Dependence of the H-mode Pedestal Structure on Aspect Ratio

R. Maingi[1], A. Kirk[2], T. Osborne[3] and the NSTX, MAST and DIII-D research teams
(email: rmaingi@pppl.gov)
[1] *Oak Ridge National Laboratory, Oak Ridge TN, 37831 USA*
[2] *UKAEA Culham, Culham, U.K.*
[3] *General Atomics, San Diego CA USA*

We report on a set of experiments between NSTX, MAST, and DIII-D to determine the aspect ratio dependence of the pedestal. The dimensionless parameters of electron collisionality ν_e^* and normalized ion gyroradius ρ_i* were matched at the top of the outboard pedestal, and the widths and gradients were assessed. These experiments were motivated in part by the fact that many of the machines in the international database used for scaling the pedestal parameters for the International Thermonuclear Experimental Reactor (ITER) have different aspect ratios, and the experiments were conducted through the ITPA pedestal physics working group. A significant dependence of the pedestal on aspect ratio would not be surprising, because variation of the aspect ratio primarily affects the edge magnetic topology.

A common double-null shape was developed for these experiments with δ~0.5 and κ~2. The toroidal fields and plasma currents used were 0.45-0.55 T and 0.6–0.8 MA in all three machines. The dimensionless parameters ν_e^*~1 and ρ_i*~0.01 were matched at the top of the outboard pedestal by variation of the target density and neutral beam heating power while maintaining ELMy H-mode. The pedestal widths and gradients were analyzed in each machine using a 'standard' modified hyperbolic tangent function; the ranges of pedestal top parameters obtained in this manner were n_e^{ped}: 3-5 $\times$ 10^{19} m^{-3}, T_e^{ped}: 100-250 eV, and P_e^{ped}: 0.4-1.5 kPa. The pedestal n_e, T_e and P_e widths measured in DIII-D for these discharges were between 6-8% in ψ_N (normalized poloidal flux), i.e. almost twice as large as the normal range of widths at the normal B_t=2.1 T. In comparison, the pedestal widths in MAST were between 1.5-4% in ψ_N, and final assessment of the widths in NSTX is still in progress. Edge stability analysis has commenced and will be presented at the conference for all three machines.

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