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Modelling the effect of resonant magnetic perturbations on neoclassical tearing modes

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A 3D time dependent quasi-analytic model is built to describe the NTM perturbations evolution under the effect of the external resonant magnetic perturbations (RMPs). The model applies to the ASDEX-Upgrade tokamak with its system of B-coils generating magnetic perturbations, having a sufficiently close realistic description of the experimental installation. A clear, quasi-analytic expression of the neoclassical perturbation calculated by solving the magnetic island resistive equations [1] is obtained, compulsory linked via the matching conditions at the magnetic island-ideal plasma boundary with a general time dependent solution satisfying the perturbed equations outside the magnetic island, separately derived [2]. The latter solution is compulsory to be derived because contains all the information about the plasma column external structures, such as the B-coils generating RMPs. Based on both solutions, the perturbation stability index is obtained to be used to solve the modified Rutherford equation. The stability index is also a measure of the influence of the RMPs on the NTM evolution, hence is has been point out the RMPs role as a trigger for the NTM onset and magnetic island seeding process. The RMPs effect on the mode frequency and phase is shown along with the influence of the B-coils arrangements effect. The results are compared to some ASDEX-Upgrade disruptions experimental results in order to assess plasma stability performance and stability control in high-beta and advanced tokamak regimes. Despite the limitations involving a model describing the small perturbations evolution, good results are obtained concerning the RMPs effect on the NTMs at least before important perturbed model equilibrium quantities significantly change.

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References

[1] C.C Hegna, J.D. Callen and R.J. LaHaye, Phys. Plasmas 6, 130 (1999)
[2] I.G. Miron, " Modeling of seed magnetic island formation", 43rd EPS Conference on Plasma Physics (Leuven, Belgium), P2.060 (2016)