Muon Finder Algorithm: Update

ePIC and EIC Physics Readiness Workshop
University of Calabria, Physics Department & INFN Cosenza

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Presented by Stephen Kay
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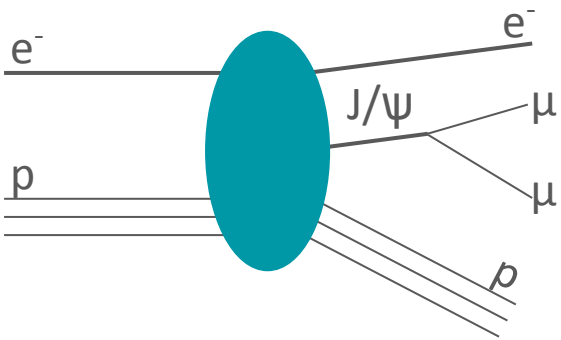
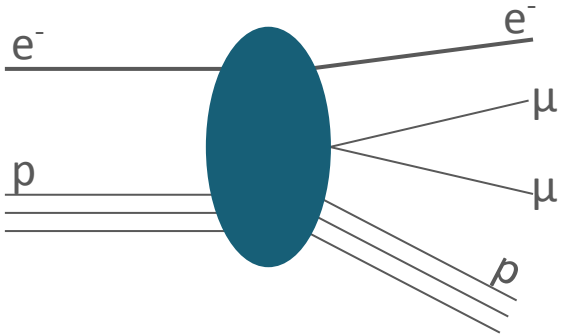
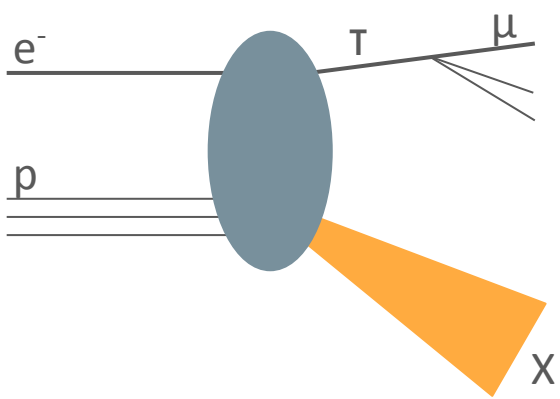
Motivation



DVMP



TCS

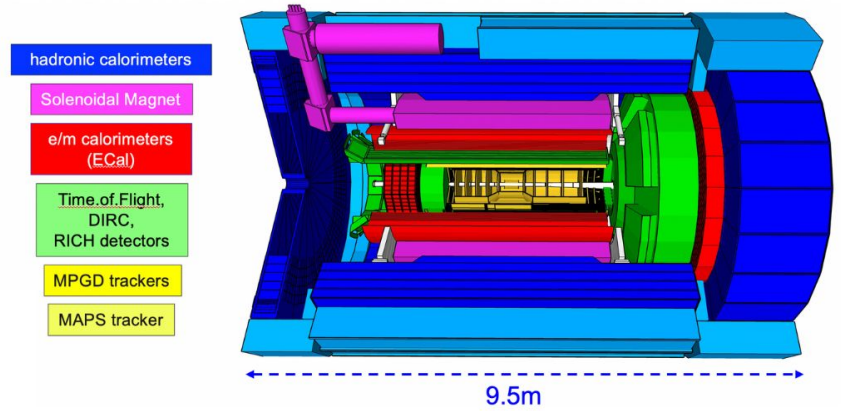


CLFV

And more

Challenges

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



μ

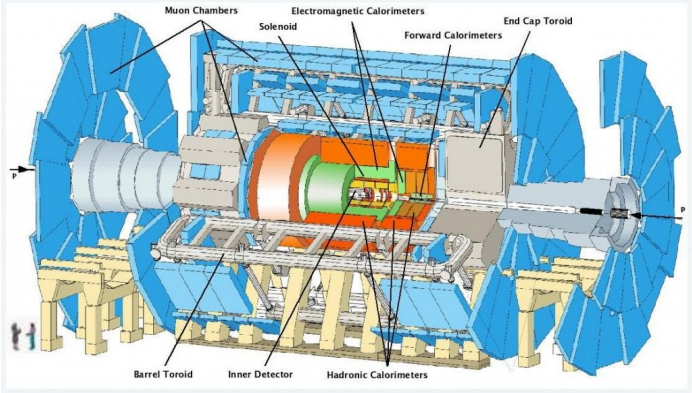
$$J = \frac{1}{2}$$

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

$\pi^{\pm}$

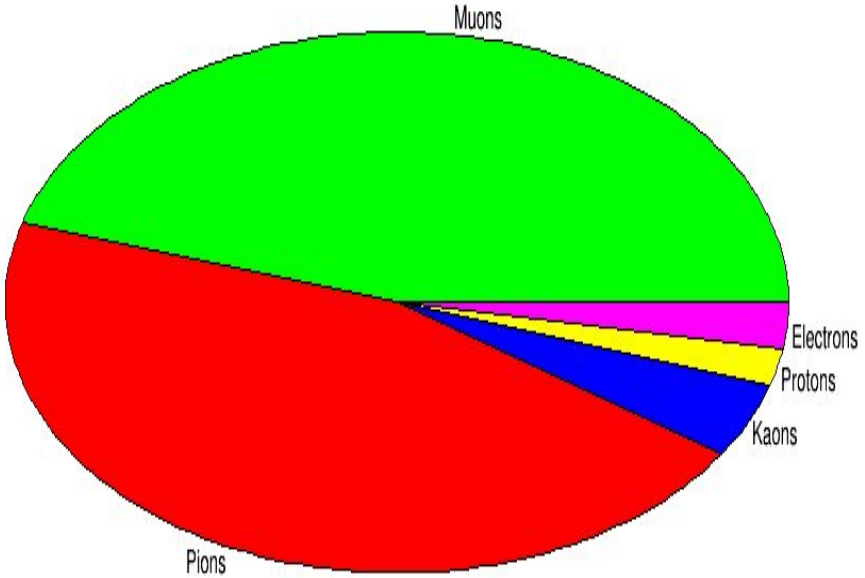
$$I^G(J^P) = 1^-(0^-)$$

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)



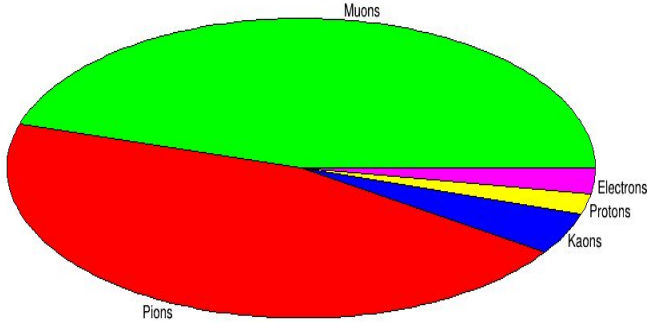
Event Sample

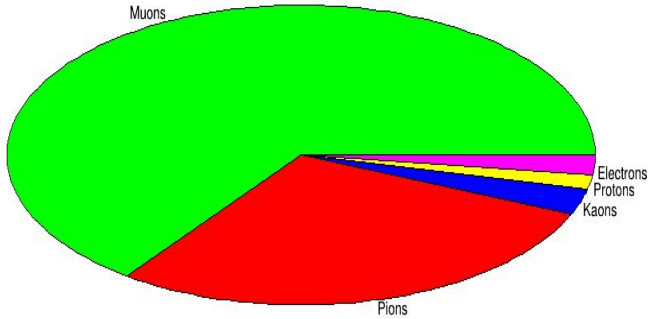
- Single particle events were generated for a range of particles.
- The sample focused on muons and pions
- Momenta: 0 to 20 GeV/c
- η: -3 to 3
- Equal numbers of π and μ
  - Lower mix of others



Cuts pt1

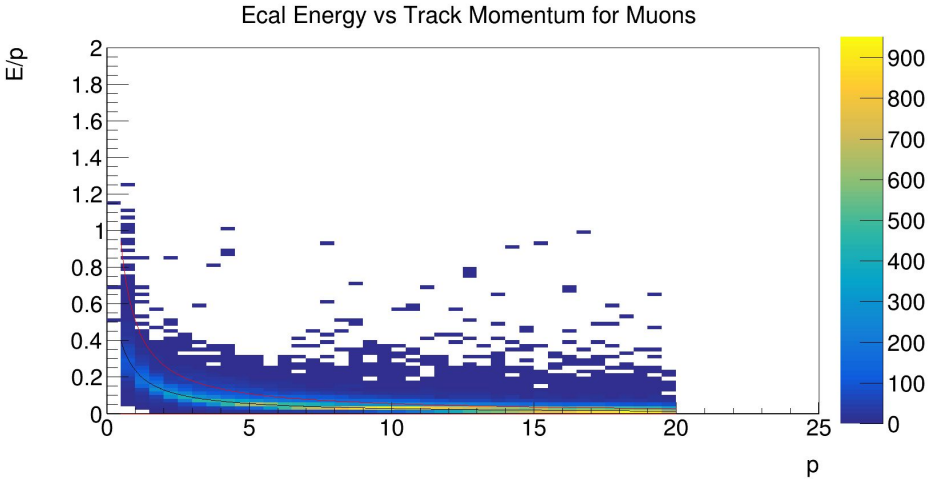
- Reconstructed PID:
  - Only particles with PID of 0 or 13 were included.
- Reconstructed momentum of > 1 GeV/c.
- Reconstructed mass of < 200 MeV/c^2.
- Tracks with |η| between 1 and 1.3:
  - Detector overlap regions

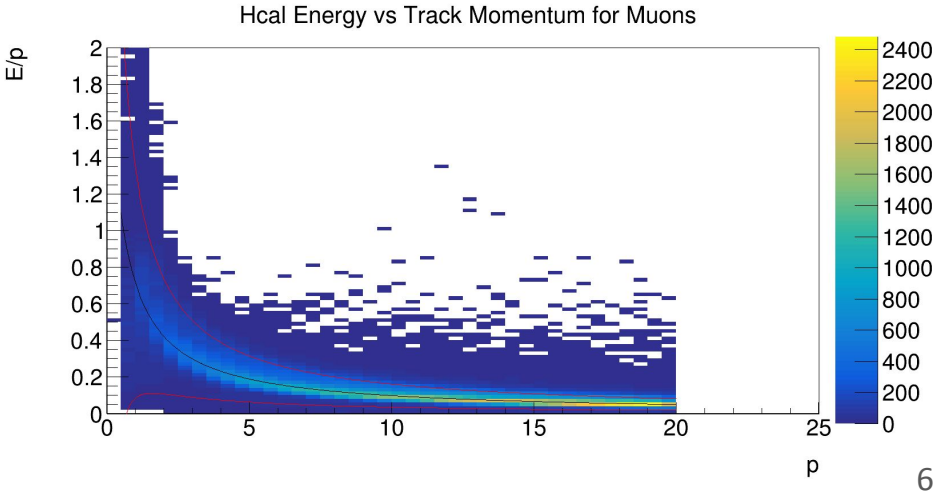




Cuts pt2

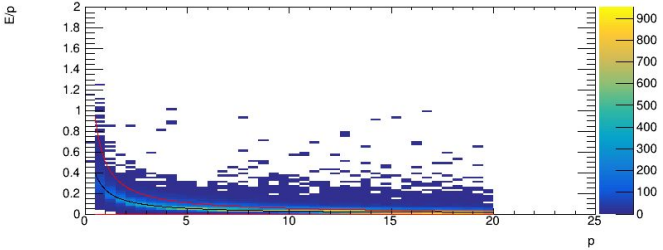
- Cuts were then made on the ratio of energy deposited in the calorimeters to the track momentum (E/p).
- These depended dynamically on the reconstructed momentum.
- Cuts were also applied on the size of clusters in the calorimeters.



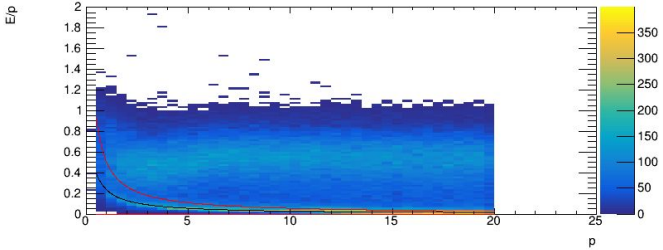


Cuts pt2 - Ecal

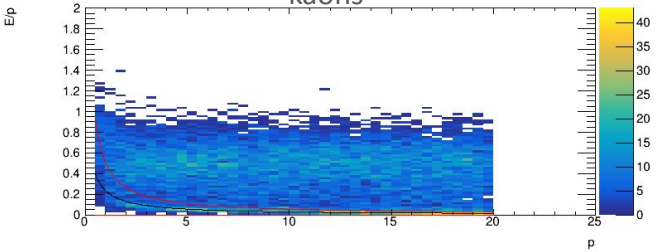
muons



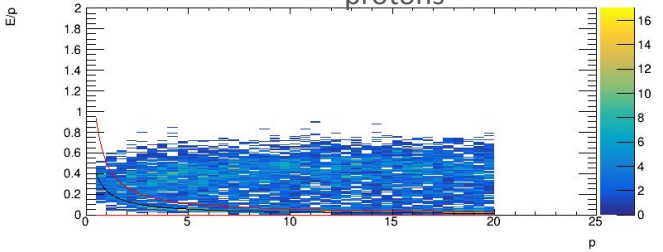
pions



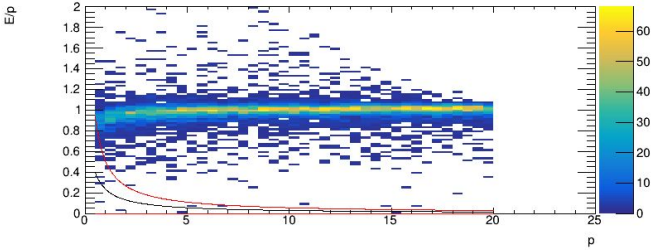
kaons

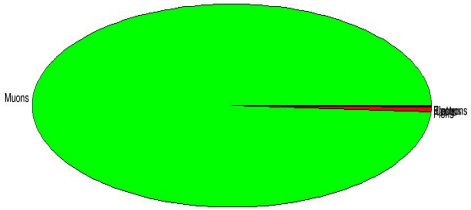


protons



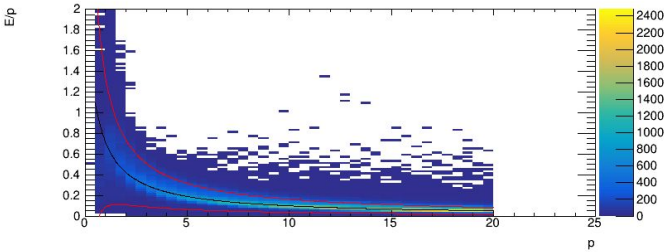
electrons



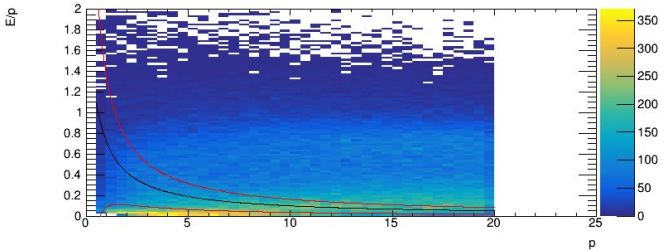


Cuts pt2 - Hcal

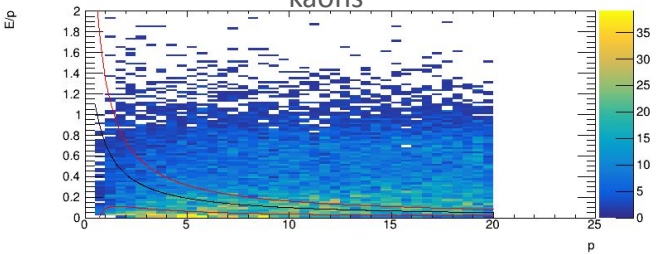
muons



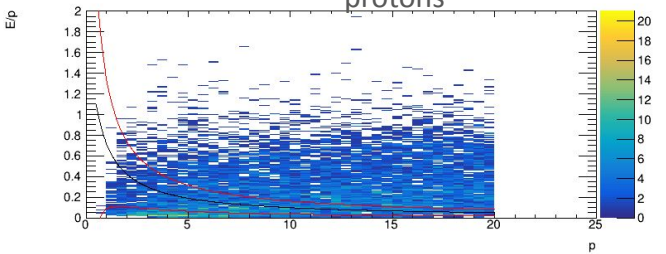
pions



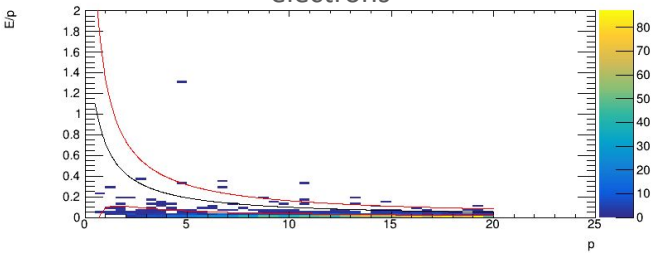
kaons

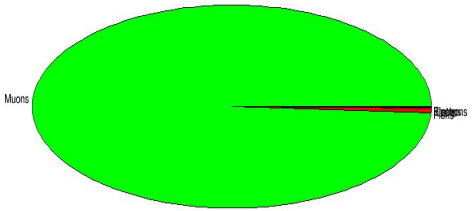


protons



electrons

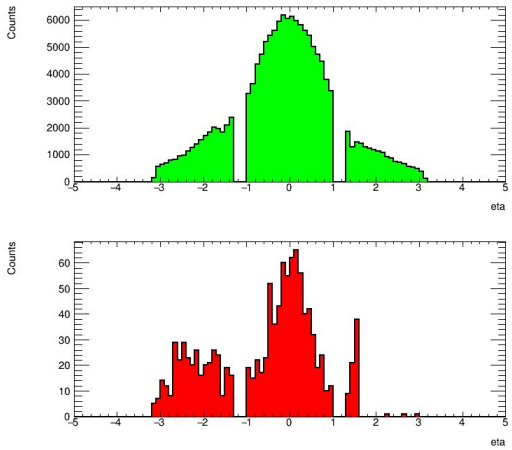




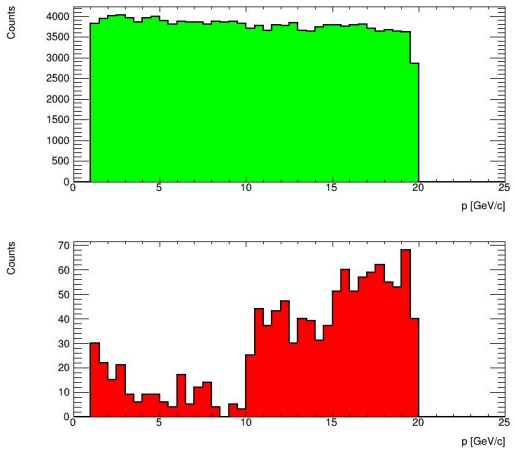
Post processed events

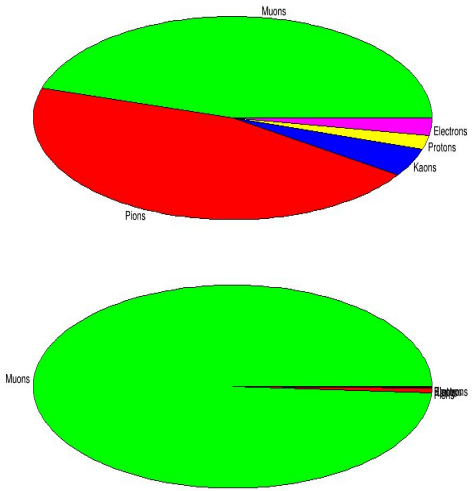
- Post cuts:
  - Muon purity: 99.1 %
  - Muon efficiency: 71.9 %

muons

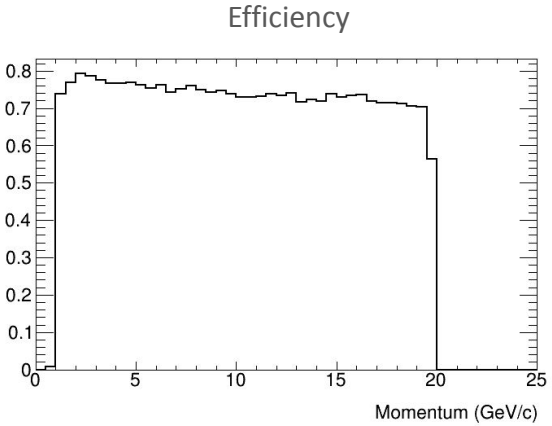


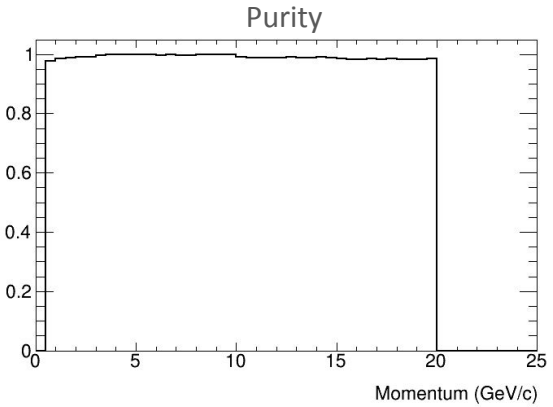
pions

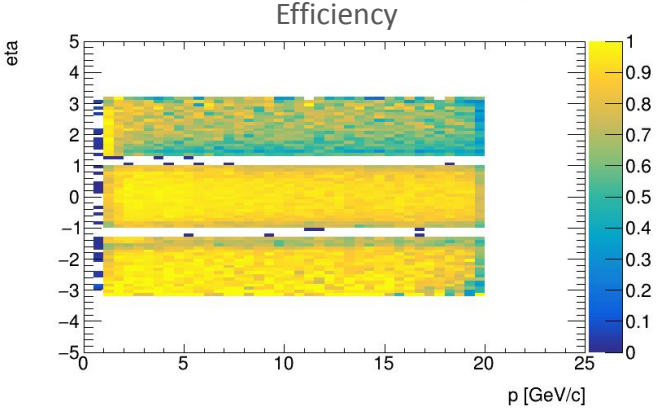


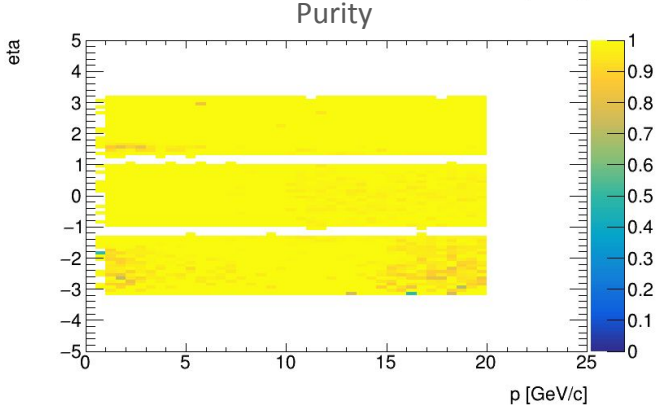


Post processed events



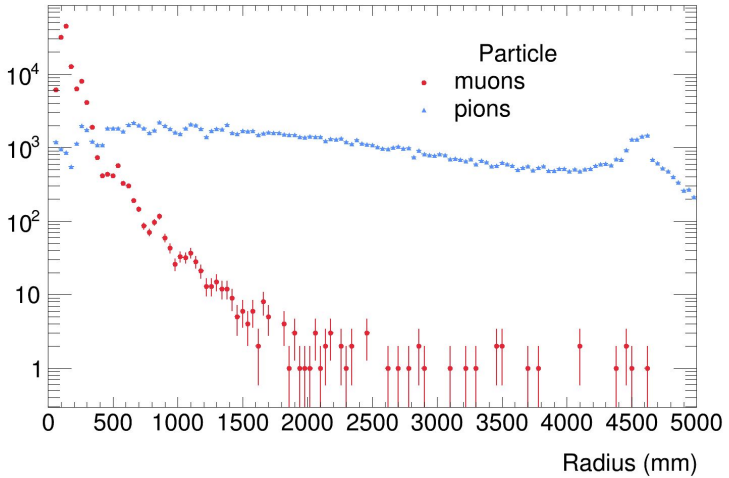






Future work for MuonID

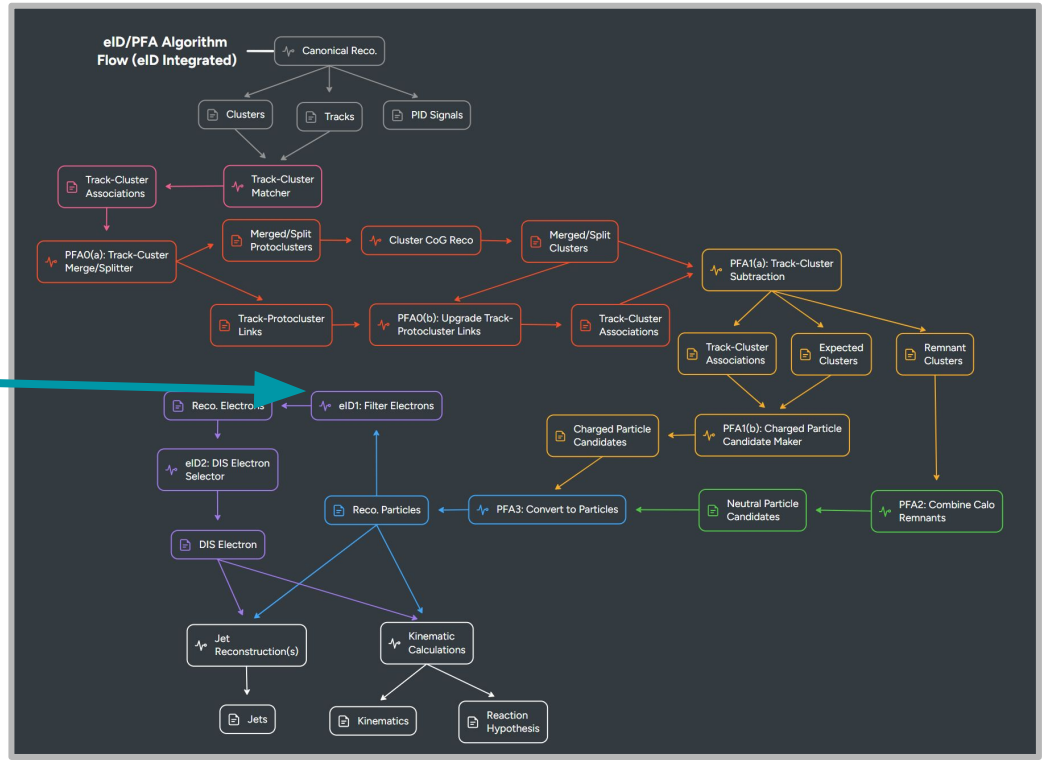
- Need to consider true rates.
  - Expect 1000x more π than μ
- PID detectors not currently contributing to μID.
  - Next detector set to evaluate
- Early investigations into shower shape ongoing.
  - Clear distinction, but need to show this can be used cleanly/easily



Hcal Barrel

Discussion

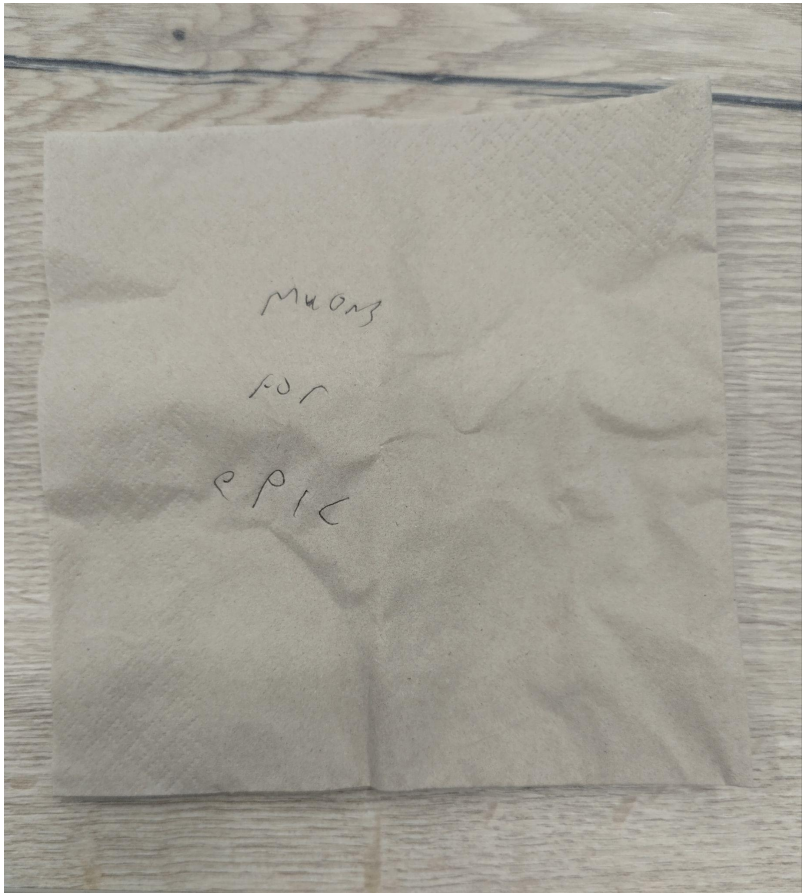
- Want to shift towards a probabilistic approach
  - Parallels holistic PID
  - Distill cuts down to this
  - Cuts/quantities shown here are part of this
- Fit in as part of eID1?
  - -> lepID1 -> Filter Leptons?
  - Generic E/p algorithm
- OR separate out?
  - Filter electrons
  - Filter Muons
  - …



Thanks for listening

Any questions?

Muon Task Force

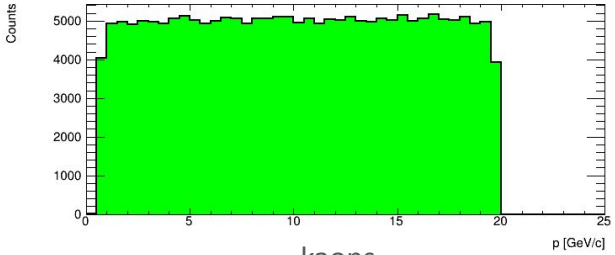


- Formed after the London meeting
- Informal group attempting to connect EDT efforts on muons to wider ePIC physics and reconstruction groups
- Biweekly Monday meetings, 1 pm UK time, in the “off” weeks of the EDT group*
- Beginning to formalise organisation now work is progressing
- All interested collaborators welcome, ask me for connection details or reach out to Stuart Fegan in York (stuart.fegan@york.ac.uk)

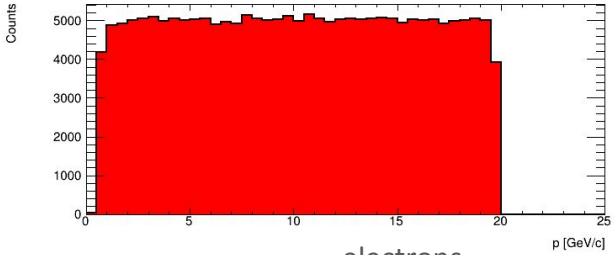
*current aspiration, sometimes varies

Backup - Event Sample

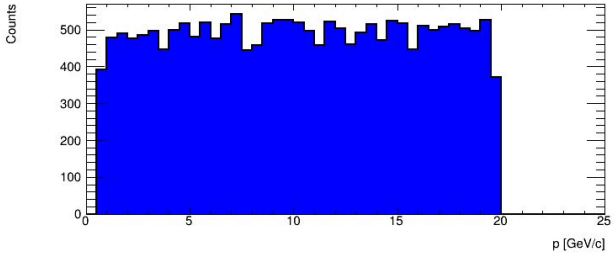
muons



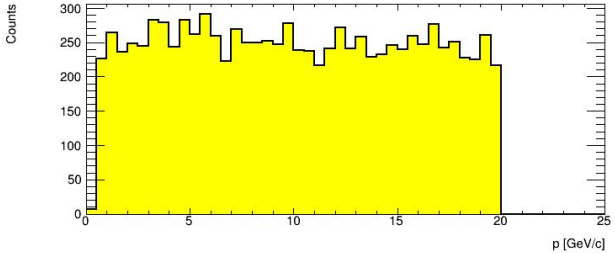
pions



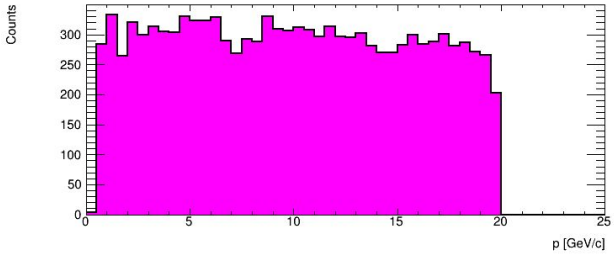
kaons



electrons

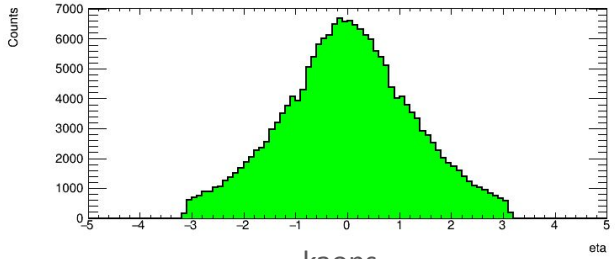


protons



Backup - Event Sample

muons



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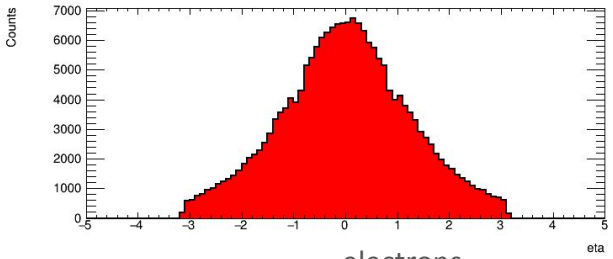

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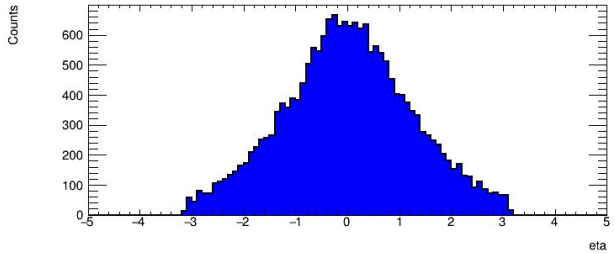
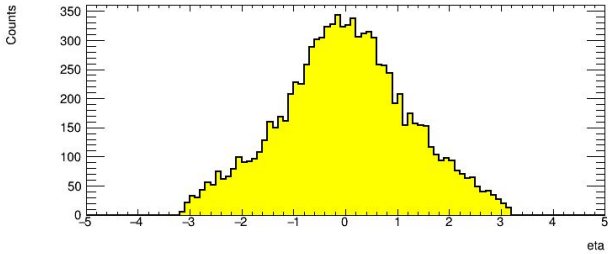


electrons



protons