P 13: Dusty Plasmas

Time: Wednesday 16:00–17:15 Location: P-H11

P 13.1 Wed 16:00 P-H11

The sticking machine: measuring electron sticking coefficients using dusty plasmas — •Armin Mengel and Franko Greiner — Institut für Experimentelle und Angewandte Physik, Christian-Albrechts-Universität zu Kiel

In many plasma-surface interactions, the electron sticking coefficient is, due to lack of better knowledge, assumed to be 1. However, recent quantum-mechanical calculations[1] hint at significantly smaller values for dielectric surfaces. The goal of the presented project is to experimentally determine the particle charge and thus (via a relative measurement scheme) the low-energy electron sticking coefficient. In order to achieve this, a new approach using microparticles of the material of interest confined in the sheath of a radiofrequency plasma is introduced, employing long-distance microscopy and an improved phase resolved resonance method.
[1] F.X.Bronold et al., Plasma Phys. Cont. Fusion **59** (2017) 014011, https://iopscience.iop.org/article/10.1088/0741-3335/59/1/014011

P 13.2 Wed 16:15 P-H11

Studying the feasibility to observe turbulence in fluid complex plasmas — •Prapti Bajaj[1], Alexei Ivlev[2], Christoph Räth[1], and Mierk Schwabe[1] — [1]Institut für Materialphysik im Weltraum, Deutsches Zentrum für Luft- und Raumfahrt (DLR) — [2]Max-Planck-Institut für Extraterrestrische Physik

Turbulence is a phenomenon observed in a dissipative system far away from thermodynamic equilibrium with many degrees of freedom and it has been studied in fields varying from microscopic to macroscopic scales[1]. In this work, we study the feasibility to observe turbulence in fluid complex plasmas, i.e., a system of micrometer-sized particles embedded in a low-temperature plasma. We performed an experiment in the ground-based setup of PK-3 Plus, where microparticles were injected in a capacitively coupled RF-plasma chamber and a laser illuminated a vertical cross-section of the microparticle cloud. Below a critical pressure, we observed self-excited Dust Acoustic Waves, which we then used to study the properties of turbulence in our system. These waves are generated due to the ion-streaming instability, i.e., motion of ions past the microparticles. Using high-speed imaging, we were able to track individual microparticles to perform a robust spatial and temporal analysis. We use novel analytical tools to study the energy spectrum in the space and time domains. Our aim is to study the spectrum of short-scale disturbances generated due to the cascade of different wave modes[1], and their isotropisation, even in the presence of a background friction force, as in the case of complex plasmas.
[1] “Wave Turbulence” by S. Nazarenko, Springer(2011).

P 13.3 Wed 16:30 P-H11

Decoupling of dust cloud and embedding plasma for high electron depletion in nanodusty plasmas — •Andreas Petersen, Oguz Han Asnaz, Benjamin Tadsen, and Franko Greiner — Institut für Experimentelle und Angewandte Physik, Christian-Albrechts-Universität zu Kiel

Understanding how dust particles can grow in a reactive plasma discharge and change its behavior, is an interesting topic, since nanoparticles (nps) have become key technological products, e.g. as coatings with tunable optical gap in third generation solar cells, as nanocrystals for photonic applications, and as pharmaceutical nanocarriers.

We have been able, to characterize an argon discharge with embedded amorphous hydrocarbon nps of different size and density, using self excited dust density waves (DDW) as a diagnostic tool.

Our results show, that the comparably high dust density (high Havnes parameter) leads to electron depletion and governs the charge of dust grains, while the size of the particles has only a weak influence on their charge. The ion density and electric potential profile are almost independent of both, dust size as well as dust density. This suggests, that the ion generation and the dust cloud coexist and the coupling of both is weak.

P 13.4 Wed 16:45 P-H11

Stereoscopic Investigation of Particle Chains in Dusty Plasmas — •Daniel Maier, Michael Himpel, Stefan Schütt, and André Melzer — Institut für Physik der Universität Greifswald, Greifswald, Deutschland

In dusty plasmas under microgravity conditions stable chains of charged dust particles can be observed. These chains are stabilized by an outward ion stream and appear near the mid-plane and around the particle free zone (void) of the plasma. So far only 2-dimensional investigations of these chains have been done, with difficulties in proofing the authenticity of a chain, observing it at full length or separating chains from each other. The use of our experimental set-up, with four high-speed cameras allows stereoscopic, 3-dimensional observation and investigation of chains and the interaction of the included particles with high temporal resolution. Here first results of these investigations will be shown.

P 13.5 Wed 17:00 P-H11

Artificial voids in nanodusty plasmas — Ulrike Küst and •Franko Greiner — Institut für Experimentelle und Angewandte Physik, Christian-Albrechts-Universität zu Kiel

Artificial voids are an interesting and frequently studied phenomenon in dusty plasmas [E. Thomas POP 2004, M. Klindworth RSE 2007, O. Arp PRE 2011, M. Schwabe NJP 2017]. Voids are created by projectiles shot into the dust cloud or by electrostatic probes. We investigated artificial voids created in nanodusty plasmas at high electron depletion. By variation of the probe voltage, the size of the void can be varied. The voids are not stable at probe potentials near the local plasma potential. Instead, the whole cloud is destabilized and strong dust streaming is observed. We present a simple force balance that explains the linear increase of the void radius for probe bias variation in the dust repelling regime (negative probe voltage in reference to the plasma potential). The ability to use this force model to estimate the plasma potential and the consequences for credible Langmuir probe measurements in nanodusty plasmas are discussed (see video https://youtu.be/Nmz2nR8uTrE or search the internet for "nanodustcloud").