凝縮系物理学ゼミナール
Condensed Matter Seminar

Date: 13:30-15:00, Wednesday, 31 May 2023

Title: Spin-triplet superconductivity from quantum geometry-induced ferromagnetic fluctuation

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Abstract:

Spin-triplet superconductivity arising from ferromagnetic fluctuation is the platform for the topological superconductivity with the Majorana fermion [1]. For the realization of the Majorana fermion, searching for spin-triplet superconductivity is a central issue of modern condensed matter physics. However, candidate materials of spin-triplet superconductivity are restricted to a few heavy-fermion systems. Especially, while two-dimensional fluctuation mediates exotic superconductivity, such as high-temperature cuprate and iron-based superconductors, two-dimensional systems tend not to show ferromagnetic fluctuation, which may imply the absence of spin-triplet superconductivity in two-dimensional systems.

Nevertheless, in this study, we show that quantum geometry, which represents the geometric properties of Bloch electrons in the wave space, enables ferromagnetic fluctuation in two-dimensional systems resulting in spin-triplet superconductivity [2]. To see this, we formulate the criterion for ferromagnetic fluctuation which contains the effective mass and the quantum geometry. When the non-Kramers-band degeneracy lies on the Fermi surface, the Fubini-Study quantum metric strongly favors the ferromagnetic fluctuation. Solving the gap equation with the effective interaction obtained by random phase approximation, we show that quantum-geometry-induced ferromagnetic fluctuation mediates spin-triplet superconductivity.

References:

[1] M. Sato and S. Fujimoto, J. Phys. Soc. Jpn. 85, 072001 (2016).
[2] T. Kitamura, et. al., arXiv:2304.11536(2023).