CPEC Tracking System Optimization

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There is a mistake : I forget to remove % in every plot on ratio in following slides.

Motivation

find out **the influence of DC layers for the momentum resolution** in barrel

and then **understand it**

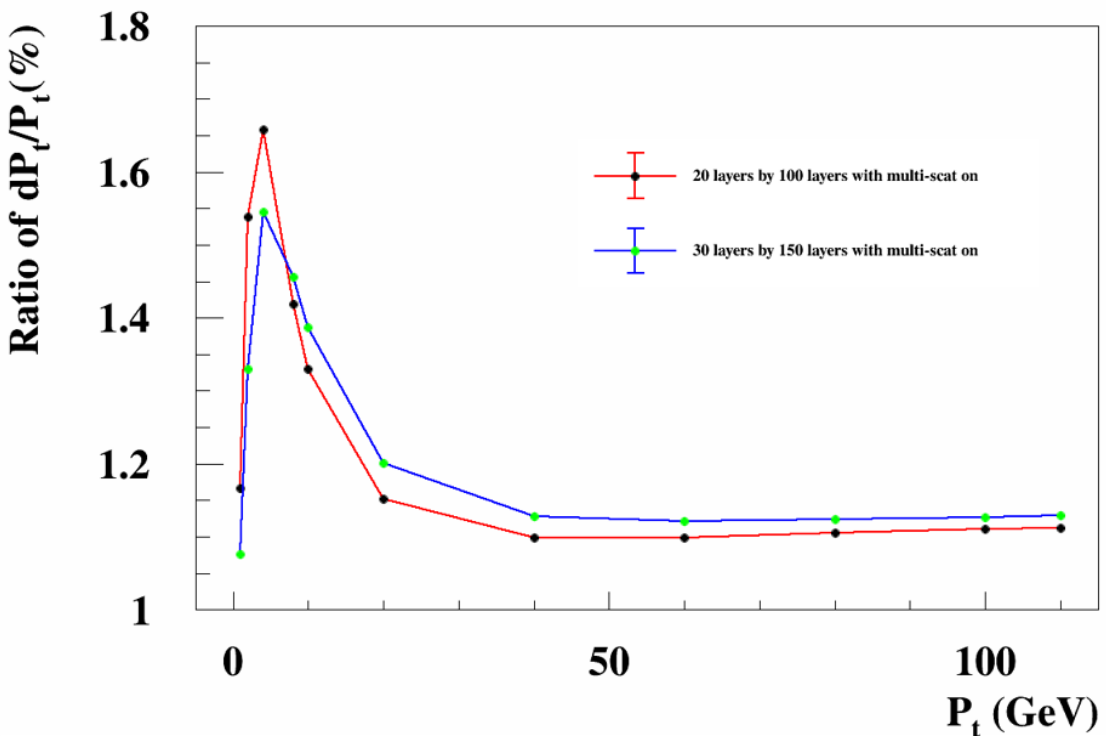
Scale down by factor 5

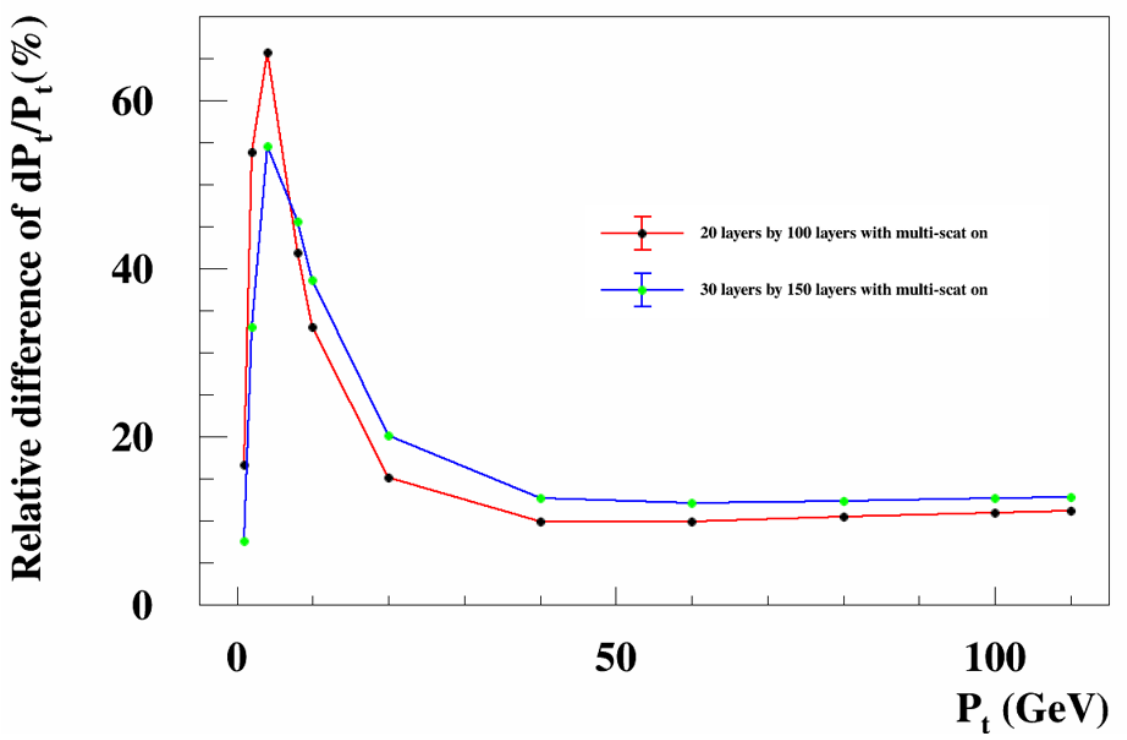
The following statement is from ‘user’s guide’ of LDT.

To test whether this method is reliable, we choose two pair of examples. The first one is comparing 100 layers and 20 layers of which setups for detector is almost same as that of 100 one except the sigma_detector is multiplied by $\sqrt{5}$ and thickness of each layer is multiplied by 5. While the other one is comparing 150 layers and 30 layers.

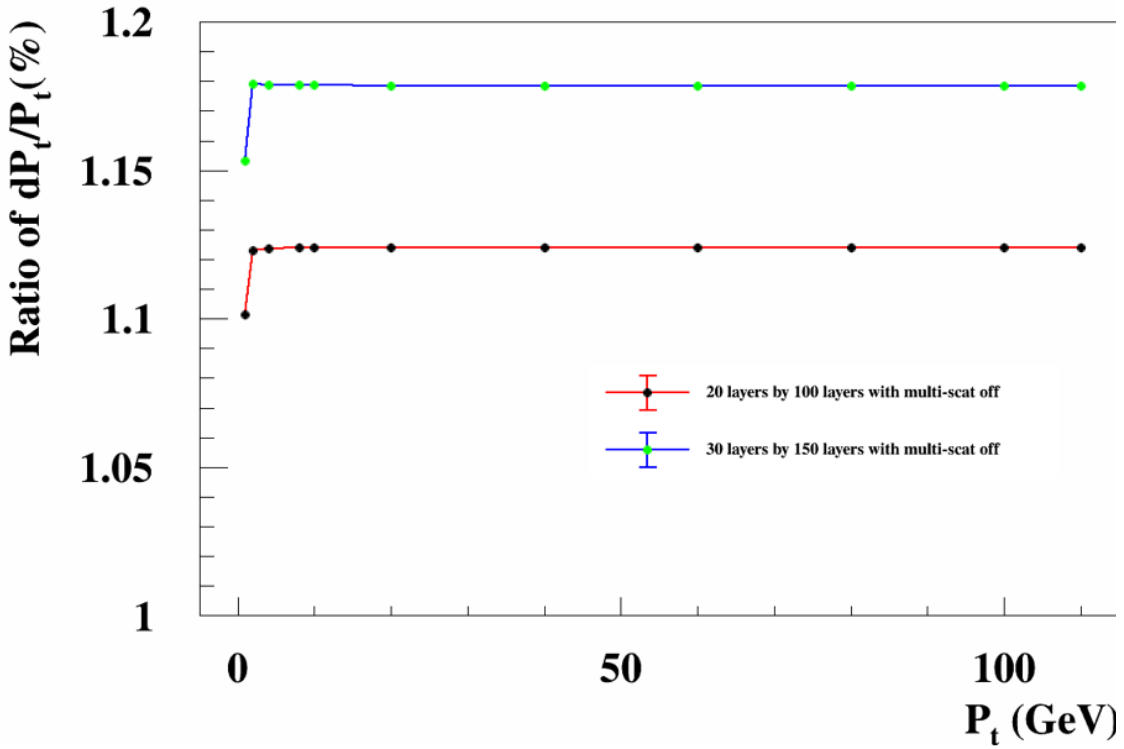
- Scale down TPC by factor 5: To increase the simulation speed, one can scale down the TPC using the flag “Scale down TPC by factor 5”. The number of layers in the TPC is devided by 5, the sigmas are multiplied by $\sqrt{5}$, and the radiation length of each remaining layer is multiplied by 5. This corresponds to replacing five detector layers by one layer with statistically corresponding properties.

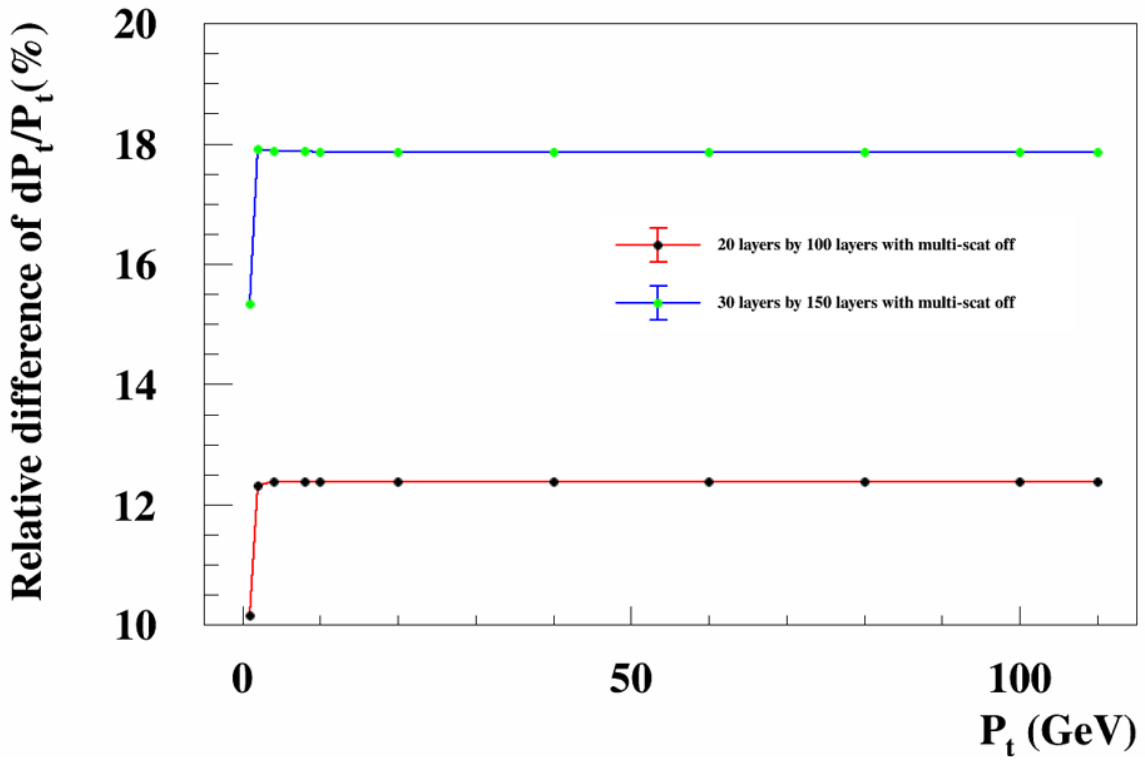
Scale down by factor 5





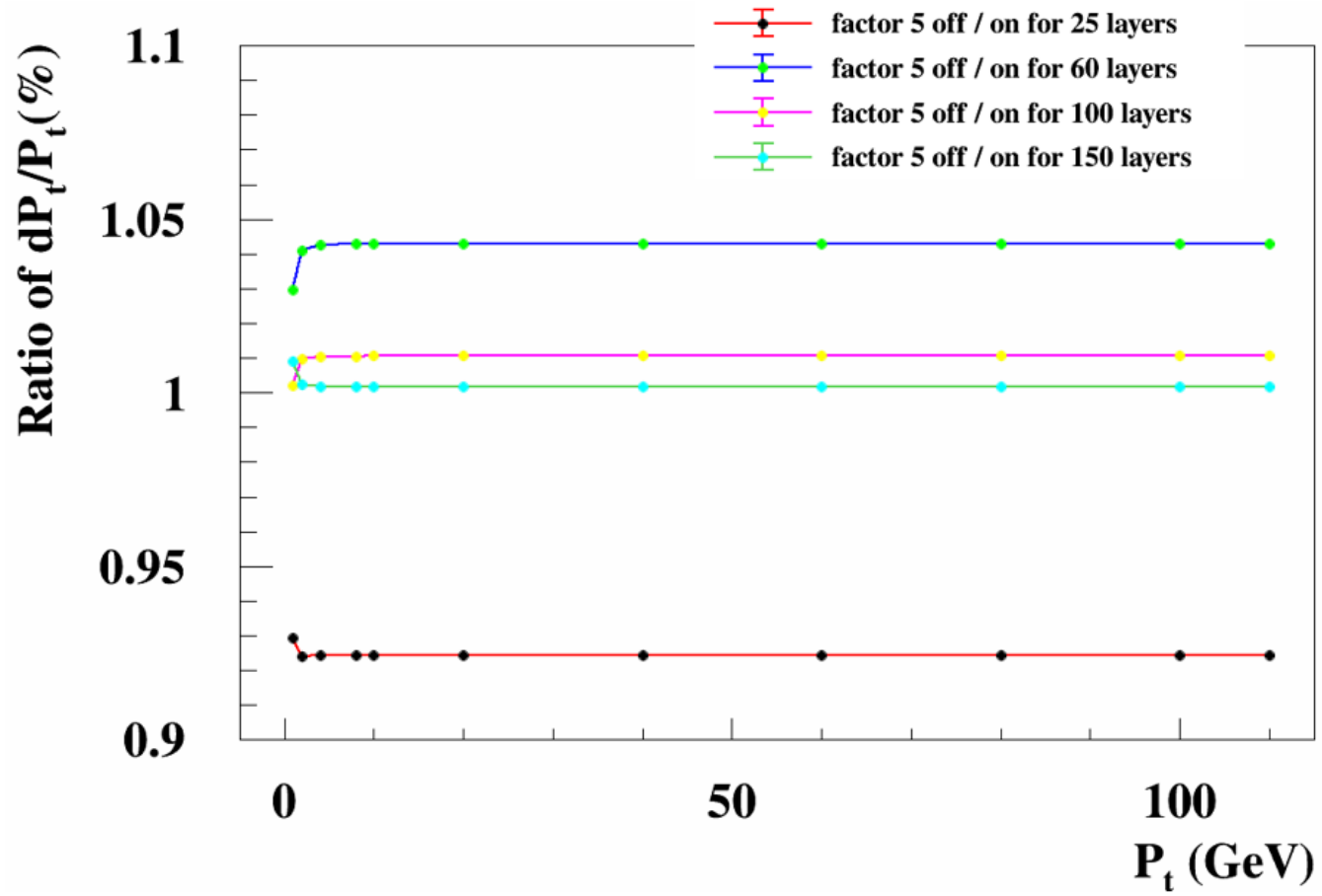
Scale down by factor 5





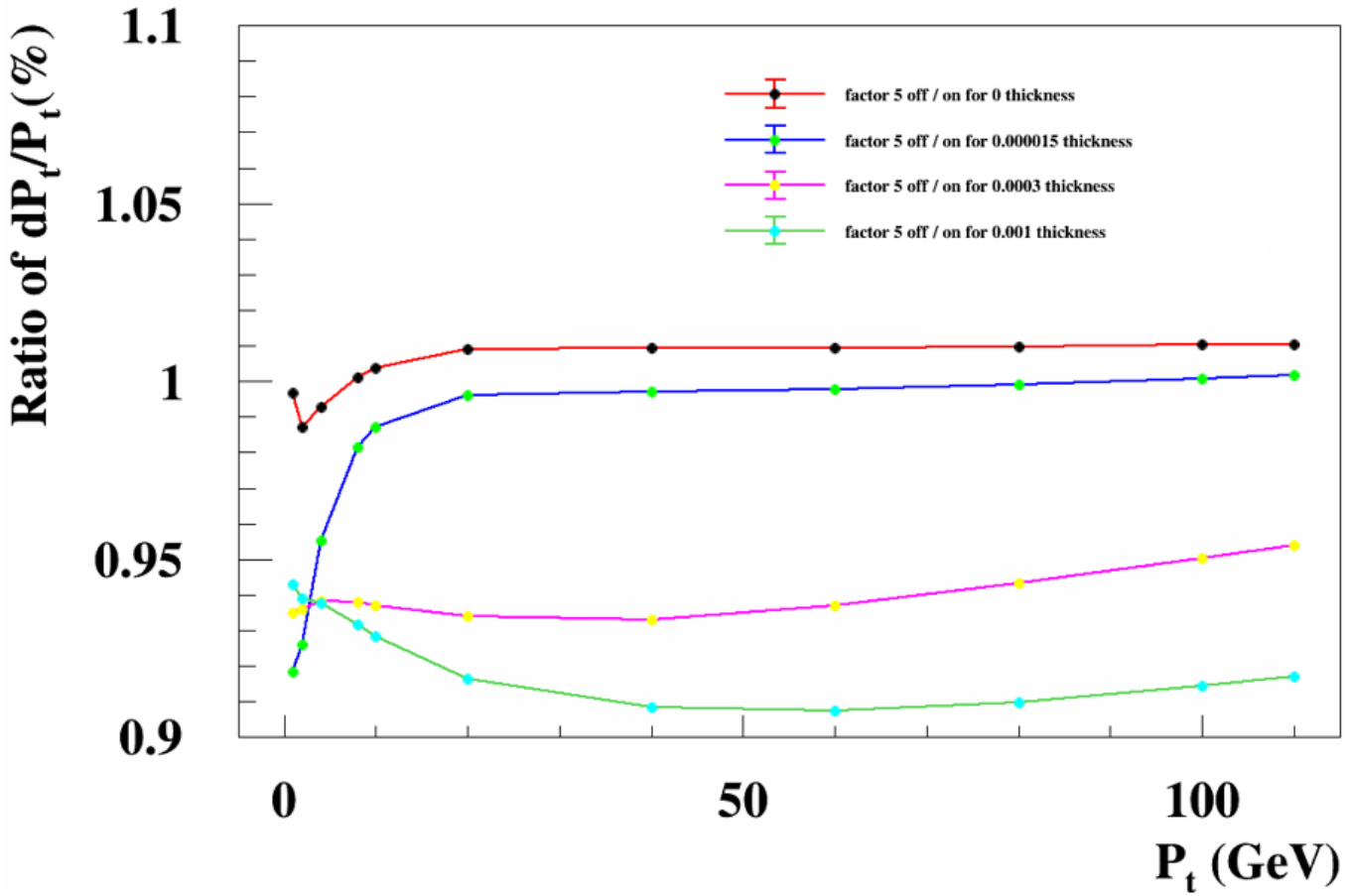
Scale down by factor 5

Compare different number of layers in DC with all multiple scattering off.



Scale down by factor 5

Compare different thickness for 100 layers in DC with multiple scattering on.



Scale down by factor 5

To conclude,

1. The scale down by factor 5 method can not be explained by such simple way.
2. Different layers could take different influence by scale 5 even though no multiple scattering.
3. For DC, different thickness could take different influence by scale 5.
4. Some ides to understand these curves related to scale 5 are put in the following part.

Since we have not understood what ‘scale down by factor 5’ does for our simulation, our opinion is **turning it off firstly** and then get the general results on influence of different number of layers in DC for dPt/Pt.

General results

We check out the ratio of dPt/Pt from 10 to 150 layers comparing with that of 0 layer, while the total material budget in DC is same between these 15 setups, which is shown in figure 1.

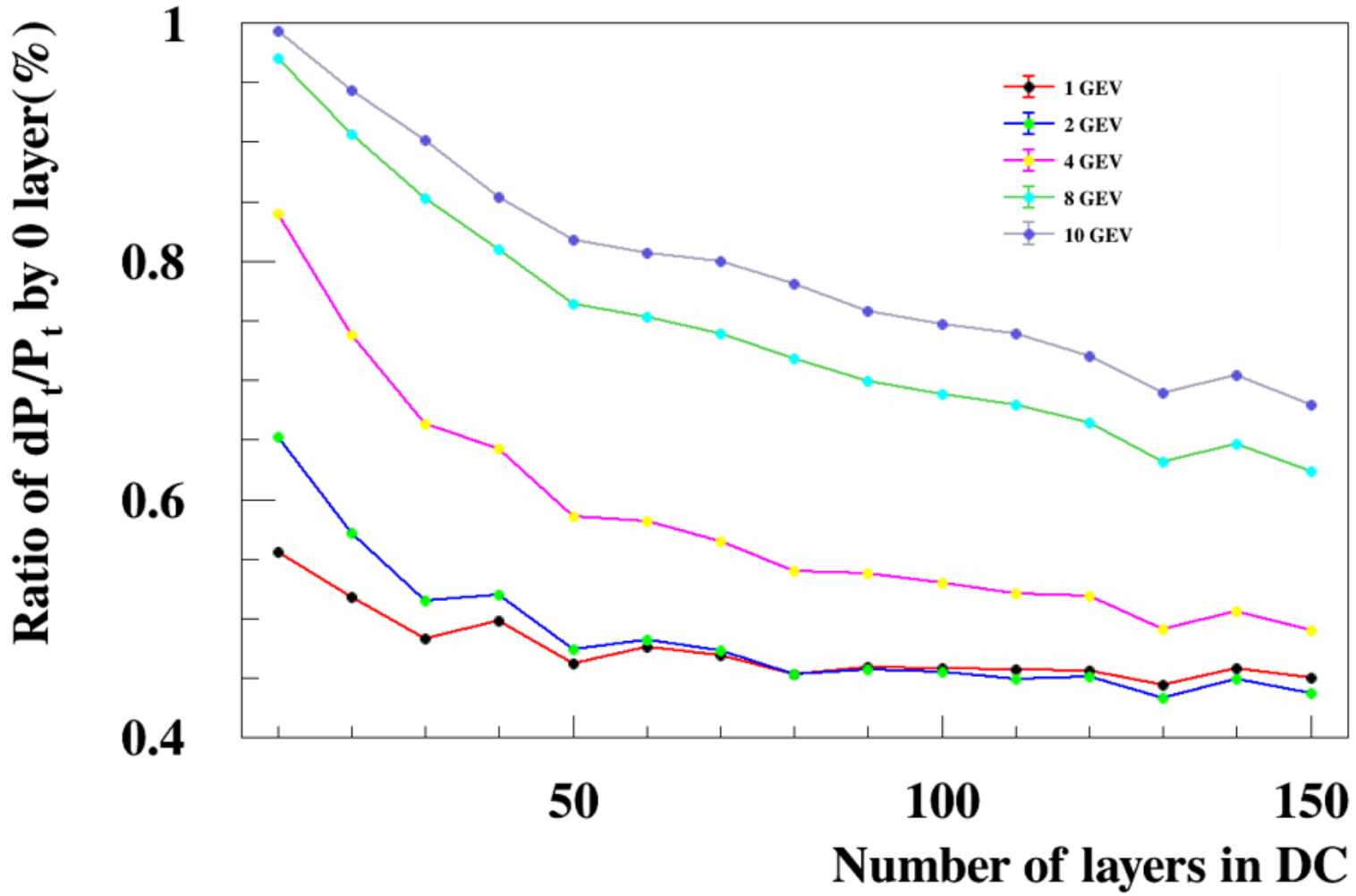


Figure 1

General results

We check out the ratio of dPt/Pt from 10 to 150 layers comparing with that of 0 layer in DC, while we turn off all multiple scattering this time, of which the results are shown in figure 2 and 3.

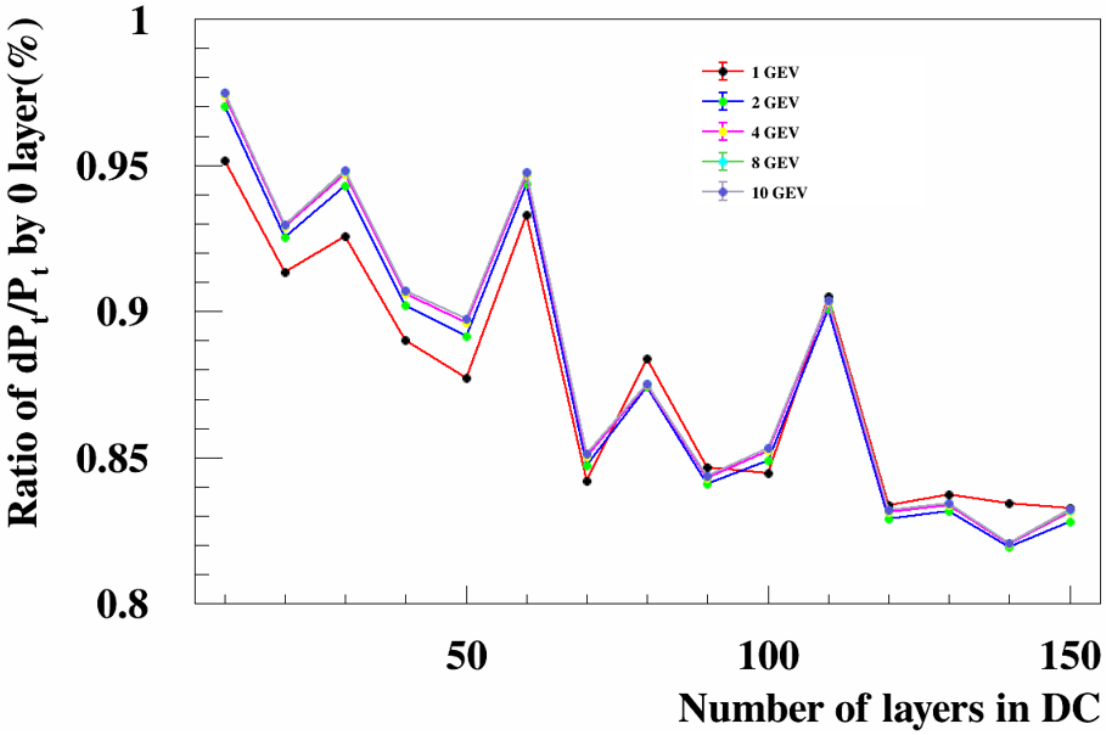


Figure 2

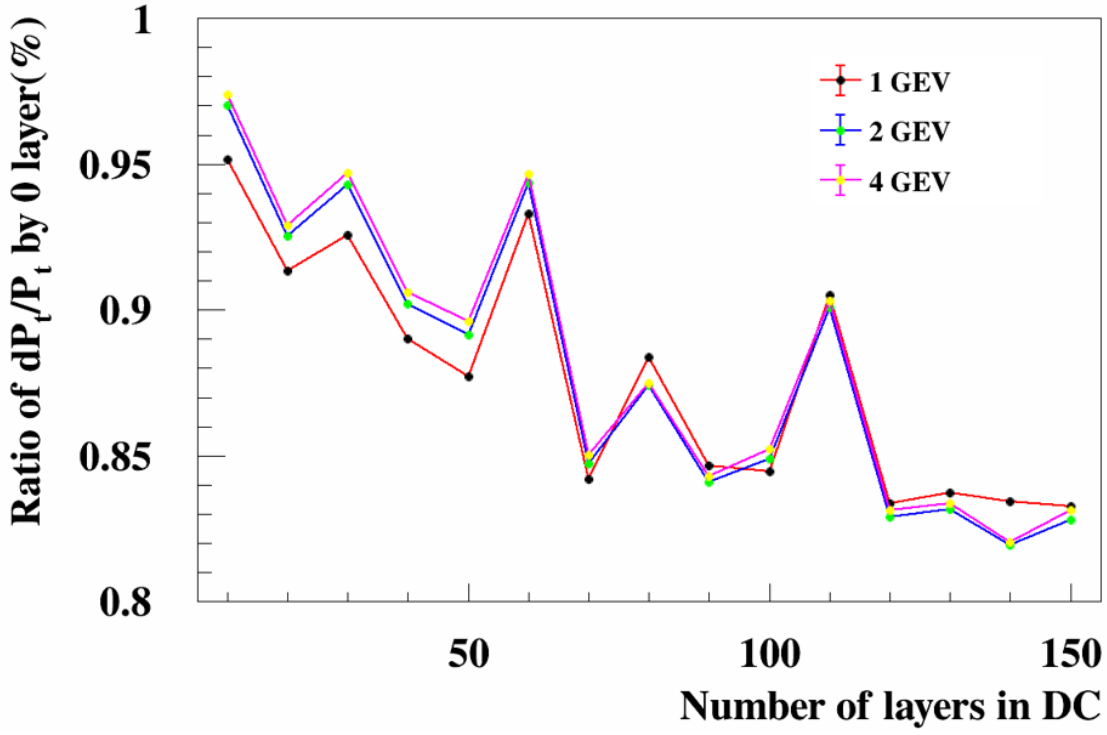


Figure 3

Plans to do

1. Scale down by factor 5.
2. Amplify the number of tracks for each event.

Thanks

Questions & Suggestions

Backup

```
LiC Detector-Toy (barrel)
SDT-CEPC
Version:                      1-1-1 (2)
Vertex Detector (VTX)

Number of layers              :   8
Description (optional)        :   |-Beamt.--|-------------------------------------Vertex detector--------------------|
Names of the layers (opt.)    :   XBT,      VTX1,     VTX2,      VTX3,       VTX4,       VTX5,      VTX6,      XVTXSHELL
Radii [mm]                    :   14.5,     16.0,      18.0,     37.0,       39.0,       58.0,     60.0,       65.0
Upper limit in z [mm]         :   4225,     62.5,      62.5,      125,        125,        125,      125,        145
Lower limit in z [mm]         :  -4225,    -62.5,     -62.5,     -125,       -125,       -125,     -125,       -145
Efficiency RPhi               :   0,         1.0,      1.0,      1.0,        1.0,        1.0,      1.0,        0.0
Efficiency 2nd coord. (eg. z):  -1
Stereo angle alpha [Rad]      :   pi/2
Thickness [rad. lengths]      :   0.0015, 0.0015,   0.0015,   0.0015,     0.0015,     0.0015,   0.0015,   0.0015
error distribution            :   0
0 normal-sigma(RPhi) [1e-6m] :   2.8, 6, 4.0, 4.0, 4.0, 4.0
          sigma(z)    [1e-6m] :   2.8, 6, 4.0, 4.0, 4.0, 4.0
1 uniform-d(RPhi) [1e-6m]     :   4.0
          d(z)    [1e-6m]     :   4.0

CMOS Tracker (CIT)

Number of layers              :   4
Description (optional)        :   |-------------CMOS tracker-------------|----TPC Inner Wall ----|
Names of the layers (opt.)    :    CIT1,         CIT2,       CIT3,          XTPCW1
Radii [mm]                    :    78.0,        238.0,      398.0,          399.0
Upper limit in z [mm]         :   150.0,        750.0,      1300.0,         2900.0
Lower limit in z [mm]         :  -150.0,       -750.0,      -1300.0,        -2900.0
Efficiency RPhi               :    1.00,         1.00,       1.00,          0.0
Efficiency 2nd coord. (eg. z):      -1
Stereo angle alpha [Rad]      :    pi/2
Thickness [rad. lengths]      :  0.0065,       0.0065,     0.0065,          0.002
error distribution            :       0
0 normal-sigma(RPhi) [1e-6m] :     7.2
          sigma(z)    [1e-6m] :    86.6
1 uniform-d(RPhi) [1e-6m]     :     7.2
          d(z)    [1e-6m]     :    86.6
```

Backup

```
40 Time Projection Chamber (TPC)
41 sigma^2=sigma0^2+sigma1^2*sin(beta)^2+Cdiff^2*6mm/h*sin(theta)*Ldrift[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 sigma0(RPhi) [1e-6m]          :   100
50 sigma1(RPhi) [1e-6m]          :     0
51 Cdiff(RPhi)  [1e-6m/sqrt(m)] :     0
52 sigma0(z)    [1e-6m]          :  2828
53 sigma1(z)    [1e-6m]          :     0
54 Cdiff(z)     [1e-6m/sqrt(m)] :     0
55
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
```