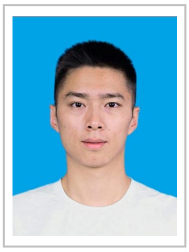
9th International Workshop on 2D Materials

Title of the Presentation: Bosonic metallic state in nanopatterned YBCO films



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Short Biography:

Chao Yang is a senior researcher in the department of electronic science and technology, University of Electronic Science and Technology of China. His research interests are superconductor-insulator transitions, bosonic anomalous metal and High-Tc Superconductors. His work is selected as one of top ten breakthrough of science and technology of Chinese academy in 2019.

Abstract:

Fermi liquid theory forms the basis for our understanding of the majority of metals that their resistivity arises from the scattering of well-defined quasiparticles at a rate following $1/\tau \sim T^2$ in the low temperature limit. Various quantum materials[1–8], notably high-temperature superconductors[1-3], however, exhibit strange metallic behavior with a linear scattering rate in temperature, deviating from this central paradigm. Here we show the unexpected signatures of strange metallicity in a bosonic system for which the quasiparticle concept does not apply[9,10]. Our nanopatterned $YBa_2Cu_3O_{7-\delta}$ (YBCO) film arrays reveal T-linear and B-linear resistance over an extended temperature and magnetic field range, respectively. Strikingly, below the onset temperature T_c^{onset} at which Cooper pairs form, the low-field magnetoresistance oscillates with a period dictated by the superconducting flux quantum of $h/2e$ where e is the electron charge and h is the Planck constant. Simultaneously, the Hall coefficient R_H drops and vanishes within the measurement resolution with decreasing temperature, indicating that Cooper pairs instead of single electrons dominate the transport process. Moreover, the characteristic time scale τ in this bosonic system follows a scale-invariant relation without intrinsic energy scale: $\hbar/\tau \approx a \cdot (k_B T + \gamma \mu_B B)$, where $\hbar$ is the reduced Planck's constant, a is of order unity[4,5] and $\gamma \approx 2$. By extending the reach of strange metal phenomenology to a bosonic system, our results suggest that there is a fundamental principle governing their transport which transcends particle statistics.

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