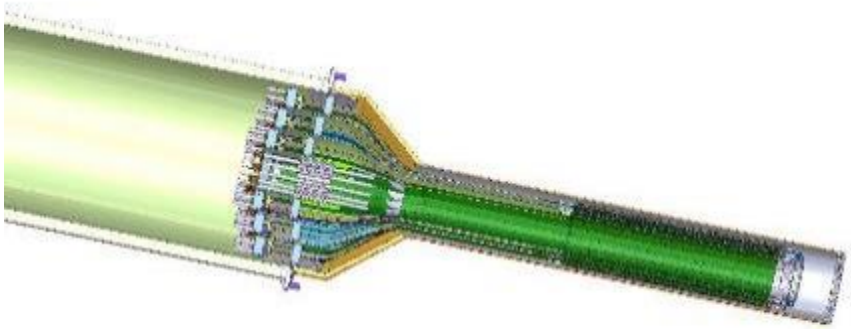
sPHENIX LDRD Review
MVTX mechanical conceptual design

Walter Sondheim

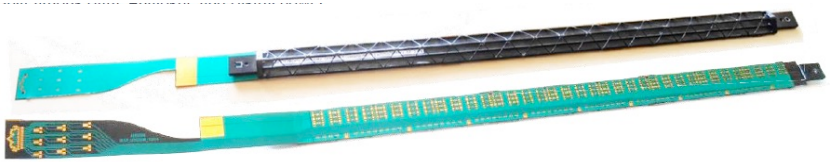
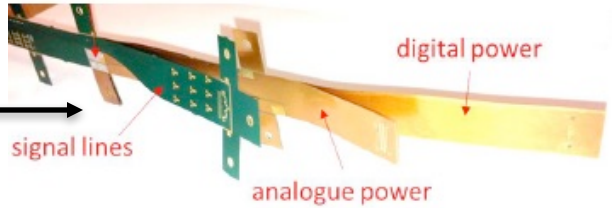
P-25

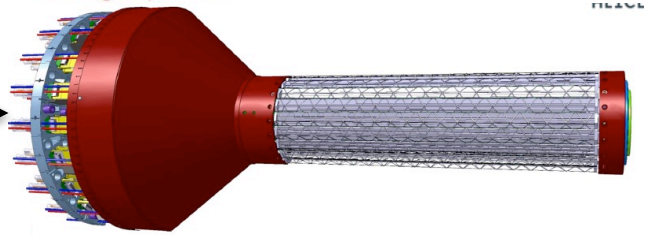
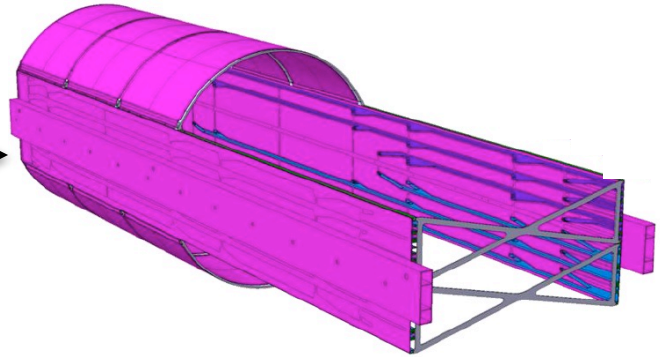


MVTX mechanical conceptual design:

- **Personnel involved:**
- **Walter Sondheim, P-25,**
  - mechanical and integration engineering
- **Christopher O'Shaughnessy, P-25,**
  - mechanical engineer, physicist,
    - Focusing on MVTX telescope and cooling
- **Hubert Van Hecke, P-25,**
  - Physicist,
    - Prototype construction
- **David Lee, P-25,**
  - Physicist,
    - "Project" file management

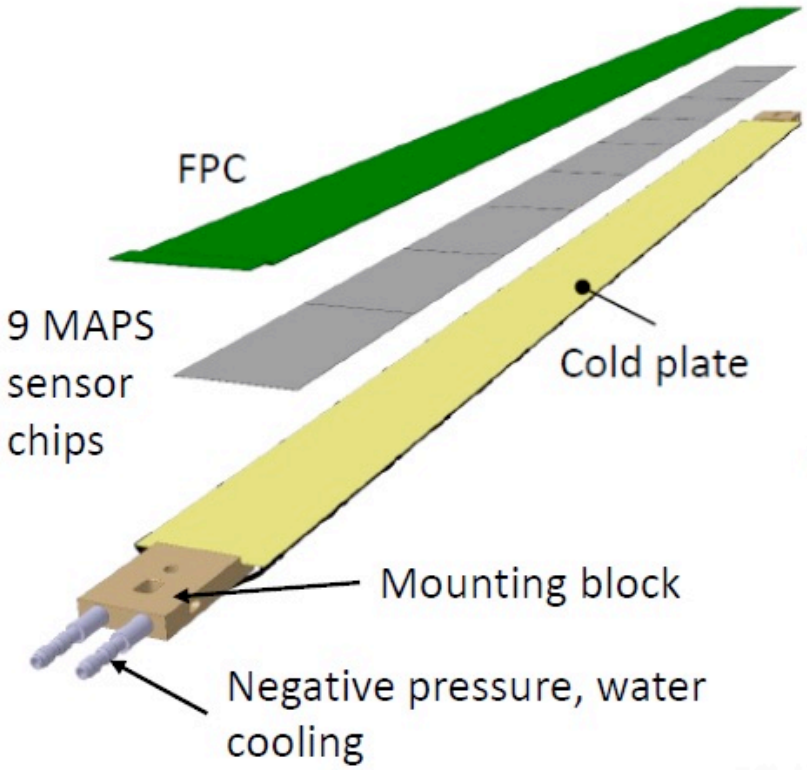
Outline:

- **MVTX mechanical components:**
  - Stave
    
    - Cabling pig-tail
      

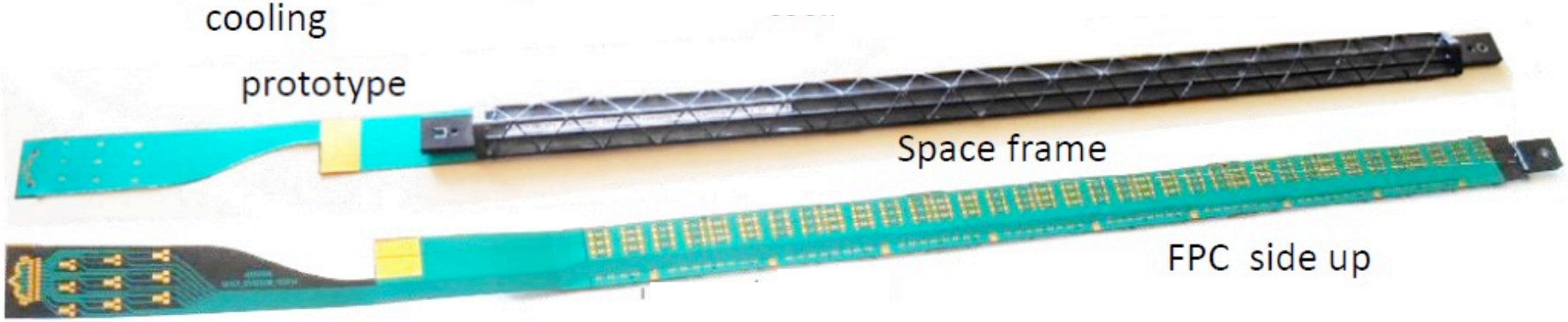
  - Half-barrel (3 layer) assembly
    
  - Service barrel
    
  - Support cylinder
    

LDRD innovation for our nation

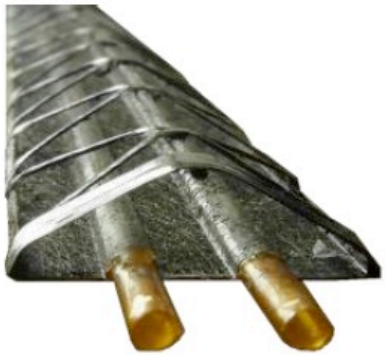
MVTX tracker stave:

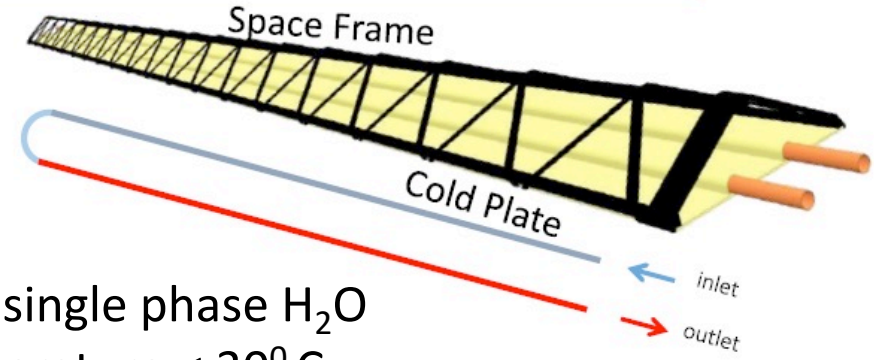


- **Stave assembly consists of:**
  - One layer with 9 MAPS chips
  - One thermally conductive carbon cold plate – space frame
  - One carbon filament truss structure
  - One flexible printed circuit (FPC) that is wire-bonded to the MAPS chips
  - Bonded assembly



MVTX stave cooling:





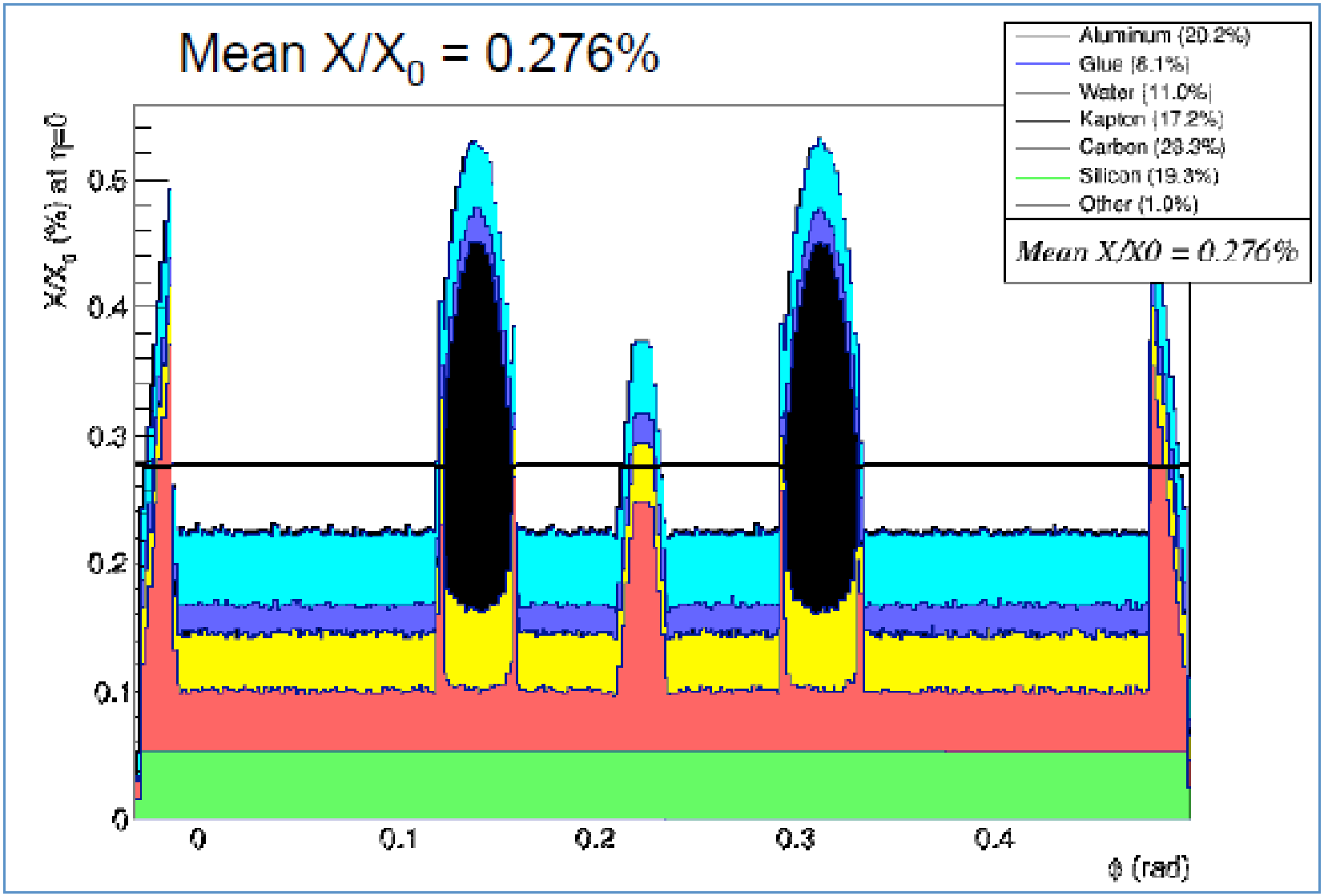
Coolant: negative pressure single phase H_2O
Pixel chip operational temperature < 30^0 C
Pixel chip max temperature non-uniformity < 5^0 C
Pixel chip (Alpide) power dissipation < 41 mW/cm^2

Total power dissipation: 184.5 mW/chip X 9 chips per stave X 48 staves in the MVTX assembly = 79.7 Watts

Full length cold plate assembly 290 mm, mass 1.7 gms.
Full stave assembly, chips, FPC, cold plate mass 15.1 gms.

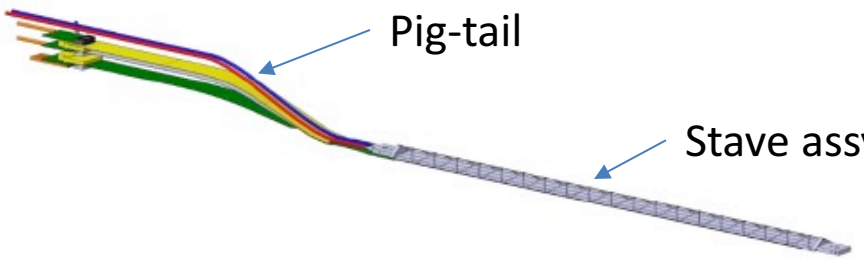
MXTX inner tracker stave cooling and support plate:

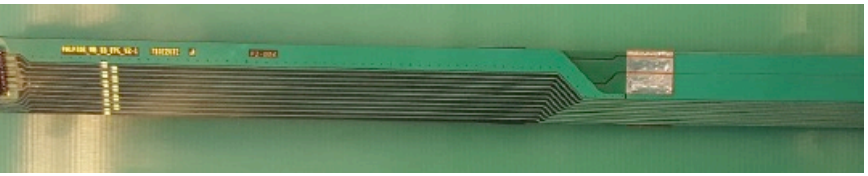
MVTX stave radiation length:



Half Barrel Service Interconnect:

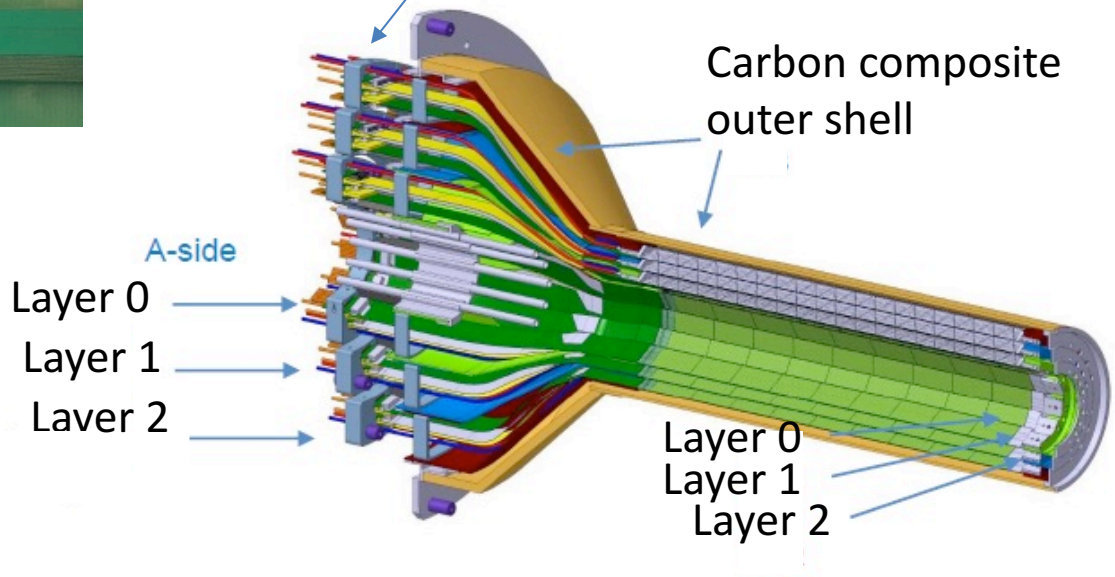
MVTX Services and Cabling and Cooling lines:





Prototype Pig-tail layers:
Signal - Firefly coax
AC
DC and bias

Interconnect patch-panel:
Signal cables, AC & DC power, Cooling



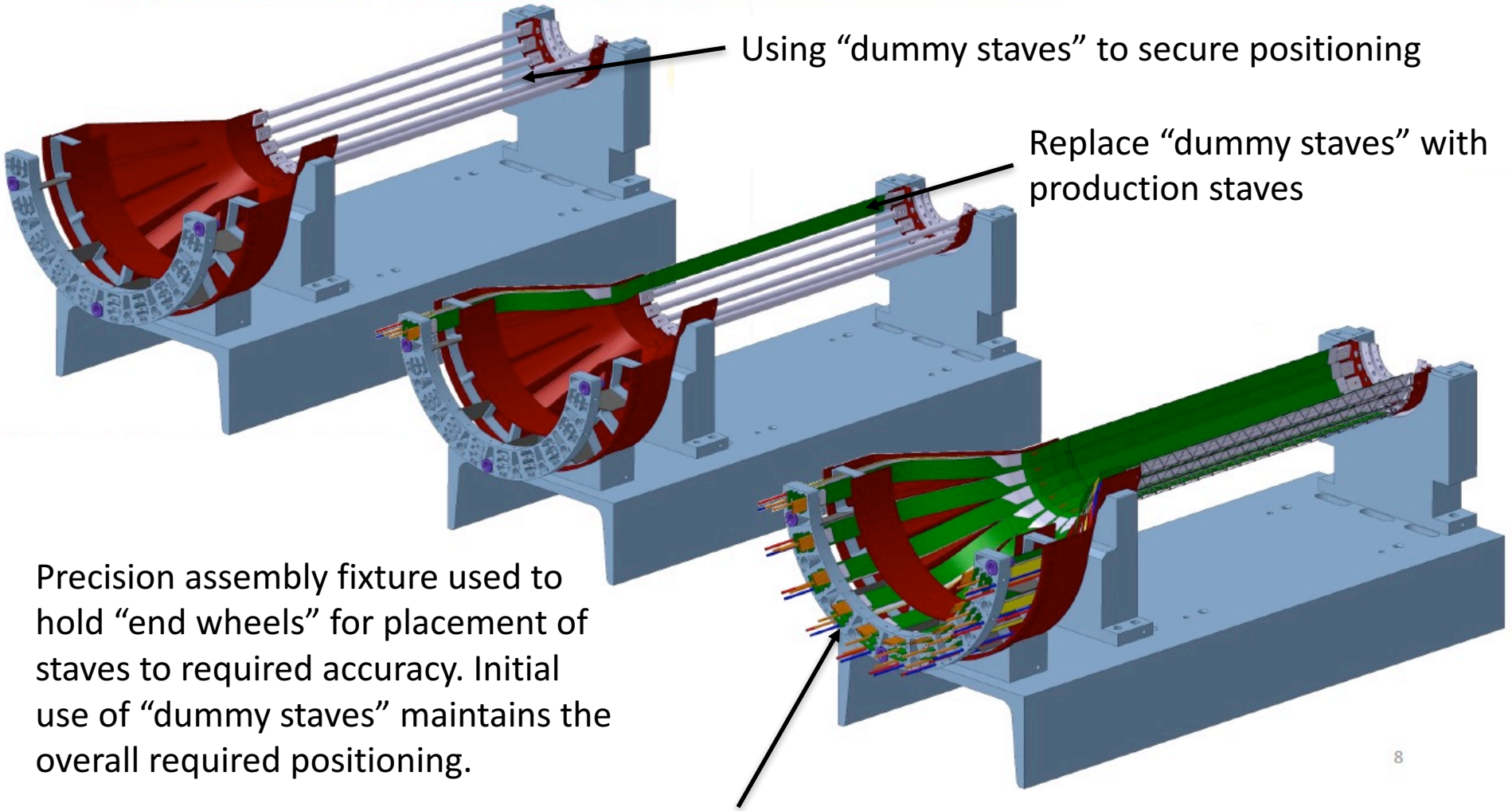
Cooling: negative pressure water, plus dry air (nitrogen) flow

Composite technology demonstrated:

Carbon composite production pieces:

These composite prototype parts made at CERN, similar to ones needed for MVTX detector:

MVTX layer assembly steps, using fixtures and dummy staves:

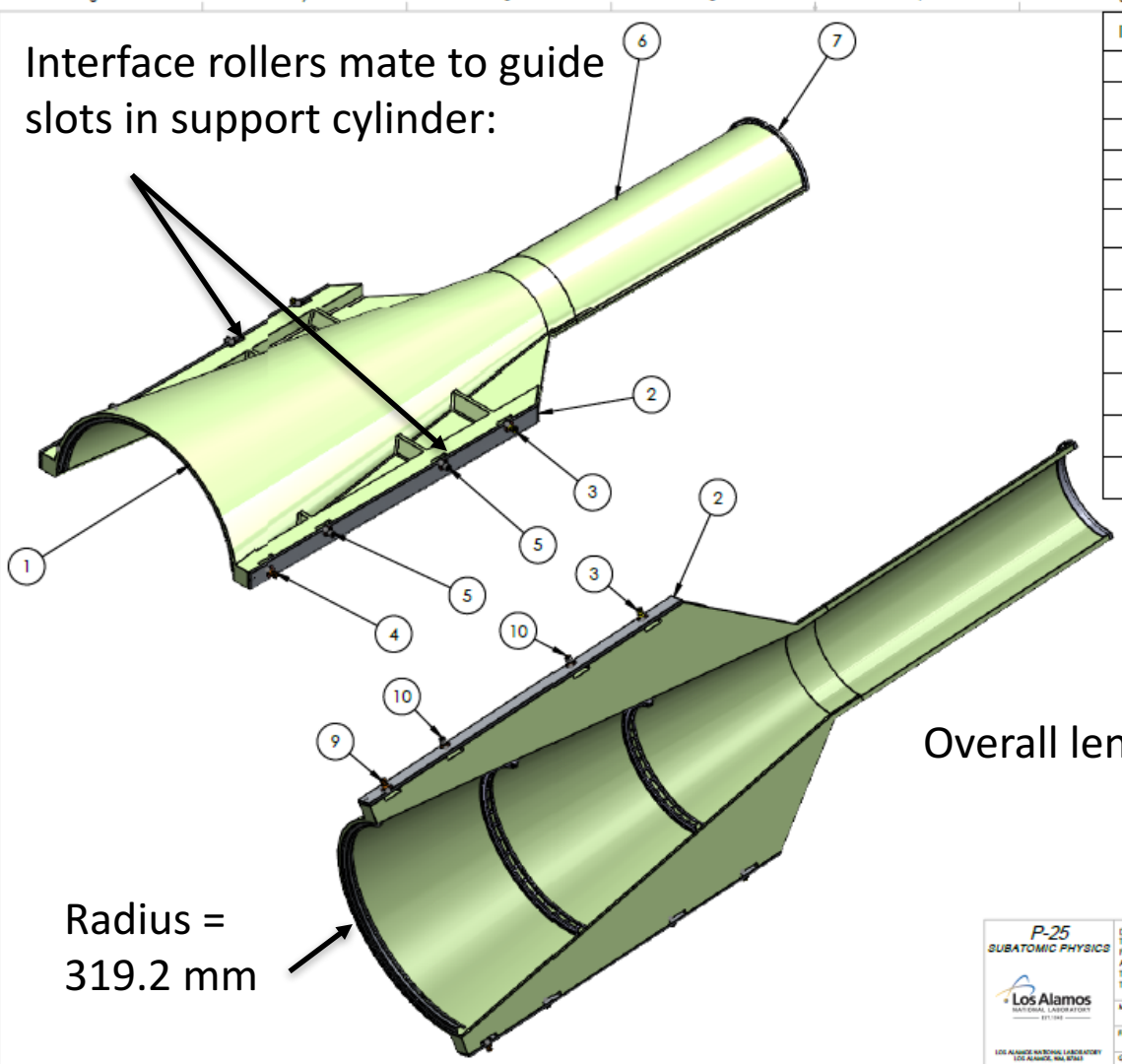


MVTX cabling configuration:

- Quantity (approximate): 48 staves x 5m = 240m
- Configuration:
  - 2x twisted pair sense wires (one each for analogue and digital)
  - 2x 0.283mm^2, low inductance analogue supply *(alternative: 0.155mm^2)*
  - 2x 1.500mm^2, low inductance digital supply *(alternative: 0.750mm^2)*
  - 1x Coax RG178 analogue bias voltage (similar to Article No 30000-178-1) (OD= 1.8 ±0.1mm)
- Connection split into two layers for digital and analogue conductors

MVTX composite service barrel:

Interface rollers mate to guide slots in support cylinder:



ITEM NO.	PART NUMBER	SHEET #	Default/ QTY.
1	test-cone		1
2	alum-side-bar-MVTX-01		2
3	ST0761393_01_1		2
4	ST0732542_01_1		2
5	ST0750417_01_1		4
6	sPHENIX-service-barrel-ver-01		1
7	service-barrel-detector-end-flange		1
8	ST0728128_01_1		1
9	ST0727966_01_1		1
10	ST0727957_01-modified		1
11	cage-left-side-top-bot-modified		1
12	cage-right-side-top-and-bot-modified		1

PARTS 11 & 12 NOT SHOWN IN THIS DRAWING

Overall length = 2161.73 mm

Radius = 319.2 mm

ALL DIMENSIONS IN MILLIMETERS

P-25 SUBATOMIC PHYSICS

Los Alamos NATIONAL LABORATORY

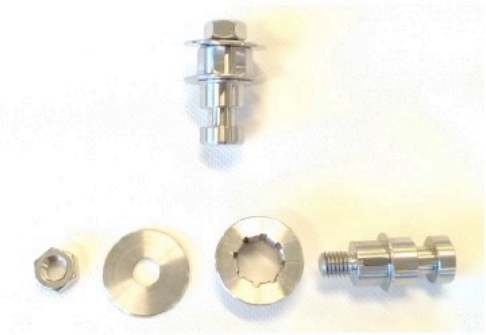
DIMENSIONS ARE IN INCHES
TOLERANCES UNLESS SPECIFIED:
FRACTIONAL ±
ANGULAR: MACH ± BEND ±
TWO PLACE DECIMAL ± 0.01
THREE PLACE DECIMAL ± 0.003
MATERIAL MIXED
FINISH
QUANTITY REQUIRED 1

	NAME	DATE
DRAWN	WALT	10/24/2017
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		
COMMENTS:		

extension-cone-MVTX

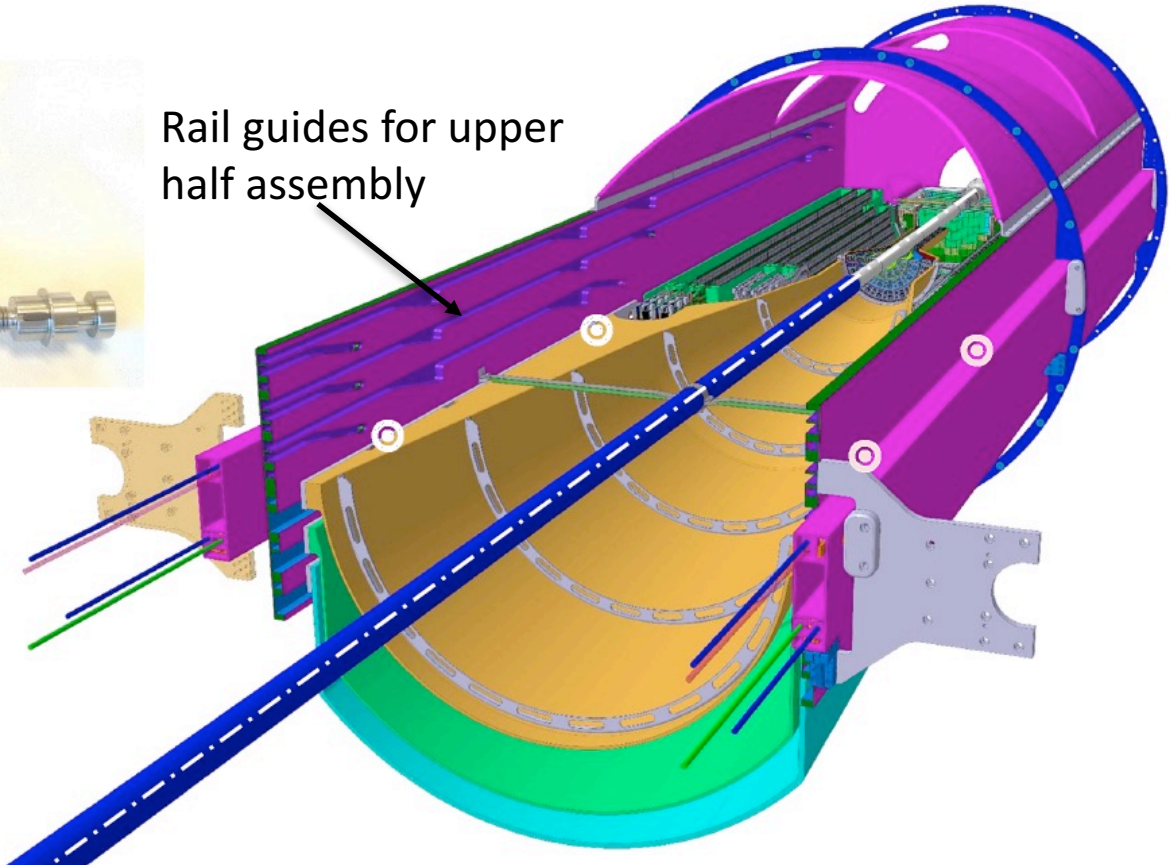
SIZE B | DWG. NO. | REV.
SCALE: 1:10 | WEIGHT: | SHEET 3 OF 3

Possible MVTX installation cylinder:



Eccentric:
Adjustable roller +/- 1mm
By step of 0.25mm

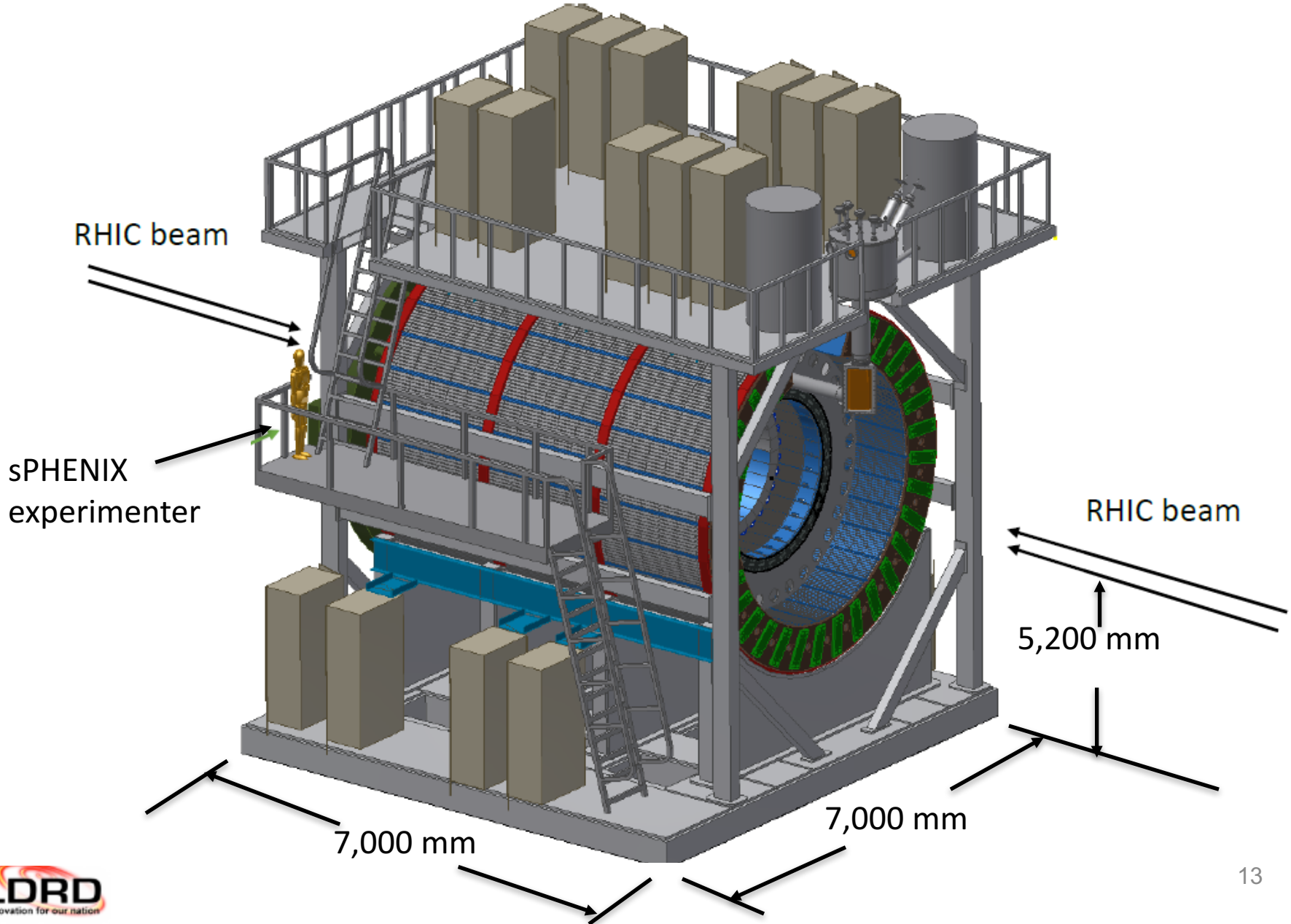
Rail guides for upper half assembly



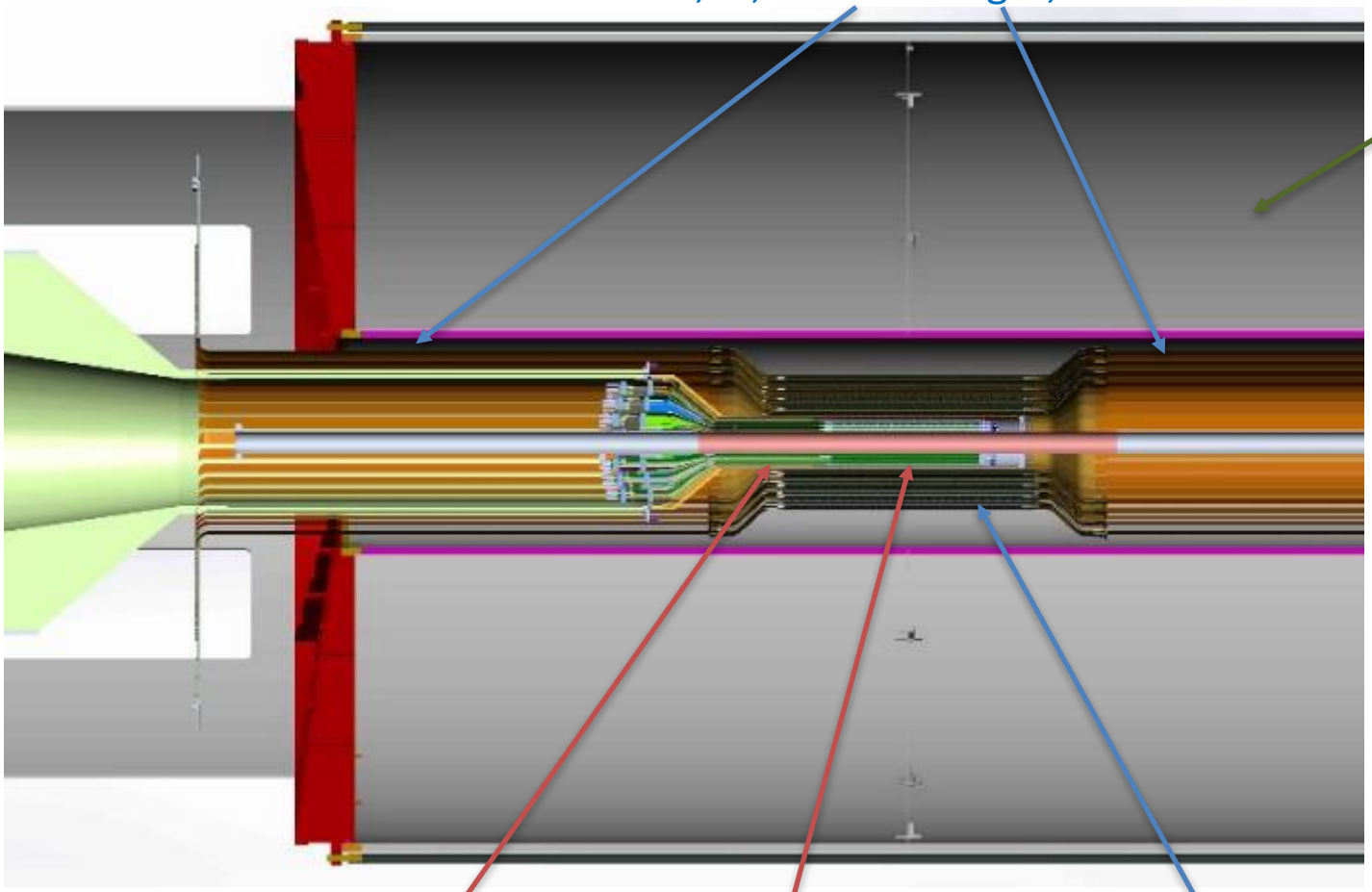
Eccentric: Adjustable roller +/- 1.0 mm, by steps of .25 mm

In sPHENIX we will not use a “service cone, rail system” anywhere near the size of that planned for the ALICE detector (shown here), but we will integrate their concept.

sPHENIX experiment CAD model:



MILESTONE: MVTX mechanical system conceptual design completed:



Milestones & integration issues:

- Milestones continued:
  - Modified model to be compatible with sPHENIX tracking detectors and beam-pipe, installation plan
- The current design for the INTT detector does not have a support structure or additional services, power & cooling.
- There is interference between the INTT extension cables and the conical region of the MVTX ("Z" locations)
- Because of the different radial dimensions between the beam-pipe in ALICE and the beam-pipe in sPHENIX, each of the three MVTX layers needs to be moved outward in radius by .75 mm.
  - This translation will *still* allow each layer to be hermetic
- Continuation of integration issues will be taking place with all of the sPHENIX tracking detector systems: TPC, INTT & MVTX by the formation of a sPHENIX tracking integration task force.

sPHENIX MAPS Detector:

Back-up: