The EPED pedestal model and ELM-suppressed regimes: Studies of quiescent H-mode and development of a model for ELM suppression via resonant magnetic perturbations

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The EPED model predicts the H-mode pedestal height and width based upon two fundamental and calculable constraints: 1) onset of non-local peeling-ballooning modes at low to intermediate mode number, 2) onset of nearly local kinetic ballooning modes at high mode number. We present detailed tests of the EPED model in discharges with edge localized modes (ELMs), employing new high resolution measurements, and finding good quantitative agreement across a range of parameters. The EPED model is then applied for the first time to Quiescent H-mode (QH), finding a similar level of agreement between predicted and observed pedestal height and width, and suggesting that the model can be used to predict the critical density for QH-mode operation. Finally, the model is applied toward understanding the suppression of ELMs with 3D resonant magnetic perturbations (RMP). Combining EPED with plasma response physics, a new working model for RMP ELM suppression is developed. We propose that ELMs are suppressed when a "wall" associated with the RMP blocks the inward penetration of the edge transport barrier. A calculation of the required location of this "wall" with EPED is consistent with observed profile changes during RMP ELM suppression, and offers an explanation for the observed dependence on safety factor (q_{95}).

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