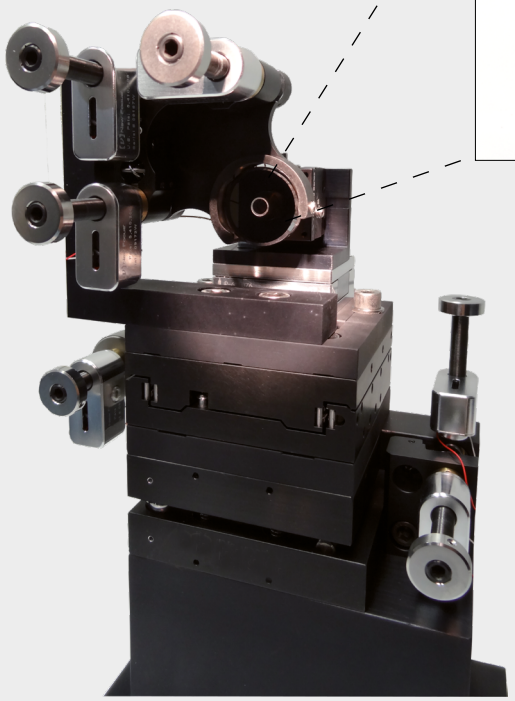
UltraFast Innovations

YOUR KEY to innovation and success

XUV / IR – Pulse Delay Unit

K2

Our pulse delay unit makes use of our XUV/soft X-ray multilayer double mirrors and combines them with our profound knowledge of pump-probe experimental setups. The two-segment mirror facilitates focusing IR pulses and lower divergent XUV/soft X-ray pulses onto a common focus with an interferometrically precisely adjustable time delay. This allows temporal resolved experiments with pumping systems of interest either with the XUV/soft X-ray pulse and probe it with the IR or vice versa. Based on the nature of e.g. attosecond pulses generated in the XUV/soft X-ray range by High Harmonic Generation (HHG) this offers state-of-the-art highest temporal resolution for your experiments. The mirror coating can be customized according to the central energy and bandwidth.



Key Product Features:

- **Temporal resolution:** 3 as
- **Scan range:** 300 fs
- Adjustment with **5 degrees of freedom**
- **Customized energy range and bandwidth**
- Vacuum compatibility: **<10^{-6} mbar** (UHV on request)
- **Travel range actuator:** ≈ 100 µm (software limits the range from 0-95 µm)
- **Resolution actuator:** 2 nm
- **Travel range:** 25 mm
- **Step size:** < 30 nm

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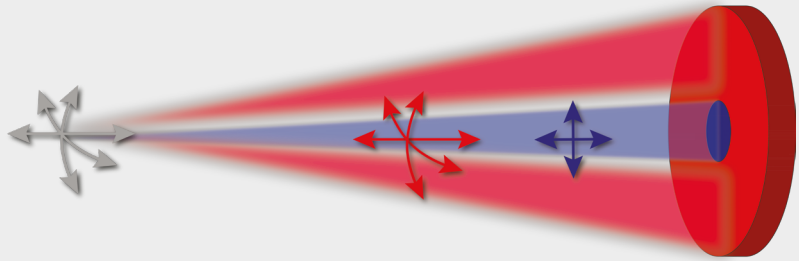
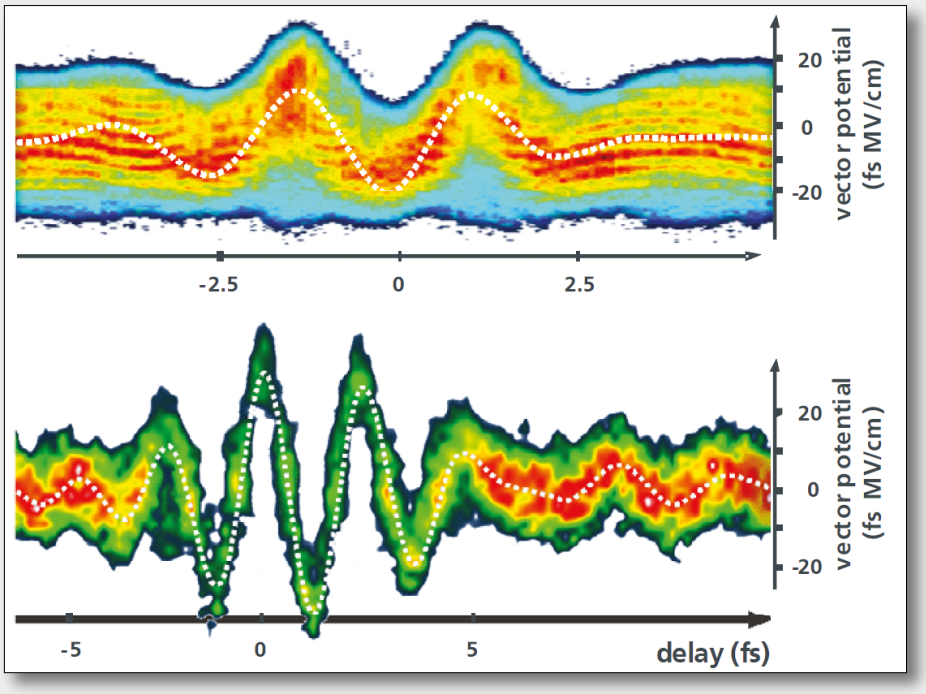
Working Principle:

Our pulse delay unit makes use of the different divergence of both beams. The outer mirror ring shapes and focuses the high divergent IR pulses whereas the core is responsible for shaping and focusing the low divergent XUV/soft X-ray pulses [1]. The lower divergence of the XUV/soft X-ray pulses is attributed to the higher photon energy. Our system offers 5 degrees of freedom adjustment to ensure a perfect spatial and temporal overlap of both pulses in the focus.



Working principle of the delay unit. The time delay is introduced by changing the core position (reflecting the XUV/soft X-ray pulses) with respect to the ring (reflecting the IR pulses). The 5 degrees of freedom offer perfect control for spatial and temporal overlap in the focus.

Application – Attosecond Streaking:



Attosecond photoelectron streaking experiments performed with our XUV/IR pulse delay unit at MPQ (Garching, Germany) are shown on the left. The top figure corresponds to the measurement performed with a short 80 as pulse and a 3.3 fs streaking IR pulse (its vector potential is shown in dashed white) [2]. The bottom results from a 250 as pulse and a 4.3 fs IR pulse. Both demonstrate the high achievable temporal resolution with our device, the key to innovation and success in ultrafast experiments.

References:

[1] R. Kienberger, E. Goulielmakis, M. Uiberacker, A. Baltuska, V. Yakovlev, F. Bammer, A. Scrinzi, Th. Westerwalbesloh, U. Kleineberg, U. Heinzmann, M. Drescher, and F. Krausz, " Atomic transient recorder," Nature **427**, 817-821 (2004).

[2] E. Goulielmakis, M. Schultze, M. Hofstetter, V. S. Yakovlev, J. Gagnon, M. Uiberacker, A. L. Aquila, E. M. Gullikson, D. T. Attwood, R. Kienberger, F. Krausz, U. Kleineberg, "Single-Cycle Nonlinear Optics," Science **320**(5883), 1614-1617 (2008).

[3] M. Behrens, L. Englert, T. Bayer, and M. Wollenhaupt, „XUV-beamline for photoelectron imaging spectroscopy with shaped pulses", Rev. Sci. Instrum. **95**, 093101 (2024)