

# 凝縮系物理学ゼミナール

## Condensed Matter Theory Seminar

Date: 13:30-15:00, Wednesday, 24 April 2024

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Title: Orbital effect on intrinsic superconducting diode effect

Speaker: Mr. Kyohei Nakamura

### Abstract:

Much ink has recently been spilled on the superconducting diode effect (SDE) characterized by the nonreciprocity of the critical current  $\Delta J_c$  [1-3]. Contrary to the fundamental and practical significance of the SDE, the precise underlying mechanism remains unclear.

In this talk, we investigate the impact of an orbital effect on the intrinsic SDE in a bilayer superconductor with Rashba spin-orbit coupling and an in-plane magnetic field [4]. We show that a small orbital effect leads to the sign reversal of  $\Delta J_c$  and a crossover of the helical superconducting state at a lower magnetic field than the monolayer superconductor. On the other hand, a large orbital effect induces a decoupling transition, stabilizing a finite momentum Cooper pairing state called the orbital Fulde-Ferrell-Larkin-Ovchinnikov state, and results in the drastic change of the SDE. Owing to the orbital effect, the field dependence of the SDE may show oscillations several times. The results shed light on the mechanism of the SDE in atomically-thin multilayer superconductors.

### References :

- [1] F. Ando *et al.*, Nature **584**, 373 (2020).
- [2] A. Daido *et al.*, Phys. Rev. Lett. **128**, 037001 (2022).
- [3] N. Q. F. Yuan and L. Fu, PNAS **119**, e2119548119 (2022).
- [4] K. Nakamura *et al.*, arXiv:2305.19317.