P 23: Complex Plasmas and Dusty Plasmas II

Time: Thursday 16:30–18:00 Location: ELP 6: HS 3

Invited Talk P 23.1 Thu 16:30 ELP 6: HS 3

Characterizing electron depleted, nanodusty plasmas recent developments and future outlooks — •Andreas Petersen and Franko Greiner — Institute of Experimental and Applied Physics, Kiel University, Kiel, Germany

Although astrophysical issues and research on fundamental questions in the field of dusty plasmas remain topical, the synthesis of nanoparticles with selectable properties has become increasingly popular in recent years. Nanodusty plasmas can be characterized in various ways, but determining multiple parameters simultaneously can be problematic. The analysis of dust density waves enables a comprehensive characterization of all components of complex plasmas by modelling the two-stream instability that occurs in dusty plasmas. The dust density wave diagnostic (DDW-D) is presented and its results are considered in the context of other characterization methods. Additionally, new perspectives are discussed.

P 23.2 Thu 17:00 ELP 6: HS 3

The asynchronous melting process of binary mixtures — •Yang Liu and Dietmar Block — IEAP, Christian-Albrechts-Universität, D-24098 Kiel, Germany

Melting processes in binary mixtures are compared to their single-component counterparts a sophisticated task. Already the collective crystalline behavior within the mixture is poorly understood [1]. The glass-like formation of irregular and stable structures in the mixing region of binary mixtures does not allow to employ methods based on empirical rules derived from topological structures to describe lattice melting issues. This contribution utilizes the local relative interparticle fluctuation (IDF) method to investigate the melting process of finite binary monolayers and its dependence on component concentrations and size differences [2]. Our results indicate that, unlike monodisperse systems, the two components of binary mixtures exhibit asynchronous melting. The individual melting points strongly depend on particle size. Especially the hopping motion of particles, i.e. the fast transition of a particle from a local potential minimum to a neighboring lattice point, is studied in detail. Based on six fundamental particle arrangements and related escape models, i.e. calculations of the energy barriers, the melting process in binary mixtures is discussed.

References

[1] G. Gompper and M. Schick, in Soft Matter, Complex Colloidal Suspensions Vol. 2 (Wiley, Weinheim, 2006).

[2] V. S. Nikolaev and A. V. Timofeev, Physics of Plasmas, 2021, 28(3): 033704.

P 23.3 Thu 17:15 ELP 6: HS 3

Mach cones in Dusty Plasmas under Weigthlessness — •Daniel Maier, Christina Knapek, André Melzer, Daniel Mohr, and Stefan Schütt — Institute of Physics, University of Greifswald, Germany

The concept of the Mach cone is well known from objects moving through air when the velocity of the moving object is higher than the speed of sound. But theoretically a Mach cone can appear in every environment if the velocity of a moving object is higher than the characteristic wave velocity of the surrounding medium.

Accordingly this phenomenon has also be seen in dusty plasmas where micrometer sized particles are added into a low temperature plasma creating a complex system. If now a single particle or a bigger agglomerate of many particles moves through the plasma at a sufficient speed a Mach cone like structure can be observed.

During our last experimental campaign with dusty plasma under weightlessness using a capacitive coupled RF - discharge Mach cone structures caused by particle agglomerates travelling through the plasma were visible. In this contribution first results on the investigations of these Mach cone structures observed with a stereoscopic camera system will be shown.

This project has been funded under the DLR grant 50WM2161.

P 23.4 Thu 17:30 ELP 6: HS 3

Agglomeration, structure and dynamics of binary dust systems — Baoxia Li[1], Yang Liu[2], Hanyu Tang[2], Xiaojiang Tang[1], Eric Guo[2], and •Feng Huang[2] — [1]College of Information and Electrical Engineering, China Agricultural University, Beijing 100083, China — [2]College of Science, China Agricultural University, Beijing 100083, China

Agglomeration and spatial distribution of a binary dusty system formed by dust particles with different sizes were experimentally studied. The agglomeration process of dust particles was characterized by direct micrograph image and the evolution of scattered light as time. The fractal dimension and average particle area in the steady state changing in space were used to show the spatial distribution of the binary dusty system. The effects of temperature and dust particle number on the structure and dynamics of a binary complex plasma system are investigated through two-dimensional (2D) Langevin dynamics simulation. Two kinds of dust particles with different masses are considered in the binary complex system. The particle distribution, Voronoi structure diagram and pair correlation function are used to characterize the system structure. The evolution process of kinetic energy, speed and trajectories of binary particles as time are used to study the dynamical characteristics of the system. The investigations indicate that the structures and dynamics of the binary complex plasma can be obviously affected by system temperature and particle number. This study is helpful for the application of phase separation in practical plasma environment related to different particle species.

P 23.5 Thu 17:45 ELP 6: HS 3

The low-energy electron sticking coefficient of dielectric materials — •Armin Mengel and Franko Greiner — Institute of Experimental and Applied Physics, Kiel University

An important property of surfaces is their interaction with electrons, which often depends on the electron energy. In particular, the electron sticking coefficient affects the plasma-surface interaction, amongst others, and has an impact on dust charging in a plasma. While it can be measured well using electron beams for conducting surfaces or at high energies, this conventional approach fails for dielectric materials at low energies ($< 10\,\mathrm{eV}$). By introducing a micrometer-sized grain of dielectric material into a low-pressure discharge, we can investigate the interaction of the dielectric surface with the ambient electrons of the plasma ($T_e \approx 2...5\,\mathrm{eV}$). Using a relative measurement scheme employing electric particle excitation methods like PRRM or PEOM as well as long-distance microscopy, the sticking coefficient of the dielectric material can then be determined in relation to particles with a conducting surface.