Experimental results of SOL transport in high and low density discharges

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Heat loads and erosion fluxes on plasma facing components (PFC) have to be controlled in next step fusion devices in order to guarantee a sufficiently long and safe plasma operation. Therefore, an understanding of scrape-off layer (SOL) transport is essential since it determines the distribution of heat and particles reaching the PFCs [1].

Particles and heat leaving the plasma through the last closed flux surface (LCFS) are thought to be dominantly transferred parallel to the magnetic field lines into the divertor. Detachment, optimized target components and seeding of impurities seem to enable the divertor PFCs to withstand the parallel heat loads of several MW/m^2 even for reactor conditions [2]. At low densities the measured power and particle fall-off lengths in the SOL confirm the assumption of dominant parallel transport, and intermittent events like blobs do not significantly change this picture.

There is however more and more experimental evidence that the perpendicular transport in the far SOL is increased and can even become larger than the parallel transport if the density surpasses a certain threshold [4, 5]. In this regime, the convective transport leads to a broadening of SOL density profiles and the size as well as the velocities of blobs are increased. Experimental investigations of reactor relevant scenarios close to the density limit suggest that the filamentary transport contributes significantly to the global power balance.

In this presentation, the common features of SOL transport in low and high density plasmas from different experiments are summarized. The prominent role of filamentary transport and its dependence on density and divertor parameters is presented. Finally, the role of finite ion temperatures on SOL transport and the implications of the presented experimental results for reactor relevant discharge scenarios are discussed.

References

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