凝縮系物理学ゼミナール
Condensed Matter Seminar

Location: Room 413, School of Science Bldg. 5 (理学5号館413号室)
Date: 13:30-15:00, Wednesday, 20 July 2016

"Classification of multi-orbital superconductors and its applications"

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Abstract:

Classification of superconducting gap functions in single-orbital systems, such as summarized in the famous review by M. Sigrist and K. Ueda [1], is indispensable for the analysis of various unconventional superconductors. Recently, however, the importance of the multi-orbital character of the gap functions has been gradually recognized (e.g., Ref. [2]). For example, we proposed that heavy fermion superconductor UPt_3 possesses the exotic multi-gap structure with twofold line nodes, which are not allowed in the classification of the single-orbital pseudo-spin model [3].

In the present study, we perform the group-theoretical classification of superconducting gap functions in O, D_4, and D_6 point groups [4]. The generalized Cooper pairs possess spin-orbital coupled (multipole) degrees of freedom, instead of the conventional spin singlet/triplet in the single-orbital systems. From the classification, we obtain the following key consequences: (1) Superconducting gap functions with $\Gamma_9 \otimes \Gamma_9$ in D_6 possesses nontrivial momentum dependence, different from the usual spin 1/2 classification. (2) Unconventional gap structure can be realized in the BCS approximation of purely local (on-site) interactions. (3) Reflecting symmetry of orbital basis functions, there appear not symmetry-protected but inevitable line nodes/gap minima, and thus, anisotropic *s*-wave superconductivity can be naturally explained without any competitive fluctuations.

References:

[1] M. Sigrist and K. Ueda, Rev. Mod. Phys. 63, 239 (1991).

[2] P. M. R. Brydon, L. Wang, M. Weinert, and D. F. Agterberg, Phys. Rev. Lett. 116, 177001 (2016).

[3] T. Nomoto and H. Ikeda, unpublished.

[4] T. Nomoto, K. Hattori, and H. Ikeda, unpublished.