

P1.1057 Runaway electron mitigation by $n=1$ and $n=2$ magnetic perturbations in COMPASS

Monday, 8 July 2019 14:00 (2 hours)

See the full abstract here:

<http://ocs.ciemat.es/EPS2019ABS/pdf/P1.1057.pdf>

The application of 3D fields might help in preventing and mitigating the avalanche generation of runaway electrons (RE) during disruption events in controlled fusion devices [1, 2]. The successful results recently obtained in ASDEX Upgrade [3] have motivated new experiments with this technique also in the COMPASS tokamak [4].

The resonant magnetic perturbation (RMP) coil system in COMPASS has been used to apply 3D fields with different amplitude and toroidal mode number ($n=1$ and $n=2$) to mitigate the RE beams generated during disruptions induced by impurity massive injection (Argon or Neon). Like in ASDEX Upgrade, the application of RMP results in a significantly higher decay rate and reduced lifetime of the generated RE beam. The strength of the observed effects strongly depends on the upper-to-lower coil phasing, i.e. on the poloidal spectrum of the applied perturbation, which has been reconstructed including the plasma response by the code MARS-F [5]. The RMP coils were powered both before and after the impurity gas puff, demonstrating that the RE deconfinement due to perturbation appears in the RE dominated disruption independently of the same effect on the hot plasma. The enhanced deconfinement of

the RE seed population was observed as an increase of HXR signal immediately after energizing the RMP coils in the pre-disruption scenario. RMPs have a different impact in disruptions

induced by Argon or Neon, indeed in the latter case a stronger reduction of the RE beam lifetime (down to -80%) has been observed. External perturbations also destabilize the RE radial beam position, increase the level of radial fluctuations and are correlated with the appearance of sudden HXR bursts for those coils phasing which maximize the predicted plasma response.

Moreover, the configuration with $n=2$ RMP odd parity induces a MHD instability accompanied by a significant increase of the radial fluctuations resulting in a faster current decay rate.

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[3] M. Gobbin et al, Plasma Phys. Control. Fusion 60 014036 (2018)

[4] J. Mlynar et al, Plasma Phys. Control. Fusion 61 014010 (2019)

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Presenter: GOBBIN, M. (EPS 2019)

Session Classification: Poster P1

Track Classification: MCF