Parallel flow and turbulence interplay in Tore Supra & TOKAM-3D modelling effort

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A series of experiments has been performed on Tore Supra to investigate the properties of the parallel flow in the SOL. A reciprocating Langmuir probe has been used for both the measurement of the parallel flows and the ion saturation current. These probes are located at the top of the device, the grad B being oriented downwards. The change of parallel flow pattern and of the turbulence properties have been performed by changing the poloidal location of the limiter contact point. In particular, when the main limiter is the lower toroidal limiter a large flow with Mach number 0.5 oriented from the low field side to the high field side is recorded at the top of the device in agreement when the data from X-point configurations with the same grad B direction. In such discharges, the SOL e-folding length exhibits two scales, a small e-folding length towards the separatrix and a longer decay length further into the SOL. This change in e-folding length is correlated to a change in the properties of the fluctuation Probability Distribution Function, in particular a change in the skewness from a nearly constant value to a steady increase outwards.

The modelling of these results has been performed with the TOKAM-3D code. This code is a full torus 3D turbulence and transport code including all drift terms and open and closed field lines with circular cross section (hence similar magnetic geometry to Tore Supra). The code is based on fluid equation, presently for isothermal plasmas, and flux driven conditions. Including the large scale flow pattern governed by the drifts and the neoclassical pattern as well as turbulence ballooning of transport and radial spreading of the flow, one recovers the experimental evidence (0.5 Mach flow at the top of the vessel).