

# First measurements of oblique ECE with a real-time moveable line-of-sight on TCV

*T.P. Goodman<sup>1</sup>, I. Klimanov<sup>1</sup>, A. Mueck<sup>1</sup>, V.S. Udintsev<sup>1</sup>*

<sup>1</sup> CRPP, EURATOM – Confédération Suisse, EPFL, CH-1015 Lausanne Switzerland

First Author e-mail: timothy.goodman@epfl.ch

ECE radiometers viewing perpendicular to the magnetic field are common on nearly all tokamaks for measuring the electron temperature with good spatial-temporal resolution. Two such radiometers are installed on TCV; one looking from the low and the other from the high field side (LFS, HFS). The HFS radiometer is especially sensitive to non-Maxwellian emission in the presence of strong electron cyclotron current drive (ECCD) provided by the 3MW second harmonic (X2) EC system, due to the fact that the non-thermal radiation is not reabsorbed by the bulk when passing to the receiver. Simultaneous HFS and LFS measurements allow higher order modeling of the electron distribution function as more constraints are provided by the dual measurements; however, the asymmetric nature of the electron distribution function required for ECCD to occur, is not put in evidence by these lines-of-sight.

Oblique ECE measurements of an asymmetric non-thermal electron distribution, on the other hand, are expected to also be asymmetric and can provide important information on the current carrying features of the non-thermal population [1].

On TCV we have used one (of 6) of the X2 launching antennas as a receiver, providing identical flexibility for the line-of-sight of the radiometer as that of the launchers. The latter have been optimized to provide coverage of the entire vacuum chamber and a nearly flat phase front (low  $k_{\parallel}$  spread) near the plasma edge.

The receiver has been used for oblique ECE measurements and variable line-of-sight “poloidal plane” measurements, as well as electron Bernstein wave emission measurements [2]. The oblique measurements are made in both the “co” and “counter” current directions during steady-state ECH or ECCD and the oblique angle is swept from  $\sim 10^{\circ}$  to  $54^{\circ}$  ( $n_{\parallel}$  at the edge  $\sim 0.2$  to  $0.8$ ) during the shot. Similarly, the poloidal plane measurements are made during a steady-state EC heating phase and the ECE line-of-sight is swept across the poloidal plane during the shot. This presentation will provide a description of the receiving antenna and its properties and discuss first measurements of swept oblique ECE and poloidal plane measurements.

A dedicated receiving antenna will soon be installed allowing future studies beyond these proof of principle experiments.

## References

- [1] M Bornatici and U Ruffina, Plasma Phys. Control. Fusion 38 (1996) 1561–1577.
- [2] A. Mueck, this conference.