

The PKE-Nefedov experiment is one of the first natural science experiments performed on the International Space Station ISS. It covers a new field of research under microgravity conditions – the complex plasmas. A complex plasma is a new form of matter with interesting properties that allow observations of its physics at the most fundamental – the kinetic – level. Interesting behaviours of complex plasmas under microgravity conditions have been observed (e.g. the 3-D crystalline structures observed in real space, collisions of complex plasma drops, shocks, instabilities etc.) in the 3 ½ years of operation.

Under microgravity conditions the typical static and dynamic behaviour of complex plasmas is illustrated in Figure 1 a). This figure shows a 3 second trajectory fragment of the microparticles, colour coded from red to blue. The dominant features which can be investigated here are:

- a microparticle free “void” in the centre of the system for most experimental parameters.
- a sharp boundary between the void and the complex plasma.
- demixing of complex plasma clouds formed by microparticles of different sizes.
- crystalline structures along the central axis.
- vortices in different areas away from the central axis.

All of the above mentioned features have been investigated in detail over the last years. These and other effects are published in a series of papers [1-7].

Fig. 1a

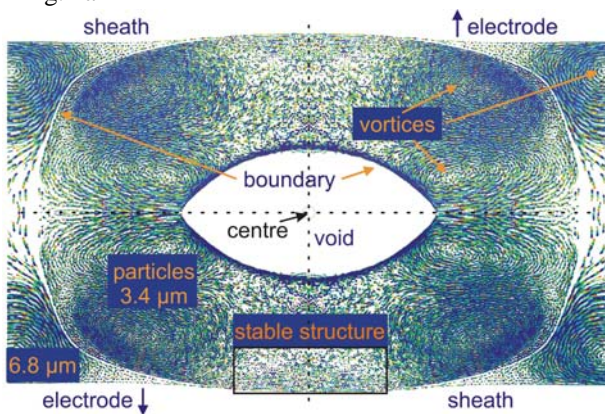
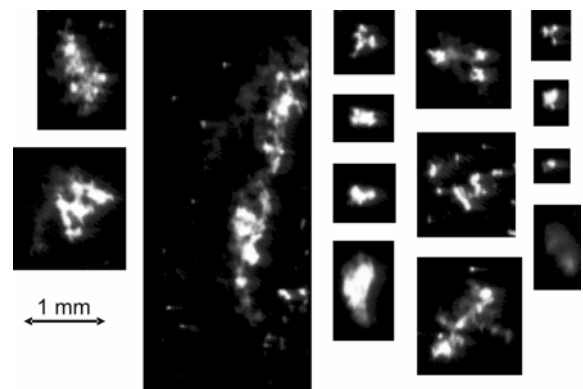


Fig. 1b



Beside the above described features of complex plasmas under microgravity conditions we observed interesting new phenomena not foreseen before. Just to mention two of those, this is the decharging [6] of the microparticles after the plasma source was switched off and the agglomeration of the microparticles after the injection into a neutral gas due to a new phase transition – the so-called gelation transition [7]. A zoo of grown agglomerates caused through this transition is shown in Fig. 1b.

References:

1. A. P. Nefedov, et al., *New Journal of Physics* **5**, 33.1–33.10 (2003)
2. V.E. Fortov, et al., *Physical Review Letters*. **90**, 5005 (2003)
3. D. Samsonov et al., *Phys. Rev. E* **67**, 036404 (2003)
4. S. Khrapak et al., *Physics of Plasmas* **10**, pp. 1-4 (2003)
5. B. M. Annaratone, et al., *Phys. Rev. E* **66**, 056411 (2002)
6. A. V. Ivlev et al., *Phys. Rev. Lett.* **90**, 055003 (2003)
7. A. V. Ivlev et al., *Phys. Rev. Lett.* **89**, 195502 (2002)