PC1-1-INV

Scanning SQUID Microscopy on Chiral Superconductor Candidates Sr_2RuO_4 and URu_2Si_2

*YUSUKE IGUCHI[1]

Department of Applied Physics, Stanford University[1]

A chiral superconductor is defined as one in which a complex superconducting gap function breaks time-reversal symmetry[1]. In this talk, I will review the superconductivity of chiral superconductor candidates Sr_2RuO_4 and URu_2Si_2, and introduce our recent studies, especially of time-reversal symmetry breaking(TRSB) using Scanning SQUID Microscopy(SSM). Our scanning SQUID microscope has a gradiometric SQUID layout with integrated pickup loops and field coils, enabling simultaneous measurements of the local magnetic flux and the local ac susceptibility[2].

Sr_2RuO_4 has been extensively studied as a possible chiral *p*-wave superconductor because of evidence for a nodal gap structure, spin triplet state, and TRSB[3]. However, a recent NMR Knight shift study suggested a spin singlet state in Sr_2RuO_4[4]. In addition, TRSB is still being discussed, because TRSB has been observed by μ-SR and polar Kerr[5], but not by our SSM[6]. On the other hand, in a chiral *p*-wave superconductor, it is theoretically predicted that the superconducting critical temperature T_c increases linearly as the uniaxial stress increases, with a cusp at zero stress, but non-local ac susceptibility measurements and local measurements by our SSM have shown a smooth and non-linear response of T_c to uniaxial stress[7].

URu_2Si_2 has also been studied as a candidate for a chiral *d*-wave superconductor[8]. TRSB in URu_2Si_2 has been reported by μ-SR and polar Kerr[9]. We will report on our studies of TRSB in the superconducting state of URu_2Si_2 using our SSM.

[1] C. Kallin and J. Berlinsky, Rep. Prog. Phys. **79**, 054502 (2016).
[2] J. R. Kirtley *et al.*, Rev. Sci. Inst. **87**, 093702 (2016).
[3] A. P. Mackenzie and Y. Maeno, Rev. Mod. Phys. **75**, 657 (2003).
[4] A. Pustogow *et al.*, arXiv:1904.00047 (2019).; K. Ishida *et al.*, arXiv:1907.12236 (2019).
[5] G. M. Luke *et al.*, Nature **394**, 558 (1998).; J. Xia *et al.*, Phys. Rev. Lett. **97**, 167002 (2006).
[6] P. G. Björnsson *et al.*, Phys. Rev. B **72**, 012504 (2005).; J. R. Kirtley *et al.*, Phys. Rev. B **76**, 014526 (2007).; C. W. Hicks *et al.*, Phys. Rev. B **81**, 214501 (2010).
[7] C. W. Hicks *et al.*, Science **344**, 283 (2014).; C. A. Watson *et al.*, Phys. Rev. B **98**, 09452 (2018).
[8] T. Shibauchi *et al.*, Phil. Mag. **94**, 3747 (2014).
[9] I. Kawasaki *et al.*, J. Phys. Soc. Jpn. **83**, 094720 (2014).; E. R. Schemm *et al.*, Phys. Rev. B **91**, 140506(2015).

Keywords: Chiral superconductor, Sr2RuO4, URu2Si2, Scanning SQUID Microscopy