DECTRIS
Next Generation X-Ray Detectors

News about DECTRIS and PILATUS

Christian Broennimann
CEO
DECTRIS Ltd

DECTRIS
Next Generation X-Ray Detectors

Outline

- About DECTRIS
- PILATUS 6M: Status and Results
- PILATUS 2M: Status and Results

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Next Generation X-Ray Detectors

About DECTRIS

- Spin-off Company of the Paul Scherrer Institut (PSI)
- Produces and sells next generation of X-ray detectors
- Founded 28th September 2006 as a private limited company
- DECTRIS has an exclusive license
- DECTRIS remains closely connected to PSI to stay at the cutting edge of detector technology

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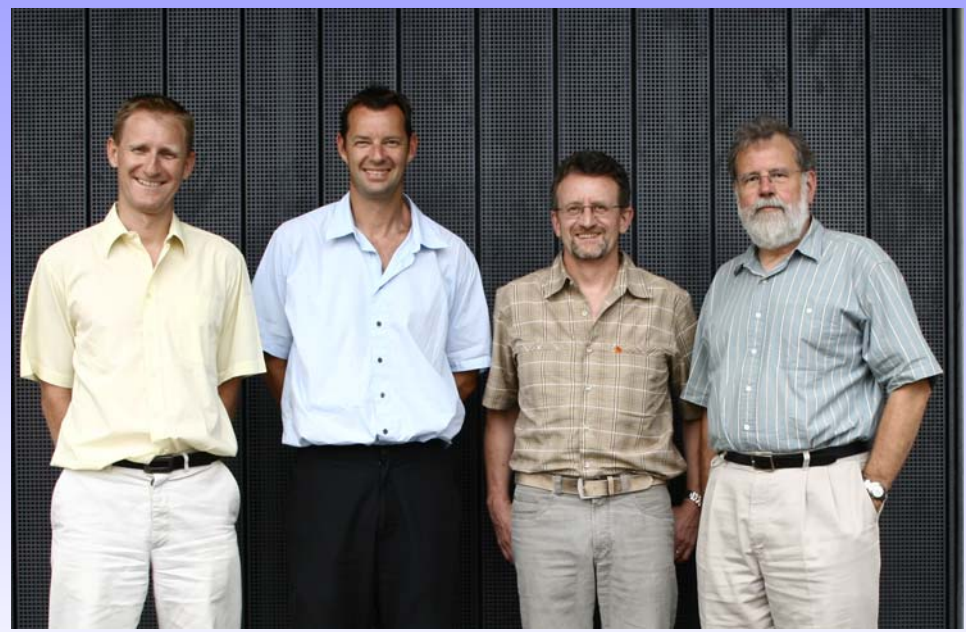
DECTRIS

- Christian Broennimann, Ph. D., CEO
- Eric F. Eikenberry, Ph. D., Software Development
- Markus Näf, Design and Production
- Petr Salficky, Marketing and Sales

- Miro Kobas, Software Development, Integration
- Tariel Sakhelashvili, Production

- 2-3 open positions



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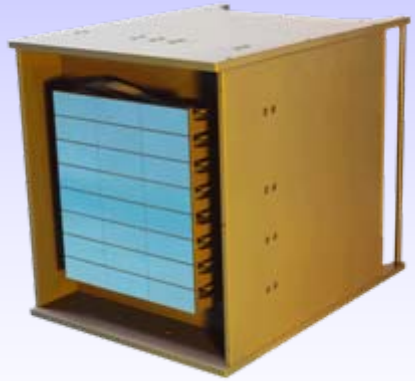
Our Products

PILATUS 100K
1 module
Area: 83.8 x 33.5 mm^2
Frame Rate: 300Hz

PILATUS 500K
1 x 5 modules
Area: 33.5 x 431 mm^2
Frame Rate: 12Hz

PILATUS 6M
5 x 12 modules
Area: 431 x 448 mm^2
Frame Rate: 12Hz



PILATUS 2M
3 x 8 modules
Area: 254 x 289 mm^2
Frame Rate: 30Hz

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Our customers

- Synchrotron sources
  - SLS (CH), SPring8 (Jpn), Diamond (UK), APS (US), Hasylab and EMBL Hamburg (Ge)
    - 15 PILATUS 100K sold
    - 7 PILATUS 100K delivered
    - 1 PILATUS 500K sold and ready to be delivered
    - 2 PILATUS 2M sold to Diamond. Delivery in 2. Quarter 2008
- Alcator C-Mod, MIT Boston (Fusion reactor)
    - 4 PILATUS 100K
- Industrial XRD
    - 5 PILATUS 100K

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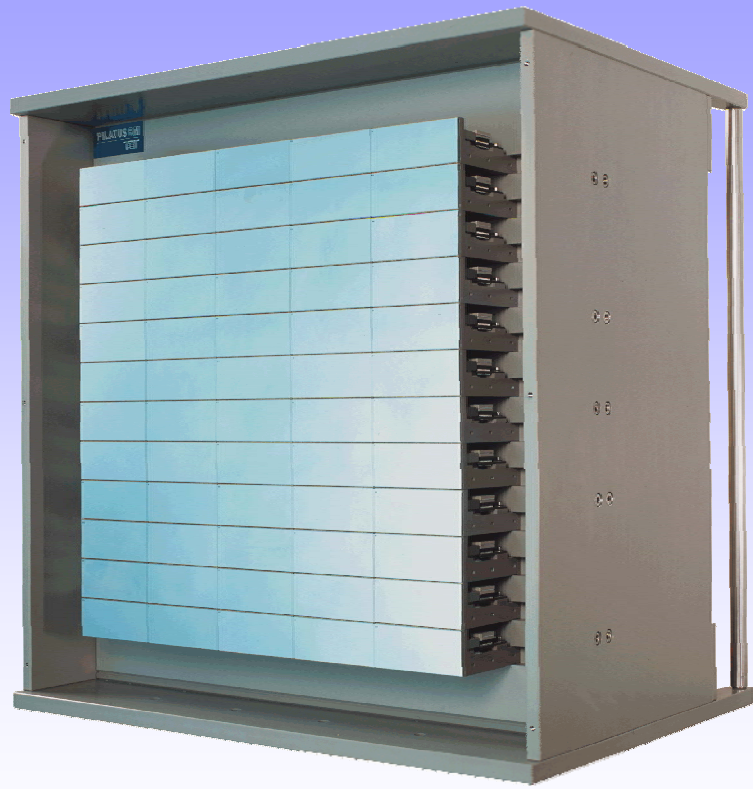
PILATUS 6M: 9 years of development

- Based on hybrid pixel technology developed by PSI for high energy physics
- Technology adapted to meet requirements of synchrotron radiation research
- Developed specifically for macromolecular crystallography



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PILATUS 6M: Specifications

No of Modules:	60
Module arrangement:	5 x 12
Detector Size:	431 x 448 mm^2
Format:	2527 x 2463 pixels
Spatial resolution:	0.172 x 0.172 mm^2
Dynamic range/pixel:	20bits
Count rate/pixel:	<8 Mcps/pixel
Readout time:	3.5 ms
Frame rate:	12.5 Hz
Mechanical positioning:	Flat geometry
Intermodule gap:	x: 7 pixels, y: 17 pixels, 8.4% of total area

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Specifications cont.

- Pixel yield: >99.99% (1.6*10^{-4} unreliable pixels)
- Module alignment: < 1.5 pixel
- Lower level threshold: 4 -12 keV
- Threshold Dispersion: 50 eV
- Energy resolution: 500 – 600 eV
- Shutter synchronization via external trigger input
- Operation modes:
  1) Continuous mode, exposure time defined by detector, shutterless operation
  2) Shutter operated mode, exposure time externally defined
- Data formats: Raw data, TIFF, EDF, CBF (compressed)

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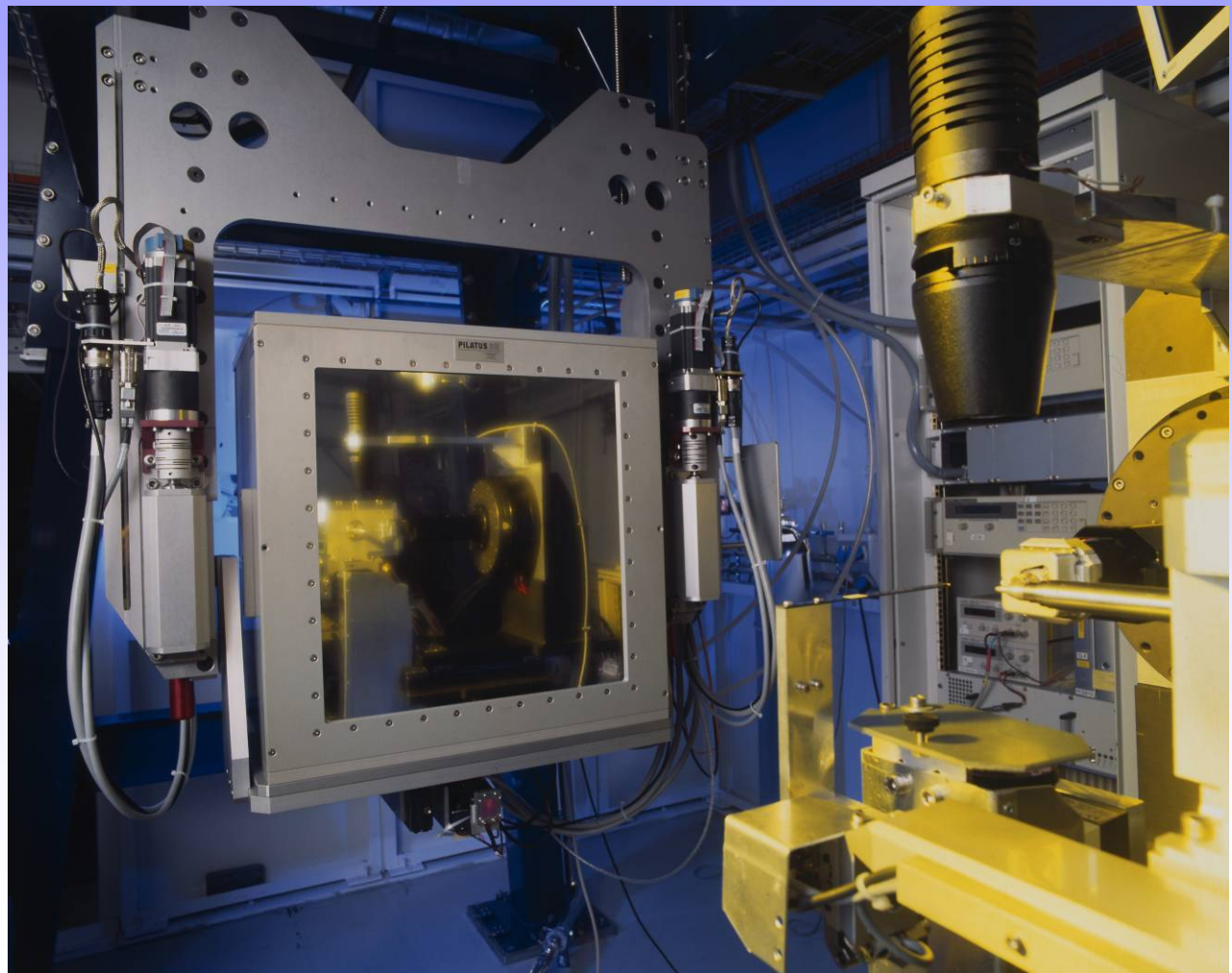
PILATUS 6M at X06SA



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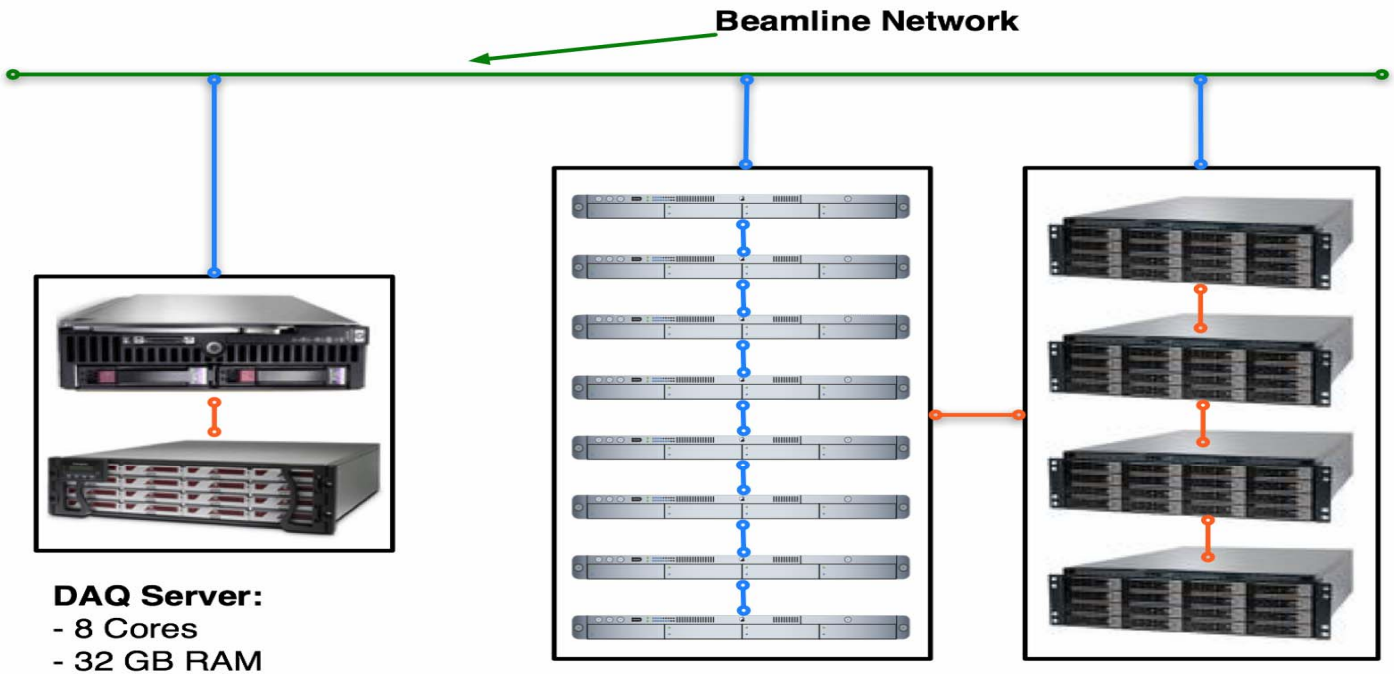
PILATUS 6M Integration at X06SA@SLS

May 2007

4 GB Fibre Channel
1 GB Ethernet

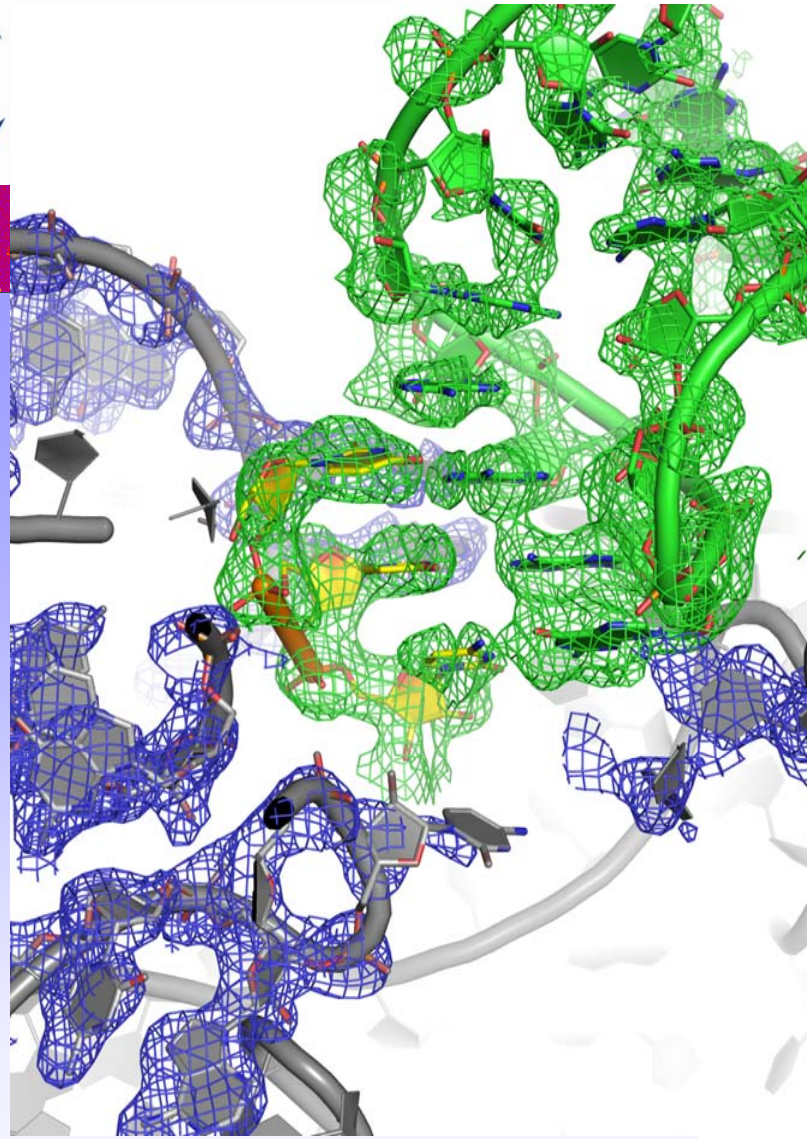


DAQ Server:
- 8 Cores
- 32 GB RAM

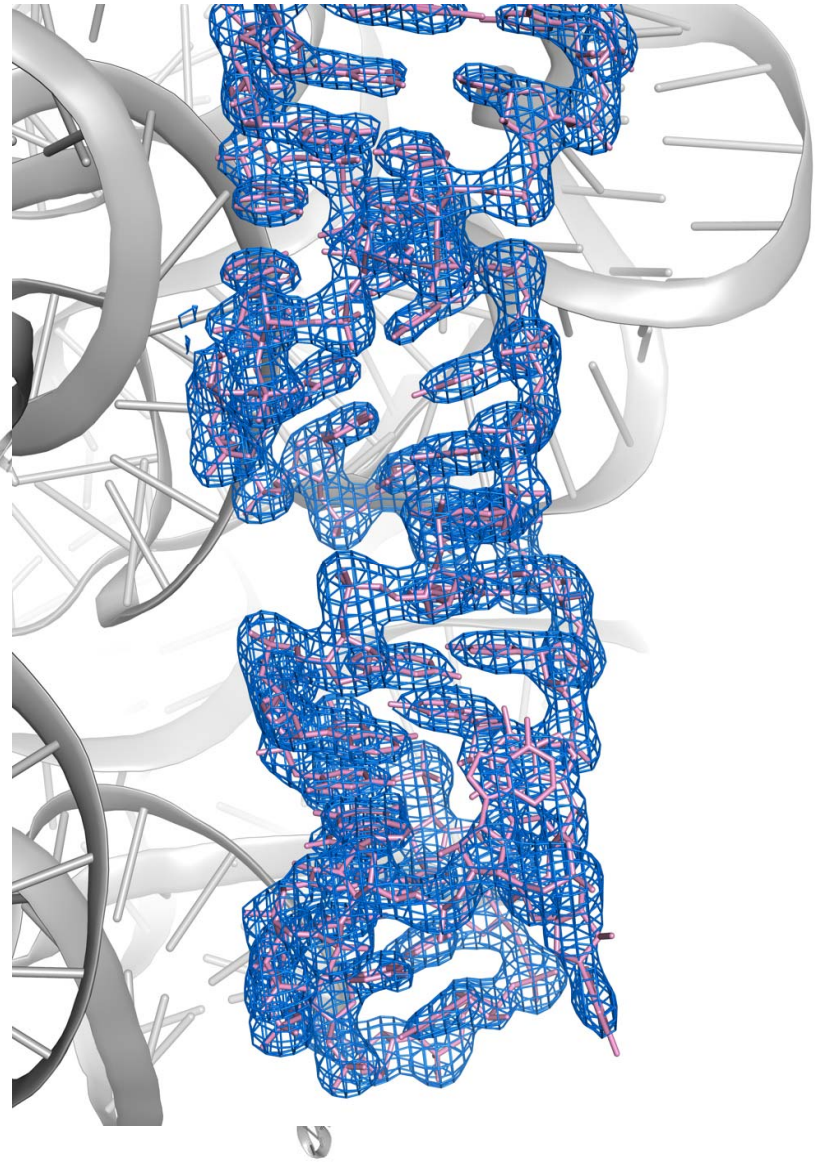
DAQ RAID:
- 10 TB Storage
- RAID 5

Computing Cluster
- 8 x 4 = 32 Cores
- 8 x 8 GB = 64 GB RAM

GPFS Fileserver
- 10 TB per Storage
- RAID 6
- 40 TB total GPFS Storage



green: fo - fc density of A-site
Blue: 2fo - fc density of rRNA



Blue: 2fo - fc density of helix 44

30S ribosomal subunit, Ramakrishnan Lab

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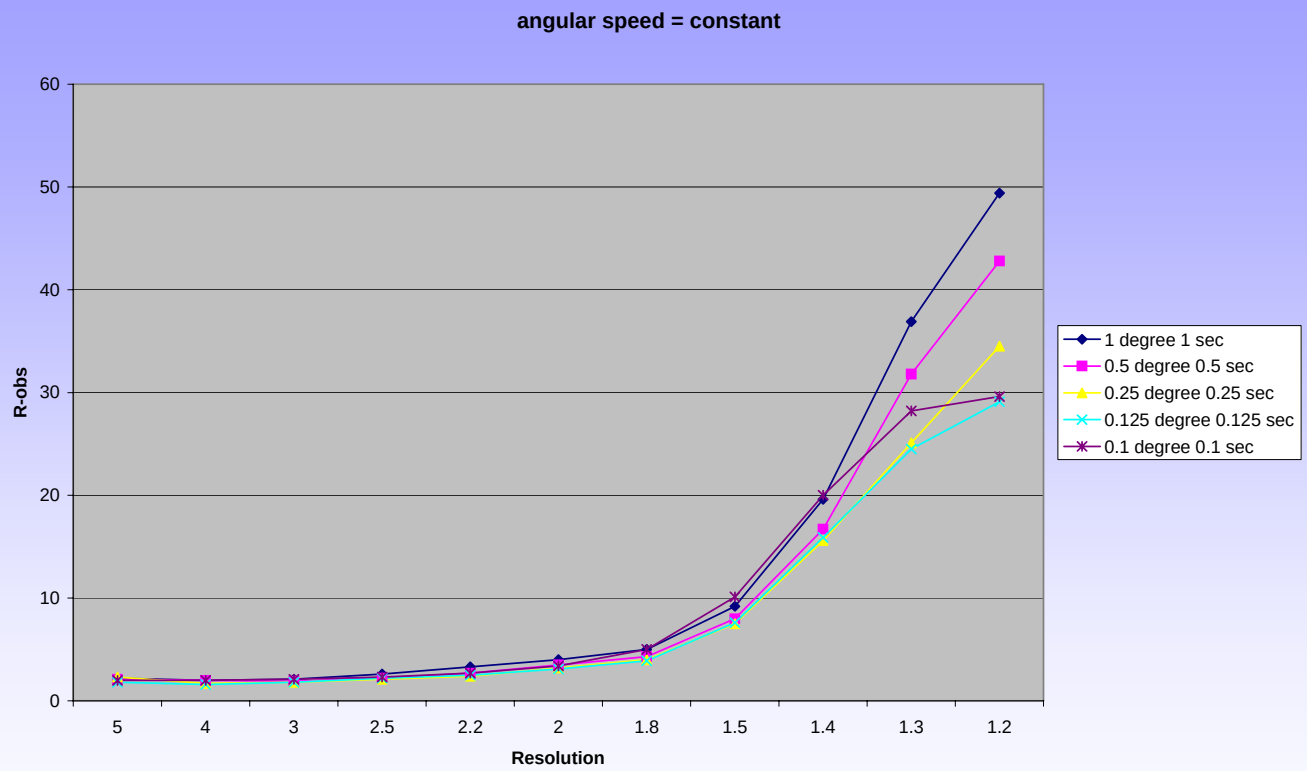
Cubic Insulin: Fine ϕ-slicing



-> Better R-factors with fine-ϕ slicing

XDS artifacts at very high resolution

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R-Factors

Resolution [Å]	1 ° 1 s	0.5 ° 0.5 s	0.25 ° 0.25 s	0.125 ° 0.125 s	0.1 ° 0.1 s
5	2.20%	2.10%	2.30%	1.80%	2.00%
4	2.00%	2.00%	1.70%	1.60%	2.00%
3	2.10%	1.90%	1.80%	1.80%	2.10%
2.5	2.60%	2.20%	2.10%	2.20%	2.30%
2.2	3.30%	2.70%	2.40%	2.50%	2.70%
2	4.00%	3.50%	3.20%	3.10%	3.40%
1.8	5.00%	4.30%	4.00%	3.90%	5.00%
1.5	9.20%	8.00%	7.50%	7.60%	10.10%
1.4	19.60%	16.70%	15.60%	15.90%	20.00%
1.3	36.90%	31.80%	25.10%	24.50%	28.20%
1.2	49.40%	42.80%	34.50%	29.10%	29.60%

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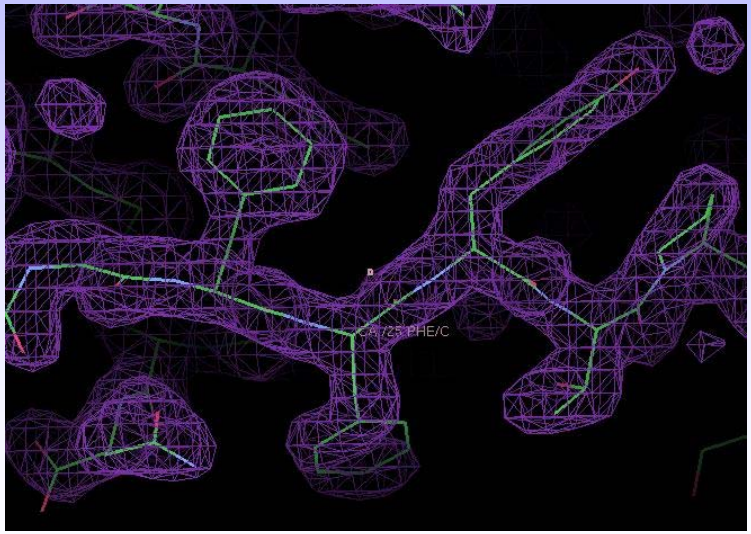
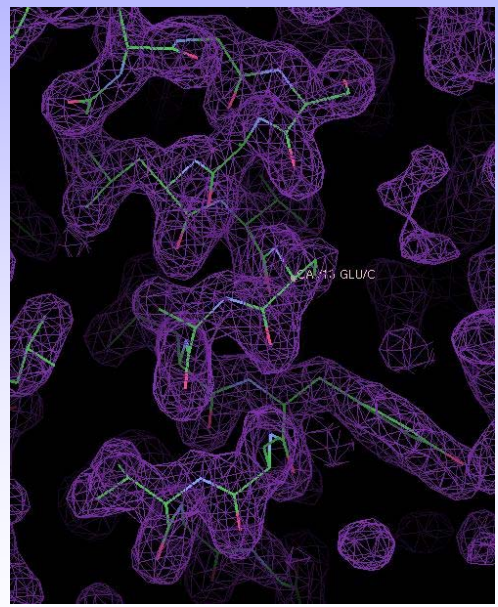
Software Support (October 2007)

- XDS, W. Kabsch, 3D profile fitting
- MOSFLM, A. Leslie, 2D profile fitting
- D*Trek (J. Pflugrath, Rigaku)





Experimental maps based on D*Trek and a SAD data-set

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Status at BL X06SA in September 2007

- Hardware and Software-Integration finished
- Regular user operation started in June 2007
- 35 user groups so far
- Processing with newest XDS version (W. Kabsch) and MOSFLM
- Usually similar or lower R-factors with fine-ϕ slicing achieved than with CCD, analysis still ongoing
- Detector system 4-5x faster than CCD

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User Feedback

- “Faster data collection”
- “Somewhat less radiation damage”
- all but 2 user groups report at least as good data as with CCD
- “We are the limiting factor”
- “We don’t have time to smoke a cigarette or to drink coffee“

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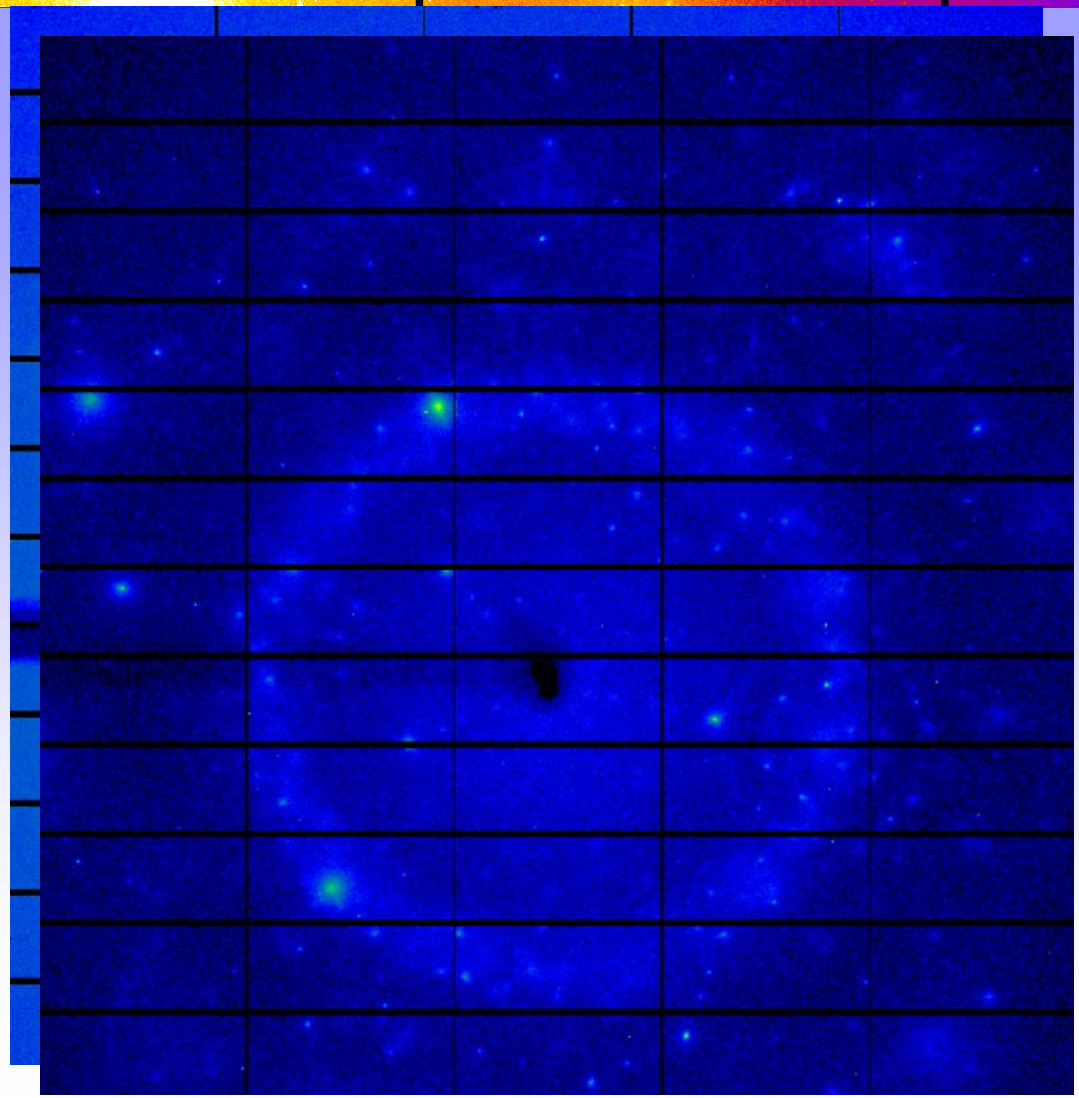
Diffuse scattering

- Icosahedral AlCuFe quasicrystal

- energy threshold set to 8 keV or 10 keV

Fluorescence suppression improves data quality in

⇨ phasing experiments
⇨ diffuse scattering



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Pilatus 2M Specs

No of Modules:	24
Detector Size	254 x 289 mm2
Number of modules	3 x 8 = 24
Format	1475 x 1679 = 2'476'525 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:	30 Hz
Power consumption	200 W
Operating temperature	25°C
Dimensions	388 x 434 x 526 mm^3
Weight Approx.	50 kg

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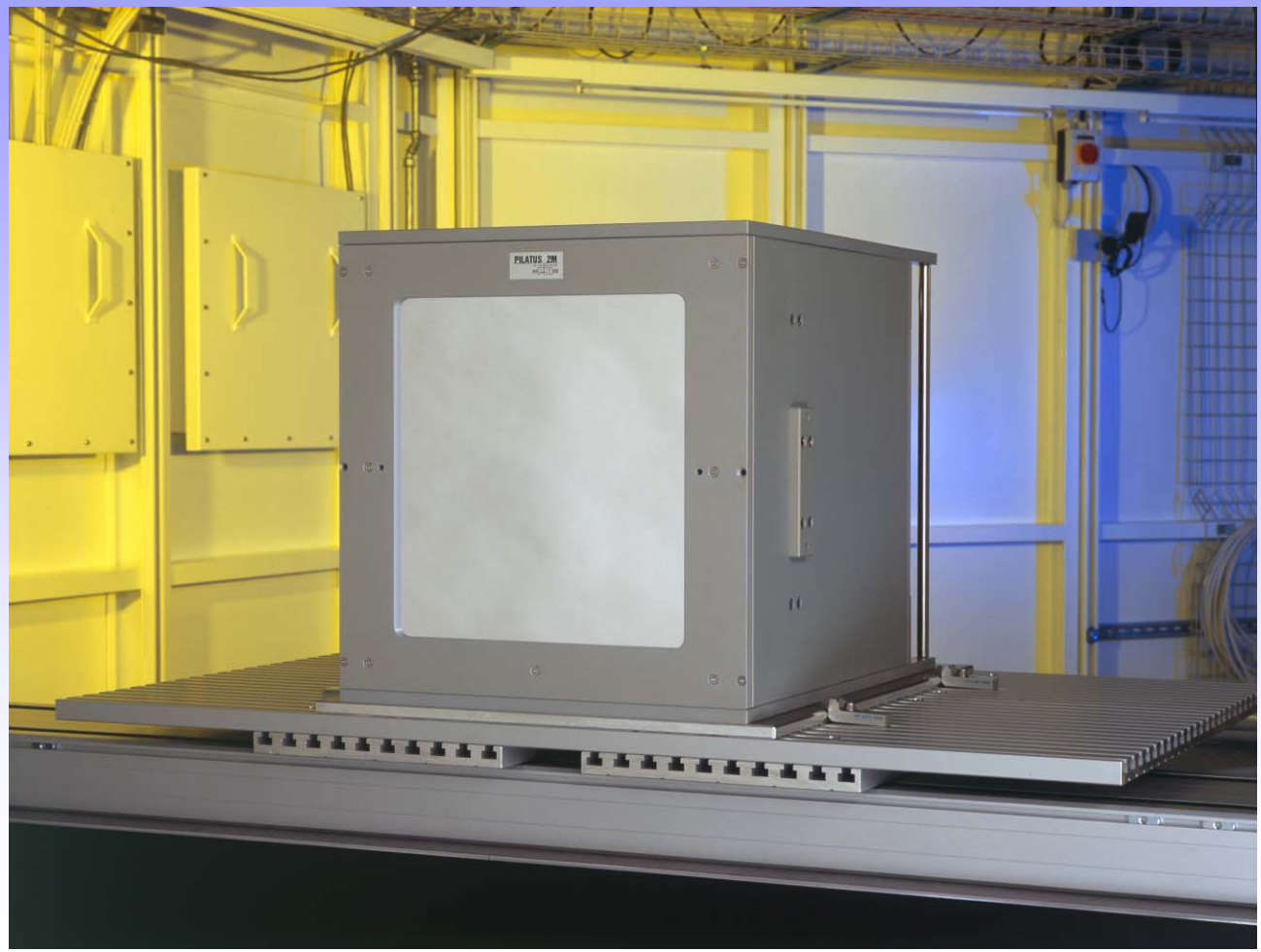
Pilatus 2M at BL X12SA



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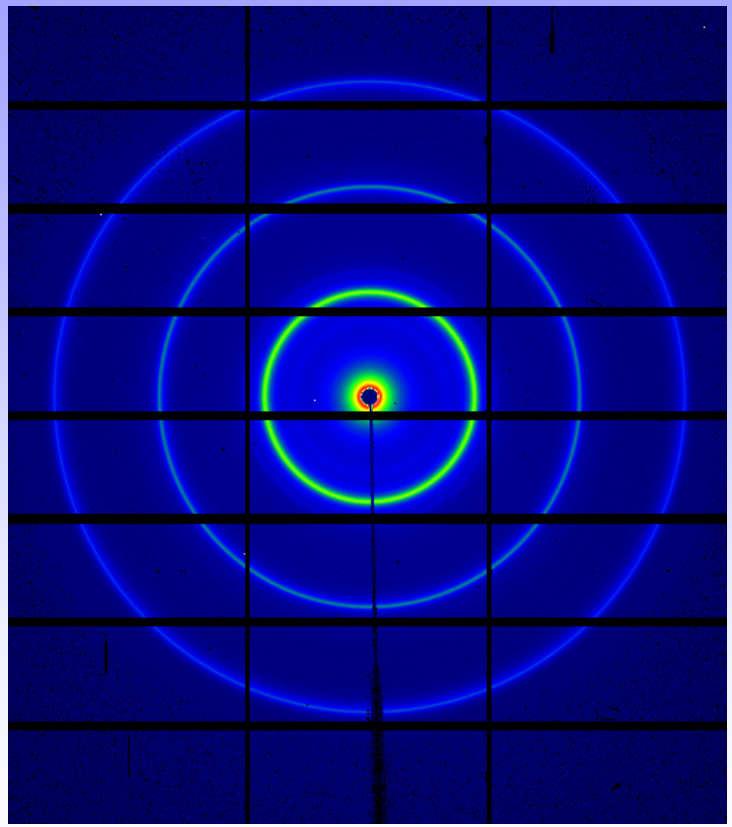
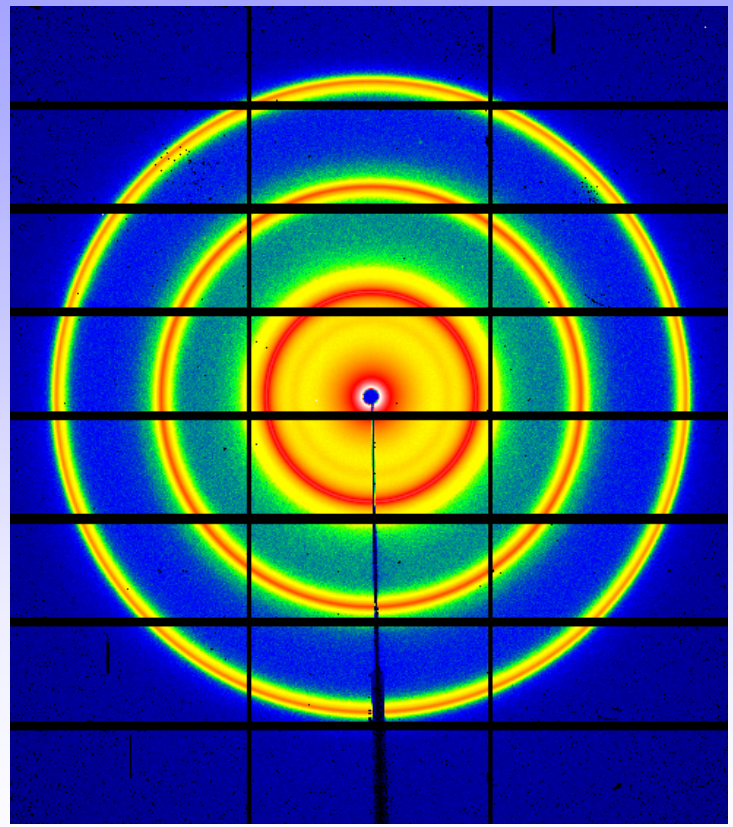
Results : Ag behenate





Silver behenate, 12 keV beam, Threshold 55 %. Vrf -0.3 V. Sample-Detector ca. 2,2 m.

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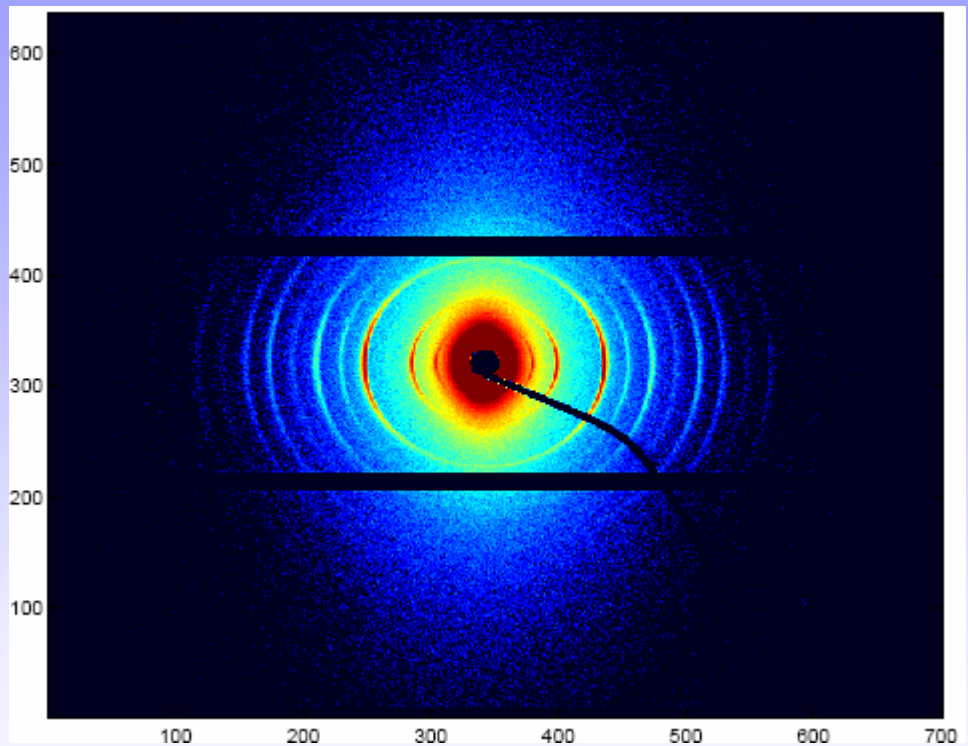
Results : Collagen Sample



One out of 45000 images collected of a collagen bone probe

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Conclusions

- PILATUS 2M and 6M integration finished at SLS
- Break-through in speed and data-quality
- Data routinely collected in user operation mode
- Huge amount of data collected, storage and data processing issues should be emphasized
- DECTRIS is on schedule

Thank you for your attention