Contribution ID: **97** Type: **not specified**

Implemented Pixelated Phosphor Detector (PPD) for laser coupled FEL beam diagnosis

Although the characterization of the beam quality is an essential prerequisite for a reliable application of pulsed high-power vacuum ultraviolet (VUV) and soft X-ray (SXR) beams (e.g. free-electron laser (FEL) light sources), the design of proper devices is still an open issue.
The approaches employed at the moment show severe limitations: direct monitoring with YAG scintillators or phosphors screens produces blurred images because of the light-spreading phenomenon; the ablative imprint over PMMA or silicon requires time-consuming ex-situ analysis; the wavefront reconstruction works only in a limited wavelength range.
We recently demonstrated an effective method to preserve the advantages of the scintillators (such as in situ and real-time detection), increasing their spatial resolution to achieve a reference technique for spatial quality diagnosis; in our Pixelated Phosphor Detector (PPD) devices, an array of micrometric phosphor pixels has been obtained by filling micrometric silicon pores arranged in a hexagonal geometry with suitable phosphor powders. The device is coupled with a CCD camera external to the experimental vacuum chamber through a telemicroscope. The design of our PPD guarantees high resolution, close to the beam size, of the order of a few micrometers. Thanks to the reduced pixels size (in the range of a few micrometers or lower), the focused beam can be traced through the simple detection of the illuminated pixel phosphors in each cavity. The VUV and SXR pulses of from FEL, as short as hundred femtoseconds, can be used to explore the temporal evolution of various processes: electronic motion, phase transitions, and chemical reactions. The measure of femtoseconds or picoseconds events however requires the so-called pump-and-probe technique: either an optical laser is used as pump and the X-ray beam as a probe beam or viceversa. In this way the temporal distance between the pump and the probe can be easily achieved by deviating the visible beam through a delay line. The conceptually simple but practically challenging precondition is to have a precise control of spatial and temporal alignment of pump and probe sources. With the available technology several days should be dedicated to the temporal tuning and the spatial alignment of the beams before starting an experiment that may last just a couple of hours. .
PPD technology represents a promising platform to design and develop a new family of beam position detectors able to monitor the spatial arrangement and the temporal delay between pump and probe beams. Taking advantage of the capability of some materials to change the transmittance at specific wavelength when they are exposed to the FEL beam, and developing a suitable micro- and nano-fabrication process, we will design a combined system of two different pixel arrays: one to monitor the FEL beam shape and the position, and another one to determine the temporal coincidence of FEL and visible beam. enabling a real time control of pump and probe experiments.

Summary

Phosphor Detector, FEL, beam diagnosis, laser, real time, in situ

Author: DAL ZILIO, simone (IOM-CNR)

Co-authors: LAZZARINO, MARCO (National Research Council (CNR)); Dr MATRUGLIO, alessia (iom-cnr); Dr MINCIGRUCCI, riccardo (Elettra ScpA –Basovizza Trieste (Italy)); Mr SERGO, rudi (Elettra ScpA –Basovizza Trieste (Italy))

Presenter: DAL ZILIO, simone (IOM-CNR)