Verification of thermodynamic mixing rules for electrons in a mixture of Thomas–Fermi atoms

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We consider a mixture of Thomas–Fermi atoms in thermal, mechanical and chemical equilibrium (at the same temperature, pressure and chemical potential) [1]. All thermodynamic functions of electrons including second derivatives of thermodynamic potential are calculated using analytical formulas with a given accuracy. We verify the accuracy of two mixing rules. In the first rule the mixture of different atoms is replaced by a monoatomic system containing atoms with averaged nuclear charge and mass. In the second rule the calculations of thermodynamic functions are performed for each element of the mixture and then the linear mixing of thermodynamic functions is used according to the stochiometric composition of the mixture. We investigate the range of temperatures from 10^3 to 10^6 K and densities from $10^{-3}\rho_0$ to $10\rho_0$ including the region of strongly coupled and degenerate plasma. Energy, thermal pressure, entropy, heat capacity and sound velocity are analyzed. In some cases the difference between exact thermodynamic functions and calculated using the mixing rules exceeds 50%. The distribution of errors of mixing rules will be presented in the whole range of investigated parameters.
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