P 2: Magnetic Confinement I

Time: Monday 10:30–12:50 Location: SPA HS202

Invited Talk P 2.1 Mon 10:30 SPA HS202

Die Physik intermittenter Transportprozesse in der Randschicht von Fusionsplasmen — •Gregor Birkenmeier[1], Peter Manz[1], Daniel Carralero[1], Florian Laggner[2], Matthias Willensdorfer[1], Elisabeth Wolfrum[1], Golo Fuchert[3], Ulrich Stroth[1] und das ASDEX Upgrade Team[1] — [1]Max-Planck-Institut für Plasmaphysik, Boltzmannstr. 2, 85748 Garching, Deutschland — [2]Institut für Angewandte Physik, Technische Universität Wien, Österreich — [3]Institut für Grenzflächenverfahrenstechnik und Plasmatechnologie, Universität Stuttgart, Deutschland

In modernen Fusionsexperimenten wird der vom Plasma ausgehende Wärme- und Teilchenfluss parallel zum Magnetfeld gezielt in einen besonders robusten Bereich, den so genannten Divertor, abgeführt. Zusätzlich bilden sich heiße und dichte Filamente, so genannte Blobs, die sich senkrecht zum Magnetfeld vom Plasma ablösen und die Wand im Hauptraum jenseits des Divertors erreichen können. Wie diese Blobs einen signifikanten Beitrag zum Energie- und Teilchentransport in der Randschicht von Fusionsplasmen leisten können, wird in diesem Vortrag diskutiert. In einem Überblick werden aktuelle Blobmodelle vorgestellt und mit Messungen am Tokamak ASDEX Upgrade verglichen. Dafür werden verschiedene Diagnostiken wie Langmuirsonden, schnelle Kameras und die Lithiumstrahldiagnostik eingesetzt, um den Einfluss heißer Ionen und Resistivität auf die Blobdynamik zu studieren. Ziel dieser Untersuchungen ist es, die Rolle der Blobs in reaktorrelevanten Szenarien nahe des Dichtelimits zu klären.

Topical Talk P 2.2 Mon 11:00 SPA HS202

High density operation using pellet fuelling on ASDEX Upgrade — •P.T. Lang[1], M. Bernert[1], L. Casali[1], R. Fischer[1], O. Kardaun[1], G. Kocsis[2], M. Maraschek[1], A. Mlynek[1], B. Plöckl[1], F. Ryter[1], T. Szepesi[2], G. Tardini[1], H. Zohm[1], and ASDEX Upgrade Team[1] — [1]MPI für Plasmaphysik, Boltzmannstr. 2, 85748 Garching, Germany — [2]Wigner RCP, RMI, P.O.Box 49, H-1525 Budapest-114, Hungary

Operating a future fusion reactor at high central densities is needed to maximise fusion power. However, an empirical density limit called Greenwald density n_{Gw} is encountered for gas fuelling. Energy confinement degradation takes place already at about $0.8 \times n_{Gw}$. This limitation can be overcome by injecting mm size pellets of frozen Deuterium. The reason is that the pellets provide a particle source inside the plasma region where a critical density exists. An advanced launching system for efficient pellet fuelling has been developed and is applied at the ASDEX Upgrade tokamak. With this system reliable and reproducible high density operation was demonstrated. Core densities have been achieved up to $1.7 \times n_{Gw}$ in steady state, and up to $4 \times n_{Gw}$ transiently, while keeping the edge density always below n_{Gw}. As an additional benefit, edge localized mode activity, responsible for intense transient heat loads to plasma facing components, can be mitigated in the high density regime. By extending the accessible plasma density range beyond $0.85 \times n_{Gw}$, the conventional energy confinement scaling no longer applies. As this regime is of special interest for the design of future larger tokamak devices, a more refined scaling has been derived.

Topical Talk P 2.3 Mon 11:25 SPA HS202

Characterisation of plasma start-up using ECRH in preparation of W7-X operation — •M. Preynas[1], H. P. Laqua[1], M. Otte[1], T. Stange[1], T. Wauters[2], H.T. Kim[3], D. Assmus[1], H. Igami[4], S. Kado[5], S. Kobayashi[5], S. Kubo[4], T. Mutoh[4], K. Nagasaki[5], T. Shimozuma[4], and Y. Yoshimura[4] — [1]IPP, D-17491 Greifswald, Germany — [2]Ass. Euratom-Belgian State, LPP-ERM/KMS, 1000 Brussels, Belgium — [3]EURATOM/CCFE Fusion Ass., Abingdon, OX14 3DB, UK — [4]NIFS, Toki 509-5292, Japan — [5]IAE, Kyoto University, Japan

Although Electron Cyclotron Resonance Heating (ECRH) is used for pre-ionization and plasma breakdown in both tokamaks and stellarators, a complete theoretical model taking into account all the main physical processes is still missing. The main purpose is to insure reliable plasma start-up in the upcoming operation of W7-X stellarator. In addition to the standard scenario corresponding to on-axis heating in X2-mode, off-axis heating and X3-mode scenarios are also requested to insure plasma operation at lower magnetic field. In order to clarify the dominant physical process in the initial start-up phase governing the breakdown time, dedicated plasma start-up experiments were performed on several stellarators: WEGA, Heliotron-J and LHD. The DYON code, initially developed to simulate plasma burn-through in tokamaks, has been extended for stellarator application. The experimental characterization is presented and compared with first modeling results. Finally, extrapolation for plasma start-up scenario on W7-X is discussed.

P 2.4 Mon 11:50 SPA HS202

Suppression of the runaway electron generation by massive gas injection at TEXTOR — •Andrey Lvovskiy[1], Hans R. Koslowski[1], and Long Zeng[2] — [1]Institute of Energy and Climate Research - Plasma Physics, Forschungszentrum Jülich GmbH, Jülich, Germany — [2]Institute of Plasma Physics, Chinese Academy of Sciences, Hefei, China

Runaway electrons (RE) are a serious threat for the first wall of the ITER tokamak. The mitigation of RE may be an insufficient action for the safety of such large tokamak. A safer approach is to completely suppress the generation of RE in ITER.

Massive gas injection (MGI) may be one of the possible techniques for the suppression of RE generation. However, there is still no clear evidence that MGI effects so.

TEXTOR tokamak is well-equipped for the MGI investigation. A small disruption mitigation valve (DMV) can inject an amount of particles up to 0.25 bar*liter in order to trigger the disruption and reliably generate RE. A larger DMV injects up to 9 bar*liter of Ar, Ne or He to suppress the RE due to collisions. The electron density is measured during disruption by a dispersion interferometer with time resolution of 2 mks for the reference to Connor-Hastie-Rosenbluth density.

The aim of MGI experiments at TEXTOR was to determine the influence of species, amount of injected gas and the time delay between DMVs on suppression of RE generation. The suppression of RE generation in case of sufficient MGI before the current quench has been observed.

P 2.5 Mon 12:05 SPA HS202

Influence of density fluctuations on microwave propagation and mode conversion — •Alf Köhn[1], Eberhard Holzhauer[1], Jarrod Leddy[3], Martin O'Brien[2], Mirko Ramisch[1], Roddy Vann[3], and Thomas Williams[3] — [1]Institut für Grenzflächenverfahrenstechnik und Plasmatechnologie, Universität Stuttgart — [2]EURATOM/CCFE Fusion Association, Culham Science Centre, Abingdon, UK — [3]York Plasma Institute, Department of Physics, York, U.K.

Electron Bernstein waves (EBWs) provide a method to heat over-dense plasmas, which are otherwise inaccessible for electromagnetic waves. EBWs are very well absorbed at the electron cyclotron resonance and their harmonics in high- and low-temperature plasmas. They are of electrostatic nature and need to be coupled to electromagnetic waves injected from the outside. This coupling process usually takes place at the plasma boundary, where large density variations can occur. These variations can significantly distort the microwaves traversing this region. To investigate this interaction, simulations with the full-wave code IPF-FDMC have been performed. In a first step, the influence of a single blob will be discussed. To this end, a Gaussian shaped density perturbation is added to a homogeneous background and the spatial distribution of the electric field of the microwave after the interaction is analyzed. The model is then extended to broadband density fluctuations. Both, the deterioration of the coupling process of the EBW and the general distortion of a traversing microwave beam is investigated.

P 2.6 Mon 12:20 SPA HS202

Tritium concentration monitoring of the purge gas stream of HCPB breeder blankets in future fusion reactors — •Sylvia Ebenhöch — Karlsruhe Institute of Technology (KIT), Institute for Technical Physics (ITEP), Tritium Laboratory Karlsruhe (TLK)

In fusion technology it is necessary to monitor tritiated gases for process monitoring. Such a system should be able to monitor the gas without taking samples. It should also be compact, cheap, the system stability should be excellent and it should recognize changes in the activity fast.

Standard tools for activity measurements are ionization chambers and calorimeters. Ionization chambers work without sample taking but they are gas species dependent. Also pressures in the 100 mbar range are needed. Calorimeters are not suitable to be used as process monitors and it takes several hours to get a result. For activity measurements with a calorimeter it is necessary to extract gas samples.

The Tritium Activity Chamber Experiment (TRACE) is a specially designed prototype to monitor traces of tritium in a gas sample utilizing Beta Induced X-Ray Spectroscopy (BIXS). Future fusion plants like ITER or DEMO could use such a system to monitor the purge gas streams in HCPB breeder blankets.

TRACE will explore the possibility to monitor the expected 10 ppm tritium in the helium purge gas stream. We will evaluate if a BIXS system can be used as a standard monitoring system for tritiated gases in the range of $(10^{-5} - 10^{0})$ mbar tritium partial pressure.

P 2.7 Mon 12:35 SPA HS202

Tritium adsorption and desorption measurement on fusion relevant materials by beta induced spectrometry — •Marco Röllig — Karlsruhe Institute of Technology, ITEP-TLK, Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen

The use of tritium in future fusion power plants has the potential to make a major contribution to a sustainable and secure energy supply. For economic, licensing and safety reasons, tritium confinement in the fusion fuel system must be absolutely assured. Tritium adsorbed on a surface or diffused into a bulk material can escape from the fuel system and is lost for the process. Therefore, tritium confinement can be optimized by the use of materials with low adsorption and diffusion tendency. The Tritium Adsorption Desorption (TRIADE) Experiment is dedicated to investigate the tritium adsorption/desorption on fusion relevant materials by Beta Induced X-ray Spectrometry (BIXS) and mass spectrometry. The experimental setup and first results of the tritium measurements will be presented.