

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)

Date: **13:30-15:00**, Wednesday, 8 August 2018

“Spin-orbit-coupled ferroelectric superconductivity”

Speaker:

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Abstract:

Recently, the relationship between superconductivity and parity-breaking order is attracting a lot of attention from both theoretical and experimental aspect. From a theoretical point of view, Kozii and Fu proposed the odd-parity superconductivity which is induced by the fluctuation of the parity-breaking order [1]. Furthermore, several materials indicate a close relationship between superconductivity and parity-breaking order, *e.g.* $\text{Cd}_2\text{Re}_2\text{O}_7$ [2], $\text{Sr}_3\text{Rh}_4\text{Sn}_{13}$ [3], and MoTe_2 [4]. Especially, a coexistent phase of the superconductivity and the ferroelectric (FE) order, namely FE superconducting phase, was discovered in SrTiO_3 last year [5]. Since the FE order had been considered to compete with the superconducting order, this experimental result reignited a flurry of interest in the relationship between superconductivity and ferroelectricity.

Motivated by the above recent studies, we investigated the coexistent phenomena of the superconductivity and the FE order [6]. As a minimal model, we consider a quasi-two-dimensional superconductivity coupled to a polar lattice distortion. In our model, electrons and lattice are coupled via the Rashba-type antisymmetric spin-orbit coupling. We show that the FE-like order is induced by the magnetic field when the system is superconducting. This result opens a way to control the electric polarization by superconductivity. Furthermore, it is revealed that the stability of the FE superconducting state is increased in low carrier density superconductors, such as dilute superconducting SrTiO_3 .

References:

- [1] V. Kozii and L. Fu, *Phys. Rev. Lett.* **115**, 207002 (2015).
- [2] J. Yamaura *et al.*, *Phys. Rev. B* **95**, 020102 (2017).
- [3] W. C. Yu *et al.*, *Phys. Rev. Lett.* **115**, 207003 (2015).
- [4] H. Takahashi *et al.*, *Phys. Rev. B* **95**, 100501 (2017).
- [5] C. W. Rischau *et al.*, *Nat. Phys.* **13**, 643 (2017).
- [6] S. Kanasugi and Y. Yanase, arXiv:1803.07279 (2018).