Study of the distribution of CalTwrEdgeCntr

1 - Short intro to data analysis

2 - Distribution of CalTwrEdgeCntr

3 - Comparison CR-data with BeamTest-data

Short introduction to the analysis

Get a sample of gamma-candidtes out of 72 hours of Cosmic Ray (CR) data taken at SLAC with full LAT

Gamma-ray selection Criteria

P.Wang @ Meeting 45, March 17, 2006
P.Wang @ Meeting 46, April 7, 2006
E. Bloom @ Glast Lunch Talk, Sep 28, 2006

Get MC gamma with input spectrum such that it matches (after the gamma selection cuts) the measured energy for the gamma-candidates

E. Bloom @ Glast Lunch Talk, Sep 28, 2006

Short introduction to the analysis

Comparison of MC gammas and gamma-candidates using Random Forest

D. Paneque @ C&A meeting, Aug 21, 2006

E. Bloom @ Glast Lunch Talk, Sep 28, 2006

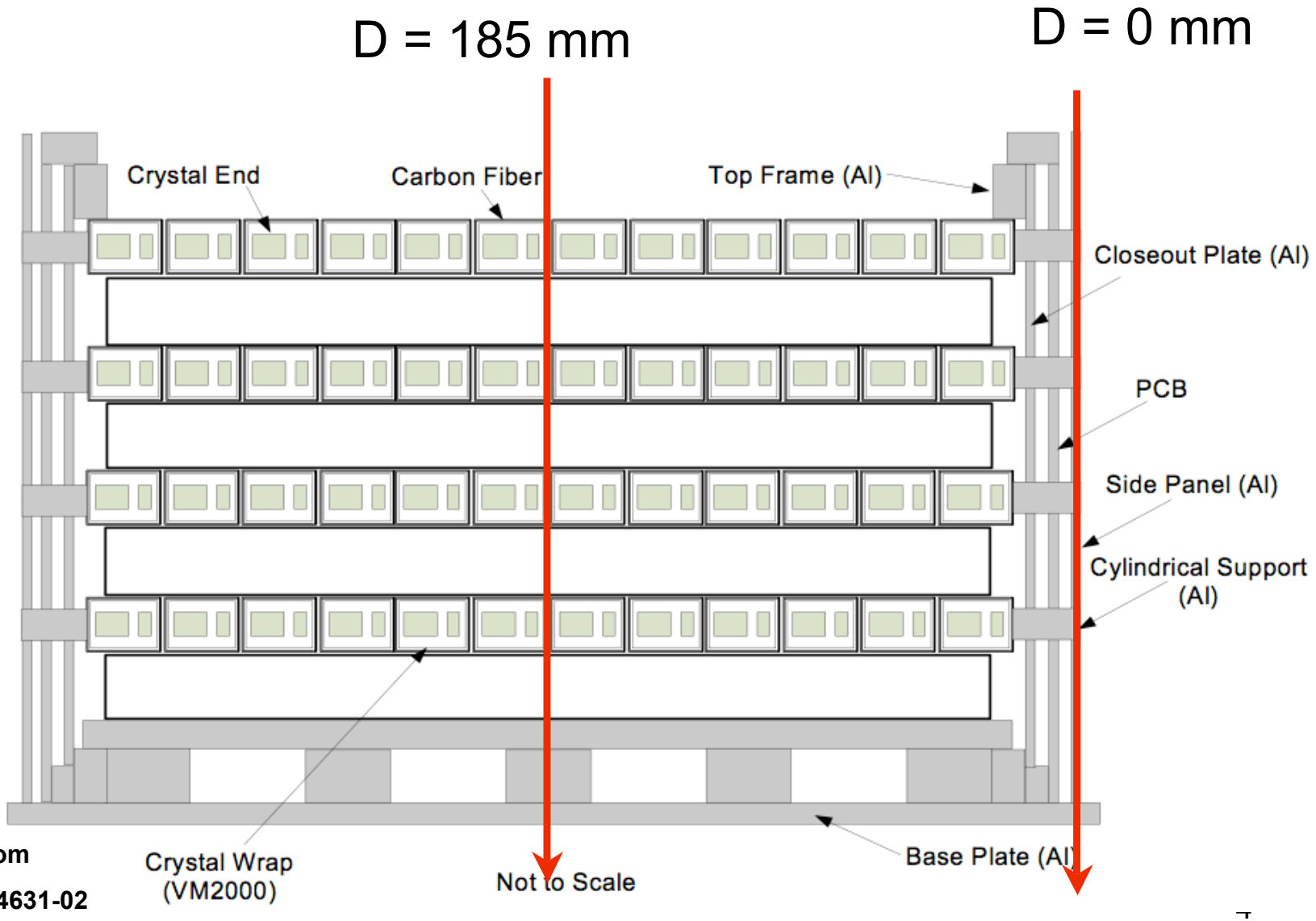
We obtained a list of parameters where MC gammas and gamma-candidates disagree significantly.

The variable **CalTwrEdgeCntr** is one with the biggest differences.

This variable is important for the enery reconstruction

We are trying to understand whether the differences are real or an artifact of the analysis (data selection…)

CalTwrEdgeCntr = Distance E Cntr to closest Tower Edge

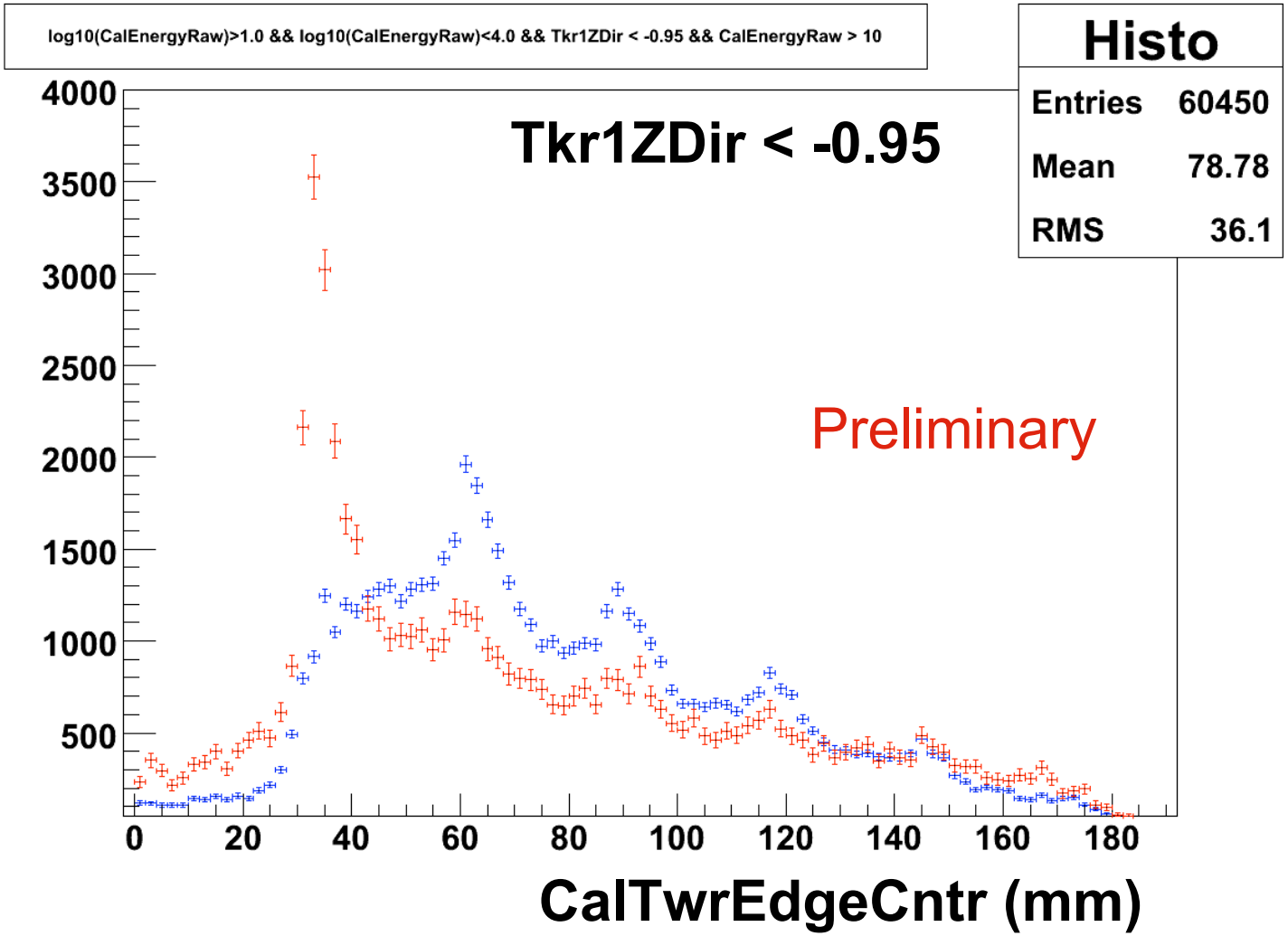


Picture from

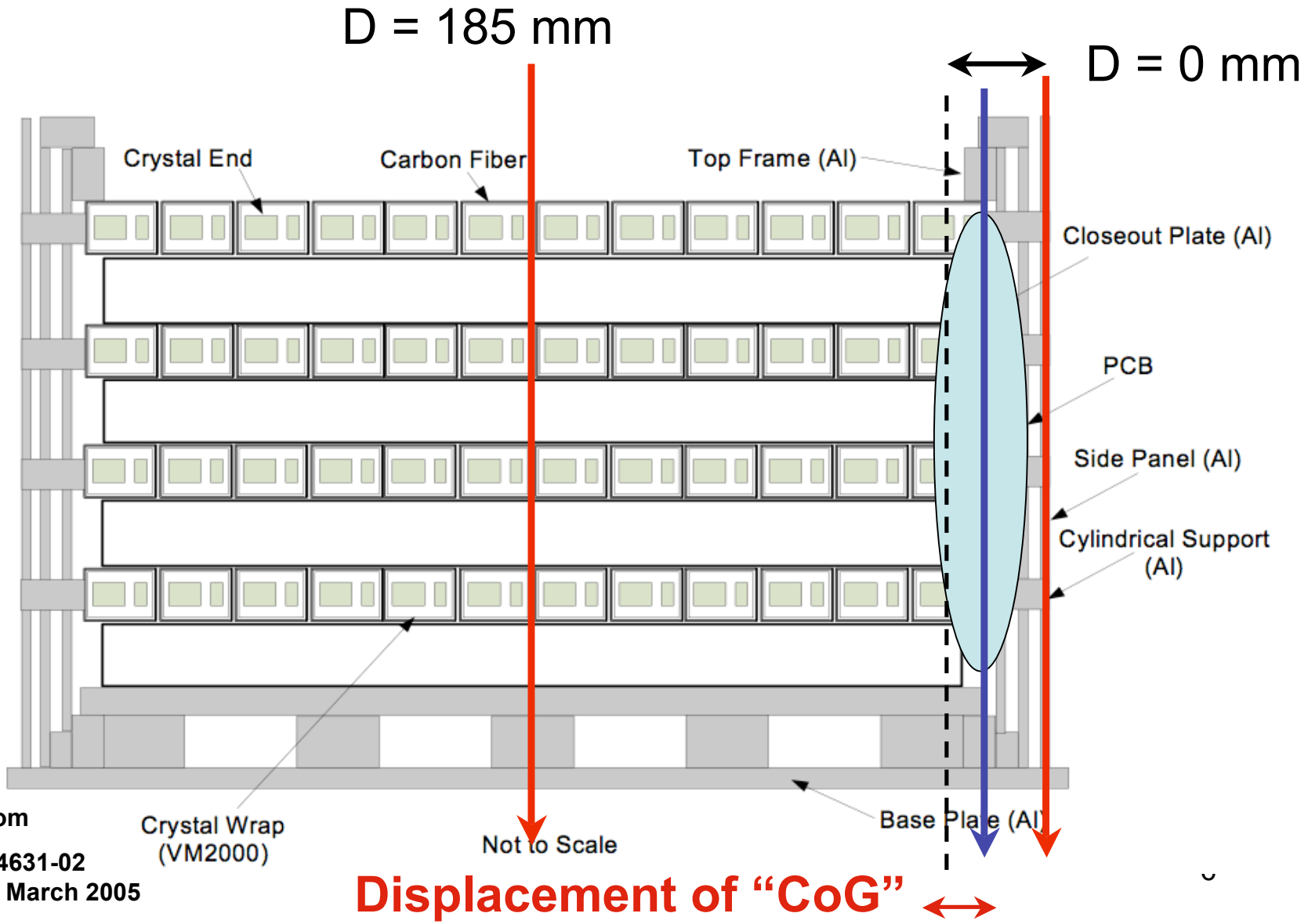
LAT-TD-04631-02
(Eduardo, March 2005

MC in red; **Data in blue**
28k Evts **104k Evts**
(before cut in Tkr1ZDir)

Disc Space problems prevented us to have larger MC statistics



CalTwrEdgeCntr will be moved to higher values in showers which are close to the edge: **First PEak**

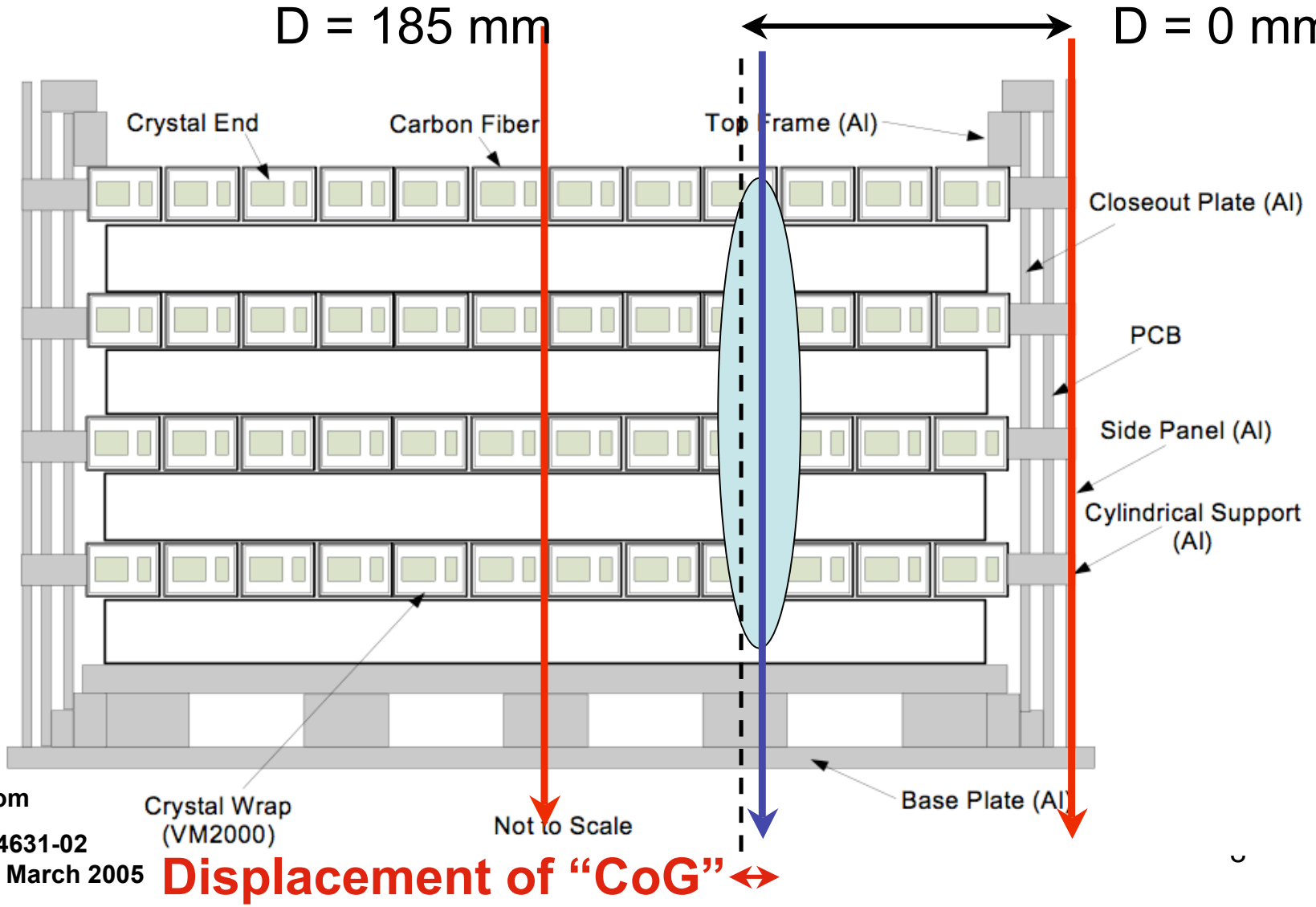


Picture from

LAT-TD-04631-02
(Eduardo, March 2005

Moving “stuff” from one location to another…
Same effect in the roads of many countries

CalTwrEdgeCntr will be somewhat quantified (for showers with small incoming angle) due to the sampling effecrt (one every two crystal layers): **2-6 PEaks**



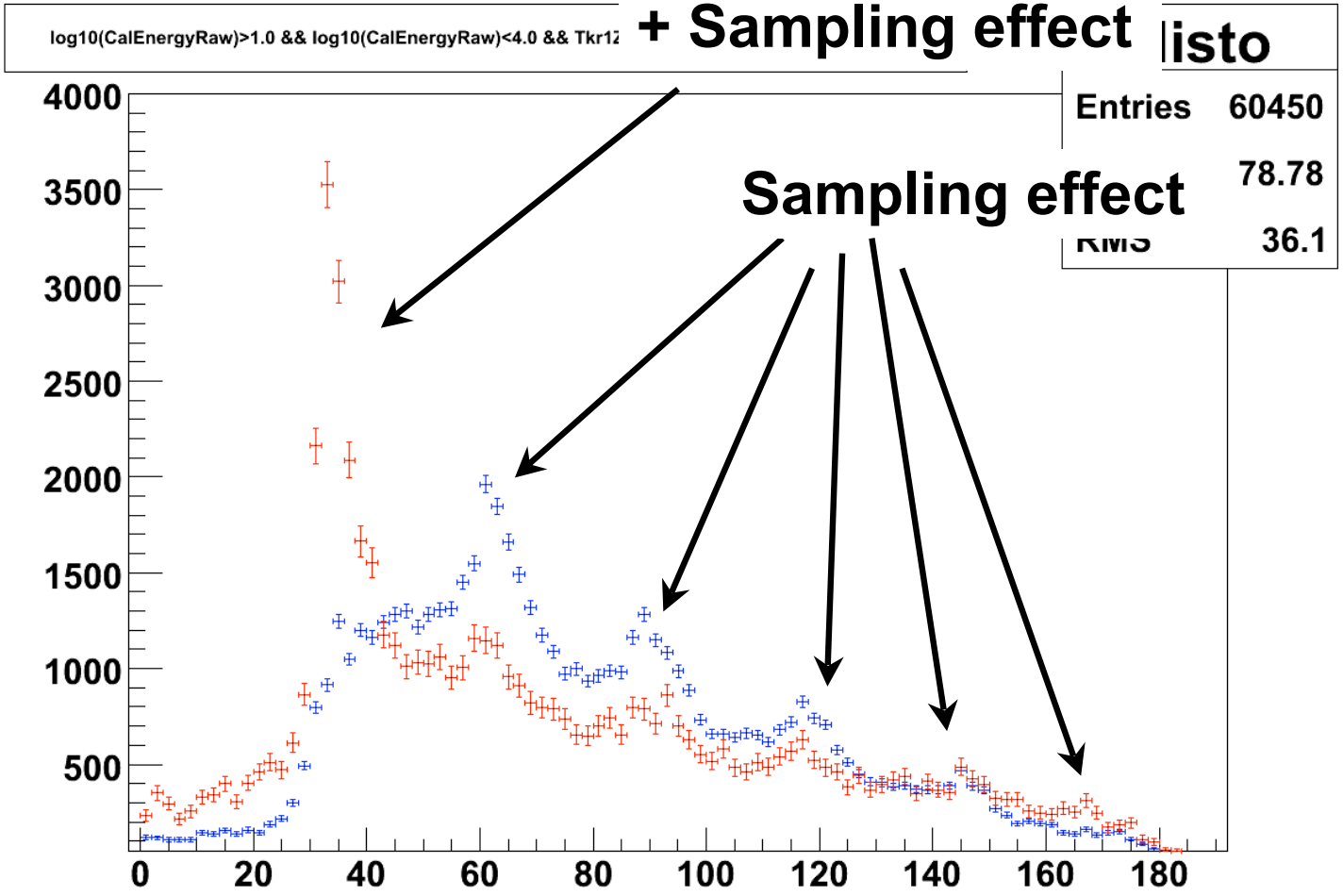
Picture from

LAT-TD-04631-02
(Eduardo, March 2005

MC in red; **Data in blue**
28k Evts 104k Evts

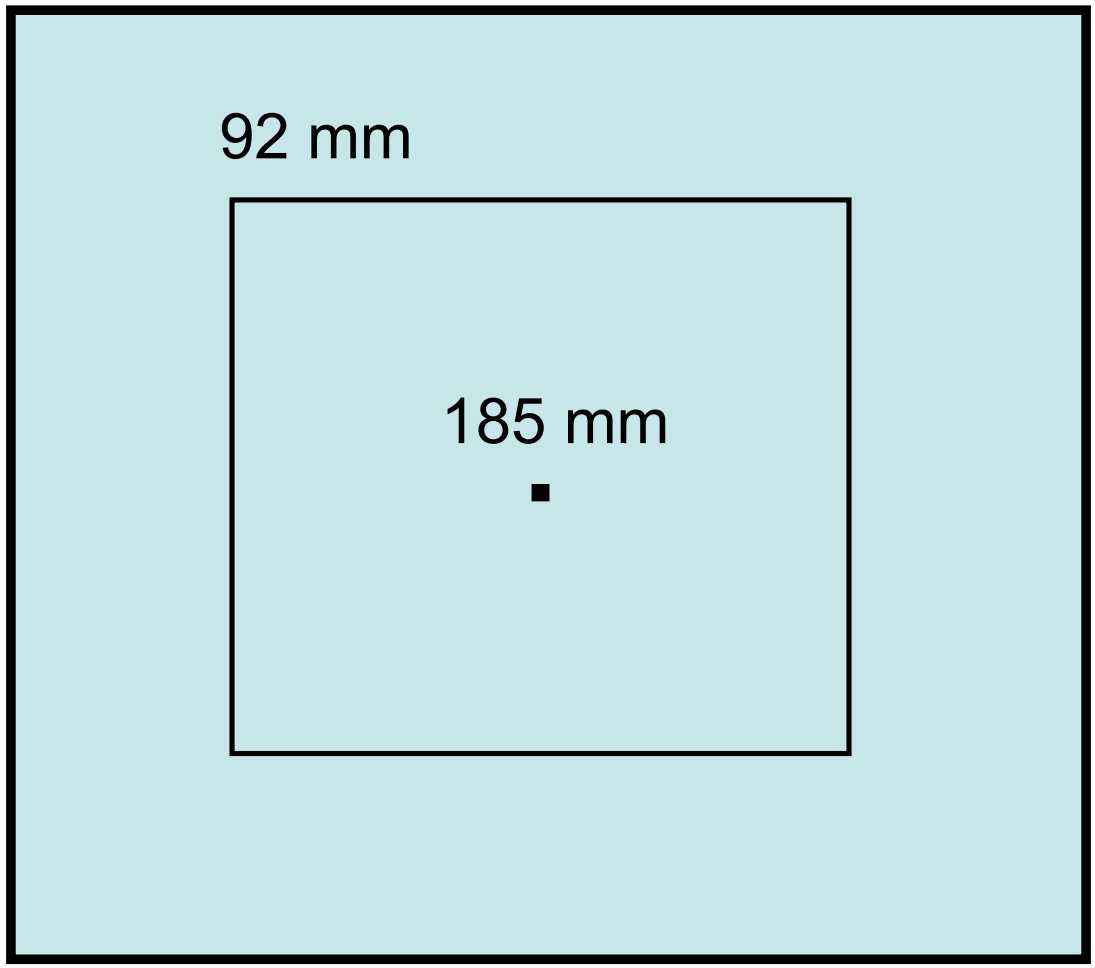
Preliminary

Tkr1ZDir < -0.95



Contours of equal CalTwrEdgeCntr are squares centered at the center of the tower

$$Area \propto (185 - CalTwrEdgeCntr)$$

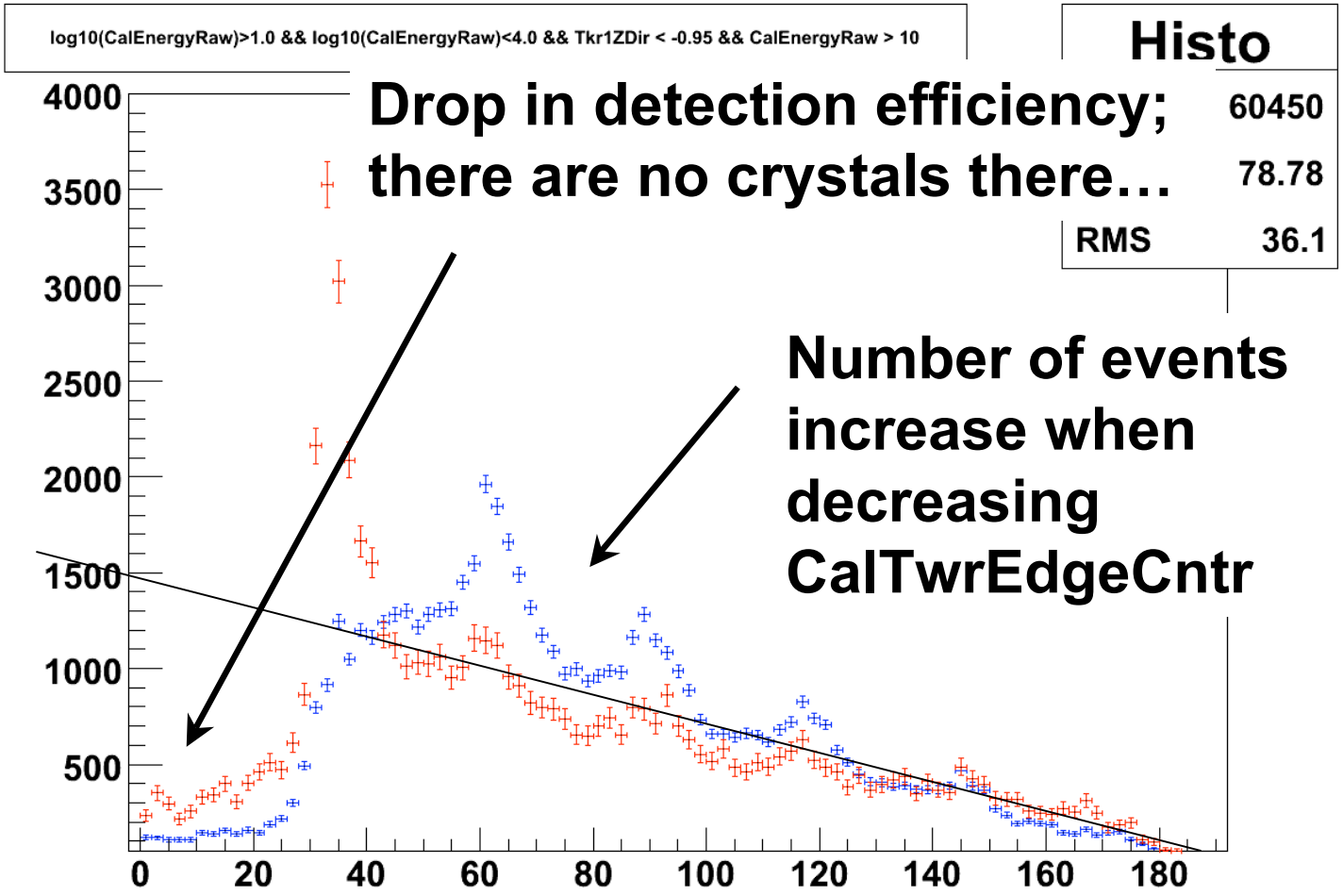


Number of events will increase when decreasing CalTwrEdgeCntr, till the LAT detection efficiency drops

MC in red; **Data in blue**
28k Evts 104k Evts

Preliminary

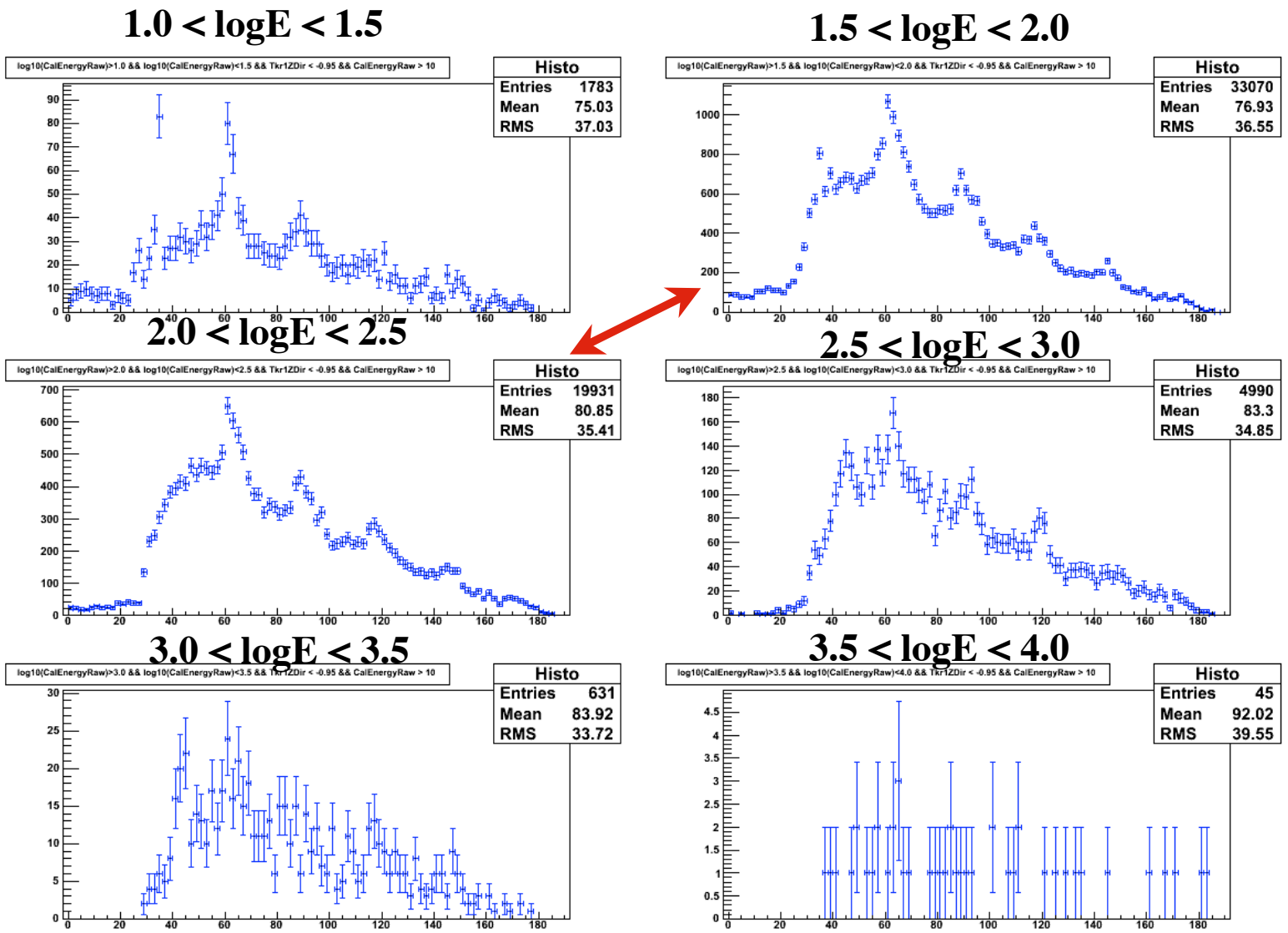
Tkr1ZDir < -0.95



Overall shape of the distribution of **CalTwrEdgeCntr** is more or less what we expect (details of the MC data still being checked)

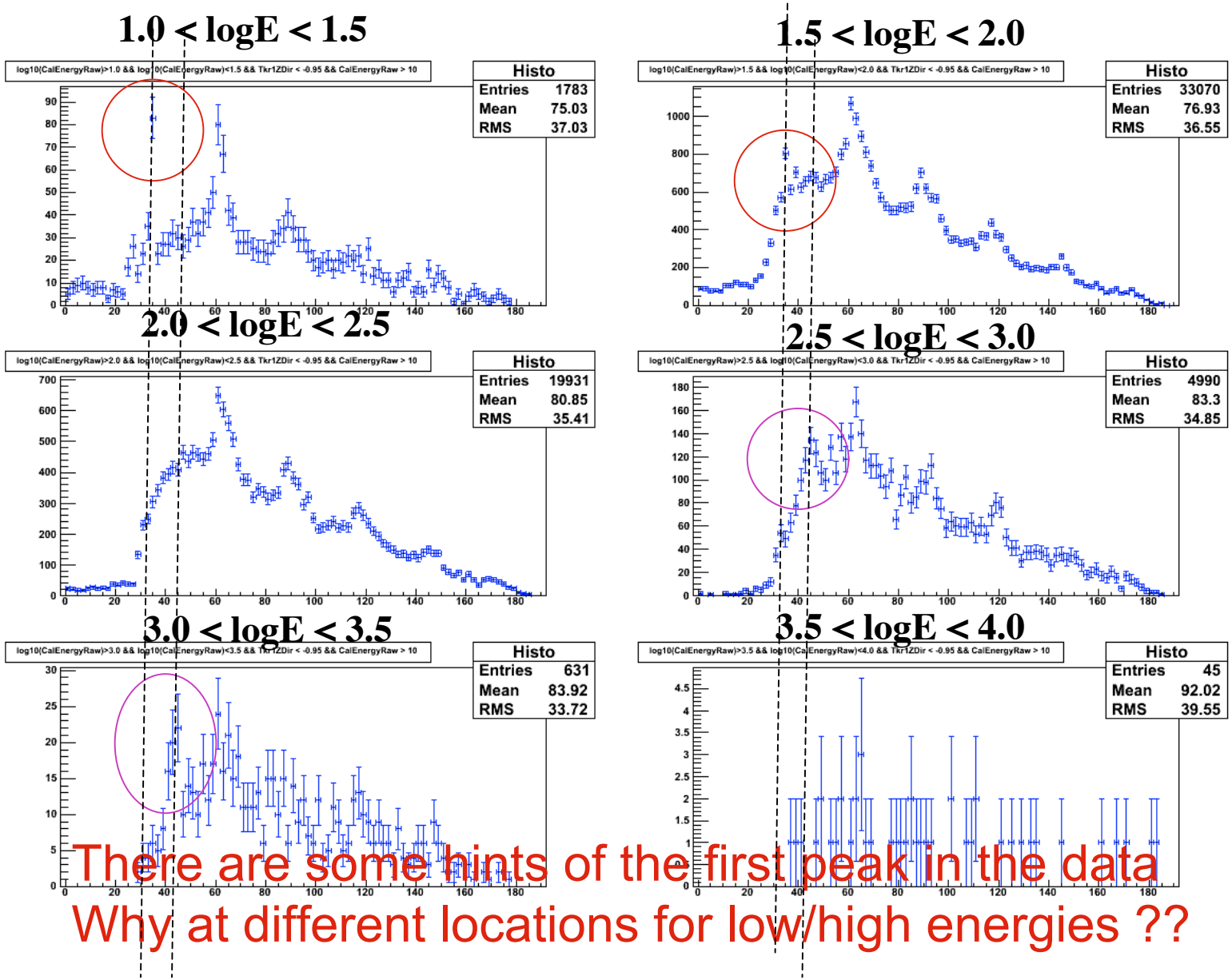
BUT we are missing **the first peak,** and **some events** at **low (<30mm) CalTwrEdgeCntr values**.

Because of power law gamma-ray fluxes; IMPORTANT to inspect variables at different energy (CalEnergyRaw) ranges



Dominant energy range : 30-300 MeV

Because of power law gamma-ray fluxes; IMPORTANT to inspect variables at different energy (CalEnergyRaw) ranges



There are some hints of the first peak in the data

Why at different locations for low/high energies ??

The first peak is not clear in the data. Why ???

Two Hypothesis

-1-

Problem in the reconstruction of the position, due to a “non-valid” algorithm (non linearities in asymetry based on the two diode measurements)

Perhaps this is the reason for a different effect at different energies…

-2-

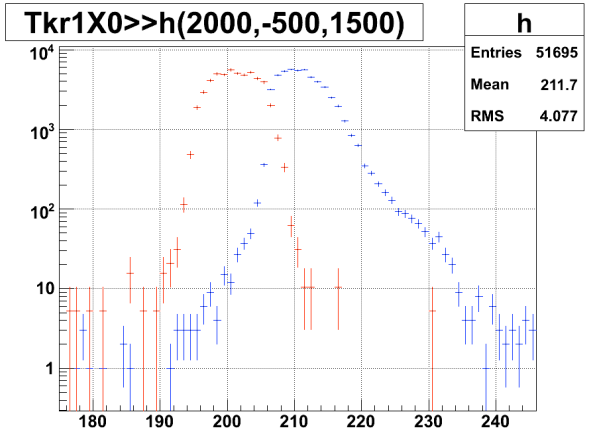
Lack of detection efficiency at the tower edges, which is not properly described by the MC

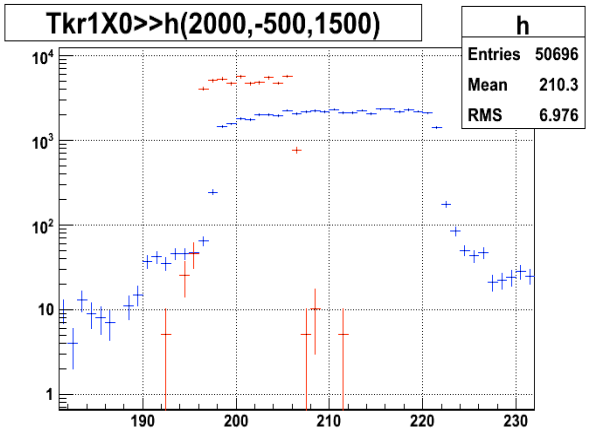
Comparison with beam test data, not easy

Beam is <2 cm width, instead of “uniform” ilumination
Generally, beam profile never (exactly) “well” described by MC

MC beam in red; **Data beam in blue**

Two examples:





We are just starting to simulate using beam characterisitcs directly from the real data. But this is **Not finished YET**.

Currently it is not possible to make direct Data-MC comparisons in what concerns to CalTwrEdgeCntr

Yet we still can study CalTwrEdgeCntr with beam test data (not using MC data)

Search for spatial (x,y) scans

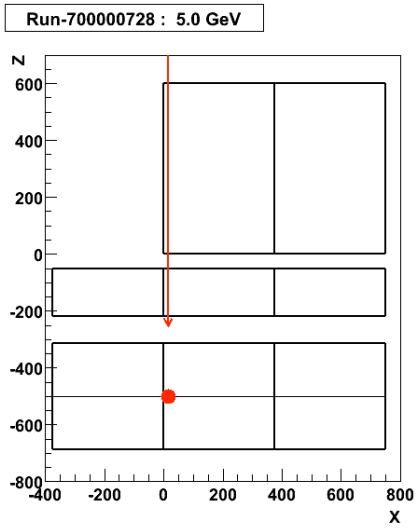
PS energies are more appropriate than SPS energies

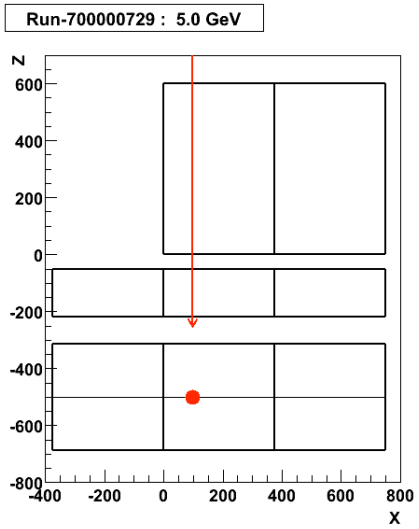
I found a scan with
5 GeV electrons

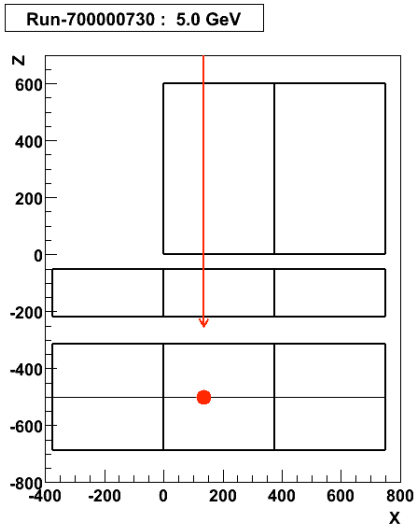
23 positions in which both towers were scanned in X direction

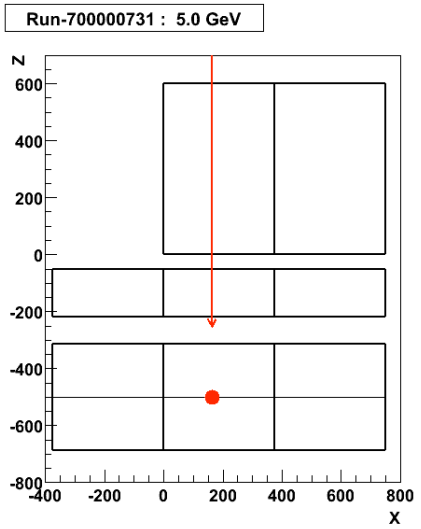
Run Number	X pos
700000728	[illegible]
700000726	61.97
[illegible]	[illegible]
700000729	97.65
700000730	135.49
700000731	163.33
700000732	191.17
700000733	219.01
700000734	246.85
700000735	274.69
700000736	302.53
700000737	330.37
700000738	398.63
700000739	426.47
700000740	454.31
700000741	477.15
700000742	504.99
700000743	532.83
700000744	560.67
700000746	588.51
700000747	616.35
700000748	644.19
700000749	672.03
700000750	699.87

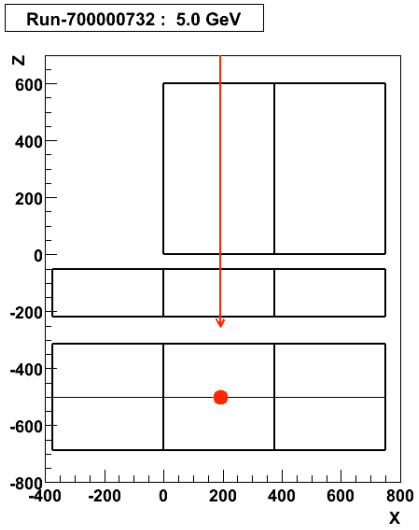
31 mm

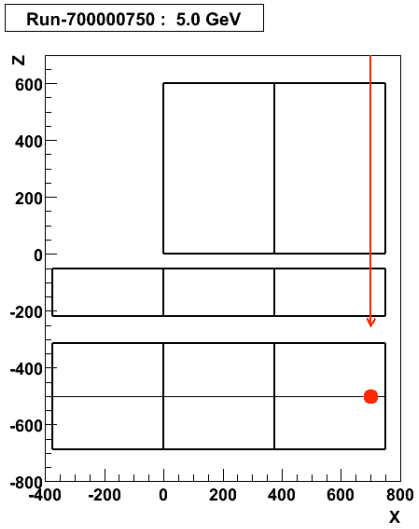












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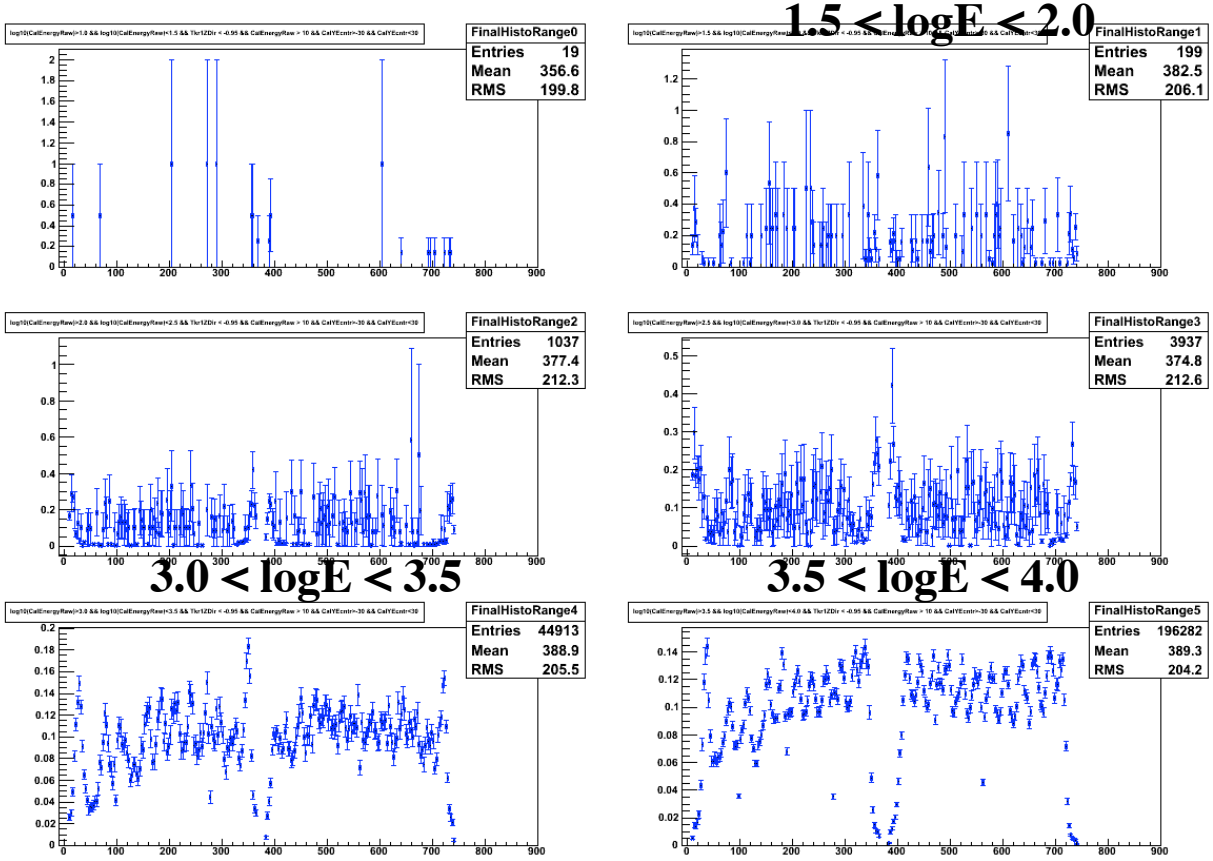
http://polywww.in2p3.fr/~bruel/btwww/summary.html

Area illuminated (Tkr1X0) more or less uniform

Individual runs are anyhow visible

Big drop in the inter-tower space, no runs just at the tower edge

Each of the runs is weighted with 1/events; thus all runs (positions) have roughly the same contribution

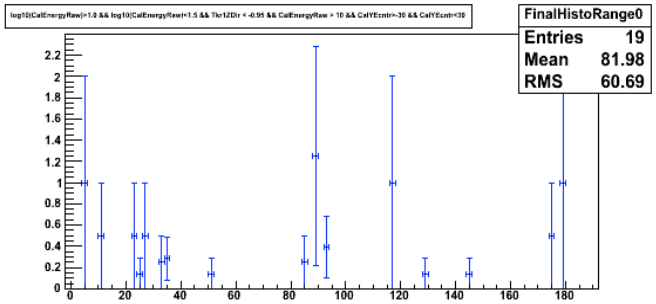


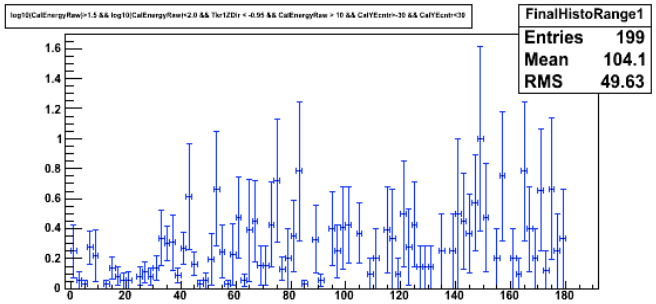
Tkr1X0

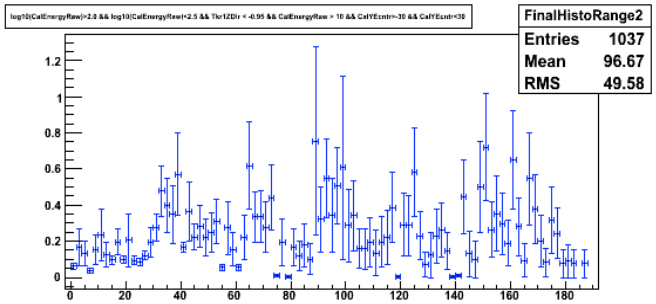
CalTwrEdgeCntr for 5 GeV PS electrons

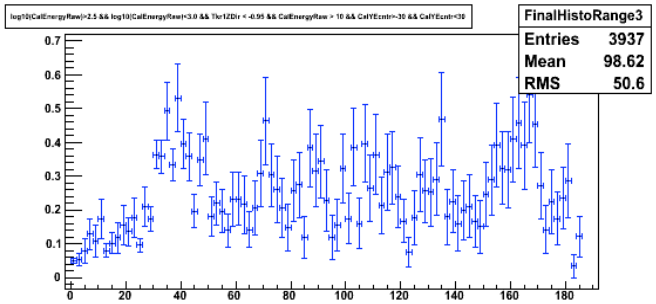
Only (decent number of) events above 1 GeV

6 peaks are well visible there…



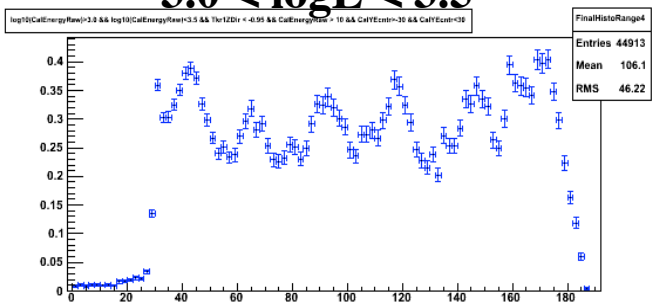


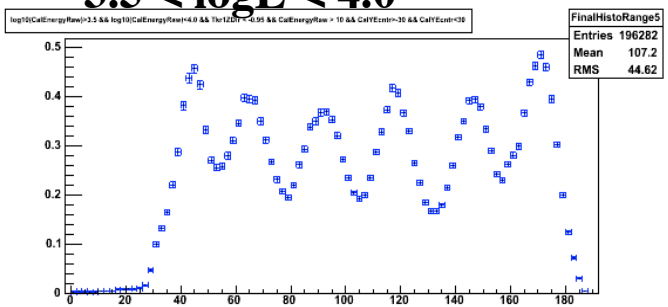


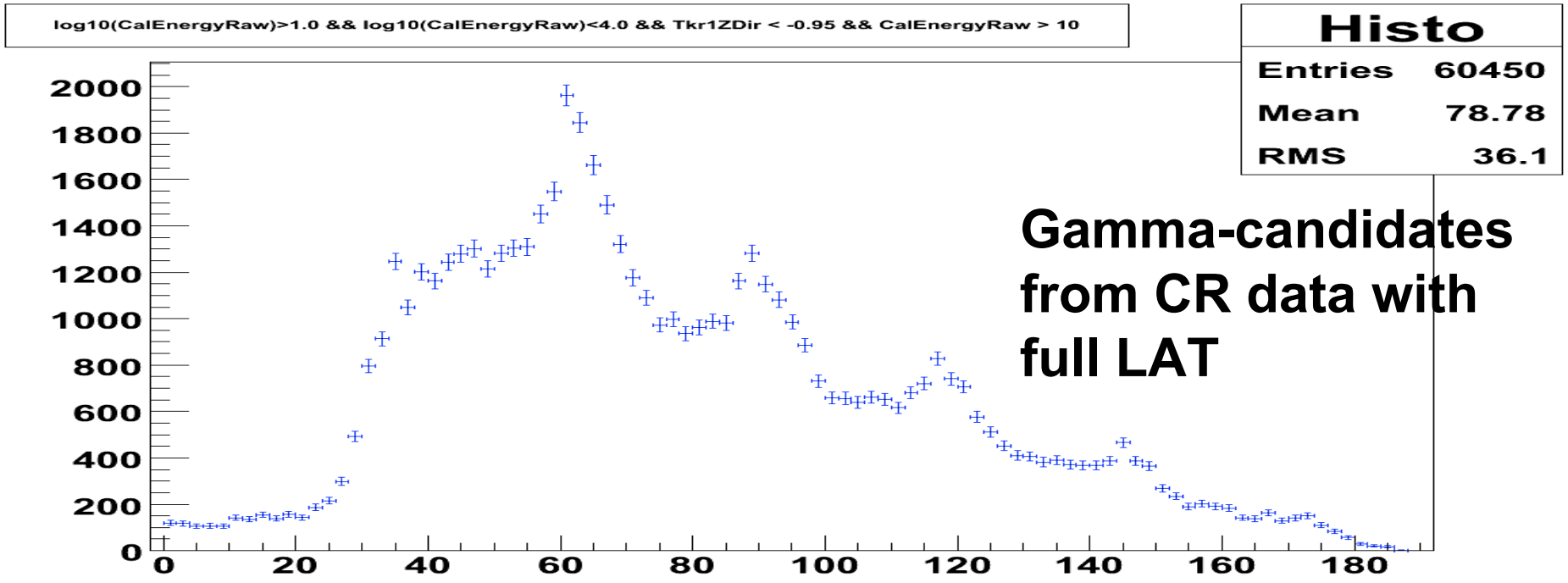


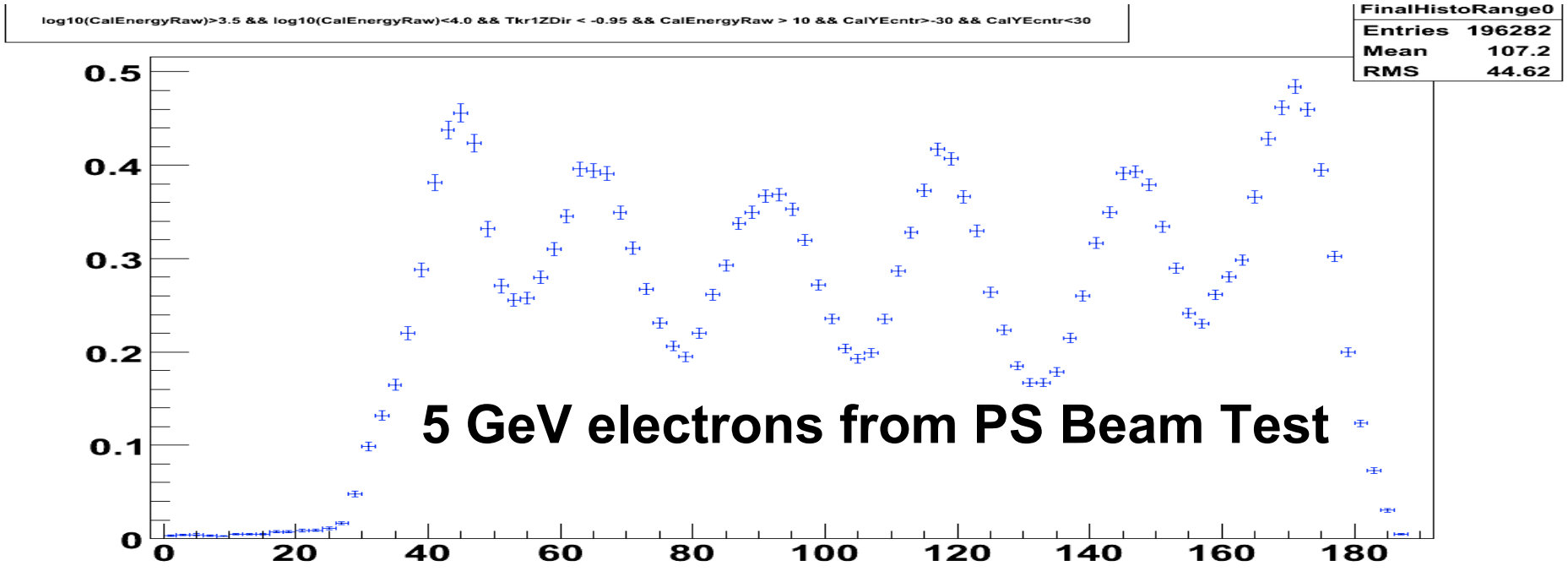
3.0 < logE < 3.5

3.5 < logE < 4.0





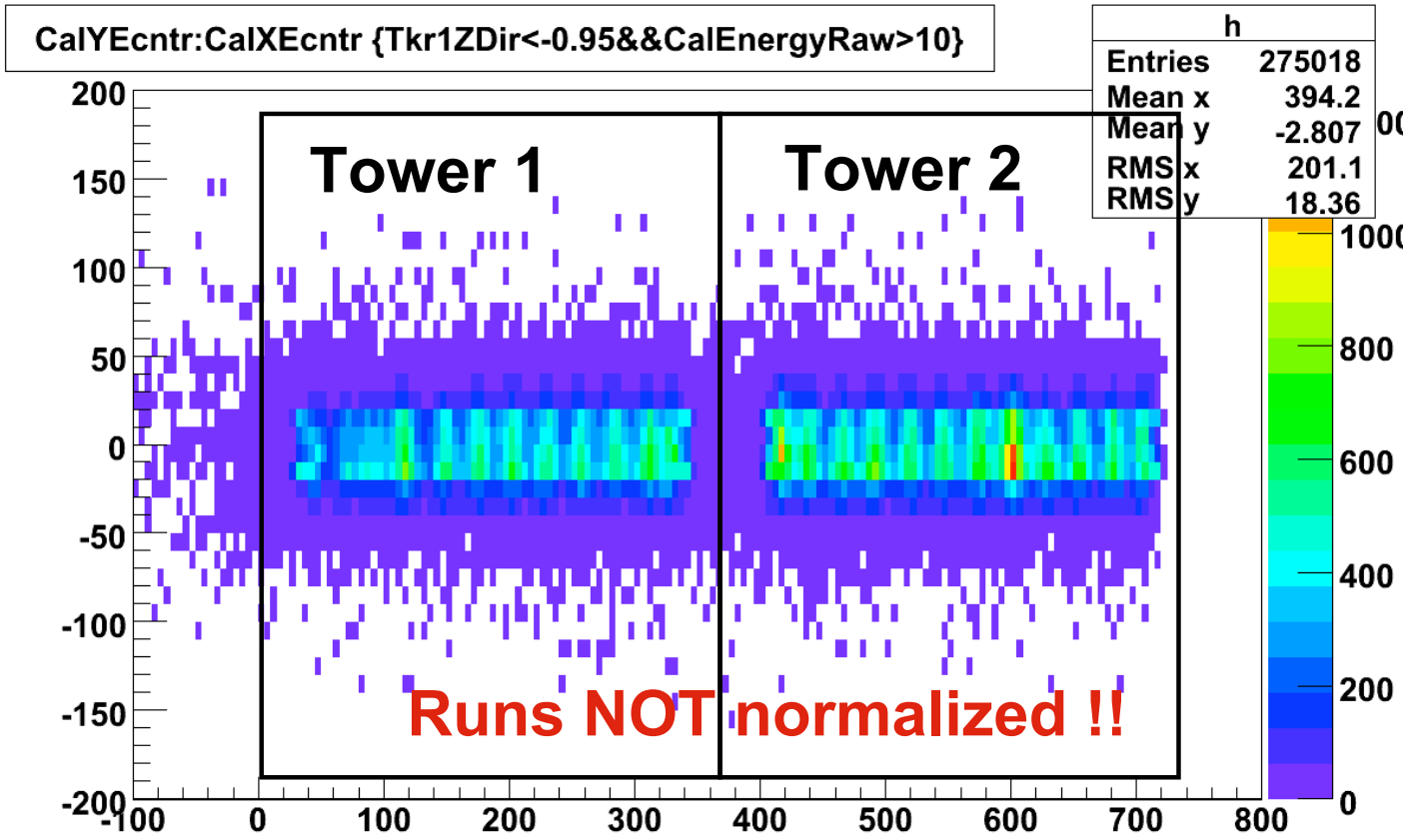

log10(CalEnergyRaw)>1.0 && log10(CalEnergyRaw)<4.0 && Tkr1ZDir < -0.95 && CalEnergyRaw > 10
Histo
Entries 60450
Mean 78.78
RMS 36.1
Gamma-candidates from CR data with full LAT


log10(CalEnergyRaw)>3.5 && log10(CalEnergyRaw)<4.0 && Tkr1ZDir < -0.95 && CalEnergyRaw > 10 && CalYEcntr>-30 && CalYEcntr<30
FinalHistoRange0
Entries 196282
Mean 107.2
RMS 44.62
5 GeV electrons from PS Beam Test

Different shape in CalTwrEdgeCntr partly due to the event distribution within the tower. This can be “fixed”

Beam test data

Distribution of center of gravities in calorimeter

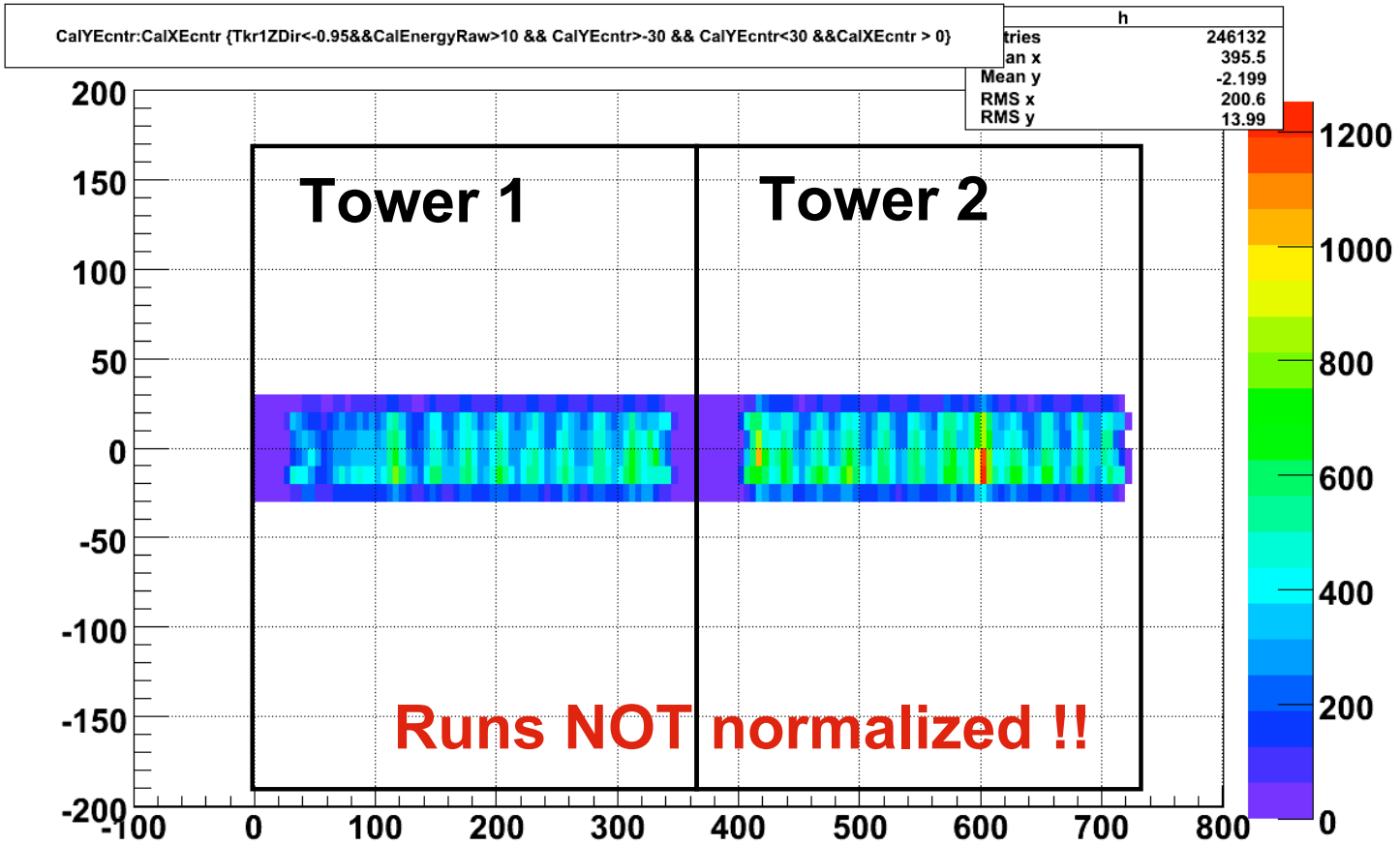


Beam test data

Interesting area for beam test data:

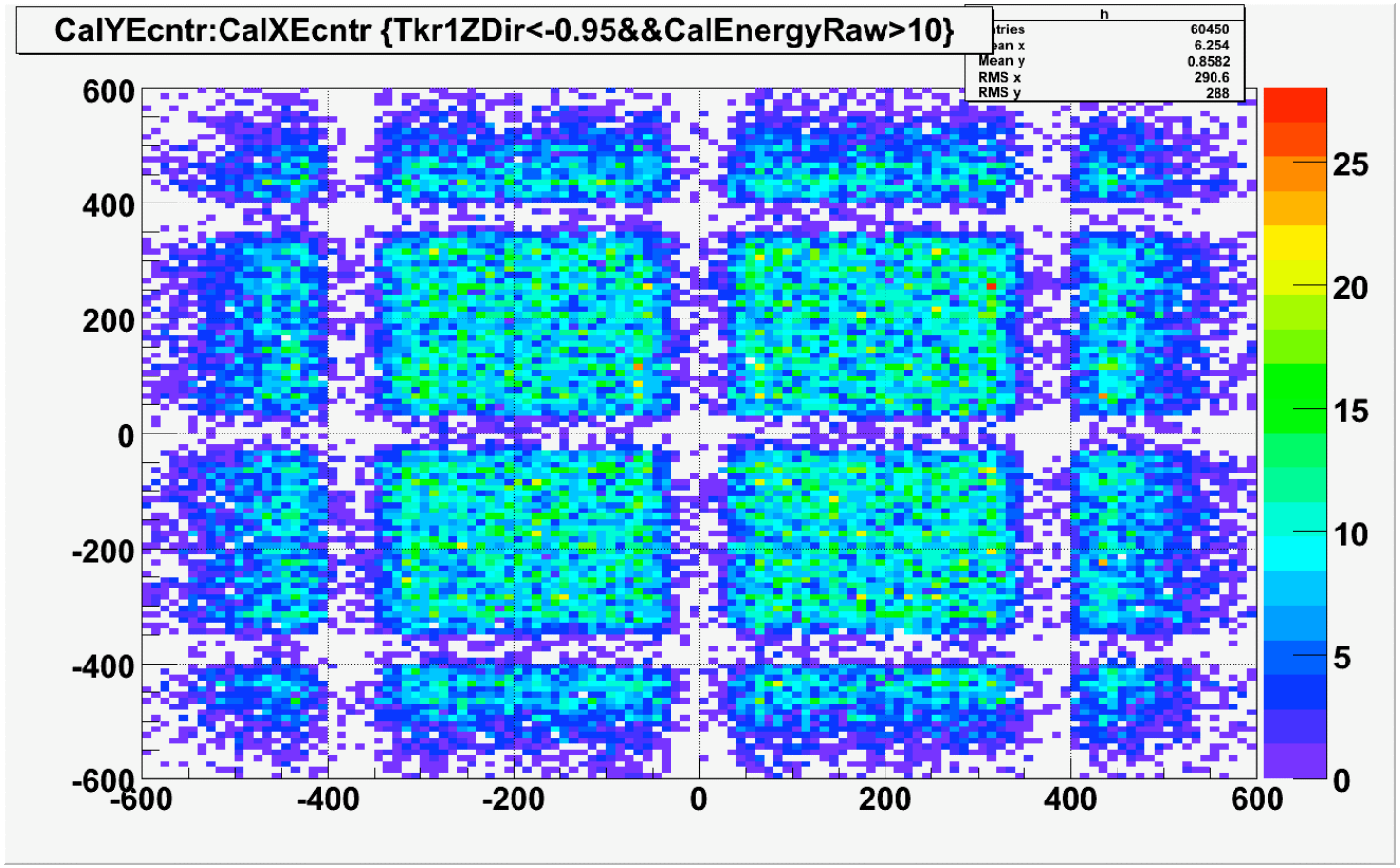
Center of tower (in Y direction) +/- 30 mm

Distribution of “good” center of gravities in calorimeter



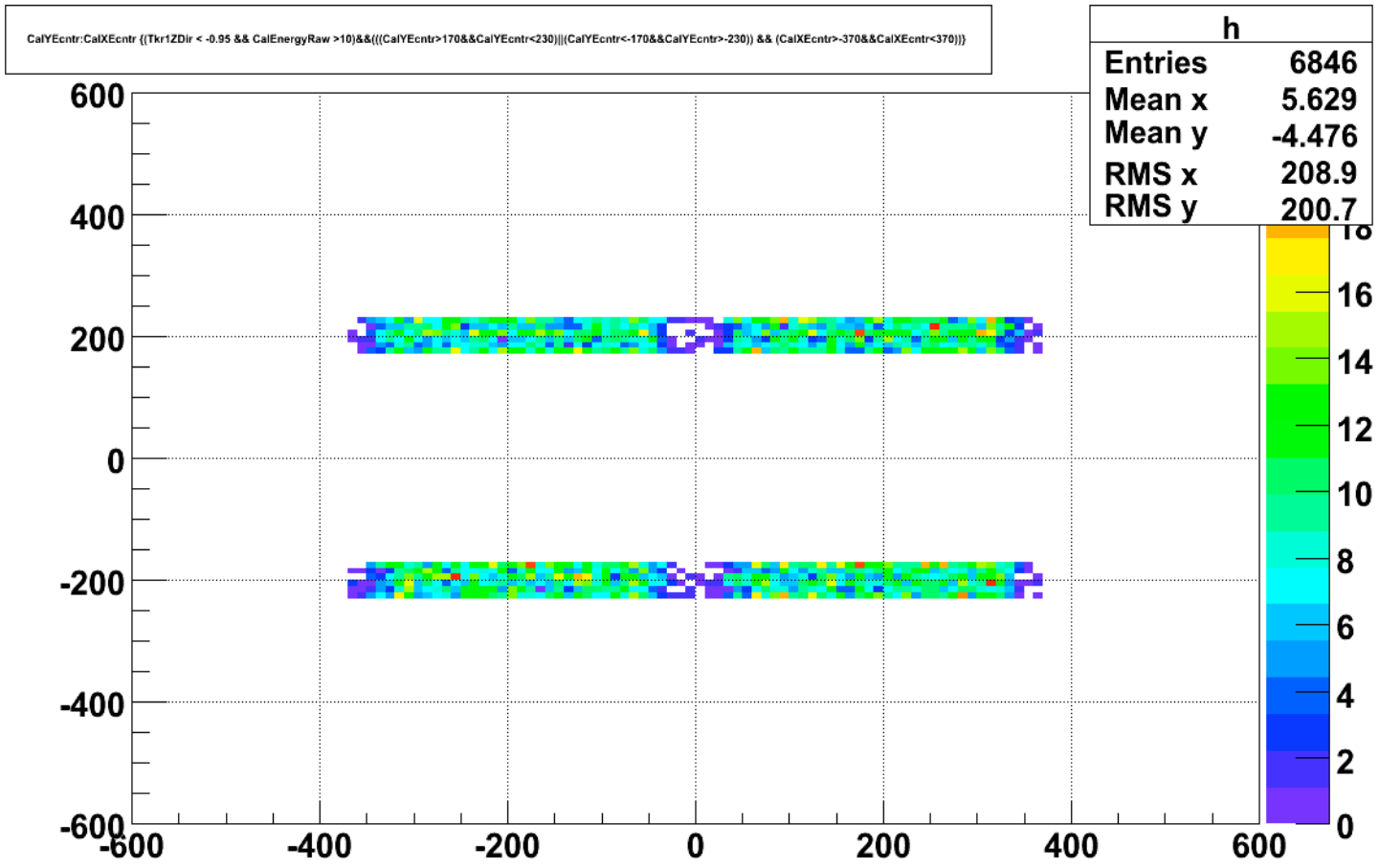
Gamma candidates from CR data

Distribution of center of gravities in calorimeter



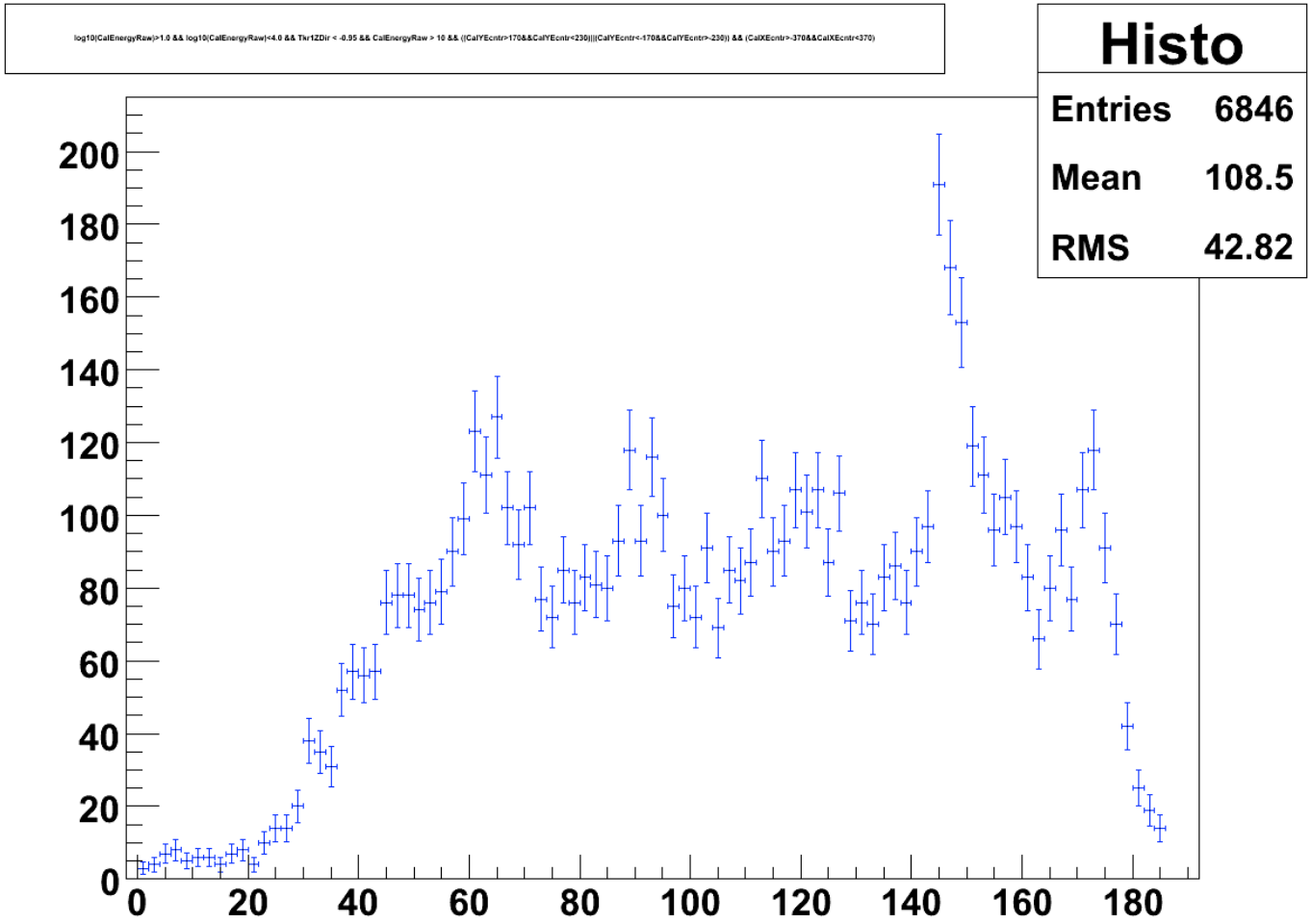
Gamma candidates from CR data

Distribution of center of gravities in calorimeter after extra fiducial cut to compare with beam test data



CalTwrEdgeCntr for CR data after extra fiducial cut

5 peaks well visible in the data.. One peak still missing



CalTwrEdgeCntr for CR data after extra fiducial cut

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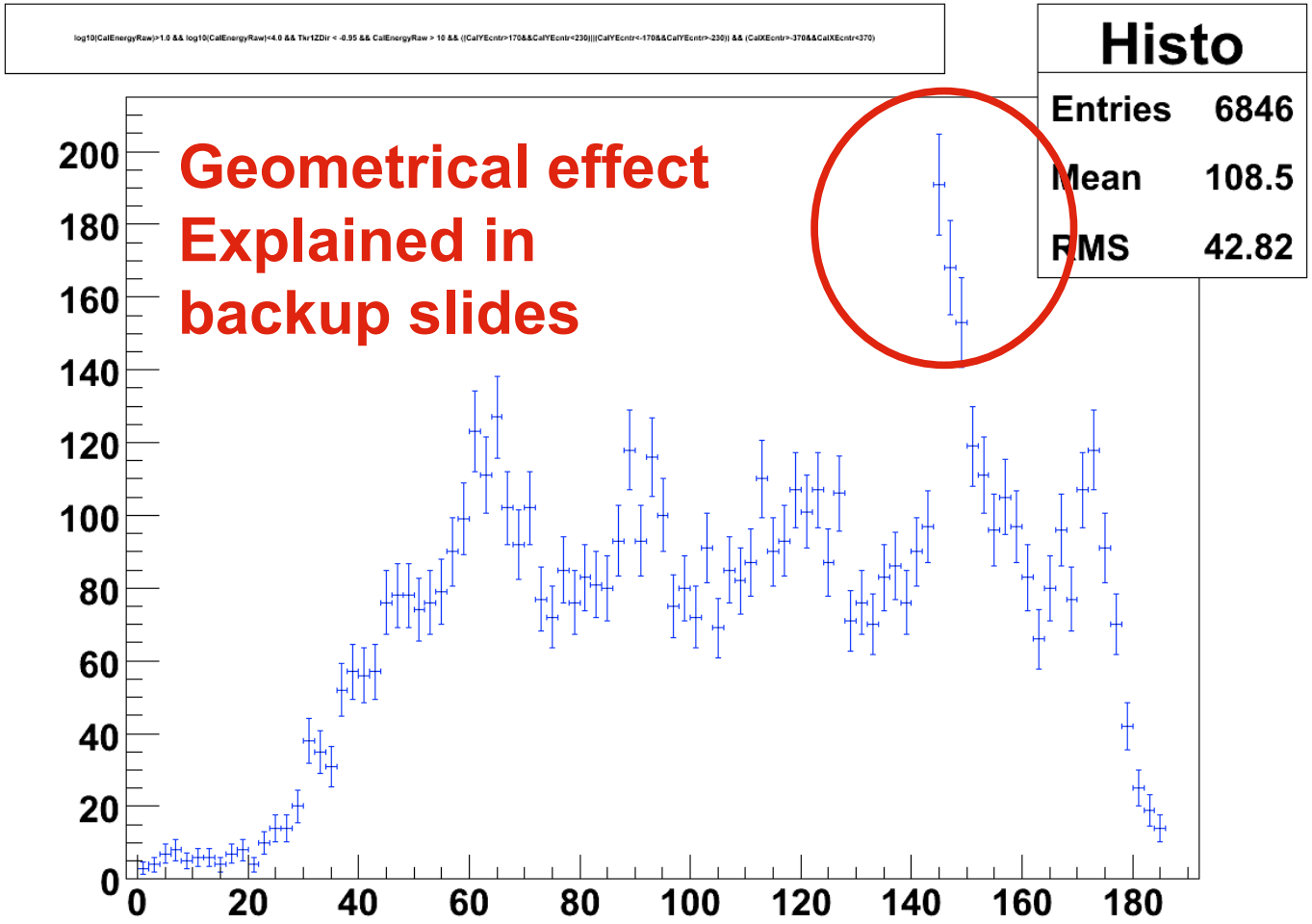
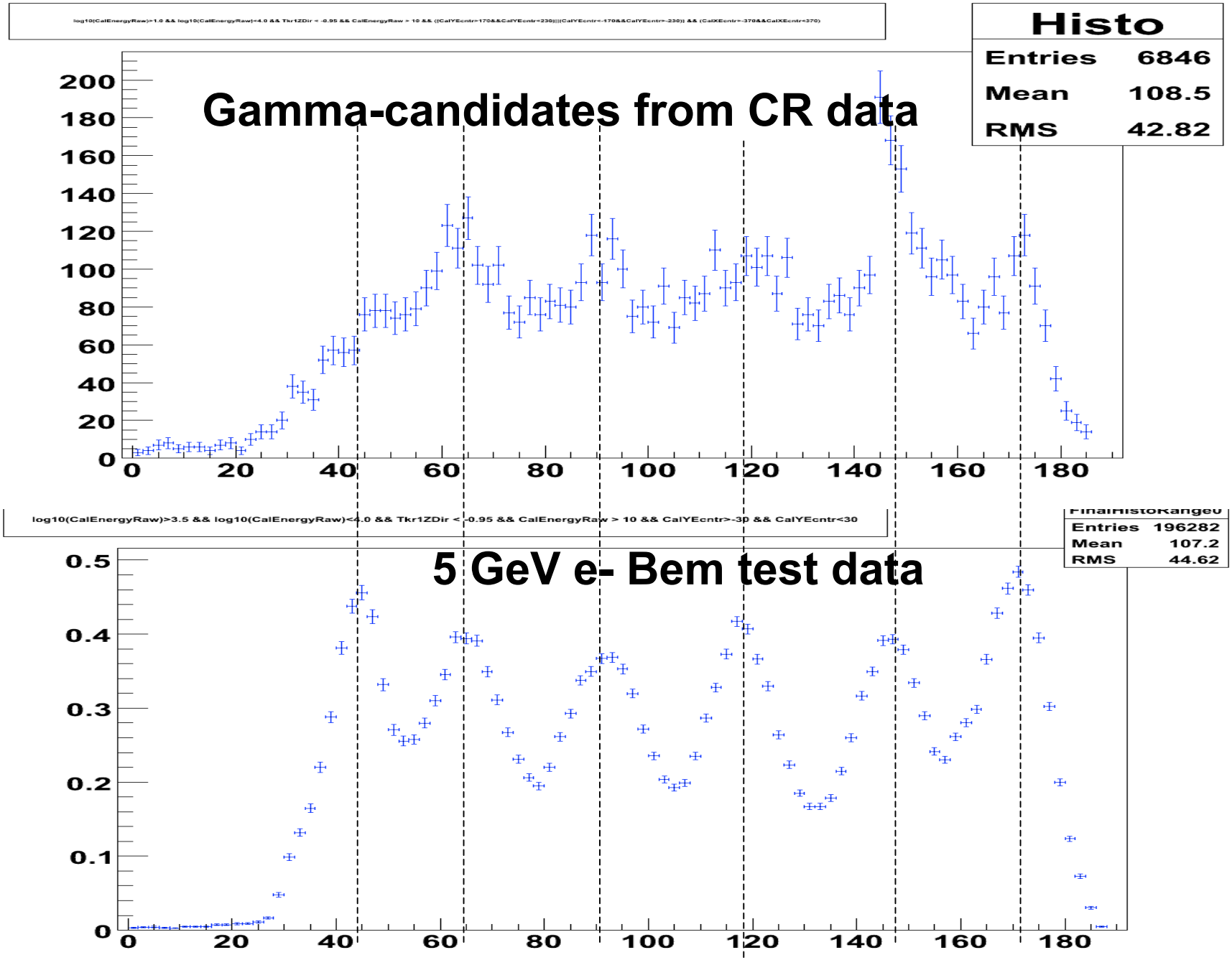



log10(CalEnergyRaw)>1.0 && log10(CalEnergyRaw)<4.0 && Tkr1ZDir < -0.95 && CalEnergyRaw > 10 && ((CalYEcntr<170&&CalYEcntr>230)||(CalYEcntr<-170&&CalYEcntr>-230)) && (CalXEcntr>-370&&CalXEcntr<370)
Histo
Entries 6846
Mean 108.5
RMS 42.82
Gamma-candidates from CR data
log10(CalEnergyRaw)>3.5 && log10(CalEnergyRaw)<4.0 && Tkr1ZDir < -0.95 && CalEnergyRaw > 10 && CalYEcntr>-30 && CalYEcntr<30
FinalHistoRangeU
Entries 196282
Mean 107.2
RMS 44.62
5 GeV e- Bem test data

The peak to valley ratio is larger in the beam test data because the incoming incident angle is smaller (it is basically zero) than in the CR data (up to 18 deg)

We cannot make comparisons in the region CalTwrEdgeCntr < 20 because, in this X scan, there is no electron beam that close to the tower edge

The first peak is very clear in the beam test data, whereas it is almost invisible in the CR data

This points to differences…

Note that the position of the first peak in beam test data is ~45 mm, and not the ~35 mm from the MC gammas Does it have something to do with the shower Energy?

Possible explanations for the lack of “first peak”:

LAT Trigger

In beam test data, the trigger is external, we record info from ALL the events; EVEN if they are close to the edge. The lack of the first peak might be caused by the difficulty of triggering on these type of events; for which we get little information.

This would imply that the trigger in the MC must be tuned in order to get the right detection efficiency for this class of events

Work ongoing:

Apply additional cuts in MC data and beam test data which mimic the effect of the REAL trigger engine

Possible explanations for the lack of “first peak”:

Bias in analysis of the LAT CR data

We are checking that the current analysis of the CR data is not artificially removing events close to the tower edges

LAT calibration

The calibration of the diodes for the full LAT is not done properly (in comparison with that of Beam Test), and consequently, events are “moved” to inner regions of the tower (to larger CalTwrEdgeCntr values)

Yet we know that the diode asymetry calibration is not correct in beam test data…
*(*http://polywww.in2p3.fr/~bruel/beamtest_20060927.pdf)

Conclusions

Analysis of CR data taken at SLAC with full LAT showed that CalTwrEdgeCntr does not behave exactly as expected for gamma-type events

Several possible explanations were presented

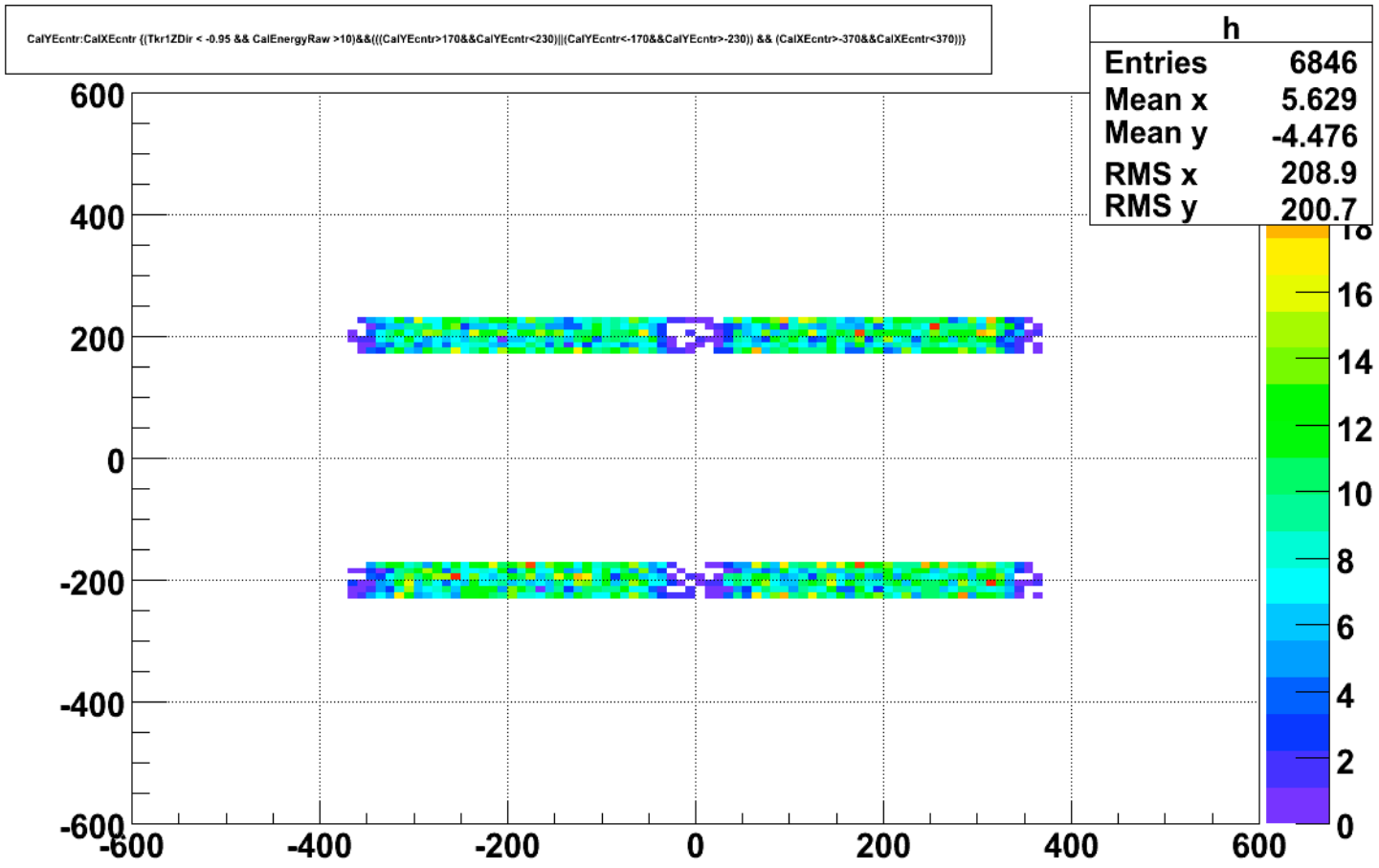
Work ongoing to test the above presented hypotheses

We can gain insights of the the LAT performance by analysing and comparing both CR data and Beam test data

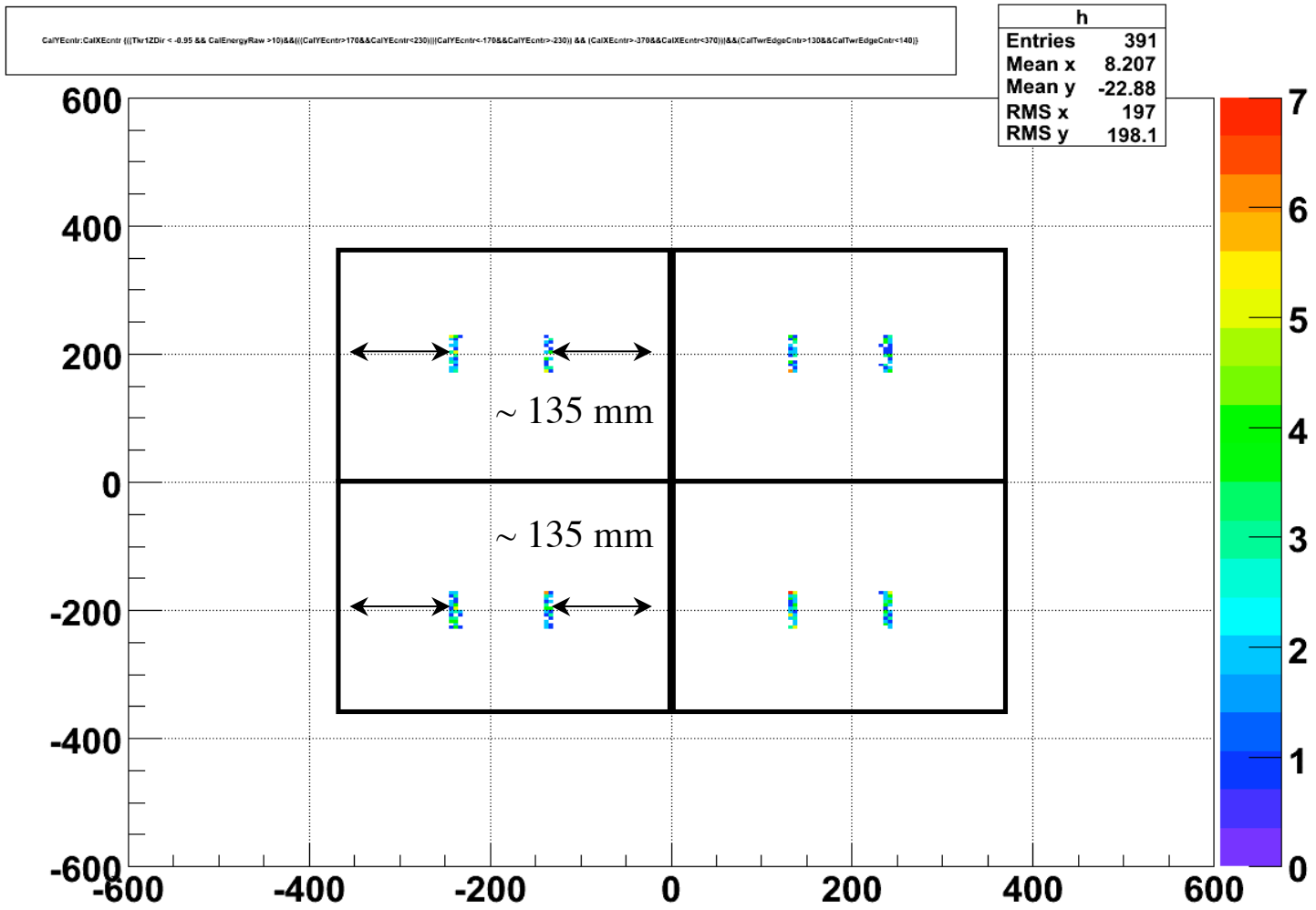
Back up

Gamma candidates from CR data

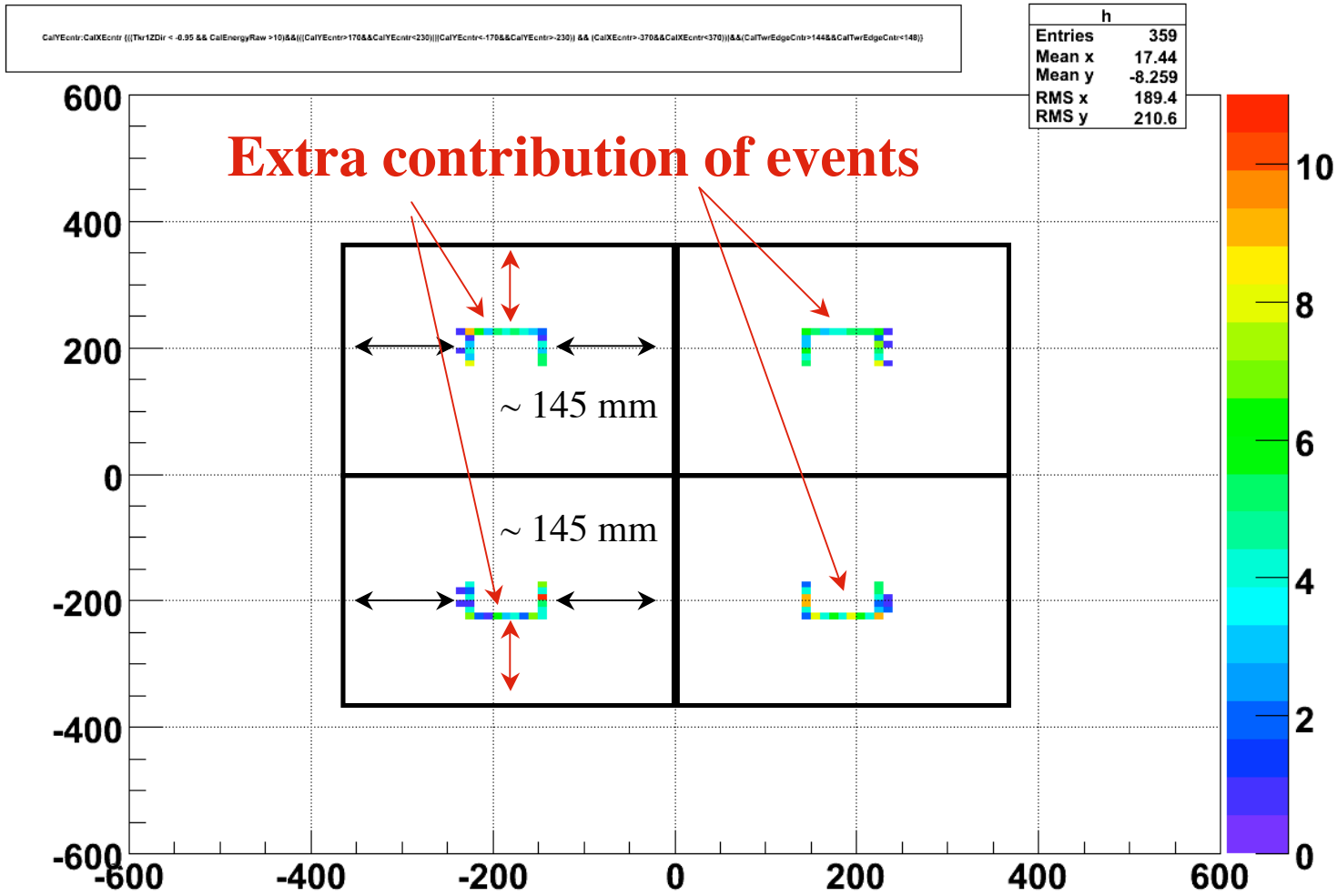
Distribution of center of gravities in calorimeter



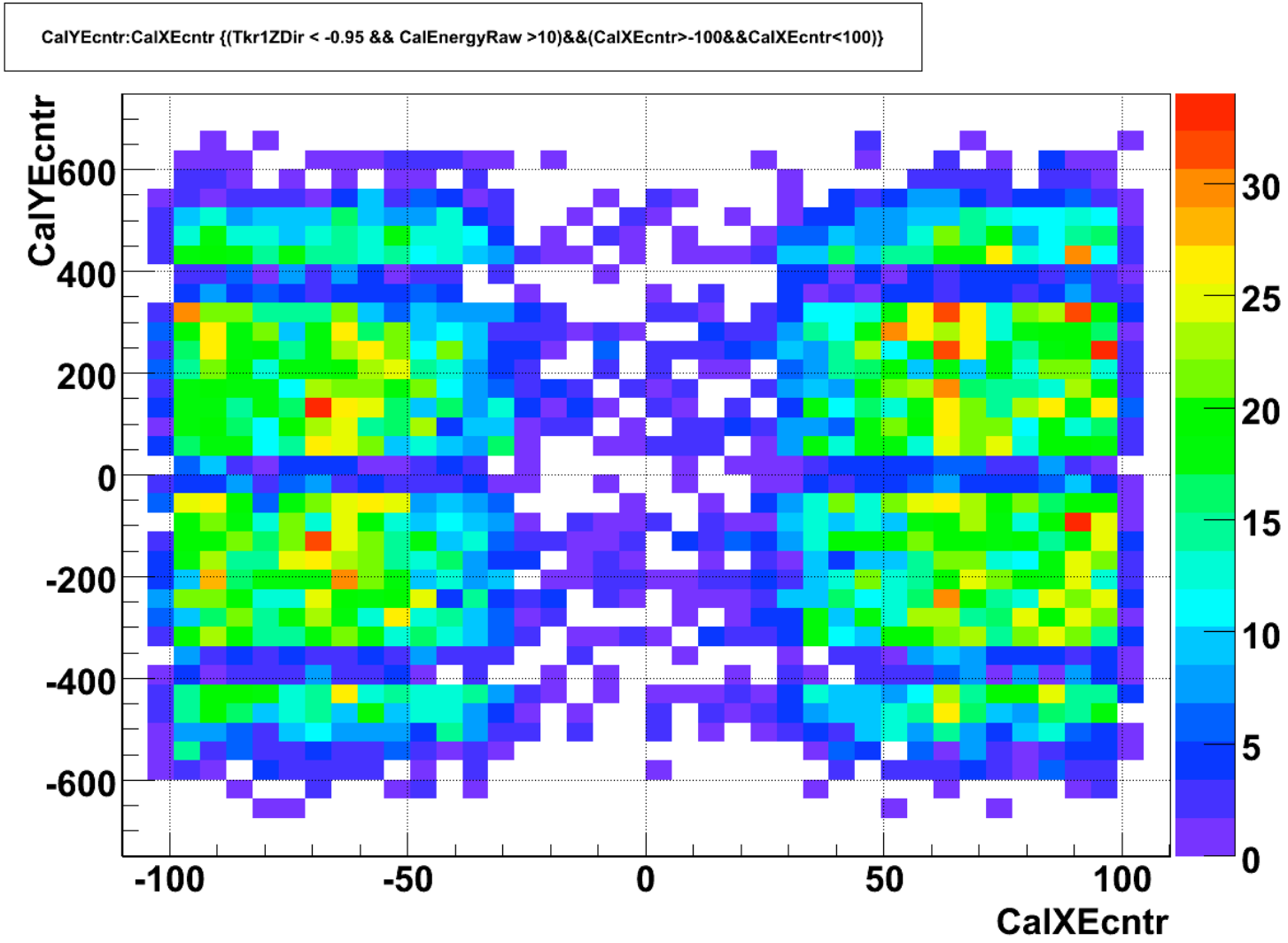
Distribution of center of gravities for that region with CalTwrEdgeCntr >130 and CalTwrEdgeCntr <140



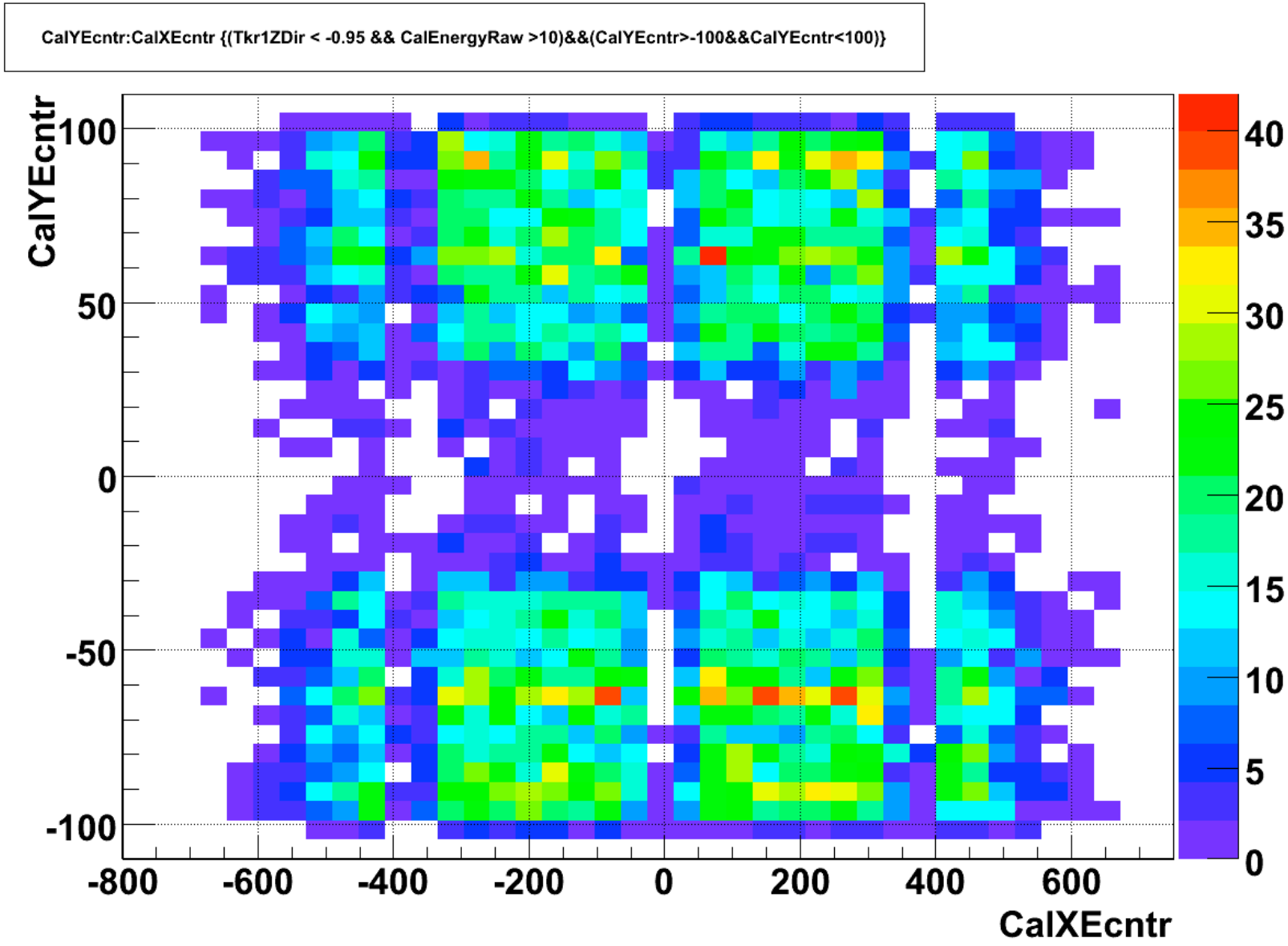
Distribution of center of gravities for that region with CalTwrEdgeCntr >144 and CalTwrEdgeCntr <148



Lack of CR events at the tower edges



Lack of CR events at the tower edges



Lack of CR events at the tower edges