Effects of high-field-side n=1 perturbations on L- and H-mode confinement plasmas in COMPASS

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Misalignment or displacement of tokamak coils generates error fields. Low-n components of these fields have detrimental effects on plasma performance; most notably those with n=1 which induce non-rotating MHD modes that degrade plasma confinement and typically lead to disruption of the whole discharge. Those effects have been quantitatively studied by creating and correcting the error fields at the low field side (LFS) of the plasma. However, the effect of high field side (HFS) error fields (arising due to displacement or tilt of central solenoid or toroidal field (TF) coils next to it) has not been experimentally studied yet due to the lack of coils for applying controlled error fields at the HFS in most experiments.

In this work we present an assessment of the effect of n=1 HFS error fields on plasma performance in L- and H-modes of confinement on tokamak COMPASS, utilizing the HFS coils of this device to generate the above-mentioned (tilting and displacement) perturbations. First, we have assessed the effects of HFS error fields on generation of MHD locked modes in L-mode and compared the observations to the predictions by IPEC code. In agreement with IPEC simulations, tilting HFS error fields lead to a more restricted operational density range without mode locking in comparison to displacement with the same level of error field coil current. In the second set of experiments, the effect of HFS error fields on L-H transition and H-mode is investigated. We have found that the L-H power threshold is increased by the tilting error field and that during H-mode operation the plasma locks soon after the L-H transition at typically 50% lower coil currents compared to L-mode. The results of further experiments to characterize the effects of HFS error fields on H-mode confinement, plasma rotation, etc. will be presented.