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P2.1004 Towards the ITER NBI: impact of the plasma parameters on the performances of a large ITER-like beam.

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The neutral beam injection (NBI) system for the ITER experiment will be based on the production and acceleration of negative H/D ions. The ion beam requirements combine high accelerated current density (230 A/m2 in H, 200 A/m2 in D) with low core divergence (<7 mrad) and high uniformity over the extraction surface (better than 90 %). The ELISE test facility has the same width and half the height of the ITER NBI source and 3 grids (ITER-like arrangements: 640 apertures grouped in 8 beamlets groups) with a maximum total high voltage of 60 keV. At ELISE, the simultaneous achievement of the ITER NBI requirements in terms of accelerated ion current density (at a stripping fraction of about 12%), electron-ion ratio lower than one at the operational filling pressure of 0.3 Pa in H have been successfully achieved [1]. In order to study the beam in terms of accelerated current and beam uniformity focusing on the vertical profile several beam diagnostics are installed along the beamline. The analysis on the surface of a diagnostic calorimeter provide a 2D map of the beam power density profiles (4×4 cm2 resolution) while beam emission spectroscopy gives divergence measurements along the vertical direction (5 cm spaced). The accelerated current shows different dependences on the source parameters and a clear inhomogeneity in terms of beamlet group intensity is observed. In this work, plasma parameters such as positive and negative ion densities will be studied at ITER-relevant source parameters in order to identify the main causes of the beam non-uniformity. This can give indications on how to actively improve and control the beam uniformity of the large beams for ITER NBI.

[1] HEINEMANN, B. et al. Achievements of the ELISE test facility in view of the ITER NBI. Fusion Engineering and Design, jan. 2019.

Presenter: MARIO, I. (EPS 2019)

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