DPP05-2005-001382

Abstract for an Invited Paper
for the DPP05 Meeting of
the American Physical Society

The effect of shaping on plasma performance on the National Spherical Torus Experiment[1]

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NSTX has explored the effects of strong shaping on plasma performance as determined by many diverse topics such as: global MHD modes (e.g. ideal external kinks and resistive wall modes), Edge Localized Modes (ELMs), bootstrap current drive, divertor flux expansion, and heat transport. Precise plasma shape control has been achieved on NSTX using real-time equilibrium reconstruction. NSTX has simultaneously achieved $\kappa \sim 2.8$ and $\delta \sim 0.8$. Ideal MHD theory predicts increased stability at high values of shaping factor $S = q_{95}[I_p/aB_t]$, which has been observed at large values of $S \sim 34$ on NSTX. The relationship between shape and stability is examined in detail. Improved shaping capability has been crucial to achieving $\beta_t \sim 40\%$. ELM behavior is observed to depend on plasma shape factor. A description of the ELM regimes attained as shape is varied will be presented. High κ is predicted to increase the bootstrap fraction at fixed I_p. The achievement of high κ, as well as H-mode triggered early in the current ramp, has enabled operation with 1s pulses with $I_p = 1$MA. Detailed analysis of the noninductive current fraction as well as empirical analysis of the achievable plasma pulse length as elongation is varied will be presented. Data is presented showing a reduction in peak divertor heat load due to increasing in flux expansion. Tokamak global transport scaling relations (e.g ITER89P, ITERH98) indicate that confinement increases with increasing κ. Comparisons are made between these scaling relations and confinement on NSTX.

[1]Work supported by DoE contract number DE-AC02-76CH03073