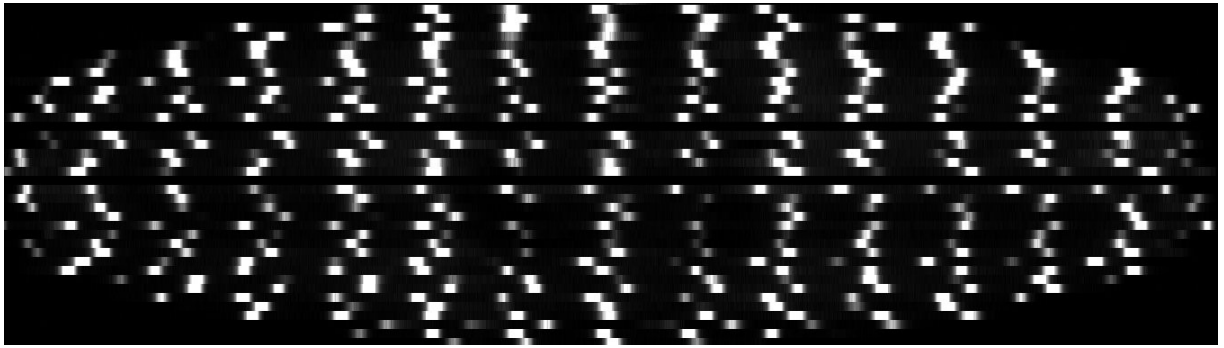
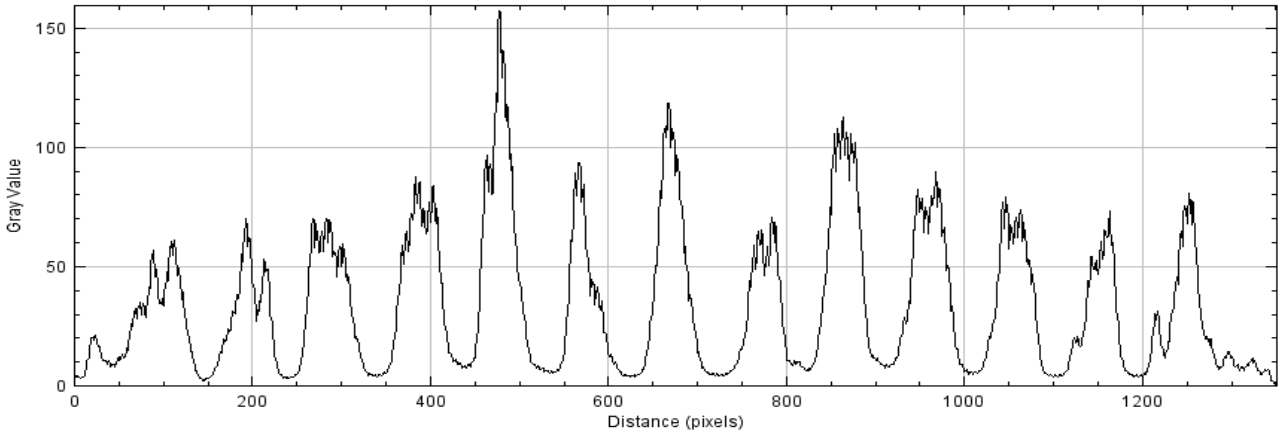
Alignment of the hRIXS Detector

Images alignment work first done with round test MCPs using UV-light (mercury lamp) through a mask with horizontal slits 3 mm in front of the MCP

Slit width: 200 micrometer
Slit distance (in x): 3 millimeter

raw image, not corrected:





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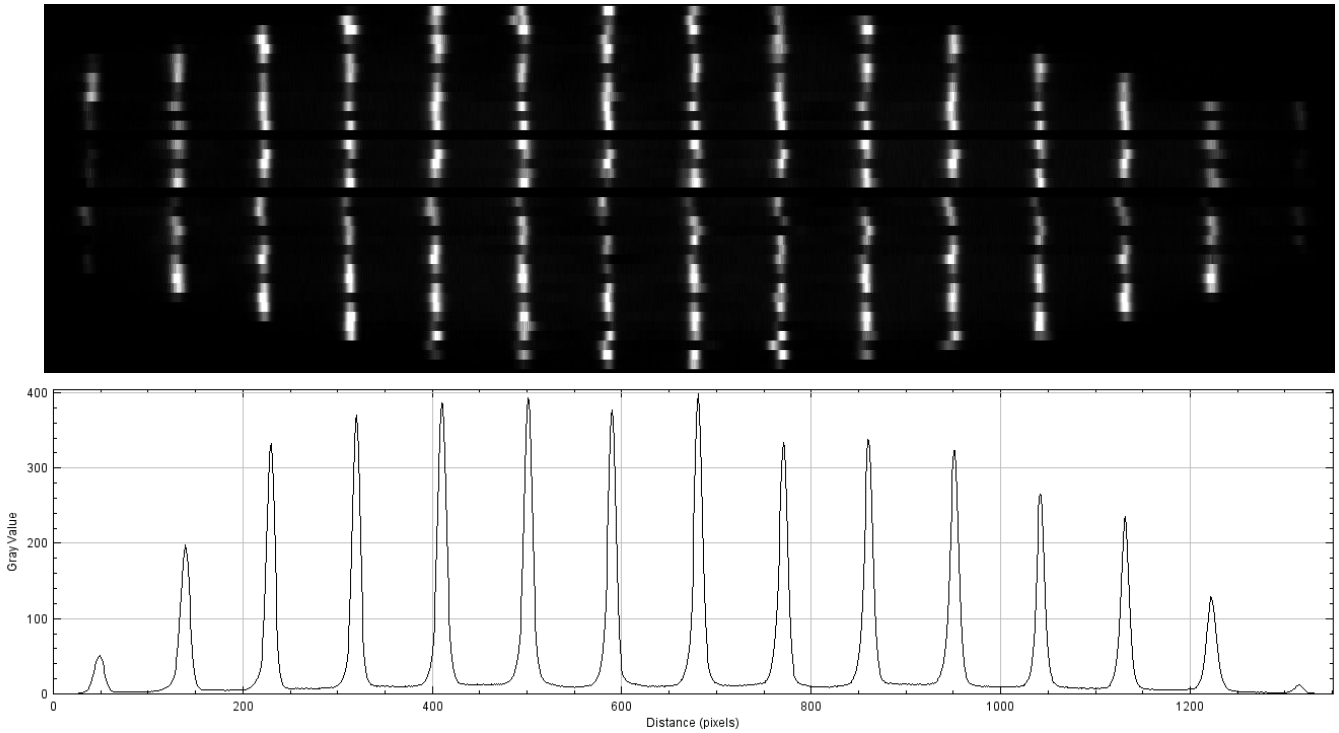
Alignment of the hRIXS Detector

after software assisted correction, requires a little human correction still



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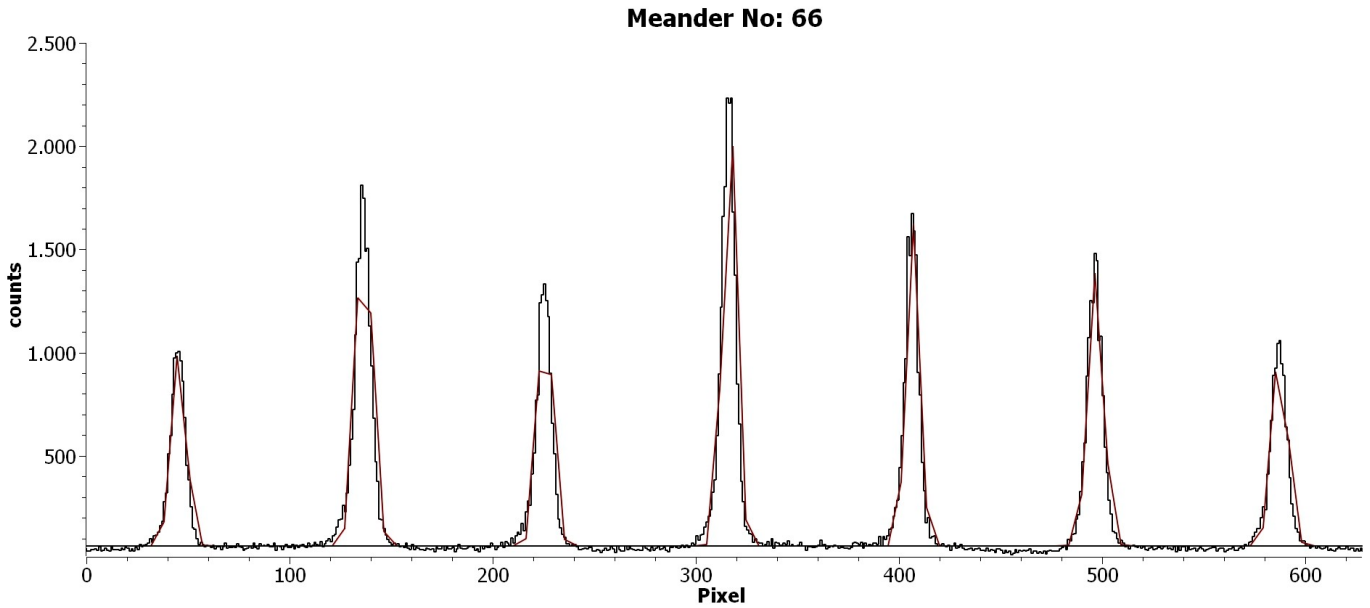
Alignment of the hRIXS Detector

Measurements of the 200µm slit imaging in an example line on different detector positions:



Peak No:	FWHM [Pixel]	FWHM [micrometer]	20%-80% [micrometer] rising // falling
1	7,19	215,7	150 // 120
2	7,70	231	150 // 120
3	7,09	212,7	120 // 120
4	6,66	199,8	120 // 120
5	6,58	197,4	120 // 90
6	7,52	225,6	120 // 90
7	7,65	229,5	150 // 120

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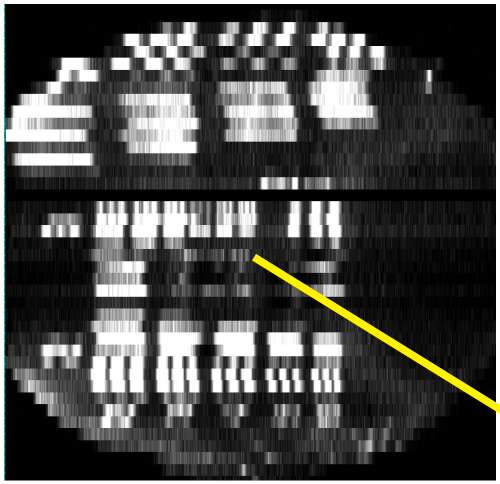
Improvement of Spatial Resolution Multiline DLDs

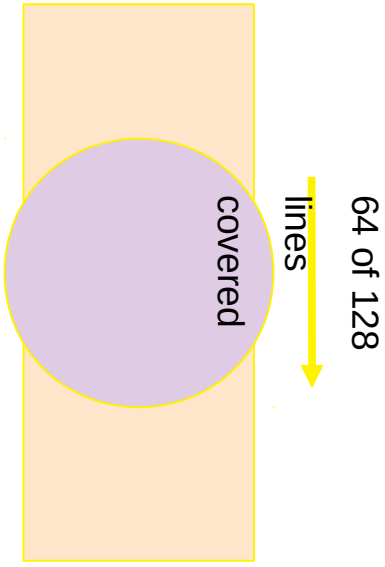
Test conditions:

- a test MCP set round 45 mm active diameter covers the middle of the 142 mm x 44 mm rectangular area

- 64 lines vertical (image stretched in vertical direction)
- USAF1951 mask projected from outside vacuum with magnification 8.6, image settings for 56 µm pixels

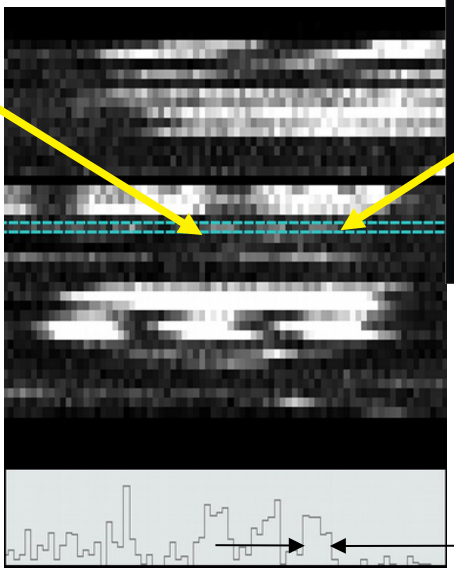
- multiple edges rise in 1 – 2 pixels that is around or below 100 µm!

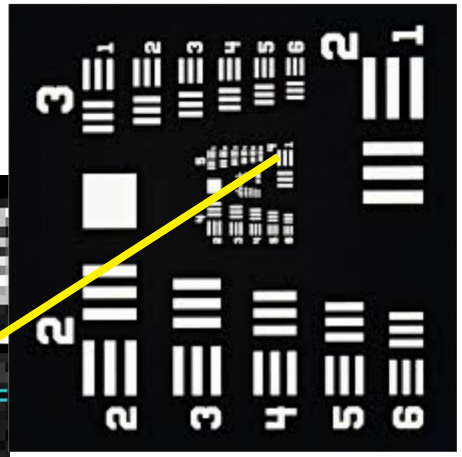




group 4

element 1





magnified projection 8.6x,

that is for

group 4 element 1

270µm width per line

56 µm per pixel

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Measurements and Results

Test with diffraction of a laser spot through a pin hole

28 µm per pixel

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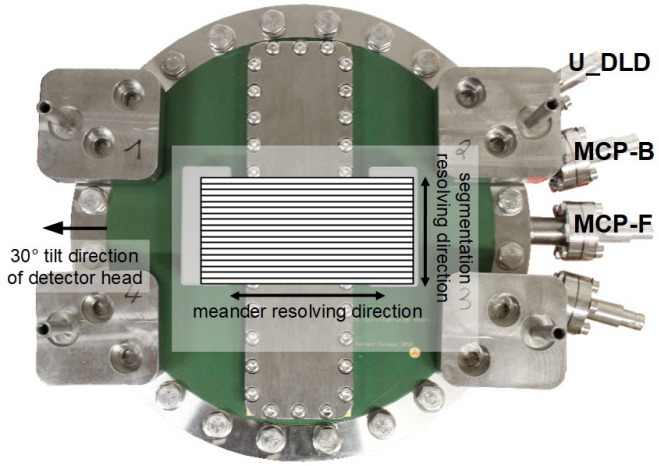
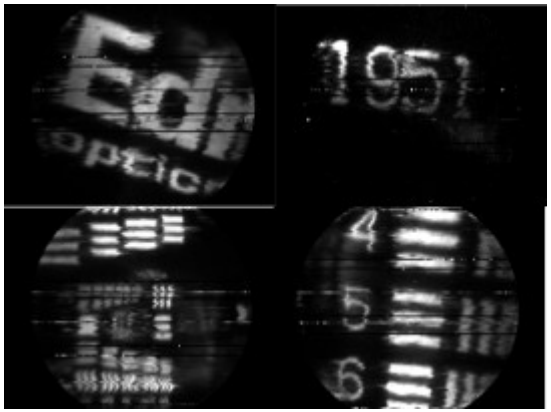
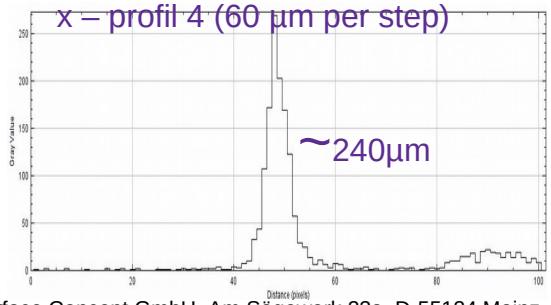
Multiline DLD Systems (under development)

DLD imaging at massive multihit capability:

- up to 256 completely independent line readouts
- several 10 multi hits possible
- < 300 ps time resolution
- < 250µm spatial resolution
- > 10 Million counts per second
- 1Gbit Ethernet data interface
- 40 mm or 60 mm active area length







Products (preliminary):

- DLD4040-64 (64 lines)
- DLD4040-128 (128 lines)
- DLD6060-256 (256 lines)

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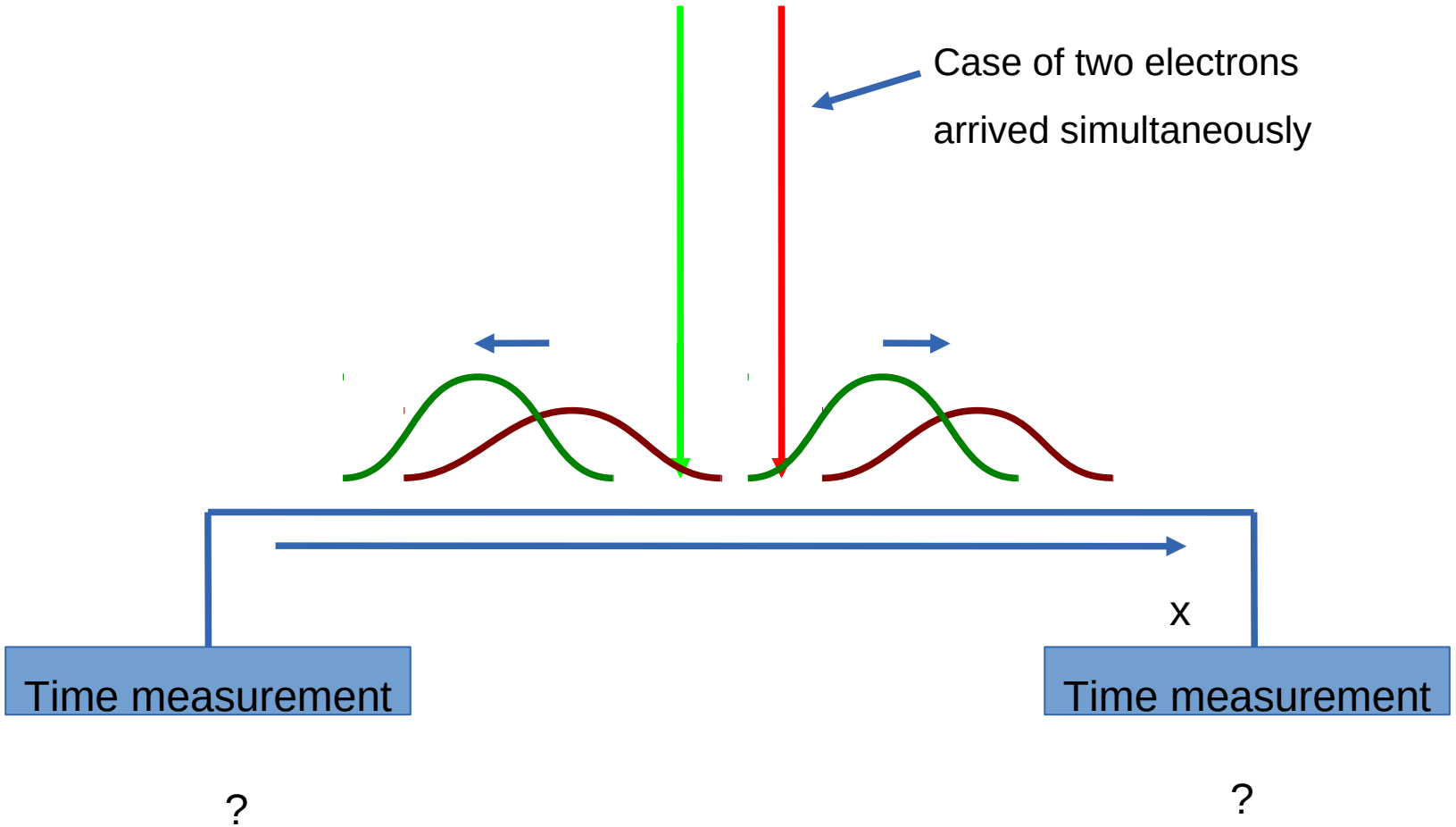
www.surface-concept.de; oelsner@surface-concept.de

Double Hit Problem of Delay Line Anodes



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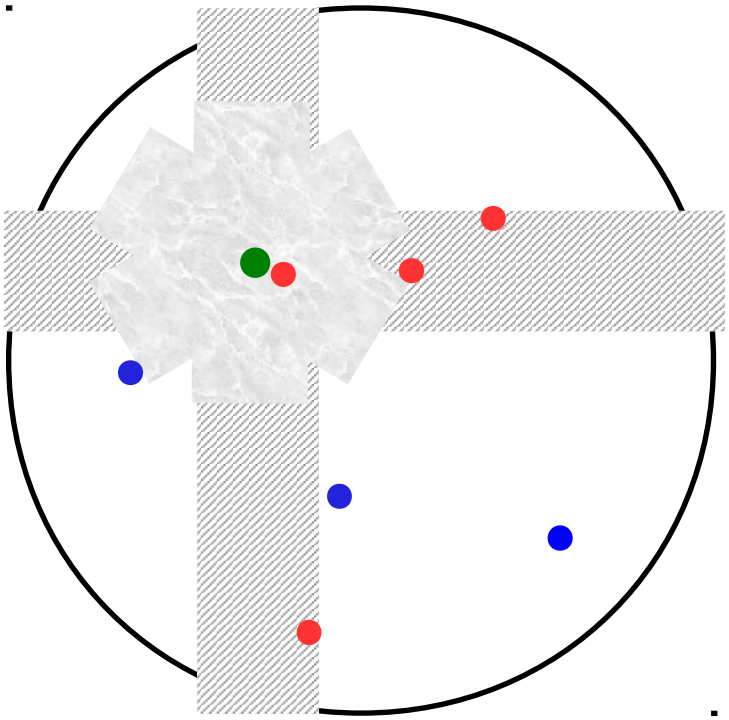
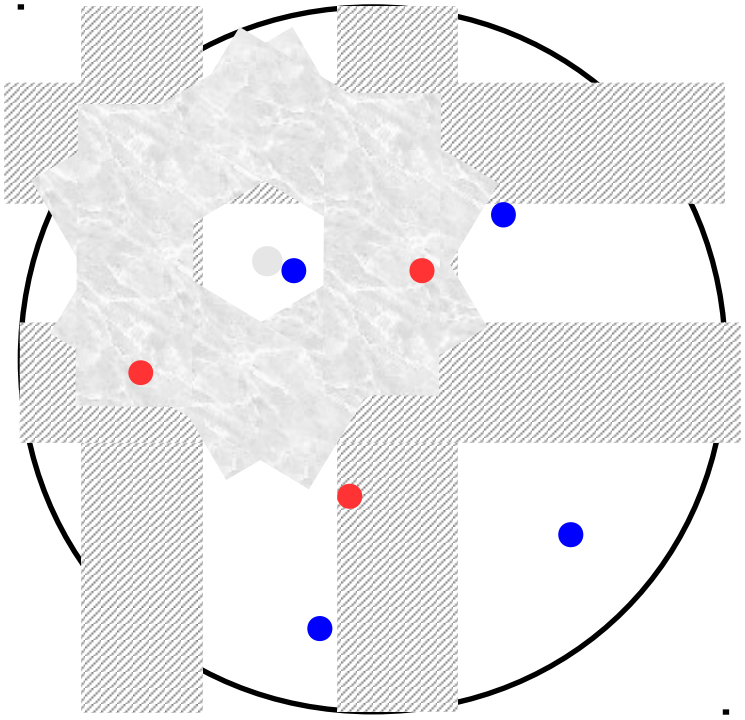
Double Hit Problem of Delay Line Anodes

The moment of the hit



A few nanoseconds later



active DLD area (not segmented)

dead area for double hit recognition in time (ring is hexanode dead area *after!* data analysis)

single hit

double hit detectable

double hit not detectable

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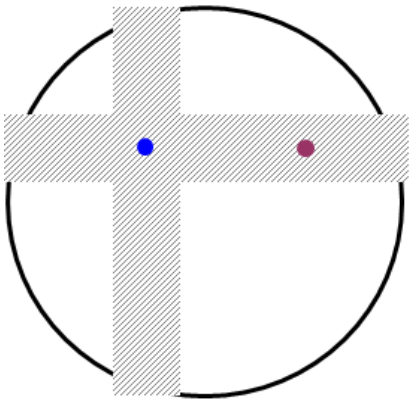
Higher Multihit Capabilities: Multi-DLD Anodes

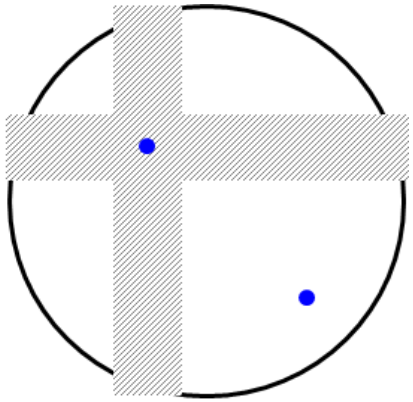
The way towards more than double hit recognition:

Separated multi-anodes with separated readouts for DLD systems

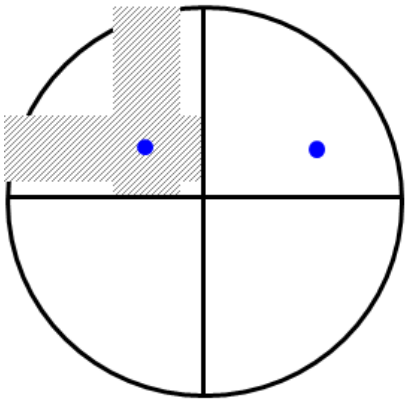
(as described in patent DE10335718 B4, granted in 2007)



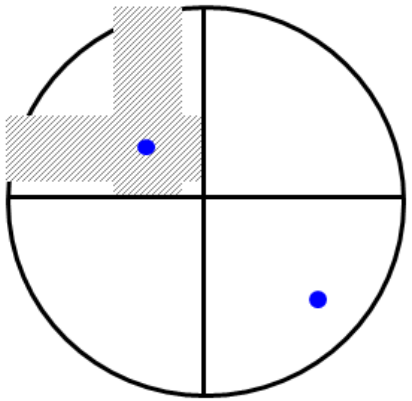
not detectable



detectable



detectable



detectable

The first success of the concept: Not only double hits, but already a few multi-hits per micro-bunch!

Not bad so far, but:

Poisson statistics always rules!

Thus, we will need MORE segments!

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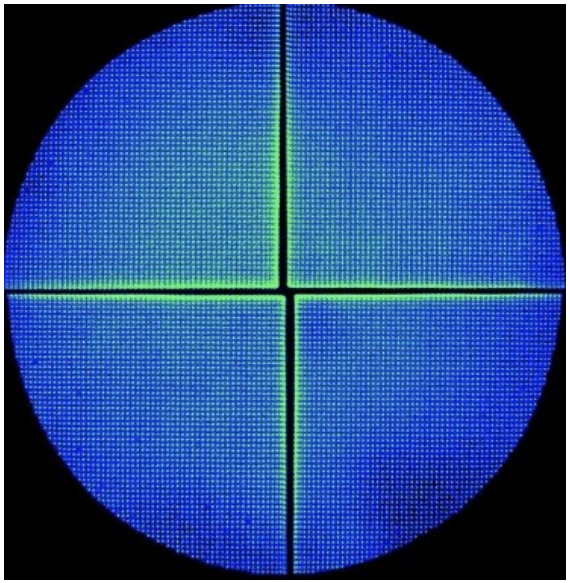
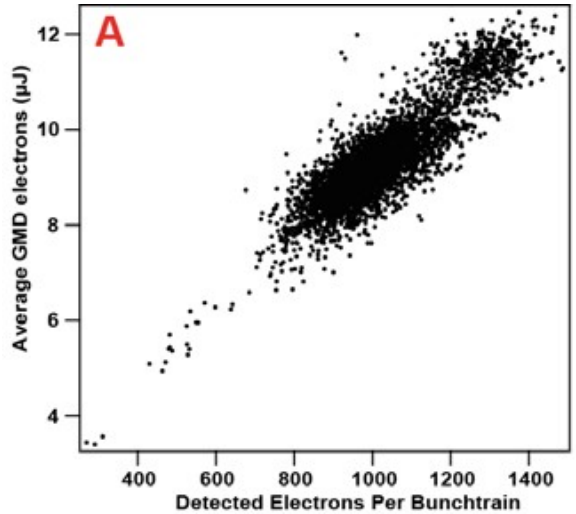
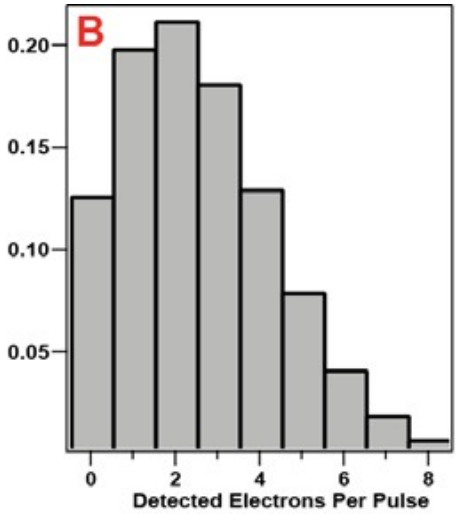
History of Multianode DLDs

2003	**patent application multianodes for Delay Line Detectors**
	granted 2007 (DE10335718 B4)
2003 – 2008	**hybrid 9-fold anodes for spectroscopy**
2006	**4q DLD introduced**
2011	**9x16 delay line anodes for high frequency short pulse operation**
Since 2013	**128/256 Multiline DLD development**
2017	**8 segment DLD**



“Single shot photoemission from GaAs at FLASH.”
M Dell'Angela et al.





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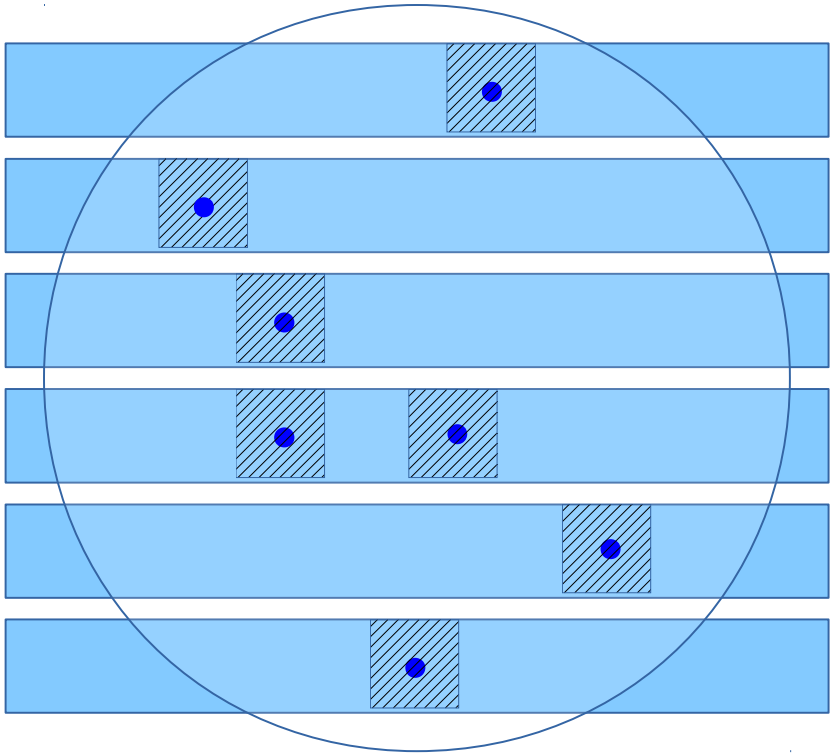
1D DLD anode splitting / segmenting



Has some advantages:

Dead time of the separate segments is much smaller!

Many different segment arrangements possible.

And:

Segments are independent, no pulse interceptions and no redundancy problems at all!

With the splitting, the DLD anodes are not “single pixel” detector anodes anymore

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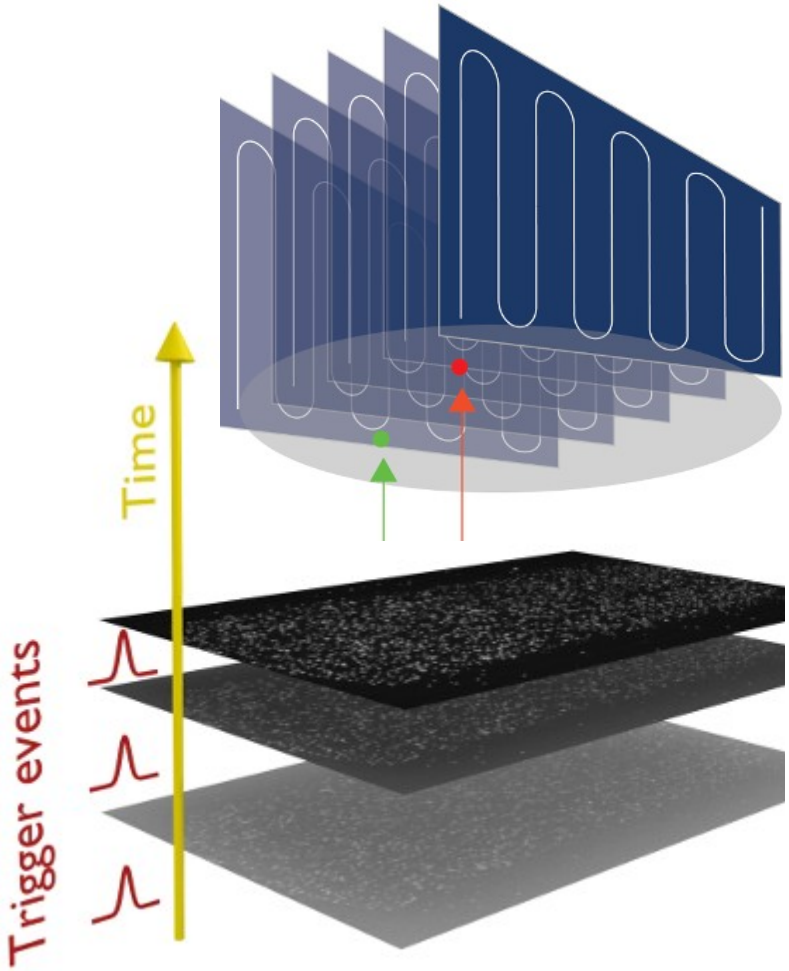
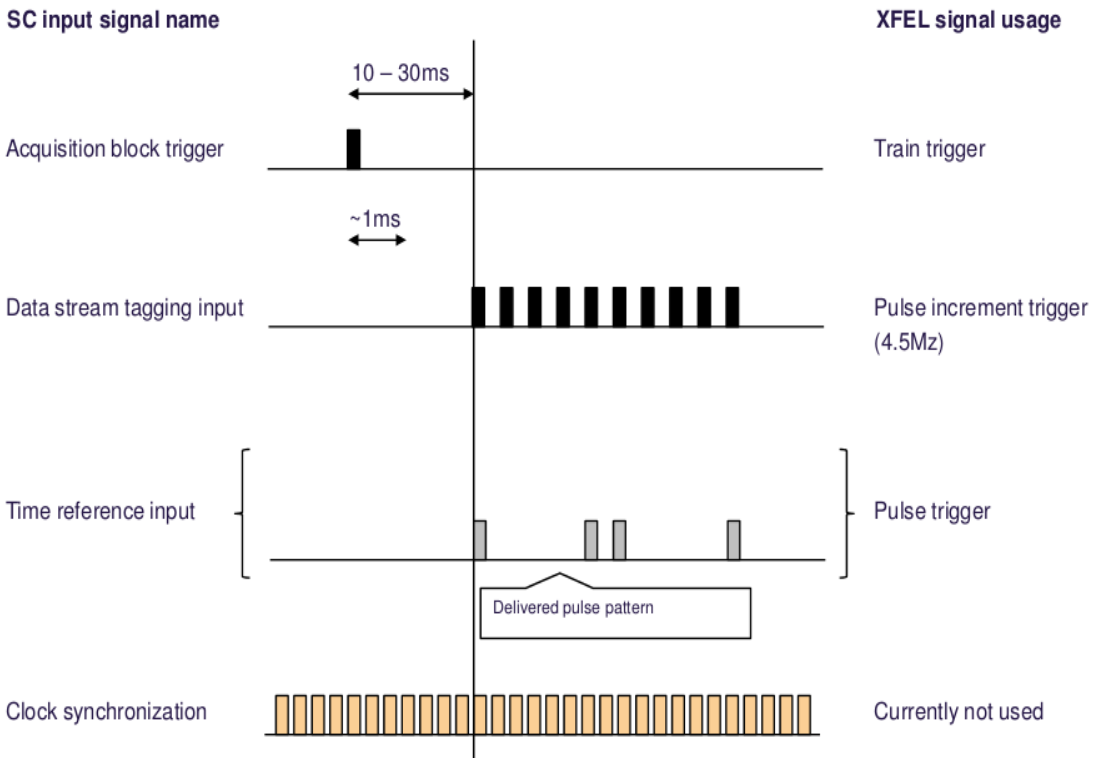
DLD readout as event stream camera readout

Deadtime of each delay line strip is about 20 ns. Double-hits of strips can be registered when their distance is > 6ns. Thus, a non-interrupted subsequent hit readout with 5 coordinates is realized (x, y, tof, pulse-No., train-No.)



XFEL Triggers



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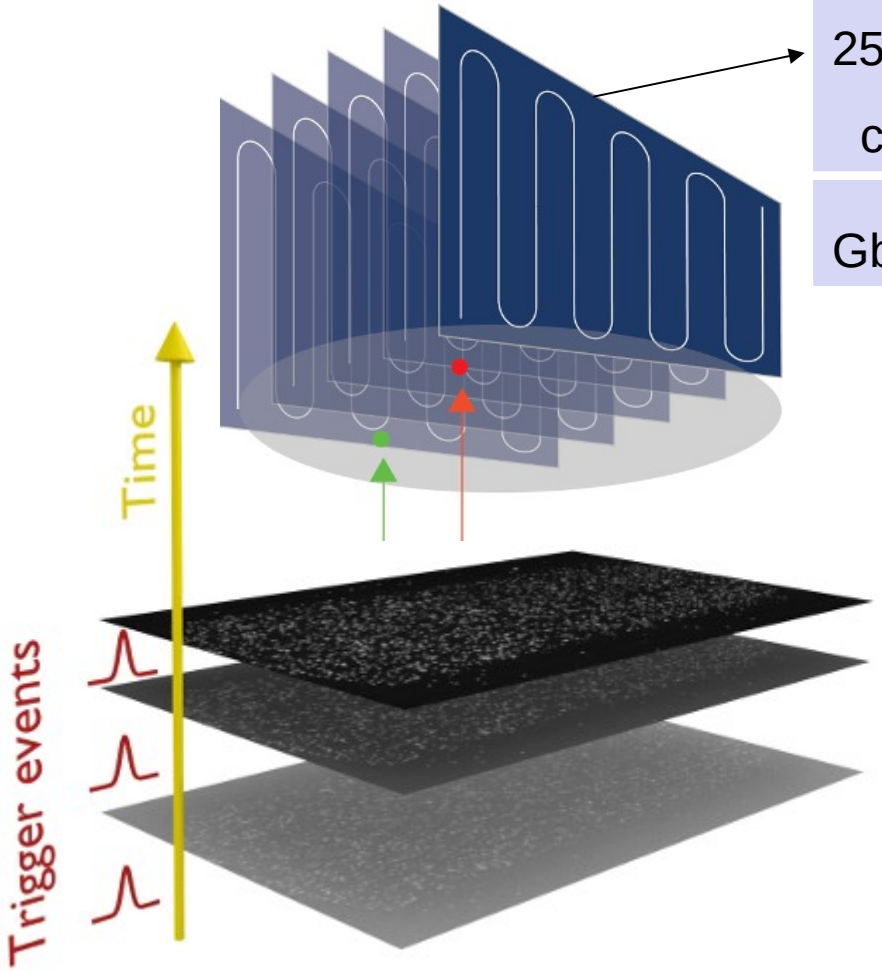

256 channel readout, coordinate tagging

XFEL Triggers

Gbit Ethernet

DAQ

Permanent stream of data:

x, y, tof, pulse-No., train-No.

….				
….				
114	1021	003.12	1204	32
002	0009	191.45	1204	32
008	0212	017.07	1204	32
024	0511	030.18	1205	32
123	1003	099.73	1205	32
034	0005	003.26	1205	32
….				

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