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Quantitative linear stability of TAEs in JET ITB scenarios designed for alpha driven modes in DT

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The destabilization of toroidal Alfven eigenmodes (TAEs) by alpha particles requires special conditions in current tokamaks, and DT operation of JET provides this rare opportunity [1]. The unambiguous observation of these modes is anticipated to be difficult, and the operation in DT is potentially limited by the availability of tritium and the allowable neutron wall activation, which might result in a reduced number of attempts that can be made at JET. The linear stability of ICRH driven TAEs during DT preparation experiments must therefore be completely understood, with careful accounting for fast and thermal plasma effects and comparison with experiment.
We demonstrate that in JET-like conditions, it is sufficient to use an incompressible cold plasma model for the TAE to reproduce the experimental adiabatic features such as frequency and position. Quantitative calculations with the full-orbit perturbative code HALO [2] during the internal transport barrier (ITB) afterglow were carried out, including full 3D constant of motion ICRH and NBI distribution functions. The core-localised modes that are predicted to be most strongly driven by minority ICRH fast ions correspond to the modes observed in the DD experiment, and conversely, modes that are predicted to be not driven are not observed. Large sensitivity of the linear growth rate to the ICRH tail was observed because of the implied uncertain population of resonant trapped particles. Linear damping rates from the thermal plasma due to a variety of mechanisms are calculated with both perturbative and non-perturbative codes, such as CASTOR-K [3] and GTC [4]. We show that analytical estimates for Landau damping can be too low by at least an order of magnitude in these experiments, owing to the neglect of higher order sideband resonances.

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[1] Dumont R J,et al. 2018 Scenario development for the observation of alpha-driven instabilities in JET DT plasmas Nucl. Fusion 58
[2] Fitzgerald M et al. 2020 HALO: A full-orbit model of nonlinear interaction of fast particles with eigenmodes Comput. Phys. Commun. 252 106773
[3] Borba D et al. 1999 CASTOR-K: Stability Analysis of Alfvén Eigenmodes in the Presence of Energetic Ions in Tokamaks J. Comput. Phys. 153 101–38
[4] Lin Z 1998 Turbulent Transport Reduction by Zonal Flows: Massively Parallel Simulations Science (80-.). 281 1835–7

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