MICROGRAVITY SCIENCES AND PROCESSES (A2)
Microgravity Sciences onboard the International Space Station and Beyond (6)

Author: Prof. Vladimir Fortov
Joint Institute for High Temperatures of the Russian Academy of Sciences, Russian Federation, fortov@ficp.ac.ru

Prof. Gregor Morfill
Max-Planck-Institut für Extraterrestrial Physics, Germany, gem@mpe.mpg.de

STRONGLY COUPLED DUSTY PLASMAS IN LABORATORY AND MICROGRAVITY: EXPERIMENTS AND MODELING

Abstract

Dusty plasma consists of neutral gas, ions, electrons, and micron-size particles (dust). The interaction of micron-sized dust particles with charges up to 102-105 elementary charges may form the ordered structures of liquid and crystal types accessible to observe them at kinetic level. 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 results are presented from the experimental studies of dusty plasmas under ground bounded and microgravity conditions on the board of International Space Station and in parabolic flight. Structural and transport characteristics of the system of macroparticles in dusty plasma were measured in a set of experiments in rf gas-discharge plasmas. The experimental studies of the viscosity of a dust-plasma liquid were carried out. The results of analysis of the obtained data made it possible to estimate the coefficient of dynamic viscosity of a dust-plasma liquid. In parabolic flights a combined dc/rf discharge chamber provided a particular advantage for investigation of different dynamical phenomena in dusty plasmas such as instabilities, shock waves formation and propagation. An attraction between negatively charged micron-sized plastic particles was observed in the bulk of a low-pressure gas-discharge. This attraction had led to the formation of a boundary-free dust cluster. The stability of this boundary-free dust cluster was possible due to its confinement by the plasma flux on the central dust particle. A propagation of the dust acoustic shock wave in an elongated three-dimensional dusty cloud was observed in low-pressure gas-discharge plasma under microgravity conditions after the action of an electrical pulse on this cloud. A pressure of dust component after the compression front is derived from the analysis of the shock wave propagation and compared with simple models of dusty plasma.