Simulation of a Disruption Using NIMROD

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Low-q disruptions are seen in tokamaks when the edge q approaches 2, placing a limit on the maximum current. However in the Compact Toroidal Hybrid (CTH) device, a tokamak-stellarator hybrid, low q-disruptions do not occur until the edge q approaches 3/2. In these low-q runs, CTH is operating in a regime where most of the rotational transform is due to the plasma current, not the helical stellarator field.

Previously, numerical simulations have described tokamak low-q disruptions as a non-linear coupling of tearing modes [1]. First, the unstable m=2, n=1 tearing mode grows, flattening the current and pressure profiles within the 2/1 island. This change to the equilibrium is such that it destabilizes the m=3, n=2 mode. Higher m modes, each with a rational surface closer to the magnetic axis, are successively destabilized in this way so that the disruption manifests as a front that advances inwards rapidly. This front breaks up good flux surfaces and leaves behind a wake of stochastic magnetic fields. The heat is then lost due to rapid parallel heat transport along field lines.

We wish to explore a CTH low-q disruption using NIMROD [2] for numerical simulation. Presently, a simulation of a low-q disruption in a tokamak having a CTH wall is shown and the results are compared to previous studies on tokamak low-q disruptions by simulation. This will serve as a starting point for future work, where we will explore the effect of the CTH helical field on the evolution of low-q disruptions.

[1] A. Bondeson, Nucl. Fusion **26**, 929 (1986)
[2] C.R. Sovinec, A.H. Glasser, T.A. Gianakon, D.C. Barnes et al, J. Comput. Phys. **195**, 355 (2004).

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