# ePIC HCal Update

## ePIC Calorimetry Meeting

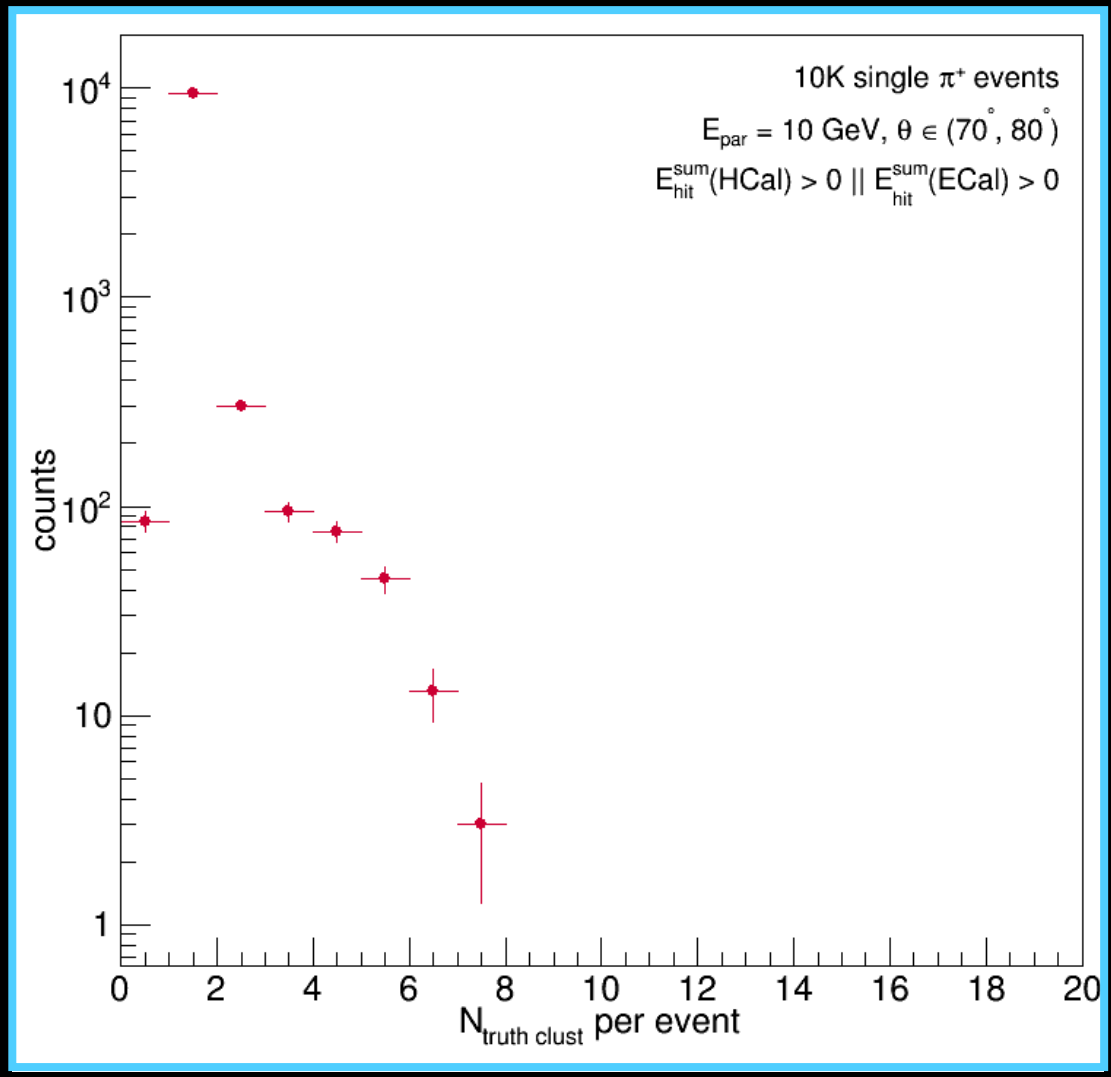
December 8th, 2022

Derek Anderson

# ePIC HCal Update | looking into the HCal response

- Working on better understanding response of current HCal implementation

- Noticed tiny number of events have more than 1 truth cluster per event
  - ∴ **Following plots split events into 2 categories:**
    a) No. of truth clusters == 1
    b) No. of truth cluster >= 2
  - Included distributions from Barrel ECal (SciGlass) as well

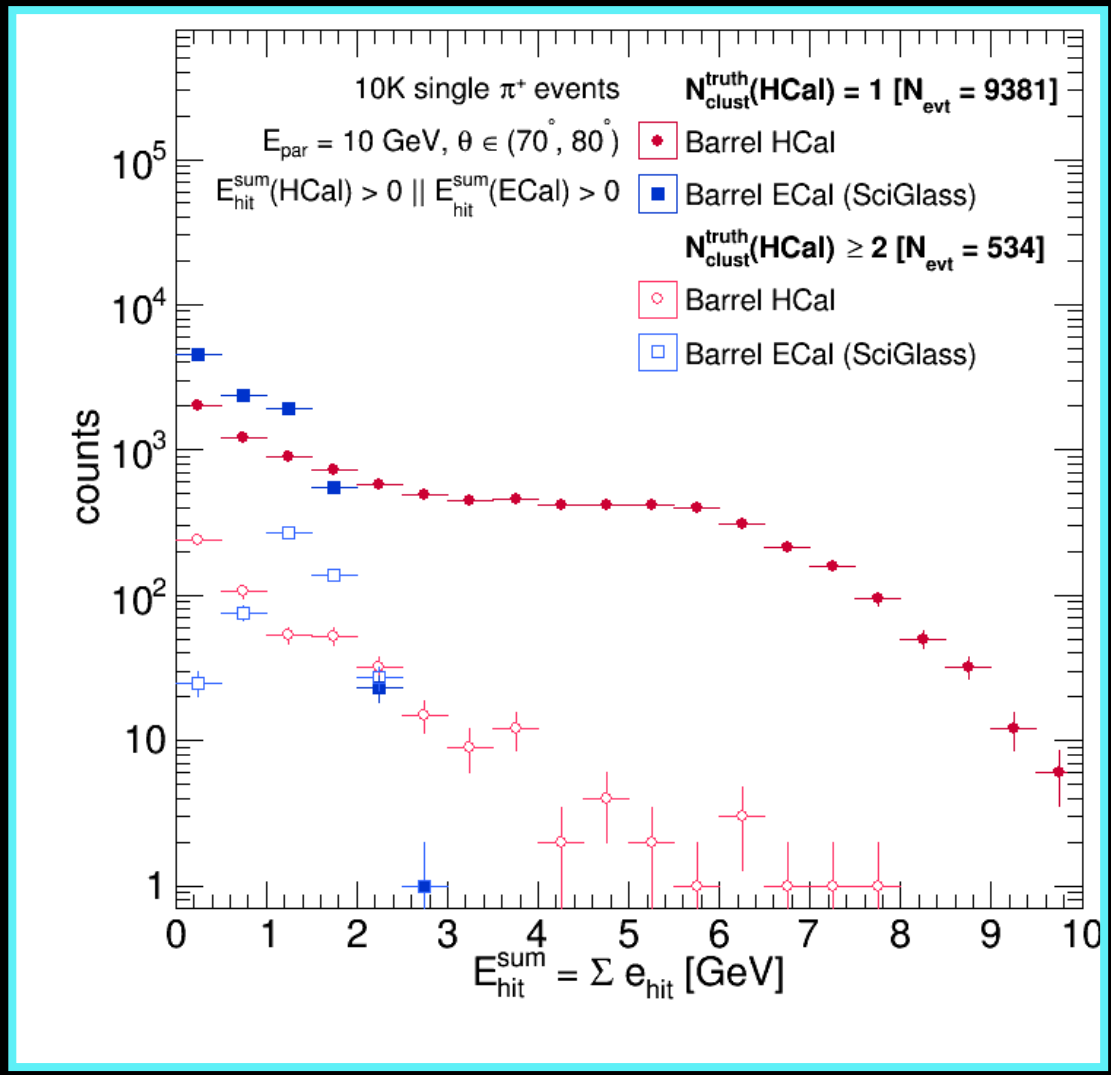


# ePIC HCal Update | sum of hit energies

- Sum of reconstructed hit energies:
  - ☞ Not unreasonable for 10 GeV $\pi^+$…

- **Solid Markers:**
  - ⇒ No. of truth HCal clusters == 1
- **Open Markers:**
  - ⇒ No. of truth HCal clusters >= 2

- **Red Markers:**
  - ⇒ Barrel HCal
- **Blue Markers:**
  - ⇒ Barrel ECal (SciGlass)

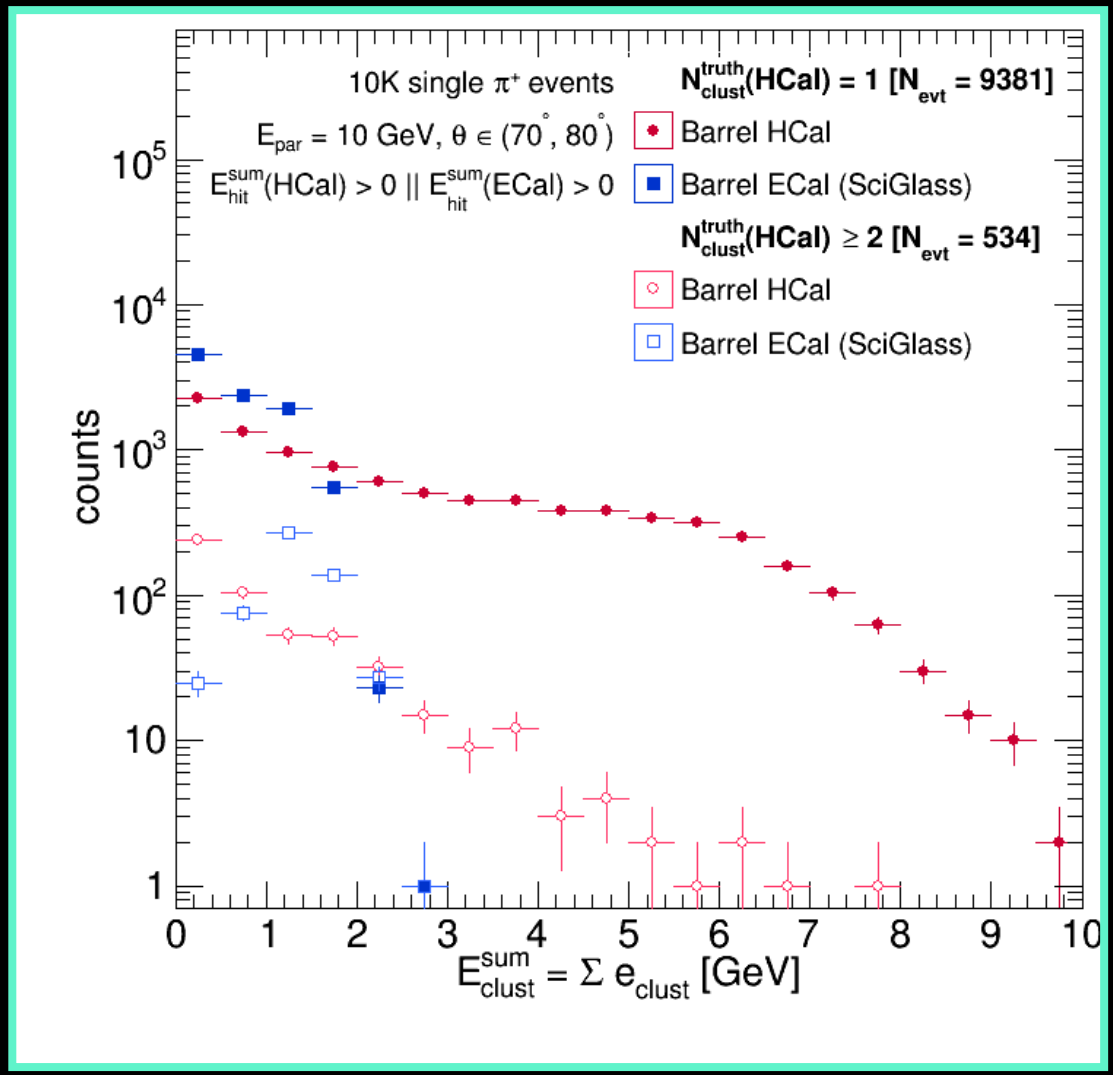


# ePIC HCal Update | sum of cluster energies

- Sum of reconstructed cluster energies:
  - ☞ Looks suspiciously close to the summed hit energies…

- **Solid Markers:**
  - ⇒ No. of truth HCal clusters == 1
- **Open Markers:**
  - ⇒ No. of truth HCal clusters >= 2

- **Red Markers:**
  - ⇒ Barrel HCal
- **Blue Markers:**
  - ⇒ Barrel ECal (SciGlass)

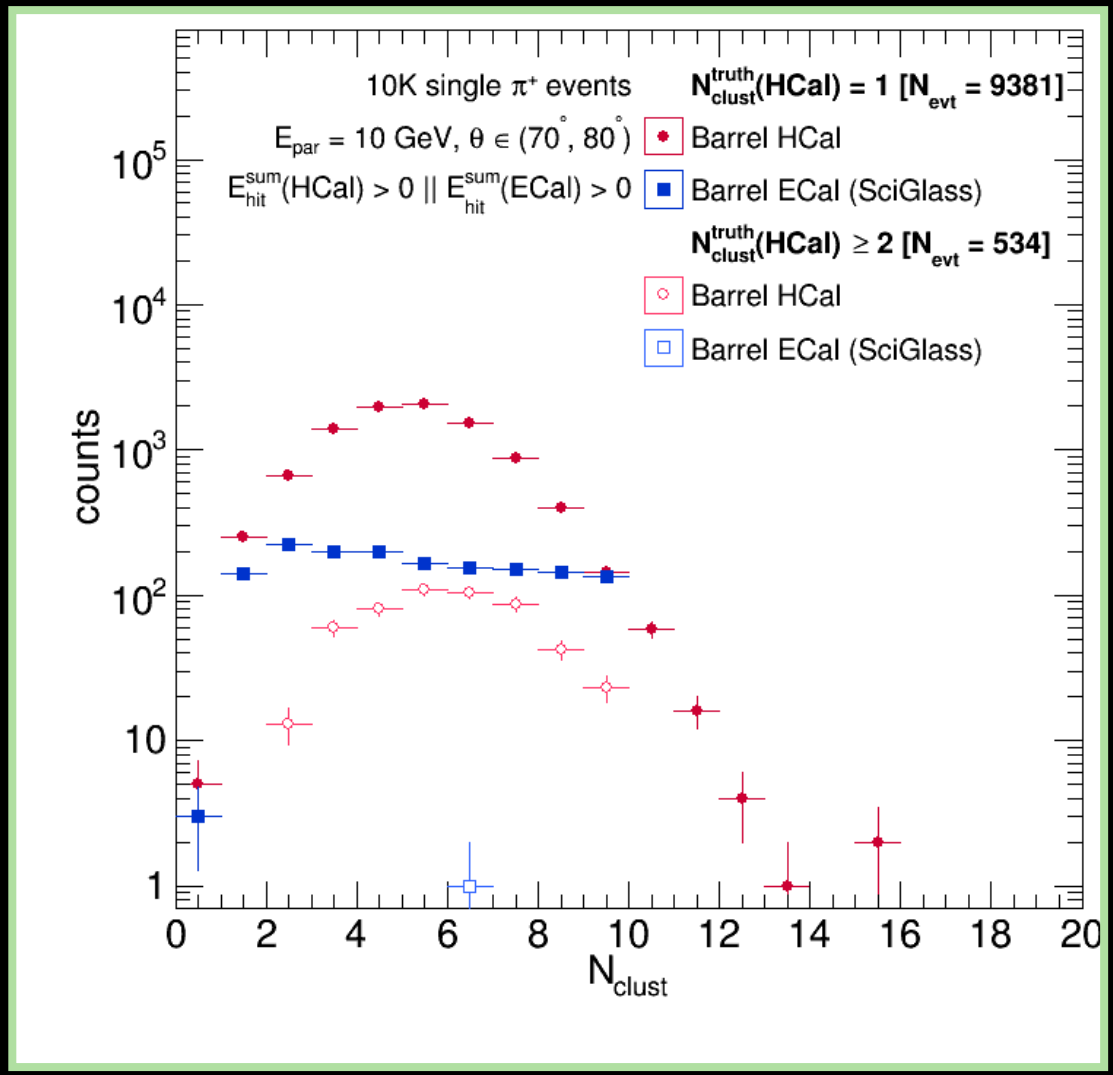


# ePIC HCal Update | number of clusters per event

- Number of reconstructed clusters per event:
  - ☞ Very high for a single $\pi^+$!

- **Solid Markers:**
  - ⇒ No. of truth HCal clusters == 1
- **Open Markers:**
  - ⇒ No. of truth HCal clusters >= 2

- **Red Markers:**
  - ⇒ Barrel HCal
- **Blue Markers:**
  - ⇒ Barrel ECal (SciGlass)



# ePIC HCal Update | take-aways/next steps

- **Take-Aways:**
  - At the very least, **clustering needs to be tuned**

- **Next Steps:**
  - Carry out more thorough study of clustering parameters
  - Begin looking at Simulation Campaign output…

# Backup

# Backup | simulation parameters

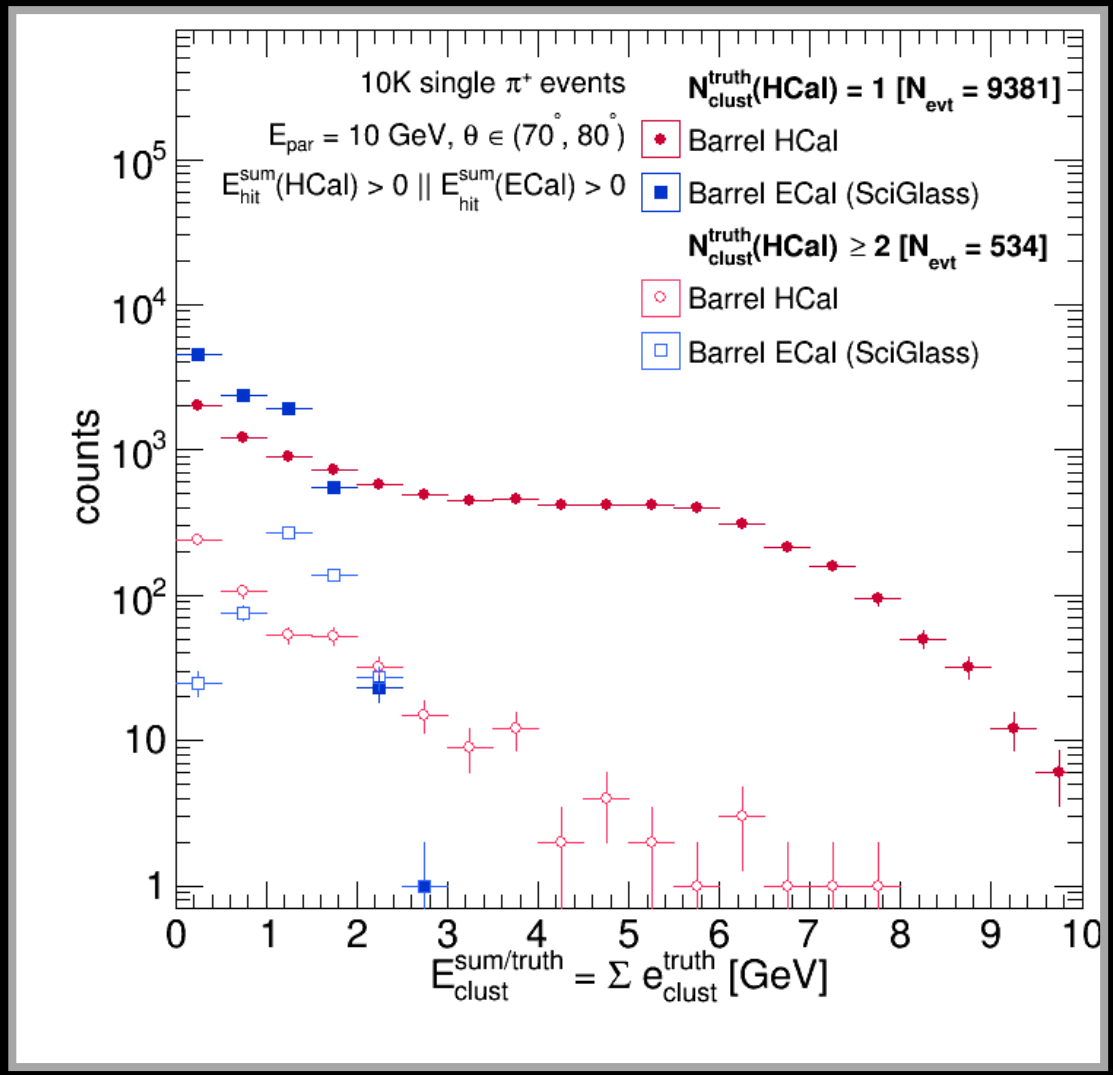
**Simulation Parameters**

- gun.energy = 10*GeV
- gun.particle = "pi+"
- gun.distribution = "cos(theta)"
- gun.thetaMin = 70*degree [$\eta \sim 0.35$]
- gun.thetaMax = 80*degree [$\eta \sim 0.18$]
- **22.11.2 Geometry**

# Backup | sum of truth cluster energies

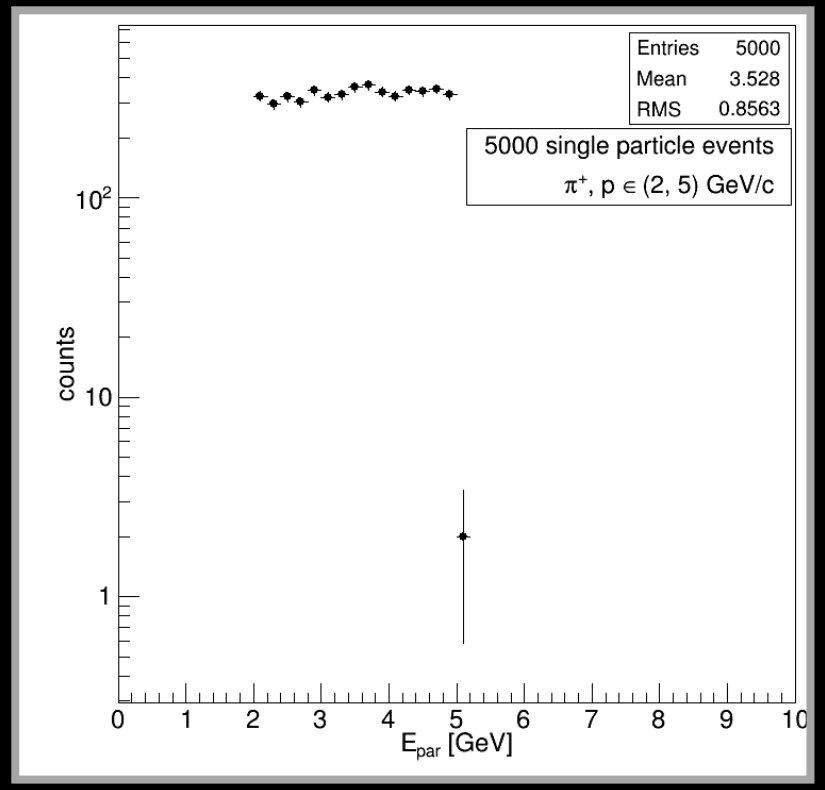
- **Solid Markers:**
  - ⇒ No. of truth HCal clusters == 1
- **Open Markers:**
  - ⇒ No. of truth HCal clusters >= 2

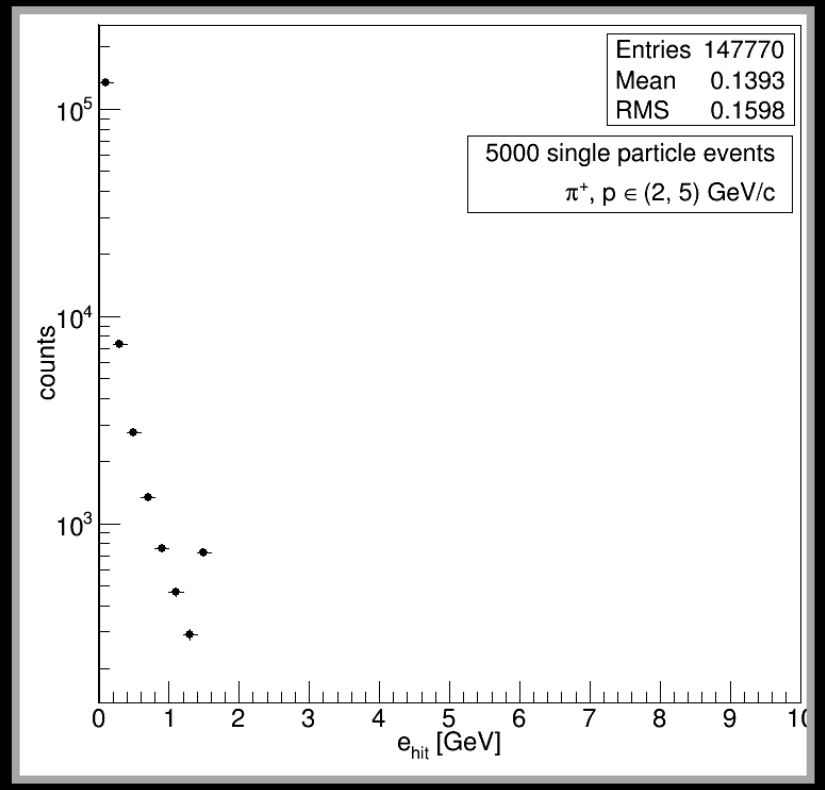
- **Red Markers:**
  - ⇒ Barrel HCal
- **Blue Markers:**
  - ⇒ Barrel ECal (SciGlass)

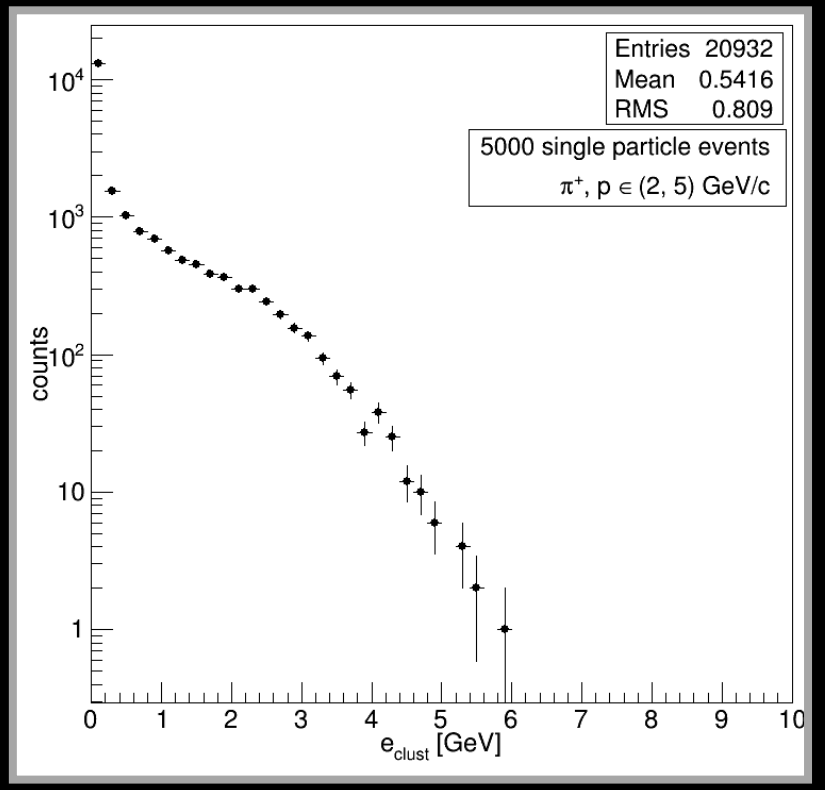


# Previous Slides

# ePIC HCal Update | energy spectra



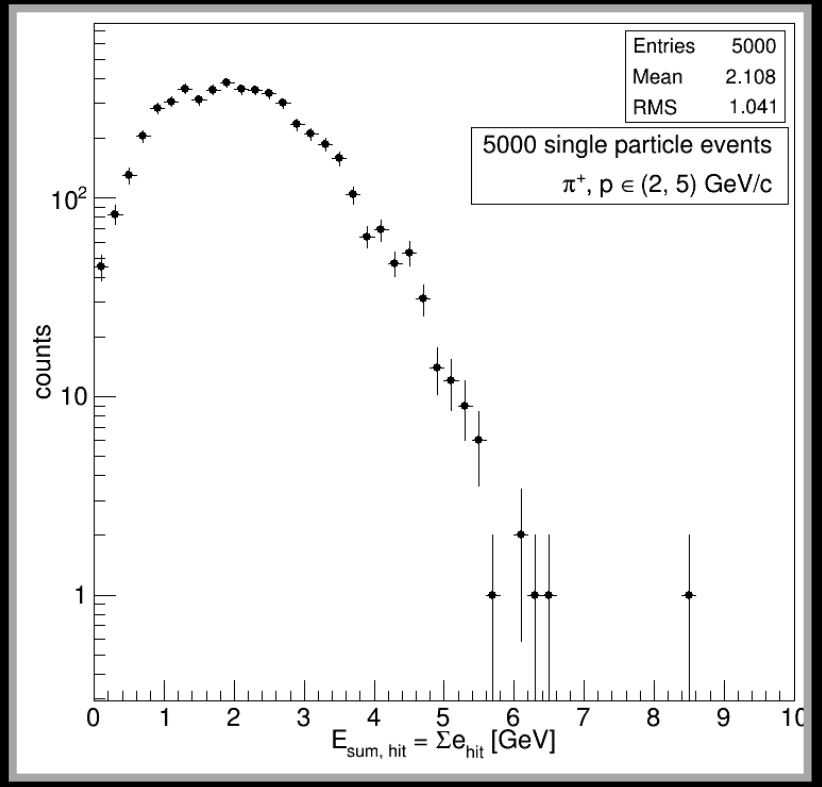

MC Particles

Reconstructed Hits

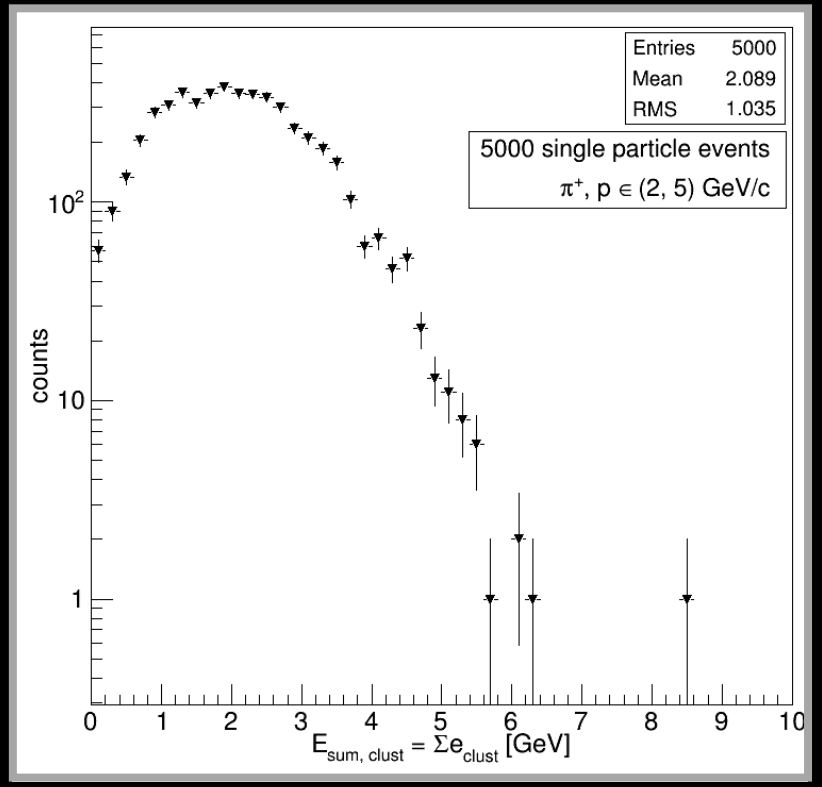
Clusters

# ePIC HCal Update | sum of hit/cluster energy

- Summed hit **(right)** and cluster **(left)** energies to compare against particle energy



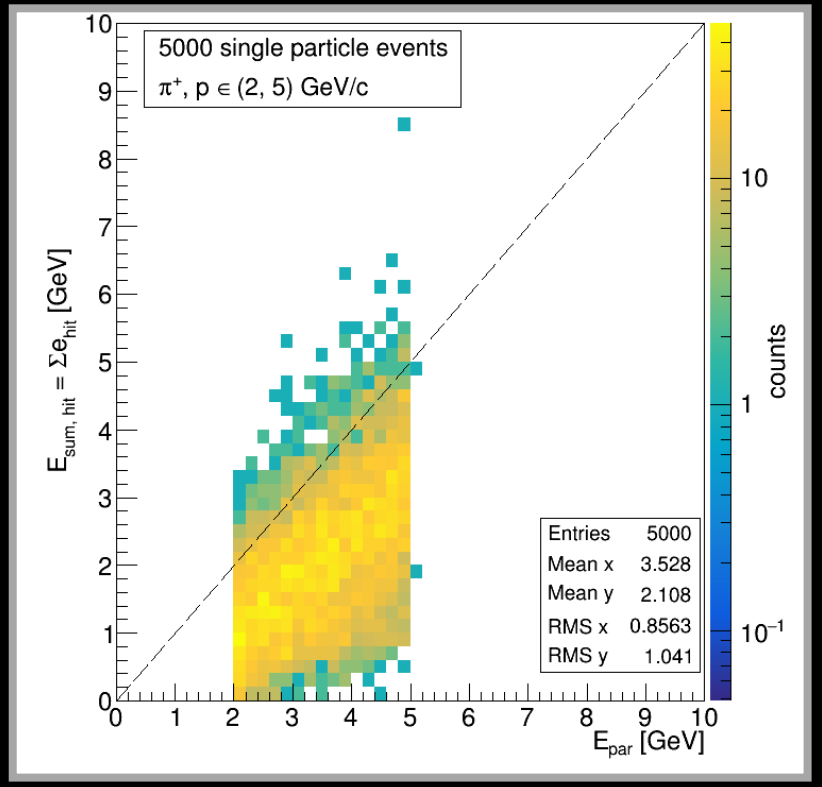

Reconstructed Hits



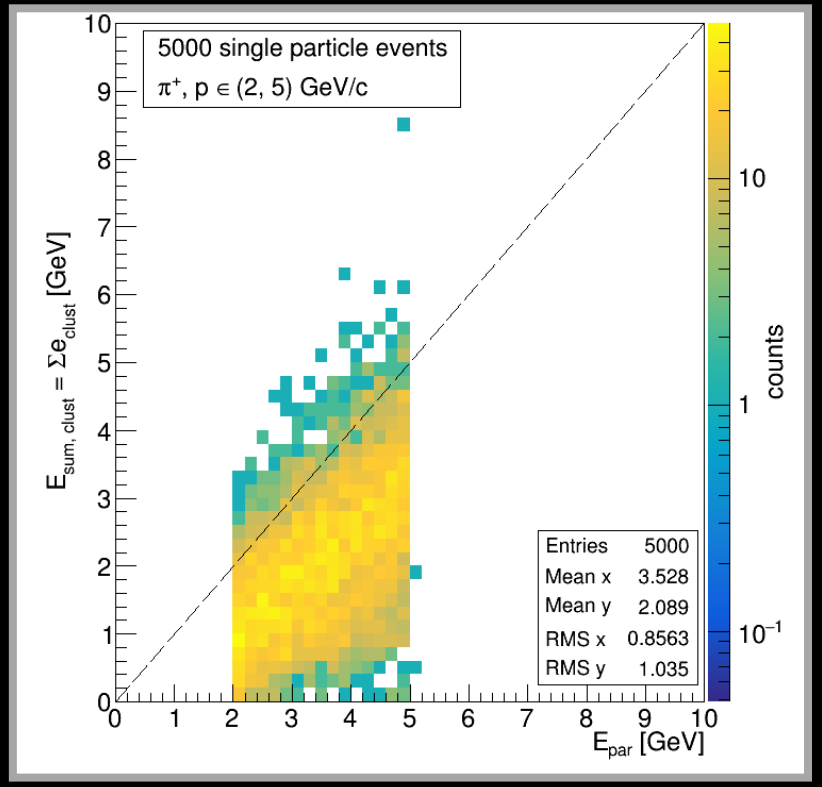

Clusters

# ePIC HCal Update | sum of hit/cluster energy vs. particle energy

- 2D distribution of particle **(x axis)** vs. summed hit/cluster energy **(y axis)**




Reconstructed Hits

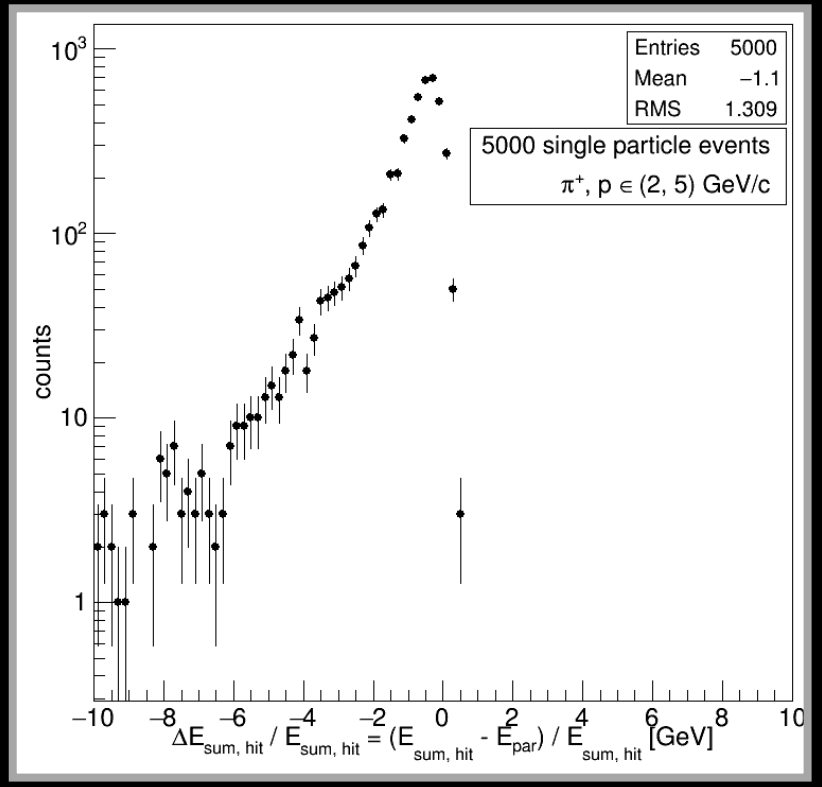



Clusters

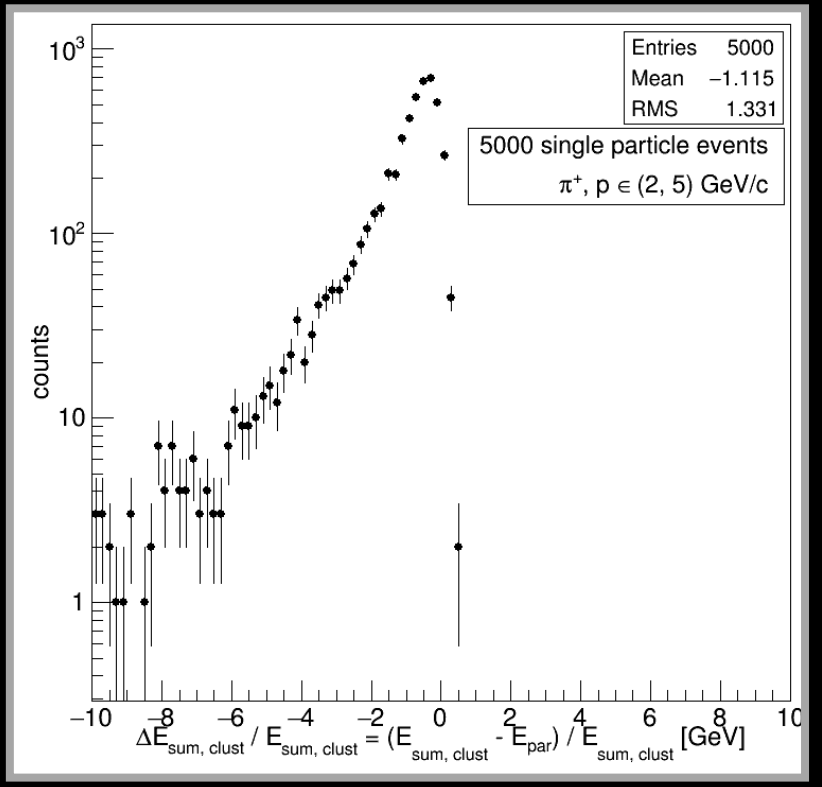
# ePIC HCal Update | sum of hit/cluster energy vs. particle energy

- Difference between summed hit/cluster energy and particle energy:

$$\frac{E_{sum,clust/hit} - E_{par}}{E_{sum,clust/hit}}$$

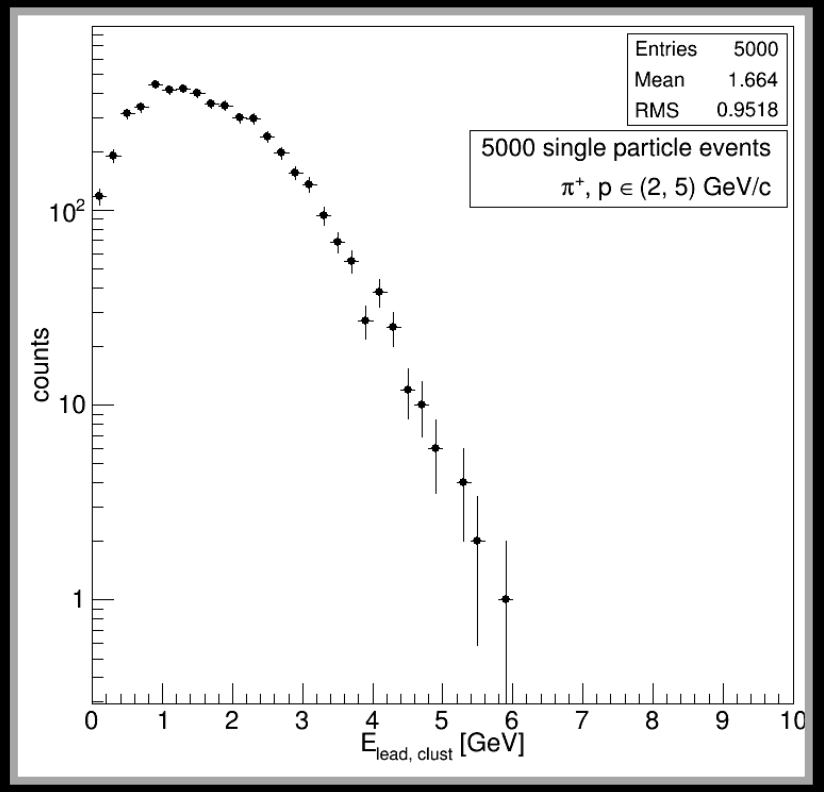


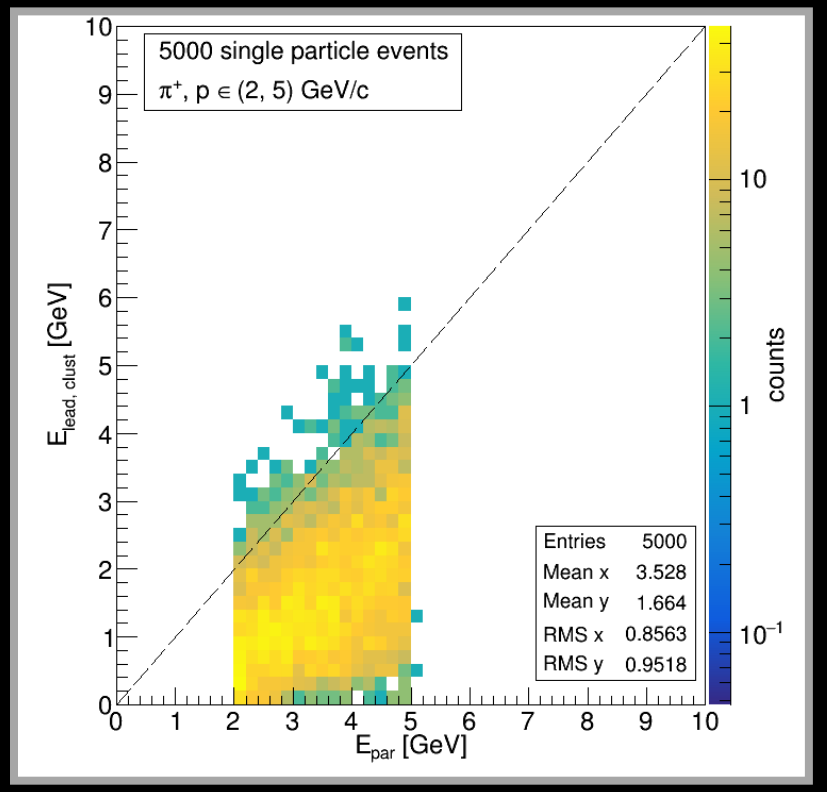

Reconstructed Hits

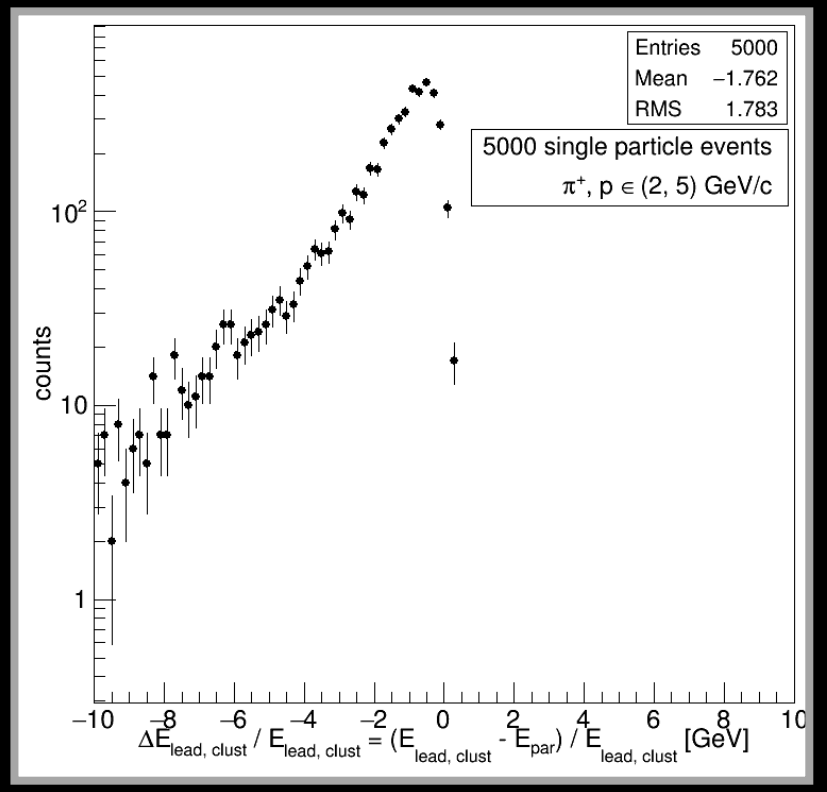



Clusters

# ePIC HCal Update | lead cluster vs. particles



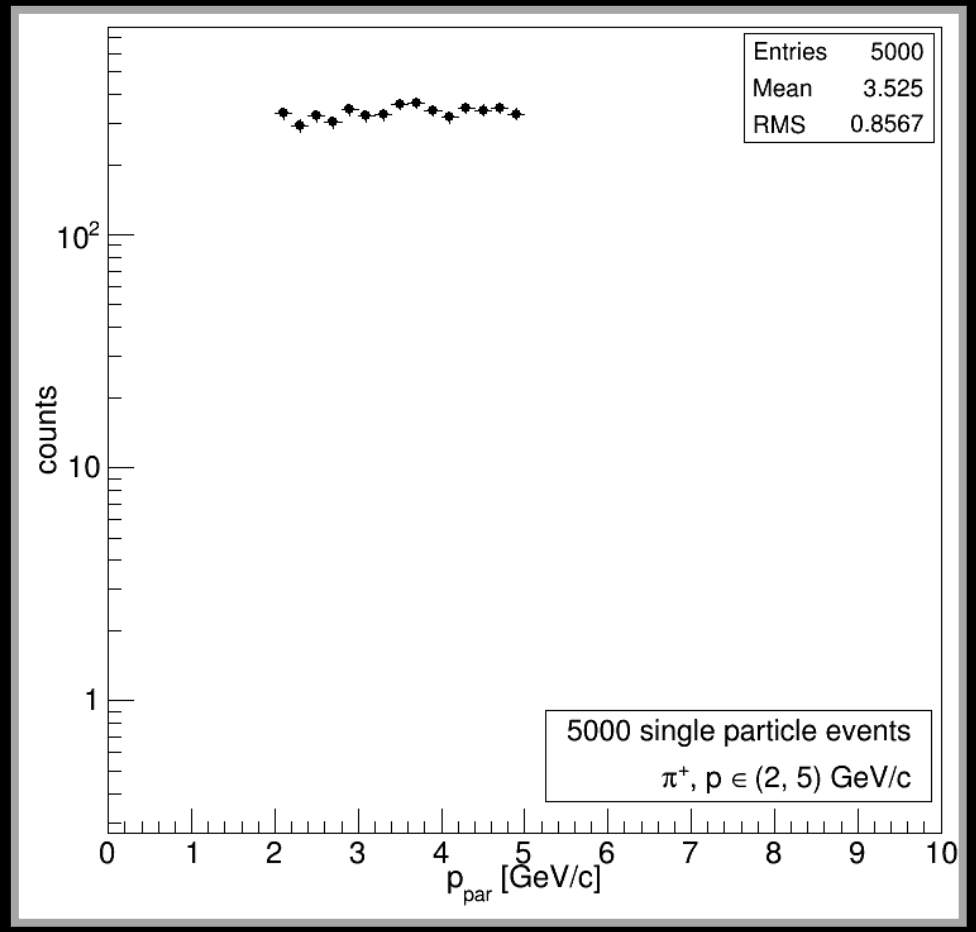

- Compared lead **(highest energy)** cluster against particle

# ePIC HCal Update | take-aways and next steps

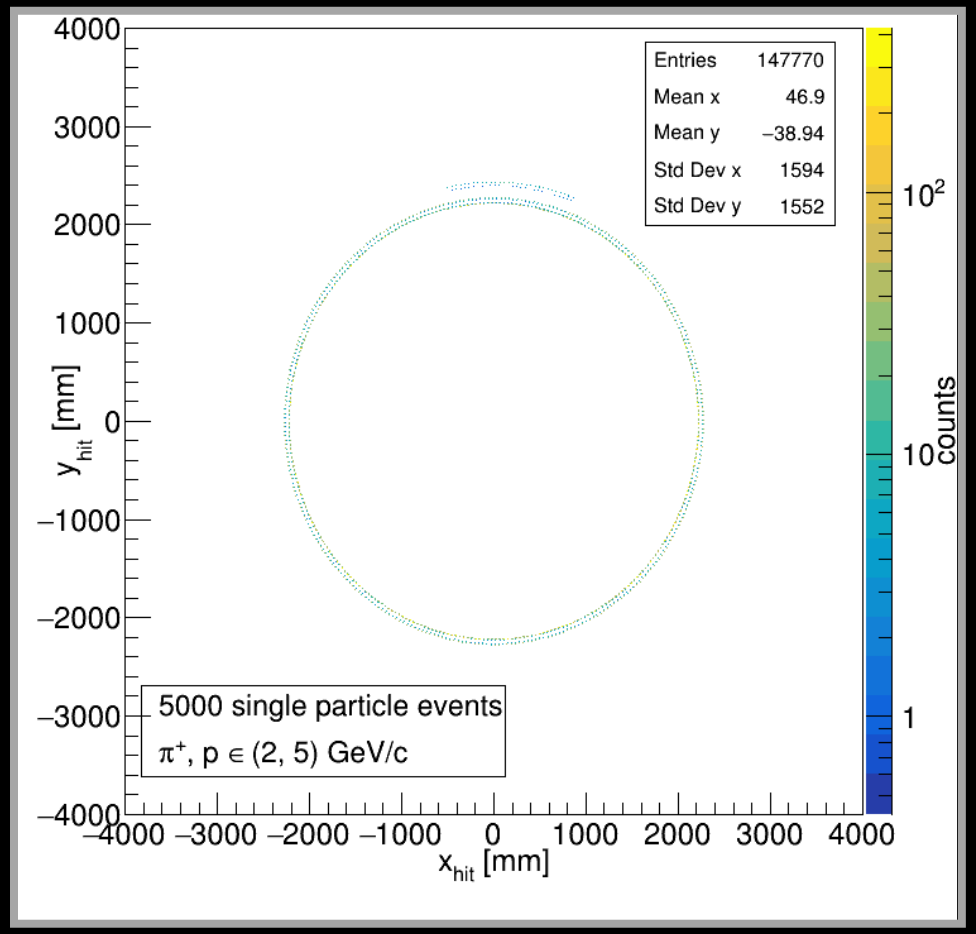
- **Take-aways:**
  - Hits look reasonable
  - Sum of hit/cluster energies get close to particle energy
  - ⇒ Current implementation will work for this simulation campaign

- **Next steps:**
  - Implement calculation of energy resolution
  - Analyze official single-particle files

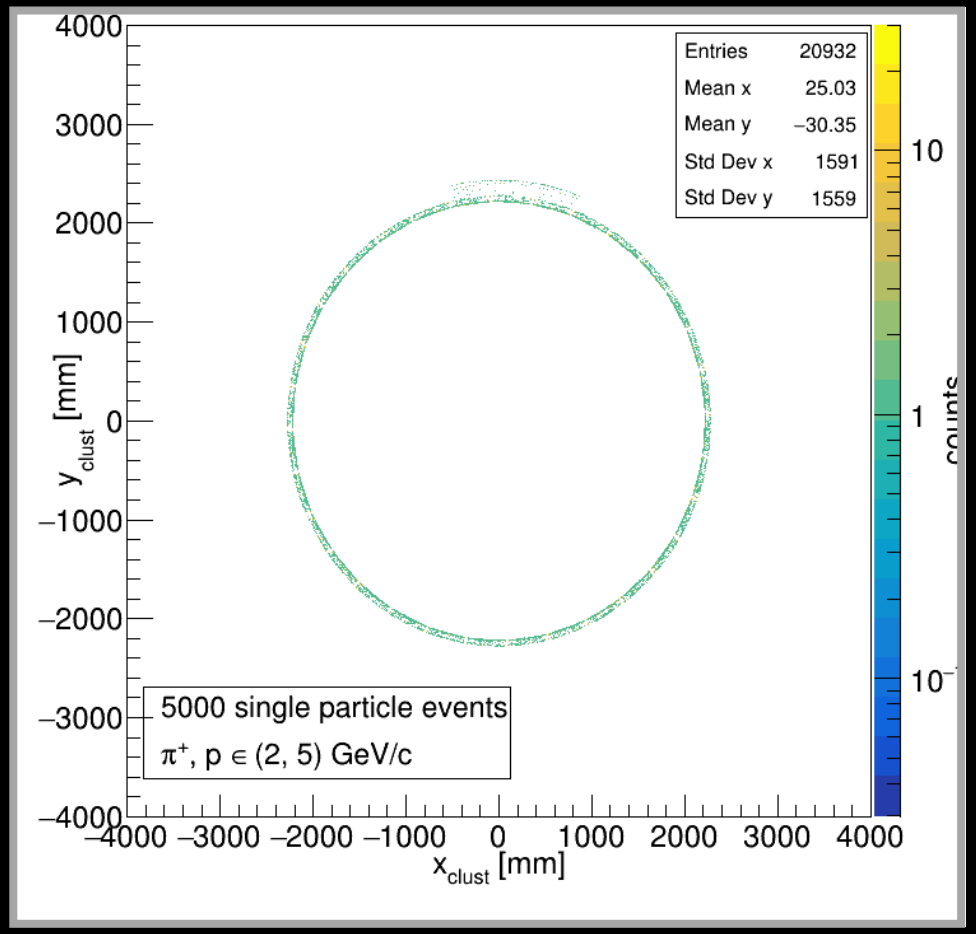
# Backup | particle momentum



# Backup | hit/cluster Y vs. X




Reconstructed Hits




Clusters