Measurement of normalized differential cross sections of inclusive Pion/Kaon/Proton at energies from 2.000 to 3.6710 GeV at BESIII

Weimin Liu

2023-06-04

Fragmentation function and Experimental observable

$D_1^h(z, \mu_0^2)$ $\quad$ $D_1^h(z, \kappa, \mu_0^2)$ → PDG definition

BESIII π^0, K_S
arXiv:2211.11253

$\boxed{\frac{1}{\sigma_{had}} \cdot \frac{d\sigma_{h+X}}{dp}}$ $\quad$ $\frac{1}{\sigma_{had}} \cdot \frac{d\sigma_{h+X}}{dp \cdot dp_t}$ → e^+e^- publication

Journal referee/Theorist needed

Eff/ISR correction

$\frac{N_{h+X}^{obs}}{N_{had}^{obs}} \cdot \frac{1}{\Delta p_h}$ $\quad$ $\frac{N_{h+X}^{obs}}{N_{had}^{obs}} \cdot \frac{1}{\Delta p_h \Delta p_t}$

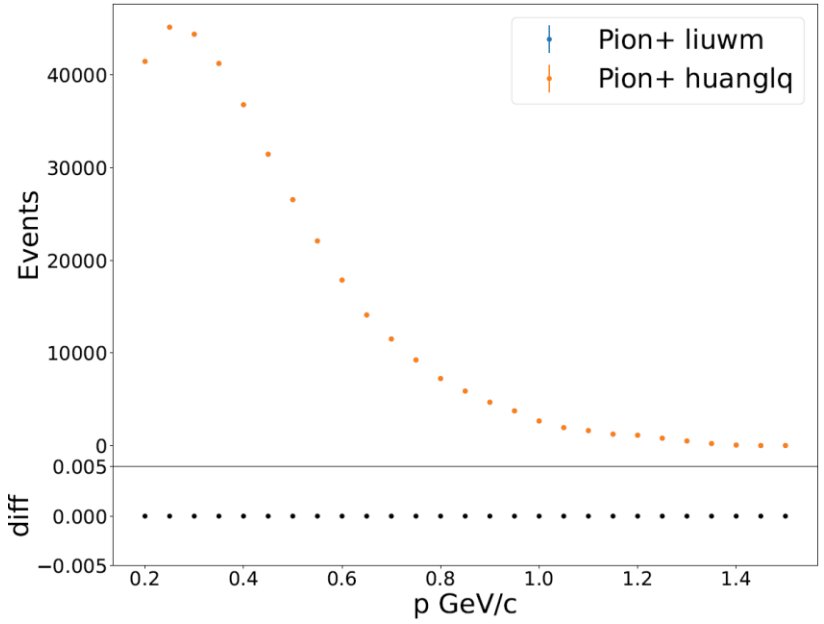
PID unfolding

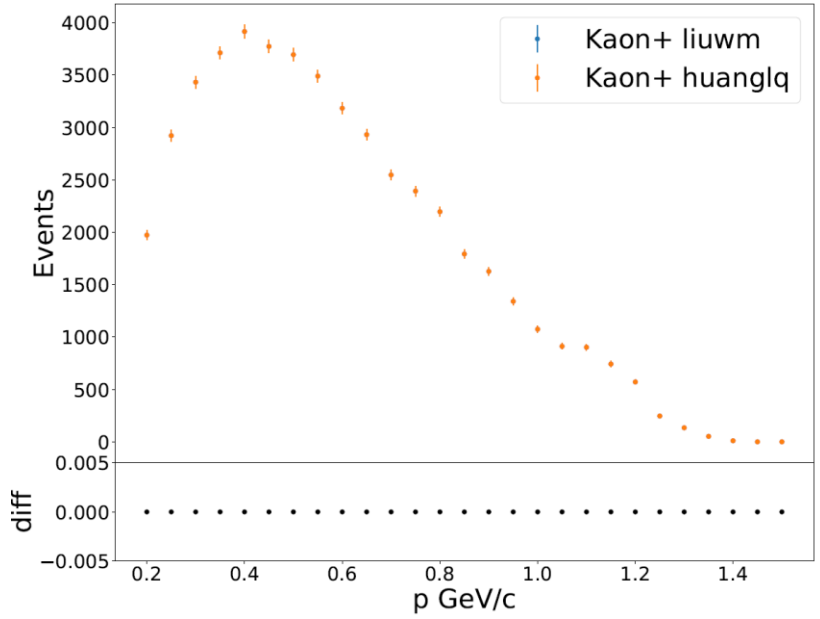
$\frac{N_{h+X}^{raw}}{N_{had}}$ → With PID effect

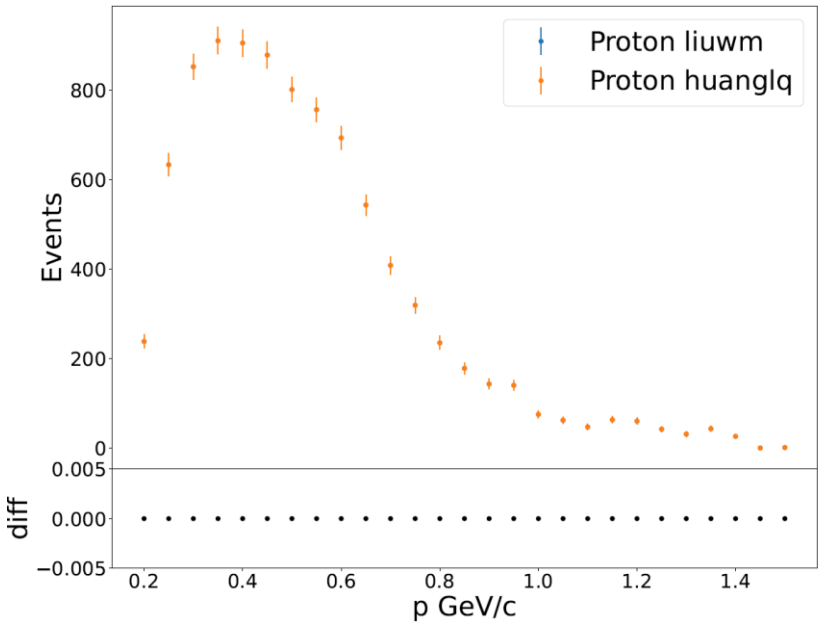
Data sets

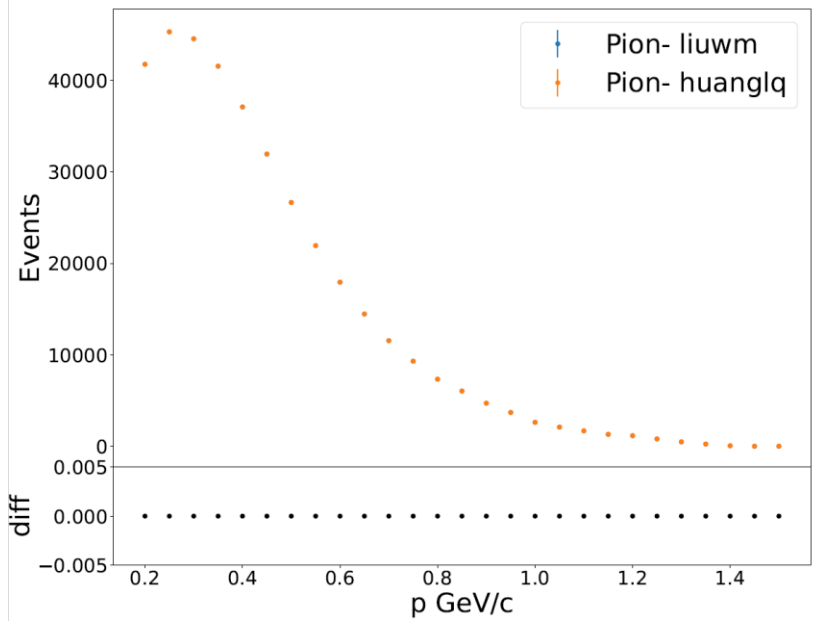
	$\sqrt{s}$ (GeV)	Run number	$\mathcal{L}$ (pb^{-1})	Date
665p01	2.0000	41729 – 41909	10.074	2015.04.18~04.27
	2.2000	40989 – 41121	13.699	2015.03.12~03.19
	2.3960	40463 – 40769	66.869	2015.02.14~02.28
	2.6444	40128 – 40298	33.722	2015.01.31~02.07
	2.9000	39775 – 40069	105.253	2015.01.16~01.29
664p01	3.0500	28312 – 28346	14.893	2012.05.28~05.30
	3.5000	33725 – 33733	3.633	2013.06.05~06.06
	3.6710	33759 – 33764	4.628	2013.06.05~06.06

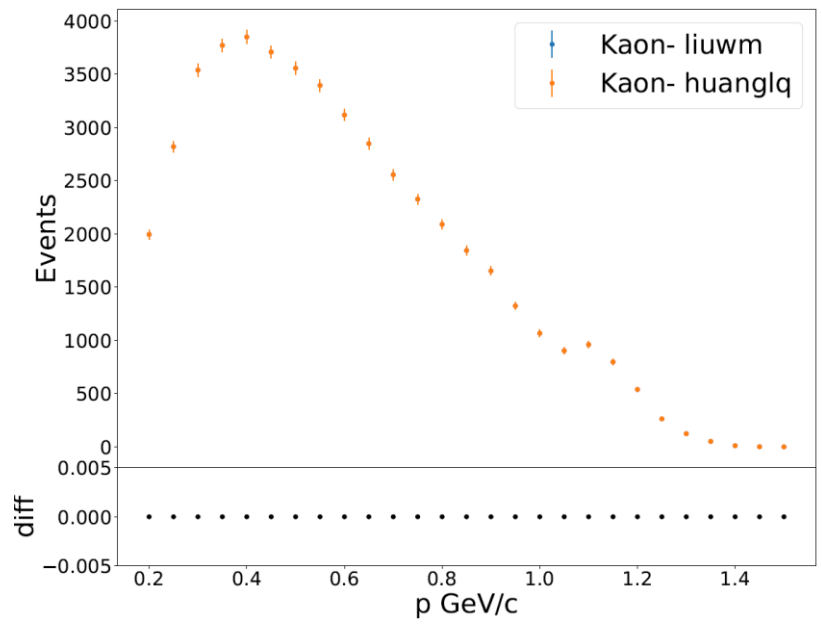
Raw counts distribution (@3.050 GeV 100 MeV)

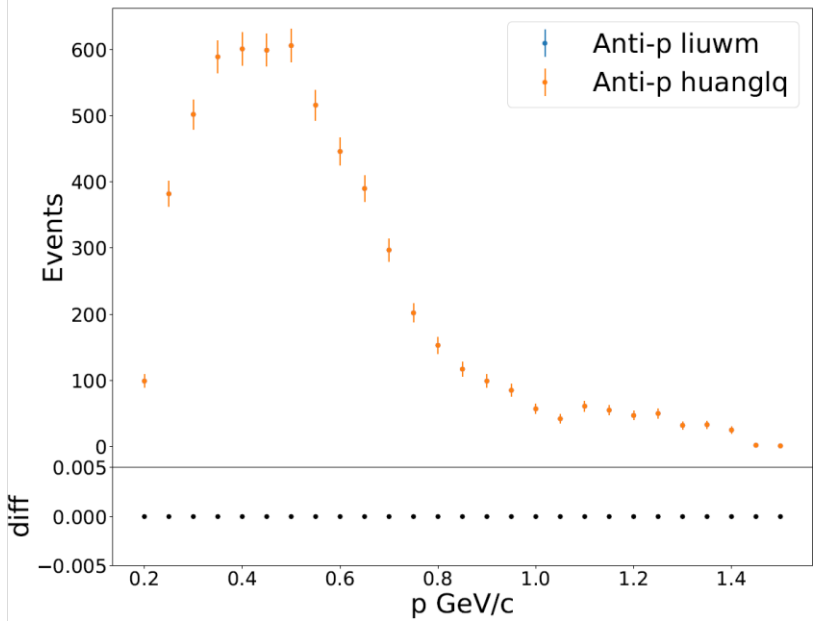




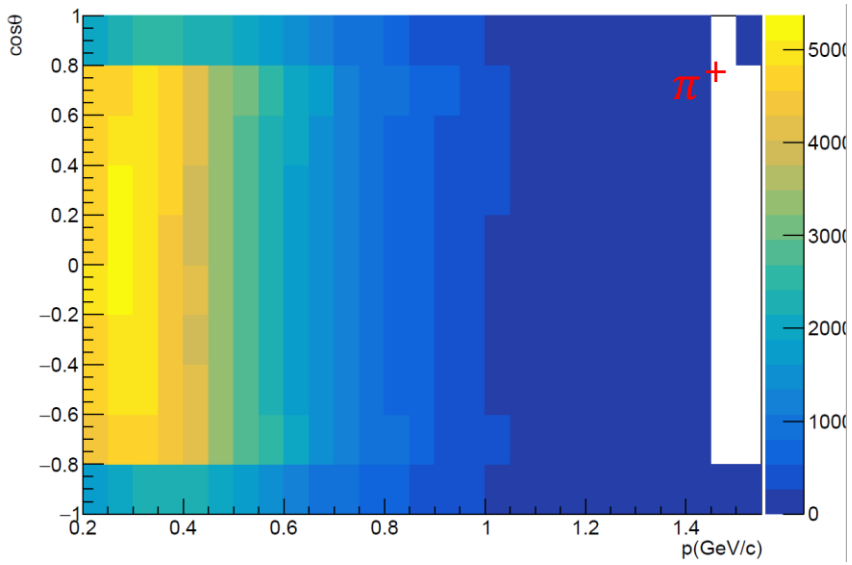


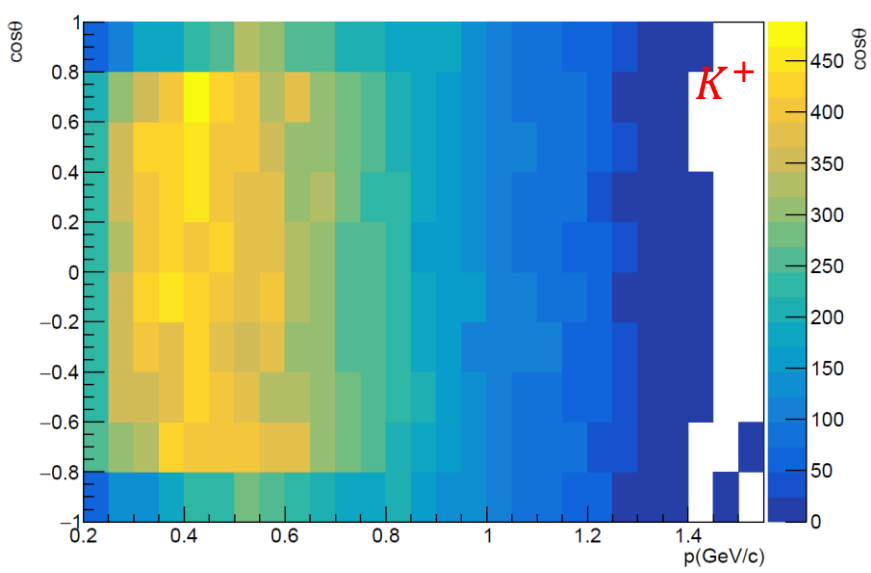


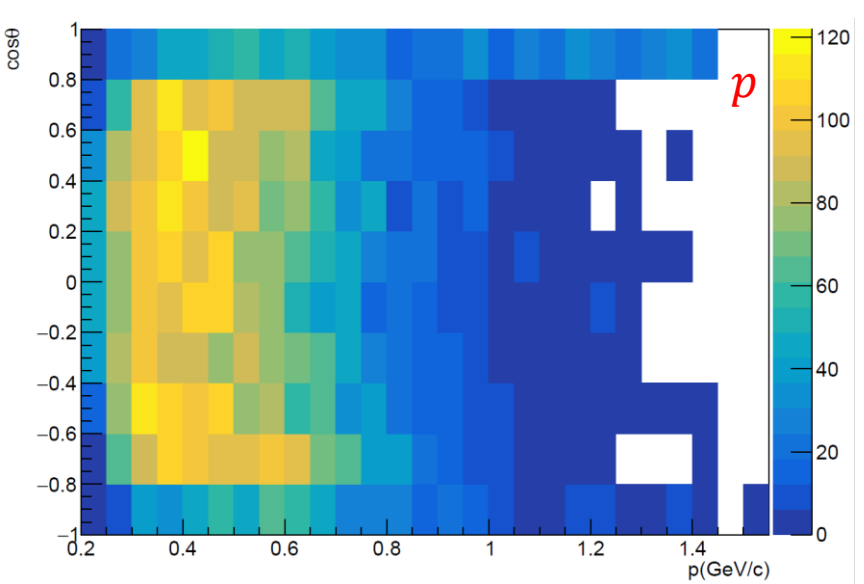


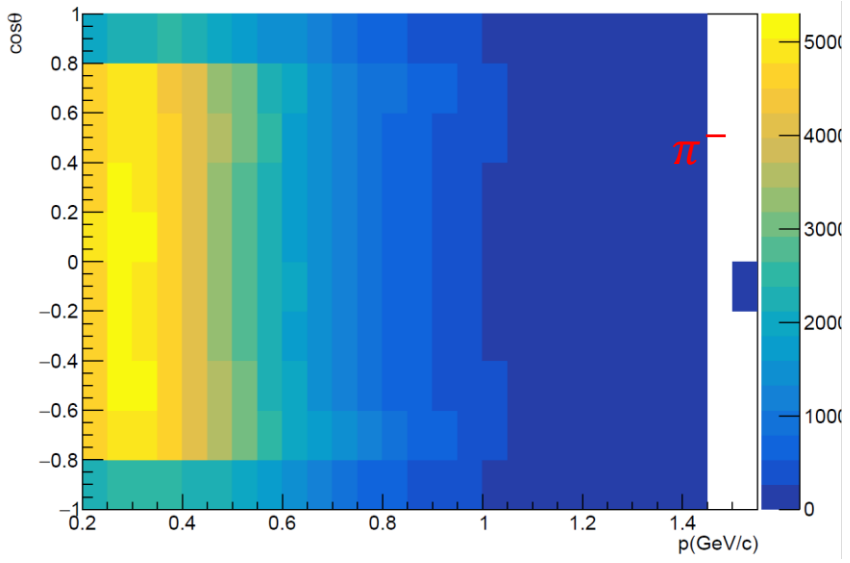


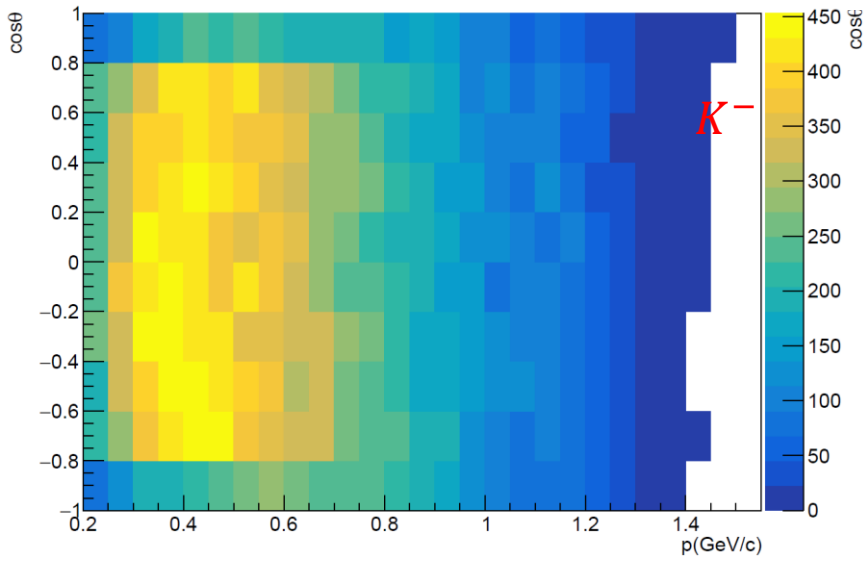
Raw counts distribution (@3.050 GeV 100 MeV_0.2)

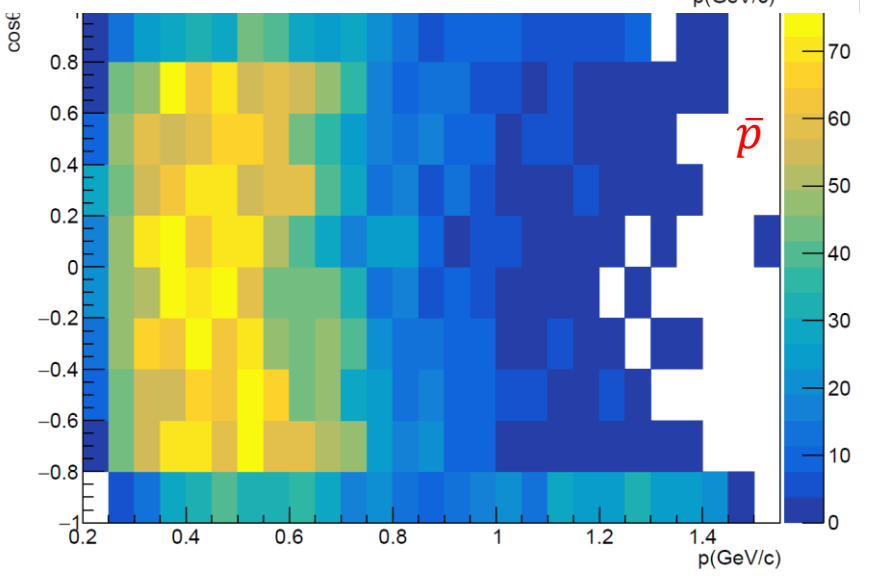












PID unfolding

$$N_{\pi^+}^{raw} = f_{\pi^+\to\pi^+} \cdot N_{\pi^+}^{obs} + f_{K^+\to\pi^+} \cdot N_{K^+}^{obs} + f_{p\to\pi^+} \cdot N_p^{obs}$$

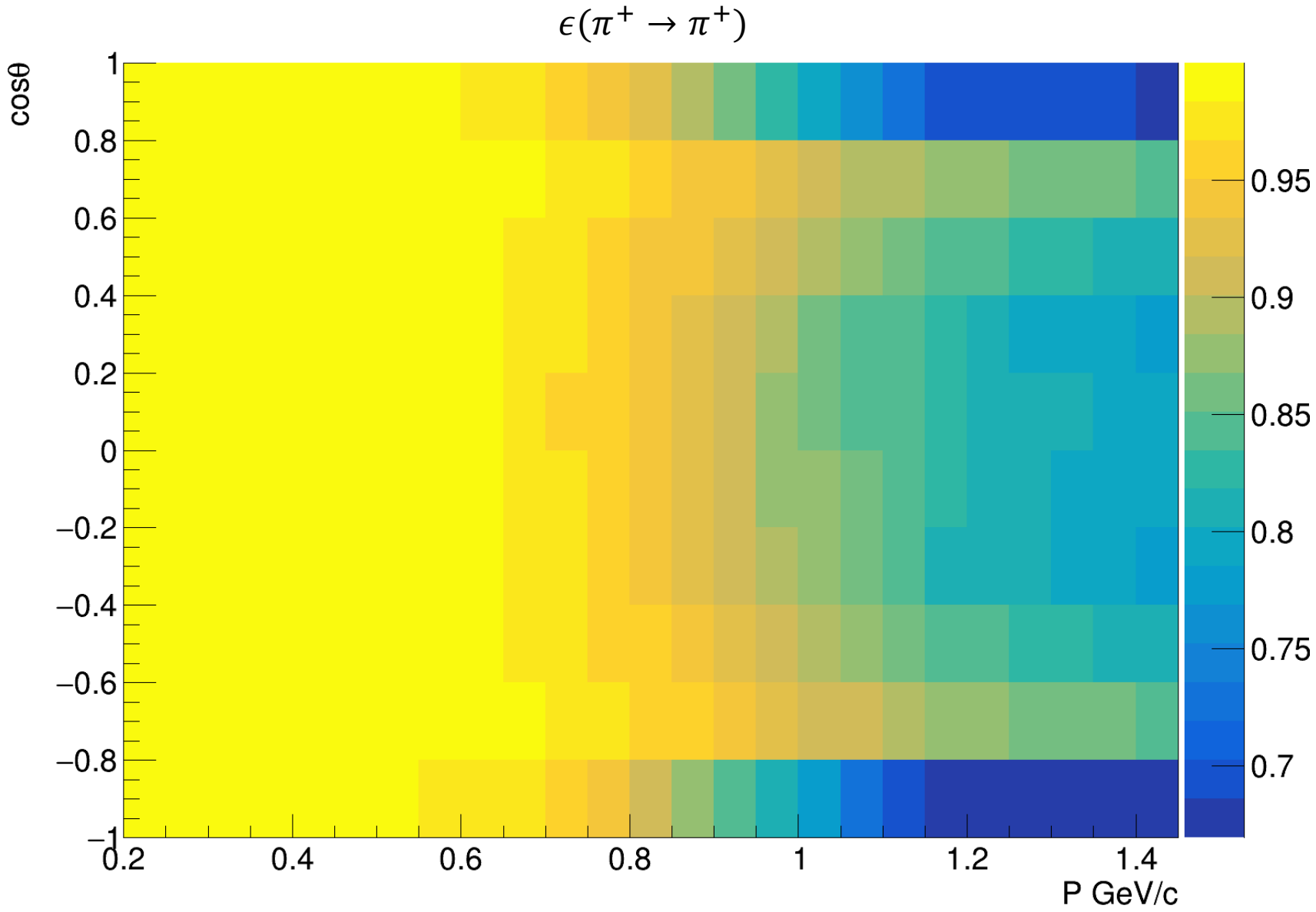
$$N_{K^+}^{raw} = f_{\pi^+\to K^+} \cdot N_{\pi^+}^{obs} + f_{K^+\to K^+} \cdot N_{K^+}^{obs} + f_{p\to K^+} \cdot N_p^{obs}$$

$$N_p^{raw} = f_{\pi^+\to p} \cdot N_{\pi^+}^{obs} + f_{K^+\to p} \cdot N_{K^+}^{obs} + f_{p\to p} \cdot N_p^{obs}$$

$$\begin{bmatrix} N_{\pi^+}^{obs} \\ N_{K^+}^{obs} \\ N_p^{obs} \end{bmatrix} = \begin{bmatrix} f_{\pi^+\to\pi^+} & f_{K^+\to\pi^+} & f_{p\to\pi^+} \\ f_{\pi^+\to K^+} & f_{K^+\to K^+} & f_{p\to K^+} \\ f_{\pi^+\to p} & f_{K^+\to p} & f_{p\to p} \end{bmatrix}^{-1} \begin{bmatrix} N_{\pi^+}^{raw} \\ N_{K^+}^{raw} \\ N_p^{raw} \end{bmatrix}$$

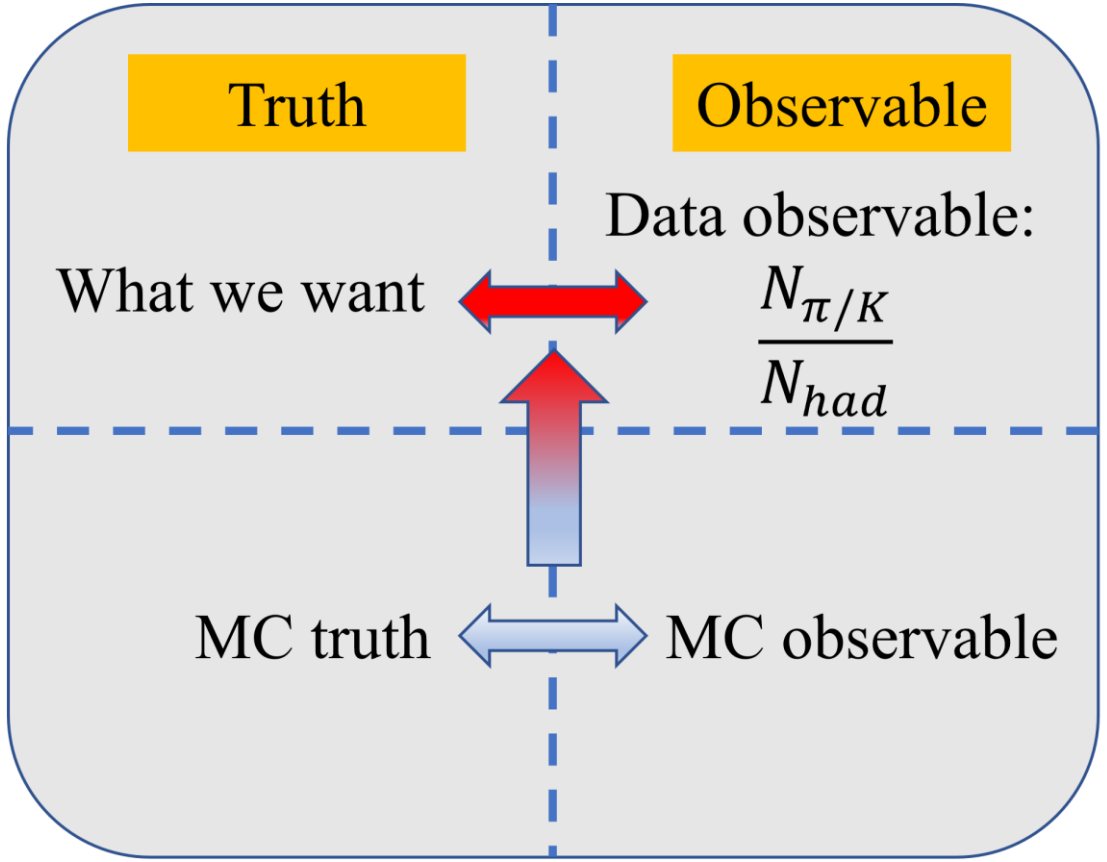
- N^{obs} is the observed counts for pion/kaon/proton with PID corrected.
- N^{raw} is the raw counts for pion/kaon/proton with PID requirements.

PID efficiency matrix



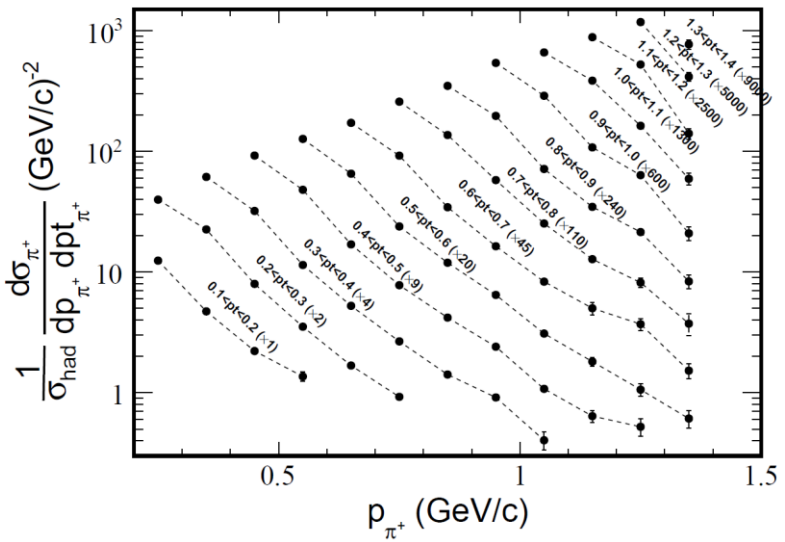
Eff/ISR correction

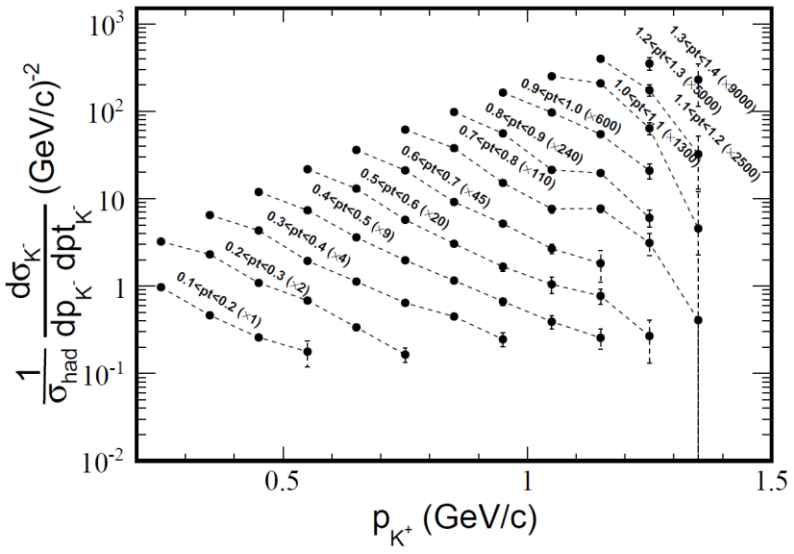
$$\frac{\frac{N_{h+X}}{N_{had}}}{\frac{N^{tru}_{h+X}(isr\ off)}{N^{tru}_{had}(isr\ off)}} = \frac{\frac{N^{obs}_{h+X}}{N^{obs}_{had}}}{\frac{N^{obs}_{h+X}(isr\ on)}{N^{obs}_{had}(isr\ on)}}$$

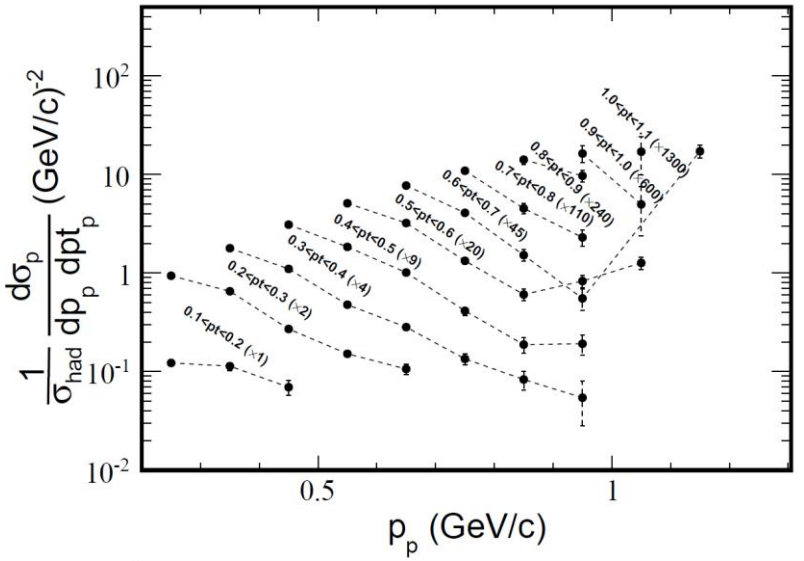


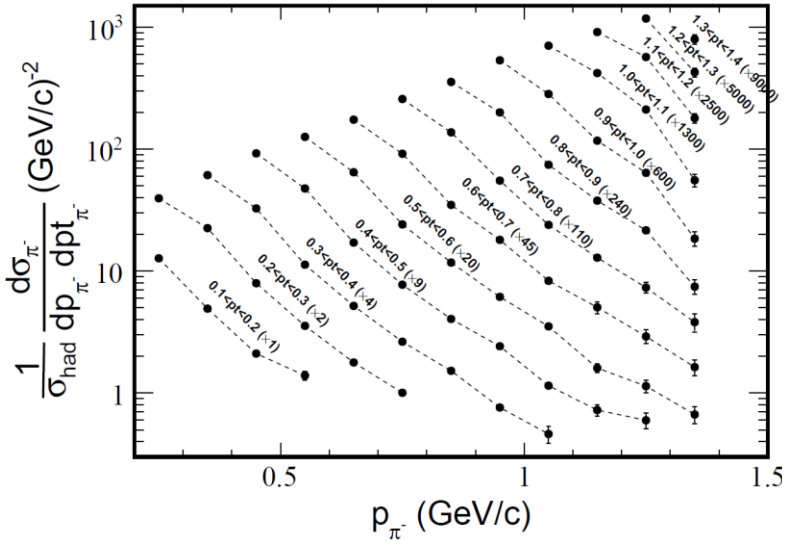
$$1/f = \frac{\frac{N^{obs}_{h+X}(isr\ on)}{N^{obs}_{had}(isr\ on)}}{\frac{N^{tru}_{h+X}(isr\ off)}{N^{tru}_{had}(isr\ off)}} = \frac{\frac{N^{obs}_{h+X}(isr\ on)}{N^{obs}_{had}(isr\ on)}}{\frac{N^{tru}_{h+X}(isr\ on)}{N^{tru}_{had}(isr\ on)}} \cdot \frac{\frac{N^{tru}_{h+X}(isr\ on)}{N^{tru}_{had}(isr\ on)}}{\frac{N^{tru}_{h+X}(isr\ off)}{N^{tru}_{had}(isr\ off)}} = f_{eff} \cdot f_{isr}$$

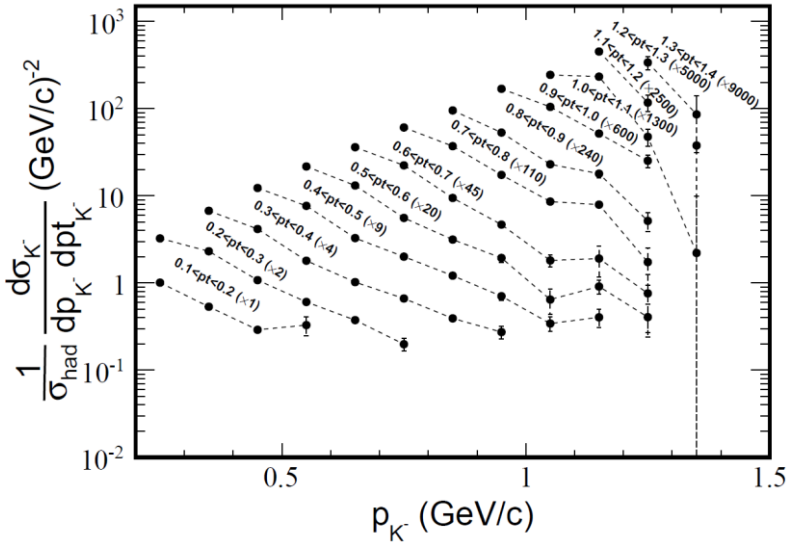
Differential cross section @3.050 GeV

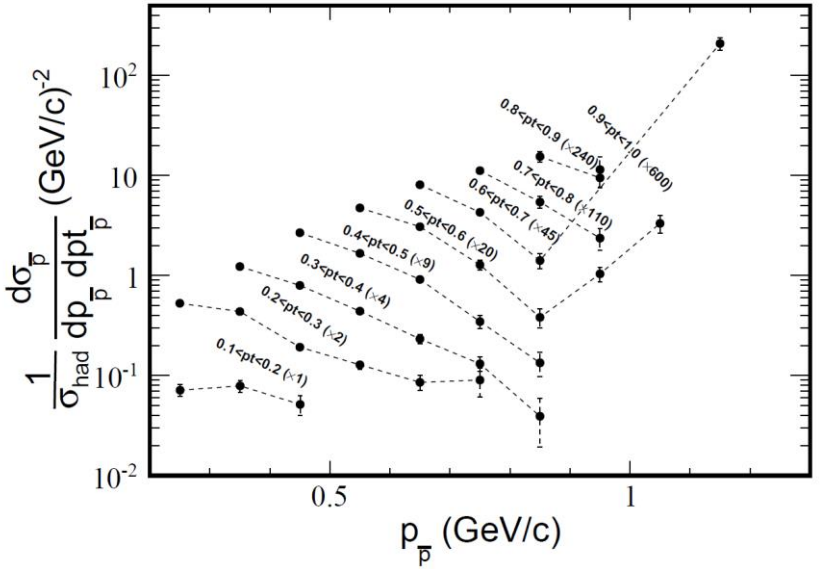












To do list

- Add more Kaon control samples, especially low-z and high-z range. (Pion)
- Prepare 1D cross check with previous result.
- Check the consistence between MC unfolding and MC truth match methods.
- Combine the positive and negative results.
- Estimate the uncertainty.
- …