Ideal core MHD stability in operational scenarios in JT-60SA

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The scientific work programme of the JT-60SA foresees several operational scenarios at normalised plasma beta close or larger than 3, ranging from full Ip inductive at 41MW heating power with different heights in the pedestal density, hybrid like scenarios with 37MW of heating power and strongly reversed shear scenarios (heating power larger than 30MW) in a full non-inductive current operation.

Considering the large operational plasma beta it is essential to infer the MHD stability of the core/pedestal plasma. While on the pedestal it is largely anticipated that all scenarios are peeling-ballooning (PB) unstable, the core MHD stability is less straightforward except when the plasma scenarios are sawtoothing. In particular, large pressure gradients may give rise to local ballooning-infernal or kink modes resonant with magnetic surfaces close to the q=1 magnetic surface or possible minima in the safety factor q-profile.

In this work we investigate the ideal core MHD stability of the foreseen scenarios and present a comprehensive analysis of the MHD spectra characteristic from each scenario. The background plasma and equilibria stem from modelling done using the CRONOS suite using dedicated models for core particle and heat transport e.g. GLF23 and CDBM [1,2]. Such models lack of some characteristics expected to be important in JT-60SA, e.g. the impact of electromagnetic effects on turbulence, and yet they were used as a first step towards a full prediction of scenarios in JT-60SA. It is found that while the fully inductive scenarios are mostly kink unstable at the q=1 surface (though the n=1 mode is not necessarily the most unstable mode), as large pressure gradients become more evident in the advanced scenarios, ballooning-infernal like modes become strongly unstable, with occasionally more than one unstable branch being inferred.

[1] L. Garzotti et al 2018 Nucl. Fusion 58 026029
[2] J. Garcia et al 2014 Nucl. Fusion 54 093010

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