DISTRIBUTION OF THE DUST PARTICLES IN THREE-DIMENSIONAL RF DISCHARGE COMPLEX PLASMAS UNDER MICROGRAVITY CONDITIONS

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We propose a method of determination of the dust particle spatial distribution in dust clouds that form in three-dimensional (3D) complex plasmas under microgravity conditions. The method utilizes the data obtained during the 3D scanning of a cloud, and it provides reasonably good accuracy. Based on this method, we investigate the particle density in a dust cloud realized in gas discharge plasma in the PK-3 Plus setup onboard the International Space Station. We find that the treated dust clouds are both anisotropic and inhomogeneous. One can isolate two regimes in which a stationary dust cloud can be observed. At low pressures, the particle density decreases monotonically with the increase of the distance from the discharge center; at higher pressures, the density distribution has a shallow minimum. Regardless of the regime, we detect a cusp of the distribution at the void boundary and a slowly varying density at larger distances (in the foot region). A theoretical interpretation of the obtained results is developed that leads to reasonable estimates of the densities for both the cusp and the foot. The modified ionization equation of state, which allows for violation of the local quasineutrality in the cusp region, predicts the spatial distributions of ion and electron densities to be measured in future experiments.