

SVT Workshop

“SVT Installation and Disks”

So far, disk design, prototyping, testing has been LBNL in practice

October 8-9, LBNL

Ben Denos, Andy Jung

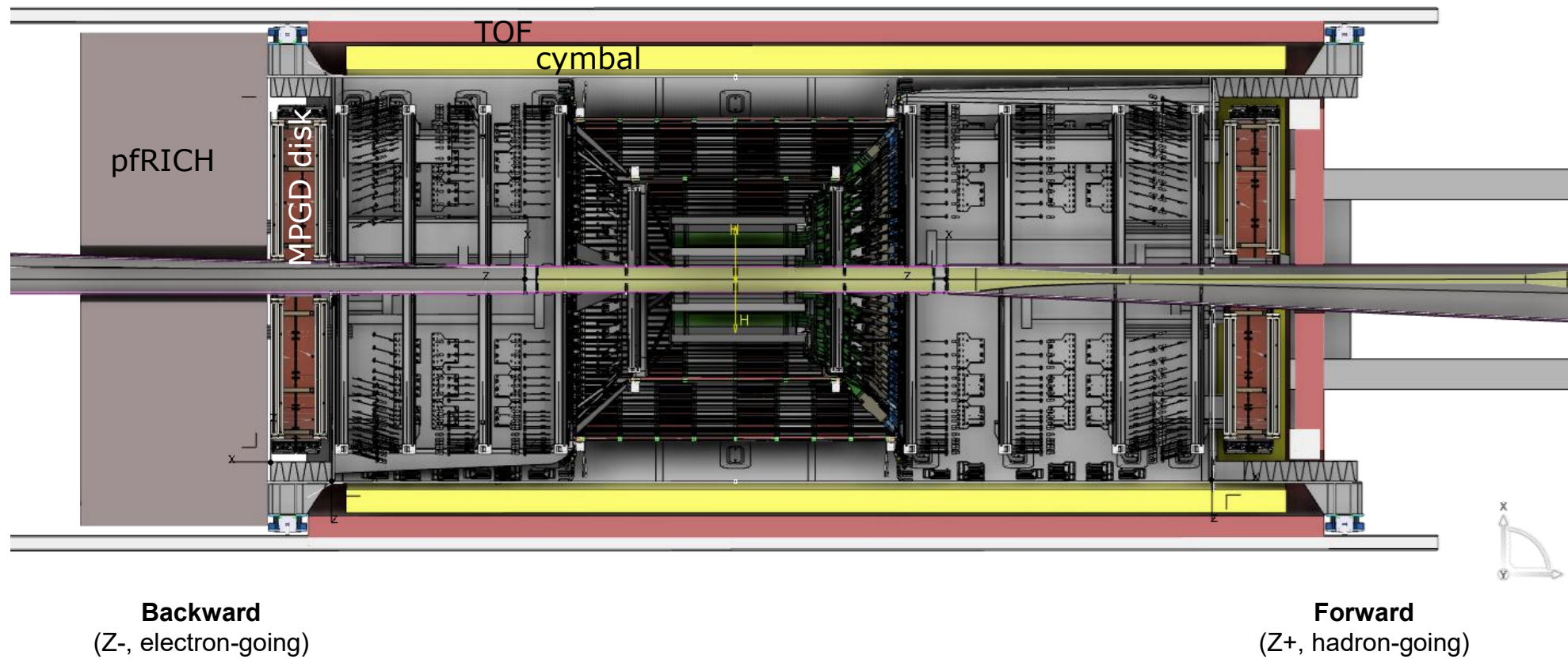
SVT Workshop

- ⬡ A few points from Andy about Purdue's role:
 - ⬡ We remain very committed to all SVT mechanics (PST, interfaces)
 - ⬡ We are keen to do disc mechanics and can take care of fraction of those discs (2-4 or more as needed/possible)
 - ⬡ Via Matthew Jones we can do module assembly and with me together even full dee assembly for those we "manufacture" at Purdue
 - ⬡ System tests are possible too, we have the knowledge and ability to do this

SVT Workshop – Current Mechanics Tasks

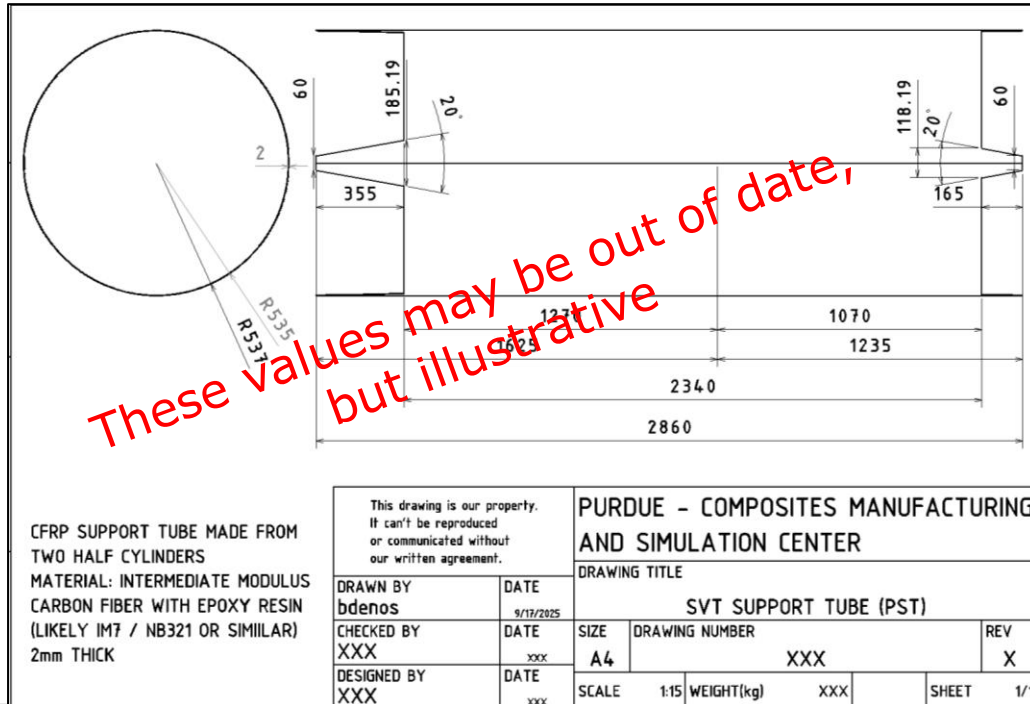
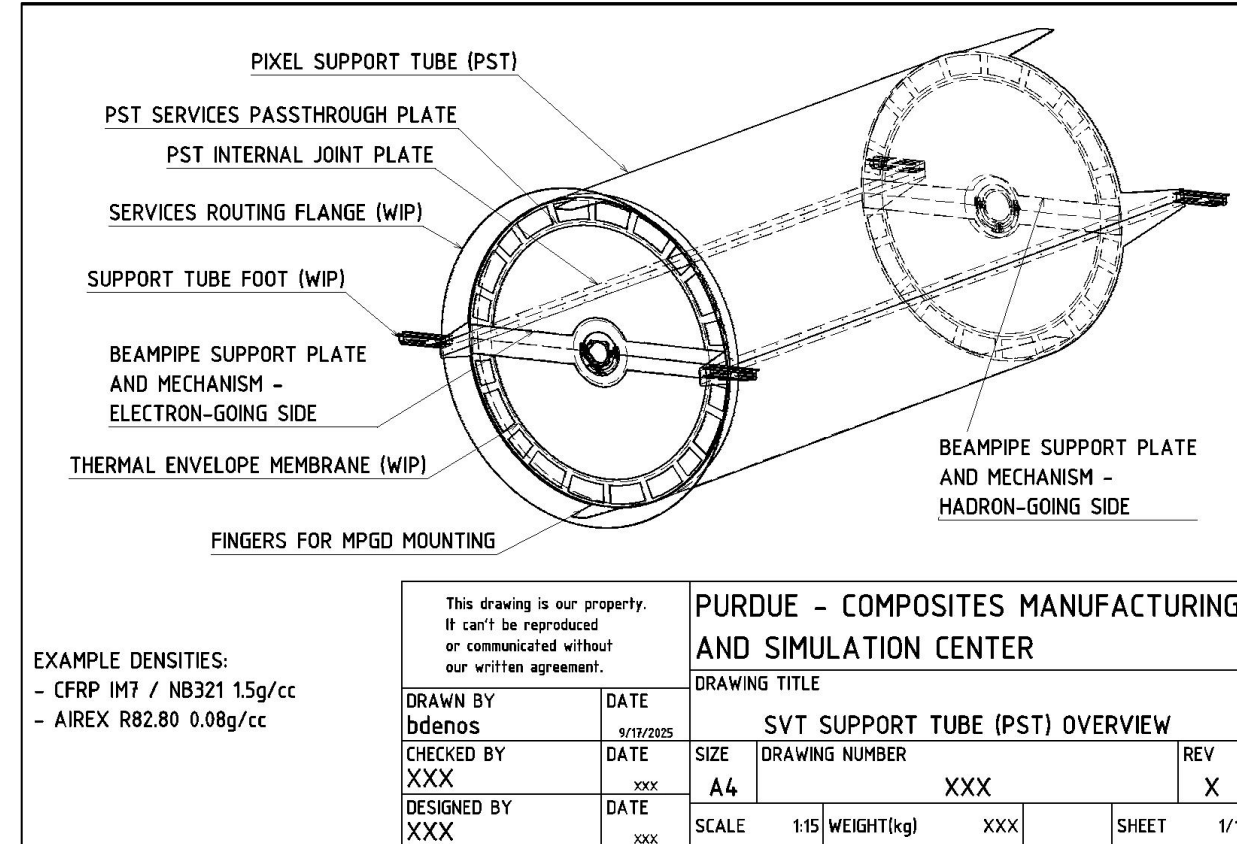
- ⬡ CAD model updates
 - ⬡ 3 IB options; A, B, C (see Domenico talk)
- ⬡ Integration sequence review
- ⬡ PST/SVT support frame for integration
- ⬡ Beampipe integration and adjustment
 - ⬡ Mechanisms and timing
 - ⬡ Translations and rotations
 - ⬡ Relative to SVT, PST, GST, detector
- ⬡ PST adjustable feet on GST rail
- ⬡ Services control/containment outside PST
- ⬡ PST modularity for later OB L4 install option
- ⬡ Other ongoing discussions in WP4/6
 - ⬡ Services – space allocated, but limited
 - ⬡ Cooling – pending request for time estimate
 - ⬡ IB electronics design, placement, FIB, SCB
 - ⬡ MPGD disk mounting – meet next week with Stefano
 - ⬡ Beampipe clearances – insulation?
 - ⬡ Single point document access and control
 - ⬡ GitHub preference
 - ⬡ CAD models in Google Drive and Vault for now

Assembly X-Z Plane View



Introduction to Support Structure

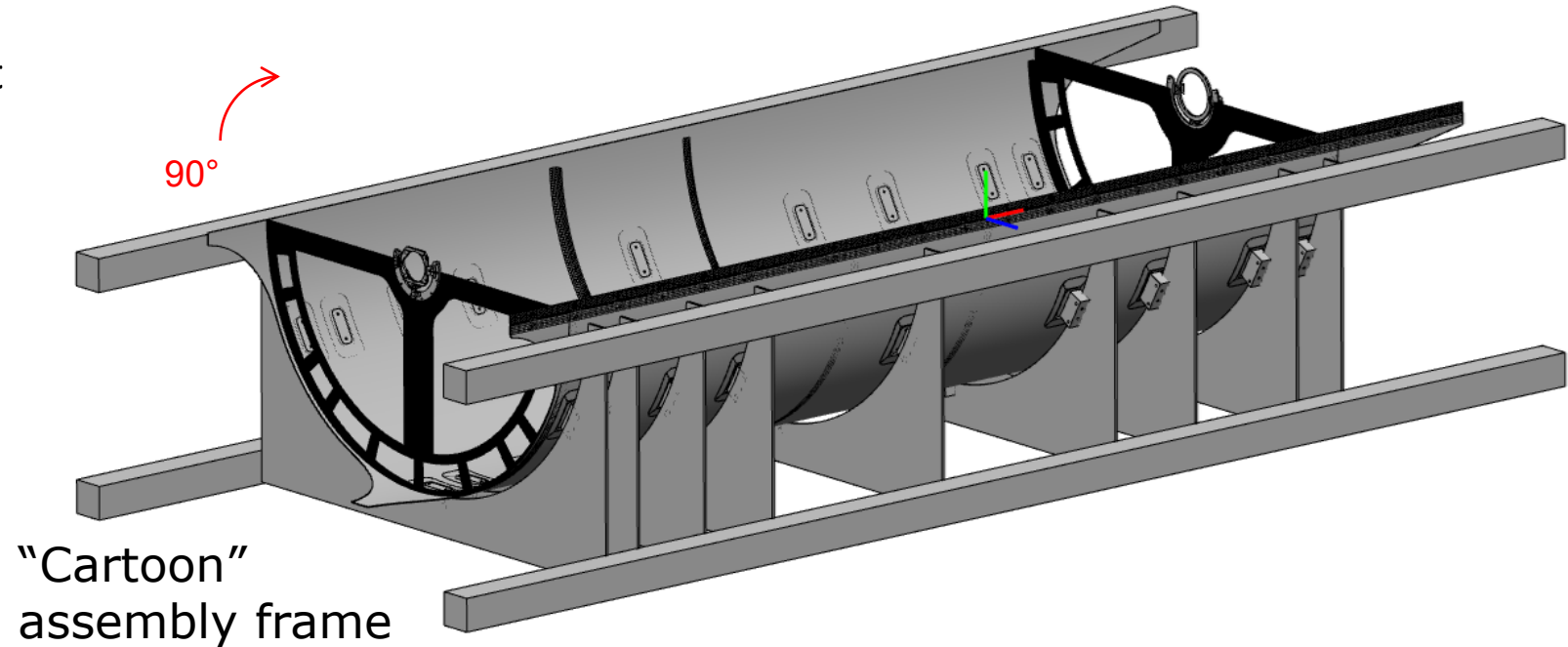
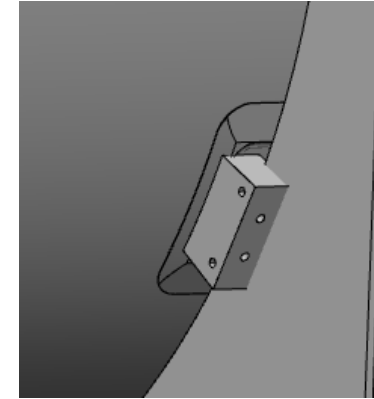
- Pixel Support Tube (PST) is 2860mm long
 - 2340mm of that is “full” cylinder
- 2mm thick CFRP laminate
- Assembled from upper and lower half cylinders
- Supports SVT, MPGD Disks
- Transfers load to GST rails via four “feet”



Preliminary Integration Support Cradle

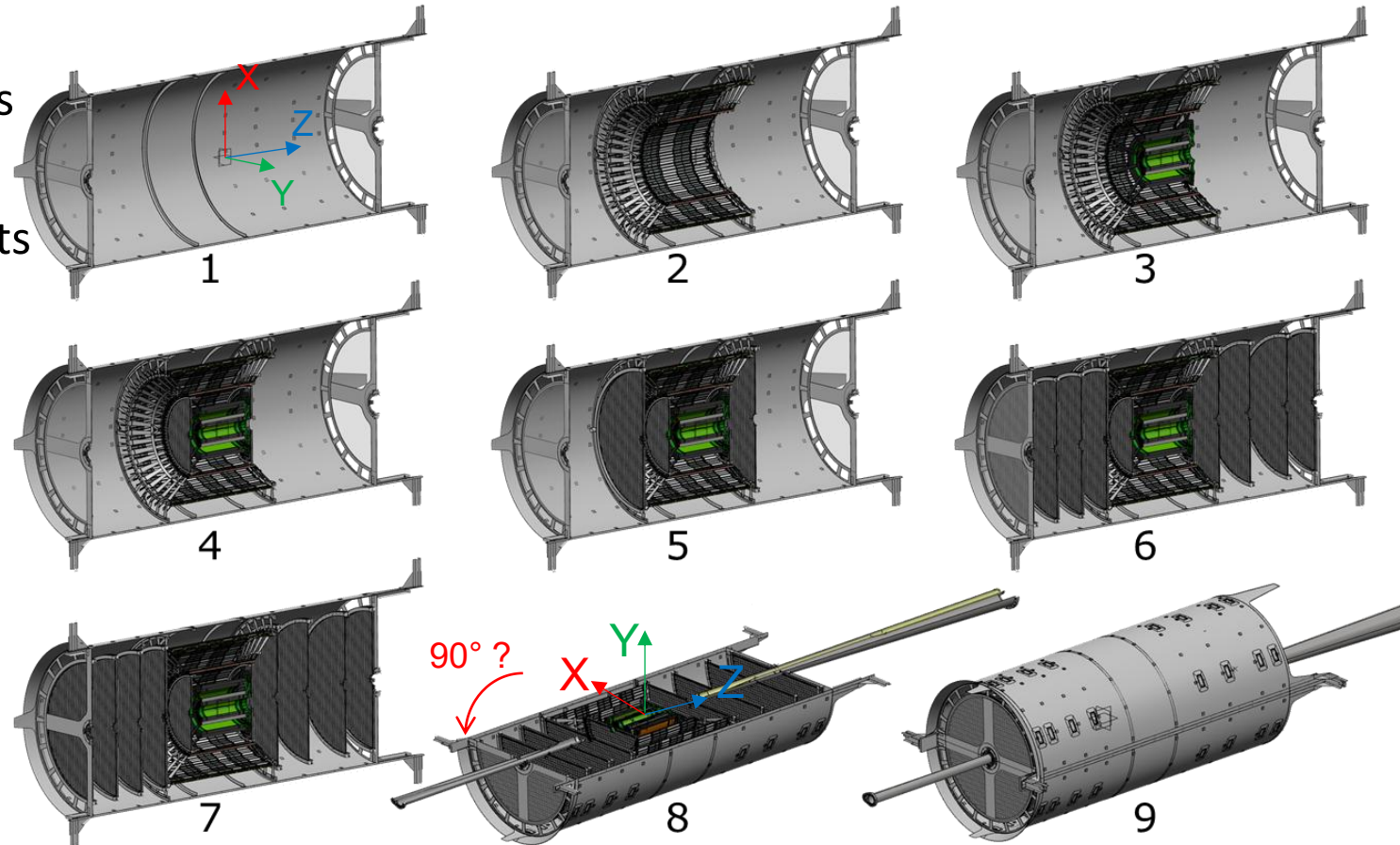
- ⬡ Provide rigid support on outside of PST
- ⬡ Connect at or near disk mounting points
- ⬡ Allow joining of two halves
- ⬡ NEEDED FEATURES:

- ⬡ Temporary beampipe support
- ⬡ Temporary services support
- ⬡ Connection specifics



SVT Integration Sequence

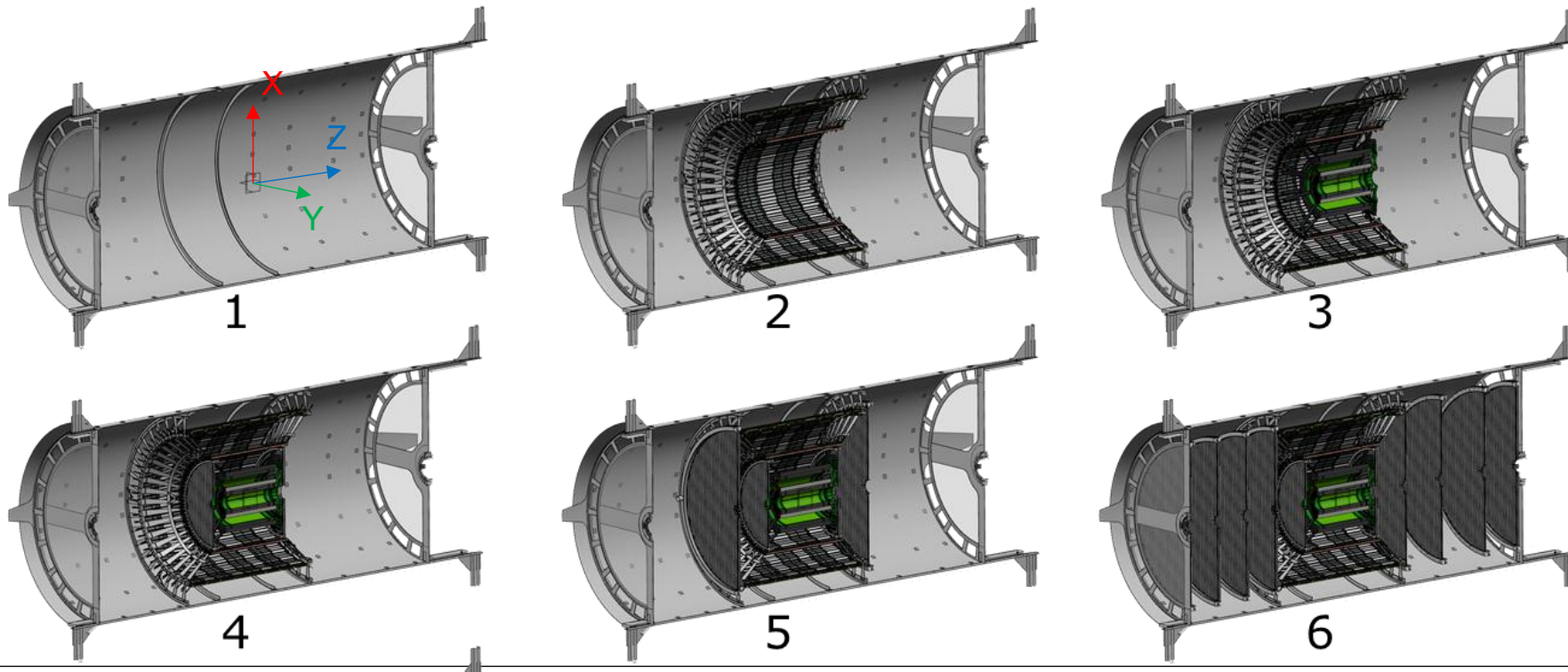
1. PST Half Cylinder secured in assembly cradle, use PST external connection points to keep shape
2. Outer barrel + boards + services + supports
3. Inner barrel + b + s
4. Disk 0 (ED0 and HD0) + b + s
5. Disk 1 on each side + b + s
6. Disk 2 - 4 on each side + b + s
7. Thermal barrier at each end
8. Beampipe install and adjust (optionally rotated 90°)
9. Close SVT-PST package, add feet



Disk Installation Sequence

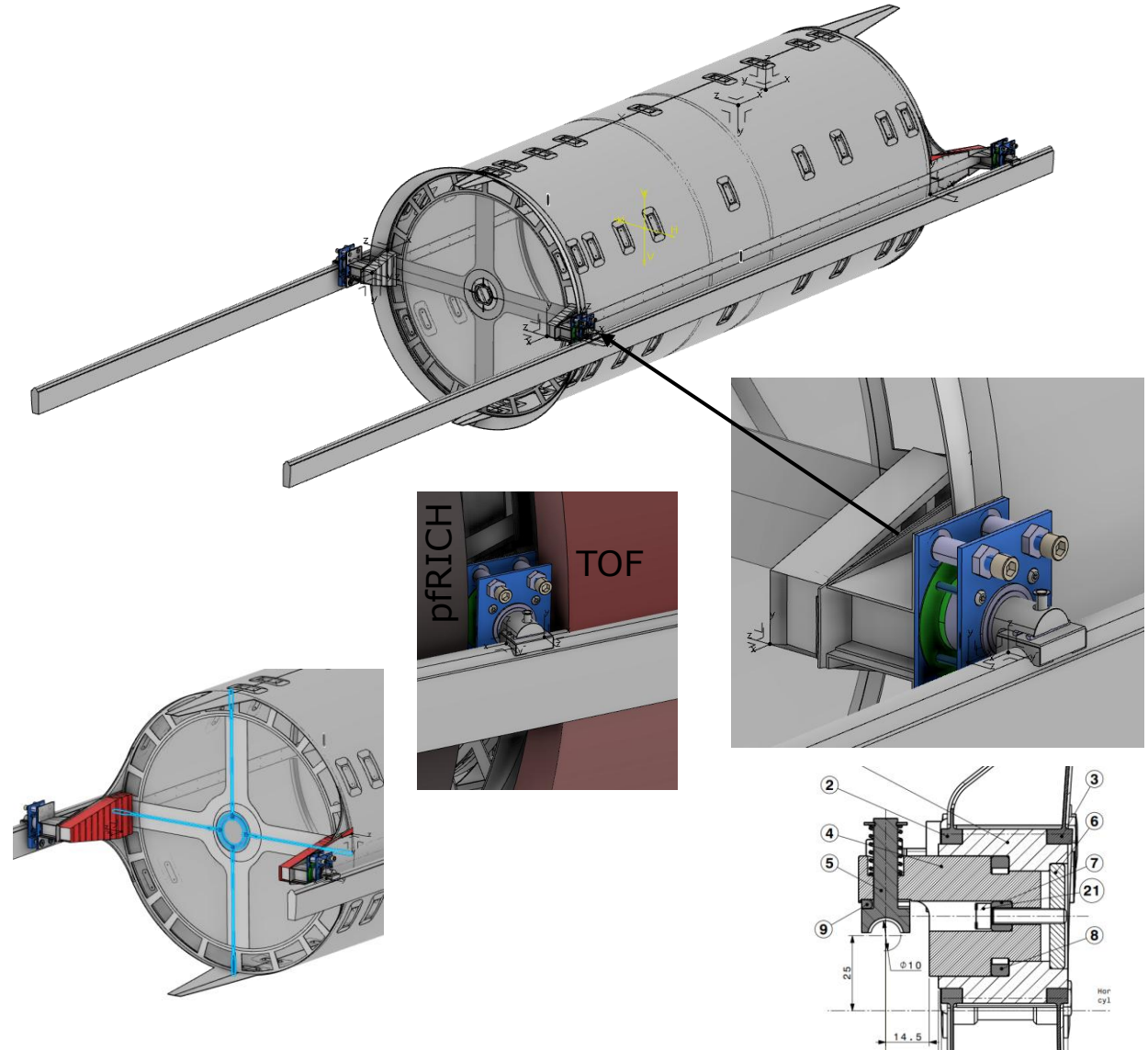
⬡ Does this sequence work?

2. OB, boards, services out to GST end
3. IB, boards, services out to GST end
4. Disk 0, boards, services out to GST end
5. Disks 1, and so forth



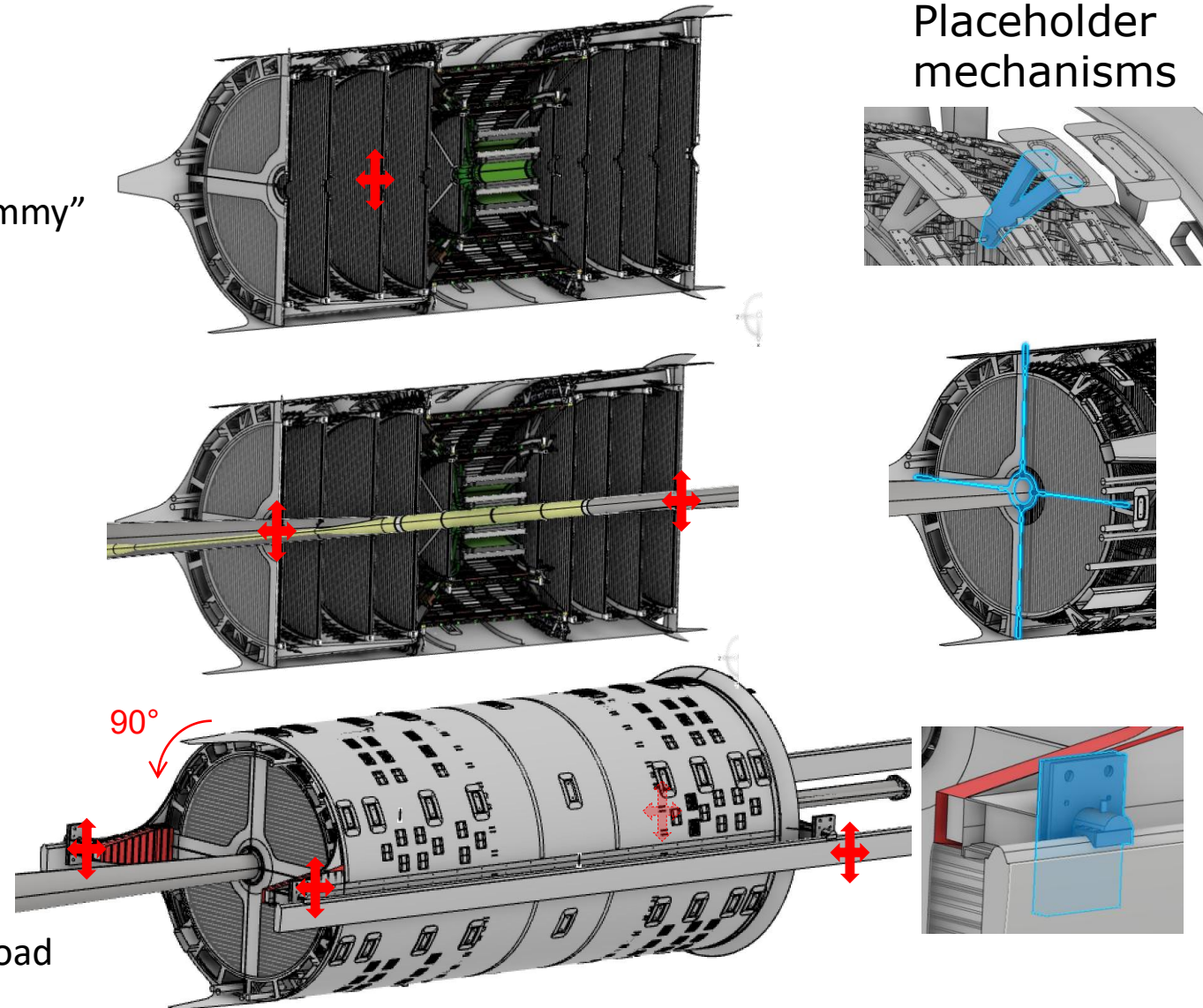
PST Updates

- ⬠ GST rails act as primary support for PST, SVT
- ⬠ PST rail support foot on version 2
 - ⬠ Match EEEMCAL foot as much as possible
 - ⬠ May need re-work for TOF service clearances
 - ⬠ *Desire to make adjustable at GST rail ends*
- ⬠ Beampipe support and adjustment still work in progress
 - ⬠ Adjusters at PST outer radius, BUT *desire adjustment from GST rail ends*
 - ⬠ Still working to confirm beampipe centering and alignment requirements, within PST, as PST package in GST, as GST package in detector



SVT and Beampipe Adjustment Proposal

1. Measure/scan open SVT half assemblies
2. Adjust disks/barrel if required
 - Maybe even contacting an oversized “dummy” beampipe?
3. Place central beampipe in SVT half
4. Adjust beampipe in open SVT half
 - Test any internal position sensors
5. Join SVT halves
6. Adjust beampipe in closed SVT?
 - Prefer to lock relative motion
7. Adjust full beampipe-PST package in GST (in assembly hall)
 - Iterate/measure with dummy EEEMCAL load

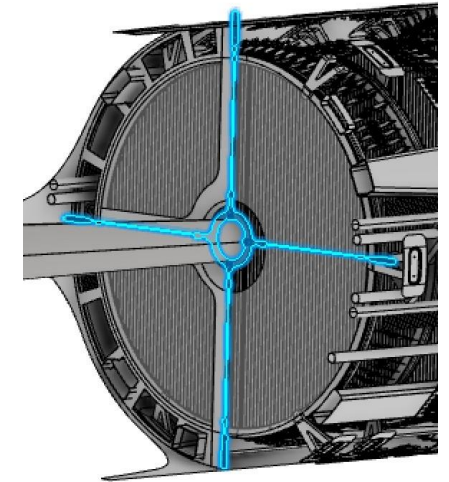


Beampipe Position within SVT

Requirement (actually for final position):

System	Desired Positional Precision (mm)			Desired Rotational Precision (mrad)			Total Adjustment (mm)			Notes
	X	Y	Z	X	Y	Z	X	Y	Z	
Beam pipe	±1	±1	±5	±1	±1	--				If there are conflicts between tolerances below, the smallest tolerance takes precedence. - This tolerance includes the tolerances of the beam pipe fabrication +/- 0.5 mm. The rest of the +/- 1mm goes in the position and deflection tolerances. +/- 1 mrad is for aligning with the electron beam direction. - The beampipe rotational tolerances drive the other requirements.

Placeholder mechanism



- NOTE: half of beampipe “precision” is already allocated to shape as manufactured (no loading)
- This is when we set (and fix) our clearances between detectors and beampipe, 5mm!!
- Might not need rotation adjustment at this level, rotate with PST
- DO need rotation prevention

Summary table based on

- https://brookhavenlab.sharepoint.com/:x:/r/sites/eRHIC/bnl&sla c/experimental%20equipment/_layouts/15/Doc.aspx?sourcedoc=%7BD77725AD-AD33-406E-98C3-CEA9605F9591%7D&file=Clearances%20and%20Tolerances%20-%20NSM%20edits%20R4.xlsx&action=default&mobileredirect=true
- All to be captured in a more accessible “engineering” document to guide beampipe support and mechanism design

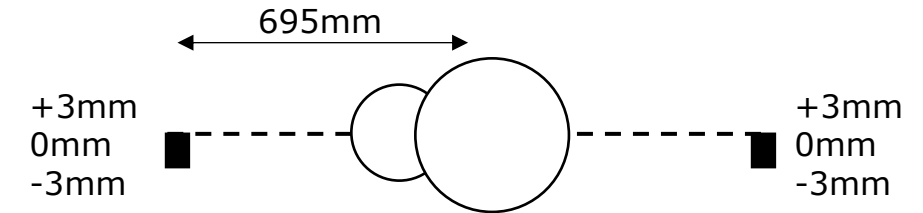
Combined Beampipe-PST Adjustment

Requirement:

System	Desired Positional Tolerance (mm)			Desired Rotational Tolerance (mrad)			Total Adjustment (mm)			Notes
	X	Y	Z	X	Y	Z	X	Y	Z	
PST	±1	±1	±1				±3	±3	±5	If there are conflicts between tolerances below, the smallest tolerance takes precedence. Andy to follow up with Ben on this 11/19/25

- Adjustability: move/support 150kg per foot +/-3mm
- What rotation of beampipe+PST is possible by only using Y adjustment at feet?
 - 4 milliradians
 - After height adjustment, might not have full +/-3mm remaining, so less mrad

No beampipe rotation if feet adjusted to same height on both sides



Max beampipe rotation if feet adjusted to +/- limits on both sides



$$\theta = \text{atan}\left(\frac{3}{695}\right) = 4\text{mrad}$$

Likely will need some SVT-package height adjustment AND rotation – so a full 4mrad may not be achievable

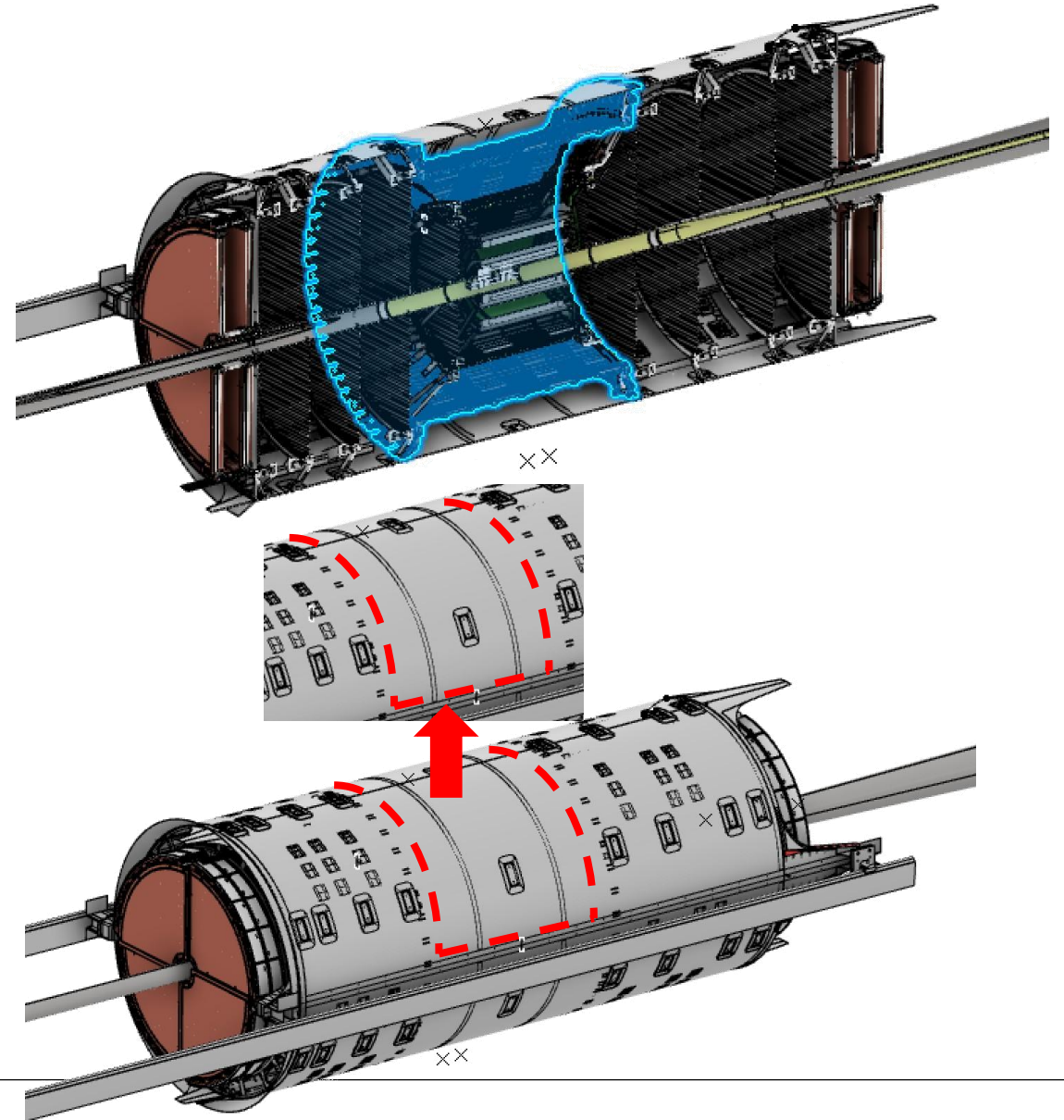
Combined Beampipe-PST + GST + All Adjustment

- What are “stacked” adjustment max/mins and how does it affect SVT?
- How do beampipe “inlet” and “outlet” mate up? Flexibility with bellows in position, or only length?

	Desired Positional Precision (mm)			Desired Rotational Precision (mrad)			Total Adjustment (mm)			Notes
System	X	Y	Z	X	Y	Z	X	Y	Z	
Cradle	±2	±2	±2				±25	±10	±25	- Tolerances listed are measured at the beampipe, as able to be positioned by the cradle alone. - The cradle will be on solid blocks and can be shimmed
GST	±3	±3	±3				±10	±10	±10	Will likely need to install EEEMCAL, measure deflection, remove, adjust, re-install
PST	±1	±1	±1				±3	±3	±5	Andy to follow up with Ben on this 11/19/25
Beampipe	±1	±1	±5	±1	±1	--				- This tolerance includes the tolerances of the beam pipe fabrication +/- 0.5 mm. The rest of the +/- 1mm goes in the position and deflection tolerances. +/- 1 mrad is for aligning with the electron beam direction. - The beampipe rotational tolerances drive the other requirements.
Bellows									±5	Tolerance in z: +/- 5mm

PST Modularity for Later OB Layer 4 Install

- ⬡ Can we add OB Layer 4 later?
- ⬡ How much disassembly is necessary?
Reasonable?
 - ⬡ Removable or swappable panel in PST
 - ⬡ Assume PST goes back into assembly frame or similar – for structure stiffness
 - ⬡ Staves
 - ⬡ One at a time? Groupings? Full half barrel?
 - ⬡ Services
 - ⬡ Pre-place?
 - ⬡ Route outside PST?
- ⬡ Can the physics goals be met without layer 4?



Summary

- ⬡ Integration support frame needs refinement
- ⬡ Integration sequences need more CAD details for electronics, services. Then review and iteration
- ⬡ PST has a few design features still in flux, dependent on beampipe requirements
 - ⬡ Need agreement about beampipe positioning, sequence, adjustability, and final position tolerance
 - ⬡ Protect barrel, disks, and beampipe!!
- ⬡ PST modularity for later OB L4 installation under consideration
- ⬡ Will re-run PST structural simulations after support (boundary conditions) more developed