Full suppression of Edge Localised Modes with non-axisymmetric magnetic perturbations at low plasma edge collisionality in ASDEX Upgrade

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Full suppression of Edge Localised Modes (ELMs) by small non-axisymmetric magnetic perturbations (MP) of high-confinement-mode plasmas is one of the most promising techniques for ITER to avoid excessive erosion of the first wall due to the impulsive energy losses induced by ELMs. However, few experiments have so far reproduced the DIII-D ELM suppression scenario [T Evans et al Plasma Fusion Res. 7 (2012) 2402046]. Based on a recent similarity experiment in ASDEX Upgrade (AUG) and DIII-D [R Nazikian et al, IAEA FEC 2016; W Suttrop et al, APS-DPP 2016], a moderately increased plasma triangularity (compared to previous experiments with ELM mitigation in AUG) has been identified as a critical requirement for access to full ELM suppression in AUG. The observation of an increased edge pressure gradient at elevated triangularity suggests stronger kink-peeling amplification of the externally applied MP [Y Q Liu et al Plasma Phys. Control. Fusion 58 (2016) 114005] as a possible origin of the plasma shape dependence. The experimental base for ELM suppression in AUG is still small, however it appears already that the main properties of the DIII-D ELM suppression scenario are reproduced, most notably an upper limit of the edge pedestal collisionality at ν*ped = 0.3, a clear reduction of pedestal density (“pump-out” effect), sensitivity to the edge safety factor q95, and the existence of “dithering” transitions between small-ELM and ELM-suppressed phases at marginal ELM suppression. However, plasma rotation does not seem to be critical, in the sense that ELM suppression is obtained in cases both with and without significant electron perpendicular flow near the pedestal top. This finding may shed new light on models that invoke an unshielded resonant response for ELM suppression. AUG is the first experiment to reproduce ELM suppression with a full high-Z (tungsten) first wall, and a first experiment with injected tungsten impurities suggests efficient outward transport despite the absence of ELMs. ELM suppression access, stability and transport studies are ongoing during the 2017 experimental campaign and will be reported.