P 9: Helmholtz Graduate School 2 and Magnetic confinement 2

Time: Tuesday 14:00–16:10 Location: b305

Invited Talk P 9.1 Tue 14:00 b305

The Wendelstein 7-X Scrape-Off Layer — •Carsten Killer and W7-X Team — Max-Planck Institut für Plasmaphysik, Greifswald, Germany

The stellarator Wendelstein 7-X employs the island divertor concept, where the intersection of out-flowing plasma by the divertor takes places in a chain of large, intrinsic magnetic islands. The Scrape-Off Layer (SOL) formed by the magnetic islands is inherently three-dimensional and features rather long connections lengths of typically several 100 m. Understanding the transport processes in the SOL is essential for controlled high performance plasma operation since the SOL profiles formed by the relation of parallel and perpendicular transport ultimately govern the heat flux distribution on the targets.
Using a multi-diagnostic approach with a focus on reciprocating probes, we show that the magnetic islands significantly affect the SOL plasma. Most notably, a strong poloidal plasma rotation along the islands' magnetic flux surfaces is observed, which is accompanied by rather flat or even hollow profiles of electron temperature and density across the islands, resulting in a large SOL width (∼5 cm). Outside the islands, the SOL reveals similarities (e.g. exponentially decaying profiles) and differences to a typical tokamak SOL. A particular focus is laid on blob-filaments, which are found to have much slower radial propagation velocities in W7-X than in tokamaks. The reasons for and implications of this observation will be discussed.

P 9.2 Tue 14:30 b305

SOLPS simulations for alternative divertor configurations in the future upper divertor in ASDEX Upgrade — •Ou Pan[1,2], Tilmann Lunt[1], Marco Wischmeier[1], David Coster[1], Ulrich Stroth[1,2], and The ASDEX Upgrade Team[1] — [1]Max-Planck-Institut für Plasmaphysik, 85748 Garching, Germany — [2]Physik-Department E28, Technische Universität München, 85748 Garching, Germany

High heat loads on the plasma facing components of tokamak divertors impose serious constraints on the achievable performance of future fusion reactors. ASDEX Upgrade (AUG) recently decided the upgrade of its upper divertor to study alternative divertor configurations (ADCs) which are currently discussed as a possible solution for the power exhaust problem. Validated by recent AUG experiments in upper single null (SN) configuration, the SOLPS code was applied to extrapolate the performance of the X-divertor and snowflake configurations in the future upper divertor. With the same heating, fueling and impurity seeding, as well as similar parameter profiles at the outer mid-plane, the simulations predict a much lower target power load in ADCs than that in SN configuration. This is explained by a larger radiation volume and an enhanced volumetric recombination rate in such ADCs. Simulations with drifts show a modified cross-field transport and the activation of a secondary strike point.

P 9.3 Tue 14:55 b305

Scrape-off layer (SOL) power width scaling and correlation between SOL and pedestal gradients across L, I and H-mode plasmas at ASDEX Upgrade — •Davide Silvagni[1,2], Thomas Eich[1], Michael Faitsch[1], Tim Happel[1], Bernhard Sieglin[1], Pierre David[1], Luis Gil[3], Ulrich Stroth[1,2], and the ASDEX Upgrade team[1] — [1]Max-Planck-Institut für Plasmaphysik, Boltzmannstr. 2, 85748 Garching, Germany — [2]Physik-Department E28, Technische Universität München, James-Franck-Str. 1, 85748 Garching, Germany — [3]Instituto de Plasmas e Fusão Nuclear, Instituto Superior Técnico, Universidade Lisboa, PT

A cross-regime (L-mode, I-mode, inter-type-I-ELM H-mode and stationary ELM-free H-mode) database combining scrape-off layer (SOL) power decay length λ_q divertor measurements and upstream SOL electron pressure, temperature and density decay lengths has been assembled at ASDEX Upgrade. It is found that a cross-regime λ_q scaling is best described by a local edge quantity, such as the edge electron pressure evaluated at $\rho_{\mathrm{pol}} = 0.95$. Furthermore, λ_q exhibits a clear correlation with edge electron pressure gradient lengths, no matter if taken inside or outside the separatrix. In addition, the database reveals that SOL and pedestal electron pressure gradients are remarkably well correlated across all confinement regimes. Moreover, it is shown that the Spitzer-Härm electron conduction regime is a reasonable approximation to estimate λ_q across different confinement regimes. The main implication of these findings is that in these regimes a widening of λ_q is linked to a reduction of edge electron pressure gradients.

P 9.4 Tue 15:20 b305

Quantitative investigation of the neutron production in ASDEX Upgrade — •Monika Koleva[1,2], Giovanni Tardini[1], Hartmut Zohm[1], and The ASDEX Upgrade Team[1] — [1]Max-Planck-Institute for Plasma Physics, Garching bei München, Germany — [2]LMU, München, Germany

A detailed ASDEX Upgrade geometry has been implemented in the MonteCarlo neutron transport code Serpent, the reference for a new absolute calibration of the neutron counters. The code allows the description of 3D geometries imported from CAD.

The experimental technique consists of a toy train carrying a radioactive source at two radial positions inside the tokamak vessel on the equatorial plane, allowing a long calibration time.

The current simulation scenario uses a neutron point source and looks at the output of the Helium-3 neutron detector. This is a prior step to including a radioactive source with an energy distribution and aims to test as well the detector response. The energy of the source has been varied between 0.025 eV and 4 MeV. A convergence assessment with respect to the total number of neutrons run is shown, ranging from 10E4 to 10E7. Taking vessel components but no moderation into account the detector already calculates about 1 n/s which is close to the experimental result. Further clarification is still in progress. The next step is providing a moderator and simulating also the BF3 and scintillation detectors at ASDEX Upgrade.

In addition, preliminary results of the discrepancies between the experimental neutron rate and the one predicted by TRANSP are shown.

P 9.5 Tue 15:45 b305

Assessment of plasma edge transport in Neon seeded plasmas in disconnected double null configuration in EAST — •Dieter Boeyaert[1,3], Sven Wiesen[1], Marco Wischmeier[2], Wouter Dekeyser[3], Stefano Carli[3], Liang Wang[4], Fang Ding[4], Kedong Li[4], Yunfeng Liang[1,4], Martine Baelmans[3], and EAST -team[5] — [1]Forschungszentrum Jülich GmbH, Institut für Energie- und Klimaforschung - Plasmaphysik, 52425 Jülich, Germany — [2]Max-Planck-Institut für Plasmaphysik, Boltzmannstraße 2, 85748 Garching, Germany — [3]KU Leuven, Department of Mechanical Engineering, Celestijnenlaan 300, 3001 Leuven, Belgium — [4]Institute of Plasma Physics, Hefei 230031, China — [5]see appendix of Wan B.N. et al., Nucl. Fusion 2019

Power and particle exhaust are key for future nuclear fusion reactors [1]. Dissipation is determined by the amount of power, particle and momentum losses inside the Scrape-Off Layer (SOL). Under high power conditions in future all-metal fusion devices like ITER or DEMO, extrinsic impurity seeding is required to induce divertor detachment through impurity radiation [1].

This contribution analyzes Ne seeded and unseeded DDN deuterium discharges at EAST with decreasing separation between the separatrices, both with experimental data from EAST and SOLPS-ITER simulations [2]. Ne seeded discharges in H-mode from the 2019 EAST campaign are studied (heating power P_heat = 2.5 MW, plasma current I_p = 0.4MA, and toroidal field B_p = 2.4T). [1] M. Wischmeier et al., Nucl. Mater. 2015 [2] S. Wiesen et al., Nucl. Mat. 2015