A stability study of \(\alpha\)-particle driven Alfvén eigenmodes in JET D-T plasmas

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Given the unique capabilities of the Joint European Torus (JET) a campaign with deuterium-tritium (DT) plasmas is being planned in advance of ITER operations [1,2]. As a contribution to the preparation efforts, a tool that has recently been developed for the systematic linear-stability assessment of Alfvén eigenmodes in the presence of fusion born \(\alpha\)-particles [3,4] is here applied to a representative set of JET DT scenarios. This study will allow us to better understand the impact of \(\alpha\)-particles on Alfvén stability. Starting from a selected set of pulses [2] the equilibria and fast particle distributions are predicted through transport modelling using the numerical transport code TRANSP [5]. The Alfvén spectrum and its stability is computed using the ASPACK suite of codes [3,4], which includes the equilibrium solver HELENA [6], the ideal magnetohydrodynamic eigensolver MISHKA [7], and the linear-stability hybrid MHD/drift-kinetic numerical code CASTOR-K [8].

As a result of an extensive linear assessment of the growth rates for the Alfvén spectra of different DT scenarios due to driving interaction with \(\alpha\)-particles and damping on thermal populations, the most unstable Alfvén eigenmodes are identified and their importance discussed. Other relevant mechanisms such as radiative and continuum dampings are also tackled and estimates are given.

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