

凝縮系物理学ゼミナール

Condensed Matter Seminar

Date: 13:30-15:00, Wednesday, 25 January 2023

Title: Piezoelectric effect and diode effect in anapole and monopole superconductors

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Abstract:

In a recent theoretical study, a new intrinsic mechanism of breaking both inversion symmetry (IS) and time-reversal symmetry (TRS) which keeps their combined symmetry (PT-symmetry) is proposed for UTe₂ [1]. In terms of the multipole order, such superconductors can be classified into (magnetic) monopole superconductors, anapole superconductors, and so on. Recent studies have revealed that these superconductors show unique properties, such as the asymmetric Bogoliubov spectrum and the finite-total-momentum Cooper pairing [2,3]. However, due to experimental difficulties, it is hard to observe these properties directly.

To explore approaches to verifying anapole and monopole superconductors, we theoretically study two macroscopic phenomena, the superconducting piezoelectric effect (SCPE) [4] and superconducting diode effect (SDE) [5,6]. Since these phenomena are possible only in superconductors lacking both IS and TRS and considered to have a close relation to finite-momentum pairing, they are expected to be potential probes of anapole and monopole superconductivity.

In this seminar, we show the calculation results of the SCPE and SDE in a minimal model for the anapole and monopole superconductors [7]. We reveal a close relation between the SCPE and finite-momentum pairing both in anapole and monopole superconducting phase. We also find the zero-field SDE with high efficiency in anapole superconductors.

Reference:

- [1] J. Ishizuka and Y. Yanase, Phys. Rev. B 103, 094504 (2021).
- [2] S. Kanasugi and Y. Yanase, Commun. Phys. 5, 39 (2022).
- [3] T. Kitamura, S. Kanasugi, M. Chazono, and Y. Yanase, arXiv:2210.01399.
- [4] M. Chazono, H. Watanabe and Y. Yanase, Phys. Rev. B 105, 024509 (2022).
- [5] F. Ando, Y. Miyasaka, T. Li, J. Ishizuka, T. Arakawa, Y. Shiota, T. Moriyama, Y. Yanase, and T. Ono, Nature 584, 373 (2020).
- [6] A. Daido, Y. Ikeda, and Y. Yanase, Phys. Rev. Lett. 128, 037001 (2022).
- [7] M. Chazono, S. Kanasugi, T. Kitamura, and Y. Yanase, arXiv:2212.13102.