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Plasma emission monitored via optical emission spectroscopy during the Cs conditioning at SPIDER

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The SPIDER test facility is the full-size ITER neutral beam injector (NBI) ion source, required to provide 355 A/m^2 extracted negative ion current density in hydrogen (285 A/m^2 in deuterium) with an electron-to-ion ratio lower than 0.5 (1 in deuterium). The negative ion source is integrated with a system of three grids, which allows the extraction and acceleration of ions. In the cases studied in this work, the source was operated with short plasma pulses, with a duration of about 30s, and repeated with an adjustable duty cycle of approximately 5 or 6 minutes. The maximum duration of the sequence was of about 1000 s. To fulfil the requirement on the extracted negative ion current with reduced amount of co-extracted electrons, the evaporation of caesium (Cs) into the ion source through Cs ovens (3 in SPIDER) and the optimisation of Cs conditioning techniques are mandatory.

At SPIDER, the plasma is monitored via optical emission spectroscopy techniques measuring the plasma emission in a line-of-sight (LOS) integrated manner in several positions inside the ion source. In particular, close to the extraction region, two sets (centred at 5 mm and at 35mm distance from the first grid) of 8 horizontal LOS are used to retrieve the vertical profile of the plasma emission.

During the Cs conditioning campaign performed at SPIDER, although the extraction capabilities were reduced due to technical problems, the RF power applied to the plasma reached 400kW with all four RF generators working simultaneously.

It is found that the surface emission originated from the first grid, the so-called plasma grid one, affects both the plasma radiation due the presence of negative ions, and the electrical measurements performed on biased components inside the ion source.

Aim of this work is to study the evolution of the plasma emission over the entire Cs conditioning campaign. The effect of Cs conditioning on electrical measurements is also presented and discussed.

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