

κ -(BEDT-TTF)₂Cu₂(CN)₃: From Spin Liquid to Fermi Liquid

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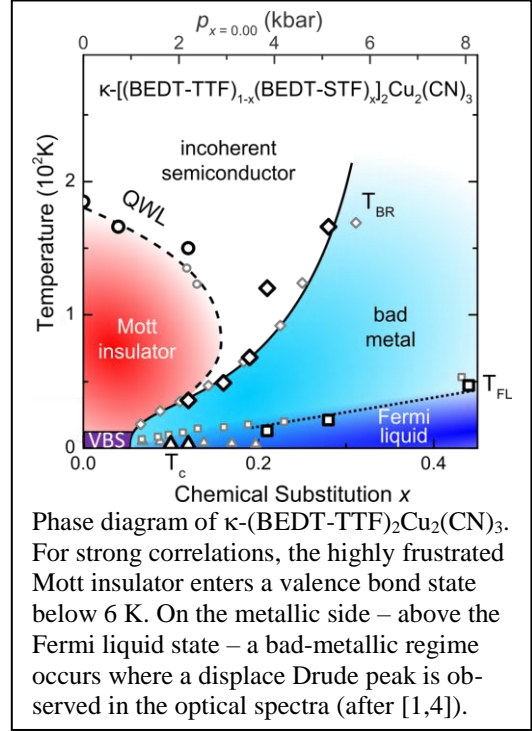
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κ -(BEDT-TTF)₂Cu₂(CN)₃ is among the best studied correlated electron systems and a model compound in many regards [1]. The triangular arrangement of dimers causes strong frustration with no magnetic order despite the sizeable interactions. Our broadband ultra-low-temperature ESR spectroscopy enabled us to unambiguously reveal a rapid drop of the spin susceptibility at the enigmatic 6 K anomaly. This opening of a spin gap, accompanied by structural modifications, evidences a valence-bond-solid ground state. We identify an impurity contribution to the ESR response that becomes dominant when the intrinsic spins form singlets [2].

When the electronic bandwidth is tuned either by external pressure or by chemical substitution, κ -(BEDT-TTF)₂Cu₂(CN)₃ crosses the first-order insulator-metal transition below $T_{\text{crit}} \approx 20$ K, where metallic and insulating regions coexist spatially, causing a divergency in the dielectric permittivity with $\epsilon_1 \approx 10^5$ and more [3].

On the metallic side, the low-energy properties can be understood in terms of long-lived Landau quasiparticles with all complex interactions included in Fermi-liquid parameters, such as the effective mass m^* and scattering rate $1/\tau$. Here we investigate the spectral and temperature-dependent complex electrodynamic response $\sigma_1(\omega, T) + i\sigma_2(\omega, T)$ as the effective correlations U/W are varied by chemical tuning. We reveal a persistent Fermi-liquid behavior with T^2 and ω^2 dependences of the optical scattering rate $1/\tau$. The strong increase of the resistivity beyond the Ioffe-Regel-Mott limit $\rho \gg \rho_{\text{IRM}}$ is accompanied by a displaced Drude peak in $\sigma_1(\omega)$. Our results, supported by a theoretical model for the optical response, demonstrate the emergence of a bad metal from resilient quasiparticles that are subject to dynamical localization and dissolve near the Mott transition [4].



References

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