MHD Stability Analysis and Preliminary Studies of Alfvénic Modes in DTT

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Stability analysis is of fundamental importance for the operation of plasma fusion devices, as it helps prevent poor confinement with consequent loss of plasma performance and potential damage to plasma-facing components. For these reasons, a detailed analysis of plasma stability properties is being carried out for the Divertor Tokamak Test (DTT) [1], a new machine under construction in Frascati, Italy, aimed at designing and testing a divertor capable of handling high thermal loads and power exhaust.

In this work, the full power scenario is investigated for both positive and negative triangularity configurations. High-resolution plasma equilibria are computed using the CHEASE code [2] and analyzed with the linear stability code MARS [3]. The considered scenario is characterized by the presence of a $q < 1$ region, which can give rise to ideal and resistive internal kink modes [4]. Moreover, high-performance scenarios relevant to next-generation reactors may also drive a class of MHD instabilities known as infernal modes, which occur near rational surfaces with low magnetic shear and sufficiently steep pressure gradients.

In addition, a preliminary analysis of global Alfvénic modes has been performed as a first step toward future investigations including energetic particles produced by neutral beam injection (NNBI). The energetic particle distribution function, obtained from ASCOT simulations [5], is modeled using an anisotropic slowing-down distribution within the hybrid MHD–gyrokinetic code HYMAGYC [6]. Finally, indicative results illustrating the impact of energetic particles are presented using a single-null equilibrium and a Maxwellian distribution function.

References

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