DPP15-2015-000184

Abstract for an Invited Paper
for the DPP15 Meeting of
the American Physical Society

Access conditions, energy and particle confinement of the I-mode regime on Alcator C-Mod[1]

AMANDA HUBBARD, MIT Plasma Science and Fusion Center

Experiments on C-Mod have shown an extended operating range for I-mode at higher magnetic fields, offering options for high-performance, ELM-suppressed operation in future devices. Stationary regimes without significant ELMs are a requirement for ITER and other large burning devices. The I-mode regime offers one potential solution. It features a strong Te and Ti pedestal, up to 1 keV, without a density pedestal. I-mode has been demonstrated on the C-Mod, ASDEX Upgrade and DIII-D tokamaks, over increasingly wide parameter ranges [1]. On C-Mod, global energy confinement is comparable to H-mode, with H98 between 0.7 and 1.2. Scaling of τ_{E} with $\mathrm{P}_{\mathrm{heat}}^{-0.3}$ is more favorable than H-mode. This lack of saturation and the natural stability to ELMs can now be understood in terms of pedestal stability, with pressure and current gradients well away from stability limits. Impurity confinement τ_{imp} is similar in level and scaling to that in L-mode, 15-30 ms for both Ca and Mo, vs 0.1-1 s in H-mode. Key questions for extrapolation to other devices are the conditions for L-I transitions and for avoiding transitions to H-mode. An important new result is that the L-I threshold is independent of field, while the upper range of power for I-mode increases with B_{T} leading to a wider operating space; at 5 T and above, many discharges remain in stationary I-mode with the full heating power of 5 MW. Scaling thresholds with size suggests that I-mode should be obtainable on ITER. Some I-modes have been observed up to 8 T. Another key question for any regime is compatibility with boundary solutions. In usual operation with Bxgrad drift away from the X-point, heat flux is predominantly to the inner divertor leg. Impurity seeding is used to reduce the flux, taking advantage of low τ_{imp}. I-modes have now been extended to near-balanced double null.

[1] A.E. Hubbard et al, IAEA FEC 2014, EX/P6-22.

[1]Supported by DOE Award DEFC02- 99ER54512-CMOD.