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Power-law liquids in the cuprates from unparticle interactions ZHIDONG LEONG, KRIDSANAPHONG LIMTRAGOOL, CHANDAN SETTY, PHILIP PHILLIPS, Univ of Illinois - Urbana — Recent photoemission measurements of the cuprates reveal that, over a wide range of doping levels, scattering rates along the nodal direction exhibit power-law scaling as a function of frequency and temperature. We show that these observations can be qualitatively reproduced by considering interactions between electrons and unparticles — a low-energy scale-invariant sector that emerges from integrating out the high-energy degrees of freedom. We perturbatively evaluate the electron self-energy Σ due to interactions with both fermionic and bosonic unparticles. We find that, at low temperatures, ImΣ exhibits the same power law in both temperature and frequency, with the exponent depending on the scaling dimension of the unparticle propagator. At high temperatures, ImΣ is linear in temperature. We attribute these non-Fermi-liquid behaviors to the incoherent component of the unparticle propagator. We find that this incoherent nature also violates the sum rules for the density of states and the density-density correlation function. Such violations can, in principle, be observed experimentally. Our work indicates that power-law scaling in the cuprates originates from the incoherent background generated from Mott-scale physics.

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