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Status of CEPC ref-TDR Chapter06

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On behalf of the gaseous tracker group

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Preparation for international review of Chapter 6 in TDR

6.1 Physics requirements

6.2 Gaseous tracker system overview

6.2.1 Technology comparison

6.2.2 Baseline gaseous tracker

6.2.3 R&D efforts and results

6.3 Pixelated readout Time Projection Chamber

6.3.1 Time Projection Chamber detector

6.3.2 Pixelated readout electronics

6.3.3 Design of mechanical and cooling

6.3.4 Commissioning and validation of prototype

6.3.5 Challenges and critical R&D

6.3.6 Costs

6.4 Performance

6.4.1 Overview of the simulation framework

6.4.2 Physical process in the framework

6.4.3 Tracking performance

6.4.4 Particle identification

6.4.5 Improvement using the machine learning algorithm

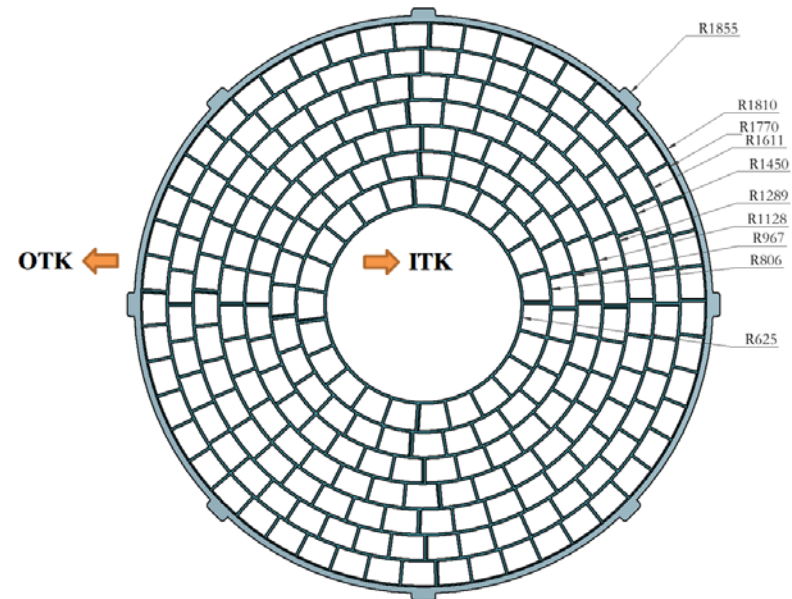
6.4.6 Beam background source and estimation

6.4.7 Alternative the drift chamber

6.5 Prospects and outlook

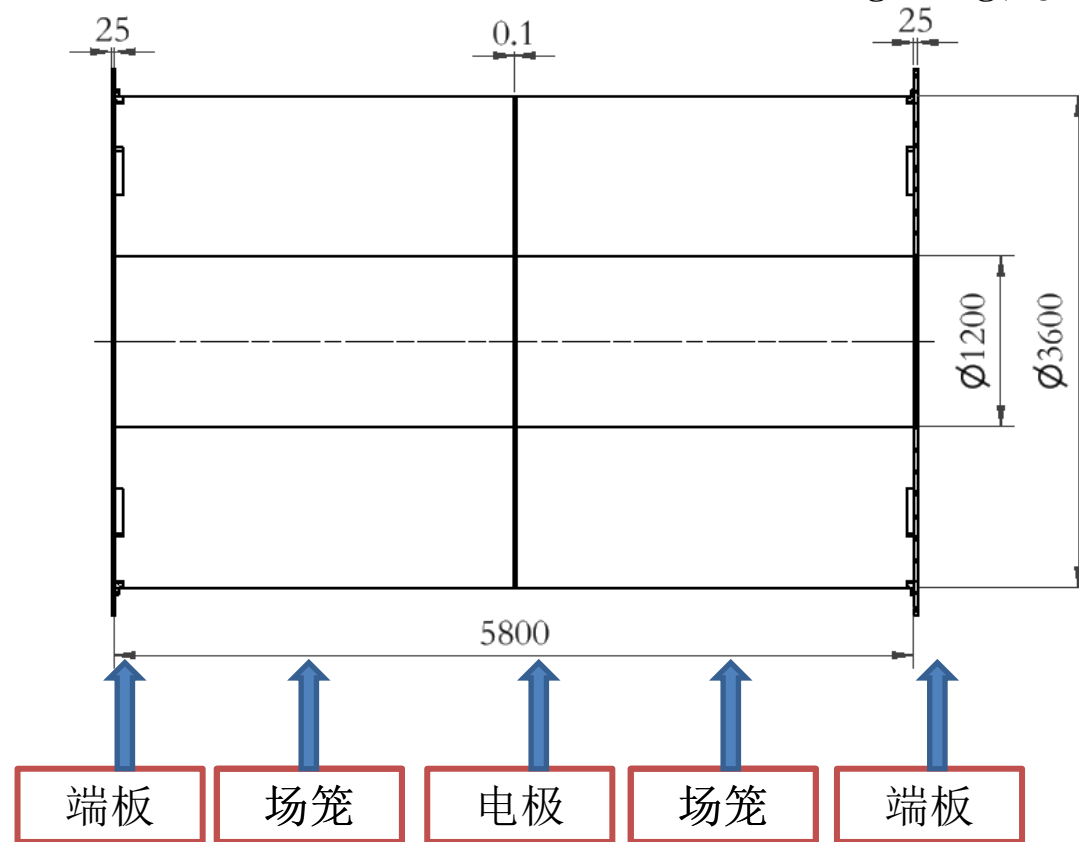
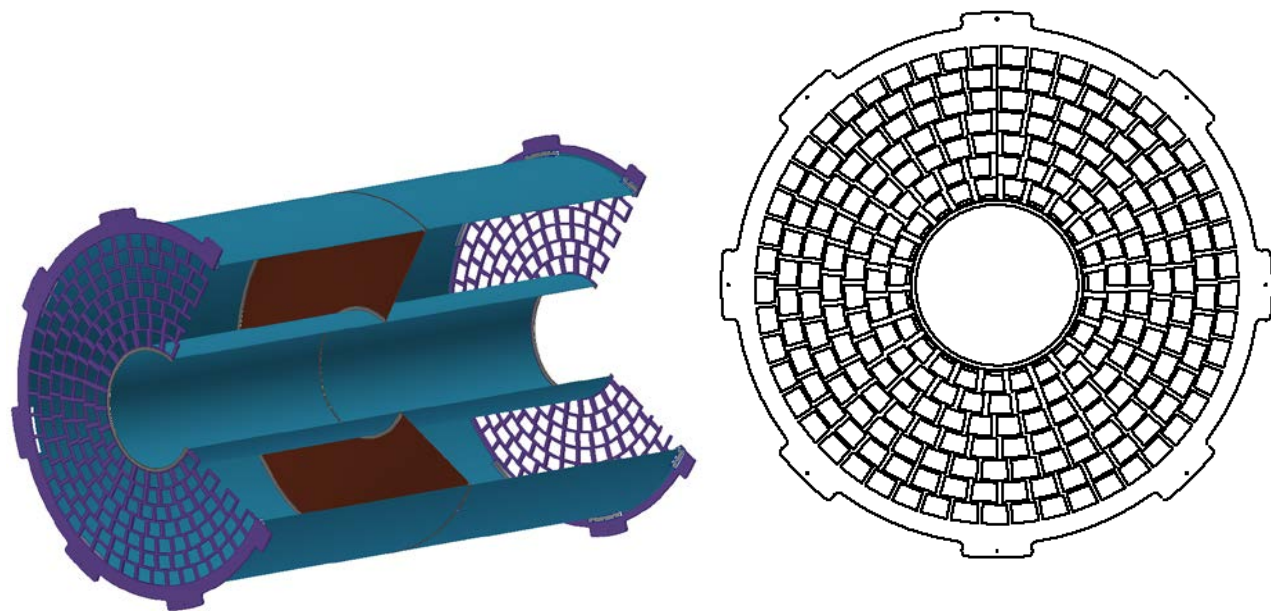
- 已整合入IHEP Overleaf文本内
- TPC本底的考虑，及可能的修正考虑（已有ALICE TPC）

TPC detector	Key Parameters
Modules per <u>endcap</u>	248 modules /endplate
Module size	206mm × 224mm × 161mm
Geometry of layout	Inner: 1.2m Outer: 3.6m Length: 5.9m
Potential at cathode	- 62,000 V
Gas mixture	T2K: <u>Ar/CF4/IC4H10=95/3/2</u>
Maximum drift time	34μs @ 2.75m
Cooling	Water cooling circulation system
Detector modules	Pixelated <u>Micromegas</u>



Overall mechanical structure design of TPC

Junsong Zhang, Quan Ji



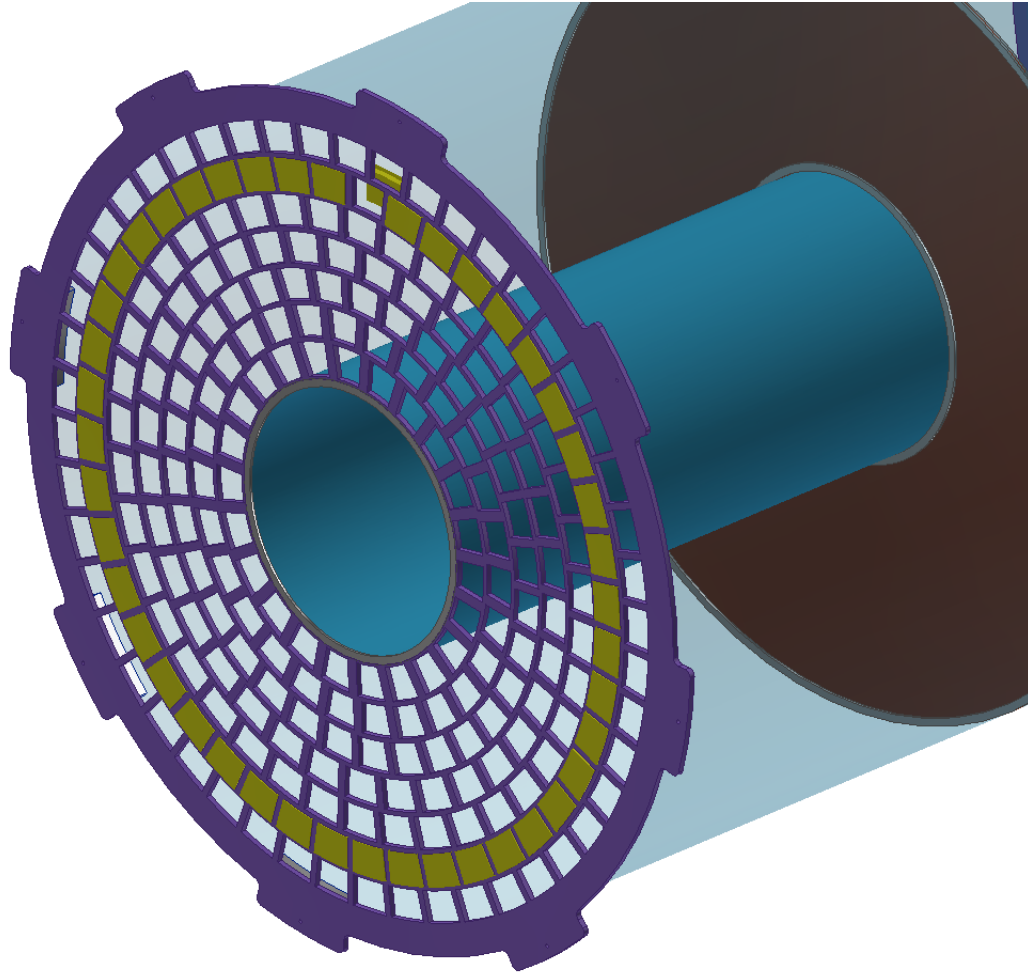
设计要求:

- 1、外尺寸: 外径3600mm, 内径1200mm, 长度5800mm
- 2、在保证非常低的物质量情况下, 桶部变形小于1mm, 应力在许用应力范围内。
- 3、气体物质主要成分为氙气, 通气流量为100-500ml/min, 气体压力为: 110Kpa

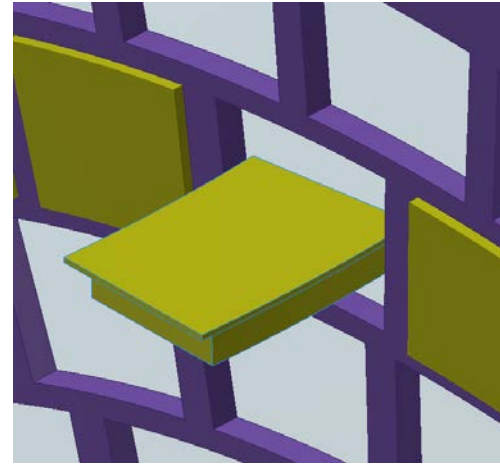
各部件重量参数

部件	端部 (共2个)	内桶	外桶	读出模块 (共2个)	总重量
重量	295Kg	9Kg	27.2Kg	424Kg	1474.2 Kg

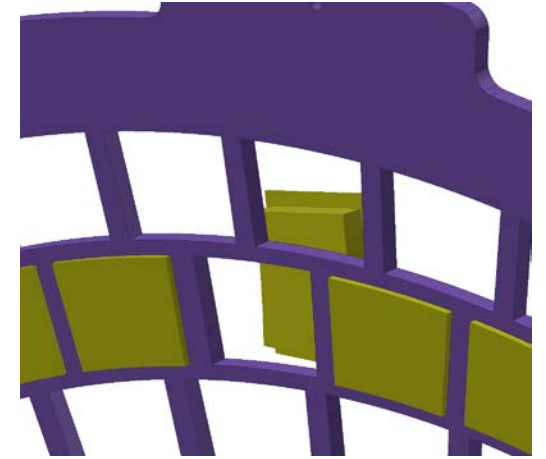
Installation of readout modules



1. Achieve minimal gaps between modules to minimize distortion between modules.
2. Installation assisted by automated robotic arms.



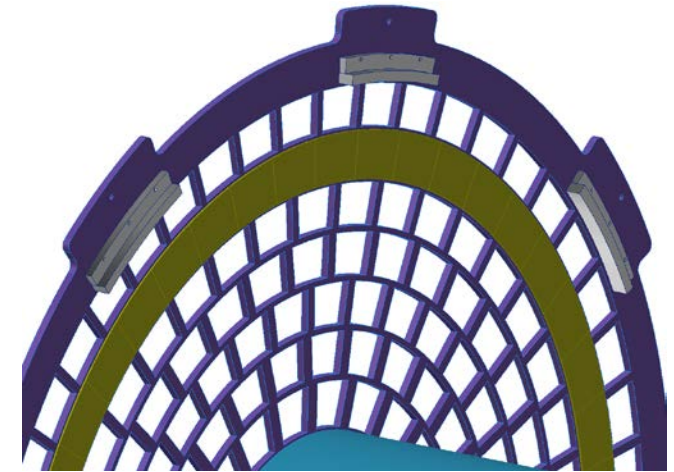
1. Rotating into the chamber



2. Auto vertical flip module



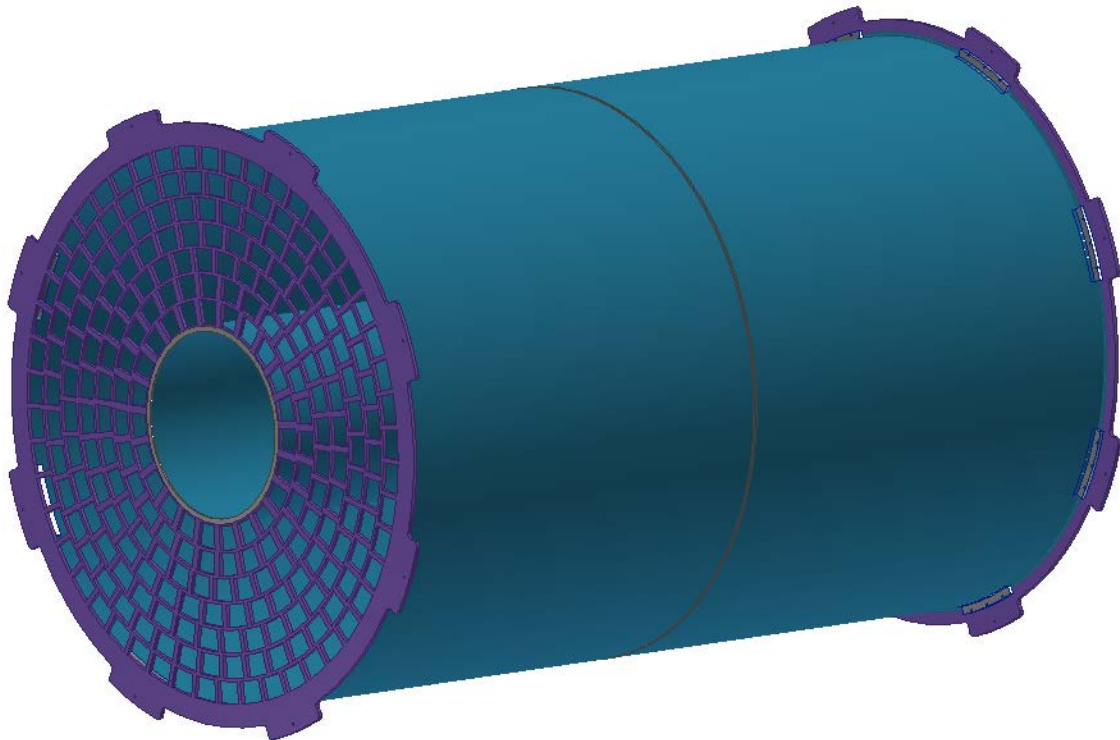
3. Auto Horizontal Flip



4. Sealed Installation

Barrel structure and materials investigation

1. The barrel section is made of thin-walled carbon fiber barrels, selected from Ningbo Institute's QM55 material.
2. Meets the need for 1000N (100Kg) loading at a centralized center location.
3. Barrel weights need to be confirmed. (OTK)



碳纤维种类	东丽M55J	东丽M55J	CCM55J	CCM55J	中简 M55	宁波所QM55	宁波所QM55
树脂种类	环氧树脂	氰酸酯	双马树脂	环氧树脂	环氧树脂	氰酸酯	环氧树脂
°拉伸强度 (MPa)	1500	1800	1780	1525	1600	2150	1851
0°拉伸模量 (GPa)	280	300	295	286	290	332	318
0°压缩强度 (MPa)	600	600	/	/	600	734	735
0°压缩模量 (GPa)	240	250	/	/	240	320	312
0°弯曲强度 (MPa)	1000	1000	1300	/	900	1135	1044
0°弯曲模量 (GPa)	250	260	280	/	250	271	288
层间剪切强度 (MPa)	55	53	54	53	43	58	61
纵横剪切强度 (MPa)	/	/	52.8	/	/	55.4	43
纵横剪切模量 (GPa)	/	/	4.55	/	/	3.89	3.2
准各向同性 拉伸强度 (MPa)	500	500	/	/	/	509	392
准各向同性 拉伸强度 (GPa)	90	95	/	/	/	116	104

Material budget of TPC barrel

Layer of the barrels	D[cm]	X ₀ [cm]	d/X ₀ [%]
Copper shielding	0.001	1.45	0.07
CF outer barrel	0.020	25.28	0.08
Mirror strips	0.003	1.35	0.19
Polyimide substrate	0.005	32.65	0.02
Field strips	0.003	1.35	0.19
CF inner barrel	0.010	25.28	0.04
Sum of the material budget			0.59

Many thanks!