Progress in mechanical design of CEPC detector TDR

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June 4, 2024

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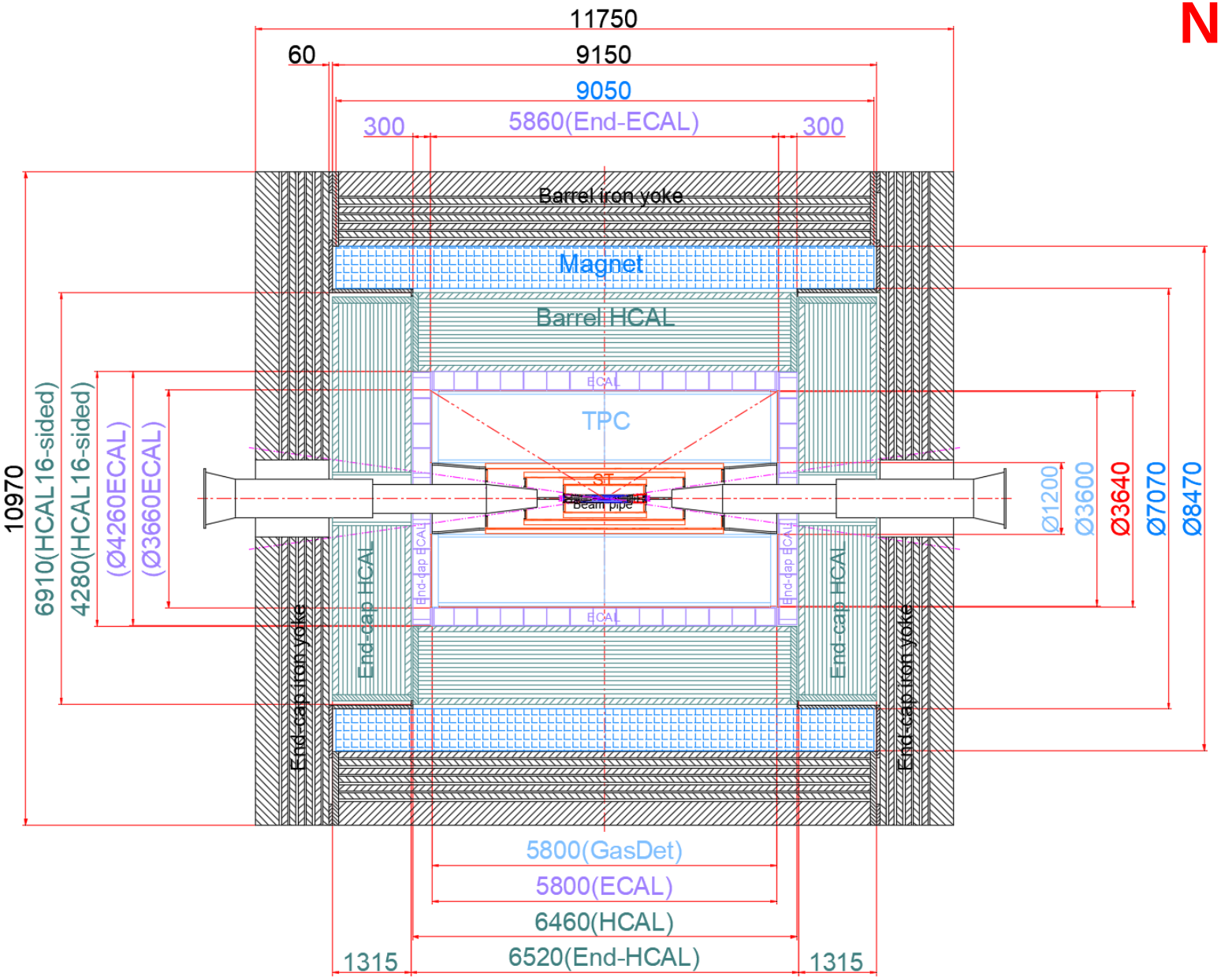
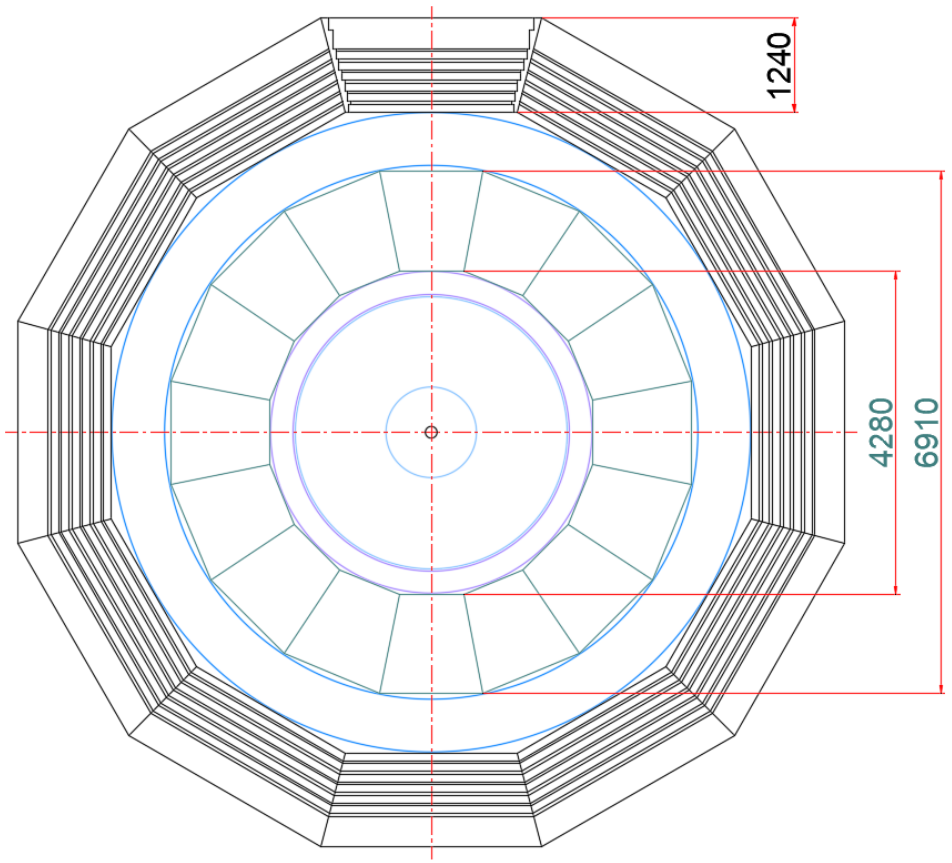
2. Progress in Mechanical Design
3. Discuss for the “Work contact form” of the Vertex
4. Next Plan

1. Progress of general drawing

Update:
No → No progress(June 4)



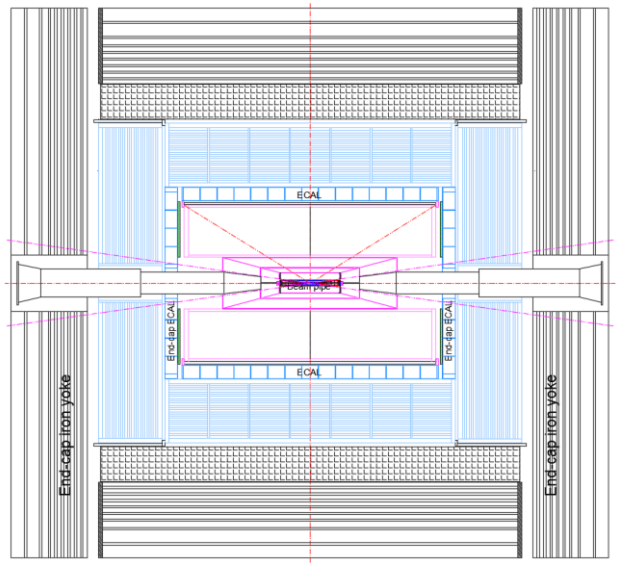


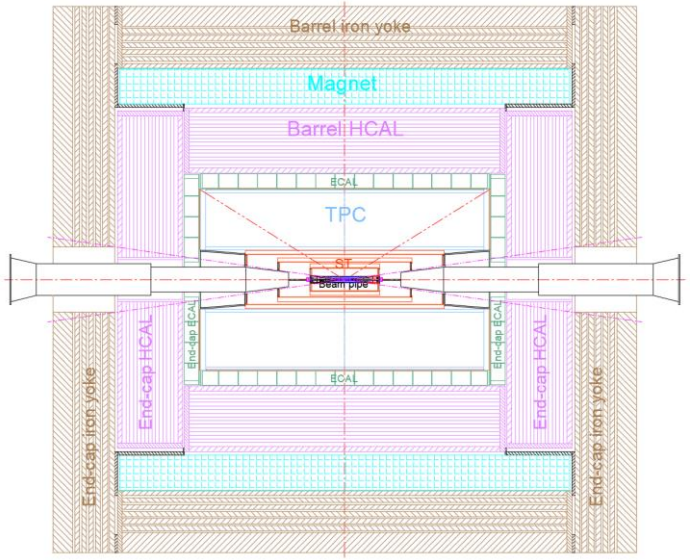
1. Progress of general drawing

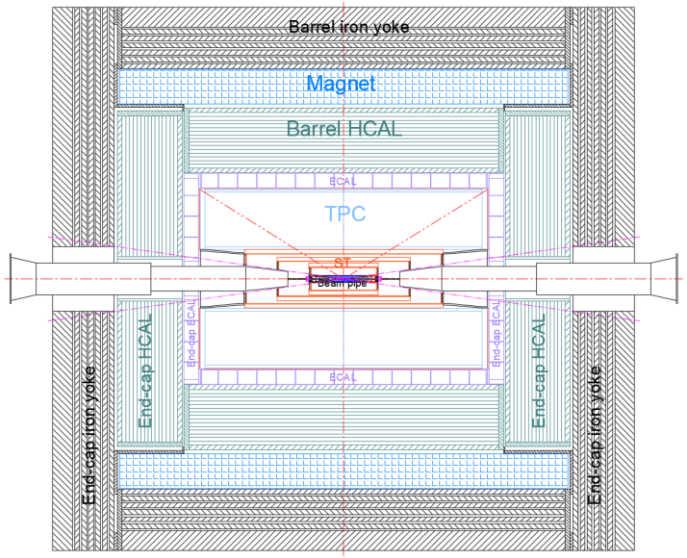
The issue of "unification" for the general drawing of Ref TDR

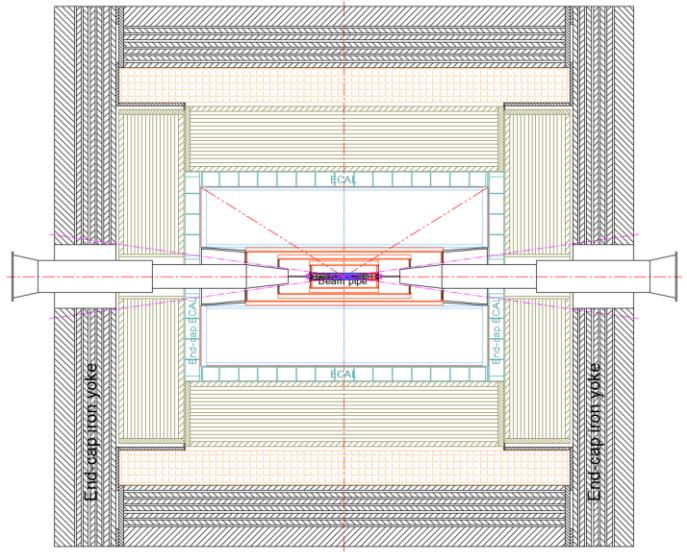
Include 3:

3-1 Mechanical general drawing









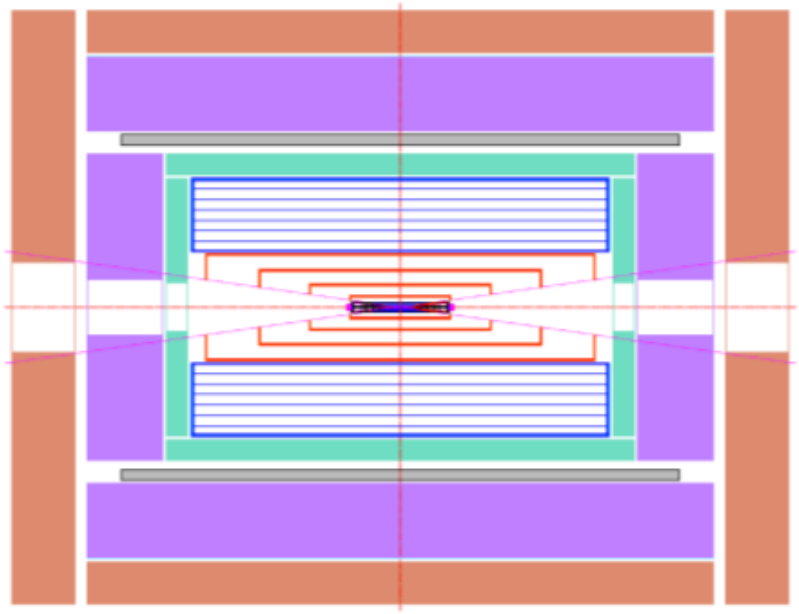
“4” color schemes

1. Progress of general drawing

The issue of "unification" for the general drawing of Ref TDR

Include 3:

3-2 Detector Layout



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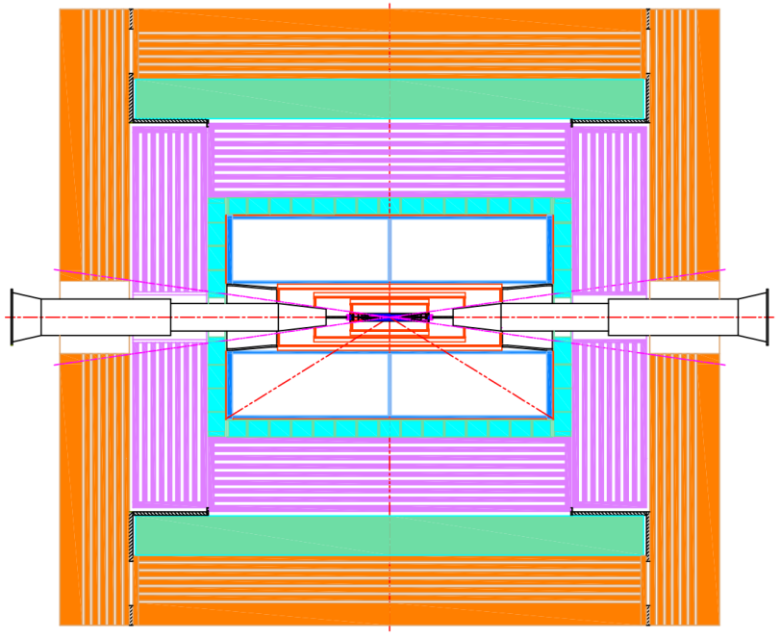


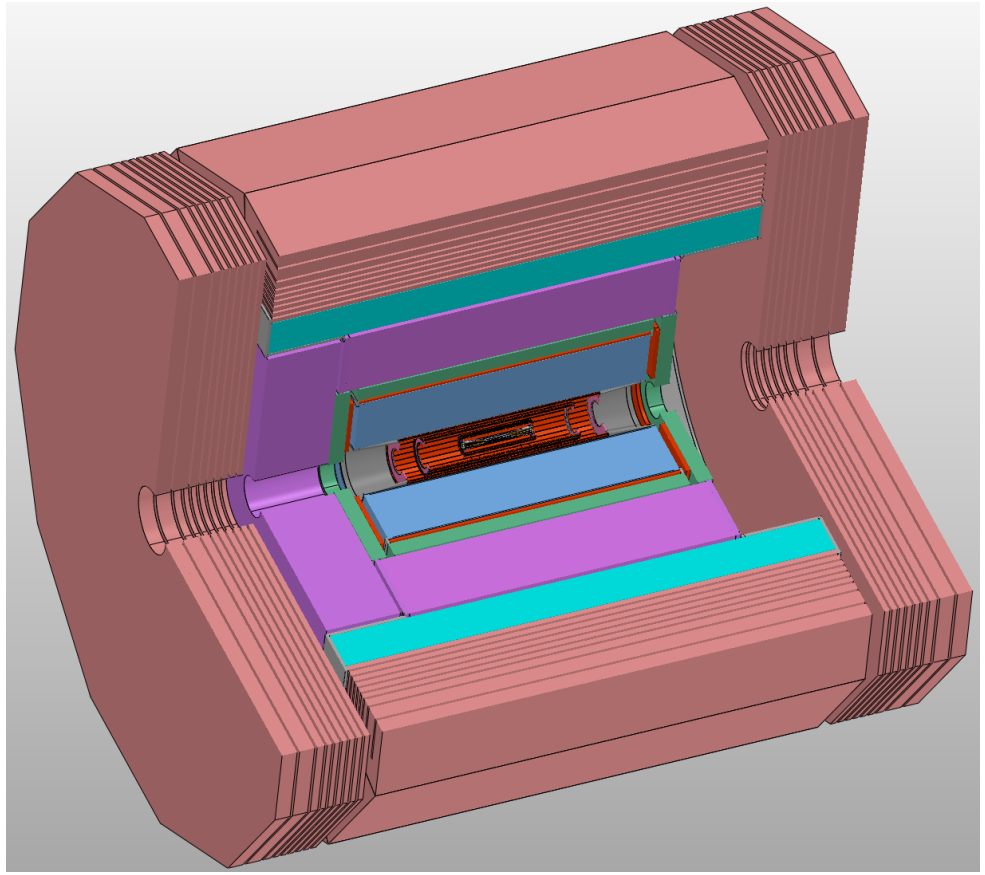
二

1. Progress of general drawing

The issue of "unification" for the general drawing of Ref TDR

Include 3:

3-3 3D Detector Layout



?

After all sub detectors have basically completed the design mechanical framework……

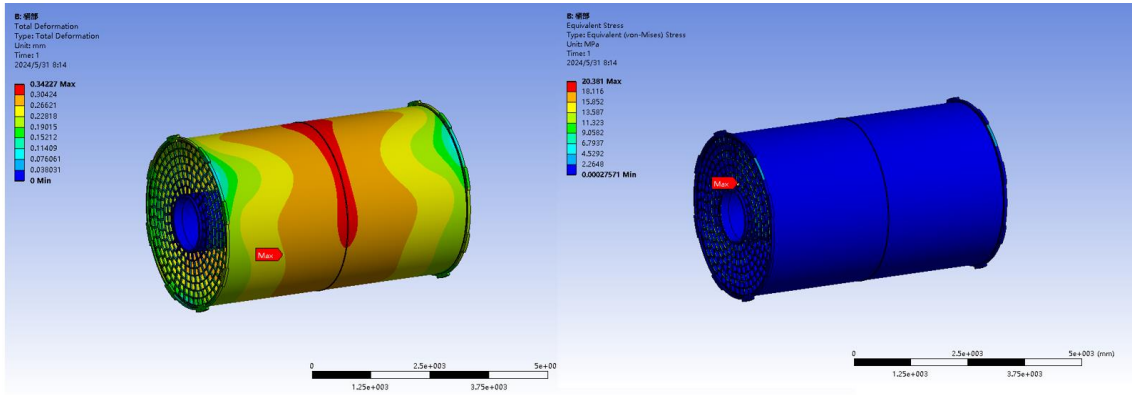
Basic dimensions and interrelationships of sub detectors (see table below): **Starting from IP**

	R (mm)		Axis (mm)		Comment/status
Yoke (T: 1300 mm)	4245 ~ 5485 (12-sided) (Barrel Yoke) L: 4575 X 2 = 9150 Total H: 5485 X 2 = 10970		4635 ~ 5875 (End Yoke) 4635 – 4575 = 60 (Total L: 5875 X 2 = 11750)		
Magnet (T: 700 mm)	R3535 ~ R4235 L: 4525 X 2 = 9050		0 ~ 4525		
HCAL (T: 1315 mm)	2140 ~ 3455 (16-sided) (Barrel HCAL) L: 3230 X 2 = 6460		3260 ~ 4575 (End HCAL) 外形待定		
ECAL (T: 300 mm)	R1830 ~ R2130 (参考圆，比较阶段) (Barrel ECAL) L: 2900 X 2 = 5800		2930 ~ 3230 (End ECAL) 外形待定		
OTK	R1800 ~ R1820 (Barrel OTK)		2910 ~ 2930 (End OTK)		
TPC	R600 ~ R1800 L: 2900 X 2 = 5800		0 ~ 2900		
ST	R79 ~ R590 (暂定和待定)		待定		
Beampipe/Vertex/LumiCal	0 ~ R76.5		0 ~ 700		
	Vertex	R1=12.5, R2=28.1 R3=45.1(See drawing)	Vertex	L1=130, L2=247 L3=374.5	
	LumiCal	See drawing	LumiCal	550 ~ 670	

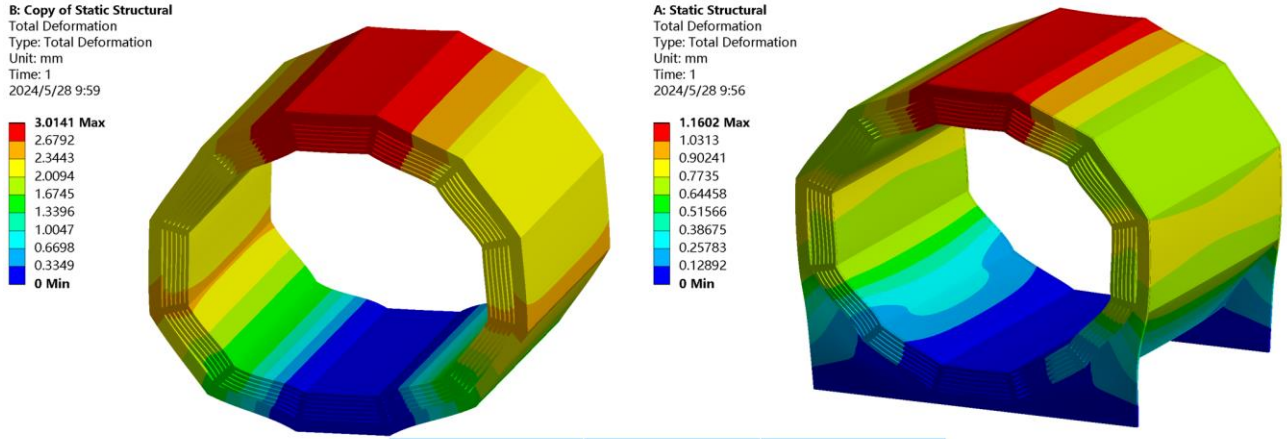
Note: The data in the table are radius and half length → No progress(June 4)

The progress of the general drawing requires sedimentation and accumulation

2. Progress in Mechanical Design



张俊嵩：TPC

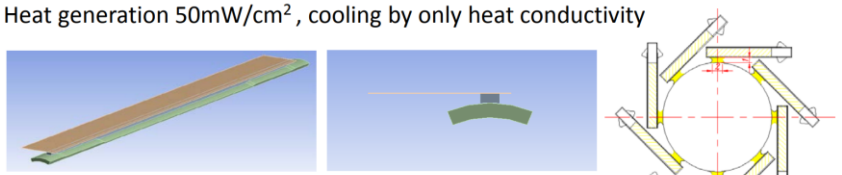


自重变形	无立柱	有立柱
对称式结构（1240mm厚度）	3.0141mm	1.1602mm

夏商：Yoke

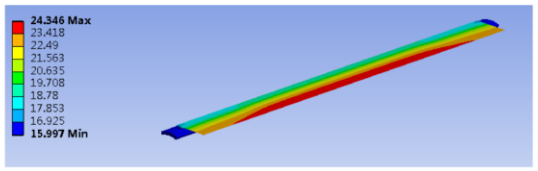
FEA of the inner layer cooling by heat conductivity

1/8 model of the inner layer sensor and beam pipe with glue between them.
Heat generation 50mW/cm^2 , cooling by only heat conductivity

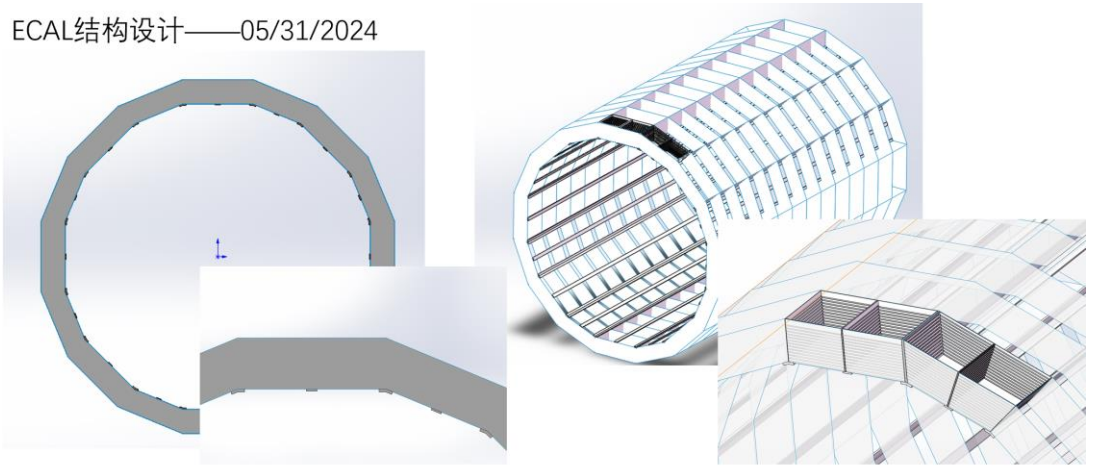


Sensor: R 12.5 mm, 148 W/m.k, 14.8x260x0.05 mm
Beam pipe (beryllium): R 10.7 mm, 16 ℃
Glue: 2 W/m.k, 2 x 260 mm

The max temperature of the sensor: ~ 24.5 ℃



付金煜：Vertex Cooling

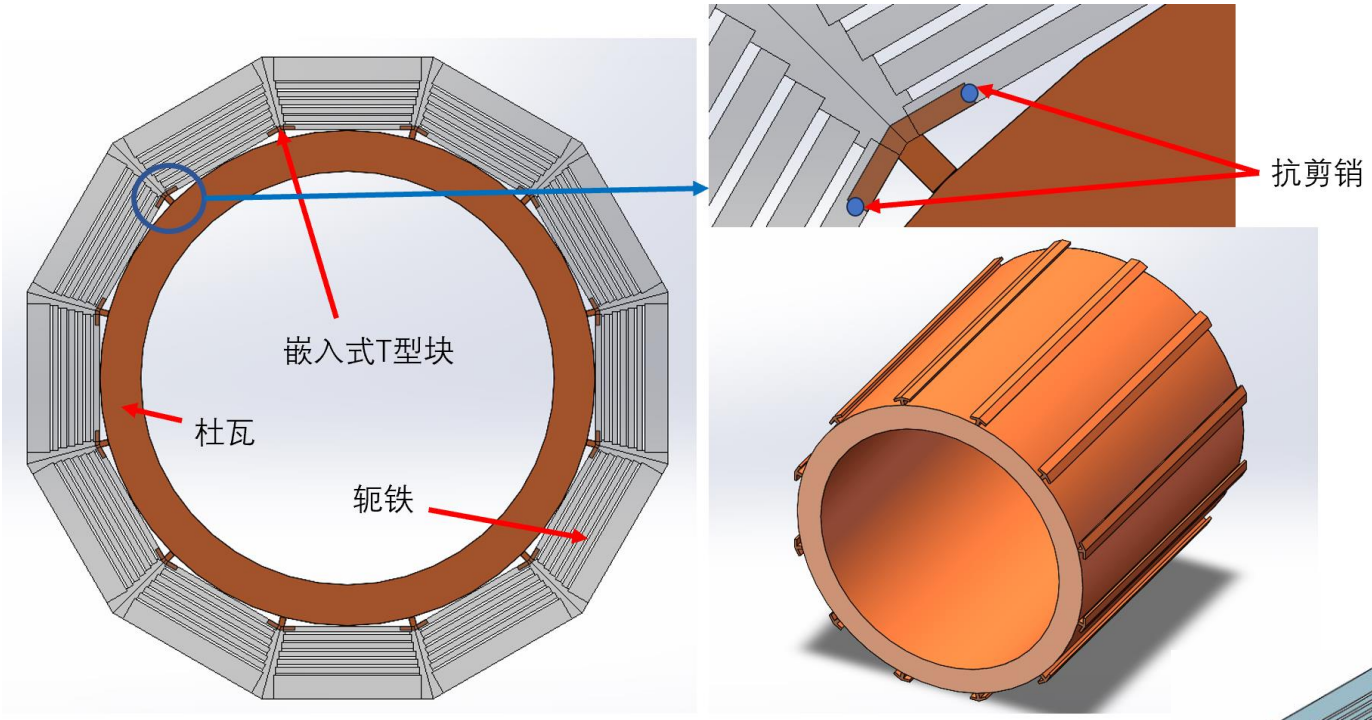


主骨架形式：16边形，轴向13等分；
材料：碳纤维增强树脂；主体厚度5mm；局部加筋，厚度15mm;
网格形式：长方形+正梯形

采用模块化安装；
每个网格内安装两个模块；
模块集成有晶体、SiPM、电子学板及安装框。

侯少静：ECAL

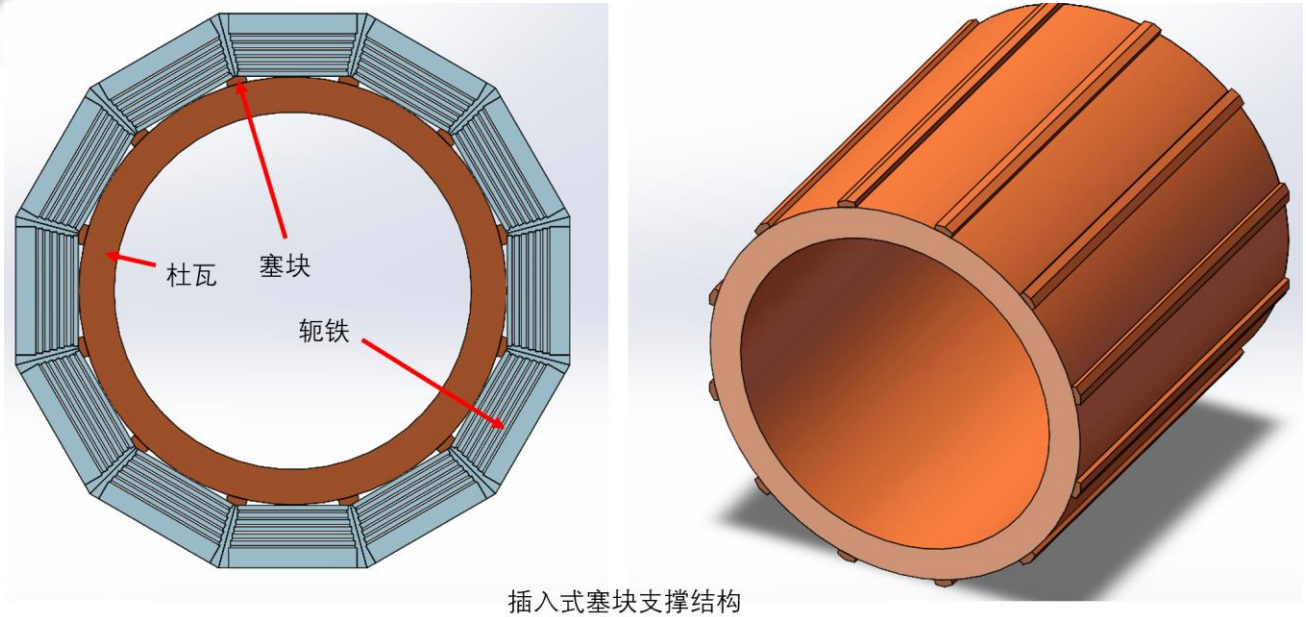
2. Progress in Mechanical Design



嵌入式T型块支撑结构

2. 比较了CEPC轭铁与CMS轭铁的不同之处，
根据不同情况，提出了自己的设计见解

1. 给出了两种支撑结构方案



插入式塞块支撑结构

裴亚田： Magnet

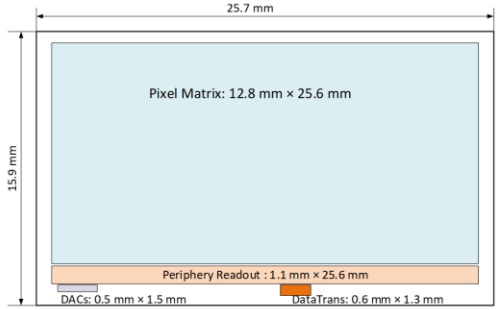
3. Discuss for the “Work contact form” of the Vertex

梁志均提前准备了PPT报告，列举了主要参数：

Long barrel layout

- Ladder width 17.4mm (25 * 25 um pixel)
- 物质量：0.15%X0/ per layer

截图一



估算说明：

- 太初3芯片：180 nm工艺，电源1.8 V;
- 65 nm芯片：电源1.2 V;
- Data rate@Triggless-CDR: 4.48 Gbps /chip
  bunch spacing (min.): 25 ns需要快前沿前端
- Data rate@Triggless-TDR (Low Lumi):
  1 Gbps/chip
- Low Lumi@TDR: bunch spacing ~几百ns，像素前端不需要快前沿，Matrix功耗可降低到60 mW

	Matrix	Periphery	DataTrans.	DACs	Total Power
太初3芯片 @ triggerless (CDR)	304 mW	135 mW	206 mW	10 mW	655 mW
65nm 芯片 @ 1 Gbps/chip (TDR LowLumi)	60 mW	80 mW	36 mW	10 mW	186 mW

25*25微米像素

截图二 (魏微)

Vertex 工作联系单讨论

1. 参照何苗提供的 JUNO 工作联系单样本，由电子学和探测器统一签发工作联系单给束流管和 Vertex 机械工程师。
   梁志均建议束流管机械工程师提供设计边界给 Vertex 做机械设计参考。
2. 梁志均和魏微确认 ladder 宽度为 17.4mm（25*25μm），魏微提供了芯片的热功耗详细分布。（详细内容请查看梁志均的报告）
3. 参会人员一致认为此工作联系单为机械工程师提供初始设计依据，将来随着设计的深入，根据实际情况调整。

Design requirement of Vertex:

$T \leq 20$ °C

$\Delta T < 10$ °C or 7 °C

Vibration < 1μm (?)

4. Next plan

Enter the converged working state of the optimization iteration:

1）Vertex 付金煜-梁志均 +魏微

1.1) Work contact sheets completed within two weeks

1.2）Structural and parametric optimization of mechanical design while refining work contact sheets

Thematic discussion:

2）TPC　张俊嵩-祁辉荣 +魏微 and all

3）Magnet 裴亚田-宁飞鹏

3) ECAL 侯少静-刘勇 + 魏微 and all

Expanded mechanical design communication:

1) Interface design with accelerator

2) Discussion on interface with μ detector

……

Thanks