TOF mechanics – Integration and support structure

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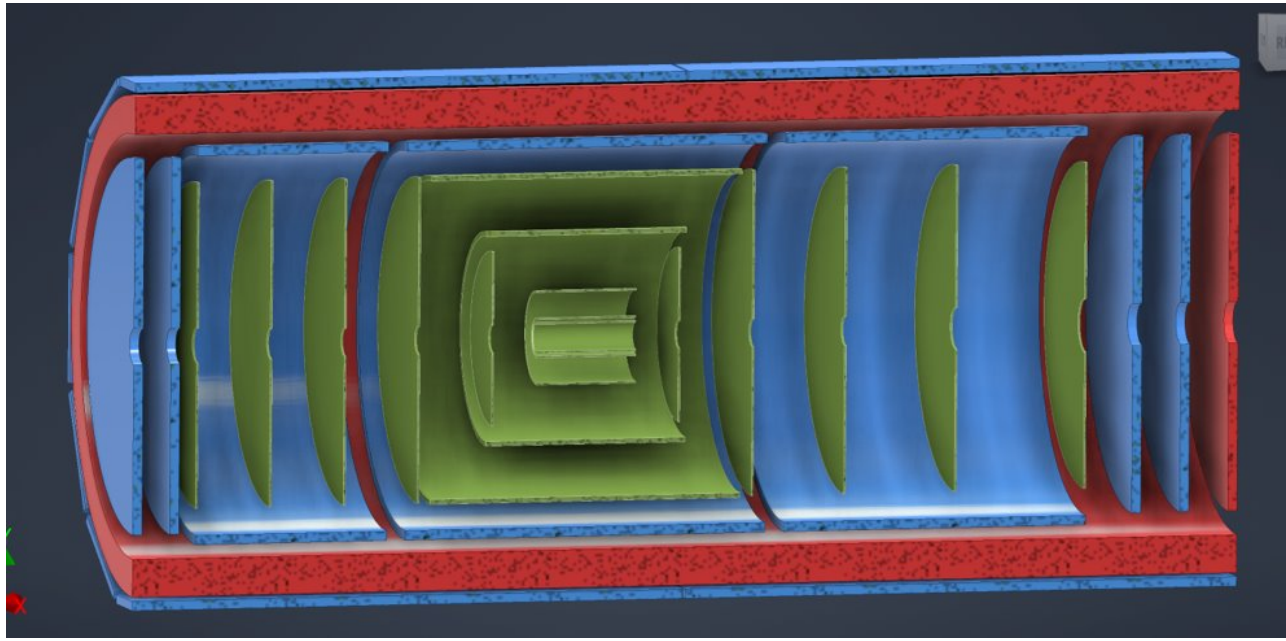
Global Support Tube / GST

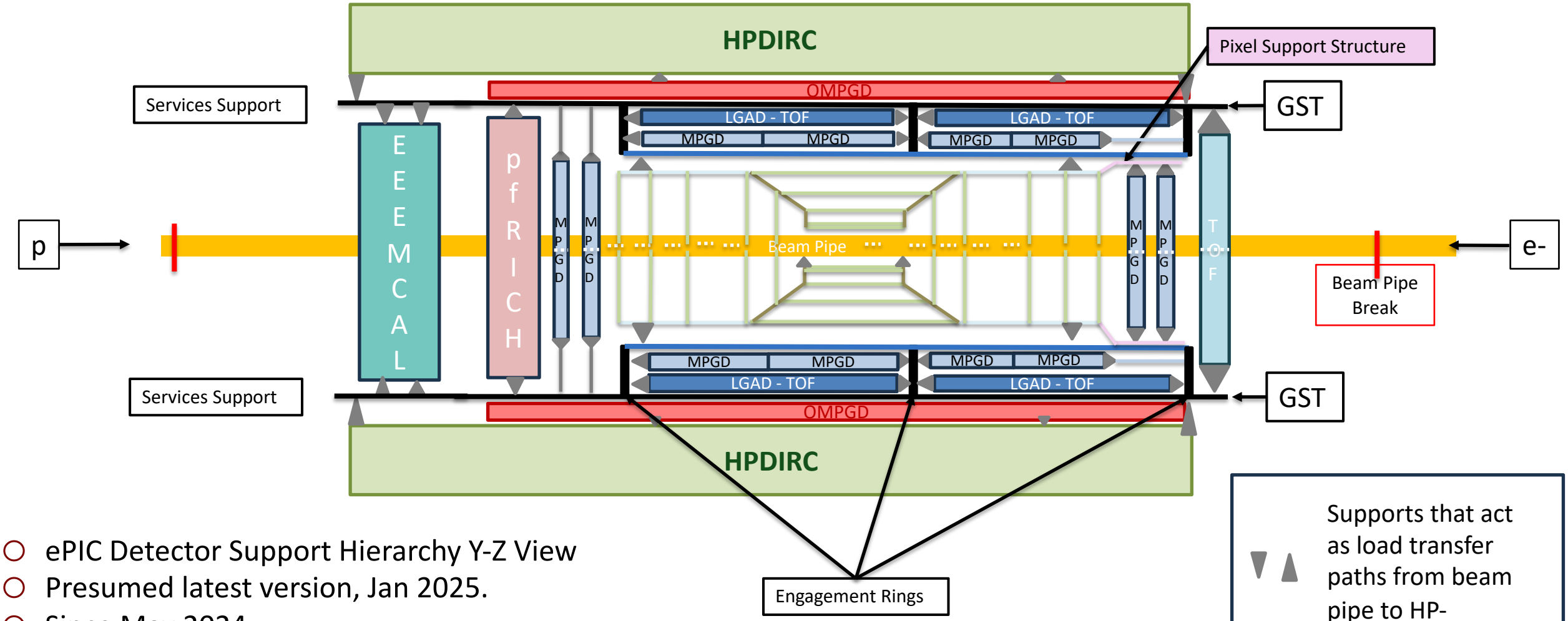
- Design of supports for inner detectors depends on support hierarchy and detector “integration” and assembly
  - Defined at the EPIC Mechanics workshop in May 2024
- Naturally, supports and interfaces are as light-weight as possible but services and “cooling” needs space and need to be considered
- Nomenclature: large global inner detector CF support tube or GST
- Lets first look at an integration sequence of **“inner detectors”**

“Inner detectors” = inside of the large global CF support tube



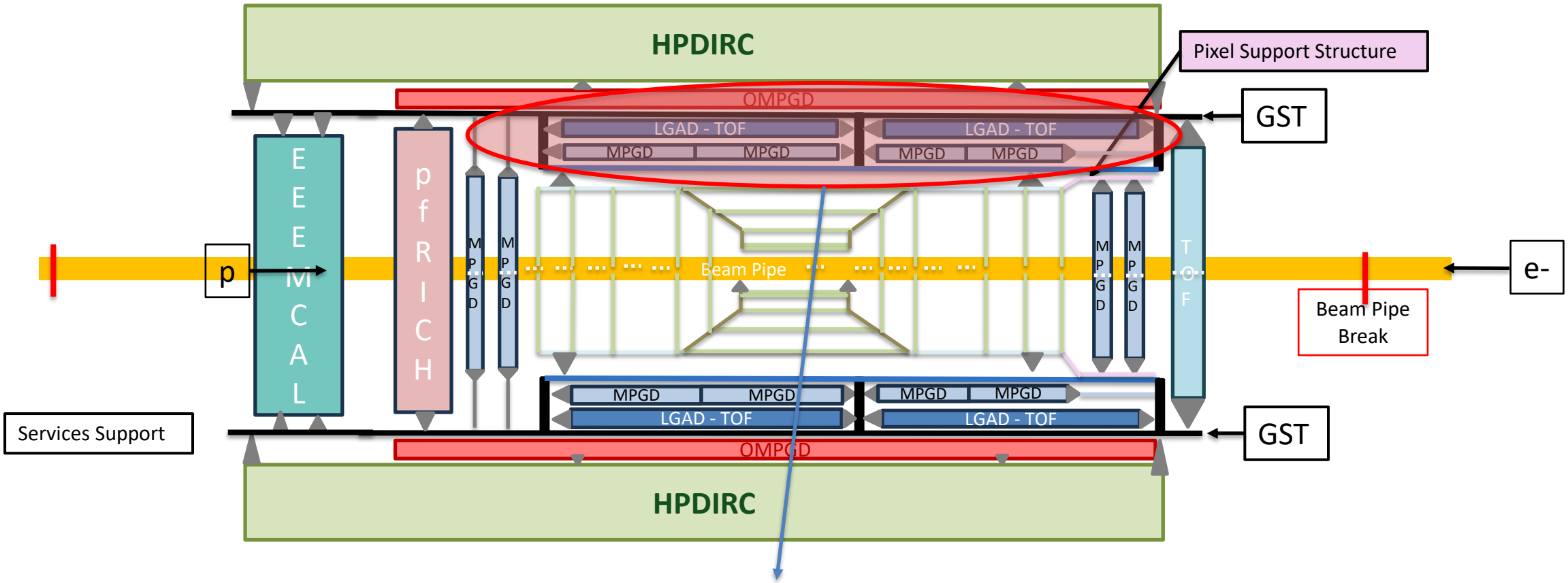
Global Support Tube / GST (**needs updates!**)

Working Draft – NOT TO SCALE



- ePIC Detector Support Hierarchy Y-Z View
- Presumed latest version, Jan 2025.
- Since May 2024:
  - GST extended beyond EEEMCal, support discussed

Global Support Tube / GST

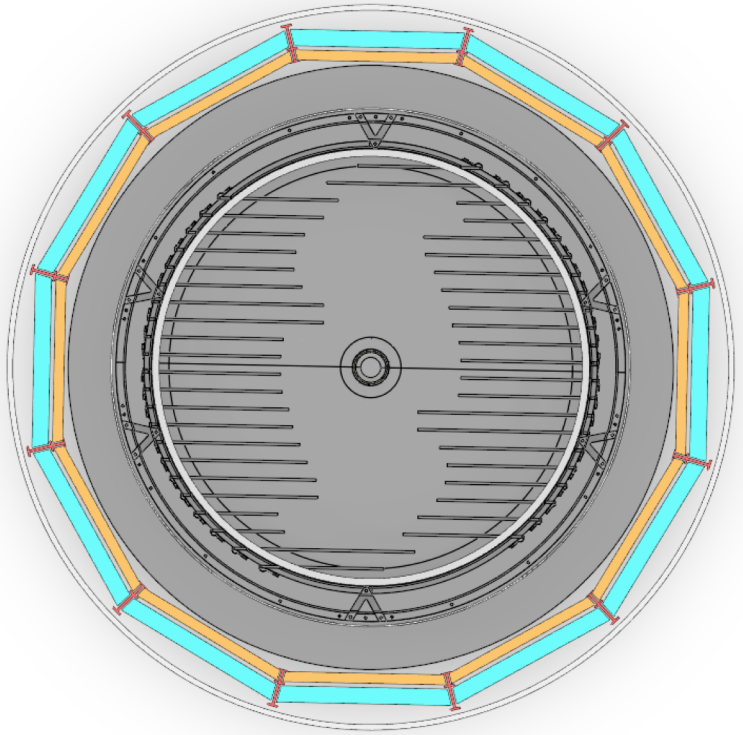


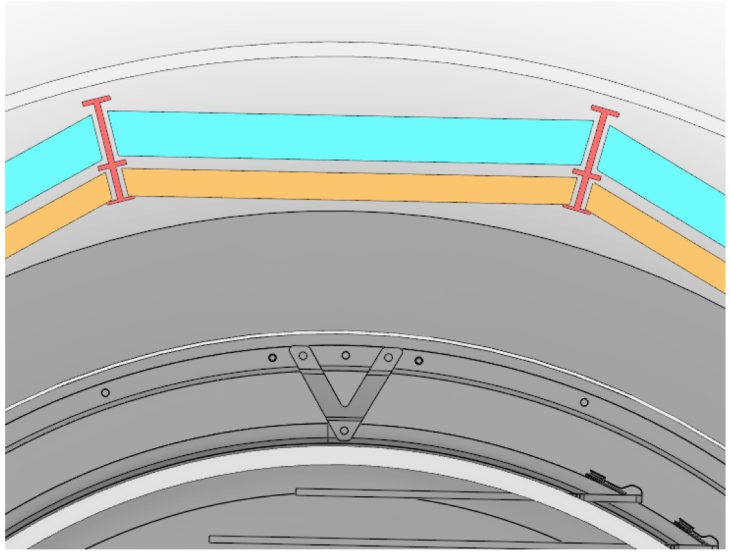
- ePIC Detector Support Hierarchy Y-Z View
- Presumed latest version, Jan 2025.
- Since May 2024:
  - GST extended beyond EEEMCal, support discussed

- Significant changes to achieve serviceability & ease maintenance
- Closer to the original bTOF support I suggested back in 2023
- No engagement rings anymore but “bTOF trays”

Maturing GST design

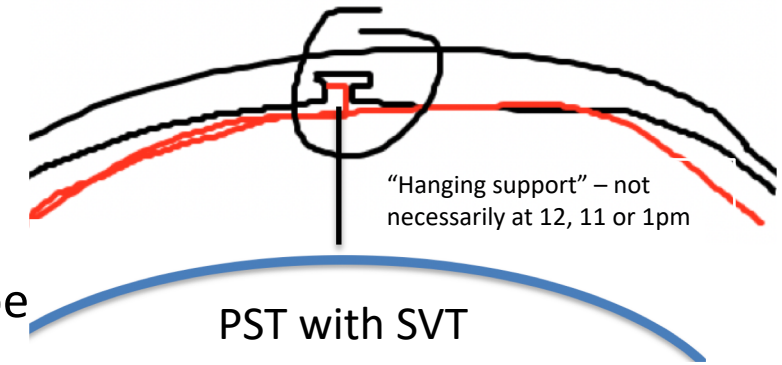
- Concept of trays in same “pattern” as inner MPGD for TOF allows to service easier
- “Rails” (red stubs) supported by GST beams and can be made as a package such that TOF does not loose acceptance in phi
- Decision to move to 12 sectors instead of 8 to avoid losses in space
  - Design changes for Cymbal 8 -> 12 sectors
  - TOF can accommodate and TOF mechanics team is directly involved in global mechanics
- Updates on Global Support Tube …

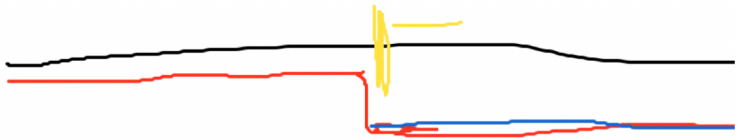




Accommodate / Develop installation sequence

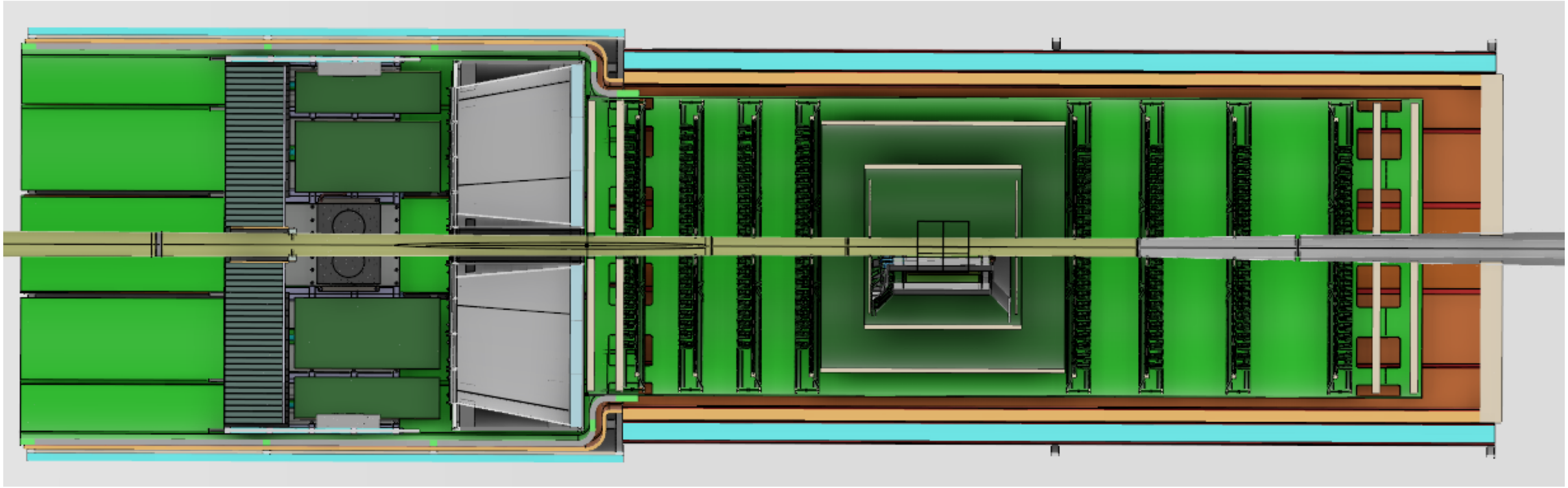
- GST full tube and cylindrical GST “beams” have a integrated “slot”
  - Allows sliding in and out a SVT package
  - Connect on dRICH side to external rails at same radii
  - SVT package is fully assembled SVT + MPGD discs and beam pipe
- SVT could mirror a TOF service arm with a “bend” structural and carry services out to past EEEMCAL
  - Allows to design a separate cassette carrying package of SVT + services, including beam pipe and MPGD discs
  - External rails from d-RICH side to install and insert the SVT package smoothly
  - Install TOF plus MPGD trays afterwards, there might be a path where only half of TOF needs to go out when pulling SVT
  - Assumes whenever something happens to SVT, the entire SVT needs to go out – this is in my view an SVT internal discussion that is happening anyways.





- PST ends and “interface” structure with bend to radii of GST
- Service arm of SVT at inner radius of GST
- Service arm runs in internal slot/track of GST

Additional sketches and drawings

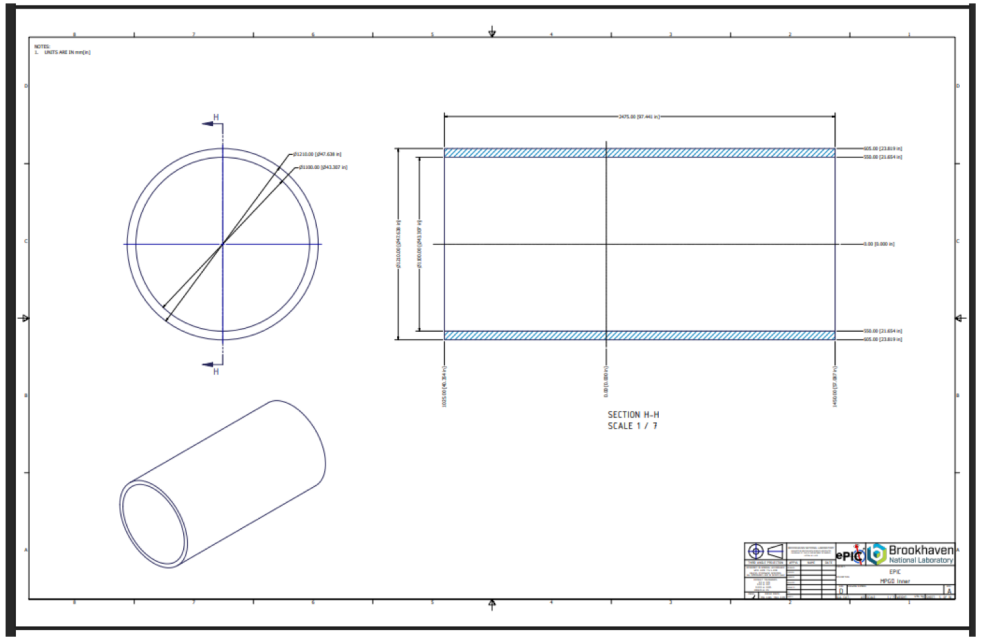


bTOF Stave production – some thoughts (my own)

- **Stave prototyping activities – happening now!**
  - Stave pathfinder institute for prototyping is Purdue + FEA baselining
  - Module thermal FEAs, activities between Santa Cruz, ORNL, and Purdue
  - Thermal testing + limited FEAs at NCKU
- **Production of staves**
  - Parts of raw material via Purdue and production via NCKU, ship back to US
- **Module assembly**
  - Purdue has experience & capacity for wire bonding, some first activities between Purdue & Santa Cruz
  - ORNL has also experience and capacity, I do not know details, @Matthieu
  - Module assembly interest by Taiwan (Yi), Japan (Satoshi)
  - Maybe have multiple sites ?
- **Flex circuits & whole electronics topic**
  - See agenda, today's discussion …
- **Stave system tests**
  - Only Stave thermal testing, see above
  - Grounding
  - Fully equipped Stave's with mock heaters or somewhat more real heaters
    - ORNL: details to be confirmed
    - Purdue can do system integration, we do have chiller for up to -10 C tests or soon (few weeks) also CO2 test setup that can be used as a facility
- **Stave integration**
  - Likely gantry supported
  - My biased view:
    - CMS pixel experience is with high TC grease for workability, screws and a CF clamp for good contact to stave
- **TOF assembly**
  - Global support tube at Purdue, limited mounting tests at Purdue. Ensure all is OK, then ship to BNL
  - Final assembly at BNL

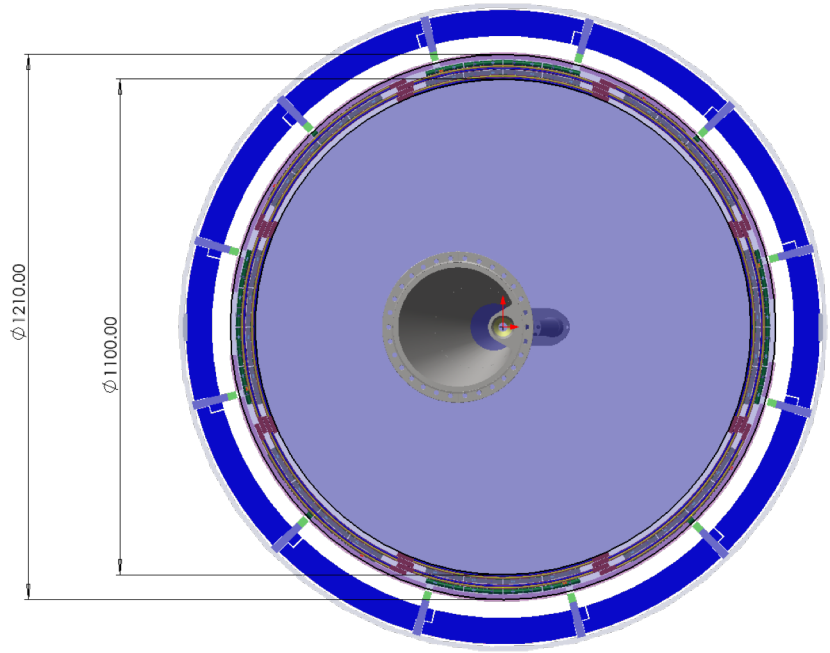
TOF assembly

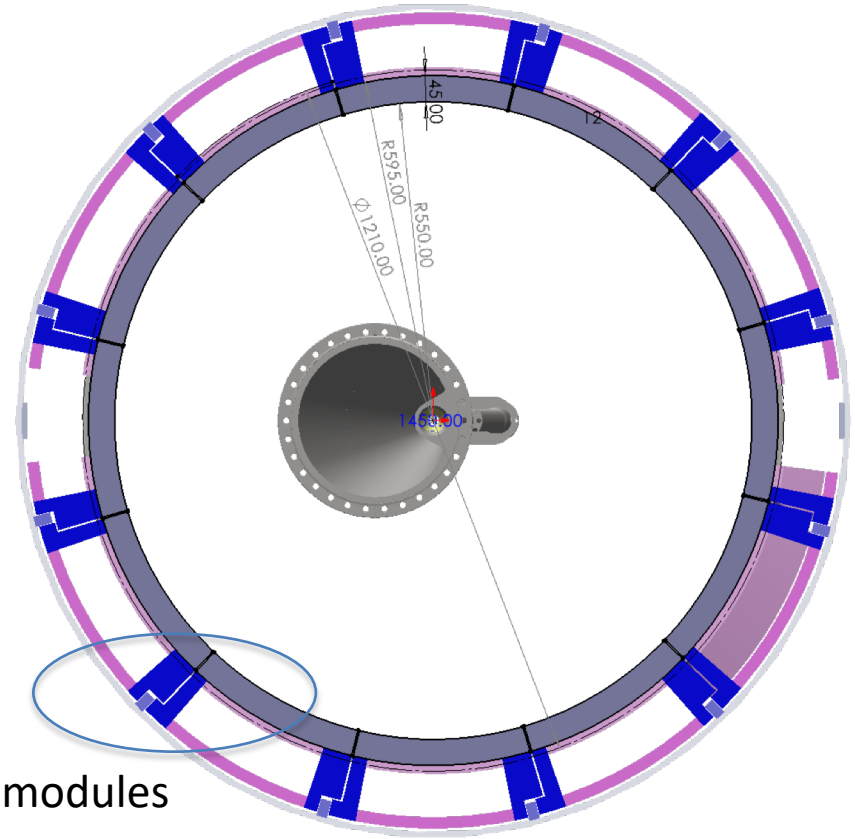
- The TOF and Cymbal will be segmented in 12 sectors along the r-phi plane inside the GST.
- This will enable installation and removal of the TOF + Cymbal sectors
- This is a second degree envelope model with interfaces for both the AC-LGAD barrel* and the Cymbal barrel mounts as positioned in the 12 sectors.
- This design allows for complete coverage in r-phi plane
- There will be some split / loss of coverage in the z which is unavoidable. (originally was 5mm due to engagement rings – still on that scale)

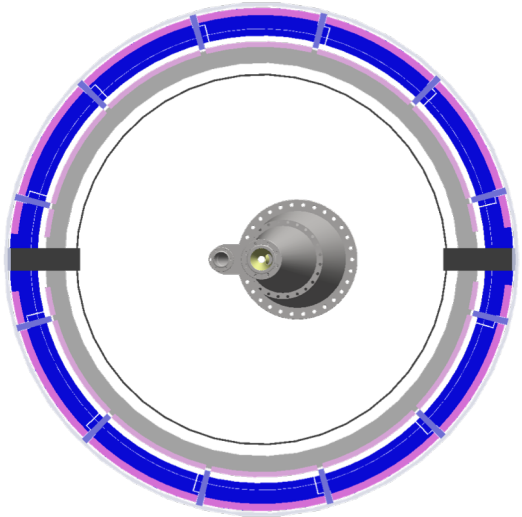


From Dan's envelope model March_2025

Cymbal MPGD Assembly Scheme

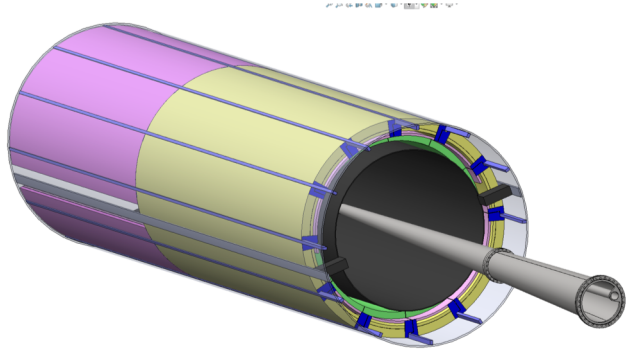


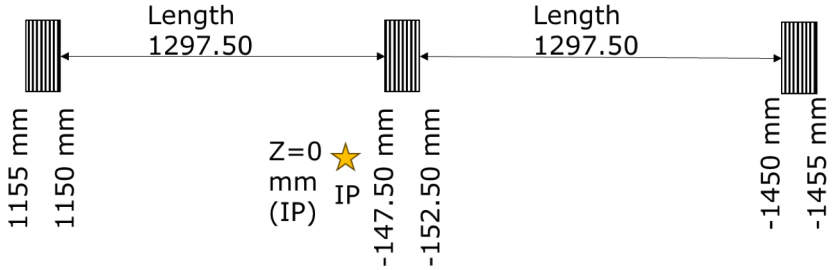




Designs allow overlapping bTOF modules in phi so that no loss of coverage

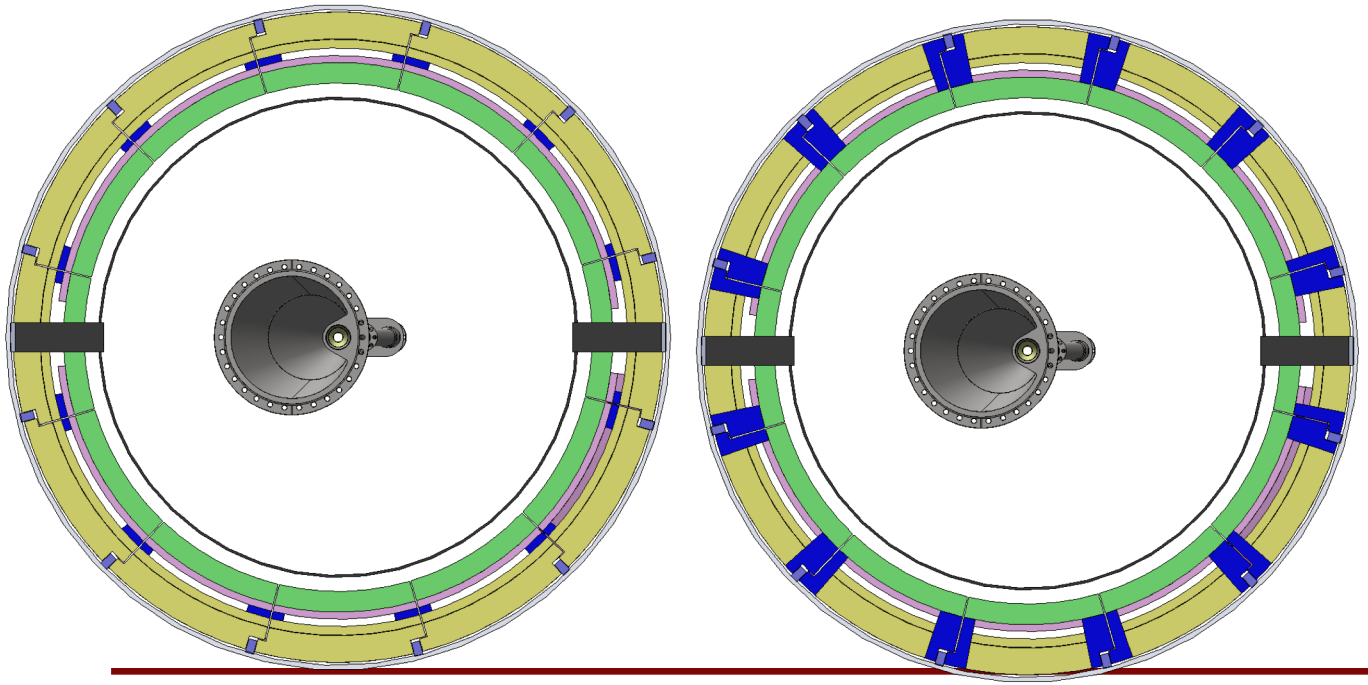
TOF assembly



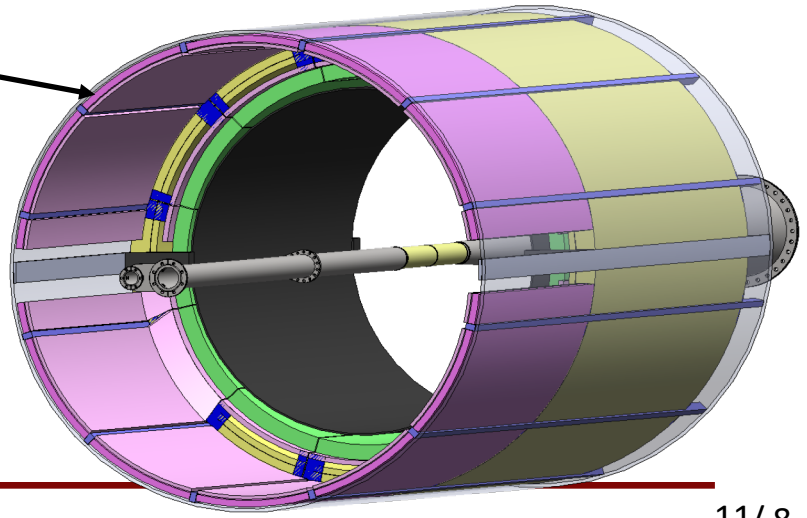


No engagement rings but otherwise the length and segmentation remains same

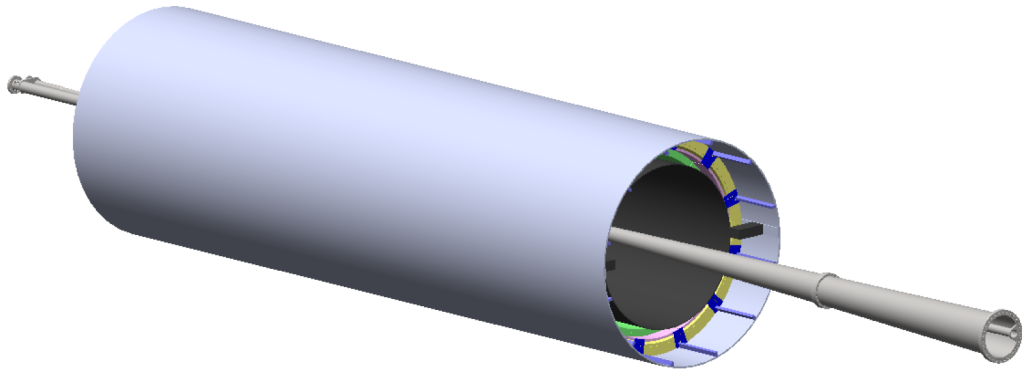
- TOF and Cymbal will be installed as combined sectors (12 sectors total) and will also share the trays for the services.
- The dimensions of the TOF and split on the staves (along z) remains unchanged.



Dark Pink if TOF service space



Global Installation Sequence



What this means for SVT

- a. installation and alignment of the PST + SVT + beam pipe package has about 2 cm radial clearance while installation.
- b. The final cabling of SVT will be AFTER installation of the 12 sectors of cymbal and barrel TOF
- c. Whenever there is a need to service a sector – at least 1/12th of the cabling on SVT will need to be un-done / un-cabled so that we can service this in the experimental cavern itself.

Global integration sequence –

1. GST with the rails in 3 and 9 o'clock is installed inside the Barrel EMCal and supported at 4 mount points at 3 and 9 o'clock on either ends in the assembly hall.
2. SVT package with the beam pipe is installed into the GST using temporary supports and Eifel tower like installation tool
3. 12 sectors of Cymbal and Barrel TOF are installed into the GST on rails in the experimental cavern.

Additional sketches and drawings