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Studies of Alfven eigenmodes in the ITER baseline scenario, sawtoothing JET plasmas, and MAST hydrogen-deuterium plasmas

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Good confinement of fusion-born alpha-particles is essential for the success of ITER. Modelling with the HAGIS code is performed to compute nonlinear stability of alpha-particle-driven TAEs and redistribution of alpha-particles in the 15 MA baseline ITER scenario. For this modelling, 129 TAEs with n's from 1 to 35 were computed with the MISHKA code, and their damping effects were assessed with the CASTOR-K code. The self-consistent evolution of TAEs and alpha-particles results in TAE saturation amplitudes $dB_r/B_0=3\ 10^{(-4)}$, with a stochastic transport of alpha-particles localized in a narrow core region, but with alpha-particle redistribution beyond r/a=0.5 being minimal. Whilst these results are positive, their sensitivity to the shear raises the issue of the hierarchy of various alpha-particle-driven AEs throughout the sawtooth cycle. Experiments on fusion products performed recently on JET sawtoothing plasmas indicate on how AEs could vary throughout the sawtooth cycle in ITER. In these JET experiments, TAE, EAE, NAE, and Alfvén Cascades (ACs) were observed throughout the sawtooth cycle. The difference in the time of excitation of these AEs is associated with the temporal evolution of the energetic particle profile, which also correlates with direct measurements of energetic particles with a suite of fast ion diagnostics. A correlation between sawtooth crash times and energy of most affected ions is investigated with ECE diagnostics is examined. Modelling of the cyclic AE excitation is performed for the JET data, and the study of alpha-driven AEs is then extended to the baseline ITER scenario. The planned D-T experiment on JET provides an important opportunity to validate the codes predicting alpha-particle effects on AEs. Preparation for AE studies in JET D-T plasma is proceeding along two avenues: i) development of JET scenarios for alpha-driven AEs. These scenarios are developed with q-profiles and β_{hot} values suitable for alpha-driven AEs, and ii) study of AEs in plasmas with mixed hydrogen isotopes. For this, D-H plasmas with NBI were obtained on MAST. A strong suppression effect of the D-H mixture was observed on Compressional AEs in the ion-ion hybrid frequency range.

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