Toroidal momentum transport in limited and diverted TCV Ohmic plasmas

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Experimental characterisation of the momentum transport in the basic scenario of L-mode Ohmic plasmas is important in the predictive modelling frame, since it is a primary test case for any proposed momentum transport model. The TCV tokamak, equipped with Diagnostic Neutral Beam based CXRS, is able to measure time resolved toroidal rotation profiles in discharges with negligible momentum input; in the used arrangement, 8 local measurements of toroidal plasma velocity are provided along the low field plasma minor radius are provided with a sample period of 90 ms.

Recent TCV experimental campaigns have extensively explored the scenario of Ohmic L-mode discharges with no momentum input, for both plasma in limited and diverted magnetic configurations, showing that non-diffusive radial fluxes dominate the toroidal momentum transport, and demonstrating the existence of distinct momentum transport regimes that depend on the plasma parameters. In limited discharges, the steady state toroidal rotation was found directed in the counter current direction, with values of $\omega_\varphi \sim$ 10-40 krad/s in the plasma core, decreasing close to zero towards the plasma edge [1]. An inversion of the toroidal rotation profile was observed when $\bar{n}_e$ exceeded 4×10^{19} m^{-3}, indicating a change of direction in the non-diffusive (pinch-like) momentum flux [2]. An apparently opposite behaviour is found for diverted discharges: the stationary ω_φ profile typically peaks in the current direction for low density plasmas, and in the counter current direction at high plasma density ($\bar{n}_e \geq 4\times10^{19}$ m^{-3}). In both cases $|\omega_{\varphi,\max}-\omega_{\varphi,\mathrm{edge}}|\sim$10-30 krad/s. Contrary to the limited case, edge toroidal rotation is found to vary with plasma parameters ($|\omega_{\varphi,\mathrm{edge}}| \leq$15 krad/s). From the present work, we will assess the stationary ω_φ profile dependence on plasma parameters (n_e, I_p, B_t, shape, magnetic configuration), characterising the non-diffusive part of momentum fluxes, in terms of magnitude, direction and profile evolution. A link between edge rotation and momentum sources will be discussed.

[1] A.Scarabosio *et al.*, Plasma Physics and Controlled Fusion 48, 633 (2006).
[2] A.Bortolon *et al.*, Physical Review Letters 97, 235003 (2006).