SOL profile and transport and relation to divertor conditions in H-Mode plasmas: a cross-machine comparison

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Plasma Wall Interaction (PWI) is a subject of intense studies in the context of fusion energy research for the understanding of the amount of heat loads, tritium retention, and the lifetime of different Plasma Facing Components. In recent years great efforts have been devoted to the interpretation of Scrape Off Layer (SOL) transport, with clear impact also on the design of future machines [1]. Transport in the SOL region, resulting from a competition between sources and losses parallel and perpendicular to the magnetic field, is dominated by the presence of intermittent structures, filaments, which strongly contribute to particle and energy losses both in L- and H-mode regimes. On the other side, with the approaching if ITER-era it is mandatory to address SOL transport in regimes which are relevant from the ITER perspective. As clearly highlighted in [2], in order to keep the power fluxes densities acceptable for the target material high neutral pressure and partial detachment are needed in order to ensure maximum tolerable loads based on avoidance of W recrystallization.

Experimentally these regimes are obtained in present experiments with high gas throughput leading to high density regimes and these regimes are generally accompanied in L-Mode by the development of a *shoulder formation* describing the progressive flattening of the density scrape off layer profile at high density [3–6]. Preliminary investigations suggested that similar inter-ELM SOL density profile broadening is observed in H-mode as well [7–9], more pronounced with high neutral pressure [9].

The present contribution will report results obtained in a coordinated effort within 3 different devices, JET, ASDEX-Upgrade and TCV focusing on the SOL profile evolution in different divertor recycling states, obtained at different recycling divertor condition, trying to correlate the observed profile modification with different turbulent SOL plasma transport. The mechanism of shoulder formation and the role of filamentary transport have been tested against variation of plasma current, magnetic topology, by comparing single and double null plasmas, and divertor neutral densities, through modification of cryopump efficiency.

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