

Calculation of the sound attenuation coefficient of strongly coupled Yukawa plasmas within the weak decaying collective-excitation approximation

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Along with the one-component Coulomb plasma, the many-particle system with Yukawa interaction holds a central position in the description of physical processes in strongly coupled plasma. This work examines the collective dynamics of ions in a Yukawa plasma in a disordered (liquid) state. The so-called weak decaying collective-excitation approximation is considered, which is based on the self-consistent relaxation theory of collective dynamics and covers spatial scales from extended hydrodynamics down to scales related to the mean interparticle distance. The spectra of the dynamic structure factor and the corresponding dispersion characteristics are reproduced by this approximation in agreement with molecular dynamics simulation data without the use of any fitting parameters. In the limit of small wave numbers, a correspondence is established between the weak decaying collective-excitation approximation and the damped harmonic oscillator model. This correspondence made it possible to obtain a simple analytical expression for the sound attenuation coefficient in a Yukawa plasmas. Calculations based on the obtained expression agree with direct computations from molecular dynamics simulation data.

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