

CEPC Tracking System Optimization

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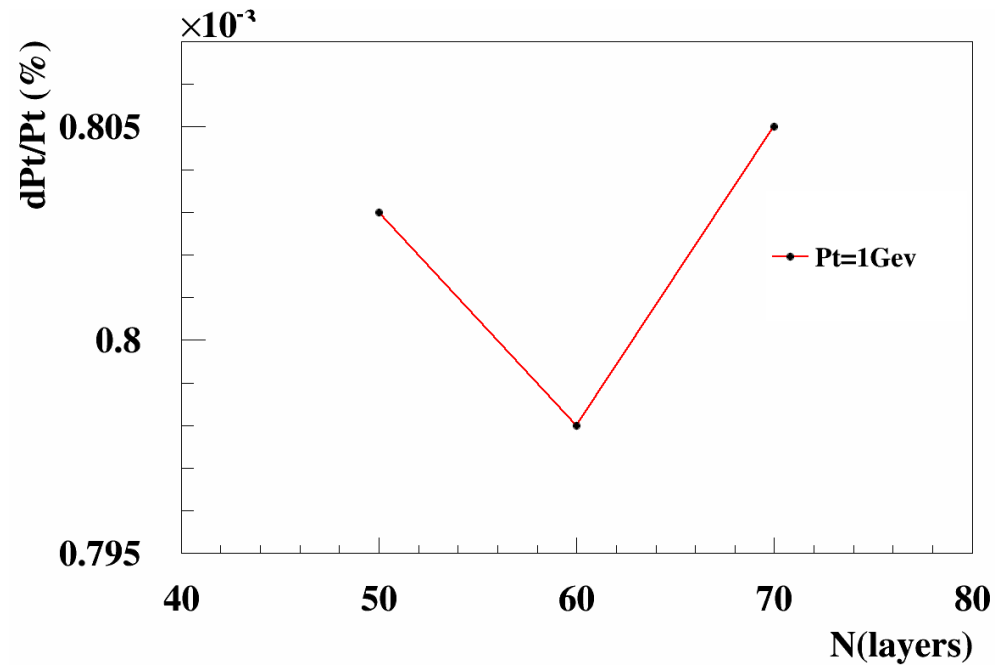
Introduction

- keep the total material budget constant
- keep the thickness of DC one meter
- exploring the variation of momentum resolution with the change of detector layers in DC

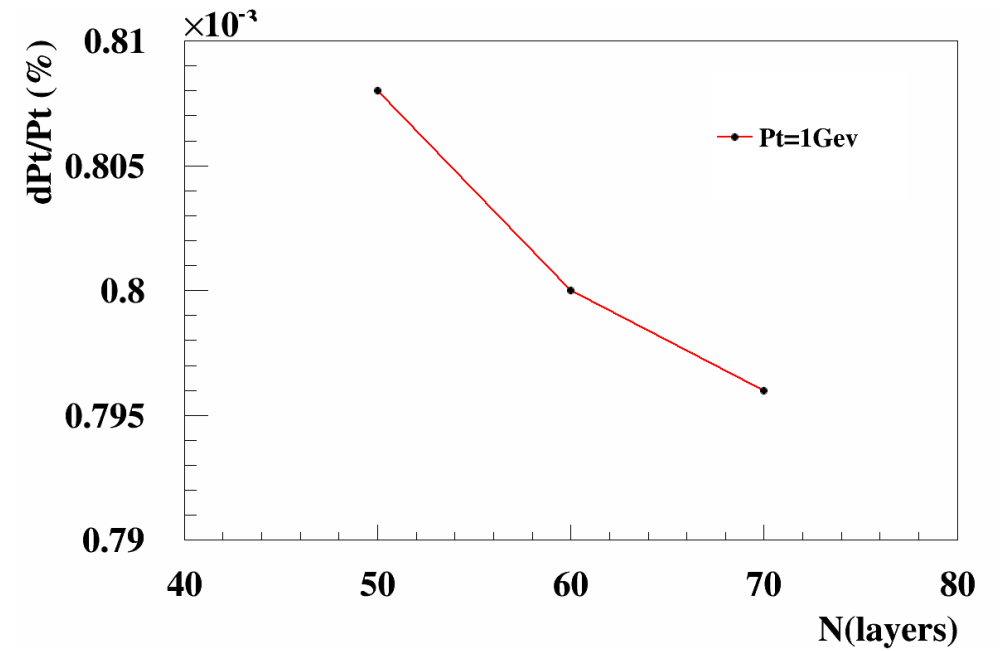
- Parameter setting (details see backup)

sub detector	N layers	Resoluton(μm)		Material budget ($\%X_0$)
		$r\text{-}\Phi$	z_0	
VXD	6	2.8 / 6 / 4 / 4 / 4 / 4	2.8 / 6 / 4 / 4 / 4 / 4	0.15per layer
SIT	4	7.2	86.6	0.65
DC	10/20/30.../140 /150/160	100	2000	1.2
SET	1	7.2	86.6	0.65

- Comparison of the number of tracks
- The more the number of tracks, the more accurate the results



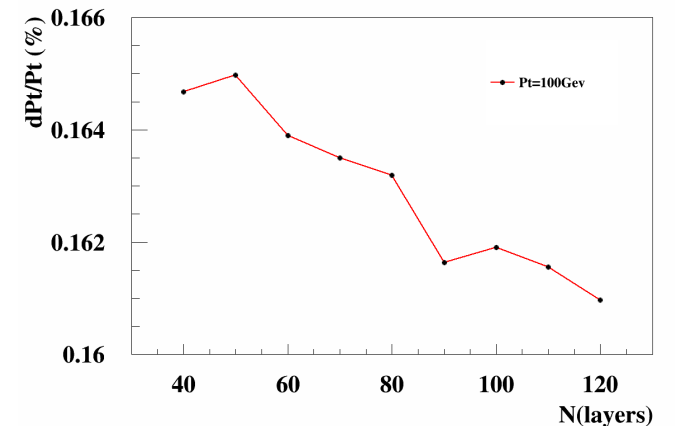
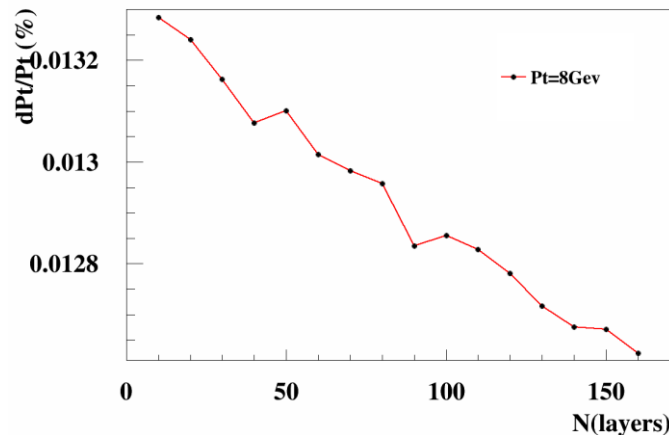
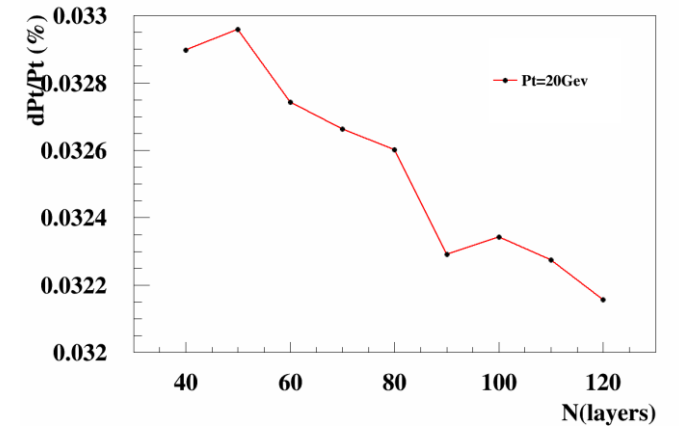
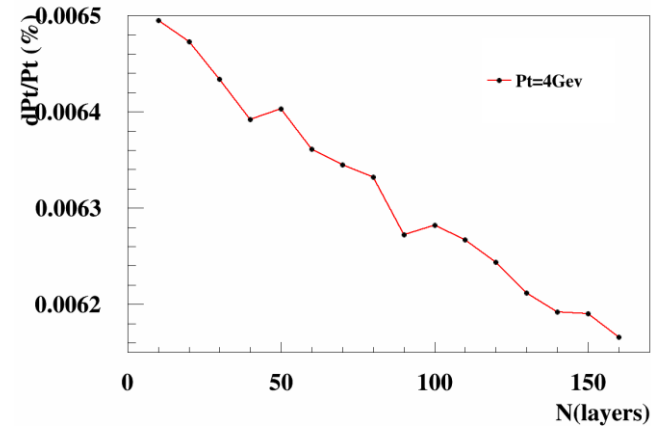
10000 tracks



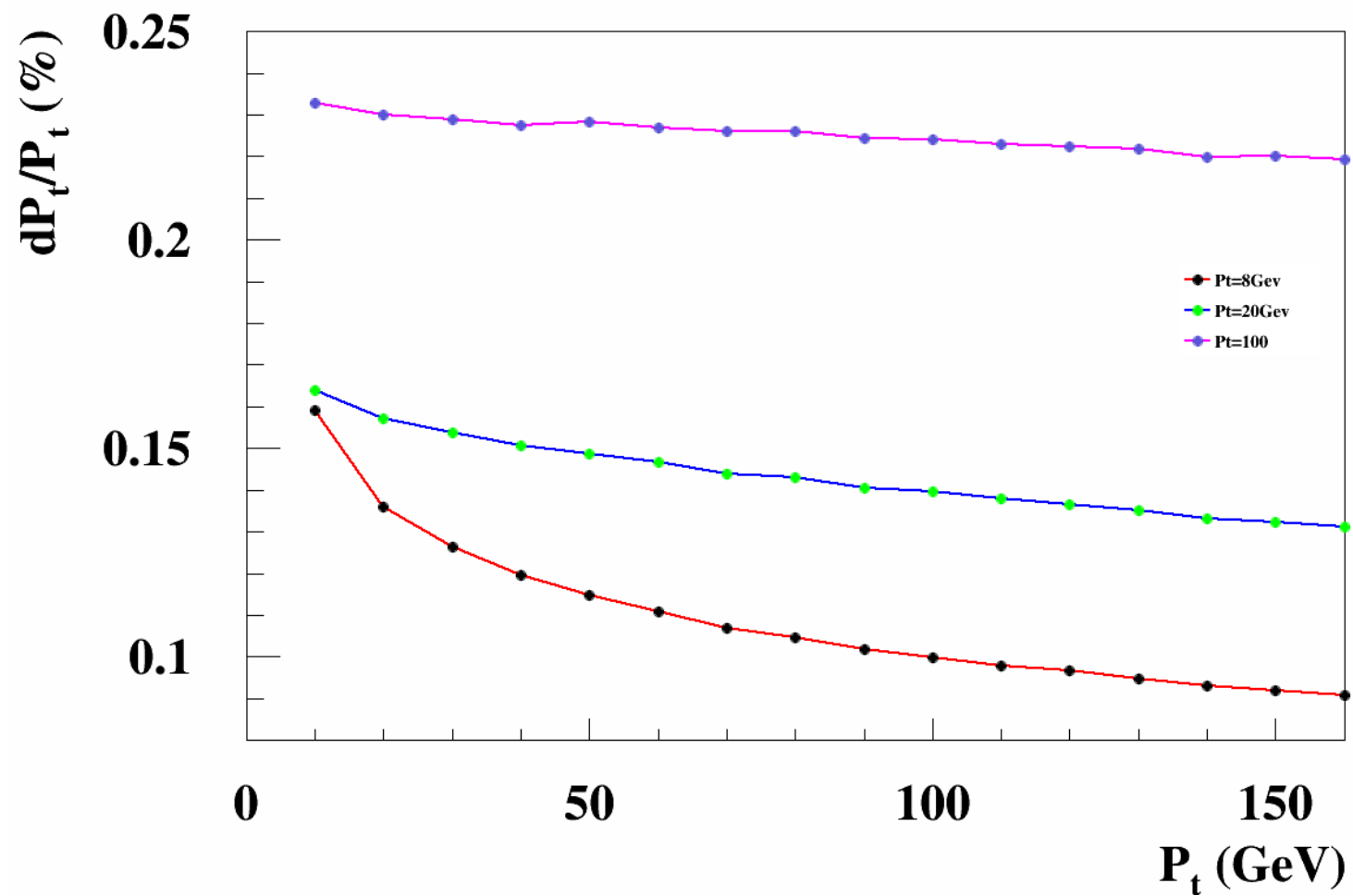
100000 tracks

- Comparing different momentum and layers

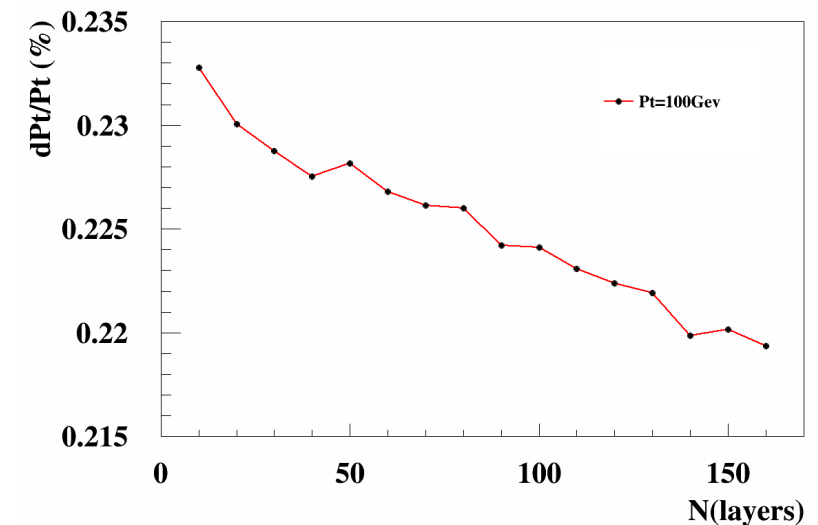
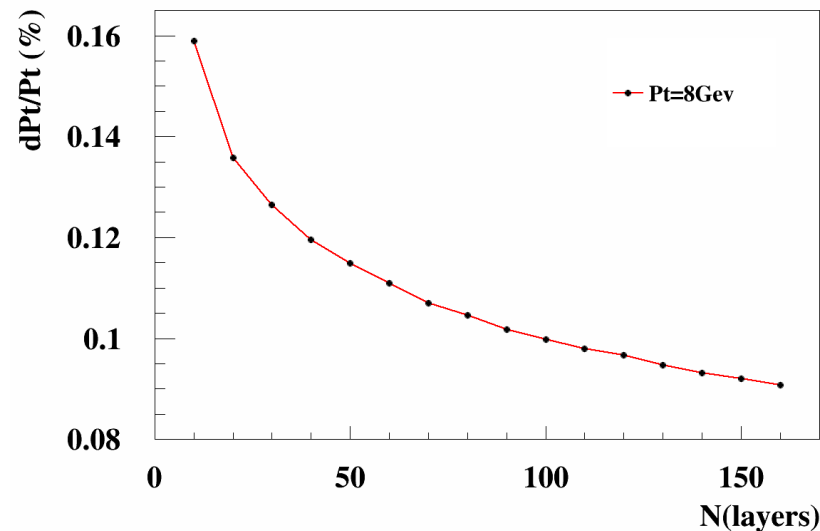
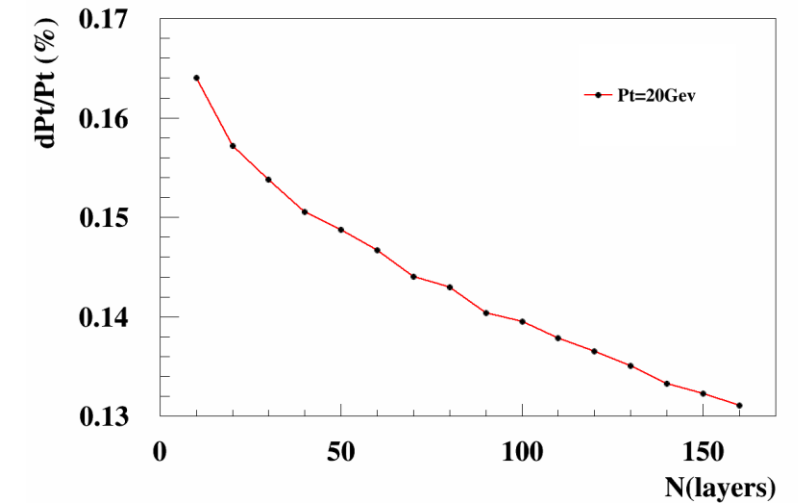
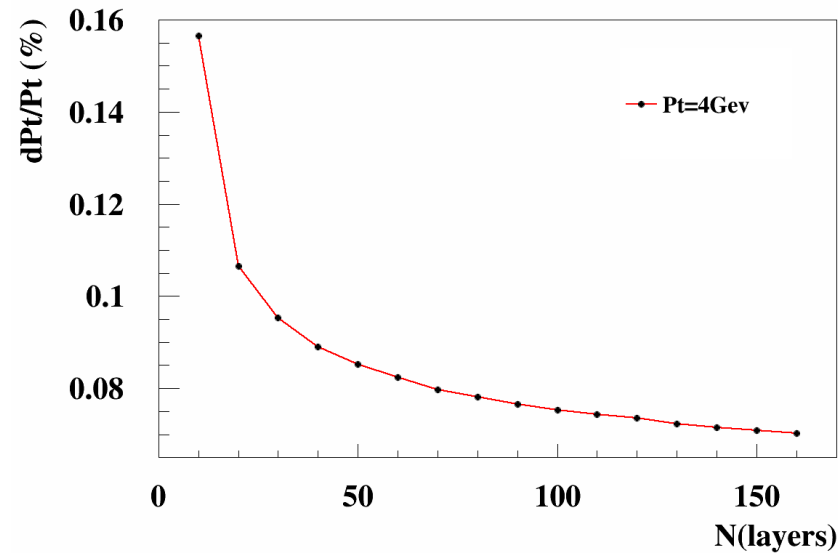
- ✓ same variation tendency without considering multiple scattering
- ✓ The momentum resolution is positively correlated with the particle momentum and negatively correlated with the detector layers .



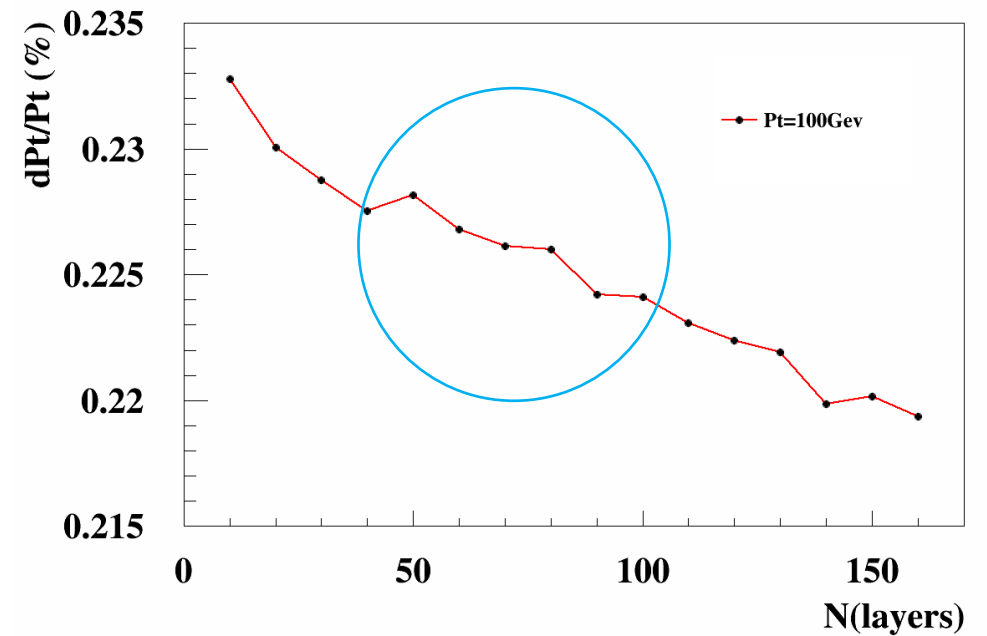
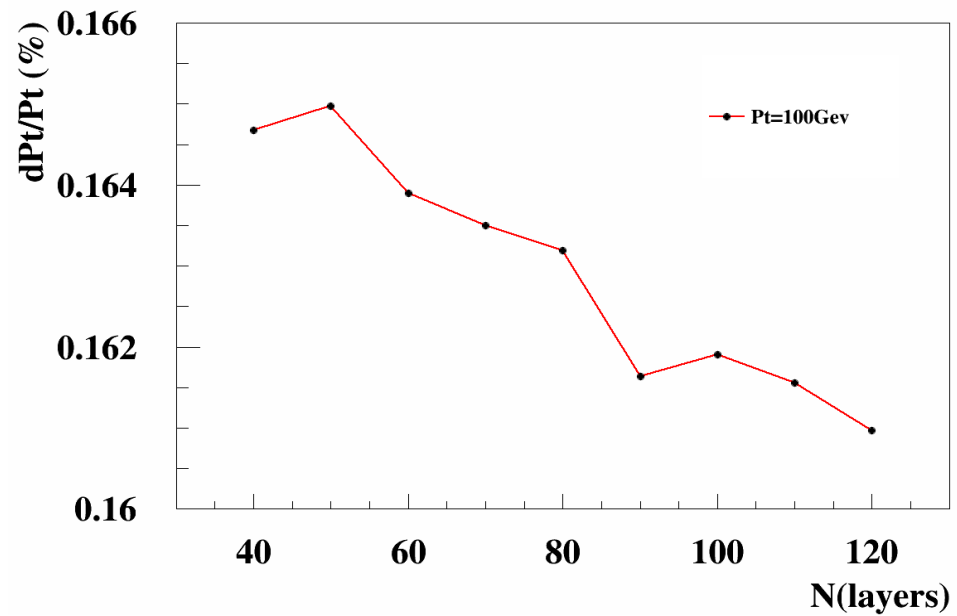
✓ consider multiple scattering



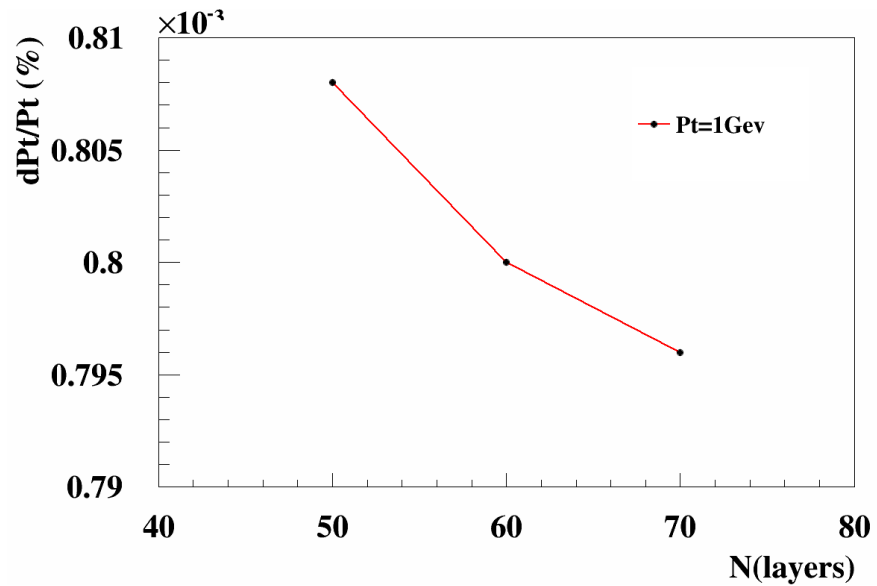
- ✓ consider multiple scattering
- ✓ The momentum resolution is positively correlated with the particle momentum and negatively correlated with the detector layers .



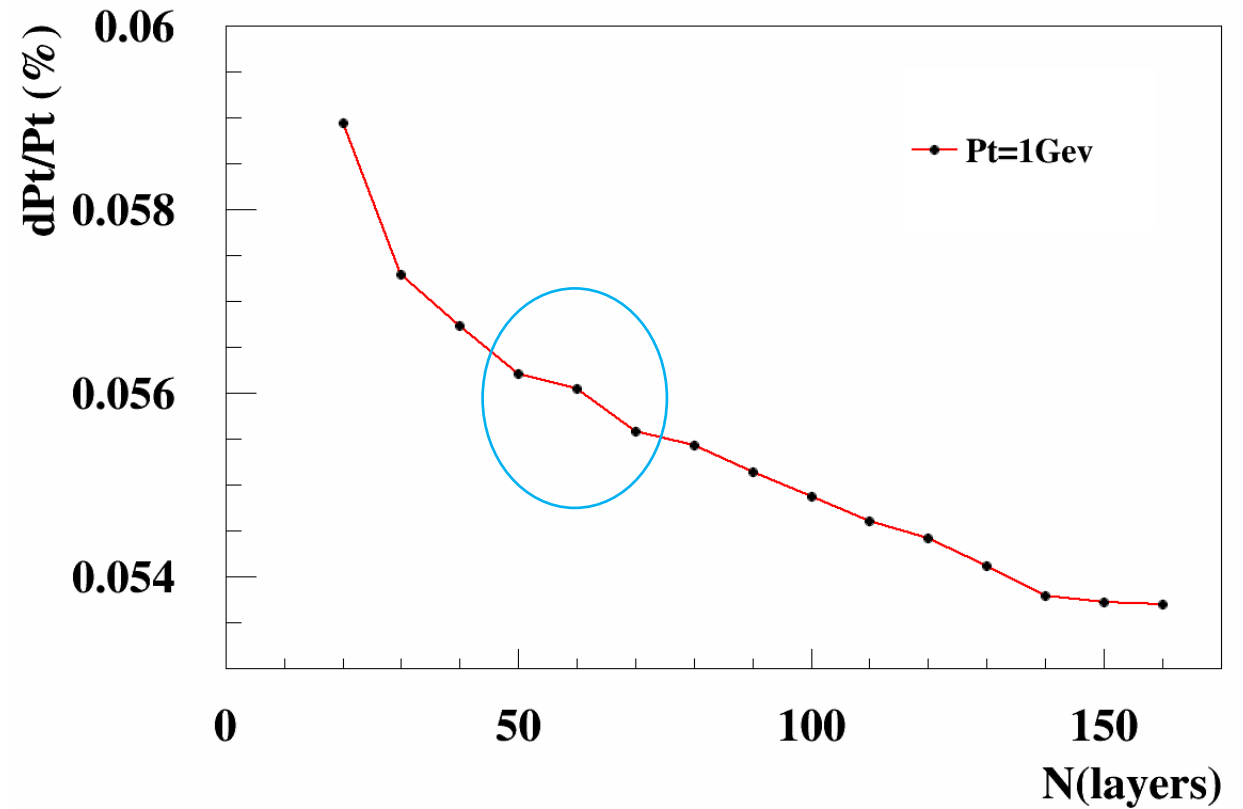
- With the increase of momentum value , it seems have the same variation trend as compared with regardless of multiple scattering.



- The momentum resolution becomes better with the increase of detector layers.



no multiple scattering



multiple scattering

summary

- The number of layers in DC should be set between 90 and 110.
- The momentum resolution becomes better with the increase of detector layers in DC , but in the high momentum region, the curve is not particularly smooth in some areas.

backup

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1 01 LiC Detector-Toy (barrel)
2 02 SDT-CEPC
3 03 Version:                20201012
4 04 Vertex Detector (VXD)
5 05
6 06 Number of layers        :      8
7 07 Description (optional)  :  |-Beamt. --|-----Vertex detector-----|
8 08 Names of the layers (opt.) :  XBT,      VTX1,    VTX2,    VTX3,      VTX4,    VTX5,    VTX6,    XVTXSHELL
9 09 Radii [mm]              :  14.5,    16.0,    18.0,    37.0,    39.0,    58.0,    60.0,    65.0
10 10 Upper limit in z [mm]   :  4225,    62.5,    62.5,    125,    125,    125,    125,    145
11 11 Lower limit in z [mm]   :  -4225,   -62.5,   -62.5,   -125,   -125,   -125,   -125,   -145
12 12 Efficiency RPhi         :  0,      1.0,    1.0,    1.0,    1.0,    1.0,    1.0,    0.0
13 13 Efficiency 2nd coord. (eg. z): -1
14 14 Stereo angle alpha [Rad] :  pi/2
15 15 Thickness [rad. lengths] :  0.0015, 0.0015, 0.0015, 0.0015, 0.0015, 0.0015, 0.0015, 0.0015
16 16 error distribution      :  0
17 17 0 normal-sigma(RPhi) [1e-6m] :  2.8, 6, 4.0, 4.0, 4.0, 4.0
18 18      sigma(z) [1e-6m] :  2.8, 6, 4.0, 4.0, 4.0, 4.0
19 19 1 uniform-d(RPhi) [1e-6m] :  4.0
20 20      d(z) [1e-6m] :  4.0
21 21
22 22 Silicon Inner Tracker (SIT)
23 23
24 24 Number of layers        :      5
25 25 Description (optional)  :  |-----Silicon Inner tracker-----|----TPC Inner Wall ----|
26 26 Names of the layers (opt.) :  SIT1,      SIT2,      SIT3,      SIT4,      XTPCW1
27 27 Radii [mm]              :  78.0,      318,      558.0,    798.0 ,    799.0
28 28 Upper limit in z [mm]   :  150.0,    750.0,    1300.0,    2900.0,    2900.0

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29	29	Lower limit in z [mm]	:	-150.0,	-750.0,	-1300.0,	-2900.0,	-2900.0
30	30	Efficiency RPhi	:	1.00,	1.00,	1.00,	1.0,	0.0
31	31	Efficiency 2nd coord. (eg. z):		-1				
32	32	Stereo angle alpha [Rad]	:	pi/2				
33	33	Thickness [rad. lengths]	:	0.0065,	0.0065,	0.0065,	0.0065,	0.002
34	34	error distribution	:	0				
35	35	0 normal-sigma(RPhi) [1e-6m]	:	7.2				
36	36	sigma(z) [1e-6m]	:	86.6				
37	37	1 uniform-d(RPhi) [1e-6m]	:	7.2				
38	38	d(z) [1e-6m]	:	86.6				
39	39							
40	40	Time Projection Chamber (DC)						
41	41	sigma^2=sigma0^2+sigma1^2*sin(beta)^2+Cdiff^2*6mm/h*sin(theta)*Ldrift[m]						
42	42	Number of layers	:	100				
43	43	Radii [mm]	:	800,1800				
44	44	Upper limit in z [mm]	:	2900				
45	45	Lower limit in z [mm]	:	-2900				
46	46	Efficiency RPhi	:	1				
47	47	Efficiency z	:	1				
48	48	Thickness [rad. lengths]	:	0.00003356				
49	49	sigma0(RPhi) [1e-6m]	:	100				
50	50	sigma1(RPhi) [1e-6m]	:	0				
51	51	Cdiff(RPhi) [1e-6m/sqrt(m)]	:	0				
52	52	sigma0(z) [1e-6m]	:	2828				
53	53	sigma1(z) [1e-6m]	:	0				
54	54	Cdiff(z) [1e-6m/sqrt(m)]	:	0				
55	55							
56	56	Silicon Tracker (SET)						
57	57							
58	58	Number of layers	:	2				
59	59	Description (optional)	:	TPC outer wall	-----External	Tracker-		
60	60	Names of the layers (opt.)	:	XTPCW2,	SET1			
61	61	Radii [mm]	:	1801.0,	1811			
62	62	Upper limit in z [mm]	:	2900,	2900			
63	63	Lower limit in z [mm]	:	-2900,	-2900			
64	64	Efficiency RPhi	:	0.0,	1.0			
65	65	Efficiency 2nd coord. (eg. z):		-1				
66	66	Stereo angle alpha [Rad]	:	pi/2				
67	67	Thickness [rad. lengths]	:	0.010,	0.0065			
68	68	error distribution	:	0				
69	69	0 normal-sigma(RPhi) [1e-6m]	:	7.2				
70	70	sigma(z) [1e-6m]	:	86.6				
71	71	1 uniform-d(RPhi) [1e-6m]	:	7.2				
72	72	d(z) [1e-6m]	:	86.6				
73	73							
74	74	Magnetic field and beam spot						
75	75							
76	76	Solenoid magnetic field [T]	:	3.0				
77	77	Range in x [mm]	:	-0.0	0.0			
78	78	Range in y [mm]	:	-0.0	0.0			
79	79	Range in z [mm]	:	-0.0	0.0			
80								