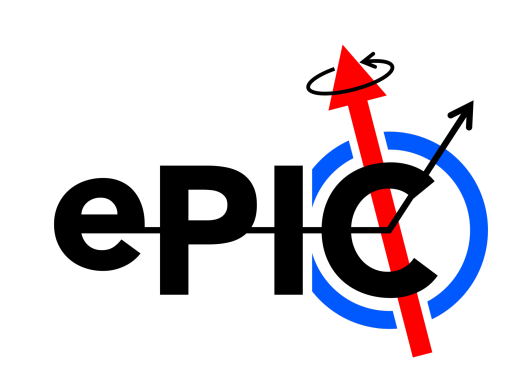




Scattered Electron-jet azimuthal correlations in $e+p$ and $e+Au$ collisions

(Statistical uncertainty projection for ep and eAu comparison)

Mounika Choppalli (PhD student)

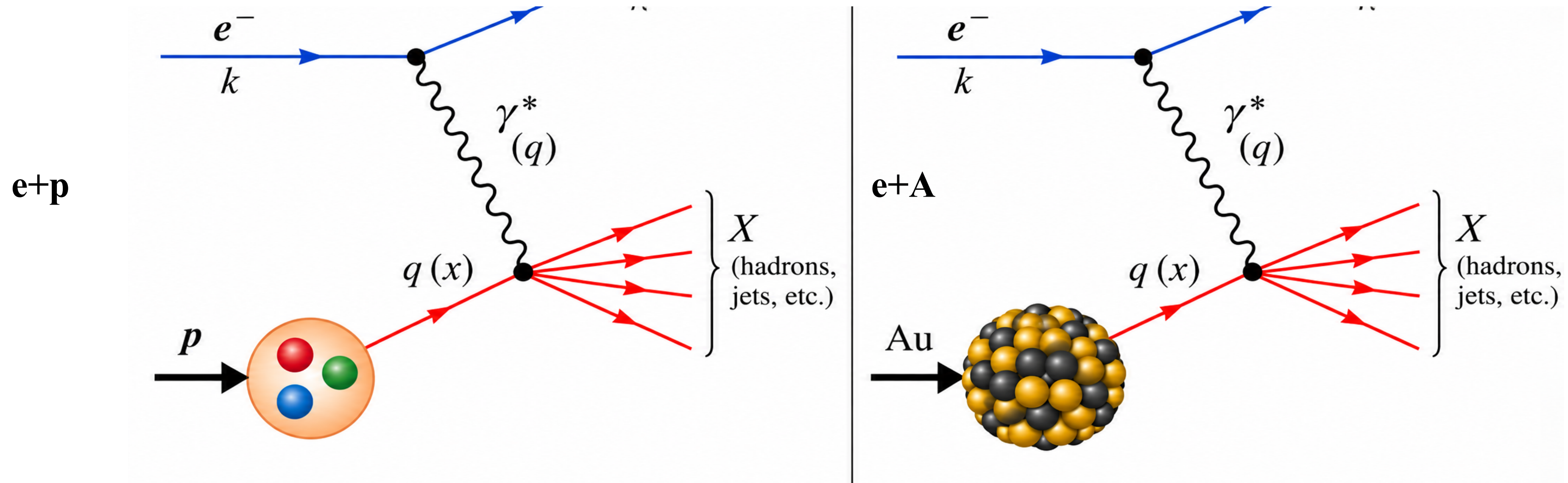
Nihar Ranjan Sahoo

IISER Tirupati, India



Jets-HF Working Group, 6 October 2026

Scattered electron–jet azimuthal correlations

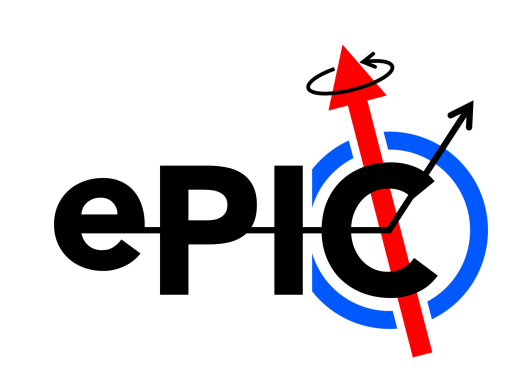


- **In $e+p$:**

- QCD radiation controls the decorrelation
 - LO produces back-to-back topology, $\Delta\phi (\phi^e - \phi^{\text{jet}}) = \pi$
 - Soft and hard gluon emissions (multiple gluon emissions) make deviation from back-to-back topology
- higher-order QCD like ISR, FSR, color coherence effects etc.
- TMD physics (width of $\Delta\phi$ is sensitive to intrinsic quark transverse momentum)

- **In $e+A$:**

- multiple scattering broadens
- Sensitive to cold nuclear matter
- constraining transverse momentum broadening and $\hat{q}$
- eA measurements at EIC is crucial



Previous presentations

30th Jun 2026 presentation:

https://indico.bnl.gov/event/30270/contributions/126495/attachments/71070/121775/EICJetAndHF_30Jun2026.pdf

14th July 2026:

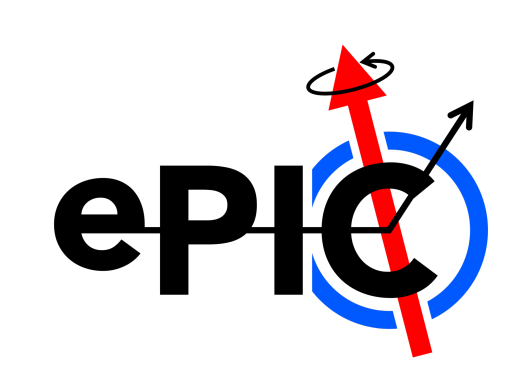
https://indico.bnl.gov/event/30271/contributions/126853/attachments/71318/122252/EIC_eJetCorr_14Jul2026_NRS.pdf

28 jul 2026:

https://indico.bnl.gov/event/33658/contributions/127484/attachments/71675/122862/EIC_eJetCorr_28Jul2026.pdf

22 Sep 2026

https://indico.bnl.gov/event/33662/contributions/129921/attachments/72710/124498/ep_eAu_eJetCorrelation_22Sep2026.pdf

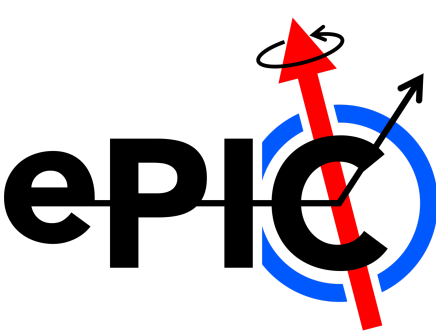


July campaign eAu @ 9x100 GeV DIS analysis

```
epic:/REC0/26.07.1/epic_craterlake/DIS/BeAGLE1.03.02-3.1/eAu/9x100/q2_1to10  
epic:/REC0/26.07.1/epic_craterlake/DIS/BeAGLE1.03.02-3.1/eAu/9x100/q2_10to100  
epic:/REC0/26.07.1/epic_craterlake/DIS/BeAGLE1.03.02-3.1/eAu/9x100/q2_100to10000
```

Reco level Q^2 , x , and y calculated using separate macro (CheckKinematics.C) Electron Method

Same kinematic cuts are used for both e+p and e+Au collisions



Stitching all Q² bins for e+p and e+Au events

e+p DIS NC 9x130 GeV

Q ² [GeV] ²	N _{gen}	σ [pb ⁻¹]
1-10	4915239	5.307E+05
10-100	4769167	4.048E+04
100-1000	3254166	1.475E+03

e+Au DIS 9x100 GeV

Q ² [GeV] ²	N _{gen}	σ [pb ⁻¹]
1-10	1595597	3.385E+05
10-100	1470804	3.34E+04
100-1000	1592794	9.867E+02

Stitching all three Q² intervals done:

$$Y(\Delta\phi) \equiv \frac{1}{N_{e'}} \frac{dN_{\text{jet}}}{d(\Delta\phi)} = \frac{\sum w_i \frac{dN_{\text{jet},i}}{d(\Delta\phi)}}{\sum w_i N_{e',i}} \quad w_i = \frac{\sigma_i}{N_i^{\text{gen}}}$$

σ_{*i*} : Cross-section of each Q² interval

N_{*i*}^{gen} : Generated event in each Q² interval

First we stitched all Q2 intervals

Then projected stat. Uncer. for $\int Ldt = 1\text{fb}^{-1}$

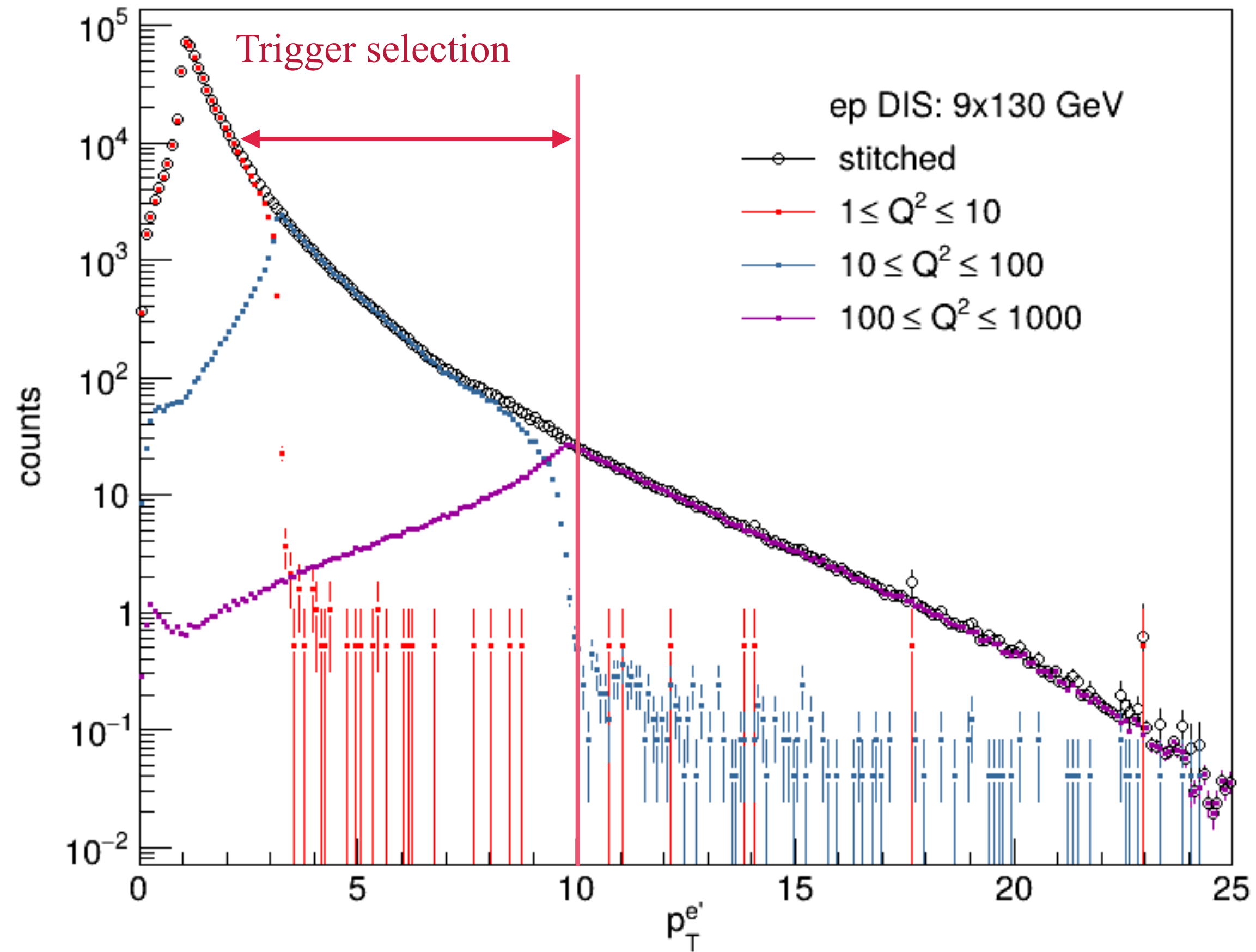
Projections are done for Y(Δφ) [using Poisson projection]

Species	Beam energy (GeV)	Integrated luminosity (fb ⁻¹)	Electron-beam polarization	Hadron-beam polarization
e+Ag	9 × 115	1.0	NO	N/A
e+D	9 × 130	1.5	LONG	NO
e + p	9 × 130	1.0	LONG	TRANS and/or LONG
e + p	9 × 275	2.5	LONG	TRANS and/or LONG
e+Au	9 × 100	1.0	LONG	N/A
e+ ³ He	9 × 166	1.5	LONG	TRANS and/or LONG

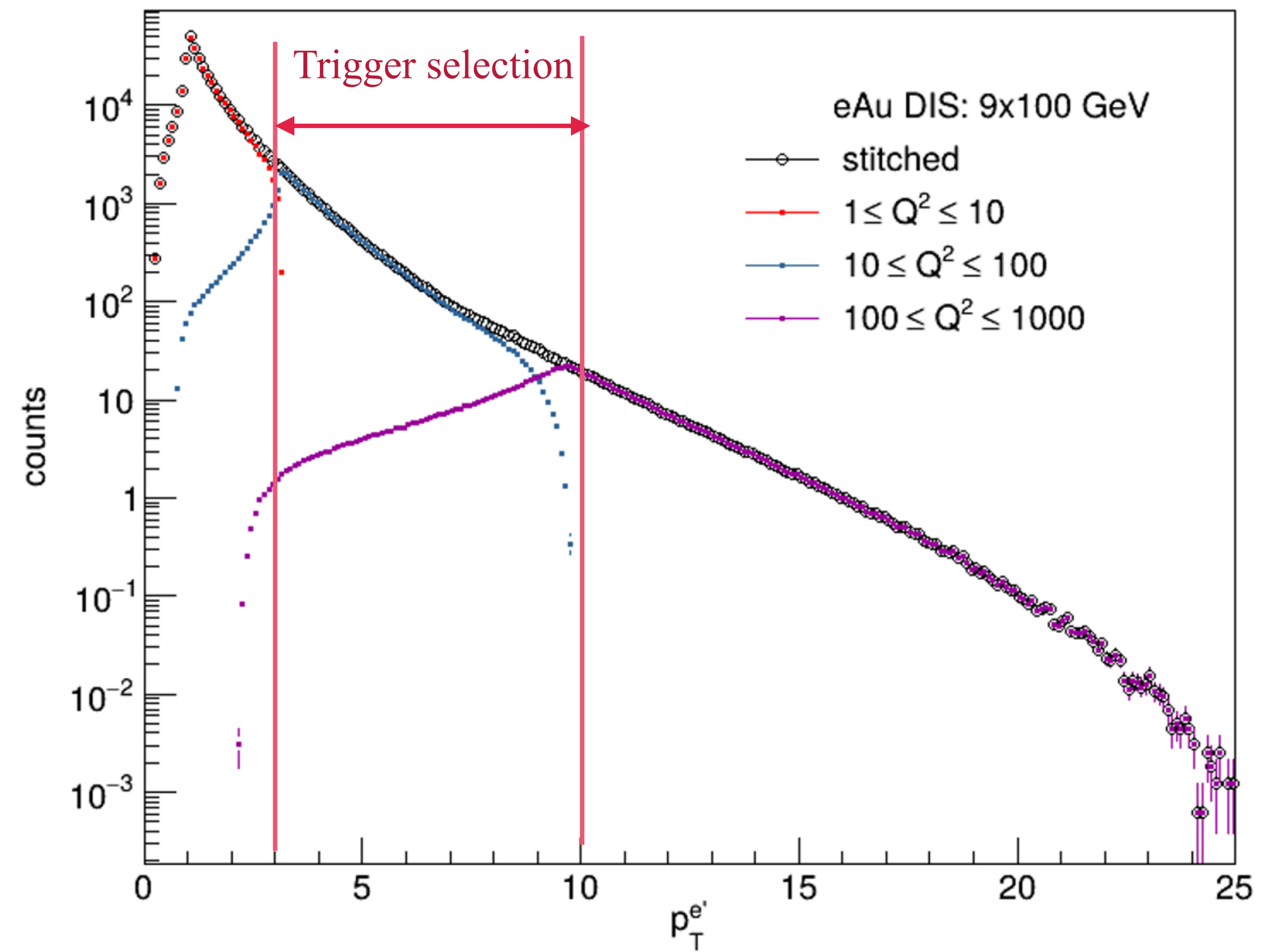
Table 2: Proposed beam configurations and corresponding luminosities for the EIC early running. The e + A energy and luminosity are per nucleon.

Stitching all Q^2 bins for e+p and e+Au events

Stitched $p_T^{e'}$ distribution

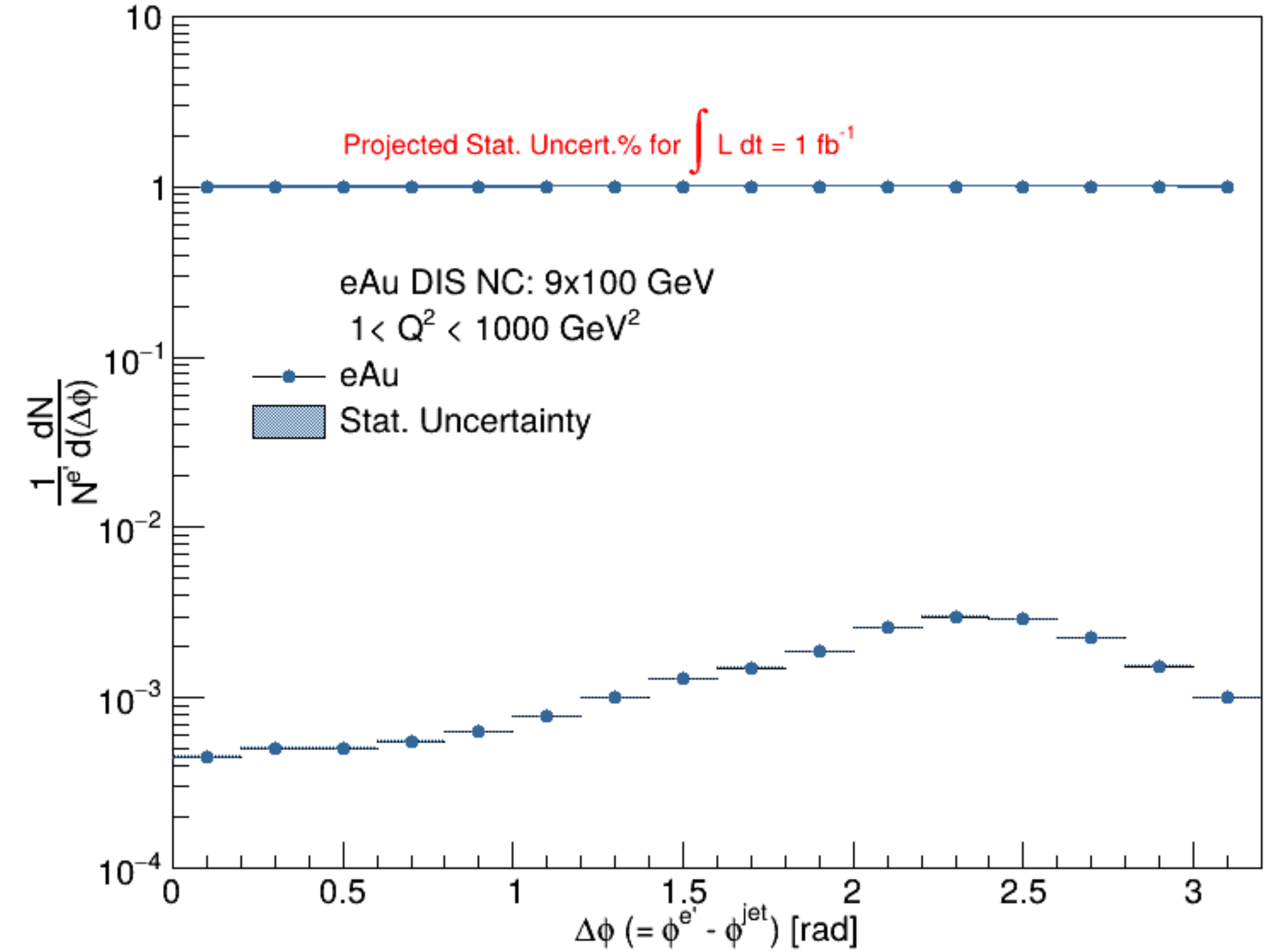
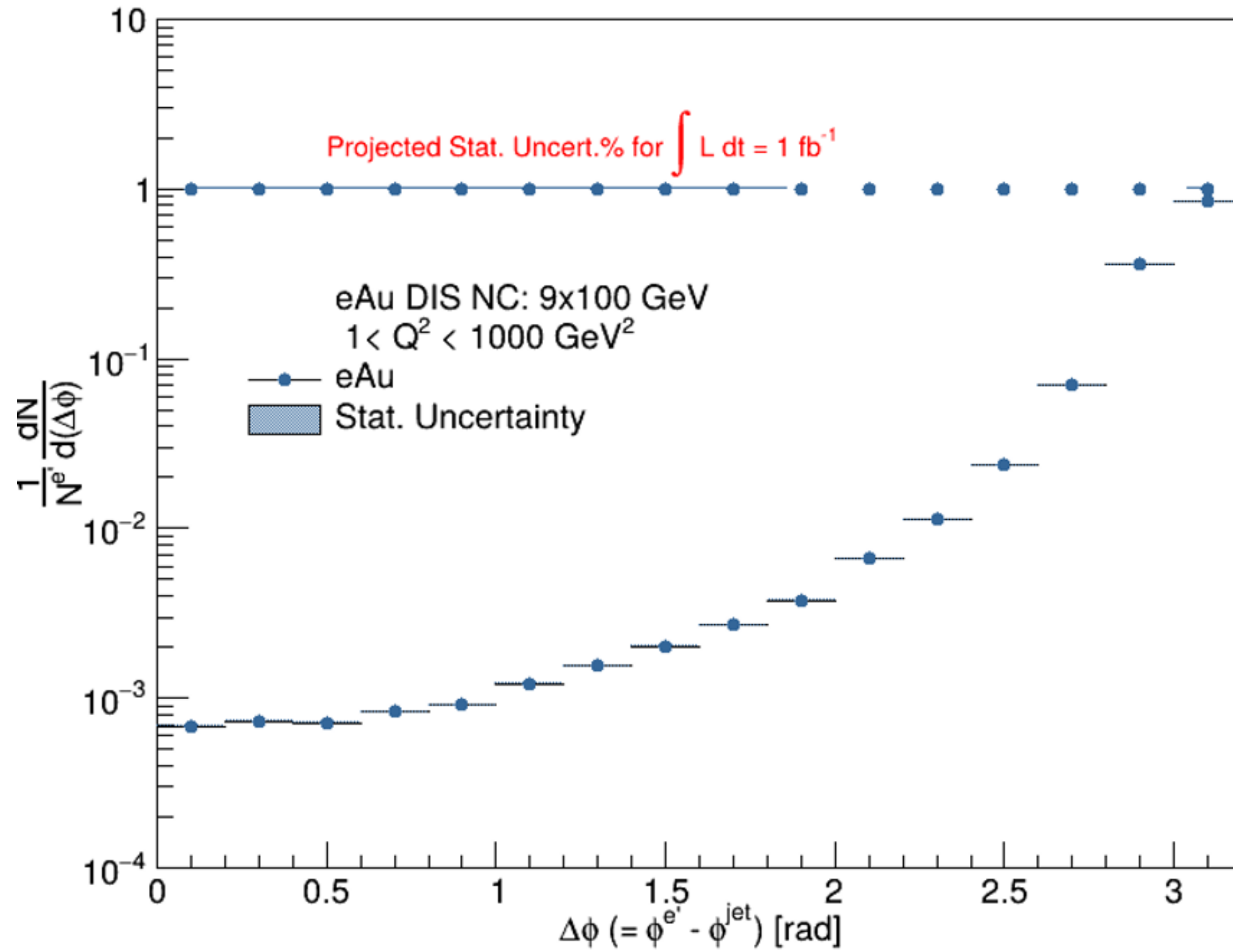


Stitched $p_T^{e'}$ distribution



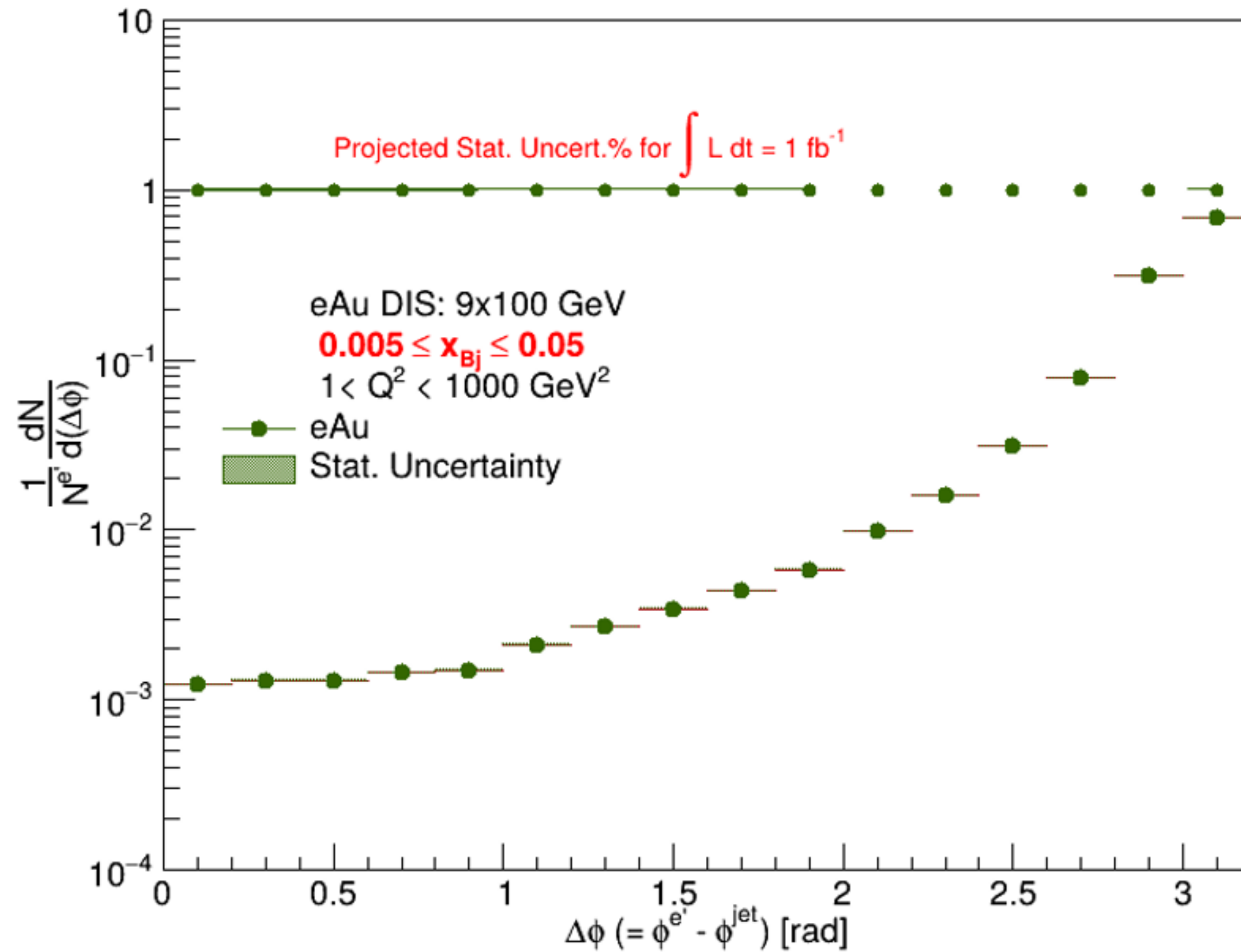
Stitching all Q^2 bins for e+Au events

For $N_{\text{jets}} \geq 1$ and $N_{\text{jets}} \geq 2$

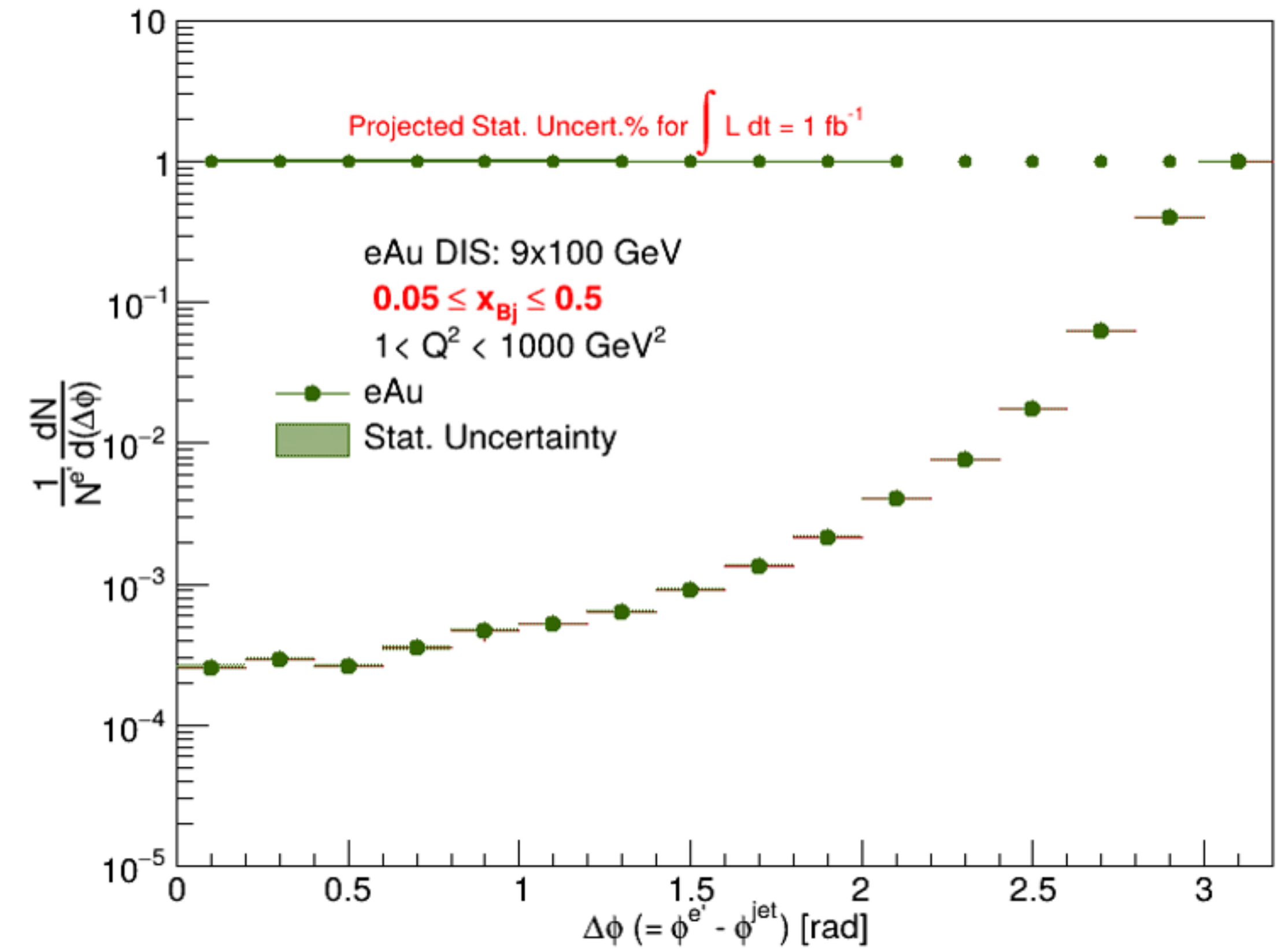


e+jet correlations in e+Au events for different x_{Bj}

For $N_{\text{jets}} \geq 1$ for **two x_{Bj} regions**



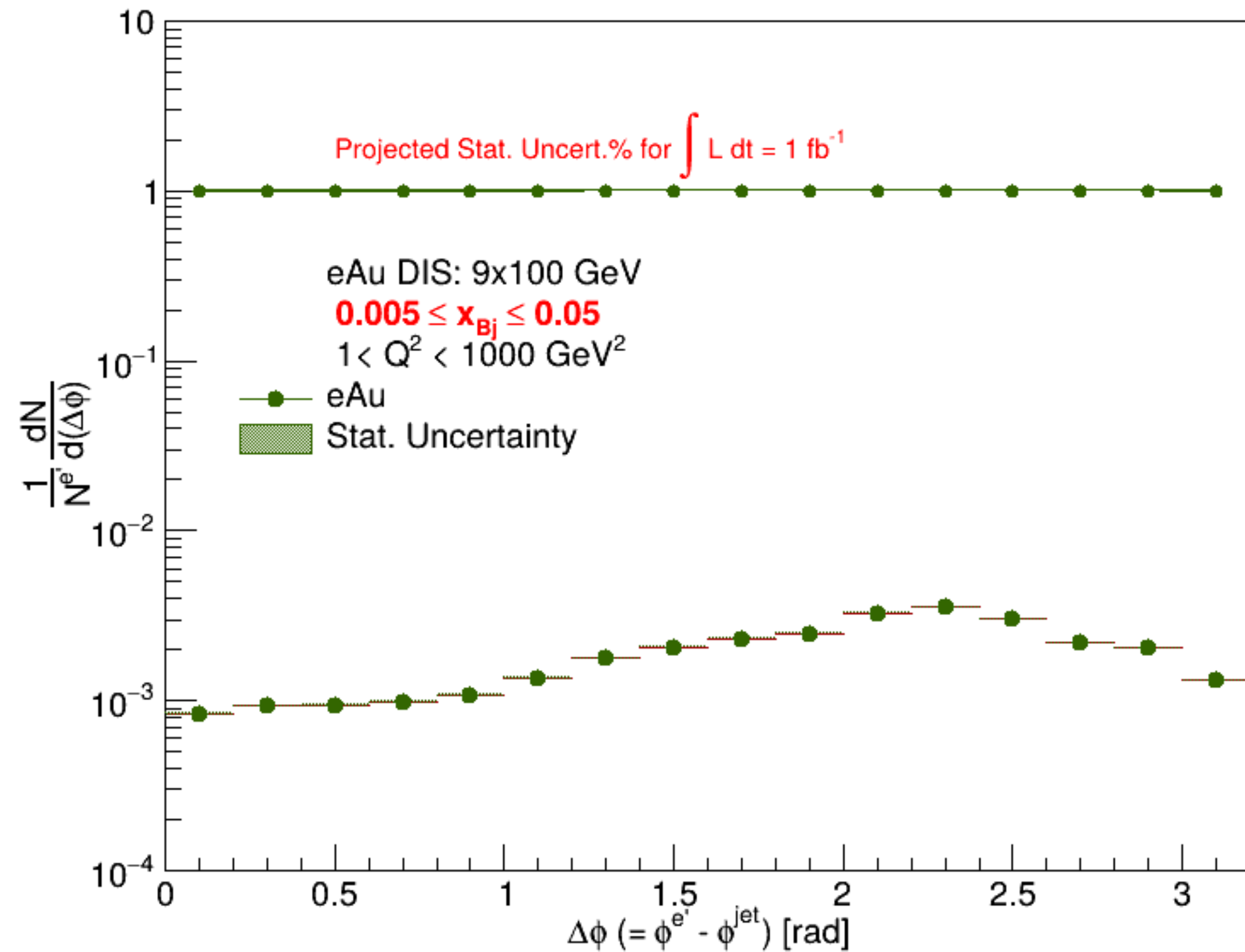
Expected maximum statistical % uncertainty $\sim 1.7\%$



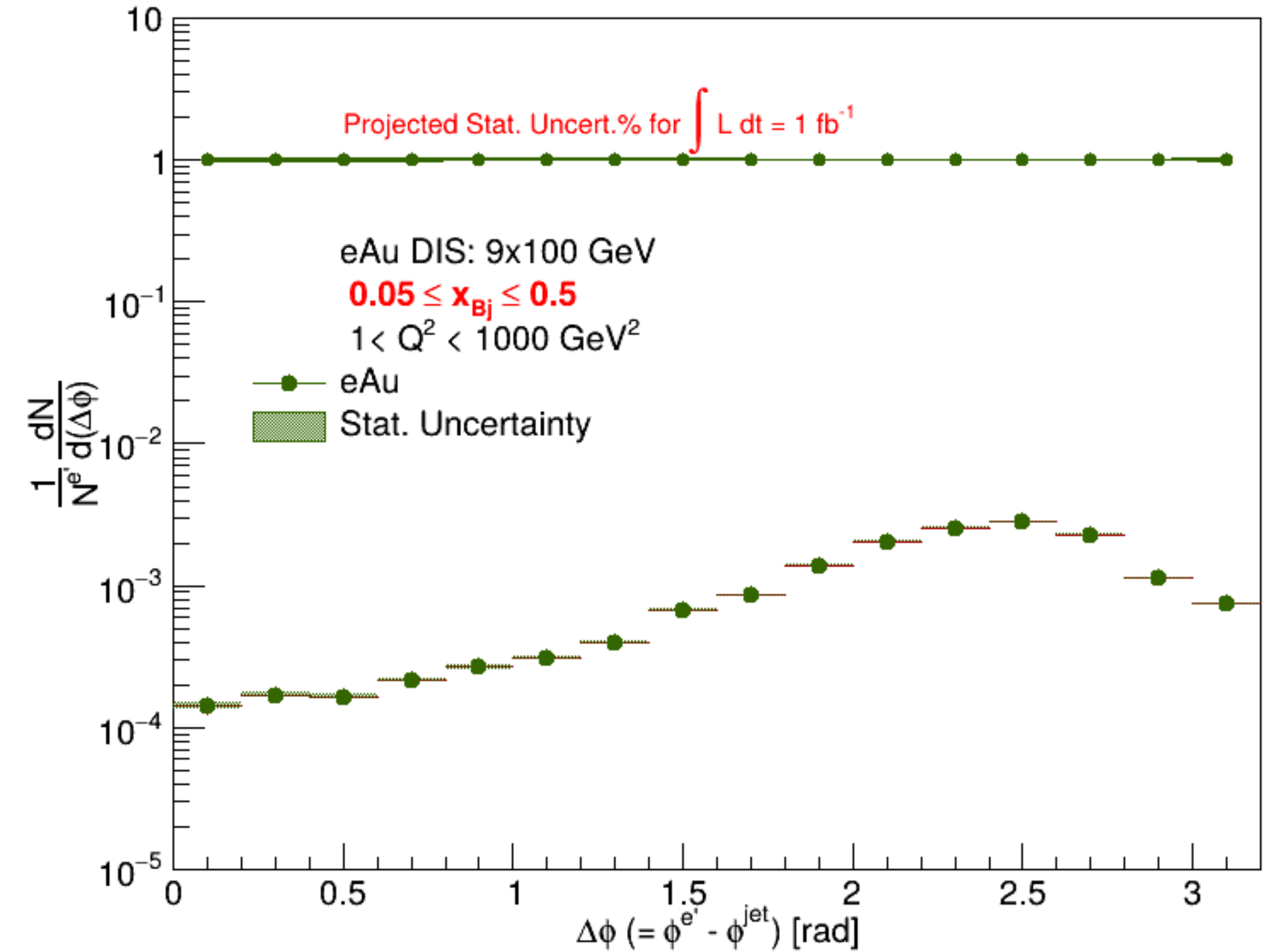
Expected maximum statistical % uncertainty $\sim 3.4\%$

e+jet correlations in e+Au events for different x_{Bj}

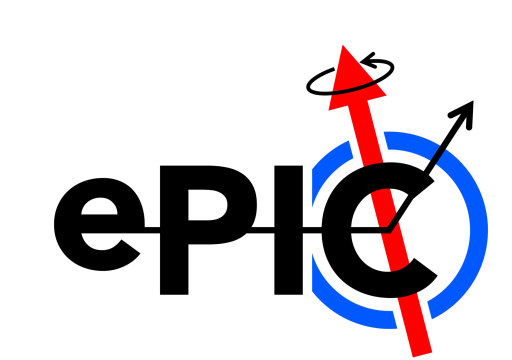
For $N_{\text{jets}} \geq 2$ for **two x_{Bj} regions**



Expected maximum statistical % uncertainty $\sim 2.1\%$

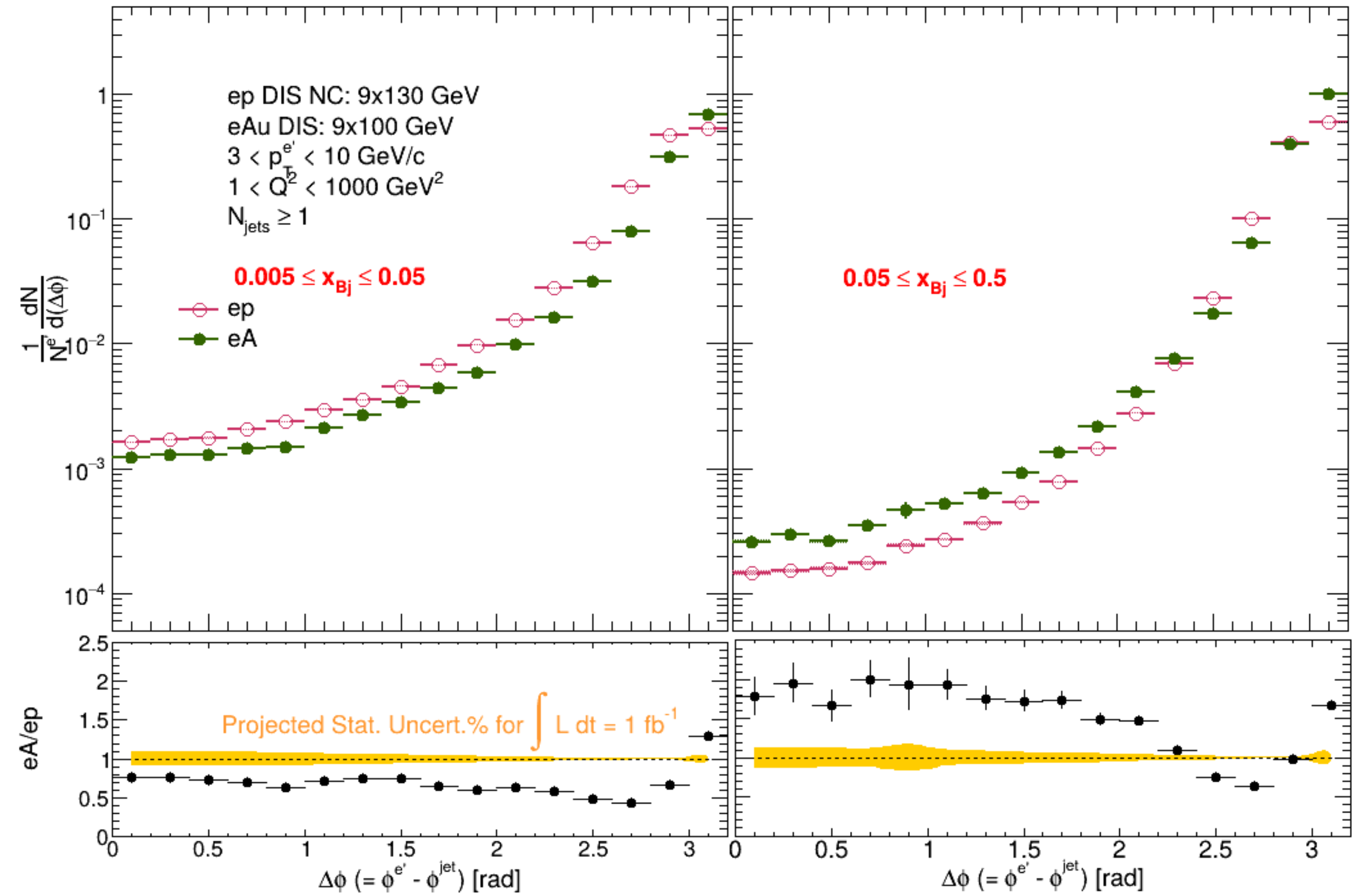


Expected maximum statistical % uncertainty $\sim 4.6\%$



e+jet correlations for different x_{Bj} : e+Au and e+p comparison for $N_{jets} \geq 1$

Nuclear acoplanarity broadening effect investigation at ePIC



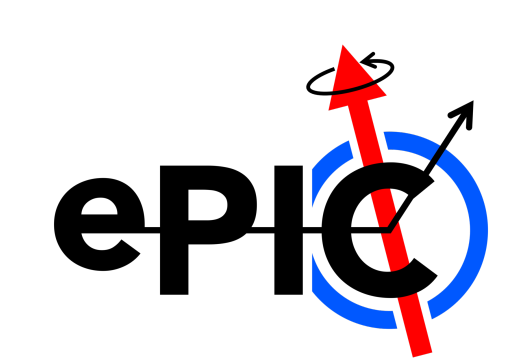
e+p : PYTHIA 8.316

e+Au: BeAGLE1.03.02-3.1

From comparison between two models:

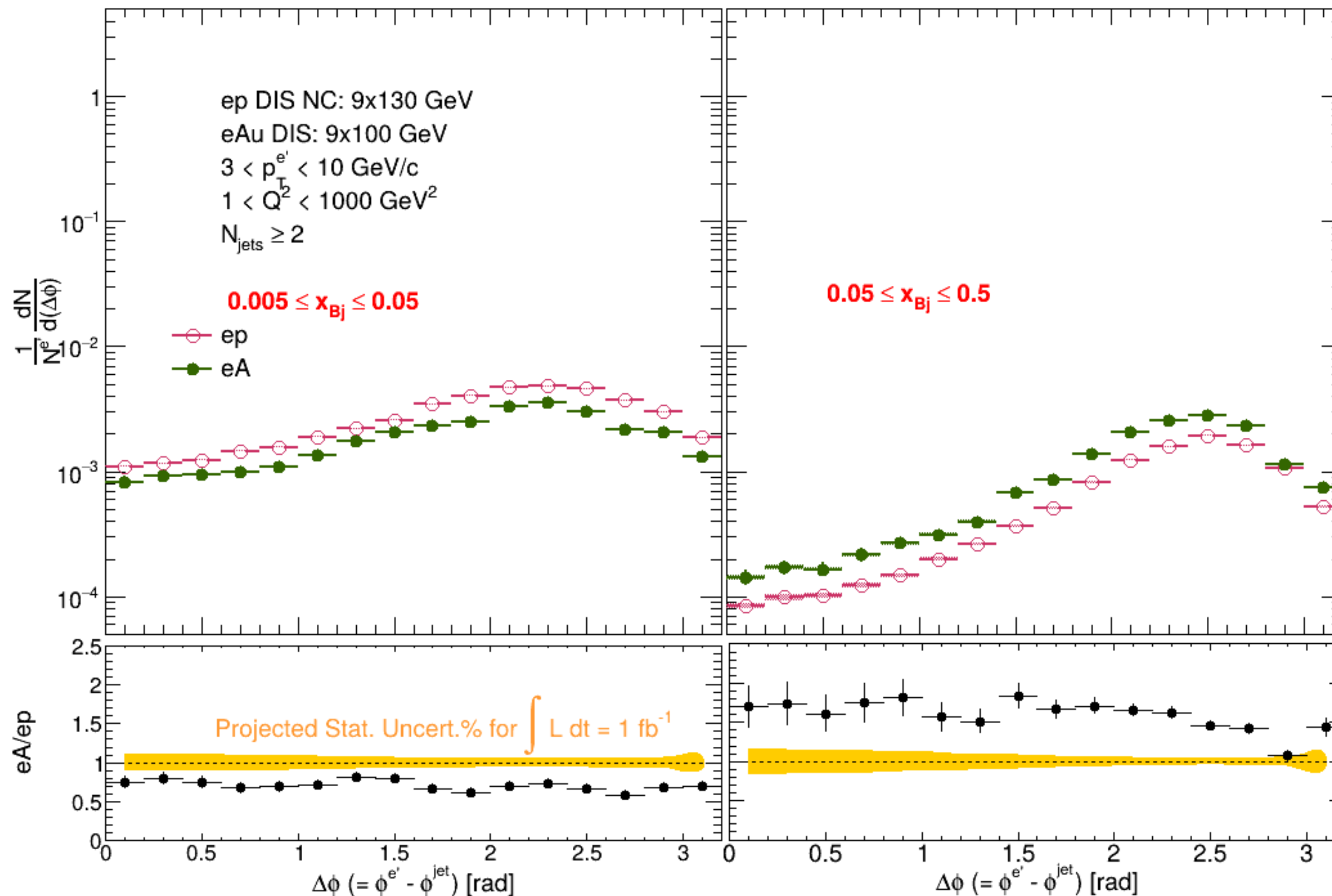
- Sizeable x_{Bj} dependent modification in eA relative to ep
- low- x_{Bj} region shows suppression away from the back-to-back configuration
- higher- x_{Bj} region shows enhanced acoplanarity

Ratio: expected maximum statistical uncertainty < 20%



e+jet correlations for different x_{Bj} : e+Au and e+p comparison for $N_{jets} \geq 2$

Nuclear acoplanarity broadening effect investigation at ePIC



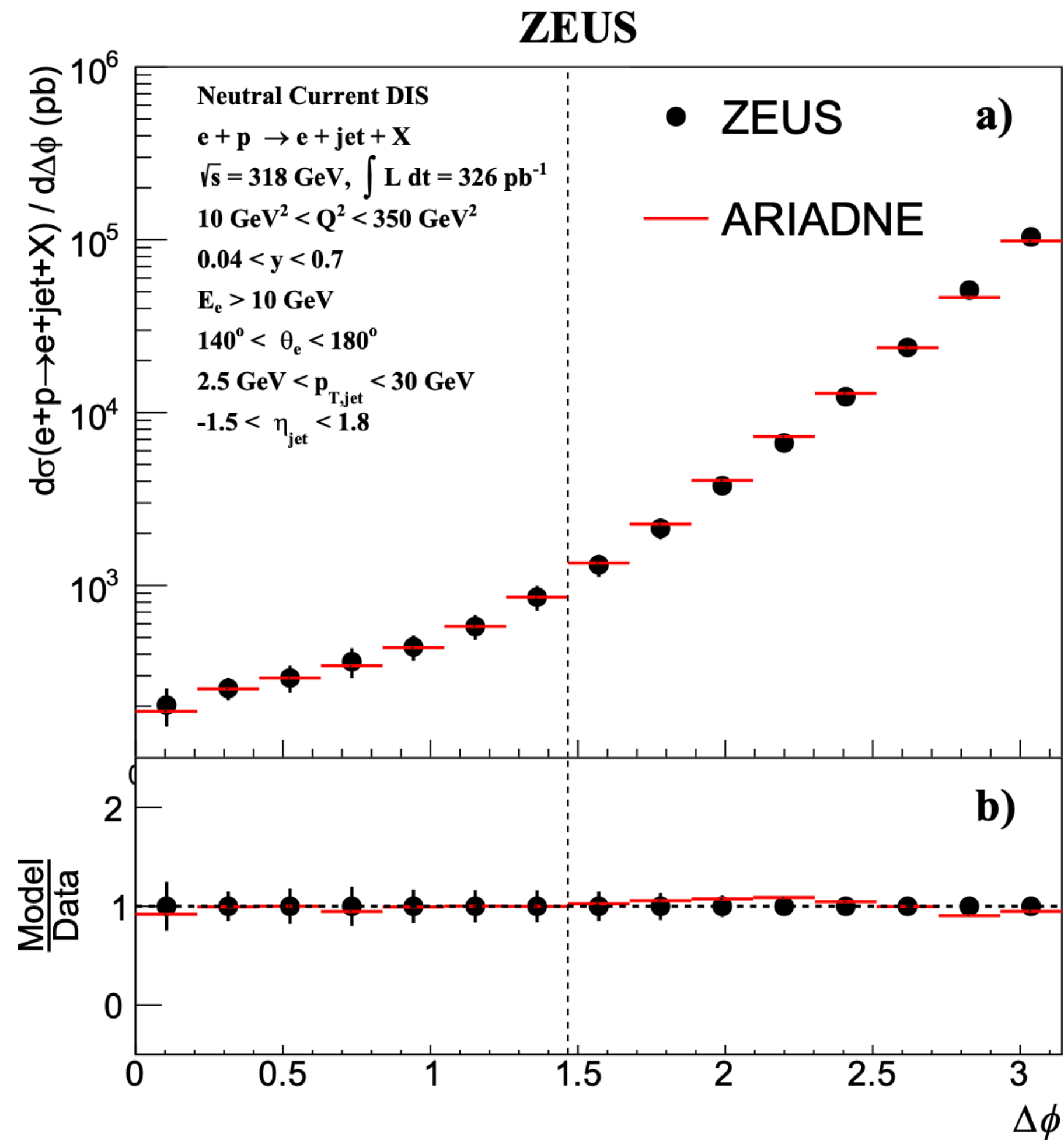
e+p : PYTHIA 8.316

e+Au: BeAGLE1.03.02-3.1

From these two models:

- Sizeable x_{Bj} dependent modification in eA relative to ep
- low- x_{Bj} region shows suppression away from the back-to-back configuration
- higher- x_{Bj} region shows enhanced acoplanarity

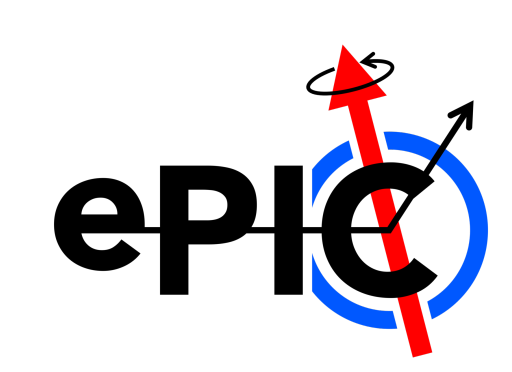
Ratio: expected maximum statistical uncertainty $< 20\%$



- Different kinematics
- ZEUS e+p data: Inclusive measurements whereas our measurement semi-inclusive
- These are two different measurements to compare.
- No e+A measurements

This analysis is unique to investigate

Nuclear acoplanarity broadening at EIC/ePIC

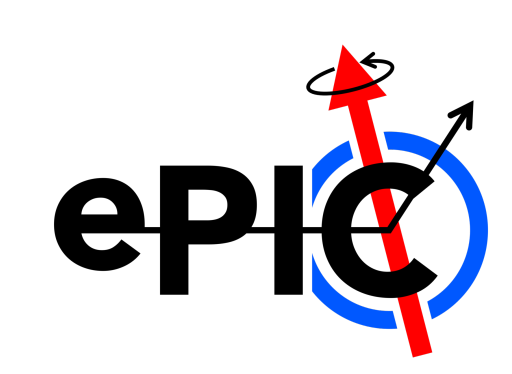


Summary and outlook

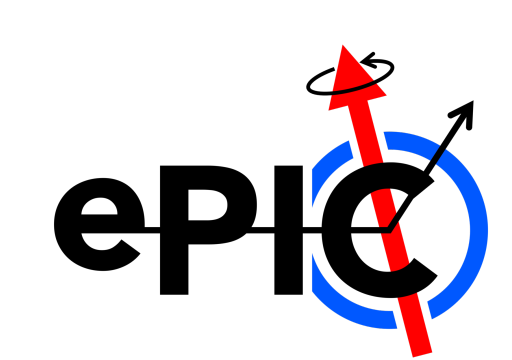
- We presented $\Delta\phi(= \phi^{e'} - \phi^{\text{jet}})$ correlations for $1 < Q^2 < 1000 \text{ GeV}^2$ and at two x_{Bj} regions in e+p and e+Au collisions
- From this study, we see effect of nuclear acoplanarity broadening in e+Au comparison to e+p
- Effect depends upon different x_{Bj}
- Theory calculations are requested; will be compared with these results
- Intend to include Slide#9 and 10 results in NIM A Special Issue

We can also perform Q^2 and larger scattered electron p_{T} ($> 10 \text{ GeV}/c$) dependent study for this analysis as a future investigation.

We welcome any additional comments and suggestions



Backup



BeAGLE - Benchmark eA Generator for LEptoproduction

```
Welcome to BeAGLE - Benchmark eA Generator for LEptoproduction

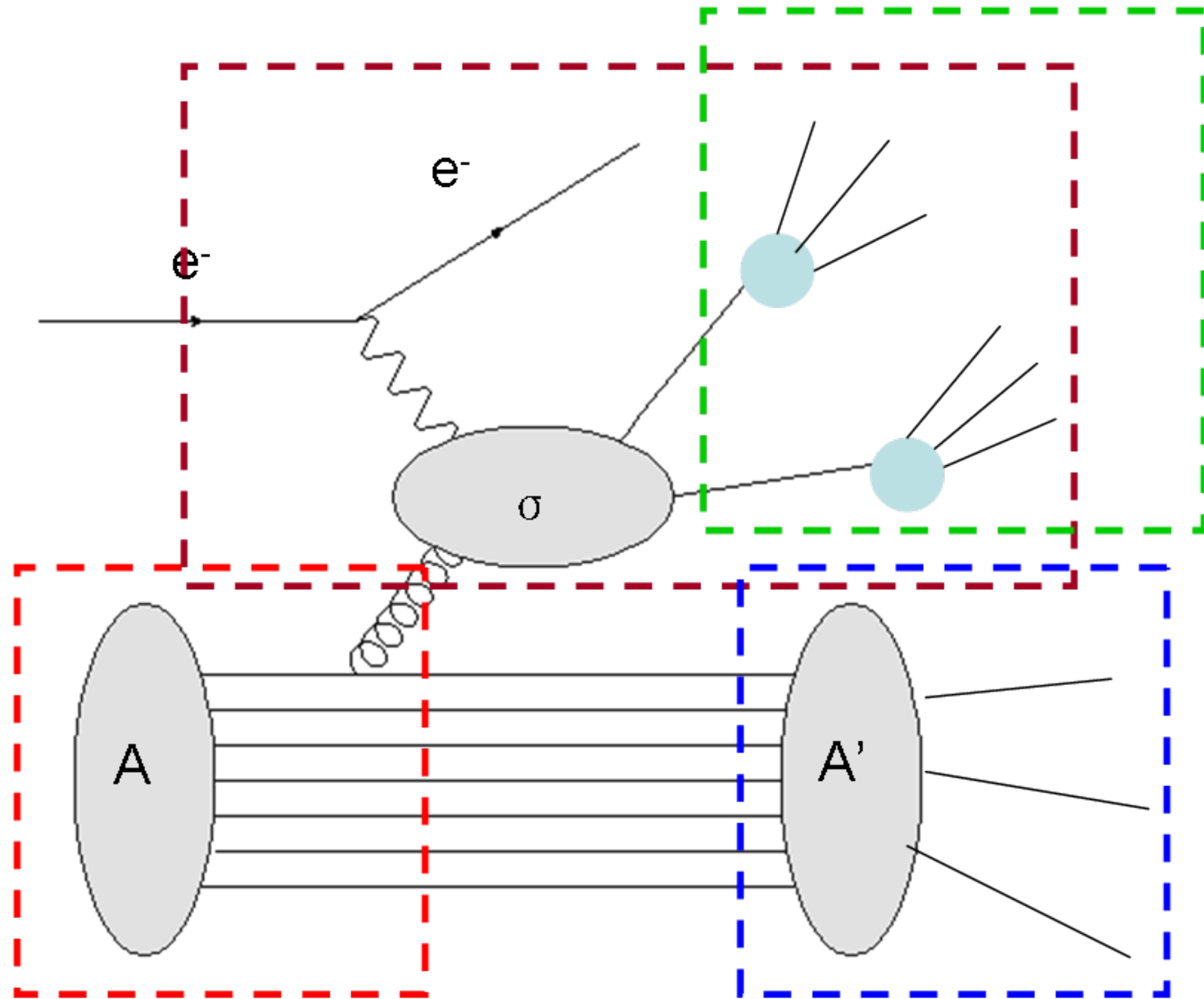
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BBBBBB EEEEEEE A A GGGGGG LLLLLLL EEEEEEE

BeAGLE Version 1.01.04

Authors: Elke Aschenauer, Mark D. Baker, J.H. Lee, Zhoudunming Tu,
Liang Zheng
Contact: mdbaker@mdbpads.com or zhoudunming@bnl.gov

This program (previously called DPMJetHybrid) links to:
DPMJET, PHOJET, & PYTHIA (see version #s below) including also
LHAPDF for pdfs, and FLUKA & PyQM for conventional nuclear effects

Art credit: asciiworld.com
```



A hybrid model consisting of DPMJet and PYTHIA with nPDF EPS09.

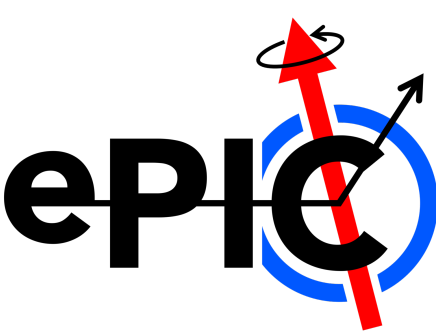
Nuclear geometry by DPMJet and nPDF provided by EPS09.

Parton level interaction and jet fragmentation completed in PYTHIA.

Nuclear evaporation (gamma dexcitation/nuclear fission/fermi break up) treated by DPMJet

Energy loss effect from routine by Salgado&Wiedemann to simulate the nuclear fragmentation effect in cold nuclear matter

<https://eic.github.io/software/beagle.html>



Stitching all Q² bins for e+Au events

Q ² [GeV] ²	N _{gen}	σ [pb ⁻¹]
1-10	1595597	3.385E+05
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100-1000	1592794	9.867E+02

First we stitched all Q² intervals
Then projected stat. Uncer. for $\int L dt = 1 \text{ fb}^{-1}$
Projections are done for $Y(\Delta\phi)$ [using Poisson projection]

ePIC ESR [arXiv:2608.05377](https://arxiv.org/abs/2608.05377)

Species	Beam energy (GeV)	Integrated luminosity (fb ⁻¹)	Electron-beam polarization	Hadron-beam polarization
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Table 2: Proposed beam configurations and corresponding luminosities for the EIC early running. The e + A energy and luminosity are per nucleon.

