Static and Dynamic Structure Factors with Account of the Ion Structure for High-temperature Alkali and Earth-alkali Plasmas

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The structure and thermodynamic properties of Alkali and Earth-alkali plasmas are of basic interest and of importance for high-temperature technical applications.

Recently, X-ray scattering has proved as a powerful technique in measuring densities, temperatures and charge states of warm dense matter regimes found in inertial confinement fusion. The static (SSF) and dynamic structure factors (DSF) are the fundamental quantities that describe the X-ray scattering cross-section from a plasma. We study the partial, charge-charge (SSF) and charge-charge (DSF) for Alkali (Li^+, Na^+, K^+, Rb^+, Cs^+) and Be^{2+} two-component plasmas (TCP) at temperatures T=30000K and T$\geq$100000K, $\Gamma_{ee} = 0.5 \div 2$ respectively where most of outer valency electrons are ionized, but the rest core electrons are still tightly bound. Recent work of Gregori et al. [1] has shown that the technique developed in the classical work of N. N. Bogoljubow provides reliable results for SSF even for moderately coupled plasmas. We calculate SSF on a base of the TCP hypernetted-chain approximation for non Local Thermodynamic Equilibrium [1], where not only the quantum-mechanical effects but also the ion shell structure are taken into account via Hellmann-Gurskii-Krasko pseudopotential model (HGKPM) [2]. We have compared our results with those obtained for Be^{2+} by Gregori et al. in a frame of the screened Deutsch model where no ion structure is taken into account and found considerable difference. The DSF for Alkali plasmas have been calculated in a frame of the HGKPM using the "method of moment" for the model semiquantal TCP developed by Adamjans' et al. for Hydrogen-like point charges plasma [3]. The plasma parameters were taken to provide the same coupling parameter and retaining of the shell structure. We have found that the present results are in a good agreement with the Adamjan's at the lower value of the fixed wave vector *k* and with an increase of *k* the curves damp while at lower *k* one observes the sharp peaks. At lower Γ there is almost no visible difference between the Alkali curves while at higher Γ the curves split.

References

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