Fast edge charge exchange measurements of E_r at the L-H transition in ASDEX Upgrade

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The high confinement mode (H-mode) is obtained via a sudden transition (L-H transition) showing the development of an edge transport barrier together with a change of the global confinement. Recent observations at ASDEX Upgrade have shown a correlation between the edge ion heat flux and the L-H transition, [1]. In line with that, a threshold for the radial electric field minimum has been observed which is independent of densities for a constant magnetic field of -2.5 T highlighting the importance of $\nabla p_i/(n_i e)$ in the L-H transition mechanism, [2].

A recent upgrade of the ASDEX Upgrade CXRS system permits a full reconstruction of the impurity ion kinetic profiles and of the radial electric field at the plasma edge without the necessity of a sweep of the plasma position. This setup allows to document for all variations in the LH threshold the E_r and ion profiles behavior. Studies for L-H transitions at different power thresholds obtained via a change ion drift direction, a Bt-scan or the isotope effect will be presented.

The characteristic time scale of the L-H transition can be associated to the typical frequency (1-10 kHz) of the fluctuating phases (sometimes called I-phase) for slow L-H transition as observed in different machines [3, 4]. Therefore, a similar time resolution is mandatory for investigating the causality of the transition mechanism. Such fast studies on the role of the ion channel for the L-H transition are now possible at ASDEX Upgrade thanks to the upgraded edge CXRS system as also a new acquisition system has been developed which allows temporal resolution of down to 50-100 μs. A good signal to noise ratio has been obtained for a sampling rate of 10 kHz in a beam blip triggered I-phase. Correlations between turbulence fluctuations as measured by Doppler reflectometry and changes in the edge profile gradients are currently investigated.

References

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