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Plasma light detection in the SPIDER beam source

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The ITER Heating Neutral Beam (HNB) injector RF plasma source is required to generate a 40A D- or 46A H- ion current, with low electron/ion ratio (<1) and high uniformity over the extraction area (800 mm x 1600 mm). The source prototype SPIDER in the Neutral Beam Test Facility at Consorzio RFX has been developed to demonstrate these performances and it is now under final installation and commissioning.

A set of diagnostics in SPIDER has to characterize the complex behaviour of the plasma in the source, assisting in the optimization of performances and providing the signals for machine protection during operation. To monitor the visible radiation emitted by the plasma in the source a set of photodiodes measures the time evolution of lines of sight integrated intensity; some are equipped with interference filters to select specific spectral lines of particular interest, like of cesium to control its evaporation, which assists the H- production, and of metal impurities lines, which are sign of severe erosion of the source inner wall or even of melting at hot spots. Other lines of sight are fed to grating spectrometers to measure the spectrum at a slower rate, either for low resolution spectral survey of hydrogen Balmer lines and impurities and for high resolution molecular Fulcher bands.

This contribution focuses on the implementation of the photodiode measurements and on preliminary results during the commissioning phase. The overall diagnostic layout is presented. The custom photodiode electronics is described, which includes a low noise variable gain amplifier, FPGA based remote control and suitably shaped digital output for interlock purposes.

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