

RICE QUANTUM GROUP MEETING SEMINAR SERIES



Lei Chen

Prof. Qimiao Si group

March 29, 2024, Friday

4 PM, SST 300

Quantum criticality and correlated topology in flat band systems

Abstract:

Strong correlation effects are believed to be the driving force behind many novel quantum phases and exotic phenomena, such as strange metallicity. They become pronounced when the electrostatic repulsive interaction is larger than, or at least comparable to the kinetic energy. This regime naturally materializes in f-electron-based heavy fermion metals, as well as in d-electron-based systems with geometry-induced flat bands.

In this talk, I will argue that these two types of systems share considerable similarities both in their static and dynamical properties. To show this, we map the flat-band systems onto a Kondo-lattice description in a molecular-orbital basis, drawing inspiration from the concept of compact localized states. From this perspective, we first demonstrate the emergence of flat bands [1] that are pinned to the Fermi energy [2], leading to a new platform for Weyl-Kondo semimetals devoid of f electrons [3]. We then uncover a continuous selective transition [4] of the molecular orbitals and the associated quantum criticality. In this case, our findings connect with recent advances on heavy fermion quantum criticality [5], provide the first theoretical understanding of the observed strange metallicity in line-graph systems, and predict a phase diagram that has been supported by some very recent experiments on kagome metals [6].

[1] L. Chen et al, arXiv:2212.08017. H. Hu et al., Sci. Adv. 9, eadg0028 (2023).

[2] J. Huang, L. Chen et al., Nat. Phys. 10, 1038 (2024)

[3] L. Chen et al, Nat. Phys. 18, 1341 (2022); H.-H. Lai et al., PNAS 115, 93 (2018); S. Dzsaber et al., PRL 118, 246601 (2017).

[4] L. Chen et al, arXiv: 2307.09431

[5] H. Hu, A. Cai, L. Chen et al., arXiv:2109.13224

[6] Y. Liu et al., arXiv:2309.13514

Bio:

Lei Chen is a senior PhD student in the group of Prof. Qimiao Si from the Department of Physics and Astronomy. He specializes in theoretical condensed matter physics, with focus on the study of strongly correlated electron systems. His research interests span a wide range of topics in quantum many-body systems, including the exploration of exotic quantum phases of matter, quantum criticality, topological materials, Kondo physics, high-temperature superconductivity, and quantum magnetism.

Snacks and Coffee will be served during the event. Wine & cheese will be served after the talk. Everyone is welcome to stay around after the seminar for further informal discussions.