



NICOS Update

Spectroscopy STAP

MATT CLARKE (ECDC)

Agenda



1. Background
2. Architecture
3. ESS Specific
4. Instrument Specific
5. YMIR
6. BIFROST
7. What next?

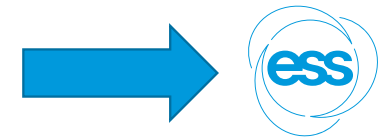
Background



- Developed for FRM II (MLZ) in Munich
 - Started ~2002, developed for specific beamlines
 - Modernisation project started in 2009
 - Decision made to use it on all beamlines (2013)
- ESS and SINQ joined the collaboration ~2016
 - Survey of existing control systems such as IBEX, SICS, Bluesky, Sardar
- Deployed at V20 for ESS tests
 - Choppers, SANS, ...
- Deployed at Utgård for integrating SE
- YMIR
 - Motion, scanning, light tomo
- BIFROST, ESTIA and ODIN



Facilities



Why NICOS?



j

What about NICOS? Is that any good?



Yes, NICOS (Neutron Instrument Control System) is a popular and widely used software package for controlling and monitoring neutron instruments. It is a flexible and extensible system that provides a user-friendly interface for controlling experiments and acquiring data. NICOS is an open-source software package that can be customized to meet the specific needs of a neutron research facility.



NICOS has several features that make it a good choice for instrument control in neutron research facilities. It provides a graphical user interface (GUI) that allows users to easily configure and control the instruments. The GUI also provides real-time data visualization, making it easy for users to monitor the progress of their experiments.

NICOS is also designed to be highly scalable, which makes it suitable for facilities with a large number of instruments and users. It supports distributed control systems and can communicate with instruments and detectors through various communication protocols.

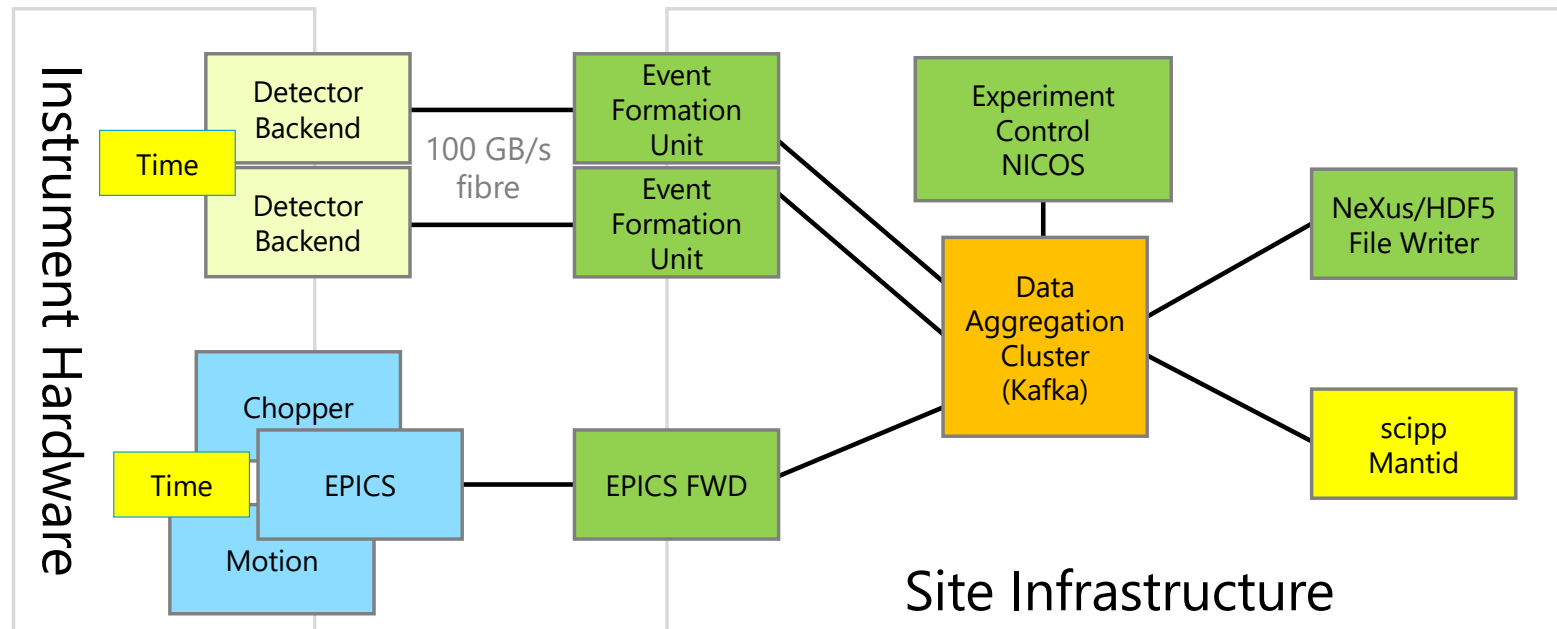
In summary, NICOS is a well-established and widely used instrument control software package for neutron research facilities. Its flexibility, scalability, and user-friendly interface make it a good choice for controlling and monitoring neutron instruments.

Architecture



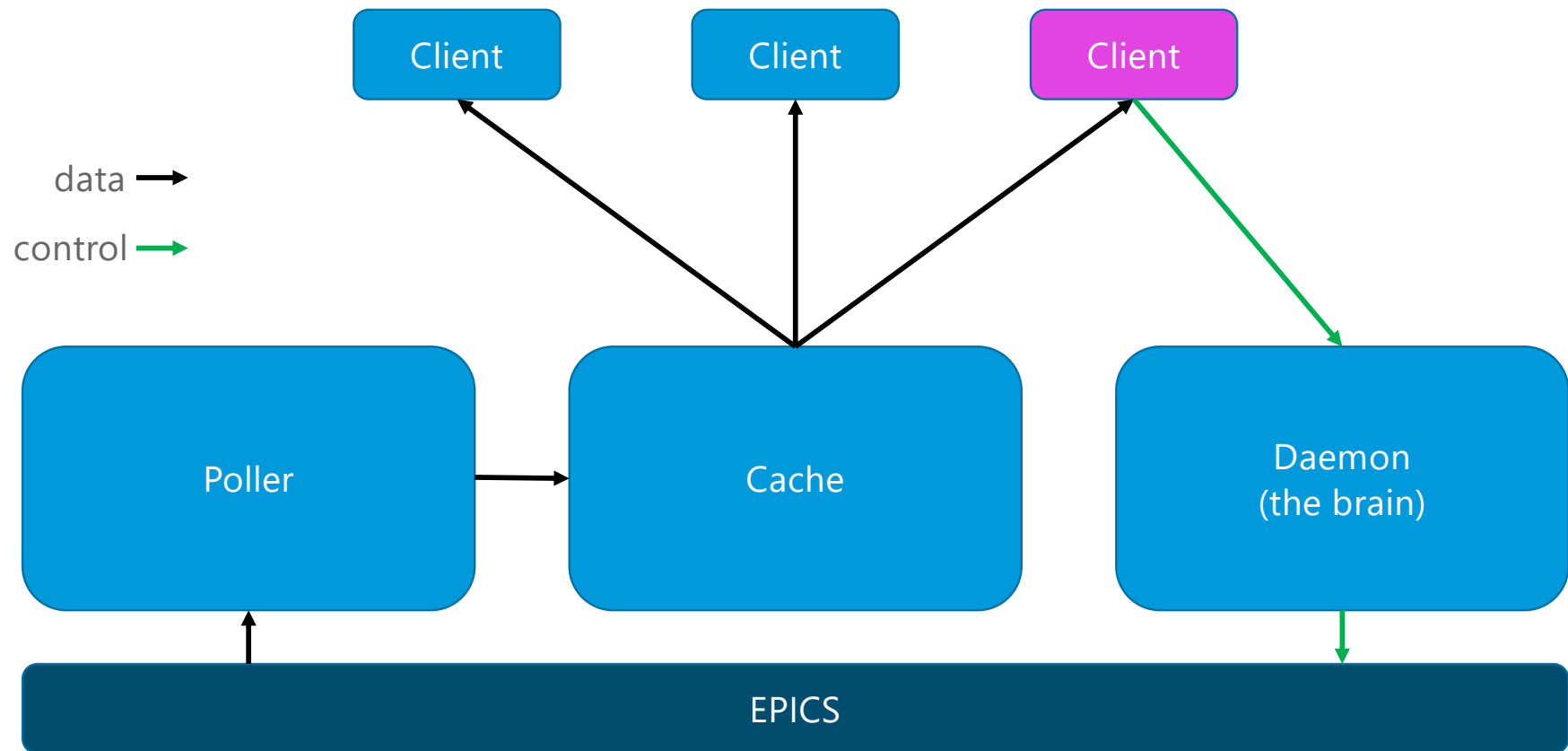
Architecture

ECDC

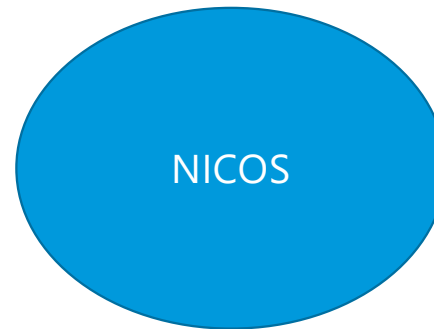


Architecture

NICOS

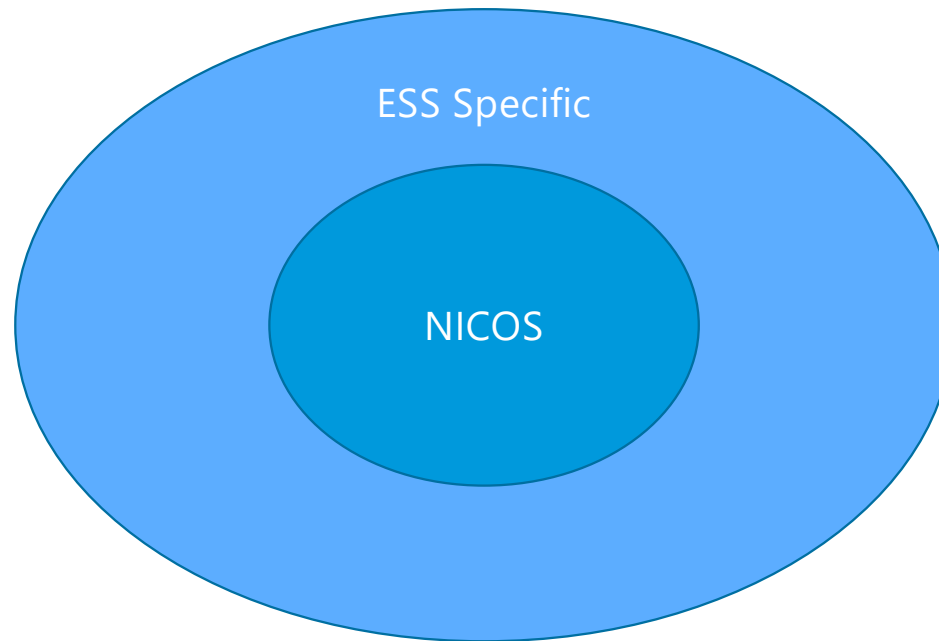


Core Functionality



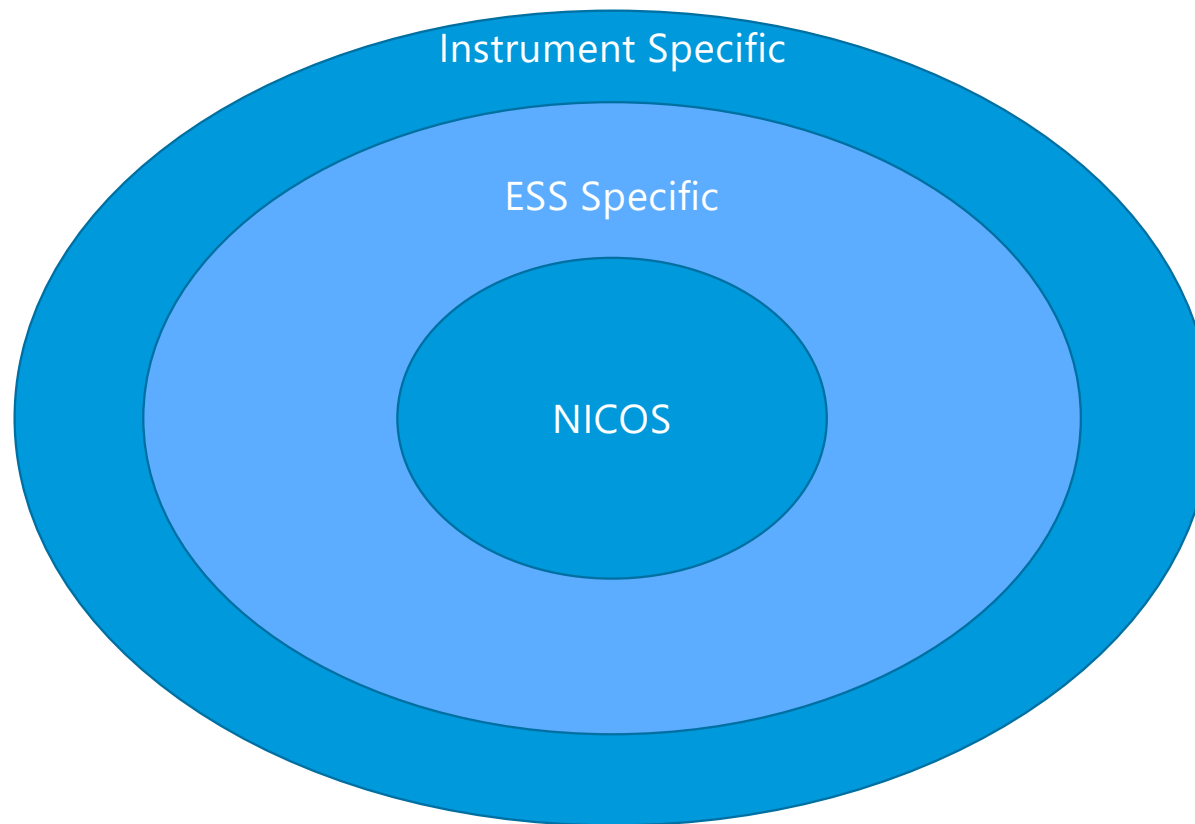
- Poller
- Cache
- Daemon
- Architecture
- Device hierarchy
- ...

ESS Specific



- EPICS support
 - Monitors
- Data files
 - Kafka file-writer
- ESS proposal system
- flowui
- Live display
- Graylog
- Common devices
- ...

Instrument Specific



- Special devices
- Custom commands
- Scripts
- GUI widgets
- ...


ESS Specific



ESS Specific

Common across all instruments



- EPICS support
- Filewriter configuration and control
- Proposal system
- Common devices
 - Choppers
 - Motors
- flowui 
- ...

NICOS GUI

Win95?



The screenshot shows the NICOS GUI interface. The main window is titled "NICOS - guest at localhost:3389". It features a sidebar on the left with "Experiment Information" (Proposal: 038243, Title: can_we_cr..., Users: ('name': '!...'), Local Contact: (), Setups: area_dete..., Samples, Environments, Detectors: area_dete..., Scans, Remark) and a central terminal window. The terminal displays the following log output:

```
1 | NicosSetup()

[10:02:18] creating device 'Space' (The amount of free space for storing data)...
[10:02:18] creating device 'YMIR' (instrument object)...
[10:02:18] creating device 'area_detector_collector' (Area detector collector)...
[10:02:18] creating device 'flir_camera' (The light tomography FLIR camera)...
[10:02:18] creating device 'flir_kafka_plugin' (The configuration of the Kafka plugin for the FLIR camera)...
[10:02:24] flir camera: shutting down device
[10:02:24] WARNING: flir_camera: could not shutdown after creation failed - AttributeError - 'AreaDetector' object has no attribute '_
[10:02:24] area_detector_collector: shutting down device
[10:02:24] ERROR [2022-11-21 10:02:24] device 'area_detector_collector' failed to create - Communication error - [flir_kafka_plugin] co
[10:02:24] creating device 'conslink'...
[10:02:24] ERROR [2022-11-21 10:02:24] device 'flir_camera' failed to create - Communication error - [flir_kafka_plugin] could not con
[10:02:24] creating device 'flir_image_type' (Image type for the tomography Setup)...
[10:02:24] ERROR [2022-11-21 10:02:24] device 'flir_kafka_plugin' failed to create - Communication error - [flir_kafka_plugin] could n
[10:02:24] creating device 'liveview'...
[10:02:24] creating device 'rotation_stage' (Rotation stage in YMIR)...
[10:02:26] ERROR [2022-11-21 10:02:26] error running startup code, ignoring - NameError - name 'area_detector_collector' is not define
[10:02:26] ERROR [2022-11-21 10:02:26] the following devices could not be created:
[10:02:26] ERROR [2022-11-21 10:02:26] area_detector_collector, flir_camera, flir_kafka_plugin
[10:02:26] use CreateDevice('device') or CreateAllDevices() later to retry
[10:02:26] setups loaded: startup, area_detectors, rotation_stage
```

The right-hand panel, titled "NICOS devices", displays a table of device status:

Name	Value	Status
area_detectors		
area_detector_collector		creating d
flir_camera		creating d
flir_image_type	-	
rotation_stage		
rotation_stage	0.000 degree	
system		
Exp		
lastpoint	1421	
lastscan	37	
FileWriterStatus		
NexusStructure		
Sample		
SciChat		
Space	58.393 GiB	58.40 GiB
YMIR		

NICOS GUI

Ask the experts

- User Journey
 - who they are; skills and background
 - what are their goals
 - what annoys them
- Workflow
 - from start to finish
- Interaction
 - how things do things in the GUI
- Perceptual
 - how things look and behaviour. E.g. buttons, icons, etc.
 - subconscious clues
 - visual impairments



<https://www.designpsykologi.dk/>

NICOS flowui

WinXP?



The screenshot shows the NICOS flowui interface. The main window title is "NICOS - guest at localhost:3389". The status bar at the top right indicates "Status: IDLE". The interface is divided into several sections:

- Experiment:** Instrument: YMIR, Experiment: can_we_crash_the_filewriter
- Setup:** Includes buttons for "New Cmd", "Dry run", and "Run".
- Instrument interaction:** A terminal window showing a log of system setup and device creation. The log includes timestamps and messages such as "loading setup 'system'", "creating device 'Exp'", and "WARNING: NexusStructure Basic: value of 'nexus_config_path' from cache".
- Devices:** A panel on the right showing a list of devices with columns for Name, Value, and Status. The list includes "area_detectors", "rotation_stage", and "system".

```
10:02:17 loading setup 'system' (system setup)
10:02:17 importing module 'nicos.commands.standard'...
10:02:17 loading setup 'startup' (NICOS startup setup)
10:02:17 Cache : now connected to localhost:14869
10:02:17 creating device 'Exp' (experiment object)...
10:02:17 creating device 'Sample' (The currently used sample)...
10:02:17 creating device 'FileWriterControl' (Control for the file-writer)...
10:02:17 creating device 'NexusStructure'...
10:02:17 creating device 'NexusStructure AreaDetector' (Provides the NeXus structure)...
10:02:17 creating device 'FileWriterStatus' (Status of the file-writer)...
10:02:17 creating device 'NexusStructure Basic' (Provides the NeXus structure)...
10:02:17 WARNING: NexusStructure Basic: value of 'nexus_config_path' from cache ('nicos_ess/ymir/nexu
10:02:17 creating device 'SciChat' (Connects to SciChat as a write-only client)...
10:02:17 creating device 'Space' (The amount of free space for storing data)...
10:02:17 creating device 'YMIR' (instrument object)...
10:02:17 creating device 'consink'...
10:02:17 creating device 'daemonsink'...
10:02:17 creating device 'liveview'...
10:02:17 setups loaded: startup
10:02:17 checking master status...
10:02:17 switched to master mode
10:02:17 loading previously used master setups: 'startup, area_detectors, rotation_stage'
10:02:18 loading setup 'system' (system setup)
10:02:18 importing module 'nicos.commands.standard'...
10:02:18 importing module 'nicos_ess.commands'...
10:02:18 loading setup 'startup' (NICOS startup setup)
10:02:18 loading setup 'area_detectors' (The area detector for YMIR)
10:02:18 loading setup 'rotation_stage' (Stray motion stage(s) at YMIR.)
10:02:18 Cache : now connected to localhost:14869
10:02:18 creating device 'Exp' (experiment object)...
10:02:18 creating device 'Sample' (The currently used sample)...
10:02:18 creating device 'FileWriterControl' (Control for the file-writer)...
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10:02:18 creating device 'NexusStructure Basic' (Provides the NeXus structure)...
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10:02:18 creating device 'Space' (The amount of free space for storing data)...
10:02:18 creating device 'YMIR' (instrument object)...
10:02:18 creating device 'area_detector_collector' (Area detector collector)...
10:02:18 creating device 'flir_camera' (The light tomography FLIR camera)...
10:02:18 creating device 'flir_kafka_plugin' (The configuration of the Kafka plugin for the FLIR cam
10:02:24 flir camera: shutting down device
10:02:24 WARNING: flir camera: could not shutdown after creation failed - AttributeError - 'AreaDete
10:02:24 area_detector_collector: shutting down device
10:02:24 ERROR [2022-11-21 10:02:24] device 'area_detector_collector' failed to create - Communicati
10:02:24 creating device 'consink'...
10:02:24 creating device 'daemonsink'...
10:02:24 ERROR [2022-11-21 10:02:24] device 'flir_camera' failed to create - Communication error - [
10:02:24 creating device 'flir_image_type' (Image type for the tomography setup)...
10:02:24 ERROR [2022-11-21 10:02:24] device 'flir_kafka_plugin' failed to create - Communication erro
10:02:24 creating device 'liveview'...
10:02:24 creating device 'rotation_stage' (Rotation stage in YMIR)...
10:02:26 ERROR [2022-11-21 10:02:26] error running startup code, ignoring - NameError - name 'area_d
10:02:26 ERROR [2022-11-21 10:02:26] the following devices could not be created:
10:02:26 ERROR [2022-11-21 10:02:26] area_detector_collector, flir_camera, flir_kafka_plugin
10:02:26 use CreateDevice('device') or CreateAllDevices() later to retry
10:02:26 setups loaded: startup, area_detectors, rotation_stage
```

NICOS flowui

WinXP?



The screenshot shows the NICOS flowui interface. The main window displays a terminal window with the following log output:

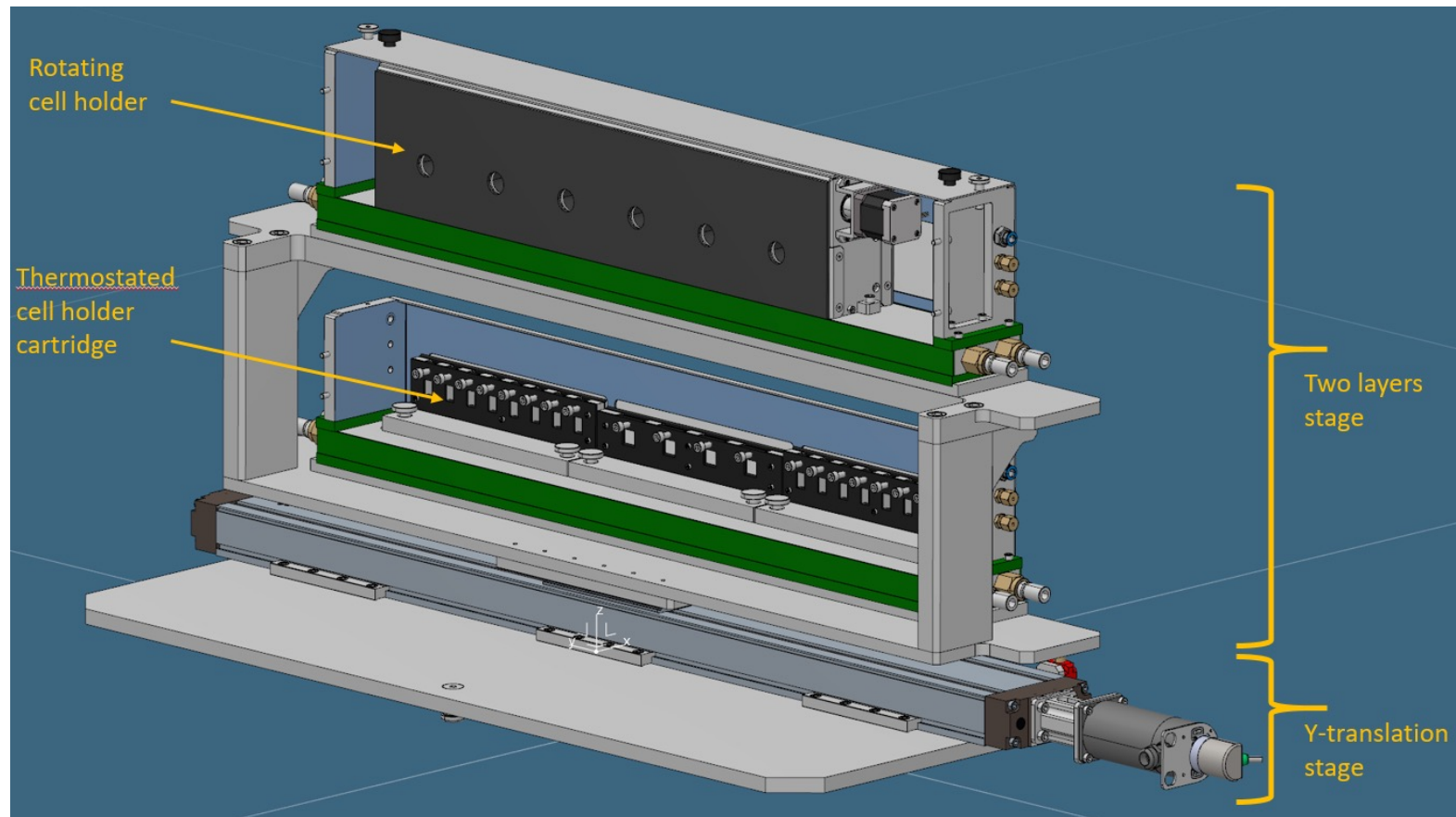
```
10:02:16 loading setup 'system' (system setup)
10:02:16 importing module 'nicos.commands.standard'...
10:02:16 importing module 'nicos.ess.commands'...
10:02:17 loading setup 'startup' (NICOS startup setup)
10:02:17 creating device 'FileWriterControl' (Control for the file-writer)...
10:02:17 creating device 'NexusStructure'...
10:02:17 creating device 'NexusStructure AreaDetector' (Provides the NeXus structure)...
10:02:17 creating device 'FileWriterStatus' (Status of the file-writer)...
10:02:17 creating device 'NexusStructure Basic' (Provides the NeXus structure)...
10:02:17 WARNING: NexusStructure Basic: Value of 'nexus_config_path' from cache ('nicos.ess/ymir/nexus') is not a string
10:02:17 creating device 'SciChat' (Connects to SciChat as a write-only client)...
10:02:17 creating device 'Space' (The amount of free space for storing data)...
10:02:17 creating device 'YMR' (Instrument object)...
10:02:17 creating device 'consink'...
10:02:17 creating device 'daemonsink'...
10:02:17 creating device 'liveview'...
10:02:17 setting up startup
10:02:17 checking status...
10:02:17 switching master mode...
10:02:17 load used previously used for startup, rotation stage, detectors, rotation stage...
10:02:18 loading setup 'system' (system setup)
10:02:18 importing module 'nicos.commands.standard'...
10:02:18 importing module 'nicos.ess.commands'...
10:02:18 loading setup 'rotation_stage' (The rotation stage in YMR)
10:02:18 loading setup 'rotation_stage' (The rotation stage in YMR)
10:02:18 Cache hit: configuration of local host is used
10:02:18 creating device 'SciChat' (Connects to SciChat as a write-only client)...
10:02:18 creating device 'Space' (The amount of free space for storing data)...
10:02:18 creating device 'FileWriterControl' (Control for the file-writer)...
10:02:18 creating device 'NexusStructure'...
10:02:18 creating device 'NexusStructure AreaDetector' (Provides the NeXus structure)...
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10:02:18 creating device 'flir_camera' (The light tomography FLIR camera)...
10:02:18 creating device 'flir_kafka_plugin' (The configuration of the Kafka plugin for the FLIR camera)...
10:02:18 flir camera: shutting down device
10:02:24 creating device 'consink'...
10:02:24 creating device 'daemonsink'...
10:02:24 ERROR [2022-11-21 10:02:24] device 'flir_camera' failed to create - Communication error - [
10:02:24 creating device type 'flir_image_type' (Image type for the tomography setup)...
10:02:24 ERROR [2022-11-21 10:02:24] device 'flir_kafka_plugin' failed to create - Communication error
10:02:24 creating device 'liveview'...
10:02:24 creating device 'rotation_stage' (Rotation stage in YMR)...
10:02:26 ERROR [2022-11-21 10:02:26] error running startup code, ignoring - NameError - name 'area_d
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10:02:26 use CreateDevice('device') or CreateAllDevices() later to retry
10:02:26 setups loaded: startup, area_detectors, rotation_stage
```

WIMP



Instrument Specific

LoKI Cell-holder



LoKI Cell-holder

Configure



NICOS Instrument: LOKI Experiment: Matt's second experiment Status: IDLE

Cell-holder Samples

Top Row

Type: rotation Calculate Type: blank Calculate Type: blank Calculate

	x	y
T1	25.0	10.0
T2	65.0	10.0
T3	105.0	10.0
T4	145.0	10.0
T5	185.0	10.0
T6	225.0	10.0

	x	y
--	---	---

	x	y
--	---	---

Bottom Row

Type: narrow Calculate Type: wide Calculate Type: narrow Calculate

	x	y
B1	0.0	0.0
B2	20.0	0.0
B3	40.0	0.0
B4	60.0	0.0
B5	80.0	0.0
B6	100.0	0.0
B7	120.0	0.0
B8	140.0	0.0

	x	y
B9	160.0	0.0
B10	190.0	0.0
B11	220.0	0.0
B12	250.0	0.0

	x	y
B13	270.0	0.0
B14	290.0	0.0
B15	310.0	0.0
B16	330.0	0.0
B17	350.0	0.0
B18	370.0	0.0
B19	390.0	0.0
B20	410.0	0.0

Cancel Save

LoKI Cell-holder

Samples



NICOS Instrument: LOKI Experiment: Matt's second experiment Status: IDLE

Cell-holder Samples

	Name	Formula	Concentration	Thickness	Notes
T1	Sample 1		1	1	
T2	Sample 2		1	2	
T3	Sample 3		1	3	
T4	Sample 4		1	4	
T5	Sample 5		1	5	
T6	Sample 6		1	1	
B1	Sample 7		1	2	
B2	Sample 8		1	3	
B3	Sample 9		1	4	
B4	Sample 10		1	5	
B5	Sample 11		1	1	
B6	Sample 12		1	2	
B7	Sample 13		1	3	
B8	Sample 14		1	4	
B9	Sample 15		1	5	
B10	Sample 16		1	1	
B11	Sample 17		1	2	
B12	Sample 18		1	3	
B13	Sample 19		1	4	
B14	Sample 20		1	5	
B15	Sample 21		1	1	
B16	Sample 22		1	2	
B17	Sample 23		1	3	
B18	Sample 24		1	4	
B19	Sample 25		1	5	
B20	Sample 26		1	1	

Cancel Save

LoKI Cell-holder

Script generator



NICOS - guest at localhost:1301

Instrument: LOKI Experiment: Matt's second experiment Status: IDLE

Experiment
Setup
Cell-holder Configuration
Instrument interaction
Script Builder
Batch file generation
History
Logs

Settings

TRANS order: All TRANS First

Do SANS: 1 time(s)

Do TRANS: 1 time(s)

TRANS duration type: Mevents

SANS duration type: Mevents

Optional

Temperature
 Pre-command
 Post-command

Position	Sample Details	TRANS Duration (Mevents)	SANS Duration (Mevents)
1	T1 'name': 'Sample 1', 'concentration': '1', 'thickness': '1'	50	75
2	T2 'name': 'Sample 2', 'concentration': '1', 'thickness': '2'	50	75
3	T3 'name': 'Sample 3', 'concentration': '1', 'thickness': '3'	50	75
4	T4 'name': 'Sample 4', 'concentration': '1', 'thickness': '4'	50	75
5	T5 'name': 'Sample 5', 'concentration': '1', 'thickness': '5'	50	75
6	T6 'name': 'Sample 6', 'concentration': '1', 'thickness': '1'	50	75
7	B1 'name': 'Sample 7', 'concentration': '1', 'thickness': '2'	50	75
8	B2 'name': 'Sample 8', 'concentration': '1', 'thickness': '3'	50	75
9	B3 'name': 'Sample 9', 'concentration': '1', 'thickness': '4'	50	75
10	B4 'name': 'Sample 10', 'concentration': '1', 'thickness': '5'	50	75
11	B5 'name': 'Sample 11', 'concentration': '1', 'thickness': '1'	50	75
12	B6 'name': 'Sample 12', 'concentration': '1', 'thickness': '2'	50	75
13	B7 'name': 'Sample 13', 'concentration': '1', 'thickness': '3'	50	75
14	B8 'name': 'Sample 14', 'concentration': '1', 'thickness': '4'	50	75
15	B9 'name': 'Sample 15', 'concentration': '1', 'thickness': '5'	50	75
16	B10 'name': 'Sample 16', 'concentration': '1', 'thickness': '1'	50	75
17	B11 'name': 'Sample 17', 'concentration': '1', 'thickness': '2'	50	75
18	B12 'name': 'Sample 18', 'concentration': '1', 'thickness': '3'	50	75
19	B13 'name': 'Sample 19', 'concentration': '1', 'thickness': '4'	50	75
20	B14 'name': 'Sample 20', 'concentration': '1', 'thickness': '5'	50	75
21	B15 'name': 'Sample 21', 'concentration': '1', 'thickness': '1'	50	75
22	B16 'name': 'Sample 22', 'concentration': '1', 'thickness': '2'	50	75
23	B17 'name': 'Sample 23', 'concentration': '1', 'thickness': '3'	50	75
24	B18 'name': 'Sample 24', 'concentration': '1', 'thickness': '4'	50	75
25	B19 'name': 'Sample 25', 'concentration': '1', 'thickness': '5'	50	75
26	B20 'name': 'Sample 26', 'concentration': '1', 'thickness': '1'	50	75

Generate

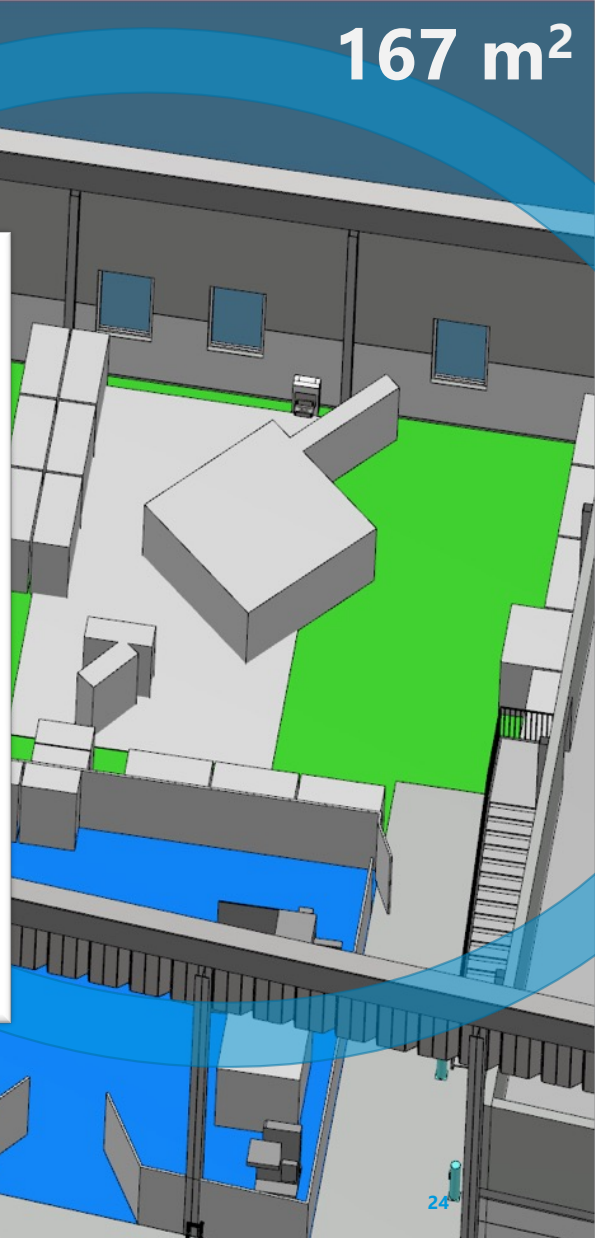
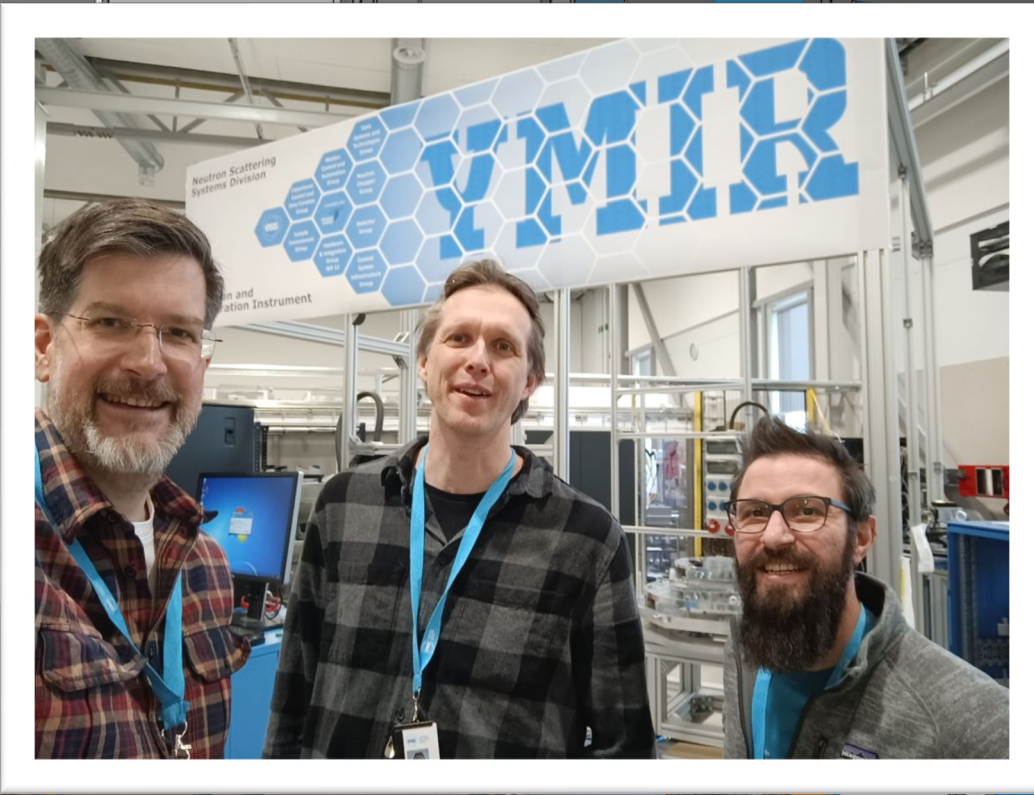
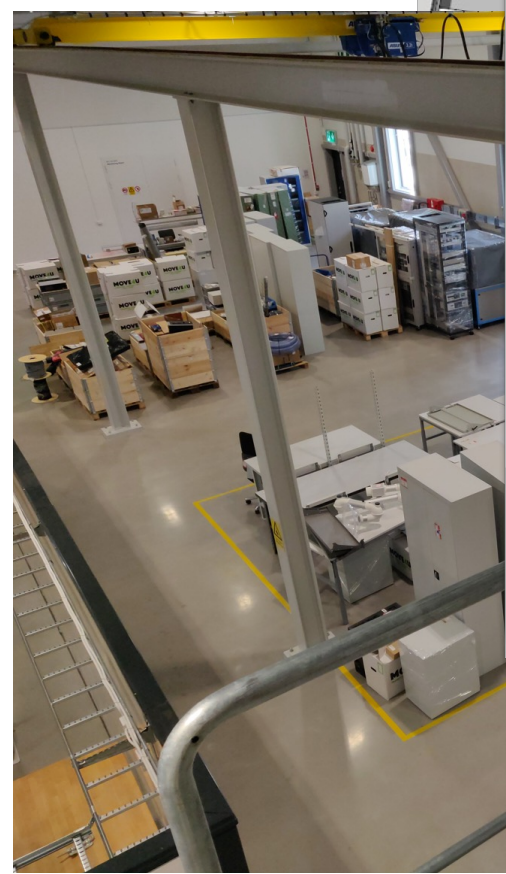
Bulk update: 75 Apply

YMIR



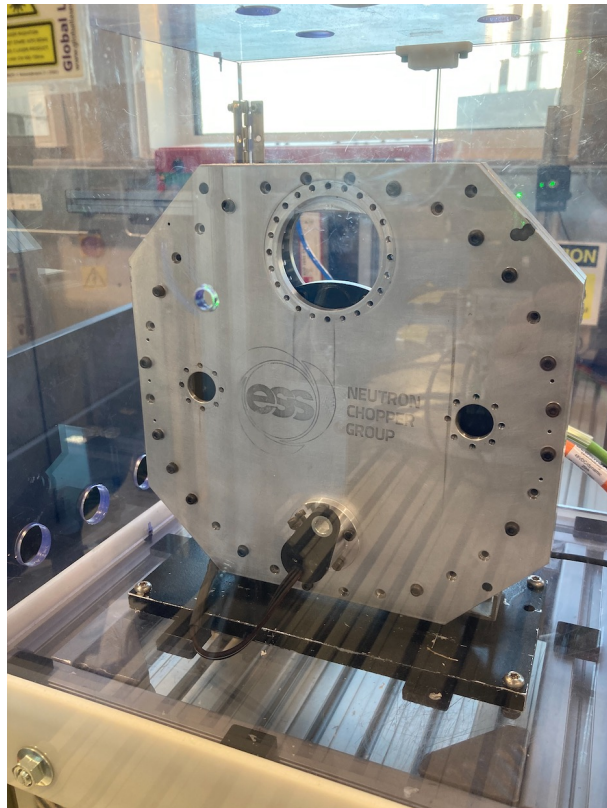
167 m²

**Integration
Platform
(Instrument)
YMIR in B02**



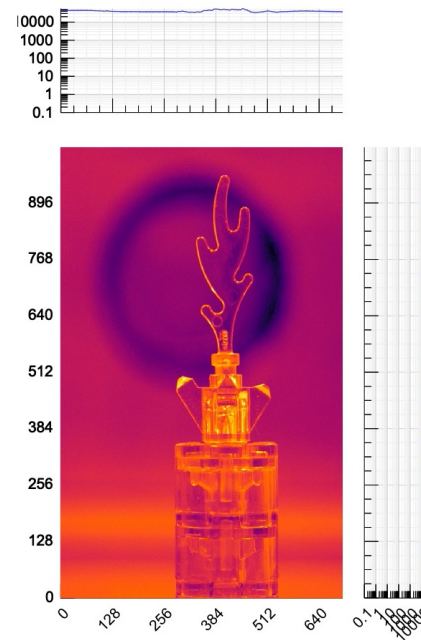
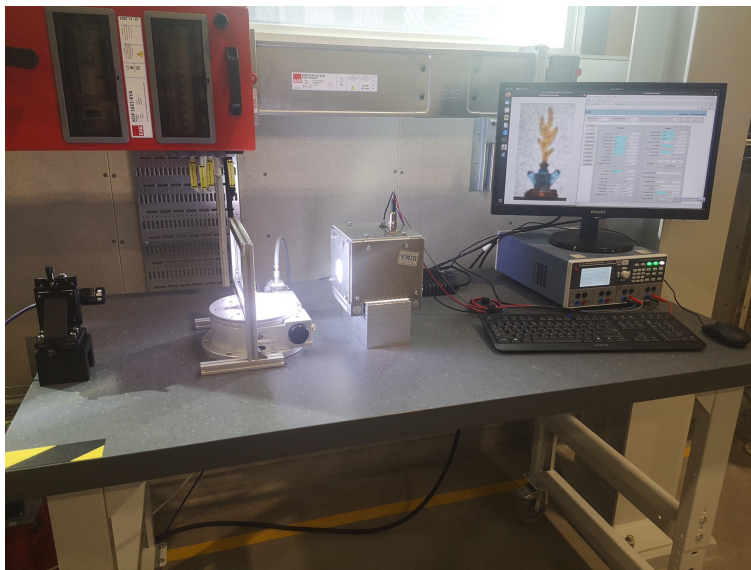
Mini-chopper and laser scanning

Like a real chopper only smaller



Light Tomography

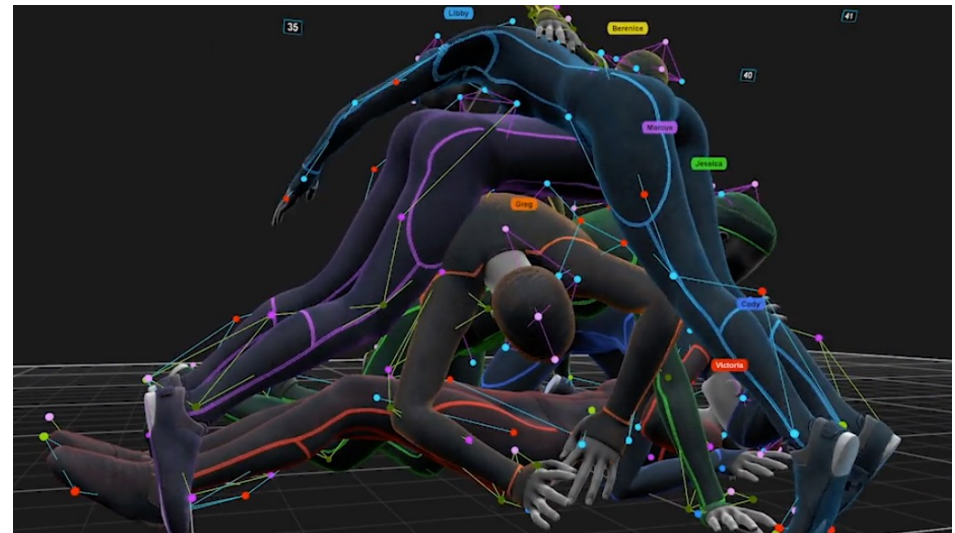
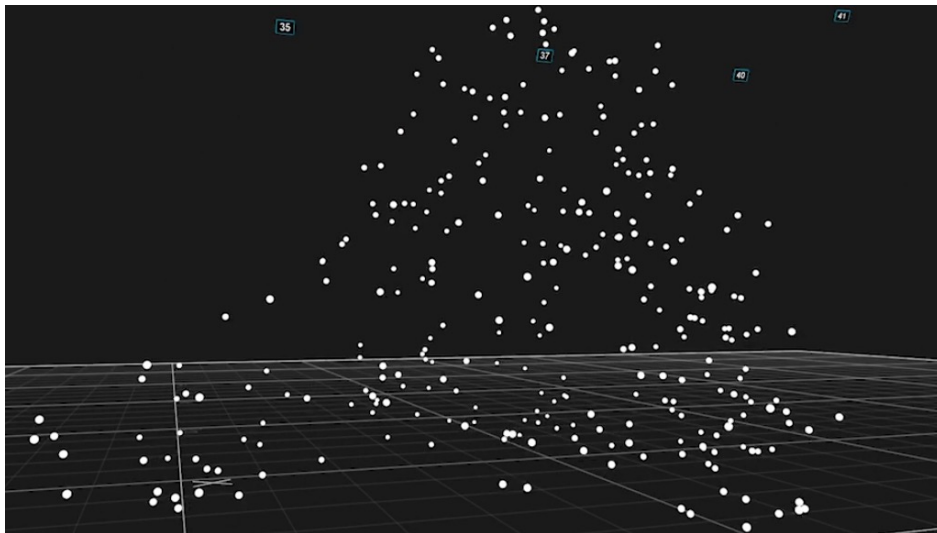
~ = to a real experiment



- Integrating different cameras
 - EPICS
 - NICOS
- Sending images to Kafka
- Writing image data to NeXus
- Real infrastructure
 - Networking (Lund & DMSC)
 - Servers
 - Timing system
 - SciCat
- Rotation stage integration
 - 0 to 360, -180 to 180 or $-\infty$ to ∞ ?

ODIN Metrology

OptiTrack Motive



BIFROST



Bandwidth Choppers



Thursday, January 19th ▾



Markus Olsson 8:53 AM

Hi Matt, I'm available but I also have some visitors from Hungary that may arrive soon.

For how long do you need to rotate the chopper and what data do you need?



Matt Clarke (he/him) 8:55 AM

if everything works then 10 minutes or so

I'm just setting up



Markus Olsson 8:56 AM

Everything will work, it's chopper controls team you are working with



Matt Clarke (he/him) 9:02 AM

Okay, let's try it. Can I start the choppers?



Bandwidth Choppers

Controlled through NICOS



Experiment Control and Data Curation

First data collected from an ESS instrument!

Through the joint effort by teams from NSS, DMSC and ICS commissioning data from the commissioned BIFROST bandwidth chopper has been collected, using the full ESS controls, data acquisition and data curation pipeline.

The bandwidth choppers' operation was controlled with the NICOS experiment control software, which will be used for future user operations.

Data from the chopper status and performance was recorded using the infrastructure in the ESS server hall in the Central Utility Building. The automatic migration of the files to the DMSC data storage in Copenhagen is also in place.

The data is being ingested into the data catalogue to make datasets findable, which is a crucial part of the scientific workflow for the future scientists.

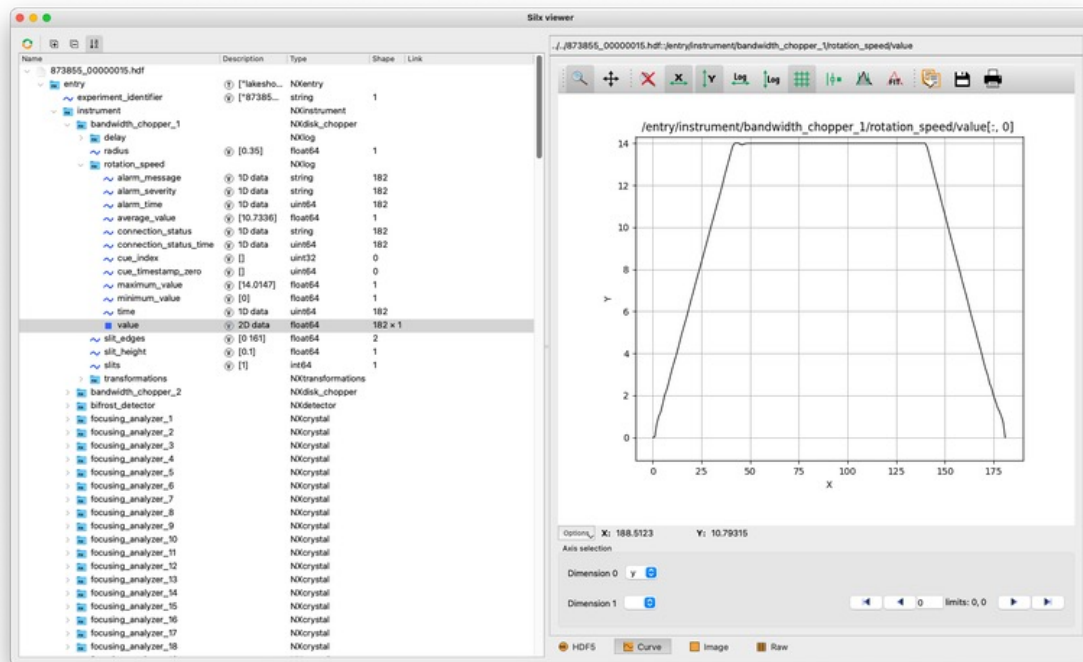


Anders Petterson (E CDC) and Nicklas Holmberg (ICS) at the BIFROST chopper in E02.

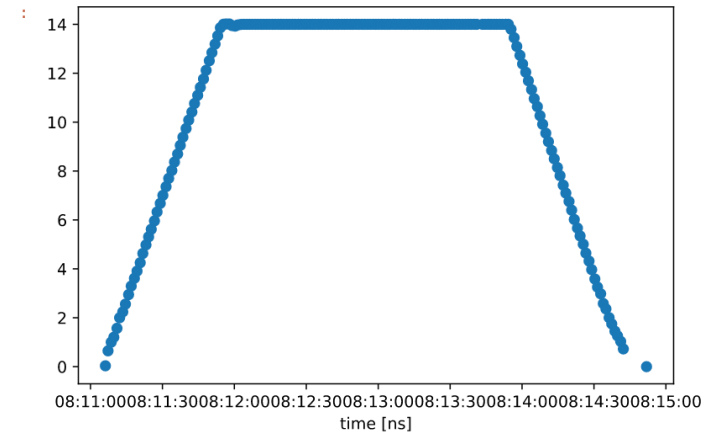


Bandwidth Choppers

NeXus file and SCIPP



```
c1 = dg['entry']['instrument']['bandwidth_chopper_1']
c1['rotation_speed'][1:].plot()
```



Lakeshore temperature controller

Second data



Experiment Control and Data Curation

First data collected from an ESS instrument!

Through the joint effort by teams from NSS, DMSC and ICS commissioning data from the commissioned BIFROST bandwidth chopper has been collected, using the full ESS controls, data acquisition and data curation pipeline.

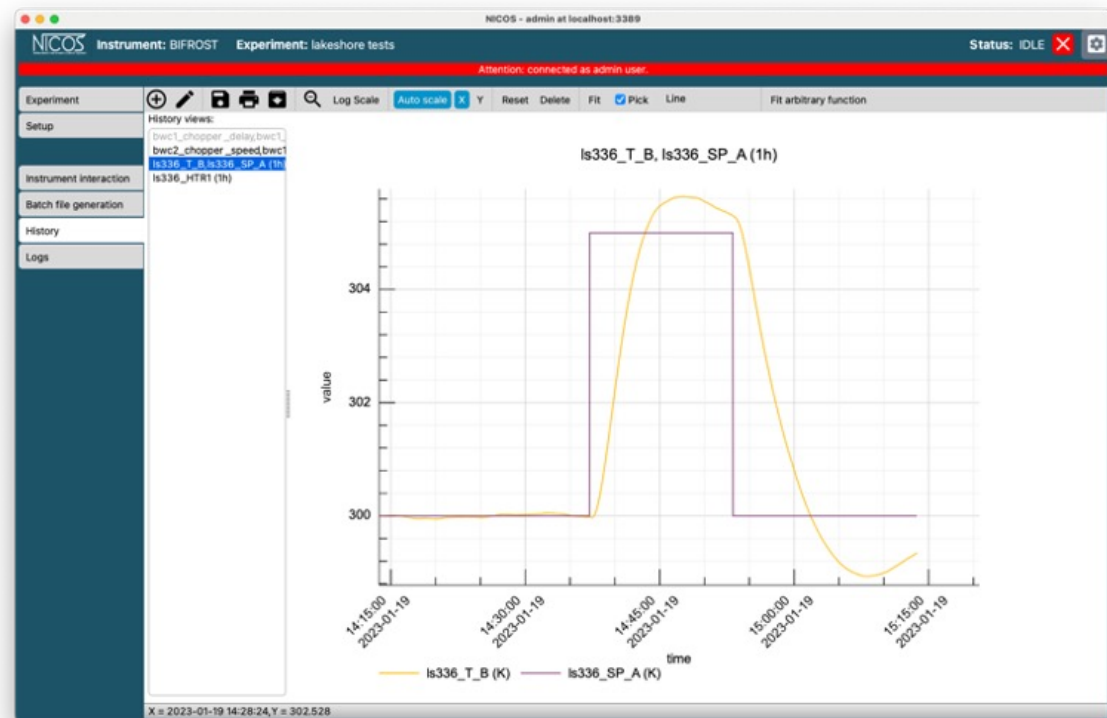
The bandwidth choppers' operation was controlled with the NICOS experiment control software, which will be used for future user operations.

Data from the chopper status and performance was recorded using the infrastructure in the ESS server hall in the Central Utility Building. The automatic migration of the files to the DMSC data storage in Copenhagen is also in place.

The data is being ingested into the data catalogue to make datasets findable, which is a crucial part of the scientific workflow for the future scientists.



Anders Pettersson (ECDC) and Nicklas Holmberg (ICS) at the BIFROST chopper in E02.



NICOS Baseline



A first pass on an instrument to see what additional functionality is required:

- NICOS demonstration at YMIR
- Discussion of instrument specifics
- Tasks created in ECDC JIRA

ECDC-3346 

control 1d/2d monitor

unlabelled-ECDC-2786


None

BIFROST, efu, filewriter, monitor

None

=

.....

ECDC-3345 

collect 1d monitor data vs some other parameter (angle) and display data live

unlabelled-ECDC-2786

Experiment Control

BIFROST, NICOS, just-bin-it, scanning

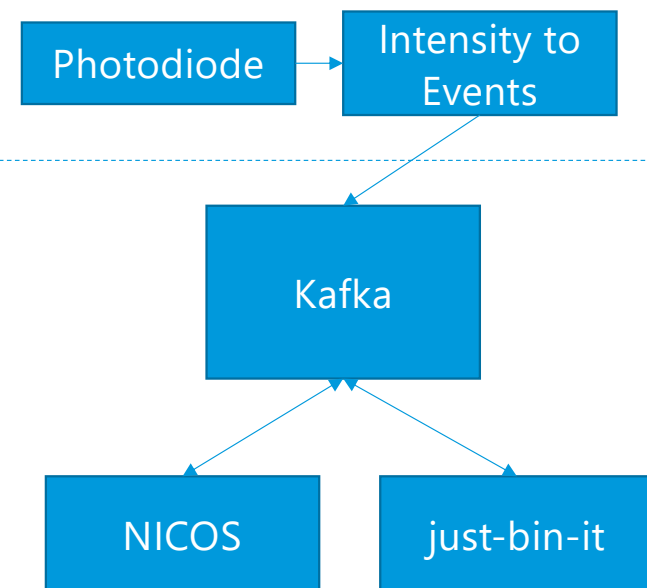
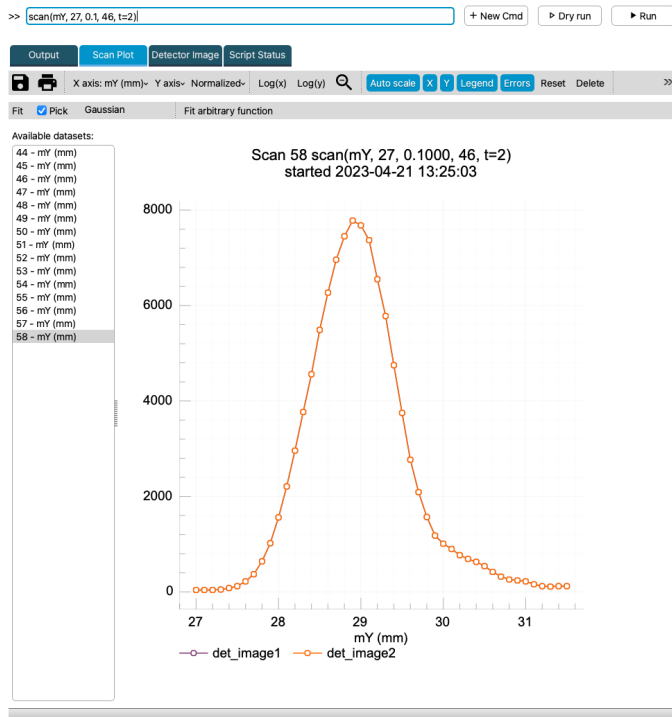
None

=

.....

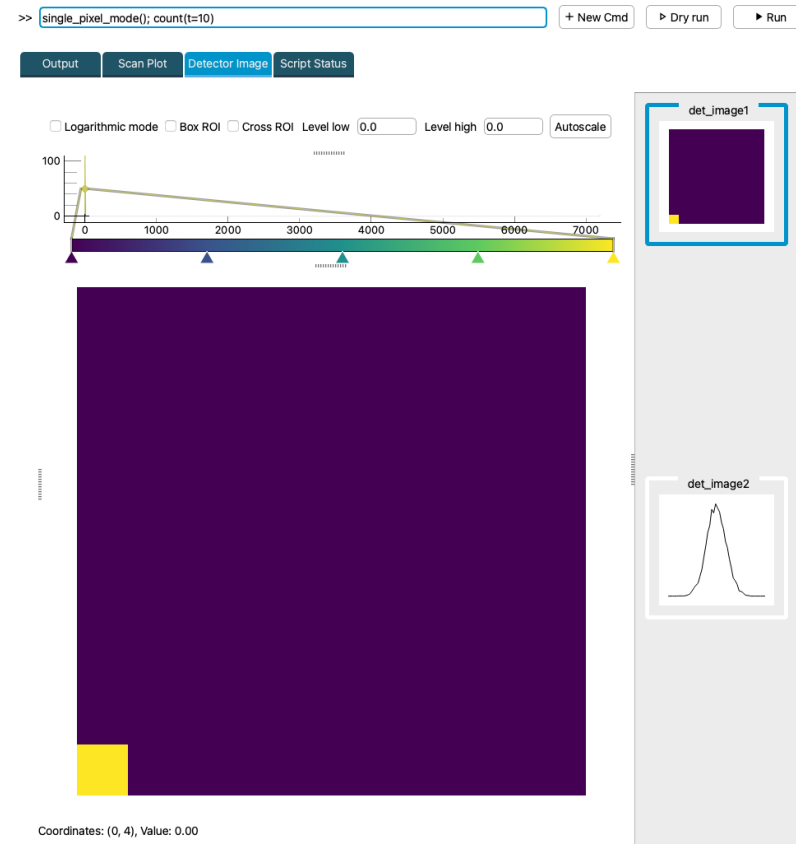
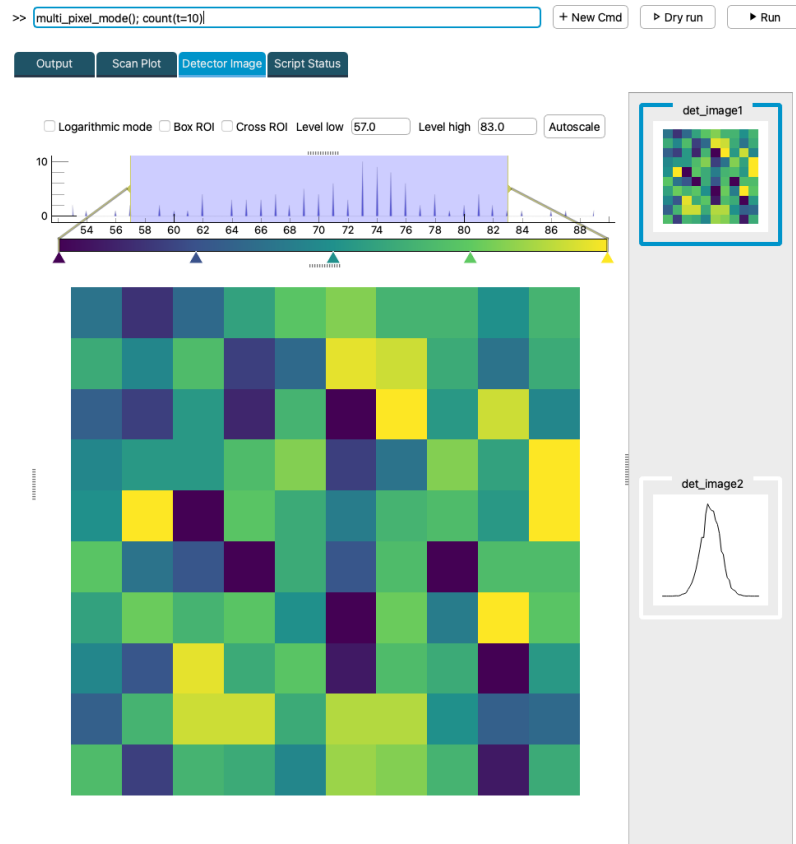
1-D Monitor Data vs Something

Angle, x, y, z, etc.



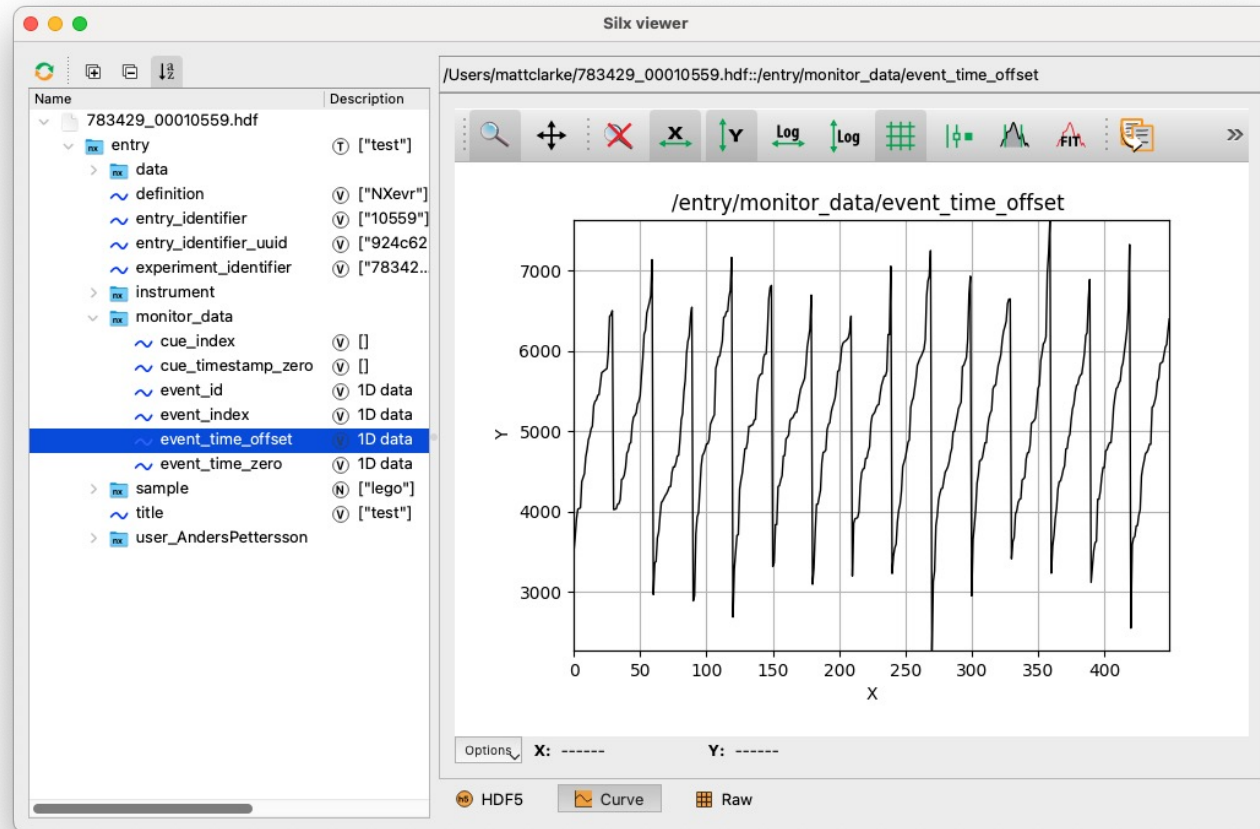
Two Mode Monitor

Position sensitive and single pixel modes



Two Mode Monitor

In the NeXus file



What Next?



What Next?



- Instrument specific baselines continue
 - Current: ODIN and BIFROST
 - Next: ?
- Cold commissioning
 - Revisiting/refining the baselines