

Silicon Tracking Performance Studies

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* http://cepc.ihep.ac.cn/cepc/cepc.twiki/index.php/Pure_Silicon_Detector

Outline

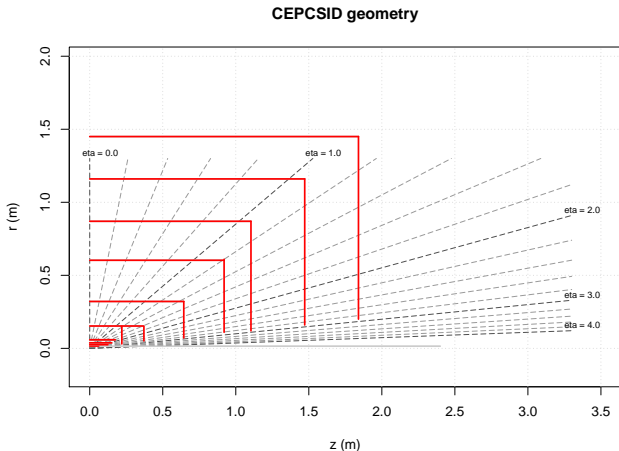
- Introduction.
- Silicon tracker designs and their performances.
- Detector simulation and reconstruction.
- Comparing with CEPC V1 performance.
- Conclusion

Introduction

- CEPC SID has been implemented in Mokka (Chengdong).
- Based on CEPC V1 silicon tracker, 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, we need to re-optimize the design and improve tracking in the future.

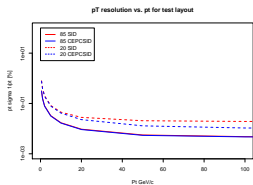
Full Silicon Tracker Concept

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

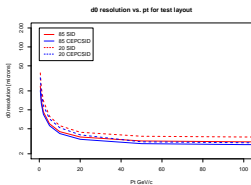


Excellent Resolutions

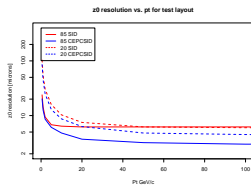
- The expected resolutions from toy simulation is slight better than SID.



(a) pT



(b) d0

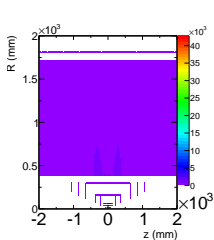


(c) z0

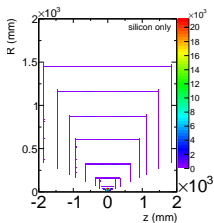
Figure: Resolutions for $1/p_T$, d_0 , and z_0 .

Full Detector Simulation and Reconstruction

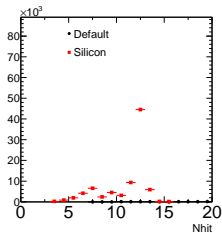
- Generated single muon in CEPC V1 and CEPC SID
- Reconstructed using Marlin Silicon+TPC or Silicon only.
- **Modifying LayersCombination to use extra silicon layers.**



(a) CEPC V1



(b) CEPC SID

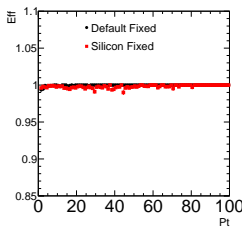


(c) Nhits

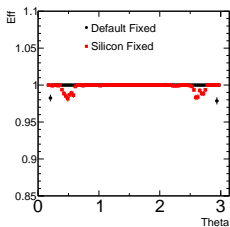
Figure: Hits r vs z from the track and the number of Hits

Tracking Efficiencies

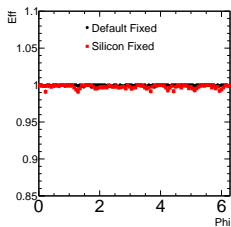
- Requiring $P_T > 1.0$ GeV and $0.18 < \theta < 2.96$.
- Efficiency is slight lower in barrel and endcap overlap region for CEPC SID, which could be improved.
- Note the plots made after a quick bug fix in FTD geometry, but it requires more study.



(a) pt



(b) theta

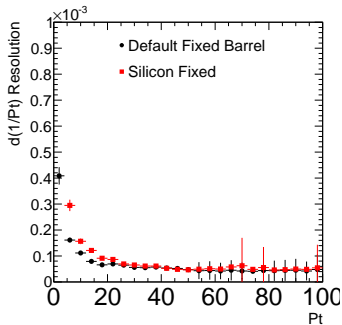


(c) phi

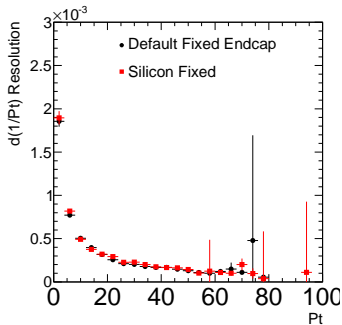
Figure: Efficiencies vs pt, theta and phi

Pt Resolution

- The pt resolution seems comparable.



(a) Barrel

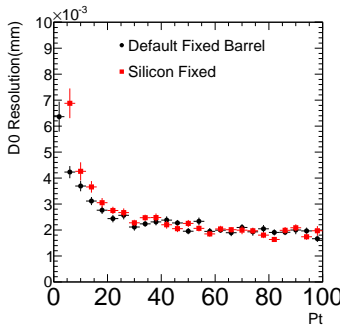


(b) Endcap

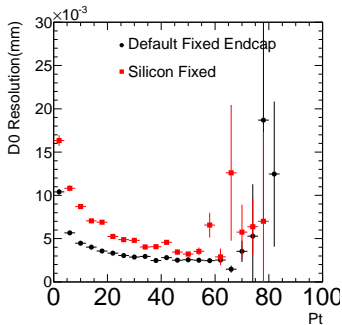
Figure: Pt resolution in Barrel and Endcap regions

d0 Resolution

- d0 resolution is quite similar.



(a) Barrel

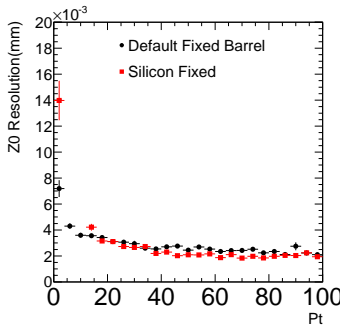


(b) Endcap

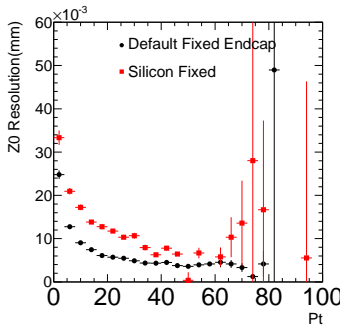
Figure: d0 resolution in Barrel and Endcap regions

z0 Resolution

- z0 resolution is quite similar.



(a) Barrel

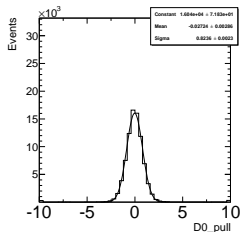


(b) Endcap

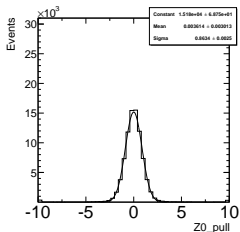
Figure: z0 resolution in Barrel and Endcap regions

d0, z0, and Omega Pulls

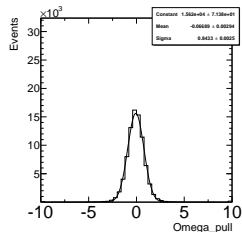
- The pull width seems off at 0.8, which is sensitive to materia and resolution.



(a) d0



(b) z0

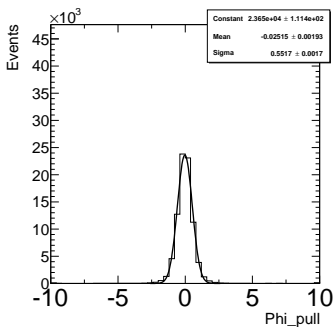


(c) Omega

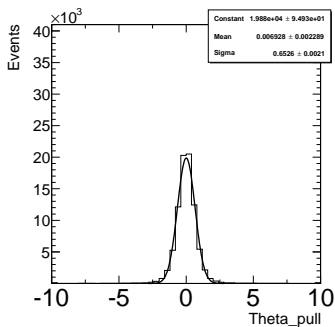
Figure:

Phi and Theta Pulls

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



(a) Theta



(b) Phi

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.