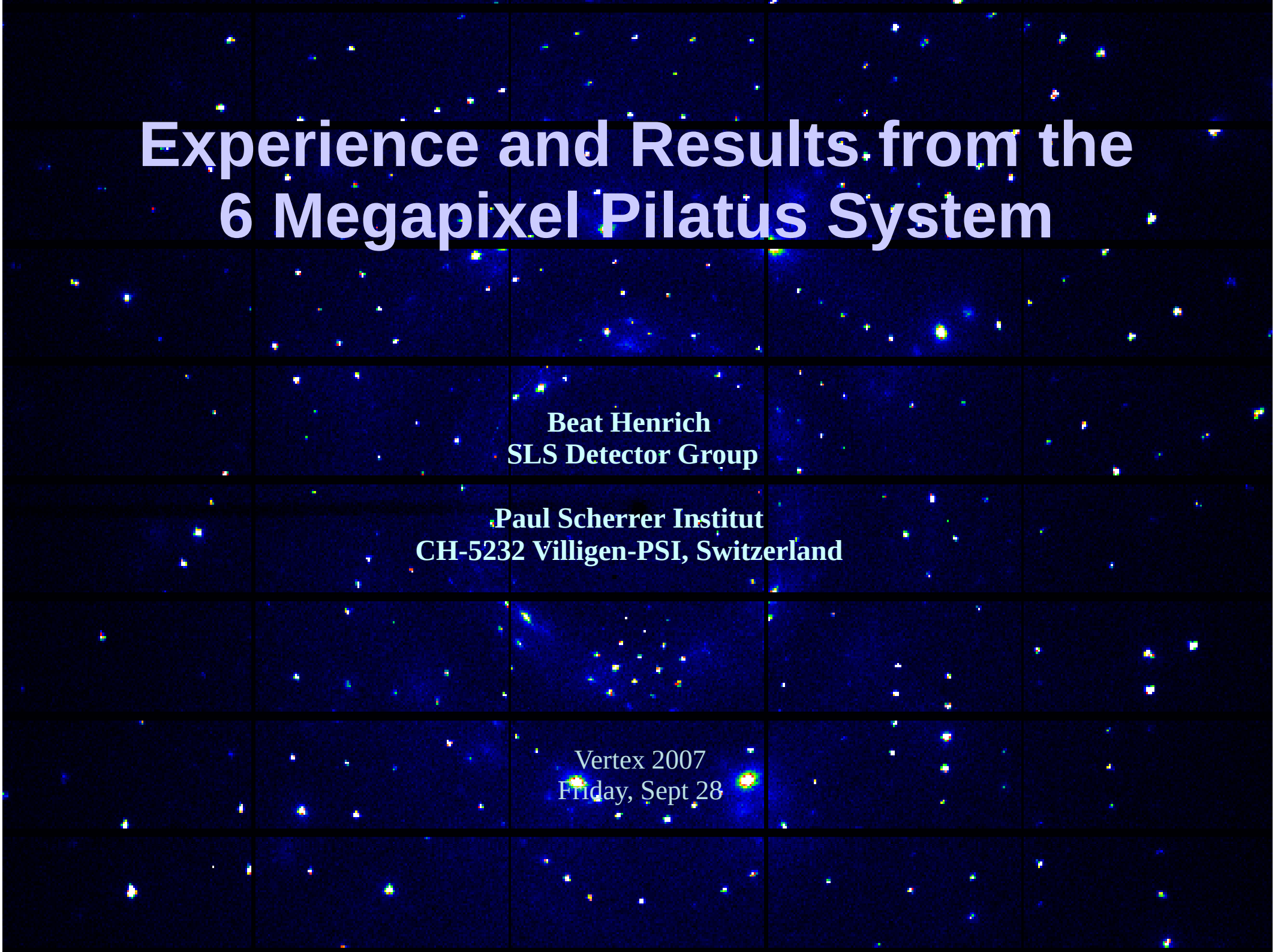


Experience and Results from the 6 Megapixel Pilatus System

Beat Henrich
SLS Detector Group

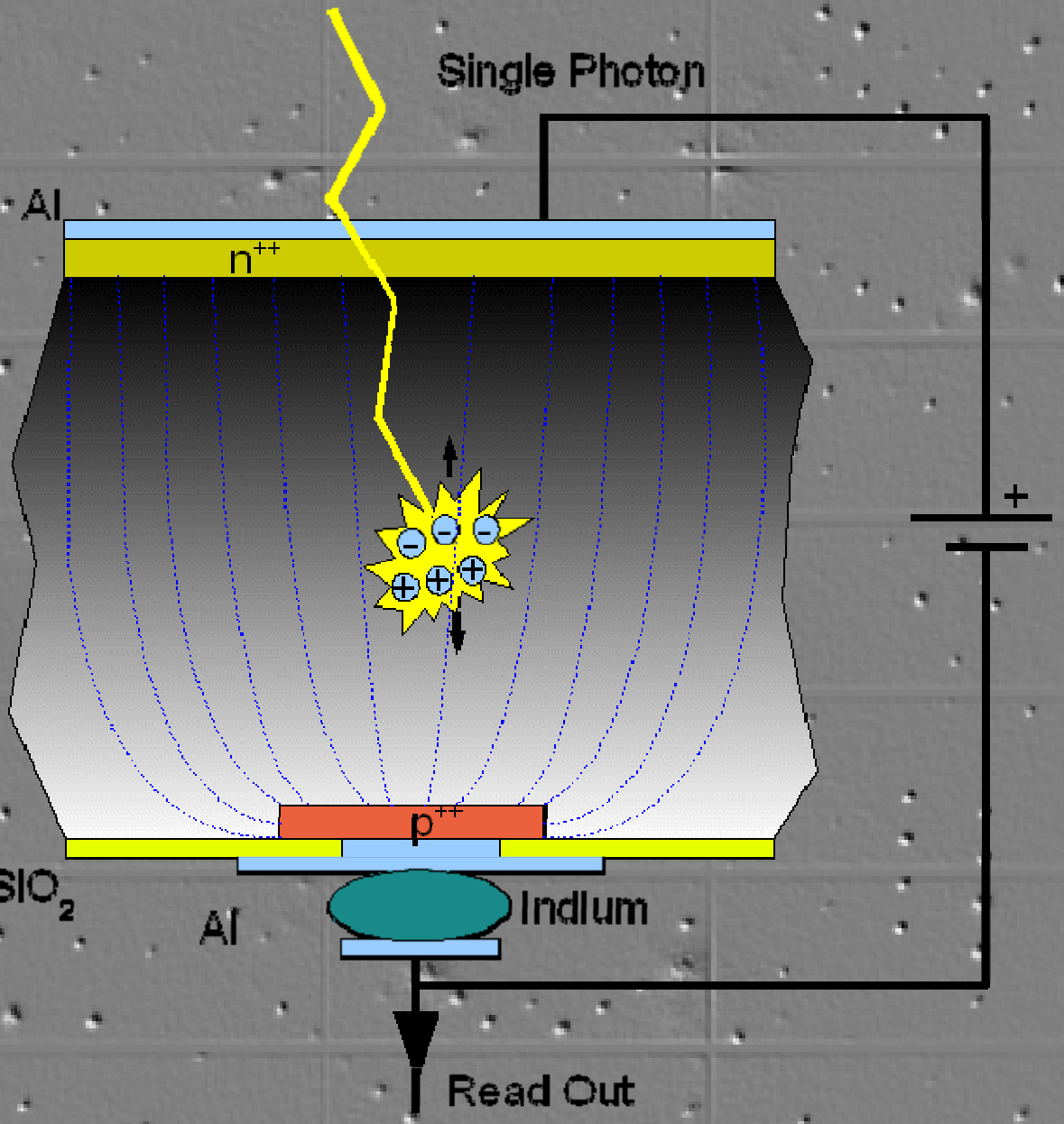
Paul Scherrer Institut
CH-5232 Villigen-PSI, Switzerland

Vertex 2007
Friday, Sept 28

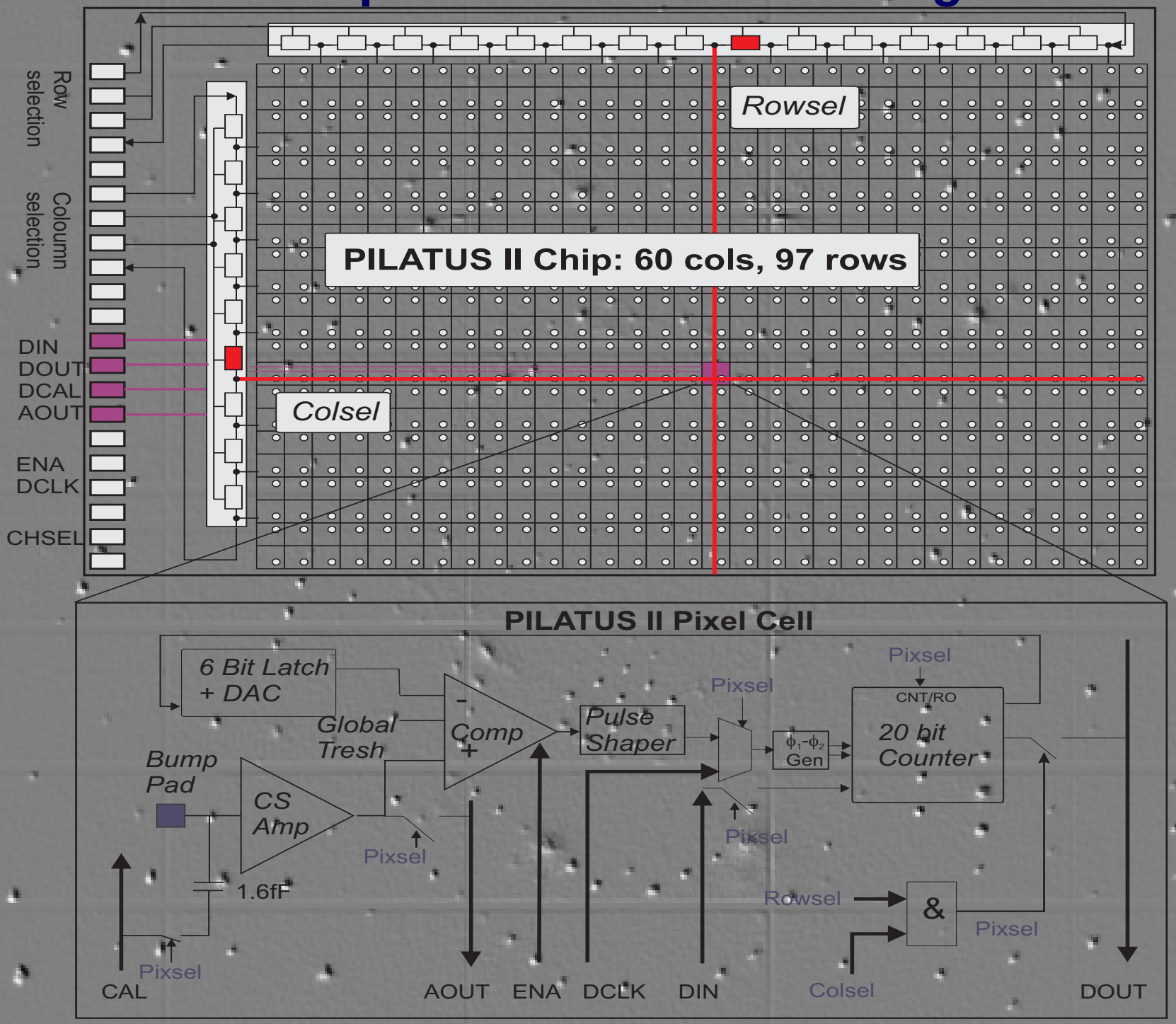
Outline

- Single Photon Counting Principle
  - Detection
  - Amplification and Counting
  - Hybrid Construction
  - Modular System
- Experimental Experiences
  - High Dynamic Range
  - Threshold Suppression
  - Point Spread Function
  - High Frame Rate
  - Fast Scan
- General Experiences
  - Charge Sharing and Calibration
  - Paralizable Counter
  - Analyze Software
  - Mismanipulation

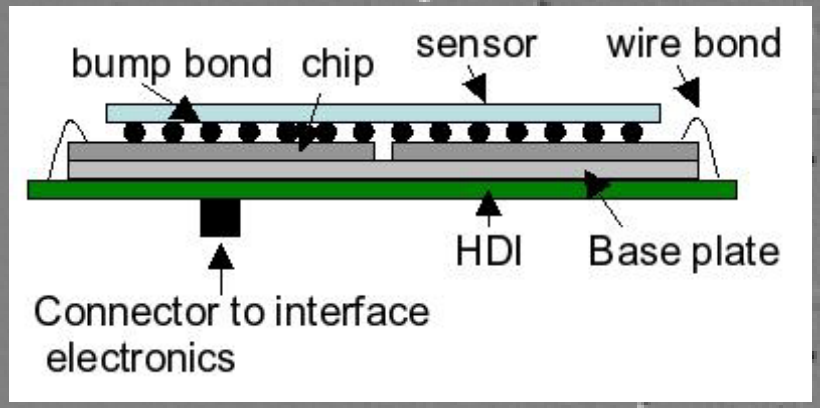
X-Ray Detection

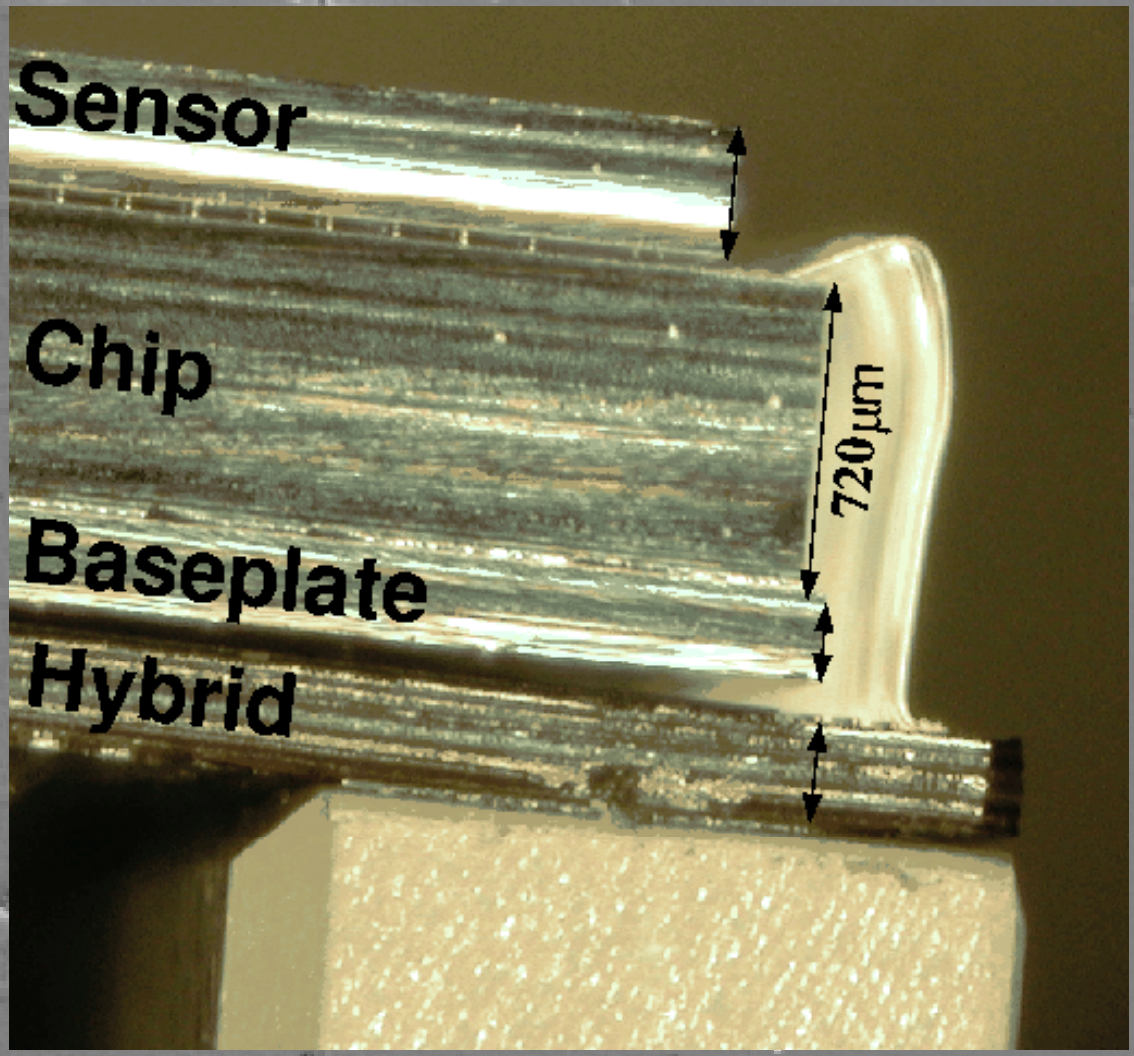


Amplification and Counting



Hybrid Construction





Modular System

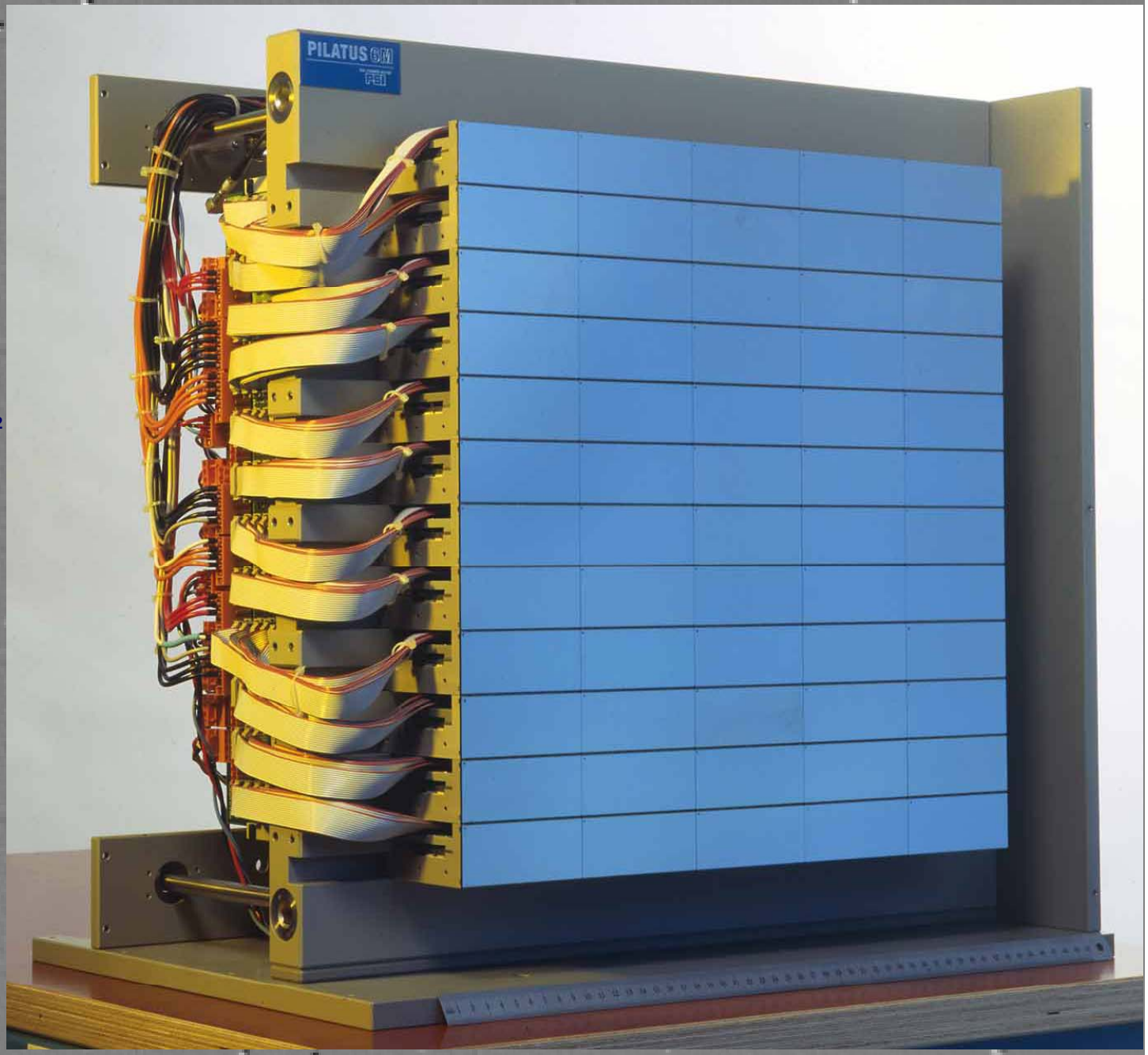
No of Modules	1
Detector Size [mm]	34 x 84
Module Array	1 x 1
Format	94’965 pixels
Spatial resolution	0.172 x 0.172 mm^2
Dynamic range/pixel	20bits
Count rate/pixel	~3 MHz/pixel
Readout time	3.5 ms
Frame rate	250 Hz
Power consumption	5 W
Operating temperature	25°C
Dimensions [mm]	265 x 140 x 85
Weight Approx.	5 kg

Modular System

No of Modules	24
Detector Size [mm]	254 x 289
Module Array	3 x 8
Format	2’279’160 pixels
Spatial resolution	0.172 x 0.172 mm^2
Dynamic range/pixel	20bits
Count rate/pixel	~3 MHz
Readout time	3.5 ms
Frame rate	30 Hz
Power consumption	200 W
Operating temperature	25°C
Dimensions [mm]	388 x 434 x 526
Weight Approx.	50 kg

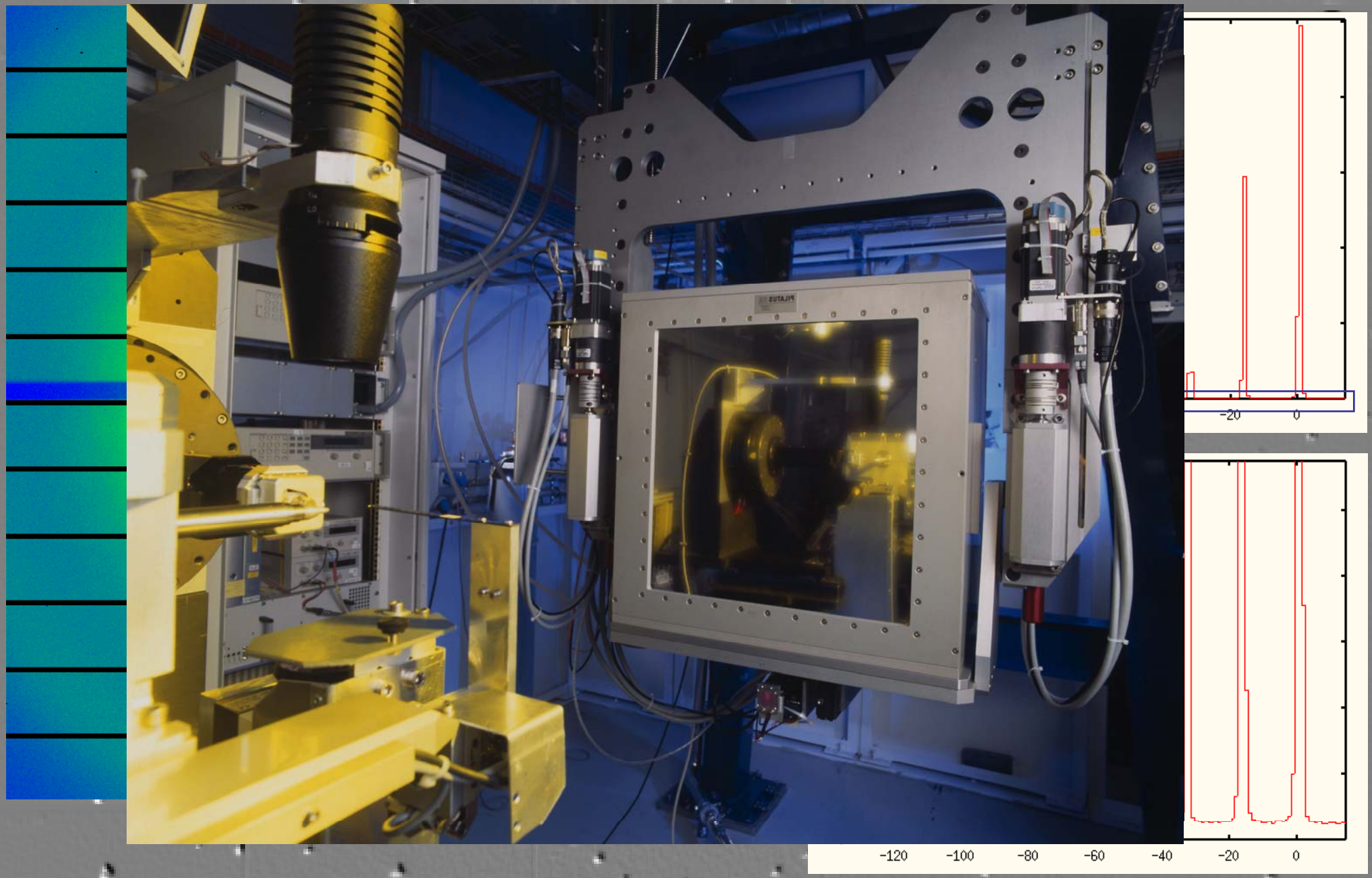
Modular System

No of Modules	60
Detector Size [mm]	431 x 448
Module Array	5 x 12
Format	6'224'001 pixels
Spatial resolution	0.172 x 0.172 mm^2
Dynamic range/pixel	20bits
Count rate/pixel	~3 MHz
Readout time	3.5 ms
Frame rate	12.5 Hz
Power consumption	500 W
Operating temperature	25°C
Dimensions [mm]	574 x 580 x 402
Weight Approx.	95 kg

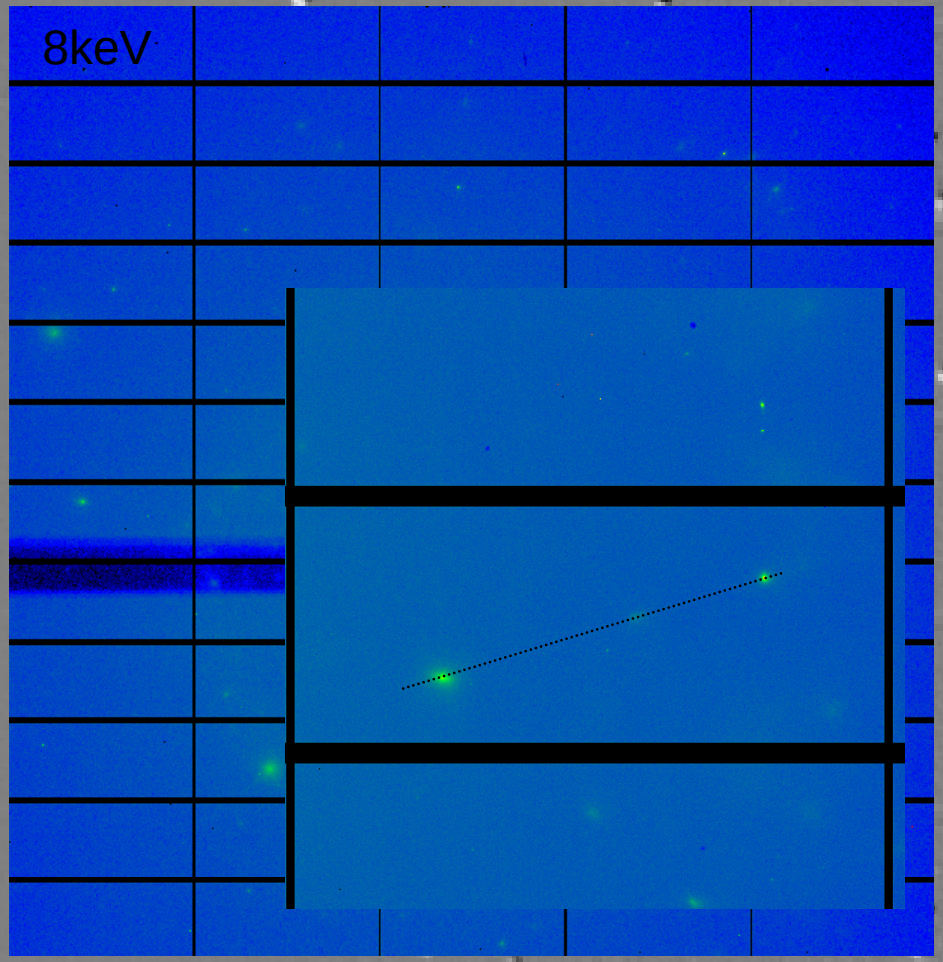


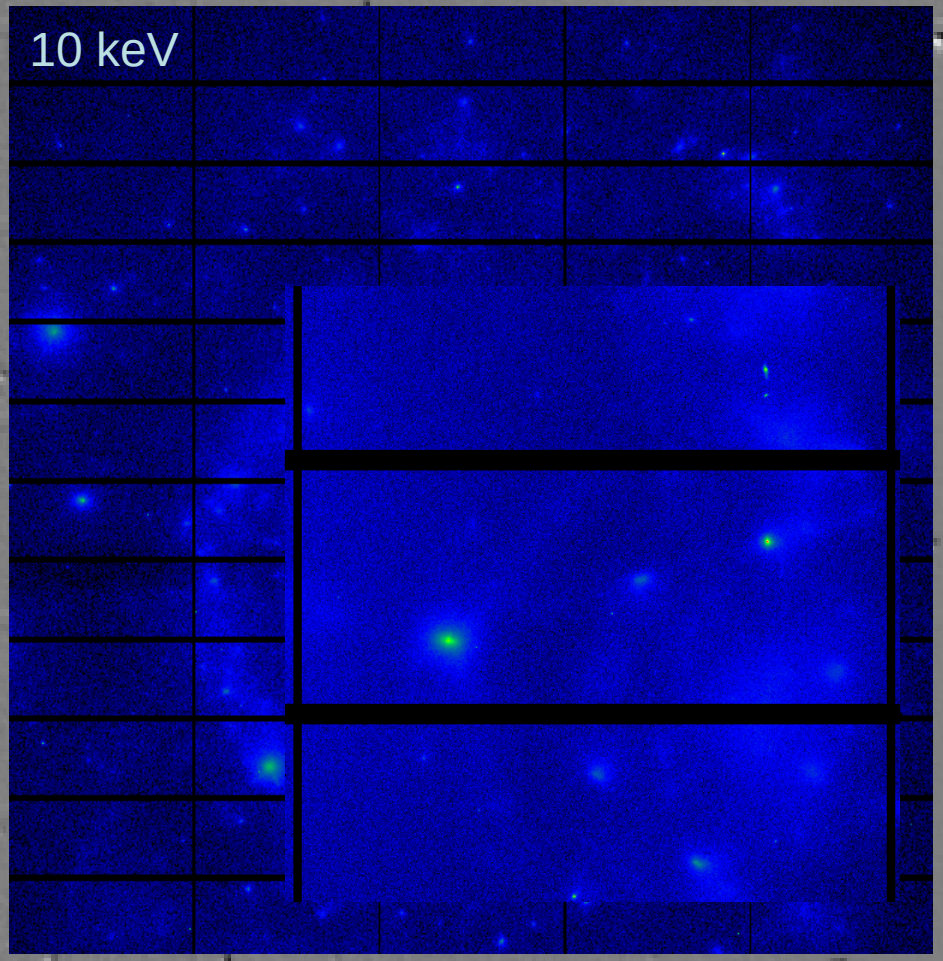
High Dynamic Range

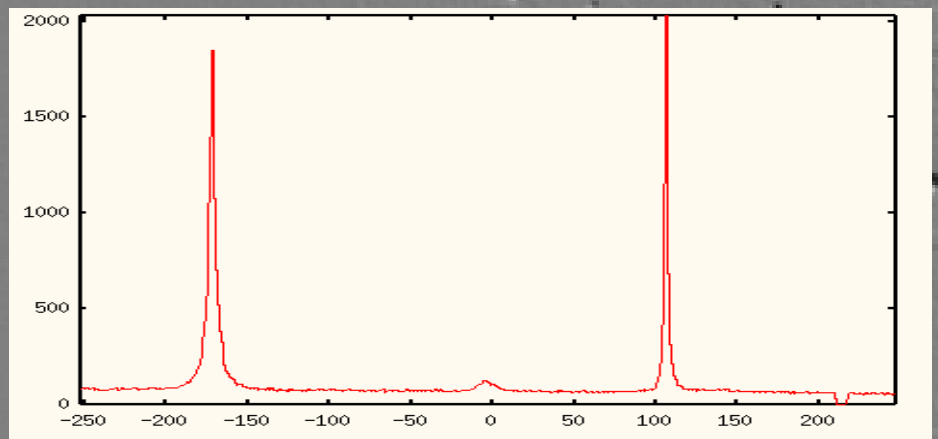
30s Ribosme (R. Venki)

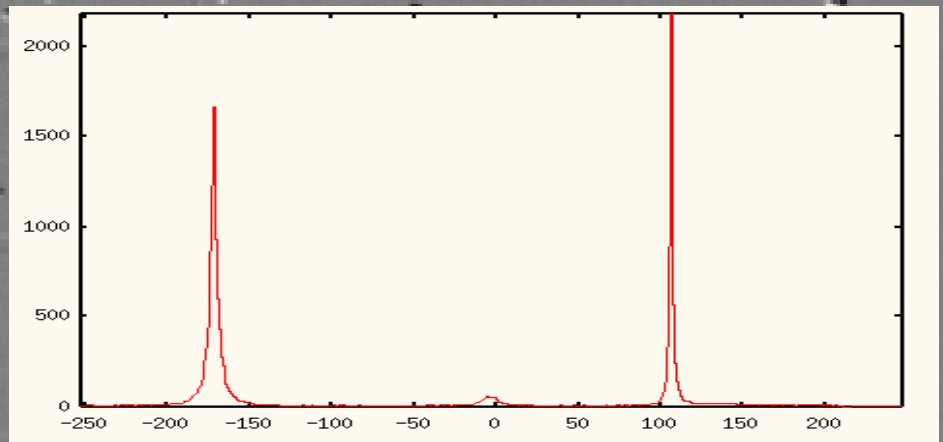


Threshold suppression on Icosaedric AlCuFe- Quasicristal (W. Steurer)





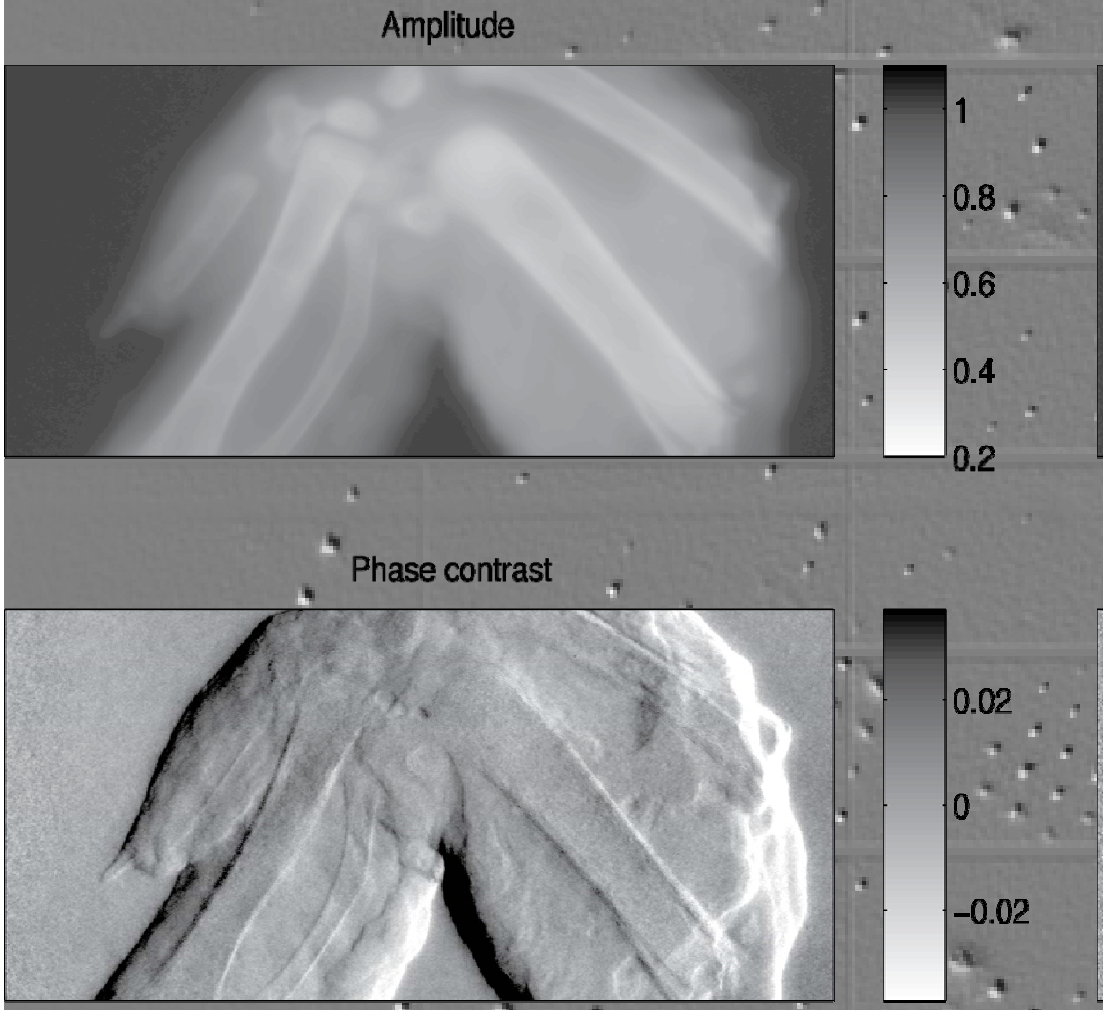




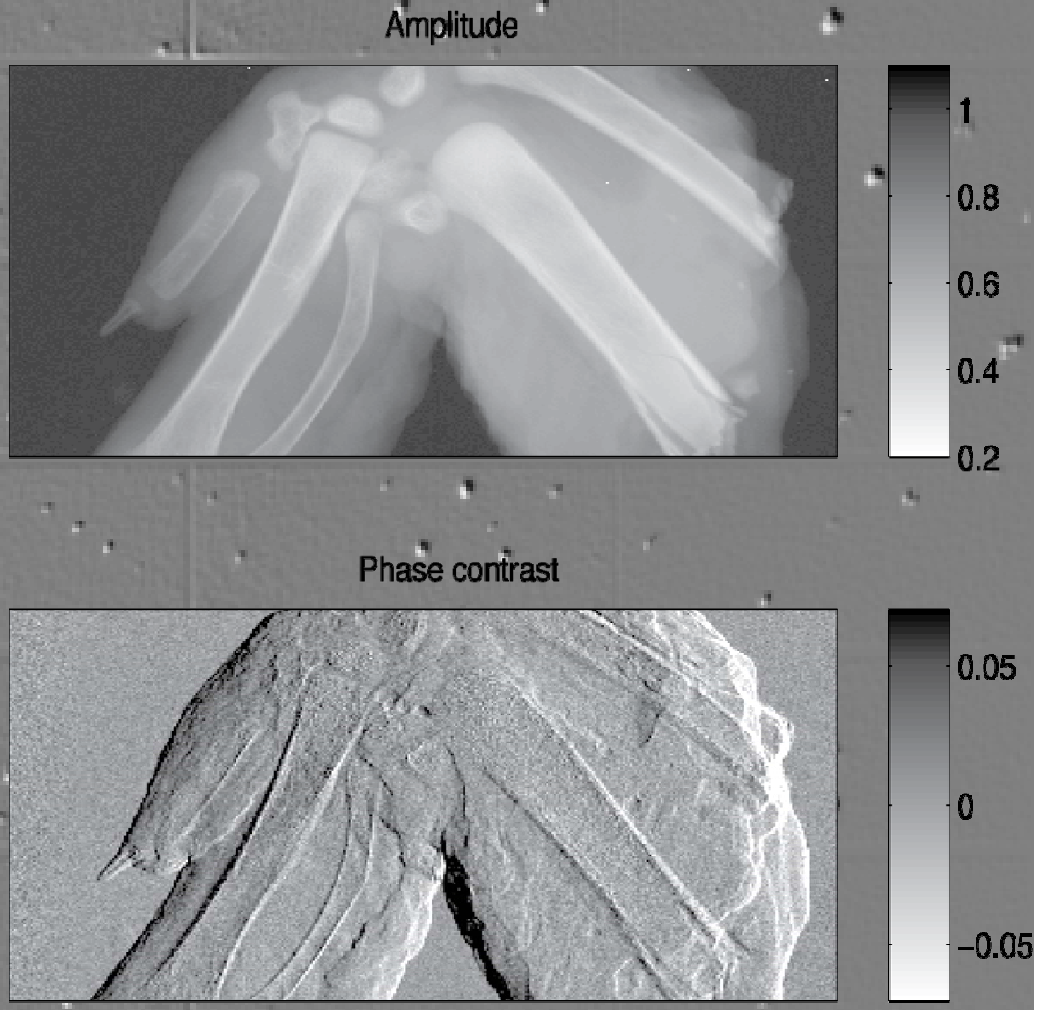
Point Spread Function

Phase contrast imaging (F. Pfeiffer et.al.)

CCD (FLI IMG 1001)

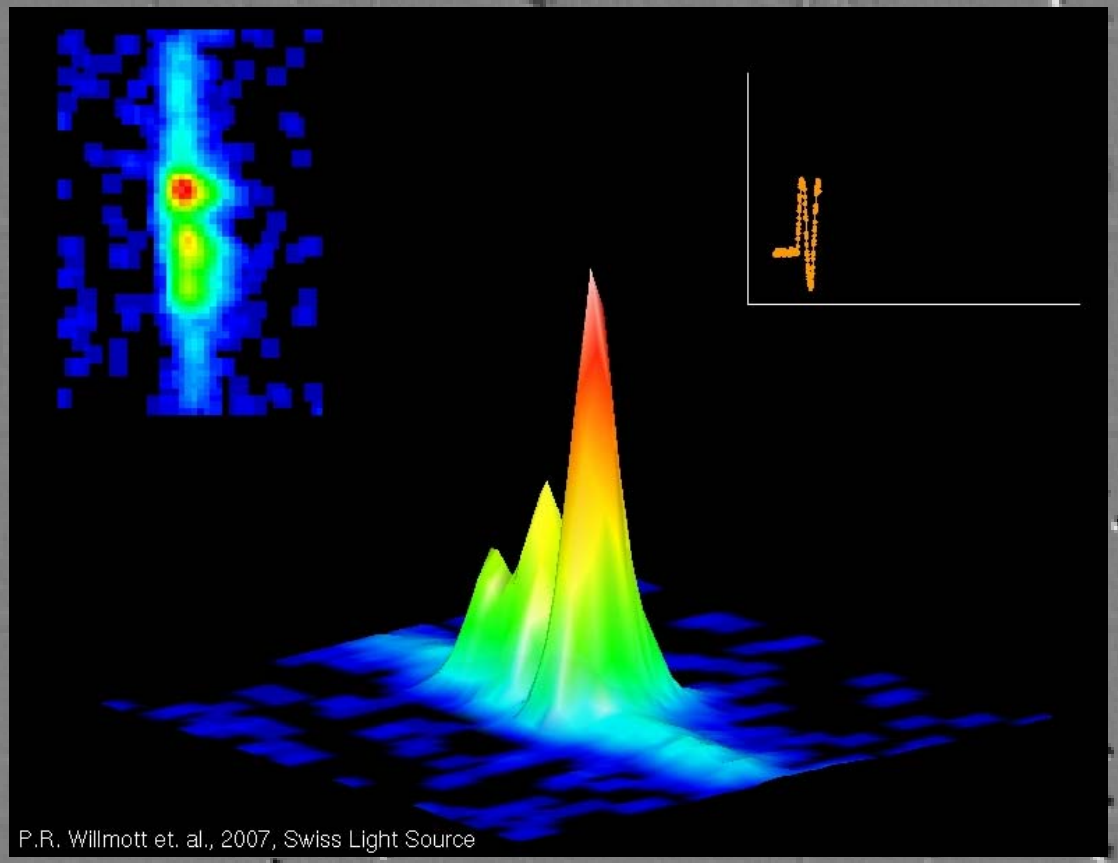


PILATUS 100k



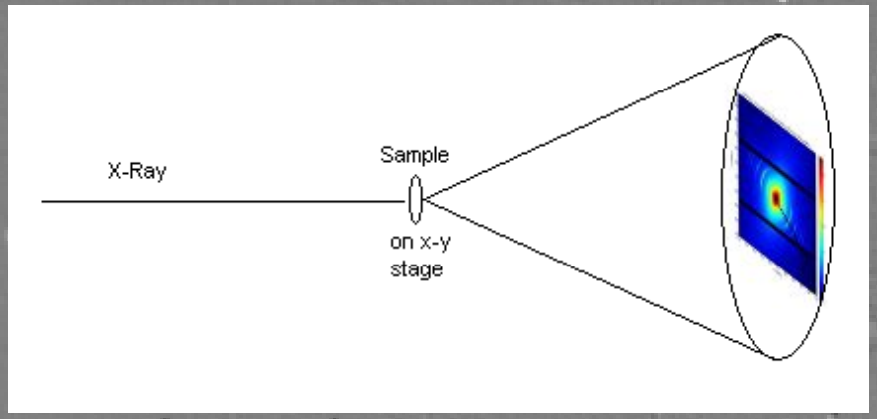
High Framing Rate

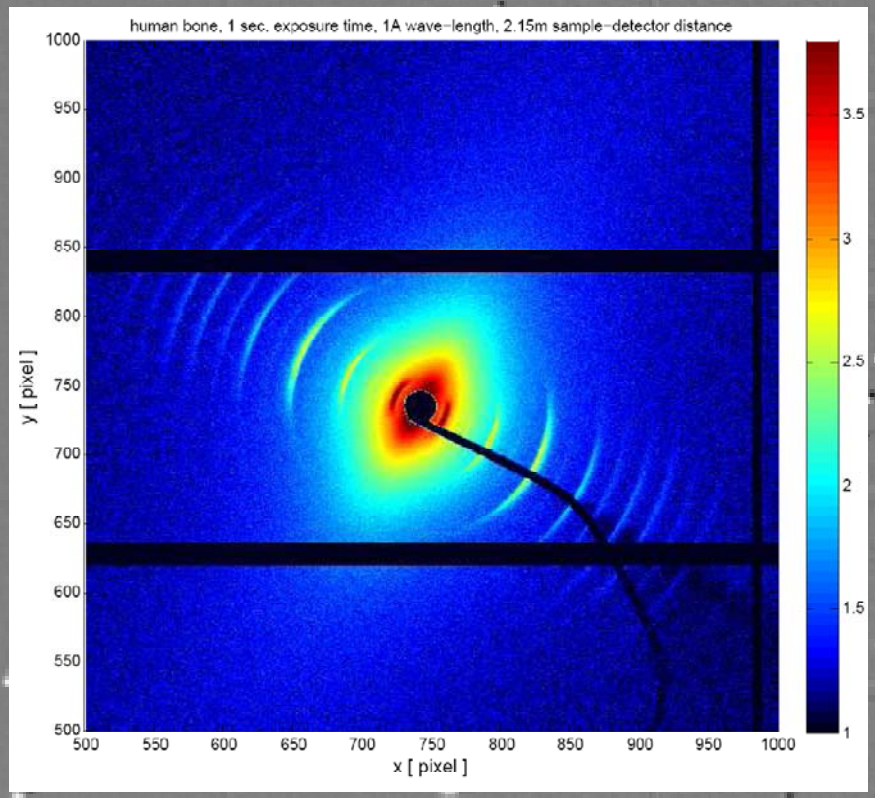
In situ thin Film growing (P. R. Willmot et.al.)



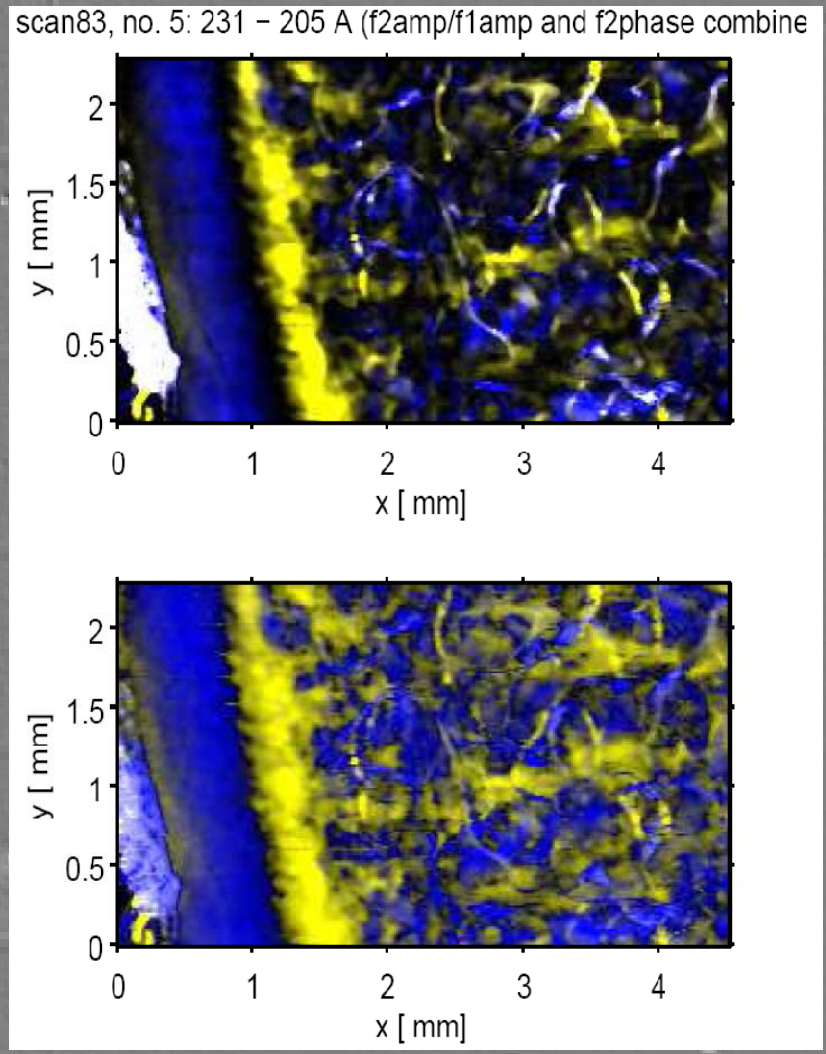
Fast Scan

Human Patella small angle scattering scan (D. A. Bradley, O. Bunk)

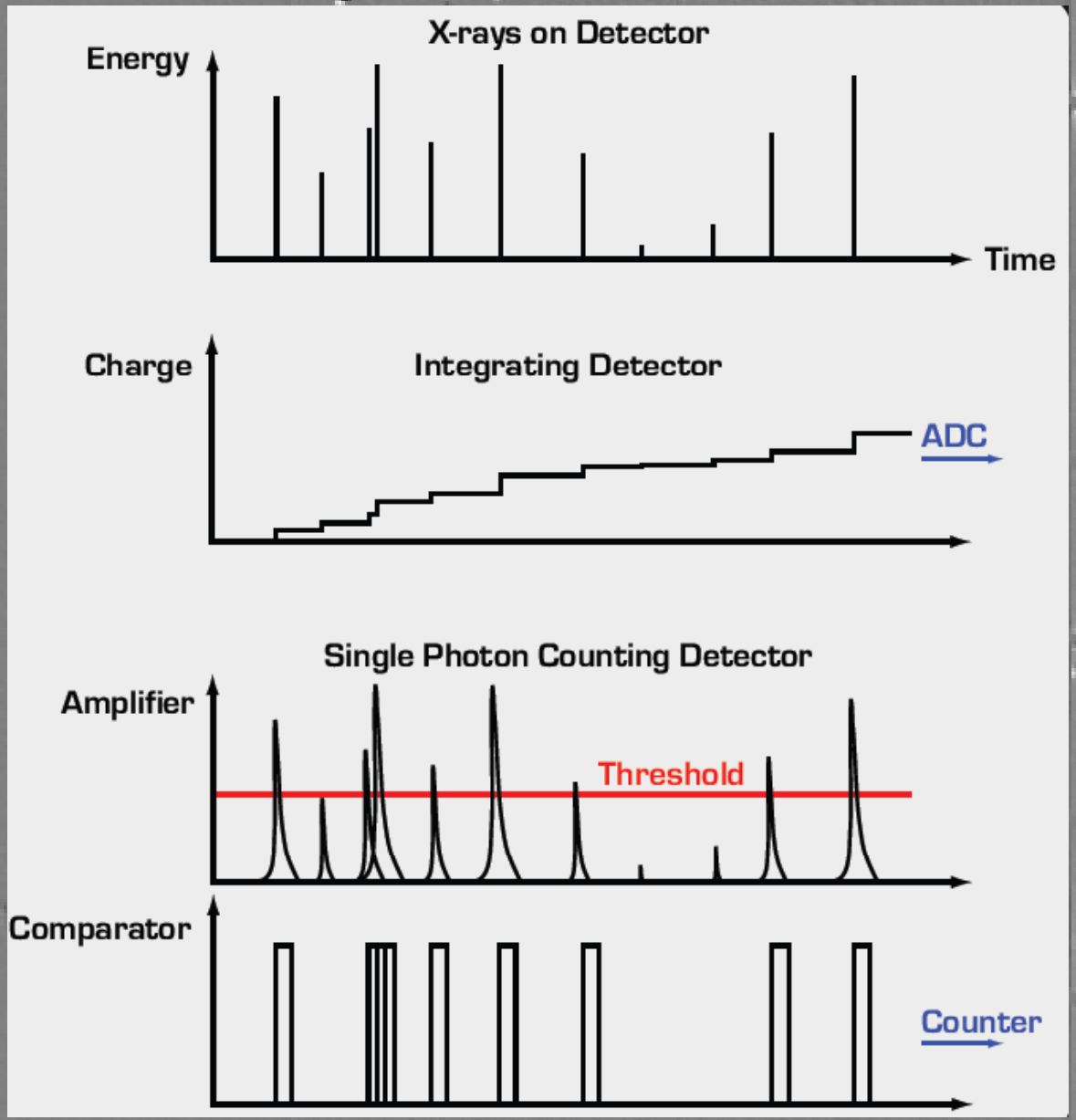




Integrated Amplitude Composition of 45‘000 scan images



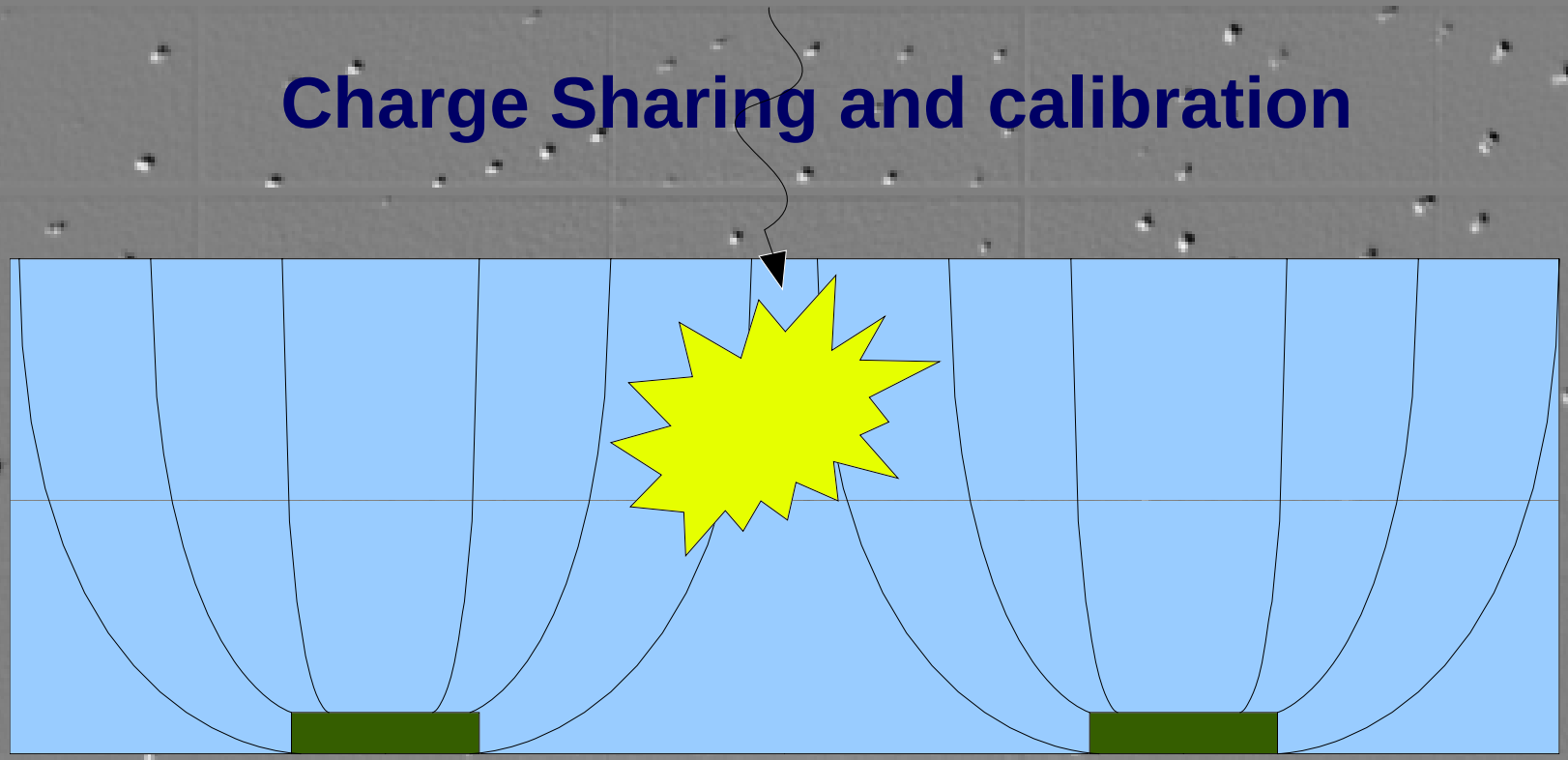
General Experience



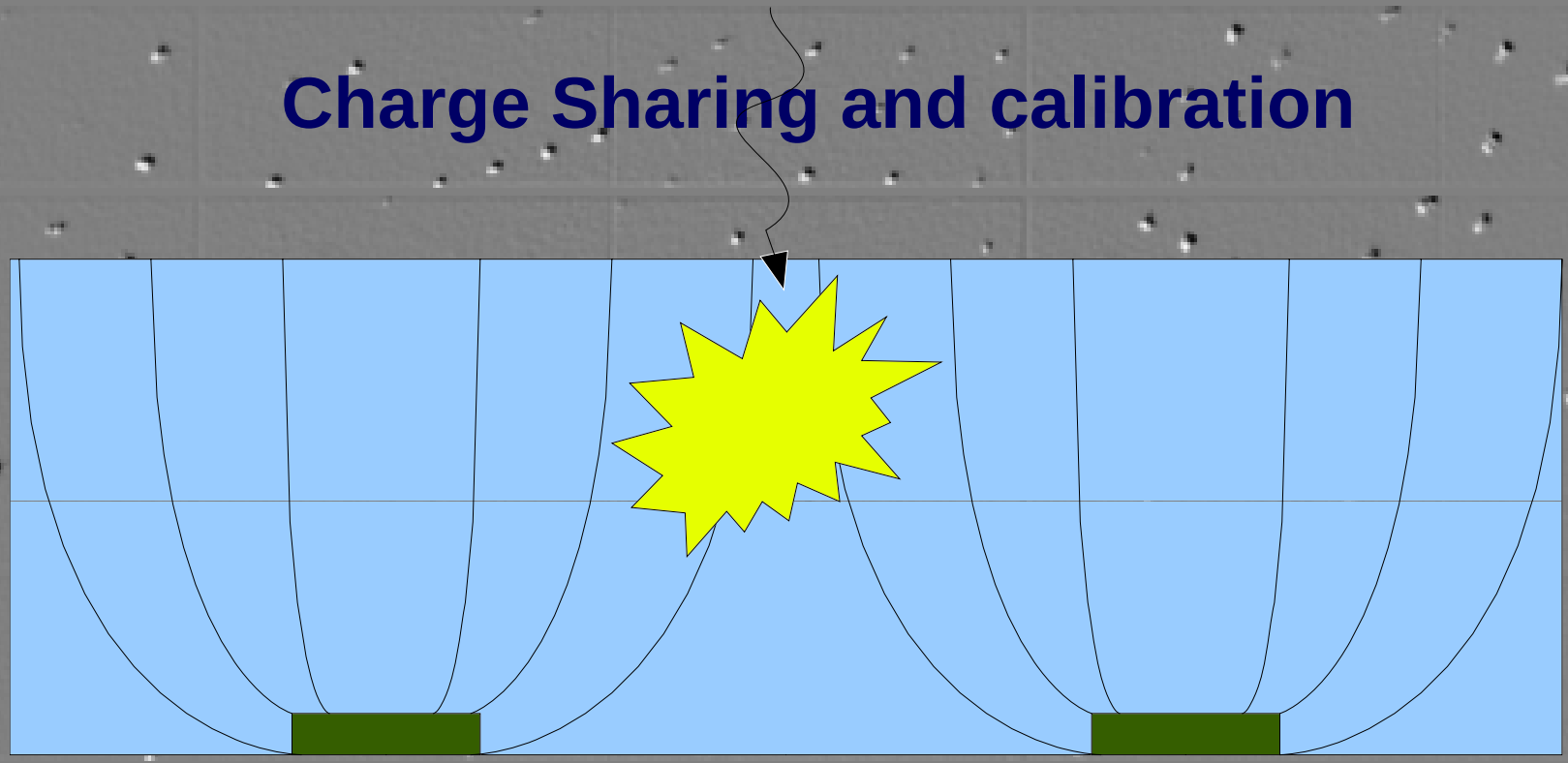
Apart from many advantages two problems:

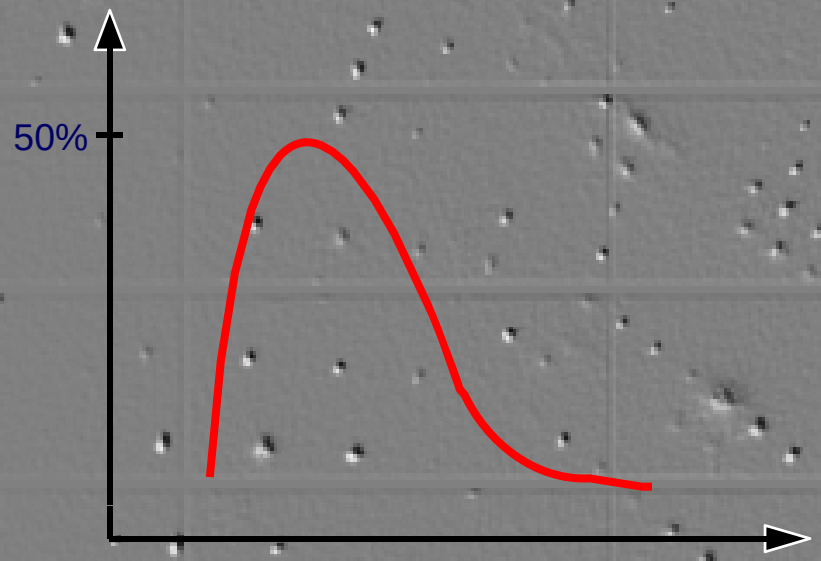
- Low energetic photons vs. charge shared high energetic photons.
- Natural limitation in counting speed. We can only count as fast as the preamplifier can resolve the incoming charge. Paralization

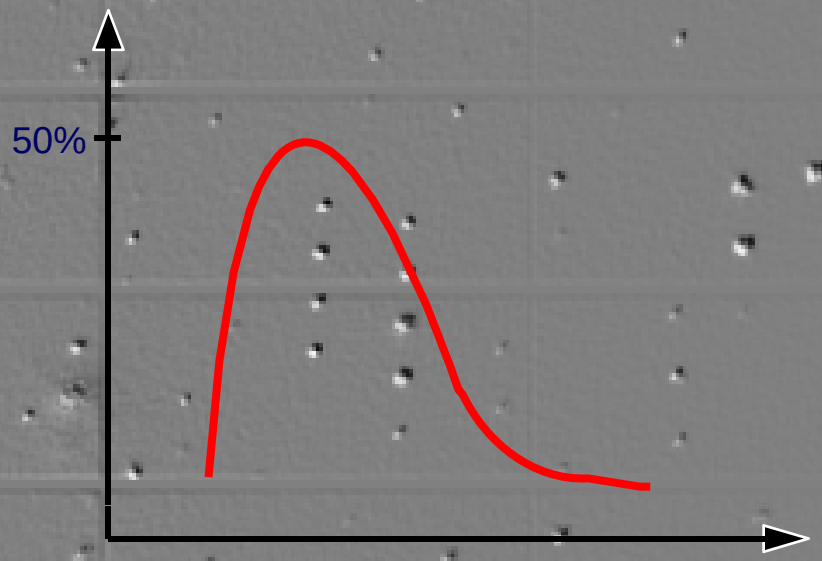
Charge Sharing and calibration



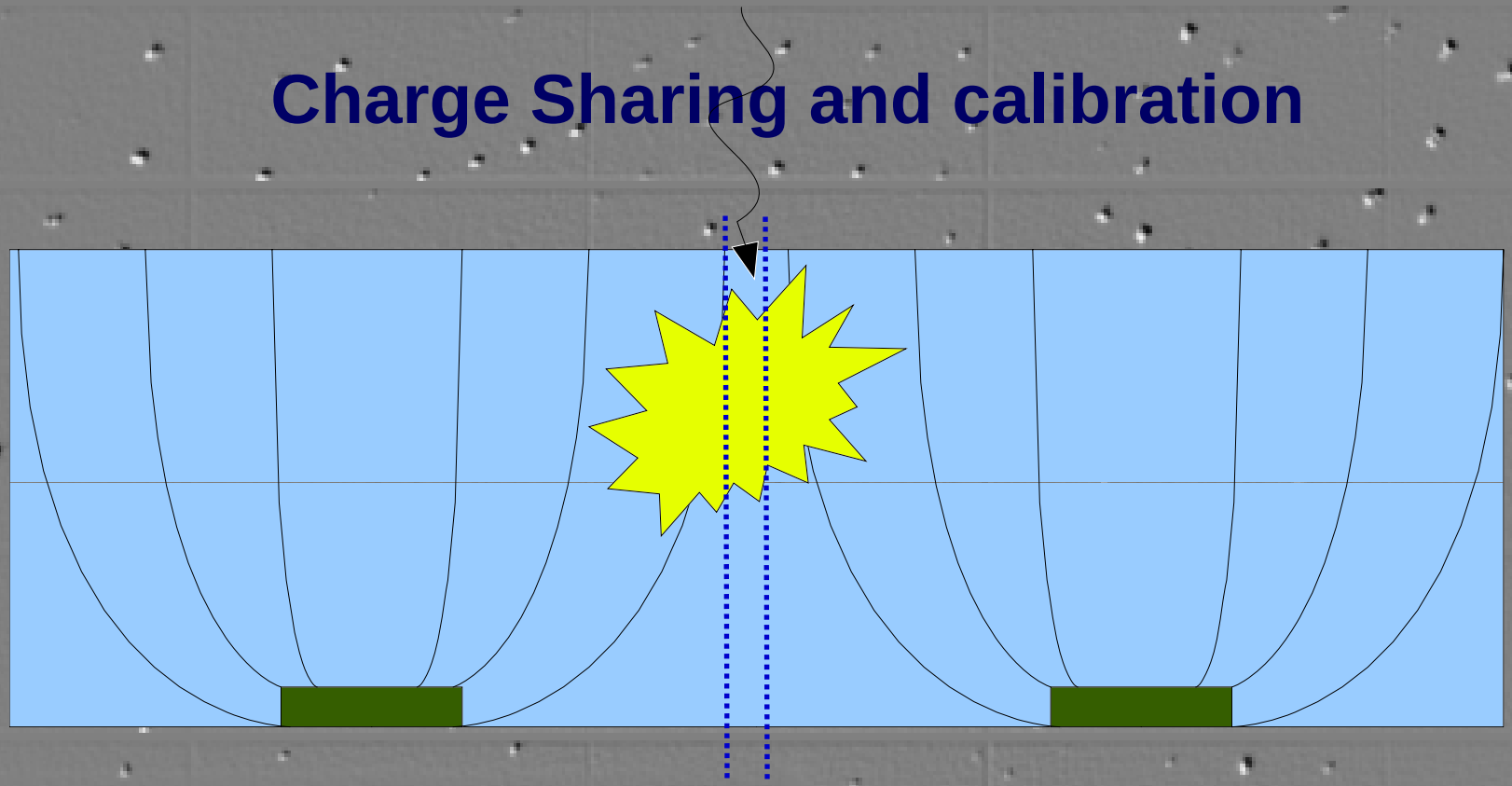
Charge Sharing and calibration

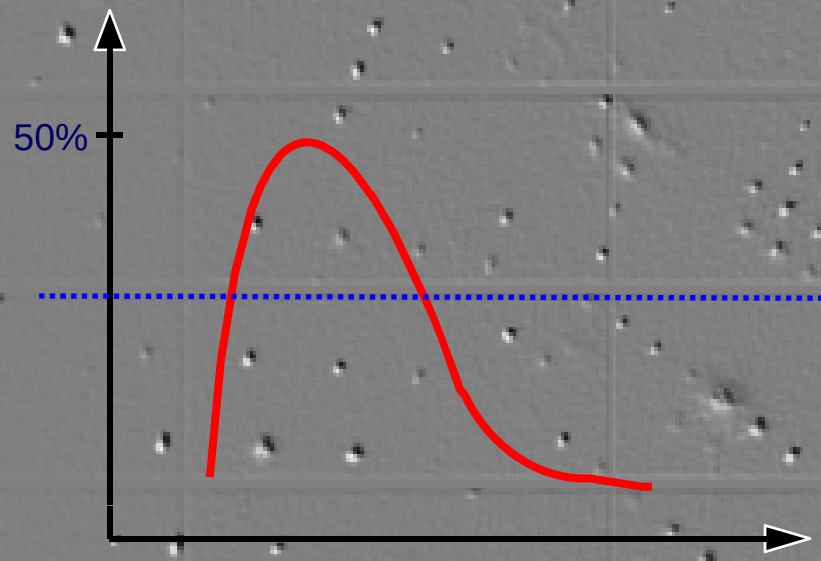


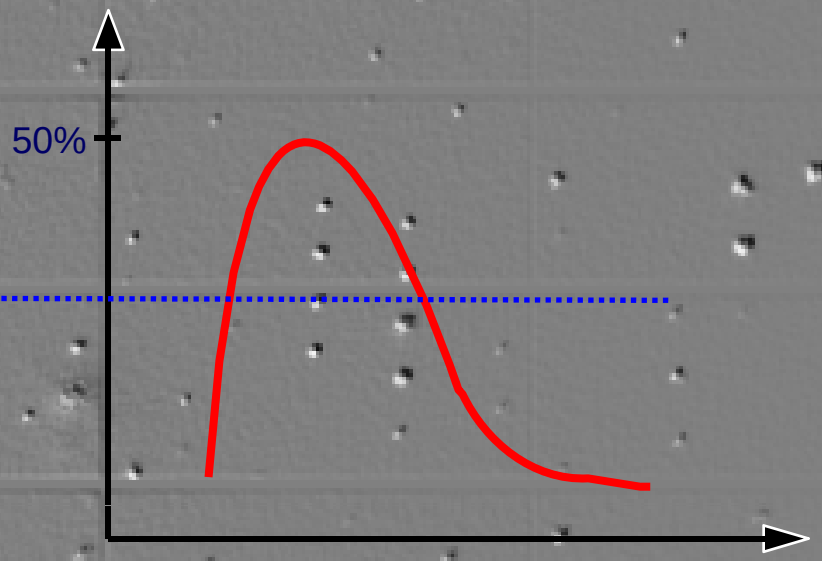




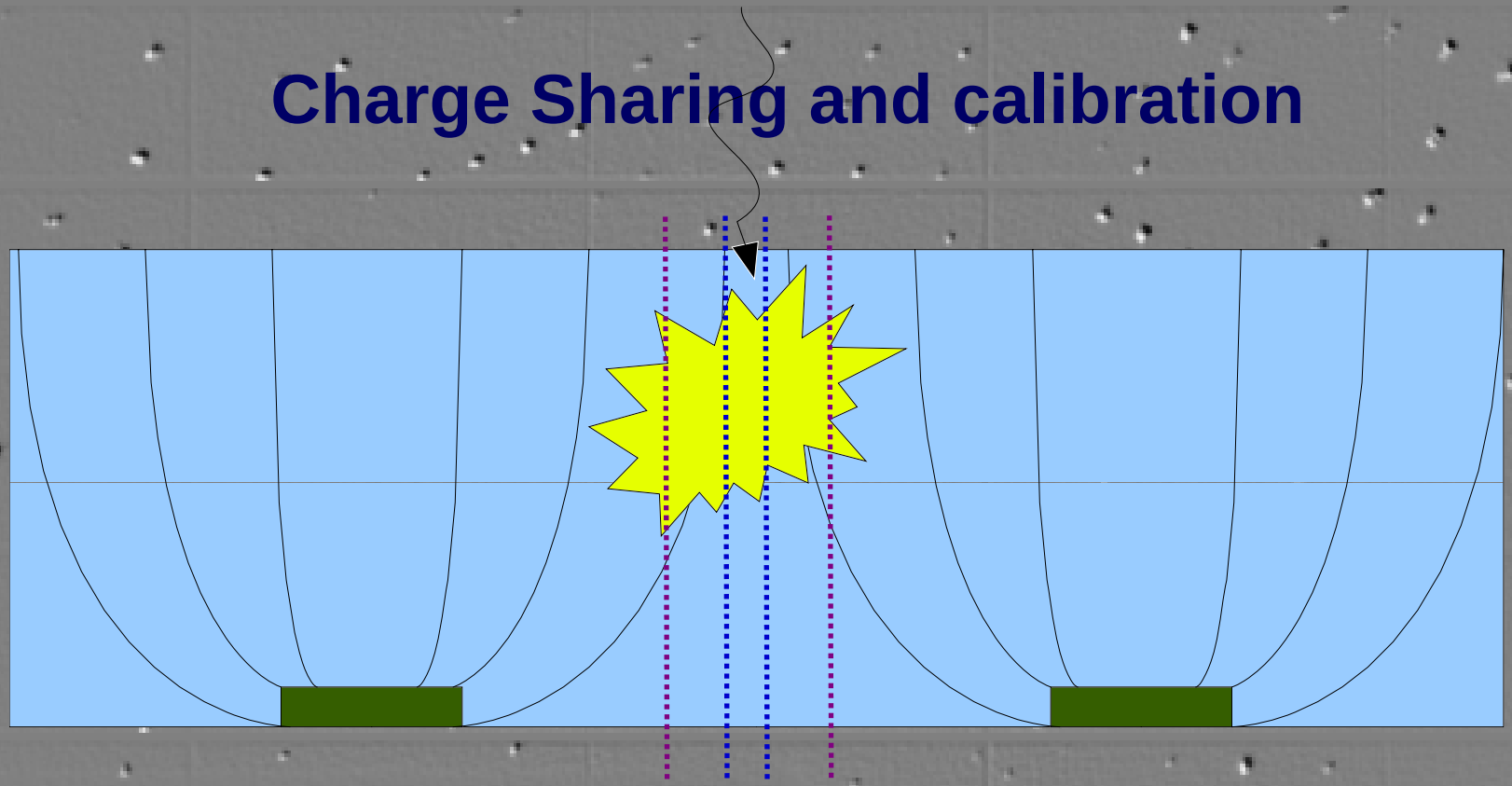
Charge Sharing and calibration

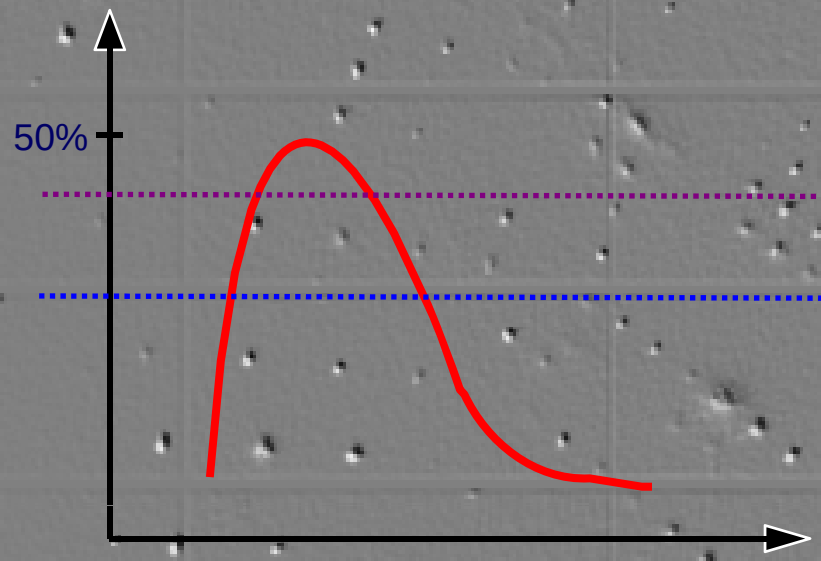


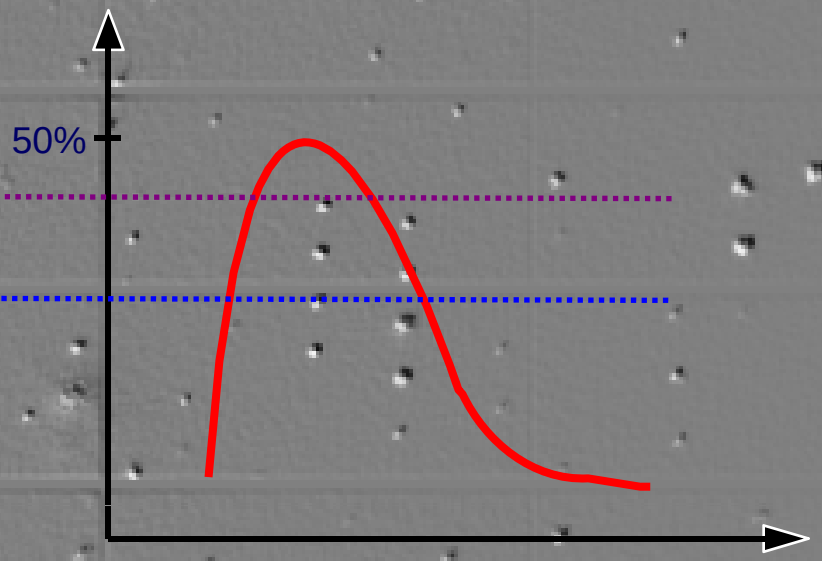




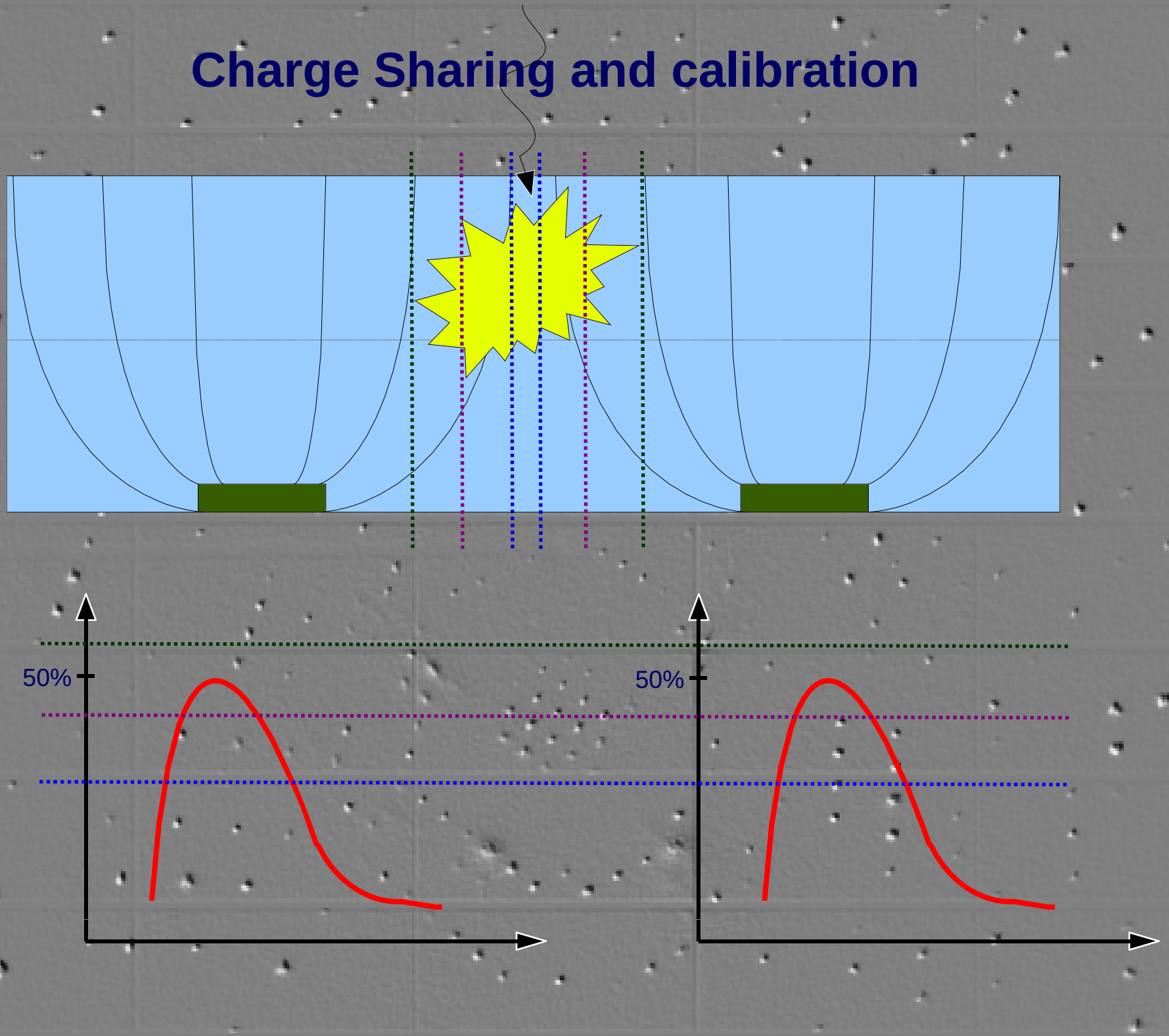
Charge Sharing and calibration





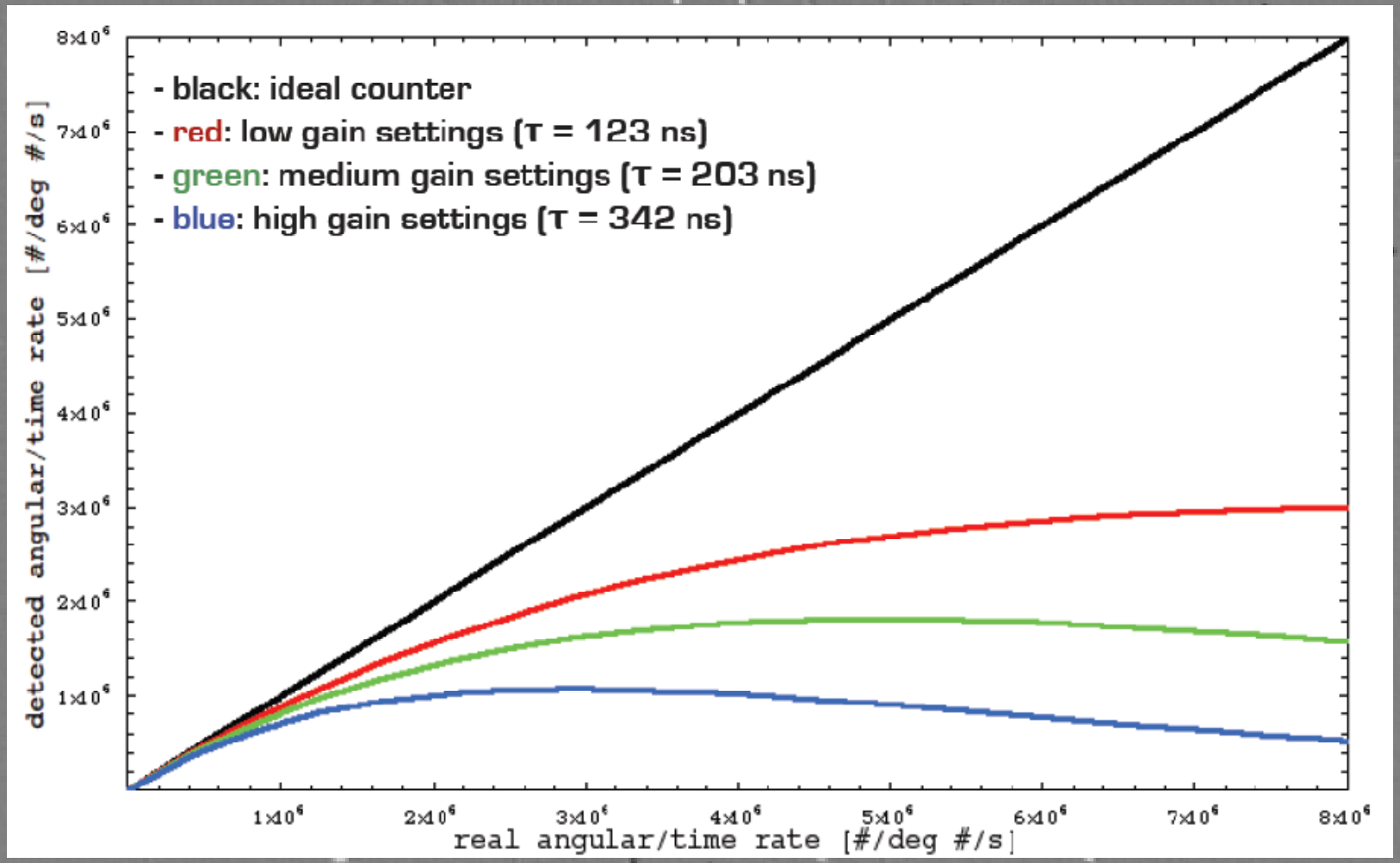


Charge Sharing and calibration



Paralyzable Counter

$$N_{obs} = N_{real} \times \exp[-N_{real} \times \tau]$$



Analyze Software

An underestimated item:

Having analyze software ready to process the PILATUS detector data when it is first delivered.

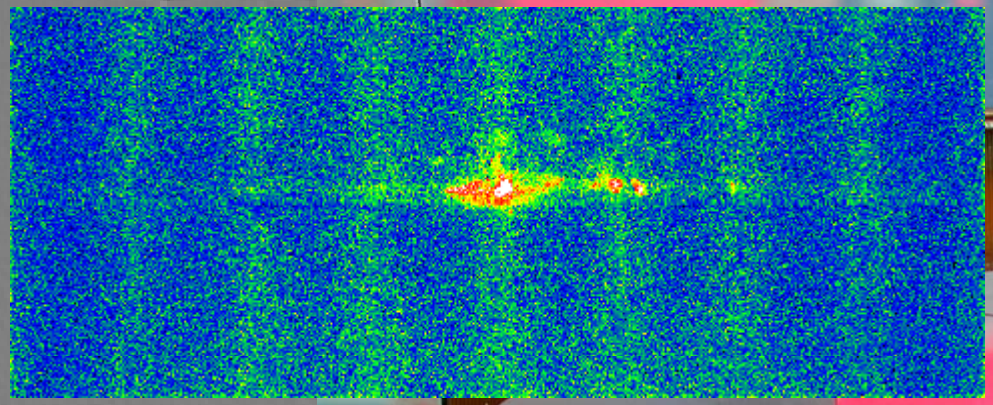
XDS (W. Kabsch): The only preprocessing software that completely incorporates the detector pecularities. Freely available.

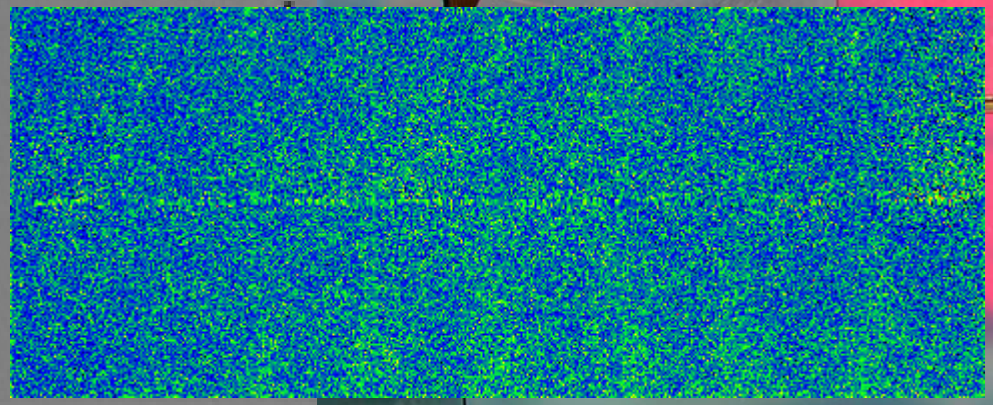
MOSFLM (A. Leslie): Can deal with the data format. No geometric corrections (distortion, paralax etc.). Not official available.

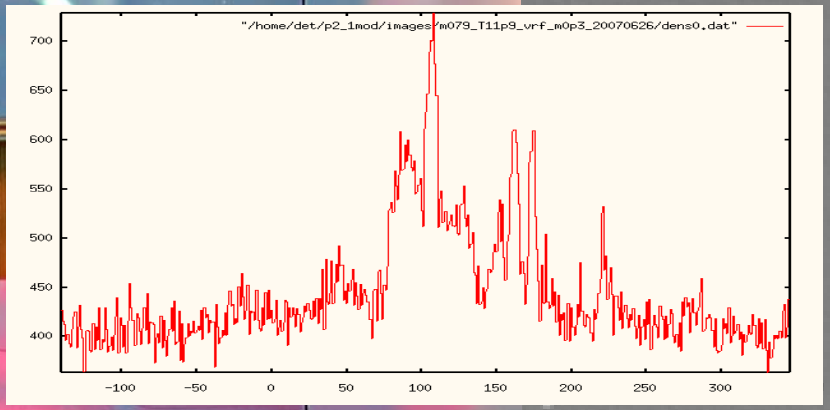
d*TREK (J. Pflugrath): Detector integration is underway. No geometric corrections (distortion, paralax etc.) yet. Commercial software.

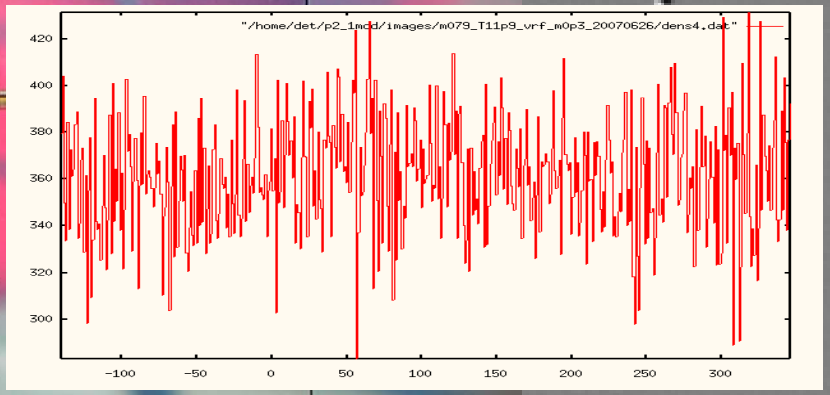
DENZO / HKL / HKL-2000 (W. Minor): Not yet compatible. This is the widely spread software in that field. Commercial.

Mismanipulation

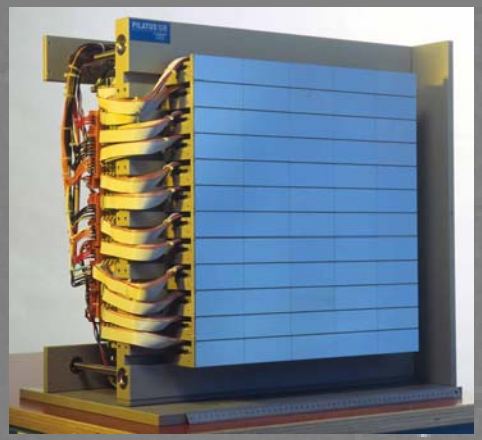


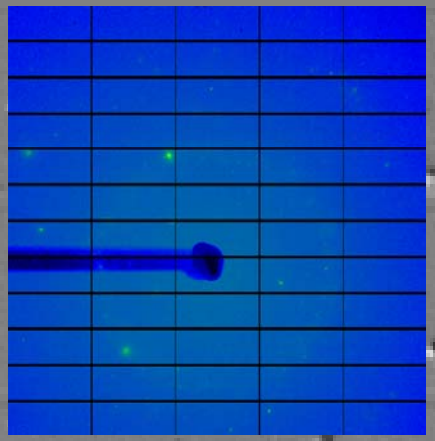


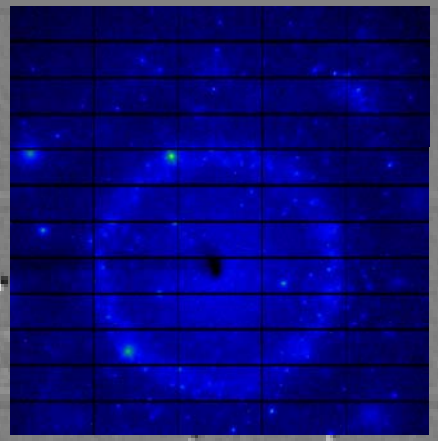


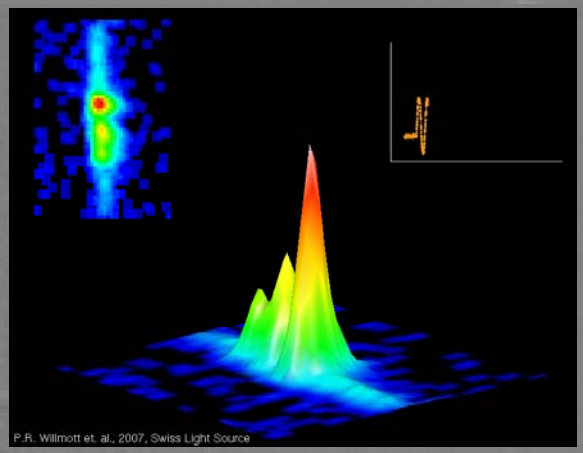


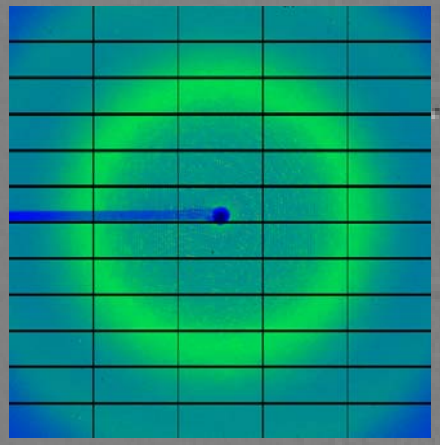
Summary

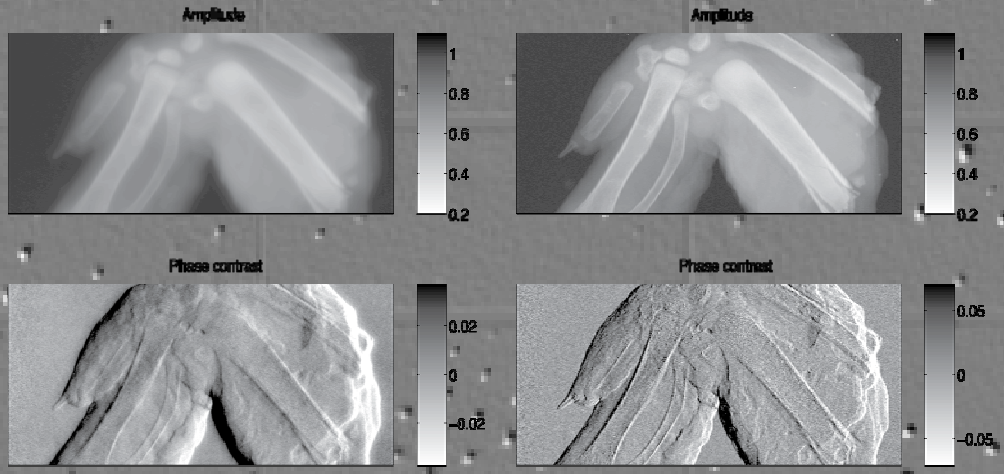


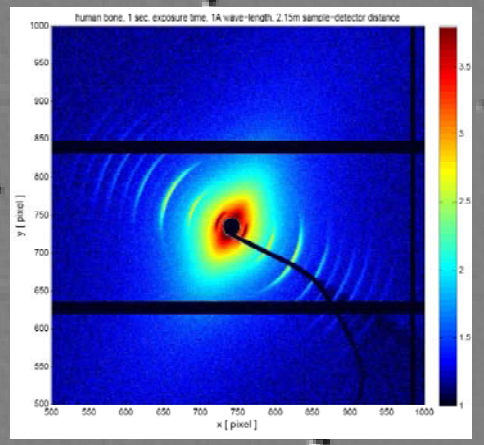


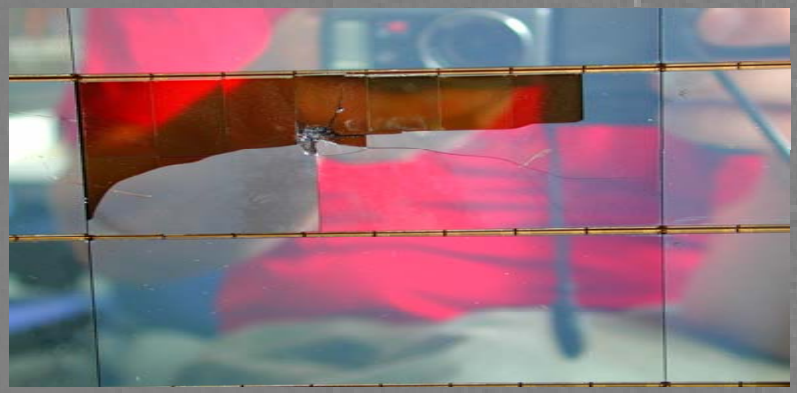


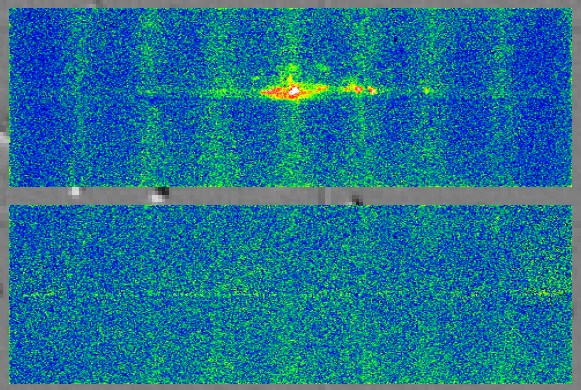

P.R. Willmott et. al., 2007, Swiss Light Source

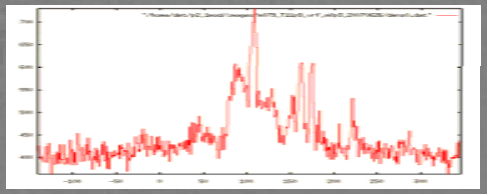


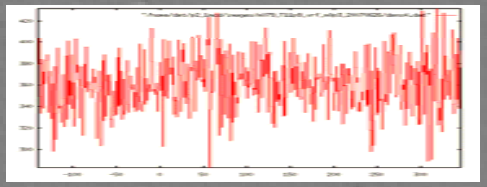

Amplitude
1
0.8
0.6
0.4
0.2
Amplitude
1
0.8
0.6
0.4
0.2
Phase contrast
0.02
0
−0.02
Phase contrast
0.05
0
−0.05


human bone, 1 sec. exposure time, 1Å wave-length, 2.15m sample-detector distance
y [pixel]
x [pixel]









FOREVER
ROCK & ROLL