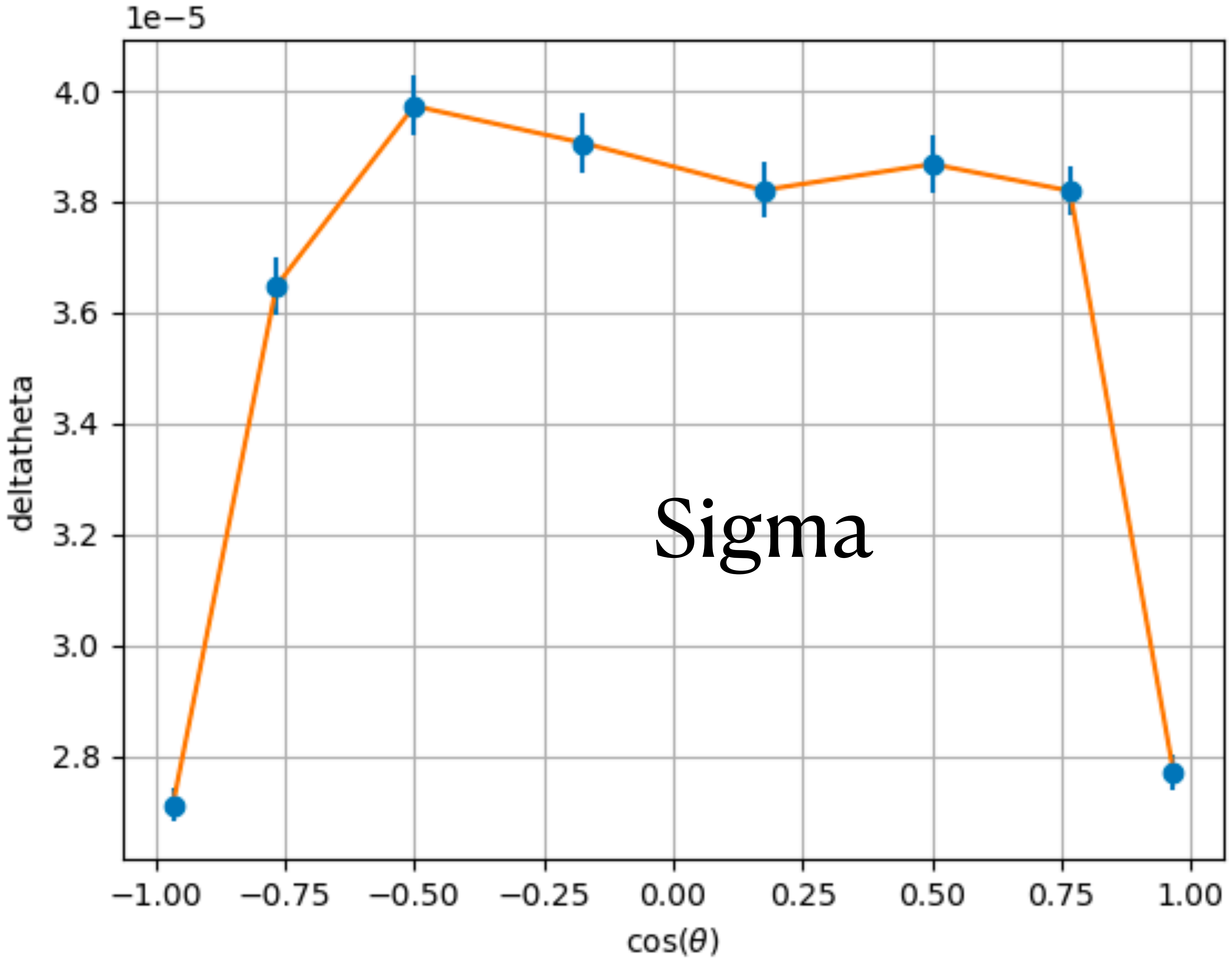
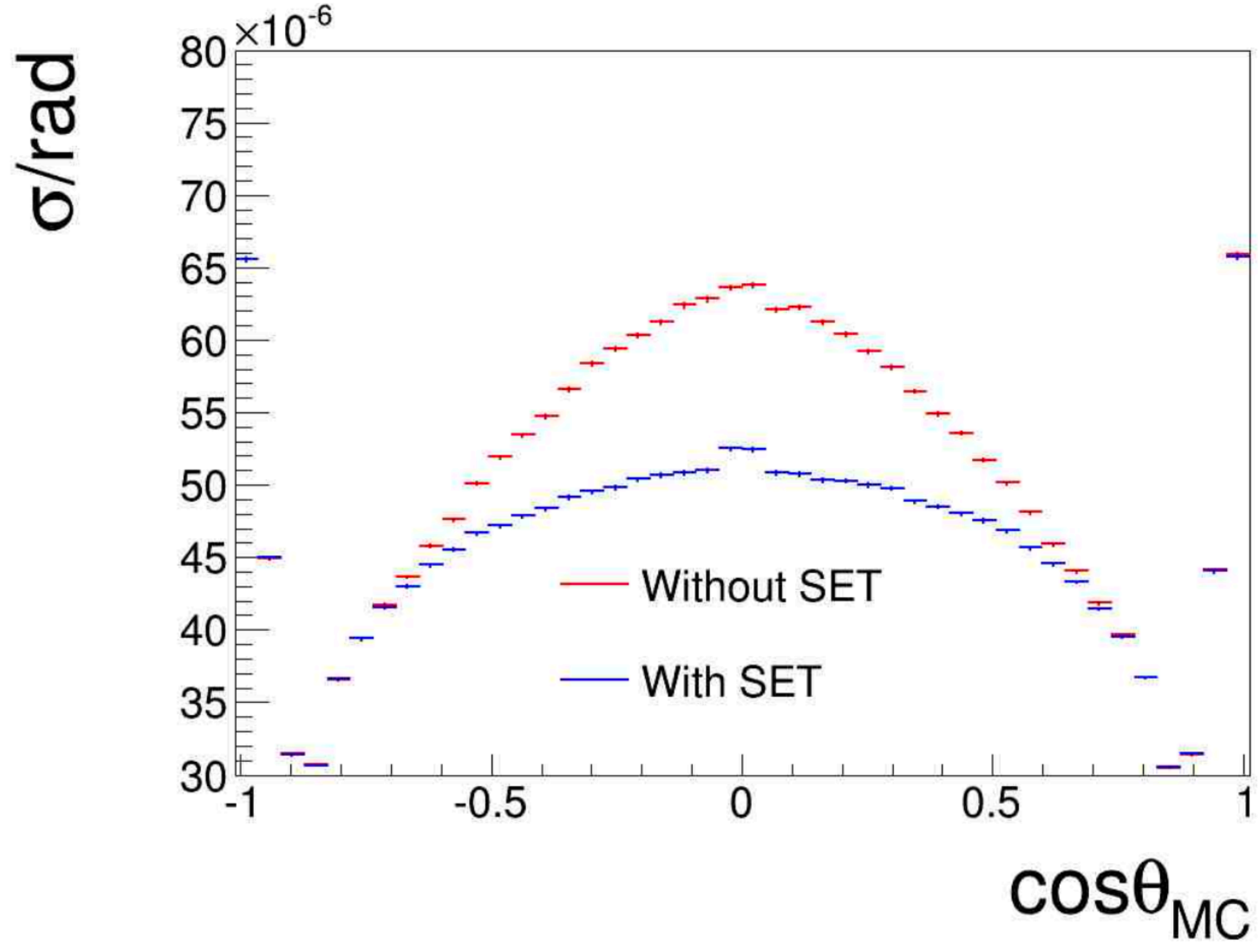
Trk performance

C.Zhang, 14Oct2024

$Rec(\theta) - Gen(\theta)$ vs. θ

- Single muons, momenta: 0.1 - 100 GeV, θ: 8° – 172°

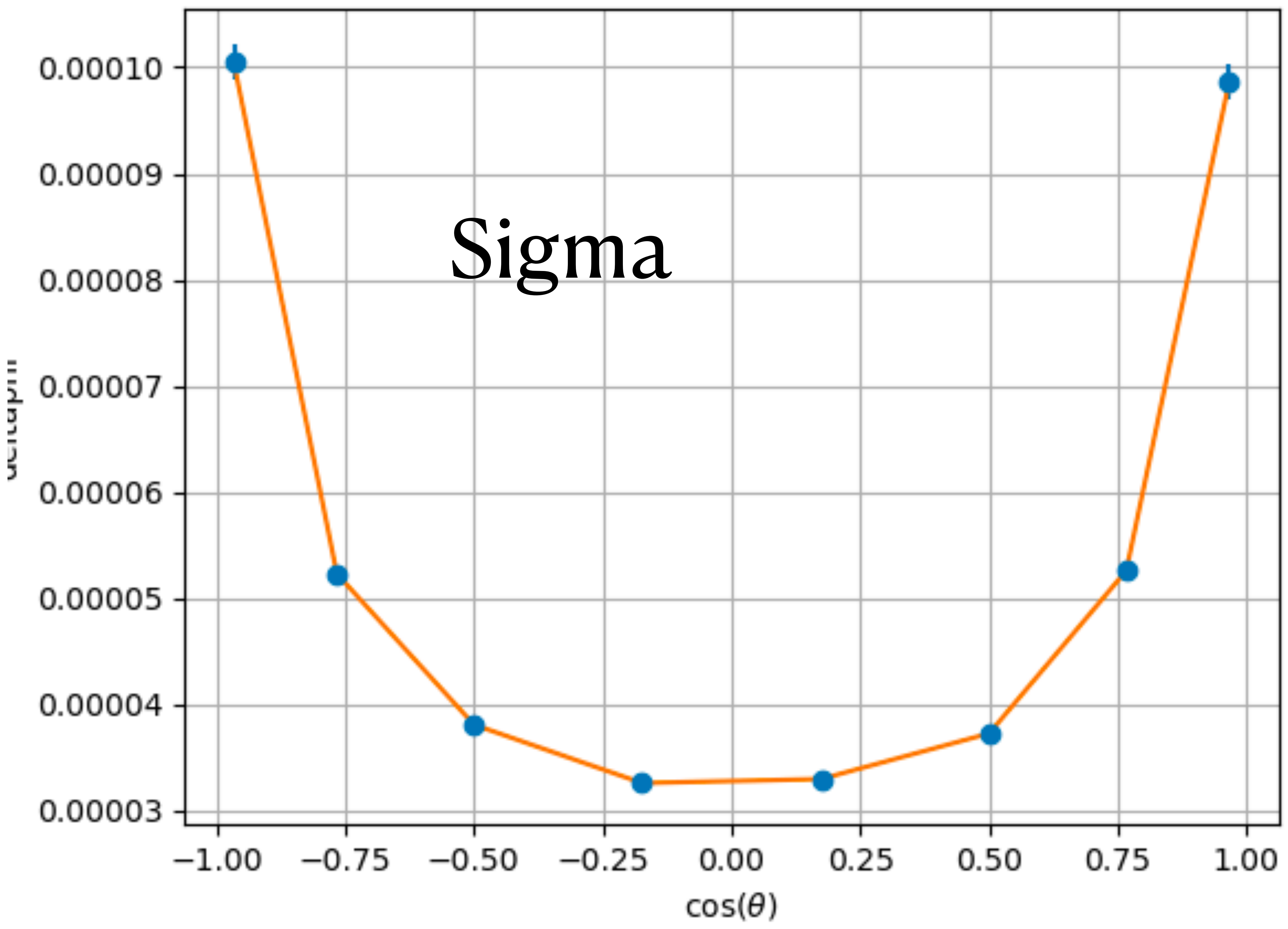


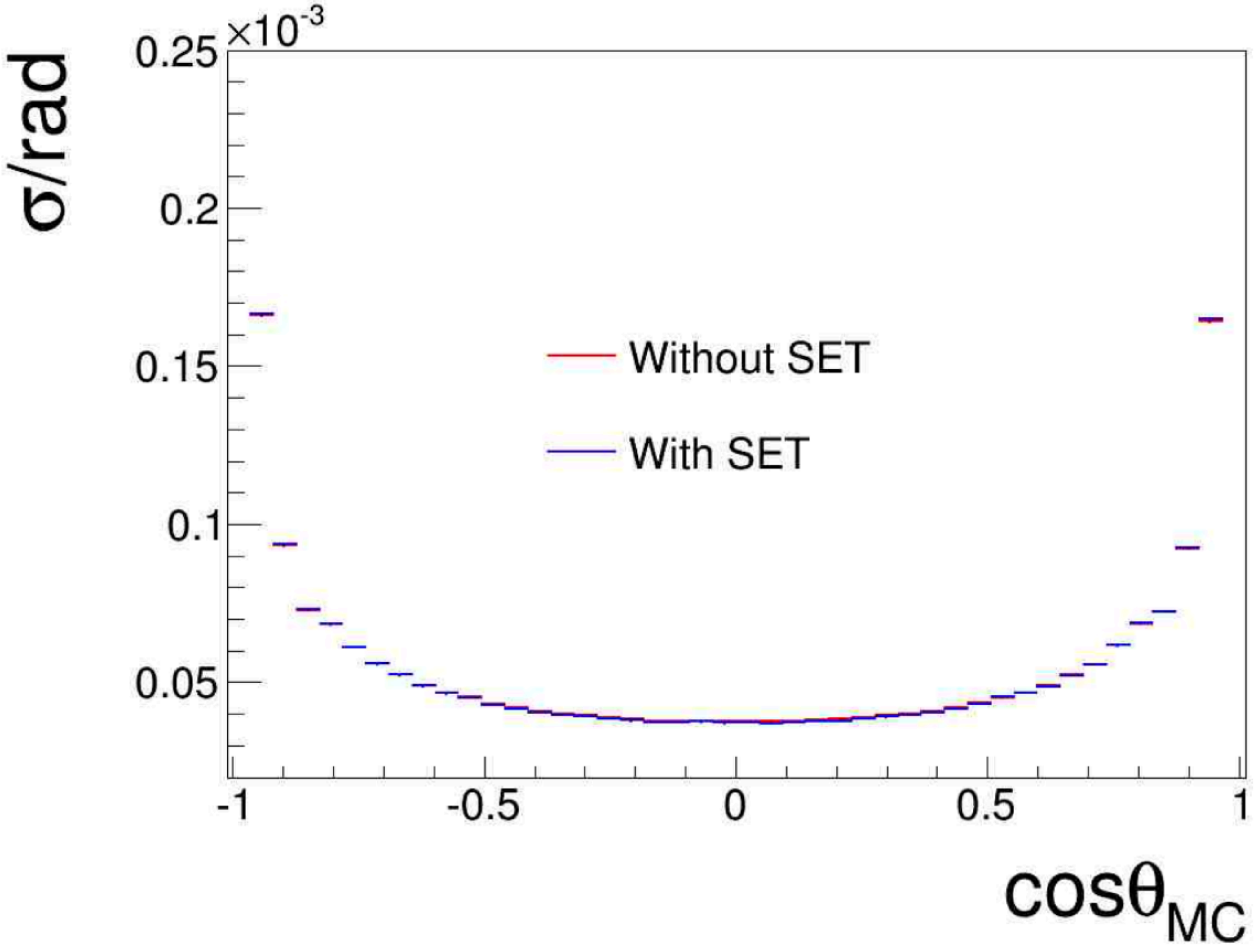


(c) σ_θ

$Rec(\phi) - Gen(\phi)$ vs . θ

- Single muons, momenta: 0.1 - 100 GeV, θ: 8° – 172°

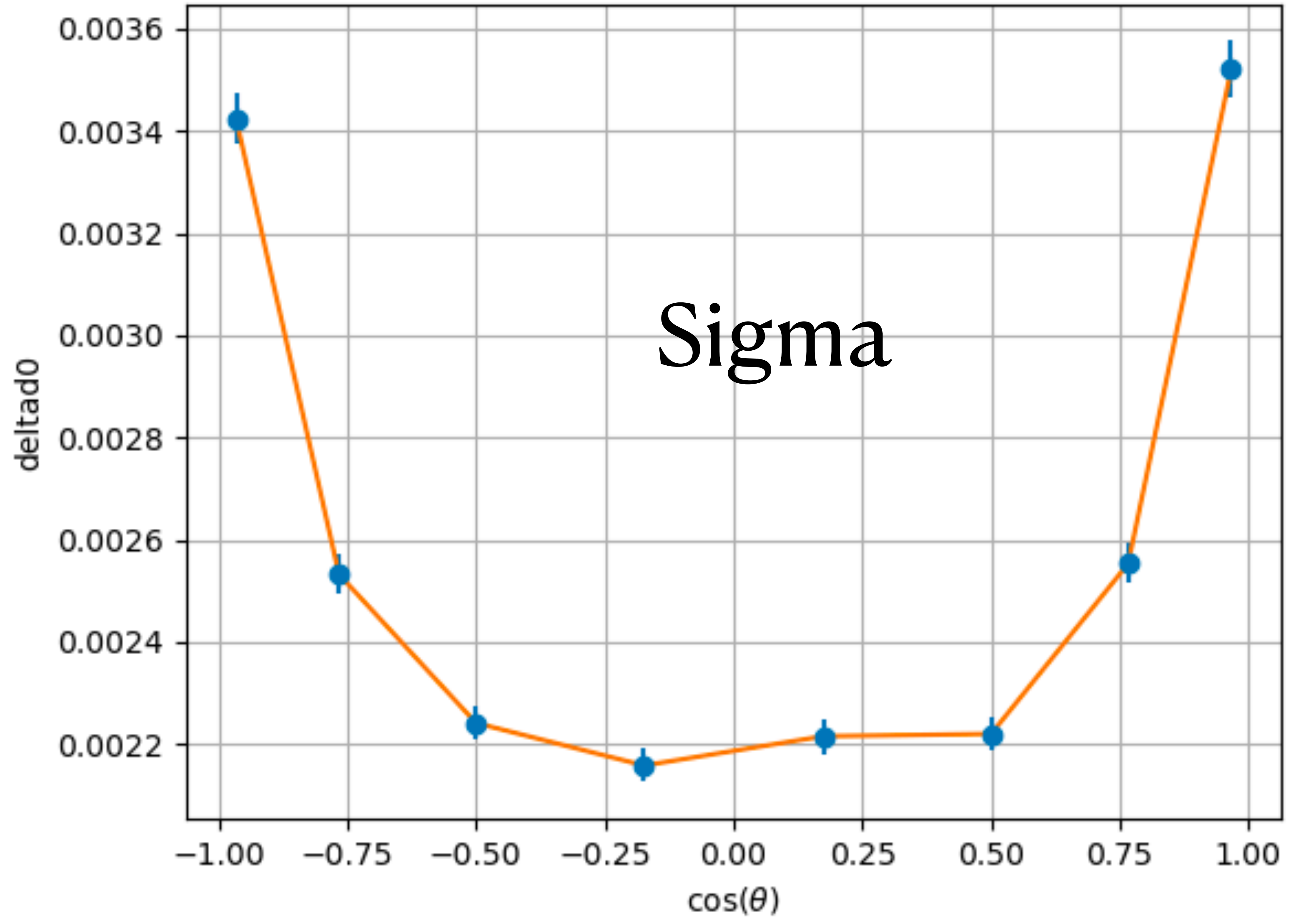


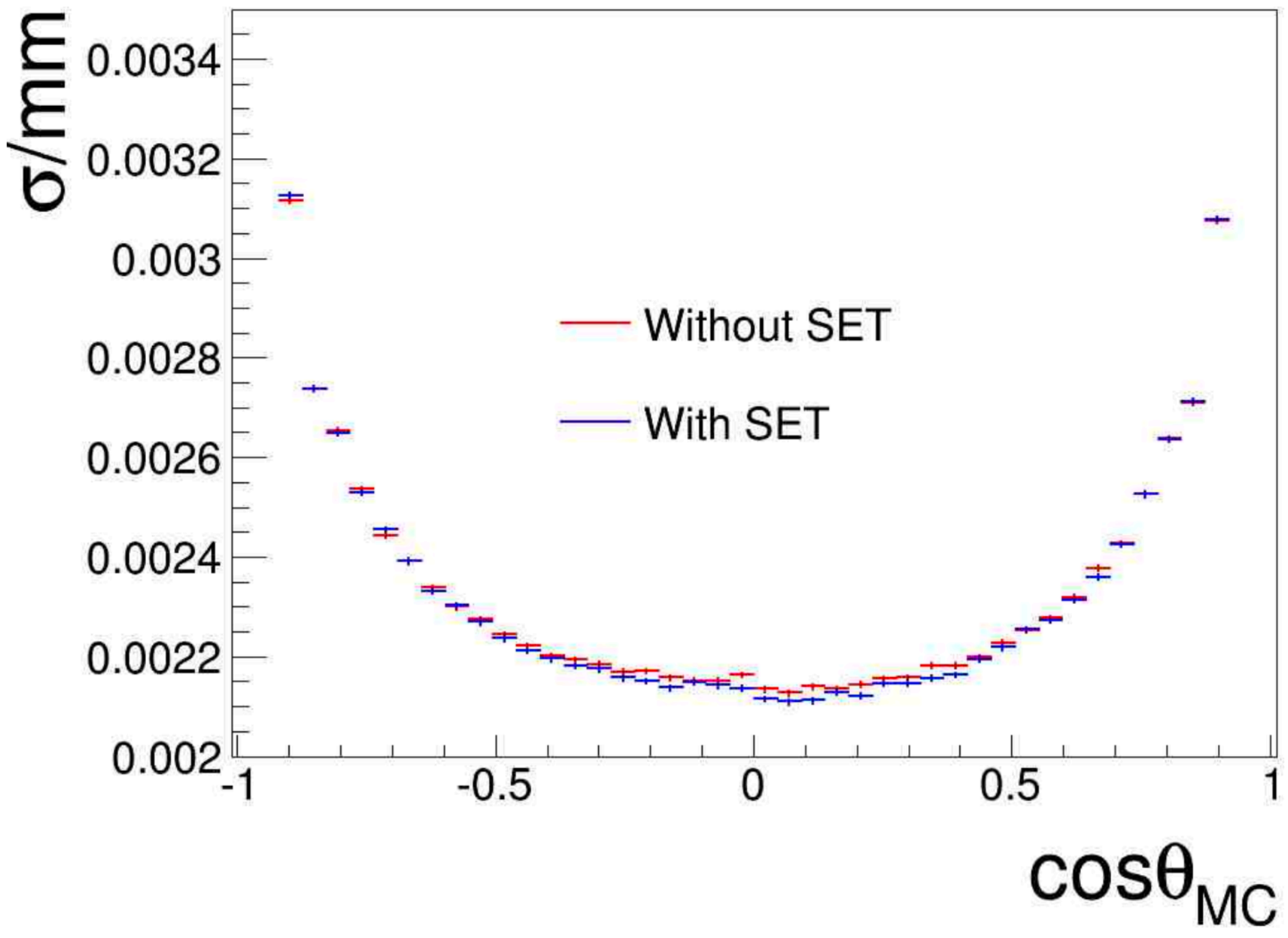


(d) σ_ϕ

$Rec(d_0)$ vs . θ

- Single muons, momenta: 0.1 - 100 GeV, θ: $8^\circ - 172^\circ$

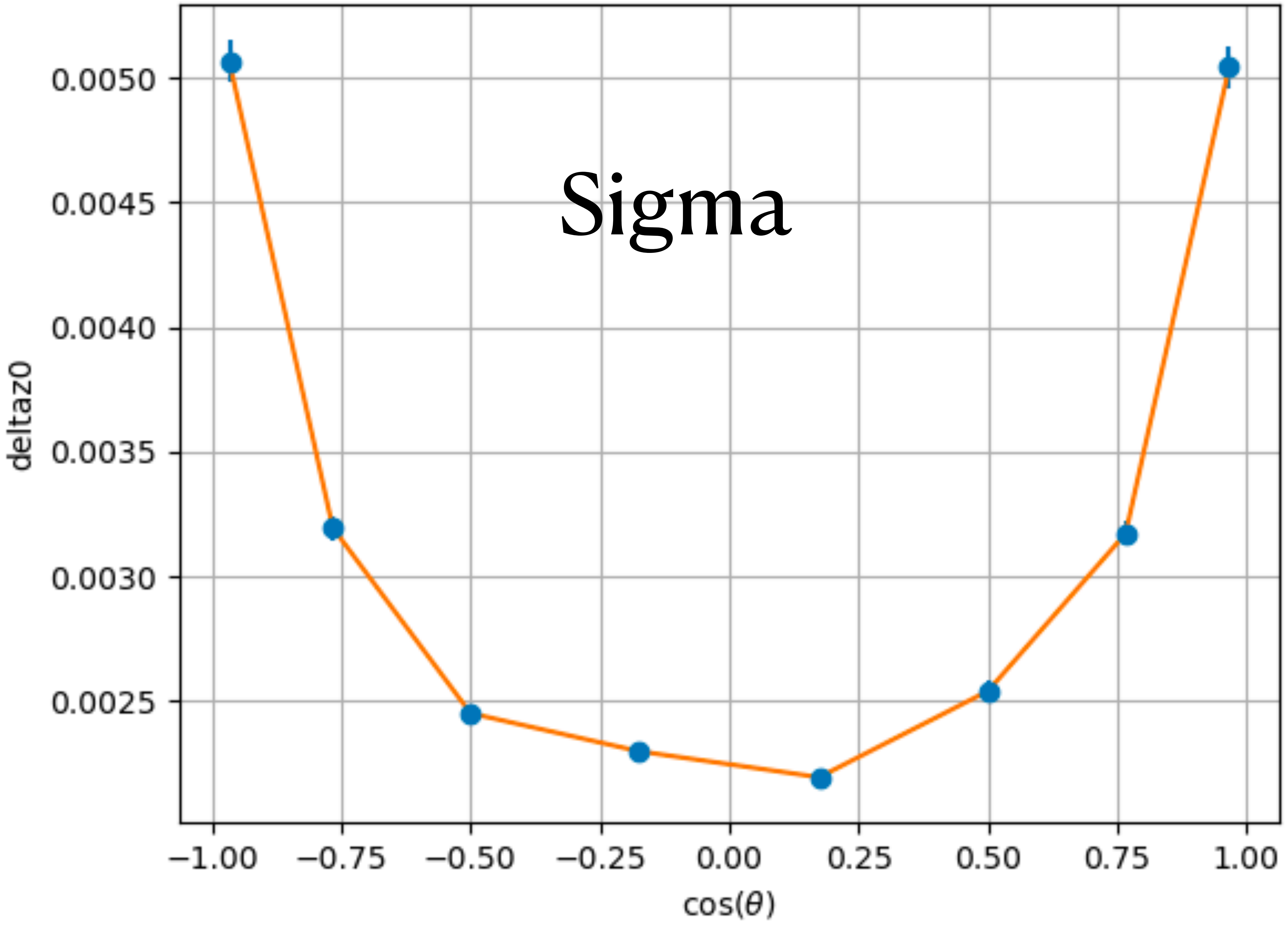


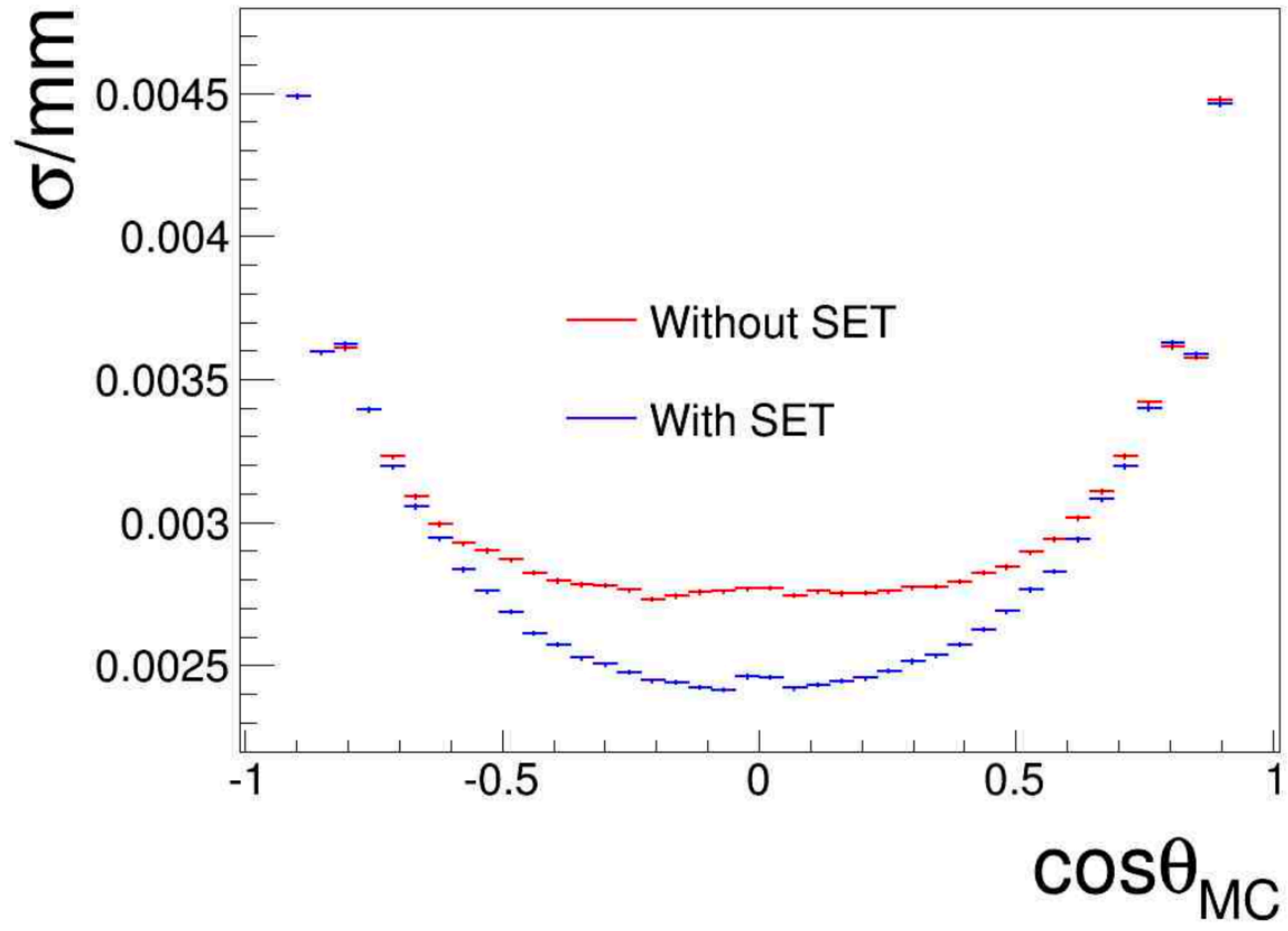


(a) σ_{d_0}

$Rec(z_0)$ vs . θ

- Single muons, momenta: 0.1 - 100 GeV, θ: 8° – 172°

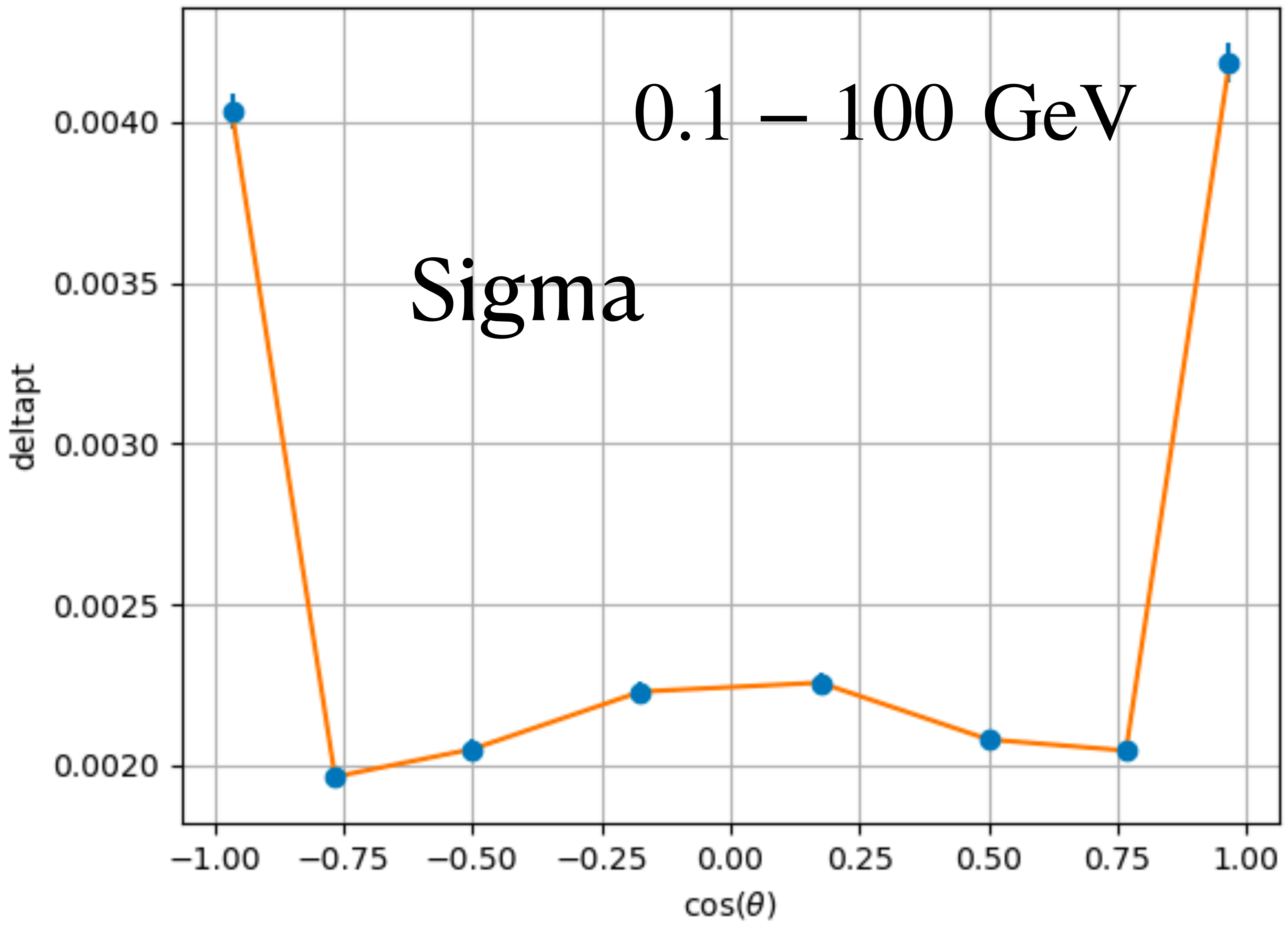


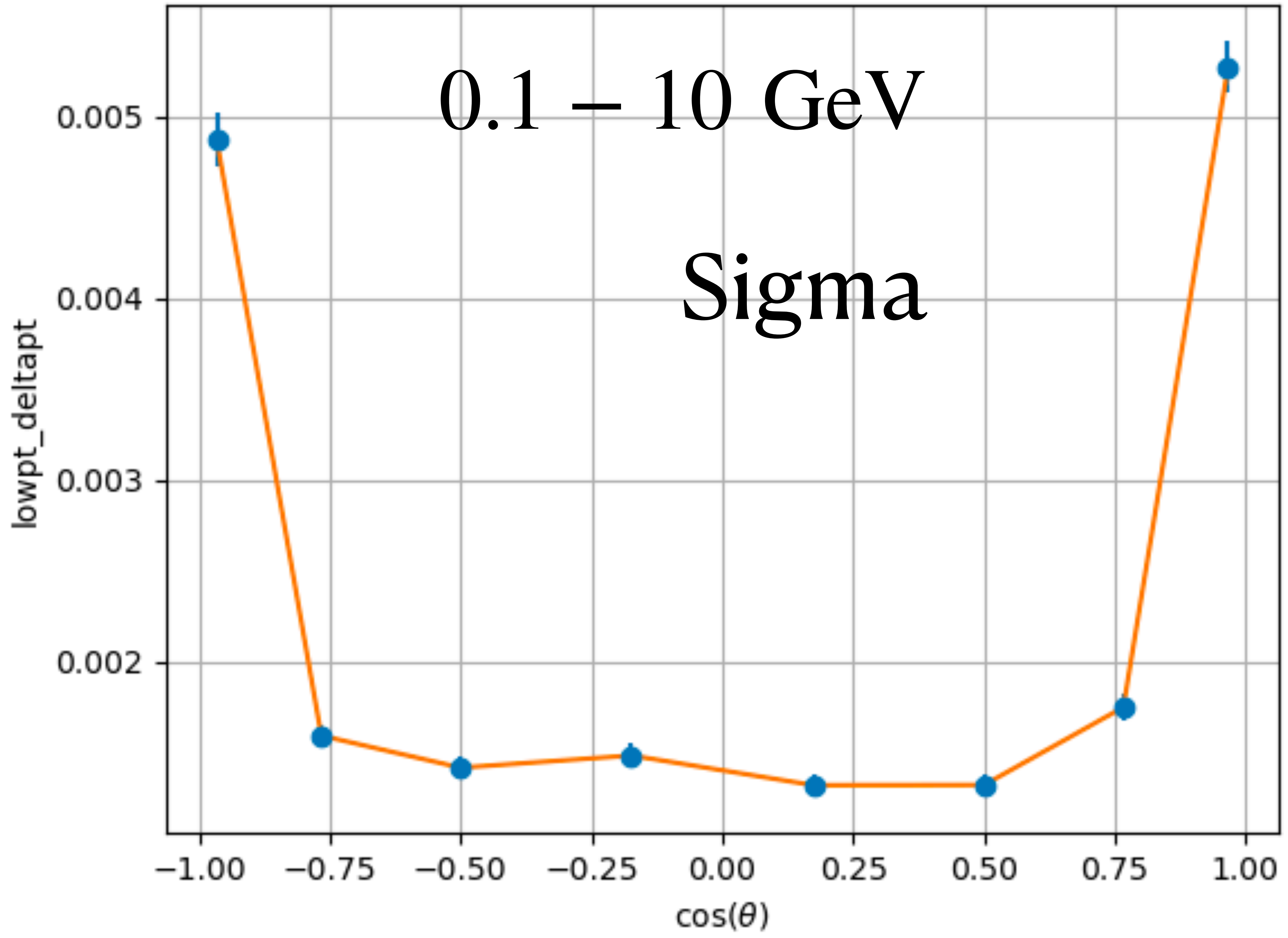


(b) σ_{z_0}

$$\frac{Rec(p_T) - Gen(p_T)}{Gen_{pT}} \text{ vs. } \theta$$

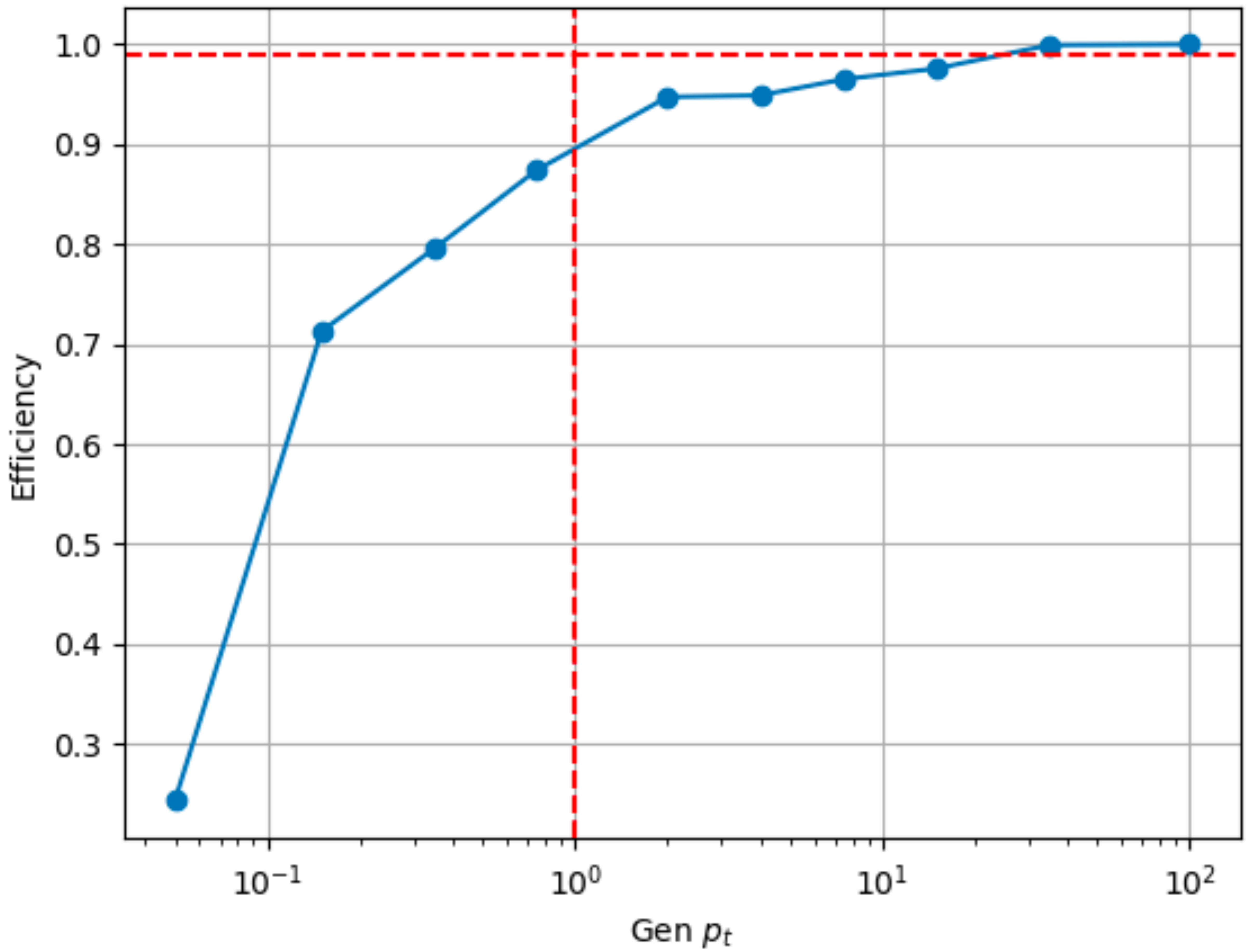
- Single muons, momenta: 0.1 - 100 GeV, θ: $8^\circ - 172^\circ$





Trk Eff. vs p_T

- Single muons, momenta: 0.1 - 100 GeV, θ: $8° - 172°$

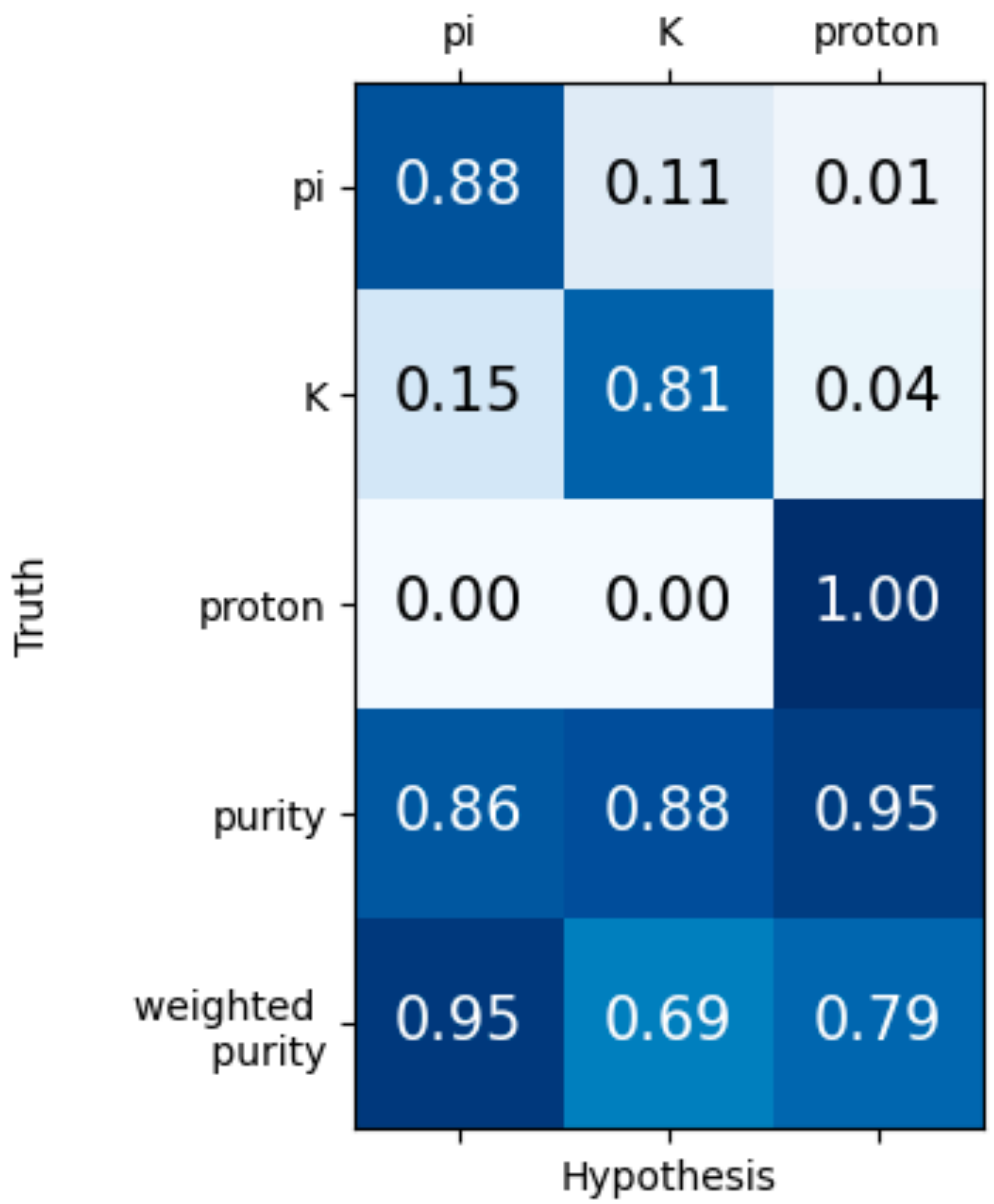


PID performance

PID eff. & purity

- Particle gun, $N_K : N_\pi : N_{proton} = 1 : 1 : 1,$ weight to 10 : 3 : 1

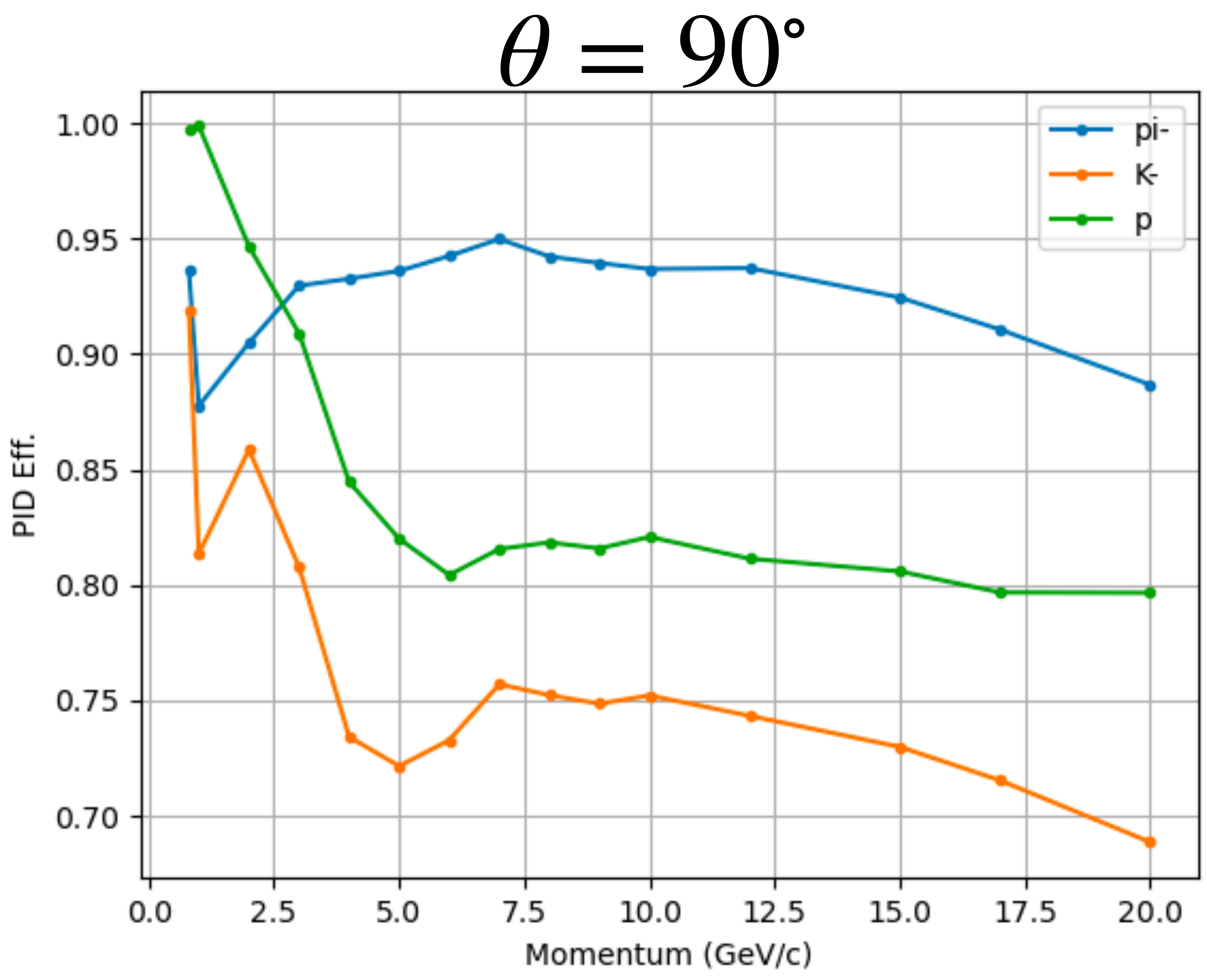
- PID efficiency/purity, K as example
  - Eff. $= \dfrac{N_{K \to K}}{N_{K_{produced}}}$
  - Purity $= \dfrac{N_{K \to K}}{N_{p \to K} + N_{K \to K} + N_{\pi \to K}}$

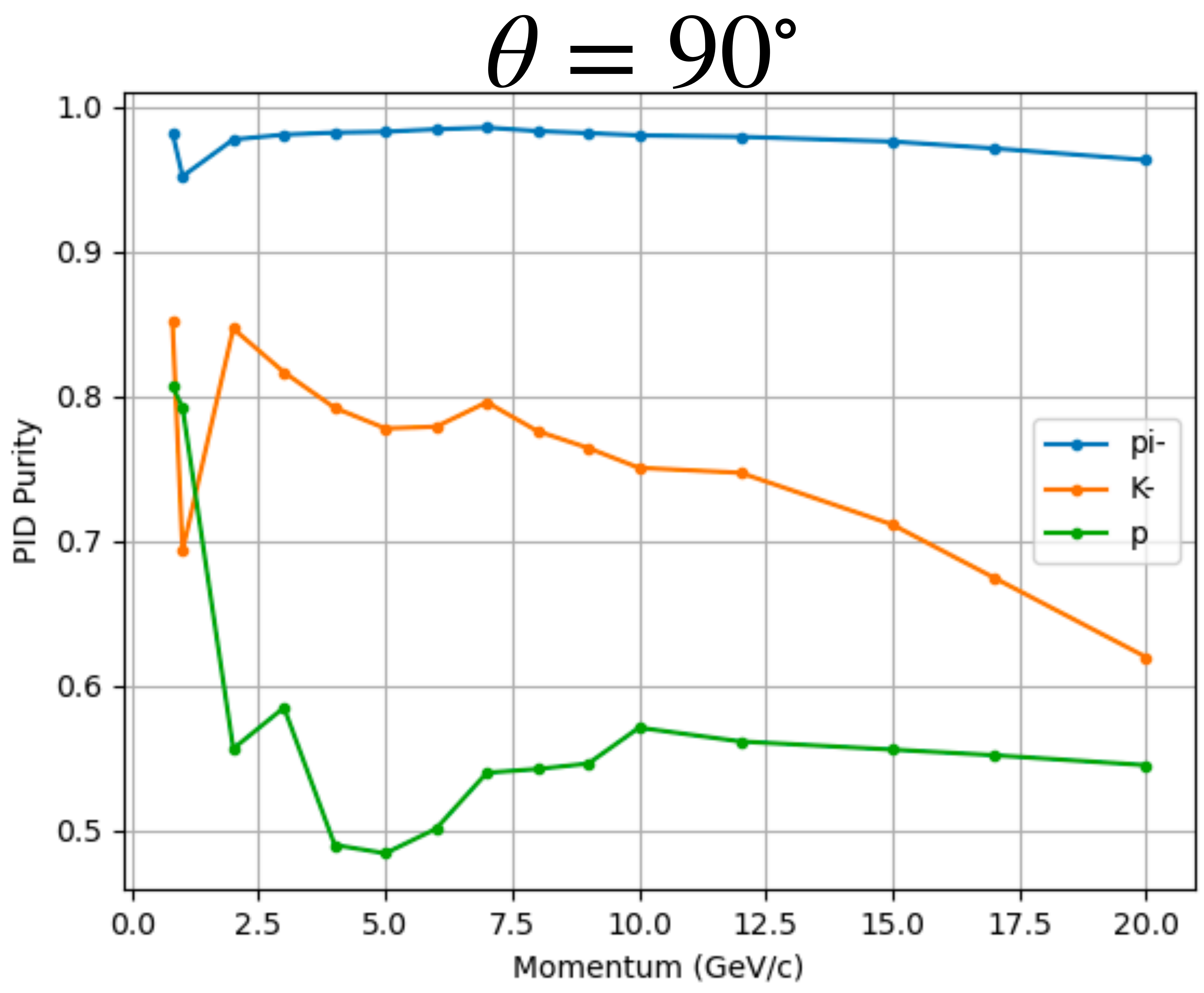


$1GeV, \theta = 90^\circ$

PID eff. & purity @$\theta = 90°$

- Particle gun, $N_K : N_\pi : N_{proton} = 1:1:1,$ weight to $10:3:1$

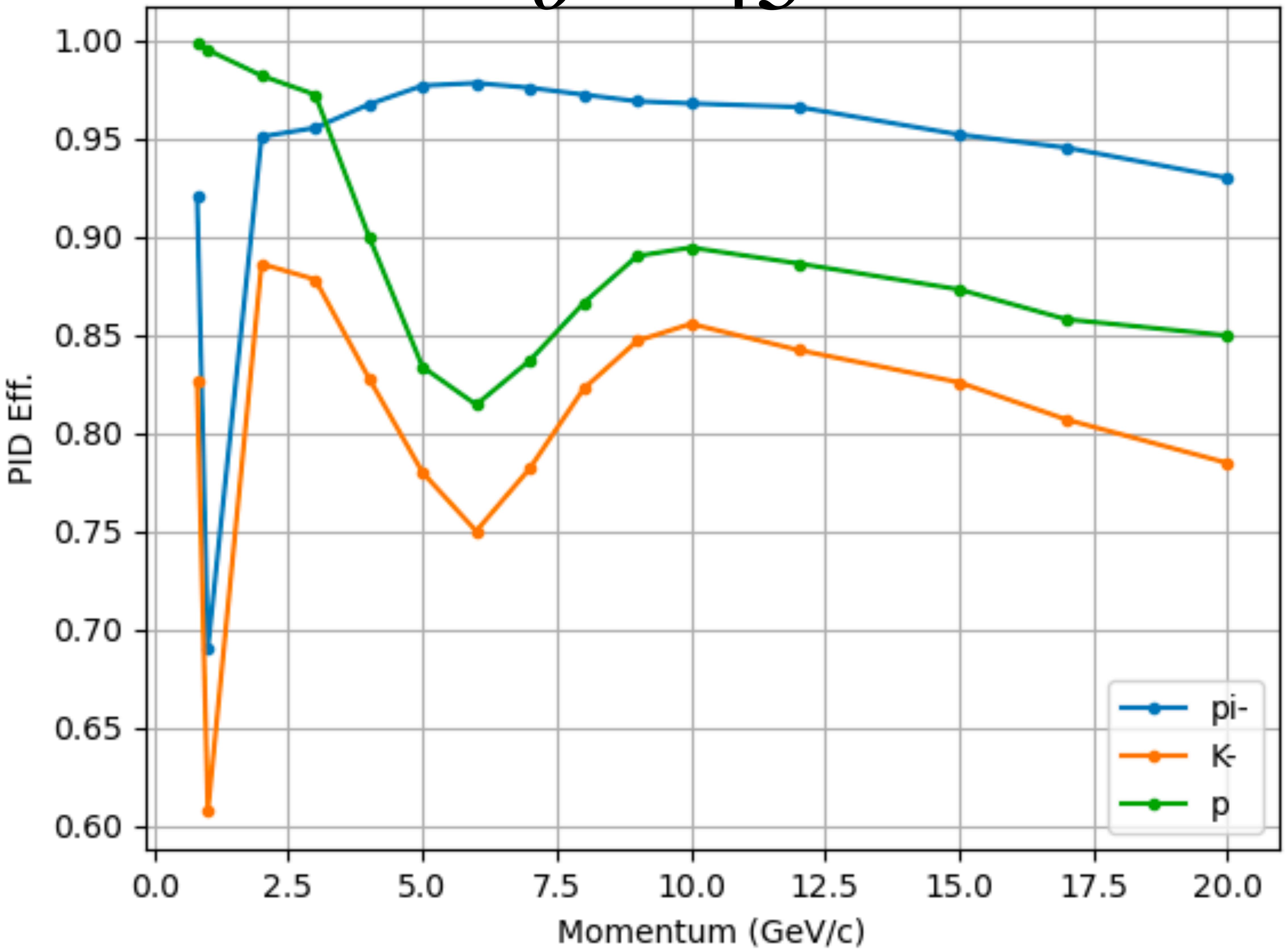




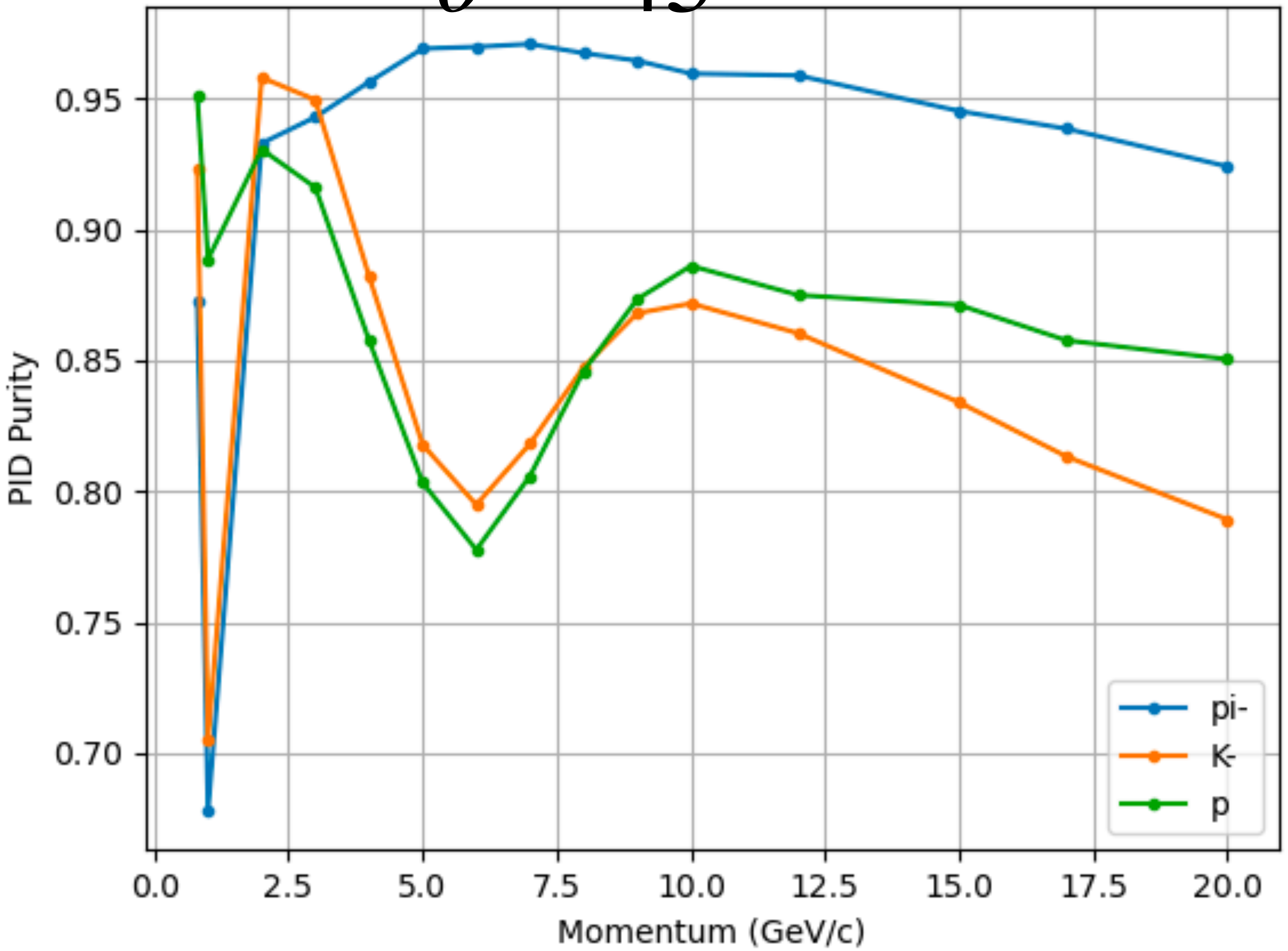
PID eff. & purity @$\theta = 45°$

- Particle gun, $N_K : N_\pi : N_{proton} = 1 : 1 : 1,$ weight to 10 : 3 : 1

$\theta = 45°$

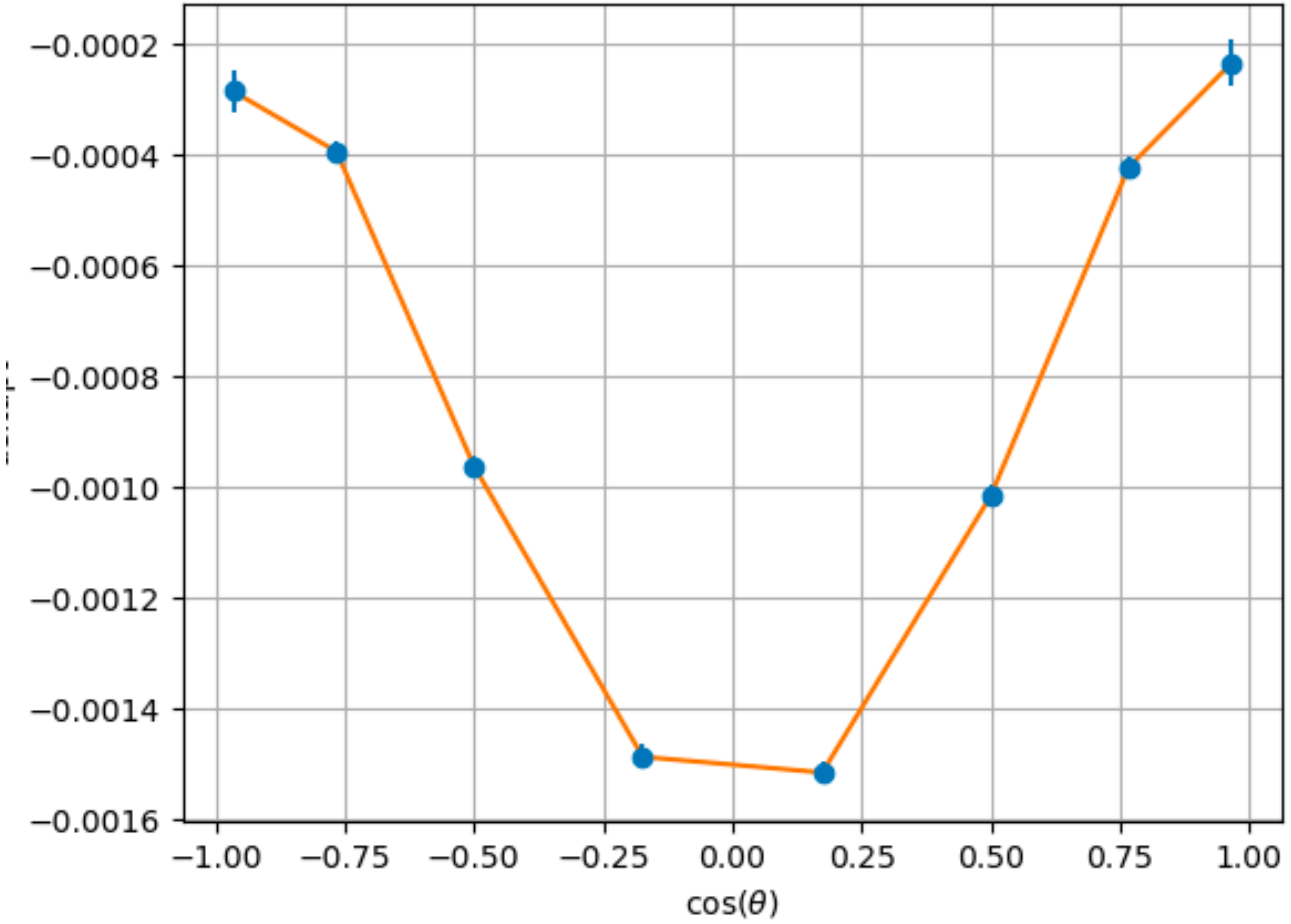


$\theta = 45°$

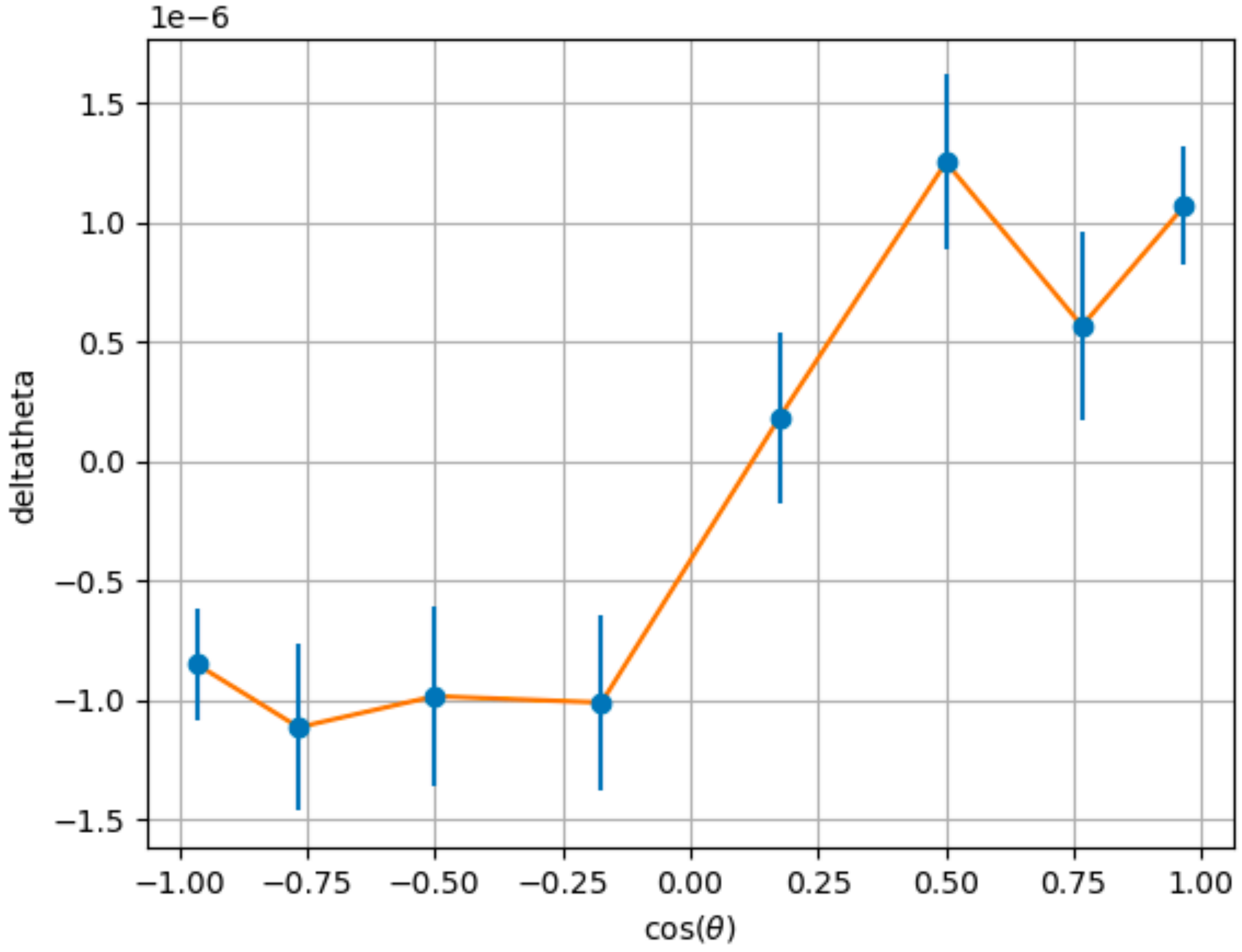


backup

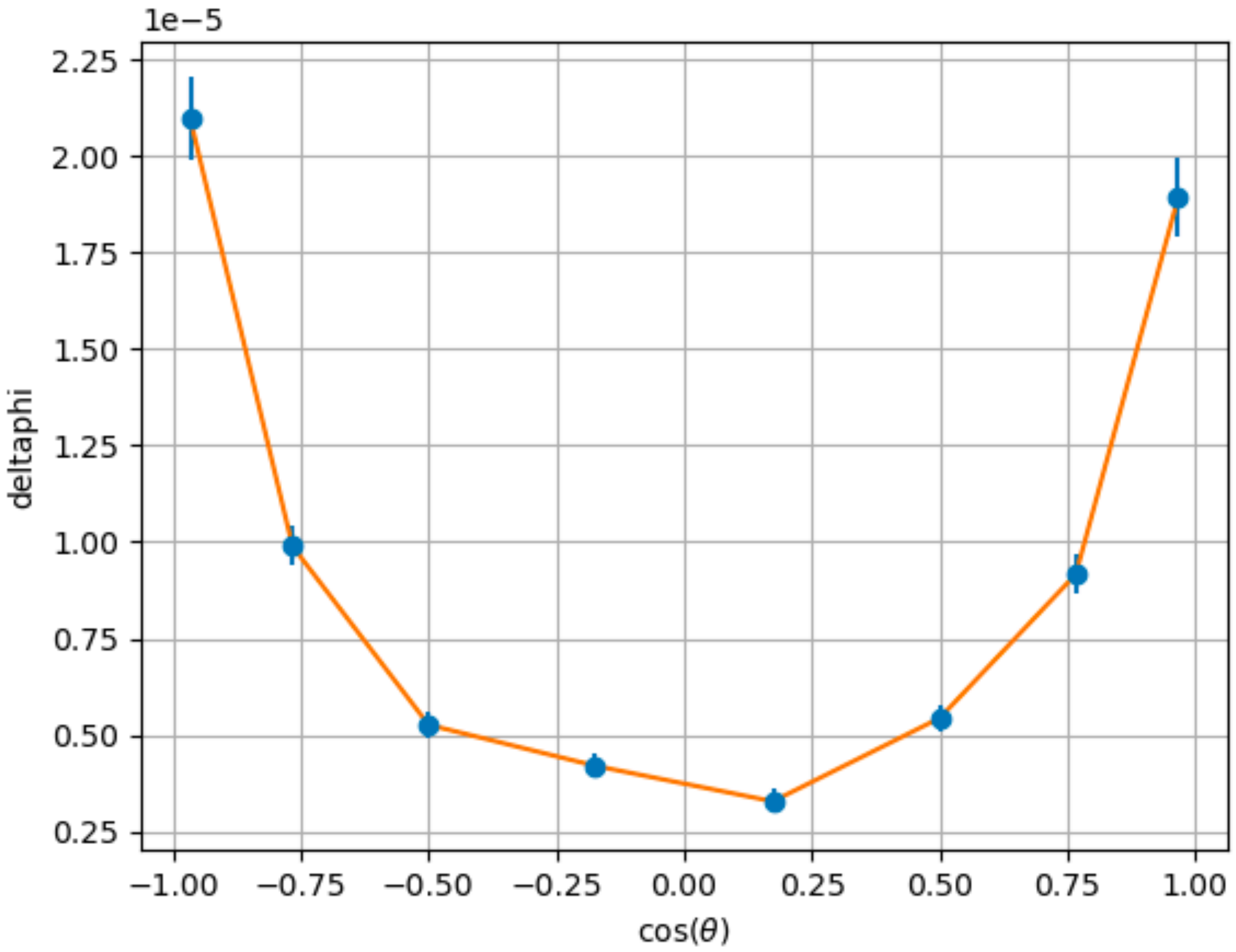
$$\mathbf{mean,}\ \frac{Rec(p_T) - Gen(p_T)}{Gen_{pT}}\ \mathrm{vs.}\ \theta$$



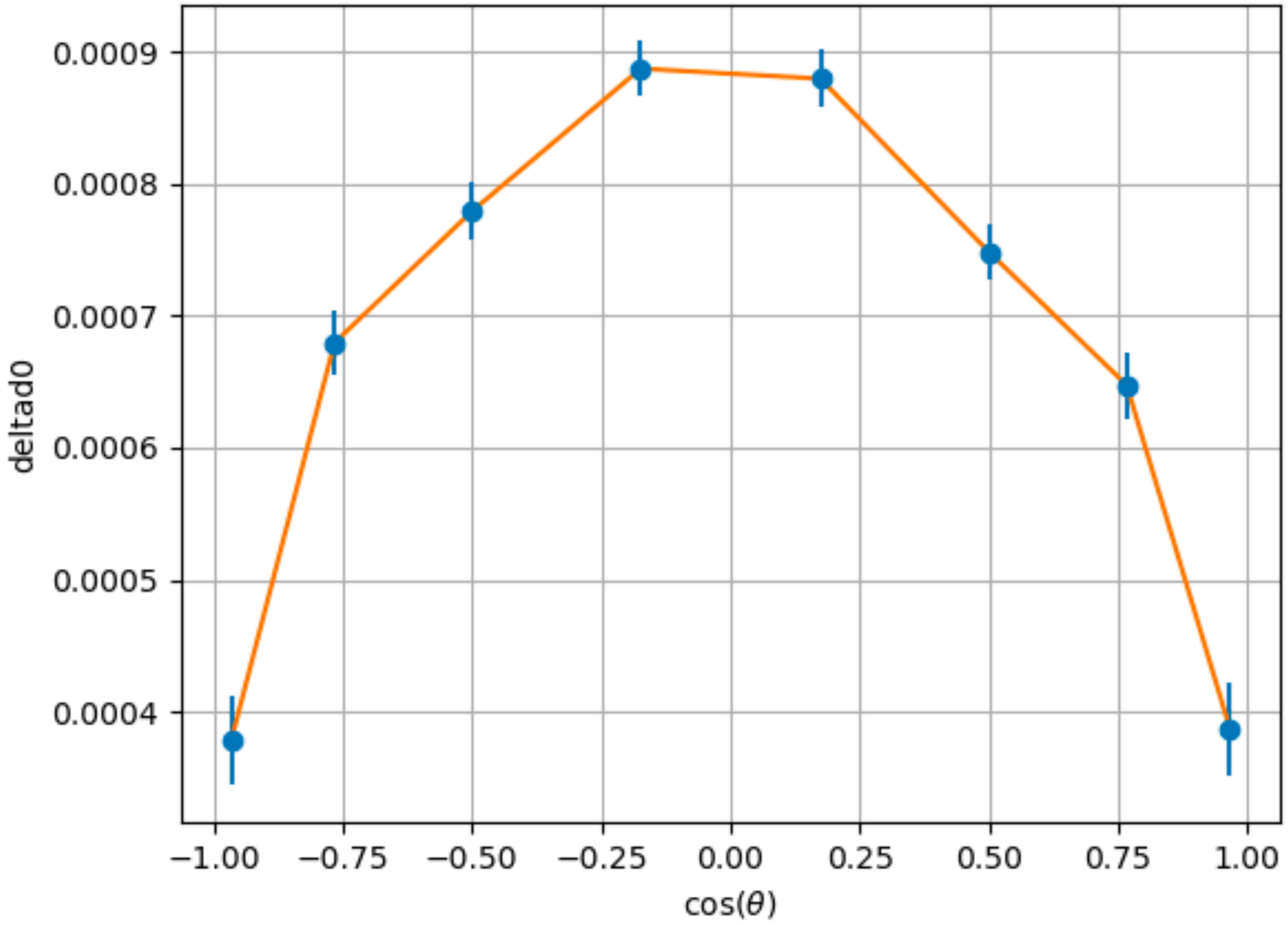
mean, $Rec(\theta) - Gen(\theta)$ vs . θ



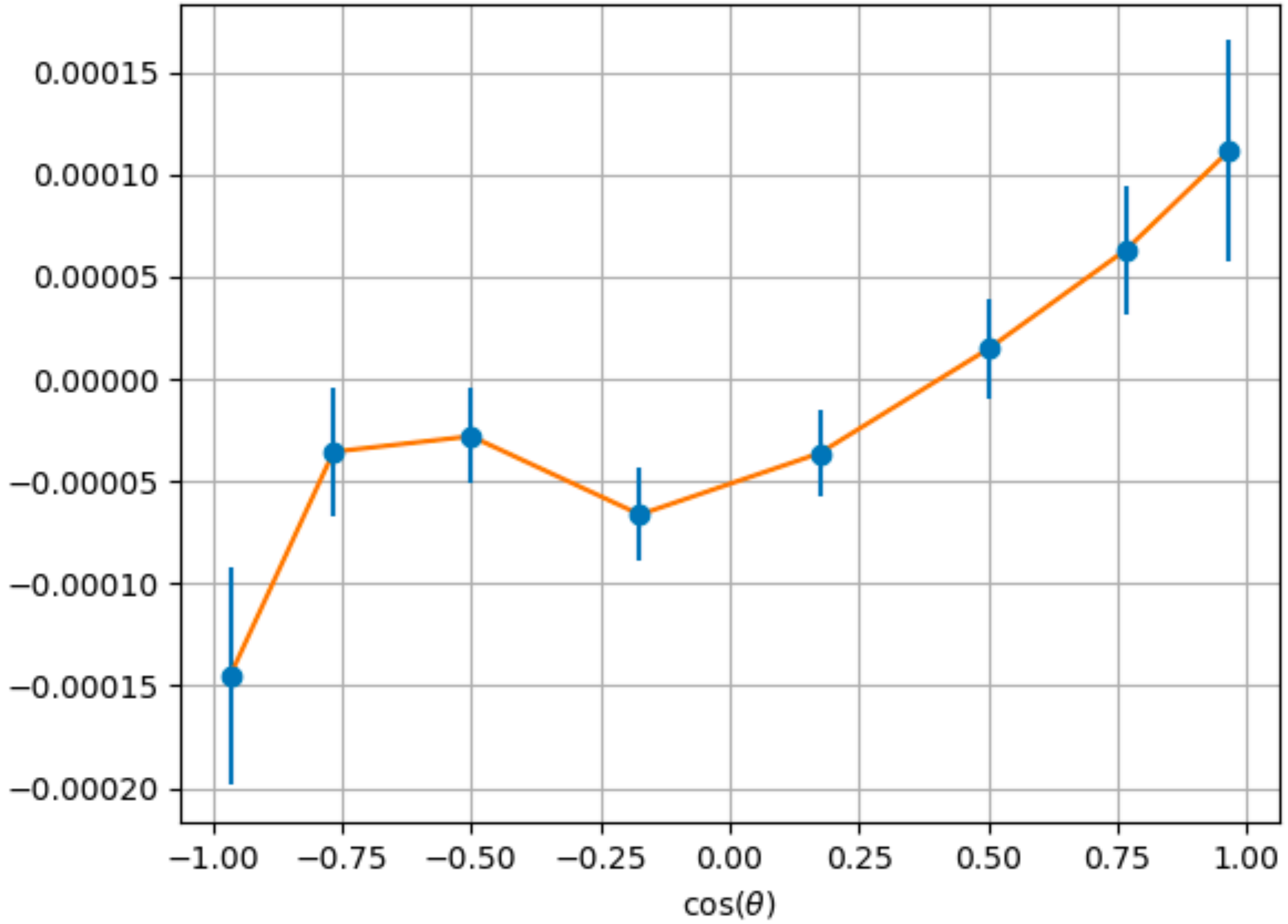
mean, $Rec(\phi) - Gen(\phi)$ vs . θ



mean, $Rec(d_0)$ vs. θ



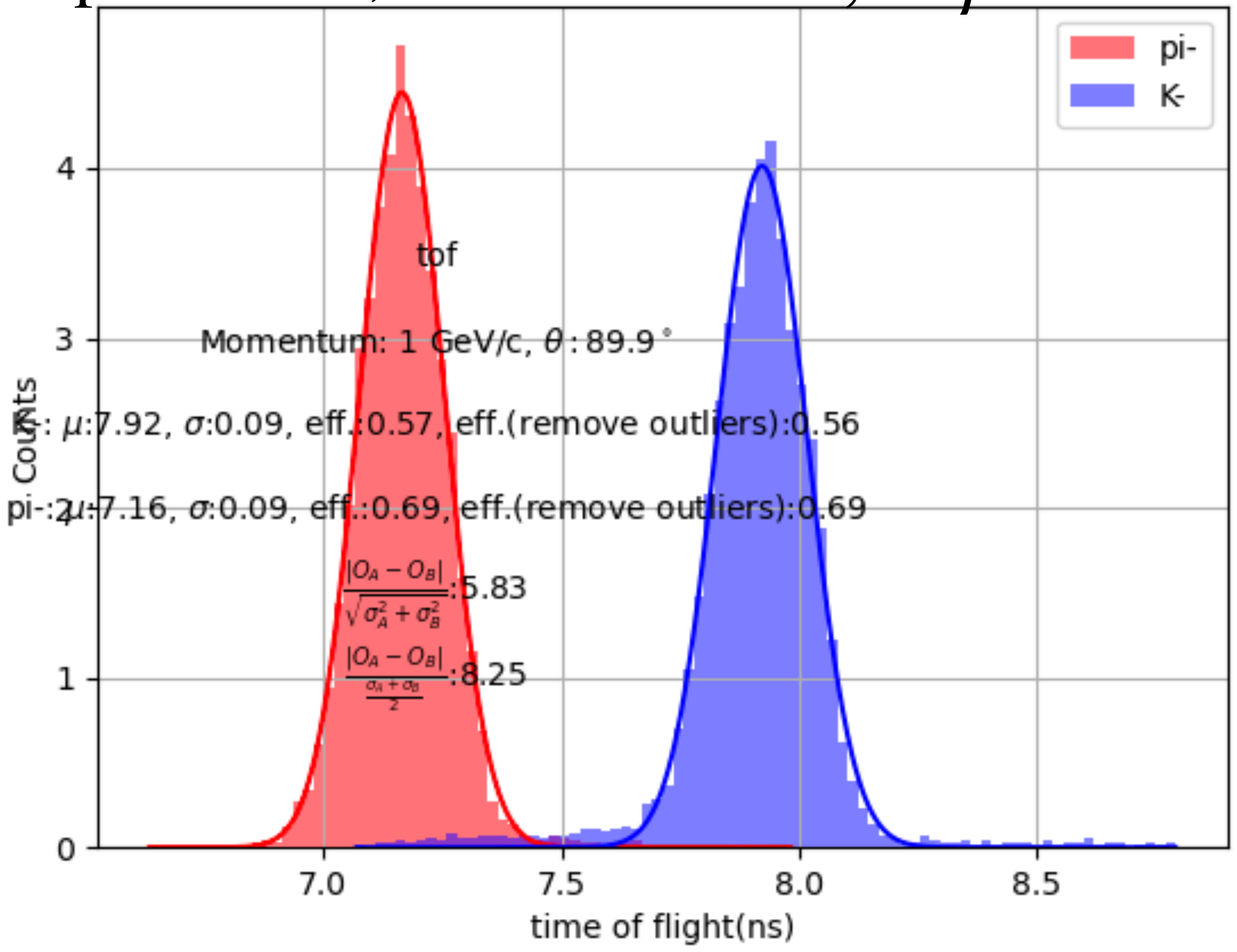
mean, $Rec(z_0)$ vs . θ



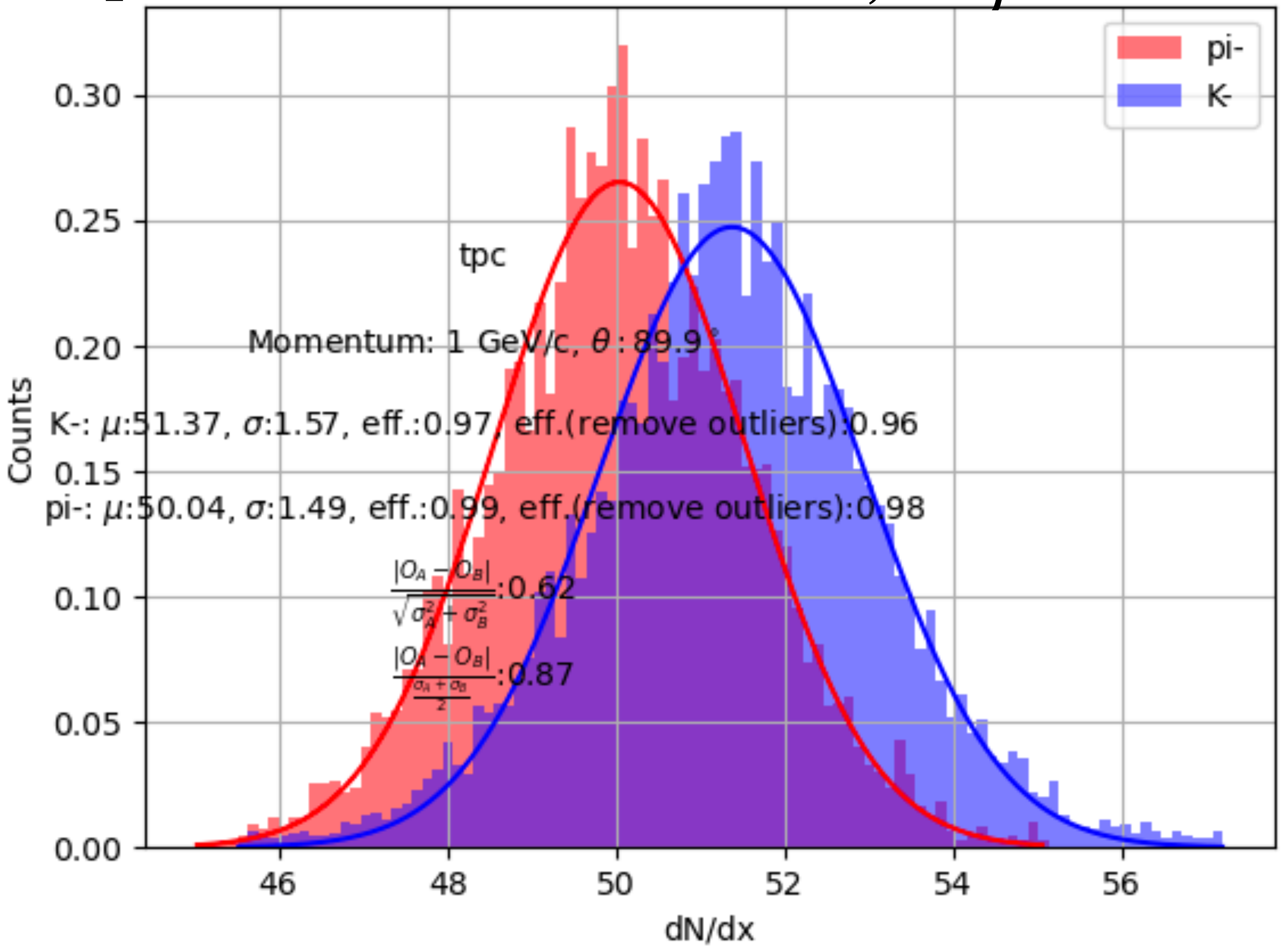
K/Pi Separation

- K^-, π^-, momenta = 1 GeV, $\theta = 90°$ as examples
  - Smear truth ToF time by $50 \oplus 20 \approx 54$ ps for intrinsic and bunch-crossing

$p = 1\mathrm{GeV}, \theta = 90°$ ToF, $\sigma/\mu \sim 2\,\%$

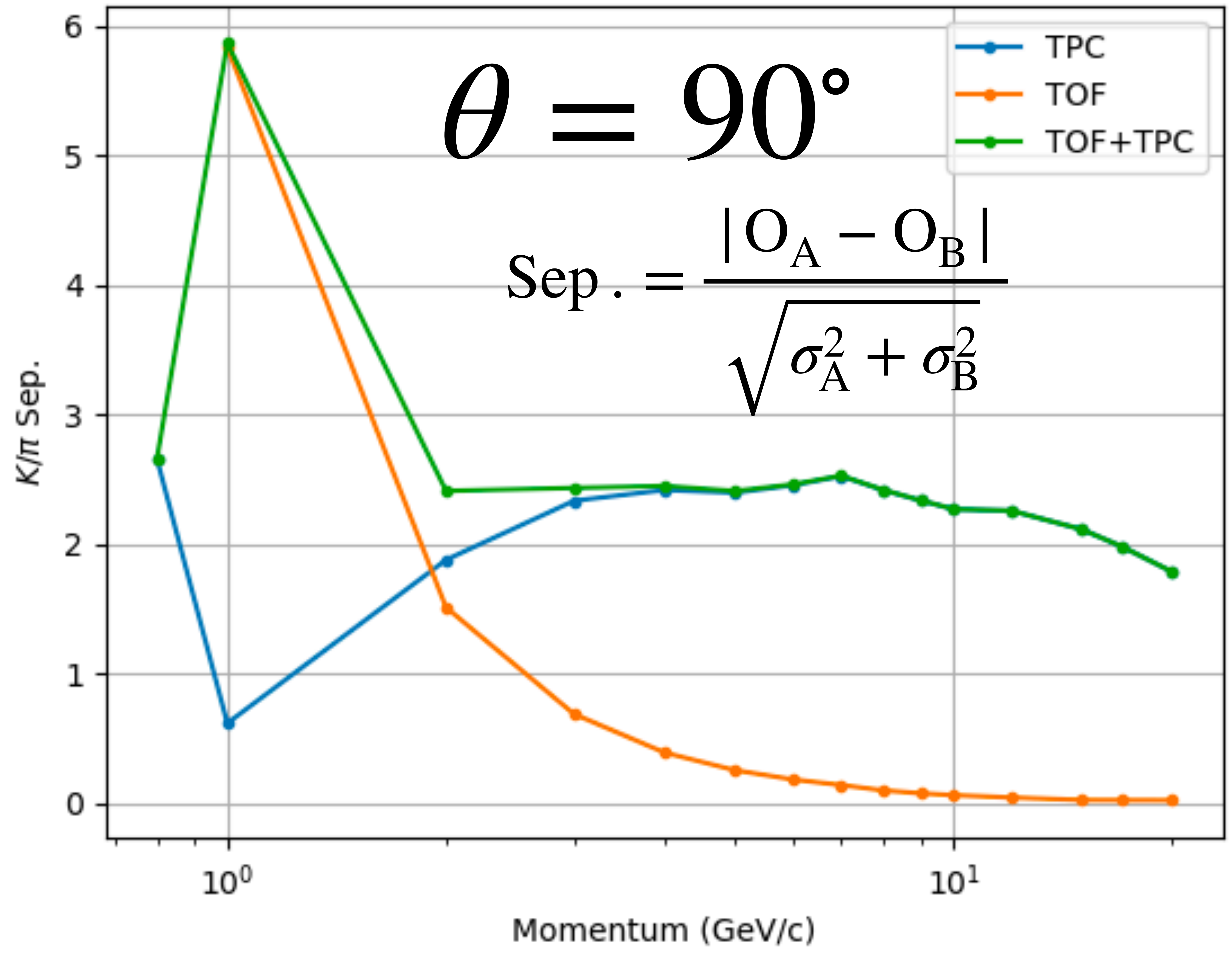


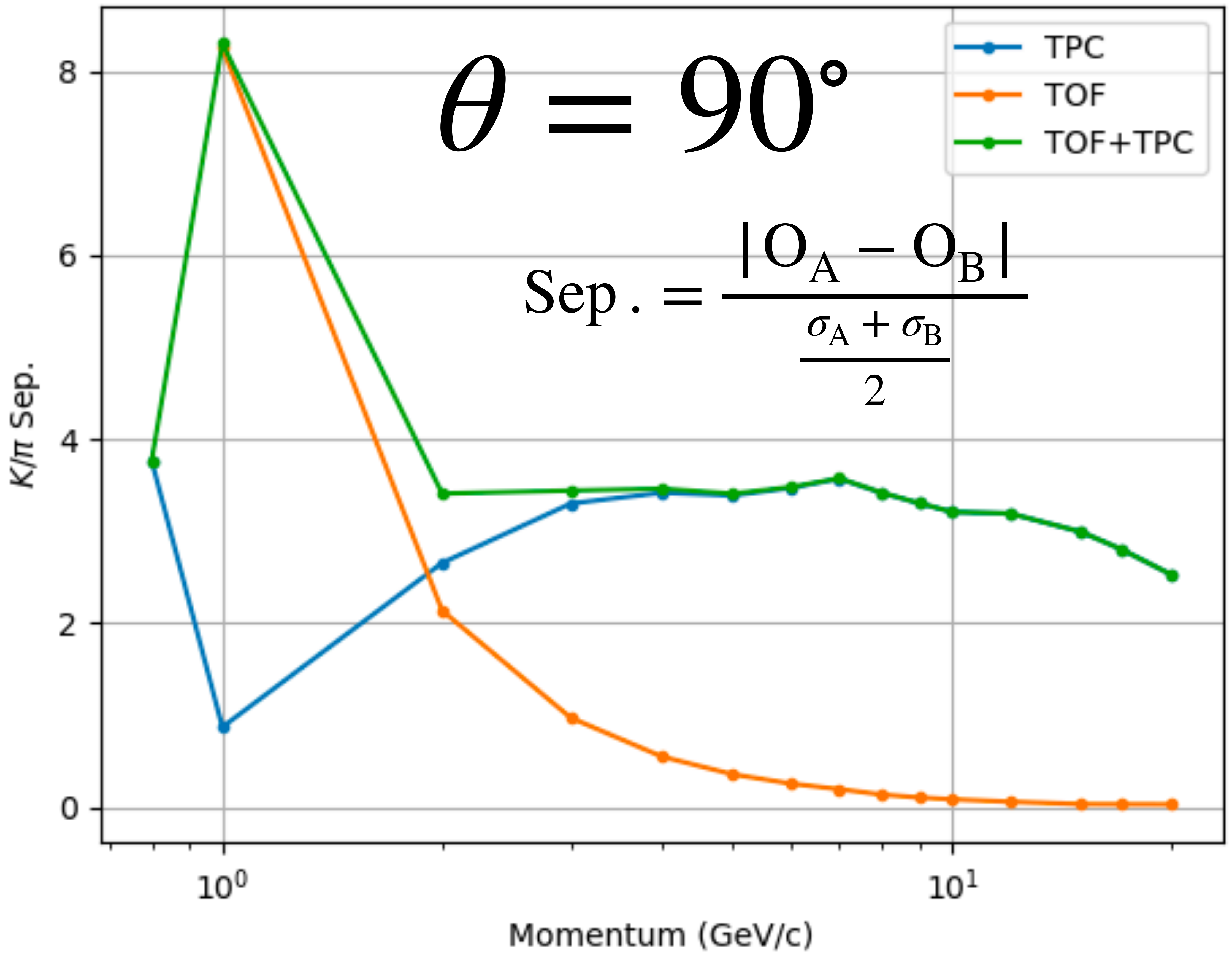
$p = 1\mathrm{GeV}, \theta = 90°$ TPC, $\sigma/\mu \sim 3\,\%$



K/Pi Separation

- K/Pi separation, $\theta = 90°$, O ~ Observable (time for ToF, dNdx for TPC), A/B ~ particle species
  - Remove ToF contribution at 0.8 GeV because of a low efficiency

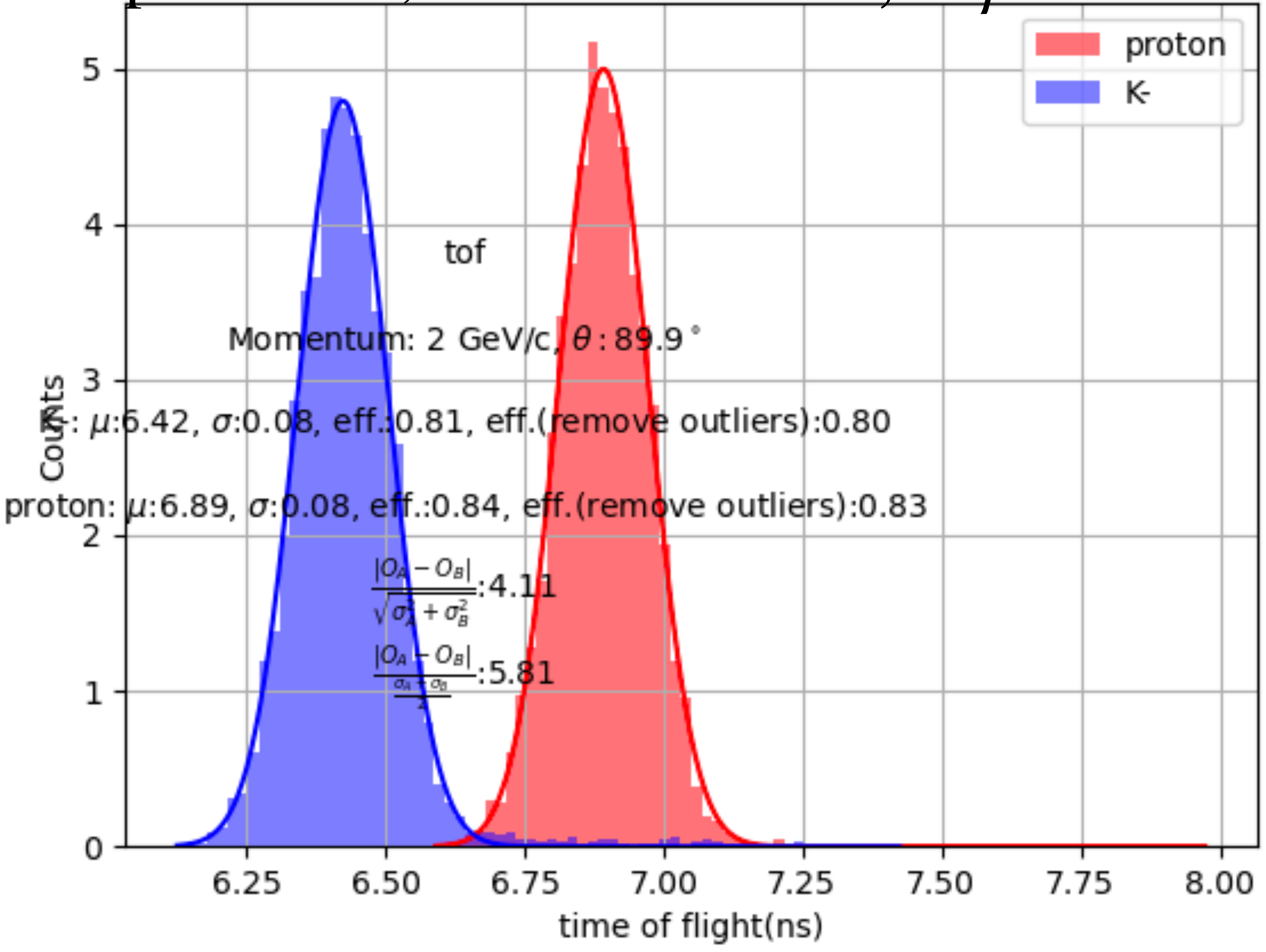




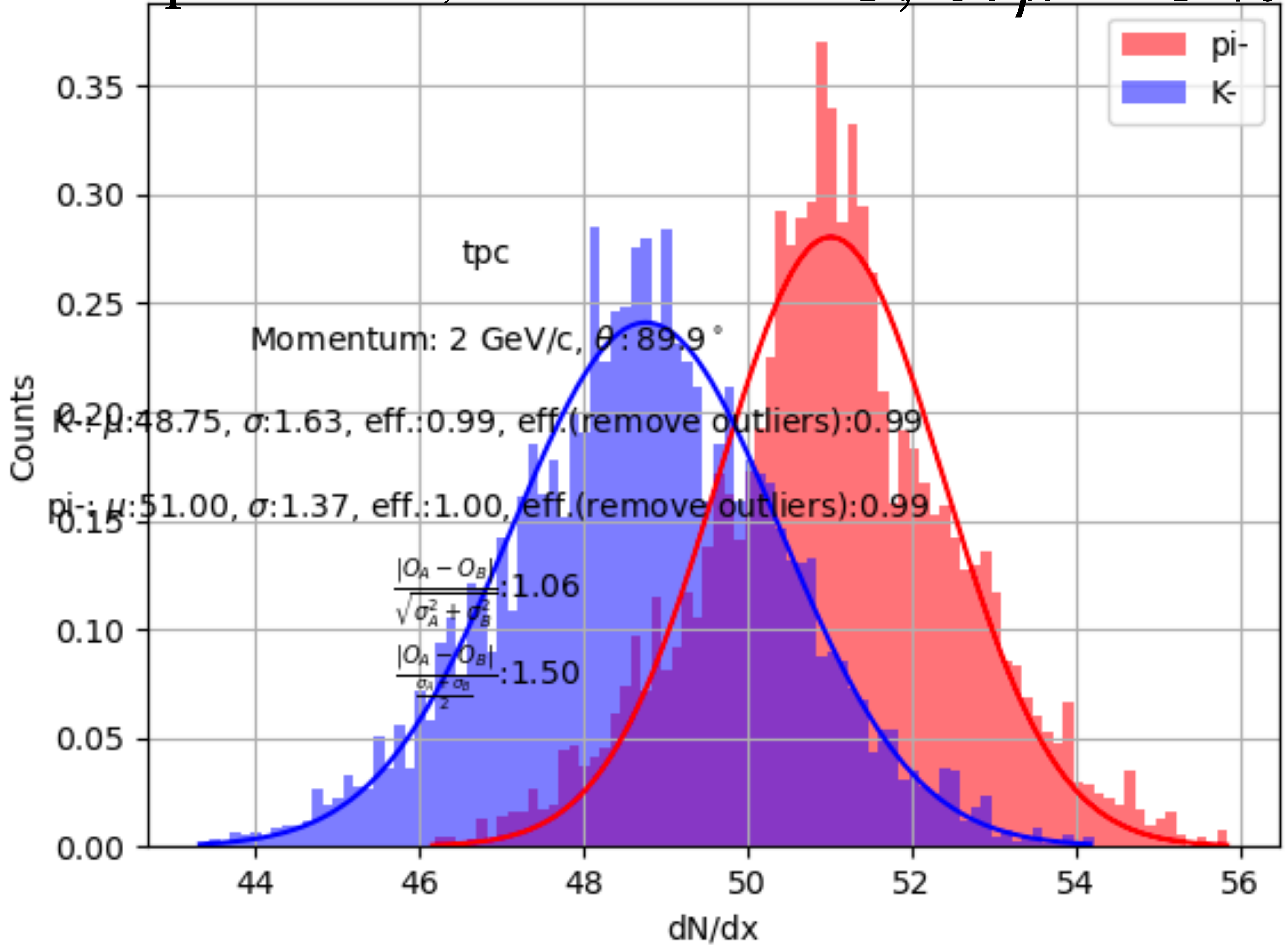
K/Proton Separation

- K^{-}, *proton*, momenta = **2** GeV, $\theta = 90^{\circ}$ as examples
- Smear truth ToF time by $50 \oplus 20 \approx 54$ ps for intrinsic and bunch-crossing

$p = 2\text{GeV}, \theta = 90^{\circ}$ ToF, $\sigma/\mu \sim 1\,\%$

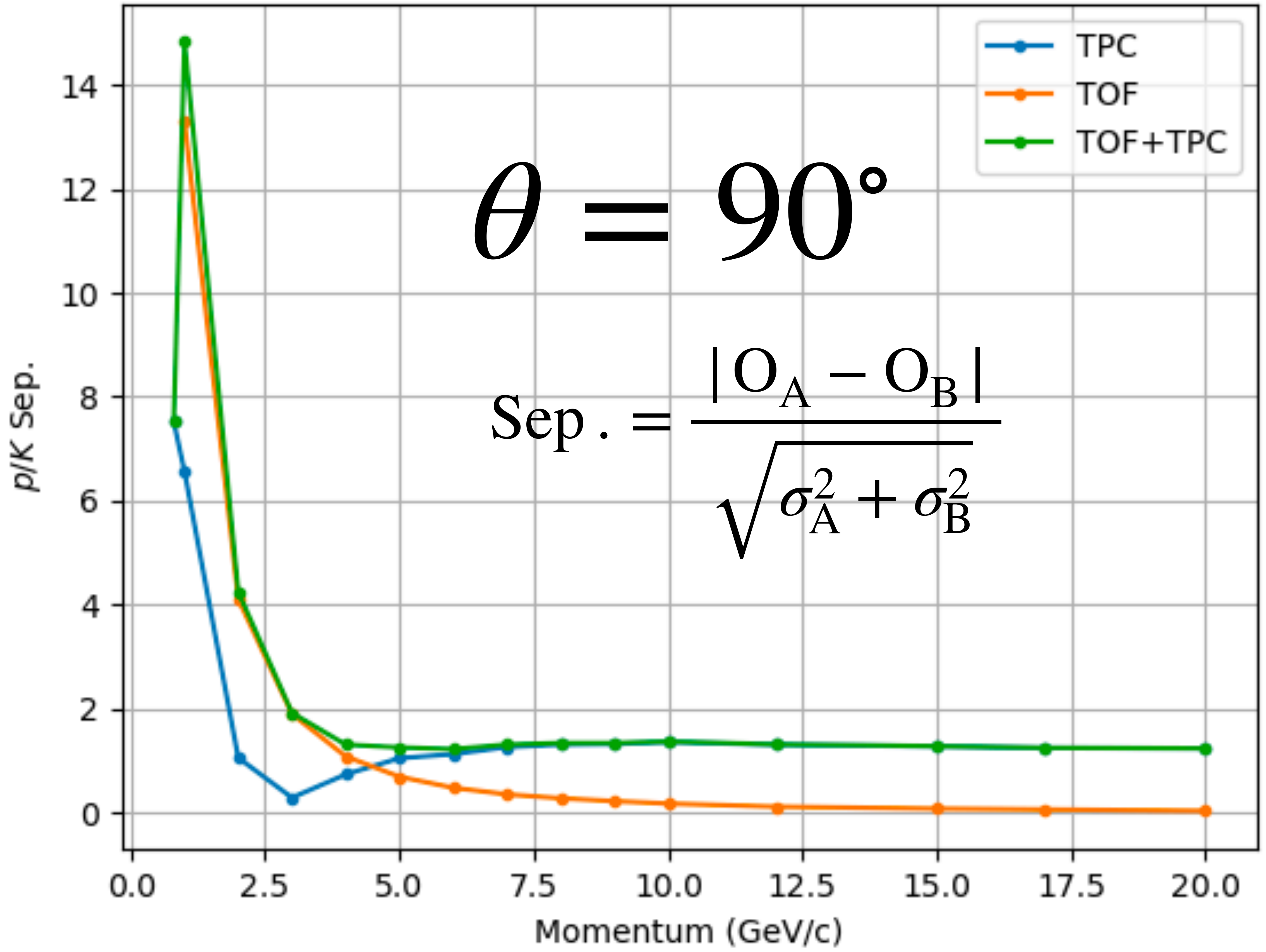


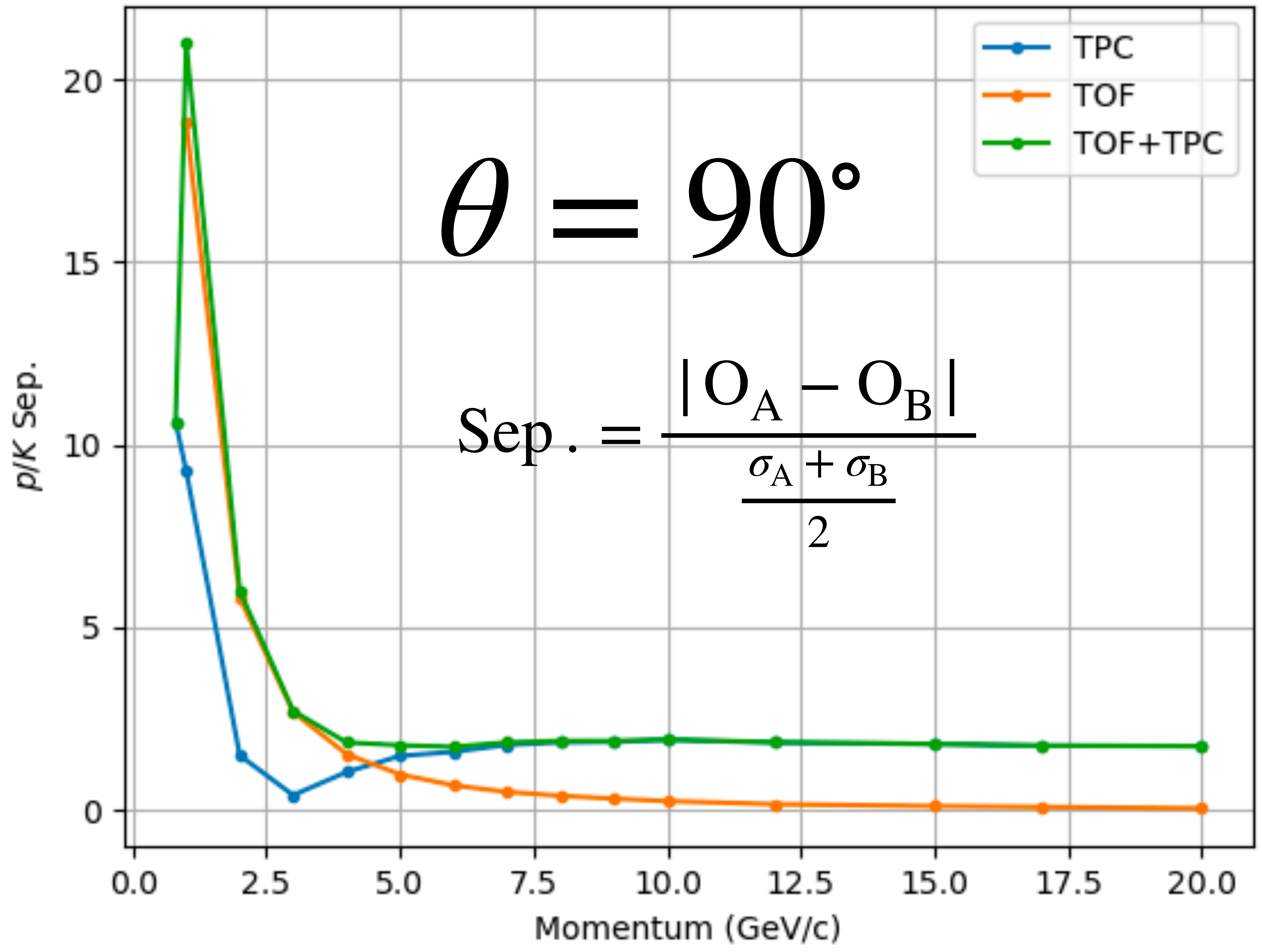
$p = 2\text{GeV}, \theta = 90^{\circ}$ TPC, $\sigma/\mu \sim 3\,\%$



K/Proton Separation

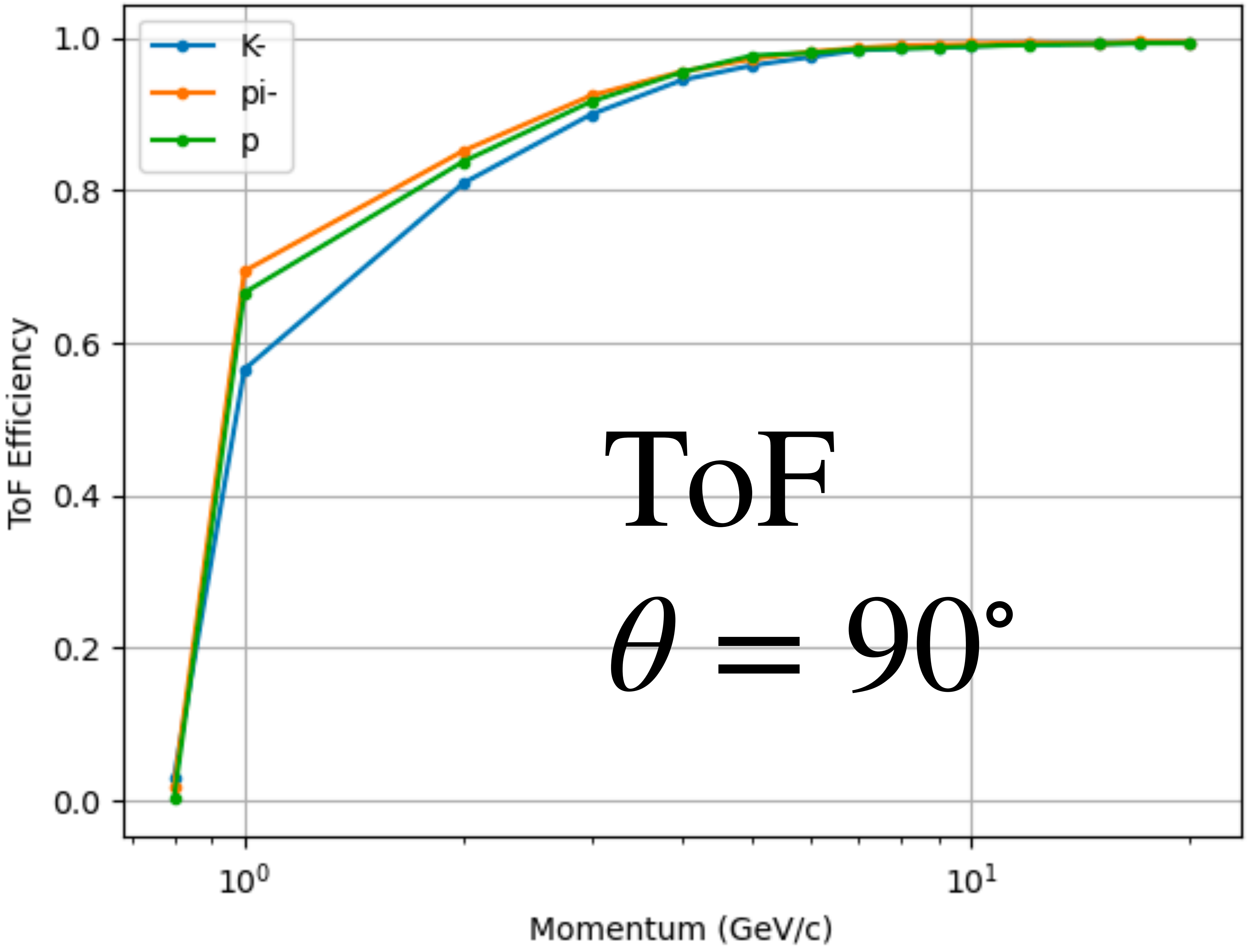
- K/Proton separation, $\theta = 90^{\circ}$, O ~ Observable (time for ToF, dNdx for TPC), A/B ~ particle species
  - Remove ToF contribution at 0.8 GeV because of a low efficiency

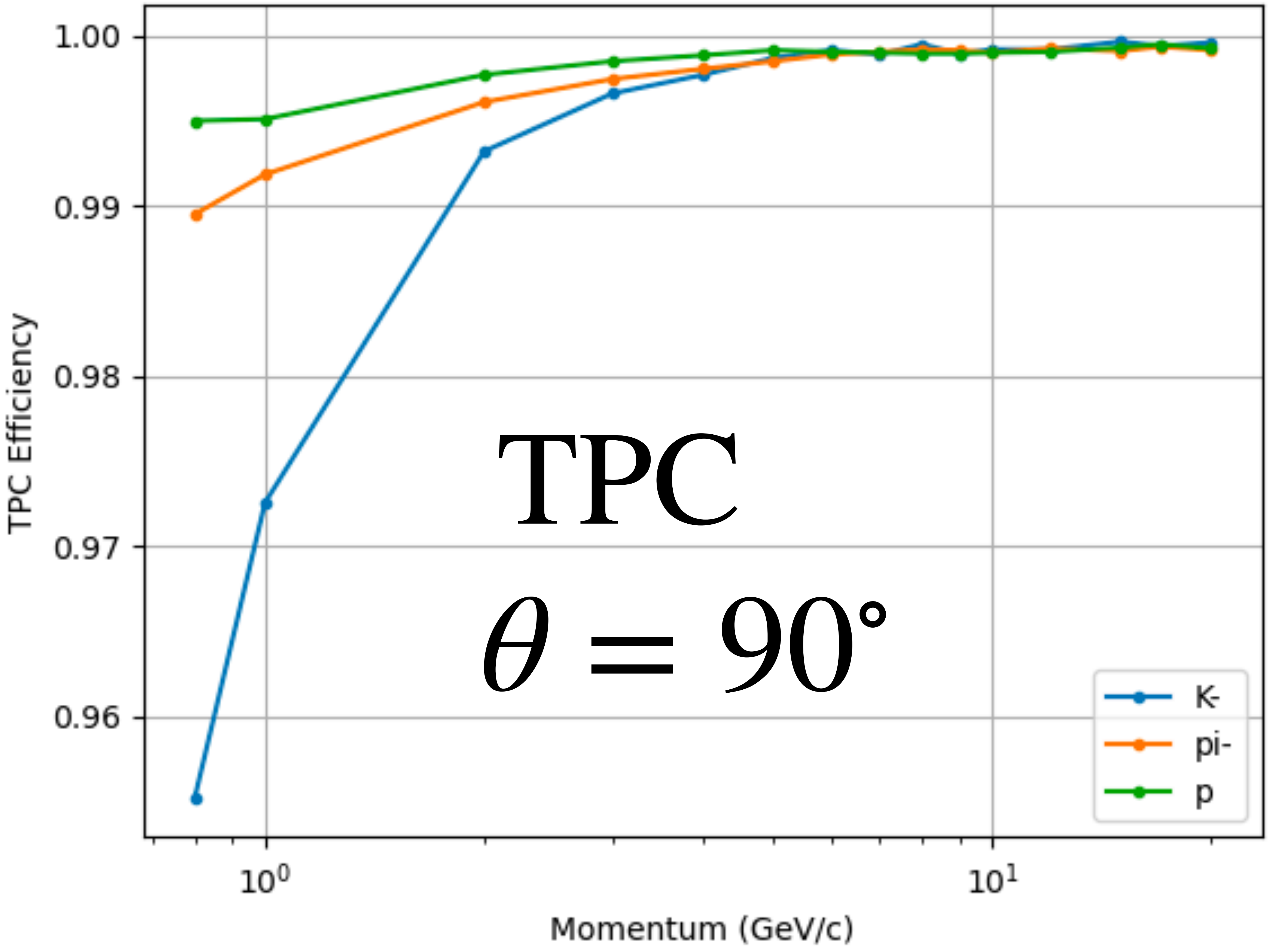




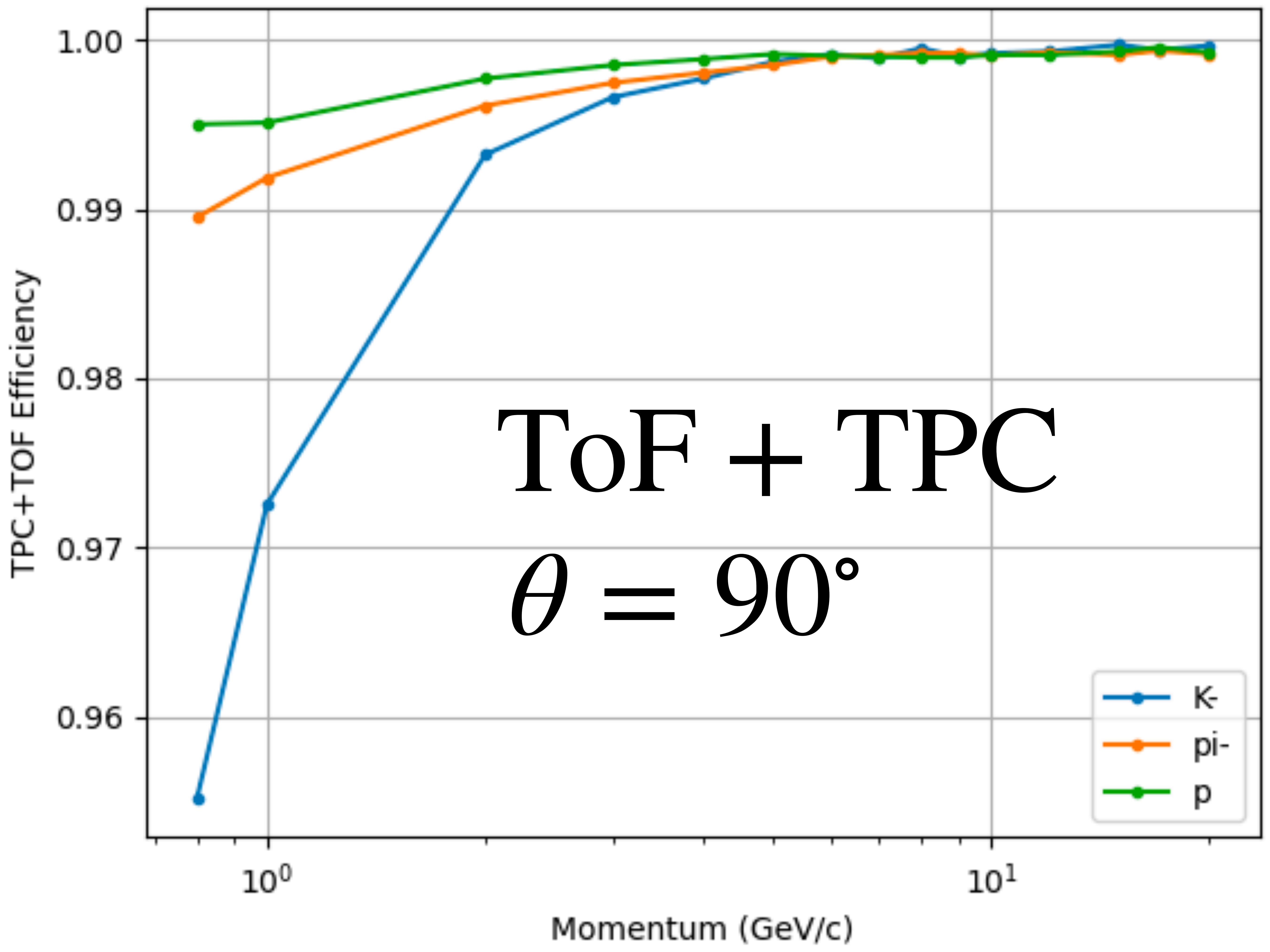
ToF & TPC Efficiencies

- Trk. used by PID algorithm, NOT PID efficiency it-self.





Combined efficiencies



- Trk. eff.
- NOT PID efficiency itself

PID evaluation

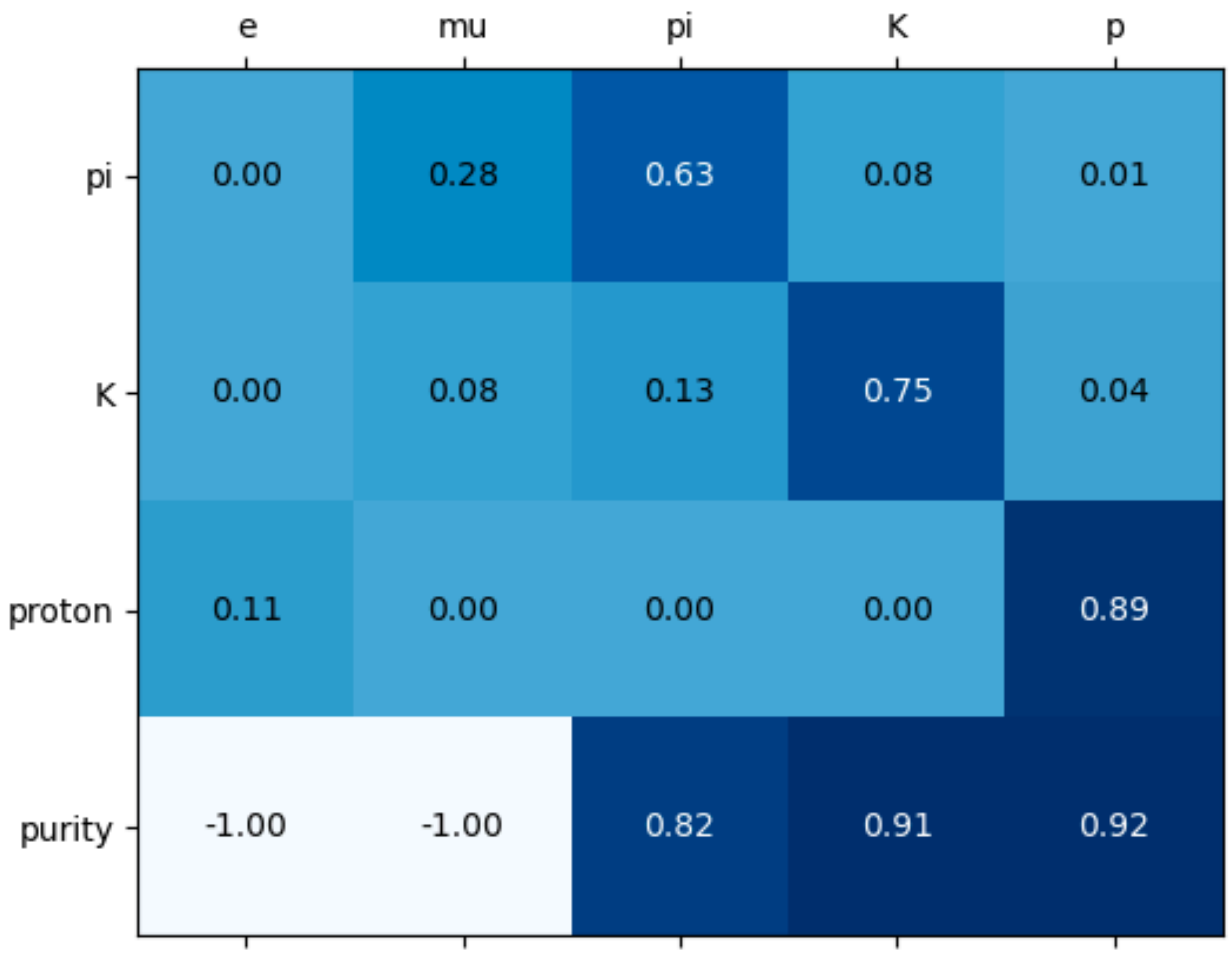
- $$\text{PID} = \frac{|\,\text{measured} - \text{expected}_{\,\text{i}}\,|}{\sqrt{\sigma^2_{\text{measured}} + \sigma^2_{\text{expected}}}}, \quad \text{i} = [\text{e}, \mu, \pi, \text{K}, \text{proton}]$$
- Observable is time-of-flight and dNdx for ToF and TPC respectively
- The smallest one in the list of hypothsis is defined as predicted PID

- PID combination
  - Two lists for TPC and ToF
  - Element-wise addition
  - The smallest one ~ predicted PID

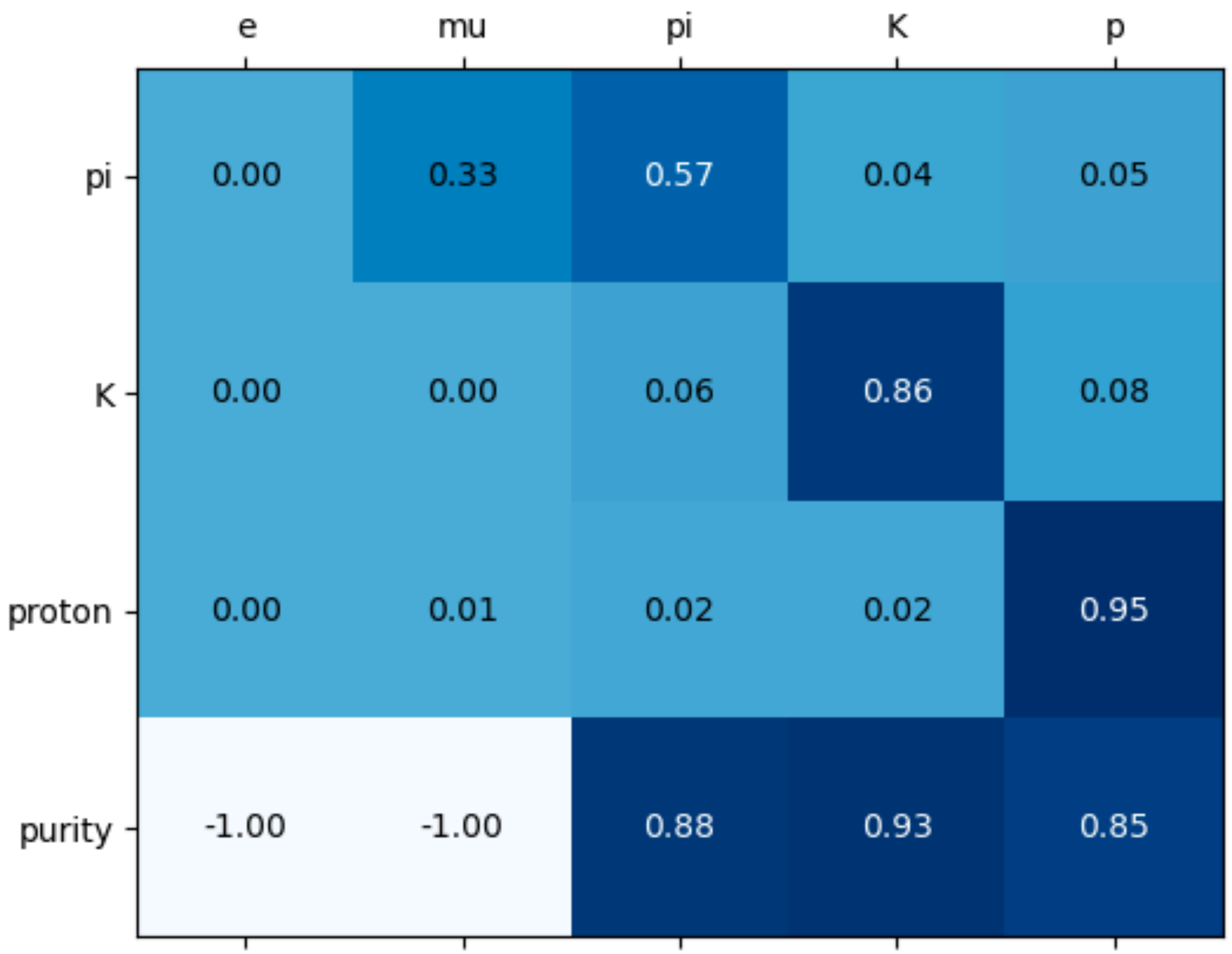
- PID efficiency/purity, K as example
  - $$\text{Eff.} = \frac{N_{K\to K}}{N_{K_{produced}}}$$
  - $$\text{Purity} = \frac{N_{K\to K}}{N_{p\to K} + N_{K\to K} + N_{\pi\to K}}$$

Eff.&Purity @ $\theta = 90^{\circ}$

- Purity depends on yields of different particles
  - Here, $\mathrm{N_p} = \mathrm{N_\pi} = \mathrm{N_K} = 20\mathrm{k}$ using particle gun



1GeV



2GeV