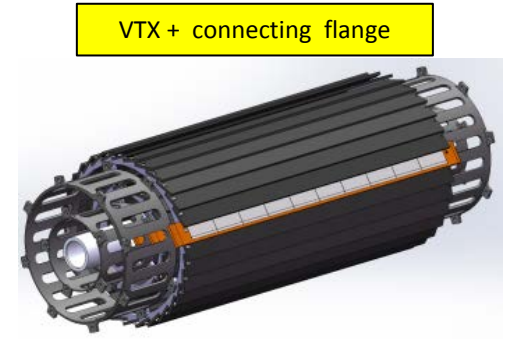
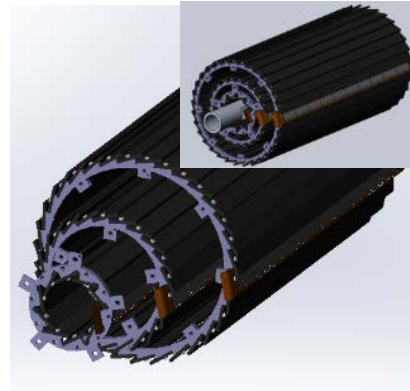
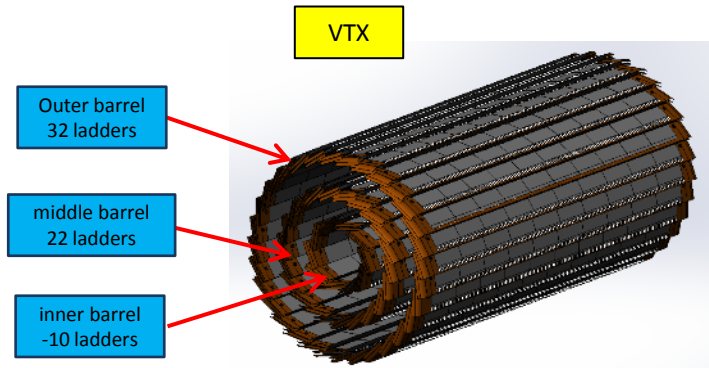


Mechanical Design of the VTX Prototype

Jinyu Fu/IHEP

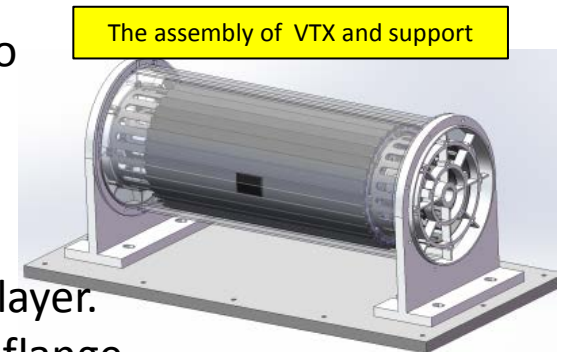
2021-6-25

The Mechanical Support of VTX Prototype



- Extend the inner layer to the same length as the other two layers based on the optimized layout.
- Assembly and structural details:
 - the connecting flange and it's joint with detector.
 - the secondary assembly of the inner layer and middle layer.
 - the joint between the overall support and connecting flange.

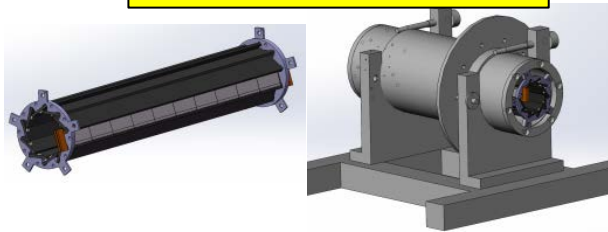
- *Investigated materials and manufacturers.*
- *Plan to fabricate some trail parts (e.g. the side ring) which are tentatively made of composite.*



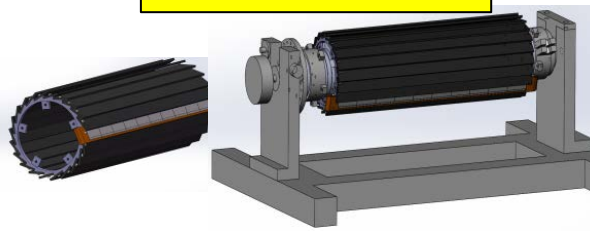
Tooling Design for Barrels Assembling

- 3 sets of tooling for barrel assembling.
- tooling and customized tool for inner and middle barrels assembling.

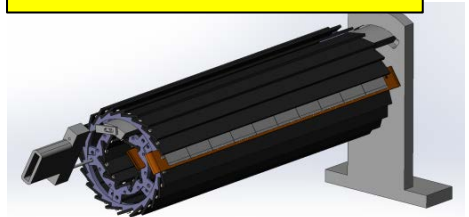
Inner barrel and tooling



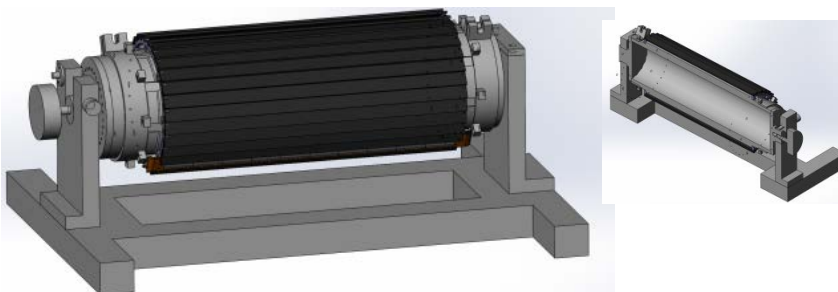
Middle barrel and tooling



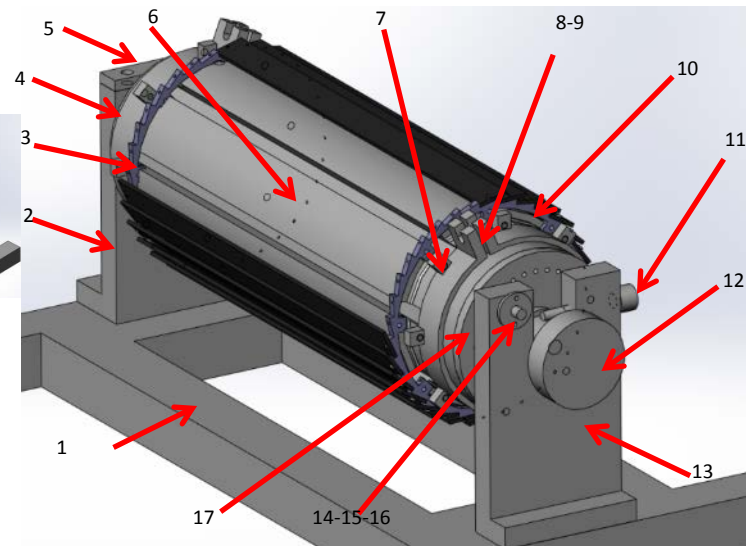
Inner and middle barrels combination and customized tool



Outer barrel tooling



Outer barrel tooling



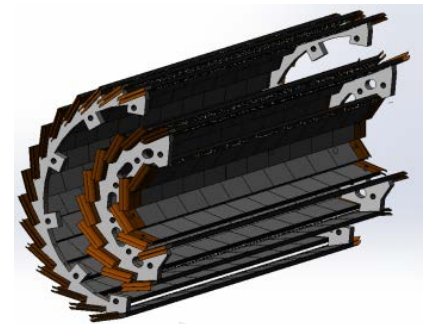
- 1 底座
- 2 固定支架
- 3 进油管
- 4 圆轴端封盖
- 5 固定板
- 6 空心轴
- 7 顶丝
- 8-9 组件夹具
- 10 进油管
- 11 锁销
- 12 转轴座
- 13 支架
- 14-15-16 组件定位销
- 17 端盖

New Design of VTX Main Support

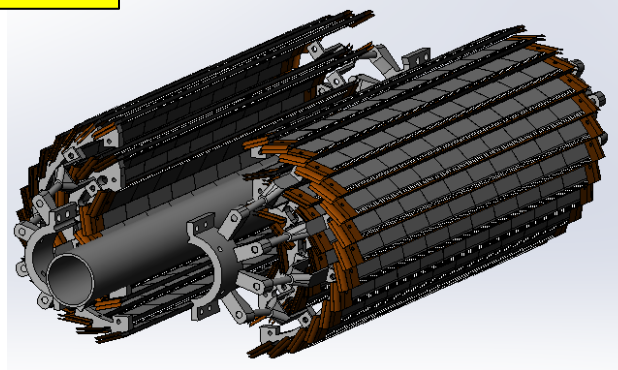
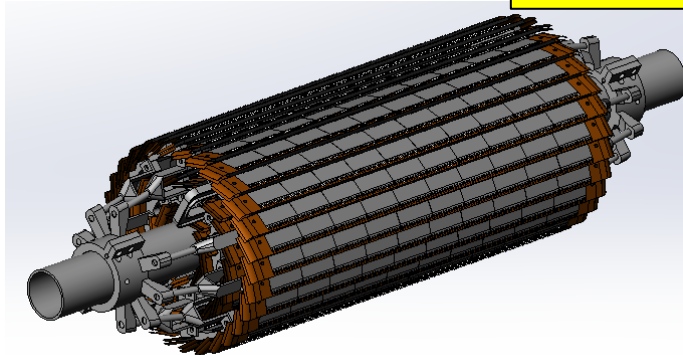
This is a split type VTX support structure (based on CEPC IP environment).

At IP region the VTX is within a very **compact space** with beam pipe at center.

- The overall VTX assembled by two halves which consist of main supports and half barrels.
- Each layer of barrel has two halves.
- Inner and middle barrels share side flange.

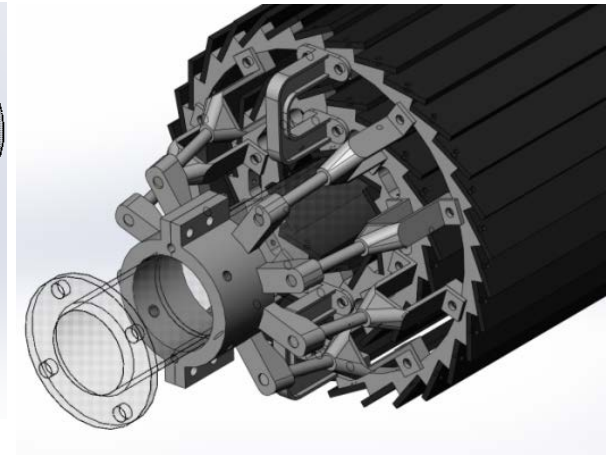
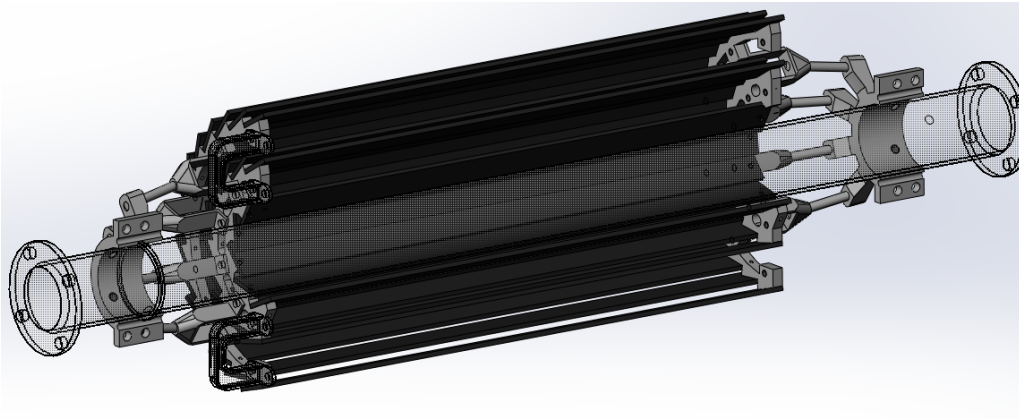


VTX-with split support



New Design of VTX Main Support

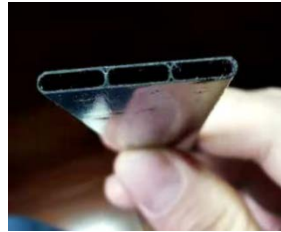
- The claw shaped main supports connect and fix 3 half barrels from two ends to form a half of the overall VTX.
- The claw shaped main supports :
 - take less space, good for material budget and cable routing
 - locate and install the VTX on beam pipe and realize the deformation adjustment in axial direction.



To apply this type support on the VTX prototype is also being considered, which requires new tooling design.

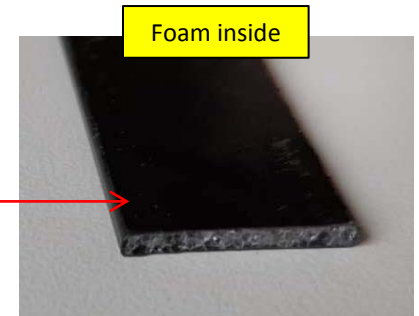
Ladder Support Prototype

The trial production of the ladder support prototype for process validation:



Only main CFRP structure , Section 16.8x2 mm, about 180 mm long(not full length) , thickness 0.12-0.18 mm.

Also trial fabrication for process validation of the optional scheme with foam inside was done.

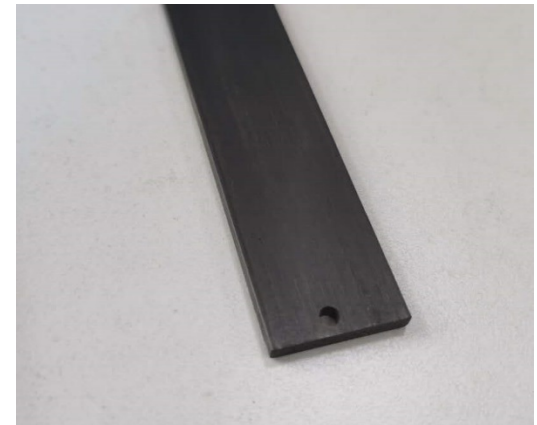
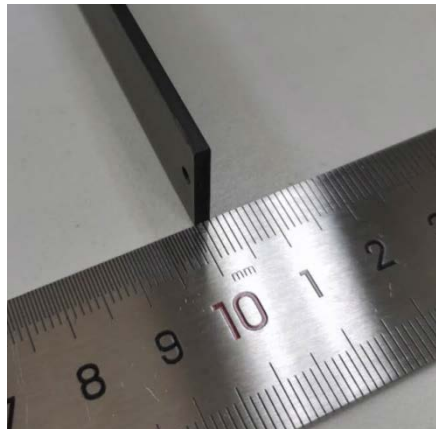


The feasibility of our design has been verified by the successful trial fabrication of the full length main CFRP structure of the ladder support.



Ladder Support Prototype

2 **informal samples** of the ladder support prototype have been fabricated.



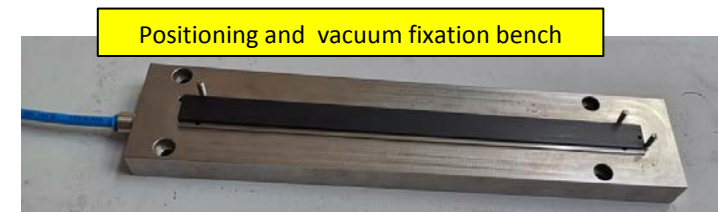
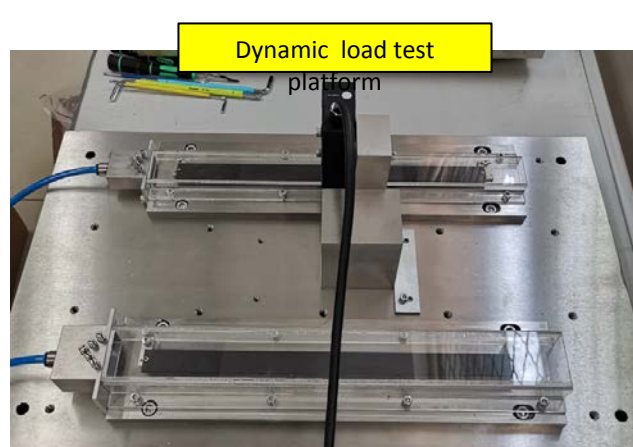
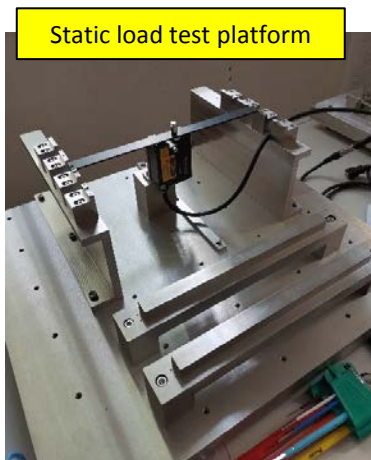
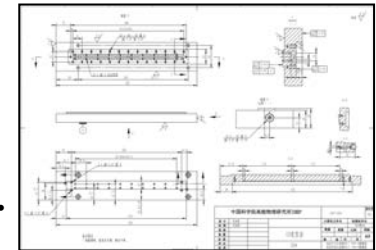
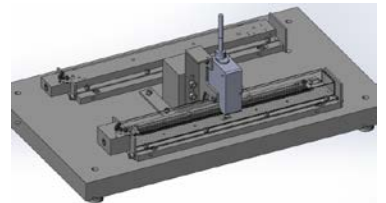
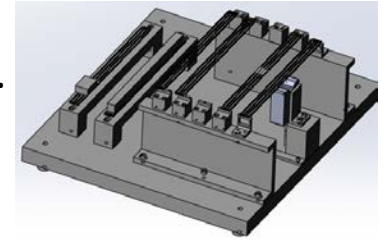
Trial fabrication of more samples are being made. Fabrication of the ladder support prototype with different design specific will start after that.

Test Platforms of Ladder and Ladder support

Most of the ladder prototype test related items have been considered.

- Design of platforms and tooling for different test.
 - Static (different support and load cases)
 - Vibration and cooling + pressed air (different cases)
 - Vacuum test - for surface check of ladder support and ladder and procedure training (i.g. module fixation).
- investigated and purchased auxiliary tools and instruments for test.

All the platforms have been fabricated and assembled , the whole system has been setup and is basically ready for test.

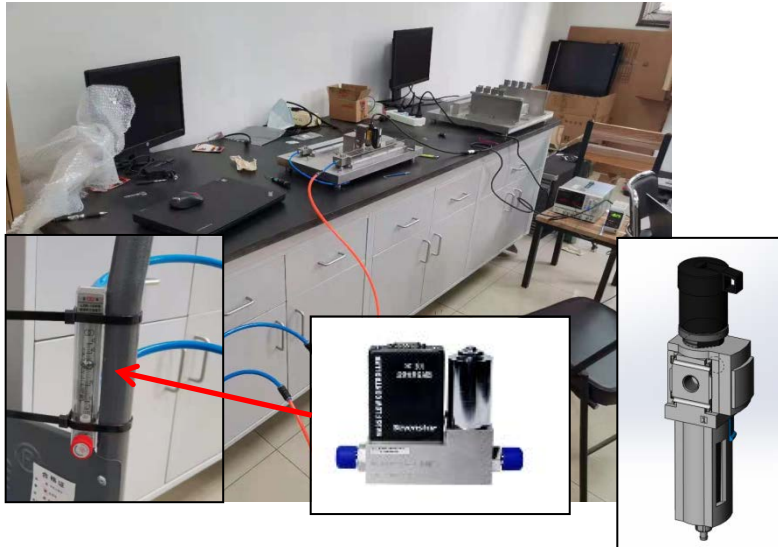


This bench allows positioning and fixation of the ladder-spt even if the ladder-spt is turned over for loading detector on the other side.
It can works as a trail fixture of our "gantry".

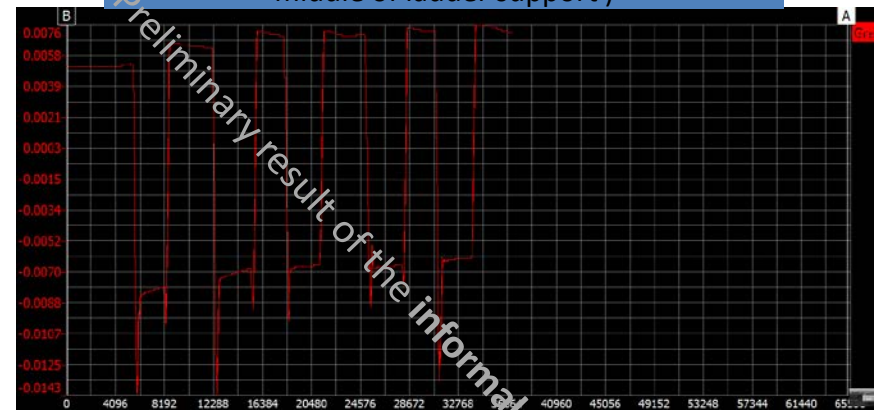
Preliminary Test of the Informal Ladder Support

Thanks to Bo Liu and Zhijun for their help.

Very preliminary test of the informal ladder support samples has been done, which is mainly for verifying the function of the test platforms and the measuring instrument.



Displacement of the middle of ladder support
(place and then remove a 10g weight 5 times on
middle of ladder support)



Displacement of the middle of ladder support
(small channel , flow 40 SLM $\sim 3.2\text{m/s}$)

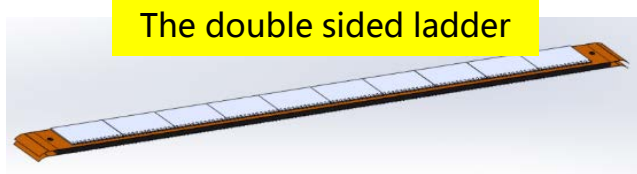


- Need more stable gas control (update pressure and flow control devices)
- More verification test combined with temperature measurement.
- Further familiar with the measuring instruments.

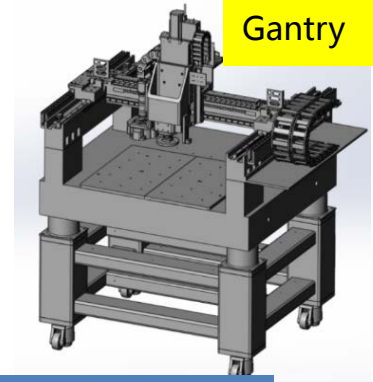
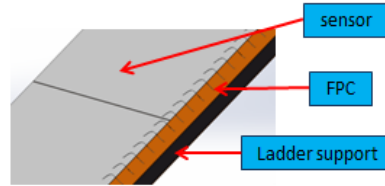
More to study.

Tooling Design for Ladder Assembling

The ladder will be assembled on a gantry automatic system. The gantry provide a 500x500 mm platform and a 3-way movable + 1 axial rotatable **spindle** which we can use directly.



The double sided ladder

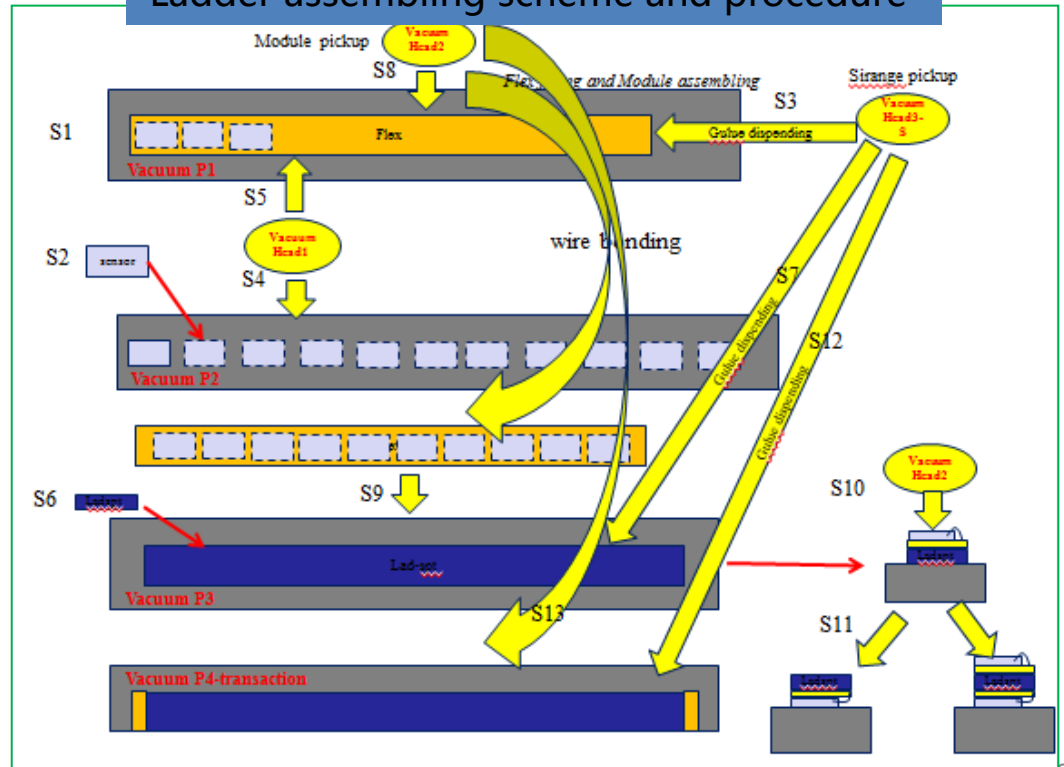


Gantry

Designed the preliminary assembling scheme. The main process:

- positioning of parts
- glue dispensing on flex
- sensor pickup
- sensor positioning and bonding in flex (module assembling)
- module (after wire bonding) shifting
- ladder semi assembling (module loading and gluing)
- ladder full assembling, etc.

Ladder assembling scheme and procedure



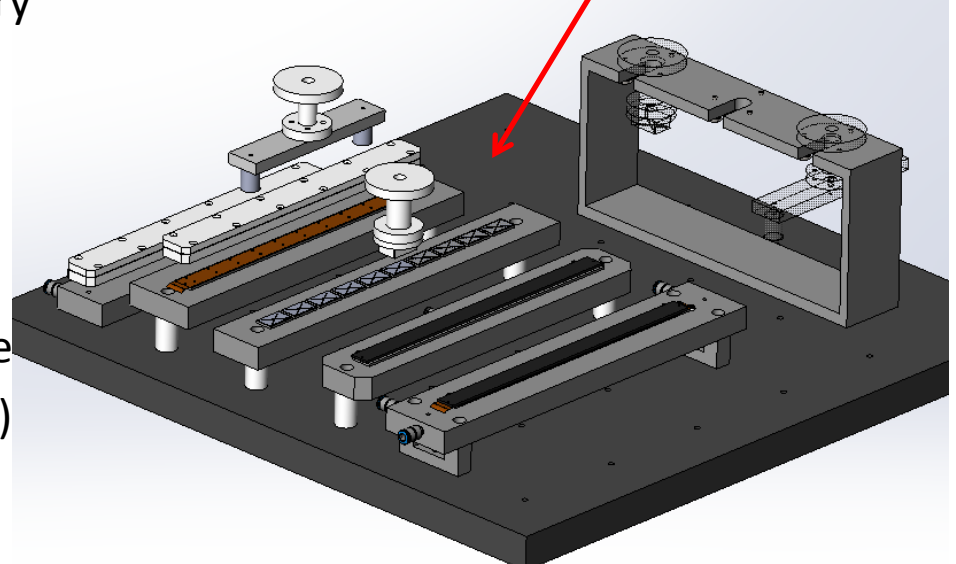
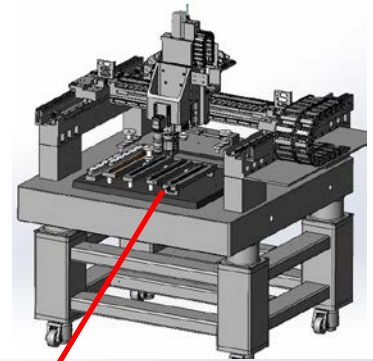
Tooling Design for Ladder Assembling

According to the ladder assembling scheme and procedure, started the following preliminary tooling design :

- Vacuum fixation assemblies
(4 types , two of them have secondary vacuum fixation function)
- Transition and positioning assembly
(with secondary fixation function)
- Vacuum pickup assemblies (3 specs)
- A rack of pickup tools (also to ensure the accuracy of repeated positioning)

.....More to be designed

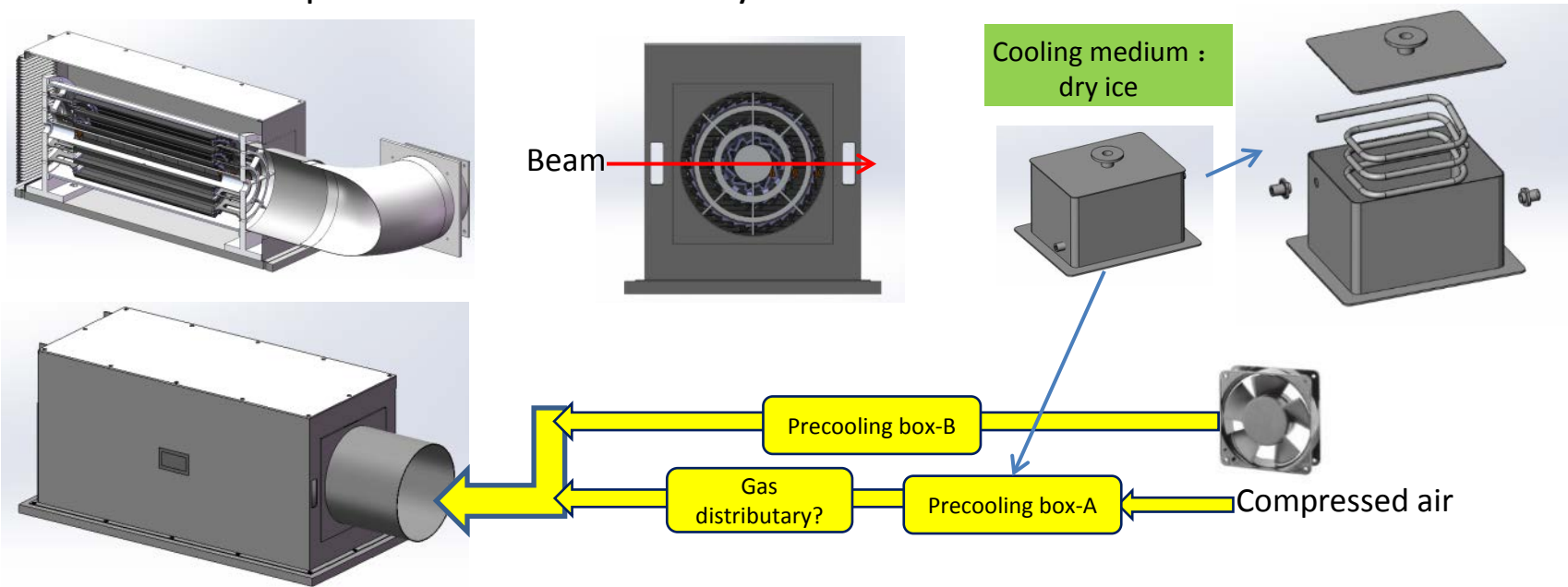
- The tooling for holding the dispensing syringe is being conducted
- The components and parts for providing and controlling vacuum and compressed air and also the vacuum suckers are under investigation.



Optimizing of the VTX Prototype Beam Test Box

The test box is used to support and fix the VTX detector and provide air-cooled and light tight environment.

- ✓ Updated the VTX integral structure
- ✓ Add a transparent channel assembly outside the VTX detector



Two cooling test schemes, **compressed air** and fan, related designs are on going:

- Precooling boxes embedded in the air duct(applicable to two cases respectively) , the design A can also be used on the ladder cooling test platform.
- Gas distributary (applicable to compressed air) .

Next in the future

- Fabricate the Ladder support prototype.
- Test the bare ladder support:
(Besides that, more test of the “ladder” with dummy flex and dummy sensor can also be done once they are ready)
- Finalize mechanical design of the overall VTX prototype and tooling.