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Anisotropic optical response in the electronic nematic phase of iron-pnictides[1]

L. DEGIORGI, Dept. of Physics, ETH Zurich

The ferropnictides harbor a structural tetragonal-to-orthorhombic transition at T_s that may either coincides or precedes a transition into a long-range antiferromagnetic order (AFM) at T_N, usually ascribed to a spin-density-wave state. There is an ongoing debate as to whether the dc anisotropy (both in the nematic phase ($T_N < T < T_s$) or in the tetragonal phase above T_s in the presence of an external symmetry breaking field) is primarily determined by the Fermi surface or scattering rate anisotropy. We measure the in-plane optical reflectivity of $BaFe_2As_2$ ($T_s = T_N = 135$ K) over a broad spectral range, covering the energy interval from the far infrared to the ultraviolet, at several combinations of uniaxial pressure, used to detwin the specimen, and temperature. Our goal is to probe the anisotropic response in the real part $\sigma_1(\omega)$ of the optical conductivity, extracted from the reflectivity data via Kramers-Kronig transformations. The infrared response reveals that the dc transport anisotropy in the orthorhombic AFM state is determined by the interplay between the Drude spectral weight and the scattering rate, but that the dominant effect is clearly associated with the metallic spectral weight. In the paramagnetic tetragonal phase, though, the dc resistivity anisotropy of strained samples is almost exclusively due to stress-induced changes in the Drude weight rather than anisotropy in the scattering rate. This result definitively establishes that the primary effect driving the resistivity anisotropy in the paramagnetic orthorhombic phase is the anisotropy of the Fermi surface [1]. Recent developments within this context on FeSe will be presented as well. [1] C. Mirri et al., Phys. Rev. Lett. 115, 107001 (2015).

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