Dissipation-driven Strange Metal Behavior in High-T_c Superconducting Cuprates

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Besides the mechanism responsible for high critical temperature superconductivity, the grand unresolved issue of the cuprates is the occurrence of a strange metallic state above the so-called pseudogap temperature T*. Even though such state has been successfully described within a phenomenological scheme, the so-called Marginal Fermi-Liquid theory, a microscopic explanation is still missing. However, recent resonant X-ray scattering experiments [1] identified a new class of charge density fluctuations characterized by low characteristic energies and short correlation lengths, which are related to the well-known charge density waves. These fluctuations are present over a wide region of the temperature-vs-doping phase diagram and extend well above T*. A recent investigation showed that charge density fluctuations can explain the strange metal phenomenology [2]. Therefore, charge density fluctuations are likely the long-sought microscopic mechanism underlying the peculiarities of the metallic state of cuprates. A more recent analysis [3] also showed that the damping of these fluctuations can cast in a single and new framework the linear-in-T resistivity of cuprates, sometimes extending down to very low T, and the surprising low-temperature divergence of the specific heat occurring at a critical doping p* slightly larger than the optimal doping. Finally, an even more recent analysis [4] shows that the interplay between overdamped charge density fluctuations and diffusive electron modes due to quenched disorder can provide a microscopic generic mechanism for the above phenomenology. This scheme puts in a completely different light the strange metal issue and provides a general perspective to account for the strange metal behavior in many other system near quantum critical points, like heavy fermions, ruthenates, iron-based superconductors, and twisted bilayer graphene.

References

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