ECPD 2021
European Conference on Plasma Diagnostics

The Electrostatic Probe System for the SPIDER Experiment

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The neutral beam injector, an additional heating system for the ITER project, is being optimized in the NBI test facility under construction in Padova. The facility includes the SPIDER ion source, currently in operation, representing the full size prototype for the production of negative ions, based on RF plasma aiming at extracting a beam up to 100keV energy and 50A current. The source is equipped with a system of 84 electrostatic probes for the investigation of the homogeneity of plasma parameters, such as plasma density, electron temperature, and plasma potential and of the Electron Energy Distribution Function. Measurements are performed in the extraction region of the ion source, where most of the extracted negative ions are produced. The system consists of 2D arrays of different sensors, covering the Plasma Grid (PG) surface and the Bias Plate (BP), which are the components facing the plasma in the extraction region. The probe system design accounts for the constraints related to the need of embedding the sensors within the PG and BP. It has been carried out with the aim of providing easy maintenance of the sensors and enough robustness during the experimental operation of SPIDER. A special machining of the insulating part has been adopted in order to avoid sensor short circuit due to deposition of metals such as caesium or copper on the BP and PG surfaces during the operation of the SPIDER source. Given the RF plasma, a particular attention is paid to the RF conditioning of the current collected by the probes in order to minimize the spurious effects on the voltage-current characteristic of the sensors.

The system is now installed on the SPIDER grids, commissioned and its scientific exploitation is presently ongoing. In this contribution, the overall system description and status is provided, including the in-vessel and ex-vessel parts, following the path from the sensors up to the conditioning electronics and the acquisition system. Selected examples of achieved measurements during the SPIDER experimental campaigns are provided.

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