Global Support Structure (GST) and interfaces

17th December 2025

Andreas Jung, Sushrut Karmarkar, Ben Denos

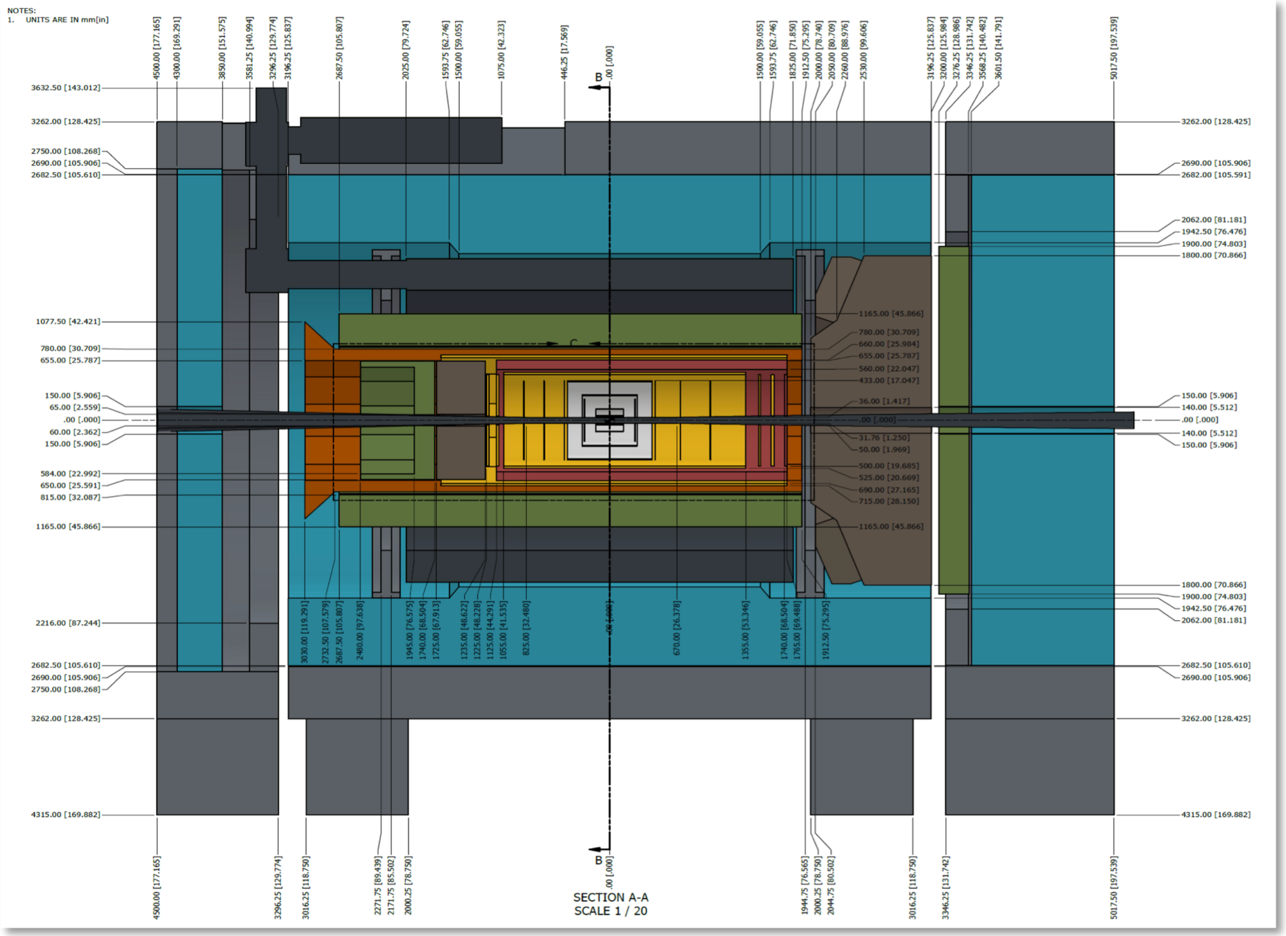
EPIC SVT workshop, Oxford University

PURDUE UNIVERSITY

Outline

Charge 1, 4

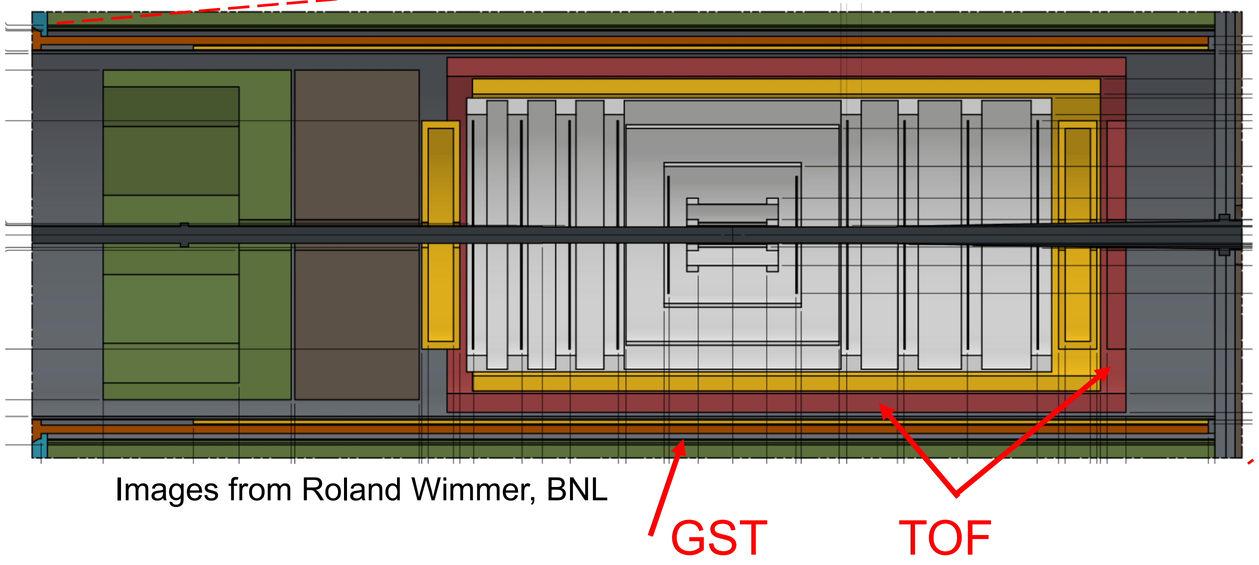
- Introduction
- TOF-LGAD mechanics
  - LGAD-TOF Barrel and Discs
  - TOF tray Integration
- Global Support Tube
  - Design
  - Envelopes & Loads
  - FEA simulations
- Integration & Assembly
  - Inner Detectors + GST
  - For PST+SVT: see Ben's talk
- QA/QC, ES&H
- Summary



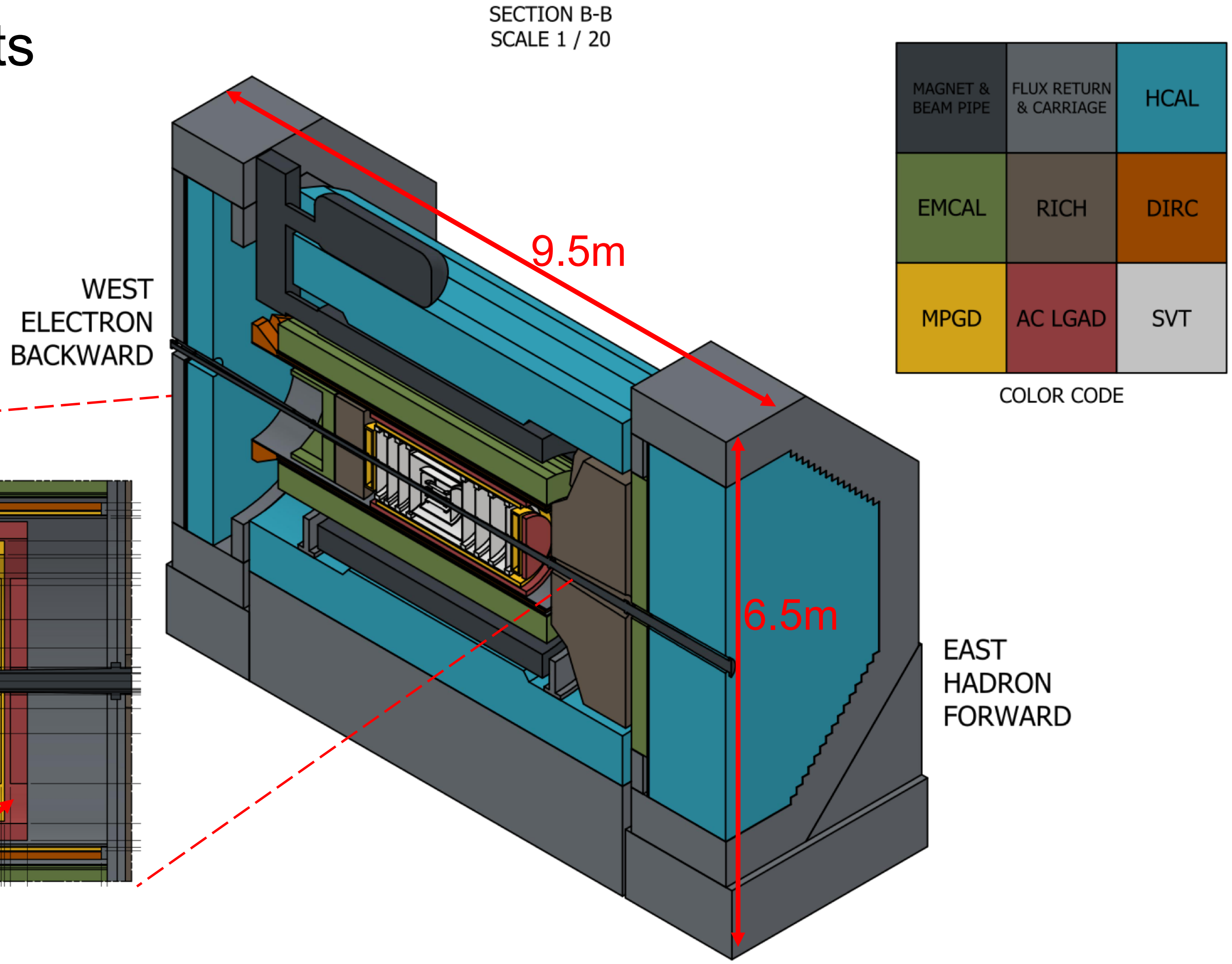
Introduction to Support Structure

Charge 1, 4

- Global Support Tube (**GST**) supports all inner detectors: DIRC, MPGD, TOF, Silicon, EEEMCAL, pfRICH
- Time-of-Flight (TOF) aka AC-LGAD
  - Detectors and services supported by Global Support Tube (**GST**)



Images from Roland Wimmer, BNL

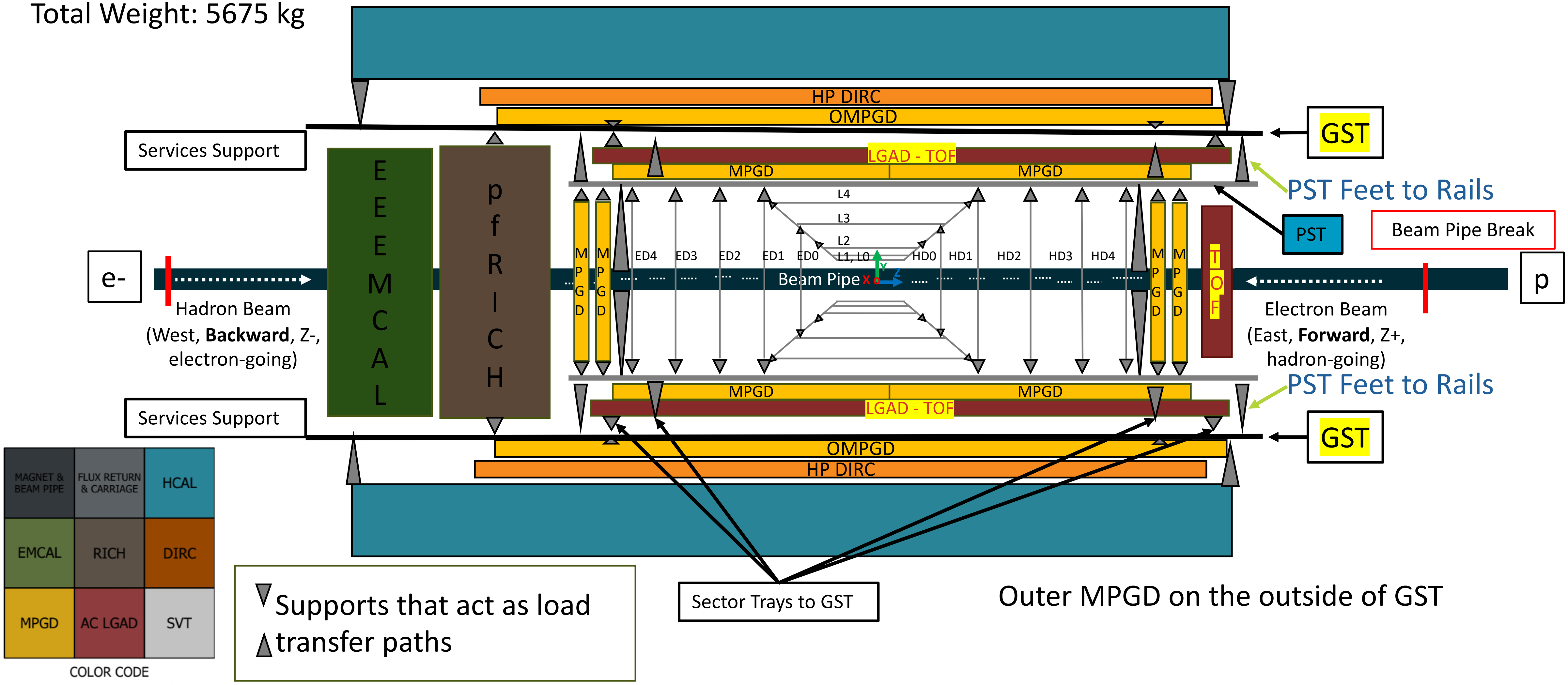


Inner Detector Support Hierarchy Y-Z View - Oct 2025

NOT TO SCALE

Charge 1, 4

- All masses are on slide 20 of this talk, details on SVT mass are in B. Denos talk
- Total Weight: 5675 kg



Outer MPGD on the outside of GST

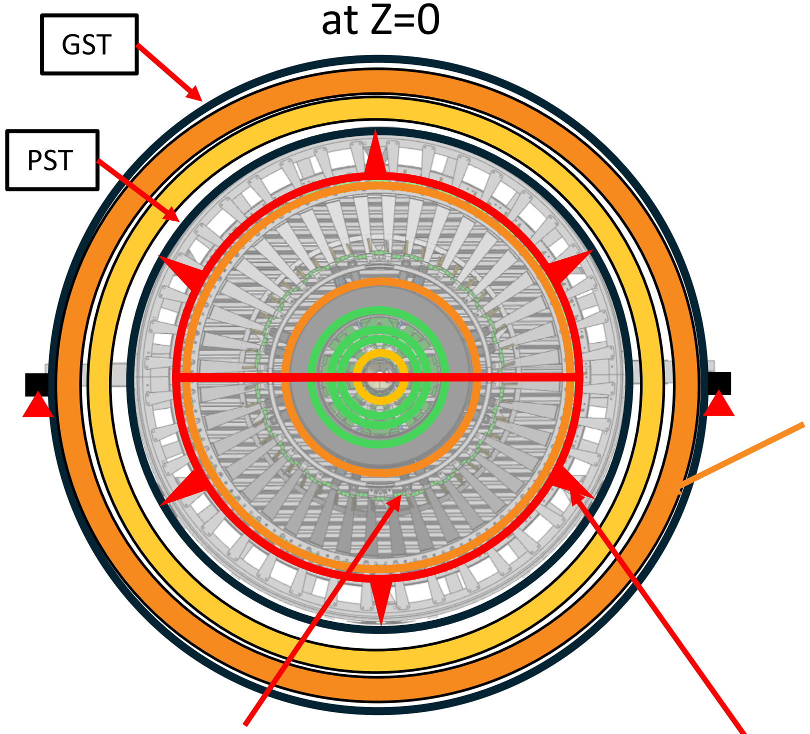
Inner Detector Support Hierarchy X-Y View - Oct 2025

NOT TO SCALE

Charge 1, 4

To ease maintenance and integration the inner detectors (TOF, i- and o-MPGD) follow a 30 degree segmentation!

Detector View
at Z=0



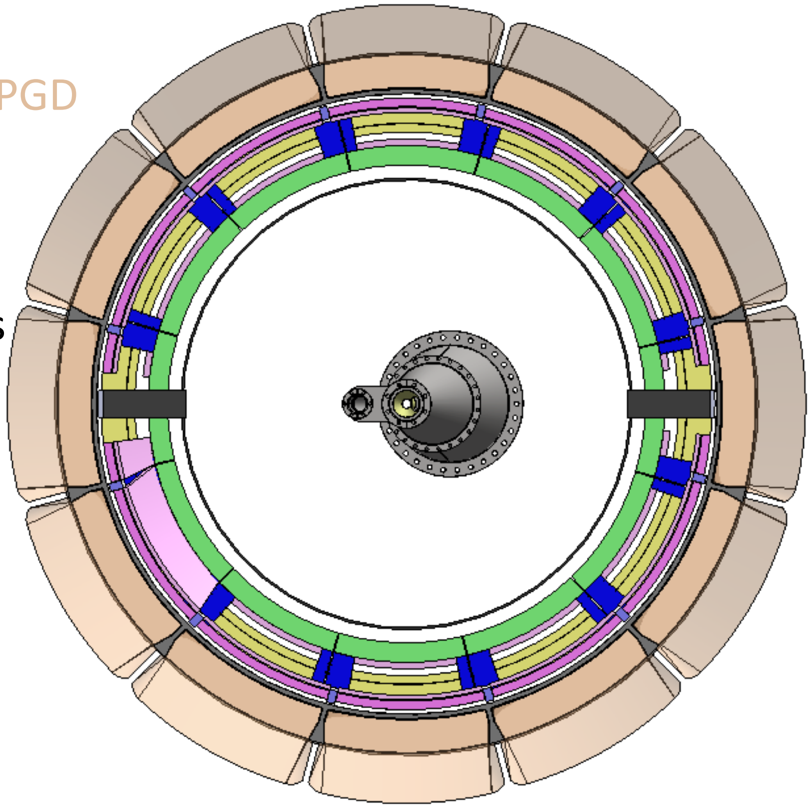
Key:
Beam Pipe
SVT Inner
Outer Barrel
SVT Disks
Inner MPGD
TOF Barrel
Composite Support Tube/s

▲ Support
■ Rail

Barrel connection radial "cone" attachments seen in gray

3 connections per SVT half-disk to PST

Key:
hpDIRC Prism
hpDIRC & oMPGD
Services
Barrel TOF
iMPGD
Support tubes
- GST & PST



GST supports (provides adjustability)

Beampipe support plates via PST (Details in B. Denos' talk)

Presentation Section 1:
Brief Overview of Sub-detector Mechanics
(all supported by GST)

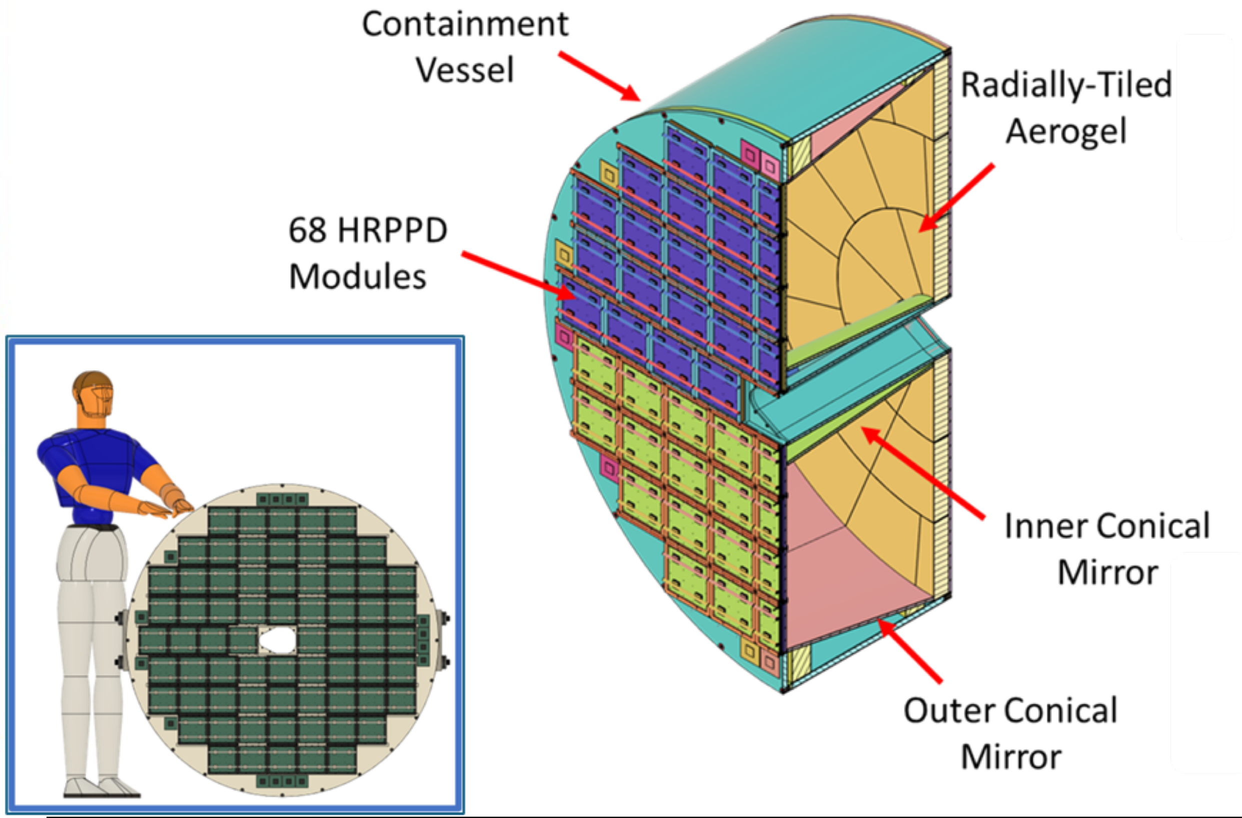
pfRICH Design

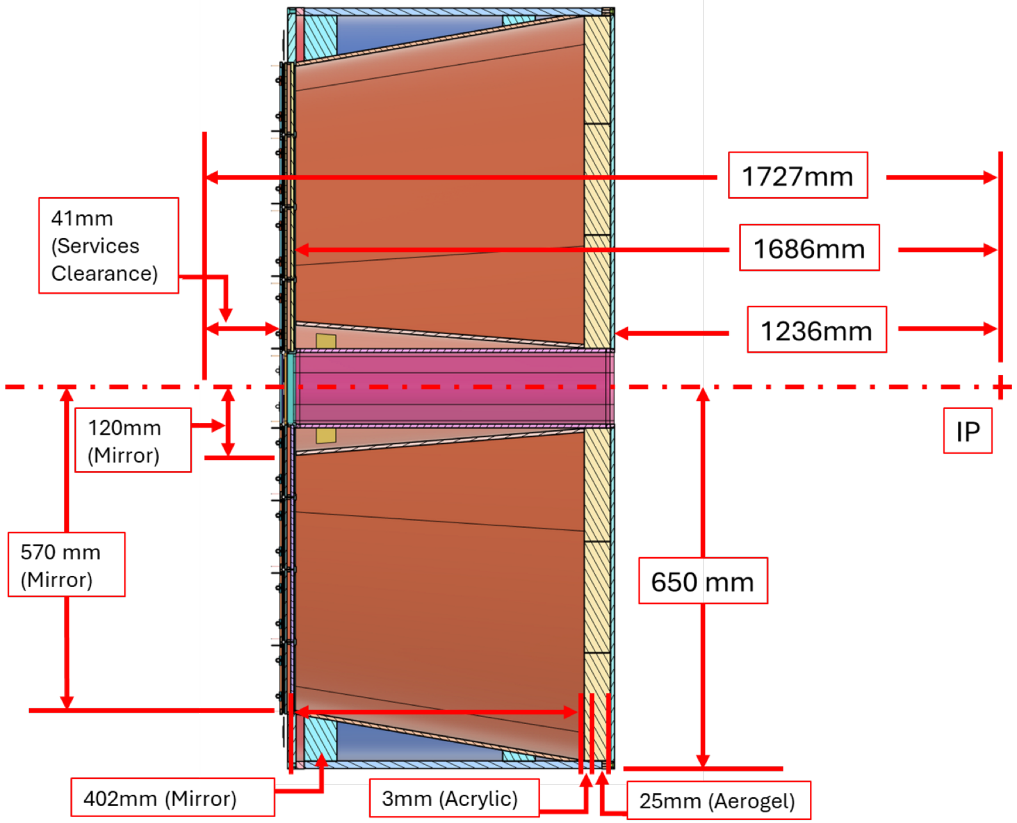
Chosen as a technology baseline for ePIC in April 2023

Major Components:

- Vessel
- Sensor Plane
- Mirrors
- Aerogel Wall

- Shape: 1/2” thick cylinder (12.7 mm)
- Outer Diameter: 1300 mm
- Length: 491 mm
- Precision: < 1 mm radius and length
- Technology: Carbon-fiber composite material with nomex honeycomb core

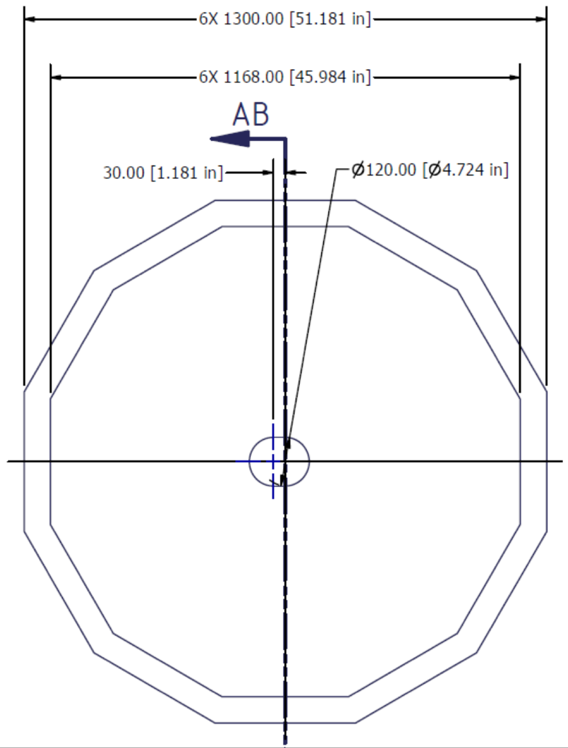


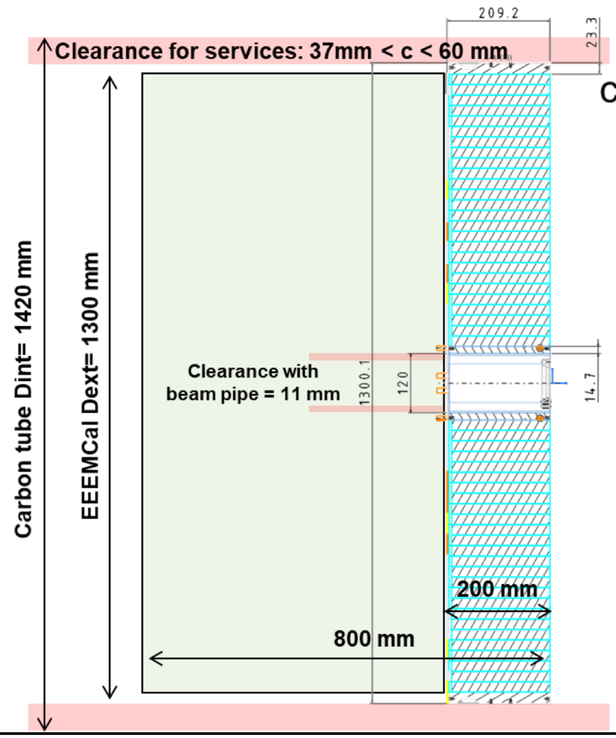


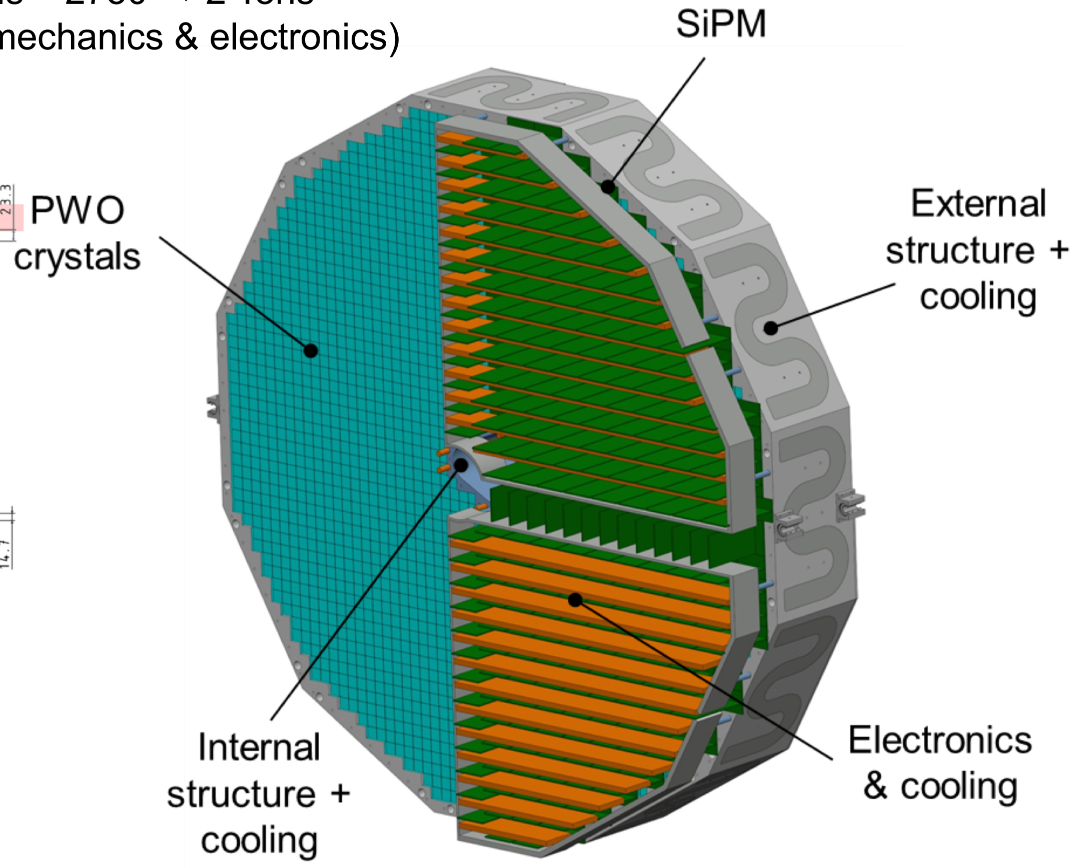
EEEMCAL Detector Design

Major components:
- PWO crystals
- External structure (Cooling, FSW coldplates)
- Internal structure (Cooling, copper tubes)
- Front copper plate (Passive cooling)
- Electronics (SiPM + Front end)

Dimensions:
- Outer diameter = 1346 mm (R673 mm)
- Inner diameter = 120 mm
- Length max (with electronics and cables) = 800 mm
- Crystal ≈ 700g / Nb of crystals ≈ 2750 → 2 Tons
- Total mass ≈ 2,5 Tons (with mechanics & electronics)



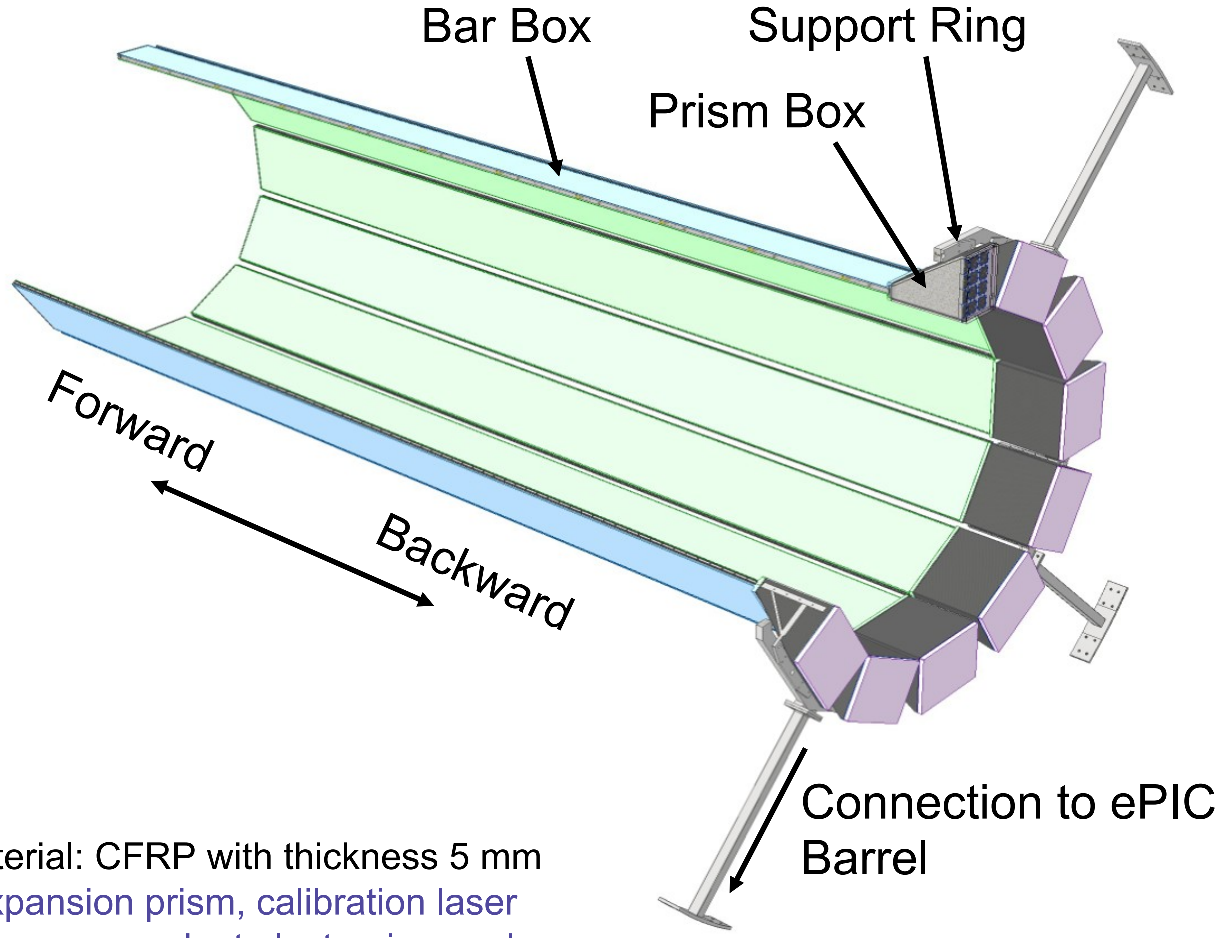


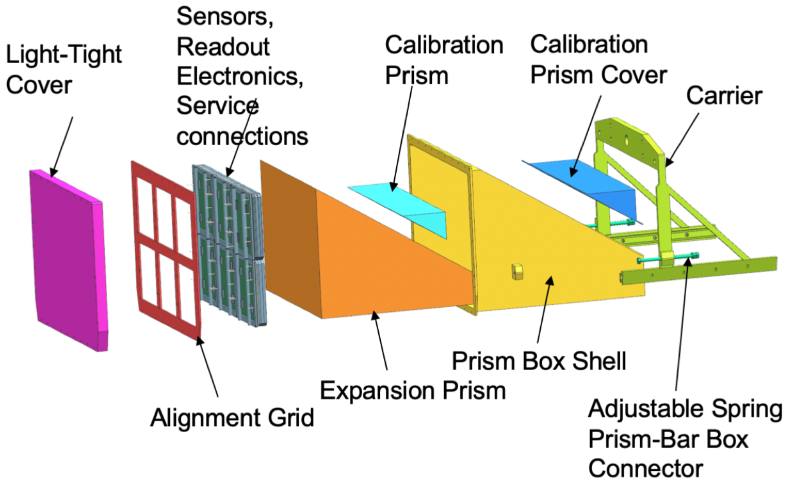


hpDIRC Detector Design

Bar Boxes:

- CFRP Shell
  - Approximately 4.6m Long
  - Thickness: 1.5 mm – 3 mm (thicker at times)
- Contains Quartz Radiator Bars, Mirrors, and Lenses
  - 10 long bars each formed by 3 short bars and a Light Guide section



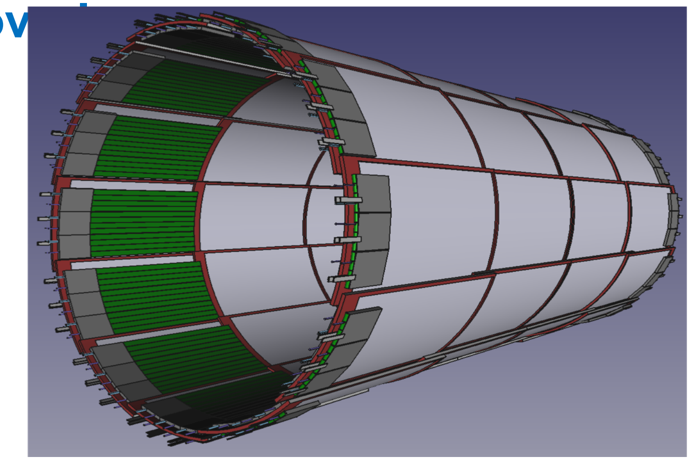


Readout Box

- Box shell
- Current Material: CFRP with thickness 5 mm
- Contains expansion prism, calibration laser
- Supports sensors, readout electronics, and associated services

Outer MPGD (μRWELL-BOT) and Inner MPGD aka CyMBaL

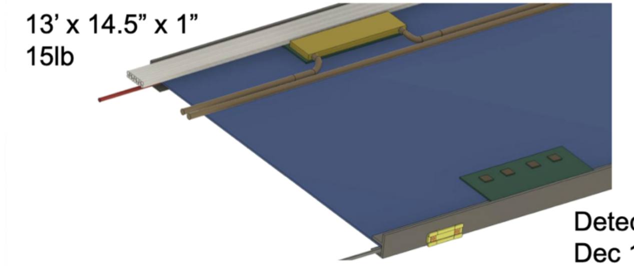
New design for inner MPGD (CyMBal): 12 sectors with fish scale ov



- New design with 12 sectors for better integration, installation and maintenance together with the barrel time of flight detector
  - 48 tiles: 12 in ϕ × 4 in z
- GST (and TOF trays) provides 4 mount points to inner MPGD (cymbal) per z-side
  - All services route within iMPGD envelope to outside, TOF is outermost radii and iMPGD is below that as far as services go

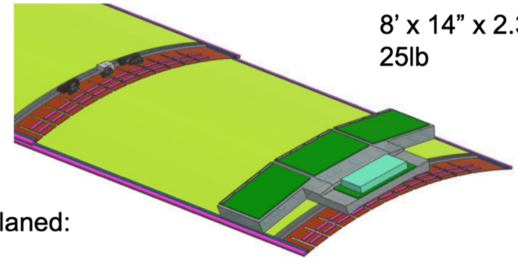
MPGD – Kapton film with composite frame

13' x 14.5" x 1"
15lb



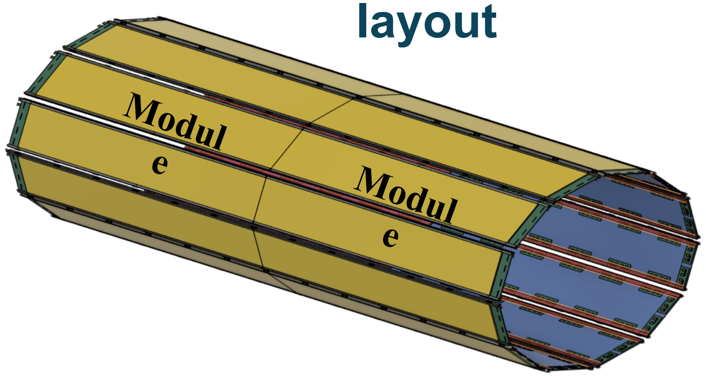
Cymbal – Kapton film with composite frame

8' x 14" x 2.375"
25lb

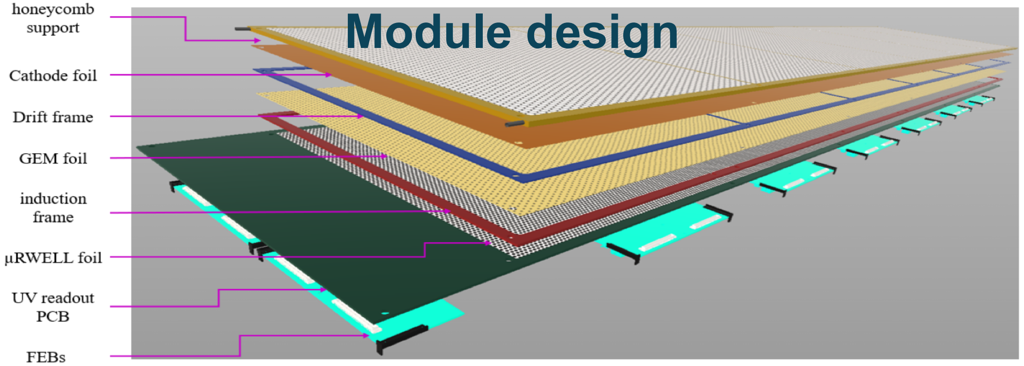


Detector PDR Planed:
Dec 15, 2026

μRWELL-BOT layout



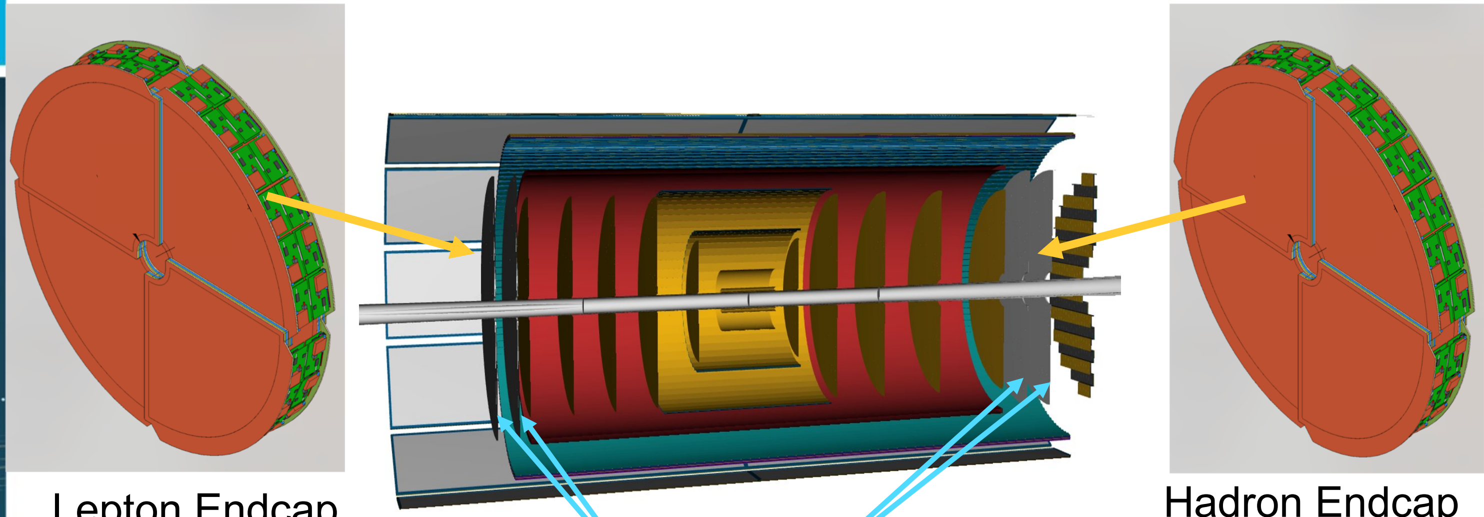
Module design



24 planar detector modules

- 12 sectors in r*φ × 2 modules in z ➔ No overlaps
- R_{min} = 72.5 cm; R_{max} = 75 cm

MPGD discs (µRWELL-ECT)



Two MPGD Endcap Tracking (ECT) disks both in the **hadronic** and in the **leptonic regions** increase the number of hits in the |η| > 2 region to improve pattern recognition.

16 Quadrant modules

- GEM- μRwell hybrid configuration guarantees gain higher than 10^4
- 2D strip read-out a "COMPASS-like" scheme
- <150 μm intrinsic spatial resolution for perpendicular tracks
- Time resolution $\sim 10\ ns$
- Material Budget <1 % X_0

On-detector Front End Boards (FEBs) based on SALSA chips

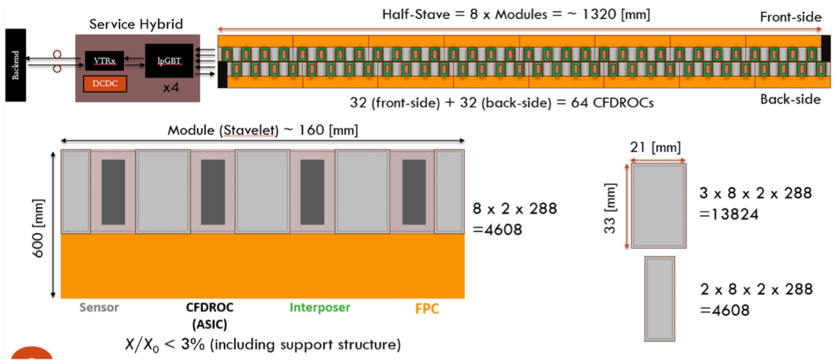
TOF Sub-Systems

To ease maintenance and integration the inner detectors follow a 30 degree segmentation!

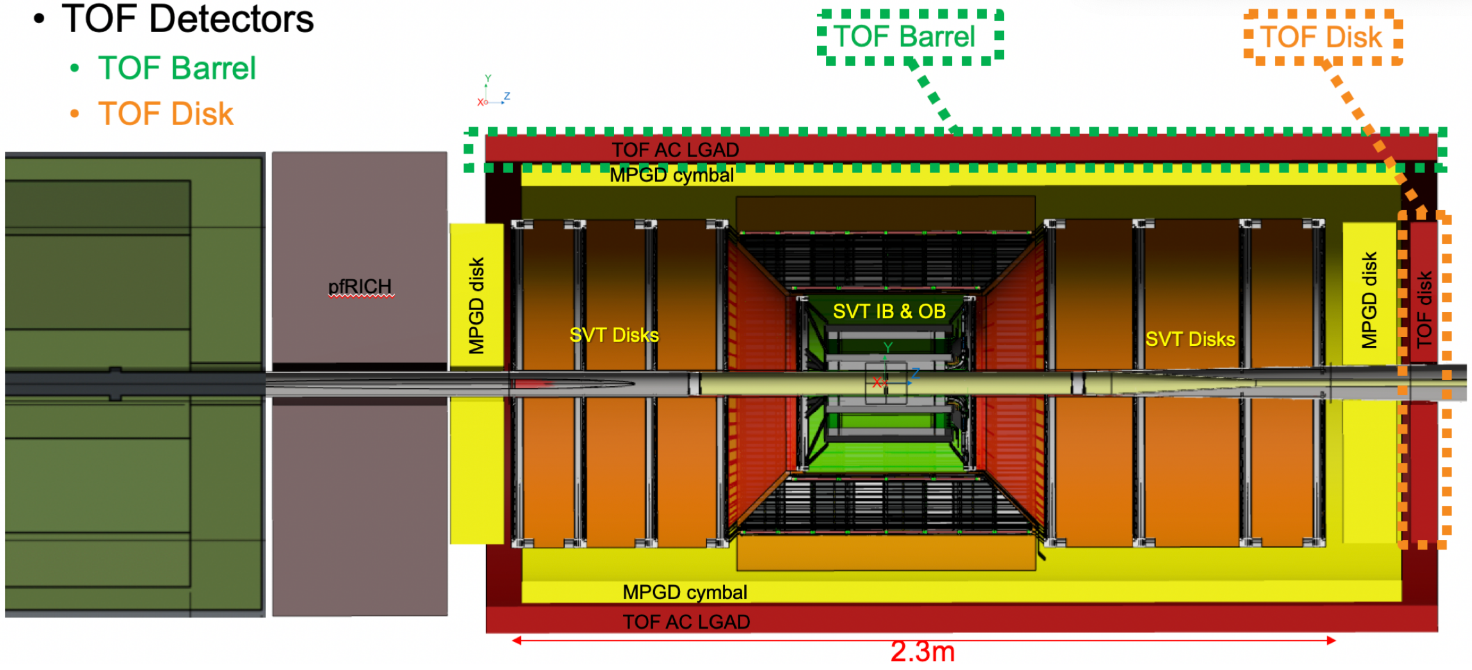
Charge 1, 4

- TOF detector provides particle ID for EPIC
- Consists of AC-LGAD’s
- Barrel “stavelet” base unit
  - 60mm wide, 160mm long
  - 2 x 8 stavelets per half-stave of 1270mm (z+) and 1370 (z-) length
    - Includes space for portcards and

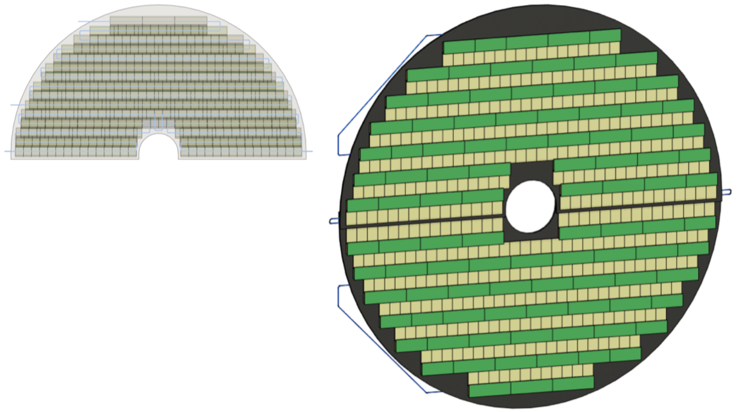
→ 288 half staves yields 4608 stavelets



- TOF Detectors
  - TOF Barrel
  - TOF Disk



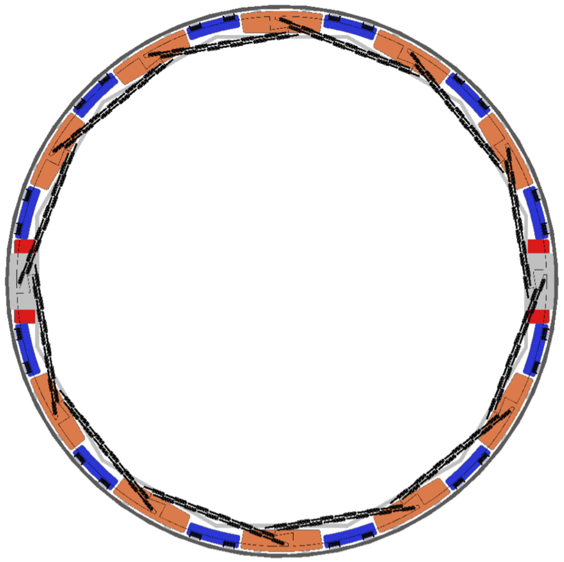
- Forward TOF (disc)
- Sandwich structure with cooling pipes
- Kinematic mount to PST - GST

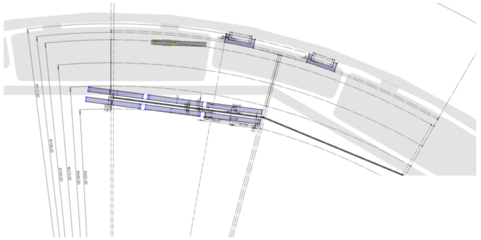


Barrel TOF & inner MPGD supports

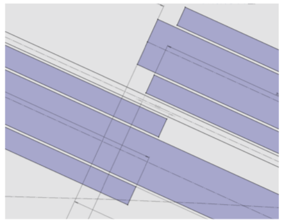
Charge 1, 4, 6

- Tray mounts via top rails to GST
  - Thin line "tracks" a TOF tray, open space inside is for services of TOF
  - Designed for 2mm overlap
- Other solidly filled areas are "reserved" for service of SVT+oMPGD and TOF+iMPGD

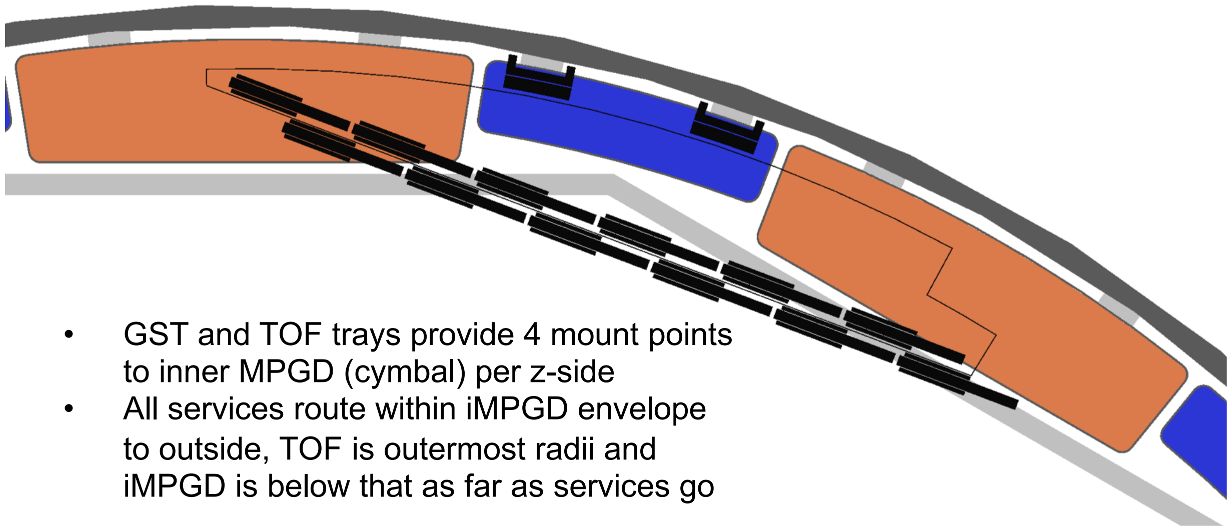




2mm overlap

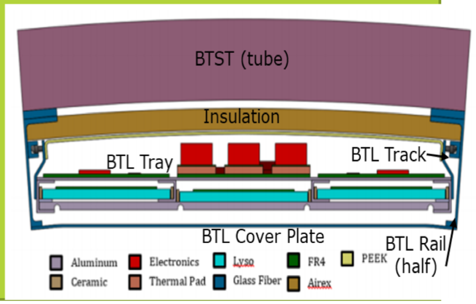


Preliminary & conceptual drawing!



- GST and TOF trays provide 4 mount points to inner MPGD (cymbal) per z-side
- All services route within iMPGD envelope to outside, TOF is outermost radii and iMPGD is below that as far as services go

Updated drawing for support of inner MPGD: Example from CMS "trays"

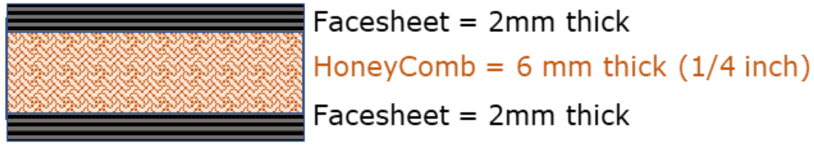


Presentation Section 2:
Global Support Tube (GST)

Global Support Structure (GST)

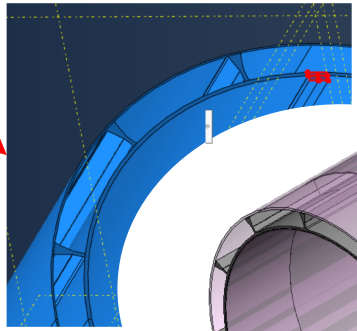
Charge 1, 4, 6

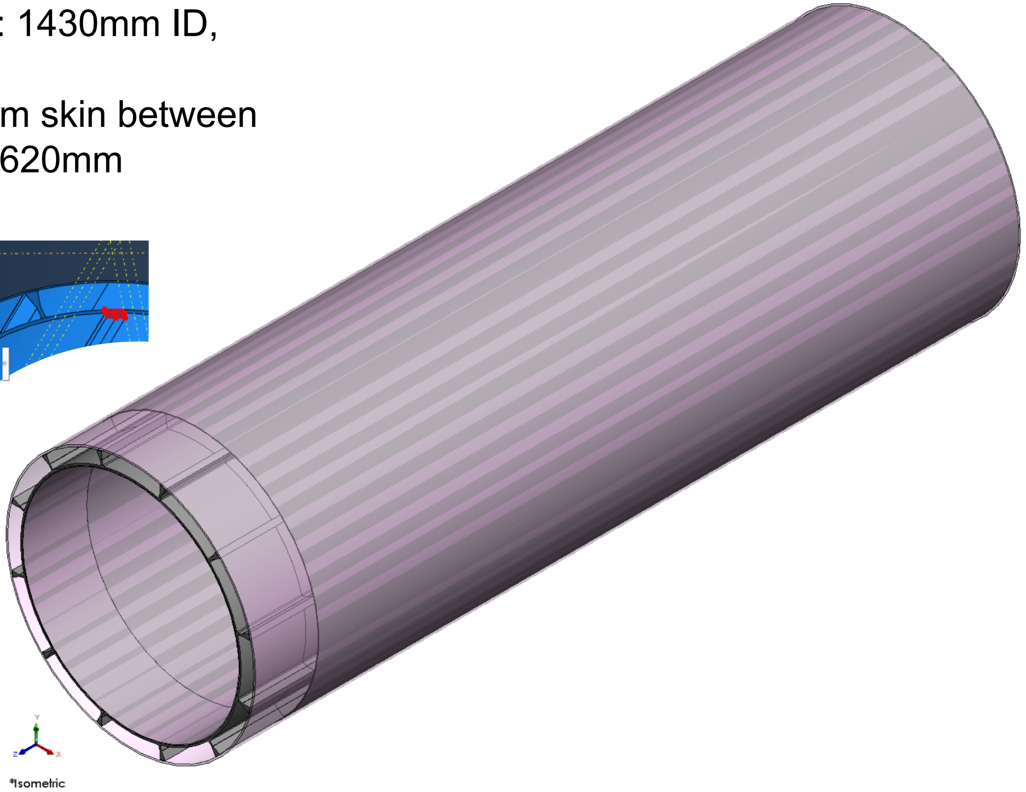
- GST supports the 2 “outer” detector systems (hpDIRC & oMPGD) and all inner detectors, all supported by the Global Support Tube
  - Total weight GST + inner and outer detectors + services: ~ 5600kg
  - For comparison: CMS is similar!
- “Double-decker” sandwich structure with internal beams and I-beam cells
  - Made from honeycomb core and two face sheets on either side bonded to it + 5mm skin further out
  - 2mm face sheets +6mm core
  - ~425kg self weight
- Two Inner detector support rails:
  - 5.3m long (or 2.65m x 2); ~14x20mm cross section
  - Support **~3100 kg** inner detectors



Face sheets:
“Carbon Fiber Reinforced Polymer” or CFRP

Dimensions:
- Structure is 5050 mm long; with the outer being shorter 4600 mm
- Sandwich tube: 1430mm ID, 1450mm OD
- Outer tube: 5mm skin between 1610mm and 1620mm

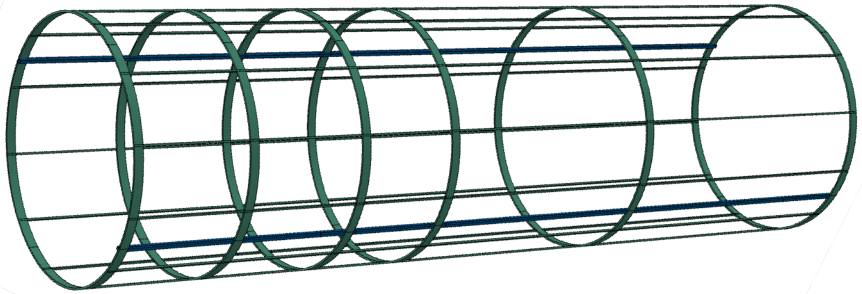




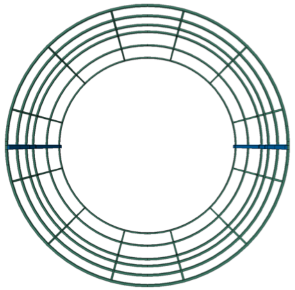
GST – internal rip structure

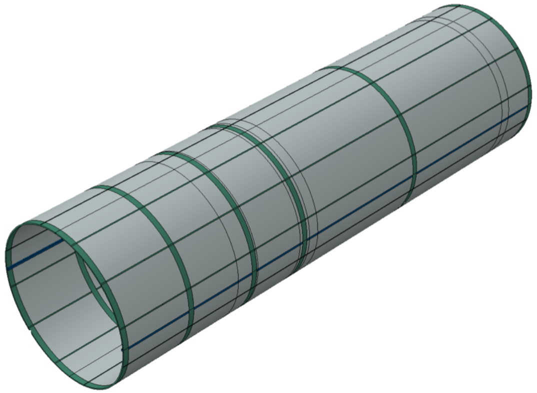
Charge 1, 4, 6

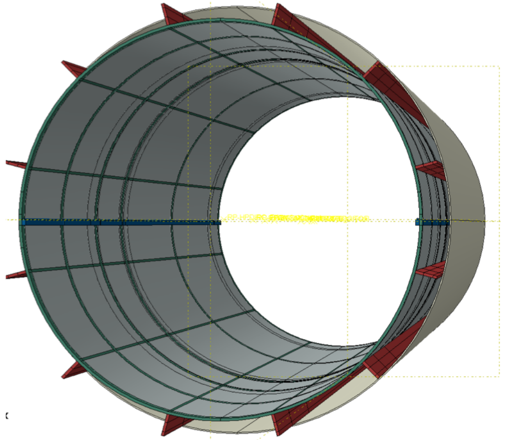
- Internal rip structure to stiffen GST as needed to support >5t
- End rings to provide support for GST bracket and to distribute load, more rings in EEEMCal area

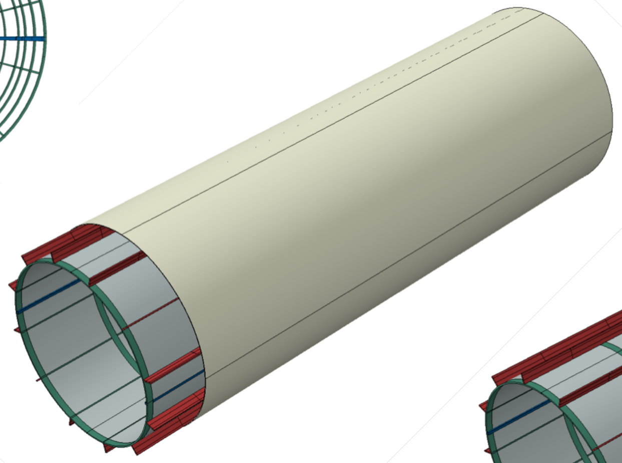


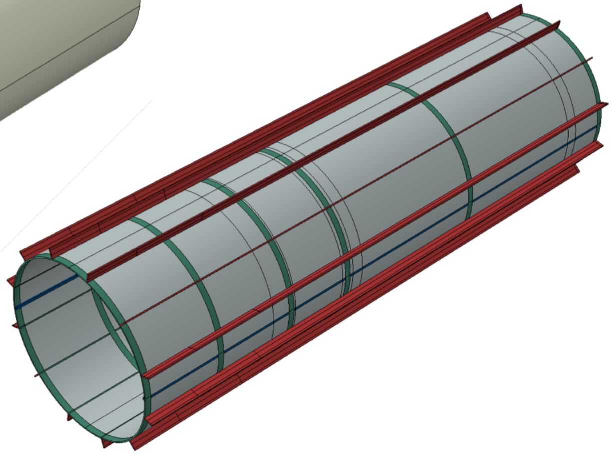
Electron direction
(EEEMCal direction)

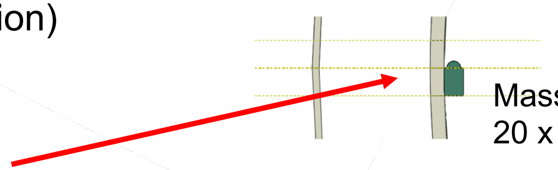












Massive CFRP
20 x 14mm, full length

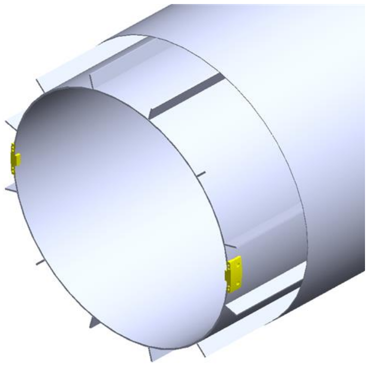
- GST support rails for PST feet

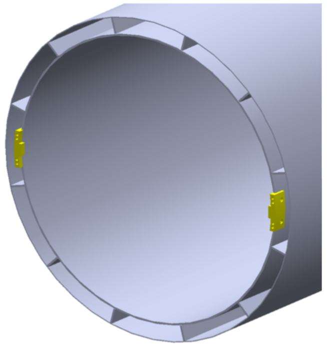
GST tolerances/constraints and mount points

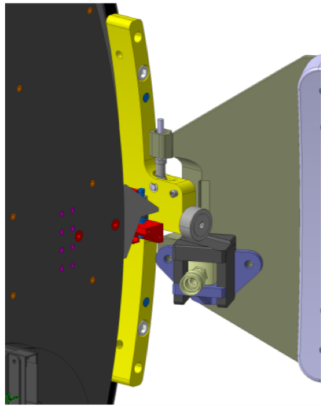
Charge 1, 4, 6

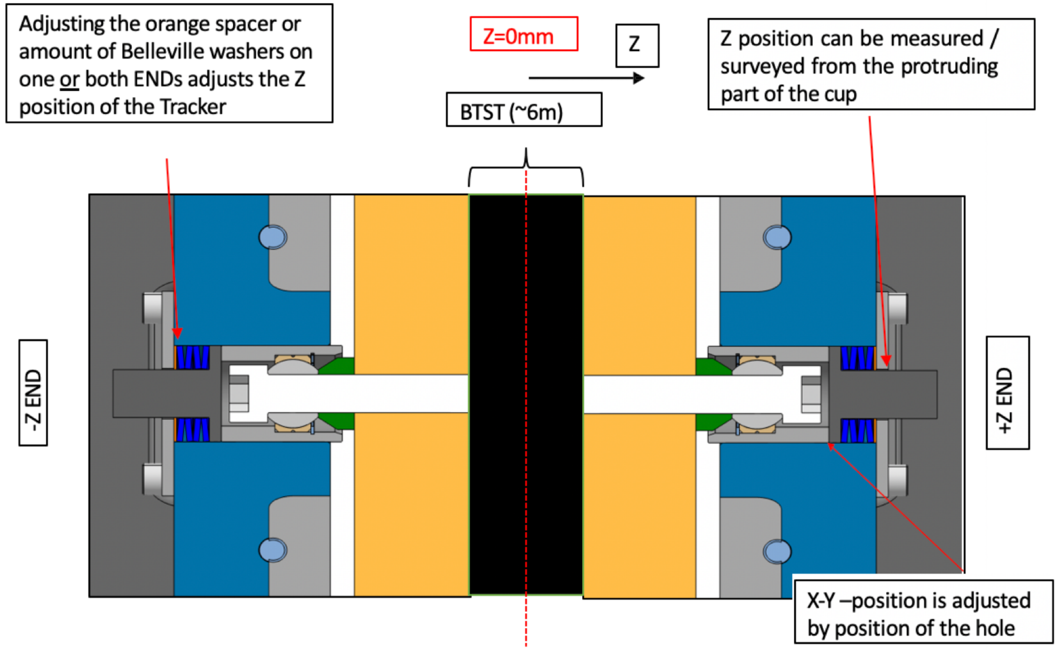
- Variety of support rails are provided by GST to support
  - PST feet
  - Mountpoints for pfRICH, EEEMCAL
  - GST itself is mounted to HCAL and EMC
  - End rings (50mm massive CRRP) to distribute load of "brackets" for GST support
- Adjustability of PST $\pm$3mm and of GST $\pm$10mm

- Envelope inner radius is 715 to 725mm
- Inner installation clearance is 710 to 715 mm
- Inner cylinder (sandwich) is z= -1900 mm to +3125mm
- Envelope outer radius = 805 to 810 mm
- Outer installation clearance = 810 to 820 mm (this is the clearance between GST and the barrel EMcal (BIC)
- Outer Cylinder (CFRP) z= -1900 to +2700 mm





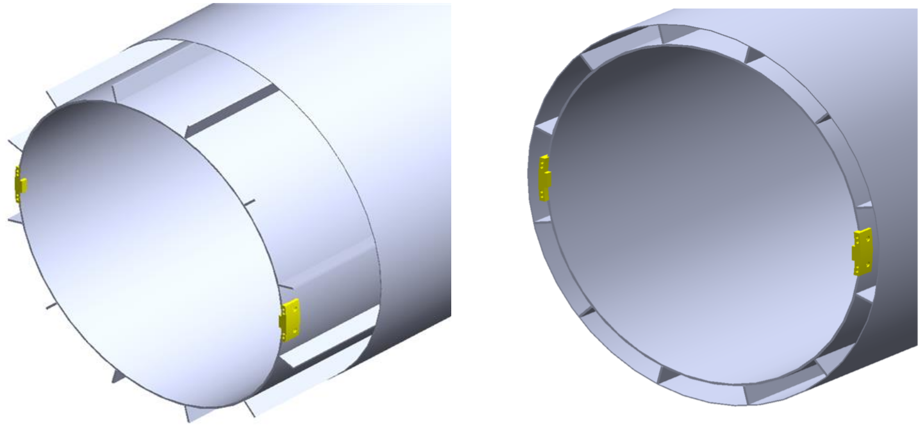


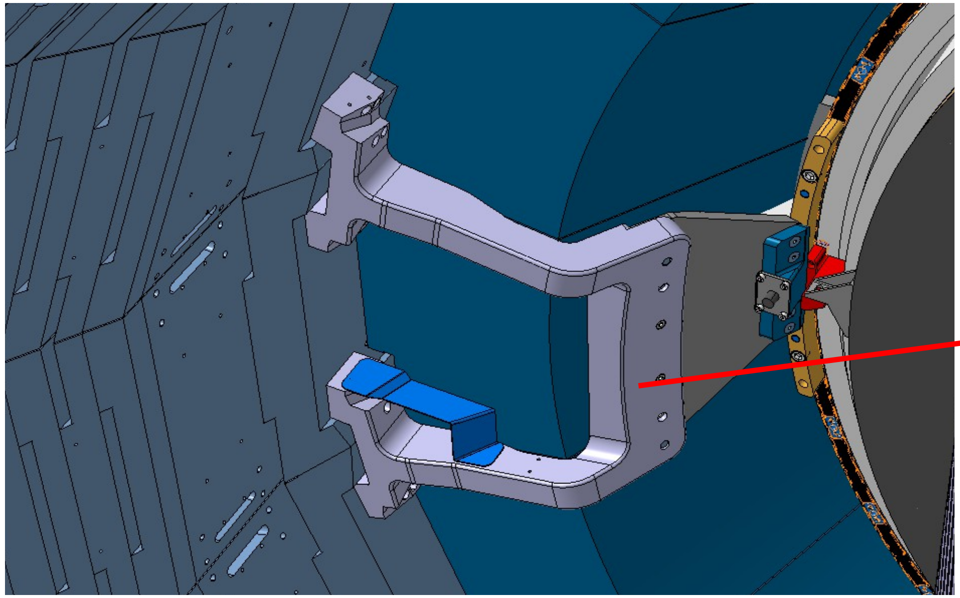


Support of the Global Support Tube

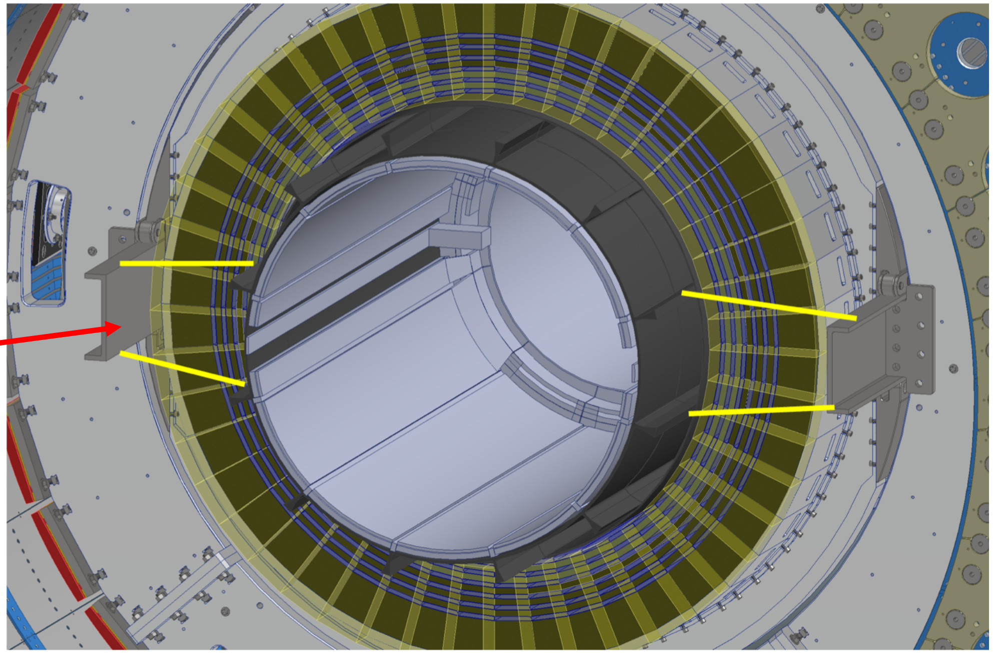
Charge 1, 4, 6

- Mechanism to support GST is in final design adjustments
- Connector on GST end ring supported by “bracket”
- Bracket allows for adjustability as presented on previous slides



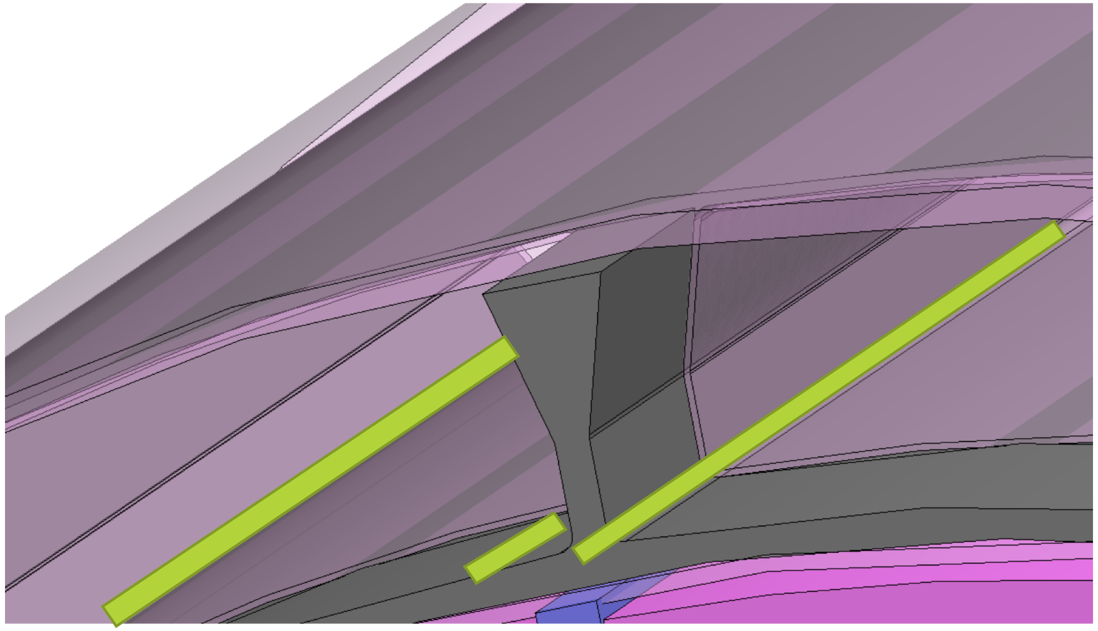


Support bracket via C-channel of EMC



HPDIRC and oMPGD support by GST

- 2mm clearance on installation of the trays into the 12 sectors between the GST inner and outer skins
- GST support “Cavities”
  - GST consists of supports for HP-DIRC and outer MPGD in between inner sandwich and outer skin
  - Provide a temporary mounting plate for interfacing to external rails for integration of hpDIRC and oMPGD
- Inner beams for Insertion trays for barrel TOF and iMPGD (CyMBal)
  - See details on sl 14



- Rails to support hpDIRC & oMPGD
- Pin holes for interfacing temp rails

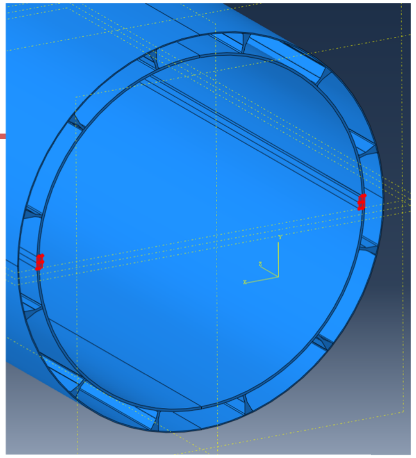
FEA: Loads of detector systems supported by GST

- Total weight is 5,675 kg
  - Comparable to CMS timing layer + all of the tracker
- Services are included in the respective detector subsystem
  - Additional service mass outside the respective detector volume is added in addition
- GST properties:
  - weight is ~ 420 kg
  - CFRP rails are 5 kg
  - For comparison if made in stainless steel GST weight is 3082 kg (7x GST), and in Al it would 1040 kg (2x GST)

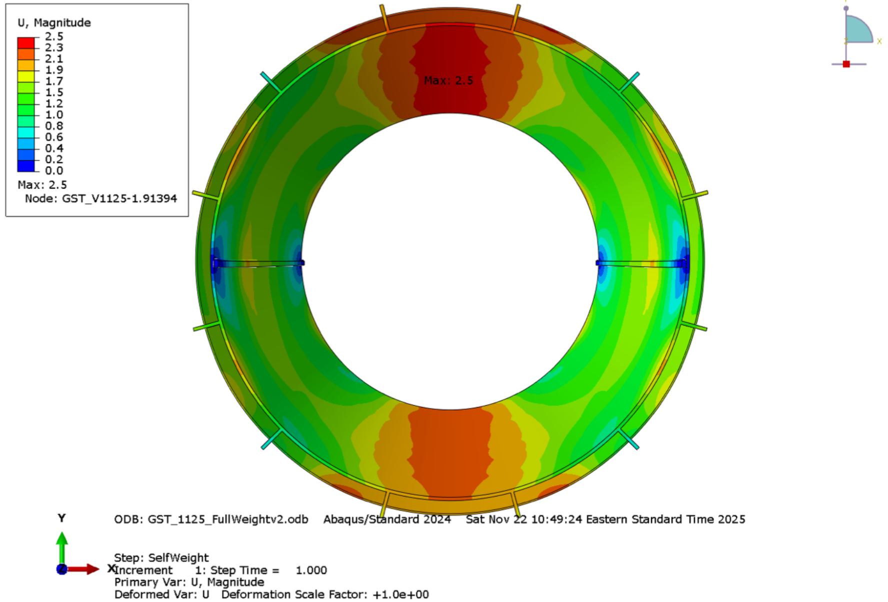
Load distribution

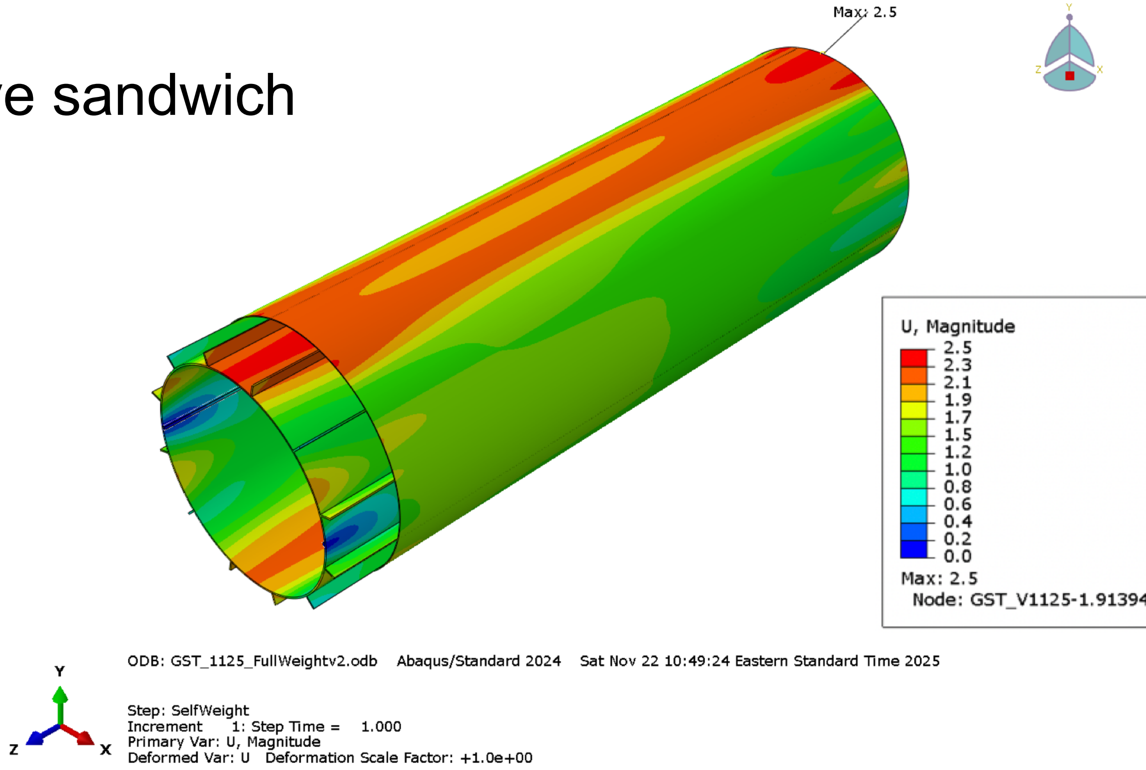
		z-coordinate	Mass (kg)
1	EEEMCal Crystals	1842.5	2000
2	EEEMCal Electronics	2212.5	500
3	HPDIRC Bars	425	1400
4	HPDIRC Prisms	3060	400
5	oMPGD	125	100
6	AC LGAD TOF	-212.5	150
7	Cymbal	-212.5	150
8	SVT	-100	285
9	pfRICH	1500	97
10	pfRICH Services	2437.5	13
11	SVT Services Zp	2187.5	50
12	SVT Services Zm	-1725	15
13	Cymbal TOF Services Zp	2150	50
14	Cymbal TOF Services Zm	-1725	15
15	EEEMCal Services Zp	2815	30
16	GST self weight	xx	420
		TOTAL	**5675**

Finite element analysis of GST



- The current GST design of a composite “double-decker” Carbon Fiber tube can support all inner detector masses within **2.5mm deflection**
- Currently assumed: HM63 + EX1515 matrix (fairly stiff, other choices exist) – Material properties are in backup
- **Sufficient within the envelope!**
- **To come**: Alternative materials and alternative sandwich

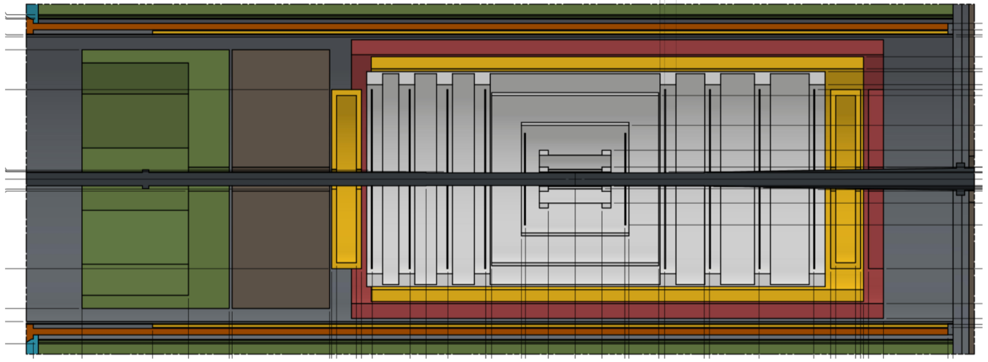




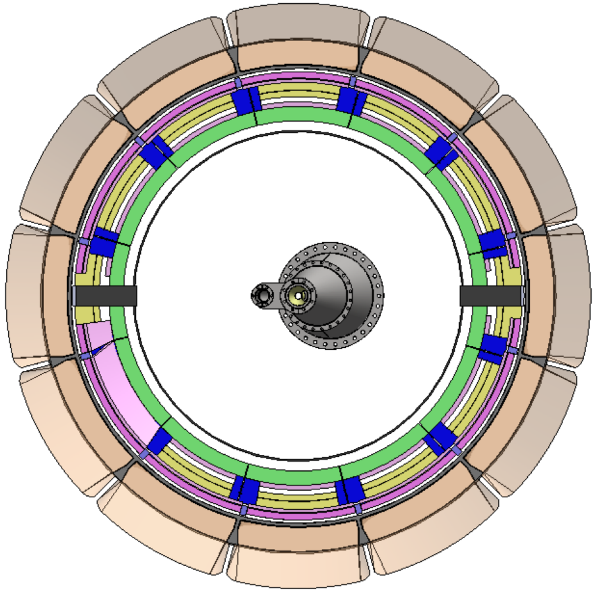
GST envelope and constraints

- Expected deflections, tolerances, geometric tolerances:
  - Deflections in final operation setup: ±2.5 vs ±2.0 mm
  - Manufacturing: ±1.5mm, Core: ±0.5mm & Cylindricity of 2mm
    - Face sheets: ±0.1mm + Core yields ±0.7mm max deviation
  - Geometric to fit within envelope in worst case: ±1.5mm
- Envelope is ±10mm for insertion
  - Worst case: ±1.5mm ±2.5/2.0mm = ±4/ ±3.5mm
  - Can consider more local add. stiffening structures

→ Adjustability of PST ±3mm in x-y and ±5mm in z
  → Tolerance is ±1mm
→ Adjustability of GST ±10mm in all directions
  → Tolerance is ±3mm



Key:
hpDIRC Prism
hpDIRC &
oMPGD
Services
Barrel TOF
iMPGD
Support tubes
- GST & PST



Presentation Section 3:
Integration and Insertion/Assembly

Ben’s talk includes SVT only assembly

ePIC Detector Support Hierarchy Y-Z View

Charge 6

- Details are on the next slide
- Two large sub-assemblies independently integrated
  - PST-SVT sub-assembly staying in one physical location
  - GST with subdetectors installed in EPIC ready to receive SVT sub-assembly

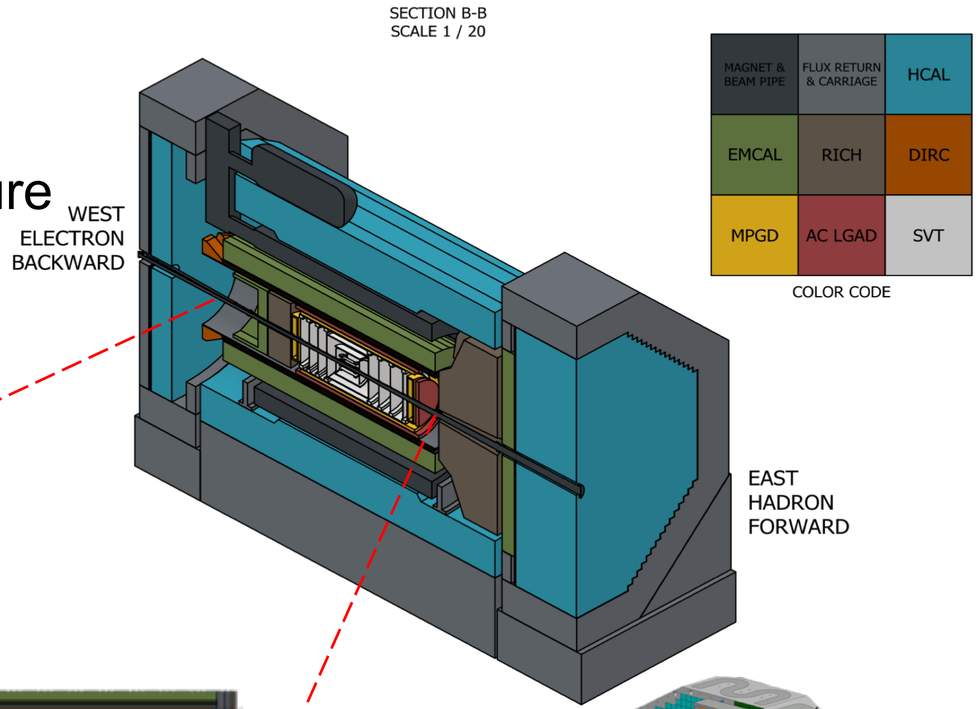
Side remarks:

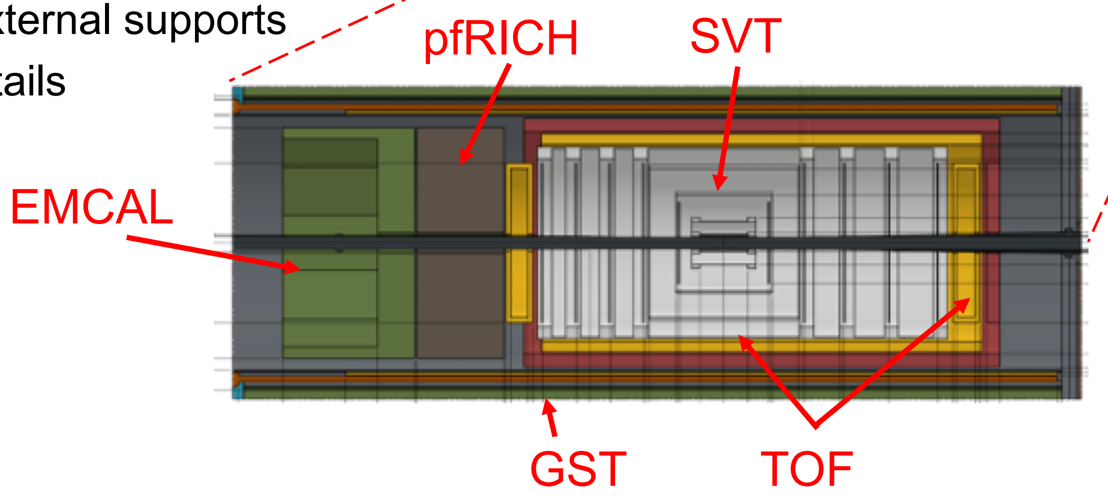
- Substantial amount of temporary supports needed for beam-pipe, service, cooling, etc
- Temporary structures needed to “slide” / integrate sub-assemblies together and also for final step into EPIC GST structure

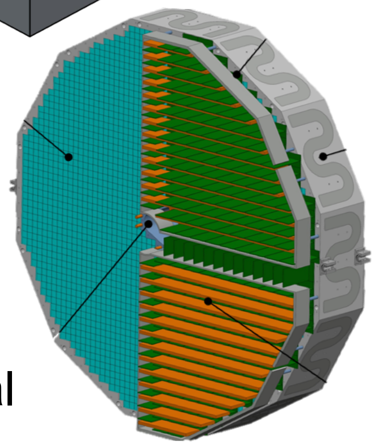
Assembly sequence

Charge 3, 6

1. GST gets integrated with outer MPGD and hpDIRC
2. Moved inside assembly hall and mounted
3. pfRICH and EEEMCal installed without services to measure deflection
4. Remove pfRICH and EEEMCal
5. Install PST and SVT package with beam pipe and align
6. Install TOF and inner MPGD (cymbal)
7. Put PST front feet in the GST rails
    1. Back of PST rests on external supports
    2. See Dan Cacace for details
8. Install pfRICH
9. Install EEEMCal
10. TOF disc







EEEMCal

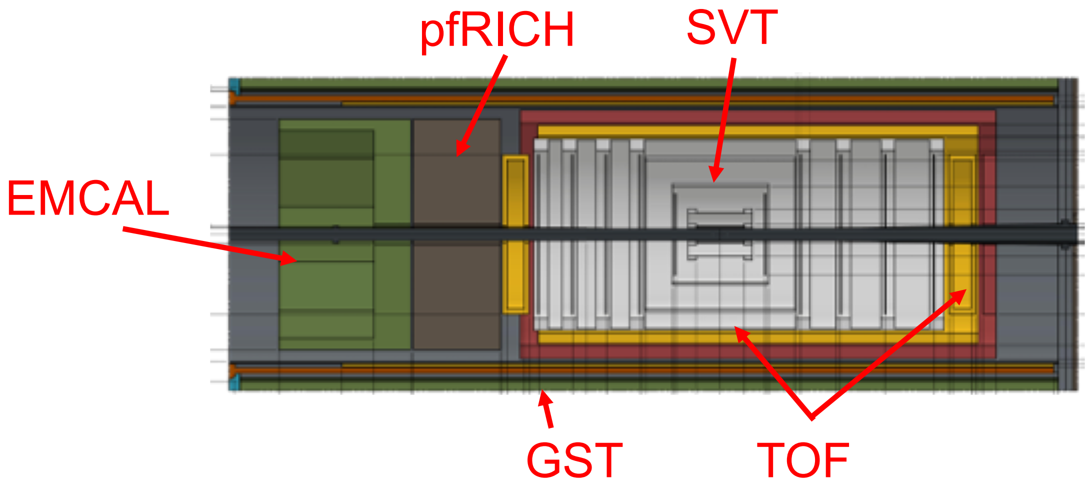
Assembly sequence – comments / discussion

Charge 3, 6

There is a arguments for why we suggested to integrate first all into GST, then entire package into EPIC.

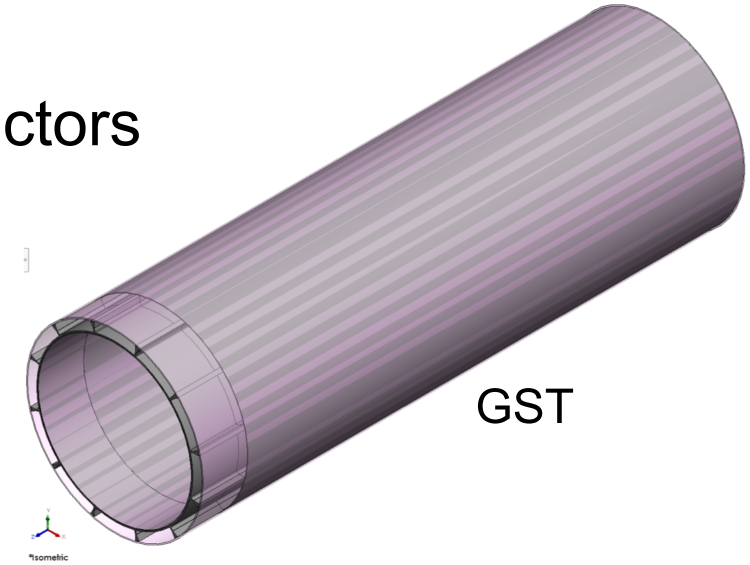
- Mostly driven by supporting now EEEMCal

1. Step 0 check “impact” of EEEMCal first
2. GST gets integrated with outer MPGD and hpDIRC
3. Moved inside assembly hall and mounted
4. pfRICH and EEEMCal installed without services to measure deflection
5. Remove pfRICH and EEEMCal
6. Install PST and SVT package with beam pipe and align
   - Reason is the services routing requires this order
7. Install TOF and inner MPGD (cymbal)
   - It needs to be after SVT
8. Put PST front feet in the GST rails
   1. Back of PST rests on external supports
   2. See Dan Cacace for details
9. Install pfRICH
10. Install EEEMCal
11. TOF disc



Next steps

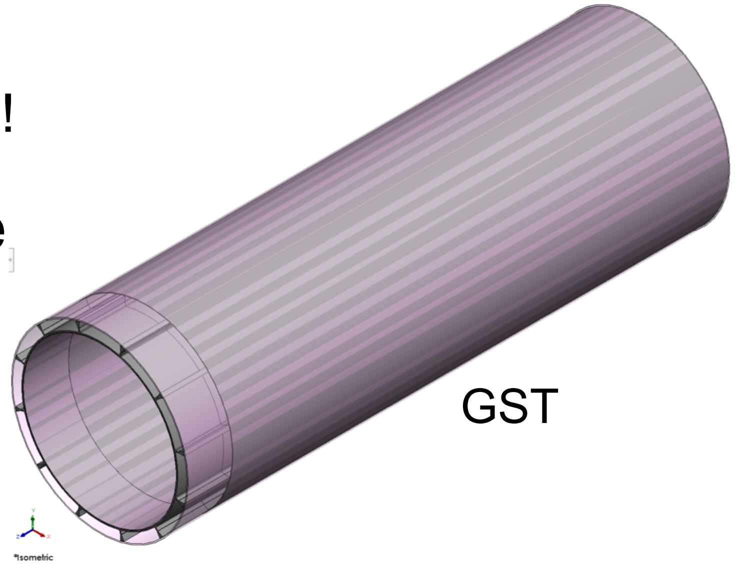
- Mature design for GST adjustment mechanism
- Carry out FEA to study material choice vs deflection
- Prototype & load test to confront FEA vs reality
- Failure mode FEA
- Finalize envelopes for GST and adjustment mechanisms
- Finalize assembly procedure for GST and supported detectors



GST

Summary

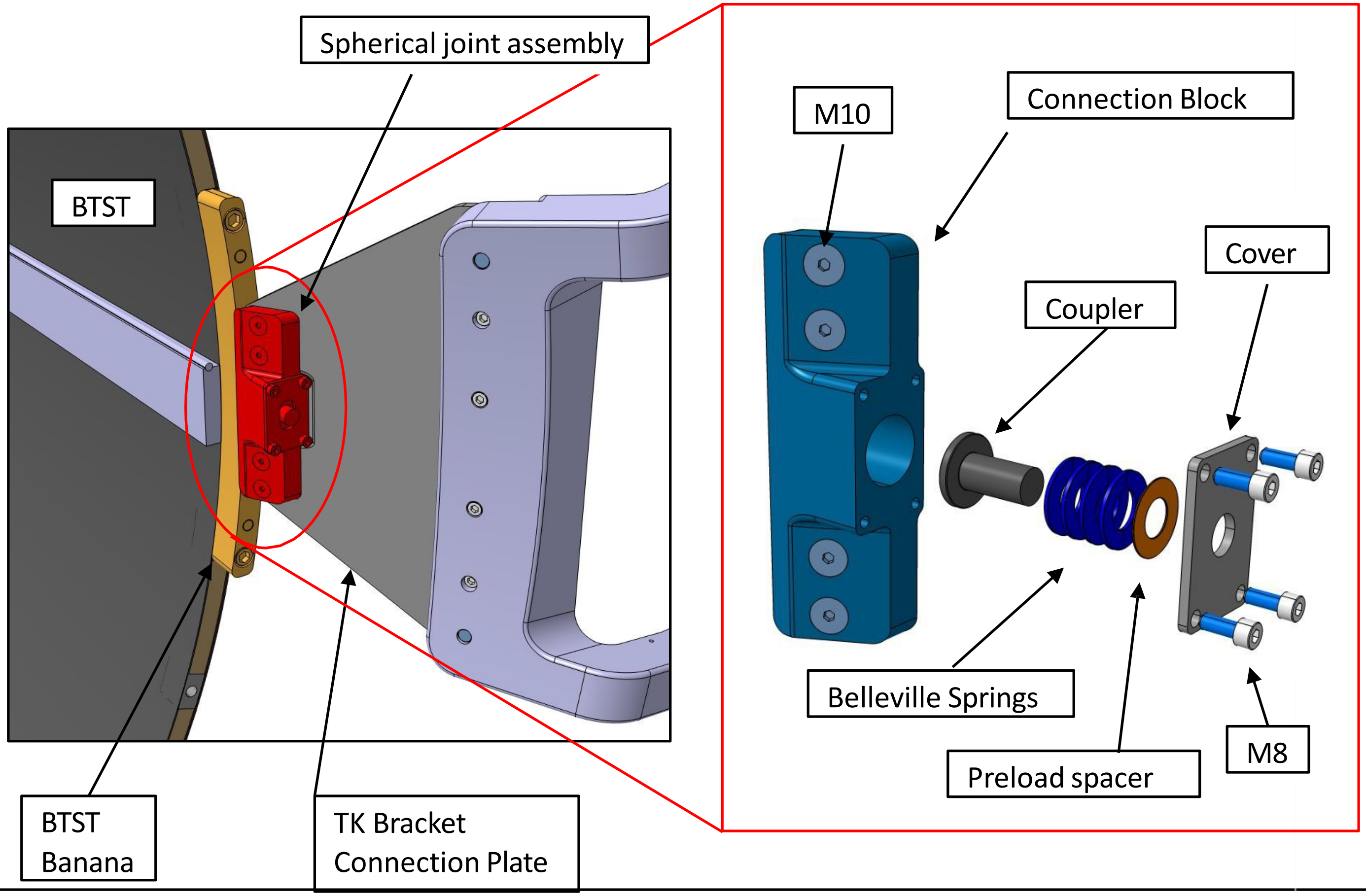
- The current designs for support structures are well developed for the current phase of the project
- The designs are all integrated into the larger central detector model
- The current procedure and approaches for the installation of the inner detectors and their support structures are well developed for the current phase of the project
  - Separation of inner detectors and outer detectors ease separations!
- Adjustments and optimizations are quickly worked into the larger integrated model
- Next steps:
  - FEA to determine material choice for GST



Backup

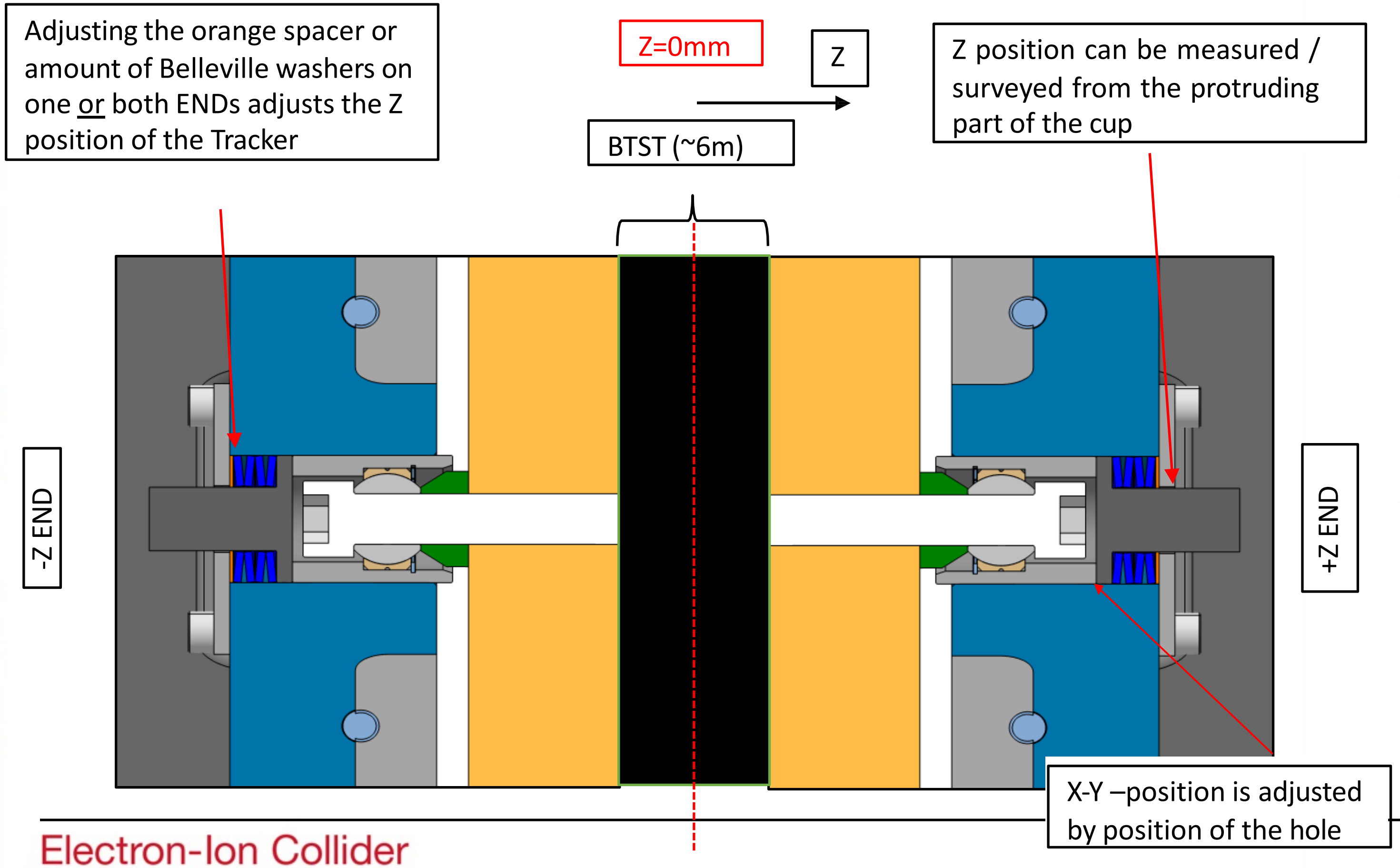
Periphery interface mapping

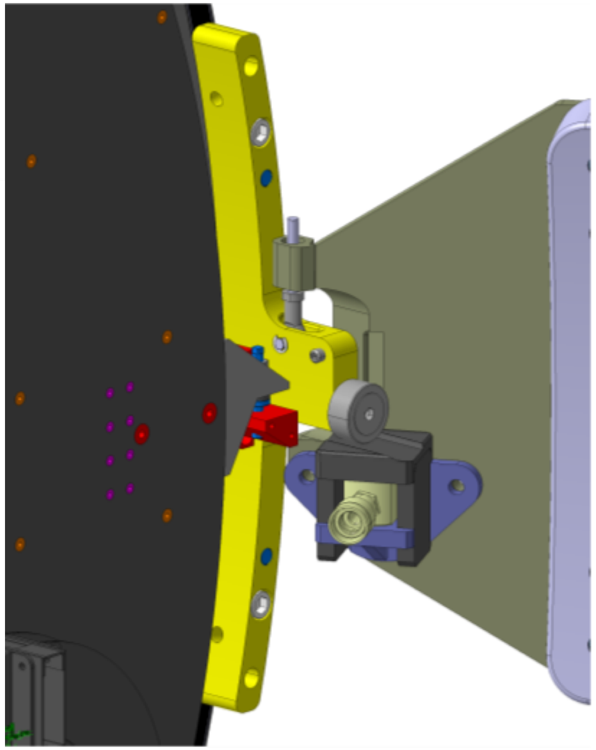
- Best existing design via CMS, adopted for EPIC as needed
- The four Tracker brackets support the GST in its final position inside EPIC
- The spherical joint allows the tracker to ”settle” without overconstraining



Periphery interface mapping

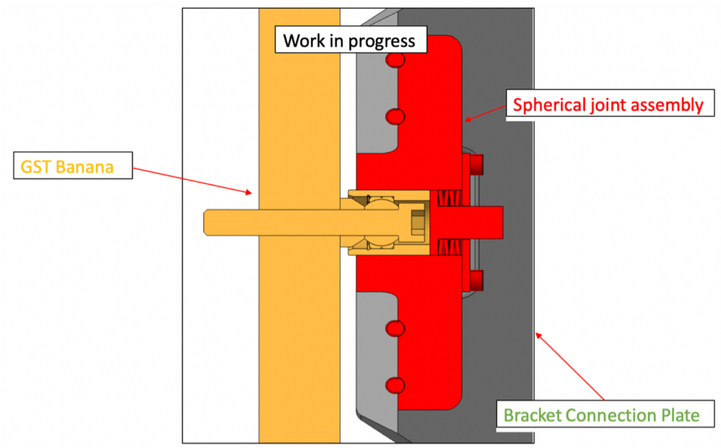
- The four Tracker brackets support the GST in its final position inside EPIC
- The spherical joint allows the tracker to ”settle” without overconstraining
- The mechanism on the right allows “alignment” by set screws which then gets “mounted” in position with the below mechanism



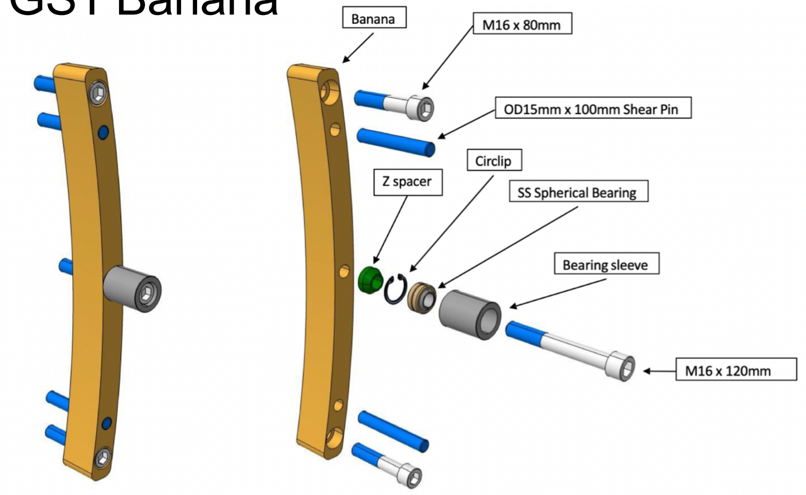


Detailed drawings on GST adjustment & support

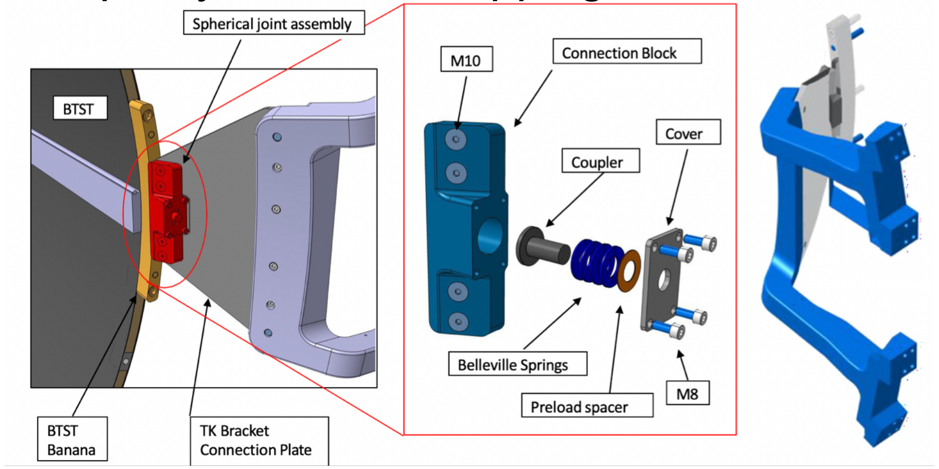
GST Bracket Spherical Joint



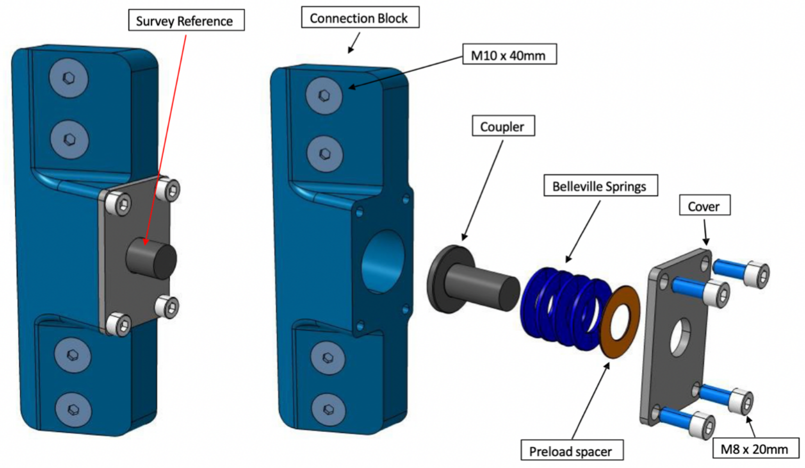
GST Banana



Periphery interface mapping



Bracket Spherical Connection



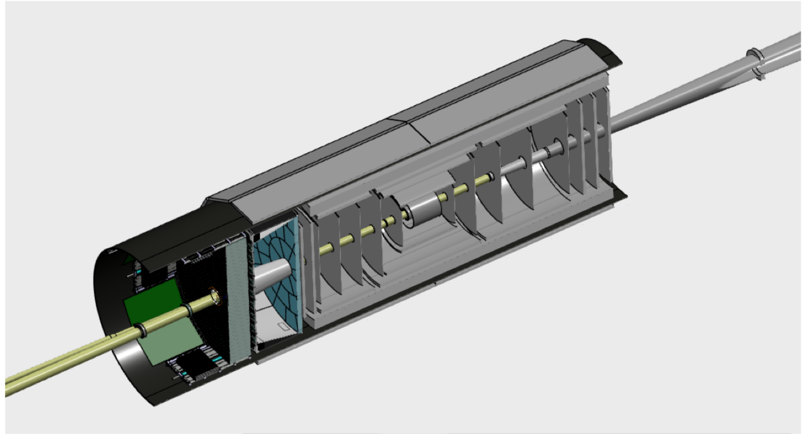
2nd sub-assembly for Beampipe + SVT

Charge 6

1. SVT + inner MPGD disc assembly

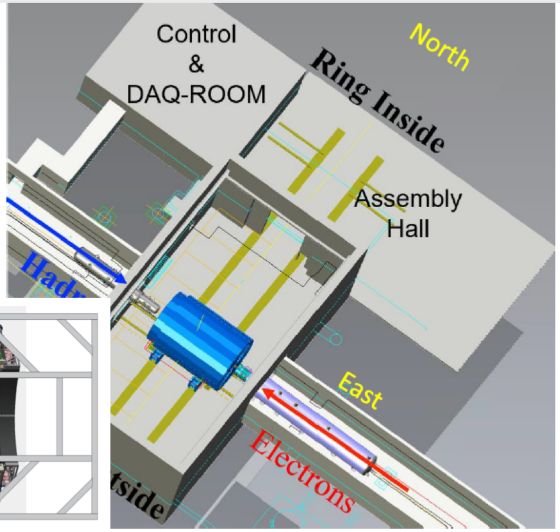
- Temporary supports for beam pipe and services
- Sub-assembly slides into GST rails
  - 4 support feet of PST in PST end ring region are supported by GST rails

See Talk by Ben Denos



<u>Next integration steps:</u>

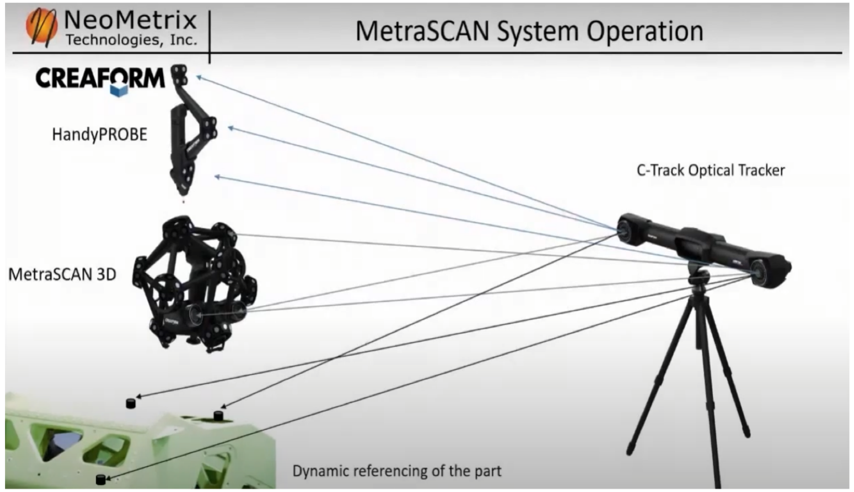
- Follow PST subassembly with pfRICH, than EEEMCAL
  - Needs temporary support for cables & beam pipe of PST subassembly, e.g. “antlers”
  - Needs installation jigs to slide pfRICH and EEEMCAL into GST
- Install outer MPGD barrel and hpDIRC with GST in place
  - Needs rails & kinematic mounts to avoid stress on either one of them

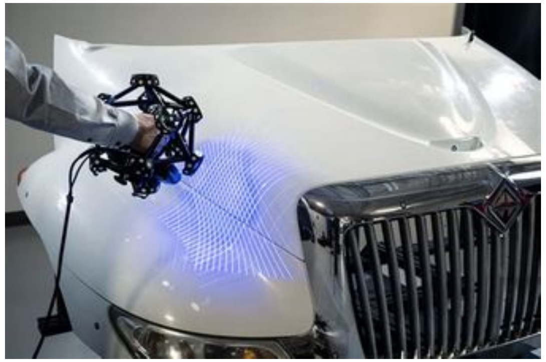


QA/QC and installation metrology

Charge 3, 6

- Metrology and loading case scenarios based on realistic EPIC parameters
  - Rely on existing experience with CMS HL-LHC projects: ITST, SC & BTST projects
  - Large area metrology system “Creaform MetraScan” (received!)
    - Best circular fit and deviations point-by-point from expected one
- Metrology and deformation studies
  - Deformation only studies (safe loads)
  - Adjust FEA to match deformation only
  - Compare to FEA to reproduce data
- **Predict** behavior of full structures in all aspects & measure all
  - Deformation only + FEA match
  - Loading scenarios + FEA match
  - Predict and extrapolate to CMS conditions





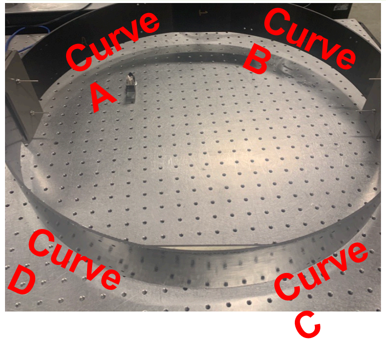
QA/QC procedures informed by CMS experience

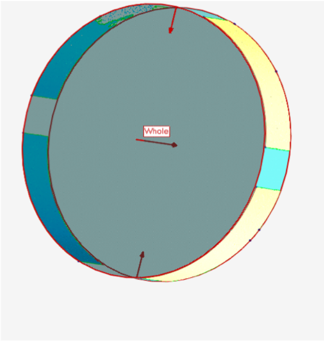
Charge 3, 6

- Following best practice and lessons learned from CMS upgrade projects
  - Iteration of FEA of manufacturing method, performance under load, metrology
  - QA/QC during and at end of the process → repeat!
- Prototyping using non-final materials
  - Smaller prototypes with final material, FEA driven
- Met tolerances – we typically achieve:
  - 1 – 2mm cylindricity (~ 6m length & 2.4m diameter)
  - < 500μm cylindricity (Solid skin tube)
  - 50-100μm parallelism (Rail/Track alignment)

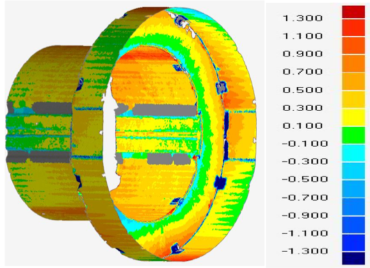
CMS IT tube end section cylindricity:

Target Diameter	606 mm
Measured dry assembled diameter	605.47 mm

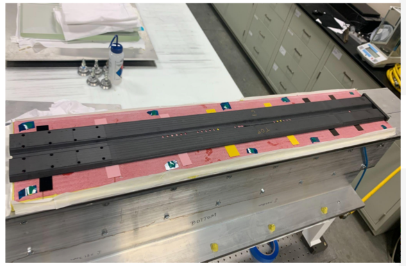


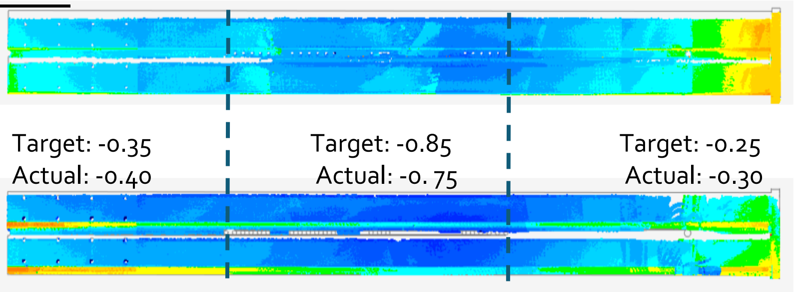


Tube transition to mid section:

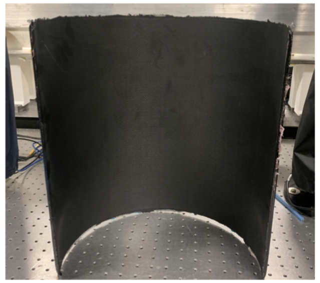


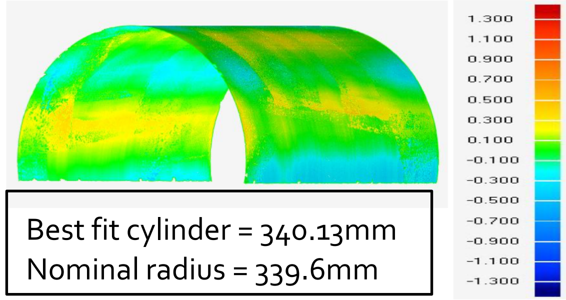
ITST track alignment:



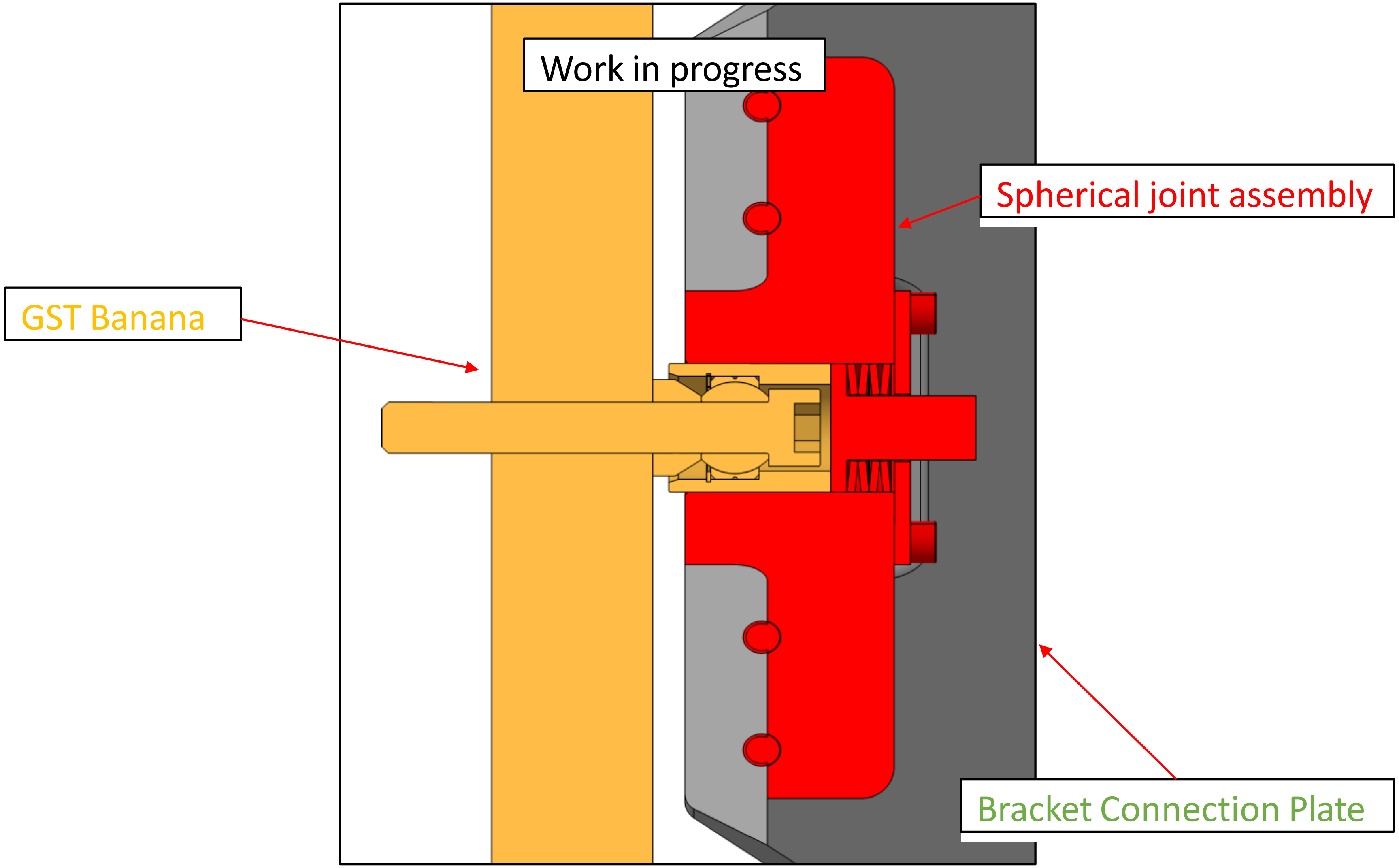


Pixel Service Cylinder cylindricity:

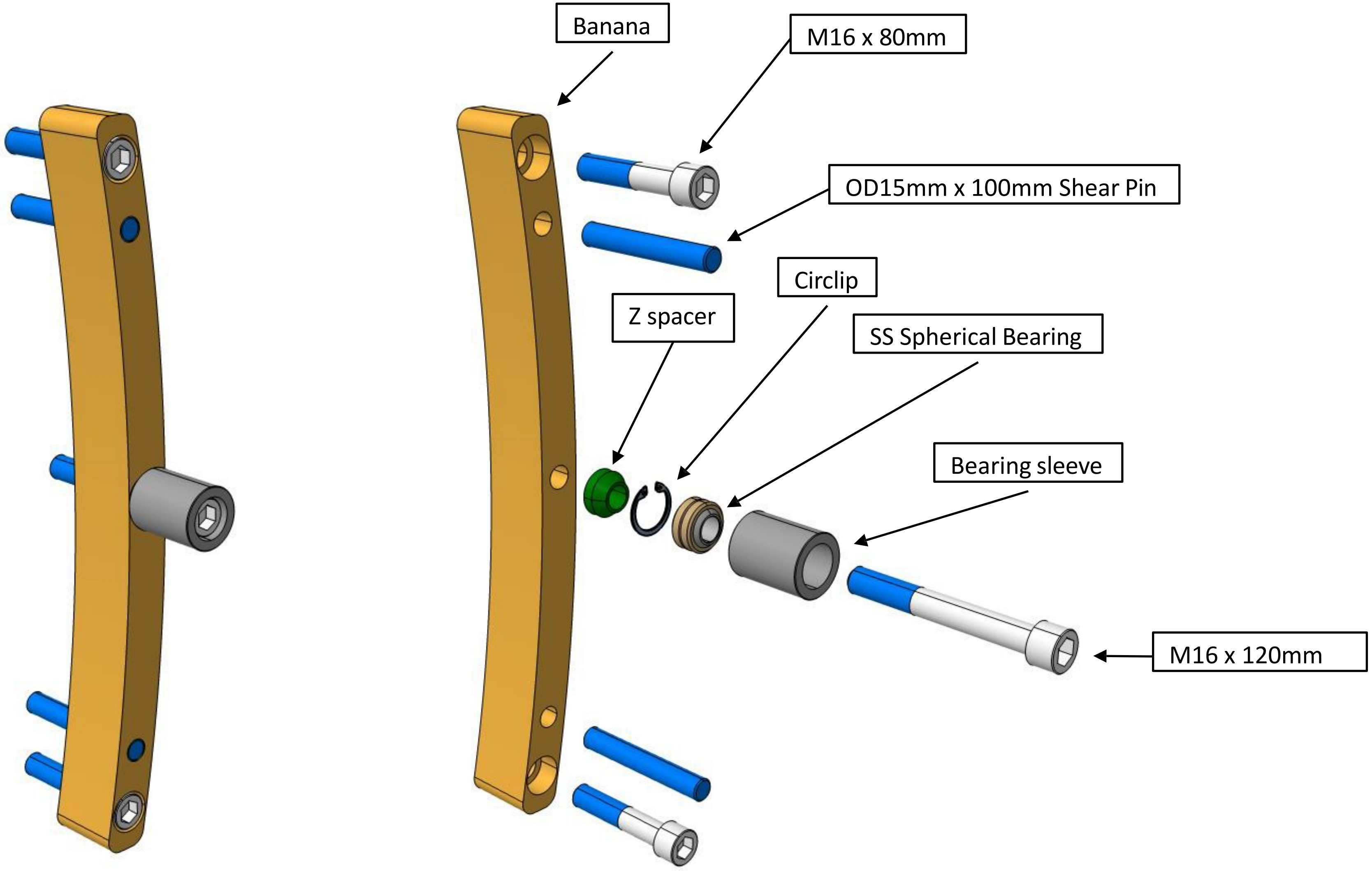




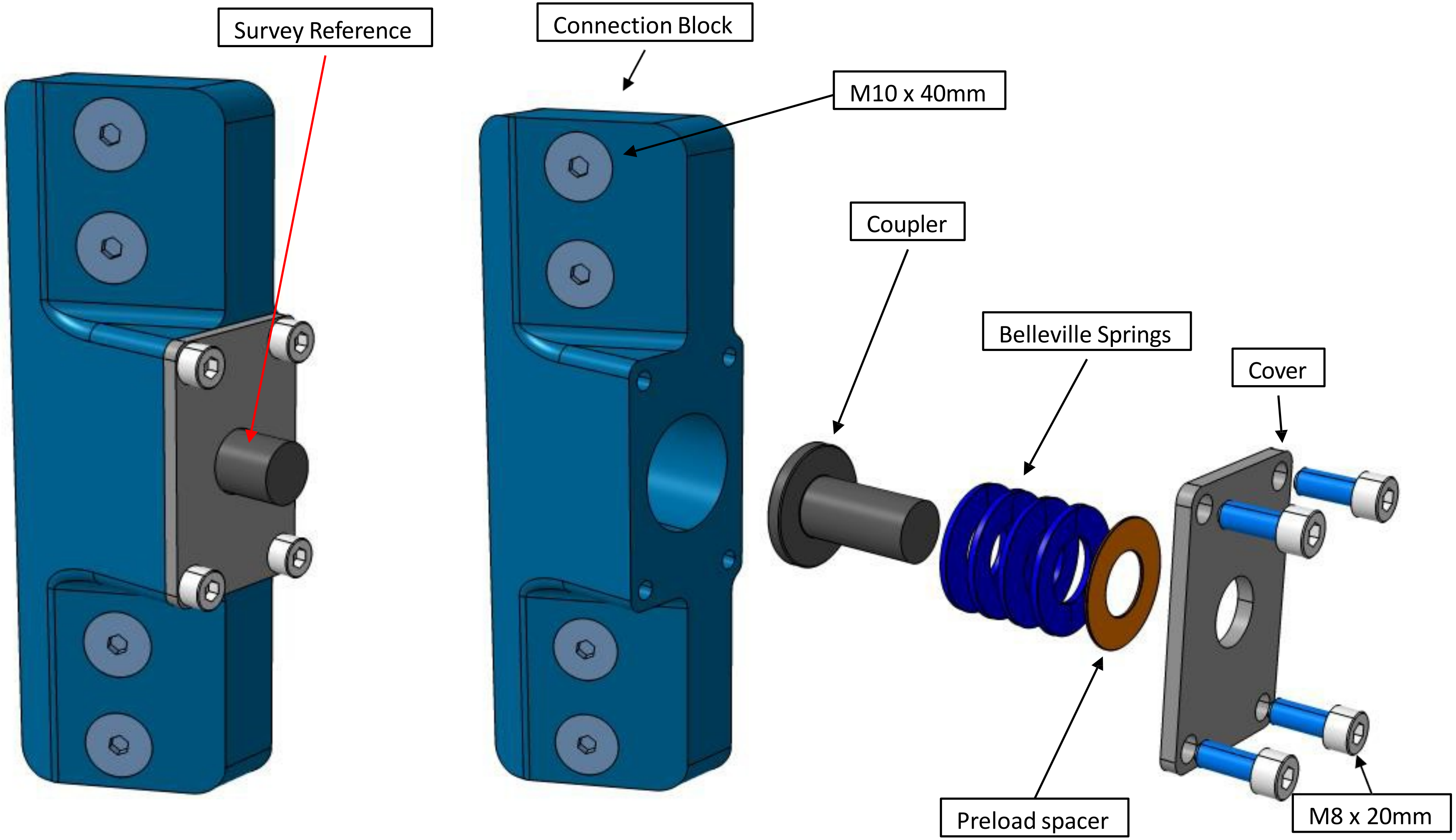
GST Bracket Spherical Joint

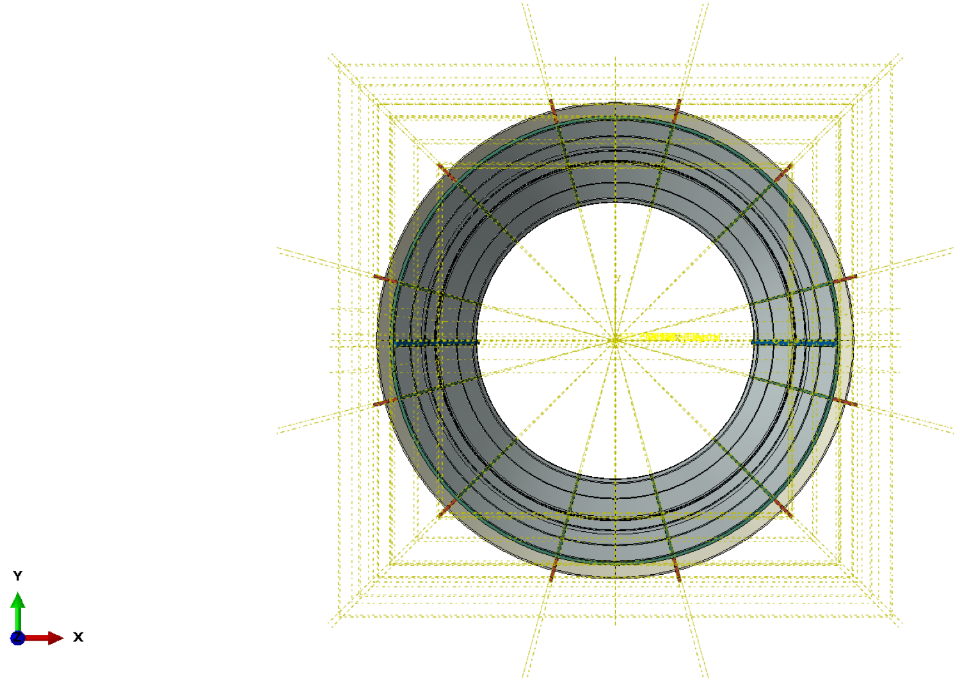


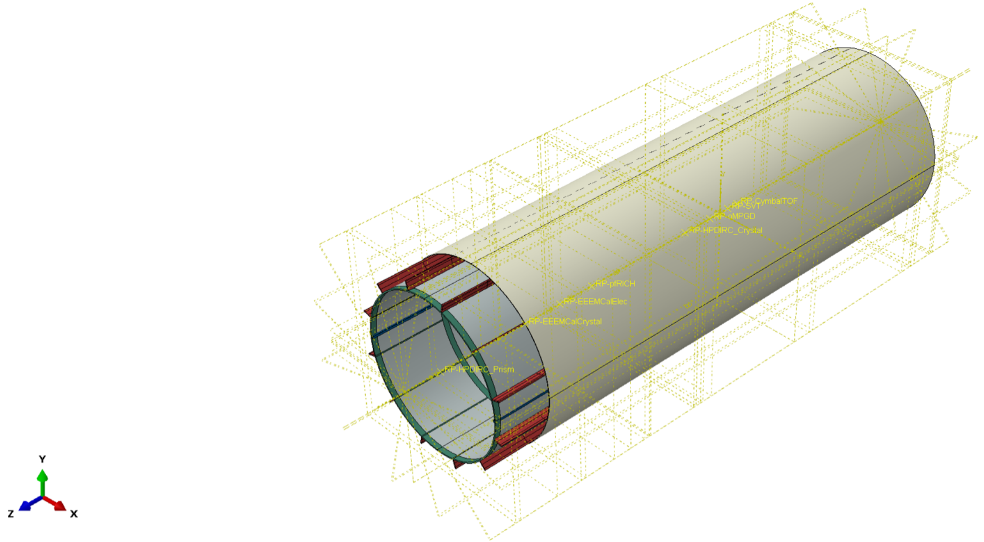
BTST Banana

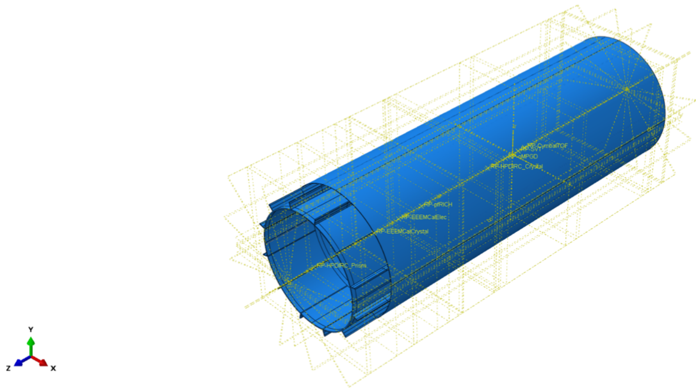

Banana
M16 x 80mm
OD15mm x 100mm Shear Pin
Circlip
Z spacer
SS Spherical Bearing
Bearing sleeve
M16 x 120mm

Bracket Spherical Connection

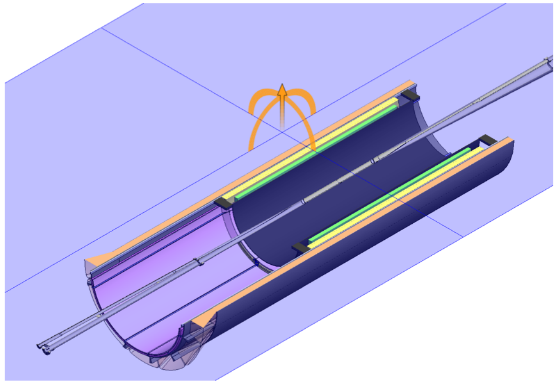


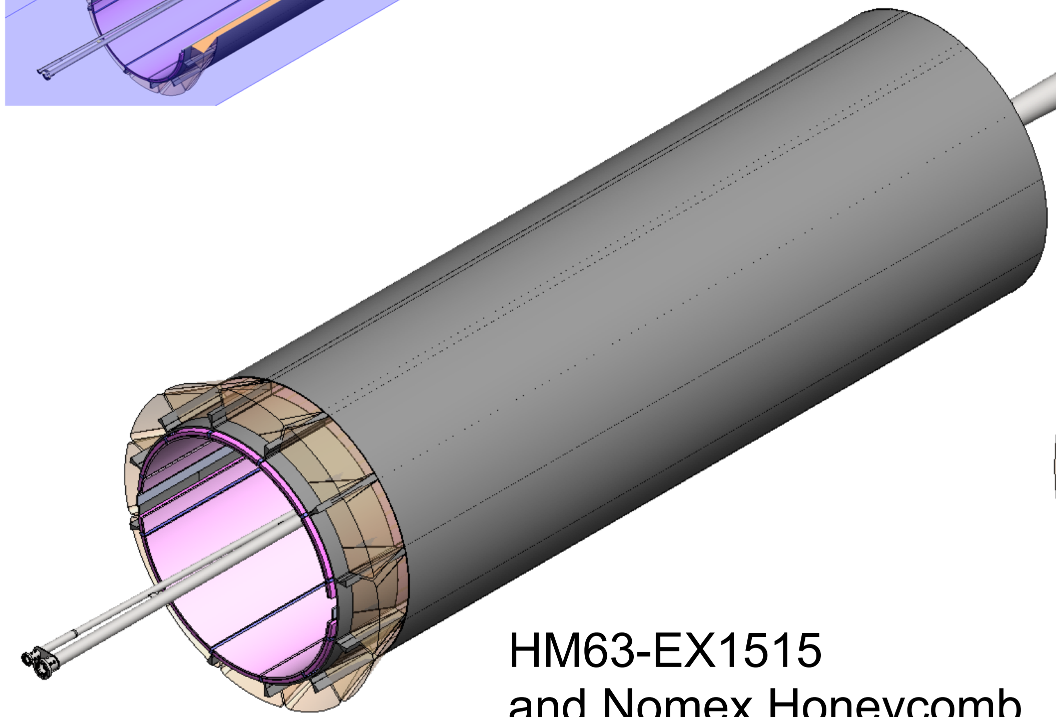

Y
X


RP-CymbalTOF
RP-SVT
RP-oMPGD
RP-HPDIRC_Crystal
RP-pfRICH
RP-EEEMCalElec
RP-EEEMCalCrystal
RP-HPDIRC_Prism
Y
Z
X

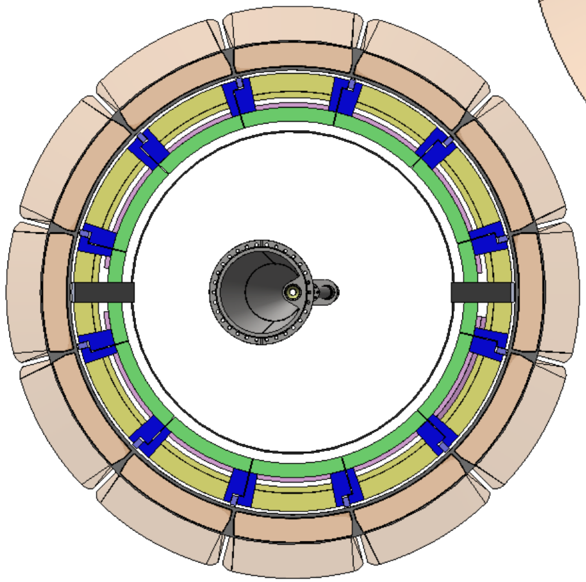


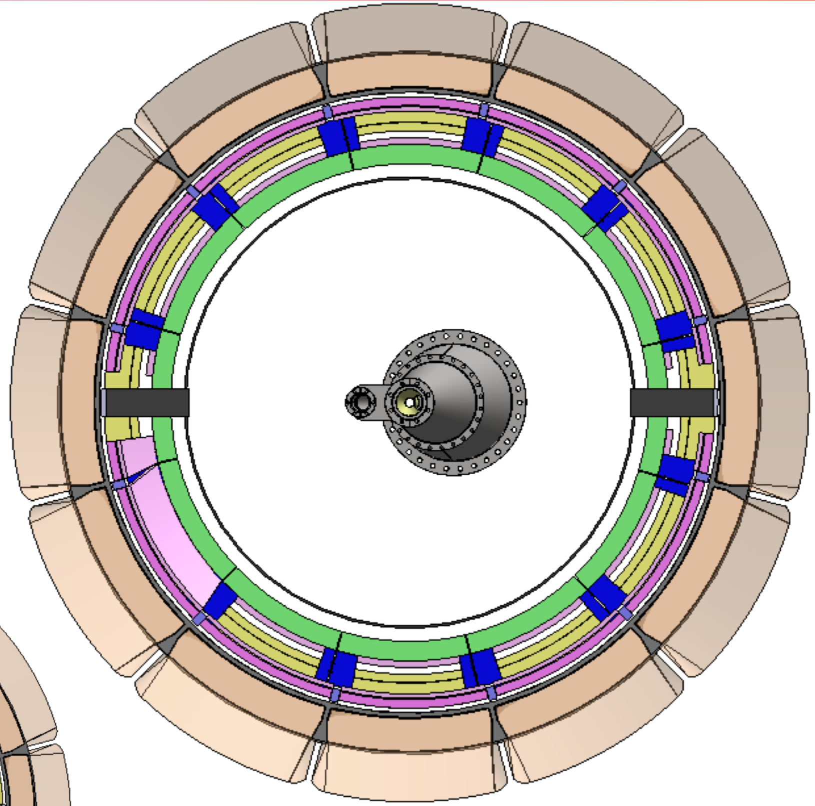
Envelope Overview / CAD





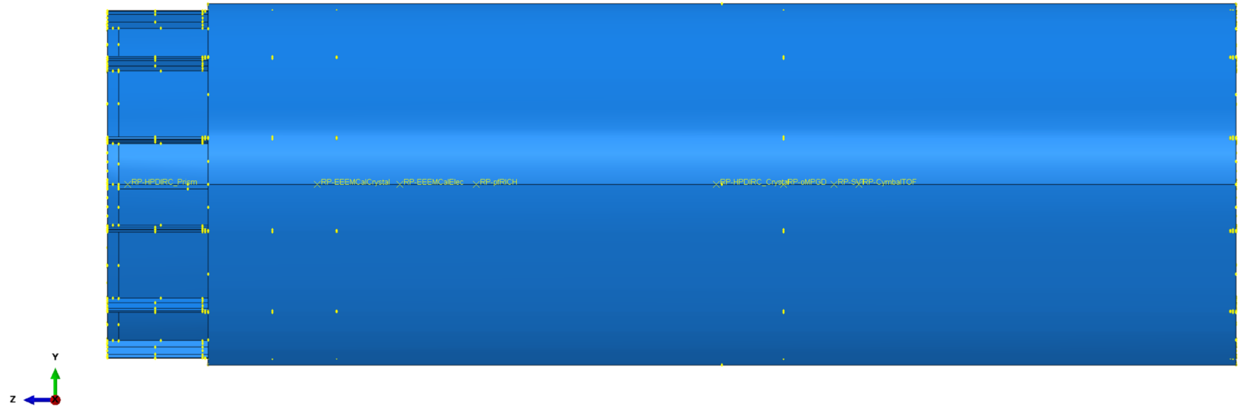
HM63-EX1515
and Nomex Honeycomb

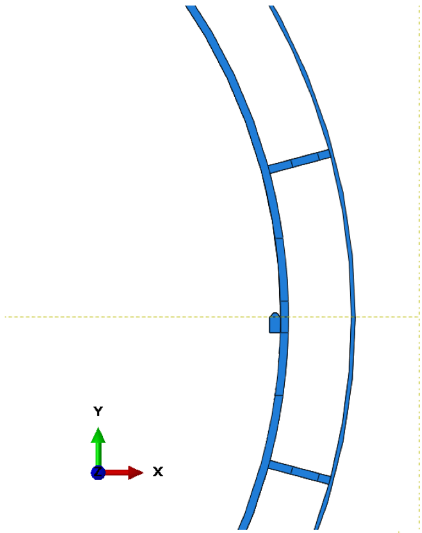


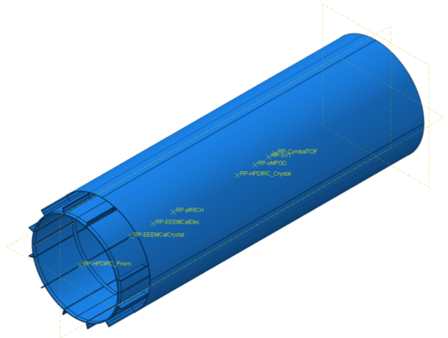


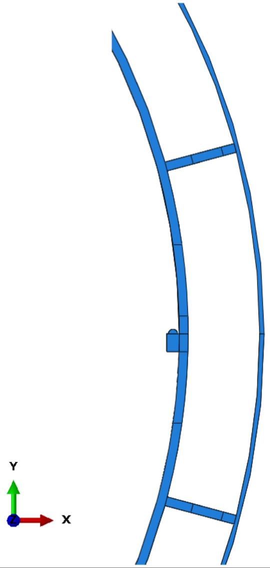
GST – additional drawings

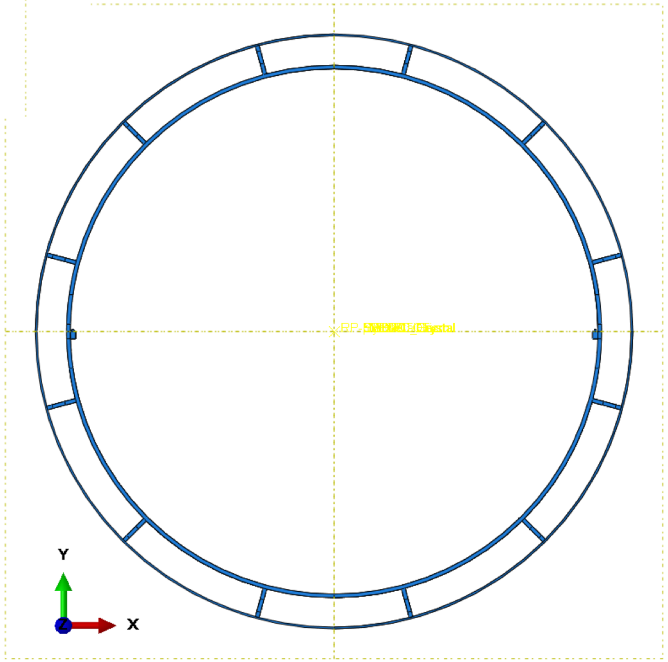
- Detailed drawings









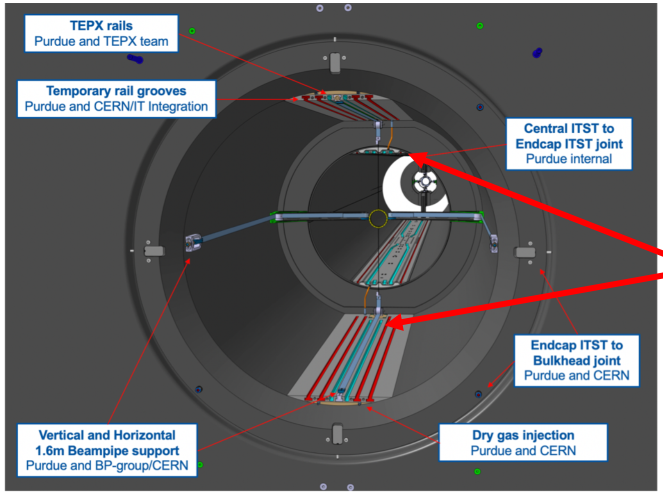


Beampipe support

Charge 3, 6

Example of the CMS permanent beam pipe support at z = 1.6m

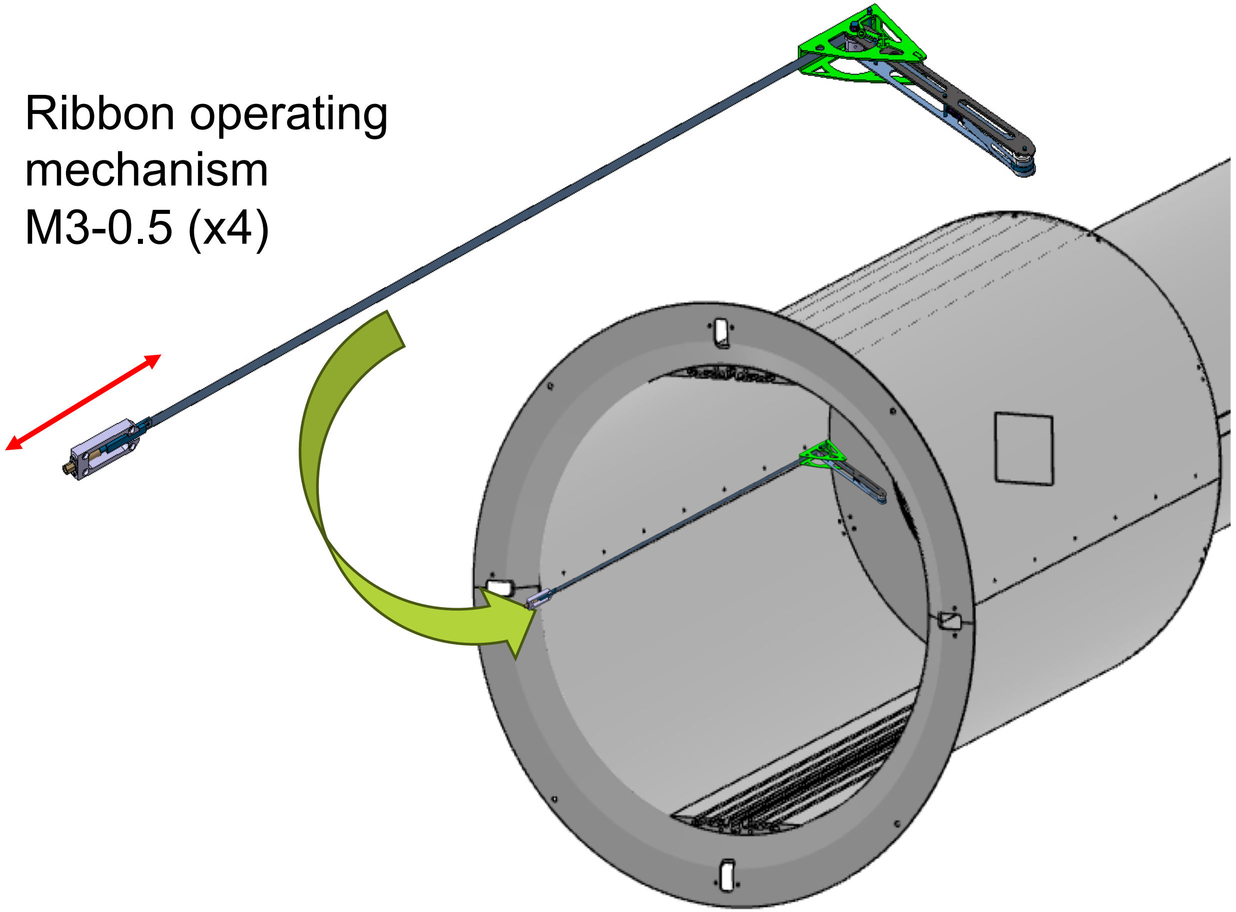
- For the arm we want to bond a curve-to-flat adapter with inserts 4x M3 inside the ITST.
  - At the moment, precise z-locations are yet to be determined, not critical

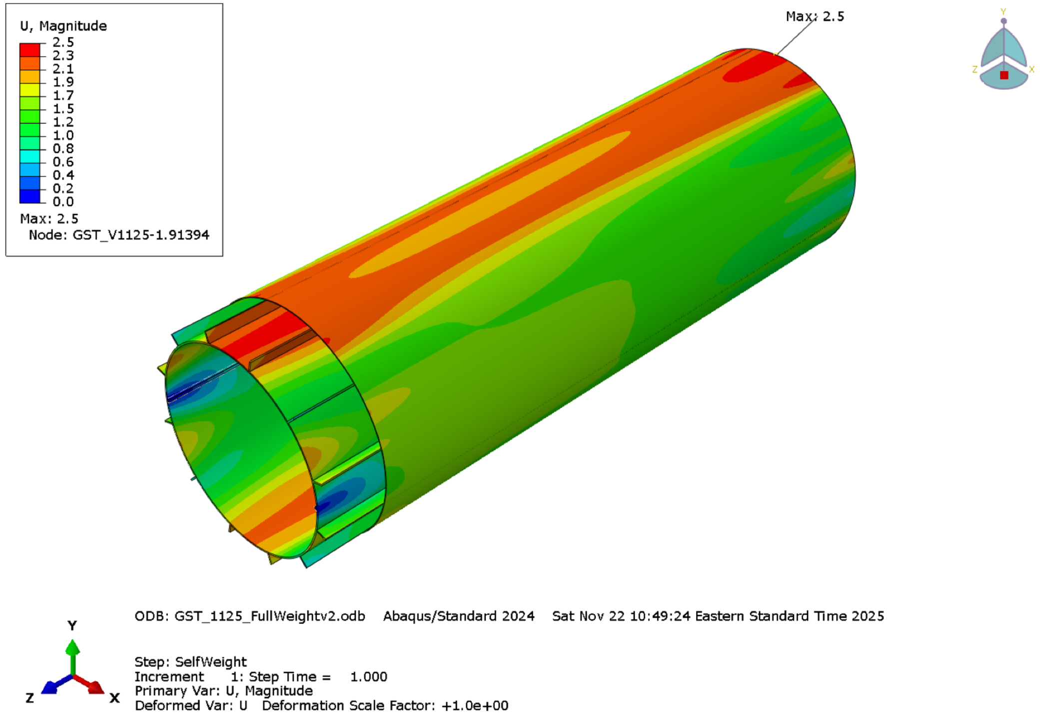


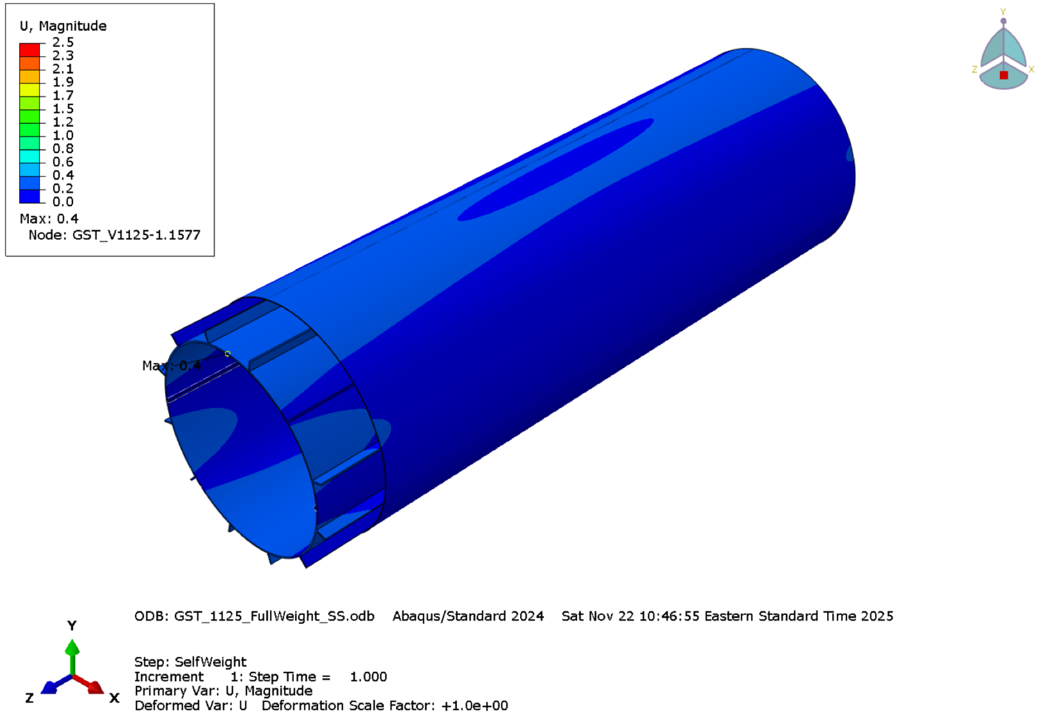
Vertical BP supports at 1.6m

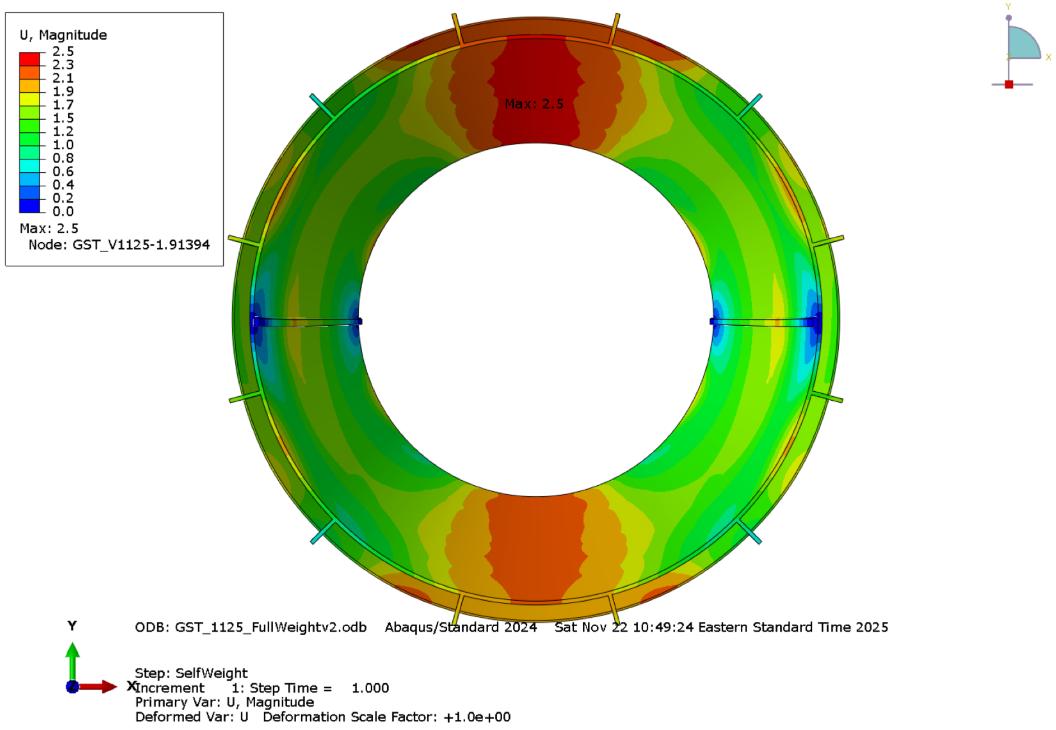
Arm with curve-to-flat adapter and M3-0.5 (x4)

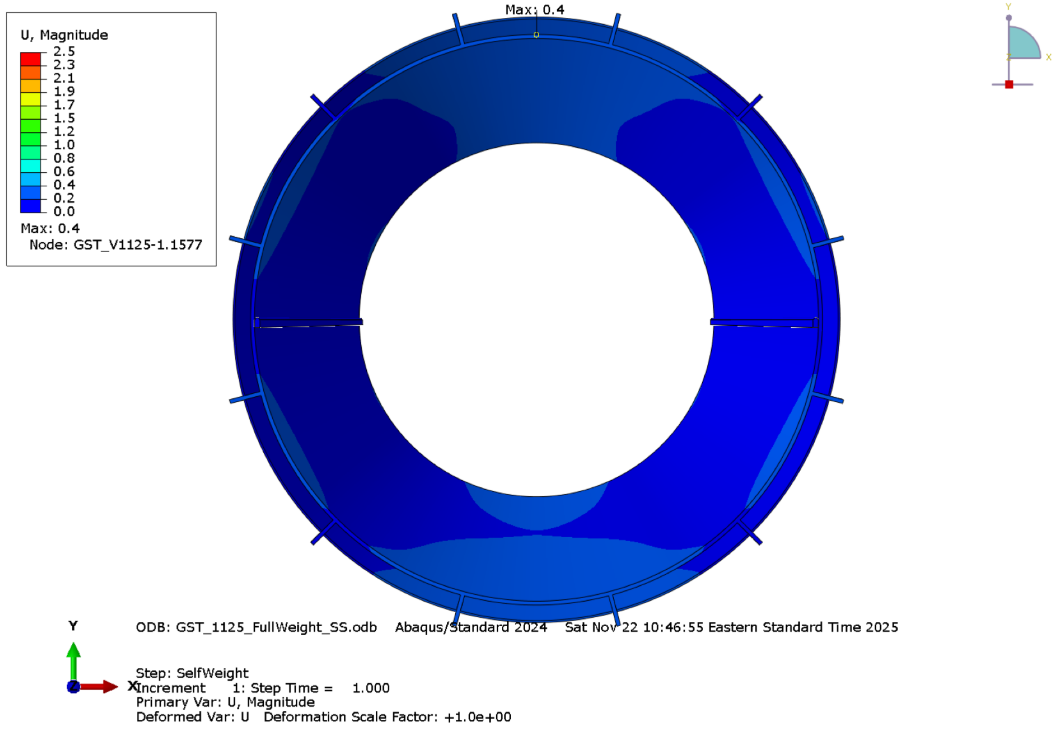
Ribbon operating mechanism M3-0.5 (x4)




U, Magnitude
2.5
2.3
2.1
1.9
1.7
1.5
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Max: 2.5
Node: GST_V1125-1.91394
Max: 2.5
ODB: GST_1125_FullWeightv2.odb Abaqus/Standard 2024 Sat Nov 22 10:49:24 Eastern Standard Time 2025
Step: SelfWeight
Increment 1: Step Time = 1.000
Primary Var: U, Magnitude
Deformed Var: U Deformation Scale Factor: +1.0e+00
Y
Z
X


U, Magnitude
2.5
2.3
2.1
1.9
1.7
1.5
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Max: 0.4
Node: GST_V1125-1.1577
Max: 0.4
ODB: GST_1125_FullWeight_SS.odb Abaqus/Standard 2024 Sat Nov 22 10:46:55 Eastern Standard Time 2025
Step: SelfWeight
Increment 1: Step Time = 1.000
Primary Var: U, Magnitude
Deformed Var: U Deformation Scale Factor: +1.0e+00
Y
Z
X


U, Magnitude
2.5
2.3
2.1
1.9
1.7
1.5
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Max: 2.5
Node: GST_V1125-1.91394
Max: 2.5
ODB: GST_1125_FullWeightv2.odb Abaqus/Standard 2024 Sat Nov 22 10:49:24 Eastern Standard Time 2025
Step: SelfWeight
Increment 1: Step Time = 1.000
Primary Var: U, Magnitude
Deformed Var: U Deformation Scale Factor: +1.0e+00

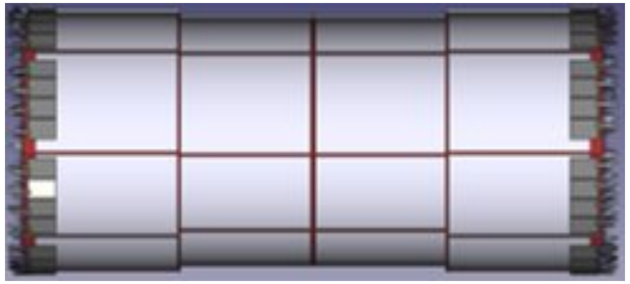

U, Magnitude
2.5
2.3
2.1
1.9
1.7
1.5
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Max: 0.4
Node: GST_V1125-1.1577
Max: 0.4
ODB: GST_1125_FullWeight_SS.odb Abaqus/Standard 2024 Sat Nov 22 10:46:55 Eastern Standard Time 2025
Step: SelfWeight
Increment 1: Step Time = 1.000
Primary Var: U, Magnitude
Deformed Var: U Deformation Scale Factor: +1.0e+00

Scope Definition

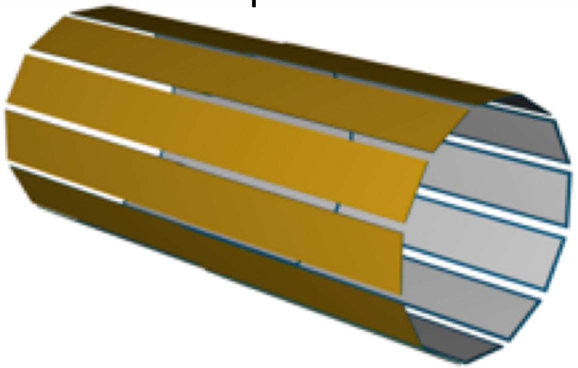
- MPGD trackers use MicroMegas for the inner barrel and μRWELL technology for the outer barrel and endcaps
- In the barrel, each tracker is segmented in 12 sectors in Phi
  - Micromegas (CyMBaL) has 4 modules in the z direction and total of 48 modules, whereas μRWELL has 2 modules in z direction with a total of 24 modules
  - μRWELL Disks have 2 layers in each direction of Z and 4 modules in Phi, adding to 16 modules
- Each MPGD detector readout with SALSA frontend electronics and equipped with all services, including cooling and gas system

Outer Barrel MPGD Tracker

MicroMegas

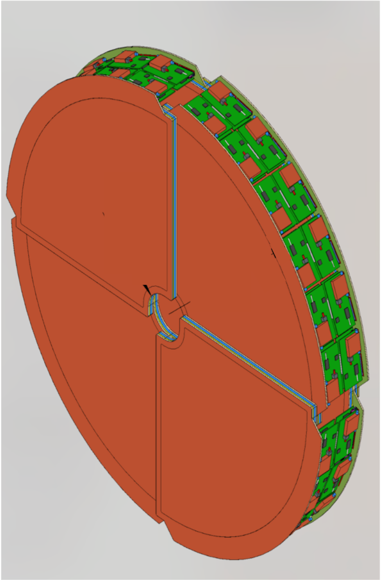


μRWELL

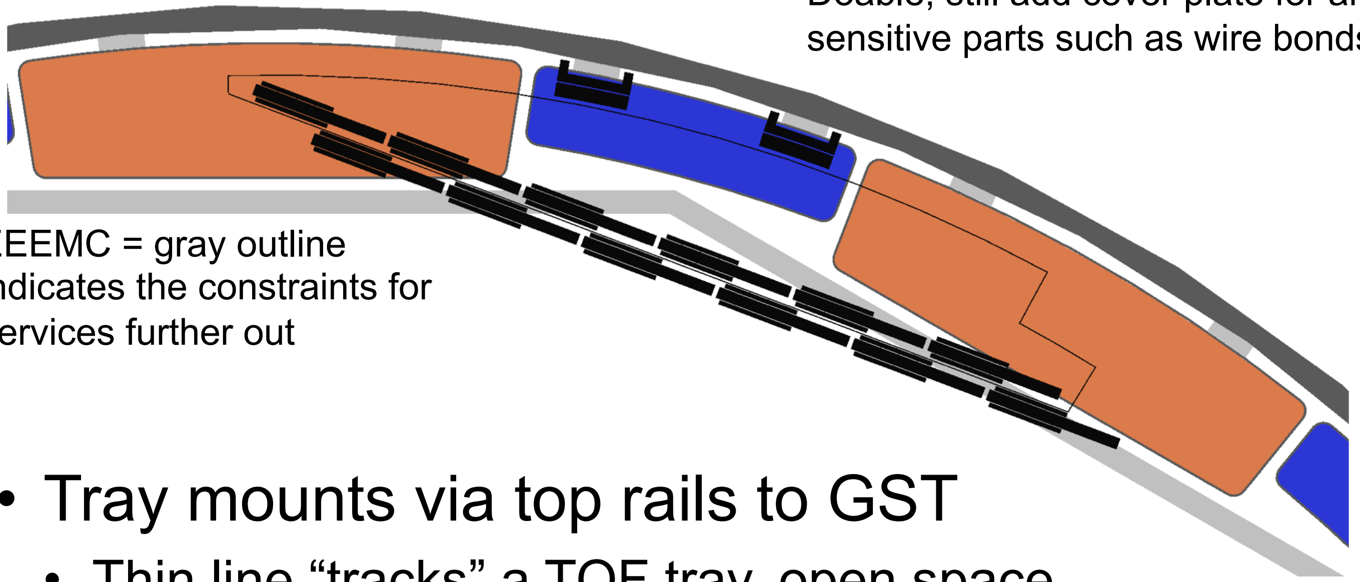


Endcap MPGD Tracker

μRWELL



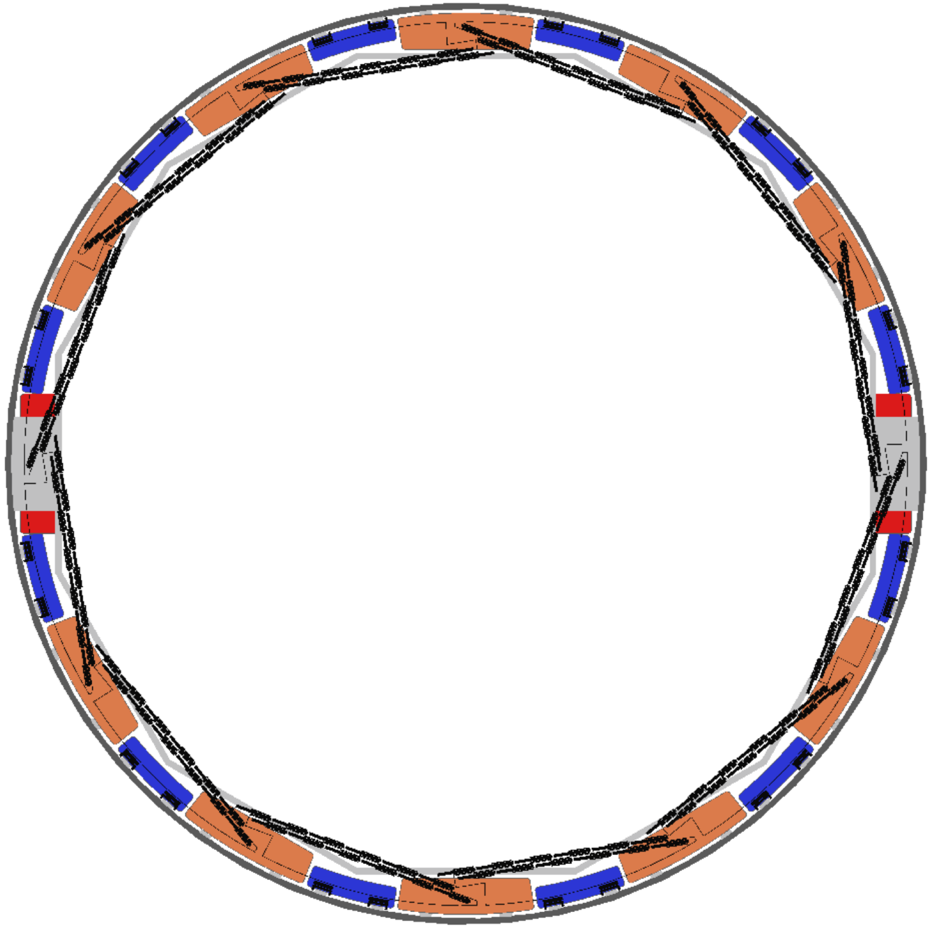
Support of the barrel TOF staves: 12 trays



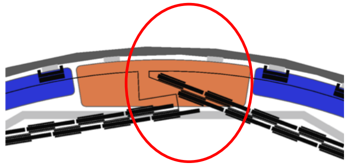
- 10mm clearance is closest distance
- Doable, still add cover plate for any sensitive parts such as wire bonds

EEEMC = gray outline indicates the constraints for services further out

Orange = mostly SVT + inner MPGD discs
Blue = TOF + inner MPGD barrel ("Cymbal")



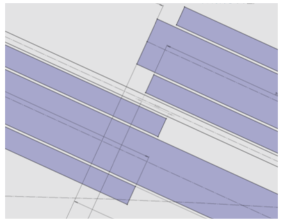
- Tray mounts via top rails to GST
  - Thin line "tracks" a TOF tray, open space inside is for services of TOF
  - Designed for 2mm overlap
- Other solidly filled areas are "reserved" for service of SVT+oMPGD and TOF+iMPGD

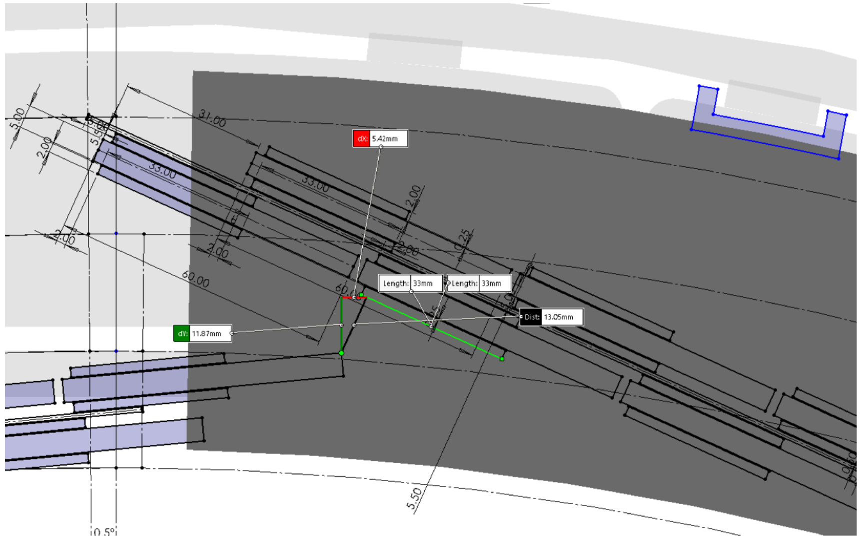


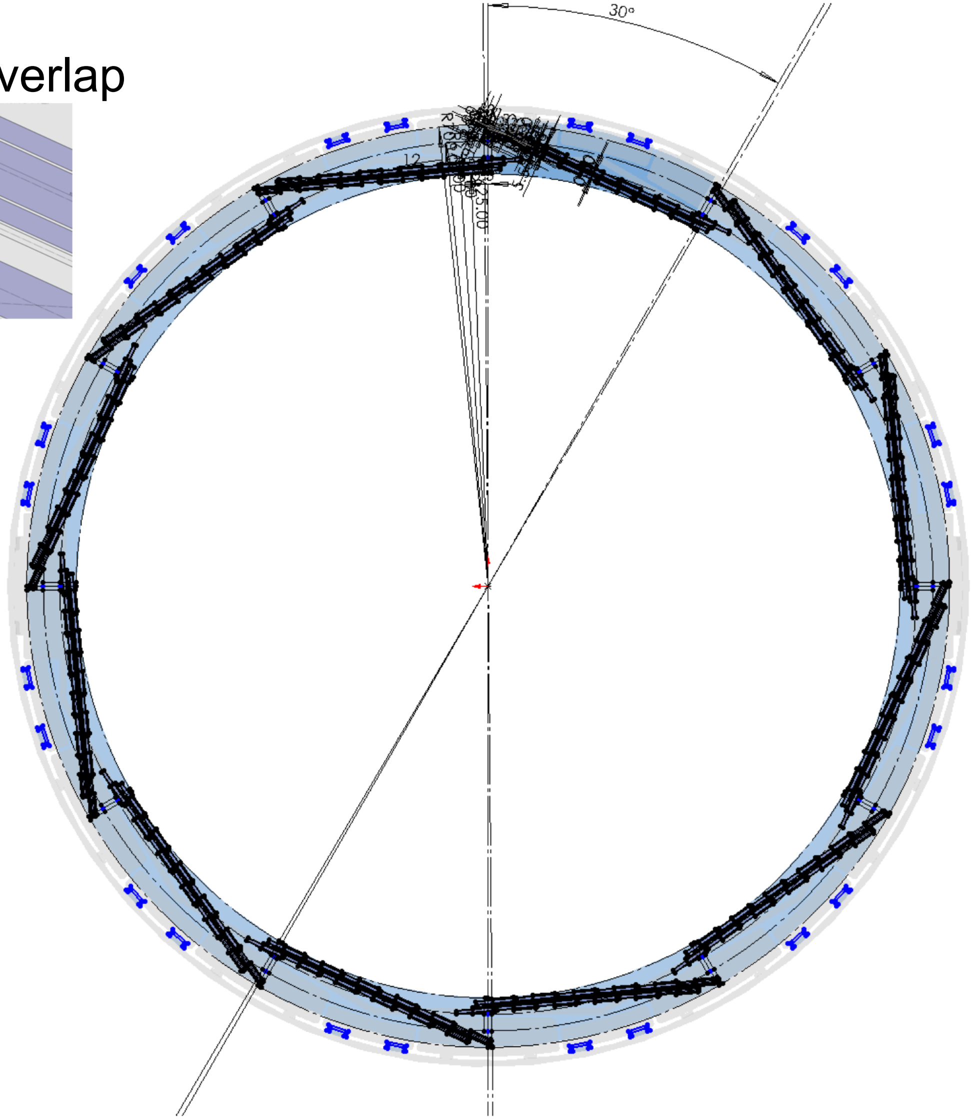
TOF – Design considerations

- Detector modules need to overlap to guarantee coverage in r-phi
  - Designed for 2mm overlap
- Integration/Assembly
  - 10mm clearance is closest distance
  - Doable, still add cover plate for any sensitive parts such as wire bonds

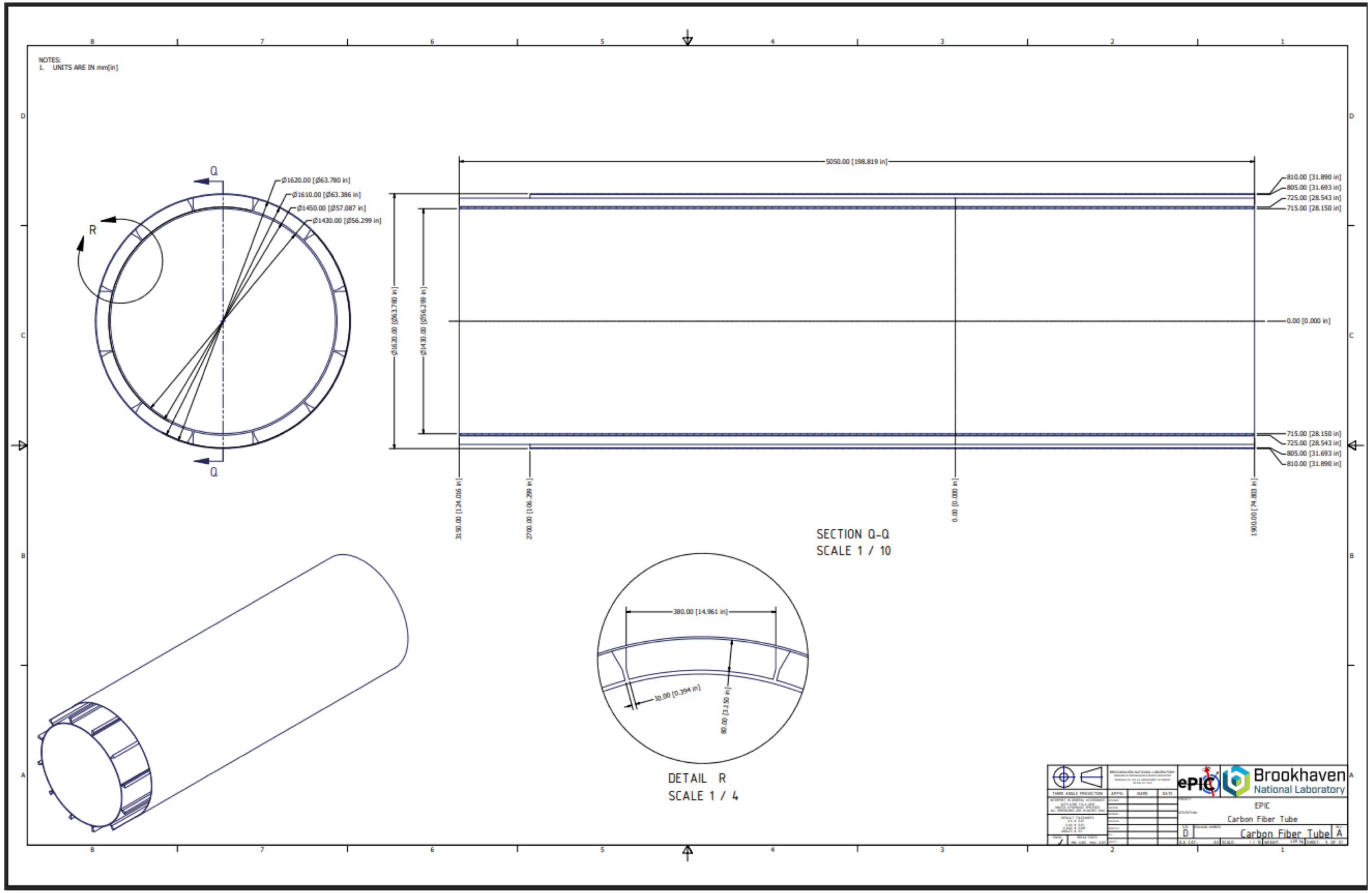
2mm overlap



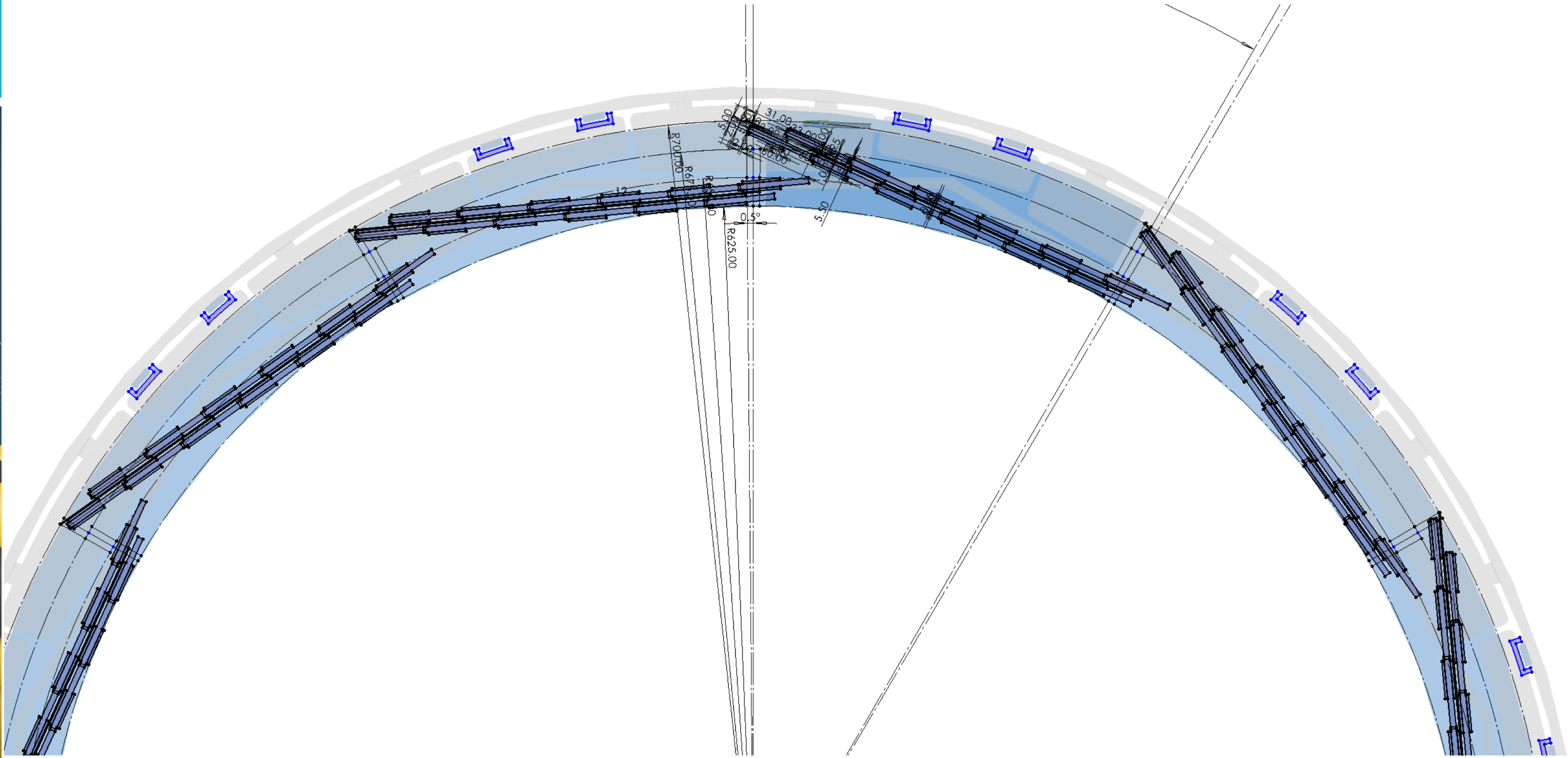




GST CAD Drawings



Closest clearance is 10mm



Detector Integration Layout

Charge 3, 6