Electron Bernstein Wave Heating in the TCV Tokamak

A. Mueck [1], *Y. Camenen* [1], *S. Coda* [1], *L. Curchod* [1], *T.P. Goodman* [1], *H.P. Laqua* [2]
A. Pochelon [1], *TCV Team* [1]

[1]Association EURATOM- Confédération Suisse, EPFL SB CRPP, CH-1015 Lausanne
[2]Max-Planck-Institut für Plasmaphysik, EURATOM Assoziation, D-17491 Greifswald

In high density plasmas, central Electron Cyclotron Resonance Heating (ECRH) accessibility is limited by wave cut-offs. The mode conversion process from ordinary mode (O-mode) to extraordinary mode (X-mode) and finally to Bernstein mode allows to overcome the plasma cut-off. At a particular launching angle, an O-mode wave converts to X-mode at the plasma cut-off and from X-mode into a Bernstein (B) mode at the upper hybrid resonance. The angular window for the O-X mode conversion is strongly dependent on the density gradient. The plasma edge density gradient is typically lower in a tokamak than in a stellarator where Electron Bernstein wave heating (EBWH) was first achieved [1]. However, diverted high triangularity H-modes in TCV provide an adequately steep density gradient.
The angular window for the O-X mode conversion is experimentally obtained in TCV for both equatorial and upper lateral launchers with central densities over $n_{e0} = 1 \cdot 10^{20} m^{-3}$. The optimum angle is determined by searching for the minimum in the ECRH stray radiation signal. The results of these experiments are compared with the size and position of the angular window calculated with the ART code [2].
Further on, EBWH experiments are performed with modulated ECRH, injected at the experimentally determined optimum angle. For the first time in a standard aspect ratio tokamak, global power deposition via EBWH could be demonstrated and its deposition location identified via the soft X-ray diagnostics. The experimentally determined deposition location, found inside the plasma cut-off, is compared with results of ART calculations.
To complement the heating experiments, Electron Bernstein emission (EBE) measurements are performed. In the inverse process B-X-O, a Bernstein wave in the plasma is converted into X-mode and then into O-mode with the same angular window for EBE as for EBWH. An additional ECRH launcher is installed for this purpose and used in reception mode to measure EBE. First results measuring EBE via angle sweeps will be presented.

References

[1] H.P.Laqua et al., Phys. Rev. Lett. **78**, 3467 (1997)
[2] F.Volpe, Electron Bernstein emission diagnostic of electron temperature profile at W7-AS Stellarator, PhD thesis, IPP Garching and Greifswald, IPP Report 13/1, March 2003 (124 pages)

The ART software has been acquired and used with kind permission of F. Volpe and IPP Garching.