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Power-law Optical Conductivity from Unparticles: Application to the Cuprates[1] KRIDSANAPHONG LIMTRAGOOL, PHILIP PHILLIPS, Univ of Illinois - Urbana — We calculate the optical conductivity using several models for unparticle or scale-invariant matter. Within a Gaussian action for unparticles that is gauged with Wilson lines, we find that the conductivity computed from the Kubo formalism with vertex corrections yields no non-trivial deviation from the free-theory result. This result obtains because at the Gaussian level, unparticles are just a superposition of particle fields and hence any transport property must be consistent with free theory. Beyond the Gaussian approach, we adopt the continuous mass formulation of unparticles and calculate the Drude conductivity directly. We show that unparticles in this context can be tailored to yield an algebraic conductivity that scales as $\omega^{-2/3}$ with the associated phase angle between the imaginary and real parts of $\arctan \frac{\sigma_2}{\sigma_1} = 60^\circ$ as is seen in the cuprates. Our results indicate that at each frequency in the scaling regime, excitations on all energy scales contribute. Hence, incoherence is at the heart of the power-law in the optical conductivity in strongly correlated systems such as the cuprates.

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