DEMONSTRATION OF HIGH PERFORMANCE NEGATIVE CENTRAL MAGNETIC SHEAR DISCHARGES ON THE DIII–D TOKAMAK

B.W. RICE, K.H. BURRELL, L.L. LAO, G. NAVATRIL, B.W. STALLARD, E.J. STRAIT, T.S. TAYLOR, M.E. AUSTIN, T.A. CASPER, M.S. CHU, C.B. FOREST, P. GOHIL, R.J. GROEBNER, W.W. HEIDBRINK, A.W. HYATT, H. IKEZI, R.J. LA HAYE, E.A. LAZARUS, Y.R. LIN-LIU, M.E. MAUEL, W.H. MEYER, C.L. RETTIG, D.P. SCHISSEL, H.E. ST. JOHN, P.L. TAYLOR, A.D. TURNBULL, and The DIII–D TEAM

Reliable operation of discharges with negative central magnetic shear has led to significant increases in plasma performance and reactivity in both low confinement, L–mode, and high confinement, H–mode, regimes in the DIII–D tokamak [*Plasma Physics and Controlled Nuclear Fusion Research, 1986* (International Atomic Energy Agency, Vienna, 1987), Vol. 1, p. 159]. Using neutral beam injection early in the initial current ramp, a large range of negative shear discharges have been produced with durations lasting up to 3.2 s. The total non-inductive current (beam plus bootstrap) ranges from 50% to 80% in these discharges. In the region of shear reversal, significant peaking of the toroidal rotation [$f_\phi(0) \sim 30$–60 kHz] and ion temperature [$T_i(0) \sim 15$–22 keV] profiles are observed. In high power discharges with an L–mode edge, peaked density profiles are also observed. Confinement enhancement factors up to $H \equiv \tau_E/\tau_{ITER-89P} \sim 2.5$ with an L–mode edge, and $H \sim 3.3$ in an Edge Localized Mode (ELM)-free H–mode, are obtained. Transport analysis shows both ion thermal diffusivity and particle diffusivity to be near or below standard neoclassical values in the core. Large pressure peaking in L–mode leads to high disruptivity with $\beta_N \equiv \beta_T/(I/aB) \leq 2.3$, while broader pressure profiles in H–mode gives low disruptivity with $\beta_N \leq 4.2$.