WIDE-RANGE MODELS OF THE OPTICAL PROPERTIES OF METALLIC AND CLASSICAL PLASMAS ON THE BASE OF QUANTUM-STATISTICAL OPERATOR METHOD

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Hydrodynamic simulations of intense laser pulses action on metals requires knowledge of their kinetic coefficients in a wide range of temperatures and densities, and also, taking into account recent advances in the creation of high-power short-wavelength laser systems, in a wide frequency range. The method of the quantum statistical operator and linear response theory make it possible to express the kinetic coefficients in terms of correlation functions and calculate them for a wide range of frequencies (from infrared to X-ray) and for a wide range of material parameters. With the help of this method, for the first time, analytical expressions were obtained for the first-order correlation functions [1–3], taking into account, in the case of a metal plasma, simultaneously the electron-phonon interaction, Umklapp processes and interband transitions. When describing the contribution of interband transitions, the oscillator strengths were calculated according to the semiclassical models [4, 5]. Results are shown for the collision frequency, dynamical conductivity and opacity of solid-density metalic plasmas as functions of laser frequency. Calculated opacities are compared with the results of first-principles DFT-MD numerical simulations and recent experiments [6]. The problem of underestimation of the values of opacities by theoretical models in the vicinity of the L edge is discussed.

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