First measurements of optical emission spectroscopy on SPIDER negative ion source

Barbara Zaniol, Marco Barbisan, Domenico Bruno, Roberto Pasqualotto, Cesare Taliercio,and Margherita Ugoletti

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Abstract:Optical Emission Spectroscopy (OES) on the SPIDER negative ion source has been collecting data since the beginning of operation in Summer2018. The first few months were devoted to complete the diagnostic commissioning and its integration with the SPIDER control and data acquisition system. Consistent sets of spectroscopic data have been acquired under different experimental conditions, not only varying the plasma source filling pressure and injected power but also changing the RF generator frequencies and the strength of the magnetic field acting as a filter in front of the plasma grid. The main results of OES data analysis are presented in this work. SPIDER optical emission diagnostic comprises a set of 66 channels wavelength resolved and 36 single line channels by means of interference filtering. Some of them collect the photons along line of sight (LOS) perpendicular to the grids through the 8 RF drivers and others along LOS parallel to and near the grids, both horizontally and vertically. Since the starting of extraction experiments, 22 channels have been dedicated to collect the extracted beam emission. The LOS layout allows tracing two 9-point vertical profiles of the source plasma in the extraction region at 35 and 5 mm from the Plasma Grid (PG) and four 4-point horizontal profiles spanning the 65 mm region before the PG. It is also possible to collect spectra from LOS looking in between the grids. Both Balmer series and Fulcher band between 600 nm and 640 nm were routinely collected. Their intensities are very sensitive to the plasma parameters and when coupled to a collisional radiative model can give an estimation of the electron density and gas dissociation. It has been found that the Balmer emission and gas dissociation inside the drivers scale linearly with the RF power, the latter reaching a value up to 20% at high power and low pressure. Rotational gas temperature has also been evaluated; it ranged between 900 K and1400 K, where higher values were reached for higher pressures and RF powers.