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# Quantum 'tails' in momentum distribution functions of the electron-hole plasma: Wigner approach and path integrals

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The new numerical version of the Wigner approach to quantum mechanics for treatment of the strongly interacting electron-hole plasma has been developed for conditions, when there are no small physical parameters, and analytical approximations used in different kind of perturbation theories cannot be applied. The new path integral representation of the quantum Wigner function in the phase space has been developed for canonical ensemble. Explicit expression of the Wigner function has been obtained in linear and harmonic approximations. The new quantum Monte-Carlo method for calculations of average values of arbitrary quantum operators has been proposed. Monte Carlo calculations of the momentum distribution function for the electron-hole plasma has been carried out. Comparison with classical Maxwell–Boltzmann distribution shows the significant influence of quantum effects on the high energy asymptotics ('tails') of the momentum distribution functions, which resulted in appearance of the power-behaved decay instead of exponential one. Quantum effects can affect the shape of the particle kinetic energy distribution function, as the interaction of a particle with its surroundings restricts the volume of configuration space, which, due to the uncertainty relation, results in an increase in the volume of the momentum space, i.e., in a rise in the fraction of particles with higher momenta. Allowing for quantum effects is important in kinetic consideration of such phenomena as the transition of combustion into detonation, flame propagation, vibrational relaxation, and even thermonuclear fusion at high pressure and low temperatures. Quantum effects are also important in treatment of transport properties of the strongly interacting systems of many particles. The direct way to consider the influence of the quantum effects on the kinetic distribution functions is to use the Wigner formulation of quantum mechanics in phase space. The quantum Wigner function is similar to distribution function in classical statistics in phase space. Thereby, average values of arbitrary physical quantities can be calculated by formulas, similar to classical statistics.

## Biography

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