

# CPEC Tracking System Optimization

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# The start point

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beam tube

0 -- 14.5 mm

shell : 14.5 mm, thickness : 0.0015  
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VTX

16 -- 60 mm

6 layers thickness : 0.0015

sigma(Rphi) 2.8, 6.0, 4.0, 4.0, 4.0, 4.0

sigma(z) 2.8, 6.0, 4.0, 4.0, 4.0, 4.0

shell : 65 mm, thickness : 0.0015  
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SIT

78 -- 798 mm

4 layers thickness : 0.0065

sigma(Rphi) 7.2

sigma(z) 86.6  
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DC

800 -- 1800 mm

100 layers

total thickness of gas : 0.003356

sigma(Rphi) 100

sigma(z) 2828

shell-1 : 799 mm, thickness : 0.002

shell-2 : 1801 mm, thickness : 0.01  
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SET

1811 mm

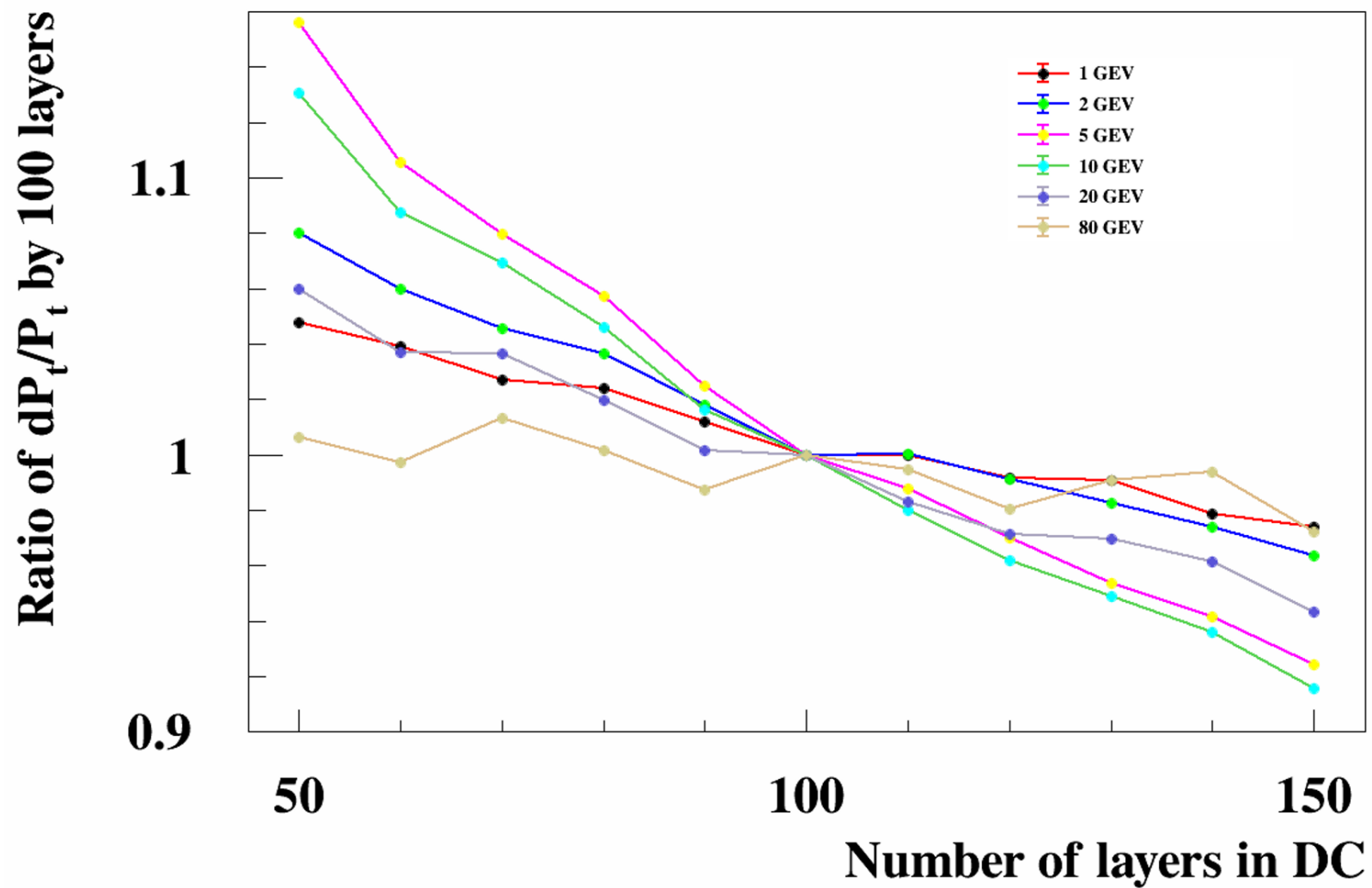
thickness : 0.0065

sigma(Rphi) 7.2

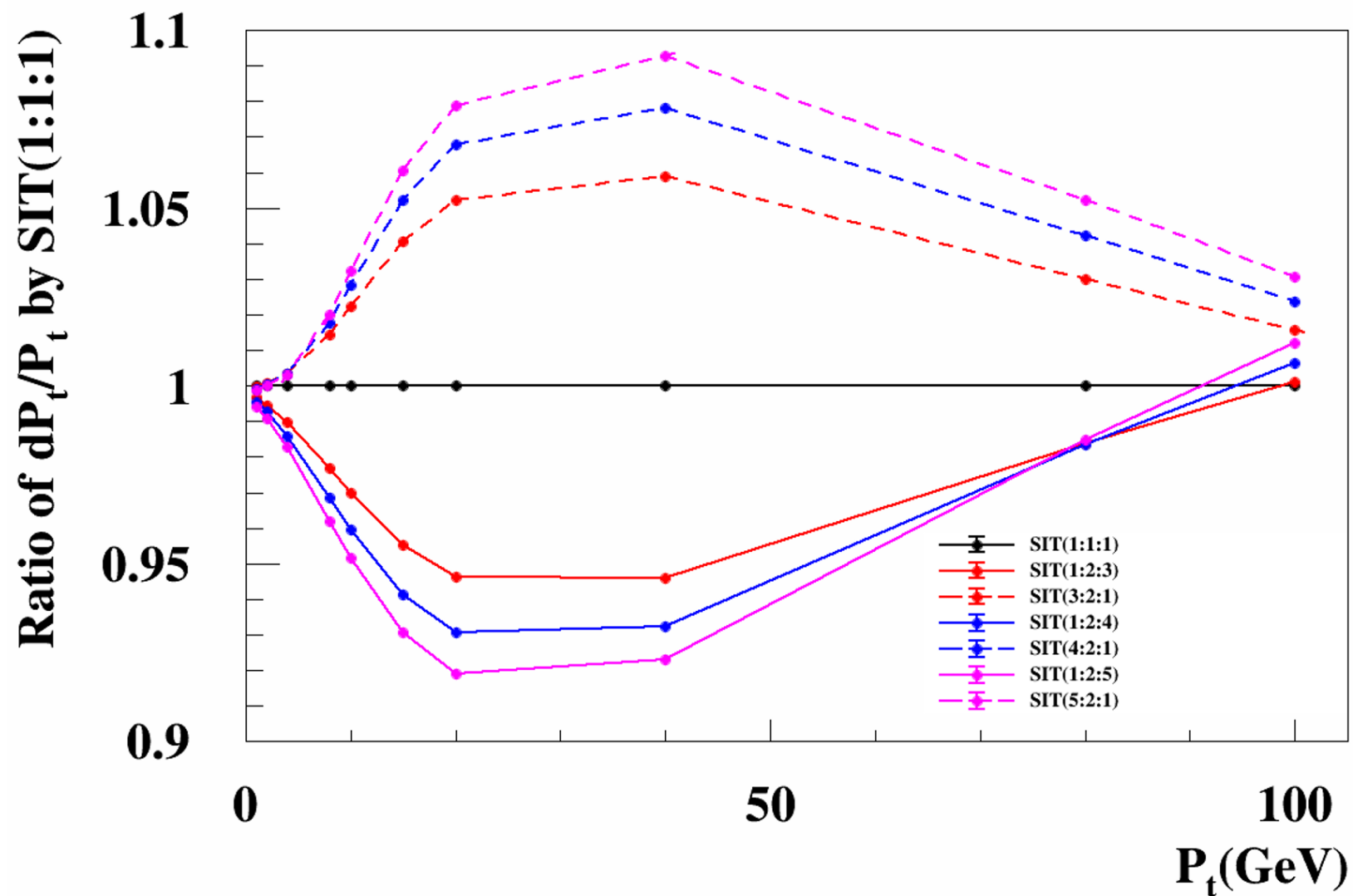
sigma(z) 86.6  
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Magnetic Field : 3.0 T  
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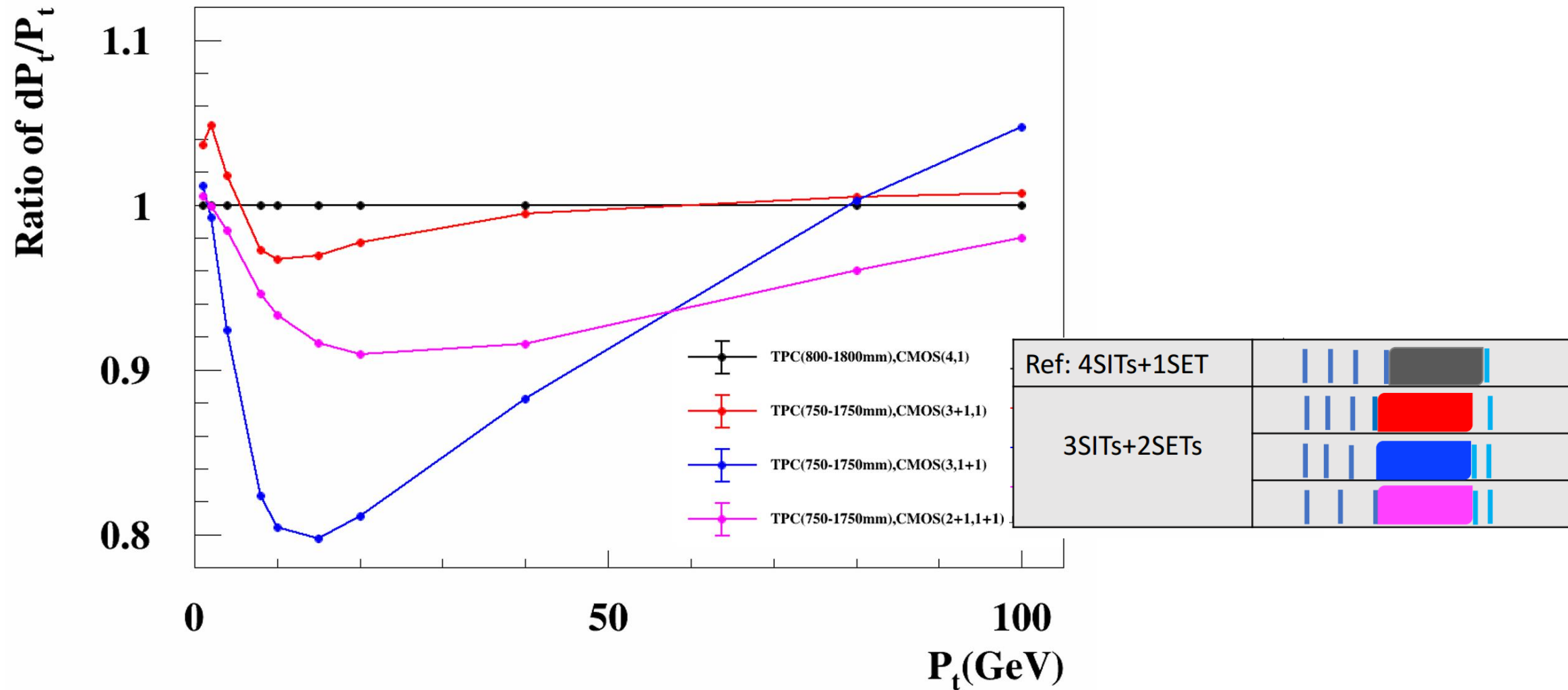
# 1. DC layers



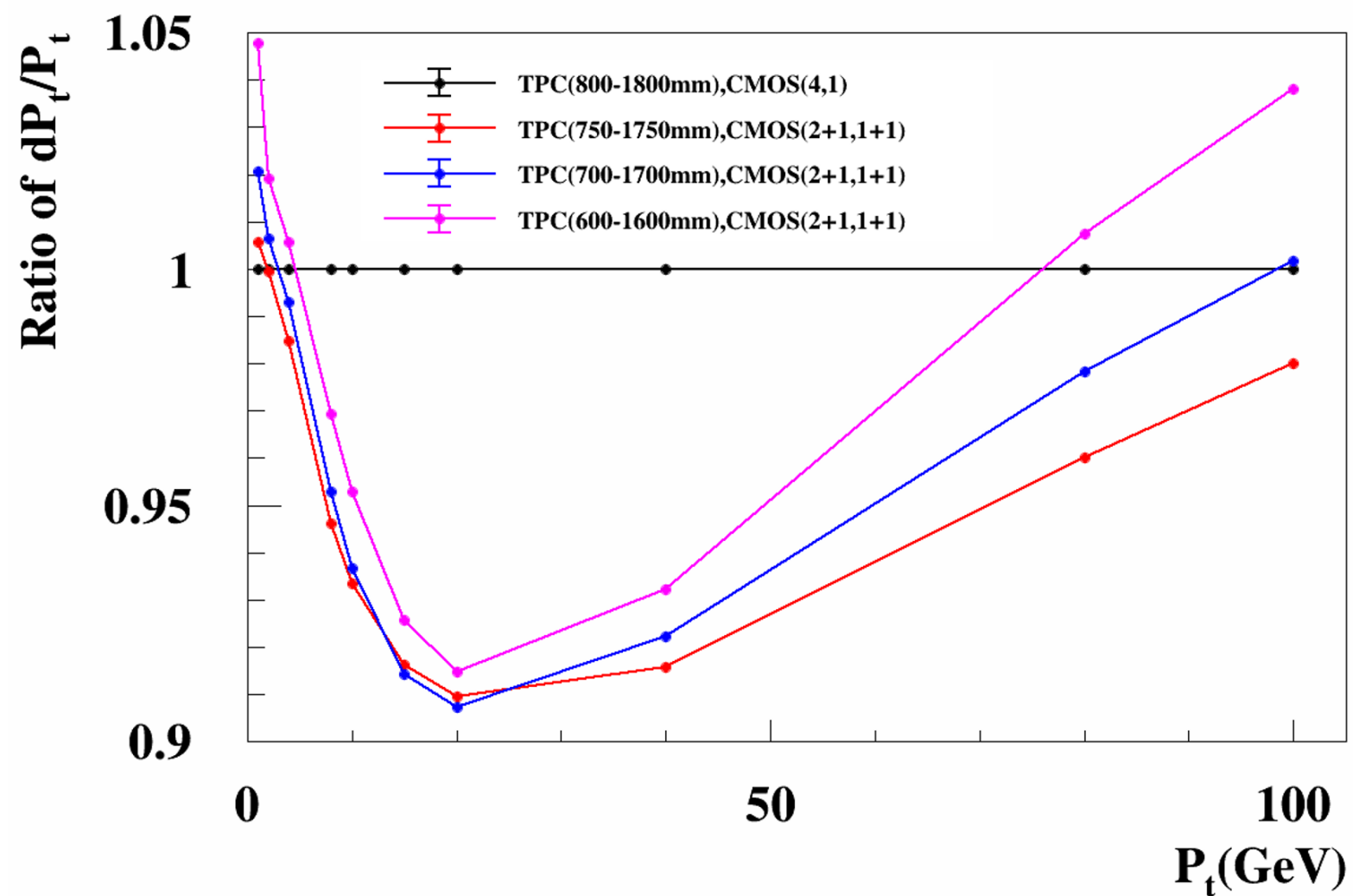
## 2. Space distribution of 4 SITs



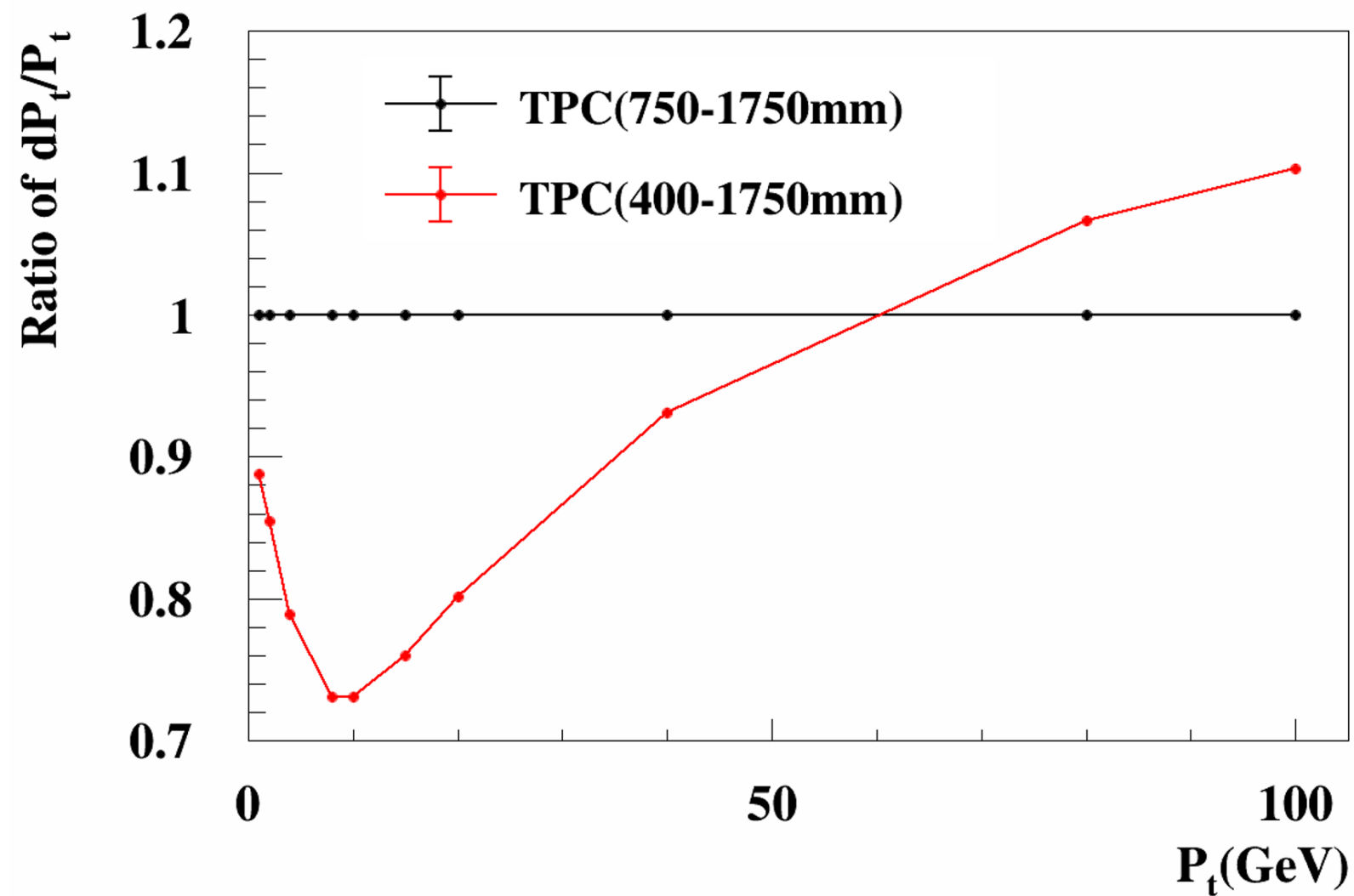
### 3. Change 1 SIT to be 1 SET



### 3. Change 1 SIT to be 1 SET



## 4. Size of DC



# Conclusion

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$$\chi^2 = \sum_{i=1}^N \left( \frac{x_m^i - x_{fit}^i}{\sigma_i} \right)^2$$

$\chi^2$  -- least square method parameter

$i = 1 \sim N$  -- number of detector layers

$x_m^i$  -- the position of measurement

$x_{fit}^i$  -- the position of track fitting

$\sigma_i$  -- the deviation of detector  $i$



# Conclusion

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$\sigma_i$  not only represents the deviation of measurement, but also contains the uncertainty of track itself.

$$\sigma = G(\sigma_{mear}, \sigma_{track})$$

When **the momentum is low**, track is affected by the multiple scattering much. With leaving the beam tube further, this condition could satisfy much better.

$$\sigma_{track} \gg \sigma_{mear} ; \sigma = \sigma_{track}$$

It is bad to put much measurement at big radius position, which explains why above tight to beam tube design is much better. Under this assumption, if the number of SET could be changed from one to two, it almost satisfy.

$$\sigma_{SET} = \frac{\sigma = G(\sigma_{mear}, \sigma_{track})}{\sqrt{2}} = \frac{\sigma_{track}}{\sqrt{2}}$$

That is why two SETs could take better momentum resolution than one SET, but this idea can not be replaced by one SET with better measurement resolution because the main factor is  $\sigma_{track}$  not  $\sigma_{mear}$ .

When the **momentum is high**, track is affected by the multiple scattering little.

$$\sigma_{mear} > \sigma_{track}$$

Under this assumption, it is better to put these detectors in the whole space not focus on which single area, which is corresponding to the trend of the above curves that the strand model becomes better relatively with momentum becomes higher.

# Conclusion

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1. There shall be only 1 SET, so the external radius of DC should be around 1800 mm ;
2. Though the cell size of DC has be changed according to new parameters from device group and we did not consider the material budget of wires, the general results of number of DC layers and size of DC would be almost same ;
3. Not only the DC size but also the space distribution of four SITs depend on which momentum range we take care of mostly. If that is low momentum, the four SITs would better be put near the VTX and there could be a big DC, while if that is high, the four SITs should better be put in an average and more space, which means the DC size must be changed to be less.

*All research results by now are based on LDT software and we appreciate it.*

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Thanks