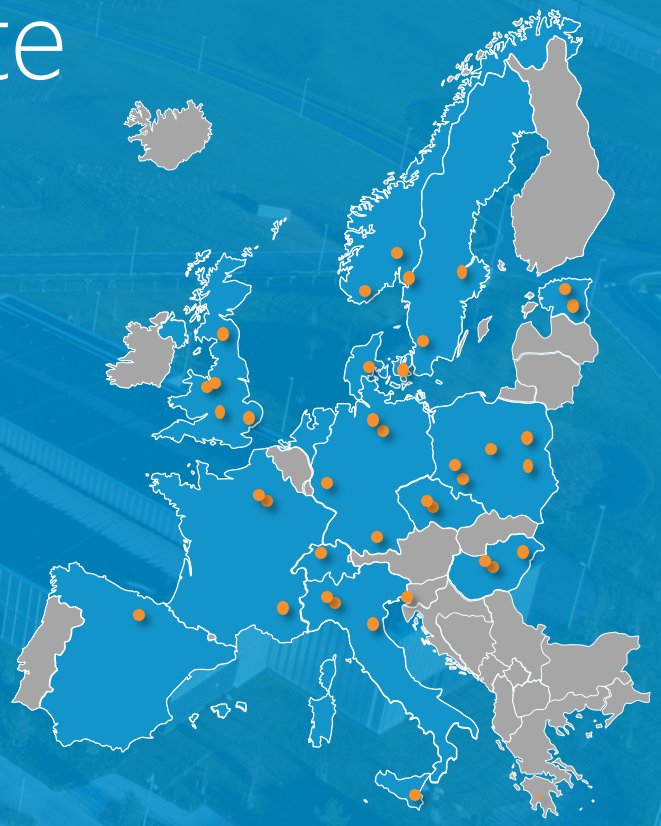
Introduction to Science Directorate and update

Common STAP meeting – October 2025

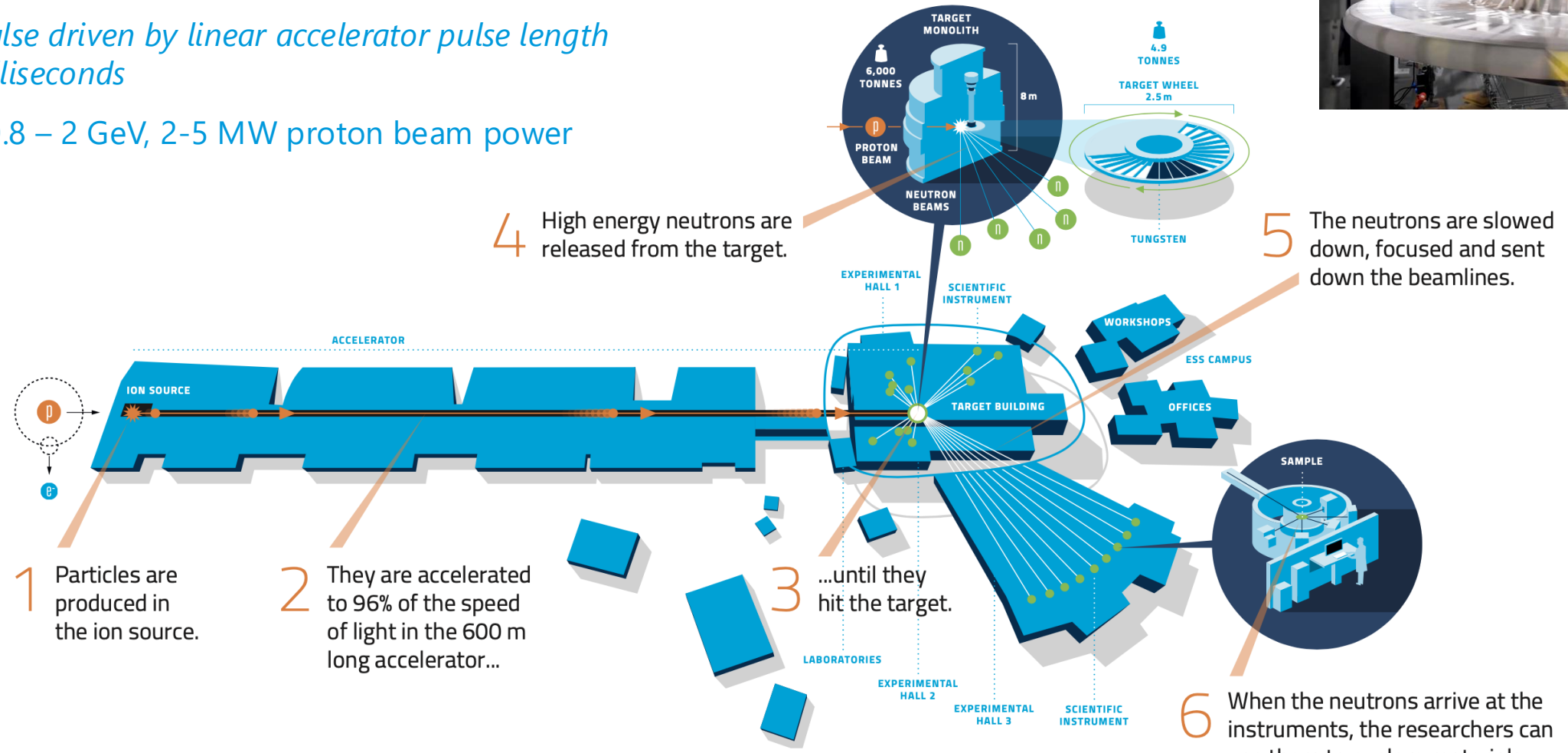


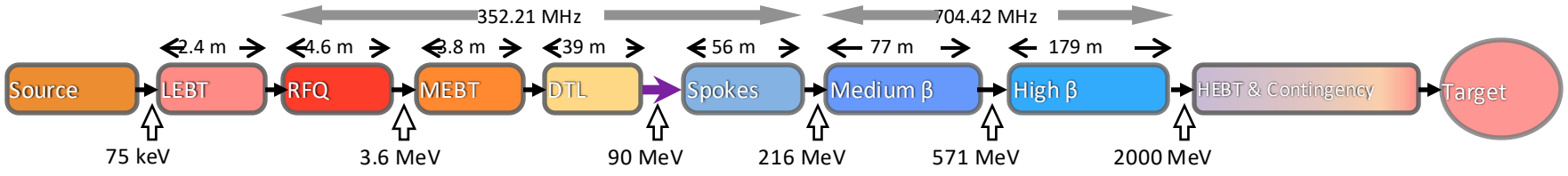
GIOVANNA FRAGNETO
2025-10-23

How ESS works

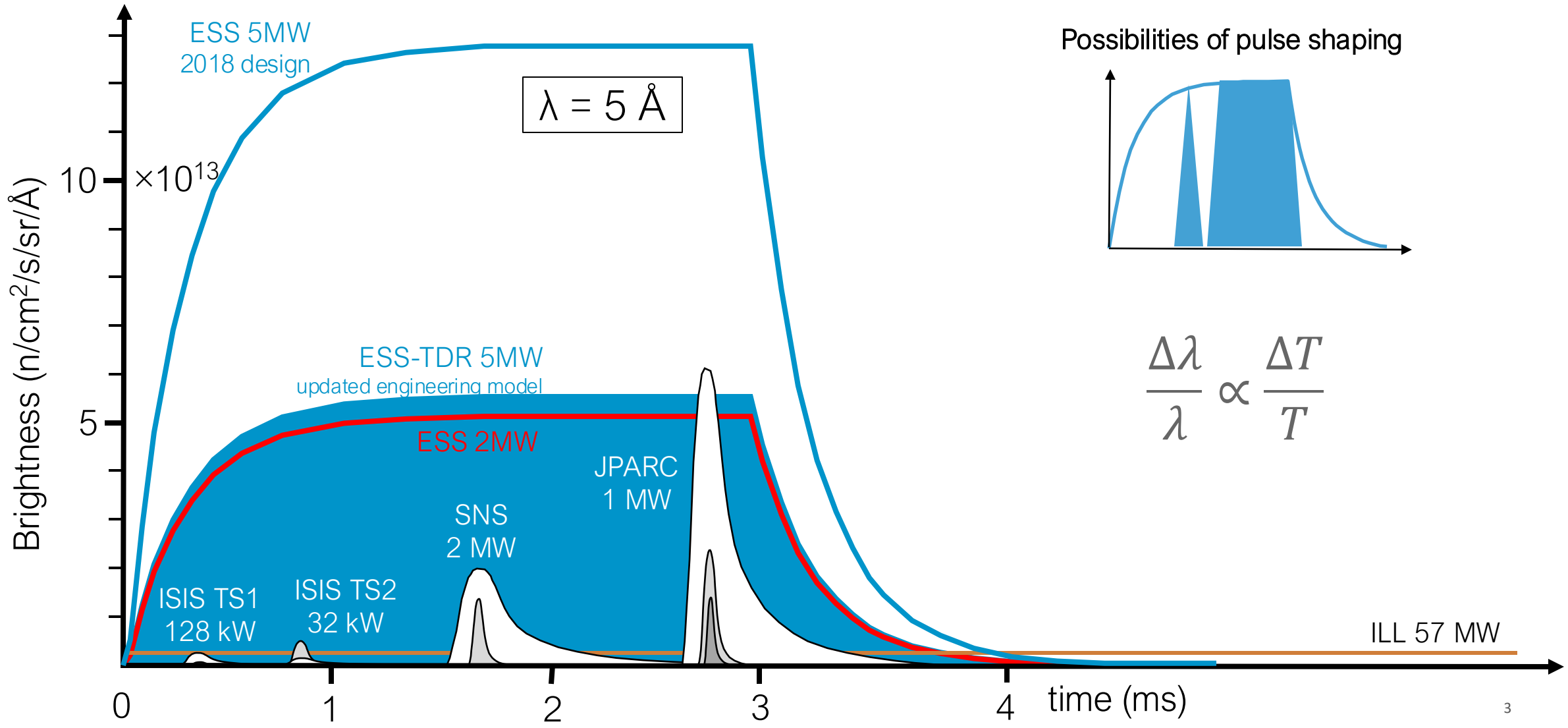
Long-pulse driven by linear accelerator pulse length 2.86 milliseconds

14 Hz, 0.8 – 2 GeV, 2-5 MW proton beam power





Long-pulse Performance and Flexibility



Possibilities of pulse shaping

$$\frac{\Delta\lambda}{\lambda} \propto \frac{\Delta T}{T}$$

Spallation and time of flight at ESS
Broad energy range from spallation & moderation process
Effective for 0.2-200 meV.

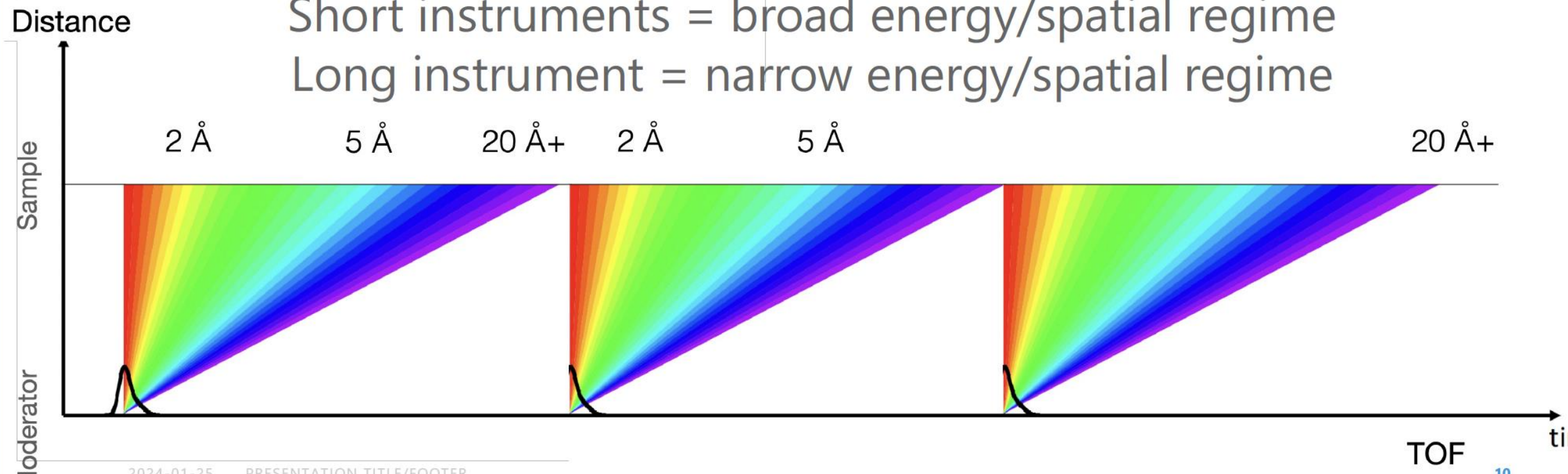
Length of instruments determined by science case.

14 Hz pulses. $\Delta T \cong 71$ ms

1) Short instruments = broad $\Delta\lambda$, long instrument = narrow $\Delta\lambda$

Short instruments = broad energy/spatial regime

Long instrument = narrow energy/spatial regime



Neutron Instruments

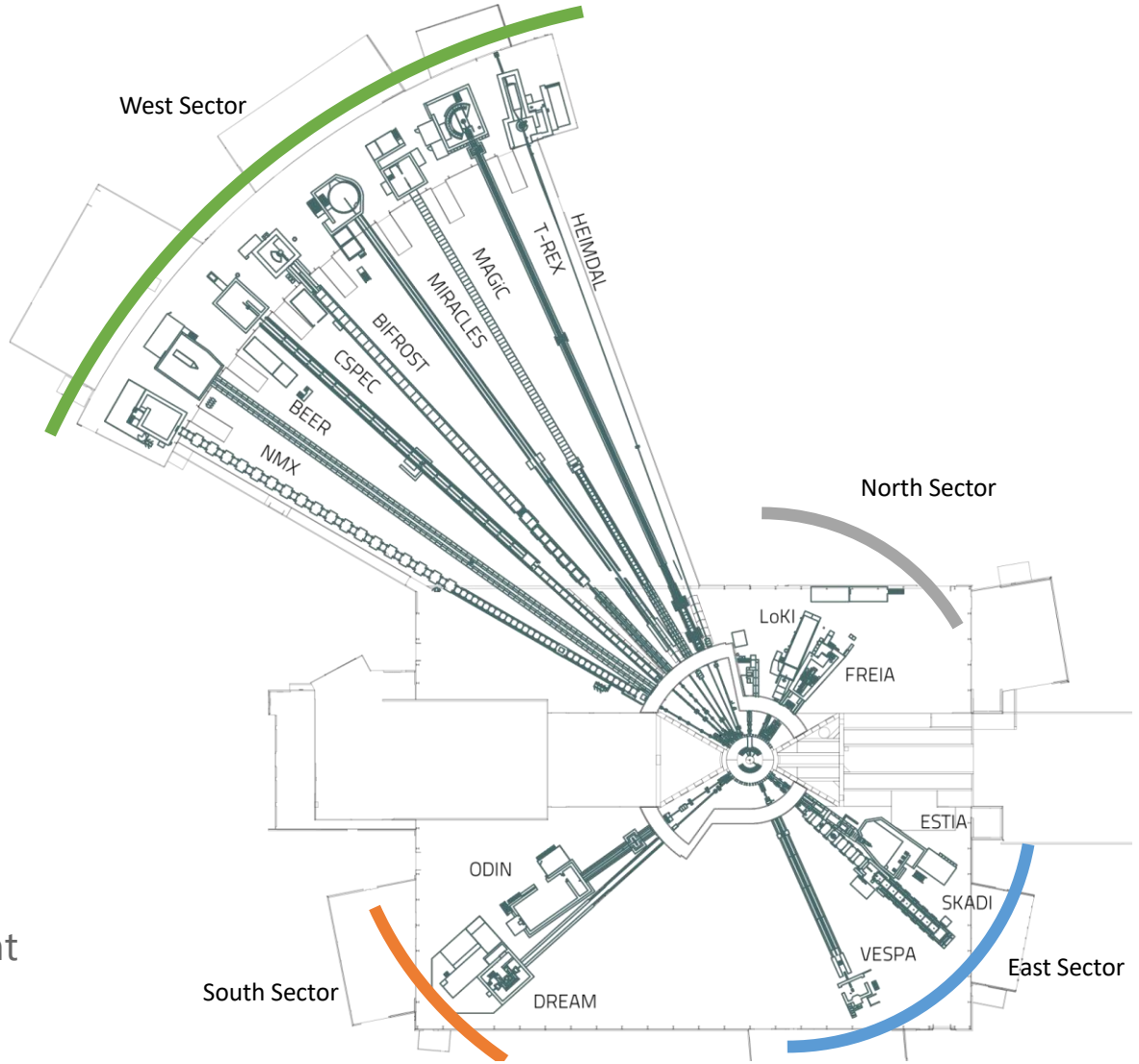
Andersen, K. H.; Argyriou, D. N.; Jackson, A. J. et al. The Instrument Suite of the European Spallation Source.
Nuclear Instruments and Methods in Physics Research Section A: **2020**, *957*, 163402.
https://doi.org/10.1016/j.nima.2020.163402.

15 instruments + Test Beamline

Diffractometers (DREAM, MAGiC, HEIMDAL)
SANS (LoKI, SKADI)
Reflectometers (Estia, FREIA)
Imaging (ODIN)
Engineering Diffraction (BEER)
Macromolecular Crystallography (NMX)
Spectrometers (CSPEC, T-REX, BIFROST, MIRACLES, VESPA)

Novel detector technologies and geometries
Complex pulse-shaping

Shared neutron bunker – common space for components
Common timing system for facility
Single controls infrastructure (EPICS)
Control and data recording running remotely from instrument

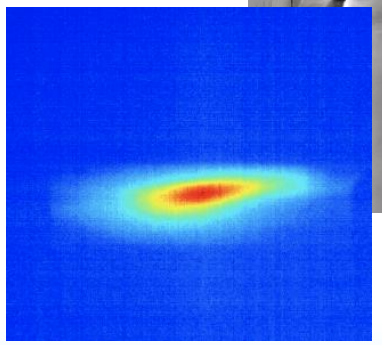


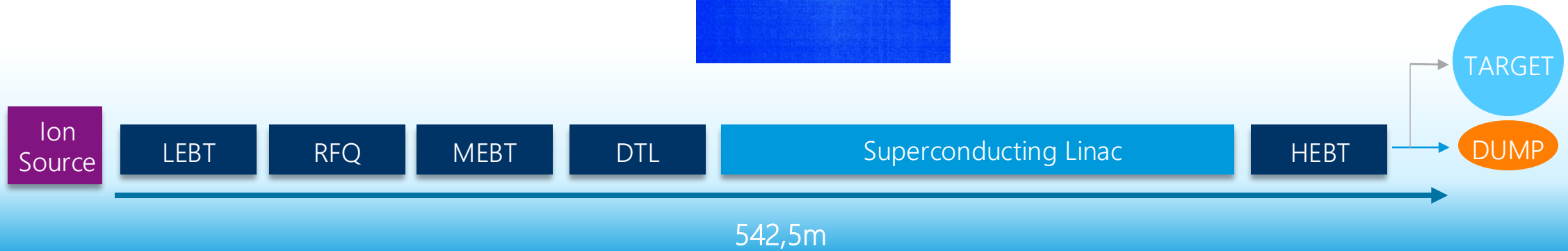
Beam on Dump on 16th May

A major milestone on ESS Road to Science

For the first time, protons have travelled the full **542.5 metres** through the ESS accelerator and beam transport system at the correct energy (800 MeV) – from the ion source all the way to the tuning beam dump.

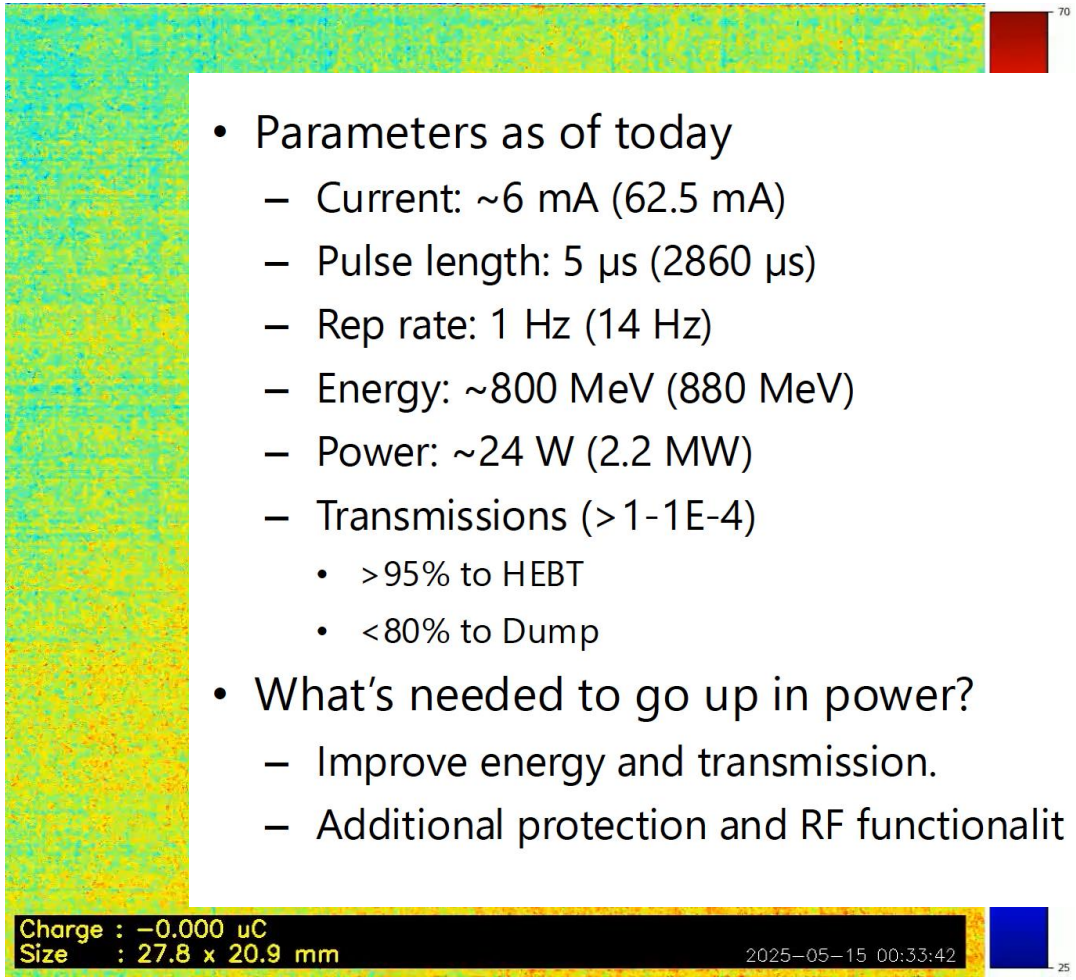
This achievement is clear proof that the accelerator and its many subsystems are operating together as a fully integrated machine.



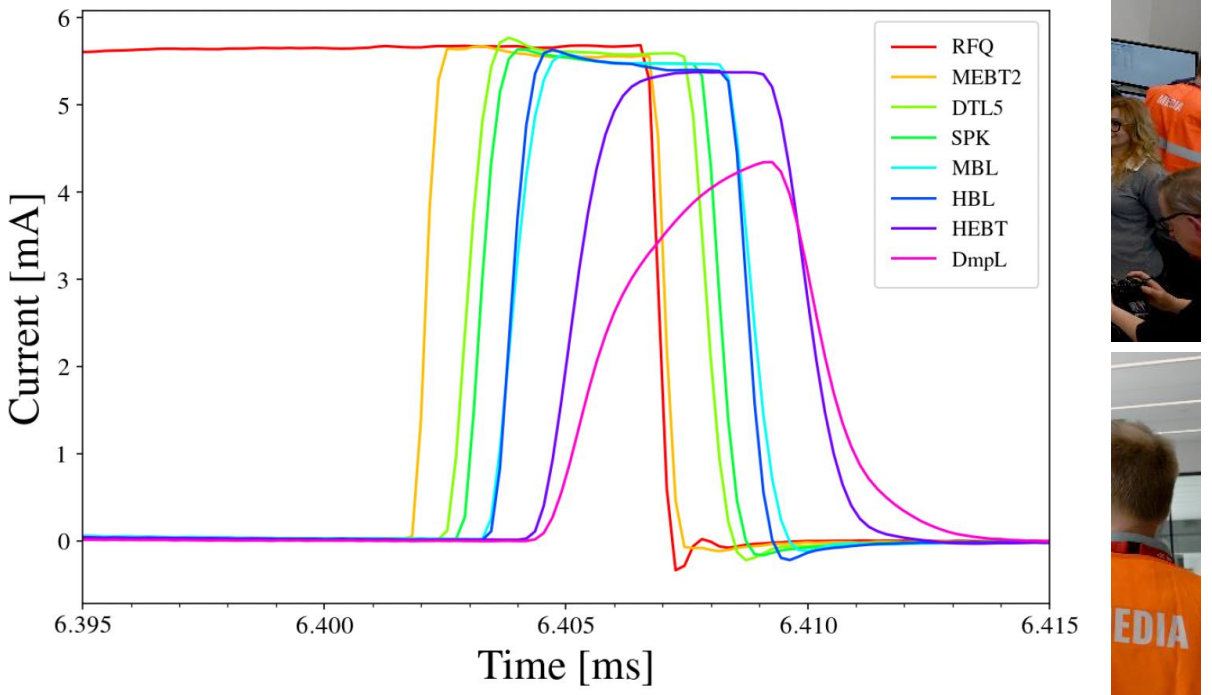


Beam on Dump on 16th May

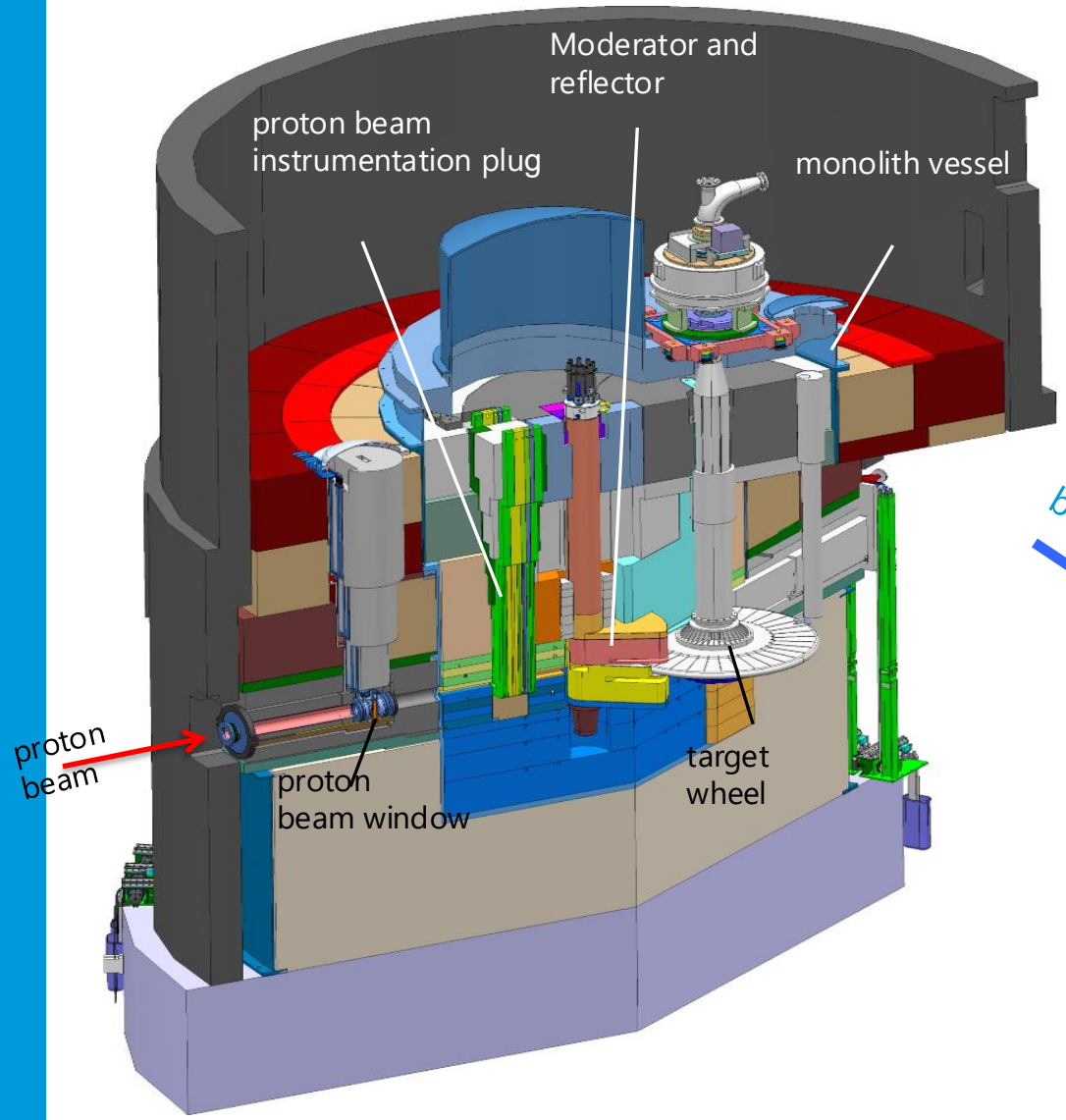
A major milestone on ESS Road to Science



- Parameters as of today
  - Current: ~6 mA (62.5 mA)
  - Pulse length: 5 µs (2860 µs)
  - Rep rate: 1 Hz (14 Hz)
  - Energy: ~800 MeV (880 MeV)
  - Power: ~24 W (2.2 MW)
  - Transmissions (>1-1E-4)
    - >95% to HEBT
    - <80% to Dump
- What's needed to go up in power?
  - Improve energy and transmission.
  - Additional protection and RF functionalit

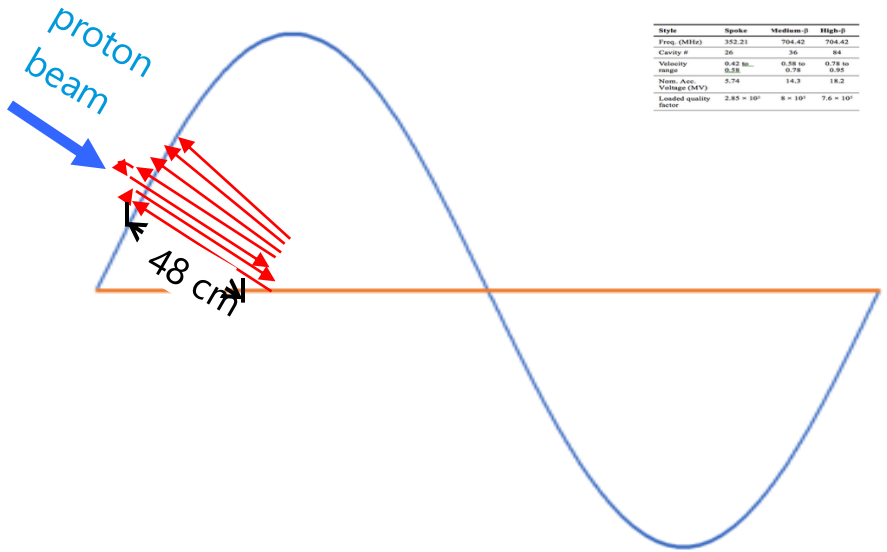


ESS Target layout



Rotating solid tungsten target

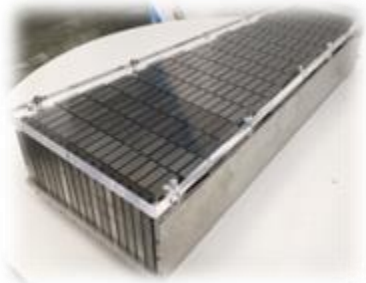
- 36 sectors
- Mass, total 11 tonnes, whereof 3 tonnes of W
- Rotates 23.3 rpm, synchronized with pulsed proton beam 14 Hz



Style	Spoke	Medium-β	High-β
Freq. (MHz)	352.21	704.42	704.42
Cavity #	26	36	84
Velocity range	0.42 to 0.58	0.58 to 0.78	0.78 to 0.95
Nom. Acc. Voltage (MV)	5.74	14.3	18.2
Loaded quality factor	2.85×10^5	8×10^5	7.6×10^5

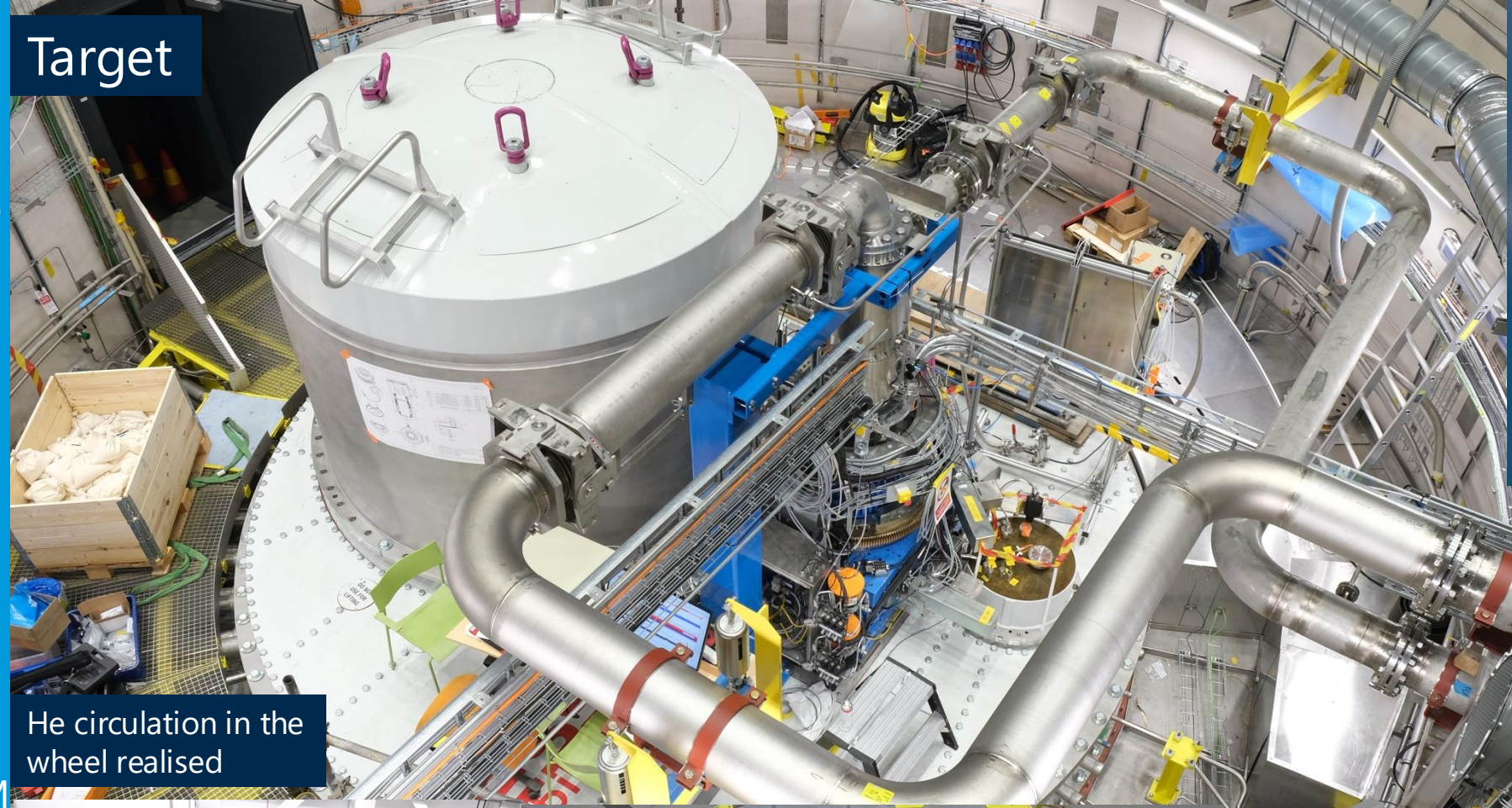
Helium cooling of target material

- Mass flow 3 kg/s
- Pressure 11 bar
- Temperature inlet/outlet 40 °C/240 °C

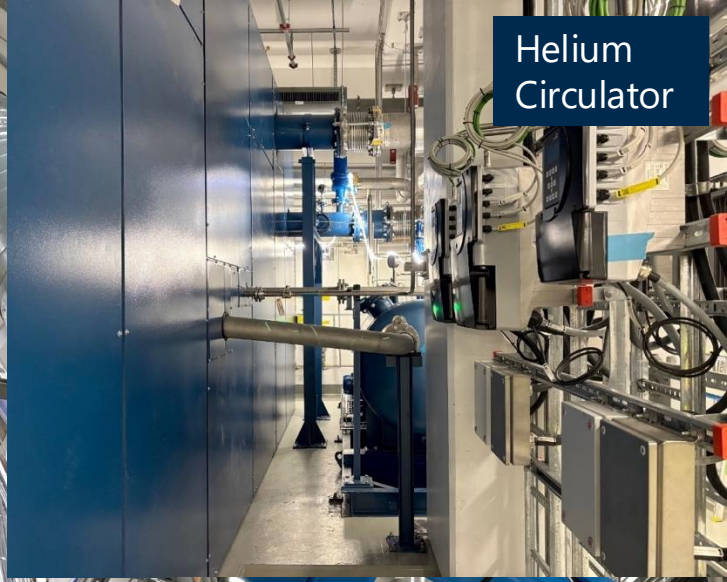


UPDATE TARGET/MODERATOR

Target

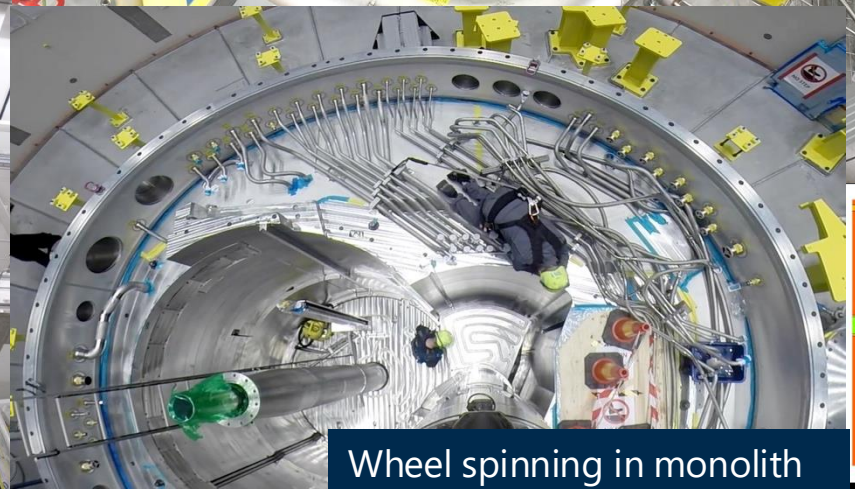


He circulation in the wheel realised

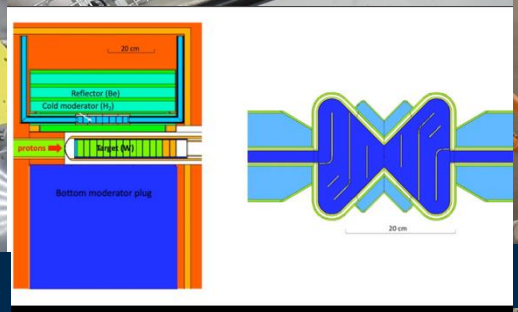


Helium Circulator

MUTS Cask 3 testing



Wheel spinning in monolith



Refurbished HRU

Instruments

UPDATE INSTRUMENTS

DREAM detector installation completed

CSPEC local crane

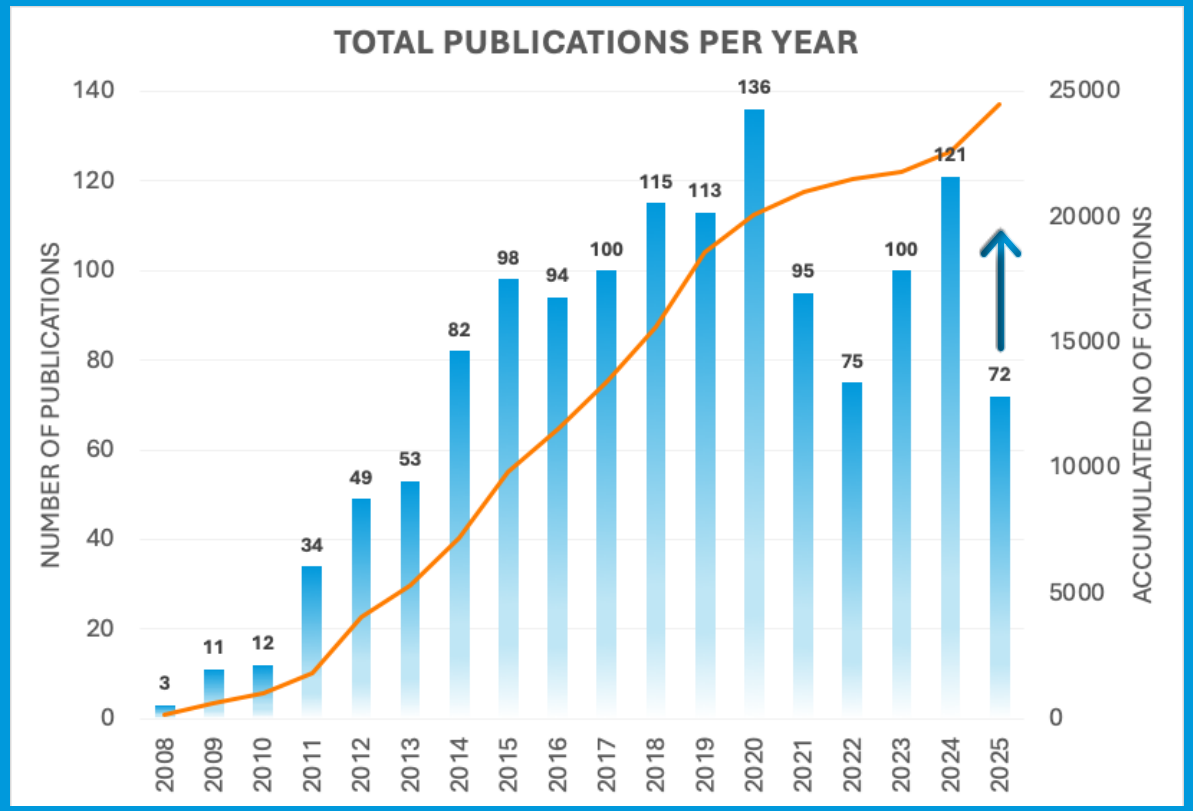
LOKI completion

BIFROST completion

BEER cave progresses

BEER detector base plates

Preparing for scientific output with neutrons



- Completion of first instruments, software and sample environments!
- Intensive recruitment of scientific and support staff combined with continuous organisational restructuring, for driving ESS's transition towards a user-oriented service facility and stable, steady-state operations.
- Hot commissioning team set-up
- User access preparation (policies, physical access, training, …)

The Science Directorate is in charge of completing and commissioning the instruments and delivering science and the user programme

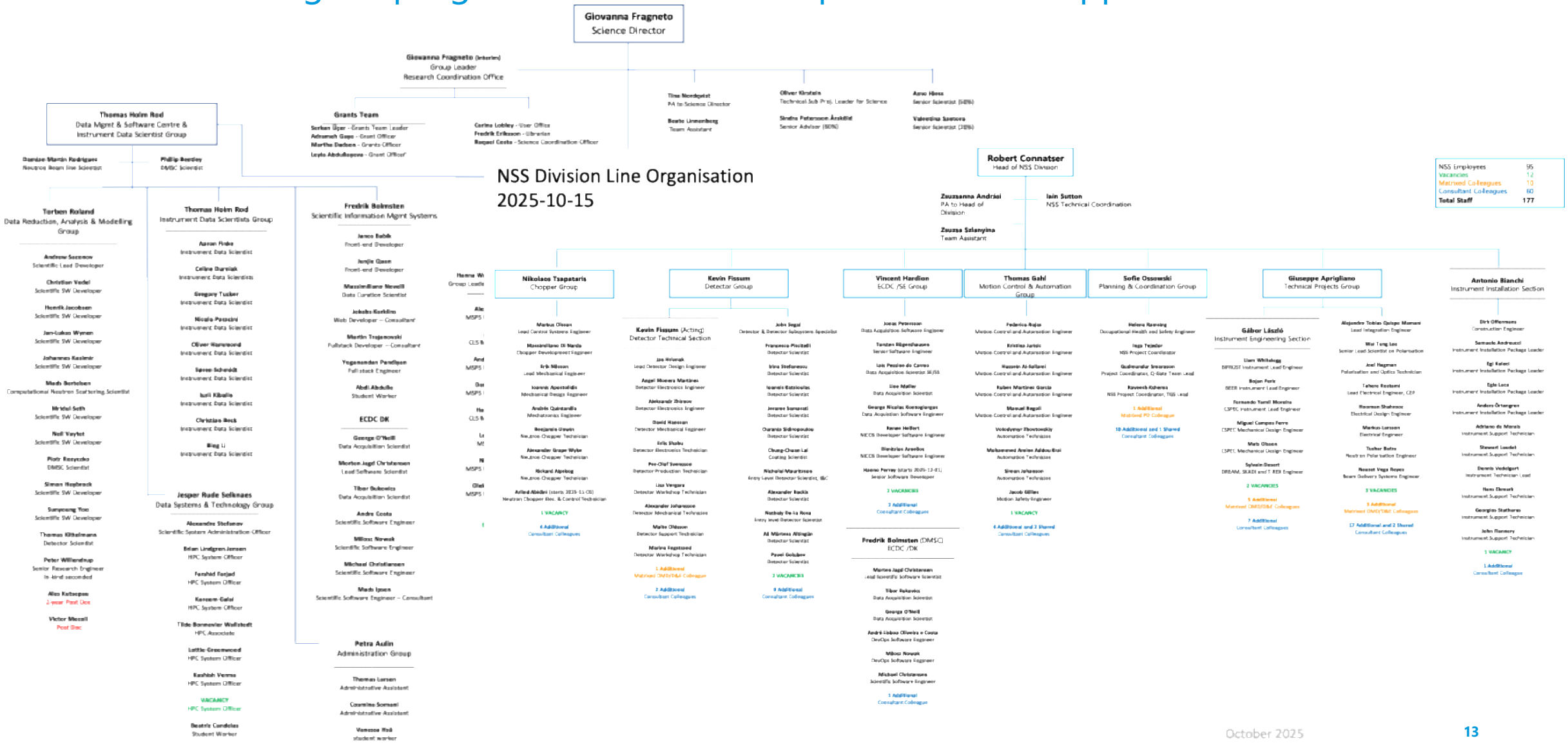





- Science Directorate
  - Research Coordination Office
  - Diffraction and Imaging
    - BEER
    - DREAM
    - HEIMDAL
    - MAGIC
    - ODIN
    - TBL
  - Large Scale Structures
    - ESTIA
    - FREIA
    - LOKI
    - NMX
    - SKADI
  - Spectroscopy
    - BIFROST
    - CSPEC
    - MIRACLES
    - T-REX
    - VESPA
  - Data Management and Software Center
    - Administration
    - Data Analysis and Modelling
    - Data Systems
    - Scientific Information Management Systems
    - INSTRUMENT DATA SCIENTISTS
  - Scientific Support
    - Sample Environment
    - Support Laboratories
    - Deuteration
    - Hall Coordinators
  - Neutron Scattering Systems
    - Chopper
    - Detector
    - ECDC
    - Motion Control and Automation
    - NSS Planning and Coordination
    - Technical Projects

Continued reorganisation towards operation

Several hirings in progress for instrument operation and support

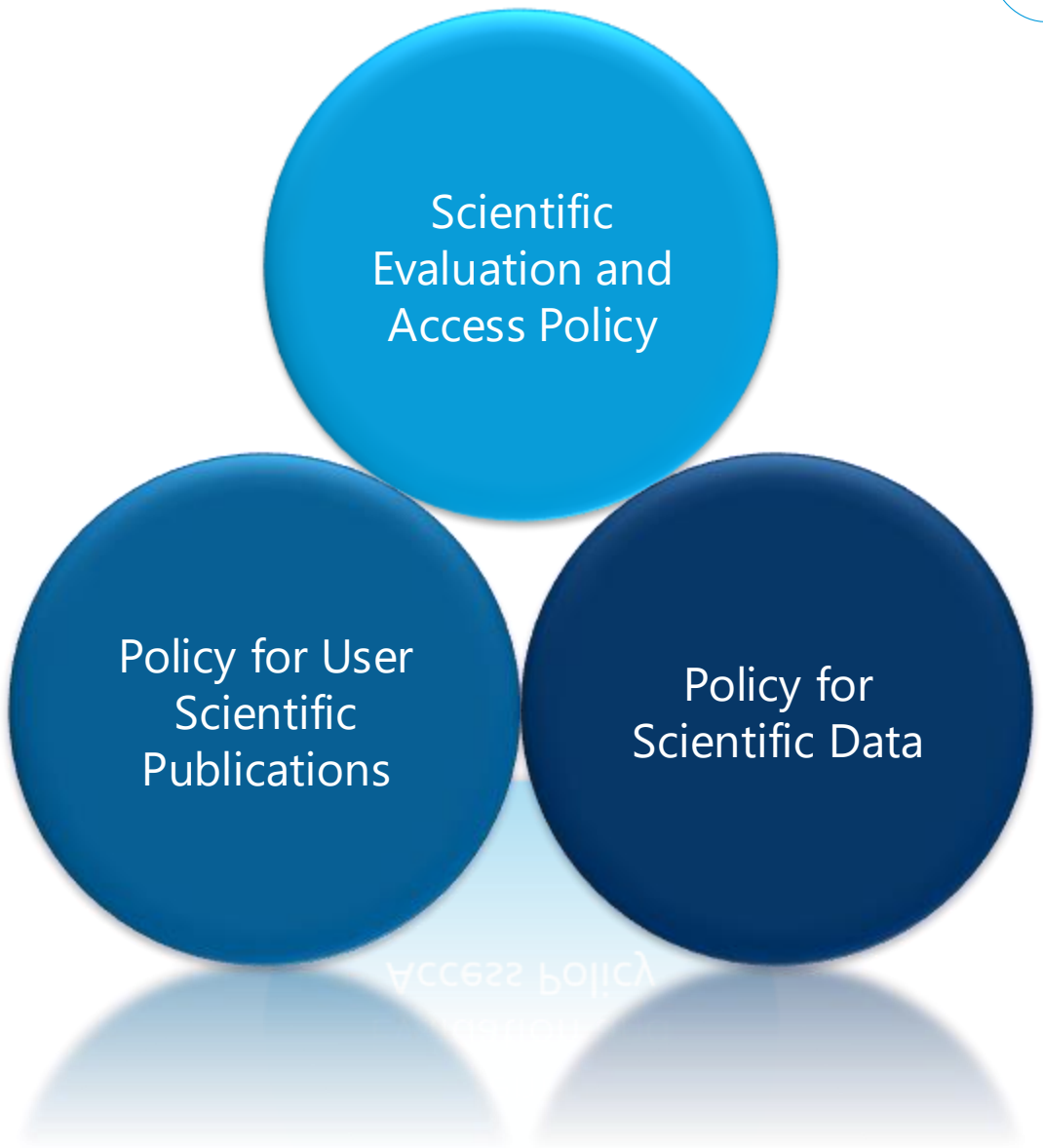


The Scientific Evaluation and Access Policy aligns with the policy for user scientific publications and the policy for scientific data. Approved by Council in June 2025.

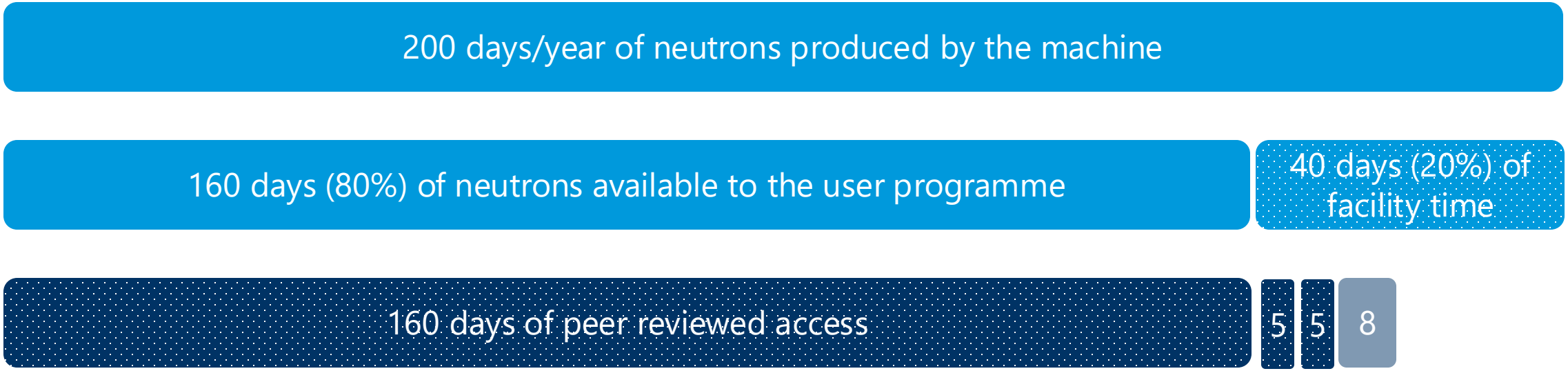
The policy for scientific publications received ESS Council approval in 2022.

A revised policy for scientific data was endorsed by SAC has been approved by Council in June 2025.

These three policies define the conditions for usage of ESS



Access to Neutron Instruments



- **User programme to be offered to member countries proportionally to their financial contribution to the facility**
- Excellent science from non member countries will be possible via discretionary access
- ESS staff are invited to use the peer review process

Community reach & impact

Main highlights since April

200+ visits hosted by the Science Directorate reflect our strategic visibility and active engagement with academia, industry, and research partners

7 guest seminars

160+ participants attending the ESS Instrument Roadmap for future instruments webinar

DMSC hosted **SciCatCon 2025**, a key community meeting for users and developers of the SciCat metadata catalog, focusing on user feedback, deployment, and data curation.

International Conference on Neutron Scattering (ICNS2025)
800 delegates
500+ participants visited ESS with a focus on instruments
80% rated the visit 5 out of 5
73 ESS staff contributed through talks, posters, and informal sessions
5 mini-symposia
3 satellite workshops

To come: ESS/ILL User Meeting/October 2025

Building talent initiatives

Main highlights since April

DMSC Summer School - hands-on training in the complete ESS Data Pipeline and on modern data practices. Aimed at supporting the next generation of researchers in making the most of their neutron data.

NNSP/SwedNess – 8th Graduate School on Neutron Scattering with 2-day lectures at ESS, incl. tour

Young Researchers Science Day – participation of ESS featuring talks, breakout sessions, and a poster mingle across diffraction, imaging, and spectroscopy.

First science post-docs internal call *6 awarded to start in 2026*

Formal framework to guide and support the **supervision of students hosted at ESS**, which includes two key documents:
ESS Policy on Supervising PhD Students

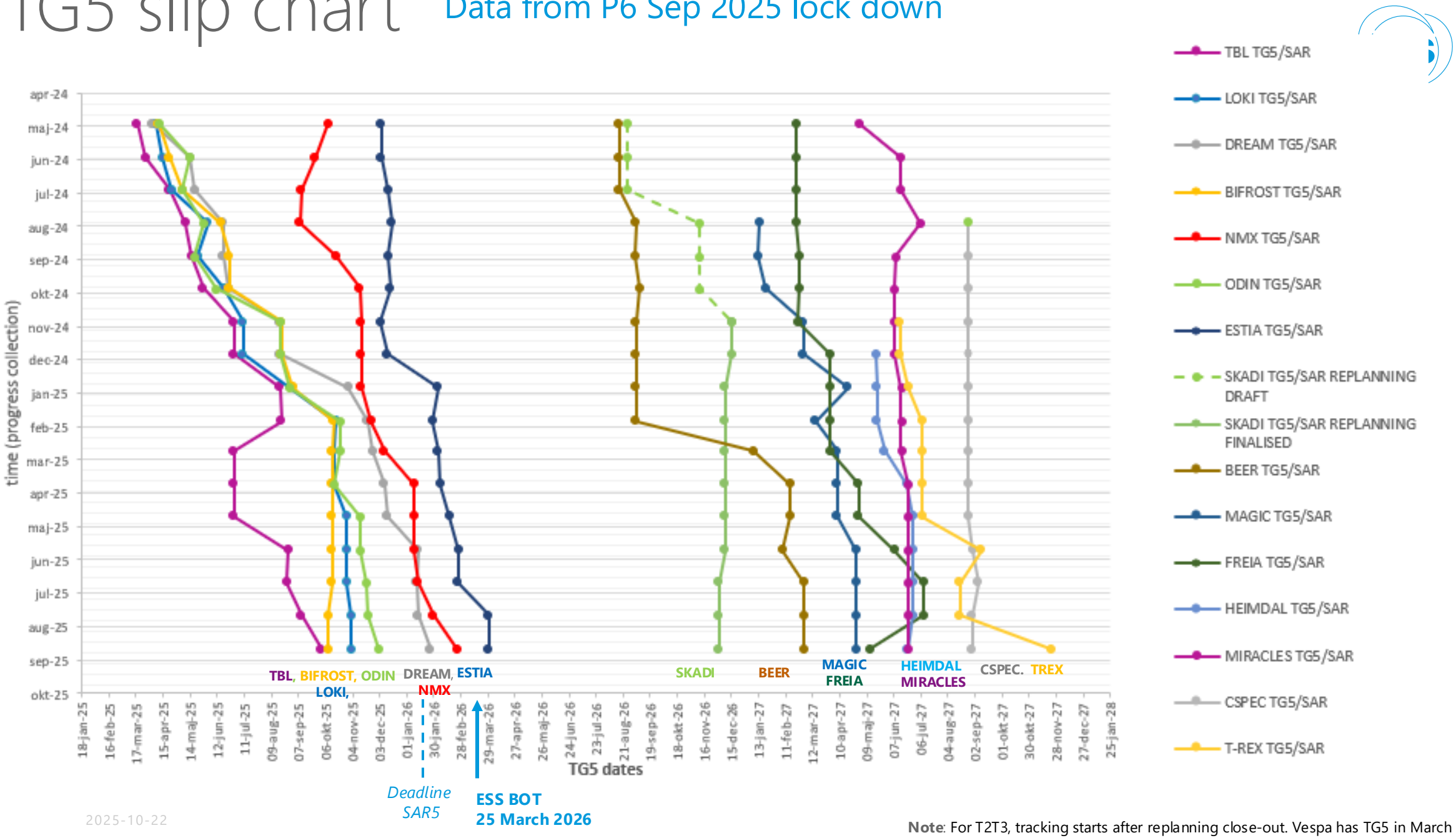
ESS Rules for Supervising PhD Students

NSS update

On behalf of Rob Connatser

TG5 slip chart

Data from P6 Sep 2025 lock down



Note: For T2T3, tracking starts after replanning close-out. Vespa has TG5 in March 2029

Focus Areas

Completion of First Instruments – Cold Commissioning

- Local Testing of individual systems on instruments (technical groups)
  - Do they work as planned?
- Integrated testing of the instruments with experimental control (instrument team, ECDC, and technical groups)
  - Can we control them as needed sufficiently for hot commissioning

Portable sources have been purchased

- Detector Group is working with RadiationProtection to be able to use them on site

Lessons Learned during Cold Commissioning

- Testing our complex systems takes longer and is harder than we expected – still having optimism bias!
- We have uncovered issues in unexpected areas – including networks, access rights, and displays of information.
- Communication, Communication, Communication!
- While close involvement of the technology groups was planned, it needs to be even tighter.
- We have developed a JIRA board – the NSS Issue Tracker - to ensure all issues found are capable of being tracked and monitored

Focus Areas

System Acceptance Review (SAR) and instrument Safety Readiness Reviews (iSRR)

- Test Beamline – Going first!
  - SAR meeting 3 June, approval on 8 October
  - iSRR meeting 10 October
- BIFROST – SAR Meeting 5 September
  - iSRR date driven by Motion Safety and PSS
- LoKI – SAR Meeting 19 September
  - iSRR date driven by Motion Safety and PSS

NSS and Instrument Divisions are keeping the focus on completing these instruments, even after their reviews!

Q: Why don't they just pass?

A: We book the meeting a month or two in advance to set a goal to work towards. The team can then be told what of the remaining issues are important for passing the review and which can wait.

Technical Achievements

DREAM T0 chopper testing

Multigrid Detector advances, getting ready for assembly of first TREX modules!

- More from Alex in his presentation

Multiblade Assembly for ESTIA

Firmware support for various detector types

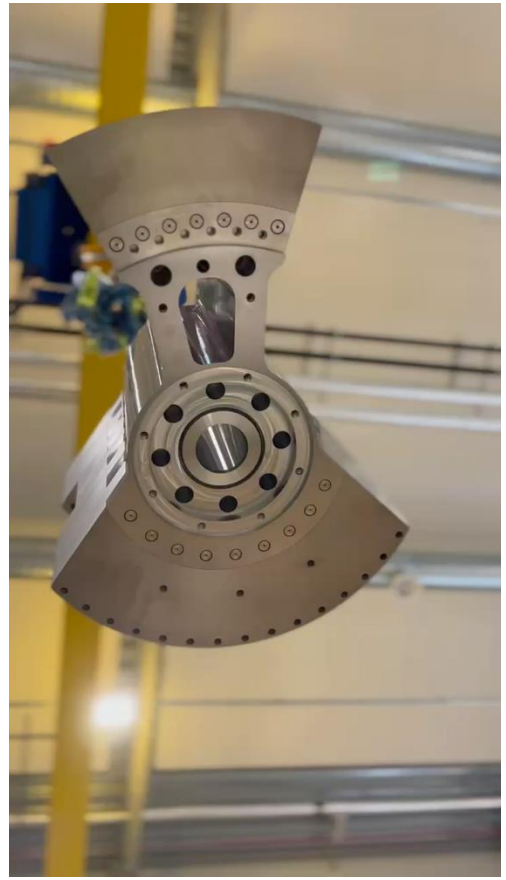
- Coordinated effort between Detector Group and ECDC

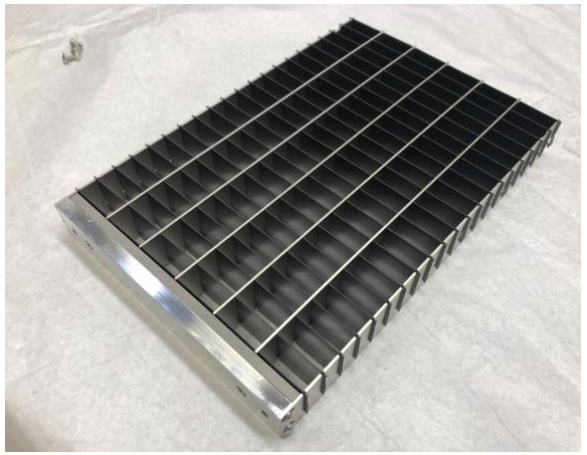
Coordination in testing of motion hardware

Bunker installation

Polarization MEOP station Preliminary Design Review

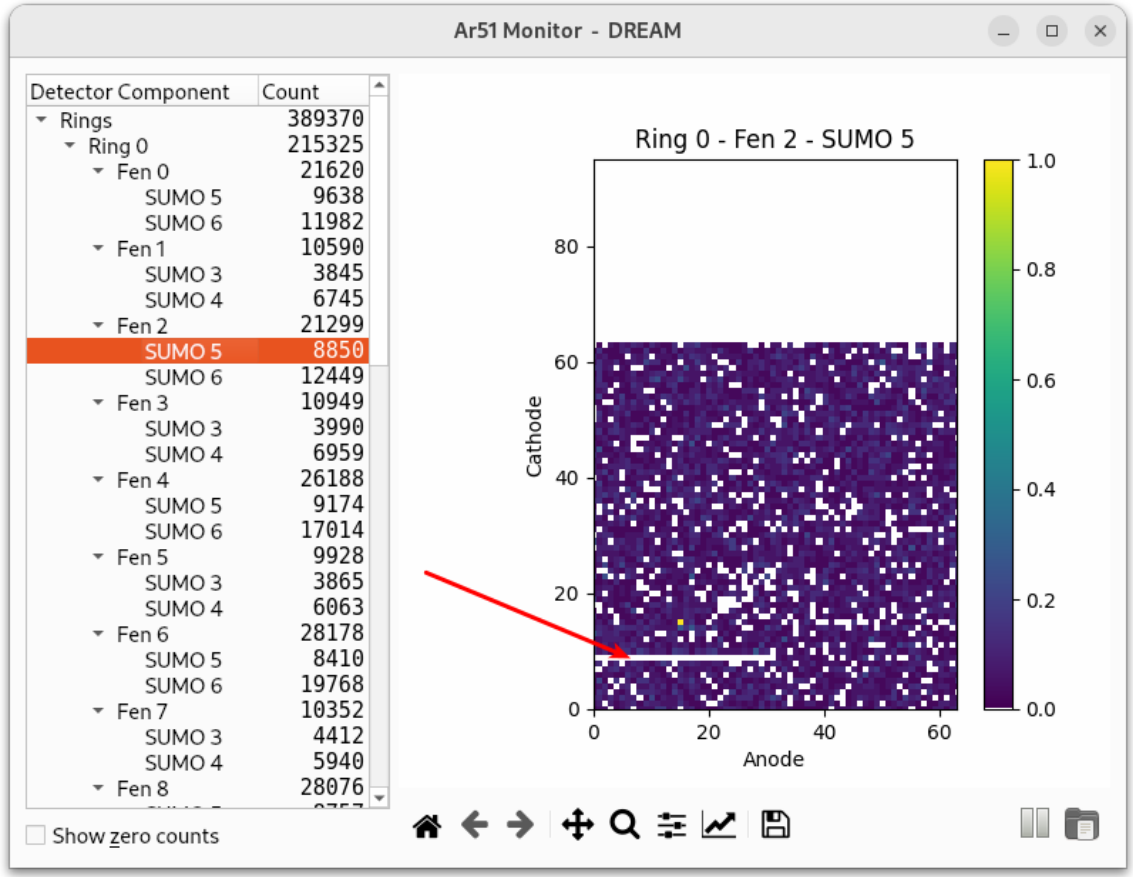
Data Acquisition software pipeline tested and improved

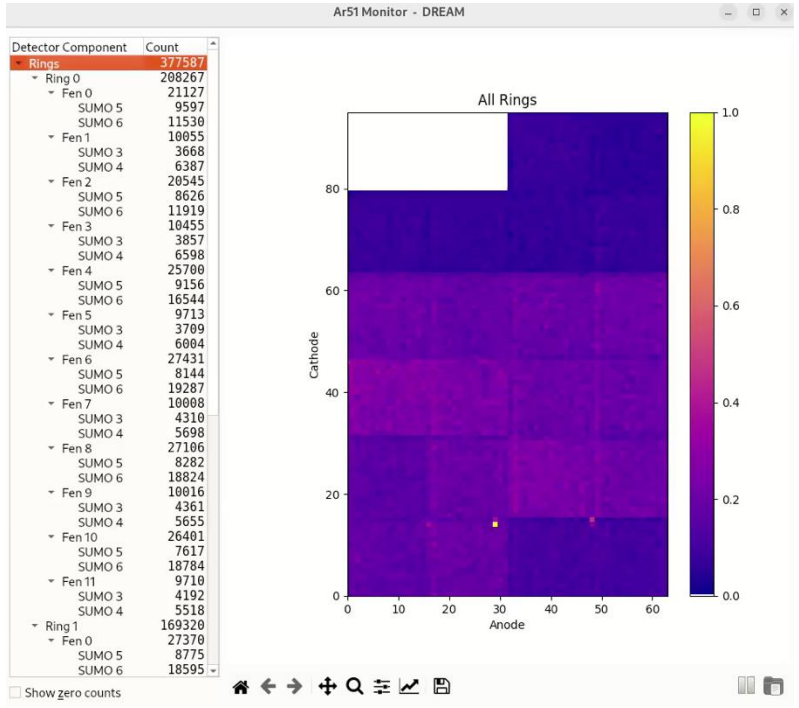




ESTIA MB detector & Integrated Chopper test for LoKI

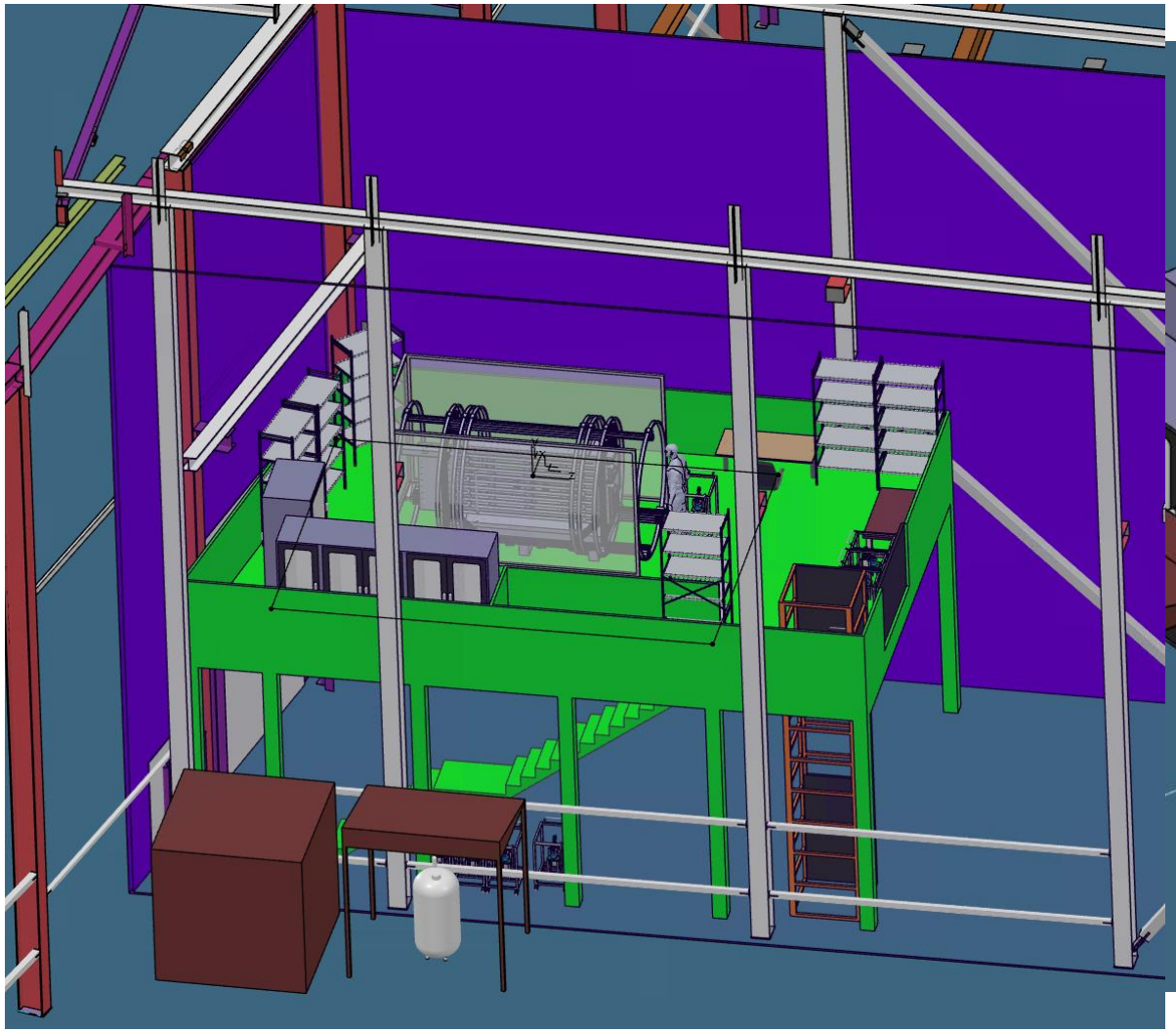
ECDC tools

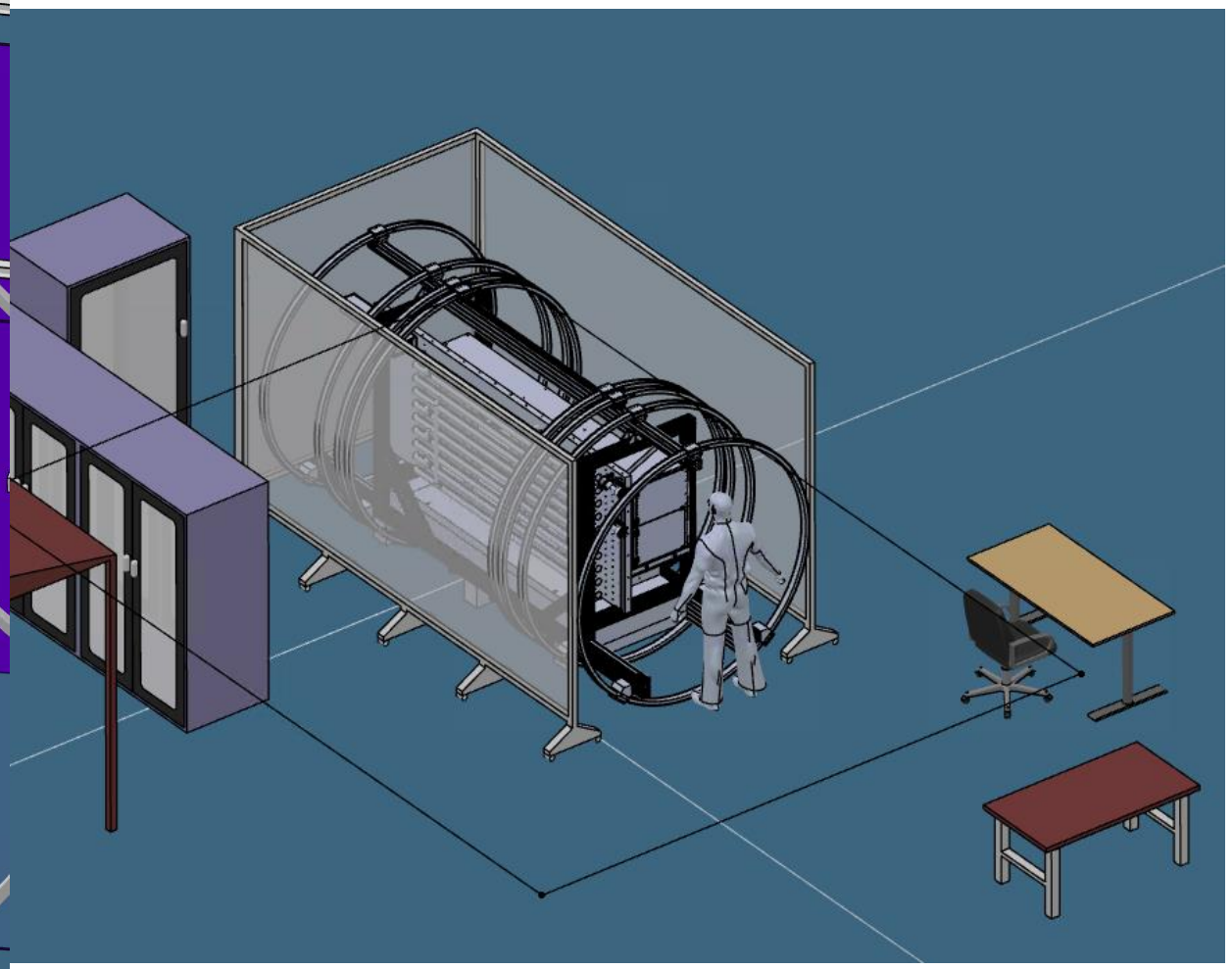




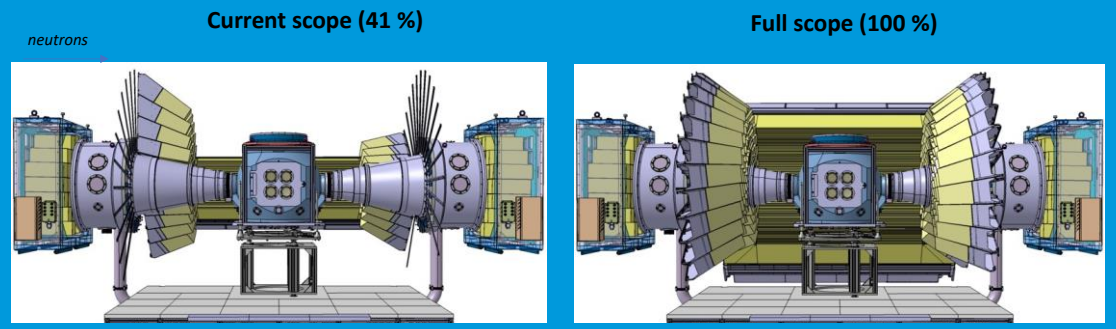
This diagnostic tool for DREAM detector allows to display the data acquisition for each module to accurately assess the output signals.

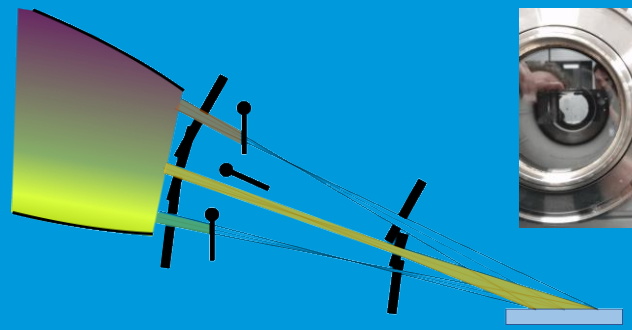
MEOP station

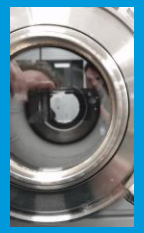


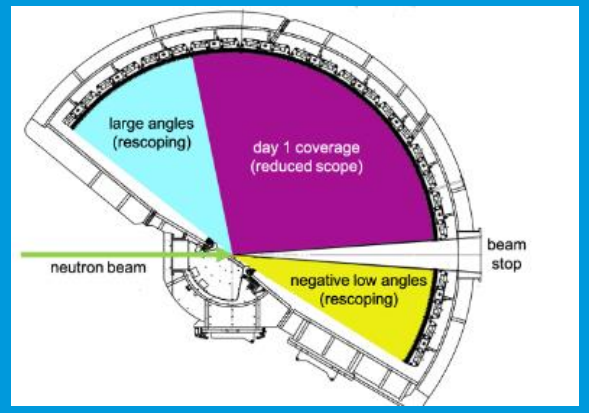


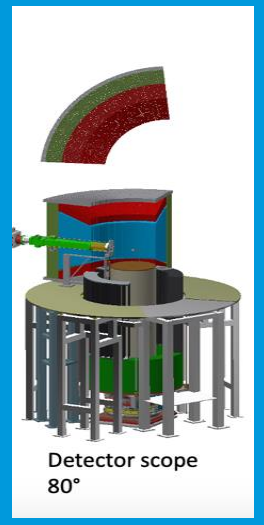
Rescoping of instruments

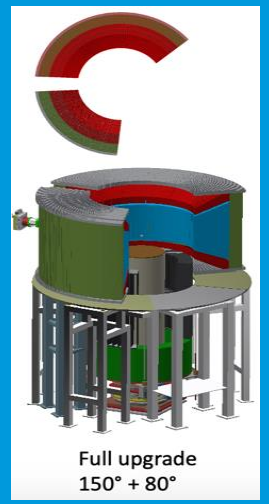












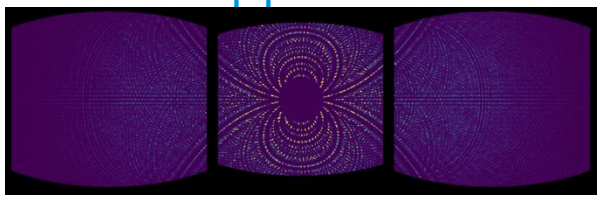
- LoKI full det coverage *in progress*
- FREIA shutters *in progress*
- DREAM full det coverage *in progress*
- VESPA T0 chopper *in progress*
- CSPEC ^{3}He ~5 bar (full det coverage) *in progress*

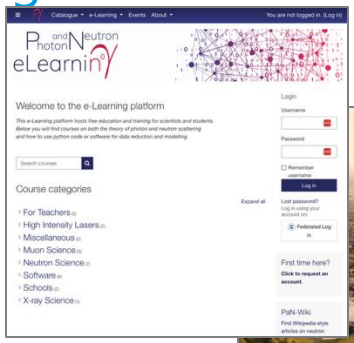
- HEIMDAL detectors *under discussion*

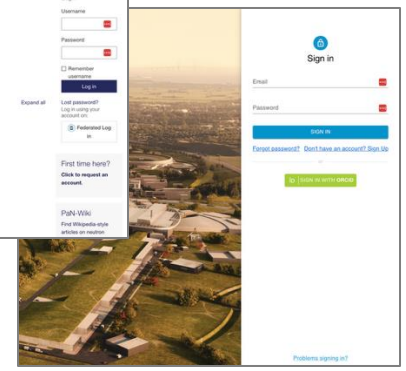
- VESPA analyser modules
- T-REX full coverage detector
- MAGiC full coverage detector
- BEER texture detectors
- BEER multiplication choppers
- ODIN 3D Polarimetric Tomography
- SKADI full coverage detector
- NMX Gd coated detectors

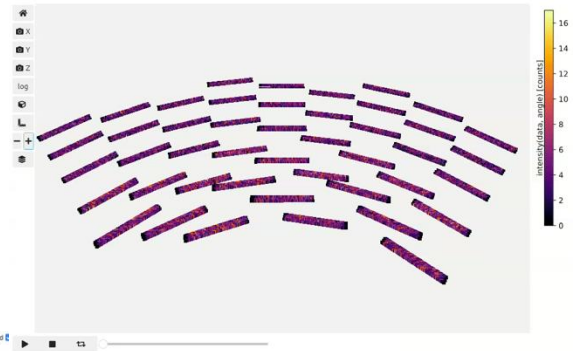
Data Managem[illegible]omputing

Support user from prop[illegible]uting tools & services

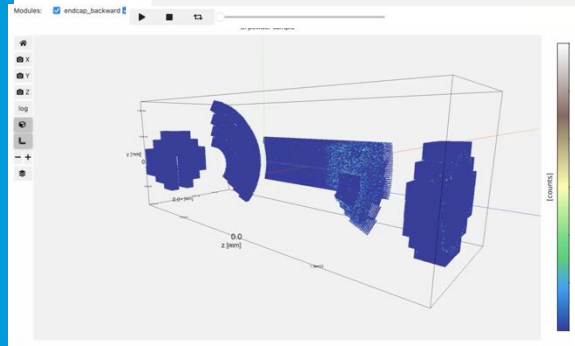


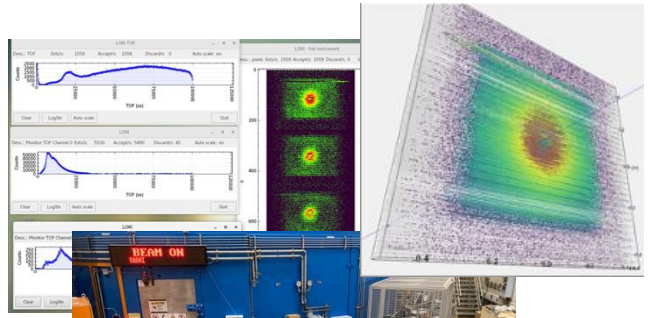


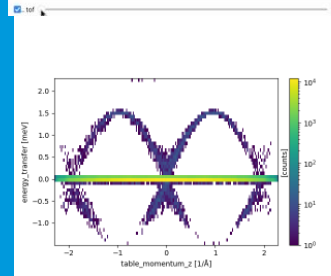


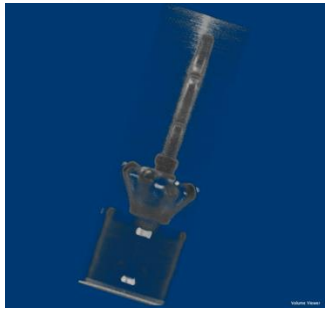


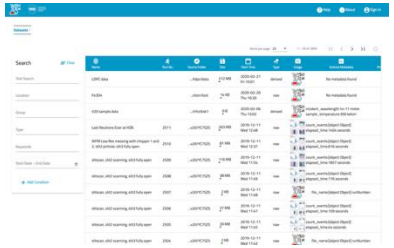
Move and refurbishing at DTU completed; hosted Council meeting on 3-4 June

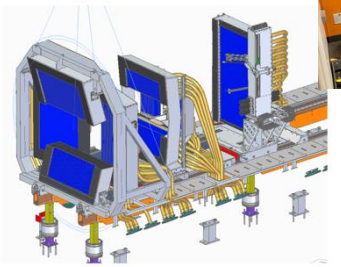








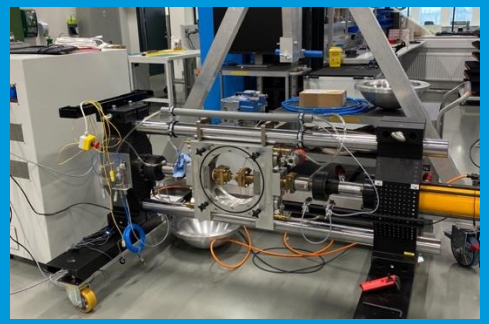






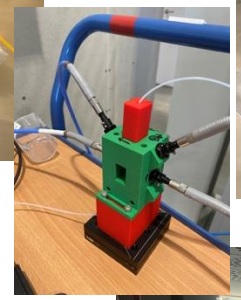


Sample environment & support laboratories



Optimisation process in progress to develop and implement vision for support during commissioning and in steady state operation.

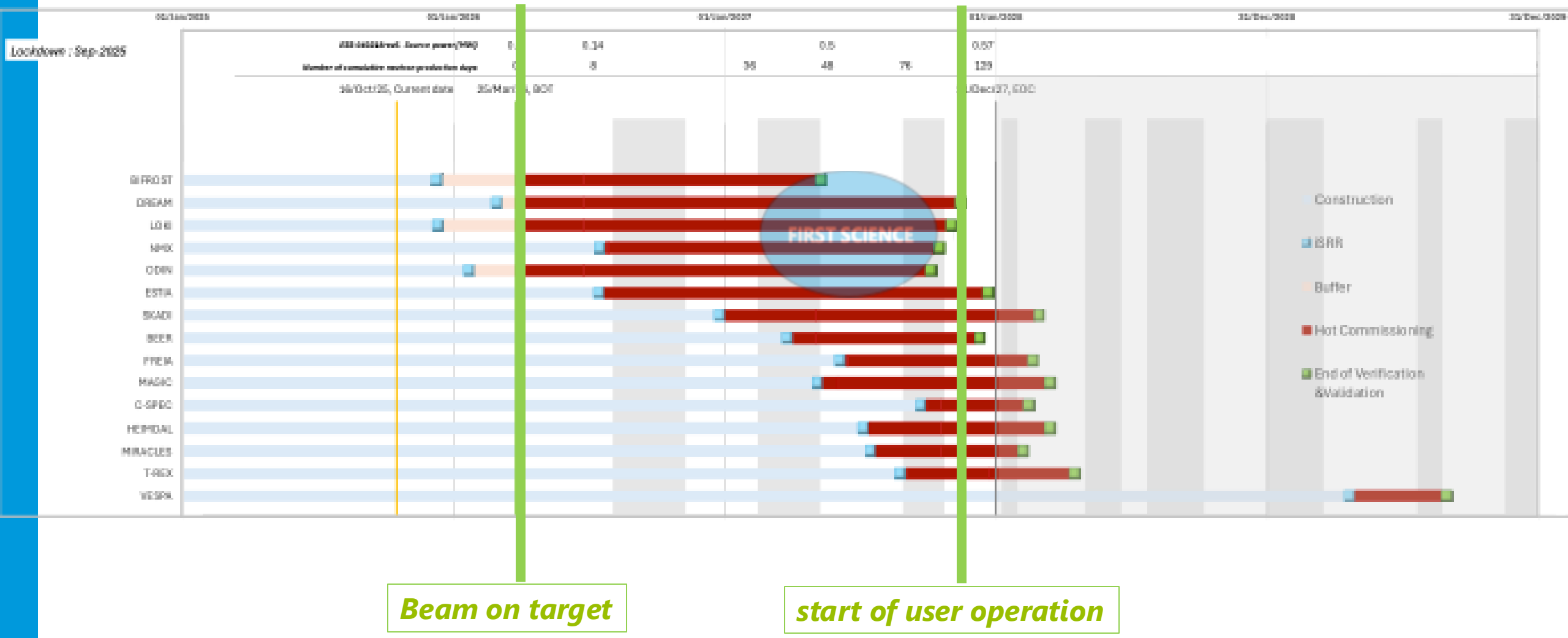
Internal call for deuteration for first science

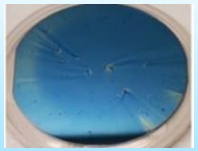


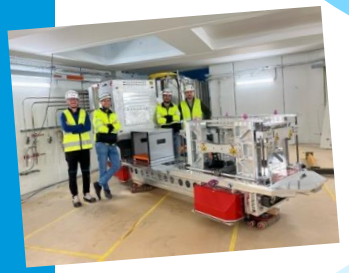
Current post-Beam On Target schedule

Start of user operation in the last quarter of 2027 at 500kW → 2MW in steady state operation (future upgrade to 5MW)



Small samples
Fast kinetics
Extreme conditions
Variable resolution





LoKi

Estia

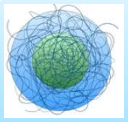
Odin

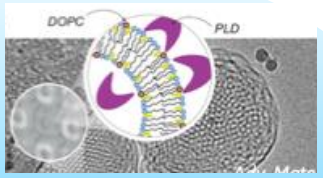
Early Science

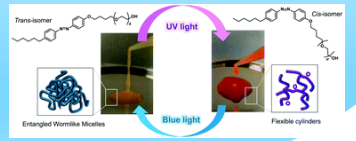
DREAM

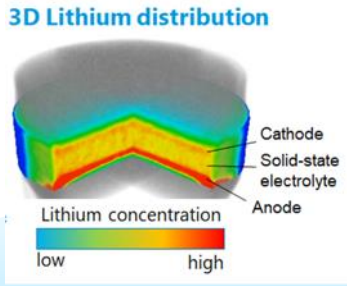
Bifrost

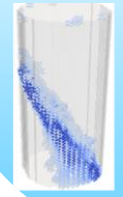
NMX

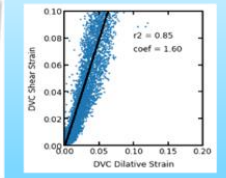


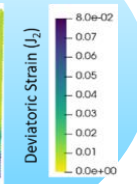


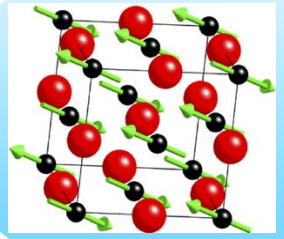


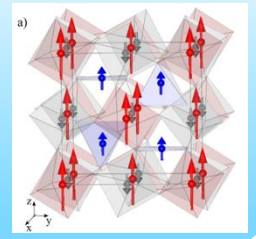


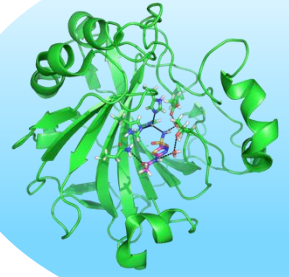


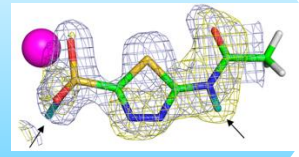


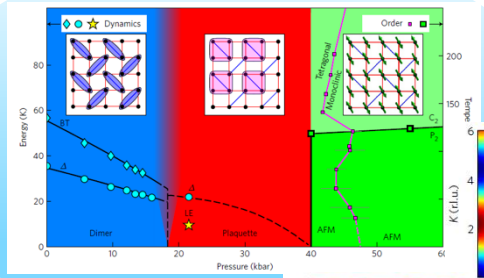


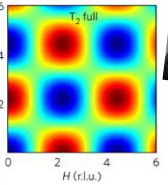


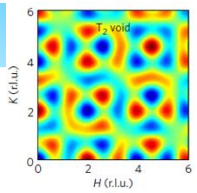












Small samples
Fast kinetics
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Call for Input to the ESS Instrument Roadmap

FEBRUARY 3, 2025

ESS is pleased to invite the European scientific community to contribute input to a roadmap for instruments beyond the 15 currently under construction. This roadmap will guide future developments of the instrument suite, ensuring that ESS supports a versatile science portfolio in the decades to come. The call will be open for one year.

Interested parties in ESS member countries are welcome to submit proposals via our instrument divisions.

We aim at proposals supported by consortia of academic and research institutions including large involvement of ESS staff.

We plan to lead construction from the ESS.

We will strive to profit from the expertise of our European partners and we are looking now at possible collaboration models within a new FRAMEWORK for PARTNERSHIPS *(to be validated)*.

Schematic of Possible Instrument Suite Expansion
Andrew Jackson 2024-10-16

Ideas for new instruments under discussion in the Diffraction & Imaging division

Mikhail Feygenson
Imaging and Diffraction

1. **Single-crystal diffractometer with high-pressure capabilities** (ESS, PSI, ESS Bilbao, ISIS, Edinburgh University)
2. **PDF dedicated diffractometer with Q_{MAX} ~50 $Å^{-1}$** (PSI, ESS, TUM, ISIS, Duisburg-Essen University, Uppsala University)
3. **MAGNI—Microscopy, Advanced and Grating Neutron Imaging-** neutron imaging instrument optimized for high neutron flux (PSI, DTU, ESS)
4. **IDUN - Guide bundle instrument** for imaging, engineering diffraction and SANS (DTI, ESS)

Ideas for new instruments under discussion in the Large Scale Structures division

Andrew Jackson
Large Scale Structures

- **SAGA – Dedicated surface scattering instrument for 3D studies of interfaces**

  Swedish Collaboration : ESS, KTH, LINXS, LiU, LU, MaU, UU – study funded by VR

- **Structural Biology Cluster – 2nd NMX with DNP and a dedicated Bio-SEC-SANS**

  Collaboration with HUN-REN Centre (HU)

- **SMÅ - High throughput SANS***

  Contacted possible collaborators, will hold zoom workshops

- **ULL - Membrane Diffractometer and WANS***

  Contacted possible collaborators, will hold zoom workshops

- **MIMER - Solid-Liquid Bio-Reflectometer***

  Contacted possible collaborators, will hold zoom workshops

- **Yggdrasil – SANS/WANS**

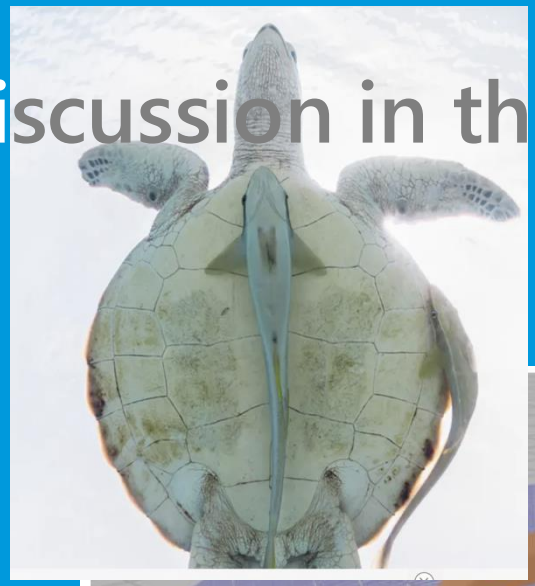
  Laboratoire Leon Brillouin (Saclay, FR)

- **SANS at very low Q – Upgrades to SKADI and/or dedicated instrument**

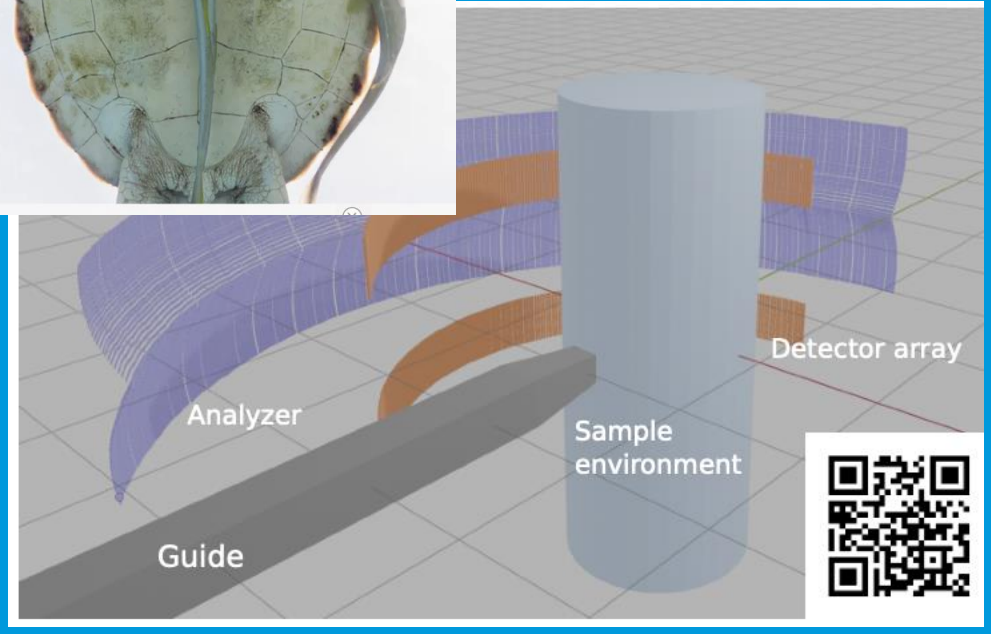
  Contacted possible collaborators, will hold zoom workshop

**names are preliminary and for convenience/entertainment only!*

Ideas for new instruments under discussion in the Spectroscopy division



Pascale Deen
Spectroscopy



1. NSE Broad community collaboration
2. NJORD
3. REMORA } ESS/DTU/TUM/FZJ
4. KVASIR ESS/KU/LLB
5. VOR ESS/KU
6. Short low div., thermal spectrometer ESS/Univ.Trento/Uni. Perugia
7. Pulsed magnetic field opportunities EPFL/TUM

Beyond neutron scattering….

1. **ANNI**
   (large consortium, CH, FR, AU, DE, …)
2. **HiBEAM**
   (large consortium, 7 countries, led by SE)
3. **Cryo-EDM**
   (US et EU countries)
4. **NNBAR**
   (large consortium, see Highness paper)
5. **ECHIR**
   (CNR, ISIS, PSI, Infineon, STMicroelectronics, Lund & Uppsala Univ.)

…. **Neutrino activities**


Fundamental Nuclear and Particle Physics
At Neutron Sources

See report for European Strategy for Particle Physics (ESPP)

Way forward: process of selection

Oct 2025	Preliminary discussions at *Scientific and Technical Advisory Panels* and *Scientific Advisory Committee* meetings - setting up of dedicated expert committee. Proposal of a strategy for projects prioritisation (scientific impact/innovation impact/maturity of concept/timescale & resources/….)
Feb 2026	Collection and editing of all proposals Call ends beginning of February 2026 Initial presentation at *Strategy Council* *Discussion on framework for partnerships (approval of funding models…)*
Apr 2026	Discussion with dedicated expert committee and prioritisation by ESS management
May 2026	Endorsement of prioritisation list by *Scientific Advisory Committee*
Jun 2026	Presentation at *ESS Council* – request of endorsement of prioritised projects
2026 - 2027	Strengthening of conceptual design of two projects
2027	**Start of detailed design of one/two projects**


Quiz
ess
EUROPEAN
SPALLATION
SOURCE


Quiz

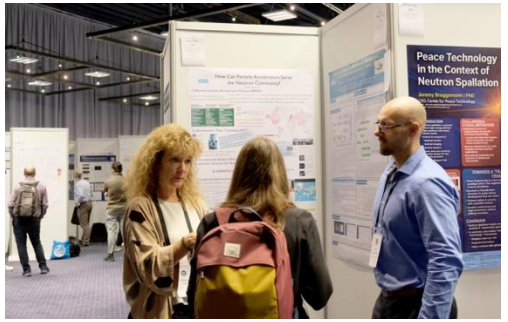

Neutrons for Europe


Auditorium 10-12
Balcony 1

Thank You!


FAU


Quiz
The ESS Road to Science


Peace Technology
in the Context of
Neutron Spallation


Neutrons for Europe
Quiz

EUROPEAN
SPALLATION
SOURCE