Pedestal stability comparison and ITER pedestal prediction

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Abstract. The pressure at the top of the edge transport barrier (or “pedestal height”) strongly impacts fusion performance, while large edge localized modes (ELMs), driven by the free energy in the pedestal region, can constrain material lifetimes. Accurately predicting the pedestal height and ELM behavior in ITER is an essential element of prediction and optimization of fusion performance. Investigation of intermediate wavelength MHD modes (or “peeling-ballooning” modes) has led to improved understanding of important constraints on the pedestal height and the mechanism for ELMs. The combination of high-resolution pedestal diagnostics, including substantial recent improvements, and a suite of highly efficient stability codes, has made edge stability analysis routine on several major tokamaks, contributing both to understanding, and to experimental planning and performance optimization. Here we present extensive comparisons of observations to predicted edge stability boundaries on several tokamaks, both for the standard (Type I) ELM regime, and for small ELM and ELM-free regimes. We further discuss a new predictive model for the pedestal height and width (EPED1), developed by self-consistently combining a simple width model with peeling-ballooning stability calculations. This model is tested against experimental measurements, and used in initial predictions of the pedestal height for ITER.