Contribution ID: **155** Contribution code: **THBO4** Type: **Contributed Oral**

AC/DC: The FERMI FEL Split and Delay Optical Device for Ultrafast X-Rays Science

Thursday, 25 August 2022 12:25 (25 minutes)

Free-electron lasers (FELs) are currently the most advanced class of light sources, by virtue of their unique capability to lase high-brightness and ultrashort pulses characterized by wavelengths spanning the Extreme-Ultraviolet (EUV), the Soft (SXR) and Hard (HXR) X-Ray spectral domains, alongside with temporal duration lying in the femtosecond (fs) timescale [1]. Specifically, the advent of FELs light sources has recently allowed to perform, in a time-resolved fashion approach, both established spectroscopies, daily employed at synchrotron light sources, and novel non-linear optical methods, mostly combining FELs and laser pulses. Nonetheless, the next step to push the ultrafast X-Ray science standards is widely recognized to be linked to go beyond the current time-resolved schemes, so performing experiments engaging exclusively EUV, SXR and HXR pulses. Indeed, exciting (and probing) matter at its (or nearby) electronic resonance is largely speculated to be one of the key for discriminating and revealing the microscopic mechanisms hiding behind some of the most exotic phases of physical, chemical, and biological systems. Such a challenge calls the design of optical devices capable to both split and delay (in time) FELs pulses, without impacting on their coherence properties, and fully user-friendly in terms of preserving the perfect overlap of the resulting focal spots, even in the few microns spatial domain, a well-known trademark for focusing EUV, SXR and HXR pulses at FELs light sources [2].
At the seeded FERMI FEL (Trieste, Italy) this goal is committed by the novel optical device known as AC/DC, which stands for the Auto Correlator/Delay Creator. AC/DC is purposely designed to double the incoming FEL photon beam into two exact pulse replicas, splitting it by inserting a grazing incidence flat mirror, and further delaying in time, in a controlled way, one of the two pulses, with an intrinsic temporal resolution of approximately 360 attoseconds. A detailed description of AC/DC is highlighted here. Specifically, strong emphasis is dedicated to the opto-mechanical design and the laser-based feedback system, purposely designed and implemented to compensate in real-time any potential drift and pointing mismatch affecting the FEL optical trajectory, ascribable to both mechanical imperfections and residual paraxial errors appearing during a temporal delay scan [3].

[1] Bostedt C., Boutet S., Fritz D.M., Huang Z., Lee H.J., Lemke H.T., Robert A., Schlotter W.F., Turner J.J., Williams G.J., Linac Coherent Light Source: The first five years. Rev. Mod. Phys.88, 015007 (2016)

[2] Manfredda M., Fava C., Gobessi R., Mahne N., Raimondi L., Simoncig A., Zangrando M., The evolution of KAOS, a multipurpose active optics system for EUV/Soft X-rays, Synchrotron Radiation News, 0, 0, (2022) DOI: 10.1080/08940886.2022.2066432
.

[3] Simoncig A., Manfredda M., Gaio G., Mahne N., Raimondi M., Fava C., Gerusina S., Gobessi R., Abrami A., Capotondi F., De Angelis D., Menk R., Pancaldi M., Pedersoli E., Zangrando M., AC/DC: The FERMI FEL Split and Delay Optical Device for Ultrafast X-rays Science, Photonics, 9(5), 314, 2022

I have read and accept the Privacy Policy Statement

Yes

Primary author: SIMONCIG, Alberto (Elettra-Sincrotrone Trieste S.C.p.A.)

Co-authors: DE ANGELIS, Dario (Elettra-Sincrotrone Trieste S.C.p.A.); PEDERSOLI, Emanuele (Elettra-Sincrotrone Trieste S.C.p.A.); CAPOTONDI, Flavio (Elettra-Sincrotrone Trieste S.C.p.A.); GAIO, Giulio (Elettra-Sincrotrone Trieste S.C.p.A.); ZANGRANDO, Marco (Elettra-Sincrotrone Trieste S.C.p.A.); PANCALDI, Matteo (Elettra-Sincrotrone Trieste S.C.p.A.); MANFREDDA, Michele (Elettra-Sincrotrone Trieste S.C.p.A.); Mr ABRAMI, Alessandro (Elettra-Sincrotrone Trieste S.C.p.A.); Dr RAIMONDI, Lorenzo (Elettra-Sincrotrone Trieste S.C.p.A.); Dr MENK, Ralf Hendrik (Elettra-Sincrotrone Trieste S.C.p.A.); Mr GOBESSI, Riccardo (Elettra-Sincrotrone Trieste S.C.p.A.); Mr GERUSINA, Simone (Elettra-Sincrotrone Trieste S.C.p.A.); Mr FAVA, Claudio (Elettra-Sincrotrone Trieste S.C.p.A.); Dr MAHNE, Nicola (CNR-IOM, Istituto Officina dei Materiali)

Presenter: SIMONCIG, Alberto (Elettra-Sincrotrone Trieste S.C.p.A.)

Session Classification: Photon beamline instrumentation & undulators

Track Classification: Photon beamline instrumentation & undulators