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EX/P2-04: Study of H-mode Access in the Alcator C-Mod Tokamak: Density, Toroidal Field and Divertor Geometry Dependence

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Knowing the conditions for H-mode access is important for ITER high performance plasma operation. The experimental study carried out on Alcator C-Mod in support of this research primarily focused on (1) determining optimum global and local plasma conditions for promoting H-mode access, (2) characterizing plasma behaviors before L-H transition at low density, and (3) demonstrating a strong (>50%) reduction in H-mode threshold power (P_th)with modified divertor geometry.
It is known that "hidden"variables other than those indicated by the multi-machine scaling law can also have a great impact on P_th. In C-Mod, we observed a strong reduction in P_th at medium and high densities with slot divertor operation. A minimum P_th of 0.7MW appears at 1.5x10ˆ20mˆ-3 in this configuration, which is only 40% of the scaling law prediction. Interestingly, the edge T_e and n_e profiles prior to L-H transition are not apparently affected by divertor geometry. This result is promising and of particular interest for H-mode access at reduced power.
H-mode access at low density is a potential concern for ITER H-mode operation. This issue has been studied in dedicated C-Mod experiments operated at two different B_T (5.4T and 3.5T). At 5.4T, both P_th and T_e,95 (T_e at psi=0.95) preceding L-H transition rise considerably for density below 1.0x10ˆ20mˆ-3. The ion and electron temperature near the pedestal top remain well equilibrated in the low-density regime, which contrasts the AUG result. The few plasmas with very low density (<0.8x10ˆ20mˆ-3) show an edge T_e pedestal formed well before L-H transition, however, no clear edge n_e or T_i pedestal emerged until after L-H transition. Another significant finding is that the low density limit for H-mode access moves to lower values of density when B_T is reduced.
Scaling of P_th and local plasma edge conditions for H-mode access was examined over a wide range of plasma parameters in C-Mod divertor plasmas with ion grad-B drift in the favorable direction for H-mode access. The obtained local conditions were employed to test the L-H transition models based on the suppression of resistive-ballooning mode and drift-Alfven wave turbulence. A new model developed recently to predict H-mode access power was also tested

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