Fishbones Activity in JET Low Density Plasmas

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Fishbone activity with frequencies around the precessional drift frequency of the fast ions $\omega \sim \omega_{DH}$ [1] and the diamagnetic frequency of the bulk ions $\omega \sim \omega_{*i}$ [2] have been observed in several tokamaks. In the first case, fishbone bursts occur when the precessional fishbone branch of the internal kink mode becomes unstable, while in the second case fishbone bursts are caused by the ion branch, which corresponds to a different solution of the same dispersion relation [3]. JET discharges carried out with low density plasmas and high ICRH power provided a scenario where the precessional fishbone branch and the ion branch coalesced. In this case, two new fishbones regimes were observed: a regime where fishbone bursts covered both ranges of frequencies and show hybrid characteristics, and a regime where low amplitude bursts of both types of fishbones occurred simultaneously. These coalescent regimes may also be reached if the radius of the q=1 surface is large, as it is predicted to be in ITER.

Fishbone activity can be analysed by means of a variational formalism that allows the calculation of the regions of stability for each branch in the space of parameters upon which the fishbone stability depends [4]. This allows not only the analysis of experimental results but also the prediction of how fishbone stability would evolve depending on the expected evolution of the relevant parameters. In addition, the mode structure and growth rates have been determined using the non-perturbative numerical code NOVA-K [5].

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