# A VUV/VIS-cross-correlator for the temporal characterization of VUV-FEL pulses

**M. Drescher[1], R. Kalms[1], M. Krikunova[1], M. Wieland[1*], S. Cunovic[2], N. Müller[2], J. Feldhaus[3], U. Frühling[3], T. Maltezopoulos[3], E. Plönjes-Palm[3], H. Redlin[3]**

*[1]Institut für Experimentalphysik, Femtosecond X-ray Physics, Luruper Chaussee 149, 22761 Hamburg, Germany*
*[2]Physics Department, University of Bielefeld, 33615 Bielefeld, Germany*
*[3]HASYLAB at DESY, Notkestr. 85, D-22603 Hamburg, Germany*

Soft x-ray- and VUV-free electron lasers (FEL) as fourth generation synchrotron sources deliver radiation with unequaled brilliance, in particular photon flux and pulse duration promise to enable new classes of experimental studies including the possibility to investigate dynamic processes with temporal resolutions in the order of a few 10fs.

FEL radiation originates from statistically fluctuating self amplified spontaneous emission (SASE). As a result, the time of emission slightly changes from pulse to pulse with respect to a synchronized visible laser by a certain amount, the so-called 'jitter' $\delta t$. Pump-Probe experiments rely on proper timing of pump and probe pulse, i.e. a fixed delay $\Delta t$ is necessary. Since at present there is no possibility to reduce or even extinguish the FEL jitter, the only way to overcome this limitation is the measurement of the jitter on a shot-to shot basis.

The presented project aims at the development and implementation of a novel cross-correlation technique for the temporal characterization of VUV-FEL pulses, i.e. both, pulse duration and jitter for each FEL pulse. The measurement principle relies on the simultaneous interaction of the FEL- and a visible laser pulse in a target gas and the subsequent spatially resolved detection of the generated energy-shifted photo electrons with an imaging electron spectrometer.

In this contribution, we present first results from recent measurements at the VUV-FEL facility at HASYLAB/DESY at a photon energy of 38eV. The feasibility of the developed cross-correlator setup consisting of (i) interaction chamber including multiple diagnostic tools for spatial and temporal overlap of the two pulses, (ii) electron optical system, (iii) adjustable gas inlet, (iv) optical setup for visible laser steering and focussing and (v) mounting platform for alignment of the vacuum chamber with respect to the FEL beam is demonstrated. So far, the obtained data is integrated over several FEL pulses and thus limited regarding the temporal resolution. Further improvements to obtain single-shot data are discussed.

* corresponding author, email: marek.wieland@desy.de