~~Non-Fermi liquids in flat-band systems~~

"Unlocking the mysteries of non-fermi liquids in flat band systems: A journey from topological quantum chemistry to emergence"

Shouvik Sur

Department of Physics and Astronomy, Rice Center for Quantum Materials, Rice University, Houston, Texas

Flat or weakly-dispersive bands arise in a wide variety of material platforms, ranging from moiré heterostructures to line-graph lattices. The low bandwidth encourages correlation effects to play a central role in organizing the phase diagram, thereby realizing new contexts for exploring strong-correlation phenomena. An unconventional aspect of these system is the presence of single and multi-particle contraints or obstructions due to topology, which adds a fascinating new dimension to the study of strongly correlated matter. Here, we investigate the impact of both forms of topological obstructions in compressible matter without Landau's quasiparticles. In the first part of the talk, motivated by recent observations of non-Fermi liquid behavior in several kagome metals [1], I will discuss our works on strongly correlated d-electron-based metals on lattices that realize destructive kinematic interference [2]. In these systems, a topologically non-trivial flat band is present at the Fermi level. While the flatness of the band generates strong electronic correlations, the non-trivial topology hybridizes it with dispersive bands at higher energies and suppresses localized states from developing. Consequently, the low energy description takes the form of an effective Anderson-lattice model. Due to the vastly dissimilar bandwidth between the flat and dispersive bands, orbital-selective Mott correlations develop over a broad range of parameters, driving a quantum phase transition between two strongly correlated metallic states with Fermi surfaces of dissimilar sizes. Non-Fermi liquid behaviors emerge in the associated quantum critical regime. In the second part of the talk, I will present a proposal for engineering topological non-Fermi liquid states in bilayer twisted transition-metal dichalcogenides [3]. Here, topological obstructions appear in multiparticle excitations, which are diagnosed through the Green's function's eigenvectors [4]. We explore the impact of the multiparticle topology on the phase diagram.

1. L. Ye et al., arXiv:2106.10824; S. A. Ekahana, 2206.13750; L. Liu et al., arXiv:2309.13514.
2. L. Chen, F. Xie, S. Sur et al., arXiv:2307.09431; arXiv:2212.08017.
3. S. Sur et al., [to appear]
4. C. Setty, S. Sur, et al., arxiv: 2301.13870; C. Setty F. Xie, S. Sur et al., arxiv 2311.12031.

References