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OV/2-2: Overview of ASDEX Upgrade Results

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The medium size divertor tokamak ASDEX Upgrade possesses flexible shaping capability and versatile heating and current drive systems. Recently the technical capabilities were extended by increasing the ECRH power and by installing 2x8 internal magnetic perturbation coils. Using these coils, reliable suppression of large type I ELMs could be demonstrated in a wide operational window, which opens up above a critical plasma density. The edge plasma parameters are little affected. Nevertheless, the ELMs are replaced by repetitive small scale events, which cause lower energy losses but are sufficient to keep the tungsten concentration in the core plasma at a low level. The temperature in the outer divertor rises moderately during ELM mitigation but the inner divertor remains detached at all times. The pellet fuelling efficiency was observed to increase which opened a path to H-mode discharges with peaked density profiles at line densities clearly exceeding the empirical Greenwald limit. With a maximum total heating of 23 MW, high P/R H-modes with moderate divertor peak power loads below 5 MW/m2 were achieved by feedback-controlled radiation cooling.
Owing to the increased ECRH power to 4 MW, H-mode discharges could be studied in regimes with dominant electron heating and low plasma rotation velocities, i.e. under conditions particularly relevant for ITER. At low densities the roles of electron and ion temperatures in the L-H transition could be disentangled. It is found that transitions appear at a critical value of the ion pressure gradient, pointing to the neoclassical radial electric field and the related flow shear as important parameters for the transition. Reynolds stress as additional source of flow shear was investigated by means of Doppler reflectometry. ECRH was used to shape the electron temperature profile and to switch between ITG and TEM dominated turbulence regimes. The relation of the dominant instability with particle, momentum, ion and electron heat transport was assessed in detail. Using probes in the SOL, for the first time electron temperature fluctuations were measured and excellent agreement of the turbulent statistics with GEMR simulations is found. Using a retarding field analyser, fluctuating and average ion temperatures were measured in the far SOL which allows assessing the power flux on the first wall.

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