Cut-Based PID

Scott Wilbur

Overview

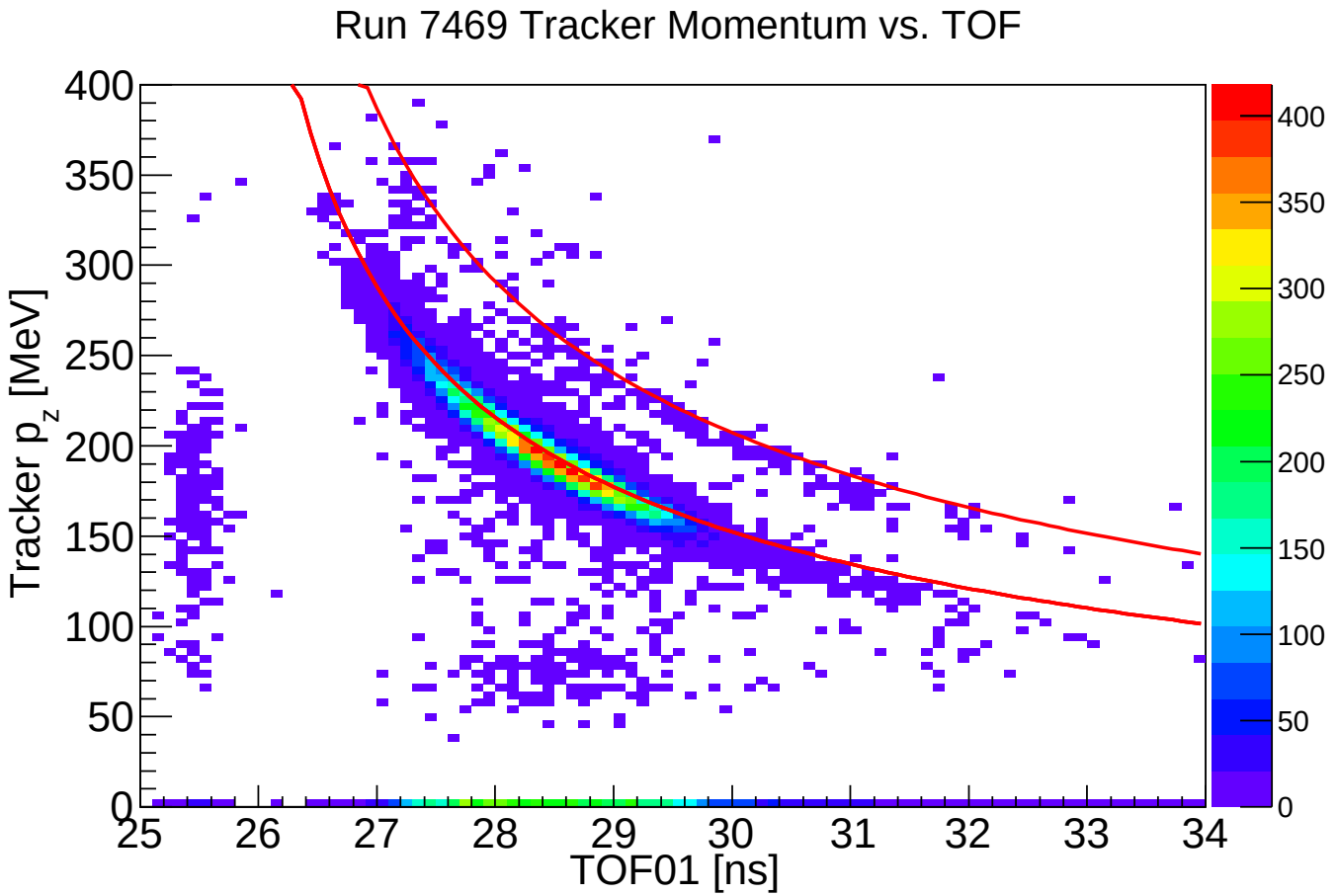
- Measure particle velocity using TOF
- Measure particle momentum using Tracker or EMR
- Add corrective factor to momentum to find momentum in TOF region
- Using velocity and momentum, find mass

Recent Updates:

- Refitting energy loss corrections in MC gives better data-MC agreement
- First pass at improving m_{EMR} calculation
- Efficiency and purity calculations in MC

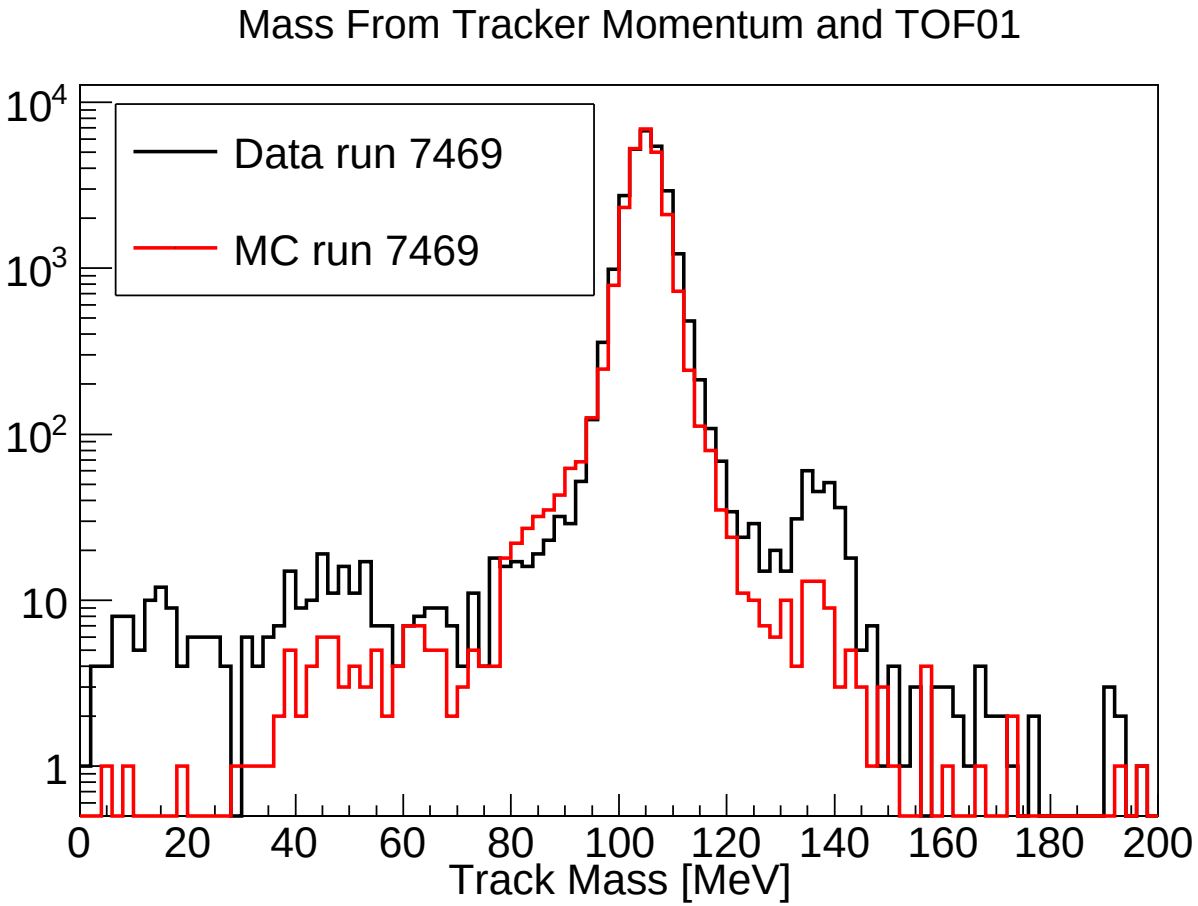
Upstream PID

- Use TOF01 and Upstream Tracker momentum
- Fit tof_e and p_{corr} using known muons
- Calculate mass with $m = (p + p_{corr})\frac{\sqrt{1-v^2}}{v}$



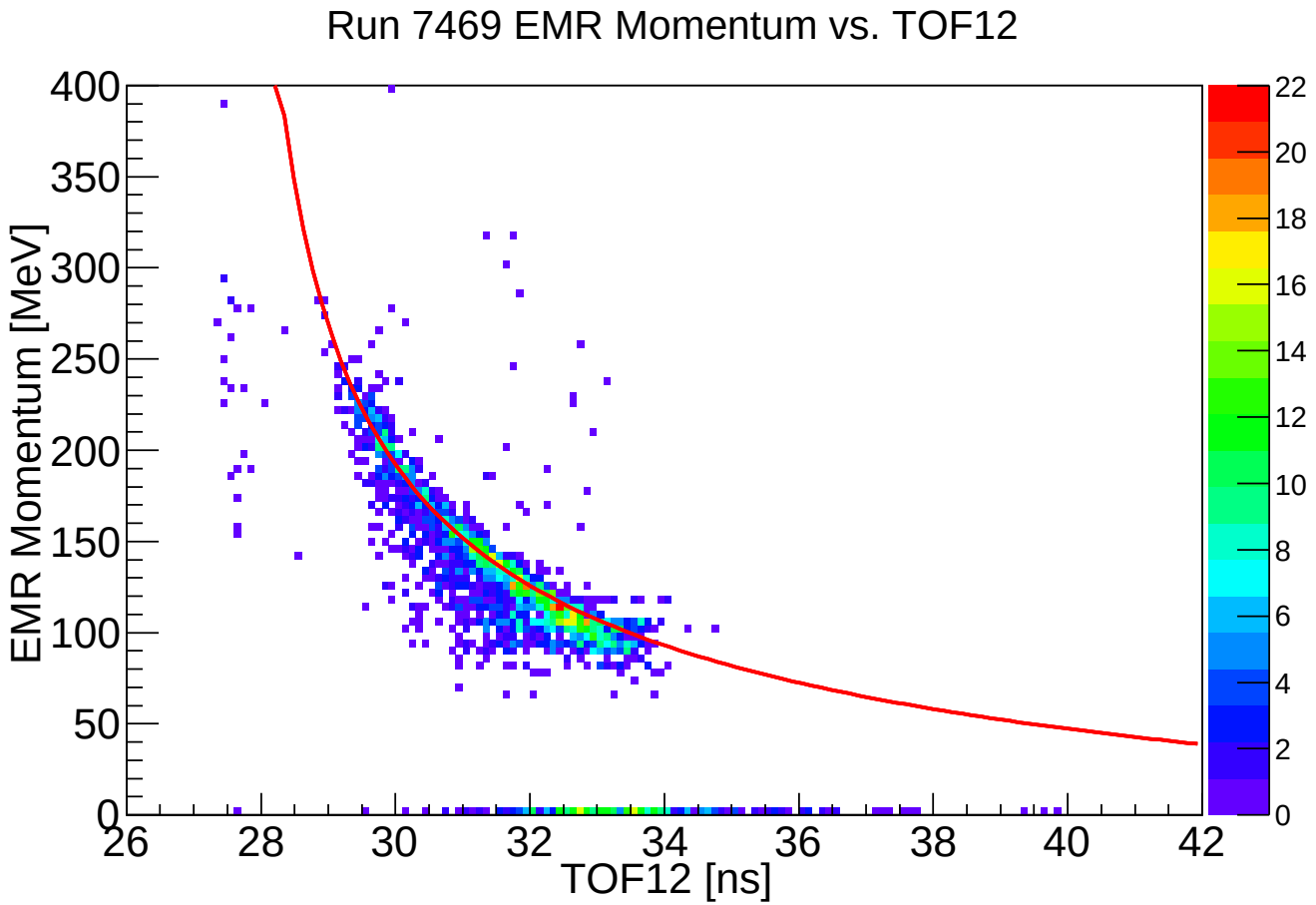
Upstream PID

- Previously, different material budget in MC gave incorrect mass plot
- Repeated tof_e and p_{corr} fit in MC; plots are now more comparable



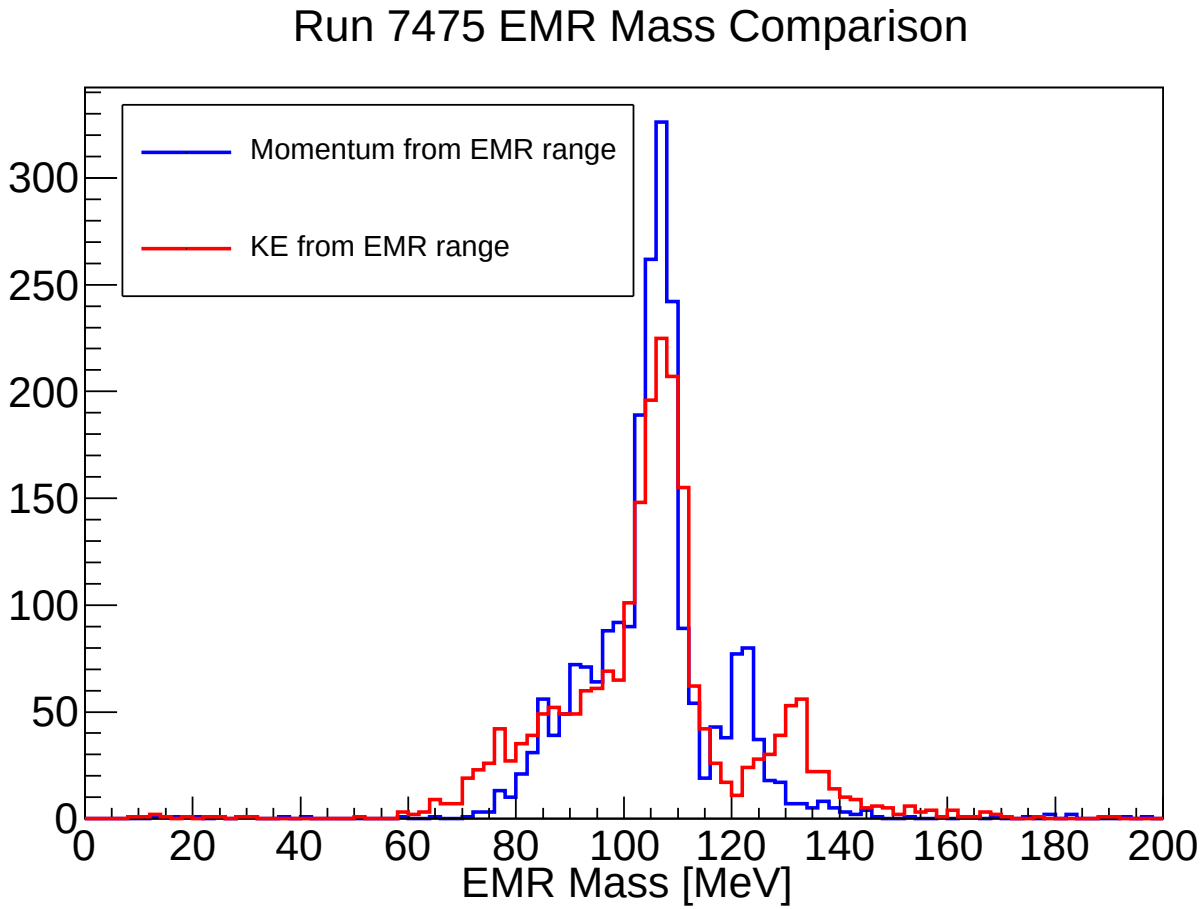
Downstream PID

- Use TOF12 and EMR Range
- Use similar tof_e and p_{corr} fit



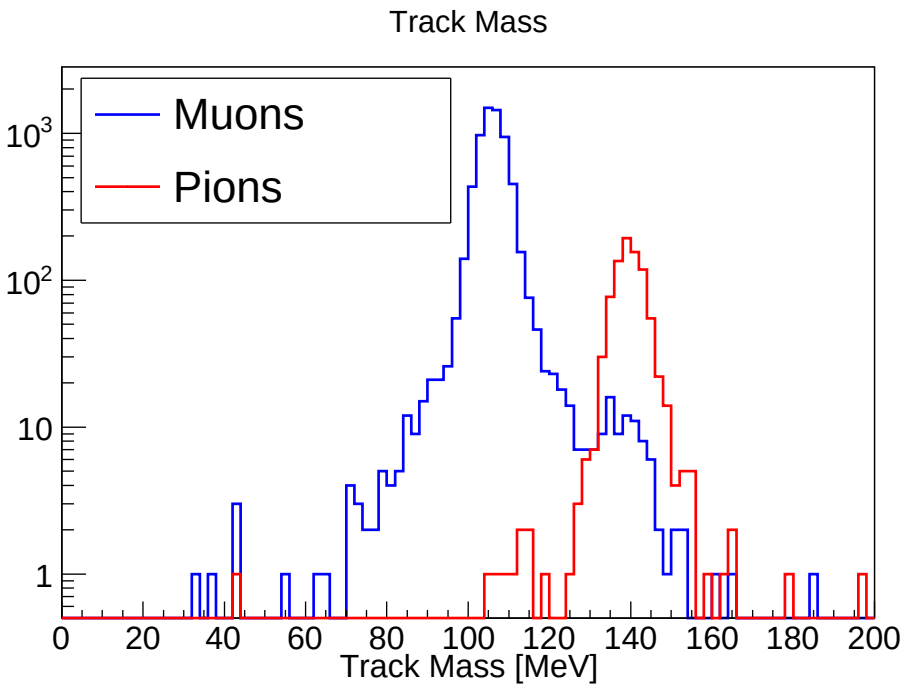
Downstream PID

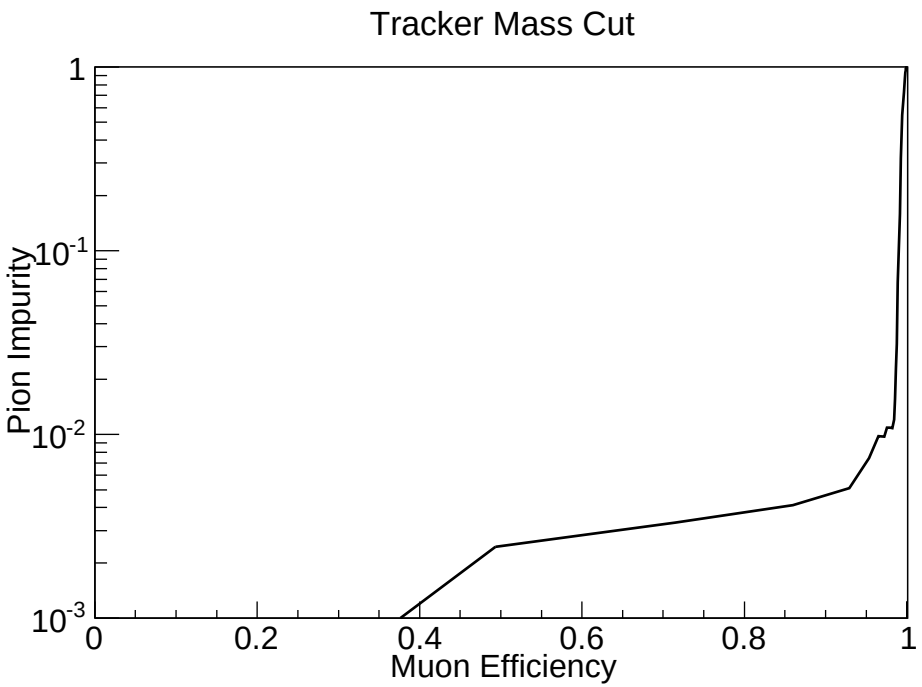
- EMR Range technically doesn't measure momentum
- Attempting to improve resolution with more complex formula than $m = p\frac{\sqrt{1-v^2}}{v}$
- Using kinetic energy from EMR range is better, but not quite correct (WIP)
- Need to use Bethe-Bloch



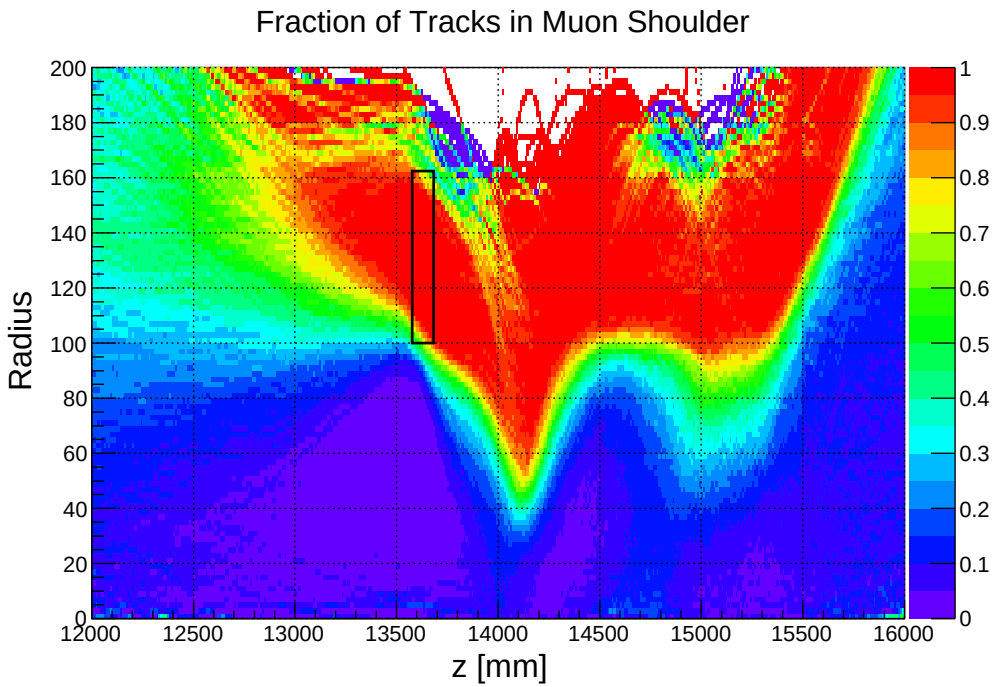
Efficiency and Purity

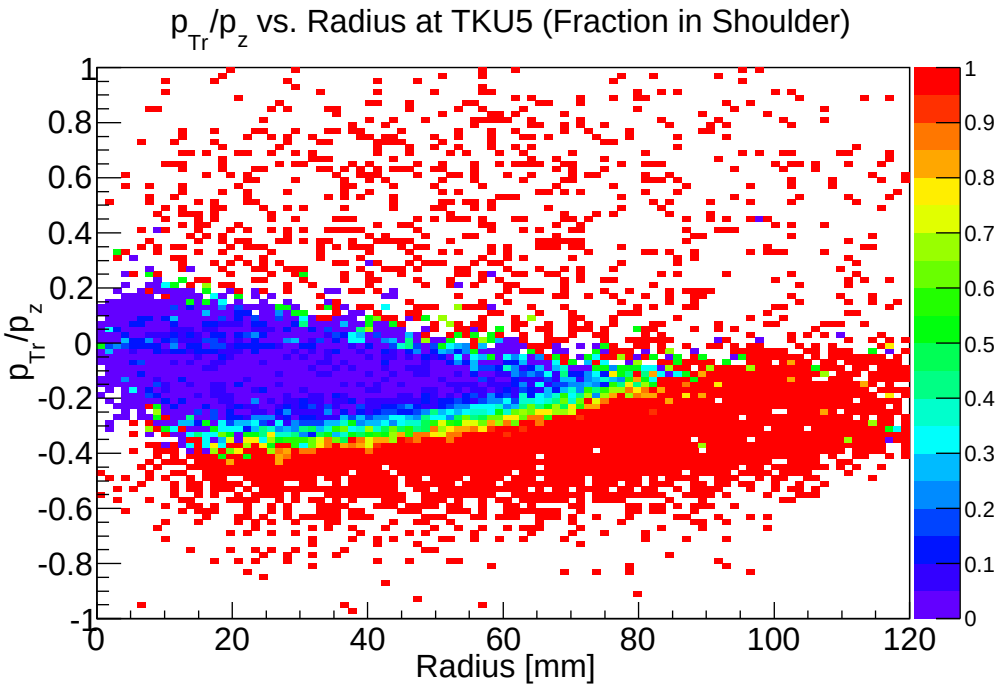
- Very good separation in upstream
- Almost looks like some 'misidentifications' are actually a problem in MC truth
-





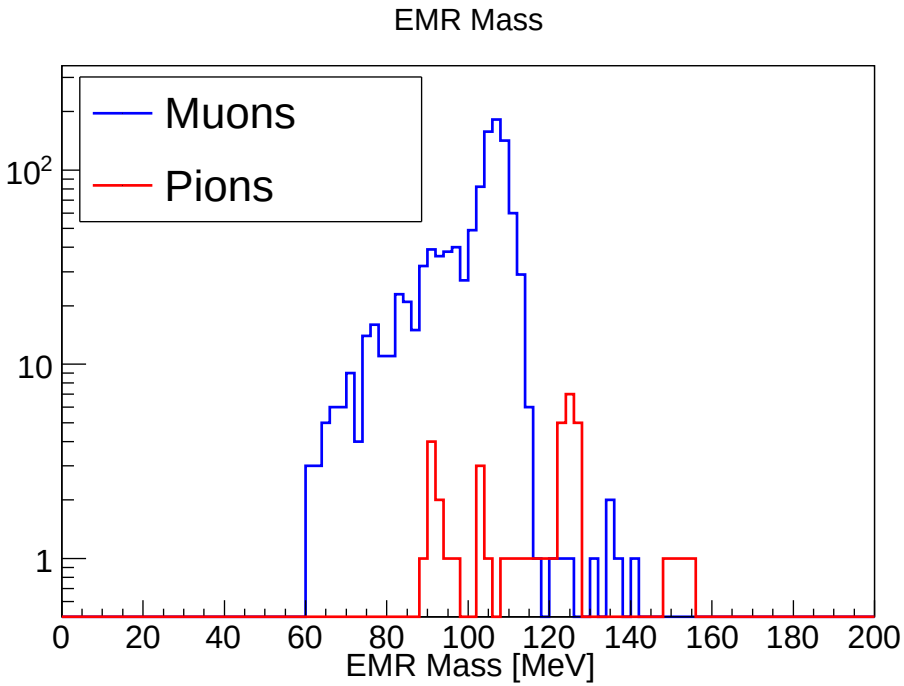
Shoulder

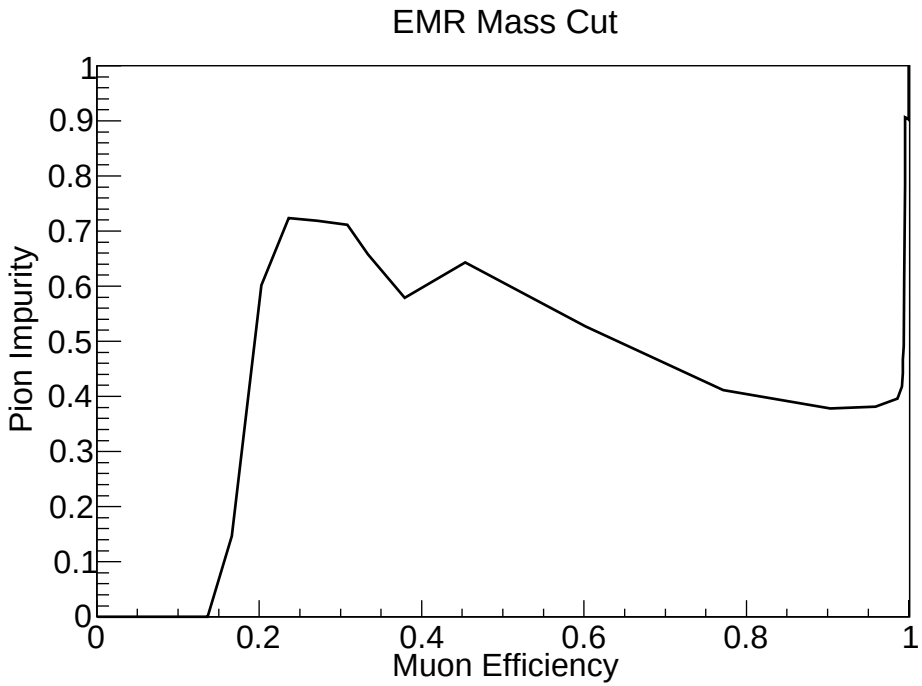

Fraction of Tracks in Muon Shoulder
Radius
z [mm]
200
180
160
140
120
100
80
60
40
20
0
12000
12500
13000
13500
14000
14500
15000
15500
16000
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0


p_Tr/p_z vs. Radius at TKU5 (Fraction in Shoulder)
p_Tr/p_z
Radius [mm]
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
20
40
60
80
100
120
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0

Efficiency and Purity

- Very few pions reach the EMR (~ 10 in Run 7469)
- Can keep nearly all muons while cutting $\sim 50\%$ of pions
- Bethe-Bloch EMR mass might help a bit





Parameters

$$m_{\text{calc}} = (p_{\text{meas}} + p_{\text{corr}}) \frac{\sqrt{1 - v_{\text{TOF}}^2}}{v_{\text{TOF}}}$$

- Originally used measured TOF_e and fit p_{corr}
- Letting TOF_e and p_{corr} float gives a noticably better fit
- However, gives larger variations in TOF_e than expected

Mass Calculation	TOF_e	p_{corr}
Data Track	25.53 ns	20.91 MeV
Data EMR	27.75 ns	61.11 MeV
MC Track	25.67 ns	21.61 MeV
MC EMR	28.25 ns	33.44 MeV

Paper

- I am writing up much of this in the PID section of the paper
- It will obviously change as I improve it or we decide to stick with simpler ideas