Contributions to preTDR from Jets&HF

Text and Figure in preTDR

- **Heavy flavor**
  - Topological **reconstruction of D0 mesons** in e+p and e+Au
    - Invariant mass of π+K pairs with and without topological selections in 10×100 GeV e+p and e+Au
    - Projection of relative statistical errors on D0 yield ratios between 10×100 GeV e+Au and e+p collisions as a function of D0 pT for three different D0 rapidity intervals
- **Jets**
  - Jet Energy Scale (JES), Jet Energy Resolution (JER)
  - Collins asymmetries of identified hadrons in jets

Comments on current text

- **Hard Probes**
  - Look to di-jets to measure the gluon sivers function that is a very challenging process as you need to measure the imbalance of the jets which shows resolution [Rongrong, Brian]
  - Projected statistical precision [100fb-1], indicated by vertical bars around data points, for measurements of **Collins asymmetries of identified hadrons in jets** as a function of hadron z. Expand beyond statistical precision to demonstrate detector performance. [Realistic PID?]
  - Add lambda-c - a strict test on detector performance? (need to generate larger stat sample if possible and request sim) [Shyam]

New structure

4.2.5 Jet Reconstruction and Calibration

- 4.2.5.1 Jet Energy Scale and Resolution

4.4.4 Hard Probes

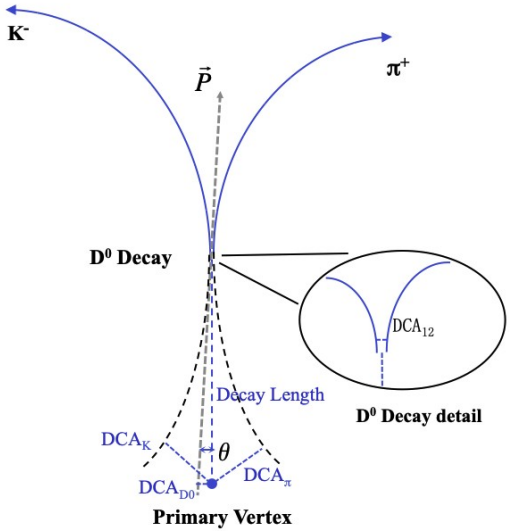
- 4.4.4.1 Heavy Flavor reconstruction
- 4.4.4.2 Displaced vertex resolution and tracking
- 4.4.4.3 Detector Impact on Key Heavy Flavor Physics Measurements
- 4.4.4.4 Influence of beam on Background on Heavy Flavour measurements
- 4.4.4.5 Jets as a Hard Probe
- 4.4.4.6 Detector Impact on Key Jet Physics Measurements
- 4.4.4.7 Influence of beam on Background on Jet measurements

4.2.5.1 Jet Energy Scale and Resolution

- Text: already in preTDR
- Figure [Brian, Dener]
  - Current: JES and JER vs. jet E in three eta bins using ep @ 18x275
  - Do we want to include such distributions from eAu? If so, switch to ep @ 10x100 as well? Will do so.

4.4.4.1 Heavy Flavor reconstruction

- Text: general introduction; mention **Helix**, KFParticle, secondary vertexing [Rongrong, Shyam]
- Figure
  - Decay topology

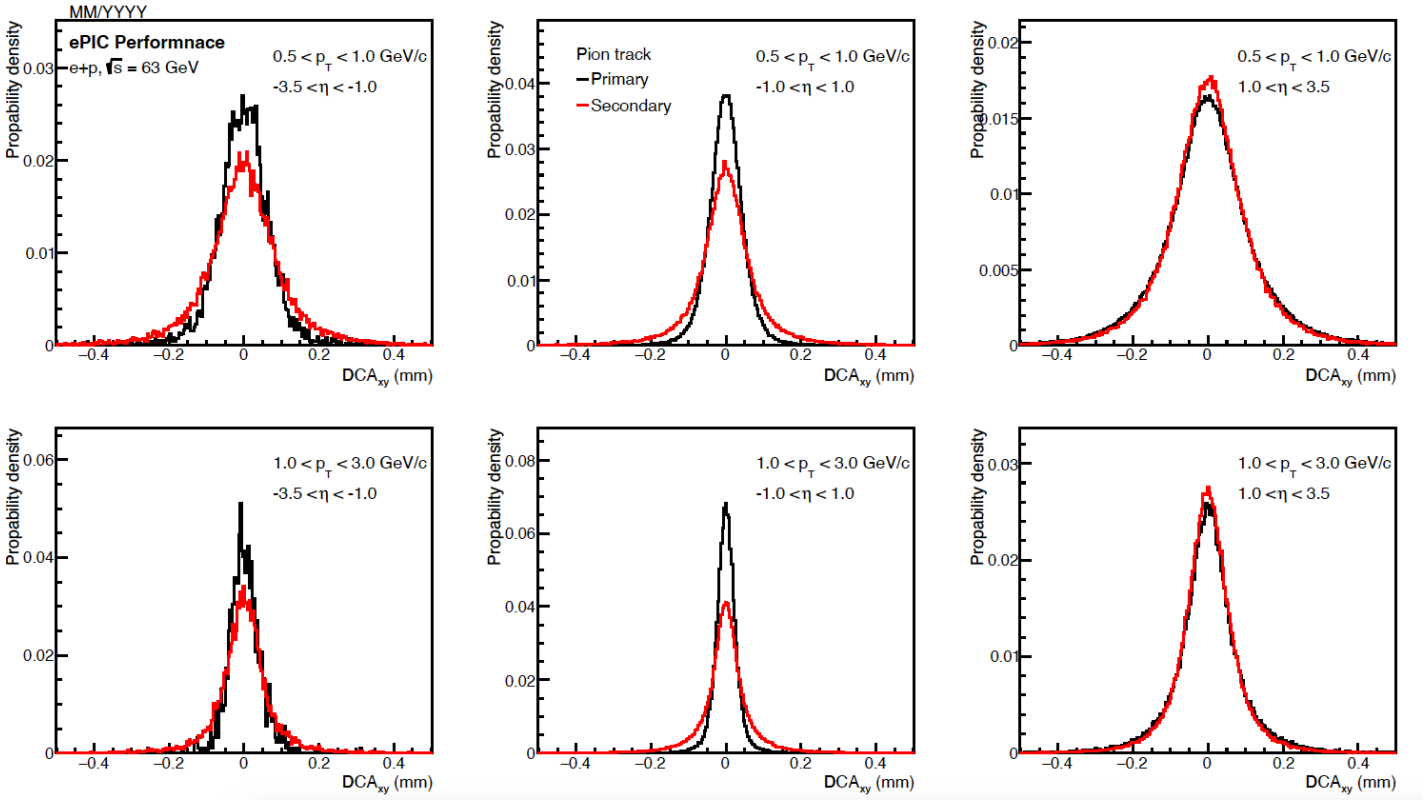


STAR, PRC 99, 034908 (2019)

4.4.4.2 Displaced vertex resolution and tracking

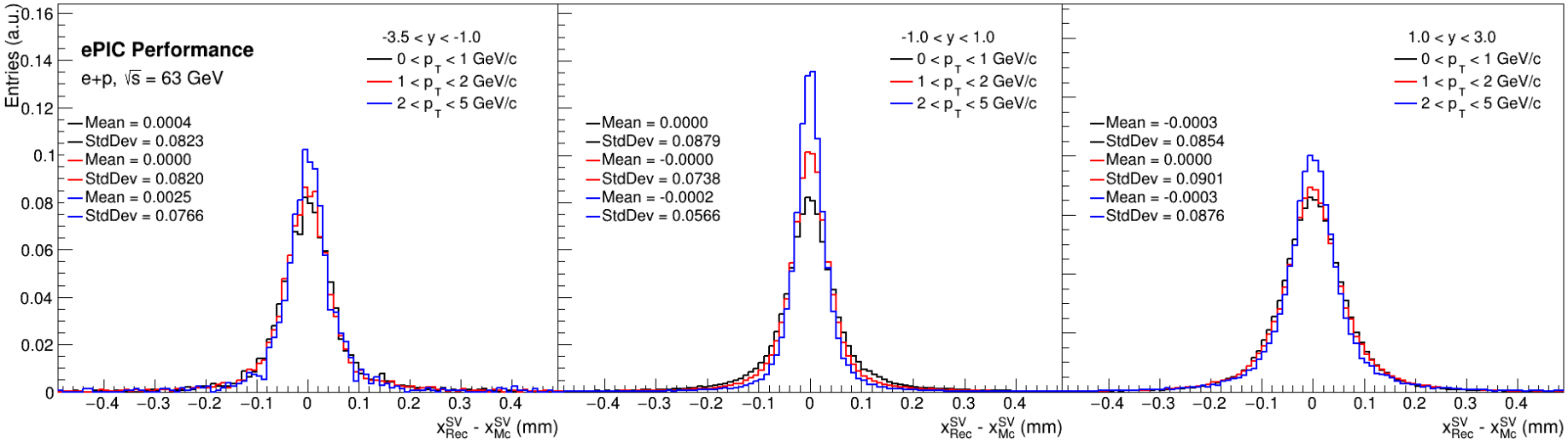
- Text [Rongrong, Shyam]
- Figure
  - Pointing resolution: primary track DCA to MC vertex [tracking group]
  - Primary vs. secondary track DCA to MC vertex using ep @ 10x100 [Rongrong]
  - Distance between reconstructed and true D0 decay vertex using ep @ 10x100 [Shyam, Bishoy]
  - Current in preTDR: Invariant mass of π+K pairs with and without topological selections in 10×100 GeV e+p and e+Au [Shyam]

Primary vs. secondary track DCA to MC vertex using ep @ 10x100 [Rongrong]

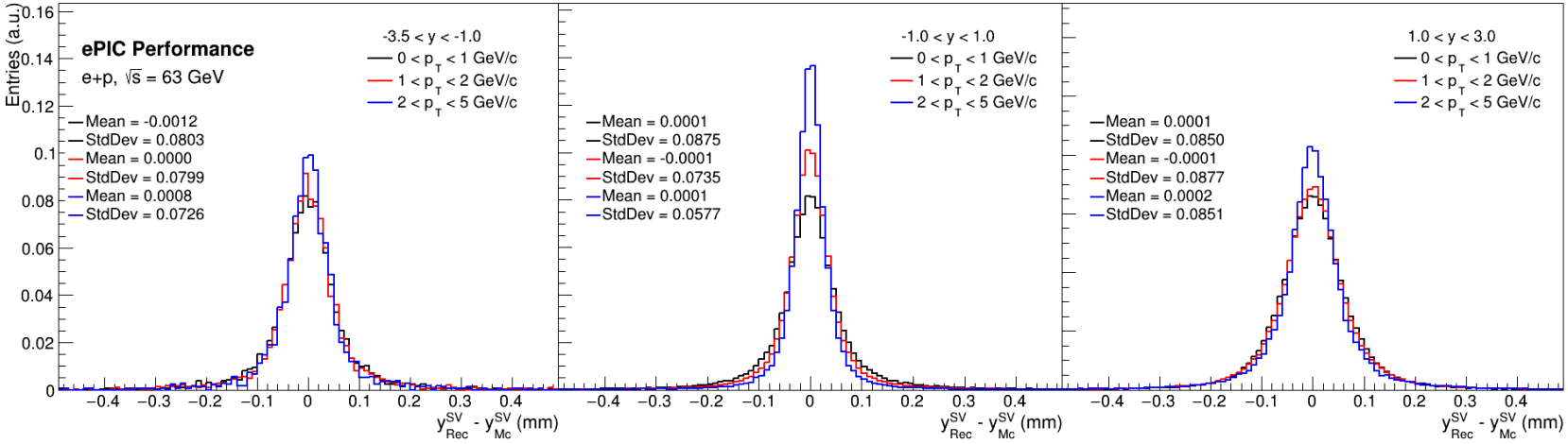


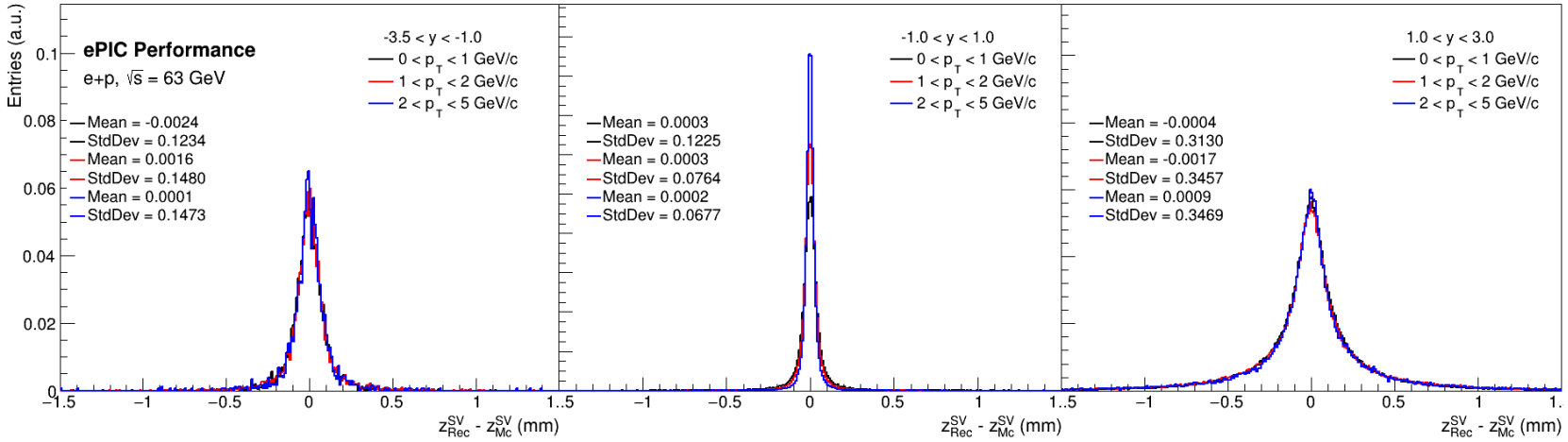
Distance between reconstructed and true D0 decay vertex using ep @ 10x100 [Shyam]

Based on Chi-square minimization

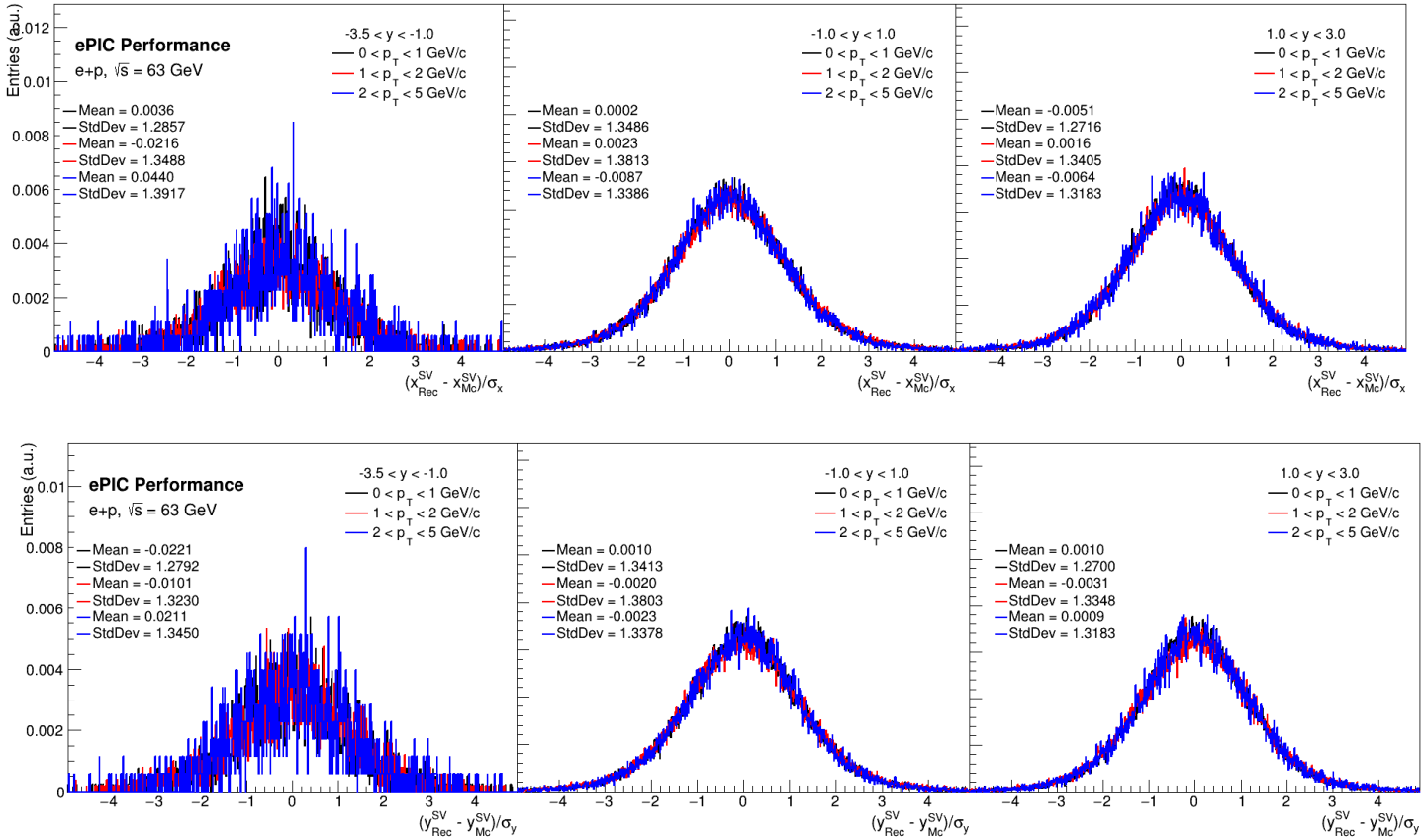


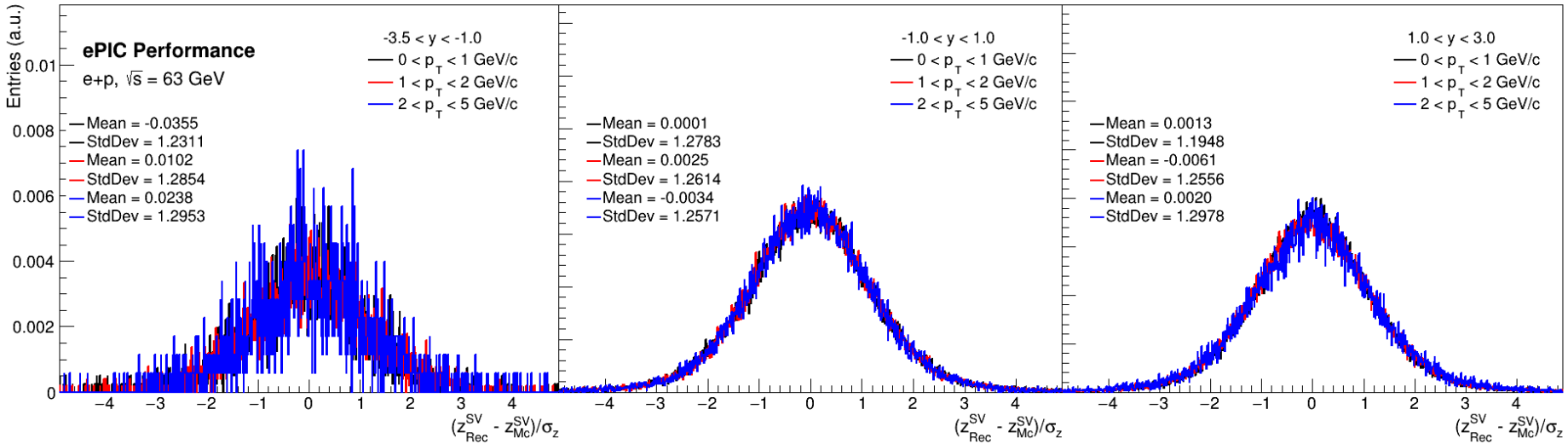
Bishoy will also produce using AdaptiveMultiVertexFinder

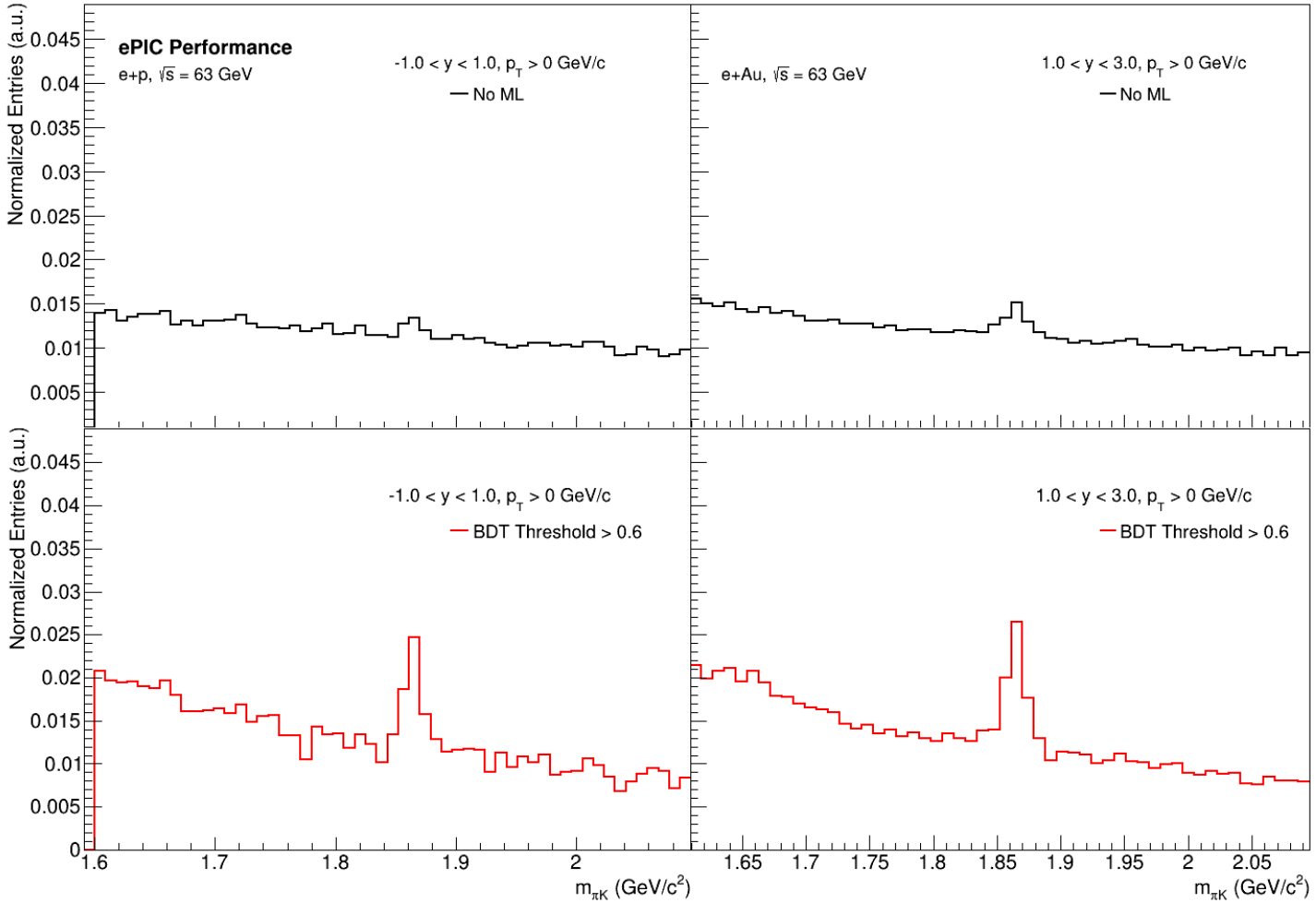

ePIC Performance
e+p, √s = 63 GeV
-3.5 < y < -1.0
0 < p_T < 1 GeV/c
1 < p_T < 2 GeV/c
2 < p_T < 5 GeV/c
Mean = -0.0012
StdDev = 0.0803
Mean = 0.0000
StdDev = 0.0799
Mean = 0.0008
StdDev = 0.0726
-1.0 < y < 1.0
Mean = 0.0001
StdDev = 0.0875
Mean = -0.0001
StdDev = 0.0735
Mean = 0.0001
StdDev = 0.0577
1.0 < y < 3.0
Mean = 0.0001
StdDev = 0.0850
Mean = -0.0001
StdDev = 0.0877
Mean = 0.0002
StdDev = 0.0851
Entries (a.u.)
y^SV_Rec - y^SV_Mc (mm)


ePIC Performance
e+p, √s = 63 GeV
-3.5 < y < -1.0
0 < p_T < 1 GeV/c
1 < p_T < 2 GeV/c
2 < p_T < 5 GeV/c
Mean = -0.0024
StdDev = 0.1234
Mean = 0.0016
StdDev = 0.1480
Mean = 0.0001
StdDev = 0.1473
-1.0 < y < 1.0
Mean = 0.0003
StdDev = 0.1225
Mean = 0.0003
StdDev = 0.0764
Mean = 0.0002
StdDev = 0.0677
1.0 < y < 3.0
Mean = -0.0004
StdDev = 0.3130
Mean = -0.0017
StdDev = 0.3457
Mean = 0.0009
StdDev = 0.3469
Entries (a.u.)
z^SV_Rec - z^SV_Mc (mm)

Based on Chi-square minimization



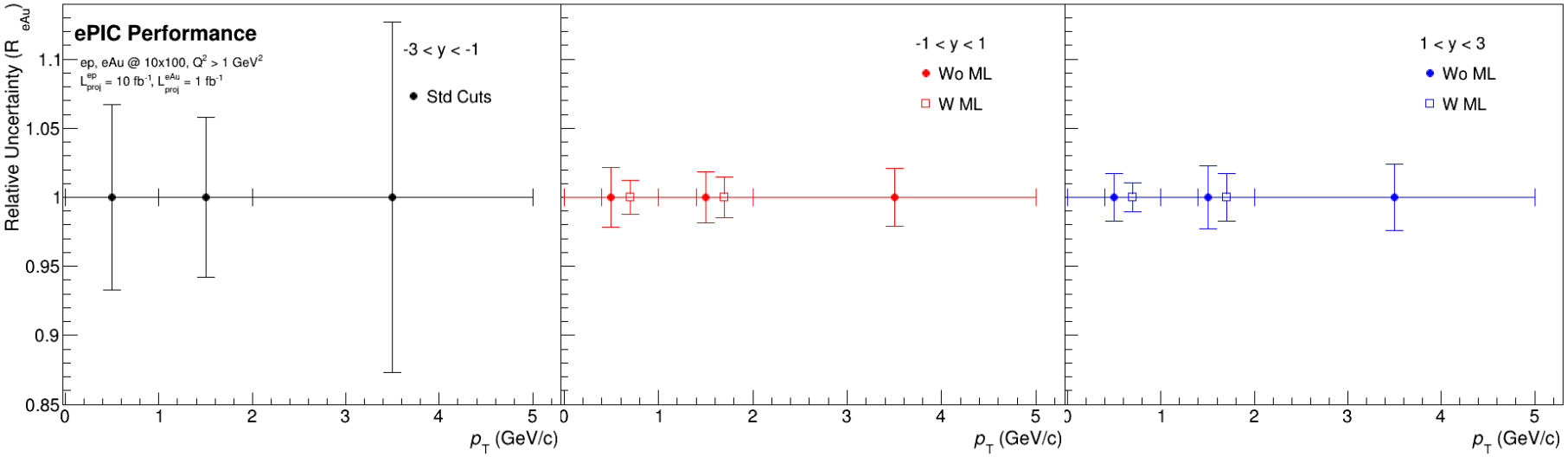

ePIC Performance
e+p, √s = 63 GeV
-3.5 < y < -1.0
0 < p_T < 1 GeV/c
1 < p_T < 2 GeV/c
2 < p_T < 5 GeV/c
Mean = -0.0355
StdDev = 1.2311
Mean = 0.0102
StdDev = 1.2854
Mean = 0.0238
StdDev = 1.2953
-1.0 < y < 1.0
0 < p_T < 1 GeV/c
1 < p_T < 2 GeV/c
2 < p_T < 5 GeV/c
Mean = 0.0001
StdDev = 1.2783
Mean = 0.0025
StdDev = 1.2614
Mean = -0.0034
StdDev = 1.2571
1.0 < y < 3.0
0 < p_T < 1 GeV/c
1 < p_T < 2 GeV/c
2 < p_T < 5 GeV/c
Mean = 0.0013
StdDev = 1.1948
Mean = -0.0061
StdDev = 1.2556
Mean = 0.0020
StdDev = 1.2978
Entries (a.u.)
0
0.002
0.004
0.006
0.008
0.01
−4 −3 −2 −1 0 1 2 3 4
(z^SV_Rec - z^SV_Mc)/σ_z


ePIC Performance
e+p, √s = 63 GeV
-1.0 < y < 1.0, p_T > 0 GeV/c
No ML
e+Au, √s = 63 GeV
1.0 < y < 3.0, p_T > 0 GeV/c
No ML
-1.0 < y < 1.0, p_T > 0 GeV/c
BDT Threshold > 0.6
1.0 < y < 3.0, p_T > 0 GeV/c
BDT Threshold > 0.6
Normalized Entries (a.u.)
m_πK (GeV/c²)

4.4.4.3 Detector Impact on Key Heavy Flavor Physics Measurements

- Text: [Rongrong]
- Figure
  - Current in preTDR: Projection of relative statistical errors on D0 yield ratios between 10×100 GeV e+Au and e+p collisions as a function of D0 pT for three different D0 rapidity intervals. [Shyam]
  - Invariant mass width different y and p_T bins
  - Lc/D0 ratio [TBD]

D0 R_{eAu} vs. p_T for three different D0 rapidity intervals. [Shyam]



4.4.4.4 Influence of beam on Background on Heavy Flavour measurements

- Text: [Rongrong]
- Figure [Connie, Deepa]
  - Compare D0 signal significance after topological cuts using 18x275 ep samples with and without background
  - D0, DIS, ep @ 18x275, with and without background, one inclusive bin

4.4.4.5 Jets as a Hard Probe

- Text: [Rongrong]
- Figure: none?

4.4.4.6 Detector Impact on Key Jet Physics Measurements

- Text: [?]
- Figure
  - Current in preTDR: Collins asymmetries of identified hadrons in jets [Kevin]
  - Jet ReAu for different radii [Dener]
  - Jet mass [Brian, Dener]
  - Jet performances (mass scale, mass resolution, reconstruction efficiency)

4.4.4.7 Influence of beam on Background on Jet measurements

- Text: [?]
- Figure
  - Jet Mass using 18x275 ep samples with and without background [Brian, Dener]

Systematics must be included in the physics performance plots. The systematic uncertainty for the luminosity is already available

Final figures

- Will need to use Oct. campaign
  - The following data samples are requested
    - D0, 18x275 ep, with and without background
    - D0, 10x100 ep and eAu
    - Lc, 10x100 ep and eAu
    - DIS 10x100 eAu
    - Requested by other WGs: DIS 10x100, 18x275 ep
- Style files: https://github.com/eic/ResultsCommittee_templates/tree/main/plot_macro
- Analysis codes and plotting macros need to be uploaded to GitHub