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A Systematic Approach to the Linear-Stability Assessment of Alfvén Eigenmodes in the Presence of Fusion-Born Alpha Particles for ITER-like Equilibria

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A systematic approach to assess the linear stability of Alfvén eigenmodes in the presence of fusion-born alpha particles is described. Because experimental results for ITER are not available yet, there is no guidance about which Alfvén eigenmodes will interact more intensively with the fast-particle population. Therefore, the number of modes that need to be considered in stability assessments becomes quite large and care must be exercised when choosing the numeric tools to work with, which must be fast and efficient. In the presented approach, the eigenmodes are first found after an intensive scan of a suitable frequency range, performed within reasonable bounds for the toroidal and poloidal mode numbers. Each solution found is then tested to find if its discretization over the radial grid in use is adequate. Finally, the interaction between the identified eigenmodes and the alpha-particle population is evaluated with the drift-kinetic code CASTOR-K, in order to assess their growth rates and hence their linear stability. The described approach enables one to single out the most unstable eigenmodes in a given scenario, which can then be handled with more specialized tools. This ability eases the task of evaluating alpha-particle interactions with Alfvén eigenmodes, either for ITER scenarios or for any other scenario planning.

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