PID efficiency study -- Outline

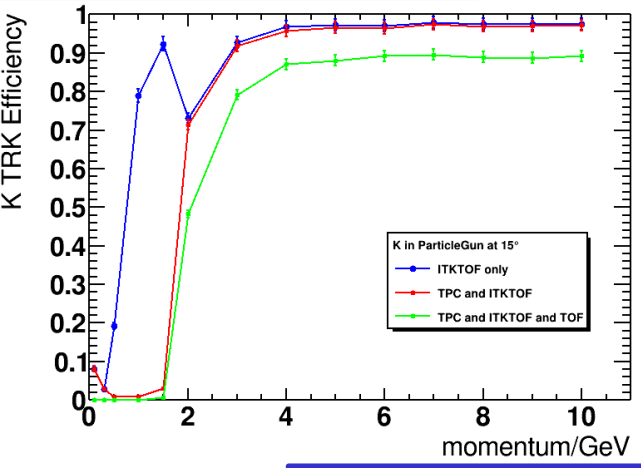
- ParticleGun K PID efficiency with ITKToF
  - (itktof and tpc and tof track) 1-10GeV and 35/45/55/65/75/85/89 degree: ~ 89.5%
  - (itktof or tpc or tof track) 1-10GeV and 35/45/55/65/75/85/89 degree: ~ 89.5%
- K PID efficiency/purity in ParticleGun and Z->qq using TPC and TOF
  - ParticleGun 1-10GeV and 35/45/55/65/75/85/89 degree: ~ 89.6%
  - Z->qq >1GeV and |costheta|<0.85: ~ 89.3%/86.0%
- K PID efficiency/purity in ParticleGun and Z->qq using TPC or TOF
  - ParticleGun 1-10GeV and 35/45/55/65/75/85/89 degree: ~ 89.1%
  - Z->qq >1GeV and |costheta|<0.85: ~ 88.4%/80.1%
  - Simple PID efficiency matrix for pi, K, p
- Samples generated under CEPCSW_tdr25.1.2
- Backup (Equations, definitions and distributions of track truth phase space)

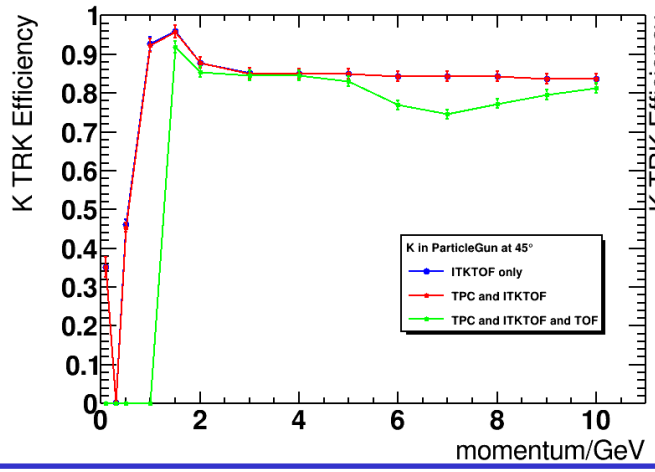
PID efficiency study -- Status

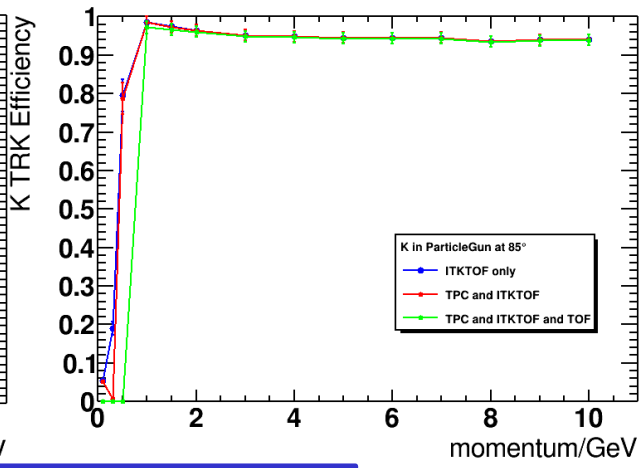
- ParticleGun K combined PID efficiency under CEPCSW_tdr25.1.2
  - Select particles without decaying and have 1 track (itktof and tpc and tof track)
  - 1-10GeV and 35/45/55/65/75/85/89 degree: ~ 89.5%
  - 1-10GeV and 25 degree: ~ 88.0%
  - 1-10GeV and 15 degree: ~ 51.3%
- ParticleGun K combined PID efficiency under CEPCSW_tdr25.1.2
  - Select particles without decaying and have 1 track (itktof or tpc or tof track)
  - 1-10GeV and 35/45/55/65/75/85/89 degree: ~ 89.5%
  - 1-10GeV and 25 degree: ~ 87.6%
  - 1-10GeV and 15 degree: ~ 53.9%

K PID efficiency of 25.1.2 with ITKToF

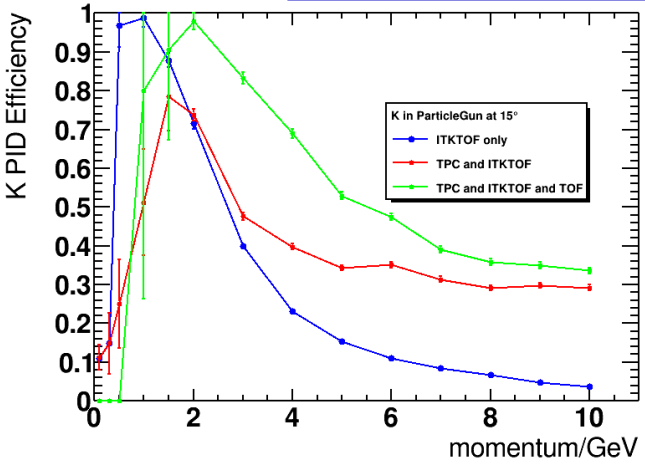
select particles without decay and with 1 track, only identify pi/k/p

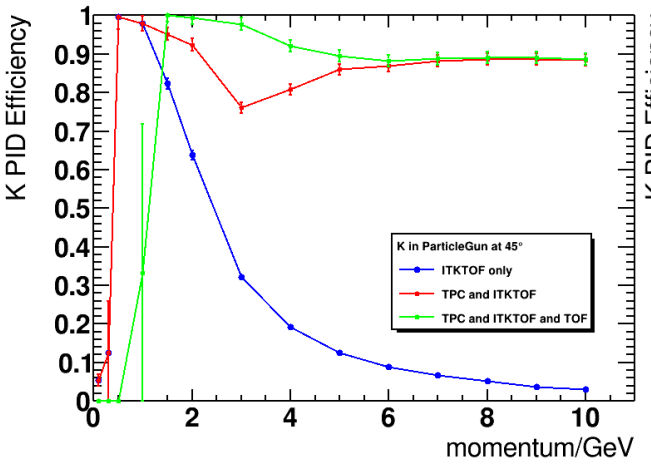


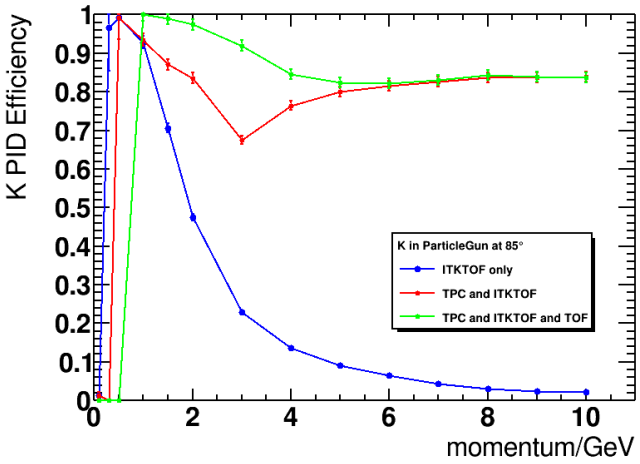




15 degree (left) VS 45 degree (middle) VS 85 degree (right)
ParticleGun K- TRK efficiency of having TPC/ToF track in reco tracks



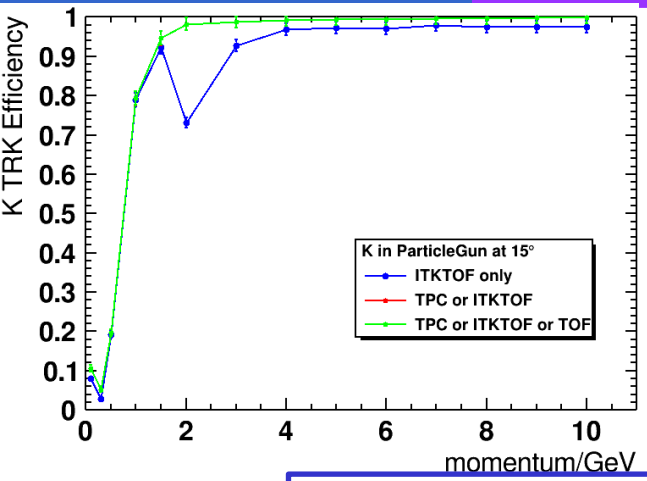


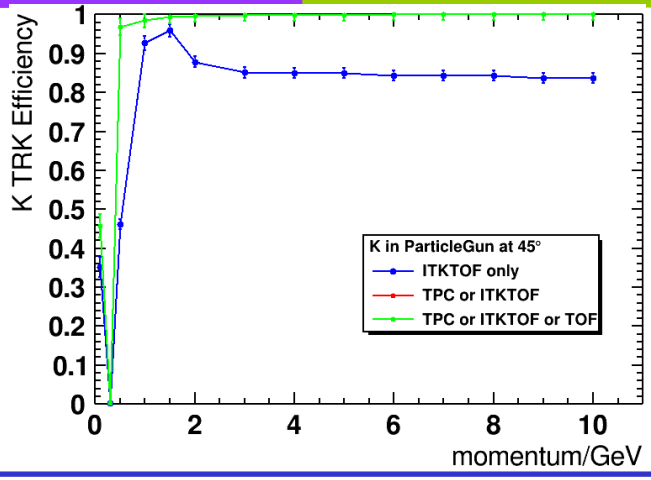


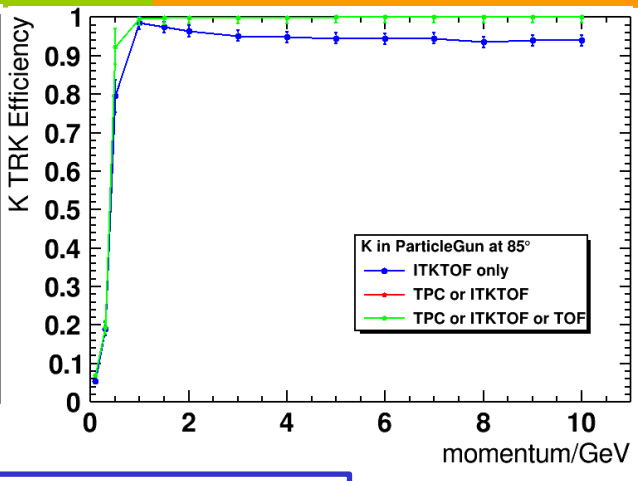
15 degree (left) VS 45 degree (middle) VS 85 degree (right)
ParticleGun K- PID efficiency of right PID

K PID efficiency of 25.1.2 with ITKToF

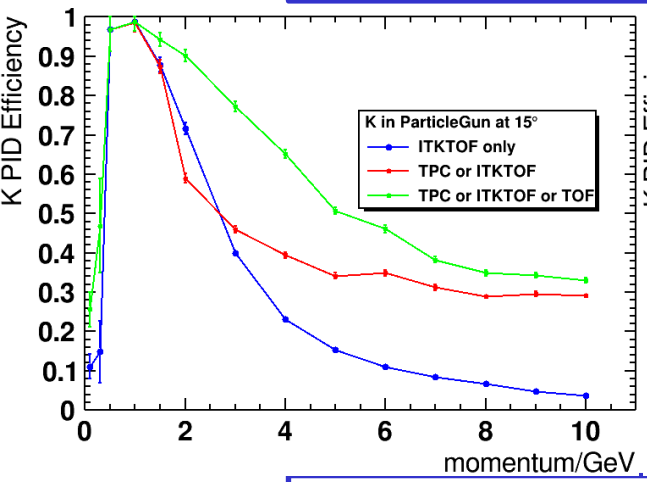
select particles without decay and with 1 track, only identify pi/k/p

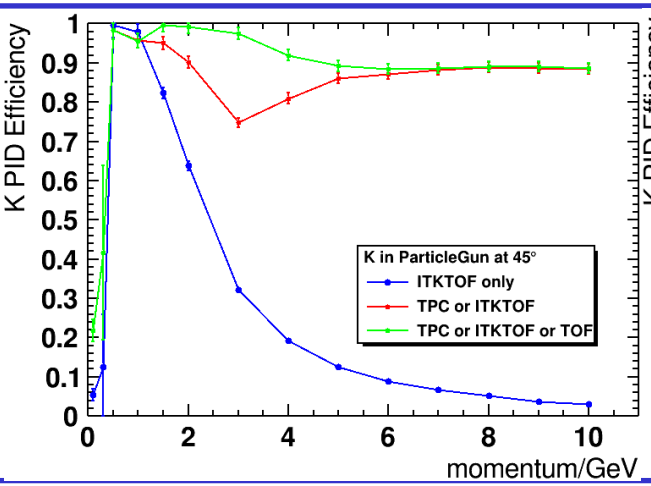


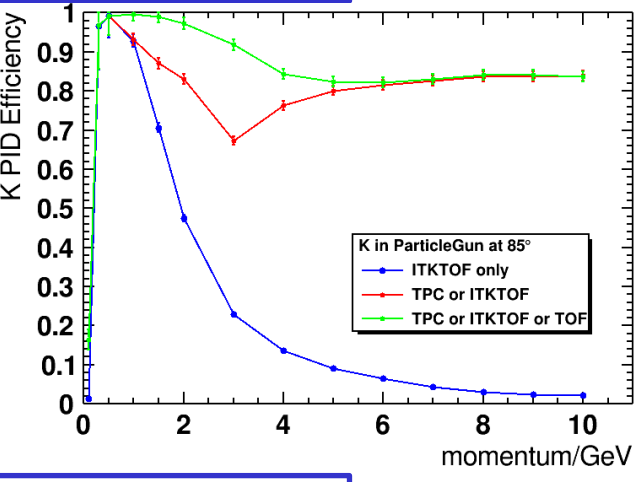




15 degree (left) VS 45 degree (middle) VS 85 degree (right)
ParticleGun K- TRK efficiency of having TPC/ToF track in reco tracks



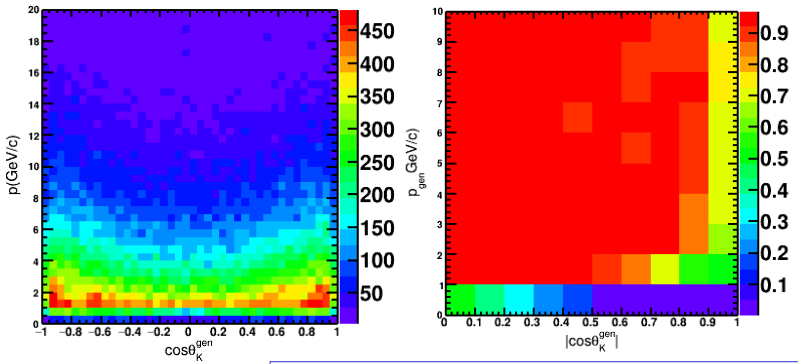


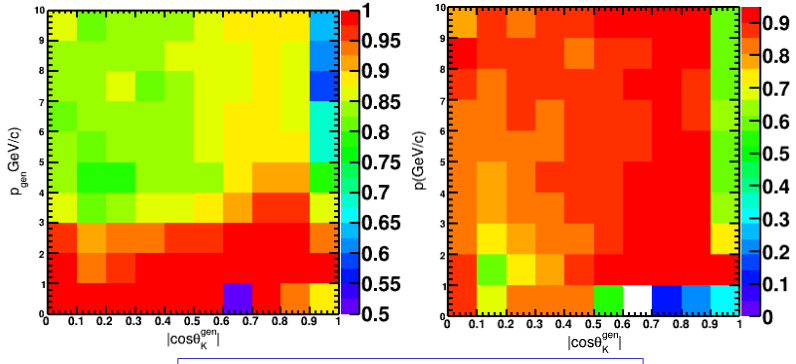


15 degree (left) VS 45 degree (middle) VS 85 degree (right)
ParticleGun K- PID efficiency of right PID

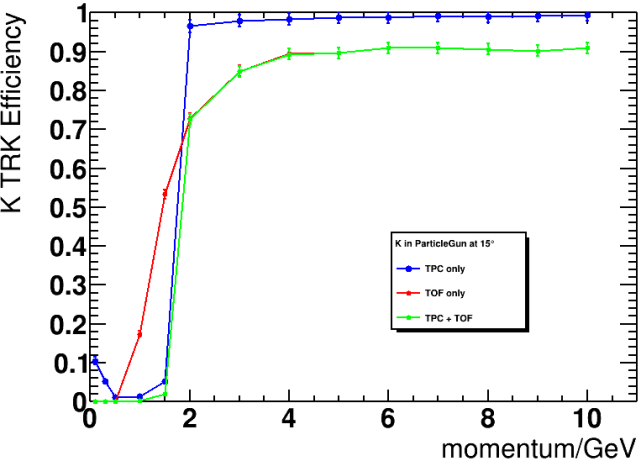
PID efficiency study -- Status

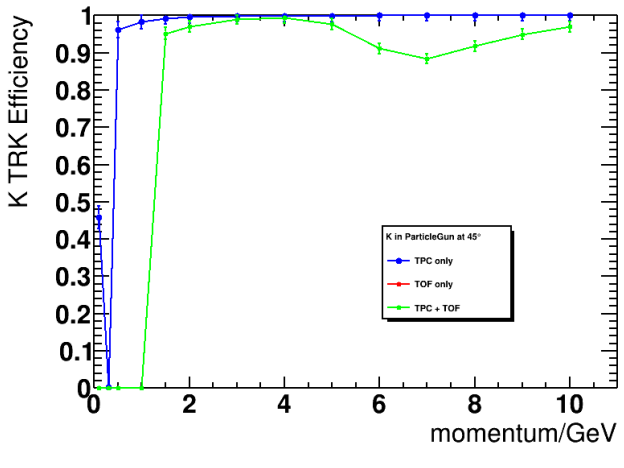
- ParticleGun K combined PID efficiency under CEPCSW_tdr25.1.2
  - Select particles without decaying and have 1 track (tpc and tof track)
  - 1-10GeV and 35/45/55/65/75/85/89 degree: ~ 89.6%
  - 1-10GeV and 25 degree: ~ 87.3%
  - 1-10GeV and 15 degree: ~ 51.4%
- Z->qq K combined PID efficiency/purity under CEPCSW_tdr25.1.2
  - Select particles without decaying and have tpc and tof tracks
  - >1GeV and |costheta|<0.85: ~ 89.3%/86.0%
  - >1GeV and 0.99>|costheta|>0.85: ~ 81.7%/74.8%

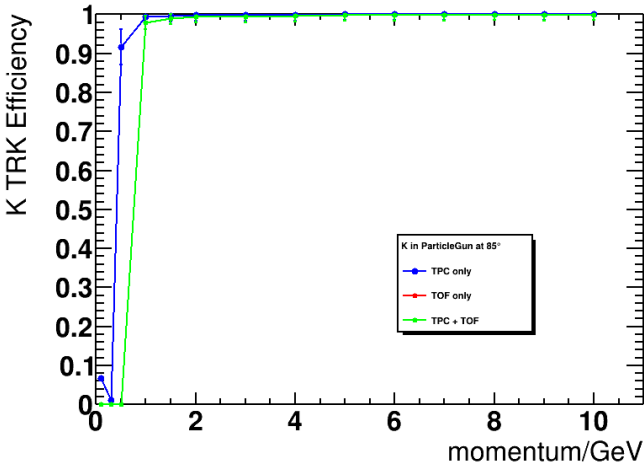


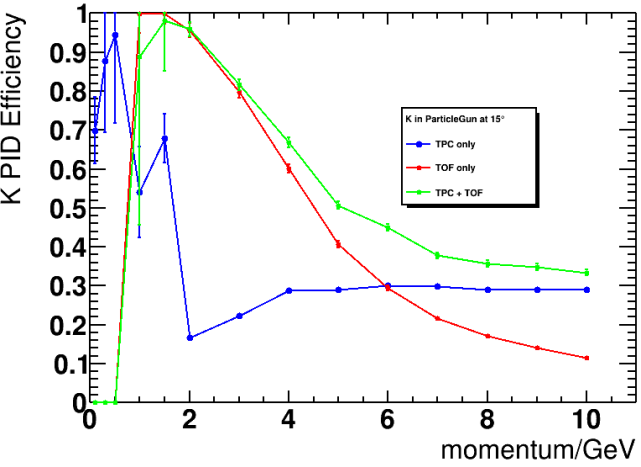


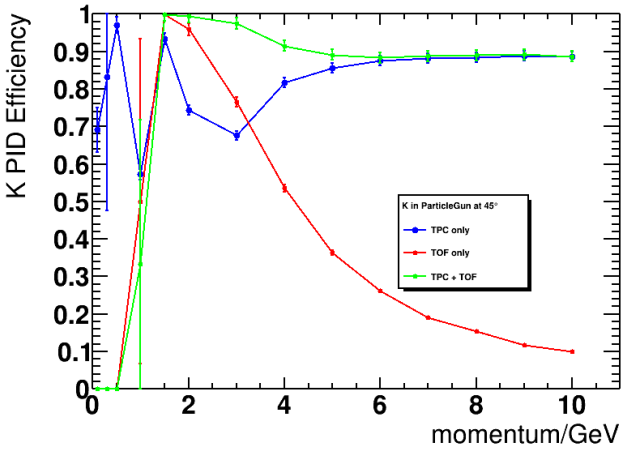
PID efficiency of 25.1.2

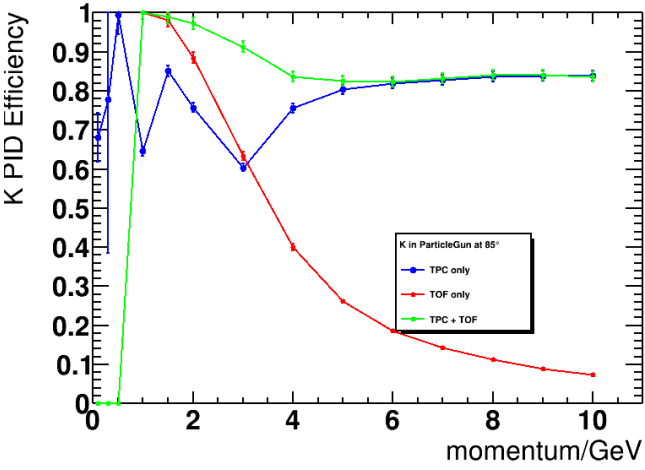






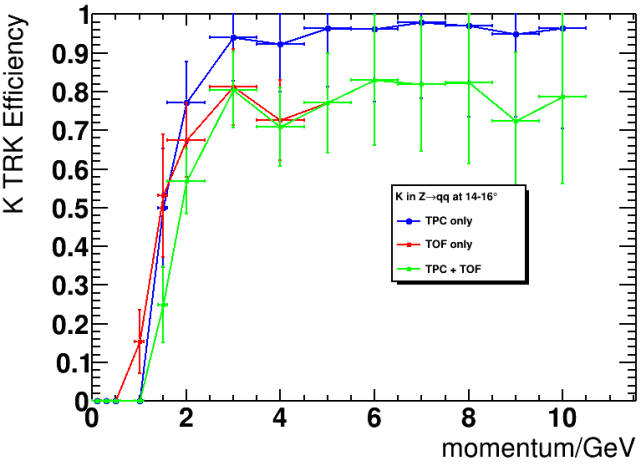


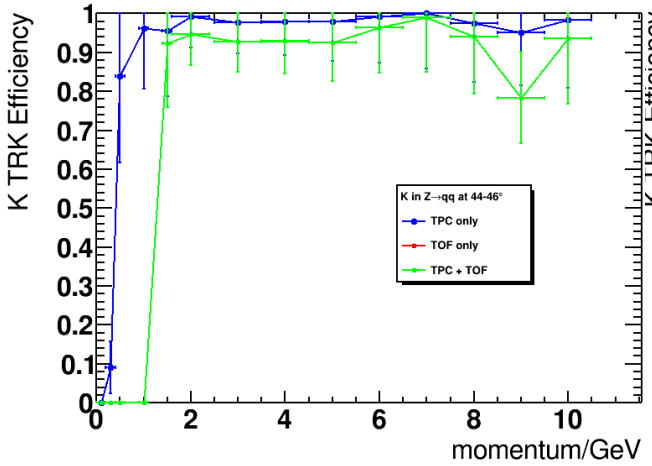


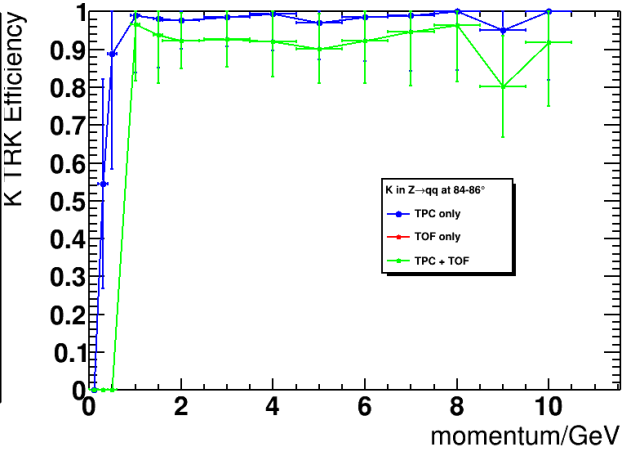


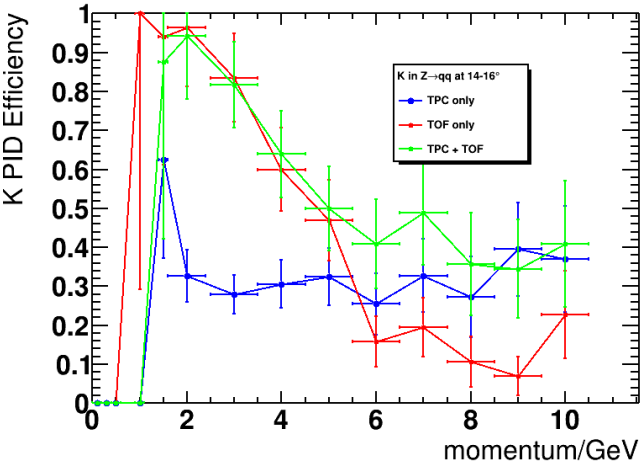
15 degree (left) VS 45 degree (middle) VS 85 degree (right)
ParticleGun K- TRK/PID efficiency

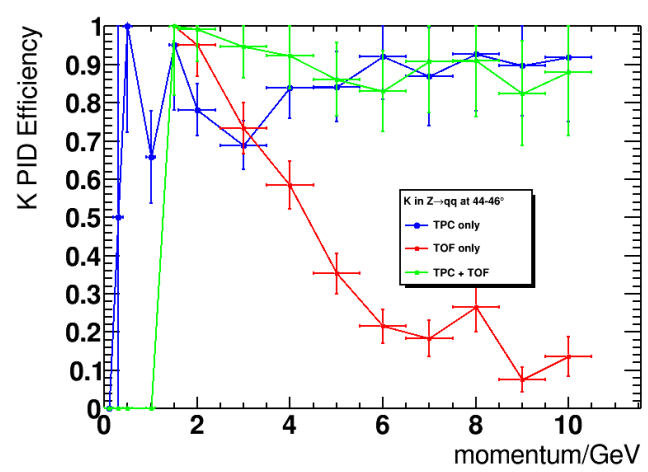
PID efficiency of 25.1.2

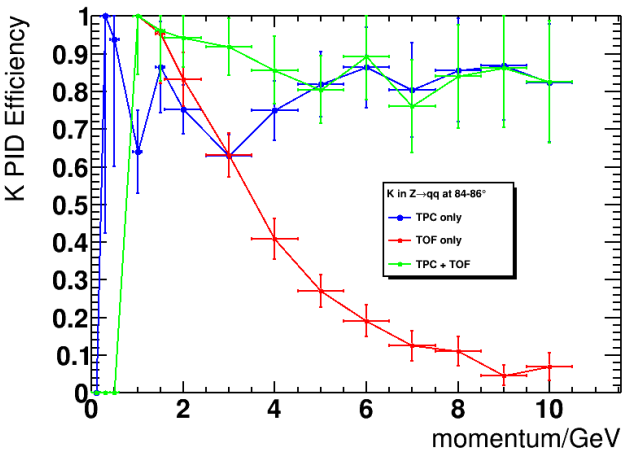








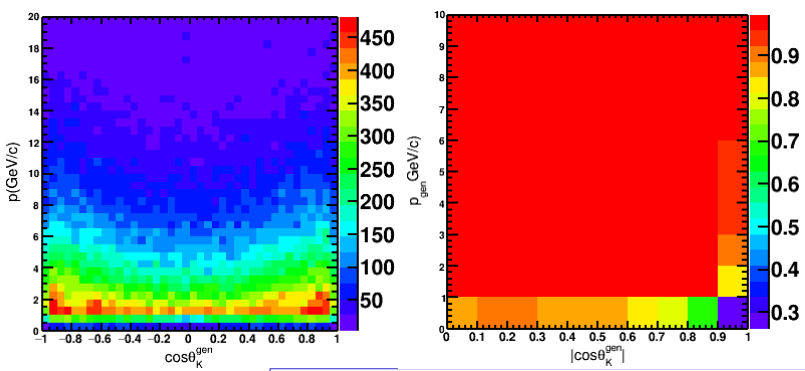


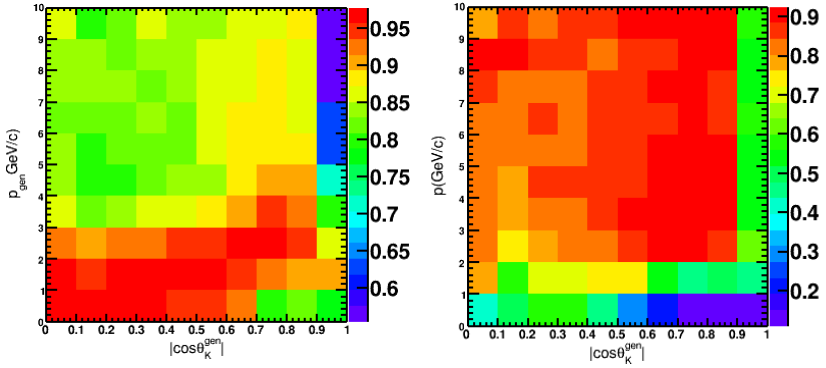


15 degree (left) VS 45 degree (middle) VS 85 degree (right)
Z->qq K- TRK/PID efficiency

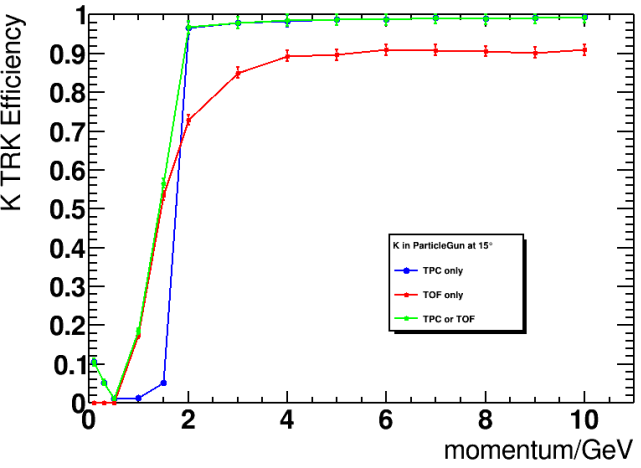
PID efficiency study -- Status

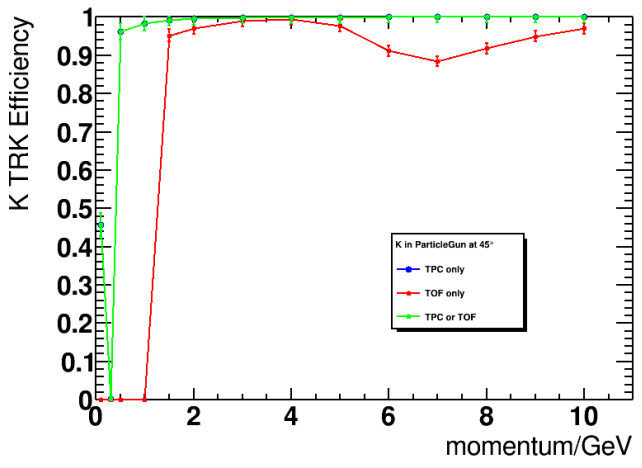
- ParticleGun K combined PID efficiency under CEPCSW_tdr25.1.2
  - Select particles without decaying and have 1 track (tpc or tof track)
  - 1-10GeV and 35/45/55/65/75/85/89 degree: ~ 89.1%
  - 1-10GeV and 25 degree: ~ 85.9%
  - 1-10GeV and 15 degree: ~ 51.1%
- Z->qq K combined PID efficiency/purity under CEPCSW_tdr25.1.2
  - Select particles without decaying and have tpc or tof tracks
  - >1GeV and |costheta|<0.85: ~ 88.4%/80.1%
  - >1GeV and 0.99>|costheta|>0.85: ~ 76.6%/61.1%

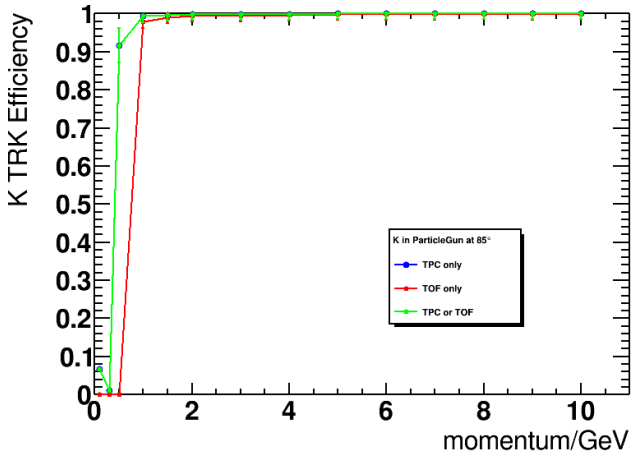


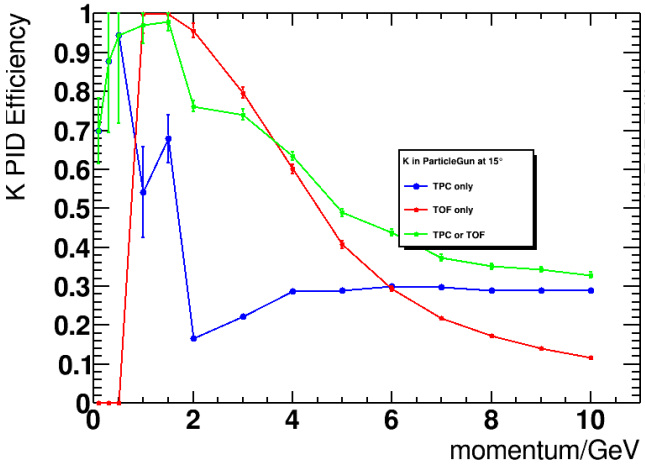


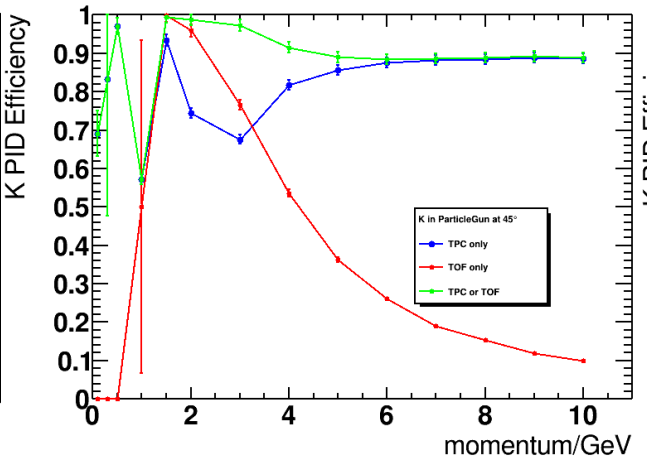
PID efficiency of 25.1.2

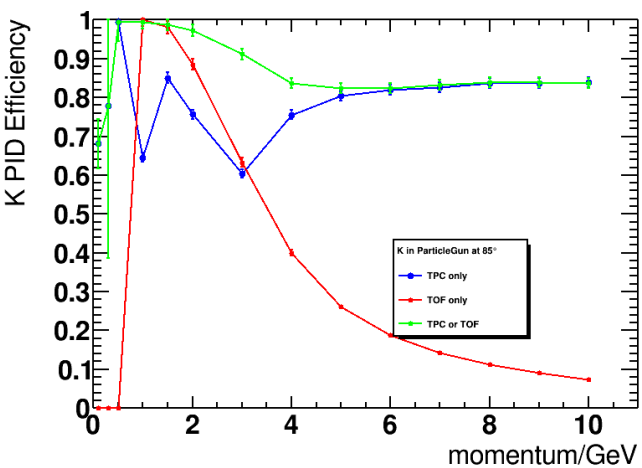






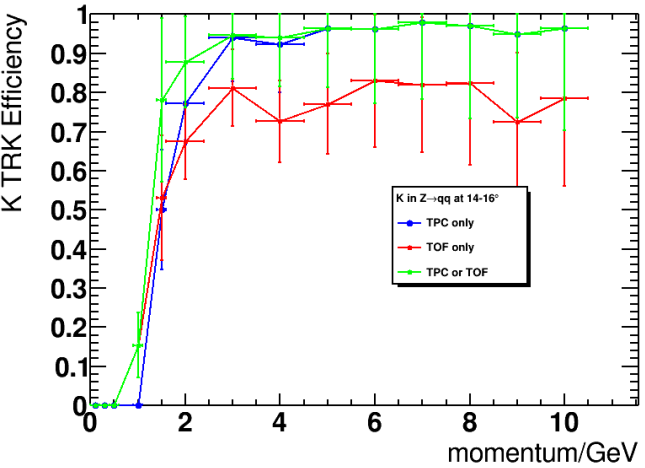


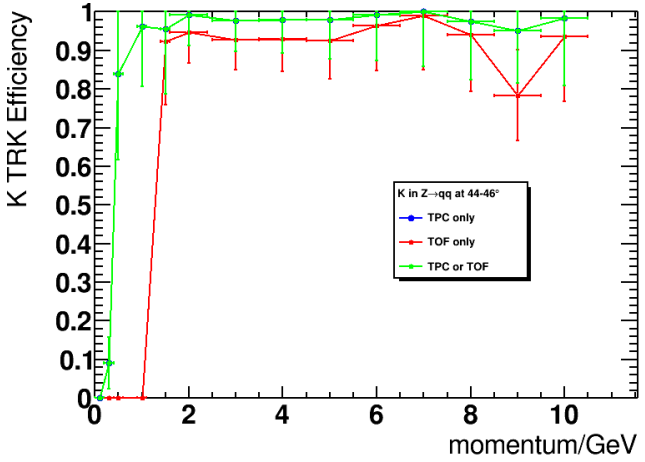


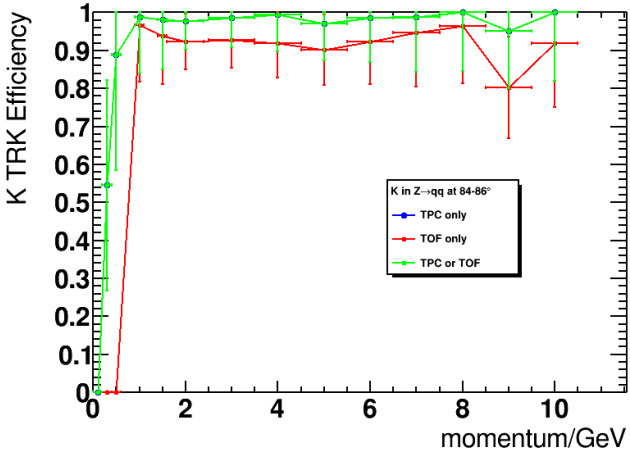


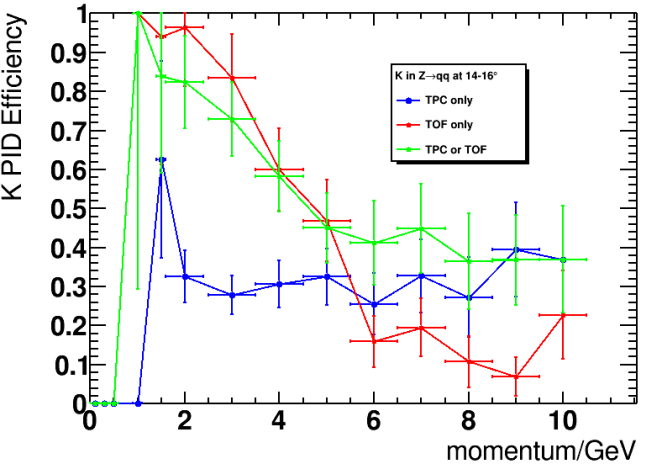
15 degree (left) VS 45 degree (middle) VS 85 degree (right)
ParticleGun K- TRK/PID efficiency

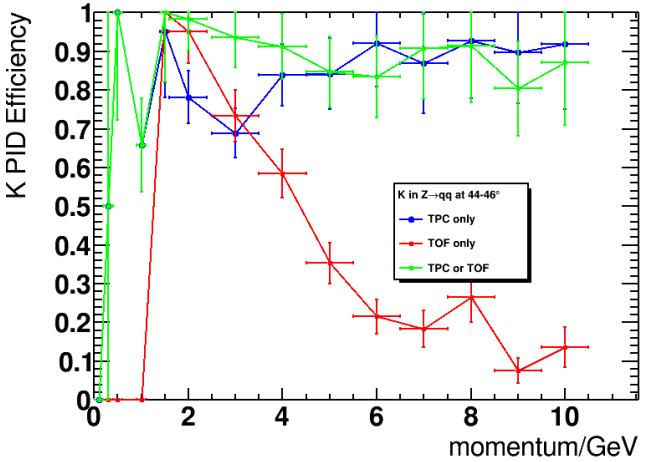
PID efficiency of 25.1.2

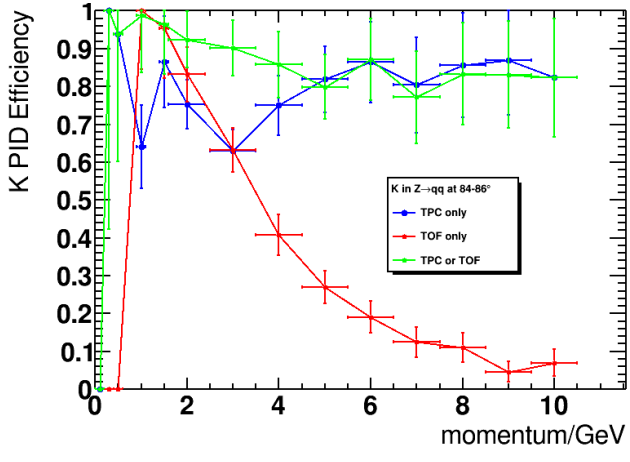








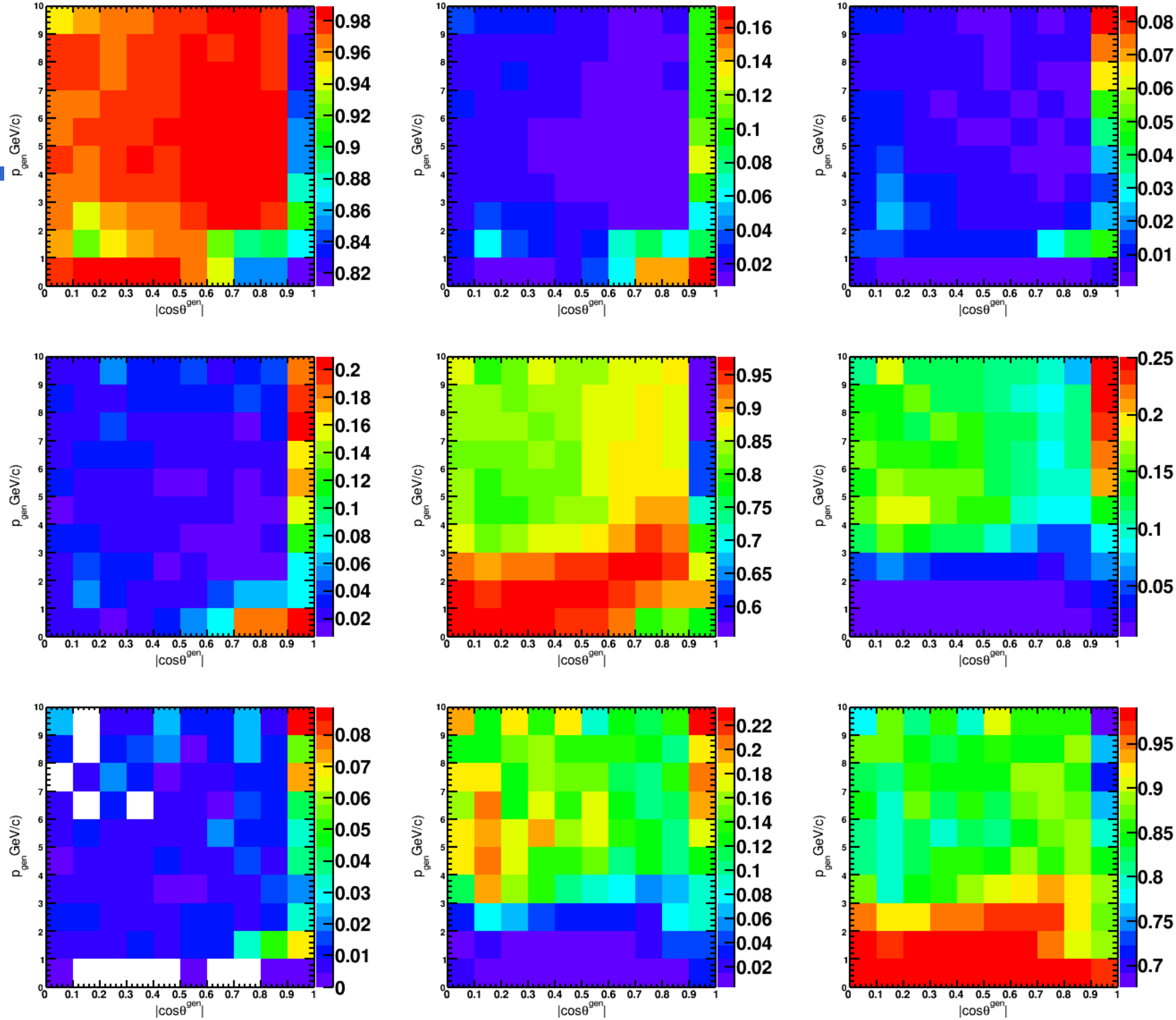




15 degree (left) VS 45 degree (middle) VS 85 degree (right)
Z->qq K- TRK/PID efficiency

pi/k/p PID Efficiency matrix in Z->qq using combined <u>TPC or TOF</u>

Truth pi(top) / K(middle) / p(bottom)



Reconstructed pi(left) / K(middle) / p(right)

Backup

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

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

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

$$\mathrm{Efficiency}_{\mathrm{trk}}(\mathrm{TPC}) = \frac{N^{\mathrm{TPC}}_{\mathrm{trk}}}{N^{\mathrm{reco}}_{\mathrm{trk}}}$$

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

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

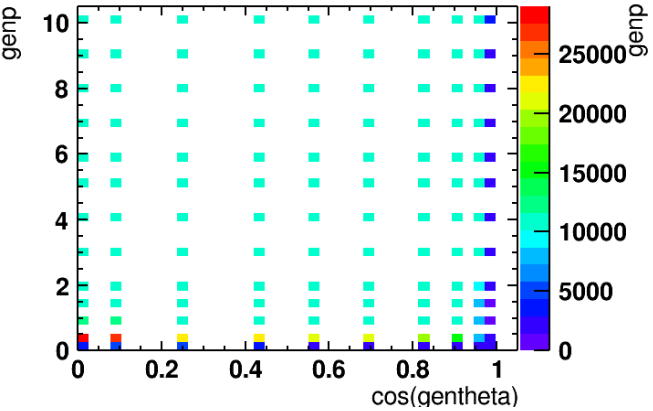
$$\mathrm{Efficiency}_{\mathrm{opti.\ PID}}(i) = \frac{N^{\mathrm{TPC}}_{\mathrm{trk}(i)}(a < \chi(i \to i) < b)}{N^{\mathrm{TPC}}_{\mathrm{trk}(i)}}$$

$$\text{Separation power: } O_{AB} = \frac{|\mathrm{A} - \mathrm{B}|}{\sqrt{(\sigma_A^2 + \sigma_B^2)/2}}$$

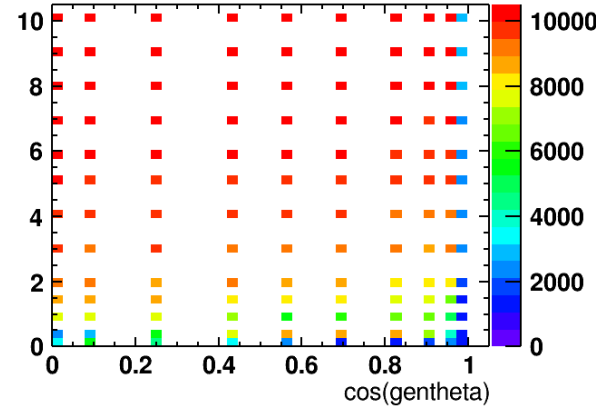
$$\text{Combined: } \sqrt{O^2_{AB,\,\mathrm{TPC}} + O^2_{AB,\,\mathrm{TOF}}}$$

MCparticle: 1400000 = 10000*10*14

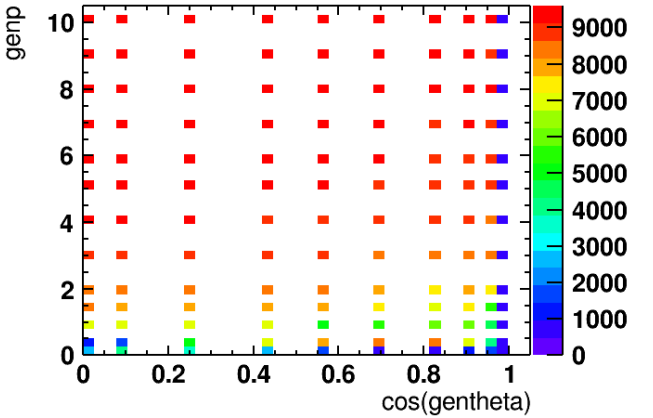
ParticleGun K- track truth phase space



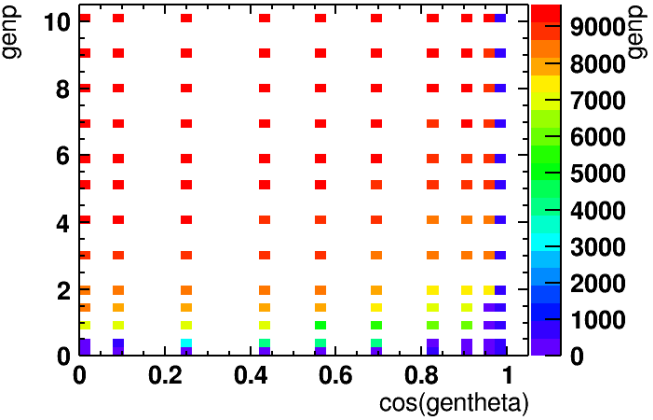
All tracks: 1318172



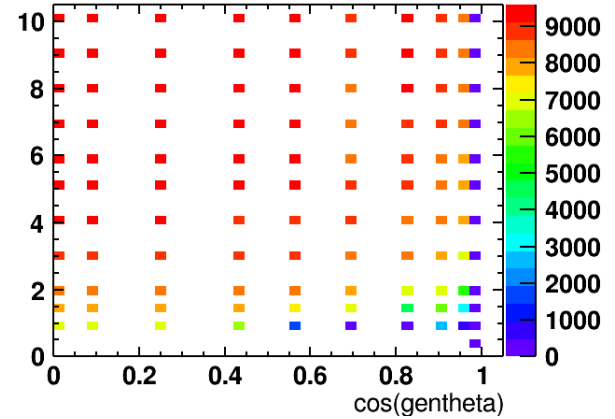
No decay: 1034409



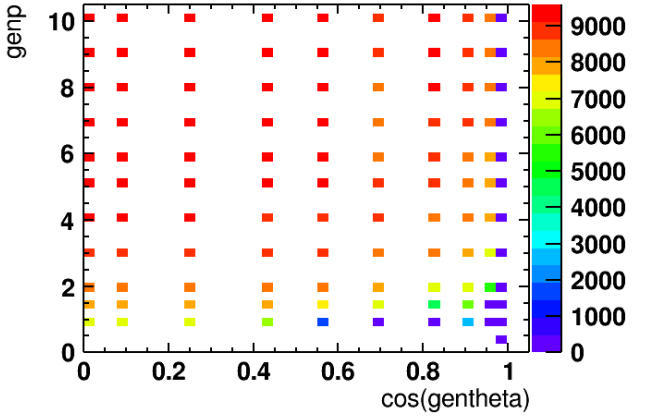
No decay && Nfulltrk==1: 934320



No decay && Nfulltrk==1 && Ndndxtrk==1: 871516



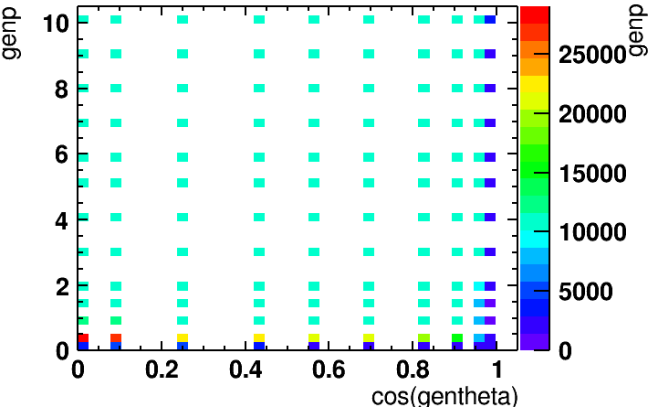
No decay && Nfulltrk==1 && Ndndxtrk==1 && Ntoftrk==1: 806801



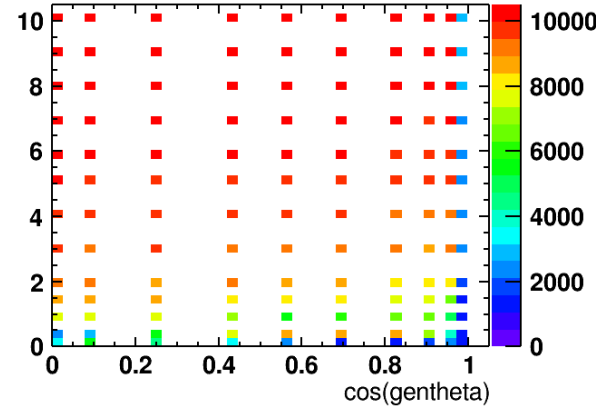
No decay && Nfulltrk==1 && Ndndxtrk==1 && Ntoftrk==1: 802976

MCparticle: 1400000 = 10000*10*14

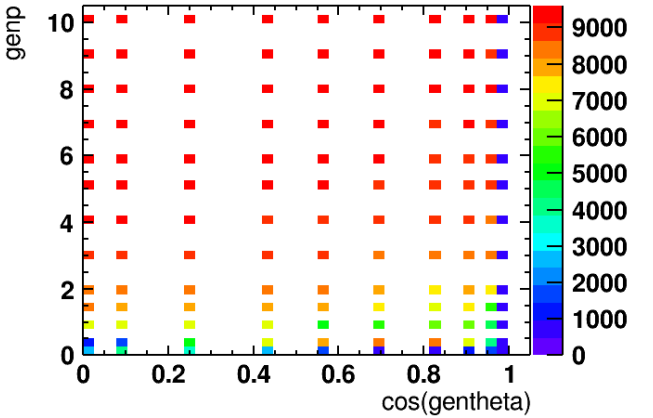
ParticleGun K- track truth phase space



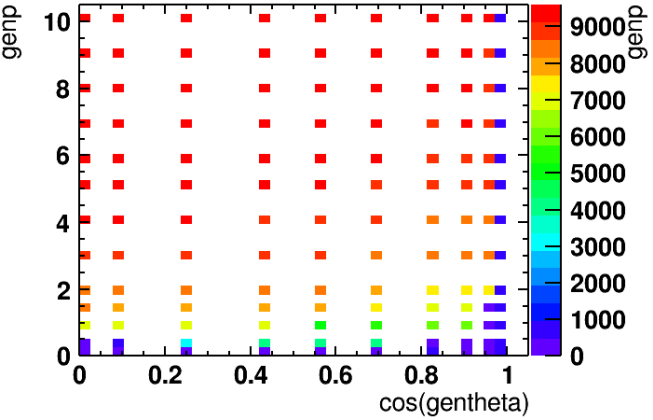
All tracks: 1318172



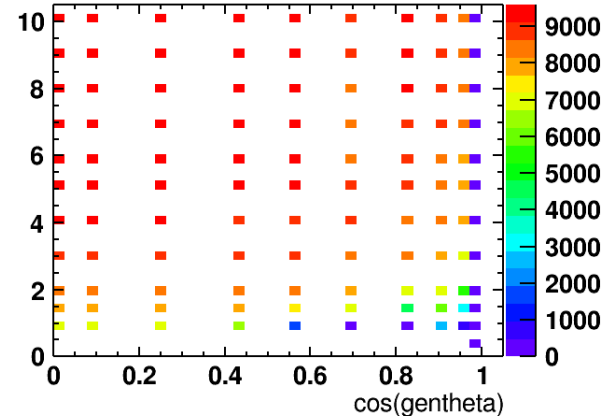
No decay: 1034409



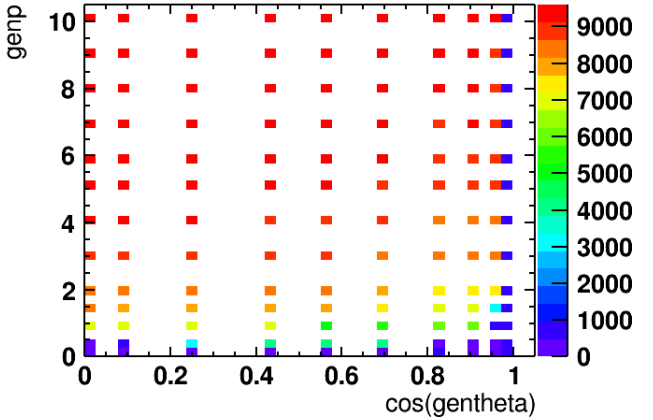
No decay && Nfulltrk==1: 934320



No decay && Nfulltrk==1 && Ndndxtrk==1: 871516

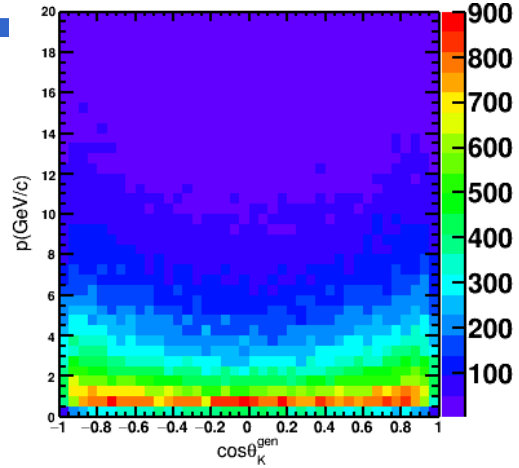


No decay && Nfulltrk==1 && Ntoftrk==1: 806801

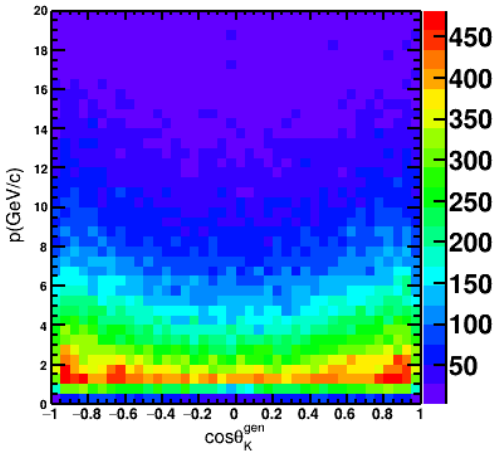


No decay && Nfulltrk==1 && (Ndndxtrk==1 || Ntoftrk==1): 875341

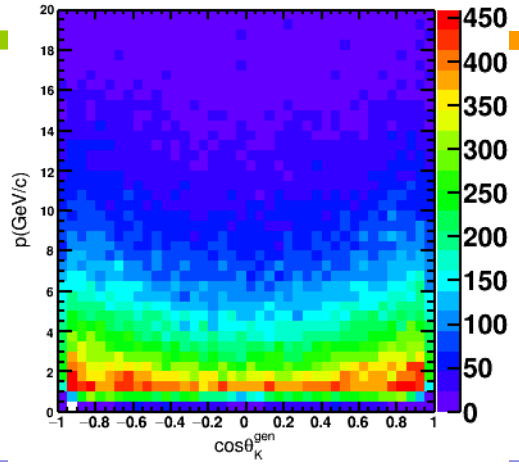
Z->qq K- track truth phase space



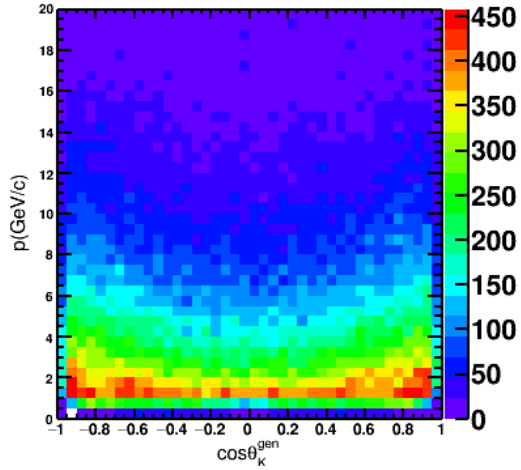
All tracks: 227421



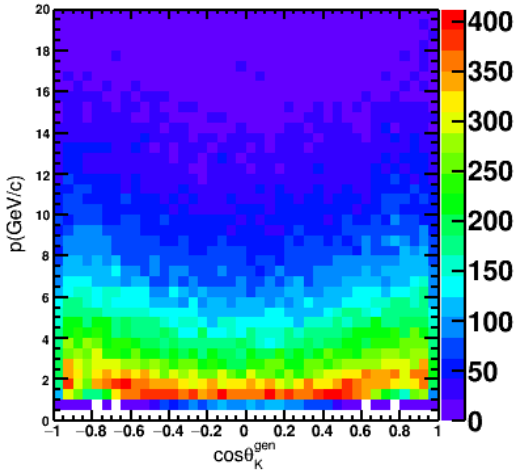
No decay: 168160



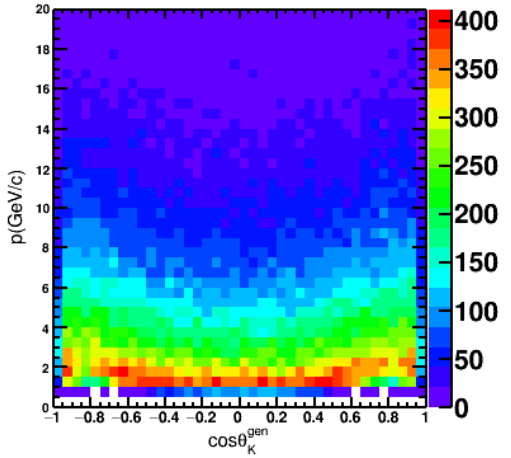
No decay && (Ndndxtrk>=1 || Ntoftrk>=1): 161412



No decay && Ndndxtrk>=1: 159262

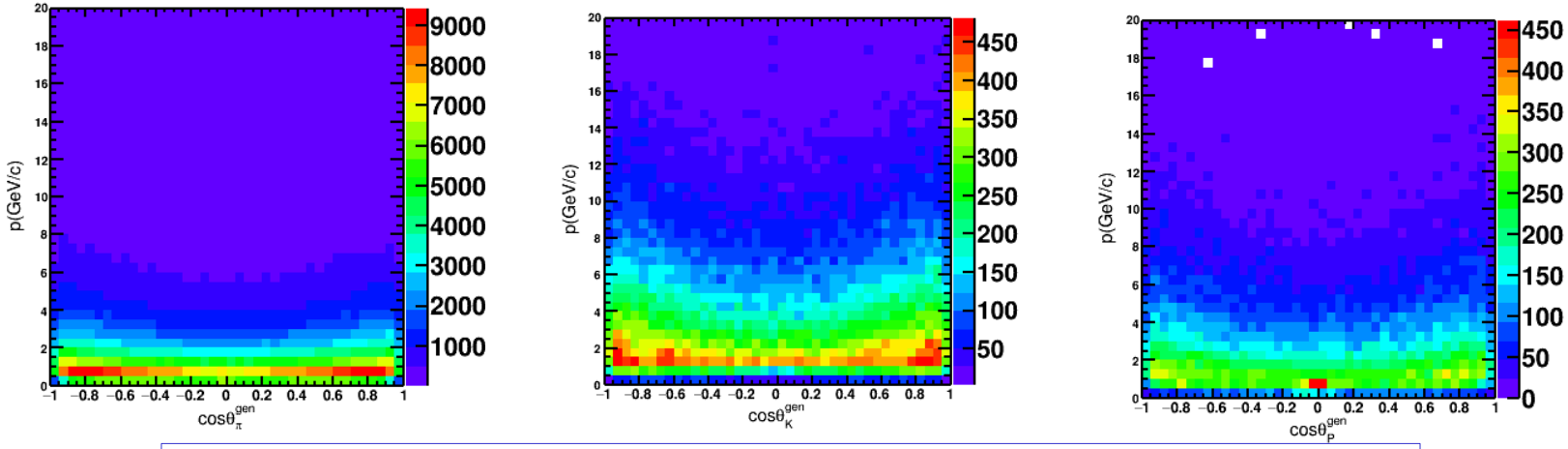


No decay && Ntoftrk>=1: 142003

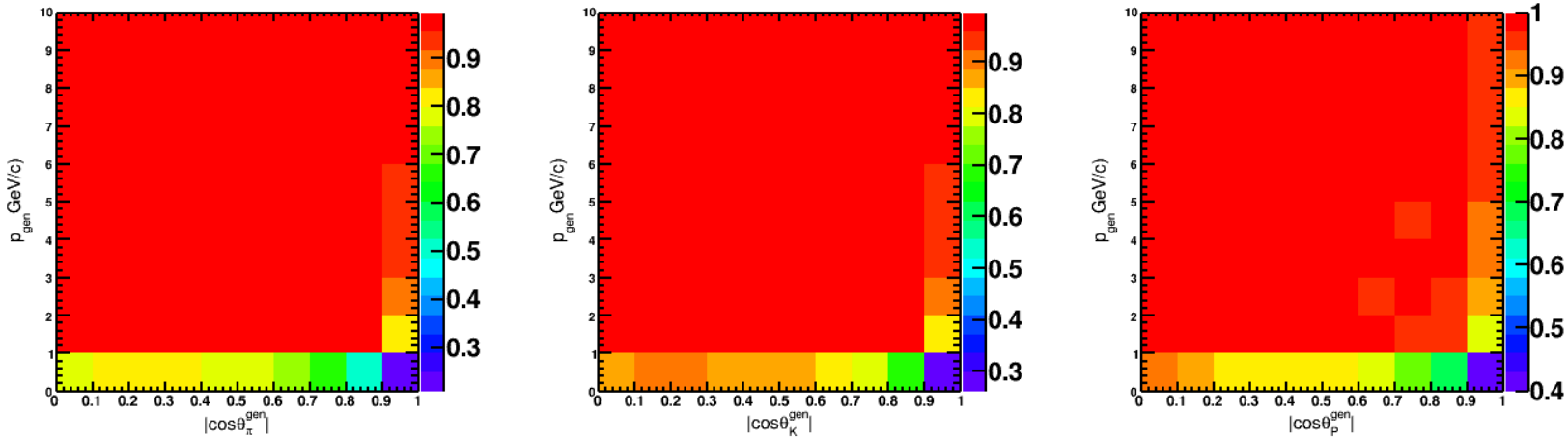


No decay && (Ndndxtrk>=1 && Ntoftrk>=1): 139853

100k Z->qq (Efficiency) distribution



pi(left) / K(middle) / p(right) TRK without decay truth phase space
Number: 1495225/168160/93491



pi(left) / K(middle) / p(right) TRK Efficiency using combined TPC or TOF