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Strange Metals and Quantum Criticality Driven by Entanglement of Multipolar Moments and Conduction Electrons

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Strange metals and quantum criticality (QC) not only hold the key to unlocking the long-standing puzzle of high-temperature superconductivity but also offer a common thread linking historically disparate fields, ranging from condensed matter and quantum optics to general relativity and high energy physics [1, 2]. Insights from wide-ranging quantum material families have overturned the assumption that magnetic instability is the sole origin of quantum critical fluctuations, demonstrating that electron orbital and charge degrees of freedom can also be prominent in generating exotic quantum phase transitions [1-3]. However, so-far studied quantum critical systems often involve multiple competing phases, making it difficult to experimentally single out a particular degree of freedom and understand its role in finite-temperature strange metallicity and quantum critical fluctuations [1-3].

The multipolar Kondo material PrV_2Al_{20} features substantial Kondo entanglement between multipolar local moments and conduction electrons, offering an ideal material platform for exploring the purely orbital-driven strange metal and quantum criticality [4-5]. In this presentation, we will focus on the magnetic field-tuning quantum criticality in PrV_2Al_{20} and show that the evolution of strange metal phases and Fermi surface across the multipolar quantum critical regime drastically differs from that in the familiar magnetic setting.

References

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