Physics Exploitation of the new Divertor Thomson Scattering at ASDEX Upgrade

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The successful commissioning of the Divertor Thomson Scattering (DTS) is a milestone for divertor studies at ASDEX Upgrade (AUG). Thomson scattering provides non-perturbative local measurements of both electron density n_e and temperature T_e offering a unique insight into the divertor physics. The AUG DTS system consists of 24 channels extending from the inner to the outer divertor passing through the X-point. It is furnished with 4-wavelength-channel polychromators to measure T_e in the range from 1 eV to 100 eV and n_e from 10^{19} m^{-3} to 10^{21} m^{-3} [1].

This work exploits the new DTS diagnostic which provides two-dimensional T_e and n_e profiles over a large portion of the divertor by sweeping the strike points vertically, similarly as in [2]. Dedicated discharges with step-wise increasing plasma density have been performed to characterise attached and detached plasmas in both L- and H-mode. Figure 1 shows the resulting 2D T_e (a), n_e (b), and p_e (c) profiles for a detached L-mode. A parallel pressure gradient is confirmed under detached plasma conditions and, for the first time, a bifurcation-like transition of T_e in the outer divertor has been observed on the way to detachment in L-mode, similar to the detachment "cliff" in the H-mode experiments in DIII-D [2]. By combining the DTS with the divertor spectroscopy, neutral and molecular densities could be derived demonstrating that the molecular assisted processes are negligible during the detachment transition. Finally, the first measurements of T_e and n_e within an X-point radiator (XPR) have been performed showing temperatures as low as 1 eV within the confined region of a 10 MW heated H-mode. However, differently from the divertor detachment, the electron pressure is observed to be constant along the field lines at the XPR position.

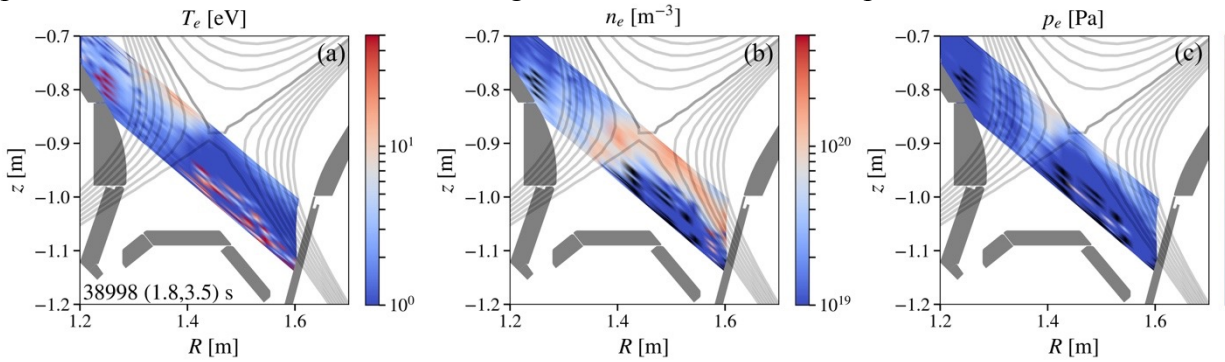

Fig. 1: Two-dimensional (a), (b), and (c) profiles from the divertor Thomson of a detached L-mode plasma

[1] Kurzan B, et al., 2021 J. Jnstr. **16**, C09012
[2] McLean A et al. 2015 J. of Nucl. Mater. **463** 533–536