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Development of integrated scenarios for ITER and DEMO on ASDEX Upgrade

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The ASDEX Upgrade (AUG) programme is directed towards physics input to critical elements of the ITER design and the preparation of ITER operation, as well as addressing physics issues for a future DEMO design. In 2017 AUG will be equipped with 20 MW of NBI, 7 MW of ICRF and 6 MW of ECRH. In 2015 AUG was equipped with a new pair of 3-strap ICRF antennas, which allowed for a significant reduction of tungsten release during ICRF operation [1]. In 2017 two new ECRH units with 2x 1 MW, 10 s, at 140 GHz/105 GHz are taken into operation.

There are two main operational scenario lines in AUG. Experiments with low collisionality, which comprise current drive, ELM mitigation / suppression and fast ion physics, are mainly done with freshly boronized walls to reduce the tungsten influx at these high edge temperature conditions. Full ELM suppression [2] and non-inductive operation up to a plasma current of Ip = 0.8 MA could be obtained at low plasma density [3]. Plasma exhaust is studied under conditions of high neutral divertor pressure and separatrix electron density, where a fresh boronization is not required.

The integration of all above mentioned operational scenarios will be feasible and naturally obtained in a large device where the edge is more opaque for neutrals and higher plasma temperatures provide a lower collisionality. The combination of exhaust control with pellet fueling has been successfully demonstrated. High divertor enrichment values of nitrogen $E_N \geq 10$ have been obtained during pellet injection, which is a prerequisite for the simultaneous achievement of good core plasma purity and high divertor radiation levels [4]. With respect to the ITER Q=10 scenario at $q_{95}=3$ low power H-modes at high triangularity were studied which so far only showed H-factors of unity at $\beta_N \geq 2.0$, i.e. 10% above the planned value for ITER [5]. These experiments will be complemented in 2017 using pure wave-heating in order to mimic the low torque input in ITER and future reactors. Impurity accumulation observed in the all-metal AUG device caused by the strong neoclassical inward transport of tungsten in the pedestal is expected to be relieved by the higher neoclassical temperature screening in larger devices [6]. So far this is achieved in AUG by sufficient central electron heating.

References

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