Global supports for the SVT

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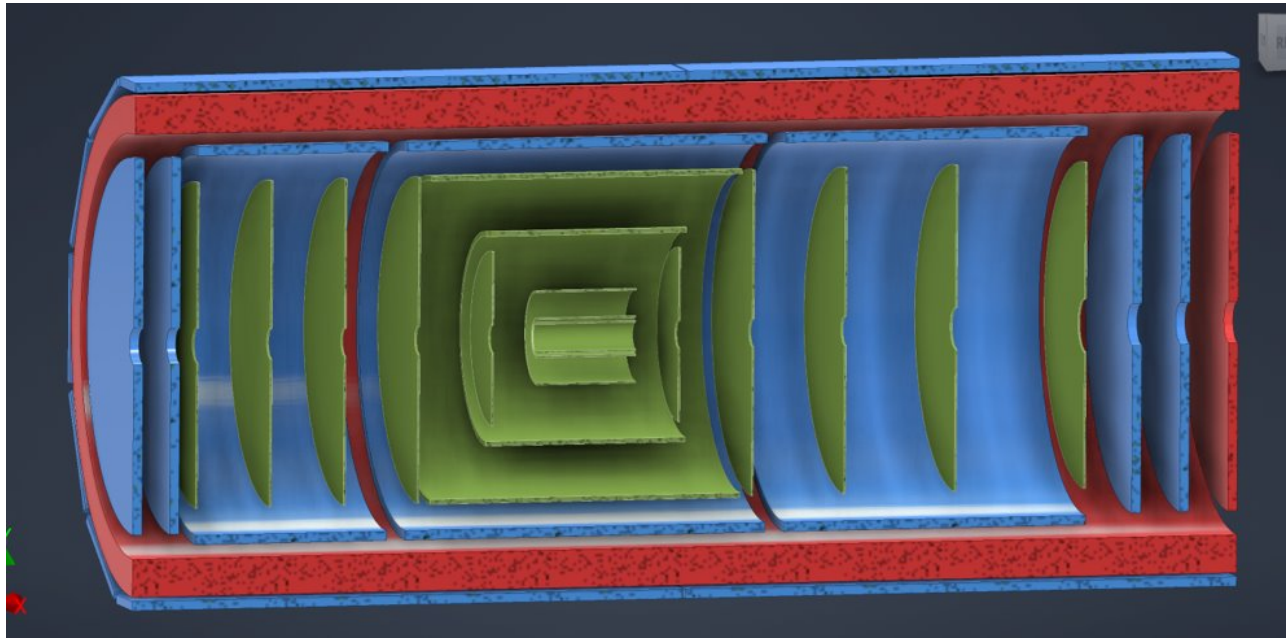
Global support structure for SVT

- Design of supports for SVT depends on support hierarchy and detector “integration” and assembly
- Dictates what structures are needed to support SVT and how…
- Naturally, as light-weight as possible but services and “cooling” needs space and need to be considered
- Lets first look at an integration sequence of **“inner detectors”**
- Nomenclature: large global inner detector CF support tube
- Suggest: “GIST”

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

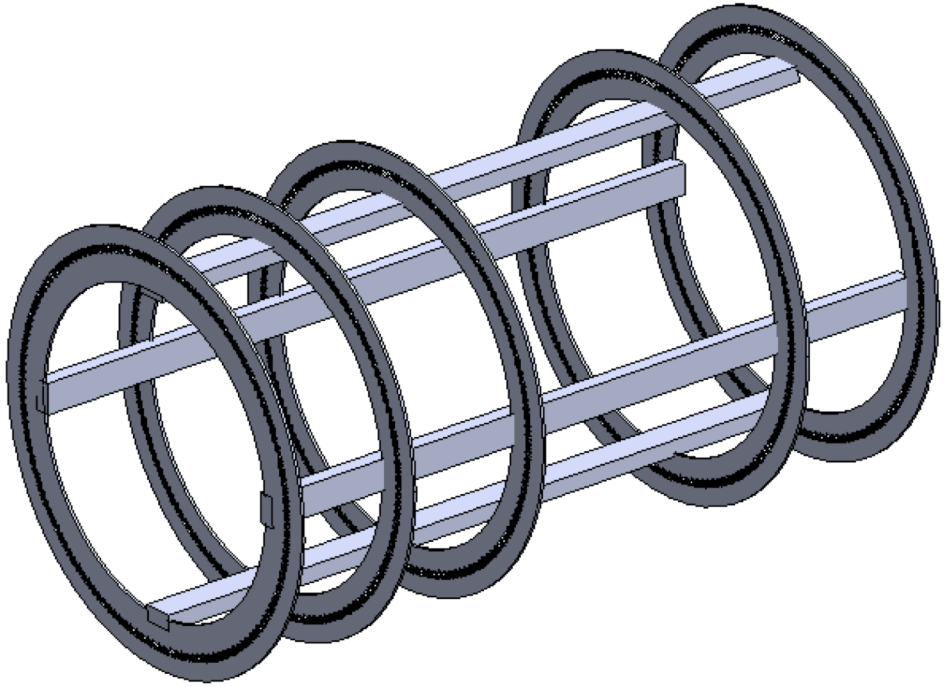


“Global” support structure for TOF

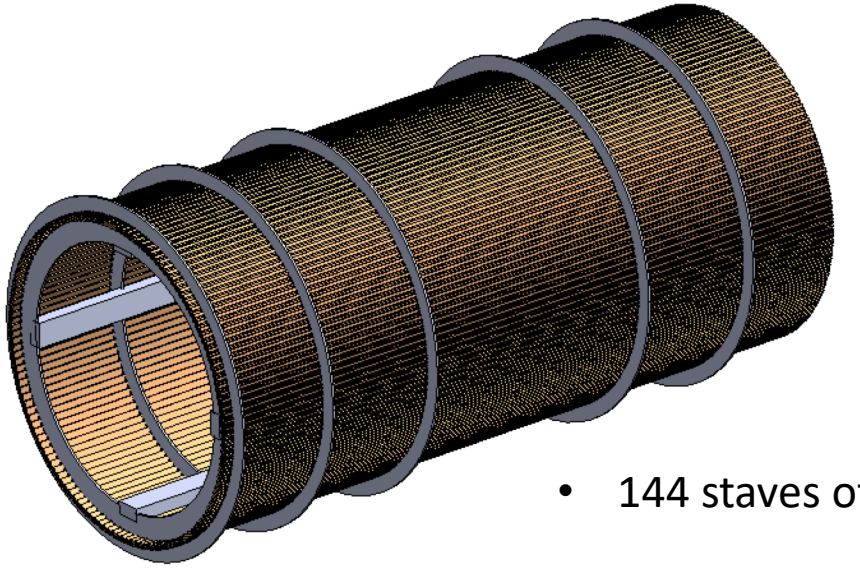
1. Set of engagement rings mounted on <u>temporary</u> inner rigid supports at 12, 3, 6, 9 o’clock positions for TOF assembly

<u>Nomenclature:</u>

- Stave = full length mechanical structure

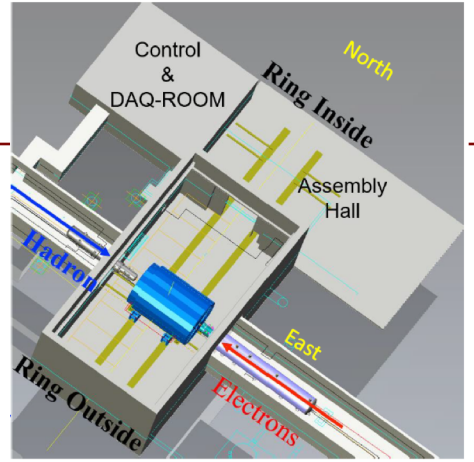


2. Completely mount and wire up the AC-LGAD staves when there is full access from inside and outside of these engagement rings
   - Permanent support for services via larger global CF support tube
   - Needs temporary support to feed out mechanics

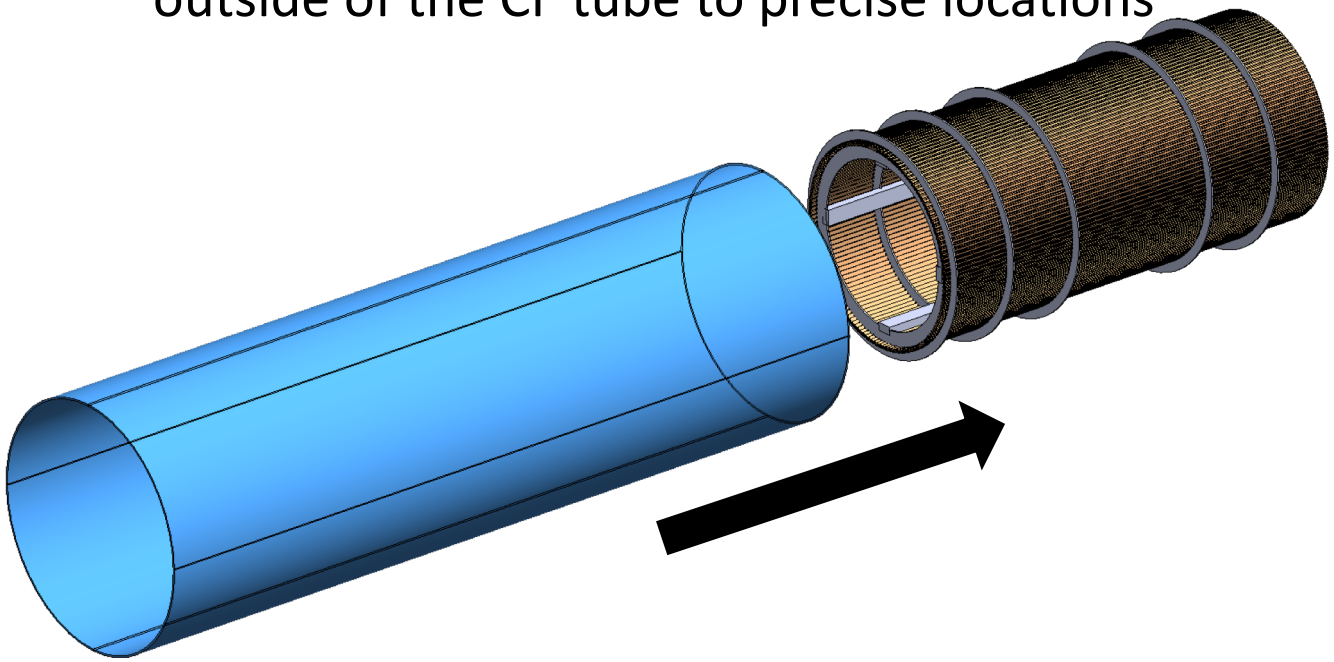


- 144 staves of 2.7m length

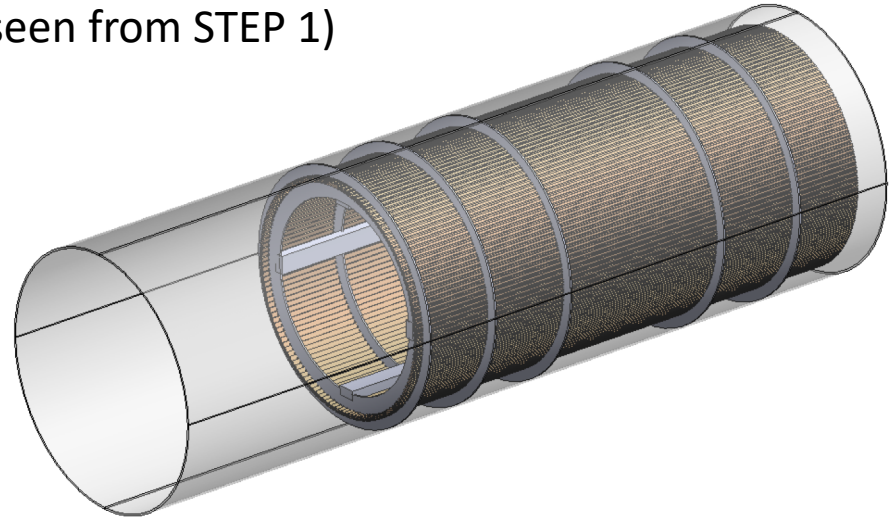
Integration sequence



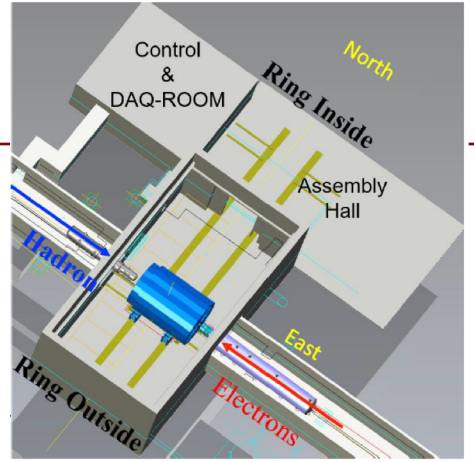
3. Slide in the CF support tube using temporary rails and other supports that can be removed later.
   - Installation “jig” and support for this task
4. Detailed FEA currently in process which may reveal adding “low-mass beams” connecting engagement rings
5. Fasten the engagement rings in place from outside of the CF tube to precise locations



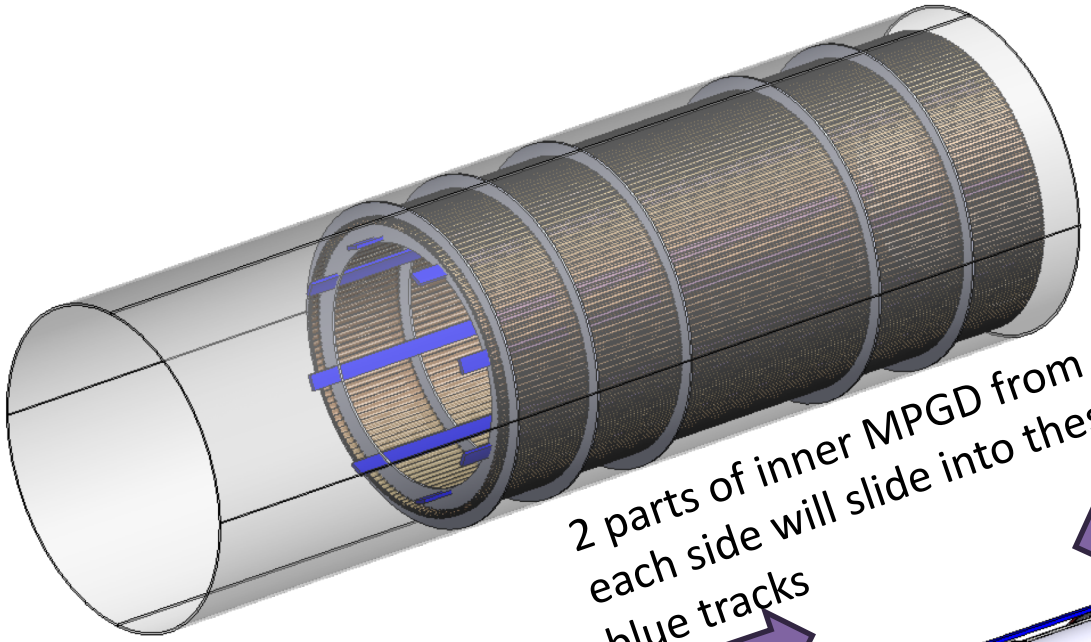
- Through-holes / threaded inserts allow to mount engagement rings
- Likely want to “de-couple” as much as possible
- Fasten the engagement rings and remove temporary inner supports (as seen from STEP 1)



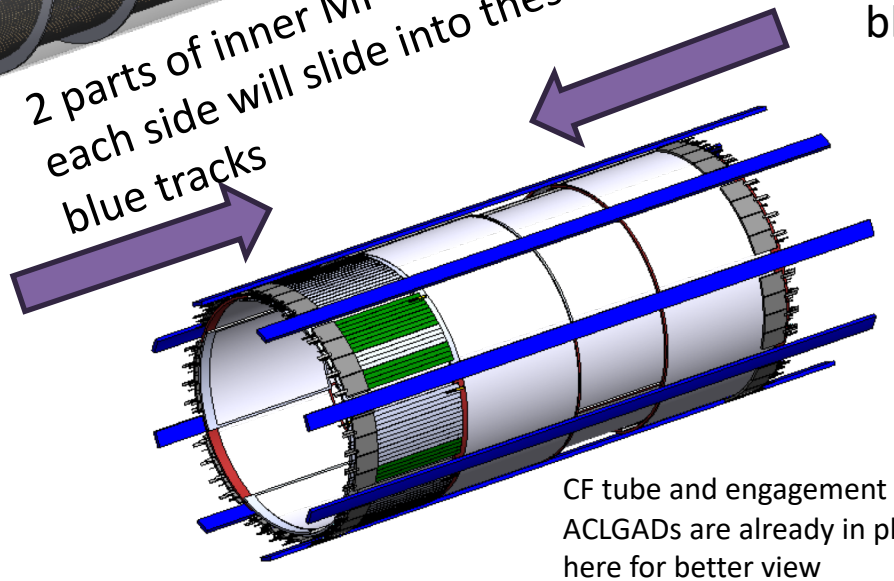
Integration sequence



5. Mount the blue inner MPGD supports on the engagement rings



2 parts of inner MPGD from each side will slide into these blue tracks



The MPGDs interface with the red supports from MPGD design onto this blue tracks that are load bearing

Temporary extension to blue tracks will be built to get those lengths all the way outside the CF tube

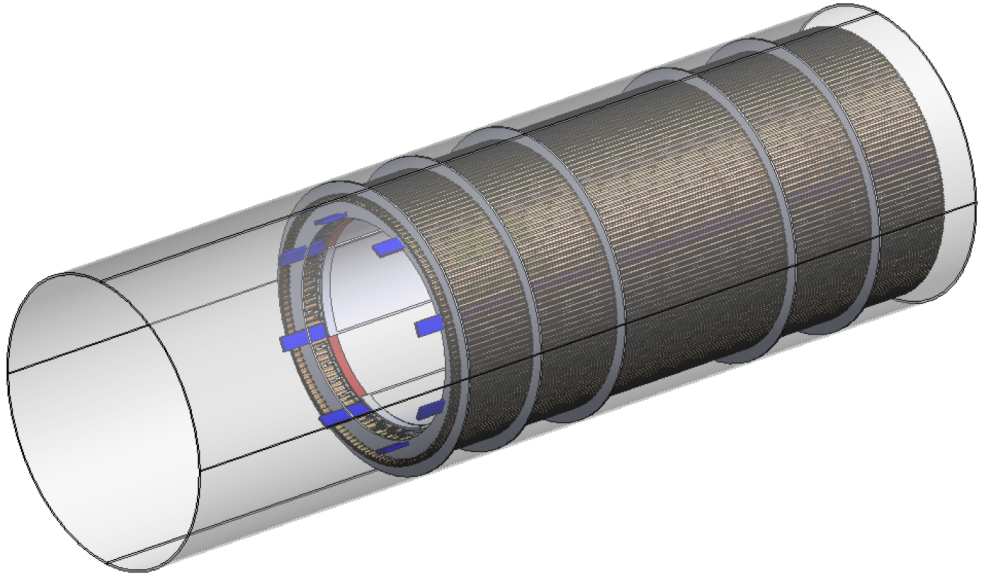
Note – this is barrelv4 – we are in the process of updating the CAD to barrelv3 – insertion concept will remain same

CF tube and engagement rings and ACLGADs are already in place – hidden here for better view

Integration sequence

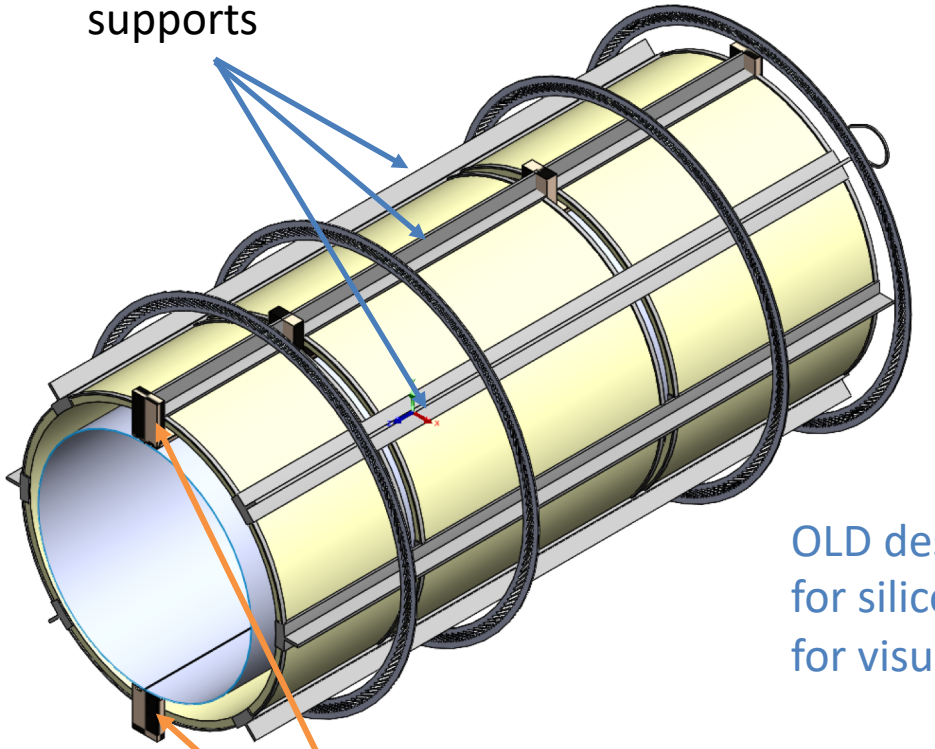
6. Wire up the inner MPGDs on electron and hadron side

- Temporary service supports might be needed



7. The rails and support structure for vertex comes next

MPGD tray supports that connect to the engagement rings and “red” MPGD supports



OLD design of the rails for silicon tracker – just for visualization

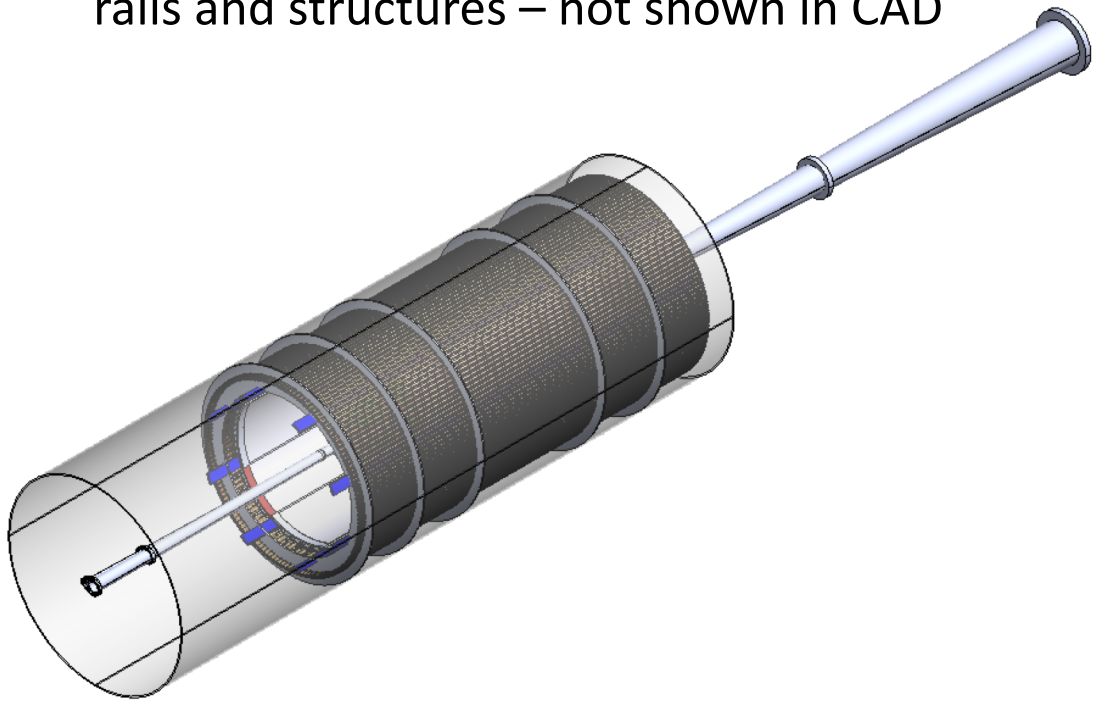
Silicon tracker can be mounted on rails to de-couple it from the MPGD support structure

Integration sequence

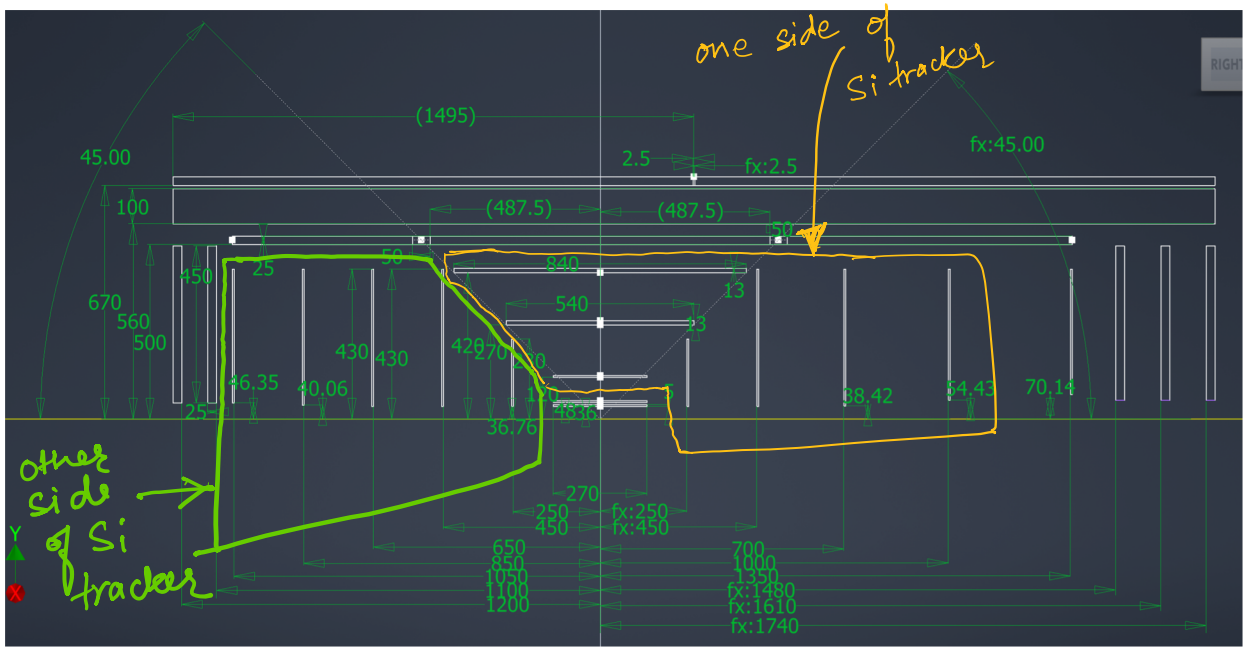
8. Beam pipe comes in next before the silicon tracker so that there is still enough room for bake out and other beam pipe installation sequence.

Caveat: **Requires full half hemispheres of SVT**

BEAM pipe is after the silicon tracker support rails and structures – not shown in CAD

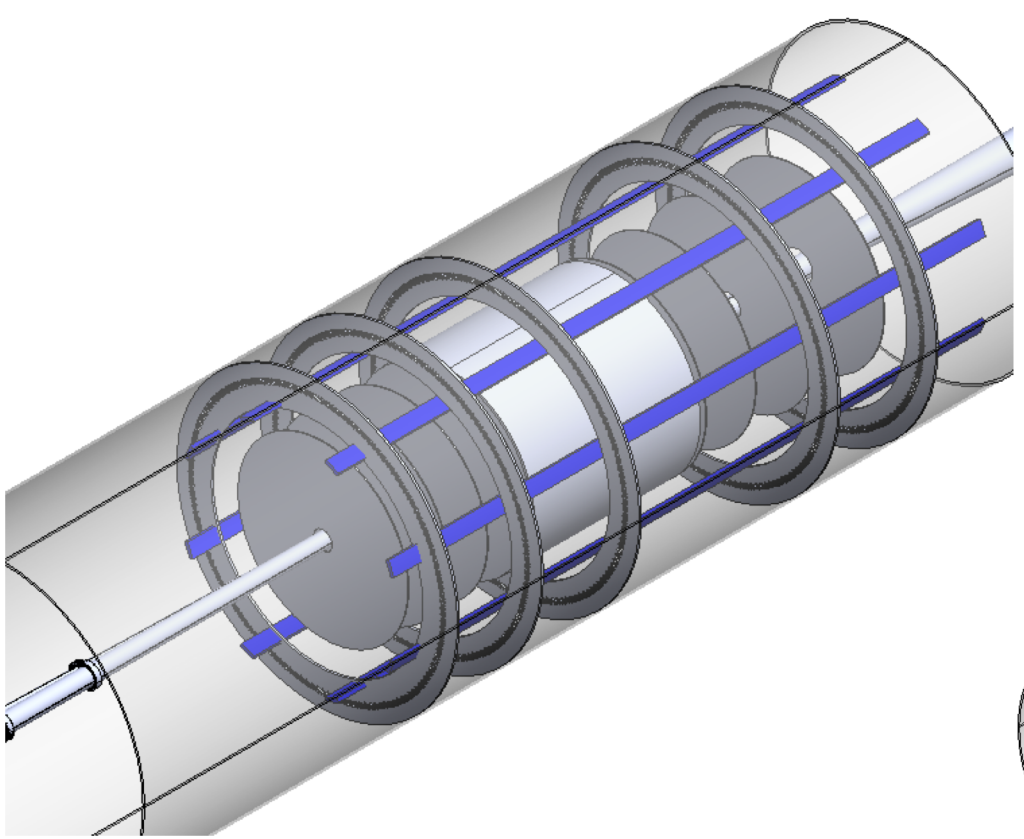


9. Inner silicon detectors are then slid on these rails from electron and hadron side – this is NOT symmetric – the structures will be split such that the changing diameter of the pipes is taken into account. A schematic is below.



Integration sequence

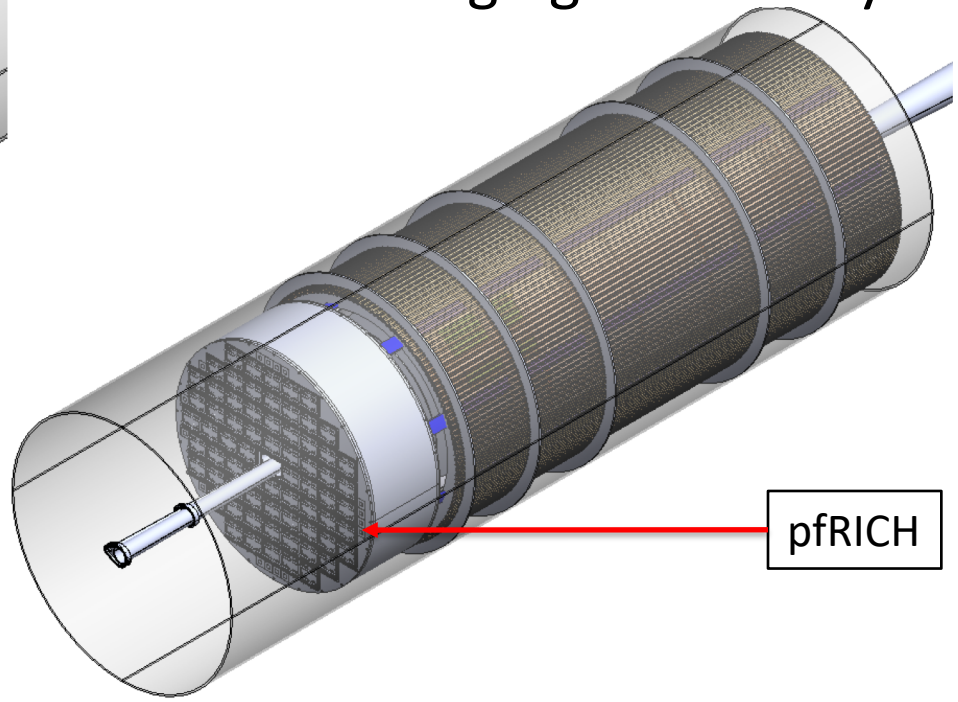
10. The outer discs of MPGDs come in next



11. All the services and wiring is pulled out till the ends of CF tubes

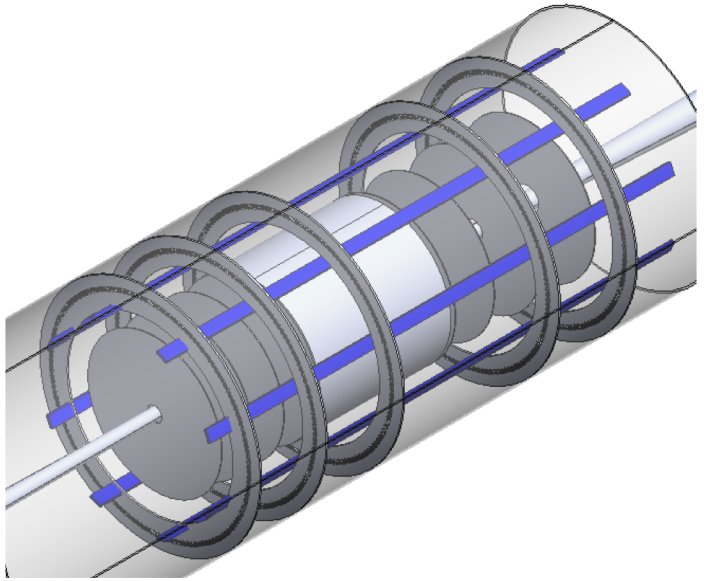
12. pfRICH and EMCAL in installed in the CF tube

- Needs “blocks” & brackets to avoid damaging the GST by EMCAL



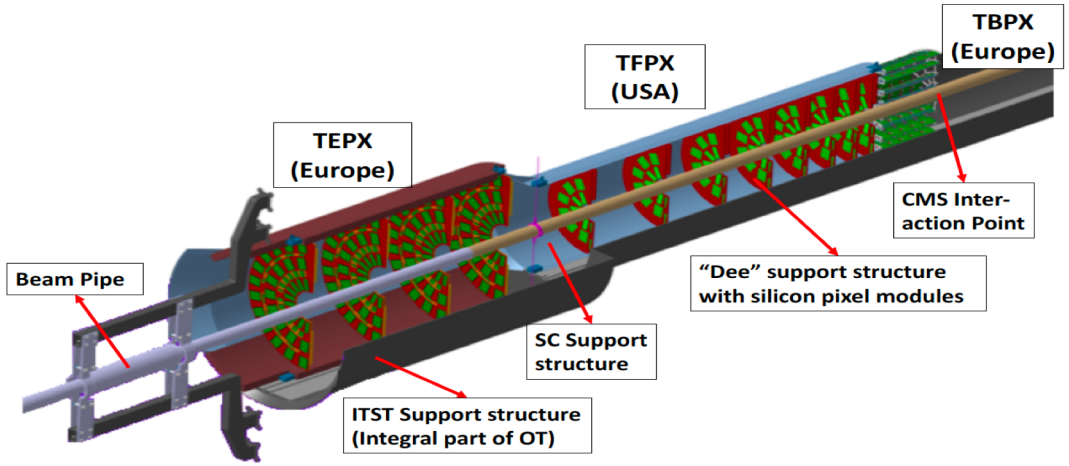
Next steps towards supports for SVT

- TOF supporting by engagement rings and GIST
- Work starts now to investigate if and how the currently devised TOF AC-LGAD support can work in SVT context
- Next steps: get ALICE ITS3 CADs and see how to integrate / support SVT via TOF

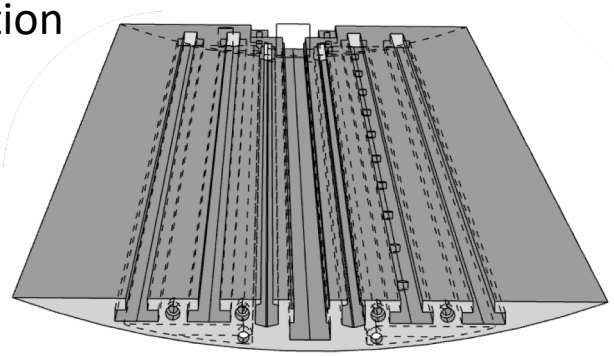


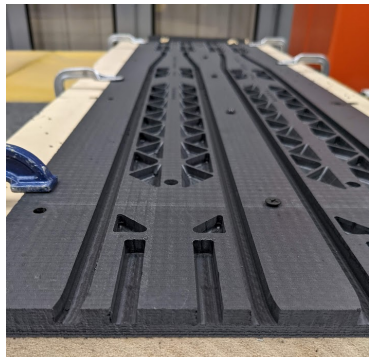
Supporting & Integration of SVT

- Design concept is to insert “half SVT” at a time
  - Requires reasonably rigid structure, at least temporarily supported with external structures

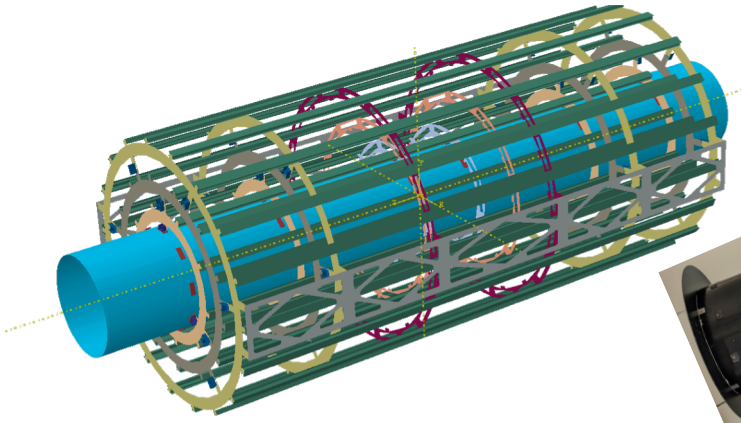


- Example “track” from CMS for SC support and insertion, incl. dry-gas injection





- Example from CMS, which is “inverted”
- The GST is outermost and engagement rings go inside with support rods as needed to provide enough support
- Low mass “tracks” to allow integration of SVT half-dectectors
- Reduces number of cylinders to 1 global (GST), none inside and no real half-cylinders either (if needed low mass, aka w lots of holes)



Discussion / Next steps

- For global mechanics need detailed FEAs: about to start
  - Closely connected to mechanics work in TOF LGAD (barrel and endcap)
  - Integrate and develop global mechanics for SVT to connect to
  - Establish hierarchy of supporting structure, i.e. which system supports whom
  - Establish better understanding of service masses and space, routing
  - General envelope's need to be refined

- Next high priority near time goals:
  - Make animation of the insertion with updated CADs for better understanding
  - Consistent FEA to understand EPIC inner detector supports better and optimize to lower mass solution where ever possible
  - Clear definition of envelopes
  - Reasonably realistic estimates for services & space relies on the next item
  - "central / global" cooling solution & its distribution within EPIC
- Propose a focused half-day discussion, say 1st week of Feb

Discussion

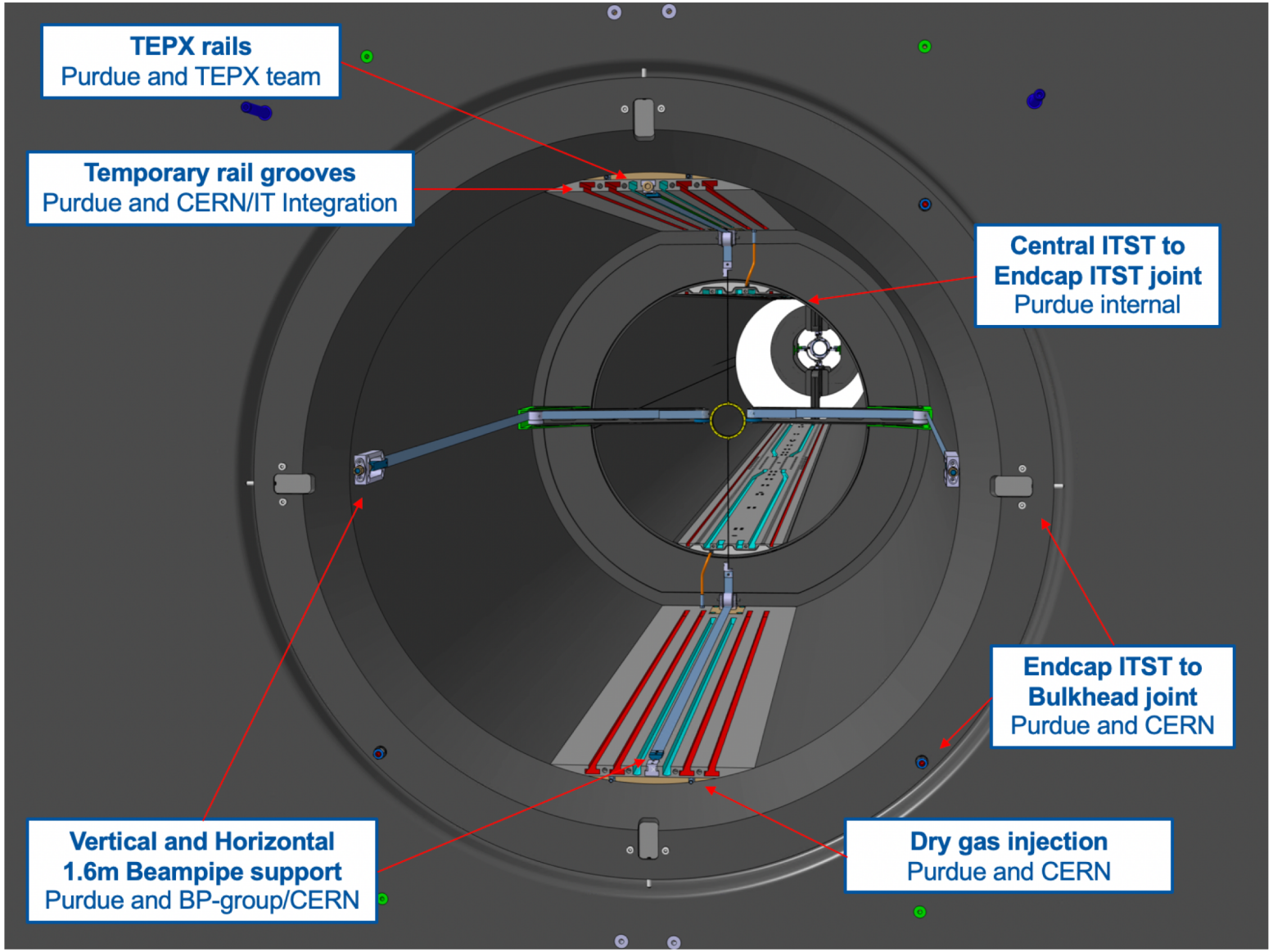
Advertisement

EPIC specific Mechanics workshop at Purdue

- Aimed specifically at Mechanics, global and subdetector level – not just SVT
- Discussed with engineering team (Rahul et al.)
- Potential topics
  - pfRICH, TOF LGAD and SVT, others subdetectors too
  - Global mechanics
  - Integration & Assembly
  - Service & Mass optimization
  - Envision 1 days ahead of the FTDM
  - Project aspects / TDR etc.
- Ahead of the forum for tracking detectors, Tuesday 28th May
- Informal announcement, official soon

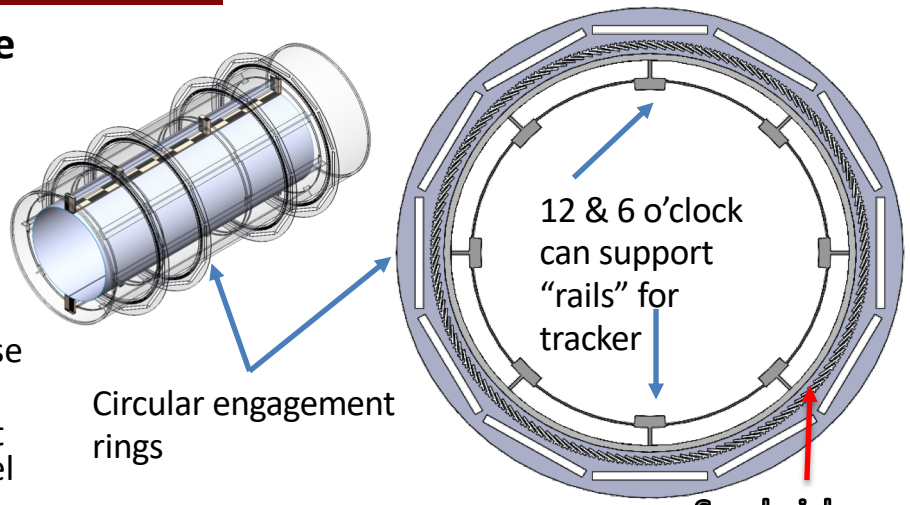
Backup

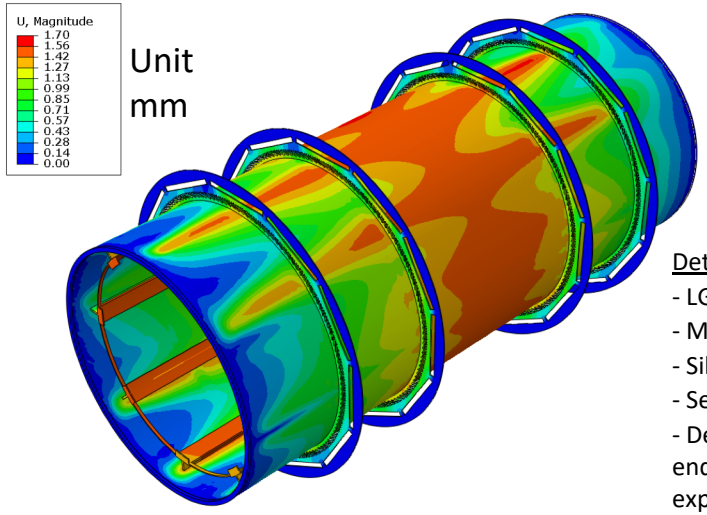
Example: IT pixel supports in CMS



Support structure for barrel TOF

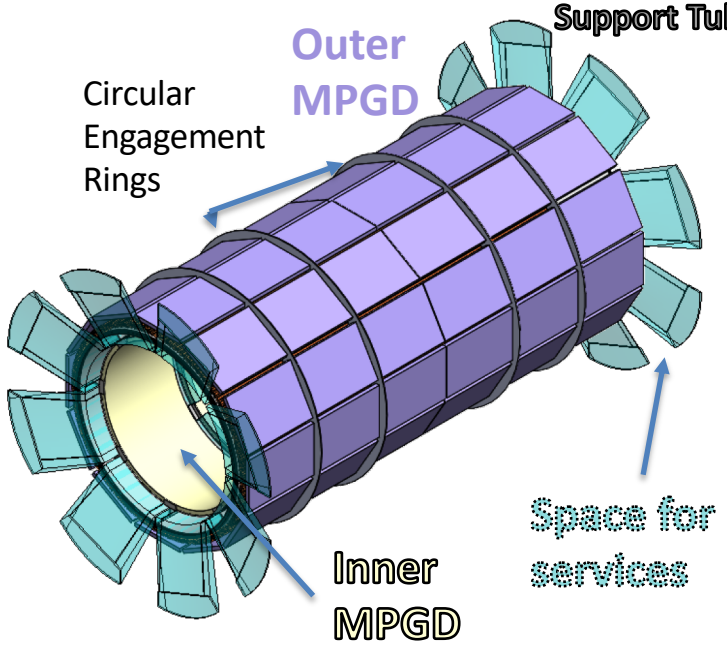
- **Concept idea of joined mechanics structure for barrel TOF, inner & outer MPGD layers, services, and even tracker**
  - 1+8+1 mm sandwich composite structure w “end-rings” to support beam pipe during installation & integration
- Integration
  - Move/Place end cap TOF closer to dRICH to ease access to inner tracking volume
  - ”Rail” system (internal and external) to support half-cylinders for tracker installation after barrel TOF system is in place
- First preliminary FEAs for this design
  - 1.7mm deflection and weak regions at engagement rings – needs to be optimized!





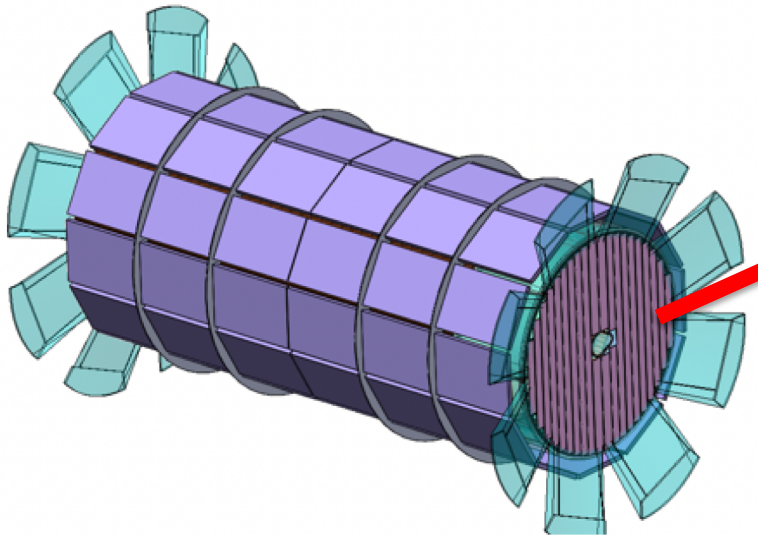
Unit mm

Details:
- LGADs = 70 kg
- MPGDs = 24 + 24 kg
- Silicone tracker = 10 kg
- Services (smeared) = 100 kg
- Designed engagement rings, end rings following CMS experience at Purdue

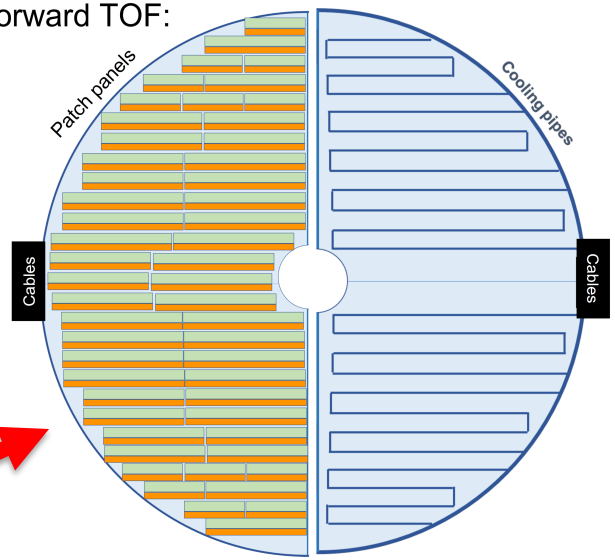


Endcap TOF

- Endcap TOF supported by common structure supporting barrel TOF system
- Under study: Integration & access to tracking volume eased if endcap TOF moved in front of dRICH



Forward TOF:



From the talk of Wei Li
https://indico.bnl.gov/event/16742/

- "Clam shells" or DEEs
  - Convenient for installation/maintenance
  - Each is patched by TOF modules (one or more types) on both faces
  - No backward TOF

Power Budget

	Endcap TOF [kW]
Sensors	0.6
ASIC	8.5
DC-DC	3.5
lpGBT, VTRx+, SCA	0.5
Power cables	0.5
Total	13.6