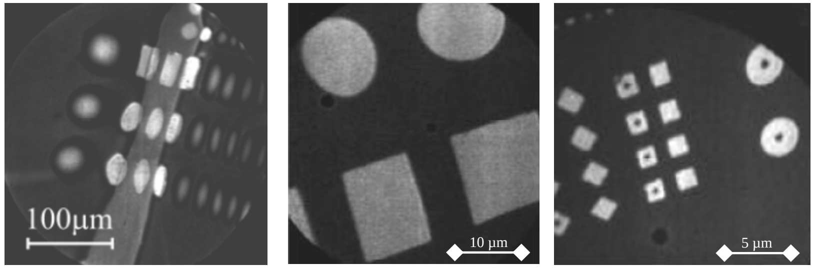
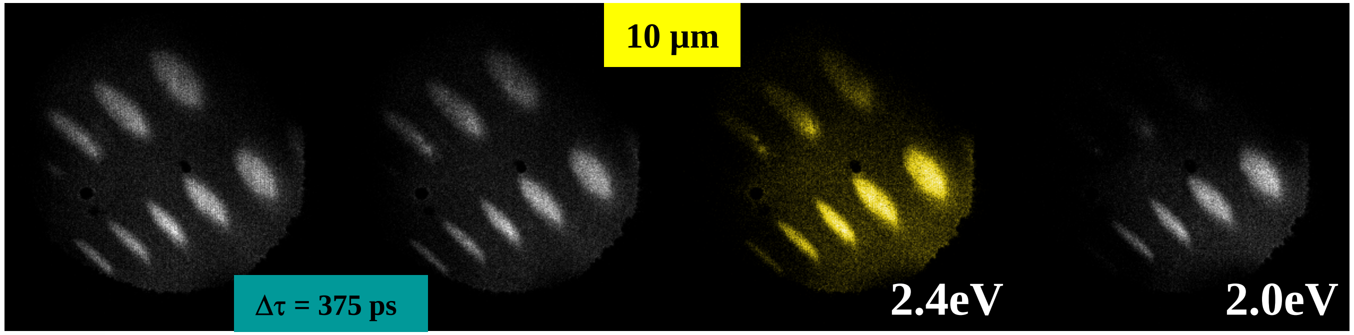
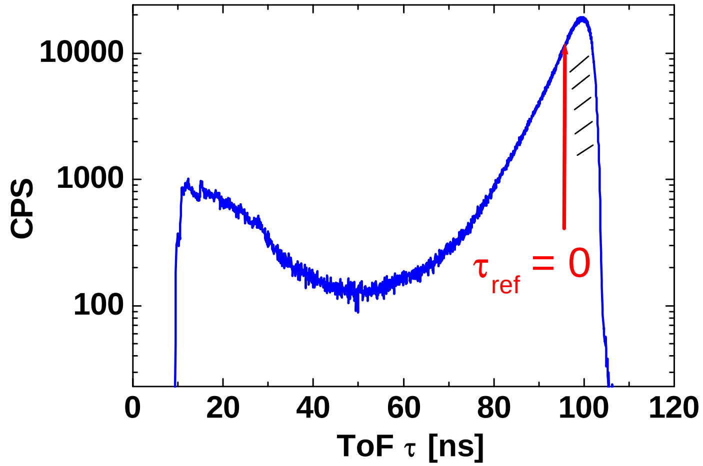
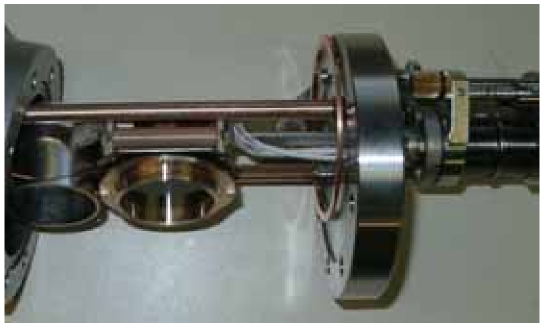
ToF-PEEM by means of the Surface Concept DLD4040-IG

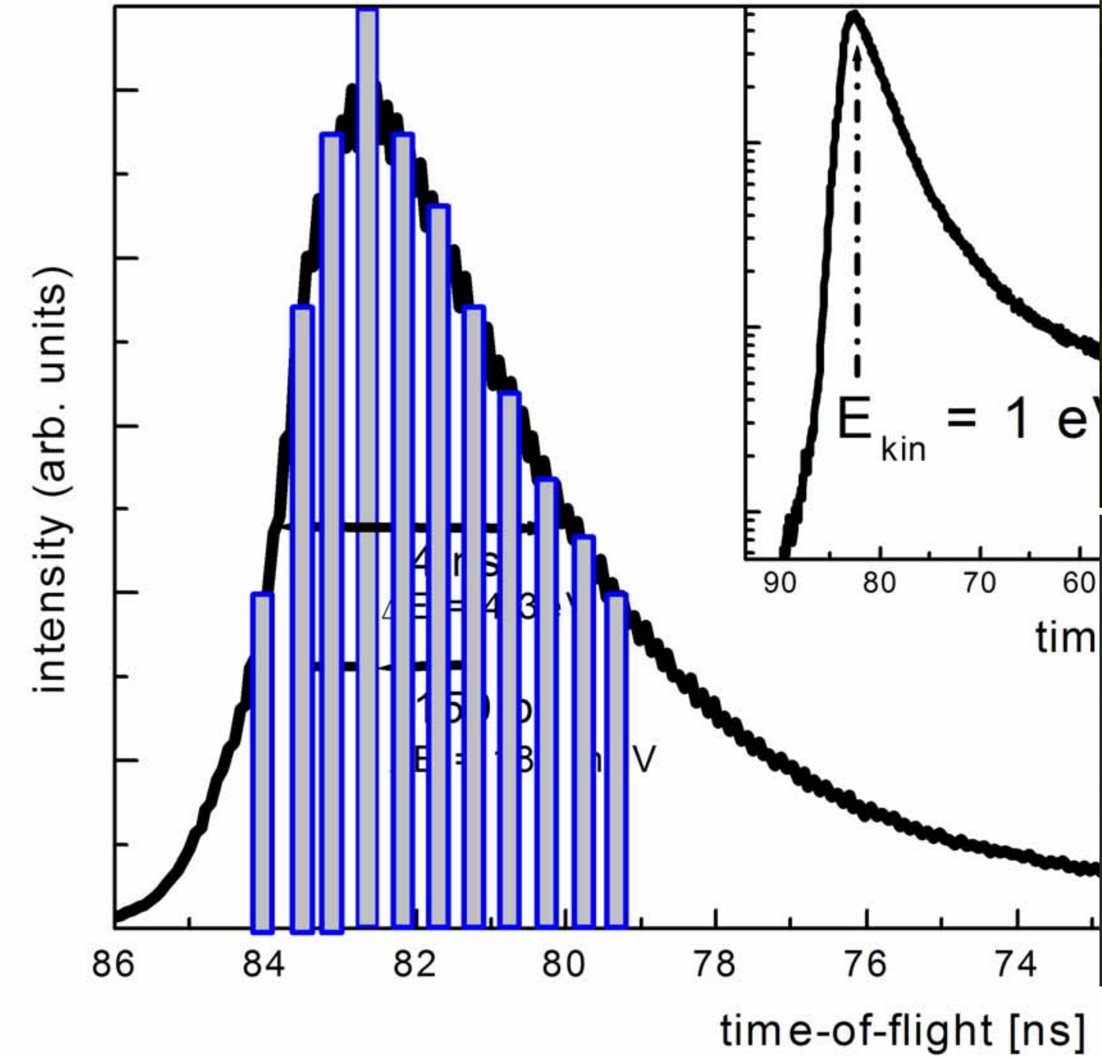


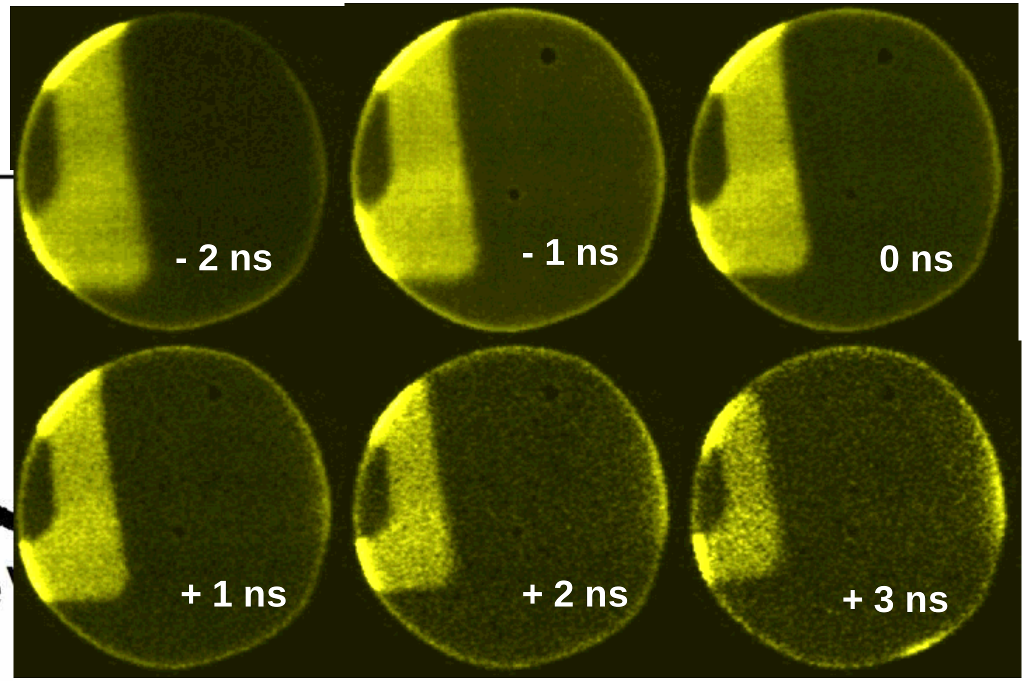


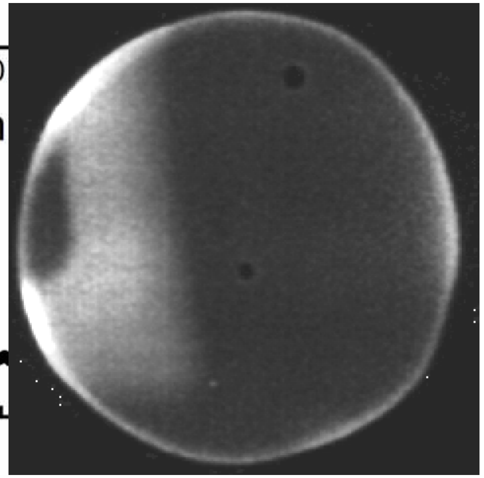


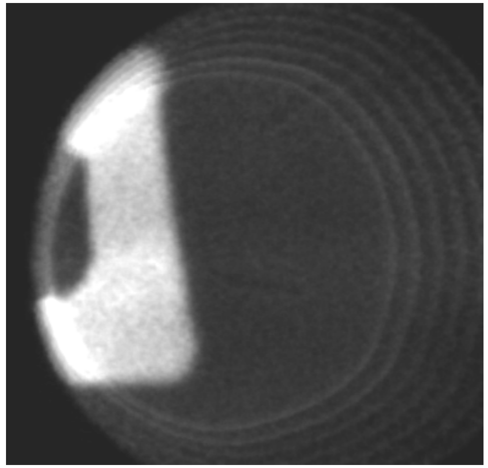


Generation of many partial images ⟹ „*time - slices*“ ⟹





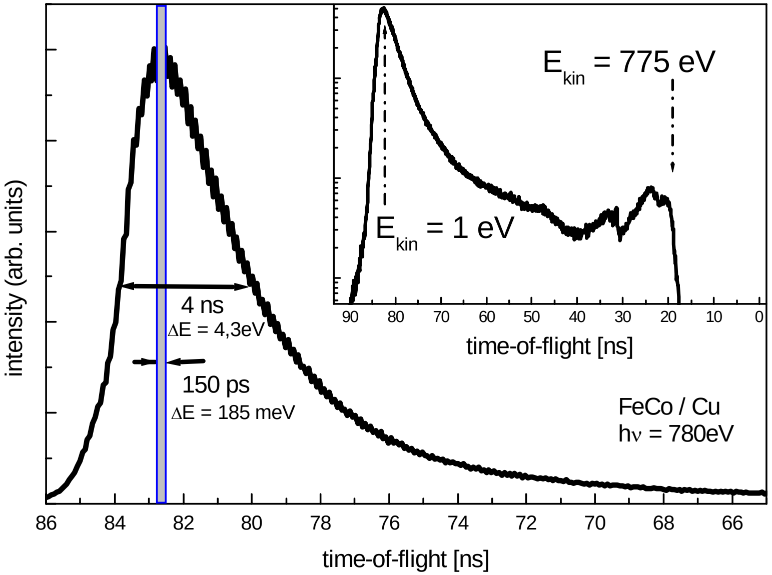




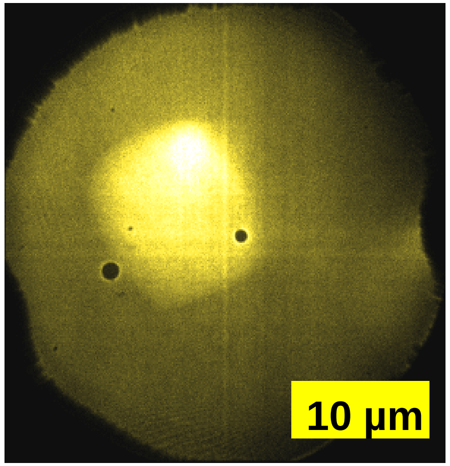
Sum images: without correction

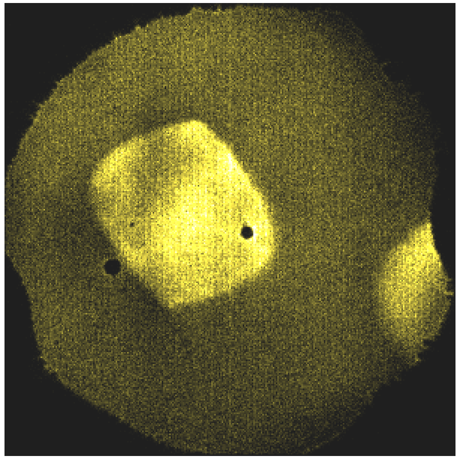
with correction
i.e. lateral rescaling

Time-of-flight spectromicroscopy
chromatic selector



TOF –filtered PEEM image





no Δt selection **Δt = 150 psec**

ToF- PEEM @ 133 ps Time Resolution

133 ps time slice
at the threshold edge

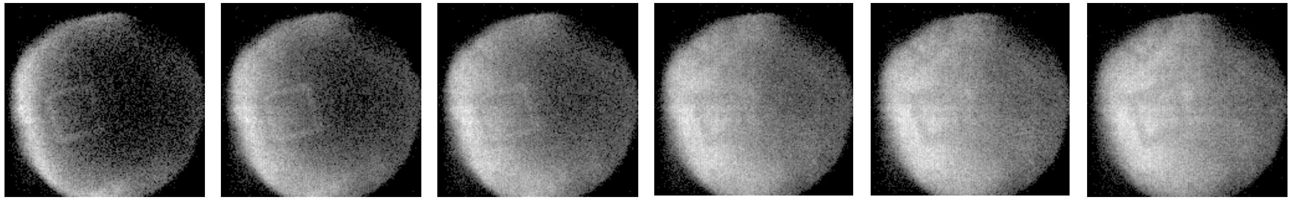
Next slice
ToF - 133 ps

ToF - 266 ps

ToF - 399 ps

ToF - 532 ps

ToF – 665 ps



workfunction dominates contrast

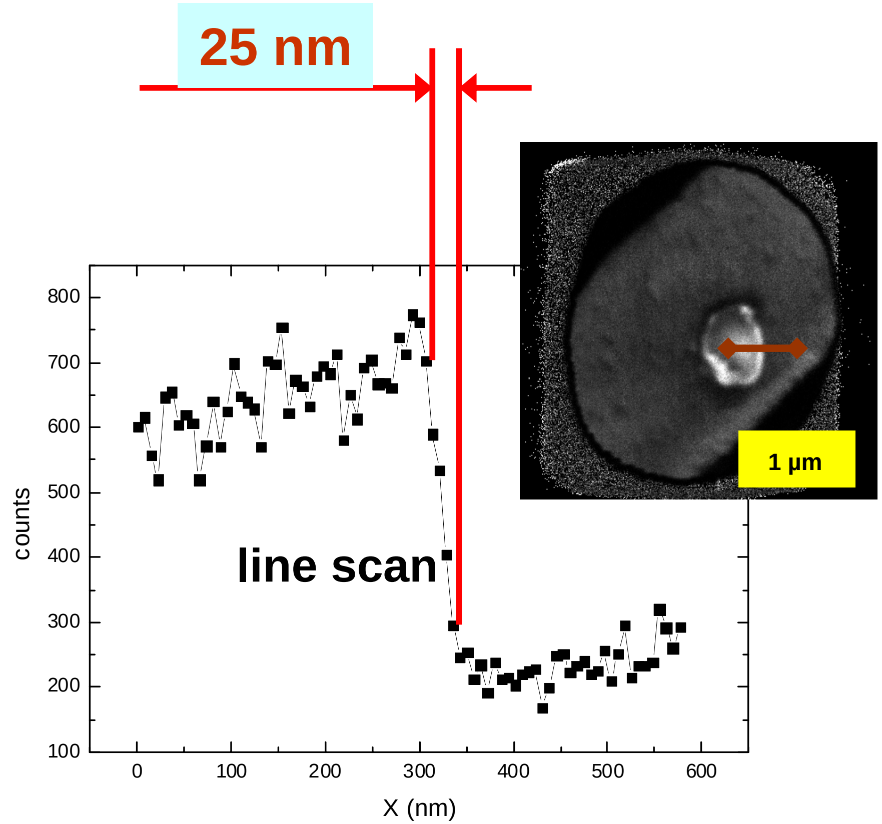
photoelectron yield dominates contrast

workfunction contrast change crossing the photoemission threshold edge from a Ni-Fe frame (25µm size) at a copper surface measured using a 1khz pulsed femtosecond UV laser source (hν = 27eV) for excitation, each time slice of 133 ps corresponds to a kinetic energy window of 0.15 eV given by the used settings of the ToF instrument (drift energy of 50 eV),

the same time resolution would enable a energy resolution of 0.014 eV @ 10 eV drift energy that was already approved for high quality imaging with the same instrument

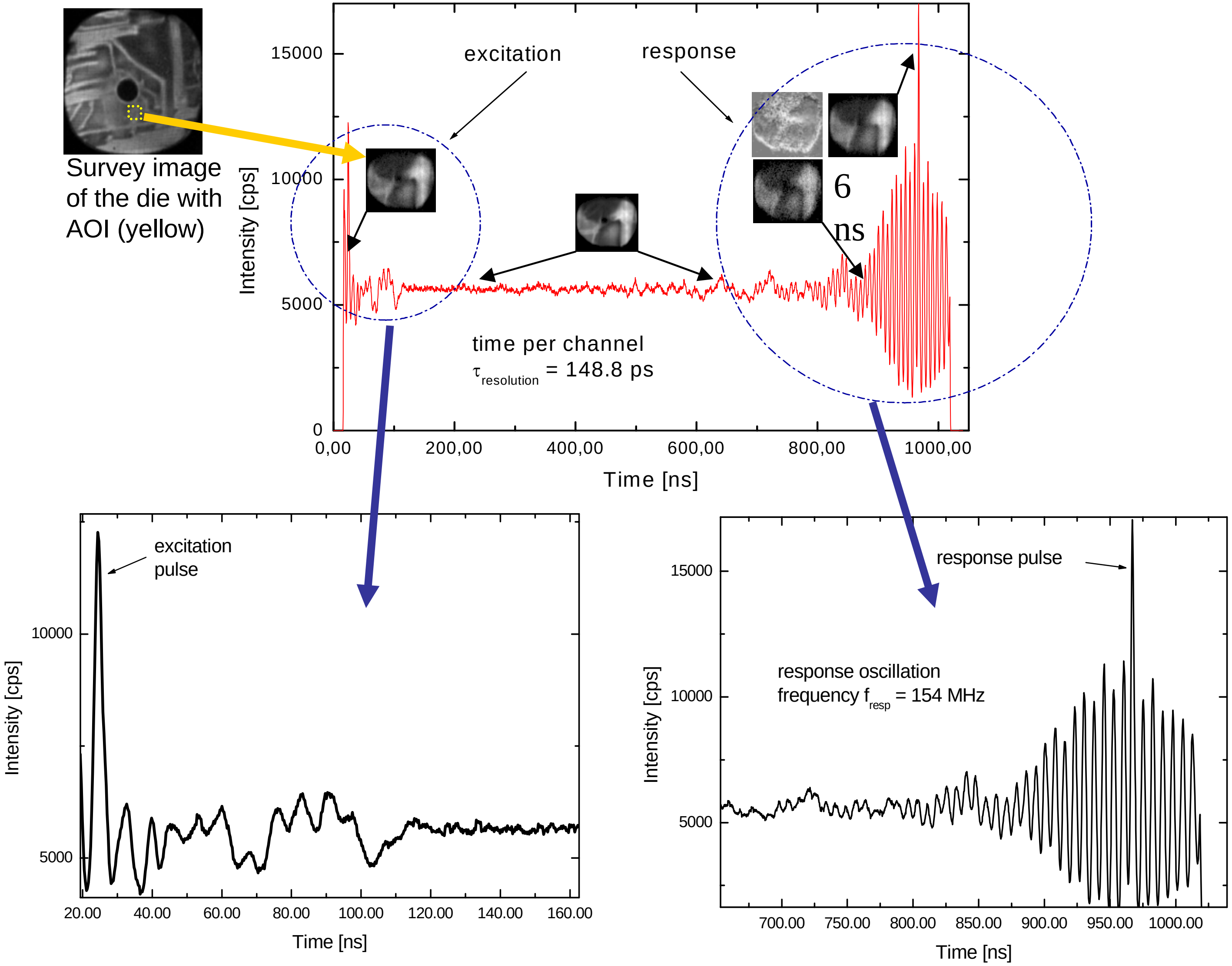
The use of dalayline detectors does not restrict the intrinsic spatial resolution of a state-of-the-art PEEM:

A superior spatial resolution could be achieved using a delayline detector as imaging unit at the FOCUS-IS-PEEM (HBO100 UV-excitation); Right: The line scan crossing the edge of a sub-micron size particle at a Pd strip demonstrates at least 25 nm in spatial resolution; due to the very low noise measurements using delayline detectors, even at weak contrasts one may measure reliable in the high resolution mode (see small structure elements at the Pd stripe).



data courtesy: Nils Weber, Focus GmbH, Hünstetten, Germany

Application Note: Testing the pulse response of a wire junction at a micro-chip surface (die):

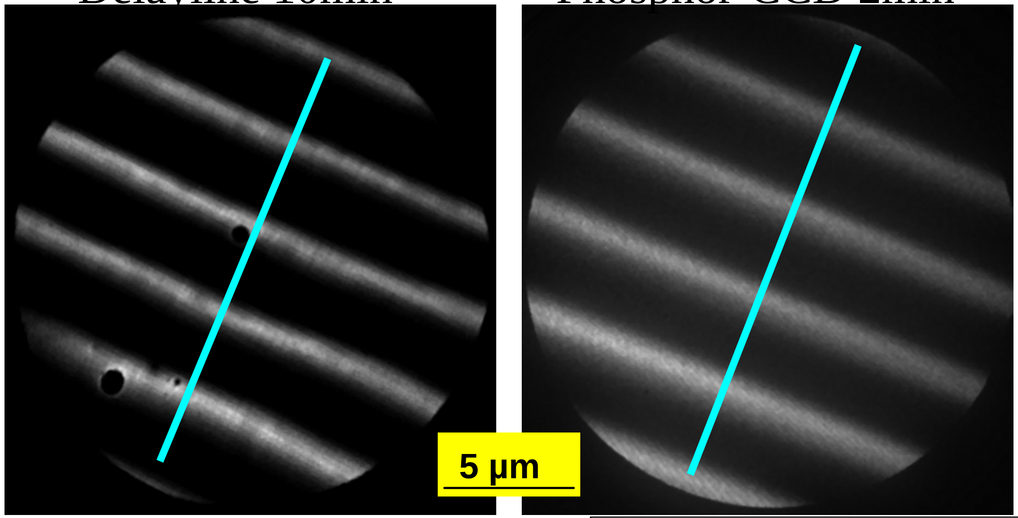


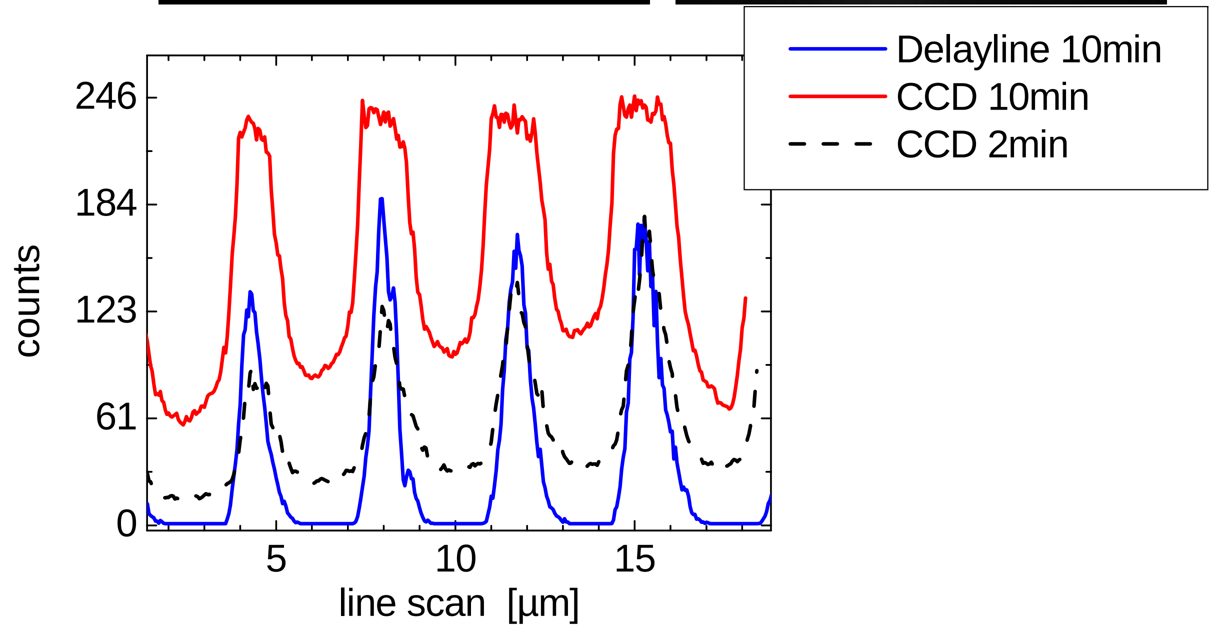
The principle of the detector data acquisition reveals a unique ability to group the x,y,t data triples in every possible combination. While a measurement is running or after a complete acquisition was taken; every valid subsequence order can be used to observe the signal evolution in a free accessible area of interest (AOI).

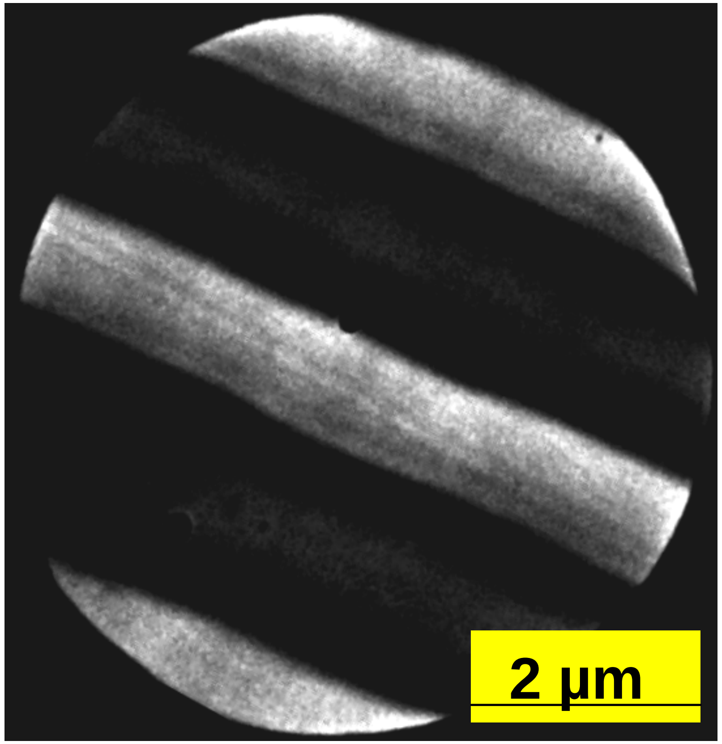
A die test with PEEM demonstrates the power of this method:
While a small voltage pulse is electrically coupled into the die, the Mini-PEEM observes a certain area of interest at its surface. The photo-electron excitation has been chosen continuous using a Hg-lamp. All measurements at the delayline detector are referenced with respect to the initial pulses and spatial resolved the 3D-detector signal responds with small changes in the 3D histogram of data.
The time variation of a small 2D-cut in space is shown directly at an electrical junction within the circuit. The initial pulse as well as the circuit response at this position are clearly seen in the data set. The complete acquisition time here was about 15 min.

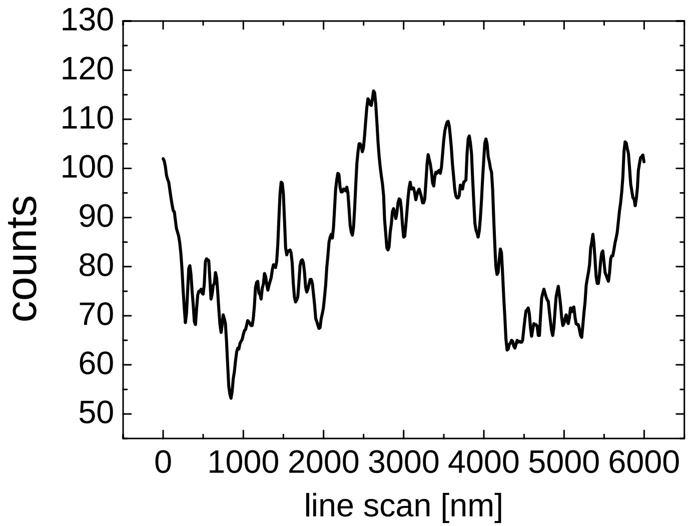
Signal-Noise, Resolution, and Dynamics Comparison DLD and CCD

Delayline 10min Phosphor-CCD 2min









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A. Oelsner, A. Krasyuk, G.H. Fecher, C.M. Schneider, G. Schönhense, J. Electron. Spectr. Rel. Phenom., 137-140 (2004) 757-761

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M. Cinchetti, D. A. Valdaitsev, A. Gloskovskii, A. Oelsner, S. A. Nepijko and G. Schönhense; J. Electron. Spectr. Rel. Phenom., 137-140 (2004) 249-257

[7] Time-resolved X-ray photoemission electron microscopy: Imaging magnetodynamics on the 100 ps time scale
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[10] M. Cinchetti, A. Gloskovskii, S. A. Nepjiko, G. Schönhense, H. Rochholz, M. Kreiter Photoemission Electron Microscopy as a tool for the investigation of optical near fields; Phys. Rev. Lett. 95 (2005) 047601

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