CPEC Tracking System Optimization

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On behalf of the CEPC Tracker Team

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Contents

Purpose at this stage

At previous report, we gave an general conclusion on influence for momentum resolution by number of layers in DC.

Now, our research stage comes to check out which is better for momentum resolution on the positions of DC and internal & external CMOS.

Some hard restrictions

Beam – Tube : 0—14.5 mm

VTX : 16—65 mm

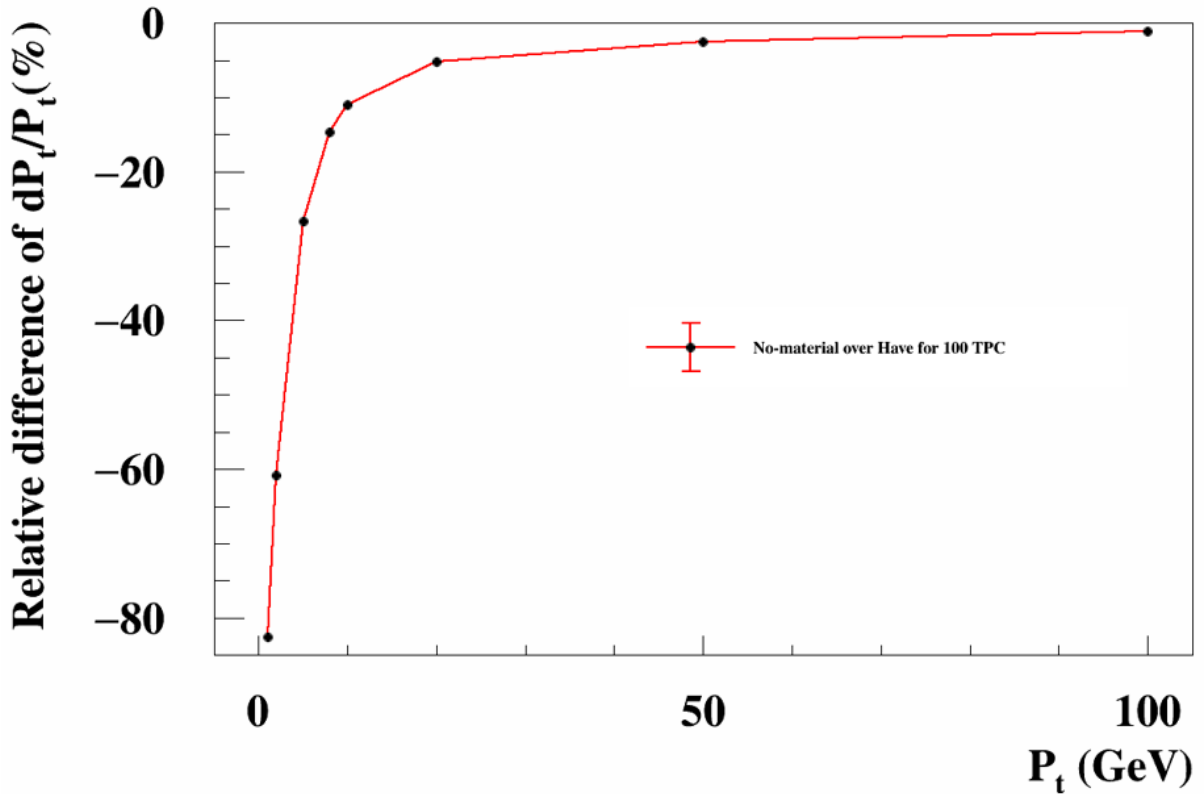
Space of DC and CMOS changing : 80—1800mm

Some soft restrictions

1. There must be at least a CMOS at 1800 mm.
2. There should be CMOS at each border of DC.

Some conjectures-1

By comparing the relative difference between whether there is material budget in DC, it is confirmed that the multiple-scattering takes a very important role on measurement for each single part of detector.

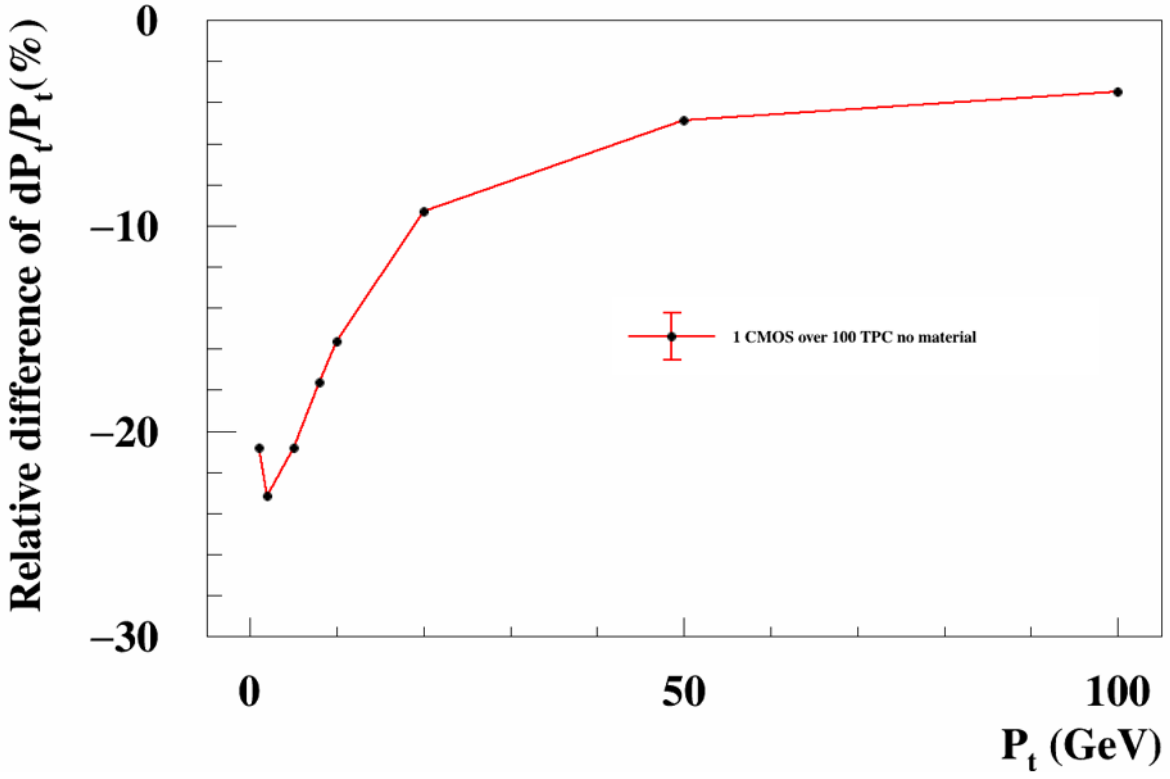


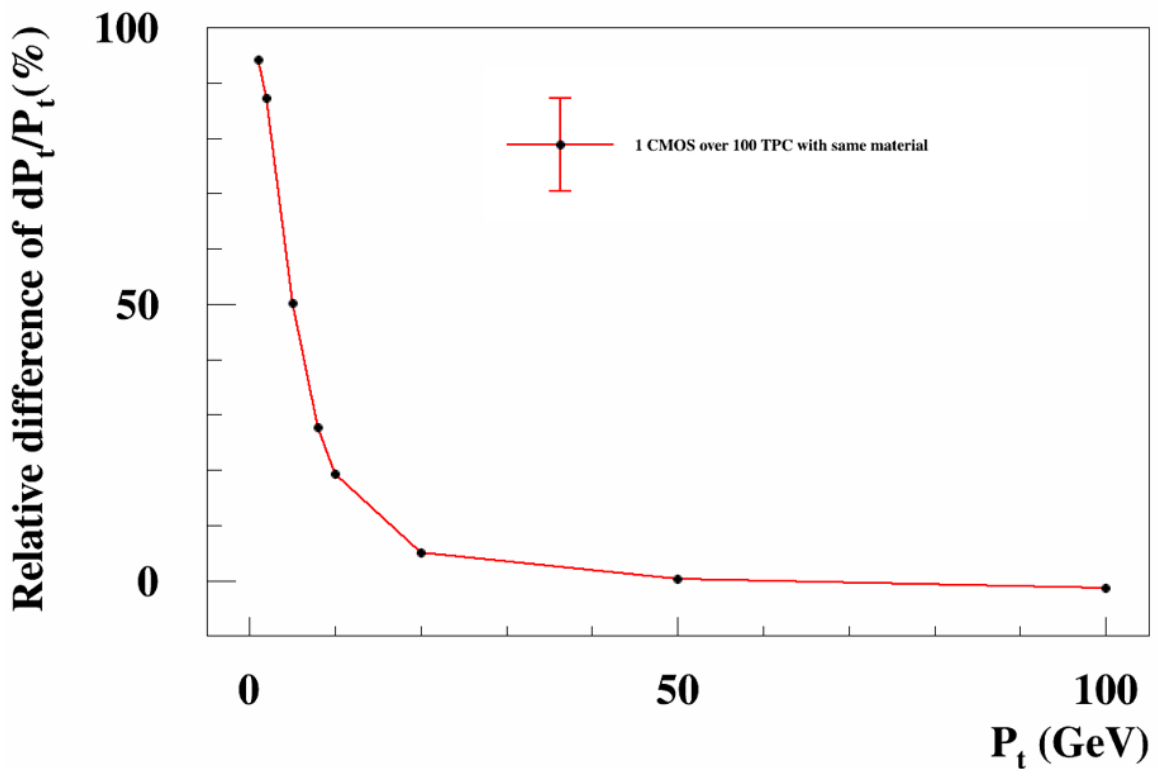
Some conjectures-2

There are 100 layers in DC while if we use a CMOS to alter it by setting its $\sigma_{Rphi} = \sigma_{Rphi}^{TPC}/\sqrt{100}$. Here we set two conditions which are there are same material budget for these two types and no any. By comparing them, we could get these conclusions.

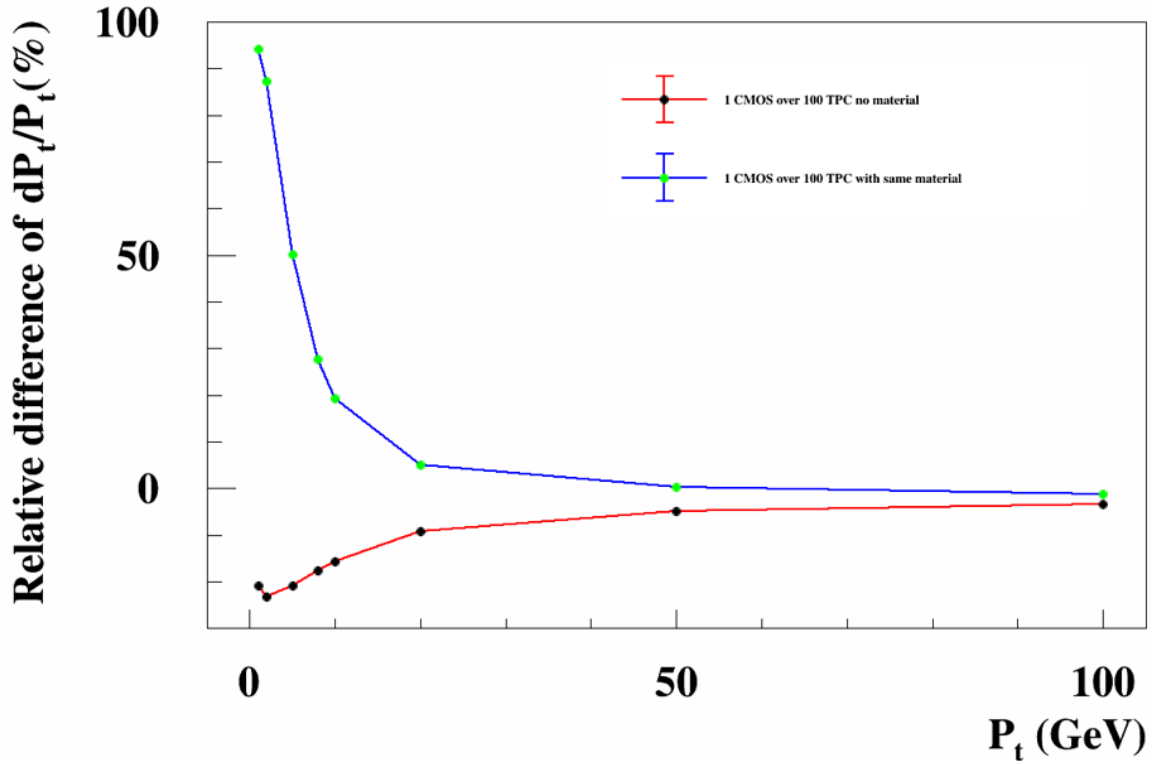
1. If we ignore the material budget in DC and there are two much better measuring layers at each side, the middle layer can take more measuring information than average value in DC.
2. If the multiple scattering influence in DC is considered, the one CMOS measuring is bad because using one layer to simulate multiple scattering of gas in 1 m is not a good model.
3. While if we use its own parameters of CMOS and compare it with 100 layers in DC. It can be found easily that the momentum of one CMOS alternative becomes worse.
4. For range of lower momentum, multiple scattering takes up very important place while the influence of scattering is much connected to distance between each measuring layer.

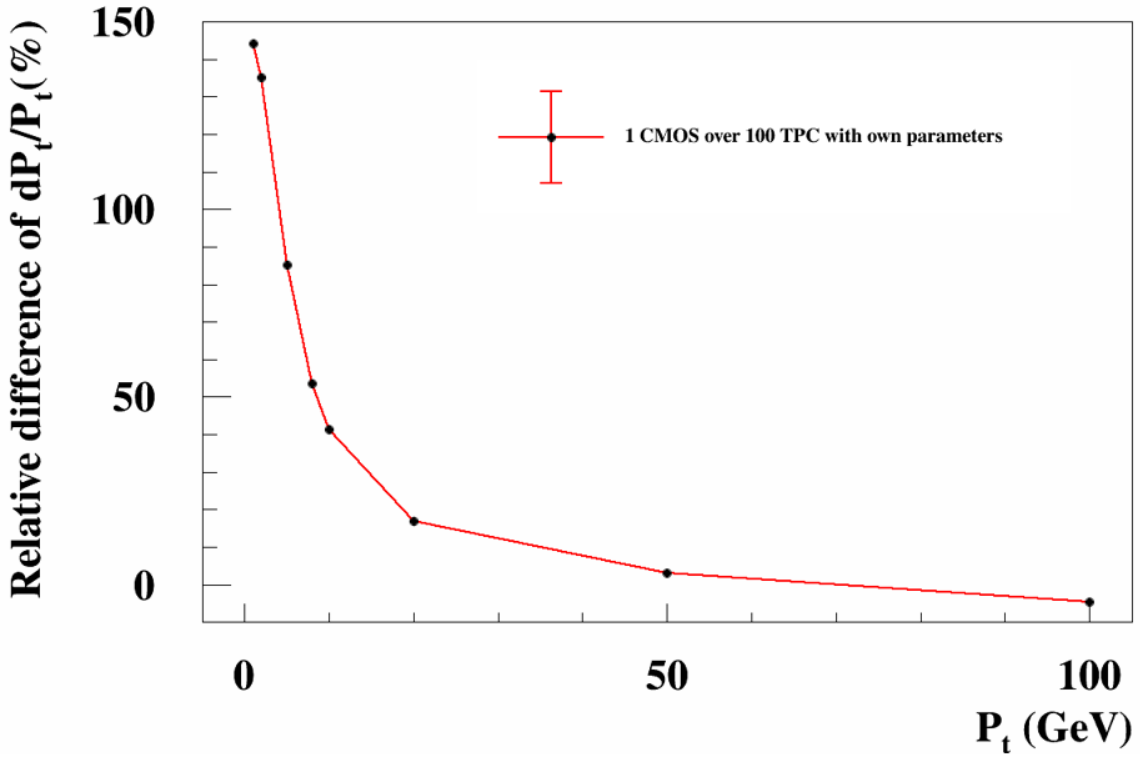
Some conjectures-2





Some conjectures-2





Some conjectures-3

Following the pre-restrictions, we checked these four detector setups:

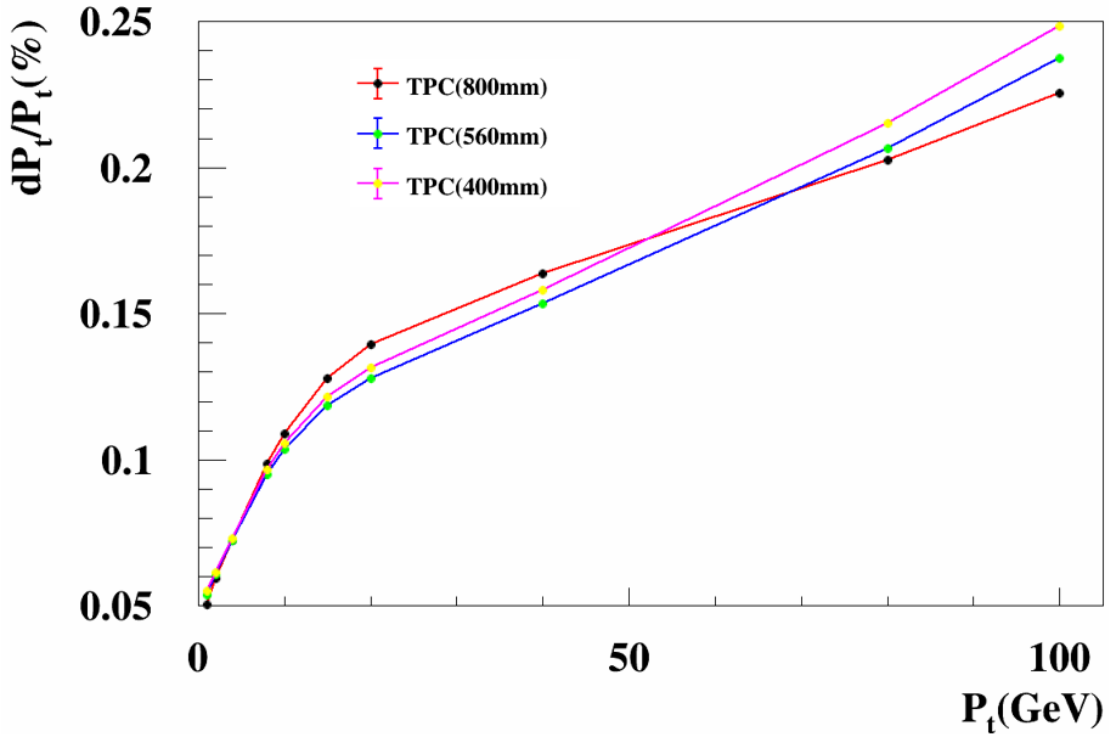
SIT : 80, 320, 560, 800
TPC : 800 -- 1800, 100 layers
SET : 1800

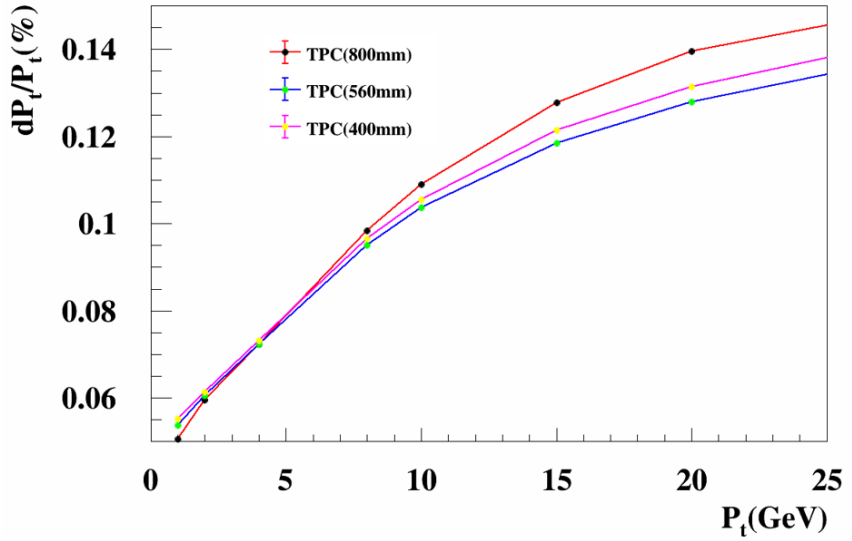
SIT : 80, 320, 560
TPC : 560 -- 1560, 100 layers
SET : 1560, 1800

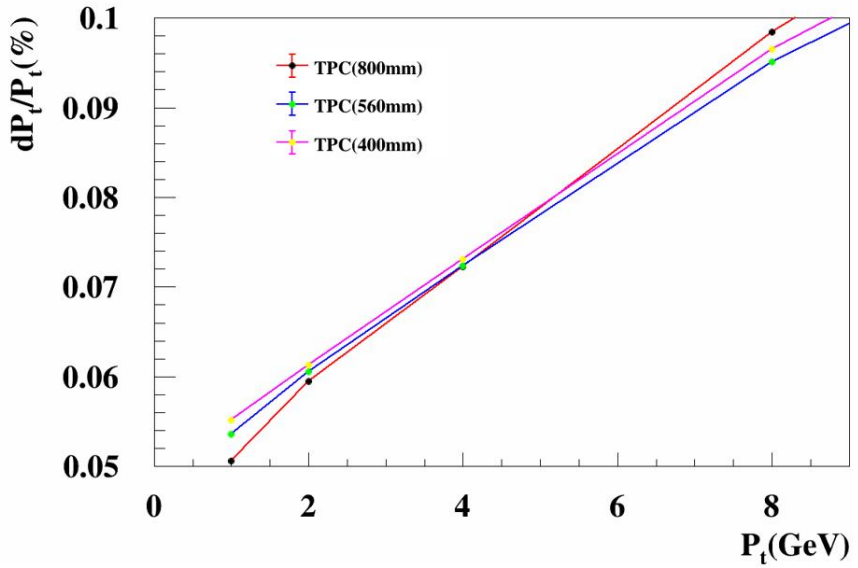
SIT : 80, 240, 400
TPC : 400 -- 1400, 100 layers
SET : 1400, 1800

SIT : 80, 320
TPC : 320 -- 1320, 100 layers
SET : 1320, 1560, 1800

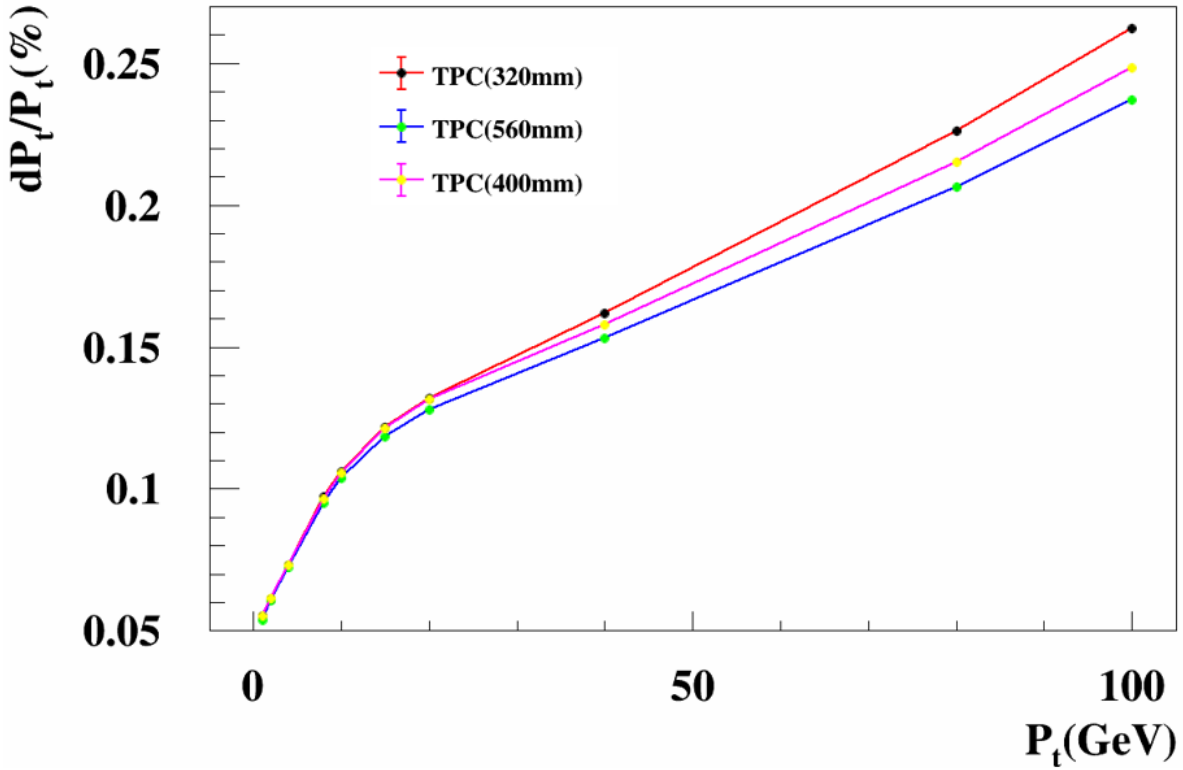
Some conjectures-3

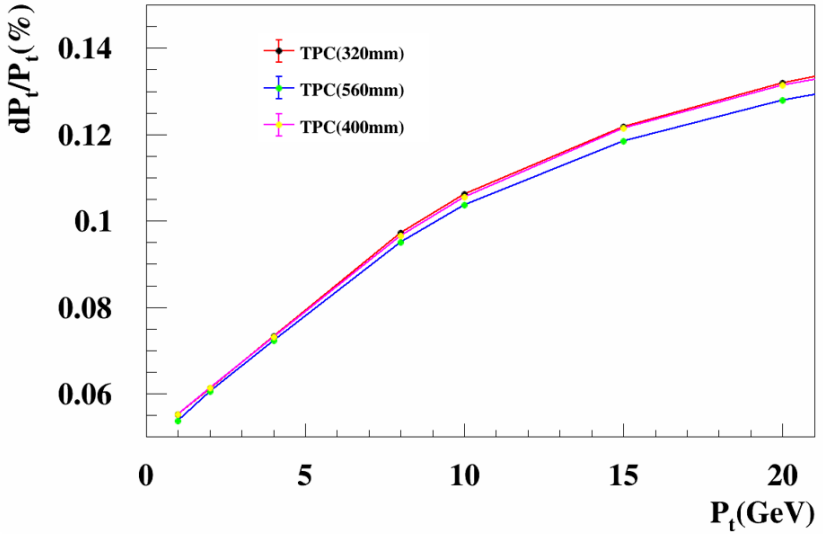


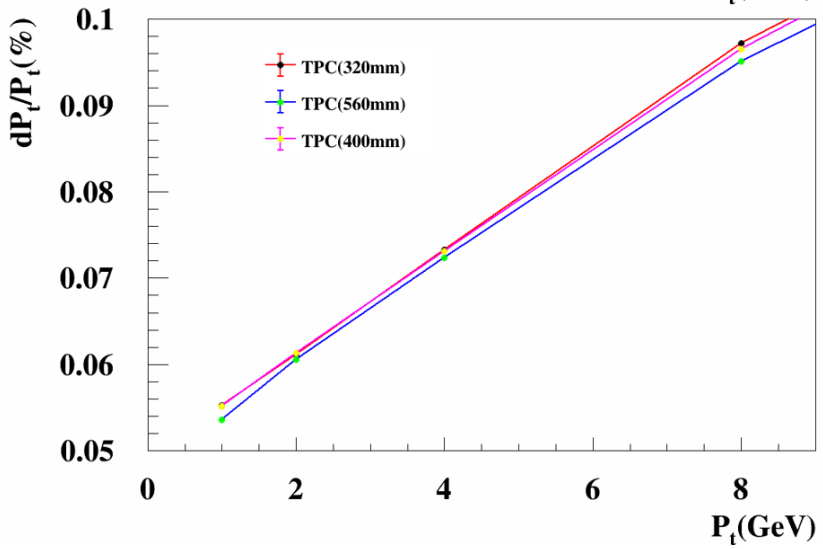




Some conjectures-3







Some conjectures-3

There are some points we can not understand by now.

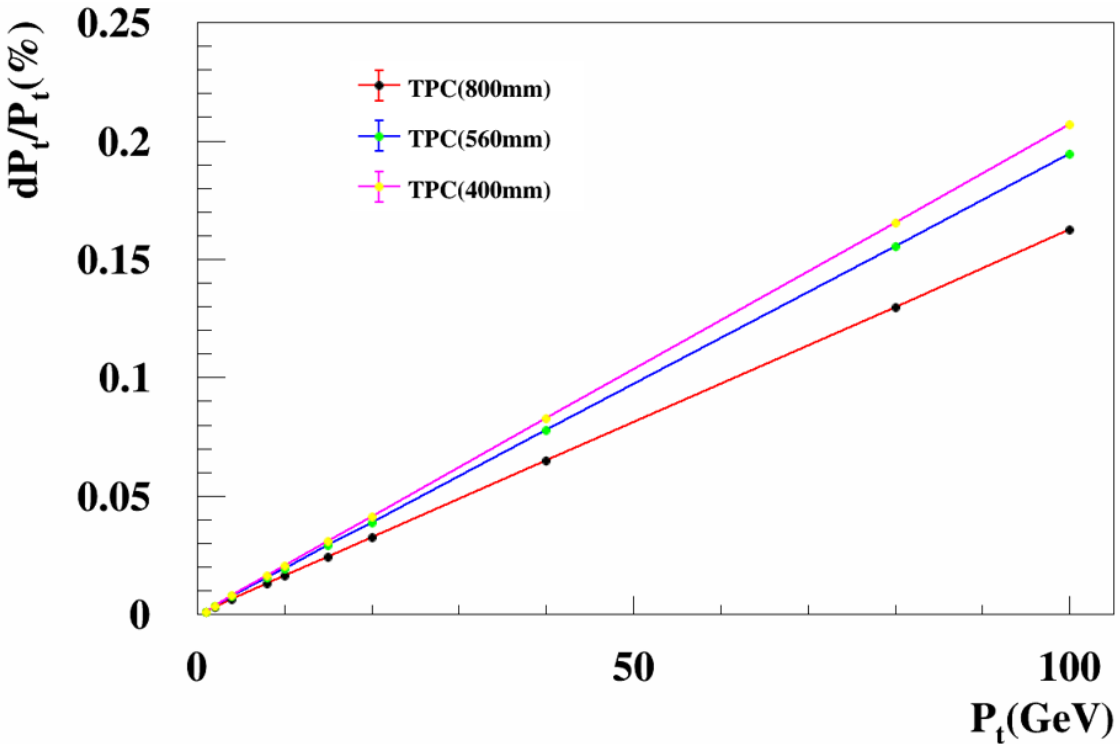
1. When there are more than 1 CMOS at external TPC, the rule seems clearly that putting TPC closer to beam tube causes worse momentum resolution. But is it true? We need to understand whether sagitta model or TPC itself causes this phenomenon.
2. While when the TPC is set at 800—1800mm, why its momentum resolution has this pattern which is that better at very low and very high momentum but worse at middle range.

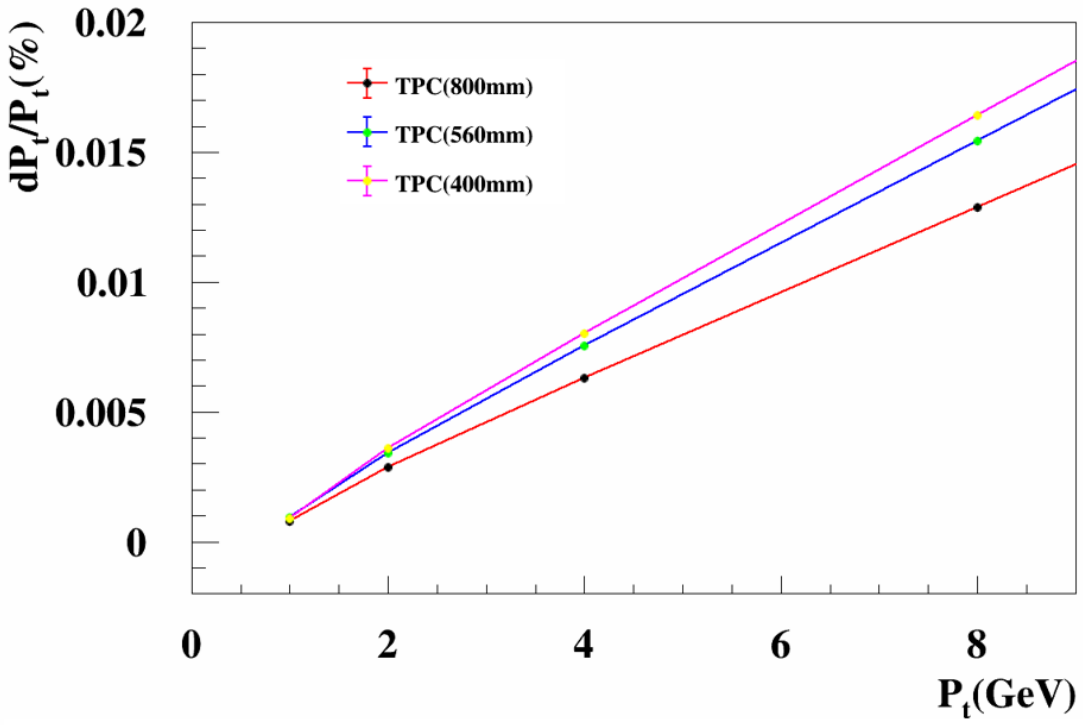
Thanks

Questions & Suggestions

Backup

Here we turn off all multiple scattering





Backup

The calculation for middle point of sagitta model

0.81 GeV : 1.272m

1 GeV : 1.011m

100 GeV : ~0.9m