

Dimensionless Scaling of the Critical Beta for Onset of a Neoclassical Tearing Mode

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Abstract

The islands from tearing modes driven unstable and sustained by the helically perturbed neoclassical bootstrap current often provide the practical limit to long-pulse, high confinement tokamak operation. The destabilization of such “metastable” plasmas depends on a “seed” island exceeding a threshold. A database from similar regimes [high confinement H-mode with periodic edge localized modes (ELMs) and periodic central sawteeth] was compiled from the tokamaks ASDEX Upgrade (AUG), DIII-D, and JET. Comparison is made of the measured critical beta for onset of the $m/n = 3/2$ mode (m and n being the poloidal and toroidal Fourier harmonics, respectively) to a model in terms of dimensionless parameters for the seed and threshold islands. This modeling is then used for extrapolation to a reactor-grade tokamak design such as ITER/FDR; this indicates that the seed island from sawteeth could be too small to sufficiently disturb the metastable plasma and excite the $m/n = 3/2$ neoclassical tearing mode.

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