ROTATIONAL AND MAGNETIC SHEAR STABILIZATION OF MAGNETOHYDRODYNAMIC MODES AND TURBULENCE IN DIII–D HIGH PERFORMANCE DISCHARGES

L.L. LAO, K.H. BURRELL, T.S. CASPER, V.S. CHAN, M.S. CHU, J.C. DeBOO, E.J. DOYLE, R.D. DURST, C.B. FOREST, C.M. GREENFIELD, R.J. GROEBNER, F.L. HINTON, Y. KAWANO, E.A. LAZARUS, Y.R. LIN-LIU, M.E. MAUEL, W.H. MEYER, R.L. MILLER, G.A. NAVRITIL, T.H. OSBORNE, Q. PENG, C.L. RETTIG, G. REWOLDT, T.L. RHODES, B.W. RICE, D.P. SCHISSEL, B.W. STALLARD, E.J. STRAIT, W.M. TANG, T.S. TAYLOR, A.D. TURNBULL, R.E. WALTZ, and The DIII–D TEAM

The confinement and the stability properties of the DIII–D tokamak [Plasma Phys. and Contrl. Nucl. Fusion Research, 1986 (International Atomic Energy Agency, Vienna, 1987), Vol. 1, p. 159] high performance discharges are evaluated in terms of rotational and magnetic shear with emphasis on the recent experimental results obtained from the negative central magnetic shear (NCS) experiments. In NCS discharges, a core transport barrier is often observed to form inside the NCS region accompanied by a reduction in core fluctuation amplitudes. Increasing negative magnetic shear contributes to the formation of this core transport barrier, but by itself is not sufficient to fully stabilize the toroidal drift mode (trapped-electron-η_i mode) to explain this formation. Comparison of the Doppler shift shear rate to the growth rate of the η_i mode suggests that the large core ExB flow shear can stabilize this mode and broaden the region of reduced core transport . Ideal and resistive stability analysis indicates the performance of NCS discharges with strongly peaked pressure profiles is limited by the resistive interchange mode to low $\beta_N \le 2.3$. This mode is insensitive to the details of the rotational and the magnetic shear profiles. A new class of discharges which has a broad region of weak or slightly negative magnetic shear (WNS) is described. The WNS discharges have broader pressure profiles and higher β values than the NCS discharges together with high confinement and high fusion reactivity.