Consequences of sawteeth on Toroidal Alfvén Eigenmodes activity in fusion plasmas

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Sawtooth oscillations in future fusion tokamaks may help remove thermal helium and impurities from the core of the plasma. However, sawtooth oscillations are also associated with a significant radial redistribution of fast particles, with the extent of the redistribution depending upon their energy and pitch angle. This is modelled by using the full-orbit code EBdyna\(_{\text{go}}\) \cite{1} that provides a complete description of the behaviour of fast ions during a sawtooth reconnection in a tokamak. In this contribution we study the consequences of fast particle redistribution on MHD stability, and in particular on TAE.

This paper uses a simple TAE stability analysis similar to the approach of \cite{2}. The linear growthrate induced by the alpha-particles is determined for various mode numbers \((n)\), at different radial positions. A simulation of a sawtooth collapse is then undertaken using the orbit-following code, EBdyna\(_{\text{go}}\). The result of the simulation is the new velocity space distribution of the fast helium, \(F(\Psi,v_\|,v_\perp)\), that arises as a direct consequence of the sawtooth. Neglecting changes in the safety factor profile upon the existence of the TAEs, a new growth rate is then obtained in the post-sawtooth-collapse configuration and compared to that calculated in the initial equilibrium. Estimates of the evolution of the damping mechanisms are also considered. The difference between the two overall growthrates (after and before sawtooth) gives the TAE modes that can potentially be destabilized by the sawtooth activity.

The study will be performed on the basis of the equilibrium from a high performance JET discharge (rescaled to a Deuterium:Tritium mixture) and for a standard ITER H-mode scenario.

References
\cite{1} F. Jaulmes, E Westerhof, H. J. de Blank, submitted to Nucl. Fusion (IAEA 13\textsuperscript{th} TM special issue), Redistribution of fast ions during a sawtooth reconnection