

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)

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k-space structure of the coexisting superconducting and antiferromagnetic orders induced by paramagnetic pair-breaking effect

Speaker: Mr. Yuhki Hatakeyama (畠山 雄気氏)

(Department of Physics, Kyoto University)

Abstract:

In the high-field low-temperature(HFLT) phase of the heavy fermion superconductor CeCoIn_5 , the coexistence of a FFLO superconducting(SC) order and an antiferromagnetic(AFM) order is realized[1-2]. However, the AFM order is observed only in the superconducting HFLT phase, and not in the normal phase or in the low-field SC phase. In our previous study[2-3], we found that the paramagnetic pair-breaking(PPB) effect induces AFM ordering in the high-field region of a d-wave SC phase, and this mechanism can explain the unusual AFM ordering in the HFLT phase.

In this study, we investigate the k-space structure of the coexisting SC and AFM orders induced by the PPB effect in order to clarify the role of the PPB effect and the d-wave gap function in the coexistence of these orders. It is shown that the PPB effect breaks Cooper pairs in the region near the d-wave nodes, and an AFM order develops in this region. On the other hand, it is shown that a SC order and an AFM order are enhanced with each other also in k-space because of the sign change of the gap function in k-space, and this enhancement play an important role in the coexistence of SC and AFM orders induced by the PPB effect. We also discuss the effect of Fermi surface curvature on the field dependence of AFM moment in terms of the k-space structure of SC and AFM orders.

Reference:

- [1] M. Kenzelmann et al., Science 321, 1652 (2008)
- [2] K. Kumagai et al., Phys. Rev. Lett. 106, 137004 (2011).
- [3] R. Ikeda, Y. Hatakeyama and K. Aoyama, Phys. Rev. B 82, 060510 (2010).
- [4] Y. Hatakeyama and R. Ikeda, Phys. Rev. B 83, 224518 (2011).