

CEPC vertex detector towards TDR

Zhijun Liang, JinYu Fu

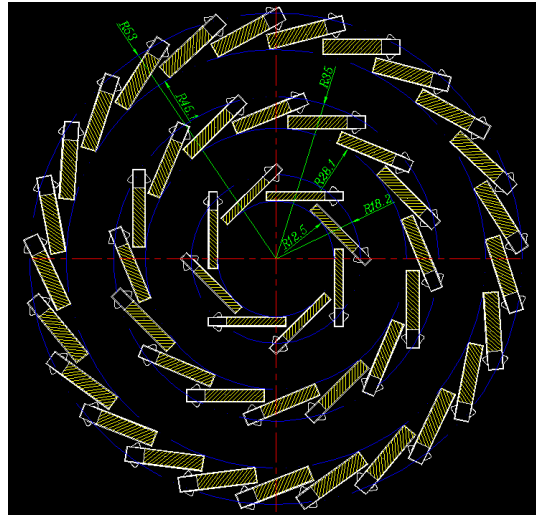
On behalf of CEPC vertex working group

Status

- Feedback from last CEPC day
 - Need design of structure of vertex detector on beam pipe
 - Need to show the robustness of mechanics design
 - Evaluate the Material budget
 - Air cooling and power consumption
- Update today
 - Focus on mechanics design of long barrel layout
 - “Short barrel + endcap” layout will come later

Layout - long barrel

The VTX - section view

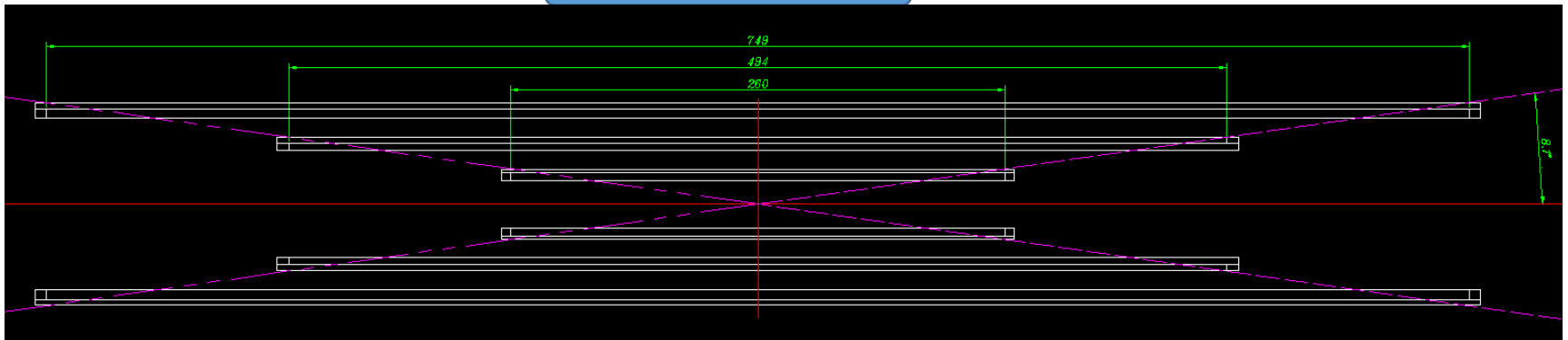


3 different sizes of ladders(section size and length) for barrels.

Ladder support size

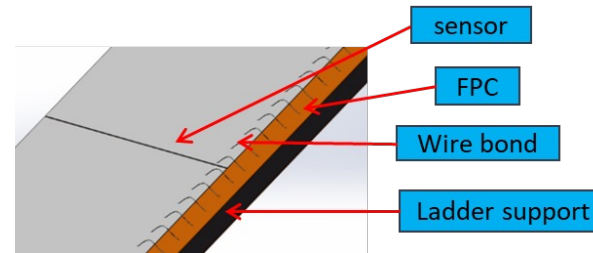
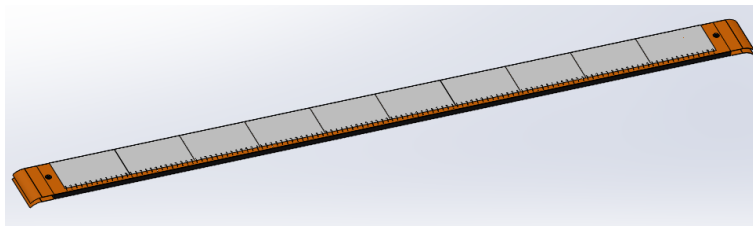
layer	Size .mm (W x H x L mm)
inner	17.4x1.7x260
middle	17.4x2.5x486
outer	17.4x3.2 x749

The VTX - side view



Ladder and ladder support

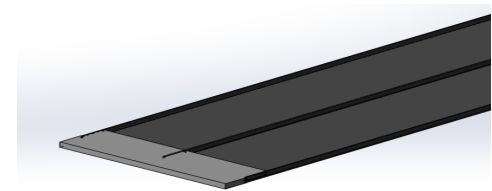
Ladder components are similar to most2 prototype



The max length of the ladder support is ~ 750 mm, about 3 times of that we made for the prototype.

The doable new sections design of such long CFRP ladder support (after comparison and confirmation):

- material selection - M40 CFRP (ultra thin prepreg)
- 4 to 5 layers of plies with the maximum thickness of 0.15 mm
- optimized ply angles design both for the rigidity and the doable fabrication process

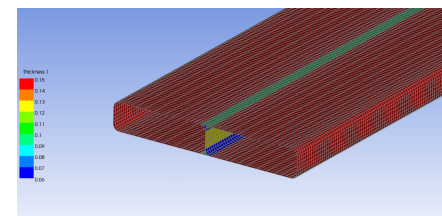
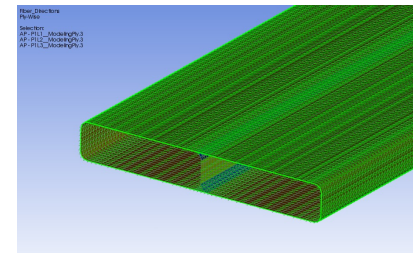
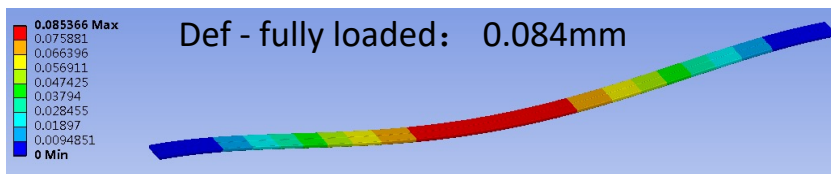
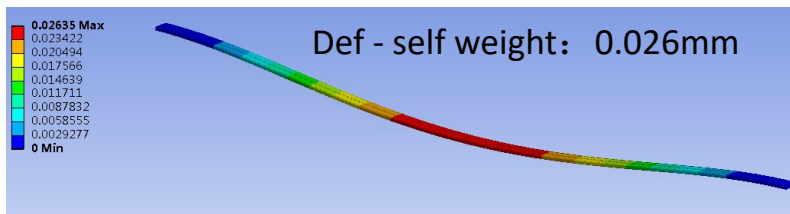


CFRP ladder support

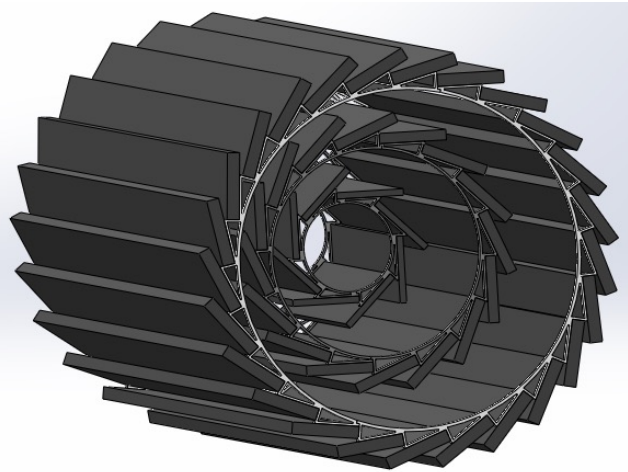
layer	Size .mm (W x H x L mm)	Thickness .mm (equivalent)	Max def .mm (Fully loaded)	Max def. mm (Self weight)
inner	17.4x1.7x260	0.167	0.019	0.006
middle	17.4x2.5x486	0.179	0.084	0.026
outer	17.4x3.2 x749	0.185	0.346	0.107

All ladder support resulted with very low IRF (the max is <0.019) under full load.(the lower IRF the higher load capacity. IRF>1 failure)

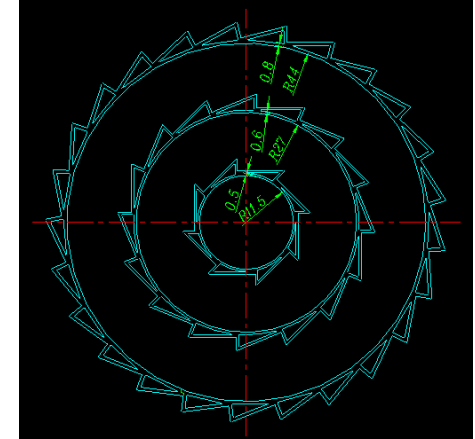
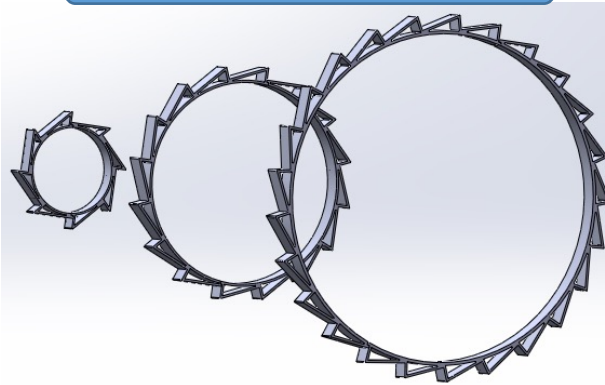
Results of the middle layer ladder support



VTX assembly



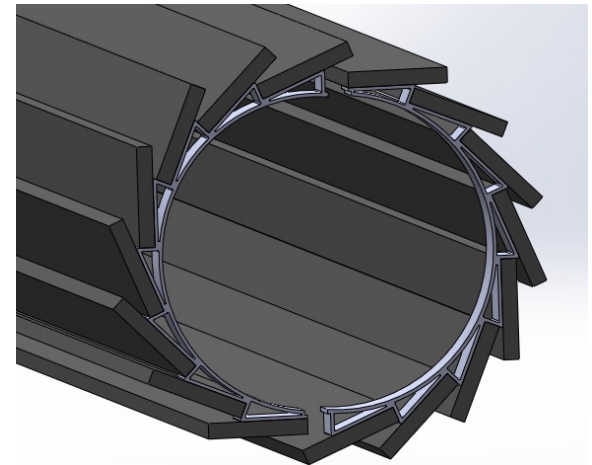
Support rings / Al alloy



Ladder can be glued / bolted to the support ring. Gluing will save space to make the ratchet teeth hollow, which helps ventilation, currently we prefer this method.

Two methods to assemble the VTX:

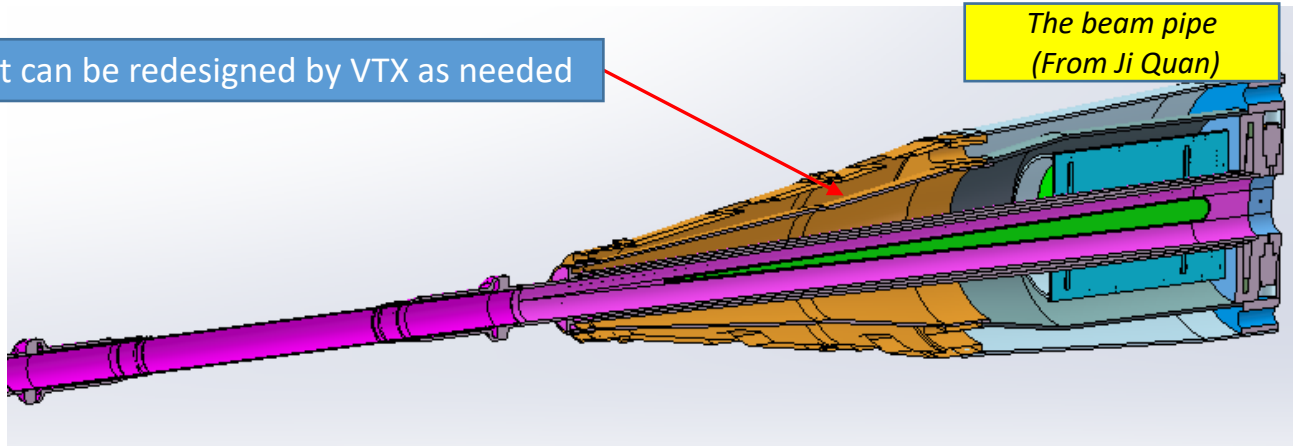
- Assemble the barrel in advance (consisting of two halves), and then install the barrel on the beam tube.
- Install (*or machined*) the support rings on beam pipe in advance, then directly install the ladders (preferred).



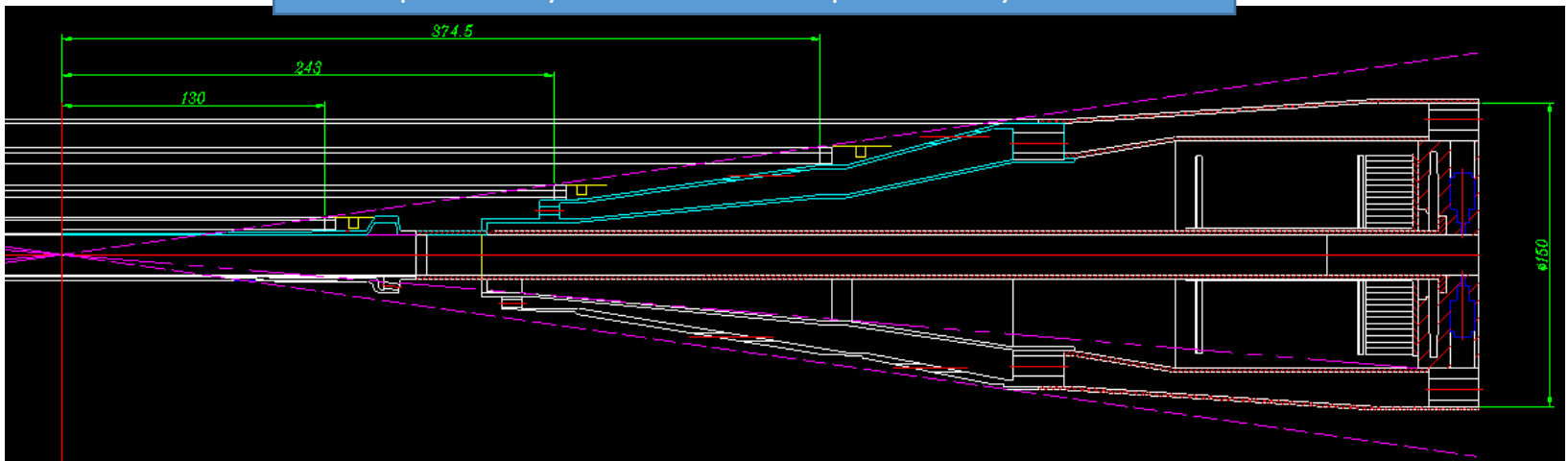
VTX installation on the beam pipe

This part can be redesigned by VTX as needed

The beam pipe
(From Ji Quan)



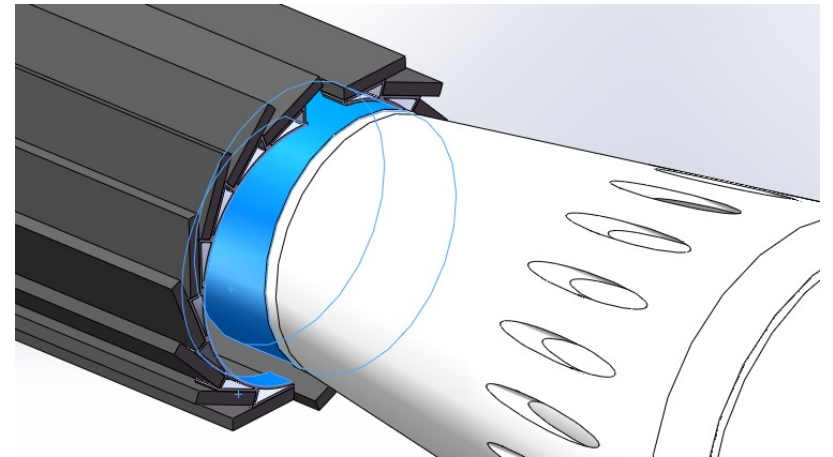
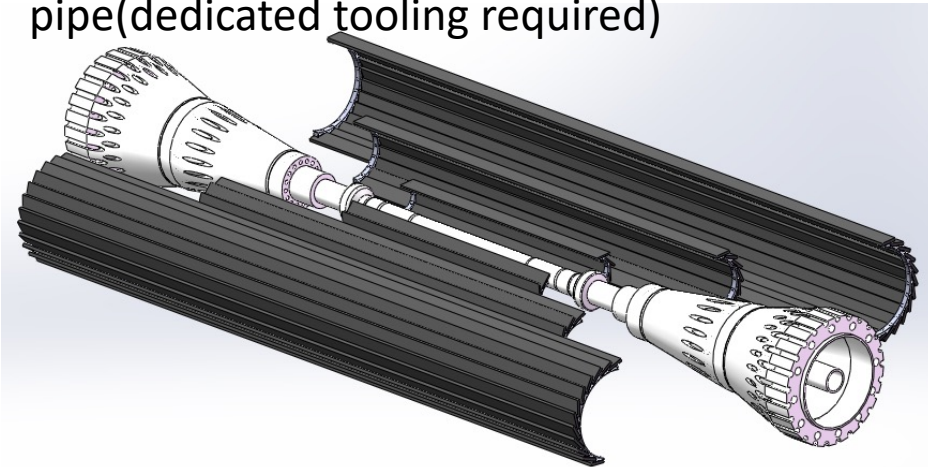
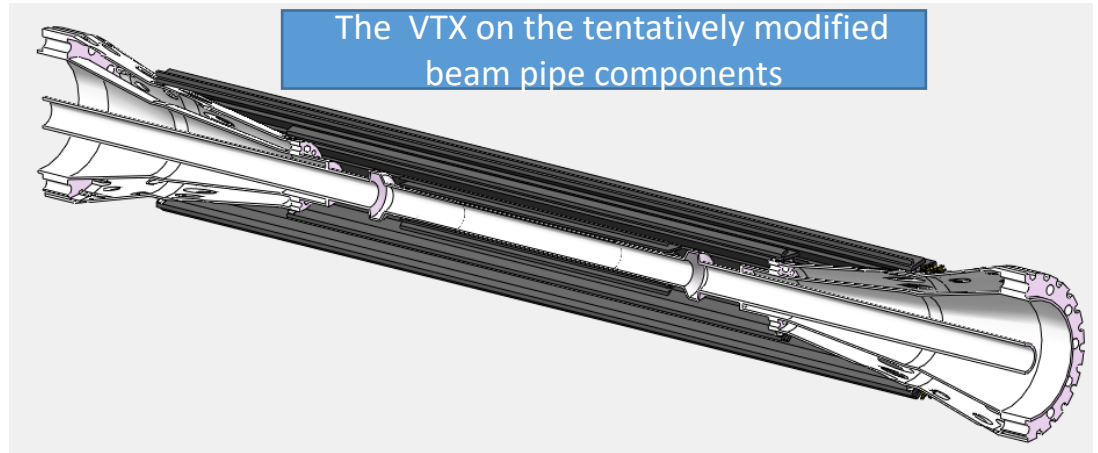
The modification shown as blue lines made to the beam pipe components by the VTX has been preliminarily confirmed



VTX installation on the beam pipe

The support ring can be either glued/bolted to or pre machined on the beam pipe related parts. (for the inner most layer bolting and machining are too difficult)

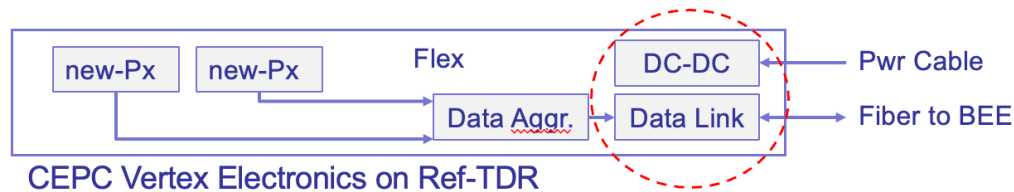
The drawings show the option that pre-assembled halves barrels mounted onto the beam pipe (dedicated tooling required)



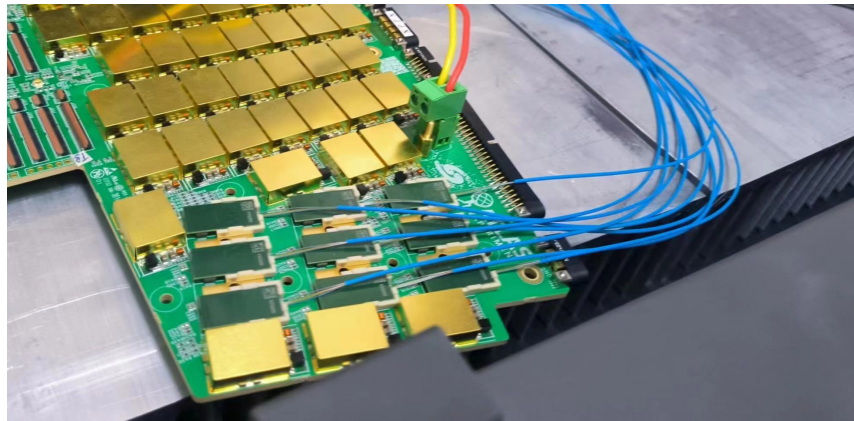
* More consideration - different constraint on two ends?

Cables routing

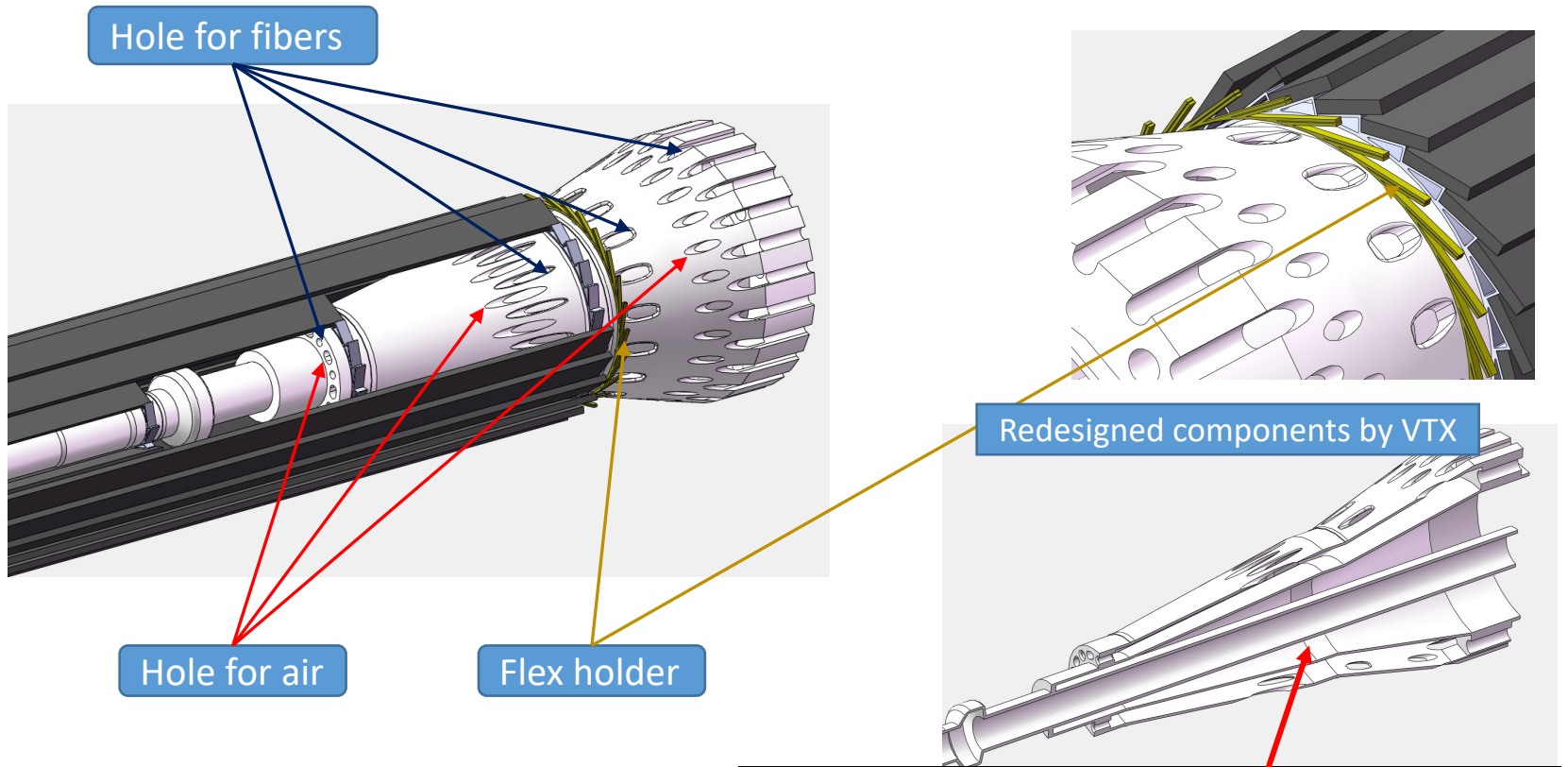
- Optoelectronics module is proposed.
 - Radiation hardness of Optoelectronics module
 - Optical fiber and power cable goes out from cabling space below
 - **Next step: estimate the space for cabling**



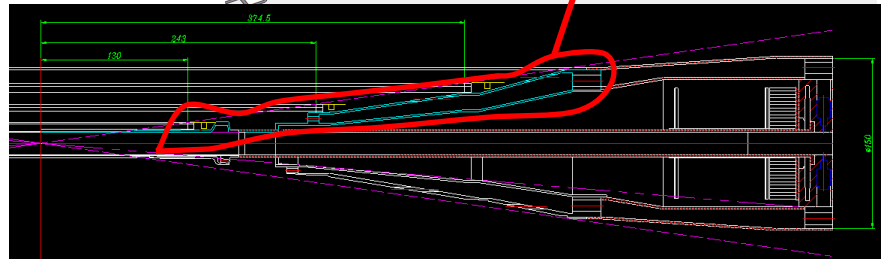
Example from CERN vtrX



Air channels and cables routing



According to the current plan, assuming the flex will be switched to fiber where beyond and near the end of the ladder.



Summary

- long barrel layout Mechanics design is in progress
- “Short barrel + endcap” layout will come later
- Next step is air cooling simulation ...

Backup: material budget

Material Budget (X_0)

