



# Charged Pion Identification

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MAIA Detector Tau Studies

September 25, 2025

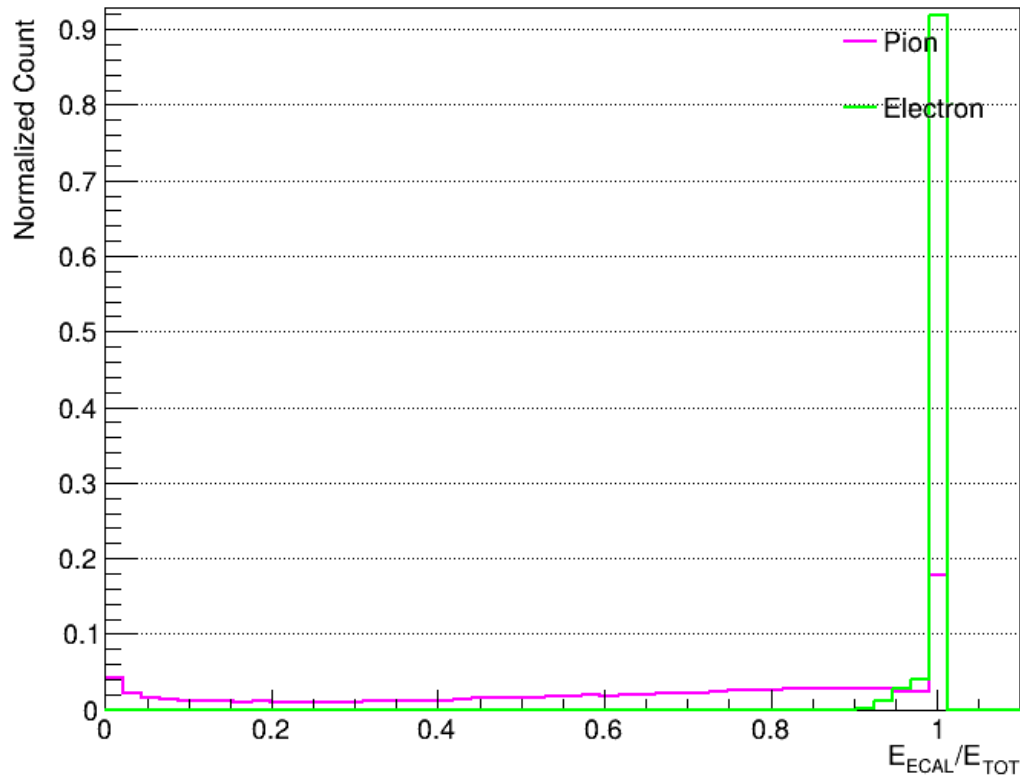
# Overview

- Motivation
- Comparing Electrons & Charged Pions
- Conclusions & Next Steps

# Motivation

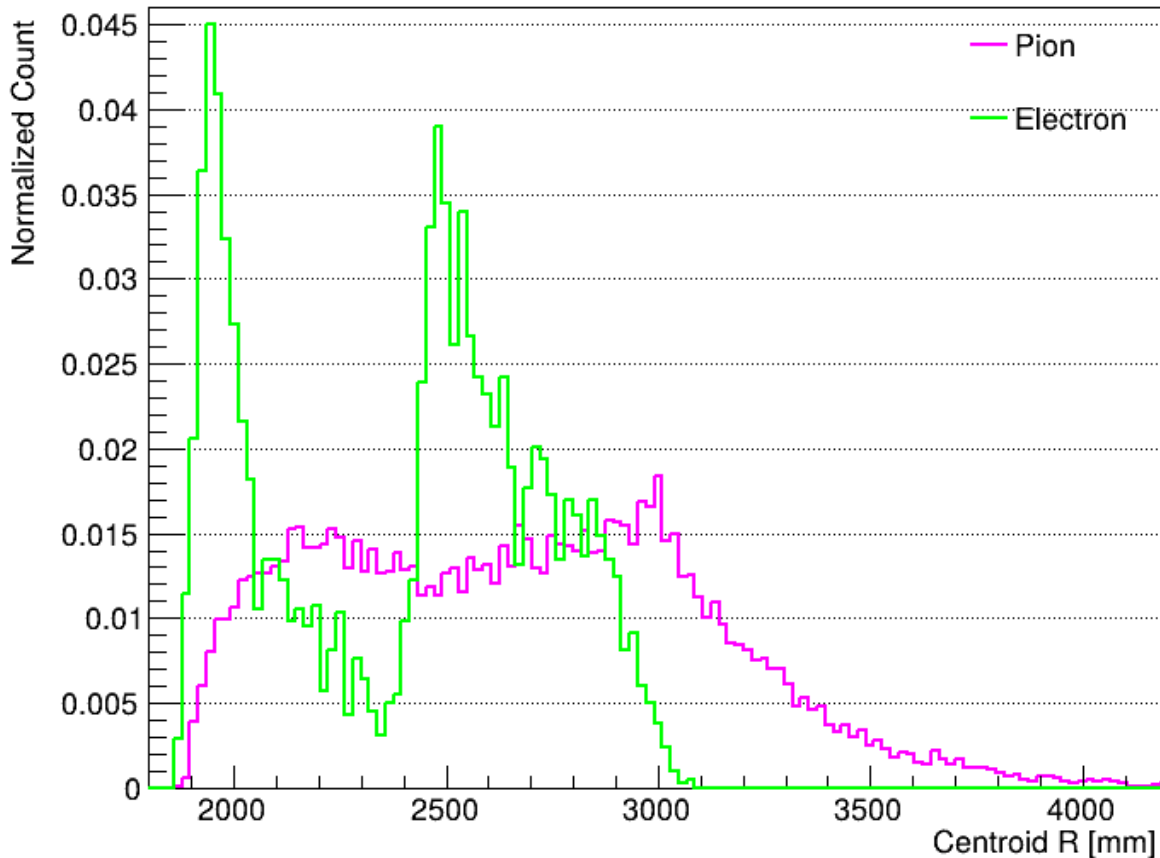
- [Electron studies](#) by Jullian Watts (University of Tennessee-Knoxville) uncovered poor electron/charged PFO identification using out-of-the-box Pandora
- [My studies](#) of 1P0N and 3P0N tau reconstruction demonstrated that losses in efficiency at low- $p_T$  in the central/transition regions were due to a higher frequency of charged pions misidentified as electrons
- [Electron rejection studies](#) by Moses confirmed that Pandora's charged PFO identification is extremely poor (~50% of pions misidentified as electrons)
- To boost tau reconstruction efficiencies, we must create a custom charged particle ID processor that runs over charged PFOs output from Pandora reconstruction and feeds re-identified charged PFOs into TauFinder. Identification should be based on sub-detector energies and depth of clusters.

# Electromagnetic Energy Fraction



- Consistent with what Kevin and Moses have shown
- Note that charged pions and electrons in distribution are labeled based on Pandora identification
- Not necessarily true that cutting at  $\frac{E_{ECAL}}{E_{TOT}} > 0.99$  reduces number of charged pions by ~20%
- Need to update distribution with truth-matching-based labels

# Centroid Radius



- Clearly, we have a charged pion if  $R_{centroid} > 3100 \text{ mm}$
- However, charged pions and electrons in distribution are labeled based on Pandora identification
- Bimodality in electron distribution implies that rightmost peak contains pions misidentified as electrons
- Realistically, any  $R_{centroid} > 2350 \text{ mm}$  could be identified as a charged pion
- To verify above claim, need to recreate distribution with truth-matching-based labels
- Plan to convert  $R_{centroid} \rightarrow$  *Innermost Layer* in the future

# Conclusions and Next Steps

- Need to create custom charged PFO identification processor to feed re-identified charged PFOs into TauFinder
- Electromagnetic energy fraction and centroid radius prove to be promising variables to distinguish electrons and charged pions
- Need to recreate distributions with truth-matching-based labels to accurately represent where thresholds should be placed
- Plan to look at these distributions as a function of polar angle  $\theta$  to understand variability of these variables in the MAIA detector due to the solenoid
- Will start implementing these selections into the charged PFO identification processor