

CPEC Tracking System Optimization

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On behalf of the CEPC Tracker Team

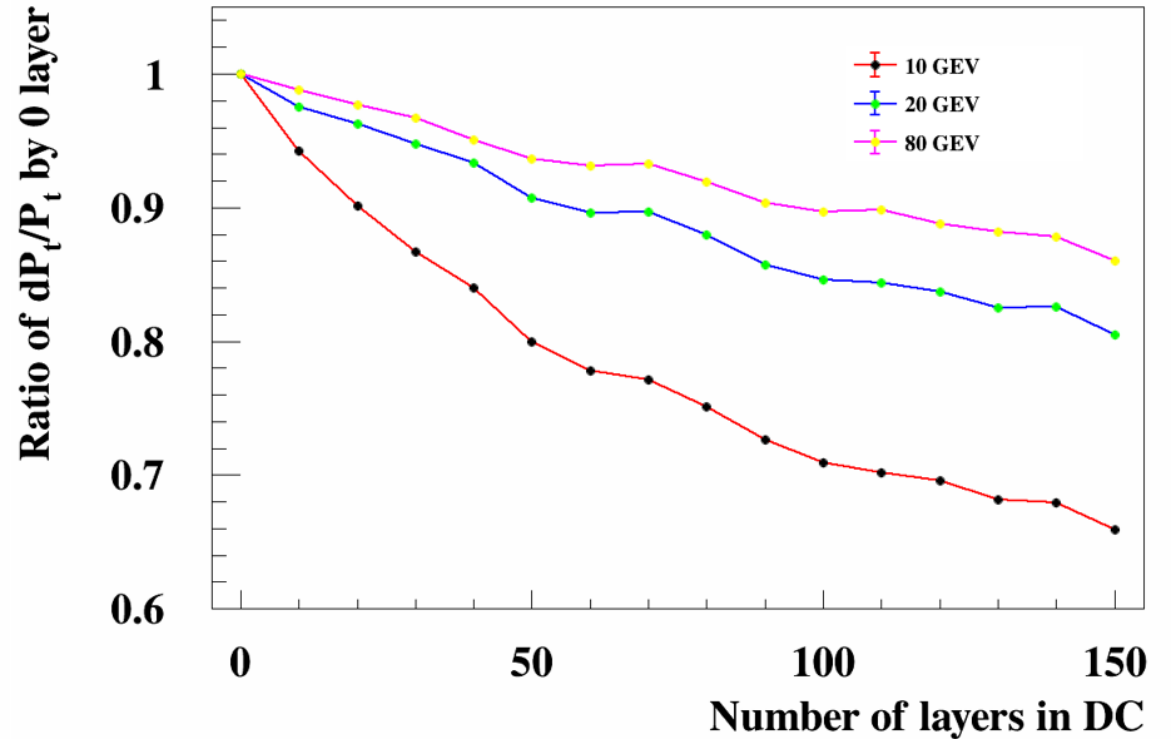
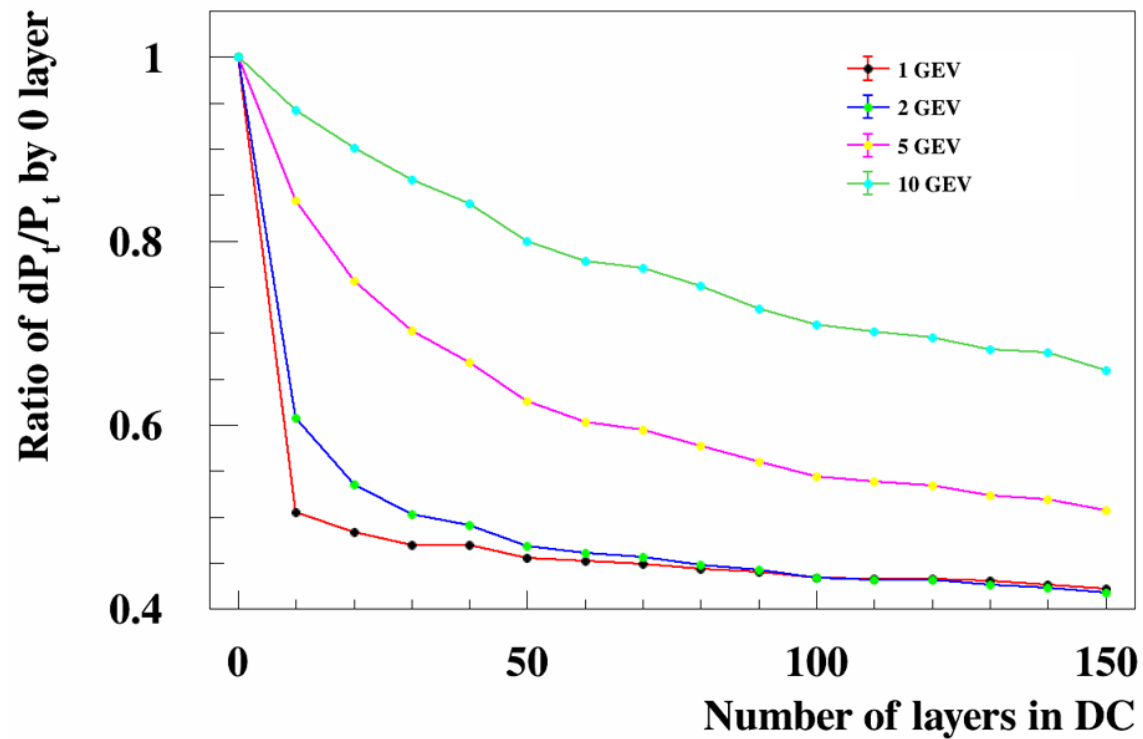
2021.8.13

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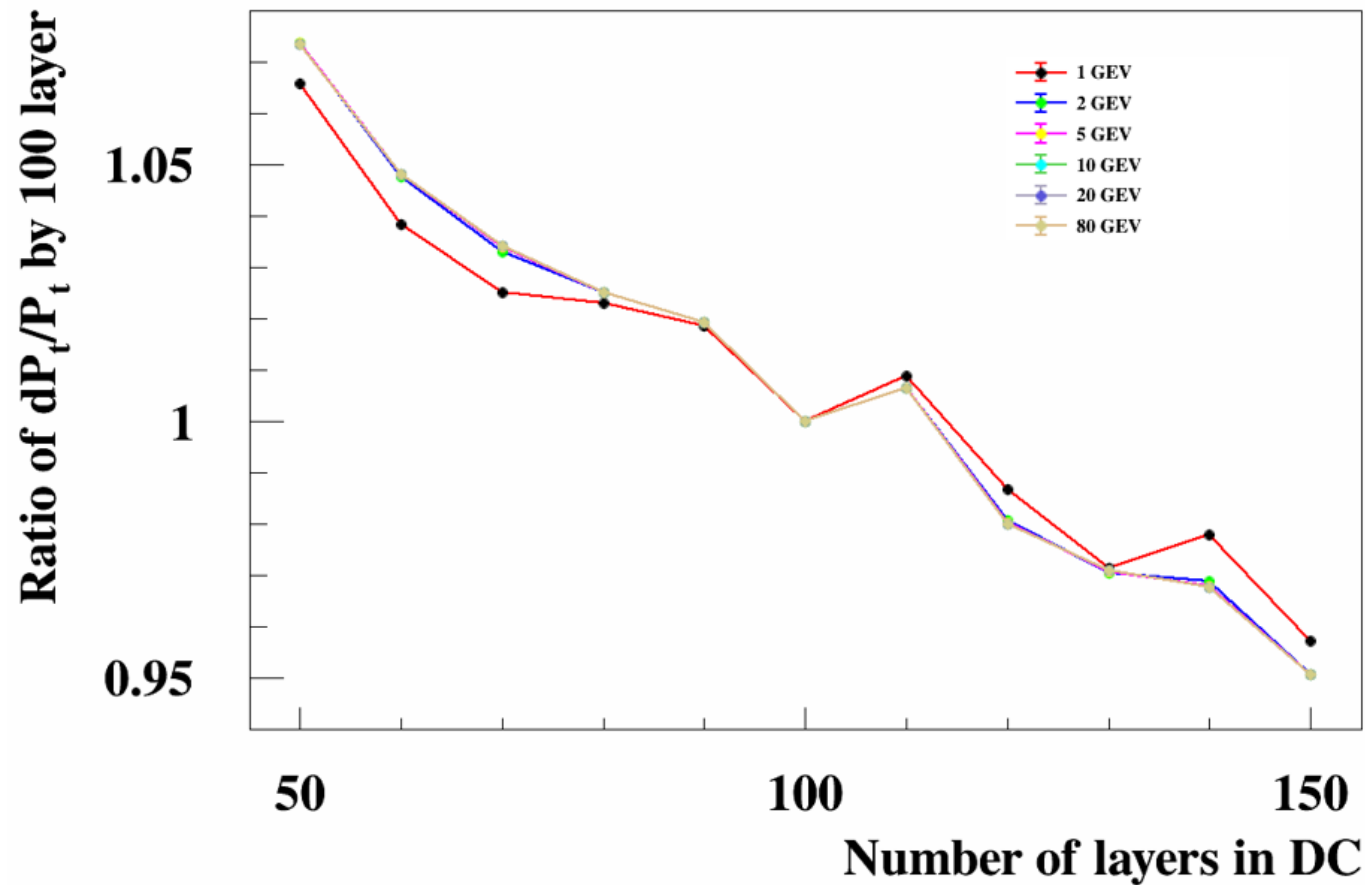
Update the general results

The number of layers in DC : 0 to 150 by space 10 considering multiple scattering



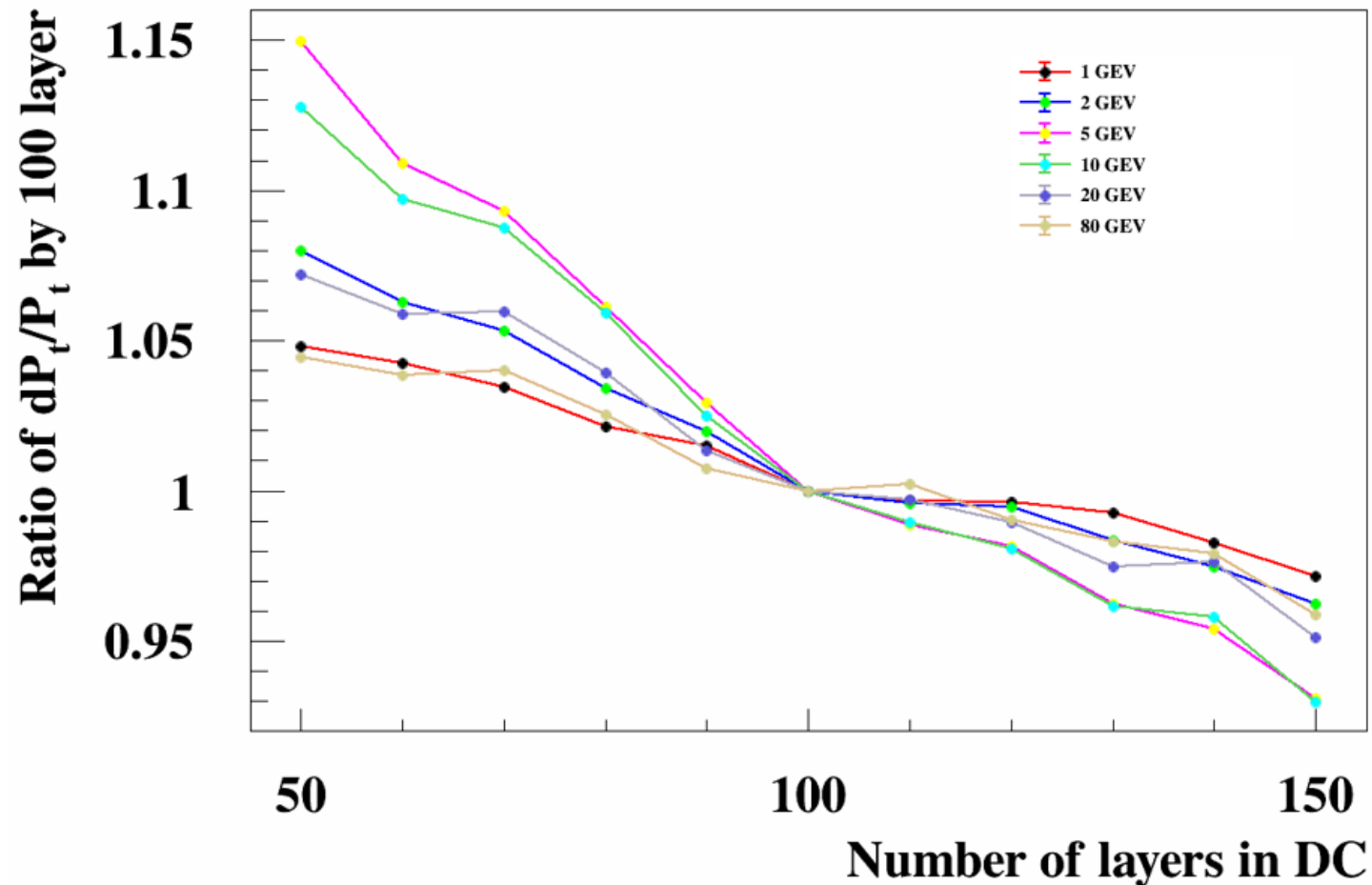
Update the general results

The number of layers in DC : 50 to 150 by space 10 ignoring multiple scattering



Update the general results

The number of layers in DC : 50 to 150 by space 10 considering multiple scattering



A brief summary

1. The general trend of the influence for momentum resolution by layers in DC is
more layers takes better resolution.
2. But this trend is gentle in a large range around 100.

Next to do

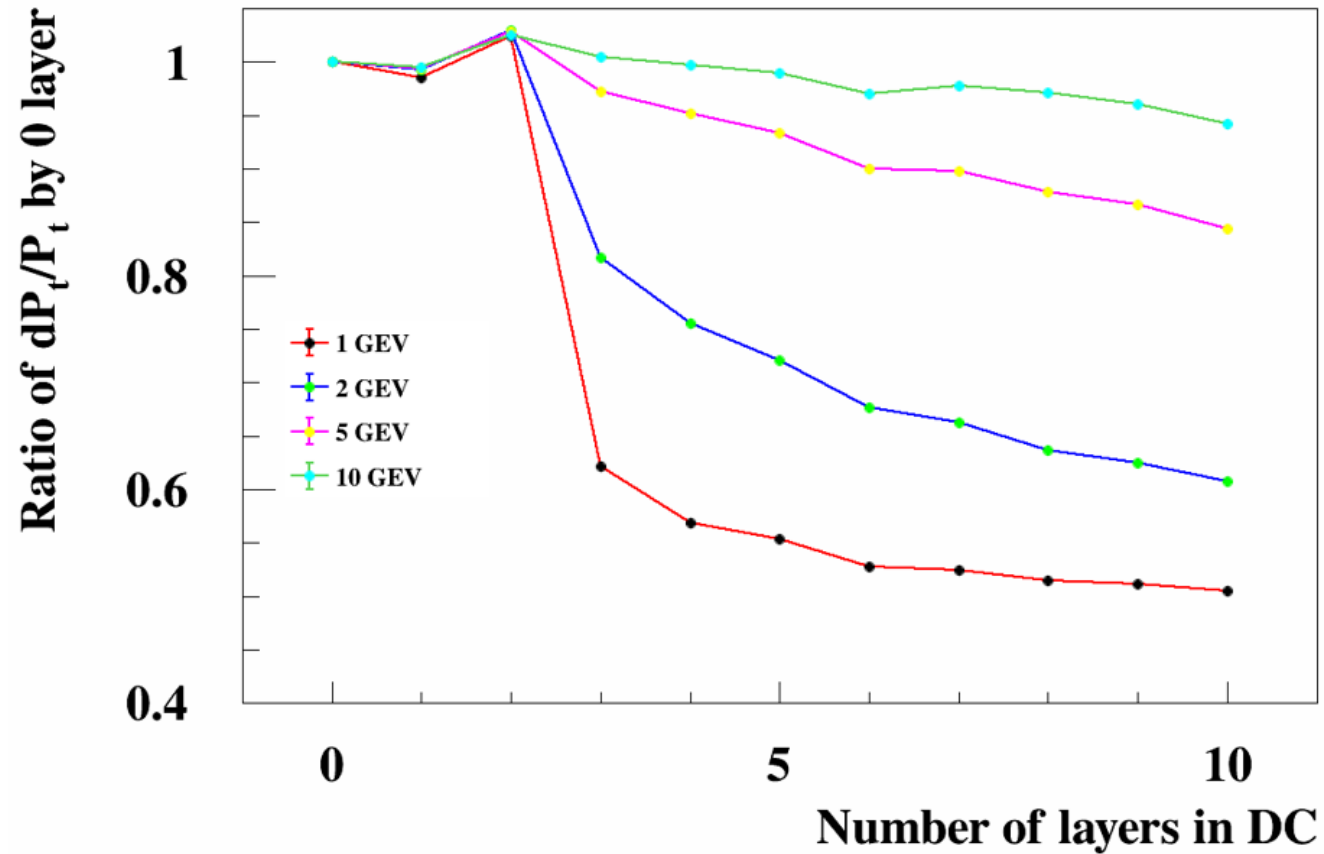
1. The previous work gives us a general conclusion on the influence for momentum resolution by layers in DC. We decide to use 1 meters radius and 100 layers as a preliminary setup for DC used for next work.
2. We are going to check the influence for momentum resolution by positions of DC and internal & external CMOS, after which we will check the influence by the number of layers again.

Thanks

Questions & Suggestions

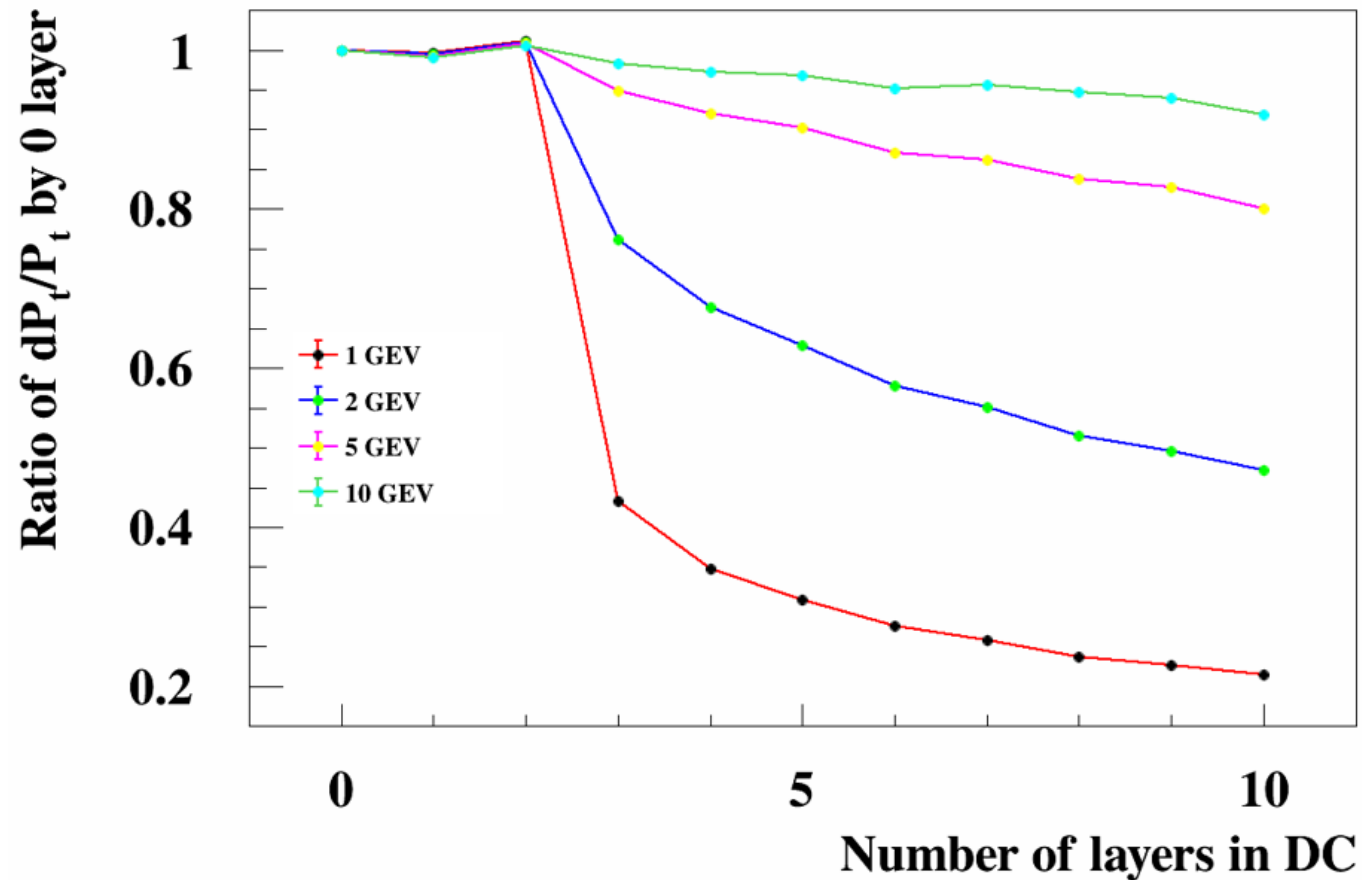
Backup

The number of layers in DC : 0 to 10 by space 1 considering multiple scattering



Backup

The number of layers in DC : 0 to 10 by space 1 considering multiple scattering but no any material budget in DC



Backup

Checking how LDT deals with TPC layers

Layers	1GEV	2GEV	5GEV
1	0.00122849	0.00136554	0.00140371
Manual-1	0.00053532	0.00104916	0.00133817
Manual-1*	0.00122829	0.00136548	0.00140369
Manual-1**	0.00122828	0.0013655	0.0014037
2	0.0012464	0.00138642	0.00142562
Manual-2	0.00043213	0.00093281	0.00130811
Manual-2*	0.00124627	0.00138639	0.00142562
3	0.00053317	0.00104575	0.00134096
Manual-3	0.0003813	0.00086192	0.00127372
Manual-3*	0.00053314	0.00104575	0.00134096
4	0.00042939	0.00092956	0.00130057
Manual-4	0.00033727	0.00078924	0.00123466

Backup

```
01 LiC Detector-Toy (barrel)
02 SDT-CEPC
03 Version:                6 + 3 + DC + 2
04 Vertex Detector (VTX)
05
06 Number of layers        :      8
07 Description (optional)  :  |-Beamt.--|-----Vertex detector-----|
08 Names of the layers (opt.) :  XBT,      VTX1,      VTX2,      VTX3,      VTX4,      VTX5,      VTX6,      XVTXSHELL
09 Radii [mm]              :  14.5,      16.0,      18.0,      37.0,      39.0,      58.0,      60.0,      65.0
10 Upper limit in z [mm]    :  4225,      62.5,      62.5,      125,      125,      125,      125,      145
11 Lower limit in z [mm]    : -4225,     -62.5,     -62.5,     -125,     -125,     -125,     -125,     -145
12 Efficiency RPhi         :    0,         1.0,         1.0,         1.0,         1.0,         1.0,         1.0,         0.0
13 Efficiency 2nd coord. (eg. z): -1
14 Stereo angle alpha [Rad] :   pi/2
15 Thickness [rad. lengths] :  0.0015, 0.0015,  0.0015,  0.0015,  0.0015,  0.0015,  0.0015,  0.0015
16 error distribution       :    0
17 0 normal-sigma(RPhi) [1e-6m] :  2.8, 6, 4.0, 4.0, 4.0, 4.0
18      sigma(z) [1e-6m] :  2.8, 6, 4.0, 4.0, 4.0, 4.0
19 1 uniform-d(RPhi) [1e-6m] :  4.0
20      d(z) [1e-6m] :  4.0
21
```

VTX-setups

Backup

```
22 CMOS Tracker (CIT)
23
24 Number of layers      :      4
25 Description (optional) : |-----CMOS tracker-----|----TPC Inner Wall ----|
26 Names of the layers (opt.) :      CIT1,          CIT2,          CIT3,          XTPCW1
27 Radii [mm]            :      78.0,          238.0,          398.0,          399.0
28 Upper limit in z [mm] :      150.0,          750.0,          1300.0,          2900.0
29 Lower limit in z [mm] :     -150.0,         -750.0,          -1300.0,          -2900.0
30 Efficiency RPhi       :      1.00,          1.00,          1.00,          0.0
31 Efficiency 2nd coord. (eg. z):      -1
32 Stereo angle alpha [Rad] :      pi/2
33 Thickness [rad. lengths] :    0.0065,          0.0065,          0.0065,          0.002
34 error distribution    :      0
35 0 normal-sigma(RPhi) [1e-6m] :      7.2
36      sigma(z) [1e-6m] :      86.6
37 1 uniform-d(RPhi) [1e-6m] :      7.2
38      d(z) [1e-6m] :      86.6
39
```

CIT-setups

Backup

```
40 Time Projection Chamber (TPC) (DC) (TPC --> DC by setting some paremeters in LDT)
41  $\sigma^2 = \sigma_0^2 + \sigma_1^2 \sin(\beta)^2 + C_{diff}^2 \cdot 6\text{mm}/h \cdot \sin(\theta) \cdot L_{drift}[\text{m}]$ 
42 Number of layers : could be changed
43 Radii [mm] : 400,1400
44 Upper limit in z [mm] : 2900.0
45 Lower limit in z [mm] : -2900.0
46 Efficiency RPhi : 1
47 Efficiency z : 1
48 Thickness [rad. lengths] : could be changed
49  $\sigma_0(\text{RPhi})$  [1e-6m] : 100
50  $\sigma_1(\text{RPhi})$  [1e-6m] : 0
51  $C_{diff}(\text{RPhi})$  [1e-6m/sqrt(m)] : 0
52  $\sigma_0(z)$  [1e-6m] : 2828
53  $\sigma_1(z)$  [1e-6m] : 0
54  $C_{diff}(z)$  [1e-6m/sqrt(m)] : 0
55
```

DC-setups

Backup

Setups for simulating there is material budget from gas but no measuring layers in DC

```
40 Time Projection Chamber (TPC)
41  $\sigma^2 = \sigma_0^2 + \sigma_1^2 \sin(\beta)^2 + C_{diff}^2 \cdot 6\text{mm}/h \cdot \sin(\theta) \cdot L_{drift} [m]$ 
42 Number of layers : 100
43 Radii [mm] : 400, 1400
44 Upper limit in z [mm] : 2900.0
45 Lower limit in z [mm] : -2900.0
46 Efficiency RPhi : 1
47 Efficiency z : 1
48 Thickness [rad. lengths] : 0.00003356
49  $\sigma_0(\text{RPhi}) [1e-6m]$  : 99999
50  $\sigma_1(\text{RPhi}) [1e-6m]$  : 0
51  $C_{diff}(\text{RPhi}) [1e-6m/\sqrt{m}]$  : 0
52  $\sigma_0(z) [1e-6m]$  : 99999
53  $\sigma_1(z) [1e-6m]$  : 0
54  $C_{diff}(z) [1e-6m/\sqrt{m}]$  : 0
55
```

Backup

```
56 CMOS Tracker (CET)
57
58 Number of layers          :      3
59 Description (optional)    :  TPC outer wall  |-----External Tracker-----|
60 Names of the layers (opt.) :      XTPCW2,   CET1,    CET2
61 Radii [mm]                :      1401.0,   1411,    1800
62 Upper limit in z [mm]     :      2900.0,   2900.0,   2900.0
63 Lower limit in z [mm]     :     -2900.0,  -2900.0,  -2900.0
64 Efficiency RPhi           :       0.0,     1.0,     1.0
65 Efficiency 2nd coord. (eg. z):          -1
66 Stereo angle alpha [Rad]  :              pi/2
67 Thickness [rad. lengths]   :      0.010, 0.0065,    0.0065
68 error distribution         :          0
69 0 normal-sigma(RPhi) [1e-6m] :       7.2
70      sigma(z) [1e-6m]       :      86.6
71 1 uniform-d(RPhi) [1e-6m]   :       7.2
72      d(z) [1e-6m]          :      86.6
73
74 Magnetic field and beam spot
75
76 Solenoid magnetic field [T] :      3.0
77 Range in x [mm]             :     -0.0   0.0
78 Range in y [mm]             :     -0.0   0.0
79 Range in z [mm]             :     -0.0   0.0
```

CET-setups

Backup

Edit simulation parameters

文件(F) 编辑(E) 查看(V) 插入(I) 工具(T) 桌面(D) 窗口(W) 帮助(H)

Mass of the particles [GeV] 0.105
Number of events 100
Number of tracks per event 100

Start parameter range

Momentum (min) [GeV]	1	2	5	10	20
Momentum (max) [GeV]	1	2	5	10	20
Polar angle theta (min) [deg]	90				
Polar angle theta (max) [deg]	90				
Azimuthal angle phi (min) [deg]	0				
Azimuthal angle phi (max) [deg]	360				

Flags

Simulation

- Symmetry in theta ☐
- Use absolute momentum ☐
- Scale down TPC by factor 5 ☐
- Multiple scattering ☒
- Measurement errors ☒

Reconstruction

- Display bad tracks ☒
- Chi2 ☒

OK

**Simulation-
parameters**