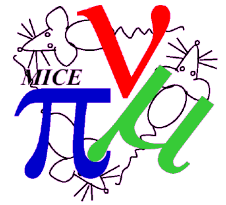




Beam Energy-Loss measurement

Rhys Gardener

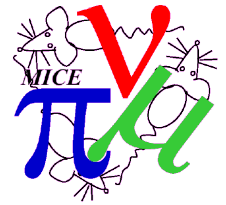
CM42
RAL



Intro/outline

- Preliminary look at the energy loss measurement – very early thoughts with a couple of simulations to assist.
- Energy loss in beam
 - LH2 absorber
- MC study
 - Simulation Details
 - Analysis
 - Plots
 - Conclusions

Beam Energy-loss



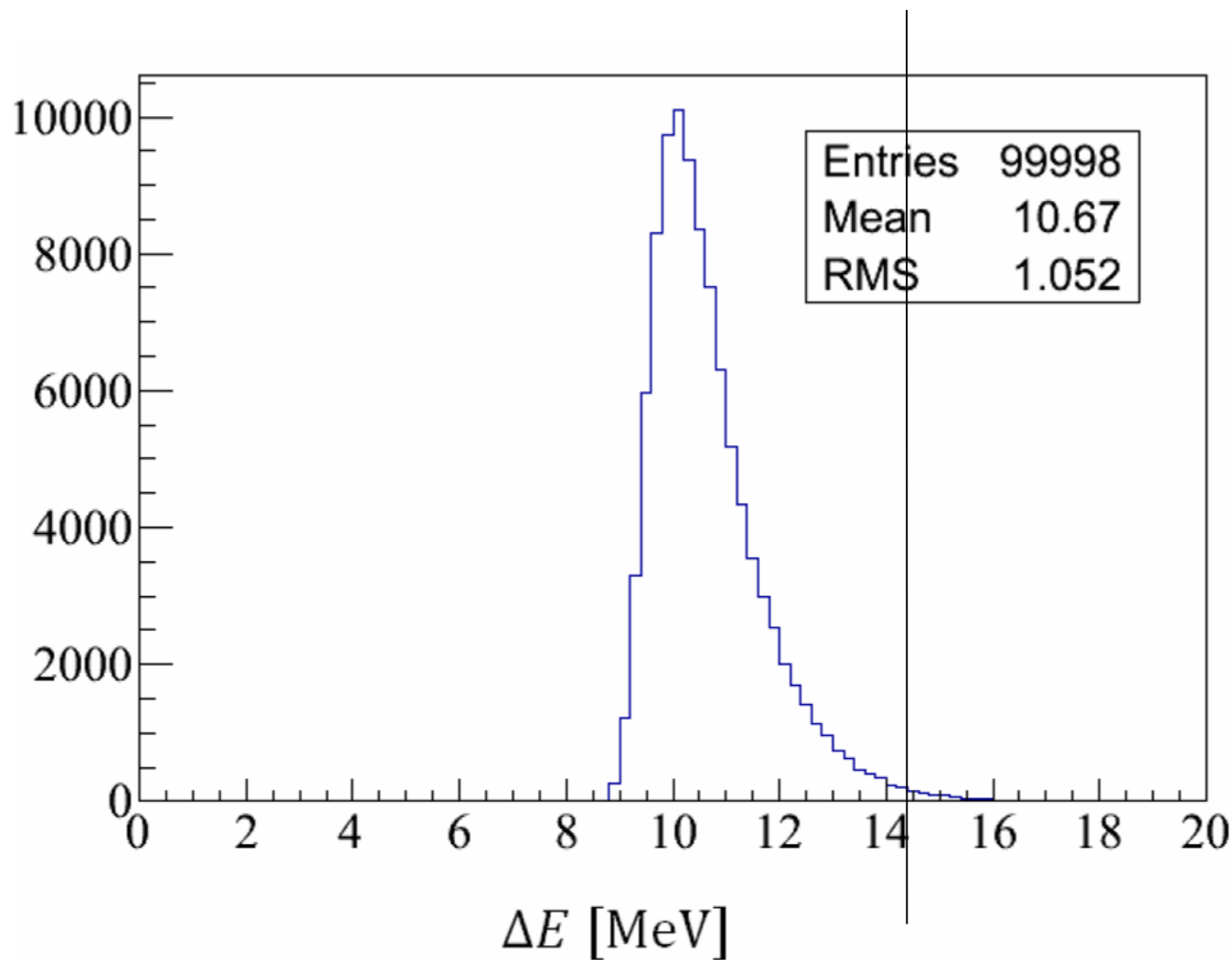
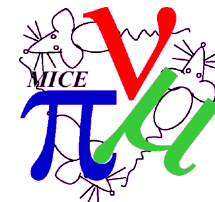
- Ionisation Cooling of a Muon beam is achieved by passing the beam through an absorber of low-Z material.
 - In our case LH2 or LiH.

- Energy-loss is an interesting measurement that will help our understanding of the beam.

- There are few (if any) instances of the muon beam energy loss being measured.
 - MUSCAT measured scattering angle distributions.

-

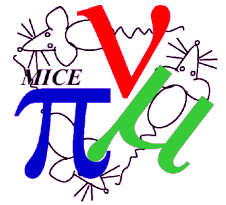
- Will initially use the trackers to measure the momentum either side of the absorber.
 - Likely all detectors will be needed to make a good measurement.



Simulated Energy loss distribution for 200MeV muons in 35cm LH2.

(from Tim Carlisle's Thesis.)

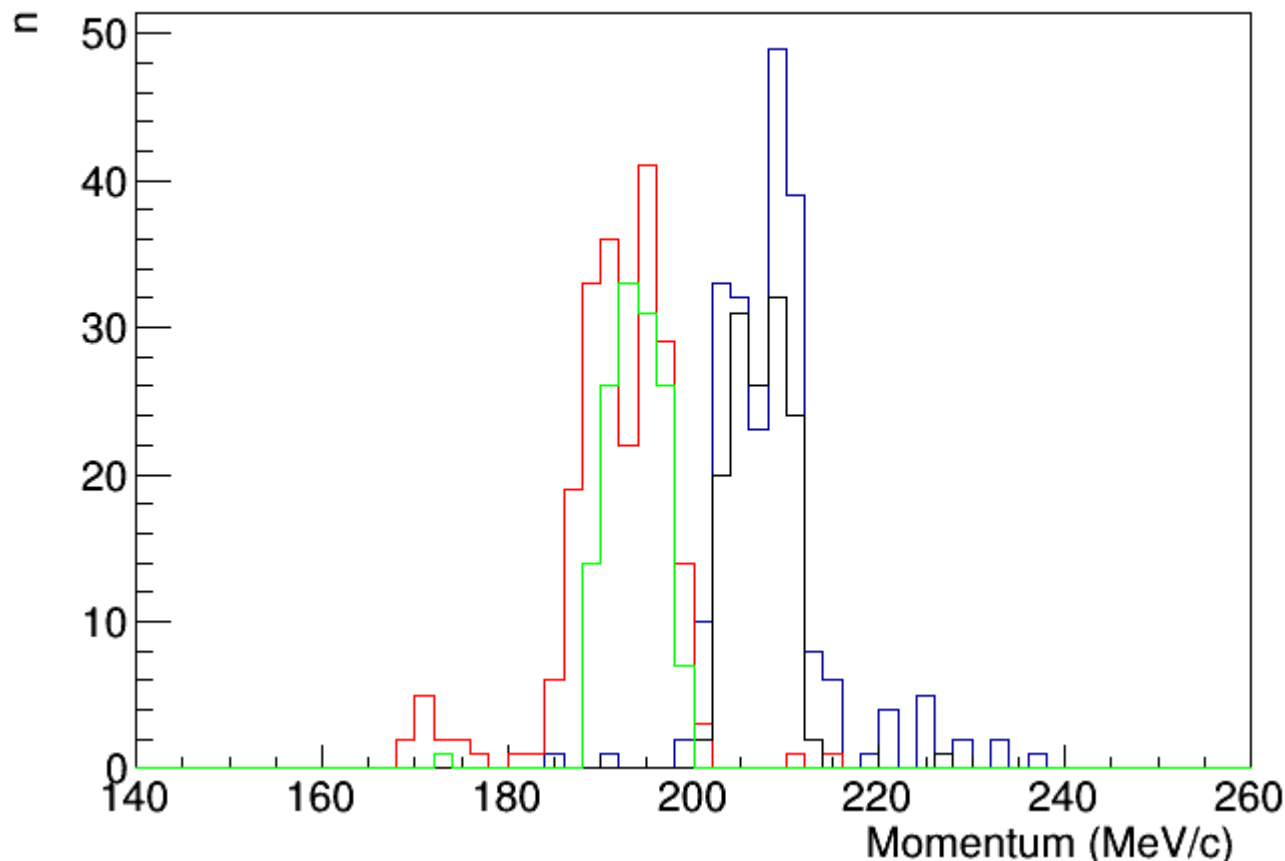
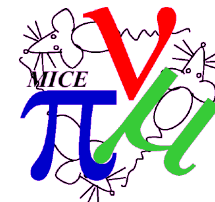
MAUS MC simulation



- Using Step IV geometry (42) with LH2 absorber.
- 100k events simulated at 200MeV/c at beginning of channel.
 - Particle decay enabled (should disable later?)
 - 22042 spills produce space points in TOF detectors.

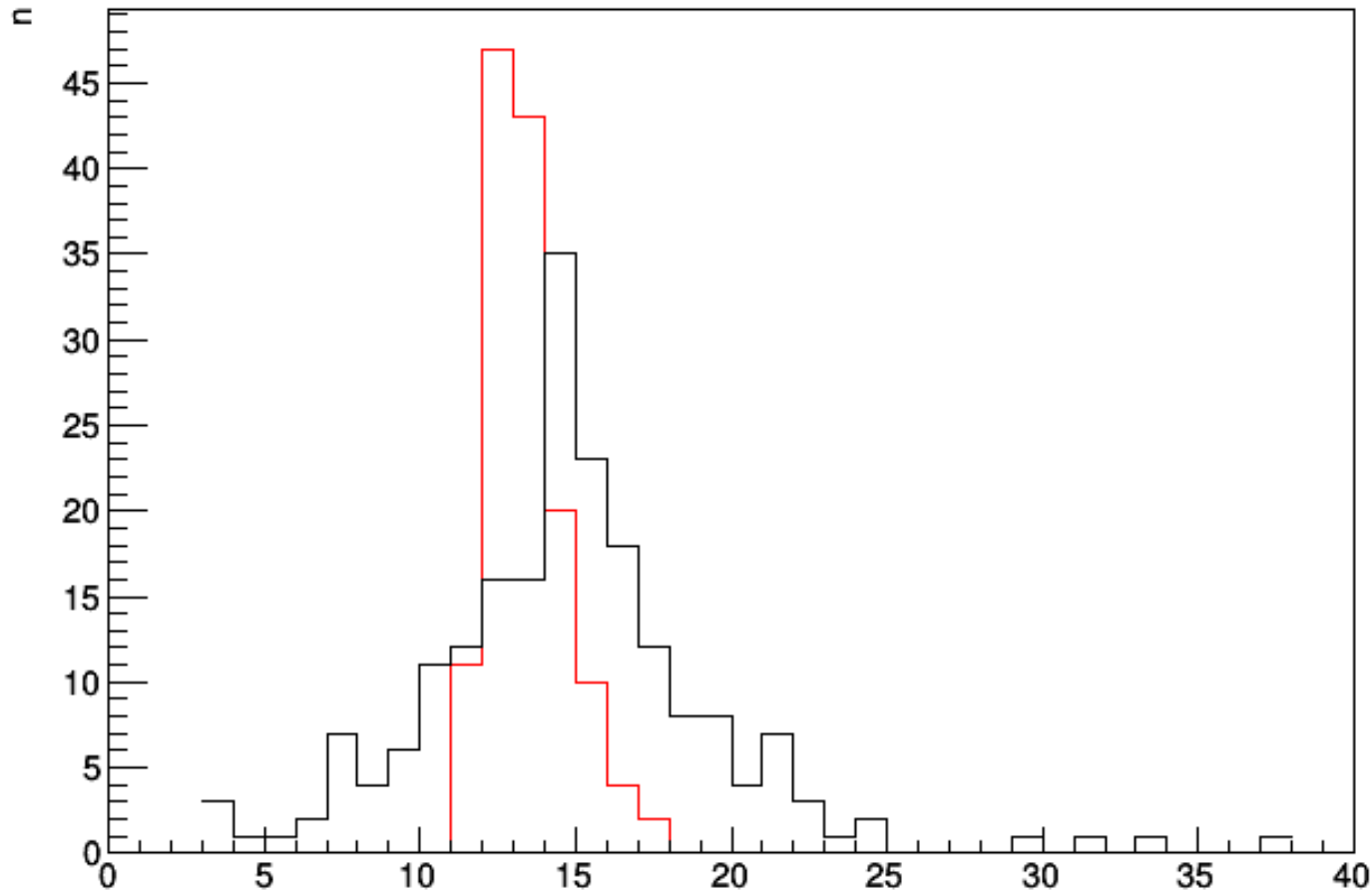
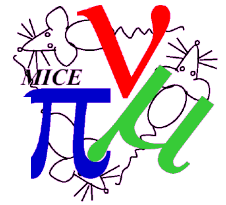
Initial MC analysis

- Use difference between TOF1 and TOF0 to select muon tracks
 - 42-48ns
 - End up with 3904 tracks reconstructed through both trackers. (4% of simulated events)
- Momentum range of muons can be flexible. I have chosen $200 \pm 5 \text{ MeV}$ at the absorber.
 - Results in selecting only ~300 reconstructed events
- Make a comparison of reconstructed momenta in upstream&downstream trackers.
 - Quick and easy, not final solution..



Blue – US reconstructed MC. Mean = 208.475 MeV/c, RMS = 6.252
Red – DS reconstructed MC. Mean = 191.643 MeV/c, RMS = 6.430
Black – US MC data Mean = 207.263 MeV/c, RMS = 3.249
Green – DS MC data Mean = 193.546 MeV/c, RMS = 3.251

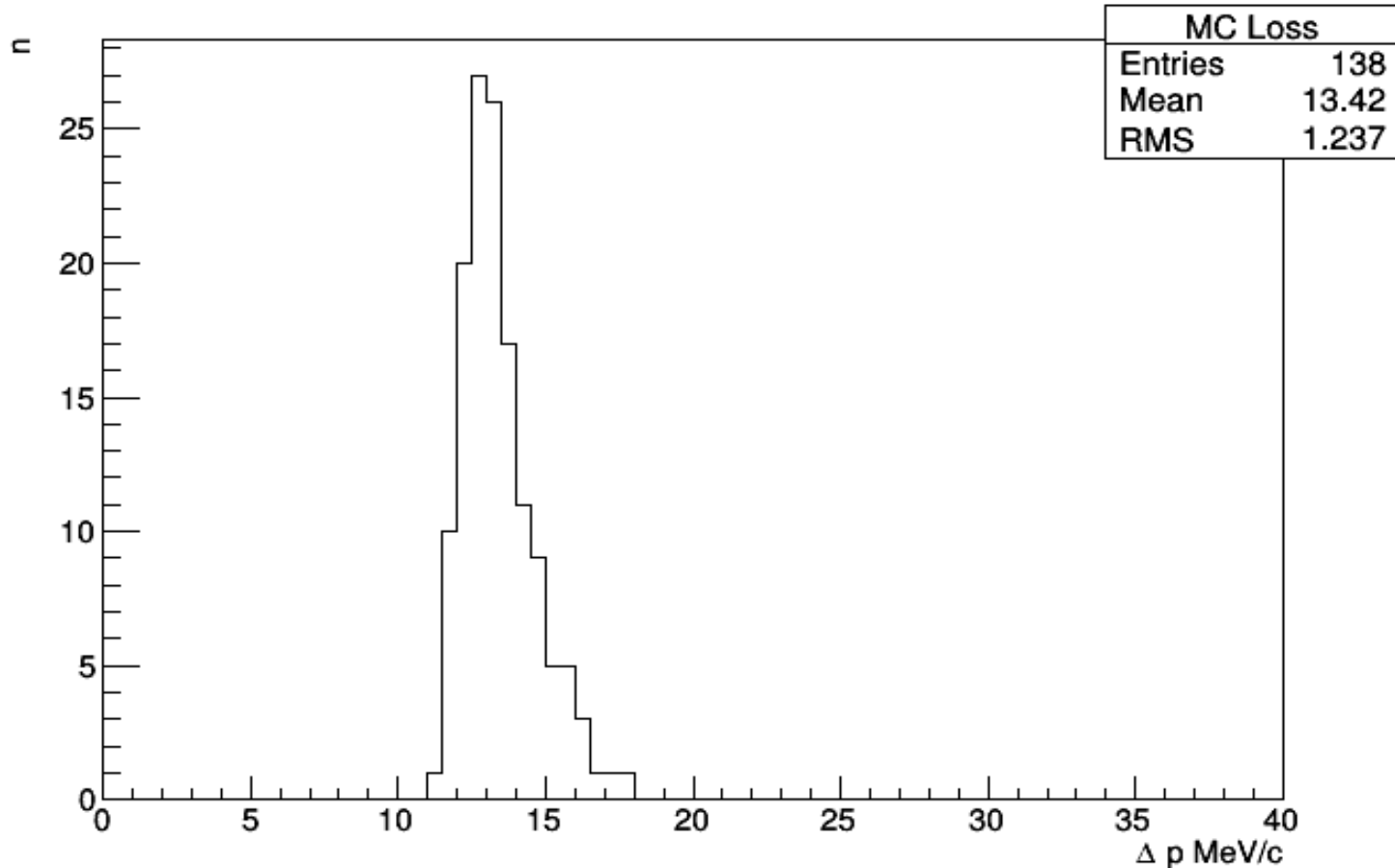
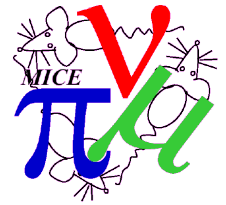
Energy Loss plots



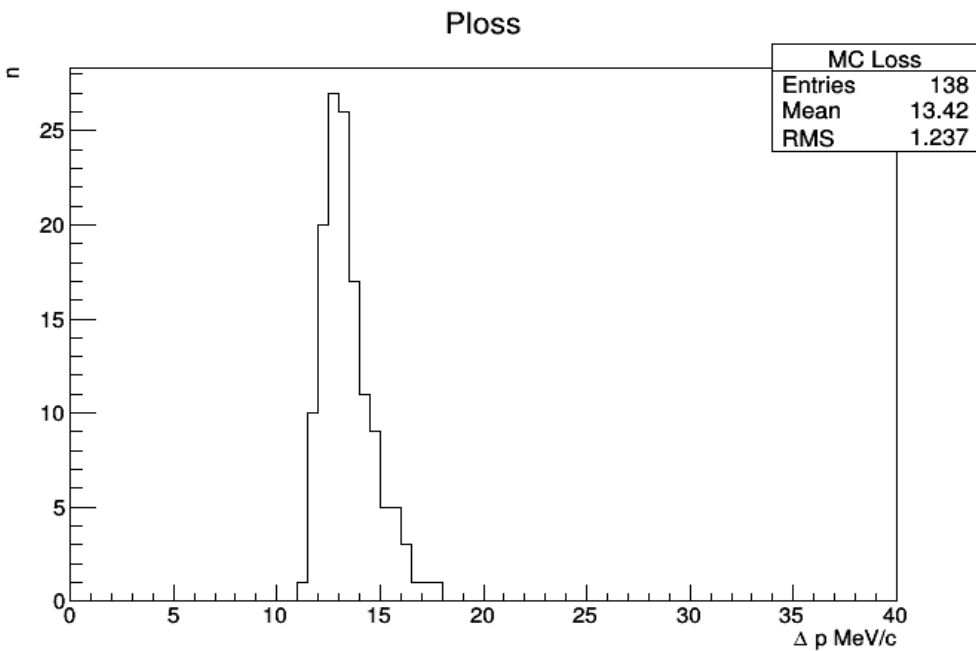
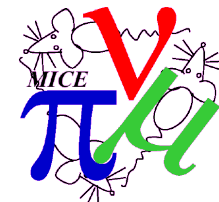
Black – Reconstructed MC data
Red – MC data

Mean = 14.8661, RMS = 4.7137
Mean = 13.4228, RMS = 1.237

- Mean (roughly) in agreement.

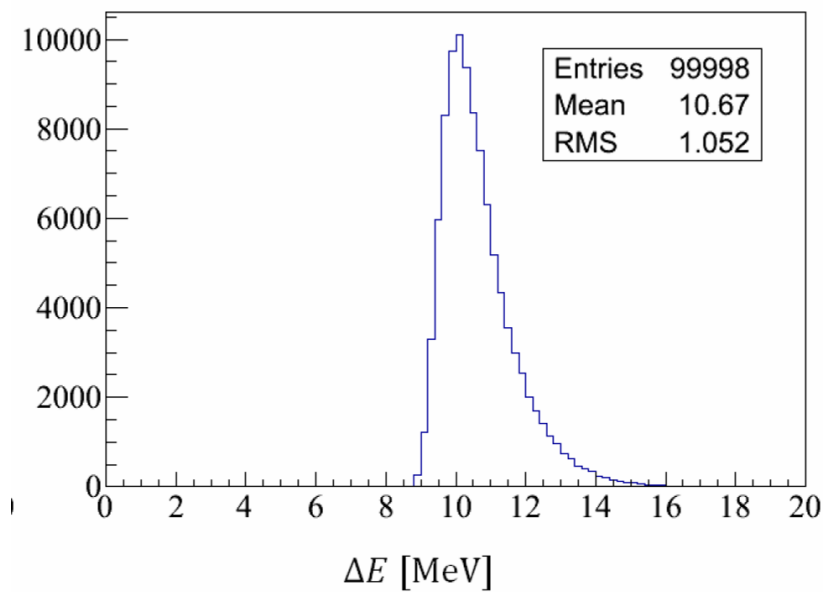


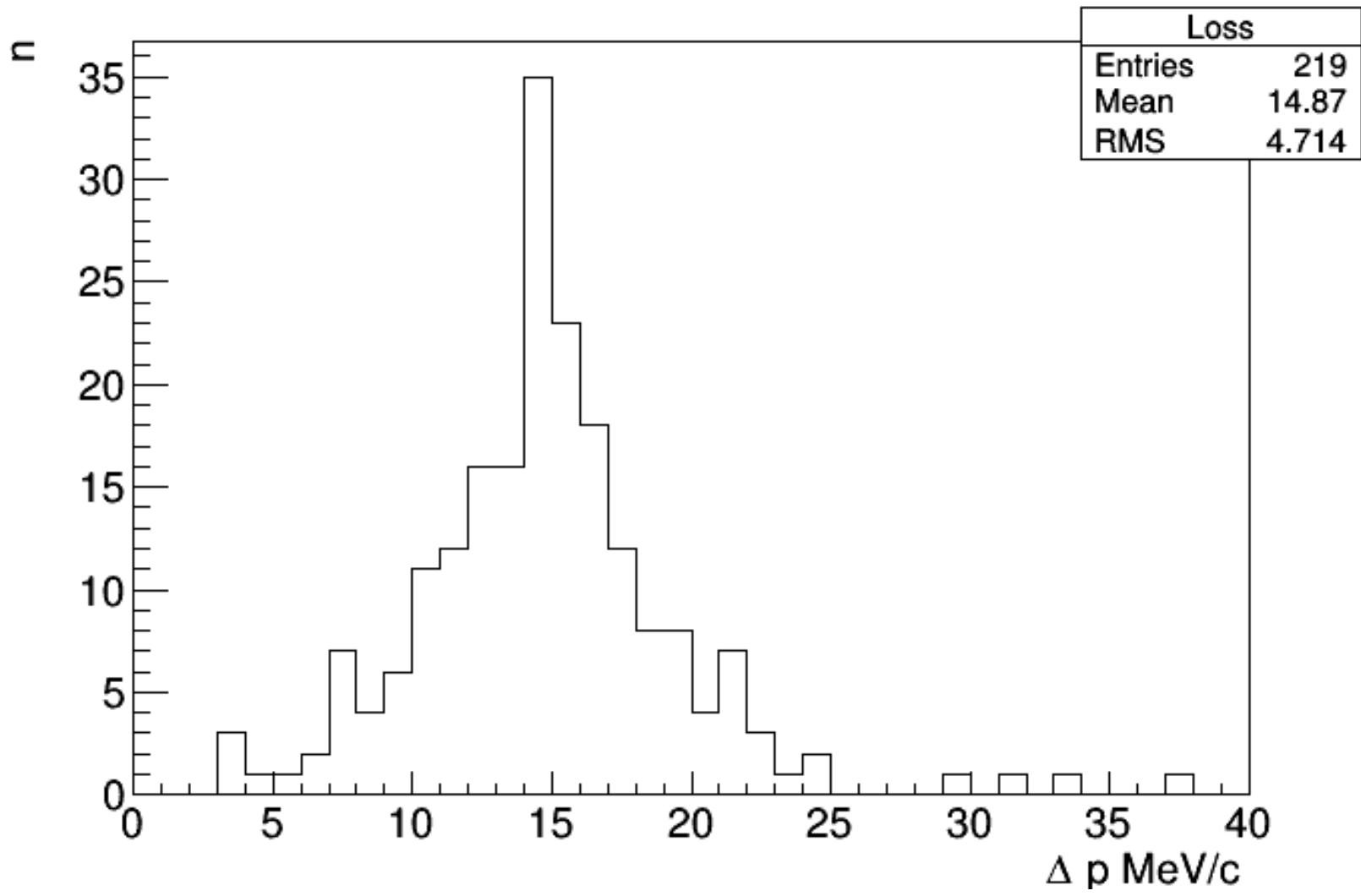
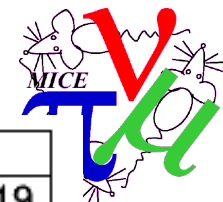
- › MC data only – good comparison with T. Carlisle's MC results above.
 - › Slightly higher mean.
- › Clear Landau distribution, will be easy enough to make a fit.

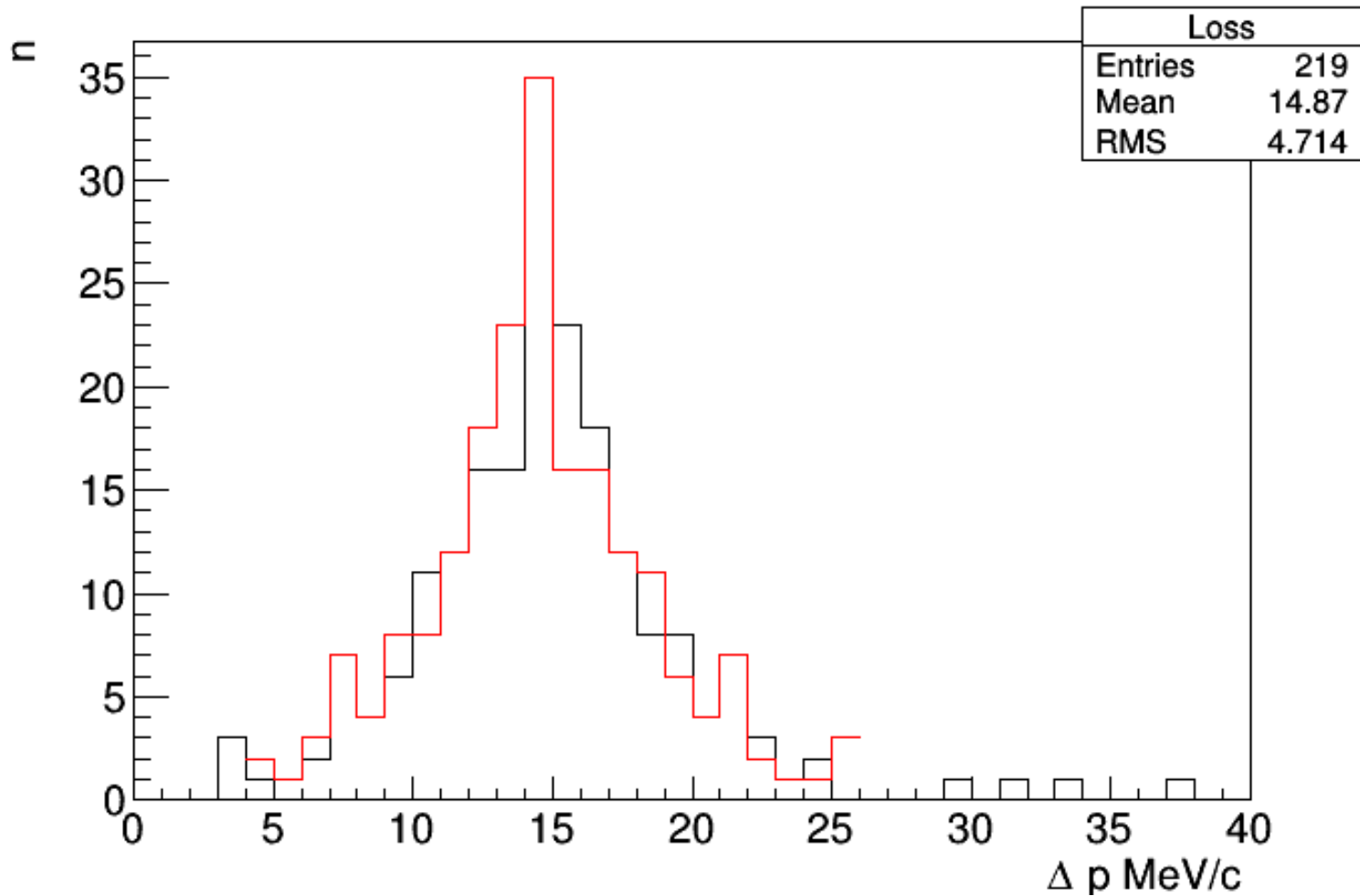
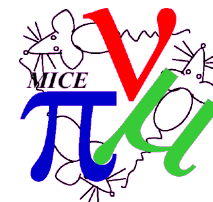


← My Monte Carlo

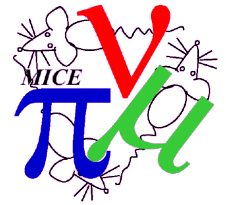
Tims Monte-Carlo -->



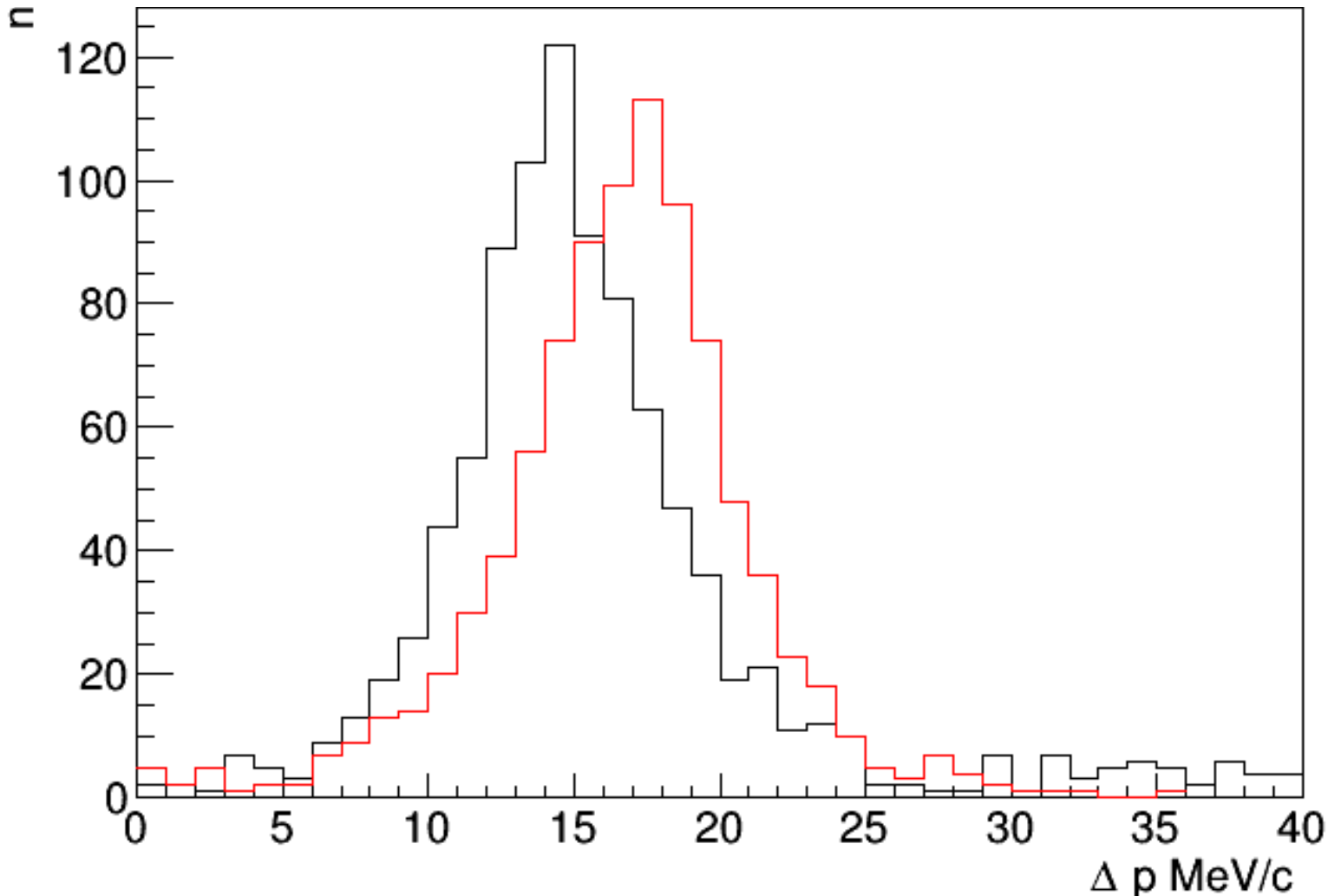




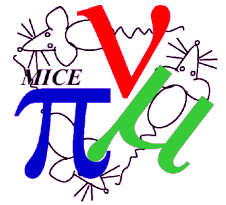
Distribution reflected around maximum.
- Could be possible to see landau asymmetry with more events..



- › Increased momentum selection range to 200 ± 20 MeV.
- › Reflect distribution around mean. (Red is reflected)
- › Landau distribution now more clear..

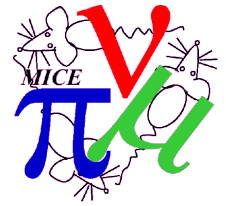


Comments/Conclusions



- Difference in mean momenta in Upstream and Downstream tracker is around 14MeV, but large error
- Reflecting distribution of energy loss potentially indicates landau, good to compare with MC.
 - More stats needed – redo MC with muon tracks only.
- Resolution on Energy loss measurement will be an issue
 - Tracker resolution \sim 3MeV (improvements coming?)
- Can potentially improve measurement by using other detectors:
 - TOF can measure momentum with resolution \sim 4MeV
 - EMR \sim 2MeV?
 - KL?

- Lots of work to do!



Thank you – Questions?

