Status and problems in tracker optimization

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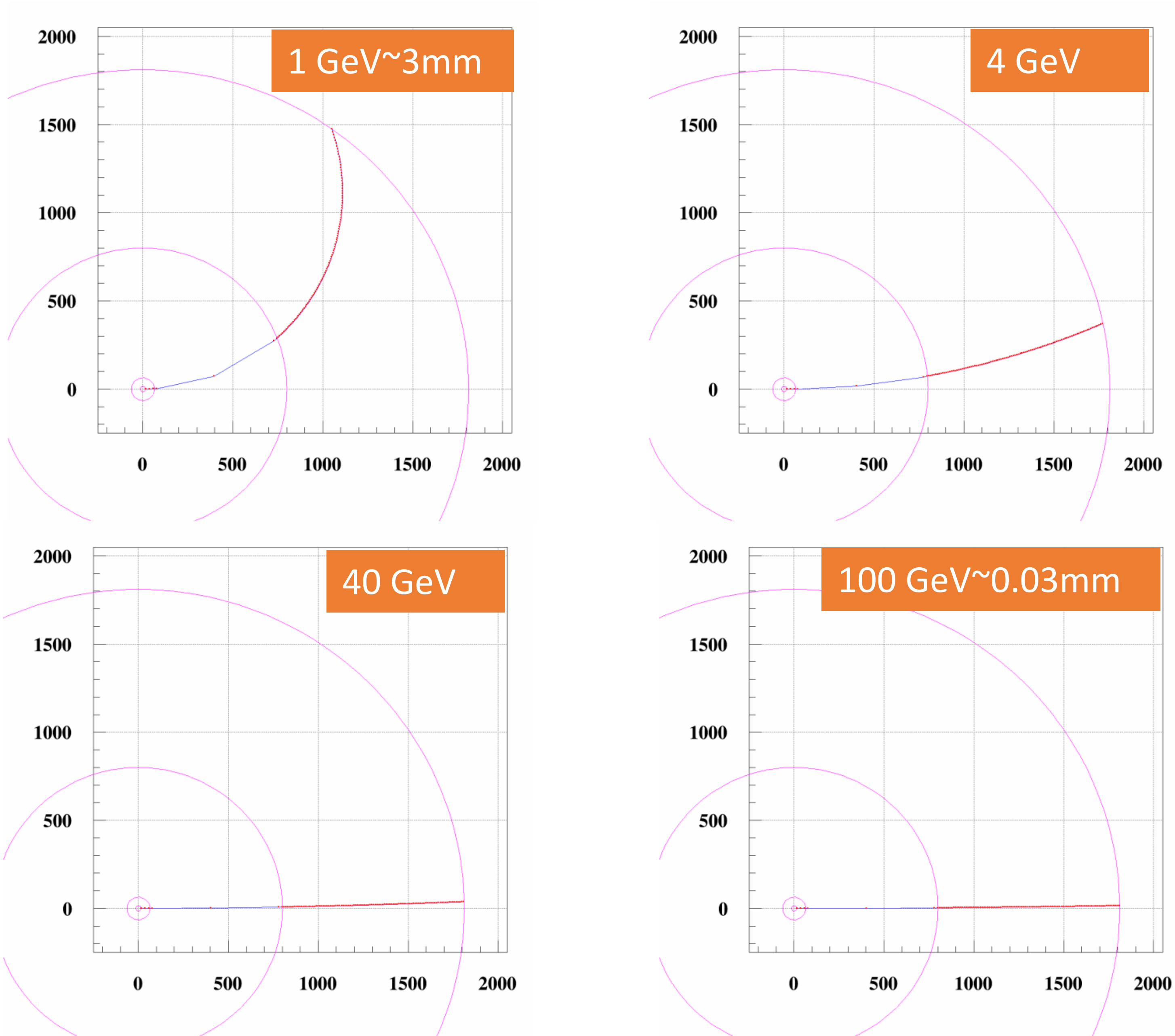
Sep. 9th, 2021

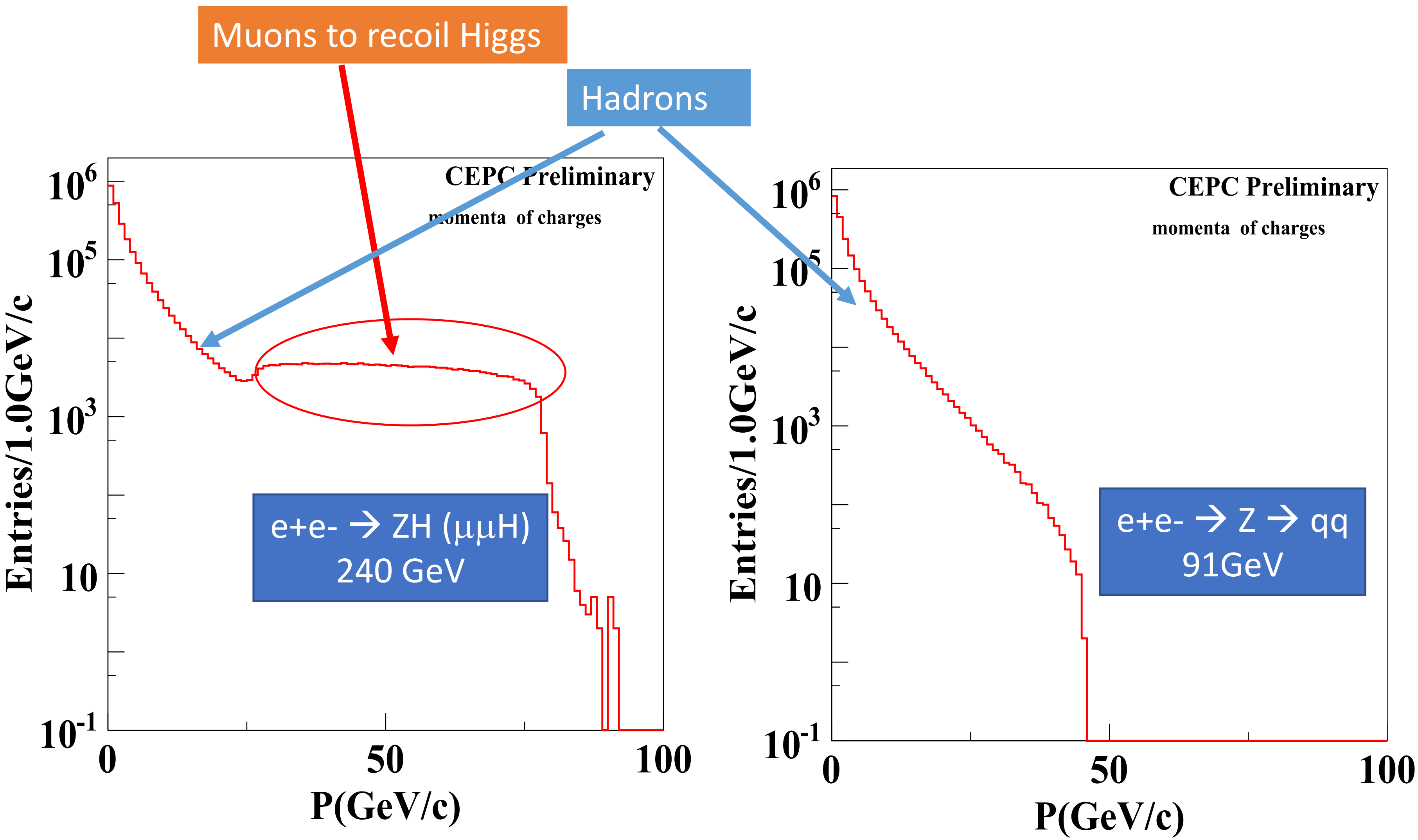
PID tracker

- ✓ The tracker must meet the requirements of
  - ☐ EW precision physics : jet energy resolution, tagging, …
  - ☐ Flavor study: narrow resonances
- ✓ To achieve the best performances for both PID & tracking
  - ☐ Tracker volume, # of layers, layout, and so on
- ✓ To optimize tracker according to *p* and *impact parameter* measurement
  - ☐ Spatial resolution
  - ☐ Multiple scattering
  - ☐ Layout of tracker layers

Tracks and spatial spread due to MS



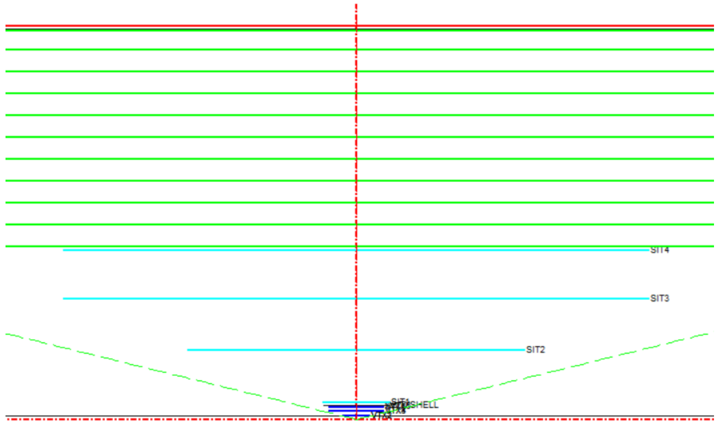
Momentum distributions @ 240 & 91 GeV



Tracking system

From Xin's Yangzhou talk, starting point

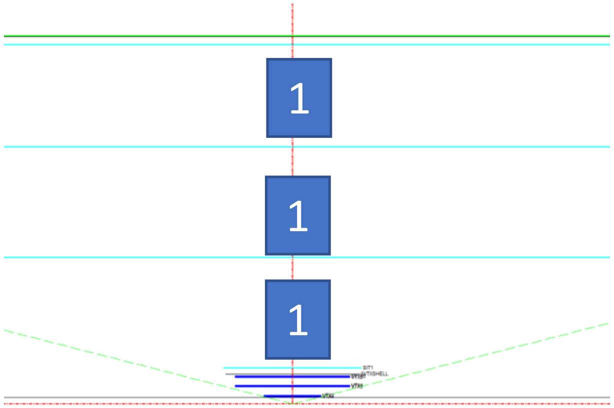
Sub detector	N layers	Resolustion (μm)		Material budget (%X_0)
		r-ϕ	z	
VXD	6	2.8 / 6 / 4 / 4 / 4 / 4	2.8 / 6 / 4 / 4 / 4 / 4	0.15 per layer
SIT	4	7.2	86.6	0.65 per layer
DC (cell 1x1cm^2)	100	100	2000	1.2
SET	1	7.2	86.6	0.65
Total	111	--	--	5.35

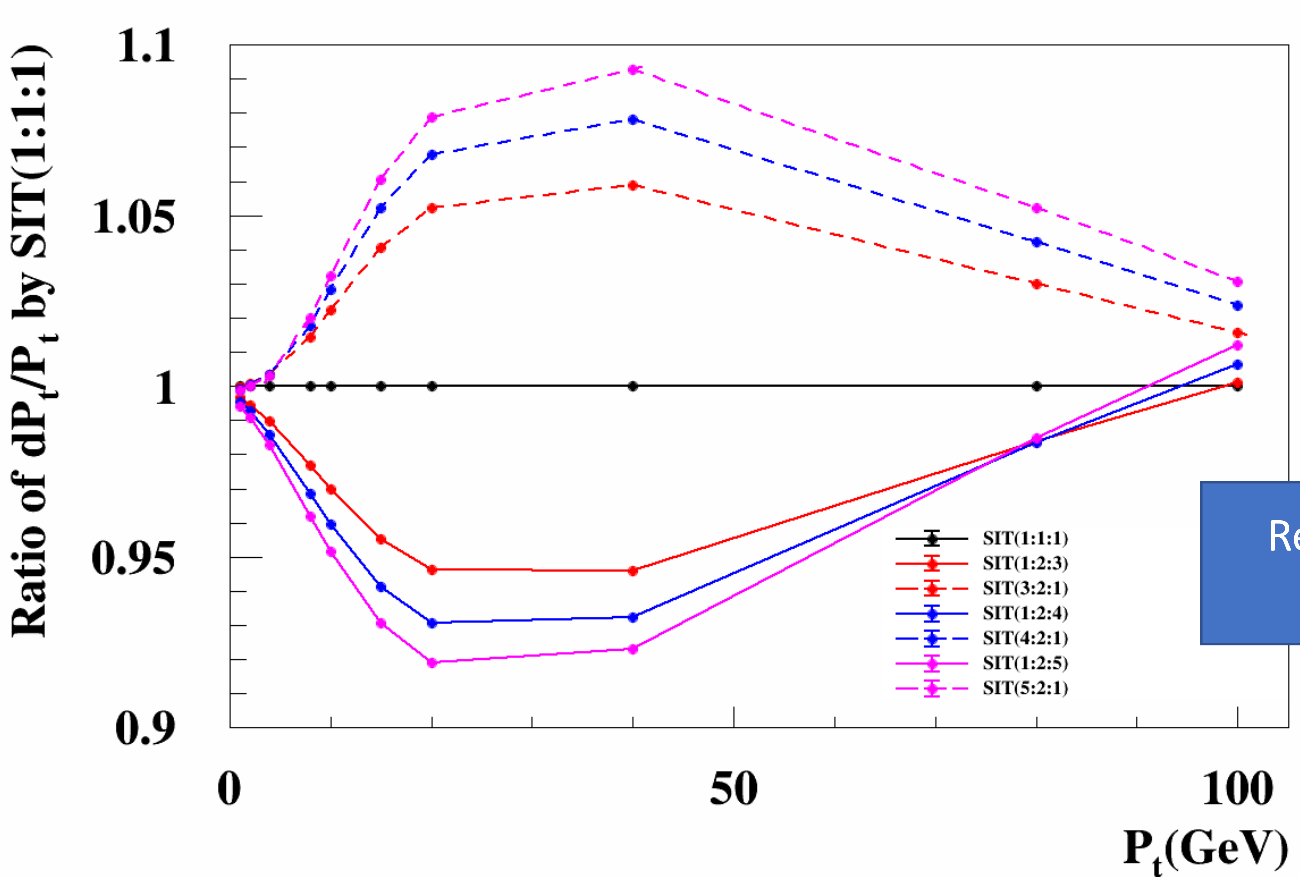


- VXD keeps unchanged
- 4 SITs
- δR of the DC =1 m
- 1 SET

Optimize SIT layout

- Layers at 78 and 800mm fixed
- Only two layer can move
- Better resolution if layers approach beamline

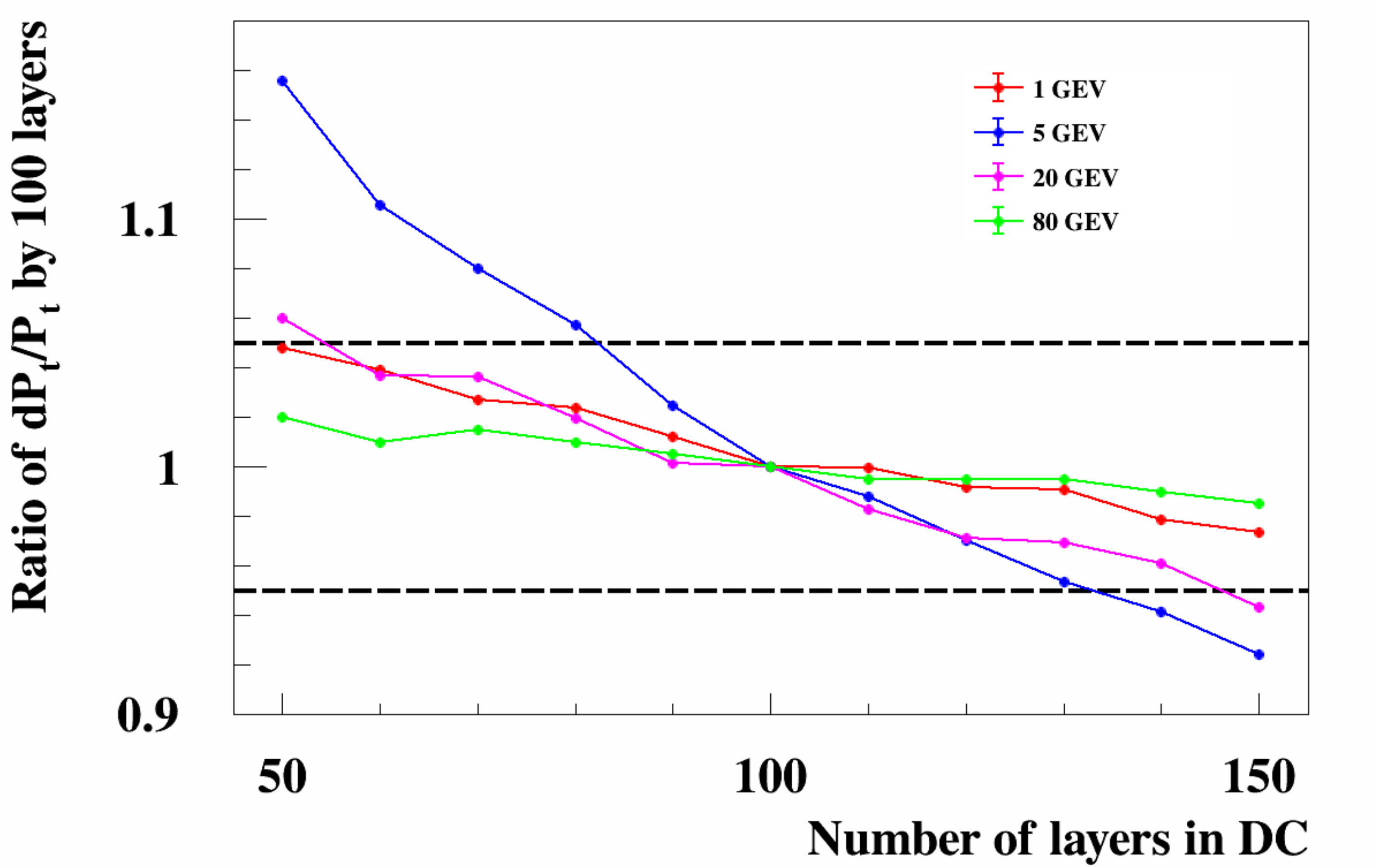




Recommendation: 1:2:4

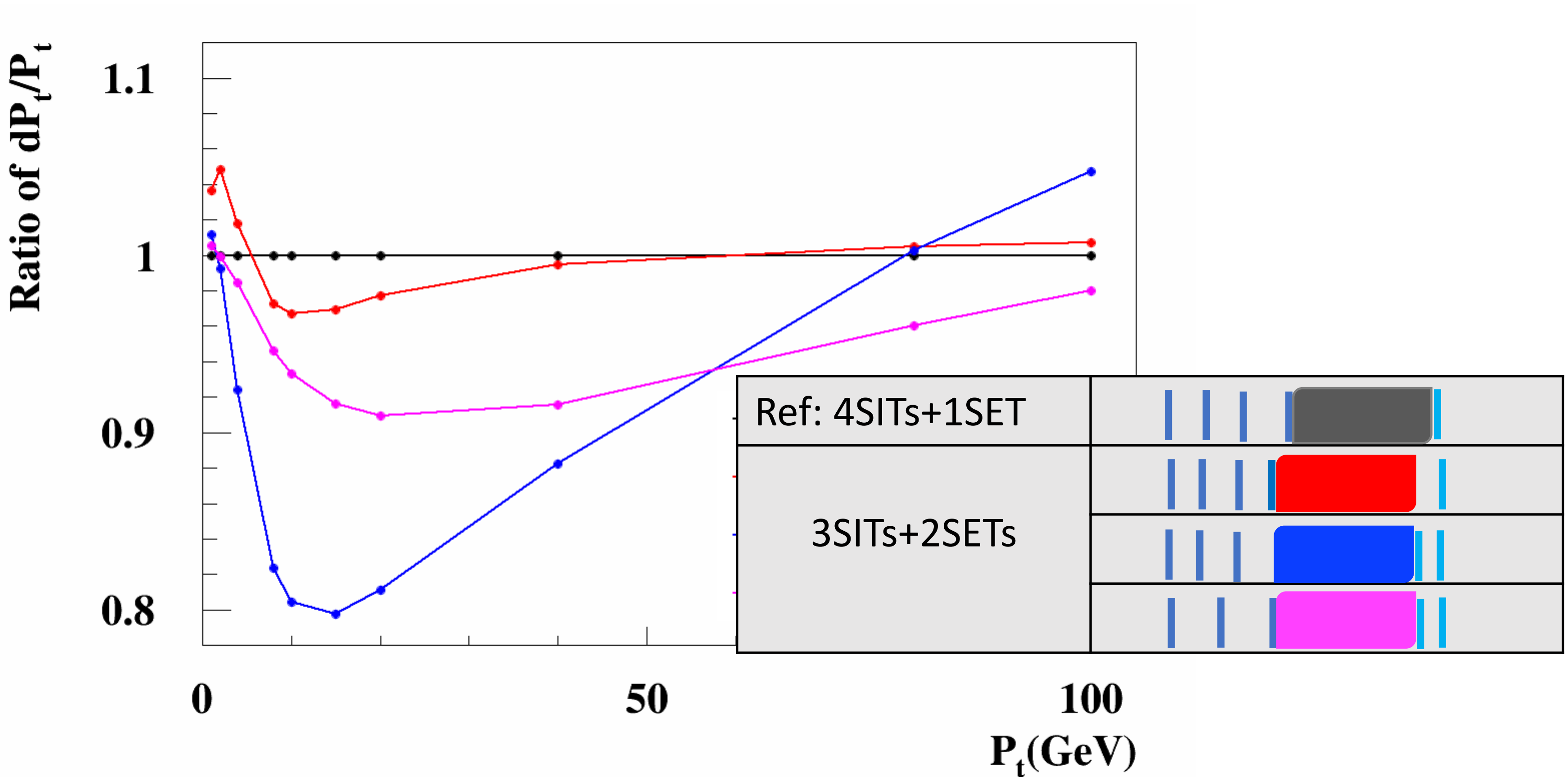
Optimize # of DC layers

- $X_{in}=0.2\%X_0$, $X_{out}=1\%X_0$
- $X_{gas}=0.0034\%X_0$ averaged by # of layers
- 80-120 layers: changes within 5%
- 5 GeV tracks more sensitive: more or less hits matter



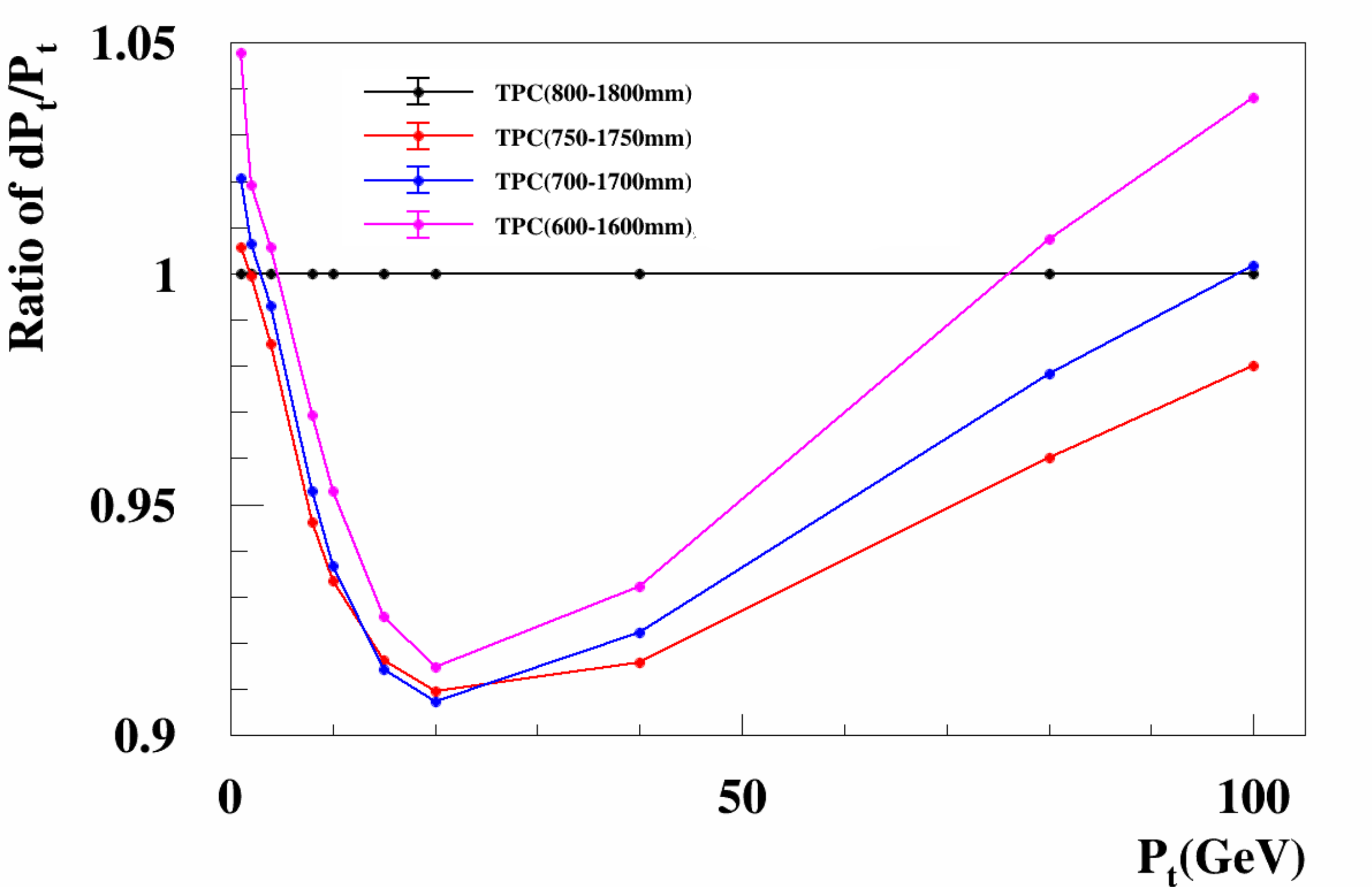
3 SITs and 2 SETs

- 1 layer SIT moved outside DC improve momentum resolution
- 5-10% improvement



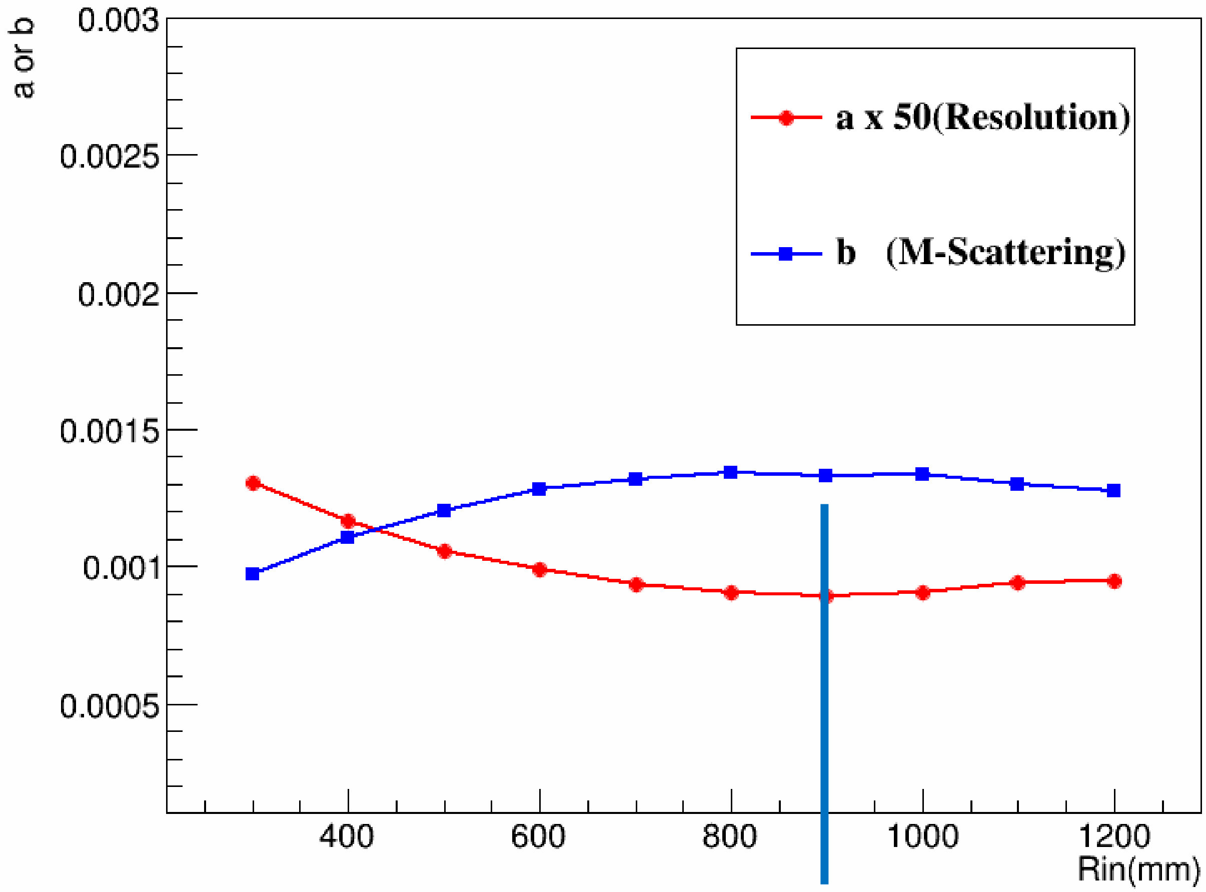
Position of DC for 3 SITs & 2SETs， δR fixed to 1000 mm

- DC as far as possible from beamline
- Overall improvement, especially for 10-40 GeV



thickness (# of layers) or inner radius of DC

- Changes of the inner radius of DC (Thickness of DC)
- The X of gas taken into account, 1 cm cell (depends on δR)
- Favors smaller inner radius if X taken into account, b is the dominant term for momentum measurement



The a consistent with Linghui' s study

Some conclusion

- Some preliminary conclusions
  - SIT layers favor to be near to beamline except the two fixed layers
  - 3 SITs + 2 SETs gets better p resolution
  - DC tends to be far from beamline if δR fixed
  - DC favors lager δR, i.e, more layers within 4SITs+1SET scheme

Updates of DC parameters from Mingyi

R (mm)	L of wires(mm) (cosθ=0.83)
1800	5356.8
1750	5208.0
1700	5059.2
1600	4761.6
1500	4464.0
800	2380.8

cell size(mm^2)	# of layers	# of Cells	T_S （10^3 kg）	T_F （10^3 kg）
10x10	100	81 682	14.8	47.4
15x15	67	36 303	6.6	21.1
18x18	56	25 210	4.6	14.6
20x20	50	20 420	3.7	11.8

R extension	800-1800 mm
Inner wall	0.2 mm (X/X0=0.00104)
Outer wall	2.6 mm (X/X0=0.01346) (averaged results)
Diameter of field wire	50μm (Gold-plated Aluminum) (X/X0=0.0036 for 10x10 cell)
Diameter of signal wire	20μm (Gold-plated Tungsten) (X/X0=0.0026 for 10x10 cell)
Square cell（F:S = 3:1）	BESIII-Like MDC
Cell size	10, 15, 18, 20 mm
Longest wire （cosθ=0.83）	5357mm
Gas：He/iC4H10	He/iC4H10=80:20

- 0.000116 / each layer vs. 0.000054 for 10x10 cell
- 0.000123 / each layer vs. 0.000081 for 15x15 cell
- 0.000139 / each layer vs. 0.000108 for 20x20 cell