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Measurement of the plasma edge profiles using the combined probe on W7-X

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Wendelstein 7-X (W7-X), one of the world's largest stellarators, located at the IPP Greifswald, started operation recently with a limiter configuration. Edge plasma profile measurements, especially those of the electron temperature and density, will play a key role in validating the performance in comparison to the tokamak and hence the viability of a stellarator fusion reactor. The first operational phase (OP 1.1) is used primarily for setting up the diagnostics and testing the magnetic configuration.

In conjunction with the multipurpose manipulator, a fast reciprocating probe has been installed. There are currently two probe heads: the combined probe measuring the edge profiles and the sample station for plasma exposure studies, namely of tungsten.

The combined probe includes i) two magnetic pick-up coil arrays, ii) Langmuir probes, and a Mach setup. This allows measuring at the same time and location, the edge radial profiles of the magnetic fields, the electron temperature and density, the electric fields; and the plasma flows.

For good measurements, sufficient knowledge of the capabilities and limitations of the diagnostics concerning the frequency limits, noise and the possible sustainable heat loads is necessary. The capabilities of the probe system will be presented, including ongoing improvements.

In this paper, the preliminary measurements of edge profiles using the combined probe in the limiter configuration will be presented. The power and density dependences of the edge transport will be discussed. The influence of magnetic perturbations induced by the Trim coils on the edge profile of the electron density and temperature, and the magnetic topology will be investigated in the upcoming experiments. The turbulence will be measured and characterized using the Langmuir probe and the Mach probe. The edge intermittent events can be observed with the negatively biased Langmuir pin and compared with the results of the reflectometry measurements.

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