DYNAMICS OF DUSTY PLASMA UNDER SPACE CONDITIONS

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The dusty plasma is a partly ionized gas that contains negatively or positively charged dust particles of micron size. Micron-sized dust particles in the dusty plasma assume a significant charge and may form quasi-stationary plasma-dust structures similar to a liquid or a solid. Dusty plasma is affected by gravity, depending on the size of the solid particles gravity can be the dominating force. Under microgravity conditions in space much weaker forces become important and other new phenomena not achievable on Earth can be observed. The experiments were performed in dusty plasma under ground bounded and microgravity conditions. The structural properties and dynamical processes were studied.

The results of the experimental studies of the diffusion of dust, charged by a photoemission in microgravity conditions are presented. The complex measurements of velocity distributions, temperatures, friction coefficient and diffusion constants of macroparticles in dusty plasma were carried out. The dust system under study represented a weakly correlated fluid.

The formation of ordered structures in dc discharge dusty plasma was also studied in microgravity experiments carried out aboard the Mir space station. Pair correlation functions obtained for 120 mcm bronze particles revealed a short-distance order with a first maximum at 700 mcm.

Effective structural and transport characteristics of the system of macroparticles in dusty plasma were measured in a set of experiments in rf gas-discharge plasmas in microgravity conditions on the board of International Space Station. A number of different phenomena were studied including self-excitation of dusty waves, formation of plasma crystal and plasma liquid regions, different vortices of charged dust grains. Three-particle correlation functions for experimental and numerical data are analyzed and compared with the superposition approximation.

Dusty plasmas were also studied in a combined dc/rf discharge under microgravity conditions in parabolic flights. The chamber provided a particular advantage for investigation of different dynamical phenomena in dusty plasmas such as sheared laminar flow of dusty liquid, boundary layers and instabilities, shock waves (solitons) formation and propagation and space dust grain separation by their size, formation of boundary free dust clusters.