Cluster counting sampling in CEPCSW

Shuiting Xin

Jan 4.2021

Introduction

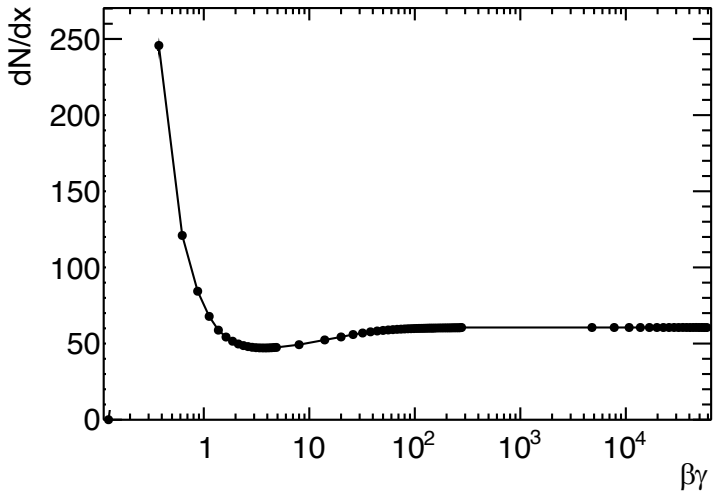
- ❖ Cluster counting methods have shown potential improvement on PID based on Garfield
- ❖ Implement dN/dx in CEPCSW

Thanks Wenxing and Tao for providing interface !

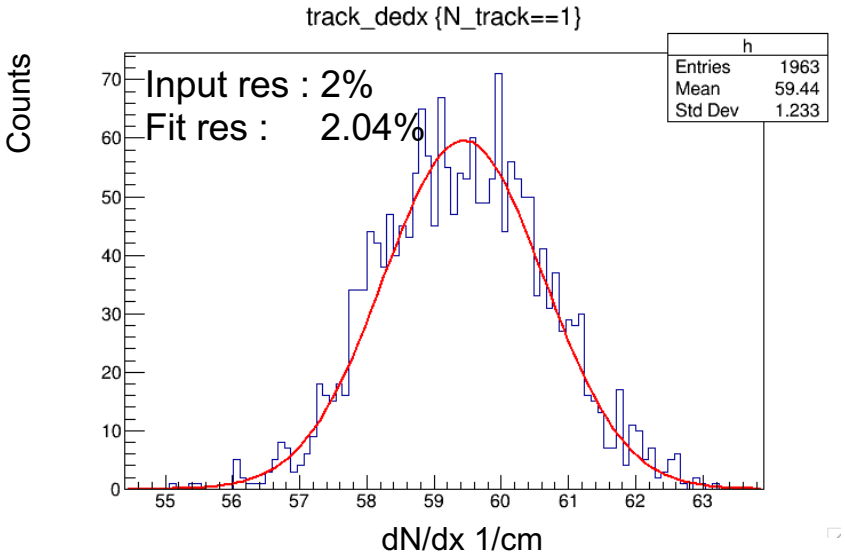
  - ◇ At track level, sampling μ and σ from expected curve of dN/dx mean and sigma, $\frac{dN}{dx} = Gaus(\mu, \sigma)$.
  - ◇ Assume a TOF detector at R=1.8m, time resolution = 20ps, calculate flight time using truth particle.
  - ◇ PID analysis combining dN/dx and TOF information

Step 1 dN/dx sampling

❖ Input : truth particle $\beta\gamma$



Expected mean from Garfield Simulation



Output: 10GeV pion, cos(theta)=0

❖ $\frac{dN}{dx} = Gaus(\mu, \sigma)$, where

◇ $\sigma = 1\%$ the prefect counting

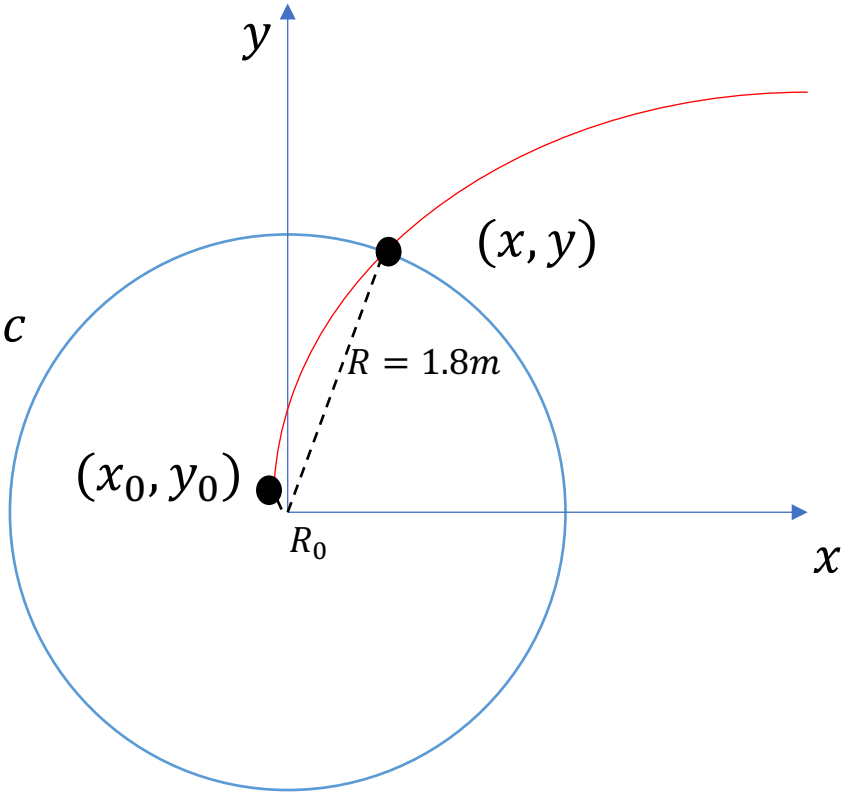
◇ $\sigma = 2\%$ some degradation scenario

Step 2 TOF

$$L = s\big((x_0, y_0) \rightarrow (x, y)\big)$$

$$t_{truth} = \frac{L}{v}, v = \frac{p_T}{\sqrt{p_T^2 + m^2}}c$$

$$tof = Gaus(t_{truth}, \sigma)$$

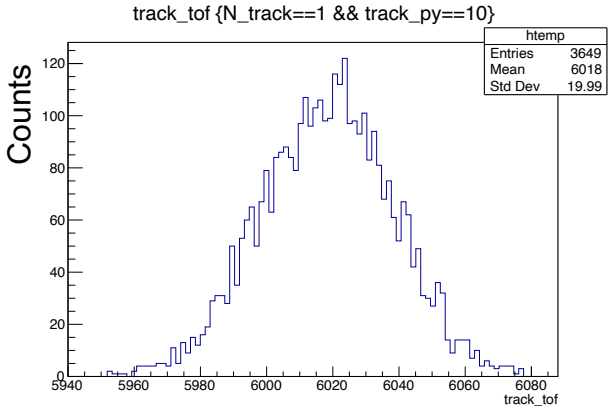


R-phi plane

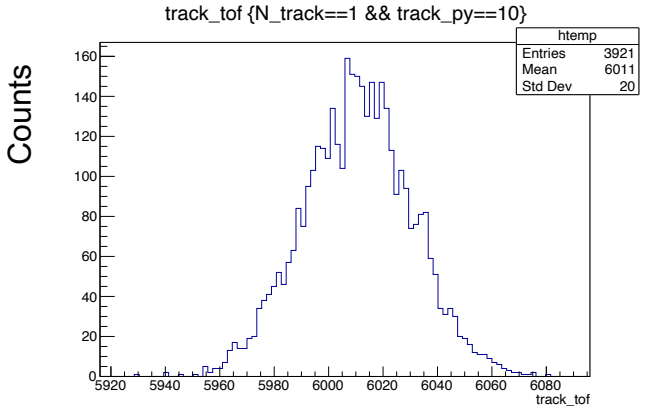
- Obtain flight time using truth track
- A TOF detector provides 20ps time resolution

Step 2 TOF

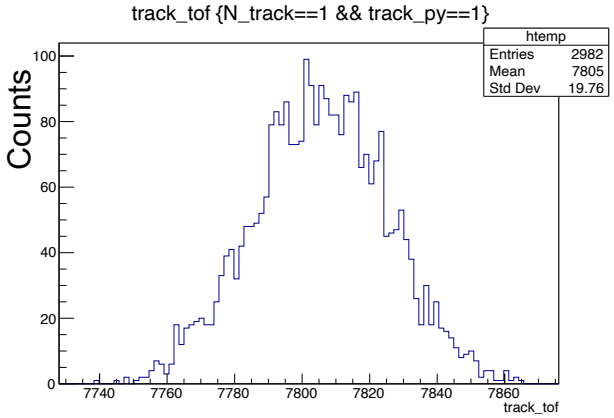
❖ TOF distribution



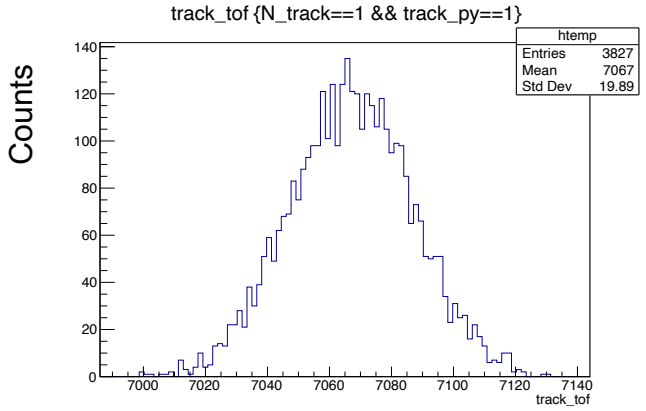
10 GeV kaon



10 GeV pion



1 GeV kaon



1 GeV pion

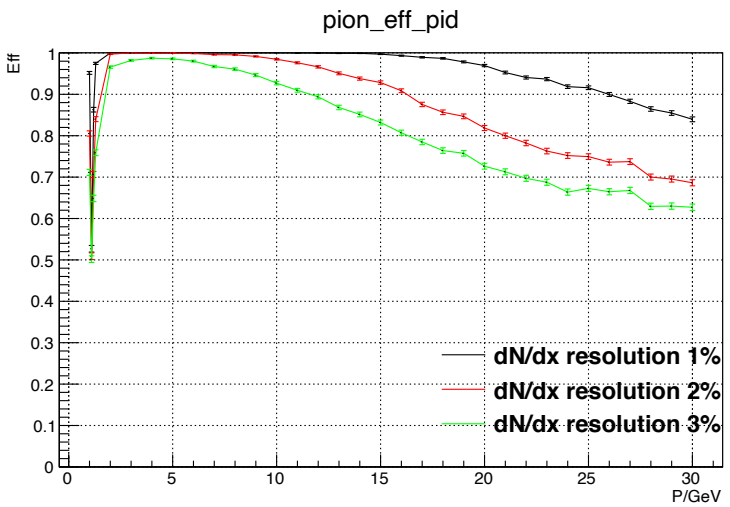
Step 3 PID efficiency

❖ Probability

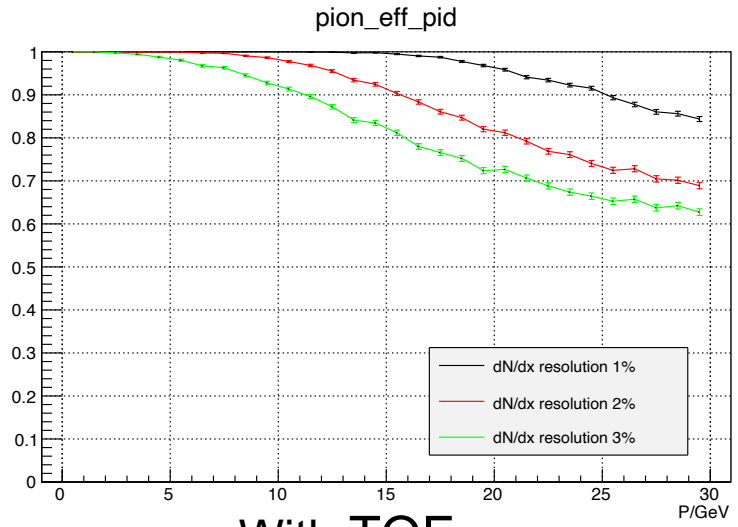
◇ $\chi^i = \sqrt{{\chi^i}_{cls}^2 + {\chi^i}_{tof}^2}, \chi^{\mathrm{i}}_{cls} = \frac{dN/dx - N^i(exp)}{\sigma_{cls}}, \chi^{\mathrm{i}}_{tof} = \frac{tof - T^i(exp)}{\sigma_t}$

◇ $i = (e, \mu, \pi, K, P)$

◇ $Prob^i$: probability for χ^2 with $N_{dof} = 2$



Without TOF

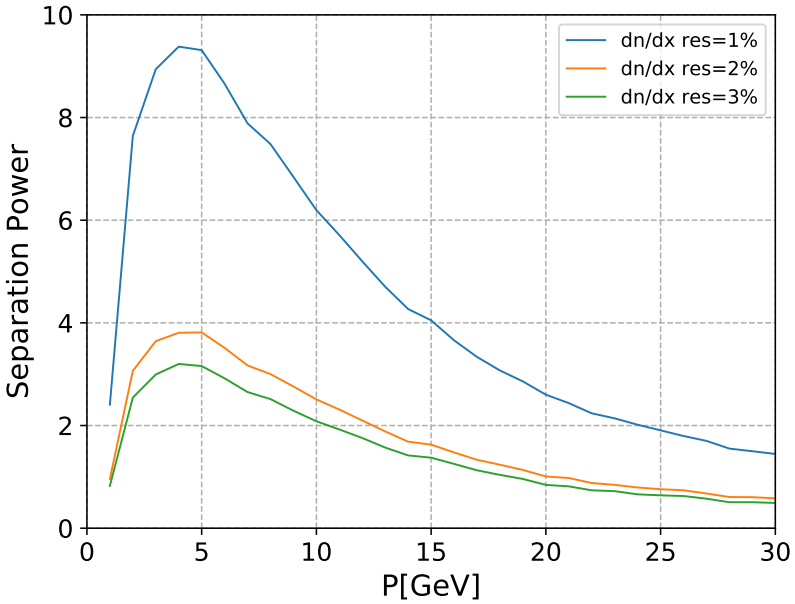


With TOF

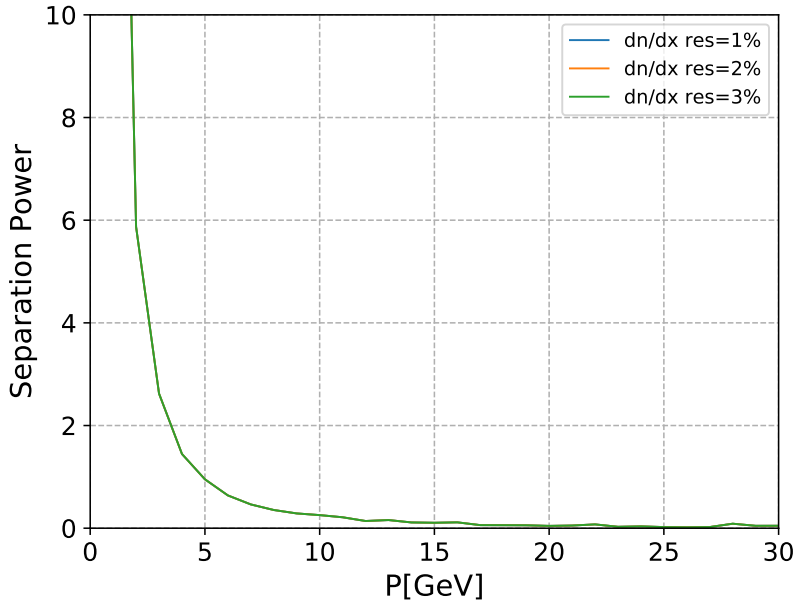
❖Pion efficiency : $Prob^{\pi} > Prob^{K}$

Summary

- A dummy method for dN/dx sampling is established
- Next step: Check separation performance



dN/dx only



TOF only