Sawtooth Control in JET with ITER relevant low field side resonance

ICRH and ITER like wall

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The stabilising role of trapped alpha particles are expected to cause long sawtooth periods in ITER. Without adequate sawtooth control techniques, long sawteeth are predicted [1] to trigger fast growing NTM’s during standard H-mode operation. Recent experiments at JET with the ITER like wall show for the first time that low field side resonance ICRH can be used to control sawteeth that have been initially lengthened by fast particles. These results are welcome not least because the ICRH antenna design of ITER does not allow for high field side resonance at full magnetic field. In contrast to previous [2,3] high field side resonance sawtooth control experiments undertaken at JET, it is found that the sawteeth of L-mode plasmas can be controlled with less accurate alignment between the resonance layer and the sawtooth inversion radius. This advantage, as well as the discovery that sawteeth can be shortened with various antenna phasings, including dipole, indicates that ICRH is a particularly effective and versatile tool that can be used in future fusion machines for controlling sawteeth. High power H-mode experiments show the extent to which ICRH can be tuned to control sawteeth and NTMs while simultaneously providing effective electron heating with improved flushing of high Z core impurities. Dedicated ICRH simulations using SELFO, SCENIC and EVE, including wide drift orbit effects, explain why sawtooth control is effective with arbitrary antenna phasing. Corresponding kinetic-MHD stability calculations using MISHKA and HAGIS unravel the optimal sawtooth control regimes in these ITER relevant plasma conditions.


*See the Appendix of F. Romanelli et al., Proceedings of the 24th IAEA Fusion Energy Conference 2012, San Diego, US