P 5: Plasma Diagnostics

Zeit: Montag 16:30–18:30 Raum: HS Foyer

P 5.1 Mo 16:30 HS Foyer

Validation of current profile diagnostics at ASDEX Upgrade — •Marvin Erdmann[1,2], Alexander Bock[1], Rainer Fischer[1], Valentin Igochine[1], Alexander Mlynek[1], Matthias Reich[1], David Rittich[1], Jörg Stober[1], and the ASDEX Upgrade Team[1] — [1]Max-Planck-Institut für Plasmaphysik, Garching, Germany — [2]Ludwig-Maximilians-Universität München, Munich, Germany

In magnetic confinement fusion, a hot plasma is confined by a magnetic field. This field balances the plasma's kinetic pressure, forming a so-called magnetic equilibrium. In the tokamak ASDEX Upgrade, the profile of the toroidal current and the related poloidal magnetic field are measured by polarimetry of a plasma-induced Faraday rotation of a DCN laser beam and by polarimetry of the Motional Stark Effect-induced polarization of the neutral beam emissions. Both diagnostics provide constraints for the equilibrium reconstruction but also suffer from calibration and background issues.

The goal of this contribution is to examine the accuracy of the equlibrium reconstruction and the agreement of the two diagnostics with the localization of Neoclassical Tearing Modes (NTMs) occuring exclusively on rational magnetic surfaces. The techniques of localizing NTMs and the validation of the two polarimetry diagnostics will be shown. Candidates for systematic uncertainties will be discussed.

P 5.2 Mo 16:30 HS Foyer

Measurement of Two-Dimensional Density and Temperature Profiles in Fully Magnetized RF Plasmas — •Jonathan Schilling, Hendrik Jung, Franko Greiner, and Alexander Piel — IEAP, Kiel University, Germany

Knowledge of the spatial structures of plasma parameters plays a key role in understanding the interplay between the plasma and its surroundings as well as embedded structures like a sputtering target or dust particles. Two-dimensional profiles of the ion density and the electron temperature at magnetic flux densities from 0 T to 4 T have been acquired using a sweeped Langmuir probe attached to a 2D positioning unit in radio frequency (rf) driven capacitively coupled parallel-plate geometry. In the present system, the connection length is in the order of centimeters as opposed to typical fusion devices where it is in the order of meters. The flux tubes can only be refilled via cross-field diffusion of charged particles which acts as a hard limit for the probe current. Since the magnetic field is aligned perpendicular to the rf electrode surface, magnetic flux tubes are electrically connected to the electrodes. This results in strong deformation of the probe characteristics and correct determination of the electron temperature is discussed.
This work was funded by DFG under contract SFB TR-24/A2.

P 5.3 Mo 16:30 HS Foyer

Measurements with microparticles trapped by optical tweezers with and without a plasma — •Viktor Schneider and Holger Kersten — Institute of Experimental and Applied Physics, Christian-Albrechts-University Kiel

Because of their small size (μm to nm) microparticles are used in studies of dynamic processes [1] as well as single probes in plasma sheath diagnostics [2, 3]. A disadvantage in a plasma although is, that they cannot be manipulated in their position as desired.
We present measurements with SiO_2 particles which can be manipulated without any temporal or spatial restrictions. Force measurements in presence of a plasma and without were made by using laser tweezers [4]. Based on the determined forces, the electric field in the sheath can be estimated and residual charges on the particle after turning off the plasma [5] can be obtained.

[1] J. Schablinski et al., Phys. Plasmas 22(2015), 043703
[2] H. R. Maurer et al., Contrib. Plasma Phys. 51(2011), 218-227
[3] A. Douglass et al., J. Plasma Phys. 82(2016), 615820402
[4] V. Schneider, H. Kersten, PAST 1(2013), 164
[5] L. Couëdel et al., Contrib. Plasma Phys. 49(2009), 235-259

P 5.4 Mo 16:30 HS Foyer

Coherence Imaging Spectroscopy Systems on Wendelstein 7-X for studies of island divertor plasma behavior — •Valeria Perseo[1], Ralf König[1], Christoph Biedermann[1], Oliver Ford[1], Dorothea Gradic[1], Maciej Krychowiak[1], Gabor Kocsis[2], Thomas Sunn Pedersen[1], and W7-X Team[1] — [1]Max-Planck-Institute for Plasma Physics, Greifswald — [2]Wigner RCP, Budapest, Hungary

In Wendelstein 7-X (W7-X) the so called "island divertor" concept has been realized in order to exploit the intrinsic magnetic islands structure in the outer region of the plasma for impurity screening. EMC3/EIRENE simulations for W7-X and experiments for W7-AS show that particle friction can dominate over ion thermal force in a regime where divertor plasma detachment is expected, pushing the impurities towards the divertor target, thereby resulting in efficient impurity screening of the core plasma. 2D measurements of impurity flow patterns in the scrape-off layer with coherence imaging spectroscopy (CIS) systems are expected to significantly contribute to the physics understanding of this process. Since the CIS system allows 2D measurement of flow pattern and it has a high optical throughput, it is advantageous respect to a standard spectrometer in terms of amount of information about W7-X 3D geometry, signal to noise ratio and velocity and temperature resolution. The project is now in the design and set-up phase, in order to be able to use two CIS systems for investigating the island divertor plasma behavior at different magnetic configurations during the upcoming W7-X operation phase OP1.2.

P 5.5 Mo 16:30 HS Foyer

Turbulence measurements in the Scrape-Off-Layer of Wendelstein 7-X — •Carsten Killer[1], Olaf Grulke[1], Dirk Nicolai[2], Guruparan Satheeswaran[2], Klaus-Peter Hollfeld[3], Bernd Schweer[2], Olaf Neubauer[2], and W7-X Team[1] — [1]Max-Planck-Institute for Plasma Physics, Greifswald, Germany — [2]Forschungszentrum Jülich, IEK4-Plasmaphysik, Jülich, Germany — [3]Forschungszentrum Jülich, ZEA-1, Jülich, Germany

Turbulent transport in the Scrape-Off-Layer (SOL) is expected to be crucial for the upcoming divertor operation of Wendelstein 7-X. Electric probes are an established tool for both SOL profile characterization and turbulence measurements and are consequently also employed in W7-X. A fast reciprocating probe carrier mounted at the outboard mid-plane allows to scan the entire SOL up to the last closed flux surface. In this contribution, scenarios of probe measurements with respect to turbulence in the SOL of W7-X are explored. Fundamental parameters such as the SOL width and pressure decay length are deduced from profiles of plasma potential, density and temperature which are obtained utilizing sweeping Langmuir probes. A dedicated probe head designed for turbulence studies (comprising radial and poloidal probe arrays and a Mach probe) allows to investigate spectra and the radial-poloidal structure of fluctuations, poloidal and radial electric fields, parallel and perpendicular plasma flows and particle transport. The connection of the probe pins along a magnetic flux tube to other SOL diagnostics allows for benchmarking of results and for studies of the parallel structure and dynamics of turbulent plasma fluctuations.

P 5.6 Mo 16:30 HS Foyer

A new laser blow off system on the W7-X stellarator. — •Th. Wegner[1], B. Geiger[1], R. Burhenn[1], S. Knauer[2], R. Foest[3], and V. Winters[4] — [1]Max-Planck-Institute for Plasma Physics, Greifswald, Germany — [2]Institute of Physics, Greifswald, Germany — [3]Leibniz Institut for Plasma Science and Technology , Greifswald, Germany — [4]University of Wisconsin, Madison, Wisconsin, USA

The impurity confinement in stellarators can lead to impurity accumulation and early pulse termination by radiation collapse. In particular, the impurities in the plasma influence the power balance by increasing the radiation losses and the dilution of the plasma. The investigation of the impurity transport is a demanding task for steady-state operation. Hence a new laser blow off (LBO) system on the W7-X will be used to insert impurities to the plasma edge in a controlled manner. Therefore, a Nd:YAG laser beam is guided through an optical system to the coated glass target which is positioned inside the torus. By using a movable lens and mirror, the position of the laser spot on the glass target as well as its diameter can be varied. Hence, single atoms, clusters, ions as well as electrons can be ablated depending on the coating, the thickness and the laser energy density on the glass target. In OP 1.2, the glass targets will be positioned by means of a multi-purpose manipulator. The transport of the impurity can be studied using differ-

ent diagnostics, e.g., emission spectroscopy. This contribution reports on the design status of the LBO system and the quantitative tests regarding the ablation of the coatings which will be used in OP 1.2.

P 5.7 Mo 16:30 HS Foyer

Development and implementation of an average Z_{eff} measurement for ASDEX Upgrade plasmas — •T. Welzel[1,2], A. Kappatou[2], R. McDermott[2], U. Stroth[2,1], R. Dux[2], R. Fischer[2], T. Pütterich[2], and The ASDEX Upgrade Team[2] — [1]Physik-Department E28, Technische Universität München, D-85748 Garching, Germany — [2]Max-Planck-Institut für Plasmaphysik, Boltzmannstraße 2, 85748 Garching, Germany

The effective charge Z_{eff} is an indicator of the plasma purity. Knowledge of Z_{eff} is important to many physics investigations, however, it is not routinely measured on ASDEX Upgrade. This work aims to develop and implement a fast, automatic and reliable routine measurement of average Z_{eff}. There are two different ways to determine this value. At ASDEX Upgrade, Z_{eff} can be inferred from the individual measurements of the dominant impurities in the plasma. Another approach is to determine the average effective charge via background bremsstrahlung emission measurements, which depend upon the wavelength, electron temperature and density as well as on Z_{eff}. Using other diagnostics to measure the electron density and temperature, Z_{eff} can be calculated. However, the bremsstrahlung emission measurements can be disturbed for example by light reflected on the tokamak wall. The main focus of this work lies in determining suitable measurements of the bremsstrahlung, which will then be used to provide a routine measurement of the average Z_{eff} in ASDEX Upgrade. The Z_{eff} values derived with this method are benchmarked against those obtained by directly measuring the impurity densities in the plasma.

P 5.8 Mo 16:30 HS Foyer

Removal of irritant gas emissions via a dielectric barrier discharge — •Marina Unseld[1,2], Sebastian Dahle[1,2], and Wolfgang Maus-Friedrichs[1,2] — [1]TU Clausthal, Institut für Energieforschung und Physikalische Technologien, Leibnizstraße 4, 38678 Clausthal-Zellerfeld — [2]TU Clausthal, Clausthaler Zentrum für Materialtechnik

We present the use of a dielectric barrier discharge (DBD) for the removal of irritant gases. To study the detailed plasma mechanisms, an experimental set-up was constructed that provides a significant concentration of the irritant gas. The gas stream is analyzed with and without plasma treatment using a commercial system based on a quadrupole mass spectrometer. Comparing results of a direct DBD application, treatments in the afterglow and the sole use of UV radiation gives way to identify the plasma species responsible for the reaction. The DBD is applied to the irritant molecule 1-Sulfinylpropane, which is produced from isoalliin by the enzyme alliinase.

P 5.9 Mo 16:30 HS Foyer

Argon Implantation in Composite Magnetron Targets — •Sascha Monje and Vincent Layes — Ruhr-Universität Bochum, Lehrstuhl für Physik reaktiver Plasmen, Bochum, Deutschland

The implantation of argon in different magnetron targets during reactive and non-reactive HPPMS processes was analyzed by doing an „in-vacuo“ characterization of the targets surface composition using x-ray photoelectron spectroscopy. The used targets were circular Al and Cr targets (50mm diameter), as well as Al@Cr and Cr@Al composite targets, which are built of normal Cr (Al) Targets with a cylindrical Insert of Al (Cr) placed in the middle of the racetrack. The non-reactive investigation was performed in the argon dominated and the selfsputtering dominated Mode. The reactive measurements were done only in argon dominated mode due to limitations of the power supply. The characterization of the plasma discharge was done using a CCD-camera and optical emission spectroscopy (OES) to get basic knowledge for the interpretation of the XPS-Measurements. The XPS-investigation was conducted after in-vacuo transfer of the magnetron target to the XPS-chamber. The distribution of redeposited species on the target surface was evaluated and showed a correlation between the redeposited species from the Insert and the concentration of implanted argon. Furthermore, the reactive measurements showed a direct correlation between surface oxidation and argon implantation. The work was supported by the C7 Projekt of the SFB TR 87.

P 5.10 Mo 16:30 HS Foyer

Investigation of Microarray Plasmas with an adjacent dielecric — •Sebastian Dzikowski[1], Ronan Michaud[2], Remi Dussart[2], and Volker Schulz-von der Gathen[1] — [1]Lehrstuhl für Experimentalphysik II, Ruhr-Universität Bochum, Germany — [2]GREMI, University of Orleans, France

Microplasma pixel devices are interesting for applications such as surface modification. A representative is the metal grid array, which is a stable alternative to silicon-based arrays. They consist of a dielectric, a grounded and a powered electrode with symmetrically arranged cavities. Typically, microplasma arrays are operated close to atmospheric pressure with noble gases like argon and helium. By applying a bipolar triangular voltage waveform with an amplitude of 700 V peak-to-peak and a frequency of 10 kHz, the discharge is ignited in the cavities having a diameter of about 200 and depth of 50 μm. For future applications, such as coating and catalysis, the interaction between the array and a dielectric surface positioned at close distance (< 100 μm) is of great importance. Here, we present the phase dependent expansion of the emission out of the cavities by application of phase resolved optical emission spectroscopy. Optical emission spectroscopy allowed the analysis of argon and nitrogen line ratios for both array configurations.

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