SOL transport and filamentary dynamics in high density tokamak 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 structures are found to dominate transport in L-Mode and to strongly contribute to particle and energy losses in H-mode as well. 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 [1–4]. Investigation of this process revealed the strong relationship between divertor conditions and the upstream profiles, mediated by filaments dynamics which varies according to the downstream conditions. Preliminary investigations suggested that similar mechanisms occur in H-Mode as well [5] and 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 combined results enlarges the operational space explored, from a device with a closed divertor, metallic first wall and 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, through a current or flux expansion scan, against magnetic topology, comparing single and double null plasmas and against divertor neutral densities, through modification of cryopump efficiency. Upstream profiles are found strongly resilient to modification through flux expansion, or magnetic topology, whereas I_p scan at constant B_t is found very efficient in modifying upstream profiles in both the devices. This is accompanied by a variation of blob sizes which are larger at smaller current for similar values of divertor collisionality in TCV. On the other hand fueling is insufficient to cause saturation of SOL profiles in H-Mode since large neutral pressure is needed. Consistently coherent fluctuations detected on J_{sat} in the inter-ELM phase in AUG are found larger whenever the cryopumps is switched off. This, together with observations from JET [7], suggests that a proper way to control upstream profiles in H-Mode can be based on pumping efficiency and design with respect to divertor geometry. 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.

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