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TH/P3-17: The EPED Pedestal Model: Extensions, Application to ELM-Suppressed Regimes, and ITER Predictions

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The pressure at the top of the edge transport barrier (or "pedestal height") strongly impacts global confinement and fusion performance, while large ELMs can significantly limit component lifetimes. Hence, accurately predicting the ped¬estal height in ITER, as well as developing a predictive understanding of ELM suppression, are essential. 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 (P-B) modes at low to intermediate mode number, 2) onset of nearly local kinetic ballooning modes (KBM) at high mode number. The model calculates both constraints directly with no fit parameters, using ELITE to calculate the P-B constraint, and a "BCP" technique, supplemented by gyrokinetic eigenvalue calculations with GYRO, to calculate the KBM constraint. EPED has been successfully compared to observed pedestal height for 259 cases on 5 tokamaks, finding agreement within ~20%. Major new results are successful testing of EPED in Quiescent H-Mode discharges, and the development of a working model to understand ELM suppression by resonant magnetic perturbations (RMPs). Dynamically, the ELM crash is typically followed by a recovery, in which the pressure gradient encounters the KBM limit, but the pedestal can continue to broaden until the P-B boundary is reached, an ELM is triggered, and the cycle repeats. The ELM can be suppressed if this recovery phase is interrupted such that the width of the edge barrier is prevented from continuing to broaden. We propose an EPED-based working model for suppression of ELMs by RMPs in which the conceptual "wall"is provided by a resonant island or stochastic region that drives strong transport and prevents inward pedestal propagation. This leads to predictions of specific profile changes and ranges of q in which ELM suppression is possible, which agree with initial tests on DIII-D. EPED predictions for ITER have been made for more than 100 baseline and hybrid cases, finding a high pedestal that is further optimized at high density. Detailed predictions, including expected requirements for QH Mode and RMP ELM suppression, as well as coupling to core transport predictions, will be discussed.

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