

凝縮系物理学ゼミナール

Condensed Matter Theory Seminar

Date: 13:30-15:00, Wednesday, 26 June 2024

Title: Nonlinear Diode Effect in a Purely 2D Noncentrosymmetric Superconductor

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Abstract:

The intrinsic superconducting diode (SD) effect [1], in which the critical currents in the forward and backward directions become inequivalent by the properties of Cooper pairs in bulk, has gained much attention in recent years. The theoretical processes have been done much at the level of the mean-field theory of two-dimensional (2D) superconductors. In a purely 2D superconductor, its critical phenomena are governed by the Berezinskii-Kosterlitz-Thouless (BKT) physics. The creation of bounded vortex-antivortex pairs is at the heart. They can be dissociated by any finite current, causing a nonlinear resistivity [2]. Thus, there is no real SD effect in a purely 2D superconductor [3].

Despite this background, it does not mean that any nonreciprocity vanishes in a purely 2D system. In this talk, I will discuss our recent work [4] on this issue. It is shown that within our theoretical approach, the voltage-current characteristics of a purely 2D noncentrosymmetric superconductor coupled with the Zeeman interaction become nonreciprocal under in-plane finite magnetic fields. The procedure to derive the effective action of phase fluctuation from the functional integral formalism and the corresponding phase diagrams are also discussed.

References :

- [1] A. Daido, Y. Ikeda, and Y. Yanase, *Phys. Rev. Lett.* **128**, 037001 (2022).
- [2] B. I. Halperin and D. R. Nelson, *J. Low Temp. Phys.* **36**, 599-616 (1979).
- [3] N. Nunchot and Y. Yanase, *Phys. Rev. B* **109**, 054508 (2024).
- [4] N. Nunchot and Y. Yanase (In preparation).