Dynamics of detachment in TCV with N2 seeding and flux expansion

O. Février[1], C. Theiler[1], C. K. Tsui[3,1], K. Verhaegh[2,1], J.A. Boedo[3], B. Duval[1], B. Labit[1], B. Lipschultz[2], R. Maurizio[1], H. Reimerdes[1], the TCV Team[a] and the EUROfusion MST1 Team[b]

[1]EPFL-SPC, CH-1015 Lausanne, Switzerland,

[2]York Plasma Institute, University of York, Heslington, York, YO10 5DQ, UK,

[3]University of California-San Diego, La Jolla, California 92093, USA

As the operation of future devices will require target heat fluxes of less than 10-20 MW/m^2, finding ways of dissipating the power is a critical issue. This can be achieved by operating in a detached regime where a drop of the target ion flux is attributed to the onset of parallel momentum losses. To further understand this process in the TCV open divertor, we investigate detachment in a lower single-null X-Divertor geometry in range of flux expansions of 2 to 20, approaching detachment through nitrogen seeding at fixed integrated core density (25% or 45% of the Greenwald limit) or integrated core density ramps (from 30% to about 70% of the Greenwald limit) in L–Mode plasmas. We particularly focus on the relation between the roll-over of the target ion flux, the development of a parallel pressure gradient along the divertor leg and the evolution of the upstream profiles. The plasma profiles at the outboard midplane reveal a saturation, and eventually a roll-over of the upstream pressure. In the density ramp experiments, the development of a pressure drop of about 70% between the outer midplane and the target, as measured by a fast reciprocating probe and a set of wall-embedded Langmuir probes, is well-correlated with the roll-over of the target ion flux, indicating a possible role of parallel momentum losses. Preliminary analysis of the evolution of the pressure drop for N2 seeded discharges indicates a much weaker pressure drop than in the density ramp experiments. The above results will be interpreted using an extended two-point model with momentum and radiation losses and a one-dimensional fluid model. We will also present the first results of detachment experiments in TCV double-null configurations that aim to investigate a possible role of coupling between inner and outer legs in the detachment process.

[a] See the author list of S. Coda et al, 2017 Nucl. Fusion 57 102011
[b] See the author list of H. Meyer et al 2017 Nucl. Fusion 57 102014