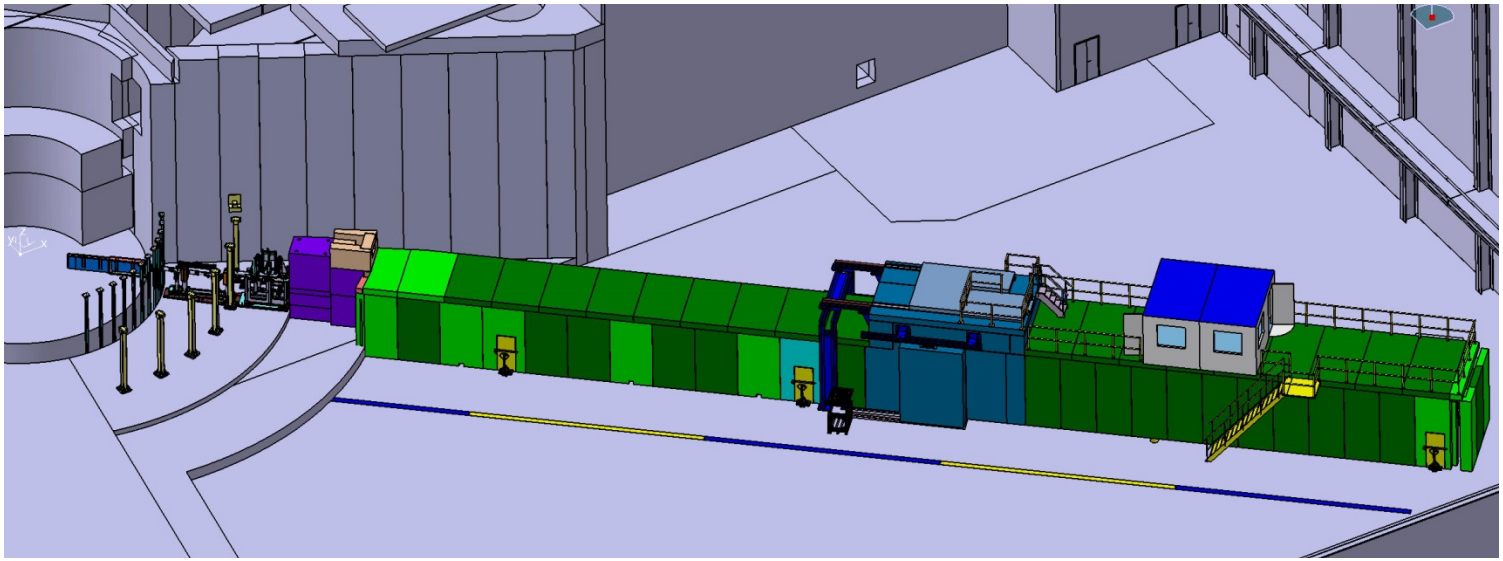
SKADI

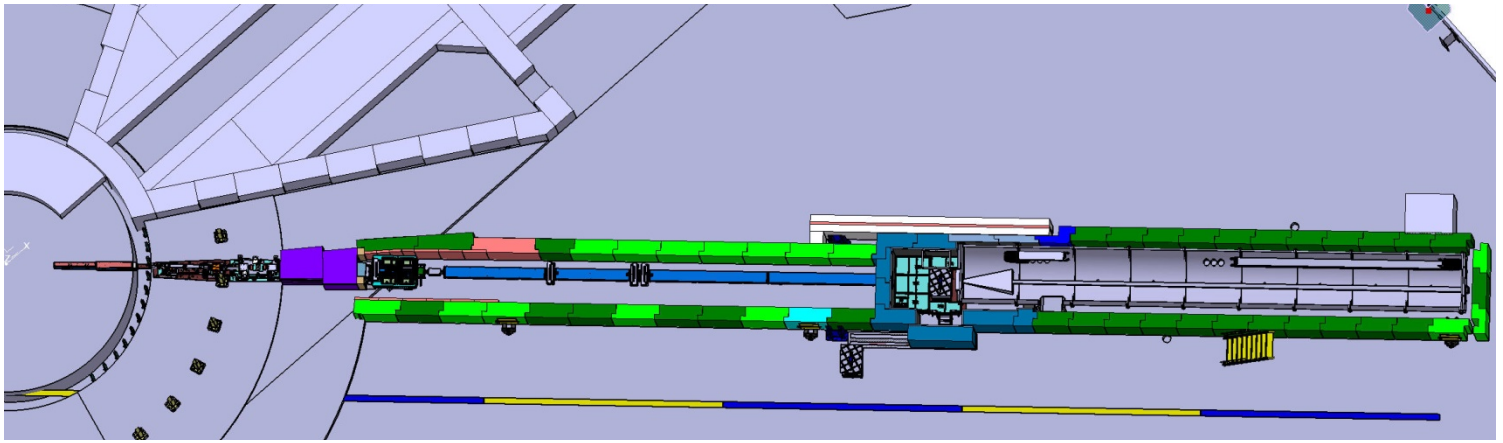
Current Status

STAP-Meeting 24.04.2020

April, 2020| Sebastian Jaksch, Romuald Hanslik, Ralf Engels, Sylvain Désert, Teddy Kozielewski et al.

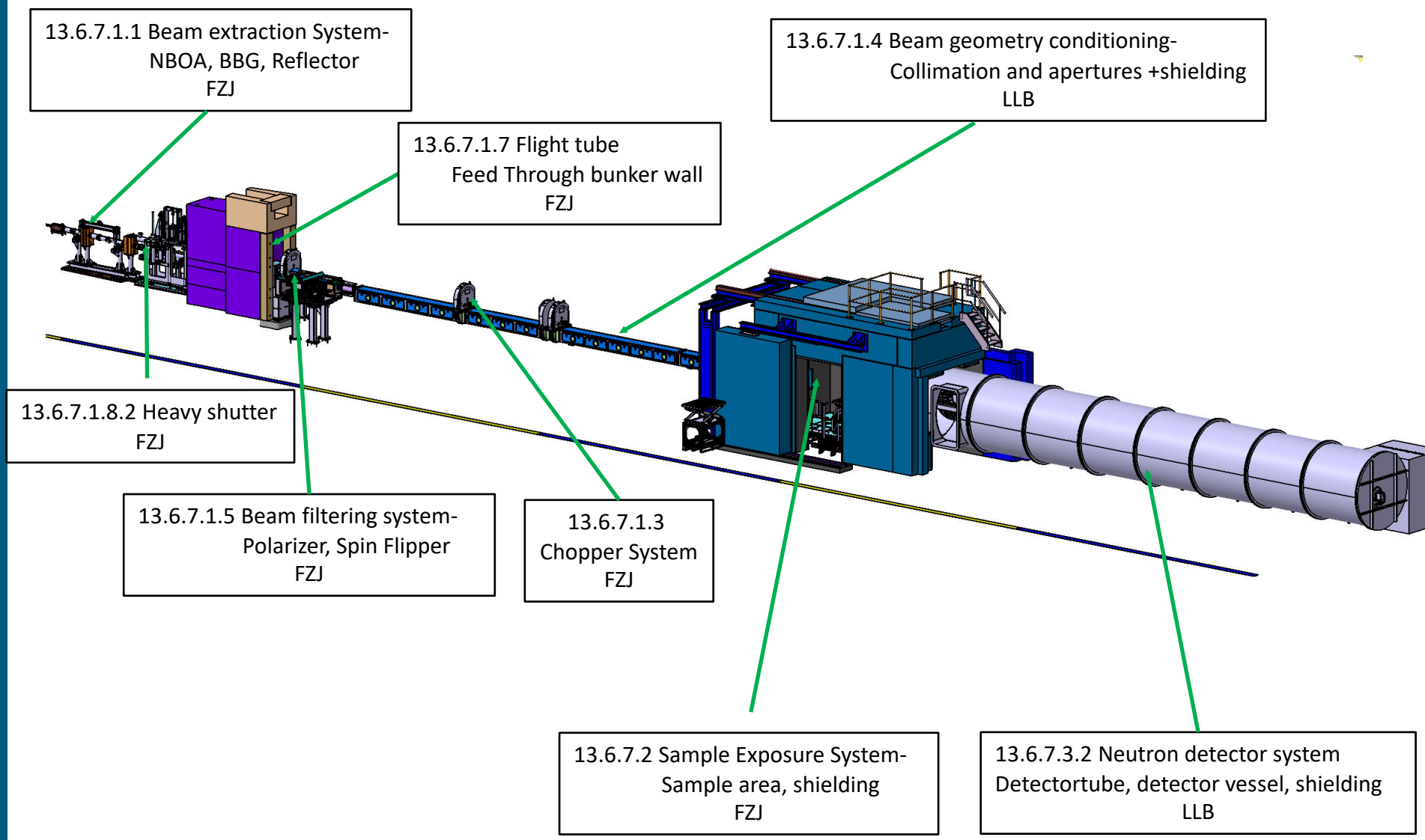
SKADI layout (short reminder)





- SKADI Complete with the shielding - E3-Port

SKADI layout (short reminder)



Major activities in SKADI project

1. Technical Annex for SKADI signed on endorsed by Jan 2020.
2. NBOA – Manufacturing start is imminent.
3. Technical part of the Call For Tender CTV of the bunker components including Bunker Wall Insert approved (G.L. 17.05.2019), but final approval delayed for to summer 2020 due to procurement priorization.
4. Initial talks with the Forschungszentrum building and purchasing department for the order of the Sample Cave Shielding were held in February 2020.
5. Choppers are procured in FZJ (March 2020).
6. New and final concept of the heavy shutter, approval by Gabor pending.
7. SoNDe project has been finalized, tests are running
8. Further development of the Detector holder and housing.
9. Collimation, Shielding, Detectortube, VSANS etc.
10. STAP Comments, Scientific Infos, Sample environment
11. Monitors handed over as ESS project.

continued

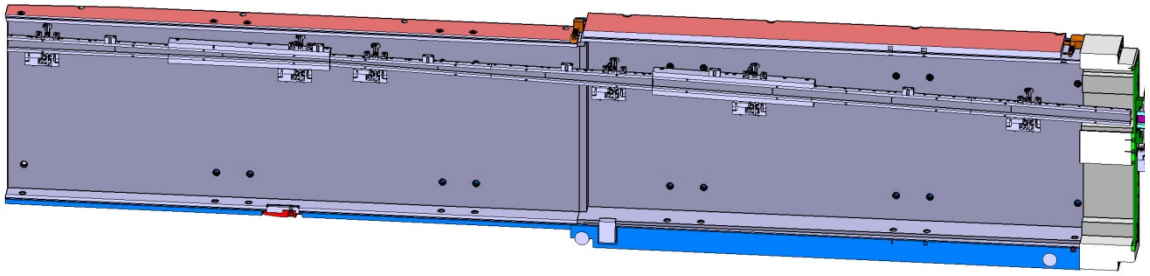
12. Change of LLB lead scientist: Alexis Chenneviere → WELCOME
13. Detector positioning stack under development, including design of interfaces between detector and tube

Corona impact

- Minimal at the moment (polarizer seems to be the only one which is affected, but was not a critical component)

13.6.7.1.1 Beam extraction system

NBOA



Neutron Optical Components & Instruments

SwissNeutronics project data			
Project title	FZJ@ESS, SKADI - NBOA neutron guide	Project No.	SN19015
Project manager	Christian Schanzer		
Email	christian.schanzer@swissneutronics.ch		
Customer project data			
Customer	FZ Jülich	Customer ref./PO	42211831
Project manager	Teddy Kozielewski	Date of contract/PO	21-Mar-19
Email	t.kozielewski@fz-juelich.de	Amendments	43895
Report / document data			
Prepard by	Christian Schanzer	Report / Doc. No.	SN19015-002
Date	8-Mar-20	Revision	10
Type	Project management	Status	final

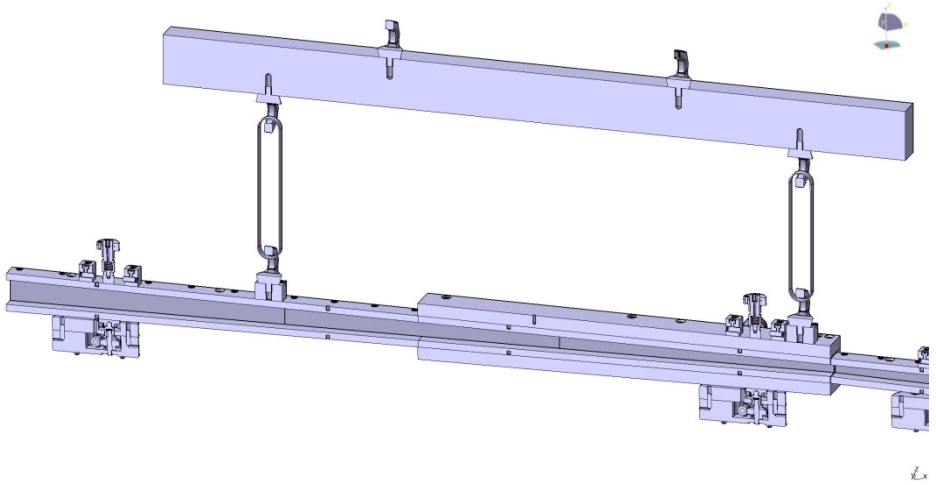
SN19015 Project Report - No. 10

Milestones

Milestone	Payment	Target date original	Target date updated	Status	Remarks
Final design review	yes	25-Aug-19	Mar-20	in progress	See open issue No. 5
Delivery	yes	28-Feb-20	Jul-20		See open issue No. 3
Installation	no	28-Aug-20			
Final acceptance	yes	28-Aug-20			

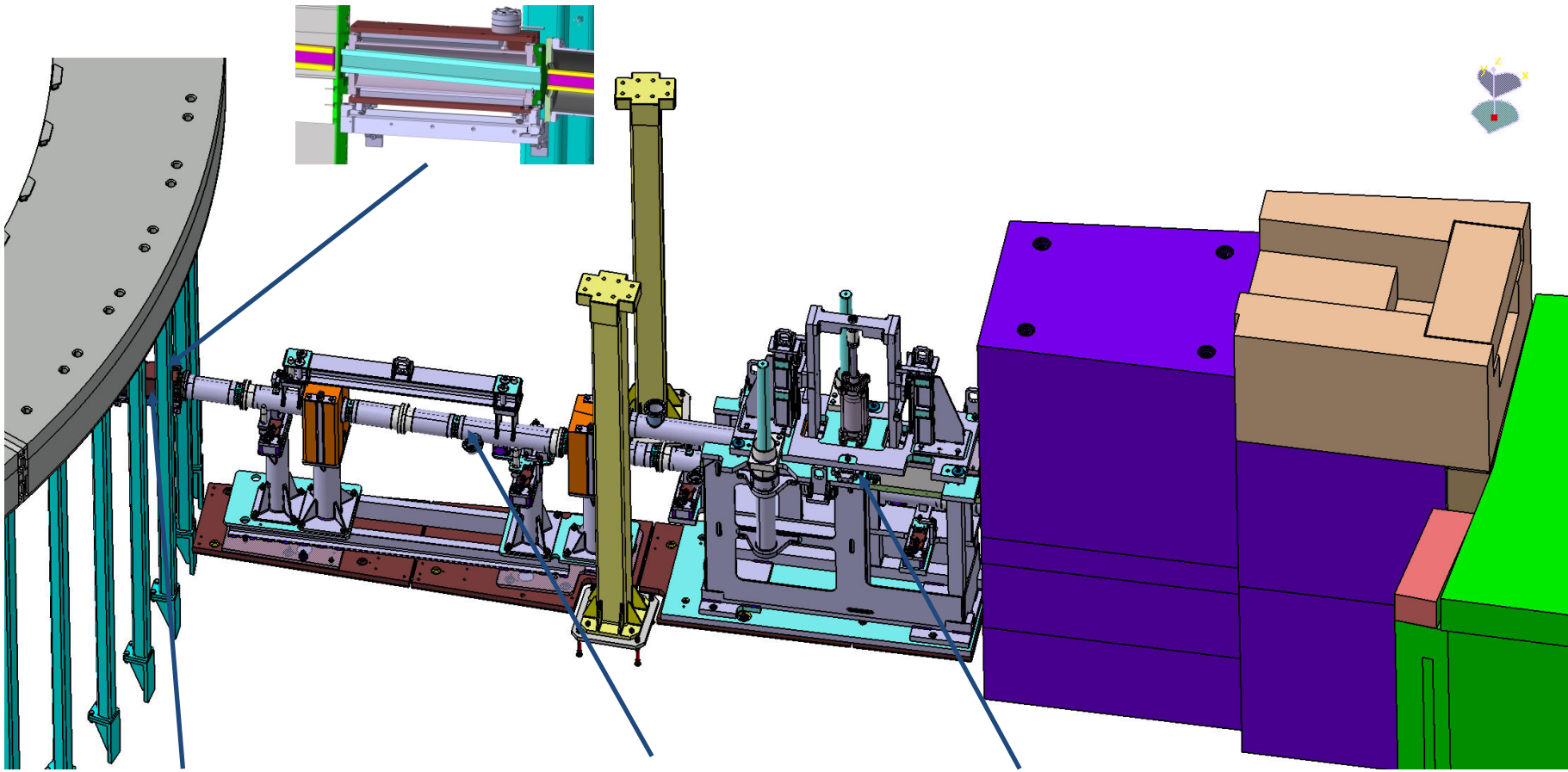
Status of activities

Section	Activity	Status	Remarks
	Project Management		
	Award of contract	complete	
	Installation of project in project management	complete	
	Project Kick-off @ SwissNeutronics (internal)	complete	
	Preparations / documents for Kick-off meetint with FZ Jülich	complete	sent to FZJ (27-Mar-2019)
	Project Kick-off meeting with FZ Jülich	complete	9-Apr-2019
	Preliminary Design		
all	Clarification of specs and interfaces	complete	Provided by ESS (22-Aug-2019)
Guides	Preparation of conceptual design	complete	In essence it can/will be already the final design
Alignment	Preparation of conceptual design	complete	The identical design of the alignment devices as for Loki is



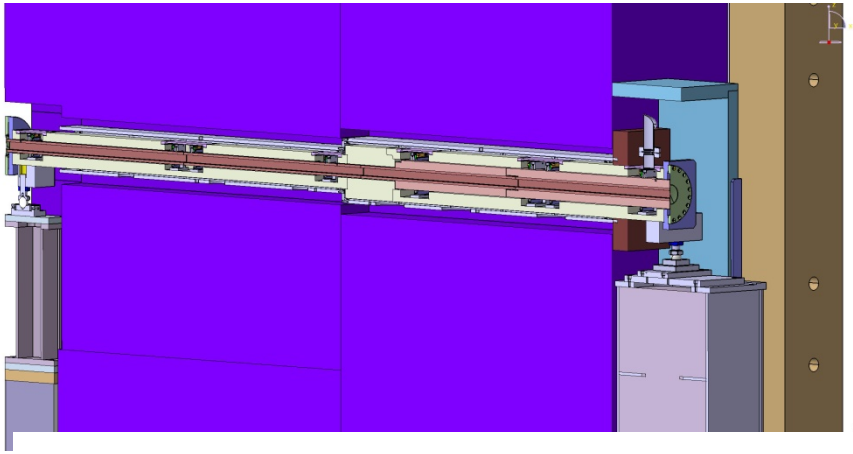
- Final design review in progress.
- Delivery delays caused by Covid-19 pandemic are to be expected.

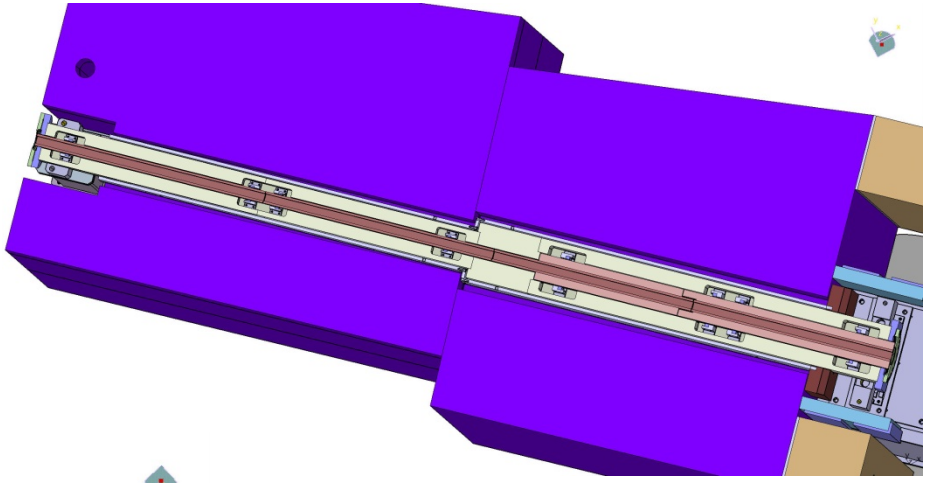
13.6.7.1.1 Beam extraction system

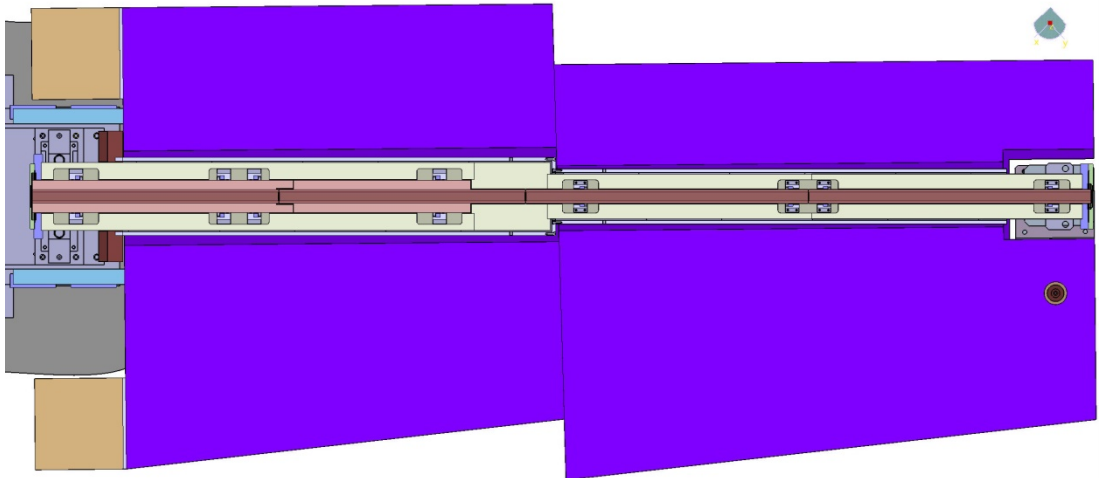


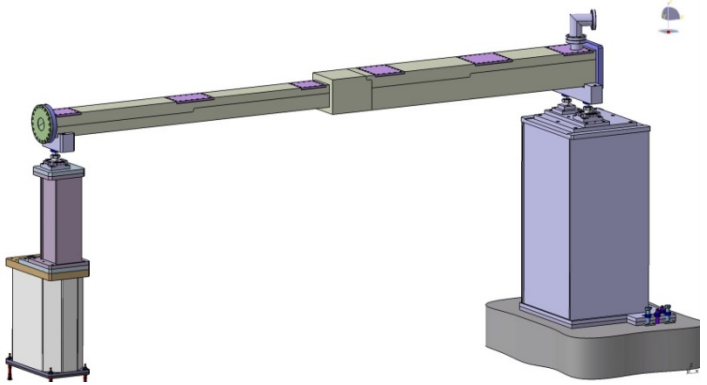
- Overview complete reflector in bunker
- The technical part of the Call For Tender of the neutron guides including BWI is approved, but due procurement prioritization, the complete approval is on hold until summer 2020.

13.6.7.1.7 Flight Tube (Feed through bunker wall)





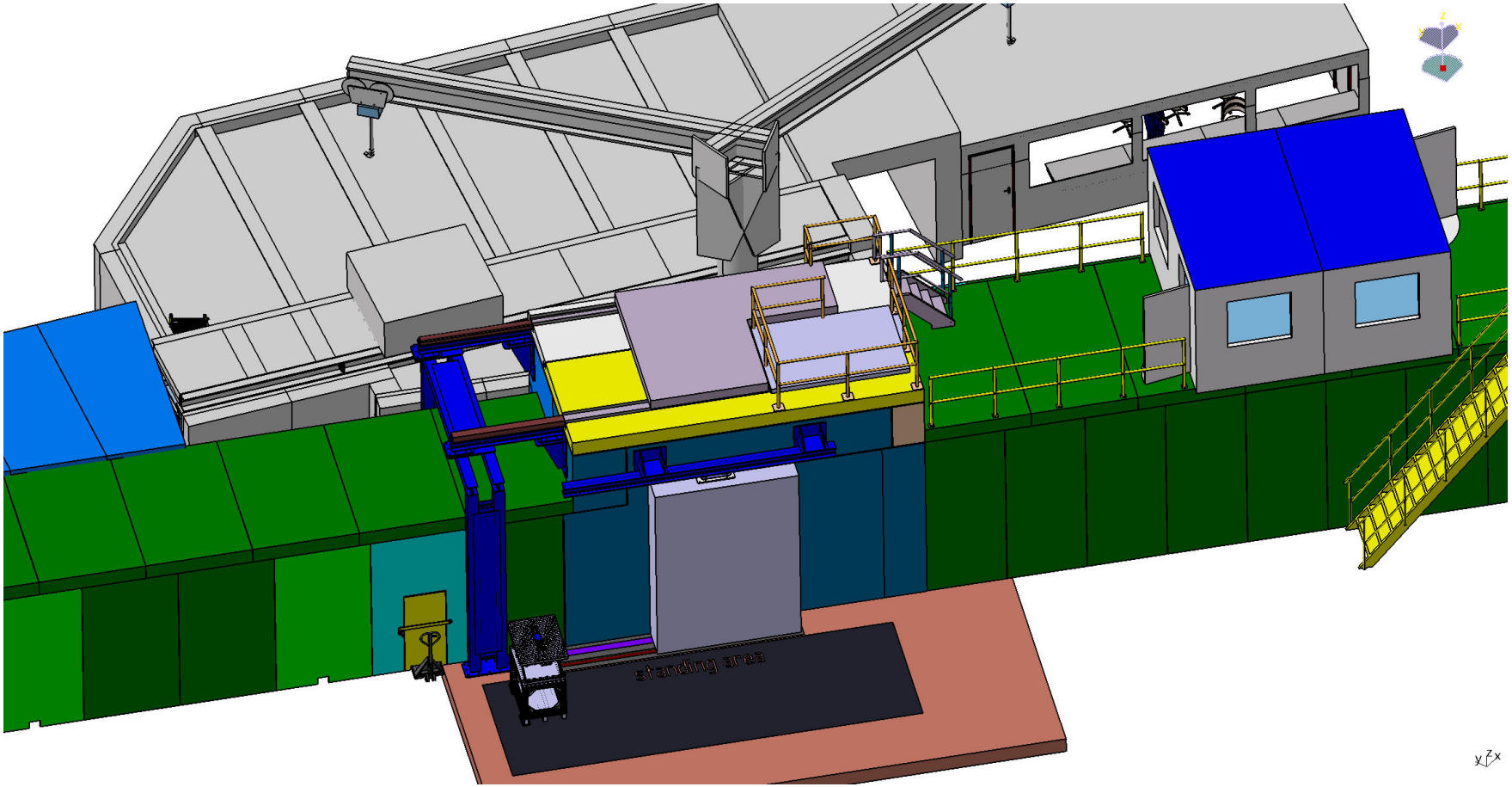




- ESS has sent us the modified feed through bunker wall. The feed through was increased in size to provide more room for the previous spacer plates. But this has no effect on our design.
- The technical part of the Call For Tender of the neutron guides including BWI is approved, but due procurement prioritization, the complete approval is on hold until summer 2020.

13.6.7.2 Sample Exposure System

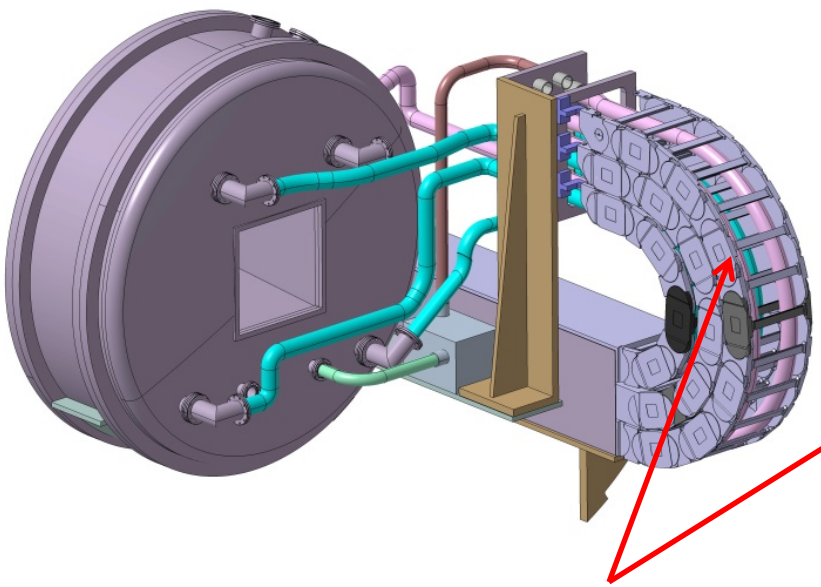
Sample Area update



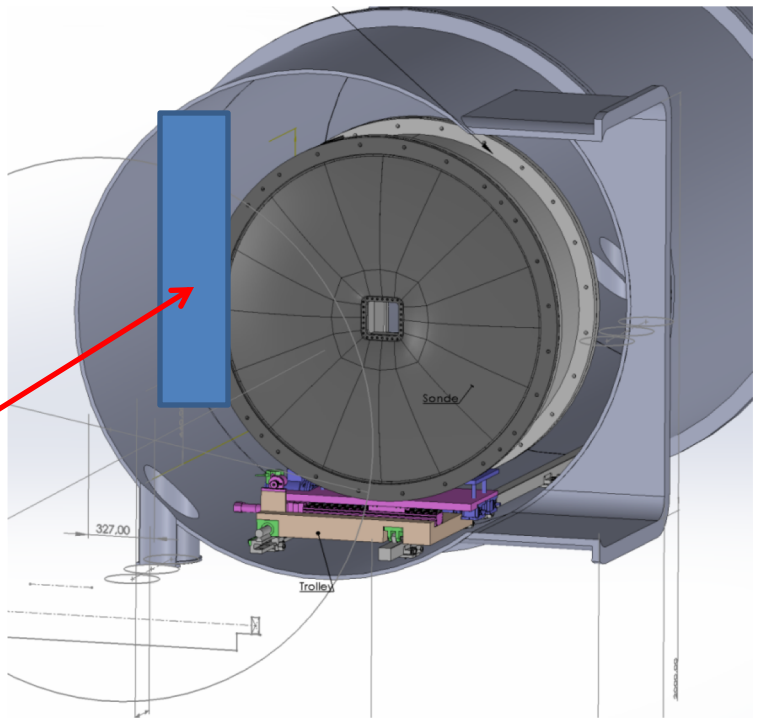
- Modified Sample Area Shielding:
  - Only one door from the operating side, detector access with pallet jack
  - Shielding wall to Estia modified

13.6.7.2 Sample Exposure System

Sample Area update



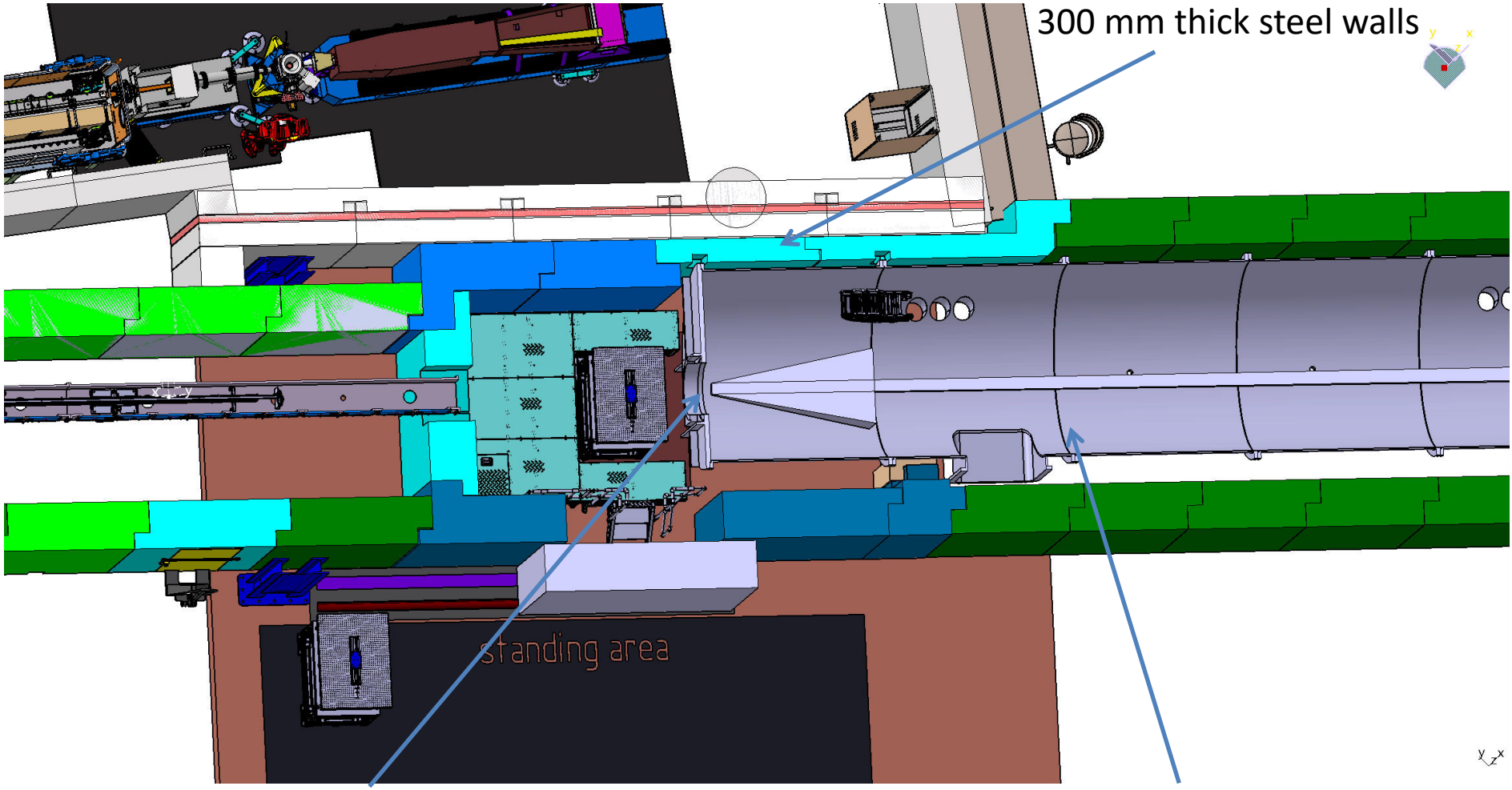
Energy chain



More space is needed on the detector housing side in detector tube. So the center of the detector tube is not the center of the beam axis.
For this reason the diameter of the detector tube is larger and the detector tube is shifted to the ESTIA side.

13.6.7.2 Sample Exposure System

Sample Area

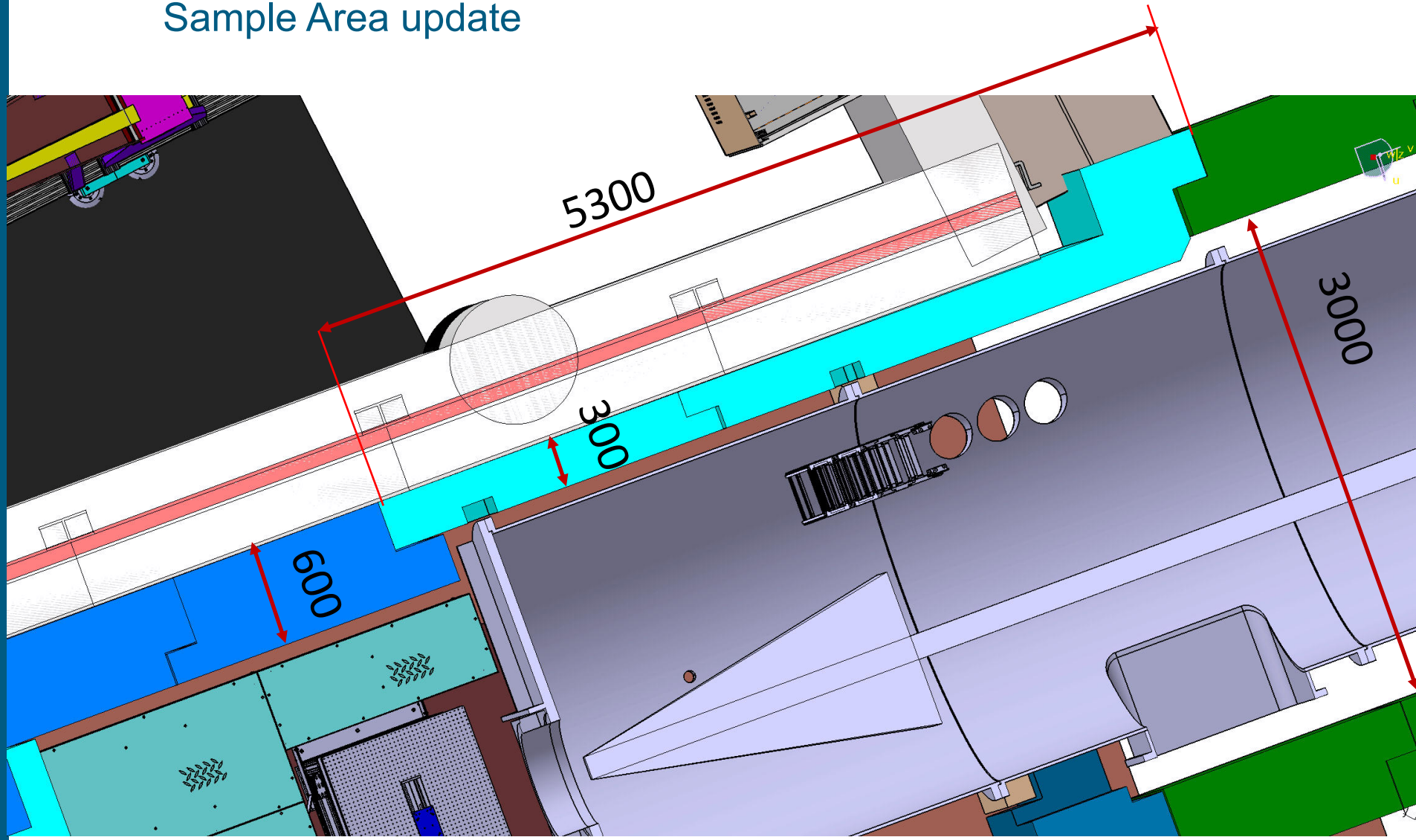


Center of Detector tube is not the neutron beam axis

Detector tube diameter = 2410mm
Detector flange outer diameter = 2590mm

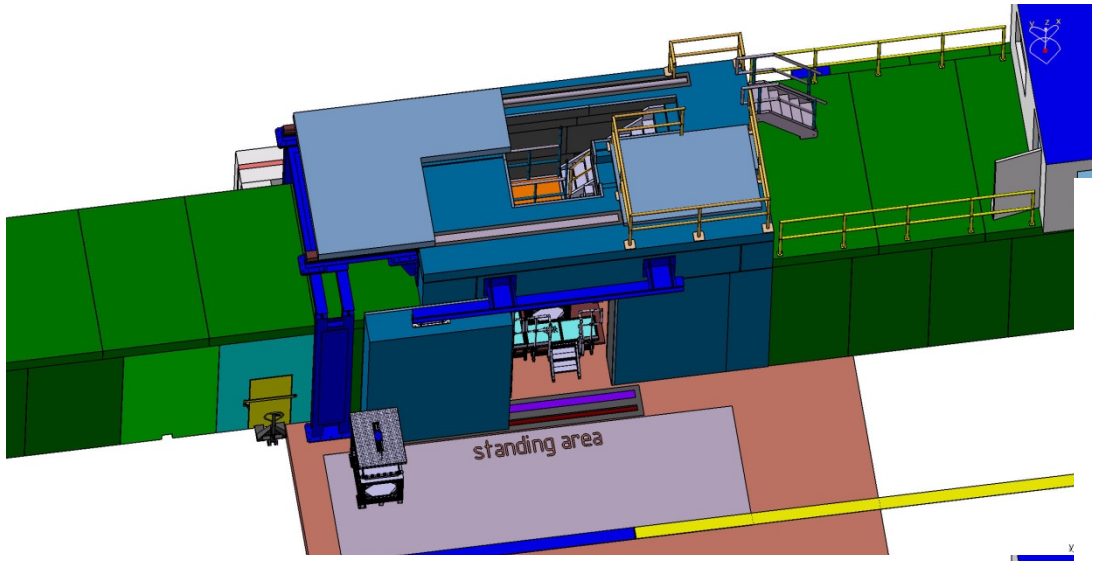
13.6.7.2 Sample Exposure System

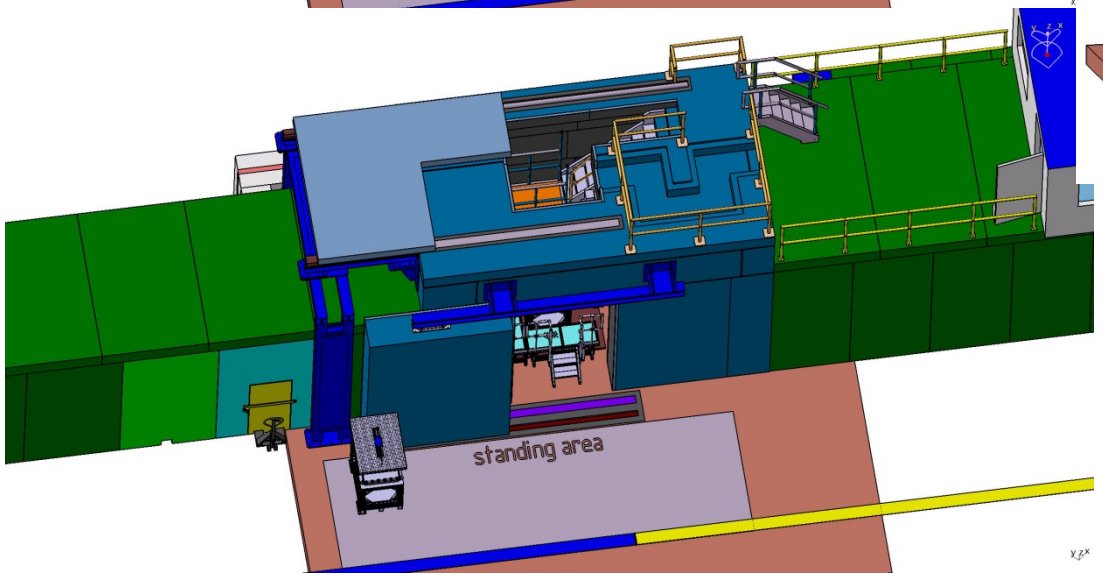
Sample Area update

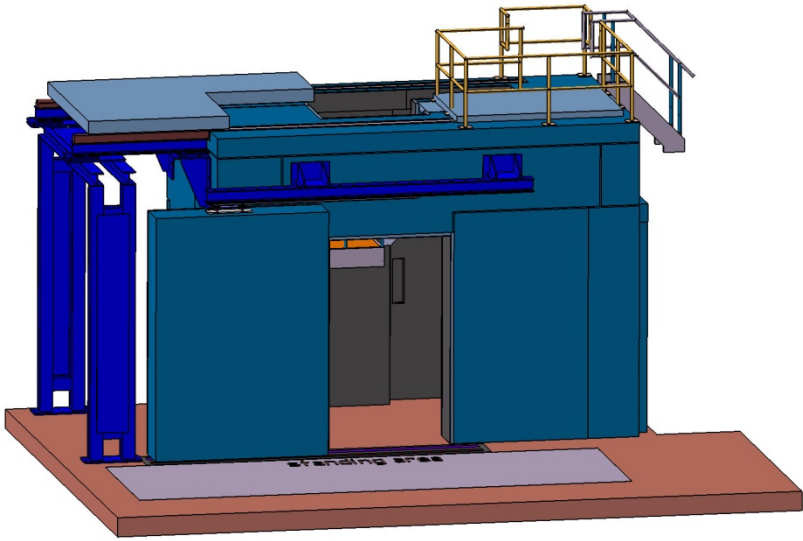


13.6.7.2 Sample Exposure System

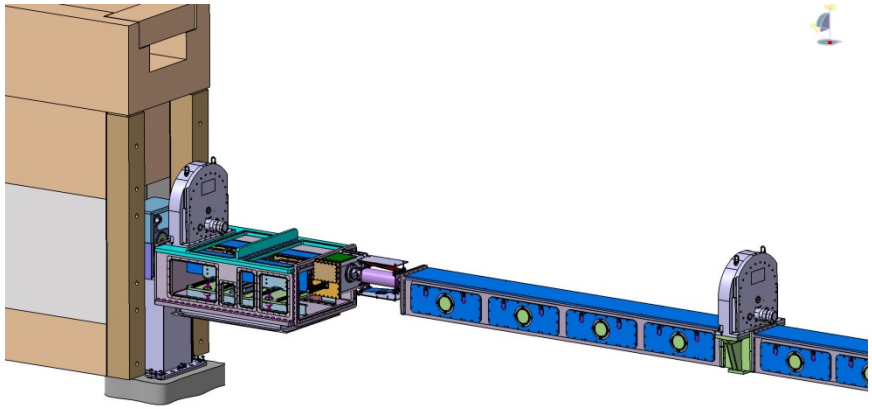
Sample Area Update

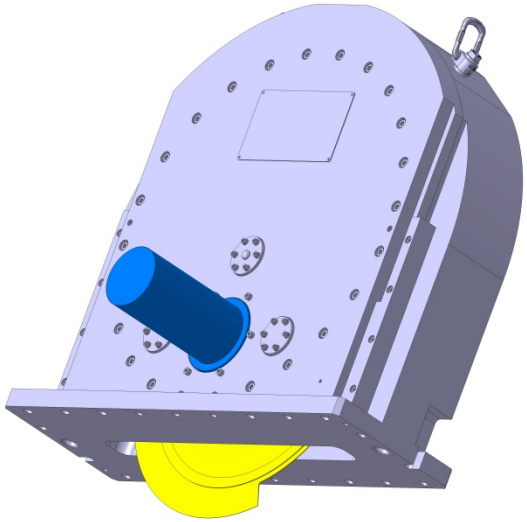


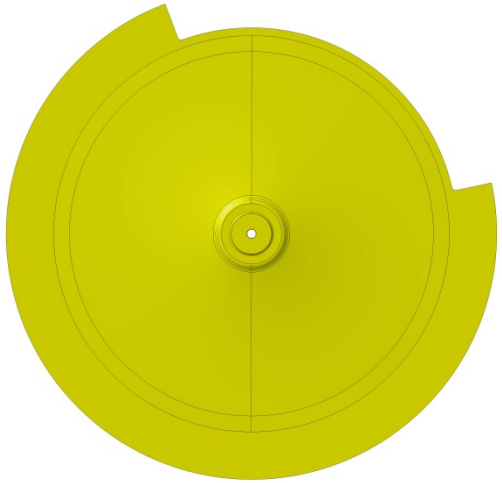




13.6.7.1.2 SKADI Chopper System



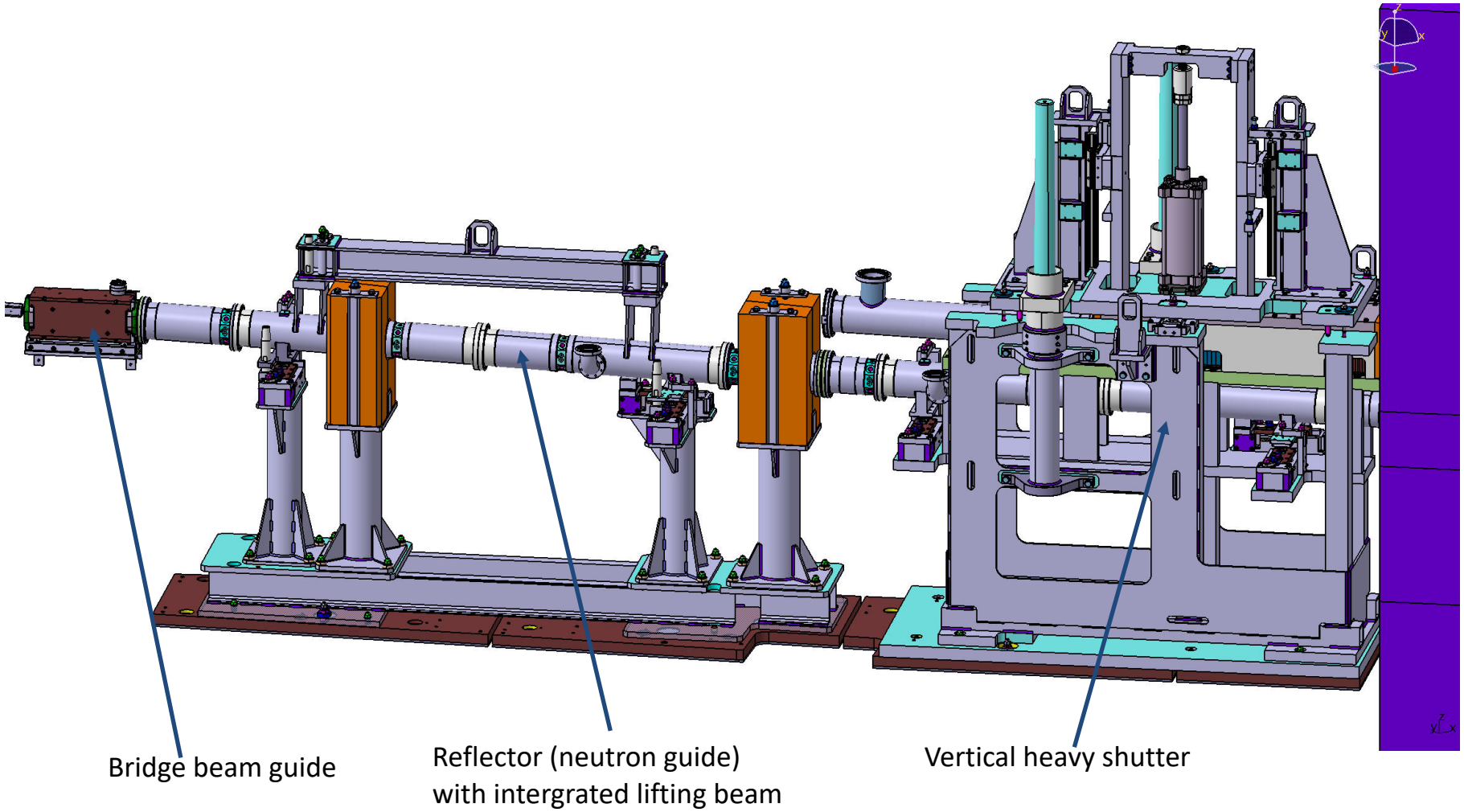




– Order of two Chopper at Forschungszentrum Juelich (March 2020).

13.6.7.1.1 Beam extraction system

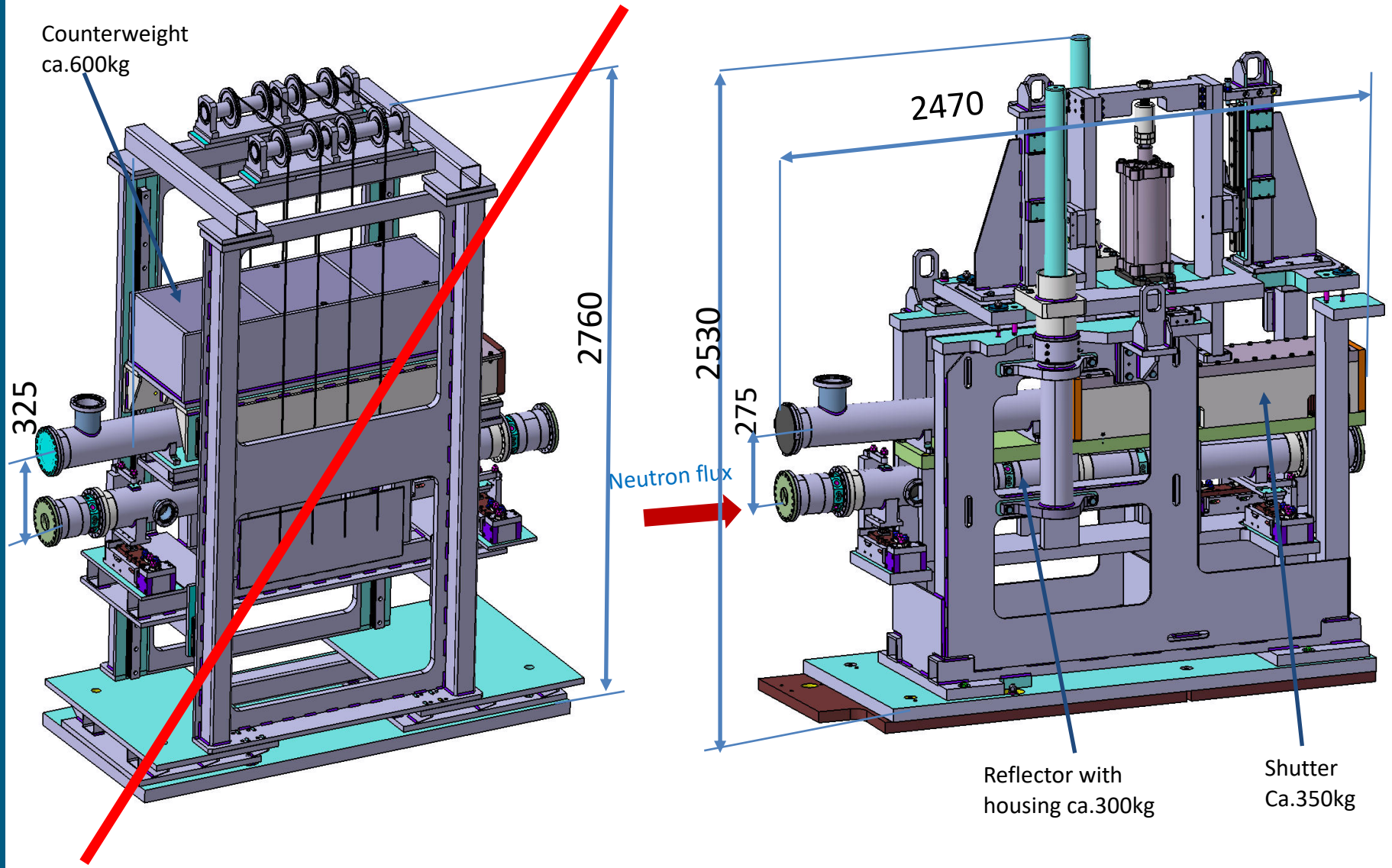
Overview complete reflector in bunker



Heavy Shutter update

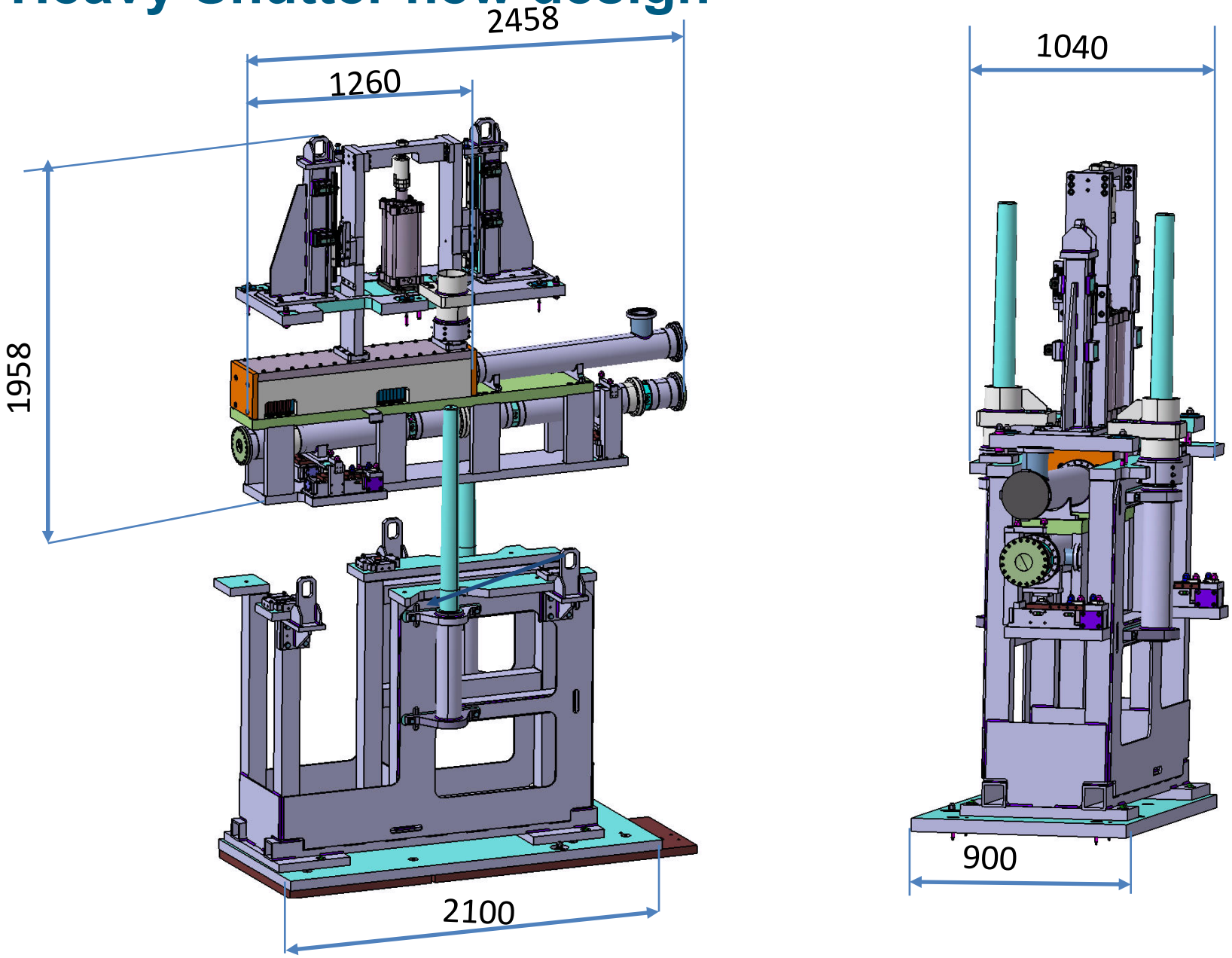
- Heavy shutter smaller and lighter (no counter weight).
- Better decoupling of the parts.
- For maintenance work only the part with the neutron guide can be removed.
- Pneumatic drive (possibly the same as ESS-Heavy shutter)
- Installation of limit and safety switches (according to the ESS Heavy Shutter)
- Safety-locking mechanisms for block during Setup/Maintenance
- Adjustable stops for the positioning of the slide
- Guide pins for reassembling the frame
- Load carrying for crane suspension

Heavy Shutter new design



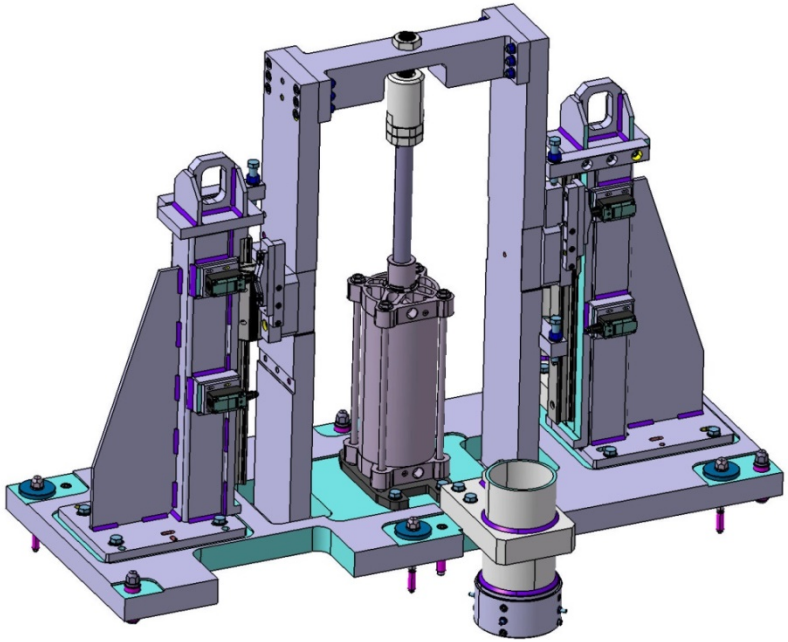
Linear guides and bearings are lubricant-free.

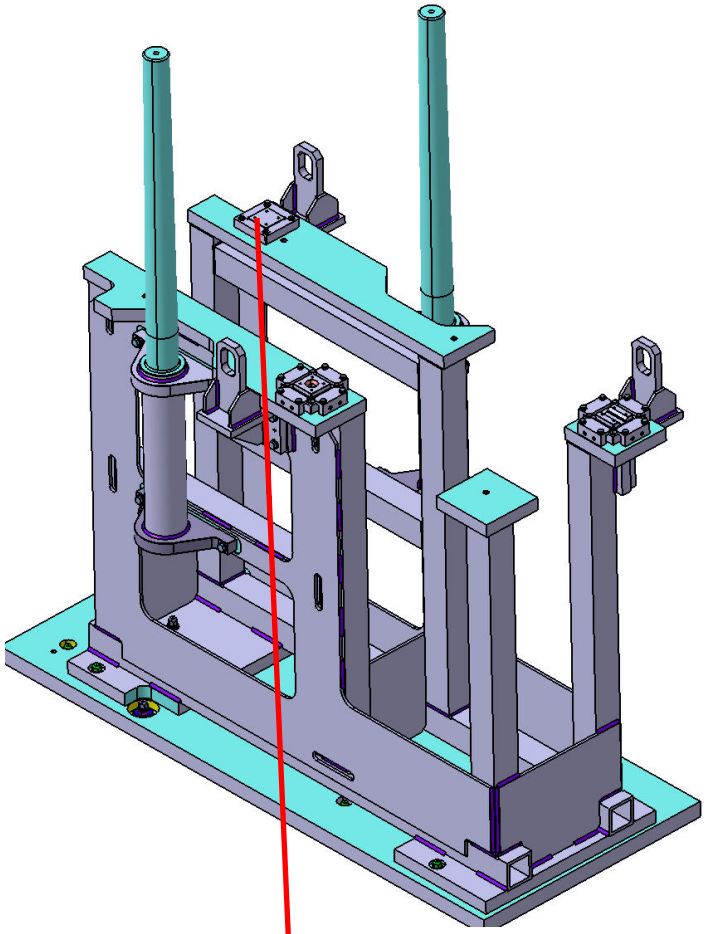
Heavy Shutter new design

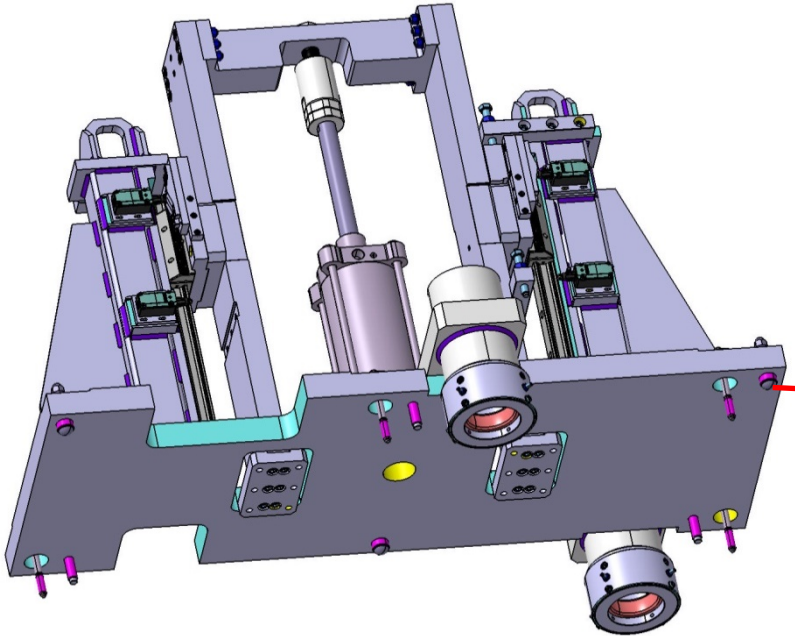


This design was discussed with Gabor at IKON18.

Heavy Shutter new design

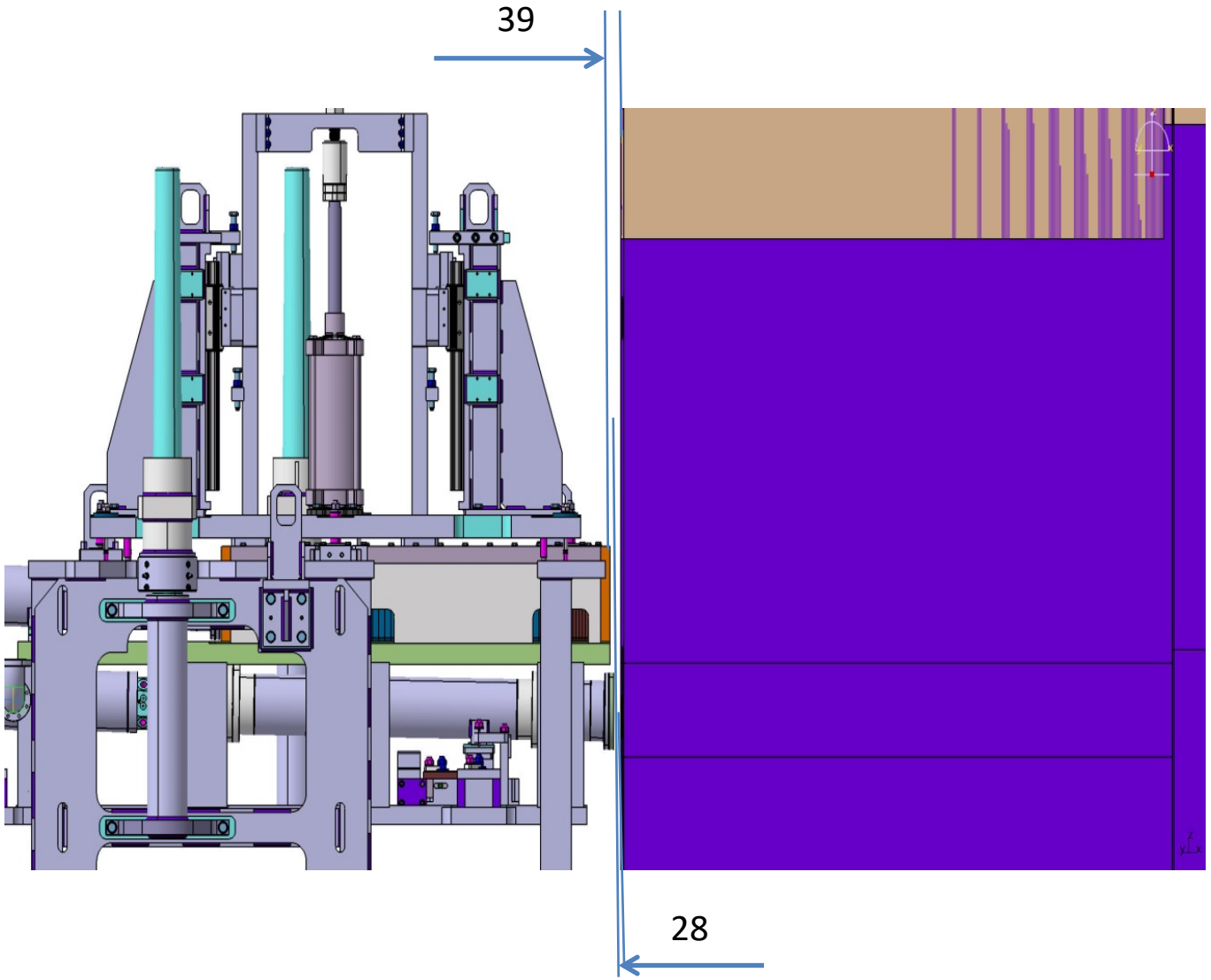




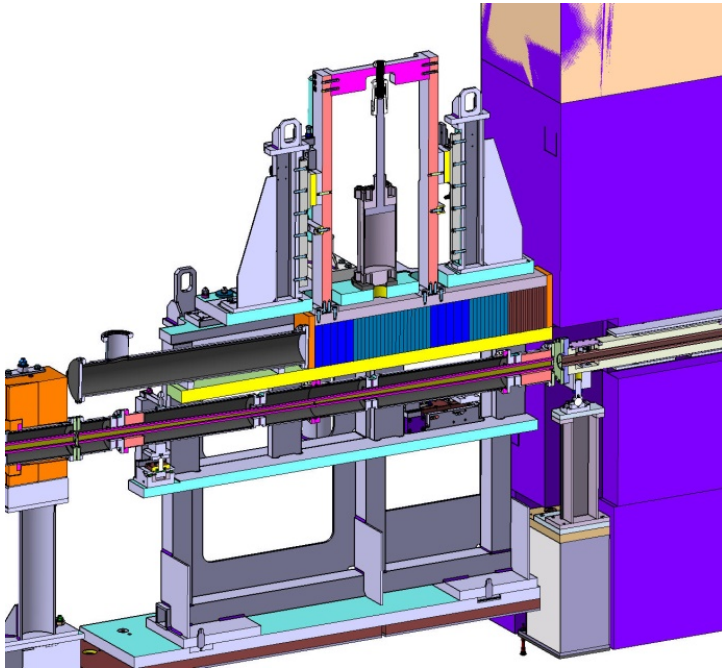


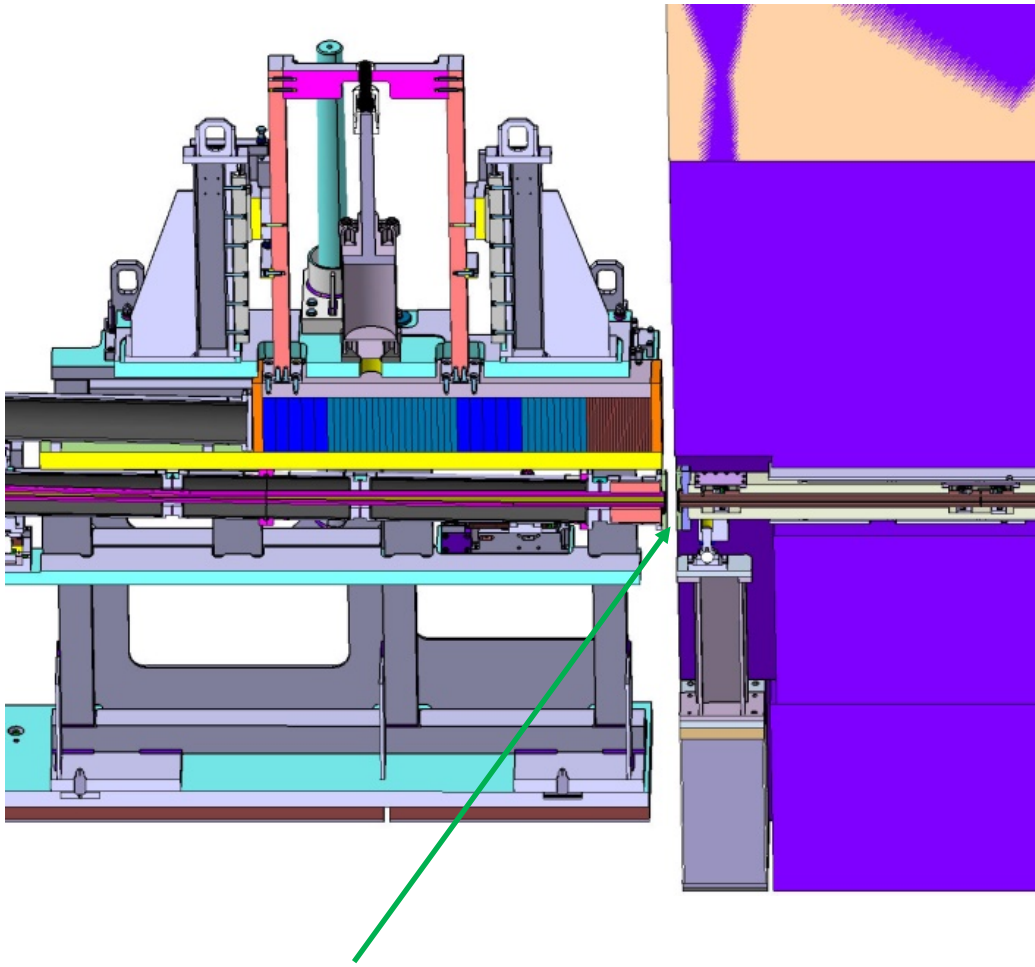
Adjustment elements

Heavy Shutter with the bunker wall



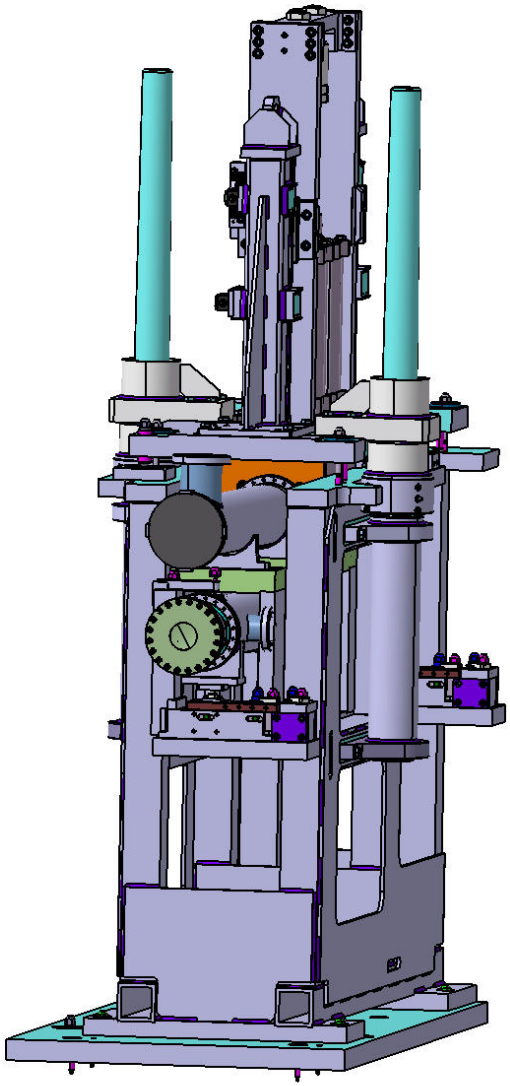
Heavy Shutter with the bunker wall



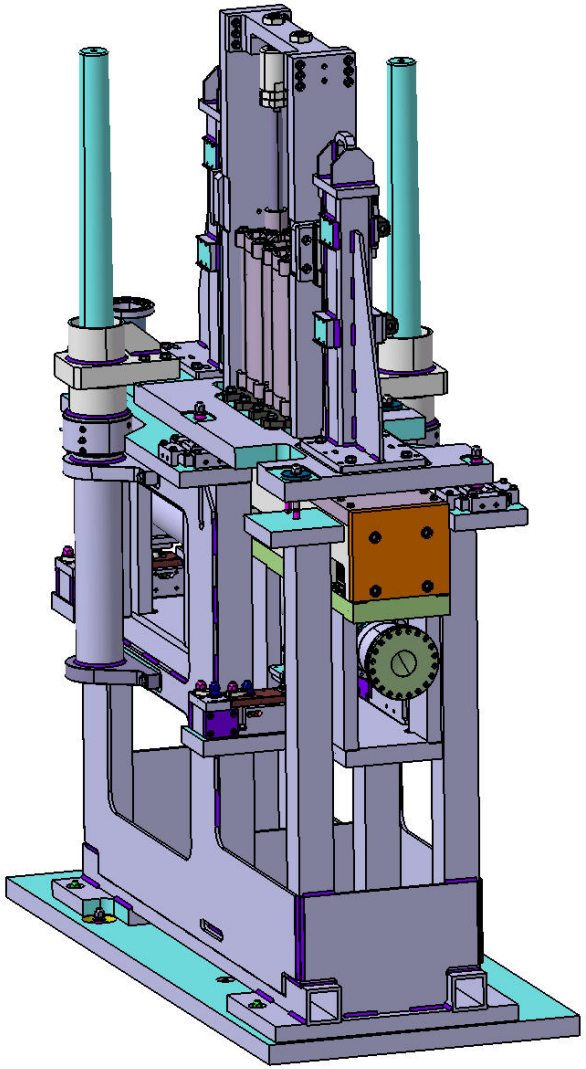


It is planned to shield the gap with a shielding cover. This is machined on site in order to avoid concrete tolerance issues.

Heavy Shutter overview

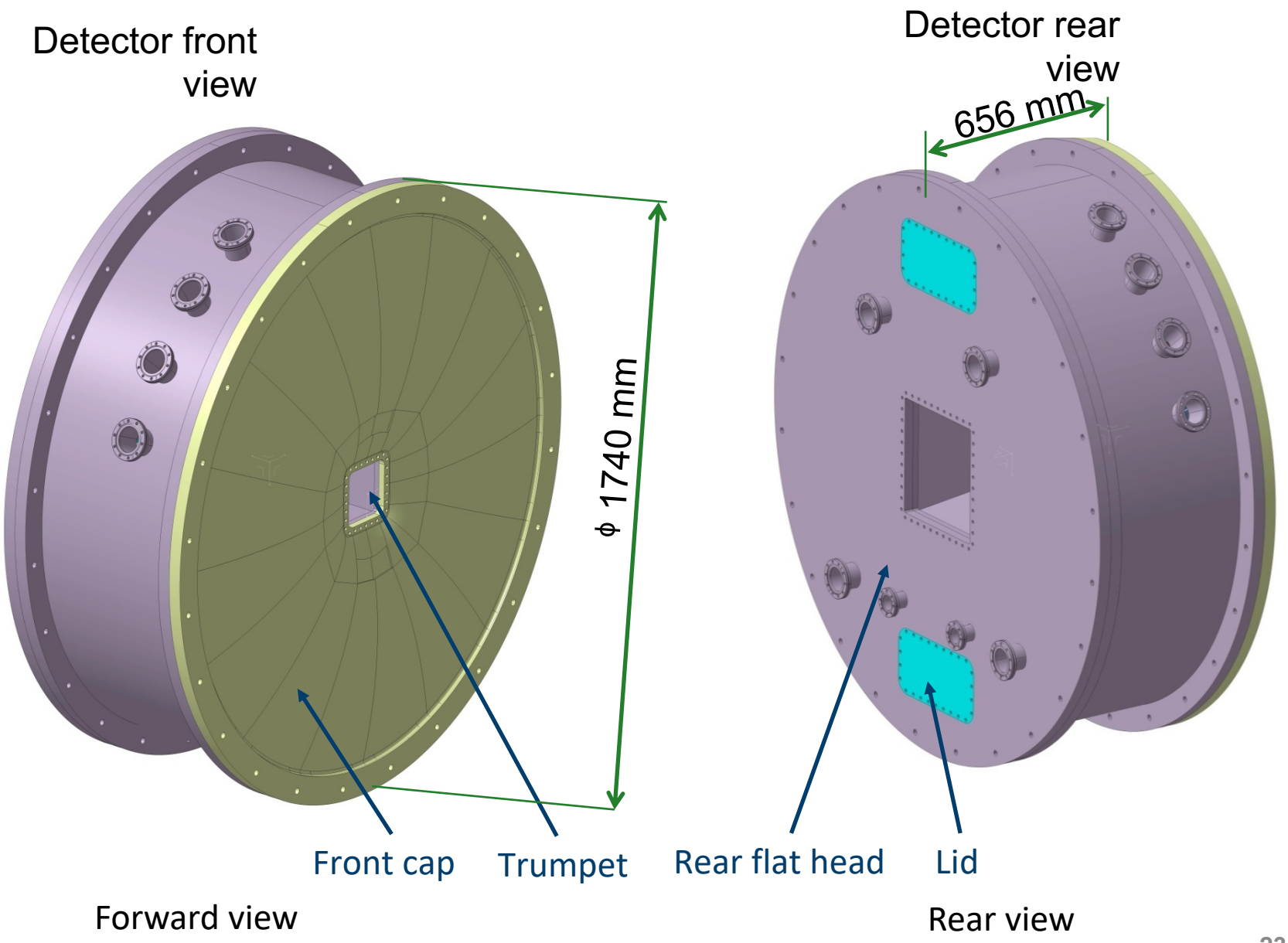


Forward view

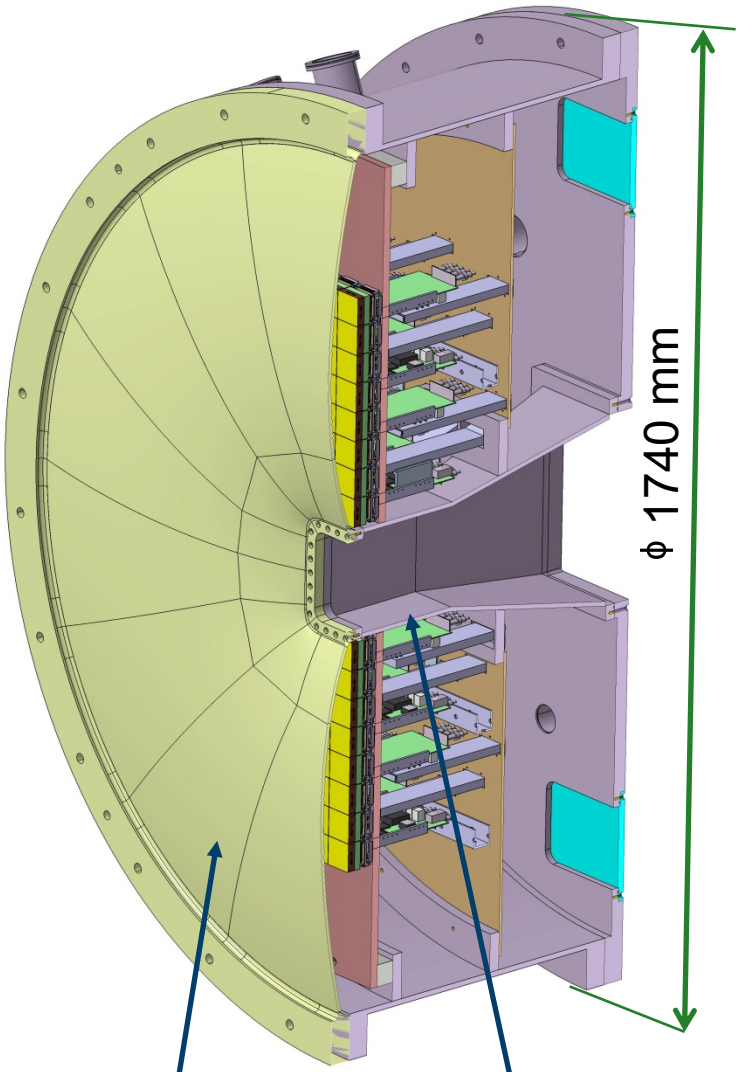


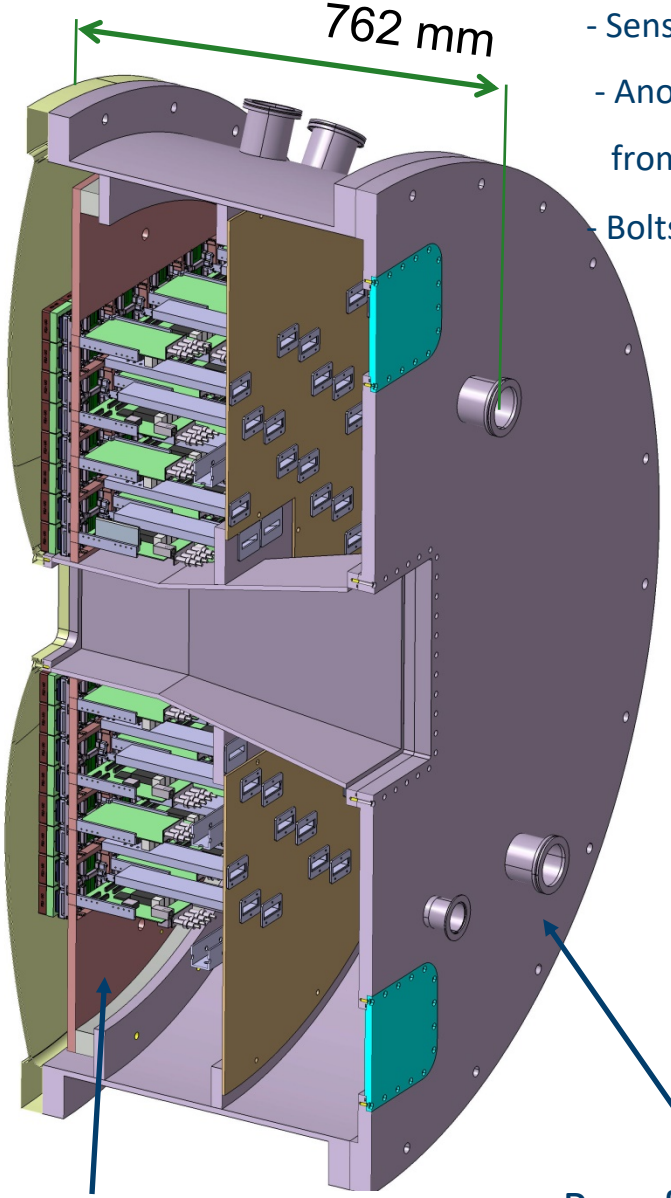
Rear view

Detector housing



Detector housing





- Sensor holder from Ti,
- Another components from AlMg4,5Mn0,7
- Bolts from Ti

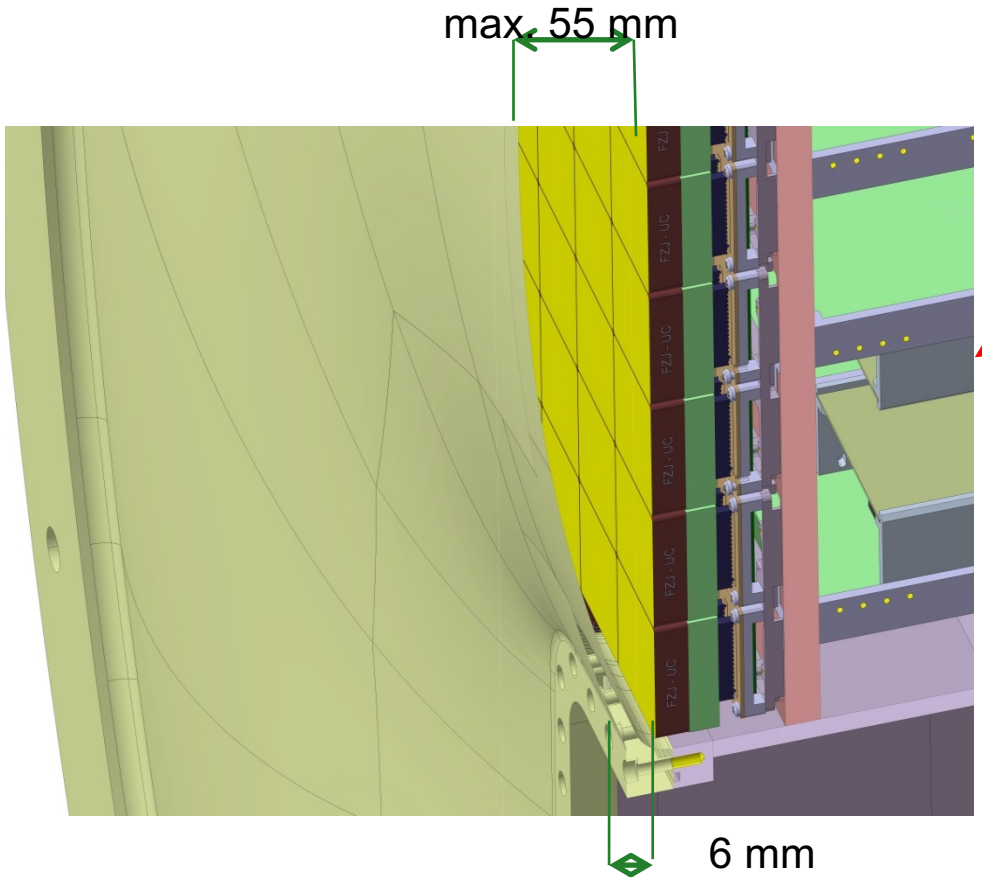
Front cap
6 mm thick (Al)

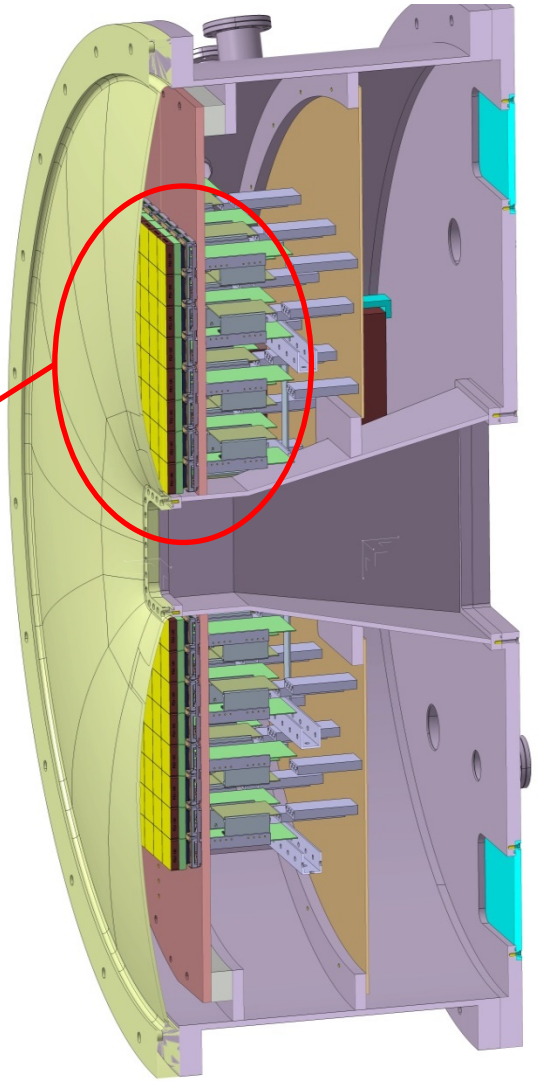
Trumpet

Sensor holder (Ti)

Rear flat head
25 mm thick (Al)

Detector housing

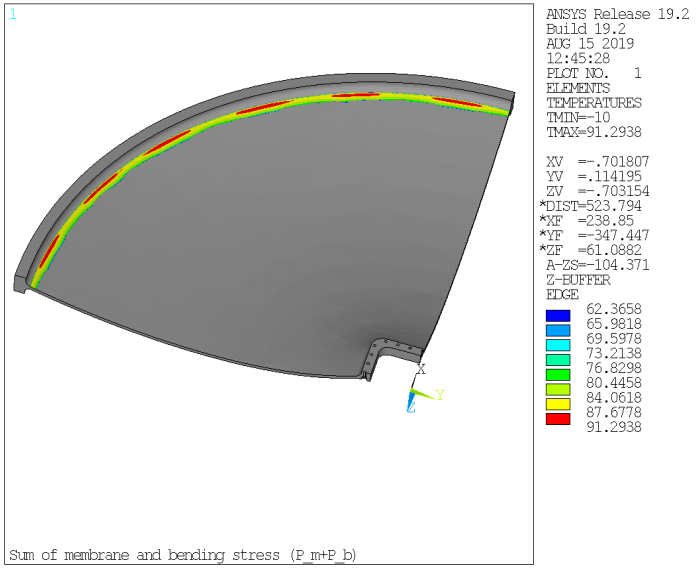




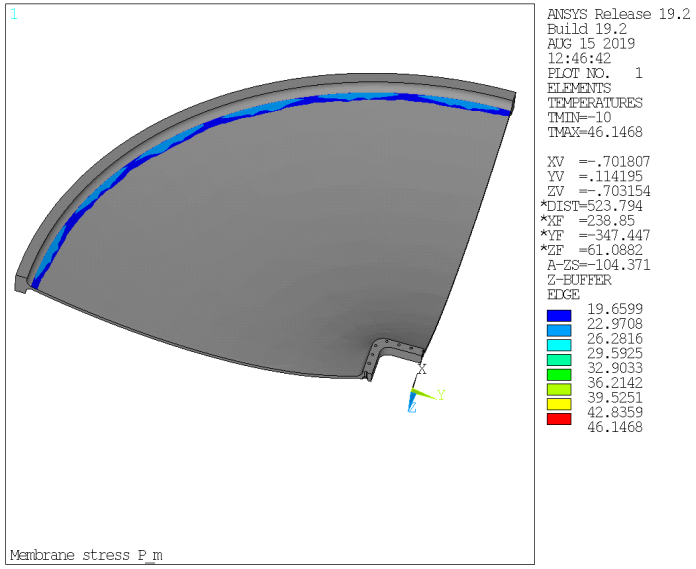
Detector housing cut

Front cup

Front Cap – Linerized stresses at 1.2 bar differential pressure



Sum of membrane and bending stress $(P_m + P_b)$



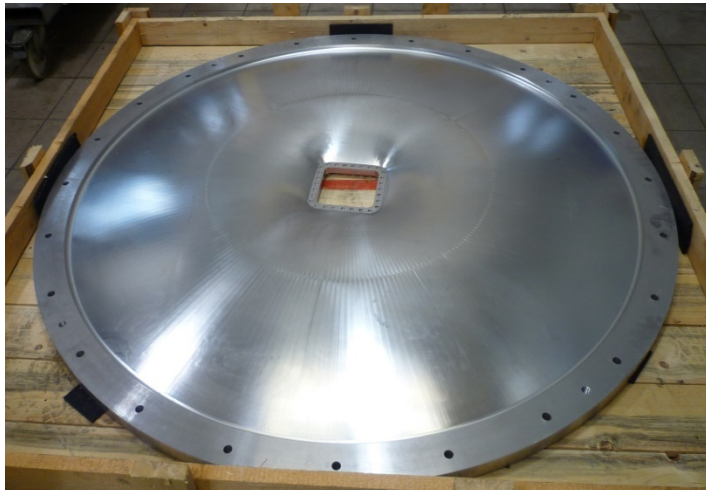
Membrane stress P_m

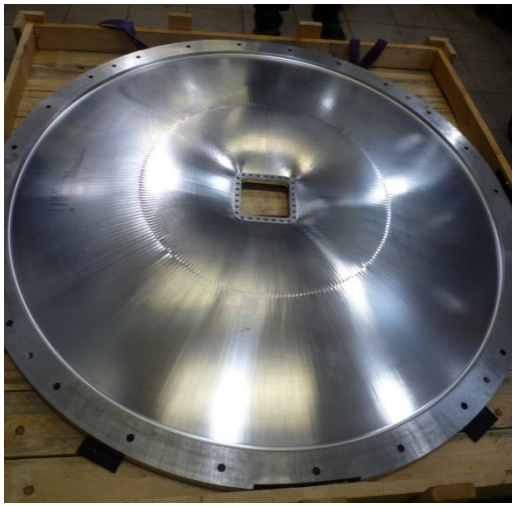
Stress limits

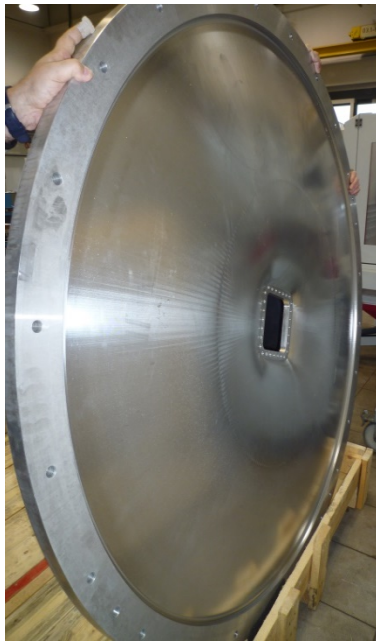
membrane stress $P_{m,max} = 46\ MPa \leq f = 73\ MPa$ ✓

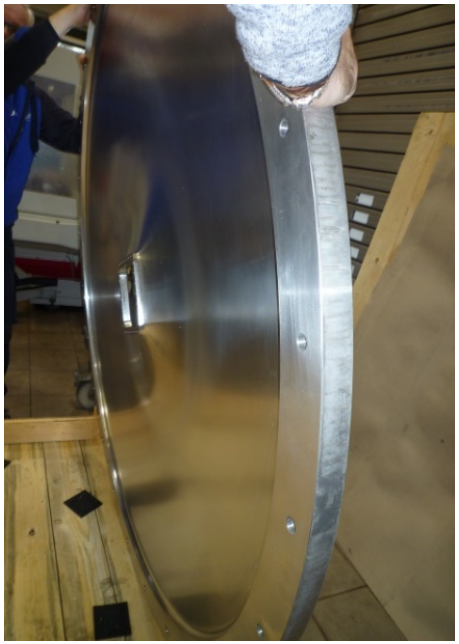
membrane + bending stress $(P_m + P_b)_{max} = 91\ MPa \leq 1.5 \cdot f = 110\ MPa$ ✓

Front cup





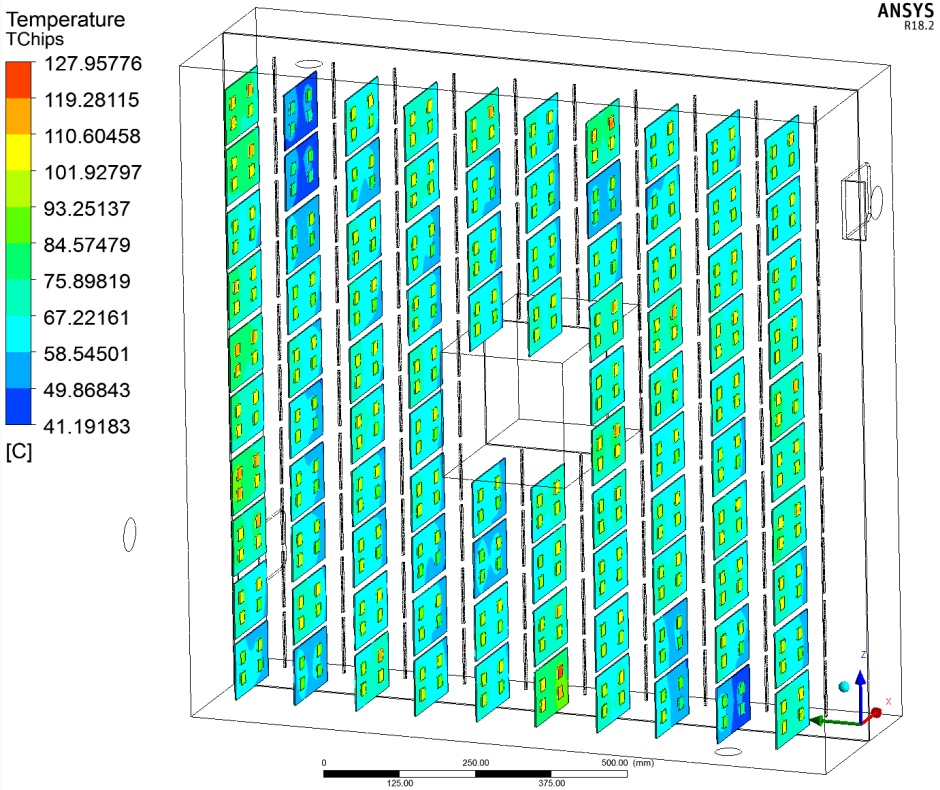




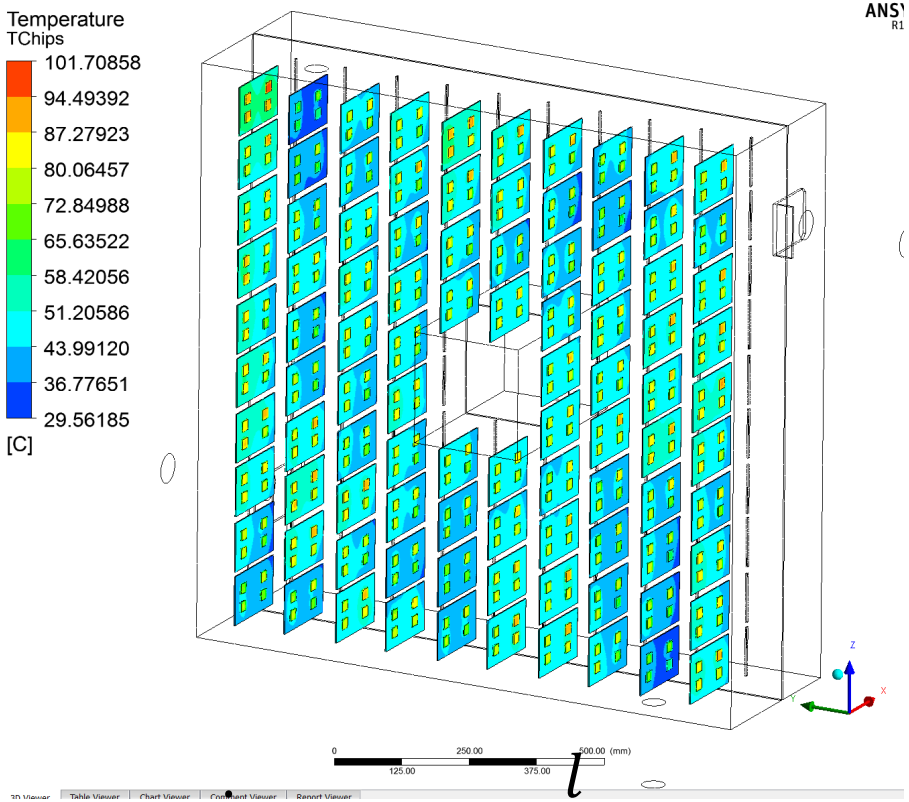
Front cup was milled from an aluminum block according to the stress calculations

Detector cooling

Temperature Chips + Boards - First calculations



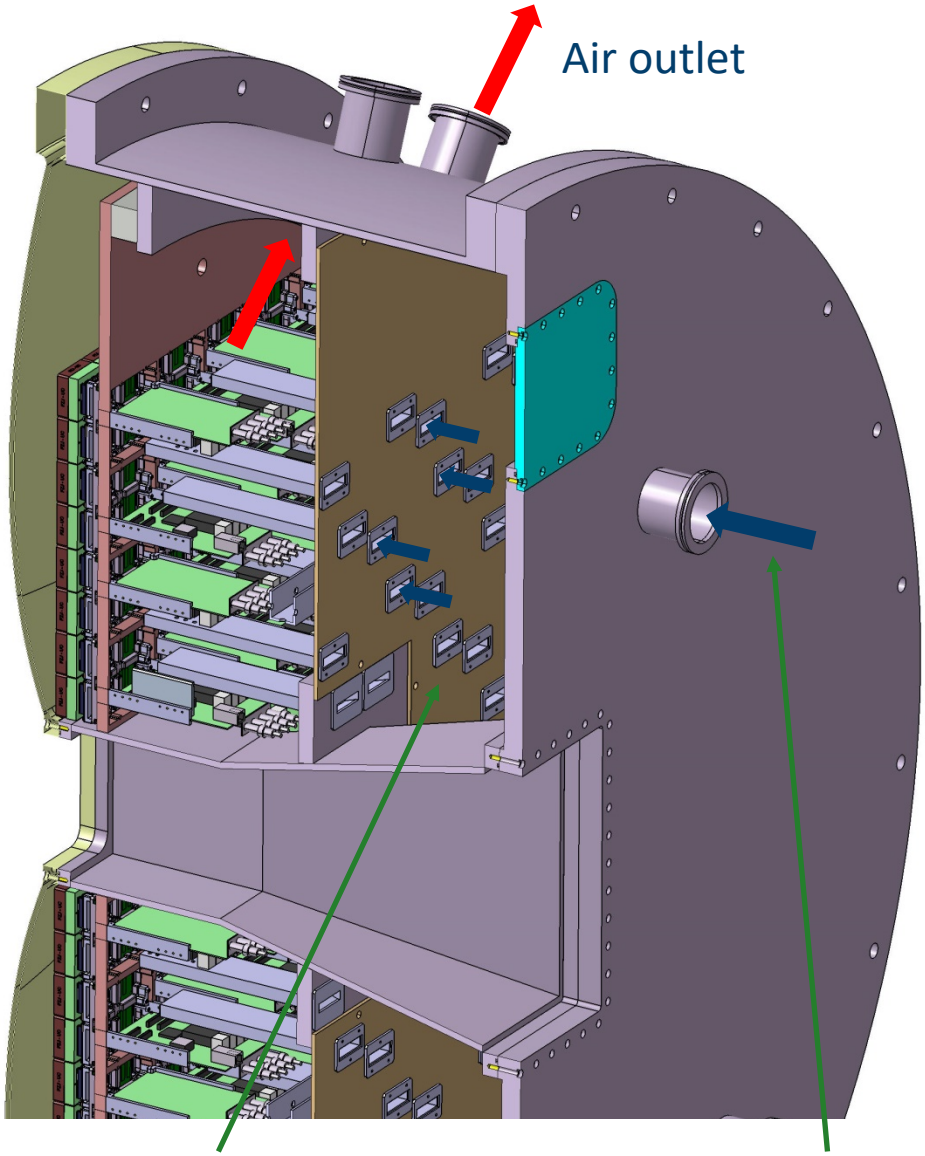
$$V = 5000 \frac{l}{min}$$

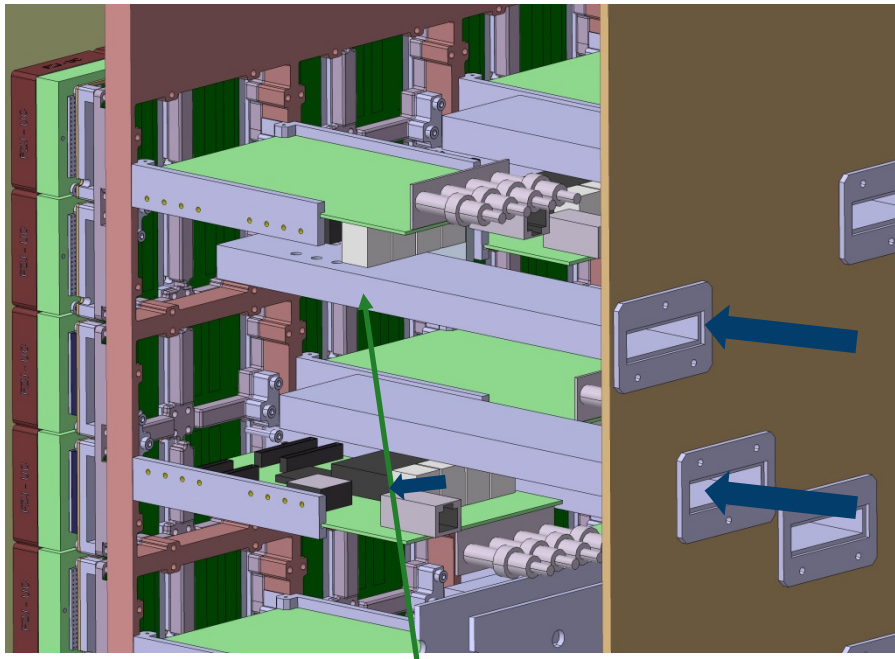


$$\dot{V} = 10000 \frac{l}{min}$$

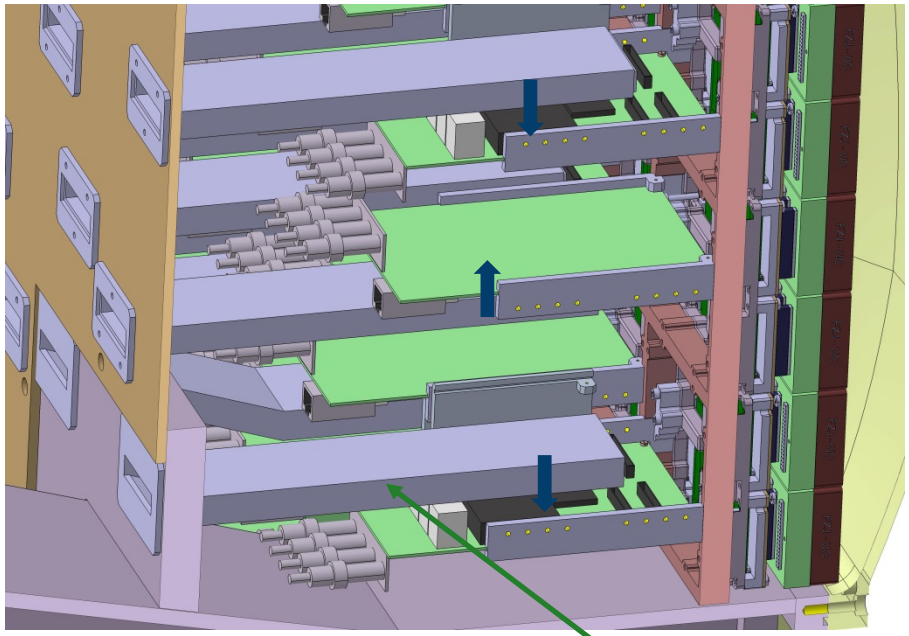
Stefan Schoenen 03. Mai 2018

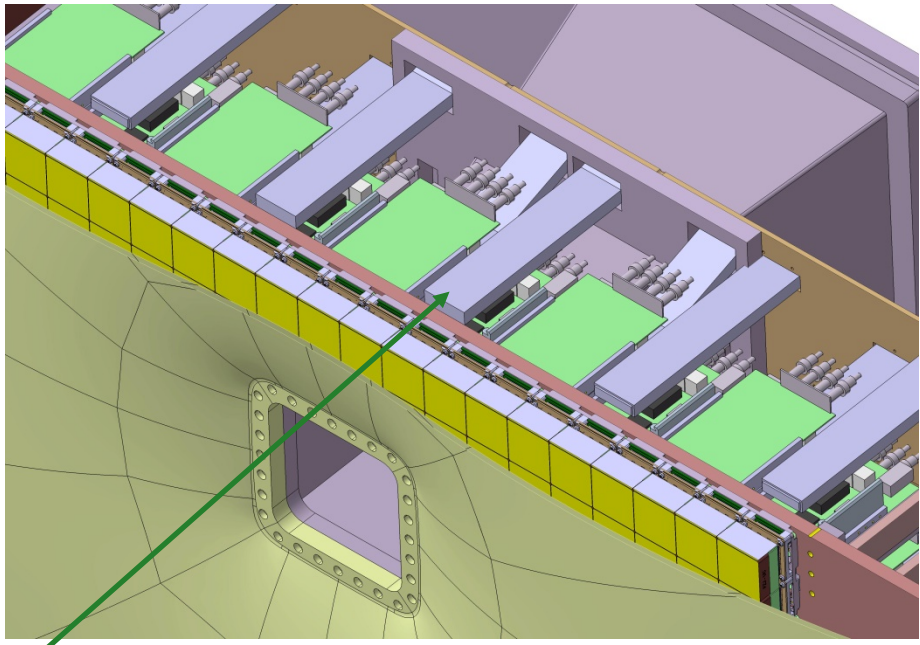
Detector cooling





Detector cooling

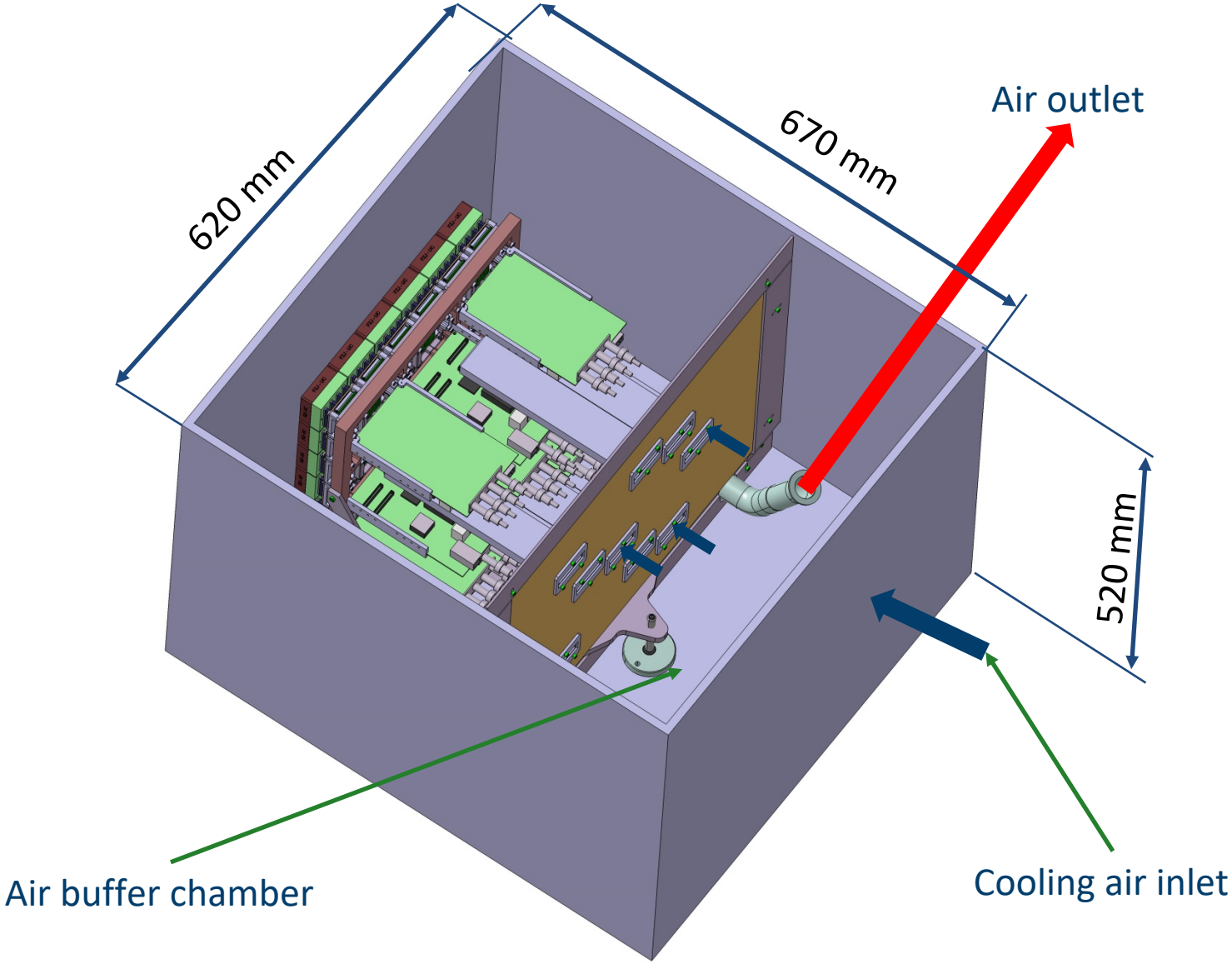




Lengthened air nozzles
with cooling air

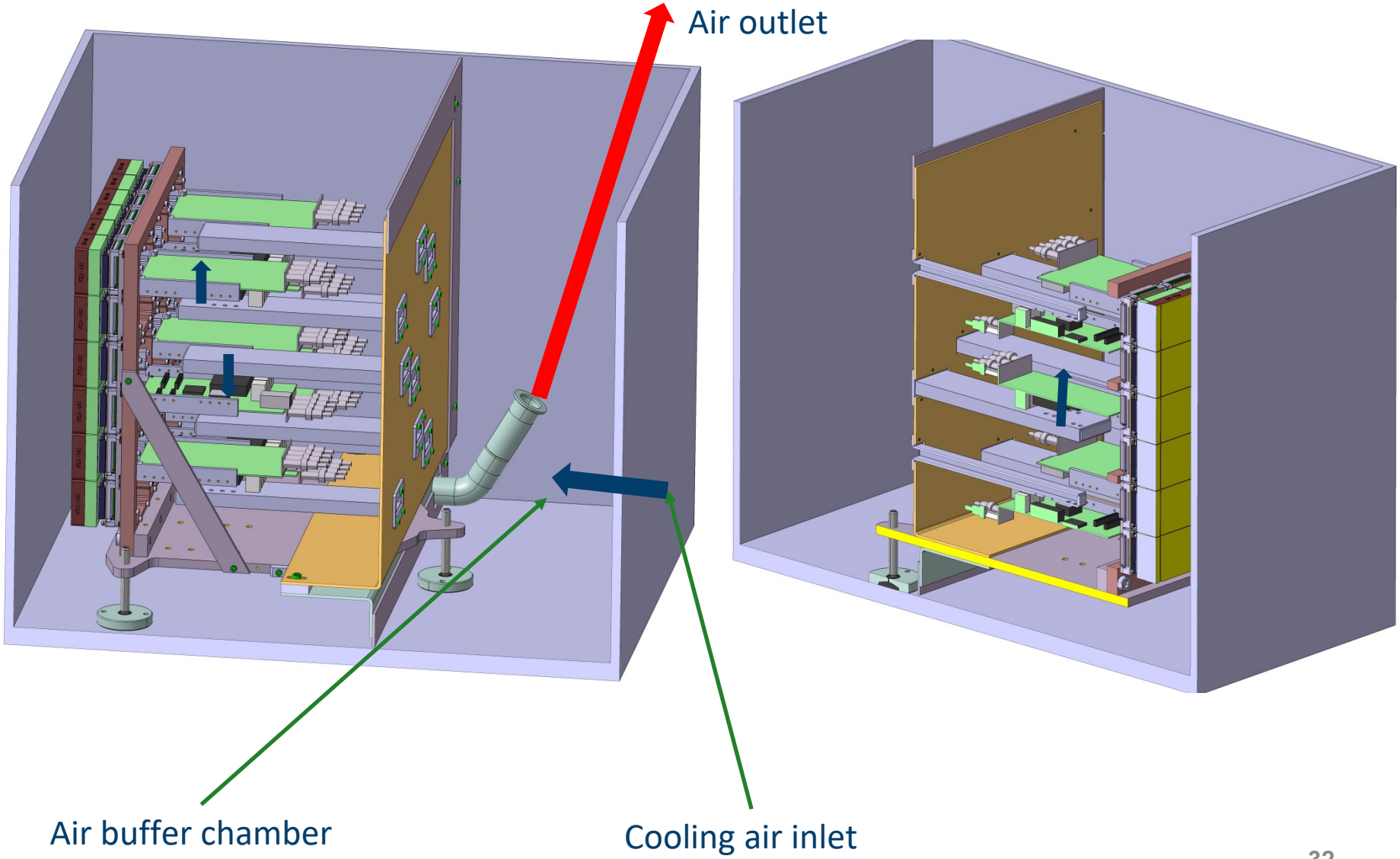
Test equipment for cooling validation

Test device for the verification of the calculation results

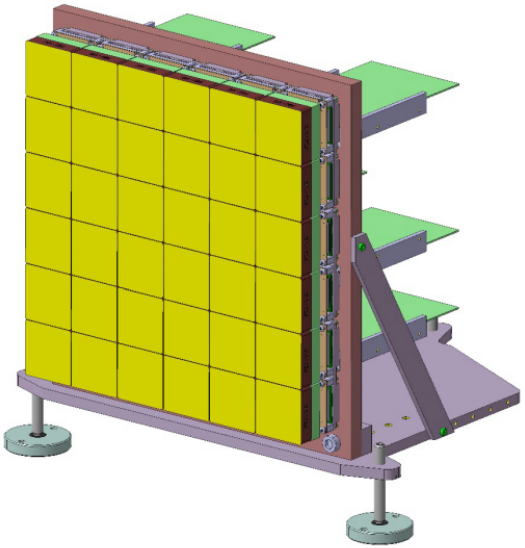


Test equipment for cooling validation

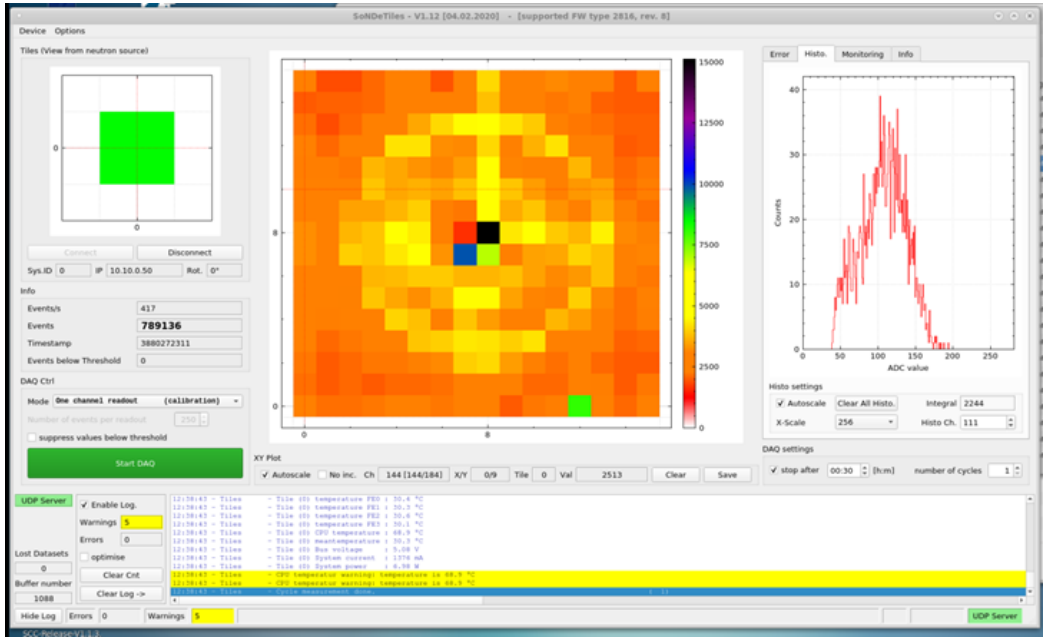
Test device for the verification of the calculation results

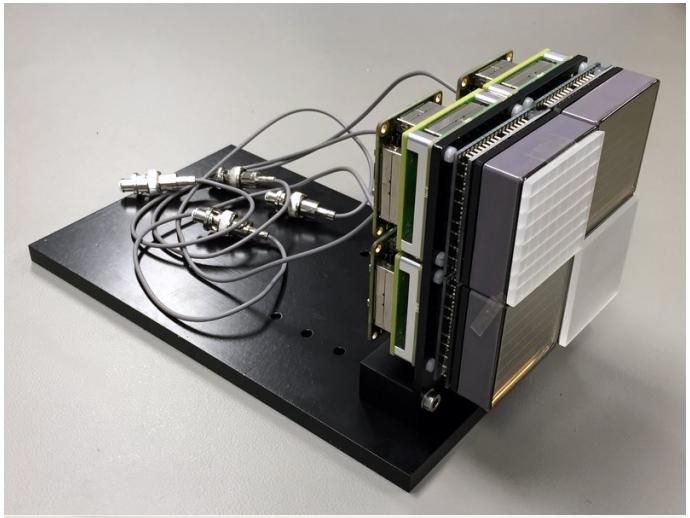


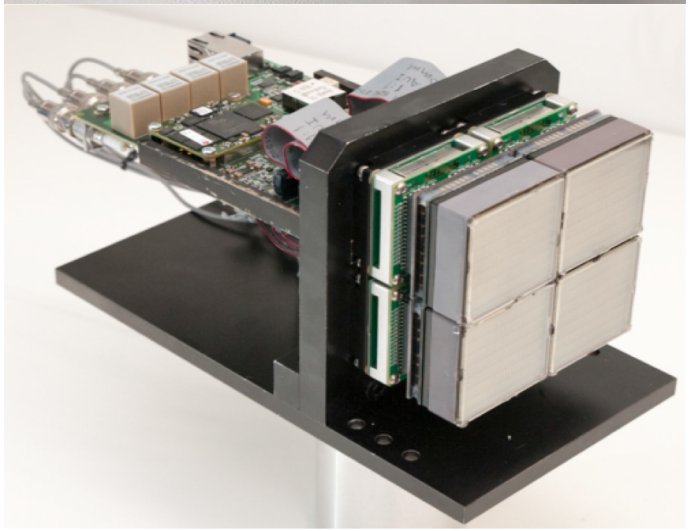
Impressions



First Tests

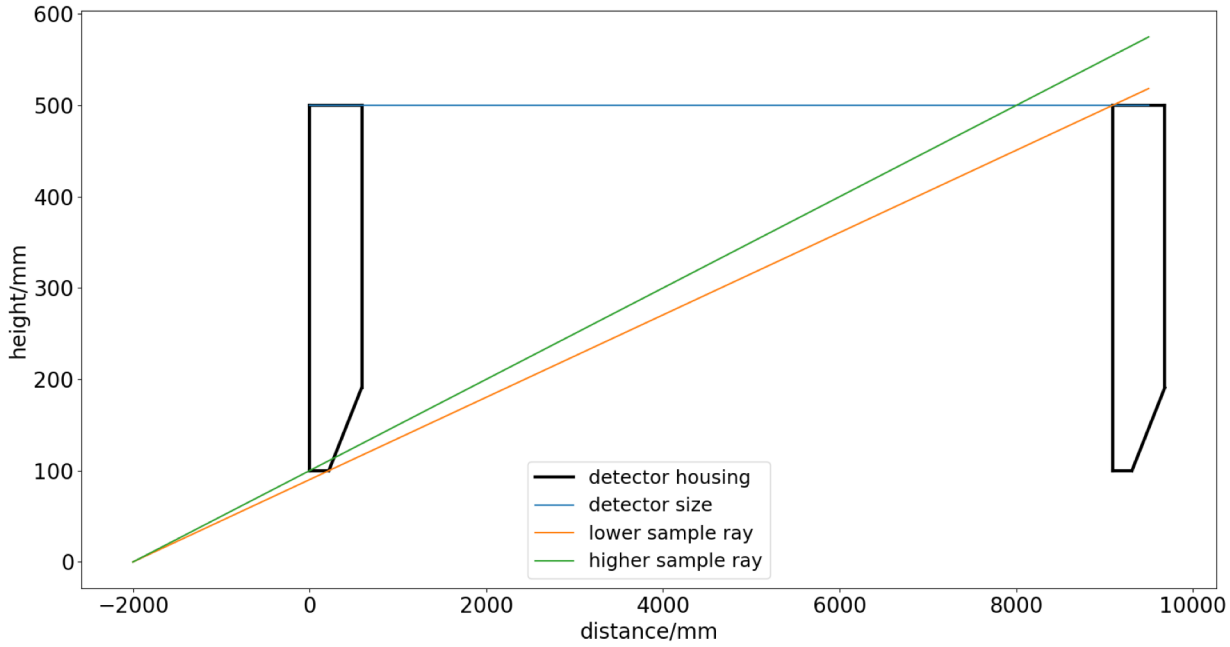


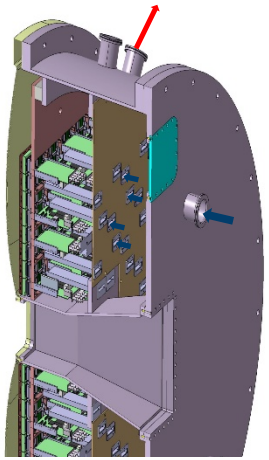




- Mesurement of AgBeh, slits, ….
- Semi-transparent beamstops/attenuators not strictly necessary, but improve S/N ratio
- Software and hardware work as expected
- Improvements on 4-pi scatterer normalization ongoing

Geometry Considerations

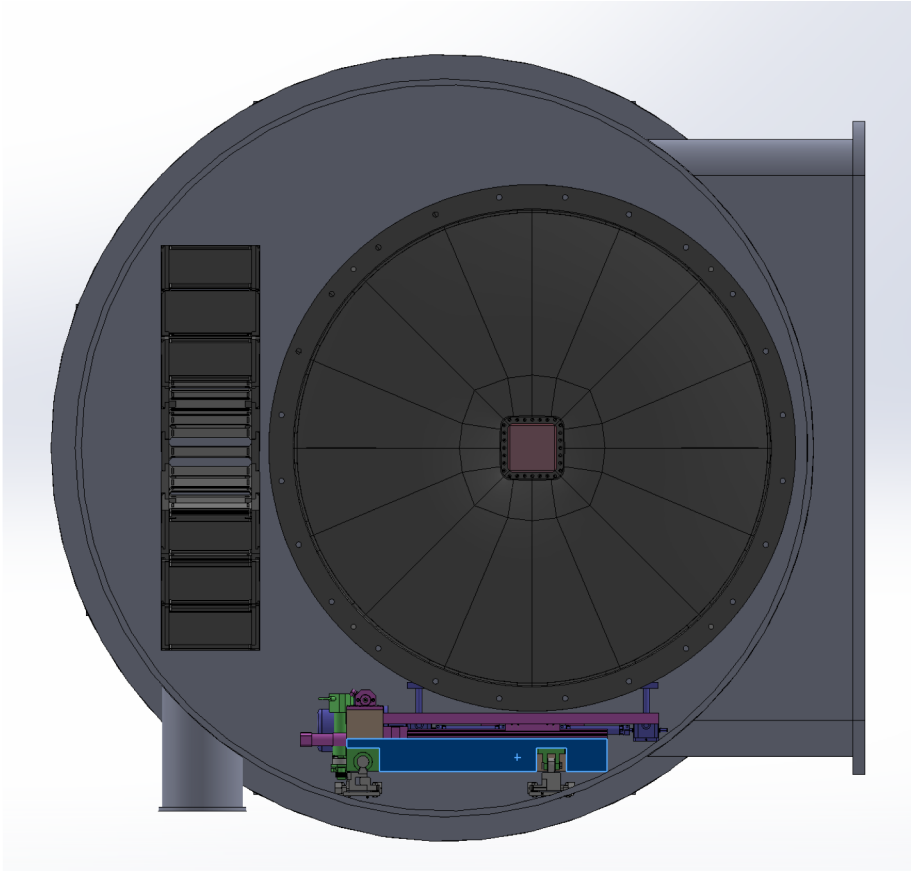


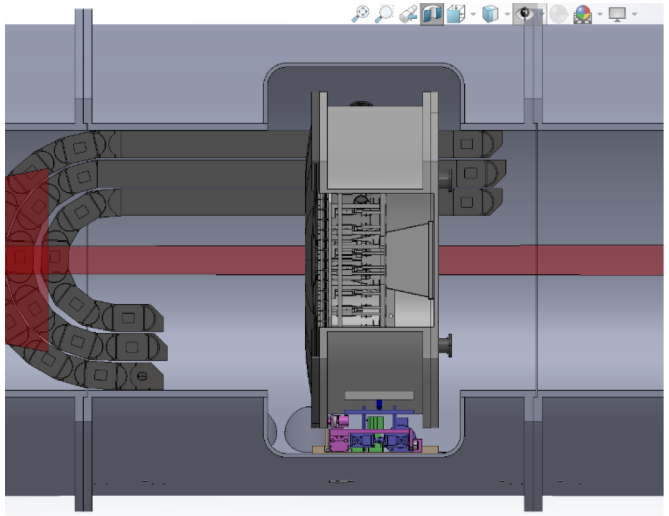


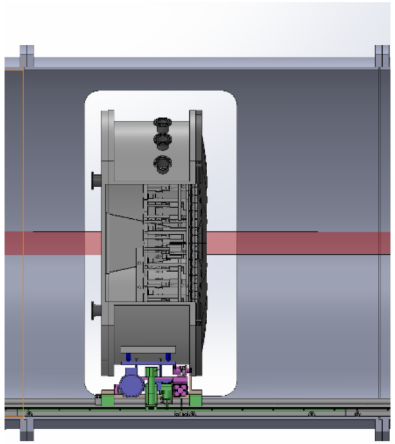
- Detector cannot be infinitesimally slim
- Partial blocking of scattered beam
- Blocked beam (green line) is from q = 0.0708 to 0.1888 $Å^{-1}$
- Open beam (orange line) is from q = 0.0785 to 0.2094 $Å^{-1}$
- Two feasible solutions for hot commissioning: larger detector distances or partial blocking of geometric space (q-space overlaps), strongly depends on statistics in specified q-regime and positioning of detector

Carrier System

- Defined positioning accuracy:
  - 10 mm along flight axis
  - After 100 repositionings
  - 1 mm perpendicular to beam (with absolute encoders)
- Completely below housing for removal
- Connected with a tender box





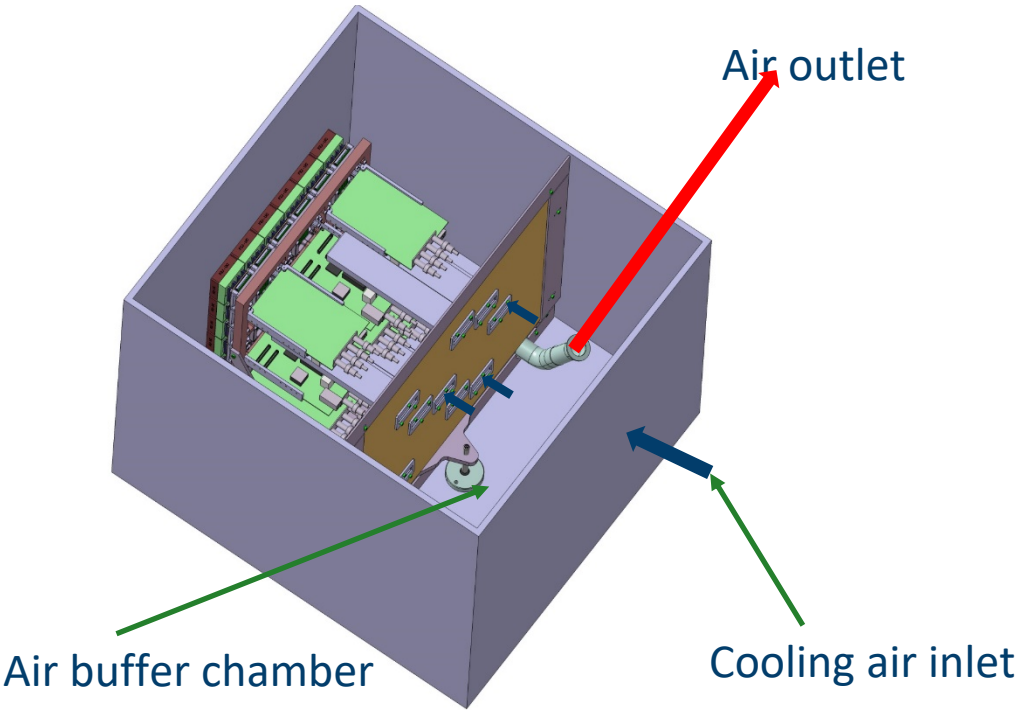


STAP comments from last meeting

- Maintenance/access to detector modules and cooling
- VSANS capabilities → new data scientist on the job
- Scheduling and team cohesion

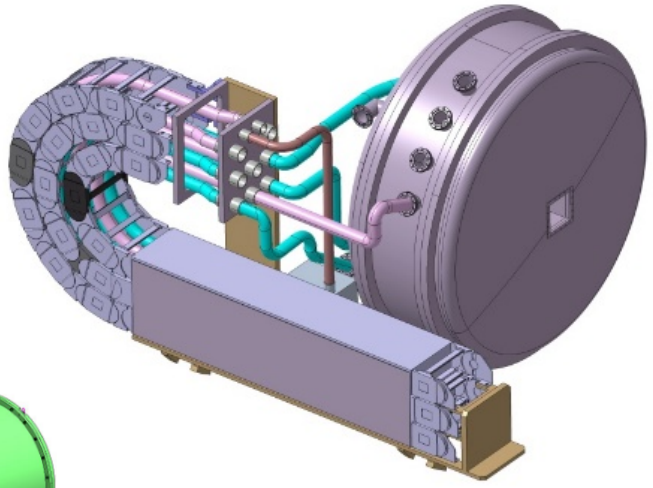
Detector

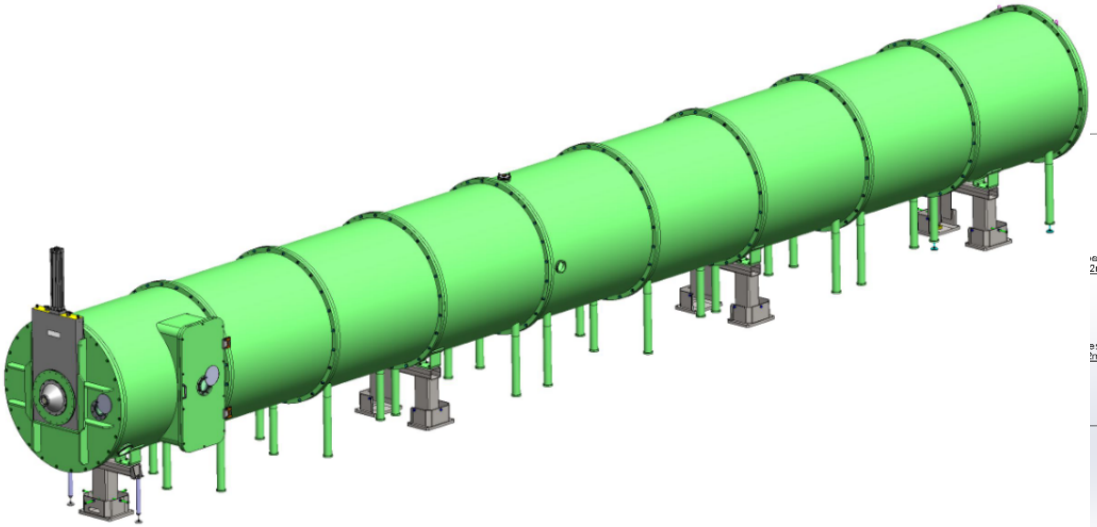
- Tests for full scale cooling being prepared
- Up to now, no heat issues (never exceeded 65°C without active cooling)

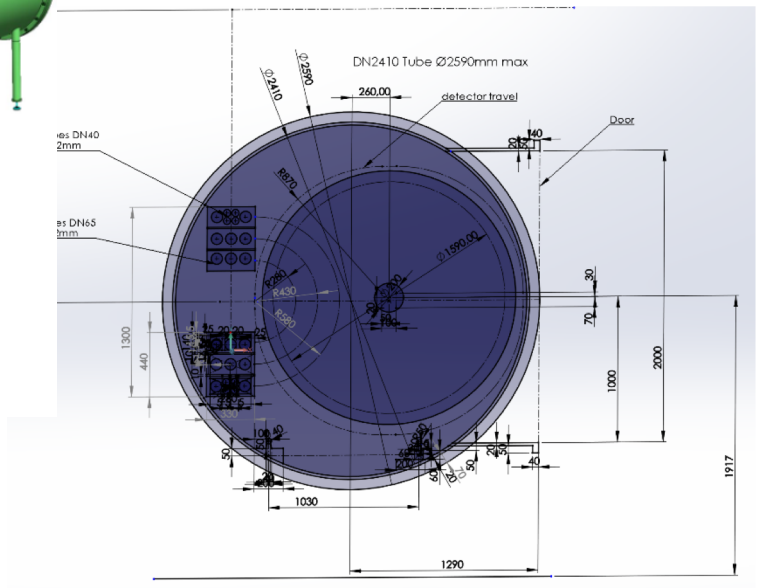


Detector

- Working on a tender box for simple removal of full detector
- Housing will be possible to handle with instrument crane through side access door







Schedule

Achieved milestones

- NBOA: CTV, procurement, SubTG3
- In Bunker components: CTV
- Sample cave: CTV
- Choppers: CTV, Procured
- SCS: Concecpt design, detector frame and housing, Manufacturing cycle 1, integration of SoNDe, FAT

Delayed milestones

- NBOA: Manufacturing, FAT, delivery

At risk

- In Bunker components prcurement
- Sample cave procurement
- SCS SubTG3

Team cohesion

Risk of loss of team members has been realized

- Exchange of LLB lead scientist: Jacques Jestin → Alexis Chenneviere
- Loss of designer (Achim Gussen), reassignment as necessary for schedule
- Loss of access to ad-hoc resources (such as S/E or similar), reassignment as necessary for schedule. Example: S/E delivery only necessary in 2024

- Resources are bound by not being able to move on (CTV ready, but ordering blocked by ESS)

→ Using fruits of previous work until now
→ Direct impact unfavourable
→ Long-term impact cannot yet be properly ascertained
→ Delays not optimal for team morale

Thank you for your attention

STAP Comments

"The Skadi instrument project is also progressing well. The conceptual design and technological choices have all been made. The Skadi project is ready to launch calls for tender for many of the main components. … It is critical that the project does not lose momentum."

As laid out on slide 40 and 41 at the moment the SKADI project can still maintain a relatively high productivity from previous achievements. However, due to reductions in priority neither the team can be kept together, nor can a similar momentum be expected in the future. Delivery of the instrument is scheduled for 2025, which can be kept as resources will be reassigned at a later date. Not being able to order already designed components impedes progress and binds resources.

“The SONDE detector technology for Skadi looks highly impressive in terms of efficiency, …stresses the cover has to withstand and also in terms of maintenance aspects of removing the cover for detector module repair.”

Data concerning the ongoing and upcoming tests is presented on slides 31-34. This includes both maintainability and heat production. Also, stresses of the front cover were calculated and the results are presented on slide. All issues seem to be manageable, pending real world tests.

Specific stress was put on the accessibility of the detector housing inside the detector tube. Results are presented on slides 36 and 39. The detector can now be removed from the tube using the instrument crane. Simple connectivity between the tube and the detector housing is provided by a tendering box.

“The VSANS option…”

VSANS data treatment is now evaluated by a data scientist at LLB.