Contribution ID: **97** Contribution code: **I.11** Type: **Invited**

Non-linear free boundary MHD simulations of ELM suppression by resonant magnetic perturbations in ASDEX Upgrade plasmas

Tuesday 3 October 2023 14:00 (40 minutes)

The presentation will introduce the principles of suppressing edge localized modes (ELMs) by external magnetic perturbations (RMPs). It will explain models that allow the description of the processes and highlight recent developments. Direct comparisons between simulations and experiments will be shown, and an outlook to the application for future machines like ITER will be given.
The suppression of ELMs by resonant magnetic perturbations RMPs in an ASDEX Upgrade plasma is modeled using the free boundary MHD code JOREK-STARWALL, which was recently extended to capture the plasma response up to the computational boundary allowing to reproduce experimentally measured flux surface corrugations precisely [1]. The simulations are performed with fully realistic plasma parameters and plasma flows. This realistic approach enables qualitative and quantitative comparisons of simulations with experimental observations, reveals important mechanisms, and forms a basis for more accurate predictive studies than previously possible.
Simulations show that, in the ELM suppressed state, there is a local structure in the radial displacement of the plasma around resonant surfaces that can be linked to the presence of magnetic islands. Together with recent experimental findings, this provides strong indications for the presence of a magnetic island chain at the pedestal top during ELM suppression in an ASDEX Upgrade discharge, contributing to resolving a long-standing open question.
Furthermore, the transition out of the ELM-suppressed phase into an ELM-unstable state is modeled through an increase of the pedestal density values. The simulations allow to disentangle the role for suppressing ELM instabilities of the edge pressure profile evolution on one hand and non-linear coupling between peeling-ballooning instabilities with the RMP-driven perturbations on the other hand.

References:
[1] V Mitterauer et al 2022 J. Phys.: Conf. Ser. 2397 012008

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Session Classification: Oral session 7 - MHD modelling