北京大学量子材料科学中心

International Center for Quantum Materials, PKU

Seminar

Strange metallicity and quantum criticality: Multipartite entanglement and its retrieval by cavity light

Yiming Wang

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Time: 13:30pm, Sept.3, 2026 (Thursday)

时间：2026年9月3日（周四）下午13:30pm

Venue: Room w563, Physics building, Peking University

地点：北京大学物理楼，西563会议室

Abstract

A quantum critical point (QCP) develops when matter undergoes a continuous transformation between distinct ground states at absolute zero. While anomalous entanglement and divergent susceptibility to external probes are well-established features of quantum criticality, connecting the underlying entanglement structure of quantum critical matter to its unconventional electronic properties and to new avenues of quantum control remains a major frontier. In this talk, I will show that the extreme responsiveness of quantum critical systems manifests in two fundamentally connected ways: in the entanglement structure associated with the destruction of quasiparticles, and in an amplified susceptibility to dynamical control.

First, I will discuss multipartite entanglement in quantum critical strange metals [1]. Using the Quantum Fisher Information (QFI) as an entanglement witness, we find that critical fluctuations generate strong multipartite entanglement whose enhancement is directly supported by neutron-scattering experiments. I will connect this behavior to Kondo-destruction quantum criticality, where the collapse of Kondo screening and the associated destruction of quasiparticles produce an entanglement structure qualitatively distinct from that of a conventional Fermi liquid. In the latter, by contrast, the local QFI remains trivial [2].

Second, I will show that coupling a quantum critical system to an optical cavity exploits its divergent susceptibility to strongly amplify light–matter interactions [3]. Quantum critical fluctuations enable superradiant phase transitions at vanishingly small coupling strengths, while simultaneously enhancing QFI and quantum squeezing, thereby providing a route for cavity light to access the quantum correlations of critical matter. Together, these results connect the intrinsic entanglement of quantum-critical matter to its retrieval and control through cavity light, opening a pathway toward harnessing quantum critical systems for quantum information science.

[1] Y. Fang*, M. Mahankali*, Y. Wang*, L. Chen*, H. Hu, S. Paschen, and Q. Si, “Amplified multipartite entanglement witnessed in a quantum critical metal.” *Nat. Commun.* **16**, 2498 (2025).

[2] Y. Wang*, Y. Fang*, F. Xie*, and Q. Si, “Local and non-local entanglement witnesses of Fermi liquid.” arXiv:2502.13958.

[3] S. Sur*, Y. Wang*, M. Mahankali, S. Paschen, and Q. Si, “Amplified response of cavity-coupled quantum-critical systems.” *Nat. Commun.* **17**, 4404 (2026).

About the speaker

Yiming Wang recently received his Ph.D. in Physics from Rice University under the supervision of Prof. Qimiao Si. He will soon join Prof. Yong-Baek Kim’s group at the University of Toronto as a postdoctoral fellow. His research focuses on strongly correlated quantum matter, particularly quantum criticality, strange metals, and their connections to quantum information science.