P 14: Complex and Dusty Plasmas II

Zeit: Mittwoch 11:00–12:40 Raum: HS 20

Hauptvortrag P 14.1 Mi 11:00 HS 20

Plasmas and the tailoring of nanomaterials — •Uros Cvelbar — Jozef Stefan Institute

In the recent direction of research, plasmas are being more and more used for tailoring nanomaterials, and to advance their properties, for example, to make them more efficient in catalysis. The aim is either to find alternative routes for the fast, large-scale synthesis of unique nanomaterials and/or their conversion. Low-temperature plasmas have proven to be a great source for the surface manipulations or supplying building blocks for nanomaterials. Furthermore, the specific plasma-surface interactions are leading to synergistic effects, where very little is understood regarding basic processes taking place. To understand these processes at the atomic scale and mechanisms taking place, we implemented different low-pressure plasma treatments of nanoscale materials such as nanowires or nanoparticles. As results of interactions of various plasma species including electrons or neutral atoms, the intrinsic properties of nanomaterials change. These observations are supported by analytical methods in order to unravel what is occurring on nanomaterial surface or bulk. Through the changes in the crystalline structure of material or reorganisation of its surfaces, the functionality of materials in applications such as gas sensing, liquid purification or similar, are significantly changed.

P 14.2 Mi 11:30 HS 20

Diagnostics and phenomena of three-dimensional dusty plasmas — •Michael Himpel and André Melzer — University Greifswald, Germany

Dusty plasmas are plasmas that contain micrometer-sized particles, which can be individually imaged by modern cameras. In the laboratory, the particles usually sediment to the bottom of the plasma due to the gravitational force where they form flat systems. Many interesting effects, e.g. self-excited waves and certain phase transitions, are only present in volumetric systems. These effects are often related to a critical dust particle number density, which can be exceeded in three-dimensional, but not in two-dimensional systems. This talk will show different possibilities to realize experiments with three-dimensional dusty plasmas and a brief overview about different phenomena is given. Additionally, imaging diagnostics are presented that are capable to retrieve three-dimensional particle trajectories in three-dimensional particle systems.

P 14.3 Mi 11:55 HS 20

Classic textbook experiment on entropy in binary complex plasmas — •Frank Wieben and Dietmar Block — Institute of Experimental and Applied Physics, Kiel University, Kiel, Germany

In physics textbooks a classic example to illustrate the concept of entropy considers two systems that are brought into thermal contact. The change in entropy of the whole system is determined by the initial temperatures and heat capacities of the subsystems and the final temperature. To realize this gedankenexperiment turns out to be difficult since the entropy has to be measured and the two systems have to be brought into contact without creating entropy while removing the barrier itself. In two-dimensional complex plasmas the full phase space information is readily available and thermodynamic phenomena can be studied on the single particle level. In this contribution we reenact this textbook experiment and show that two particle species in a binary complex plasma can serve as two isolated subsystems where the isolation can be switched off instantaneously. Binary complex plasmas contain two particle species of different sizes and materials. The two subsystems are represented by the particle species which attain different temperatures in a laser heating scenario. Due to the nature of the laser forces acting on the particles the temperature ratio can be adjusted by variation of neutral gas pressure. The changes in entropy are determined from phase spaces and results of both experiment and numerical simulation are validated through the heat capacity. This work has been supported by the Deutsche Forschungsgemeinschaft (DFG) in the framework of SFB TR24, Project A3b and Research Grant BL555/3-1.

P 14.4 Mi 12:10 HS 20

Wave transmission across an interface in a complex plasma — •Mierk Schwabe[1], Cheng-Ran Du[2], Wei Sun[2], Li Yang[2], and Hubertus Thomas[1] — [1]Institut für Materialphysik im Weltraum, Deutsches Zentrum für Luft- und Raumfahrt (DLR), 82234 Weßling, Germany — [2]College of Science, Donghua University, 201620 Shanghai, PRC

Complex plasmas consist of low-temperature plasmas with embedded microparticles. The microparticles acquire electric charges of thousands of electrons and strongly interact with each other. Due to their relatively large size and slow speed, their movement can be recorded with digital cameras and traced from frame to frame. Here, we study the propagation of waves across an interface formed between two subclouds of microparticles of different sizes. For this, we use data recorded under microgravity using the PK-3 Plus Laboratory on board the International Space Station, as well as Langevin dynamics simulations of a complex plasma. Firstly, we study how self-excited waves are transmitted across the interface and demonstrate that a collision zone and a merger zone form. Secondly, we study the propagation of a solitary wave across an interface and demonstrate that at low pressures, reflection at the interface can be observed.

P 14.5 Mi 12:25 HS 20

Experimental Studies of Phase Separation in Dusty Plasmas under Microgravity — •Stefan Schütt and André Melzer — Institute of Physics, University of Greifswald, Germany

Dusty plasmas allow to access the dynamical behavior of single dust particles, making them a suitable tool for studying phase separation processes. To prevent the particles from sedimenting in the lower discharge sheath and, hence, to be able to observe three-dimensionally extended systems, measurements are conducted under microgravity conditions on parabolic flights. Binary systems consisting of two particle species exhibit phase separation even for small relative size disparities of about 3%. Particles marked with a fluorecscent dye are used for one of the species. This makes it possible to distinguish between the species despite their small size disparity using a two-camera video microscopy setup and appropriate filters. The availability of high-resolution, high-speed cameras allows to track single particles during the separation process. As the particle number density as well as the flux is available, diffusion coefficients can be determined. In this contribution, measurements conducted on two parabolic flight campaigns are presented. This work was supported by DLR under grant no. 50WM1638.