Long-range interaction between dust grains in plasma

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We discussed a problem of the spatial ordering in the low-temperature ($T \sim 10^3$) plasma. It is supposed that plasma is in the thermal equilibrium and it is consisting of monodisperse particles of the size $r_p \sim (10^{-6} \div 10^{-4})$ cm and neutral buffer gas (dusty plasma). It is taken into account that the electro neutral cells are formed around dust grains. These cells do not interact with each other in the mean field approximation. However, the electric multipole (long-range) interaction between two electro neutral cells is formed due to fluctuations of the charge density into a cell and its surface.

The interaction potential between two cells (grains) can be represented as $U(r) = U_r(r) + U_a(r)$, where $U_r(r)$ and $U_a(r)$ are the repulsive and the attractive parts of $U(r)$ respectively. The repulsive part of the potential is modeled by the combination of the hard-core potential and the potential of Coulomb repulsion on distances $2r_p < r < 2r_D$. The attractive part of $U(r)$ is due to forces of multipole interaction:

$$U_a(r) = -\left(\frac{A_6}{r^6} + \frac{A_8}{r^8} + \frac{A_{10}}{r^{10}} + \ldots\right),$$

where r is a distance between dust grains centers, and coefficients A_i ($i = 6, 8, 10, \ldots$) are expressed through the mean square values of the multipole moments for a cell and its polarizability α.

The multipole moments and polarizability of the cell are calculated. The peculiarities of the spatial ordering of dust grains are investigated and the possibility of existing of the dust crystal is discussed.