**Simultaneous measurement of co- and counter-current ions with a Fast Ion Loss Detector on the TCV tokamak**

J. Poley-Sanjuán1,\*, A. Clément1, A. Fasoli1, A. Karpushov1, B. Duval1, B. Schmidt3, J. Galdón-Quiroga2, J. Ayllon-Guerola4, L. Simons1, M. Garcia-Munoz2, M. Toussaint1, M. Vallar1, Y. Andrebe1 and the TCV team1, a

*1Ecole Polytechnique Fédérale de Lausanne (EPFL), Swiss Plasma Center (SPC), CH-1015 Lausanne, Switzerland.*

*2Department of Atomic, Molecular and Nuclear Physics, University of Seville, 41012 Seville, Spain.*

*3Department of Physics, Technical University of Denmark, Fysikvej, 2800 Kgs. Lyngby, Denmark*

*4Department of Mechanical Engineering and Manufacturing, University of Seville, 41092 Seville, Spain*

\*e-mail: jesus.poley@epfl.ch

Supra-thermal ions play an essential role in the plasma’s heating, current drive, and production of the fusion reactions. The supra-thermal ion confinement is critical to prevent degradation of the fusion performance and damage to the plasma-facing components [1]. To study the supra-thermal ion confinement on tokamaks, a wide range of diagnostics can be used, such as Neutral Particle Analyzers (NPA), Fast Ion Deuterium Alpha detectors (FIDA) and Fast Ion Loss Detectors (FILD) [2]. To this end, a new FILD has been designed, installed, and used for the first time on the TCV tokamak. The diagnostic has a high-resolution medium-speed (up to 10 kHz) camera to characterise the velocity space parameters of the supra-thermal ion losses and a fast acquisition system (up to 2MHz) based on a Photo Multiplier Tube (PMT) to characterise the supra-thermal ion losses frequency spectra. However, recently the PMT has been replaced with a 128-avalanche photodiode matrix camera which allows a fast response (up to 4MHz) with a medium spatial resolution (~ 5-10 keV in energy and ~ 0.1-0.15 in pitch, $v\_{∥}/v$). A double collimator has been installed to simultaneously measure co- and counter-current supra-thermal ions for the first time. A fast removal system was also installed, which retracts the FILD if the temperature in the head (measured by means of a pyrometer) reaches more than 300 degrees Celsius. This allows respectively measuring the FI losses in both plasma current directions and inserting the detector closer to the plasma without the risk of damaging the FILD head. A synthetic characterization of the diagnostic using the e-FILDSIM code [3] has been developed, allowing the data interpretation and possibly the implementation of reconstruction techniques currently under development. Measurements over a wide range of equilibria have already been taken to explore the detector’s capabilities showing the FI first orbit losses of both NBI beams installed on TCV, as well as the FI interaction with MHD activity at frequencies up to 100kHz, which appear correlated with the magnetic perturbations, the neutron measurements, and the soft X-ray emission. Modelling using the orbit following code ASCOT5 agrees qualitatively with the experimental observations of the first orbit losses on the FILD. With the already installed NPA, FIDA, and fast neutron detector, the FILD extends the FI studies on the TCV tokamak.

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