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Life and Microgravity Sciences on board ISS and beyond (Part I) (6)

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EKOPLASMA - THE FUTURE OF COMPLEX PLASMA RESEARCH ABOARD THE INTERNATIONAL SPACE STATION

Abstract

Ekoplasma is a joint German-Russian project, developing the future multi-purpose laboratory for the investigation of complex plasmas under microgravity conditions aboard the International Space Station (ISS).

Complex plasmas are low-temperature plasmas, consisting of neutral gas atoms, ions, electrons and micro-meter sized particles as an additional component. The particles become charged in the plasma and as a result of their mutual repulsion form an optically thin cloud that can be studied in its full spatial and dynamical complexity on the granularity scale of each particle by optical cameras. Therefore, complex plasmas allow fundamental investigations down to the kinetic level of individual particles also for a wide field of interdisciplinary topics in classical condensed matter physics. Since gravity prevents the formation of large, homogeneous systems on earth, research on the ISS is essential, and Ekoplasma will follow in

a line of successful preceding experiments aboard the ISS: PKE-Nefedov, PK-3 Plus and the currently operating PK-4 facility.

The experimental apparatus of Ekoplasma features a newly developed large, cylindrical plasma chamber (the Zyflex chamber) with an adaptive internal geometry and 4 rf-driven electrodes for plasma generation. With the implemented technology, the accessible experimental parameter range will be extended by magnitudes (e.g. particle charge, neutral gas pressure range) and it will allow an independent control of plasma parameters. Further, particle dynamics will be investigated by a 3D optical diagnostic system, giving new insights into physical phenomena by adding the information of the 3rd dimension, which is usually lost when observing a 2D cross-section of the observation volume.

Ekoplasma is planned to be launched to the ISS after 2022, and it will cover a wide range of research topics such as solidification and melting, phase separation in binary systems, the transition to turbulence, active matter or electrorheology. The current status of Ekoplasma will be presented, as well as an overview of recent results of experiments performed on parabolic flights and in the ground laboratory, demonstrating the scientific possibilities and the technology of this new laboratory.

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