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EX/3-4: Mitigation of Edge Localised Modes with Small Non-axisymmetric Magnetic Perturbations in ASDEX Upgrade

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The ASDEX Upgrade tokamak is currently being enhanced with a set of in-vessel saddle coils to study the effects of non-axisymmetric magnetic perturbations. One of the most pronounced phenomena is the mitigation of Edge Localised Modes (ELMs) when n=2 perturbation fields are applied in High-confinement mode. In addition, the effects on the H-mode transition threshold, pellet injection, scrape-off-layer transport, plasma rotation, radial electrical field, divertor target power deposition, and edge gradients in the H-mode transport barrier region are studied in recent experiments.
ELM mitigation appears as a distinct transition from type-I ELMs to a type of small ELMs with much reduced divertor power load. Stored energy, plasma density and pedestal pressure in the mitigated phase remain close to unmitigated type-I ELMy phases. H-mode edge barrier gradients do not change significantly as ELMs become mitigated, however the H-mode pedestal top density increases slightly due to increased particle confinement with coil currents on. The edge pedestal top electron pressure remains virtually unchanged. Effective ion charge, Zeff, and tungsten concentration typically drop as ELMs become mitigated. A main requirement for ELM mitigation is the plasma edge density exceeding a threshold which depends on plasma current and can be described as a fixed fraction of the Greenwald density, f_GW = 0.65. So far, "density pump-out"has been observed at lower plasma density, but not above the ELM mitigation threshold.
Access to ELM mitigation does not seem to depend on whether the applied perturbation field is aligned with the equilibrium magnetic field ('resonant') or not. This is tested by changing the parity of upper and lower coil currents, which yields a variation of the resonant field component by a factor of five. However, the coil current threshold for ELM mitigation is found to be unchanged.
Effects of the non-axisymmetric field perturbation are observed at the plasma boundary however in the plasma core no effect on plasma rotation and no interaction with pre-existing neoclassical tearing mode islands are detected. This indicates that the resonant perturbation field amplitude is effectively shielded in the plasma interior.

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