Nonlinear ELM Crash Simulations

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Simulations of edge localized mode (ELM) crashes have been carried out in ITER and DIII-D equilibria. Resistive and two fluid MHD simulations were carried out using the M3D code [1]. ELM crash simulations show the growth, saturation, and decay of the modes, along with relaxation of equilibrium profiles.

Linear simulations including gyroviscosity show the stabilization of toroidal mode number \(n = 10\) modes, when the Hall parameter \(H\), the ratio of ion skin depth to major radius, exceeds a threshold. For a typical DIII-D case, modes with \(nH > 0.6\) are stable, corresponding to \(n > 20\) for a typical experimental value of \(H = 0.03\). Nonlinear simulations show gyroviscous stabilization has relatively little effect, when the ELMs are dominated by lower \(n\) modes.

Simulations are in progress which couple to the XGC code[2], which simulates the edge plasma density and temperature pedestal, as well as the ion contribution to the bootstrap current.

Upper, outer quadrant of pressure contours in a DIII-D ELM simulation

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