The Problem of thermodynamic stability in asymmetric complex plasma

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The range of applicability for the well-known phase diagram [1] of so-called complex plasma (dusty, colloid etc) in *κ*–Γ plane is under discussion (*κ* is a structural parameter, Γ is a coupling parameter). Existence of extensive domains of negative total pressure and negative isothermal compressibility in the phase diagram of asymmetric complex plasma [1] was claimed [2] if one used equations of state with non-ideality corrections [1, 3]. Thus, thermodynamic properties for the *uniform* system with the Debye potential and applicability limit of the phase diagram [1] are discussable. The present work is devoted to the analysis of the range of applicability for one of the basic assumptions in the phase diagram [1], i.e., linearized (Debye) screening of macroions by microions which leads to the Yukawa form of effective macroions interactions. Also, parameters of the gas-liquid phase transition in the Debye system which were obtained by direct numerical simulations [4] are replotted in the initial phase diagram [1]. The Poisson-Boltzmann approximation is used in the Wigner-Seitz cell with a central macroion. Parameters of non-linear screening are obtained in the cell [2]. Two effects were revealed as a result: (1) a decomposition of all microions into two subclasses, bound and free ones, and (2) a significant reduction of the effective (“visible”) macroion charge *Z*\* to the initial charge *Z* under the non-linear screening by a small high-density envelope of the bound microions. The work was supported by the RAS Scientific Program “Plasma and condensed materials at high energy density state”.

References

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