

Radial electric field profile, magnetic topology and improvement of the confinement in the WEST tokamak

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WEST is a large aspect ratio tokamak ($A=5-6$) with superconducting coils (magnetic ripple around 2.3% at the plasma edge) and all tungsten plasma-facing components. It possesses symmetric upper and lower divertors and its plasmas are RF heated (using both Lower Hybrid and Ion Cyclotron Resonance Heating systems) with active X-point either on the upper or lower divertor and a $B \times \nabla B$ drift pointing downwards [1,2]. The profile of the radial electric field is measured by Doppler BackScattering system (DBS) [3] in different magnetic configurations and for various levels of additional power.

It is found that the radial velocity profile is clearly more sheared in LSN than in USN configuration for ohmic and low current plasmas, consistently with the expectation comparing respectively “favourable” versus “unfavourable” configuration. Interestingly, this tendency is sensitive to the plasma current and to the amount of additional heating power leading to plasma conditions in which the $E \times B$ velocity exhibits a deeper well in USN configuration. For example, while the velocity profile exhibits a clear and deep well just inside the separatrix concomitant with the formation of a density pedestal during L-H transitions observed in LSN configuration, deeper E_r wells are observed in USN configuration during similar transitions with less pronounced density pedestal.

In addition, in these discharges in USN, two kind of dynamics are observed on DBS signal. The most commune behavior corresponds to an oscillation around a certain value of both the signal amplitude (i.e fluctuation intensity) and the frequency signal (i.e velocity). The other dynamics, appearing at a particular time in the discharge, is a bursty dynamics : the amplitude signal exhibit burst events with a frequency in a radial zone which extends across the well and inner branch associated with bursts of high Doppler velocities.

In this contribution, the shape of the $E \times B$ velocity profile and its dynamics measured by DBS are investigated in both favourable and unfavourable, in presence of various levels of additional power regarding the access to transitions towards improved confinement regimes.

[1] Bucalossi J. and the WEST team, Fusion Eng. and Design 89 (2014) 907-912

[2] Bourdelle C. et al., Nucl. Fusion 55, 063017 (2015)

[3] Hennequin P. et al. Nucl. Fusion 46, S771–S779 (2006)