# A single shot sensitive X-ray streak camera with kilohertz repetition rate

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We have developed a streak camera system with single shot sensitivity, kilohertz repetition rate and 300 fs time resolution. Using a pulsed UV-source we have demonstrated how this system can be used as an absolute timing diagnostic in pump-probe experiments at free electron X-ray lasers, to measure the relative delay from shot to shot between a pump laser pulse and an X-FEL X-ray pulse, directly at the sample position.

When doing time resolved experiments at the future X-FEL sources using a laser for exciting the sample, there will always be synchronization issues between the pump and the probe pulses since these are generated by independent sources. The method that so far has received most attention is electro-optical sampling. This method measures the arrival time of the electron bunch at a certain point inside the accelerator, rather than the generated X-ray pulse itself. The large distance between the measurement position and the experimental station means that this method is sensitive to thermal drifts, making it difficult to accumulate data during long times.

The method we propose, using an X-ray streak camera, can measure the arrival time exactly in the sample position, eliminating any such uncertainty. The streak camera we have developed is capable of retrieving the arrival time from shot to shot even at repetition rates of several kilohertz. This is made possible by using a read out camera with on-chip image processing capabilities. Thus the analysis of each image is performed in the camera itself, eliminating the slow process of transferring images to the host computer. We have demonstrated the system using UV pulses from a femtosecond laser, at a repetition rate of 4.25 kHz, yielding a time resolution of 300 fs.

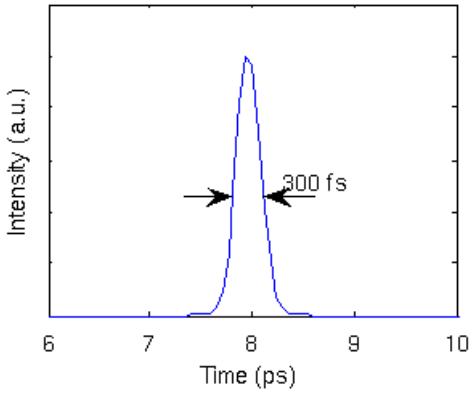


**Fig. 1:** Measured arrival time of a UV-pulse with a fixed delay of 8 ps. FWHM is 300 fs.