TEARING MODE STABILITY STUDIES ON DIII-D*

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The understanding of tearing mode stability is critical to all magnetically confined plasmas, but poses a formidable challenge when pressure and realistic geometry are included in the modeling. The classical tearing mode linear stability index Δ' is defined in axisymmetric equilibria without islands, and yet is used to predict the non-linear island evolution. Calculations of Δ' with equilibrium re-constructions from experimental data are challenging because of an extreme sensitivity of Δ' to equilibrium profiles. Recently, attempts have been made to define a tearing mode stability index $\Delta'(w)$ in the presence of an island of width w. We compare Δ' calculations to experimental data, the non-linear saturated island size, and to $\Delta'(w)$ formulations from the literature.[1,2]

For high β, highly shaped plasmas in the DIII-D tokamak, the value of Δ' calculated at a rational surface can be especially sensitive to the pressure and current profiles. Fitting equilibria to diagnostic data for a single time slice around a minimum in the statistical figure of merit χ^2 we show that near marginal stability for a global ideal mode, a pole in Δ' exists in equilibrium parameter space using the PEST-III code, as predicted by analytic theory.[3] For low q_{min} sawtoothing H-mode shots the proximity of the best equilibrium fit to this pole in parameter space is crucial to the accuracy and validity of the Δ' calculations. However, for a high q_{min} H-mode shot and a low β L-mode shot, linear calculations are robust, and are qualitatively consistent with experimental data.

Evolving these equilibria in time using the nonlinear 3D resistive code NIMROD, Δ' will be estimated from the linear growth rate and compared to the PEST-III and analytical results. The saturated island widths from the non-linear evolution of these seed equilibria and eigenfunctions will then be compared to the analytical saturated island width predictions from the island evolution equation. Formulations of $\Delta'(w)$ previously used on ASDEX[1] and TFTR[2] will also be compared to these results.

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