DEEP UNDERGROUND NEUTRINO EXPERIMENT

UNIVERSITY of HOUSTON
YOU ARE THE PRIDE
DEPARTMENT OF PHYSICS

Updated on Electron Energy Reconstruction

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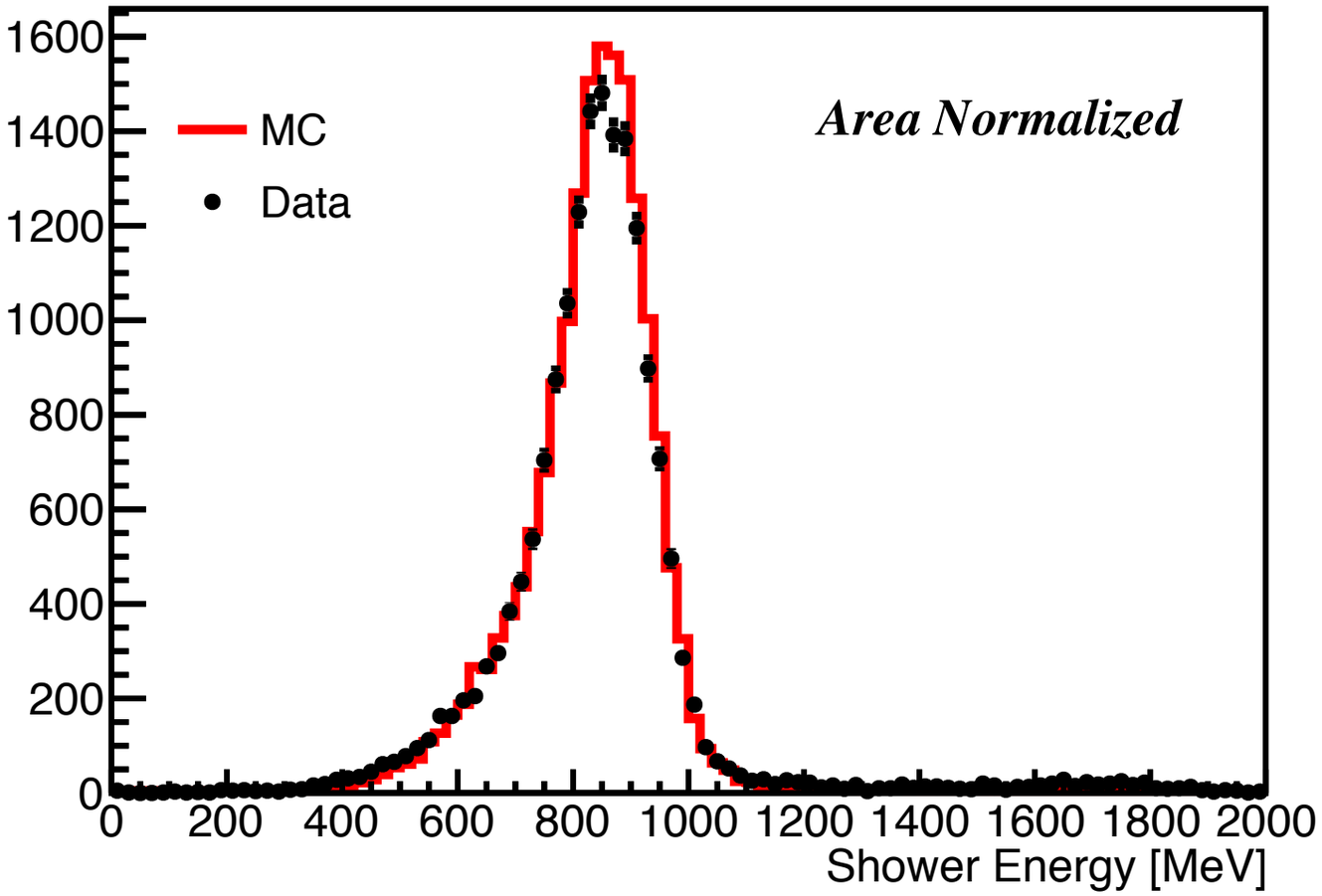
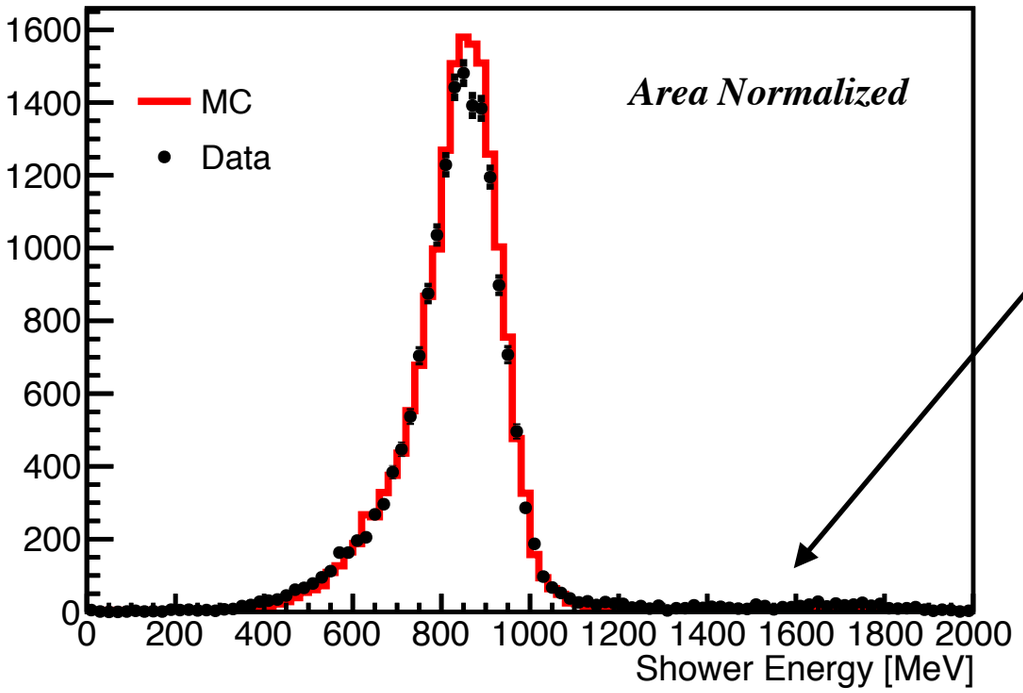
Energy Reconstruction

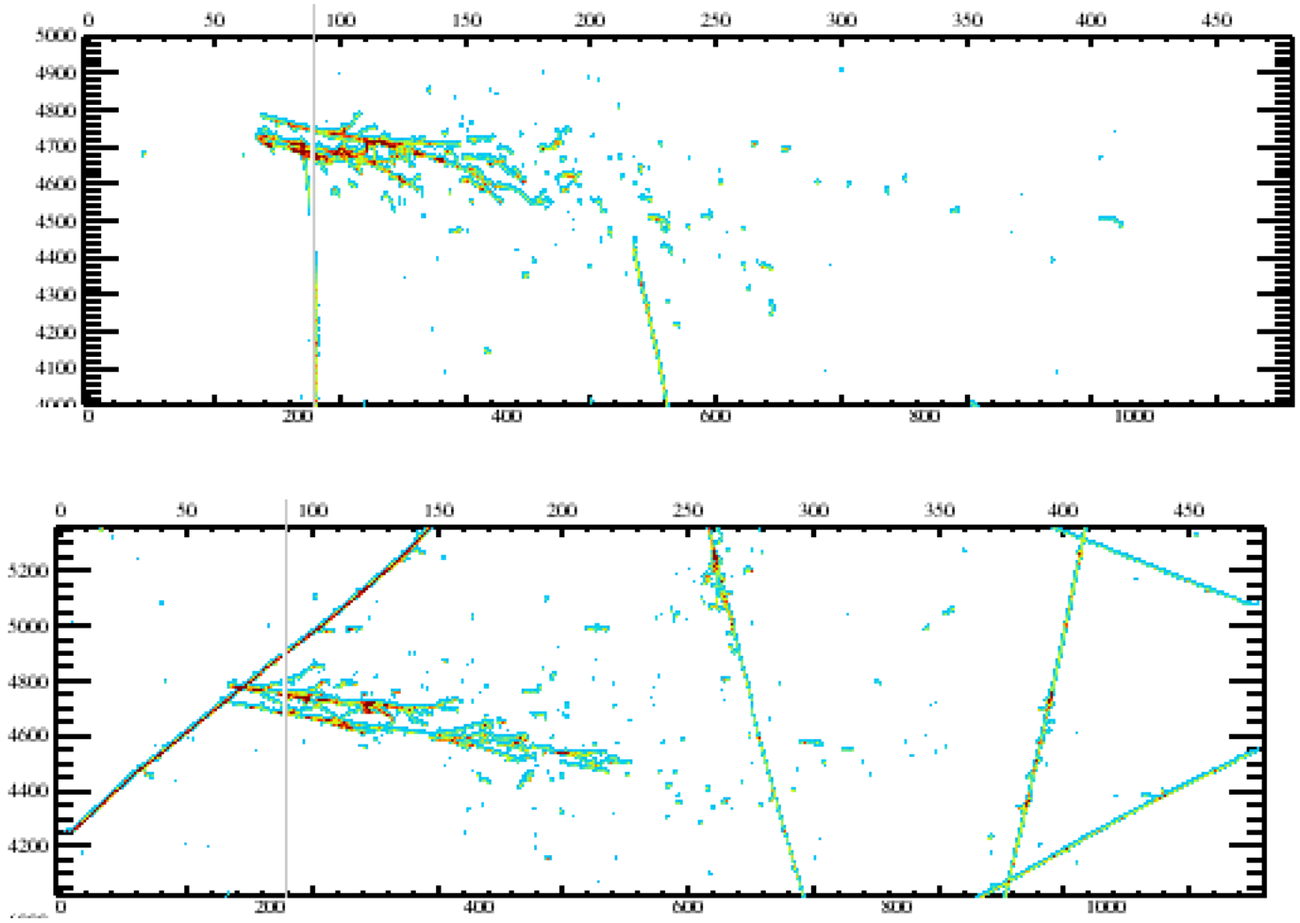
$$E_{calo} = \sum_{i=1}^{i=N\ \ hits} \frac{\epsilon_i(X,YZ) dQ_i W_{ion}}{calorimetry\ \ factor \cdot Recombination\ \ factor}$$



- epsilon_{i} = correction factor X(life time) and YZ(wire response, etc.) run 5809
- dQ_{i} = hit charge
- W_{ion} = 23.6e-6, from Argoneut
- calorimetry factor = 5.58e-3 run 5809
- Recombination factor = 0.63, from FERMILAB-PUB-15-458-ND

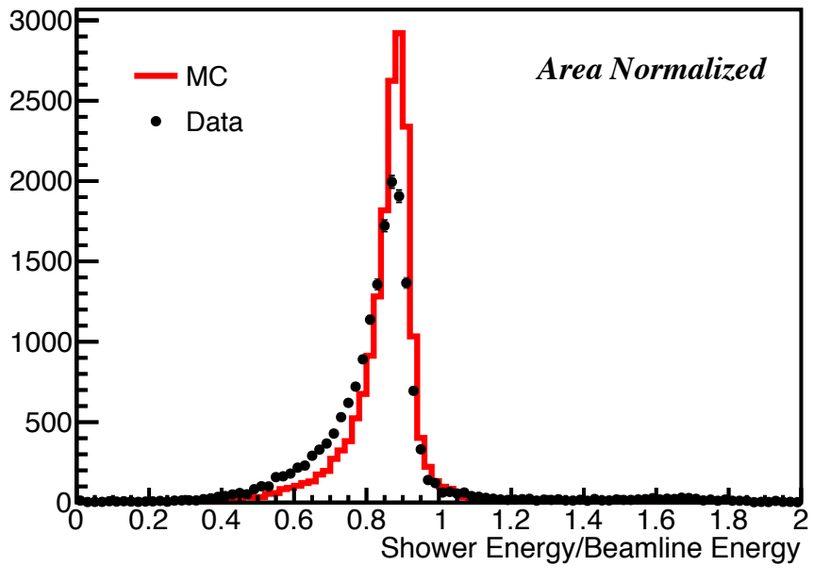
Energy Reconstruction

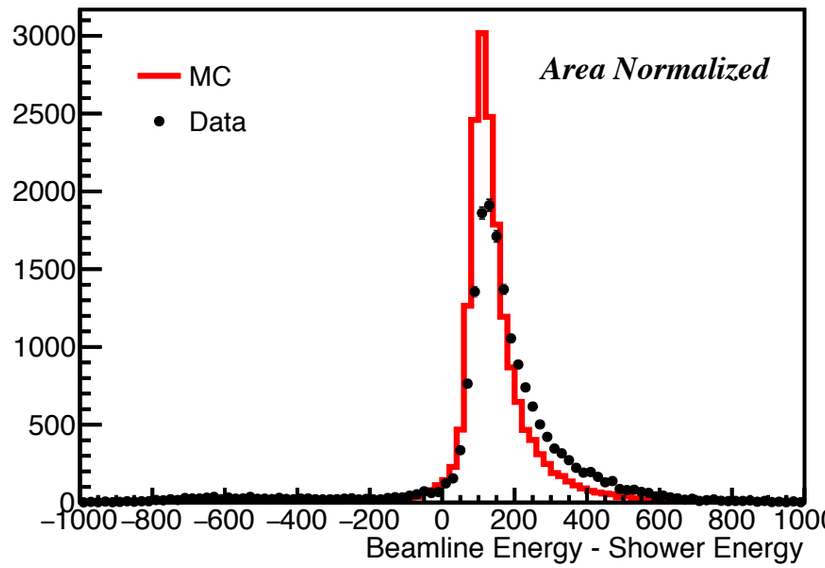




Two electrons coming in the same beam spill
This is a common feature at all momenta
BTW `beaminfo` says there is just one

Energy Reconstruction

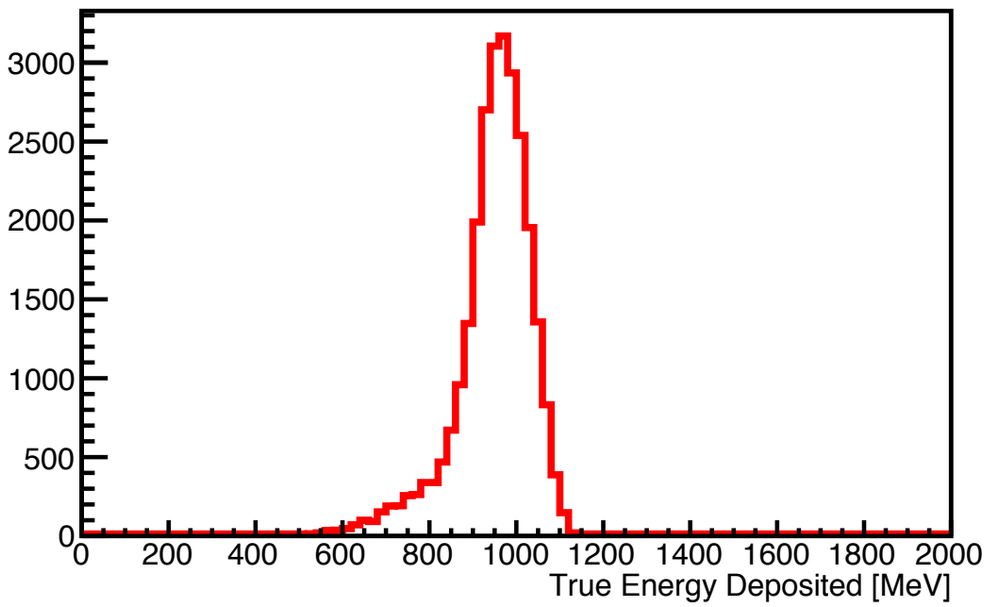


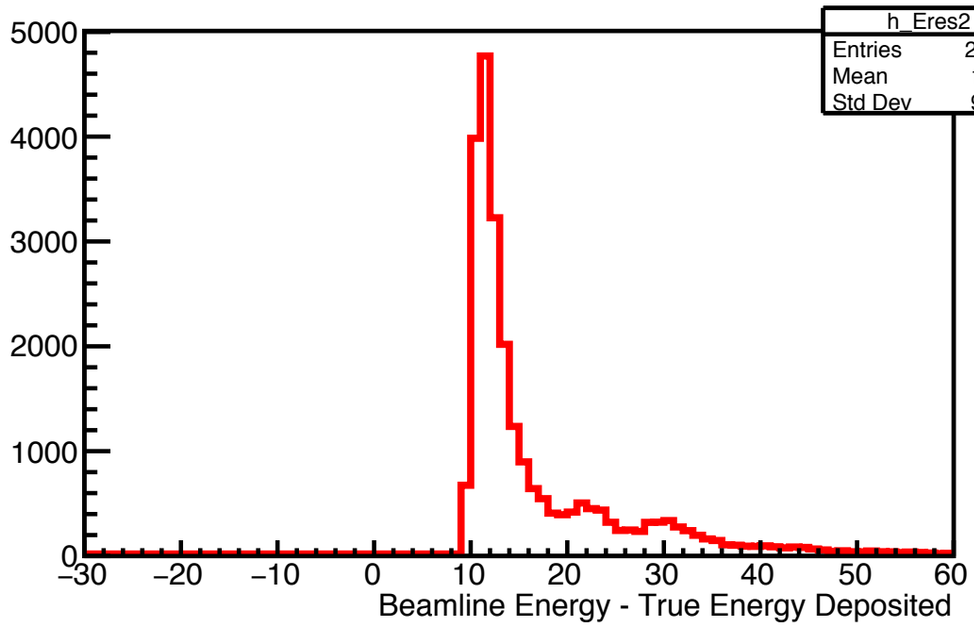


There is a bias between the shower energy and the beamline ~150 MeV
Where is this coming from?

Energy Reconstruction

There is a bias between the shower energy and the beamline ~150 MeV
Where is this coming from?
Look at true energy deposited using `sim::SimChannel`



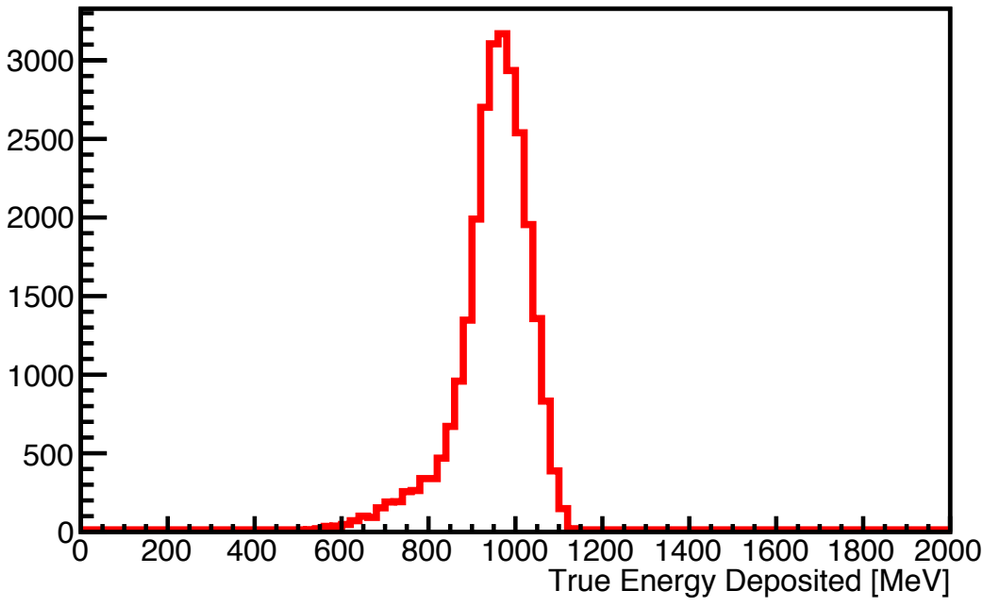


Energy loss upstream of the TPC is ~18 MeV
Is this consistent with beam experts information?

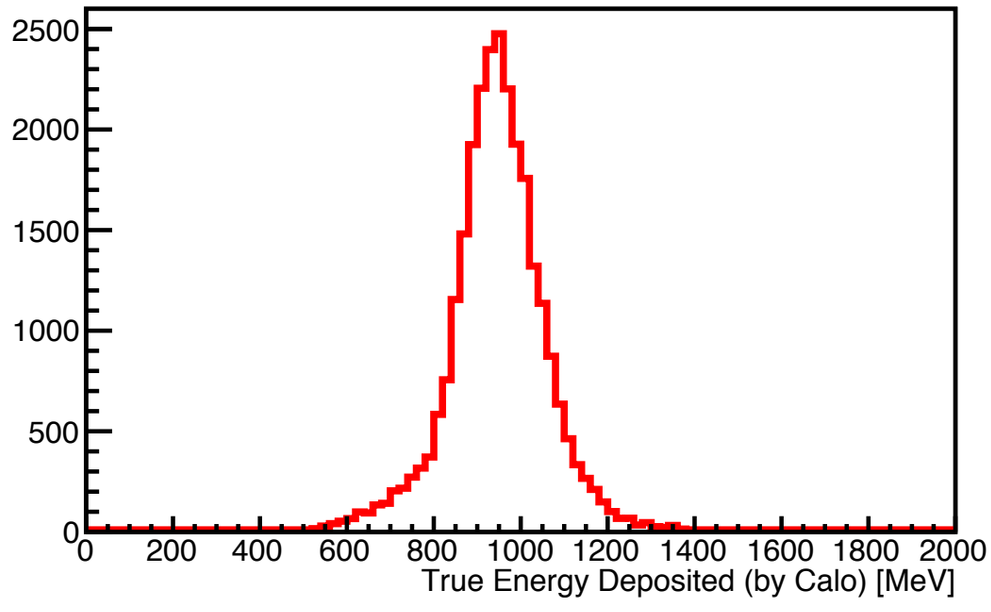
Energy Reconstruction

There is a bias between the shower energy and the beamline ~150 MeV
Energy loss upstream of the TPC is ~18 MeV
Is the calorimetry reconstruction introducing a bias?
Using true hits(charge) calculated the energy using our calorimetry method

true deposited energy



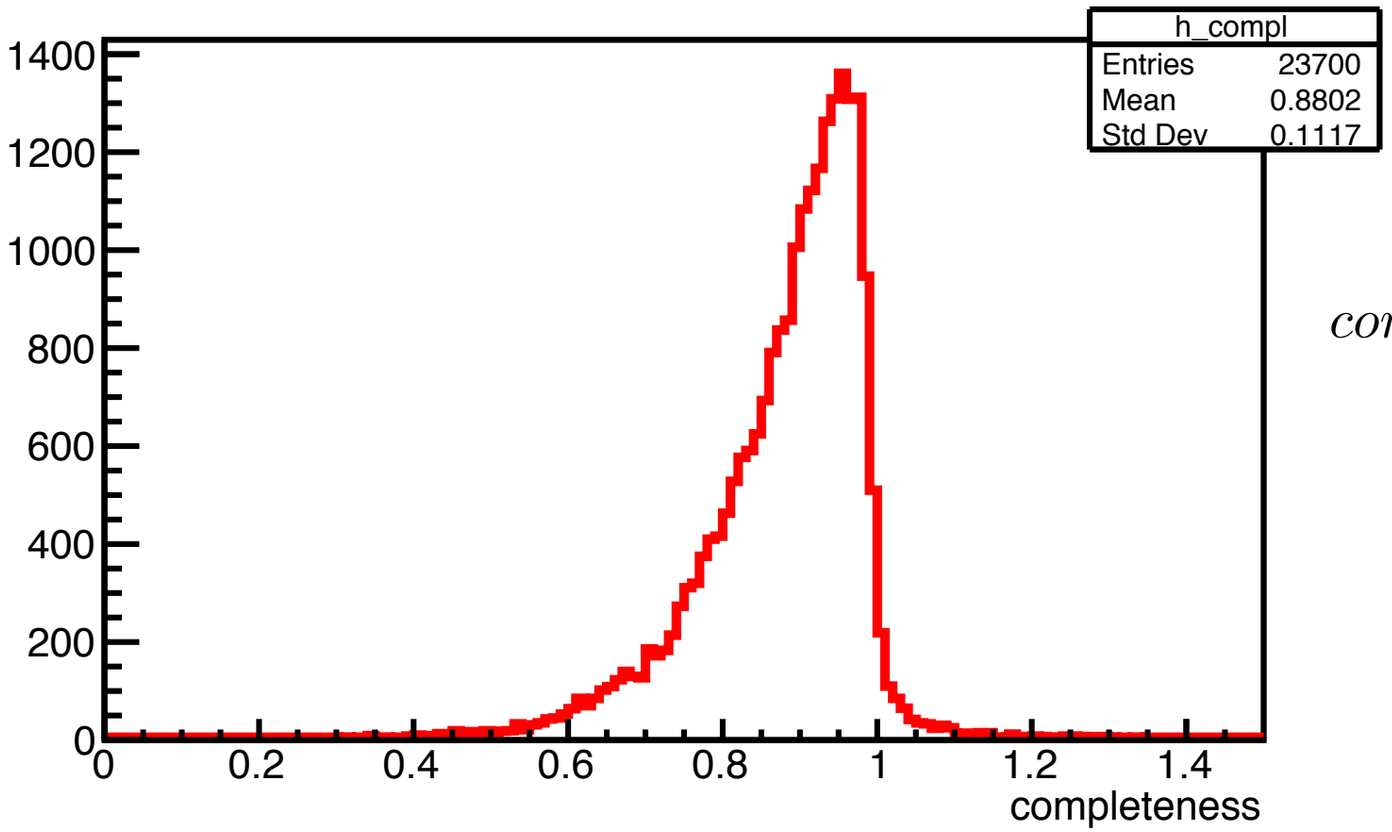
hit charge—> energy



using our calorimetry method does not introduce a bias

Energy Reconstruction

There is a bias between the shower energy and the beamline ~150 MeV
Energy loss upstream of the TPC is ~18 MeV
Is the calorimetry reconstruction introducing a bias? NO
Look at shower completeness



$$compl = \frac{\sum_i reco\ pandora\ hit_i charge}{\sum_i MC\ particle\ hit_i charge}$$

Energy Reconstruction

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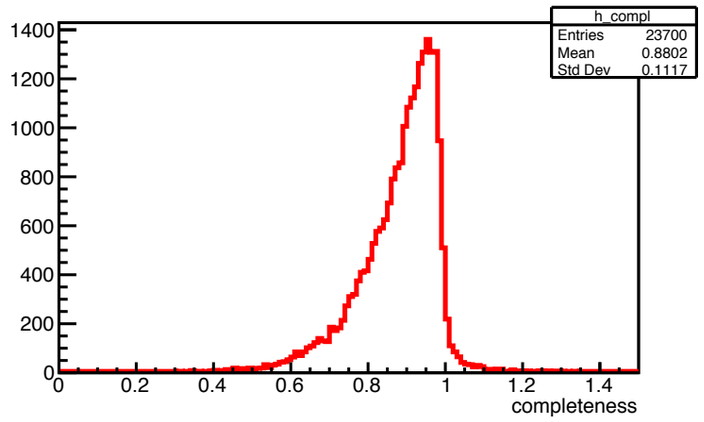
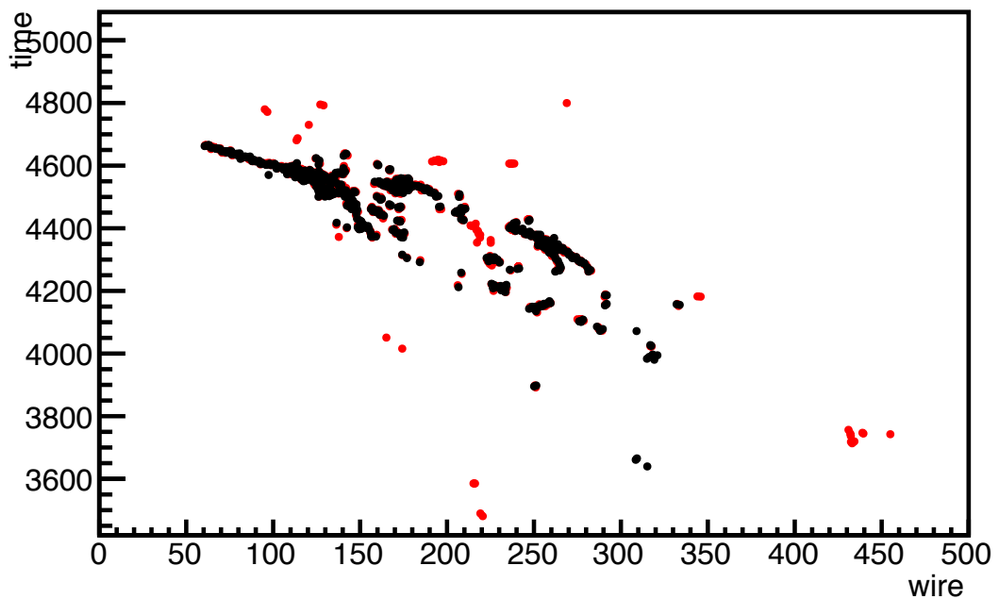
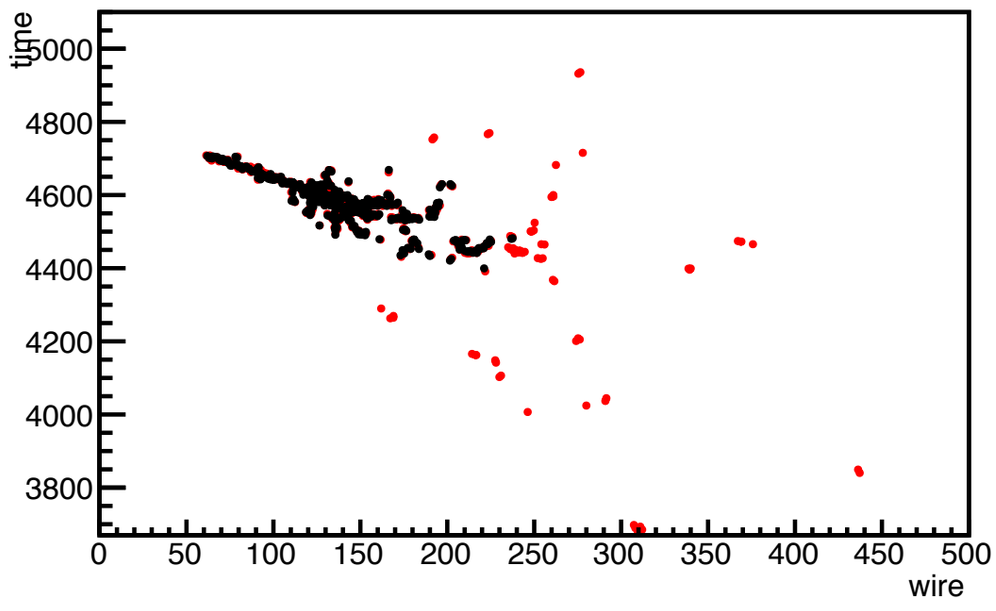


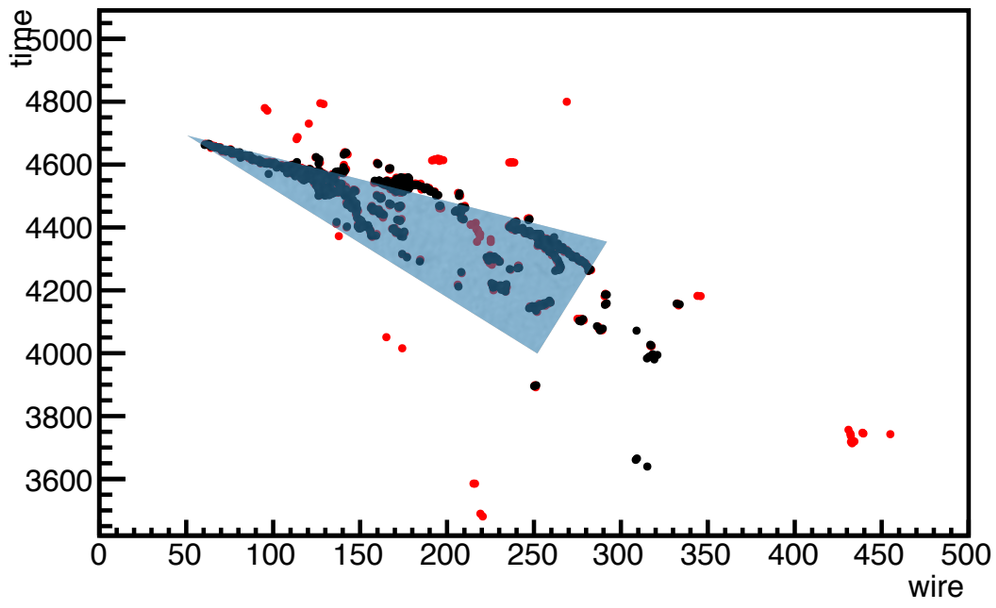
true hits
Pandora shower hits

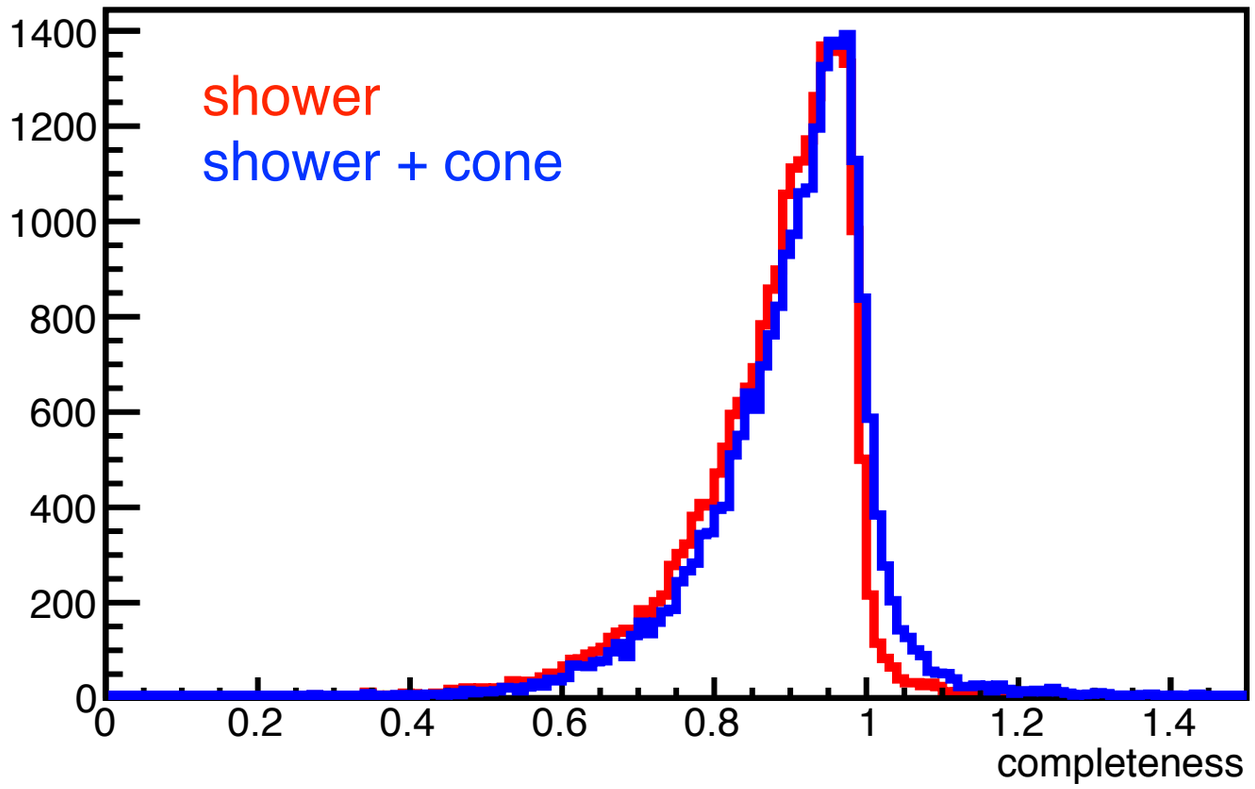




Energy Reconstruction

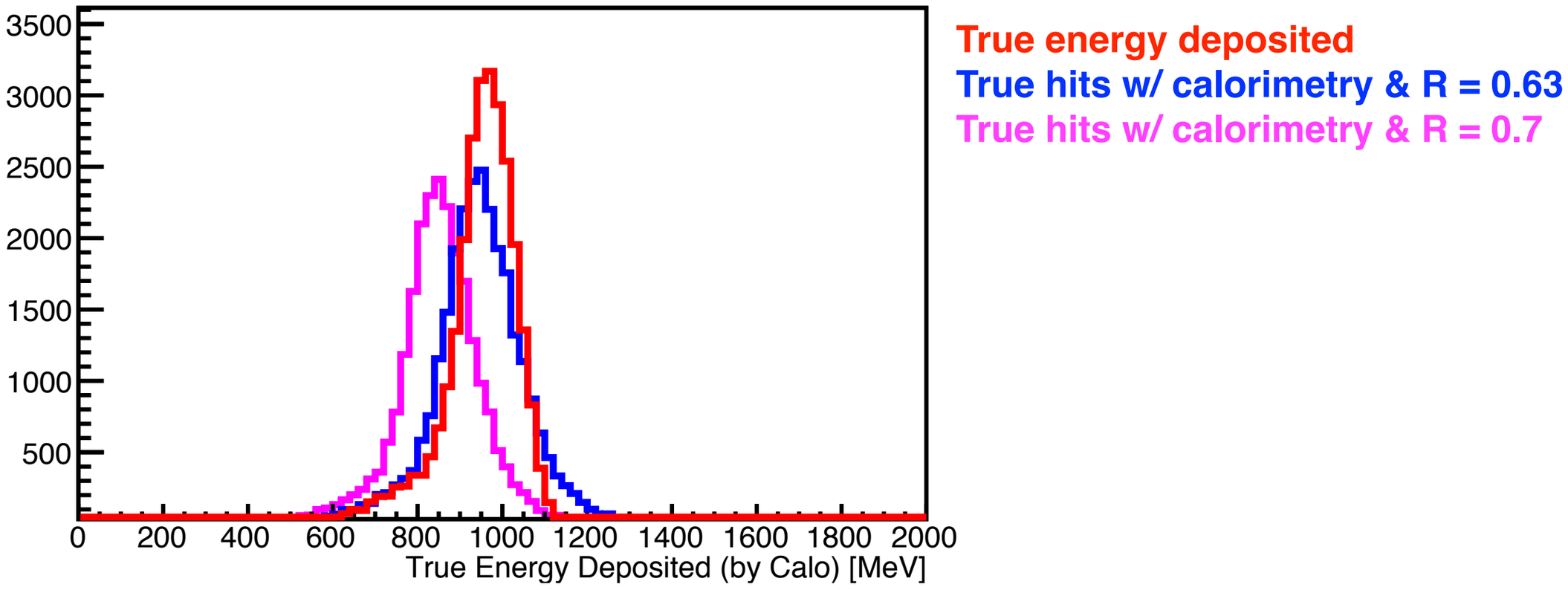
Can we recover some of the missing hits?
Project the shower direction into a the XZ plane (collection)
Look for hits within a 2D cone given then shower length and 30 degrees
Calculated completeness again
New completeness does not look better it seems that we have some cosmic contamination from intersecting cosmic with the cone… more work need to be done, what about a 3D cone?
Look also at purity





Energy Reconstruction

Recombination factor:
Given our E-field recombination factor is approximately(box mode) ~0.7
However a recombination value of 0.63 gives better results?



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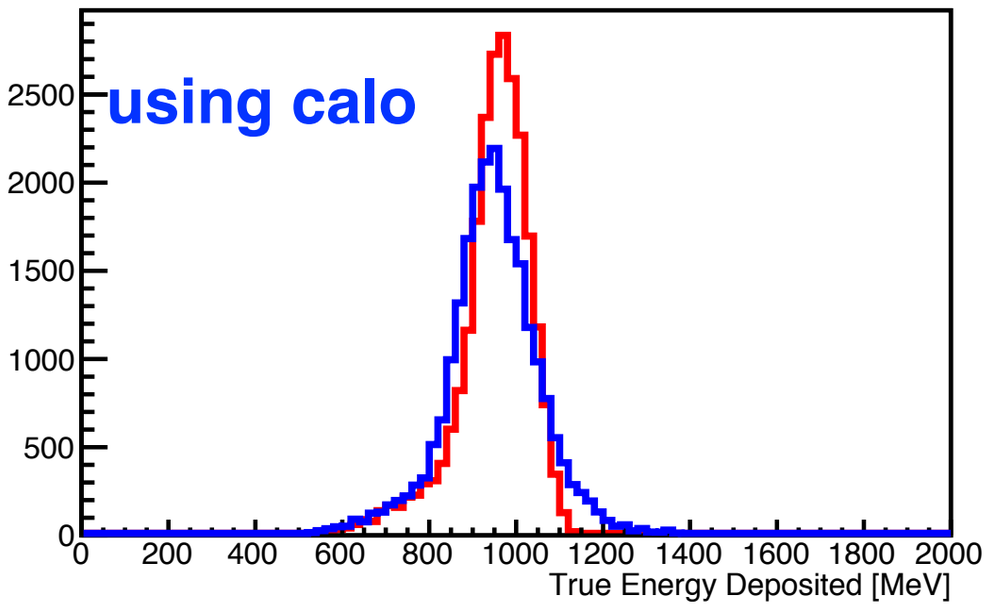
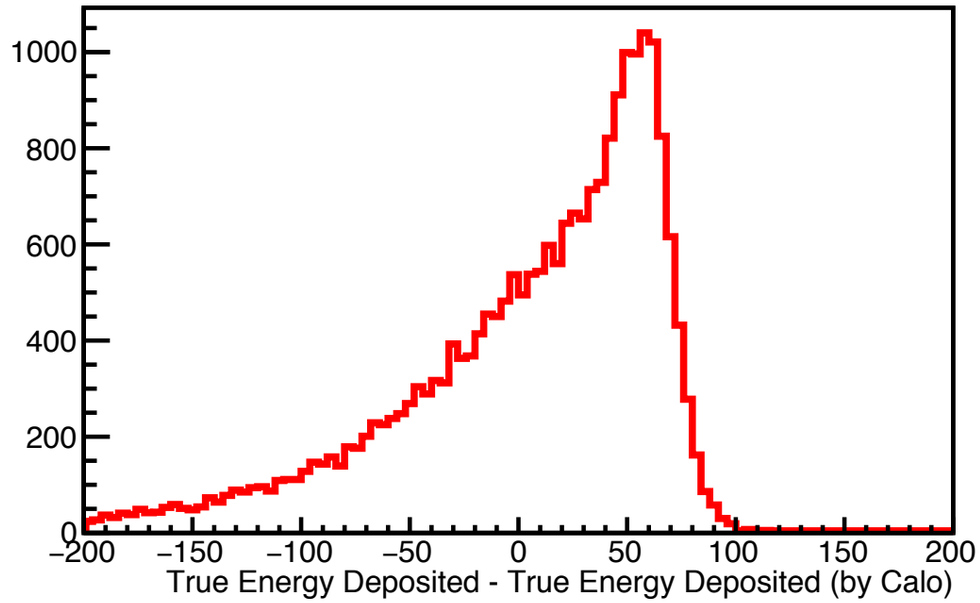
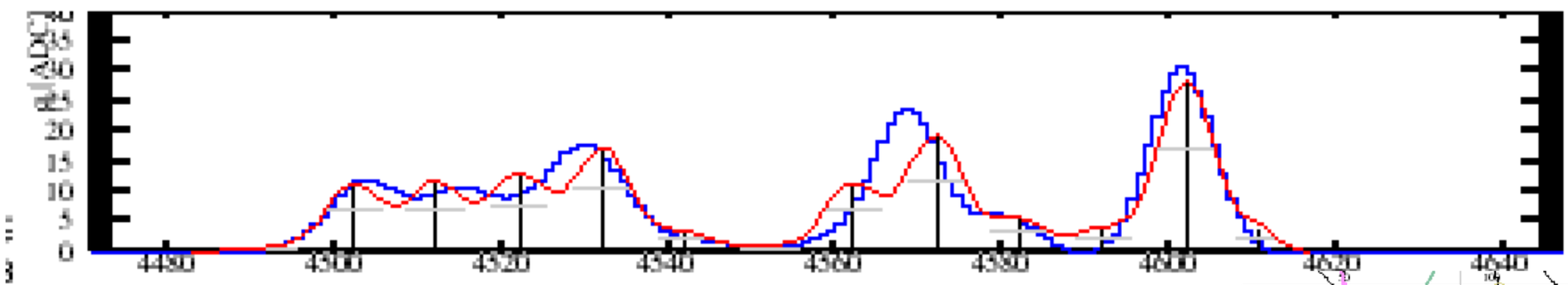
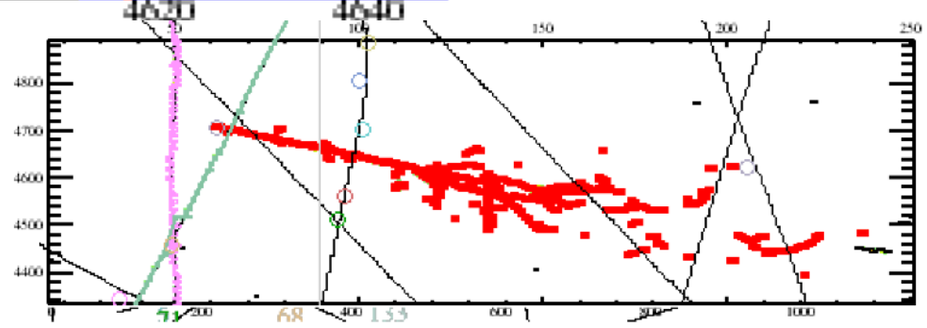




Fitting multiple gaussians to a long pulse is just an approximation
An alternative would be use recob::Wire signals and sum up the ADC values on each wire based on the shower hit peak time





Summary

- We understand (sort of) where the bias is coming from in the energy reconstruction
  - Biggest contribution comes from missing hits in the shower
  - Upstream energy loss according to simulation is ~18 MeV according to beam experts is ~50 MeV
  - Recombination factor still an open question

The End