Physical and experimental background of the design of the ELISE test facility

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In 2007 the IPP RF driven negative hydrogen ion source [1,2] was chosen by the ITER board as the new reference source for the ITER neutral beam system. In order to support the design of the Neutral Beam Test Facility in Padua and its commissioning and operating phases, IPP is presently constructing a new test facility ELISE (Extraction from a Large Ion Source Experiment) for a large-scale extraction from a half-size ITER RF source [3]. Plasma operation of up to one hour is foreseen; but due to the limits of the IPP HV system, pulsed extraction only is possible (10 second every 3 min). The extraction system is designed for acceleration of negative ions of up to 60 kV. The start of the ELISE operation is planned for the end of 2009.

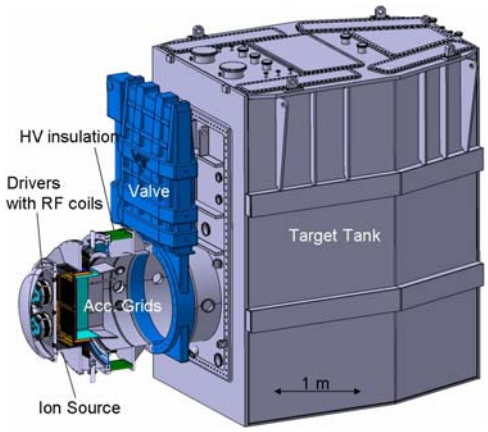

Figure 1: ELISE test facility.

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 paper discusses these design choices and their physical and experimental background that was gained at the present IPP test facilities. The design was also supported by diagnostics [4,5] and modeling efforts [6] of the processes leading to negative ion production and extraction in a RF source.

Examples are the “bias plate” that improved the source performance of the small IPP source, the increase of the source size due to measurements of the plasma decay towards the source walls and the coating of the source inner walls with Mo [7]. A still open issue is the optimum filter field for the RF source. This might be different from the ITER reference filter field that is still based on the arc driven source experience.

References

[1] E. Speth et al., Nuclear Fusion 46(6) (2006) S220
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[3] B. Heinemann et al., submitted to the 25th Symposium on Fusion Technology, 2008
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