

Radial electric field profiles in JET advanced tokamak scenarios with toroidal field ripple

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A dedicated campaign to study the effect toroidal field (TF) ripple on plasma performance has been carried out on JET. The toroidal rotation velocity (v_ϕ) profiles are modified by the ripple induced losses of both fast and thermal ions creating an edge region with counter rotation [1]. The changes in the toroidal rotation profile affect the radial electric field (E_r) and \mathbf{ExB} shearing rate ($\omega_{\mathbf{ExB}}$) and influence the formation and sustainment of internal transport barriers (ITBs) [2]. Neoclassical estimates for poloidal rotation (v_θ) were calculated by NCLASS in the JETTO code. However, a local spin-up of v_θ in the ITB region has recently been measured on JET [3] and was also observed in plasmas with both reversed and optimised magnetic shear in the presence of various levels of TF ripple. Experimental measurements of poloidal rotation velocity are considerably higher than the neoclassical values and seem to increase with the strength of the ITB (i.e. the pressure gradient). The dependence of v_θ on the local ion temperature gradient scale length and on the background toroidal rotation is examined. The edge and core rotation and pressure gradient profiles are combined for the first time to calculate the full experimental E_r and $\omega_{\mathbf{ExB}}$ profiles over the entire plasma radius. The relationship between the ITB performance, $\omega_{\mathbf{ExB}}$ and v_θ is explored for values of TF ripple similar to those expected on ITER. A comparison is made between plasmas with strongly reversed and optimised magnetic shear.

[1] P. de Vries et al., Nucl. Fusion **48** (2008) 035007

[2] P. de Vries et al., "Toroidal Field Ripple and the Formation of Internal Transport Barriers" accepted for publication in PPCF (2008)

[3] K. Crombé et al., Phys. Rev. Letters **95** (2005) 155003

*See appendix of M.L. Watkins et al., Proc. 21st Int. Conf. On Fusion Energy 2006 (Chengdu, China) Vienna:IAEA