

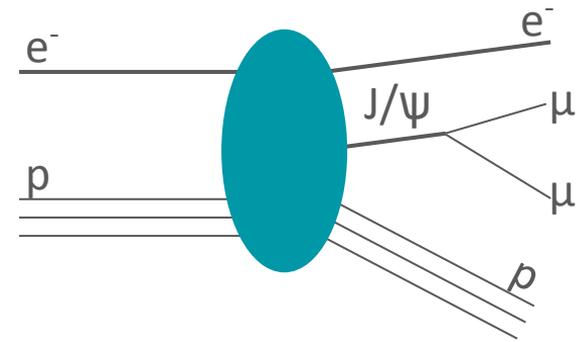


# Identifying Muons at ePIC

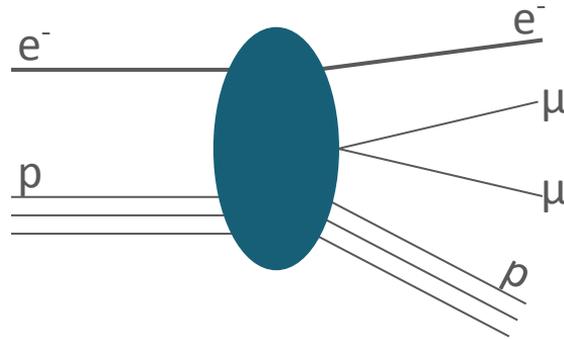
Reconstruction Working Group Meeting 16/02/26

Alex Smith  
University of York  
alex.smith3@york.ac.uk

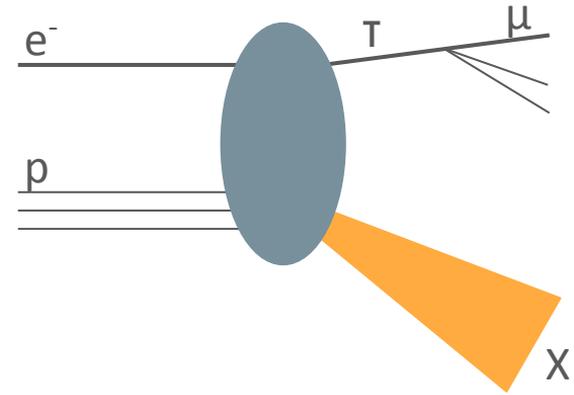
# Motivation



DVMP



TCS



CLFV

And more

# Challenges

- No dedicated muon detectors.
- Main source of contamination comes from pions.

$\mu$

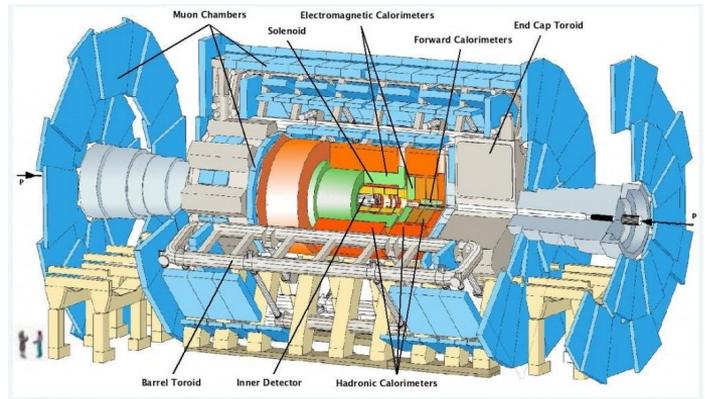
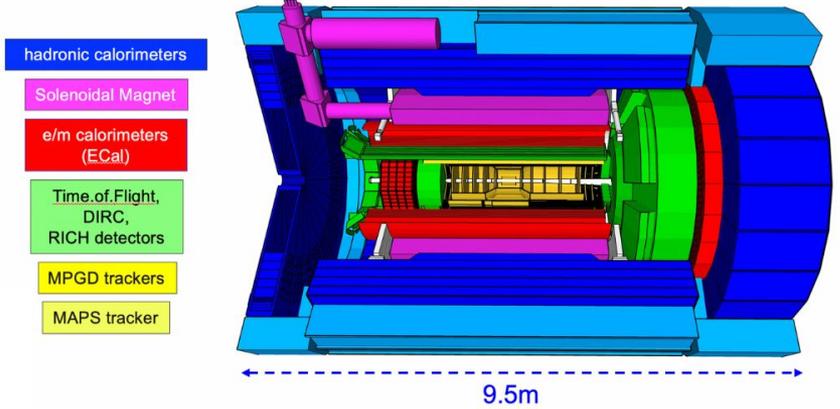
$$J = \frac{1}{2}$$

Mass  $m = 0.1134289259 \pm 0.0000000025$  u  
 Mass  $m = 105.6583755 \pm 0.0000023$  MeV  
 Mean life  $\tau = (2.1969811 \pm 0.0000022) \times 10^{-6}$  s

$\pi^\pm$

$$I^G(J^P) = 1^-(0^-)$$

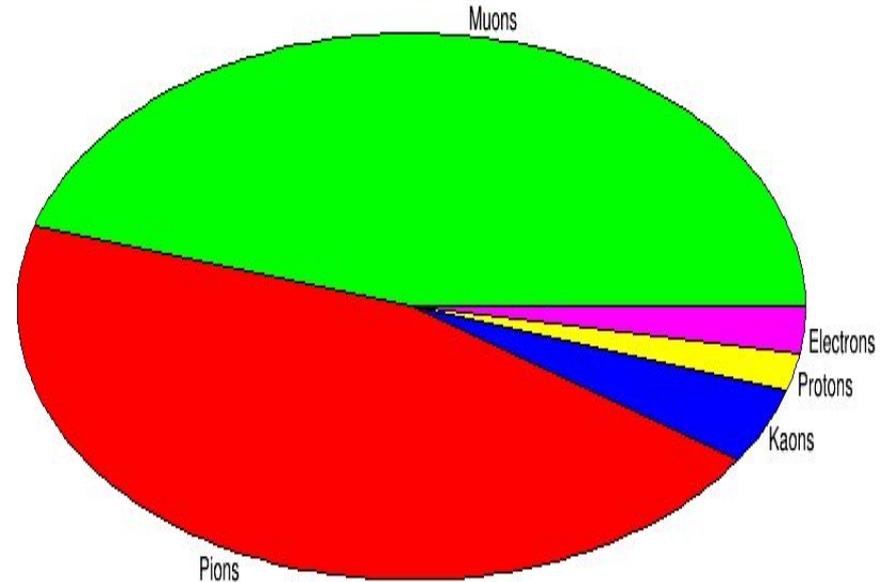
Mass  $m = 139.57039 \pm 0.00018$  MeV (S = 1.8)  
 Mean life  $\tau = (2.6033 \pm 0.0005) \times 10^{-8}$  s (S = 1.2)



# Event Sample



- Single particle events were generated for a range of particles.
- The sample focused on muons and pions
- Apart from particle type, all other properties were kept constant.

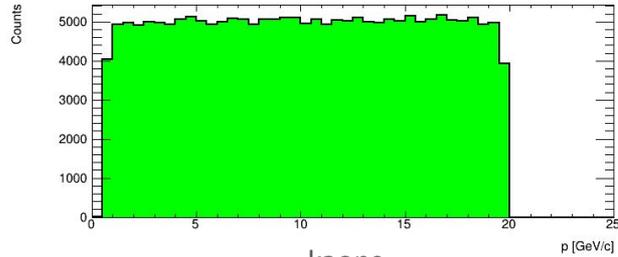


# Event Sample

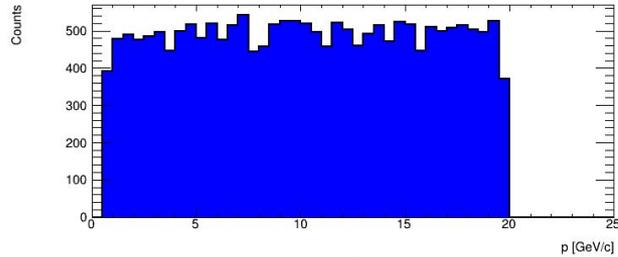


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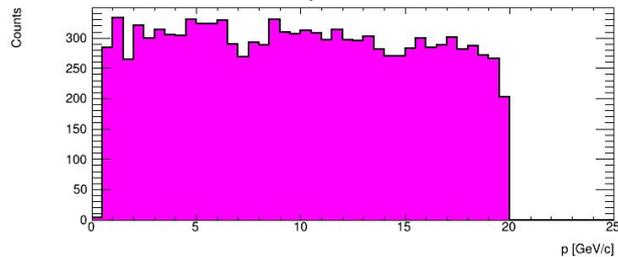
muons



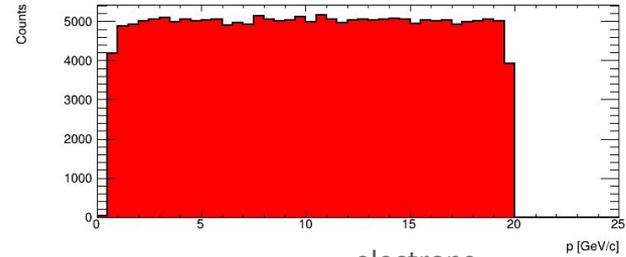
kaons



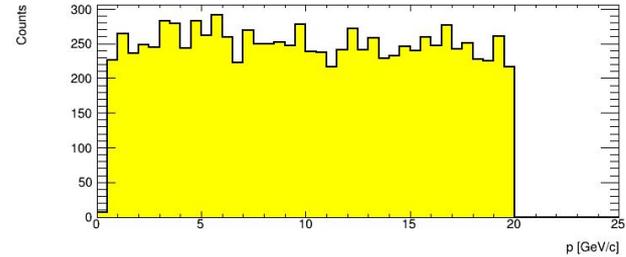
protons



pions



electrons

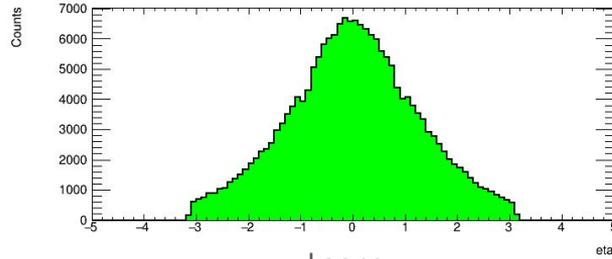


# Event Sample

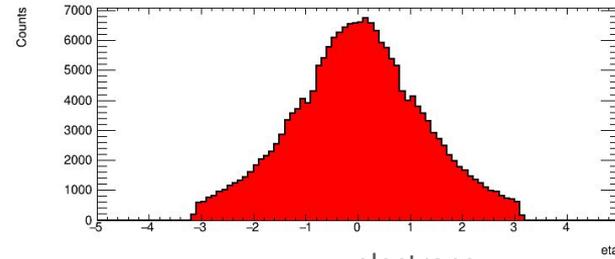


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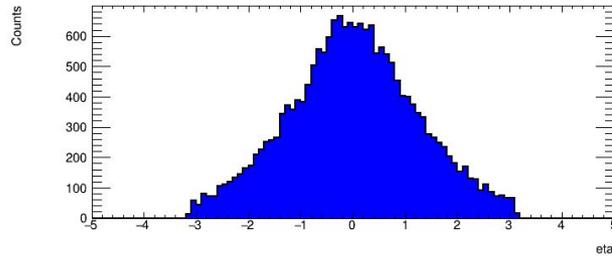
muons



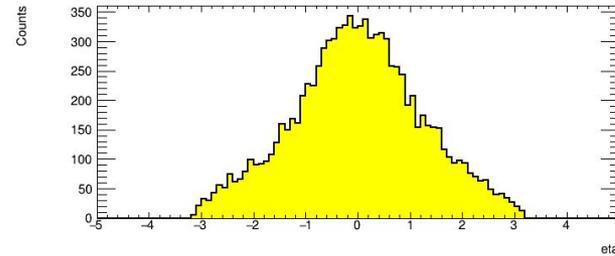
pions



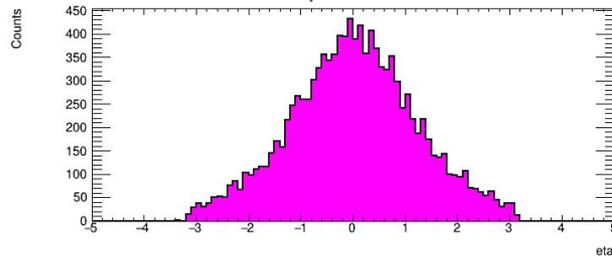
kaons



electrons



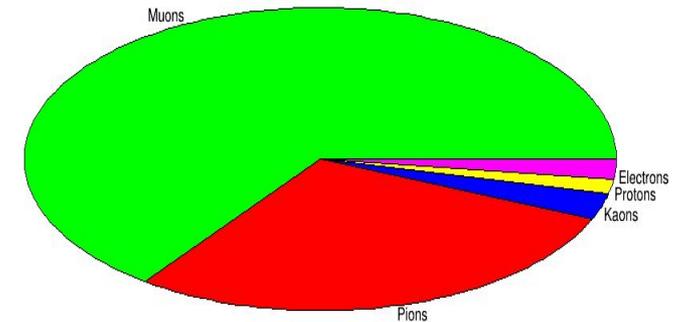
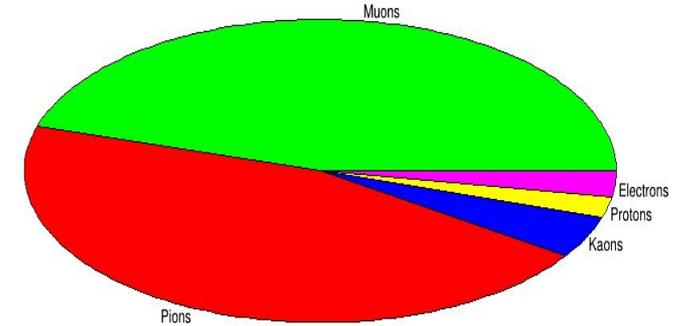
protons



# Cuts pt1



- Reconstructed PID:
  - Only particles with PID of 0 or 13 were included.
- Reconstructed momentum of  $< 1$  GeV.
- Reconstructed mass of less than 200 MeV.
- Tracks with  $|\eta|$  between 1 and 1.3:
  - Remove issue at detector overlap regions

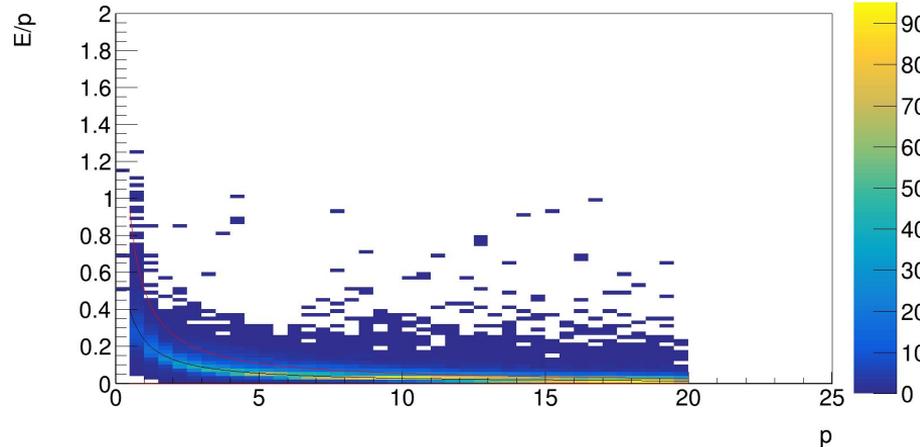


# Cuts pt2

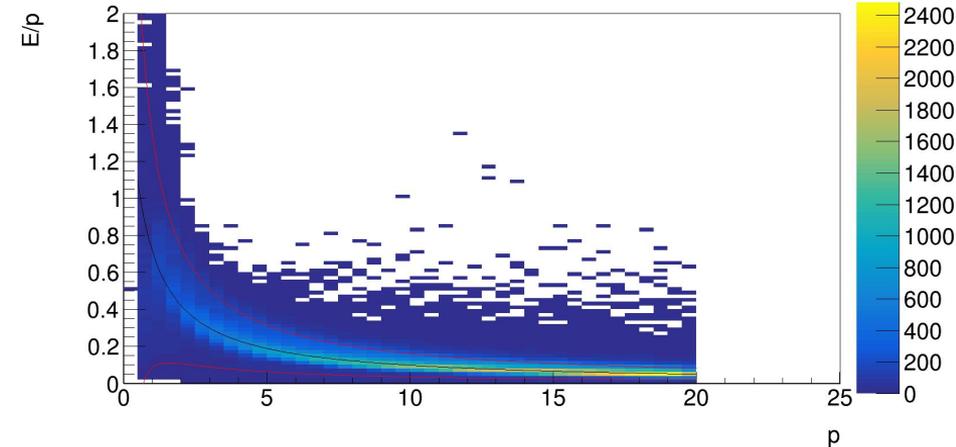


- Cuts were then made on the ratio of energy deposited in the calorimeters to the track momentum ( $E/p$ ).
- These depended dynamically on the reconstructed momentum.
- Cuts were also applied on the size of clusters in the calorimeters.

Ecal Energy vs Track Momentum for Muons



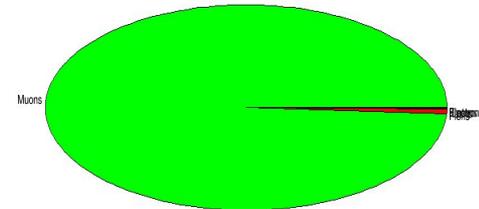
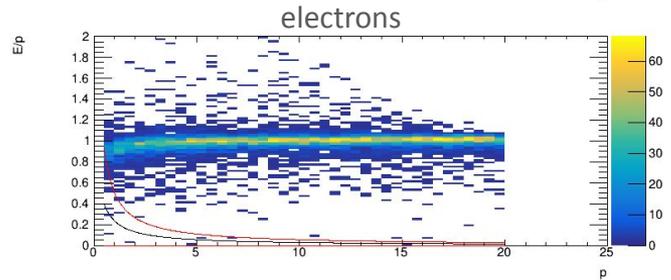
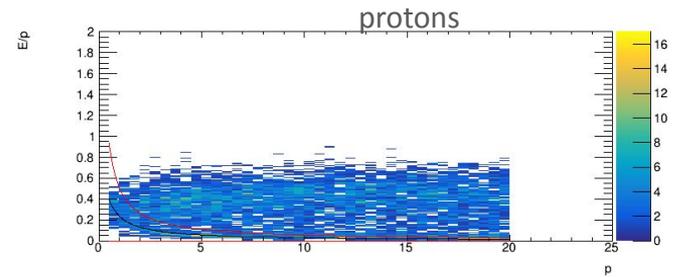
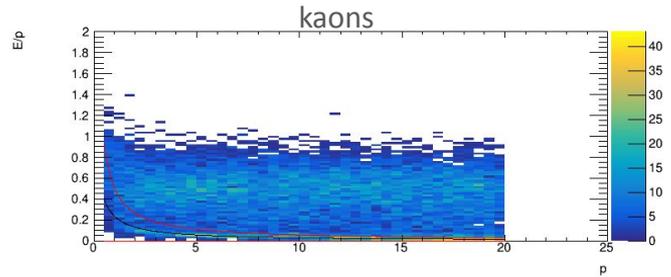
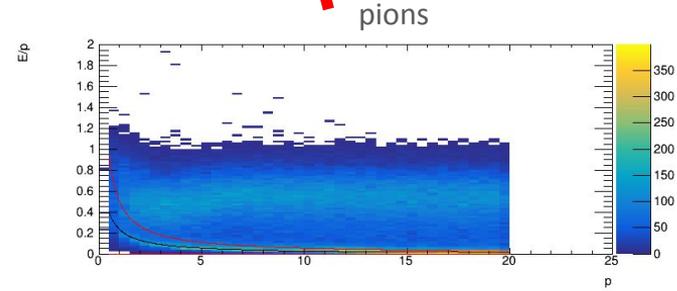
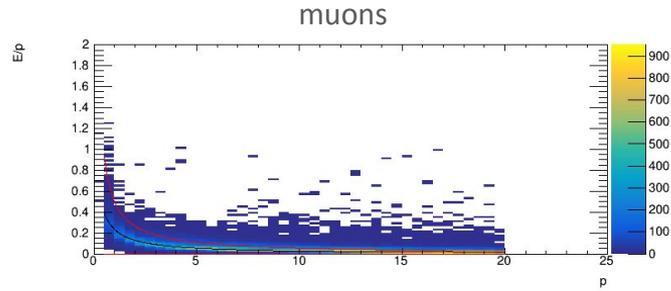
Hcal Energy vs Track Momentum for Muons



# Cuts pt2 - Ecal



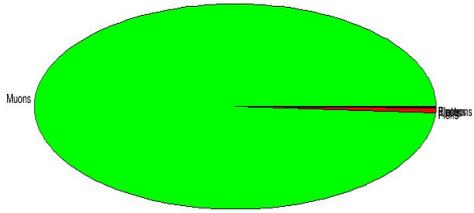
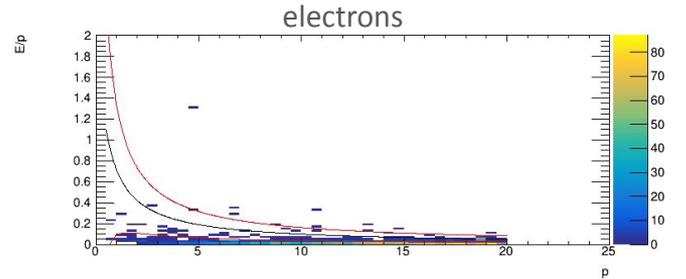
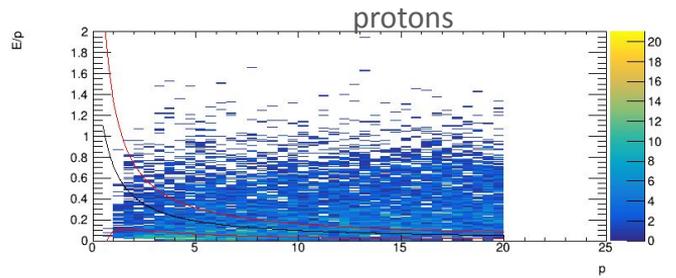
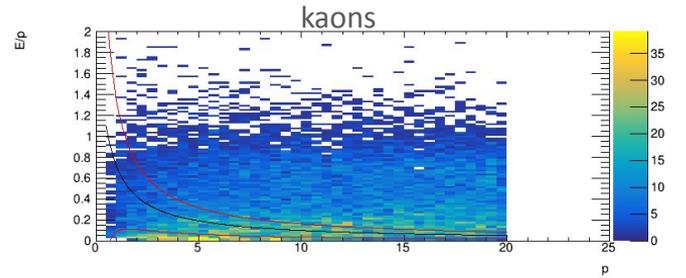
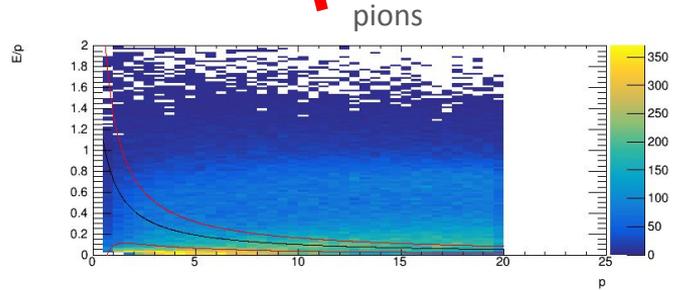
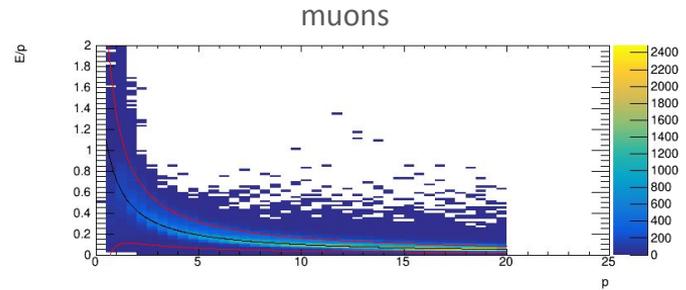
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# Cuts pt2 - Hcal



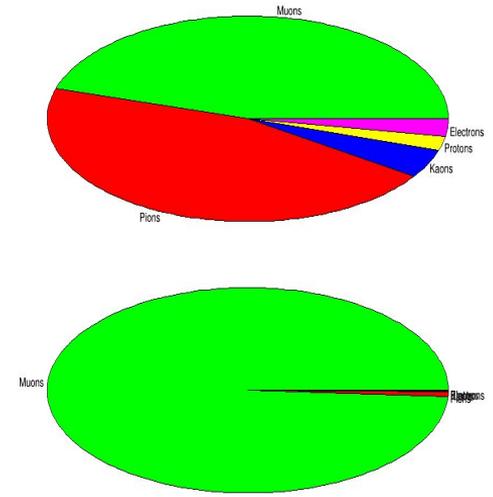
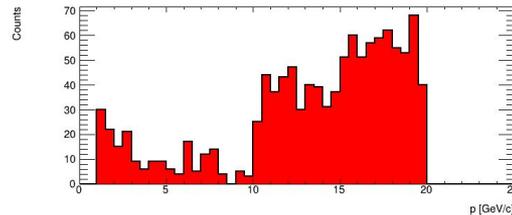
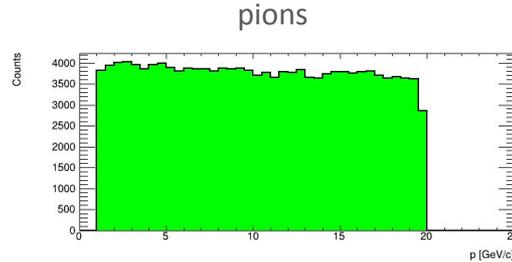
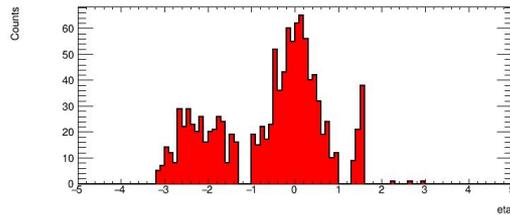
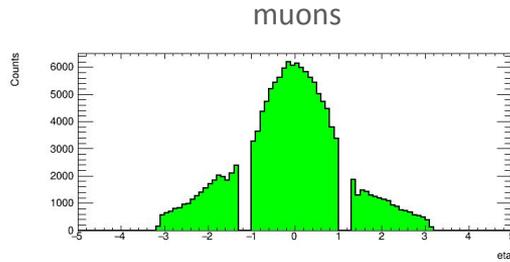
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# Post processed events



- Post cuts:
  - Muon purity: 99.1 %
  - Muon efficiency: 71.9 %

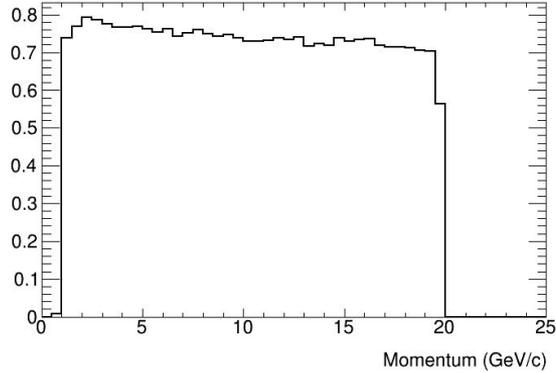


# Post processed events

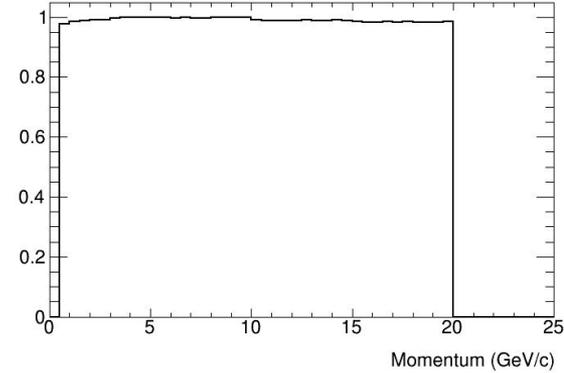


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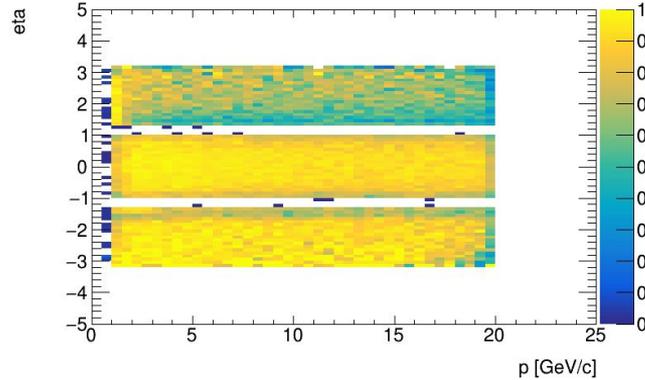
Efficiency



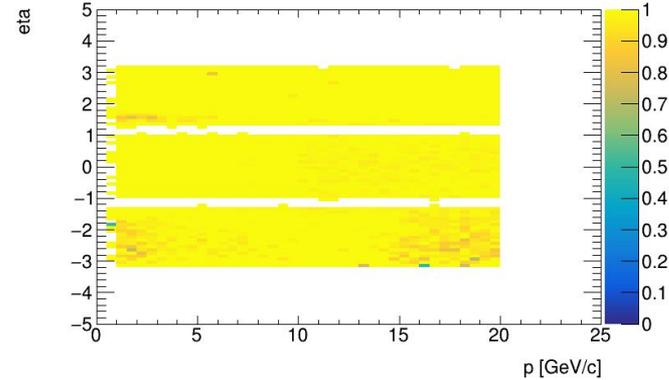
Purity



Efficiency



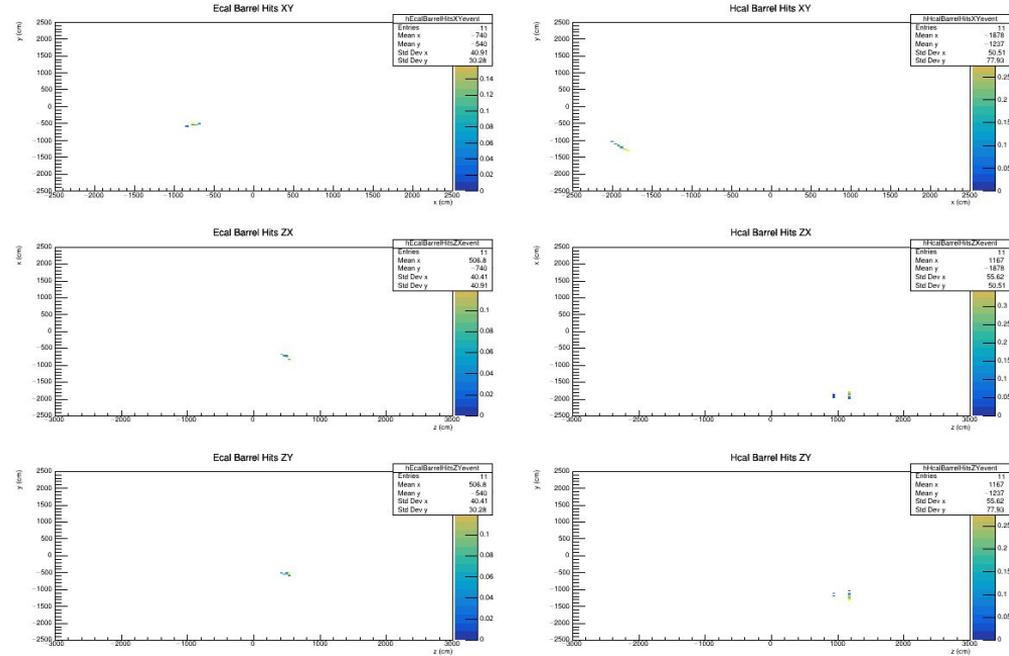
Purity



# Future work for MuonID



- Need to consider true rates.
  - Expecting 1000x more pions than muons
- PID detectors not currently implemented.
  - Some improvement should be seen between 2 - 10 GeV.
- No consideration of the shower shape?



# Discussion Point

- Where is PID value currently coming from?
- What are we aiming for from the Muon Finder™
- New branch with reconstructed charged track features?
  - Give information on E/p?
  - Could link to Electron Finder

