

Heimdal Instrument @ ESS Diffraction STAP October 2021

Dan Mannix

Lead Scientist Heimdal Instrument ESS, Lund Sweden



ESS October 2021



The **New** ESS Heimdal Lead Scientist



ESS Contract signed 11th October 2021

Start 1st January 2022
at end of AU in-kind contract

Verification

Transaction 0922215557455236511

Document

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Main document
3 pages
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Finalised on 2021-10-11 09:16:24 CEST (+0200)

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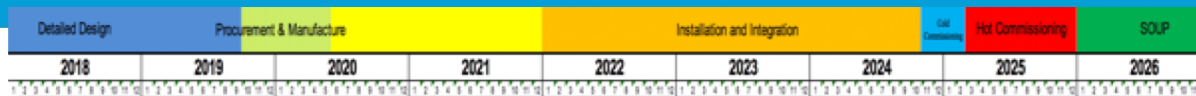
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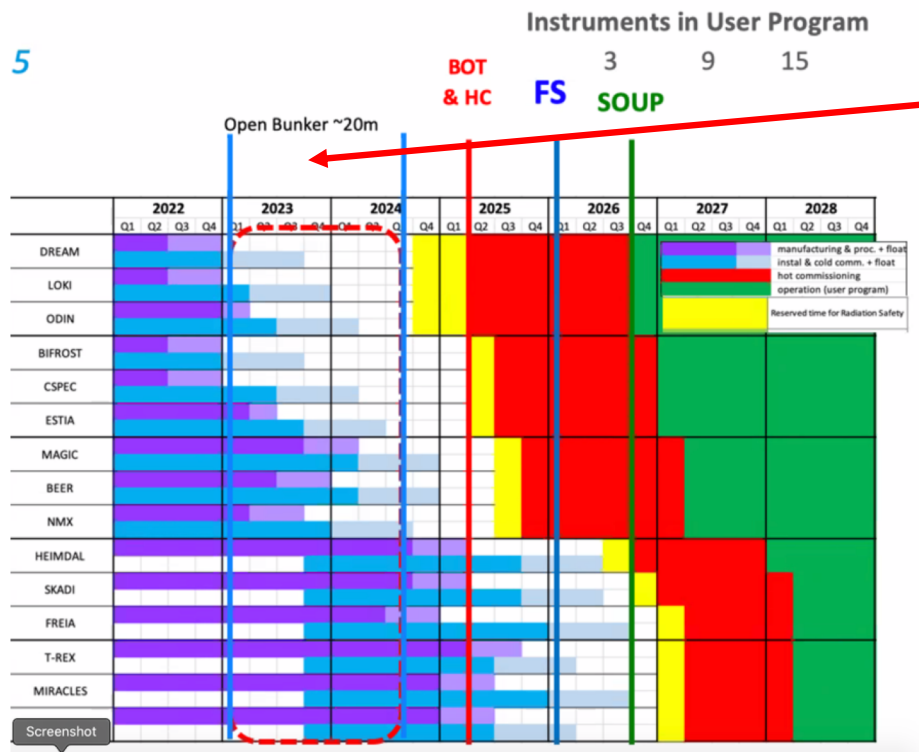
Signed 2021-10-08 13:35:03 CEST (+0200)

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Heimdal Timeline



5



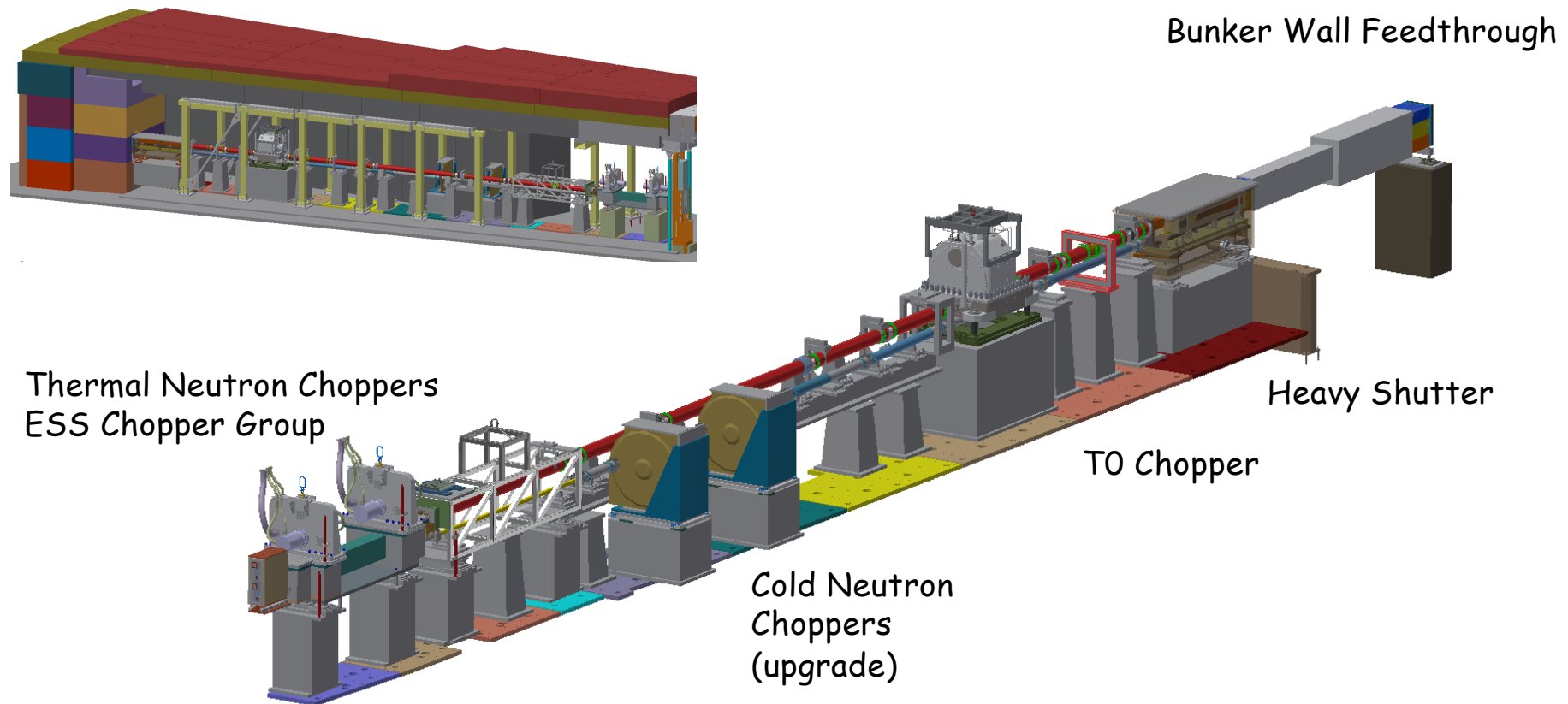
New Build Focus for Instrument:

Delay to BOT & Longer open access to bunker

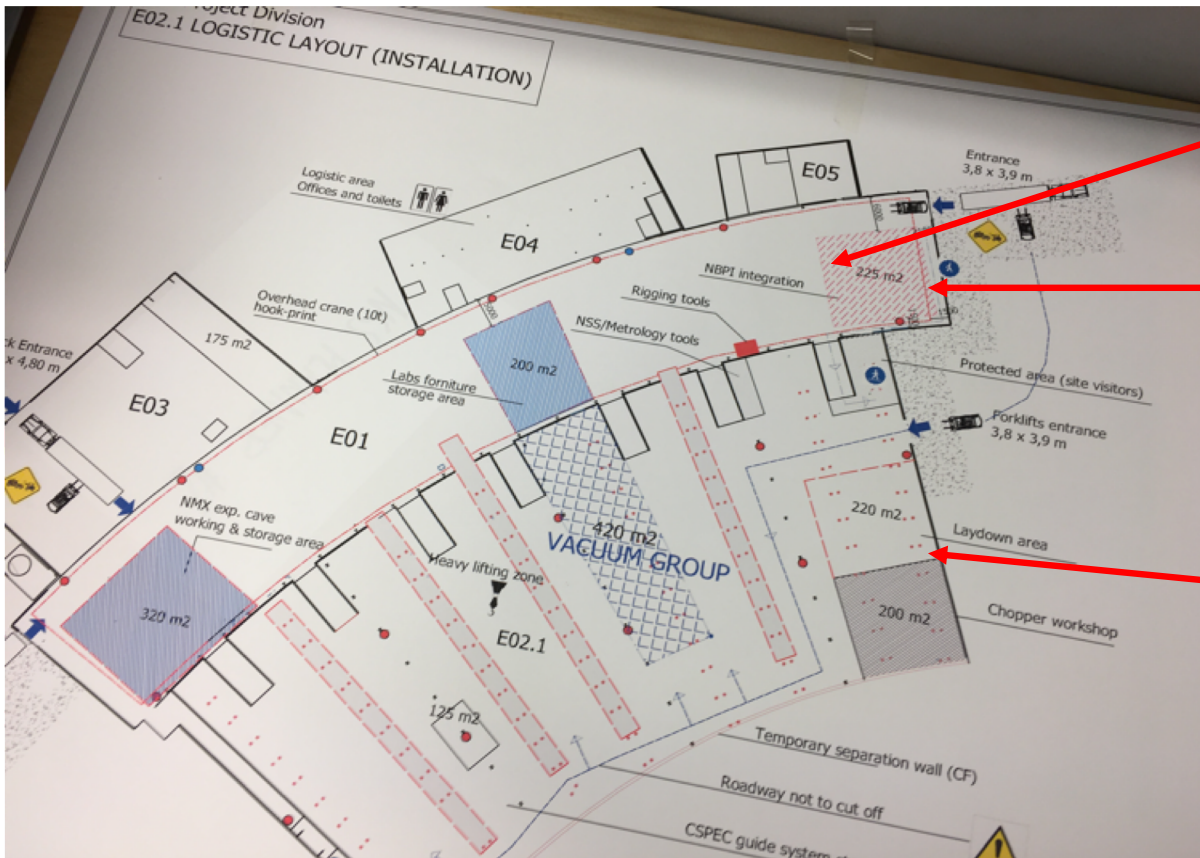
Procurement of Bunker components:

- Thermal Choppers
- T0 Chopper
- Guide Optics, Support & Vacuum Housings
- Heavy Shutter
- Light Shutter

Heimdal inside Bunker Components



Heimdal Start of Installation November 2022



Heimdal Instrument

NBOA Storage – 2020
NBOA Installation 6/20 – 6/21
Storage Zone until June 2022

November 2022 Start of Heimdal Cave
Installation

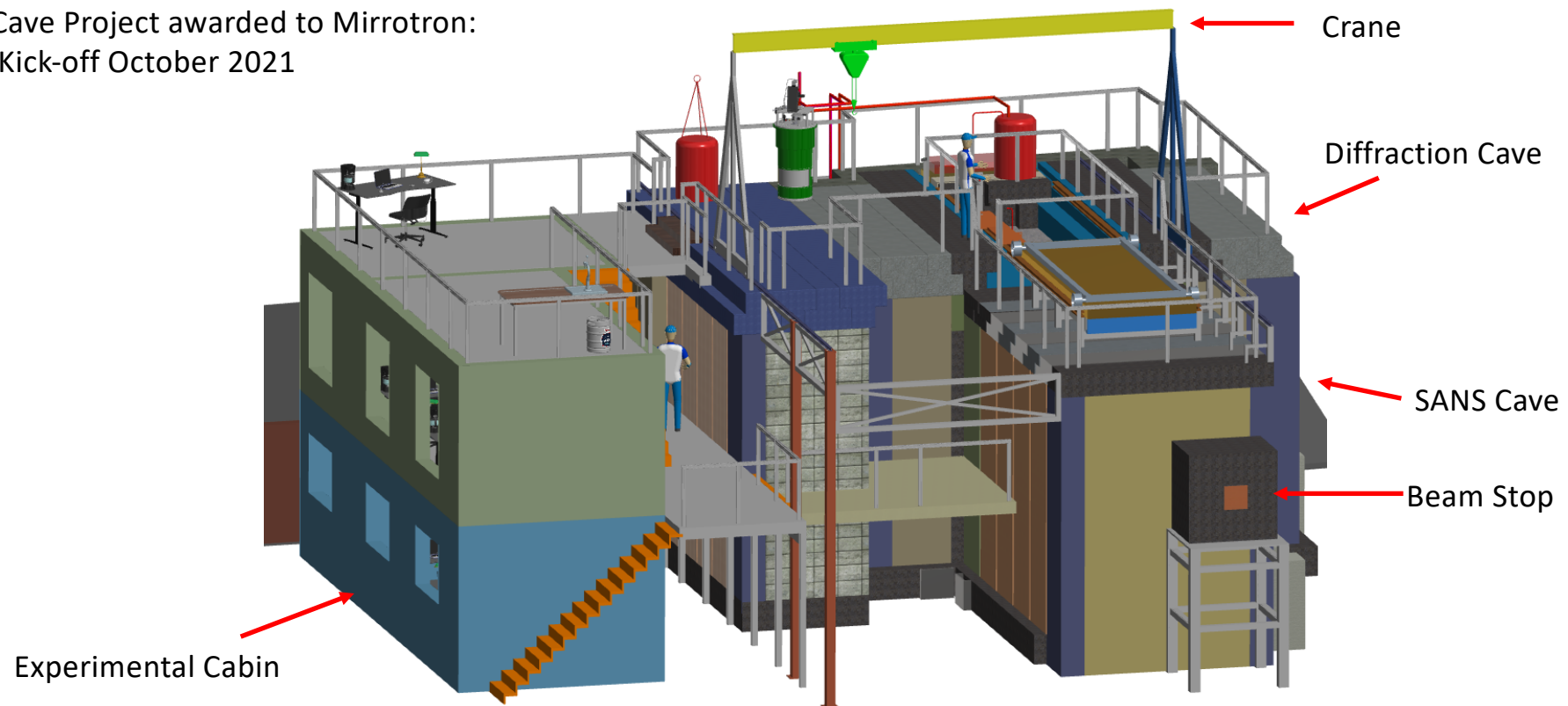
Storage and Chopper Workshop

Moved to permanent Chopper Workshop
in mid 2021 in D01

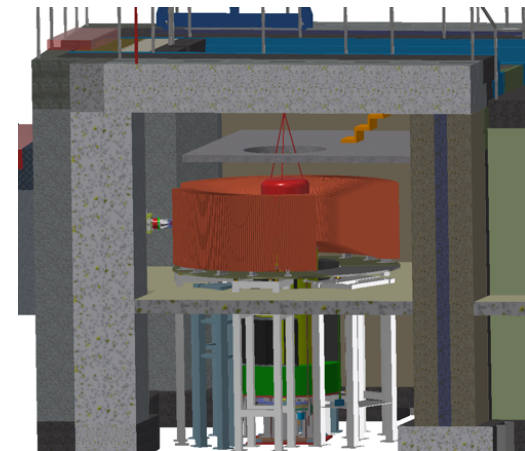
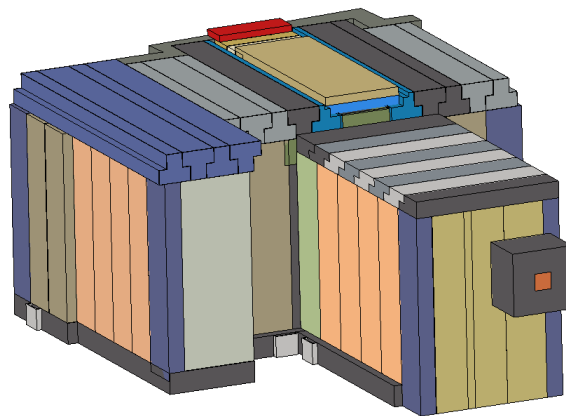
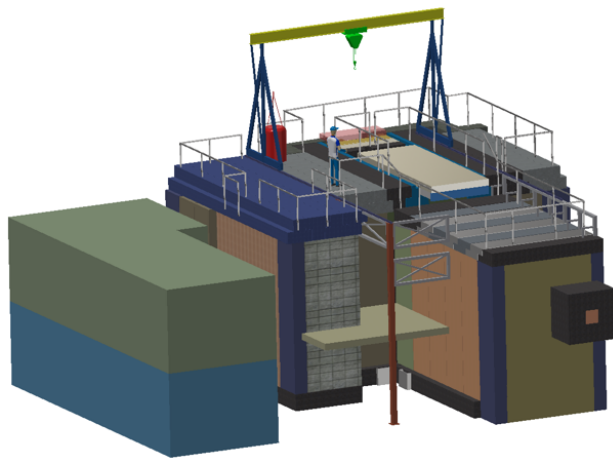
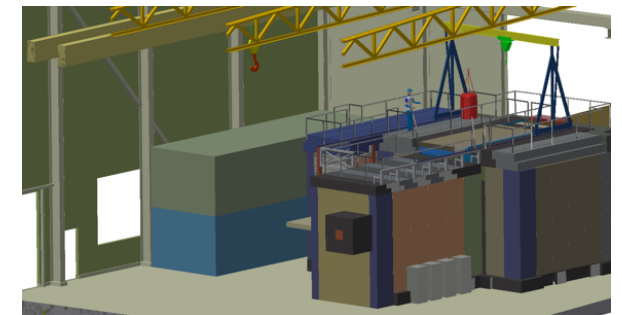
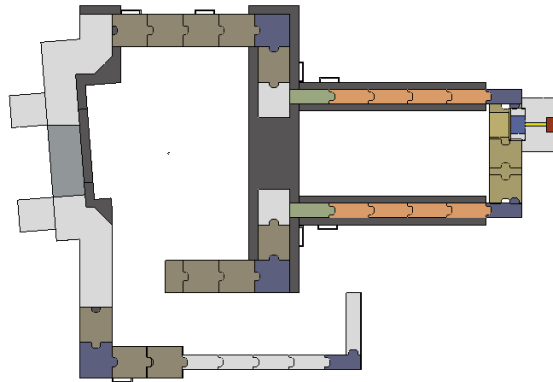
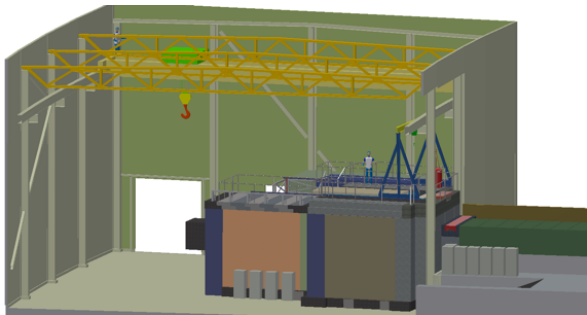
Heimdal Cave: Mirrotron Installation Start End 2022



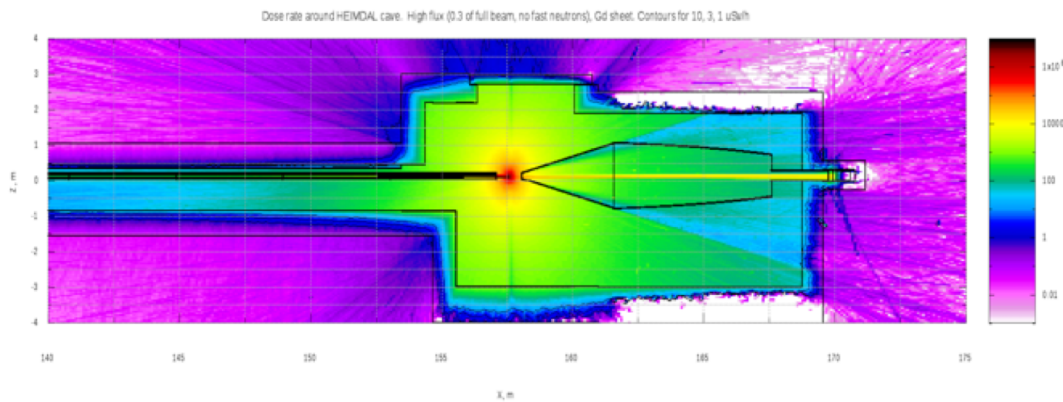
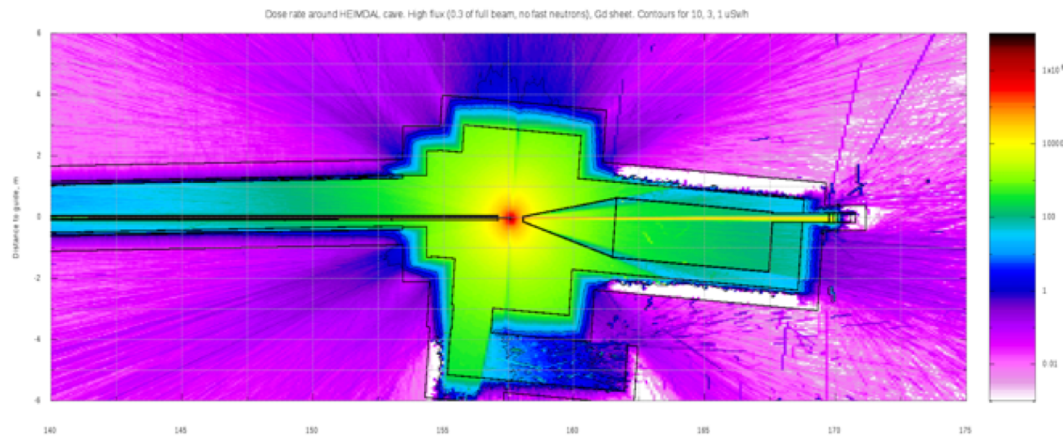
Cave Project awarded to Mirrotron:
Kick-off October 2021



Heimdal Cave Conceptual Design



Cave Shielding Calculations



Neutronics Calculations – Optimising costs

90cm concrete walls (Diffraction).

40cm concrete walls (SANS)

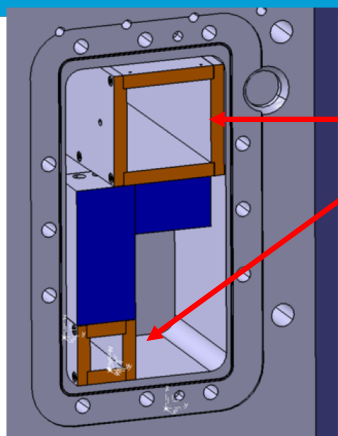
70cm concrete roof (Diffraction)

30cm Concrete roof (SANS)

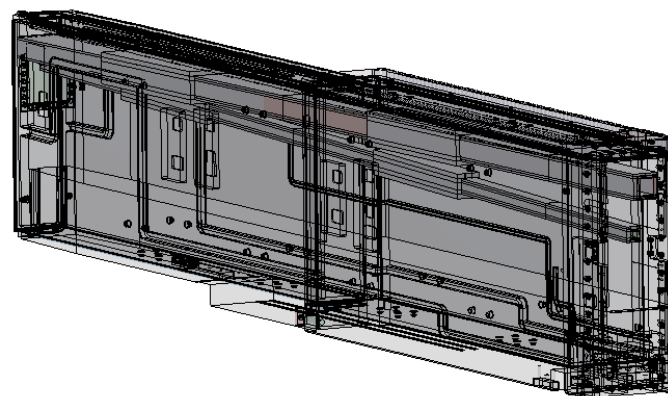
Beam stop Steel Bar inside heavy concrete

H1H2 Scenarios submitted (Feb. 2020)

NBOA Project: Swiss Neutronics

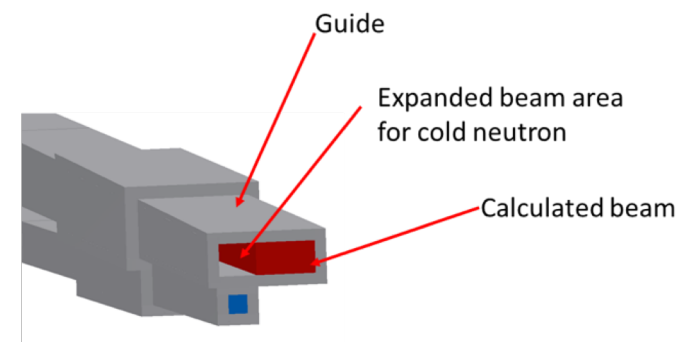


Reduced window thickness from 2mm to 1.5



Milestones

Milestone	Payment	Target date original	Target date updated	Status	Remarks
Final design review	no	31-May-19	expected Sep-2021		updated target date because extra time needed to complete CDR (interface review)
Ready for manufacturing	yes		expected Oct-2021		updated because of delay of FDR
Ready for delivery	yes	23-Dec-19	expected Feb-2022		see open issue No. 2
Installation	no		expected Q2-2022		see open issue No. 2
Final acceptance	yes	15-Jan-21	expected Q2-2022		see open issue No. 2



Heimdal Guide Systems: Moving forward with PSI

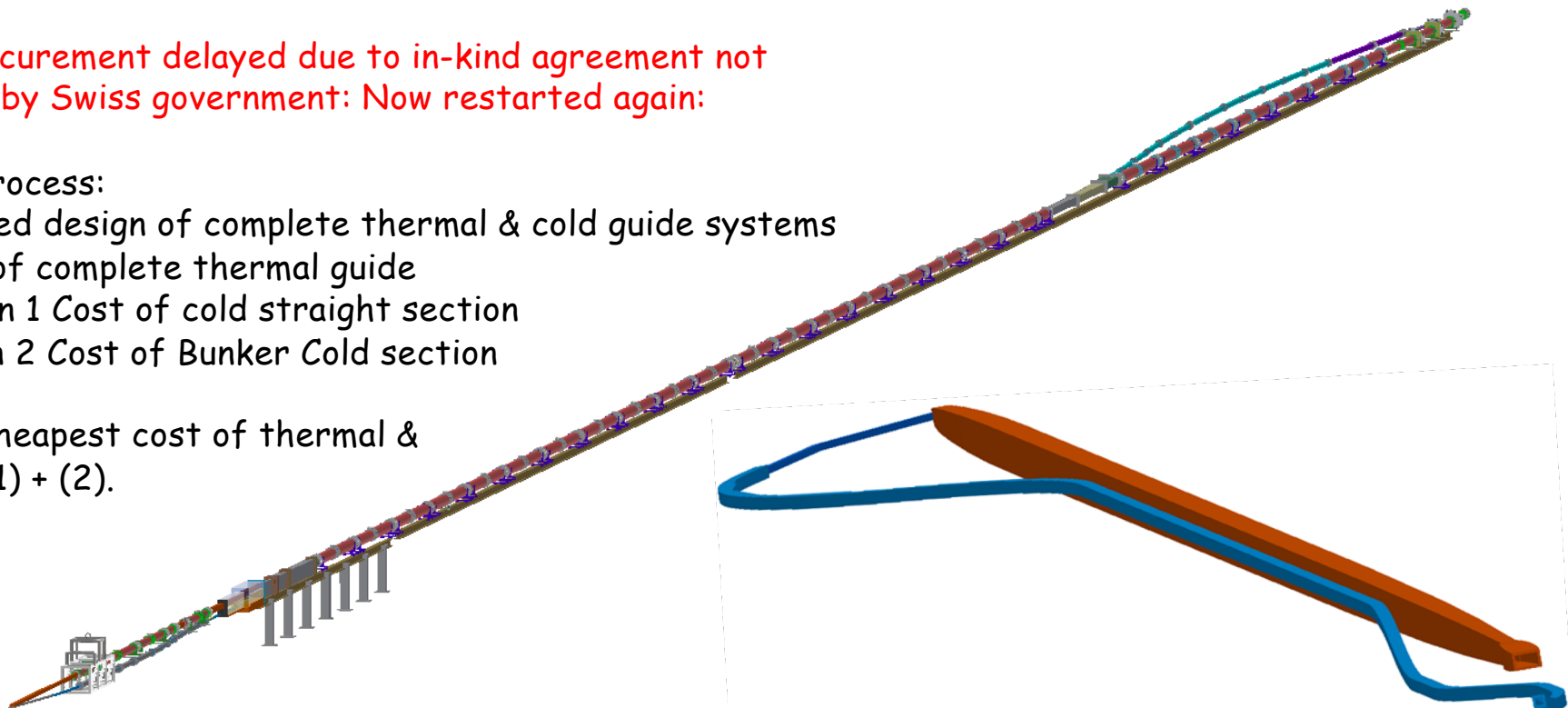


Guide procurement delayed due to in-kind agreement not approved by Swiss government: Now restarted again:

Tender Process:

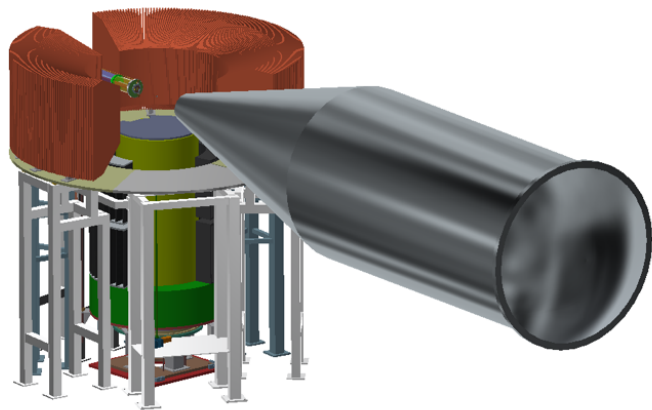
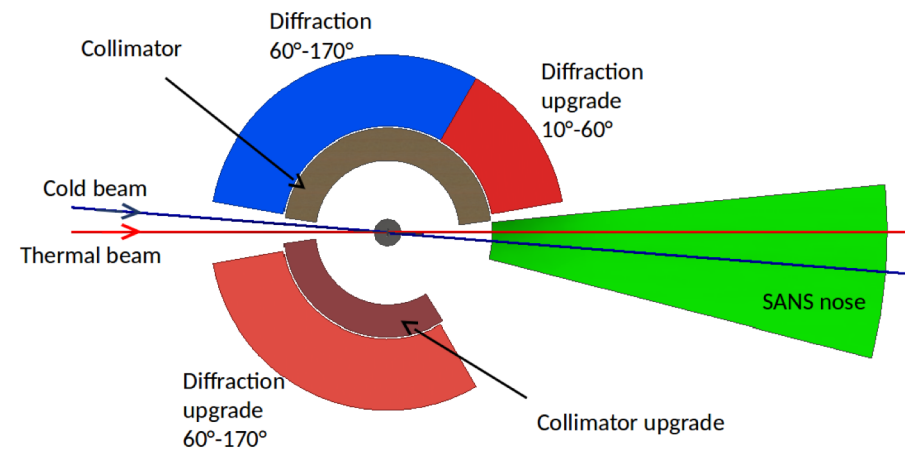
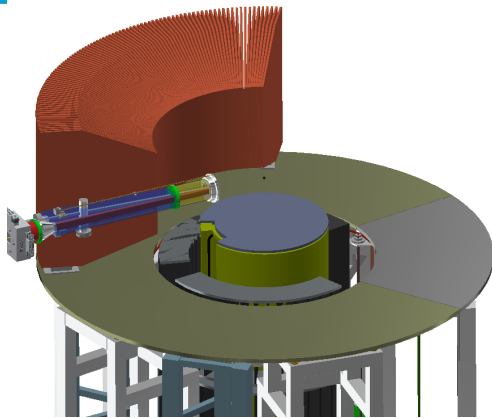
- (1) Detailed design of complete thermal & cold guide systems
- (2) Cost of complete thermal guide
- (3) Option 1 Cost of cold straight section
- (4) Option 2 Cost of Bunker Cold section

Winner Cheapest cost of thermal & Options (1) + (2).



Rights reserved on order of cold guide options

Heimdal Detector System



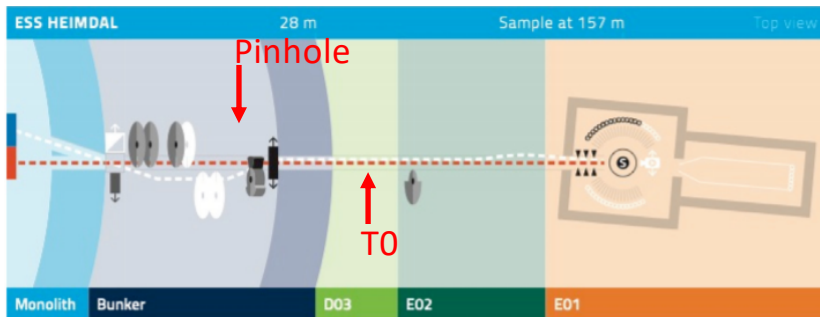
Technical Specification design finished May 2020

ESS B¹⁰ 2D Diffraction Detectors - Dream -> Magic -> Heimdal

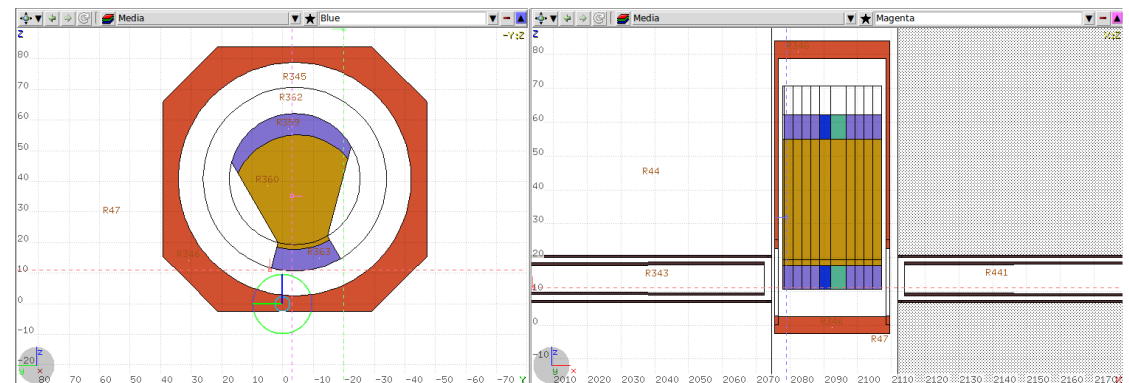
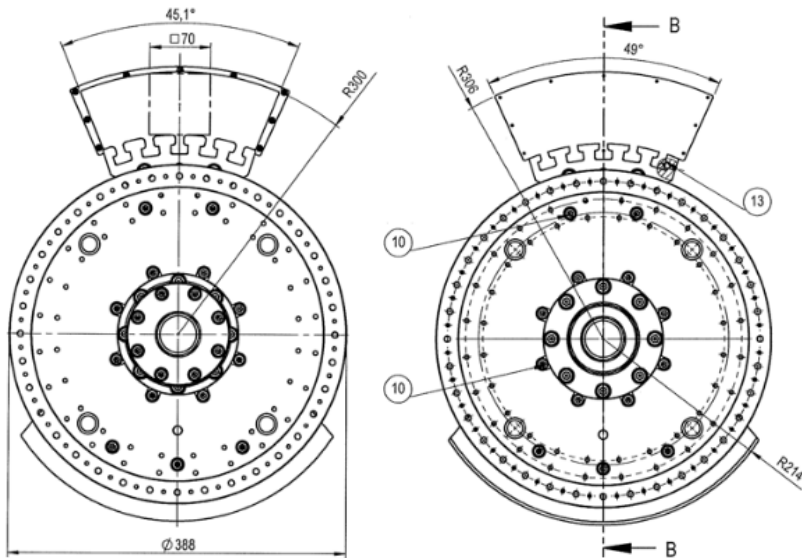
Delayed to 2021 due to no PSI in-kind approval

PSI -> Guide procurement first then Detector & Monitors.

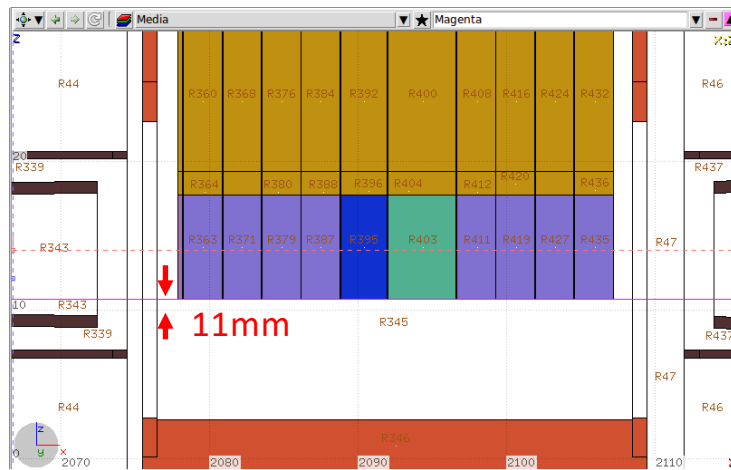
T0 chopper



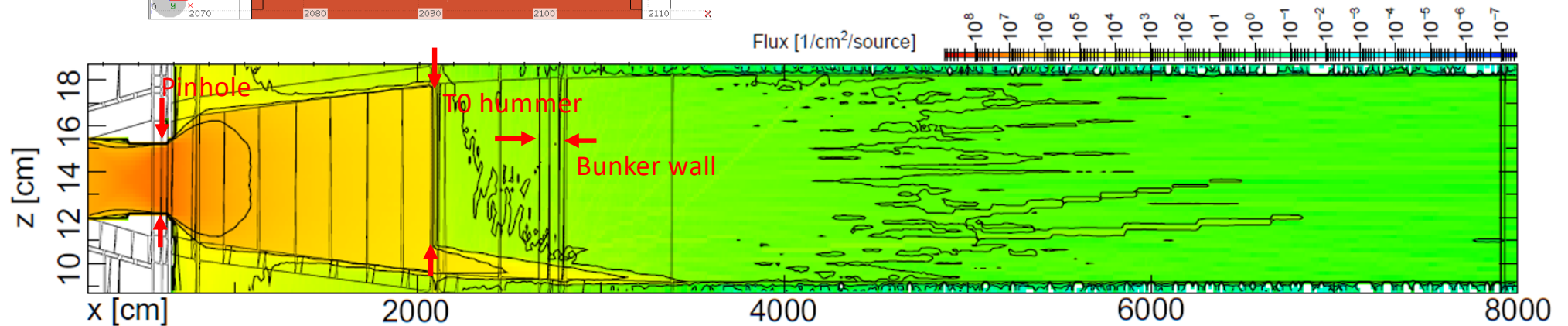
- Standard ESS T0 chopper rotor is designed for 60x60mm guide opening and has 70mm coverage in height
- HEIMDAL guide at a nominal position of T0chopper placement has a height of 81mm
- A pinhole at 6.4 m is 50 mm tall and is fully blocked by the tungsten hammer when viewed from the far end of the guide.
- A possibility for savings from using a rotor with standard hammer dimensions



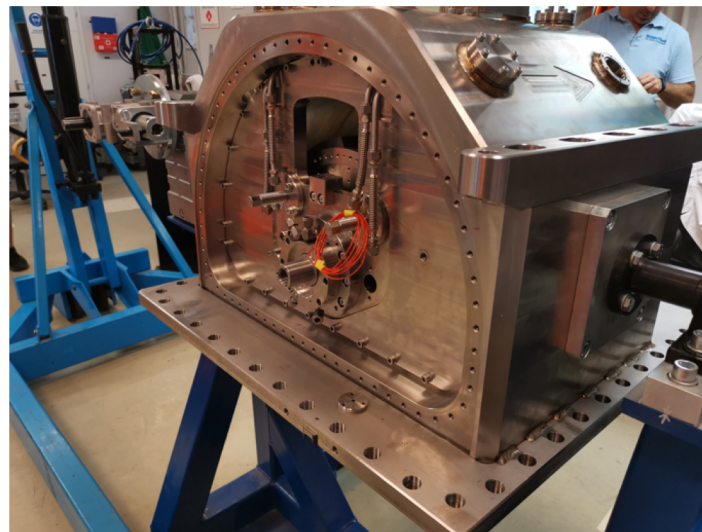
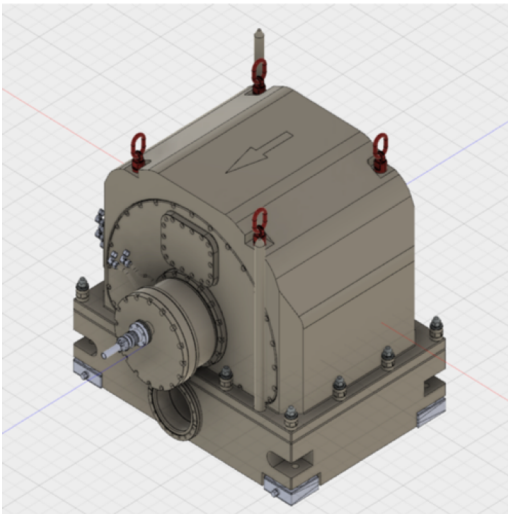
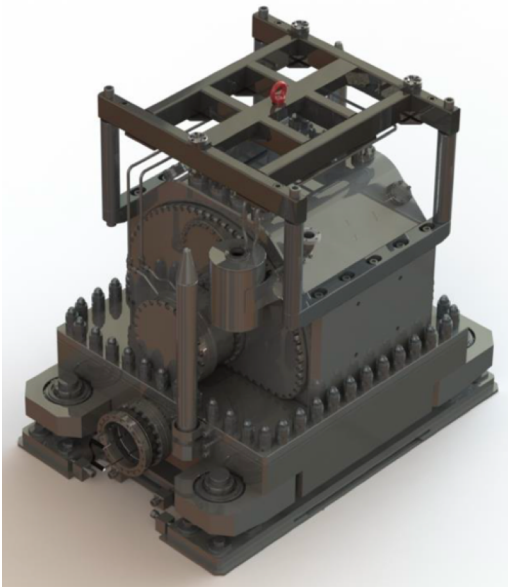
Heimdal T0 Neutronics



- A T0 chopper is placed leaving 11 mm of the guide space below the hammer open.
- Streaming of neutrons below the hammer is absent beyond 35 meters from target (figure for $E_n > 20\text{MeV}$)
- Same background as for full-sized T0
- Radiation safety fulfilled: guide shielding is designed to provide 1.5 uSv/h outside with T0 parked open.
- 300 uSv/h contact dose rate at T0 hammer 1h after shutdown, well within 10mSv/h limit.



T0 Chopper



Prototype T0 Chopper Design

Moving forward with Chopper Group: Expected to be within budget

Change Request to include more cold guide scope



Item	Contractor	Costed	Within Budget ?
Chopper Systems	ESS Common	Yes	Yes
T0 Chopper	ESS	Yes	Yes
Guide Shielding	ESS Common	Yes	Yes
Cave Shielding	Mirrotron	Yes	Yes
Cave Infrastructure	ESS Common	No	?*
Detector	CDT	No	?
Monitors	ESS Common	Yes	Yes
Guide Optics	?	No	Yes

Heimdal Fast Sample Environments High Throughput Neutron Scattering



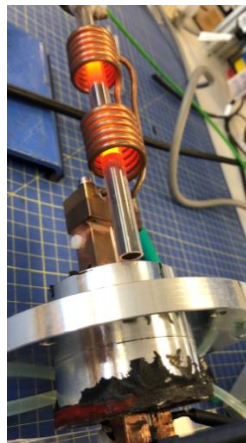
Open Flow Cooling



Oxford Cryosystems:
N₂ cryo system
80-500 K

Cryo Industries America:
Cryocool-LHe : 10-600 K
Consumption: 2L/hour 10 K
Cold zone: 10 mm
Cool down time: 10 min

Induction Heating

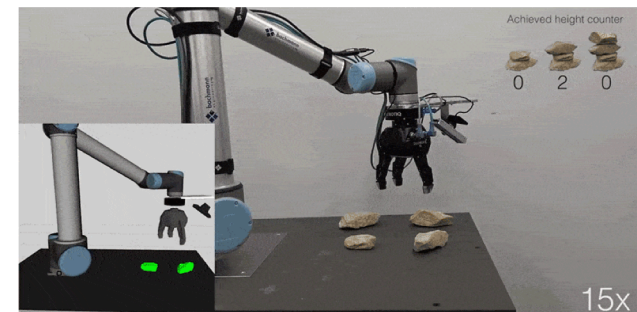


- Electromagnetic radiation
- Fast heating
- High temperature >1370 °C

Hot Air Blower



- 1000 W system**
 - 40 L/m dry air**
 - RT - 1000 K in 100s
 - combined with
 - flow system
 - active cooling by dry air
 - => fast sample change
- + Robot sample changer



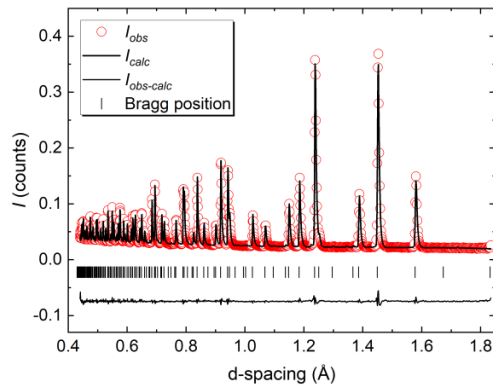
Nordforsk proposal 2020
Heimdal/Dream compatible sample environment
- Fast Heating
+ Post Doc Started @ AU:
Jakob Voldum Ahlburg

2D Rietveld Refinement

Mathias Mørch Ph.D Started @ AU 2020

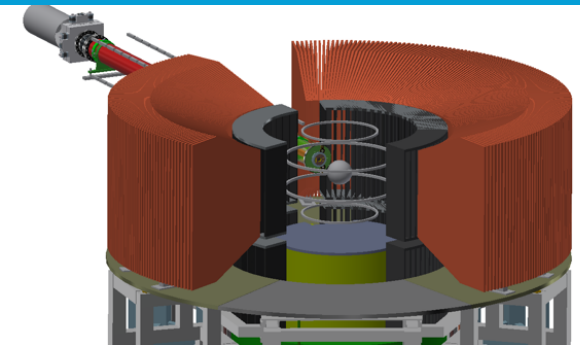
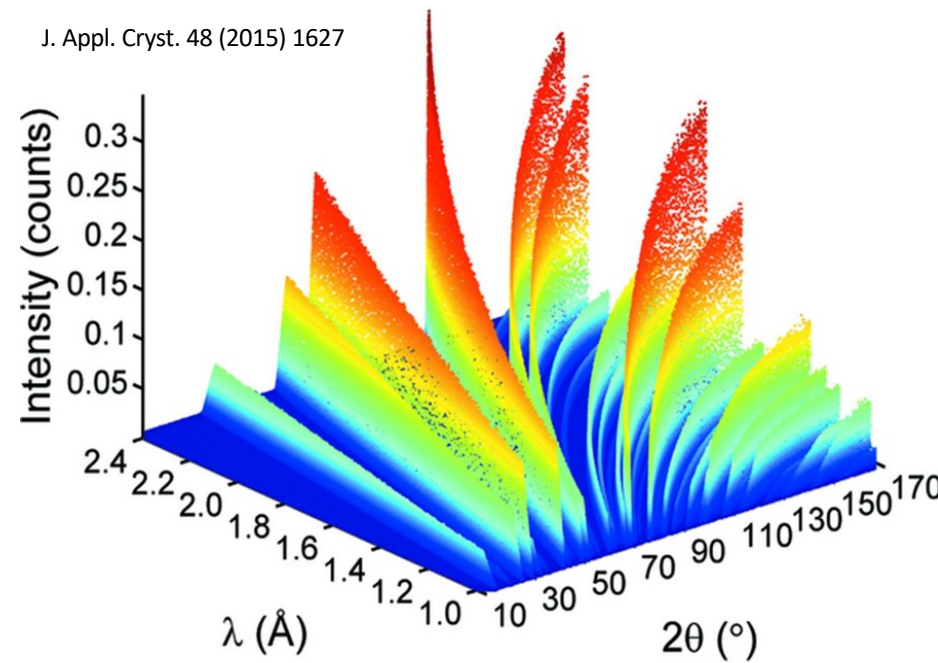


Hugo Rietveld



Powder Diffraction

J. Appl. Cryst. 48 (2015) 1627



Heimdal B¹⁰ 2D Detector



Heimdal Continues to Make Progress



Thank
you