P 15: Invited Talks Mayer, Liang, Wolfrum, Schulz-von der Gathen

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

Invited Talk P 15.1 Th 11:00 B 305
Hydrogen retention in tungsten - from laboratory experiments to ITER — •Matej Mayer, Olga Ogorodnikova, Volker Rohde, Joachim Roth, pwi team, and asdex upgrade team — Max-Planck-Institut für Plasmaphysik, EURATOM Association, Garching, Germany

ITER will use deuterium and tritium as fusion fuels. Both hydrogen isotopes can be retained in plasma-facing materials by implantation, diffusion, and co-deposition with eroded material. The accumulation of tritium is an important safety concern for ITER due to its radioactivity, and the maximum amount of tritium in the vessel is restricted.

A decrease of the retained hydrogen inventory by about one order of magnitude could be demonstrated at ASDEX Upgrade by replacing all plasma-facing components made from carbon by tungsten. Laboratory experiments on hydrogen retention in and permeation through tungsten allow a detailed understanding of the physics of hydrogen behavior in tungsten. Implanted hydrogen atoms can diffuse and are trapped in natural and ion induced defects. Plastic deformations of the tungsten material due to hydrogen accumulation are observed at high fluences.

The combination of laboratory and tokamak data allows a reliable extrapolation to hydrogen retention in ITER, which can be significantly reduced by replacing carbon by tungsten.

Invited Talk P 15.2 Th 11:30 B 305
Active control of tokamak instabilities by resonant magnetic perturbations — •Yunfeng Liang — Forschungszentrum Jülich GmbH, Association EURATOM-FZ Jülich, Institut für Energieforschung - Plasmaphysik, Trilateral Euregio Cluster, D-52425 Jülich, Germany

The standard tokamak H-mode, which is foreseen as the ITER baseline operating scenario, is characterised by a steep plasma pressure gradient and associated increased current density at the edge transport barrier which exceeds a threshold value to drive magnetohydrodynamic (MHD) instabilities referred to as Edge Localized Modes (ELMs). The so-called Type-I ELMs lead to a periodic expulsion of a considerable fraction of the stored energy content onto the plasma facing components. The associated transient heat loads might cause excess erosion and lead to a strong reduction of the plasma facing components lifetime. Active control of ELMs by resonant magnetic perturbation fields offers an attractive method for ITER. D-III D has shown that type-I ELMs are completely suppressed when n = 3 magnetic perturbations are applied. On JET, the type-I ELM frequency rises by a factor of about 4-5 when a low n (1, 2) field is applied. The frequency of the mitigated ELMs is proportional to the input heating power similarly to type-I ELMs, but the controlled ELMs have a higher frequency and are smaller in amplitude. In this paper, an overview of the influence on the plasma confinement and key physics issues related to ELM control with magnetic perturbation fields is given.

Invited Talk P 15.3 Th 12:00 B 305
The latest experimental results for the edge transport barrier in tokamaks — •Elisabeth Wolfrum, Bernd Wieland, Philip Schneider, Andreas Burckhart, Bernd Kurzan, Rainer Fischer, Thomas Puetterich, and ASDEX Upgrade Team — Max-Planck-Institut für Plasmaphysik, EURATOM, Boltzmannstr. 2, 85748 Garching, Deutschland

Improvements to edge diagnostics in terms of spatial and temporal resolution allow a more detailed look at the edge transport barrier, which determines not only the performance in the core of an H-mode (high confinement mode) plasma but also the processes in the region outside the last closed flux surface.

The profiles of electron density, electron and ion temperature, toroidal velocity as well as of the radial electric field show a narrow edge transport barrier, approximately the same width as one poloidal gyroradius. While the electron temperature width changes with plasma pressure, the electron density width does not. The radial electric field exhibits a minimum at the position of the maximum of the ratio of pressure gradient and density, which is in accordance with the radial force balance equation, provided that the perpendicular fluid velocity is small.

An investigation of the temporal development of electron density and temperature profiles in between ELMs, reveals different phases, in which various transport mechanisms dominate. It can be shown, that the gradients of density and temperature develop on different time scales, but influence each other.

Invited Talk P 15.4 Th 12:30 B 305
Physik der Mikroplasmen — •Volker Schulz-von der Gathen — Institut für Experimentalphysik II, Ruhr-Universität Bochum, 44801 Bochum

Mikroplasmen haben in jüngster Vergangenheit aufgrund ihrer Anwendungsmöglichkeiten hohe Aufmerksamkeit erregt. Mikroplasmen werden bei Atmosphärendruck betrieben und haben typische Abmessungen von einigen 10 bis 1000 Mikrometern. Sie sind stark durch Stöße bestimmt. Dennoch haben sie einen ausgeprägten Nicht-Gleichgewichts-Charakter mit hohen Elektronen- aber geringen Gastemperaturen, der durch den Einschluss in kleinen Volumina begünstigt wird. Aufgrund ihrer Dimensionen sind in Mikroplasmen u.a. die Leistungsdichten enorm hoch und es treten sehr hohe elektrische Felder nahe der Oberfläche auf. Die Plasma-Oberflächen- Wechselwirkung ist sehr intensiv. Die Debyelänge schrumpft auf ca. 1 μm, die mittleren freien Weglängen der Spezies sind sehr klein und die Systeme neigen zur Ausbildung von Instabilitäten.

In diesem Beitrag werden an Hand ausgewählter Mikroplasma-Konfigurationen Untersuchungen zum besseren Verständnis ihrer komplexen Dynamik, dem zeit- und ortsabhängigen Transport von Energie, Strahlung und reaktiven Spezies sowie der Plasma-Oberflächen- Wechselwirkung diskutiert. In diesem Zusammenhang werden auch die auf hohe Orts- und Zeitauflösung ausgelegten und mit theoretischer Modellierung kombinierten Diagnostikverfahren vorgestellt.

Die vorgestellten Arbeiten werden im Wesentlichen innerhalb der Forschergruppe FOR1123 "Physik der Mikroplasmen" durchgeführt.