Mode Coupling in Hybrid discharges at JET

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Multiple magneto-hydrodynamic (MHD) instabilities may contemporarily appear in a Tokamak discharge and, in certain cases, interact and couple one another because of either linear effects (toroidicity) \cite{1} or non-linear effects \cite{2}. Non-linear coupling can be a cause of 3/2 NTM triggering, and in general modifies the toroidal rotation of the magnetic islands.

In both kinds of coupling, the frequencies of the involved modes as well as their wave number, i.e. the order numbers m, n of the modes, have to fulfil selection rules. In particular, following the observation that magnetic islands are dragged by the ion fluid \cite{3}, one can look at the constraints on the mode frequencies as constraints on the shape of the rotation profile. As an example, selection rules for linear coupling can be considered as an indication of a flat rotation profile in the plasma core.

During last experimental campaign, around 100 pulses in Hybrid scenario performed at JET with ITER Like Wall (ILW) were analysed. In several cases (30 out of 100), multiple magneto-hydrodynamic (MHD) instabilities were contemporarily affecting the discharge and showing evidence of mutual coupling behaviour. After the appearance of non-linear coupling, it is observed that the natural frequencies of the modes being involved change to satisfy the condition for linear coupling, then flattening the rotation profile. From the above consideration, a (preliminary) study about changes on the rotation profiles in case of mode coupling is here presented, together with a discussion of some cases where mode coupling occurs, and focusing at those cases where a 3/2 mode is triggered by non-linear coupling between 4/3 and 1/1 modes. The three modes coupling is validated by calculating the bicoherence degree of the magnetic fluctuations at the natural frequencies of the modes \cite{4}.

References:


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