Pion and Kaon Form Factors at the EIC

Love Preet[1], G. M. Huber[1], S. J. D. Kay[1,2]

[1]University of Regina, [2]University of York

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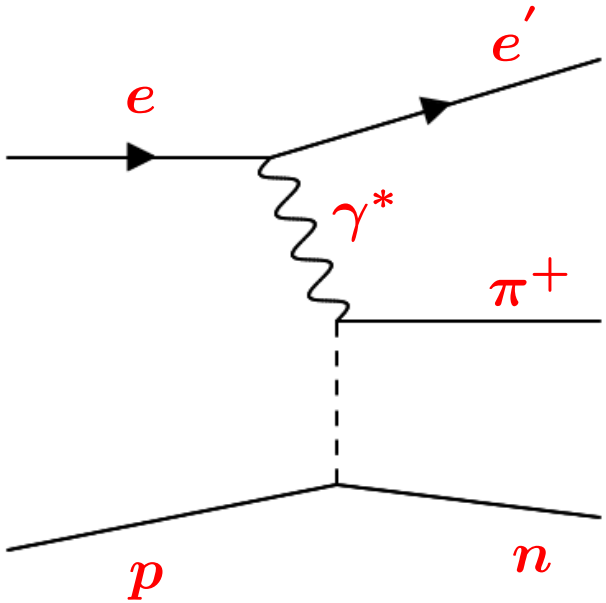
ePIC simulations for exclusive reactions

- Feasibility studies of Deep Exclusive Meson Production (DEMP) reactions through ePIC simulations.
- Utilized DEMPgen to generate files for both reactions (π^+, K^+), passed π^+ files through the latest ePIC simulations.
- Begin with π^+ electroproduction reaction.

$$e + p \rightarrow e' + \pi^+ + n$$

  - Indirectly use the "pion cloud" of the proton via the p(e,e' π^+ n) process.
- Identification involves reconstructing all final state particles.



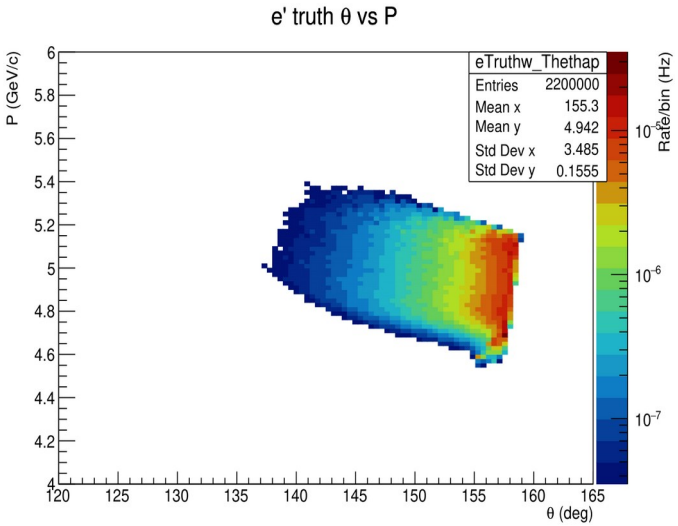
https://arxiv.org/abs/2403.06000

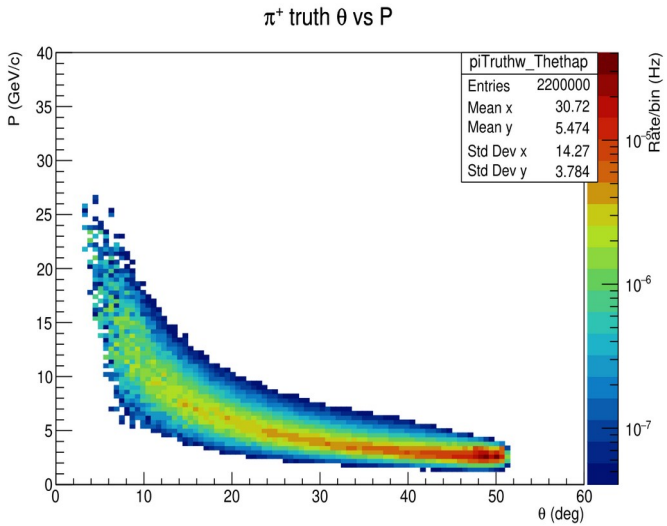
Why are these studies important?

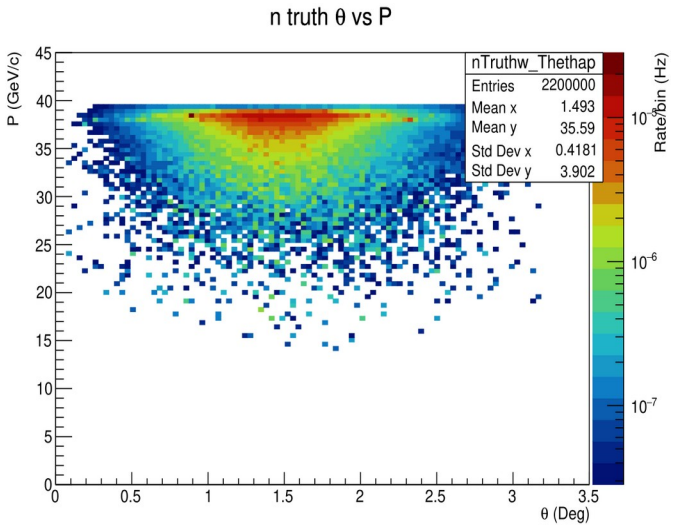
- Emergence of hadronic mass generation is directly linked to the internal structure of the constituents ($\pi^{\pm}$, $K^{\pm}$).
  - Can examine this internal structure by looking at quantities like the form factor.
  - Form factor describes the spatial distribution of partons within a hadron.
- Comparing pion ($\pi^{\pm}$) and kaon ($K^{\pm}$) form factors (F_{π} , F_{K}) provides unique information on mass generation mechanisms.
- One of the ways to measure the form factor is through Deep Exclusive Meson Production (DEMP) reactions at EIC.

Spatial topology of weighted truth variables at ePIC detector

- Simulated 2200k events for 5(e) on 41(p) GeV collisions.
- $e^{'}$, π^{+} hits the central detector, n hits far-forward detectors (mainly ZDC).



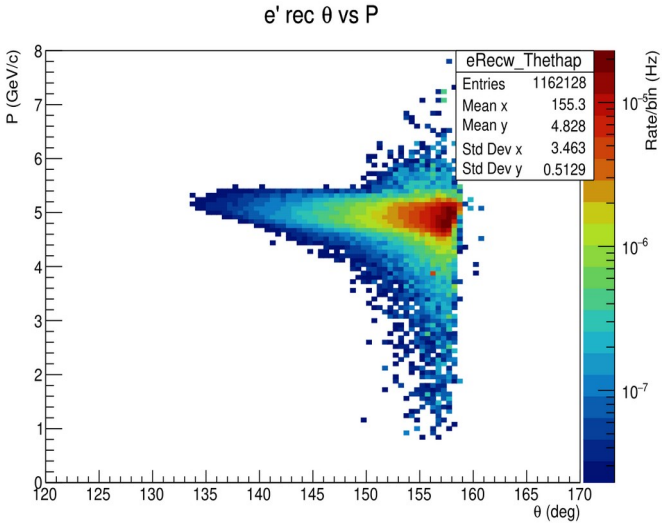




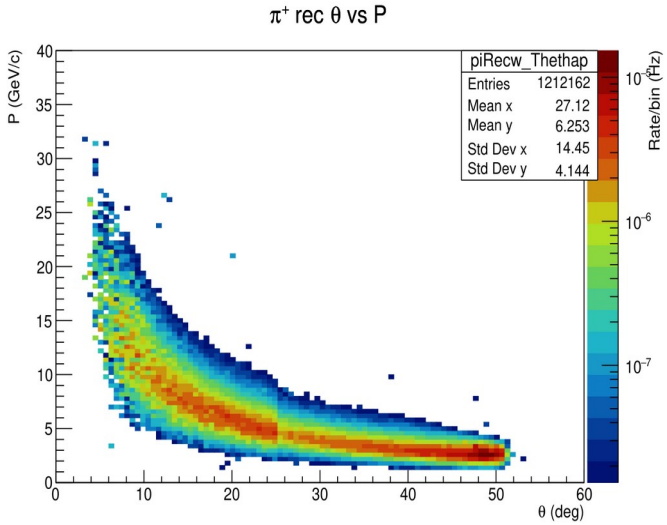
Spatial topology of weighted rec variables at ePIC detector

- Simulated 2200k events for 5(e) on 41(p) GeV collisions.
- $e^{'}$, π^{+} hits the central detector, n hits far-forward detectors (mainly ZDC).

Reconstruction efficiency for $e^{'}$, π^{+} drops significantly compared to January simulated files.



~47% Events lost

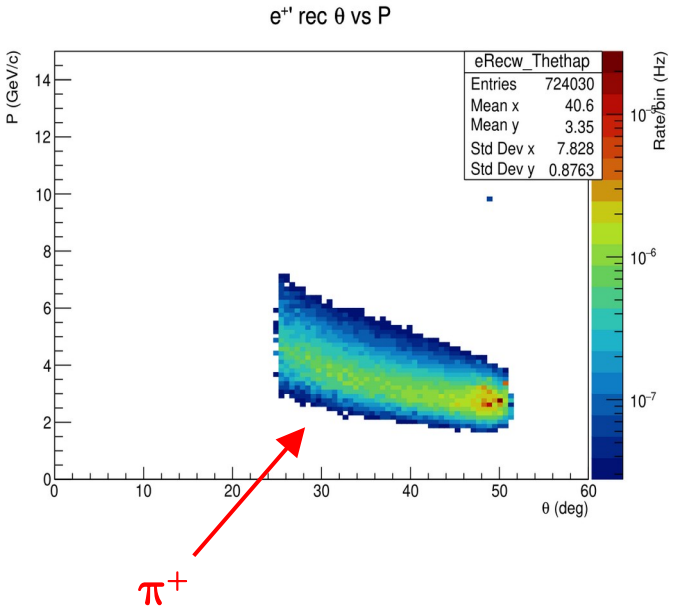


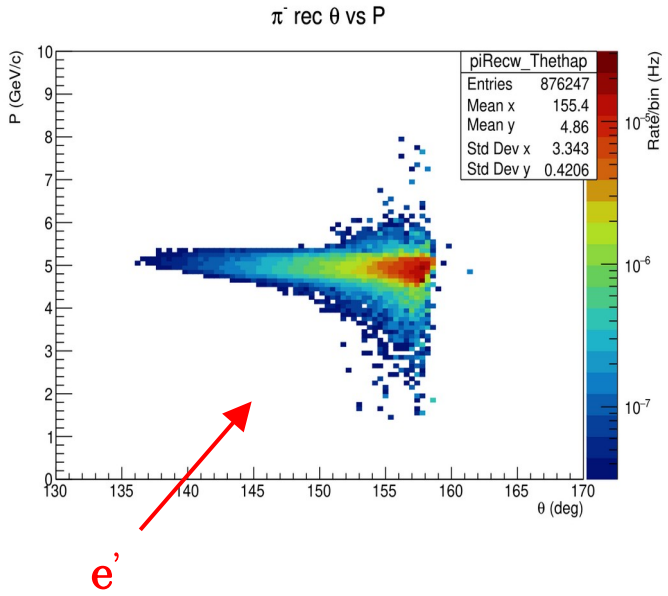
~45% Events lost

[Using ReconstructedChargedParticles with a cut on PDG]

Spatial topology of weighted rec variables at ePIC detector

- Central detector algorithm misidentifies (~50 %) $e^{'}$ as π^{-} and π^{+} as $e^{+'}$.
- Reduction in identification efficiency, but not in detection efficiency.

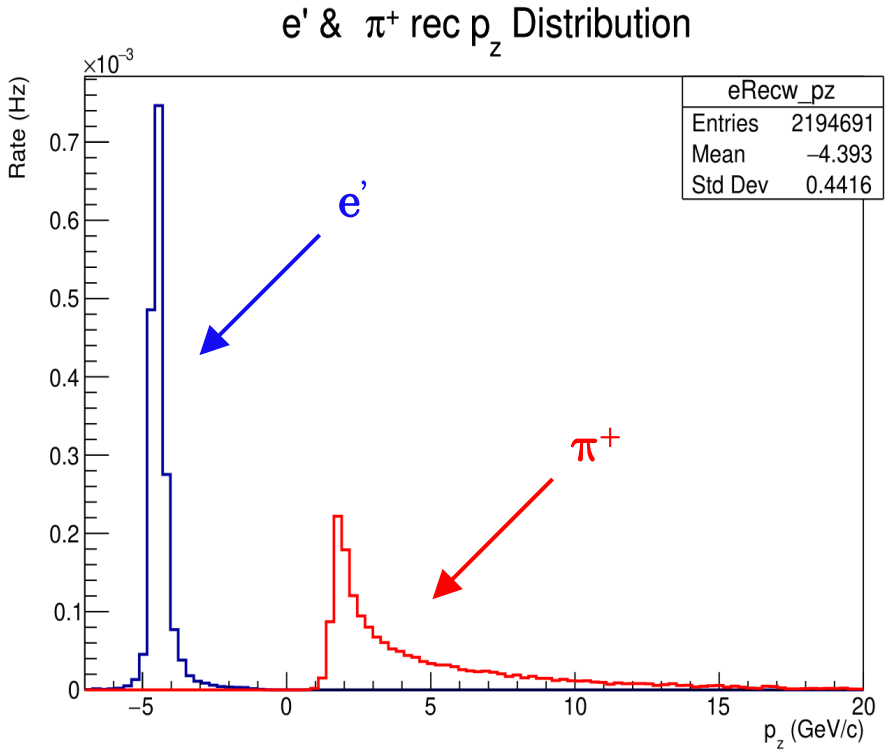




[Using ReconstructedChargedParticles with a cut on negative PDG]

Spatial topology of weighted rec variables at ePIC detector

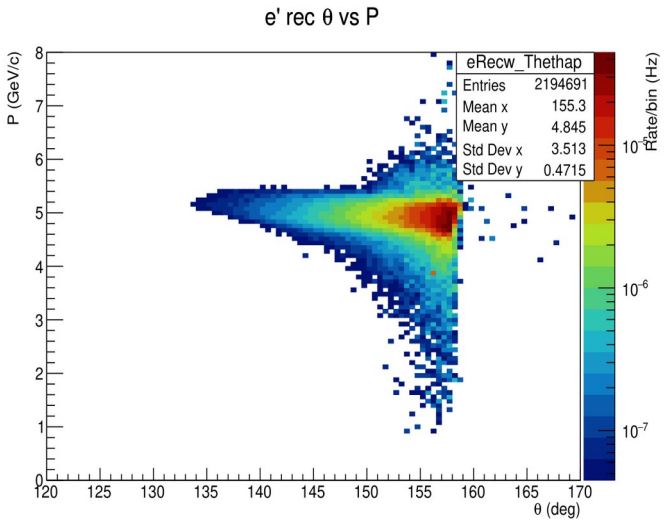
- Resolved by placing a cut on the momentum-z component and the charge.



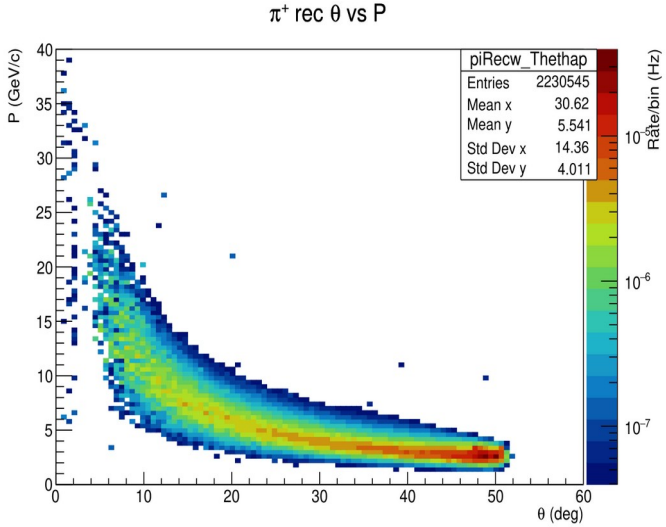
[Using ReconstructedChargedParticles with a cut on mom-z and charge]

Spatial topology of weighted rec variables at ePIC detector

- Resolved by placing a cut on the momentum-z component and the charge.



~0.2% Events lost



~1.3% Events lost

[Using ReconstructedChargedParticles with a cut on mom-z and charge]

Summary

- PID lookup tables are having trouble identifying particles.
- Particles are going into different regions of the central detector.
- Using momentum-z component and the charge information to reconstruct particles.

Thank you !

University of Regina

UNIVERSITY of York

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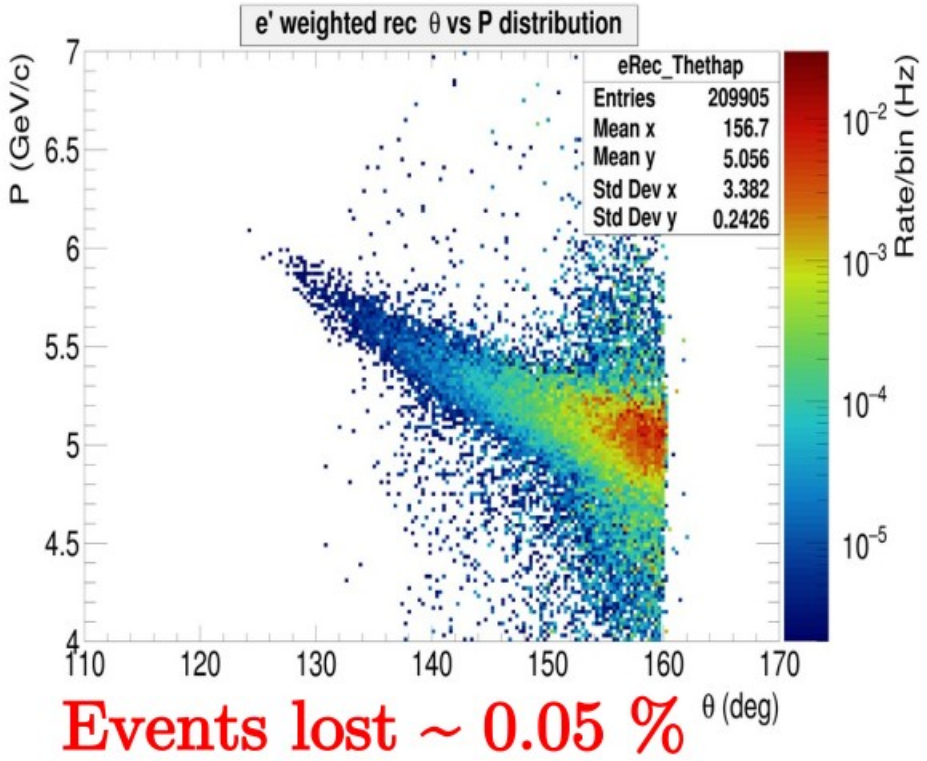
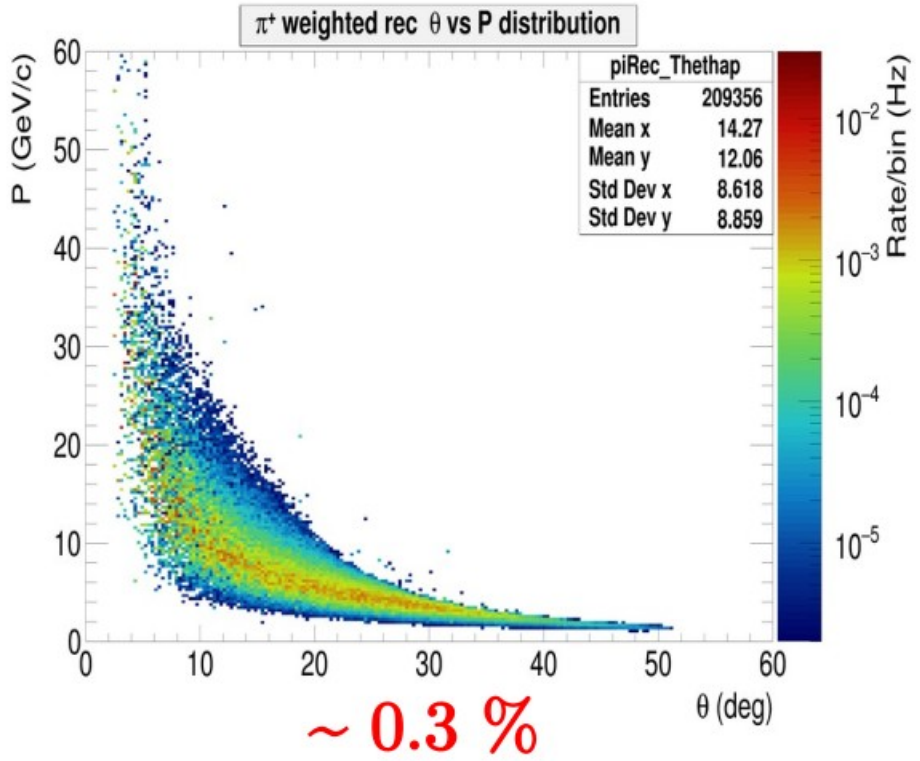
Email : navisaharan3@gmail.com

January simulations results

- For 5(e) on 100(p) GeV collisions from ePIC simulations.





Tracking efficiency as fn of η