Full Silicon Tracking Studies for CEPC

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[*]http://cepc.ihep.ac.cn/ cepc/cepc_twiki/index.php/Pure_Silicon_Detector

Outline

- Introduction.
- Silicon tracker designs and their performances.
- Detector simulation and reconstruction.
- Comparing with CEPC V1 performance.
- Conclusion

Introduction

- CEPC full silicon tracker has been implemented in Mokka (Chengdong).
- Based on CEPC V1 silicon elements, we replace TPC with additional SIT layers and FTD endcaps.
- The advantage is to recycle the ILD silicon tracking, which seems work out of box.
- The current design means to prove a principle.
- But, it would allow us to re-optimize the design and improve tracking.
- ILC SID vs CEPC: B=5T $\rightarrow$ 3.5T, $r_{max} = 1.2 \rightarrow 1.45m$, Barrel strip single $\rightarrow$ double sided.

Full Silicon Tracker Concept

- We compared the tracking performance of several design options using a toy MC.
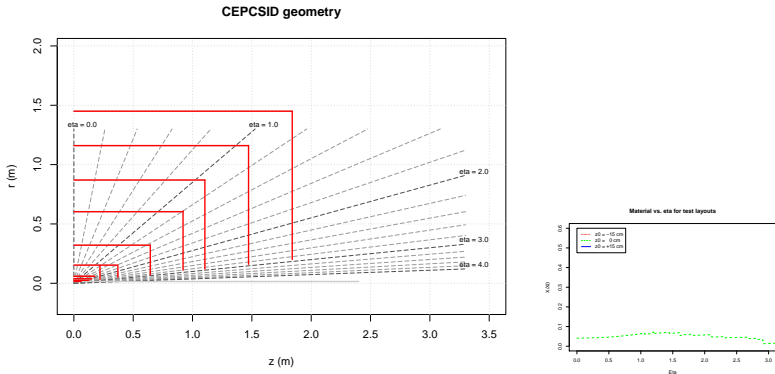

Figure: CEPC full silicon tracker with rad length up to 7%

Excellent Resolutions

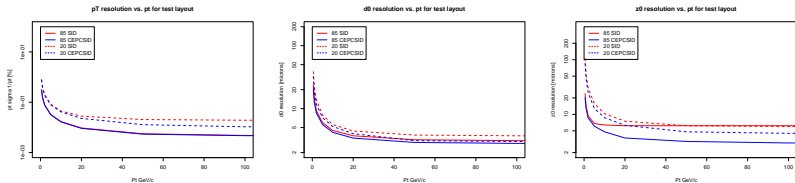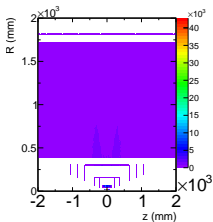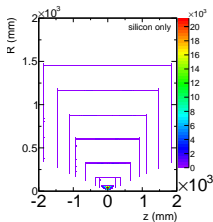- The expected resolutions from toy simulation is better than ILC SID.

Figure: Resolutions for 1/pt, d0, and z0.

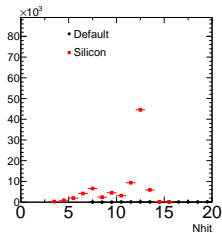# Full Detector Simulation and Reconstruction

- Generated single muon in CEPC full silicon.
- Reconstructed using Marlin Silicon only.
- Modifying pattern recognition to use more silicon layers.

(a) CEPC V1(Default)   (b) CEPC full silicon   (c) Number of hits

Tracking Efficiencies

- Requiring $P_T > 1.0$ GeV and $0.18 < \theta < 2.96$.
- Efficiency is bit lower in barrel and endcap overlap region for full silicon, which could be improved.
- Note the plots made after a quick bug fix in FTD geometry, but it requires more study.
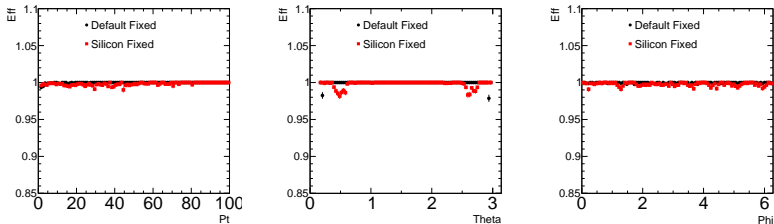

Figure: Efficiencies vs pt, theta and phi

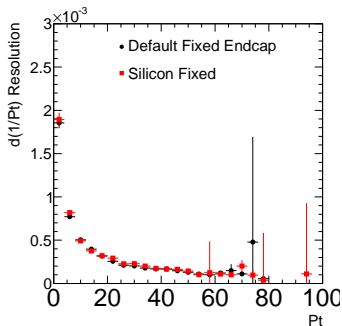# Pt Resolution

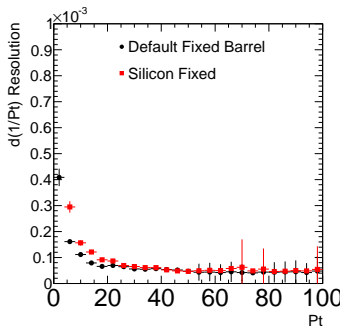- The pt resolution seems comparable.

Figure: Pt resolution in Barrel and Endcap regions

d0 Resolution

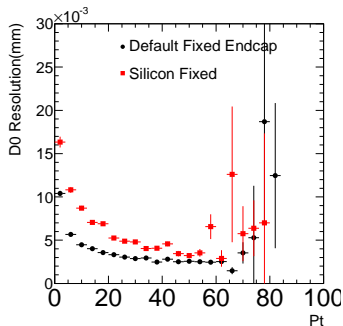- d0 resolution is quite similar in barrel, bit worse in endcap.
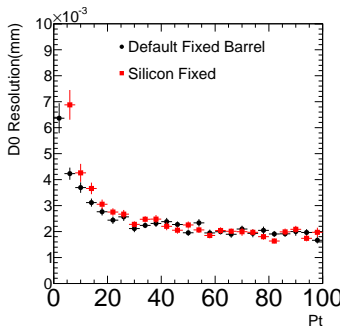

Figure: d0 resolution in Barrel and Endcap regions

z0 Resolution

- z0 resolution is quite similar in barrel, bit worse in endcap.
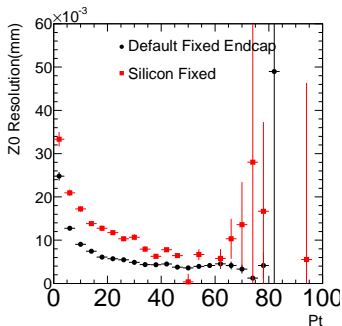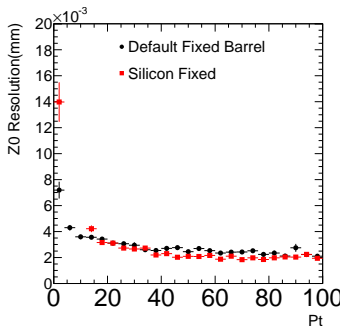

Figure: z0 resolution in Barrel and Endcap regions

d0, z0, and Omega Pulls

- The pull width seems off at 0.8, which is sensitive to materia and resolution in simulation and reconstruction.
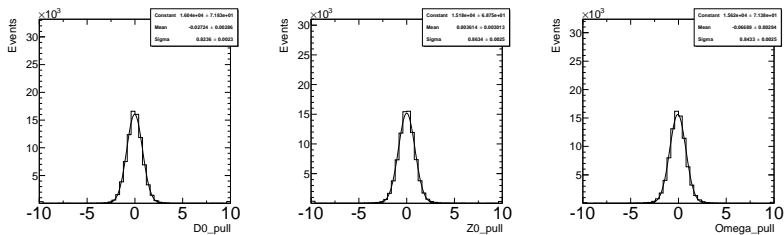

Figure: Track parameter pull for d0, z0, and omega

Phi and Theta Pulls

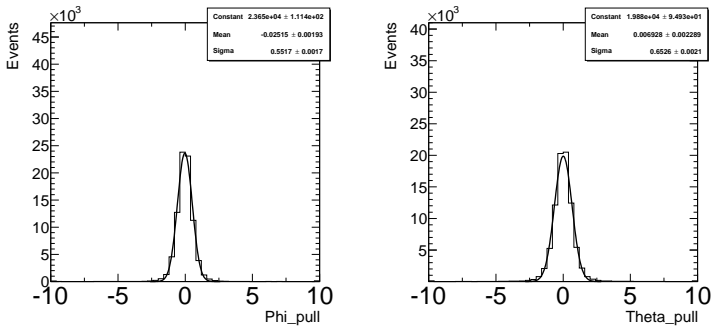- The pull width also seems low, which needs to be understood.

Figure: Track parameter pull for phi and theta

Conclusion

- The concept of full silicon tracker has been implemented and seems working.
- Its single particle performance is comparable to CEPC V1, meeting the physics requirements.
- There are rooms for improvement, especially for improving silicon clustering and fitting.
- Allow us to start reoptimizing its design and improving silicon tracking for CDR.