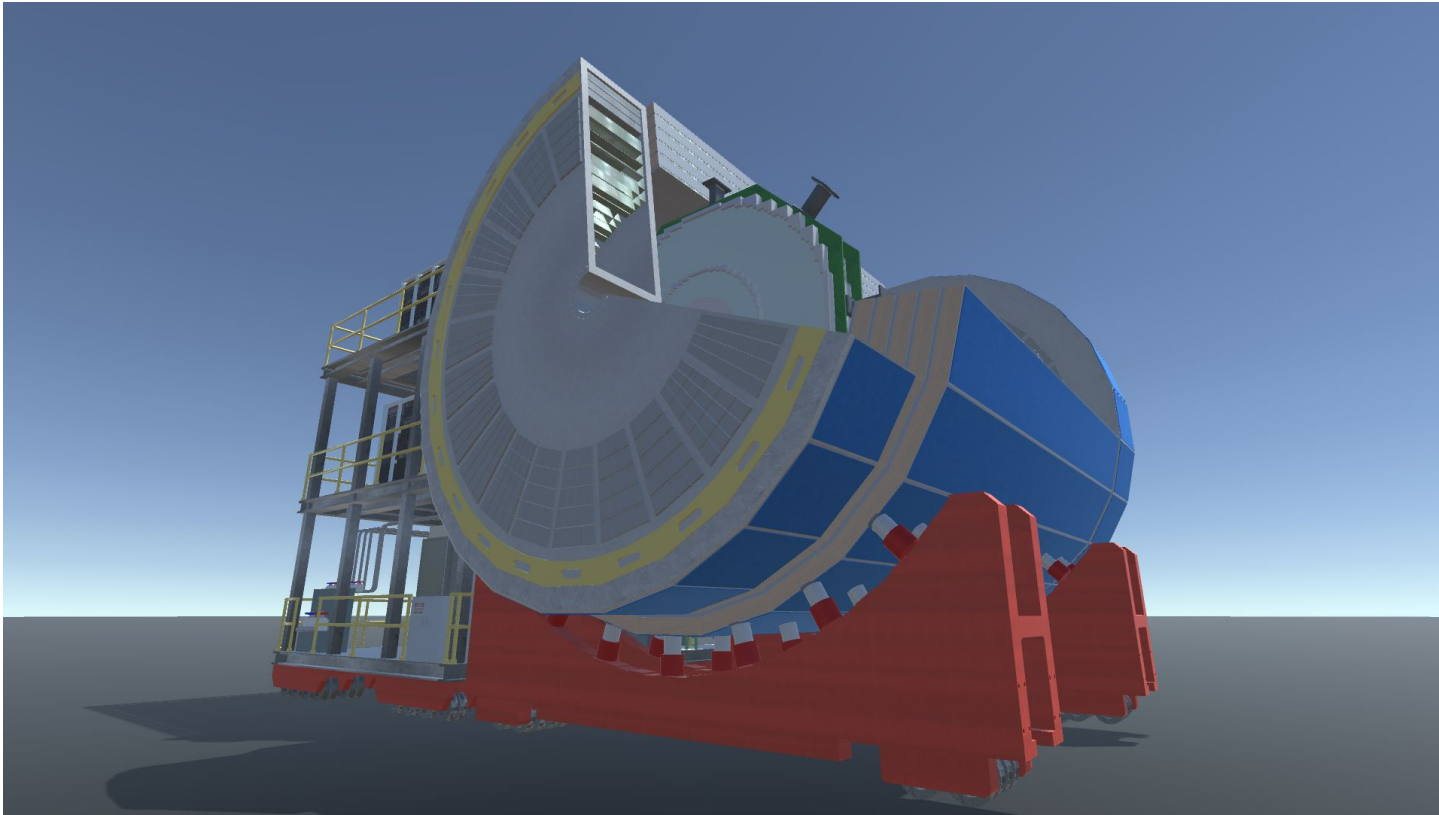


Jet/HF/EW/BSM



ATHENA Monthly Meeting, July 1st 2021



The Proposals should include two parts:

1. A description of the science addressed and performance estimated through simulation including, but not limited to, e/γ , jets, $\pi/K/p$ separation, vertex, and tracking, and how the simulated performance compares to the requirements detailed in the YR. The realization of the conceptual detector design given the technology choices, the R&D needs, risks, and, if applicable, adoption of emerging new technologies.

- We have identified some of the 'low-level' plots , which seem required by proposal, that are relevant for our group

Performance plots relevant for this group (there is overlap with other groups)

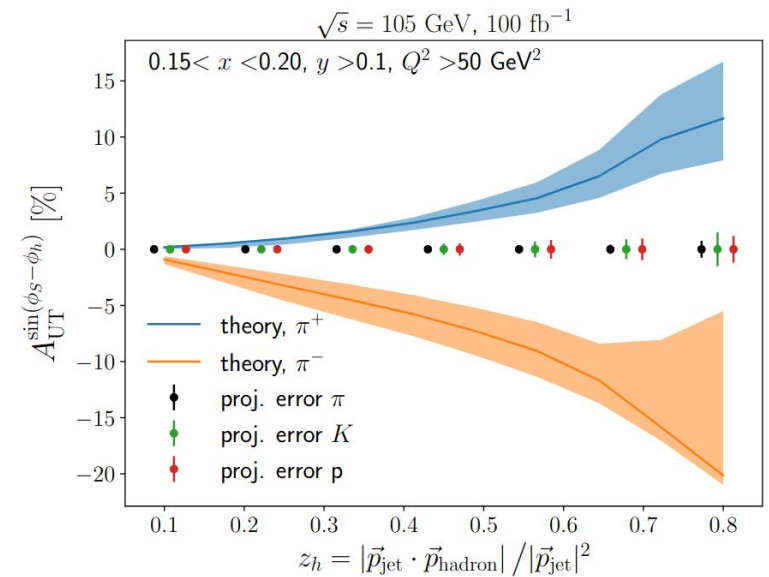
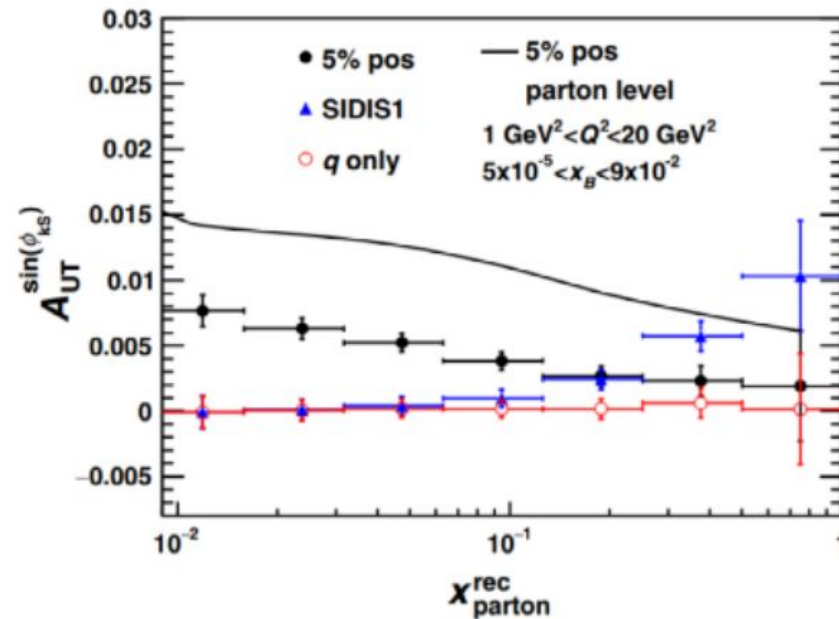
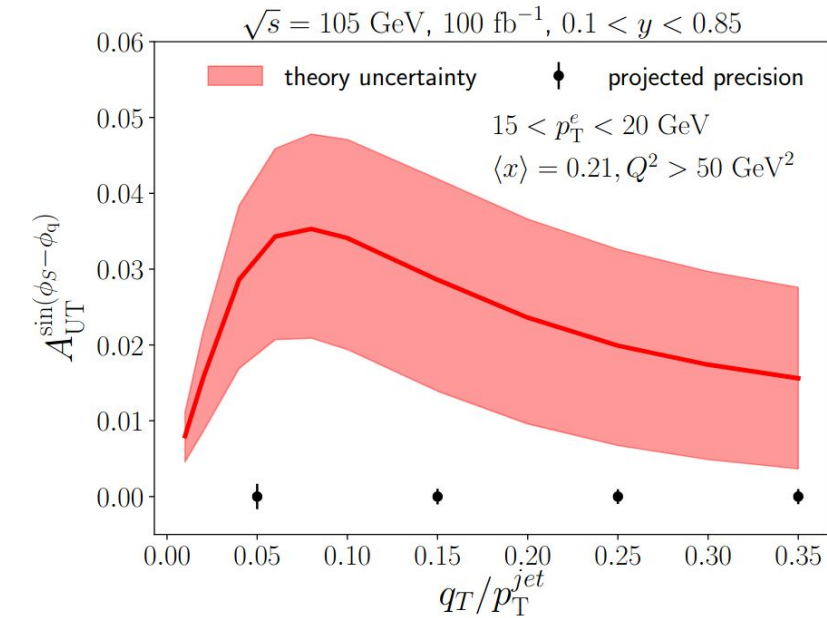
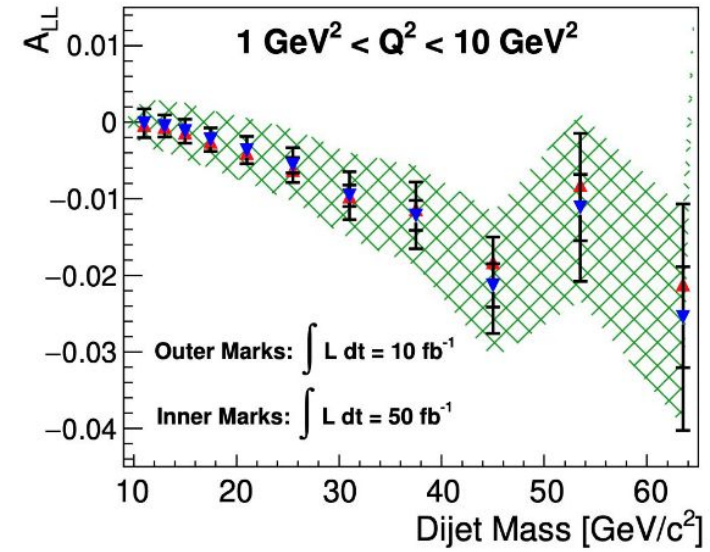
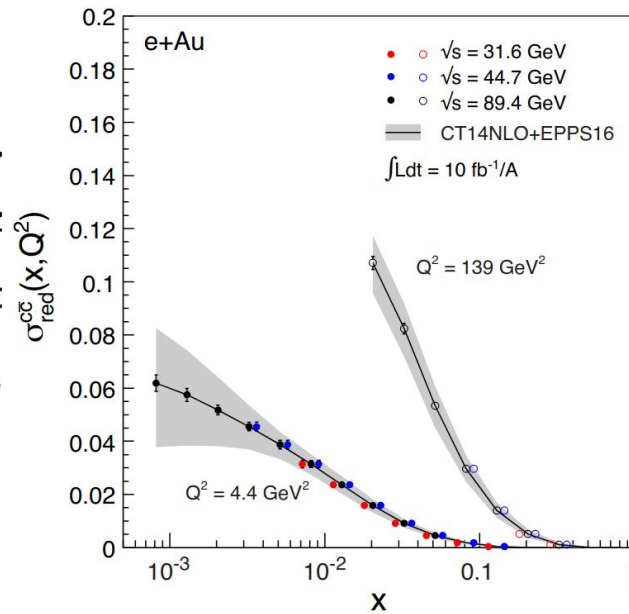
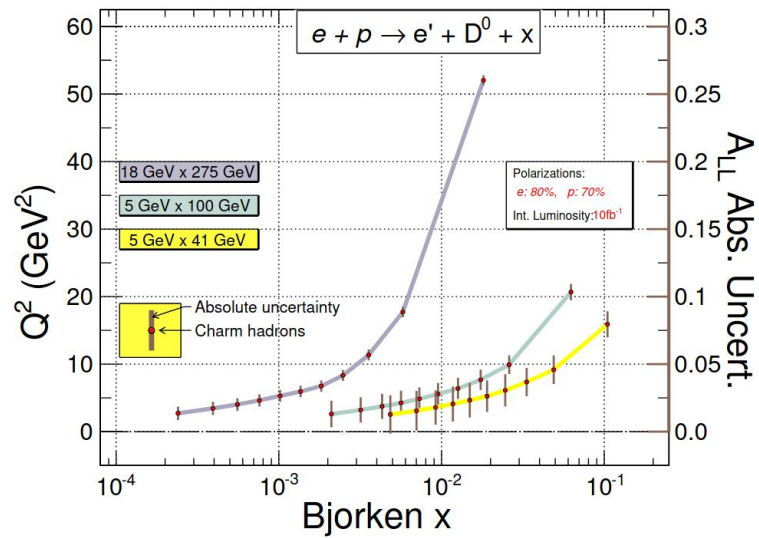
- 1 Secondary vertex performance (resolution)
- 2 Hadronic-final-state reconstruction (energy-flow algorithm)
- 2 Jet performance (resolution and bias)
with energy-flow, calorimetric reco. PID for 4-vectors (?).
- 3 Charm-jet performance (tagging efficiency/mis-id)

Golden channels

(candidates)

- **Heavy-flavour channels**
 - F_2^c
 - A_{LL} heavy quark
 - charm meson and charm-jet R_{eA} .
- **Lepton-jet and dijet correlations:**
 - quark-Sivers and gluon-Sivers [DIS]
 - low-x, Wigner function [diffractive DIS]
 - ΔG , photon structure [photo-production, DIS]
 - Cold-nuclear matter [(n)DIS]
- **Jet substructure and event-shapes**
 - Hadron-in-jet Collins [DIS].
 - Hadronization studies with angularities, correlations. [(n)DIS]
- **Electroweak/BSM**
 - EW Structure functions [CC DIS].

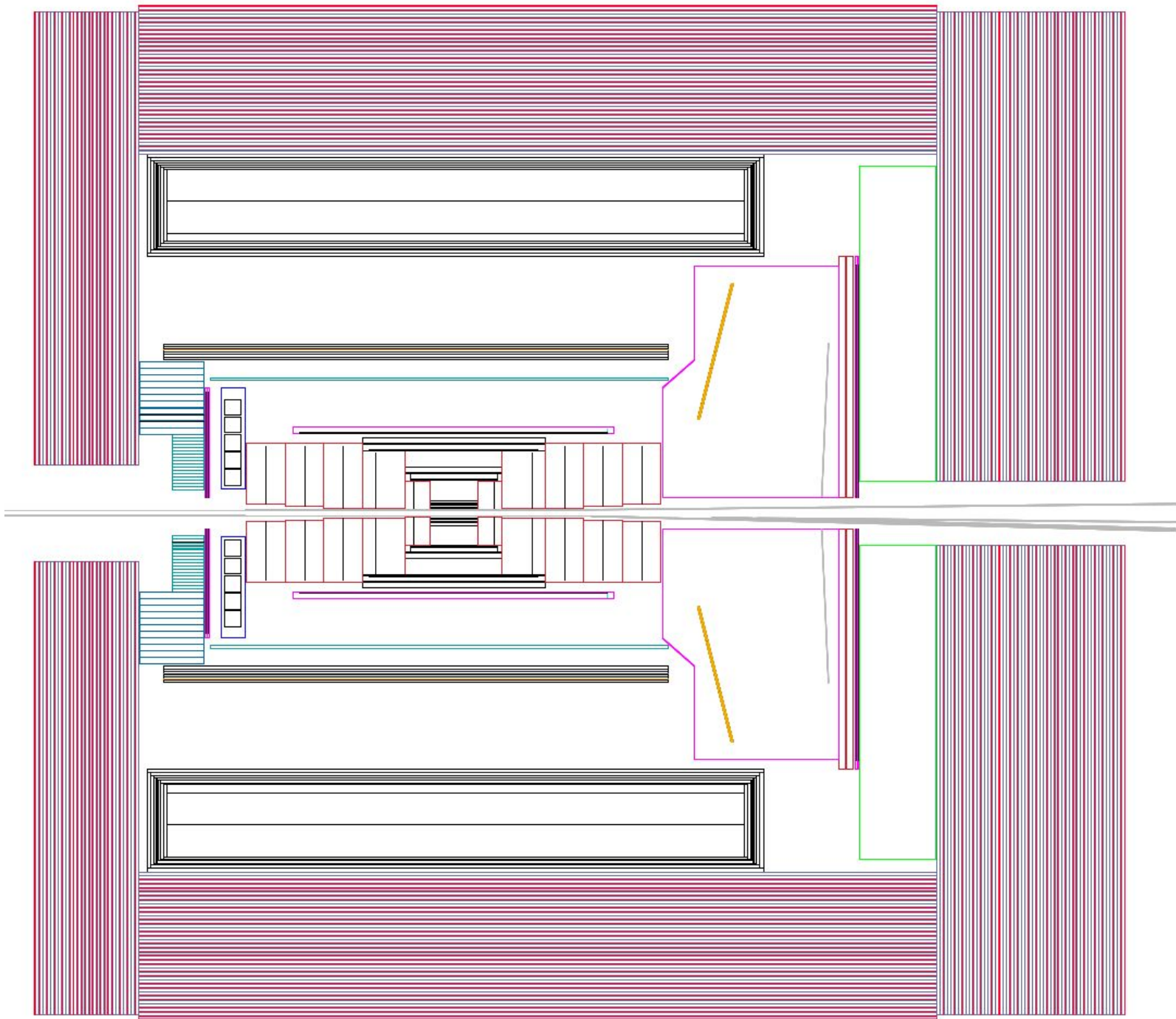
Summary (some of our golden channels)



<https://eicweb.phy.anl.gov/EIC/detectors/athena>

Geometry, materials and reconstruction code is already in place to do calorimeter-based hadronic reco

Full-simulation samples of NC and CC DIS Pythia8 events, with beam divergence, angles, etc available since about 3 weeks

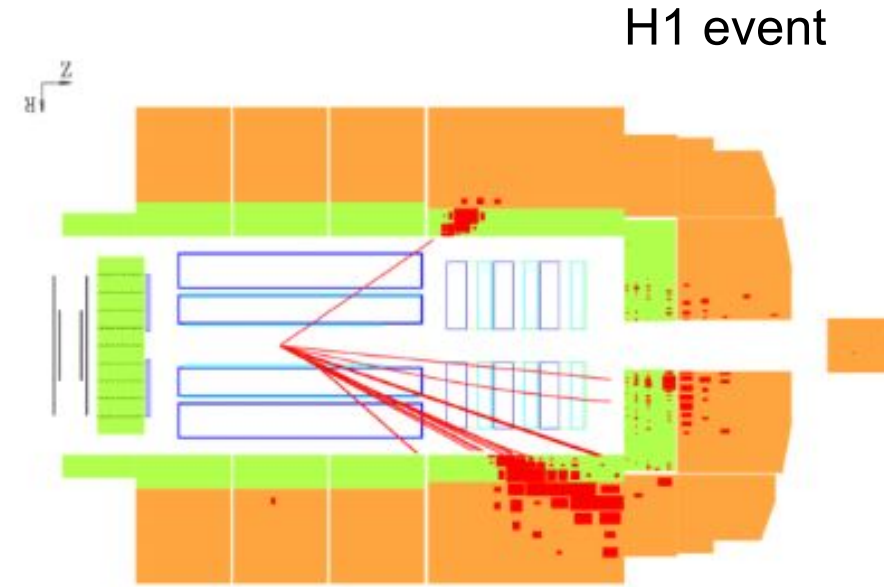


Measuring the “hadronic final state” is essential to

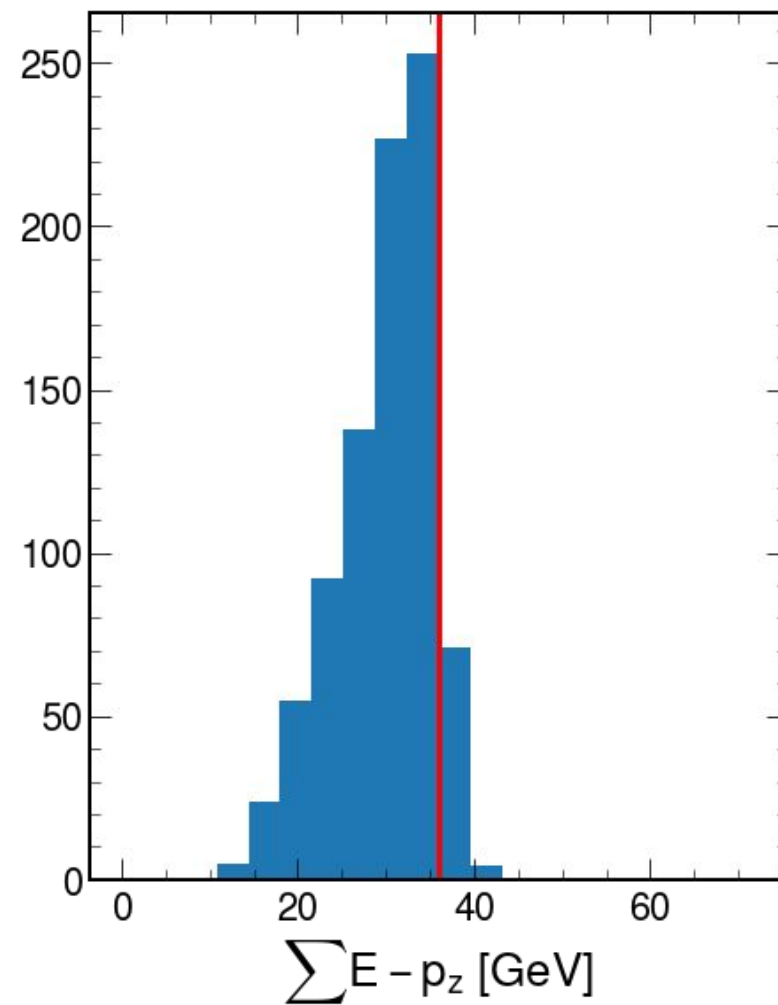
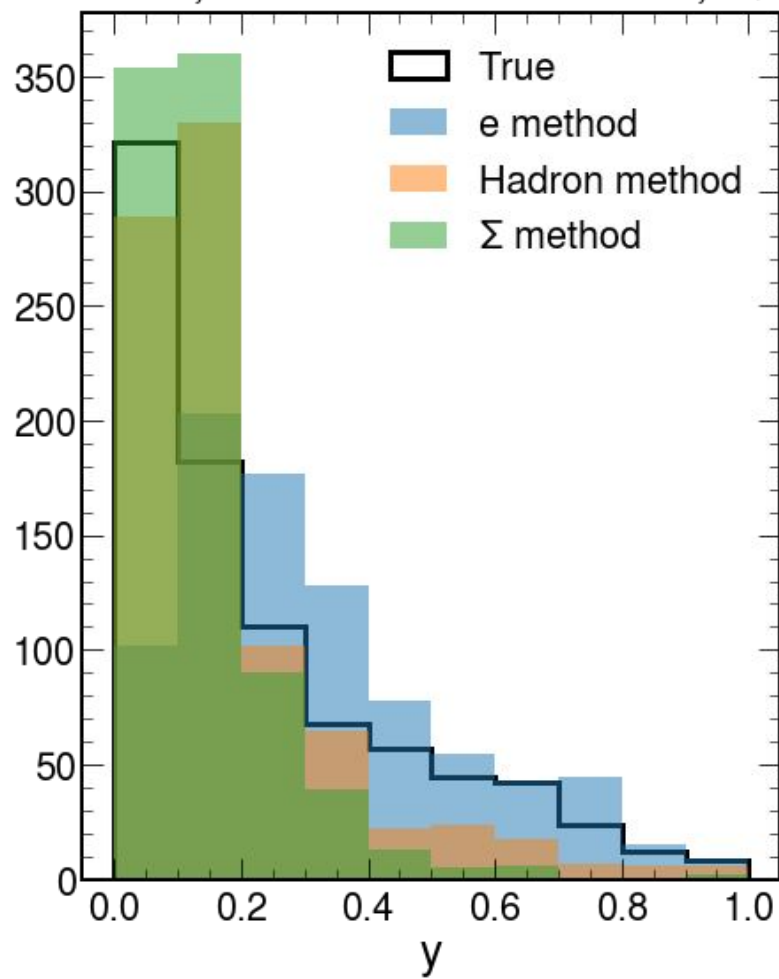
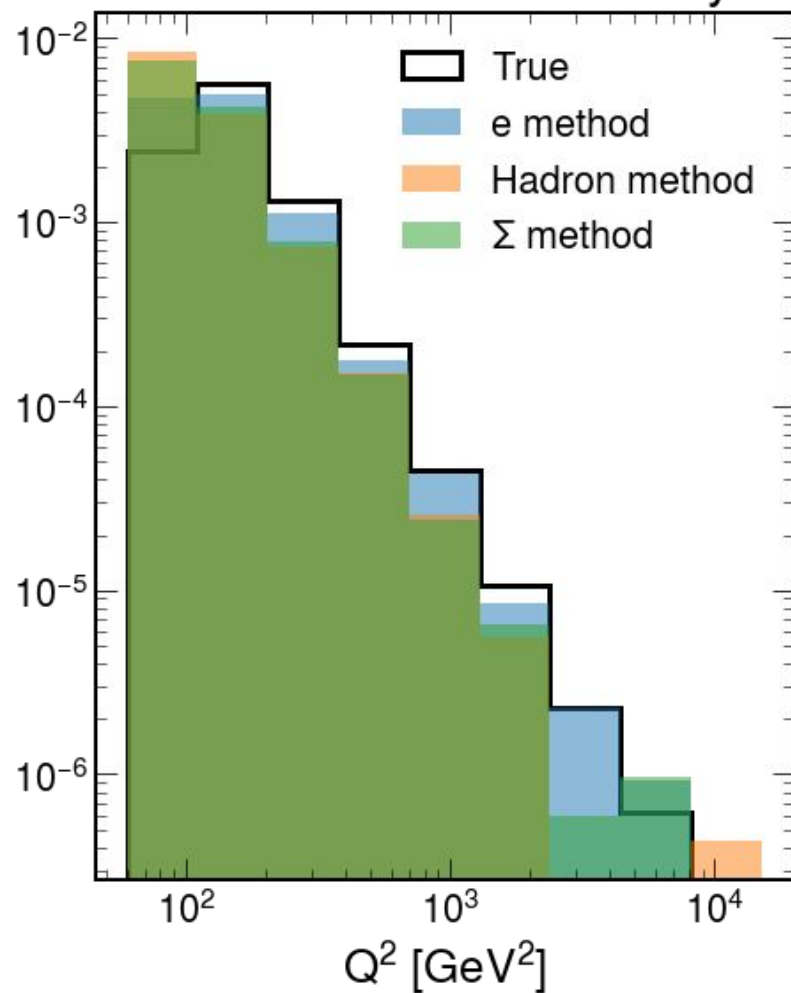
- 1) Reconstruct DIS variables in neutral-current DIS (lepton alone not enough)
- 2) Reconstruct DIS variables in charged-current DIS (neutrino in final state)
- 3) Jets, Missing energy, event shapes, rapidity gaps, etc.

All of these are HFS measurements.

Jets are subset of HFS.

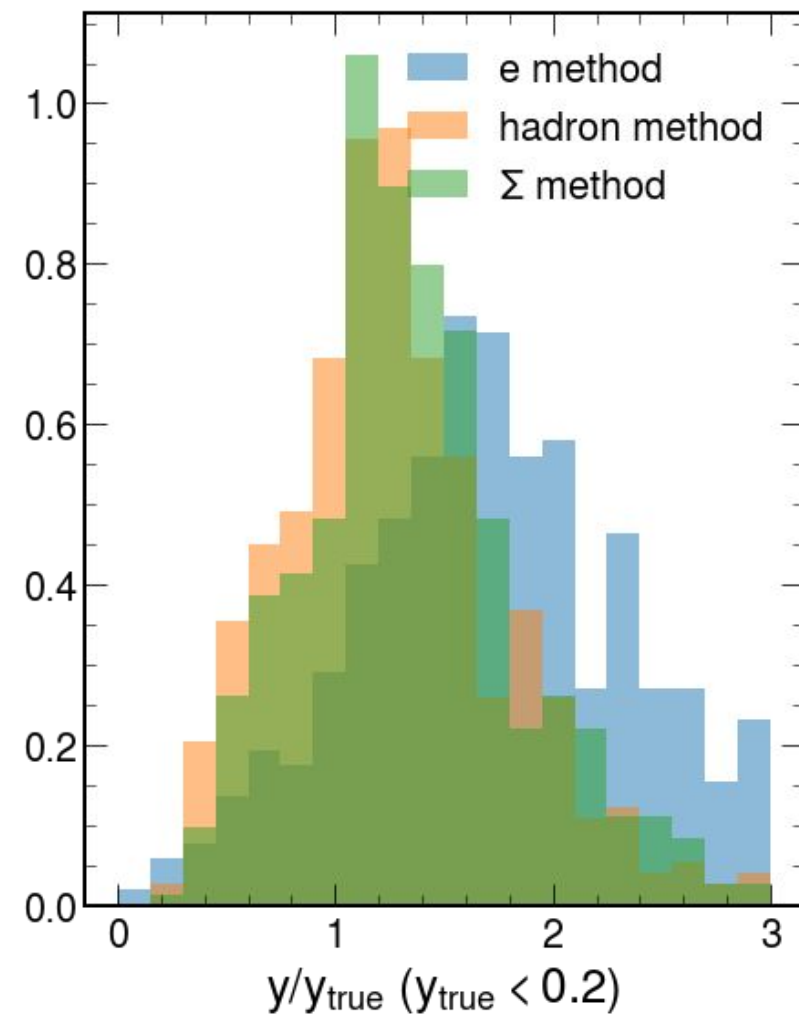
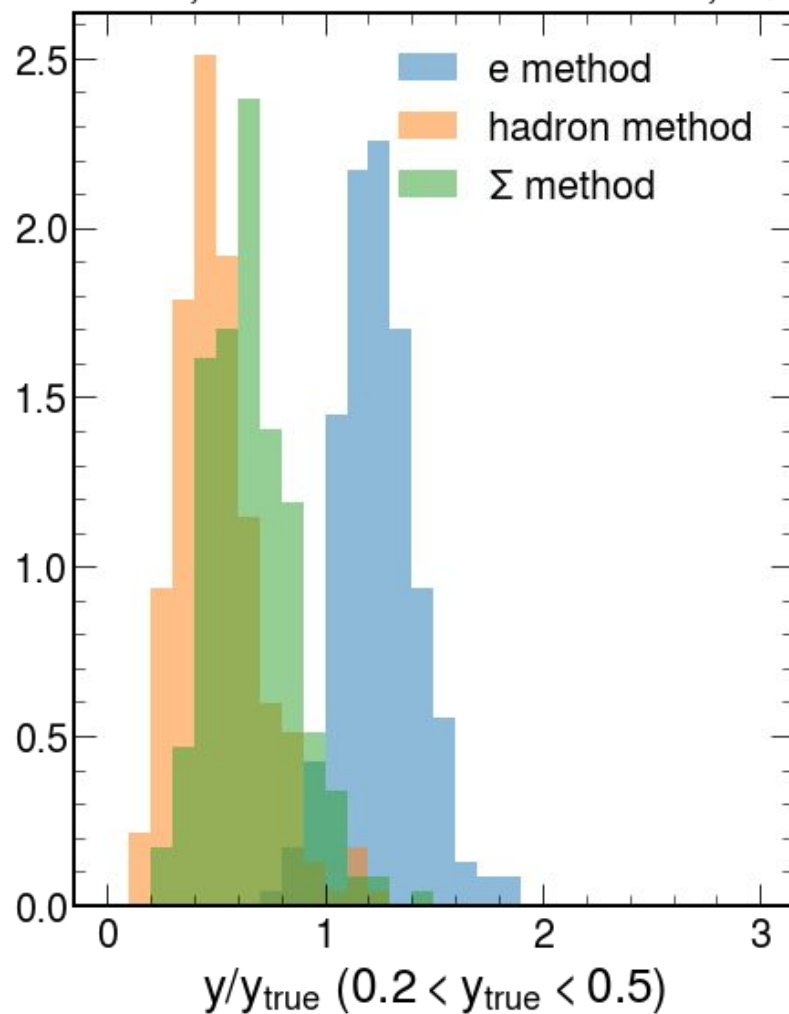
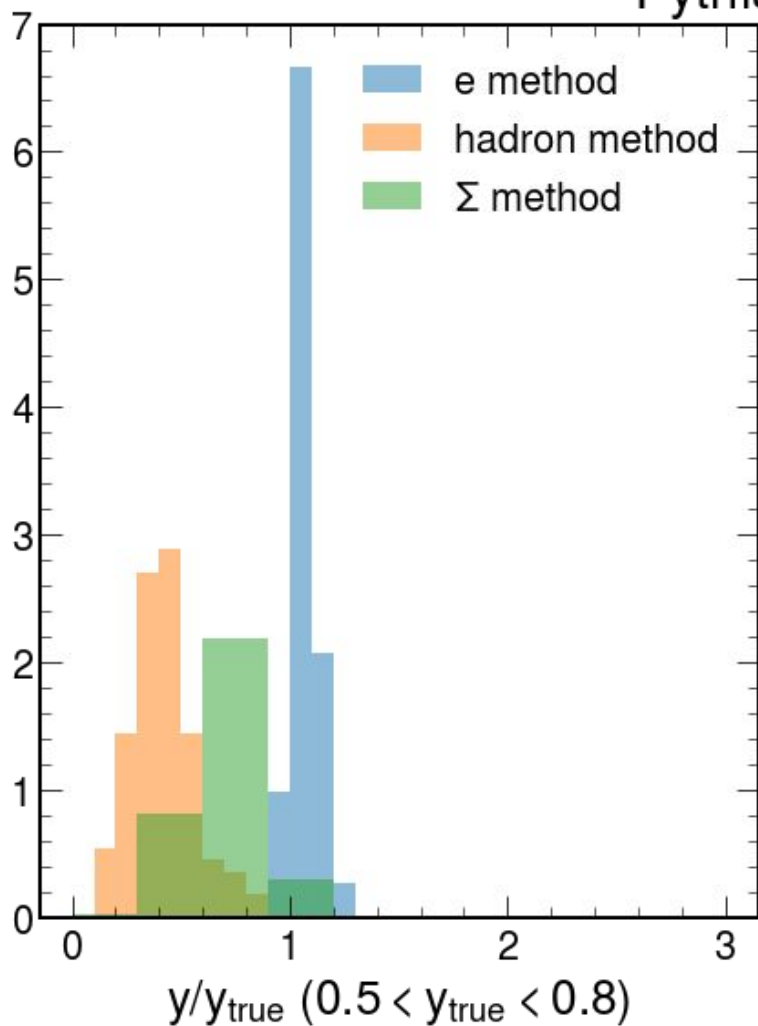


ATHENA full simulation [DD4hep]
 Pythia8+Geant4, NC DIS 18x275 GeV, $Q^2 > 100 \text{ GeV}^2$

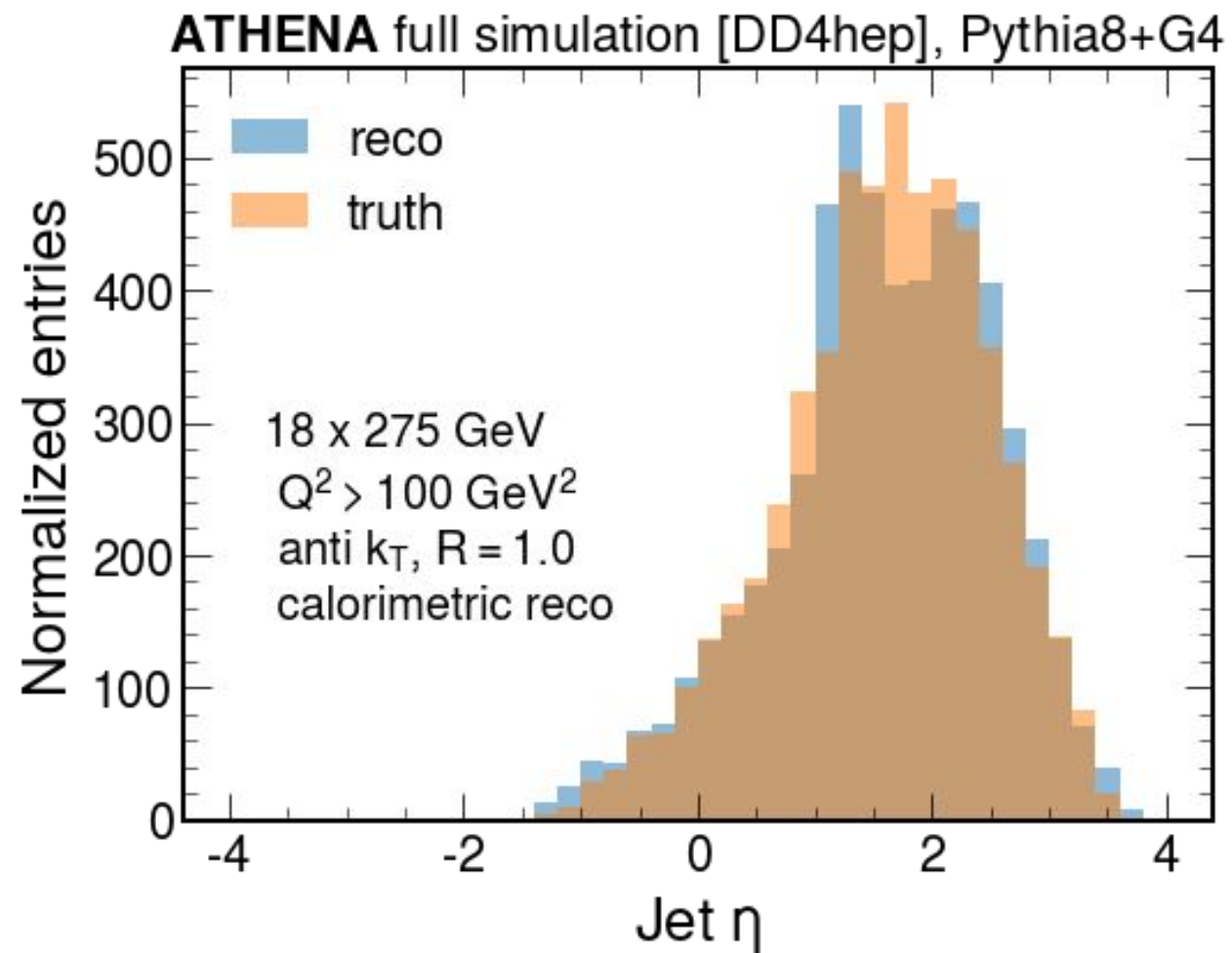
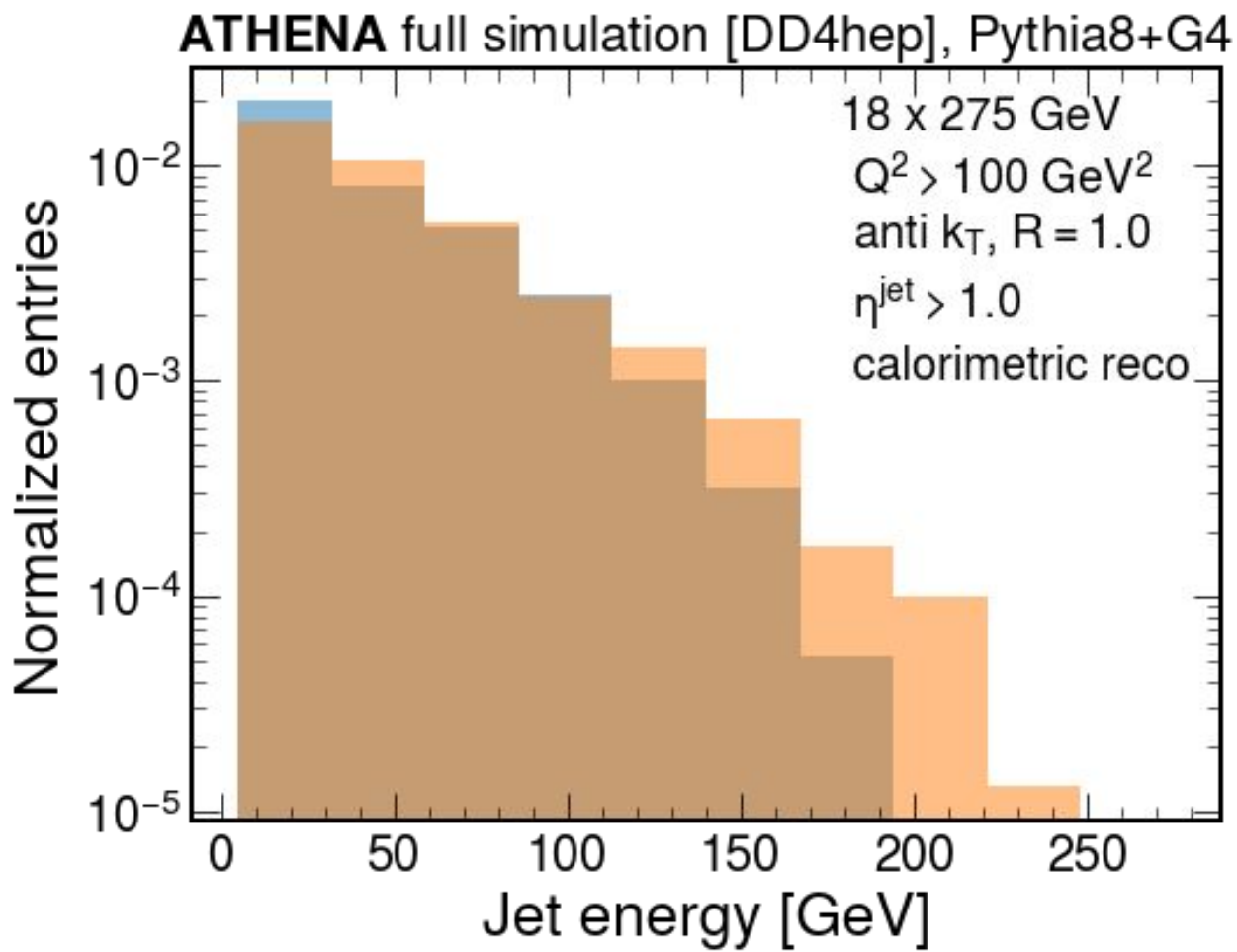


ATHENA full simulation [DD4hep]

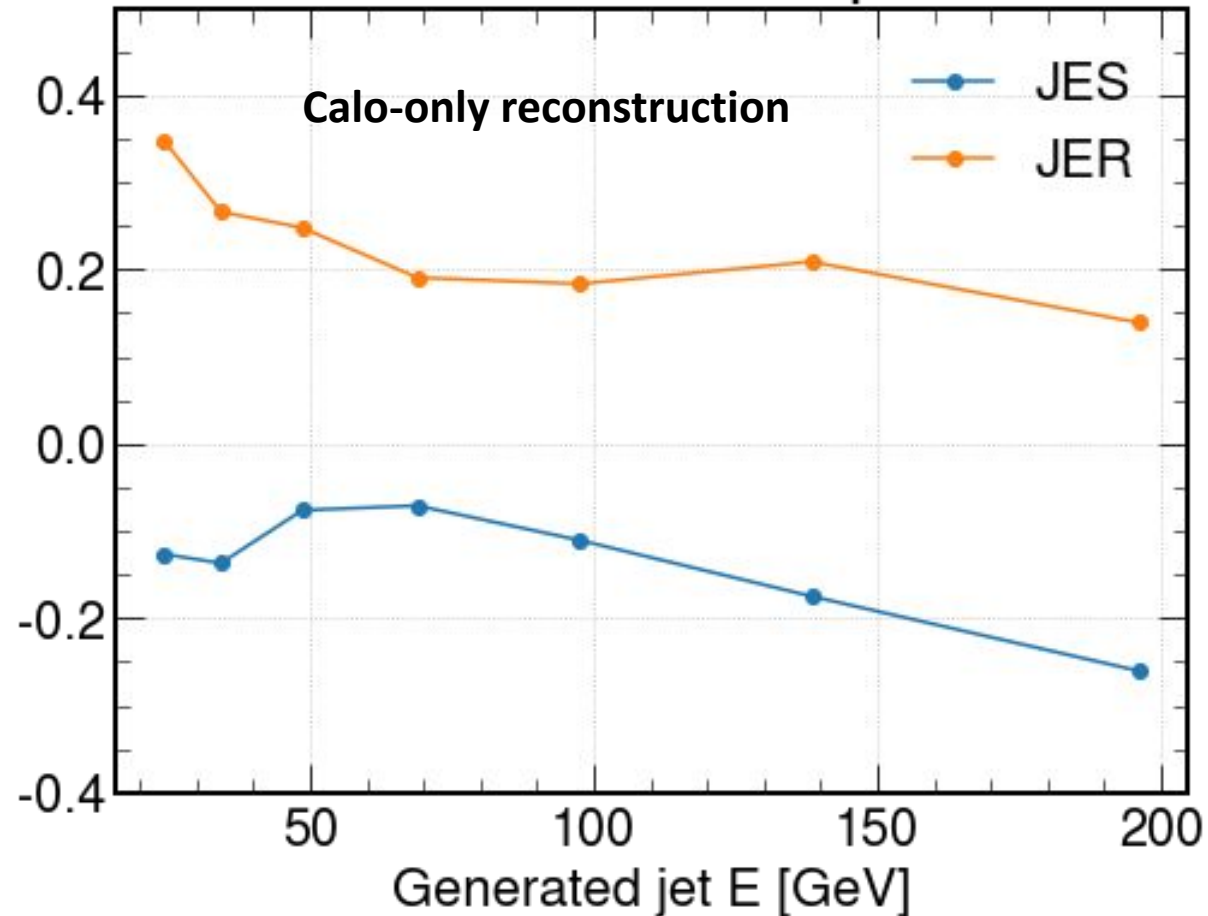
Pythia8+Geant4, NC DIS 18x275 GeV, $Q^2 > 100 \text{ GeV}^2$



Jet reconstruction (calorimeter based)



Relative jet-energy scale and resolution, $\eta > 1.5$



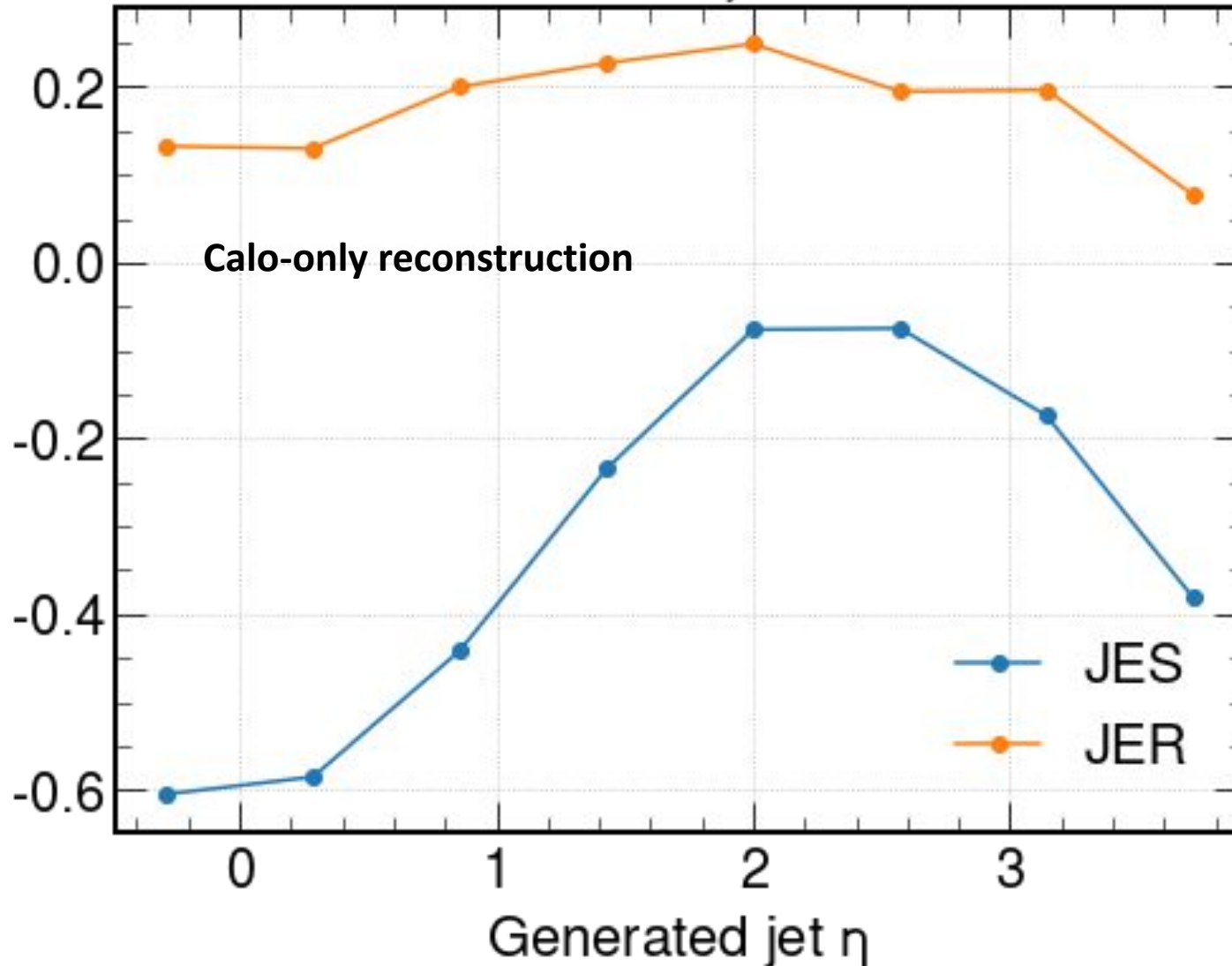
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First look into jet resolution
(calorimeter based) done!

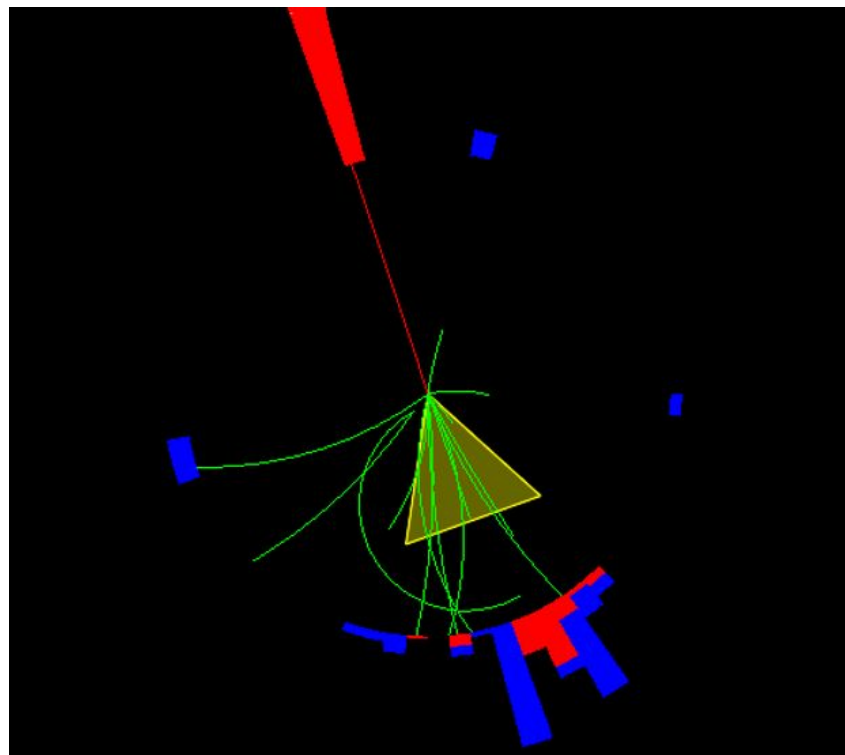
Will improve as we improve
“calibration” of ECAL+HCAL clusters

Relative jet-energy scale and resolution, $E > 20$ GeV



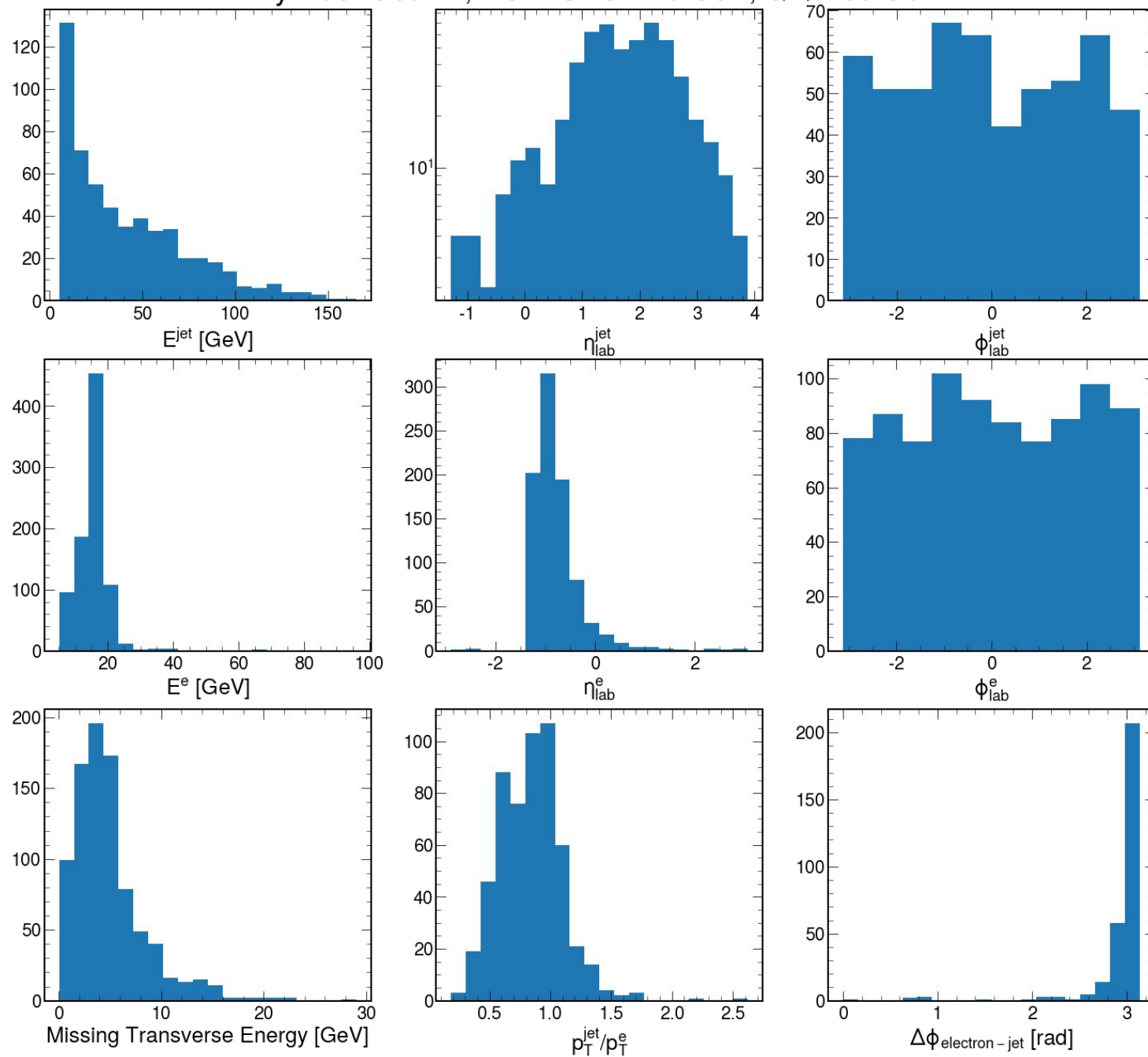
Clear impact of magnet material at barrel, and leakage to beam pipe in the forward region

FYI, we are very close to get first performance metrics for this channel!



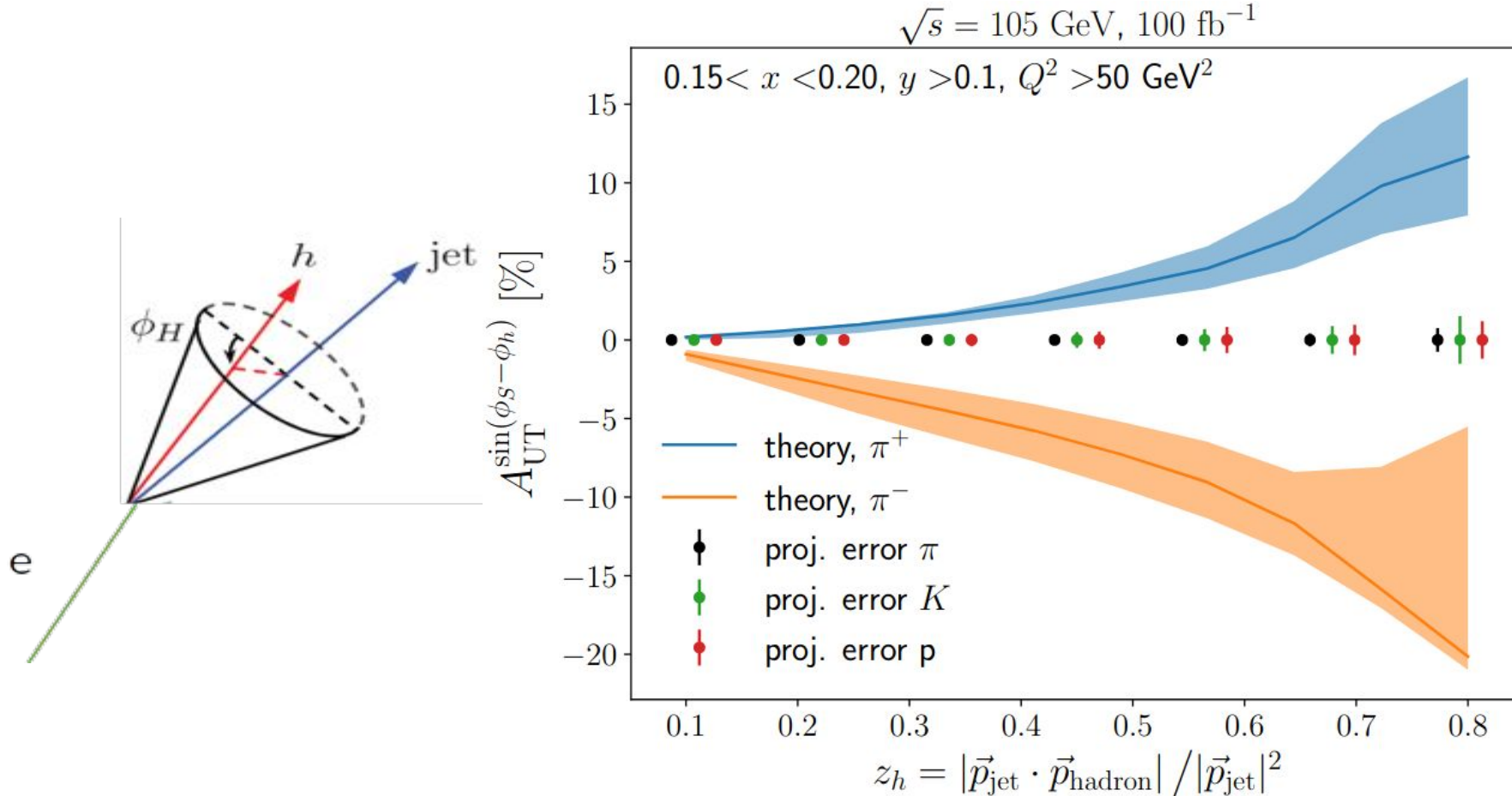
ATHENA full simulation [DD4hep]

Pythia8+Geant4, NC DIS 18x275 GeV, $Q^2 > 100 \text{ GeV}^2$



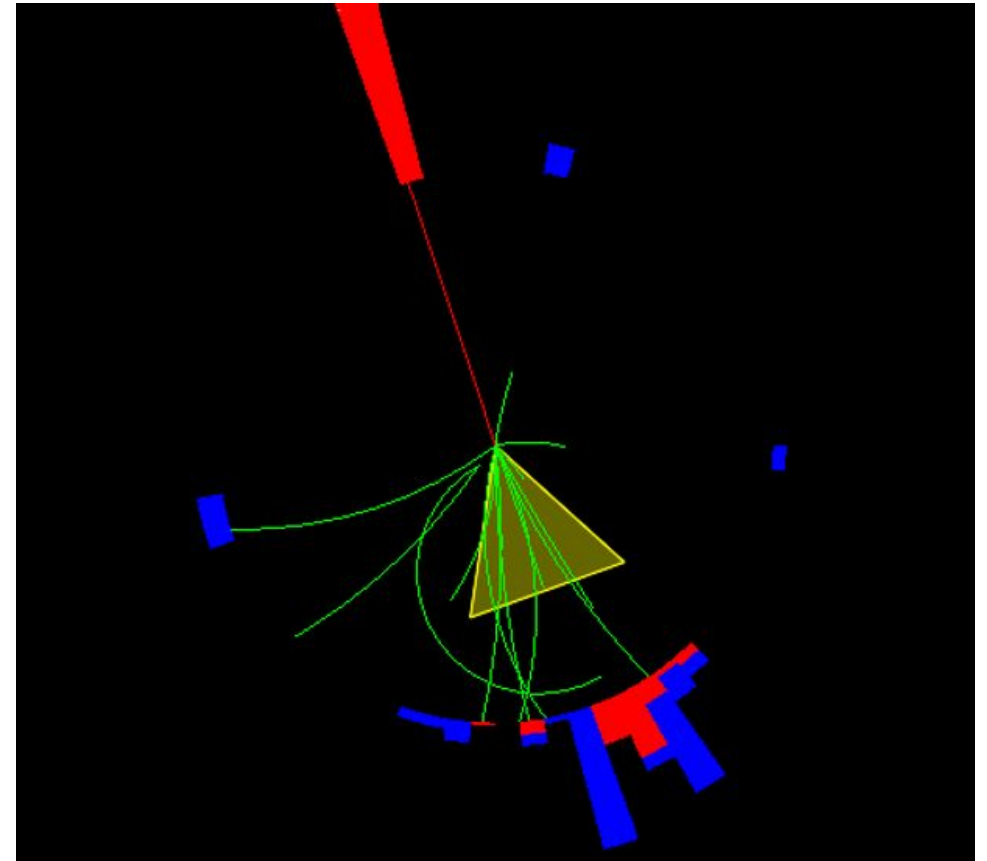
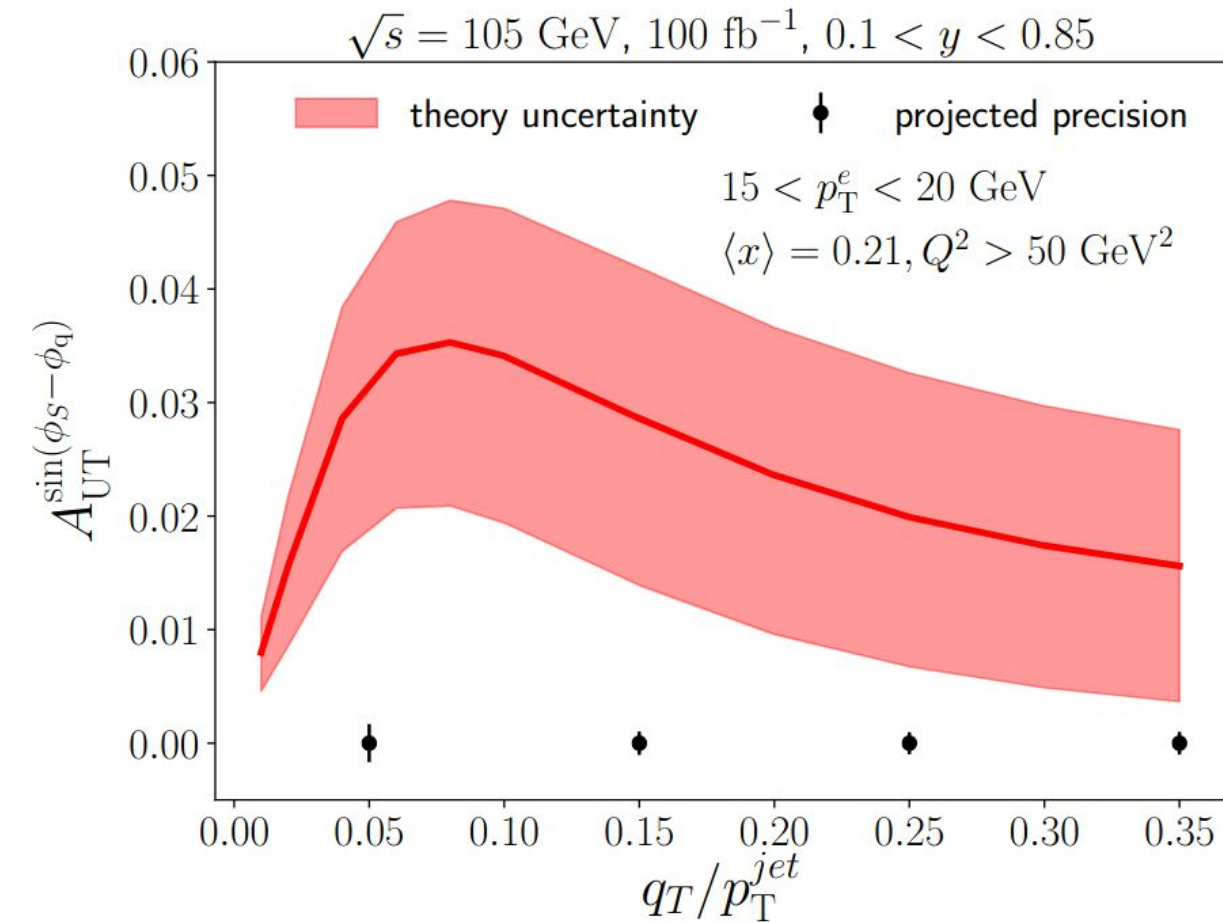
BACKUP

Jet-substructure measurements: e.g. Collins asymmetry



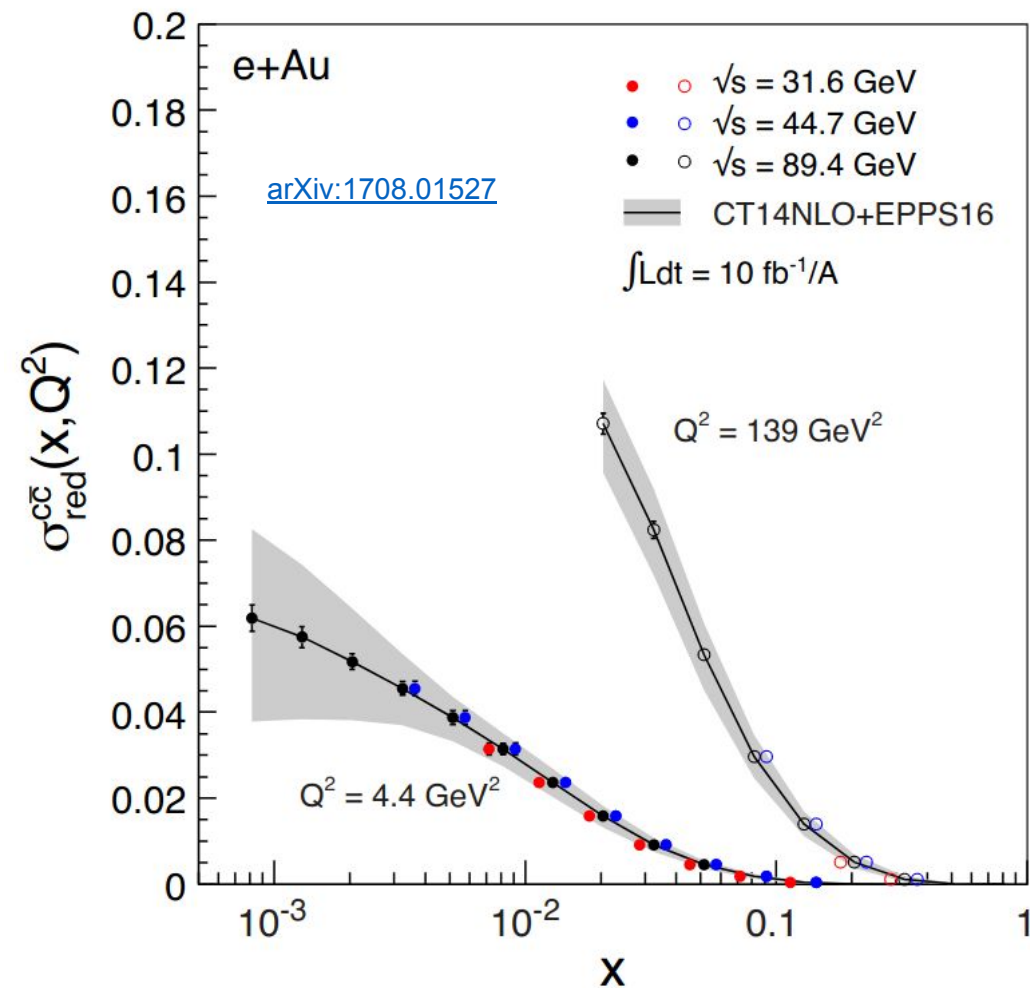
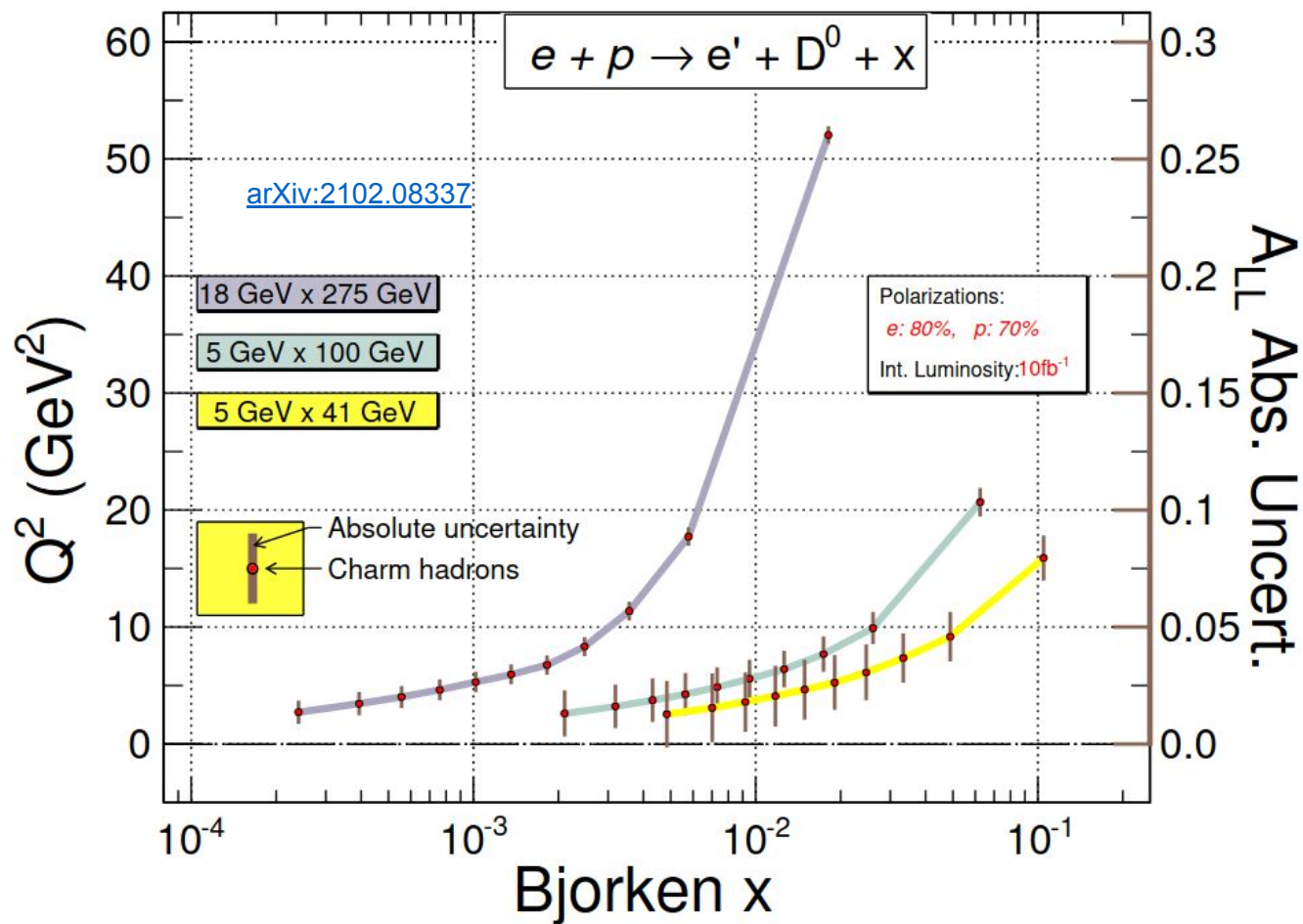
- Identification of hadrons inside jets.
- This is an example of an entire class of substructure measurements
- Require PID, angular resolution

Jet kinematics measurements, e.g. **Lepton- Jet Sivers asymmetry**

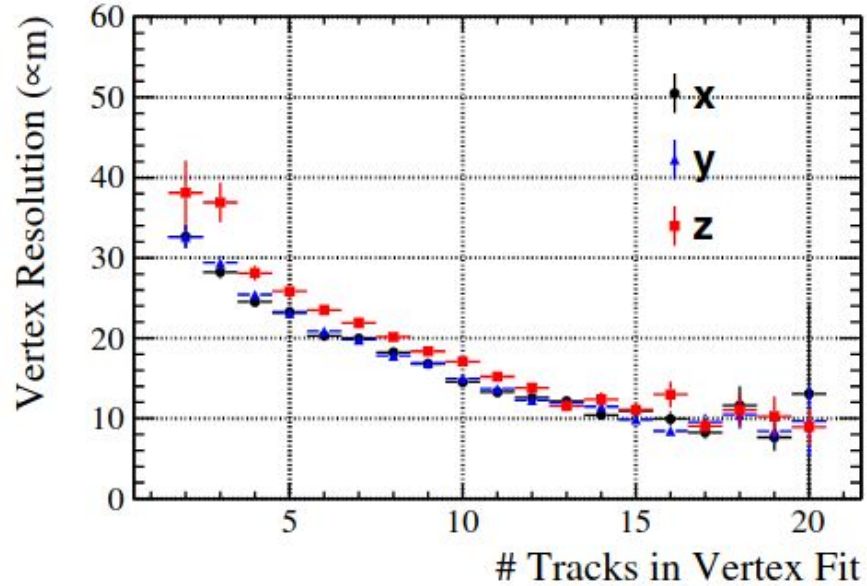


- Addresses NAS/White-Paper with new tools
- Requires energy and angle of jets (4-vector)

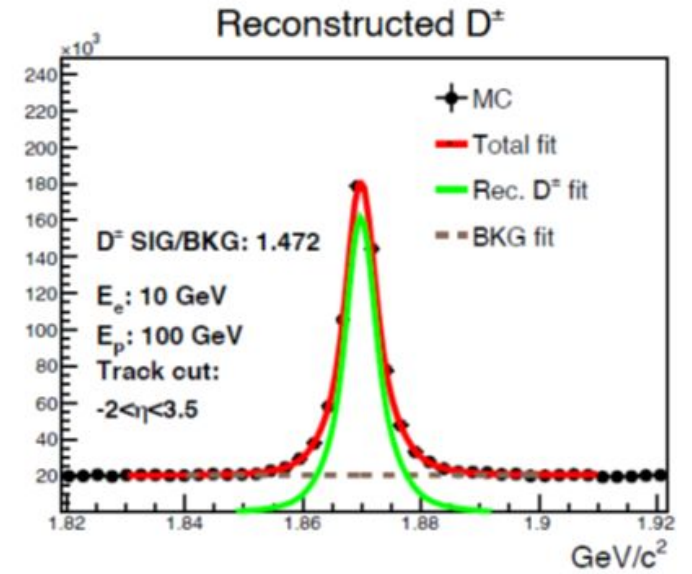
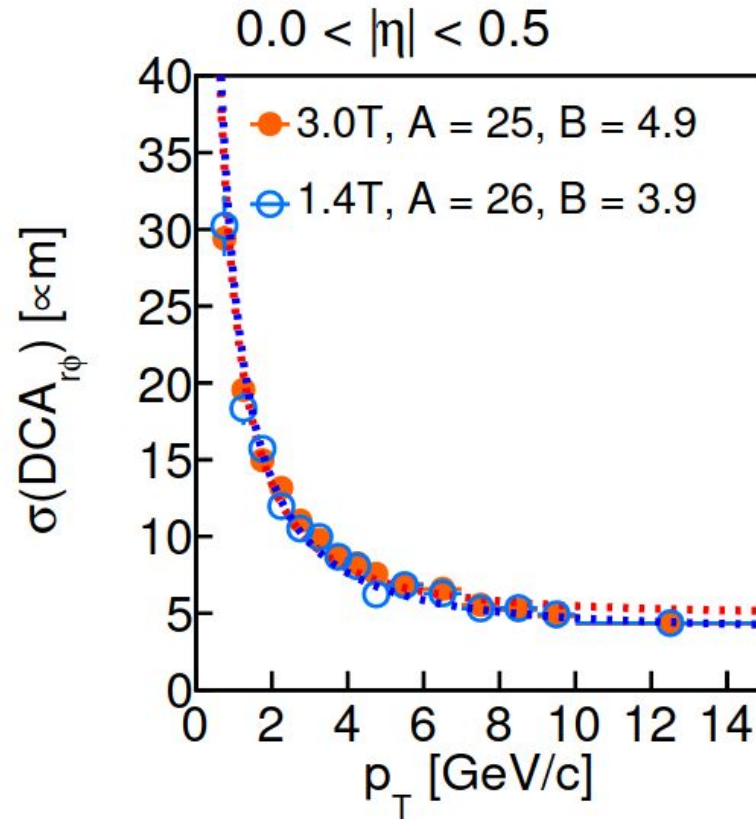
Heavy-flavour



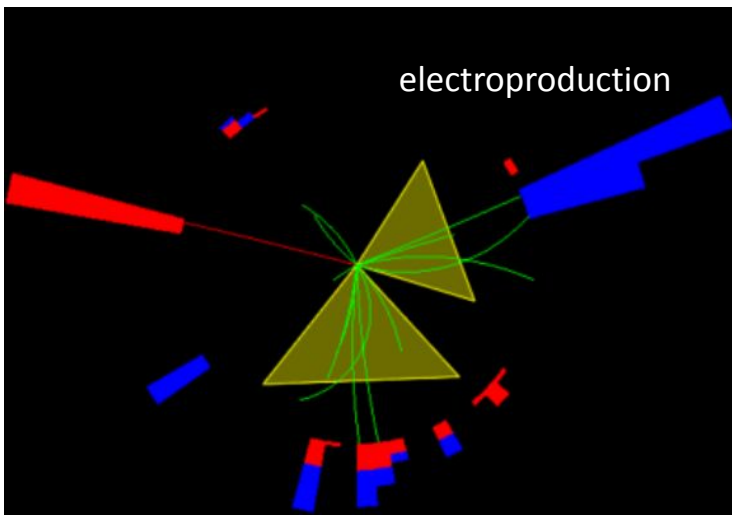
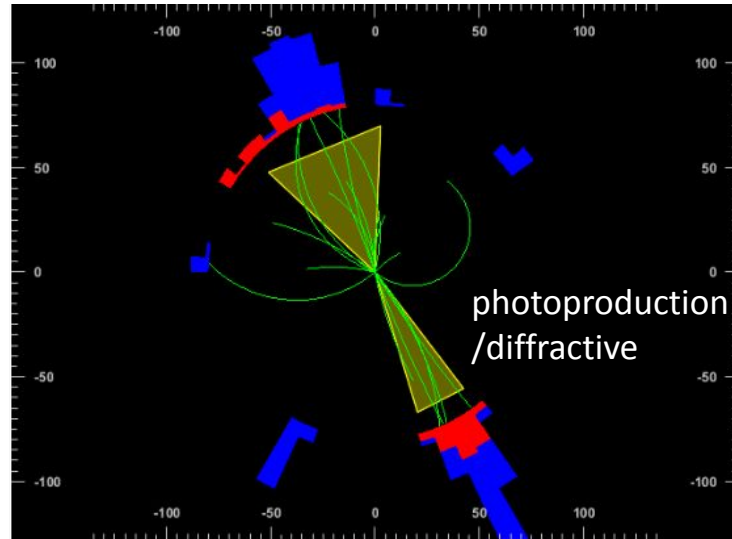
Tracking, vertexing performance plots, e.g.



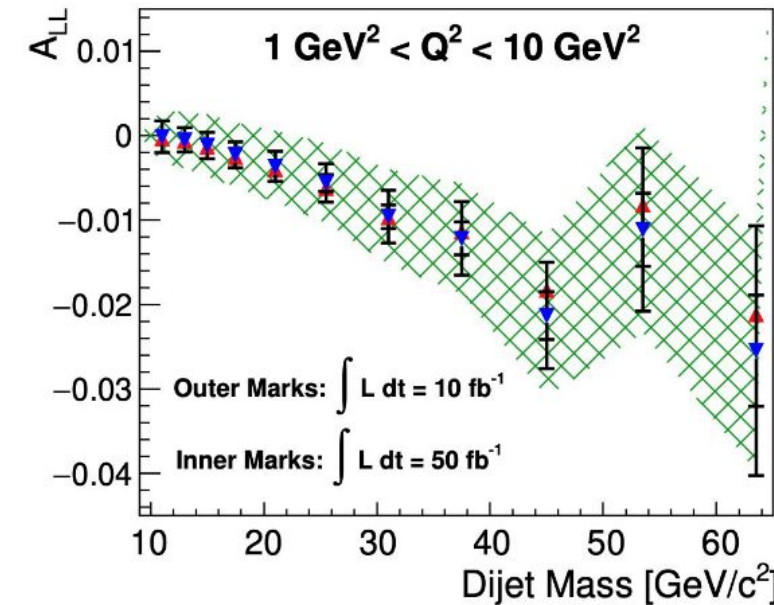
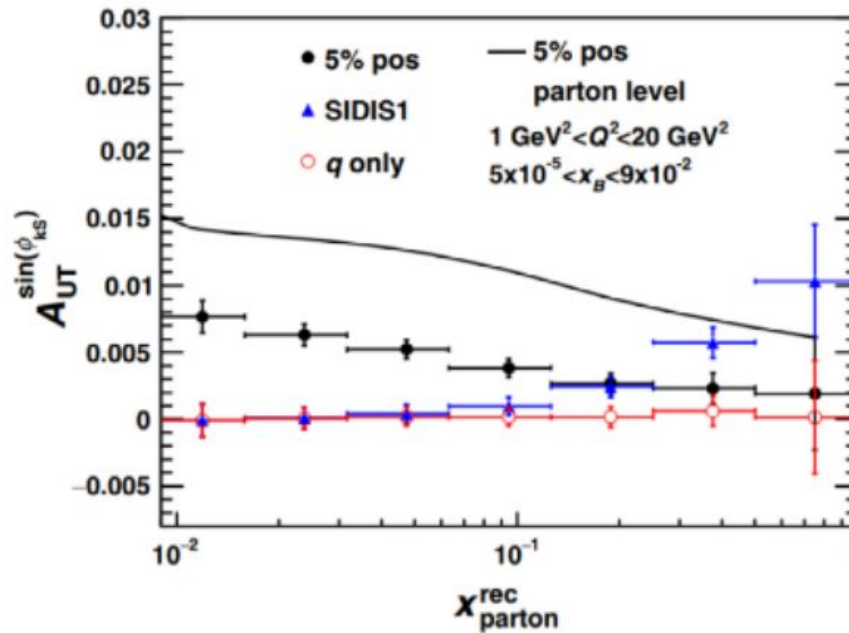
[arXiv:2102.08337](https://arxiv.org/abs/2102.08337)



Jet kinematics measurements, e.g. Dijets correlations (gluon Sivers, Wigner, delta-G)



gluon Sivers:



- Addresses core EIC science with jets
- Requires energy and angle of jets (4-vector)