Condensed Matter Physics Journal Club Seminar

“Crossover of Charge Fluctuations across the Strange Metal Phase Diagram”

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The strange metal is an enigmatic phase found in a wide range of strongly-correlated systems and is characterized by its violations of the standard Fermi liquid theory of metals. Thus, charge in the strange metal is commonly believed to be too “strongly correlated” to be described in terms of electron-like quasiparticles. In this talk I will quantify the precise nature of the strong charge correlations in the prototypical strange metal $Bi_2Sr_2CaCu_2O_{8+x}$ with the new technique of Momentum-resolved Electron Energy-Loss Spectroscopy (M-EELS). While Fermi liquid charge correlations give rise to freely-propagating plasmons with well-defined energy and momentum, I will show the strange metal is dominated by a featureless continuum of non-propagating charge fluctuations up to an energy of about 1000 meV [1,2]. Unlike the Fermi liquid, this continuum is unaffected by doping at high temperature, but exhibits massive changes in spectral weight up to about 500 meV at low temperature with a sign reversal at optimal doping. These findings imply that strange metal charge carriers can essentially dissipate energy and momentum arbitrarily without kinematic constraints, and furthermore that momentum ceases to be a good quantum number, suggesting a highly inhomogeneous local picture as the more natural starting point. Finally, I will discuss new M-EELS results on Sr_2RuO_4 where we observe the coexistence of a strange metal continuum and a propagating Fermi liquid collective mode [3].

References

1. A. A. Husain, M. Mitrano, et al., arXiv 1903.04038 (2019) (in press at Phys. Rev. X)
2. M. Mitrano, A. A. Husain, et al., PNAS 115 (21) 5392-5396 (2018)
3. A. A. Husain, et al., *in preparation*

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