Energetic particle modes in TCV with two neutral beam injectors

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TCV is equipped with two Neutral Beam Injectors (NBI), injecting particles tangentially and in opposite toroidal direction at the energies of 25 keV and 50 keV. The additional power coupled to the plasma allows to enter easily H-mode and perform power exhaust studies. In addition, Alfvènic modes have been observed in the presence of both beams, with different combinations of injection energy, power and geometry. Energetic particle modes are critical for ITER and their control is critical for the safety of the device. Understanding the presence of such modes in TCV will improve our capability to control Alfvènic modes thanks to the shaping capabilities and electron cyclotron heating in TCV. In TCV, modes with co-current beam feature strong chirping behavior (i.e. quick change in frequency), while modes with counter-injected beam have a steadier frequency. The reason behind this observation could be given by the amount of fast particles confined in TCV plasma: the fast ion pressure is so high that the drive/damping balance is modified. In the counter-current case, a reduction of $\sim 10/15\%$ in the neutron rates is observed when the modes are present. In this work, the modelling of the MHD stability using TRANSP [1] and LIGKA [2] codes is performed, comparing the separate scenarios where such modes have been observed. This allows to quantify the fast particle content and estimate the additional transport induced by such MHD activity, comparing (when possible) the experimentally measured neutron rates and the simulated ones.

References

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