Updates on 1 GeV beam π^+-Ar inclusive cross section measurement

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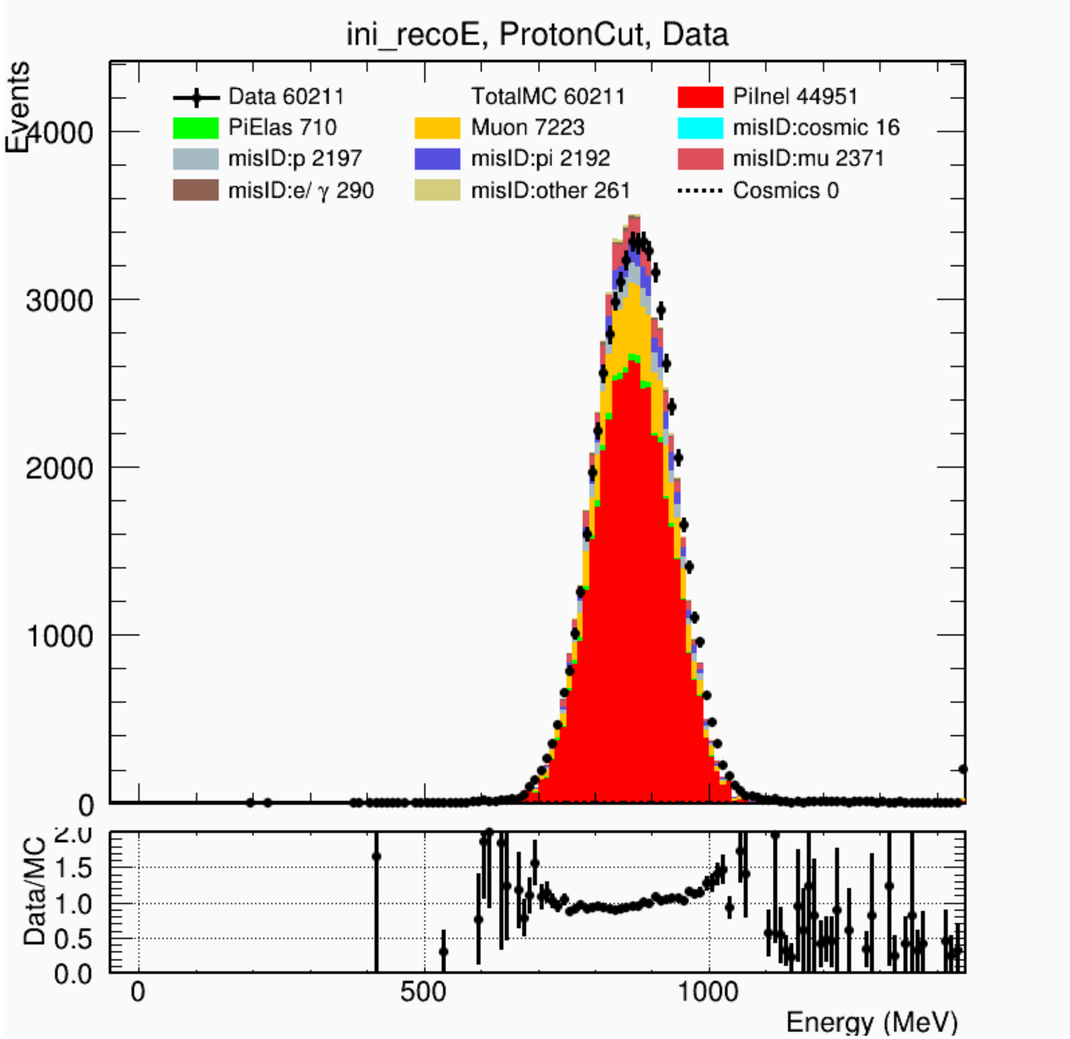
Sungbin's reweighting

- Fit **MC true** beam momentum with a Gaus(μ1, σ1)
- Fit **MC instrumented** beam momentum with a Gaus(μ2, σ2)
- Derive the required resolution σr = sqrt(σ2^2-σ1^2)
- Fit **data instrumented** beam momentum with a Gaus(μ3, σ3)
- Estimate the **data true** beam momentum σ4 = sqrt(σ3^2-σr^2)
- Reweight **MC true** to **data true** by assigning the factor Gaus(μ1, σ4)/Gaus(μ1, σ1)

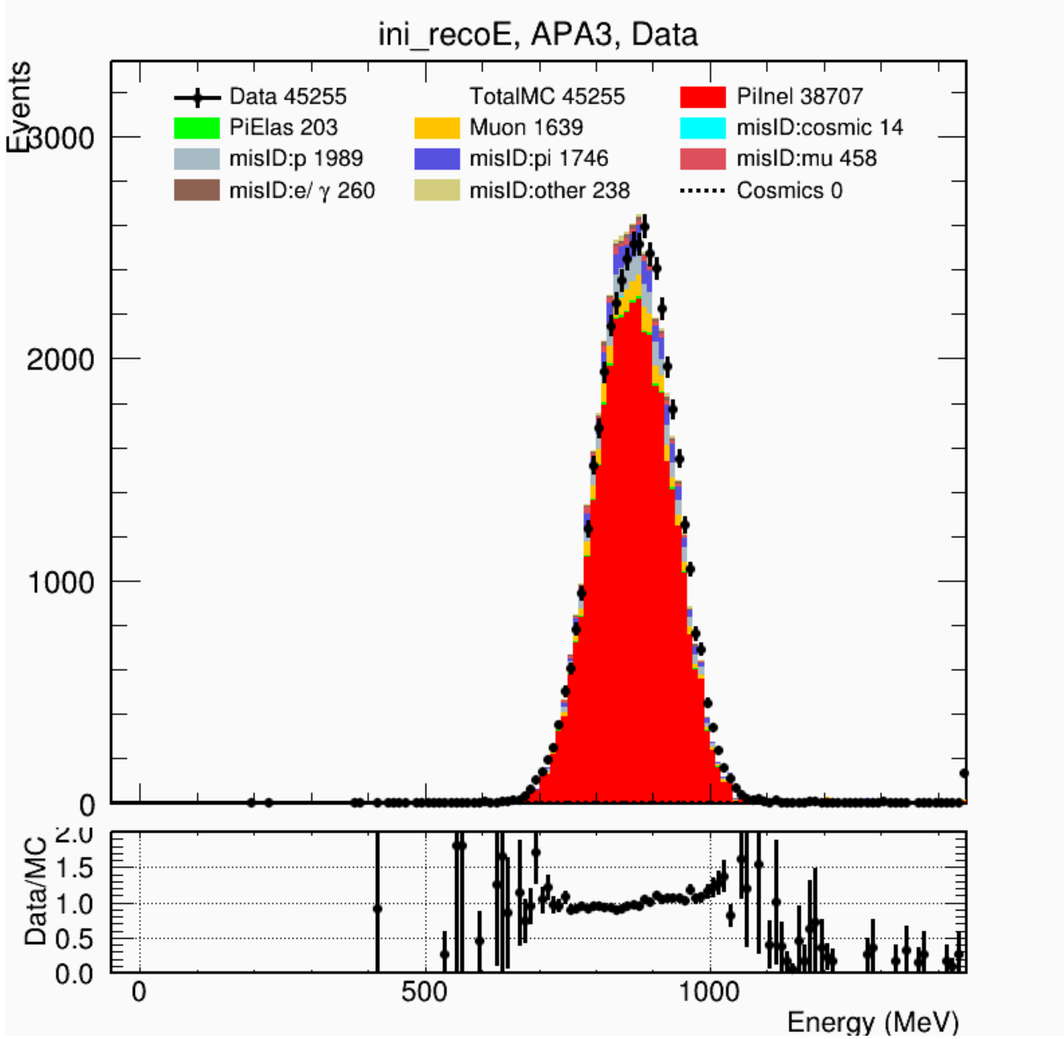
- Sungbin assumes the resolution for data and MC is the same, because "it is only related with scintillation fibre width of beam spectrometer".
- Plan to consider difference in μ as well.

Using Sungbin's parameters

weight=Gaus(1007, 68.17)/Gaus(1007, 57.7)



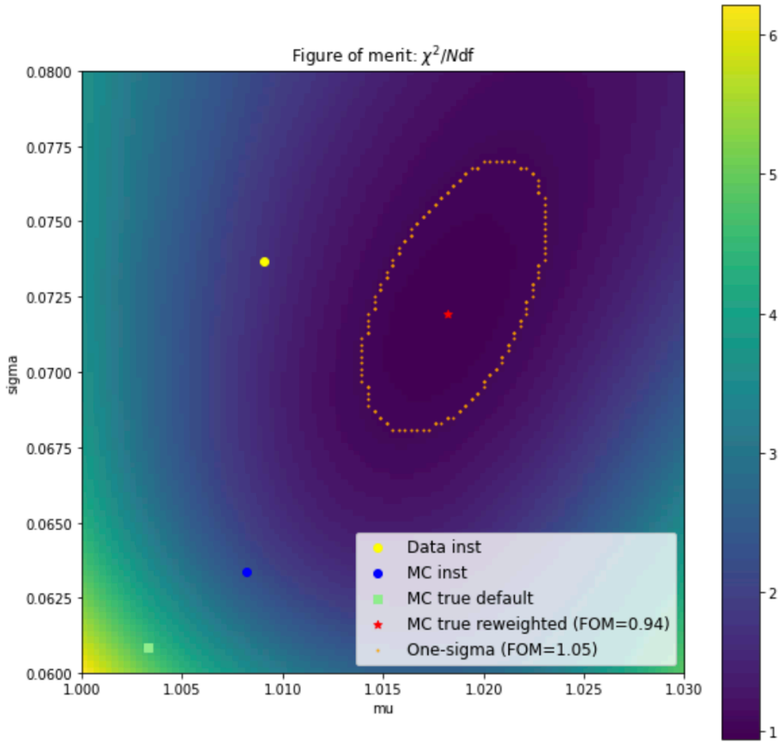
Before muon cuts



After muon cuts

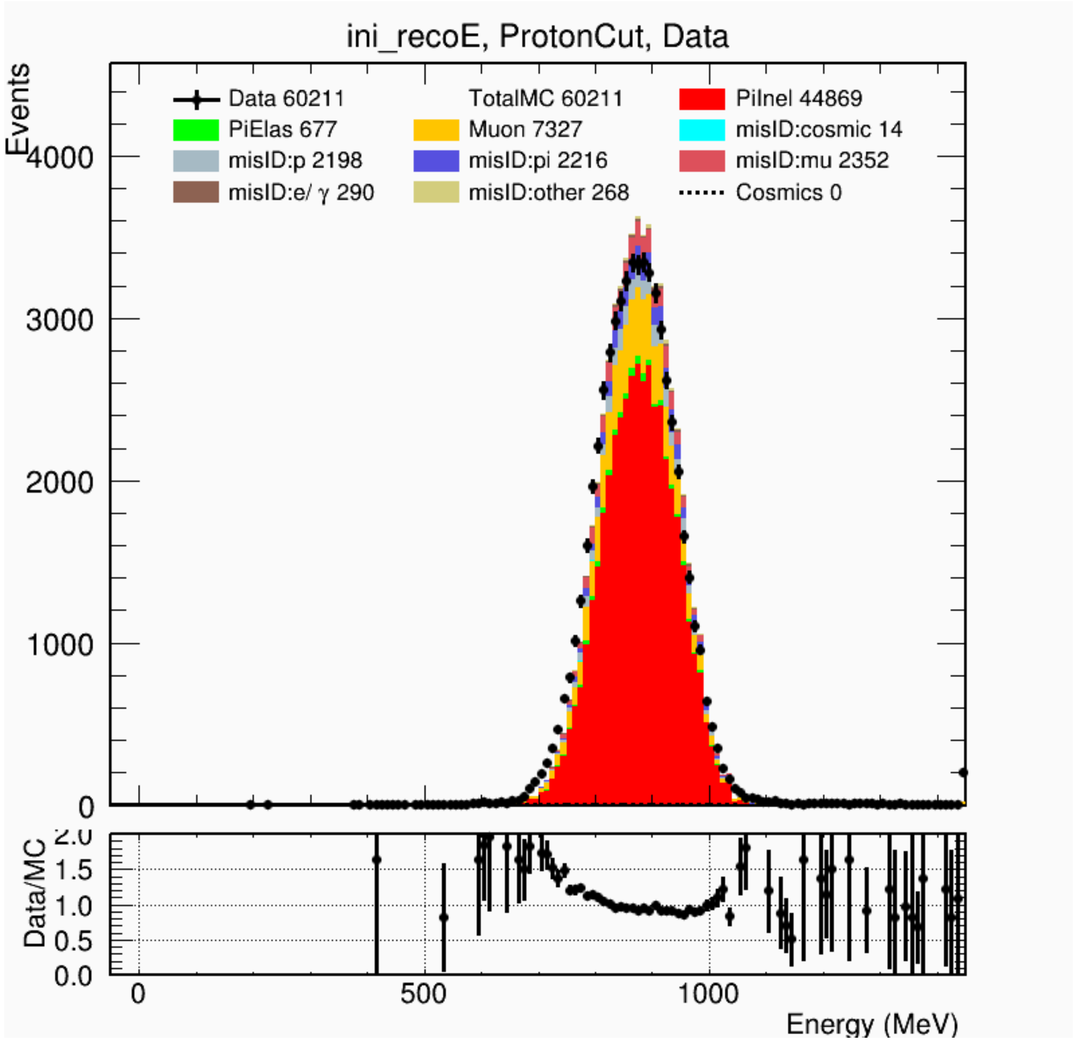
My reweighting procedure

- Select stopping muon sample in both data and MC as standard candle
- Calculate their front-face KE using reco_trklen
- Reweight MC true beam momentum for the lowest chi2 on KEff_from_trklen for data/MC
- Now we expect data and MC have the same true beam momentum.
- We assume this result from muons can also be applied to pions.

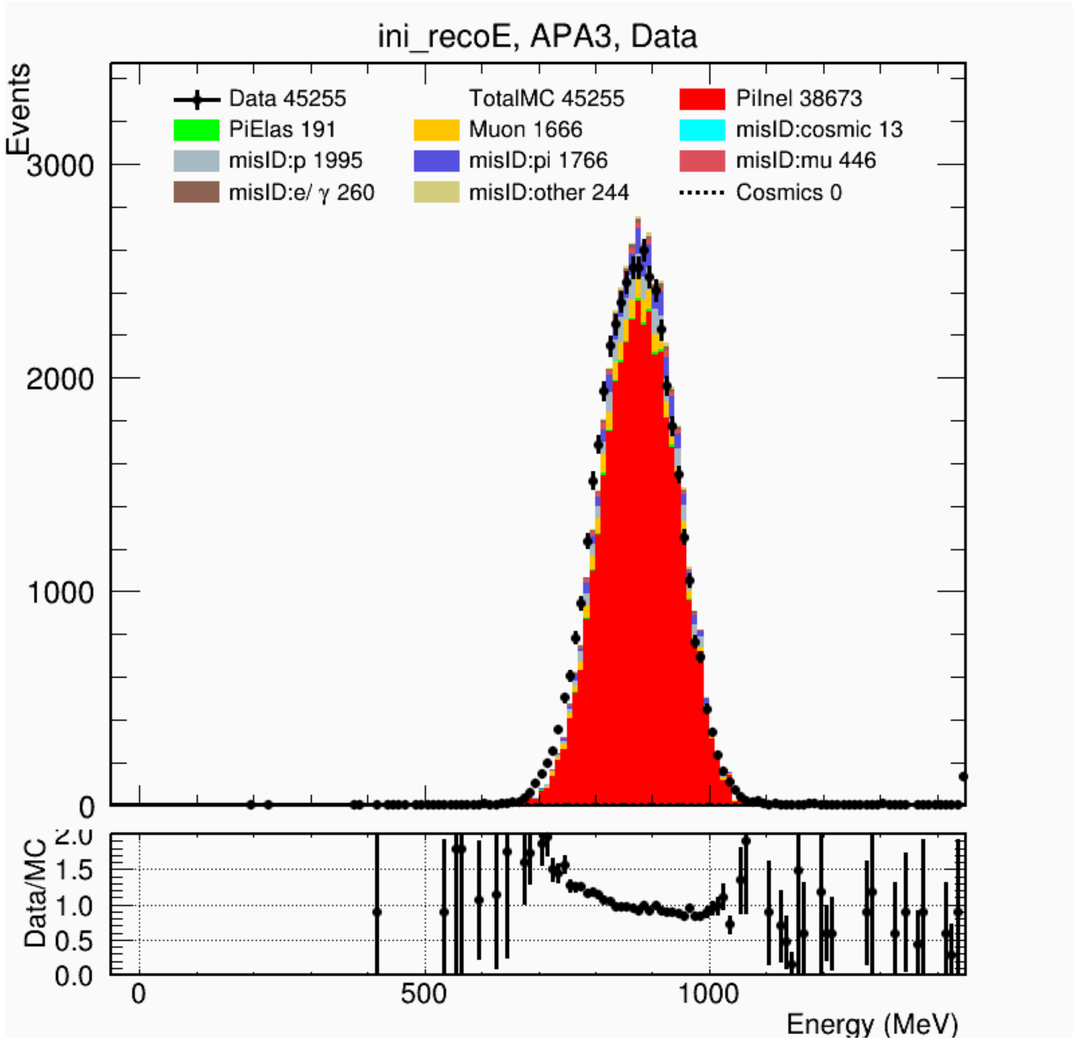


Results

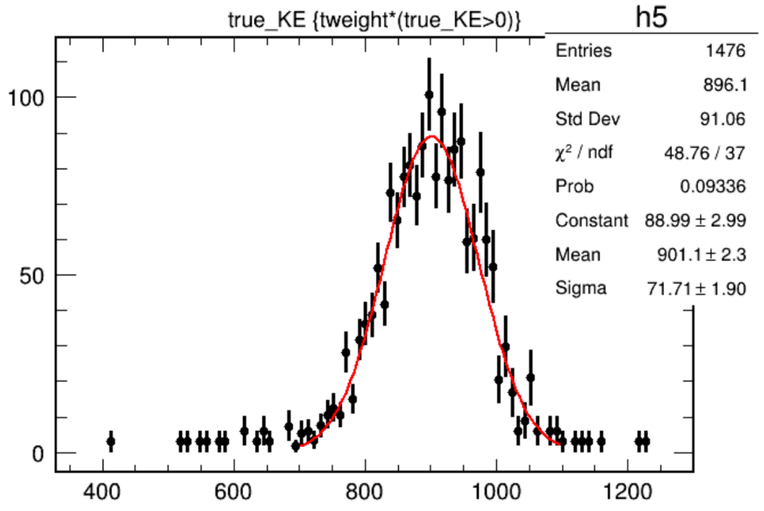
weight=Gaus(1018.18, 71.92)/Gaus(1003.3, 60.9)

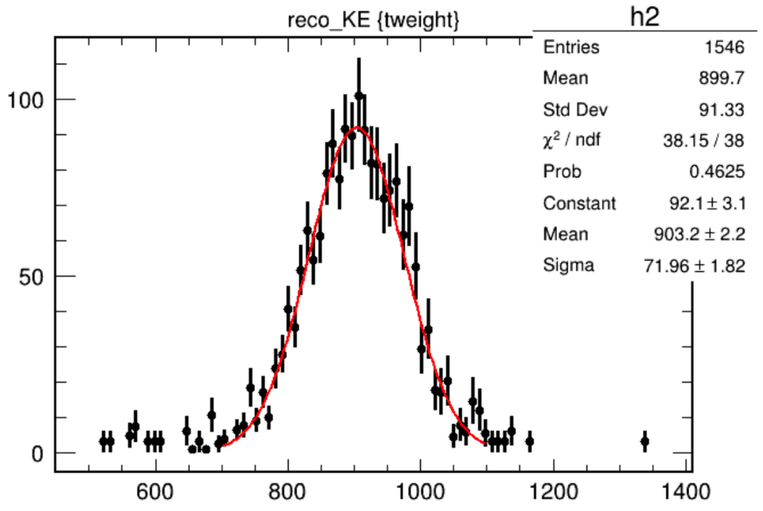


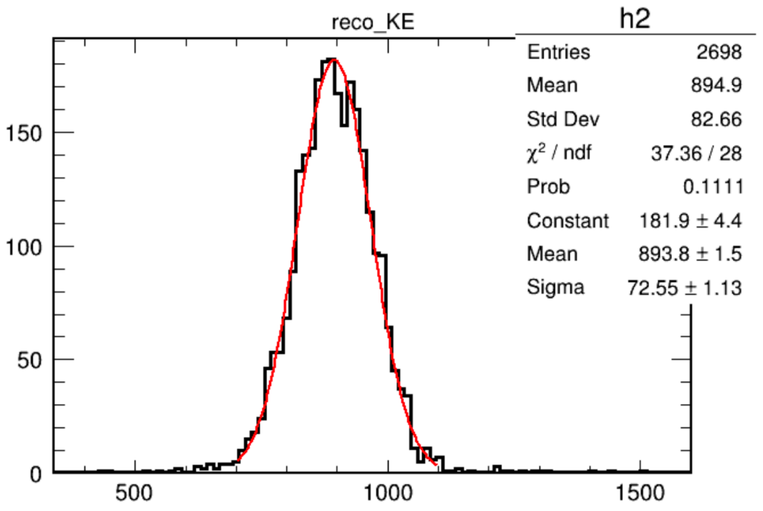
Before muon cuts

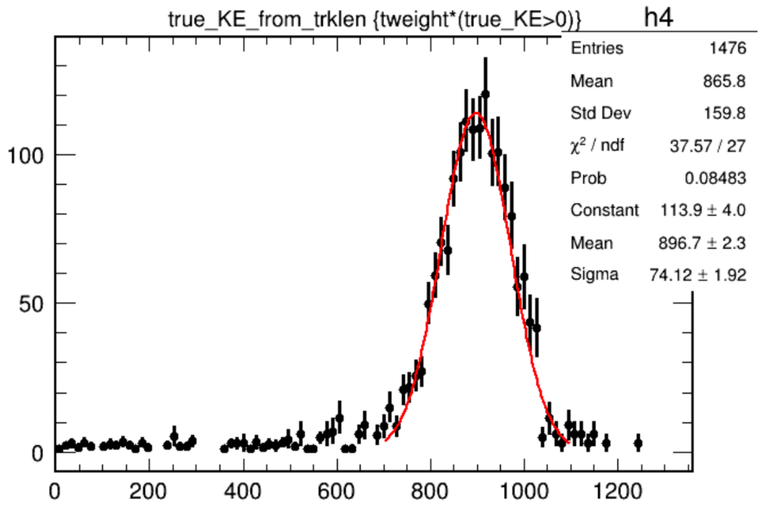


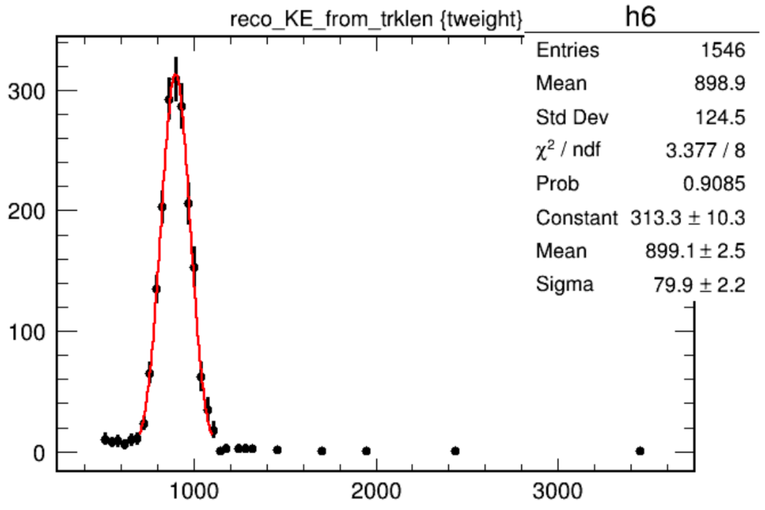
After muon cuts

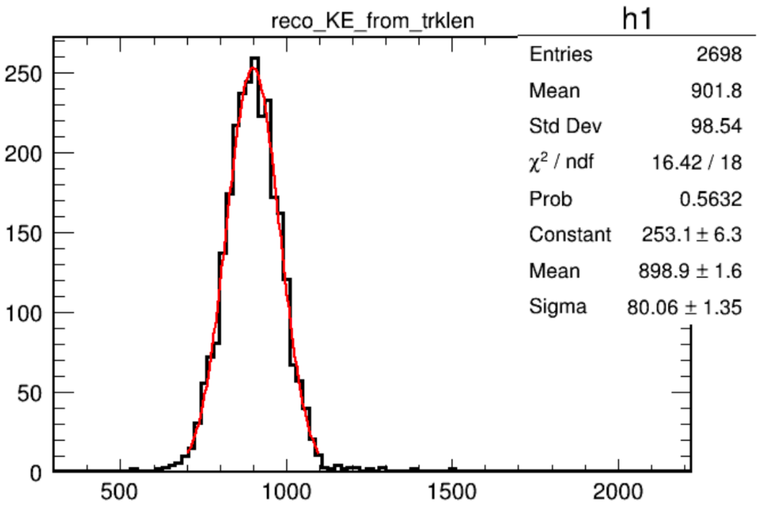

true_KE {tweight*(true_KE>0)}
h5
Entries 1476
Mean 896.1
Std Dev 91.06
χ² / ndf 48.76 / 37
Prob 0.09336
Constant 88.99 ± 2.99
Mean 901.1 ± 2.3
Sigma 71.71 ± 1.90

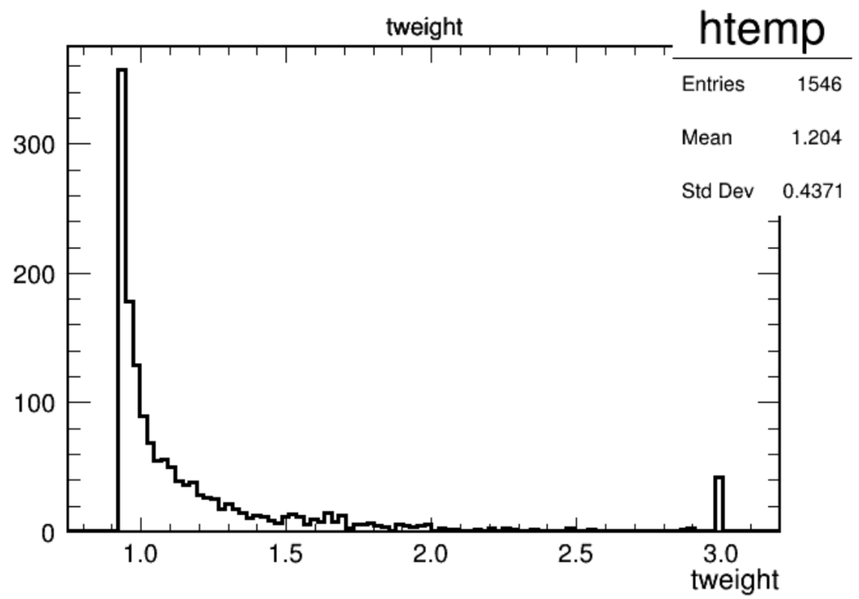

reco_KE {tweight}
h2
Entries 1546
Mean 899.7
Std Dev 91.33
χ² / ndf 38.15 / 38
Prob 0.4625
Constant 92.1 ± 3.1
Mean 903.2 ± 2.2
Sigma 71.96 ± 1.82

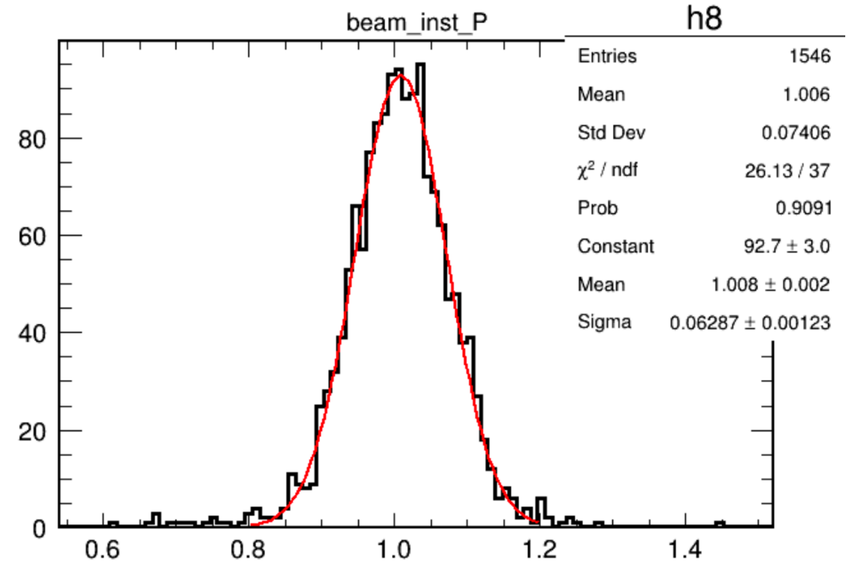

reco_KE
h2
Entries 2698
Mean 894.9
Std Dev 82.66
χ² / ndf 37.36 / 28
Prob 0.1111
Constant 181.9 ± 4.4
Mean 893.8 ± 1.5
Sigma 72.55 ± 1.13

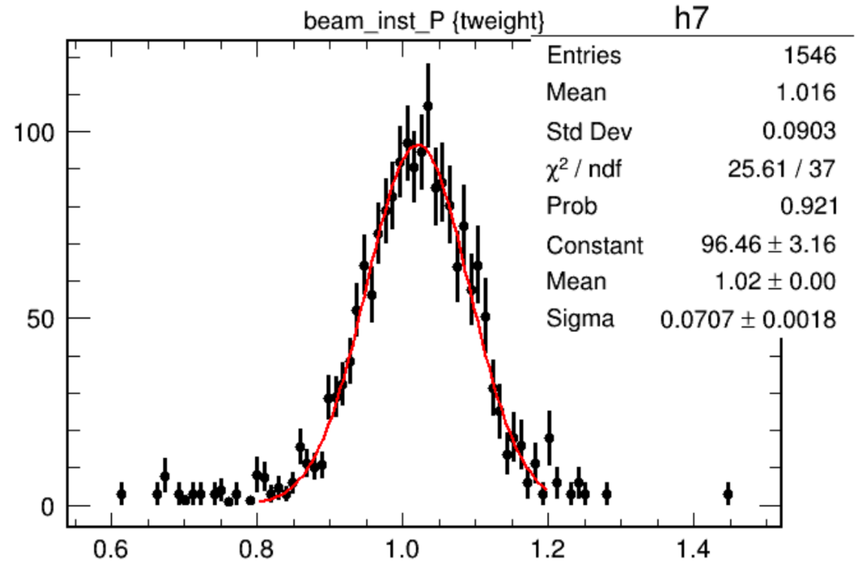

true_KE_from_trklen {tweight*(true_KE>0)}
h4
Entries 1476
Mean 865.8
Std Dev 159.8
χ² / ndf 37.57 / 27
Prob 0.08483
Constant 113.9 ± 4.0
Mean 896.7 ± 2.3
Sigma 74.12 ± 1.92

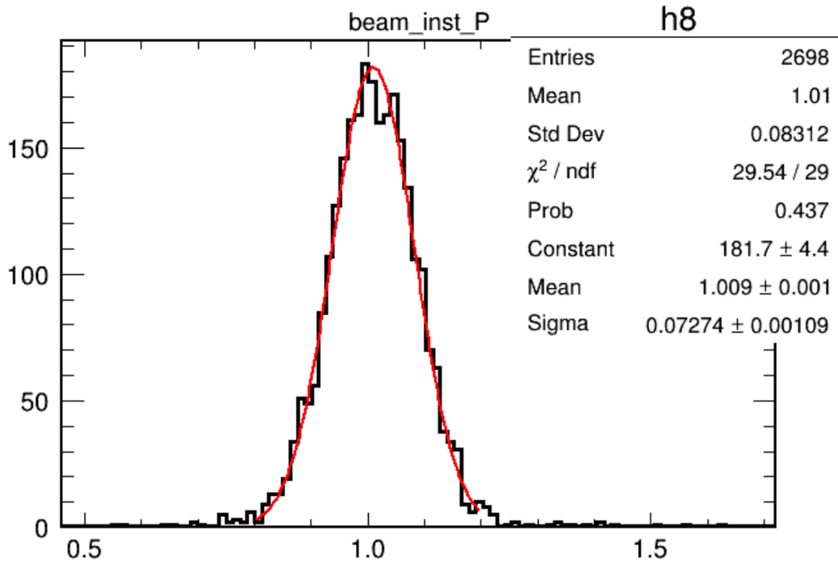

reco_KE_from_trklen {tweight}
h6
Entries 1546
Mean 898.9
Std Dev 124.5
χ² / ndf 3.377 / 8
Prob 0.9085
Constant 313.3 ± 10.3
Mean 899.1 ± 2.5
Sigma 79.9 ± 2.2


reco_KE_from_trklen
h1
Entries 2698
Mean 901.8
Std Dev 98.54
χ² / ndf 16.42 / 18
Prob 0.5632
Constant 253.1 ± 6.3
Mean 898.9 ± 1.6
Sigma 80.06 ± 1.35


tweight
htemp
Entries 1546
Mean 1.204
Std Dev 0.4371
300
200
100
0
1.0
1.5
2.0
2.5
3.0
tweight


beam_inst_P
h8
Entries 1546
Mean 1.006
Std Dev 0.07406
χ² / ndf 26.13 / 37
Prob 0.9091
Constant 92.7 ± 3.0
Mean 1.008 ± 0.002
Sigma 0.06287 ± 0.00123
80
60
40
20
0
0.6
0.8
1.0
1.2
1.4


beam_inst_P {tweight}
h7
Entries 1546
Mean 1.016
Std Dev 0.0903
χ² / ndf 25.61 / 37
Prob 0.921
Constant 96.46 ± 3.16
Mean 1.02 ± 0.00
Sigma 0.0707 ± 0.0018
100
50
0
0.6
0.8
1.0
1.2
1.4

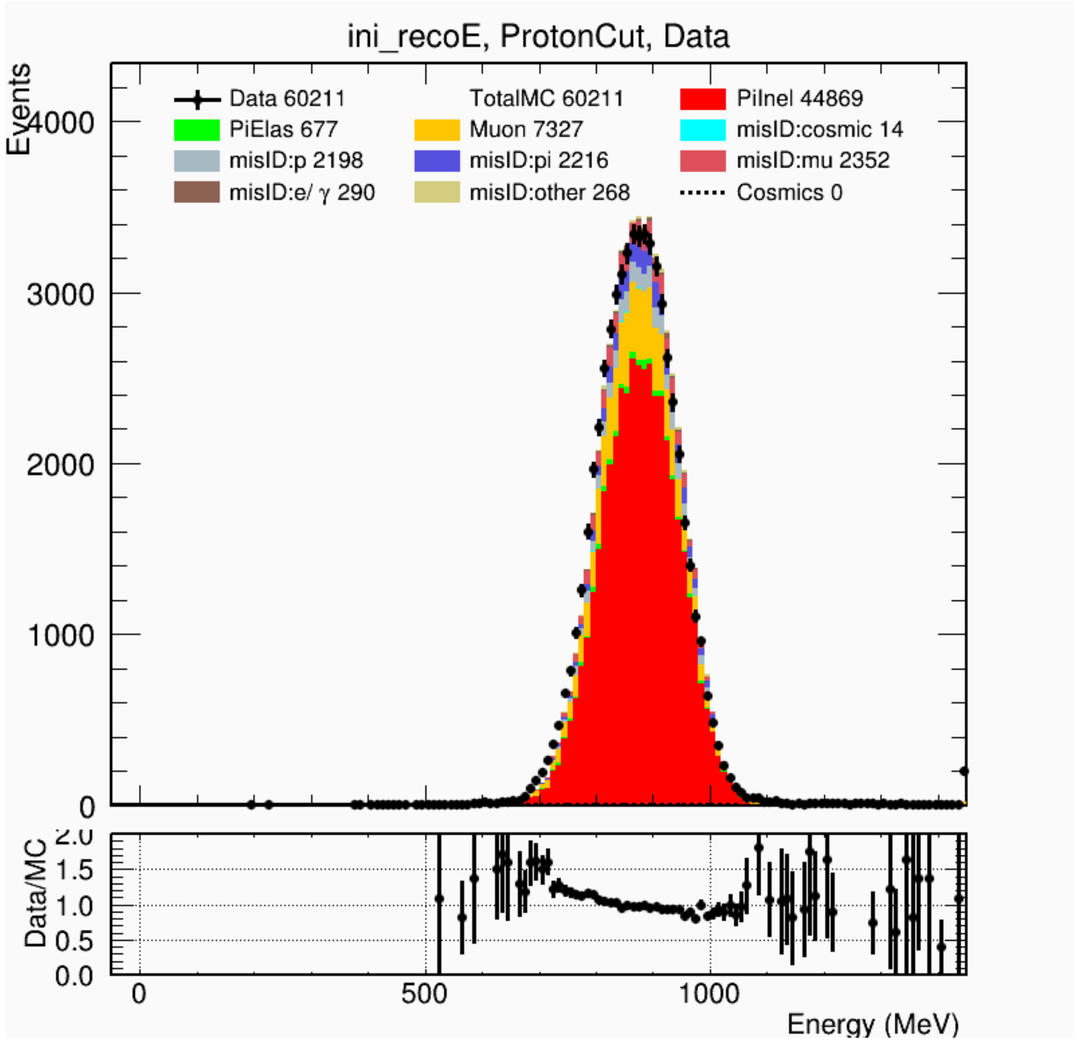

beam_inst_P
h8
Entries 2698
Mean 1.01
Std Dev 0.08312
χ² / ndf 29.54 / 29
Prob 0.437
Constant 181.7 ± 4.4
Mean 1.009 ± 0.001
Sigma 0.07274 ± 0.00109
150
100
50
0
0.5
1.0
1.5

An extra smearing

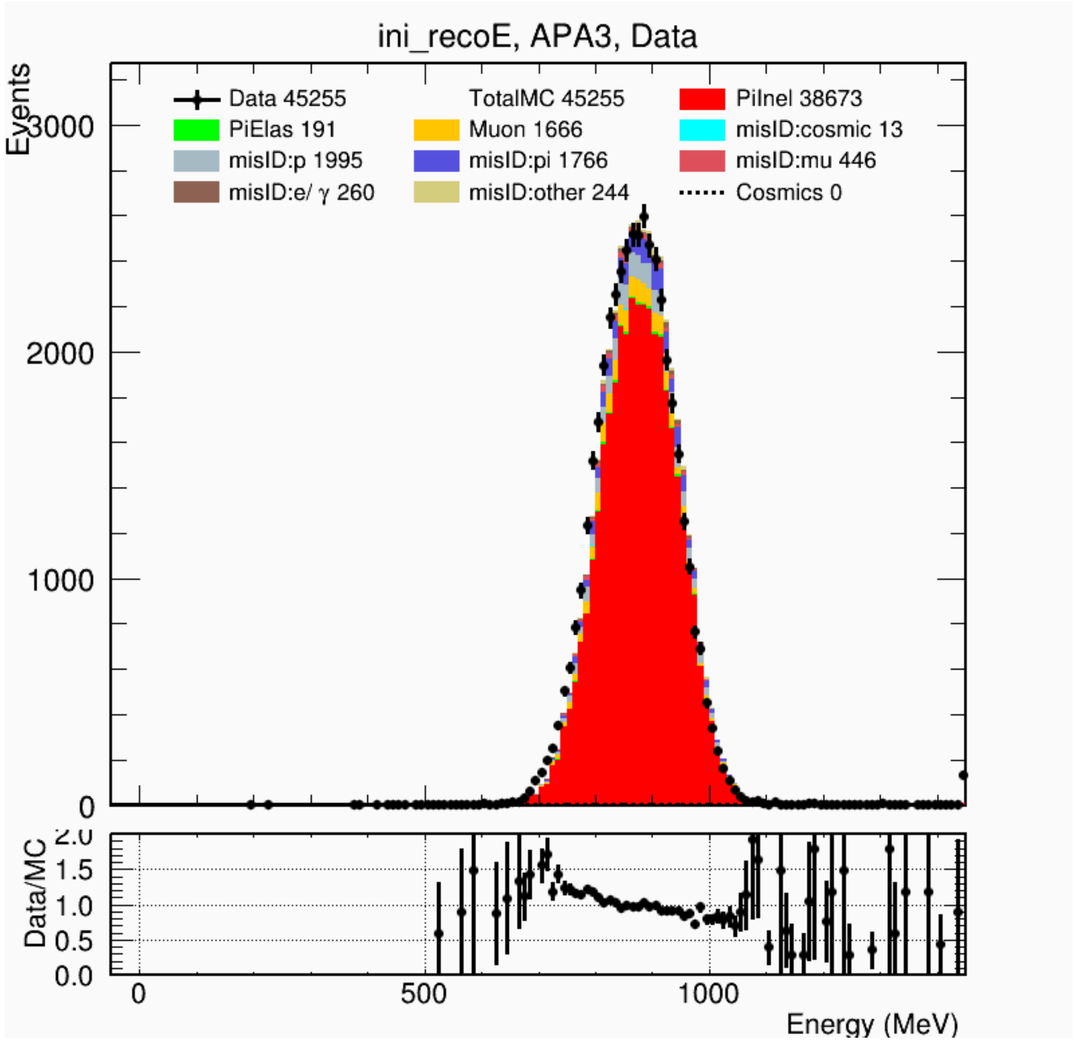
- The remaining difference in beam instrumented momentum σ could be due to data/MC difference in resolution.
- Still using the stopping muon sample
  - Fit **data instrumented** beam momentum with a Gaus(μ1, σ1)
  - Fit **MC instrumented** beam momentum with a Gaus(μ2, σ2)
  - Convolute an extra smearing σr=sqrt(σ1^2-σ2^2) in MC. (Add a random Gaus(0,σr) to **MC instrumented** beam momentum). Now we should have the same KEff.
- The difference between μ1 and μ2 could be due to difference in upstream E loss, but it's not needed since we've aligned the front-face KE.

Results

weight=Gaus(1018.18, 71.92)/Gaus(1003.3, 60.9), and an extra smearing Gaus(0,17.8) in MC beam_inst_P



Before muon cuts

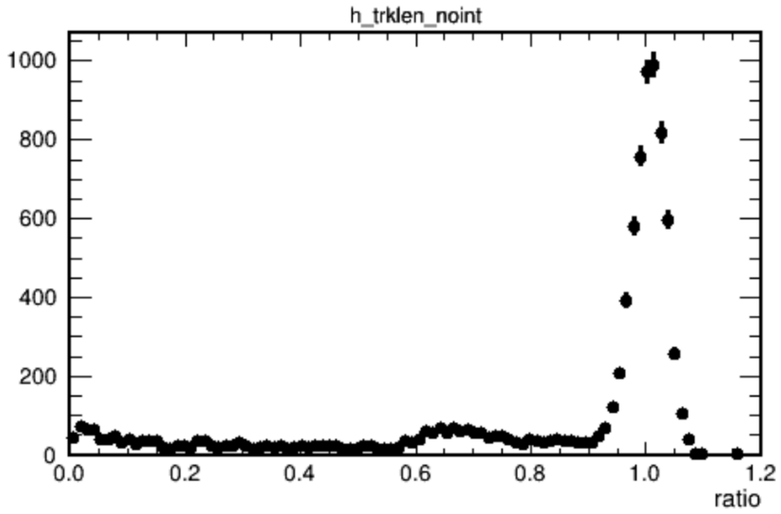


After muon cuts

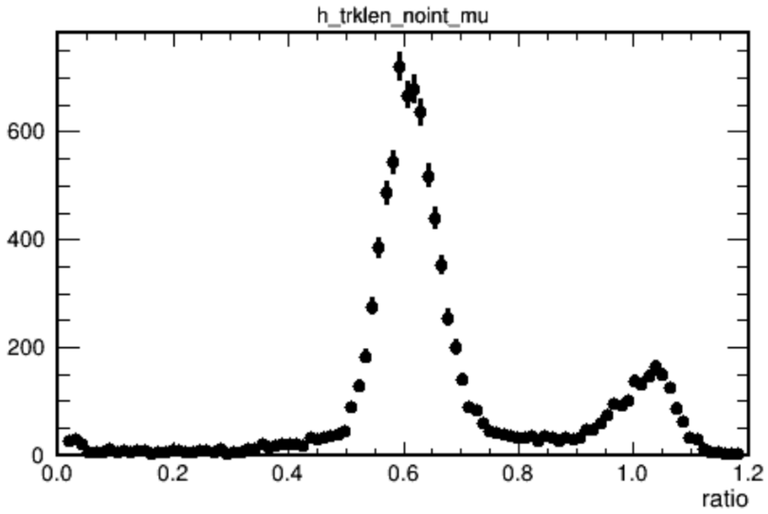
Back-ups

Stopping beam muon sample

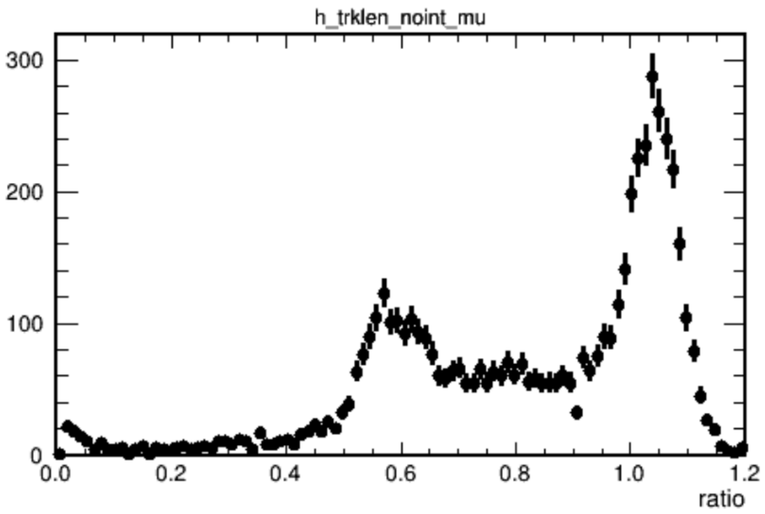
- BeamQualityCut && Michel_score > 0.6
- Ratio = trklen / RangeFromKE(Eff)



MC true

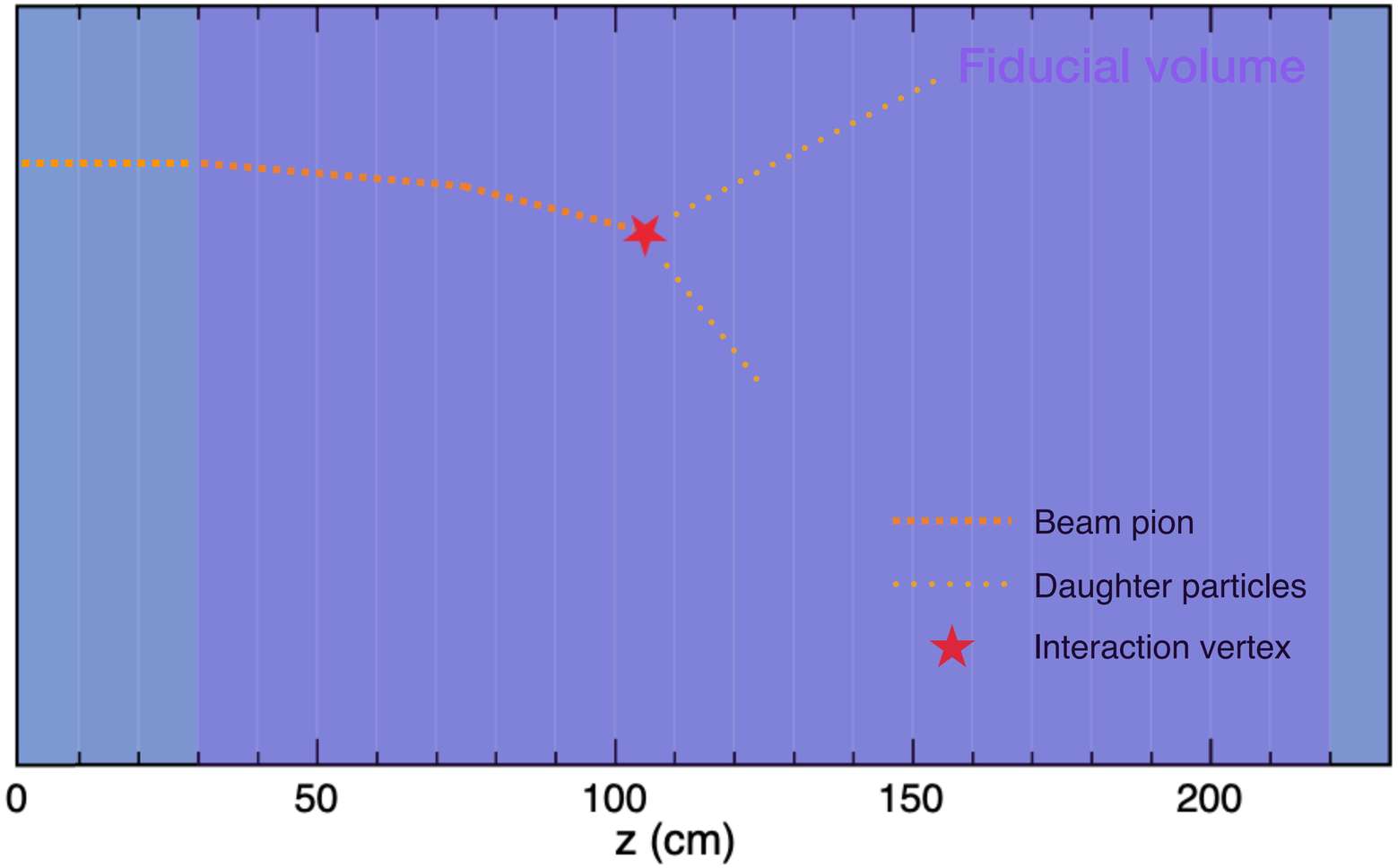


MC reco



Data reco

Select Ratio > 0.9 as stopping muon sample


Fiducial volume
Beam pion
Daughter particles
Interaction vertex
0
50
100
150
200
z (cm)