P 12: Helmholtz Graduate School for Plasma Physics I

Zeit: Dienstag 14:00–16:10 Raum: HZO 50

Fachvortrag P 12.1 Di 14:00 HZO 50

3D structure of large dust clouds in dusty plasmas — •Carsten Killer and André Melzer — Insitut für Physik, Ernst-Moritz-Arndt-Universität Greifswald

Dust clouds which fill almost the entire discharge volume can be confined in capacitively coupled radio frequency plasmas. In contrast to many dusty plasma experiments with finite dust clouds, which are studied by observing individual particles, our large dust clouds consist of about 10^6 particles, requiring a more global experimental approach.

In order to investigate the global properties of such a cloud, a plasma chamber with a 360° optical access has been constructed. The 3D dust density distribution is obtained by a computer tomography-like technique, where the line-of-sight integrated light extinction (due to scattering and absorption by the dust particles) is measured from many different angles.

Furthermore, the dust size distribution is investigated with a spatially resolving Mie Imaging technique, which is able to determine the dust size very precisely. The high resolution is achieved by measuring the angle-resolved Mie scattering intensities of illuminated particles over a wide angular range. Using the Mie Imaging technique, interesting effect such as the self-organized de-mixing of slightly differently sized dust particles or variations of the dust size over time (due to dust-plasma interaction) are investigated.

Fachvortrag P 12.2 Di 14:25 HZO 50

Electronic correlations during the neutralization of strontium ions on gold surfaces — •Mathias Pamperin, Franz Xaver Bronold, and Holger Fehske — Institut für Physik, Universität Greifswald, 17489 Greifswald, Germany

Wall recombination of positively charged ions is one of the main surface-based loss processes for positive ions in a low-temperature gas discharge. It thus affects the overall charge balance of the discharge significantly. Depending on the electronic structure of the ion and the wall electronic mixed-valence correlations may lead to an unexpectedly high recombination probability with an anomalous temperature dependence. There is experimental evidence that this is the case for strontium ions hitting a gold surface. Because of its fundamental importance we analyzed this particular charge-transferring atom-surface collision theoretically using an Anderson-Newns model and non-equilibrium Green function techniques. Our results for the neutralization probability do not yet agree with the experimental data quantitatively. The order of magnitude can be however reproduced as well as the tendency of a negative temperature dependence at high temperatures. The projectile's time-resolved spectral densities show moreover a strong enhancement near the Fermi energy, which is a clear indication that mixed-valence correlations are present. Refinements of the theory necessary to bring experimental and theoretical data in better agreement will be discussed. Supported by the DFG through CRC/Transregio TRR24 and the Federal State of Mecklenburg-Vorpommern through the International Helmholtz Graduate School.

Fachvortrag P 12.3 Di 14:50 HZO 50

Dissipation processes in turbulent plasmas: Hybrid Vlasov-Maxwell simulations — •Silvio Sergio Cerri[1], Francesco Califano[2], Frank Jenko[3], and Francesco Pegoraro[2] — [1]Max Planck Institute for Plasma Physics, Garching, Germany — [2]Physics Dept., Univ. of Pisa, Italy — [3]Dept. of Physics and Astronomy, Univ. of California Los Angeles, USA

Turbulence is an ubiquitous phenomenon observed in laboratory, space and astrophysical collisionless plasmas where kinetic effects do play a fundamental role by affecting the turbulent spectrum. In particular, these effects come into play as soon as the ion Larmor scale is approached by the turbulent cascade, entering the so-called dissipation range, on which recent and on-going satellite measurements in the solar wind have focused their attention. This first transition from fluid to ion kinetic turbulence is our main focus. We use a hybrid Vlasov-Maxwell approach (Vespa code) where ions are treated as kinetic and electrons are assumed as a neutralising background massless fluid.

We present a high-resolution numerical study of 2D3V magnetised driven turbulence and a survey of similarities and differences between various regimes is given. One of the main result is the formation of strong current sheets where magnetic reconnection occurs within a turbulent environment. The reconnection events represent a fundamental transition for what concerns the nature of the turbulence as represented by the slope of power-law energy spectra, here covering more than two decades in wave numbers. We also show the formation of plasmoid chains and shocks structures.

Fachvortrag P 12.4 Di 15:15 HZO 50

Computer simulations of the Scraper Element for the nuclear fusion experiment Wendelstein 7-X — •Hauke Hölbe, Thomas Sunn Pedersen, Joachim Geiger, Sergey Bozhenkov, and Yühe Feng — Max Planck Institute for Plasma Physics, Wendelsteinstr. 1, 17491 Greifswald, Germany

The nuclear fusion experiment Wendelstein 7-X (W7-X), located in Greifswald (Germany), will go into operation in a few months (summer 2015). Than W7-X will become the world leading stellarator. The stellarator concept is intrinsically capable of steady state operation while other nuclear fusion concepts based on magnetic confinement such as the Tokamak have to operate in pulsed mode.

In W7-X the plasma-wall interaction will take place at a specifically designed region called the divertor. The divertor itself has regions with different heat load capabilities, the most prominent parts can withstand energy fluxes of up to $10MW/m^2$ in steady state operation (almost the energy flux at the surface of the sun).

Simulations of certain experimental scenarios have shown that the heat flux limit may be exceeded at one special region of the divertor where the cooling capabilities are less strong. There are several options to deal with this challenge. One of them are an additional divertor plate, called the scraper element (SE), that takes up some of the heat load that would otherwise hit and damage the vulnerable region.

The talk is about the effects of an SE in steady state operation as well as the development of new magnetic field configurations to test the SE in an early operational phase.

P 12.5 Di 15:40 HZO 50

Quenching processes in terrestrial nightglow green line and Meinel band emissions in the MLT region — •Olexandr Lednyts'kyy and Christian von Savigny — Ernst-Moritz-Arndt-University of Greifswald, Greifswald, Germany

We consider terrestrial airglow emissions used for remote sensing of the chemical composition of the Earth's upper mesosphere and lower thermosphere (MLT). Atomic oxygen concentration ([O]) profiles were retrieved from $O(^1S\text{-}^1D)$ nightglow emission rates (provided by SCIAMACHY (SCanning Imaging Absorption spectroMeter for Atmospheric CHartographY) on Envisat from August 2002 to April 2012 daily at approximately 22:00 local solar time) according to the 2-step Barth transfer scheme. A comparison between the retrieved [O] profiles and available reference [O] profiles enabled a selection of the most appropriate photochemical model. The Bates-Nicolet mechanism was applied to model the OH Meinel band emission layer in the MLT. The performed modeling confirms the previously considered assumption that collisional quenching of OH* by O causes vertical shifts of the OH layers. The retrieval results show that there is a significant correlation of solar forcing activity with [O] and [OH*] at high altitudes. Chemical reactions involved into both the 2-step Barth transfer scheme and the Bates-Nicolet mechanism were considered with account of quenching processes.

P 12.6 Di 15:55 HZO 50

A Particle in Fourier Method for Field Aligned Gyrokinetic Models — •Jakob Ameres[1,2], Roman Hatzky[1], and Eric Sonnendrücker[1,2] — [1]Max Planck Institut für Plasmaphysik, Garching, Germany — [2]Technische Universität München, Lehrstuhl für Numerische Methoden der Plasmaphysik, Garching, Germany

The gyrokinetic model, which approximates the Vlasov-Maxwell equations by averaging over the gyro-motion, is well suited for the study of turbulent transport in tokamaks and stellarators. Gyrokinetic PIC codes using a finite element field description are known to conserve energy but not momentum. Using the Vlasov-Poisson equations in periodic domains with a purely Fourier based field solver yields a Monte Carlo particle method, Particle in Fourier (PIF), conserving both energy and momentum. Similiar to Fourier filtering techniques on finite elements this also reduces the statistical noise. However, the computational costs per particle are high. But for many problems the total number of physically relevant Fourier modes remains small thus reducing the overall computational effort. In the scope of a field aligned description we derive a field solver, which couples a two dimensional Fourier transform in the torus' angular directions to B-splines over the radial coordinate yielding a hybrid PIC/PIF scheme. We study our solver for a guiding center approximation in polar and cylindrical coordinates, in particular to quantify the stochastical error.