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

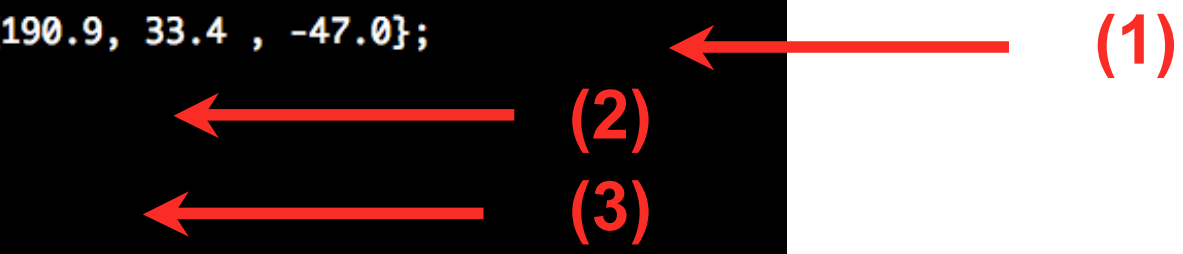
beamtest06

Gleam

2 - Data-MC comparisons of of beam profile for 700002082

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) 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):

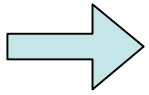
GlastRelease v9r25

+ G4Generator v5r17p2gr0

+ TkrDigi v2r6

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

Tkr1XDir = - 0.870415443
Tkr1YDir = + 0.0033201057



Table_rotation = + 60.51
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 good… 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")*

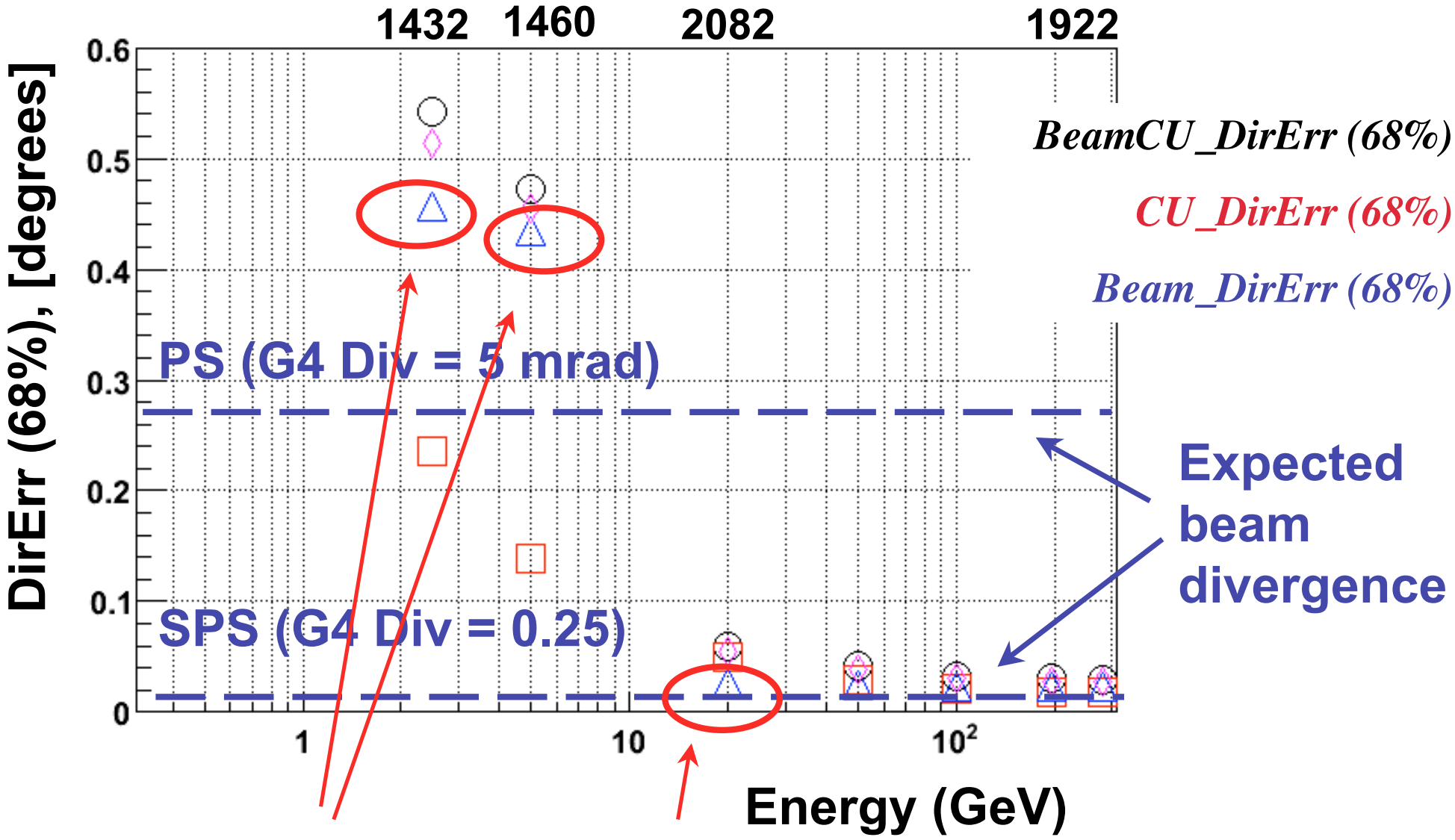
$$Cos(CU_DirErr) = McXDir * Tkr1XDir + McYDir* Tkr1YDir + McZDir* Tkr1ZDir$$

CU Resolution (True PSF)

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

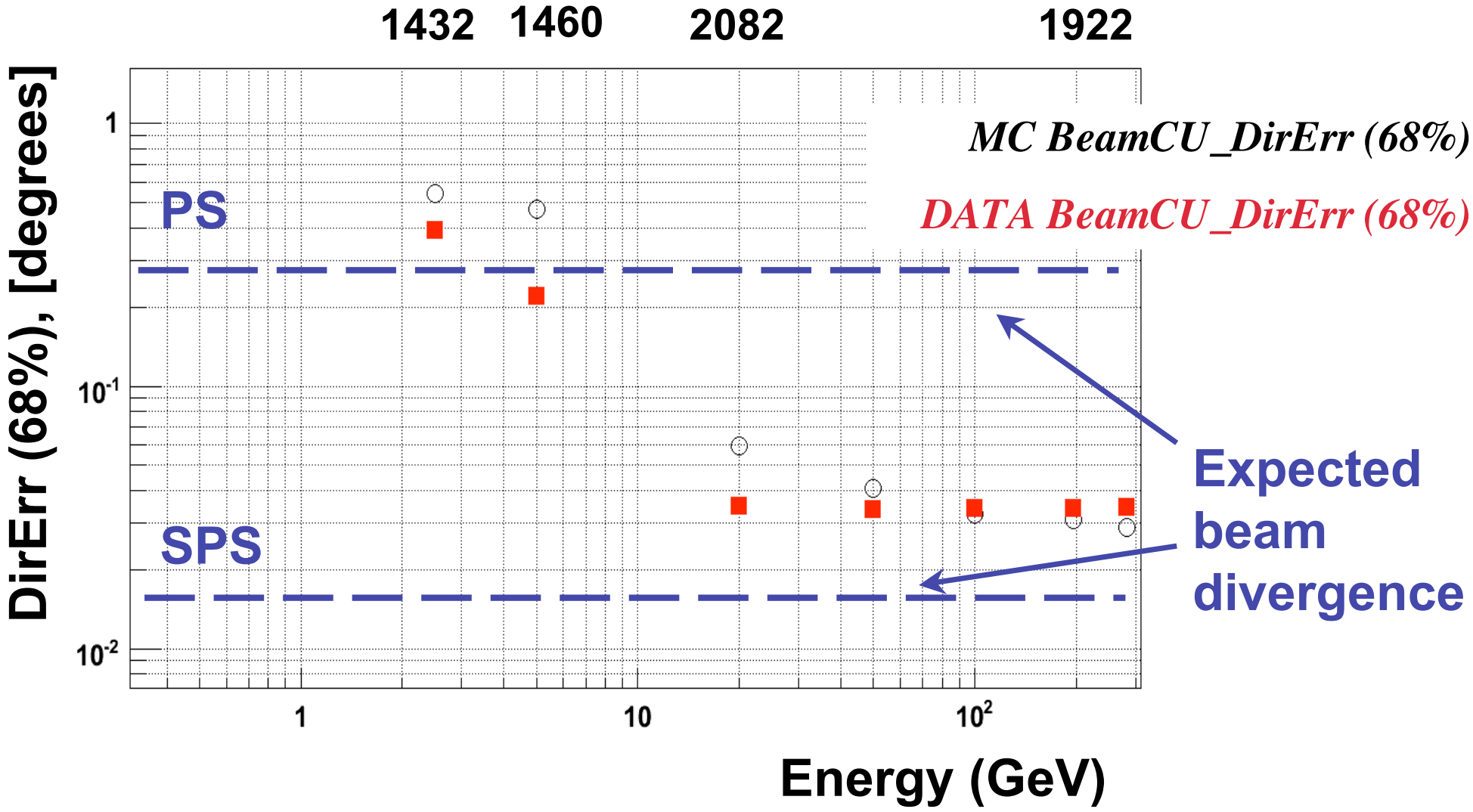
Beam Divergence

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



Beam divergence in the "merit file" is higher than the one set in the G4 config file: unresolved issue

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



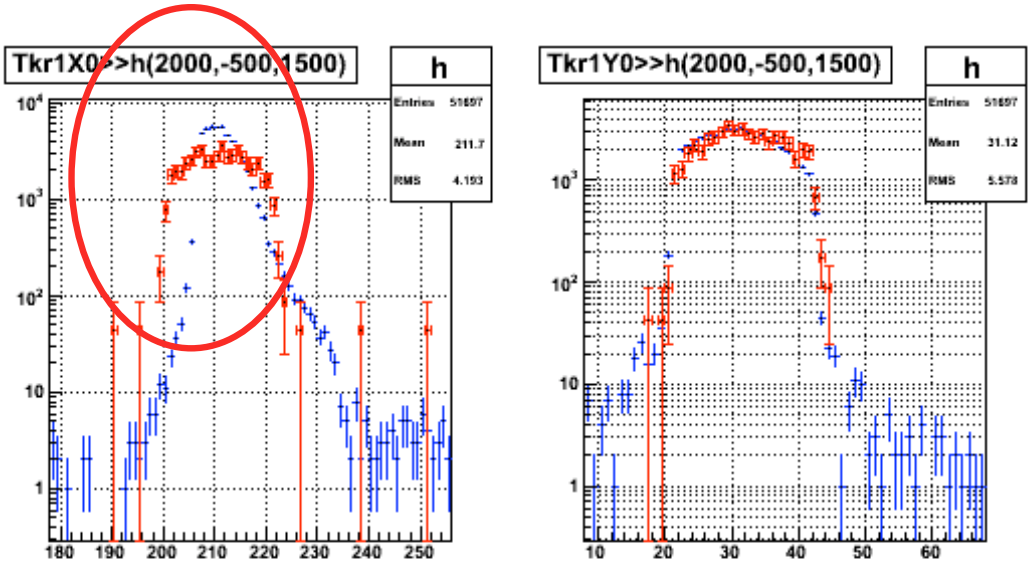
Below 100 GeV, Data has a lower BeamCU_DirErr than MC

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 decided to 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.

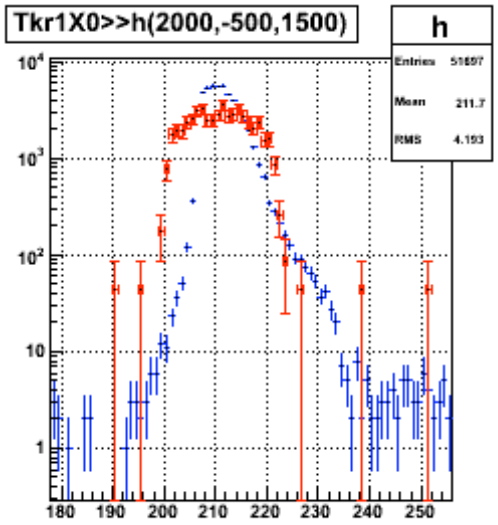
More sophisticated cuts (e.j. removing events crossing cracks, removing MIPs…) which might improve the agreement data-mc are NOT applied. These additional cuts must be applied with care, since they might also bias the comparison if not carefully done

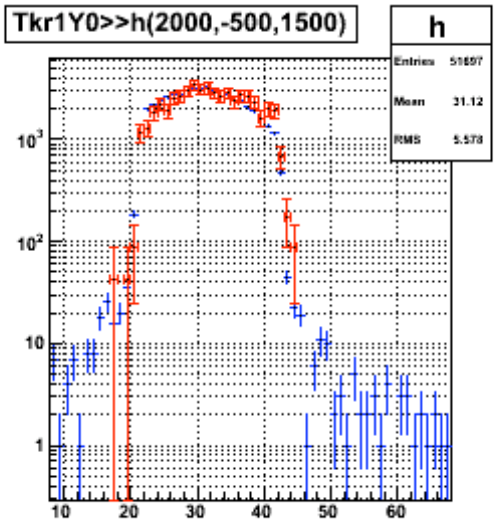
Comparison of profile between Data run 2082 and Custom MC run

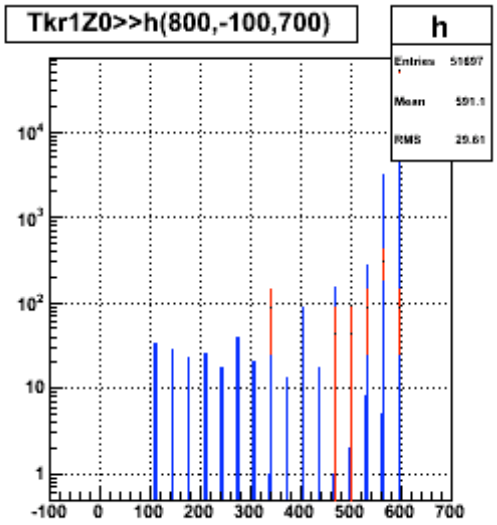
Data run 700002082

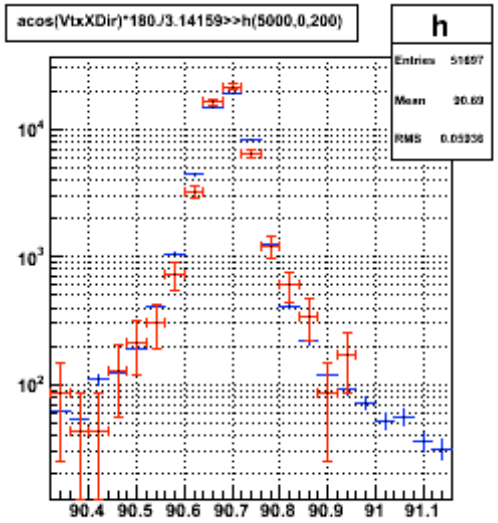
E = 20 GeV , 0 deg

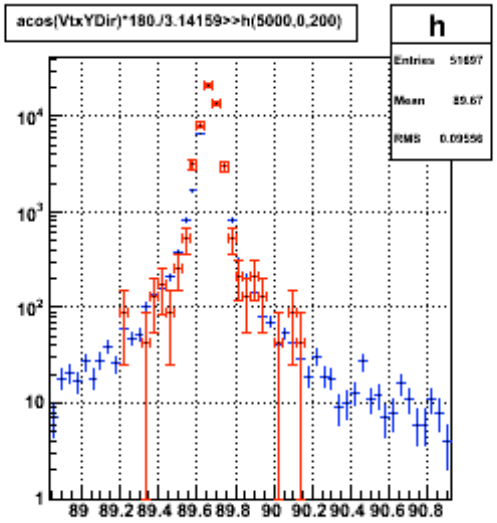
MC in red; **Data in blue**

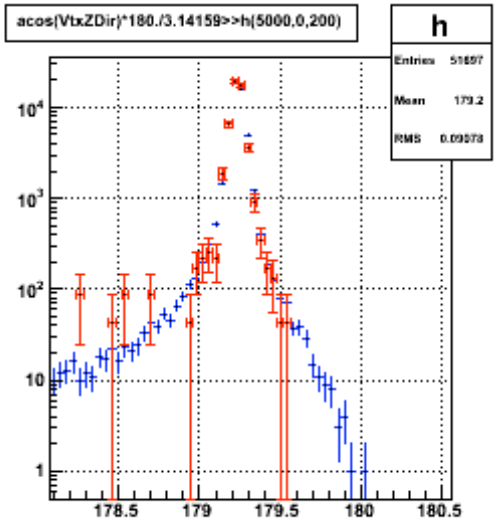






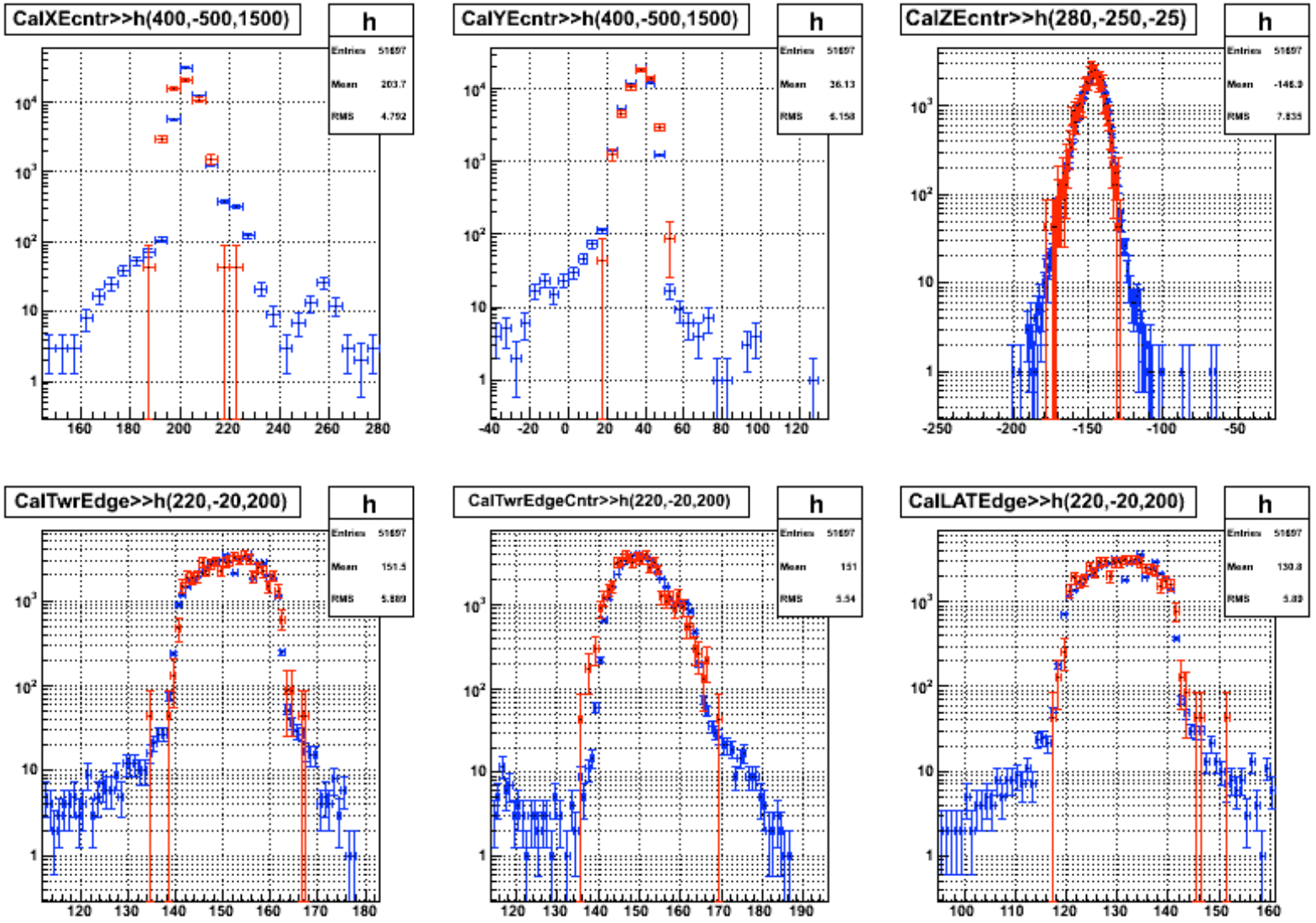






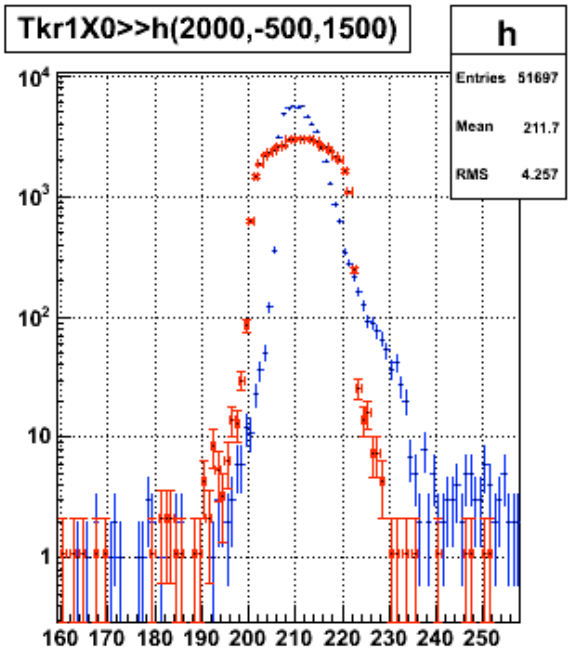
Data run 700002082

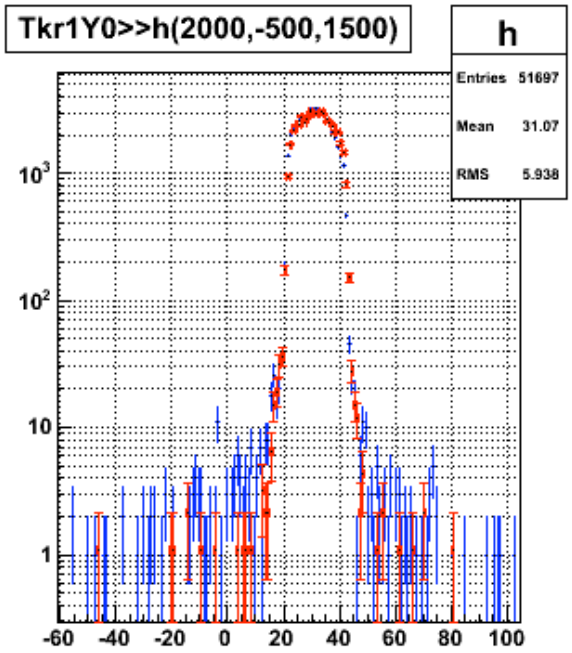
E = 20 GeV , 0 deg **MC in red**; **Data in blue**

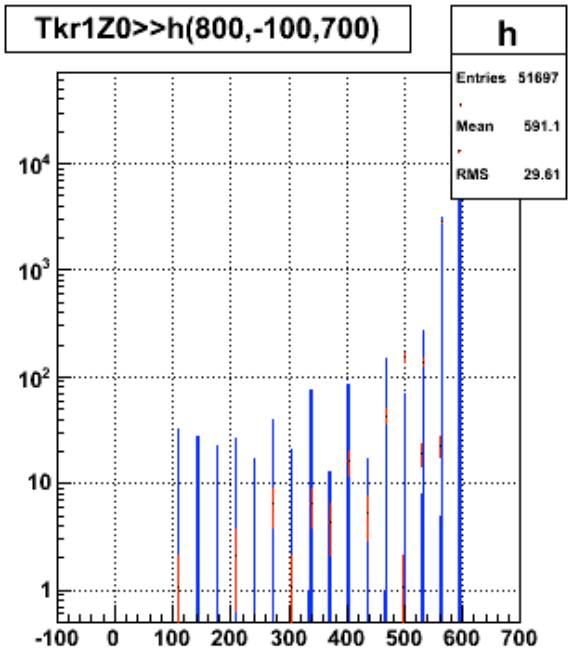


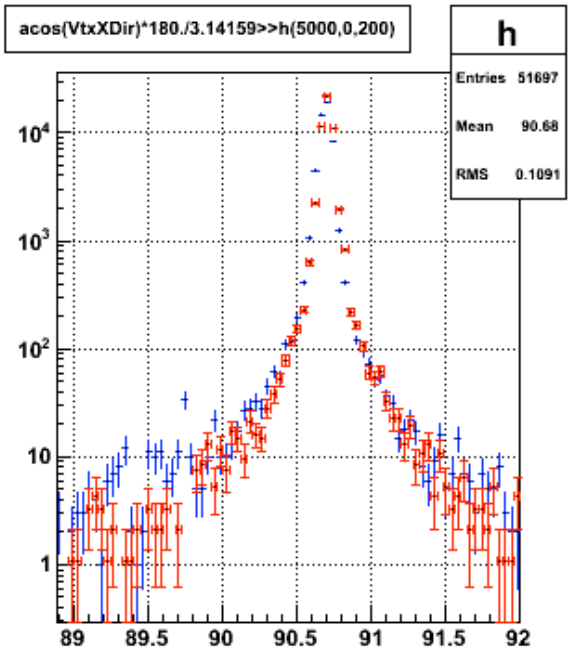
Johan produced MC data with the beam profile parameters estimated from the data

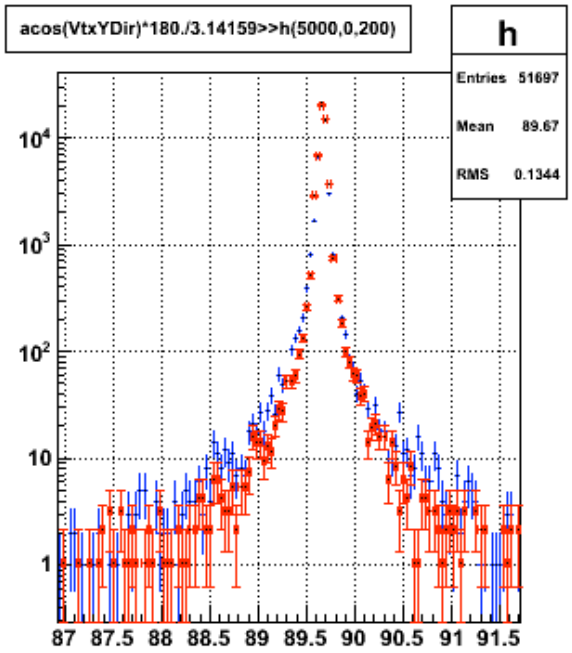
MC runs from June 2007

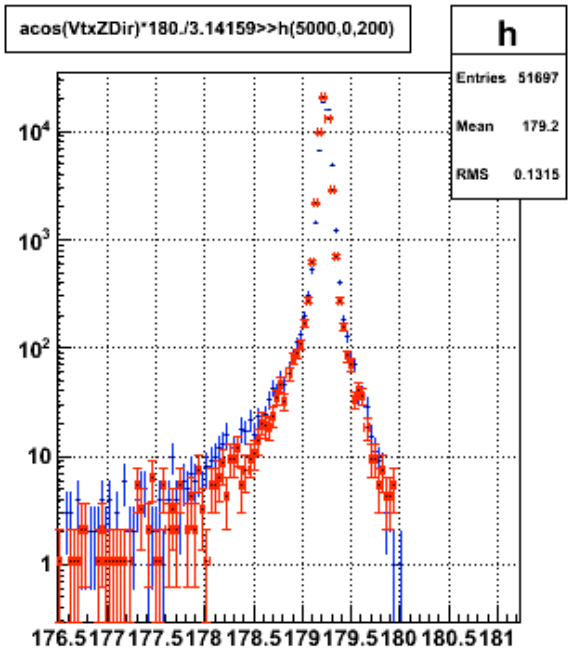

Tkr1X0>>h(2000,-500,1500)
h
Entries 51697
Mean 211.7
RMS 4.257


Tkr1Y0>>h(2000,-500,1500)
h
Entries 51697
Mean 31.07
RMS 5.938


Tkr1Z0>>h(800,-100,700)
h
Entries 51697
Mean 591.1
RMS 29.61

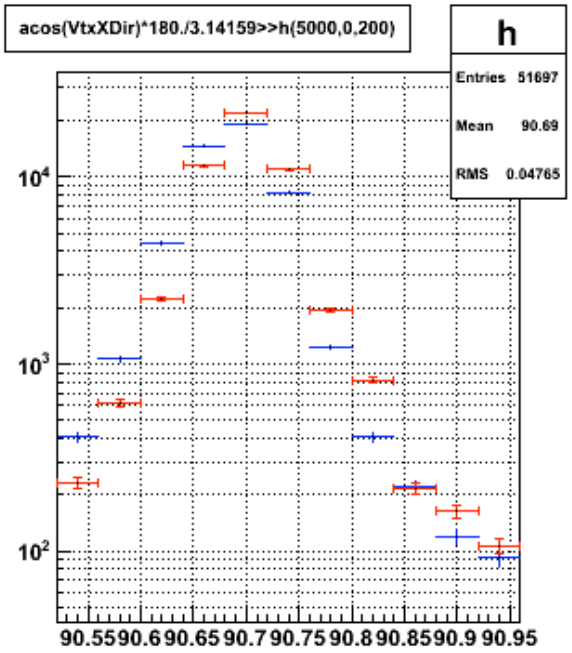

acos(VtxXDir)*180./3.14159>>h(5000,0,200)
h
Entries 51697
Mean 90.68
RMS 0.1091

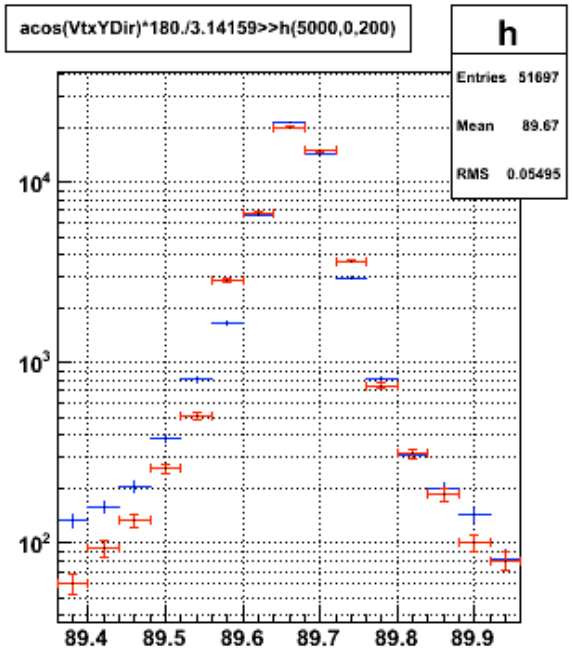

acos(VtxYDir)*180./3.14159>>h(5000,0,200)
h
Entries 51697
Mean 89.67
RMS 0.1344

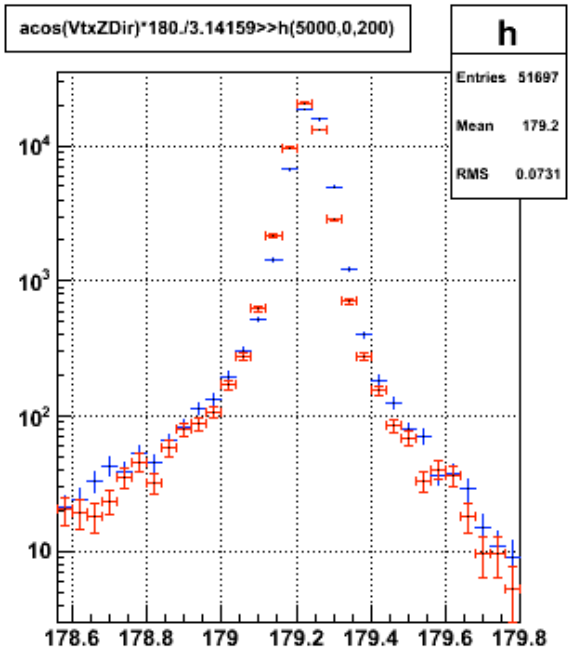

acos(VtxZDir)*180./3.14159>>h(5000,0,200)
h
Entries 51697
Mean 179.2
RMS 0.1315

Agreement in incoming directions is good, this is by construction…

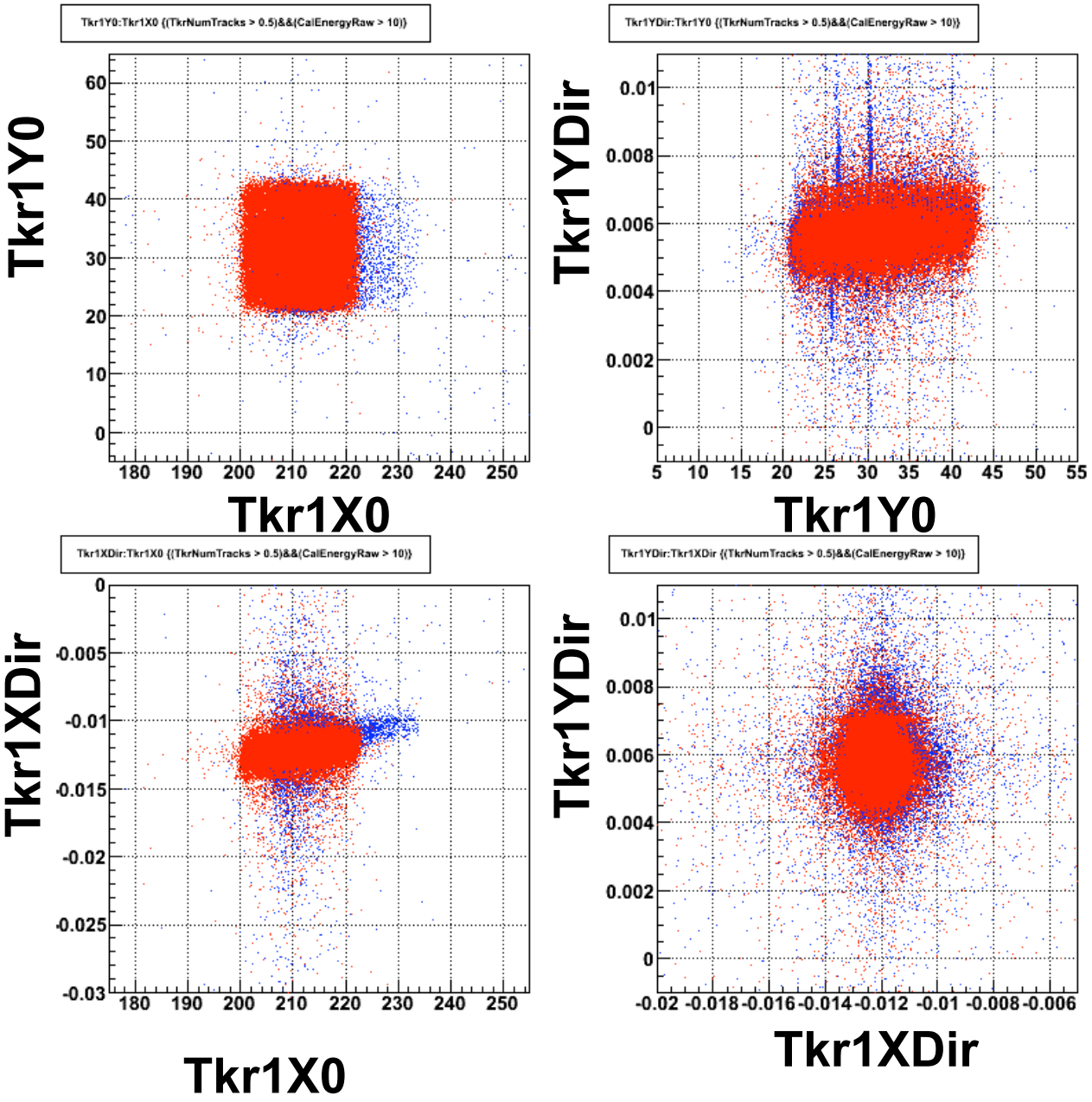
ZOOM on plots from previous slide







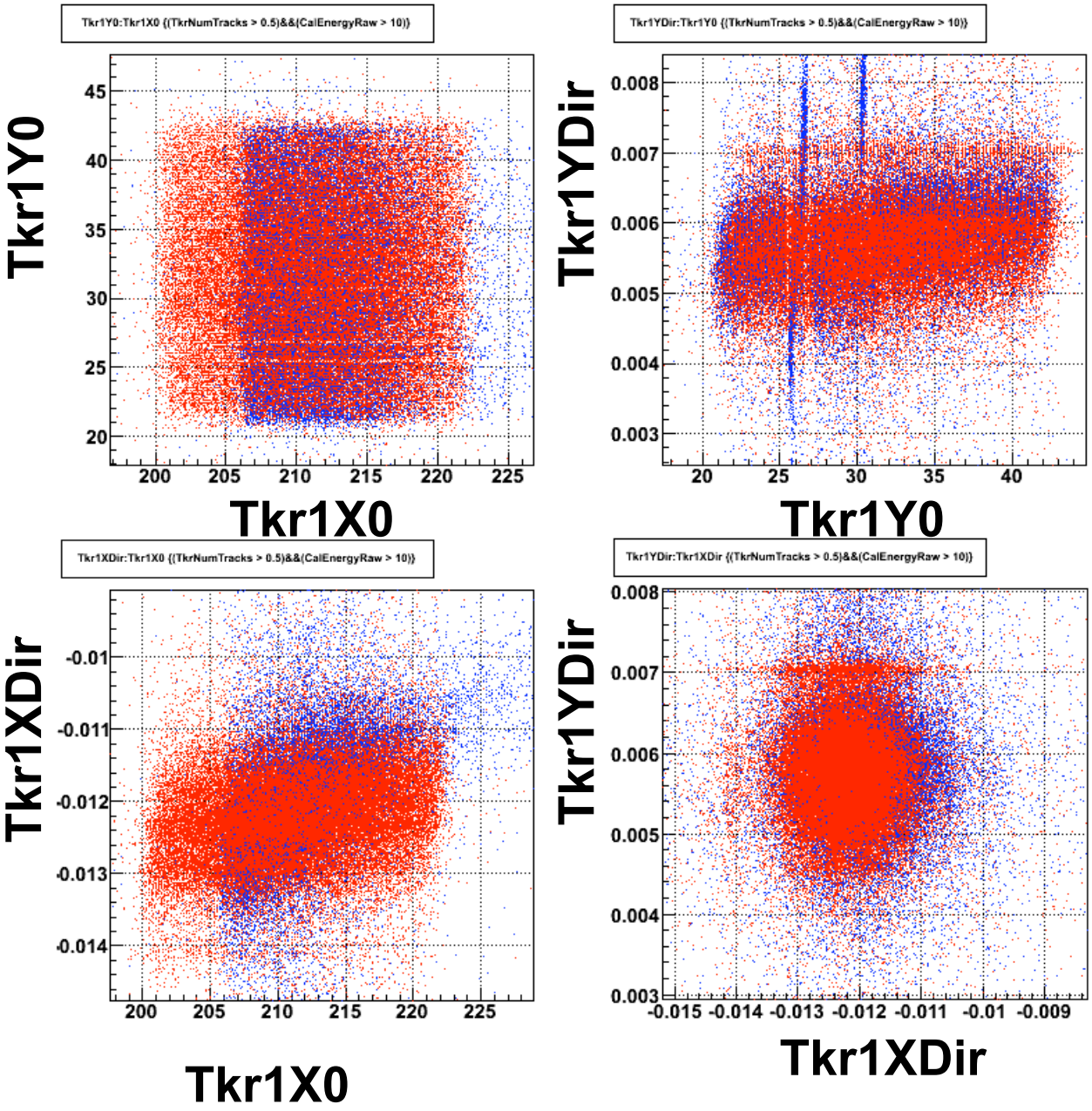
Bill-type scatter plots for the beam profile



Agreement is also good. Those scatter plots show more "dramatically" the tails of the distribution, where agreement is certainly not good

Spikes in Tkr1YDir:Tkr1Y0 plot are also clearly visible

Bill-type scatter plots for the beam profile (zoom)



Agreement is also good. Those scatter plots show more "dramatically" the tails of the distribution, where agreement is certainly not good

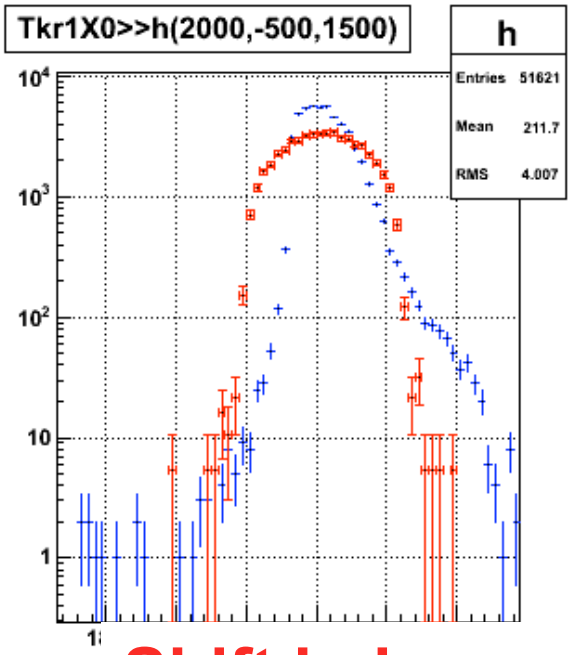
Spikes in Tkr1YDir:Tkr1Y0 plot are also clearly visible

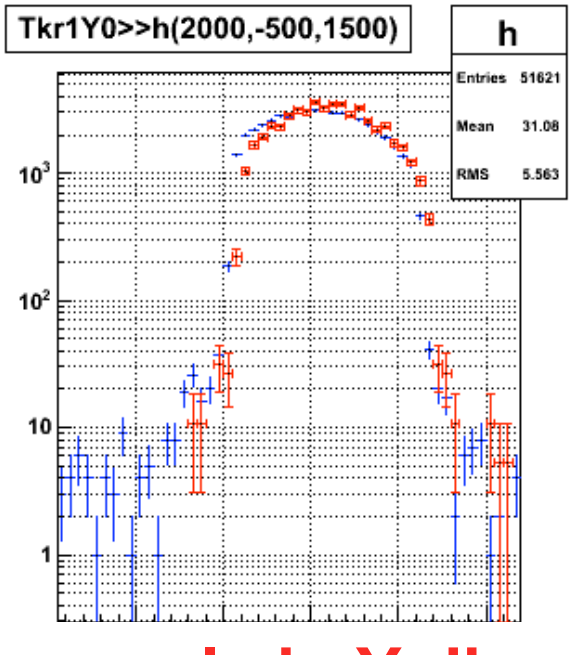
Johan produced MC data with the beam profile parameters estimated from the data

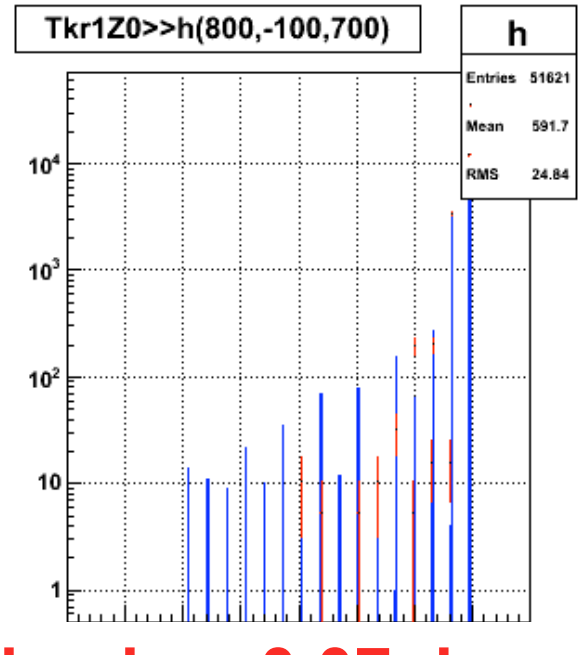
MC runs from November 2007

https://confluence.slac.stanford.edu/display/BeamTest/Good+runs

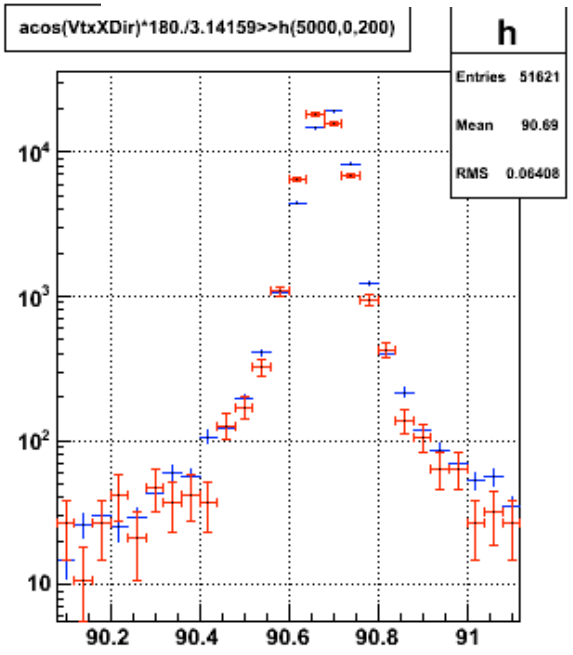
“New Electron runs with Nominal Helium pressure in the Cerenkov”

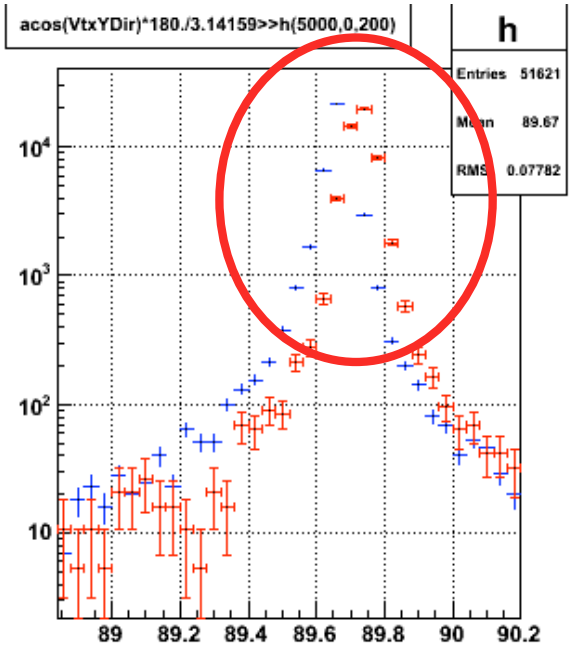


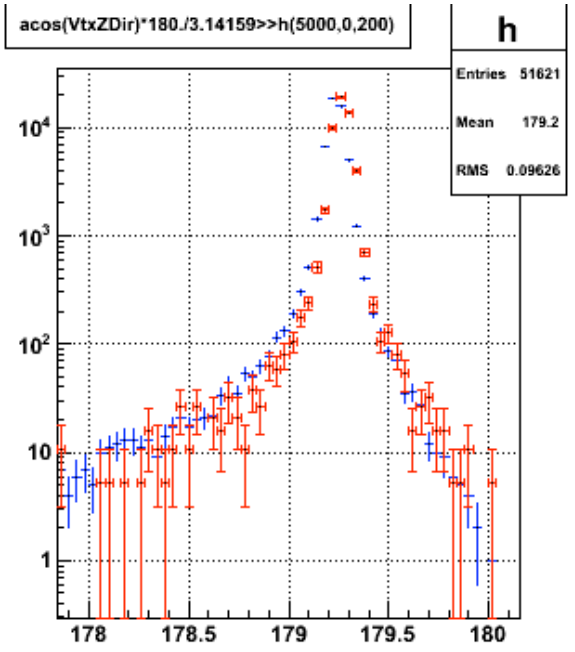


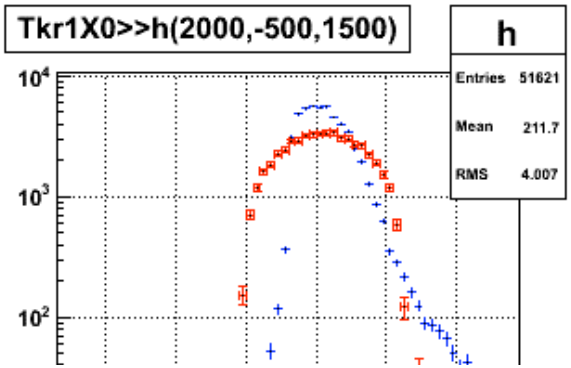


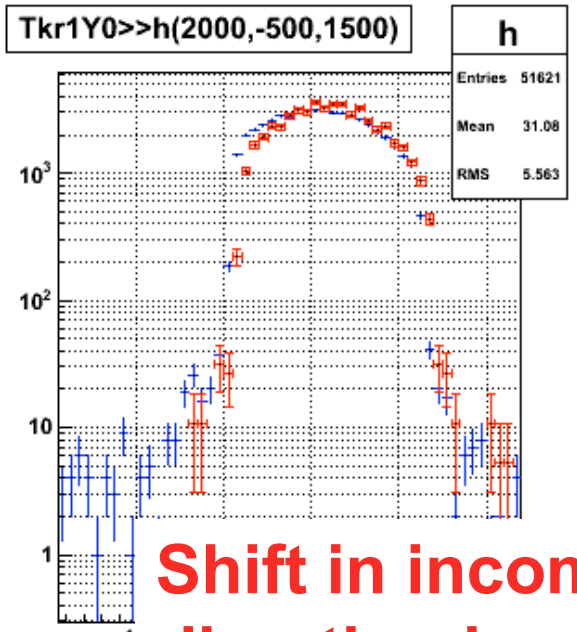
Shift in incoming angle in Y direction by ~0.07 deg

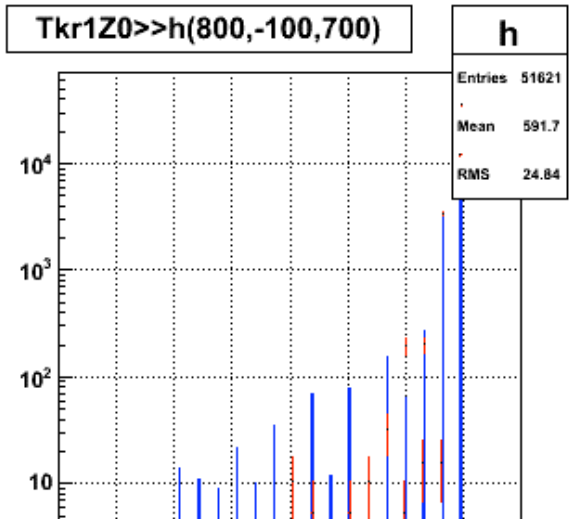






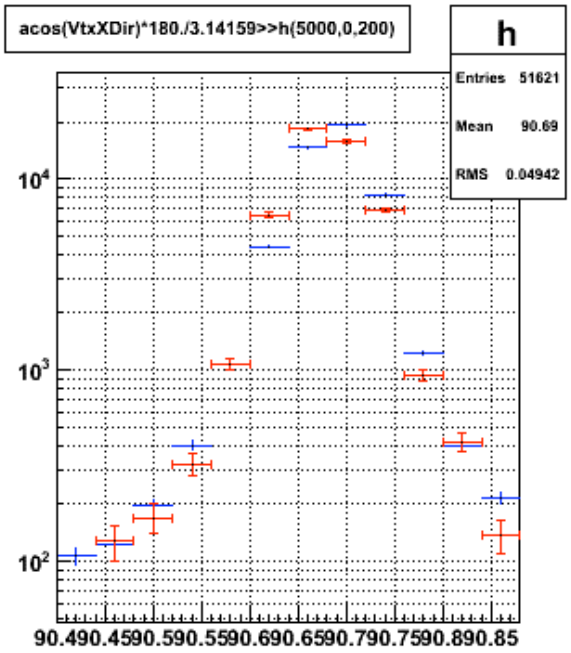


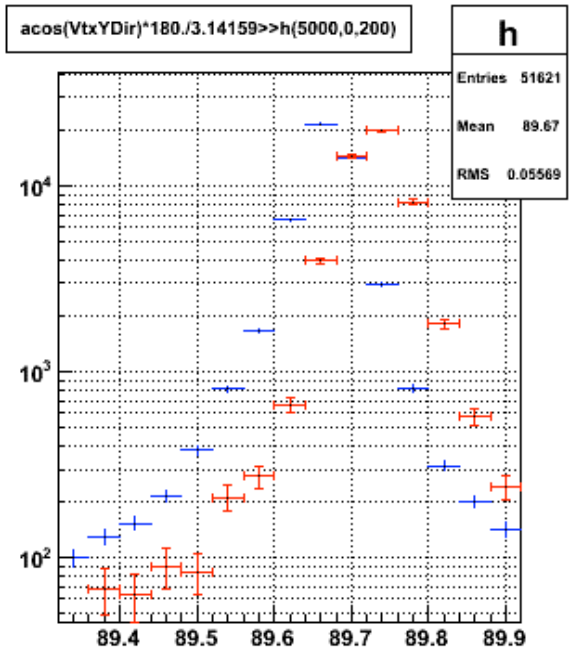


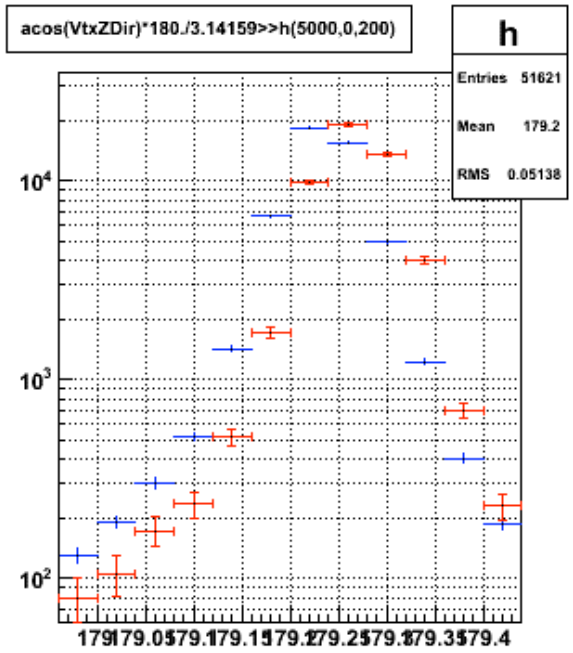


Small Shift in incoming angle in X direction by ~0.02 deg

Shift in incoming angle in Y direction by ~0.07 deg

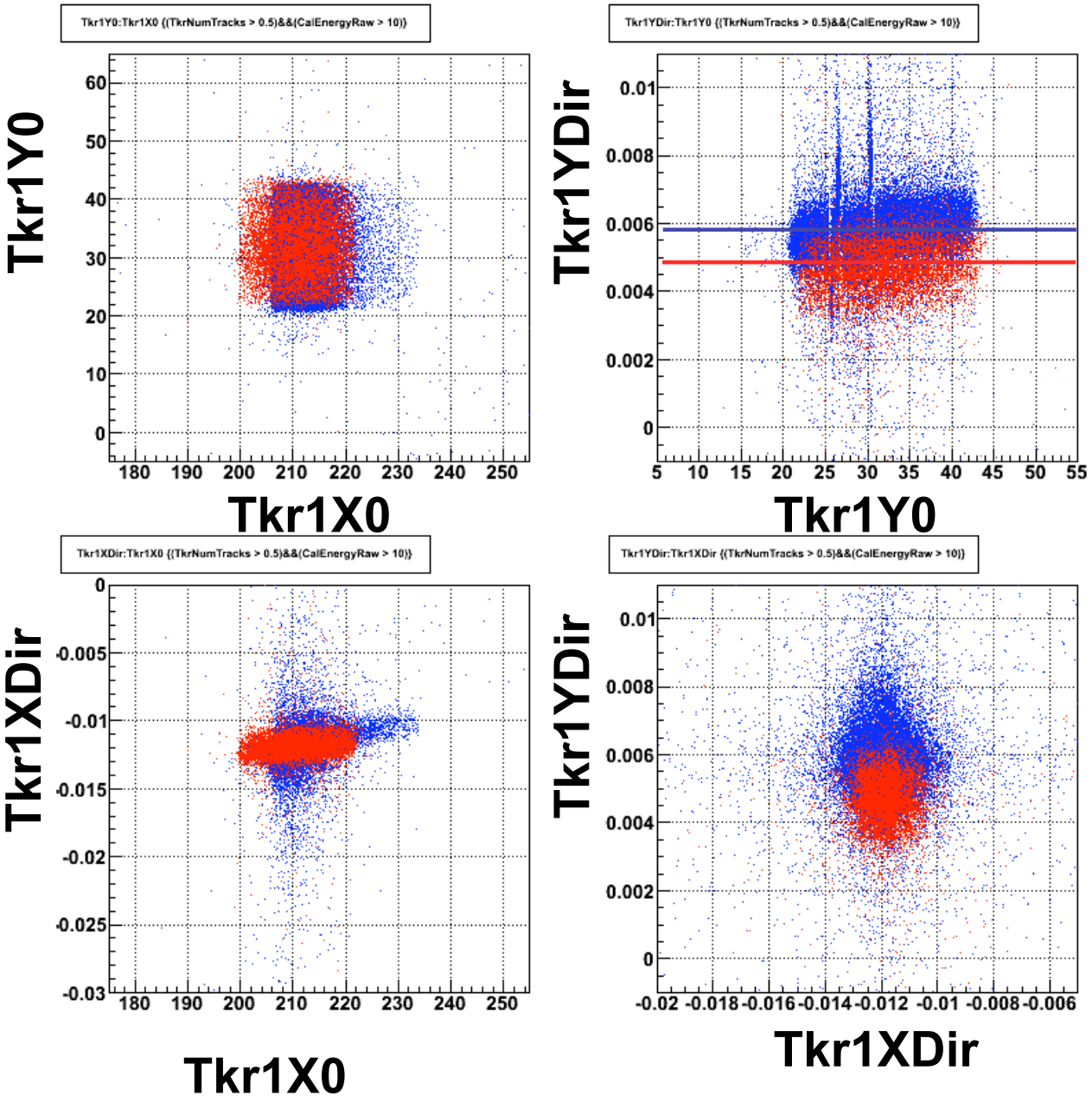






Bill-type scatter plots for the beam profile

Disagreement in Tkr1YDir, as shown by Bill on Monday at C&A meeting



(acos(0.005)-acos(0.006))
*180./3.14159 ~ 0.06 deg

The reason is a “typo” in the Gleam config file

Original config file (June 2007):

u37/MC-tasks/BT-2082-v6r0925p2-GLAST-NOTALIGNED/config/
700002082_v6r0925p2_BTopts.txt

```
////////////////////////////////////////////////////////////////////////
// End of Defaul global settings
// The following lines shall be written by the script and run specific
////////////////////////////////////////////////////////////////////////

//Automatically written by JOcreator on Wed Jun  6 09:28:59 2007
BeamTransform.table_rotation      = 0.700000 ;
BeamTransform.table_tilt          = 0.330000 ;
BeamTransform.point_on_beamline    = {203.40, 34.70, -47.40} ;
//ToolSvc.GeneralNoiseTool.occupancy = 0.000005 ;
//CalibDataSvc.startTime                    = "2006-8-10 23:59:59" ;
G4Generator.physics_choice        = "GLAST" ;
```

New Config file (Nov 2007):

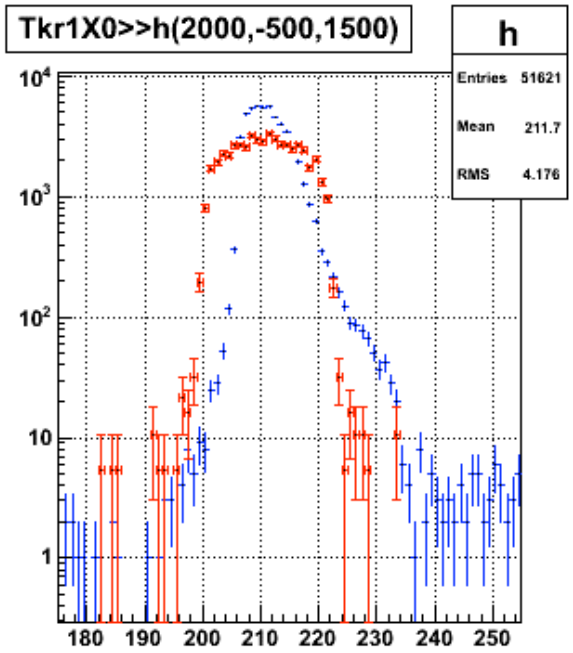
u35/MC-tasks/BT-2082-v7r1117p1He-GLAST/config/
700002082_v7r1117p1_BTopts.txt

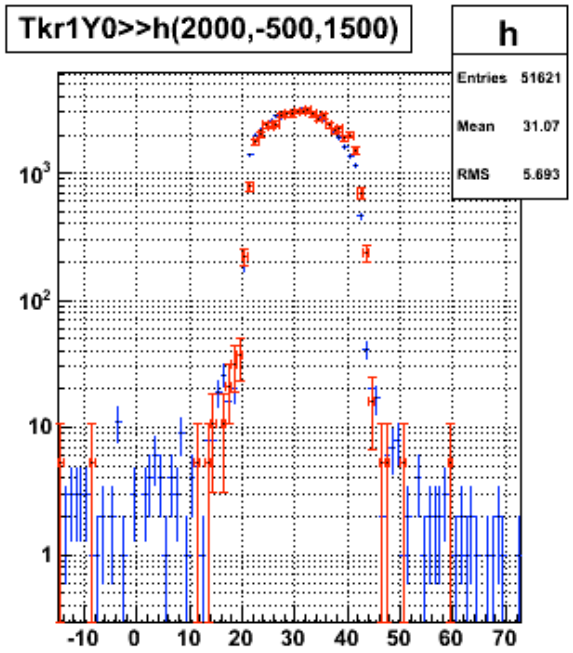
```
////////////////////////////////////////////////////////////////////////
// End of Defaul global settings
// The following lines shall be written by the script and run specific
////////////////////////////////////////////////////////////////////////

//Automatically written by JOcreator on Sat Nov  3 15:28:25 2007
BeamTransform.table_rotation      = 0.680000 ;
BeamTransform.table_tilt          = 0.270000 ;
BeamTransform.point_on_beamline    = {203.40, 34.70, -47.40} ;
//ToolSvc.GeneralNoiseTool.occupancy = 0.000005 ;
//CalibDataSvc.startTime                    = "2006-8-10 23:59:59" ;
G4Generator.physics_choice        = "GLAST" ;
```

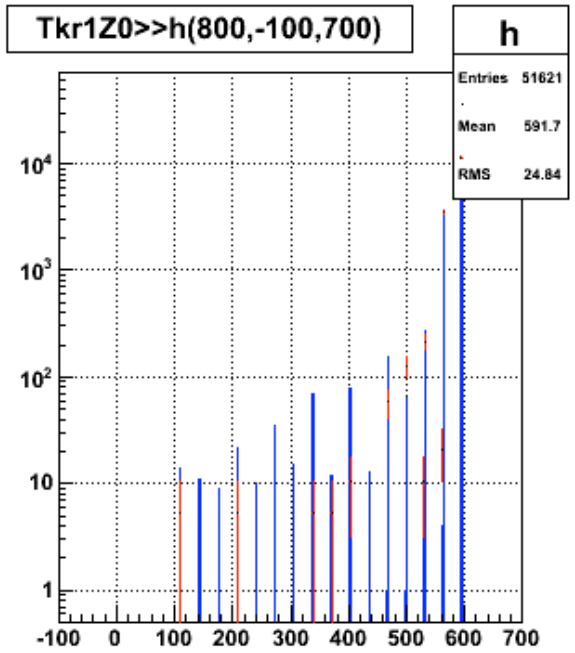
Johan produced MC data with the beam profile parameters estimated from the data

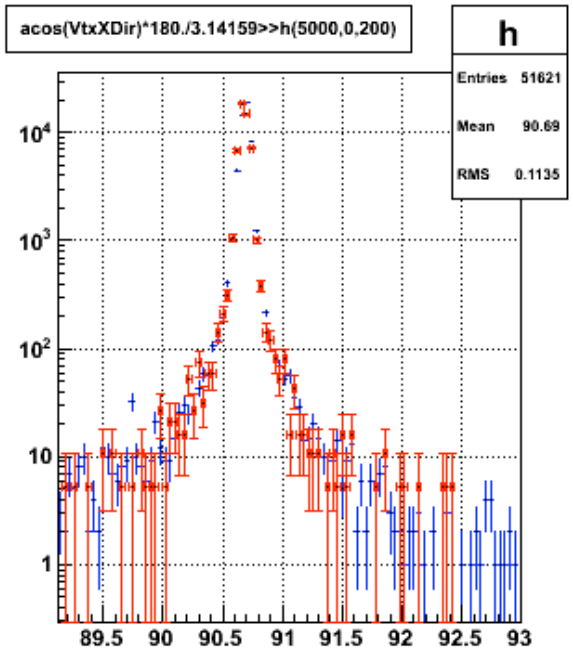
MC runs from November 26th 2007: LATEST

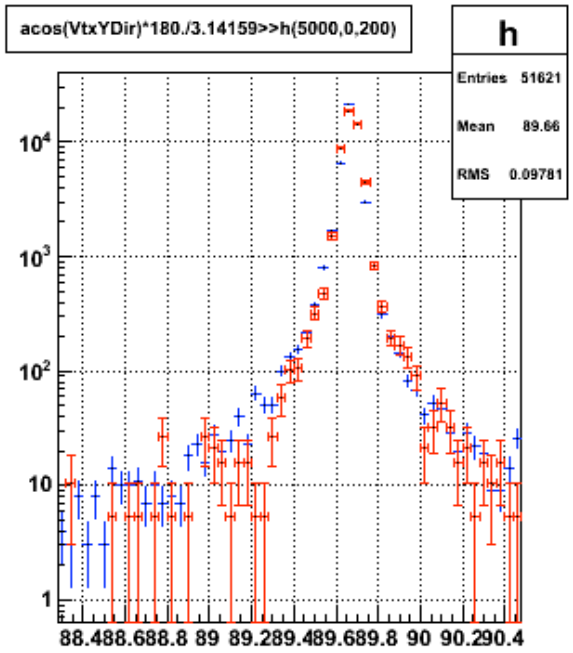
ftp://ftp-glast.slac.stanford.edu/glast.u35/MC-tasks/Specials/BT-2082-v7r1117p1-GLAST-merit-NewBS.root

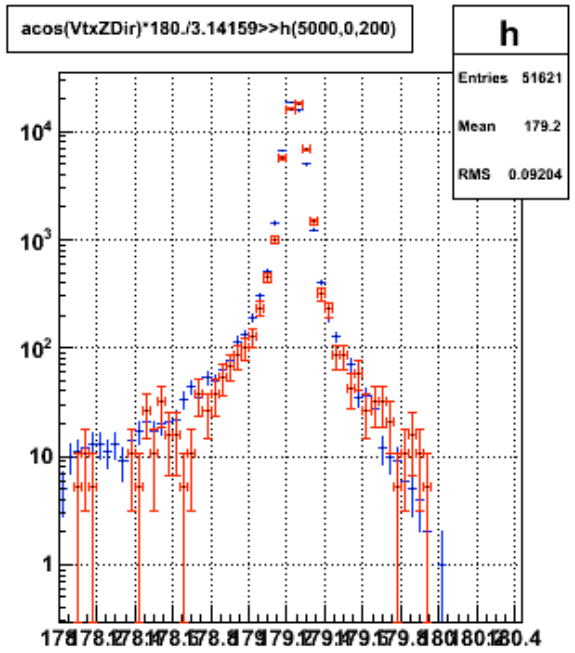

Tkr1X0>>h(2000,-500,1500)
h
Entries 51621
Mean 211.7
RMS 4.176


Tkr1Y0>>h(2000,-500,1500)
h
Entries 51621
Mean 31.07
RMS 5.693

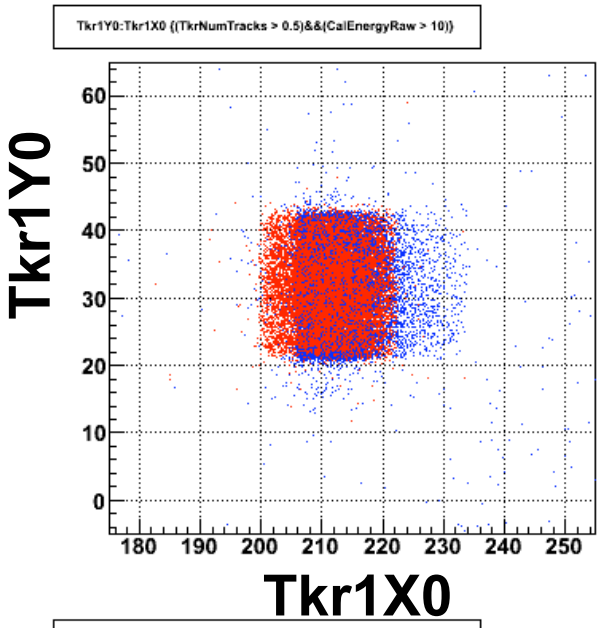

Tkr1Z0>>h(800,-100,700)
h
Entries 51621
Mean 591.7
RMS 24.84

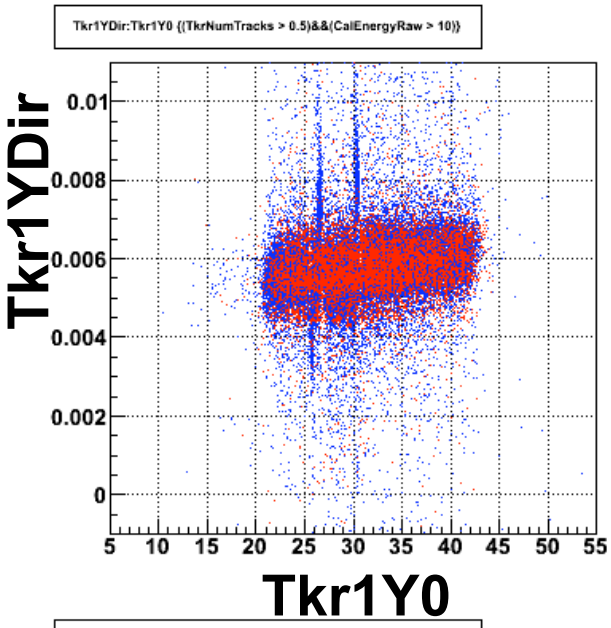

acos(VtxXDir)*180./3.14159>>h(5000,0,200)
h
Entries 51621
Mean 90.69
RMS 0.1135

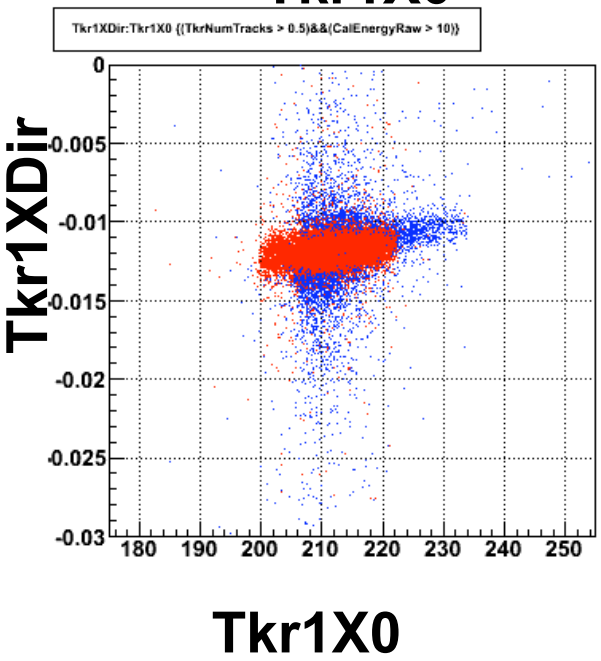

acos(VtxYDir)*180./3.14159>>h(5000,0,200)
h
Entries 51621
Mean 89.66
RMS 0.09781

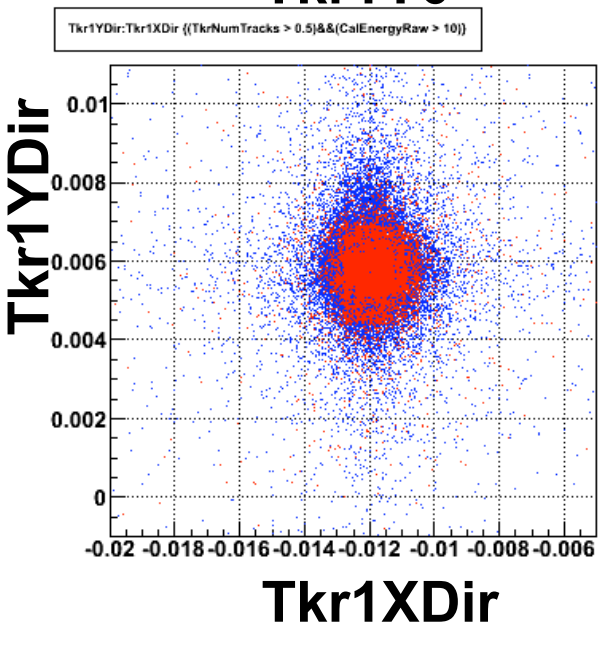

acos(VtxZDir)*180./3.14159>>h(5000,0,200)
h
Entries 51621
Mean 179.2
RMS 0.09204

Bill-type scatter plots for the beam profile









Again, reasonably good agreement in profiles