Study of near SOL decay lengths in AUG under attached and detached divertor conditions

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Improvements to the Thomson Scattering diagnostic have enabled the study of near scrape-off layer (SOL) decay lengths in ASDEX Upgrade. A database with attached, partially detached and completely detached divertors has been constructed of ASDEX Upgrade discharges in both H-mode and L-mode plasmas with Thomson Scattering data suitable for the analysis of the upstream SOL electron profiles. SOL electron temperature $T_e$ profiles have been found to have a radial exponential decay distribution and which does not vary poloidally, consistent with the two-point model. By comparing upstream, $\lambda_{T_e,u}$, with the scaling based on the downstream IR measurements, $\lambda_{qle}$, it is found that the results are consistent with a dominant classical electron conductivity in relating the electron temperature decay width, $\lambda_{T_e,u}$, and power width, $\lambda_{qle}$. The combined dataset can be described by both a single scaling and a separate scaling for H-mode and L-mode. For the single scaling, the temperature decay width, $\lambda_{T_e,u}$, is inversely proportional to the separatrix temperature, $T_{e,s}$. This dependence explains why, for the same global plasma parameters, $\lambda_{qle}$ in L-mode is approximately twice that in H-mode and under detached conditions, the SOL upstream electron profile broadens when the density reaches a critical value. Comparing the derived scaling from experimental data with a simple expression derived from power balance, gives the cross-field thermal diffusivity as $\chi_\perp \propto T_e^{1/2}/n_e$, consistent with earlier studies on Compass-D, JET and Alcator C-Mod. The separate scaling gives results similar to those previously reported for the H-mode, but here the wider SOL width for L-mode plasmas is explained simply by the larger premultiplying coefficient. The relative merits of the two scalings in representing the data are discussed.