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Understanding the roots of tearing mode onset and growth in DIII-D

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A new database study of DIII-D discharges is used to assess the sensitivity of the onset of 2/1 tearing modes to global plasma parameters and to quantify the relative occurrence of the different root causes.

Tearing modes (TMs) are resistive MHD instabilities that form magnetic islands, degrading plasma confinement and potentially leading to disruptions. As future power plants will need to operate with stable equilibria free of disruptive islands, active and passive TM stabilization strategies are crucial components for the successful operation of ITER and other future devices.

Despite decades of progress toward understanding TM physics, the variety in physical drivers makes regular and robust avoidance of TMs elusive. Better characterization of the principle seeding mechanisms and TM drive in experiment can aid in resolving this challenge. To this end, a new large-scale database study of 2/1 modes has been conducted using decades of experimental data of DIII-D H-mode discharges.

This study investigates the sensitivity of TM onset to a large set of global plasma parameters and the relative importance of various seeding and driving mechanisms such as: rapid core and edge MHD transients (sawtooth and ELM crashes); classical tearing stability; bootstrap current drive; 3-wave coupling; and the role of plasma rotation.

This study also compares TM onset across different reactor-relevant scenarios. The results of this work can help inform the development of scenarios that are passively stable to disruptive 2,1 islands. Work supported by US DOE under DE-FC02-04ER54698.