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Investigation of the Boundary Layer during the Transition from Volume to Surface Dominated H⁻ Production at the BATMAN Test Facility

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The BATMAN test facility is equipped with a 1/8 scale H⁻ source for the ITER NNBI. BATMAN is dedicated to physical investigations including the understanding of the processes involved in the surface negative ion generation and extraction. As most of the extracted negative ions are generated on the caesiated plasma grid (1st grid of the accelerator system), understanding the physics occurring in the vicinity of the plasma grid, called the boundary layer, is of particular importance. Several diagnostics are available to study this several cm thick layer: Langmuir probes and OES are used to determine basic plasma parameters, Cavity-Ring-Down Spectroscopy allows for the measurement of the H⁻ density. Moreover, Tunable Diode Laser Absorption Spectroscopy is dedicated to measure the caesium density.

A transition from volume to surface dominated H⁻ production can be observed during the Cs conditioning phase, however only if the source had been carefully cleaned from remaining caesium and its compounds. This phase was followed by the mentioned diagnostics in the boundary layer while operating the source at ITER relevant parameters (in particular at a pressure of 0.3 Pa). The transition from an electron-ion plasma towards an ion-ion plasma, in which negative hydrogen ions become the dominant negatively charged particle species, will be presented. The influence on the plasma composition, distribution and potential as well as on the source performance (extracted H⁻ current density as well as co-extracted electron current density) will be shown.