中国科学院高能物理研究所

Institute of High Energy Physics Chinese Academy of Sciences

Mechanical design considerations

Jinyu Fu, Zhijun Liang

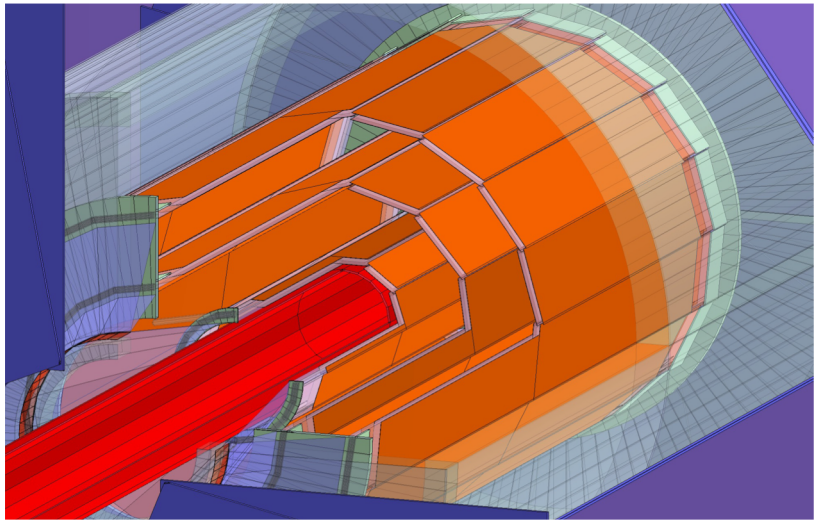
Institute of High Energy Physics ,
Chinese Academy of Science

outline

- Mechanical design considered
- Missing pieces
- Recent collaboration activities
- Next steps and future collaboration

Detector Layout in Preliminary Design

		R (mm)	$\lvert z\rvert$ (mm)	$\lvert\cos\theta\rvert$	σ(μm)
Ladder 1	Layer 1	16	62.5	0.97	2.8
	Layer 2	18	62.5	0.96	6
Ladder 2	Layer 3	37	125.0	0.96	4
	Layer 4	39	125.0	0.95	4
Ladder 3	Layer 5	58	125.0	0.91	4
	Layer 6	60	125.0	0.90	4



6 layer of sensors (3 layer barrels, each has sensors mounted double sides)

* **Material budget:** 0.15% X/X0 for each single sensor layer.

* **Power dissipation:**

  Final goal: ≤ 50mW/cm2 (air cooling).

  Current (short term) goal: ≤ 200mW/cm2. (active air cooling)

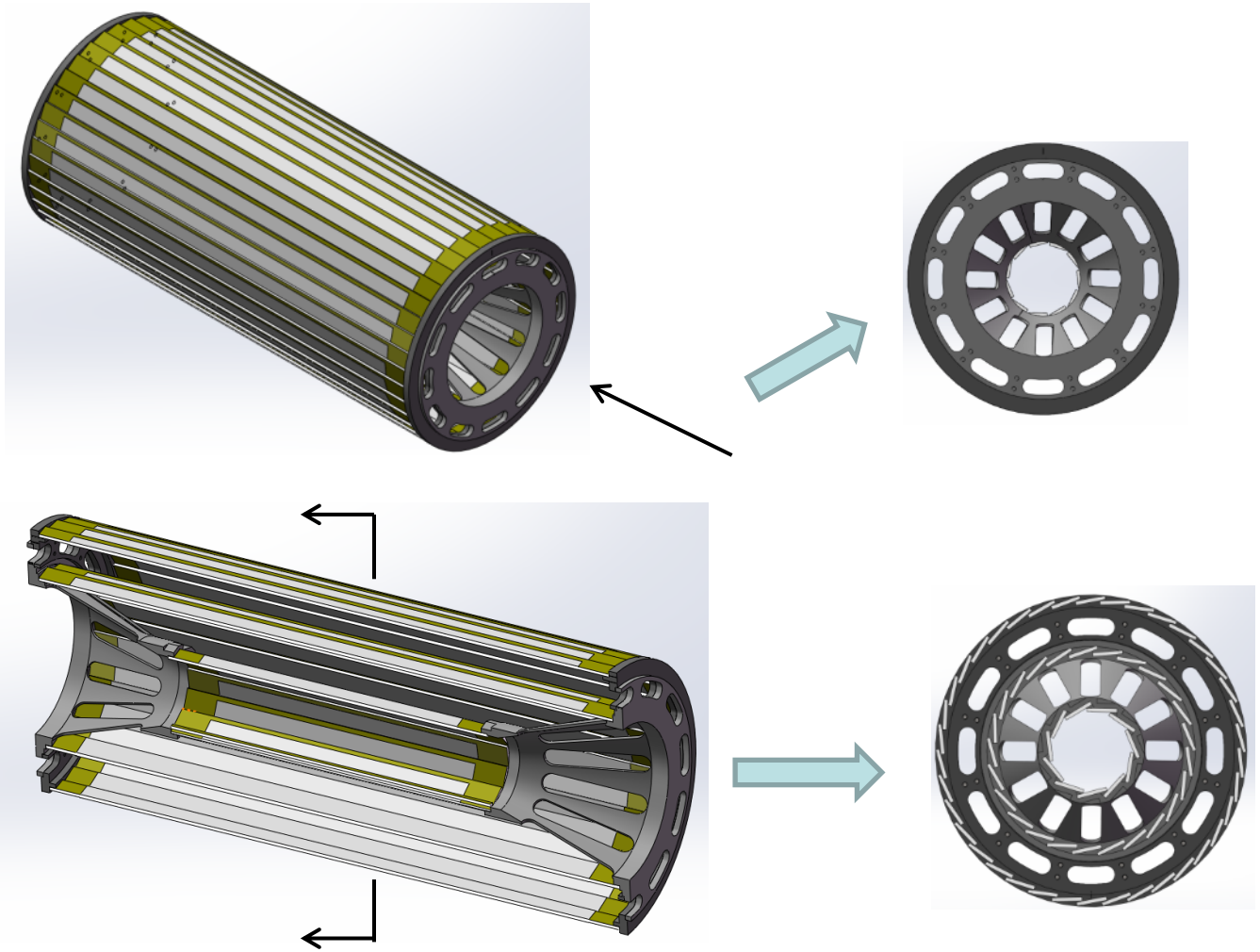
* **Single point resolution**: currently in CDR range from 2.8-6 μm, eventually there will be only one type of pixel sensor with single point resolution of 3-5μm.

* **Material budget:** 0.15% X/X0 for each single sensor layer.

* **Working temperature range:** 20-50 Centigrade.

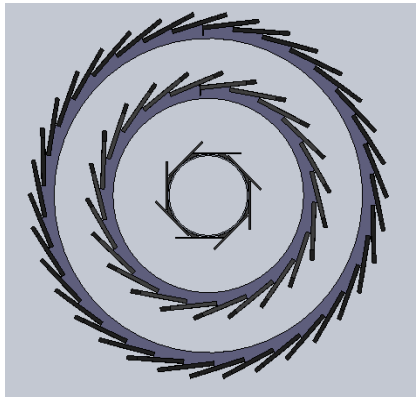
Conceptual Design of VTX Support -V0

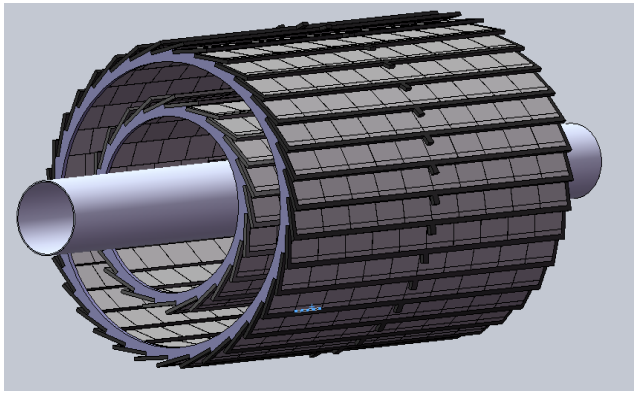
This is a conceptual design with unclear size of sensors and without considering boundary conditions, assuming three barrels integrated together.



Conceptual Design of VTX Support –V1

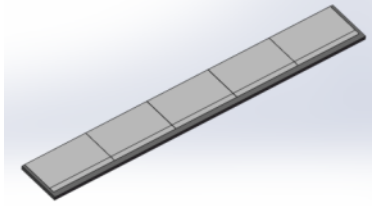
Sensor chip : 14.8 x 25.6 x 0.05 mm (2mm wide margin at one side for wire bonding)



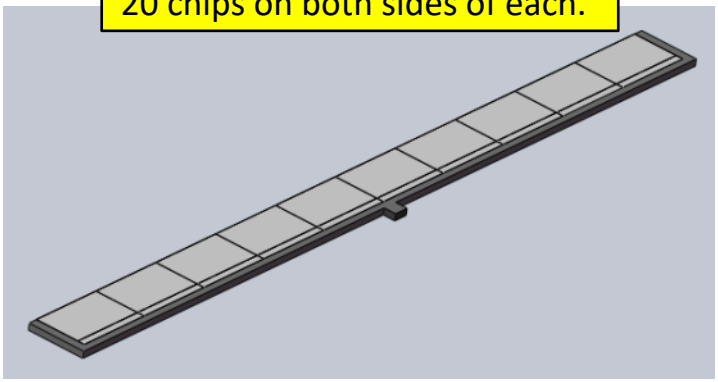


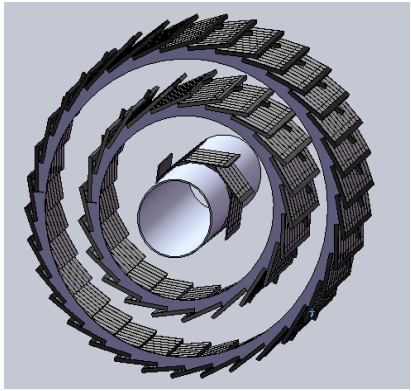
Module: local support + chips + FPC

Module of inner layer:
10 chips on both sides of each.



Module of outer two layers:
20 chips on both sides of each.



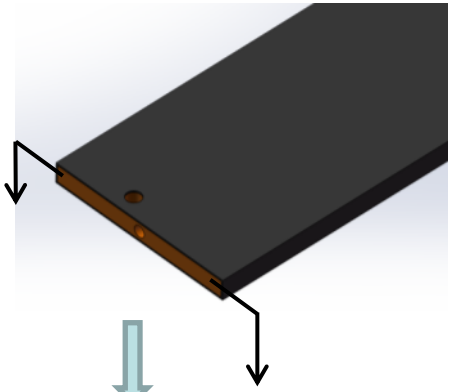


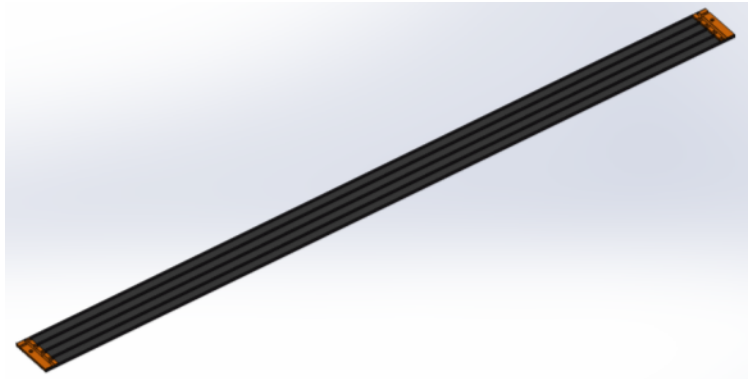
Local Support of Module

Size: 263.1 x 16.80 x 1.80 mm (L x W x H), for outer and middle barrels. Half length for inner barrel.

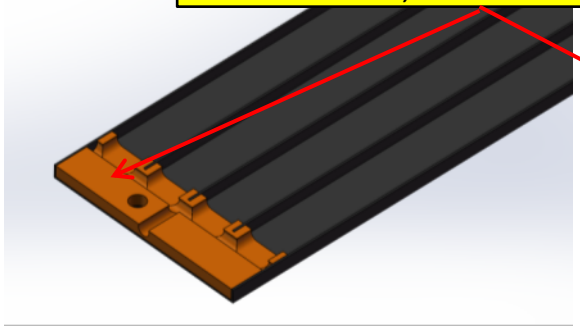
Material: Carbon fiber in thickness of 0.15 mm (3 layer 0-90-0).

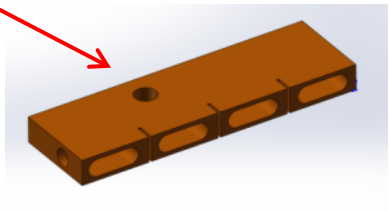
Channels inside the local support: to increase stiffness(Inertial of Moment), also work as a backup for air cooling from inside of the support.





End block (PEEK): strengthen the end for bolting connection, also works as air distributor, webs terminator.

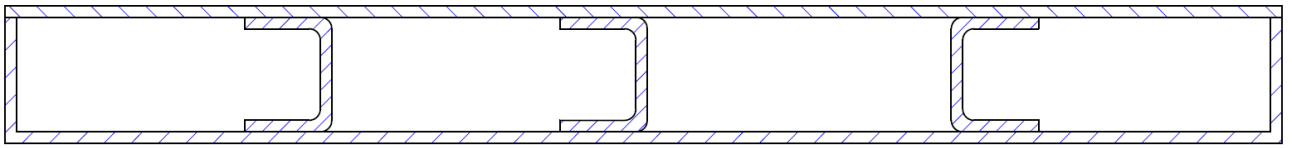




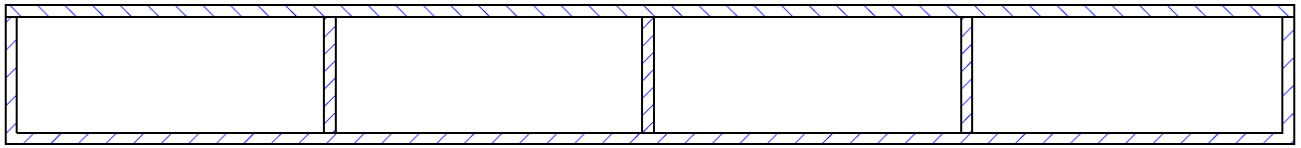
Local Support of Module

To glue webs inside the local support, considering:

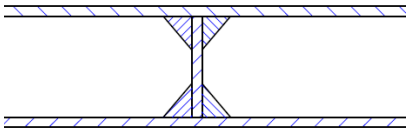
Option 1



Option 2

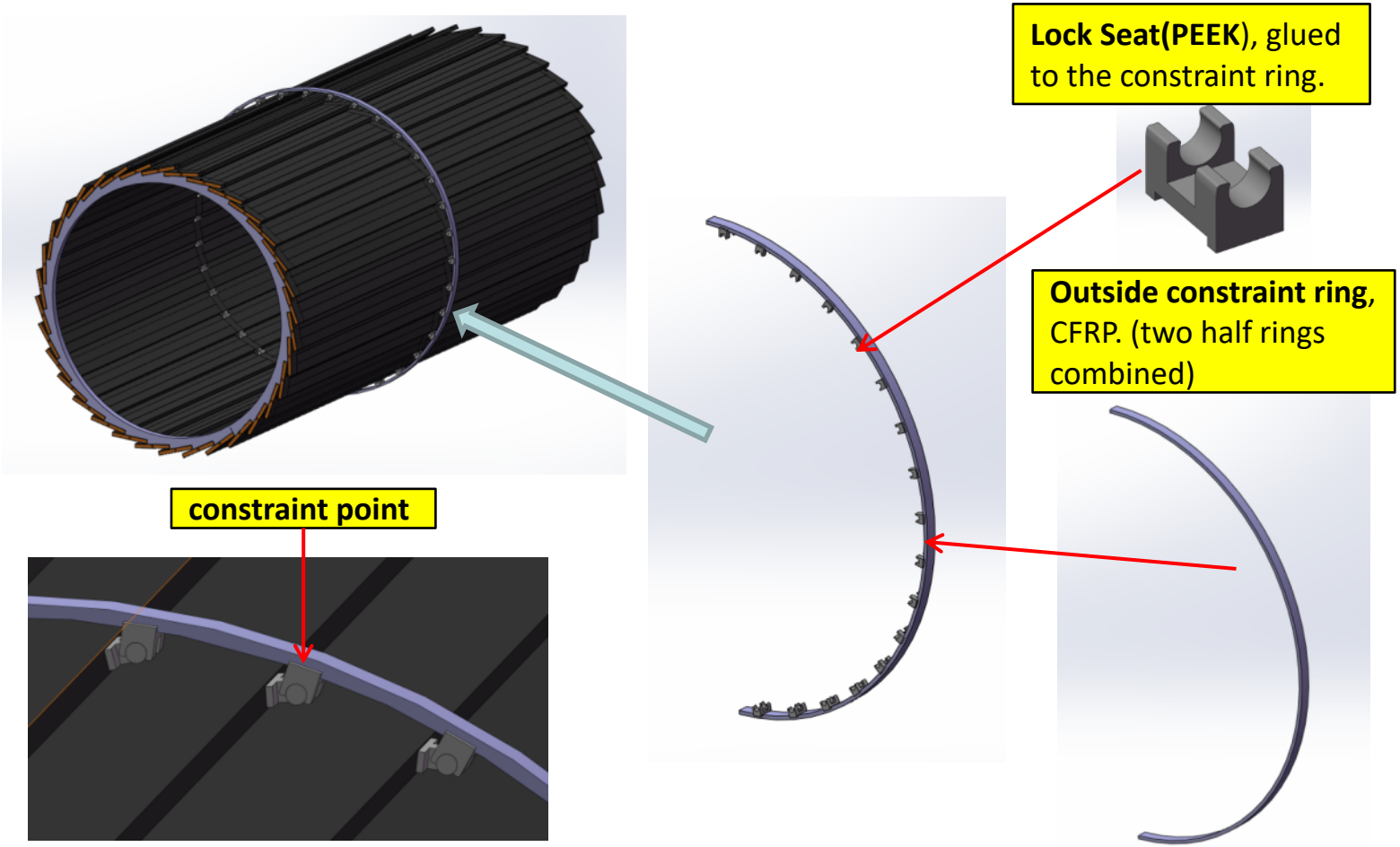


Option 3



To Increase the Stability of the Local Support

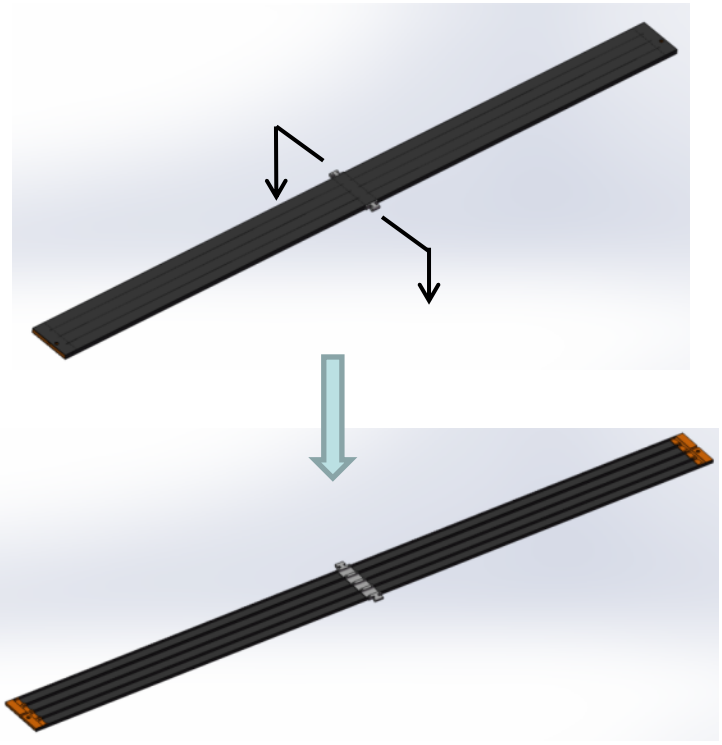
Link each module(directly on the local support) in middle to a constraint ring from outside of the barrel. Depends on further analysis, if needed, modules can also be linked to an inside constraint ring. Here just show the outside linking structure which currently is just a backup design.

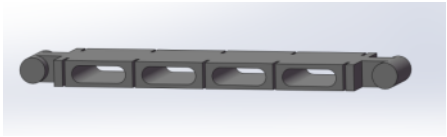


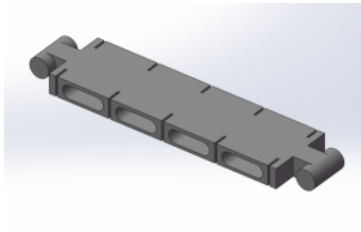
To Increase the Stability of the Local Support

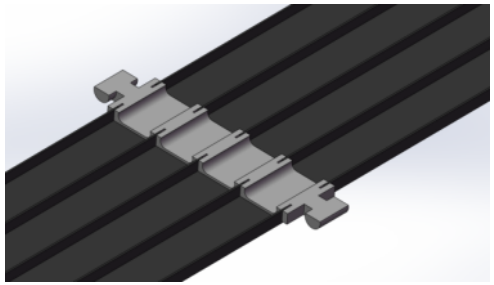
To mate with the lock seat on the constraint rings, inside the local support embeds a connector.

Middle embedded connector (CF 3D printed for prototype): to generally constraint the local support at middle, also works as air distributor and webs connector locally inside the support.









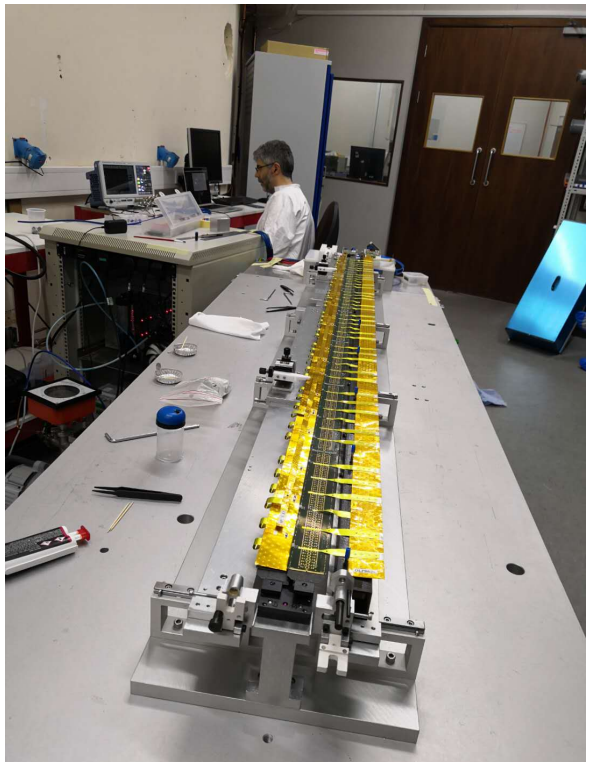
Missing pieces

- Only one mechanical engineer this project.
  - Jinyu Fu: expert in large structure Mechanical design
- Missing expertise in many field
    - Cooling design (airflow), thermal simulation
    - Mechanical simulation for carbon fiber structure
      - For module and pixel prototype
    - Carbon fiber structure manufacture
- Please consider to play a Role in these area:
  - **Consulting role on mechanical design of ladders and structure**
  - **Design of any mechanical aspects**
  - **Investigation of cooling needs R&D on cooling aspects**
  - **Adding forward disks**

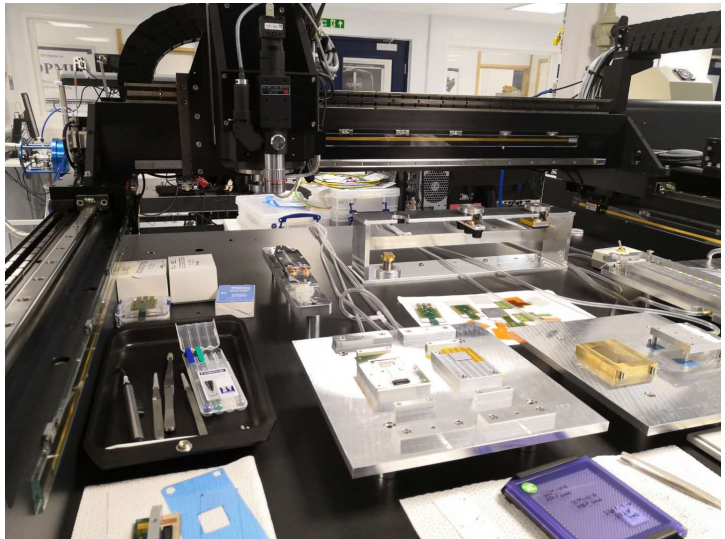
Recent collaboration activities

- Jinyu Fu visited Oxford and Liverpool
  - Learn a lots from Oxford and Livepool colleague about silicon

Lab visit in Liverpool
Thanks Yanyan, Tim, Peter, Joost



Lab visit in Oxford.
Thanks Daniela, Ian, Kirk
Richard , Chris , Georg , Stephanie



Next steps for MOST2 project

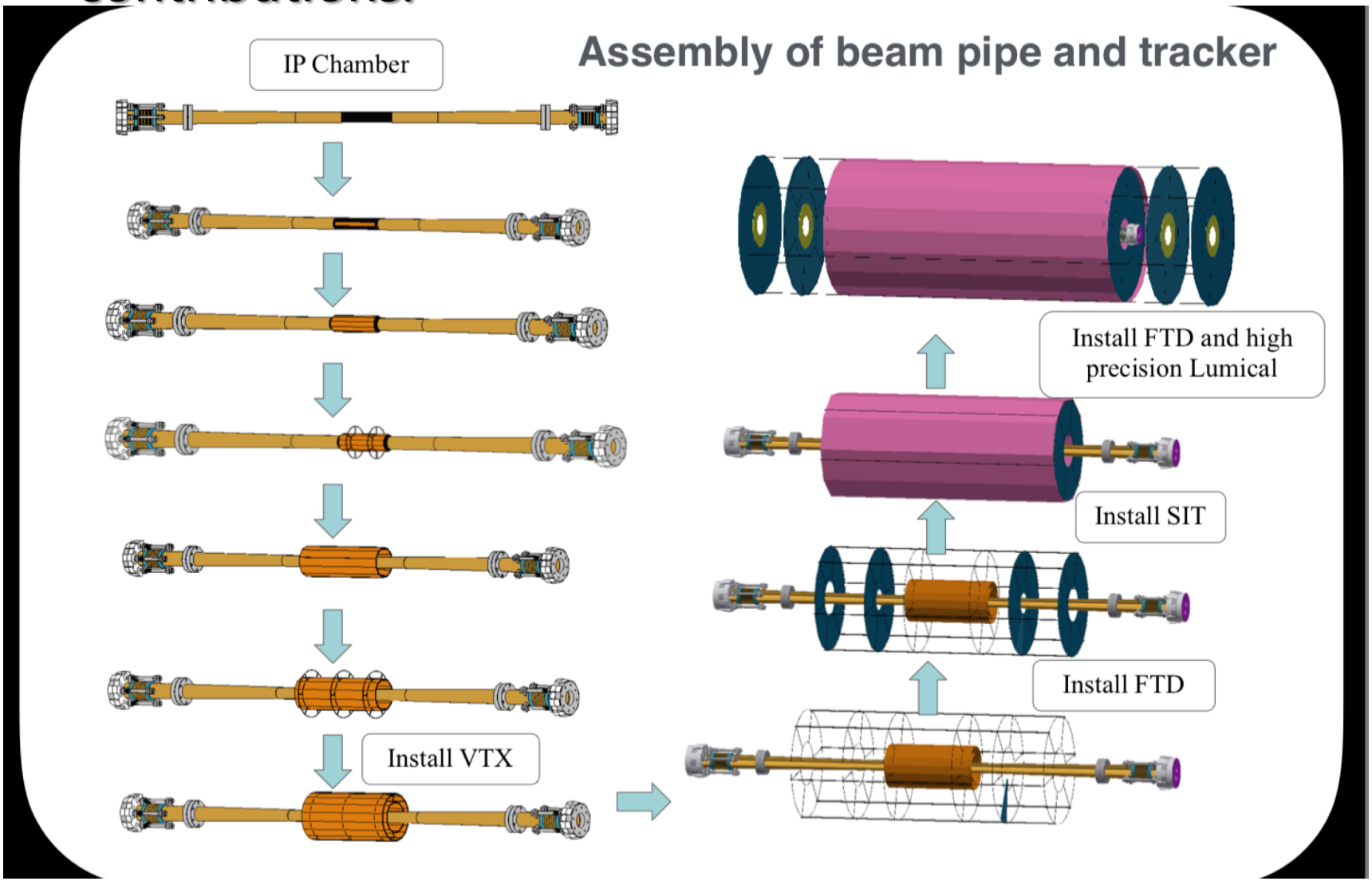
- Manufacture a module/prototype carbon fiber structure
  - Validate mechanical simulation of carbon fiber
- Cooling design
  - Thermal simulation (air cooling)
  - Thermal mockup with "dummy module" + "heaters"
  - Looking for contributions on this

Next steps for CEPC

- More items will be designed and defined after further clarification by discussing with other groups (pixel sensor, MDI, other detectors):
  - The end support structure for barres and how structurally correlated the three barrels
  - Services routing
  - Integration with Beam pipe and outer tracking detectors.

Next steps for CEPC

- Global structure, service and integration need more contributions.



Next steps for CEPC

- Investigation of cooling needs R&D on cooling aspects
- Adding forward disks