



ECDC Progress Report

HANNO PERREY, ON BEHALF OF THE ECDC GROUP

2026-04-21

Reporting ECDC updates on...



1. Our group

2. Cold Commissioning

3. ECDC-provided infrastructure

4. User Operation readiness

ECDC purpose and responsibilities



Project scope: Develop and deliver user-facing software to execute experiment protocols and collect scientific data and metadata for all ESS instruments which includes:

- **Experiment Control GUI:**
NICOS, a neutron community software. Integration of all EPICS-controlled equipment and sample environment necessary to orchestrate experiments and perform commissioning.

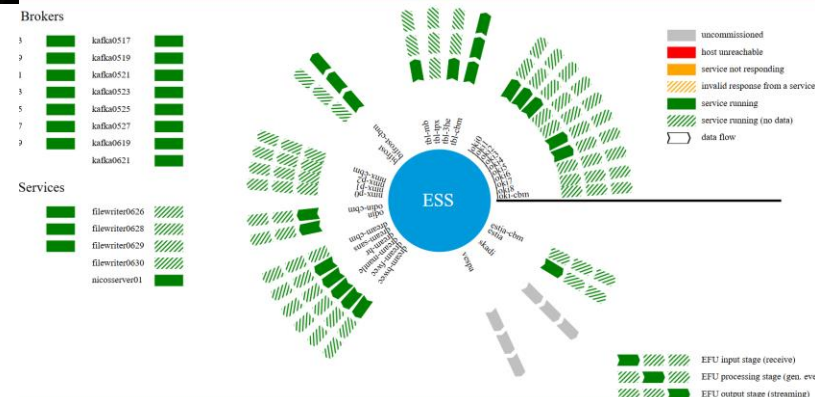
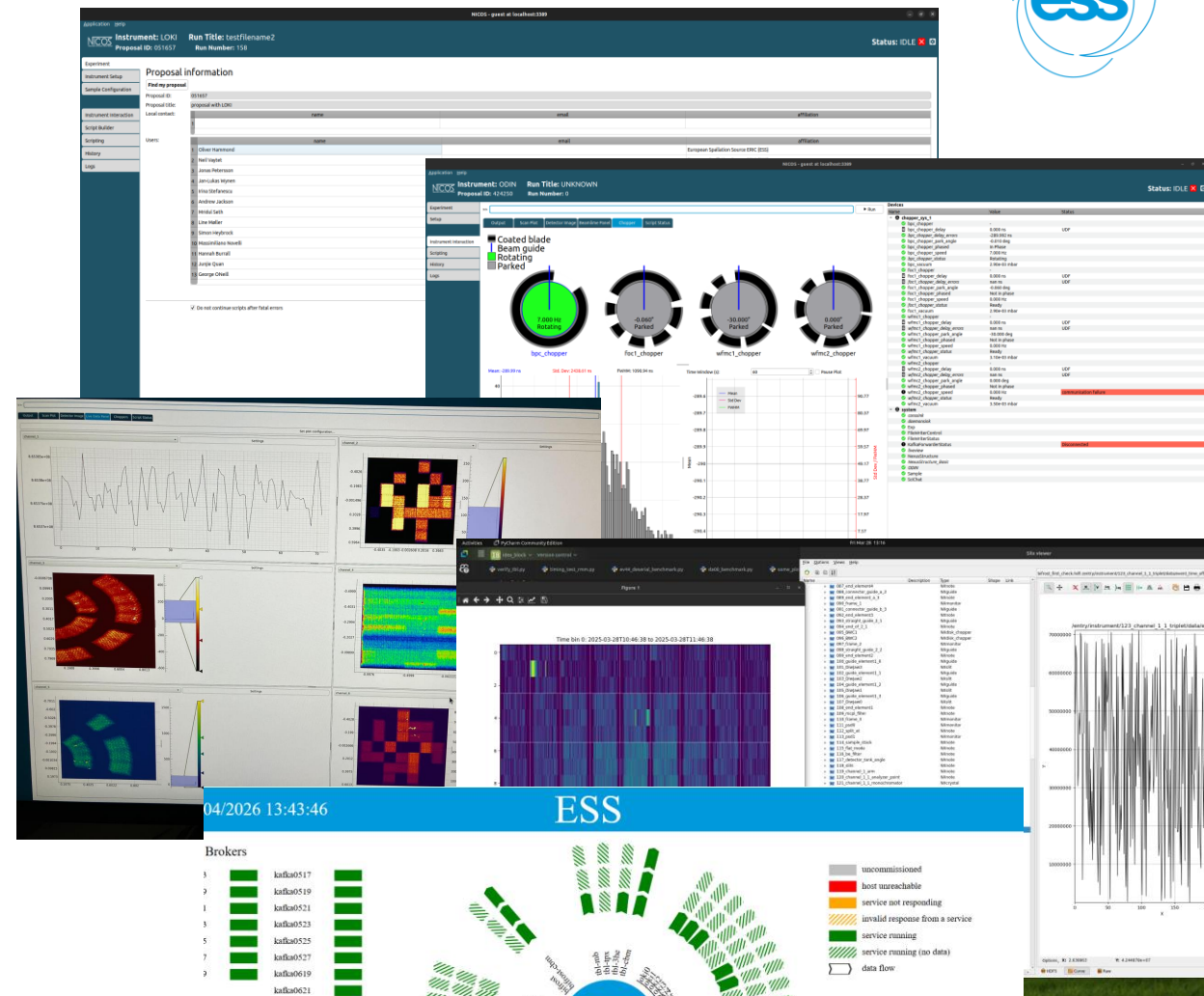
- **Data Collection:**
Event Formation Unit (EFU), collecting data from the different instruments detectors and reducing data to the minimal user raw data

Data Recording: pipeline recording data and meta data, ensuring compliance with NEXUS and SciCAT standards.

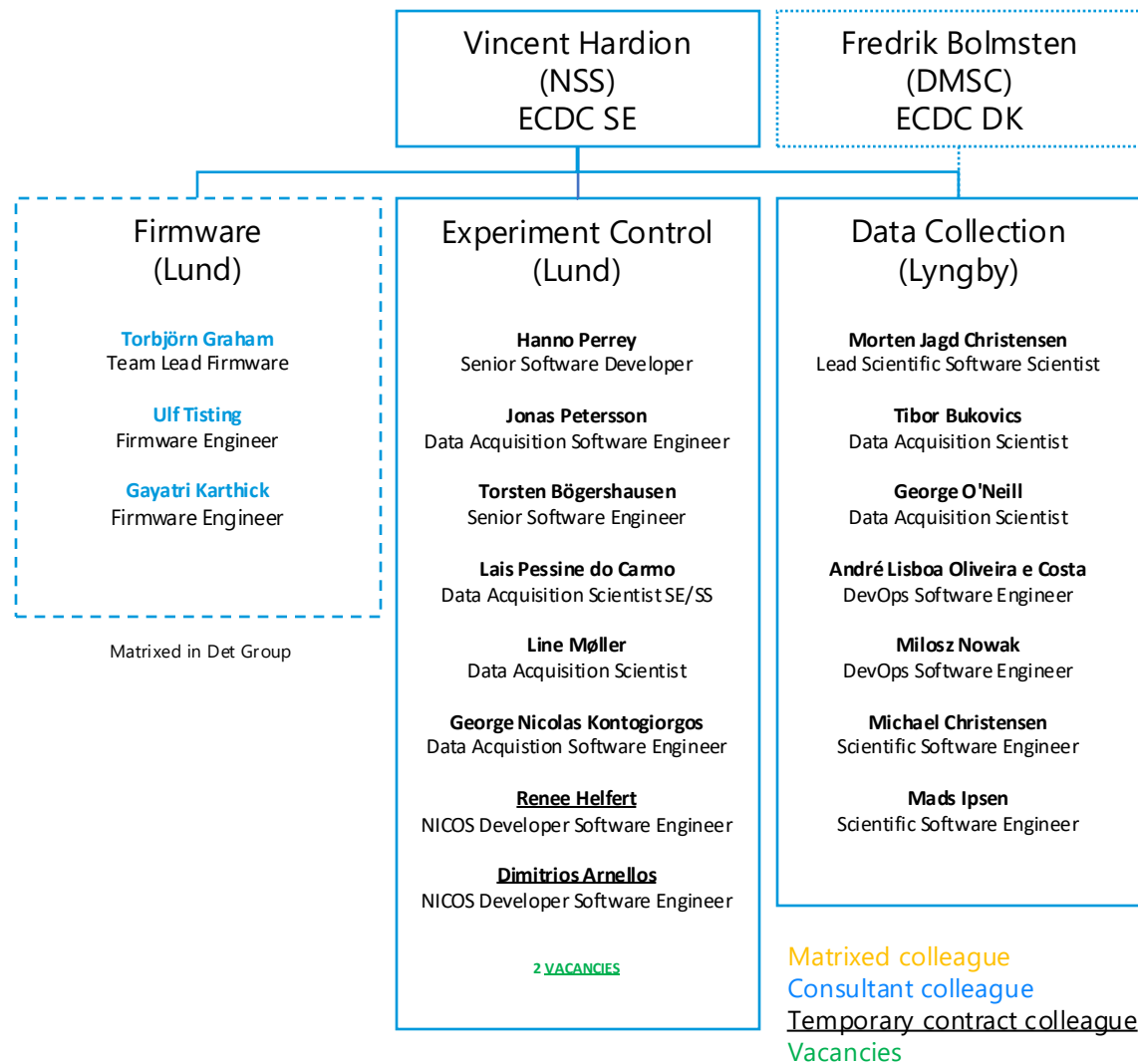
- Tools & diagnostics for operation support

Operation scope:

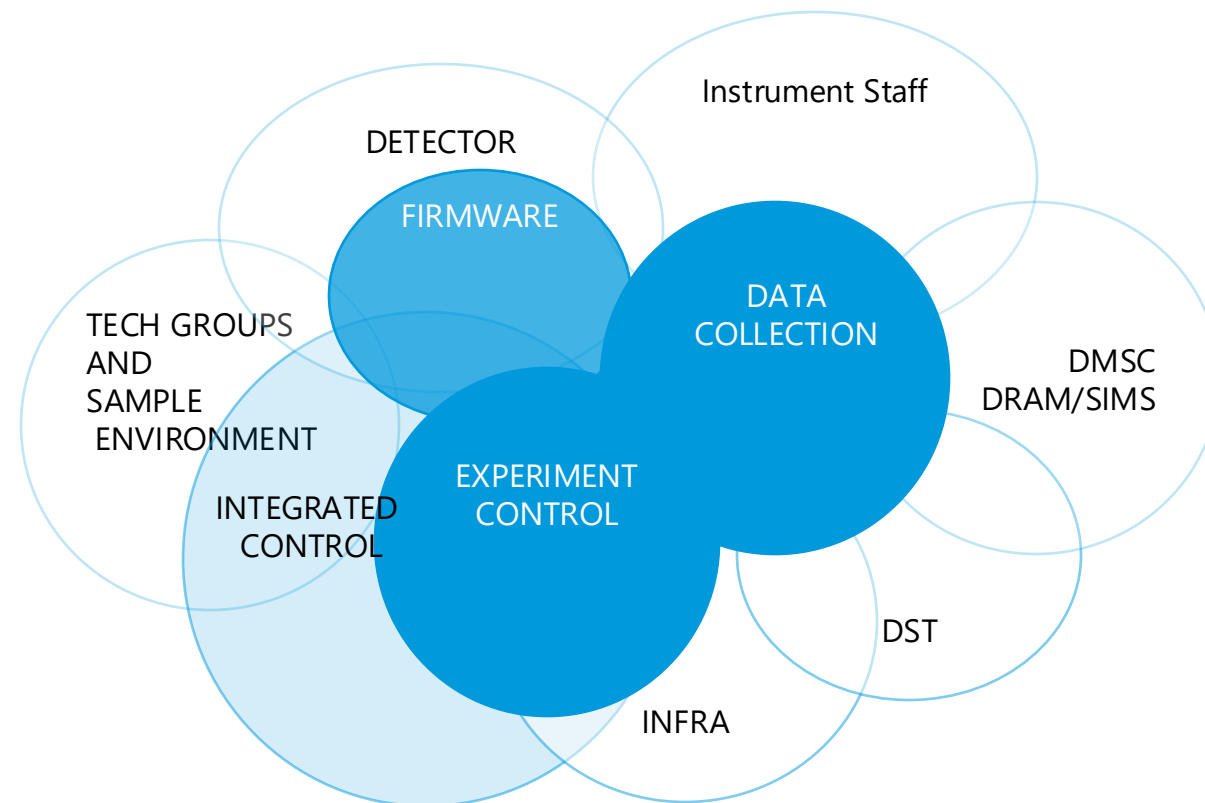
- Maintenance of developed tools
- Adapting software to new scientific use cases
- Experiment and operation support with on-call availability
- Collaborating with engineering and scientific staff



Organisation ...



... and stakeholders



ECDC group updates



Team:

- Hanno started Dec 2025
- Recruitment 3y temporary position was on hold 3 months.
 - 2 “senior” recruitments in progress (1SE, 1DK)
 - 1 “entry level” on stand-by

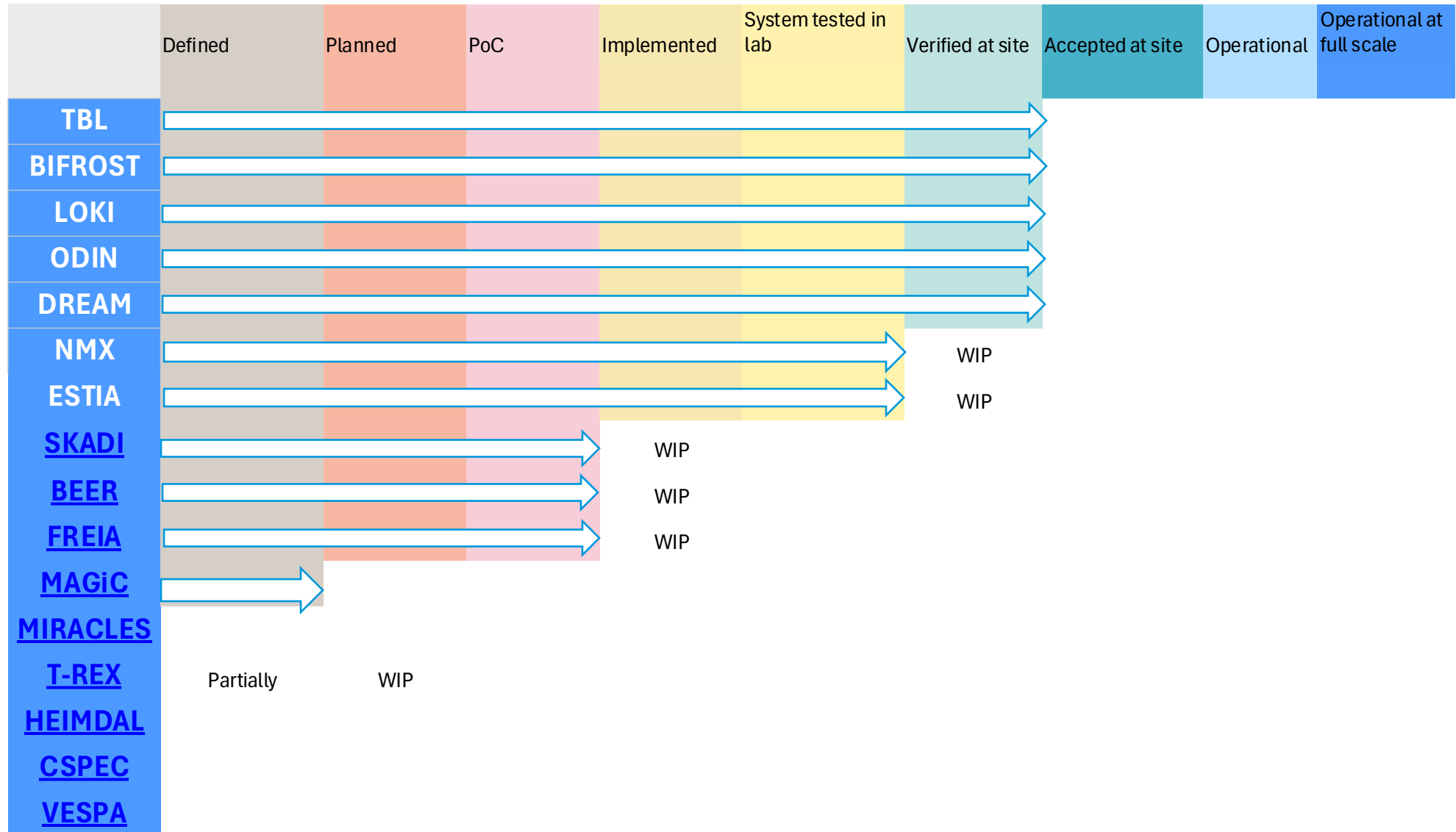
Location:

- ECDC SE permanent office space in B02 workshop.
- ~ Weekly cross-bridge visits

Cold Commissioning Instruments Status Spring 2026



ECDC Readiness



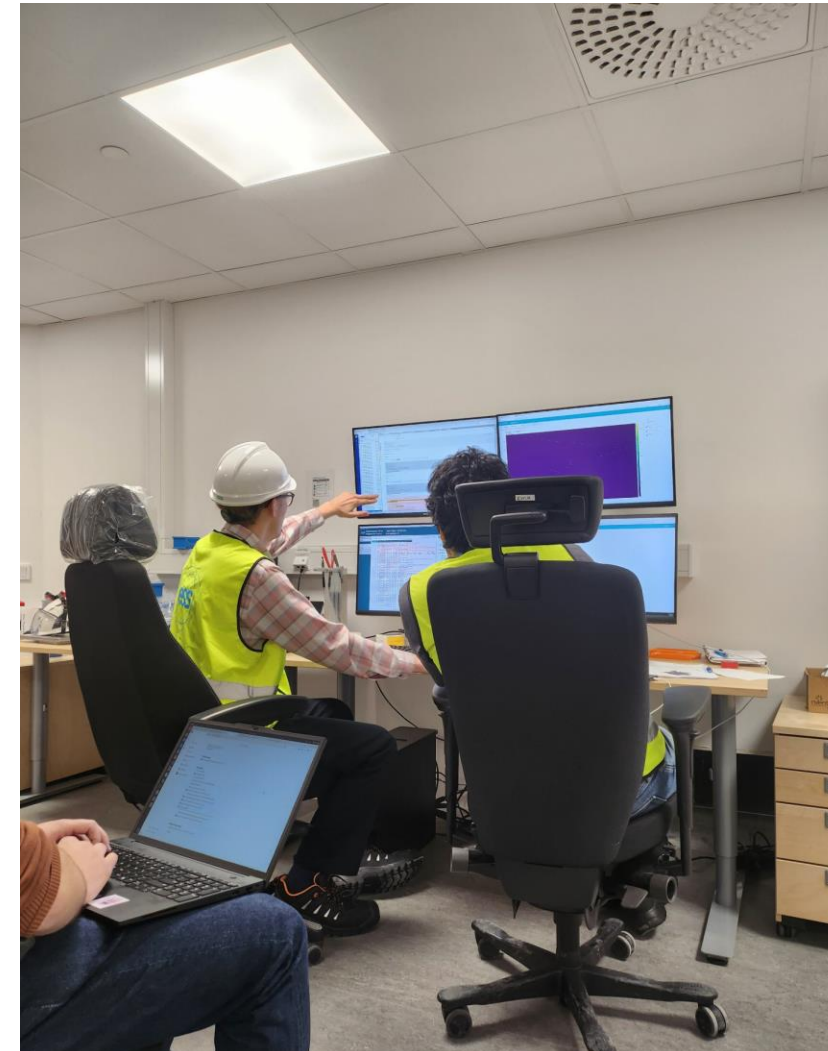
TBL, BIFROST, LOKI, ODIN, DREAM

Instruments toward hot commissioning

- TBL
 - **Beam Monitor (ADC value errors and irrecoverable state) -- fixed**
- BiFrost
 - BMs to integrate. W16 all BM connected, to start local and integrated tests
- LOKI
 - NIT tickets: TG6 work continued, some TG5 still in review
 - Continue integration of sample environment
 - Validation delayed by the availability of equipment
 - Integrating the 5 BMs
- ODIN
 - SAR presentation with few ECDC remarks
- DREAM
 - Integrated test passed after fixing major technical issue with hardware (additional fan) and supplier firmware issue
 - Major issues to solve for SAR:
 - **ESS global oscillator running fast (solution designed)**
 - **Time-stamps received out-of-order (fixed)**



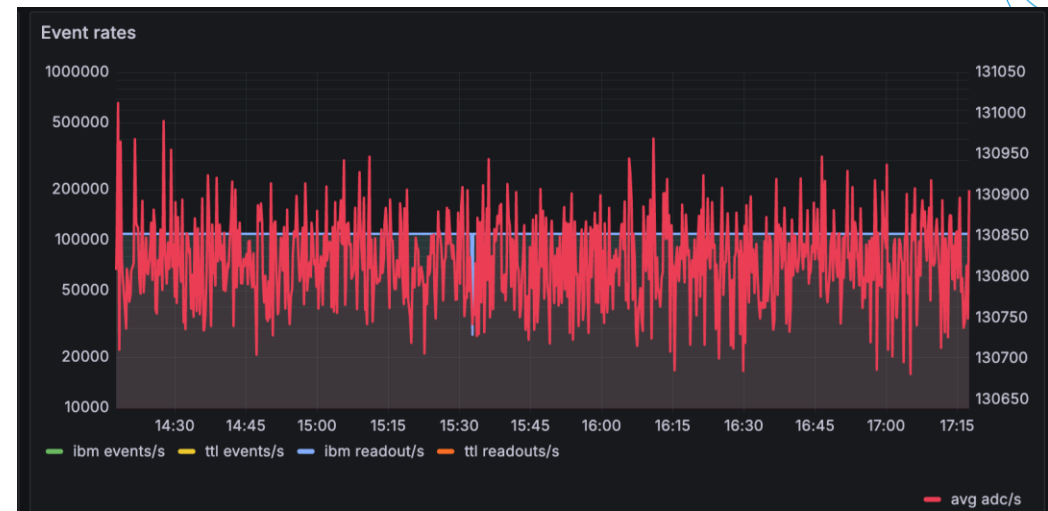
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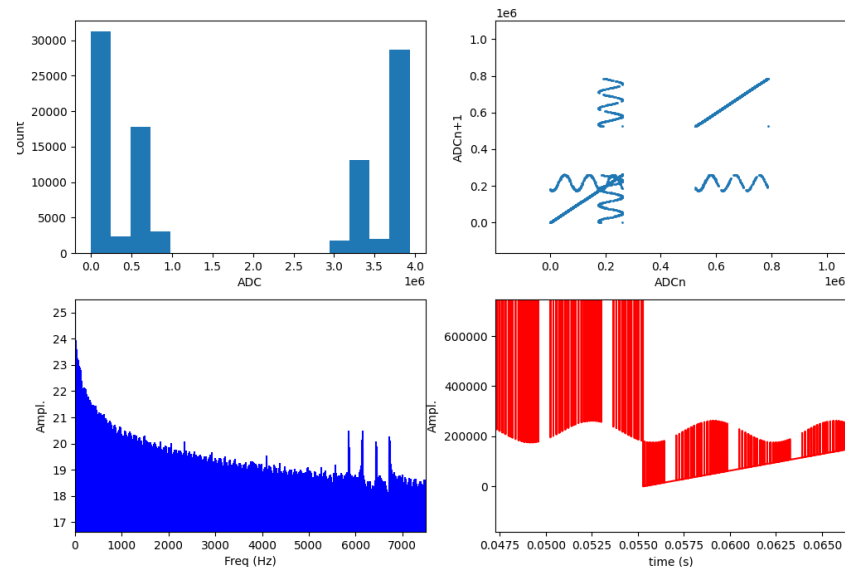
I-BM Beam Monitor issue [Fixed]

Instruments toward hot commissioning

- I-BMs are used for many instruments
- Issue found at PSI in July 2025 while operating the full acquisition chain (complex)
- Data values were inconsistent, discontinuous, and didn't reflect the configuration
- New analysis tool was developed (AR51)
- Long painful debug campaign
- Eventually identified as Firmware issues (CDT + ESS) and specification/documentation issues



Beamline test at PSI – incorrect baseline of 130800 (a.u.)



Prototype debug tool showing unrecoverable I-BM state with invalid data (from lab test)

Timing shift

Instruments toward hot commissioning



- Discovered in January 2026
- Time synchronisation error caused all data for DREAM to be dropped – correct processing behaviour but unexpected
- Expectations were 88.0525MHz ESS clock, but site timing runs 0.039Hz fast
- The drift will affect correctly allocating detector readout to ESS neutron pulses – potentially big issue
- From a catalogue of 5-6 solutions, one has been chosen (FEN-RMM interface)

Bit	Description	Values
0	time source	0: MRF, 1: local
1	sync source	0: MRF, 1: local
2	local sync type	0: internal, 1: external TTL
3	status	0: Time OK, 1: Time Error
4	even fibre status	0: even fibre synced, 1: even fibre down
5	odd fibre status	0: odd fibre synced, 1: odd fibre down
6	reserved	
7	reserved	

Time source error flag (bit 3) in combination with MRF time source (bit 0) triggered packet drop and initially identified the issue

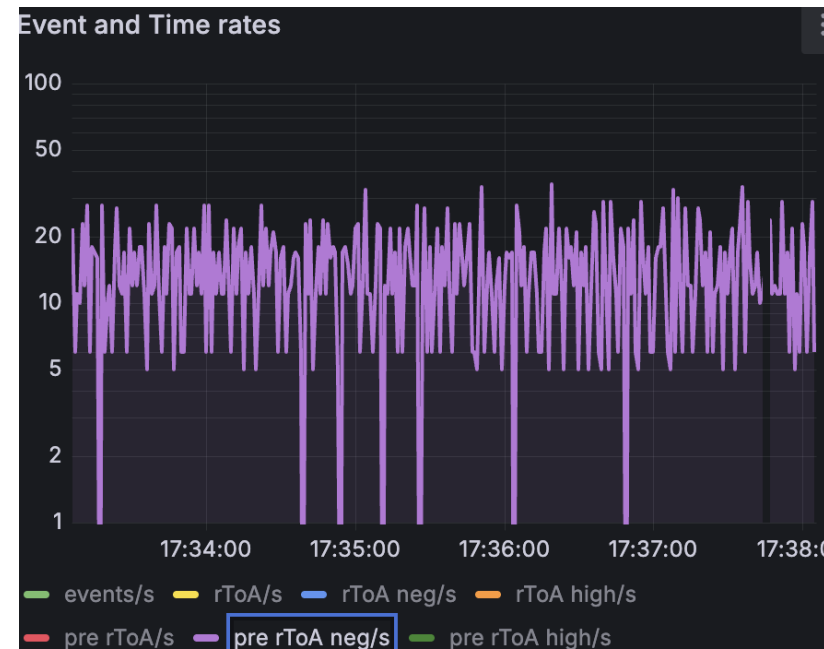
Reality is that this was the first time the MRF timing hardware was used in operation. All previous campaigns used RMM timing in free-running mode for a number of practical reasons.

Timestamps received out-of-order



Instruments toward hot commissioning

- Readout appeared 'in the past' compared to pulse time
- Detected and discarded by EFU due to timestamping inconsistency
- Likely affects all CDT-based readout
- Possibly a combination of several issues, but mainly that data was buffered in FIFO until full
- Mostly an issue at low rates but this is what we have now (background neutrons)



These three issues can be seen as a sign that we are approaching normal operation:

Using full detector systems, ESS time, introducing Beam Monitors, full data acquisition chain

→ **We have tools to catch and debug these errors**

Next Instruments

Instruments toward cold commissioning

- ESTIA
 - Detector Integrated Test in January/February: No major issue
 - Motion integrated test in progress
 - TG5 17 June 2026
- NMX
 - Targeting TG5 on 6 November 2026, with pre-SAR in September.
 - Expecting full scope
- **SKADI**
 - Architecture redesign validated, prototype functional, firmware and software in progress. EFU version 1
 - integration in the test CODA platform started
- FREIA
 - Expecting starting CC in May
 - integration in the test CODA platform started
 - Strong focus on Hexapod and pivot point development
- BEER
 - Expecting Detector test in September
 - integration in the test CODA platform started
 - Strong focus on Hexapod

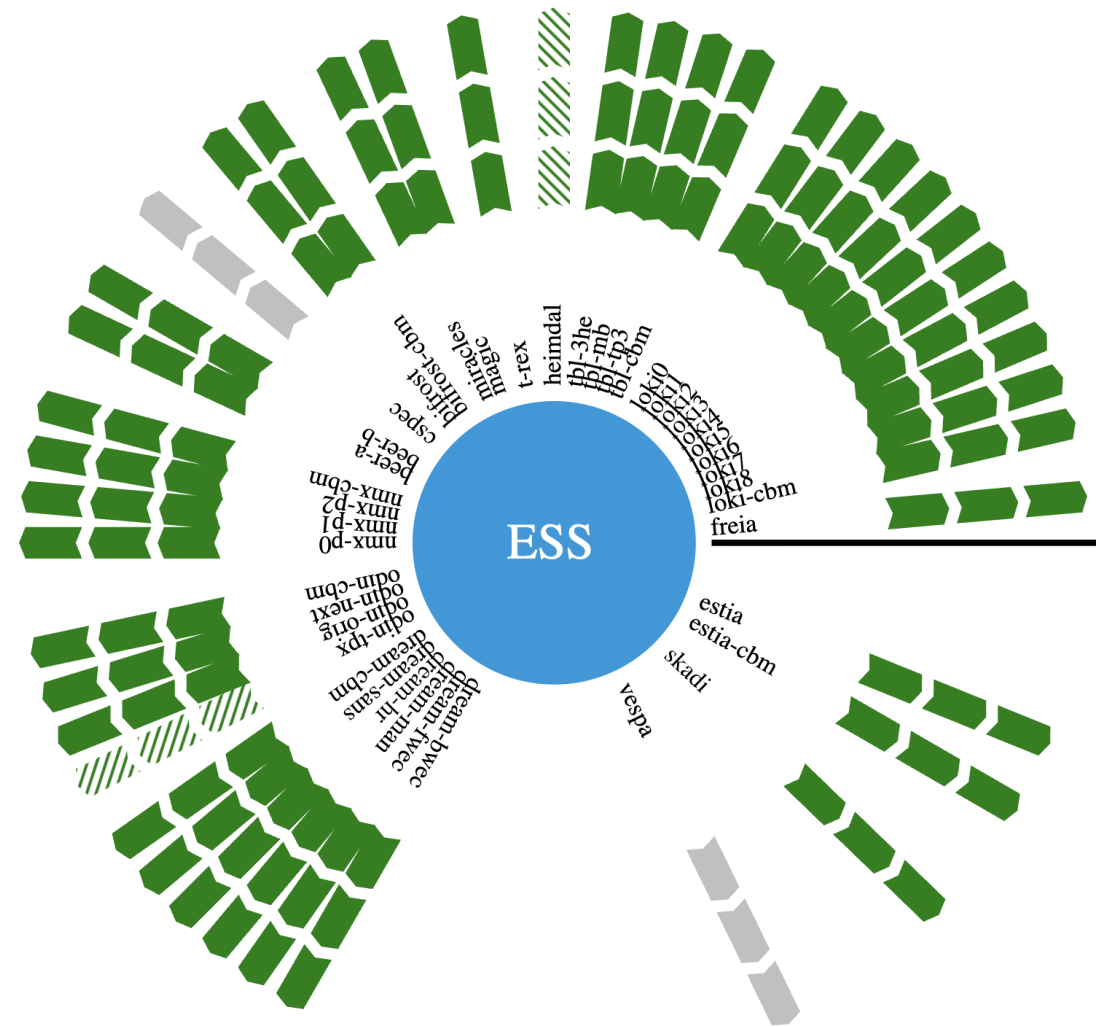


First real data from lab tests of full SKADI detector stack.

Next Instruments

Instruments toward cold commissioning

- Magic: Readiness in review
- TREX: First ICD version
- Common: CODA integrating T2



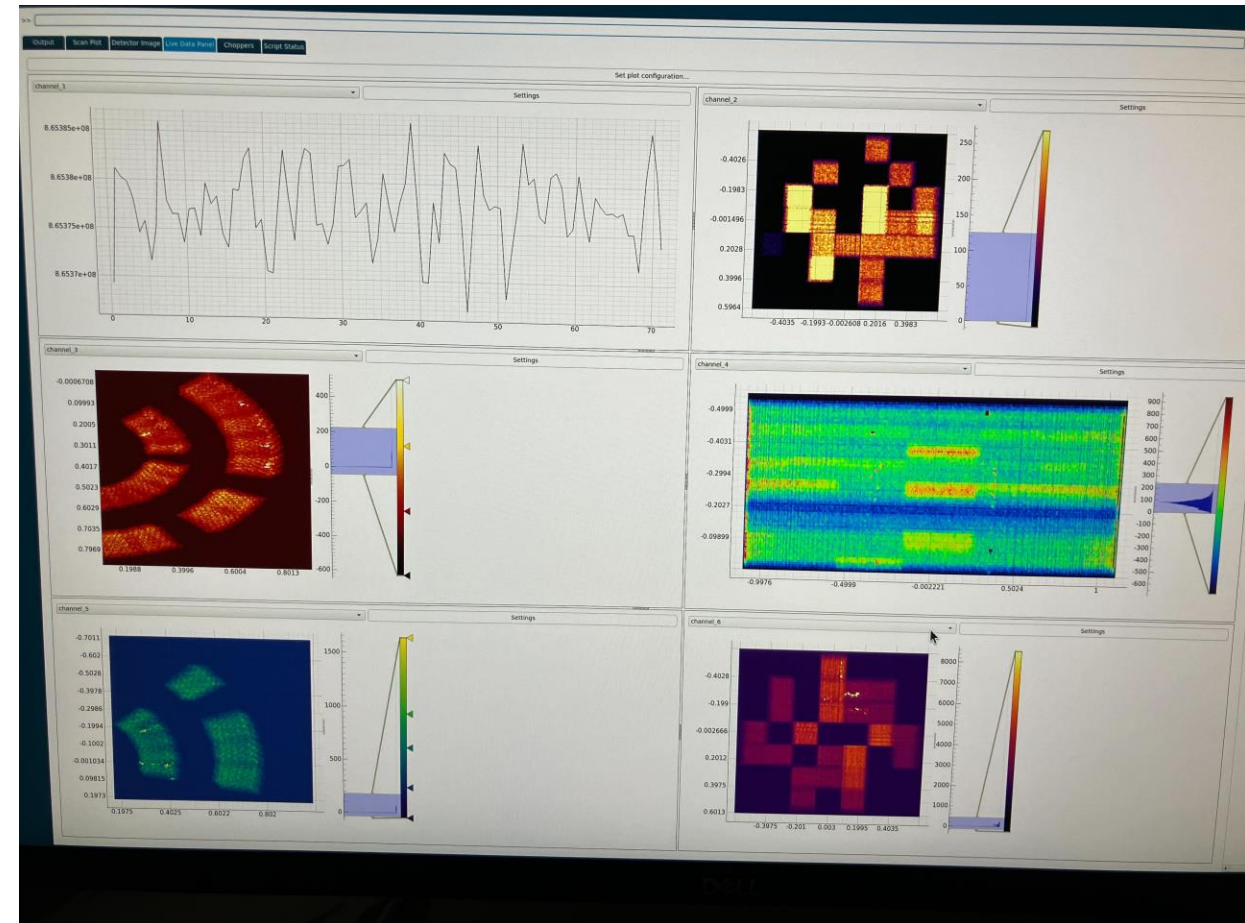
EFU monitoring application

Lessons Learned

What Worked Well

- End-to-end control chain functional (NICOS–EPICS–DAQ)
- Data pipeline validated under nominal conditions
- Integration test protocols helped align teams
- Implementation for basic experiment control logic
- SW management and deployment working well
- System-level monitoring important for diagnosis of issues

→ Strong foundation for operations





Pain Points Observed

Typical operational friction:

- Manual recovery after safety events (PSS, power cuts)
 - Ambiguous system states in NICOS
 - Limited observability when data is missing or delayed
 - Dependency on expert knowledge during routine tasks
- Issues are not failures, but UX and support gaps

Status: IDLE

Name	Value	Status
adjustable_collimator		
axis_attenuator_changer	-0.785 mm	E: DrvHW notrdy 4650
axis_attenuator_chang...	19.225 °C	
axis_horizontal	1.709 mm	W: Axis not homed
axis_horizontal_temp	19.235 °C	
axis_pinhole_changer	-0.628 mm	W: Axis not homed
axis_pinhole_changer_t...	15.931 °C	
axis_vertical	0.077 mm	W: Axis not homed
axis_vertical_temp	19.013 °C	
config_attenuator	In Between	axis_horizontal=W: Axis not homed, axis_attenuator_changer=E: DrvHW ...
config_collimator	In Between	axis_horizontal=W: Axis not homed, axis_attenuator_changer=E: DrvHW ...
config_pinhole	In Between	axis_horizontal=W: Axis not homed, axis_attenuator_changer=E: DrvHW ...
config_set	In Between	axis_horizontal=W: Axis not homed, axis_attenuator_changer=E: DrvHW ...
beam_monitor		
monitor_1		creating device failed: could not connect to PV TBL:MFHist:signal
monitor_high_voltage	11.000 V	moving to 100.0
monitor_high_voltage_s...	0.000	UDF
monitor_high_voltage_s...	Idle	Async in progress
monitor_n_summation	8.000	
monitor_sampling_period	1.200 us	moving to 1.2
bwc_choppers		
bwc1_chopper	Rotating	chic_conn=communication failure, command=communication failure
bwc1_chopper_delay	0.000 ns	UDF
bwc1_chopper_park_co...	Open	communication failure
bwc1_chopper_phase	0.000 degrees	phase=UDF
bwc1_chopper_phased	In Phase	communication failure
bwc1_chopper_speed	14.000 Hz	
bwc2_chopper	Rotating	chic_conn=communication failure, command=communication failure
bwc2_chopper_delay	0.000 ns	UDF
bwc2_chopper_park_co...	Open	communication failure
bwc2_chopper_phase	0.000 degrees	phase=UDF
bwc2_chopper_phased	In Phase	communication failure
bwc2_chopper_speed	14.000 Hz	
filter_station		
bank_1_axis	0.025 mm	E: DrvHW notrdy 4650
bank_1_temp	17.800 °C	
bank_2_axis	0.826 mm	W: Axis not homed
bank_2_temp	17.720 °C	
bank_3_axis	1.605 mm	E: DrvHW notrdy 4650
bank_3_temp	17.800 °C	
config_bank_1	In Between	E: DrvHW notrdy 4650
config_bank_2	In Between	W: Axis not homed
config_bank_3	In Between	E: DrvHW notrdy 4650
he3_hvps		
he3_101_Ch00_enable	No	
he3_101_Ch00_leak_cu...	-0.068 uA	
he3_101_Ch00_voltage	2.070 V	moving to 1740.0
he3_101_Ch01_enable	No	
he3_101_Ch01_leak_cu...	-0.074 uA	
he3_101_Ch01_voltage	2.010 V	moving to 1740.0
he3_101_Ch02_enable	No	
he3_101_Ch02_leak_cu...	-0.062 uA	
he3_101_Ch02_voltage	1.910 V	moving to 1740.0

ECDC infrastructure

NICOS



- Decision to merge the ESS core to upstream
- Deployment under control (configuration management)
- New initiatives:
 - Synoptic as Instrument overview
 - Telemetry for monitoring
 - **Direct SECOP communication is in study**
- Live view: Integration of ESSLiveData
 - Just-Bin-It as backup for operation continuity
- Next: NICOS training program

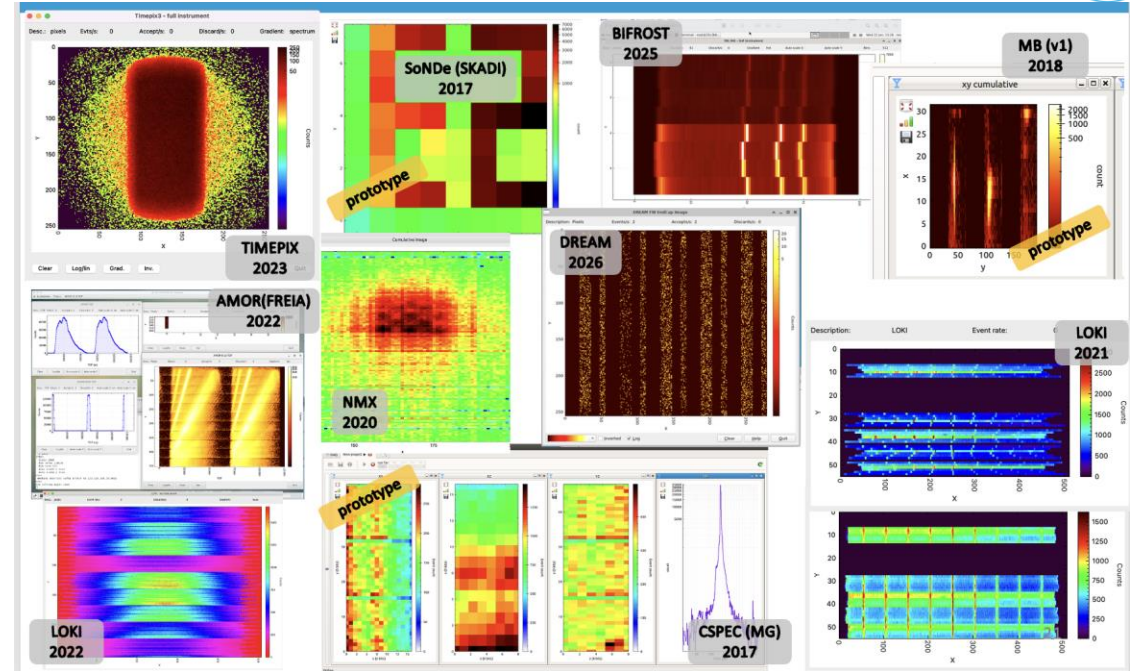


2nd NICOS collaboration meeting, PSI, March 2026

Event Formation Unit (EFU)



- Gradually evolving since 2017
- Turning readouts into neutron events, streamed to Kafka
- provides extensive runtime debug counters
- Common core and instrument specific software
- Latest additions
 - Version 2 deployed end of 2025
 - BM
 - Common metrics



instrument support since 2017



90 day plot of extensive runtime stats

File writing



- Data/meta-data written from kafka to HDF (NeXus) files for analysis
- Recent large-scale code review helped fix bugs and edge cases
- Part of continuous testing chain through CODA
- SoF: A FileWriting Team is being formally established (kickoff June 25)



IT infrastructure



- ECDC scope: Large improvement in configuration management and rationalization of CI/CD pipeline
- Network topology
 - ECDC system is located on networks shared/managed by different computing team using different tools and systems
 - Workshop and regular visit helped to improve the situation.
 - Instrument workstations support in transfer to Lund
 - Investment in hardware router will improve the reliability and the control of inter-network communication
- AlmaLinux 9 migration
- Remote Desktop WIP (NoMachine)

Feature Development



- Precise Timestamp Protocol
 - 10th of a microsecond precision
- Automated testing
 - Improve software validation process
- Operation Support
 - On-call and diagnosis tooling
- Remote monitoring of experiments
- Sample environment management
- DevOps

Risk to operation



- Sample Environment integration
 - Only a fraction covered during CC
- IT infrastructure
 - hardware router will improve ECDC network infrastructure reliability
- Operation
 - **On-call Support** and routing to different experts
 - ECDC will be on-call.
 - Some Support roles are not yet defined:
Sample Environment, EPICS, firmware, ...
 - **Knowledge retention:** EPICS, Firmware
 - **Instrument calibration** process and management gap

Next Steps

**User Operation
readiness
& High-Level
Requirements**

Emerging High-Level Requirements



- User workflow and UIX
- Remote Operation and notification
- Automatic recovery
- Increase reliability
- Integrated diagnostics across control & data
- Reduced need for manual and repetitive operation
- Support of operation (on-call)

→ These are **cross-instrument needs**



Looking forward



- From *subsystem expert* operation to *instrument* operation
- Feed hot commissioning experience into user operation

- Continue close collaboration between:
 - instruments
 - ECDC
 - in-kind partners

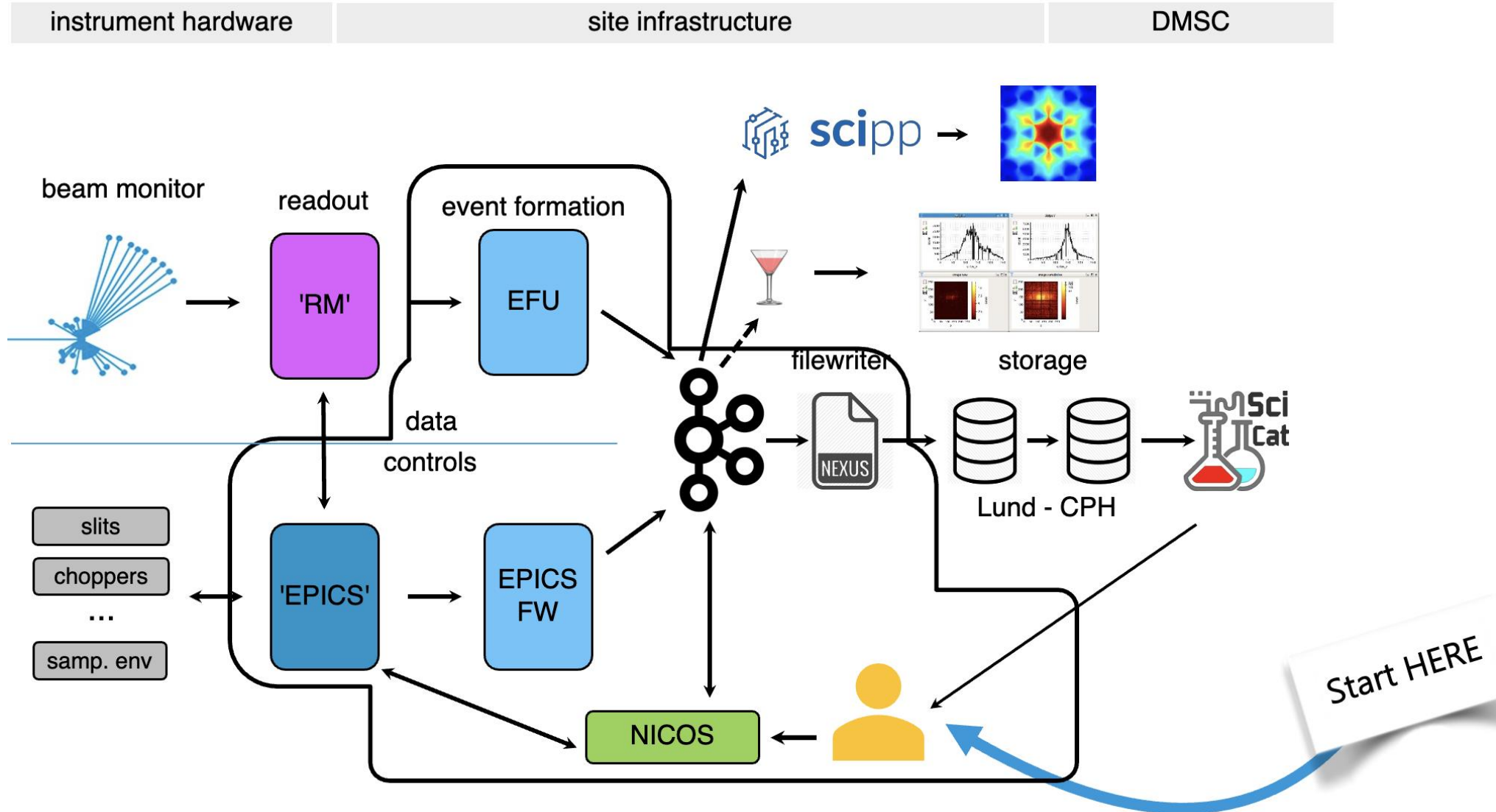
- Goal:**
 - **Smooth transition from** *expert operation* to *user operation*



Questions?

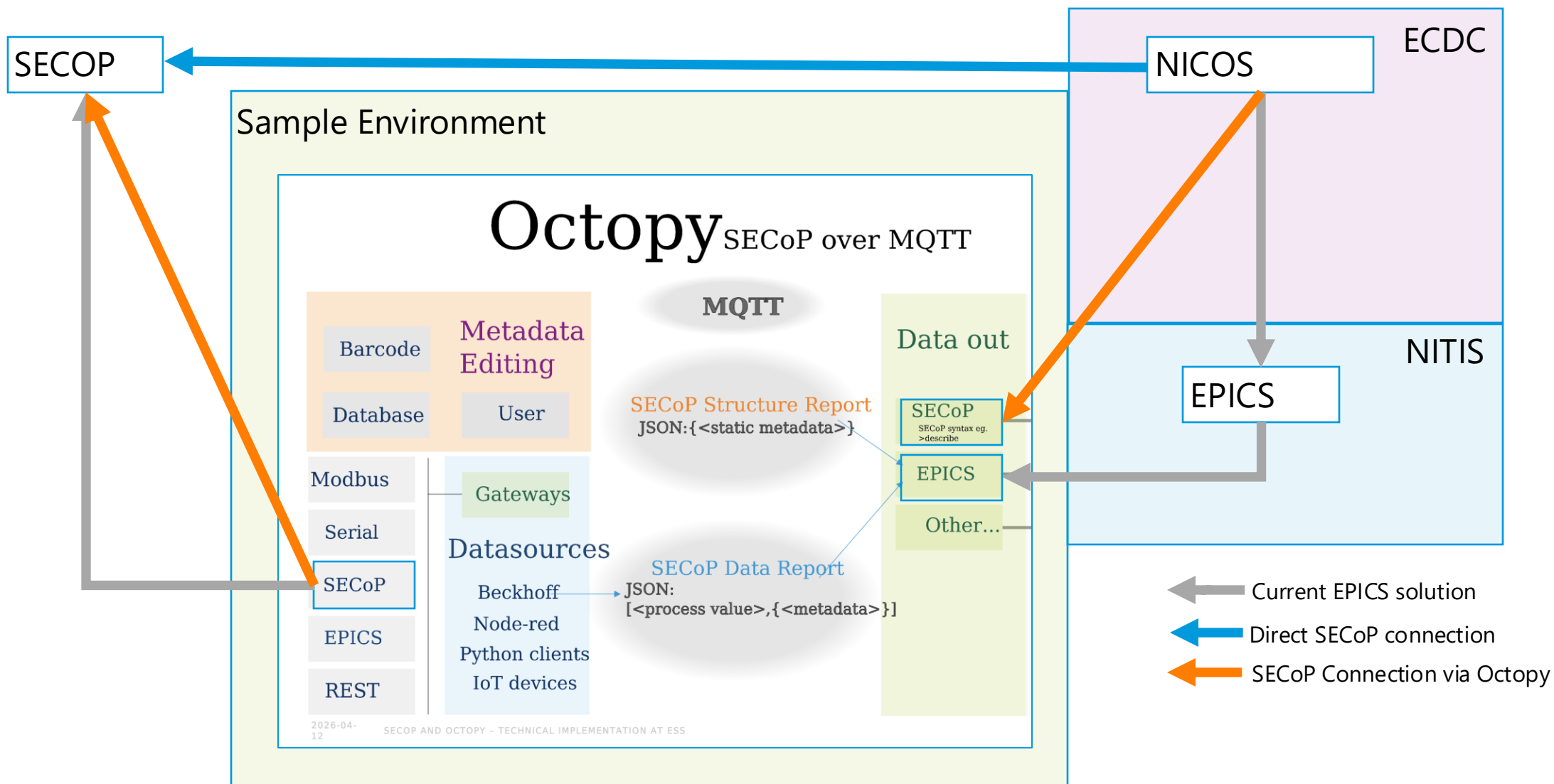
2025-02-13

ECDC-provided infrastructure in context



Workshop Outcome & Key Issues

NICOS-SECoP Integration Workshop 2026-03-24, Loops, Lund



ECDC perspective



Transition from Cold Commissioning to Hot Commissioning

- Started to transition to step by step in operational state
- Increasing the level of basic control for the next TG5 i.e selenium guide, pivot point ...
- Concerns starting with potentially 8 instruments in hot commissioning

→ Hot commissioning will expose UX gaps immediately

Cold Commissioning:	Hot commissioning:
Subsystem Expert-driven	Instrument staff -driven
Component Integration	System usage
Debug-oriented	Workflow-oriented
Tolerance for manual steps	Expectation of automation
Ad-hoc recovery	Predictable recovery



**EUROPEAN
SPALLATION
SOURCE**