Event generators for pi and K form factor experiments

For EicC CDR working group

2022-10-29

目录

- pi&K exclusive 事例产生器简单介绍
- EicC上$ep \rightarrow en\pi^+$和$ep \rightarrow e\Lambda K^+$的运动学
- Born-level pion pole的微分截面模型

README.txt

1. Event generation of e p --> e' n pi^+ data

Using ROOT to execute the codes:

>root -l test.cpp

Using ACLiC to compile and execute

>root -l

[0] .x test.cpp+

2. In this version (v1.0), the beam-crossing angle is implemented.

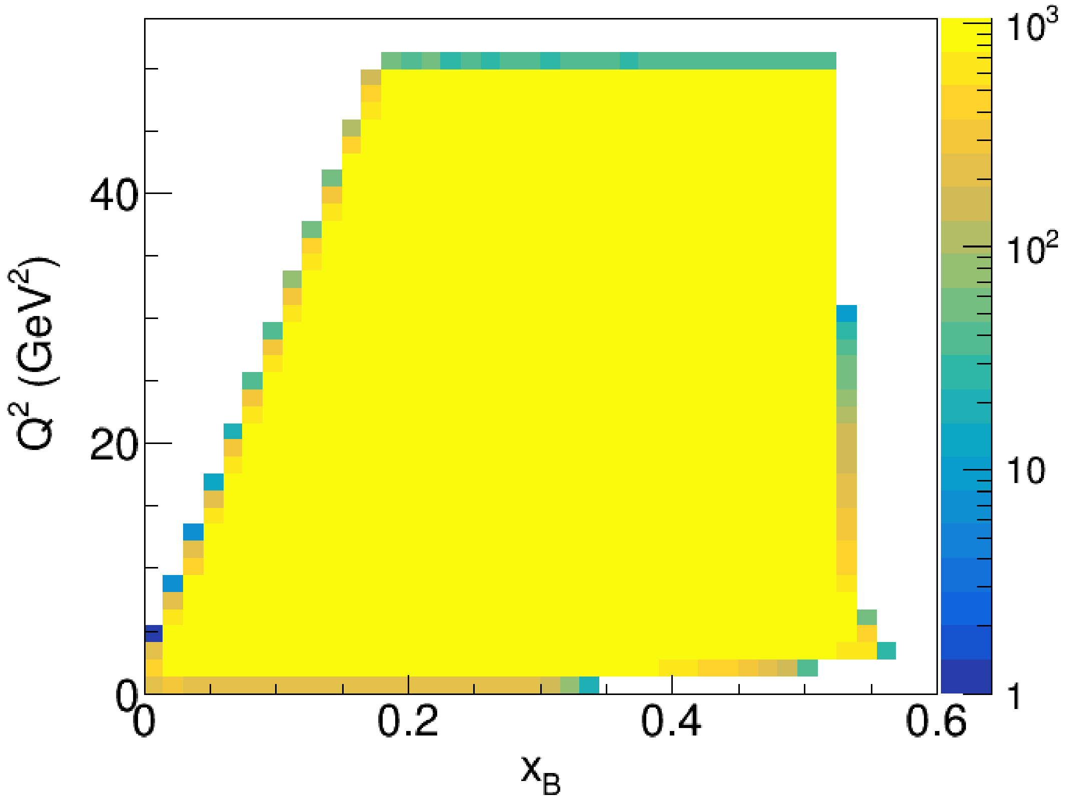
The electron goes to the z direction, consistent with the fixed-target experiment. see "PionExculsiveElectroproduction()" or "SetBeamCrossAngle(double _angle)" for details of how the crossing angle is implemented.

例子：test.cpp

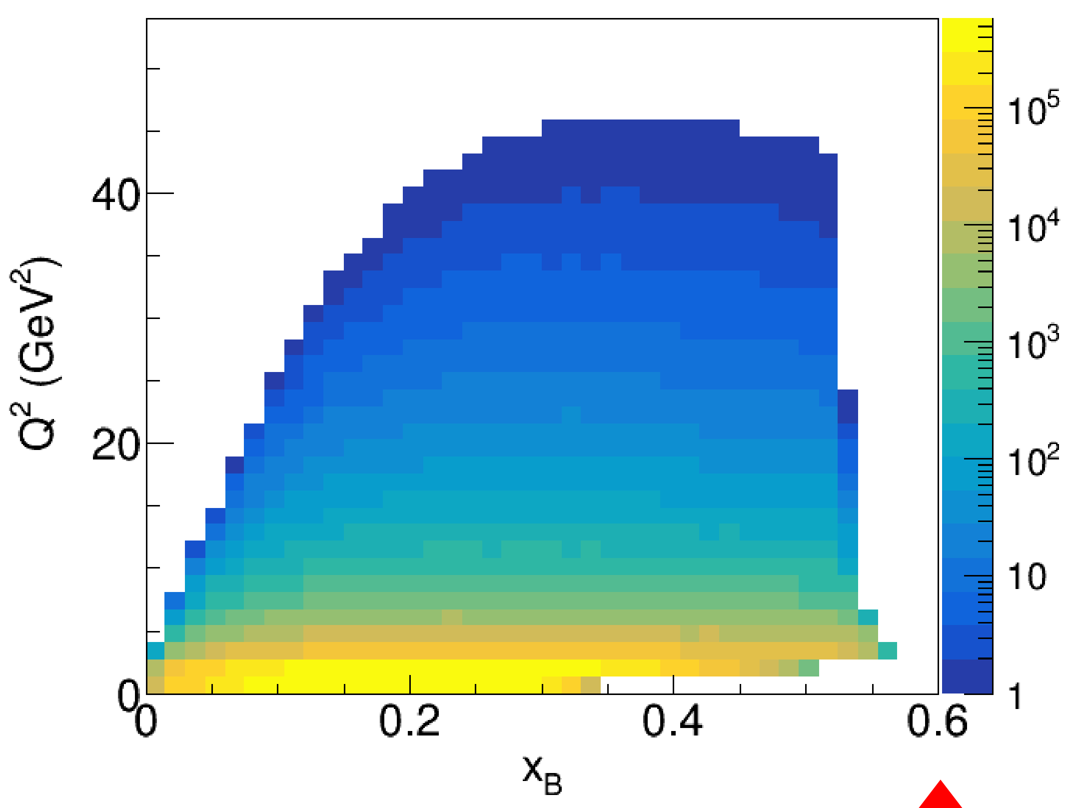
```
#include***
void test(){
	PionExculsiveElectroproduction demp_pion;
	demp_pion.SetTmax(0.5);		demp_pion.SetTmin(0.01);
	demp_pion.SetQ2max(50);		demp_pion.SetQ2min(1);
	demp_pion.SetxBmax(0.8);		demp_pion.SetxBmin(0.001);
	char filename[50] = "DEMP-pion-pole-at-EicC.root";
	demp_pion.SetOutputFileName(filename);
	demp_pion.SetElecBeamEnergy(3.5);
	demp_pion.SetProtBeamEnergy(20);
	demp_pion.SetBeamCrossAngle(0.05);

	demp_pion.Generate(500000);
}
```

$ep \to en\pi^+$, Q2 vs xB

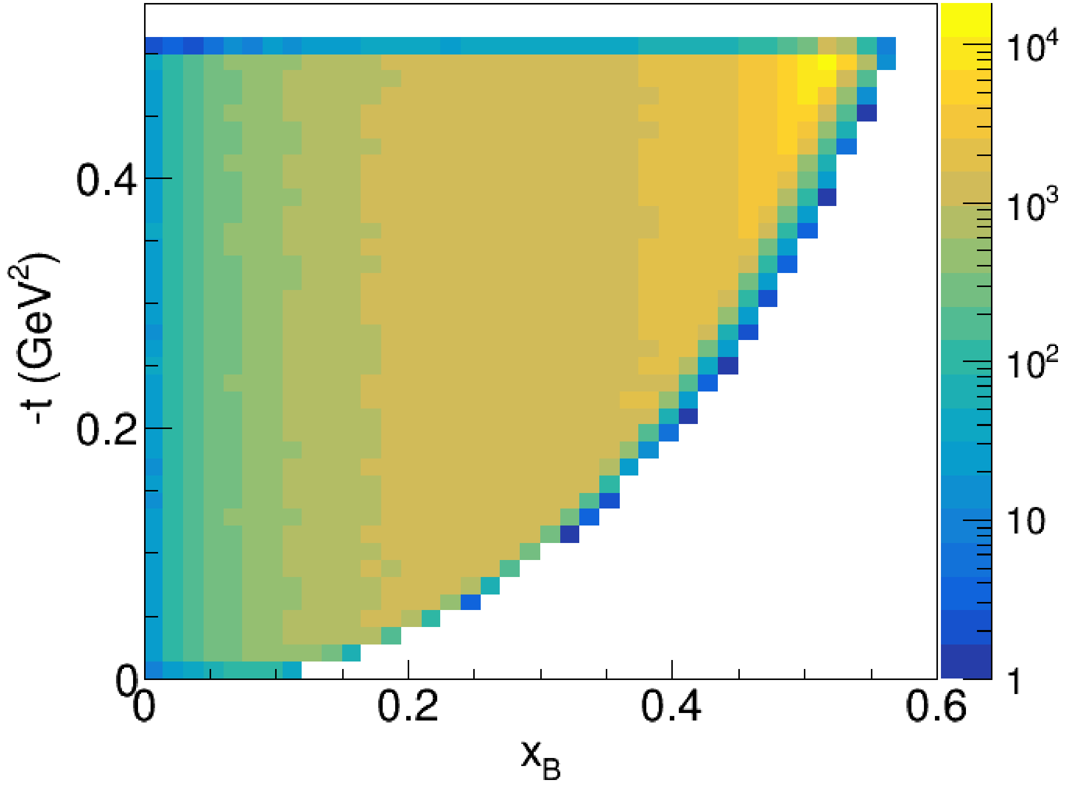


Unweighted

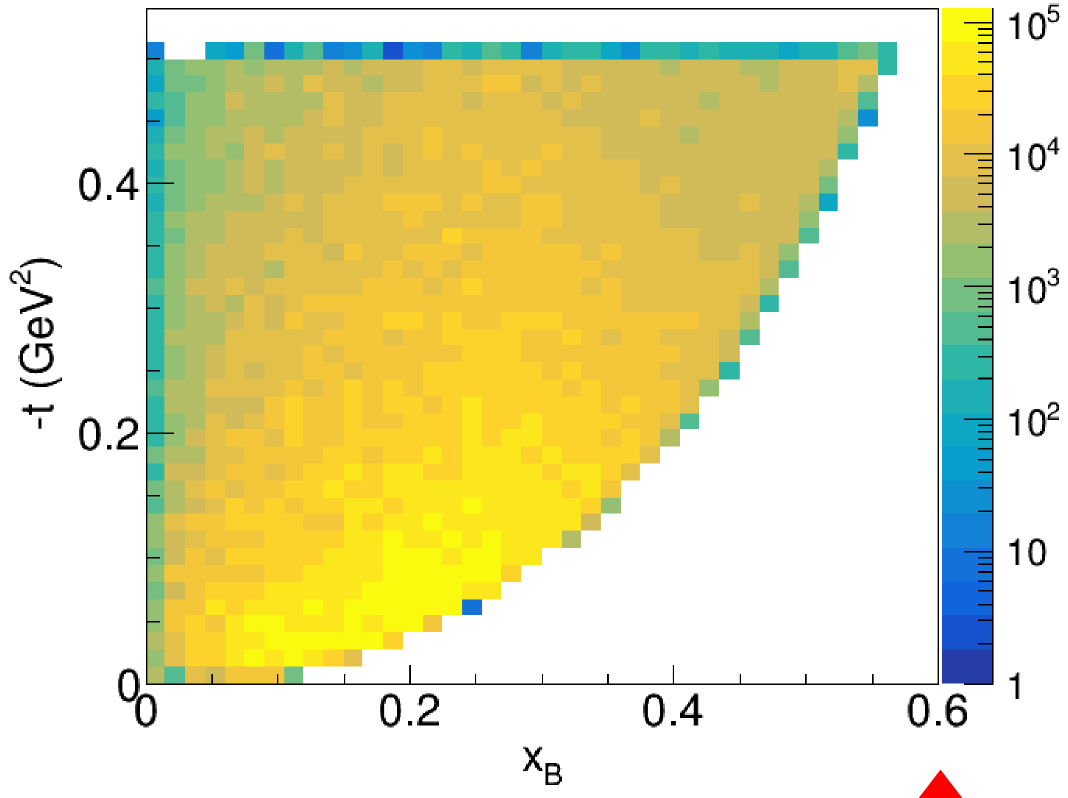


Differential cross section weighted:
tree->Draw("Q2:xB","d4sigma*1000","colz");

$ep \to en\pi^+$, $-t$ vs xB

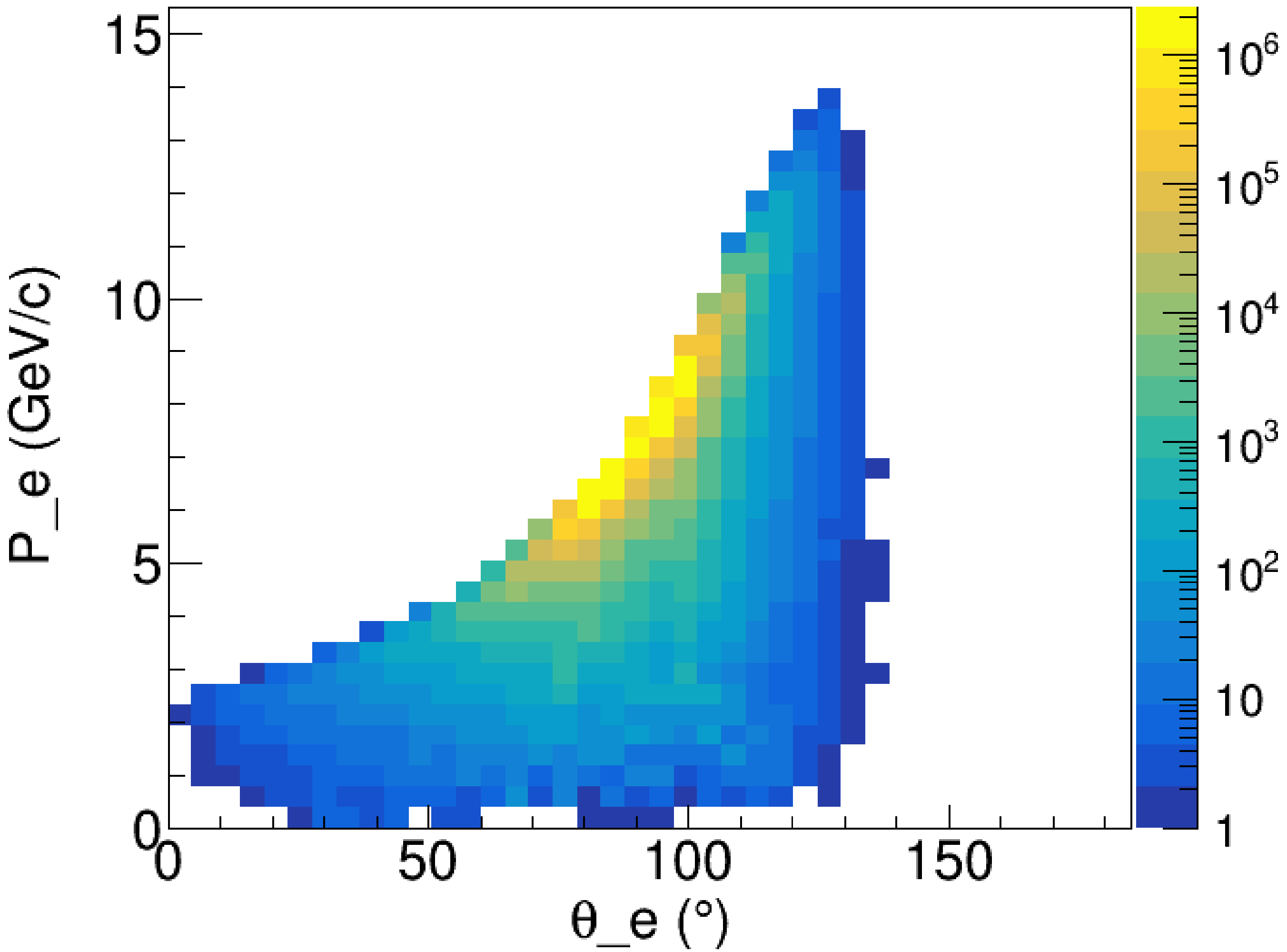


Unweighted



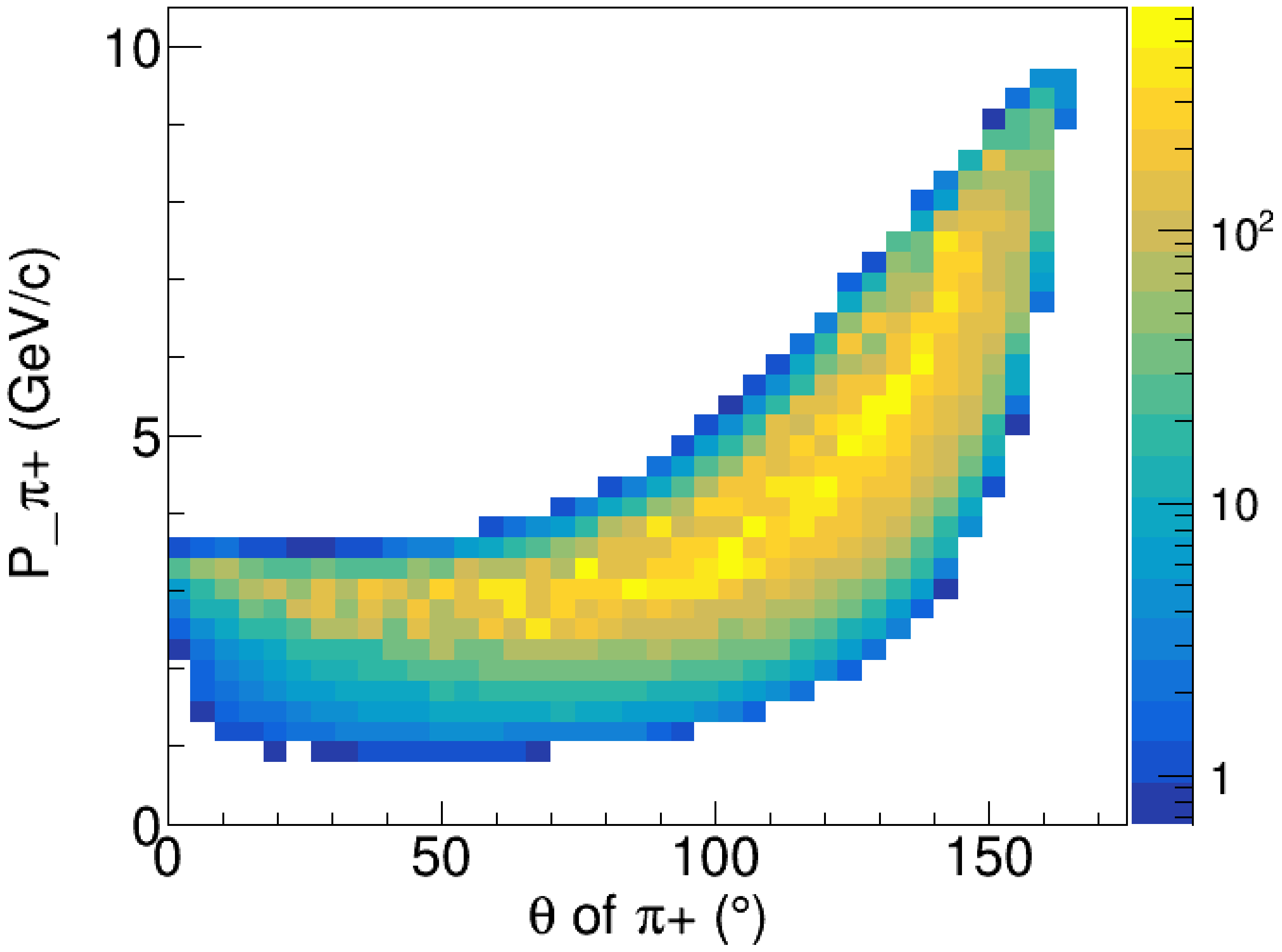
Differential cross section weighted:
tree->Draw(“-t:xB","d4sigma*1000","colz");

$ep \to en\pi^+$, final-state electron



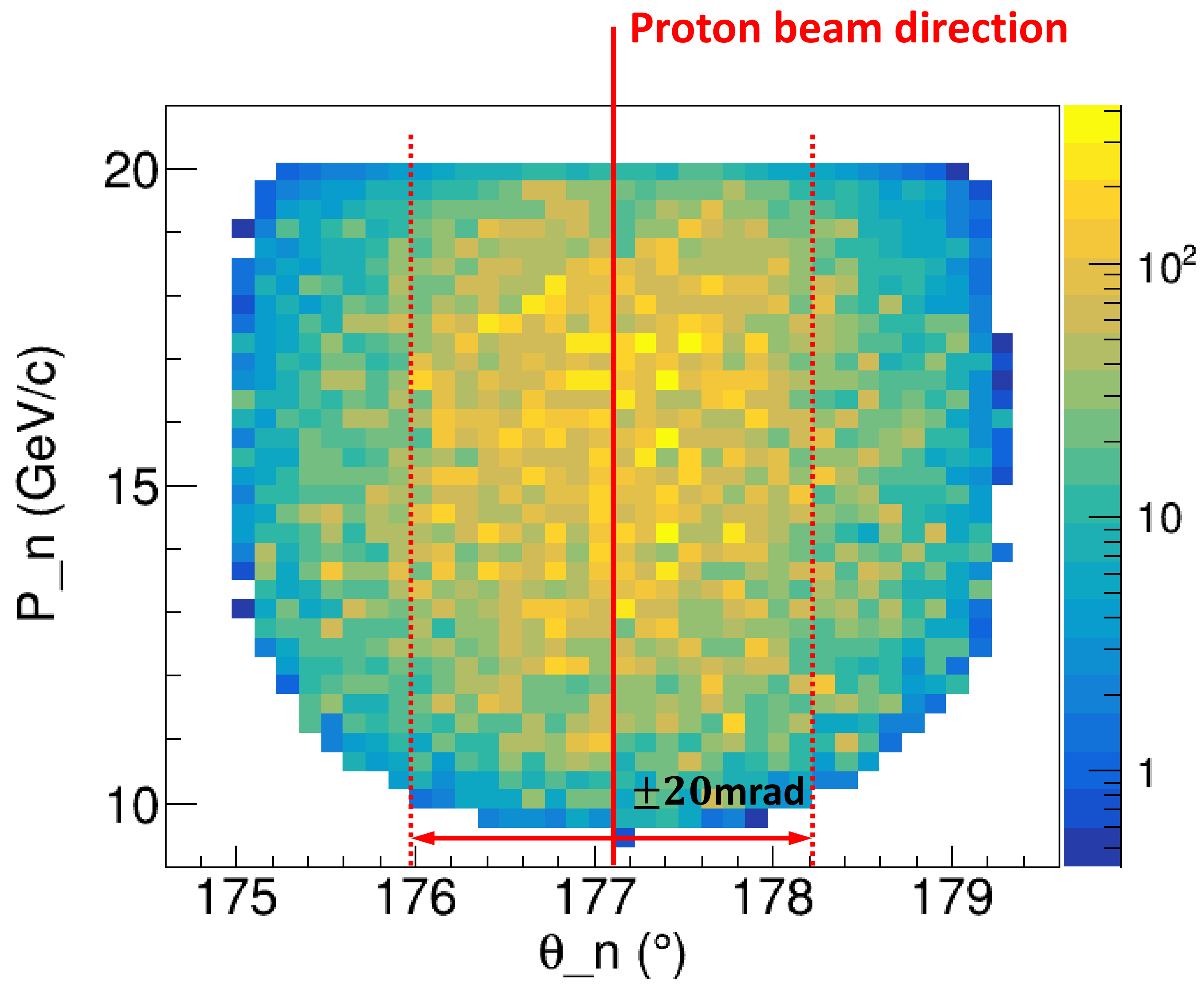
Differential cross section weighted!

$ep \to en\pi^+$, final-state π^+



Differential cross section weighted!

$ep \to en\pi^+$, final-state neutron

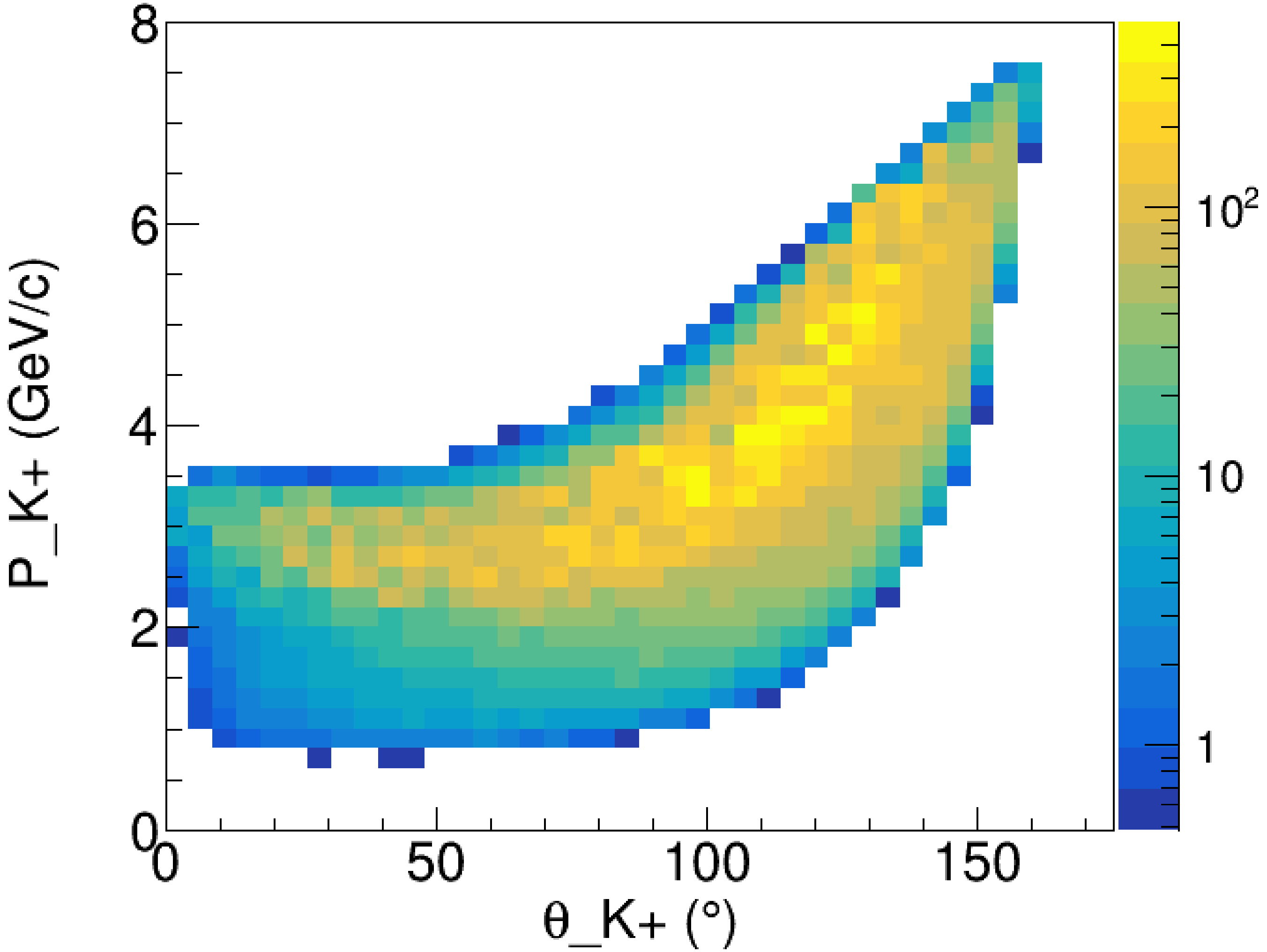


Differential cross section weighted!

Kaon form factor experiment

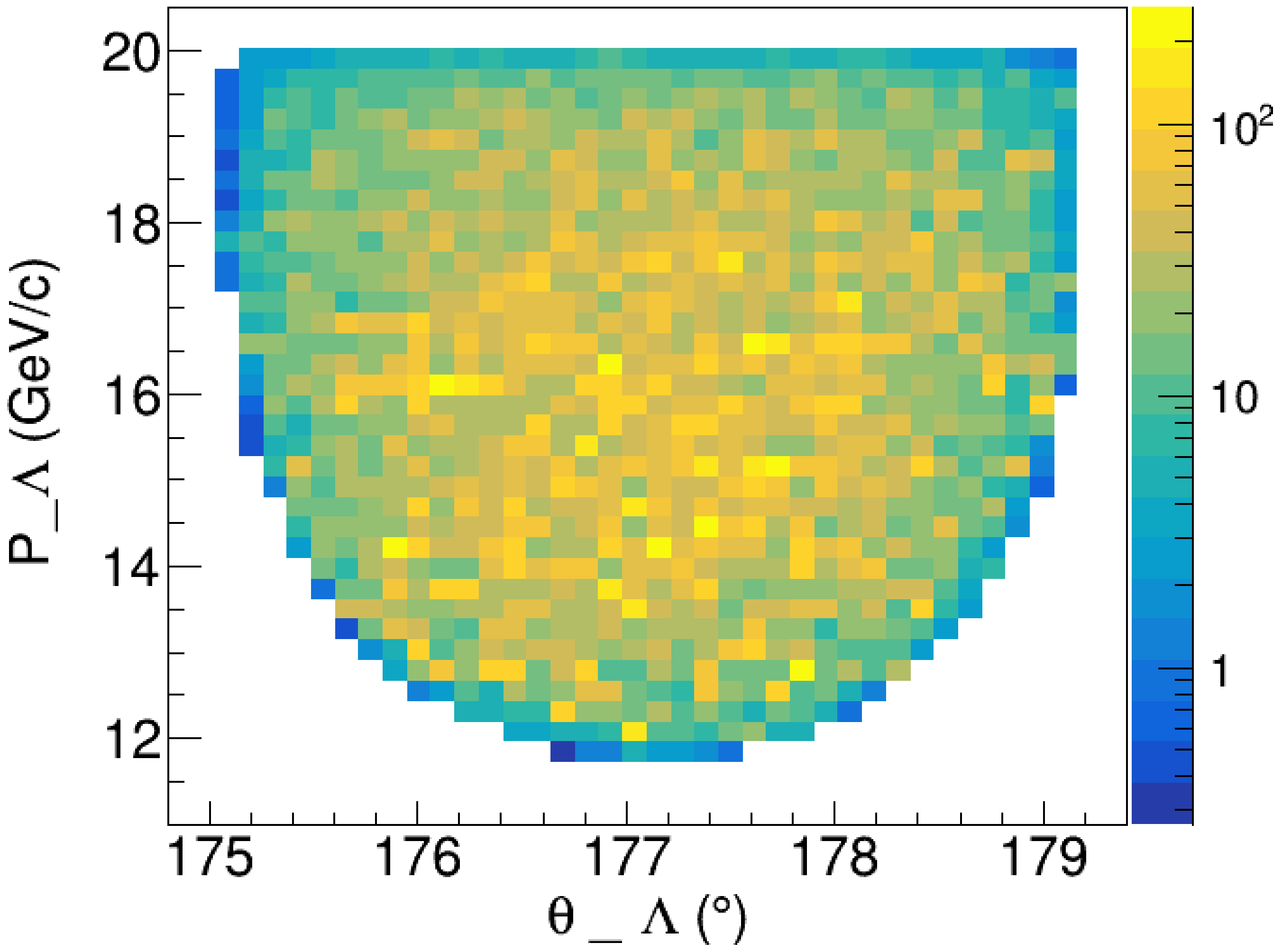
$$ep \to e\Lambda K^{+}$$

$ep \to e\Lambda K^+$, final-state K+



Differential cross section weighted!

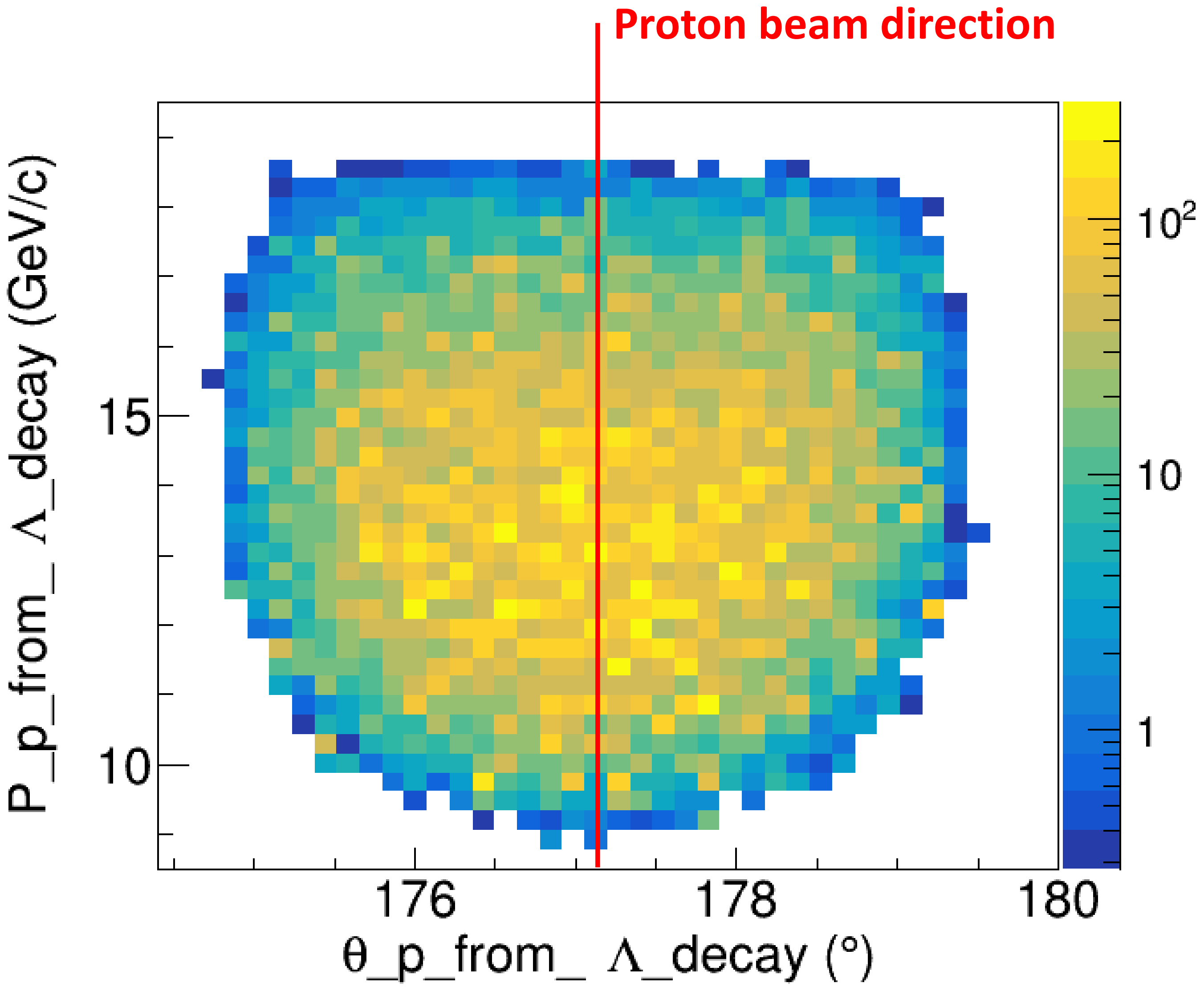
$ep \to e\Lambda K^+$, final-state Λ



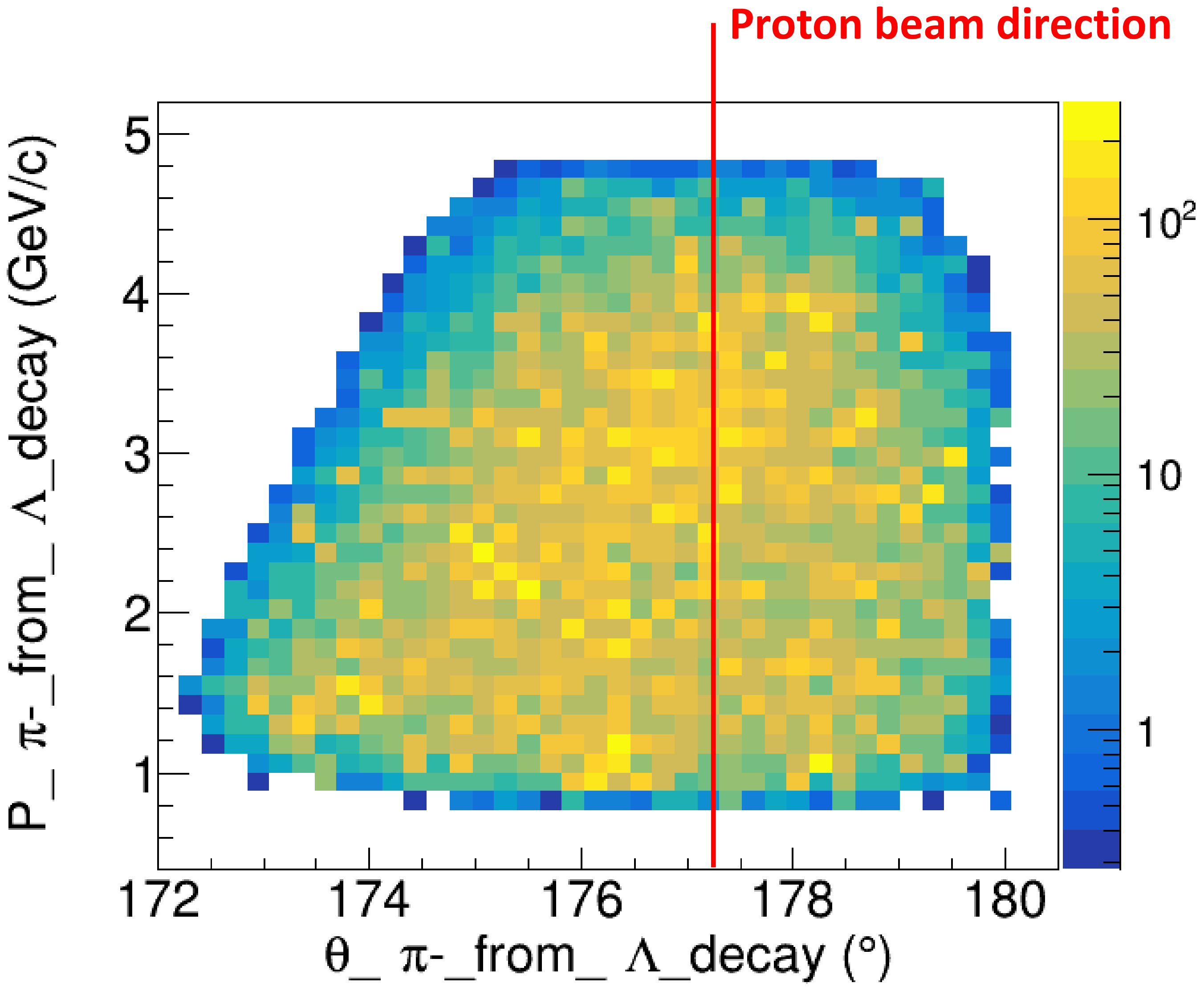
Differential cross section weighted!

$ep \rightarrow e\Lambda K^{+}$, final-state proton from Λ decay

Differential cross section weighted!

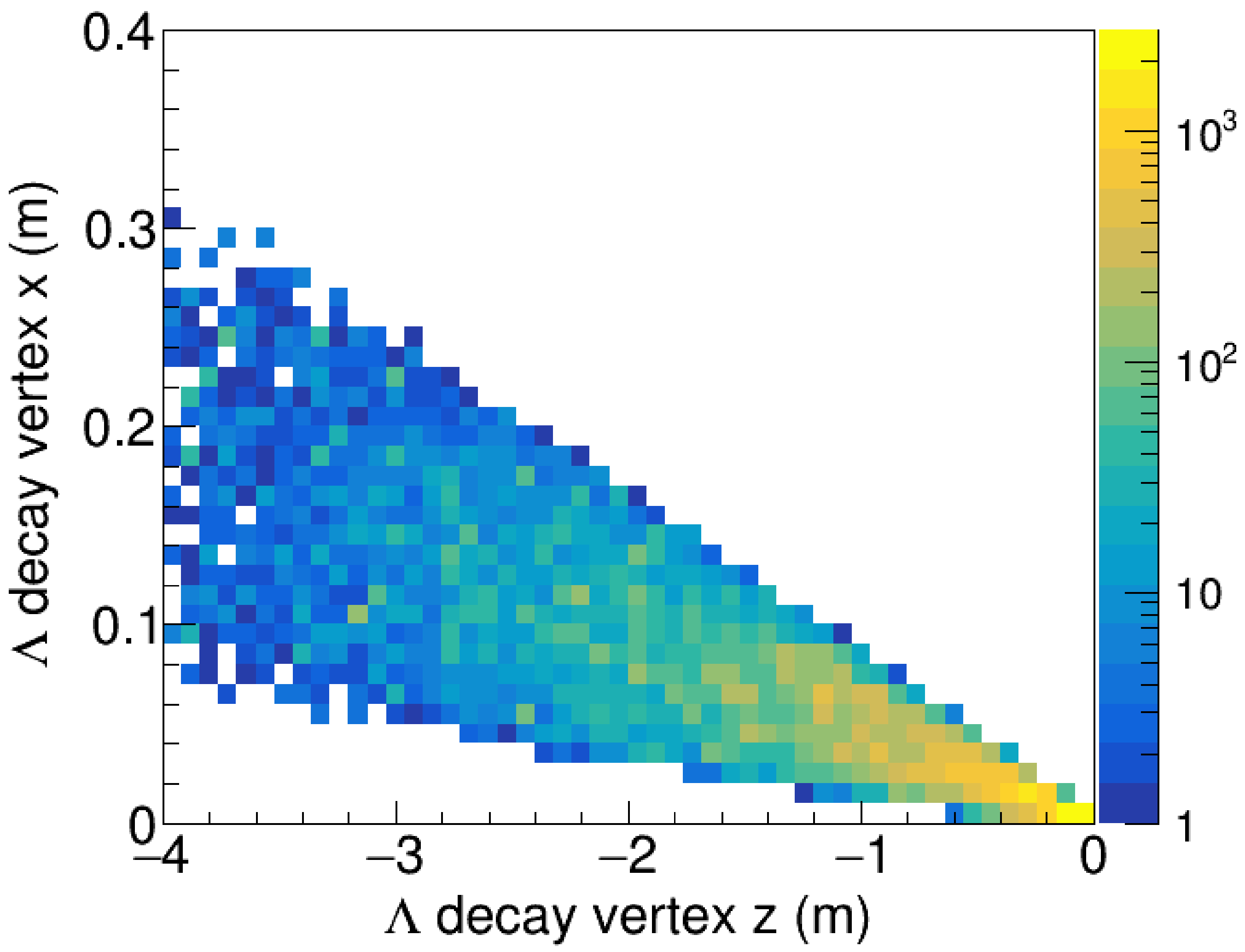


$ep \to e\Lambda K^+$, final-state π^- from Λ decay



Differential cross section weighted!

$ep \to e\Lambda K^+$, Λ decay vertex



Differential cross section weighted!

Backup: born-level pion pole model

$$\frac{d^3\sigma}{dQ^2 dx_B dt} = \Gamma(Q^2, x_B, s)\left[\frac{d\sigma_T}{dt} + \epsilon\frac{d\sigma_L}{dt}\right]$$

$$\Gamma(Q^2, x_B, s) = \frac{\alpha y^2(1-x_B)}{2\pi x_B(1-\epsilon)Q^2}$$

$$\epsilon = \frac{1 - y - \frac{Q^2}{4E^2}}{1 - y + \frac{y^2}{2} + \frac{Q^2}{4E^4}}$$

$$N\frac{d\sigma_L}{dt} = 4\hbar c(eg_{\pi NN}(t))^2 \boxed{\frac{-t}{(t-m_\pi^2)^2}Q^2F_\pi^2(Q^2)}$$

Pion pole and pion form factor

$$N = 32\pi(W^2 - m_p^2)\sqrt{(W^2-m_p^2)^2 + Q^4 + 2Q^2(W^2+m_p^2)}$$

$$g_{\pi NN}(t) = g_{\pi NN}(m_\pi^2)\left(\frac{\Lambda_\pi^2 - m_\pi^2}{\Lambda_\pi^2 - t}\right)$$

$$F_\pi(Q^2) = \frac{1}{1+Q^2/\Lambda_\pi^2}$$