ISOTHERMAL DUST PLASMA WITH NEGATIVELY CHARGED BY ELECTRONS DUST PARTICLES

I.I. Klimovsky, D.S. Lapitsky, A.D. Yashkov

United institute of high temperature RAS, Moscow

In report results concerning theoretical analysis of the potentials of interaction dust particles in isothermal dust plasma where spherical dust particles are charged by electrons are presented. Main assumptions are: dust particle radius R_n is negligible to Debay radius R_D; non-dimensional potential of dust particle $\varphi_0 = << R_D/R_n$, free paths of electrons and ions is larger than R_D. Equations for the potential of spherical particle $U(r)$ and distribution of concentration of electrons $n_e(r)$ and ions $n_i(r)$ are taken from theory of electric probe in plasma and take stock of flowing electrons and ions to dust particle.

During the analysis about influence of on the potential of interaction magnitude of n_e varied from 10^7 to 10^{12} sm^{-3}. Temperature of plasma was taken 950K and 1500K and $R_D/R_n = 20$, that is critical value. The values of φ_0 are $\varphi_0 = 3.26$ for Li and $\varphi_0 = 4.49$ for Cs. The calculating result is that in isothermal plasma with represented values T and expression R_D/R_n attraction of dust particles is realized in all presented range of n_e. Minimum of potential well for all n_e is situated at distance R_D/R_n: $\cong 1,9$ and the value of potential well is being decreased with increasing of n_e.

The analysis concerning possibility of realization of attraction dust particles in isothermal plasma in fallow of alkali elements (Li, Na, K, Rb, Cs) was carried out. In analysis temperatures T_1 and T_2 were taken as independent variables, where T_1 appoint the pressure of saturated vapor (and concentration n_a), T_2 – degree of ionization (n_e and n_i). Using known values of n_a free paths of electrons and ions were counted. The correctness of calculations was determined by condition $\lambda_e, \lambda_i >> R_D$.

The calculations were run for the range of T_1 and T_2, where n_a varied from 10^{17} to 10^{19} sm^{-3} and n_e – from 10^8 to 10^{12} sm^{-3}. The expression R_D/R_n was taken 0,05 and 0,03.

On the picture the potentials concerning interactions of dust particles in isothermal plasma in fallow of alkali elements (Li,Cs) for equal values of $R_n/R_D = 0,05$ and $n_e = 10^8$ sm^{-3} are presented. Temperatures T_2 for Cs and Li were taken 880 and 1270 K correspondingly. The value of potential well for Cs is bigger than for Li and equal to ~0,8 eV. This circumstance allows us to expect the realization of attraction of dust particles at least in conditions with low gravitation.