On the link between flows, turbulence and electric fields in the edge of the TJ-II stellarator

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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 the TJ-II stellarator. The structure of turbulence and flows has been investigated during the spontaneous development of edge ExB sheared flows[1] and the transition to biasing induced improved confinement regimes[2]. Edge turbulence was characterized by means of arrays of Langmuir probes and fast camera diagnostics. Edge radial electric fields and ExB shear increases and the level of edge fluctuations is significantly reduced during biasing-induced improved confinement regimes in TJ-II. In addition, parallel flows show changes in the order of $\Delta M_{\|} \approx 0.3$ in the edge plasma region.

In order to investigate the role of ExB sheared flows as a symmetry breaking mechanism[3] the cross correlation coefficient $\left\langle \tilde{v}_r \tilde{v}_{\|} \right\rangle / v_r^{rms} v_{\|}^{rms}$ was computed during the development of biasing induced ExB flows. Experimental results show that, although the level of turbulence decreases, the phase coherence increases and sustains gradients in the Reynolds component $\left\langle \tilde{v}_r \tilde{v}_{\|} \right\rangle$ that are found to be of same order of the change in the friction term $\mu \Delta M$. Significant turbulent parallel forces at plasma densities above the threshold value to trigger ExB sheared flows have also been found in the TJ-II stellarator[4].

These experiments can provide some light to critically test the importance of symmetry breaking mechanisms (via sheared electric fields) and convective turbulent transport on parallel momentum dynamics.

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[3] O. Gurcan, et al. Phys. of Plasma (submitted)
[4] B. Gonçalves, et al. 2006 Phys. Rev. Lett. **96** 145001