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Coherent Diffraction Imaging Project at FERMI@Elettra: present status and research opportunities

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The high transverse coherence and peak brightness of ultra-short SASE-FEL pulses have already demonstrated the extraordinary potential for coherent diffraction imaging (CDI) in a single shot experiment before the radiation damage of the sample is manifested [1]. The limitations imposed by the partial longitudinal coherence of SASE-FEL for getting selective chemical information using single shot resonant (R-) CDI, should be overcome by the seeded FEL sources, as FERMI@Elettra [2]. This opens unique opportunities for single-shot R-CDI experiments with access to elemental and/or magnetic structure of morphologically complex targets using the energy tunability and multiple (circular or linear) polarization of the fully coherent seeded FEL pulses.
The measurement station for CDI, operating at the DiProI beamline of the FERMI@Elettra, is designed to meet the requirements for performing a wide range of static and dynamic studies and has been already commissioned using both synchrotron and FEL radiation [3]. This presentation will report the first CDI measurements illustrating the performance of the measurement station in single-shot CDI and the advent of tunability and multiple polarization of the FERMI pulses in resonant magnetic scattering at Co M-absorption edges. Finally, the unprecedented opportunity offered by FERMI@Elettra source to performe jitter-free pump-probe experiments using both infrared laser and EUV/Soft-Xray pulses will be discussed. In particular recent results of a FEL-based two color pump and probe experiment at the Ti M-edge, showing the XUV optical constant change under high power FEL irradiation will be presented [4].

Figures (See right)

Figure. a) The end-station for Coherent Diffraction Imaging installed at the DiProI FERMI@Elettra beamline b) Single shot diffraction pattern of Fermi@Elettra logo taken at 32.5 nm wavelength and its CDI reconstruction (inset).

[1] H. N. Chapman et al, Nature Physics 2, 839 - 843 (2006).
[2] E.Allaria et. al, Nature Photonics 6, 699-704 (2012).
[3] F. Capotondi et al, Rev. Sci. Instrum. 82, 043711 (2011).
[4] E.Allaria et. al, Nature Comm. 4, 2476 (2013).

Summary

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