Comparison of Analytic Model for Density Profile to UEDGE Simulations*

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As reported at the TTF meeting in 2001, an analytic model has been developed for the density profile at the periphery of a confined plasma. Within its range of validity (edge temperature in the range 0.02–0.3 keV) this model has successfully predicted measured widths of the edge density pedestal and observed scalings of the width and gradient of the profile in the DIII–D tokamak. Due to the complexity of neutral transport in the scrape-off layer and confined plasma, some simplifying assumptions were required to produce the analytic model. Neutrals arriving at the separatrix are assumed to be a combination of charge exchange neutrals with the local ion temperature and Frank-Condon neutrals with energies of a few eV, the rate coefficients for ionization and charge exchange in the plasma are assumed to be constant (approximately valid for temperatures of 0.02–0.3 keV), multiple charge exchange in the confined plasma is ignored and the fueling is assumed to be poloidally localized in the vicinity of the divertor. Initial bench-marking of this simplified model with the neutral fluid neutrals model in the UEDGE boundary simulation code have been initiated to test the validity of these assumptions. Preliminary results show that the widths of the density profiles computed with the analytic code are ~ 50% larger than those computed with UEDGE. The UEDGE code predicts that the width decreases as the pedestal density increases, as predicted qualitatively by the analytic model. However, the UEDGE code predicts that the fuelling location expands poloidally as the density increases and this results in the width not falling of quite as fast as the analytic prediction of $1/n_{e,ped}$.

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