Edge plasma measurements on the Op. 1.2 divertor plasmas at W7-X using the upgraded combined probe

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During the second operational campaign (OP1.2a) W7-X will operate with the so-called island divertor. Because of the better protection of the in-vessel components higher power and energy levels are allowed and therefore higher densities (5e19-1e20 m-3) could be reached as compared to the previous campaign with the inboard limiters [1]. In order to assess the transport and the plasma boundary properties, such as the electron temperature and density, the ion temperature, the radial electric field and plasma flow, measurements have been performed with the combined probe mounted on the multipurpose manipulator. The probe contains a set of Langmuir pins, Mach probes, compensation coils and a set of 3D pick up coils for the measurement of the local magnetic field and fluctuations, and an ion sensitive probe to record the ion temperature profiles. A tungsten sample was placed at the front facing surface of the probe in order to provide a possibility to study material deposition and to relate it to local plasma parameters.

A comparison of the measured parameters is possible with the dedicated fluctuation probe, a Mach probe array, a retarding field analyzer (RFA) and a gas puffing probe head, for fueling and impurity seeding, which also features a set of Langmuir probes for obtaining the electron temperature and density. The data from the correlation reflectometer will be used to compare the measured radial electric field, this is especially useful to identify the position and the extend of the magnetic island and the location of the last closed flux surface. Field line tracing was used to map the measured temperatures and densities and the resulting heat fluxes onto the wall elements and to the results to measurements performed with the divertor Langmuir probes and the infrared cameras observing the divertor targets.

Measurements from the ongoing campaign report electron temperatures of up 100 eV and densities of up to 10^{19} m^{-3} in the edge. It has been observed, in addition to differences due to the magnetic configurations, that the magnetic topology is sensitive to the plasma beta. During the experiments the 5/5 island structure has been identified with the measured edge plasma profiles and compared with the predictions from the field line tracing code [2]. Those electron densities and temperatures have been used as an input for the EMC3-EIRENE modeling to improve the understanding of the plasma edge transport.

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