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High-Flux Table-Top Ultrafast Water Window X-Ray Source Driven By Mid-IR Laser Pulses

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Until very recently, Free Electron Lasers (FEL) and synchrotrons offering femtosecond (10^{-15}s) slicing technology have been the only facilities able to generate femtosecond X-Ray pulses in the water window (280-530 eV) spectral range. Bringing ultrafast science to the soft-X-Ray offer a wide range of application like studying multielectron dynamics in gas phase atoms/molecules, spectroscopy and imaging of biostructures in solution and time-resolved L-edge absorption spectroscopy to study ultrafast dynamics in magnetic materials. However, these facilities are associated with a huge initial investment and offer only limited access to a broad user community. An alternative technology is therefore necessary to make those ultrafast water window X-Ray pulses widely available. To generate those pulses, we realized a totally different approach, based on a taple-top extreme frequency upconversion mechanism called High Harmonic Generation (HHG). To do so, we use a customised high-energy optical parametric amplifier (OPA), delivering up to 10mJ of few-cycles pulses centered around 1.8 µm. We focus these pulses into a home-build gas-cell containing few tens of bars of helium, coupled to a flat-field X-Ray spectrometer. Through this highly nonlinear laser-atom interaction (HHG), high-flux ultrafast X-ray pulse trains, spanning almost the entire water window spectral range are than generated [1]. Single laser shot measurement of carbon K-edge (280eV) will be presented.

[1] Légaré et al. (Manuscript in preparation)

Author: Mr BEAULIEU, Samuel (INRS-EMT)

Co-authors: Dr SCHMIDT, Bruno E. (INRS-EMT); Prof. LÉGARÉ, François (INRS-EMT); Dr THIRÉ, Nicolas (INRS-EMT)

Presenter: Mr BEAULIEU, Samuel (INRS-EMT)

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