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Spectral and intensity diagnostics of the SPARC free-electron-laser

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We present the instrument that is used for the spectral and intensity diagnostics of the SPARC FEL test facility. The SPARC FEL is composed by a high brightness accelerator providing a high quality beam at energies between 110 and 180 MeV and an undulator beam line composed by six, variable gap, modules. The flexibility offered by the variable gap configuration of the SPARC undulator and the natural synchronization of the electron beam with the laser driving the photo-injector, makes the SPARC layout particularly suited for a number of experiments, where the FEL amplifier is seeded by an external laser source. Both chirped pulse operation in the SASE mode and seeded emissions have been demonstrated.

The spectral and intensity diagnostics at SPARC are performed through a normal-incidence grating spectrometer designed and realized by CNR-IFN. The instrument hosts three interchangeable gratings covering the 40-600 nm spectral region and an EUV-enhanced CCD detector. The spectral resolution in the single pixel is in the range $\lambda/\Delta\lambda = 5000-10000$, giving the FEL spectrum in the single-shot operation with high resolution.

Furthermore, all the optical elements after the exit from the last undulator module, i.e. the mirror to deviate the light toward the spectrometer, the gratings and the CCD detector, have been calibrated, to obtain finally the total absolute response of the instrument in the whole spectral range of operation. This allow to measure also the absolute intensity of the FEL emission.

The design, characterization and calibration of the instrument will be presented. Some results obtained at SPARC will be discussed.

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