Asymmetric Distributions of Energetic Circulating Ions and Sawtooth Control using ICCD and Unbalanced NBI

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There is little doubt that various auxiliary heating systems are successfully and routinely controlling sawteeth. There is however some room for improving our understanding of the mechanisms that influence these important changes to the discharges. A mechanism that appears to be common across ECCD, ICCD and unbalanced NBI discharges involves the effect of the $q = 1$ localised current drive perturbation on resistive diffusion during the sawtooth ramp. Nevertheless, it is important to look for explanations for sawtooth control which may exist in ion based auxiliary systems, but may differ or not exist in electron auxiliary means of sawtooth control. The reason for this is that monster sawteeth, initially lengthened by trapped energetic ions, have up to the present day only been controlled using ICCD [1], while in ITER the primary method for sawtooth control could be ECCD. A mechanism based on the finite orbit width of parallel asymmetric energetic circulating particles [2] is only non-negligible for ion based auxiliary systems. The present contribution examines the relevance of the latter in sawtooth control experiments, such as those using ICCD [1] and NBI [3] at JET, by looking carefully at the role of circulating ions close to the trapped boundary. At such pitch angles the orbit width is largest, and the parallel asymmetry of the distribution function has the greatest influence.

References

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