# GST – extended till end of HGCal – static structural simulation v3

Sushrut Karmarkar, Ben Denos,
Andy Jung

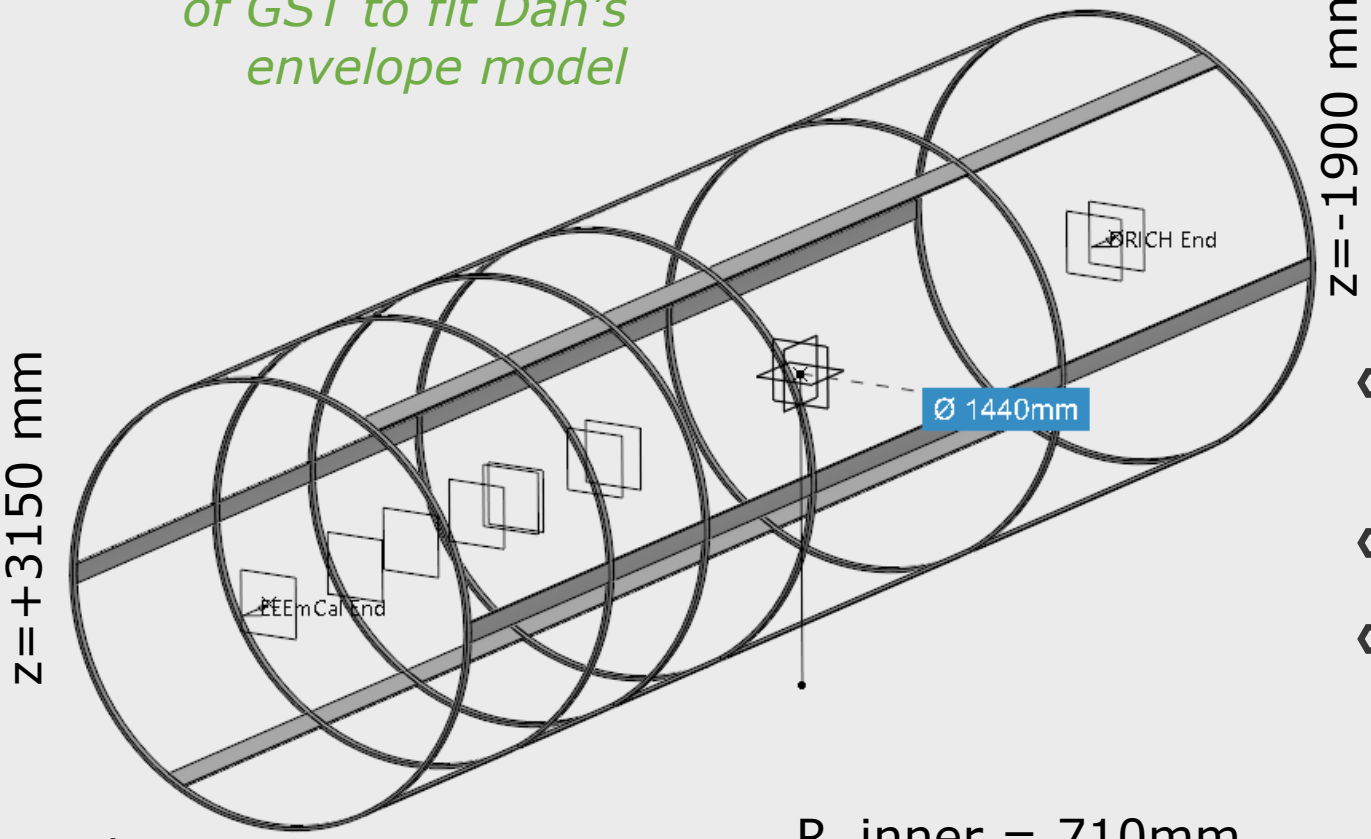
24 March 2025

# Introduction

- GST structural simulation iteration v3 with updated EEEMCal weights (2500 kg)
- ***Deformations are within 1.8 mm***
- Structural rails updated for mounting and inserting / pushing pfRICH and EEEMCal into the GST using linear bearings

# RibCage Design v2025-03

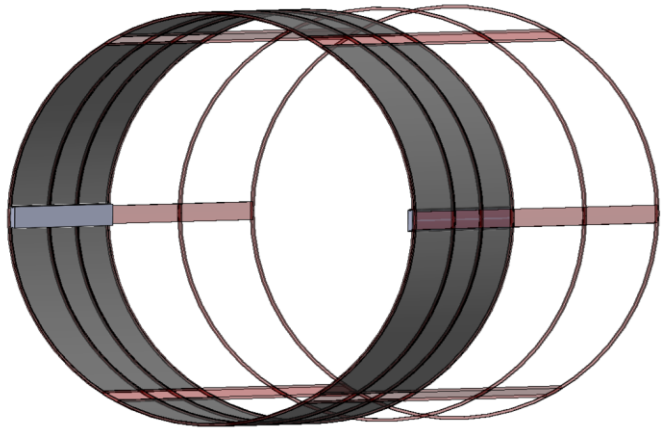
*SRK 1540-20250225 changed the end length of GST to fit Dan's envelope model*




This end is extended till Barrel HCal

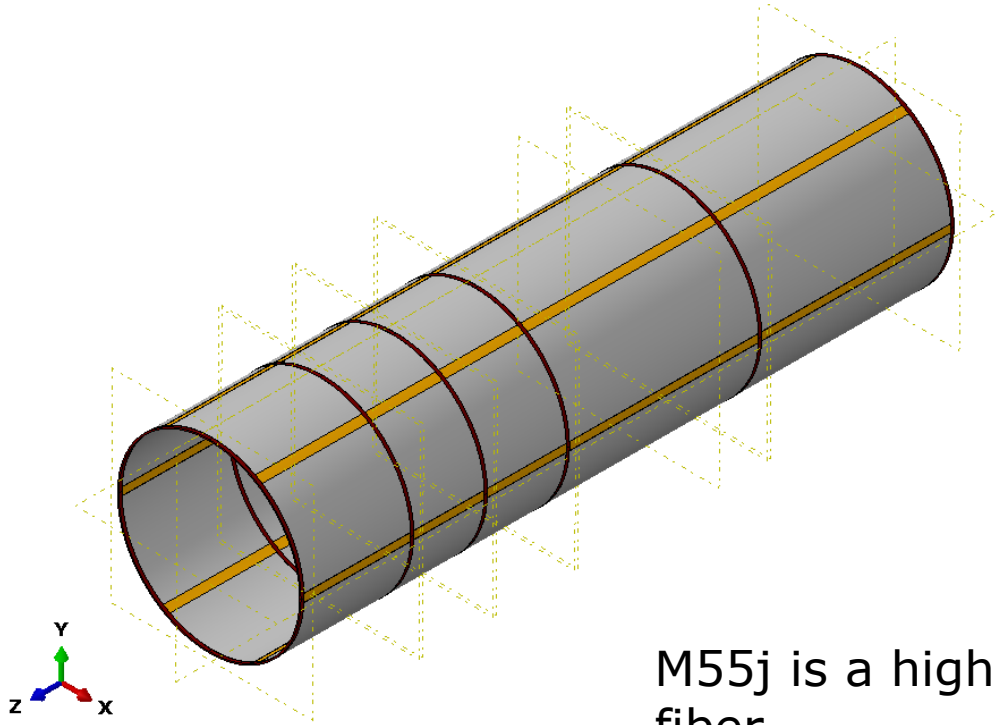
R_inner = 710mm

R_outer = 720mm

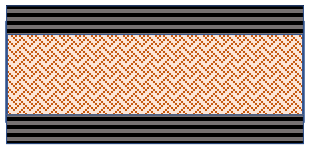


- New ribcage design has 6 load rings and 6 longitudinal stiffeners
- There are 2 end rings
- 2 rings just at the ends of EEEmCal and 1 ring at z+ end of TOF and 1 ring at the mid plane of TOF

# Material and Section Details




M55j is a high modulus fiber
Patz-F6 is a cyanate ester resin system



Facesheet = 2mm thick
HoneyComb = 6 mm thick (1/4 inch)
Facesheet = 2mm thick

- Section assignment – Rings – Beams and Sandwich Panel

Sandwich Panel

Name: SandwichPanels_Nomex
Type: Solid, Composite
Layup name:
Symmetric layers

| Material | Element Relative Thickness | Orientation Angle | Integration Points |
|---|---|---|---|
| M55j F6 | 2 | 0 | 1 |
| Nomex-HoneyComb | 6 | 0 | 1 |
| M55j F6 | 2 | 0 | 1 |

End_Rings for GST

Name: ERings_Solid
Type: Solid, Composite
Layup name:
Symmetric layers

| Material | Element Relative Thickness | Orientation Angle | Integration Points |
|---|---|---|---|
| M55j F6 | 1 | 0 | 1 |
| M55j Patz F6 UD | 5 | 0 | 1 |

Longitudinal Beams

Name: Beams_UD
Type: Solid, Composite
Layup name:
Symmetric layers

| Material | Element Relative Thickness | Orientation Angle | Integration Points |
|---|---|---|---|
| M55j Patz F6 UD | 1 | 0 | 1 |
| M55j Patz F6 UD | 1 | 0 | 1 |

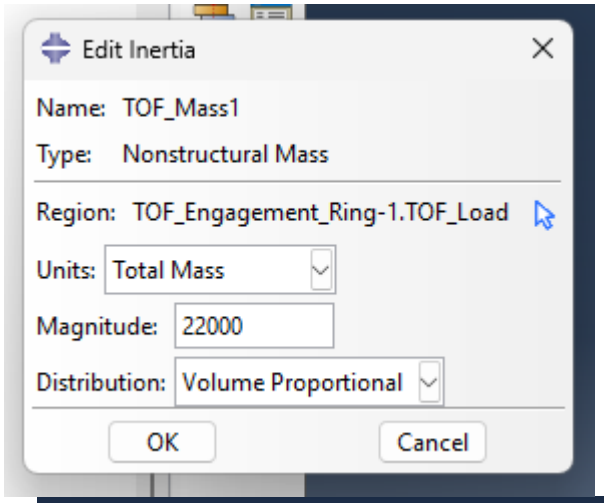
Engagement Ring

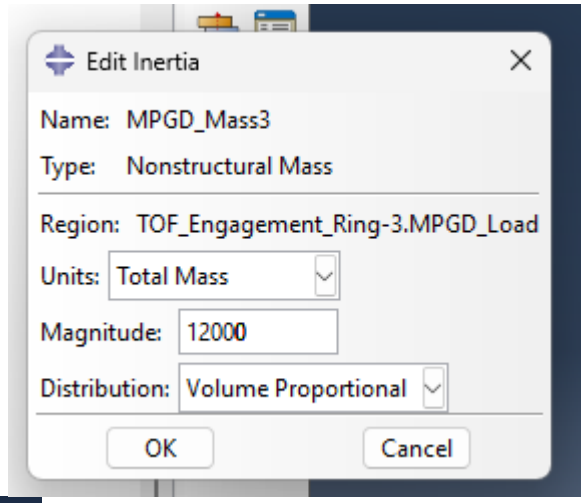
Name: EnDRing
Type: Solid, Composite
Layup name:
Symmetric layers

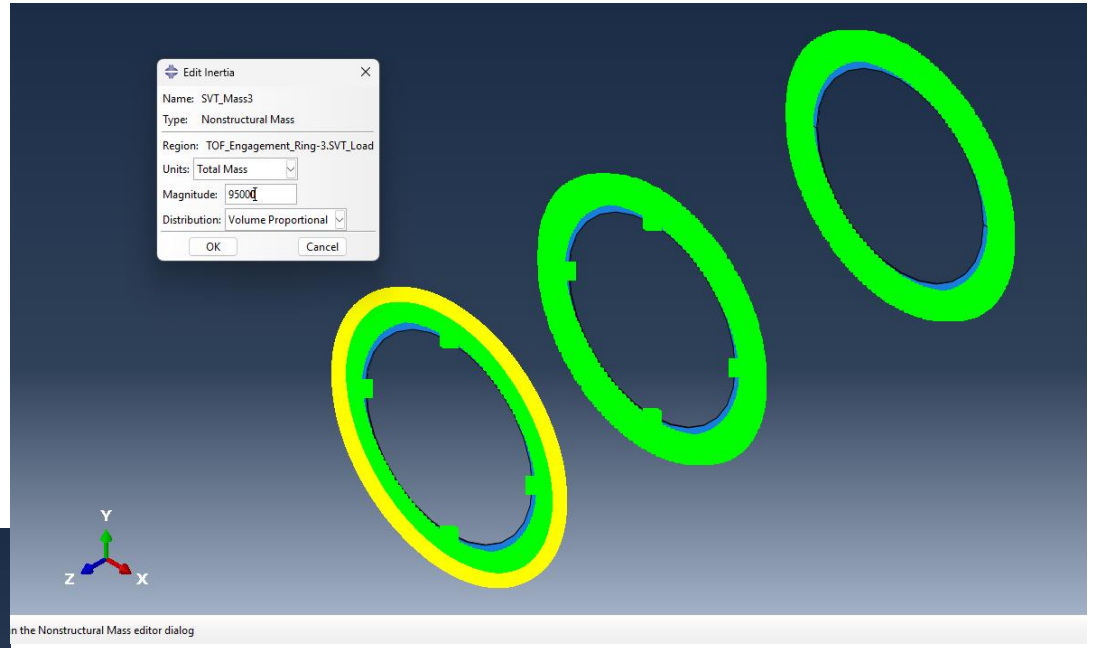
| Material | Element Relative Thickness | Orientation Angle | Integration Points |
|---|---|---|---|
| M55j F6 | 1 | 0 | 1 |
| M55j F6 | 1 | 45 | 1 |
| M55j F6 | 1 | -45 | 1 |
| M55j F6 | 1 | 90 | 1 |

# Loads –

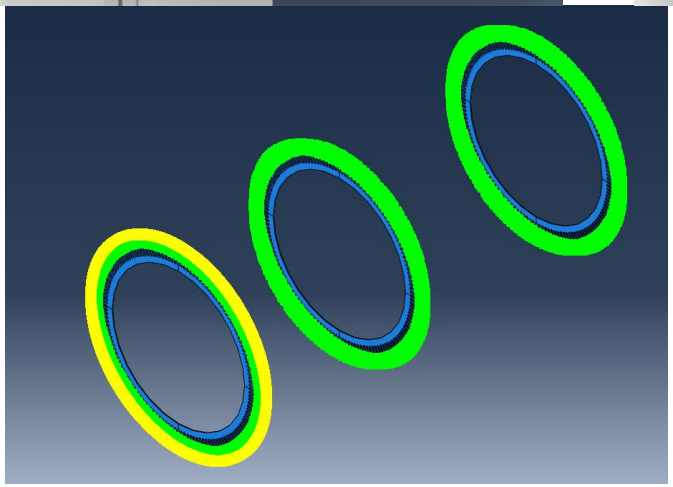
Mass is in grams – (magnitude part here)



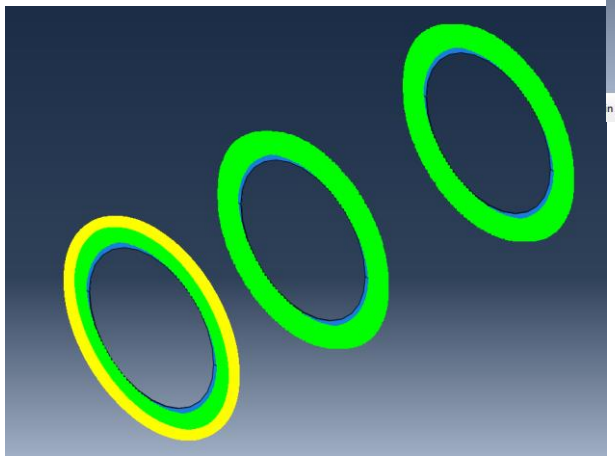




SVT – 285 kgs

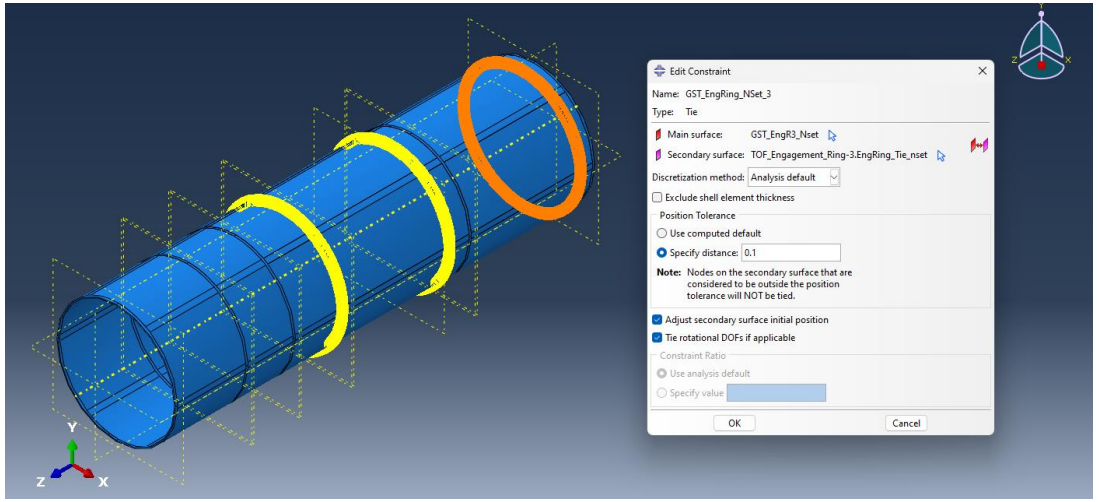


TOF Mass – 66kgs

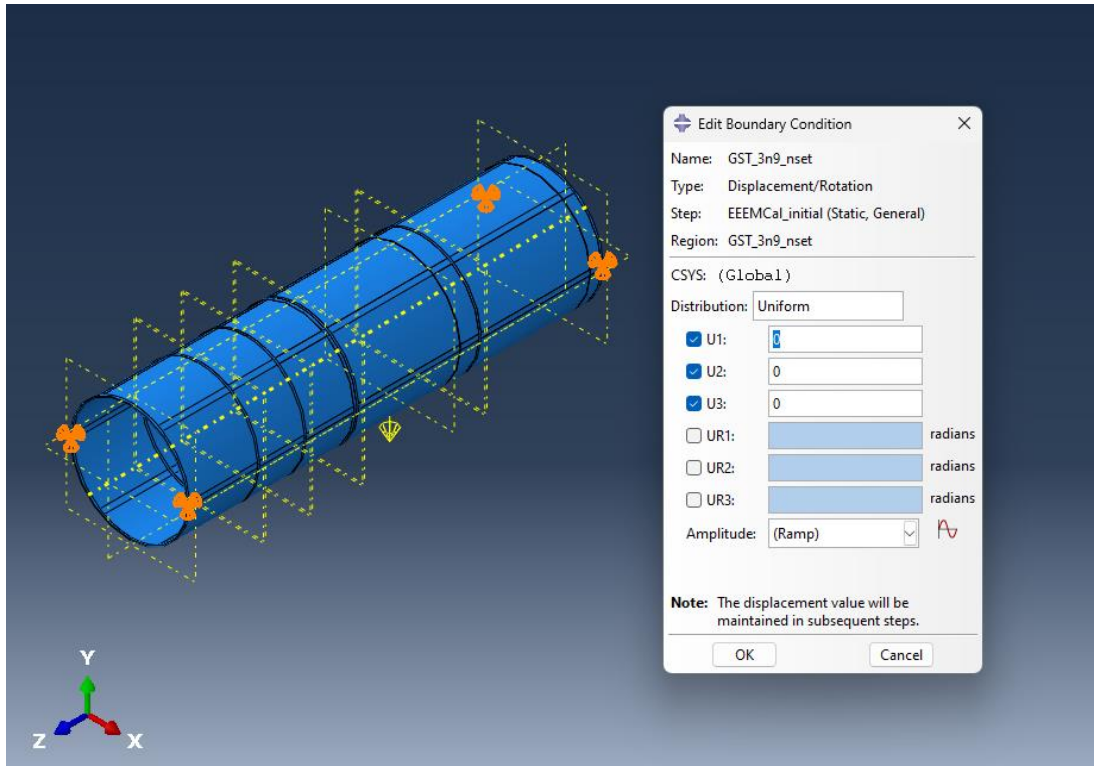


InnerMPGD – 36 kgs

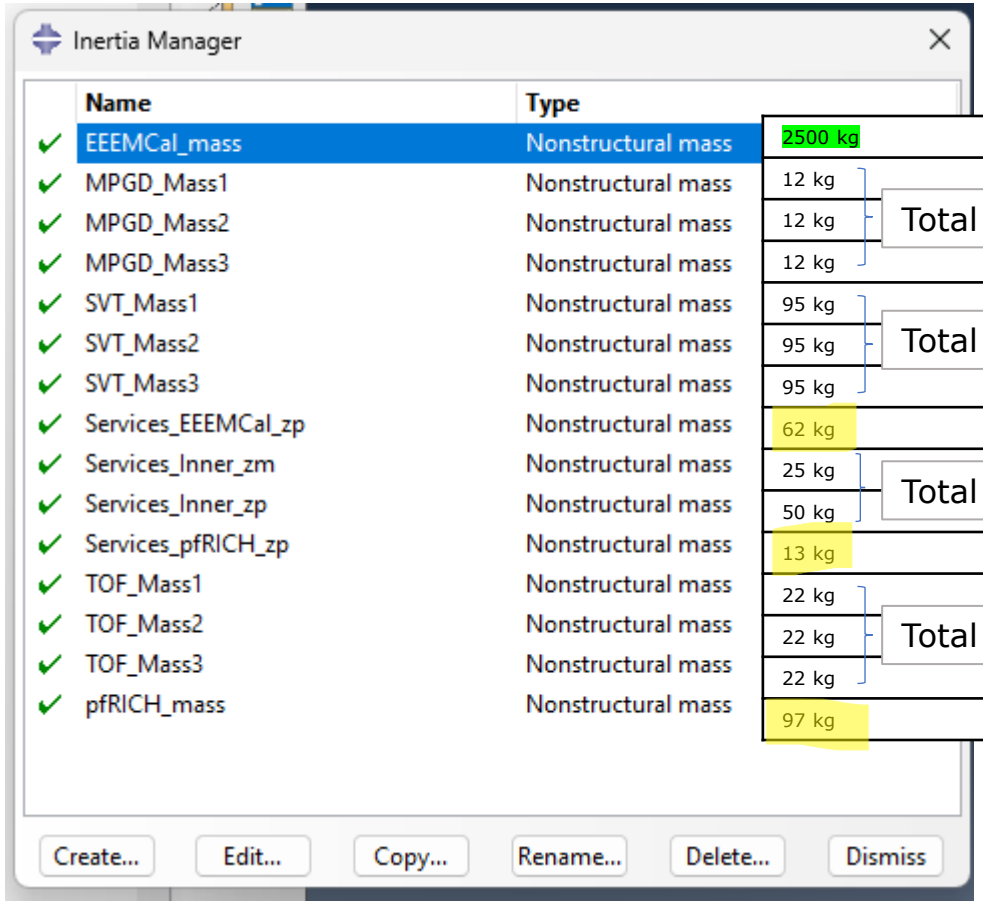
# Tie constraints EngRing (secondary) and GST (primary)



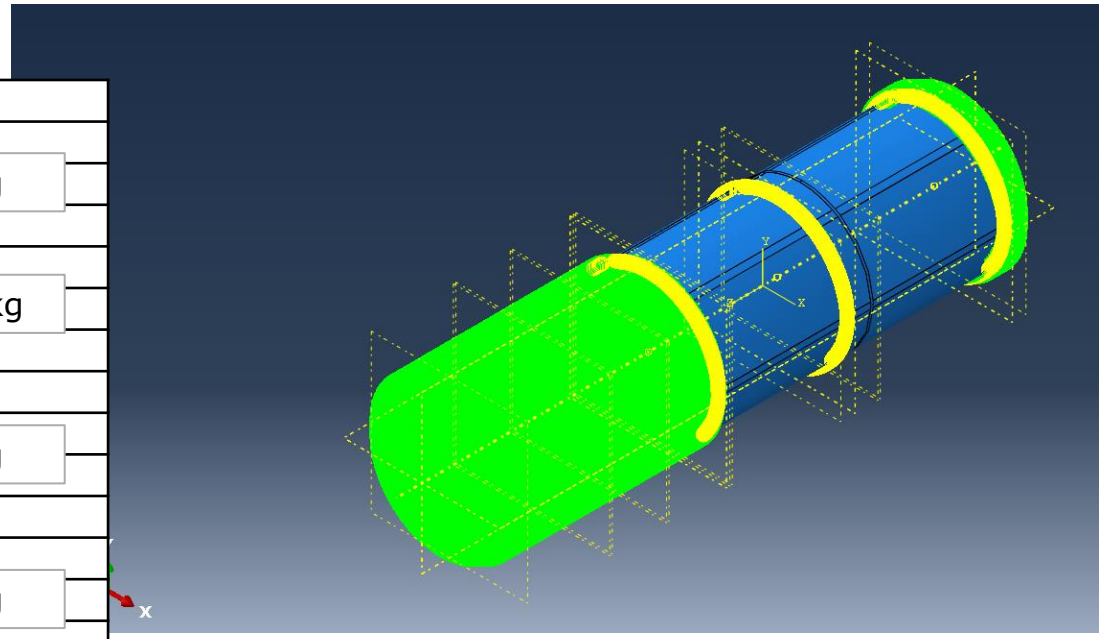

Global BC



# Loads – GST – approximated numbers as a starting point



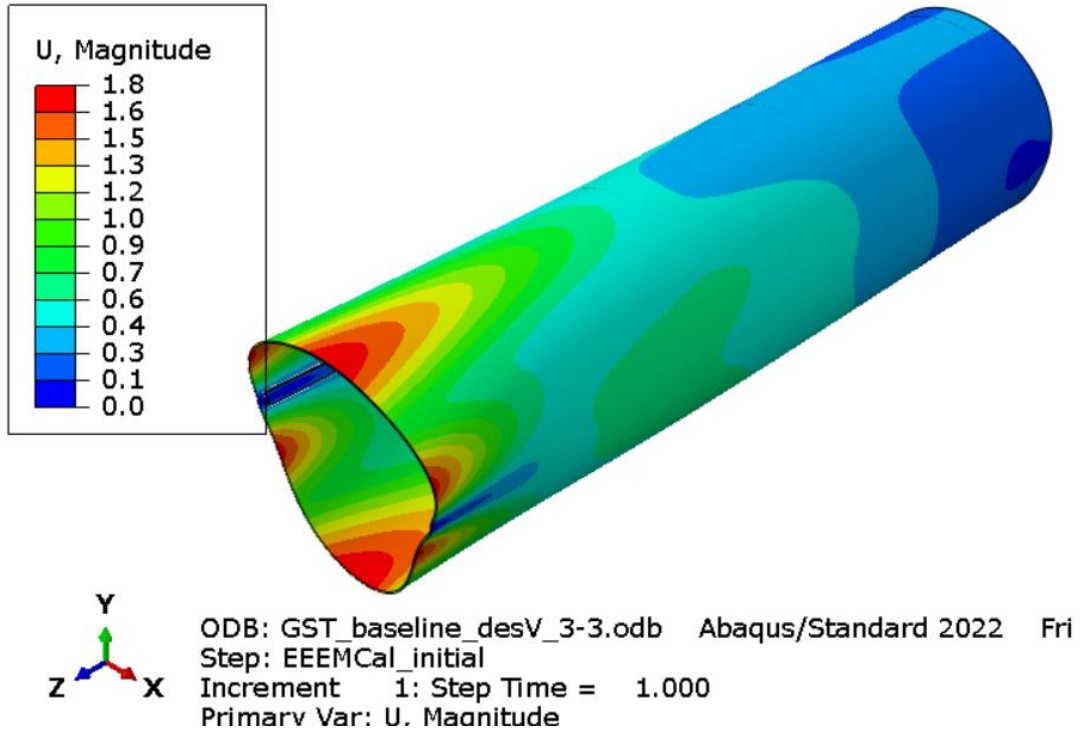

2500 kg
12 kg
12 kg
12 kg
Total = 36 kg
95 kg
95 kg
95 kg
Total = 285 kg
62 kg
25 kg
50 kg
Total = 75 kg
13 kg
22 kg
22 kg
22 kg
Total = 66 kg
97 kg

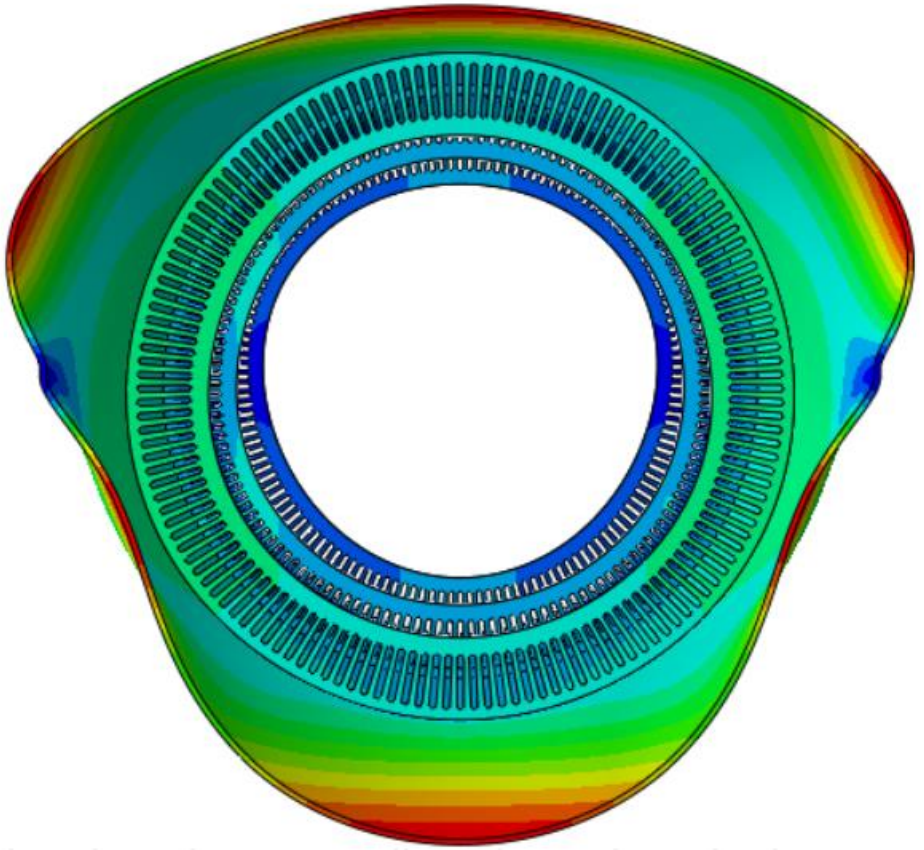


```
The set 'Services_GST_zm' has been created (7616 elements).
The set 'Services_GST_Inner_ZP' has been created (91840 elements).
The set 'Load_EEEMCal_eset' has been created (660 elements).
The set 'Load_EEEMCal_eset_Lower4' has been created (3960 elements).
The set 'Load_EEEMCal_eset_3n9' has been edited (1980 elements).
The set 'Load_pfRICH_eset_3n9' has been created (2088 elements).
The set 'Services_GST_pfRICH_ZP' has been created (65856 elements).
The set 'Services_GST_EEEMCal_ZP' has been created (38528 elements).
```

*Note – eeemcal weight updated – SRK 1100-20250321*

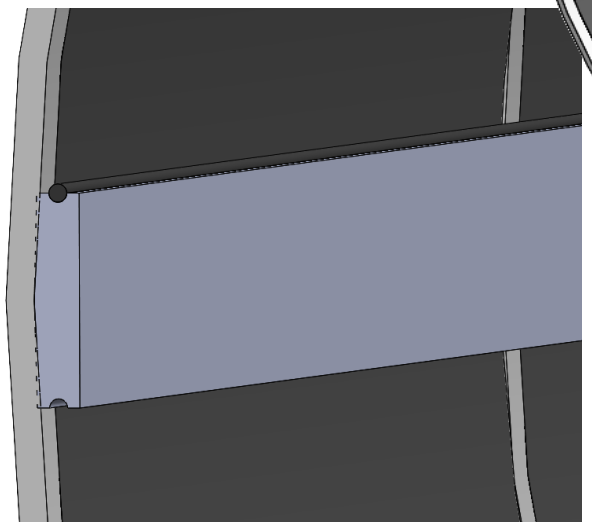
# Updated weight of the EEEMCal

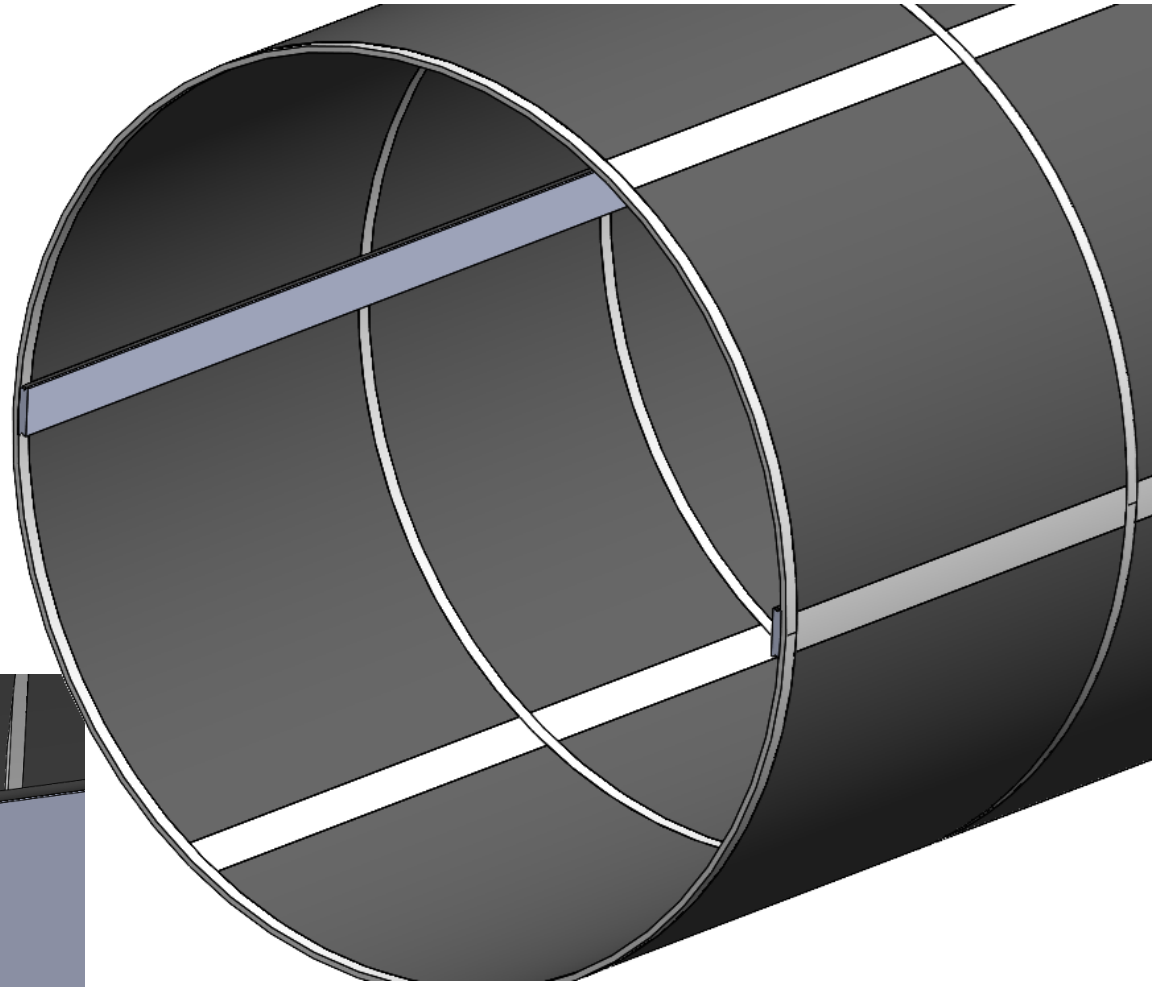


X50 deformation for visualization

# First iteration and concept of rails at 3 and 9 o'clock



# Summary and next steps

- Integrating the rail into the GST structure provides the necessary stiffness to support the EEEMCal and the inner detectors.
- Iterations on the changed geometry of the engagement ring – coupled structural simulations.
- Mounting concepts for the discs for SVT and MPGD