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The universality of inter-ELM pedestal fluctuations in AUG and DIII-D - Impacting the edge profile structure by clamping of the gradients

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For wide ranges of operational parameters and in machines with different wall materials, the inter-ELM pedestal profile evolution was robustly linked to characteristic fluctuations, indicating that universal instabilities dominate the pedestal structure and its dynamics in between edge localized modes (ELMs). The presented results substantially advance the comprehension of the underlying instabilities that determine the pedestal structure because ion and electron density as well as temperature gradients were found to become clamped in different phases of the ELM cycle. The general behavior of the inter-ELM fluctuations supports that similar mechanisms determine the pedestal of future fusion devices, and stresses the necessity that predictive models need to incorporate a robust mechanism, which describes the clamping of individual profile gradients across wide ranges of pedestal parameters.

The inter-ELM fluctuations exhibit a similar sequence of their onsets in ASDEX Upgrade and DIII-D. This gives strong evidence that their origin is the same, although both machines usually operate in different parameter regimes. Generally, low fluctuation amplitudes are found during the initial recovery of the maximum electron density gradient. After this phase, maximum electron density gradient saturates. The electron temperature pedestal evolves further and the saturation of maximum electron temperature gradient correlates with the onset of high frequency fluctuations.

Fast vertical plasma oscillations were utilized as a tool to probe the pedestal fluctuations as well as the pedestal stability. Such oscillations perturb the edge current. To make them an effective ELM pacing method, the pedestal must evolve close to its gradient saturation. This state of saturated gradients is stable, but marginal to the stability limit. If a perturbation, e.g. of the edge current, is applied, it is highly probable that an ELM crash is triggered.

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