INFLUENCE OF A LOW FREQUENCY ELECTRIC FIELD ON DUSTY STRUCTURES UNDER MICROGRAVITY CONDITIONS

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The experiments performed onboard the International Space Station (ISS) demonstrate that a formation of homogeneous 3D dusty plasma structures under microgravity conditions is accompanied by the same difficulties as in laboratory. The plasma flows connected with plasma nonuniformity and a leaving of charged particles on walls lead to an appearance in the discharge center of a region free of dust grains, the so-called void. We present the analysis of the experiments performed onboard the ISS with the PKE-Nefedov facility when an additional low frequency (lf) voltage was applied to the electrodes. The sketch of the RF plasma chamber with the rf parallel plate discharge is well known. The aim of these experiments was an increase of a stability of dust structures and a void closure under an action of an external electric field. When the rf voltage amplitude increases the void axial size decreases and the radial size, on the contrary, increases. The void is being closed practically without a distortion of its form when the rf voltage on the electrodes decreases. The void boundary is sharp at all pressures analysed. When we apply the additional lf voltage the void behavior is quite different a new additional force acting on the dust particle in the electrostatic trap generated by the averaged rf plasma fields modulated by the low frequency voltage appears. This force, as applied to the dust particles, was not considered previously. The force can be called as the force of the dynamical low frequency pressure by analogy with the force of the high frequency pressure which confines, for example, ions in the radio frequency Paul trap. This force appears due to the low frequency modulation of the grain equilibrium position in the nonuniform electric field of the trap. The amplitude of dust grains oscillations in the low frequency field does not exceed the interparticle distance and is about 200 microns. The dust grains are shifted under the action of this force in the direction of the weaker electric field that is to the trap center. When the amplitude of the low frequency modulation is comparable with the rf voltage amplitude on the electrodes, this force is comparable with the electric field force. This will serve to the void closure when the low frequency voltage is applied to the discharge. When the low frequency field is imposed on the rf discharge initially grains are shifted to the center from the regions with higher electric field. Consequently, the void starts to close from its boundary.