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From Edge Non-Stiffness to Improved IN-Mode: a New Perspective on Global Tokamak Radial Transport

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Dedicated experiments have been performed on the TCV tokamak to compare the inverse scalelengths of the main plasma region with the one observed in the edge region in standard L-mode plasmas. The main plasma region is known to be characterized by a central region with relatively flat profiles, influenced by the sawtooth activity, and a stiff region where the inverse scalelength is relatively independent on the heat flux. TCV has demonstrated recently that the edge region, inside the last closed flux surface, is not stiff and is key to understanding global confinement properties [1]. It is shown that the inverse scalelength in this region increases with increasing I_p, increasing P_ECH, increasing density and with a change of the plasma triangularity from positive to negative.
The role of this non-stiff edge region is also key to understanding the saturation of the ohmic confinement at high density [1]. In these experiments, the ion transport is seen to be essentially neoclassical and the dependence of T_i profiles with I_p will be discussed as well.
A new improved L-mode, called the IN-mode, has been obtained on TCV with global confinement time scaling near H-mode values, H_98y2=0.9. This mode will be discussed in detail and compared with the edge non-stiffness discussed above. On TCV, the edge T_e does not show a steep gradient, but the edge density is maintained high, hence the name IN-mode. This high edge density is favourable for keeping high T_i values and good global confinement. The IN-mode has been obtained over a wide range of q_95 and density values, thanks to either a short transition into H-mode or a high gas puffing rate applied directly after break-down and sustained during the I_p ramp-up. Indications are that low l_i are sustained in this way.
Core and edge transport properties of these L-mode plasmas are studied in detail with ASTRA simulations [2] and help to better characterize the non-stiff edge properties. The evolution of the profiles up to the L- to H-mode transition is analyzed as well. In particular the role of the edge bootstrap current on the edge q profile is analyzed, with the bootstrap current building up thanks to the edge non-stiff region having steep gradients.

[1] O. Sauter et al, accepted in PoP.

[2] G.V. Pereverzev and P.N. Yushmanov, IPP Report, 2002.

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