P 8: Complex Plasmas and Dusty Plasmas I

Time: Tuesday 11:00–12:30 Location: WW 1: HS

Invited Talk P 8.1 Tue 11:00 WW 1: HS

Pulsed Complex Plasma In Microgravity — •Christina A. Knapek[1,2], Daniel P. Mohr[1,2], and Peter Huber[2] — [1]Institute of Physics, University of Greifswald, 17489 Greifswald, Germany — [2]Institut für Materialphysik im Weltraum, Deutsches Zentrum für Luft- und Raumfahrt, 51147 Köln, Germany

A new experimental method for creating void-free complex plasmas under microgravity conditions is presented. The method is based on a pulsed operation mode of a four-channel radio-frequency generator for plasma generation. A dust cloud of micrometer-sized particles can be immersed in the bulk of a low temperature plasma under microgravity conditions. It typically contains a central volume depleted of particles – the void – that prevents the generation of large, continuous clouds. Experiments performed at different neutral gas pressures and discharge volumes during the microgravity phase of a parabolic flight show that the central void is closed completely once the pulsed operation mode is applied. The particle cloud shape, and the density distribution within the cloud, are practically independent on the pulse period within the investigated parameter range. The proposed method has great potential for future application in experimental facilities dedicated to fundamental studies of large three-dimensional, homogeneous complex plasma systems in microgravity. Prospective ongoing studies are outlined that are dedicated to investigate the underlying physical processes for the observed void closure.

This work is funded by DLR/BMWi (FKZ 50WP0700, 50WM1441, 50WM2161) and StMWi.

P 8.2 Tue 11:30 WW 1: HS

A full Stokes imaging polarimeter for nanodusty plasma applications — •Alexander Schmitz, Andreas Petersen, and Franko Greiner — Institute of Experimental and Applied Physics, Kiel University, Kiel, Germany

Full Stokes imaging Mie polarimeters are required to study the detailed dynamic of particle growth in reactive plasmas. Various concepts exist, which often rely on the rotation or switching of optical components. Our setup, constructed from two divisions of focal plane CMOS cameras, presents a new imaging polarimeter with high spatial resolution that does not require moving optics.

The accuracy of the polarimeter has been carefully investigated. The performance of the new polarimeter is demonstrated by visualizing two-generation layered particle growth in a reactive Argon-Acetylene plasma.

P 8.3 Tue 11:45 WW 1: HS

Three-dimensional investigation of dust flows around obstacles under microgravity — •Stefan Schütt, Christina Knapek, Daniel Maier, Daniel Mohr, and André Melzer — University of Greifswald, Greifswald, Germany

Dust flows around a tungsten wire in three-dimensionally extended dusty plasmas have been investigated on parabolic flights. A fixed wire has been installed in the midplane between the electrodes of a parallel plate rf discharge. The dust particles were captured three-dimensionally with a stereoscopic four-camera system. The dust flow around the wire was investigated during the pull-out phase at the end of each parabola, when gravity sets in and the dust cloud moves downward past the wire. Additionally, a periodic dust motion was generated by superimposing a low-frequency ($f \approx 1\,\mathrm{Hz}$) modulation on the electrodes. The repetitive nature of the dust motion in the latter case allows to stroboscopically overlay dust trajectories from multiple modulation periods and to accurately obtain fluid properties in three dimensions.

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P 8.4 Tue 12:00 WW 1: HS

Electrostatic probes in high Havnes nanodusty plasmas — •Franko Greiner[1] and Julian Held[2] — [1]Institute of Experimental and Applied Physics, Kiel University, Kiel, Germany — [2]Department of Mechanical Engineering, University of Minnesota, Minneapolis, USA

Invasive diagnostics, such as Langmuir probes, pose challenges when employed in nanodusty plasmas with high dust density. When a floating probe is utilized, it establishes a dust-free 'probe void' around itself. Applying a more negative probe voltage expands this void, while a more positive probe voltage results in a significant dust flow toward the probe upon reaching the plasma potential. Since the plasma potential is unknown, probe contamination and the disruption of the nanodusty plasma become inevitable.

Double probes, which inherently float below the plasma potential at zero voltage bias, appear to be the preferred choice for probes. This choice helps in avoiding probe contamination, and the impact on dust density is minimal across all probe voltages. In our study, we present measurements of ion density and electron temperature in a nanodusty, strongly electron-depleted argon plasma.

P 8.5 Tue 12:15 WW 1: HS

Surface modification and core-shell structure of MF particles in the plasma sheath — •Sören Wohlfahrt, Franziska Reiser, and Dietmar Block — Kiel University, Kiel, Germany

Complex (dusty) plasmas consist if micrometer sized particles in addition to the typical plasma species of ions, electrons and neutrals. Dependent on the particle material, they show a distinct plasma-particle interaction that leads to a modification of the particles surface and even a decrease of the particle size in a process commonly referred to as 'etching'. In case of the widely used melamine formaldehyde (MF) particles, there is a strong connection between the surface reactivity and the etch process itself, which can be explained in the framework of an increasingly roughened surface shell and an unmodified particle core. We use a polarization resolved light scattering technique based on Lorentz-Mie theory to investigate the size and size evolution of single MF-particles in the plasma sheath. Our scattering-model assumes a coated sphere, which is analogous to a core-shell structure. Thus, the optical properties of the particle surface become directly accessible in the experiment. We will present time resolved measurements of single MF particles whose core is unaffected by the etch process, while the shell shows a steep increase in the imaginary part of the refractive index. Although the shell is only 100 nm thick ($< 5\%$ of particle size), this increase has a significant influence on the overall scattering- and absorption cross section of the particle and affects the particle dynamics as well.