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INSTALLATION OF IN-VACUUM EIGER2S 9M INTO SAXS FLIGHT TUBE AT 12IDB

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Advanced Photon Source
Argonne National Laboratory

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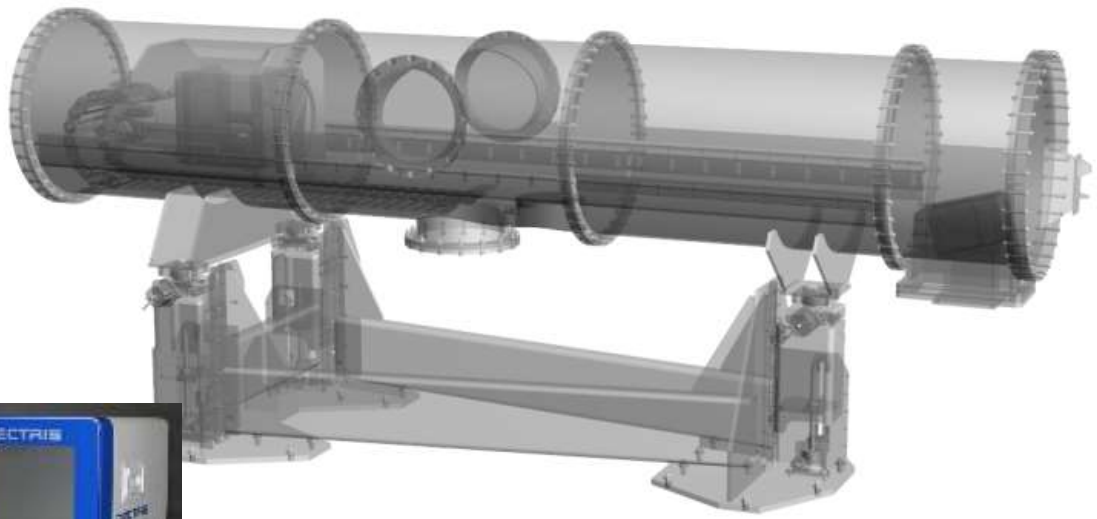
12IDB SAXS/WAXS BEAMLINE

12IDB VACUUM FLIGHT TUBE

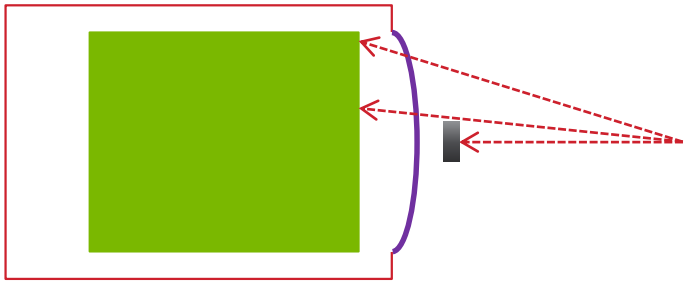
Schmidt design

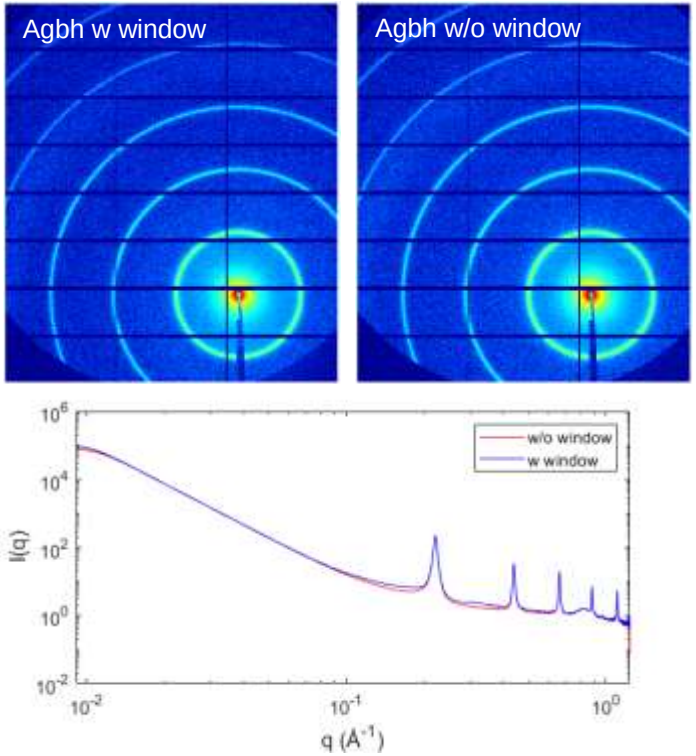


12IDB VACUUM FLIGHT TUBE

Schmidt design

PILATUS2M IN THE AIR BOX





EIGER 9M

Sensitive area 233.1 x 244.7mm^2 (75 x 75 μm^2)
Dynamic range: 20bits
Frame rate: 40Hz
Count rate: 1E7/pixel
QE @12kev: 86%
Operation pressure: <1E-2 mbar

Detector technology	Hybrid Photon Counting (HPC)
Number of modules (W x H)	3 x 6 = 18
Sensor material	Silicon (Si)
Sensor thickness	450 µm
Pixel size (W x H)	75 µm x 75 µm = 5625 µm^2
Module size (W x H)	77.1 mm x 38.4 mm = 2961 mm^2
Pixel array format (W x H)	3108 pixel x 3262 pixel = 10 138 296 pixel
Active area (W x H)	233.1 mm x 244.65 mm = 57 027.915 mm^2
Inter-module gap	hor. 12 pixels, vert. 38 pixels
Defective pixels	< 0.05%
Image bit depth	32 bit or 16 bit
Readout bit depth	16 bit
Maximum count rate	1.7 x 10^9 photons/s/mm^2
Adjustable threshold range	3.5 keV to 30 keV
Energy range	6 keV to 40 keV
Number of thresholds	two independent thresholds
Readout time	continuous readout, with zero dead time
Maximum frame rate [1]	40 Hz
ROI maximum frame rate	40 Hz
Point-spread function	1 pixel (FWHM)
Connection to detector control unit	4 x LC/UPC duplex fiber optic connectors
Power supply	External power supply unit
Software interface	HTTP REST interface (via network connection)
Dimensions (W x H x D)	340 mm x 370 mm x 500 mm
Weight	45 kg
Overvoltage category	II

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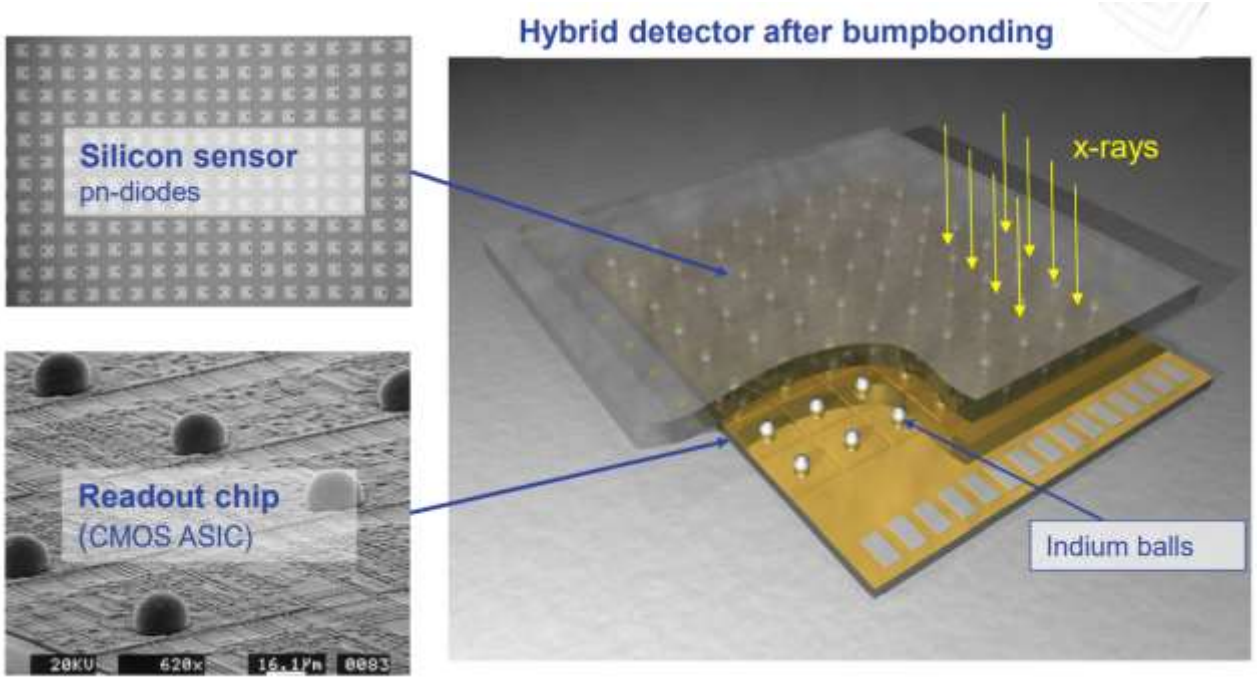
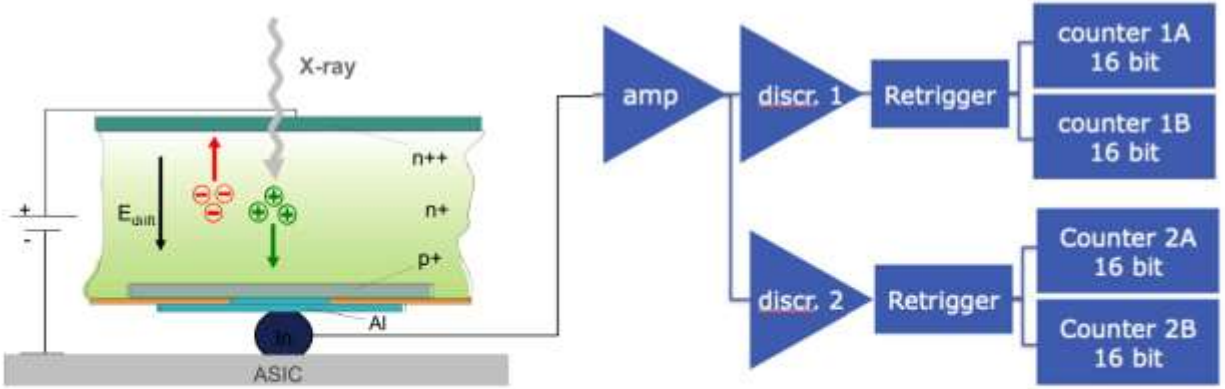
HPC TECHNOLOGY

Dectris



EIGER2 PIXEL



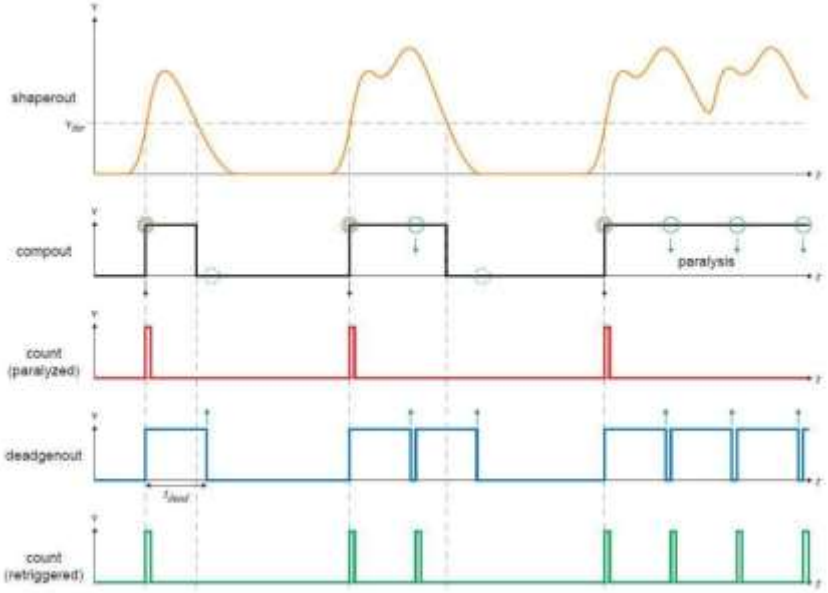
– ***Direct conversion of X-rays in semiconductor sensor***

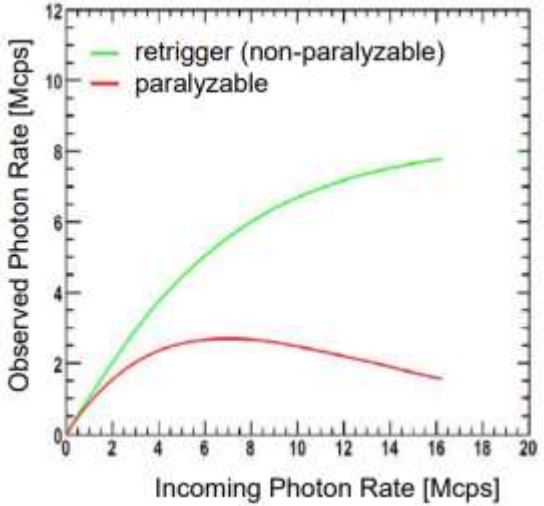
→ *Optimal spatial resolution (PSF of ~1 pixel)*

– ***Single-photon counting with two energy thresholds***

→ *No readout noise or dark current*
→ *High dynamic range*
→ *Fast readout*

DEADTIME





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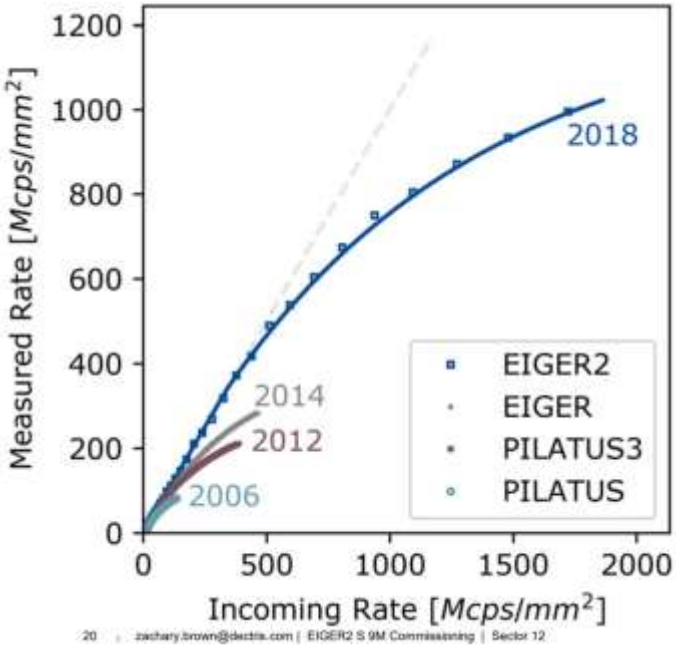
COUNT RATE COMPARISON



EIGER X: ***2.4 x 10^6 cps/pixel***

EIGER2 X: ***1.0 x 10^7 cps/pixel***

25 times increased count rate capability since PILATUS

DECTRIS
detecting the future

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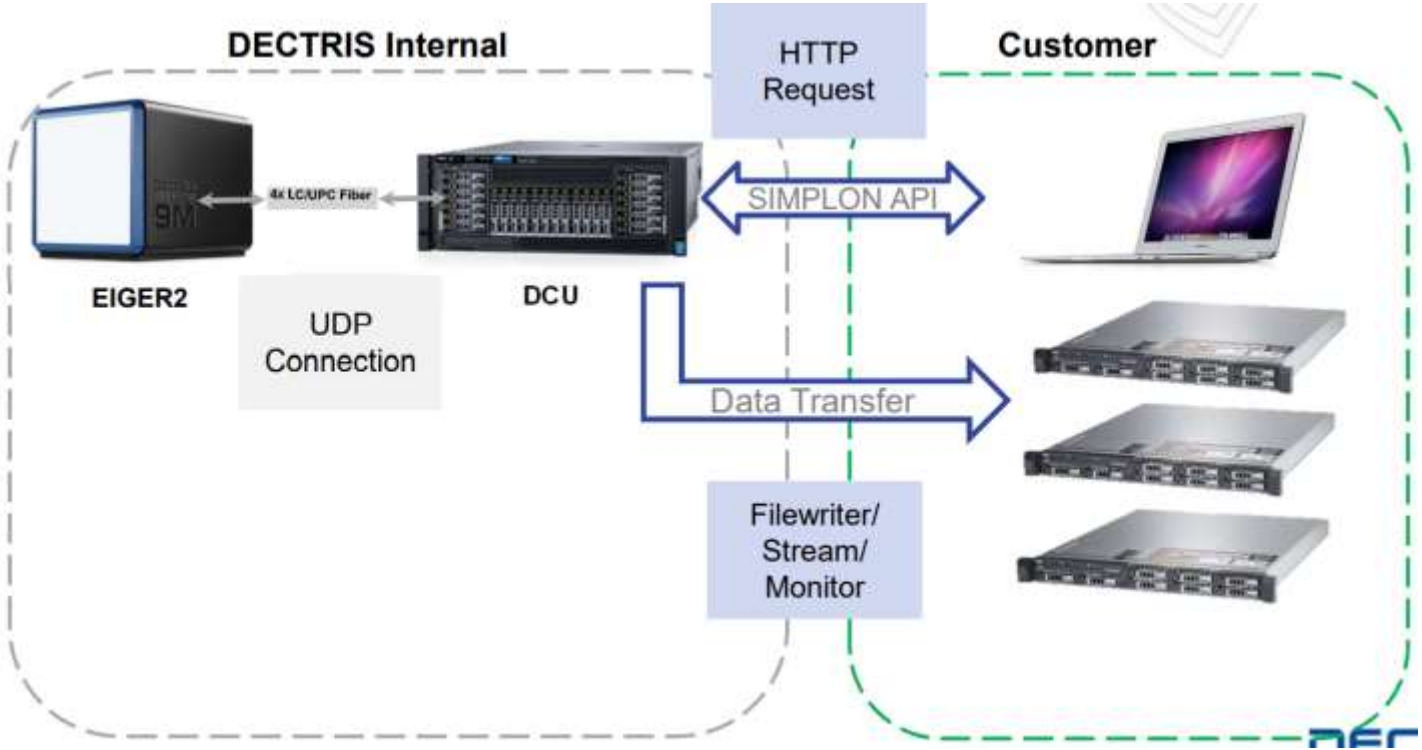
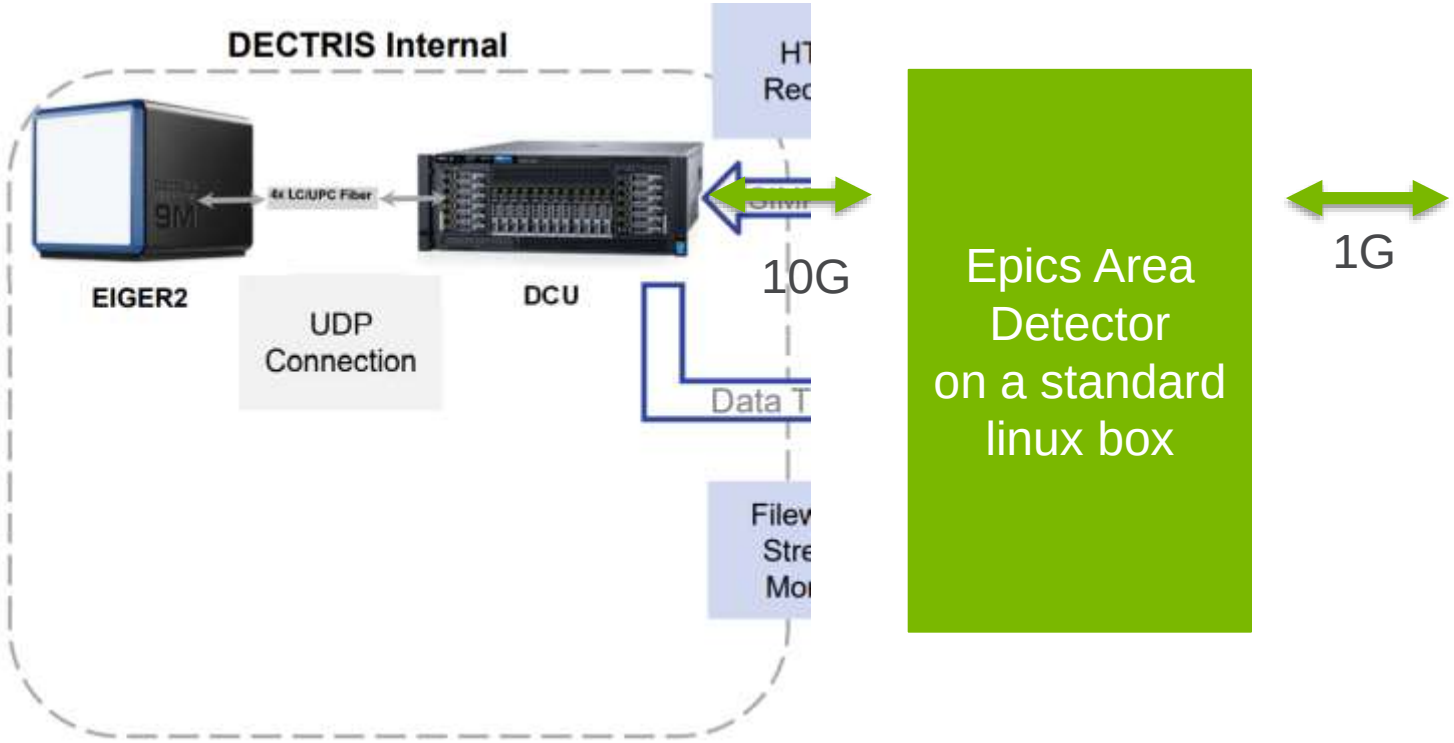
SYSTEM


DECTRIS Internal
HTTP Request
Customer
4x LC/UPC Fiber
SIMPLON API
EIGER2
UDP Connection
DCU
Data Transfer
Filewriter/ Stream/ Monitor

SYSTEM


DECTRIS Internal
HT
Rec
4x LC/UPC Fiber
EIGER2
UDP
Connection
DCU
10G
Data T
Filev
Stre
Mo
Epics Area
Detector
on a standard
linux box
1G

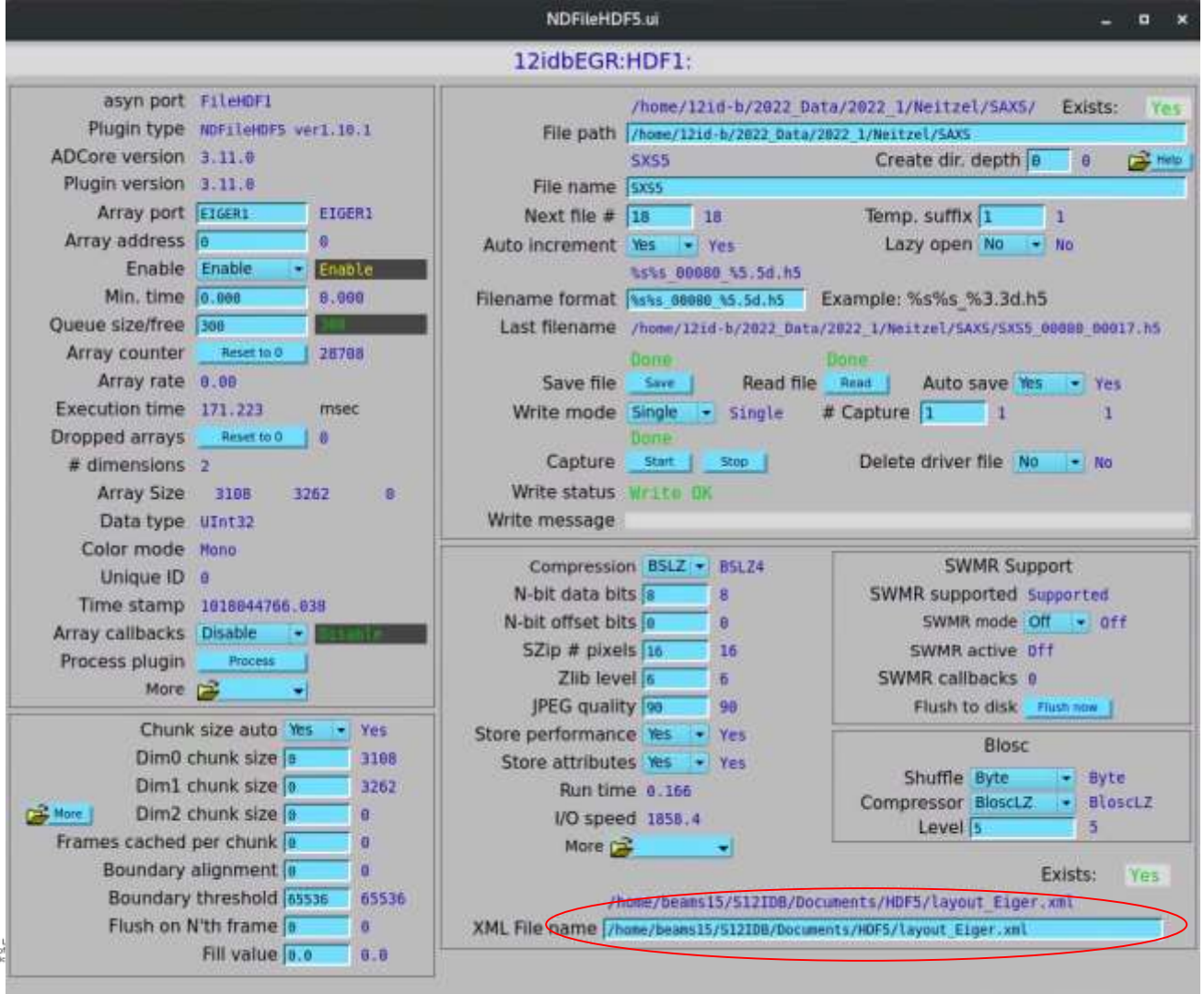
ARE

eiger2Detector.ui
Eiger2 Detector Control 12idbEGR:cam1:
Setup
asyn port EIGER1
EPICS name 12idbEGR:cam1:
Manufacturer Dectris
Model EIGER2 Si 9M
Serial number E-18-0125
Firmware version release-2020.2.2
SDK version 1.8.0
Driver version 3.2.0
ADCore version 3.11.0
Connected
Connection Connect Disconnect
Debugging
Plugins
All File ROI
Stats Other #3 Other #4
Detector Status
Detector State Idle
Error Parameters []
Temperature C 28.7
Humidity % 0.0
HV State READY
HV Reset Time 30 30
HV Reset
Initialize
Read Status Rate 1 second
Shutter
Shutter mode None
Status: Det. Closed EPICS
Open/Close Open Close
Delay: Open 0.000 Close 0.000
EPICS shutter setup
Acquisition Setup
Threshold 1 (eV) 6650.000 6650.000
Threshold 1 enable Enable Enable
Threshold 2 (eV) 11257.400 18620.000
Threshold 2 enable Disabl Disable
Threshold diff. Disabl Disable
Photon energy (eV) 13300.000 13300.000
Energy Epsil. (eV) 0.050 0.050
Exposure time (s) 5.000e-01 5.000e-01
Acquire period (s) 7.000e-01 7.000e-01
Images 1 1
Exposures/image 1 0
Counting mode Normal Normal
Trigger Setup
Trig. mode External Serie External Series
Start Delay 0.0000e+00 0.0000e+00
Ext. gate mode HDR HDR
Trig. Exposure 0.000e+00 0.000e+00
Manual Trig. Disable Disable
Software Trig. Trigger
Triggers 1 1
Acquisition Status
Acquire Start Stop
Acquire Status Done
Queued arrays 0
Wait for plugins No
Acquire busy Done
Acquire Message Ready
Detector State Idle
Detector Armed Unarmed
Image Bit Depth 32
Readout Time 1.000e-07
Rate Cutoff 2e+06
Images Complete 1
Image counter 0 1
Image rate 0.00
File Writer
Enable Enable Enable
State error
Compression Enable Enable
Images/File 1000 1000
File Name Pattern
(e.g. testA_$id)
Current seq. id 27236
Save Files Local Disable Disable
Local Path
Local Path Exists No
Create dir. depth 0 0 Help
File Owner s12idb
File Group s12user
File Perms. 0644 0644
DCU RAM Disk Free 0.073 GB
Auto Remove Enable Enable
Stream
Enable Enable Enable
State ready
Header Detail Basic Basic
Decompress Enable Enable
Dropped Frames 0
Monitor
Enable Disable Disable
State normal
Timeout (ms) 500.0 500.0
Buffers
Buffers used 3
Buffers alloc/free 12 9
Memory max/used (MB) 0.0 367.4
Buffer & memory polling 1 second
Empty free list Empty
Detector Metadata
Beam Center X 1438.990 1438.990 pix.
Beam Center Y 208.600 208.600 pix.
Wavelength 1.5419 0.9322 Ang.
Wavelen. Eps. 0.000500 0.000500 Ang.
Det. distance 1999.820 1999.820 mm
Angle Start Increment
Chi 0.000 0.000 deg
0.000 0.000
Kappa 0.000 0.000 deg
0.000 0.000
Omega 0.000 0.000 deg
0.000 0.000
Phi 0.000 0.000 deg
0.000 0.000
Two Theta 0.000 0.000 deg
0.000 0.000
Detector Info
Description Dectris EIGER2 Si 9M
Detector Size 3108 3262
Pixel Size 0.000075 0.000075
Sensor Material Si
Sensor Thickness 4.500000e-04
Readout
ROI mode Disable Disable
Flatfield Corr. Enable Enable
Countrate Corr. Enable Enable
Pixel mask Enable Enable
Auto Summation Enable Enable
Compress. Alg. BS LZ4 BS LZ4
Array Callbacks Enable Enable
Data Source Stream Stream
Attributes
File
Macros
Status Attributes file OK

DATA TRANSFER

	FileWriter	Monitor	Stream
Usage	Data acquisition	Monitoring	Real time processing
Data format	hdf5	Tiff	raw (zeromq)
Features	- All meta data included in each master file. - Compression via filter plugins (lz4/bslz4).	- Slim data format. - Two thresholds - No complete meta data. - No compression. - <10 Hz	- Compressed data (lz4 / bslz4). - Full performance only with bslz4. - Configurable meta data (all, basic, none). - «Raw» Image data. - ZMQ allows user implementation.

eigerFW-series_15_data_000001.h5	1/14/2022 4:22 PM	H5 File	828 KB
eigerFW-series_15_master.h5	1/14/2022 4:22 PM	H5 File	79,505 KB
eigerFW-series_16_data_000001.h5	1/14/2022 4:23 PM	H5 File	4,109 KB
eigerFW-series_16_master.h5	1/14/2022 4:23 PM	H5 File	79,505 KB
eigerFW-series_17_data_000001.h5	1/14/2022 4:32 PM	H5 File	2,307 KB
eigerFW-series_17_master.h5	1/14/2022 4:31 PM	H5 File	79,505 KB
eigerFW-series_18_data_000001.h5	1/14/2022 4:33 PM	H5 File	719 KB
eigerFW-series_18_master.h5	1/14/2022 4:32 PM	H5 File	79,505 KB
eigerFW-series_19_data_000001.h5	1/14/2022 4:33 PM	H5 File	719 KB
eigerFW-series_19_master.h5	1/14/2022 4:33 PM	H5 File	79,505 KB
eigerFW-series_20_data_000001.h5	1/14/2022 4:34 PM	H5 File	722 KB
eigerFW-series_20_master.h5	1/14/2022 4:33 PM	H5 File	79,505 KB
eigerFW-series_21_data_000001.h5	1/14/2022 4:37 PM	H5 File	723 KB


NDFileHDF5.ui
12idbEGR:HDF1:
asyn port FileHDF1
Plugin type NDFileHDF5 ver1.10.1
ADCore version 3.11.0
Plugin version 3.11.0
Array port EIGER1 EIGER1
Array address 0 0
Enable Enable Enable
Min. time 0.000 0.000
Queue size/free 300
Array counter Reset to 0 28708
Array rate 0.00
Execution time 171.223 msec
Dropped arrays Reset to 0 0
dimensions 2
Array Size 3108 3262 0
Data type UInt32
Color mode Mono
Unique ID 0
Time stamp 1018044766.038
Array callbacks Disable Disable
Process plugin Process
More
Chunk size auto Yes Yes
Dim0 chunk size 0 3108
Dim1 chunk size 0 3262
More
Dim2 chunk size 0 0
Frames cached per chunk 0 0
Boundary alignment 0 0
Boundary threshold 65536 65536
Flush on N'th frame 0 0
Fill value 0.0 0.0
/home/12id-b/2022_Data/2022_1/Neitzel/SAXS/ Exists: Yes
File path /home/12id-b/2022_Data/2022_1/Neitzel/SAXS
SXS5 Create dir. depth 0 0 Help
File name SXS5
Next file # 18 18 Temp. suffix 1 1
Auto increment Yes Yes Lazy open No No
%s%s_00000_%5.5d.h5
Filename format %s%s_00000_%5.5d.h5 Example: %s%s_%3.3d.h5
Last filename /home/12id-b/2022_Data/2022_1/Neitzel/SAXS/SXS5_00000_00017.h5
Done Done
Save file Save Read file Read Auto save Yes Yes
Write mode Single Single # Capture 1 1 1
Done
Capture Start Stop Delete driver file No No
Write status Write OK
Write message
Compression BSLZ BSLZ4
N-bit data bits 8 8
N-bit offset bits 0 0
SZip # pixels 16 16
Zlib level 6 6
JPEG quality 90 90
Store performance Yes Yes
Store attributes Yes Yes
Run time 0.166
I/O speed 1858.4
More
SWMR Support
SWMR supported Supported
SWMR mode Off Off
SWMR active Off
SWMR callbacks 0
Flush to disk Flush now
Blosc
Shuffle Byte Byte
Compressor BloscLZ BloscLZ
Level 5 5
Exists: Yes
/home/beams15/S12IDB/Documents/HDF5/layout_Eiger.xml
XML File name /home/beams15/S12IDB/Documents/HDF5/layout_Eiger.xml

UNPACKING

INTERFACES

Table 3.2: Power Ratings

Detector power input	Power 1 and 2: +48 VDC, 400 W (i.e. 800 W total)
Detector external trigger input	High level: 2.1 – 5.0 V Low level: 0.0 – 0.8 V
	Caution #4 Absolute maximum is 5 V. Applying a higher voltage will damage the detector.
External trigger input impedance	47 kΩ
Detector trigger output	High level: 2.3 V to 3.3 V Low level: 0.0 V to 0.8 V Max. current: 24 mA

Quick-connector for air
Swagelok for vac.

VAC FEEDTHROUGH

Pilatus1M Feedthrough

Eiger9M Feedthrough

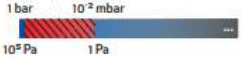
KF50-Swagelok

DN100

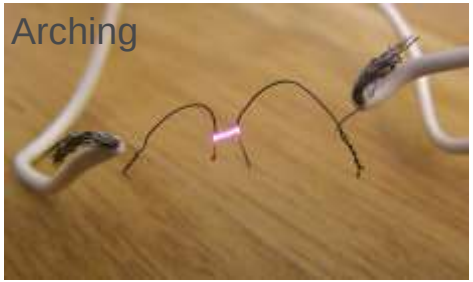
VAC INTERLOCK

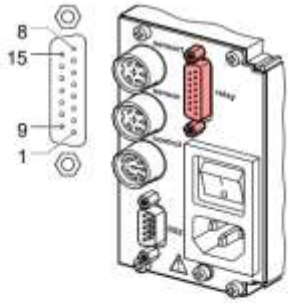
Definition

atmospheric pressure or less than 0.01 mbar



10 °C to 25 °C

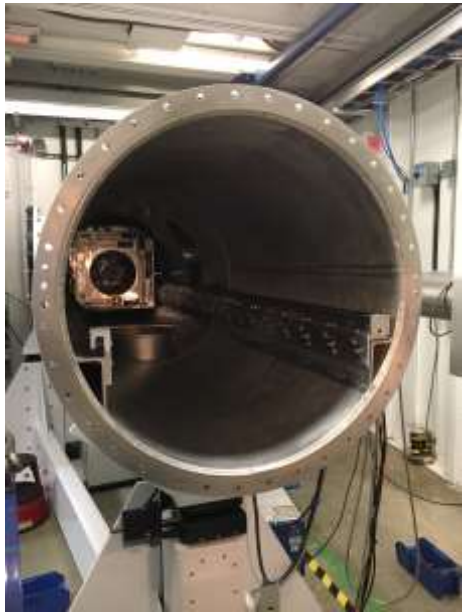




Pin assignment of the female 15-pole D-Sub appliance connector:

Pin	Signal		
	Switching function 1 **SP1**		
4 3 2		Pressure below threshold	Pressure above threshold or power supply turned off
	Switching function 2 **SP2**		
7 6 5		Pressure below threshold	Pressure above threshold or power supply turned off
	Switching function 3 **SP3**		
11 10 9		Pressure below threshold	Pressure above threshold or power supply turned off
	Switching function 4 **SP4**		
14 13 12		Pressure below threshold	Pressure above threshold or power supply turned off

INSTALLATION IN THE VAC FLIGHT TUBE



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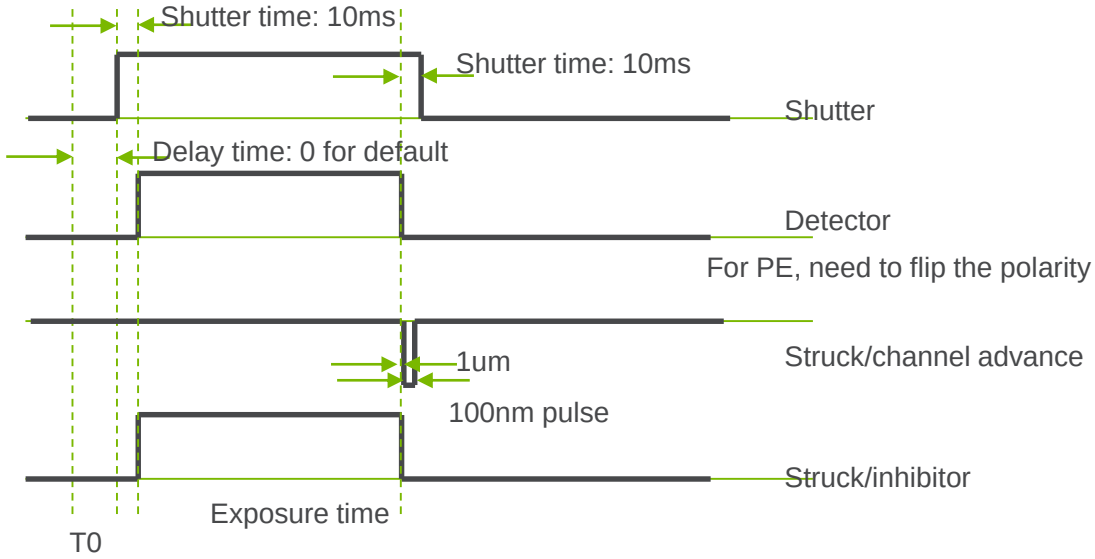
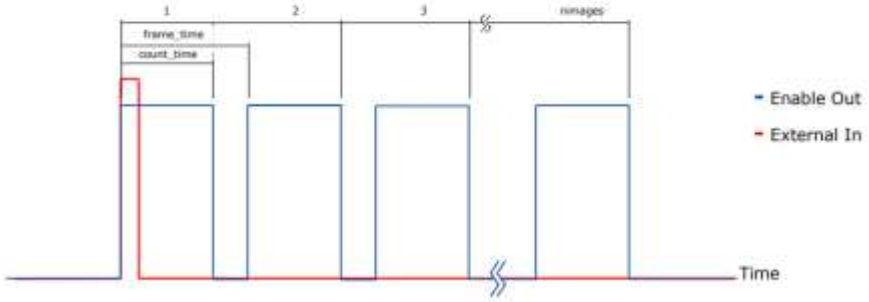
DG645

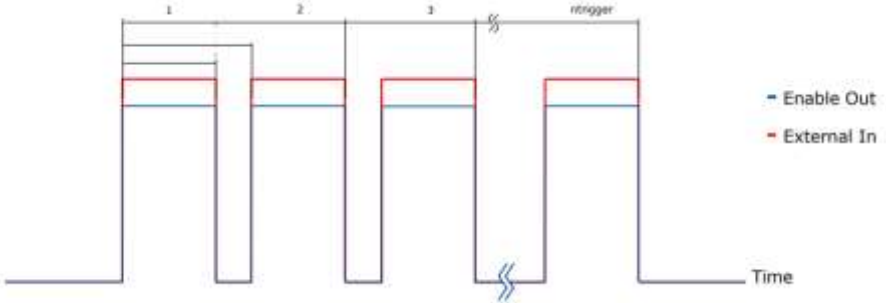

Shutter time: 10ms
Shutter time: 10ms
Shutter
Delay time: 0 for default
Detector
For PE, need to flip the polarity
Struck/channel advance
1um
100nm pulse
Struck/inhibitor
Exposure time
T0

EXTERNAL TRIGGER MODES

Externally triggered exposure series



Externally enabled exposure series



Starts counting at the rising edge and stops at the falling edge.

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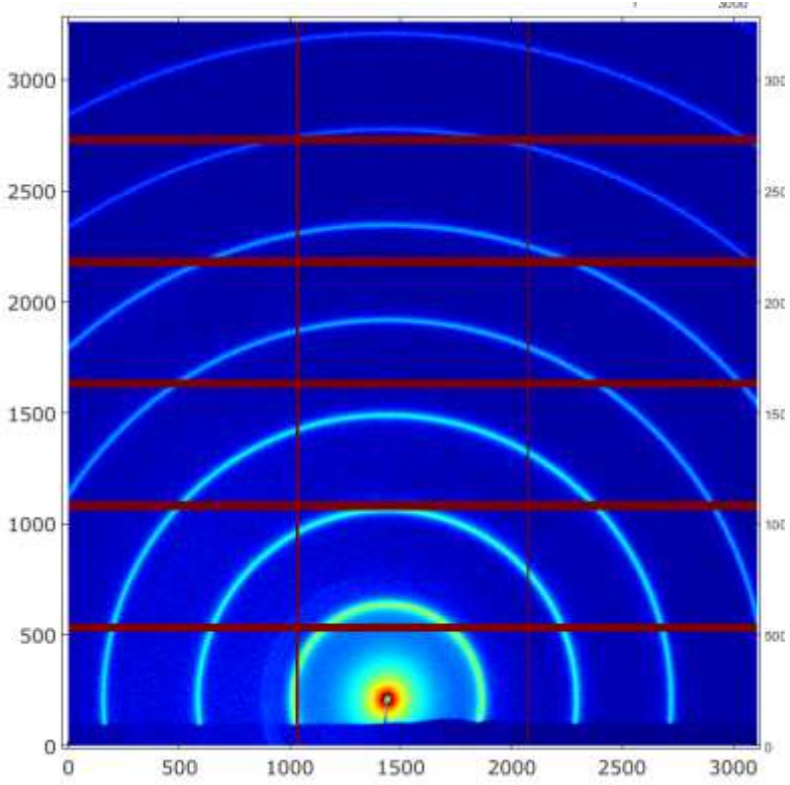
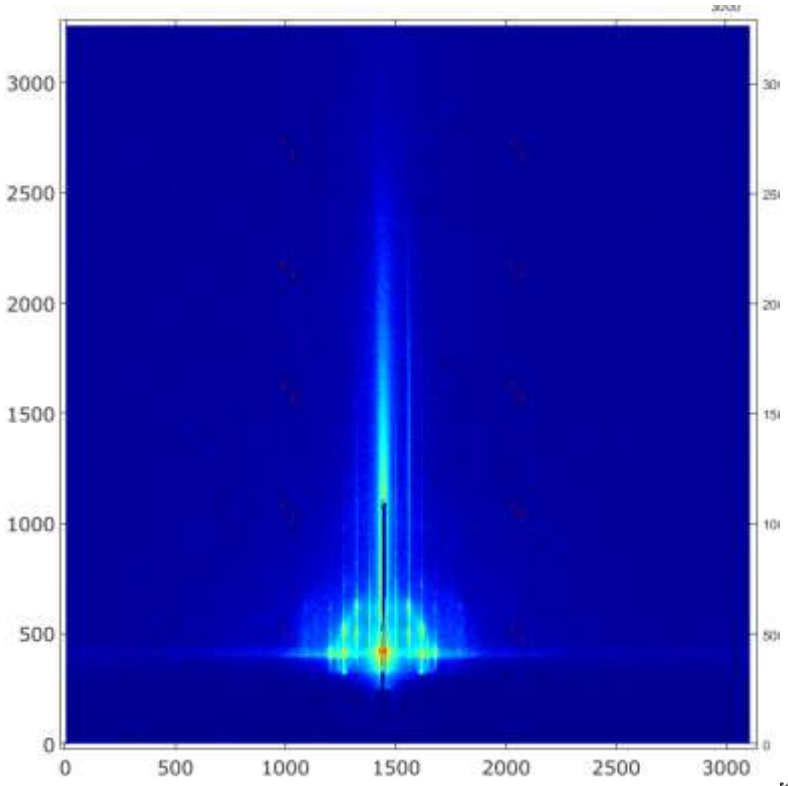
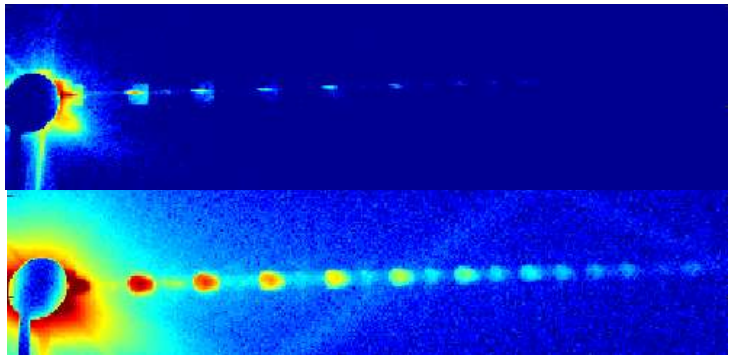
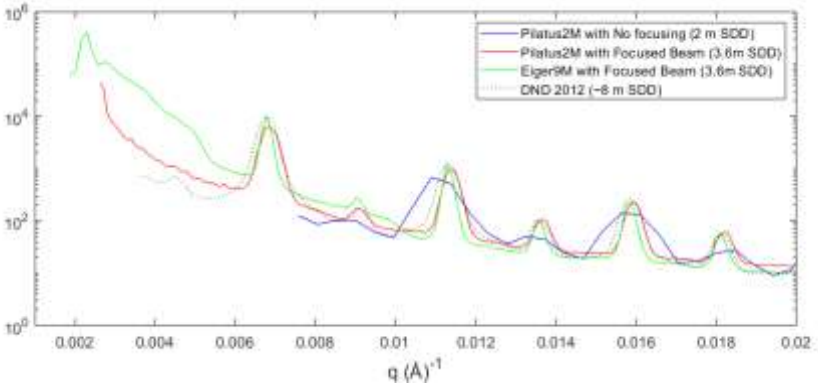

3000
2500
2000
1500
1000
500
0
0
500
1000
1500
2000
2500
3000


3000
2500
2000
1500
1000
500
0
0
500
1000
1500
2000
2500
3000

IMPROVED 12ID SAXS RESOLUTION

1:1 CRL focusing and measuring an ideal peak shape





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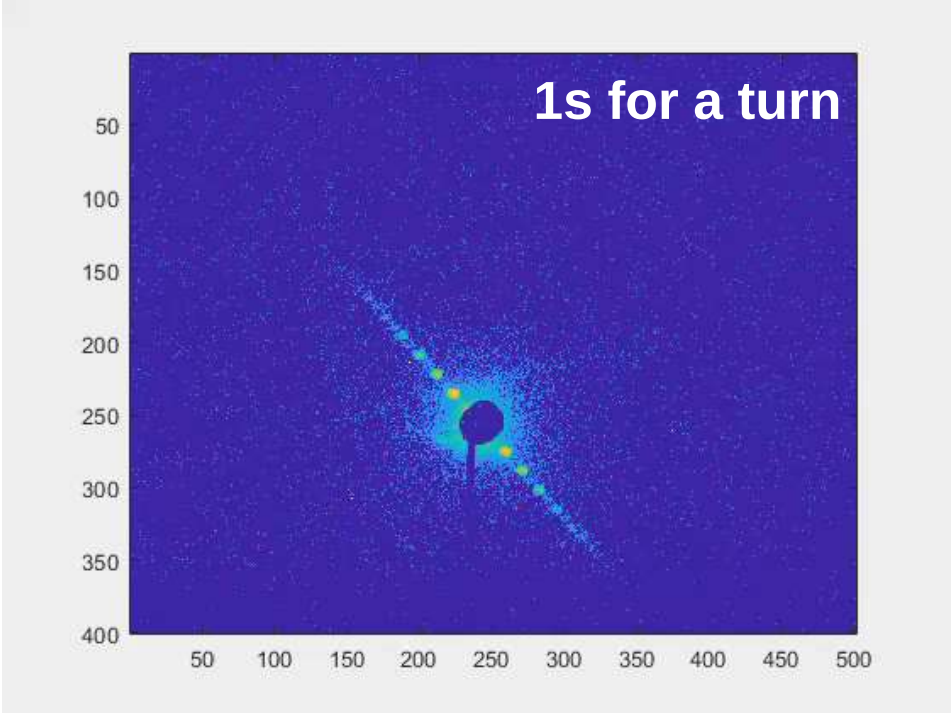
asyn port	FileHDF1		
Plugin type	NDFileHDF5 ver1.10.1		
ADCore version	3.11.0		
Plugin version	3.11.0		
Array port	EIGER1	EIGER1	
Array address	0	0	
Enable	Enable	Enable	
Min. time	0.000	0.000	
Queue size/free	300	300	
Array counter	Reset to 0	21704	
Array rate	0.00		
Execution time	149.435	msec	
Dropped arrays	Reset to 0	79	
# dimensions	2		
Array Size	3108	3262	0



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APS-OPS

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