Importance of sheared ExB flows on the control of the ISTTOK turbulent transport

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Emissive electrode biasing experiments have been previously investigated on ISTTOK [1]. Experiments revealed that although a large radial electric field is induced by emissive electrode bias for both polarities (up to ±15 kV/m), a significant improvement in particle confinement is only observed for negative bias. A substantial increase in the plasma density is observed for both polarities; however, positive bias tends to increase recycling. The main motivation for this work is therefore to contribute to the better understanding of the distinct plasma behaviour with positive and negative bias. The boundary plasma was further characterized with focus on the relation between ExB sheared flows and particle transport. The use of emissive electrodes allowed, for the first time, the extension of this investigation to negative bias.

The ExB flow shear has been independently estimated from a radial array of Langmuir probes and a Gundestrup probe, which measures the parallel and perpendicular plasma flows. A good agreement has been found both in the profile and the absolute magnitude. We have observed that the magnitude of the ExB flow shear, in the region just inside the limiter position, is larger for negative bias. The ExB sheared flows induced by negative bias exceeds significantly the turbulence de-correlation time across most of the boundary plasma, while for positive bias this is only valid near the LCFS (r-a>-4 mm). The importance of the ExB flow shear on the global particle confinement has been demonstrated by the good correlation observed between these two quantities for both polarities in a wide range of bias conditions. Results support therefore that the distinct particle confinement behaviour observed for positive and negative bias is related with the different ExB flow profile induced by edge biasing.

The effect of electrode bias on the edge turbulent transport has also been investigated identifying the changes induced on the fluctuations frequency spectrum and probability distribution function, PDF. We have observed that negative electrode bias reduces the large amplitude, low frequency events, resulting in low amplitude fluctuations with a near Gaussian distribution across most of the scanned region. For positive bias, a substantial reduction of the fluctuations is also observed in the SOL. However, large amplitude, broad spectrum fluctuations appear in the core periphery, which increase the cross-field transport and contribute to the observed asymmetry in particle confinement with the bias polarity.

References

[1] C. Silva, I. Nedzelskiy, H. Figueiredo, R.M.O. Galvão, J.A.C. Cabral and C.A.F. Varandas, Nucl. Fusion 44 (2004) 799