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Title of the talk: **Unveiling two electronic subsystems in cuprates through transport and optical conductivity**

Understanding the physical properties of unconventional superconductors and other correlated materials is a challenging task due to their unusual evolution with doping, frequency, and temperature, often leading to non-Fermi-liquid (non-FL) interpretations. One major challenge in this context is the interpretation of optical conductivity. In our study, the optical spectra of two archetypal cuprates, underdoped $HgBa_2CuO_{4+\delta}$ and optimally-doped $Bi_2Sr_2CaCu_2O_{8+\delta}$, were interpreted based on the standard Fermi liquid (FL) paradigm. Our study found that, at both dopings, perfect frequency-temperature FL scaling was modified by the presence of a second, gapped electronic subsystem. This non-FL component emerged as a well-defined mid-infrared spectral feature after the FL contribution, determined independently by transport, was subtracted. The mid-infrared feature's evolution with temperature, frequency, and doping indicated a gapped response rather than a dissipative response. In contrast, the dissipative response was found to be relevant for pnictides and ruthenates. This unbiased FL/non-FL separation was extended across the cuprate phase diagram, capturing all the key features of the normal state and providing a natural explanation for why the superfluid density is attenuated on the overdoped side. The unambiguous experimental determination of the non-conducting part of optical responses simplifies our understanding overall. For cuprates, it proves that the conducting part is always an ordinary FL, while the non-Fermi liquid character is entirely due to a secondary contribution. This insight has been employed to understand the optical responses of superconducting pnictides and strontium ruthenate, representing a breakthrough in understanding entire classes of functional materials.