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ITR/P1-01: Commissioning and First Results of the ITER-Relevant Negative Ion Beam Test Facility ELISE

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For heating and current drive the ITER NBI system requires a negative hydrogen ion source capable of delivering above 40 A of D^- ions for up to one hour pulses with an accelerated current density of 200 A/mˆ2. In order to limit the power loads and ion losses in the accelerator, the source must be operated at a pressure of 0.3 Pa at maximum and the amount of co-extracted electrons must not exceed the amount of extracted negative ions. As presently these parameters have not yet been achieved simultaneously, also due to a lack of adequate test facilities, the European ITER domestic agency F4E has defined an R&D roadmap for the construction of the neutral beam heating systems. An important step herein is the new test facility ELISE (Extraction from a Large Ion Source Experiment) for a large-scale extraction from a half-size ITER RF source which was constructed in the last 2 years at IPP Garching. The early experience of the operation of such a large RF driven source (1x1 mˆ2 with an extraction area of 0.1 mˆ2) will give an important input for the design of the Neutral Beam Test Facility PRIMA in Padova and the ITER NBI systems and for their commissioning and operating phases. PRIMA consists of the 1 MeV full power test facility MITICA, operational 2017, and the 100 kV ion source test facility SPIDER, operational 2015.
The aim of the design of the ELISE source and extraction system was to be as close as possible to the ITER design; it has however some modifications allowing a better diagnostic access as well as more flexibility for exploring open questions. The extraction system is designed for the acceleration of 20 A of negative hydrogen ions of up to 60 kV. Plasma operation of up to one hour is foreseen; but due to the limits of the IPP HV system, pulsed extraction only is possible.
ELISE went into operation in spring 2012 with first plasma and beam pulses. The paper discusses critical issues of the manufacturing and describes the commissioning phases of the different subsystems with a special emphasis on the HV conditioning of the large grids. First results of the dependence of the plasma homogeneity on the magnetic filter field, measured by optical emission spectroscopy, are shown and compared with beam homogeneity measurements by calorimetry and beam emission spectroscopy.

Country or International Organization of Primary Author

Germany

Primary author: Mr FRANZEN, Peter (Germany)

Co-authors: Mr RUF, Benjamin (Max-Planck-Institut für Plasmaphysik, EURATOM Association); Mr HEINEMANN, Bernd (Max-Planck-Institut für Plasmaphysik, EURATOM Association); Mr MARTENS, Christian (Max--Planck-Institut für Plasmaphysik, EURATOM Association); Mr WIMMER, Christian (Max-Planck-Institut für Plasmaphysik, EURATOM Association); Dr WUENDERLICH, Dirk (Max-Planck-Institut für Plasmaphysik, EURATOM Association); Mr SCHIESKO, Loic (Max-Planck-Institut für Plasmaphysik, EURATOM Association); Mr FROESCHLE, Markus (Max-Planck-Institut für Plasmaphysik, EURATOM Association); Mr RIEDL, Rudolf (Max-Planck-Institut für Plasmaphysik, EURATOM Association); Prof. FANTZ, Ursel (Max-Planck-Institut für Plasmaphysik, EURATOM Association); Dr KRAUS, Werner (Max-Planck-Institut für Plasmaphysik, EURATOM Association)

Presenter: Mr FRANZEN, Peter (Germany)

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