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COMPLEX PLASMA EXPERIMENTS IN PK-4 FACILITY ON BOARD THE INTERNATIONAL SPACE STATION

Abstract

Complex plasmas are low-temperature plasmas containing a strongly coupled subsystem of charged solid microparticles. Plasmas are designed in such a way that the subsystem of microparticles can be used as an atomistic model of classical condensed matter [1]. It has been previously shown that complex plasmas allow to investigate many generic condensed matter phenomena, such as melting and crystallization, viscosity, diffusion, wave propagation, etc. Since complex plasmas contain solid particles, they are significantly affected by gravity. Unstressed 3D microparticle systems can only be obtained under microgravity conditions.

Plasmakristall-4 (PK-4) is microgravity complex plasma facility on-board the International Space Station. In PK-4, the experiments are performed in a glass tube plasma chamber of 3 cm diameter and about 20 cm working area length [2]. In this chamber, plasma is generated by means of a dc discharge, whose polarity can be switched with the frequency up to 5 kHz. Starting with the polarity-switching frequency of several hundred Hz, microparticles (plastic spheres of 1-10 μm diameter) become insensitive to the oscillations of the discharge polarity. The microparticle suspension can therefore be trapped within the working area of the plasma chamber. Manipulation devices like RF coils, manipulation laser, thermal manipulator are also available.

Since PK-4 commissioning in June, 2015, four scientific campaigns have been conducted. The topics include charging and drift of the microparticles in a dc discharge, dust-acoustic waves and 3D structure of the shear flow. Scientific outcome of the PK-4 campaigns will be presented and discussed.

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References

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