P 23: Helmholtz Graduate School for Plasma II

Time: Thursday 14:30–16:25 Location: b302

Fachvortrag P 23.1 Thu 14:30 b302

Investigating structure and dynamics of Yukawa-balls — •Matthias Mulsow and André Melzer — Institut für Physik, Ernst-Moritz-Arndt-Universität Greifswald, 17487 Greifswald

The aim of this talk is to give an overview on our current research in the field of Yukawa-balls. These three-dimensional strongly coupled systems usually consist of less than one hundred micron-sized particles. By using a harmonic trapping potential they form spherical, crystal-like structures in the plasma sheath region.

In order to investigate their structural and dynamical properties, we developed a new experimental setup. Its centerpiece is a segmented confinement ring that provides us with a trapping potential without disturbing the visual observation. By applying electrical potentials to the ring segments it is possible to modulate fluid mode oscillations onto the cluster. With a slightly modified version of the ring the confinement potential can also be switched off in two spacial directions, inducing a uniform expansion of the cluster. The characteristic expansion behavior is then compared with theoretical prediction [1].

Furthermore, as an example of cluster thermodynamics we have studied structural transitions and analyzed them in terms of configurational Shannon entropies and associated specific heat capacities, as proposed in [2].

The talk will present the new methods mentioned above in detail and put them into perspective.

[1] A. Piel and J. A. Goree, Phys. Rev. E 88, 063103 (2013)
[2] H. Thomsen and M. Bonitz, Phys. Rev. E 91, 043104 (2015)

Fachvortrag P 23.2 Thu 14:55 b302

Particle in Fourier Discretization of Kinetic Equations — •Jakob Ameres[1,2] and Eric Sonnendrücker[1,2] — [1]Zentrum Mathematik, Technische Universität München — [2]Max-Planck-Institut für Plasmaphysik, Garching

Particle methods are very popular when it comes to the discretization of kinetic equations. They are easy to implement and embarrassingly parallel. In plasma physics the high dimensionality (6D) of the problems raises the costs of grid based codes, favouring the mesh free transport with particles and its inherent adaptivity by following characteristics. The Particle in Cell (PIC) scheme couples the particle density to a grid based field solver using finite elements or finite differences. Finite elements yield an energy conserving scheme, whereas finite differences exclusively conserve momentum by the absence of particle self force. In this particle mesh coupling the stochastic error appears as noise, while the deterministic error leads to e.g. aliasing, inducing unphysical instabilities. By projecting the particles onto a spectral grid, we derive an energy and momentum conserving, aliasing-free scheme, Particle in Fourier (PIF). This method allows us to investigate the aliasing and stochastic errors of a B-spline based PIC code in case of the turbulent kinetic electrostatic electron nonlinear (KEEN) waves. In electrostatic problems governed by a strong magnetic field the anisotropies are transported along the magnetic field lines. These anisotropies can often be resolved with few Fourier modes. Here, PIF allows for the selective calculation of these relevant field aligned Fourier modes in a tokamak model, hence reducing the computational complexity.

Fachvortrag P 23.3 Thu 15:20 b302

Doppler Coherence Imaging of Ion Dynamics in VINETA.II and ASDEX-Upgrade — •Dorothea Gradic[1], Oliver Ford[1], Tilmann Lunt[2], and Robert Wolf[1] — [1]Max-Planck Institut für Plasmaphysik, D-17491 Greifswald, Germany — [2]Max-Planck Institut für Plasmaphysik, D-85748 Garching, Germany

In magnetically confining plasma experiments, diagnosis of ion flows is of great importance to measure the plasma response to the magnetic field or the exhaust particle flows in the divertor areas. Doppler coherence imaging spectroscopy (CIS) is a relatively new technique for the observation of plasma bulk ion dynamics. It is a passive optical diagnostic enabling line-integrated measurements to obtain 2D images of the ion flow and ion temperature. The general principle is similar to traditional Doppler spectroscopy, however CIS uses an imaging interferometer to perform narrow-bandwidth Fourier spectroscopy.

A major advantage of the coherence imaging technique is the large amount of spatial information recovered. This allows tomographic inversion of the line-integrated measurements. With existing CIS setups, scrape-off-layer and high field side edge impurity flows could be observed in the MAST, core and edge poloidal He II flows in the WEGA stellarator and divertor impurity flows in DIII-D.

The main objective of this study is the research of ion dynamics in the small linear plasma experiment VINETA.II and ASDEX-Upgrade. First Doppler CIS measurements from Ar-II plasma discharges in VINETA.II and He-II, C-III divertor flows in ASDEX-Upgrade and their preliminary interpretation will be presented.

Fachvortrag P 23.4 Thu 15:45 b302

Heavy ion transport in the core of ASDEX Upgrade — •Tomáš Odstrčil[1,2], Thomas Pütterich[1], Clemente Angioni[1], Roberto Bilato[1], Anja Gude[1], Didier Mazon[3], Didier Vezinet[1], and ASDEX Upgrade Team[1] — [1]Max-Planck-Institut für Plasmaphysik, Boltzmannstraße 2, D-85748 Garching, Germany — [2]Physik-Department E28, Technische Universität München, 85747 Garching, Germany — [3]CEA, IRFM F-13108 Saint Paul-lez-Durance, France

High impurity concentration in the core of the future fusion reactors can lead to the serious degradation of the achievable fusion gain. Therefore, a better understanding of the underlying impurity transport processes is necessary for higher performance, more efficient power exhaust and avoidance of impurity accumulation.

Radial impurity transport is mainly driven by neoclassical and turbulent particle fluxes. Both these components show substantial variation depending on the poloidal angle. Consequently, an asymmetry in the poloidal distribution of impurities leads to significant changes in the radial impurity flow and the total content of the plasma core.

The aim of this contribution is to experimentally verify a model describing the poloidal asymmetry of heavy impurities using measurements from ASDEX Upgrade. The observed asymmetries are caused mainly by the centrifugal force and poloidal electric force created by the fast particles produced by intensive ion-cyclotron heating. Finally, a change in the radial transport of the tungsten ions will be presented in the case of large inboard and outboard impurity accumulation.

P 23.5 Thu 16:10 b302

O(^{1}S) formation and loss processes in the terrestrial nightglow — •Olexandr Lednyts'kyy and Christian von Savigny — Ernst-Moritz-Arndt-University of Greifswald, Greifswald, Germany

The retrieval of atomic oxygen concentration ([O]) profiles was performed with help of volume emission rate (VER) profiles calculated from the measured by SCIAMACHY (SCanning Imaging Absorption spectroMeter for Atmospheric CHartographY) emissions of green line nightglow in the MLT (Mesosphere/Lower Thermosphere) region. To reflect complex molecularity of the green line emissions we discussed quenching profiles that correspond to retrieved [O] profiles. The peak of a VER profile is placed approximately at the altitude of the maximum of an [O] profile, where the contributions of the O and O_2 quenching processes are similar. However, the [O]:[O_2] ratio was observed to be low (at lower altitudes, where VER values are proportional to $[O]^3$) and high (at higher altitudes, where VER values are proportional to $[O]^2[M]$) in dependence on pressure and temperature. So, fast collisional relaxation dominate the radiative deactivation of both O_2^* and O(^{1}S) metastable species at low altitudes and vice versa at high altitudes. However, in the [O] retrieval according to the well-known cubic equation it is assumed that laboratory measured reaction rates of quenching processes can be represented in dependence on temperature only. Nevertheless, we applied the extended cubic equation in the [O] retrieval to reflect the pressure and temperature dependence of the laboratory measured reaction rates of quenching processes under atmospheric conditions in the MLT region.