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### Quantum critical transport phenomena in the nematic $FeSe_{1-x}S_x$

*Matija Čulo[1], S. Licciardello[1], J. Ayres[1], M. Berben[1], Y.-T. Hsu[1], S. Kasahara[2], Y. Matsuda[2], T. Shibauchi[3], N. Maksimovic[4], J. G. Analytis[4], N. E. Hussey[1]

High Field Magnet Laboratory (HFML-EMFL) and Institute for Molecules and Materials, Radboud University, Toernooiveld 7, 6525 ED, Nijmegen, Netherlands[1]
Department of Physics, Kyoto University, Sakyo-ku, Kyoto 606-8502, Japan[2]
Department of Advanced Materials Science, University of Tokyo, Kashiwa, Chiba 277-8561, Japan[3]
Department of Physics, University of California and Materials Science Division, Lawrence Berkeley National Laboratory, Berkeley, California 94720, USA[4]

Many high-temperature superconductors in their normal state show marked deviations from Fermi liquid (FL) theory, the standard model of metals. The most prominent is the linear temperature dependence of resistivity believed to be related to the maximum (Planckian) dissipation allowed by quantum mechanics. Such behavior is often ascribed to the existence of a quantum critical point (QCP) located inside the superconducting dome in vicinity of which a coupling between critical fluctuations of an order parameter and low-energy quasi-particle excitations gives rise to novel non-FL physics. In a host of metallic systems that exhibit this so-called quantum critical behavior, evidence for electronic nematicity, a correlated electronic state with broken rotational symmetry, has been reported. In all cases, however, the nematicity is found to be intertwined with other forms of order, such as antiferromagnetism or charge density wave, that might themselves be responsible for the existence of the QCP. The iron-chalcogenide family $FeSe_{1-x}S_x$ is unique in this respect since the superconductivity emerges from an electronic nematic state which exists in isolation and therefore provides a unique opportunity to study the influence of nematic fluctuations on high-temperature superconductivity. Substitution of Se with S effectively suppresses the nematic transition which is believed to terminate inside the superconducting dome at the QCP $x = 0.16$. In this talk, we report the results of our dc transport experiments – at both ambient and applied pressures – in magnetic field strengths strong enough to suppress the superconductivity and access the field-induced normal state and reveal classic signatures of quantum criticality: an enhancement in the coefficient of the $T^2$ resistivity on approaching the QCP and, at the QCP itself, a strictly $T$-linear resistivity that extends over a decade in temperature. We also report a detailed study of the normal state transverse magnetoresistance in $FeSe_{1-x}S_x$ across the nematic QCP that reveals unambiguously and for the first time, the coexistence of two charge sectors in a quantum critical system: one associated with the fermionic quasiparticles and possibly associated with the quantum critical excitations. Finally, we present our most recent Hall effect measurements performed on the same series of single-crystalline $FeSe_{1-x}S_x$ samples which indicate that a conventional, multi-band model fails to capture the longitudinal and Hall resistivities self-consistently, suggesting that there exists a component in the Hall resistivity associated with the quantum critical sector.

Keywords: High temperature superconductivity, Quantum criticality, Electronic nematicity, Electrical transport