P 1: Helmholtz Graduate School for Plasma Physics I

Time: Monday 11:00–13:05 Location: b302

Fachvortrag P 1.1 Mon 11:00 b302

Non-linear simulations of ELMs in ASDEX Upgrade — •Alexander Lessig[1], Matthias Hoelzl[1], François Orain[1], Sibylle Guenter[1], Marina Becoulet[2], Guido Huysmans[2], and the ASDEX Upgrade Team[1] — [1]Max-Planck-Institut für Plasmaphysik, Boltzmannstrasse 2, 85748 Garching, Germany — [2]CEA-IRFM, Cadarache, 13108 Saint-Paul-Lez-Durance, France

Large edge localized modes (ELMs) are a severe concern for the operation of future tokamak devices like ITER or DEMO due to the high transient heat loads induced on divertor targets and wall structures. It is therefore important to study ELMs both theoretically and experimentally in order to obtain a comprehensive understanding of the underlying mechanisms which is necessary for the prediction of ELM properties and the design of ELM mitigation systems.

Using the non-linear MHD code JOREK, we have performed first simulations of full ELM crashes in ASDEX Upgrade, taking into account a large number of toroidal Fourier harmonics. The evolution of the toroidal mode spectrum has been investigated. In particular, we confirm the previously observed non-linear drive of linearly subdominant low-n components in the early non-linear phase of the ELM crash. Preliminary comparisons of the simulations with experimental observations regarding heat and particle losses, pedestal evolution and heat deposition patterns are shown. On the long run we aim at code validation as well as an improved understanding of the ELM dynamics and possibly a better characterization of different ELM types.

Fachvortrag P 1.2 Mon 11:25 b302

Study of TEM-ITG turbulence transitions using Poloidal Correlation Reflectometry at AUG — •Dmitrii Prisiazhniuk[1,2], Andreas Krämer-Flecken[3], Garrard Conway[1], Peter Manz[1], Tim Happel[1], Ulrich Stroth[1,2], and The ASDEX Upgrade Team[1] — [1]Max-Planck-Institut für Plasmaphysik, Boltzmannstraße 2, 85748 Garching, Germany — [2]Physik-Department E28, Technische Universität München, 85748 Garching,Germany — [3]Institut für Energieforschung - Plasmaphysik,Forschungszentrum Jülich, Association EURATOM-FZJ, 52425 Jülich, Germany

In several tokamaks a linear increase of the energy confinement time of Ohmic plasmas with the line averaged electron density has been reported. However, above a critical density the energy confinement time saturates. The corresponding regimes are named LOC and SOC, respectively. One hypothesis for the transition from LOC to SOC is a change in the dominant drive of the turbulence, from the trapped electron mode (TEM) to the ion temperature gradient (ITG). The main plasma parameters responsible for the change of the transport behaviour are still not identified. The recently upgraded Poloidal Correlation Reflectometer system in ASDEX Upgrade has been used to study the TEM-ITG transition. The system allows the study of turbulence characteristics (perpendicular & radial correlation length as well as the decorrelation time) and its interaction with the mean flow for a wide range of densities. The change of these parameters during the transition from TEM to ITG turbulence will be presented and the role of quasi-coherent structures will be discussed.

Fachvortrag P 1.3 Mon 11:50 b302

Deuterium Implantation into Tungsten at Low Temperature — •Johannes Bauer[1,2], Thomas Schwarz-Selinger[1], Martin Balden[1], and Klaus Schmid[1] — [1]Max-Planck-Institut für Plasmaphysik, Boltzmannstr. 2, D-85748 Garching — [2]Physik-Department E28, Technische Universität München, James-Franck-Str. 1, D-85748 Garching

To study the interaction of hydrogen isotopes with tungsten many experiments are conducted in linear plasma devices, which provide high enough hydrogen fluxes to supersaturate the tungsten sample and create defects such as blister. Here an alternative approach is presented. Instead of achieving a high deuterium concentration via high flux exposure, the sample temperature is reduced and the implantation energy of deuterium into tungsten is increased. The lower temperature associated with a reduction in diffusivity as well as the deeper implantation of deuterium lead to an increase of deuterium concentration within the implantation zone. Deuterium is stepwise implanted into polycrystalline tungsten up to a fluence of 1×10^{22} D/m^2 with an energy of 3.0 keV/D at a sample temperature of 134 K. The retained deuterium is measured in-situ by nuclear reaction analysis. For low fluence approximately 100 % of the implanted deuterium is retained, while for higher fluence the retention saturates. Close to the surface deuterium concentrations up to 64 % are reached. This leads to massive grain orientation dependent blistering with blister sizes between $100 - 1000$ nm at depths between $30 - 150$ nm. Besides the characterization of the blisters their influence on deuterium transport is studied.

Fachvortrag P 1.4 Mon 12:15 b302

High frequency magnetic fluctuations correlated with the inter-ELM pedestal recovery — •Florian M. Laggner[1], Elisabeth Wolfrum[2], Felician Mink[2], Marco Cavedon[2], Mike G. Dunne[2], Gregor Birkenmeier[2], Friedrich Aumayr[1], the ASDEX Upgrade Team[2], and the EUROfusion MST1 Team[2] — [1]Institute of Applied Physics, TU Wien, Fusion@ÖAW, Wiedner Hauptstr. 8-10, 1040 Vienna, Austria — [2]Max Planck Institute for Plasma Physics, Boltzmannstr. 2, 85748 Garching, Germany

In H-mode plasmas, the maximum achievable pressure gradient at the plasma edge (pedestal) is usually set by an ideal MHD limit (peeling-ballooning), which if exceeded is leading to edge localised modes (ELMs), that relax the pedestal. However, the mechanisms setting the final pedestal shape (height and width) are not fully understood. This contribution focuses on the temporal evolution of the pedestal density and temperature profiles. After the maximum pre-ELM pedestal gradients are established a phase that is accompanied by the sharp onset of radial magnetic fluctuations with frequencies larger than 200 kHz is identified. During their presence the gradients of the edge electron density and temperature are clamped. The observed fluctuation frequencies scale with the minimum $E \times B$ velocity at the edge, that is estimated from neoclassical theory, indicating that the underlying modes are located in the steep gradient region. The toroidal mode number (n) of approximately 10 as well as the detection of the fluctuations on the high field side points in the direction of a MHD-type instability with low/high field side symmetric amplitude.

Fachvortrag P 1.5 Mon 12:40 b302

Experimental study of turbulence with the Ultra-fast swept Reflectometer in ASDEX Upgrade — •Anna Medvedeva[1,2,3,4], Christine Bottereau[3], Marco Cavedon[1], Frederic Clairet[3], Garrard D. Conway[1], Stephane Heureaux[2], Diego Molina[3], Antonio Silva[5], Ulrich Stroth[1,4], and AUG Team[1] — [1]Max-Planck-Institut für Plasmaphysik, Boltzmannstraße 2, D-85748 Garching — [2]Université de Lorraine, Nancy, France — [3]CEA, IRFM, St-Paul-Lez-Durance, France — [4]Physik-Department E28, Technische Universität München, Garching, Germany — [5]IST, Lisbon, Portugal

The experimental documentation of density fluctuations and their dependence on plasma parameters provides insights in the nature of turbulence and its driving parameters. In this contribution we will present measurements on the ASDEX Upgrade tokamak of the turbulence characteristics provided by an ultra-fast swept reflectometer with a time resolution as low as 1 μs. The focus will be on the dynamics in the transition from the Low (L) to the High (H) confinement mode which goes through an intermediate (I) phase where turbulence and shear flows strongly interact. I-phases for various plasma conditions are documented and the density gradient evolution is compared with the turbulence level. This investigation is carried out to discriminate between turbulence-driven zonal flows and neoclassically driven shear flows. In addition we present results on high frequency coherent modes appearing at the plasma edge during the H-mode and their link to MHD events (ELMs). The fast density profile dynamics during the ELM cycle is studied in relation to the local turbulence behavior.