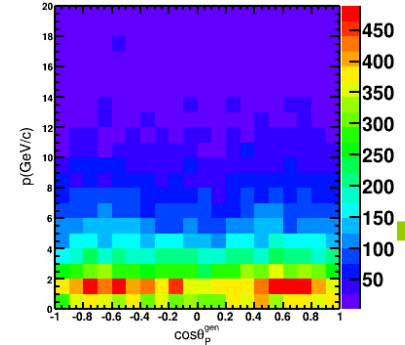
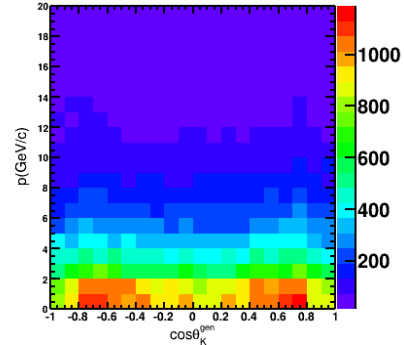
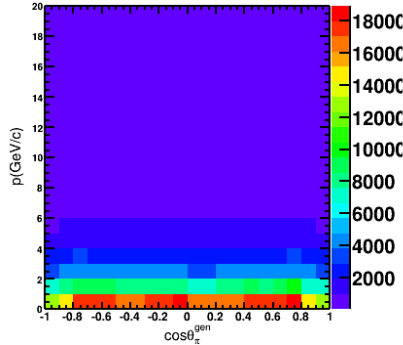
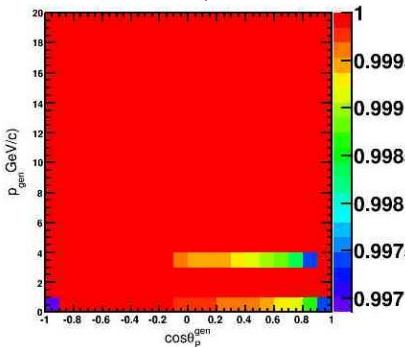
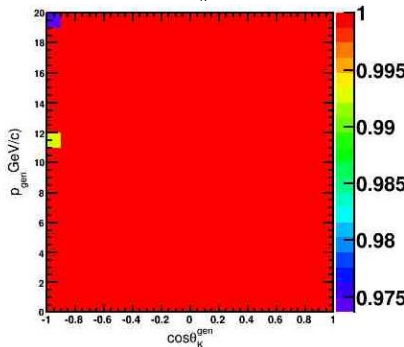
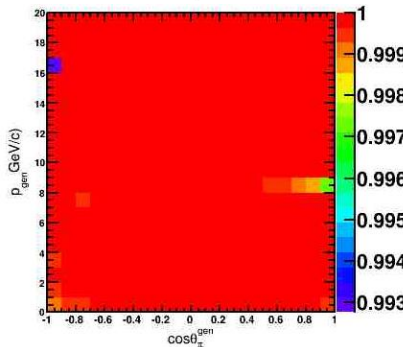


# PID efficiency study

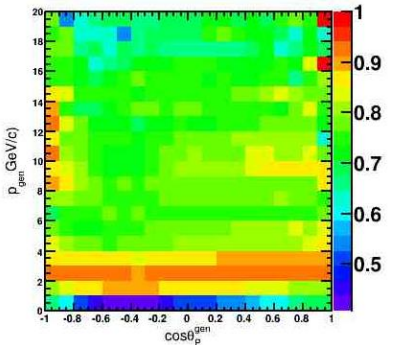
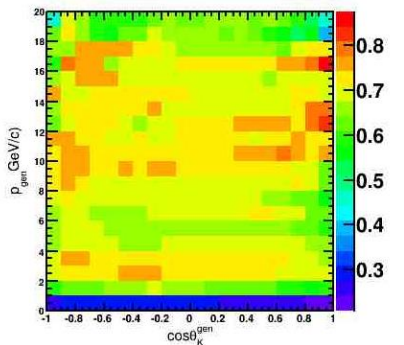
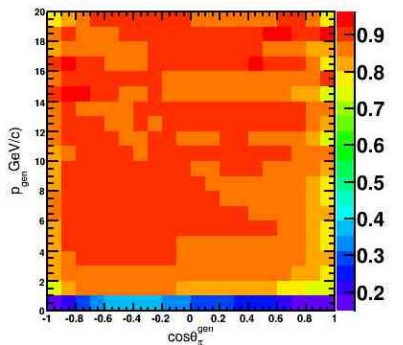
- ❖ Perform efficiency study in physical process  $Z \rightarrow qq$ 
  - Calculate efficiency and purity in all phase space using minimum  $\chi^2$  PID
- ❖ Samples used
  - Release version: CEPCSW\_tdr24.10.0
  - $Z \rightarrow qq$  40000 events (truth  $\pi$ :  $K$ :  $p$  = 744817: 95485: 39553)



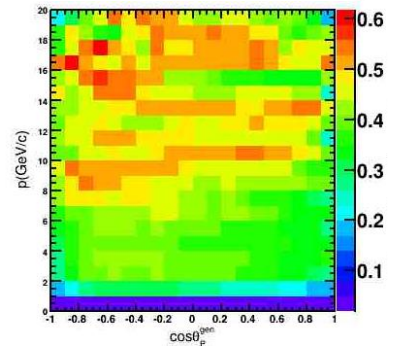
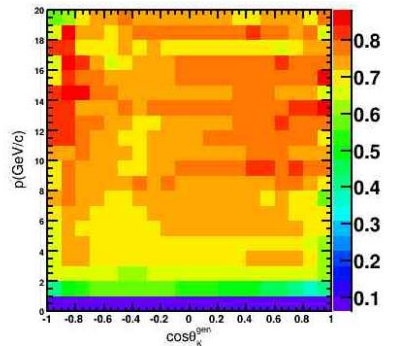
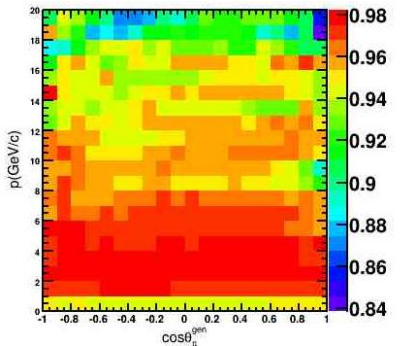
❖ Phase space  
 $(p_{gen}, \cos\theta_{gen})$   
 0-20GeV



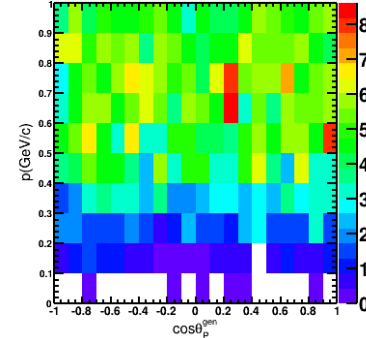
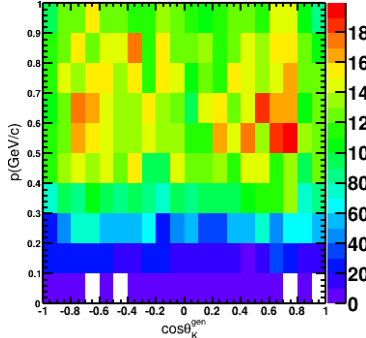
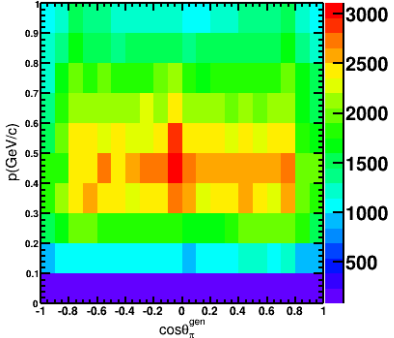
❖ Track efficiency  
 distribution of truth  
 $\pi/K/p$  (have  $dN/dx$  or  $t$ )



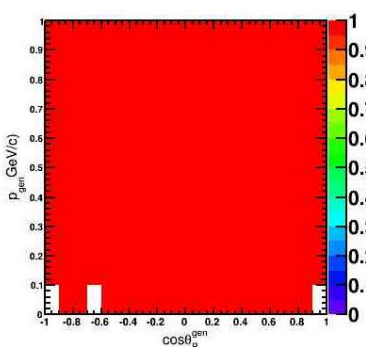
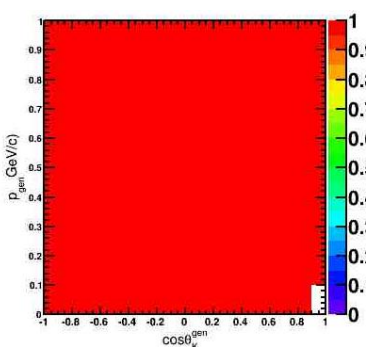
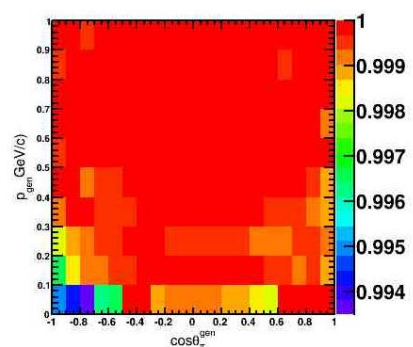
❖ PID efficiency  
 distribution of truth  
 $\pi/K/p$  (minimum  
 combined  $\chi^2$ )



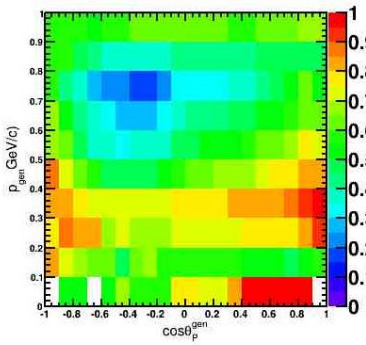
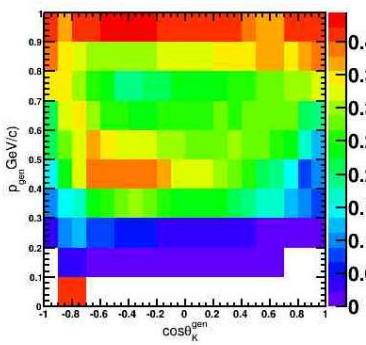
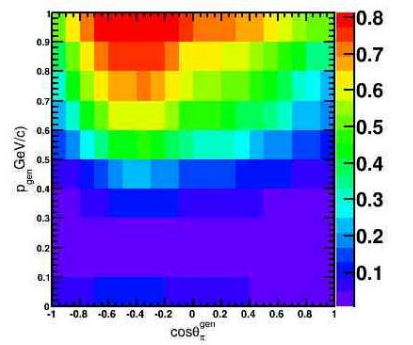
❖ Purity distribution of  
 truth  $\pi/K/p$



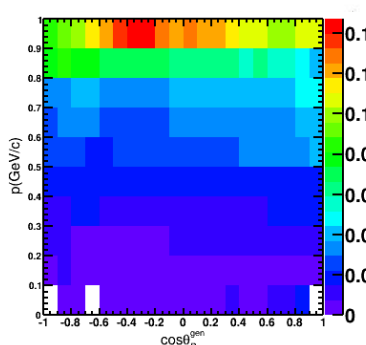
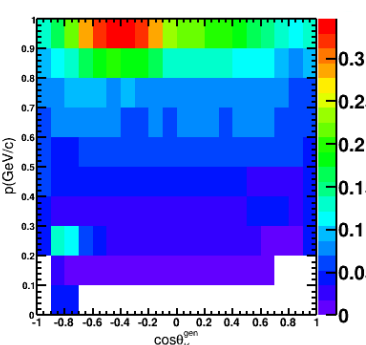
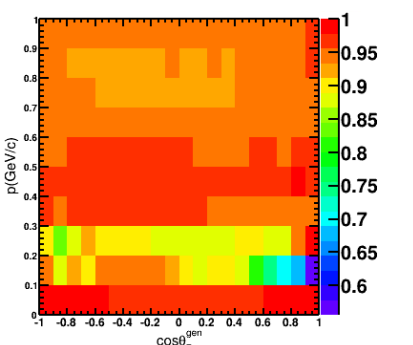
❖ Phase space  
 $(p_{gen}, \cos\theta_{gen})$   
 0-1GeV



❖ Track efficiency  
 distribution of truth  
 $\pi/K/p$  (have  $dN/dx$  or  $t$ )

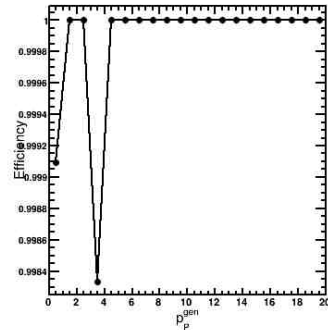
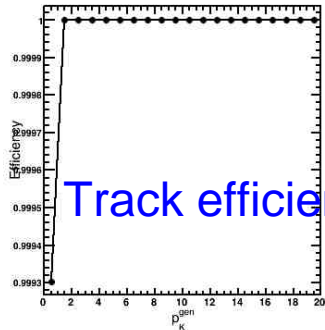
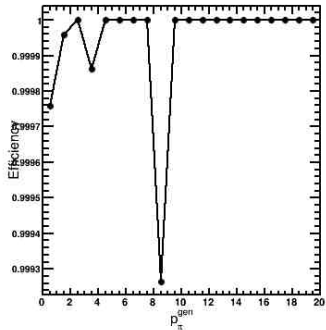


❖ PID efficiency  
 distribution of truth  
 $\pi/K/p$  (minimum  
 combined  $\chi^2$ )

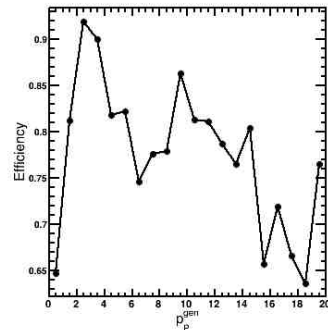
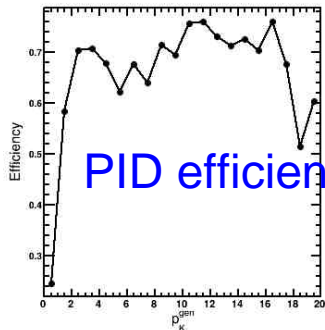
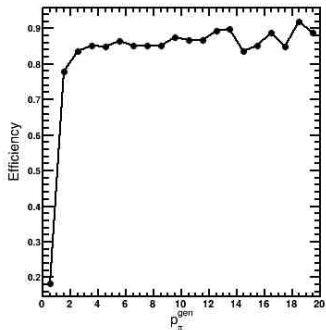


❖ Purity distribution of  
 truth  $\pi/K/p$

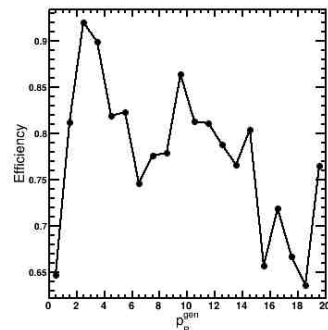
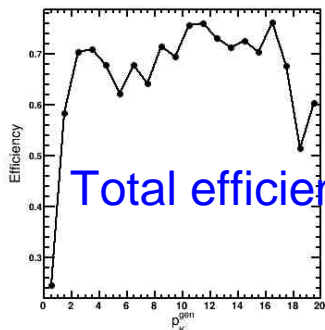
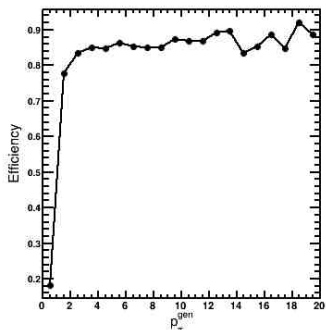
# PID efficiency comparison



Track efficiency

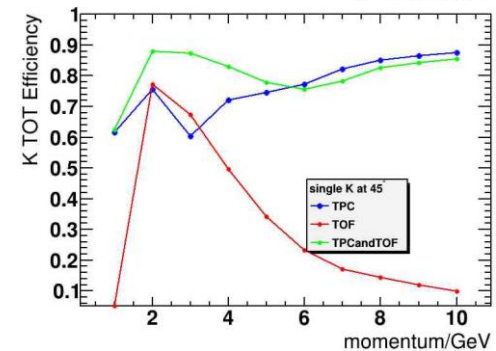
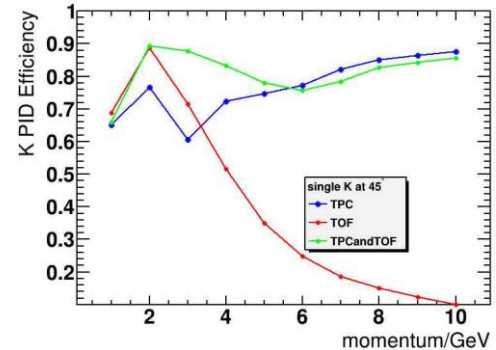
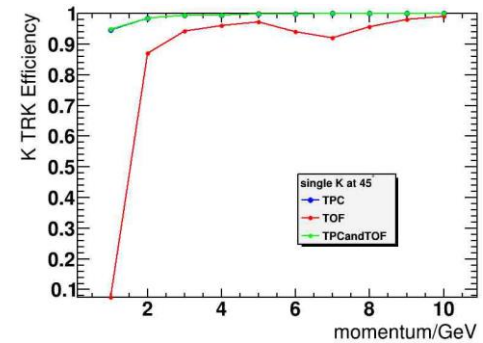


PID efficiency



Total efficiency

$\pi/K/p$  efficiency at  $\cos\theta=0.7-0.8$ (37-45 degree)



ParticleGun's K efficiency **4**

# Backup

$$\chi_{\text{TPC}}(i) = \frac{(dN/dx)_{\text{meas}} - (dN/dx)_{\text{exp}}^i}{\sigma_{(dN/dx)_{\text{meas}}}}, i = \pi/K/p$$

$$\chi_{\text{TOF}}(i) = \frac{t_{\text{meas}} - t_{\text{exp}}^i}{\sigma_{t_{\text{meas}}}}, \sigma_{t_{\text{meas}}} = \sqrt{0.05^2 + 0.02^2}$$

$$\chi^2(i) = \chi_{\text{TOF}}^2(i) + \chi_{\text{TPC}}^2(i)$$

$$\chi(i) = \sqrt{\chi^2(i)}$$

$$\text{Efficiency}_{\text{tot}}(i) = \text{Efficiency}_{\text{trk}}(i) \times \text{Efficiency}_{\text{PID}}(i)$$

$$\text{Efficiency}_{\text{trk}}(i) = \frac{N_i^{\text{reco}}}{N_i^{\text{gen}}}$$

$$\text{Efficiency}_{\text{PID}}(i) = \frac{N_i^{\text{reco}}(\chi^2(i) < \chi^2(j))}{N_i^{\text{reco}}} (j \neq i)$$

$$\text{purity}(K) = \frac{N_{K \rightarrow K}}{N_{K \rightarrow K} + N_{\pi \rightarrow K} + N_{p \rightarrow K}}$$

$$= \frac{3 \times \text{Efficiency}_{K \rightarrow K} + 10 \times \text{Efficiency}_{\pi \rightarrow K} + 1 \times \text{Efficiency}_{p \rightarrow K}}{3 \times \text{Efficiency}_{K \rightarrow K} + 10 \times \text{Efficiency}_{\pi \rightarrow K} + 1 \times \text{Efficiency}_{p \rightarrow K}}$$

$$\text{Efficiency}_{\text{opti. PID}}(i) = \frac{N_i^{\text{reco}}(a < \chi(i \rightarrow i) < b)}{N_i^{\text{reco}}}$$

$$\text{purity}_{\text{opti.}}(K)$$