P 11: Invited Talks Windisch, Manz, Loffhagen, Hauser

Time: Wednesday 11:00–13:00 Location: B 305

Invited Talk P 11.1 We 11:00 B 305

Intermittent plasma transport — •Thomas Windisch[1], Olaf Grulke[1,2], and Thomas Klinger[1,2] — [1]Max-Planck-Institute for Plasma Physics, EURATOM Association, 17491 Greifswald, Germany — [2]Ernst-Moritz-Arndt University Greifswald, Germany

The edge turbulence in toroidal fusion devices is characterized by intermittent fluctuations of the density and potential, thereby strongly affecting the transport. This fluctuation-induced transport of plasma particles and energy across the confining magnetic field affects several key reactor issues, e.g., heat and particle fluxes to the first wall, recycling, impurities and Helium ash removal. Experimental results and numerical simulations show that the intermittent bursts in the scrape-off layer (SOL) can be ascribed to large-amplitude self-organized coherent structures, called 'blobs', which propagate radially outwards through the SOL with a velocity of less than one tenth of the ion sound speed typically. A statistical analysis clearly revealed that radially propagating turbulent structures are also observed in the linearly magnetized laboratory experiment VINETA. Their formation is closely related to the primary drift-wave instability and their radial velocity is determined by the E×B-convection due to the self-consistent potential perturbation. In the talk special attention is paid to the evolution of the spatio-temporal dynamics of the turbulent structures across an externally imposed E×B-shear layer. An emissive filament is used to produce a local variation of the radial potential profile, which gives rise to an azimuthally sheared E×B-flow. The nonlinear response of the structure is studied using multi-probe arrays.

Invited Talk P 11.2 We 11:30 B 305

Structure formation in drift-wave turbulence — •Peter Manz, Mirko Ramisch, and Ulrich Stroth — Institut für Plasmaforschung, Universität Stuttgart

Turbulence is studied for more than 250 years. Although famous scientists as Reynolds, Kolmogorov, Heisenberg or Landau worked on this topic, a general mathematical or physical solution could not be found yet. This is because turbulence corresponds to a highly nonequilibrium state, where dynamical processes on micro and macro-scales are closely coupled.

Many current problems in climate, economy and energy research are directly or indirectly related to turbulence. Also for the major part of particle and energy losses in toroidal fusion plasmas turbulence is responsible. Of special interest is the spontaneous generation of transport barriers triggered by azimuthally symmetric, band like shear flows called zonal flows, which can decorrelate the turbulence and absorb energy from the fluctuations. As in rotating geophysical fluids turbulence in magnetically confined plasmas is two-dimensional. Energy cascades from small to large scales such as zonal flows or hurricanes. The contribution will give a general overview of the physical mechanisms active in the turbulent cascades. The fundamental processes are investigated using data from the stellarator TJ-K. The physics of turbulence suppression by sheared flows will be explained by a somewhat different mechanism as the generally expected one.

Invited Talk P 11.3 We 12:00 B 305

Dynamic behaviour of dc discharges — •Detlef Loffhagen and Florian Sigeneger — INP Greifswald, Felix-Hausdorff-Str. 2, 17489 Greifswald, Germany

Motivated by the demand to understand the basic processes and dynamics of gas discharge plasmas and by the advancement of gas discharge applications, modelling has gained increasingly in importance. Different numerical methods are in use to describe theoretically the behaviour of the gas discharge plasma including fluid (or hydrodynamic) models, a fully kinetic treatment as well as so-called hybrid methods. The present contribution deals with the numerical modelling and analysis of weakly ionized low-temperature plasmas by means of time- and space-dependent hybrid methods, which combine a fluid treatment of the plasma species with the solution of the spatially inhomogeneous electron Boltzmann equation. Main aspects of the hybrid method are given and results of its application to study the temporal evolution of spatially one-dimensional plasmas are discussed. In particular, the dynamic behaviour of the column-anode plasma of a neon glow discharge after a short disturbance of the positive column by a laser pulse is analysed from its initiation until reaching steady state. The laser-pulse induced local decrease of the ionization rate causes a strong modulation of the electric field which produces spatial structures of the particle densities and rate coefficients. These structures are closely connected with the nonlocal response of the electron component in the inhomogeneous electric field. They are typical of ionization waves with an anode-directed group velocity and a cathode-directed phase velocity.

Invited Talk P 11.4 We 12:30 B 305

The numerical simulation of diffuse axial magnetic field vacuum arcs — •Andreas Hauser[1], Werner Hartmann[1], Andreas Lawall[2], Roman Renz[2], and Norbert Wenzel[1] — [1]Siemens AG, Corporate Technology, Erlangen, Germany — [2]Siemens AG, Energy Distribution, Berlin, Germany

Vacuum interrupters are central components in medium voltage distribution networks. While having reached a high degree of maturity, the future demands on energy distribution networks require a considerable increase in switching capability due to higher energy densities.

As the arc determines the switching capability to a large extent, it is the understanding and interpretation of the arc, the plasma bulk and its interaction with the contact system, which enables new and more powerful designs. In contrast to gas insulated switchgear, where LTE plasma can be assumed, the physical processes in vacuum arcs during the switching process are still not fully understood.

Although experiments are indispensible, their benefit is limited as not all quantities of interest can be accessed. With the advances in physical modeling and the increase of computational resources the numerical simulation of realistic problems yields further insight.

We present a transient 3D vacuum arc model taking into account realistic external magnetic fields. Moreover, we show the very different scales in time and space of the physical processes observed experimentally and present in the underlying model, which eventually have to be captured and solved numerically.