Contribution ID: **47** Type: **not specified**

Quantum statistical operator approach to optical properties of metallic and classical plasmas

Thursday, 30 January 2020 18:20 (25 minutes)

Hydrodynamic simulations of action of intense energy fluxes on metals requires knowledge of their kinetic coefficients in a wide range of temperatures and densities, and taking into account the recent progress in powerfull short-wavelength laser systems, also in a wide range of frequencies. The quantum-statistical operator method and linear response theory allow to express kinetic coefficients through correlation functions, and to calculate them for a wide range of frequencies (from infrared to X-ray range) and for a wide range of substance parameters.

Using this method, analytical expressions for the first-order correlation functions [1-3], taking into account in the case of metalic plasmas simultaneously electron-phonon interaction, Umklapp processes and interband transitions, were obtained for the first time. When describing the contribution of interband transitions, the forces of the oscillators were calculated from a quasi-classical model [4]. Using the constructed model, the dependences of the real part of dynamic conductivity on the frequency of laser radiation for both simple (aluminium) and noble (silver) metals was investigated for the case of disordered [1,5] ion subsystem, when individual electron-electron and electron-ion interactions are important, and the case of ion lattice, when electron-phonon interaction and Umklapp processes play a main role [1-3].

For simple metals, transitions from the discrete to the continuous spectrum occur at relatively high quant energies (higher than Fermi energies). This transitions are accompanied by a sharp increase in the real part of correlation functions and dynamic conductivity. For noble metals, the energy distance from the d-zone to the conduction zone is comparable to Fermi energy. In this case both thermal and optical excitation of the d-zone play a role at temperatures and quant energies of the order of Fermi energy.

[1] M. Veysman, G. Ropke, H.~Reinholz, Particles 2, 242 (2019).

[2] M. Veysman, G.~R\"opke, H.~Reinholz, J. Phys. Conf. Ser. 946, 012012 (2018)

[3] M. Veysman, G.~R\"opke, H.~Reinholz, J. Phys. Conf. Ser. 1147, 012071 (2019)

[4] L.G. D'Yachkov and P.M. Pankratov, J. Quantit. Spectroscopy and Radiat. Transf. 47, 75 (1992)

[5] M. Veysman, G. Röpke, M. Winkel, and H. Reinholz, Optical conductivity of warm dense matter within a wide frequency range using quantum statistical and kinetic approaches, Phys. Rev. E 94, 013203 (2016)

Primary author: Dr VEYSMAN, Mikhail (JIHT RAS)

Co-authors: Prof. ROEPKE, Gerd (Universitaet Rostock, Institut fuer Physik); Dr REINHOLZ, Heidi (Universität Rostock)

Presenter: Dr VEYSMAN, Mikhail (JIHT RAS)

Session Classification: Modelling HED Physics