

THE NEGATIVE ION SOURCE TEST FACILITY ELISE

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The ITER neutral beam system will be based on inductively coupled radio frequency (rf) ion sources that have been under development at IPP Garching for many years. Several test facilities are in operation there for the production and extraction of negative hydrogen ions, having proved the required ITER parameters, but so far with significantly smaller ion sources and extraction systems. The next step towards the full ITER size is a “half-size” ITER source that will be tested on a dedicated test facility ELISE (“Extraction from a Large Ion Source Experiment”). The experience gained early with ELISE will support the design as well as the commissioning and operating phases of the PRIMA NBI test facilities and the ITER neutral beam system.

The “half-size” ITER source has approximately the width but only half the height of the full size, using four circular rf drivers in a 2x2 arrangement. As ELISE makes use of existing IPP hardware to a wide extent, beam acceleration is only possible in pulsed mode, up to 60 kV for 10 seconds every 3 minutes, while plasma operation of the source can be performed continuously for one hour.

The design implements a high experimental flexibility by allowing source operation in air and vacuum, by providing numerous diagnostic ports and by installing a large gate valve between the target chamber and the ion source. The grid design uses the same aperture pattern as ITER but it is optimized with respect to a more homogenous magnetic filter field that is created by a 4 kA current driven through the plasma grid. Furthermore the cooling channels are optimized to tolerate higher heat loads on the grids and to minimize deformations. The ion source will be operated at elevated temperature of 50°C, the plasma grid at 150°C.

Due to the lack of large diameter circular insulator tubes the 60 kV main insulator between ion source and target chamber is being realized by a large flat glass ring disc of 15 mm thickness and about 2 m in diameter. For neutron shielding during D₂ operation ELISE will be surrounded by a concrete building with typically 70 cm thick walls, aiming to 10 hours per year beam-on time.

The project is funded by F4E and started in November 2009. Presently all major components are already under construction. The setup of the test facility with all auxiliaries is in progress. The start of operation is planned for the end of 2011.

The paper presents an overview on the design of the test facility of ELISE and will describe its main components and the status of manufacturing and assembly.