



FREIA Project Update

Reflectometry STAP

PRESENTED BY TOM ARNOLD

FREIA TEAM:

STFC ALEXANDRA CHRYSAFI, KEVIN JONES,...

ESS: CLARA LOPEZ, ELLEN WILSON,...

2025-10-21

Changes to the team

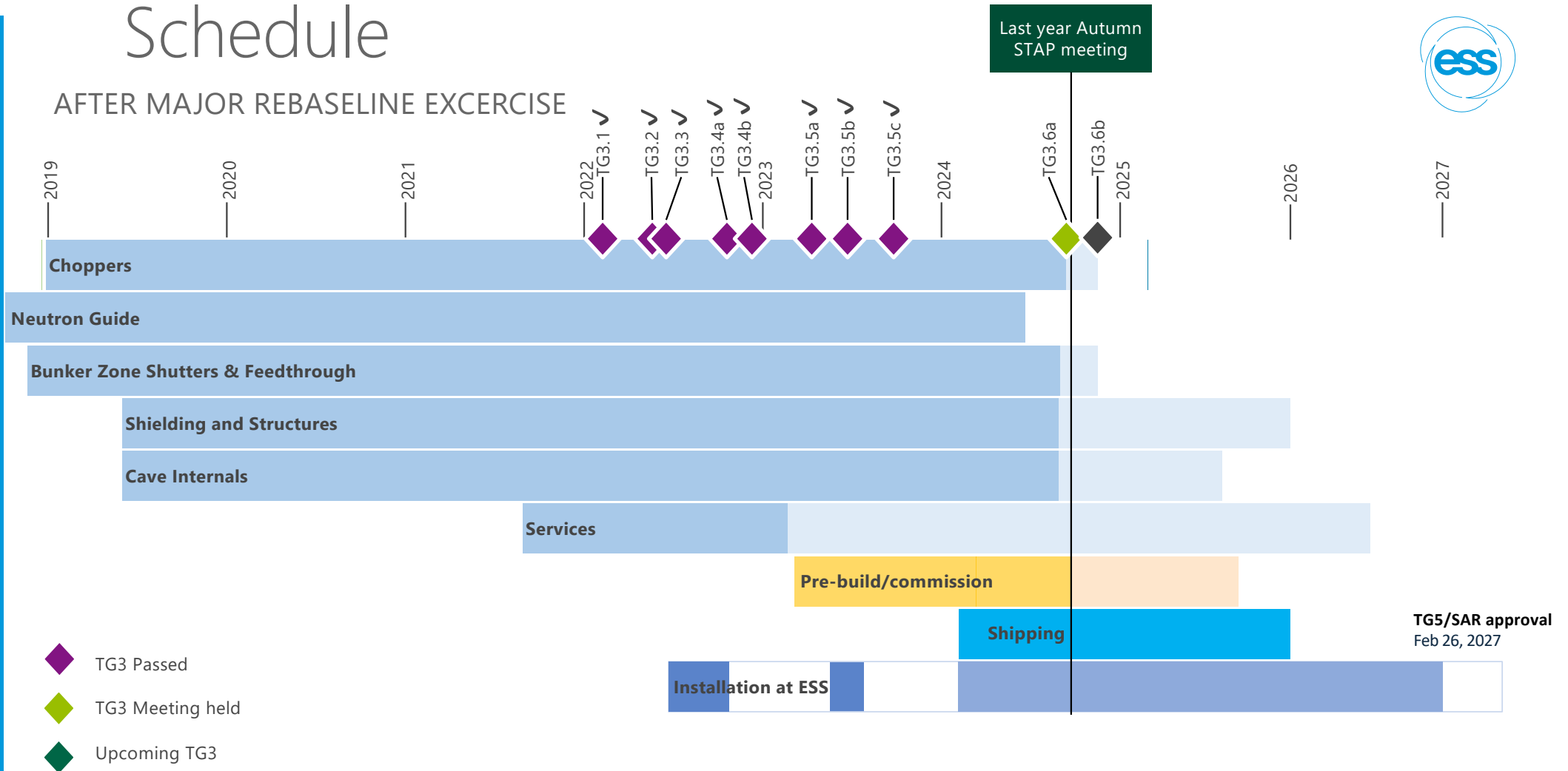
Since the last meeting



	2024 meeting	Now
Lead Scientist	Tom Arnold	Tom Arnold
Lead Engineer	Jone Elmer	Alexandra Chrysafi
STFC project manager	Kevin Jones	Kevin Jones
ESS integration engineer	Alexandra Schönbeck	Clara Lopez
Post doc	Ellen Wilson (part time)	On maternity leave until Jan
Instrument Associate	none	Recruiting
Instrument Data Scientist (shared with ESTIA)	Nico Paracini	Nico Paracini

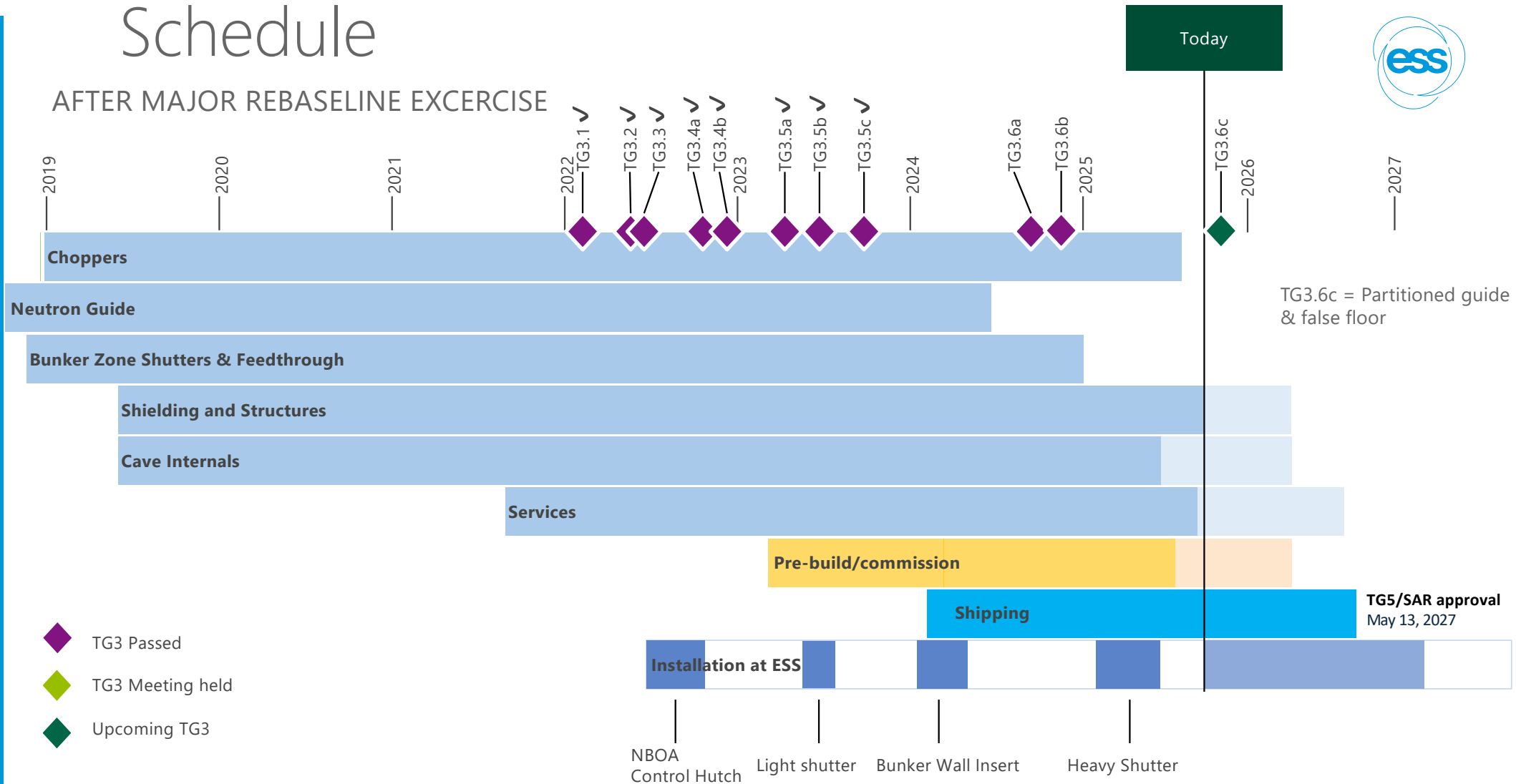
Schedule

AFTER MAJOR REBASELINE EXERCISE



Schedule

AFTER MAJOR REBASELINE EXERCISE



Freia Critical Paths

Data from P6 August 2024 lockdown

2024		2025		2026		2027
Q1	Q3	Q1	Q3	Q1	Q3	Q1

2027

Final TG3
Oct 29, 2025

Start of CC
Sep 28, 2026

TG5/SAR approval
Feb 26, 2027

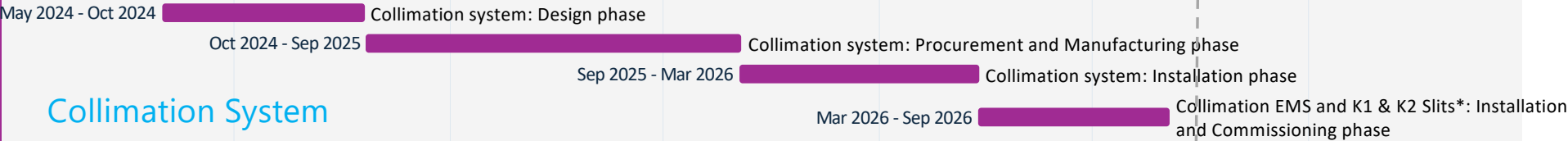
No. 1 - Critical
Path
(0 days TF)

Beam Monitors



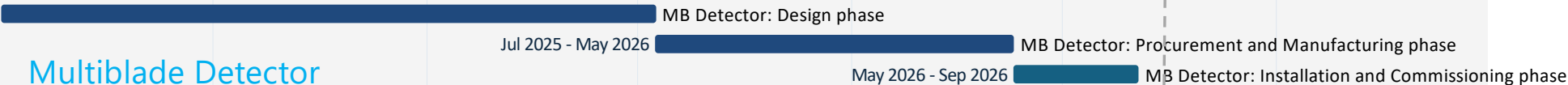
No. 2 - Critical
Path
(14 days TF)

Collimation System



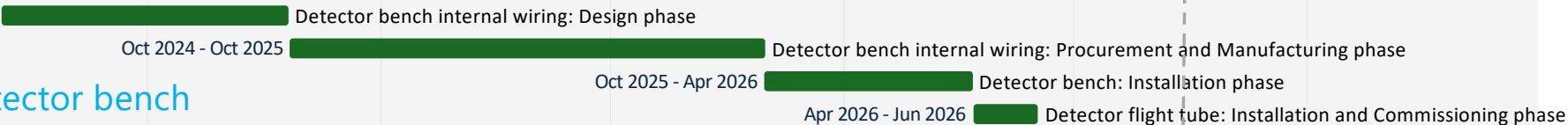
No. 3 - Critical
Path
(14 days TF)

Multiblade Detector



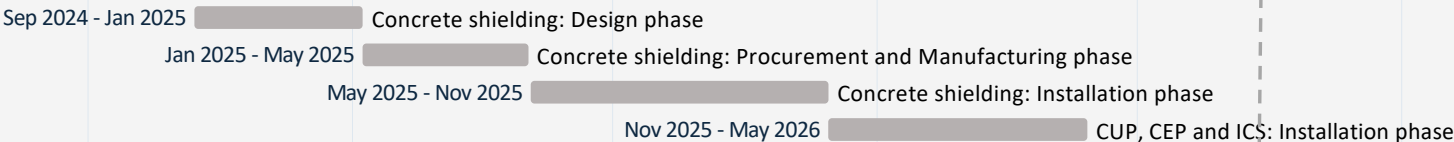
No. 4 - Critical
Path
(60 days TF)

Detector bench



No. 5 - Critical
Path
(64 days TF)

Cave



Design phase ends at CDR approval

Procurement and Manufacturing phase ends at FAT closure of open points

Installation and Commissioning phase ends at SAT approval

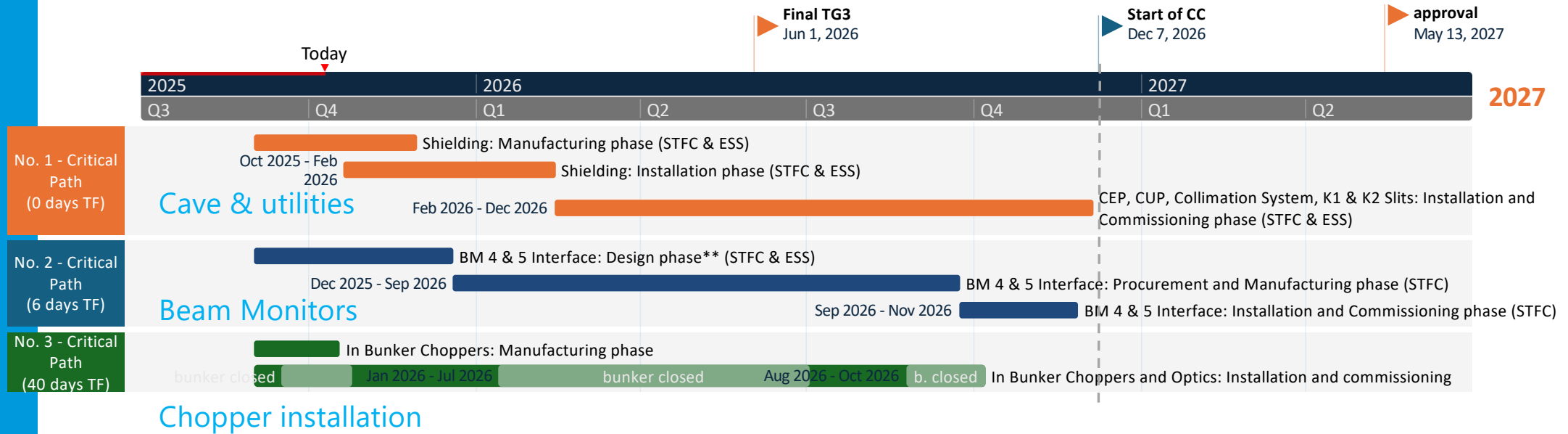
TF: number days of total float to Instrument's TG5

*Dependency to beam monitor project

Note: Beam Monitors 3-6 are not included in the above critical paths. Plans are under evaluation

Freia Critical Paths

Data from P6 September 2025 lockdown



Design phase ends at CDR approval

Procurement and Manufacturing phase ends at FAT closure of open points

Installation and Commissioning phase ends at SAT approval

TF: number days of **total float** to Instrument's TG5

**Dependency to beam monitor project

Note: Beam Monitors 3-6 are not included in the above critical paths. Plans are under evaluation

FREIA Status



WFM Choppers

- Quality issues resolved
- Testing complete
- Shipping in progress

WBC chopper discs

- Manufacture complete
- Testing complete
- Shipping in progress

Collimation System

- Mostly complete
- Finalising wiring and testing

Detector Bench

- Assembly/Testing of motion system in progress

Services

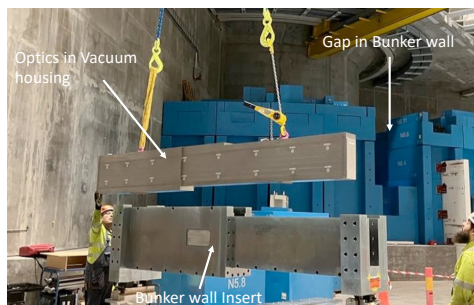
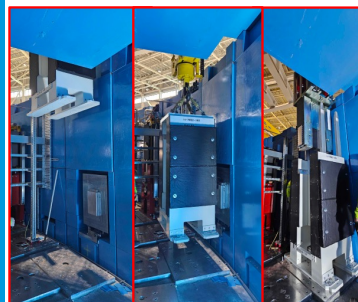
- Design concepts frozen
- In detailed design

Heavy Shutter

- Installed

Bunker Wall Feedthrough

- Installed



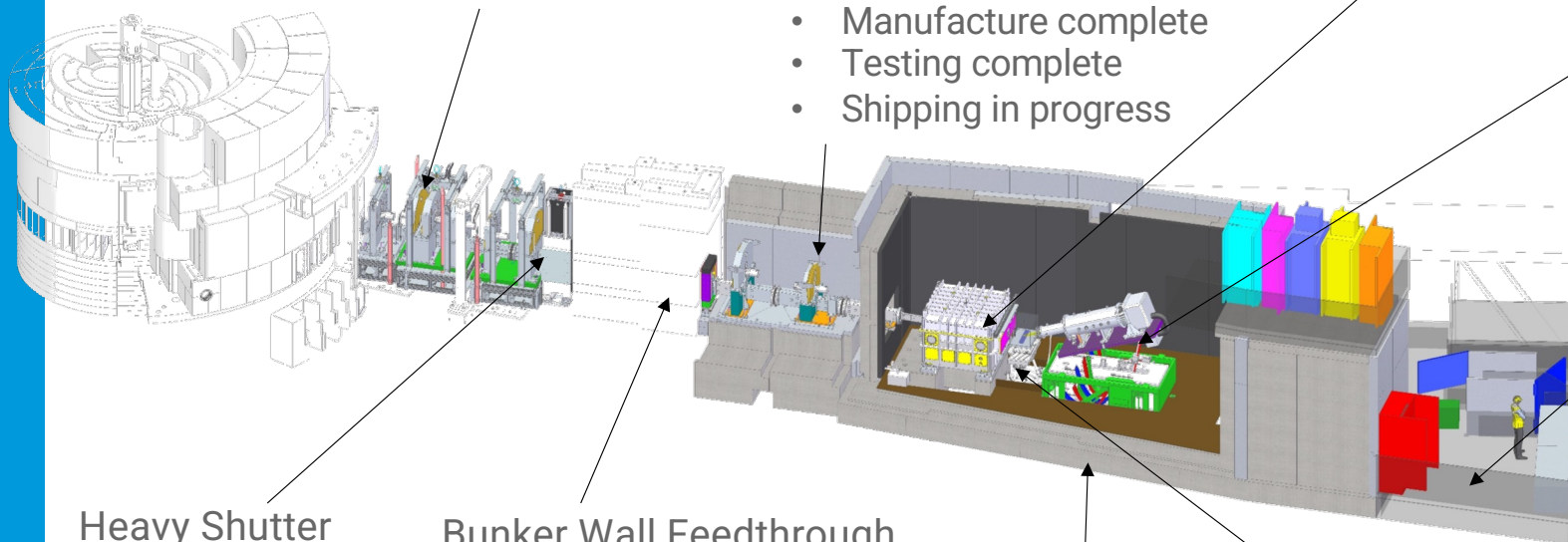
Sample Positioning System

- Delivered to ESS
- EPICS testing offline in E01

Shielding

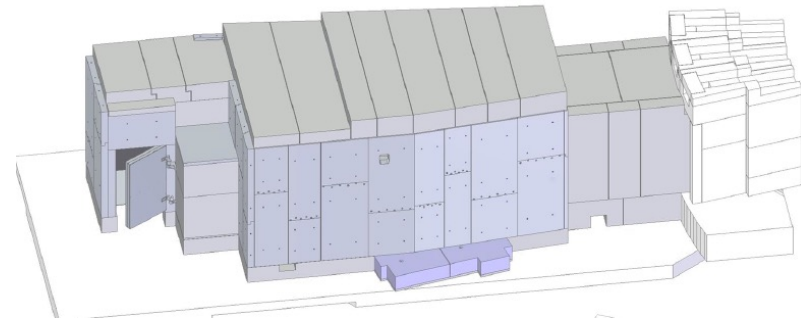
- Concrete installation starts this week
- Steel Manufacture in progress, installation starts November

Hutch furniture delivered!



Installation Progress

Installation of key components at ESS
Cave installation started on Monday!

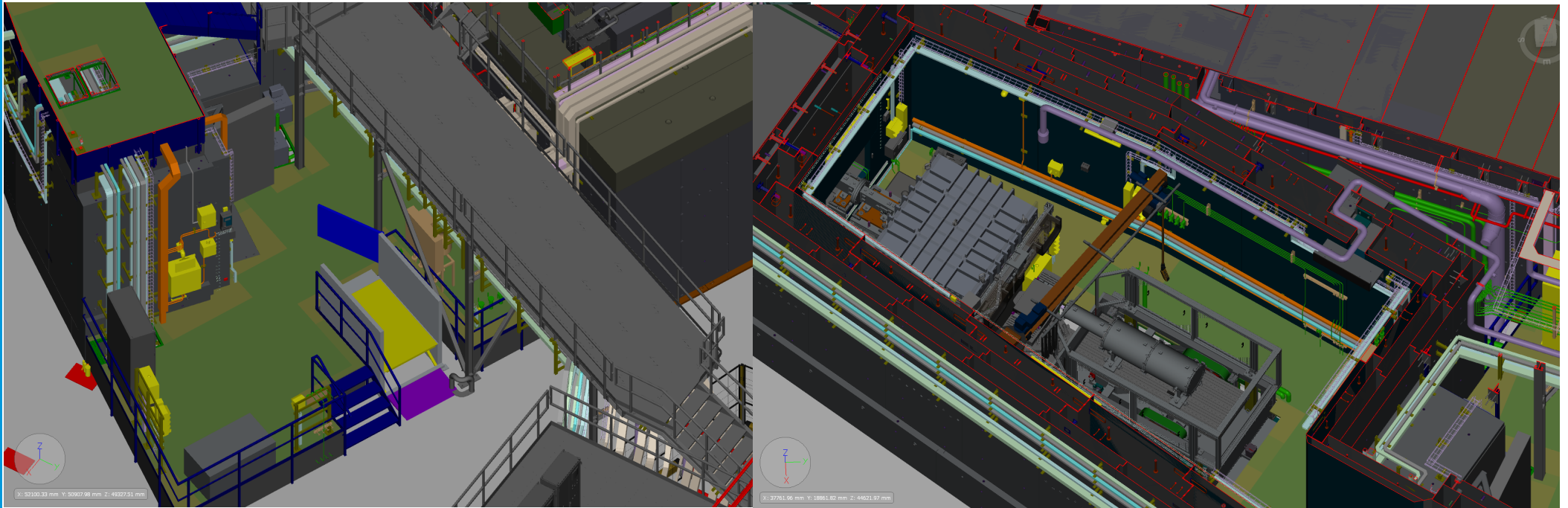


24 hrs



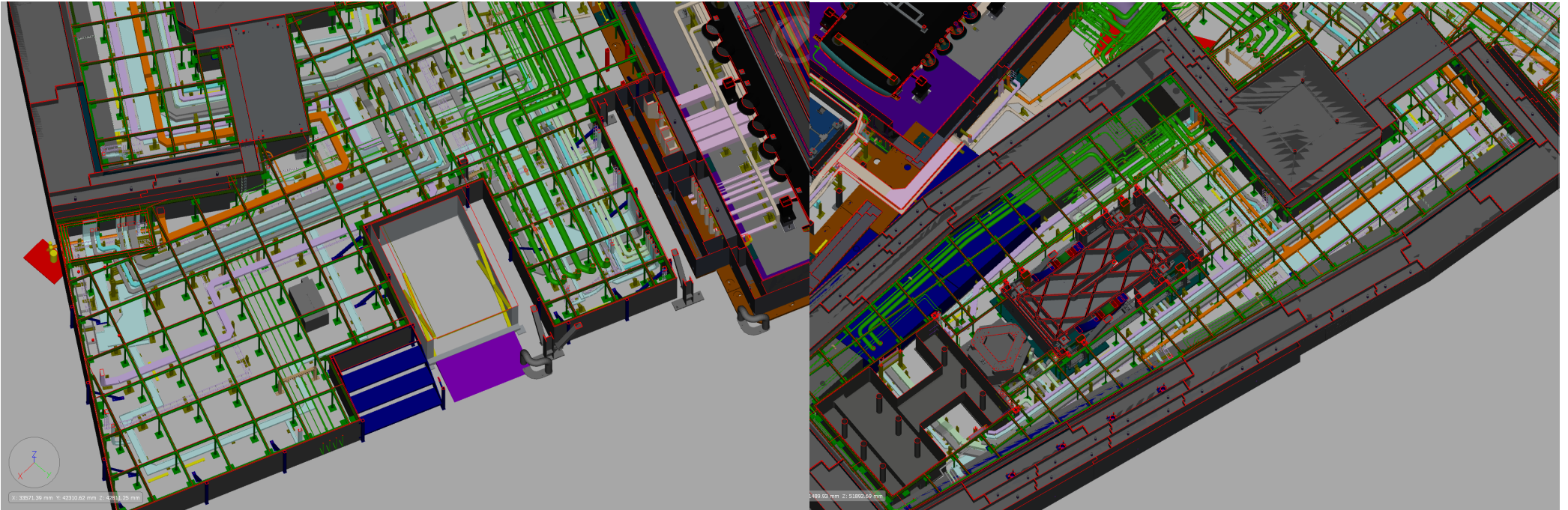
Common Electrical and Utilities

Designs concepts are effectively frozen and detailed design in progress



Common Electrical and Utilities

Designs concepts are effectively frozen and detailed design in progress



FREIA Choppers



All choppers fully tested at ISIS

Delivery to be scheduled in October

Looking at the details of testing and installation now...

- Significant reassembly and testing required before final installation
- need to work around bunker open periods
- Final install is likely to be post-BOT bunker open period in July



FREIA Choppers

Wavelength Frame Multiplication

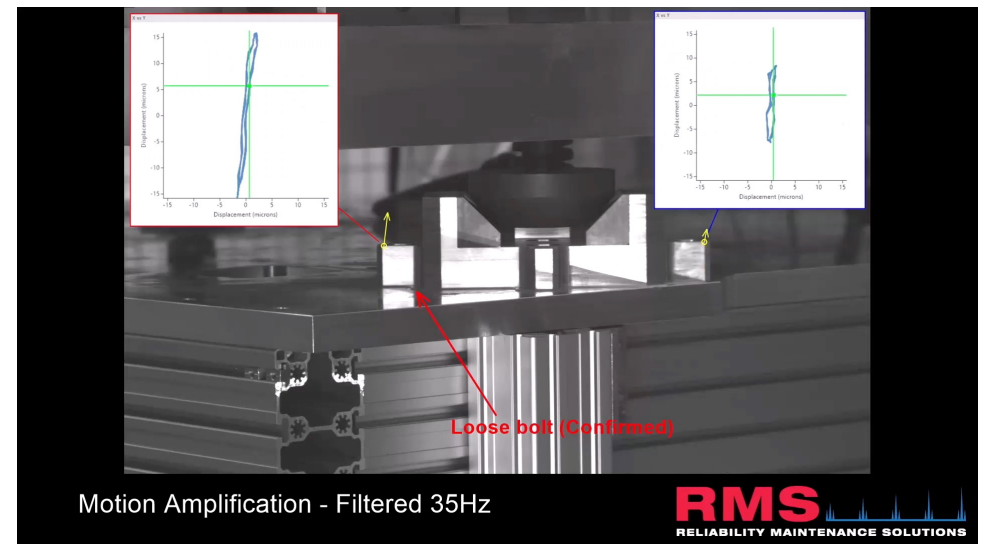


Testing identified various vibration issues:

Modules with multiple choppers showed vibrations during the balance optimisation process

Video helped identify resonances, possible assembly issues and led to improvements to the stiffness.

Final testing at ESS will need to be done with the same base configuration.

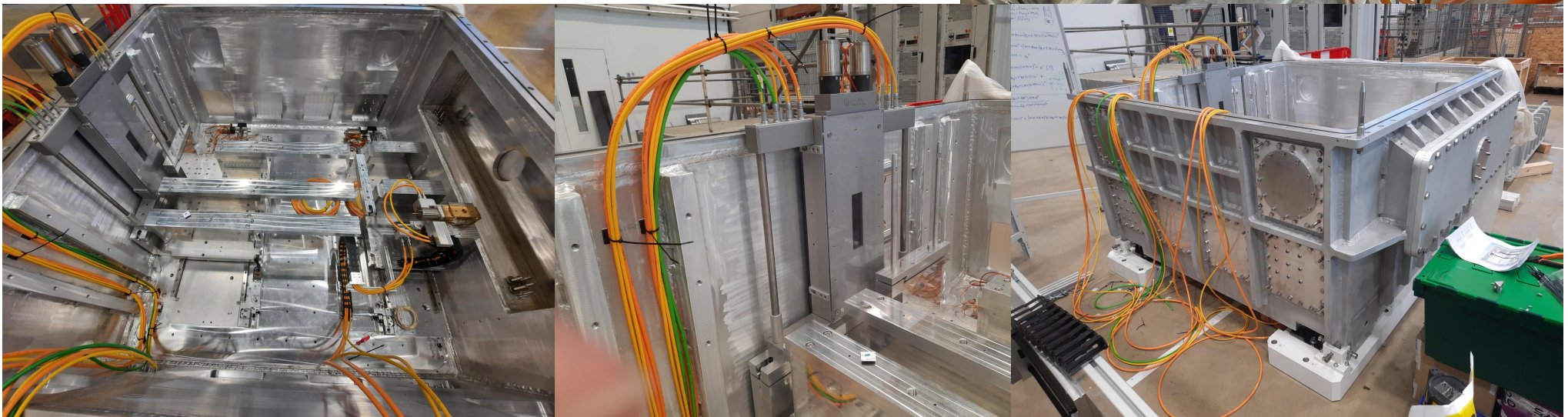
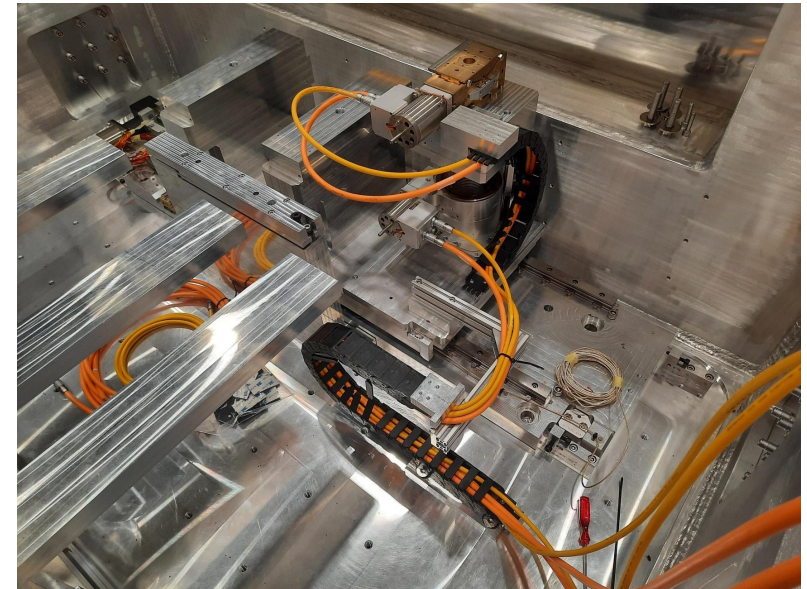


Collimation System

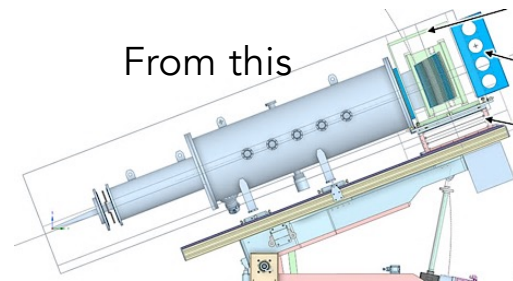
Final assembly and motion testing is underway (using temporary cables)

Identified some wiring issues that required new parts – this has meant a delay of a few months to delivery, now planned late this year

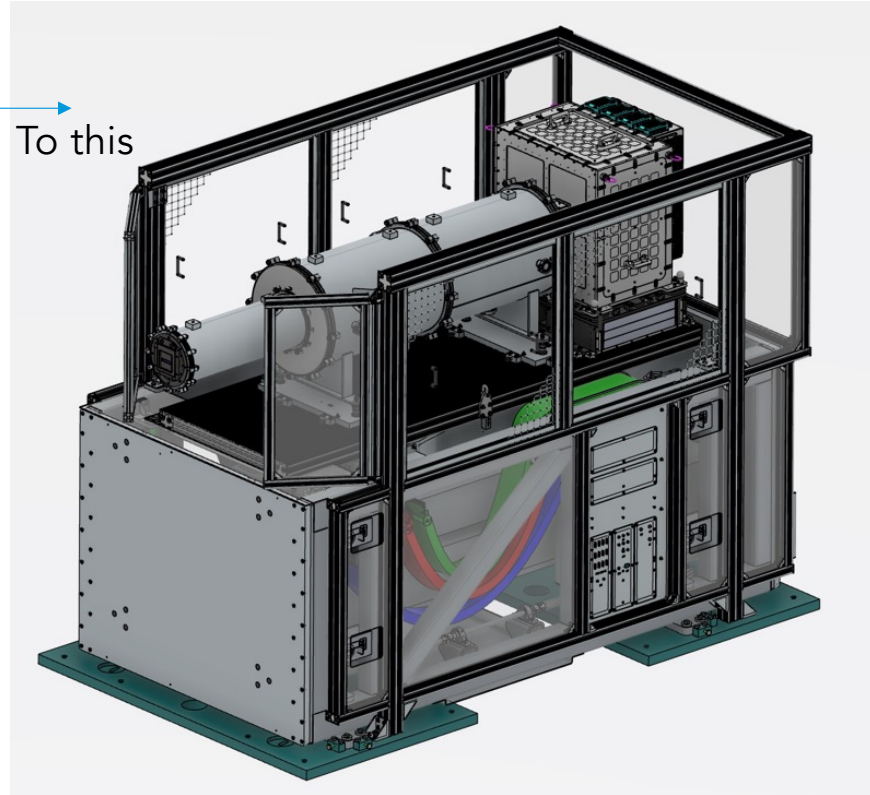
Final design/pre-build task is looking at cable management for the monitor etc.



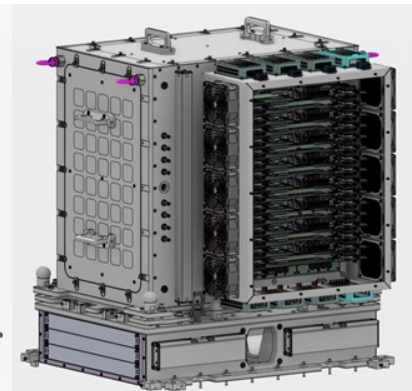
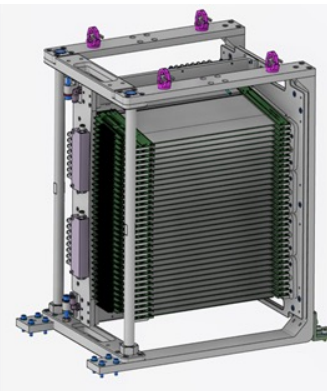
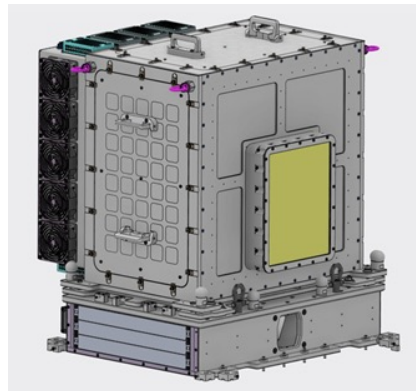
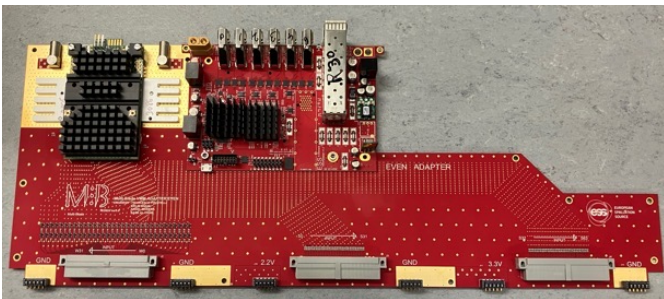
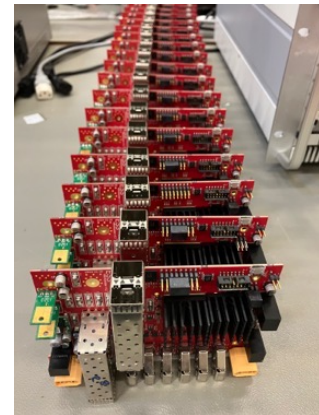
Multi-Blade: FREIA



To this



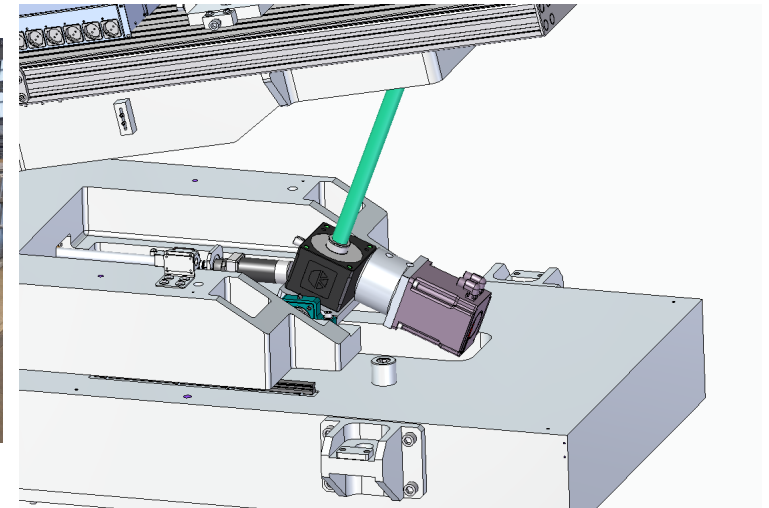
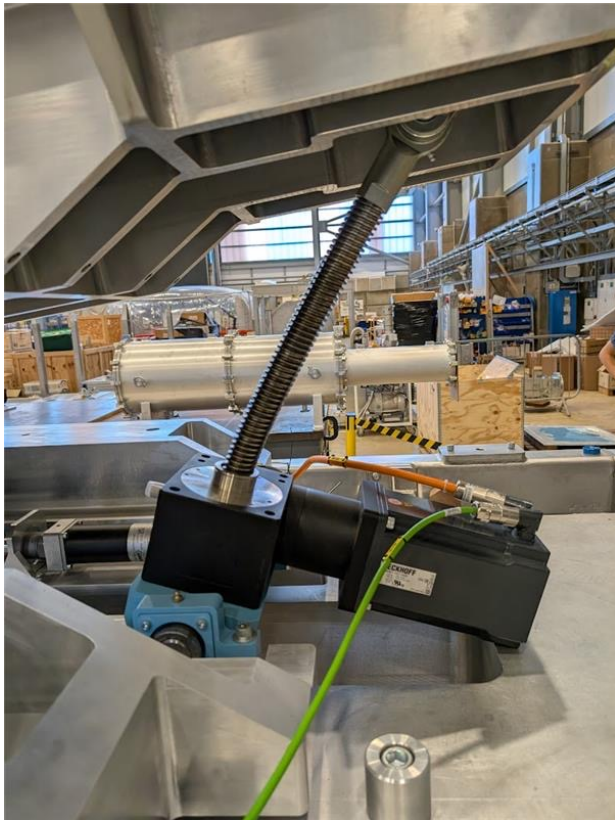
- Detailed design nearly finished
- Documentation on-going
- Electronics finalized and some tested, some in production
- Mechanics manufacture starts soon
- Blades already in Utgard and tested
- TO DO:
 - CE marking
 - Documentation
 - Cable manufacture
 - E-plan



Detector Bench



During testing the rotation stage was operated while the linear X-Axis stage was not in the correct position. This caused the motor to clash with the table bending the screw.

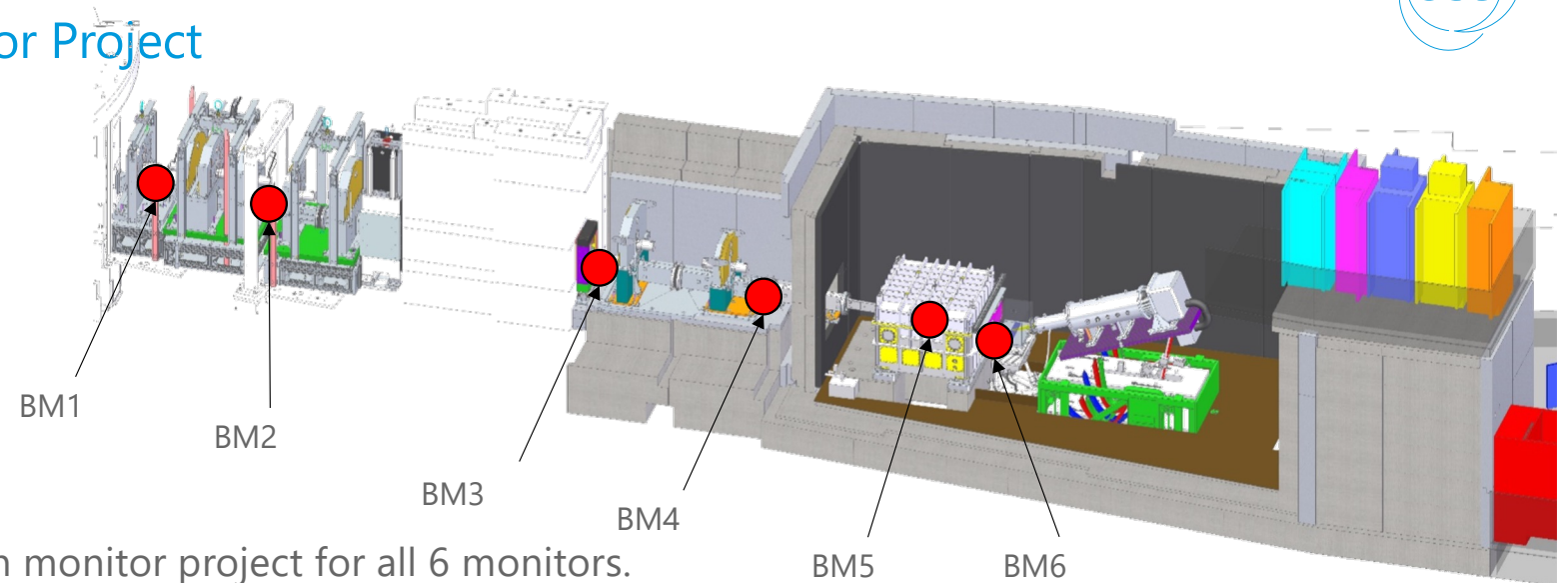


In 4 weeks:

- Jacking screw was sent for repair and has returned
 - Z-Axis table was disassembled for re-surveying
 - Components inspected
 - Re-assembly has begun with no expected delays to end date
- For Future testing and operation, Clash avoidance software will be used ensuring no repeat incidents.
- Delivery to ESS delayed (to Jan) but does not impact installation

Beam Monitor Progress

Common Monitor Project



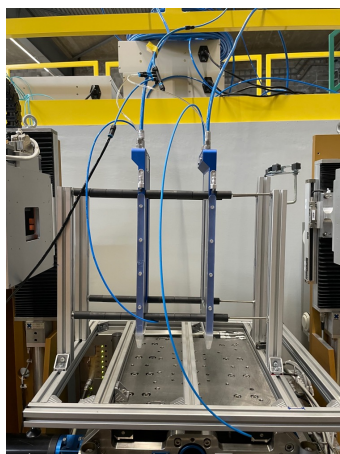
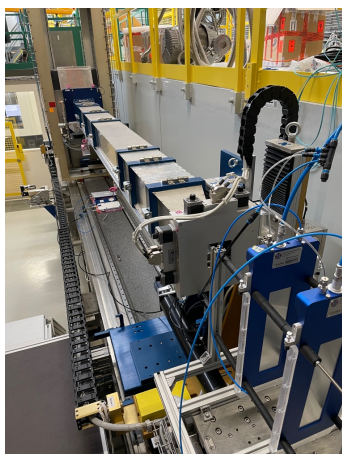
FREIA is part of common monitor project for all 6 monitors.

- In-bunker monitors
 - BM1 chopper diagnostic
 - BM2 chopper diagnostic
- Out of bunker – delayed due to prioritization of monitor project
 - BM3 chopper diagnostic
 - BM4 chopper diagnostic
 - BM5 in-collimation diagnostic
 - BM6 normalisation

Beam monitor system - FREIA

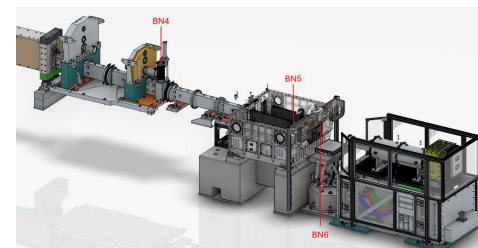
Status update

CDT I-BM
designed
specifically for
FREIA (Feb 2025)

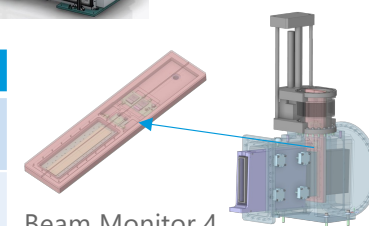


FREIA BM1 & BM 2 successfully tested at
AMOR-PSI (Jun 2025)

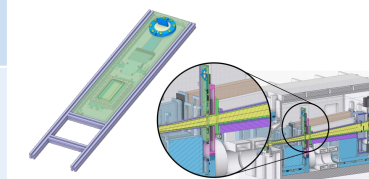
Out of bunker beam
monitor locations



BM#	Technology	Function	Zone	Status
1	CDT I-BM	WBC1 monitoring	Bunker	Delivered & Tested
2	CDT I-BM	PSC1-3 monitoring	Bunker	Delivered & Tested
3	CDT I-BM	WBC2 & PSC4 monitoring	D03	Procurement expected by end of 2025
4	ESS-NFM (0D) (in vacuum)	Outside bunker/WBC3 & PSC5 monitoring	D03	Vacuum vessel and PCB under design
5	ESS-uRWELL (1D) (in vacuum)	Pre-sample/fast-shutter diagnostics	D03	Vacuum vessel and PCB under design
6	ESS-NFM (0D)	pre-sample/normatisation	D03	Prototype testing



Beam Monitor 4
ESS-NFM



Beam Monitor 5
ESS-uRWELL



Beam Monitor 6
ESS-NFM

*In-bunker BM installations are aligned with bunker opening dates and installation of relevant equipment of the instrument
(Currently planned for Jul 2026)*

Fast Shutter Concept

Significantly increases the speed for angle changes



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Technology
Facilities Council

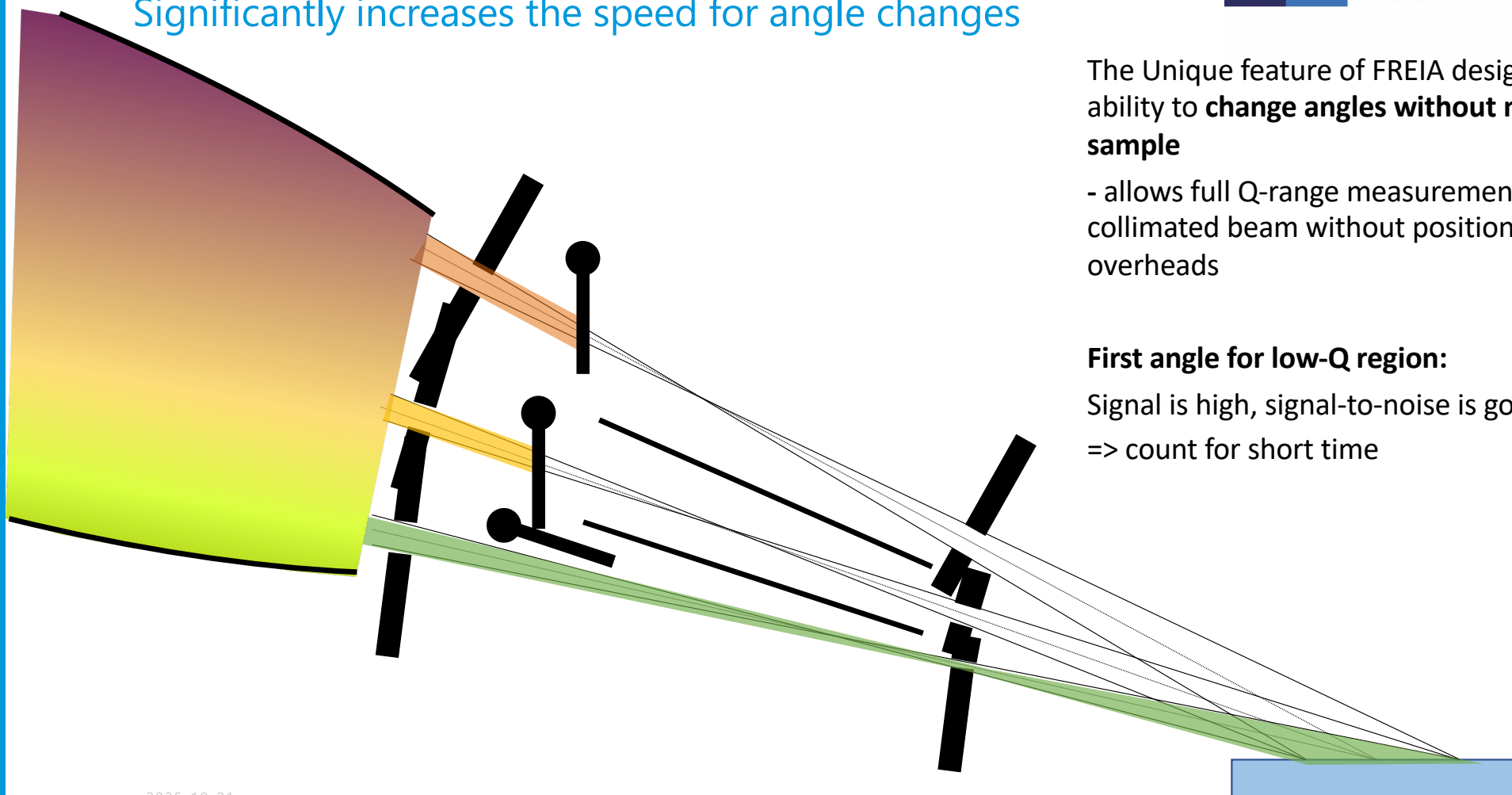


The Unique feature of FREIA design is the ability to **change angles without moving sample**

- allows full Q-range measurement with collimated beam without positioning overheads

First angle for low-Q region:

Signal is high, signal-to-noise is good
=> count for short time



Fast Shutter Concept

Significantly increases the speed for angle changes



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Facilities Council

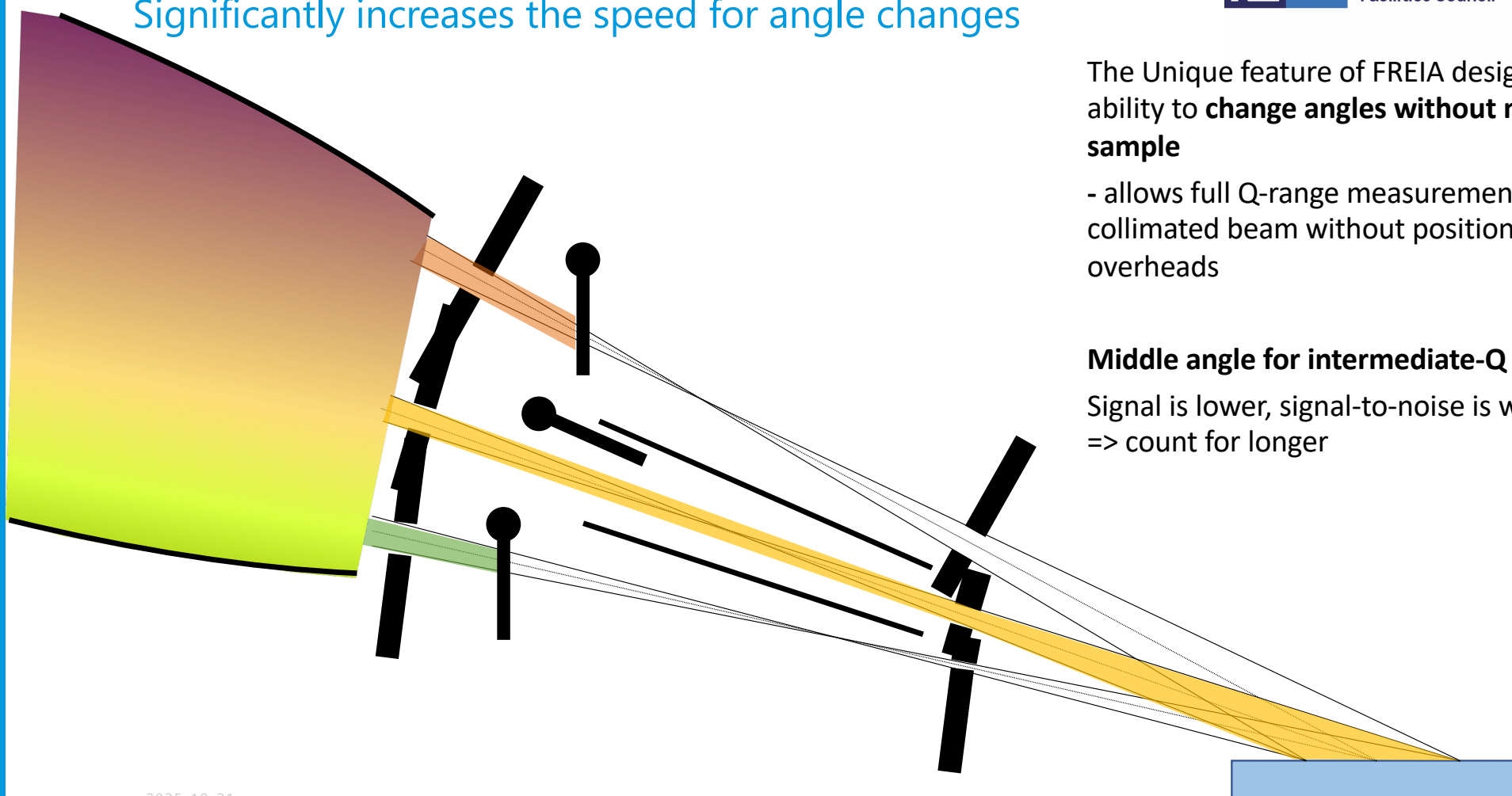


The Unique feature of FREIA design is the ability to **change angles without moving sample**

- allows full Q-range measurement with collimated beam without positioning overheads

Middle angle for intermediate-Q region:

Signal is lower, signal-to-noise is worse
=> count for longer



Fast Shutter Concept

Significantly increases the speed for angle changes



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Facilities Council

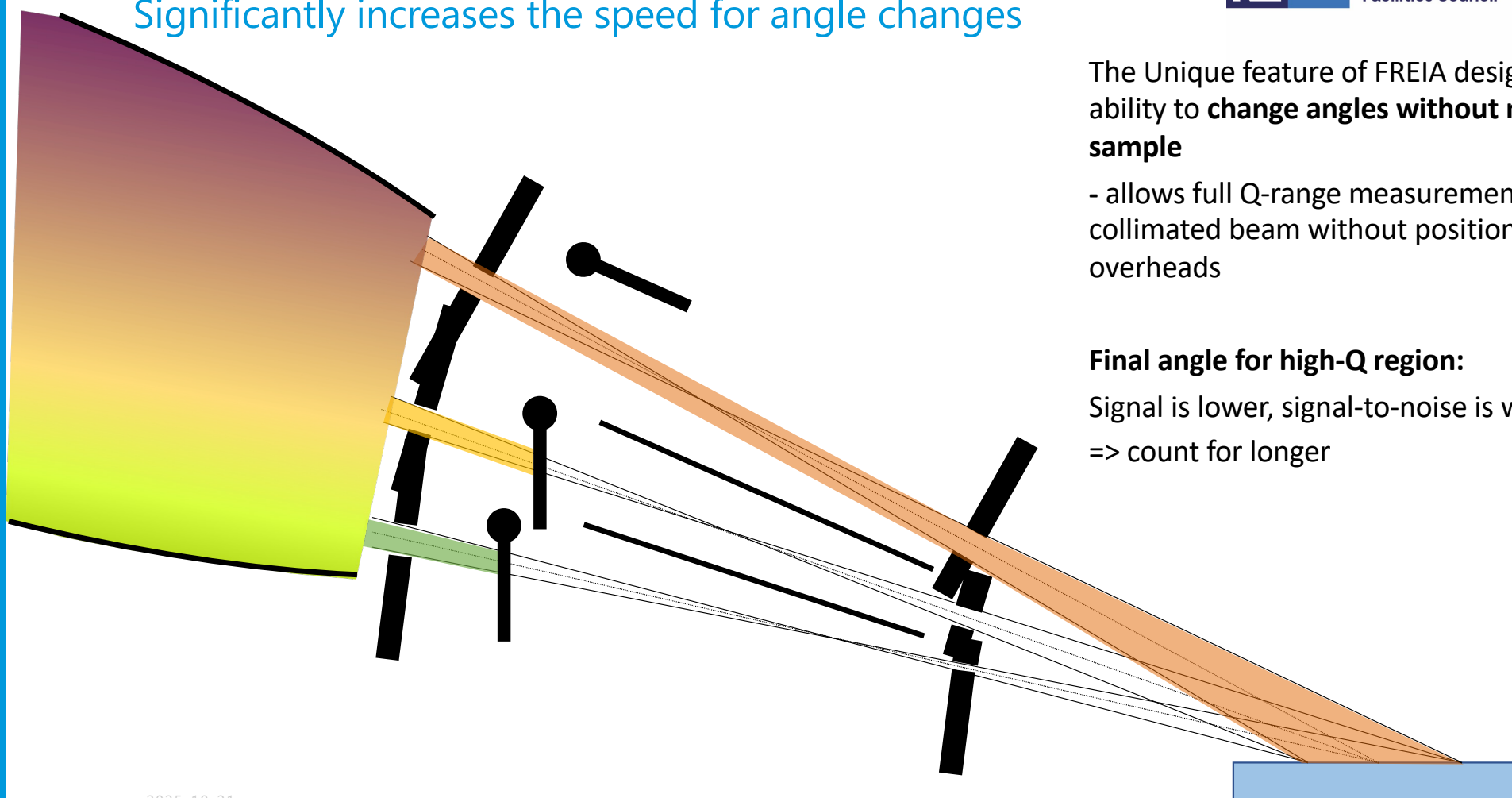


The Unique feature of FREIA design is the ability to **change angles without moving sample**

- allows full Q-range measurement with collimated beam without positioning overheads

Final angle for high-Q region:

Signal is lower, signal-to-noise is worse
=> count for longer



Fast Shutter Progress

Development project funded by VR



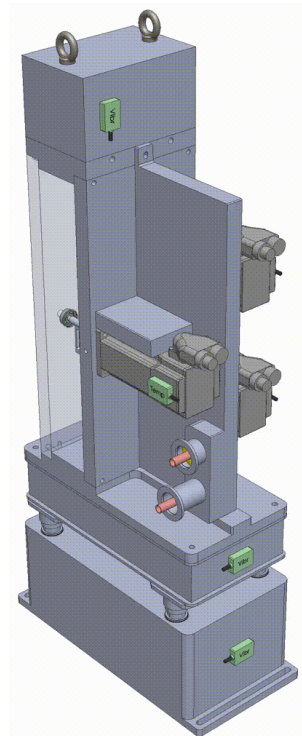
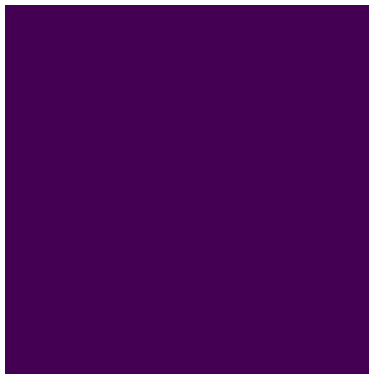
Fast shutter technology concept was proven with VR funded project in collaboration with FREIA lab at UU

TG3 passed and in manufacture!

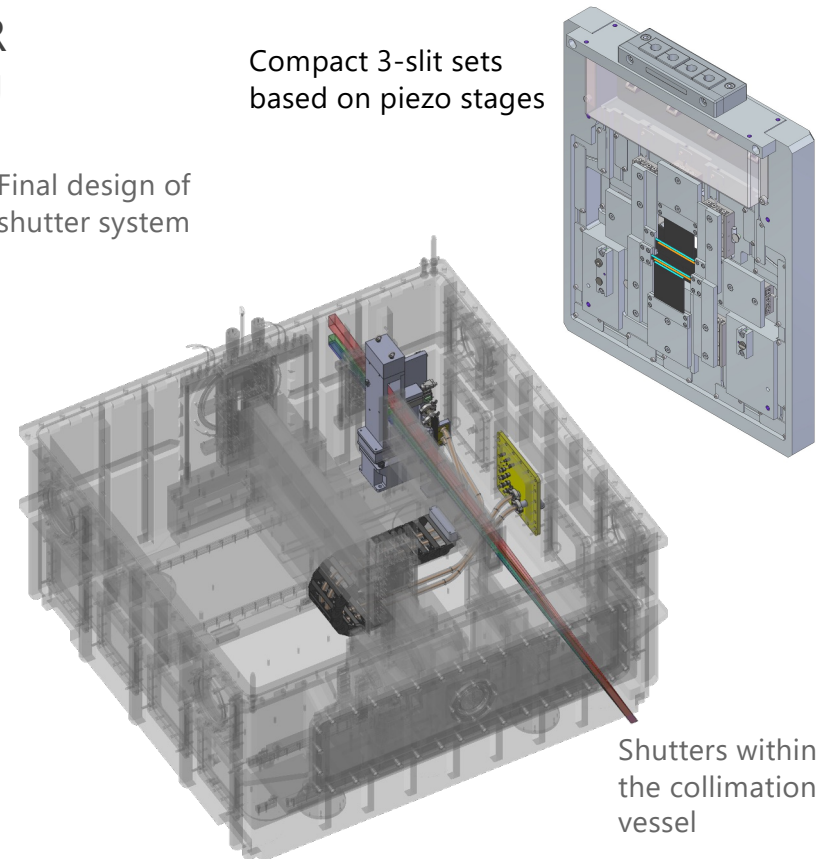
To be installed with the rest of the collimation system



Test measurement at ISIS (ZOOM)



Final design of shutter system



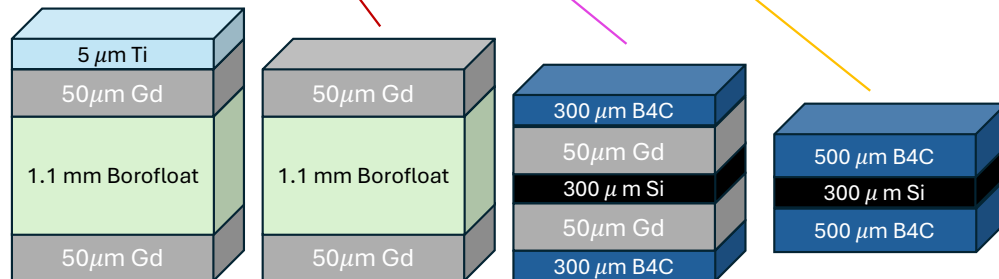
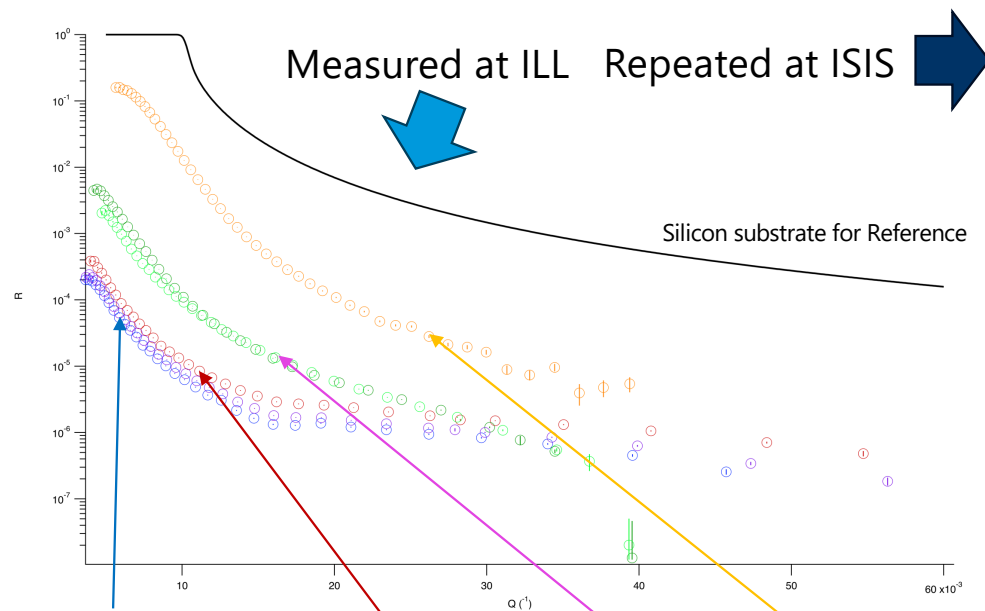
Compact 3-slit sets based on piezo stages

Shutters within the collimation vessel

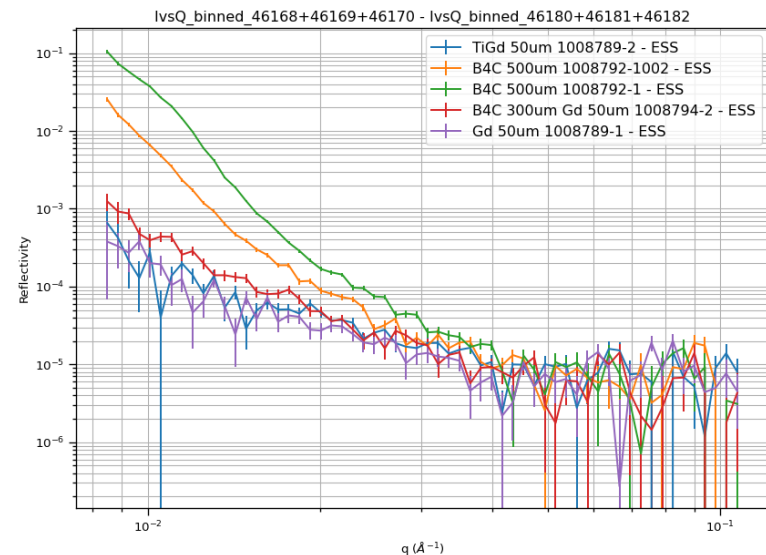
Partitioned guide under development

Fast Shutter Progress

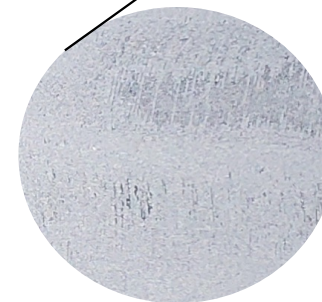
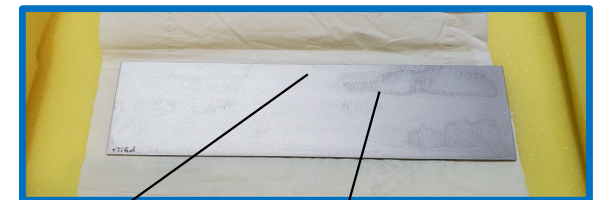
Absorbing vane NR tests



Guide detailed design in progress with TG3 in November



Deliberately roughened surface



Thanks to
Philipp Gutfreund,
Sophie Ayscough,
Max Skoda,
Andrew Caruana

Top risks and issues



- Chopper testing at ESS still has a high risk
- Logistics of deliveries from STFC has been problematic – could cause delays to the cave construction
- Jon Elmer is now only available to consult, which means legacy knowledge is harder to deal with
- **A lot** of installations are about to happen – many dependencies and potential resource constraints

Questions?

Sample Environment

Several projects including developing automation

- Solid-liquid changer for FREIA under design
- Robot arm liquid trough exchange – prototyping concepts
- Subphase exchange in Langmuir troughs – prototyping concepts
- In-situ IR and Ellipsometry – all parts delivered

