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P1.3005 Charging of microparticles in a dc discharge in ground-based and microgravity experiments

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The charge of microparticles immersed into the dc discharge of PK-4 experimental facility was estimated using the particle velocities from the experiments performed on Earth and under microgravity conditions on the International Space Station (ISS). PK-4 is an experimental laboratory developed to provide a range of various complex plasma experiments in the direct current (dc) and/or radiofrequency (rf) low temperature gas discharge [1]. It was installed in the Columbus module of the International Space Station (ISS) in November 2014. The experiments were performed in the flight model (FM) onboard ISS as well as in science reference model 1 (SRM 1) of PK-4 in a ground-based laboratory, which is functionally identical to the FM. The gas pressure was varied from 20 to 100 Pa and the discharge current from 0.5 to 1.5 mA for argon and neon gases. The microparticles of three different diameters 1.3, 2.5 and 3.4 m were injected into the chamber. They were illuminated by a laser beam and their motion was recorded by video cameras with 35 fps and 14,3 m/pixel resolution. The velocities were estimated by measuring the front velocity of the whole particle cloud while entering and leaving the field of view within several consecutive frames. Another method is the method of the so-called space-time diagrams, where the averaged frame intensity in y direction is plotted within the certain time for every x coordinate, since the particles are mainly moving in x direction. The particle velocity was estimated from the slope of intensity distribution on this diagram. The experimental data from ISS showed that under microgravity conditions the velocities of microparticles are systematically lower than those measured on the ground, as it was already observed in parabolic flight experiments [2]. The difference is more pronounced in the lower pressure range (20-30 Pa). Using the analytical model of particle charging which takes into account the radial variation of the discharge parameters within the discharge tube and different values of electron reflection coefficient [3] we compared experimentally measured particle velocities with the results of the model. Both the experimentally measured and theoretically estimated particle velocities as well as the particle charge show different behaviour for argon and neon discharges with respect to the pressure. Also the quantitative values of the charge differ for these two gases. All authors greatly acknowledge the joint ESA-Roscosmos "Experiment Plasmakristall-4" onboard the International Space Station.

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