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Electronic correlations and superconducting response in the optical properties of $FeTe_{0.55}Se_{0.45}$[1] C.C. HOMES, A. AKRAP, J.S. WEN, Z.J. XU, Z.W. LIN, Q. LI, G.D. GU, Condensed Matter Physics and Materials Science Dept., Brookhaven National Laboratory, Upton, New York — The in-plane complex optical properties of the iron-chalcogenide superconductor $FeTe_{0.55}Se_{0.45}$ have been determined above and below $T_c = 14$ K. At room temperature the conductivity is described by a weakly-interacting Fermi liquid with $\omega_{p,D} \simeq 7200$ cm^{-1} and $1/\tau_D \simeq 414$ cm^{-1}. Below 100 K the conductivity is no longer described by the Drude model. Adopting the generalized Drude model reveals that $1/\tau(\omega) \propto \omega$ in the terahertz region just above T_c, signaling the increasingly correlated nature of this material.[2] For $T \ll T_c$ the superconducting plasma frequency $\omega_{p,S} \simeq 3000$ cm^{-1} ($\lambda_{eff} \simeq 5300$ Å); $\omega_{p,S}^2/\omega_{p,D}^2 \ll 1$ indicating that this material is not in the clean limit. Allowing $\sigma_{dc} \equiv \sigma_1(\omega \to 0)$, then $\sigma_{dc}(T \simeq T_c) \simeq 3500 \pm 400$ Ω^{-1}cm^{-1} and the superfluid density $\rho_{s0} \equiv \omega_{p,S}^2 \simeq 9 \pm 1 \times 10^6$ cm^{-2} places material close to the scaling line $\rho_{s0}/8 \simeq 8.1\,\sigma_{dc}T_c$ for a BCS dirty-limit superconductor. Below T_c the optical conductivity reveals two energy scales for the superconductivity at $\Delta_1(0) \simeq 2.5$ meV and $\Delta_2(0) \simeq 5.1$ meV, consistent with the $s^{\pm}$ model.

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[2]C. C. Homes *et al.*, Phys. Rev. B **81**, 180508(R) (2010).

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