Investigation of the boundary distortions in the presence of rotating external magnetic perturbations on ASDEX Upgrade

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At ASDEX Upgrade non-axisymmetric magnetic perturbations produced by 16 in-vessel saddle coils have successfully been used to mitigate the plasma energy loss and peak divertor power load caused by Edge Localized Modes (ELMs), whereas concerning confinement and impurity concentration both unperturbed ELMy reference discharges and plasmas with mitigated ELMs show a similar behaviour [1]. The installed saddle coils, which allow magnetic perturbations with toroidal mode numbers up to \( n = 4 \) and varying relative phase between the upper and lower rings, are now being equipped with an AC power supply that allows arbitrary waveforms on individual coils and therefore also toroidally rotating magnetic perturbation fields.

In previous experiments with static perturbation fields, various profile measurements at the edge revealed a distortion of the boundary around the torus, which was consistent with results found by modeling using either a simple three dimensional field line tracing code, or a more detailed reconstruction of the perturbed equilibrium in respect of a consistent balance of forces with the NEMEC equilibrium solver [2]. The measured displacements appeared to be small compared to other tokamaks [3], partly because the static perturbation field did not always allow a configuration where the profile measurements were at the position of the maximum of the displacement. The new capabilities with rotating perturbation fields should now allow an even better resolution of the distortion. Furthermore, improved diagnostic capabilities allow a more detailed measurement of lobes also at the high field side, as well as in the divertor, which will be compared with modeling results e.g. from EMC3-Eirene calculations.

[3] I. Chapman et al., submitted to PPCF