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Overview of ASDEX Upgrade results

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The ASDEX Upgrade program is devoted to the preparation of ITER operation and the development of plasma scenarios and physics understanding for a future DEMO. Different scenario lines adapted to critical research tasks are developed and naturally integrated with the metallic, high-Z plasma facing components environment. The scenarios can be mainly divided into low core collisionality and high divertor collisionality conditions, which can be achieved simultaneously only in devices of ITER size.
The development of non-inductive scenarios relies on low core collisionality and is performed with low neutral divertor pressure and an attached divertor. Fully non-inductive operation with a combination of NBCD and ECCD has been achieved at Ip= 0.8 MA and a safety factor q95= 5.4. The core W concentration is quite high as a consequence of the hot SOL and divertor which result in high W sputtering yields.

A normalized exhaust power Psep/R of 10 MW/m has been achieved with nitrogen (N) seeding and a partially detached outer divertor at a total heating power of 25 MW. A high neutral deuterium divertor pressure was found to be essential for efficient divertor cooling. Confinement degradation connected to a high neutral pressure is partly compensated by improvement due to the effects of N. Investigations of the cause for the improved energy confinement with N seeding suggest that an inward shift of the pedestal density profile in relation to the temperature profile is the main driver for an enhanced pedestal stability which is associated with the improved confinement. The inward shift is attributed to a shrinking of a high density region on the high field side SOL due to the power reduction caused by the N radiation, which effects the fueling in the X-point region.

The new pair of ICRF antennas with 3 straps has fulfilled the predicted reduction of tungsten release from connected limiters. The tungsten influx during antenna operation is similar or even slightly smaller compared to the 2-strap antenna pair with boron coated limiters. With the 3-strap antennas operated for central heating, generally a reduction of the central tungsten concentration is observed despite a still moderately increased W influx. A high local density in front of the antenna, achieved by well-tailored gas puffing, further optimizes ICRF operation with regard to coupling and low W release.

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Germany

Primary author: Dr KALLENBACH, Arne (Max-Planck-Institut f. Plasmaphysik)

Presenter: Dr KALLENBACH, Arne (Max-Planck-Institut f. Plasmaphysik)

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