition by Coulomb interaction. The insulator-metal transition is a peculiar property of UTe₂, which was not observed in other uranium-based superconductors nor in Kondo insulators. The Fermi surfaces indicate topological superconductivity for the moderate values of U , and accompanied surface states are provided [5]. We also predict the superconducting gap node at zero magnetic field and under magnetic field along b axis. Based on these results, we proposed multiple superconducting phases under the magnetic field.

References:

- [1] S. Ran, *et al.*, Science **365**, 684 (2019).
- [2] D. Aoki, *et al.*, J. Phys. Soc. Jpn. **88**, 043702 (2019).
- [3] G. Knebel, *et al.*, J. Phys. Soc. Jpn. **88**, 063707 (2019).
- [4] G. Nakamine, *et al.*, J. Phys. Soc. Jpn. **88**, 113703 (2019).
- [5] J. Ishizuka, *et al.*, Phys. Rev. Lett. **123**, 217001 (2019).