凝縮系物理学ゼミナール

Condensed Matter Seminar

(※ seminar is held online via zoom, in Japanese)

Date: **13:30-15:00**, Wednesday, 27th January 2021

"Quantum geometric correction for Superfluid Weight in FeSe"

Speaker:

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Abstract:

Berezinskii, Kosterlitz, Thouless have shown that a quasi-range-ordered state known as the KT phase exists at low temperatures in the two-dimensional XY model [1]. The KT phase is a phase in which the vortices are strongly bound to each other and cannot move freely, so that the system is not disturbed much by the vortex excitations and remains orderly. However, as the temperature rises, the thermal fluctuations increase, and when the temperature exceeds T_{BKT}, the vortices break their bonds and move freely, and the system transitions to a disordered state. This transition is called the BKT transition. The transition temperature T_{BKT} can be expressed as $T_{BKT} = \pi J/2$ using the coupling constant J.

The BKT transition occurs not only in the two-dimensional XY model, but also in superfluid thin films and two-dimensional superconductors. In these systems, the coupling constant corresponds to the superfluid weight. Recently, Peotta, Törmä clarified that the superfluid weight has not only the conventional contribution proportional to the inverse of the effective mass, but also the quantum geometric contribution which can have a finite value due to the existence of many bands. [2, 3]. Since the conventional contribution is zero in the flat-band limit, superfluid weight has been studied in Twisted Bilayer Graphene where quasi-flat bands are realized, and it has been confirmed that the quantum geometric contribution is large [4].

In this study, we investigate the quantum geometrical corrections to the superfluid weight of monolayer FeSe. The quantum geometrical contribution is expected to play an important role because the monolayer FeSe has a much larger superconducting transition temperature than the bulk, a large effective mass due to the strong correlation effect, and multiple bands on the Fermi surface. In fact, the present study confirms that the quantum geometrical contribution is sufficiently large in the realistic parameter regime that it cannot be neglected in the consideration of transport phenomena and T_{BKT}.

References:

[1] J. M. Kosterlitz et al., Journal of Physics C: Solid State Physics **6** (1973) 1181.
[2] S. Peotta et al., Nature Communication **6**, 8944 (2015).
[3] L. Liang et al., Physical Review B 9**5** (2017) 024515.
[4] A. Julku et al., New Journal of Physics **20** (2018) 085004.