ID contributo: **3** Tipo: **non specificato**

Powerful RF ion sources for fusion

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The neutral beam injection system for the international fusion experiment ITER is based on large and powerful RF-driven ion sources which have to deliver extracted negative hydrogen ion currents of 66 A (H^-) and 57 A (D^-) being accelerated to 870 keV and 1 MeV, respectively. The hydrogen plasma is generated in eight individual cylindrical RF-drivers for which a total RF power of up to 800 kW at a frequency of 1 MHz will be available. The plasma expands in a rectangular expansion source with a width of 0.9 m and a height of 1.9 m. The negative hydrogen ions are created by utilizing the conversion of hydrogen atoms at a surface with low work function for which caesium is evaporated into the source. Extraction takes place from 1280 apertures with a diameter of 14 mm each resulting in an extraction area of 0.2 m2. In order to prevent damages of the grid system, the co-extracted electron current has to be kept below the extracted ion current. The source must be operated at a pressure of 0.3 Pa at maximum to limit the ion losses in the accelerator. Another challenging requirement concerns the beam duration and homogeneity: beams up to 3600 s have to be achieved with deviations in the uniformity over the large beam below 10%.

The RF prototype source for ITER (1/8 scale) has been successfully developed in the last years. At the test facility BATMAN it was demonstrated that the required negative ion current density can be achieved at 0.3 Pa with an electron-to-ion ratio below for short pulses (4 s), whereas MANITU demonstrated long pulse operation up to one hour for hydrogen and deuterium but with reduced beam parameters. RADI was a size scaling experiment without extraction for the purpose to prove the modular driver concept and to illuminate homogeneously an area of half the size of the ITER source.

As the required parameters have not been achieved simultaneously in a large source, the facility ELISE has been set up as part of the R&D roadmap of the European ITER domestic agency F4E. ELISE is dedicated to demonstrate the required negative hydrogen densities (extracted: 329 A/m2 H^-, 286 A/m2 D^-) at an electron-to-ion ratio of less than one for a source of the same width but only half the height of the ITER source (0.9 x 1 m2). Consequently, the ELISE source is driven by four RF drivers for which a total RF power of 360 kW is available. Since the first plasma in March 2013, ELISE has made enormous progress towards the ITER parameters: first stable one hour discharges with 10 s beam pulses every 3 min (limited by the available high voltage power supply) are demonstrated in hydrogen and deuterium, however at reduced RF power only. The limiting factor in the source performance is the amount and the temporal stability of co-extracted electrons, which is in particular a challenge for deuterium. Advanced beam diagnostics reveal that the requirements in beam uniformity of these large beams (about 1x1 m2) can be met.

If a proceedings is prepared,
</br> will you submit a contribution?

No

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Classifica Sessioni: Morning Session (Chair: P. Veltri)