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SOL transport and filamentary dynamics in high density tokamak regimes

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Addressing the role of Scrape Off Layer filamentary transport is a subject of intense studies in fusion science. Intermittent structures dominate transport in L-Mode and strongly contribute to particle and energy losses in H-mode. The role of convective radial losses has become even more important due to its contribution to the shoulder formation in L-Mode, describing the progressive flattening of the density scrape off layer profile at high density [1–3]. Investigation of this process revealed the strong relationship between divertor conditions and the upstream profiles, mediated by filaments dynamics which varies according to the downstream conditions. Preliminary investigations suggested that similar mechanisms occur in H-Mode [1] and that filaments contribute the SOL transport in H-mode density limit (HDL) as well [4]. The present contribution will report on results obtained on ASDEX-Upgrade and TCV tokamaks, to address the role of filamentary transport in high density regimes both in L- and H-Mode. The combined results enlarge the operational space, from a device with a closed divertor, metallic first wall and cryogenic pumping system to a carbon machine with a completely open divertor. The mechanism of shoulder formation and the role of filaments have been tested against variation of plasma current, magnetic configuration (single and double null plasmas), and divertor neutral densities, through modification of cryopump efficiency. At constant magnetic field the density decay length increases with filament-size independently of the plasma current for both machines in L-mode, consistently with the fact that upstream profiles and divertor neutral pressure exhibit the same trend with normalized greenwald fraction. In H-Mode fueling is insufficient to cause flattening of SOL profiles in the inter-ELM phases since large neutral pressure is needed. Consistently inter-ELM blob size in AUG are found larger whenever the cryopumps is switched off. The resulting picture suggests a complex relationship between divertor and upstream profiles, where filaments are modified by divertor conditions as well as by neutral particles interaction. [1] Carralero, D et al. Nucl. Fus. 57, 056044 (2017) [2] Militello, F et al. Nucl. Fus. 56, 016006 (2016). [3] Vianello, N. et al. Nucl. Fus. 57, 116014 (2017) [4] Bernert, M et al. Plasma Phys. Control. Fus. 57, 014038 (2014).

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