P 28: Helmholtz Graduate School III

Zeit: Donnerstag 14:00–16:30 Raum: HS 1010

P 28.1 Do 14:00 HS 1010

Modelling of Caesium redistribution in the RF negative hydrogen ion source ELISE — •Alessandro Mimo, Christian Wimmer, Dirk Wünderlich, and Ursel Fantz — Max-Planck-Institut für Plasmaphysik, Boltzmannstr. 2, 85748 Garching, Germany

The Neutral Beam Injection systems for ITER rely on large and powerful RF sources of negative hydrogen ions, which are mostly produced by conversion of neutral hydrogen atoms on a converter surface. The conversion efficiency is increased by evaporating Cs in the source, which provides a reduction of the converter surface work function. Experiments have shown that a sufficient flux of Cs onto the converter surface during the beam pulse needs to be provided in order to avoid a reduction of the performance. The dynamics of Cs redistribution in negative ion sources was modeled by means of the Monte Carlo transport code CsFlow3D, which calculates the time evolution of Cs fluxes and coverage onto the source surfaces. Preliminary simulations have shown that the Cs dynamics is influenced by the location of the Cs evaporation nozzle and the amount of Cs present inside the source. This work focuses on the application of the code to the large ion source ELISE, half of the ITER NBI source size. Results of Cs redistribution simulations for different operational parameters, such as the Cs evaporation rate, the duty cycle and the duration of the beam pulse (from ten seconds up to one hour) will be presented and compared with experimental measurements. The results will help to improve the Cs management and to reduce the Cs consumption which is, in particular, of high relevance for a NBI system for DEMO.

P 28.2 Do 14:25 HS 1010

New Massive Gas Injection system for disruption mitigation studies at ASDEX Upgrade — •Mathias Dibon[1,2], Albrecht Herrmann[1], Klaus Mank[1], Vitus Mertens[1], Rudolf Neu[1,2], Gabriella Pautasso[1], Bernhard Ploeckl[1], and ASDEX Upgrade Team[1] — [1]Max-Planck-Institute for Plasmaphysics, Boltzmannstr. 2, 85748 Garching, Germany — [2]Technical University Munich, Boltzmannstr. 15, 85748 Garching, Germany

Tokamak fusion devices rely on a high plasma current (several MA) for magnetic confinement. When the plasma suddenly loses most of its thermal energy due to instabilities, the plasma current disrupts. This leads to high heat loads onto the plasma facing components, large forces on the vacuum vessel due to induced eddy and halo currents in the strong toroidal magnetic field and electrons at relativistic energies. Massive gas injection (MGI) has proven to be an effective tool for mitigating heat loads, induced currents and runaway electrons. For this purpose, the tokamak ASDEX Upgrade has been equipped with a new system of in-vessel fast gas valves which are able to release a strong pulse of noble gas into the vessel within milliseconds (typical flow rate 10^5 Pam^3/s). The system consists of two pairs of valves located on opposite toroidal positions. The first pair is composed of two identical spring-driven valves (max. gas inventory 640 Pam^3), one on the mag. low field side (LFS) and one the high field side (HFS). The second pair includes a piezoelectric valve (210 Pam^3) on the HFS and a spring-driven valve (400 Pam^3) on the LFS. Details on the valve development and the in-vessel setup will be presented.

P 28.3 Do 14:50 HS 1010

Line ratio spectroscopy on thermal helium provides electron temperature and density information at the plasma edge of ASDEX Upgrade — •Michael Griener[1,2], Elisabeth Wolfrum[1], Jorge Muños Burgos[3], Oliver Schmitz[4], Ulrich Stroth[1,2], and the ASDEX Upgrade Team[1] — [1]Max Planck Institute for Plasma Physics, Boltzmannstr. 2, 85748 Garching, Germany — [2]Physik Department E28, TUM, Garching — [3]Department of Physics & Astronomy, Johns Hopkins University, Baltimore, USA — [4]Engineering Physics Department, University of Wisconsin-Madison

In magnetically confined fusion devices large power fluxes cross the last closed flux surface. The local power deposited on the first wall depends strongly on the transport perpendicular to the magnetic field lines. It can be dominated e.g. by filamentary structures or turbulence. To investigate steady-state as well as fast transport processes, a thermal helium beam has been implemented as plasma edge diagnostic at the ASDEX Upgrade experiment. Helium emission intensity ratios of two singlet lines combined with a collisional radiative model (CRM) enable the reconstruction of electron density values, whereas singlet-triplet ratios provide the electron temperature.
In this talk, the physical principle as well as the hardware components of the He-diagnostic will be presented. The measured absolute emission intensity profiles of several He I transitions are compared to the calculated values of two CRMs. One is based on equilibrium assumptions, the other models the time evolution of the two spin systems. This influence on the resulting n_e and T_e profiles is discussed.

P 28.4 Do 15:15 HS 1010

Argon LIF Measurements in a high-power helicon discharge — •Nils Fahrenkamp, Birger Buttenschön, and Olaf Grulke — Max Planck Institute for Plasma Physics, 17491 Greifswald, Germany

The laser-induced-fluorescence (LIF) method is a widely used non-invasive technique to gain information about the velocity distribution, temperature and density of plasma ions and the neutral gas. It has often been speculated that neutral gas pumping represents an important mechanism limiting the plasma density in high-power helicon discharges. Prometheus-A is an extremely high-power helicon discharge using multiple, spatially distributed helicon antennas to achieve rf power densities up to $P_{rf} \leq 100\,MW/m^{-3}$. The peak plasma density shows a transient behavior over the discharge and decreases with a typical time scale of $\approx 1\,ms$, which indicates the importance of the neutral gas inventory. LIF is used to measure the radial neutral gas and ion density profile with high temporal resolution. Detailed measurements of the neutral pumping effect for various operation parameters and neutral gas inlet options are presented with special emphasis on its effect on the peak metastable density and the plasma density dynamics. The results are compared with a zero dimensional reaction rate model developed for low temperature argon plasmas and plasma density measurements of a CO_2-interferometer setup. Calculations of temporally resolved radial electron temperature profiles are shown using atomic line intensity ratio measurements.

P 28.5 Do 15:40 HS 1010

Interpretation of the Electron Cyclotron Emission of hot thermal and non-thermal ASDEX Upgrade plasmas — •Severin S. Denk[1,2], Rainer Fischer[1], Joan Decker[3], Omar Maj[1], Stefan K. Nielsen[4], Morten Stejner[4], Emanuele Poli[1], Jörg Stober[1], Ulrich Stroth[1,2], Wolfgang Suttrop[1], Branka Vanovac[5], Egbert Westerhof[5], Matthias Willensdorfer[1], and The ASDEX Upgrade Team[1] — [1]MPI für Plasmaphysik, Garching, Germany — [2]Physik-Department E28, TUM Garching, Germany — [3]EPFL, Centre de Recherches en Physique des Plasmas Lausanne, Switzerland — [4]Department of Physics, DTU, Lyngby, Denmark — [5]FOM-Institute DIFFER, Eindhoven, The Netherlands

The electron cyclotron emission (ECE) diagnostic is a well established and robust instrument for the measurement of the electron temperature T_e. However, the conventional interpretation of ECE measurements is inaccurate near the plasma edge, for $T_\mathrm{e} > 7\,\mathrm{keV}$, and for plasmas with fast electron populations. It will be shown that these limitations can be overcome if the electron cyclotron radiation transport is integrated in the analysis of the ECE measurements. For hot plasmas the accuracy of the radiation transport model could be greatly improved, by extending the model with a fully relativistic absorption coefficient, where the dispersion of the plasma is considered in the cold plasma limit. Furthermore, the model allows the ECE by fast electrons to be estimated. Moreover, models predicting the formation of fast electron populations will be compared with experimental observations.

P 28.6 Do 16:05 HS 1010

Acceleration of Bayesian Model Based Data Analysis for W7-X Density and Temperature Profiles — •Humberto Trimino Mora[1], Jakob Svensson[1], Andreas Werner[1], Oliver Ford[1], Sergey Bozhenkov[1], Dirk Timmermann[2], Robert Wolf[1], and W7-X Team[1] — [1]MPI für Plasmaphysik — [2]Rostock University

Density estimation for plasma analysis and control is a crucial element in magnetic confinement devices. Most of these have redundant density diagnostics to compare or calibrate; meaning that data from two different diagnostics measuring the same plasma parameter are available. Although the data is typically analyzed separately, a good solution

for data fusion of two or more diagnostics is Bayesian data analysis. This allows estimation of specific parameters and their uncertainties for non-linear inverse problems in a strictly mathematical way.
The computation time and power required for the aforementioned problem is usually long, making it a post-processing technique that cannot be used in real time with rare exceptions.
This contribution proposes a design to accelerate data fusion of the W7-X Dispersion Interferometer's line integrated electron density with the Thomson Scattering's electron density and temperature along congruent lines of sight. This in order to provide in real time, a temperature profile and a more reliable density profile. The proposed design is implemented with reconfigurable hardware taking advantage of application specific circuits and parallelism to improve its processing time. An acceleration of Bayesian analysis for inverse problems is often necessary and would prove generally valuable for scientific inference.