Fortov V E, J Biot Phyt 2017

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Joint institute for high temperatures of RAS, Russia

Space experiment “plasma kristall–4” on the international space statin: first results

The new Russian-European “Plasma Kristall – 4” (PK-4) space laboratory is intended for investigation of fundamental properties of strongly coupled dusty (complex) plasma under microgtravity conditions. In dusty plasmas, the subsystem of μm-sized microparticles immersed in low-pressure weakly ionized gas-discharge plasmas becomes strongly coupled due to the high (103–104 e) electric charge on the microparticle surface. The microparticle subsystem of complex plasmas is available for the observation at the kinetic level, which makes complex plasmas appropriate for particle-resolved modeling of classical condensed matter phenomena. The PK-4 equipment was developed in close cooperation between scientists of the joint institute for high temperatures of RAS (JIHT RAS) and scientists of the Max-planck-institute fur extraterrestrische physik (MPE) in garching (Germany). The PK-4 space experiment is a continuation of previous Russian-German “Plasma Kristall – 3” (PK-3) and “Plasma Kristall – 3 Plus” space experiments. While the PK-3 setups were suitable mostly for investigations of dusty plasma crystals, the modern PK-4 setup is intended for investigations of hydrodynamic phenomena of highly nonideal dusty plasma liquid. The PK-4 setup was installed in the European laboratory module Columbus at the end of 2014 and commissioned at June 2015. The operation of the PK-4 laboratory is performing with the participation of the International Coordination Group (Facility Science Team). In contrast to the PK-3 setups, to generate plasma the PK-4 facility makes use of a classical dc discharge in a glass tube. The facility is equipped with two videocameras and illumination laser for the microparticle imaging, kaleidoscopic plasma glow observation sys-tem and mini spectrometer for plasma diagnostics and various micro particle manipulation devices (e.g., powerful manipulation laser). Scientific experiments are programmed in the form of scripts written with the help of specially developed C scripting language libraries. PK-4 is mainly operated from the ground (control center CADMOS in Toulouse, France) with the support of the space station crew. Data recorded during the experiments are later on delivered to the ground on the removable hard disk drives and distributed to participating scientists for the detailed analysis. The first experimental results from the PK-4 facility will be reported. Space experiment PK-4 is supported by the Russian State Corporation ROSCOSMOS and the European Space Agency.

Biography

Fortov V E is a well-known scientist in the field of plasma and space physics, extremely high pressures and temperatures, physics and chemistry of strong shock and detonation waves, pulsed energetics. He is academician of Russian Academy of Sciences, head of the division of energetics, machinery, mechanics and control systems of RAS and director of joint institute for high temperature of RAS. He performed experimental investigations on physical properties of hot dense matter at mega bar pressure range. He is one of the first who applied the intense shock and detonation waves for investigations of physical properties of plasmas under extreme pressure and temperature. Along with the Russian prizes and medals he was awarded L.P. Karpinsky international prize in physics and chemistry, 1997; international P. Bridgeman prize for achievements in high pressure physics and technology; 1999, international Max-Plank award for physics, 2002; international alfven prize of European Physical Society in plasma science; 2003; Americal Physical Society prize in shock compression science for pioneering research in high energy density physics, 2005; A.Einstein gold medal of UNESCO for achievements in science and international collaboration, 2005; order of merit of the Federal Republic of Germany (Bundesverdienstkreuz) for achievements in science and collaboration with german researchers, 2006; Honoured legion order, france, 2006; International glass memory award for achievements in shock wave science, 2009.

fortov@ficp.ac.ru