

# Neoclassical and transport driven parallel SOL flows on TCV

R. A. Pitts<sup>1</sup>, J. Horacek<sup>2</sup>, X. Bonnin<sup>3</sup> and the TCV Team<sup>1</sup>

<sup>1</sup>*École Polytechnique Fédérale de Lausanne (EPFL), Centre de Recherches en Physique des Plasmas, Association Euratom – Confédération Suisse, 1015 Lausanne, Switzerland*

<sup>2</sup>*Association EURATOM–Institute of Plasma Physics, Prague, Czech Republic*

<sup>3</sup>*CNRS-LIMHP, Université Paris 13, 99 ave JB Clément, F-93430 Villetaneuse, France*

Ion flows parallel to the magnetic field in the tokamak scrape-off layer (SOL) are now widely suspected to be an important player in the process of material migration, itself known to influence fuel retention. In addition to the neoclassical (field direction dependent), Pfirsch-Schlüter (P-S) component, a second contribution receiving increasing attention is a field direction independent flow, thought to be a consequence of the ballooning nature of cross-field transport into the SOL. Previous experiments on TCV clearly identified a possible “transport driven flow offset” and showed it to be of magnitude consistent with radial particle transport in the outboard SOL driven by convective interchange motions [1]. Nevertheless, given the chosen TCV magnetic equilibrium geometry and the measurement location *below* the outboard midplane, it was not possible in that earlier study to exclude a particle sink effect of the outer divertor target driving a parallel flow extending into the main SOL.

In new experiments, described here, the shape flexibility of TCV has been used to position the plasma such that a fast reciprocating Mach probe samples the outboard SOL radial flow profile precisely on the magnetic axis in a series of closely matched single null lower (SNL) ohmic discharges with forward (FWD) and reversed (REV) toroidal field at five densities. Averaging the measured flow at each density and for both field directions reveals no offset within experimental error, demonstrating that the midplane is indeed the “neutral point” of the transport driven flow. The field dependent flow magnitudes and directions measured on the midplane are quantitatively matched by a simple theoretical expression for P-S flows at all densities. Combined with the earlier experiment, this new data indirectly exclude the outer divertor target sink as a driver for the flow offset. To provide more direct confirmation, a second series of closely matched FWD and REV field discharges has been executed in a SNU configuration, where the probe now enters the SOL *above* the outer midplane with respect to the X-point location. Once again, the field dependent flow magnitudes and directions match analytic theory, but the offset returns, this time directed towards the inner divertor target and of similar magnitude to that seen in the SNL discharges.

These new measurements provide striking evidence for the existence of a transport driven component. They also provide further confirmation that neoclassical flows account for most of the parallel flow in the outboard midplane vicinity, and thus present an excellent opportunity for code benchmarking - the first results of SOLPS5 simulations including poloidal drifts applied to these TCV cases will be presented.