Poster-1-3

Universal relation between residual resistivity and A coefficient in correlated metals

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Understanding how electronic correlations and disorder jointly influence charge transport remains a central challenge in quantum materials. In this work, we disentangle these intertwined effects by independently tuning the degree of randomness (via chemical substitution) and the strength of electronic correlations (via physical pressure) in metallic phases proximate to a Mott–insulating state. Focusing on the low-temperature Fermi-liquid regime, where the resistivity follows

$$\rho(T) = \rho 0 + A * T^2$$

, we systematically extract both the residual resistivity $\rho 0$ and the coefficient A, which scales with the square of the quasiparticle mass enhancement. Contrary to conventional expectations that $\rho 0$ is independent of correlation strength, our experiments reveal a robust linear scaling between $\rho 0$ and A at fixed disorder level. We interpret this finding through a phenomenological framework in which spatial fluctuations of the chemical potential enhance the residual scattering rate, leading to

$$\rho 0 \propto A * \sigma \mu^2$$

, where $\sigma \mu^2$ quantifies the variance of chemical-potential disorder. Crucially, when comparing our results with transport data from a wide range of correlated metals-organic Mott systems, oxides, heavy-fermion compounds, and moiré heterostructures-we find this linear relation to be universal across diverse material classes. This discovery establishes a new scaling law linking disorder and correlation effects in strongly interacting electron systems and provides a unified perspective on charge transport in correlated metals.

[1] arXiv:2508.21759.