

Developing and Testing a Predictive Model of the Pedestal Height*

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The pressure at the top of the edge transport barrier (or “pedestal height”) strongly impacts fusion performance. Predicting the pedestal height in future devices such as ITER remains an important challenge for plasma theory. While uncertainties remain, MHD stability calculations, accounting for diamagnetic stabilization, have been largely successful in predicting the observed pedestal height, when the barrier width is taken as an input [e.g. 1-2]. Such peeling-balloonning stability studies typically find that the predicted pedestal height (β_{Nped}) scales roughly with the 3/4 power of the pedestal width [2]. This strong correlation between the stability-constrained height and the width, along with significant measurement uncertainty in the width, have complicated prior efforts to discern the dependencies of the width on observed parameters. Here, we employ the peeling-balloonning stability calculations as a constraint, accounting for the strong correlation of the width and height, and allowing study of the dependencies of the width itself. In a large set of DIII-D data, as well as a set of power scans [3], we find a relatively simple scaling for the pedestal width, similar to the β_{POLped} scaling observed in [4]. Employing this working model of the pedestal width, along with peeling-balloonning stability calculations using the ELITE code, we are able to predict the pedestal height in both past and future experiments. We present an extensive set of such comparisons to DIII-D data, finding generally good agreement. Future work includes exploring variation of the width with parameters such as aspect ratio and species mass, and further study of the connection of the working model for the width with first principles theory and simulations.

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