

凝縮系物理学ゼミナール

Condensed Matter Seminar

Date: 13:30-15:00, Wednesday, 22 June 2022

Title: Even-odd parity transition in strongly correlated locally noncentrosymmetric superconductors

: An application to CeRh₂As₂

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Abstract:

The recent discovery of superconductivity in CeRh₂As₂ clarified an unusual H - T phase diagram with two superconducting phases [1]. CeRh₂As₂ crystallizes in the centrosymmetric tetragonal CaBe₂Ge₂-type structure with stacking Ce layers and Rh₂As₂ layers. Importantly, Rh₂As₂ layers at the top and bottom of the Ce layer have different compositions. Therefore, the inversion symmetry is locally broken at the Ce sites, although the global inversion center exists in the middle of the two Ce sites. Surprisingly, a similar phase diagram was predicted in theoretical work about locally noncentrosymmetric superconductors [2]. The qualitative similarity of the phase diagrams between the experiment [1] and theory [2] suggests that the local inversion symmetry breaking plays an essential role in CeRh₂As₂ and the superconducting phase in the high magnetic field region is the pair-density-wave (PDW) state. PDW state is an odd parity superconducting state with dominant spin-singlet pairing. We showed that the PDW phase in CeRh₂As₂ is topological superconductivity [3]. However, there are contradicting points between the weak-coupling theory and the experiment. In particular, the parity transition field obtained by the weak-coupling theory is small by a factor of five [1,2].

In this talk, we focus on strong correlation effects in CeRh₂As₂. We find XY -type magnetic fluctuation consistent with a recent NMR study [4]. We also clarify that in the resulting superconducting phase diagram, the parity transition field is significantly enhanced [5].

Reference:

- [1] S. Khim *et al.*, Science **373**, 1012 (2021).
- [2] T. Yoshida, M. Sigrist, and Y. Yanase, Phys. Rev. B **86**, 134514 (2012).
- [3] K. Nogaki, A. Daido, J. Ishizuka, and Y. Yanase, Phys. Rev. Research **3**, L032071 (2021).
- [4] S. Kitagawa *et al.*, J. Phys. Soc. Jpn. **91**, 043702 (2022).
- [5] K. Nogaki and Y. Yanase, arxiv:2206.04288