P 22: Complex Plasmas and Dusty Plasmas - Poster

Time: Wednesday 16:15–18:15 Location: Zelt West

P 22.1 Wed 16:15 Zelt West

Operando size meansurements of microparticles using angular resolved mie scattering — •Niklas Kohlmann, Oguz Han Asnaz, Franko Greiner, and Dietmar Block — Institute of Experimental and Applied Physics, Kiel University, Germany

Besides structural and dynamic processes in complex plasmas, the particles themselves are recently more and more in focus of research. Important parameters are the particle size, shape and surface topology. However, non-invasive in-situ or even operando methods to determine the named parameters during plasma operation are missing. Angular resolved mie scattering measurements can fill this gap and provide particle sizes with high precision. An out-of-focus imaging technique similar to ILIDS is used to obtain the angular-dependent scattering intensities. Correlating the so called phase function to the data provided by the Lorenz-Mie theory for spherical objects the particle size and refractive index can be obtained. The particle size measurements are validated with complimentary measurements using a long distance microscope. It is found that the sizes are in good agreement for both methods. Further applications, like the detection of changes of particle surface topology due to plasma-particle interaction or the decrease in particle size due to prolonged plasma exposure, are discussed as well.

P 22.2 Wed 16:15 Zelt West

Controlled transport and extraction of charged nanoparticles through the plasma-sheath in an acetylene RF plasma — •Zahra Marvi, Erik von Wahl, Thomas Trottenberg, and Holger Kersten — Institute of Experimental and Applied Physics, Kiel University, Germany

As nano-sized dust particles have been shown to exhibit interesting properties, which can be applied in innovative materials, there is a strong need to control the extraction of these dust particles from the plasma. One of the most important challenges about dust transport is the accurate description of the force balance which is coupled with the ion and electron currents onto the dust particle surface in electrostatic field along the plasma-sheath.

In this work, we propose a multi-fluid approach to investigate the charging process, force balance and transport of the nanoparticles through the plasma sheath between a nanodust forming CCRF plasma and a biased silicon substrate. The requirements for the extraction of nanoparticles for differently biased substrates are investigated both in simulation and experiment, respectively, and the results are compared with together.

P 22.3 Wed 16:15 Zelt West

Mach cones in inhomogeneous plasma crystals — •Sven Werner Schmidt, Frank Wieben, and Dietmar Block — Institute of Experimental and Applied Physics, Kiel University, Germany

Complex plasmas are ideal systems to study wave phenomena in strongly coupled system at the kinetic level. The sound speed of dust acoustic waves depends on charge-to-mass ratio and screening strength κ. The Mach cones which are generated by a supersonic perturbation can thus be used as a diagnostic tool. Most experiments and simulations investigate Mach cones only in the central parts of a 2D crystal where a homogeneous density is assumed. This contribution investigates Mach cones in inhomogeneous media. Especially for small dust systems the parabolic confinement yields to a notable radial density gradient. In order to correctly measure q/m or κ in an inhomogeneous system it is essential to analyse the Mach cone shape. Mach cones in a plasma crystal are excited by a moving laser beam. Using a model for Mach cone curvature in inhomogeneous media [1] a reliable measurement of the sound speeds is shown to be possible.

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[1] S.K. Zhdanov et. al., Phys. Rev. E **69**, 026407 (2004)

P 22.4 Wed 16:15 Zelt West

Local extraction of nanoparticles from a dusty CCRF discharge — •Erik von Wahl[1], Zahra Marvi[1], William Desdions[2], Isabelle Géraud-Grenier[2], Véronique Massereau-Guibaud[2], Maxime Mikikian[3], and Holger Kersten[1] — [1]Institute of Experimental and Applied Physics, Kiel University, Germany — [2]GREMI, UMR7344 / Univ. Orléans, F-18020 Bourges, France — [3]GREMI, UMR7344 / Univ. Orléans, F-45067 Orléans, France

Contrary to microparticles, clouds of nanoparticles can easily levitate inside a plasma due to little importance of the gravitational force. As each particle collects ions and electrons, it changes the plasma in its vicinity. Having particles distributed in a large volume of the discharge the effect of nanodust on the entire discharge is yet to be fully understood.

In this study, nanoparticles are extracted by a biased silicon substrate at different locations inside the plasma and then examined by scanning electron microscopy. In order to fully comprehend the extraction method the shape of the dust particle cloud is observed by laser light scattering at the wavelength of 350 nm. Differences in the collection results due to the choice of the substrate position are discussed.

P 22.5 Wed 16:15 Zelt West

Ekoplasma - The Future of Complex Plasma Research in Space — •Christina Knapek[1], Peter Huber[1], Daniel Mohr[1], Erich Zaehringer[1], Vladimir Molotkov[2], Andrey Lipaev[2], Vadim Naumkin[2], Uwe Konopka[3], Hubertus Thomas[1], and Vladimir Fortov[2] — [1]DLR, Institut für Materialphysik im Weltraum, Wessling, Germany — [2]Joint Institute for High Temperatures, Moscow, Russia — [3]Auburn University, Auburn, AL, USA

Complex plasmas consist of highly charged micrometer-sized grains injected into a low temperature noble gas discharge. The particles interact with each other via a screened Coulomb potential, and can form gaseous, liquid or solid states. On ground, gravity compresses the system and prevents the generation of larger, three-dimensional particle clouds. The Ekoplasma project, a Russian-German cooperation, is the future laboratory for the investigation of complex plasmas under microgravity conditions on the International Space Station (ISS). The essential part of Ekoplasma is the newly developed Zyflex chamber – a large, cylindrical plasma chamber with parallel, rf-driven electrodes and a flexible inner geometry. It is designed to extend the accessible experimental parameter range and to allow an independent control of the plasma parameters, therefore increasing the experimental possibilities and expected knowledge gain significantly. The experimental setup and the current project status will be presented, as well as selected results of experiments on earth and in parabolic flights, which demonstrate the scientific possibilities of this new laboratory.

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P 22.6 Wed 16:15 Zelt West

Experimental investigation of 3D vortex motion in a dusty plasma — •Matthias Mulsow, Michael Himpel und André Melzer — Institut für Physik, Ernst-Moritz-Arndt-Universität Greifswald, 17487 Greifswald

In low-temperature plasmas micrometer-sized particles are able to form highly ordered structures. Using a harmonic three-dimensional trapping potential strongly coupled finite systems can be created, the Yukawa-balls.

Under certain conditions the particles of such a ball are able to perform a vertical vortex motion, which can be observed by a four-camera stereoscopic system. From the camera images three-dimensional positions and velocities of the individual particles in the vortex can be reconstructed.

By analyzing the three-dimensional dust flow of clusters consisting of 50 to 1000 particles we were able to find a dependency between the vorticity and the cluster size. Furthermore, we identified radial gradients of the ion drag force as a possible drive of the vortex.

This contribution presents the experimental setup we used as well as the characteristics of the investigated vortex motion.