Impact of the current profile evolution on tearing stability of ITER demonstration discharges in DIII-D

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Abstract

A set of >100 DIII-D ITER demonstration discharges was analyzed with the goal of characterizing the tearing stability of ITER baseline scenario plasmas on the energy and resistive evolution time scales. In DIII-D these discharges are limited by the appearance of an $n=1$ tearing instability, after the discharge has run at constant pressure for several confinement times ($\tau_E \lesssim 200$ ms). Since the resistive time is $\gtrsim 1$ s, the current profile is still evolving when the modes appear. Across the ranges of pressure explored around the ITER design value, the probability of a discharge remaining stable equals that of encountering a mode; therefore, it seems that the tearing stability boundary cannot be characterized as a pressure limit. The internal inductance, a measure of the current distribution, does not contain enough detail to describe the tearing stability limits precisely, despite clear evidence that the evolution of the current profile is the cause of the instability, and not the reaching of a β limit. The onset of the instability does not seem to be correlated to the plasma rotation or the presence of ELMs.