On the link between flows, turbulence and electric fields in the edge of fusion plasmas

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This paper presents a view of experimental results and progress in the investigation the role of Reynolds stresses in the self-organization of parallel/perpendicular flows in the edge region of fusion plasmas.

The structure of turbulence and flows has been investigated during the spontaneous development of edge ExB sheared flows [1] and transition to biasing induced improved confinement regimes in the TJ-II stellarator [2].

Edge radial electric fields and ExB shear increase and the level of edge fluctuations is significantly reduced during biasing-induced improved confinement regimes in TJ-II. Indications are found suggesting that the turbulence reduction could be scale – selective and the increased ExB shear could affect the eddy anisotropy in the increased ExB shear could affect the eddy anisotropy in the radial-poloidal plane [3]. In addition, parallel flow measurements show changes in the order of $\Delta M_{||} \approx 0.2$ in the edge plasma region.

In order to investigate the role of ExB sheared flows as a symmetry breaking mechanism [4] the cross-correlation coefficient ($< \tilde{v}_r \tilde{v}_{||} > / v_r^{rms} v_{||}^{rms}$) was computed during the development of biasing induced ExB flows. Experimental results show that, although the level of turbulence decreases, the phase coherence increases. The evolution of $< \tilde{v}_r \tilde{v}_{||} >$ and $< \tilde{v}_r \tilde{v}_{||} > / v_r^{rms} v_{||}^{rms}$ during the development of spontaneous ExB sheared flows, which organize themselves near marginal stability with fluctuations, will be reported.

These experiments can provide some light to test critically the importance of symmetry breaking mechanisms (via ExB sheared electric fields) on momentum driven by turbulence [4].

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[3] A. Alonso et al., Plasma Physics and Control Fusion 48 (2006) B465-B473
[4] O. Gurcan et al., Phys of Plasma (2006)