



筑波大学

University of Tsukuba

Condensed Matter Seminar

物性論セミナー

2022年12月14日 (水), Dec.14 (Wed.) 2022

13:00-14:00 Hybrid (自B301 (学内者) & Zoom)

Relationship between two-particle topology and fractional Chern insulator

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Abstract:

Lattice generalizations of fractional quantum Hall (FQH) systems, called fractional Chern insulators (FCIs), have been extensively investigated in strongly correlated systems. From the early stage, a nearly flat energy dispersion and a finite Chern number are thought of as two essential ingredients for realizing FCIs [1-3]. In addition to these, it has recently been revealed that more sophisticated features are required to mimic the Landau-level physics. To date, the guiding principles to search for ideal platforms of the FCIs have still been explored extensively.

In this seminar, we report our attempt to find a novel marker of the FCI ground state, that is, the topological band structure of the two-particle problem [4]. Focusing on the bosonic Hubbard model, we provide a formulation to argue the topology of two-particle states. We elucidate that the “reduced Hamiltonian”, which contains the information of the bound states, plays an essential role. Then, we investigate a relationship between the topological band structure in the two-particle problem and the FCI ground states in the many-body problem at filling factor $\nu=1/2$. By the comprehensively study on various tight-binding models, we find that the two-particle topology characterizes the degree of similarity to the FQH systems.

[1] E. Tang, J.-W. Mei, and X.-G. Wen, PRL **106**, 236802 (2011).

[2] K. Sun, Z. Gu, H. Katsura, and S. Das Sarma, PRL **106**, 236803 (2011).

[3] T. Neupert, L. Santos, C. Chamon, and C. Mudry, PRL **106**, 236804 (2011).

[4] N. Okuma and [TM](#), arXiv:2209.13215.

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