Progress in ECE diagnostics development on TCV

V.S. Udintsev, I. Klimanov, T.P. Goodman, P. Blanchard, H. Weisen, S. Alberti, S. Coda, L. Porte, O. Sauter, E. Fable, R. Patterson, and the TCV Team

Association Euratom-Confédération Suisse, EPFL/SB/CRPP, Station 13, CH-1015 Lausanne, Switzerland

Electron Cyclotron Emission (ECE) diagnostics are powerful tools for studying MHD, heat transport and fast electron dynamics on the Tokamak à Configuration Variable (TCV; R/a = 0.88 m/ 0.24 m, h = 1.5 m, B_T < 1.54 T). The second harmonic X-mode ECE is received from both the Low Field Side (LFS) and the High Field Side (HFS) by separate radiometers to ensure the full radial coverage of the plasma cross-section with a sampling rate up to 200 kHz. Because the plasma can be placed at a variety of vertical locations (Z), two lines-of-sight perpendicular to the magnetic field (at Z = 0 cm and Z = +21 cm) are being routinely used by both radiometers to measure the electron radiation temperature. In addition, a third line of sight making use of a steerable antenna can be used for oblique ECE studies.

Recently, oscillations of the electron temperature have been observed on TCV in low-density on-axis counter-ECCD discharges by means of ECE and Soft X-Ray tomography. These oscillations are reminiscent of the oscillations of the central electron temperature (O-regime) seen in low loop voltage or fully non-inductive LHCD plasmas with reversed central magnetic shear on Tore Supra [1]. During the decay of the oscillation, a transition from a 16 kHz to a 7 kHz MHD mode is observed. A possible link between the evolution of the electron temperature, the MHD modes and the current density profile will be discussed in the paper.

The study of plasma turbulence and associated electron temperature fluctuations is a new task for the TCV experimental programme. For this purpose, a correlation ECE radiometer has been designed as an additional branch to the existing LFS radiometer. Two frequency tunable channels will allow radial scans between r/a = 0 and 0.9 with a sampling rate up to 1 MHz. Thanks to the small poloidal spot size of the sample volume of 2 – 2.5 cm ($1/e^2$-value), it will be possible to resolve structures in the plasma with $k_\theta \leq 1.5$ cm^{-1}. The details of the correlation diagnostic design will be presented in the paper.

[1] G. Giruzzi, Plasma Phys. Control. Fusion **47**, B93 (2005).