Contribution ID: **46** Type: **Invited talk (by invitation only)**

Quantum criticality and emerging universality in kagome metals and twisted WSe2

Thursday 8 January 2026 10:50 (35 minutes)

Flat bands emerge in a diverse array of materials, spanning twisted heterostructures and compounds with geometrically-frustrated lattices. They feature strong correlations as well as non-trivial topology. Recent experiments on kagome and pyrochlore metals have uncovered a rich variety of strong-correlation phenomena [1], and the 2024 discovery of superconductivity in TMD moiré systems has likewise generated much excitement. Here, we theoretically investigate the correlation phenomena in d-electron-based metals on lattices that realize destructive kinematic interference [2], and discuss the similarities and differences with the physics of TMD moiré systems [3]. The shared methodology we have developed is in terms of the notion of compact molecular orbitals, which enable effective models in the form of Kondo lattice models: From the dissimilar bandwidth between the flat and dispersive bands, artificial heavy fermion metals arise. Accordingly, our approach allows for the understanding of strange metallicity and unconventional superconductivity. In the process, we advance the general notion that topology induces quantum fluctuations and thus leads to new correlation physics, a route that complements its converse of strong correlations giving rise to new topological states.

References:

[1] J. Huang et al., Nat. Phys. 20, 603 (2024); L S. A. Ekahana, Nature 627, 67 (2024); L. Ye et al., Nat. Phys. 20, 610 (2024); L. Liu et al., Nature 632, 1032 (2024); J. Huang et al., npj Quantum Materials 9, 71 (2024).

[2] L. Chen et al., Nat. Commun. 15, 5242 (2024); L. Chen et al., arXiv:2307.09431; H. Hu et al., Sci. Adv. 9, eadg0028 (2023); F. Xie et al., Phys. Rev. Research 7, L022061 (2025).

[3] F. Xie et al., Phys. Rev. Lett. 134, 136503 (2025); C. Li et al., arXiv:2507.21043

email address

qmsi@rice.edu

Affiliation

Rice University

Author: Prof. SI, Qimiao (Rice University)

Presenter: Prof. SI, Qimiao (Rice University)

Session Classification: Thursday Morning Session II, Chair L. Rademaker

Track Classification: Categories: Theory