

Comparison of Experimental H-mode Pedestal Widths in DIII-D to a Neoclassical Pedestal Model*

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Many theoretical and empirical models predict that the width of the H-mode barrier is related to characteristics of the ion orbits and therefore to the ion temperature. One such model uses a Monte Carlo code to follow ion orbits in real diverted tokamak geometry plus a neutrals model to allow for an edge particle source [1]. This model predicts that profiles of the ion temperature and ion density have large gradients just inside the separatrix, which are qualitatively similar to what is seen in experiments. Many runs of this code [2] have been used to develop a simple prediction for the width of the ion density pedestal Δn_i :

$$\Delta n_i \sim M_i^{0.5} (T_i^{0.5} - 0.23) / B_T,$$

where T_i is the pedestal top ion temperature in keV, M_i is the ion mass and B_T is the toroidal magnetic field. A set of DIII-D data have been assembled to make an initial test of this prediction. The data are obtained from discharges which have approximately the same shape as used in the model calculations and are obtained from the pedestal buildup during the edge localized mode (ELM)-free phase of these discharges. The range of parameters in this dataset was $B_T \sim 1.0\text{-}2.0$ T, $T_i^{\text{ped}} \sim 0.3\text{-}1.2$ keV, $n_e^{\text{ped}} \sim 2.5\text{-}7.5 \times 10^{19}$ m⁻³ (where Δn_e was used as a measure of Δn_i). The model described the data reasonably well. In particular, as the ELM-free phase evolved, the width of the n_e barrier and the height of the T_i barrier both increased, and the numerical prediction of the model roughly captures the relationship between these parameters. In addition, an inverse dependence of the width of the n_e barrier on B_T is present in the data set. Further tests of this model require more careful single parameter scans of the density width against B_T and the pedestal ion temperature.

- [1] C.S. Chang, Phys. Plasmas **1**, 2649 (2004).
- [2] C.S. Chang et al., Bull. Am. Phys. Soc. **49**, 314 (2004).

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