

MVD Status Detector

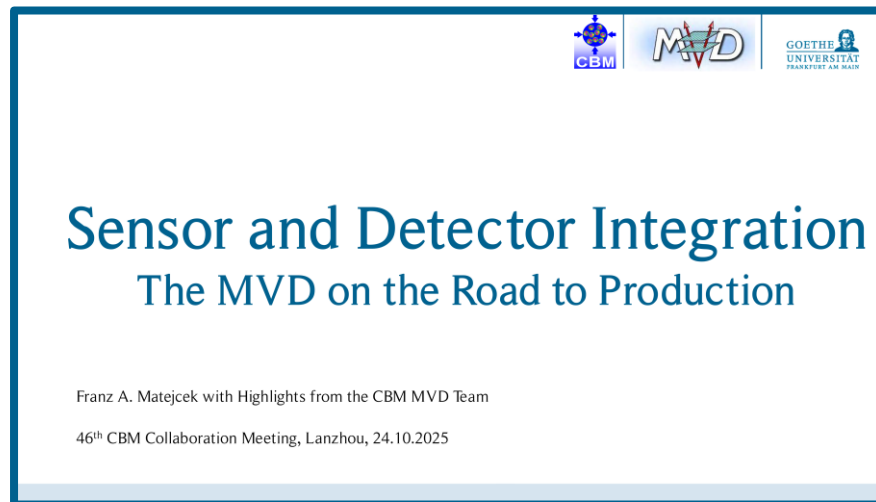
Franz A. Matejcek for the CBM MVD Team

46th CBM Collaboration Meeting, Lanzhou, 21.10.2025

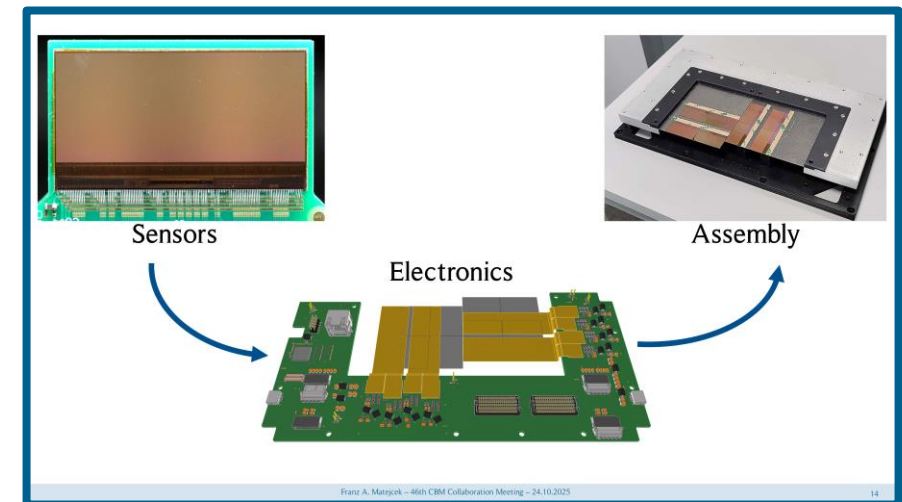
Disclaimer: Integration Highlights on Friday

Project Status

Mechanics and up- / down-stream interfaces
Data feedthrough design



[Link to the Contribution](#)



Sneak Peek


Status EDR

MVD Core EDR (Sensors & Mechanics) is (still) due

- MIMOSIS is the central piece
- Timeline driven by understanding and complexity of sensor
- Disentangling work packages difficult
- Electronics + mechanics developments in parallel

| | | | | | |
|---|-------|--|--|--|--|
| ppQc coldplate PRR *) | 06/25 | | | | Sync. w/ PhD, includes carrier now +3 M |
| ppQc (coldplate) production and QA → FOS *) | 08/24 | | | | pre-prd cold plates in house |
| Engineering design → PRR **) | 07/25 | | | | EDR sensor integration & cooling? |
| Testing + testing → FOS | 08/25 | | | | We try to keep that |
| MVD Core EDR (Sensors + Mechanics) | 09/25 | | | | Shift due to previous milestones, + 3 M |
| FEB design → PRR | 08/25 | | | | Pre-production FEB: Design in progress |
| FEB production/testing → FAT | 02/26 | | | | |
| Flex design → PRR | 08/25 | | | | Pre-production flex: Design in progress |
| Flex production/testing → FAT | 01/26 | | | | |
| Mechanics and Services | | | | | |
| Carrier + cold plates engineering → PRR | 10/25 | | | | Adjusted to MVD Core EDR, + 6 M |
| Carriers + cold plates production/testing → FAT | 02/26 | | | | |
| System level mechanics design → PRR | 05/26 | | | | |
| Mechanics production/testing → FAT | 09/26 | | | | |
| Cooling + LV EDR | 08/25 | | | | Cooling: Design in progress, switch to water-based |
| Cooling + LV PRR | 11/25 | | | | |
| Cooling + LV FAT | 02/26 | | | | |

“Integration-related documentation, towards MVD core EDR
→ Goal: 2025 (no show-stoppers, just needs to be done)”
CBM TB 09/25



COMPRESSED BARYONIC MATTER EXPERIMENT

FAIR

CBM-TN-25001

February 14, 2025

MVD Sensor Integration

F. Matejcek¹, C. Müntz² for the MVD team


1. Institute for Nuclear Physics, Goethe-University Frankfurt, Germany

Email: matejcek@physik.uni-frankfurt.de

Abstract

This note presents the engineering design of MVD modules including all the components, techniques and tools necessary to integrate a fully functioning quadrant and half-stations. A module comprises the dedicated CMDS sensors (MIMOSIS), the carriers, the different adhesives, the readout flexible printed circuit (FPC), the front-end boards (FEBs), and the heat sinks. All important aspects regarding the mechanical integration and the proposed measures for quality assessment (QA) are presented. The discussion is limited to the day-one setup (Tracking Geometry) which uses Thermal Pyrolytic Graphite (TPG) carriers in all stations, an alternative using (Velocity Geometry) featuring pCVD-diamond carriers for the first MVD station is not covered in this Note.

Draft ready



COMPRESSED BARYONIC MATTER EXPERIMENT

FAIR

CBM-TN-25002

February 14, 2025

MVD Detector Integration

F. Matejcek¹, C. Müntz² for the MVD team

1. Institute for Nuclear Physics, Goethe-University Frankfurt, Germany

Email: matejcek@physik.uni-frankfurt.de

Abstract

This note presents the engineering design of the detector mechanics of the MVD. This includes the mounting of Half Stations to Half Detectors, the mounting of Half Detectors to the Front Flange, and the mounting of the assembled MVD in the CBM case. It also presents the design of the Rotating Positioning System which allows to displace the MVD Half Detectors into a safe position 1 cm lateral to the beam, e.g. during beam tuning, and the placement of service pipes and cables for cooling, powering and readout. The mechanics are prepared for the day-one setup (Tracking Geometry) which comprises 2x2 stations (geometry 0 and geometry 1), placed 8, 12, 16 and 20 cm downstream of the target.

Draft ready

Status EDR

MIMOSIS-1 first full-scale prototype

→ Focus (and funding) for sensor performance

→ Not all features implemented, flaws

Mimosis-2.1 close to final

→ Representative for e.g. electrical integration

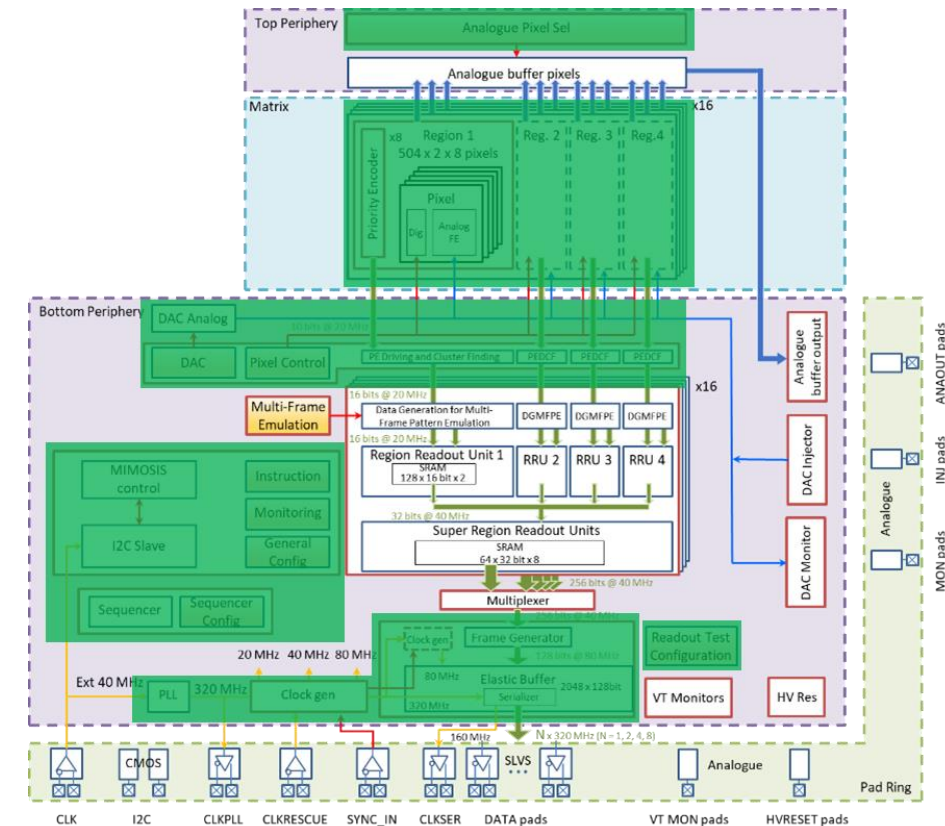
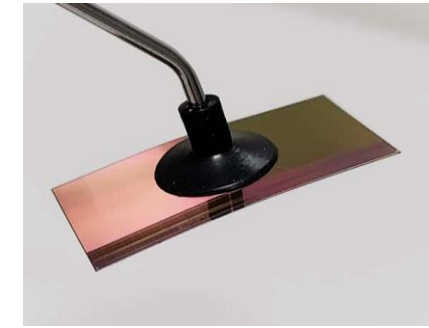
→ More flaws showing up in MVD-like environment

Key progress towards EDR

→ Electronics, powering & r/o

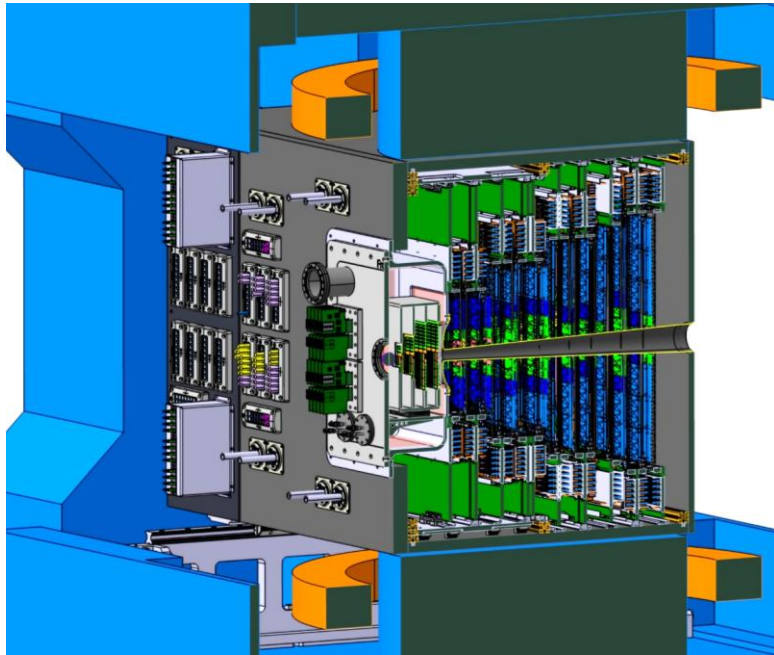
→ Mechanics, “MVD-specials” s.a. feedthroughs, heat sinks, TPG, ...

→ Documentation ongoing

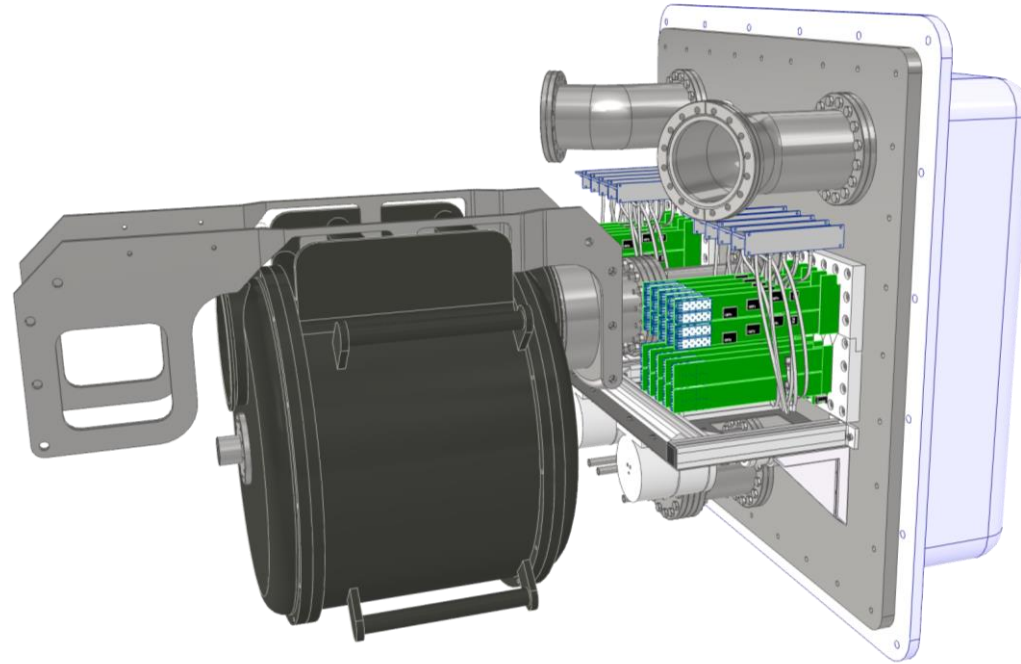


Block diagram MIMOSIS with
changes M1→M2.1 highlighted

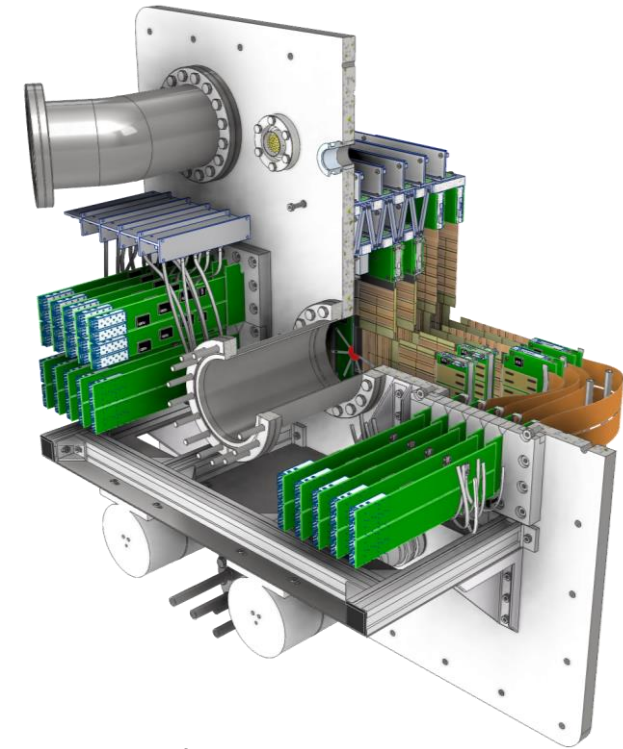
MVD Interfaces



Dipole ↔ STS ↔ MVD



TED ↔ MVD ↔ Target Chamber



Front Flange ↔ Stations

Interface TED ↔ MVD

Vacuum ↔ 0.12 MPa (20% safety margin)

→ ~300 µm peak 20 mm SS (choice)

→ ~800 µm peak 20 mm Al

SS preferred choice

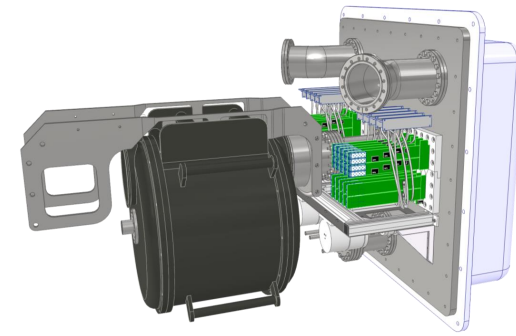
→ TED interface welded, TED screwed

Stress on the target exchange device?

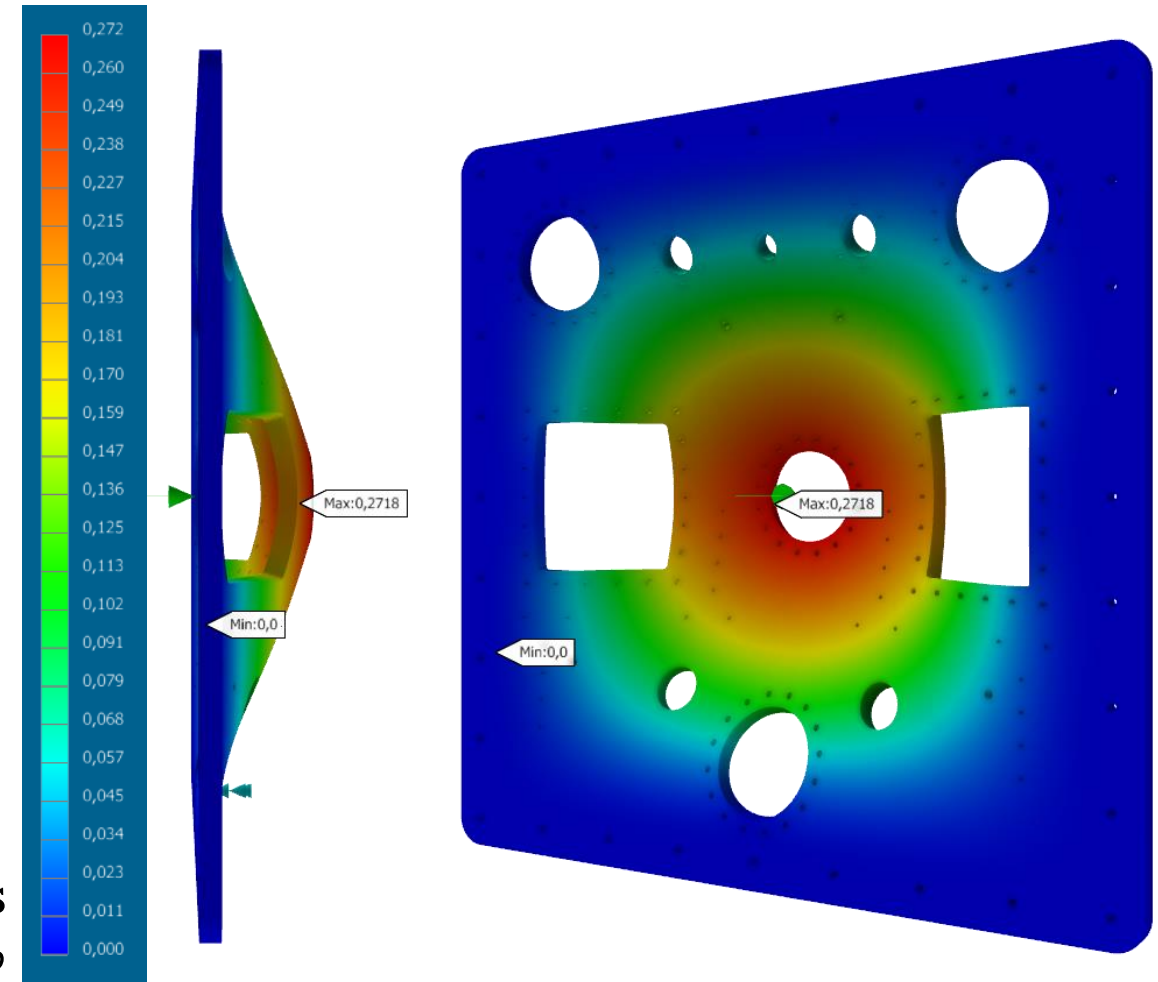
→ Symmetric deformation

→ Specifications on maximum deformation?

→ Reinforcement necessary?



Deformation Stainless
Steel, vacuum + 20%

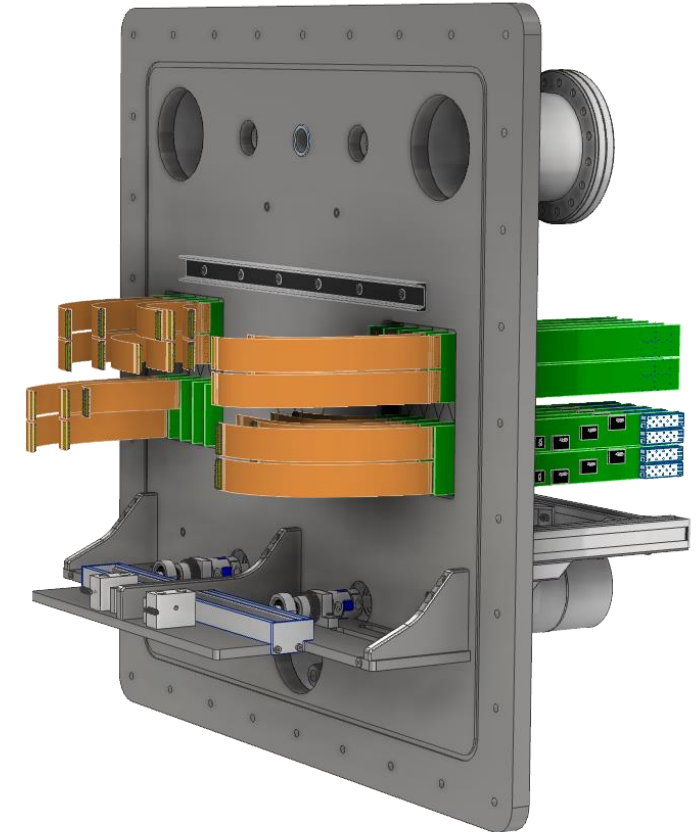
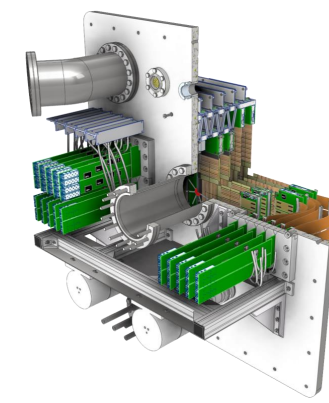


Interface Front Flange ↔ Stations

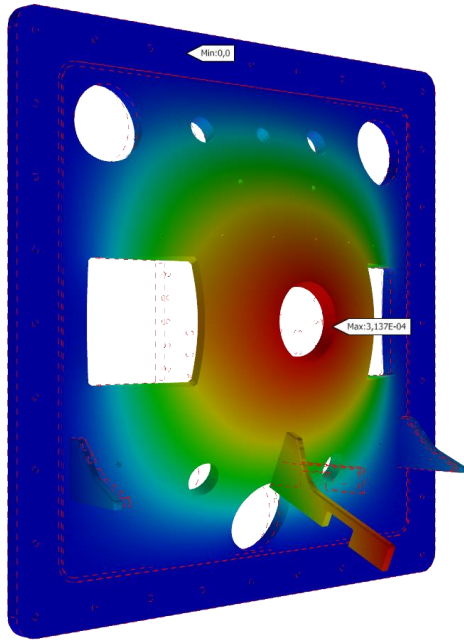
Note: Front Flange and mounting mechanics not finalized yet
→ Remote Positioning System

Mounting (and alignment) system needs refinement
→ Lessons learned from first full scale demo

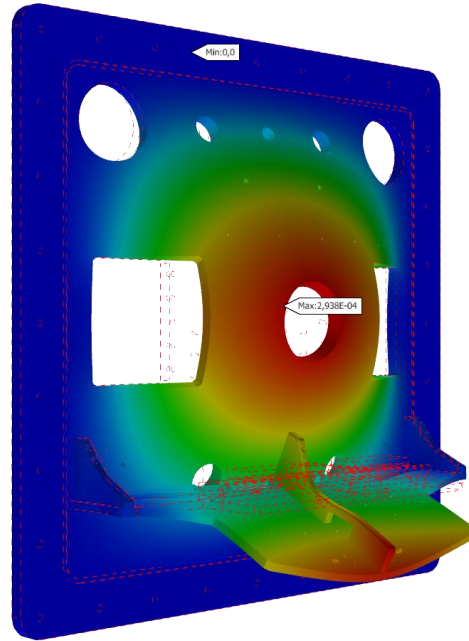
Minimize residual forces on stations
→ FEA linear static w/ gravity +20%, vacuum +20%



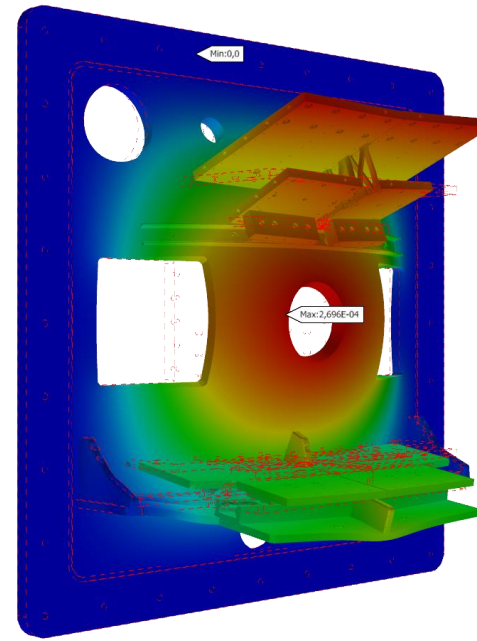
Interface Front Flange ↔ Stations



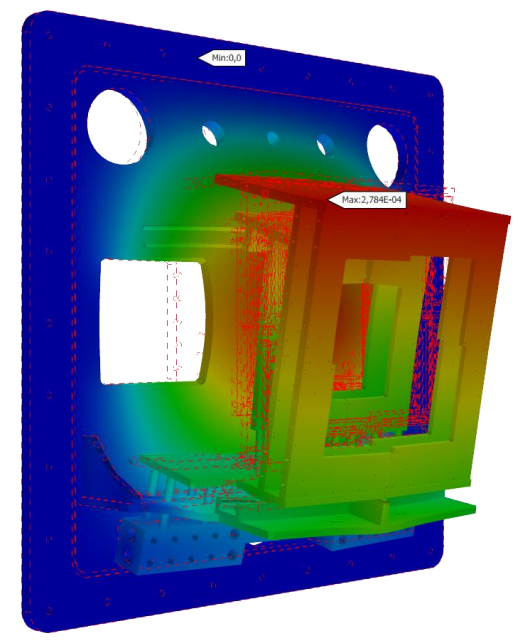
Deform. vacuum +20%,
gravity +20%
Max: 314 μm



Deform. vacuum +20%,
gravity +20%
Max: 294 μm

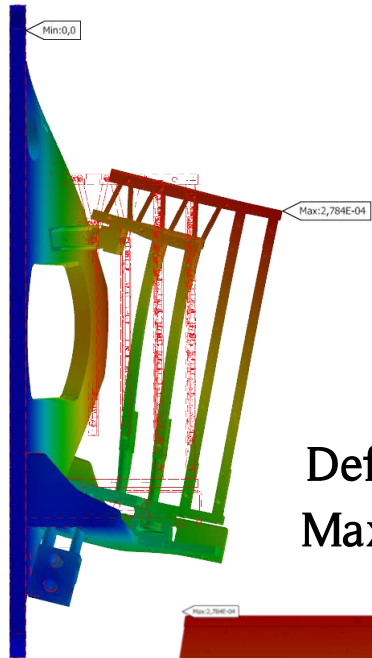


Deform. vacuum +20%,
gravity +20%
Max: 270 μm

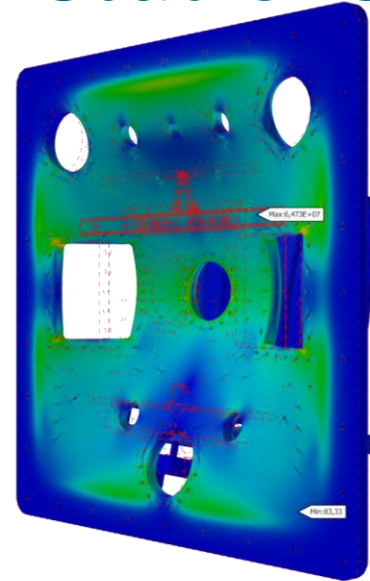
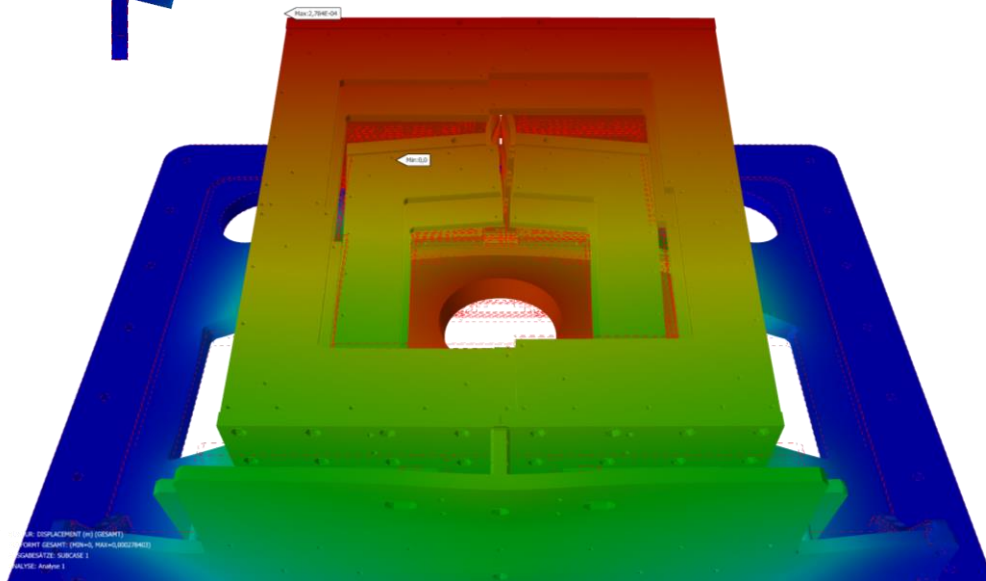


Deform. vacuum +20%,
gravity +20%
Max: 278 μm

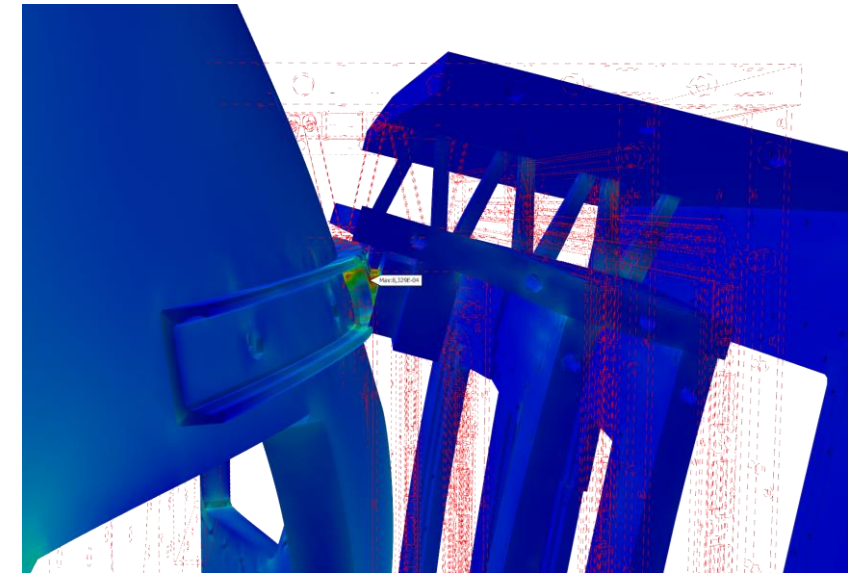
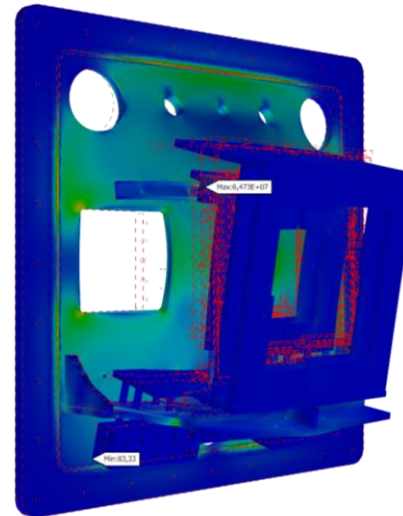
Interface Front Flange ↔ Stations



Deformation
Max: 278 μm



Von-Mises Stress
Max: 65 MPa



Strain
Max: 8.3 10^{-4}

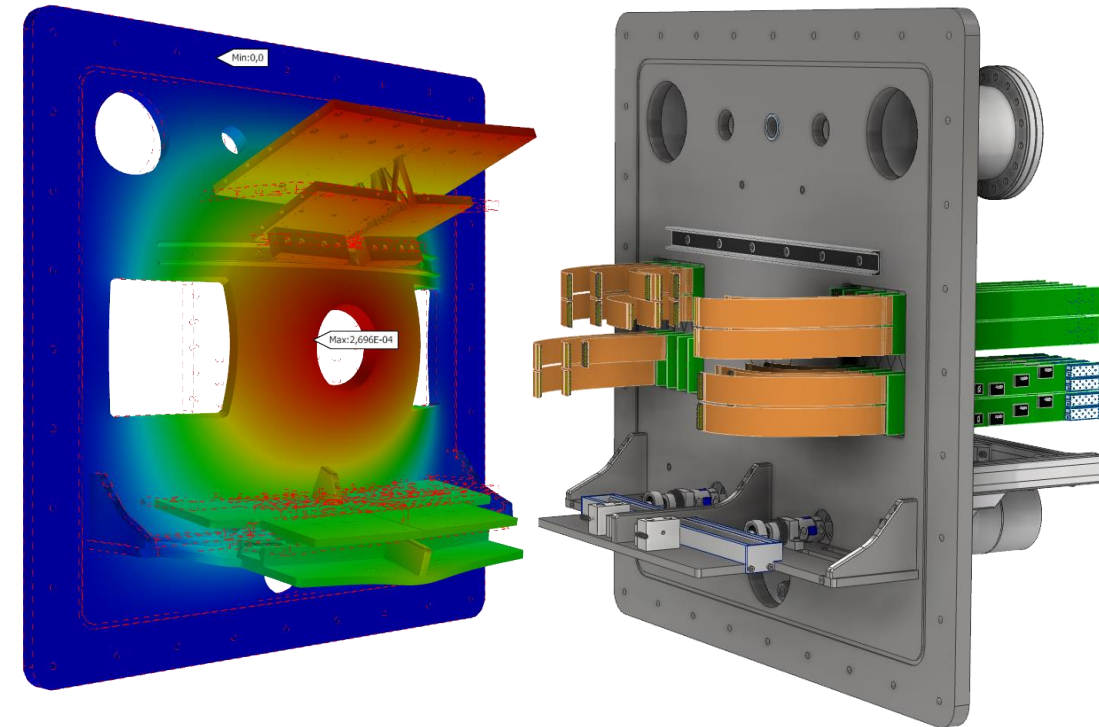
Interface Front Flange ↔ Stations

Detector mounting needs independence from Front Flange deformation

- Master Table separation from Front Flange
- No middle support bar
 - Possibly reinforcement underneath, SS ↔ Al
- “Floating” rail on the top side

But: No show-stoppers

- Deformation of Front Flange in acceptable range
- Sufficient understanding for target chamber specifications

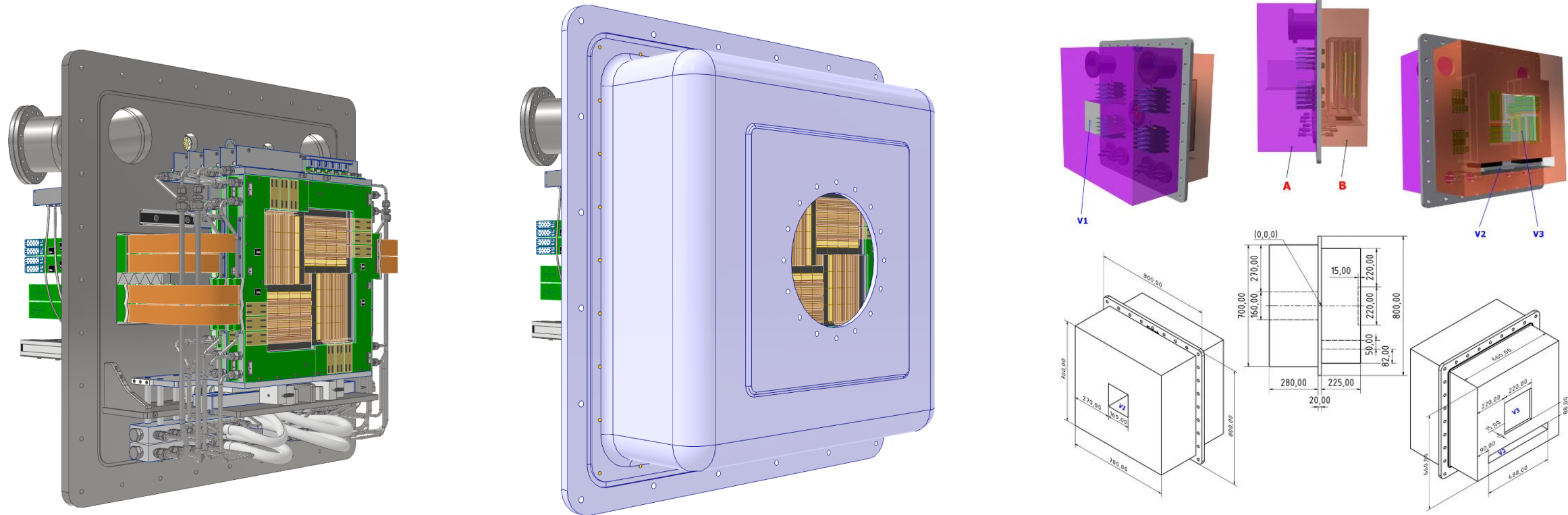


Interface MVD \leftrightarrow Target Chamber

MVD in target chamber

Remote Positioning System

→ Half-Detectors move 5 cm laterally from beam axis



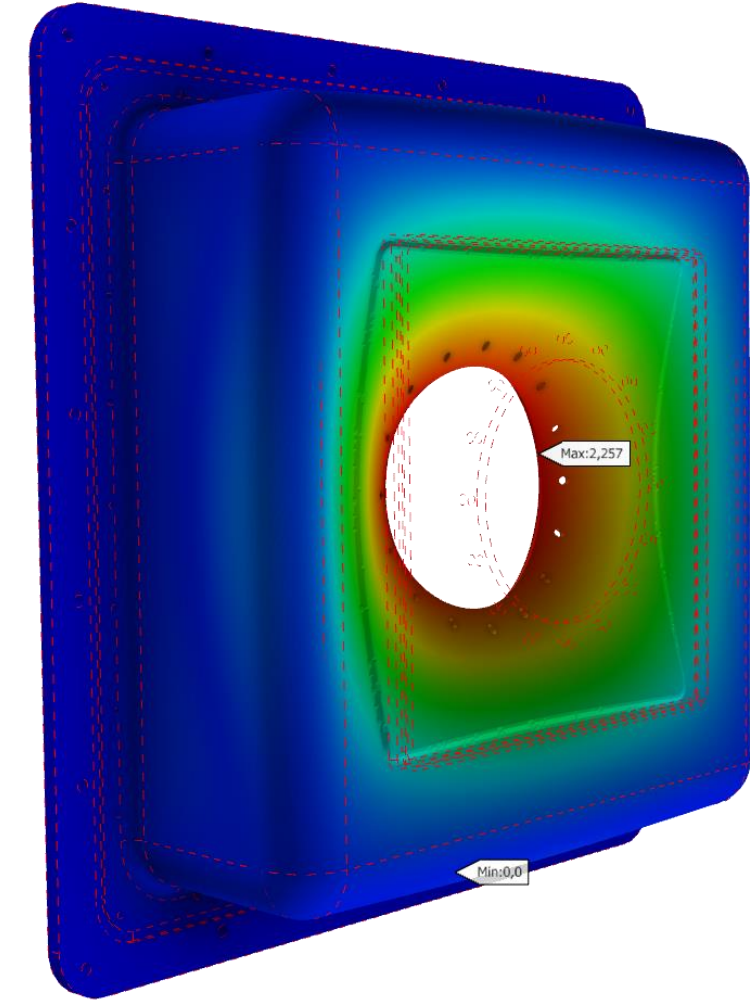
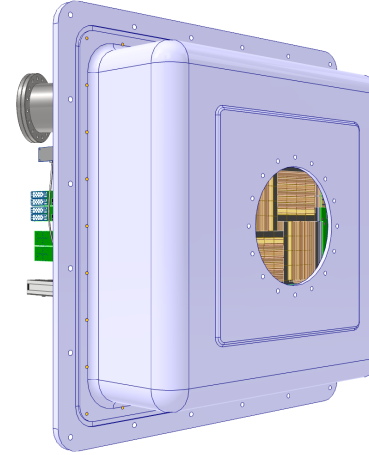
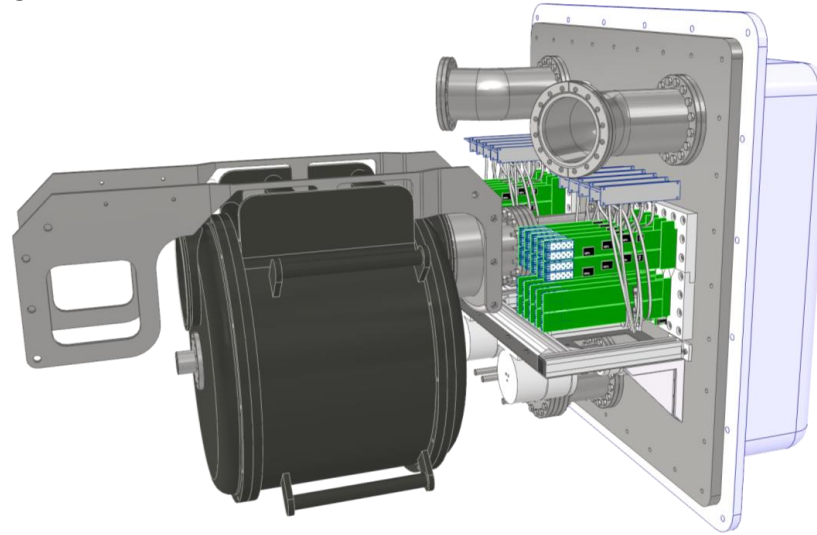
Interface MVD ↔ Target Chamber

Target chamber according to MVD specifications

- Internal volume / keep-out
- Maximum deformation under load
- Mounting, alignment, adjustment

We prefer Stainless Steel

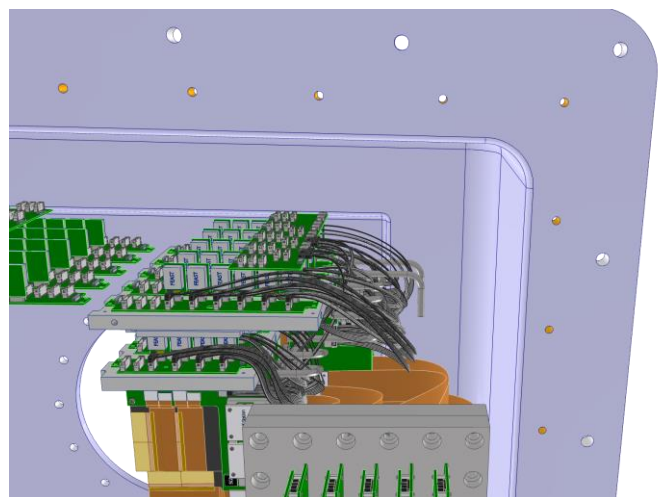
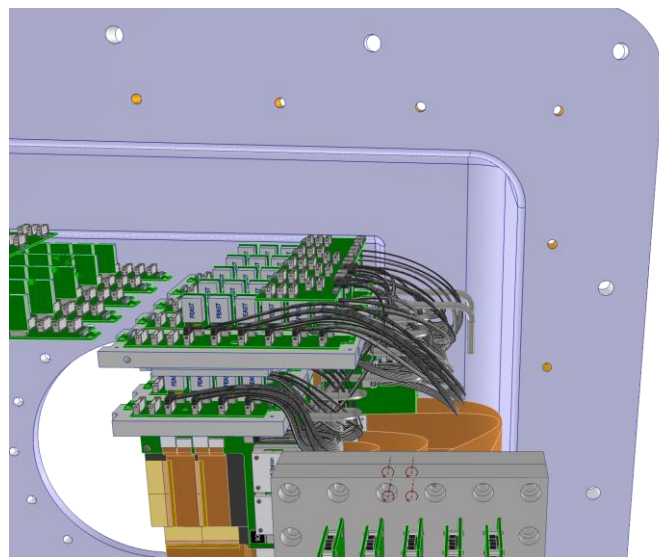
... in close discussion with GSI engineers



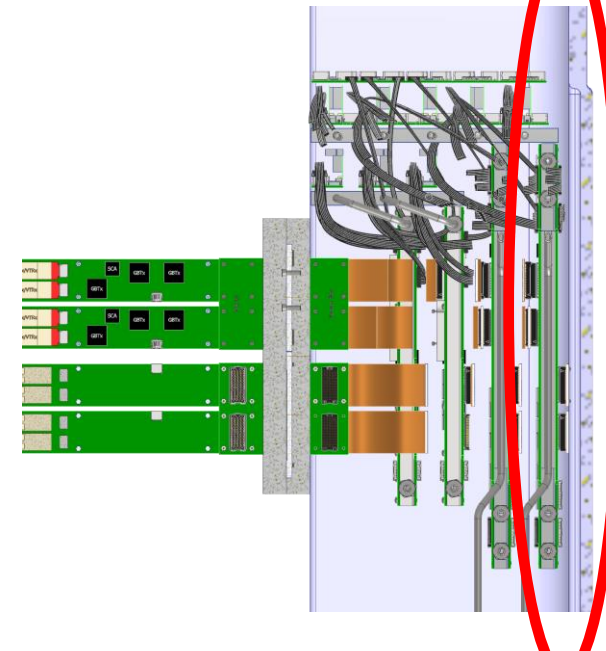
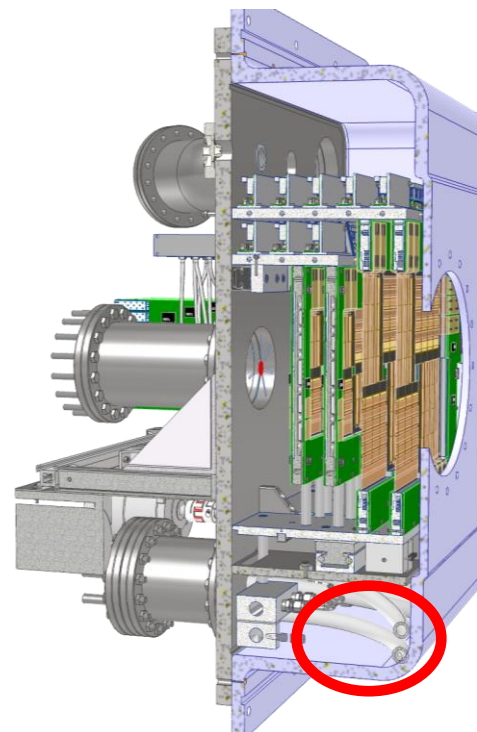
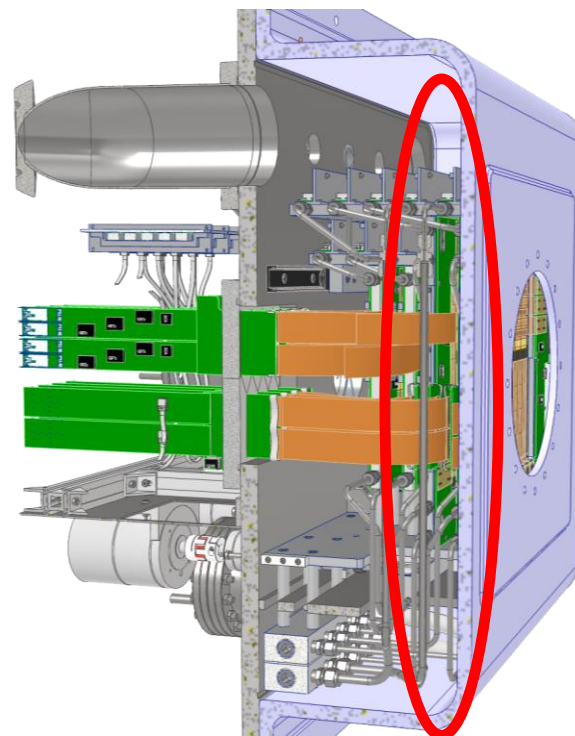
Deform. aluminum vacuum +20%,
gravity +20%, Max: 2.26 mm

See also Patrick's contribution:
<https://indico.gsi.de/event/20881/contributions/92724/>

Interface MVD ↔ Target Chamber

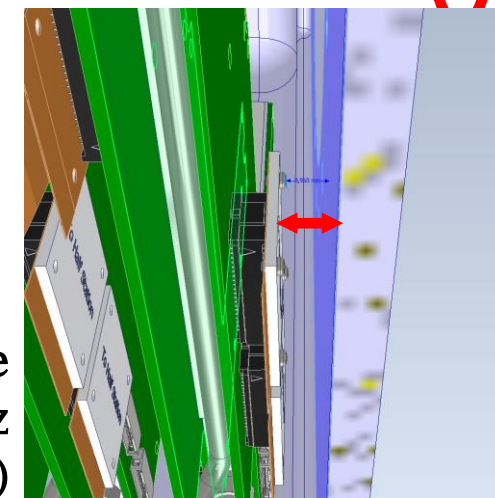


Tightest space in x/y in
opened/closed configuration



Tightest space in z
→ Flexible piping
→ FMC connectors backside 4th station

Currently 3.95 mm clearance
to nominal keep-out in z
(without deformation)



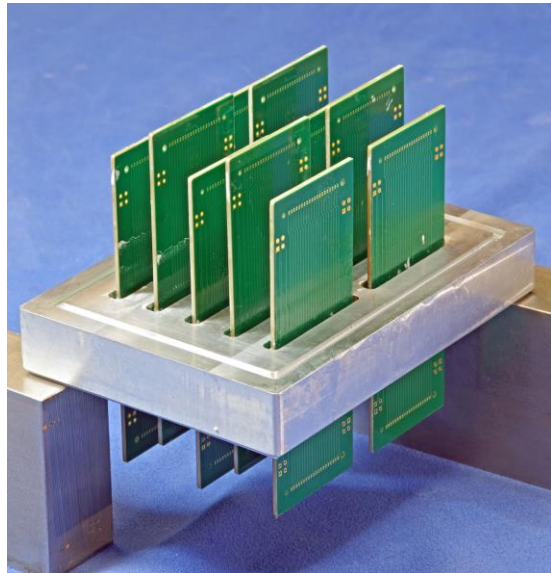
Data Feedthrough

One of the more MVD-unique pieces of engineering...

- O(5k) Clock and Data lines through vacuum
- Tight space constraints on FEB and Front Flange
- Connectors defined on CROB, 1-to-1 connection (tight routing)
- Data FPC, FEB, and Flange need to be designed in parallel

In close discussion with GSI engineers

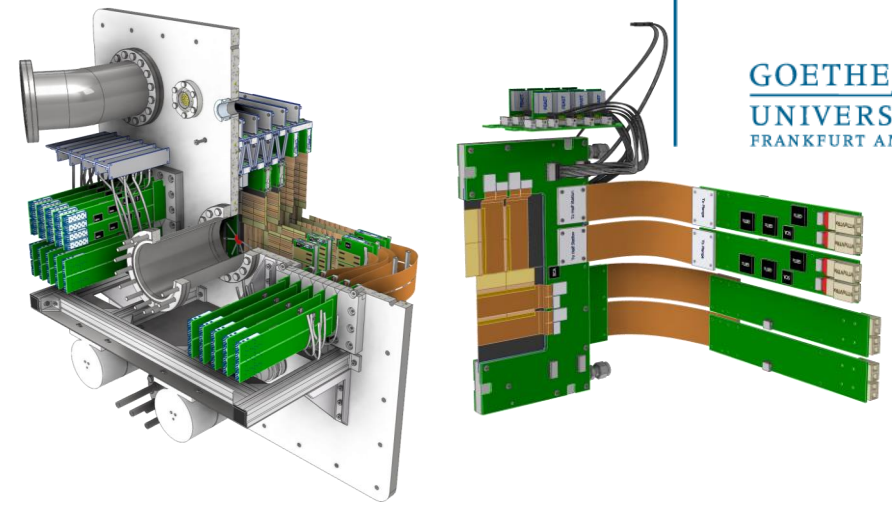
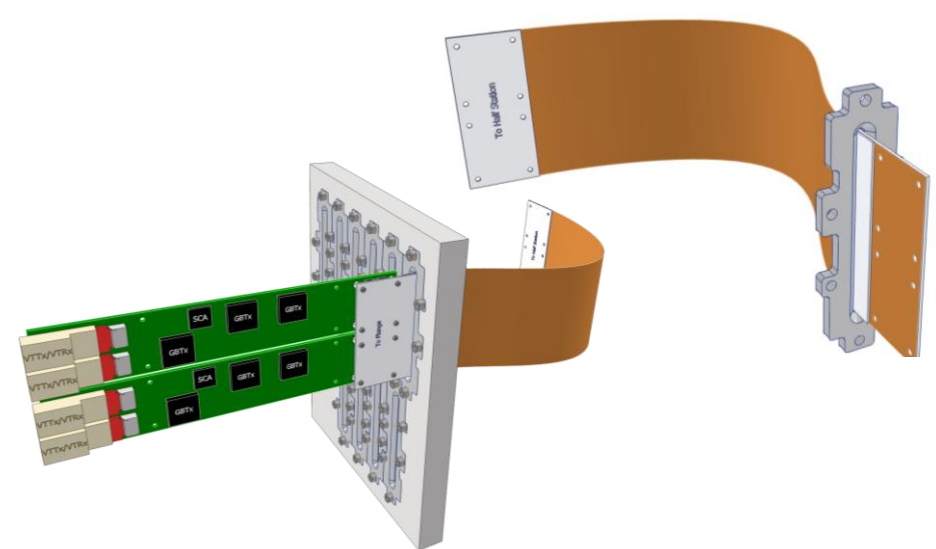
“Monolithic”, PCB-based prototype (TDR)



“Monolithic”, FPC-based prototype (PRESTO)



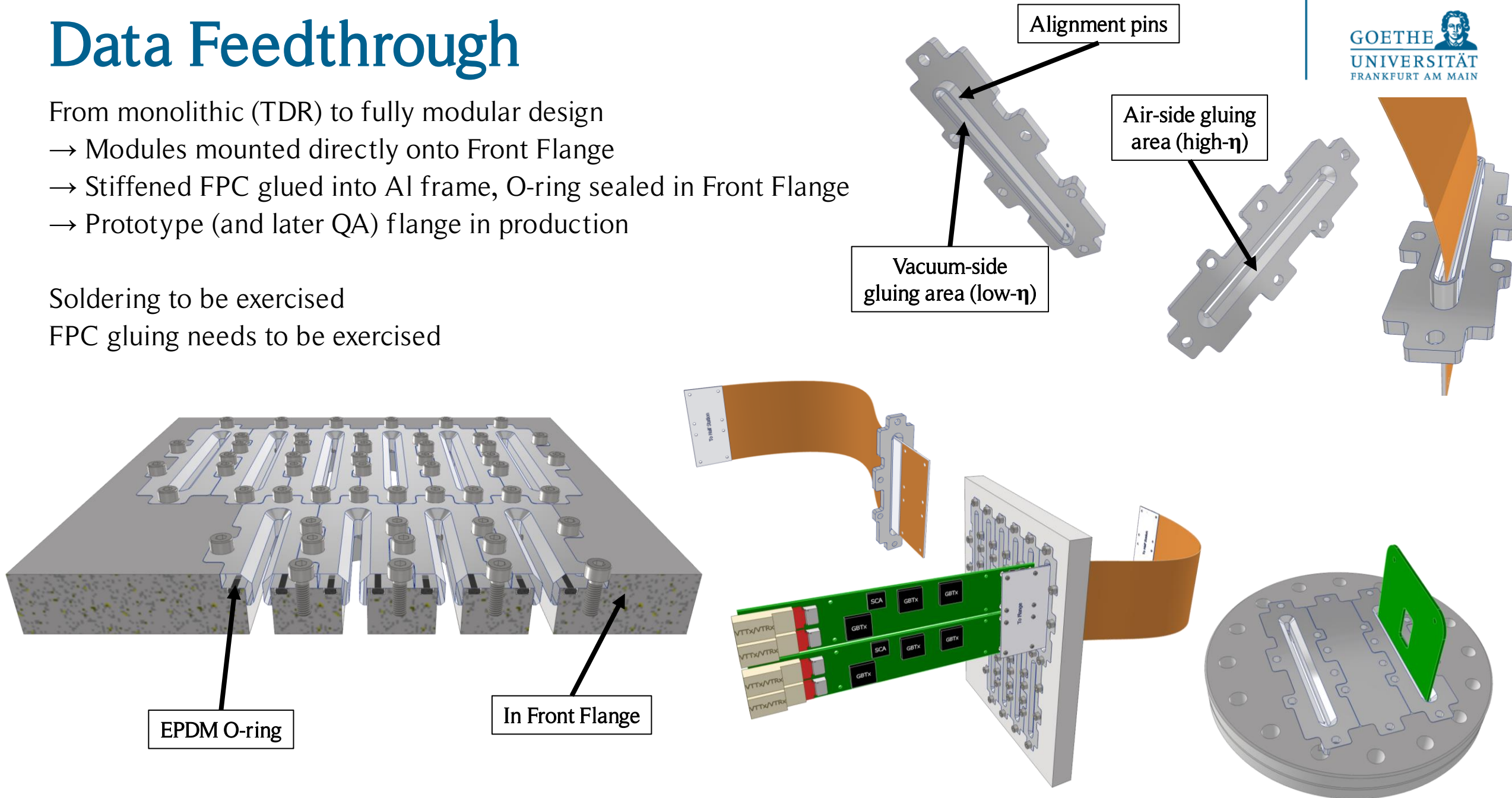
Modular, stiffened FPC-based (MVD)



Data Feedthrough

From monolithic (TDR) to fully modular design
→ Modules mounted directly onto Front Flange
→ Stiffened FPC glued into Al frame, O-ring sealed in Front Flange
→ Prototype (and later QA) flange in production

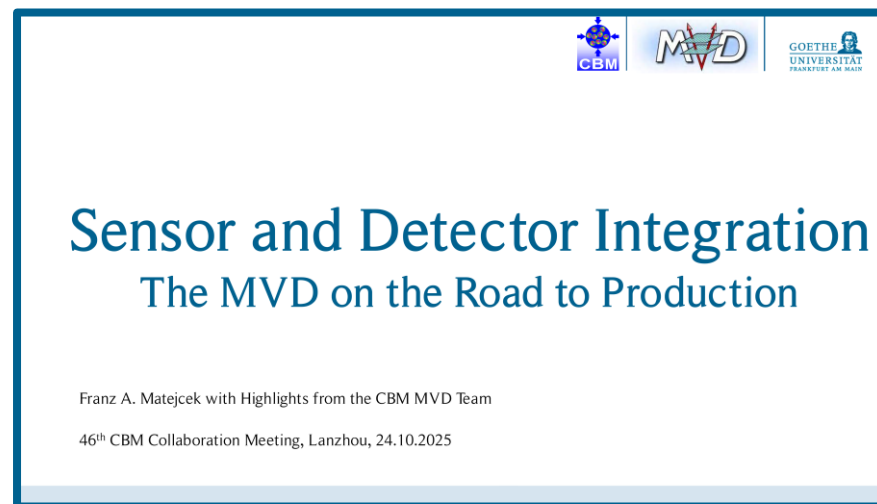
Soldering to be exercised
FPC gluing needs to be exercised



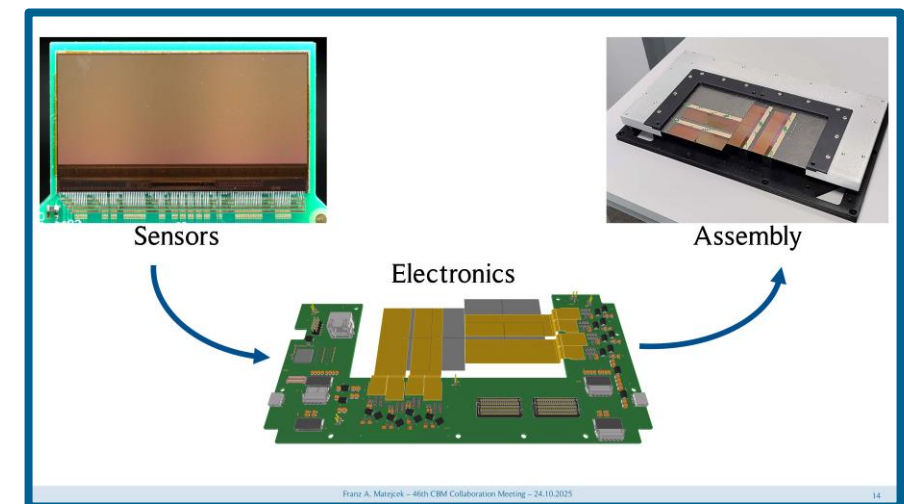
More developments (and outlook) in the Integration Highlights on Friday

Project Status

Mechanics and up- / down-stream interfaces
Data feedthrough design



[Link to the Contribution](#)



Sneak Peek