

^3He Measurements

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2nd EIC Yellow Report Workshop

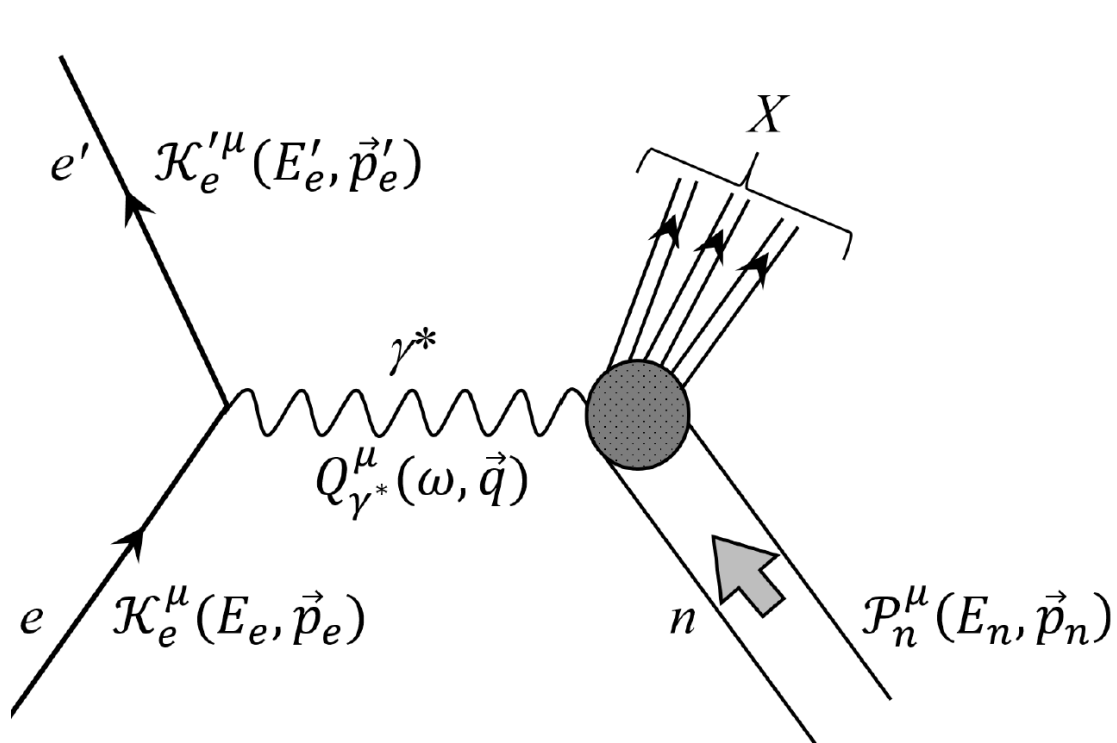


**Massachusetts
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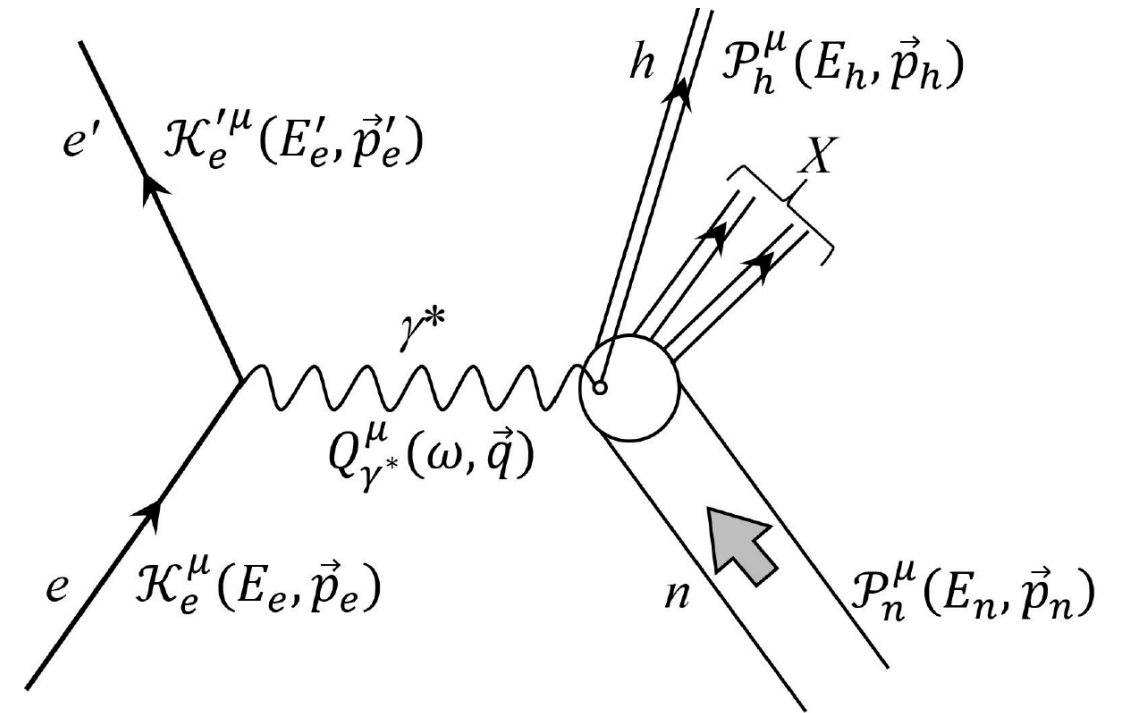
EIC general outline, e + p

- Hadron ring, proton values: $E_p = 41 - 275$ GeV
- Electron ring: $E_e = 2.5 - 18$ GeV
- High Luminosity: 10^{34} 1/(cm² s)
- Center of Mass Energy range: $\sqrt{s} = \sqrt{m_p^2 + m_e^2 + 2(E_p E_e + p_p p_e)} \Rightarrow 20.3 - 140.7$ GeV

Inclusive DIS and Semi-Inclusive DIS of ${}^3\text{He}$



- Measurement of structure functions F_L and F_2 (g_1 for polarized beams)



- Measurement of transverse momentum dependent (TMD) quark distributions in nucleons.

CLASDIS generator

- CLAS version of SIDIS Monte Carlo generator based on PEPSI (Polarized Electron Proton Scattering Interactions, L. Mankiewicz, A. Schafer, and M. Veltri, Comput. Phys. Commun. 71, 305 (1992).)
- It is made for fixed target experiments (EIC is collider)
 - > choose energies of the beams in collider frame
 - > boost the electron beam in the fixed target frame
 - > generate events using CLASDIS
 - > boost obtained particles back into the collider frame

From Collider frame to Fixed target frame

- Min. and max. momenta for the ^3He ($Z = 2$):

^3He	Minimal Values	Maximal Values
p [GeV]	81.9785	549.997
$\gamma = E_{^3\text{He}}/m_{^3\text{He}}$	29.1971	195.7718
$\beta = p_{^3\text{He}}/E_{^3\text{He}}$	0.999413	0.999987

- Now we can boost electron from the collider frame into the fixed target frame:

$$E_e^{Fix} = \gamma(E_e^{Col} + \beta p_e^{Col})$$

Electron	$E_e^{Col} = 2.5$ GeV	$E_e^{Col} = 18$ GeV
E_e^{Fix} [GeV]	145.943	7047.74

Rate estimation from CLASDIS generator

- Inclusive DIS cuts: $W^2 > 4 \text{ GeV}^2$, $Q^2 > 2 \text{ GeV}^2$, $x_B > 0.1$
- SIDIS cuts: $W^2 > 4 \text{ GeV}^2$, $Q^2 > 2 \text{ GeV}^2$, $x_B > 0.1$, $Z > 0.3$

$$E_e^{Col} = 2.5 \text{ GeV} \text{ and } E_{3He}^{Col} = 81.9 \text{ GeV}$$

$$E_e^{Col} = 18 \text{ GeV} \text{ and } E_{3He}^{Col} = 550 \text{ GeV}$$

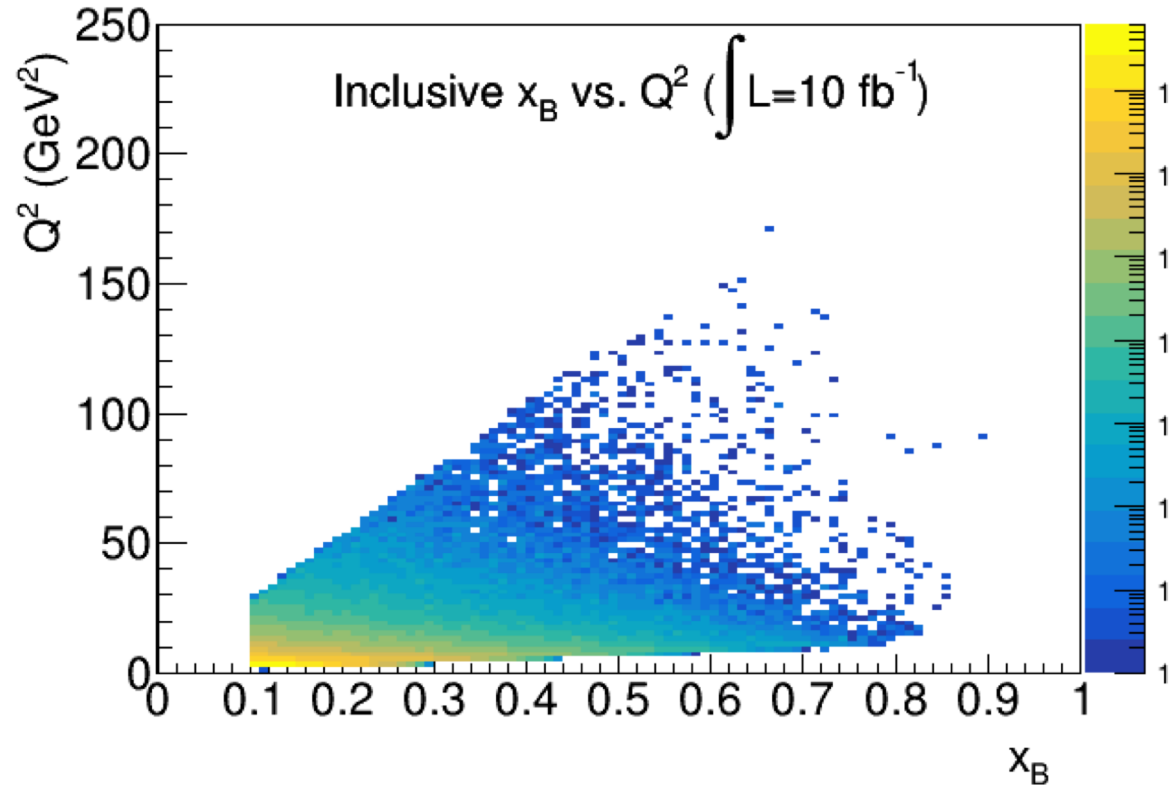
Reaction	Rate (1/sek)
${}^3\text{He}(e, e')X$	1126.15
${}^3\text{He}(e, e' \pi^+)X$	108.03
${}^3\text{He}(e, e' \pi^-)X$	90.84
${}^3\text{He}(e, e' K^+)X$	75.44
${}^3\text{He}(e, e' K^-)X$	35.62

Reaction	Rate (1/sek)
${}^3\text{He}(e, e')X$	0.091
${}^3\text{He}(e, e' \pi^+)X$	0.0036
${}^3\text{He}(e, e' \pi^-)X$	0.0018
${}^3\text{He}(e, e' K^+)X$	0.0031
${}^3\text{He}(e, e' K^-)X$	0.0011

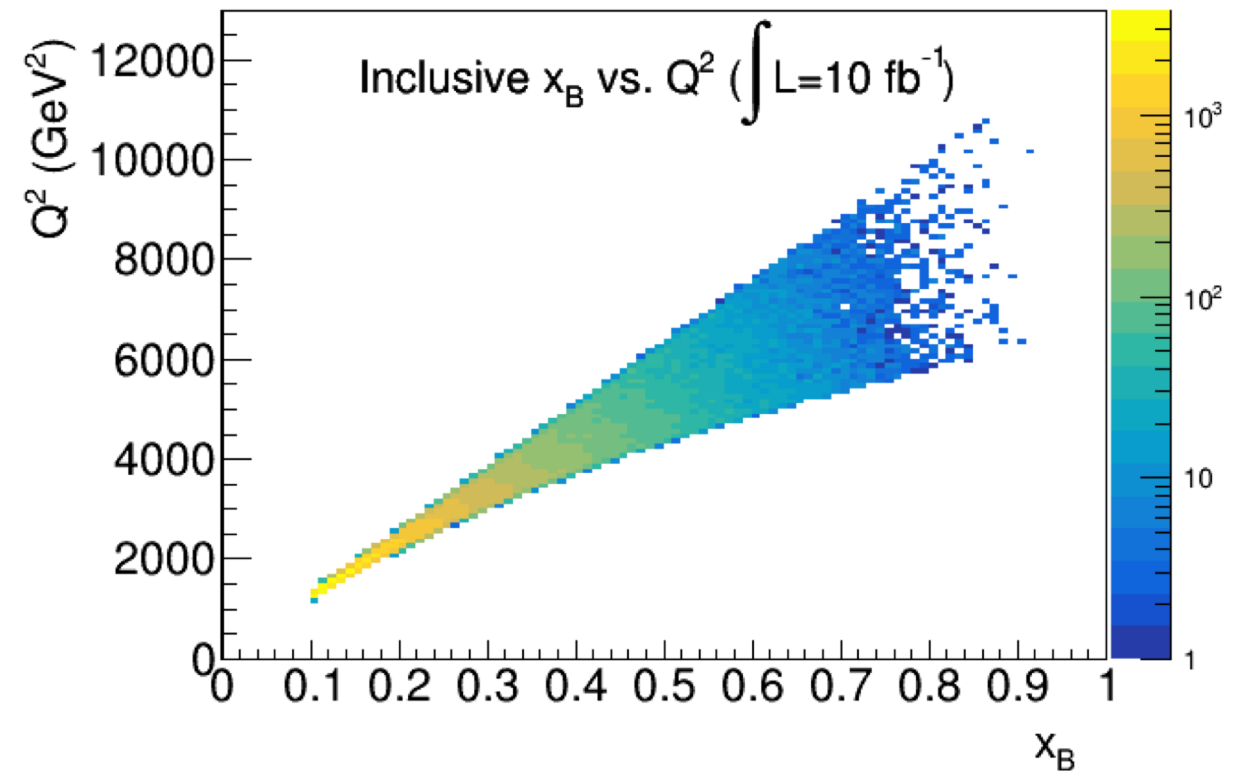
Inclusive DIS ${}^3\text{He}(e, e')X$

- Inclusive DIS cuts: $W^2 > 4 \text{ GeV}^2$, $Q^2 > 2 \text{ GeV}^2$, $x_B > 0.1$

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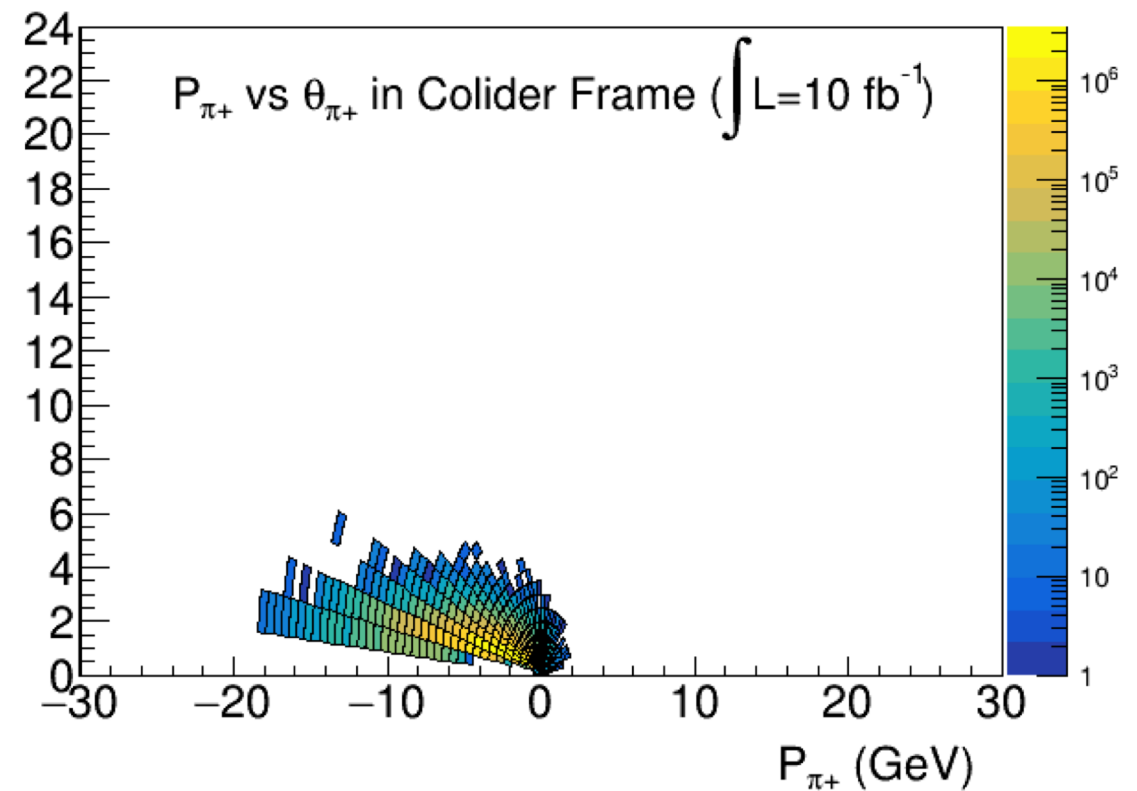
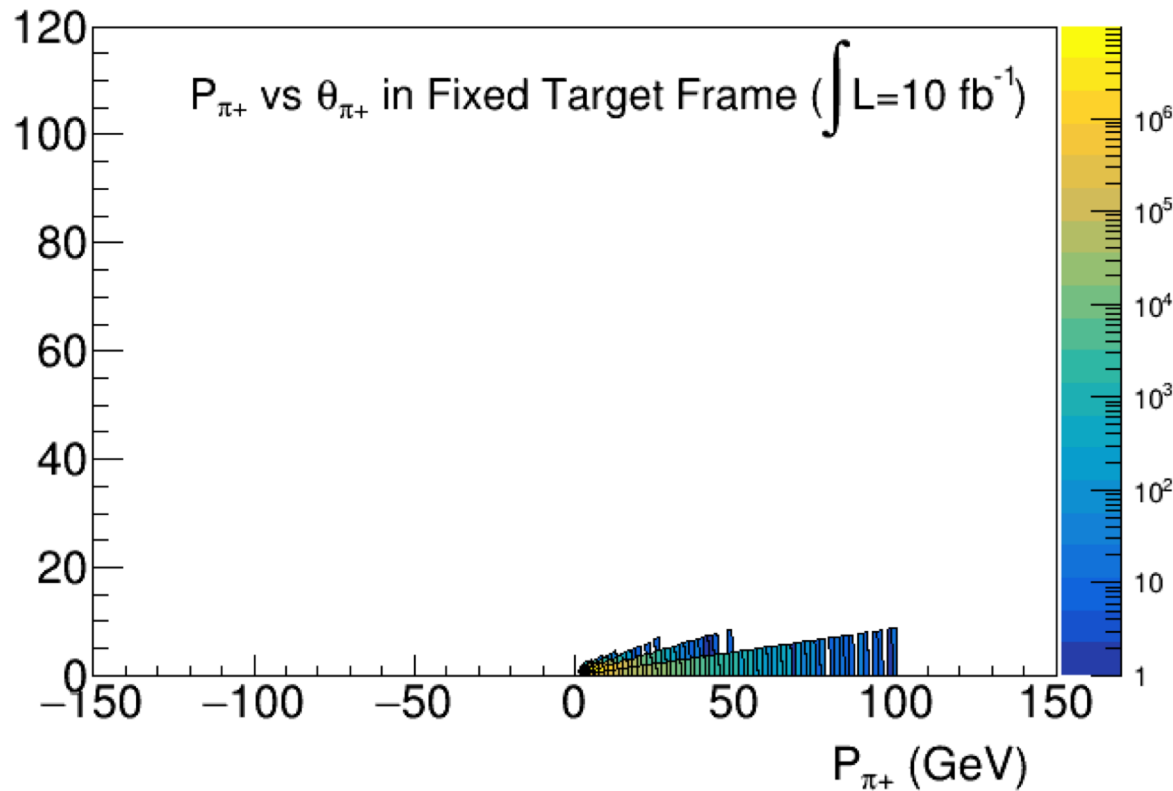


$$E_e^{Col} = 18 \text{ GeV} \text{ and } E_{{}^3\text{He}}^{Col} = 550 \text{ GeV}$$



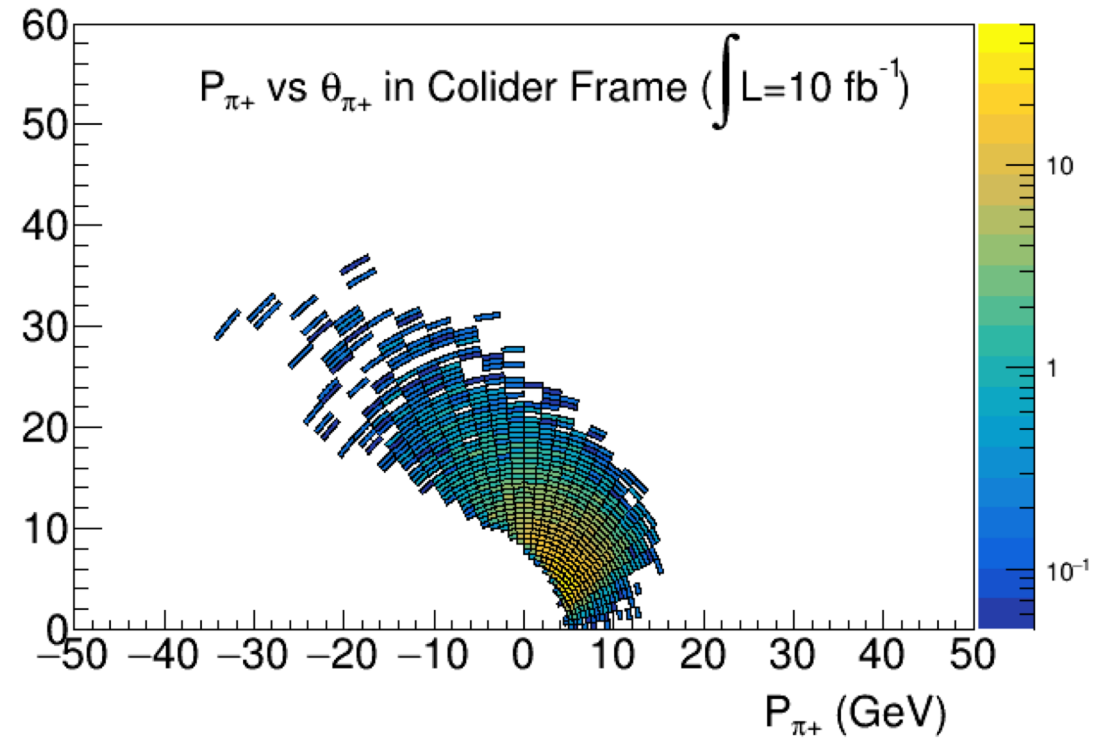
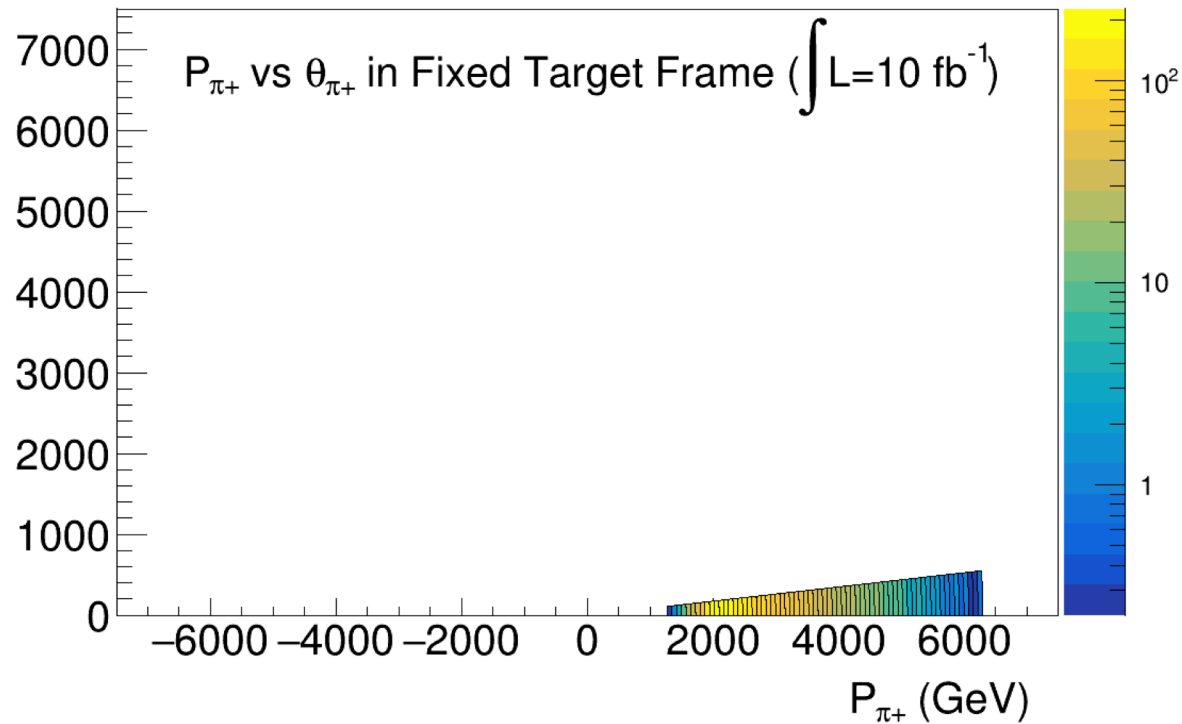
Semi-Inclusive DIS ${}^3\text{He}(e, e'\pi^+)X$

- SIDIS cuts: $W^2 > 4 \text{ GeV}^2$, $Q^2 > 2 \text{ GeV}^2$, $x_B > 0.1$, $Z > 0.3$
 $E_e^{Col} = 2.5 \text{ GeV}$ and $E_{3He}^{Col} = 81.9 \text{ GeV}$



Semi-Inclusive DIS ${}^3\text{He}(e, e'\pi^+)X$

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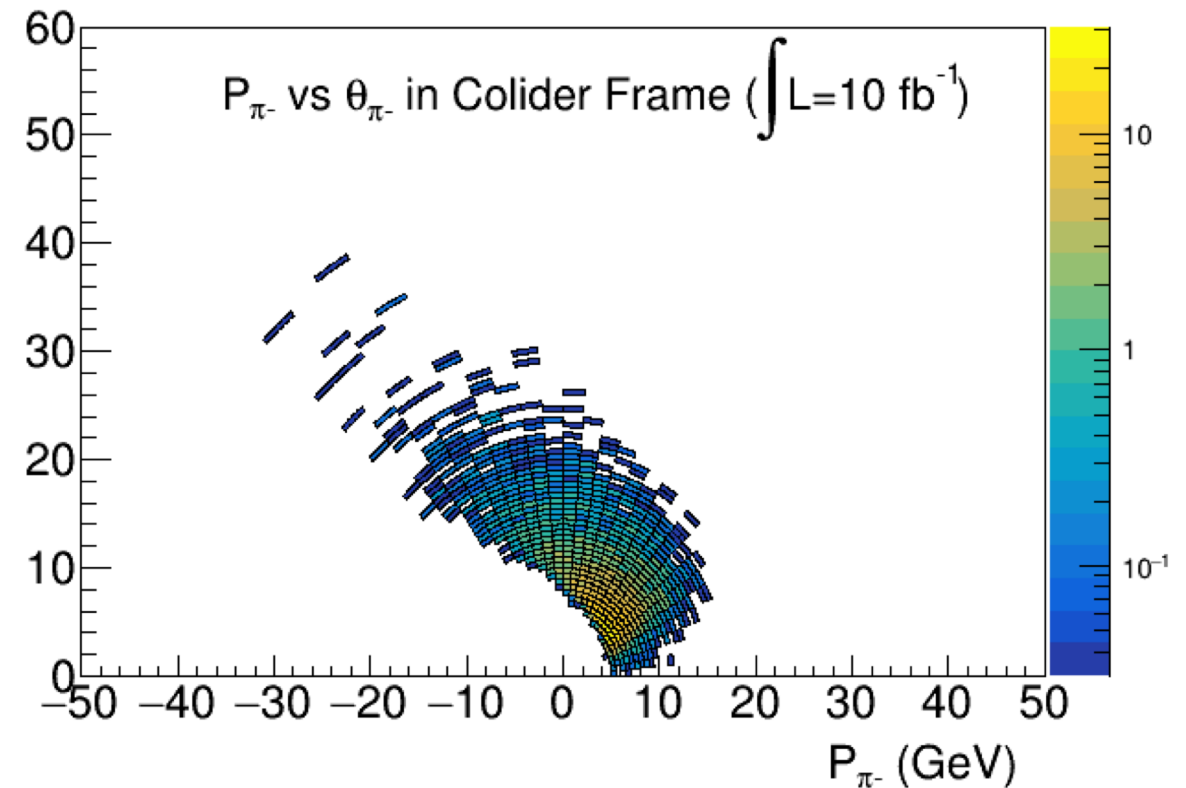
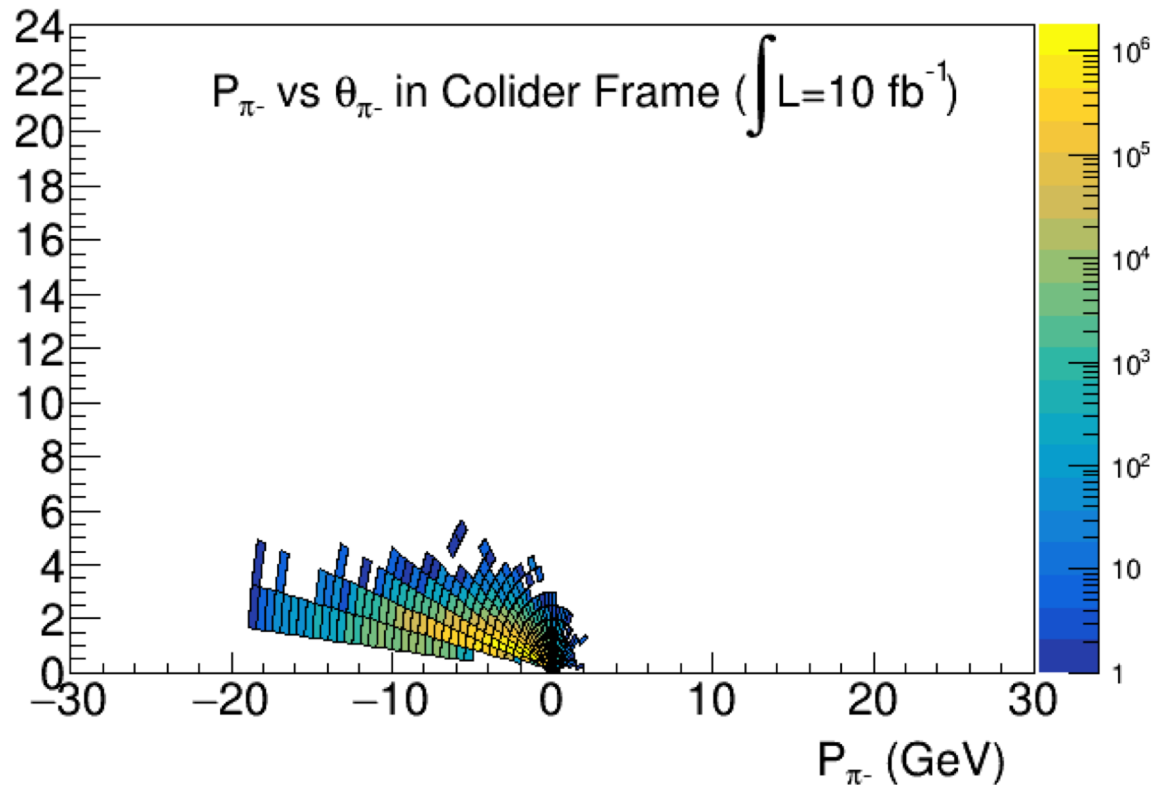


Semi-Inclusive DIS ${}^3\text{He}(e, e'\pi^-)X$

- SIDIS cuts : $W^2 > 4 \text{ GeV}^2$, $Q^2 > 2 \text{ GeV}^2$, $x_B > 0.1$, $Z > 0.3$

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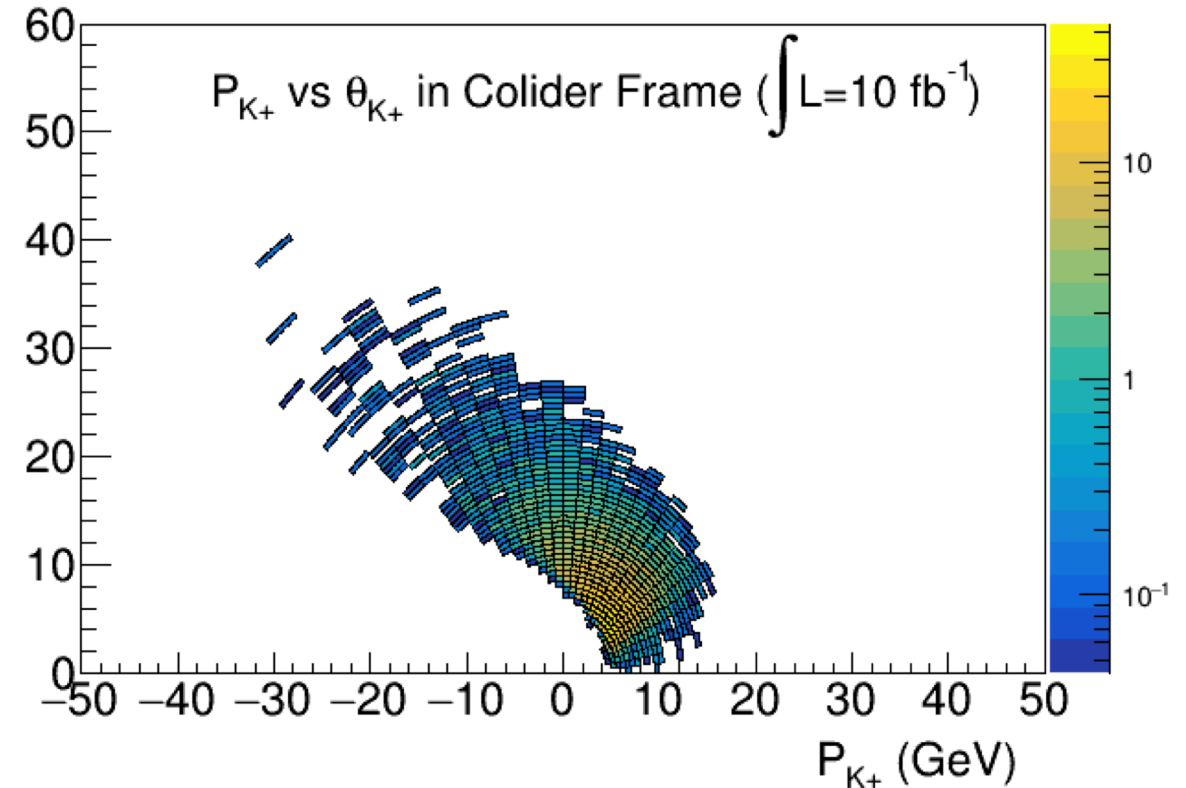
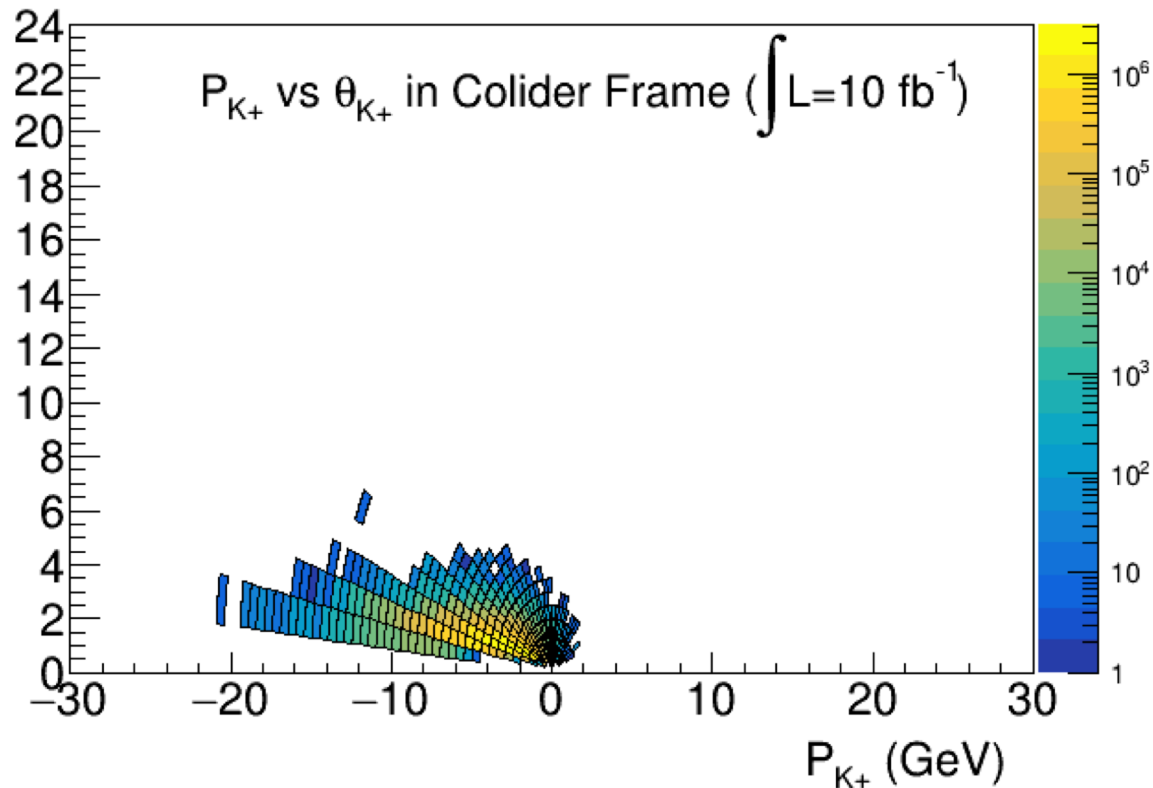


Semi-Inclusive DIS ${}^3\text{He}(e, e'K^+)X$

- SIDIS cuts: $W^2 > 4 \text{ GeV}^2$, $Q^2 > 2 \text{ GeV}^2$, $x_B > 0.1$, $Z > 0.3$

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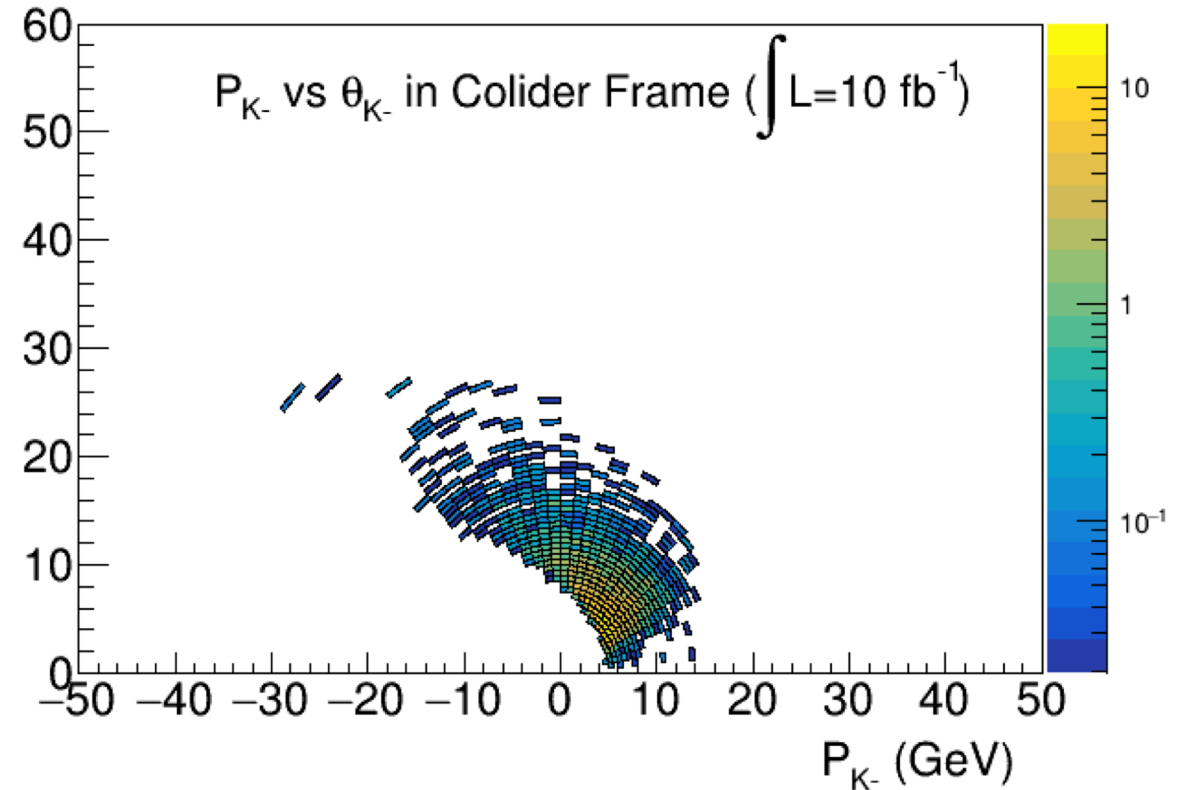
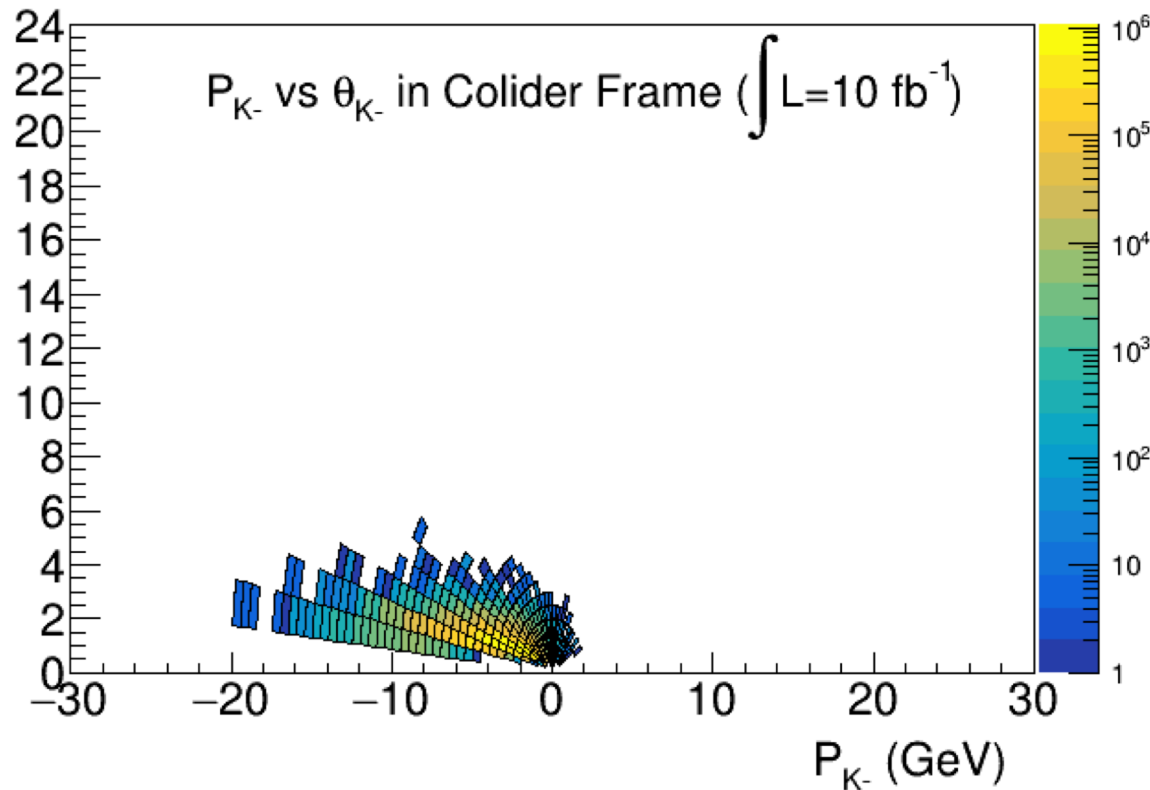


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Outlook

- Run the generated events through detector simulation
 - => Acceptance correction
 - => Smearing
- Include the polarization