Muon reconstruction and updates

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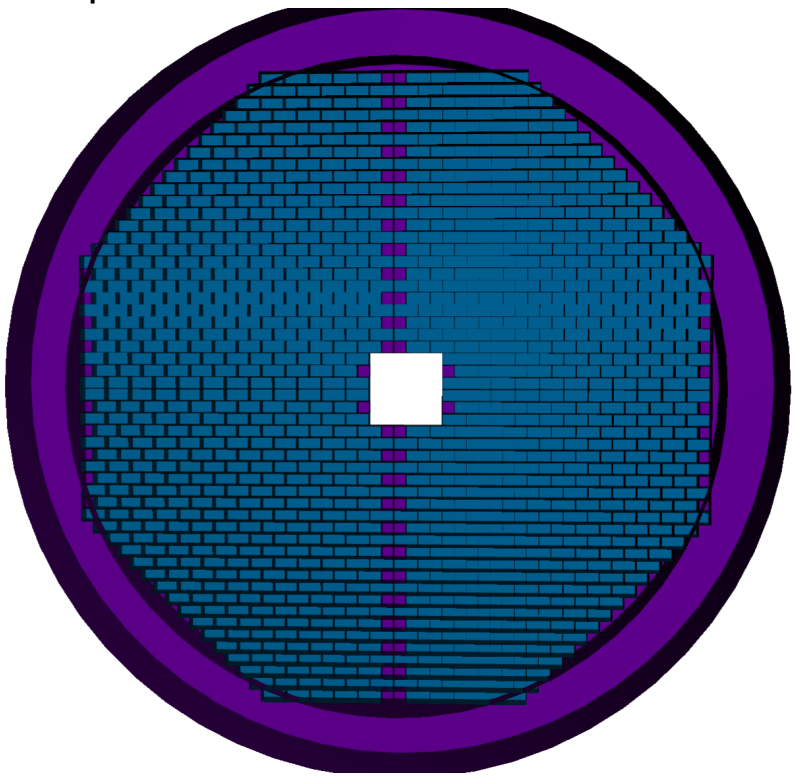
THE OHIO STATE UNIVERSITY

Outline

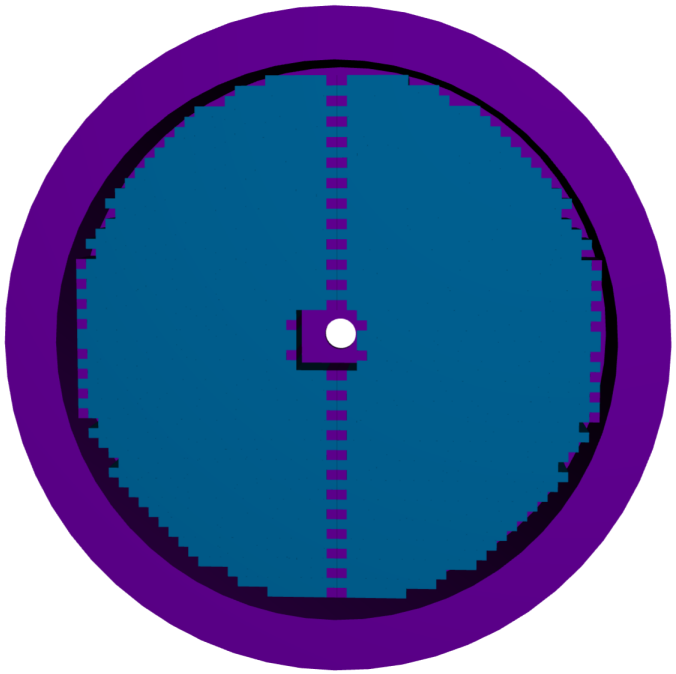
1. Updates
2. Di-muon reconstruction

Updates - geometry

overlaps

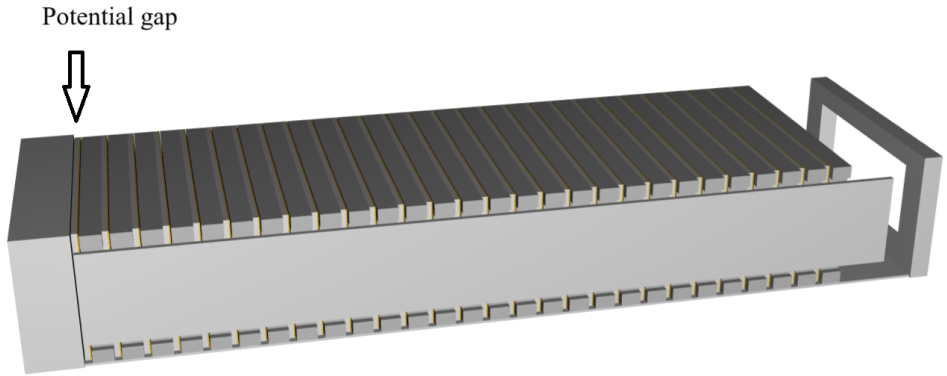


no overlaps



- Removed modules overlapping with the collar
- Proper numbering of layers eg. increasing in negative z direction
- Implemented here: `https://github.com/eic/epic/tree/nHCal-dev-update`
- Need to separate nHCal and LFHCAL constructors

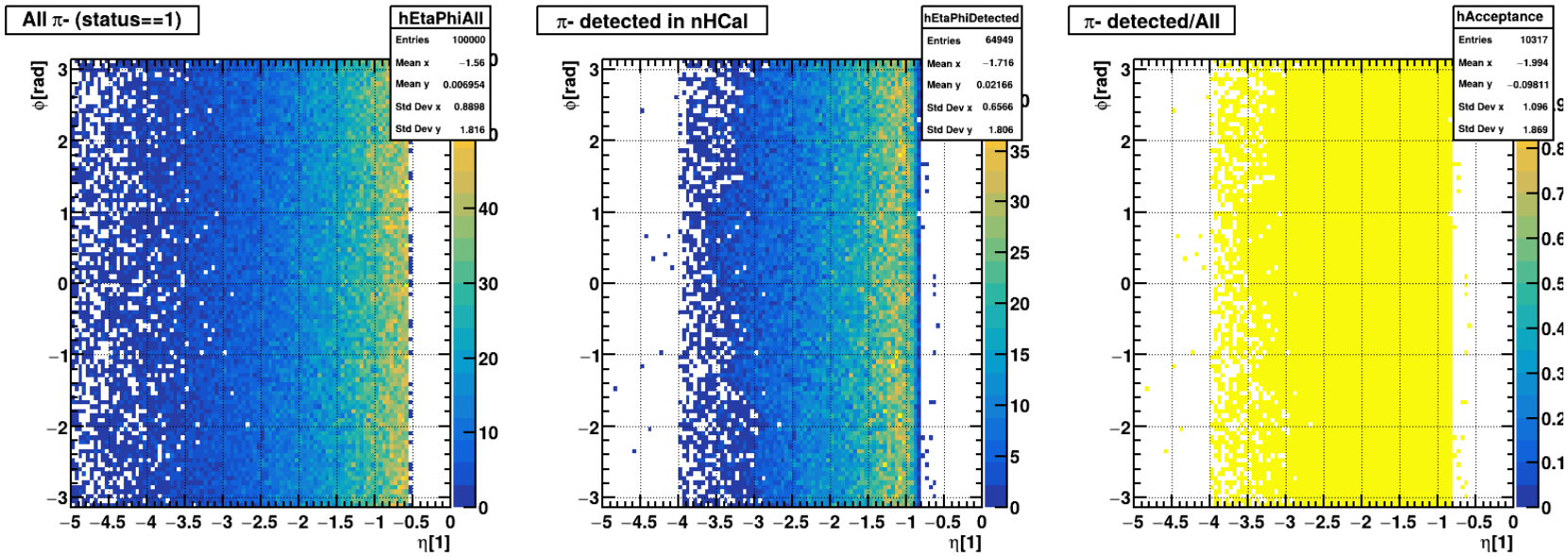
Acceptance of LFHCAL-type geometry



- Need to adjust colors
- There may be a very small gap in the back between last layer and "'front"'(actually back) and mounting plates

Acceptance of LFHCAL-type geometry

$1\,\mathrm{GeV}\ \pi^-$



- Above plots with no insert taken directly from acceptance benchmark!
- `https://eicweb.phy.anl.gov/EIC/benchmarks/detector_benchmarks/-/jobs/6421134`
- No insert acceptance $-4.0 < \eta < -0.8$ (69 cm)
  - Changes to $-4.0 < \eta < -0.9$ for π^- with $p > 5\ \mathrm{GeV/c}$ (more boosted shower?)
  - A bit patchy between $-4.0 < \eta < -3.0$ due to modules around beampipe
  - May need to add a few extra modules to remedy this
- Old geometry $-4.16 < \eta < -1.16$ (45 cm)

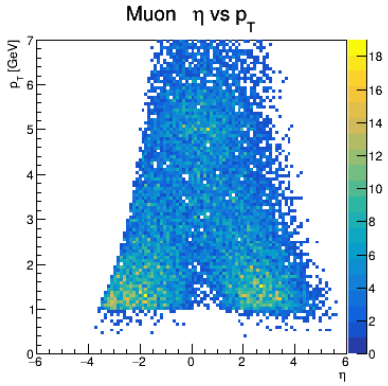
Di-muon reconstruction - PYTHIA simulation

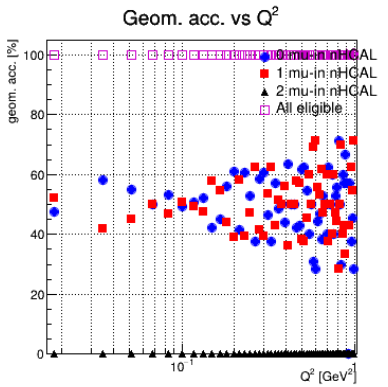
- $e + p$ collisions at $18 \times 275\ \mathrm{GeV}$
- Repository here: `https://github.com/lkosarz/dimuonPythia`

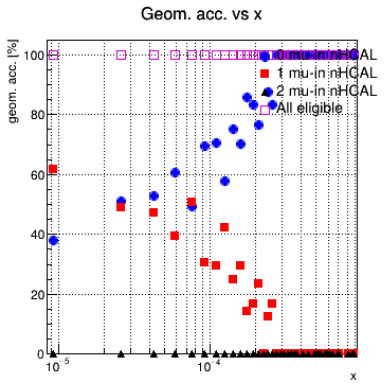
Listing: Simulation settings

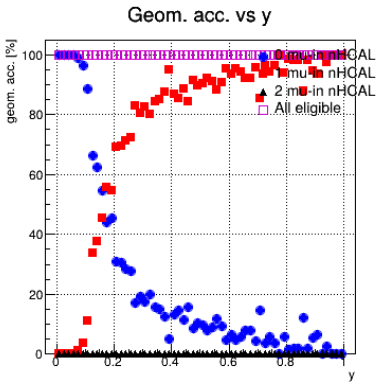
```
# Enable equivalent photon approximation (EPA) for both beams
Photon:Q2Max = 1.0  ! Upper Q^2 limit for EPA photons (in GeV^2)
Photon:ProcessType = 4 ! 4 = direct-direct photons
#Photon:EPA = on

PDF:beamA2gamma = on ! EPA photon flux from beam A
PDF:beamB2gamma = on ! EPA photon flux from beam B

# Enable gamma-gamma -> mu+ -mu
PhotonCollision:gmgm2mumu = on

# Optional: Turn off other QED or QCD backgrounds if you want exclusivity
PartonLevel:ISR = off
PartonLevel:FSR = off
HadronLevel:all = off
```

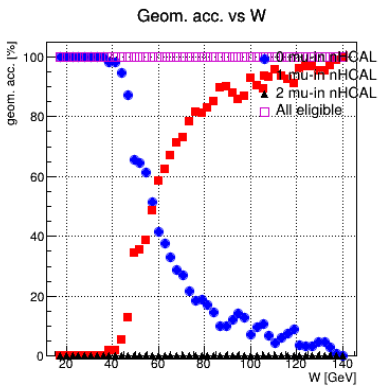
Di-muon reconstruction

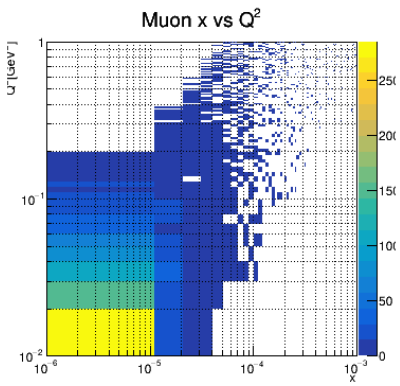


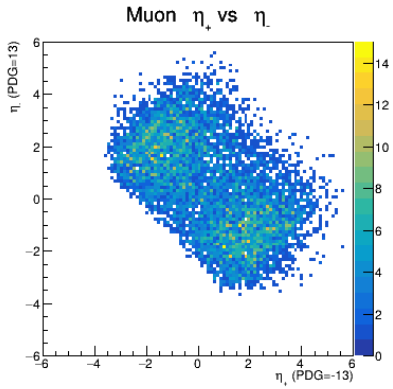






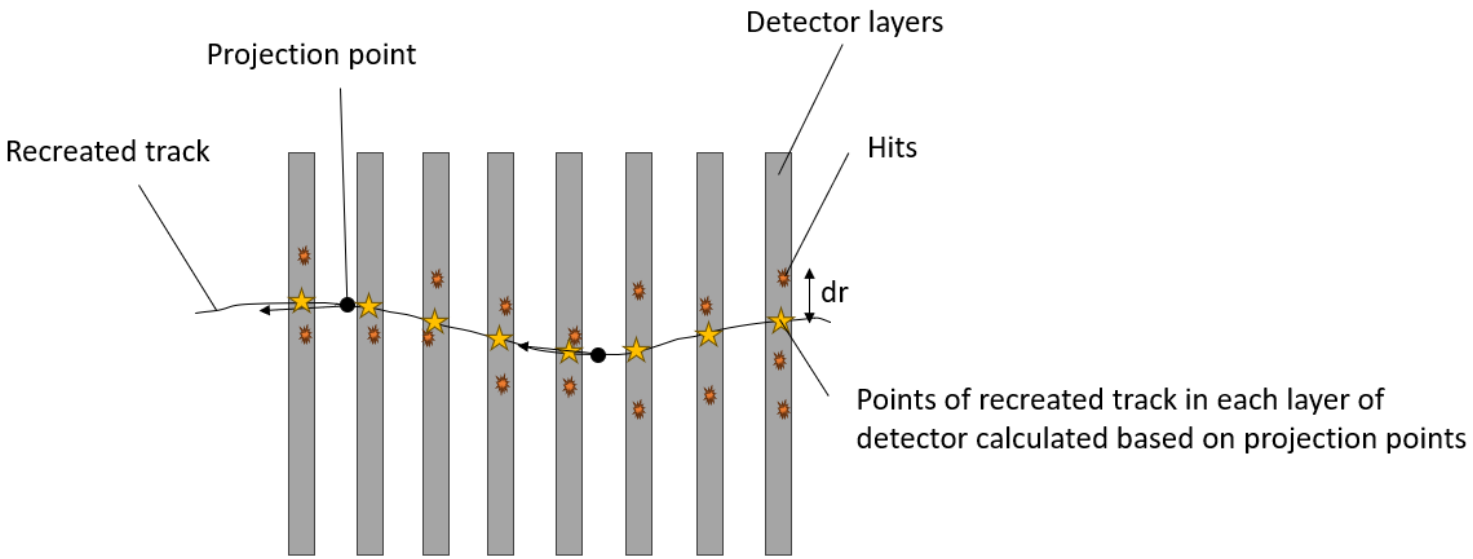






- Reconstructed kinematics for photoproduced-dimuon events
- At most a single muon in nHCal acceptance
- nHCal still needed to get 2× the statistics

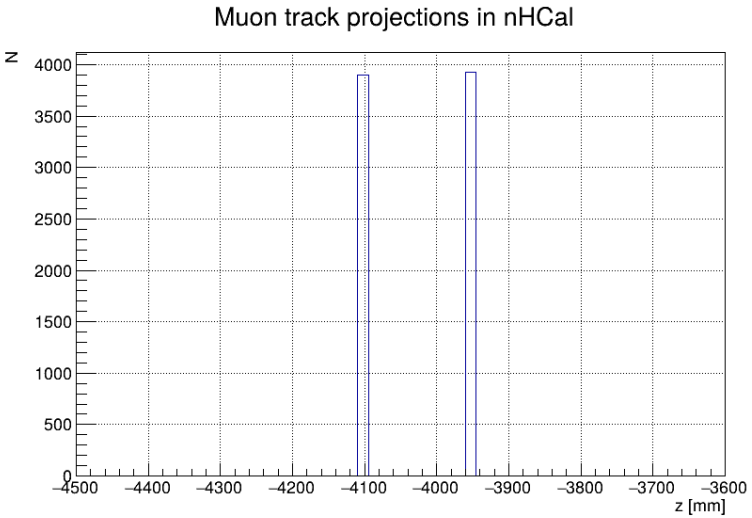
Di-muon reconstruction

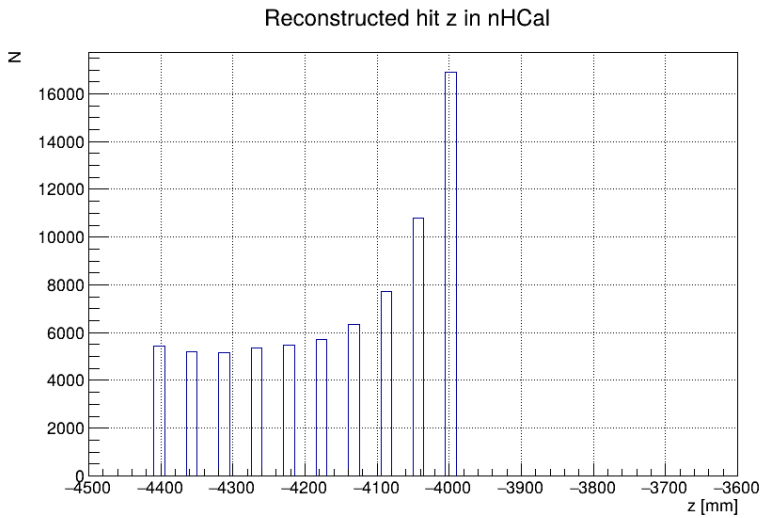


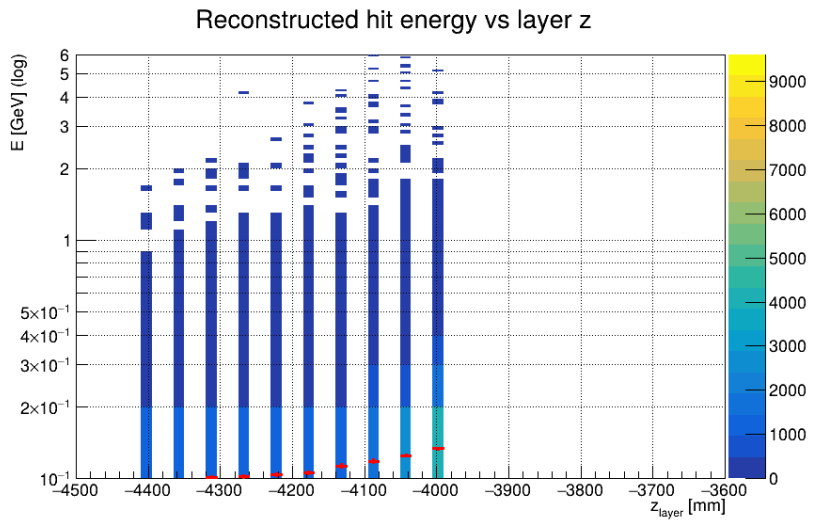
Algorithm: Using the points and moments from the projection, the X and Y values for the hit's Z coordinate are geometrically calculated. Next, the distance dr between the recreated point and the hits is calculated. We are looking for the shortest distance and if dr < 10 cm, the recreated point and the hit is matched. The entire path is not calculated because only the part of the points that are in the same layer as the hits are needed.

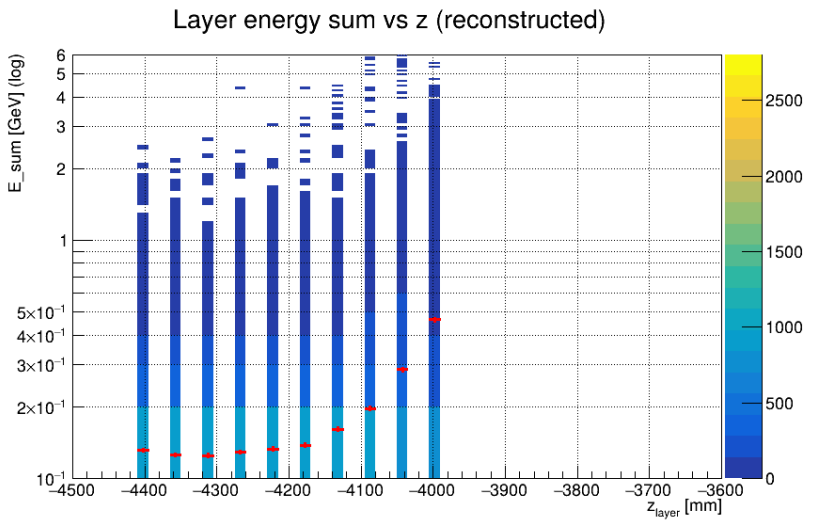
- Used 2 projection points and their momenta to determine the trajectory in nHCal
- First projection on the surface at $-395\mathrm{cm}$
- Second projection in the nHCal at $-410\mathrm{cm}$
- Work in progress

Di-muon reconstruction

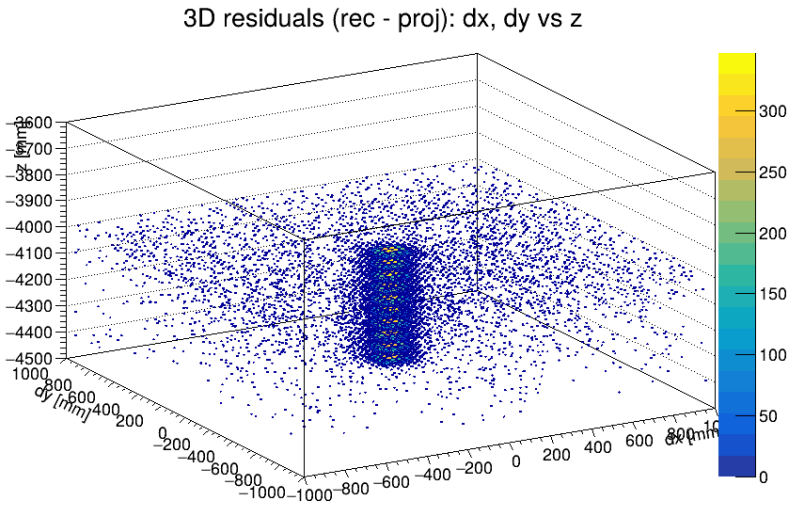


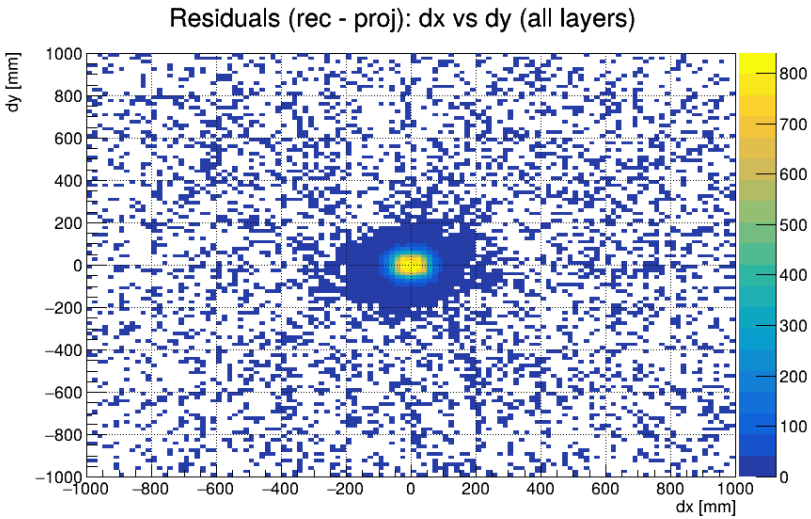


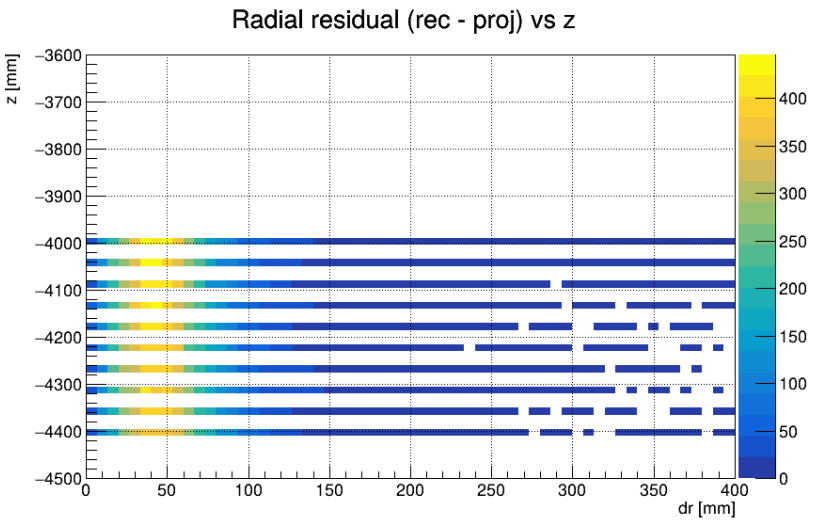


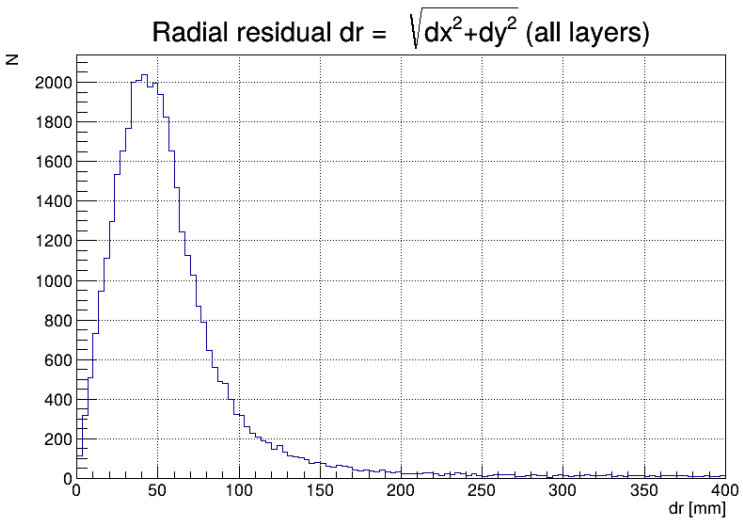


Di-muon reconstruction

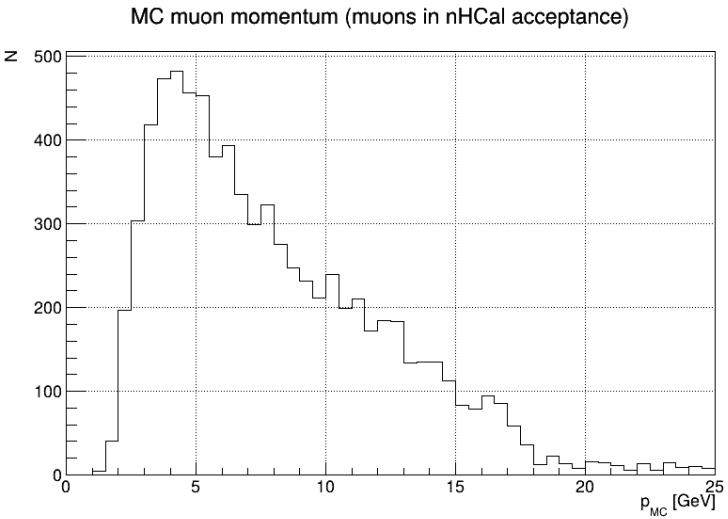


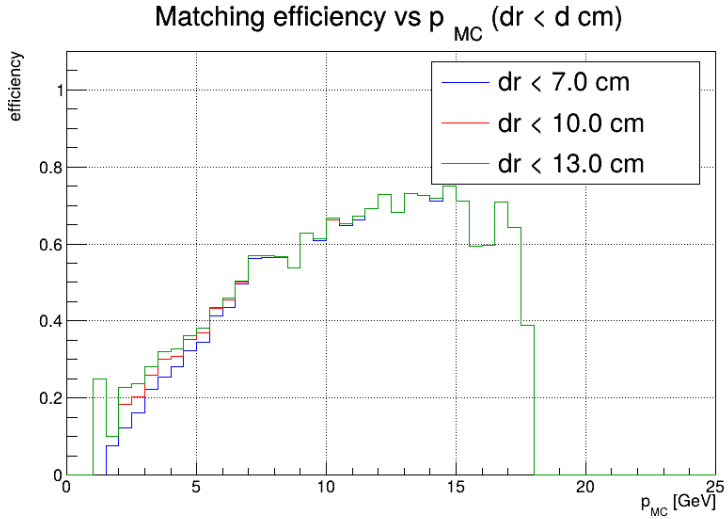


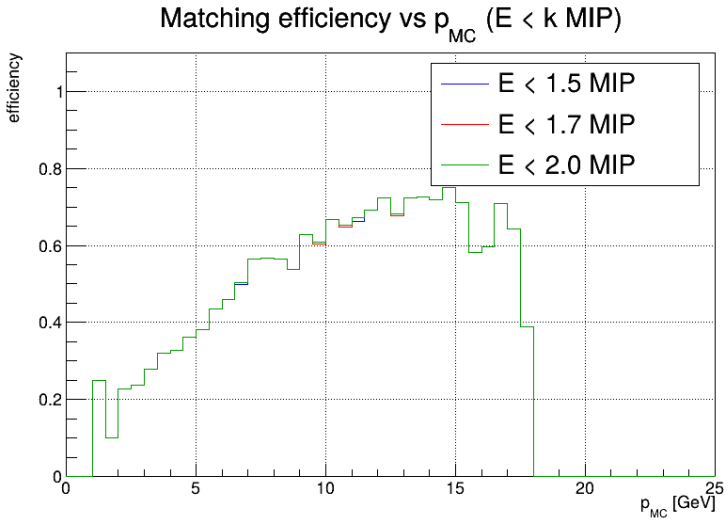




Di-muon reconstruction efficiency







- Looks to small because of a few issues
- Double counting of muons in the denominator
- Muon counted as reconstructed if at least 1 hit passess the cuts instead of eg. 50 – 80% of hits

Summary

- Updated geometry
- Benchmarks provide automatic acceptance checks etc.
- First look at muon reconstruction in photoproduced dimuon events

BACKUP