ABSTRACT

The method of moments occupies a special place among the theoretical methods dedicated to the study of systems with Coulomb interaction between particles. Its essence lies in the fact that the system linear response function is parameterized as a fractional-linear transformation of a (Nevanlinna) parameter function (NPF) with certain mathematical properties. The zero-frequency approximation is applied to determine the latter which permitted to relate it, on the basis of justified physical considerations, to the moments themselves. This NPF static approximation is shown to be consistent within the Shannon entropy maximization method.

In the present work, the self-consistent version of the method of moments is applied to the investigation of the dynamic local field correction and other dynamic characteristics of classical strongly coupled one-component systems, such as dense Coulomb and Yukawa plasmas. The self-consistency of the approach means that the dynamic properties are obtained without any data input from simulations so that the dielectric function satisfies the first five sum rules automatically. Moreover, the dynamic structure factor, dispersion and the dynamic local-field correction are determined using exclusively the static structure factor calculated from the hypernetted chain approximation. A good quantitative agreement with molecular dynamics simulation data is achieved.

In addition, little discrepancy is observed in the plasma dynamic characteristics calculated with the static structure factors, obtained within various methods of calculation of the static structure factor, namely, the hyper-netted chain approximation (HNC), the modified HNC (MHNC) and the variational modified HNC (VMHNC). This stability implies the robustness of the present approach.

Possibilities to abandon the NPF static approximation are analyzed as well.