Comparison between Icarus and ArgoNeuT Electronics

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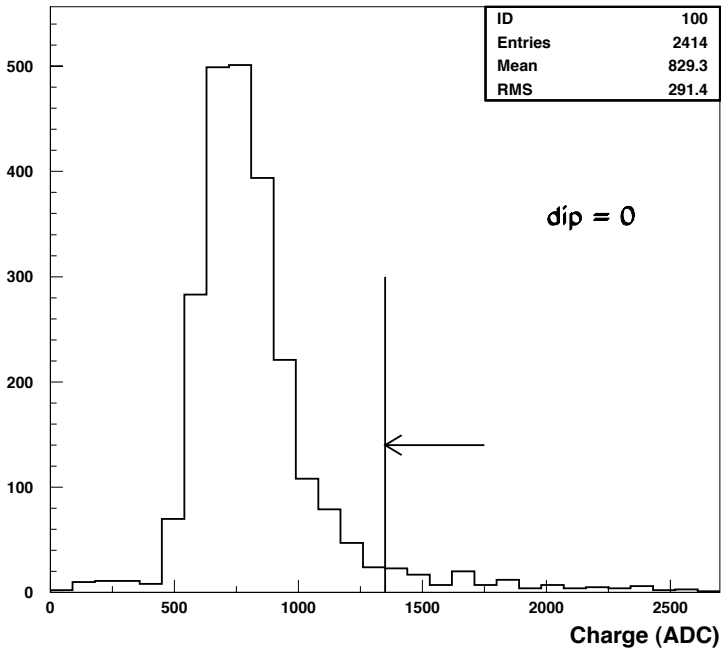
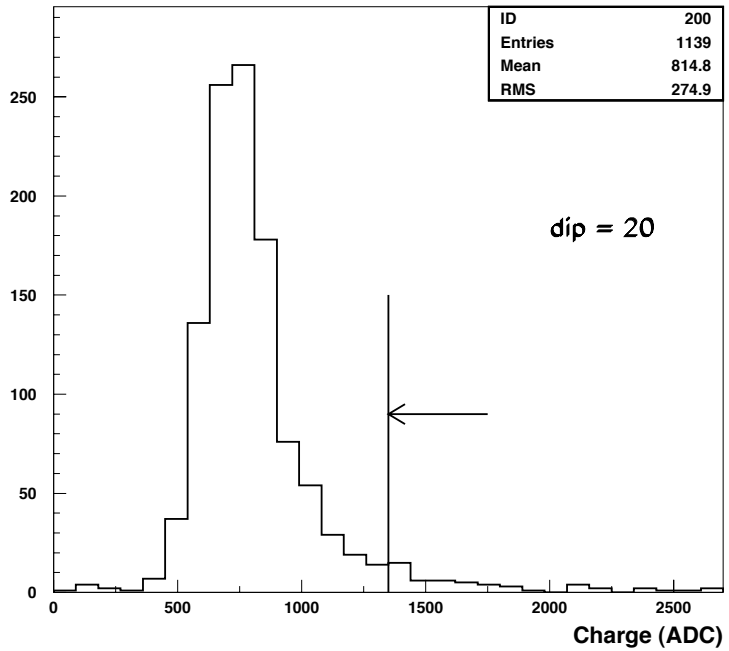
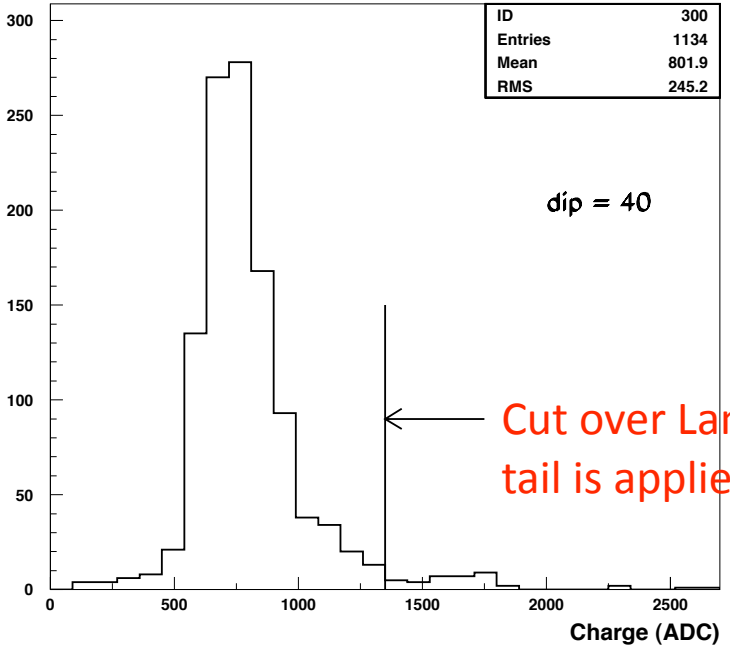
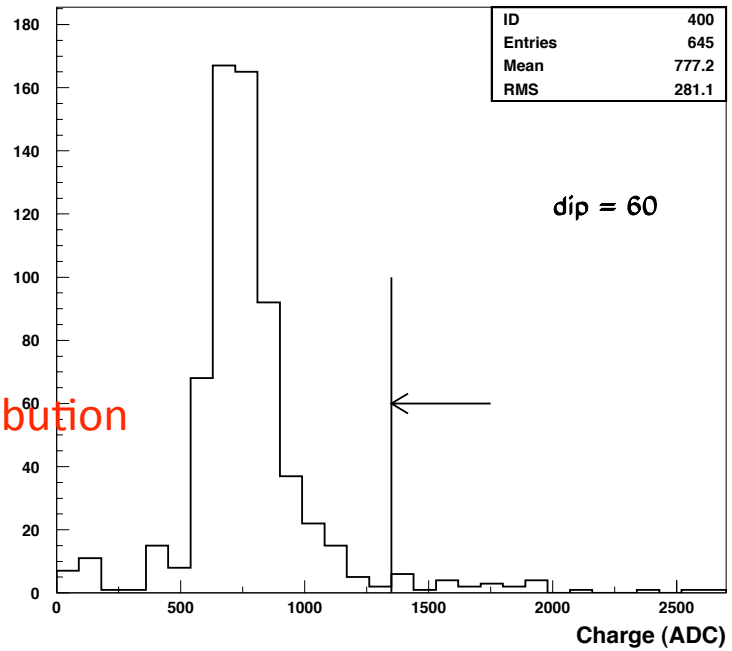
- Bruce provided a simulated set of straight muons at different deep angles: 0, 20, 40, 60 degree. Only in the collection view
- Tracks presenting δ rays have been discarded - Using the same data set as Bruce
- The Hit Finding has been performed on each wire;
- HIT "TIME" has been extracted fitting the signal. HIT deposited "ENERGY" has been evaluated through the hit pulse height sum.
- Correct the pulse height sum for the path length - cos(dip)
- Deposited "ENERGY" distributions in following histograms







Cut over Landau distribution tail is applied

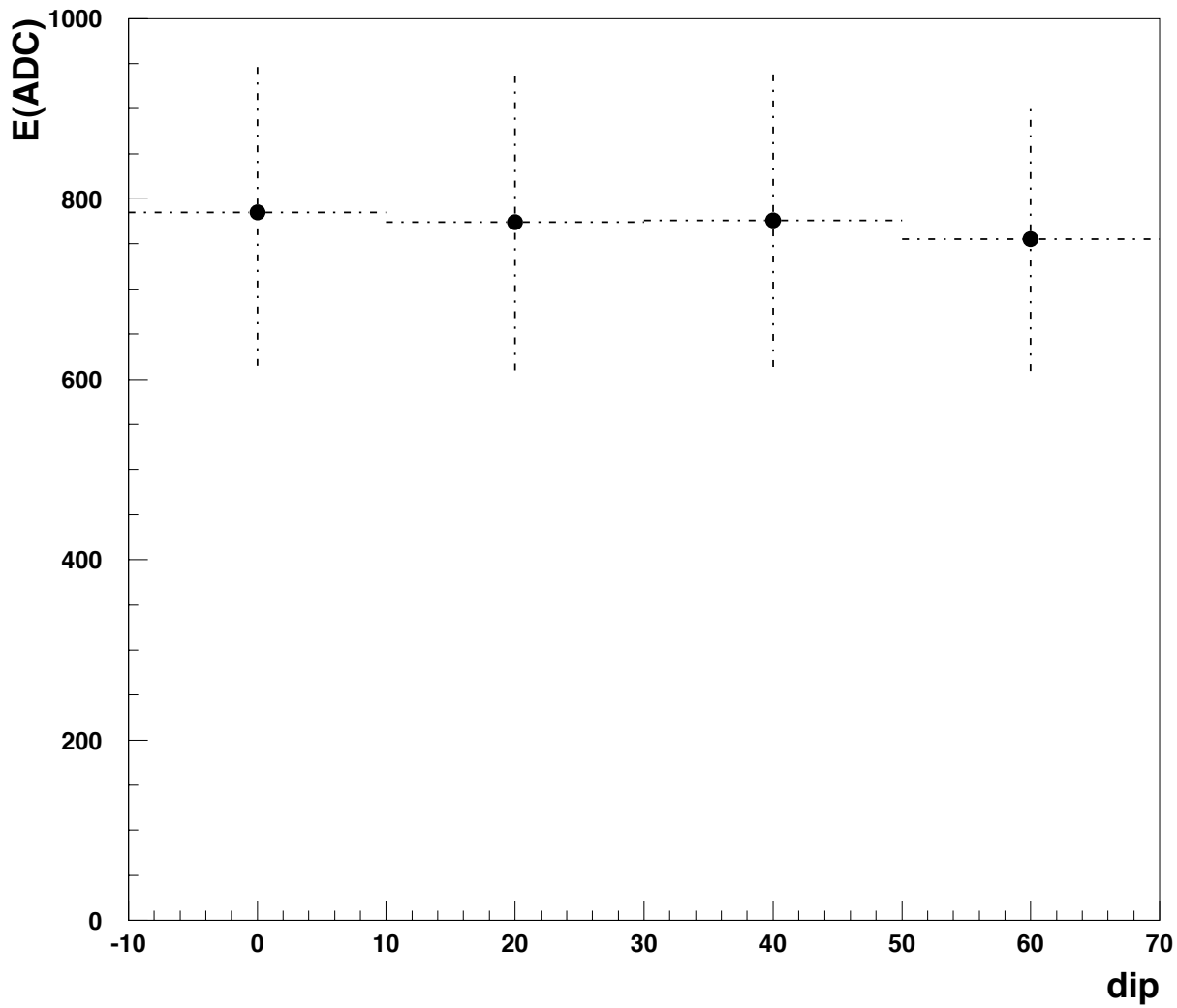


Calorimetric Resolution definition

- From each distribution, once applied the cut to the landau tail, the MEAN and the RMS are extracted.
- Resolution = RMS / MEAN

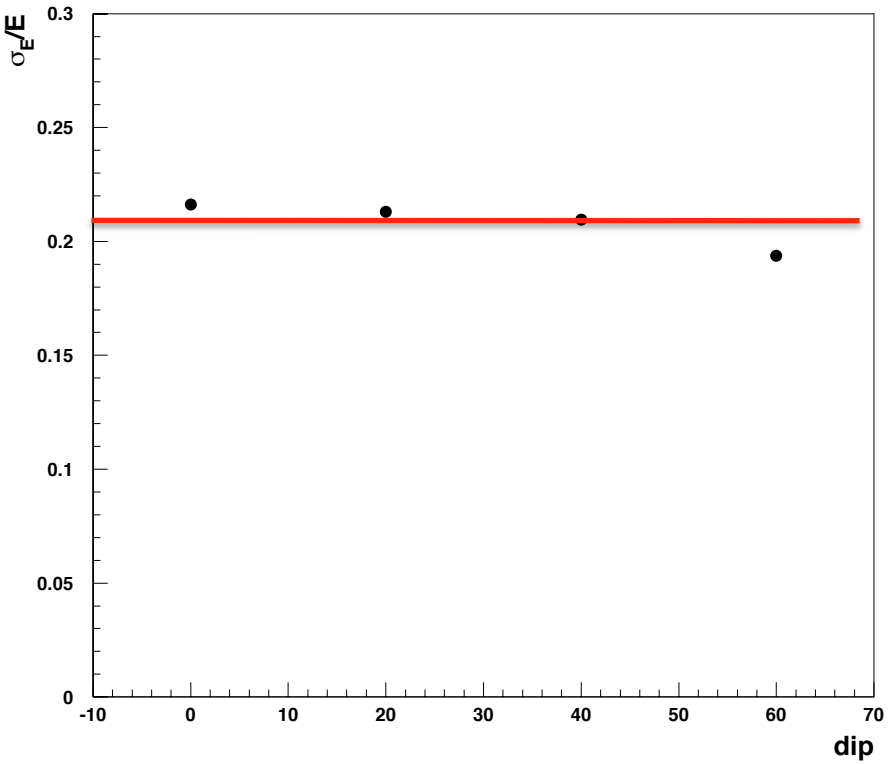
The analysis done by Bruce on ArgoNeuT data was exactly repeted on Icarus simulated signals in order to have a meaningfull comparison

Mean values, corrected for the path length are constant at increasing dip angles

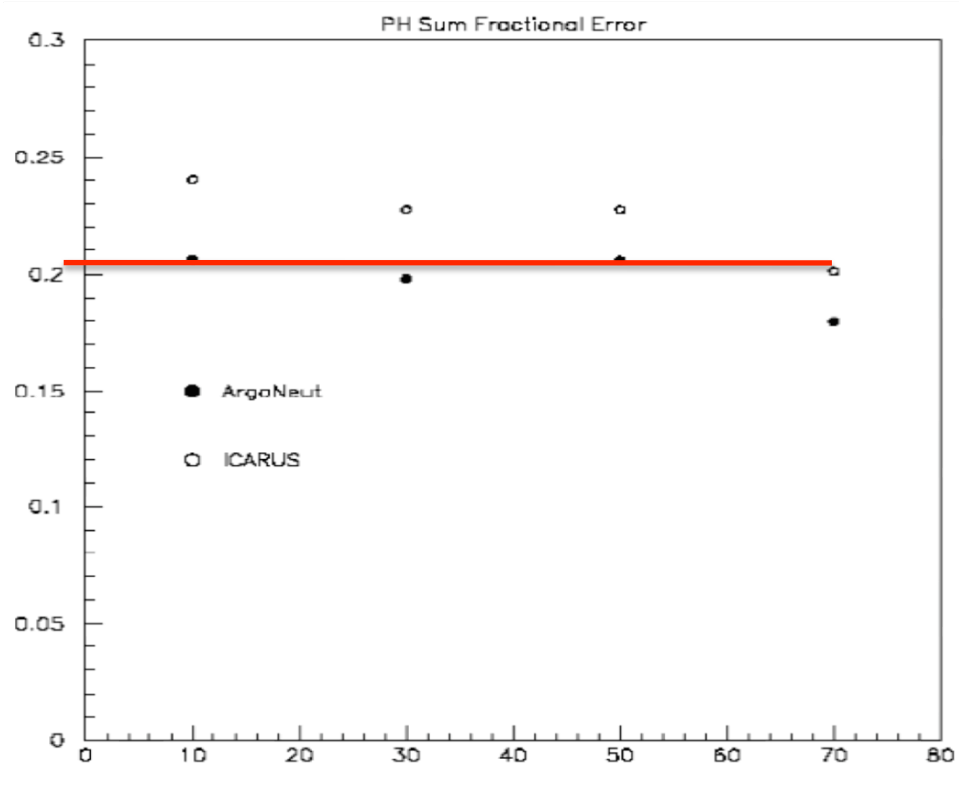


Electronics “alla ArgoNeuT” and Electronics “alla ICARUS” seem to give the same Calorimetric Resolution !!!

My Result



Bruce’s Result



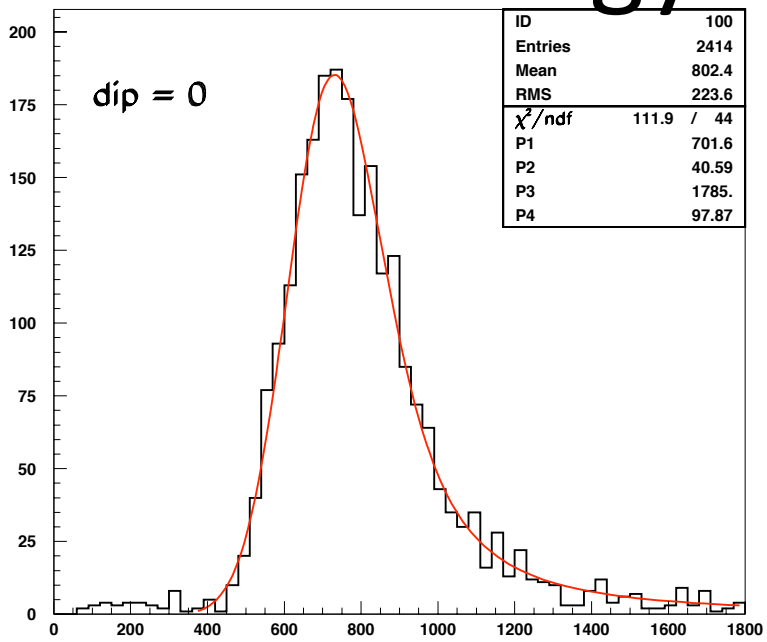
In both cases resolution is around 20%

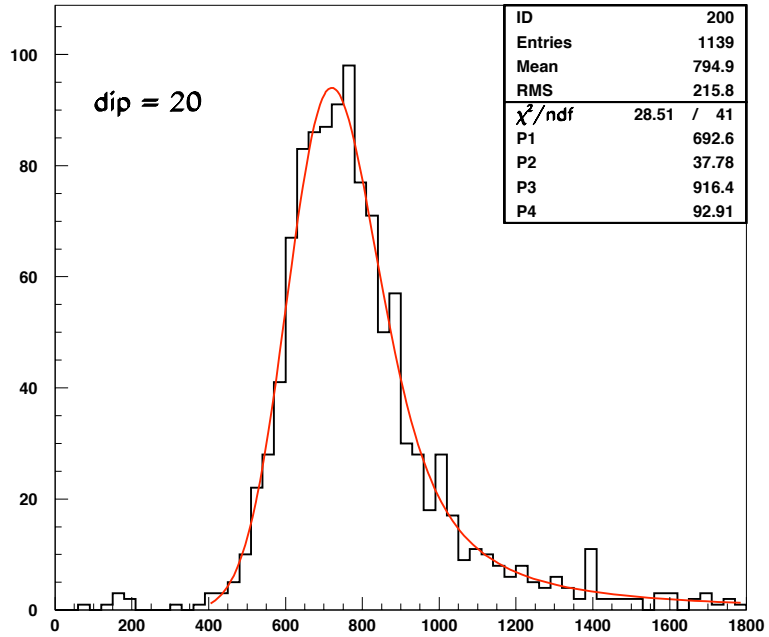
Calorimetric resolution: a more accurate analysis

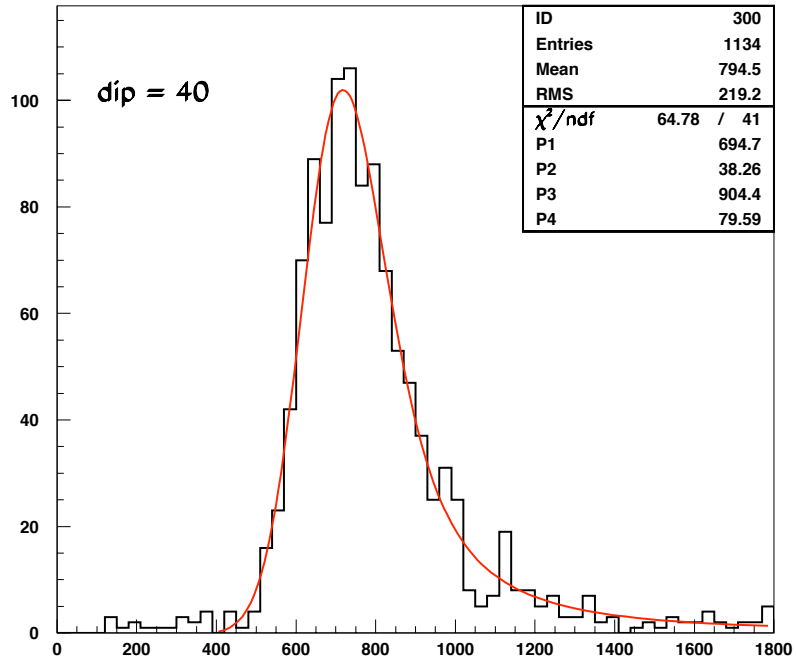
- Energy distributions have been fitted with a LANDAU function convoluted with a GAUSSIAN in order to evaluate the most probable value E_{mp} and the distribution spread σ (from the Gaussian function).
  - The Landau distribution describes the fluctuations in the energy loss of a particle through matter due to the intrinsic statistical nature of the ionization process.
  - The Gaussian function describes fluctuations in the measured charge due to various sources, the main one being electronic noise.
- Energy resolution has been defined as

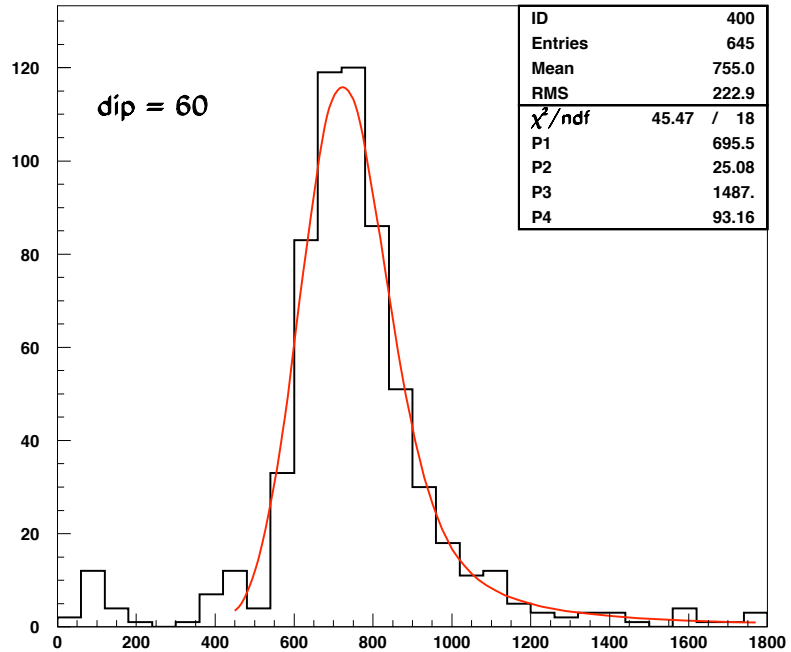
$R=\sigma/E_{mp}$

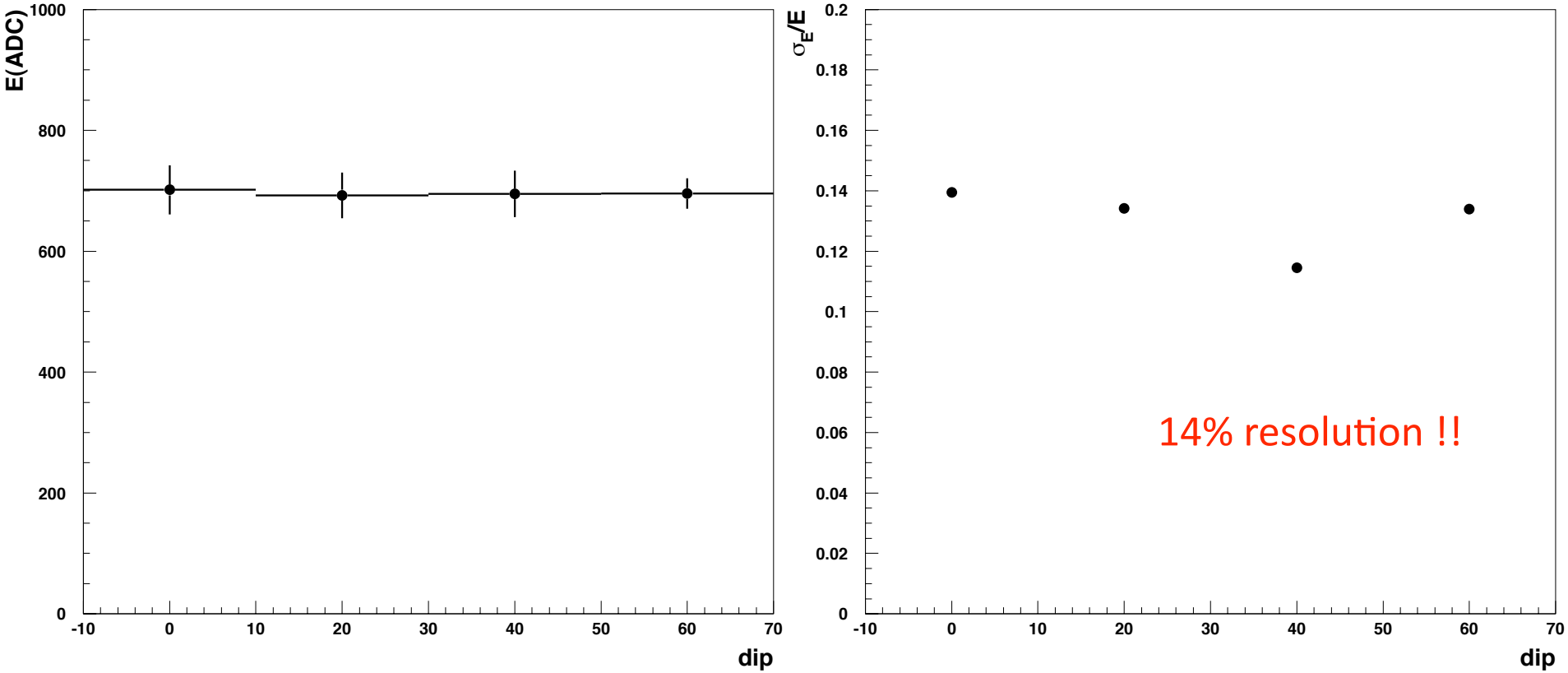
Energy distributions









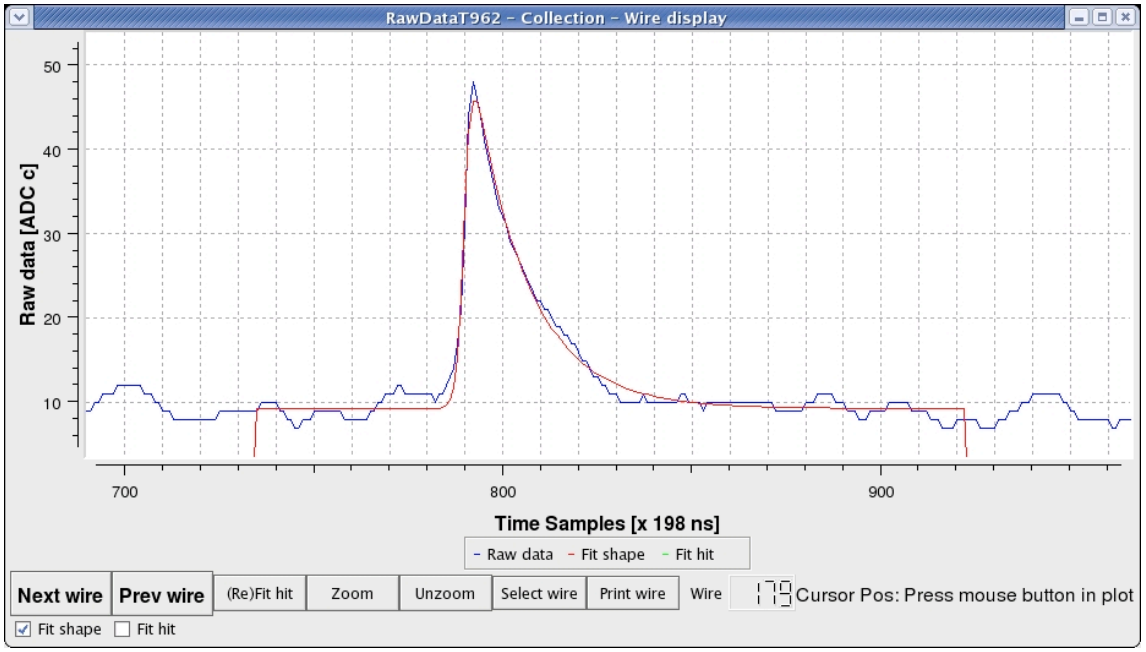


Most probable value vs dip angle is constant.

Calorimetric Resolution is evaluated to be around 14%

Time Resolution

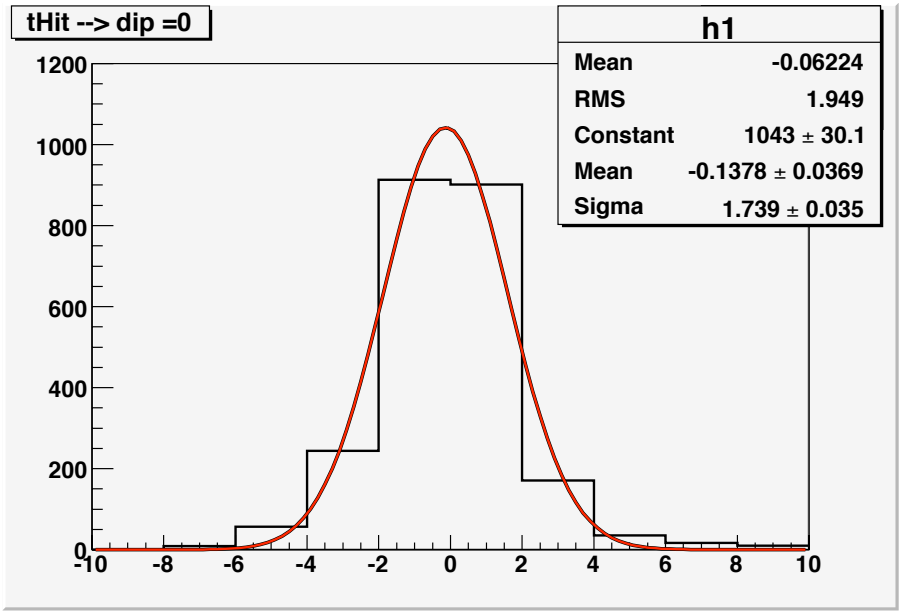
- The Hit Position (tHit) is extracted from the signal fit: it is the time of maximum of the fitted function.
- tHit is proportional to the total charge collected and depends on the PreAmp input impedance.
- No cuts have been applied to the Landau tail, for this reason the tHit expected distribution is not symmetric.

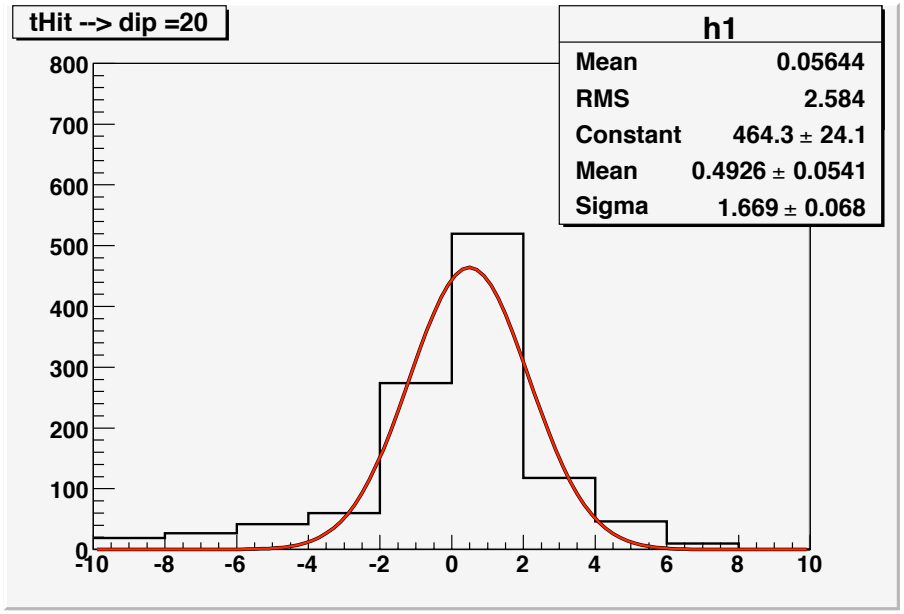


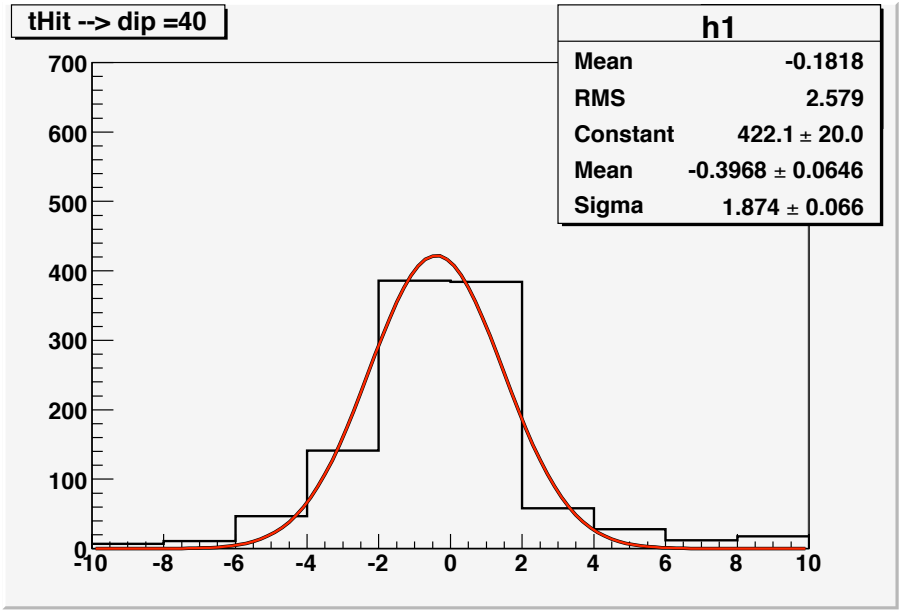
Blu line : Raw Data Signal
Red line: Fit function

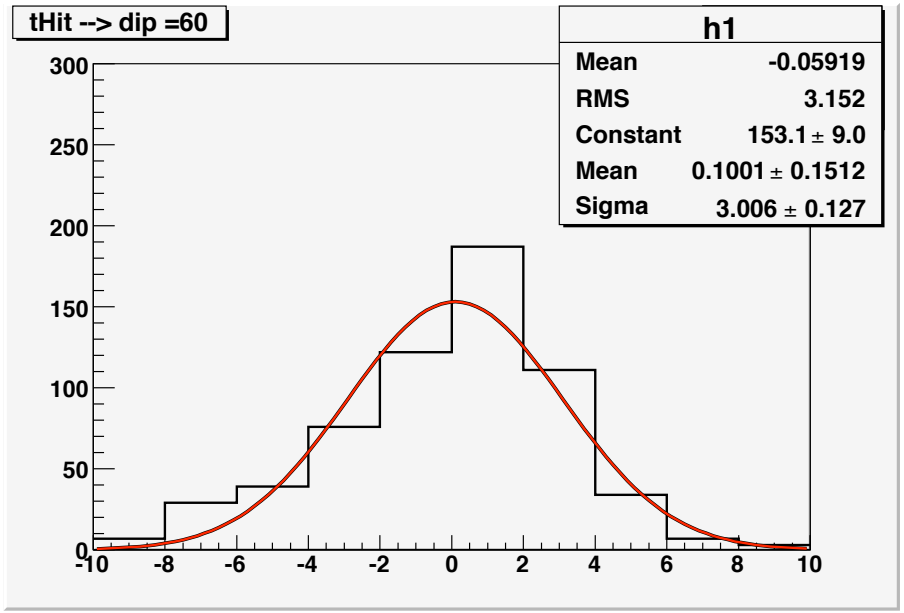
$\chi^2 < 1$

Time distributions: σ between 1.7 and 3 time samples









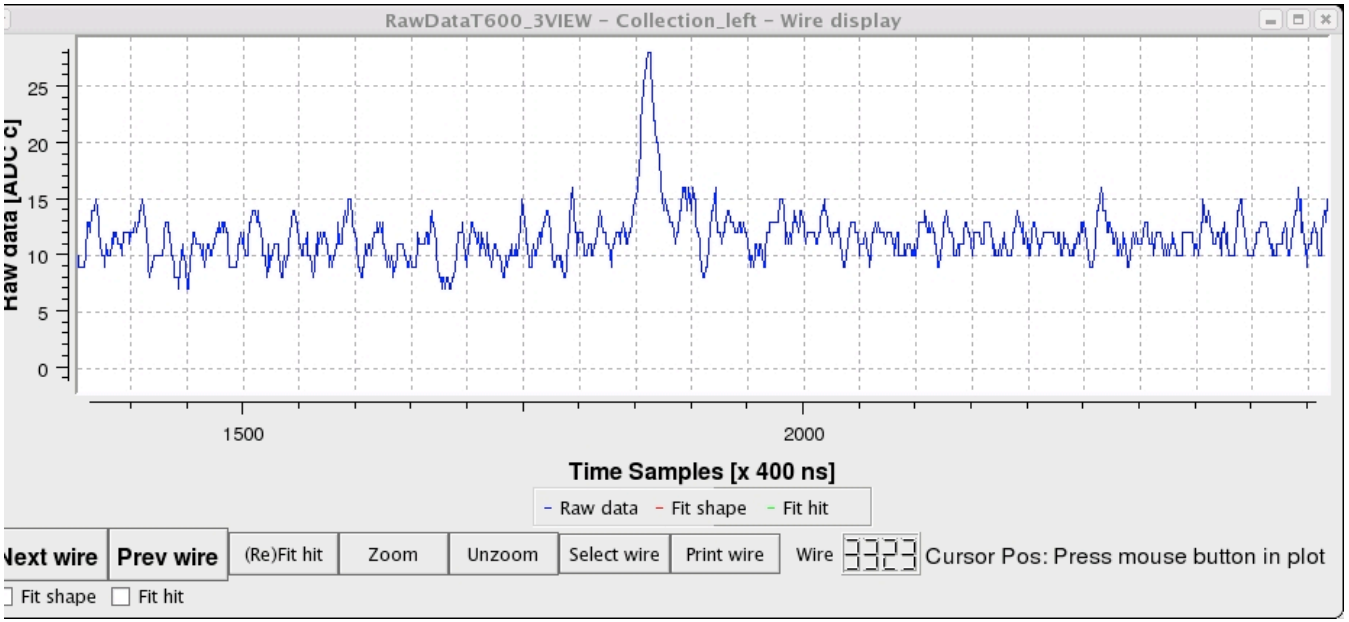
Conclusions

- Calorimetric resolution has been evaluated, both for simualted signals "alla Icarus" and for simulated ArgoNeuT signals.
- Data sample is the same in both cases; analysis method used is the same.
- In the two cases Calorimetric resolution is around 20%

- A more accure analysis has been also done: a landau function convoluted with a gaussian has been used to fit the energy distributions and extract the resolution parameter.
- About 14% resolution has been found for dip angles spanning from 0 to 60 degrees.

- Hit time resolution has been evaluated to be around 2 time samples for all dip angles except for dip = 60degrees, in which case it is 3 samples.

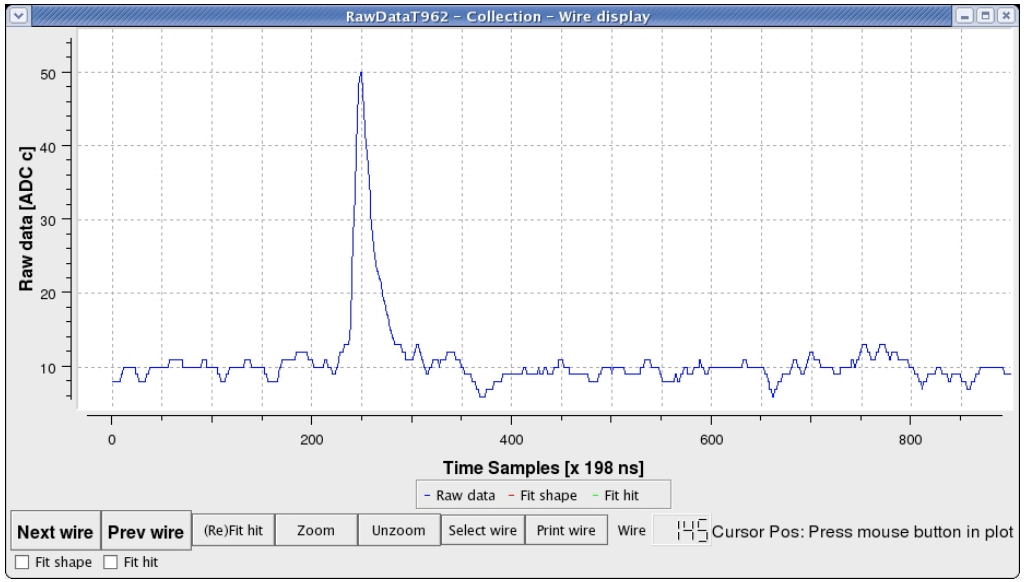
Real and Simulated Icarus Signals



Real Icarus signal
FHWM ~ 25 samples
Corresponding to 10µs
Sampling time 400ns

40 deep angle track

Simulated Icarus signal
FWHM ~ 30 samples
Corresponding to 6µs
40 deep angle track



Now real signals and simulated signals are more similar : start with the comparison