

Validation of a NTM model using databases of disruptive plasmas at JET

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A dynamic, multi-mode, self-consistent model that provides a quasi analytic approach is proposed to be checked. The NTM solution requires the solving of the perturbed equations in the whole space. Along with the perturbed equations in the ideal plasma, vacuum, plasma column external structures and continuity equations across boundaries, a new approach of the jump equations across the magnetic island has been chosen. The latter boundary equation takes into account the bootstrap effect and completes the whole system of the perturbed equations.

Basically this boundary equation couples the Rutherford equation to the perturbed equations everywhere, except the magnetic island. A parametric island width is chosen that preserves the linear approach of the system of equations and basically is equivalent to the approximation of a saturated island regime. No pre-existent time dependent form is assumed for the perturbation. The perturbed time differential equations are Laplace transformed, solved and the solutions are finally inverse Laplace transformed in order to show its derived explicit time dependence. In order to check our model results against real experimental results, we have considered the presumed equilibrium quantities of our small perturbations model as being the ones directly taken from discharges diagnostics data tables at JET. Obviously these quantities (such as ions and electrons densities, temperatures and so on) are not static and they would drive our perturbed equations nonlinear. On the other hand the growth rate of the perturbations is usually significantly higher compared to any diagnostic data growth rate we use, therefore we approximate the latter as behaving like equilibrium quantities on the perturbations time scale. An example of our model accuracy is shown in the figure above, describing the JET 96947 discharge dynamics.

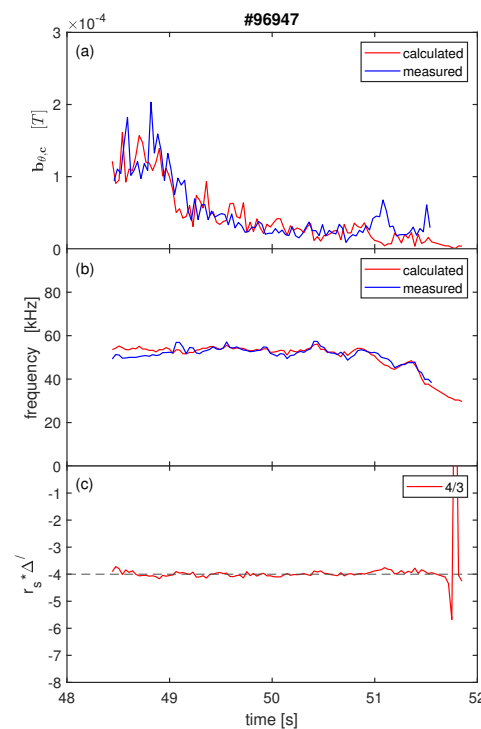


Figure 1: JET 96947 calculated vs. measured 4/3 NTM (a) amplitude and (b) frequency and (c) calculated magnetic island delta prime

*See the author list of E. Joffrin *et al.*, Nucl. Fusion **59**, 112021 (2019)