P 15: Helmholtz Graduate School V - Magnetic Confinement II

Zeit: Mittwoch 11:00–13:05 Raum: HS 21

Hauptvortrag P 15.1 Mi 11:00 HS 21

Turbulence in the Wendelstein 7-X Stellarator — •Adrian von Stechow for the The Wendelstein 7-X Team-Collaboration — Institut für Plasmaphysik, Greifswald, Germany

A central design goal of magnetic confinement fusion devices is the minimization of heat and particle losses to their walls. The Wendelstein 7-X superconducting stellarator has a neoclassically optimized (and variable) 3D magnetic field geometry, such that turbulent transport can be a major loss channel. These losses are expected from analytical and numerical models to be highly geometry-dependent, both in terms of density and temperature profiles as well as geometrical properties of the field itself, e.g. local flux compression and symmetries such as quasi-isodynamicity. Turbulence in W7-X has therefore been experimentally investigated in the recently completed campaign that demonstrated long pulse operation at high density and triple product using a range of dedicated diagnostics which provide coverage from the plasma core to the scrape-off layer. Comparison of neoclassical transport simulations of plasma profiles with measured ones, as well as radial diffusion coefficient measurements based on particle transport studies suggest that a significant fraction of transport is indeed turbulent. Ion-scale turbulence is generally observed in the confied region, and is shown to be significantly reduced by profile shaping during pellet-fueled discharges while confinement is improved. Gyrokinetic simulations support these findings by showing that ITG and TEM growth rates are minimized when the ion temperature and density gradients are of similar magnitude and spatially overlap.

Hauptvortrag P 15.2 Mi 11:30 HS 21

Reduction of microwave beam quality due to plasma density fluctuations — •Alf Köhn[1], Pavel Aleynikov[2], Lorenzo Guidi[3], Eberhard Holzhauer[1], Omar Maj[3], Emanuele Poli[3], Michael Brookman[4], Antti Snicker[3], Thomas Matthew[5], Roddy Vann[5], and Hannes Weber[3] — [1]IGVP, Universität Stuttgart, Germany — [2]Max-Planck-Institut für Plasmaphysik, Greifswald, Germany — [3]Max-Planck-Institut für Plasmaphysik, Garching, Germany — [4]Institute for Fusion Studies, Austin, Texas — [5]York Plasma Institute, York, U.K.

Microwaves are commonly used in plasma experiments for heating and diagnostic purposes. When passing through the plasma boundary, the microwaves have to traverse an area where significant density fluctuations are known to occur. The beam is disturbed, resulting in reduced heating efficiencies or ambiguous diagnostics results. This is in particular problematic for the stabilization of MHD modes, which requires a highly localized power deposition. Concern has been raised recently if ITER might suffer from this. Here we present full-wave simulations of the interaction of microwaves with a layer of fluctuating plasma density. A novel wave-kinetic equation solver using a statistical description of the turbulence is compared to the full-wave simulations. The broadening of a microwave beam is investigated as a function of the turbulence properties. The possibility of density variations leading to mode-scattering is discussed. Finally, experimental verification of microwave beam broadening caused by edge density fluctuations is presented and compared with simulations for the DIII-D tokamak.

P 15.3 Mi 12:00 HS 21

Edge fast-ion transport study using passive FIDA spectroscopy at ASDEX-Upgrade — •A. Jansen van Vuuren, B. Geiger, P.A. Schneider, A. Jacobsen, K. Mitosinkova, and The ASDEX-Upgrade Team — Max-Planck-Institut für Plasmaphysik, D-85748 Garching, Germany

Good confinement of fast-ions is mandatory in fusion plasmas since these supra-thermal particles are responsible for plasma heating and current-drive. However, instabilities and asymmetries in the magnetic field structure might redistribute fast-ions to unconfined orbits which is of particular importance for fast particles close to the plasma boundary.

A standard technique to obtain radial information on the fast-ion content is fast ion D-alpha (FIDA) spectroscopy, which measures the Doppler shifted Balmer alpha emission resulting from charge exchange reactions between fast ions and donor neutrals. On the one hand, donor neutrals are introduced by neutral beams causing so-called active FIDA radiation. On the other hand, thermal neutrals from the walls yield passive FIDA radiation which contains useful information on the fast-ion density close to the plasma edge.

This talk presents results based on the analysis of passive FIDA radiation. Background neutral densities are calculated with KN1D, with the passive D-alpha emission used as a constraint. Measurements from edge lines of sight show strongly reduced FIDA intensities after edge-localized modes. Forward modelling indicates a reduction in fast-ion density along the lines of sight, since the background neutral density is required to increase to match the passive D-alpha emission.

P 15.4 Mi 12:25 HS 21

Gas balance of Wendelstein 7-X — •Georg Schlisio, Uwe Wenzel, Thomas Sunn Pedersen, and W7X Team — Max-Planck-Institut für Plasmaphysik, Wendelsteinstraße 1, 17491 Greifswald

Wendelstein 7-X is the worlds most advanced stellarator fusion experiment. With its graphite island divertor and steady state magnetic field, it is designed for long pulse operation up to 30 minutes. This requires a continuous fuel cycle of particle input and exhaust. An accounting of all gas sources and sinks is done in a gas balance. A global approach to the gas balance is presented, along with results from the first divertor operation campaign OP1.2.

The effects of different fueling schemes as well as neutral beam heating is considered and evaluated with respect to the gas balance.

The particle output was diagnosed with total pressure gauges and a diagnostic RGA to provide more detailed insight into gas output.

P 15.5 Mi 12:50 HS 21

Towards efficient fuelling control in nuclear fusion devices: investigations at ASDEX Upgrade — •Peter Thomas Lang, Bernhard Ploeckl, and ASDEX Upgrade Team — Max-Planck-Insitut für Plasmaphysik, Boltzmannstr. 2, 85748 Garching, Germany

Efficient fuelling will be a critical task in a future nuclear fusion power plant. Basic requirement of any approach is to establish a plasma core density sufficiently high to harvest ample fusion power. This has to be achieved with high efficiency in order to keep the related burden on the fuel cycle and with respect to the stored reservoir of hazardous fuel low. To develop suitable strategies and useful tools for the emerging control and actuation needs, an ambitious R&D program is carried out at ASDEX Upgrade, a reactor relevant all-metal-wall mid-size tokamak. Particle fuelling in the planned EU-DEMO reactor is assigned to the injection of mm sized pellets composed from solid fuel. Investigations anticipated the multi-purpose challenges in a reactor by trying to establish, with restricted diagnostics capabilities, feedback core density control while keeping the plasma performance high. Simultaneously, the isotopic mixture for optimised burn conditions has to be kept. Pellets proved also useful as probe for physics investigations and auxiliary matter injection needs. Our investigations demonstrated pellet fuelling in the high-density high-confinement regime providing control over the relevant parameters; even synergetic effects have been found improving simultaneously both pellet and plasma performance. However, in this pellet created regime the observed plasma behaviour sometimes significantly deviates from extrapolation-based predictions.