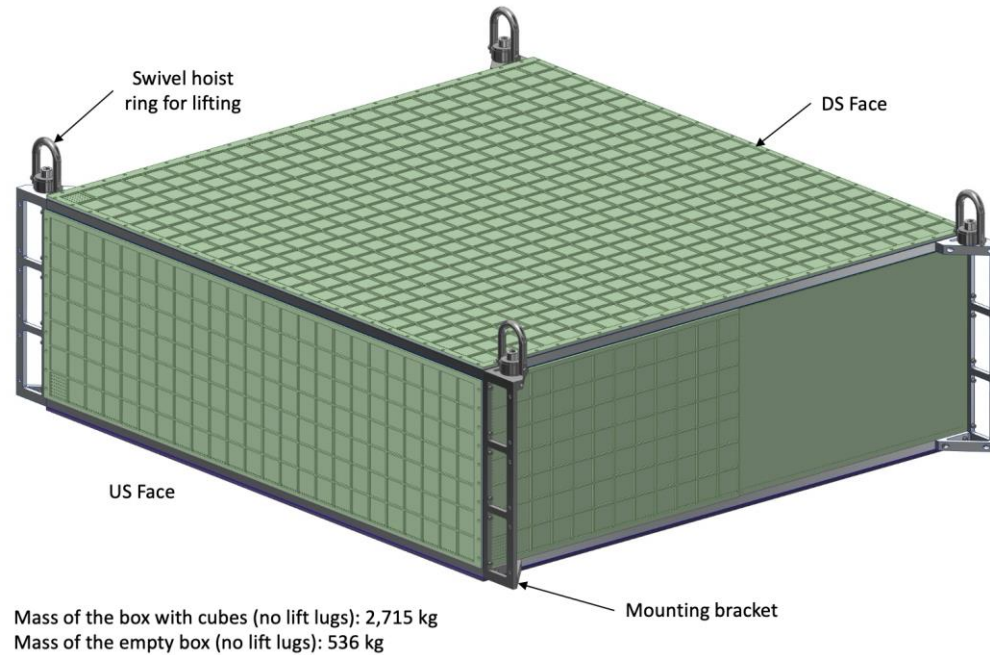


SFGD Mechanics

On behalf of “Mechanics group”

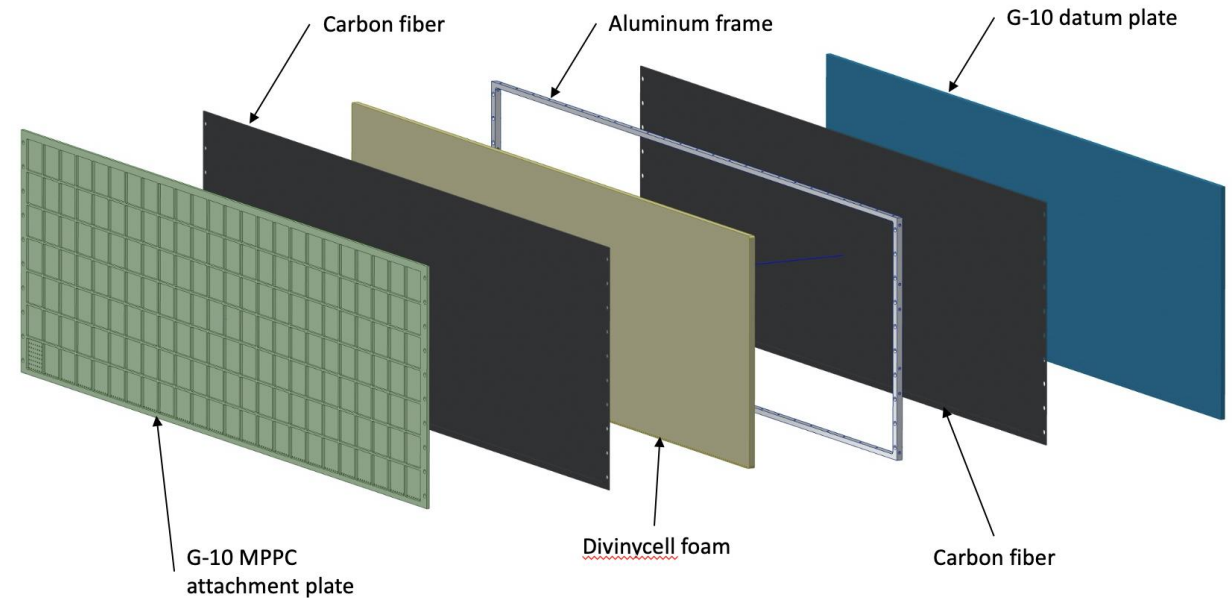
The SuperFGD box plate structure



- The box will contains cubes
- Max deformation at the bottom is 5mm for 1.7G (gravity + earthquake)
- Production readiness review passed in August '21, started production in September '21 (some delays in the fiberglass production)

Example of box plate composition (Upstream)

Some box plates don't have the "datum" plate



Panels Ready for assembly



- DownStream and Right panels are ready
- Top and Bottom panels produced
- CIMFORM is now drilling the Bottom panel
- Keep Top panel as latest one to machine, unless other delays in the remaining fiberglass plates from NEXUS ...

Remaining Fiberglass @NEXUS

All the plates have been machined but some plates to match the target tolerance

Pos	Quantity	Part Name	Material	
1	1	Downstream Panel	Black Pigmented Fiber Glass	Completed
2	1	Upstream Panel MPPC	Black Pigmented Fiber Glass	Relaminated
3	1	Upstream Panel Datum	Black Pigmented Fiber Glass	Relaminated
4	1	Bottom Panel Calibration	Black Pigmented Fiber Glass	Completed
5	1	Bottom Panel Datum	Black Pigmented Fiber Glass	Completed
6	1	Left Panel MPPC	Black Pigmented Fiber Glass	Completed
7	1	Left Panel Datum	Black Pigmented Fiber Glass	Relaminated
8	1	Right Panel	Black Pigmented Fiber Glass	Completed
9	1	Top Panel MPPC	Black Pigmented Fiber Glass	Completed

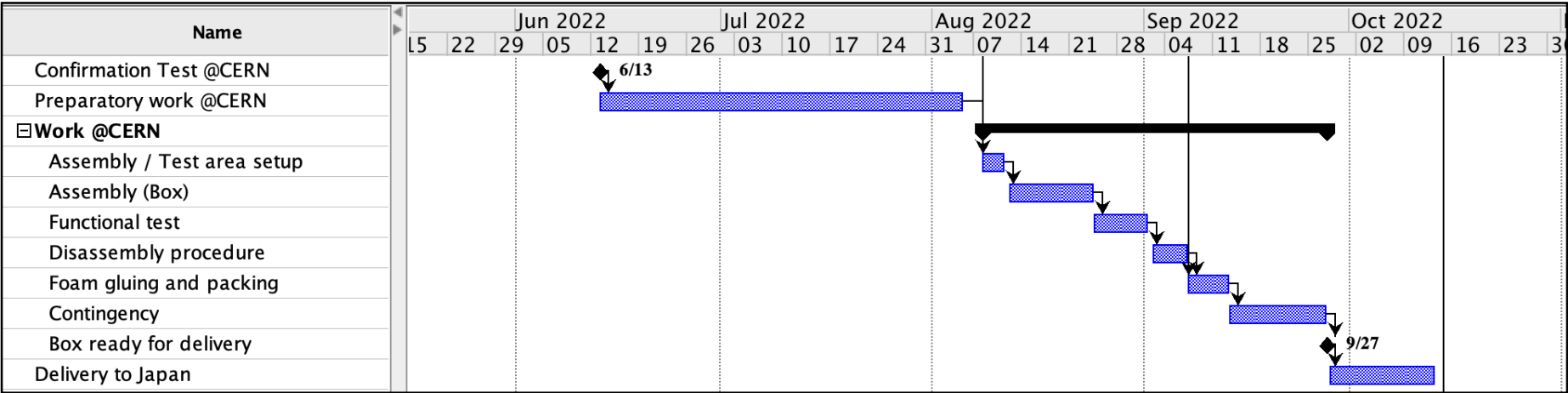
- NEXUS has received panels #2,3,7 after the relamination
- Metrology is ongoing to verify the tolerances

Production and Tests at CERN

The box is expected to be ready in the beginning of August '22

Detailed schedule for the tests at CERN discussed with Neutrino Platform

◆ Box mounting and bottom deformation under load

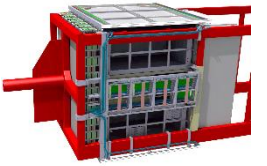


Delivery of the box by airplane investigated. No issues found

Box will arrive in J-PARC by middle October '22 weeks contingency are included at the end

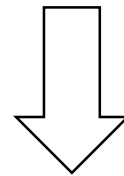
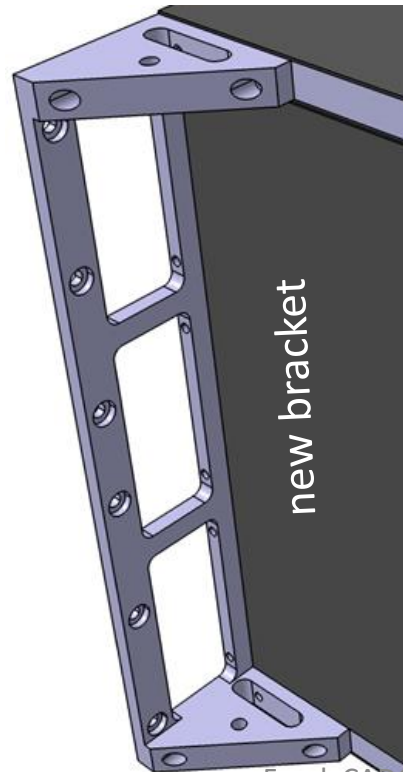
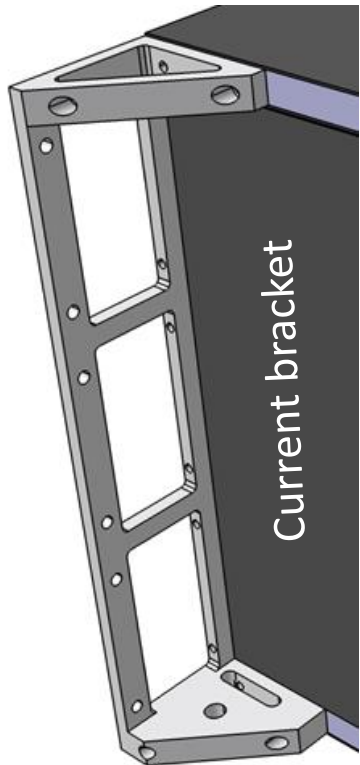
SFGD Bracket design

ND280 sFGD Bracket modification

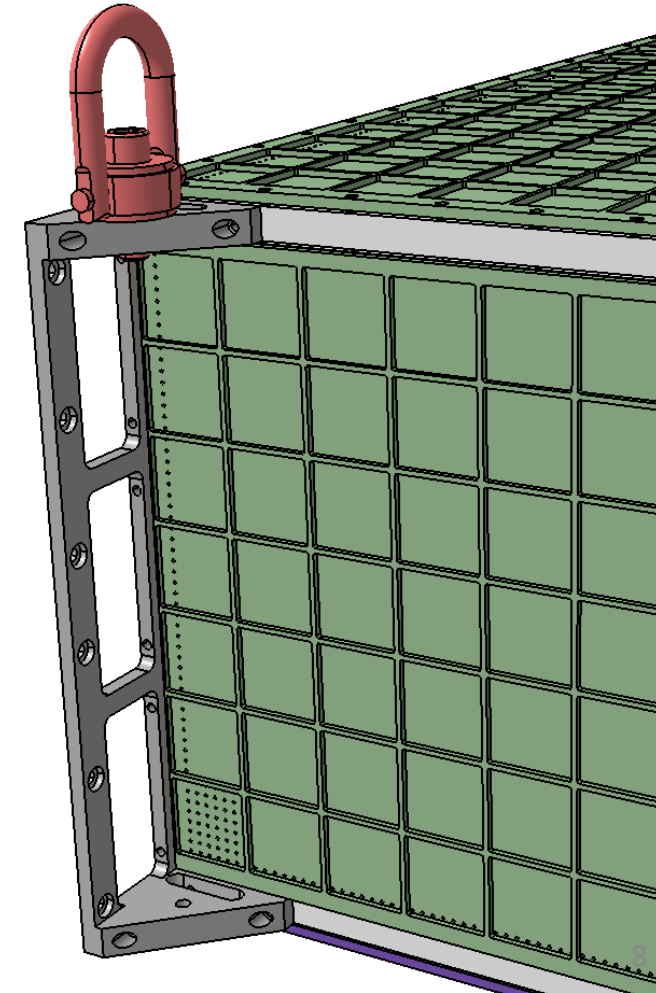


SFGD Bracket design

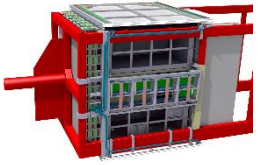
- Accommodate with the side SFGD Crates insertion (both sides)
- Ease the SFGD insertion thru BASKET top side (originally 5mm clearances on both sides)
- Adjustable / Basket dimensions, deformations... (slotted holes)
- Allow cable clamp fixation (coming from MPPC's)...
- Ease the fabrication (**Aluminum EN AW7075** vs **Stainless steel**)



- Reduced in one direction
- Symmetrical (Top vs Bottom)
- Threaded holes for cable clamps

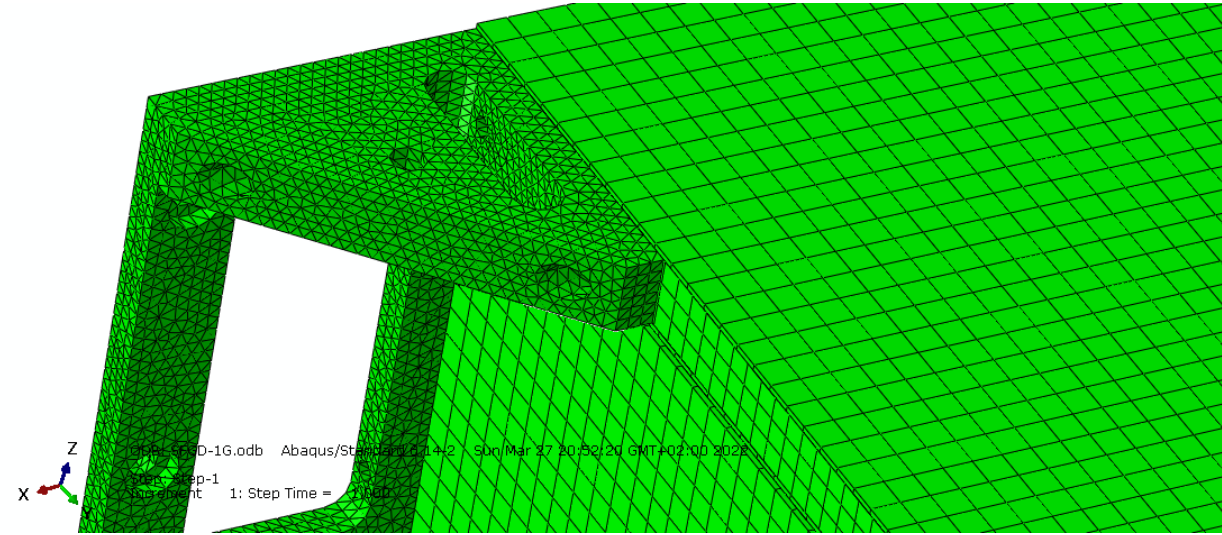


ND280 sFGD Bracket (comparative FEA)

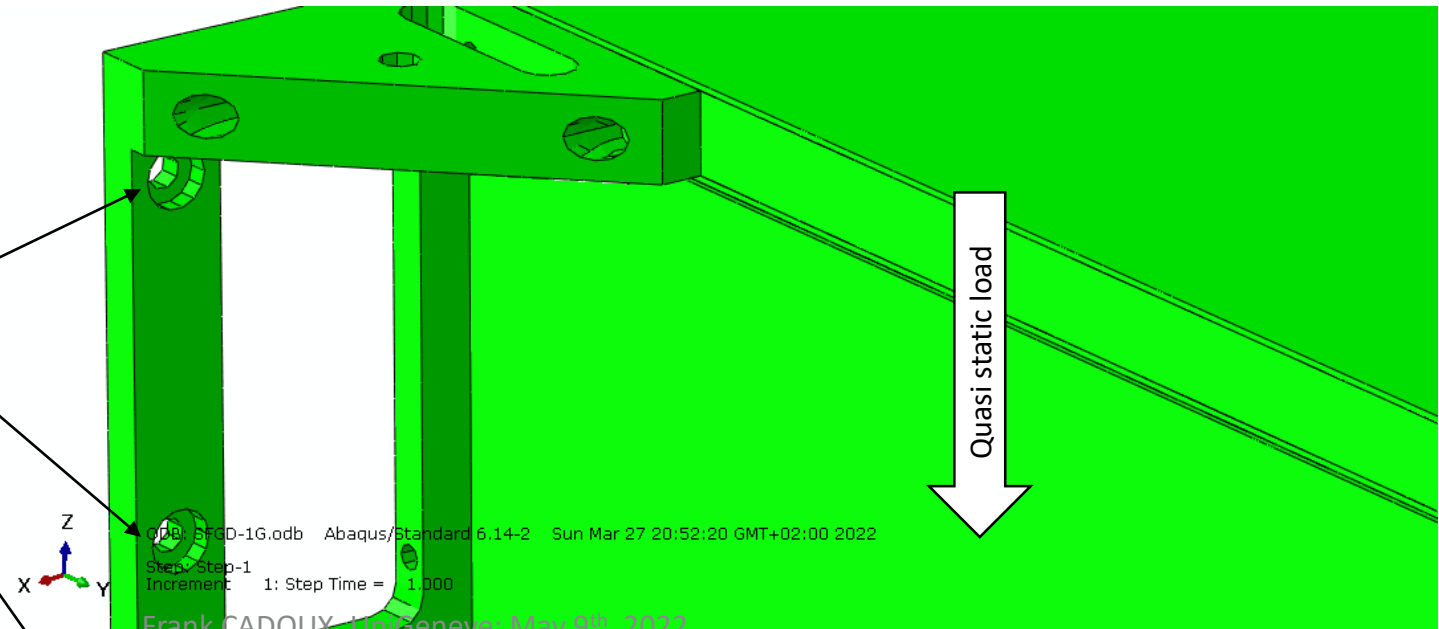


FEA Models (fine meshing on Brackets)

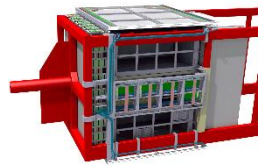
- Focus is only on Bracket part
- Load is **1,65G** down
- Cubes as a volume (connected to the bottom panel only)



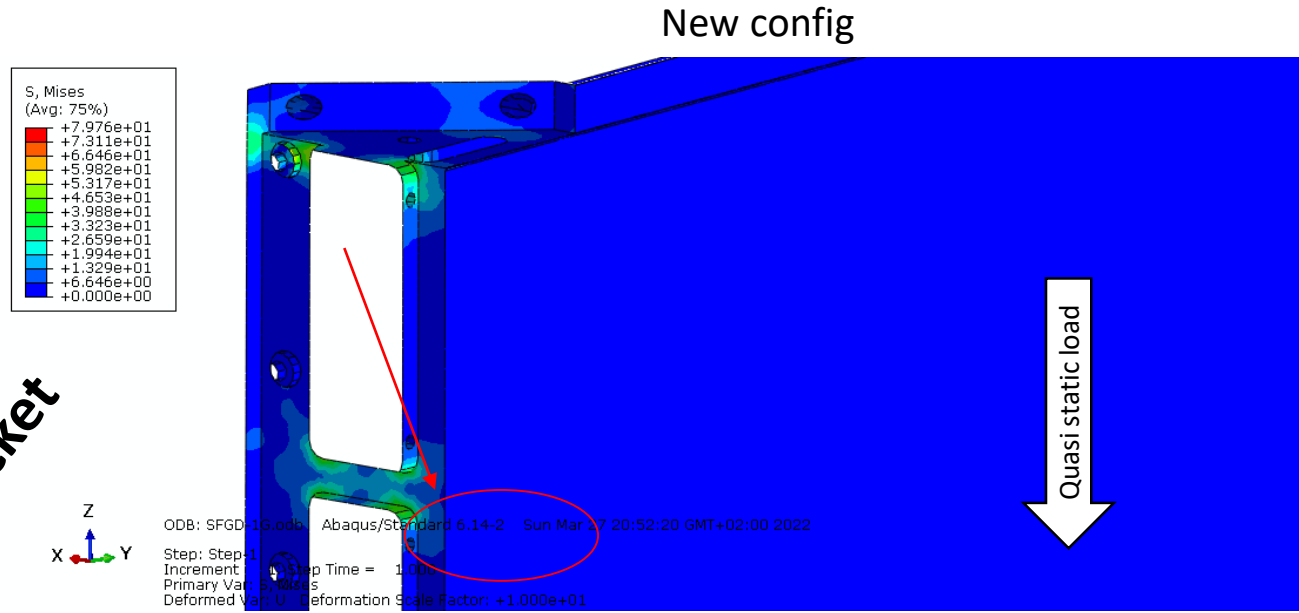
Boundary conditions on every holes (inner cylinders blocked)



ND280 sFGD Bracket (comparative FEA)

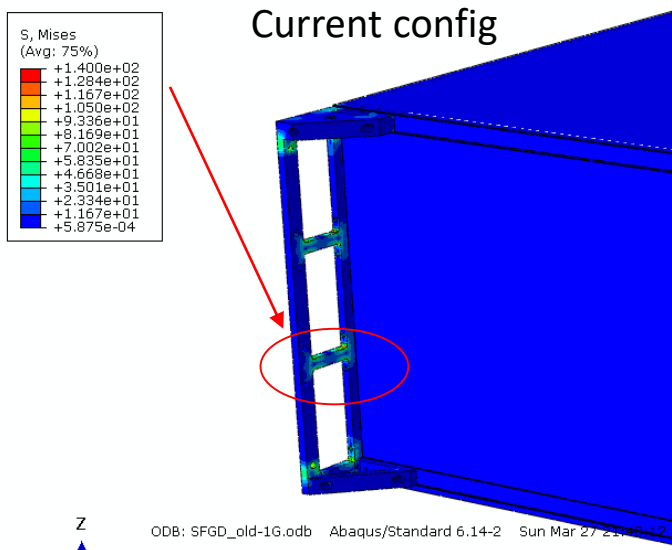


VonMises stresses on Bracket



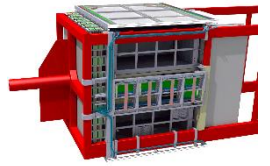
⇒ 80 Mpa Max

Max Stress is quite reduced (deflection about the same)

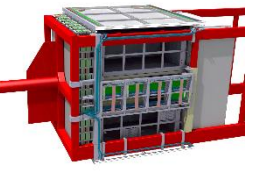


⇒ 140 Mpa (due to top/bottom asymmetry?)

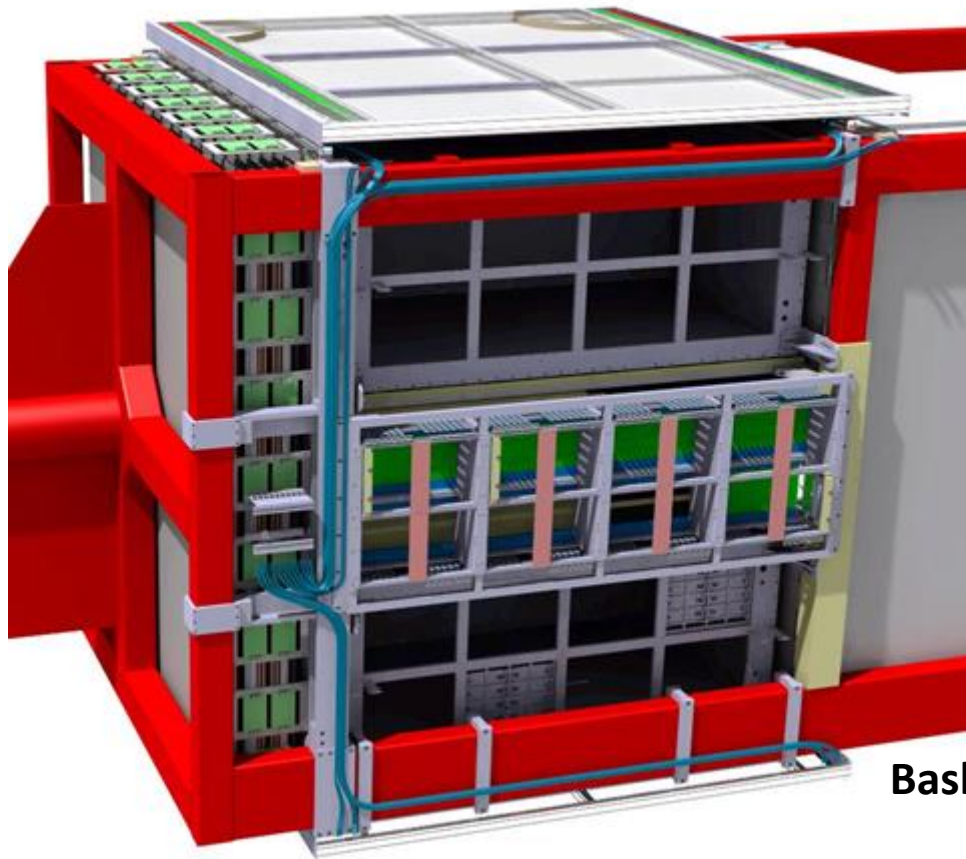
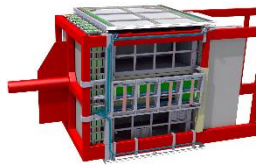
ND280 sFGD Bracket (conclusions)



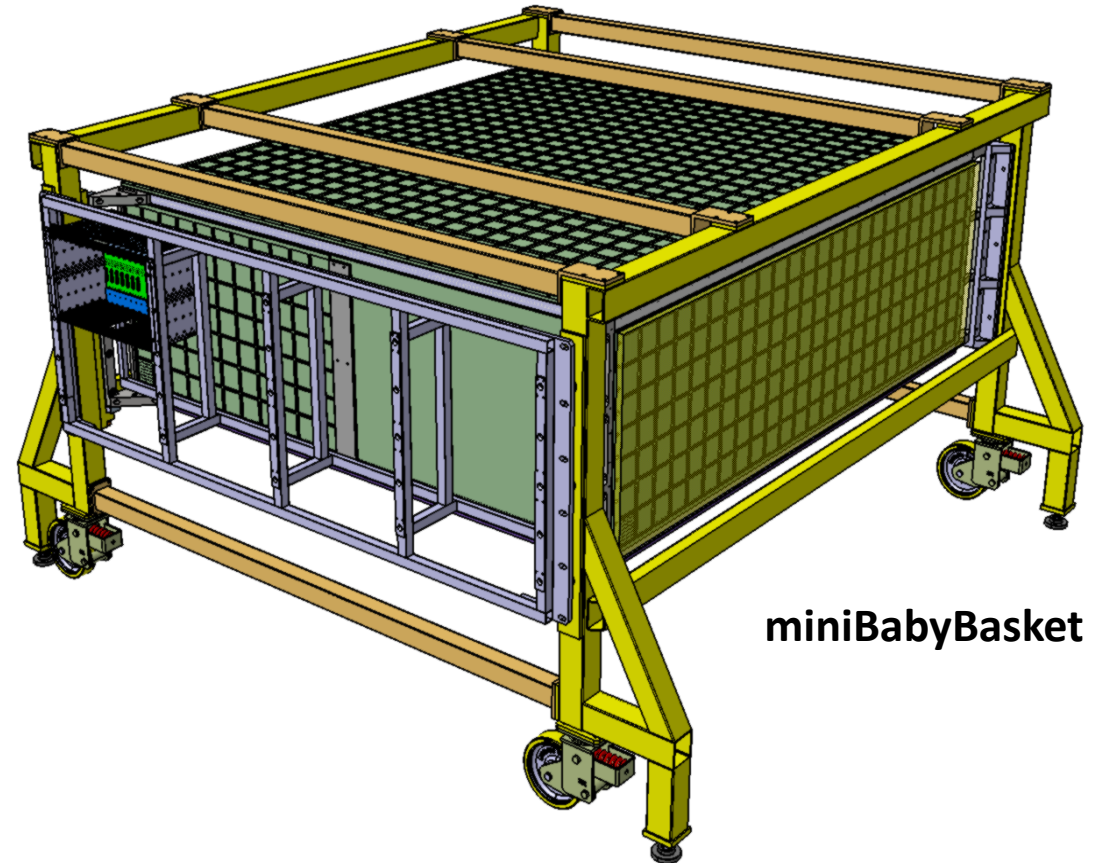
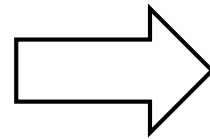
- ✓ Design looks OK both in term of deflection and Stresses (simple comparison)
- ✓ **EN AW 7075 or equivalent** (aluminum) has many advantages:
 - ✓ Machinability (stabilized material, nice cutting properties...)
 - ✓ So less expensive in term of CNC machining
 - ✓ Yield stress is high: **410 Mpa** (500Mpa as ultimate)
 - ✓ Offers a large margin of safety / our case
 - ✓ Used in space experiments (AMS02_ECAL, Dampe, POLAR...)



SFGD miniBabyBasket

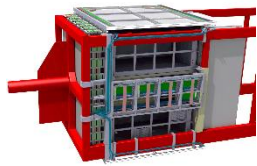


Basket

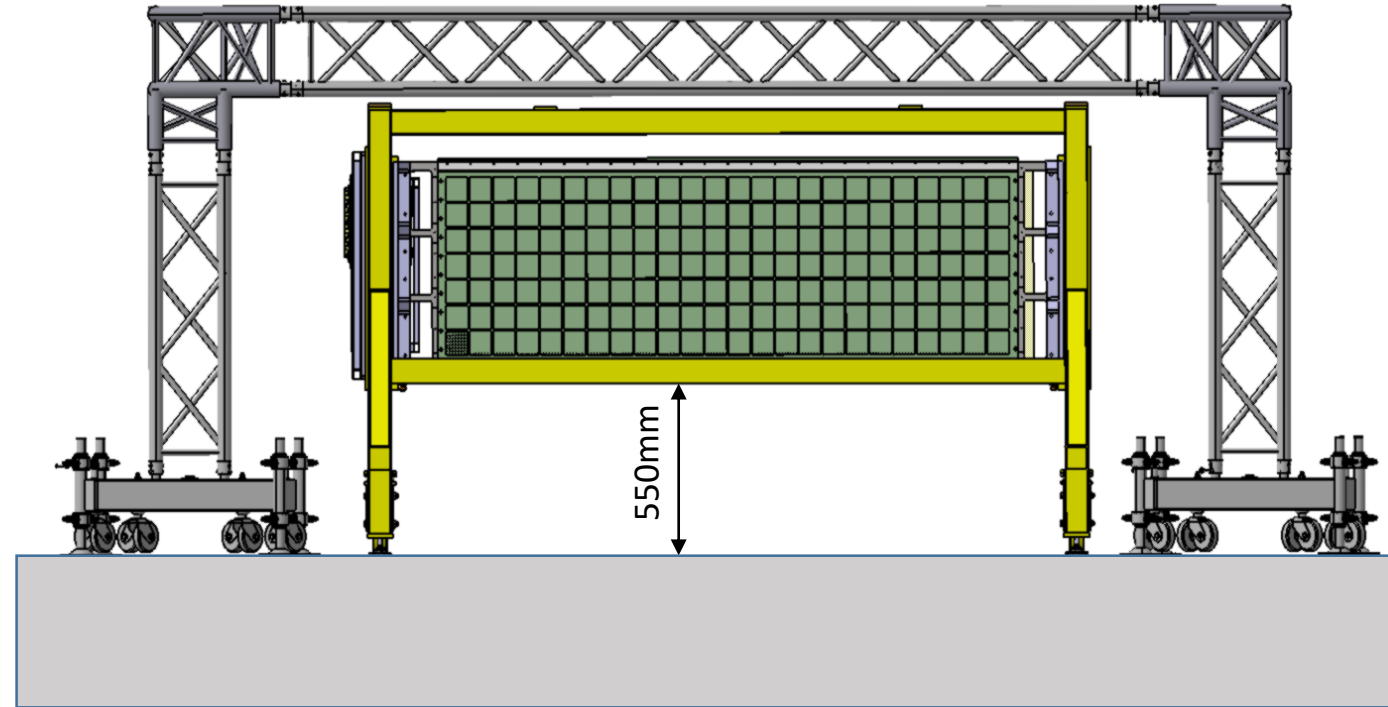
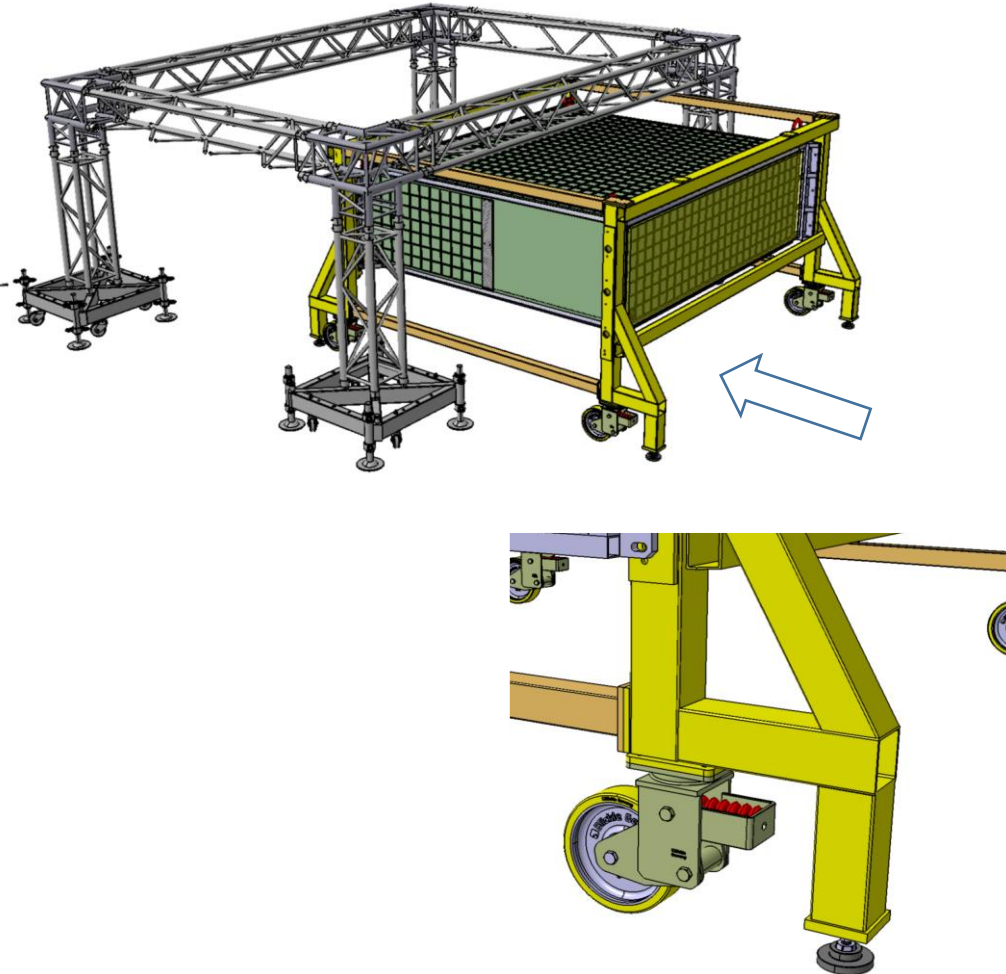


miniBabyBasket

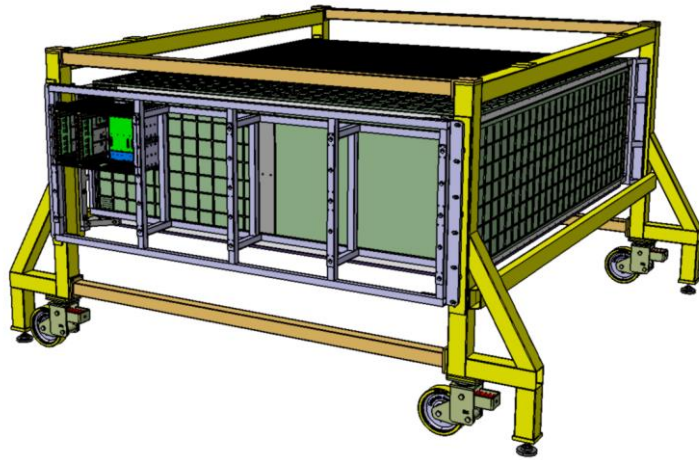
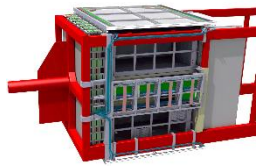
- Mimic the size of Basket (vertical beams, same I/F)
- Dismountable in parts to ease the shipment and storage
- Mix of machined pieces & welded parts (steel frames)



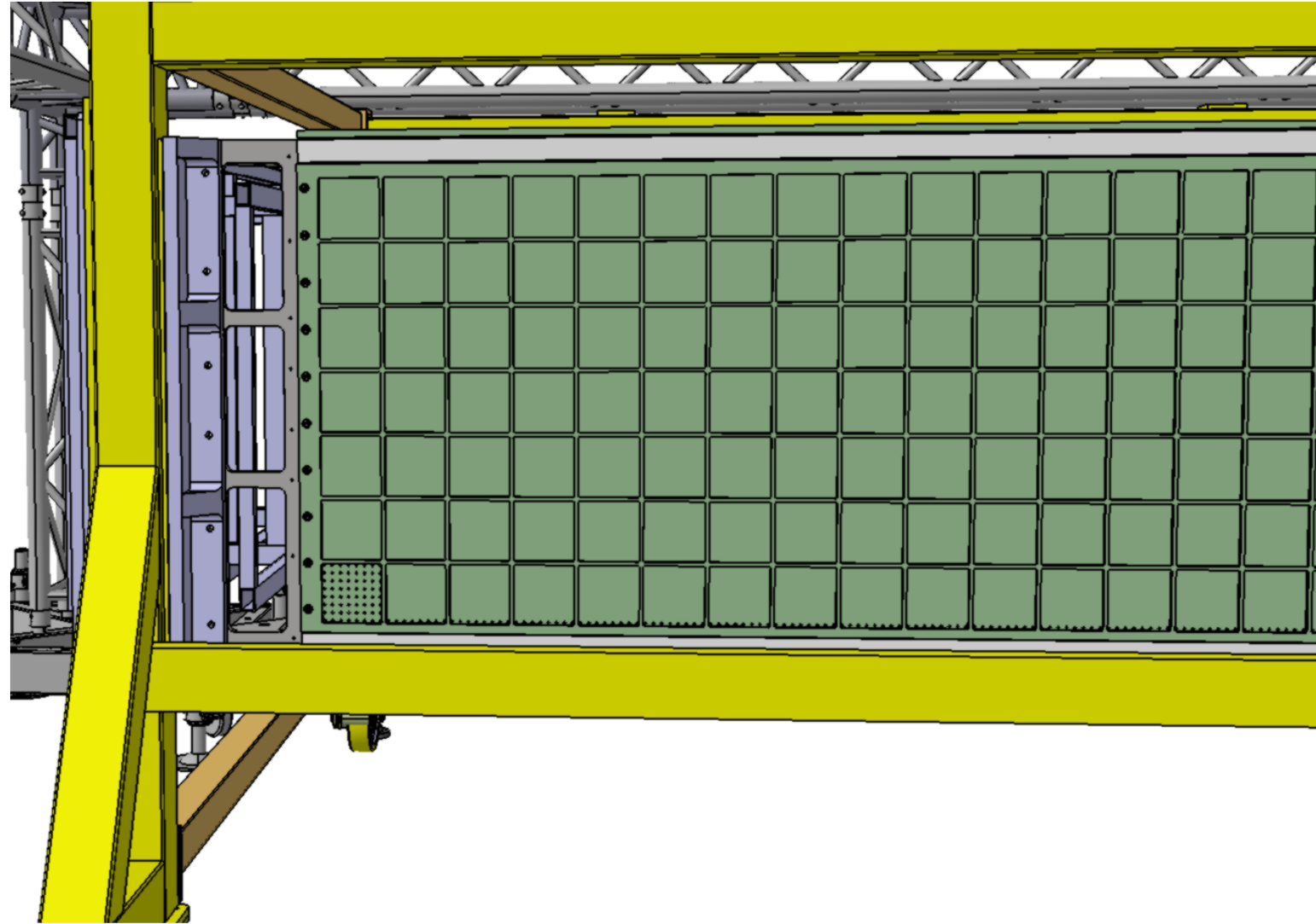
Assembly platform

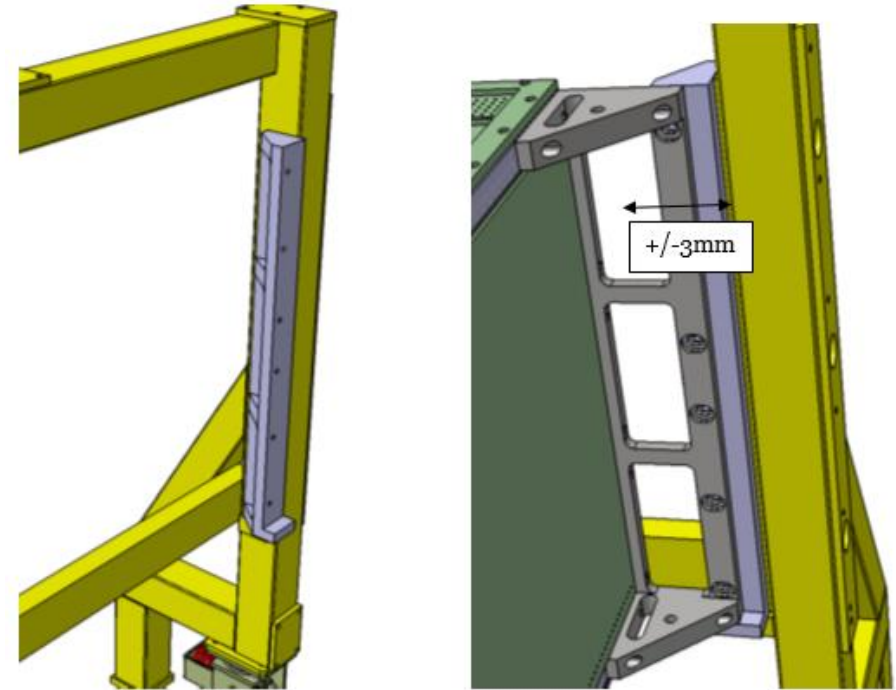
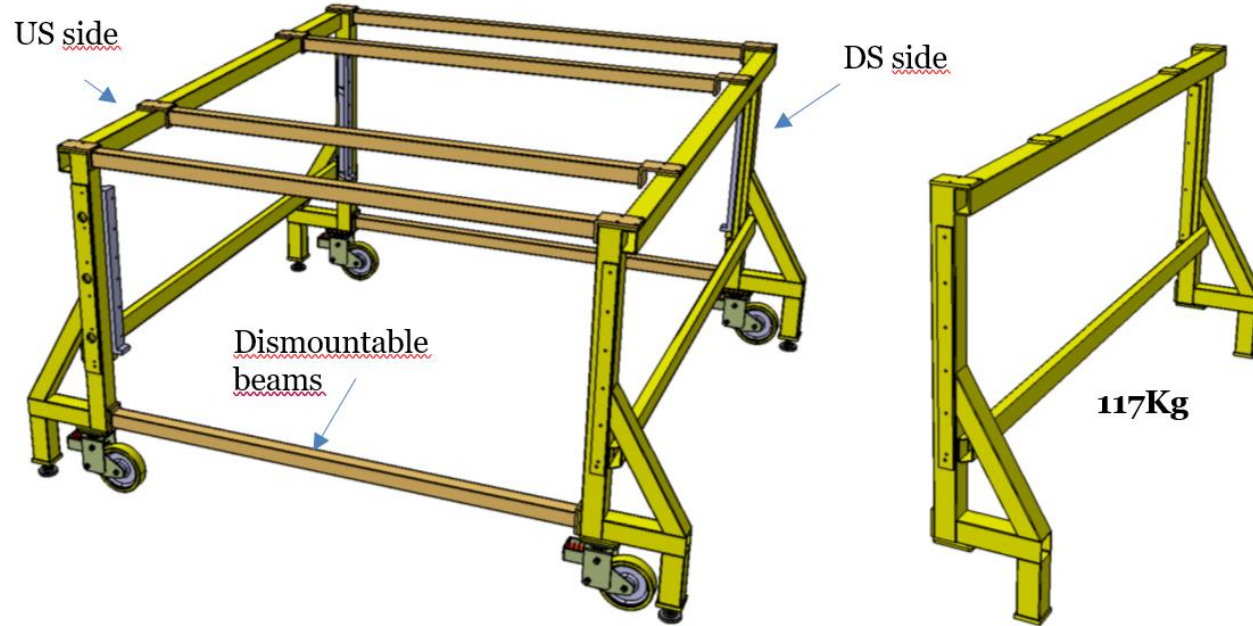
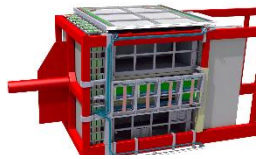


- Should slide underneath the platform
- Allow people working on bottom SFGD panel (calibration)
- Movable by wheels + stabilization on the floor (adjustable feet)



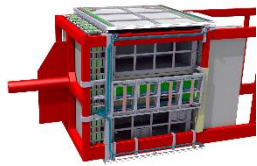
- Access is guaranteed for US/DS sides (MPPC cabling + Calibration system)
- The rest is even more accessible



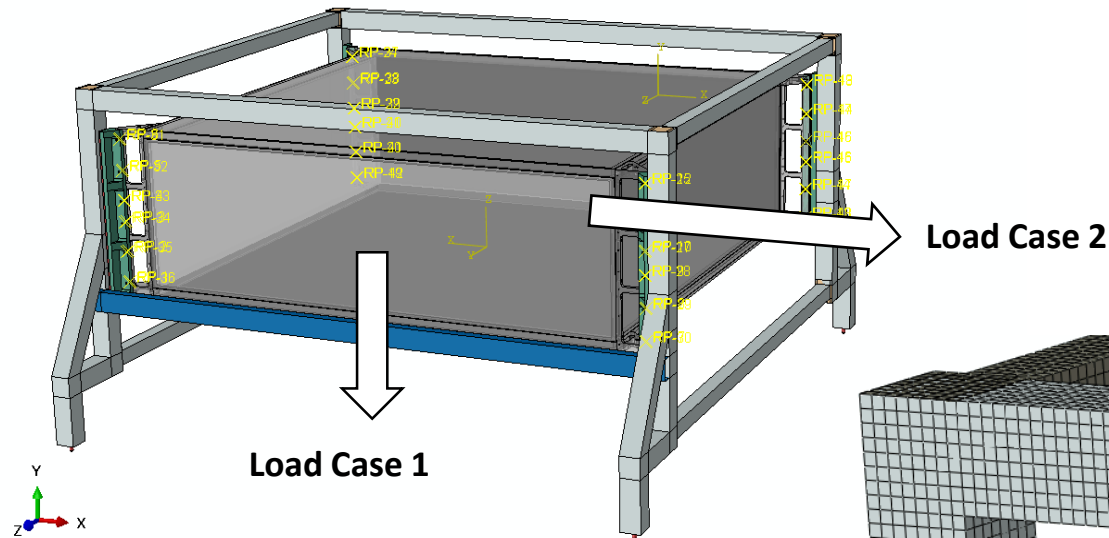


- 2 welded sub parts (US/DS)
- 6 interconnections (dismountable)
- Bracket I/F to *miniBabyBasket* are identical to final

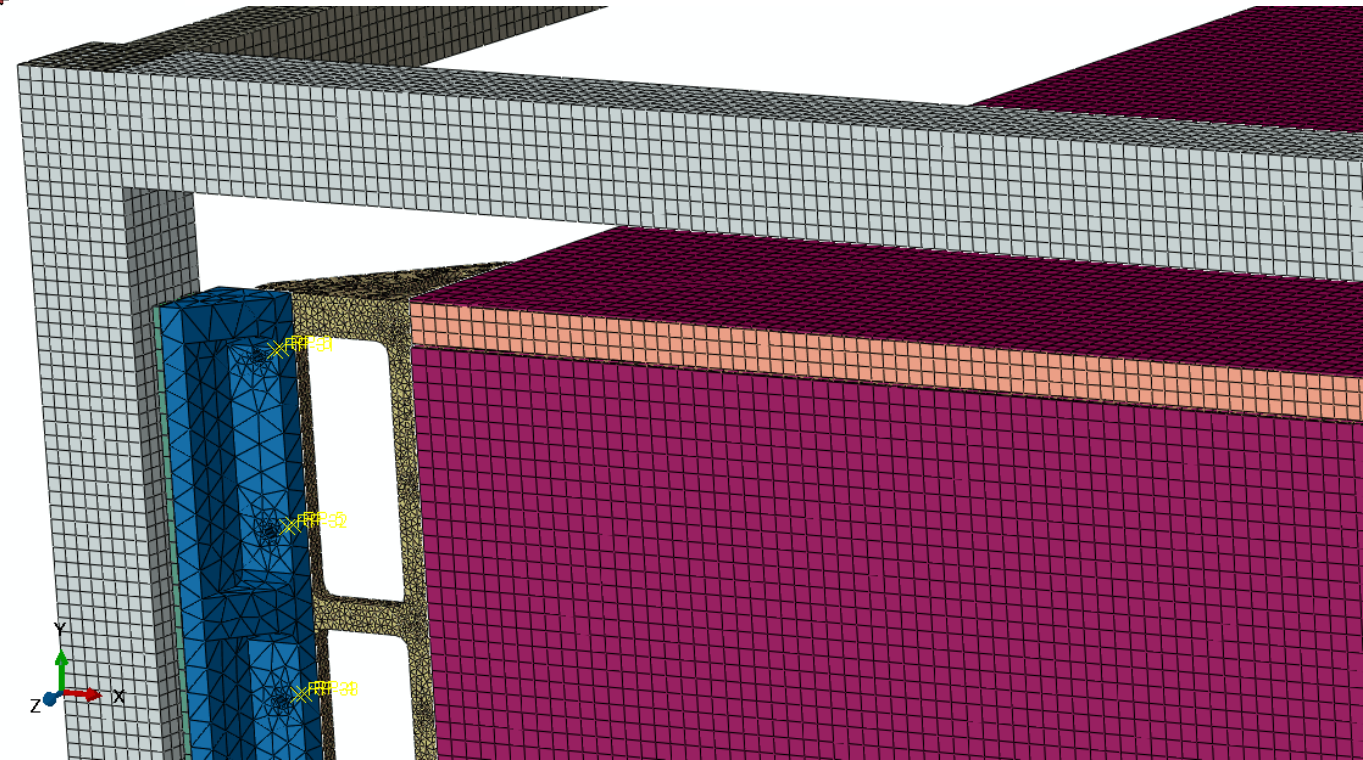




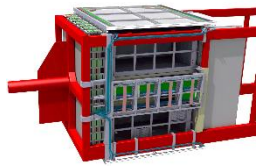
FEA analyses



Load case 1 = 1,65G / Y
 Load case 2 = 1G / Y + 0,65G / X

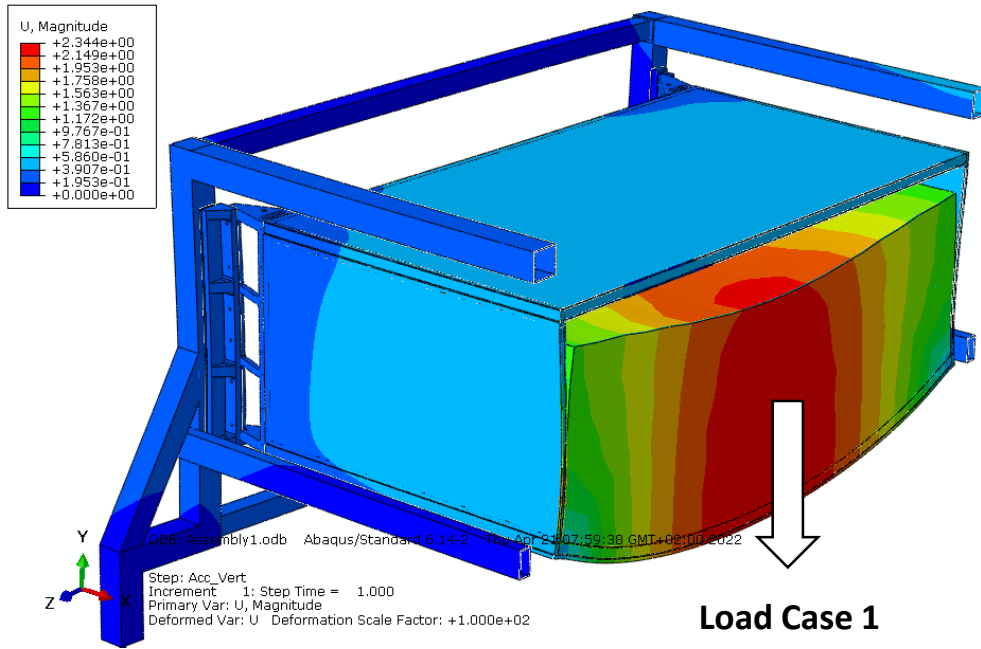


- Some fine meshing at SFGD bracket locations
- Natural frequency + loads cases (vertical + side axis)
- Based on S355 steel ($\sigma_e = 355\text{Mpa}$)

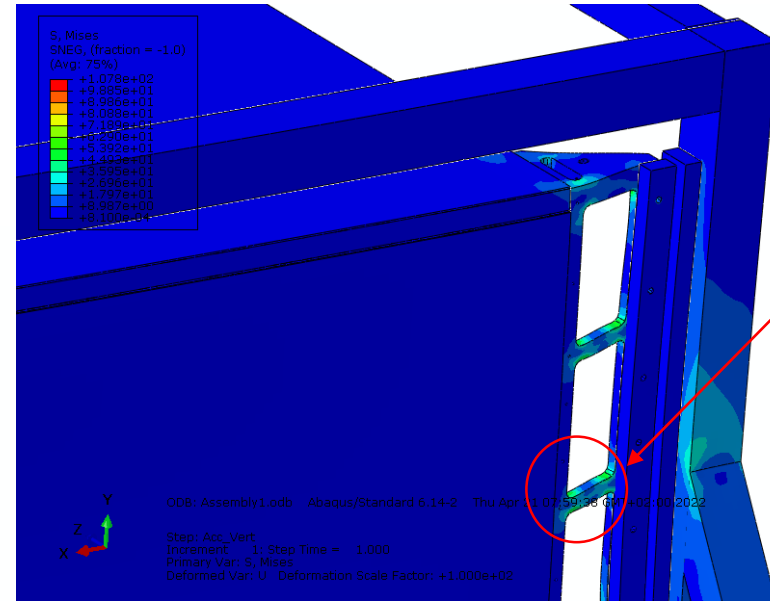


FEA Outputs (stresses and deflection... LOAD CASE#1)

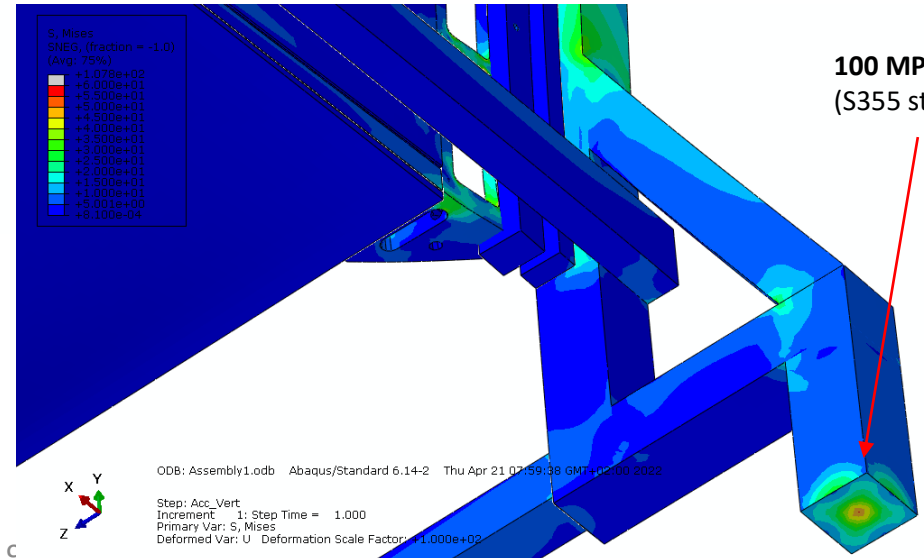
Deflection (2,5mm max)

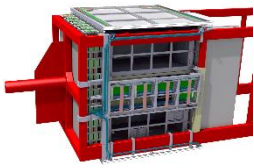


No issue stress related!



VonMises stresses





Some conclusions...

- Should decide SOON who is doing what and where ... Design OK but fabrication...??
- Easier to do the welded parts in Geneva area... (iterations with workshop)
- Plus in case we pass by EHN1 to assemble the SFGD Box... better to keep everything closeby
- Use of MiniBabyBasket @ CERN under discussion with Luiis

BACKUP

sFGD box production chain

The production is divided into the following steps

1) The following should happen in parallel...

Production of the fiberglass plates
@NEXUS (Spain)



- ✦ The fiberglass is produced at NEXUS
- ✦ Machining (cutting and milling) is done by a company in Spain sub-contracted by NEXUS
- achieve the designed tolerance

Production of CF-Foam sandwich
@CompositeDesign (Switzerland)



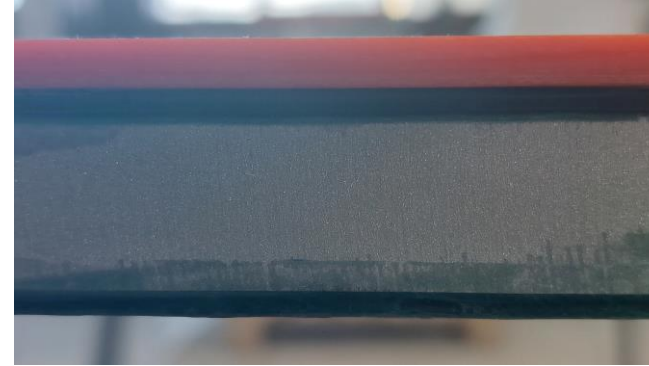
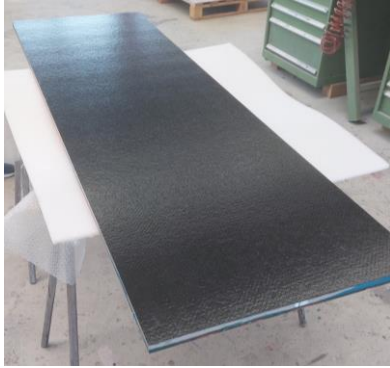
- ✦ Aluminum bars provided by ETHZ
- ✦ CompositeDesign procure CF and Foam and glue them

Eventually fiberglass and CF sandwich are at CompositeDesign for final gluing

sFGD box production chain

2)

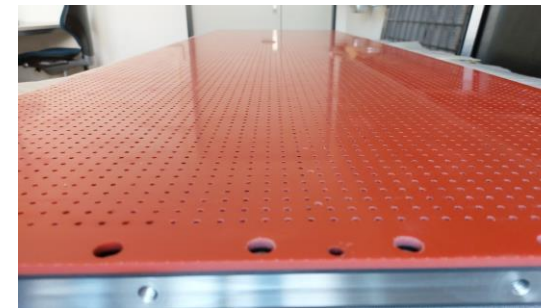
Gluing of fiberglass to CF sandwich at [@CompositeDesign](#)



Then, the box plate is sent to CIMFORM for the final machining

3)

Final drilling and machining [@CIMFORM](#)



The plate is ready for mounting the box

After each step above, QA is done in order to proceed to the step after

DownStream Panel

Ready for the box mounting

