Investigation of dusty plasma under microgravity conditions on board the International Space Station

Fortov V.E., Molotkov V.I., Lipaev A.M.,
Institute for High Energy Densities, Russian Academy of Sciences, Moscow

Morfill G., Thomas H., Ivlev A.V, Khrapak S.A.
Max-Plank Institute for Extraterrestrial Physics, D-85740 Garching, Germany

Ivanov A.I., Krikalev S.K., Vinogradov P.V.
RSC "Energia"

Tokarev V.I.
Y.A. Gagarin Cosmonauts Training Center

The short overview of investigations performed on the International Space Station by the unique experimental plasma crystal facility "PKE-Nefedov" (Plasma Crystal 3) will be presented. The facility was designed to study dusty (complex) plasmas (ions, electrons and charge microparticles) at the most elementary, the kinetic level.

The plasma of the rf parallel plate discharge in argon is excited between two electrodes in the plasma chamber. The neutral gas pressure was in the range of 0.1 and 1.0 mbar. Monodisperse particles of two different sizes (3.4 μm and 6.8 μm) can be injected into the plasma chamber and visualized by a thin sheet of laser light. The presentation will include experimental data on self-organization of highly charged dust grains, plasma-dusty plasma boundary formation, dynamics of a behavior of the dusty plasma system under the action of low frequency external electrical field of a variable frequency and amplitude and information on some other effects.

Besides, we shall present peculiarities of the new facility "Plasma Crystal 3 Plus". The facility allows investigations at neutral gas pressures (argon and/or neon) between 0.05-2.5 mbar and rf-power of 0.01-1 W. The plasma chamber and electrode assembly have been changed so that a much better symmetry and homogeneity of the electric field between electrodes is achieved. The complex plasma can consist of monodisperse particles in a size range from 1-15 μm. Up to six particle sizes can be added to the experimental volume. The particle cloud can be excited by an electrical low frequency signal on the electrodes (0.1 – 100 Hz at a maximum amplitude of 50 V) or by a low frequency modulation of the rf- amplitude in different wave forms. The results of the first experiments devoted to a search of critical point in complex plasmas and phase transitions will be presented.