P 9: HEPP III

Time: Tuesday 14:00–16:05 Location: ELP 6: HS 3

P 9.1 Tue 14:00 ELP 6: HS 3

Integrated modelling of impurity transport in ASDEX Upgrade — •Daniel Fajardo[1], Clemente Angioni[1], Ralph Dux[1], Emiliano Fable[1], Giovanni Tardini[1], and the ASDEX Upgrade Team[2] — [1]Max-Planck-Institut für Plasmaphysik, Garching, Germany — [2]see author list of Stroth *et al* 2022 *Nucl. Fusion* **62** 042006

Impurities play crucial roles in fusion devices, from the deleterious fuel dilution and radiative cooling of the core to the beneficial edge cooling for safe power exhaust. Predicting their behavior and effects becomes essential as tokamaks approach reactor operation. We present an integrated framework that demonstrates multi-species, multi-channel modelling capabilities for the prediction of impurity density profiles and their feedback on the main plasma through radiation and dilution. It combines all presently known theoretical elements in the local description of quasi-linear turbulent and collisional transport.

The workflow reproduces ASDEX Upgrade experimental results in L-mode and H-mode, with full-radius and core simulations, respectively. In particular, predictions of a radiative L-mode with one seeded (Ar) and two intrinsic (B, W) impurities match its measured radiated power and H-mode-like confinement. Likewise, the control of W accumulation with ECRH and ICRH in NBI-heated H-mode plasmas is studied in dynamical simulations of experiments featuring wave heating power steps, finding good agreement with the measured W peaking.

P 9.2 Tue 14:25 ELP 6: HS 3

Shattered pellet injection experiments performed at ASDEX Upgrade — •Paul Heinrich[1], G. Papp[1], M. Bernert[1], P. de Marné[1], M. Dibon[2], S. Jachmich[2], M. Lehnen[2], T. Peherstorfer[3], N. Schwarz[1], U. Sheikh[4], B. Sieglin[1], J. Svoboda[5], and the ASDEX Upgrade team[6] — [1]Max-Planck-Institut für Plasmaphysik, Garching, Germany — [2]ITER, St. Paul-lez-Durance, France — [3]TU Wien, Wien, Austria — [4]EPFL, Lausanne, Switzerland — [5]IPP CAS, Prague, Czech Republic — [6]See author list of U. Stroth et al. 2022 NF 62 042006

Future fusion devices like ITER, which are based on the tokamak concept, require a disruption mitigation system (DMS) to ensure machine protection. While the fusion reactions will naturally come to a hold within a fraction of a second in an unforeseen event causing a disruption, this can cause large forces and heat loads on the structure which might damage the device. In order to support the design of the ITER disruption mitigation system, a highly flexible shattered pellet injection (SPI) system was installed at the tokamak ASDEX Upgrade. Hereby, frozen pellets of deuterium, neon or a mixture thereof, are injected into the plasma to isotropically radiate the confined energy. Optimized mitigation is investigated by variation of the pellet parameters (e.g. size, velocity) or shatter geometry. The injection parameters are found to have a stronger impact on material assimilation, while the radiation characteristics are dominated by the pellet composition. A system overview as well as first analysis results for the experimental campaign – with focus on the radiation characteristics – are presented.

P 9.3 Tue 14:50 ELP 6: HS 3

Exploring the influence of plasma triangularity on pedestal stability and structure in ASDEX Upgrade — •Lidija Radovanovic[1], Elisabeth Wolfrum[2], Mike Dunne[2], Tobias Görler[2], Georg Harrer[1], Facundo Sheffield Heit[2], Friedrich Aumayr[1], and The ASDEX Upgrade Team[3] — [1]Institute of Applied Physics, TU Wien, 1040 Vienna, Austria — [2]Max Planck Institute for Plasma Physics, 85748 Garching, Germany — [3]See author list of U. Stroth et al. 2022 Nucl. Fusion 62 042006

The confinement and the performance of a tokamak plasma in the high confinement regime are closely related to the structure of the pedestal. One possible factor limiting the pedestal width is the onset of instabilities, kinetic ballooning modes (KBMs), at the top of the pedestal, which we approximate by local ideal ballooning modes (IBMs). The stability of these modes can be altered by varying the plasma shape. To determine the role of local IBMs at the pedestal top, other possible instabilities present in the pedestal top are analysed with the local linear version of the gyro kinetic code GENE and compared with the shearing rate. The results show that different physical mechanisms influence the pedestal width of the electrons and ions with respect to their density and temperature. Particularly, the electron pressure pedestal top strongly correlates with the minimum in ballooning stability. The objective of this study is to link physical processes in frameworks of MHD, transport and gyro kinetics with the experimentally observed pedestal structure.

P 9.4 Tue 15:15 ELP 6: HS 3

Properties of Tungsten Particles Produced by Arcing — •Albertto Castillo Castillo[1,2], Martin Balden[2], Volker Rohde[2], Peter Siemroth[3], Michael Laux[3], Heinz Pursch[3], Juergen Sachtleben[3], and Rudolf Neu[1,2] — [1]Technische Universität München, 85748 Garching, Germany — [2]Max-Planck-Institut für Plasmaphysik, 85748 Garching, Germany — [3]retired, was with Arc-Precision GmbH, 15711 Königs Wusterhausen, Germany

Metal droplet emission by arcing is one of the mechanisms generating dust in a magnetic confinement fusion device. Tungsten droplet production is of particular interest for full tungsten wall devices. The potential of a droplet to introduce impurities in the plasma depends on its velocity, diameter, and angle. The distributions of these parameters has been measured in a dedicated device with multiple independent methods in order to provide useful data to evaluate their effect on plasma operation.

In a addition to a time-of-flight detection system based on light scattering by droplets to measure their size, velocity and angle, a high-speed camera was added to record videos of the flying droplets. Dedicated software was developed to track the trajectories in the video, and fitting the thermal radiation curves to a model of the cooling of particles allows measurement of diameter and initial temperature. This first measurement of initial temperatures reveals that a significant fraction of particles are ejected in a solid state. This is supported by microscopy analysis of the particle deposition showing non-spherical particles.

P 9.5 Tue 15:40 ELP 6: HS 3

Spectroscopy based inference of impurity transport at the plasma edge in different tokamak confinement regimes — •Tabea Gleiter[1,2], Ralph Dux[1], Francesco Sciortino[3], Tomáš Odstrčil[4], Thomas Hayward-Schneider[1], Daniel Fajardo[1], Ulrich Stroth[1,2], and the ASDEX Upgrade Team[5] — [1]Max-Planck-Institut für Plasmaphysik, Garching, Germany — [2]Physik-Department E28, Technische Universität München, Garching, Germany — [3]Proxima Fusion GmbH — [4]General Atomics, San Diego, USA — [5]Authors of U. Stroth et al. 2022 Nucl. Fusion 62 042006

We present the inference of radial impurity diffusion and convection profiles in steady state discharges. The experimental basis are customized charge exchange recombination spectroscopy (CXRS) measurements, yielding line radiances from multiple impurity charge states. A forward model based on the impurity transport solver Aurora is able to generate synthetic CXRS-data for given transport coefficients. It requires additional inputs, such as neutral beam and thermal deuterium densities, kinetic profiles and atomic rate data. This model is used for a Bayesian inverse inference of transport coefficent probabilities. Due to the complexity, the selection of suitable free parameter sets, prior distributions and data likelihoods is important.

The framework is mostly suitable for the plasma edge, i.e. where impurities are not fully ionized. Since the pedestal impurity transport in tokamaks is crucial for energy confinement and radiative power exhaust, we compare various confinement regimes at ASDEX Upgrade, including promising reactor scenarios without large ELMs.