Benchmarks in the Insert and FEMC

Sebouh Paul
UC Riverside
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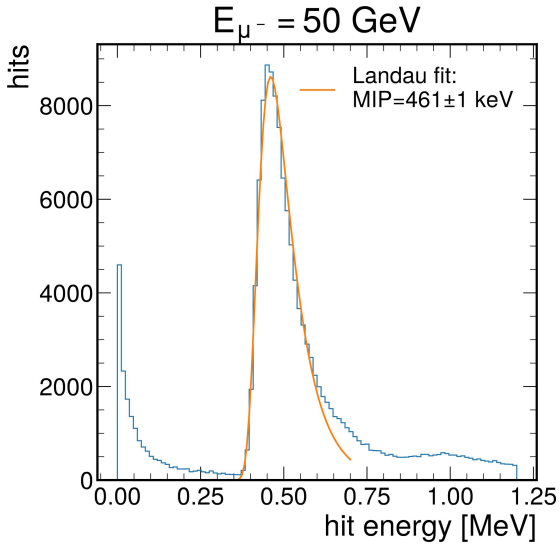
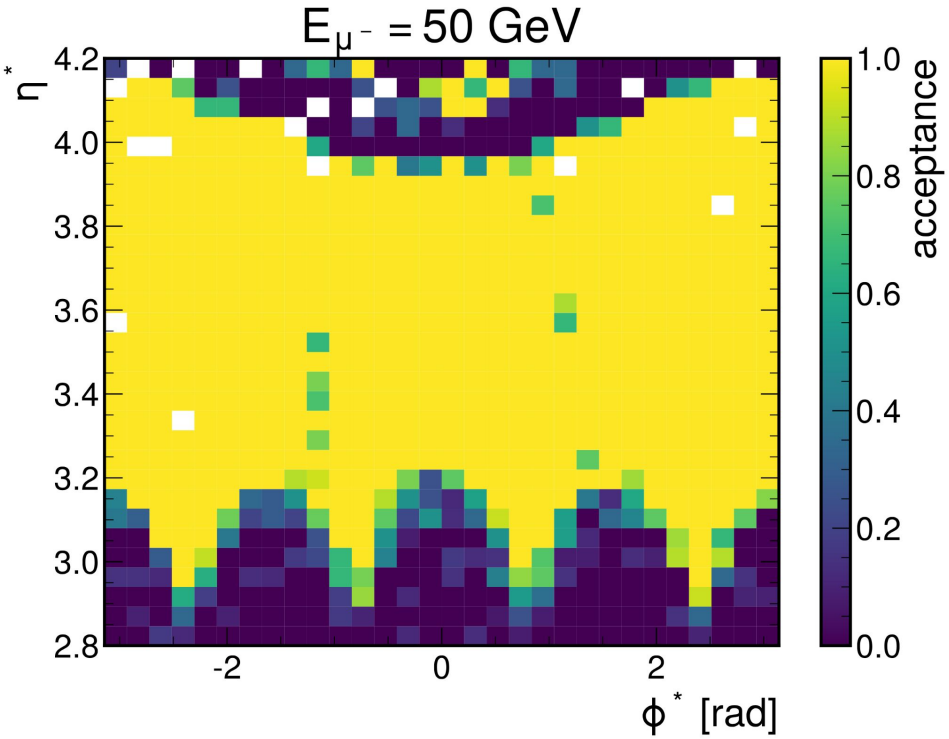
Muons

https://github.com/eic/detector_benchmarks/tree/master/benchmarks/insert_muon

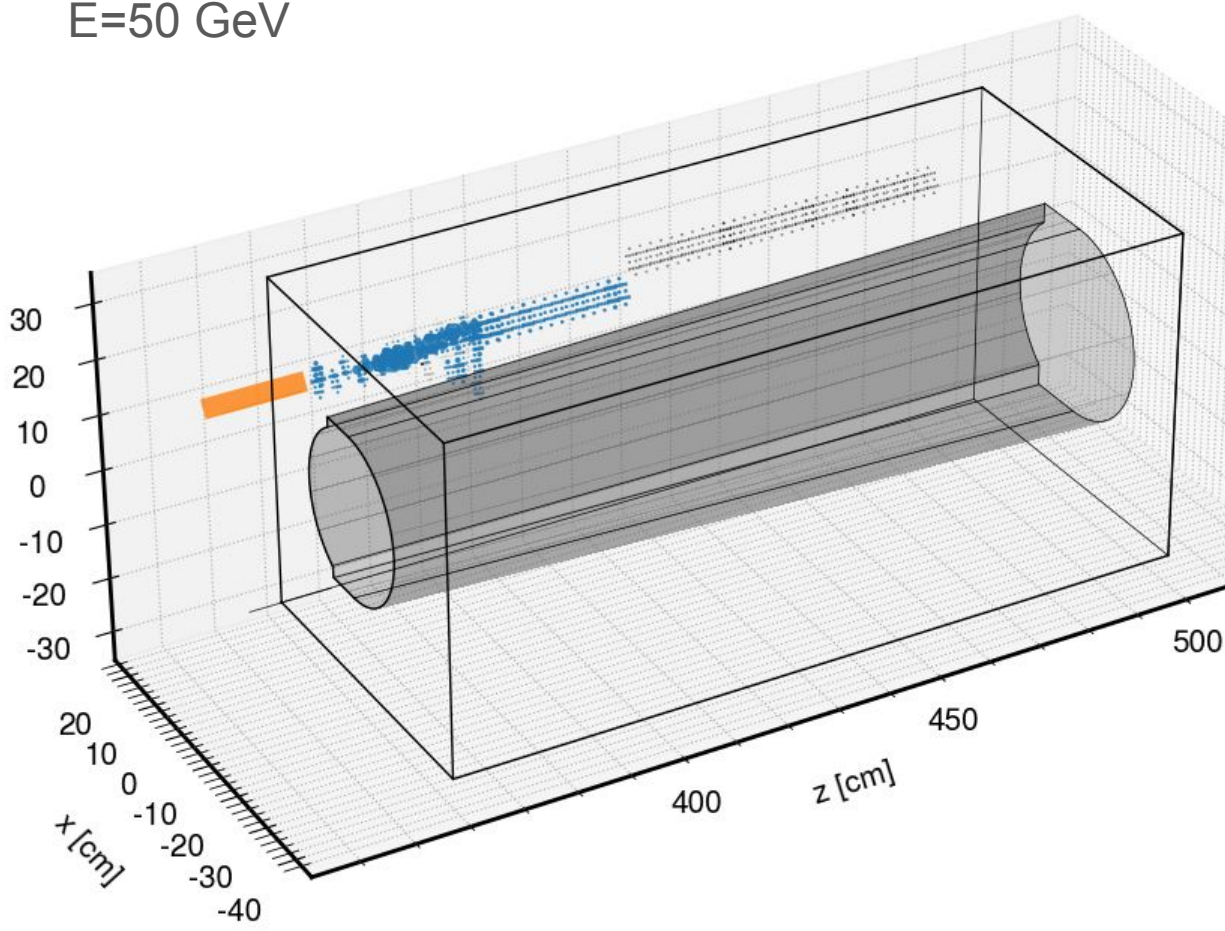
- Purpose:
  - Determine MIP value
  - Determine the acceptance (# of single μ- events with at least one hit>0.5 MIP)/(# total events)
  - Can also be used for position resolution (TODO)





Muon
(event display)

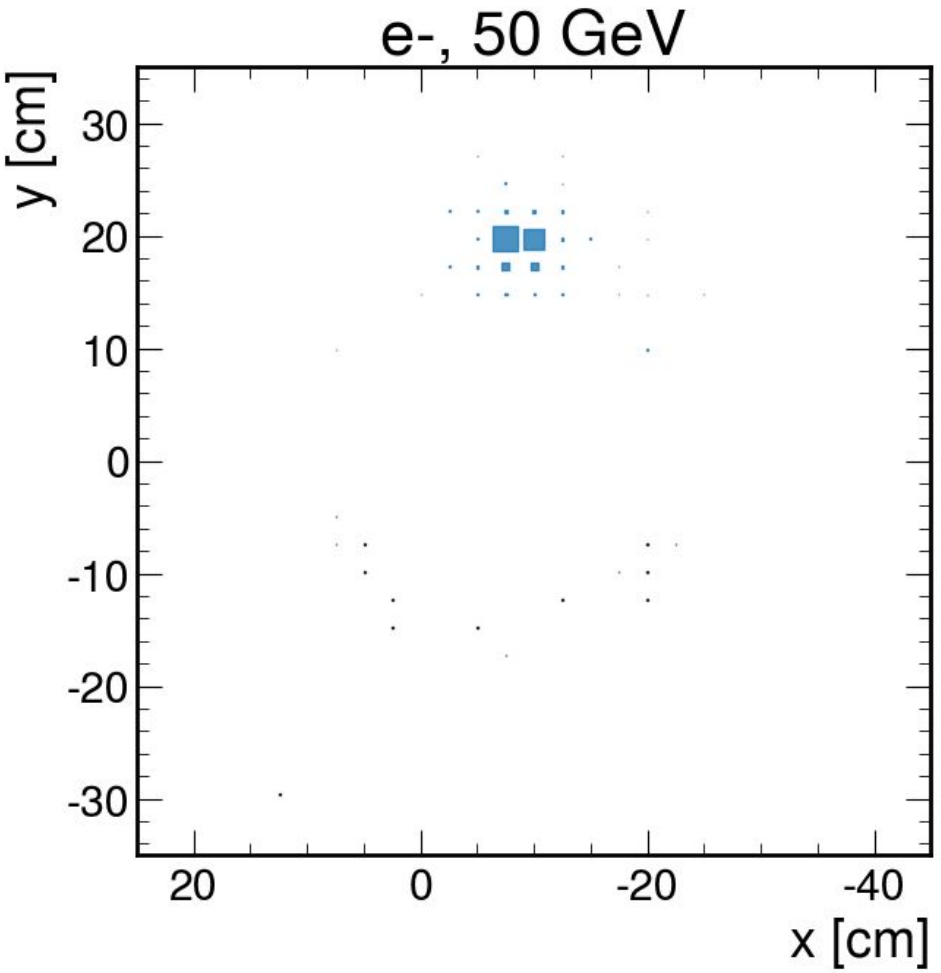
E=50 GeV



Electron benchmark (in progress)

Purpose:

- Determine energy scale of the forward Ecal endcap (FEMC)
- Checks that the clustering in the FEMC identifies one cluster per electron



https://github.com/eic/detector_benchmarks/tree/femc_electron

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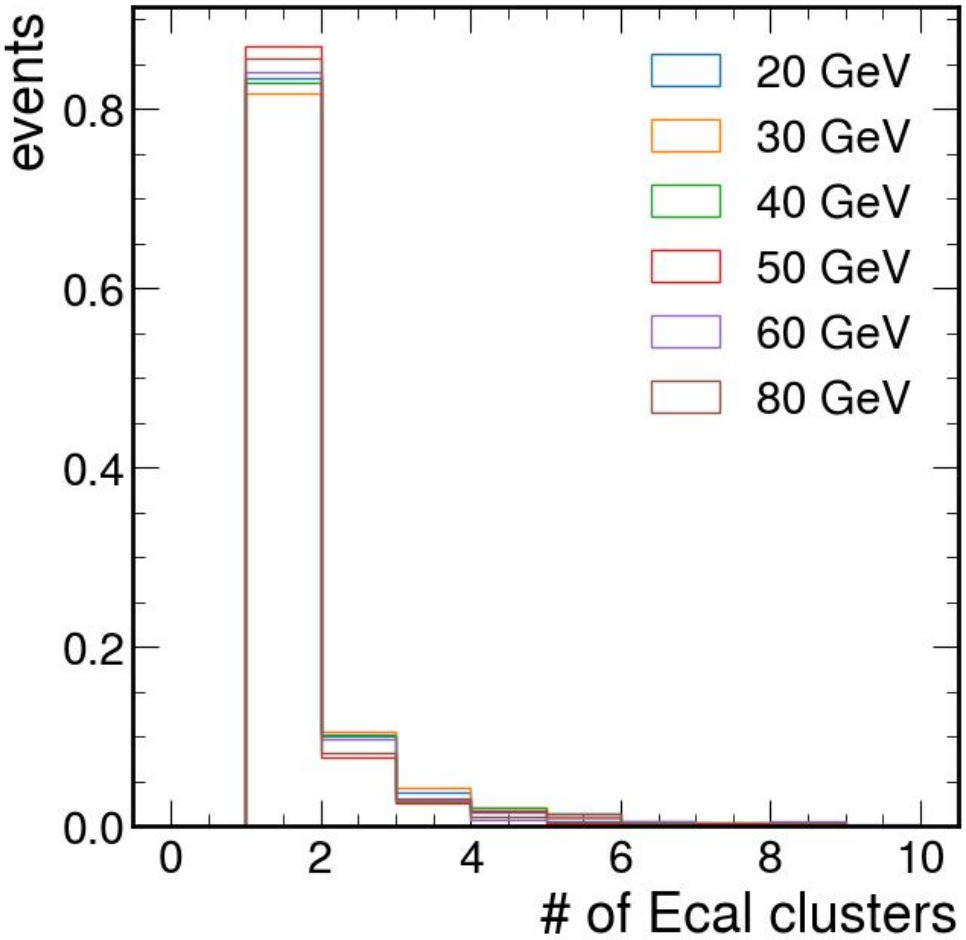

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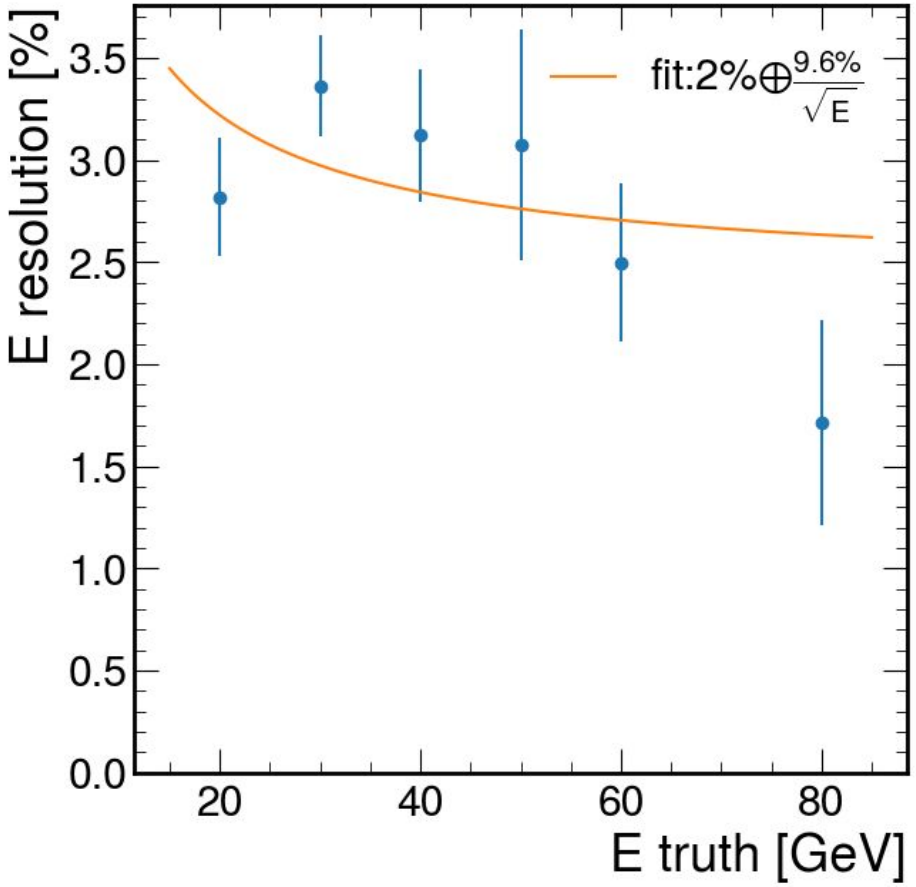

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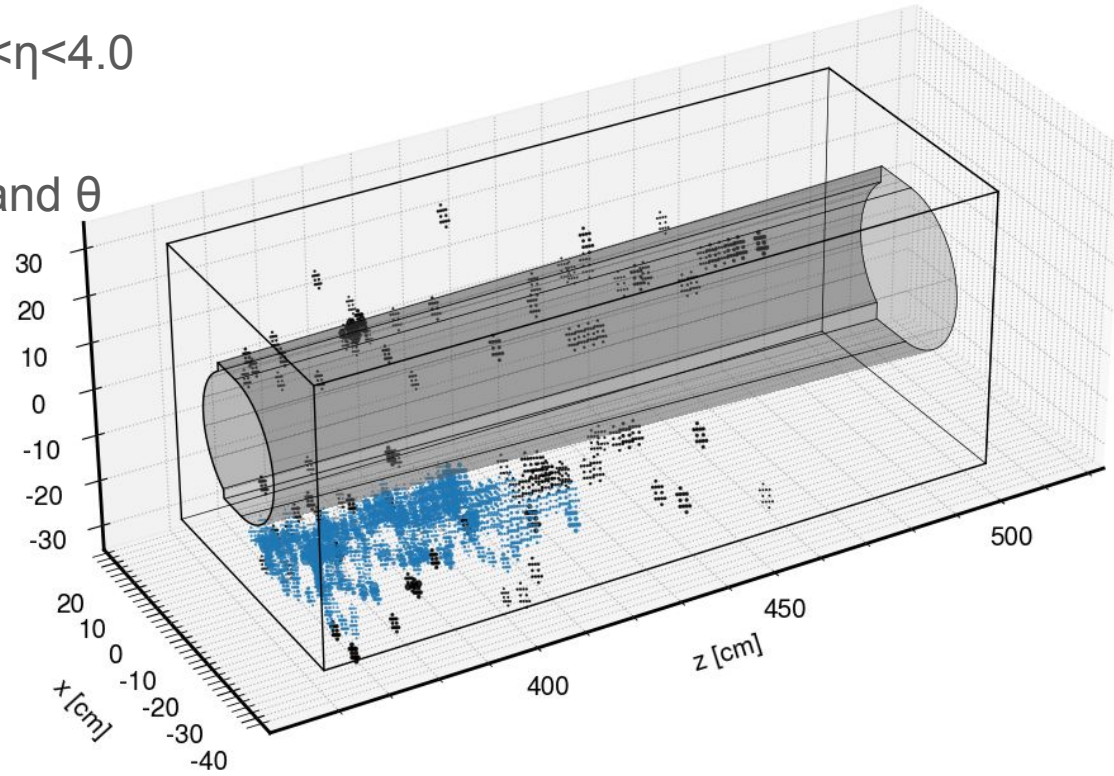
Neutron benchmark

$E_{truth,\ total}$ = 50 GeV, η=3.6

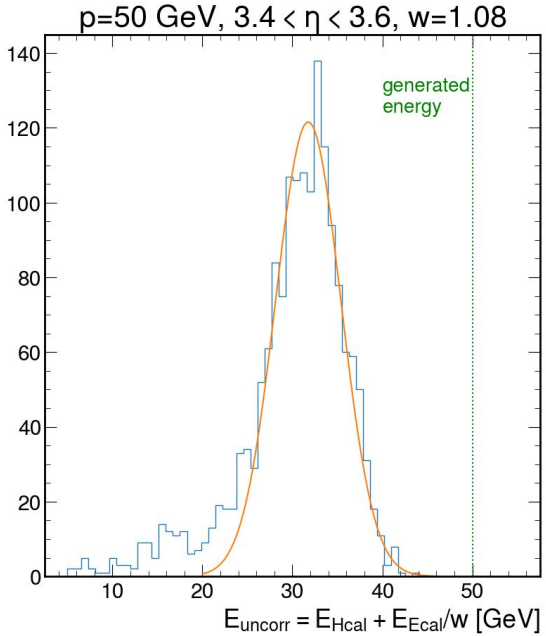
- Neutrons generated with 3.0<η<4.0
- Determine energy and theta resolution as a function of p and θ

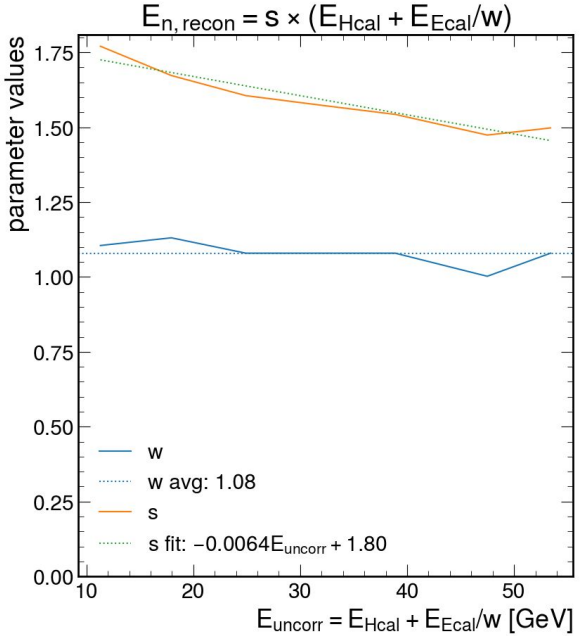


https://github.com/eic/detector_benchmarks/tree/master/benchmarks/insert_neutron

Neutron energy reconstruction

- Hcal sampling fraction determined at EM scale
- To correct for e/h effects:
  - w parameter: relative energy scale of Ecal vs. Hcal
    - Determined by minimizing σ/μ ratio for gaussian fits to $E_{uncorr}=E_{Hcal}+E_{Ecal}/w$ distribution
  - s parameter: Energy dependent overall scale of e/h. Determined as 1/μ of E_{uncorr}/E_{truth} distribution





Neutron benchmark

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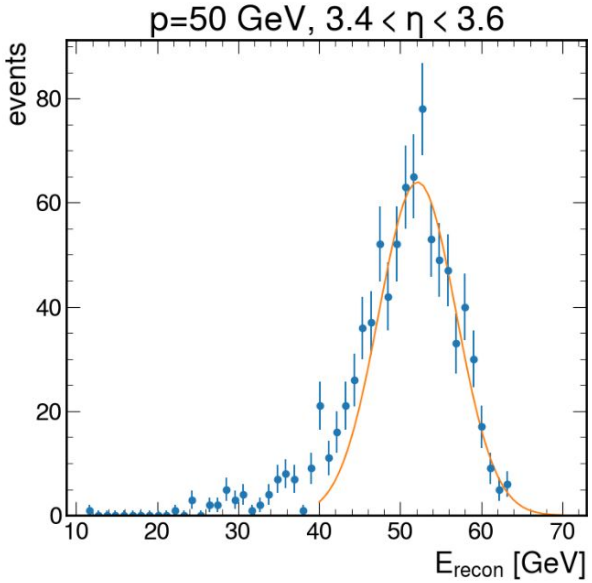

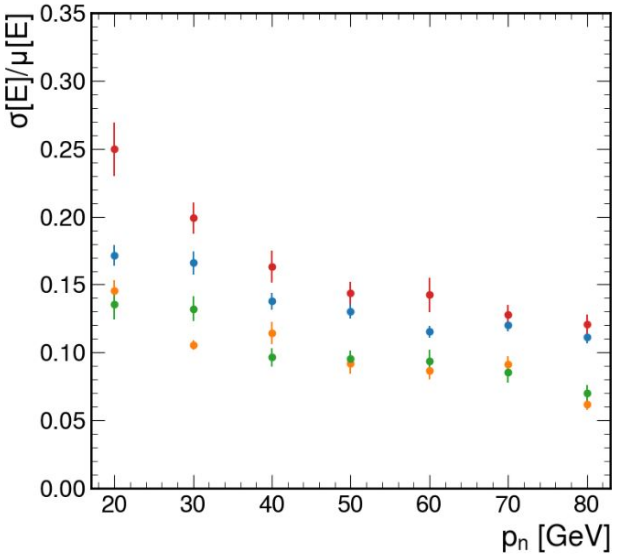

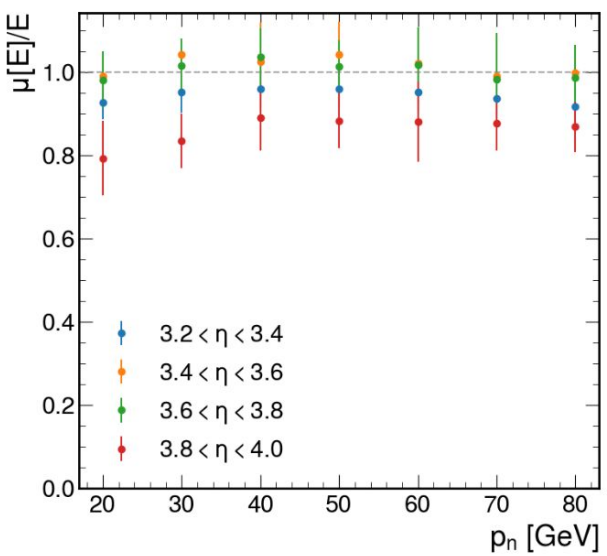

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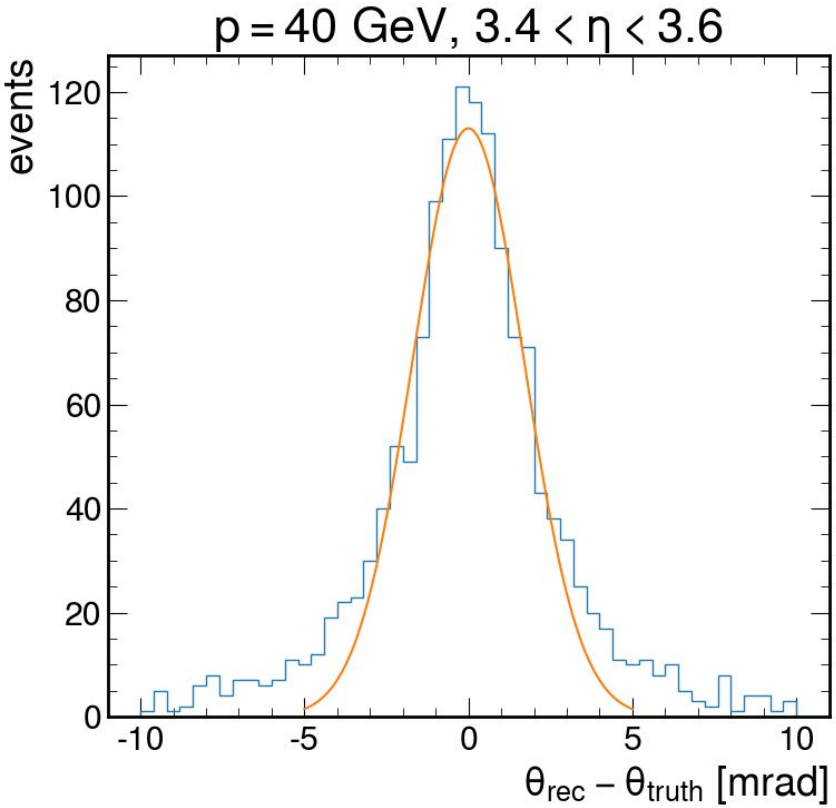
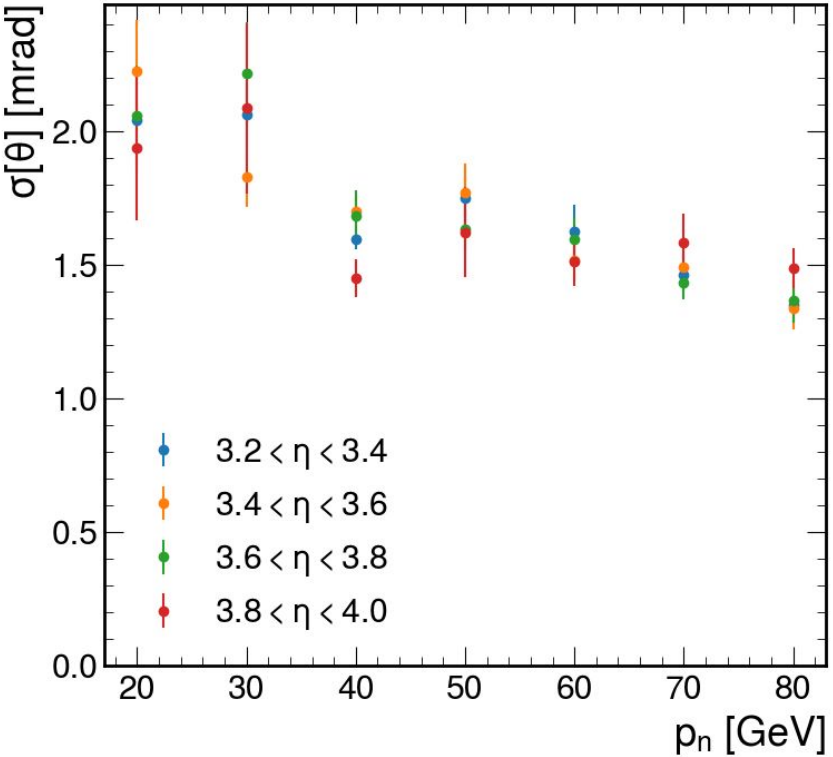
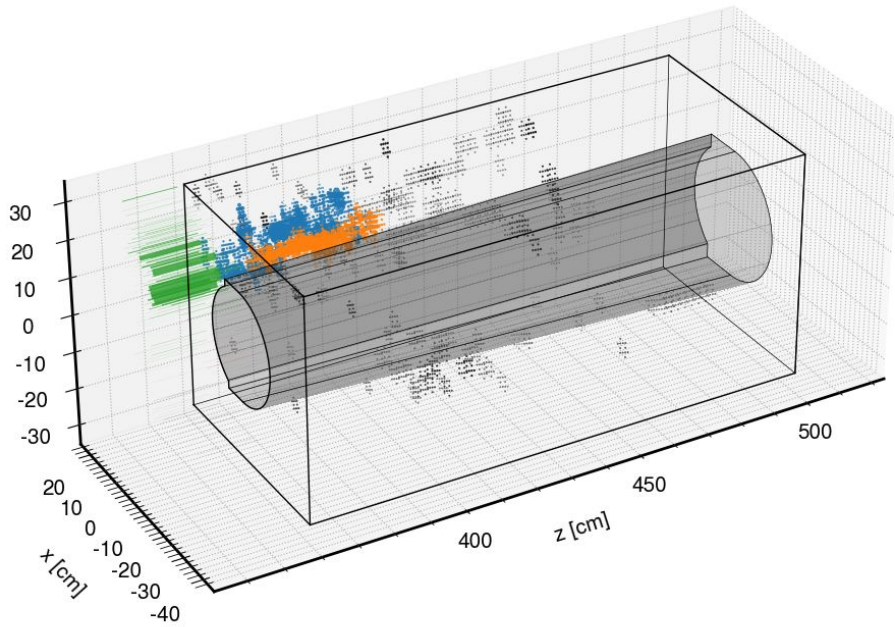
Neutron benchmark (continued)





In progress: τ benchmark as proxy for jets

- Simulate τ with $3.0<\eta<4.0$
- Allow them to decay in dd4hep
  - ~65% of τ decays are hadronic
  - In analysis, only select events with no muons nor electrons
- Truth “hadronic final state” four momentum, $p_{hfs}=p_{\tau}-p_{\nu\tau}$
  - Further require $m_{hfs}>m_{\pi\pm}$ to ensure that there is more than one hadron in the jet



https://github.com/eic/detector_benchmarks/tree/insert_tau

Summary and conclusions

Detector benchmarks have been added for the insert and FEMC for several particle types:

- Muons:
  - Acceptance
  - MIP energy scale
- Electrons (in progress)
  - Energy scale
  - Clustering in FEMC
- Neutrons:
  - Energy and angle resolution
- Tau (in progress)
  - Source for jets in insert through hadronic decay channel