Workfest summary for Jets & HF WG

Rongrong Ma, Olga Evdokimov, Shyam Kumar
Aug. 1st, 2025

Jets & HF working group

- **Official webpage**: https://www.epic-eic.org/physics/jets_hf.html
  - Include information on simulation samples and analysis script examples
- **Conveners**
  - Rongrong Ma, Olga Evdokimov (outgoing), Shyam Kumar (incoming)
- **Contact and administrative info**
  - Mailing list: eic-projdet-jethf-l@lists.bnl.gov
  - To subscribe, visit: https://lists.bnl.gov/sympa/info/eic-projdet-jethf-l
  - Indico: https://indico.bnl.gov/category/420/
- **WG meetings**
  - Tuesdays at 11:30 am ET (bi-weekly)
  - Zoom link available on Indico

Simulation samples

Currently available
✓: small statistics
✓✓: good statistics

Need for preTDR
Need for ES

		5x41	10x100	10x130	10x250	18x275
ep	D0	Submitted (900k)	✓✓		Need	✓
	Lc		Submitted (750k)			✓
	DIS	✓✓	✓✓	Need (Q^2>10)	Need	✓✓
		5x41	10x100			
eAu	D0	Produced (650k)	Produced (700k)			
	Lc		Produced (640k)			
	DIS	Produced (10M)	Produced (10M)			
			10x115			
eRu/Cu	D0					
	DIS		✓✓			

ES: early science

Task list: HF

Topic	Analyzer	Target document	Simulations needed	Simulation status
Lc/D0 ratios in ep and eAu	Shyam Kumar	preTDR, ES	ep, eAu@10x100, DIS, D0, Lc, Q2 > 1	
F_2^{cc} in ep and eAu	Xin Dong	preTDR, ES	ep@10x100, 10x250, 5x41, DIS, D0, Q2 > 1 eAu@10x100, 5x41, DIS, D0, Q2 > 1	
D0 R_{eAu} vs. pT, x, z	Rongrong Ma Connie Yang Deepa Thomas	preTDR, ES	ep, eAu@10x100, DIS, D0, Q2 > 1	
D0 mass peak, pointing resolution, Primary vs. secondary track DCA	Rongrong Ma	preTDR	ep, eAu@10x100, DIS, D0, Q2 > 1	

- Welcome to join current efforts and/or propose new topics

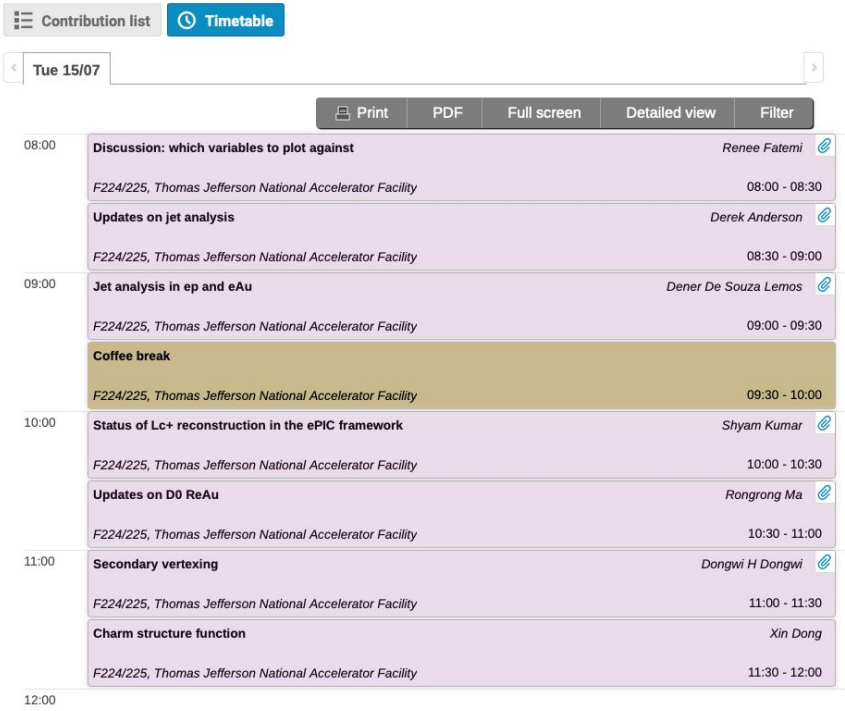
ES: early science

Task list: jets

Topic	Analyzer	Target document	Simulations needed	Simulation status
JES, JER	Brian Page	preTDR	ep@10x100, 18x275, NC DIS	Done
Jet mass in ep and eAu	Brian Page	preTDR	ep, eAu@10x100, NC DIS	eAu: small sample available; large sample requested
Jet R_{eAu} for different radius ratio	Brian, Dener	preTDR	ep, eAu@10x100, NC DIS	
Nucleon EEC	Derek Anderson	ES	ep@10x100, NC DIS, Q2 > 10 10x130 (if desired later on)	Done
Hadron-in-jet Collins				

- Welcome to join current efforts and/or propose new topics

Parallel session at JLab



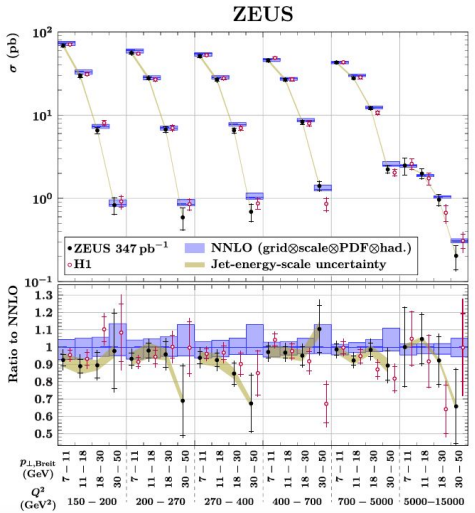
- Tuesday morning
- 7 talks
- ~ 10 participants

How Should We Plot Jet Observables?

Renee Fatemi (Kentucky) SLIDES

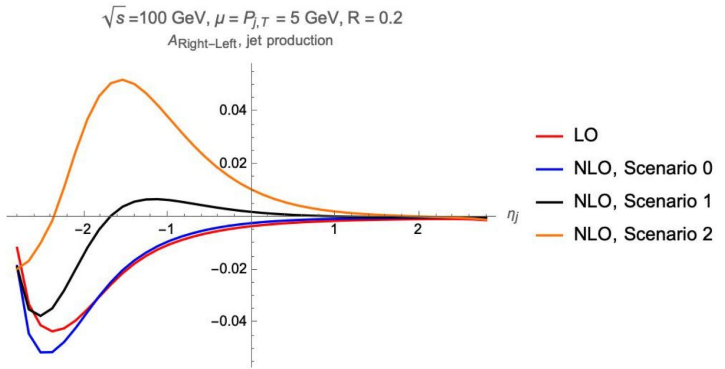
- Motivated by discussions @ INT workshop
- It depends on the physics goals

Inclusive jet x-sec in Breit frame



ZEUS, EPJC 83, 1082 (2023)

Inclusive jet TSSA in lab frame



arXiv:2503.16119

TSSA: Transverse Single Spin Asymmetry

Nucleon EEC & Software Updates

Derek Anderson (JLab) SLIDES

- Nucleon energy-energy correlator
  - Measured in Breit frame to separate target and current regions

Nucleon-Energy Correlators (NEC)

$$\mathrm{NEEC} = \sum_i \int d\sigma(x_B, Q^2, p_i) x_B^{N-1} \frac{E_i}{E_p} \delta(\theta - \theta_i)$$

- E_i, θ_i = energy, Breit frame angle of i$^{\text{th}}$ particle
- E_p = energy of scattered proton

  - Potential connections to TMD PDFs and Fracture Functions
  - *Code development in progress*

PRL 130, 091910 (2023); arXiv:2312.07655; arXiv:2403.08874, arXiv:2406.08559

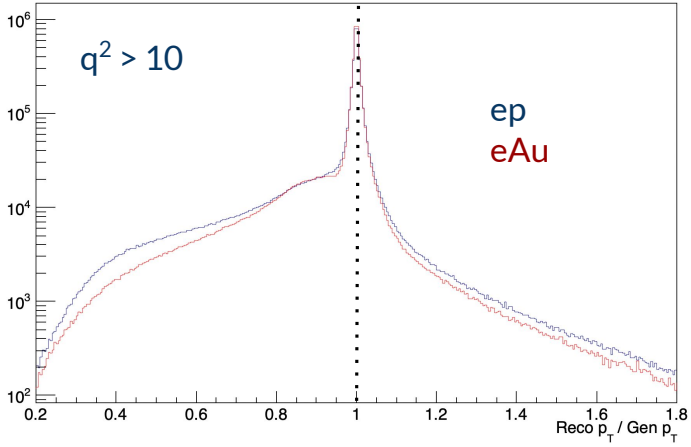
- Propose a new data type for jets
  - Currently stored as edm4eic:: ReconstructedParticle
  - Not ideal for jets
  - PR: EDM4eic#118
  - Look out for updating your codes

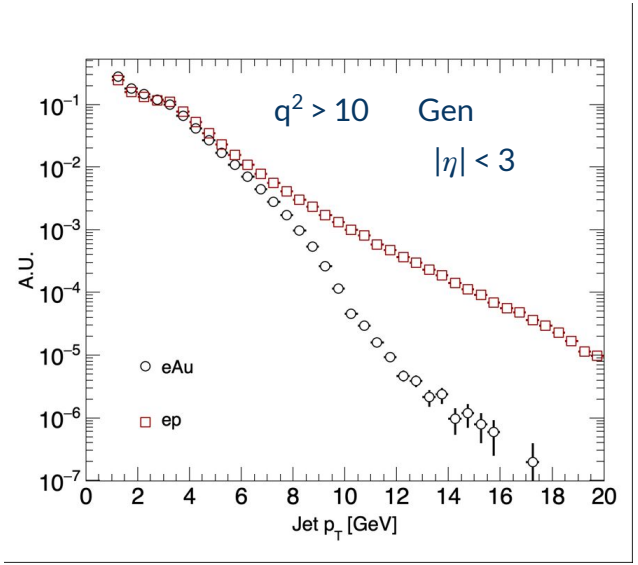
```
529 + ## ============================================================================
530 + ## Jets
531 + ## ============================================================================
532 +
533 + edm4eic::Jet:
534 +   Description:  "A reconstructed jet, inspired by the FastJet PseudoJet"
535 +   Author: "D. Anderson"
536 +   Members:
537 +     - float             area             // jet area
538 +     - float             energy           // jet energy [GeV]
539 +     - float             backgroundEnergy // background energy density * area [GeV]
540 +     - edm4hep::Vector3f momentum         // jet 3-momentum [GeV]
541 +   OneToManyRelations:
542 +     - edm4eic::Jet                 jets         // jets that have been combined to form this jet
543 +     - edm4eic::ReconstructedParticle constituents // constituents of this jet
```

Jet Analysis in ep and eAu

Dener De Souza Lemos (BNL) SLIDES

- **Goal: jet R_{eAu} for different radii** *PRL 126 252001 (2021)*
- First look at jets in ep and eAu @ 10x100

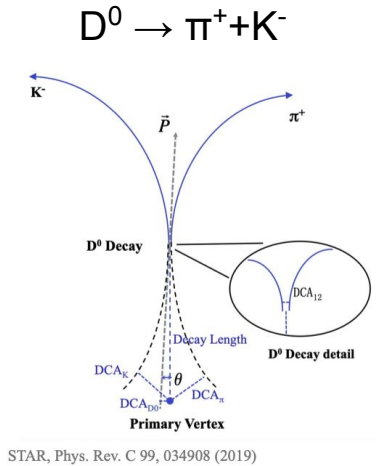




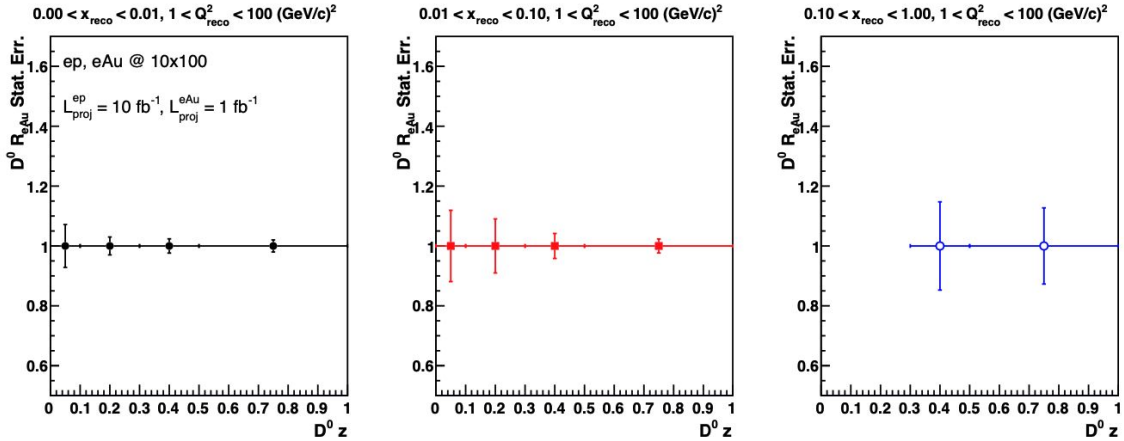
Update on D0 R_{eAu}

Rongrong Ma (BNL) SLIDES

- **Goal: D0 R_{eAu} projection**
- D0 decay reconstructed topologically based on Helix
- $z = p_{proton} * p_{D0} / p_{proton} * q$ in different (x, Q^2) ranges



STAR, Phys. Rev. C 99, 034908 (2019)

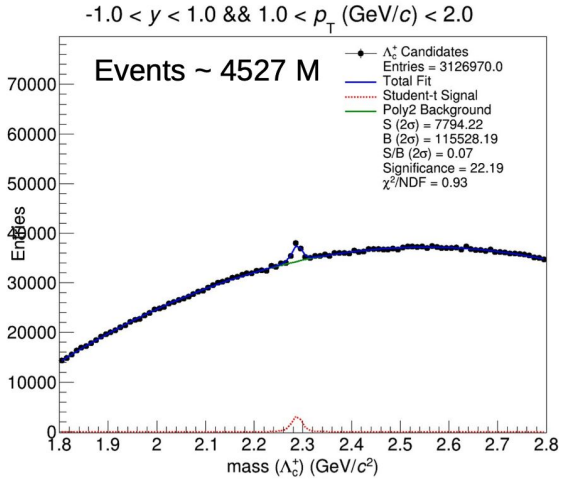


Status of Λc Reconstruction in the ePIC Framework

Shyam Kumar (INFN Bari) SLIDES

- **Goal: Λc/D0 ratio in ep and eAu**
- Very challenging due to small Λc decay length
- Next: apply machine learning & incorporate track errors

Particle	Mass (GeV/c^2)	cτ (μm)
$D^{\pm}$	1.869	312
D^0	1.864	123
$B^{\pm}$	5.279	491
B^0	5.280	456
Λ_c^+	2.286	60



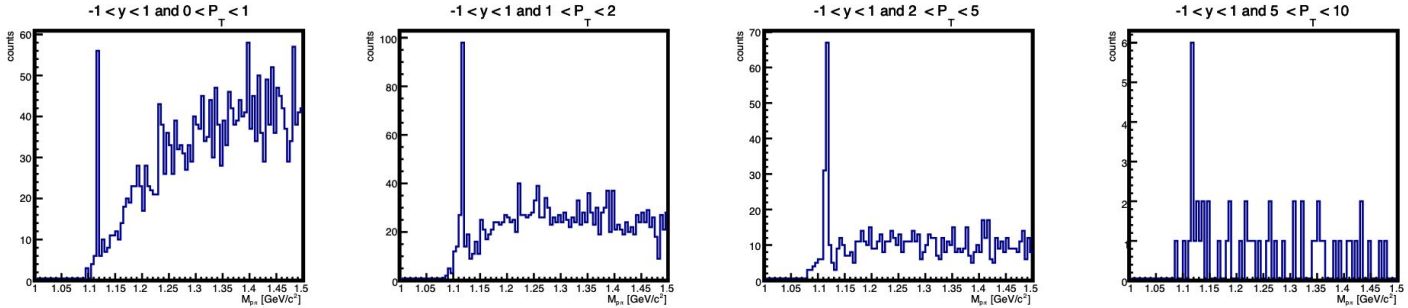
- ep @ 10x100, L_{proj} = 10 fb^{-1}
- $\Lambda_c \rightarrow \pi^+ + K^- + p$
- Very loose topological cuts
- Truth PID

Secondary Vertexing

Bishoy Dongwi (SBU) SLIDES

- Based on ACTS::AdaptiveMultiVertexFinder
- Can find both primary and secondary vertices
- PR: EICrecon#1915

$\Lambda^0 \rightarrow p+\pi$

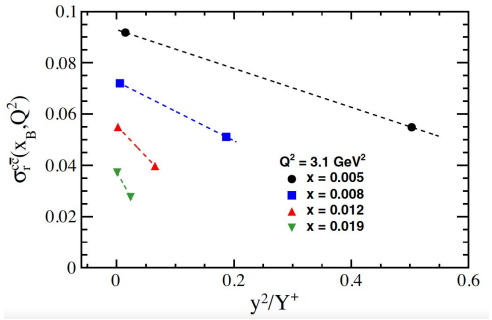


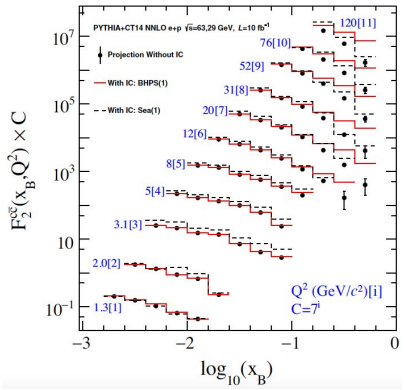
- Next: apply to D0 sample

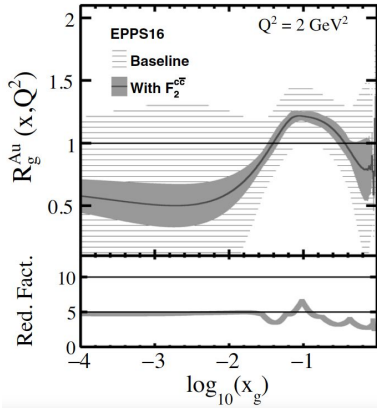
Charm Structure Function and Gluon nPDFs

Xin Dong (LBNL) SLIDES

- Goal: extract charm quark structure functions using D0 x-section
- Initial studies based on fast simulation *PRD 104, 054002 (2021)*







- We are now in a position to re-evaluate the performance using latest ePIC detector simulation and luminosity projection
- Looking for workforce

Summary

- Identified a list of physics performance evaluations for preTDR and early science report
- Requested HF-enriched simulation samples are being produced
- Continuous updates on analysis status at bi-weekly WG meetings
- Additional help is always welcome :)