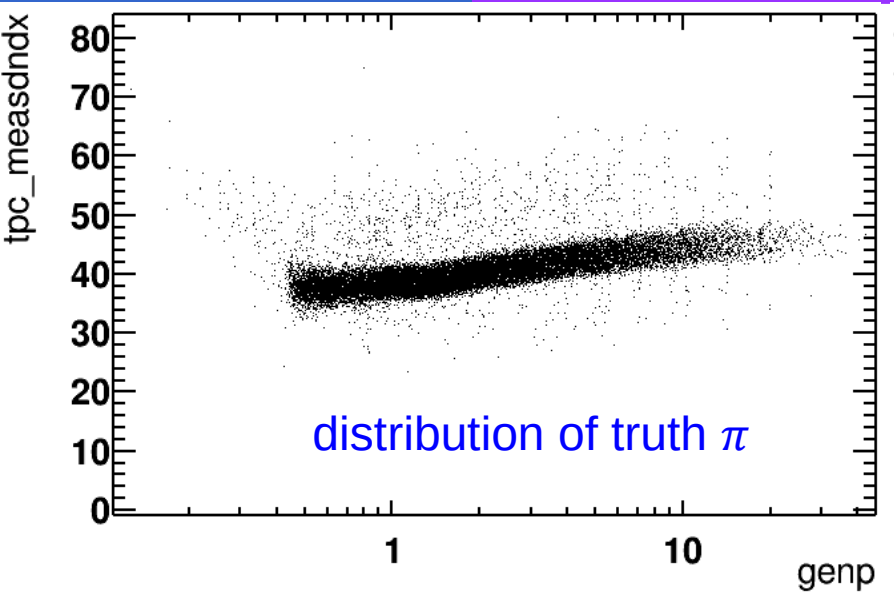
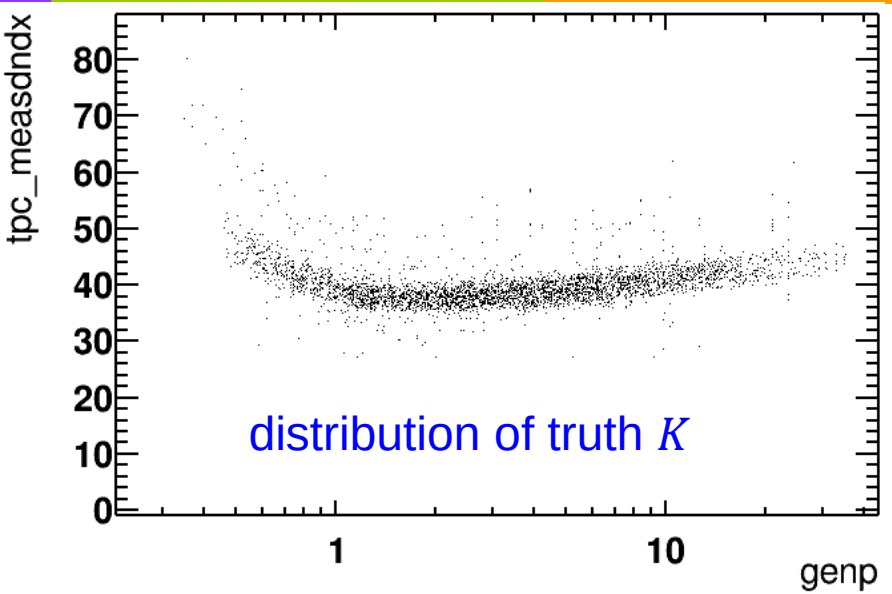
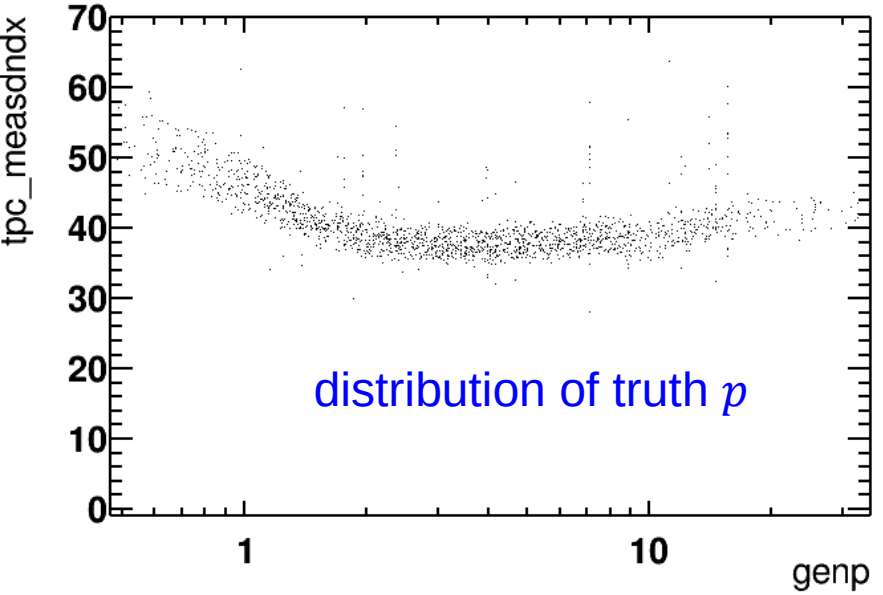
PID efficiency study

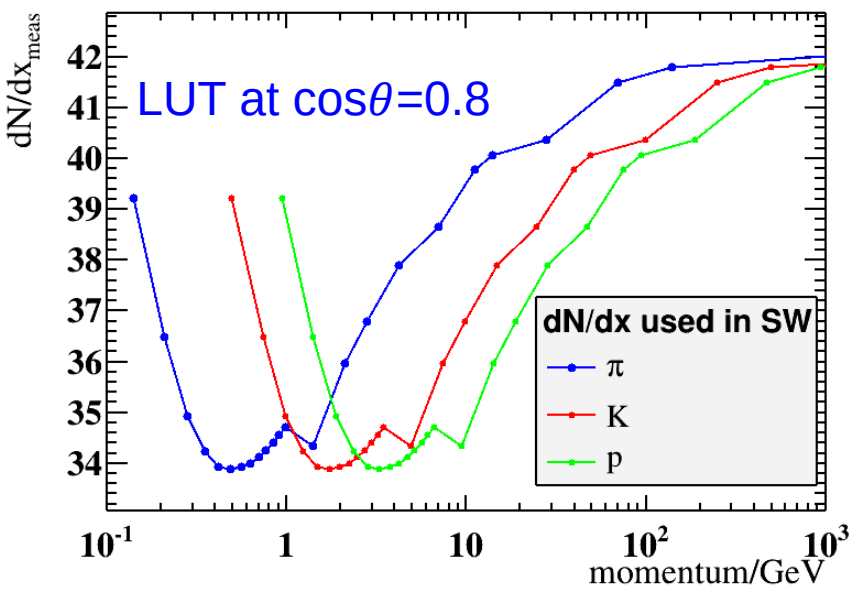
- Perform efficiency study in physical process $Z \rightarrow qq$
  - Calculate efficiency and purity in all phase space using minimum χ^2 PID
  - Modify one bug which caused wrong gen costheta
  - Use CompleteTracks and find maxweighted corresponding CompleteTracksParticleAssociation to match truth and rec info
- Samples used
  - Release version: CEPCSW_tdr24.10.0
  - $Z \rightarrow qq$ 100000 events (truth π: K: p = 1478354: 206389: 90225)

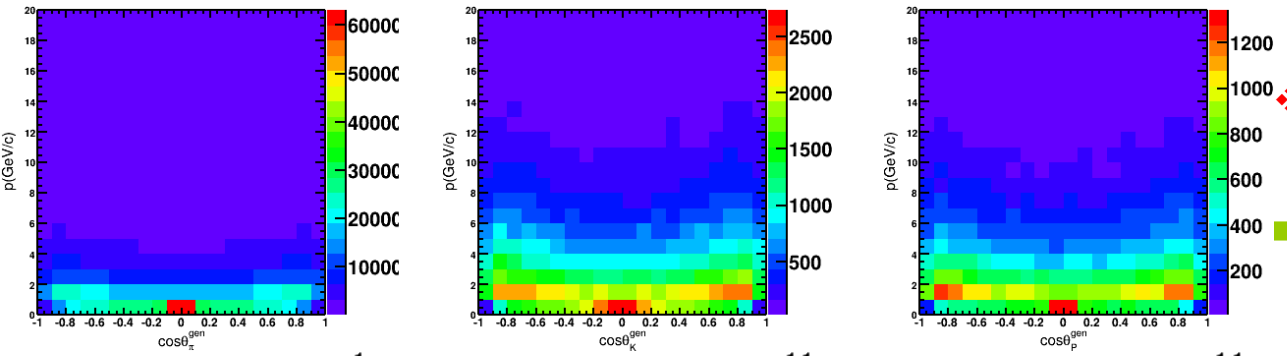
Track match at cosθ=0.7-0.8





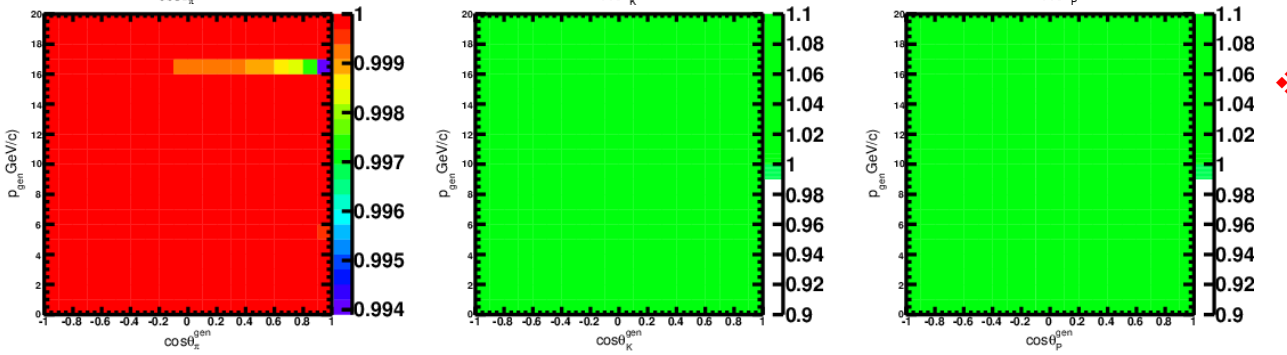




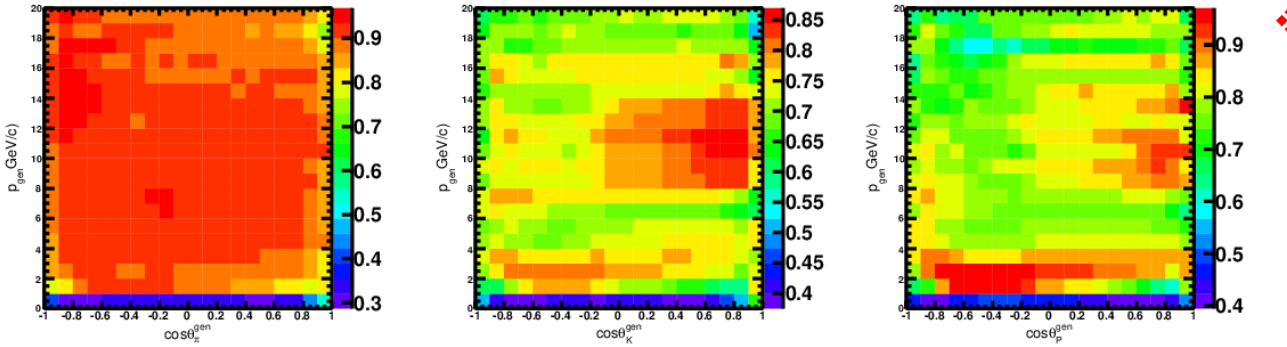


- Phase space $(p_{\mathrm{gen}}, \cos\theta_{\mathrm{gen}})$

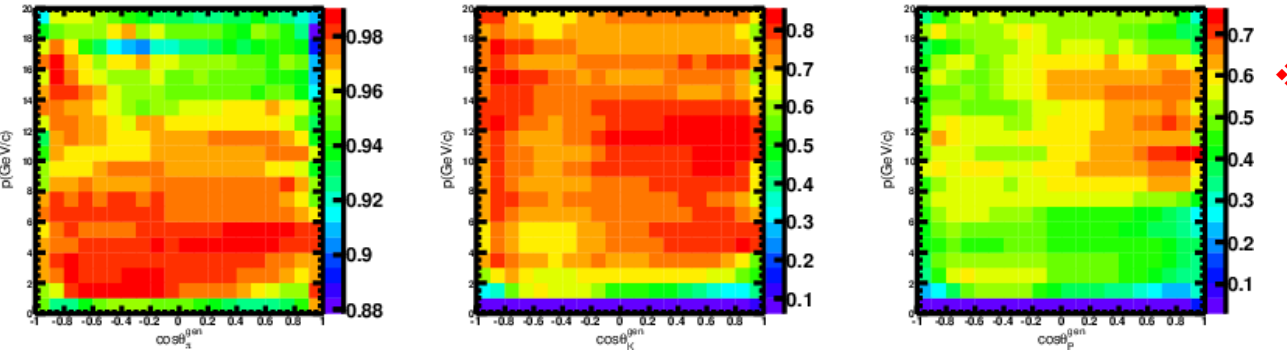
0-20GeV



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

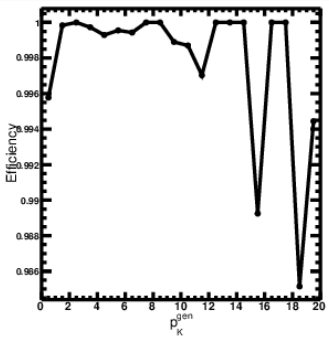


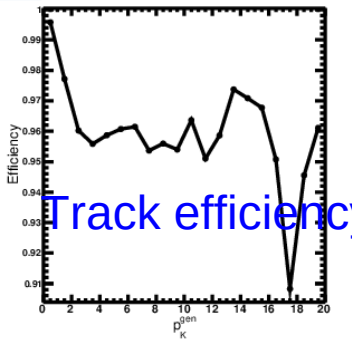
- PID efficiency distribution of truth $\pi/K/p$ (minimum combined χ^2)



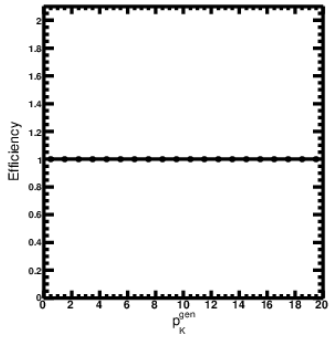
- Purity distribution of truth $\pi/K/p$

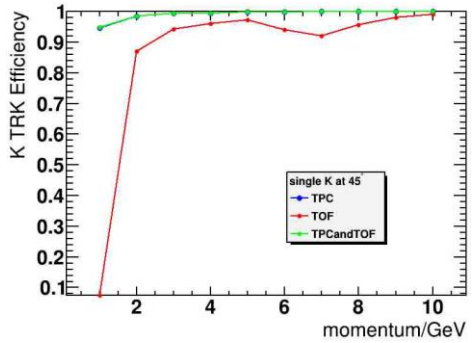
PID efficiency comparison

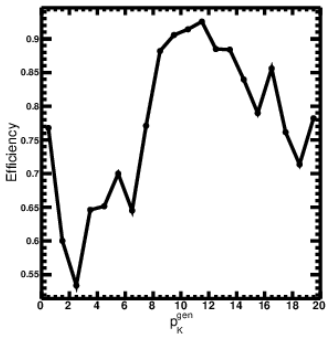


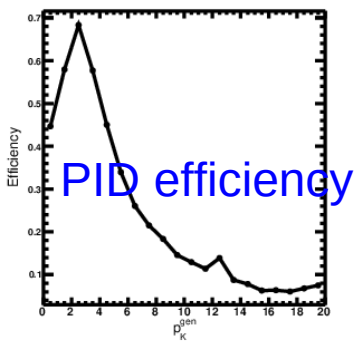


Track efficiency

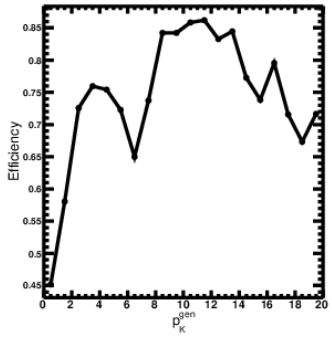


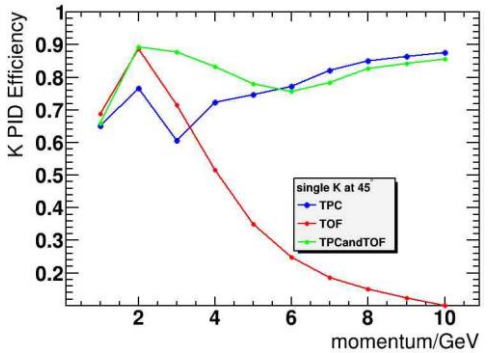


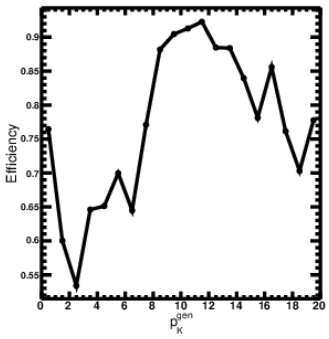


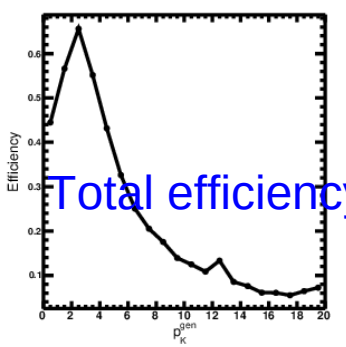


PID efficiency

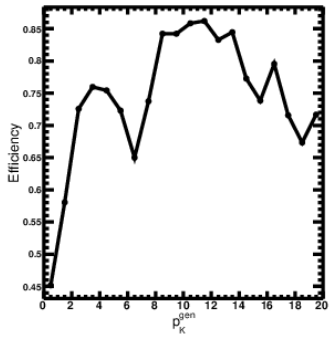


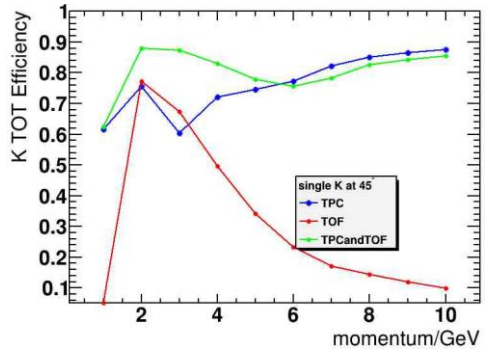






Total efficiency





K efficiency at cosθ=0.7-0.8(37-45 degree)
TPC only/TOF only/Combined

ParticleGun's K efficiency

Backup

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

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

$$\chi^2(i) = \chi^2_{\mathrm{TOF}}(i) + \chi^2_{\mathrm{TPC}}(i)$$

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

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

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

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

$$\mathrm{purity}(K) = \frac{N_{K\to K}}{N_{K\to K} + N_{\pi\to K} + N_{p\to K}}$$

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

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