凝縮系物理学ゼミナール
Condensed Matter Theory Seminar
Date: 13:30-15:00, Wednesday, 8 January 2024

Title: Magnetism and superconductivity in the two sublattice periodic Anderson model for UTe_2

Speaker: Mr. Ryuji Hakuno

Abstract:

UTe_2 has been attracting much attention in recent years as a strong candidate for spin-triplet superconductors. Magnetic fluctuations are important for elucidating the mechanism of superconductivity, and much research has been performed from both theoretical and experimental aspects to clarify the relationship between them, but a consensus has not yet been achieved. UTe_2 has a crystal structure with two uranium sublattices in each unit cell [1] and is also a superconductor with a locally broken inversion symmetry in which the inversion center does not exist at the uranium site, which is important for superconductivity. Strong anisotropy has been reported in magnetic fluctuations and the upper critical field [2,3], and spin-orbit coupling is thought to play an important role in magnetism and superconductivity. In addition, a reentrant transition, in which superconductivity is enhanced under b-axis magnetic field, and multiple phase transitions under pressure have been reported to occur [3], and recently, experiments have shown that these superconducting phases are identical.

In this study, we extend the effective model [4] used in our previous studies to a model with sublattice degrees of freedom and discuss the results considering sublattice-dependent antisymmetric spin-orbit coupling. Since the spin-orbit coupling induces anisotropy in magnetic fluctuation and d-vector, the analysis of this model enables us to precisely determine the superconducting state including the spin degrees of freedom. We discuss the superconducting symmetry by comparing the calculated results with experimental results like NMR measurements [5].

References:
[1] Vladimir Hutanu *et al*, arXiv:1905.04377. (2019).
[2] Sheng Ran *et al*., Science **365**, 684-7 (2019).
[3] Knebel Georg *et al*., J. Phys. Soc. Jpn. **88**, 063707 (2019).
[4] Ryuji Hakuno, Kosuke Nogaki and Youichi Yanase, Phys. Rev. B, **109**, 104509 (2024).
[5] Hiroki Matsumura *et al*., J. Phys. Soc. Jpn. **92**, 063701(2023).