Pair correlations in string-fluid complex plasmas

M. Y. Pustylnik[1], B. Klumov[1,2], M. Rubin-Zuzic[1], A. M. Lipaev[2], V. Nosenko[1], A. D. Usachev[2], A. D. Zobnin[2], V. I. Molotkov[2], G. Joyce, H. M. Thomas[1], M. H. Thoma[3], O. F. Petrov[2], V. E. Fortov[2]

[1]*Institut für Materialphysik im Weltraum, Deutsches Zentrum für Luft- und Raumfahrt (DLR), Münchener Straße 20, 82234 Weßling, Germany*

[2]*Institute for High Temperatures, Russian Academy of Sciences, Izhorskaya 13/19, 125412 Moscow, Russia*

[3]*I. Physikalisches Institut, Justus-Liebig-Universität Gießen, Heinrich-Buff-Ring 16, 35392 Gießen, Germany*

We report on the complex plasma experiments performed under microgravity conditions on the International Space Station in the PK-4 facility [1]. In PK-4, the monodisperse microparticles ($1.3-6.7$ μm diameter) are injected into the plasma chamber and trapped in a polarity-switched dc discharge at argon pressures between $0.1-2$ mbar, current up to 3 mA and frequency up to 1 kHz. Microparticles are illuminated with a laser and observed by two videocameras. The 3D structure of a microparticle suspension can be obtained by simultaneously moving the cameras and the laser perpendicular to the image plane (scanning).

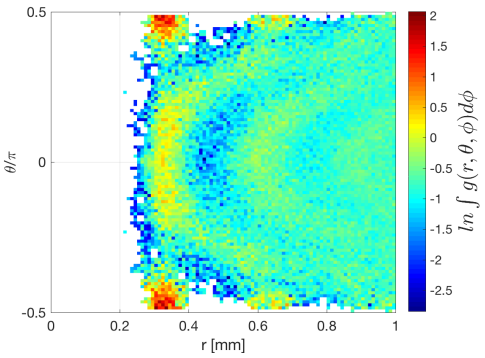

Figure 1: *ϕ-projection of $g(r,\theta,\phi)$ with strong peaks along the discharge axis.*

To characterize the 3D structure obtained in the scans, we used a pair correlation function $g(r,\theta,\phi)$ with r, θ and ϕ being the radius, polar angle and azimutal angle, respectively. One of its integrals is shown in Fig. 1. It contains peaks at $\theta = \pm\pi/2$, indicating the formation of strings aligned with the discharge axis [2]. Results of the experimental data analysis will be discussed and compared to the results of the molecular dynamics simulations.

All authors greatly acknowledge the joint ESA-Roscosmos "Experiment Plasmakristall-4" on board the International Space Station.

References

[1] M.Y. Pustylnik, M. Fink, V. Nosenko et. al., Rev. Sci. Instrum. **87**, 093505 (2016)

[2] A.V. Ivlev, M.H Thoma, C. Räth, G. Joyce and G.E. Morfill, Phys. Rev. Lett. **106**, 155001 (2011)