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Optimized H-mode pedestal predictive model for coupled core-pedestal simulations on EAST

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The physical processes in tokamak plasma are strongly related to the coupling between the core and the pedestal. The accurate prediction of the kinetic profiles (electron temperature and density) from the pedestal to the core lays the physics basis for fusion performance optimization in future plasma-burning tokamak devices. An integrated modeling workflow was developed to predict the kinetic profiles ranging from the axis to the separatrix for DIII-D discharges [1], which mainly based on the EPED model [2-3] and the TGYRO transport module [4]. EAST have achieved a series of records in steady-state long-pulse H-mode operation in past experimental campaigns, it is necessary to predict the kinetic profiles ranging from the axis to the separatrix for EAST H-mode plasmas based on the same workflow.

The REPED model was developed to predict the pedestal height for EAST H-mode discharges [5], where the width model ($\Delta_\psi = 0.12\beta_{p,ped}^{1/2}$, Δ_ψ is the pedestal width and $\beta_{p,ped}$ is the poloidal pedestal beta) was optimized based on experimental observations (Figure 1); compared to the EPED model, the coefficient between Δ_ψ and $\beta_{p,ped}^{1/2}$ in EAST (~0.12) is higher than that in DIII-D (~0.076). For the core plasma, the prediction of the kinetic profiles (electron density and temperature) was successfully achieved using the TGYRO transport solver [6-7].

Based on the REPED model and the TGYRO module, the method of core-pedestal coupling was applied for EAST H-mode simulations, and figure 2 shows the comparison of profile predictions with experiments for EAST discharge. It demonstrates that the REPED model and the TYGRO transport module can provided initial predictions of the kinetic profiles ranging form the core to the pedestal by comparing the experiments with the simulations. However, it is necessary to refine the core-pedestal coupling simulation to improve its generality and adaptability in the future work.

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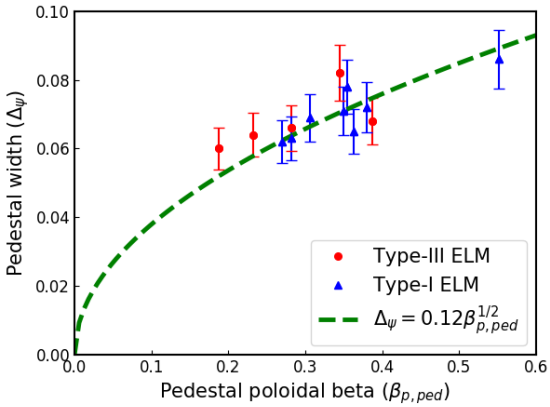

Figure 1. The measurements of Δ_ψ and $\beta_{p,ped}$ are plotted for H-mode discharges on EAST.

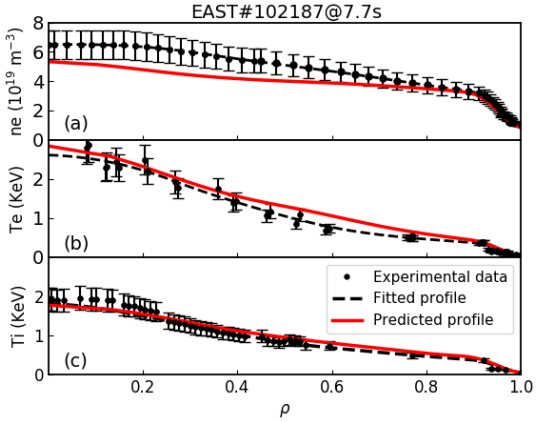

Figure 2. The comparison of profile predictions with experiments are plotted for EAST discharge. The black dashed lines are the fitted profiles, and the red solid lines represent the predicted kinetic profiles.