SOL transport and filamentary dynamics in tokamaks: from L to inter-ELM filaments in high density regimes

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Addressing the role of Scrape Off Layer filamentary transport is presently a subject of intense studies in fusion science. Intermittent coherent structures are found to dominate transport in the L-Mode scenarios and to strongly contribute to particle and energy losses in the ELM and inter-ELM phases in H-mode. The role of convective radial losses towards the first wall has become even more important due to its contribution to the so called process of *shoulder formation* in L-Mode, describing the progressive flattening of the density scrape off layer profile at high density [1–4]. Investigation of this process revealed the strong relationship between divertor conditions and the upstream profiles, mediated by filaments dynamics, which varies according to the modification of the downstream condition. Preliminary investigations suggested that similar mechanisms are likely to occur in H-Mode as well [5] and even contribute to the so-called H-mode density limit (HDL) [6]. The present contribution will report the results obtained in a coordinated effort between the ASDEX-Upgrade and TCV tokamaks, to address the role of filamentary transport in high density regimes both in L and H-Mode. The combination of results from different machines enlarges the operational space explored, from a device with a closed divertor, metallic first wall and a highly efficient cryogenic pumping system to a carbon machine with a complete open divertor. The mechanism of shoulder formation and the role of filamentary transport have been tested against variation of parallel connection length, obtained through a current scan and poloidal flux variation, against magnetic topology, comparing single and double null configurations and against divertor neutral densities, through modification of cryopump efficiency. Upstream profiles are found strongly resilient to modification through flux expansion whereas current variation at constant B_t is found very efficient in modifying both the target and upstream profiles. On the other hand fueling is not a sufficient ingredient to cause saturation of SOL profiles in H-Mode since a certain amount of neutral pressure is needed. The resulting picture suggests a complex relationship between divertor and upstream profiles, where filaments are modified by divertor collisionality as well as by neutral particles interaction.

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