Entanglement Properties as a Characterization of Kondo-driven Quantum Criticality

Mounica Mahankali[1], Lei Chen[1], Yiming Wang[1], Haoyu Hu[2], Qimiao Si[1]
[1]*Department of Physics and Astronomy, Rice Center for Quantum Materials, Rice University, Houston, Texas, USA*
[2]*Donostia International Physics Center, Donostia-San Sebastian, Spain*

Quantum critical metals without quasiparticles are of extensive current interest [1]. An exemplary case appears in heavy fermion metals, where the notion of Kondo destruction quantum criticality plays a central role. It goes beyond the conventional Landau order-parameter framework. Across the Kondo destruction quantum critical point, a "large" to "small" Fermi surface transformation takes place, reflecting the suppression of the Kondo singlet in the ground state [1]. However, a dynamical Kondo effect has been shown to persist, leading to a singular charge response [2,3]. An important way to characterize the dynamical Kondo effect is to use quantum entanglement properties [4,5]. Here, we study the behavior of the entanglement entropy and mutual information across the Kondo destruction transitions in the context of Infinite-U Multichannel Bose-Fermi Anderson model and discuss its implications in characterizing the nature of the Kondo destruction quantum criticality.

Work supported by the NSF Grant No. DMR-2220603 and the Welch Foundation Grant No. C1-411.

[1] H. Hu, L. Chen, Q. Si, Quantum critical metals: dynamical Planckian scaling and loss of quasiparticles, arXiv:2210.14183. S. Paschen and Q. Si, Quantum phases driven by strong correlations. Nat. Phys. Rev. 3, 9 (2021). Q. Si, S. Rabello, K. Ingersent, & J. L. Smith, Locally critical quantum phase transitions in strongly correlated metals. *Nature* **413**, 804–808 (2001).
[2] A. Cai, Z. Yu, H. Hu, S. Kirchner, & Q. Si, Dynamical Scaling of Charge and Spin Responses at a Kondo Destruction Quantum Critical Point. *Phys. Rev. Lett.* **124**, 027205 (2020).
[3] L. Prochaska *et al.* Singular charge fluctuations at a magnetic quantum critical point. *Science* **367**, 285–288 (2020).
[4] H. Hu, A. Cai, & Q. Si, Quantum Criticality and Dynamical Kondo Effect in an SU(2) Anderson Lattice Model. *arXiv:2004.04679* (2020).
[5] M. Mahankali et al., in preparation (2023).