P 6: Magnetischer Einschluss II

Zeit: Dienstag 14:00–15:45 Raum: HS 3

Hauptvortrag P 6.1 Di 14:00 HS 3

Off-diagonal transport in tokamak plasmas, the bridge from theory to experiments and from microscopic to macroscopic — •Clemente Angioni — Max-Planck-Institut für Plasmaphysik, IPP-EURATOM Association, D-85748 Garching bei München, Germany

In the high temperature plasmas of tokamaks, the dominant part of the radial transport is provided by micro-turbulence, at ion and electron Larmor radius scales. The radial turbulent transport of particles and toroidal momentum is experimentally observed, and theoretically predicted, to be characterized by off-diagonal transport components, which cannot be attributed to the presence of density or rotation gradients respectively. These components are of high relevance for the achievement of fusion energy, since, at a macroscopic level, they determine the radial profiles of density and rotation. Furthermore, they are of extreme physical interest, since they are theoretically predicted to be determined by the characteristics of the micro-turbulence. A combined research, which assesses the correspondence between the observed behaviours of density and toroidal rotation and the theoretically predicted mechanisms of off-diagonal transport, provides an effective approach to shed light on the complex field of turbulence and transport in magnetized plasmas. By this, not only a bridge between theory and experiment is built, but also a correspondence between microscopic properties of the turbulence and macroscopic dependences of the plasma profiles is established. The main results of this research, performed at the Max-Planck-Institut für Plasmaphysik, are presented.

Hauptvortrag P 6.2 Di 14:30 HS 3

MHD Simulations of Edge Localized Modes in ASDEX Upgrade — •Matthias Hölzl[1], Isabel Krebs[1], Karl Lackner[1], Sibylle Günter[1], Guido Huysmans[2], Ronald Wenninger[3], and The ASDEX Upgrade Team[1] — [1]Max Planck Institute for Plasmaphysics, EURATOM Association, Boltzmannstr. 2, Garching, Germany — [2]ITER Organisation, Route de Vinon sur Verdon, St-Paul-lez-Durance, France — [3]Universitätssternwarte der Ludwig-Maximilians-Universität, München, Germany

In the high confinement mode, edge localized modes (ELMs) are observed at the plasma edge. As these may damage wall structures in future fusion devices, a detailed physical understanding is necessary.

We use the non-linear MHD code JOREK to study ELMs in realistic tokamak geometry. Toroidal mode numbers, poloidal filament sizes, and radial propagation speeds agree well with observations for type-I ELMs in ASDEX Upgrade. When a large number of toroidal harmonics is taken into account, a strong localization is found as also observed experimentally in ASDEX Upgrade. In the simulations, harmonics with low toroidal mode-numbers may be driven non-linearly to large energy levels. This is observed already in the early phase of the instability and can be explained by an interaction between several strong harmonics with adjacent toroidal mode numbers.

An outlook onto ongoing work is given. This includes further theory-experiment comparisons and the interaction between ELMs and external perturbation fields. The resistive wall model currently being implemented into JOREK is briefly presented.

P 6.3 Di 15:00 HS 3

Experimental Results and SOLPS-Modeling of H-Mode Detachment in full-tungsten ASDEX Upgrade — •Felix Reimold, Matthias Bernert, Arne Kallenbach, Steffen Potzel, Marco Wischmeier, and the ASDEX Upgrade Team — Max-Planck Institut für Plasmaphysik, Boltzmannstr. 2, 85748 Garching

Detached divertor operation in H-Mode is essential for future fusion reactors to be able to handle the occuring power fluxes into the divertor and to avoid major material erosion of the divertor targets. Complete detachment is characterized by a substantial reduction of plasma pressure along a fieldline from midplane to target across the whole Scrape-Off Layer.

Complete detachment has only been observed at the inner target in the boronized full-tungsten wall tokamak ASDEX Upgrade so far. Recently, stable H-Mode operation with a completely detached plasma at both divertor targets has been achieved by significant nitrogen seeding. The pressure loss along the field line exceeded a factor of ten and the power flux was effectively reduced to negligible levels at both targets simultaneously. Tungsten sputtering at the targets is strongly reduced during detached plasma operation.

This contribution will highlight the experimental results and show the accessible operational space for nitrogen induced detachment in H-Mode. Accompanying SOLPS-modeling of the detachment process will be presented.

P 6.4 Di 15:15 HS 3

Axial flows in expanding arched, plasma-filled flux tubes — •Eve Stenson[1] and Paul Bellan[2] — [1]Max Planck Institute for Plasma Physics, EURATOM Association, Wendelsteinstr. 1, 17491 Greifswald, Germany — [2]California Institute of Technology, Pasadena, CA, U.S.A.

Magnetic flux tubes are significant features in a diverse array of plasma systems, including fusion devices and solar and astrophysical environments. Laboratory experiments are a valuable tool for elucidating the fundamental physics of these structures. Highly dynamic, individual arched flux tubes were created with a magnetized plasma gun and studied with a variety of diagnostics (magnetic probes, dual-gas techniques, spectroscopy, etc.). Bulk flows were found to carry plasma into a flux tube from both footpoints, keeping the density high even as the major radius increased significantly and the axis underwent a kink instability. A pair of complementary MHD models provides a quantitative description of the evolution.

P 6.5 Di 15:30 HS 3

Derivation of Stochastic differential Equations for Scrape-off Layer Plasma fluctuations from experimentally measured statistics — •Abdessamad Mekkaoui — IEK-4 Forschungszentrum Jülich 52428, Germany

A method to derive stochastic differential equations for intermittent plasma density dynamics in magnetic fusion edge plasma is presented. It uses a measured first four moments (mean, variance, Skewness and Kurtosis) and the correlation time of turbulence to write a Pearson equation for the probability distribution function of fluctuations. The Fokker-Planck equation is then used to derive a Langevin equation for the plasma density fluctuations. A theoretical expectations are used as a constraints to fix the nonlinearity structure of the stochastic differential equation. In particular when the quadratically nonlinear dynamics is assumed, then it is shown that the plasma density is driven by a multiplicative Wiener process and evolves on the turbulence correlation time scale, while the linear growth is quadratically damped by the fluctuation level. Strong criteria for statistical discrimination of experimental time series are proposed as an alternative to the Kurtosis-Skewness scaling. This scaling is broadly used in contemporary literature to characterize edge turbulence, but it is inappropriate because a large family of distributions could share this scaling. Strong criteria allow us to focus on the relevant candidate distribution and approach a nonlinear structure of edge turbulence model.