EFFECTS OF DIVERTOR GEOMETRY AND PUMPING ON PLASMA PERFORMANCE ON DIII–D[*]

S.L. Allen,[†] T.W. Petrie, M.E. Fenstermacher,[†] B.W. Rice,[†] C.M. Greenfield, D.N. Hill,[†] C.J. Lasnier,[†] A.W. Leonard, T.C. Luce, M.A. Mahdavi, R. Maingi,[‡] G.D. Porter,[†] J.P. Smith, T.S. Taylor, M.R. Wade,[#] W.P. West, R.D. Wood,[†]
and The DIII–D Team

General Atomics, P.O. Box 85608, San Diego, CA 92138-9784

We have investigated the influence of several different divertor and plasma geometries on the confinement of ELMing and ELM-free discharges on DIII–D. In low-δ (triangularity) lower single null (LSN) open-divertor operation the cryopump can maintain the plasma density a factor of 2 below the natural density of the ELMing H–mode. With D_2 puffing and pumping, we have sustained radiative divertor operation close to the desired ITER parameters [τ/τ(ITER 93) ~ 1, Z_{eff} ~ 1.8]. An extensive 2-D divertor diagnostic set, including Thomson Scattering and several spectrometers, has determined that in these (partially) detached plasmas that the divertor T_e ~ 2 eV and there is a substantial pressure drop along the field line from the midplane to the divertor (MARFE). At the outer divertor leg, a fairly uniform radiation distribution is composed of carbon radiation near the x-point and deuterium near the plate; conditions at the inner leg are also important in the transition to the detached state. We have also used density control to significantly improve the performance of weak central magnetic shear (NCS) ELMing H–mode shots (H ~ 2.4, β_n ~ 2.8, Z_{eff} ~ 1.8) and low-δ LSN ELM-free discharges with NCS [τ/τ-(ITER-89P] ~4, β_n ~ 4, T_i ~ 25-keV).

In double-null (DN) high-δ discharges without pumping, we have obtained the best plasma performance. For ELMing H-mode (low-δ), the discharge is less sensitive to D_2 gas puffing at higher x-points (~0.15 m). D_2 puffing does not cause a dramatic pressure drop along the field line and the formation of a MARFE. Changing the up/down magnetic bias and/or the ∇B drift can be used to control the direction of heat or particle exhaust.

These results have motivated the installation of a new divertor configuration on DIII–D. A graphite baffle and pump have been installed in the upper divertor so that high-δ USN or DN discharges can be pumped and the divertor will be more closed. UEDGE and DEGAS calculations predict that this structure can significantly reduce the core ionization; these codes were also used to determine the optimum slot width and length. Care was taken in the installation to insure good gas baffling and good alignment relative to the plasma. The extensive lower divertor diagnostic set is maintained, and we measure pressure, radiation, and ion flux in the upper divertor. Results with this new closed high-δ pumped divertor configuration will be compared with the previous results using the lower open divertor.

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[†]Lawrence Livermore National Laboratory.
[‡]Oak Ridge Associated Universities.
[£]Oak Ridge National Laboratory.