ECRH Heating Scenarios and In-Vessel Components at the Wendelstein7-X Stellarator

H.P. Laqua, V.Erckmann, W. Kasparek[1], N.B. Marushchenko, Y. Turkin, M.Weißgerber, F.Volpe
Max-Planck-Institut für Plasmaphysik, EURATOM Ass.
D-85748 Garching, FRG,
[1]Institut für Plasmaforschung, Univ. Stuttgart, D-70569 Stuttgart, FRG

The large super-conducting Wendelstein7-X Stellarator (W7-X), which is under construction in Greifswald (Germany) now, will be equipped with a 10 MW ECRH system at 140 GHz. The ECRH will be the main heating system and the only one, which is capable for CW operation [1]. Therefore, it has to cover a wide experimental parameter range and its components should have a high reliability. The heating scenarios cover the full operation range of W7-X in density. For plasma start-up and "low" density ($<1.2\ 10^{20}\ m^{-3}$) operation heating with the second harmonic X-mode (X2) is foreseen. At "medium" densities ($<2.4\ 10^{20}\ m^{-3}$) a heating scenario with a multi-pass absorption of the second harmonic O-mode (O2) was developed. Since stellarators do not suffer upon density limit based on MHD-stability, high density operation above the 140 GHz cut-off ($2.4\ 10^{20}\ m^{-3}$) is expected. Here the use of the OXB-mode conversion heating, which was developed at the Wendelstein7-AS stellarator [2], is proposed. These scenarios are restricted to a resonant magnetic field of around 2.5 T. A second operation point in the magnetic field will be covered by the third harmonic X-mode (X3), which is resonant at 1.7 T. Although in stellarators neither a permanent ECCD for the plasma confinement nor any NTM-stabilisation is needed, the control of the divertor strike point position requires a permanent control of the edge rotational transform iota. Therefore ECCD will be used for residual plasma current compensation and rotational transform control on a fast time scale. For long time scales the iota will be controlled by the currents in the coil system. Beside the standard low field side oblique launch, special ports for advanced current drive scenarios are foreseen, where the phase space interaction can be optimised.
The different ECRH scenarios listed above require a highly flexible launching system. Furthermore, the high heat load conditions in CW-operation necessitate a reliable technical solution for the in-vessel components, which can sustain both the power load of the microwaves and the plasma radiation. Several critical components have already been tested for reliability and heat loading. The actual status of the ECRH antenna system will be presented.

References

[1] V. Erckmann et al. In this conference
[2] H.P. Laqua et al., PRL 78, 18 (1997);