

COSP: compact wide band spectrometer for free electron laser monitoring

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In recent years generation and control, both in amplitude and in phase, of multiple harmonics at the seeded Free Electron Lasers (FELs) FERMI have opened the way to a new class of experiments based on the wave mixing paradigm. For these experiments, the simultaneous acquisition of the whole spectrum of harmonics is required to monitor the stability of the emission, the relative intensity ratio between harmonics and the amount of possible spurious harmonics. A grating spectrometer designed to provide medium resolution in a wide spectral range can be used as a real-time monitor of the FEL operation, and the information gathered can be used to normalize and validate data in a multi messenger (electrons/photons) approach.

At FERMI, the online spectrometer PRESTO used to monitor the FEL emission is conceived for the acquisition of one harmonic at a time with high resolution. The request to extend the spectral range for single-shot acquisitions has driven the realization of a compact spectrometer capable of resolving a set of consecutive harmonics in an extended spectral range, and easily portable to the different end-stations of FERMI. It consists of a flat-field concave grating (Shimadzu) having a groove density of 300 gr/mm. The detector is a 40-mm-diameter MCP (Micro Channel Plate) with MgF₂ photocathode and phosphor screen (PHOTEK VID140) read by a CMOS camera (Basler aca1300-75gm, 1280 X 1024 px) on a single-shot basis (50 Hz repetition rate). The use of a large-area MCP detector allows to acquire at-once a spectrum spanning the 10-100 nm region (120-12 eV). The detector can be manually displaced along the flat focal curve to cover wavelengths down to 5 nm (250 eV) or up to 124 nm (10 eV). The spectrometer is a useful tool both in the preparatory phase, when the machine parameters have to be optimized, and in the experiment phase, when absolute and relative stability between the different harmonics has to be monitored.

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