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EX/P2-08: Long-pulse Stability Limits of ITER Baseline Scenario Plasmas in DIII-D

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Long duration plasmas, stable to m/n=2/1 tearing modes (TM), with an ITER similar shape and an ITER similar value of I_p/aB_T have been demonstrated in DIII-D, evolving to stationary conditions with the most stable operating point at beta_N approximately 2. Lower beta_N, corresponding to an ITER baseline scenario 2 value of 1.8, led to a higher probability of m/n=2/1 tearing modes modes, which is the opposite of predictions from neoclassical tearing mode theory. These plasmas (delta t_duration less equal 7.5 s and less equal 11tau_R), without electron cyclo¬tron current drive (ECCD) for TM mitigation, have extended shorter pulse experiments in which the internal inductance was continually evolving [1] often until rotating m/n=2/1 TMs or locked modes occurred, which are a concern for ITER operation.
Although long-pulse plasmas have reached sta¬tionary conditions, in some cases with similar programming m/n=2/1 TMs and locked modes limited the duration, indicating operation near stability limits. In addition to the plasmas described above, the use of ECCD, broadly deposited near q=3/2, allowed stable operation in plasmas with reduced torque which were otherwise found to be 2/1 TM unstable. We note that direct stabilization of 2/1 TMs was not attempted in these experiments.
With one toroidal row of the DIII-D internal coil set (n=3 configuration) and broad ECCD for 2/1 TM mitigation, edge localized mode suppression with periods up to 1 s was observed (q_95=3.15) in plasmas with an ITER similar shape.

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[1] F. Turco and T.C. Luce, Nucl. Fusion 50 (2010) 095010.

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