Effect of Peeling Ballooning Stability on Steady-State ELM-Free H-Mode Regimes in DIII-D *

T.H. Osborne, General Atomics, San Diego, CA

Recent stability modeling provides insight into two operating regimes that maintain the good energy confinement properties associated with the edge H-mode transport barrier (ETB), but without edge-localized modes (ELMs), or the buildup of plasma impurities characteristic of other ELM-free regimes. The steady state, low toroidal mode number, edge localized mode observed in Q(quiescent)H-mode, the edge harmonic oscillation (EHO), is consistent with a model in which the low collisionality and high rotational shear, associated with the low density and counter neutral beam injection, leads to a low n peeling-kink mode becoming the most unstable. This model suggests that this mode is saturated by the stabilizing effects of the conducting wall, both through the wall currents canceling the mode magnetic field perturbation, and through the reduced rotational shear associated with drag of the mode on the wall which reduces the linear growth rate at low n. In addition transport associated with the mode itself may help to keep it near the marginal stability point as observed experimentally. In resonant magnetic perturbation (RMP) H-mode, an external n=3 coil provides the non-axisymmetric perturbation. Complete ELM suppression is limited to low collisionality where the RMP generated stochastic field is effective at increasing transport in the ETB. The ETB pressure gradient is kept below the stability limit and its value controlled with the RMP coil. In the case of QH-mode the EHO may play the role of the RMP field in enhancing particle transport, avoiding the buildup of impurity or main ion density. Planned experiments, using the new counter neutral beam injector on DIII-D, will address the importance of rotation in these two regimes, and the effect of plasma shaping on RMP H-mode will also be reported.

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