P 2: Complex and Dusty Plasmas I

Zeit: Montag 11:15–12:45 Raum: HS 20

Hauptvortrag P 2.1 Mo 11:15 HS 20

Diagnostics of nanodusty plasmas — •Franko Greiner and the SFB-TR24 Team — Institut für Experimentelle und Angewandte Physik, Christian-Albrechts-Universität zu Kiel

In plasma technology reactive nanodusty plasmas are widely used. In contrast the basic physics of nanodusty plasmas is only little examined. Nanodusty plasmas can have a very high nanoparticle density and therefore a high degree of electron depletion, i.e., the Havnes parameter is high compared to unity. The diagnostic of nanodusty argon plasmas consisting of ions, electrons and nanoparticles is challenging. When it comes to reactive plasmas, the plasma chemistry plays a major rule and the diagnostic of the multi component plasma is even more challenging. Standard diagnostics like Langmuir probes disturb the plasma and coating of the probe obscures the I(U) characteristic. Optical emission spectroscopy and laser spectroscopy are difficult due to the light scattered or absorbed by the nanoparticles, especially under optical thick conditions.
During the last years we have developed new methods like I-Mie and DDW-D for the diagnostic of nanoparticles and nanodusty plasmas [1]. This talk presents an overview of the available methods and the new insight they give.

[1] F. Greiner et al, Eur. Phys. J. D (2018) 72: **81**
https://doi.org/10.1140/epjd/e2017-80400-7

P 2.2 Mo 11:45 HS 20

Experiments on Surface Floating Potential of Spherical Object in the Magnetized RF Discharge Plasma — •Mangilal Choudhary, M. H. Thoma, R. Bergert, and S. Mitic — I. Physikalisches Institut, Justus-Liebig Universität Gießen

The floating potential of magnetic and non-magnetic spherical probes, which can be used as model of a dust grain, immersed in the magnetized RF discharge plasma are experimentally measured. The discharge is ignited between a transparent indium tin coated (TIO) glass electrode and a metal electrode after applying the 13.56 MHz RF signal. A strong superconducting electromagnet (0 to 4 T) with Helmholtz coils configuration is used to magnetize the plasma spices in the discharge column. The size of spherical probes (r) are taken either in the range or greater than the electron Debye length (λ_{De}). To get the floating surface potential, plasma potential is measured using the emissive probe for the given discharge conditions at which the floating potential of spherical objects or probes is measured. The surface potential of spherical probe first increases (or more negative) at lower magnetic field, attains maximum value at some B-field value and after that it starts to decrease with increasing the magnetic field. The floating surface potential of magnetic spherical probe in plasma is observed to be higher (more negative) than the non-magnetic spherical probe in the presence of magnetic field. The variation of floating potential or negative charges on the spherical probes is understood on the basis of modification of collection currents to the spherical object due to the cross field diffusion in the presence of external magnetic field.

P 2.3 Mo 12:00 HS 20

In-situ Measurements of the Temperature Gradient in Complex Plasmas — •Aleksandr Pikalev, Mikhail Pustylnik, Christoph Räth, and Hubertus Thomas — DLR, Institut für Materialphysik im Weltraum, Gruppe Komplexe Plasmen, Münchener Str. 20, 82234 Weßling

Complex or dusty plasma is a medium containing ionized gas and micron-sized solid particles. The microparticles are sensitive to the thermophoretic force. Thermophoresis is often a disturbing factor in microgravity complex plasma experiments or a way to control the microparticle suspensions. In spite of that, no attempts to measure the temperature gradient in-situ in complex plasma are known in the literature. We present such measurements performed in Ar rf discharge used for complex plasma experiments with the help of laser spectroscopy.

The experiments were performed in the PK-3 Plus chamber, where we could control the axial temperature gradient up to 5 K/cm by heating the bottom electrode. We used tunable diode laser absorption spectroscopy (TDLAS) and laser induced fluorescence (LIF) for the temperature measurement from Doppler profiles. In the case of TDLAS, two parallel laser beams passed through the discharge with a height difference of 1.5 cm. They allowed us to measure line-integrated temperatures at those two positions. The temperature differences could be measured with accuracy better than 0.5 K. The fluorescence was observed with a video camera through a narrow bandpass filter in a direction, perpendicular to the laser beam, hence the temperature could be determined locally in both axial and radial directions.

P 2.4 Mo 12:15 HS 20

Size, density and charge analysis of Al_2O_3 nanoparticles in argon discharges — •Harald Krüger and André Melzer — Institute of Physics, University of Greifswald

Dusty plasmas with nanoparticles have attracted increased attention in the last few years. Beside the existing experimental setups with nanoparticles grown in the rf discharge, we present the insertion of industrial, nanoscaled Al_2O_3 dust with a gas jet injection setup.

The confined particles are being investigated in terms of size and density distribution by a Mie scattering and absorption spectroscopy setup.

Furthermore, theoretical calculations have shown a charge dependent shift in the infrared spectral range of the particles. Existing experiments have already given a proof of concept, but did not show a charge variation due to a low resolution of the FTIR spectrometer yet. Therefore, new experiments with a higher resolution have been carried out and first results will be presented.

P 2.5 Mo 12:30 HS 20

High precision size measurement of microparticles during plasma operation — •Niklas Kohlmann, Frank Wieben, Oguz-Han Asnaz, Franko Greiner, and Dietmar Block — Kiel University, 24098 Kiel, Germany

Besides structural and dynamic processes in complex plasmas, the particles themselves are recently more and more in the focus of research. Important parameters are the particle size, shape and surface topology. However, non-invasive in-situ methods to determine the named parameters during plasma operation are missing. Angle-resolved Mie scattering measurements can fill this gap and provide particle sizes with high precision. An out-of-focus imaging technique similar to Interferometric Laser Imaging for Droplet Sizing (ILIDS) is used to obtain the angle-dependent scattering intensities. Correlating the measured data to those provided by the Lorenz-Mie theory for spherical objects, particle size and refractive index can be obtained. It is shown that the method allows to measure the particle size with an accuracy of a few nanometers if the polarization state of the laser light is taken into account. 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.