# P 6: Magnetic Confinement III & Helmholtz Graduate School II

Time: Tuesday 16:30–17:50 Location: H5

**Invited Talk** P 6.1 Tue 16:30 H5

**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 parallel connection lengths of typically several 100 m, adding additional transport channels and complexity compared to a typical tokamak SOL. 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, the islands result in a very wide SOL ($\sim$5 cm) with flat or even locally hollow/peaked profiles of $T_e$ and $n_e$ across the islands. In addition, the islands affect parallel and poloidal plasma flows. Finally, the role of turbulent radial particle transport is found to be smaller in the W7-X SOL compared to tokamaks.

P 6.2 Tue 17:00 H5

**GENE-X: A Gyrokinetic Turbulence Code for the Edge and Scrape-Off Layer** — •Dominik Michels[1], Andreas Stegmeir[1], Philipp Ulbl[1], Frank Jenko[1,2], and the ASDEX Upgrade Team[3] — [1]Max Planck Institute for Plasma Physics, Boltzmannstraße 2, 85748 Garching, Germany — [2]University of Texas at Austin, Austin, TX 78712, USA — [3]See author list of Meyer H et al 2019 Nucl. Fusion 59 112014

Plasma turbulence in the edge and scrape-off layer is characterized by steep gradients and large fluctuation amplitudes. As such, nonlinear effects caused by the coupling between the plasma background and fluctuations are important and a so called full-$f$ treatment of the underlying equations is necessary. Furthermore, the poloidal magnetic field vanishes at the X-Point of a tokamak – which introduces a coordinate singularity in the commonly used flux coordinates.

To tackle these problems we have created the gyrokinetic turbulence code GENE-X [1], a new version of the established GENE [2] code. GENE-X implements a full-$f$ gyrokinetic model and is able to perform simulations in single-null, double-null as well as other advanced divertor geometries by using the flux coordinate independent approach [3]. We present a careful verification of the GENE-X code and demonstrate its ability to simulate gyrokinetic turbulence in single null geometry at the example of ASDEX Upgrade.

[1] F. Jenko et al., Phys. Plasmas 7 (2000) 1904
[2] D. Michels et al., Comput. Phys. Commun. 264 (2021) 107986
[3] F. Hariri et al., Comput. Phys. Commun. 184 (2013) 2419

P 6.3 Tue 17:25 H5

**Core plasma density fluctuations in Wendelstein 7-X ECRH plasmas** — •Jan-Peter Bähner[1], Jorge A. Alcusón[1], Søren K. Hansen[2], Håkan M. Smith[1], Adrian von Stechow[1], Zhouji Huang[2], Eric M. Edlund[3], Miklos Porkolab[2], Olaf Grulke[1,4], and The W7-X Team[1] — [1]Max-Planck-Institute for Plasma Physics, Greifswald, Germany — [2]MIT Plasma Science and Fusion Center, Cambridge, MA, USA — [3]SUNY Cortland, Cortland, NY, USA — [4]Technical University of Denmark, Kongens Lyngby, Denmark

Ion-scale turbulence is thought to be the main driver for anomalous transport in the optimised stellarator Wendelstein 7-X (W7-X). The most important instabilities on this scale are the ion-temperature-gradient (ITG) mode and the trapped-electron mode (TEM). The Phase Contrast Imaging (PCI) diagnostic measures line-integrated density fluctuations throughout the plasma core with temporal and wavenumber resolution spanning the ITG and TEM scales. In edge-fuelled, electron cyclotron heated discharges, a localisation of density fluctuations to approximately 75% of the plasma minor radius is shown experimentally via a match of the dominant measured phase velocity of fluctuations to the profile of the $E \times B$ rotation velocity and via gyrokinetic simulations with GENE. The localisation and characteristics of the measured fluctuations and gyrokinetic simulations match the expectation of ITG dominated turbulence in W7-X. The dynamic evolution of multiple phase velocities connected to a qualitative change of turbulence during improved confinement after pellet injection as well as low frequency oscillations reminiscent of ZFOs are presented.