



Status of TPC for CEPC Physics and Detector TDR Preparation

Huirong Qi

LCTPC WP meeting, May 16, 2024

Brief reminder about CEPC

- CEPC operation stages: **10-years Higgs → 2-years Z pole → 1-year W**
- CEPC phy./det. TDR (**preparation**)
 - Physics and detector concept designed under the principle.
 - **Requirements may be with regard to runs of Higgs and Z-pole separately.**
 - Mandatory requirements **MUST** be met.
 - Auxiliary requirements, if any, are optional.

Chapter 3 of this report outlines that the CEPC is planned to be in operation for 8 months annually, totaling 6,000 hours. This operational schedule is used to calculate the cumulative absorbed doses for magnet coil insulations, as illustrated in Figure 4.2.4.16, **considering a 10-year Higgs operation, 2-year Z operation, and 1-year W operation.** Figure 4.2.4.17 displays the absorbed doses when an additional 5-year $t\bar{t}$ operation is included. These plots also include the upper limit for absorbed dose in epoxy resin, which is measured at 2×10^7 Gy [11].

CEPC- TDR p116

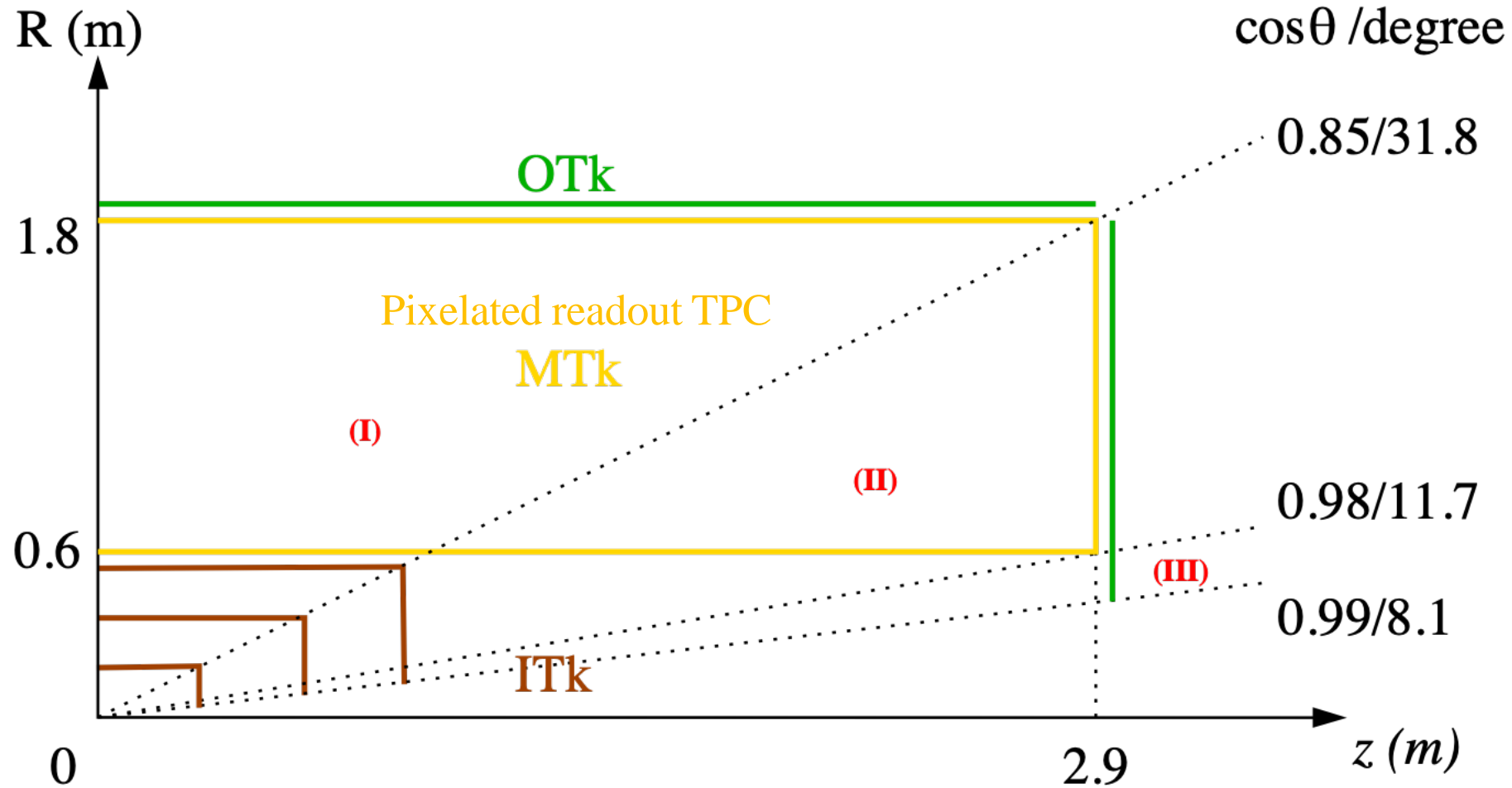
Decision on TPC for CEPC Phy.&Det. TDR

- Pixelated readout TPC has been formally chosen as the BASELINE TRACK DETECTOR in the CEPC Physics and Detector TDR document.
 - After the TPC/DC review meeting and the several discussions in the community.
- I fully agree with the recommendations of the mini-review committee.
- We are forced to choose is mainly due to the **PID** requirement, which is dominantly relevant to the **Z-pole** run.
- However, we will start with the **Higgs** run for more than **ten years**.
- Should CEPC be approved by the 15th-Five, we need something deliverable *immediately*
 - ◆ TPC, for instance, with non-pixelated readout, would be a choice of promising;
 - ◆ We may continue our R&D for the PID-oriented TPC and DC with a serene certainty.
- Hence, I would recommend **TPC** for our reference-detector TDR.

Slides from the Track Detector Group

Track detector system in CEPC Phy.&Det. TDR

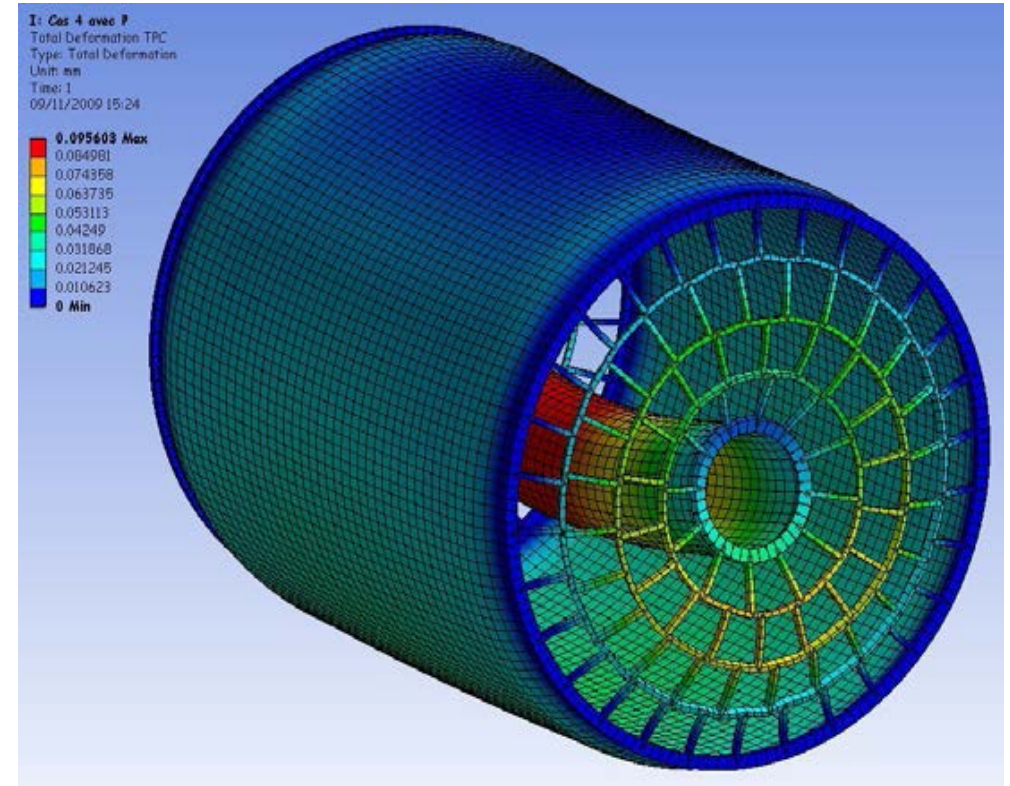
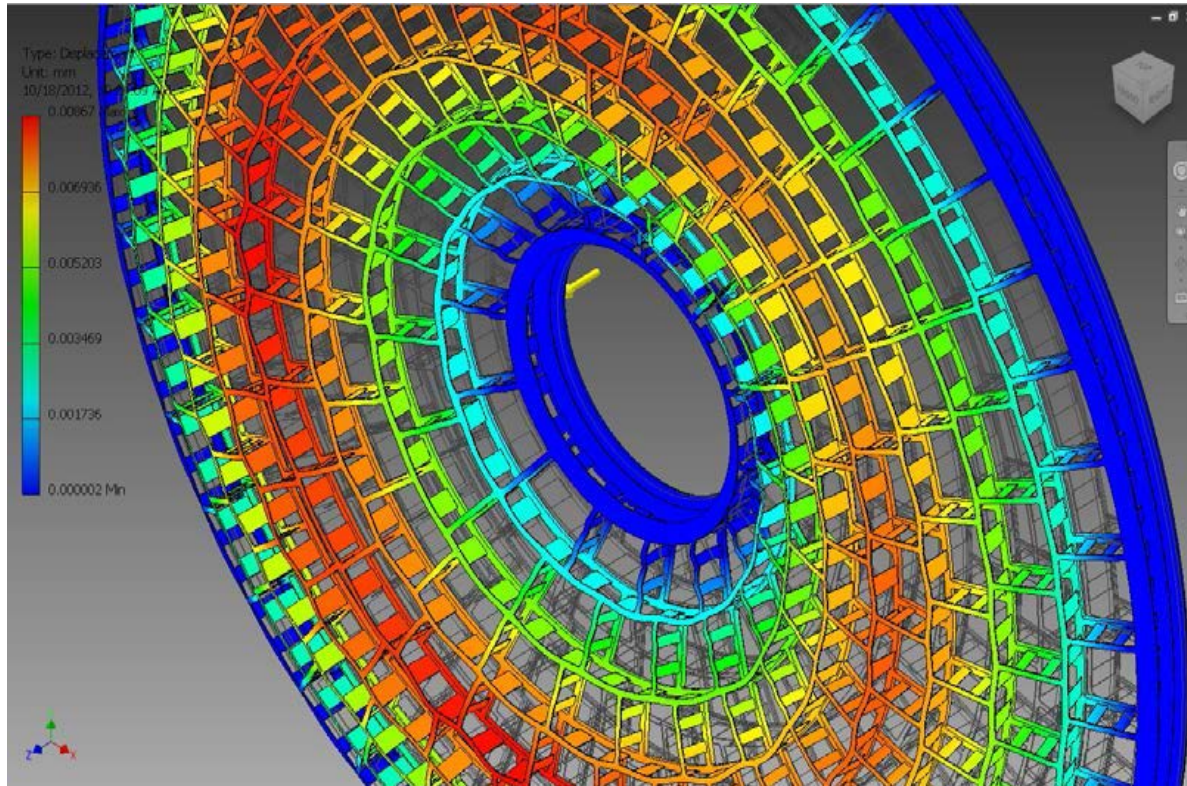
- The track detector system's geometry finalized.
 - All of physics simulation used the updated geometries for CEPC TDR document
 - Pixelated readout TPC as the **main track (MTK)** from radius of 0.6m to 1.8m



Geometry of the track detector system in CEPC TDR

Optimization of Endcap and barrel of Pixelated readout TPC

- Mechanical **FEA calculation starting and on going** at IHEP from March
 - Optimized the endcap and barrel design
- Endplate deflections were calculated with finite element analysis (FEA) from LCTPC design
 - Maximum deflection of the model: 0.008mm/100N
 - Endcap deflection for 2.1 millibar over pressure (2190N) =0.19mm



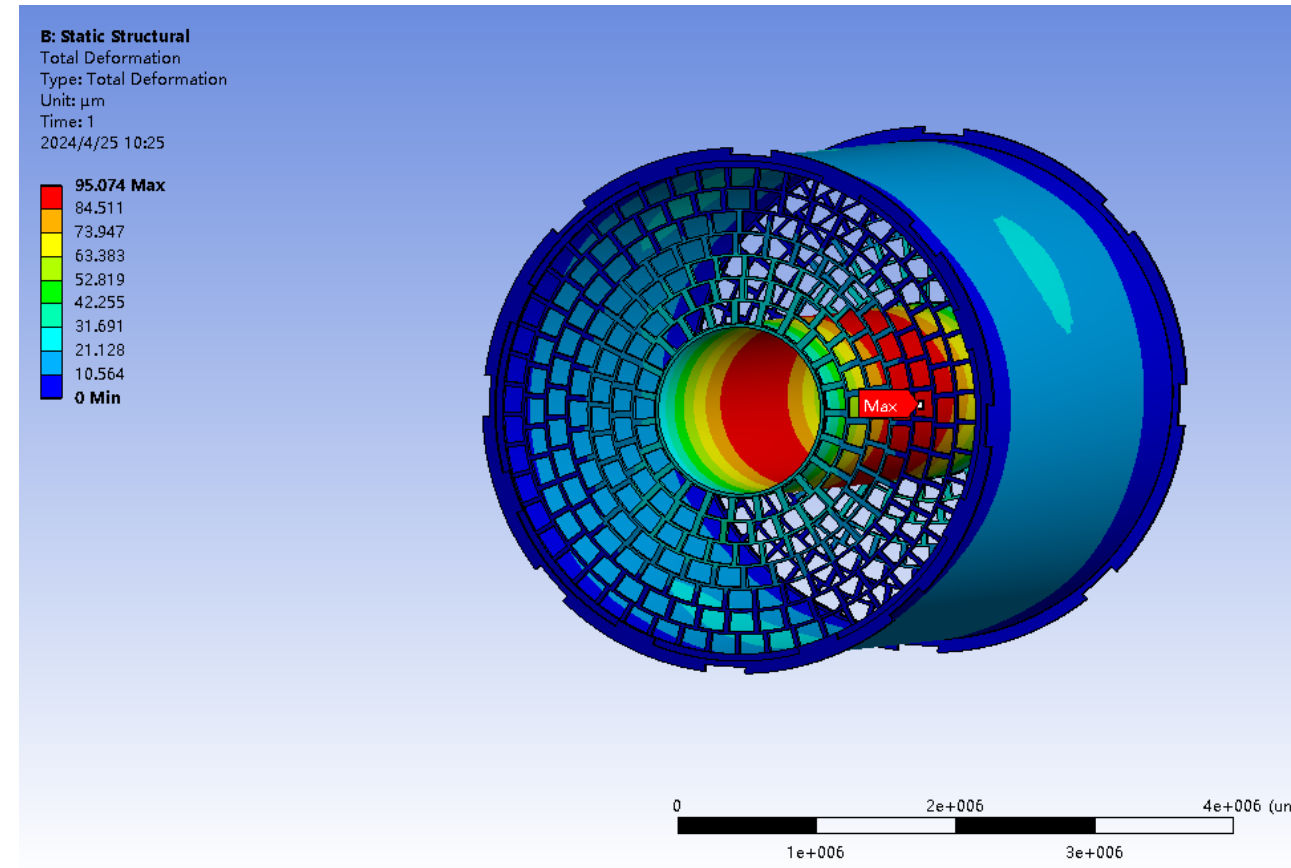
Optimization of Geometry of TPC detector and the Endplate

Consideration of new ultra-light barrel

- Consideration of new Carbon Fiber barrel instead of the honeycomb barrel (LCTPC)
- Low material of the TPC barrel (**FEA calculation on going**)
0.55% X_0 in total, including

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	0.010	25.28	0.04
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			0.55



- We should continue to push TPC technology for e+e- HEP application.
- Pixelated readout TPC can be as a **realistic and promised** track detector in CEPC TDR, some key issues will be simulated and validated.
 - Material budget at endcap/barrel
 - Occupancy and hit density
 - Improved $dE/dx+dN/dx$
 - Ion backflow suppression
 - Reasonable channels and power consumption
 - Running at 2 Tesla
 - Beamstrahlung and distortion
 - Cost estimation
 - LCTPC international collaboration

Many thanks!