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Evidence of Electron-Plasmon Coupling in Single Crystal Bismuth RICCARDO TEDIOSI, University of Geneva, Switzerland, N. PETER ARMITAGE, The Johns Hopkins University, ENRICO GIANNINI, DIRK VAN DER MAREL, University of Geneva, , Switzerland — We present a detailed optical study via the extended-Drude model analysis of single crystal bismuth using infrared reflectivity and visible-light ellipsometry. The extremely narrow Drude peak and the small value of the screened plasma frequency are consistent with the small carriers density typical for this semimetallic system. The temperature dependence of the optical properties is dominated on one side by the progressive narrowing of the free electron Drude peak and on the other side by the progressive appearance of an absorption peak in the region between the itra-band and inter-band contributions with a consequent change in the frequency dependent scattering rate $\tau^{-1}(\omega)$. We observed that the inflection point $\omega_\tau(T)$ corresponding to the increase of $\tau^{-1}(\omega, T)$ closely follows the change of the plasma frequency with temperature according to the relation $\omega_\tau(T) \simeq \omega_p(T)$. This aspect suggests a possible interaction between free electrons and collective modes as already theoretically demonstarted in earlier works. In this scenario we calculated the scattering rate contribution for electron-plasmon interaction starting from the plasmon dispersion relation observing an astonishing good agreement between experimental result and theoretical expectation.

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