MVD Status Detector

Franz A. Matejcek for the CBM MVD Team

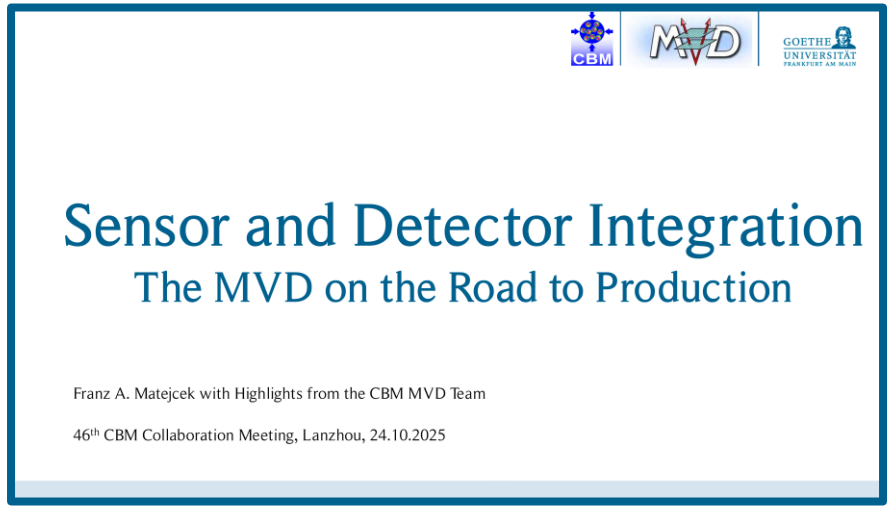
46th CBM Collaboration Meeting, Lanzhou, 21.10.2025

Disclaimer:
Integration Highlights on Friday

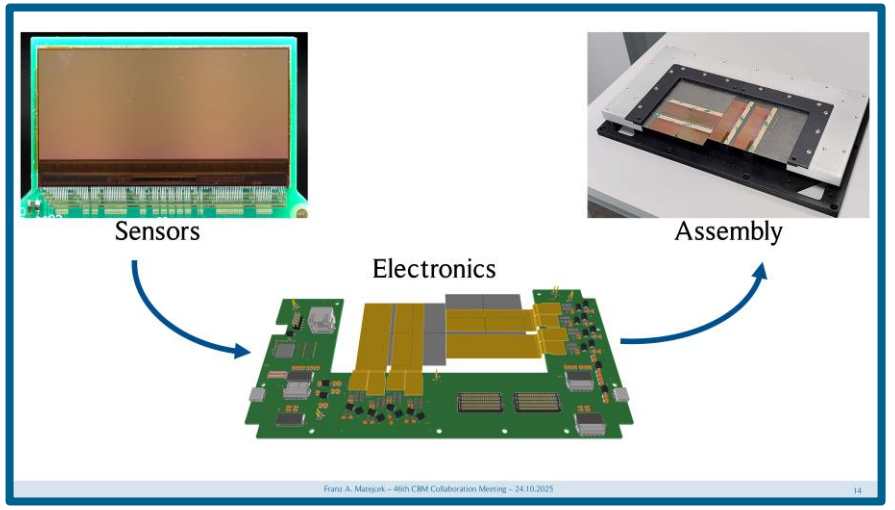
Project Status

Mechanics and up- / down-stream interfaces

Data feedthrough design



Link to the Contribution



Sneak Peek

Status EDR

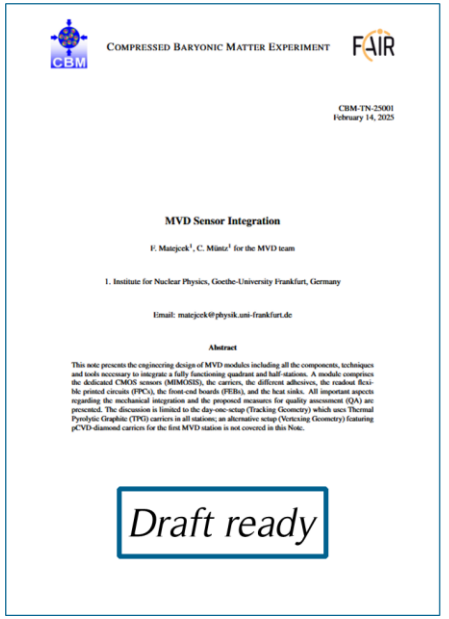
MVD Core EDR (Sensors & Mechanics) is (still) due

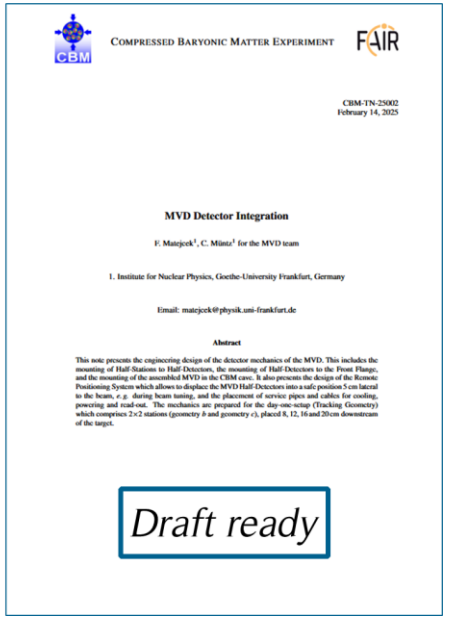
MIMOSIS is the central piece
→ Timeline driven by understanding and complexity of sensor
→ Disentangling work packages difficult
→ Electronics + mechanics developments in parallel

ppQc coldplate PRR *)	06/25					Sync. w/ PhD, includes carrier now +3 M, pre-prd cold plates in house
ppQc (coldplate) production and QA → FOS *)	08/24					
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					

Not yet modified

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



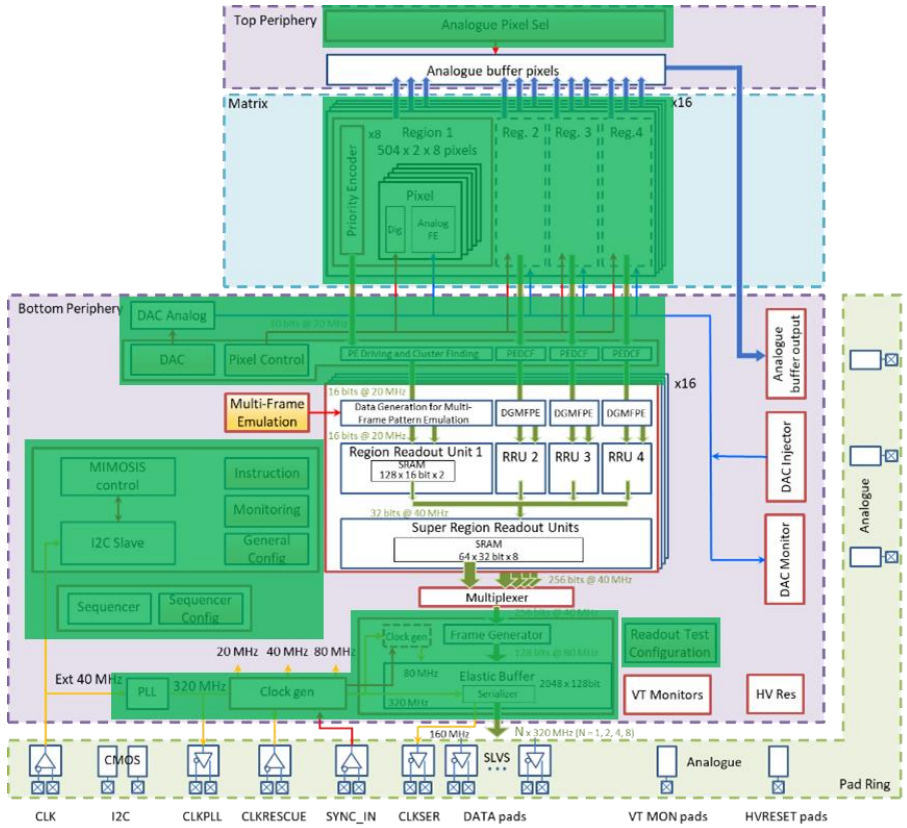


Status EDR

MIMOSIS-1 first full-scale prototype
→ Focus (and funding) for sensor performance
→ Not all features implemented, flaws

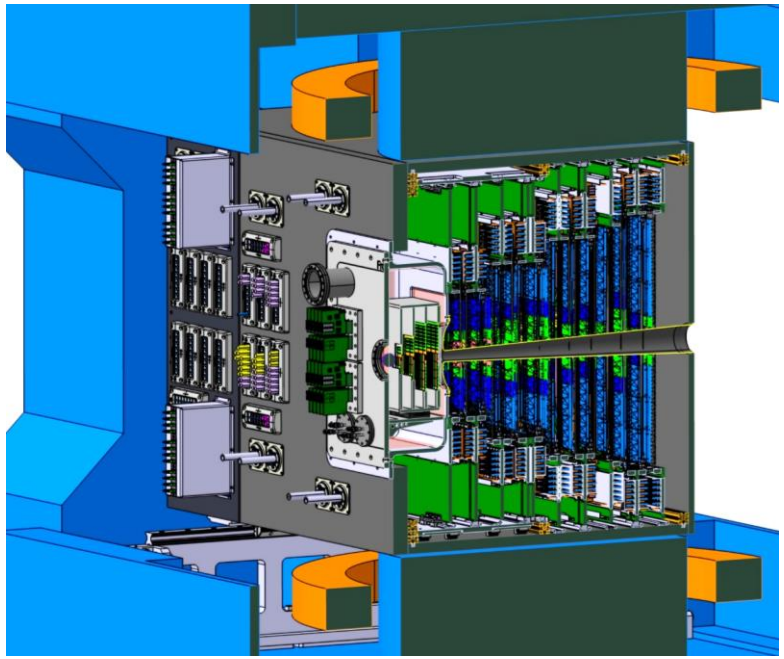
Mimosis-2.1 close to final
→ Representative for e.g. electrical integration
→ More flaws showing up in MVD-like environment

Key progress towards EDR
→ Electronics, powering & r/o
→ Mechanics, "MVD-specials" s.a. feedthroughs, heat sinks, TPG, …
→ Documentation ongoing

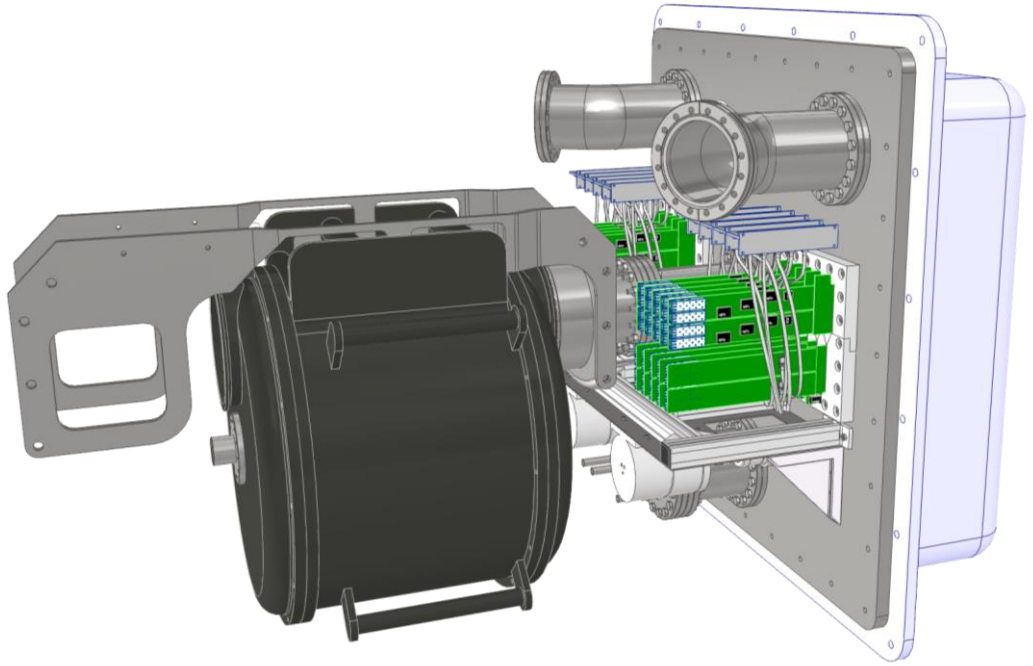


Block diagram MIMOSIS with changes M1→M2.1 highlighted

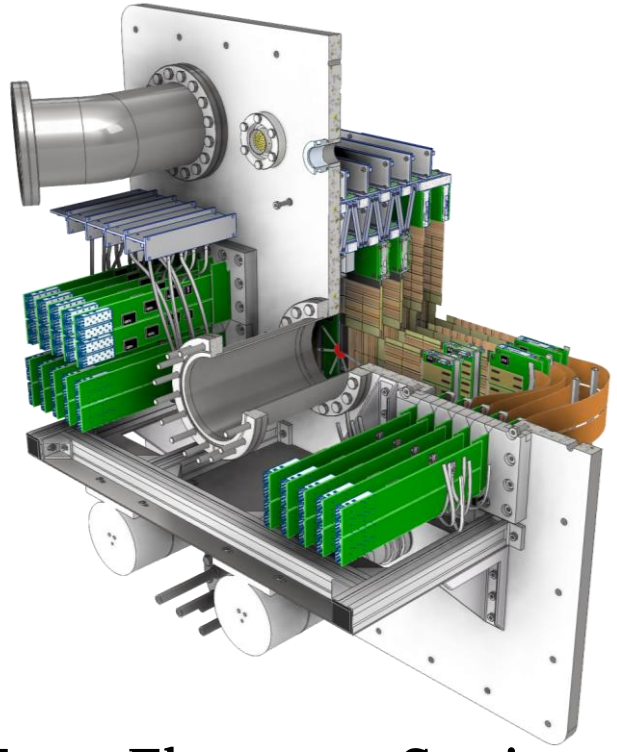
MVD Interfaces



Dipole ↔ STS ↔ MVD

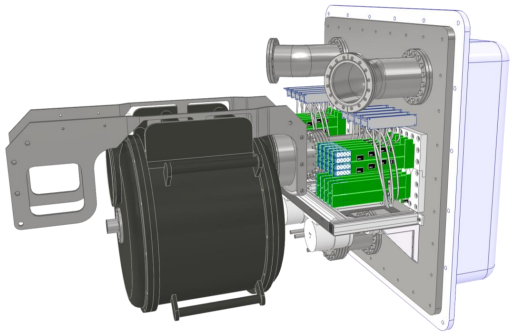


TED ↔ MVD ↔ Target Chamber



Front Flange ↔ Stations

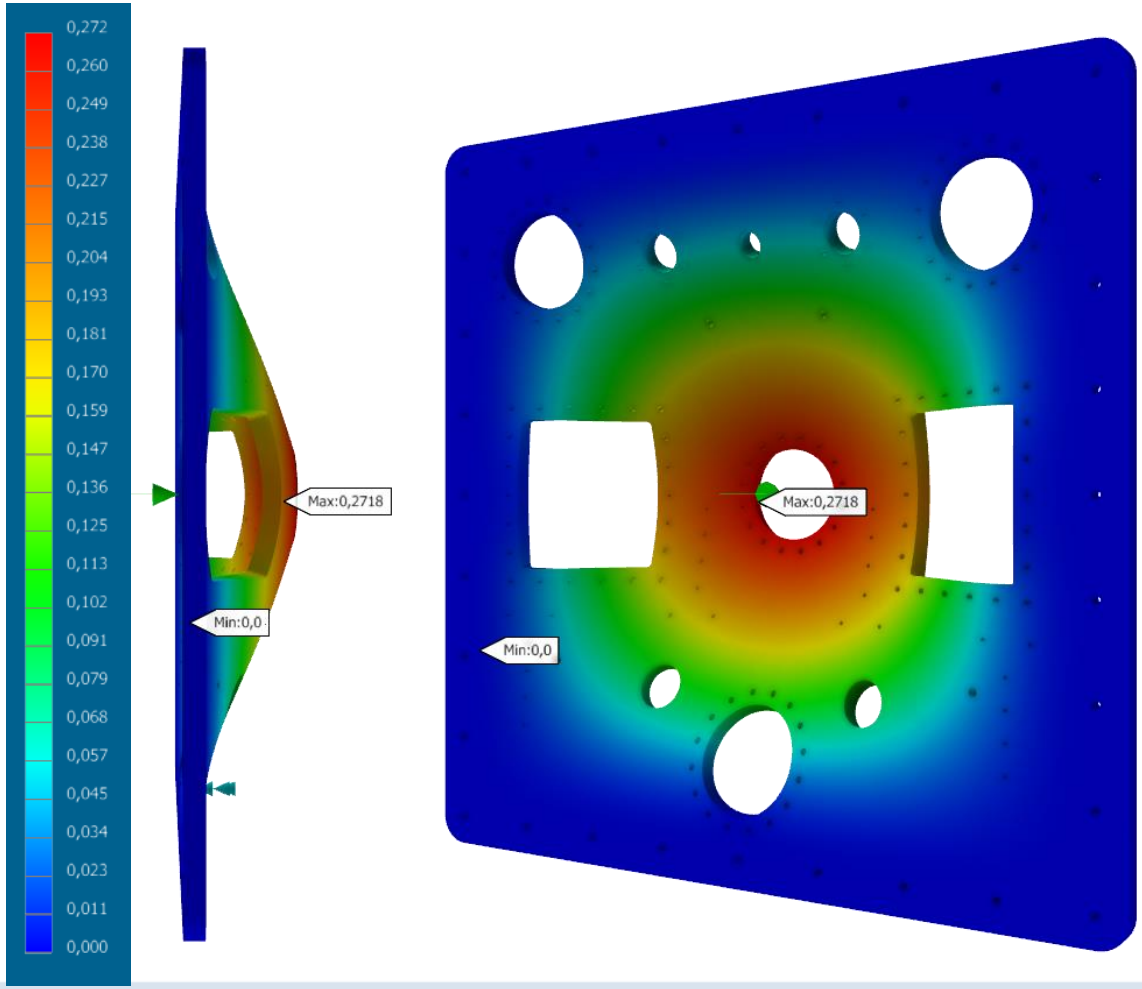
Interface TED ↔ MVD



Vacuum ↔ 0.12 MPa (20% safety margin)
→ **~300 µm peak 20 mm SS (choice)**
→ ~800 µm peak 20 mm Al

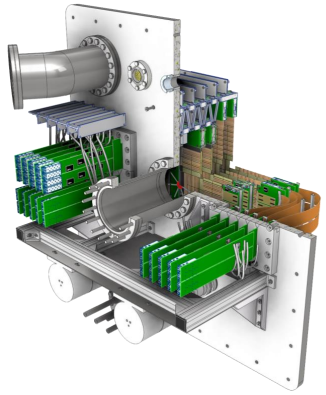
SS preferred choice
→ TED interface welded, TED screwed

Stress on the target exchange device?
→ Symmetric deformation
→ Specifications on maximum deformation?
→ Reinforcement necessary?



Deformation Stainless Steel, vacuum + 20%

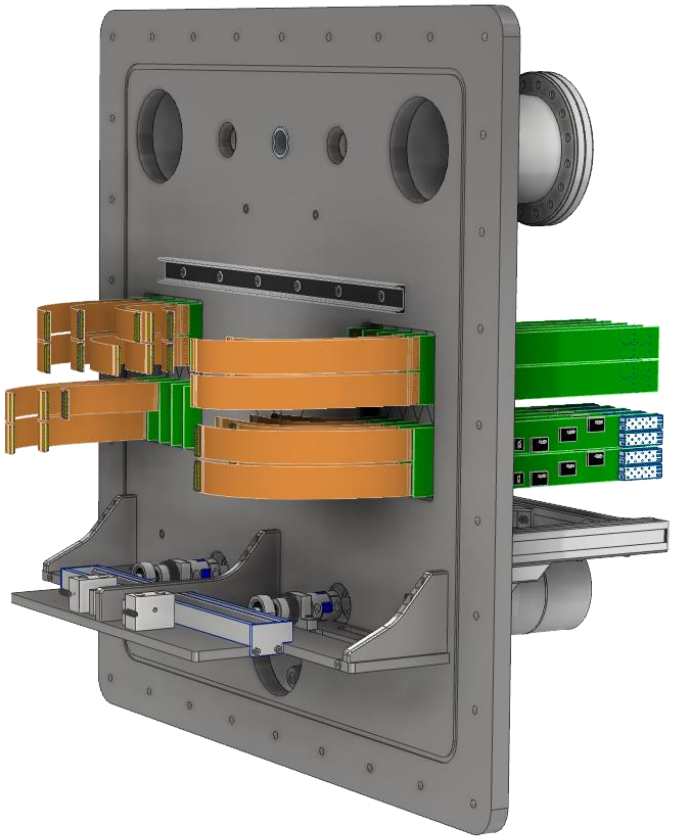
Interface Front Flange ↔ Stations



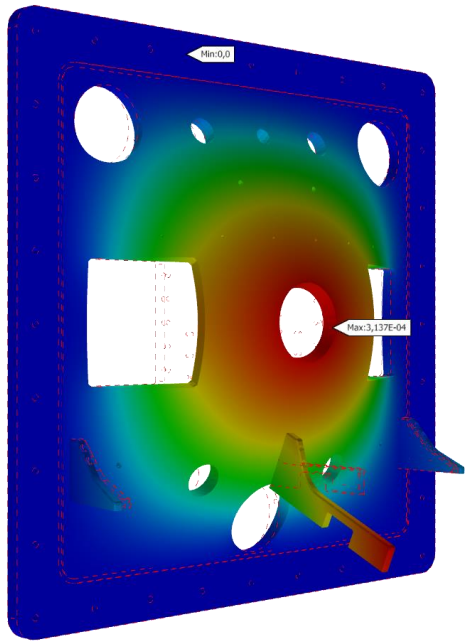
Note: Front Flange and mounting mechanics not finalized yet
→ Remote Positioning System

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

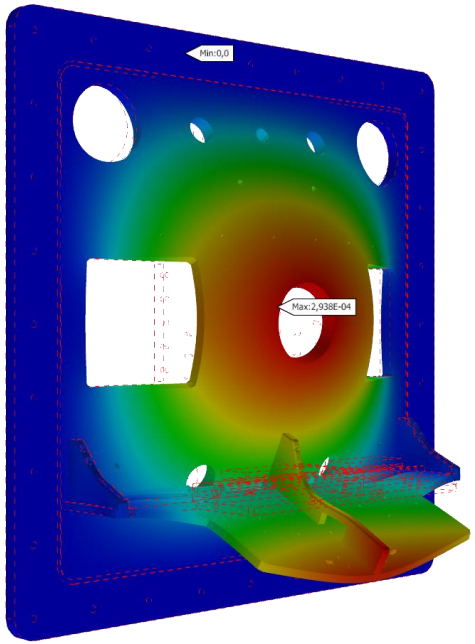
Minimize residual forces on stations
→ FEA linear static w/ gravity +20%, vacuum +20%



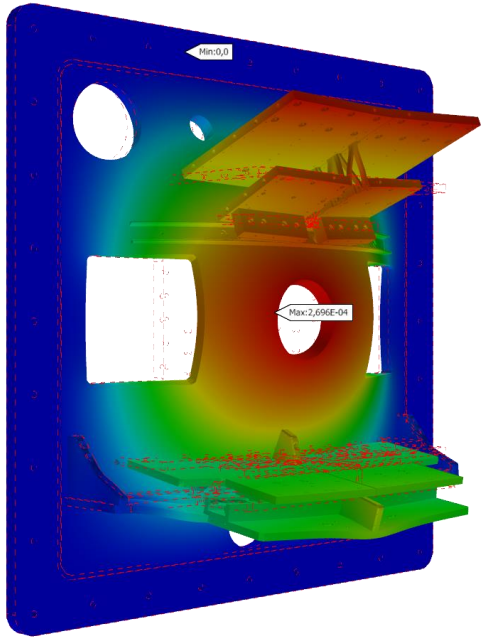
Interface Front Flange ↔ Stations



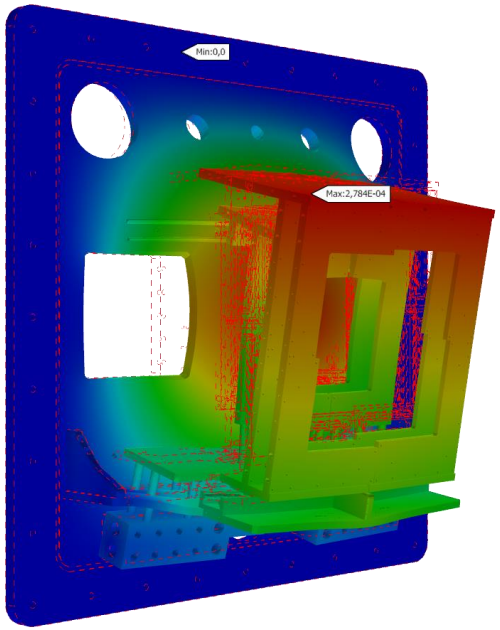
Deform. vacuum +20%,
gravity +20%
Max: 314 µm



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

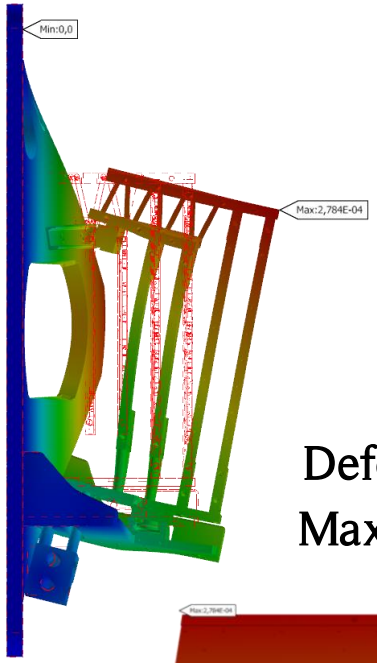


Deform. vacuum +20%,
gravity +20%
Max: 270 µm

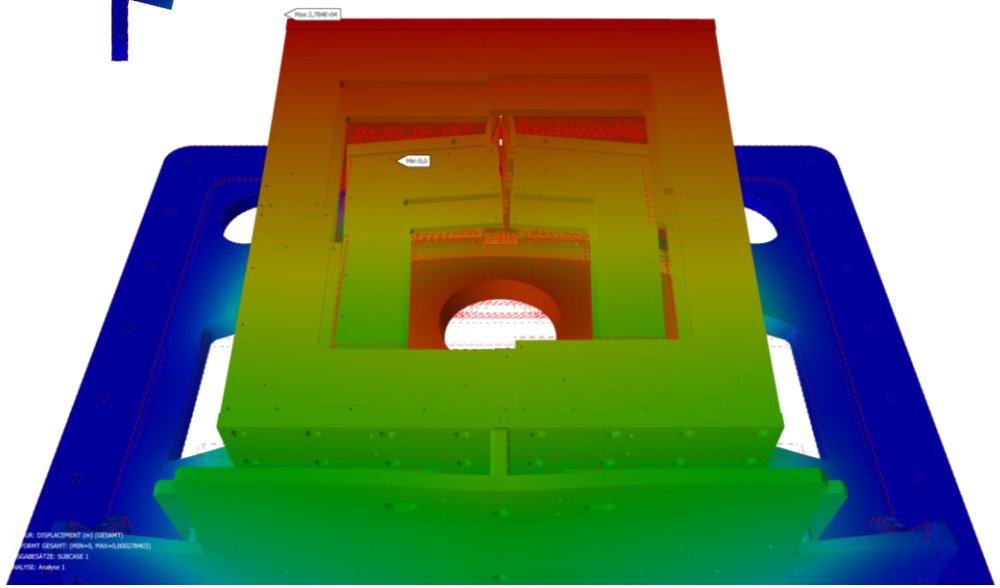


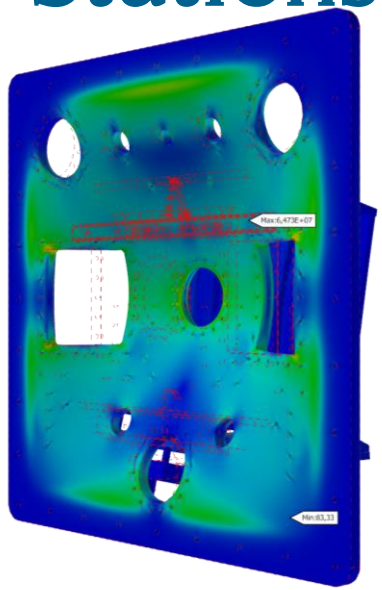
Deform. vacuum +20%,
gravity +20%
Max: 278 µm

Interface Front Flange ↔ Stations

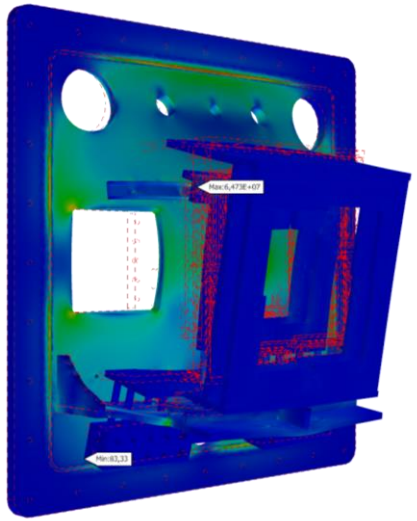


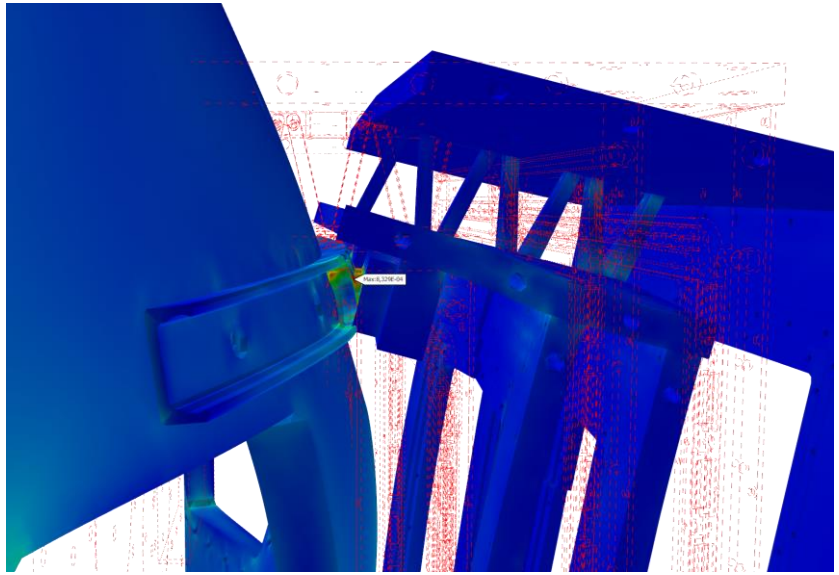
Deformation
Max: 278 µm





Von-Mises Stress
Max: 65 MPa



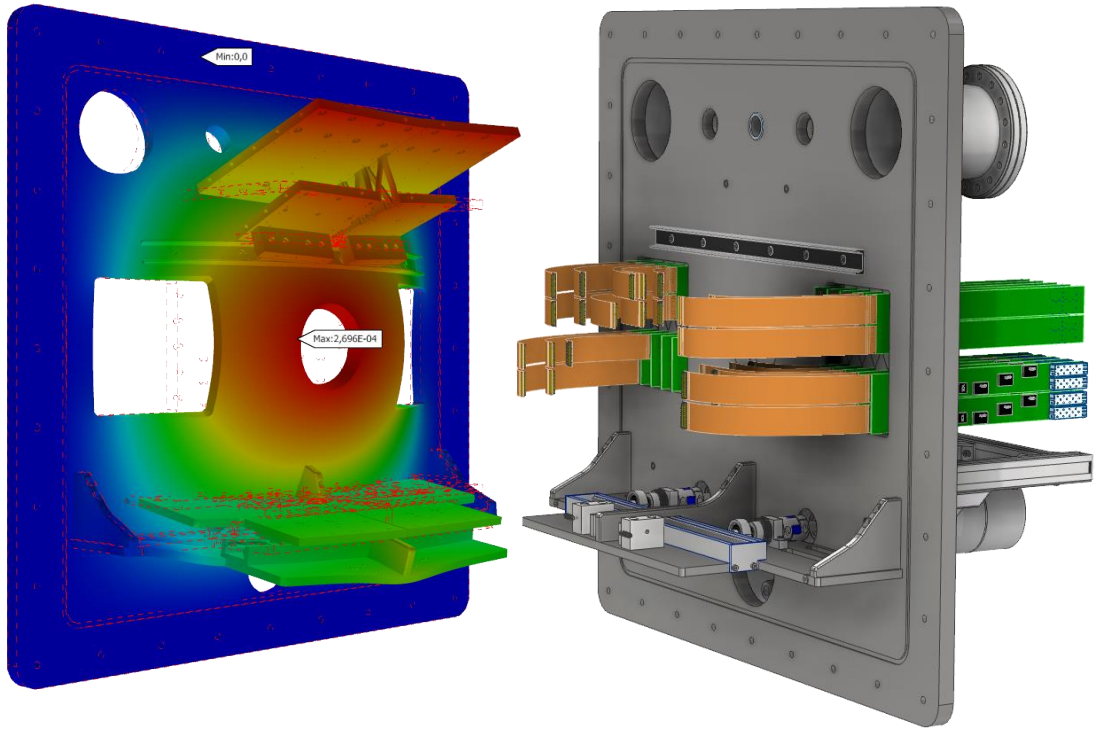


Strain
Max: 8.3 10^{-4}

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

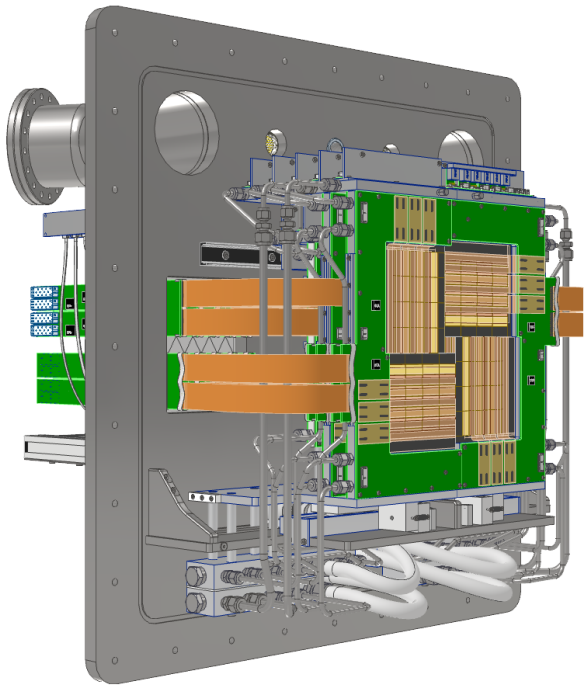


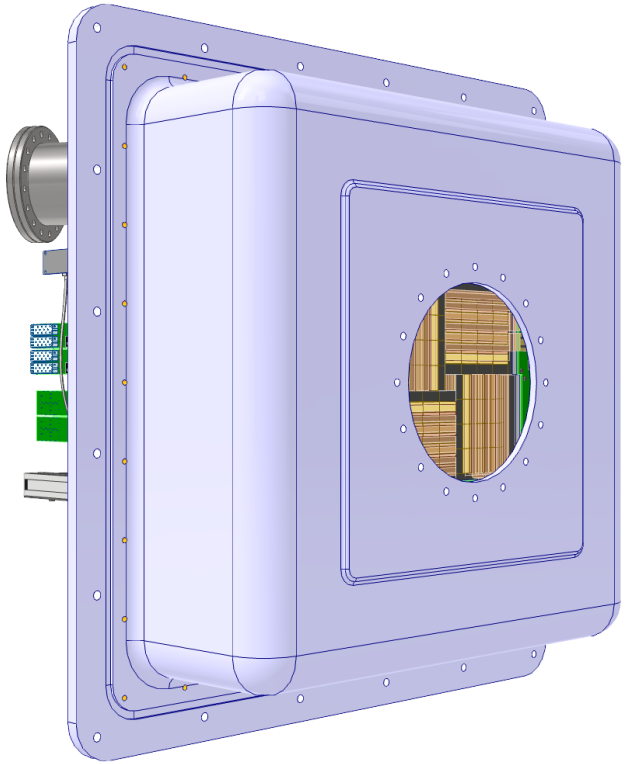
Interface MVD ↔ Target Chamber

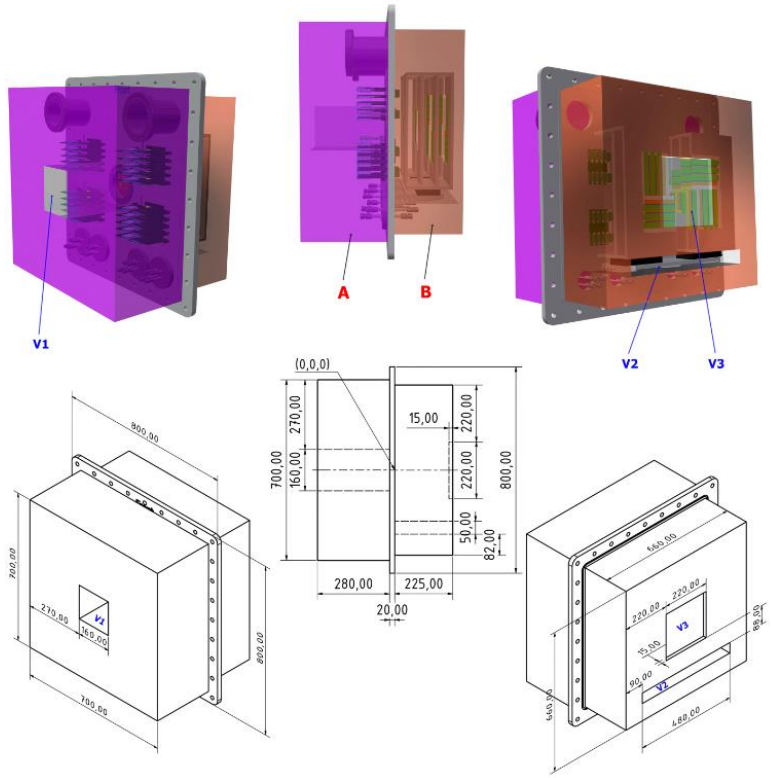
MVD in target chamber

Remote Positioning System

→ Half-Detectors move 5 cm laterally from beam axis





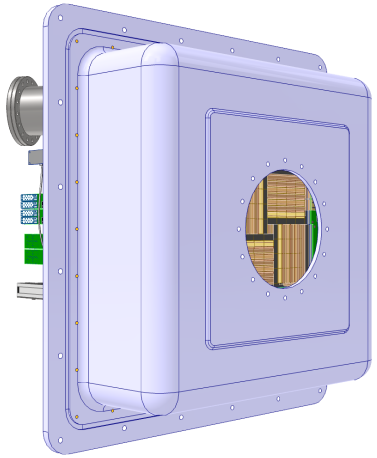


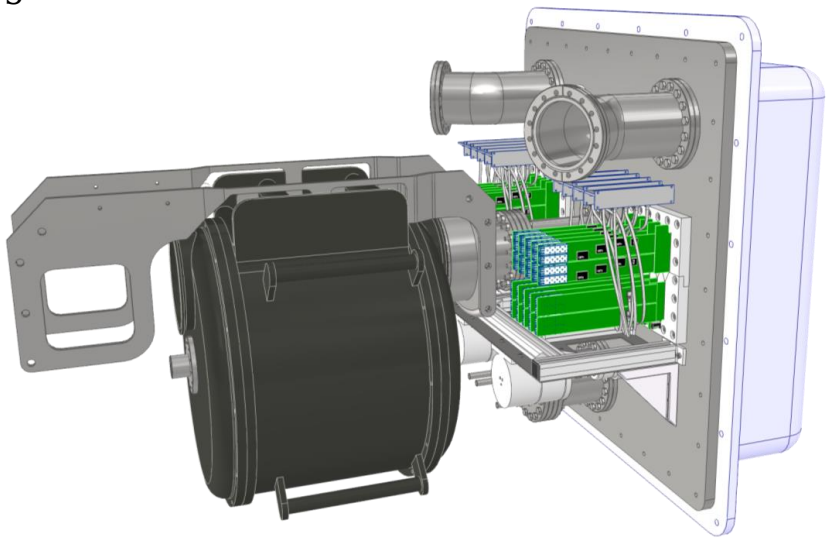
Interface MVD ↔ Target Chamber

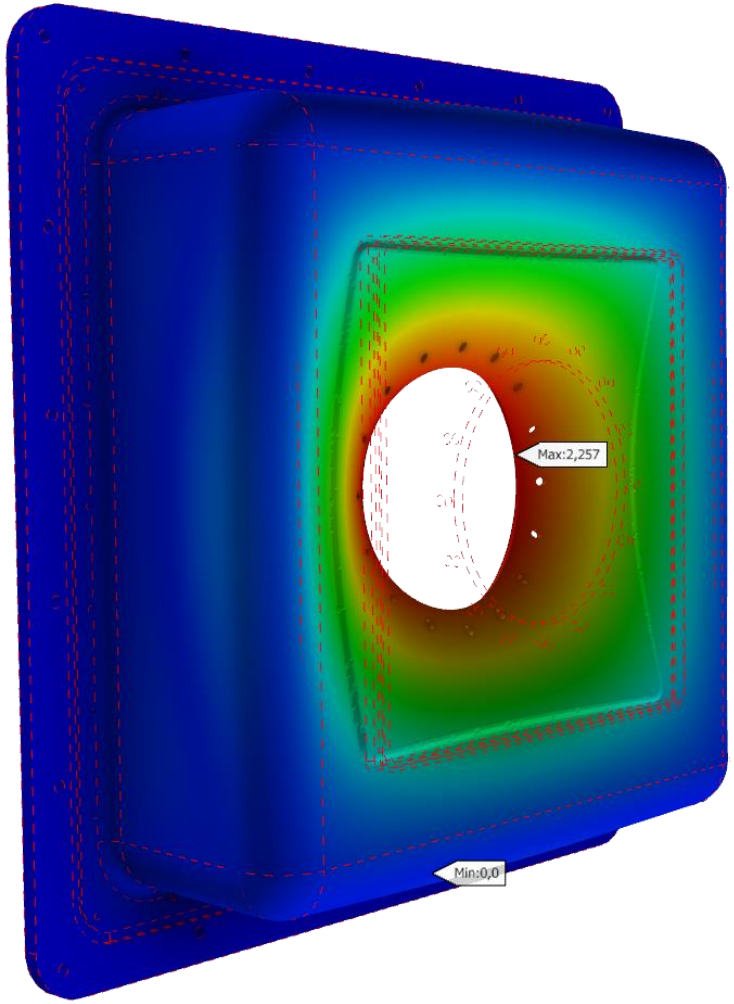
Target chamber according to MVD specifications
→ Internal volume / keep-out
→ Maximum deformation under load
→ Mounting, alignment, adjustment

We prefer Stainless Steel

… in close discussion with GSI engineers



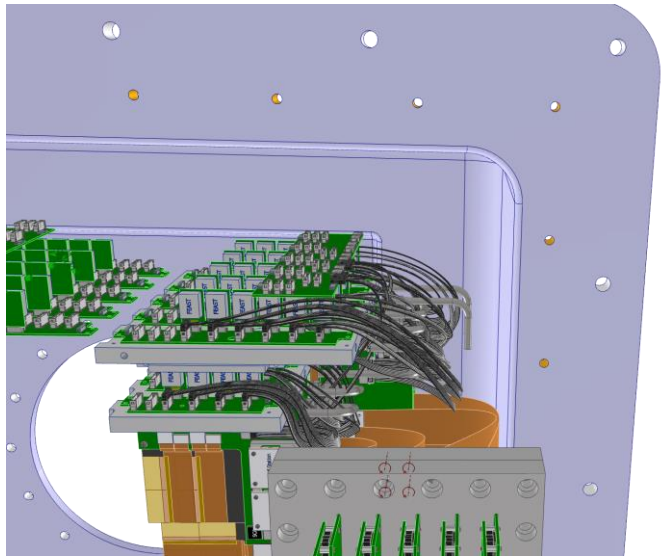


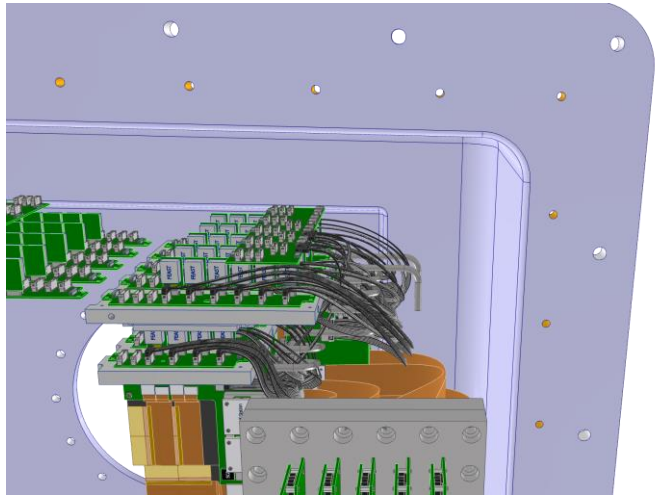


See also Patrick‘s contribution:
https://indico.gsi.de/event/20881/contributions/92724/

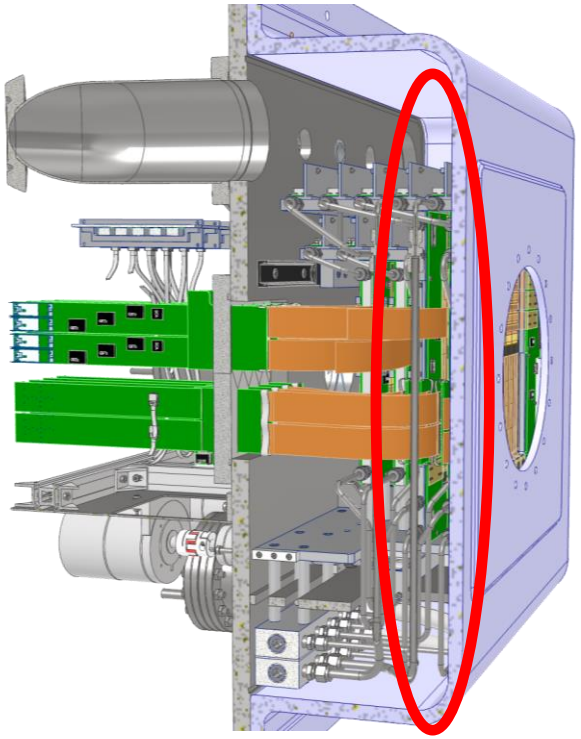
Deform. aluminum vacuum +20%, gravity +20%, Max: 2.26 mm

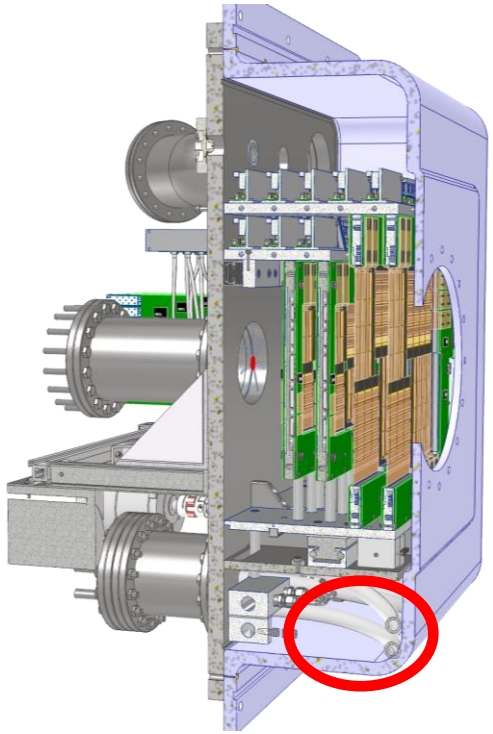
Interface MVD ↔ Target Chamber

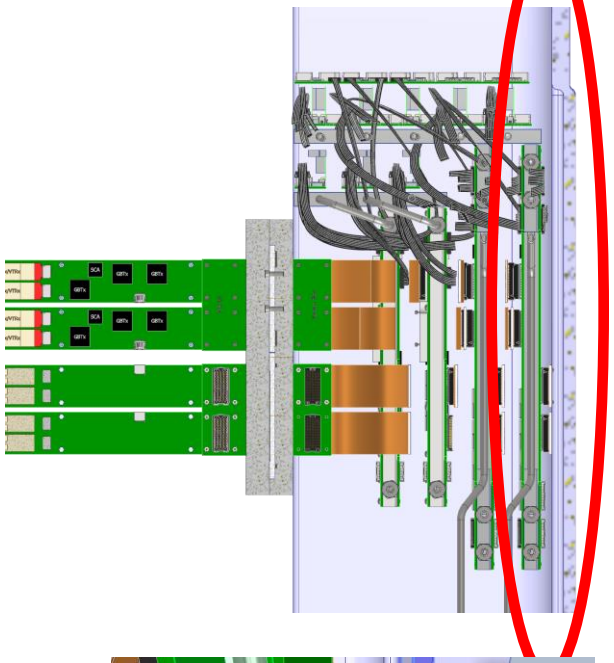




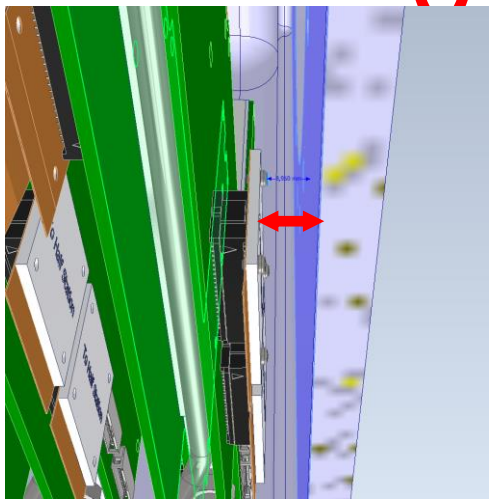
Tightest space in x/y in opened/closed configuration





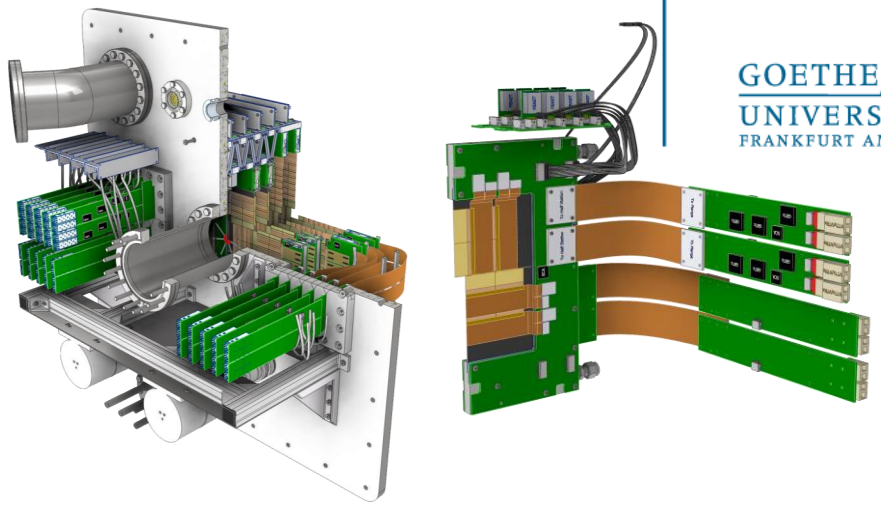


Tightest space in z
→ Flexible piping
→ FMC connectors backside 4th station



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

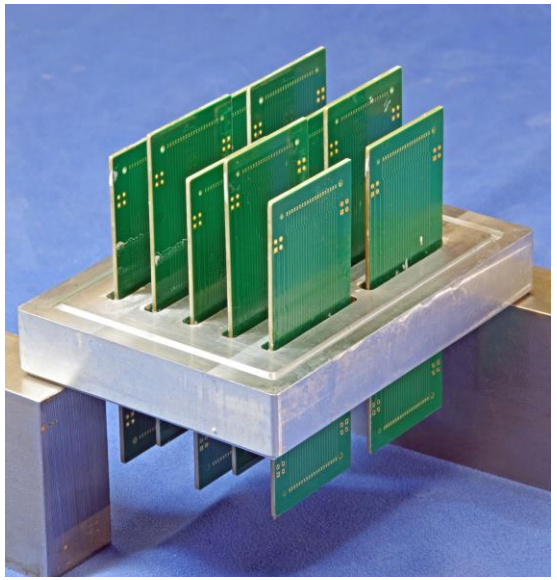
Data Feedthrough



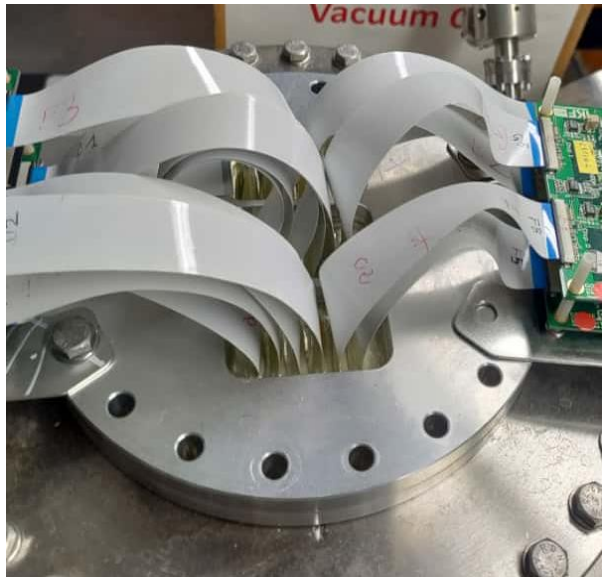
One of the more MVD-unique pieces of engineering…
→ O(5k) Clock and Data lines through vacuum
→ Tight space constraints on FEB and Front Flange
→ Connectors defined on CROB, 1-to-1 connection (tight routing)
→ Data FPC, FEB, and Flange need to be designed in parallel

In close discussion with GSI engineers

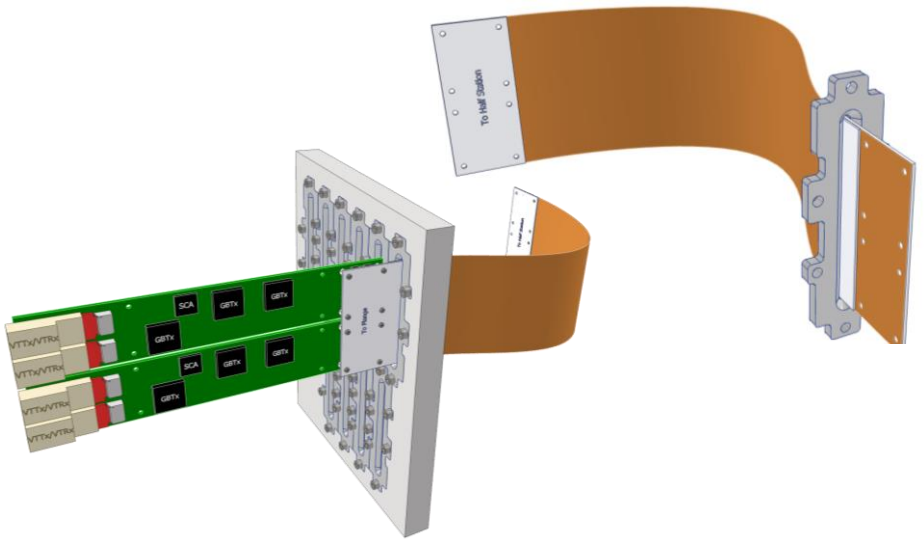
"Monolithic", PCB-based prototype (TDR)



"Monolithic", FPC-based prototype (PRESTO)



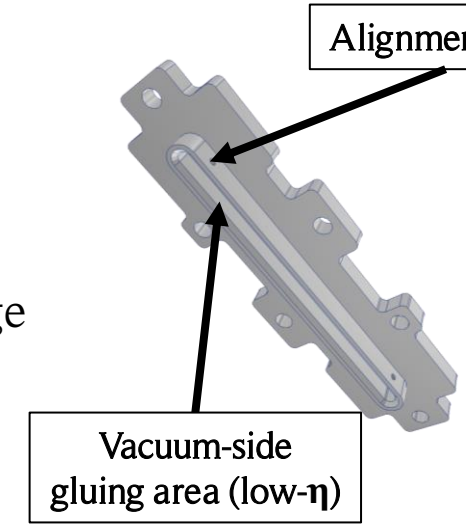
Modular, stiffened FPC-based (MVD)

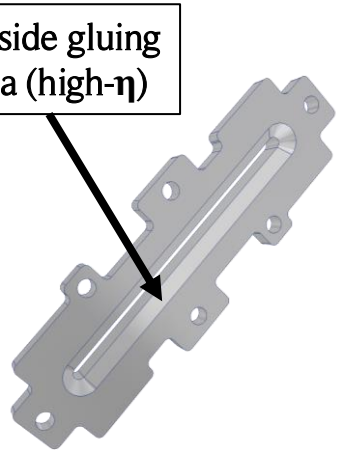


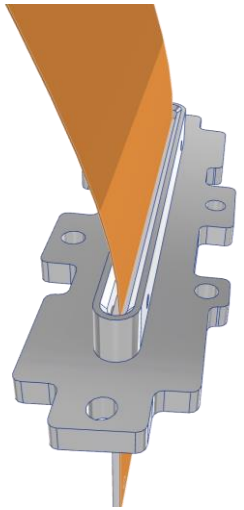
Data Feedthrough

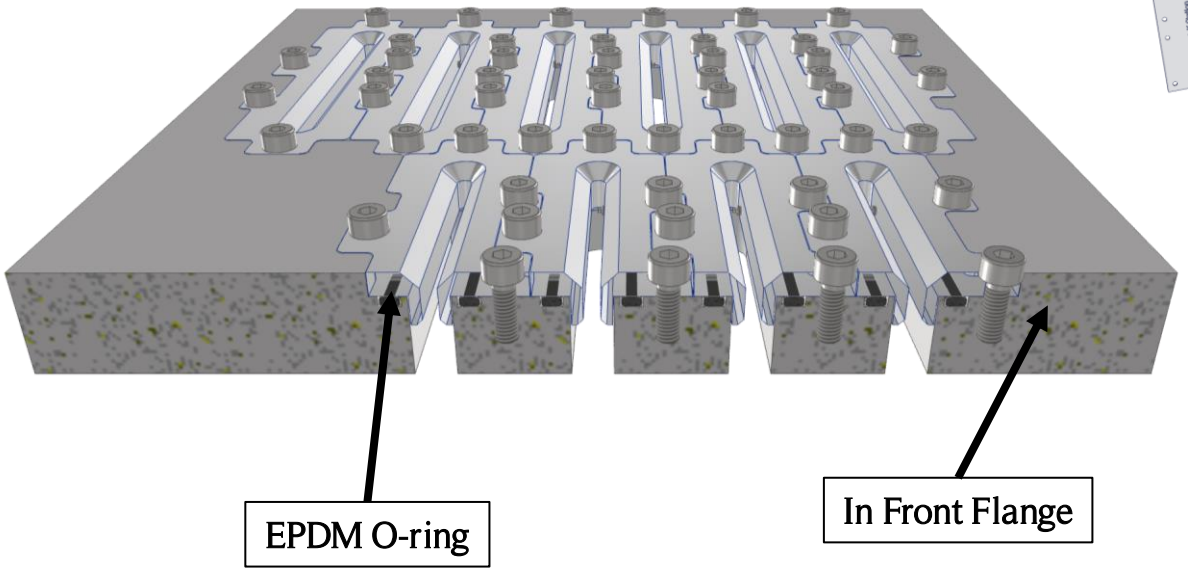
From monolithic (TDR) to fully modular design
→ Modules mounted directly onto Front Flange
→ Stiffened FPC glued into Al frame, O-ring sealed in Front Flange
→ Prototype (and later QA) flange in production

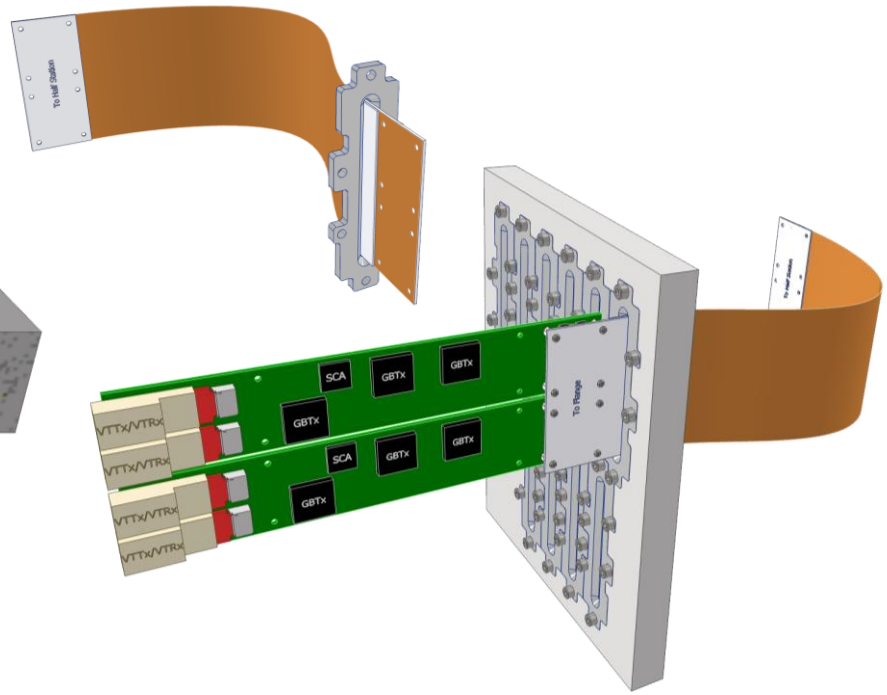
Soldering to be exercised
FPC gluing needs to be exercised

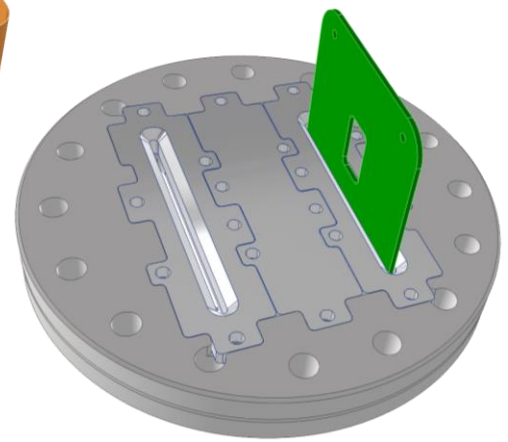










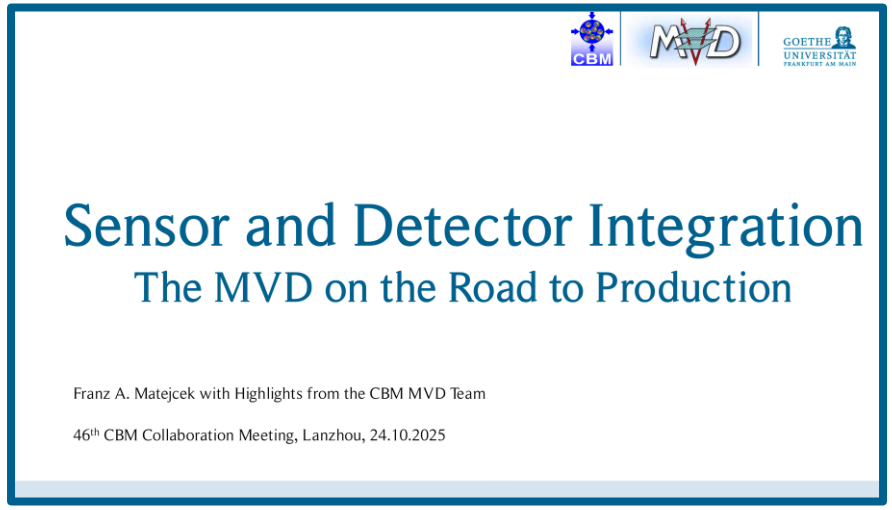


More developments (and outlook) in the Integration Highlights on Friday

Project Status

Mechanics and up- / down-stream interfaces

Data feedthrough design



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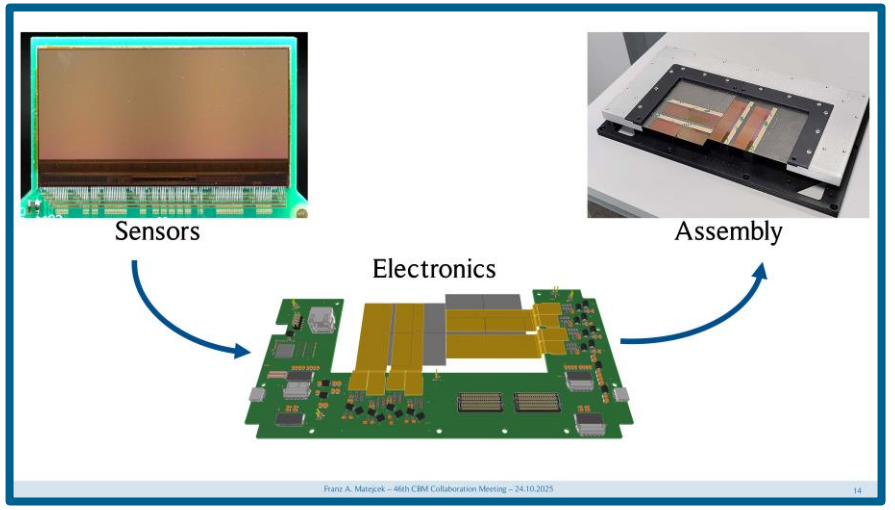

Sneak Peek