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Book of Abstracts

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ON THE EQUATION OF STATE OF THE DUST COMPONENT OF COMPLEX PLASMA

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Abstract

Investigation of the dusty plasma properties is becoming a quickly developing scientific branch that attracts attentions of many scientists. Dusty plasma can be found in nature (comet tails, rings of the planets, space nebula and etc.), at the same time dusty plasma is under active investigation in laboratory conditions (thermonuclear facility, plasma technologies, gas discharges). There are not many experiments related with finding dusty plasmas' equation of state. That is why the experimental and theoretical investigation of dusty plasma thermodynamics is an actual task.

In this work, on the basis of the radial distribution functions of the dusty plasma particles the excess pressure of the dust particles due to the interaction was evaluated. Evaluated results where compared with experimental ones [1] and data of computer simulation of other authors [2].

Radial distribution functions where defined in two different ways: in experiments [3, 4] and with following formula:

$$g_{\alpha\beta}(r)=\exp(-\Phi_{\alpha\beta}(r)/k_BT), \qquad (1)$$

where $\Phi_{\alpha\beta}(r)$ is the effective interaction potential of particles α and β types.

Effective interaction potential obtained in work [5] was used for the dust grains. Interaction potential was obtained on the basis of linear dielectric response theory in random phase approximation. This potential describes interaction of charged particles with dipole moment, taking into account screening effects at large distances.

Dusty plasma pressure is expressed via radial distribution functions and interaction potential by the following relation [2]:

$$P=P_{id}-\frac{2\pi}{3}\int_0^\infty\sum_{\alpha,\beta}n_\alpha n_\beta g^{\alpha\beta}(r)\frac{\partial\Phi_{\alpha\beta}(r)}{\partial r}r^3dr, \qquad (2)$$

where $P_{id}=\sum_\alpha n_\alpha k_BT$ is ideal gas pressure. The obtained results are compared with information of other authors and have a reasonable agreement with experimental data.

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