

Modelling the Effect of Toroidal Plasma Rotation on Magnetohydrodynamic Instabilities in MAST

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Present day tokamaks are capable of generating toroidal flows approaching the ion sound speed. Such toroidal rotation is known to have a stabilising effect on the stability of resistive wall modes [1]. This plasma rotation introduces new effects such as centrifugal and Coriolis forces and redistribution of pressure and density. Here the effects of plasma rotation and diamagnetic drifts on the $n=1$ internal kink mode and high- n ballooning modes are presented with specific comparison to experimental data from MAST.

Results from MAST concerning the effect of toroidal rotation driven by neutral beam injection (NBI) on sawteeth are presented. The sawtooth period is shown to increase as the co-NBI power, and thus the toroidal plasma rotation, is increased. Conversely, as the counter-NBI is increased, the sawtooth period decreases to some minimum that is shorter than in Ohmically heated plasmas, before lengthening at high toroidal flows. Magnetohydrodynamic stability analyses of the $n=1$ internal kink mode with respect to toroidal rotation at finite ion diamagnetic frequency have been performed using a new code, called MISHKA-F [2]. The results indicate that the marginally stable radial location of the $q=1$ surface reaches a minimum at approximately the same counter-toroidal rotation as that which minimises the sawtooth period experimentally [3].

It has also been shown that sheared toroidal rotation is able to stabilise the peeling-ballooning modes which are thought to be the likely trigger of Edge Localised Modes (ELMs). A model for ELM triggering in MAST is proposed, such that, initially the rotation shear keeps the edge stabilised until the pressure gradient sufficiently exceeds the stability boundary for static plasmas. When the mode becomes unstable, it grows, ties the flux surfaces together and consequently flattens the rotation profile. This further destabilises the plasma edge, leading to the ELM crash [4].

[1] Y Liu, A Bondeson, Y Gribov and A Polevoi, *Nucl. Fusion*, **44**, 232 (2004)

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[4] S Saarelma, T Hender, A Kirk, H Meyer and H Wilson, *sub Plasma Phys. Control. Fusion* (2006)

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