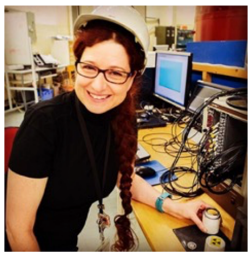
The HEIMDAL Instrument at ESS
Diffraction STAP Meeting April 2024
Update Summary

(1) Heimdal Team update:

We have recruited an additional engineer Bengt Jönsson Bengt will be permanently be based at ESS working full time of Heimdal on a two year contract funded by in-kind partner Aarhus University.

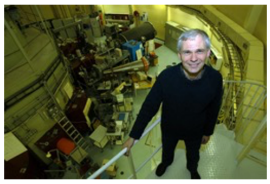


Isabel Llamas Scientist (IFE)
Choppers & Neutronics

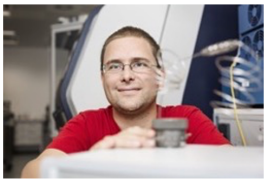
Dan Mannix (ESS)
Lead Scientist

Kåre Iversen (AU)
Lead Engineer

Bengt Jönsson (ESS)
Engineer 2023



Bjørn Hauback
In-kind Partner IFE



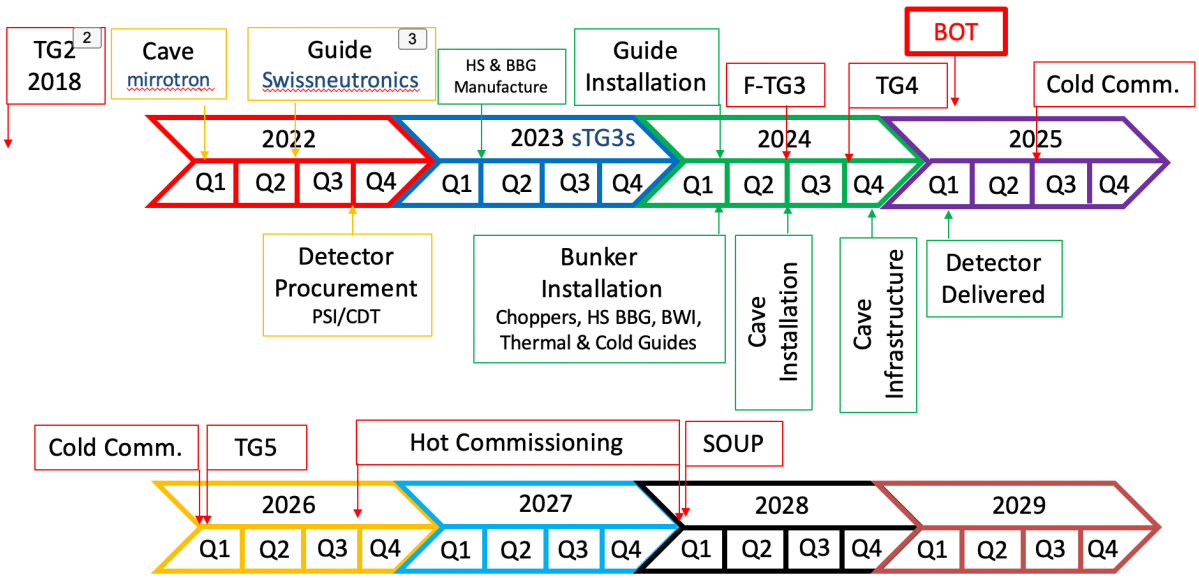
P.I Mogens Christensen
In-Kind Partner AU

Autur Glavic
In-kind Partner PSI

In addition, Artur Glavic will be the new in-kind representative for in-kind partner PSI.

(2) Instrument timeline and contract suppliers:

Swiss neutronics have the contract to deliver the guides. Mirrotron will deliver the cave and have now a new contract with ESS to deliver the guide shielding. CDT were awarded the contract for the 2D detectors as of August. The ESS common projects will deliver the choppers and T0 chopper. AU will delivery the heavy and light shutters and sample translation and detector support inside cave. Heimdal is in process of re-evaluating the timeline for detailed design and installation. Final TG3 and TG5 are expected to be a year later than current timeline, largely due to ESS priorities.



(3) Inclusion of additional cold guide scope

The contract for the guide systems was awarded to Swiss Neutronics via in-kind partner PSI. We have been informed that the total thermal guide and vacuum housings together with a cold guide option-1 sections fits within the PSI budget. The cold guide option-1 consists of the in-bunker sections and long-straight section including vacuum housing. This corresponds to around 116meters of additional scope cold guide. See figure below. This will provide a streamlined upgrade of the Heimdal instrument to simultaneous diffraction and SANS. We now only need to fund 35 extra meters of cold guide and vacuum housings (464k Euros) to complete the guide systems to full scope. The upgrade will also require costs for changing the guide shielding from a narrow to wide format. The guide project is moving ahead, we have been optimising the design of thermal and cold guides in a coherent detailed design and working on optimising the beam transport with neutronics simulations. We have a sub-TG3 scheduled for the outside bunker guides in mid-october 2023 so that manufacturing can start.

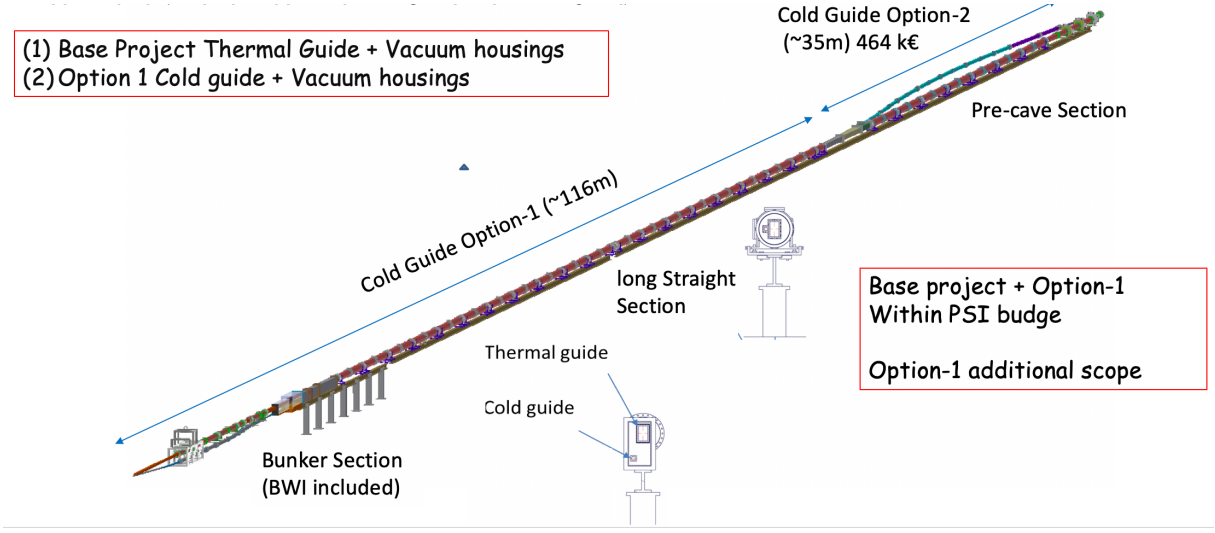


Figure 1. Drawing of the thermal and cold guides. The thermal guide and vacuum housings (base project) and the cold guide option-1 are within budget for the PSI guide systems. The corresponds to additional scope of 116meters of cold guide and vacuum housings in the bunker and long straight section.

(4) Toll Gate Milestones Schedule.

The Final TG3 was scheduled for June 2024, TG4 October 2024, TG5 February 2026. Cold Commissioning January 2025 and Hot Commissioning Q3 2027. The current projection for final TG3 and TG5 is around a year later than these dates. The current focus of the instrument is completing the installation of in-bunker components before BOT, which is currently forecast around May 2025. Recent overview of milestones passe are:

(1) Bunker Wall Insert (Swissneutronics) SAT February 2024. Installed March 2024.
(2) Heavy Shutter Detailed design approved, Manufacturing Started April 2024.
(3) BBG + bispectral switch detailed design complete.
(4) Guides out of bunker long straight 1 approved.
(5) Guide optics deposition for long straight completed.
(6) Guides out of bunker long straight 2 approved.
(7) 2D detector Kick-off with CDT completed March 2024.
(8) Choppers detailed design approved March 24.

(5) ICEB meetings: The last Heimdal ICEB took place in January 2024.

(6) Instrumentation

6.1 NBOA

The NBOA has been manufactured by swissneutronics and was installed at ESS in May 2023. This represents the first installation milestone for Heimdal.

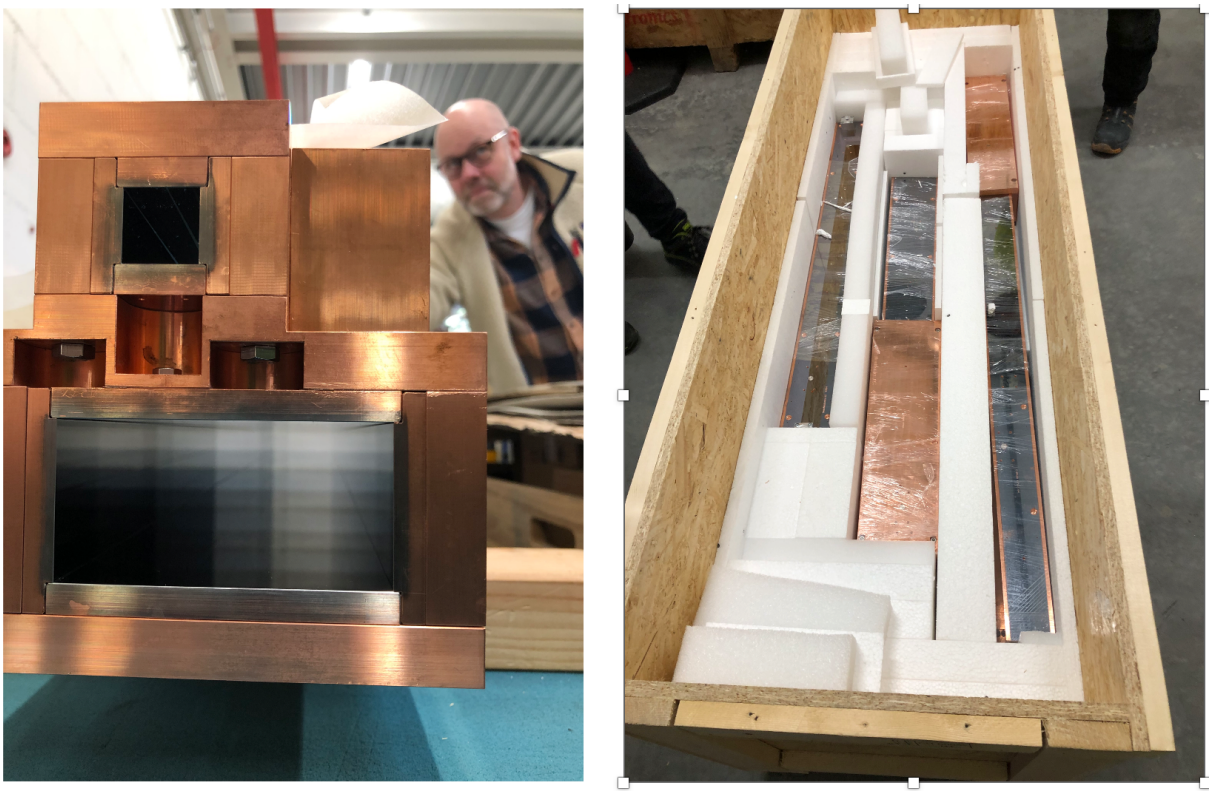


Figure 2: Left the Heimdal NBOA during FAT at swissneutronics, with thermal and cold guides. Right the Heimdal NBOA shipped to ESS.

6.2. Choppers

The choppers are being procured via the common monitor project. We have had the detailed design for for the chopper systems in March 24, which has been approved.

The T0 chopper: The T0 chopper based on the prototype developed by Mirrotron is being developed by ESS with some slight modifications. The technical specifications have now been finalised and reviewed. Scope will be transferred to ESS. The T0 Chopper project is currently with-in budget. It is not certain that the T0 will arrive before BOT. If not at piece of vacuum tube will be temporally installed until Bunker access in mid 2026.

6.3 Guides

The guide project continues with swissneutronics and optimisation of the cold guide design work with PSI. The detailed design for the long straight sections 1&2 have been approved so than manufacturing can begin on the guides as early as possible. The long straights are the simplest sections to manufacture.

6.4 Detector:

The 2D project was awarded to CDT, like Dream and Magic. The offer from CDT falls within budget and scope of the technical specification of 1.0sr or around 80-degree coverage. It is hoped money will be found to provide more detector coverage earlier on as being discussed for other instruments. The build-up to full detector coverage will be made during a later ESS upgrade. The kick-off for the 2D detector contract was undertaken in March 2024.

6.5 Guide Shielding

The guide shielding will be provided by the common guide shielding project. The last round of the tender for the guide shielding was awarded to Mirrotron, who will also fabricate the Heimdal cave shielding.

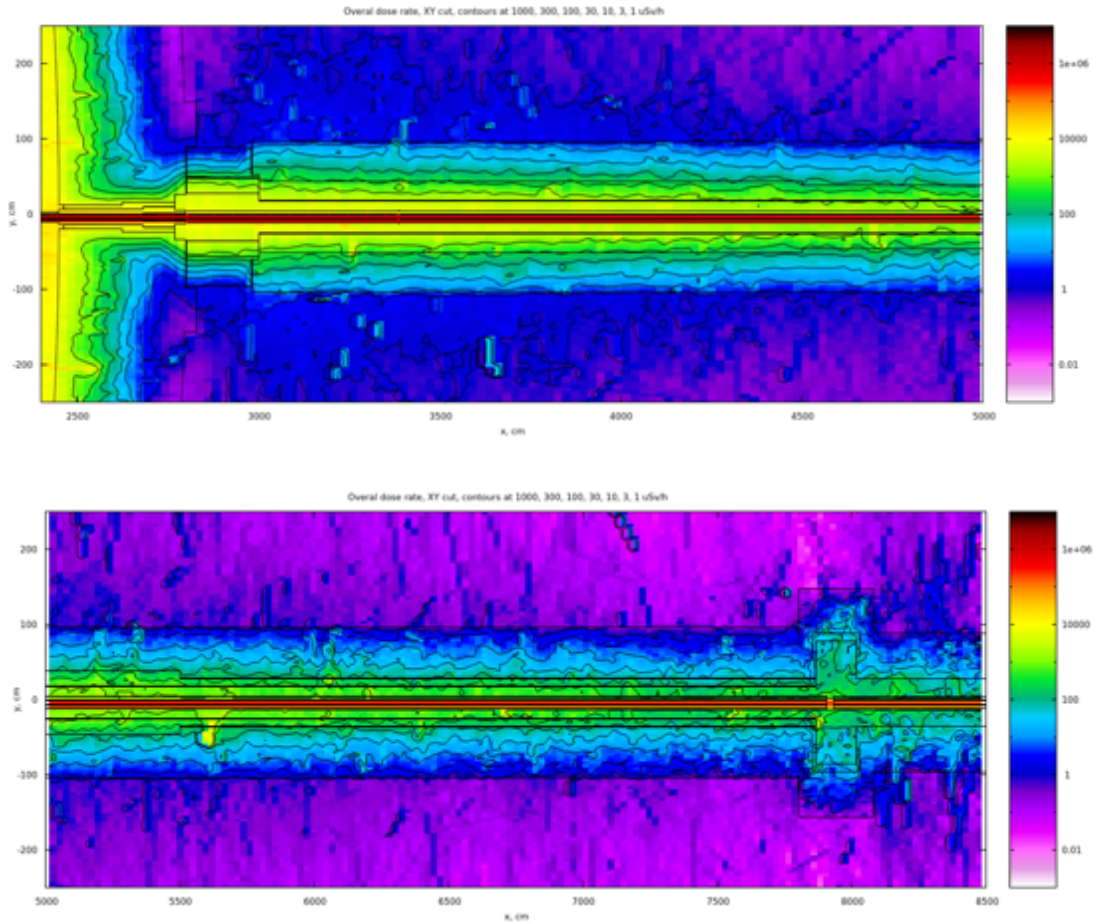


Figure 3. Guide shielding calculations for Heimdal guides. Top is for the section after the bunker wall from 25M to 50M. Bottom is from 50m to 85M, just after the frame-overlap chopper. The current design is still giving too high back ground and is being refined. This can be seen by the dark blue area just after the bunker.

The neutronics are performed for the below shielding.
Interface (28-30m, first 2 meters from bunker wall) 20 cm steel 40 cm heavy concrete (3.8 g/cm3)
30-45 m: 25 cm steel 50 cm regular concrete (2.3 g /cm3)
45-55 m: 20 cm steel 55 cm regular concrete
55-chopper pit: 10 cm steel 65 cm regular concrete
Chopper pit shielding according to common shielding project (will need extra steel when contribution from thermal neutron beam will be considered)
Beyond chopper pit: 60 cm regular concrete.
Inner steel shielding is lined with 5 mm B4C both inside and outside B4C/epoxy tiles.

6.6 Cave Shielding Neutronics:

The Call for Tender for the cave was awarded to Mirrotron with a bid including cave shielding and beamstop which was within budget. Due to quality issues in the Odin cave project delivered by Mirrotron, ESS advised us to look into a new design solution using smaller lego-type concrete blocks,

that can be reused later by ESS. We have started to use this concept in the Mirrotron design. ESS is having quality issues with civil engineering project from Mirrotron and continuation of this project with Mirrotron is under review.

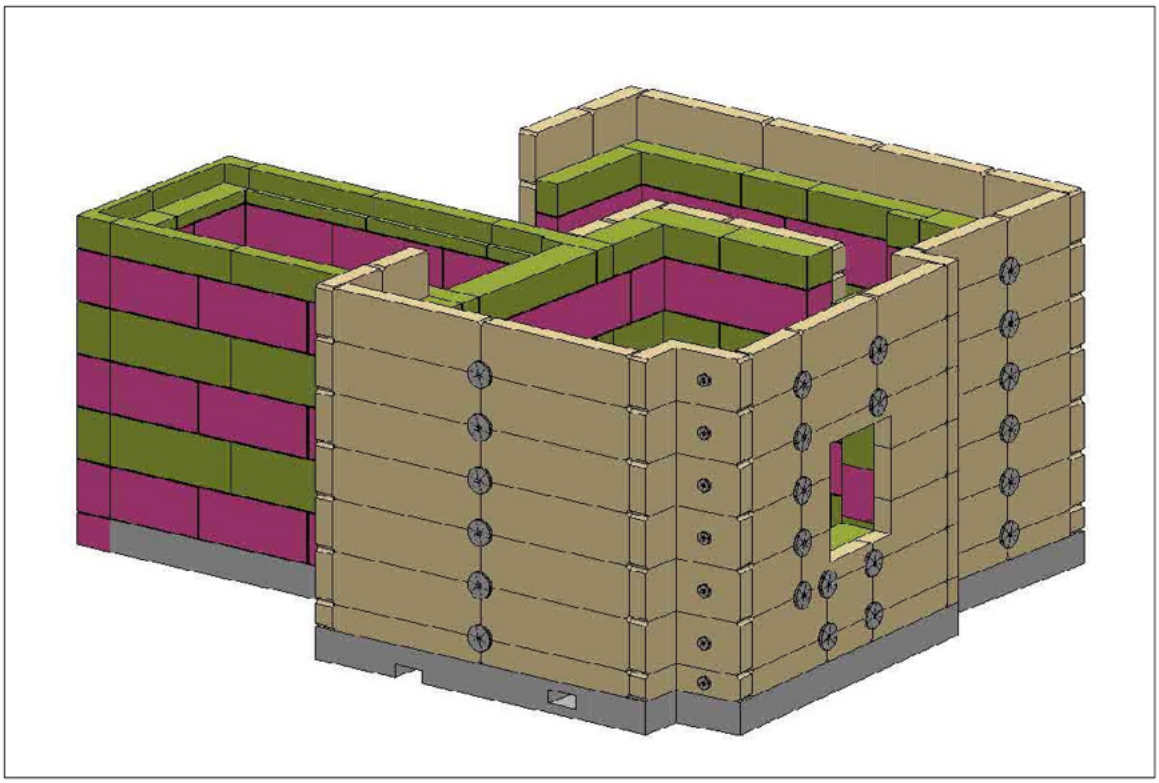


Figure 4. Cave shielding new design using small lego block concept. with walls of 40-90cm thick concrete.

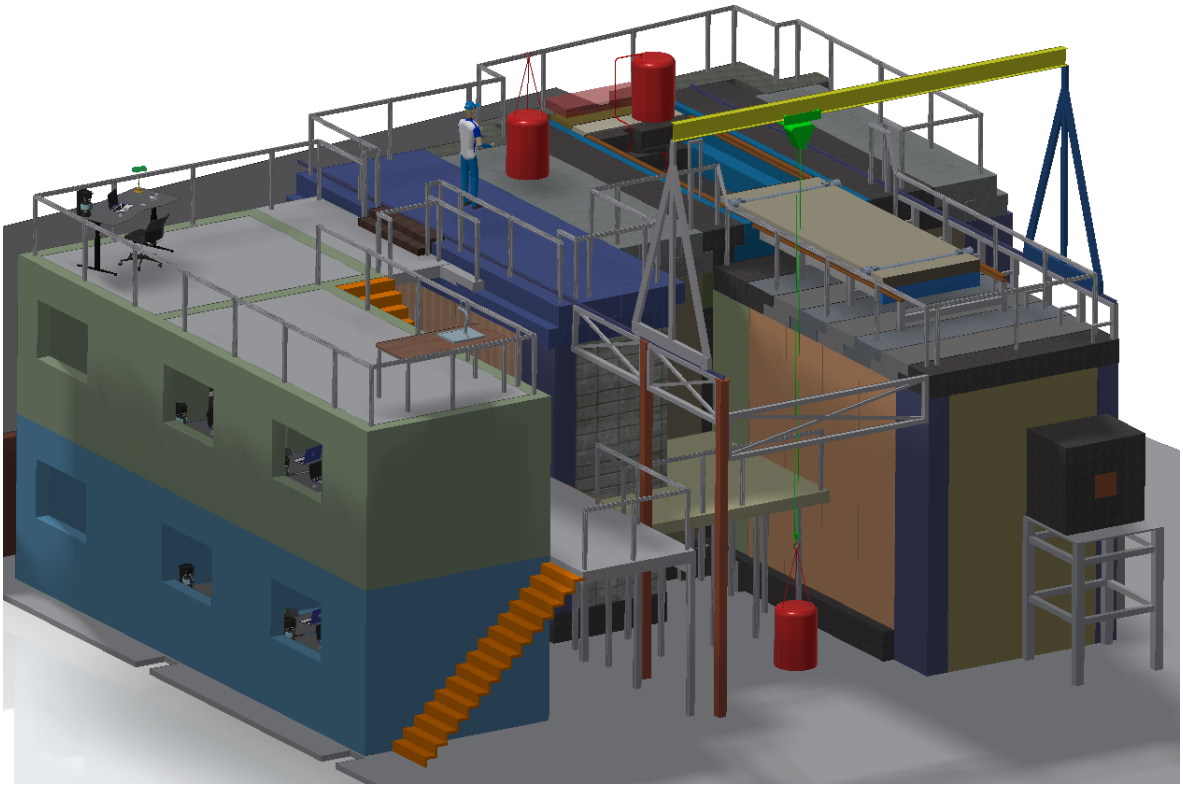


Figure 5: Design of the Heimdal Cave.

7.0 Heimdal Instrument Risk Register

At the moment, Heimdal is a Tranche-3 instrument and DMSC does not have resources to cover a dedicated software engineer for Heimdal. This is highlighted as a large risk and is being observed by NSS.