Heimdal Instrument STAP Meeting

Dan Mannix

Lead Scientist Heimdal Instrument ESS, Lund Sweden

ESS - October 25th 2022

Previous STAP Report

EUROPEAN SPALLATION SOURCE

HEIMDAL

HEIMDAL will offer a combination of powder neutron diffraction, small angle neutron scattering (SANS) and neutron imaging to enable complex and evolving systems to be studied over multiple length scales. Separate guides and detectors for the cold and thermal neutron spectra are integral to the instrument plan. STAP continues to support the original science case to which the simultaneous measurements are fundamental.

- STAP notes continuing good progress of HEIMDAL plans. The instrument SoUP is expected to be 2028. Two areas of high risk were identified in the ESS Risk register – delay to installation of the T0 chopper, and the guide plans.
- The T0-chopper risk seem to be declining and is bearable given other delays to the ESS project.
- The putative Change of Scope request to include the cold guide within the initial construction phase is a long-running issue. As ever we encourage the HEIMDAL team and ESS to reach agreement over the instrument budget and build. Good progress on gathering costs to provide an accurate budget is noted and STAP recommends that this process is completed for a firm deadline of the next (October 2022) STAP meeting.
- Provision of adequate Engineering support for the project is becoming a critical issue as detailed designs for many components will soon be required. This needs to be addressed at project management level with proper costs for the time of additional engineers built into the overall budget.
- STAP continues to recommend that the original science case of Diffraction + SANS + Imaging be achieved as early as possible.

T0 Chopper not before (current) BOT Q1 2025

Real Progress made on Cold Guide

Additional Engineering agreed (verbally)

1.1 Overview of Components

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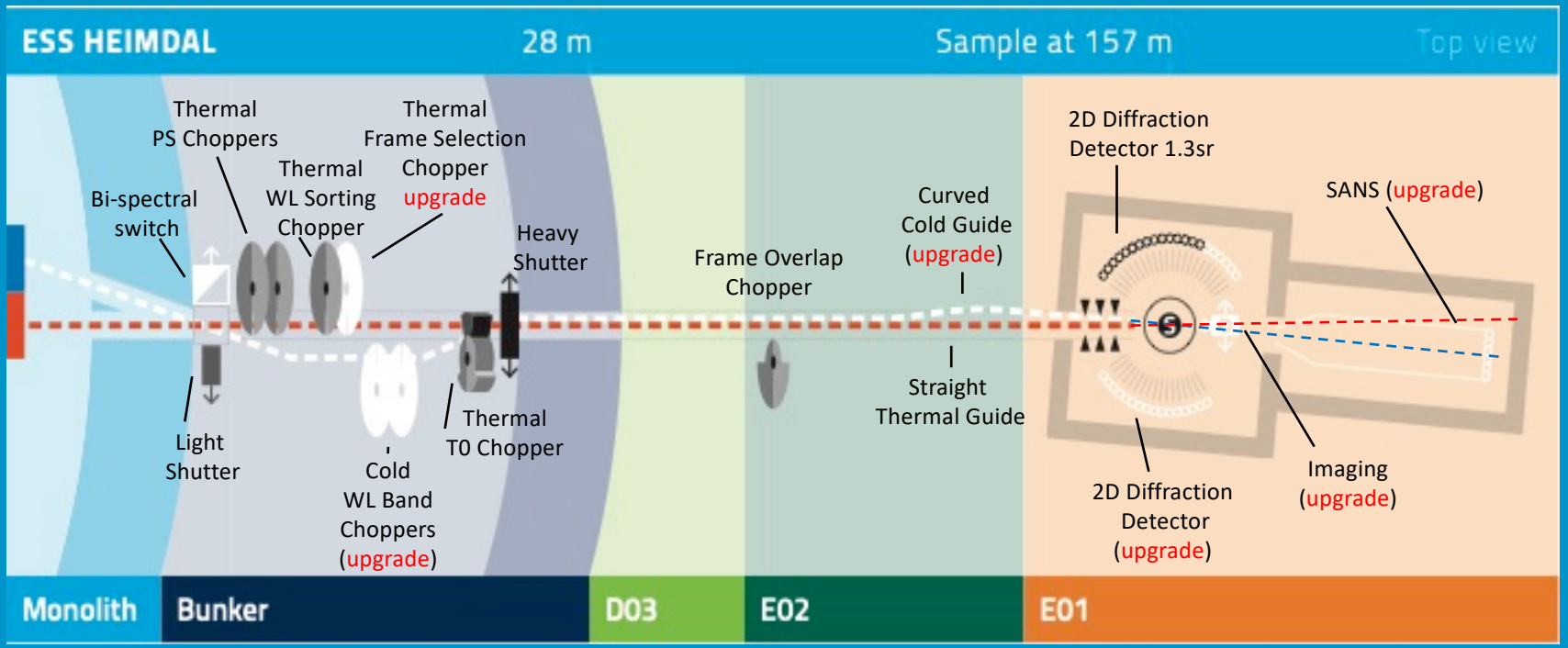
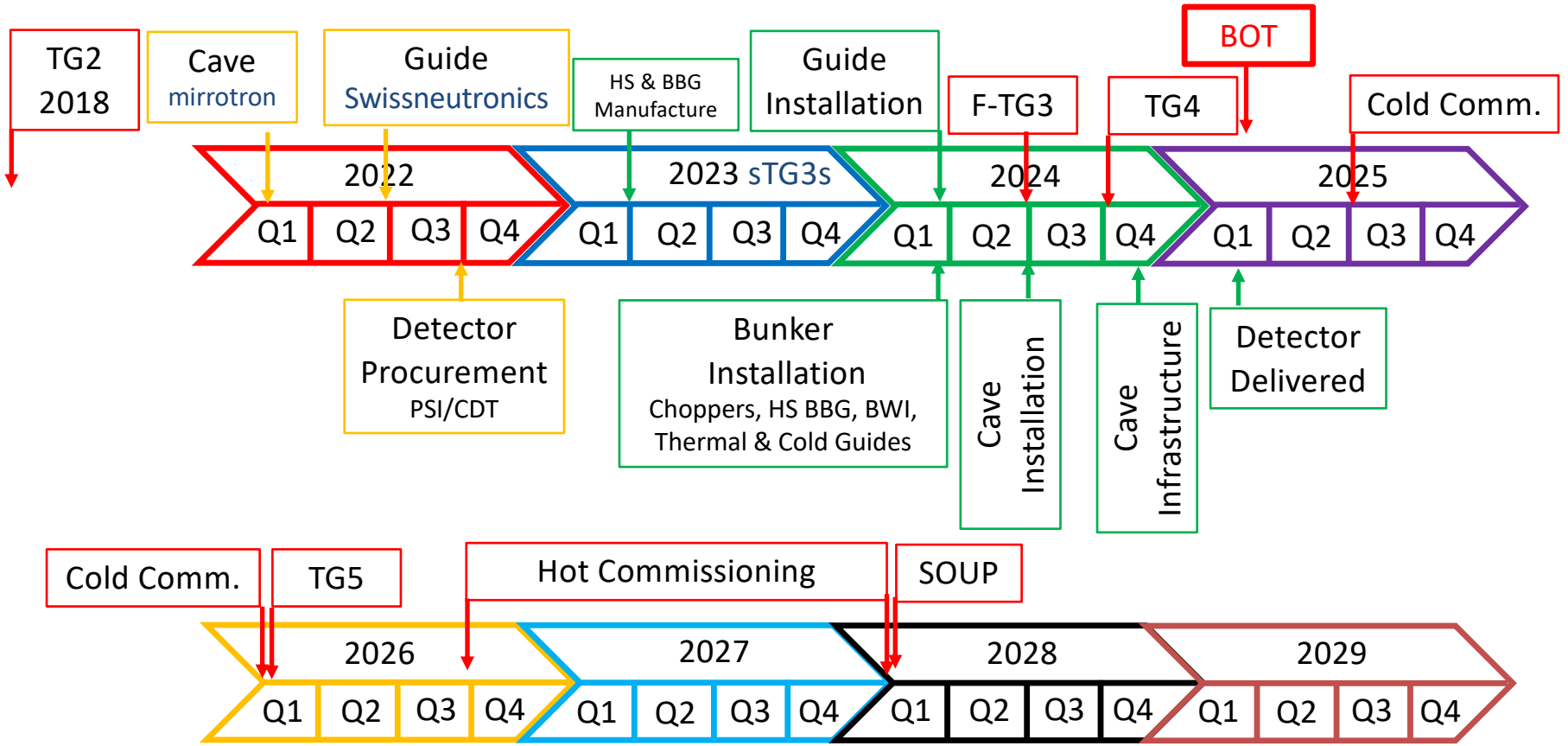


Phase 1: Thermal Neutron Powder Diffraction
Upgrade: Cold Guide SANS
Upgrade: Neutron Imaging

1.1 Heimdal Schedule Overview



2.1 Heimdal RISK Register
2.3 Additional Engineering Support

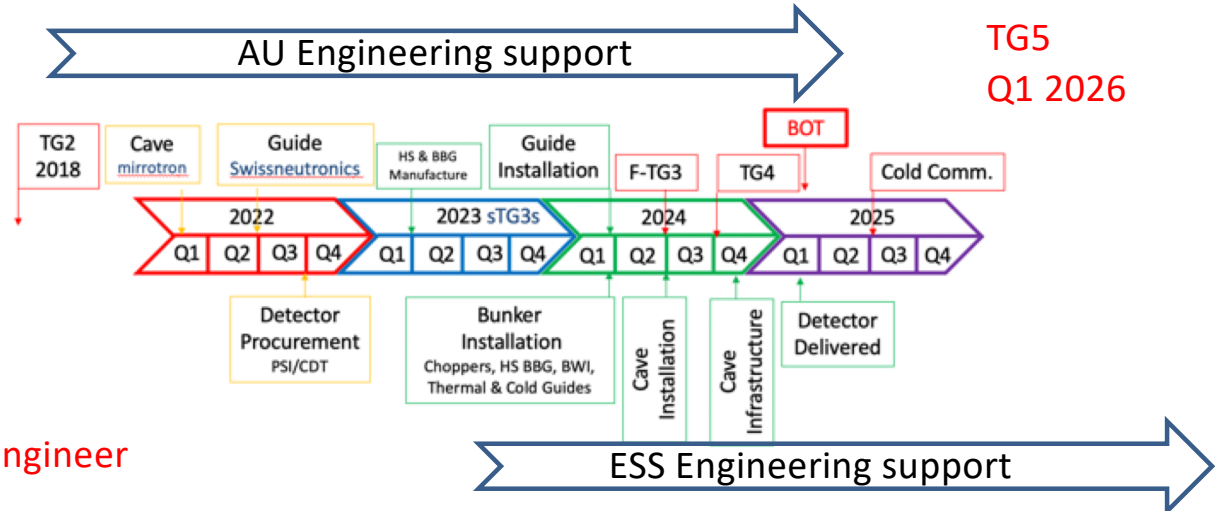
EUROPEAN SPALLATION SOURCE

Top 5 Risks

Title	Rating	Category	Partner	Treatment
RISKS to Heimdal project: Delay, Quality & Costs	20	Cost	ESS	Reduce
SANS upgradability	16	Quality	ESS	Reduce
Delay of 2D Detector Procurement from PSI	4	Schedule	PSI	Reduce
T0 Cost / High Background	4	Quality	ESS	Observe
Delay of Guide procurement from PSI	4	Schedule	PSI	Reduce

As a result of lack of Engineering resources based at ESS. Lead Engineer is only Engineering resource, based in Denmark. Close to retirement age. No Engineering manpower. There is a risk that Heimdal can not complete engineering documentation according to schedule. Lead engineer retiring and not enough overlap with replacement engineer. Risk of delay and quality of final instrument. This would result on delay in instrument schedule. Impact quality of Instrument delivered. Increased labor costs from delay.

Because a proposal for simultaneous build of cold and thermal guide is rejected there is a risk that an upgrade to support the SANS options will be too costly resulting in the instrument will never get upgraded to this scope and loose part of its intended purpose/science case.



ICEB Meeting has agreed to hire additional engineer

2.4 Heimdal Guide (PSI) Project Awarded to Swiss Neutronics

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Dear Dan, dear Werner,

I am happy to inform you that PSI has received a suitable offer from SwissNeutronics AG for the HEIMDAL optics WTO specification (see attached). The proposal fully complies with all our technical requirements and the price for the base project + option 1 are reasonable and lie within our budget for this item [redacted] (incl. contingency)).

The supplier will not be able to meet the desired delivery schedule for the in-bunker components, but the exact delivery dates will depend on the date of the signature. We hope that, with the recent delays to ESS, we might still be able to install these items in the available bunker access spot.

We will now enter price negotiations and subsequently sign the procurement contract as soon as possible to prevent further delays.

Kind regards,
Artur

2.4 Heimdal Guide (PSI) Project Awarded to Swiss Neutronics

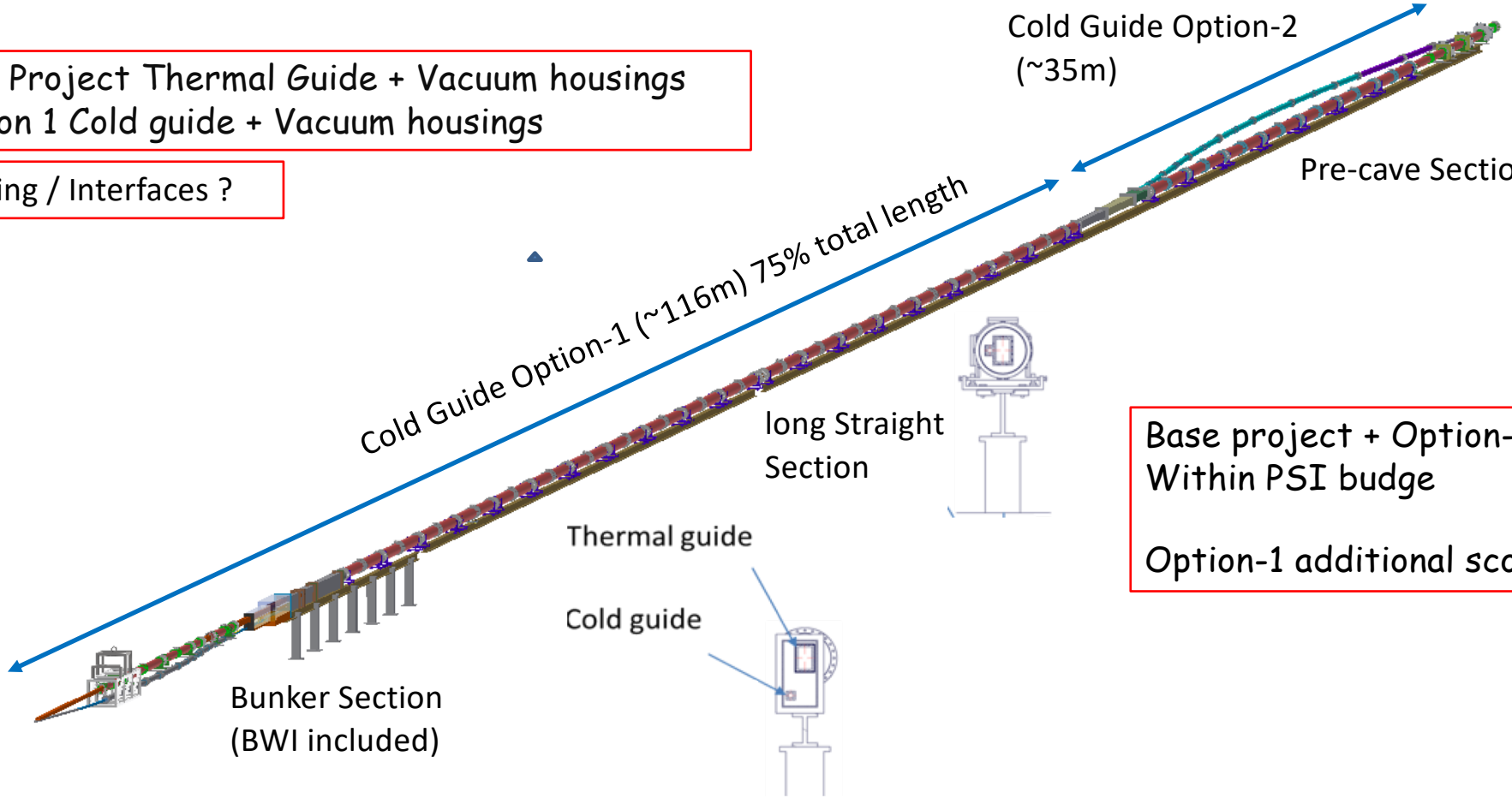
EUROPEAN SPALLATION SOURCE

2.4 Heimdal Guide (PSI) Project Awarded to Swiss Neutronics

EUROPEAN SPALLATION SOURCE

(1) Base Project Thermal Guide + Vacuum housings
(2) Option 1 Cold guide + Vacuum housings

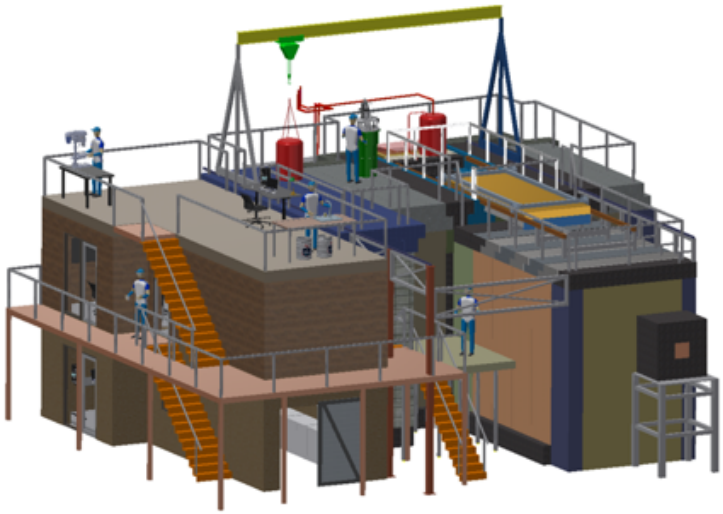
Engineering / Interfaces ?

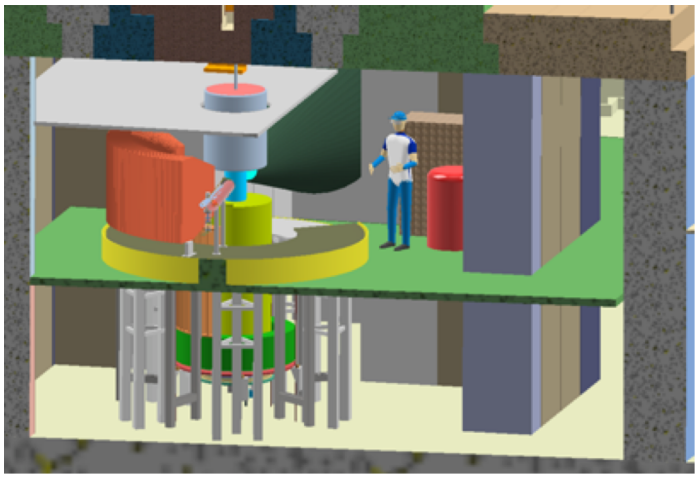


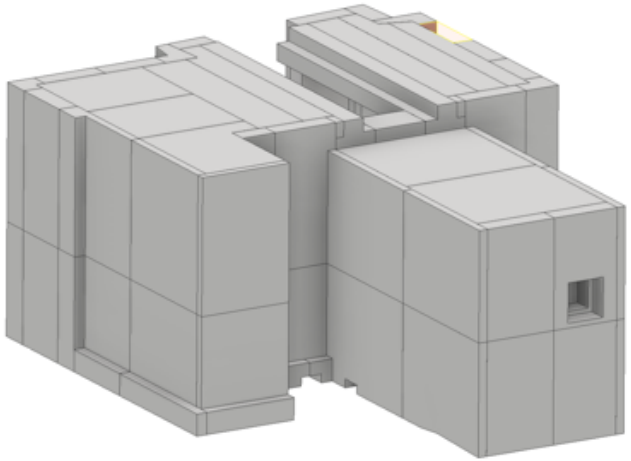
Base project + Option-1
Within PSI budge

Option-1 additional scope

2.5 Cave Shielding : Mirrotron





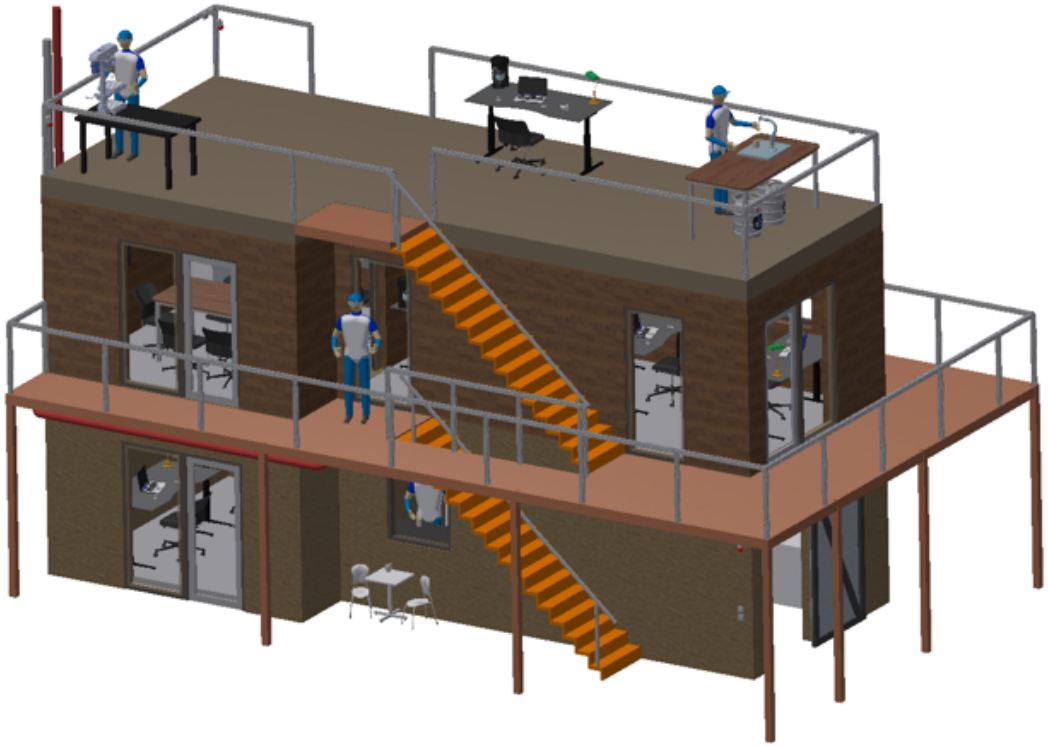


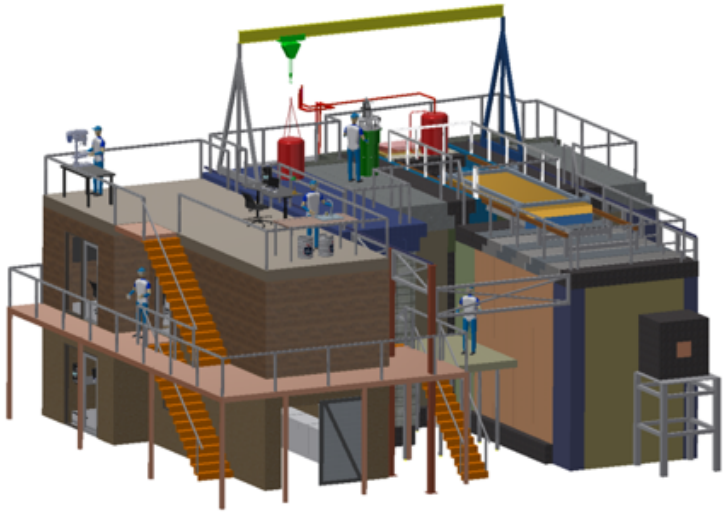
Modular system:
SANS back-wall demountable
Possibility to extend SANS cave:
Current: 8m SANS
Upgrade: 10-12m+ SANS

Extra costs:
Gantry Crane ?
Sliding Hatch Mechanism
Cost request to Mirrotron.
Increased material costs?
Cost variance (estimate)

Internal structures (AU):
False floor (level 1)
Hanging floor (down hatch)
(waiting quote from Mirrotron)
Detector table
Stairs (FM?)

2.6 Experiment Cabin





Internal structures (AU):

False floor (level 1)

Hanging floor (down hatch)

(quote from Mirrotron FM)

Detector table

Stairs (FM?)

2.7 Detector & Monitor (PSI)

Next priority for PSI procurement

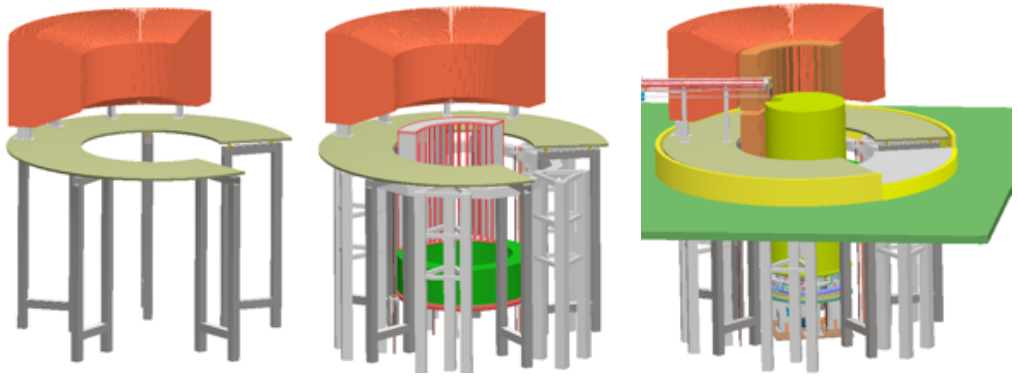
MS ID	Task Name	Date
8	Detector and monitor specifications and tender	01.11.2022
14a	Ordering beam delivery system	31.10.2022
4b	Monolith optics delivered to ESS	22.12.2022
23a	Beam monitors and beam validation procurement start	30.05.2023

CDT

^{10}B Based Jalousie Detector

CDT
CASCADE Detector Technologies GmbH

Manual for I-BM and TIA-DAQ
21.03.2018

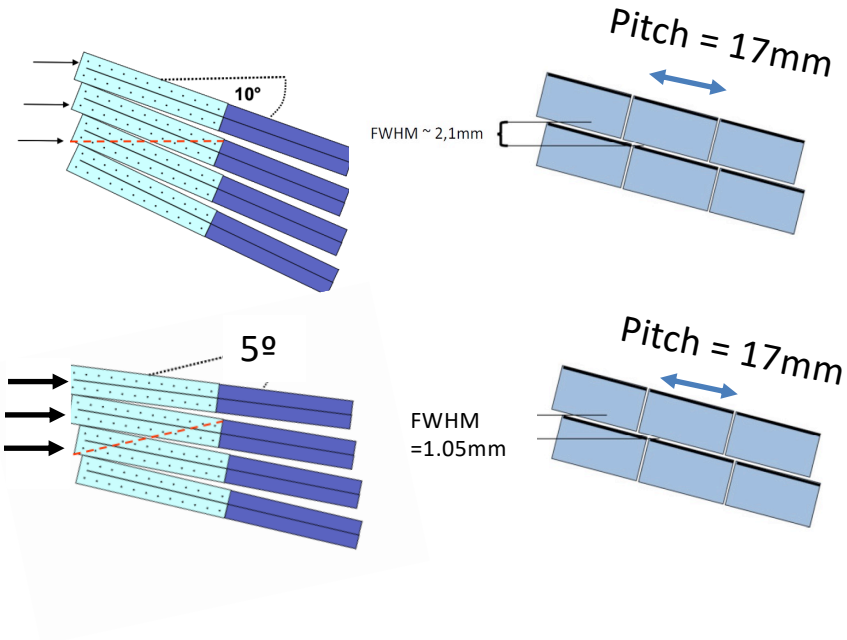


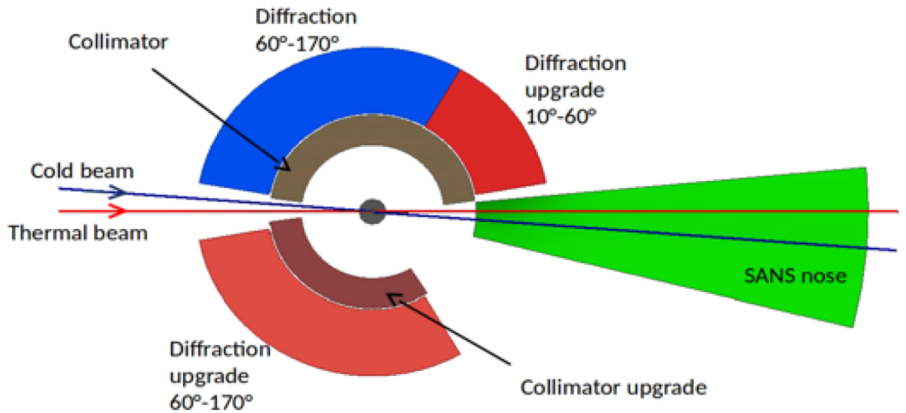
2.7 2D Detector
(PSI 2/3 IFE 1/3)

CDT

Add on? Gas mixing system CDT scope from utilities ?
Note: 1.3sr costed and 1.0sr is scope.
Schedule: Tender Q3 2022 -> SAT Q4 2024.

^{10}B Based Jalousie Detector



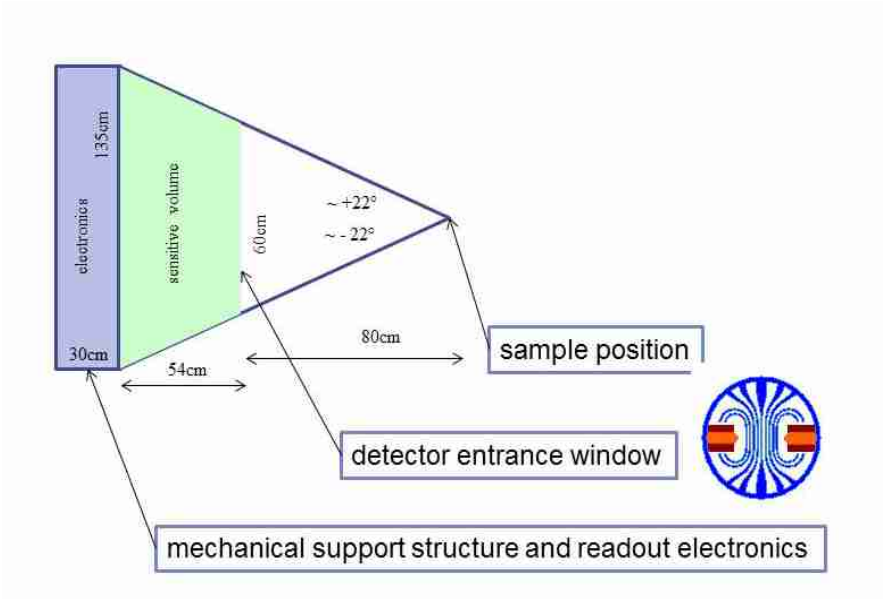


2.7 2D Detector
(PSI 2/3 IFE 1/3)

PAUL SCHERRER INSTITUT PSI

EUROPEAN SPALLATION SOURCE

CDT



Sample to detector (r) = 800 for ϕ=90 and 854 for $\phi = \pm 22$
32 voxels of 16.4mm -> 1.42mm (0.1°) @ η =5°

Coordinate 2θ:
Resolution in 2θ: 1.02mm (0.07°) FWHM for η =5°

Coordinate ϕ:
Number of channels in ϕ along the segment: 64 (128?)
Width of channel (binning) $\Delta\phi$ = 44° /64 = 0.68° or 640mm / 64 = 10mm

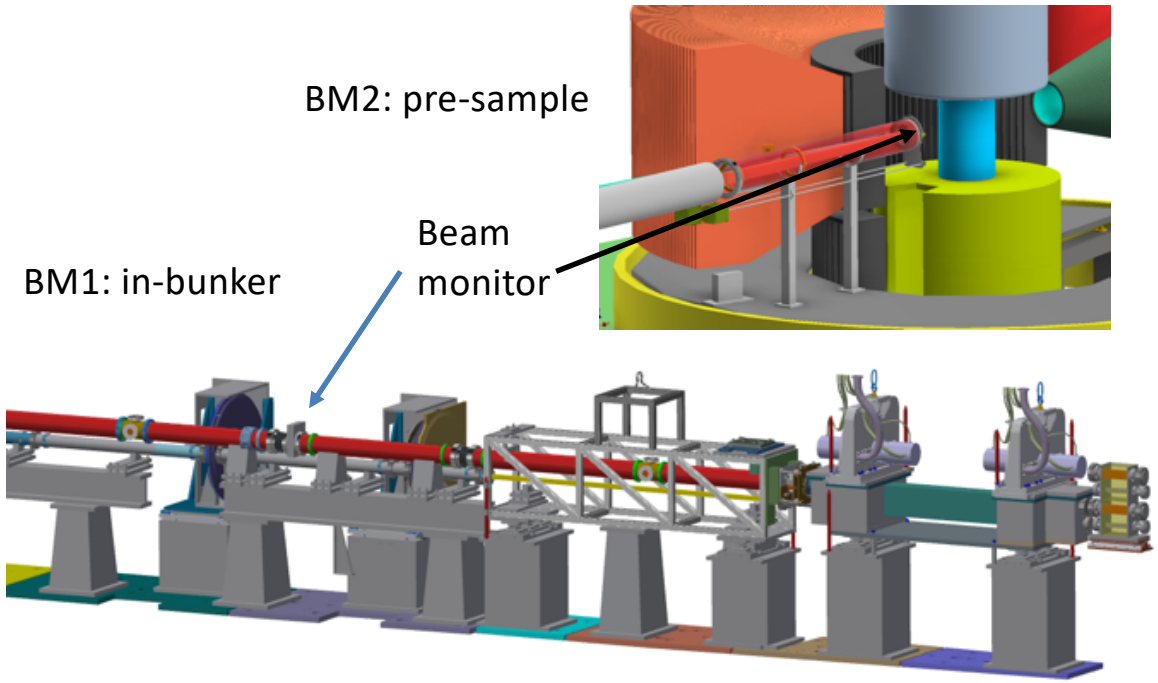
Time resolution **3 µs for** 1 Å neutrons
Efficiency 50% at λ=0.8Å

2.7 Beam Monitors

Monitor positions:
Bunker after choppers 3-4
FOC position 80m
Before sample (Cave)

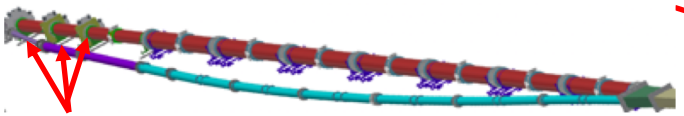
CDT
CASCADE Detector Technologies GmbH

Manual for I-BM and TIA-DAQ
21.03.2018



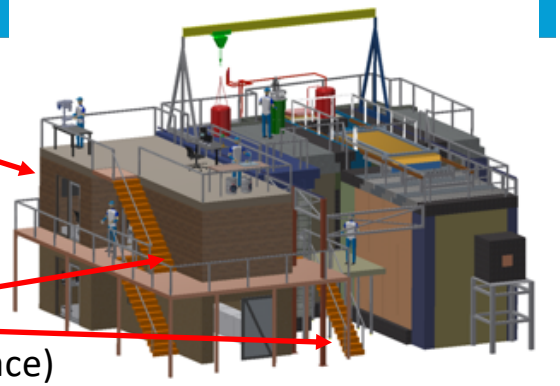
2.8 Cave Internal Structure & Instrumentation
Aarhus University

EUROPEAN SPALLATION SOURCE



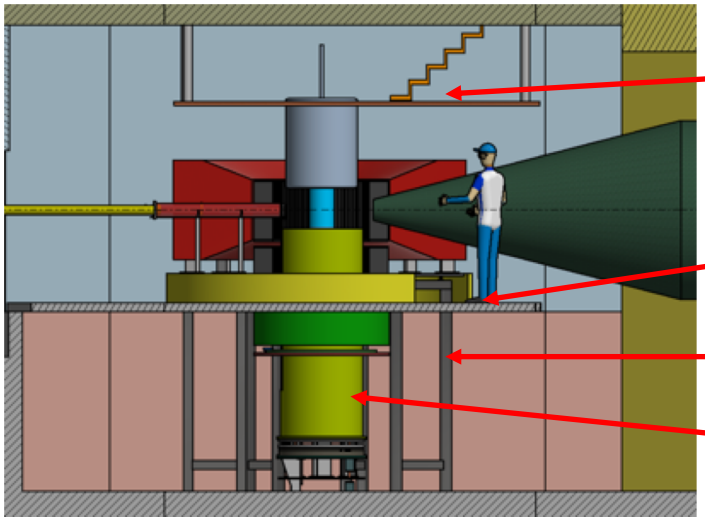
3 x Divergence slits (Guide interface)

Experiment cabin (IFE)



Stairs (cabin interface)

Detector Interface

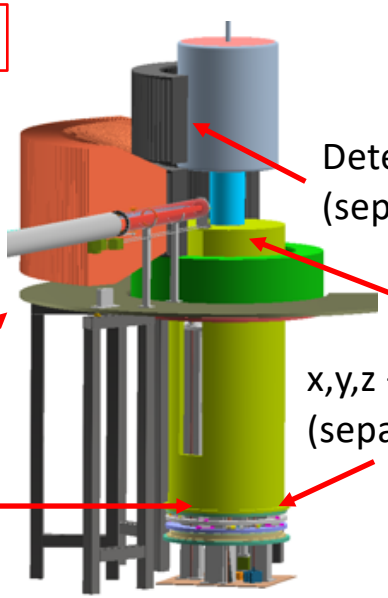


suspended floor
(cave interface)

False floor

Detector Table

Sample table lift



Detector collimator & lift
(separate budget)

x,y,z + omega sample table
(separate budget)

2.8 Cave Internal Structure & Instrumentation
Aarhus University

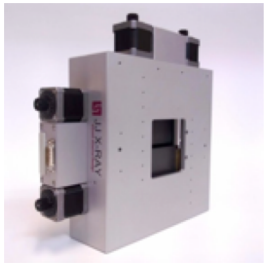
EUROPEAN SPALLATION SOURCE

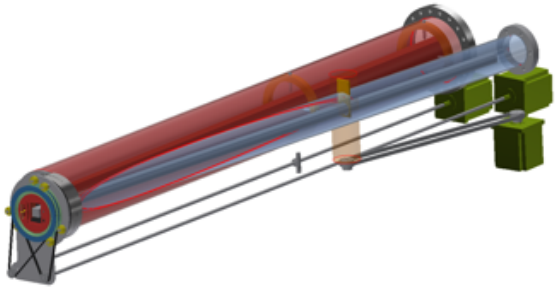
Instrument Team (partner responsible and people's names): *To be included by the Inst Team*

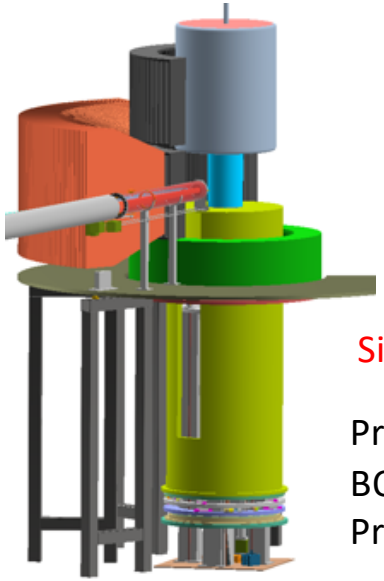
Outcome:

- ***The Call For Tender for the* Collimator selector *jaws is approved. (G.L. 11.05.2020.)***
- ***The Call For Tender for the* Collimator selector vessel *is approved. (G.L. 11.05.2020.)***

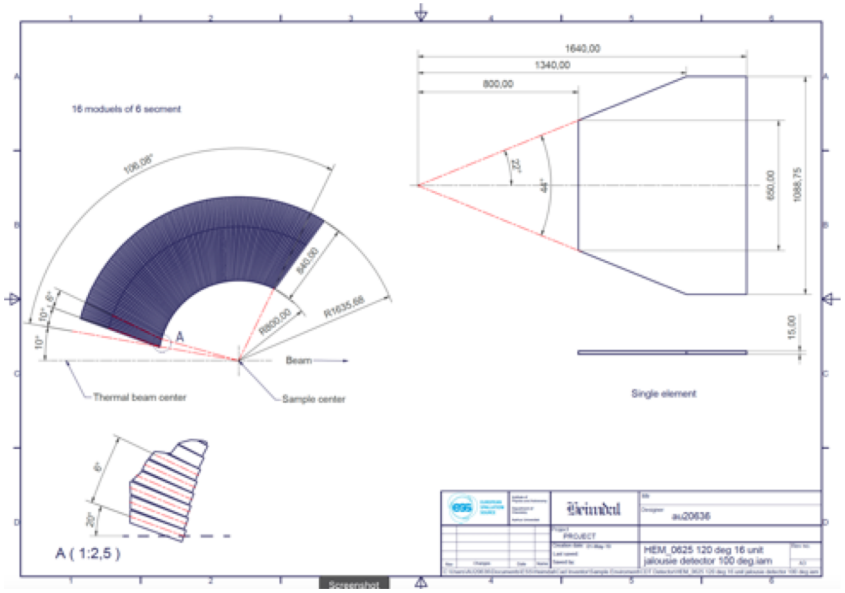
Significant interface with guide project (swissneutronics)







IDR / sTG3 of table put on hold due to integration concerns in the review meeting: detailed 2D detector design required?



Significant interface with 2D Detector (CDT)

Project moved to lower priority due to delay to BOT & longer open bunker access:
Priority moved to bunker components

2.9 Bi-spectral Switch ?

Dream Bi-spectral switch

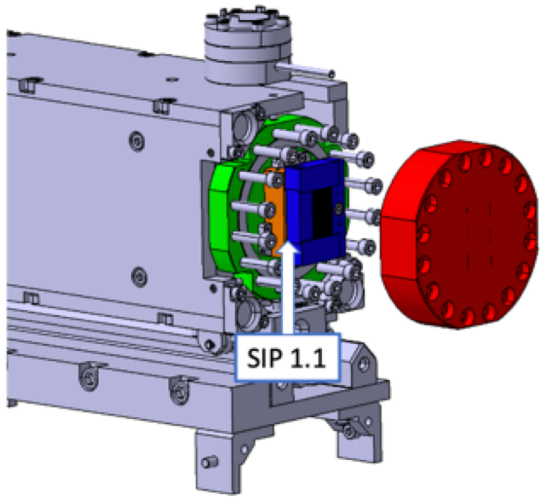
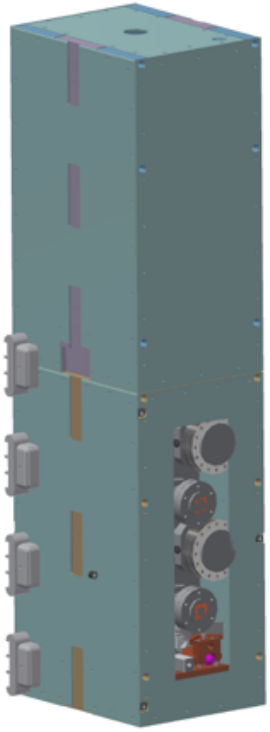
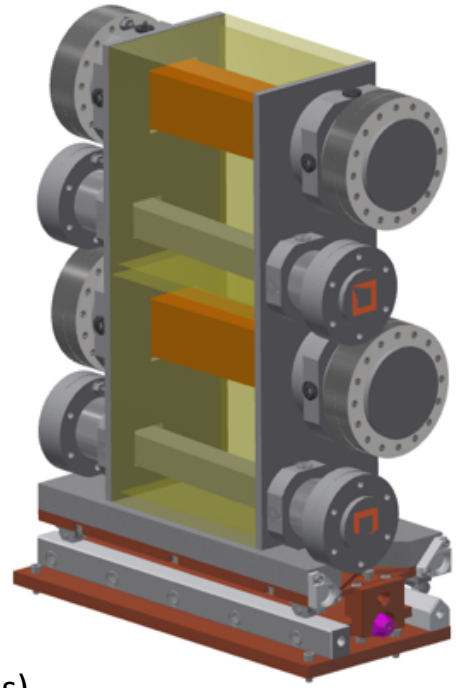


Figure 1 Drawing of the light shutter with bi-spectral switch



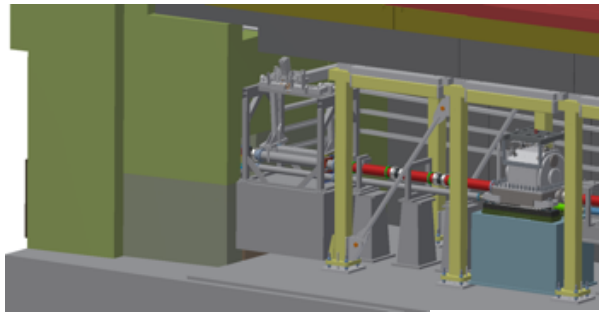
Reflects cold neutrons from cold moderator into thermal guide



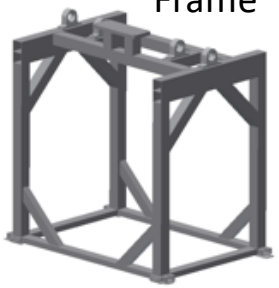
No budget but low cost 10s k€ - interfaces with guide project (swiss neutronics)
What alignment is required?

2.10 Heavy Shutter

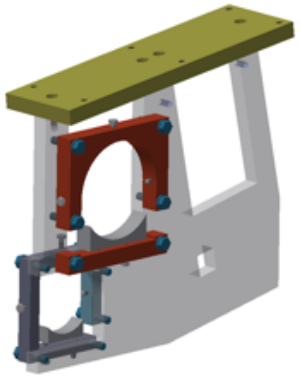
Heimdal heavy shutter swing model (TBL)



Frame

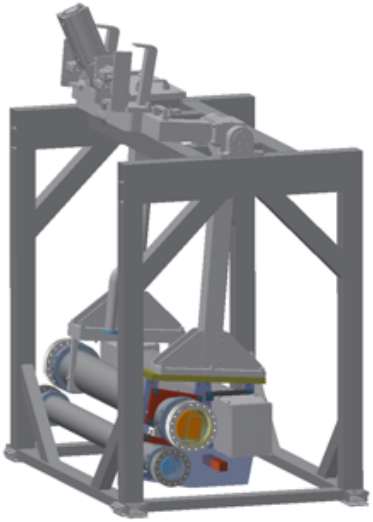


To be changed

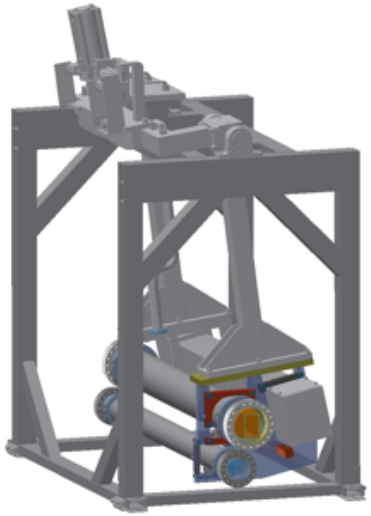


Guide support bracket

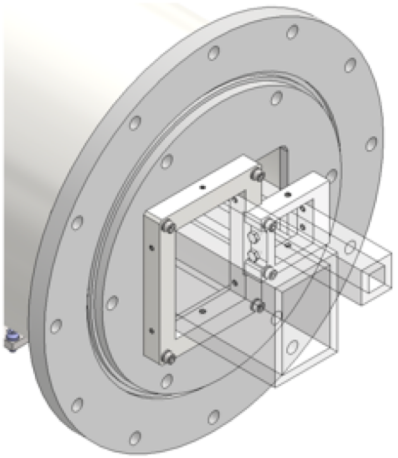
Common design:
Scope transfer AU to ESS ?



Closed position



Open position



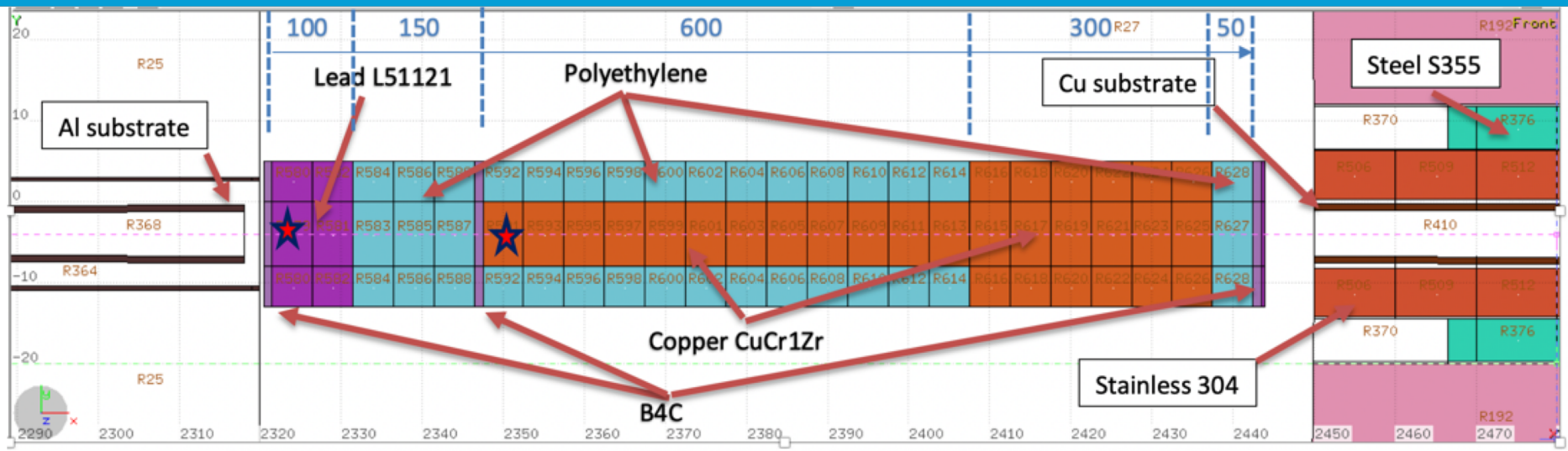
Guide vacuum tube suggested by swiss neutronics

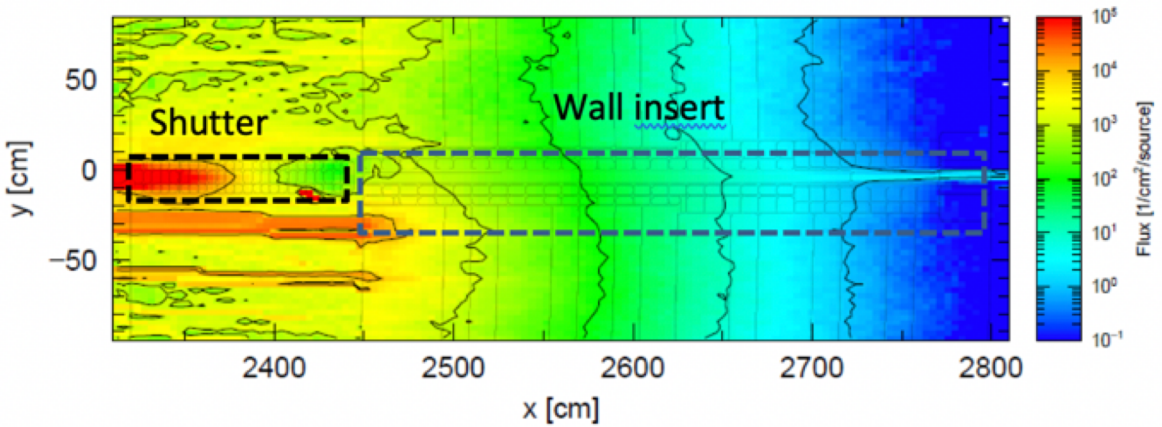
Interfaced between HS and guides

Should start soon with swiss neutronics

How do we block cold guide beam during operations?

Heavy Shutter Block





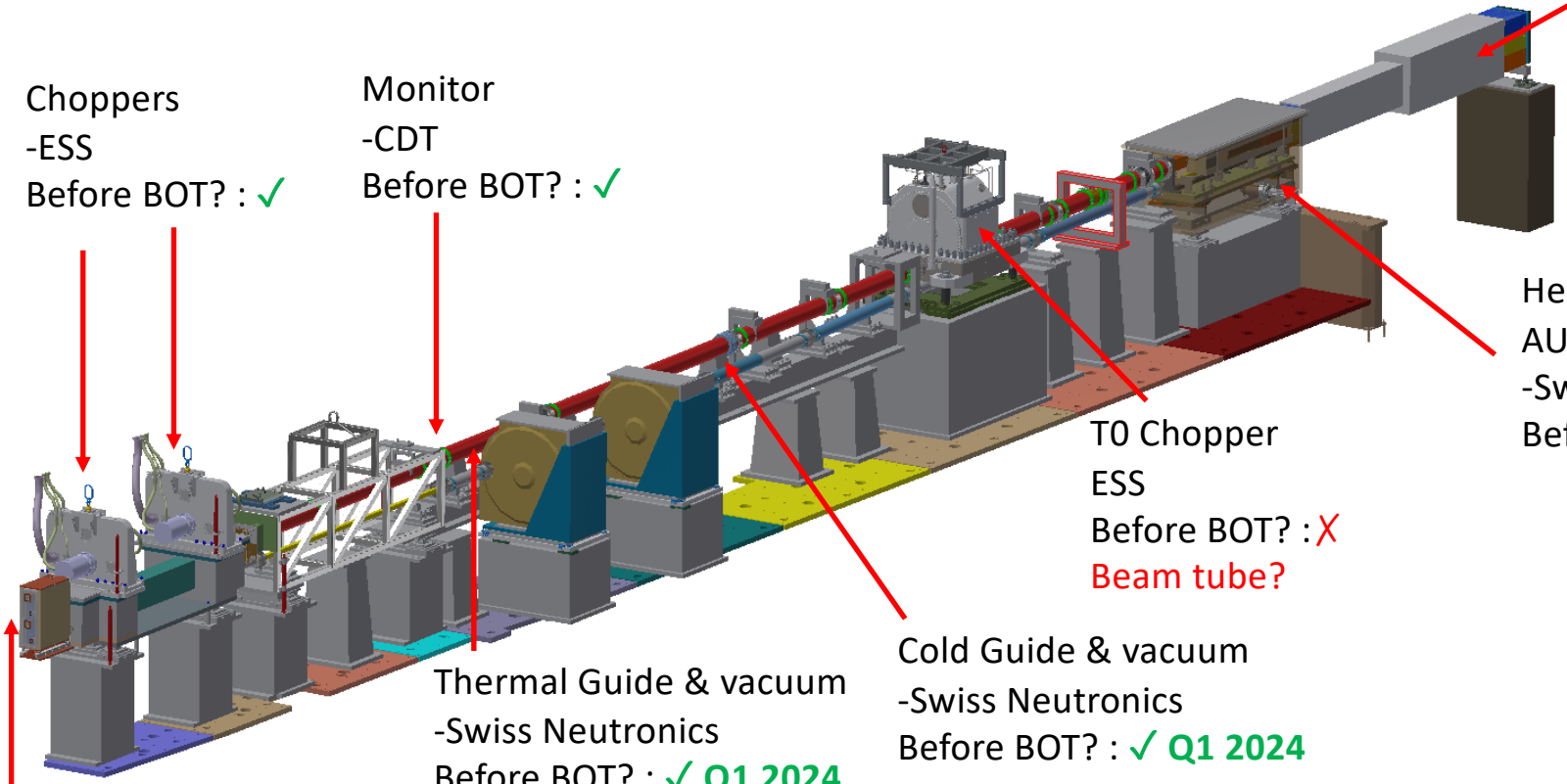
2.11 Work toward in-bunker installation before BOT

Current Beam on Target: Nov. 2024 – May 2025

NBOA
Swissneutronics

Choppers
-ESS
Before BOT? : ✓

Monitor
-CDT
Before BOT? : ✓



BWI optics & housings
-Swiss Neutronics
Before BOT? : ✓ **Q1 2024**

Heavy Shutter & optics
AU / ESS
-Swiss Neutronics
Before BOT? : ✓ **Q4 2023**

T0 Chopper
ESS
Before BOT? : ✗
Beam tube?

Thermal Guide & vacuum
-Swiss Neutronics
Before BOT? : ✓ **Q1 2024**

Cold Guide & vacuum
-Swiss Neutronics
Before BOT? : ✓ **Q1 2024**

BBG & optics (AU)
-Swiss Neutronics
Bi-spectral switch
Before BOT? : ✓ **Q4 2023**

Summary / Main points

EUROPEAN SPALLATION SOURCE

Major items now contracted: Guide shielding (ESS), Choppers (ESS), Cave (Mirrotron), Guides (swissneutronics), 2D detector (CDT) (not costed but can be reduced to be in-budged).

Guide systems contract awarded to Swissneutronics:
Complete thermal guide + Vacuum housing (Base project)
75% of cold guide + vacuum housing also within PSS budget (option-1).
- Request STAP support for additional cold guide for the upgradeability of Heimdal.
  No Change request required.

Additional Engineer support: Located permanently at ESS paid from Heimdal budget:
We think we can afford this ~ current total budget projection ~xxxk Euros in budget
- Request STAP support for additional engineering

Current focus of instrument is to have all components installed in-bunker before BOT.
We think we can do this except for T0 Chopper. But this depends on actual BOT date.

Projected Budget including additional 75% cold guide