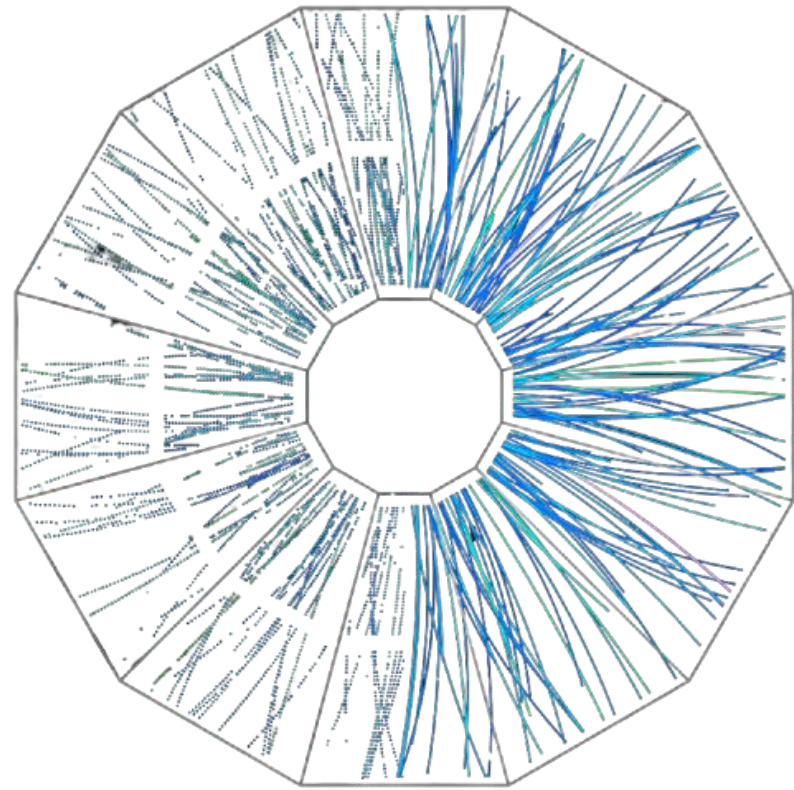


# First Look at Jet Fragmentations

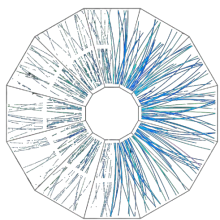
Dener De Souza Lemos (BNL)  
Gabriel Reis Garcia (BNL)

Jets&HF Working Group

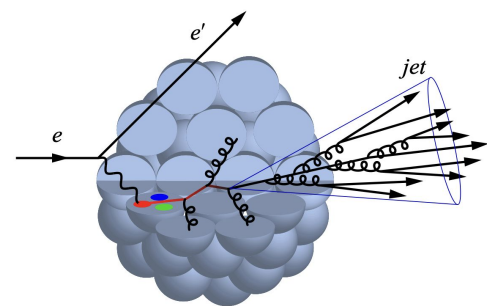
April 21<sup>st</sup>, 2026



**Brookhaven**  
National Laboratory



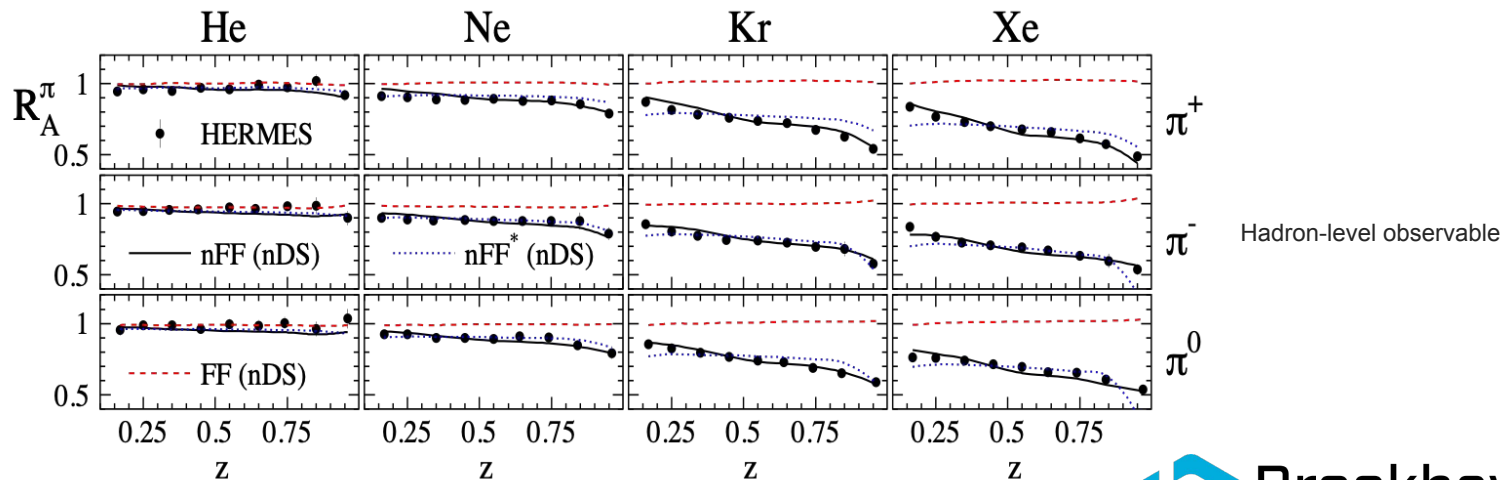
# Motivation



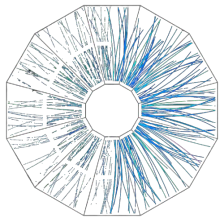
➤ Study nuclear effects on fragmentation functions

○ What we know?

■ From Hermes (fixed-target mode): Production differs between ep and eA

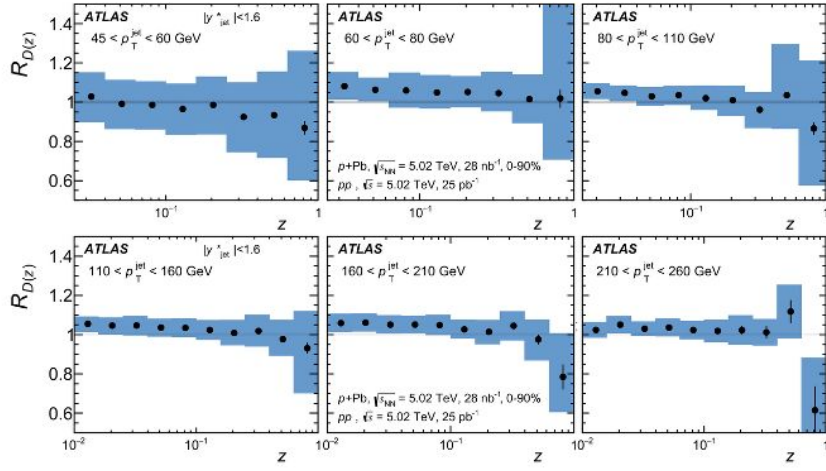
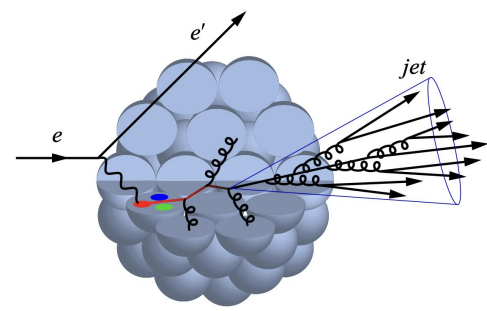


$$R_A = (N_h/N_{DIS})^{-1}_{ep} (N_h/N_{DIS})_{eA}$$



# Motivation

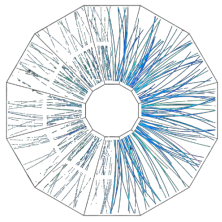
- Study nuclear effects on fragmentation functions
  - What we know?
    - From ATLAS/LHC: Consistent with 1 (within uncertainties) for pA/pp



Hadron inside jet observable



$$R_D = (N_h / N_{jet})^{-1}_{pp} (N_h / N_{jet})_{pA}$$

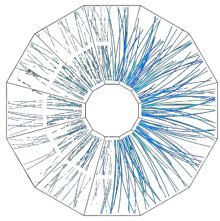


# Simulation Details

- Energy: 10x100
- Geometry: **25.10**
- ep: official production (NCDIS)
  - PYTHIA8.306
    - $q^2 \text{ min} = 1$  and  $q^2 \text{ min} = 10$
- eAu: official production (DIS)
  - BeAGLE103
    - $1 < q^2 < 10$  and  $10 < q^2 < 100$

- Jet reconstruction
  - Charged jets:
    - ReconstructedChargedJets
    - GeneratedChargedJets
    - Remove jets with 1 track inside
    - Cuts in the plots
    - Electron removed using true PID
    - Geometrical matching  $\Delta R < 1.0$
  - Jet Tree makers (anti- $k_T$  with  $R = 1.0$ ):
    - <https://github.com/denerslemos/CHJetTrees>
    - <https://github.com/denerslemos/CHJetsReCluster>



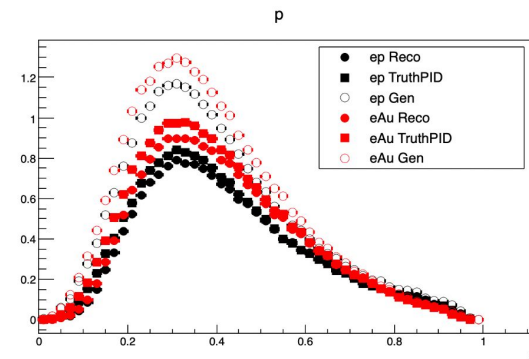
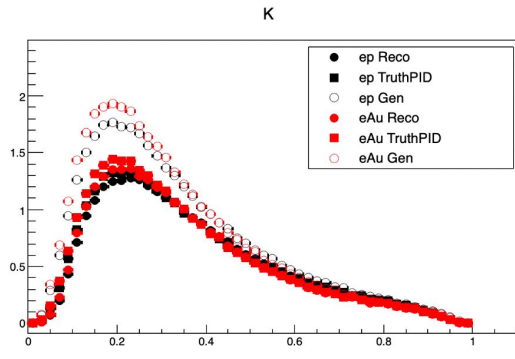
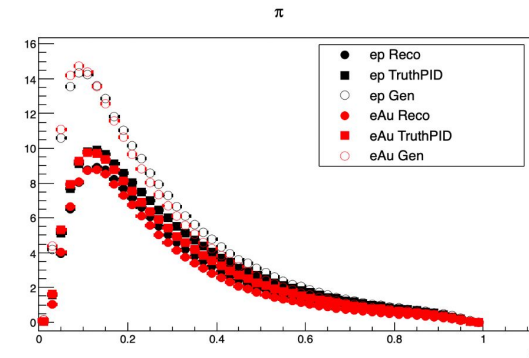
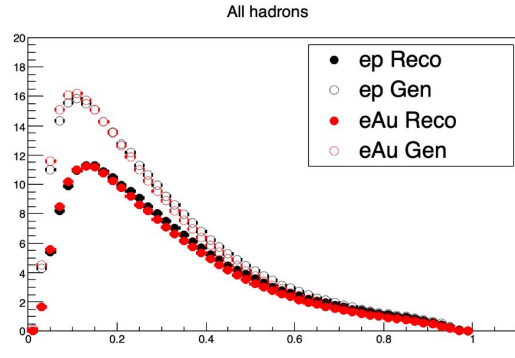


# FF as function of $z$

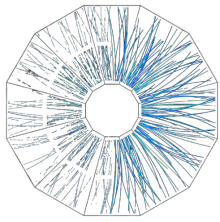
Jet  $p_T > 3$  GeV  
 Jet  $E > 5$  and  $< 50$  GeV  
 Jet  $\eta$  between  $-2$  and  $2.5$   
 No cut on tracks

$$z = \frac{\vec{p}_{\text{hadron}} \cdot \hat{n}_{\text{jet}}}{|\vec{p}_{\text{jet}}|}$$

- **Low  $z$ :** soft radiation, UE, medium effects
- **High  $z$ :** leading fragments (hard splittings)



Normalized by  $N_{\text{jets}}$

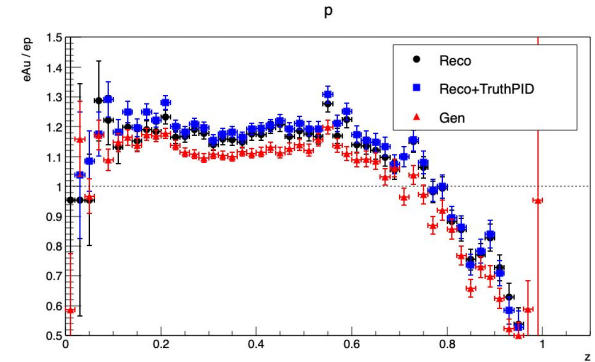
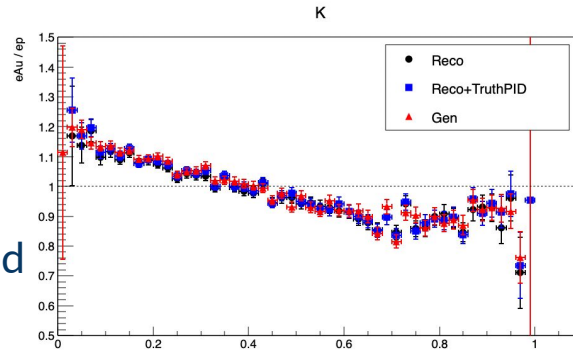
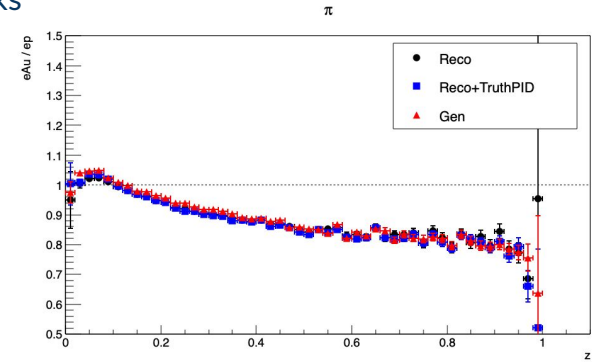
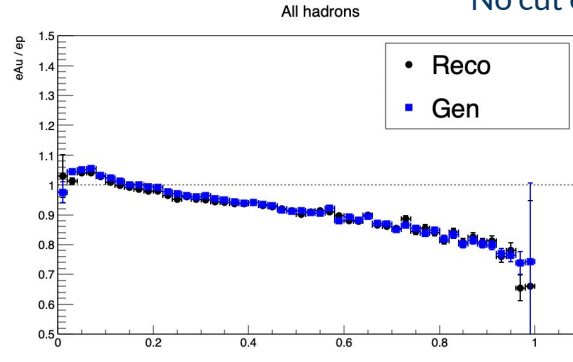


# FF as function of $z$

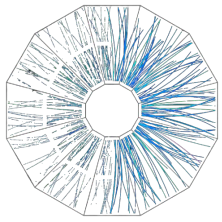
Jet  $p_T > 3$  GeV  
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 Jet  $\eta$  between  $-2$  and  $2.5$   
 No cut on tracks

$$z = \frac{\vec{p}_{\text{hadron}} \cdot \hat{n}_{\text{jet}}}{|\vec{p}_{\text{jet}}|}$$

- **Low  $z$ :** soft radiation, UE, medium effects
- **High  $z$ :** leading fragments (hard splittings)
- PID efficiency seems to be good in general
  - Maybe not for  $p$
- Similar behavior as observed by Hermes



$$RD = (N_h/N_{\text{jet}})^{-1}_{pp} (N_h/N_{\text{jet}})_{pA}$$

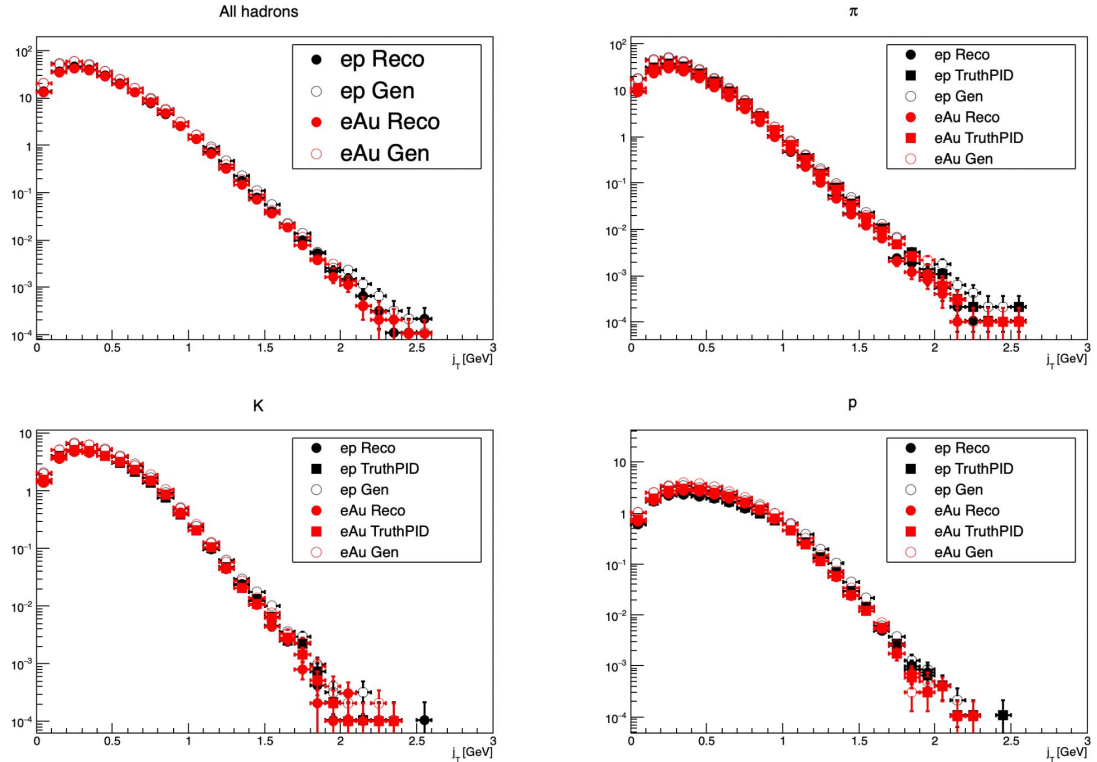


# FF as function of $j_T$

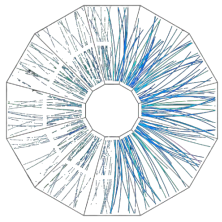
Jet  $p_T > 3$  GeV  
 Jet  $E > 5$  and  $< 50$  GeV  
 Jet  $\eta$  between  $-2$  and  $2.5$   
 No cut on tracks

$$j_T = |\vec{p}_{\text{hadron}} \times \hat{n}_{\text{jet}}|$$

- Low  $j_T$ : collimated jet
- High  $j_T$ : broadening
  - multiple scattering
  - nuclear effects



Normalized by  $N_{\text{jets}}$

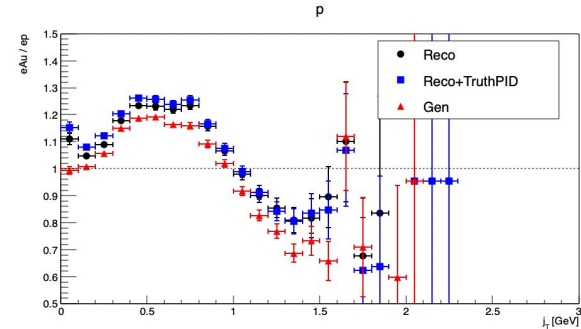
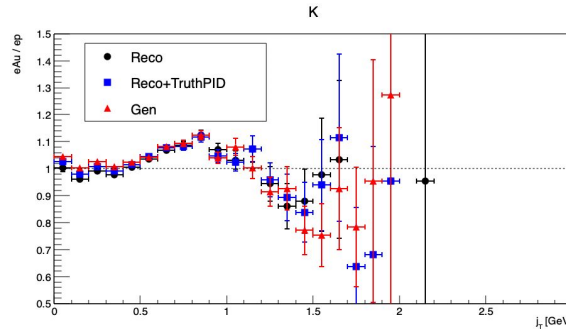
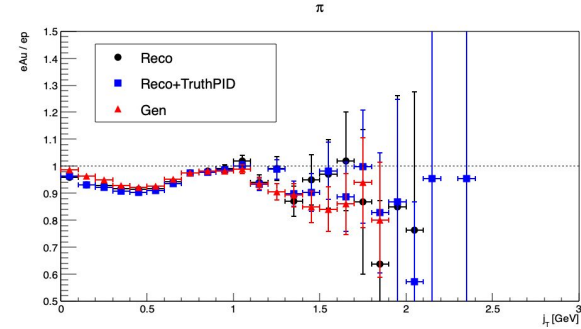
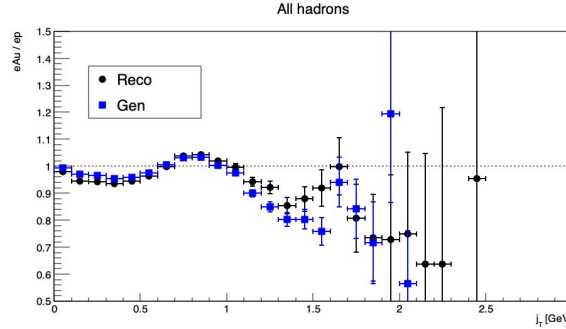


# FF as function of $j_T$

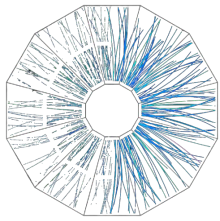
Jet  $p_T > 3$  GeV  
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 Jet  $\eta$  between  $-2$  and  $2.5$   
 No cut on tracks

$$j_T = |\vec{p}_{\text{hadron}} \times \hat{n}_{\text{jet}}|$$

- Low  $j_T$ : collimated jet
- High  $j_T$ : broadening
  - multiple scattering
  - nuclear effects
- PID efficiency seems to be good in general
  - Maybe not for p



$$RD = (N_h/N_{\text{jet}})^{-1}_{pp} (N_h/N_{\text{jet}})_{pA}$$



# Outlook

- First look at fragmentation functions with PID using ePIC official simulation
- z dependency in MC is similar to observed at Hermes
- This is a first look, need a bit more investigation
  - Improvements coming for next meetings

