Custom simulation for SPS data runs

	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

1 - Parameters modified in the MC configuration files to match the MC beam profile to that of the data

beamtest06

Gleam

2 - Distributions of some params. before/after new MC sim.

Gleam Job options

```
BeamTransform.point_on_beamline = {190.9, 33.4 , -47.0};

BeamTransform.table_rotation=60.51;

BeamTransform.table_tilt = 0.19;



BeamTransform.OutputLevel = 0;


GlastDetSvc.xmlfile="$(XMLGEODBSROOT)/xml/cu06/cu06SegVols.xml";
HepRepSvc.GeometryDepth = 7;
mcRootReaderAlg.Outputlevel=4;
mcRootReaderAlg.clearOption = "ALL";
mcRootWriterAlg.clearOption = "ALL";
```

(1)

(2)

(3)

(1) Beam incidence position (X,Y) at Z = -47mm

(2) Beam incidence angle in X direction

(3) Beam incidence angle in Y direction, recently implemented

These quantities are directly retrieved from inspection of data runs. Easy stuff (~ 1 minute)

For Tilt in Y direction (Leon suggestion):

GlastRelease v9r25

+ G4Generator v5r17p2gr0

+ TkrDigi v2r6

Detail: note that **table_rotation** (X direction) and **table_tilt** (Y direction) go with opposite signs

Tkr1XDir = - 0.870415443	Table_rotation = + 60.51
Tkr1YDir = + 0.0033201057	Table_tilt = + 0.19

Beamtest06 SPS job option

```
# Macro file for 2006 sps electron runs
# Sets some default verbose
/control/verbose 2
/run/initialize
/run/verbose 2

/Cern/random/run 0
/Cern/random/event 1
###################################################
#END OF GLOBAL CONFIG FILE
#Following lines should be written by the script
###################################################


#Automatically written by JOcreator on Fri Dec 15 17:45:39 2006
#Using Analysis report is True
#/Cern/detector/trigger 2
#/Cern/detector/field 0
/Cern/gun/ydiv 1.000000 mrad
/Cern/gun/zdiv 1.000000 mrad
/Cern/gun/edispersion 1.000000
/Cern/gun/ywidth 1.000000 cm
/Cern/gun/zwidth 1.000000 cm
/gun/particle e-
/Cern/gun/pos -5000. 0 0 cm
/Cern/detector/cherenkovpressure 0.800000
/Cern/gun/energy 196.120000 GeV
/run/beamOn 100
```

(1)

0.00001 for all SPS runs; no significant change

(1) Quantities derived from beam profile inspection (sigma_x, sigma_y) are not those values. No direct relation is known. Used approach is to simulate many beams and find those numbers iteratively…

Beamtest06 SPS job option

```
# Macro file for 2006 sps electron runs
# Sets some default verbose
/control/verbose 2
/run/initialize
/run/verbose 2

/Cern/random/run 0
/Cern/random/event 1
####################################################
#END OF GLOBAL CONFIG FILE
#Following lines should be written by the script
####################################################


#Automatically written by JOcreator on Fri Dec 15 17:45:39 2006
#Using Analysis report is True
#/Cern/detector/trigger 2
#/Cern/detector/field 0
/Cern/gun/ydiv 1.000000 mrad
/Cern/gun/zdiv 1.000000 mrad
/Cern/gun/edispersion 1.000000
/Cern/gun/ywidth 1.000000 cm
/Cern/gun/zwidth 1.000000 cm
/gun/particle e-
/Cern/gun/pos -5000. 0 0 cm
/Cern/detector/cherenkovpressure 0.800000
/Cern/gun/energy 196.120000 GeV
/run/beamOn 100
```

(2)

(1)

(2)

Beam divergence has to be tunned too !!

1.0 mrad → 0.25 mrad

Details in talk given on March 7

0.00001 for all SPS runs; no significant change

(1) Quantities derived from beam profile inspection (sigma_x, sigma_y) are not those values. No direct relation is known. Used approach is to simulate many beams and find those numbers iteratively…

I could find parameters which match profile data-mc:

Very good:

280 GeV (1922)

200 GeV (1911)

100 GeV (1981)

Rather good:

50 GeV (2039)

Not very well… but ok…:

20 GeV (2082)

In MC data, beam width and divergence increases “too much” as energy decreases. Reason not identified…

In MC data we know:

a) The exact incoming direction of the beam

b) The exact incoming direction of event i (Mc[ZYX]Dir)

Therefore, we can compute, the following quantities:

Cos(BeamCU_DirErr) = cos(XthetaBeam) Tkr1XDir +*
cos(YthetaBeam) Tkr1YDir +*
cos(ZThetaBeam) Tkr1ZDir*

CU Resolution + BeamDiv
("Measured PSF")

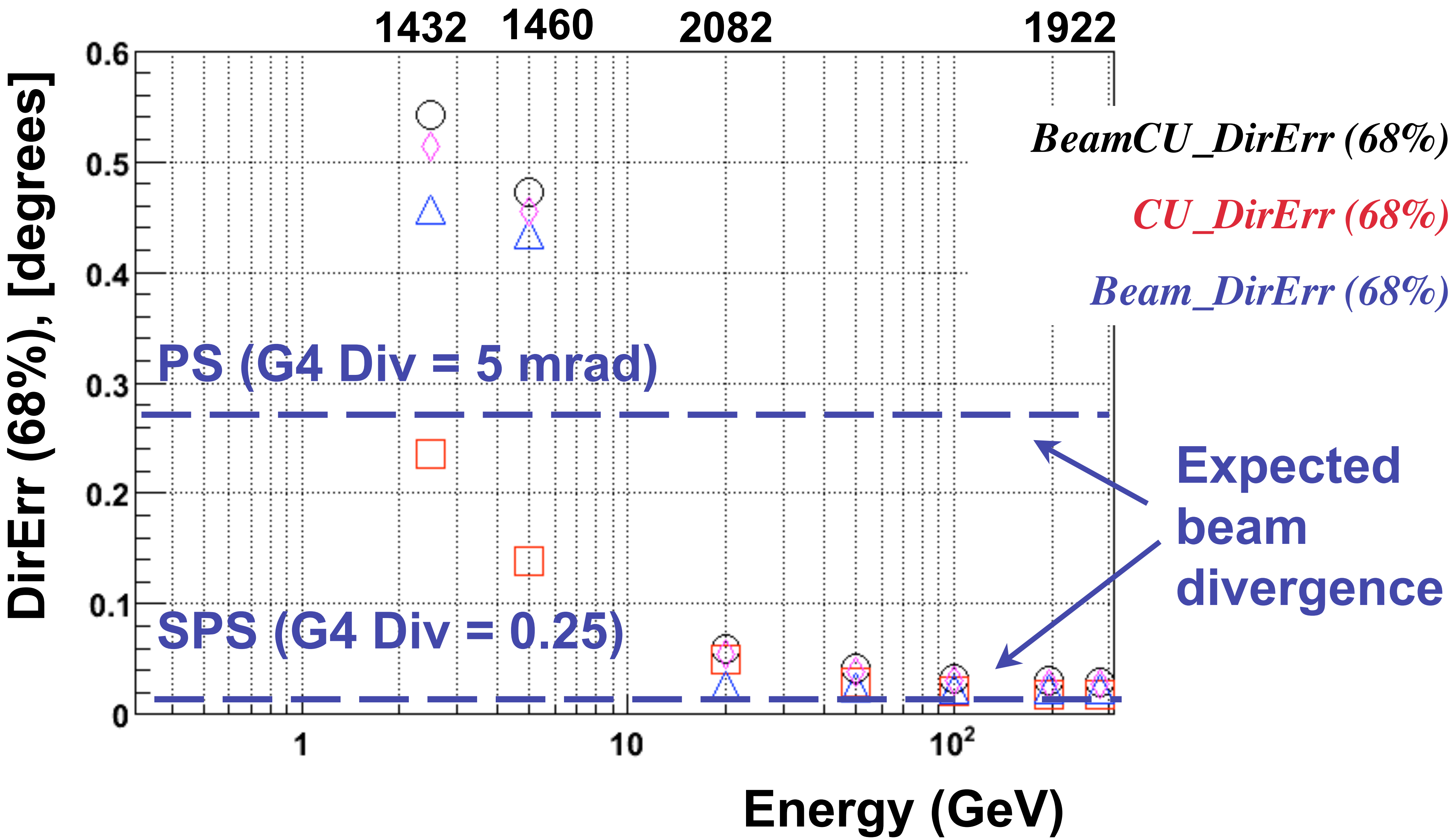
*Cos(CU_DirErr) = McXDir * Tkr1XDir +*
McYDir Tkr1YDir +*
McZDir Tkr1ZDir*

CU Resolution (True PSF)

Cos(BeamCU_DirErr) = cos(XthetaBeam) McXDir +*
cos(YthetaBeam) McYDir +*
cos(ZThetaBeam) McZDir*

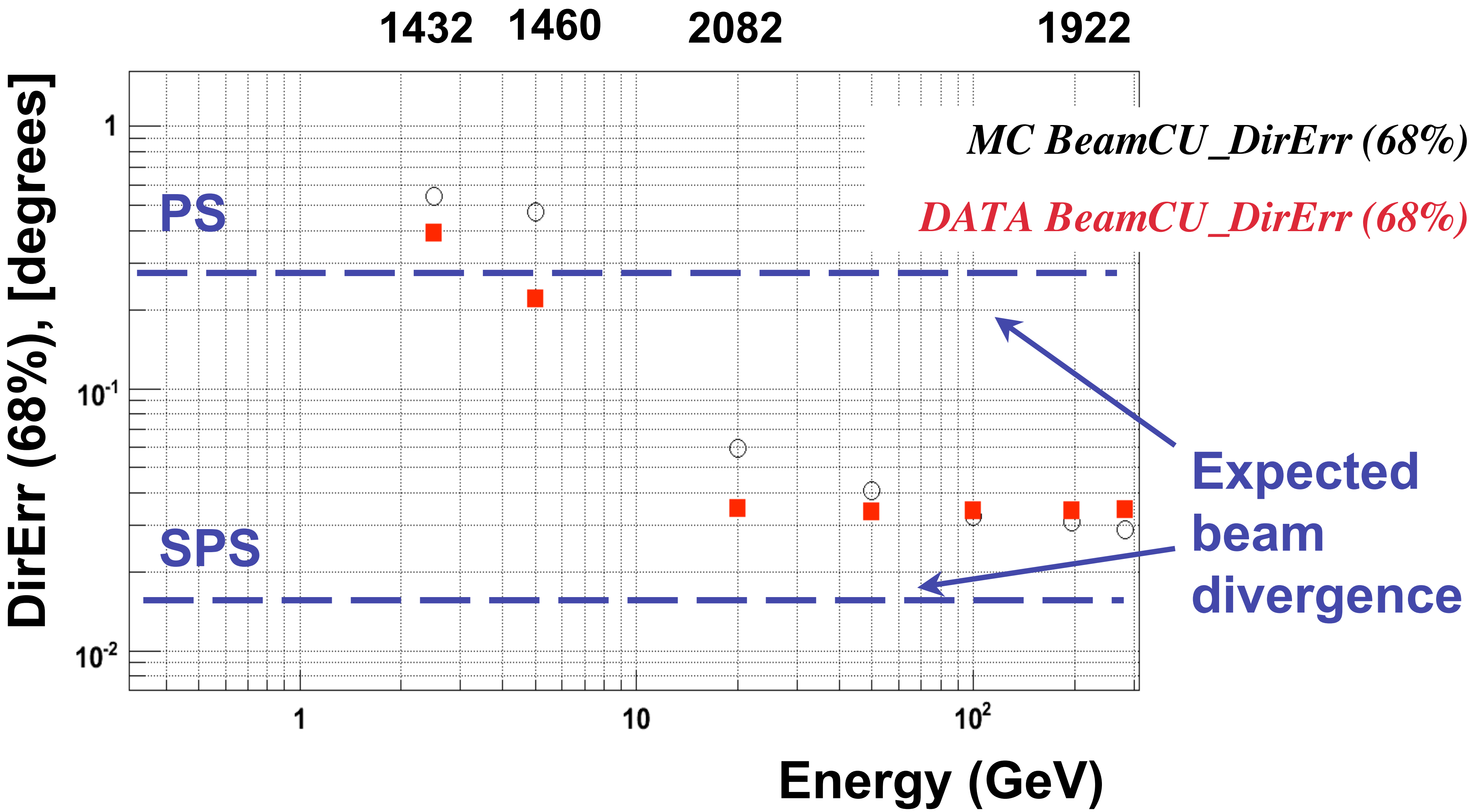
Beam Divergence

BeamCU_DirErr (68%), CU_DirErr (68%) and Beam_DirErr (68%) vs Energy



Below 100 GeV, beam divergence > CU resolution

COMPARISON DATA-MC : BeamCU_DirErr (68%) vs Energy



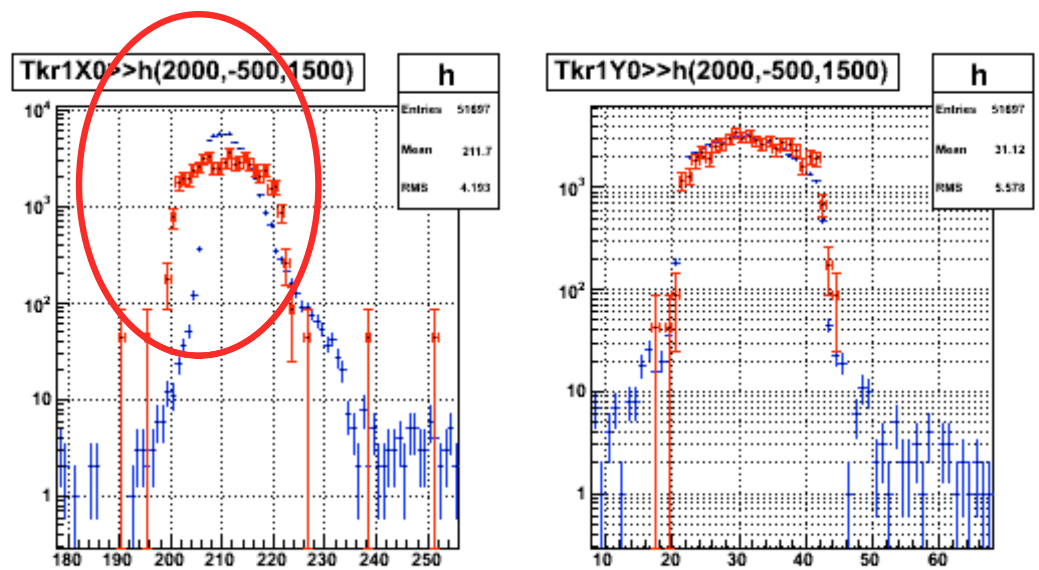
Below 100 GeV, Data has a lower BeamCU_DirErr than MC

Electron beam divergence (and beam width) increases when decreasing energy of electrons due to Coulomb scattering

This increase in beam divergence and dimensions is larger in the MC than in the data

Changing G4config parameters (divergence and beam dimensions) is not sufficient to get an exact matching of the beam profiles data-mc

In any case, the agreement is rather good (see next slides); so we move forward



Quick Comparison data-mc for some parameters

Important remark

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)

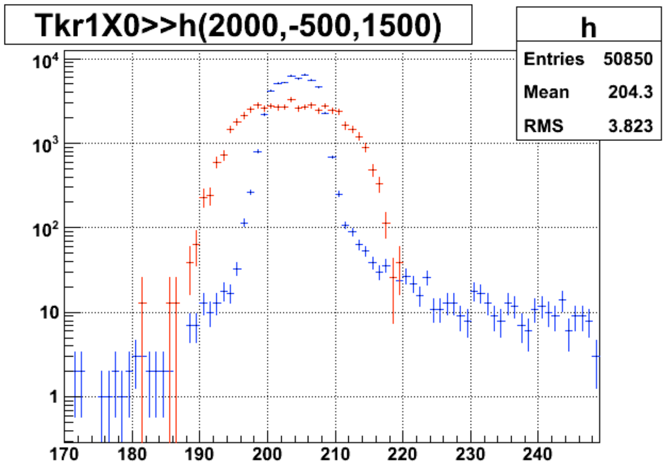
These are very simple cuts which are expected to be fulfilled by all the electrons (>20 GeV) entering in the calibration unit.

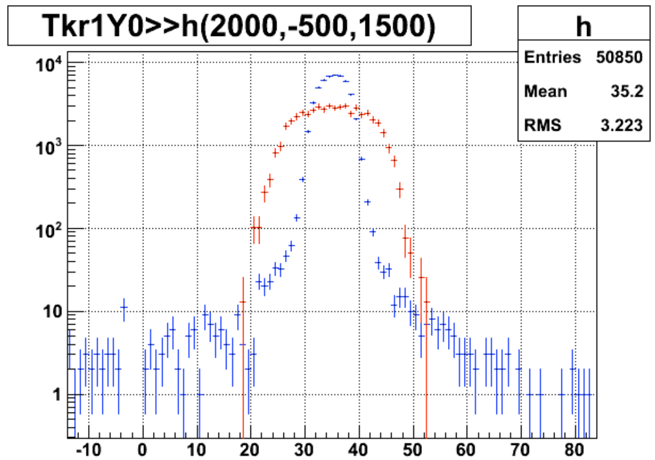
More sophisticated cuts (e.j. removing events crossing cracks, removing MIPs…) which might improve the agreement data-mc are NOT applied. These additional cuts must be applied with care, since they might also bias the comparison if not carefully done

BT-1885, which matches with data run 700001911

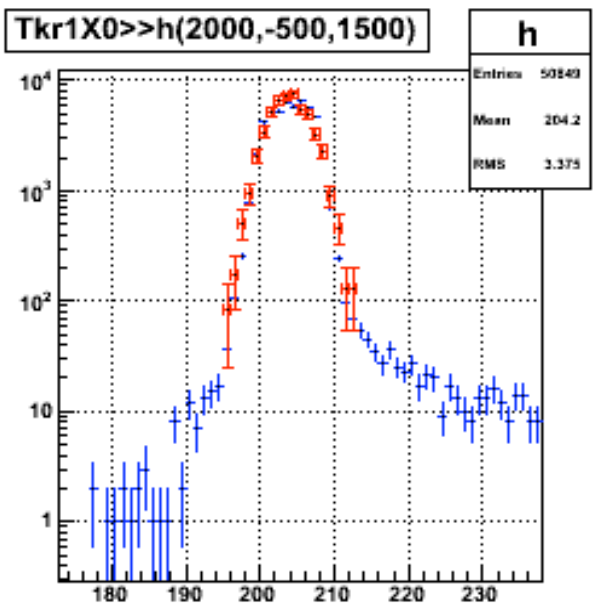
E = 196 GeV , 0 deg **MC in red**; **Data in blue**

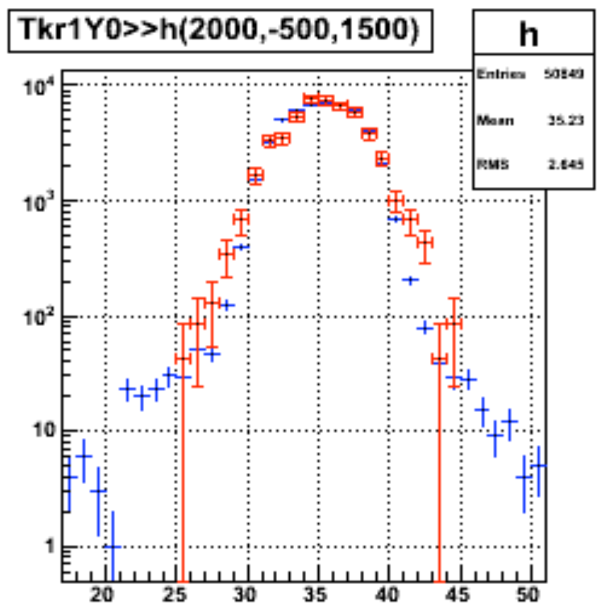
Run 1911





Before



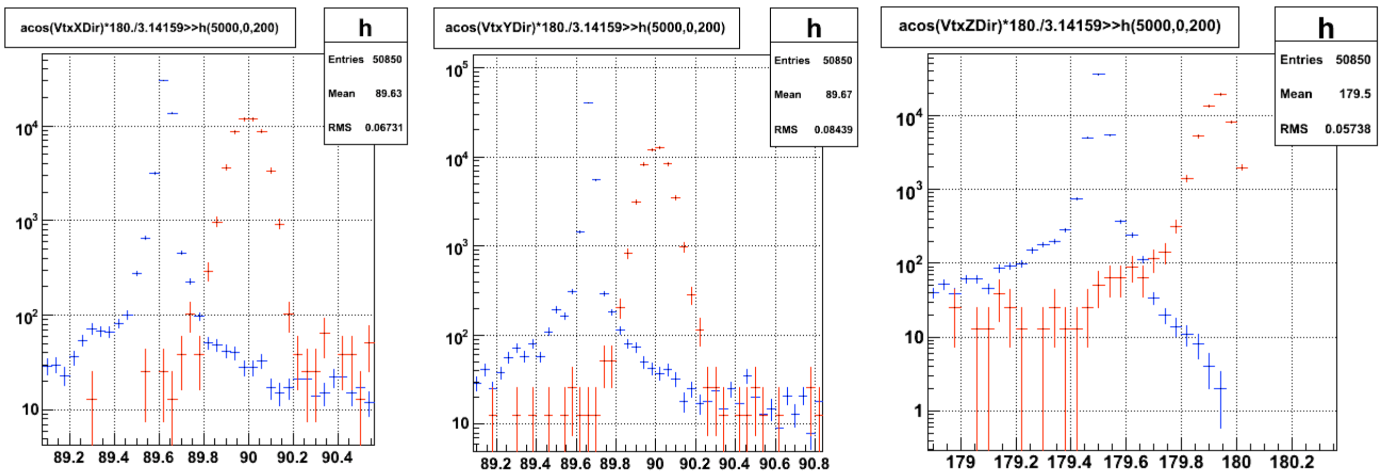


After

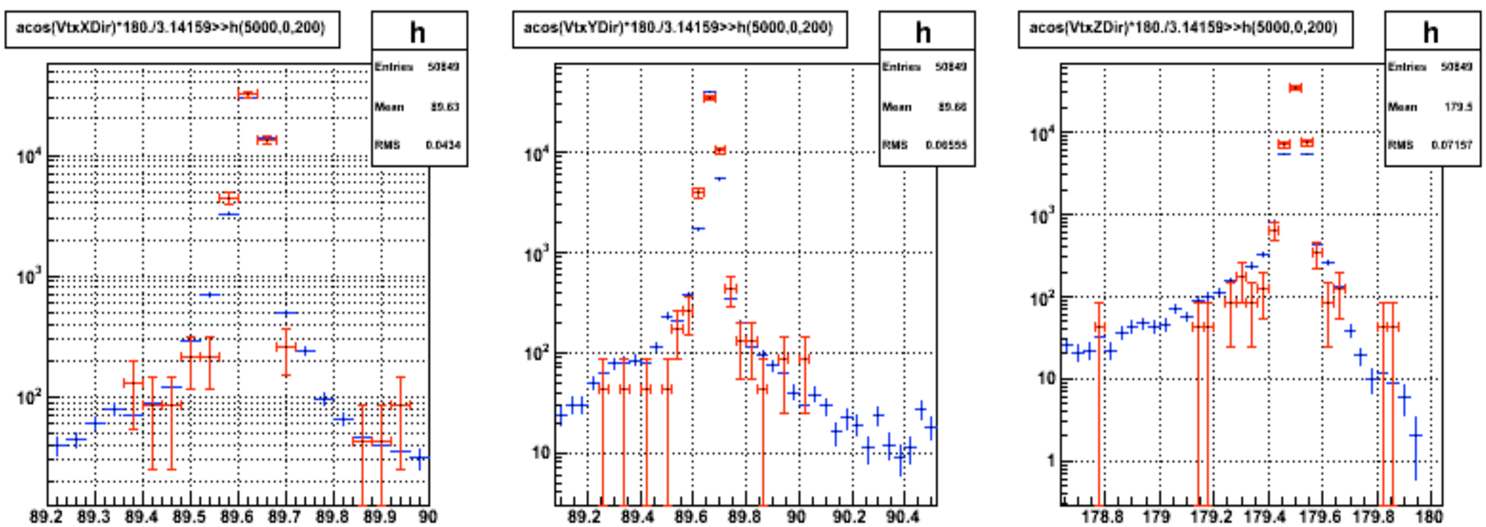
BT-1885, which matches with data run 700001911

E = 196 GeV , 0 deg **MC in red**; **Data in blue**

Run 1911



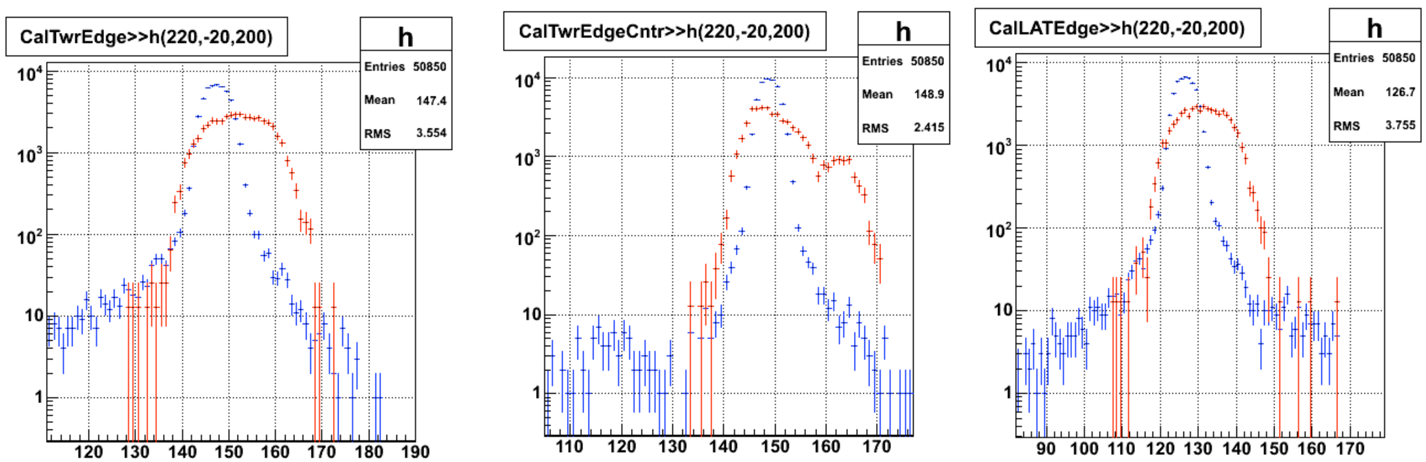
Before



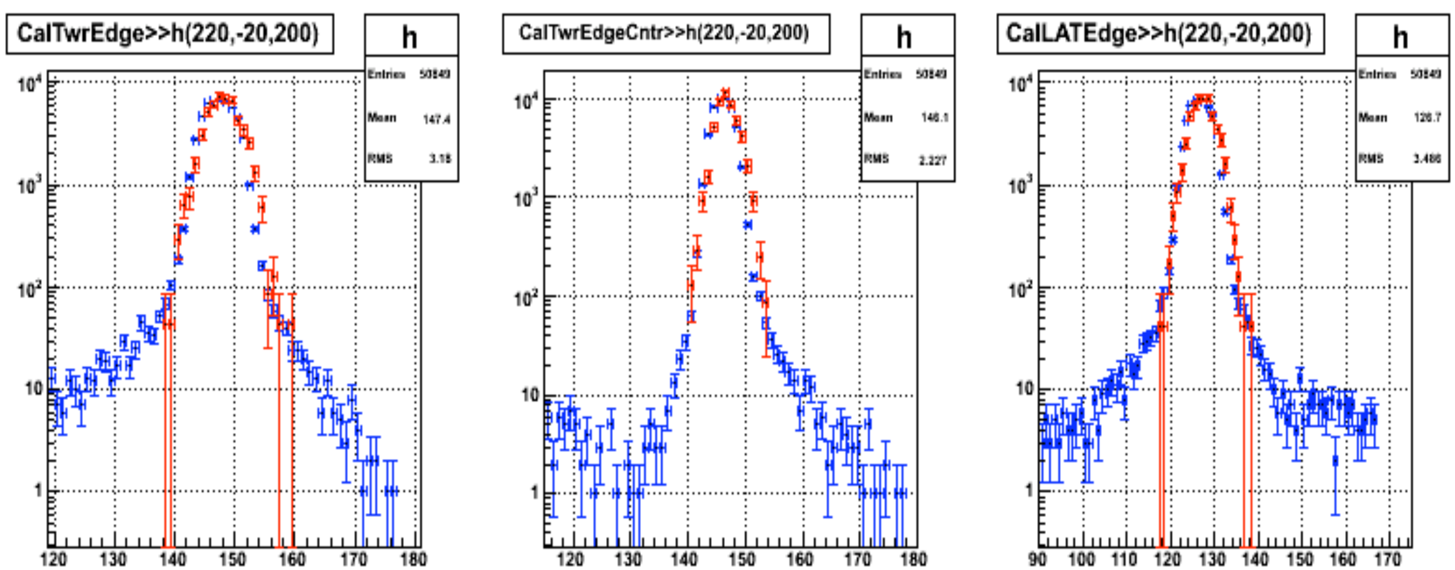
After

BT-1885, which matches with data run 700001911

E = 196 GeV , 0 deg **MC in red**; **Data in blue**



Before



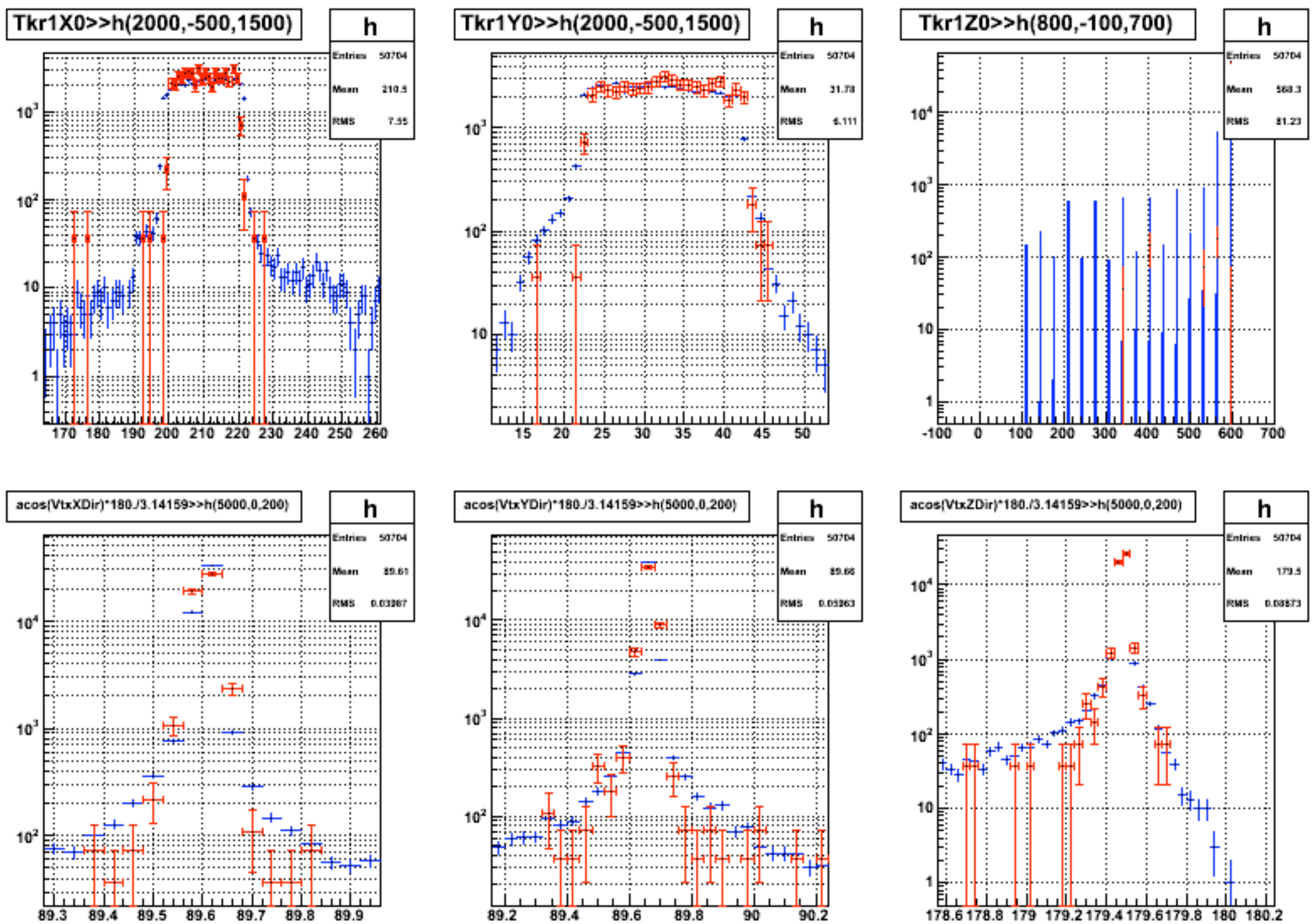
After

Improvement in beam profile agreement has an impact in the agreement in other high level variables

Next slides show a summary of the level of agreement in beam profile for all SPS data runs used for this study

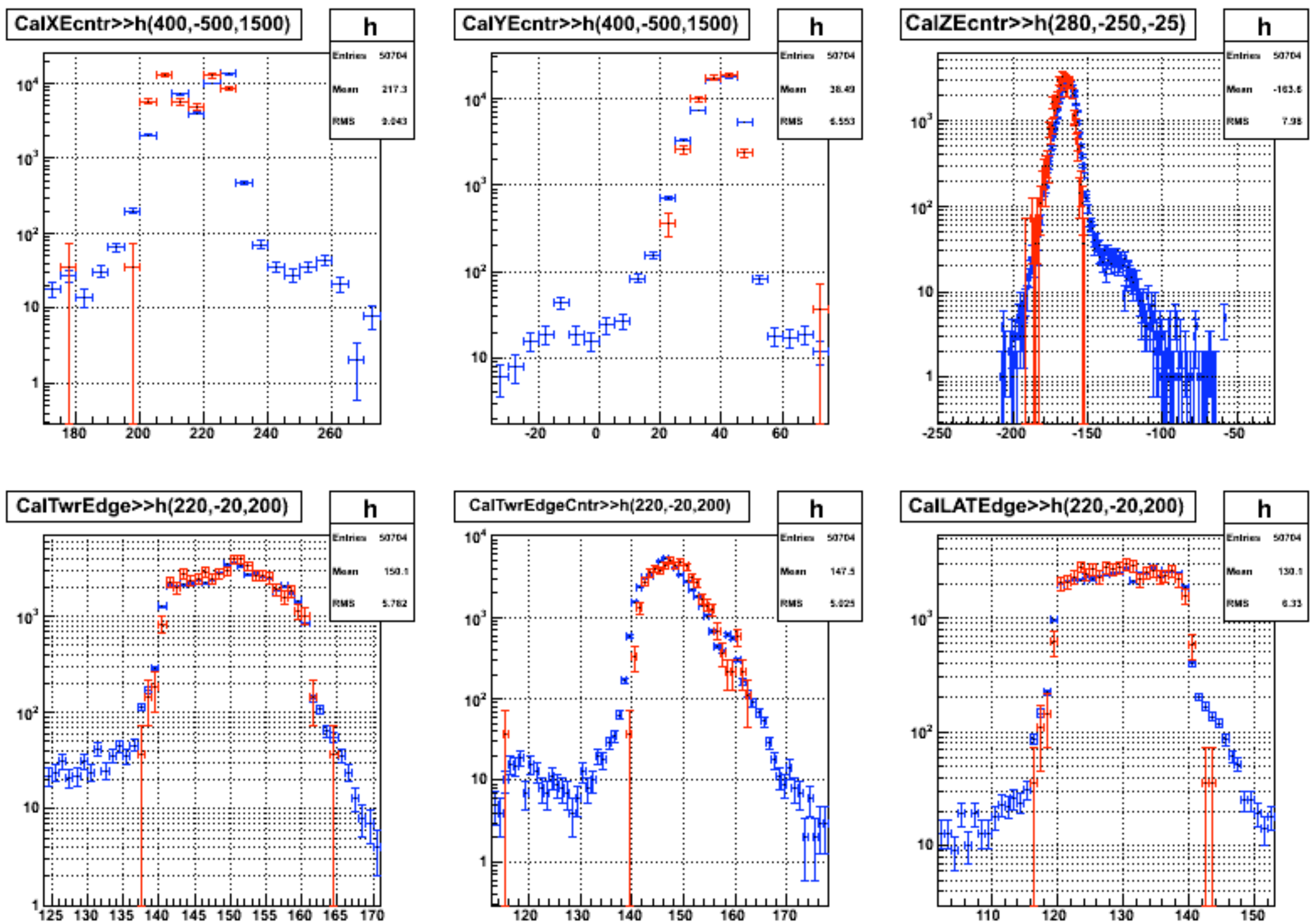
Data run 700001922

E = 282 GeV , 0 deg **MC in red**; **Data in blue**



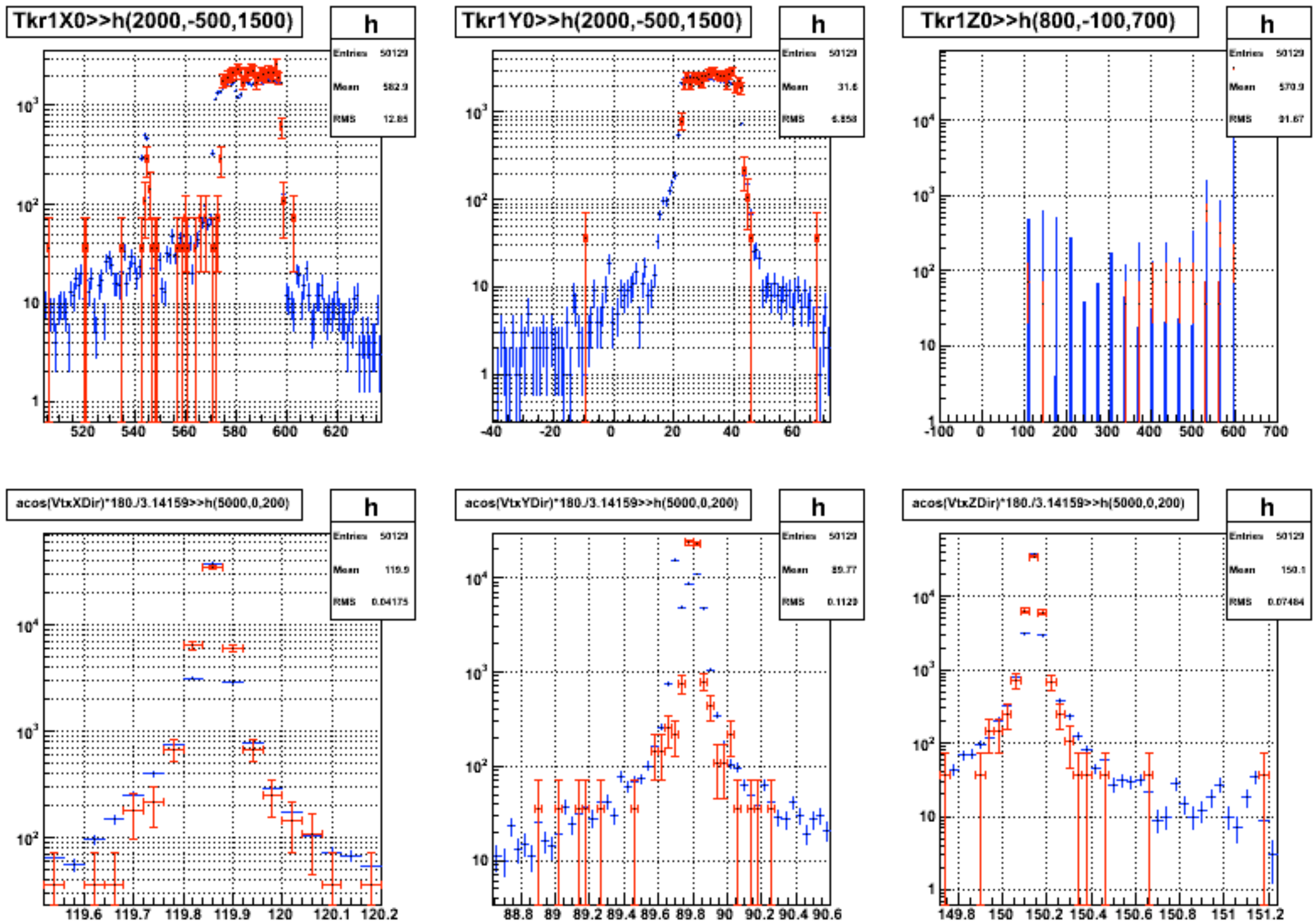
Data run 700001922

E = 282 GeV , 0 deg   MC in red; Data in blue



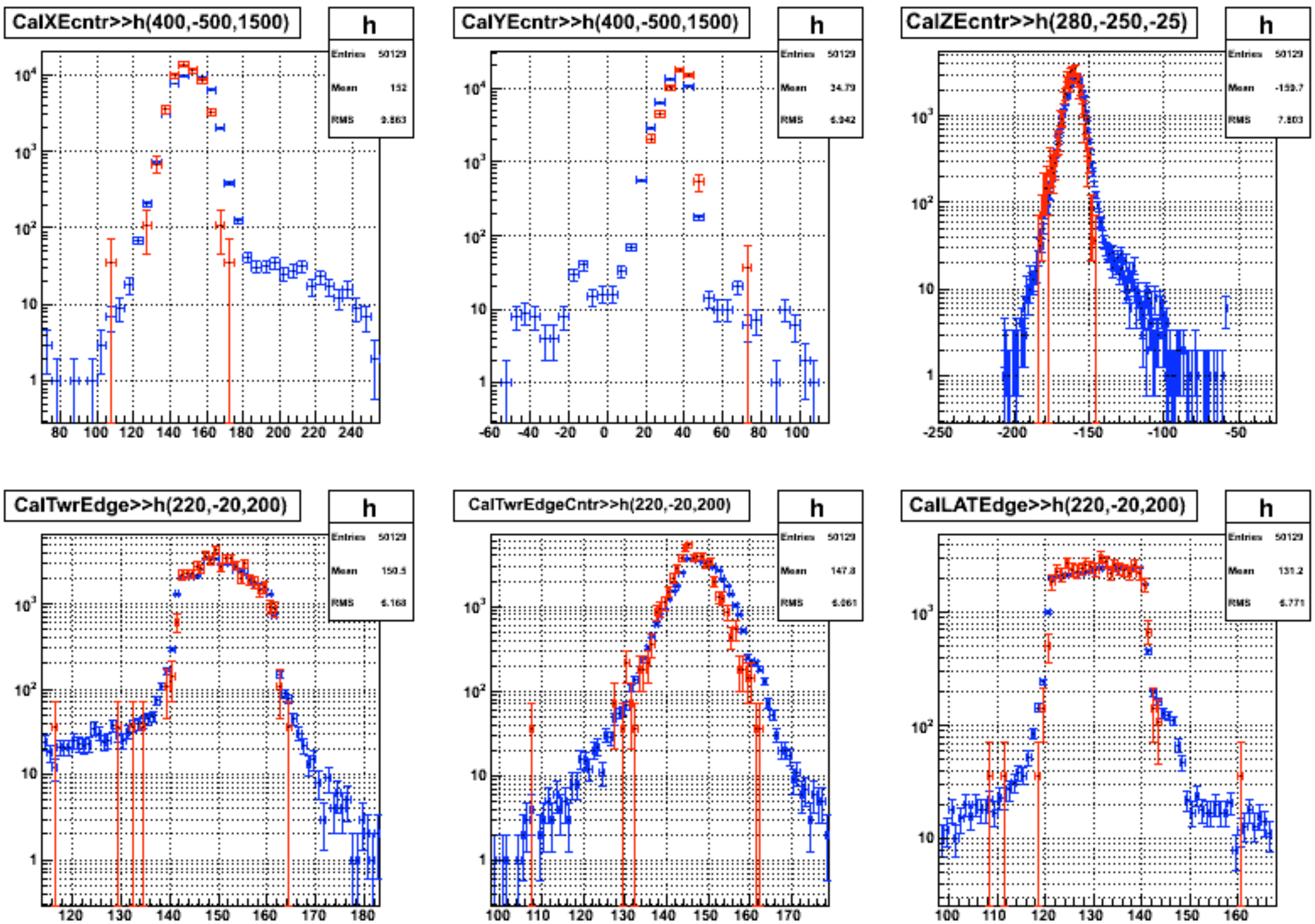
Data run 700001942

E = 282 GeV , 30 deg   **MC in red**; **Data in blue**



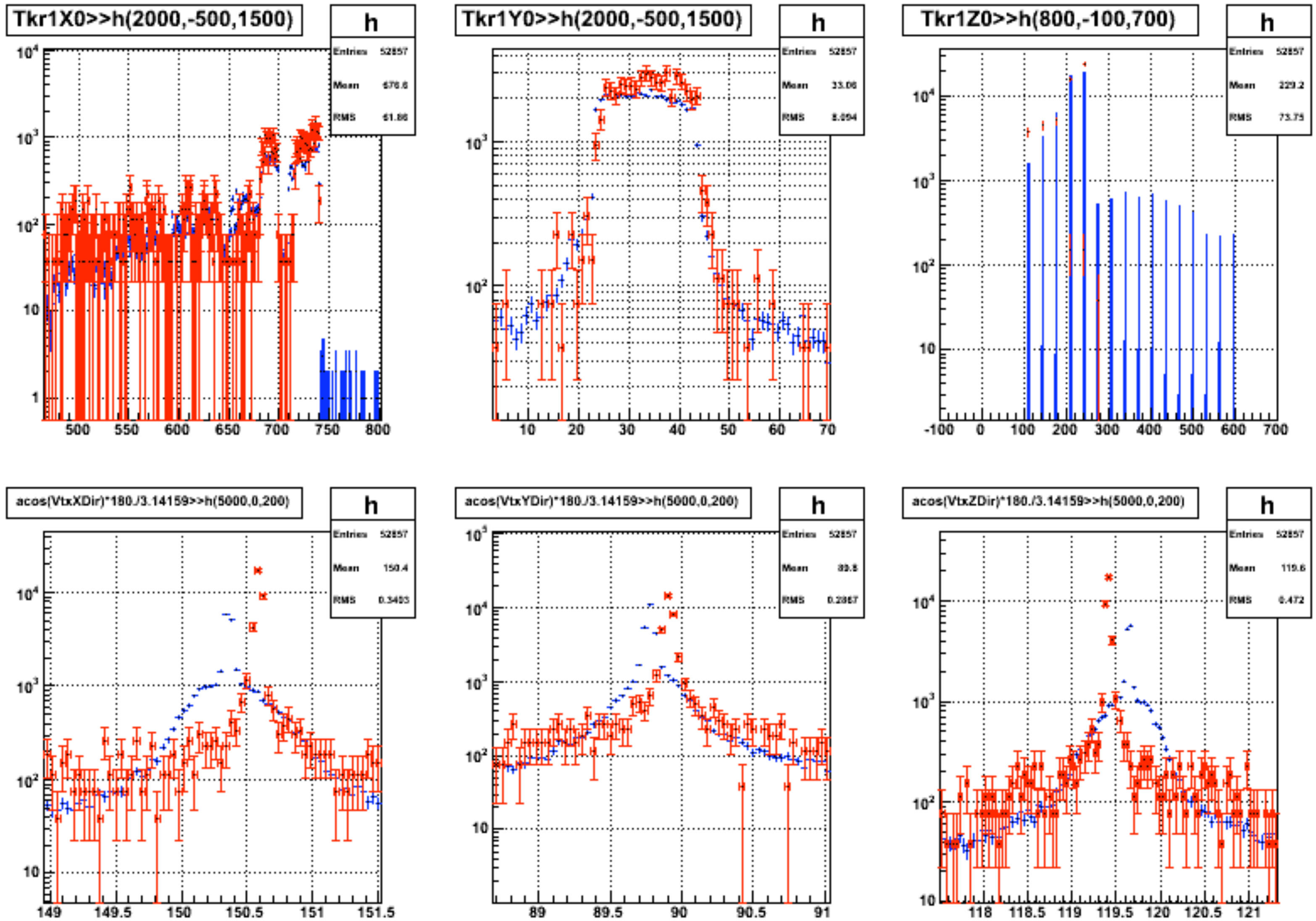
Data run 700001942

E = 282 GeV , 30 deg **MC in red**; **Data in blue**



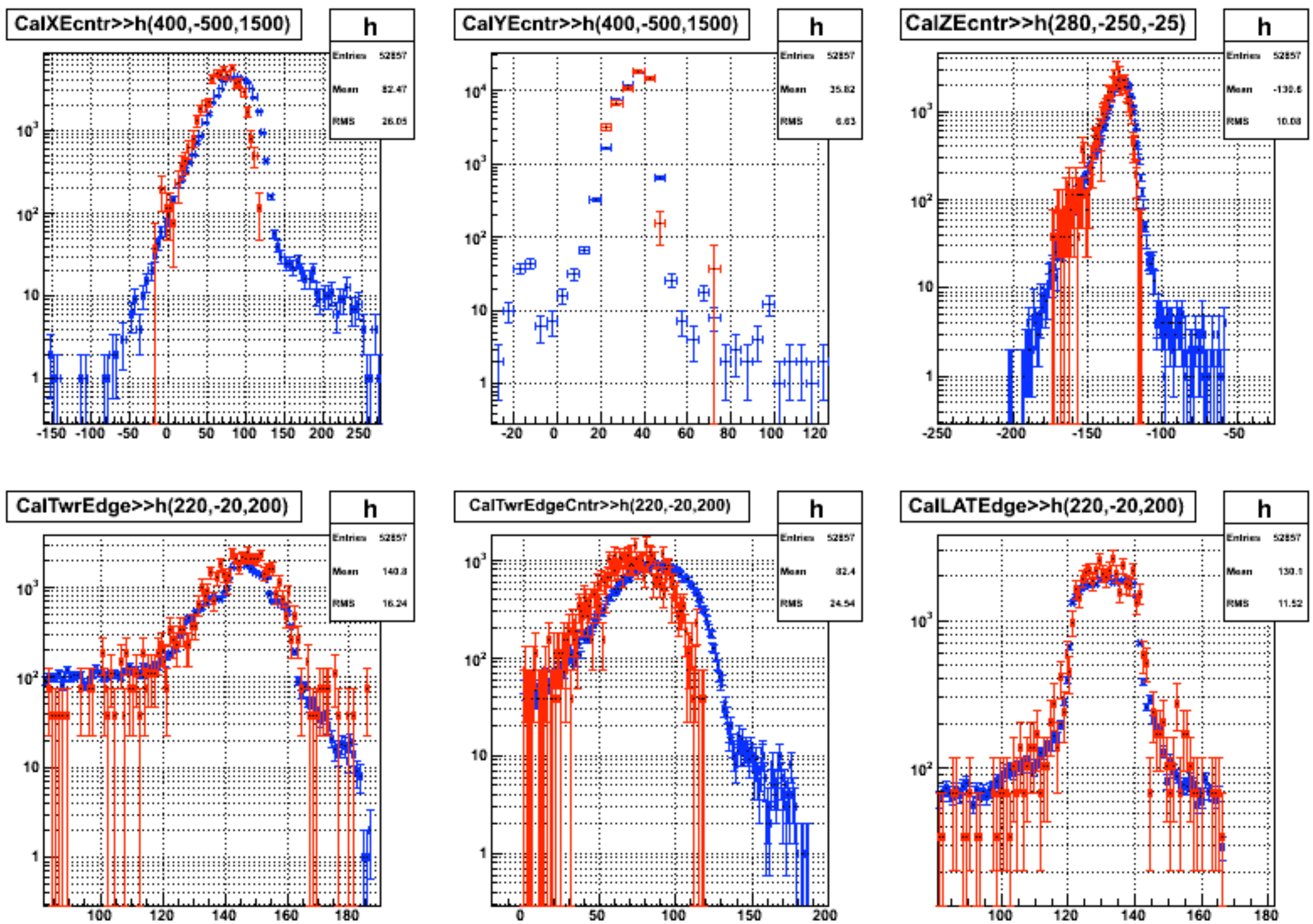
Data run 700001949 ***To be checked !!***

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



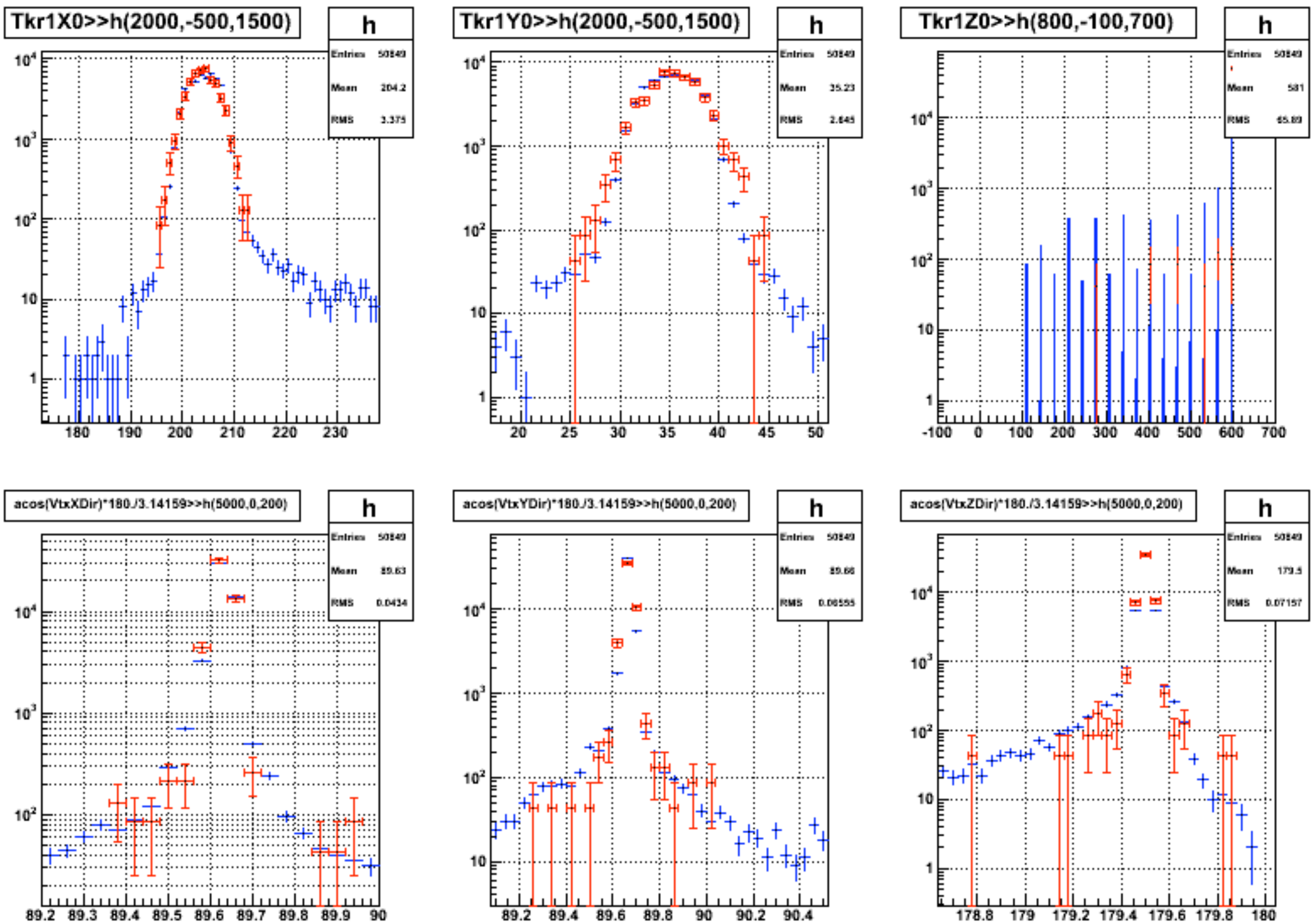
Data run 700001949 ***To be checked !!***

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



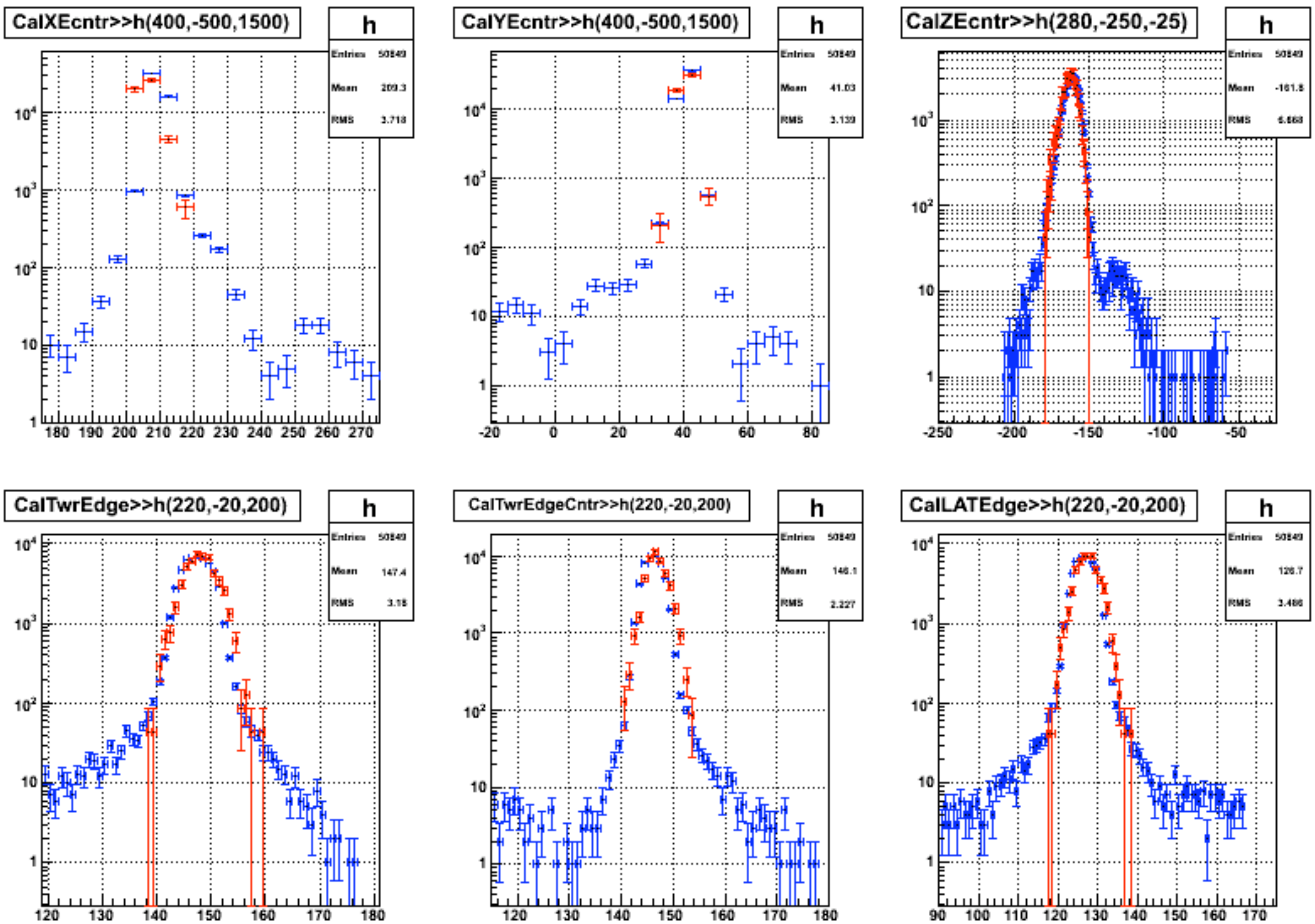
Data run 700001911

E = 196 GeV , 0 deg **MC in red**; **Data in blue**



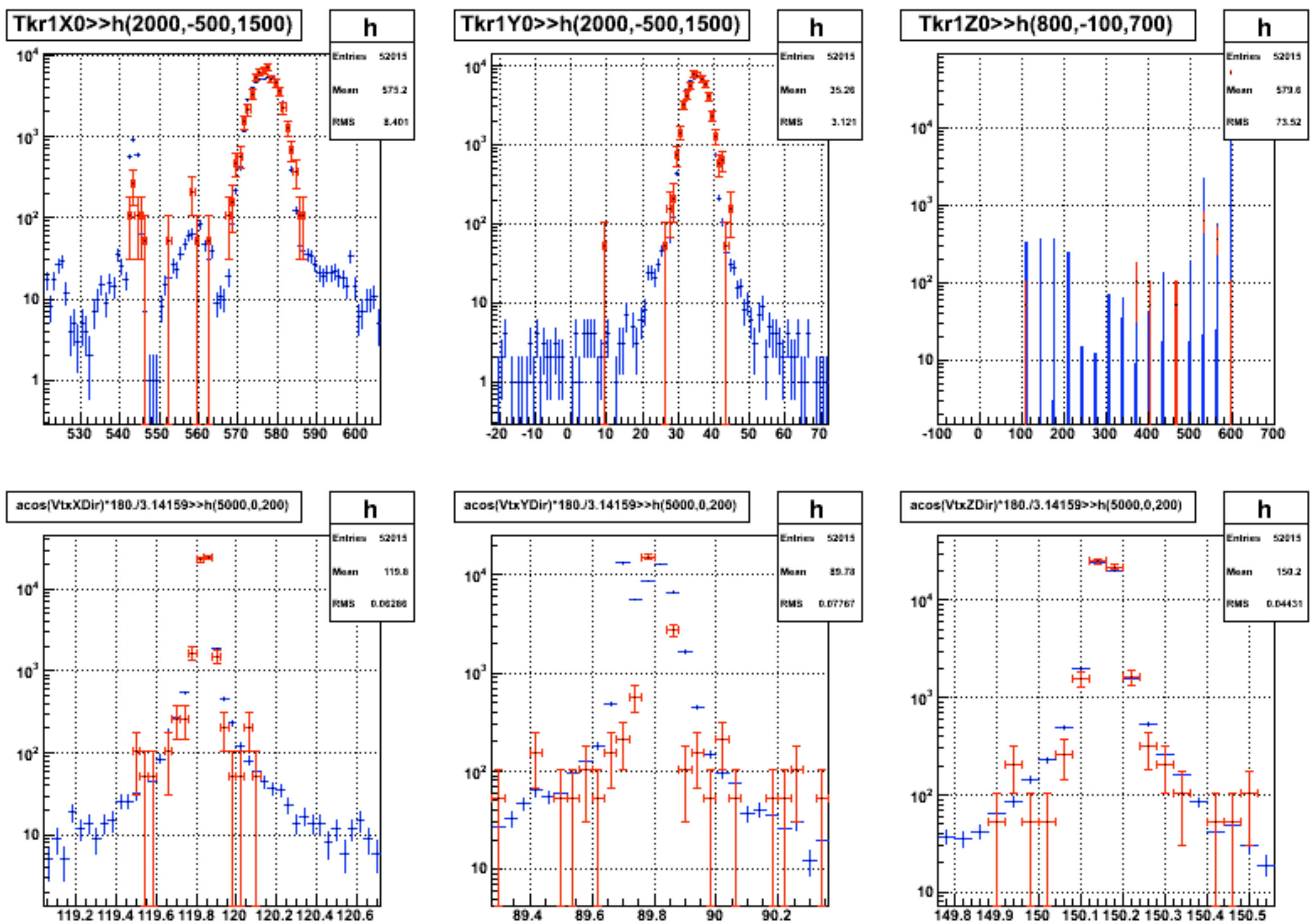
Data run 700001911

E = 196 GeV , 0 deg MC in red; Data in blue



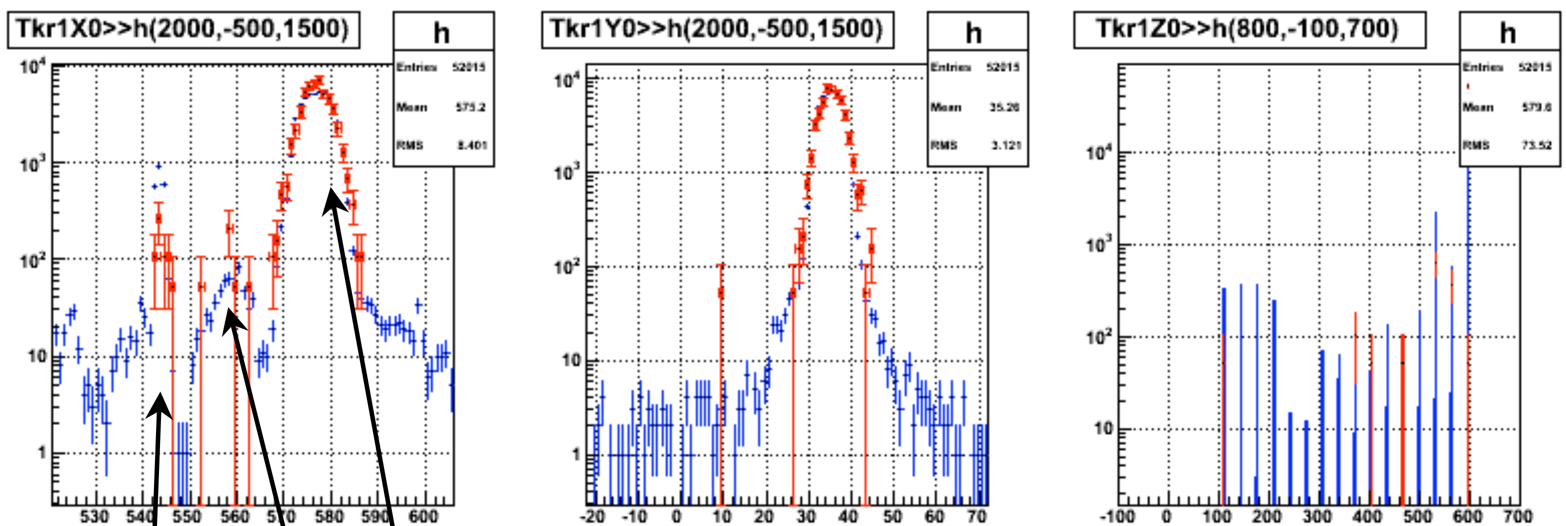
Data run 700001902

E = 196 GeV , 30 deg   MC in red; Data in blue



Data run 700001902

E = 196 GeV , 30 deg   MC in red; Data in blue



Signal in First Layer crossing the trajectory

Signal in second Layer crossing the trajectory

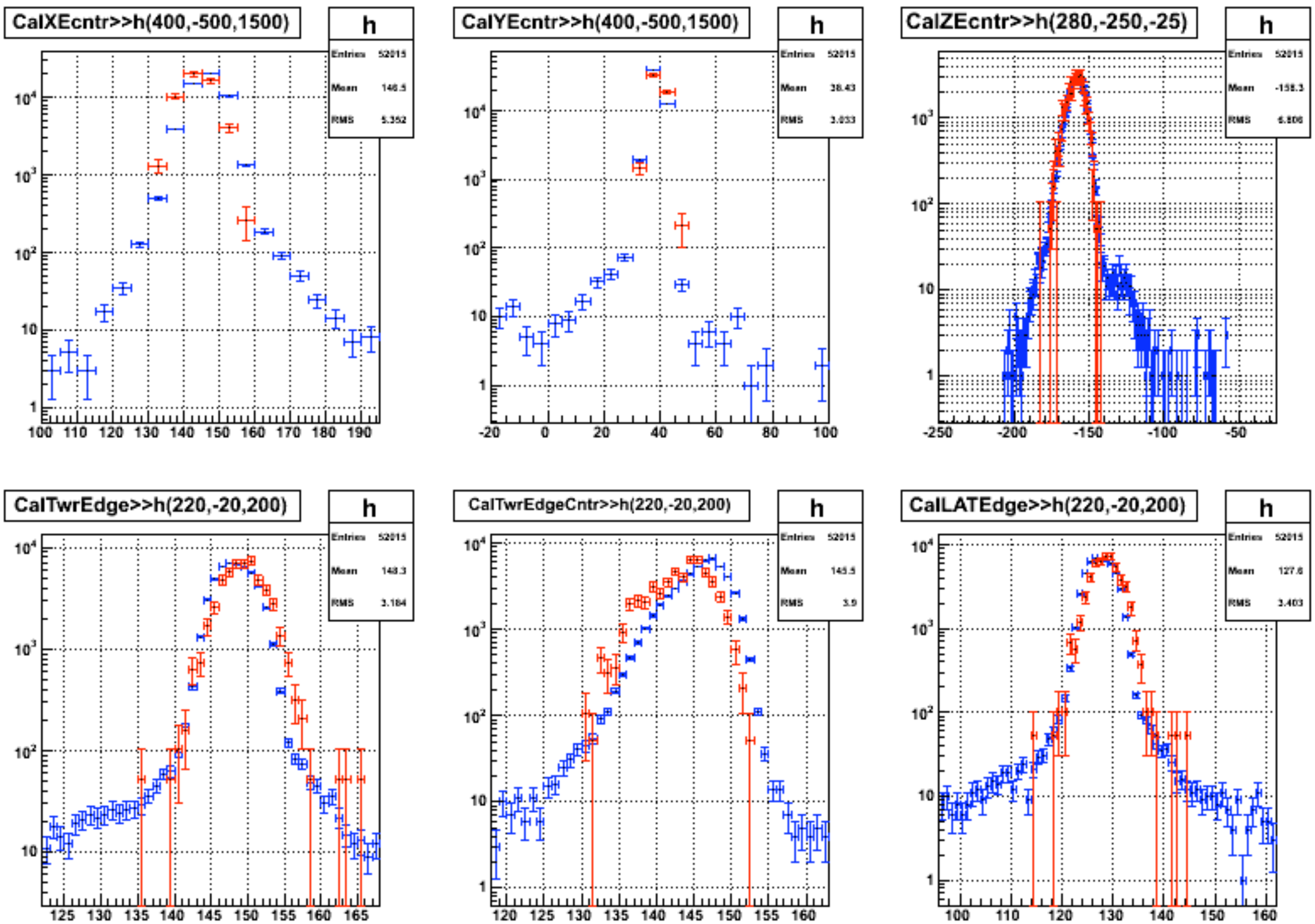
DeltaX = 640./19. * (-0.5/sqrt(1-pow(-0.5,2))) = 19 mm

Signal in third Layer crossing the trajectory

DeltaX = 2* 640./19. * (-0.5/sqrt(1-pow(-0.5,2))) = 38 mm

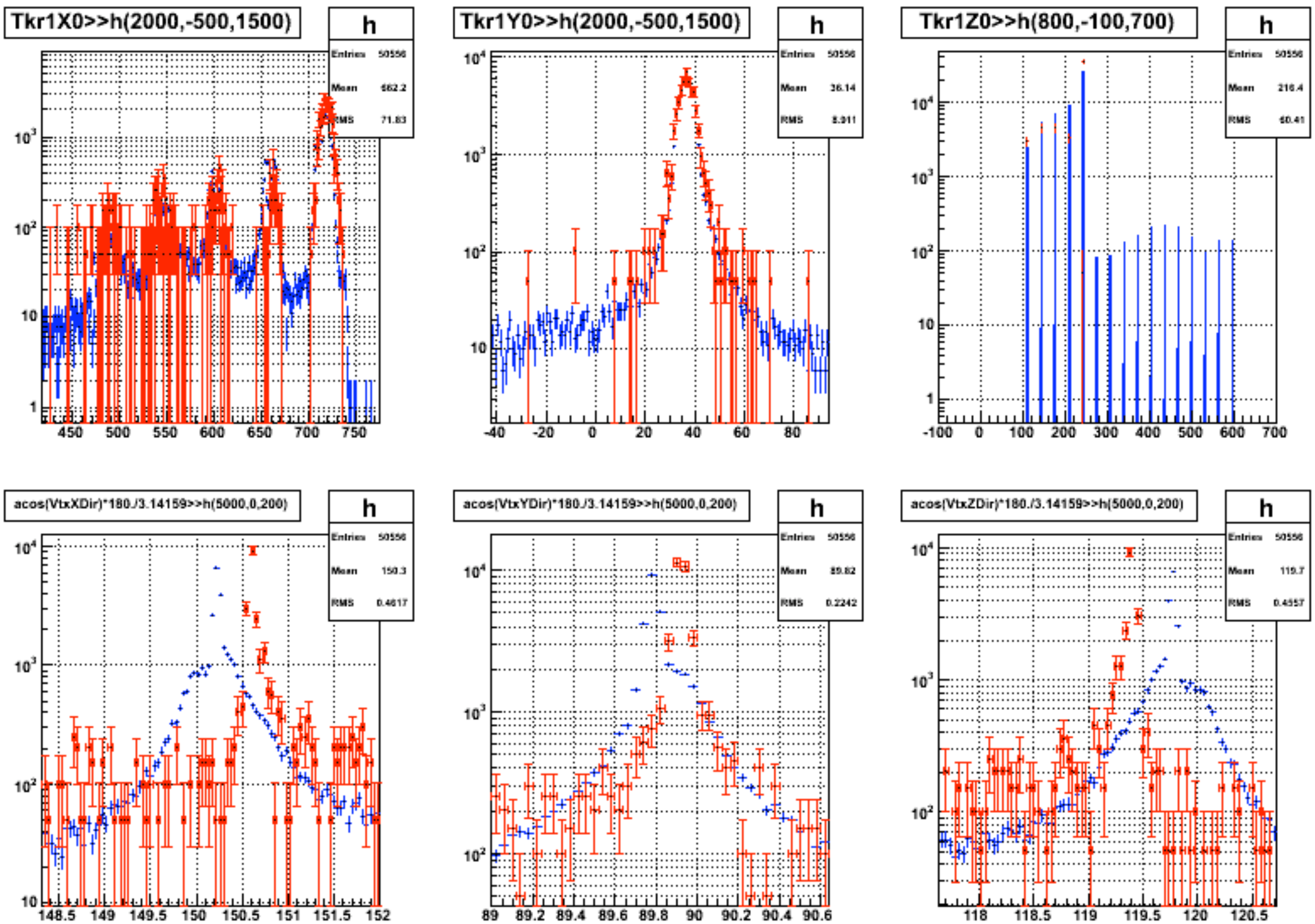
Data run 700001902

E = 196 GeV , 30 deg   **MC in red**; **Data in blue**



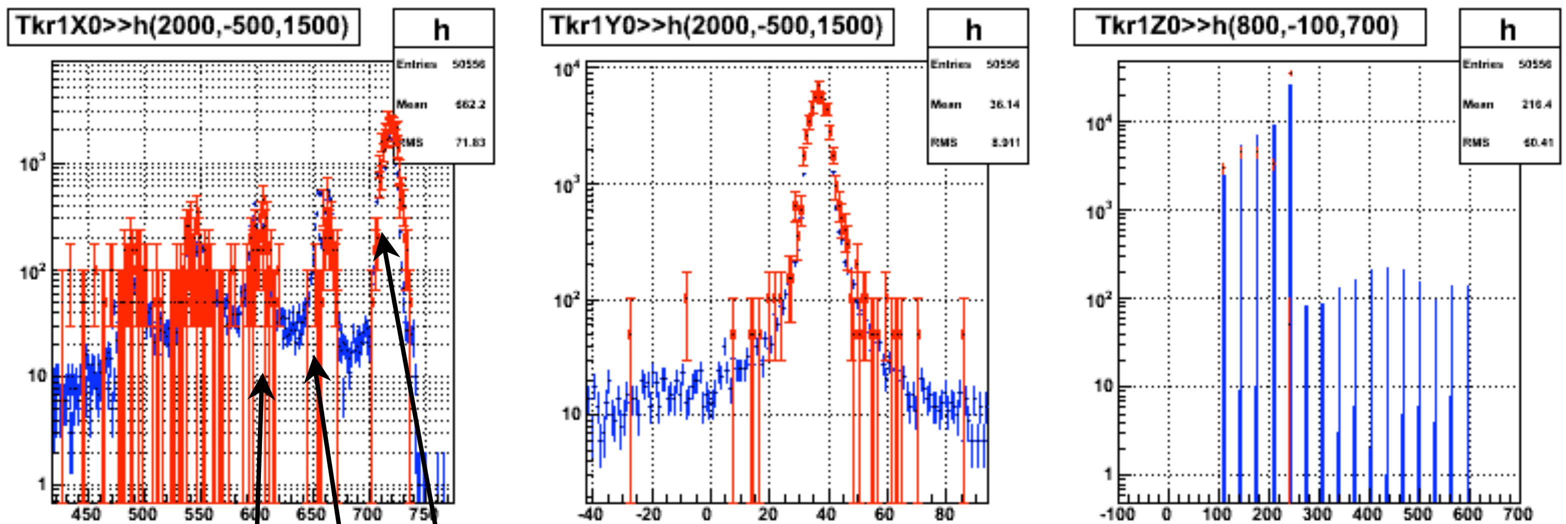
Data run 700001909 ***To be checked !!***

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



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

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



Signal in First Layer crossing the trajectory

Signal in second Layer crossing the trajectory

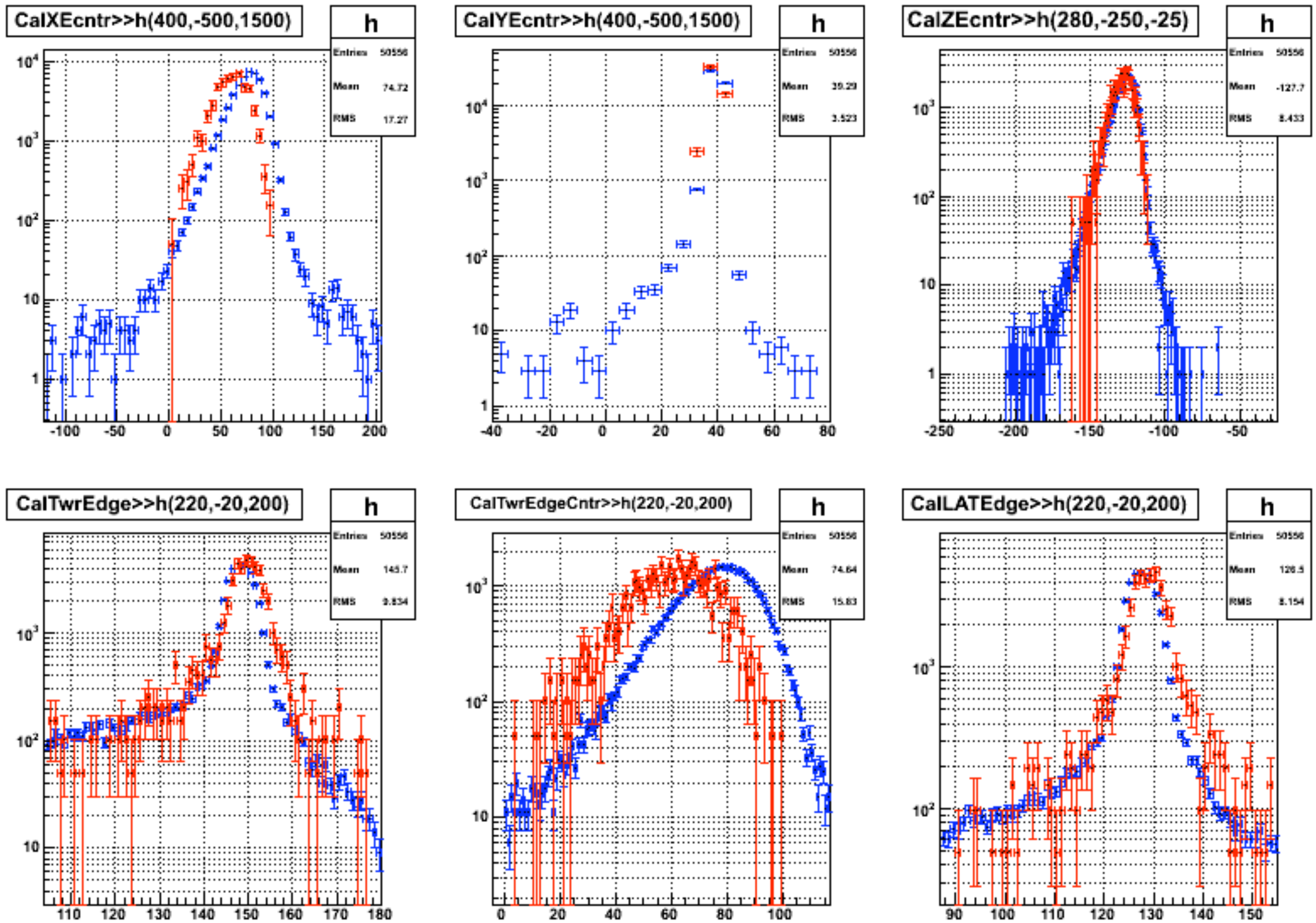
DeltaX = 640./19. * (-0.87/sqrt(1-pow(-0.87,2))) = 59 mm

Signal in third Layer crossing the trajectory

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

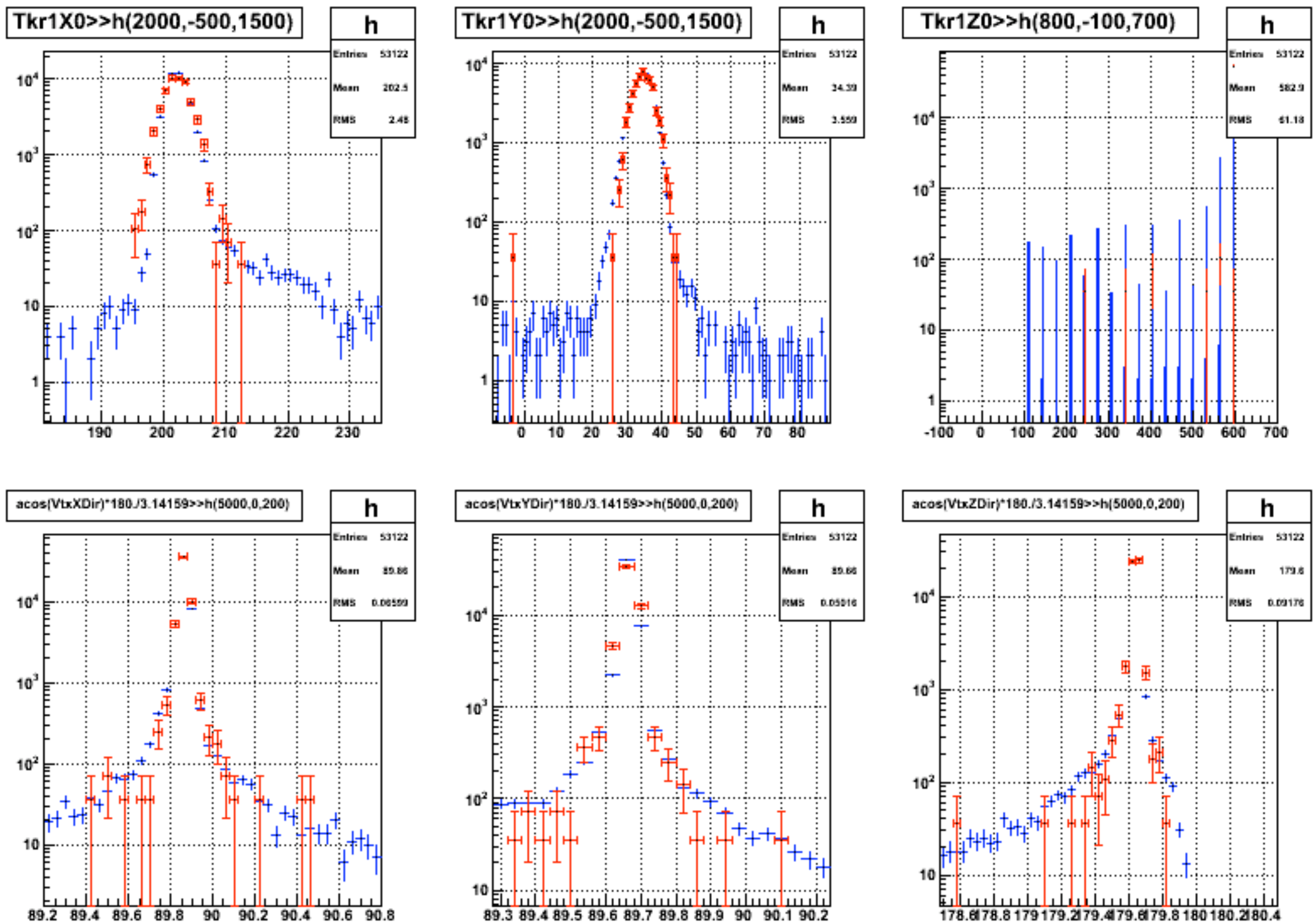
Data run 700001909 ***To be checked !!***

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



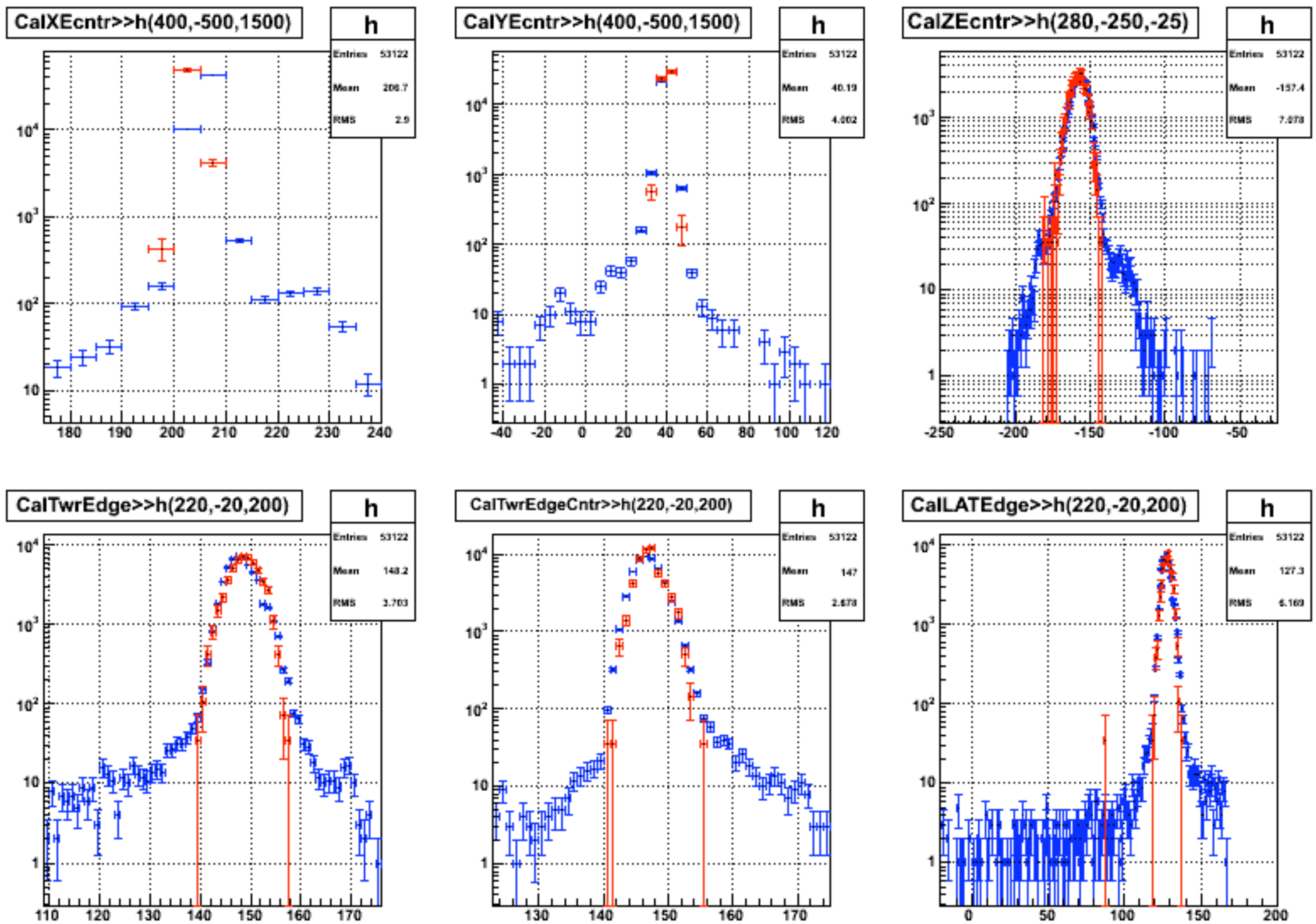
Data run 700001981

E = 100 GeV , 0 deg   **MC in red**; **Data in blue**



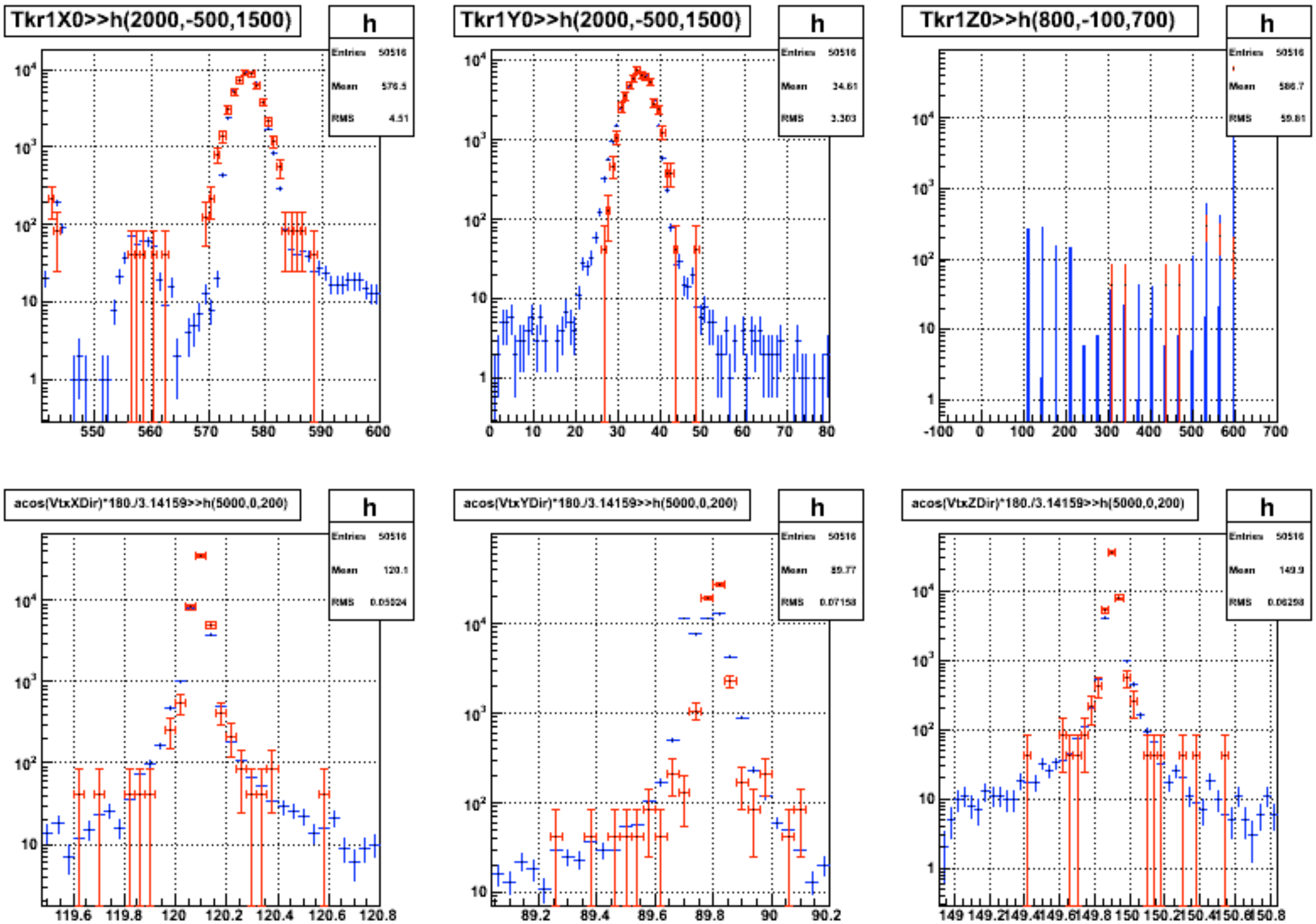
Data run 700001981

E = 100 GeV , 0 deg **MC in red**; **Data in blue**



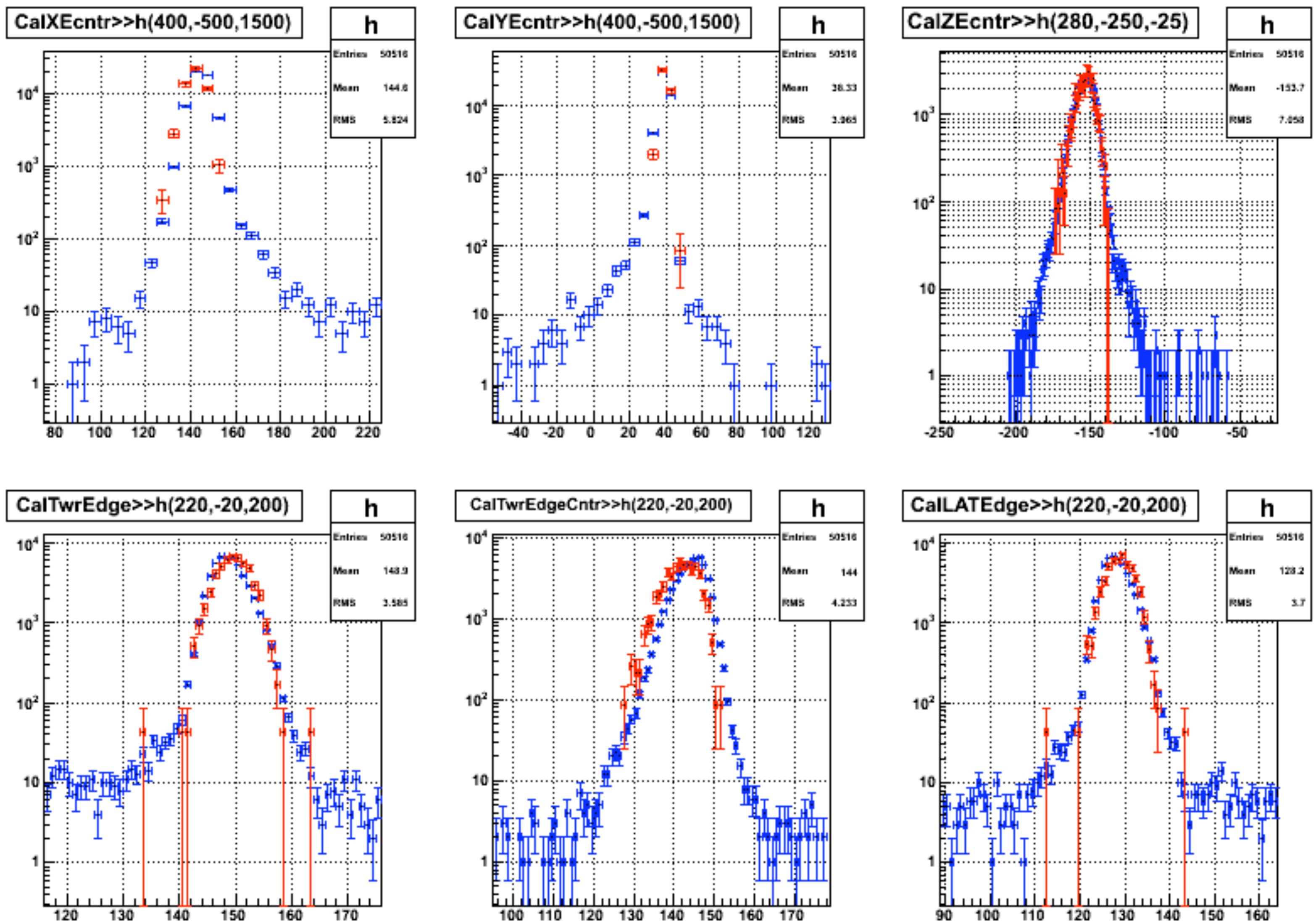
Data run 700001999

E = 100 GeV , 30 deg MC in red; Data in blue



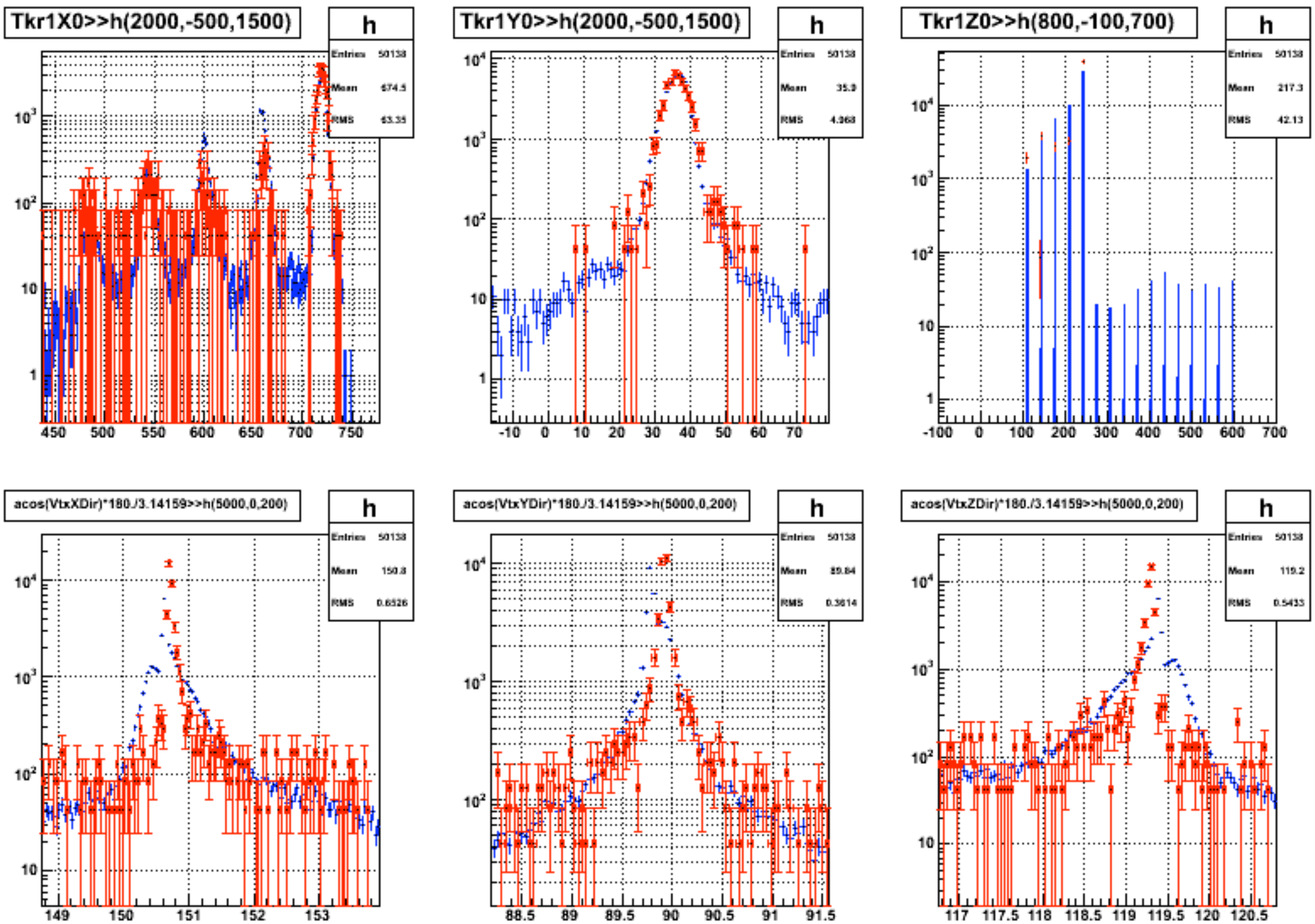
Data run 700001999

E = 100 GeV , 30 deg **MC in red**; **Data in blue**



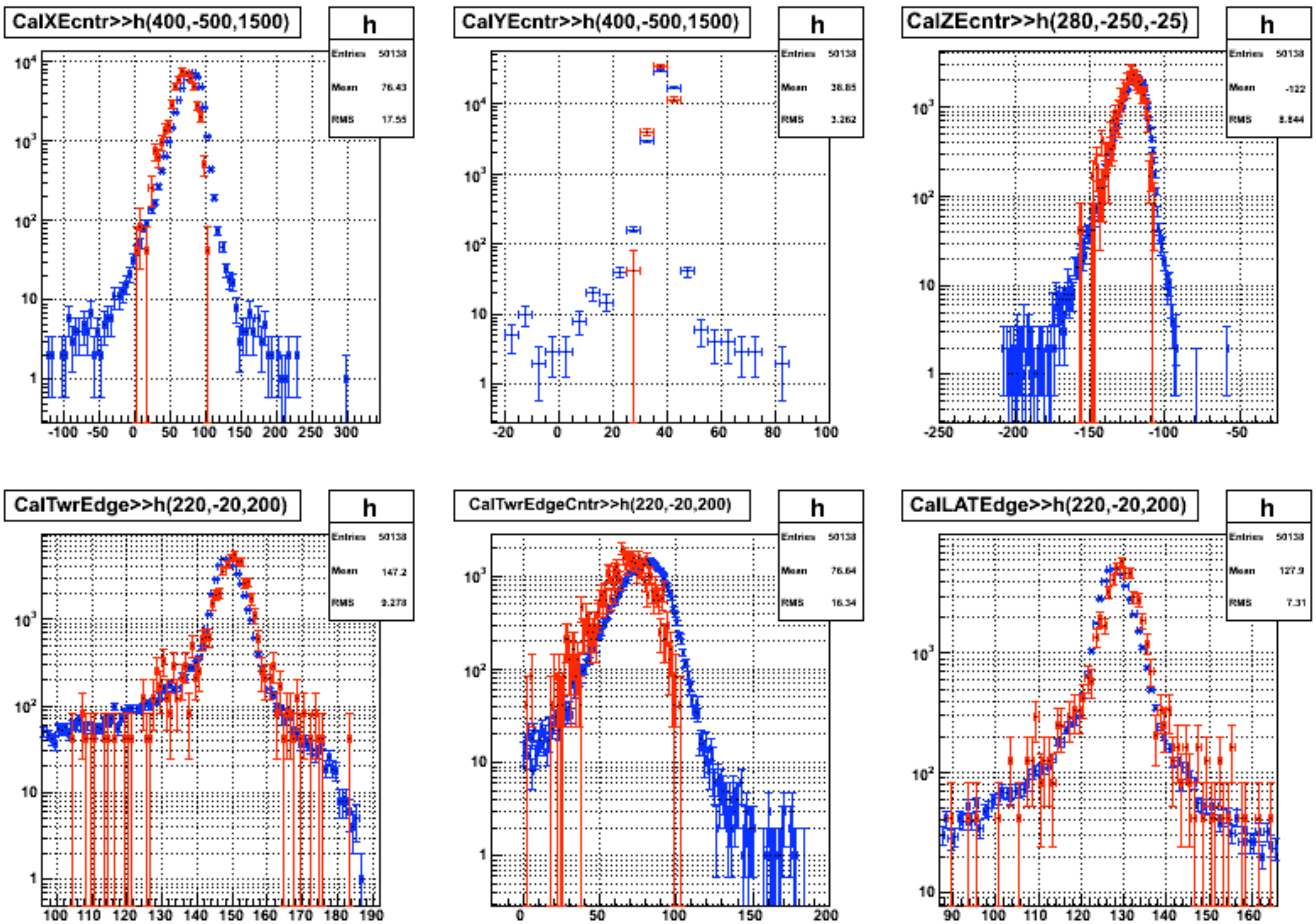
Data run 700002006

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



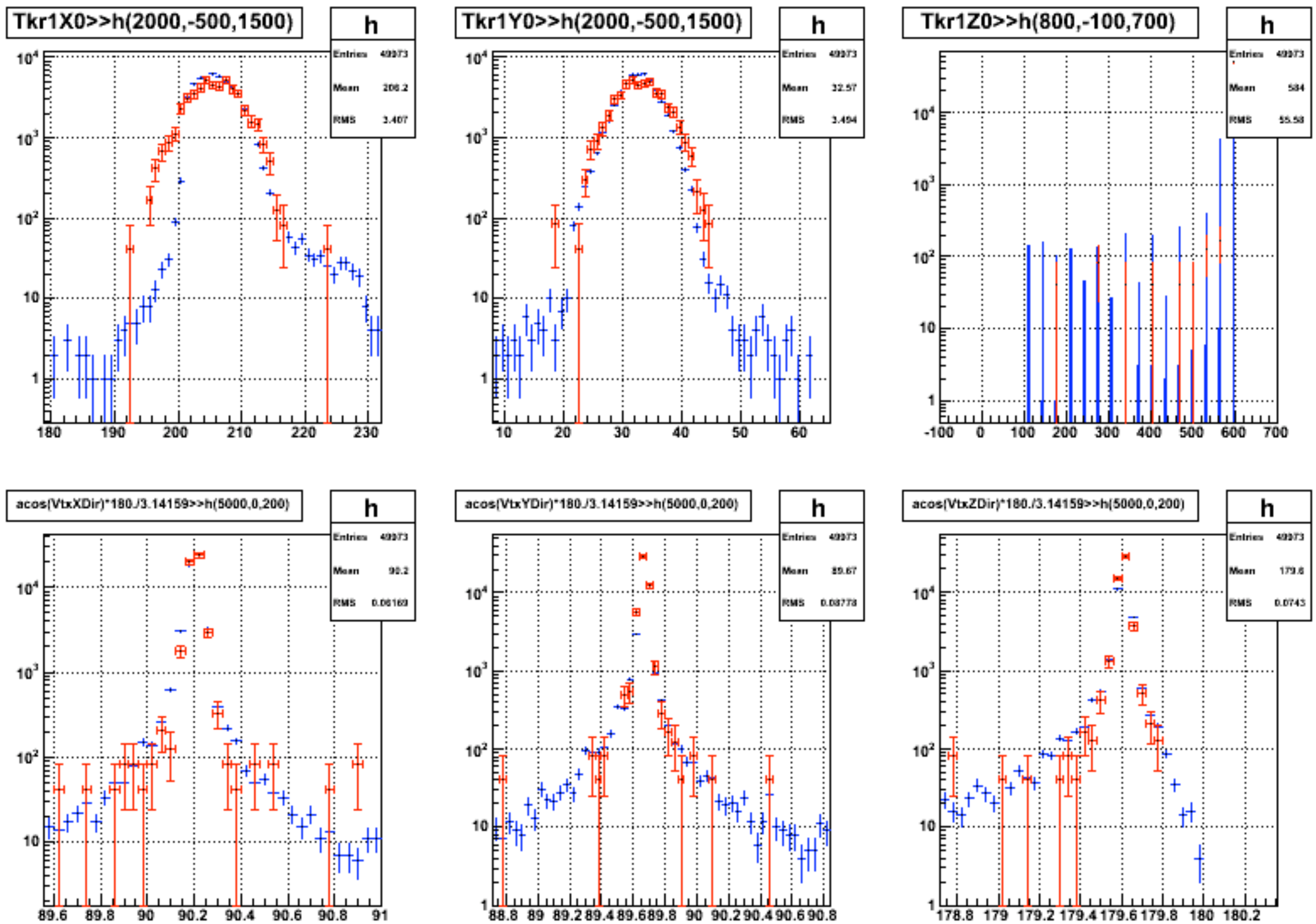
Data run 700002006

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



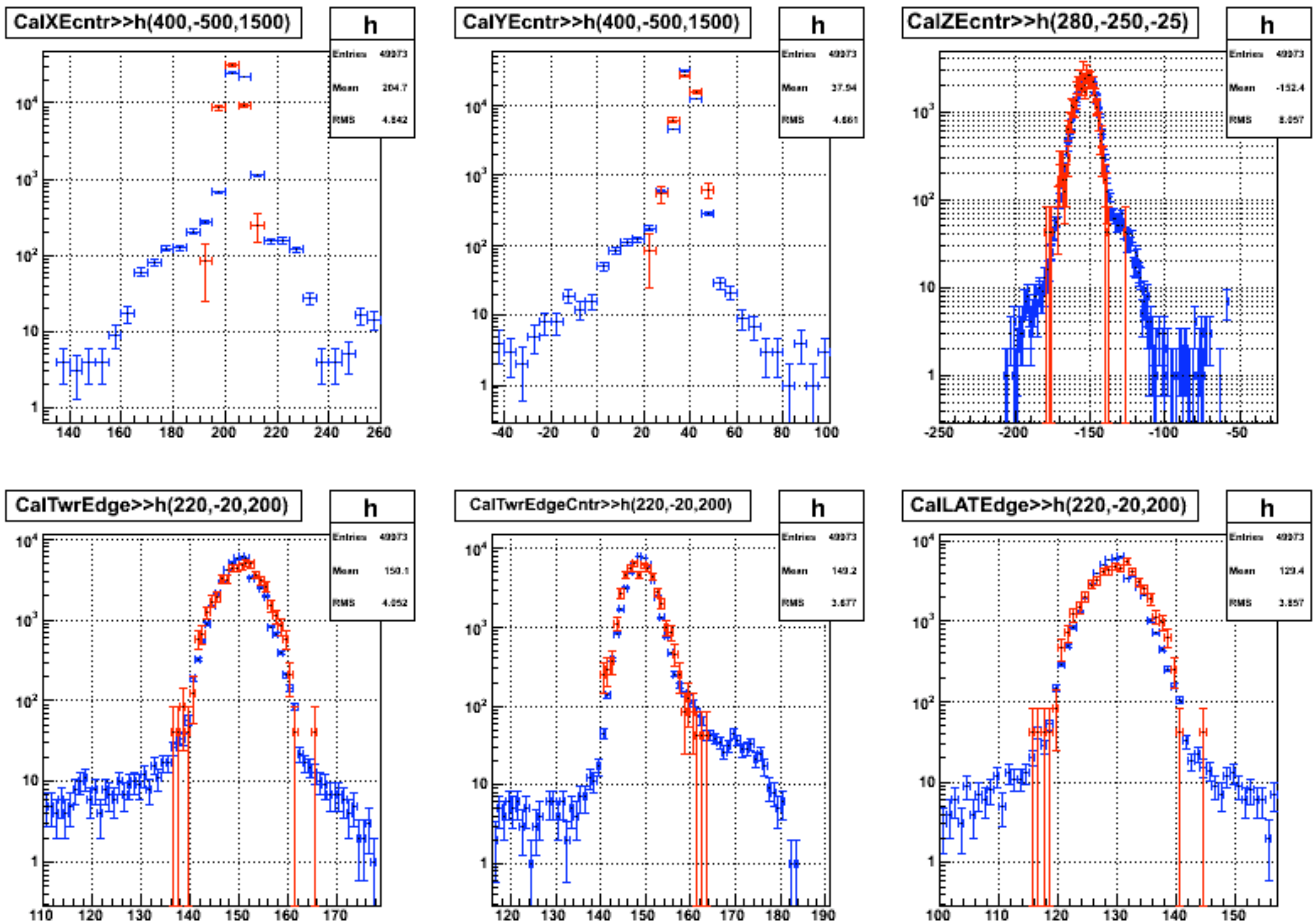
Data run 700002039

E = 50 GeV , 0 deg **MC in red**; **Data in blue**



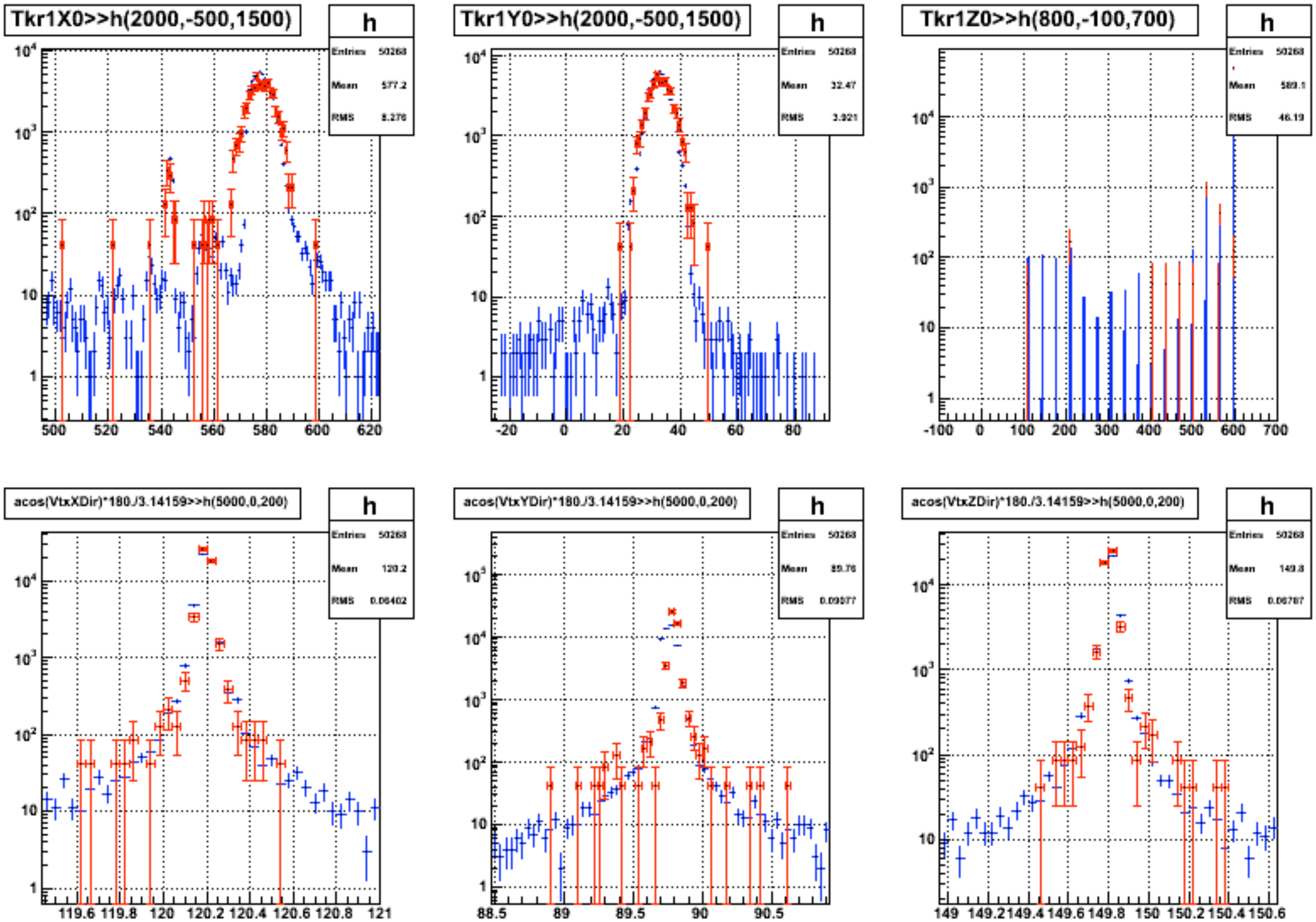
Data run 700002039

E = 50 GeV , 0 deg **MC in red**; **Data in blue**



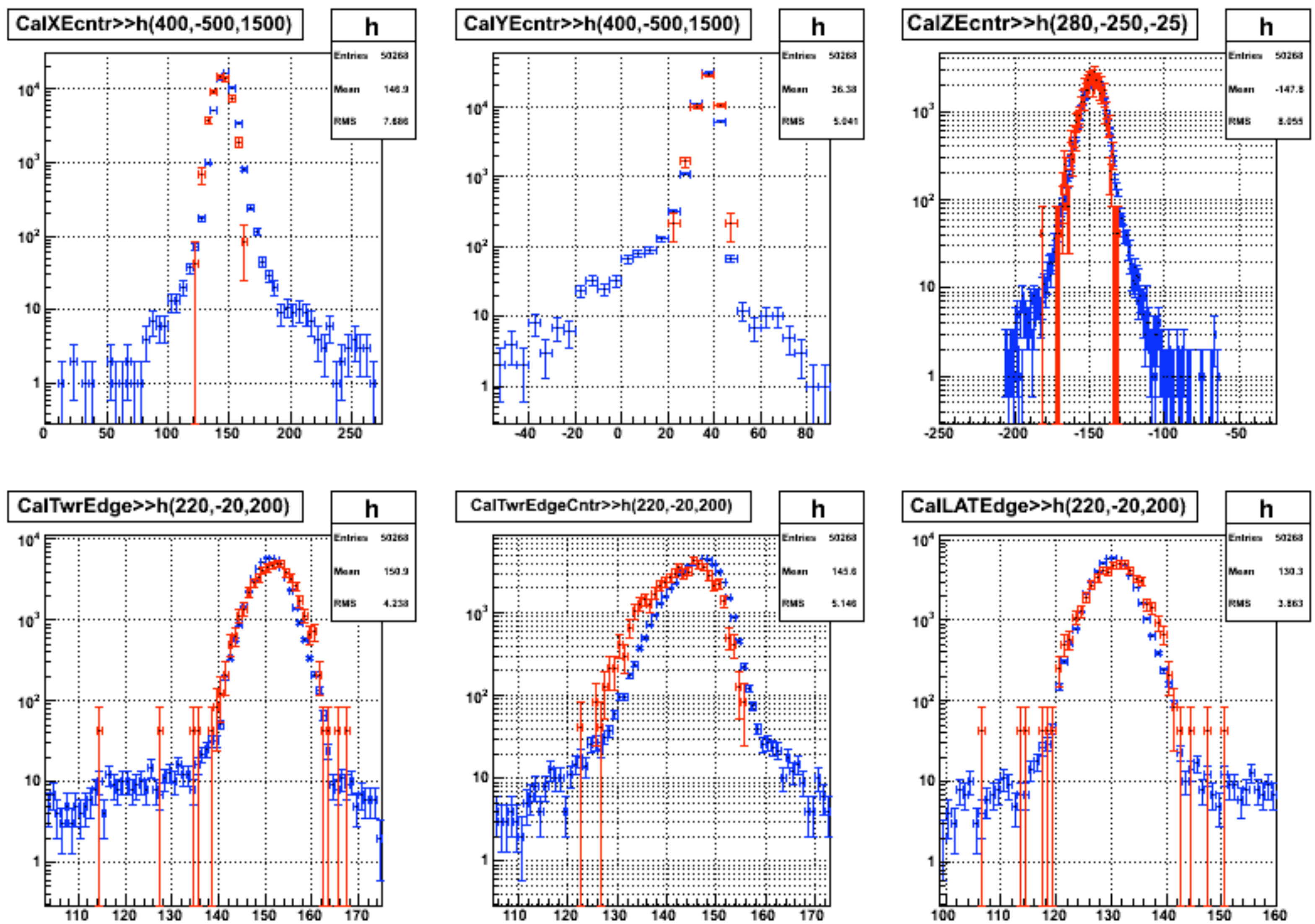
Data run 700002054

E = 50 GeV , 30 deg **MC in red**; **Data in blue**



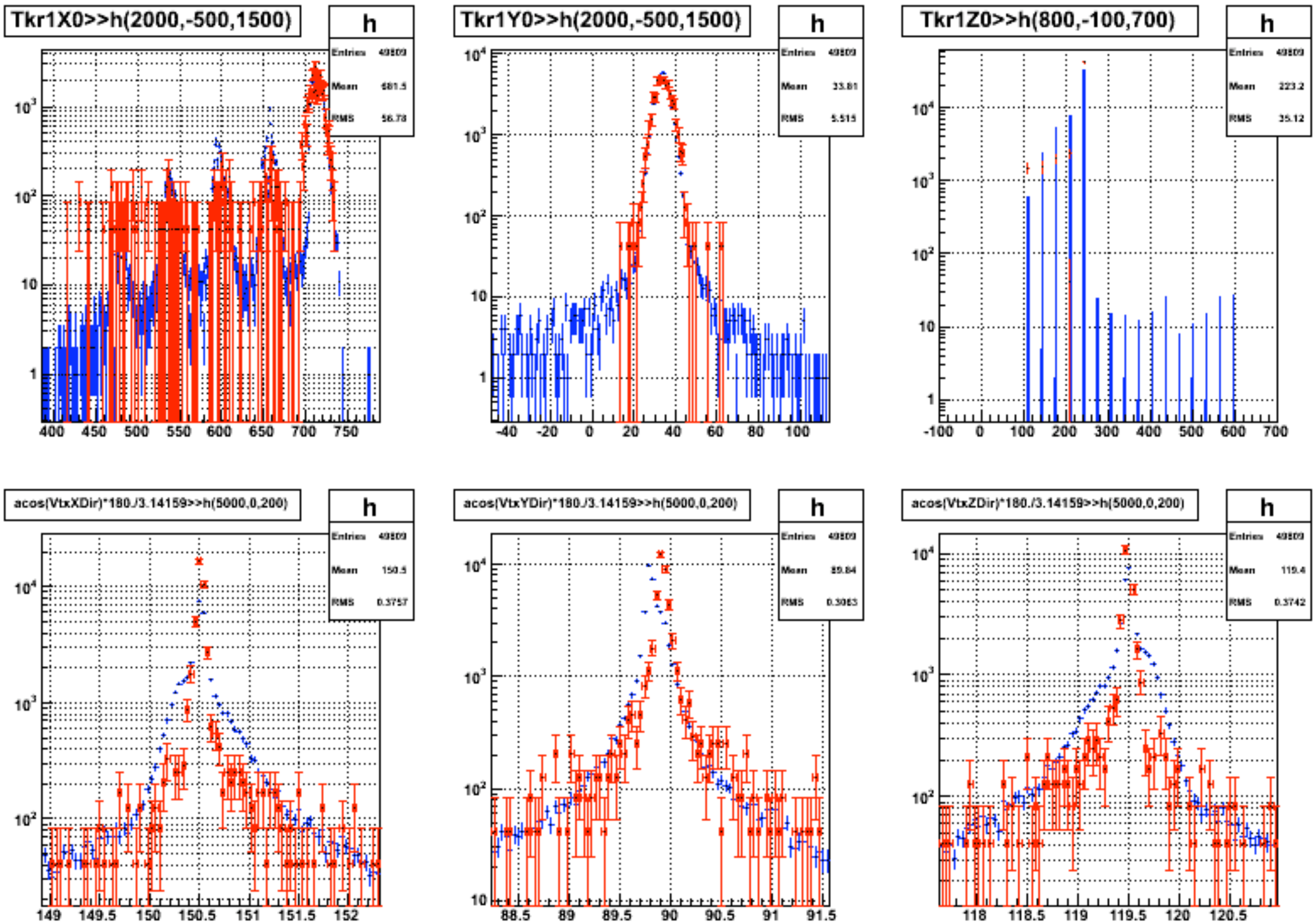
Data run 700002054

E = 50 GeV , 30 deg **MC in red**; **Data in blue**



Data run 700002064

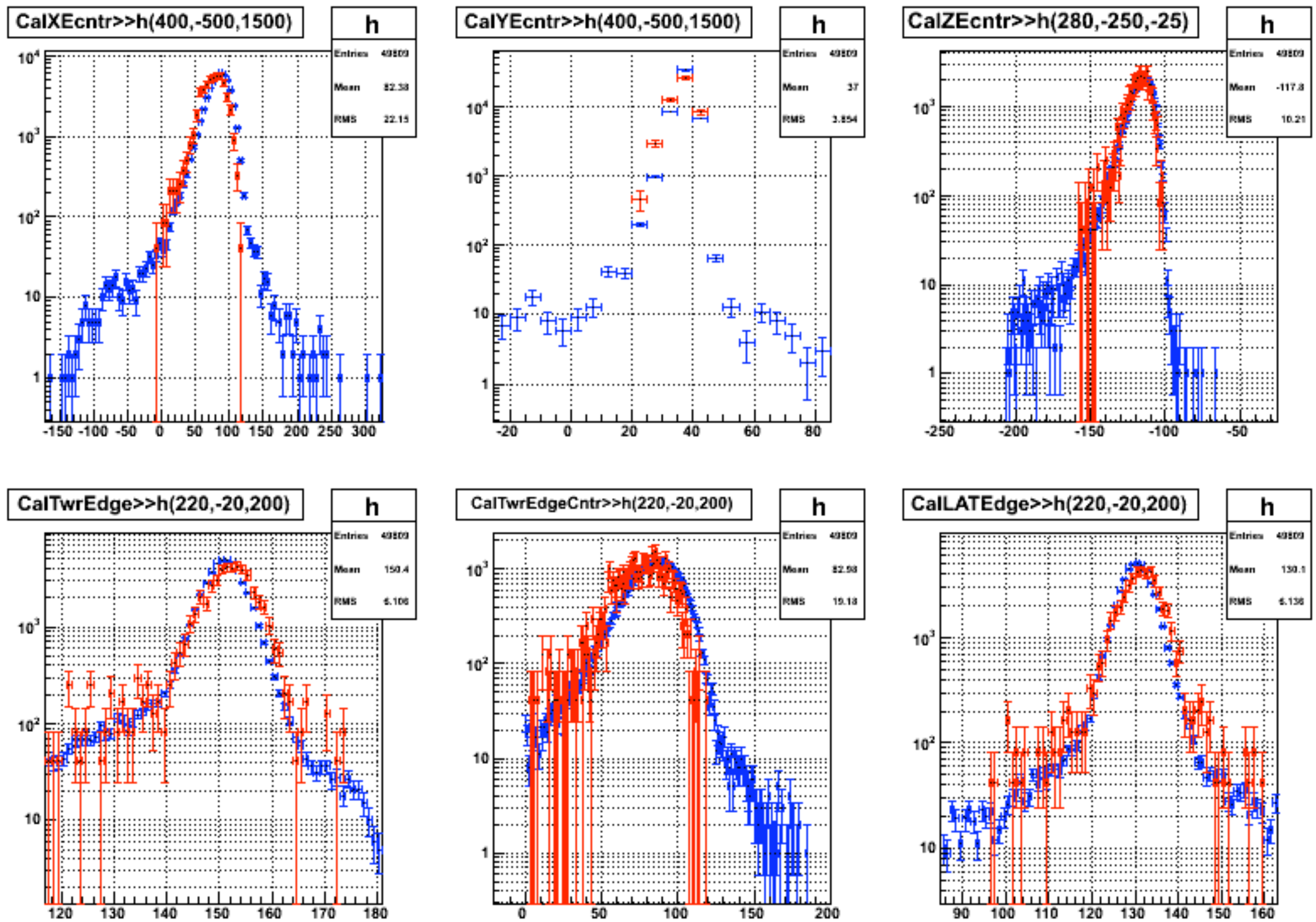
E = 50 GeV , 60 deg **MC in red**; **Data in blue**



Data run 700002064

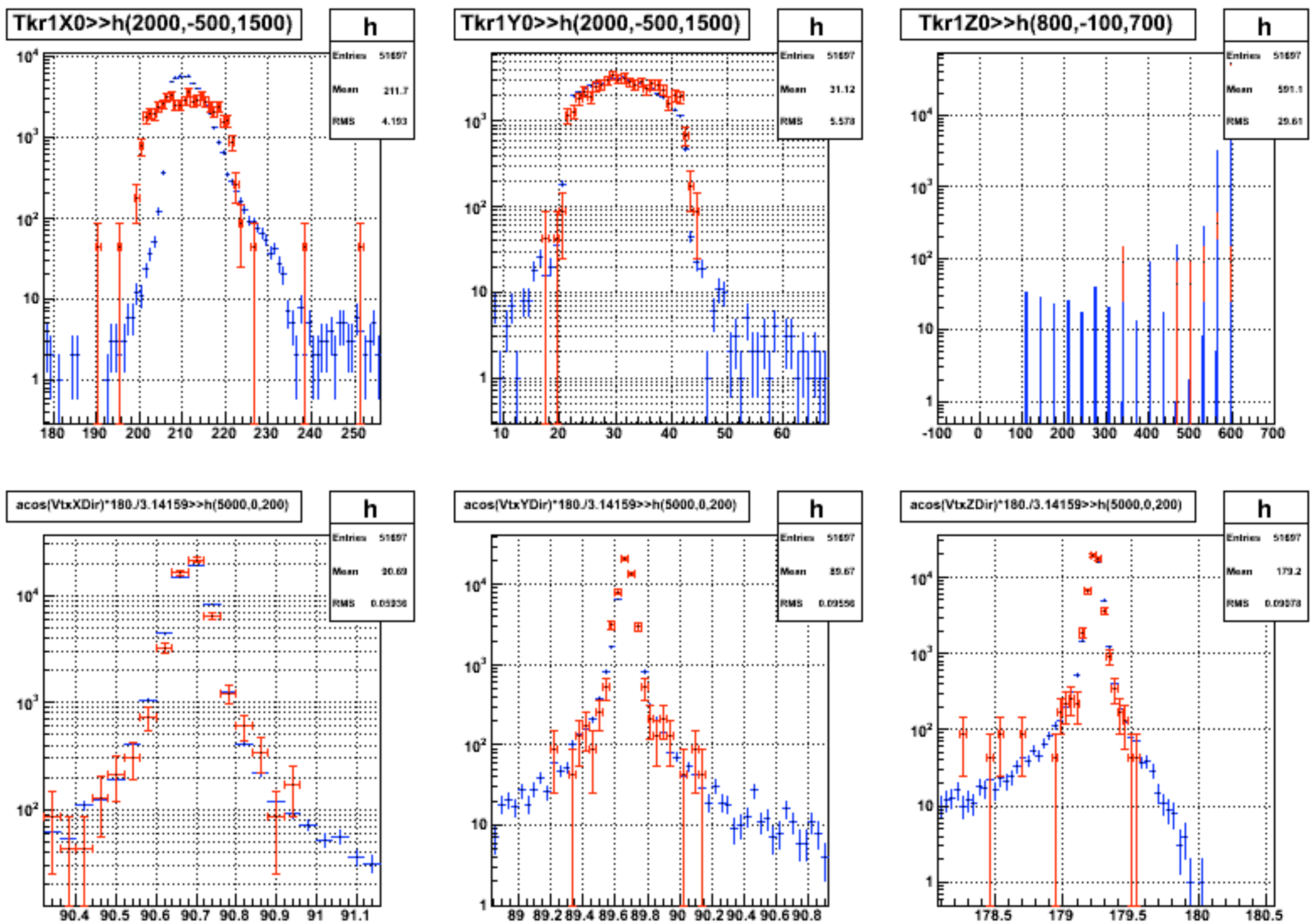
E = 50 GeV , 60 deg

MC in red; **Data in blue**



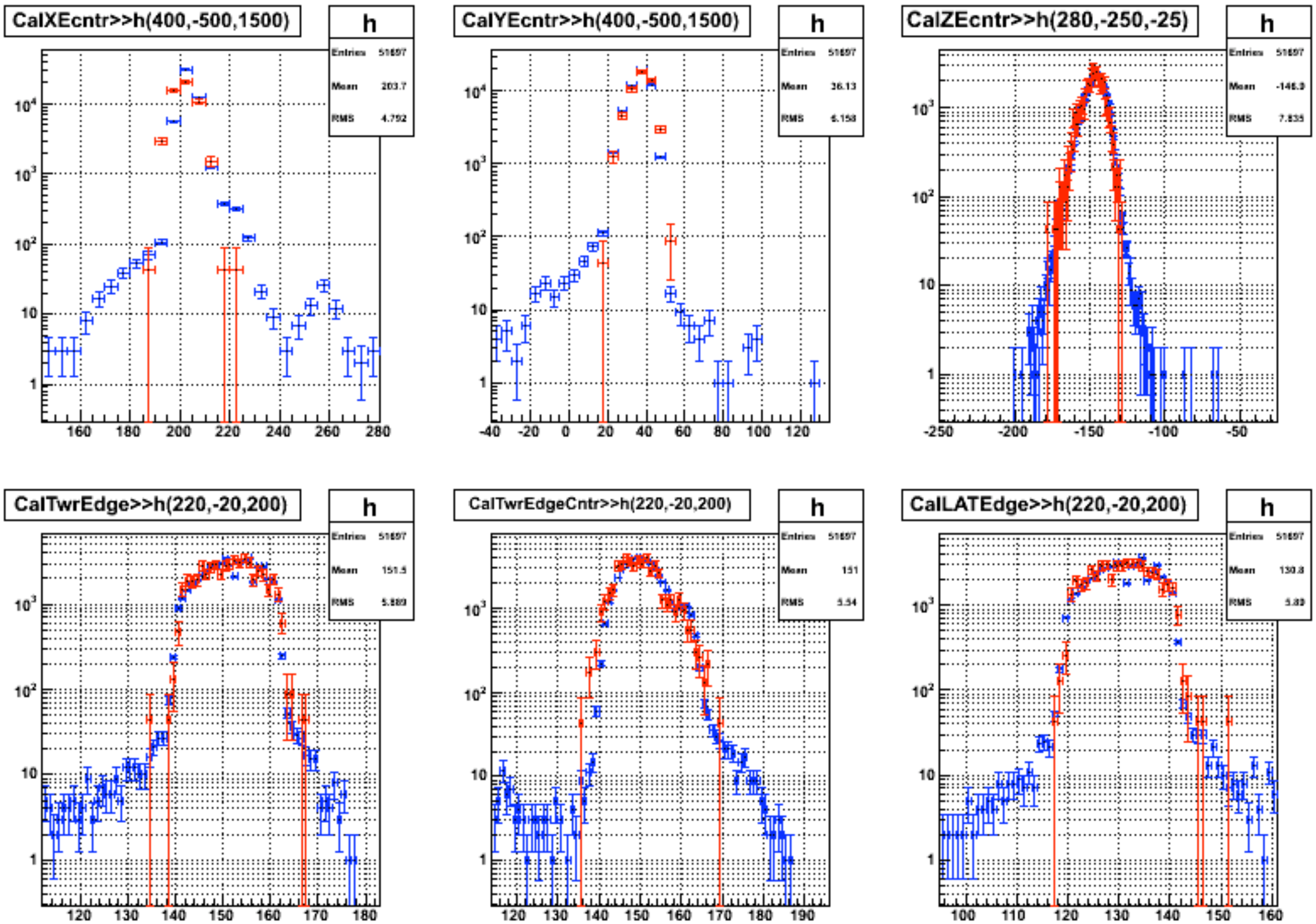
Data run 700002082

E = 20 GeV , 0 deg   MC in red; Data in blue



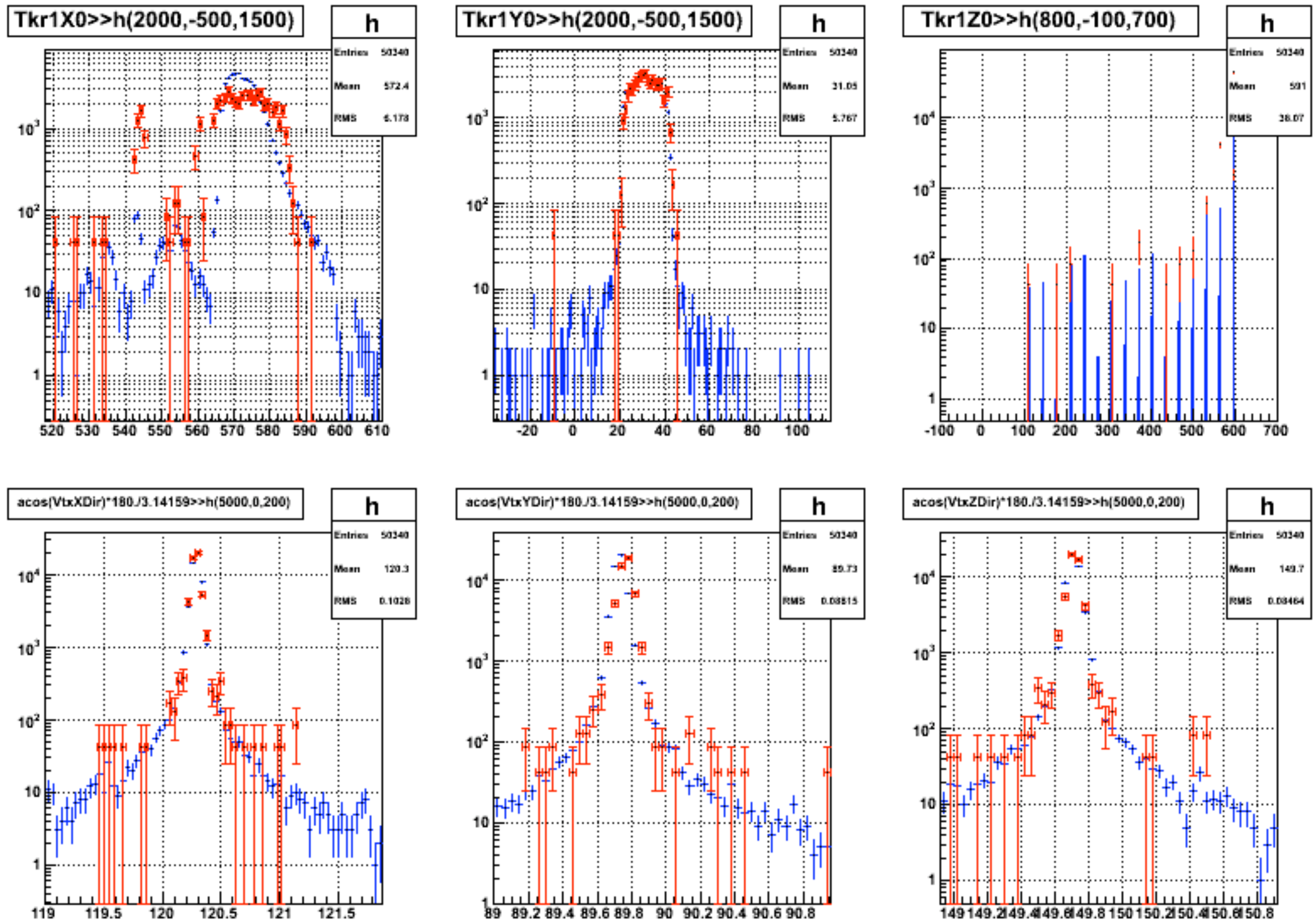
Data run 700002082

E = 20 GeV , 0 deg **MC in red**; **Data in blue**



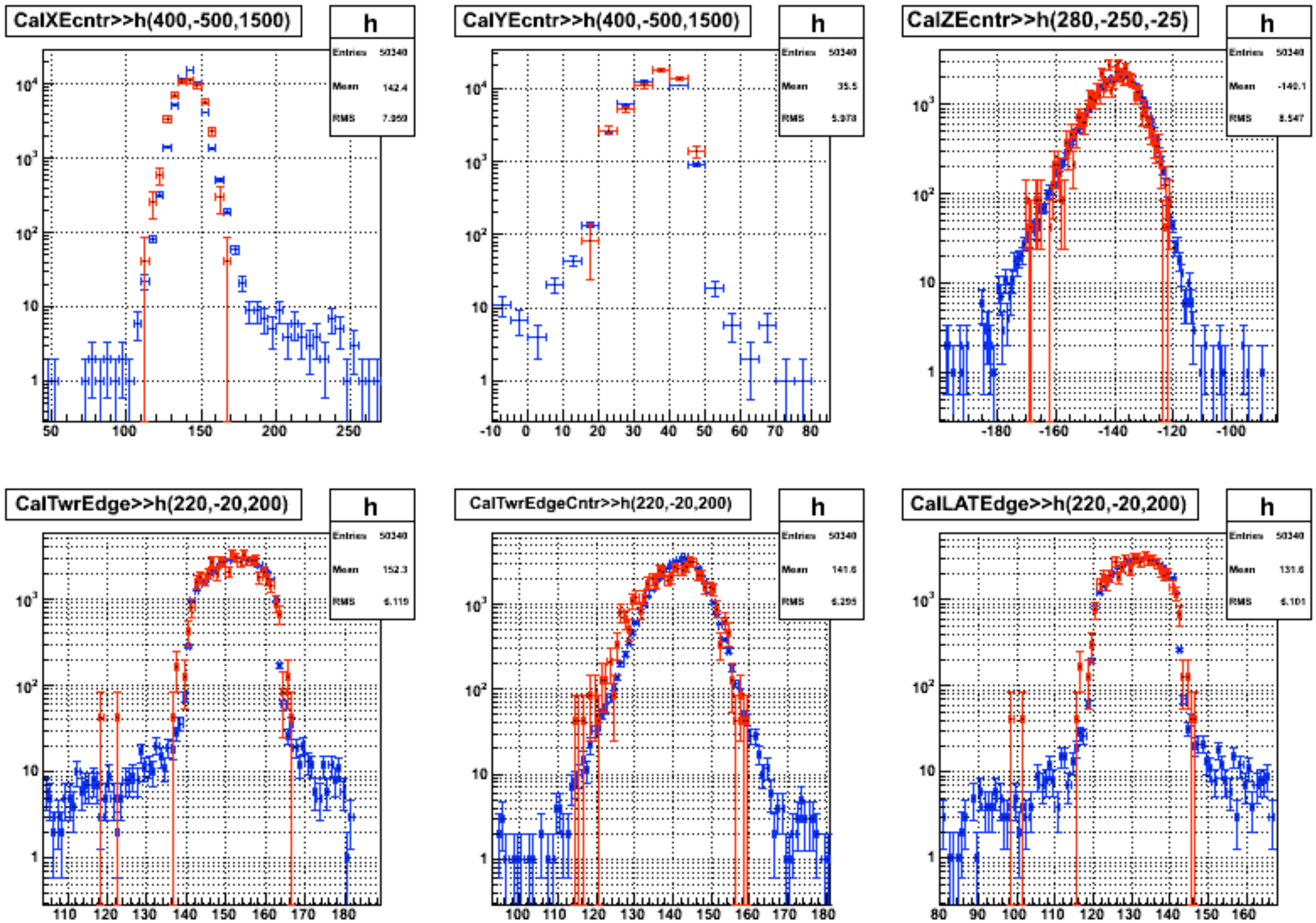
Data run 700002096

E = 20 GeV , 30 deg MC in red; Data in blue



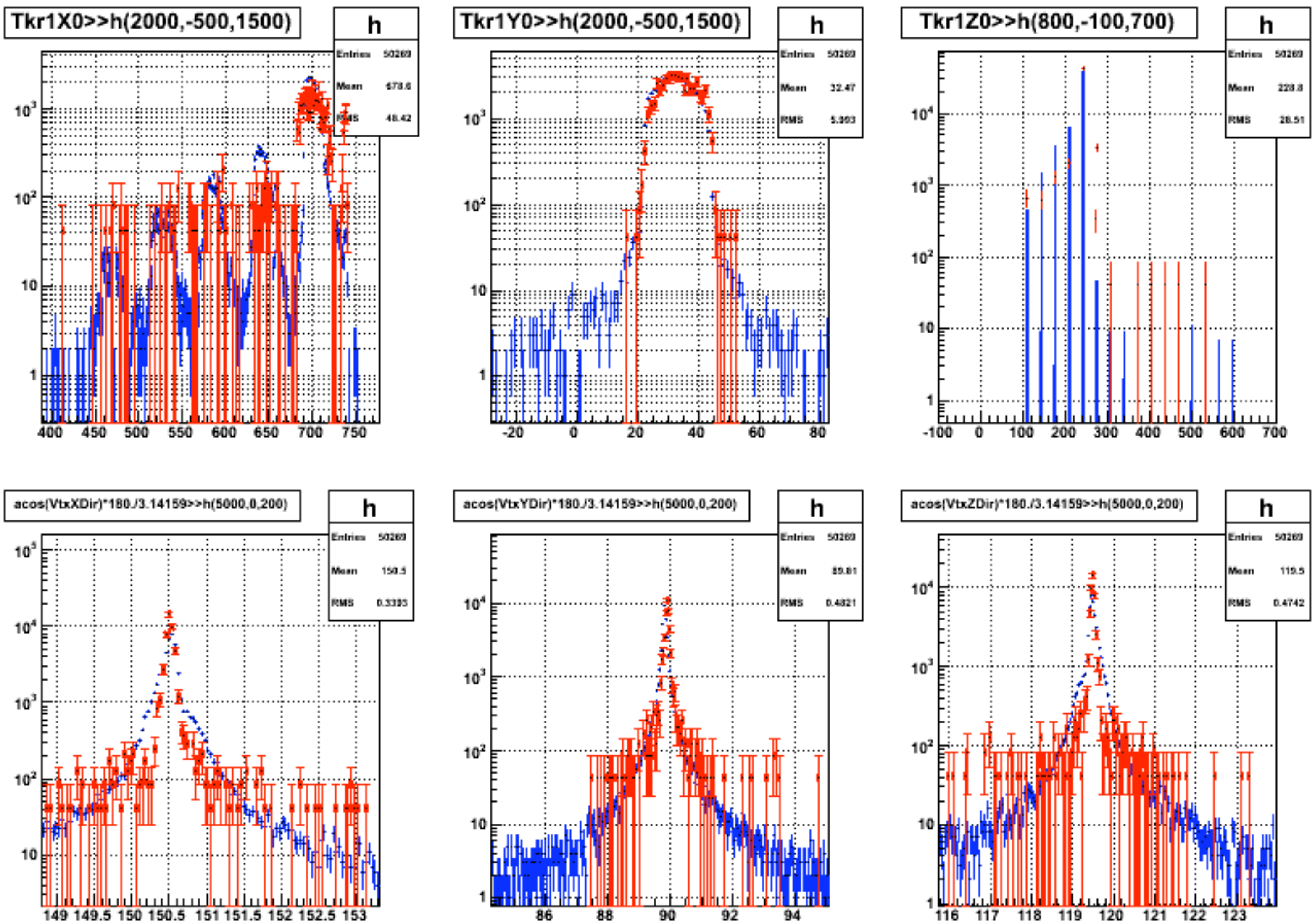
Data run 700002096

E = 20 GeV , 30 deg **MC in red**; **Data in blue**



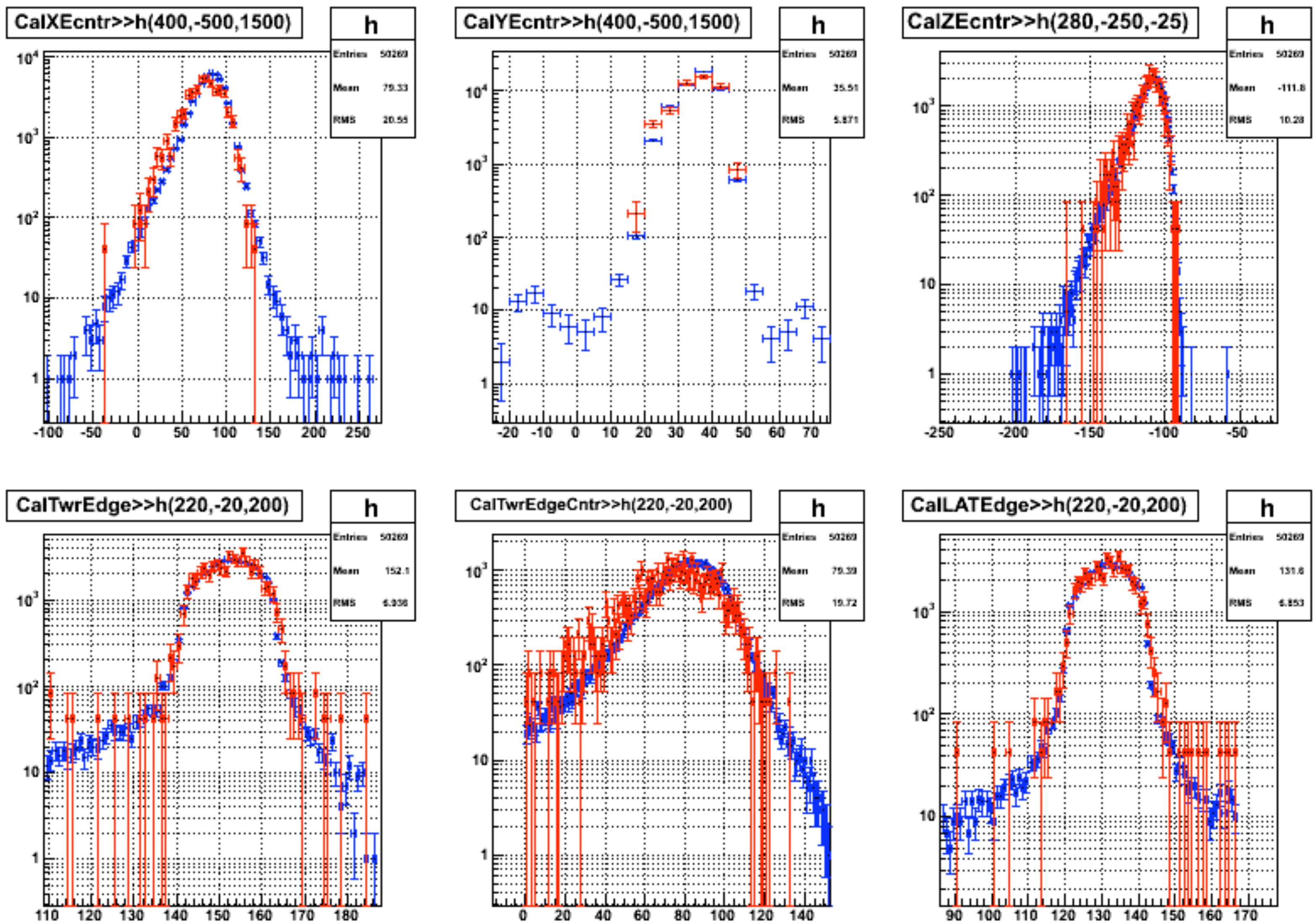
Data run 700002103

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



Data run 700002103

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



Comparison of parameter TkrTotalHits (Merit tuple)

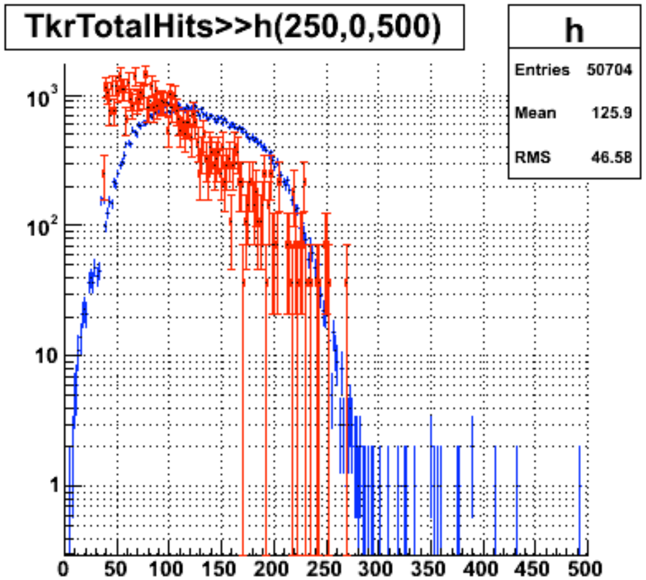
TkrTotalHits: Number of clusters inside an energy- and angle-dependent cone centered on the reconstructed axis of the best track and starting at the head of track 1

Different to TkrTotalHits[tower] from SVAC, which is the Total number of strip hits in [tower].

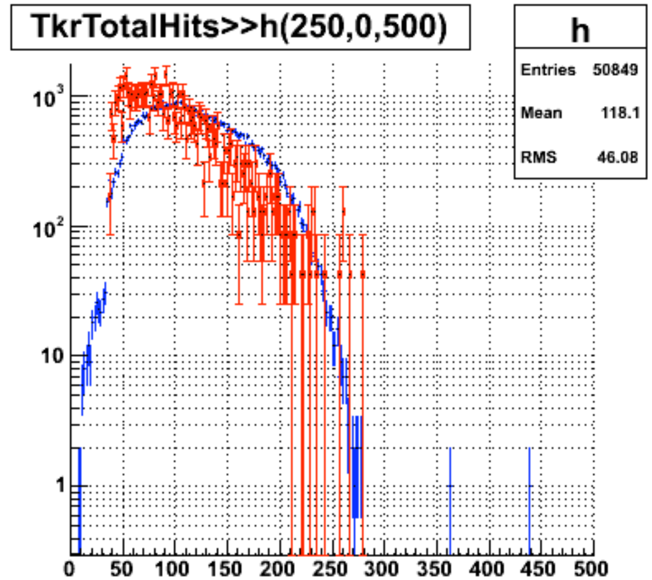
Incidence angle, 0 deg

MC in red; Data in blue

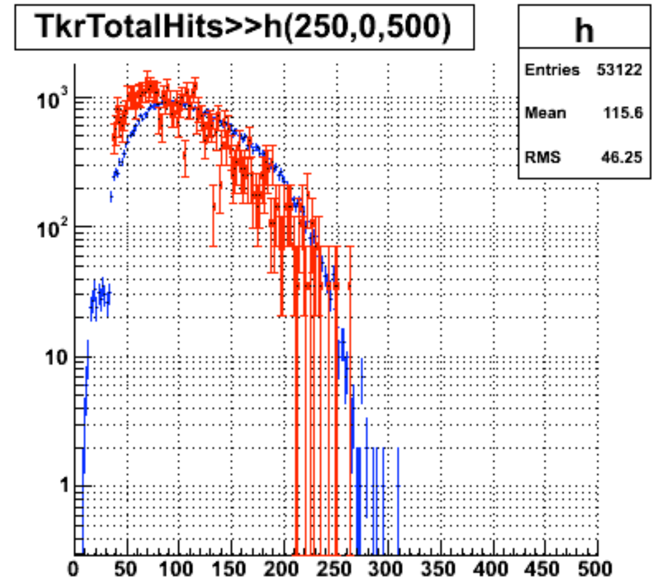
E = 282 GeV



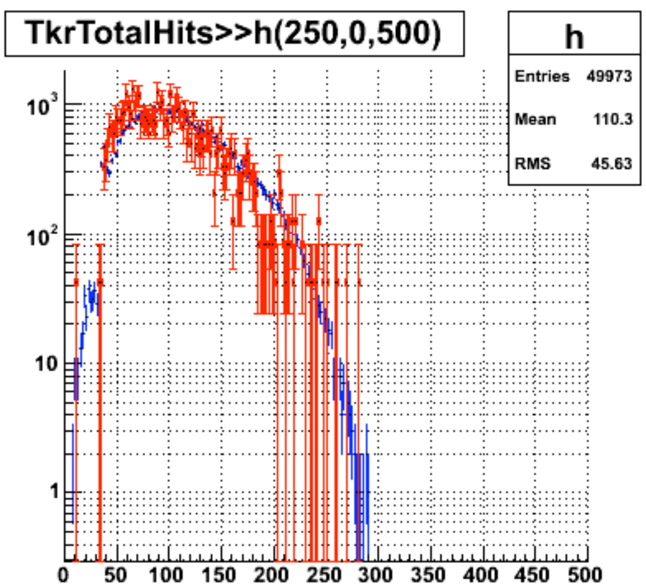
E = 200 GeV



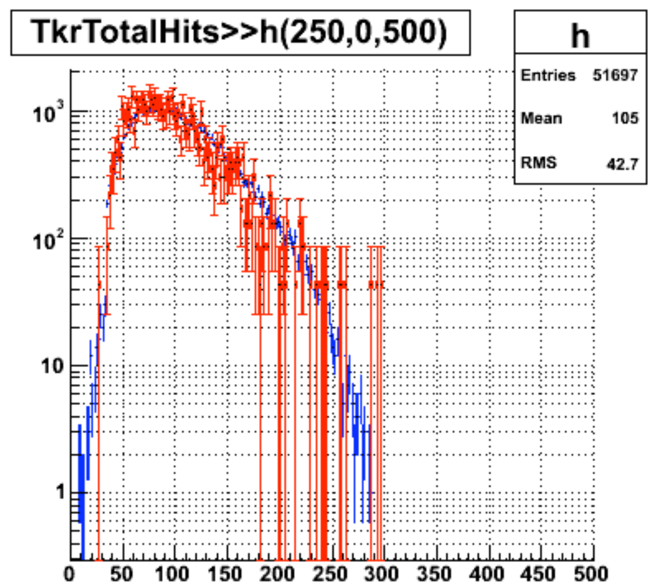
E = 100 GeV



E = 50 GeV



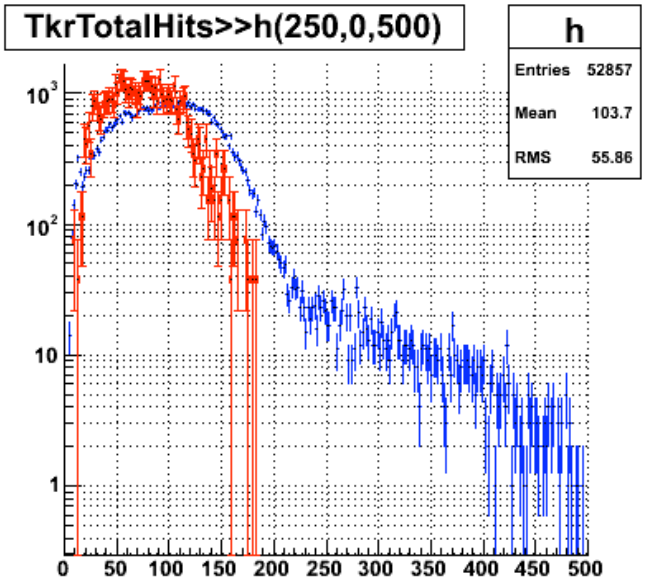
E = 20 GeV



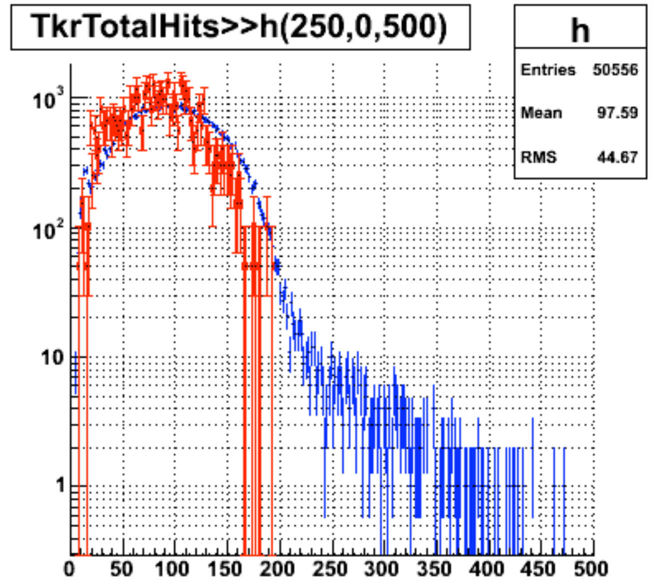
Incidence angle, 60 deg

MC in red; Data in blue

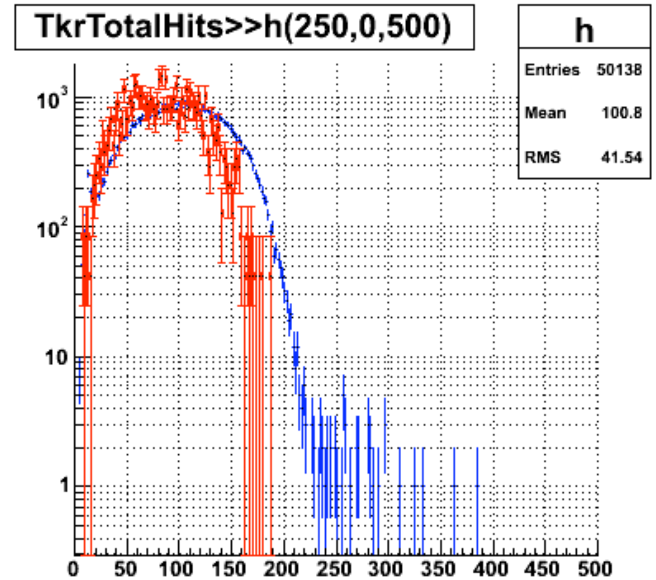
E = 282 GeV



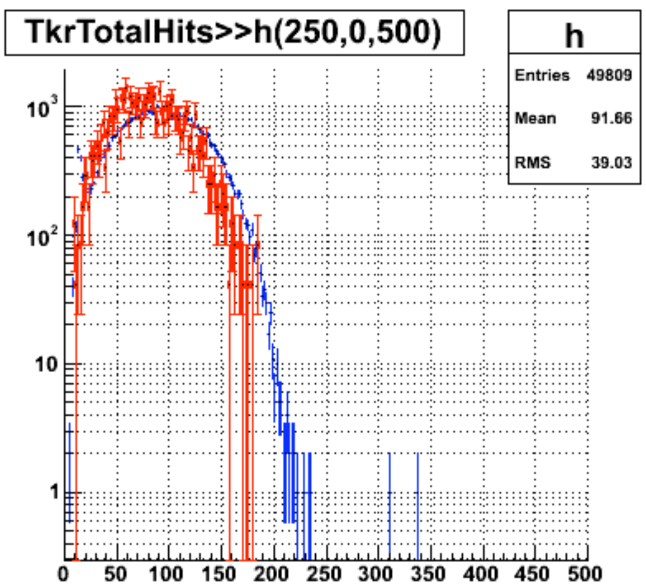
E = 200 GeV



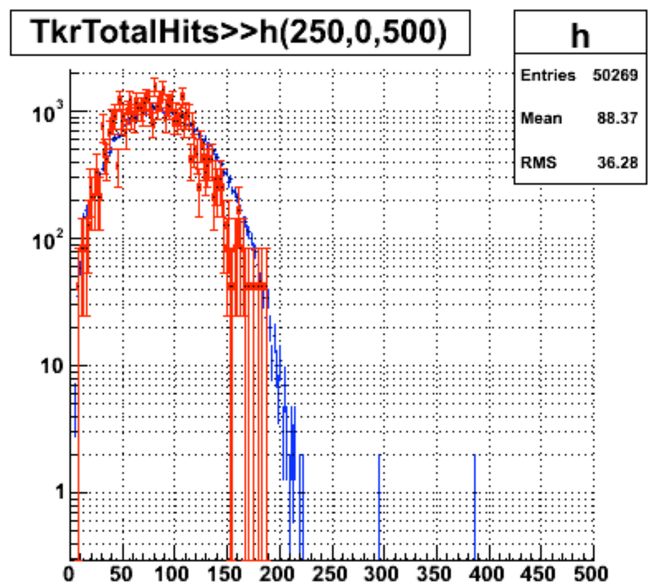
E = 100 GeV



E = 50 GeV



E = 20 GeV



Agreement is rather good at 20 GeV, but it worsens at as the initial electron energy increases.

Therefore, at high energies, besides having more hits, we also have more clusters in the data with respect to the MC.

The situation seems to be different for muons (Bijan) and protons (Johan), where the number of clusters between data and mc agree rather well (but not the number of hits)

Conclusions

Proper estimation of parameters to be used in the config files for beam simulation can improve the agreement data-mc

Configuration files (with beam characteristics) for several (characteristic) SPS runs were provided to Francesco.

As soon as he generates MC through the pipeline (~50000 evts) I will perform the comparison data-mc in the “so-called CTB variables”