Pedestal confinement degradation in the vicinity of the H-mode density limit in ASDEX Upgrade

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This work reports on the evolution of the pedestal profiles when approaching the H-mode Density Limit (HDL) in ASDEX Upgrade. Previous work at ASDEX Upgrade showed that the pedestal top pressure decreases when a critical line averaged density in H-Mode discharges is reached [1], in line with observations at other machines. Also, it was conjectured that the origin of the HDL is the outer mid plane, and subsequent filamentary transport starting from there is leading to an additional loss channel of the plasma as suggested e.g. by the work of [2, 3, 4]. Well in line with these results, more recent work at AUG and JET proposed that the HDL occurs when the critical ballooning parameter is attained at the separatrix [5]. The critical separatrix density n_{sep} was there quantified to scale with the Greenwald density n_{G} and found to be at maximum $0.5\,n_{\mathrm{G}}$ before the back transition to L-Mode is observed. The highest density achievable at the separatrix is a key quantity for power exhaust in a reactor like tokamak, and the overall confinement quality is largely dependent on the pedestal top pressure. For these reasons this paper investigates the evolution of both the pedestal top and the separatrix values when approaching the predicted level of $0.5\,n_{\mathrm{G}}$ at the separatrix. The studied HDL discharges on AUG have a plasma current of 0.8 MA, toroidal magnetic field between 2 and 2.5 T, injected powers of 7.5 and 15 MW. The discharges are fueled by gas puffing and the measured densities at the separatrix range from 0.2 to $0.5\,n_{\mathrm{G}}$ and the line averaged ones from 0.5 to $0.9\,n_{\mathrm{G}}$.

References

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