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Recent progress towards a quantitative description of filamentary SOL transport

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Heat and particle transport onto plasma-facing components is a key issue for next generation tokamaks, as it will determine the erosion levels and the heat loads at the main chamber first wall. In the Scrape-off Layer (SOL), this transport is thought to be dominated by the perpendicular convection of filaments. In this work, we present recent experiments which have led to an improved picture of filamentary transport, and its role on the onset of a density profile flattening, known in the literature as the density "shoulder"[B. LaBombard, et al., Phys. Plasmas 8, 2107 (2001)]. First, L-mode experiments carried out in the three tokamaks of the ITER stepladder (COMPASS, AUG and JET) showed how normalized divertor collisionality [J. R. Myra, et al., Phys. Plasmas 13, 092509 (2006)] can be used to scale both filament size and the density e-folding length in the far SOL. Furthermore, a transition in the filament regime is found to be the reason for the formation of the density shoulder, as it coincided with a change in the scaling of filament size with propagation velocity from Sheath Limited regime to Inertial regime [D. Carralero et al, Phys. Rev. Lett., 115, 215002 (2015)]. This result was later confirmed in AUG by independent experiments which showed how the polarization term in the charge conservation equation became dominant after the onset of the shoulder and how the transition was reversed as filaments propagate radially across regions of decreasing collisionality. Besides, measurements carried out in AUG with a Retarding Field Analyzer in equivalent discharges have led to the discovery of a strong reduction of T_i in the far SOL after the onset of the shoulder, both in filaments and background plasmas, which can not be explained by the minor reduction of T_i at the separatrix. Finally, equivalent experiments in H-mode carried out in AUG have shown how inter-ELM filaments follow the same general behavior as L-mode filaments, and how a density profile flattening reminiscent of the density shoulder is observed when collisionality is increased over a similar threshold. Besides, Thomson Scattering data indicate the same sharp increase on the e-folding length of density and electron temperature in the near SOL above a critical collisionality.

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