P 11: Complex Plasmas and Dusty Plasmas I

Time: Thursday 11:00–12:30 Location: H4

Invited Talk P 11.1 Thu 11:00 H4

Microfluidic flow in single-layer dusty plasmas — •Peter Hartmann[1] and Truell W. Hyde[2] — [1]Wigner Research Centre for Physics, Budapest, Hungary — [2]CASPER, Baylor University, Waco, TX, USA

Experiments on strongly coupled dusty plasmas provide unique access to the microscopic details of macroscopic processes in condensed matter. Since the early years of this field, the application to hydrodynamic processes was one of the main motivations. In most cases, however, the complexities of the experiments prevented the drawing of universal conclusions. In our experiment, utilizing the control provided by a plane-parallel radio frequency (RF) discharge, two metallic disks are used to form an electrostatic potential channel. Dust particle flow through the channel was induced by indirect laser manipulation, which is essential in order to keep the external effects acting on the particles under control. By adjusting the argon gas pressure and RF power, the channel was tuned to allow the formation of single or multiple lanes of transiting dust particles. We use this system to address fundamental details of microfluidic flows like the acceleration and stopping of particles, lane formation and ordering in the channel, etc.

P 11.2 Thu 11:30 H4

String Formation and Recrystallisation — •E Joshi[1], M Pustylnik[1], M Schwabe[1], H Thomas[1], M Thoma[2], A Lipaev[3], A Zobnin[3], A Usachev[3], and A Ivanishin[4] — [1]Institut für Materialphysik im Weltraum, Deutsches Zentrum für Luft- und Raumfahrt, Weßling, Germany — [2]I. Physikalisches Institut, Justus-Liebig Universität Giessen, Giessen, Germany — [3]Joint Institute for High Temperatures, Russian Academy of Sciences — [4]Gagarin Cosmonaut Training Center, Russia

Plasmas with micrometre sized particles embedded in them where the particles gain high negative charges and become strongly coupled are known as complex plasmas. These complex plasmas can be studied in microgravity conditions using the Plasmakristall-4 (PK-4) facility onboard the International Space Station. Recrystallisation was studied in a complex plasma with string-like structure using the PK-4 lab by turning the plasma off for a fraction of a second to destroy the stringy order, then turning the plasma on again to see how the structure reforms. We characterised the 'stringiness' of the system by the average number of string neighbours at a given time and noted how it changed during the experiment. We then performed molecular dynamics (MD) simulations using Large-scale Atomic/Molecular Massively Parallel Simulator (LAMMPS) to compare with the experiment, and used a Yukawa + wake potential for the interparticle interactions. This lets us mimic the effect of ions in our simulation which led to string formation. We found that the simulations had a good agreement with experimental findings.

P 11.3 Thu 11:45 H4

Video aided 1D Extinction – a novel technique for nanodust density measurements — •Andreas Petersen, Alexander Schmitz, and Franko Greiner — Institut für Experimentelle und Angewandte Physik, Christian-Albrechts-Universität zu Kiel

Extinction measurements are the basis of dust density diagnostics in nanodusty plasmas. Standard techniques are computed tomography (CT) for arbitrarily shaped clouds and Abel inversion (AIN) for cylindrically symmetric dust clouds. For density measurements in a plasma chamber, where no full optical access is possible, we developed a new technique, which utilizes a laser stripe, two CMOS line cameras and one 2D camera. The VaEM method can be used to measure the dust density along a slice through the dust cloud and does not require cylindrical symmetry.

P 11.4 Thu 12:00 H4

High precision in-situ particle size measurement — •Sören Wohlfahrt, Niklas Kohlmann, and Dietmar Block — Institute of Experimental and Applied Physics, Kiel University, Germany

Microparticles are the essential component of a (dusty) complex plasma. The forces affect-ing these particles, as well as their accumulated charge, depend prominently on their size. In addition, the (complex) refractive index of the particles is of importance when optical tech-niques are used for particle manipulation or in-situ diagnostic purposes. Thus, a precise knowledge of these particle parameters is a key input for a quantitative description and modelling. However, in interaction with the plasma the particle properties can change. The size and refractive index of particles can be determined simultaneously with very high preci-sion by means of angle- and polarisation-resolved light scattering (APRLS), which is based on a comparison of experimental data with Lorentz-Mie theory [1]. We will present the time resolved evolution of the size and refractive index of silica (SiO2)- and melamine-formaldehyde (MF) microparticles. Especially the consistency and absolute precision of the measurements as well as the time resolved changes in the refractive index for MF-particles are discussed.
[1] N. Kohlmann, F. Wieben, O. H. Asnaz, D. Block, F. Greiner, Phys. Plasmas 26, 053701 (2019)

P 11.5 Thu 12:15 H4

Charge measurement of SiO_2 nanoparticles in an RF-plasma by IR absorption — •Harald Krüger and André Melzer — Institute of Physics, University Greifswald

Dusty plasmas with nanoparticles have drawn increased attention in the last few years. We have performed measurements of the IR absorption of SiO_2 nanoparticles confined in an argon radio-frequency plasma discharge using an FTIR spectrometer. By varying the gas pressure of the discharge and duty cycle of the applied radio-frequency voltage we observed a shift of the absorption peak of SiO_2. We attributed this shift to charge-dependent absorption features of SiO_2. The charge-dependent shift has been calculated for SiO2 particles and from comparisons with the experiment the particle charge has been retrieved. With the two different approaches of changing the gas pressure and altering the duty cycle we are able to deduce a relative change of the particle charge with pressure variations and an absolute estimate of the charge with the duty cycle.