Custom simulation for SPS data runs

Runs at 60 deg incidence angle

	0 deg	30 deg	60 deg
282 GeV:	700001922,	700001942,	700001949
200 GeV:	700001911,	700001902,	700001909
100 GeV:	700001981,	700001999,	700002006
50 GeV:	700002034,	700002056,	700002064
20 GeV:	700002082,	700002096,	700002103

In presentation done on May 9 I pointed out some issues in runs 1949 and 1909. Those issues exist, although less evident, in runs 2006, 2064 and 2103.

Here I report on the origin of the problem

Important remark on Data-MC plots

The only cuts applied to the data are :

1 - CalEnergyRaw > 10 MeV (No-empty events)

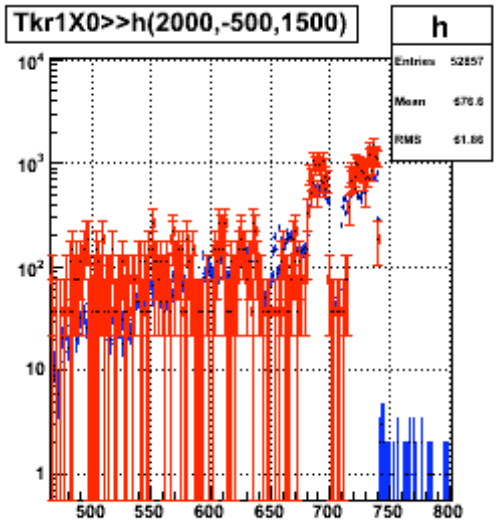
2 - TkrNumTracks > 0.5 (events with at least 1 track)

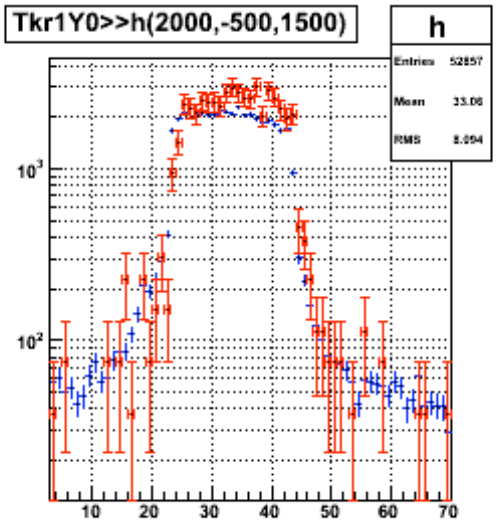
These are very simple cuts which are expected to be fulfilled by all the electrons in PS and SPS entering in the calibration unit.

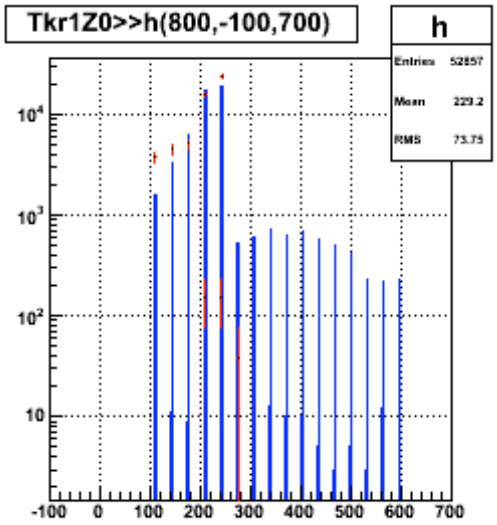
More sophisticated cuts (e.j. removing events crossing cracks, removing MIPs…) which might improve the agreement data-mc are NOT applied. These additional cuts must be applied with care, since they might also bias the comparison if not carefully done

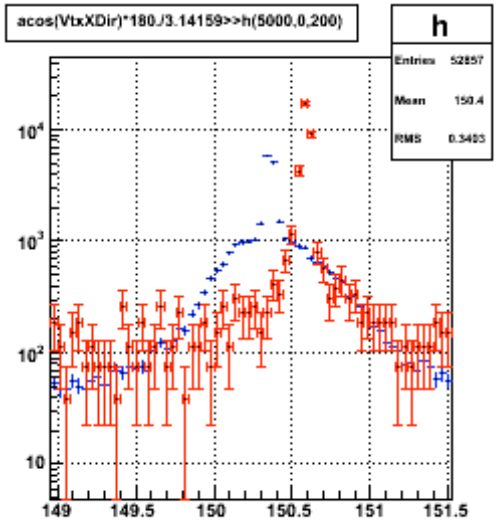
Data run 700001949 ***To be checked !!***

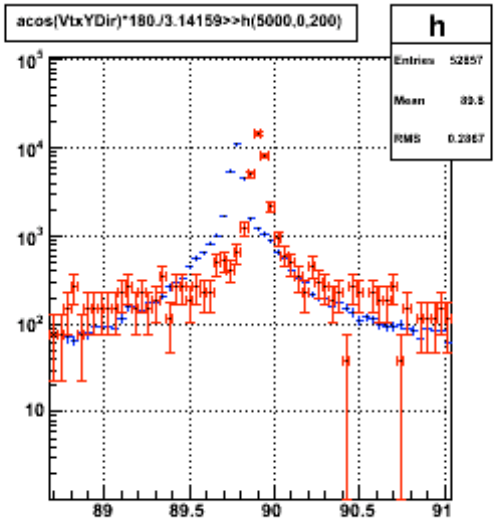
E = 282 GeV , 60 deg **MC in red**; **Data in blue**

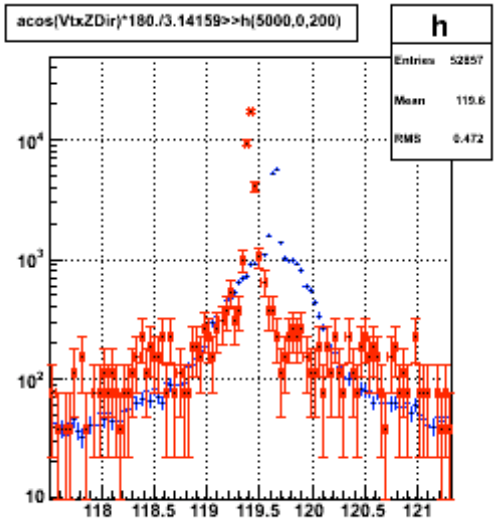






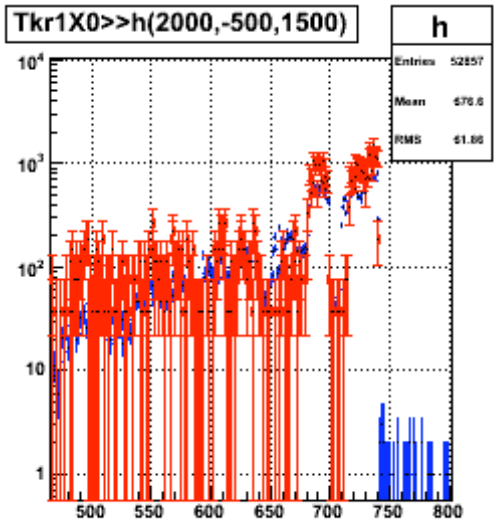


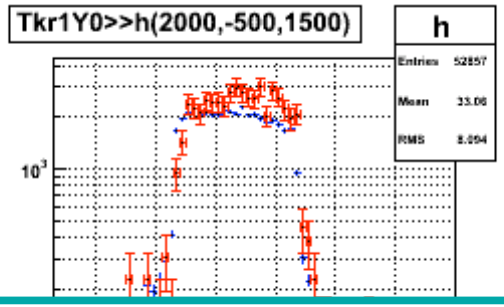


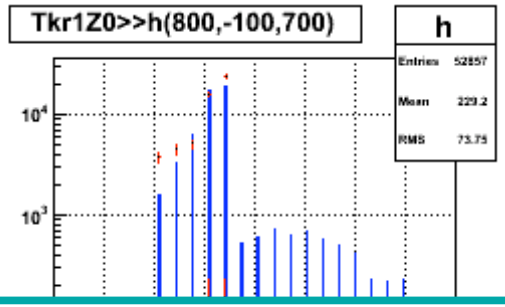


Data run 700001949 ***To be checked !!***

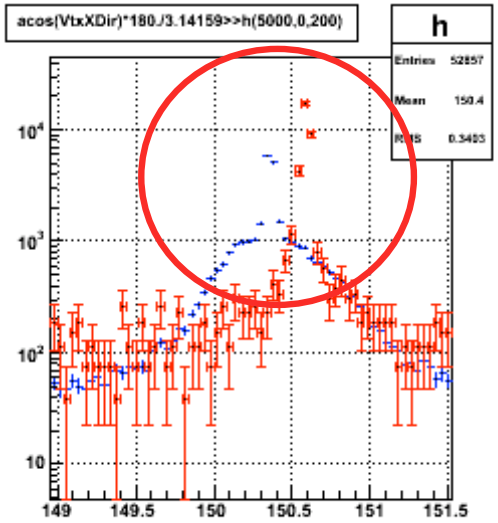
E = 282 GeV , 60 deg **MC in red**; **Data in blue**

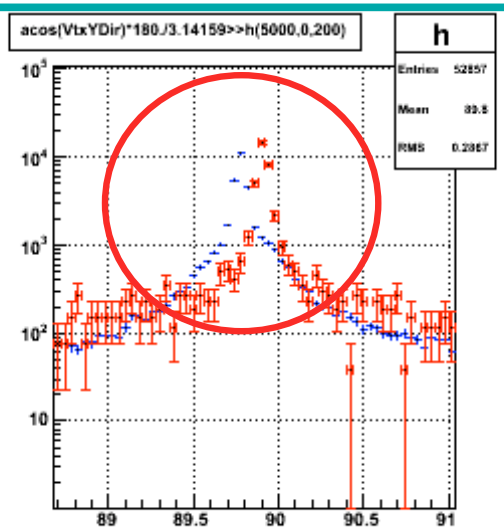


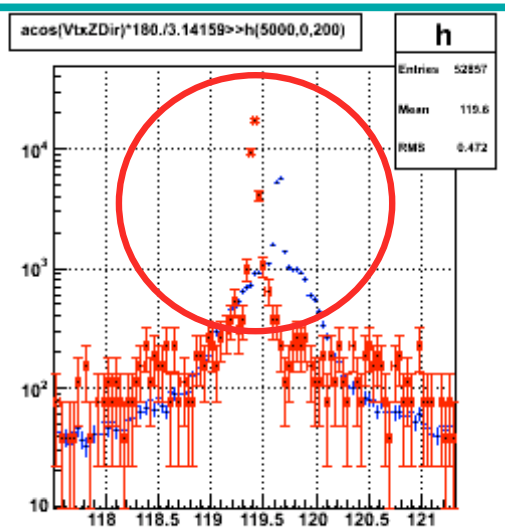




Incoming directions estimated from the data do not produce satisfactory results on the generated MC

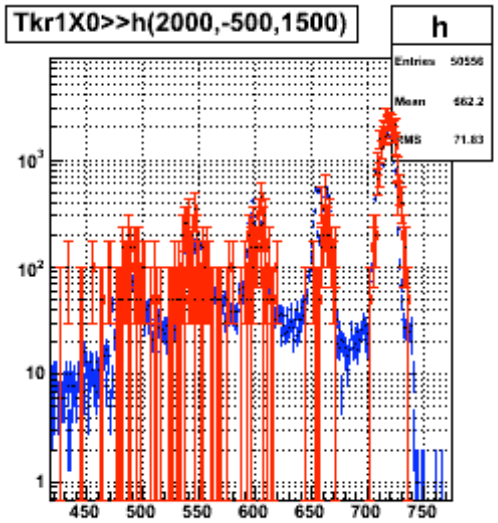


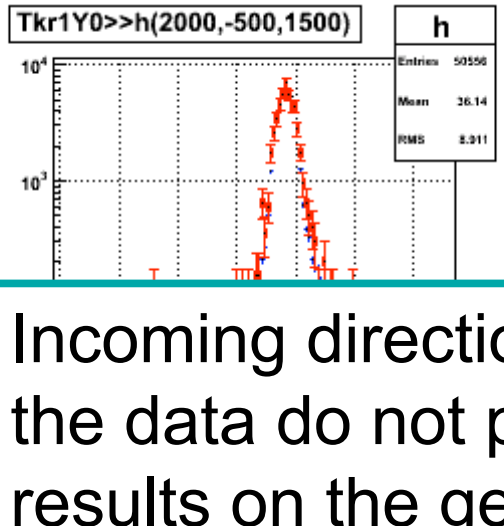


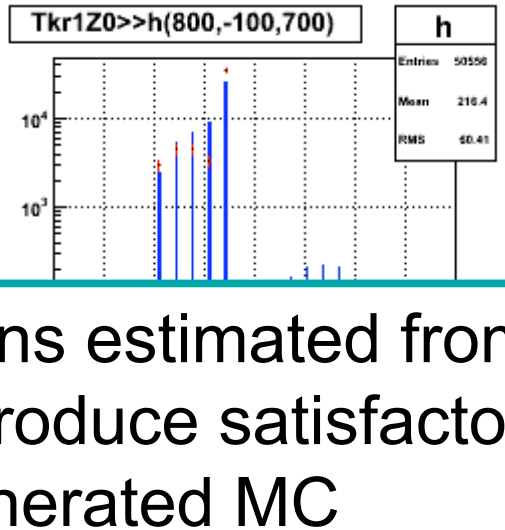


Data run 700001909 ***To be checked !!***

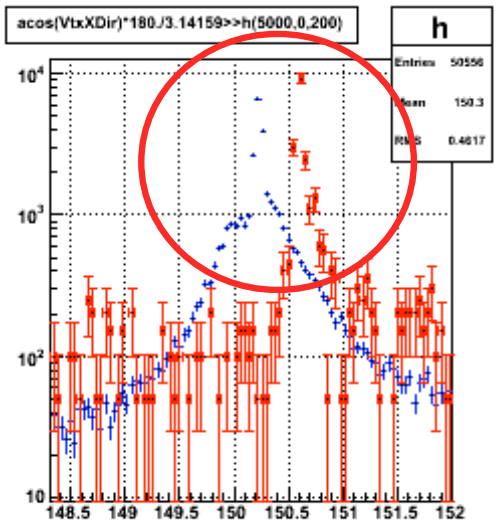
E = 196 GeV , 60 deg **MC in red**; **Data in blue**

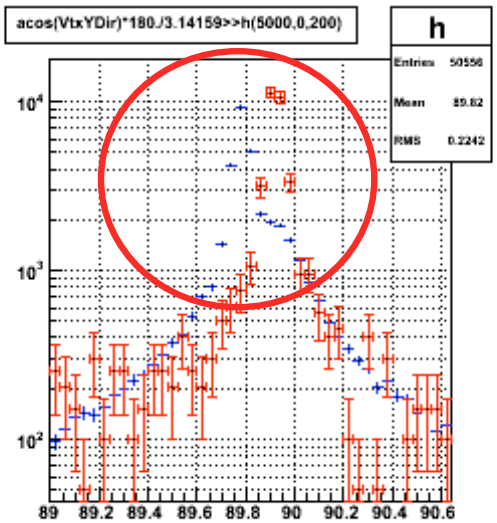


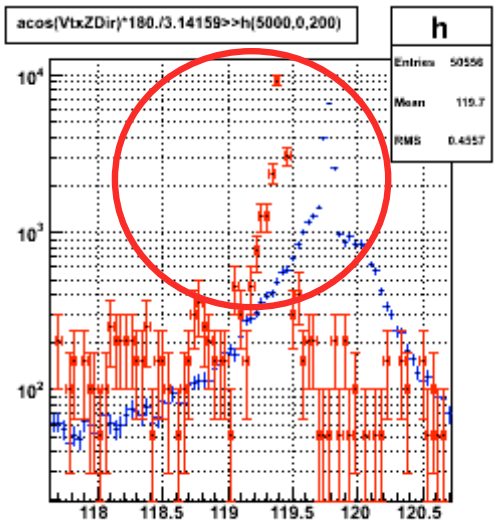




Incoming directions estimated from the data do not produce satisfactory results on the generated MC

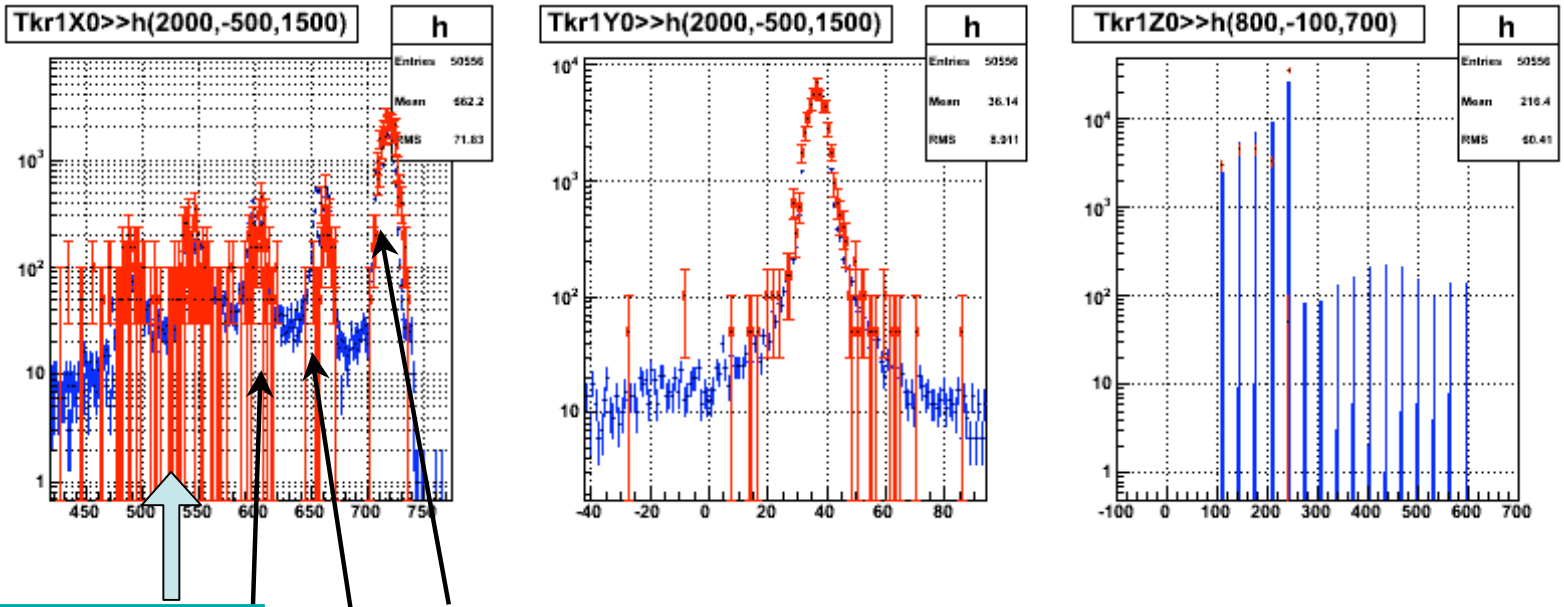






Data run 700001909 ***To be checked !!***

E = 196 GeV , 60 deg **MC in red**; **Data in blue**



This is "normal"

Signal in First Layer crossing the trajectory

Signal in second Layer crossing the trajectory

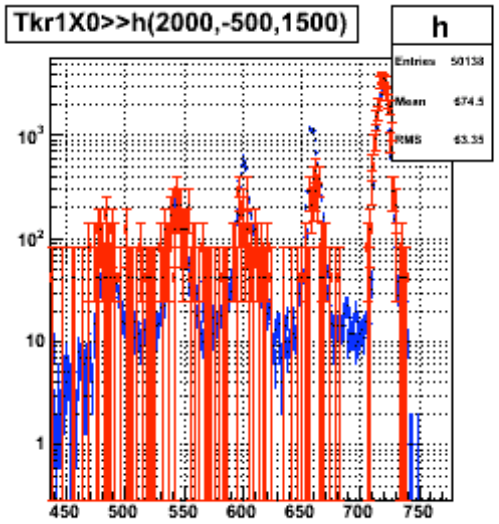
DeltaX = 640./19. * (-0.87/sqrt(1-pow(-0.87,2))) = 59 mm

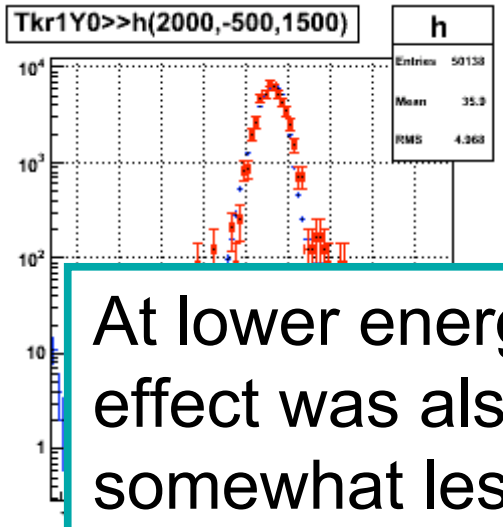
Signal in third Layer crossing the trajectory

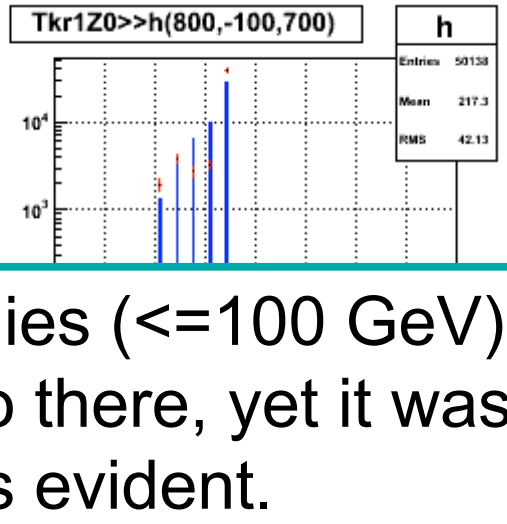
DeltaX = 2 * 640./19. * (-0.87/sqrt(1-pow(-0.87,2))) = 118 mm

Data run 700002006

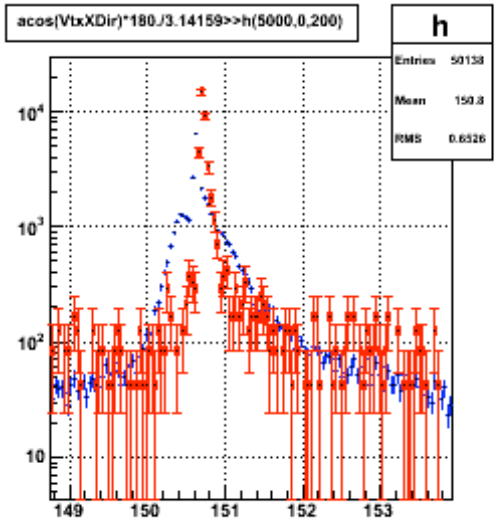
E = 100 GeV , 60 deg **MC in red**; **Data in blue**

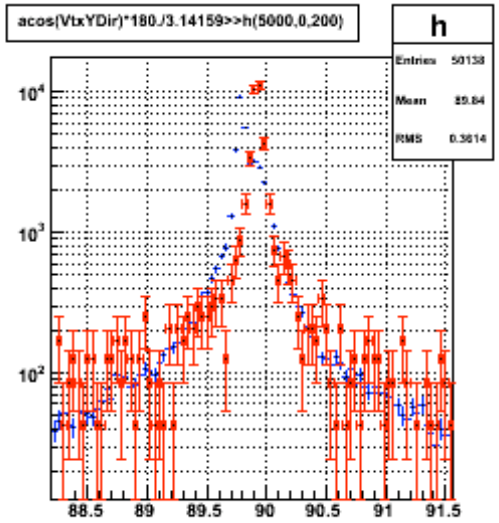


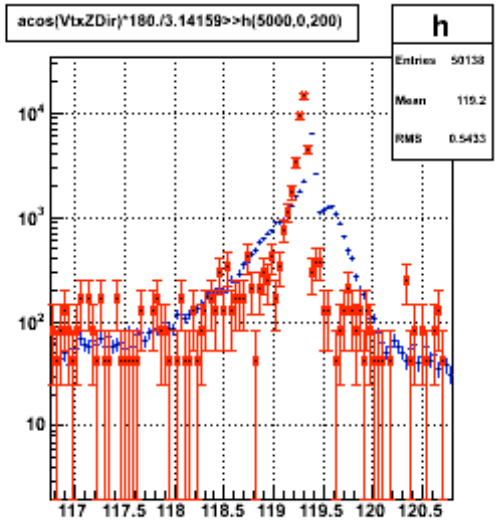




At lower energies (<=100 GeV) the effect was also there, yet it was somewhat less evident.

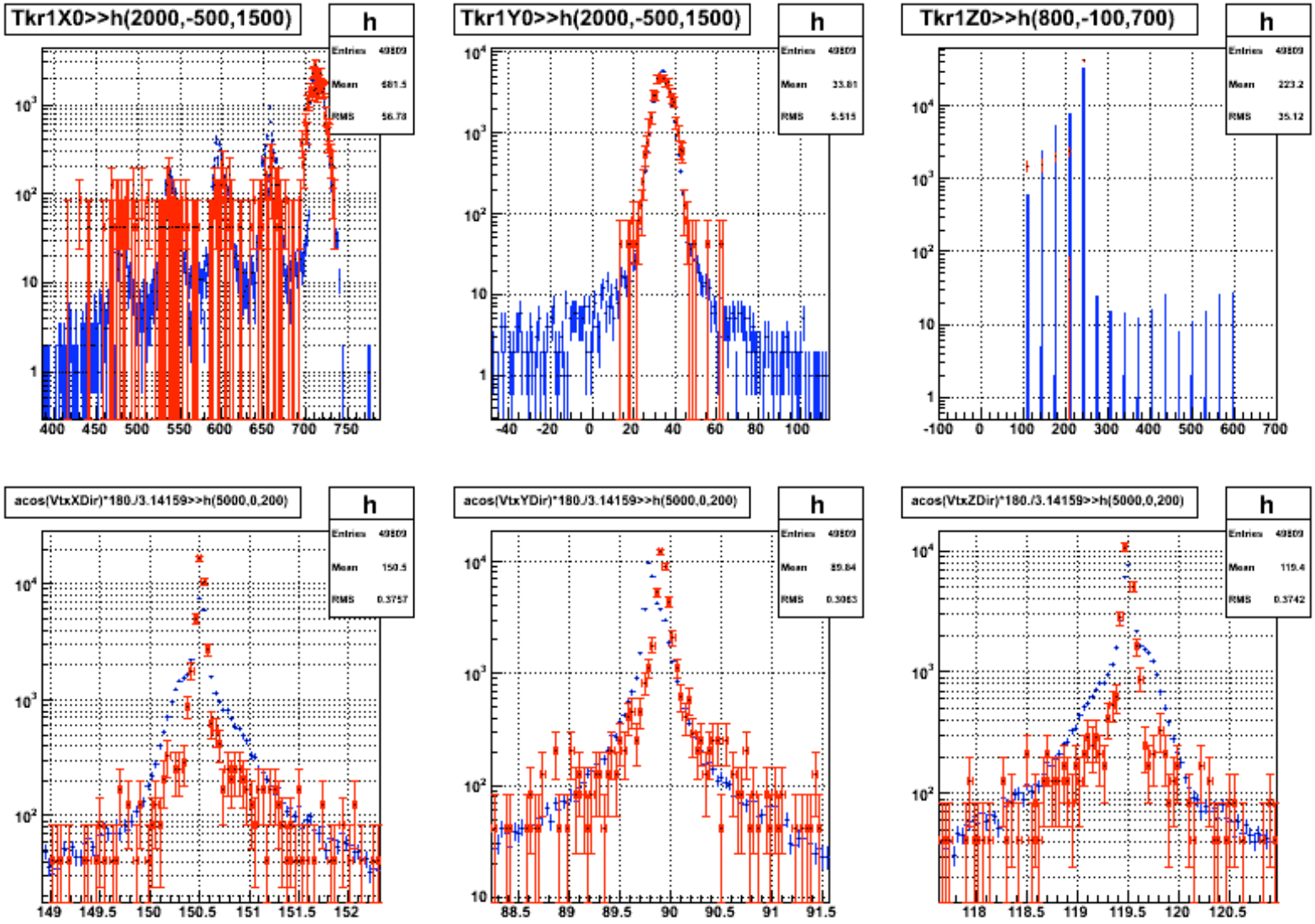






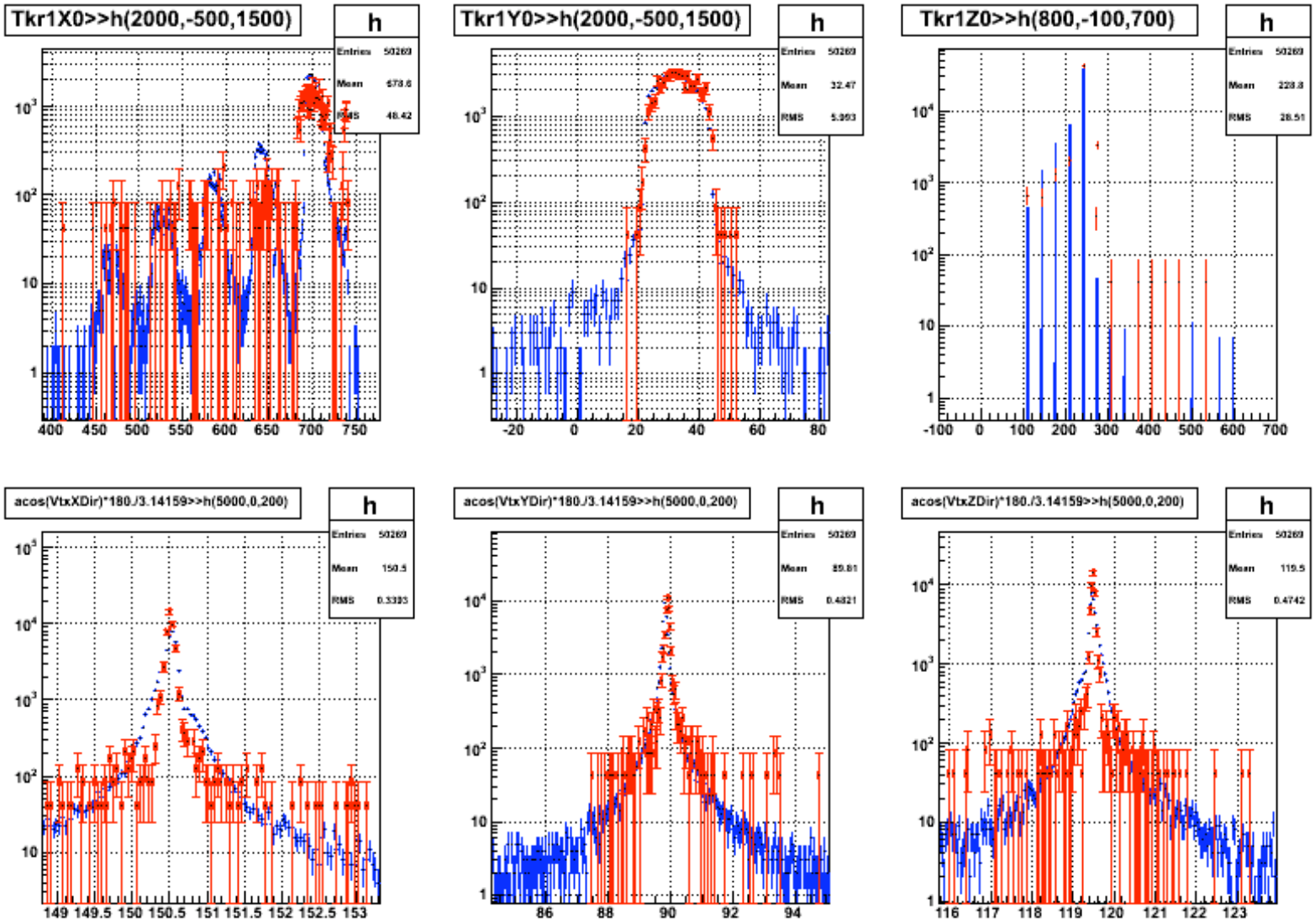
Data run 700002064

E = 50 GeV , 60 deg **MC in red**; **Data in blue**



Data run 700002103

E = 20 GeV , 60 deg **MC in red**; **Data in blue**



Important remark on Beam profile estimation

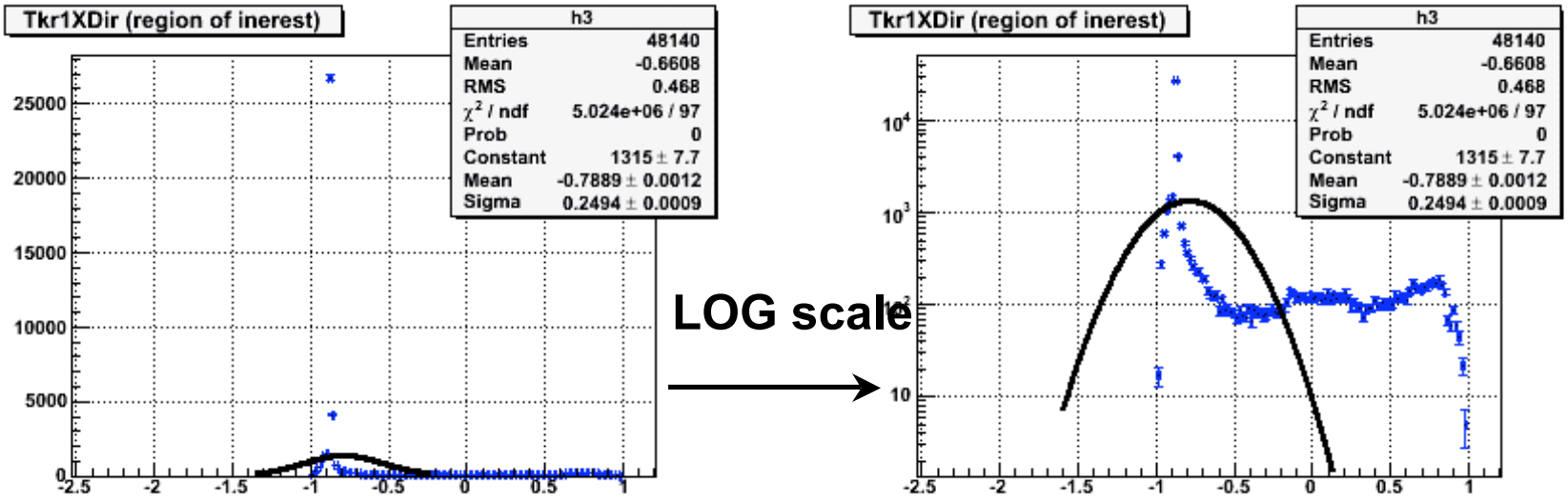
The only cuts applied to the data are :

1 - CalEnergyRaw > 200 MeV
2 - TkrNumTracks > 0.5
3 - TkrNumTracks < 10

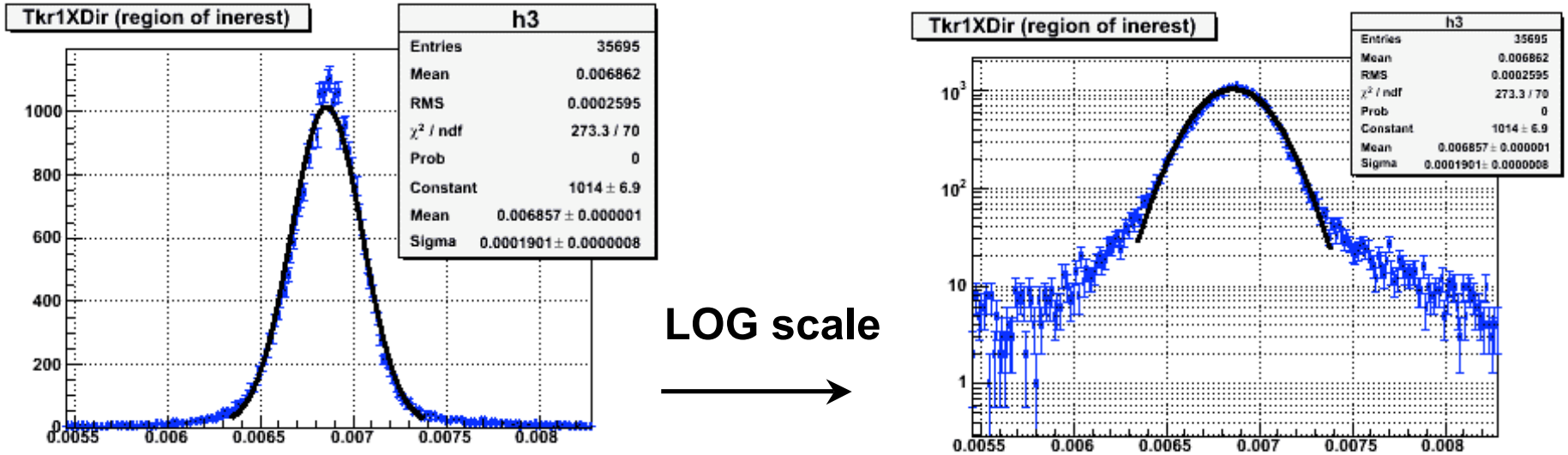
The cut 1) is expected to remove MIPs, the cut 2) removes events which are tracker-empty and cut 3) removes events which are "tracker-messy". A tighter cut in TkrNumTracks improves cleanless of events, but reduces statistics; accuracy of results is worse.

These are very simple cuts which are expected to be fulfilled by most electrons in PS and SPS entering in the calibration unit. Only low energy electrons passing through "cracks" will be removed

Run 1949 (282 GeV, 60 deg) Incoming angle in X direction

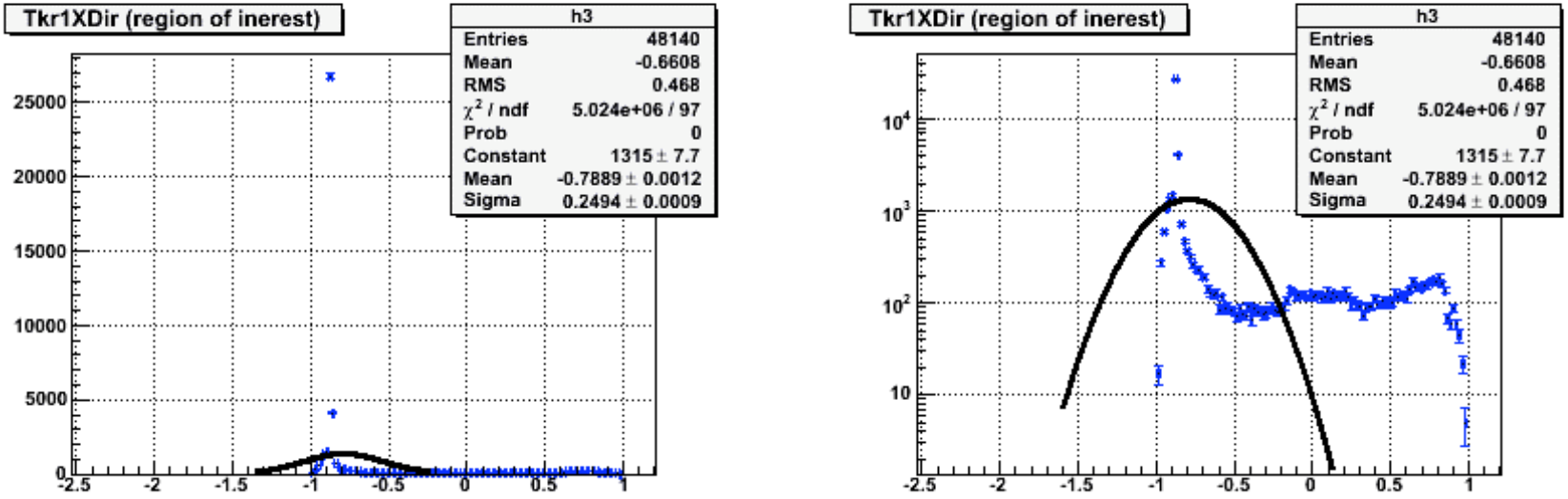


Run 1922 (282 GeV, 0 deg) Incoming angle in X direction



Run 1949 (282 GeV, 60 deg)

Incoming angle in X direction



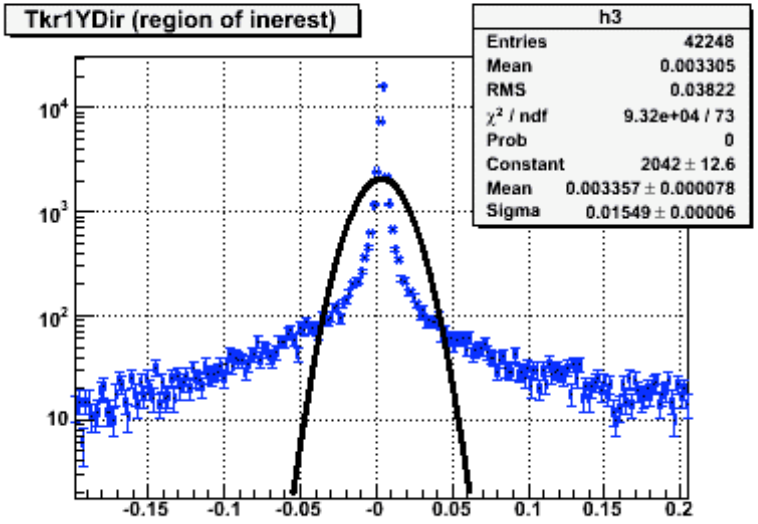
"Pedestal" of events covering all incoming anlges in X dir.

Extra bkg of particles or **miss-reconstructed events** ?

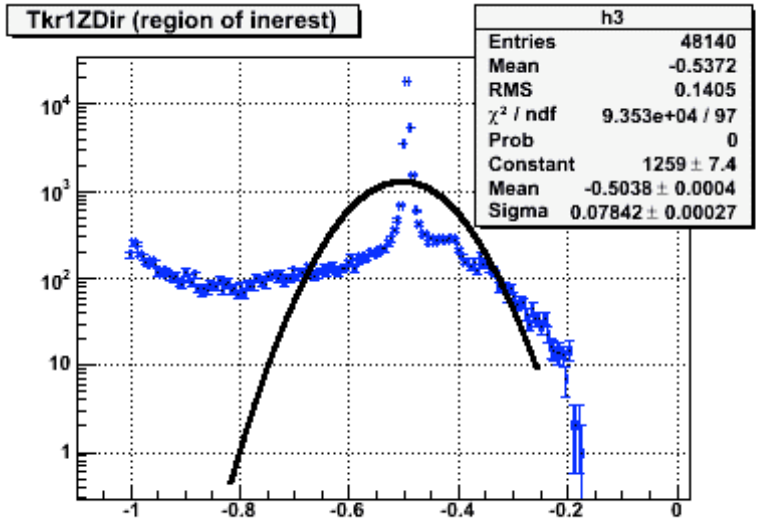
The effect is that the "extracted" beam incoming angle is somewhat shifted

Run 1949 (282 GeV, 60 deg)

Incoming angle in Y direction



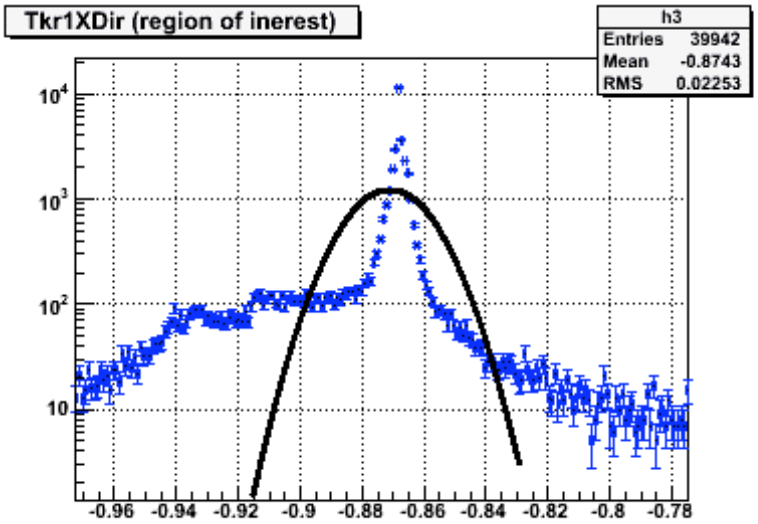
Incoming angle in Z direction



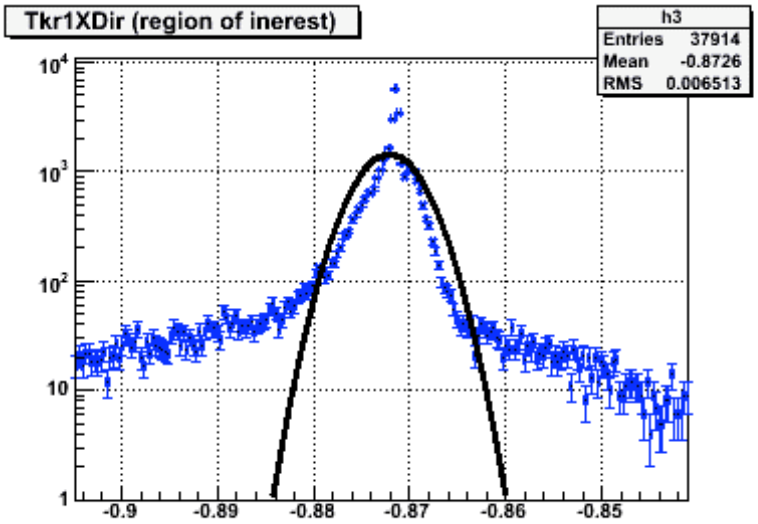
Effect in Y direction is smaller than in X direction, but we can still see long tails

Tkr1ZDir =-sqrt{1-Tkr1XDir² - Tkr1YDir²}

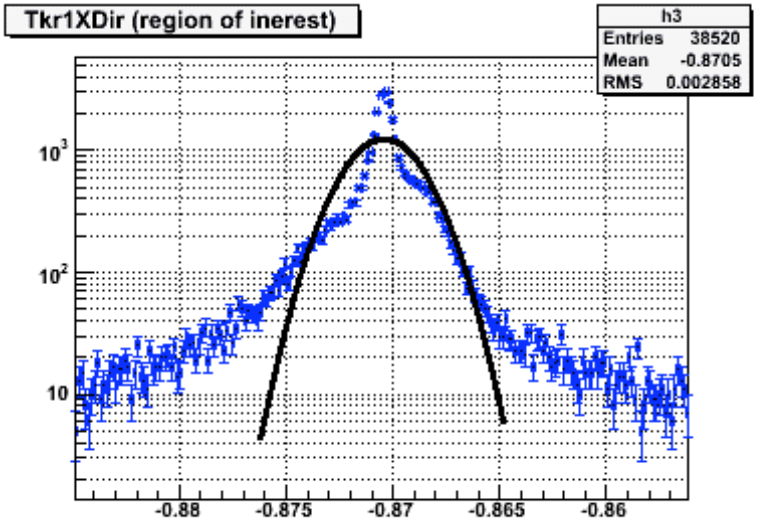
Run 1909 (200 GeV)



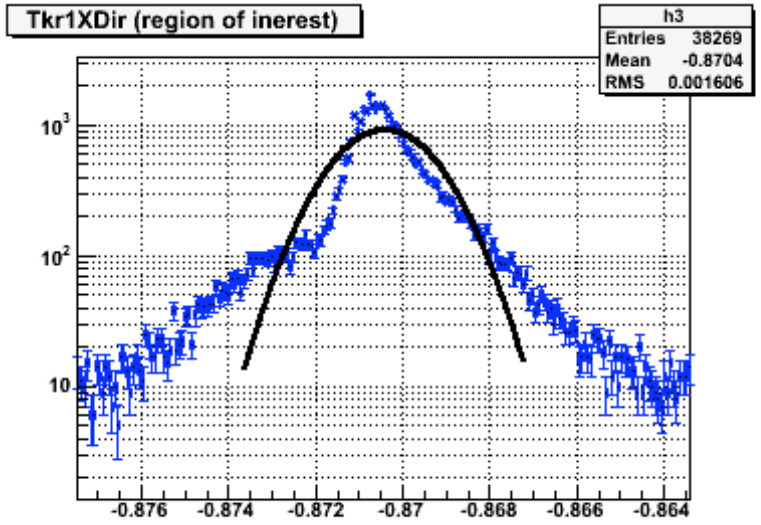
Run 2006 (100 GeV)



Run 2064 (50 GeV)

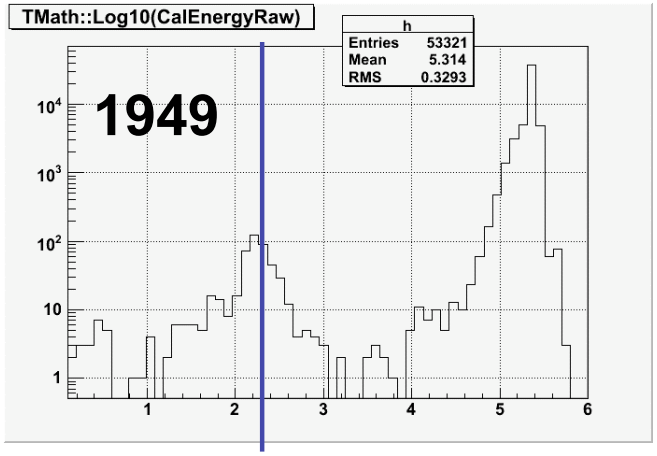


Run 2103 (20 GeV)

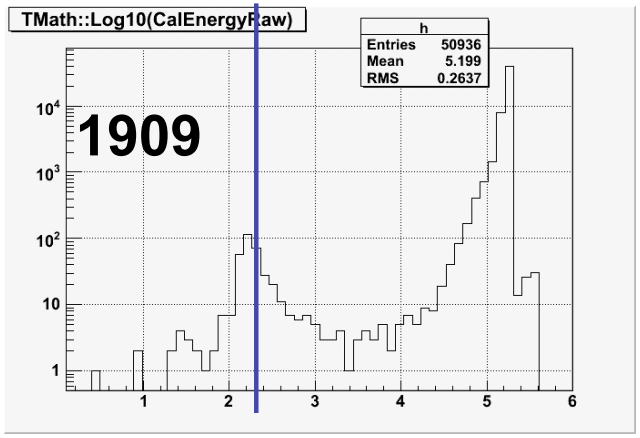


Tails decrease when decreasing energy

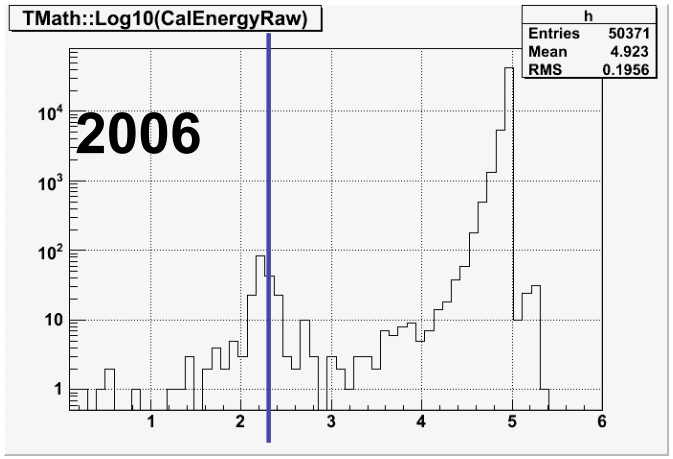
Distributions of CalEnergyRaw



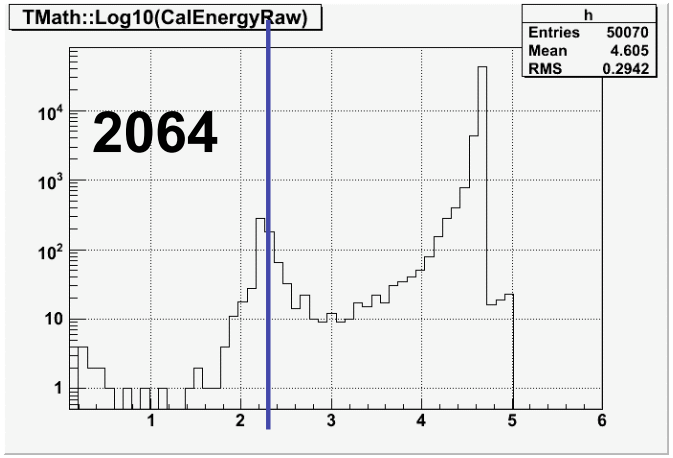
200 MeV



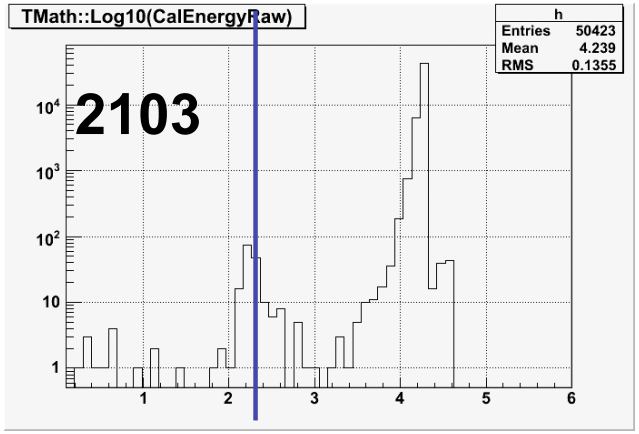
200 MeV



200 MeV



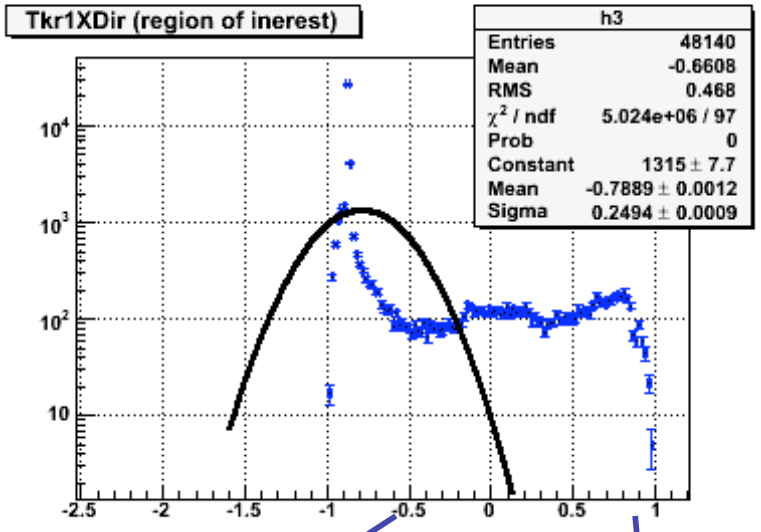
200 MeV



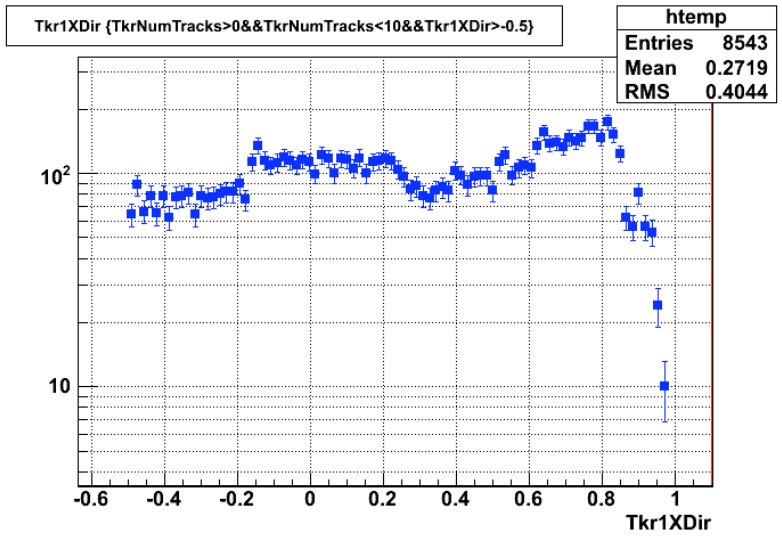
200 MeV

CalEnergyRaw>200 NOT enough to remove MIPs at 60 deg. YET the remaining MIPs are only few, and CANNOT be the reason for the "weird" Tkr1[X,Y,Z]Dir values

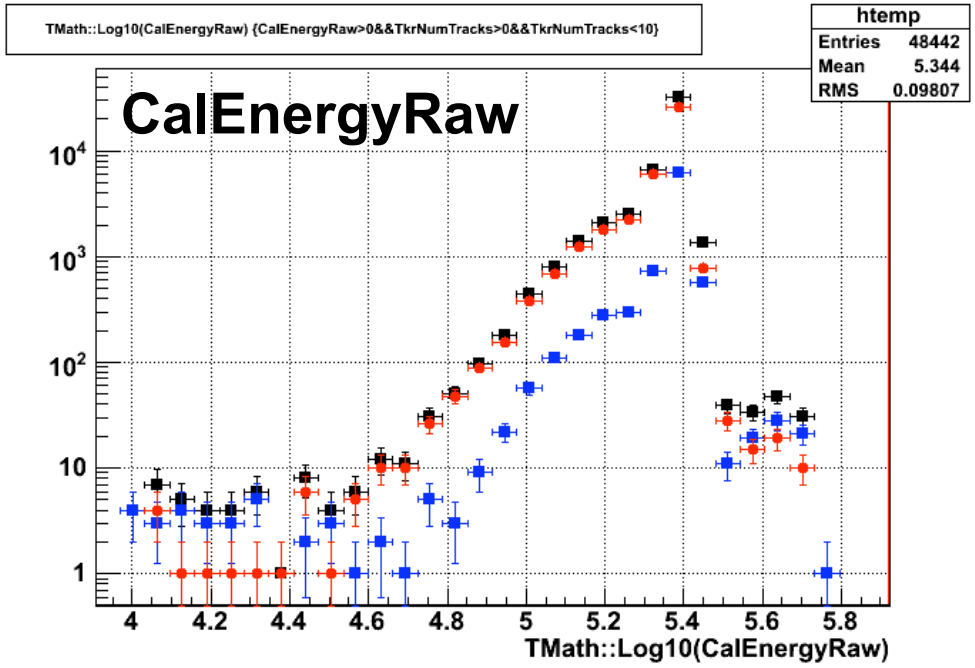
Run 1949 (282 GeV, 60 deg) Incoming angle in X direction



Evts to inspect

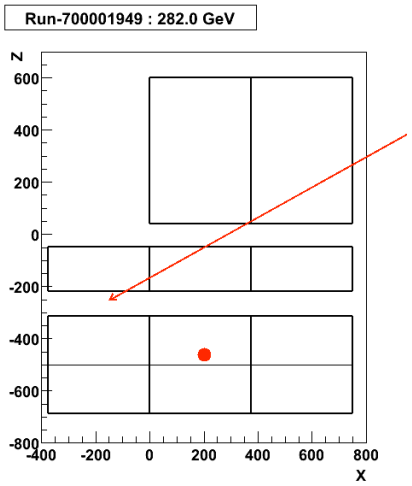


- **All events**
- **Normal Evts: Tkr1XDir < -0.05**
- **Weird Evts: Tkr1XDir > -0.05**

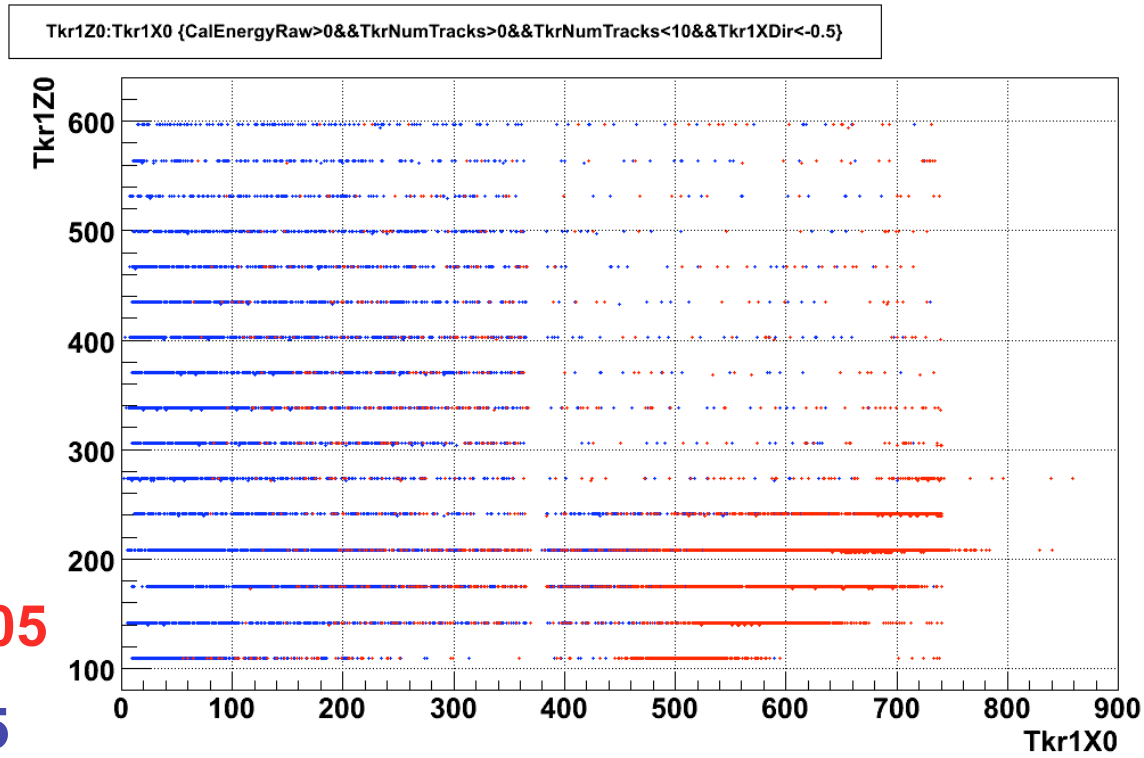


Distribution of CalEnergyRaw is equal for Normal and Weird evts

Impact point in tracker

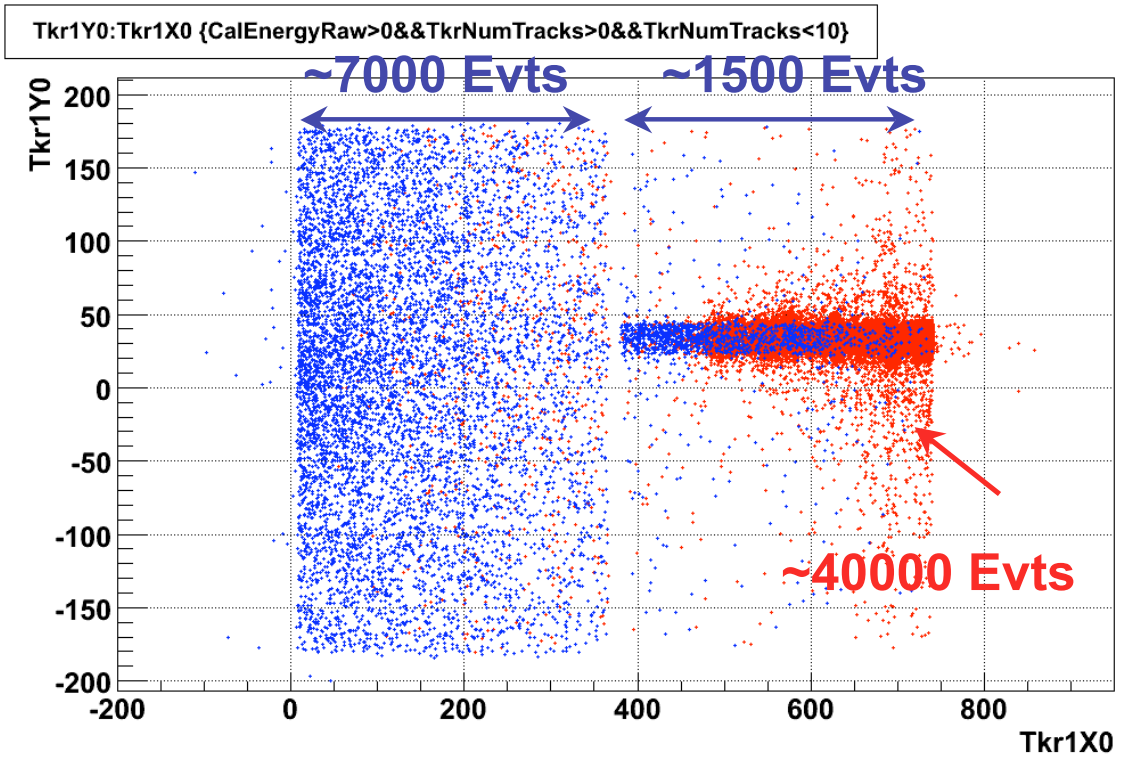


- **Normal Evts: Tkr1XDir < -0.05**
- **Weird Evts: Tkr1XDir > -0.05**

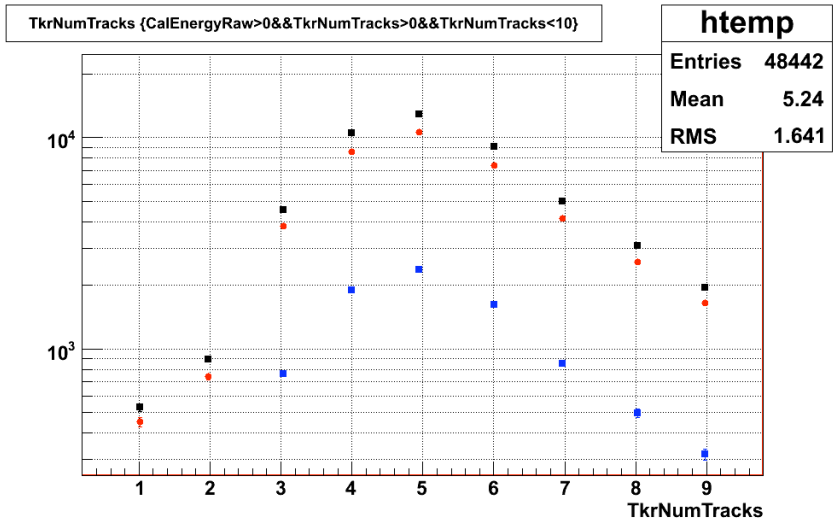


Two population of Weird evts

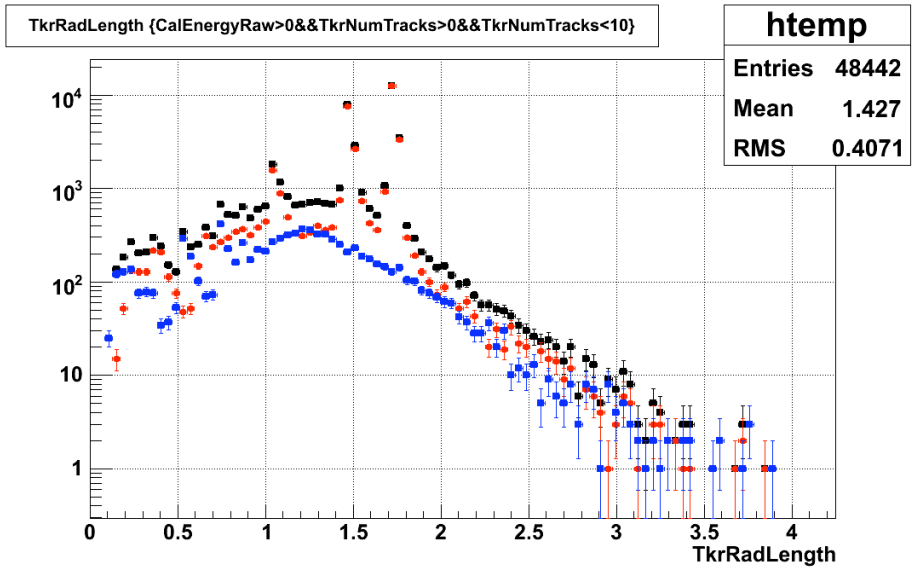
They get into the CU mostly through the tower 1, with Impact points up to Z=600 mm (!!??)



Tracker related quantities



???

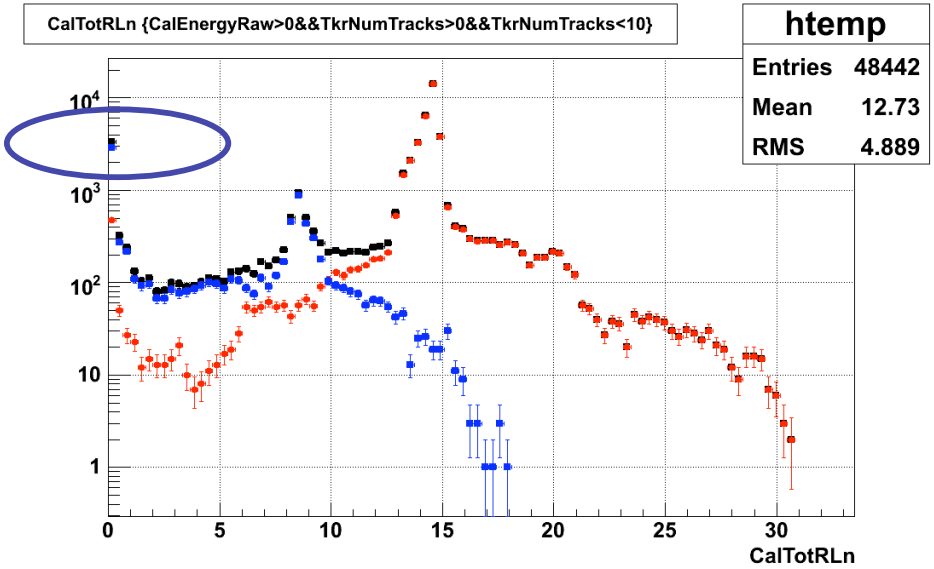


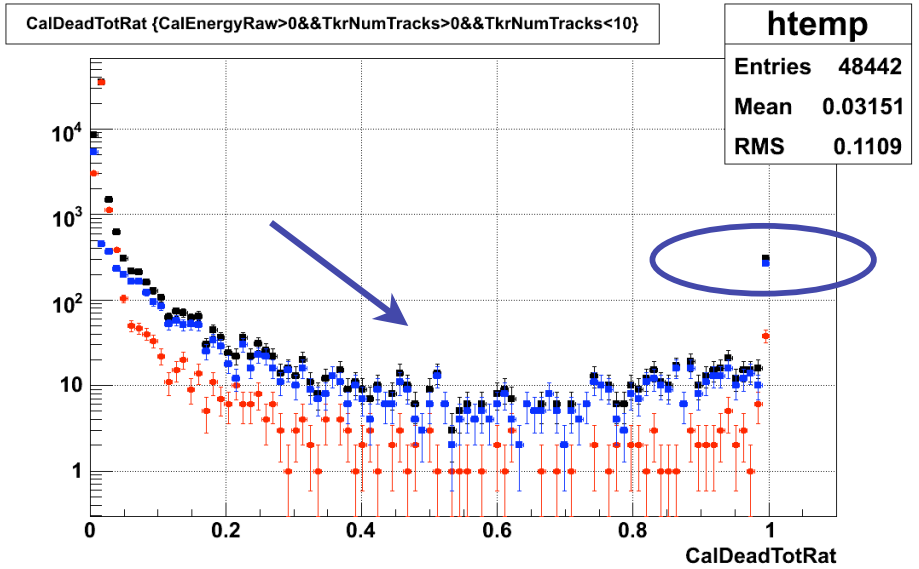
Peaks in TkrRadLength are in **Normal Evts**

A thick layer at 60 deg is ~0.38 radiation lengths

Do not quite understand the peaks yet…. But they seem to be “normal” …

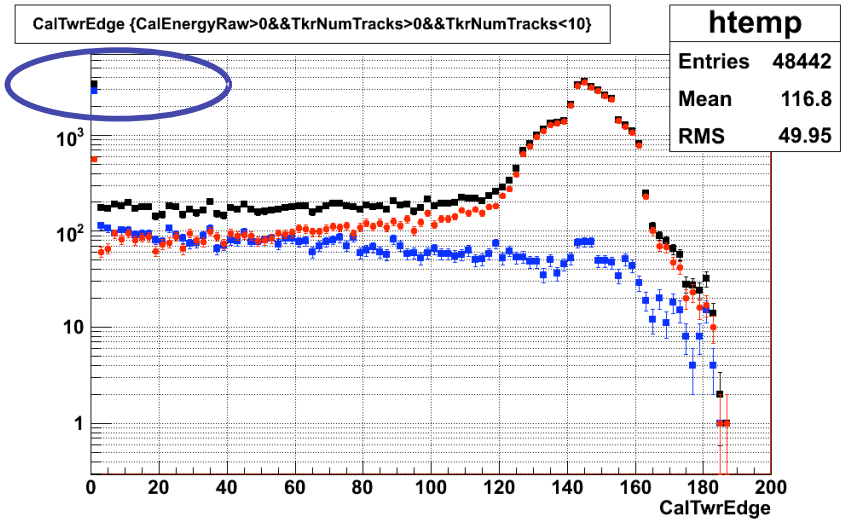
Calorimeter related quantities





Weird Evts have less Rad. Lengths

Weird Evts cross lots of dead mat.



A big fraction of Weird Evts "do not go" through the calorimeter, yet they have deposited ~ 200 GeV in it

Inspection of the data with FRED to see what is going on…

5 Type of events were inspected:

1 - Reference 1: Run 1922 (280 GeV, 0 incidence angle)

Filter Cuts:"CalEnergyRaw>100000 &&TkrNumTracks>0.5&&TkrNumTracks<10 && CalTotRLn>8.4 && CalTotRLn<8.6"

2 - Reference 2: Run 1949 (280 GeV, 60 incidence angle)

"Expected" impact point and incoming angle

*Filte cuts: CalEnergyRaw>100000 && TkrNumTracks>0.5&&TkrNumTracks<10 && **Tkr1XDir<-0.5&&Tkr1X0>390** && CalTotRLn>13 && CalTotRLn<16*

3 - Weird Evts A: Run 1949 (280 GeV, 60 deg); *CalTotRLn ~ 14*

*Filte cuts: CalEnergyRaw>10000 && TkrNumTracks>0.5&&TkrNumTracks<10&& **Tkr1XDir>-0.8&& Tkr1XDir<-0.7 &&Tkr1X0>390** && CalTotRLn<16 && CalTotRLn>13*

4 - Weird Evts B: Run 1949 (280 GeV, 60 deg); *CalTotRLn ~ 8.5*

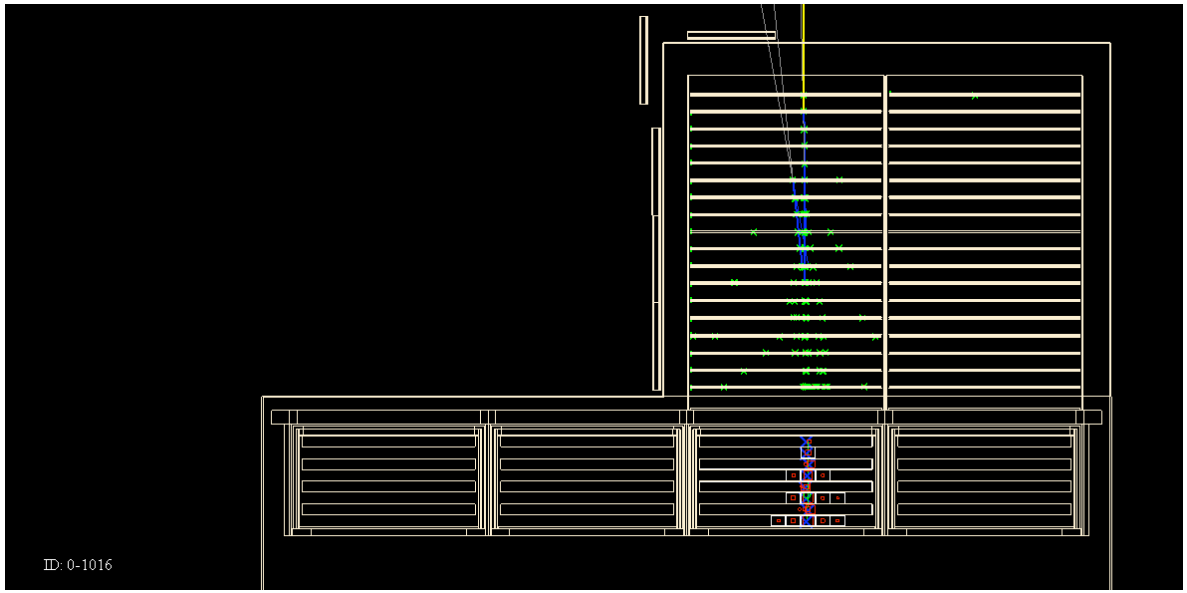
*Filte cuts: CalEnergyRaw>100000 && TkrNumTracks>0.5&&TkrNumTracks<10 && **Tkr1XDir>-0.5&&Tkr1X0<380** && CalTotRLn>8.4 && CalTotRLn<8.6*

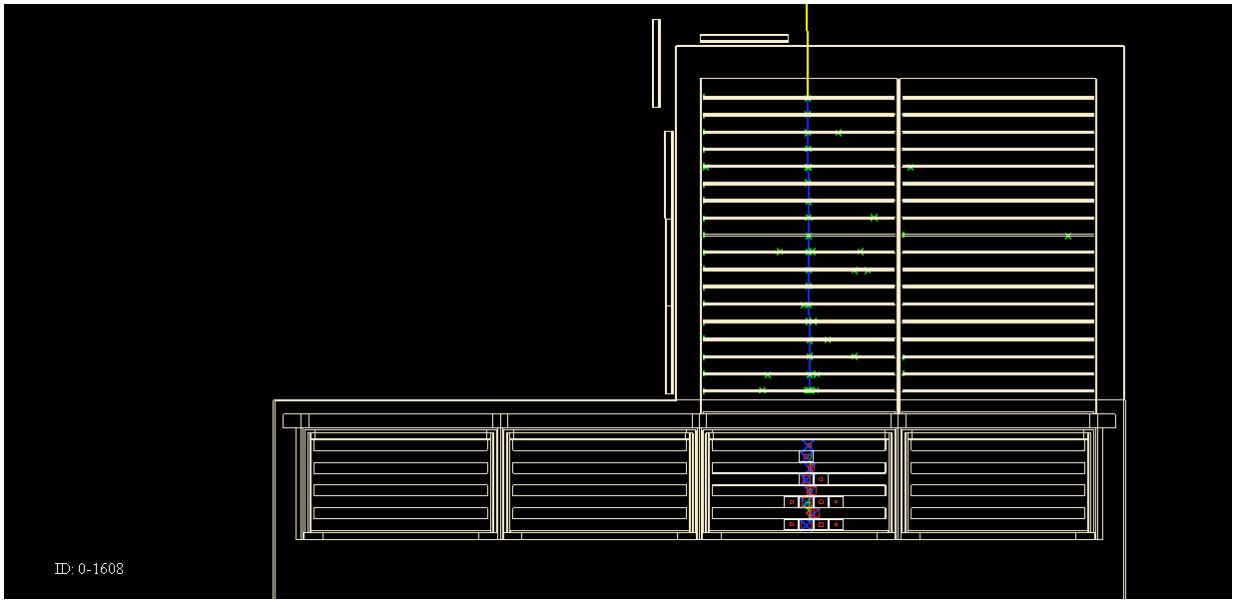
5 - Weird Evts C: Run 1949 (280 GeV, 60 deg); *CalTotRLn ~ 0.1*

*Filte cuts: CalEnergyRaw>100000 && TkrNumTracks>0.5&&TkrNumTracks<10 && **Tkr1XDir>-0.5&&Tkr1X0<380** && CalTotRLn<0.1*

1 - Reference 1: Run 1922 (280 GeV, 0 incidence angle)

Filter Cuts:"CalEnergyRaw>100000 &&TkrNumTracks>0.5&&TkrNumTracks<10 && CalTotRLn>8.4 && CalTotRLn<8.6"





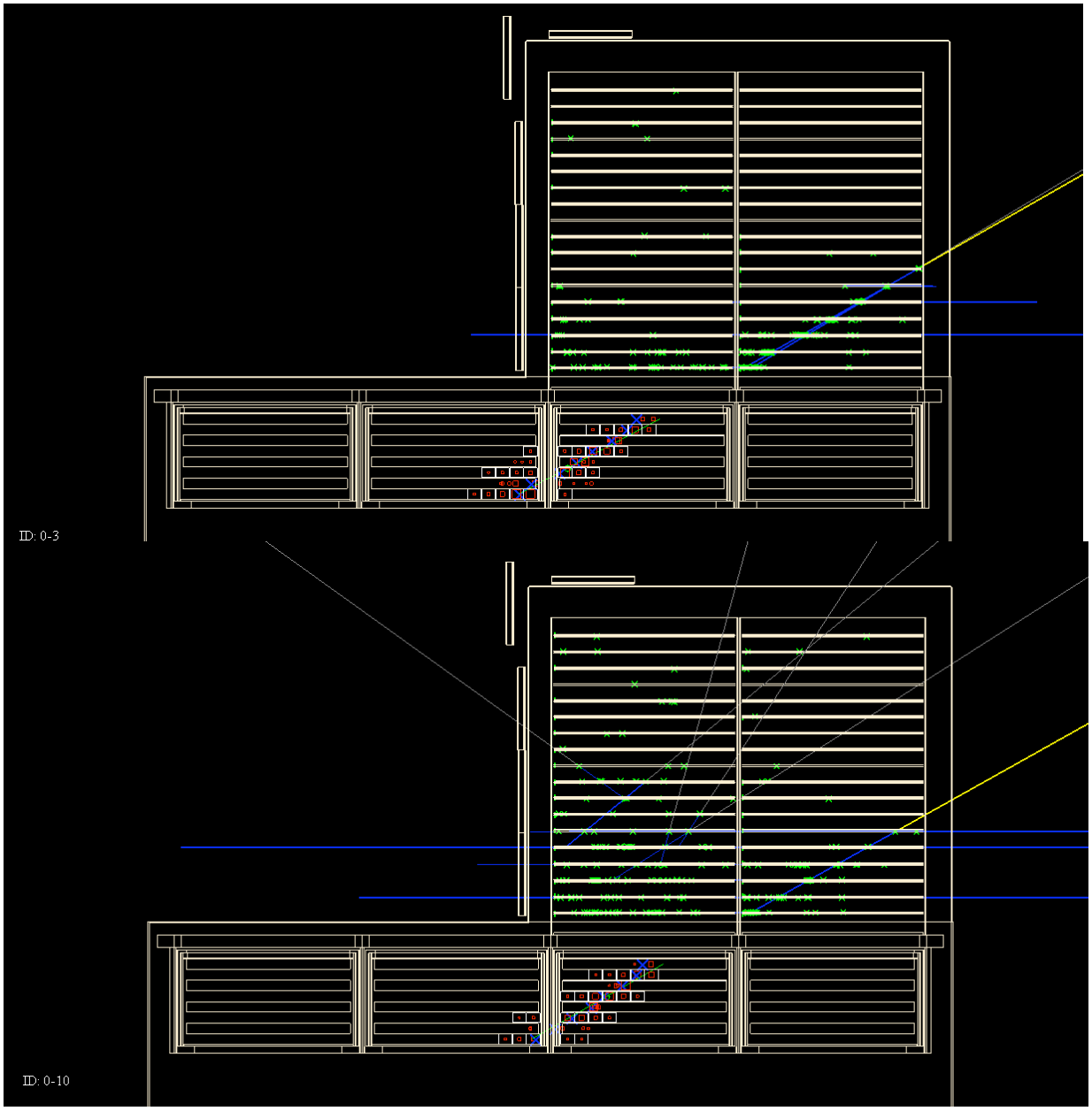
Delta rays and some backsplash is visible

Track is however relatively clean, and well reconstructed

2 - Reference 2: Run 1949 (280 GeV, 60 incidence angle)

"Expected" impact point and incoming angle

Filte cuts: CalEnergyRaw>100000 && TkrNumTracks>0.5&&TkrNumTracks<10 &&Tkr1XDir<-0.5&&Tkr1X0>390 && CalTotRLn>13 && CalTotRLn<16

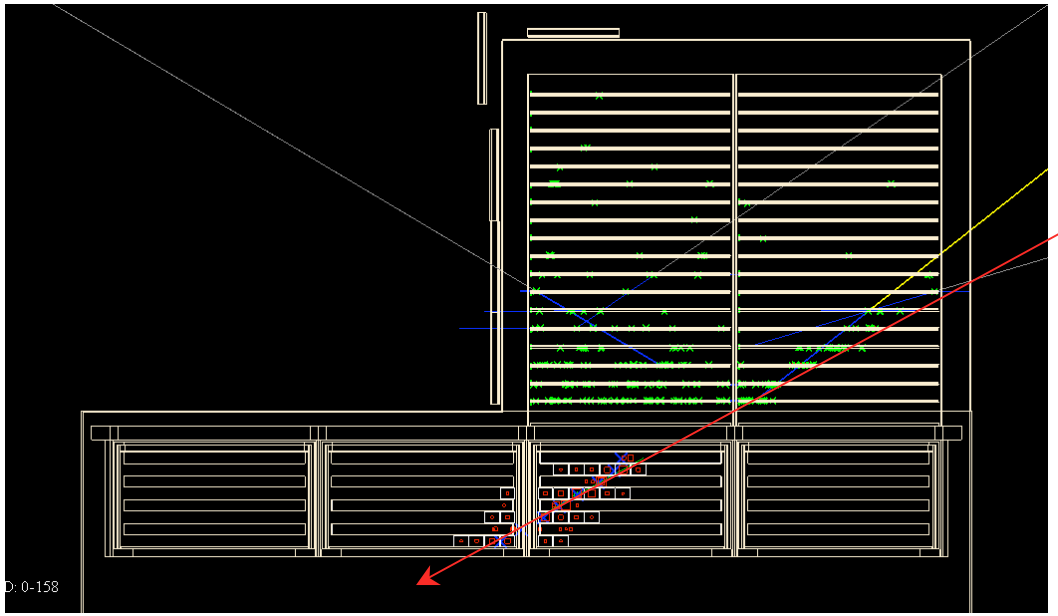


Backsplash is substantially larger than at 0 degrees incident angle

Despite of that, the "right" track is taken as first track of this event. That means proper incoming angle and impact point determination

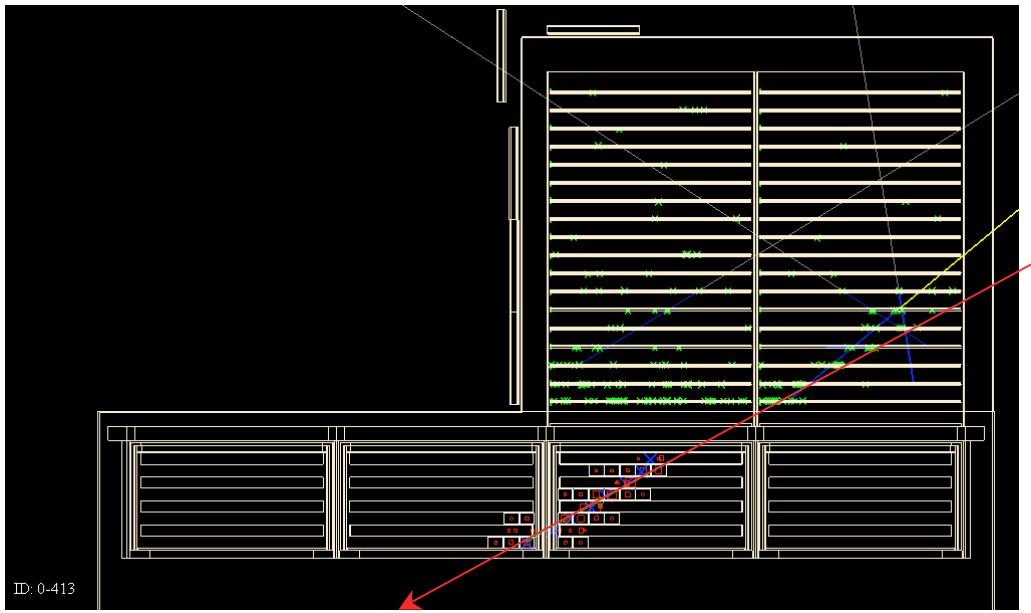
3 - Weird Evts A: Run 1949 (280 GeV, 60 deg); *CalTotRLn ~ 14*

Filte cuts: CalEnergyRaw>10000 && TkrNumTracks>0.5&&TkrNumTracks<10&& Tkr1XDir>-0.8&& Tkr1XDir<-0.7 &&Tkr1X0>390 && CalTotRLn<16 && CalTotRLn>13



Backsplash is substantially larger than at 0 degrees incident angle

BECAUSE of back-splash and delta rays, the “right” track is NOT taken as first track of this event.

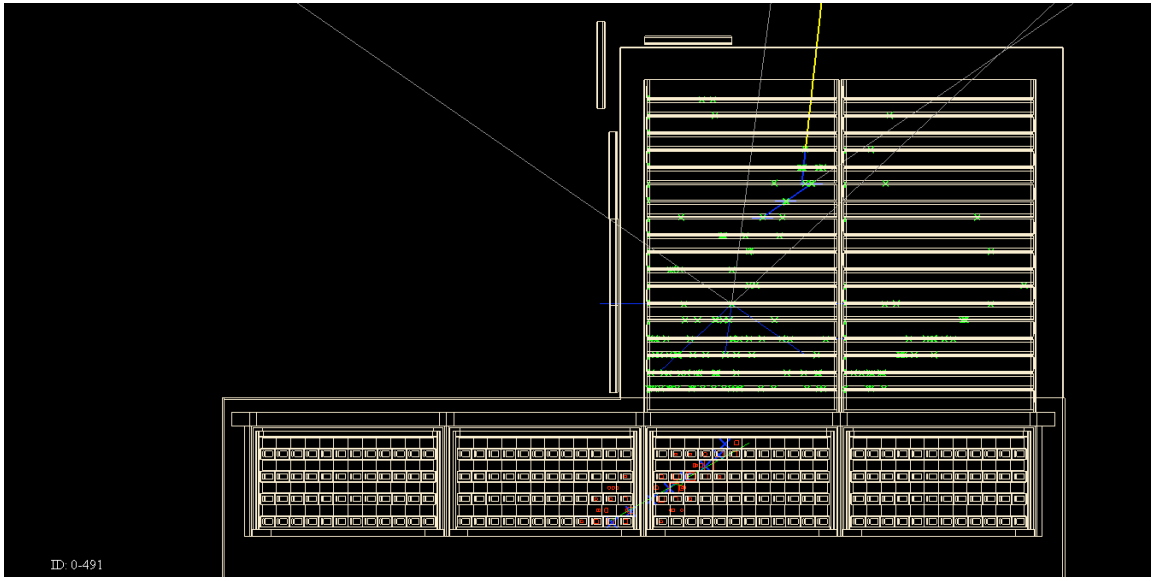


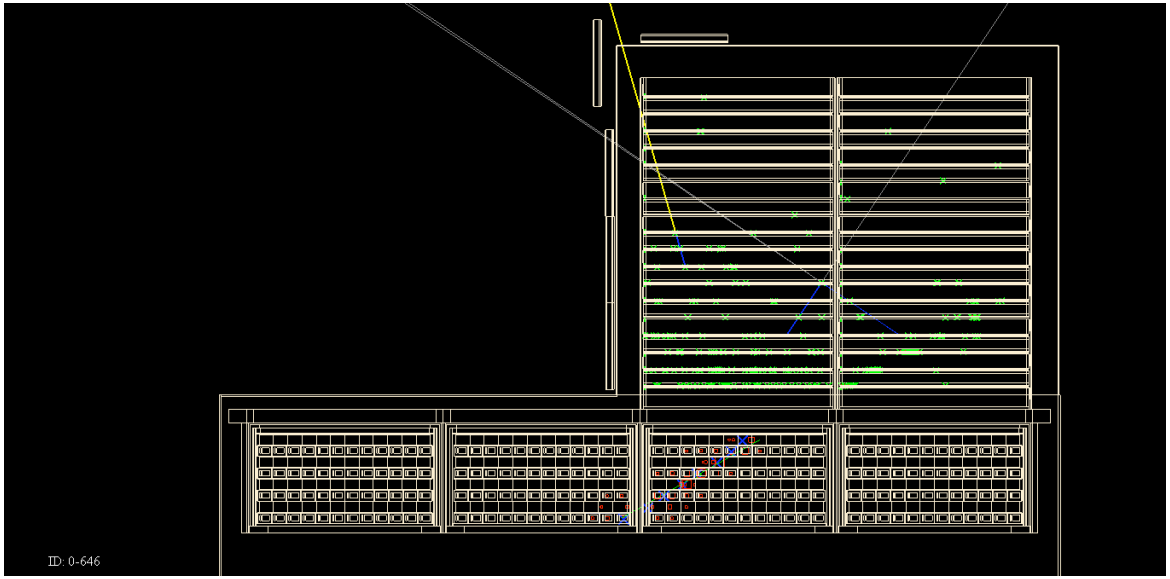
There is an angle difference of ΔΘ with respect to the right trajectory

3 - Weird Evts B: Run 1949 (280 GeV, 60 incidence angle)

CalTotRLn ~ 8.5

Filte cuts: CalEnergyRaw>100000 && TkrNumTracks>0.5&&TkrNumTracks<10 &&Tkr1XDir>-0.5&&Tkr1X0<380 && CalTotRLn>8.4 && CalTotRLn<8.6





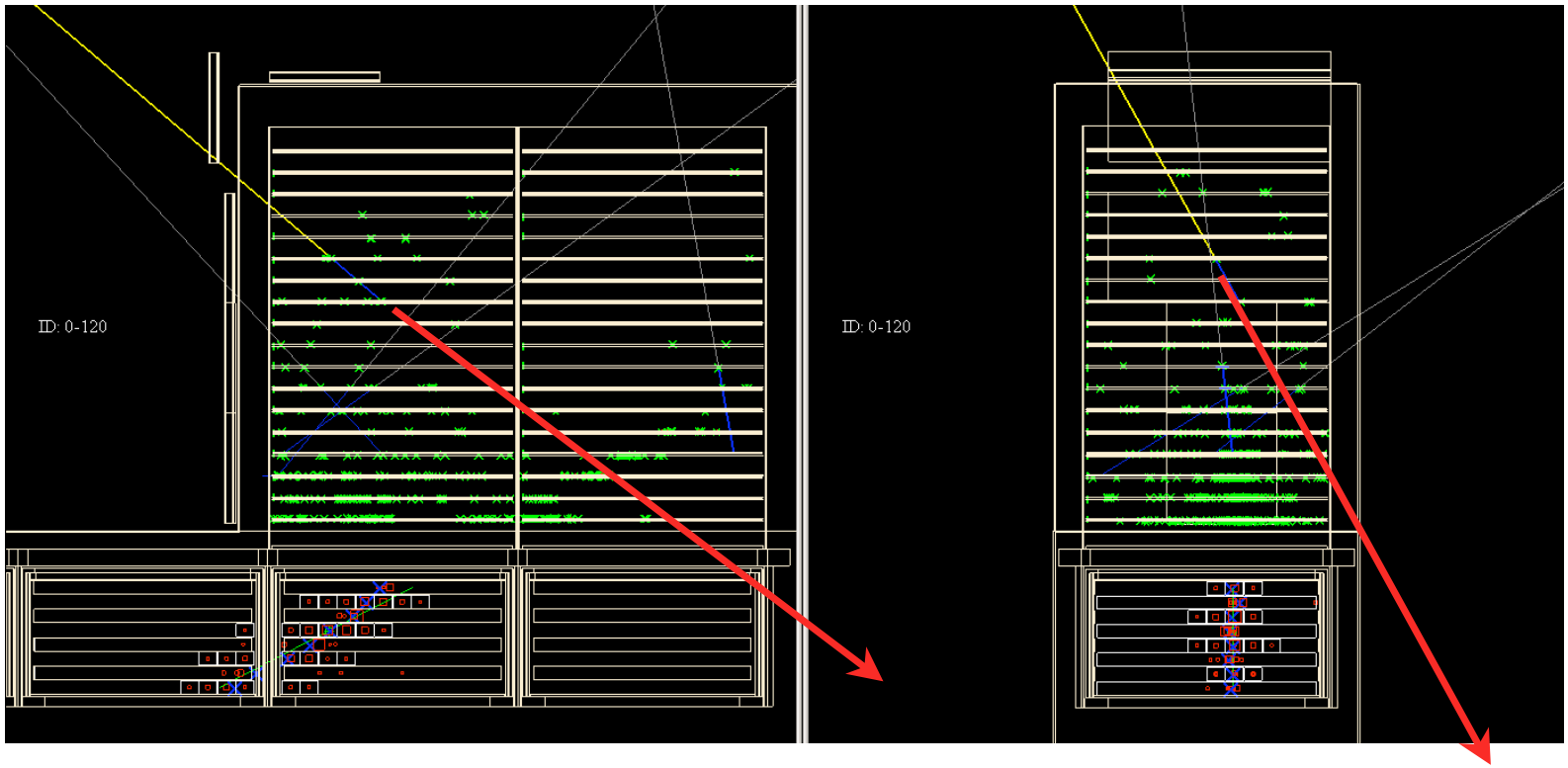
Backsplash is substantially larger than at 0 degrees incident angle

BECAUSE of that, the "right" track is NOT taken as first track of this event. *Sometimes it is not even recognized as a track (?).* That means WRONG (random) incoming angle and impact point determination for this event class

4 - Weird Evts C: Run 1949 (280 GeV, 60 incidence angle)

CalTotRLn < 0.1

Filte cuts: CalEnergyRaw>100000 && TkrNumTracks>0.5&&TkrNumTracks<10 &&Tkr1XDir>-0.5&&Tkr1X0<380 && CalTotRLn<0.1



Backsplash is substantially larger than at 0 degrees

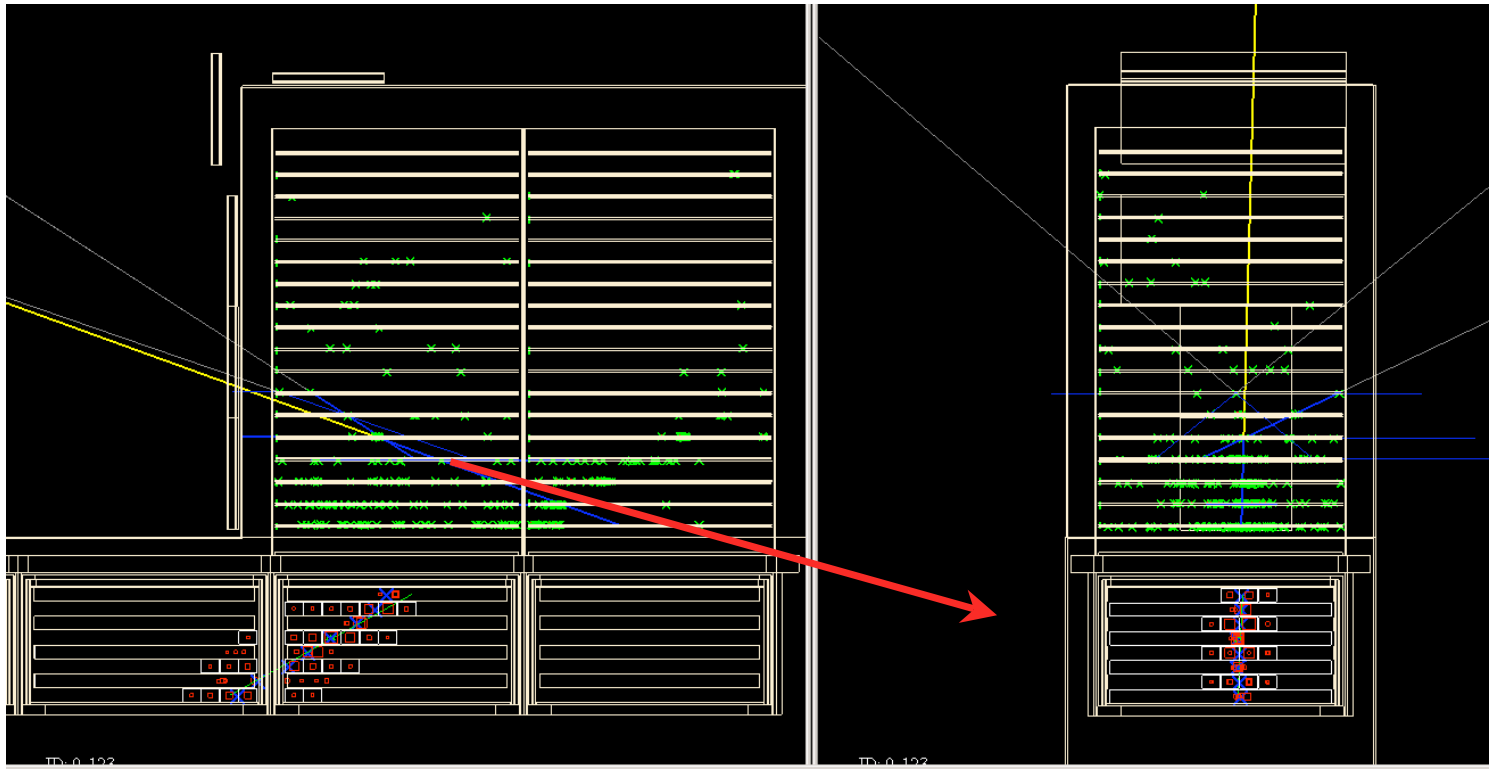
WRONG (random) incoming angle and impact point calculation

“Recognized Track 1” is missing the calorimeter

4 - Weird Evts C: Run 1949 (280 GeV, 60 incidence angle)

CalTotRLn < 0.1

Filte cuts: CalEnergyRaw>100000 && TkrNumTracks>0.5&&TkrNumTracks<10 &&Tkr1XDir>-0.5&&Tkr1X0<380 && CalTotRLn<0.1



Backsplash is substantially larger than at 0 degrees

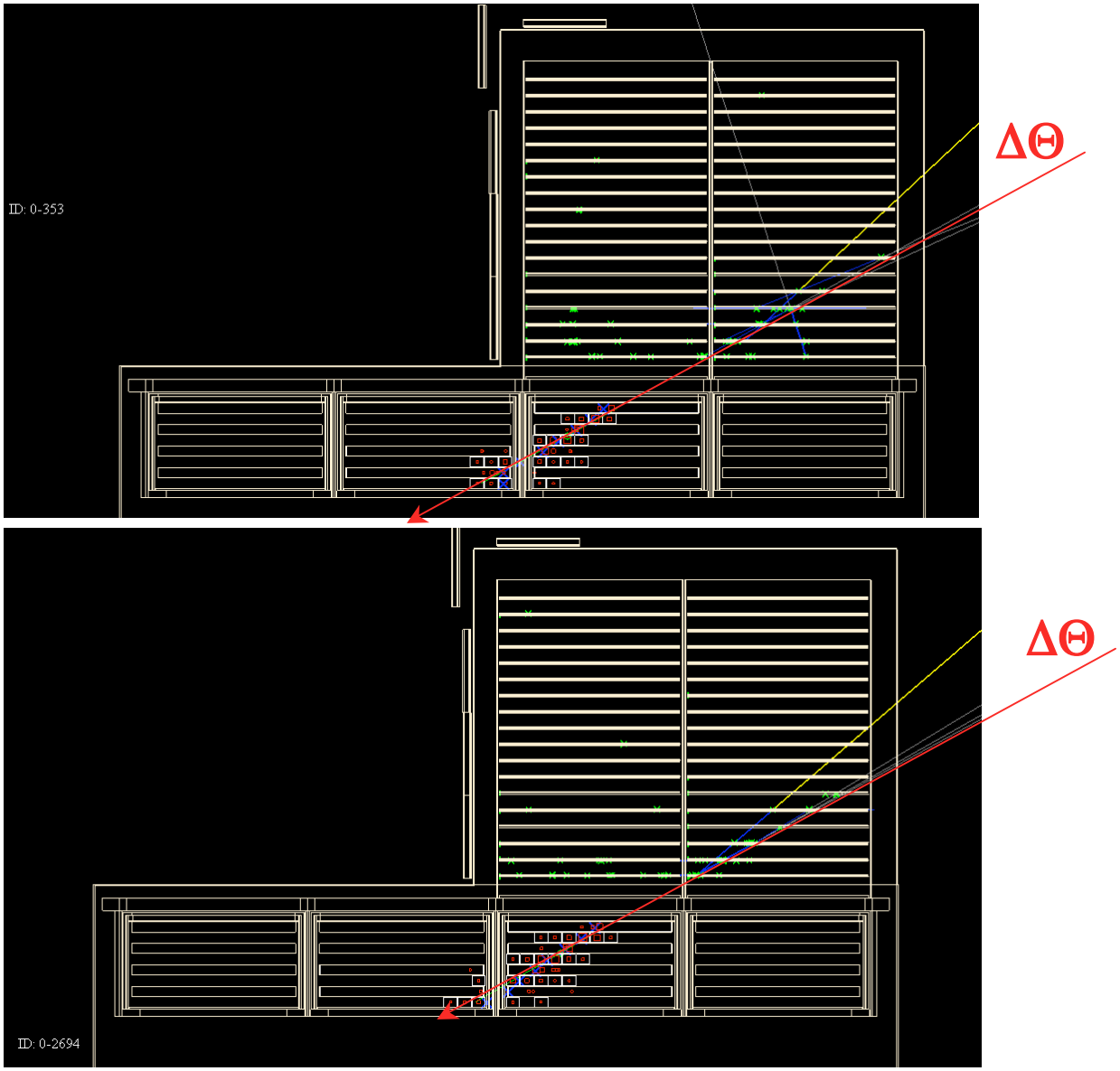
WRONG (random) incoming angle and impact point calculation

“Recognized Track 1” is missing the calorimeter

Weird Evts A for run 2103 (20 GeV, 60 deg)

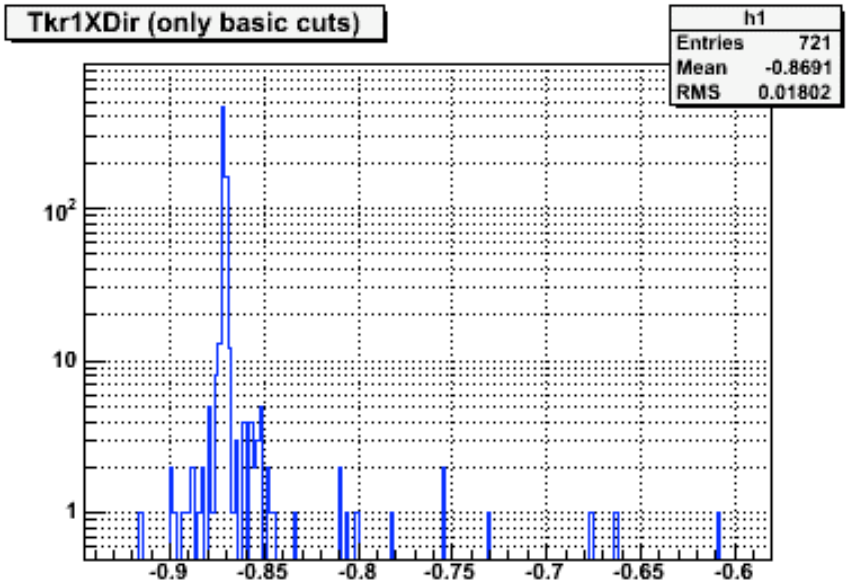
Filte cuts: CalEnergyRaw>10000 && TkrNumTracks>0.5&&TkrNumTracks<10&& Tkr1XDir>-0.8&& Tkr1XDir<-0.7 &&Tkr1X0>390 && CalTotRLn<16 && CalTotRLn>13

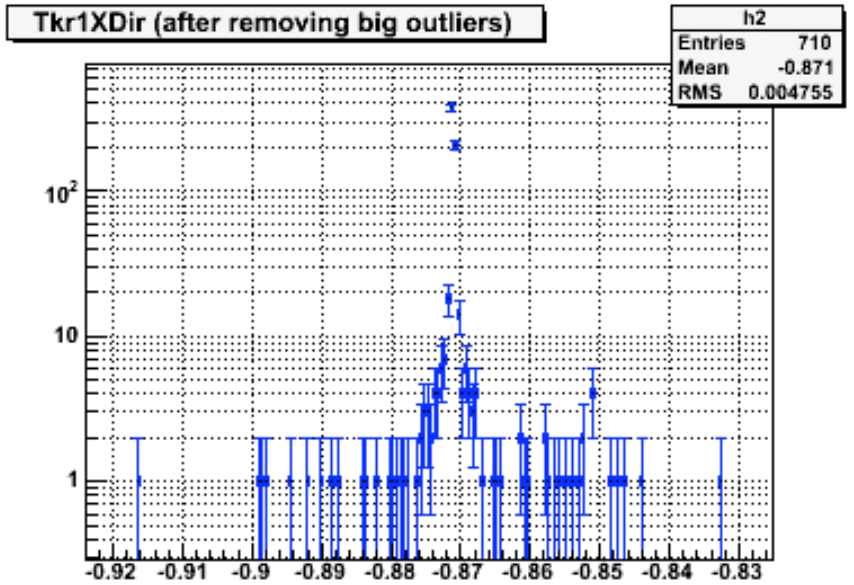
Essentially the only type of "weird events" for that run

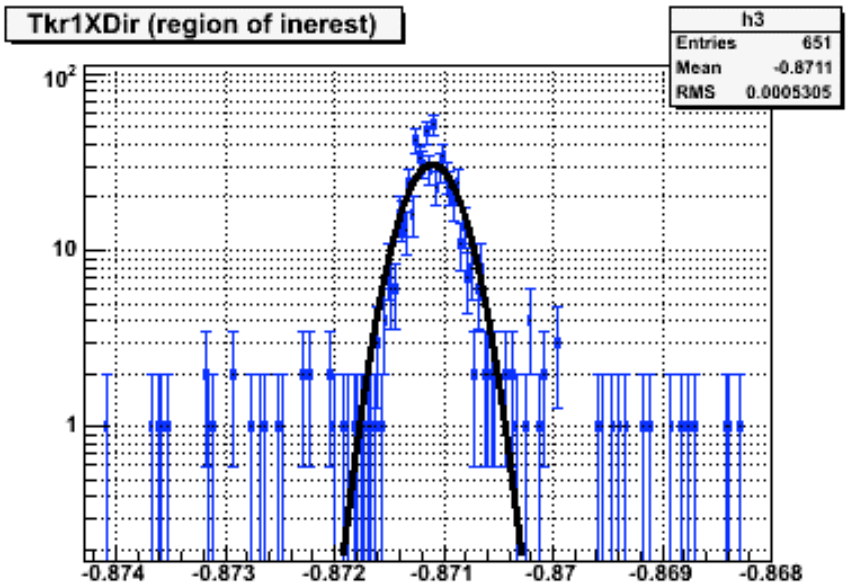


As we decrease energy the amount of backsplash and delat rays decreases, and this effect becomes smaller

Comparison with MC data: Custom BT-1949(280GeV, 60deg)

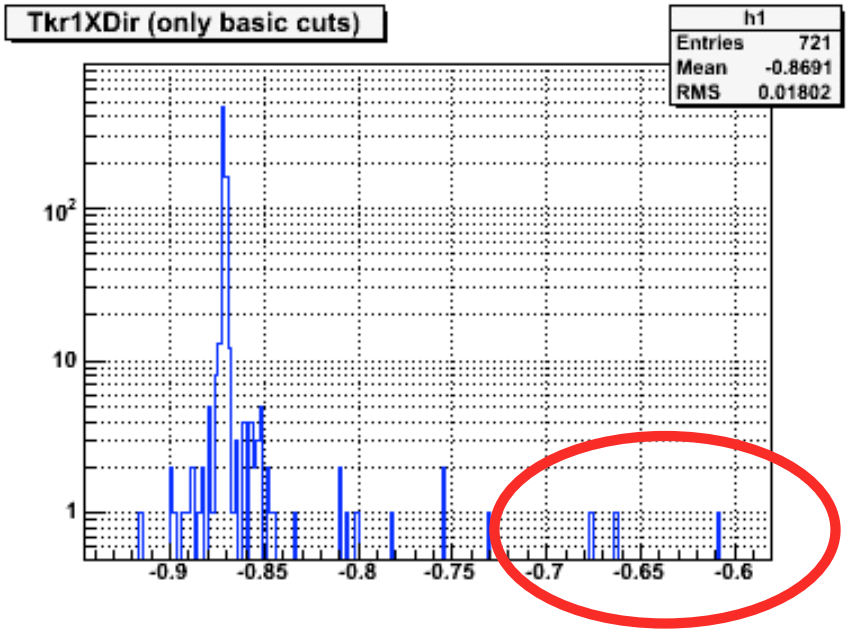


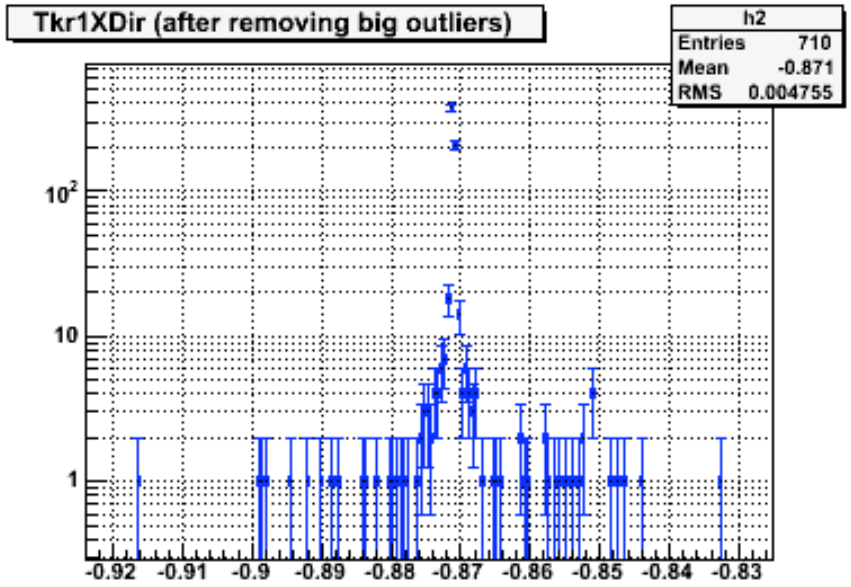


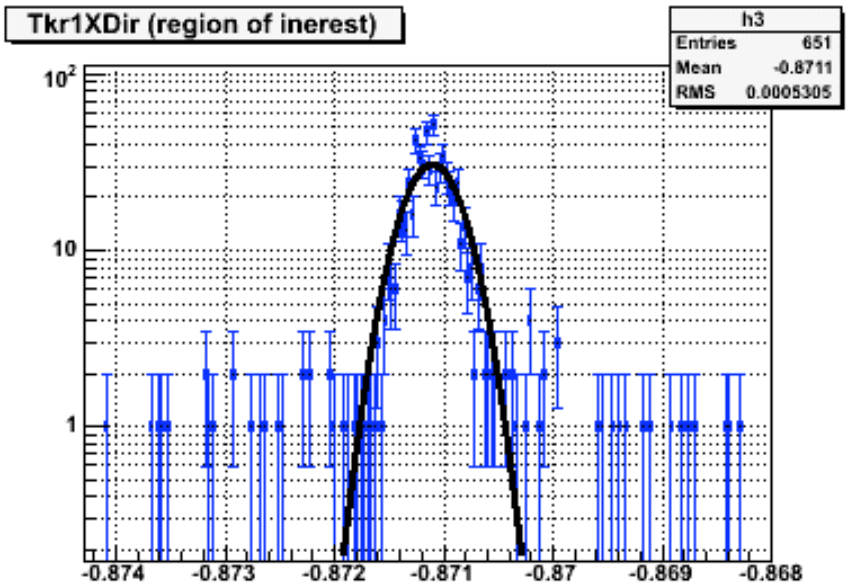


Even though statistics in MC is reduced (only ~700 evts), the distribution of reconstructed incoming angle in X direction does not have those big tails.

Comparison with MC data: Custom BT-1949(280GeV, 60deg)



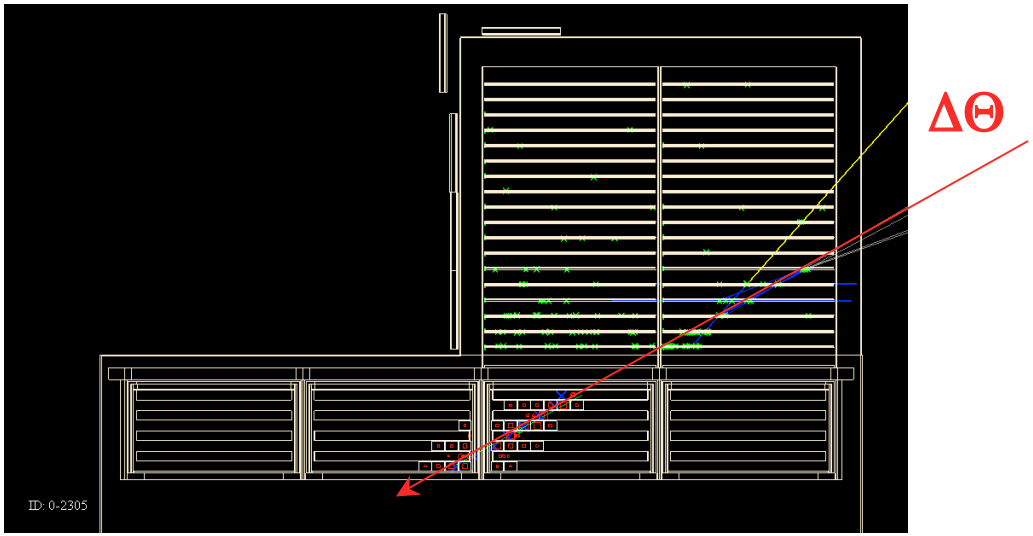




Let's inspect the 3 most "weird" events in MC

Comparison with MC data: Custom BT-1949(280GeV, 60deg)

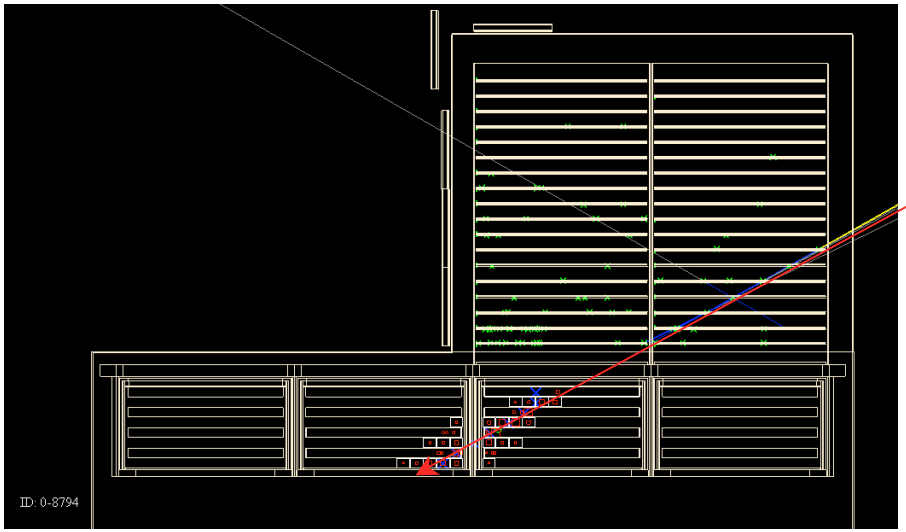
Evt 2905



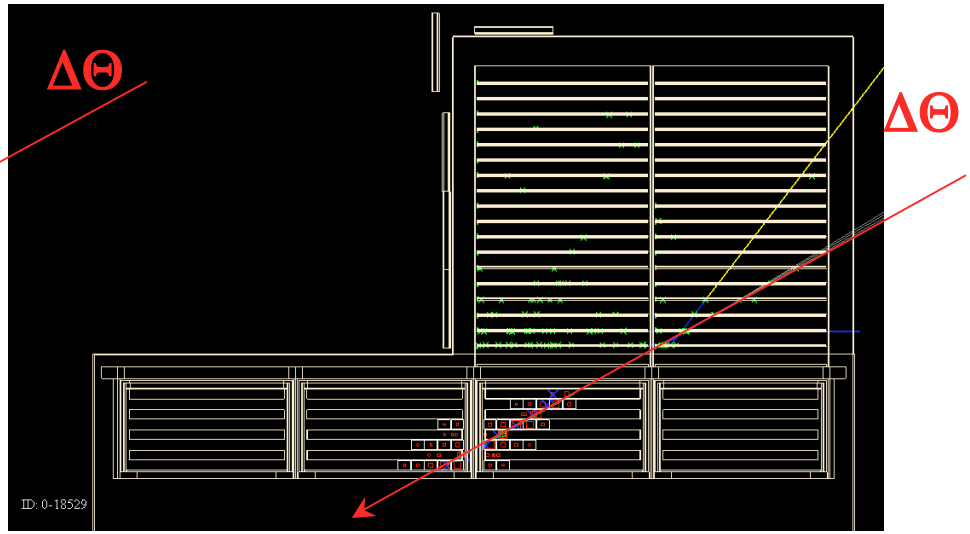
Amount of backsplash in MC seems to be smaller than in real data

Tracker reconstruction is most of the times correct

Evt 8794 (see next slide)

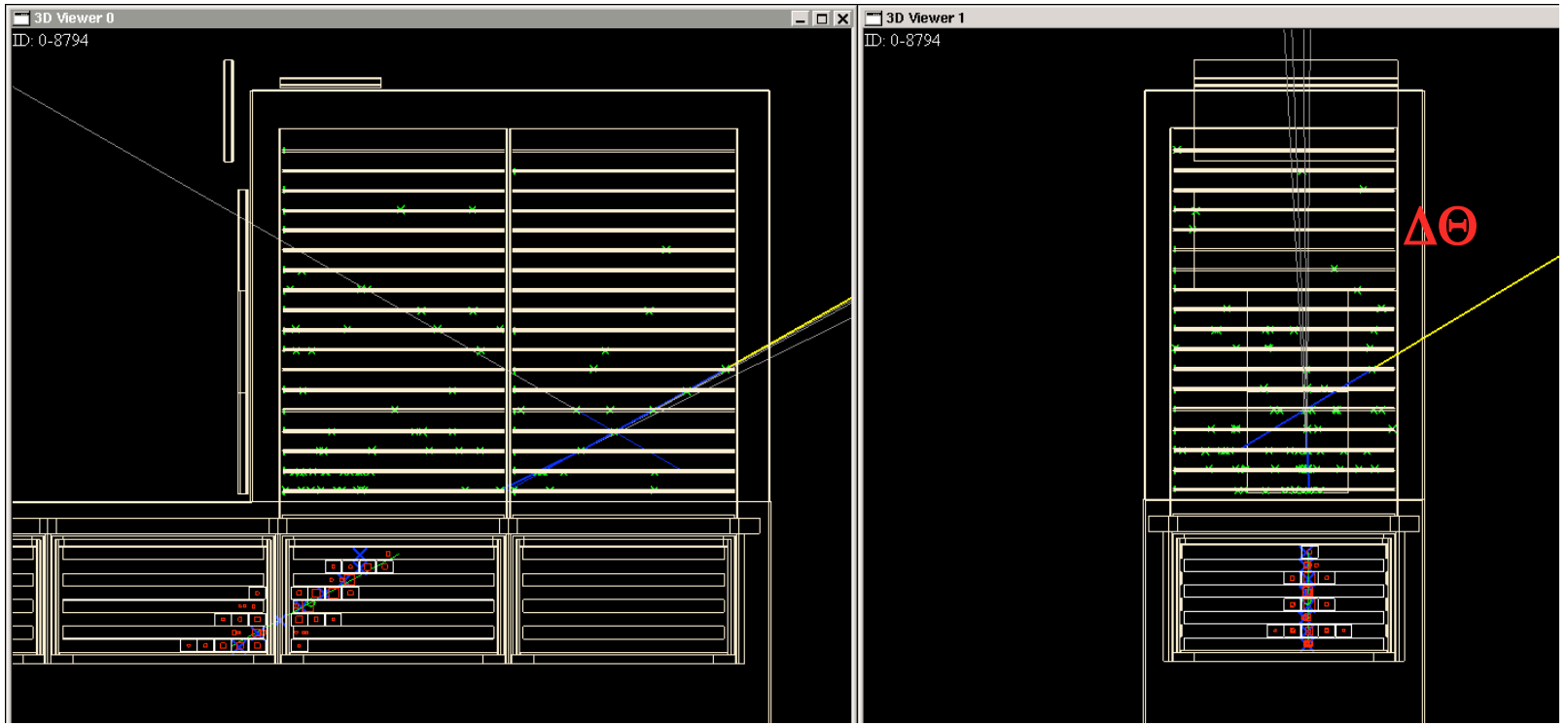


Evt 18529



Comparison with MC data: Custom BT-1949(280GeV, 60deg)

Evt 8794 the big difference is visible in the other plane



Amount of backsplash in MC seems to be smaller than in real data

Tracker reconstruction is most of the times correct

Conclusions

Backsplash at high energies && large incident angles can substantially change the reconstruction of the incoming angle (and impact point).

Can we pick a "tracker track" which agrees with the incoming angle that is determined with the calorimeter info ?

The effect seems to be smaller in the MC data. Should we update delta-rays/backsplash production ?

This effect introduced a shift in calculated impact point and angle by the macro I used to evaluate beam profiles.

Consequently, the beam profile from the MC I generated does not match properly that one of the data

New MC with "subjective" (based on plots) beam parameters needs to be generated for 60 deg… ongoing …