SRC Weekly Meeting
June 19, 2012

- Revisit Optics for LHRS,
- LHRS Timing, RHRS Timing
- BigBite Scintillator- PID & Timing

LEFT & RIGHT HRS OPTICS ANOTHER VISIT

Navaphon Muangma (Tai)
"SRC Weekly Meeting", June 19, 2011

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Optics Overview

Optics calibration is the calibration of the transport matrix. The transport matrix translates the focal plan information to the target information, i.e.,

$(x_{fp}, y_{fp}, \theta_{fp}, \Phi_{fp})$ to

$(dp, y_{tg}, \theta_{tg}, \Phi_{tg})$

Where each target variable can be expressed as the series expansion of the focal plan variables.

i.e. $y_{tg} = Y_{jki}\, \theta^j * y^k * \Phi^l$

where $Y_{jki} = C_i * x^i$

Optics Overview

The optic runs with known target variables are required as follow:

Optimized variable	Required
Vertex	Multiple-foil target. [known separations and locations]
Theta & Phi	Multiple-foil target with Sieve inserted. [know holes separation, Sieve location]
dp	Various dp scan for the same central_p, i.e., +/-4% +/-2% and 0%. For carbon target and Hydrogen target

Possible Vertex Check During Production

Kinematic	Target Type	Runlist
1	C-optics	2869, 2871, 2873, 2875-6
1	15cm Al dummy	2892-4
1	BeO	2867-8, 2890,2930, 2952
2	15cm Al dummy	3104-6
2	BeO	3024
3	15cm Al dummy	3179-85(left), 3442(both)
3	BeO	3186, 3341

LEFT Optics

- Vertex Scaling Effect
- Miss-Pointing Calculation
- Re-Calibration of phi
- Timing Clarification

VERTEX SCALING EFFECT

Left Vertex (16.5 deg) without scaling

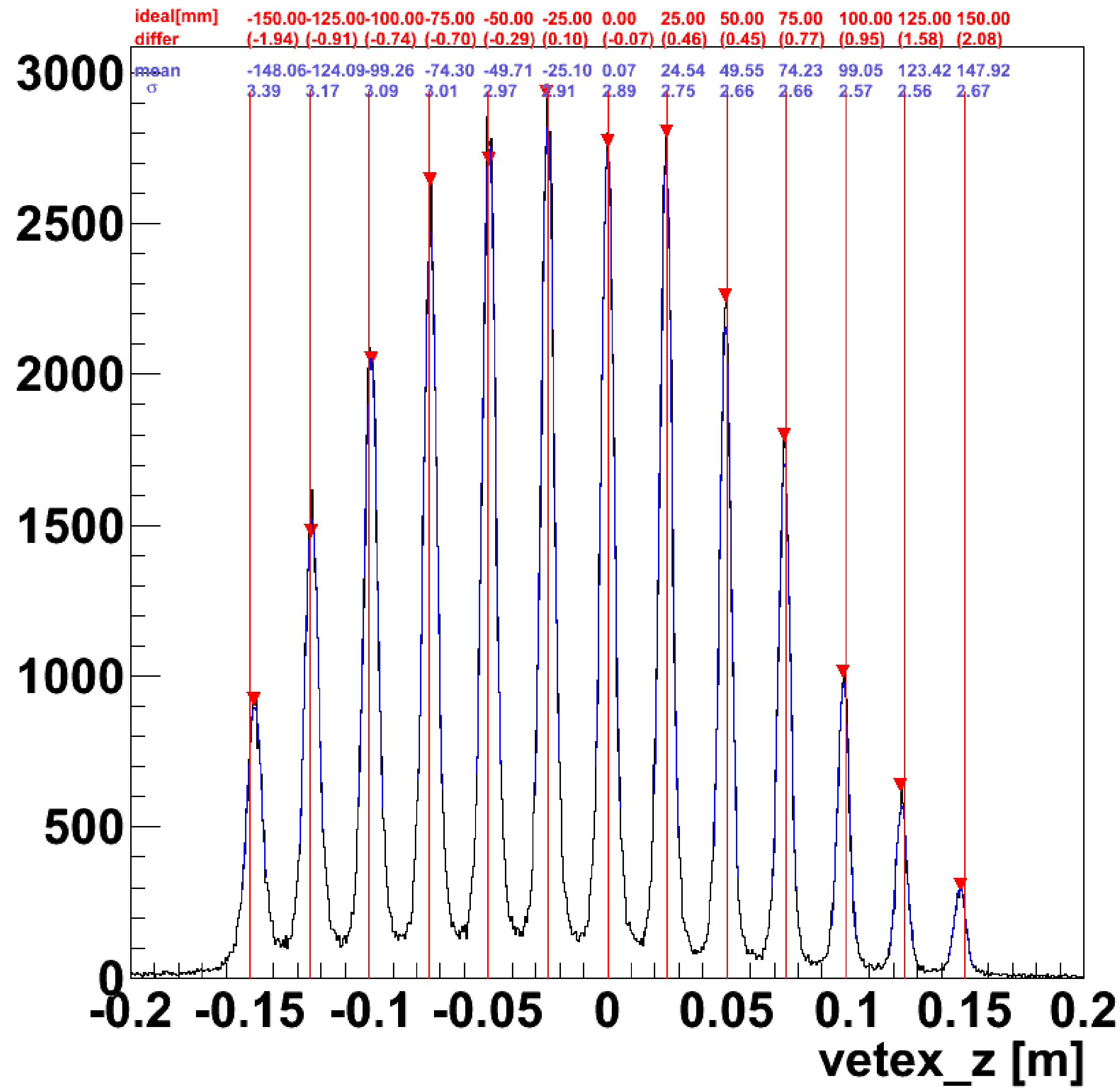
The red line shows the ideal location. With each ideal value and its difference from the fit peak. (red)

The mean and sigma of the fit for each peak are in blue.

Max difference to the ideal location are 2 mm in 300 mm range. It is the scaling effect. I fix this with a simple scaling on target_Y (hence vertex_Z).

New_target_Y = scaling*target_Y

Run 1237 [With miss-pointing offset imposed.]



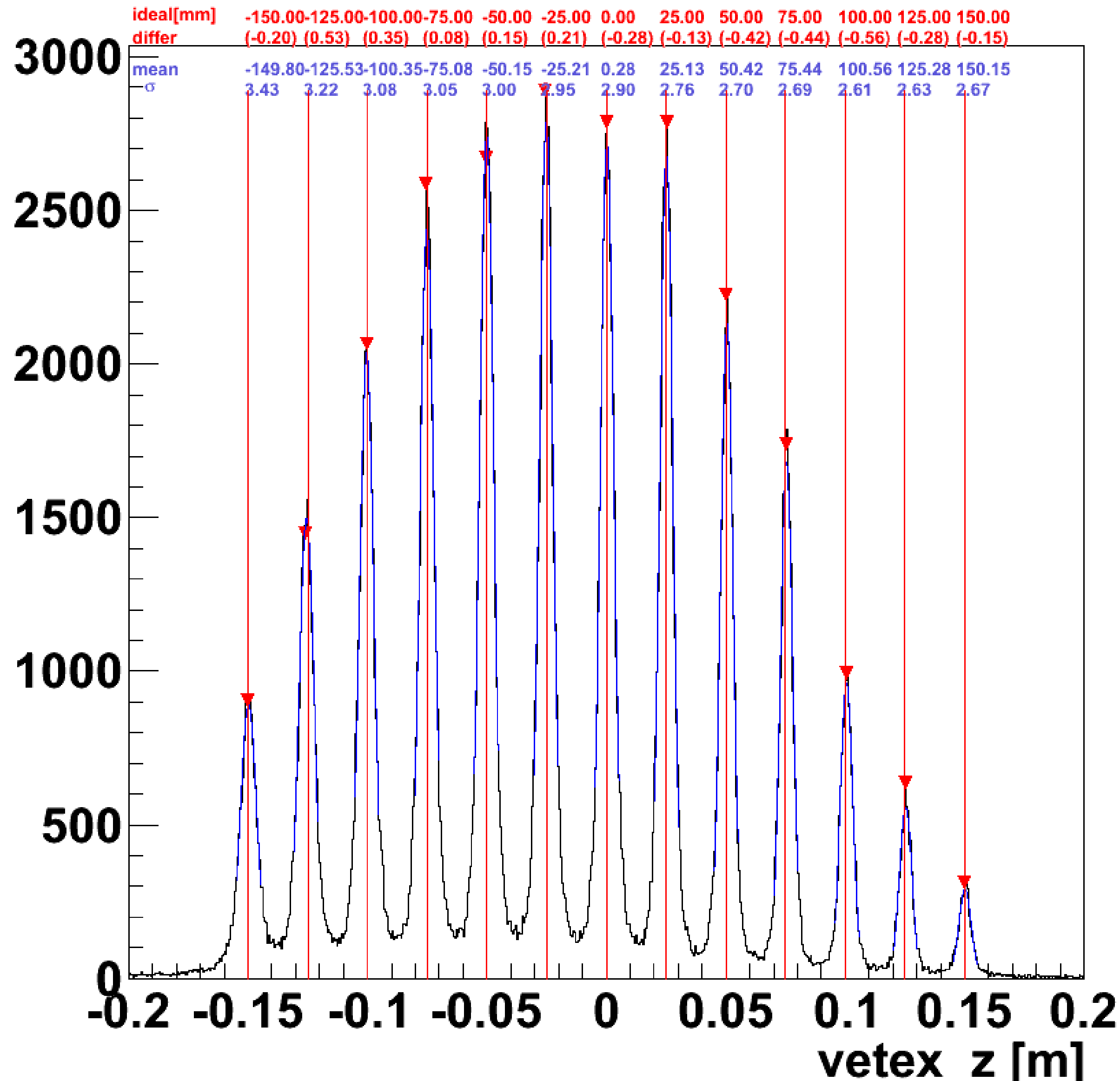
Left Vertex (16.5 deg) with scaling

The red line shows the ideal location. With each ideal value and its difference from the fit peak. (red)

The mean and sigma of the fit for each peak are in blue.

Max difference to the ideal location are 0.5 mm in 300 mm range.

Run 1237 [With miss-pointing offset imposed.]



[For none-survey point]

MISS-POINTING CALCULATION

Miss-pointing calculation

- For other angles, we do have the miss-pointing survey so we must obtain the offset from the calculation.
- We are actually interested in the Left arm not at 16.5 degree but at 20.3 degree where we have our production data.
- Need to do miss-pointing twice for this angle.
- First period: March 15 to April 13, 2011 period
- Second period: on May 11-13, 2011 (This will be calculated later as many modification has been made to various database for x>2 production)

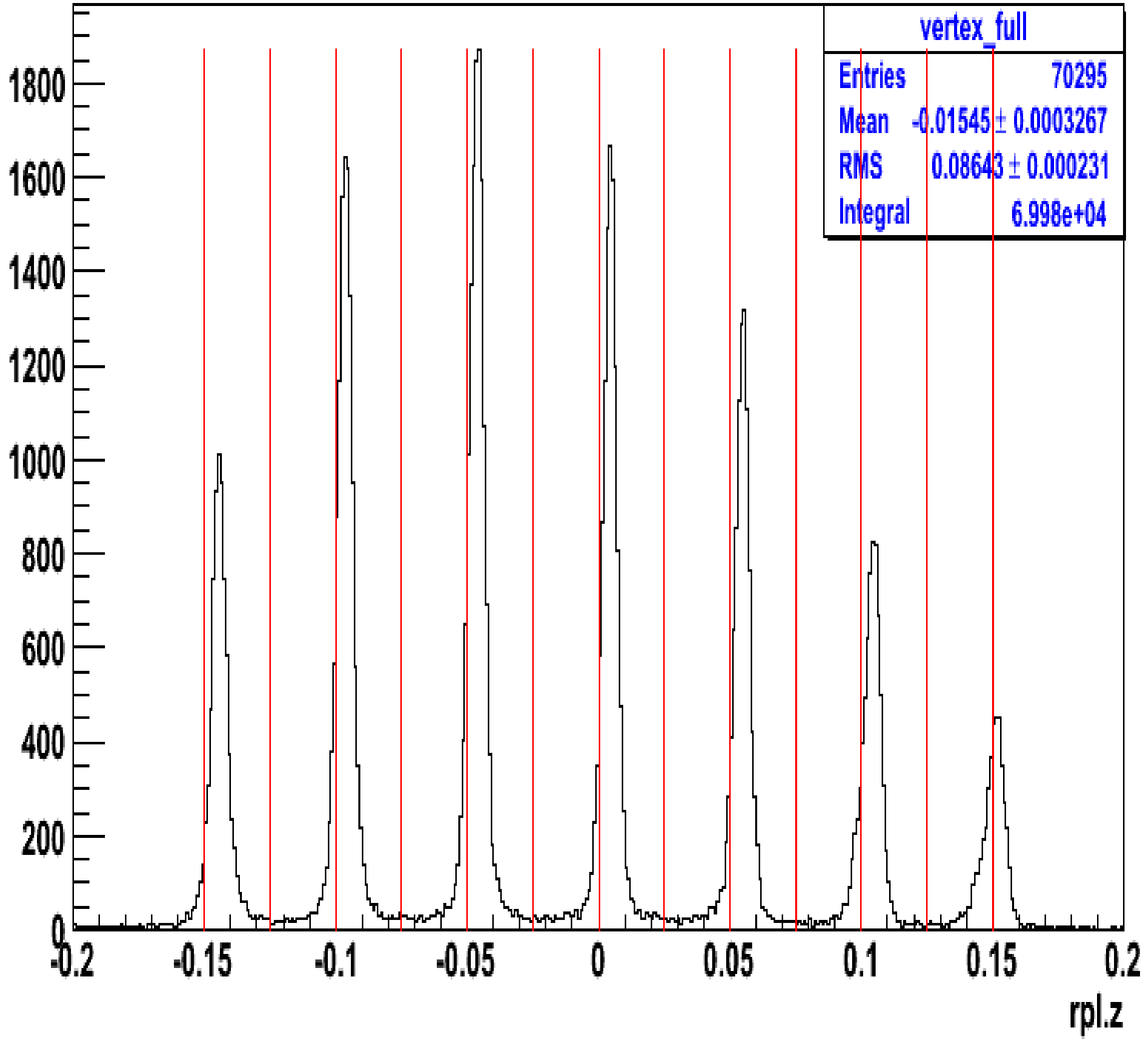
Left Vertex (20.3 deg) without miss-pointing

The red line shows the ideal location.

Run 2869

Note that the number of carbon optic foils has already be reduced from 13 to 7 foils.

Clearly, the miss-pointing offset is needed to be calculated.



Miss-Pointing Calculation

- **Note that the reaction vertex calculation is:**

$$Z_{react} = \frac{-(y_{tg}+Dy) + x_{beam}(\cos(\theta_{HRS})-\sin(\theta_{HRS})*\Phi_{tg})}{\sin(\theta_{HRS})+\cos(\theta_{HRS})*\Phi_{tg}}$$

- **So at z_{react} = 0, we have**
  - $Dy = -y_{tg} + x_{beam}(\cos(\theta_{HRS})-\sin(\theta_{HRS})*\Phi_{tg})$

  Where we then calculated the offset as,
  - $Offset[x,y,z] = [Dy*\cos(\theta_{HRS}), off\_y, -Dy*\sin(\theta_{HRS})]$

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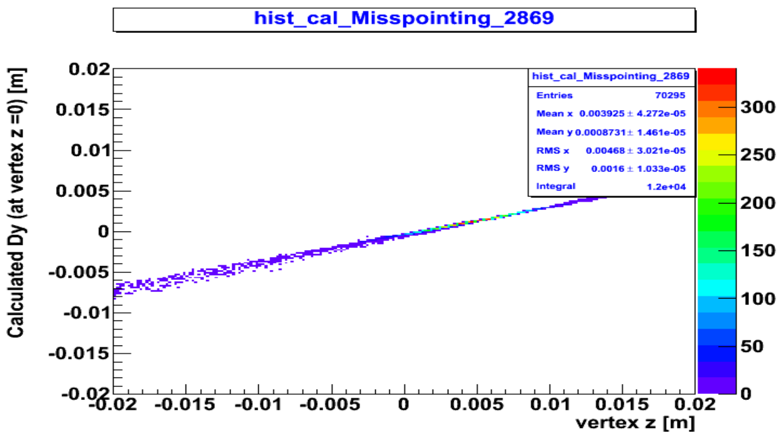
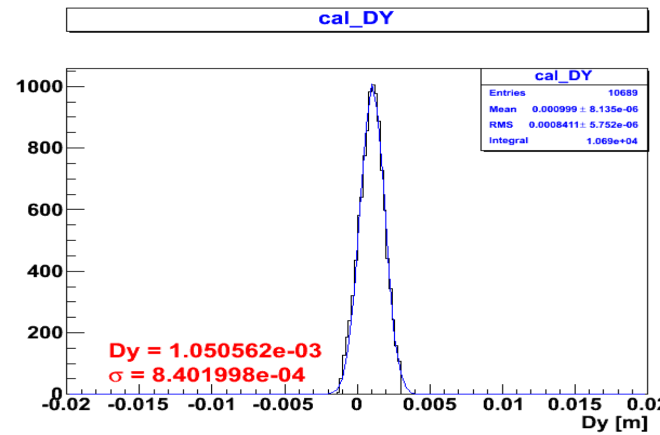
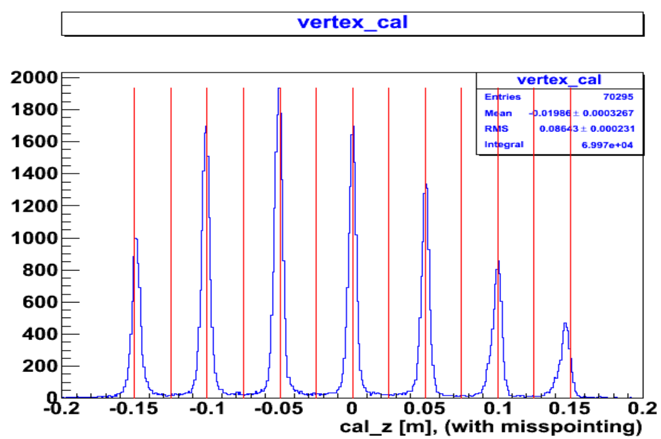
Miss-Pointing Calculation







Run #2869

Left angle 20.3008

Dy = 1.050562e-03

Add the following to the db_run.dat

L.off_x = 9.853058e-04

L.off_y = 0.54e-3

L.off_z = -3.028005e-03

Left Vertex (20.3 deg) with miss-pointing

[The red line shows the ideal location. With each ideal value and its difference from the fit peak. (red)]

[The mean and sigma of the fit for each peak are in blue.]

Run 2869

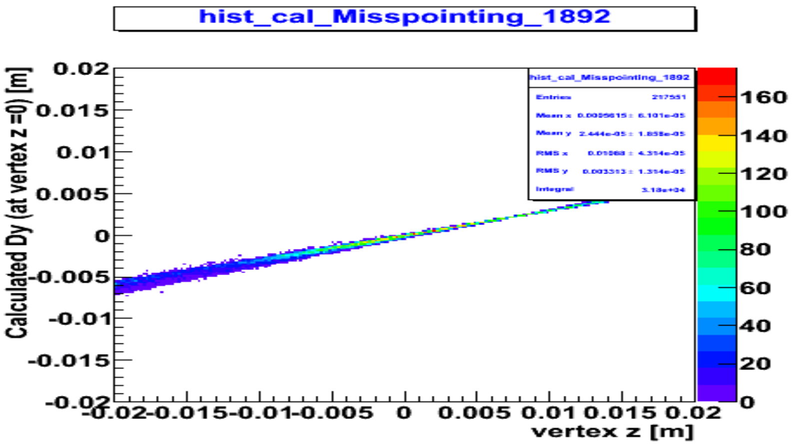
With calculated miss-pointing offset into the database.

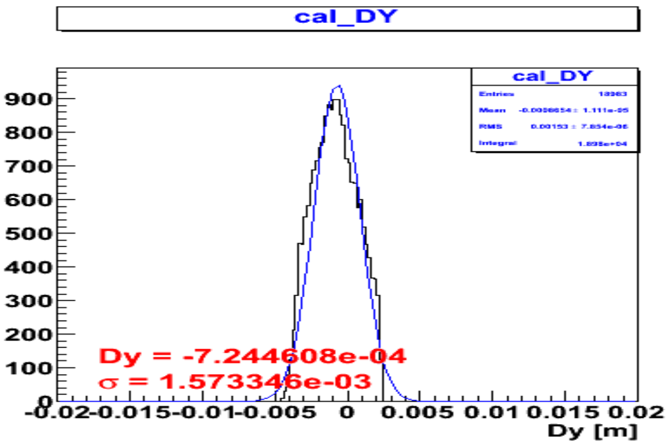
Miss-Pointing Calculation

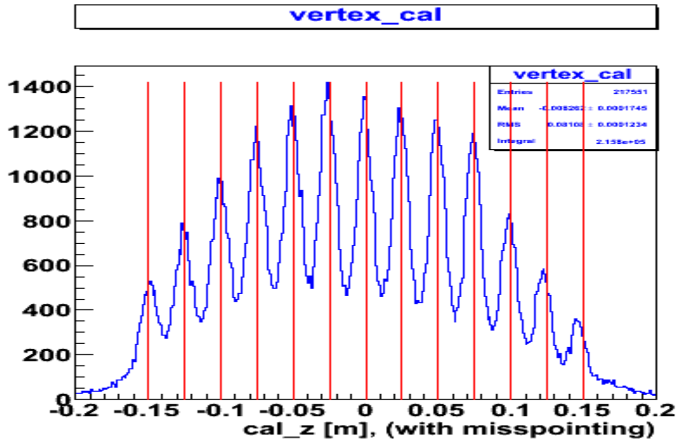
The following are the list of calculations needed(?)

Run	Angle	Reasons	Offset_X	Offset_Y	Offset_Z
1237	16.5 (survey)	Vertex, theta,phi LH2 delta scan			
1892, 2013	17.5	1 pass Sieve Optics: C delta scan, BigBite Optics	Run,run		
2026	20.5	BigBite Optics	run		
2869	20.3	Production			

Miss-Pointing Calculation







Run #1892

Left angle 17.4997

Dy = -7.244608e-04

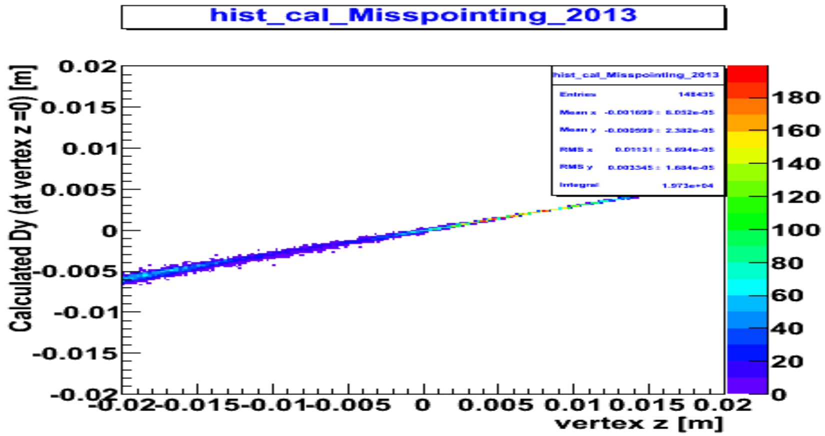
Add the following to the db_run.dat

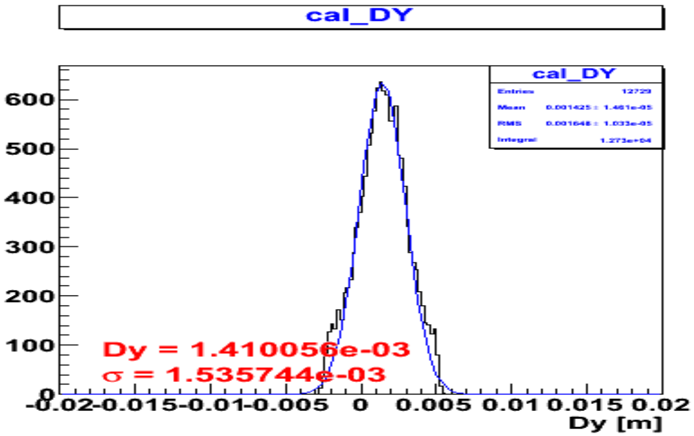
L.off_x = -6.909317e-04

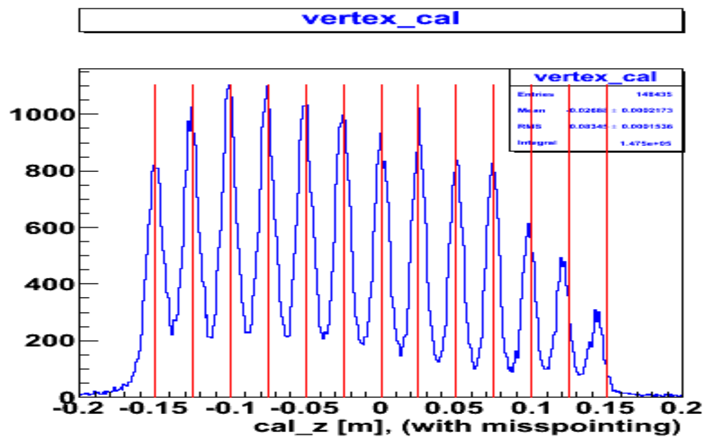
L.off_y = 0.54e-3

L.off_z = 2.409241e-03

Miss-Pointing Calculation







Run #2013

Left angle 17.4997

Dy = 1.410056e-03

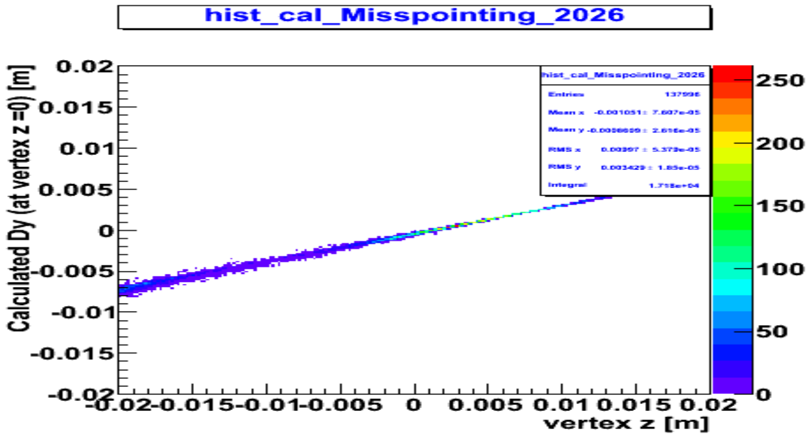
Add the following to the db_run.dat

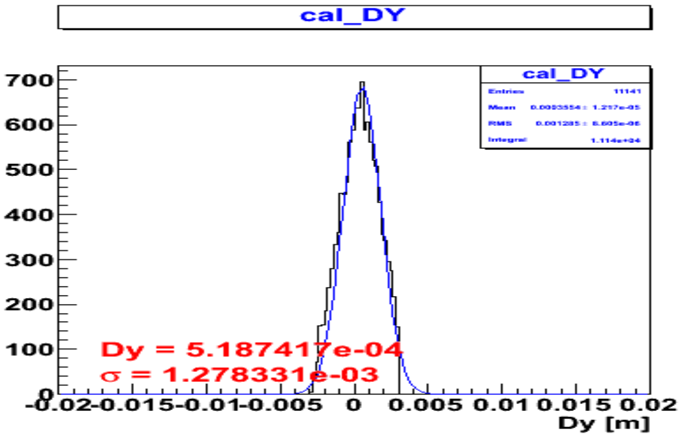
L.off_x = 1.344797e-03

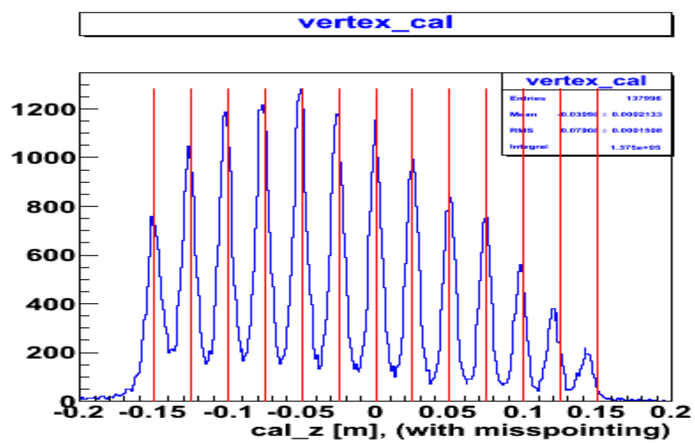
L.off_y = 0.54e-3

L.off_z = -4.689233e-03

Miss-Pointing Calculation







Run #2026

Left angle 20.4997

Dy = 5.187417e-04

Add the following to the db_run.dat

L.off_x = 4.858918e-04

L.off_y = 0.54e-3

L.off_z = -1.481262e-03

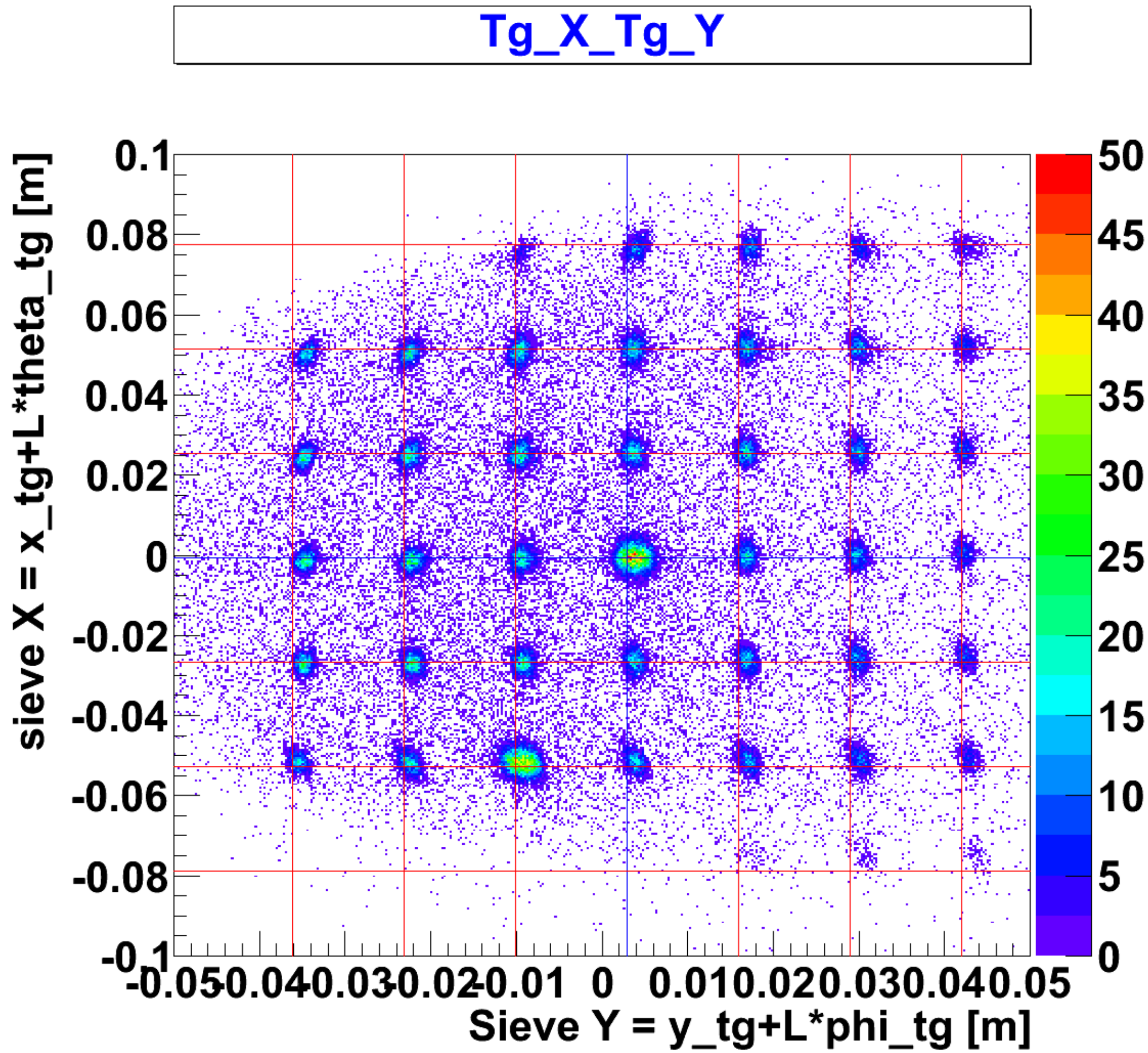
SIEVE X & Y RECONSTRUCTION → RECALIBRATION OF Φ IS NEEDED

Sieve X Y

After Vertex calibration, the theta and phi are next to consider. The figure shows the Sieve after applying the correction to vertex Z.

With scale Effect on the vertex Z, the change is made to target_Y calculation. This effect only the phi variable as the Sieve Y defined as:

$Y_{sieve} = L^{*}phi_{tg} + Y_{tg}$



Run 1238

C12- 13foils

At 16.5 degree

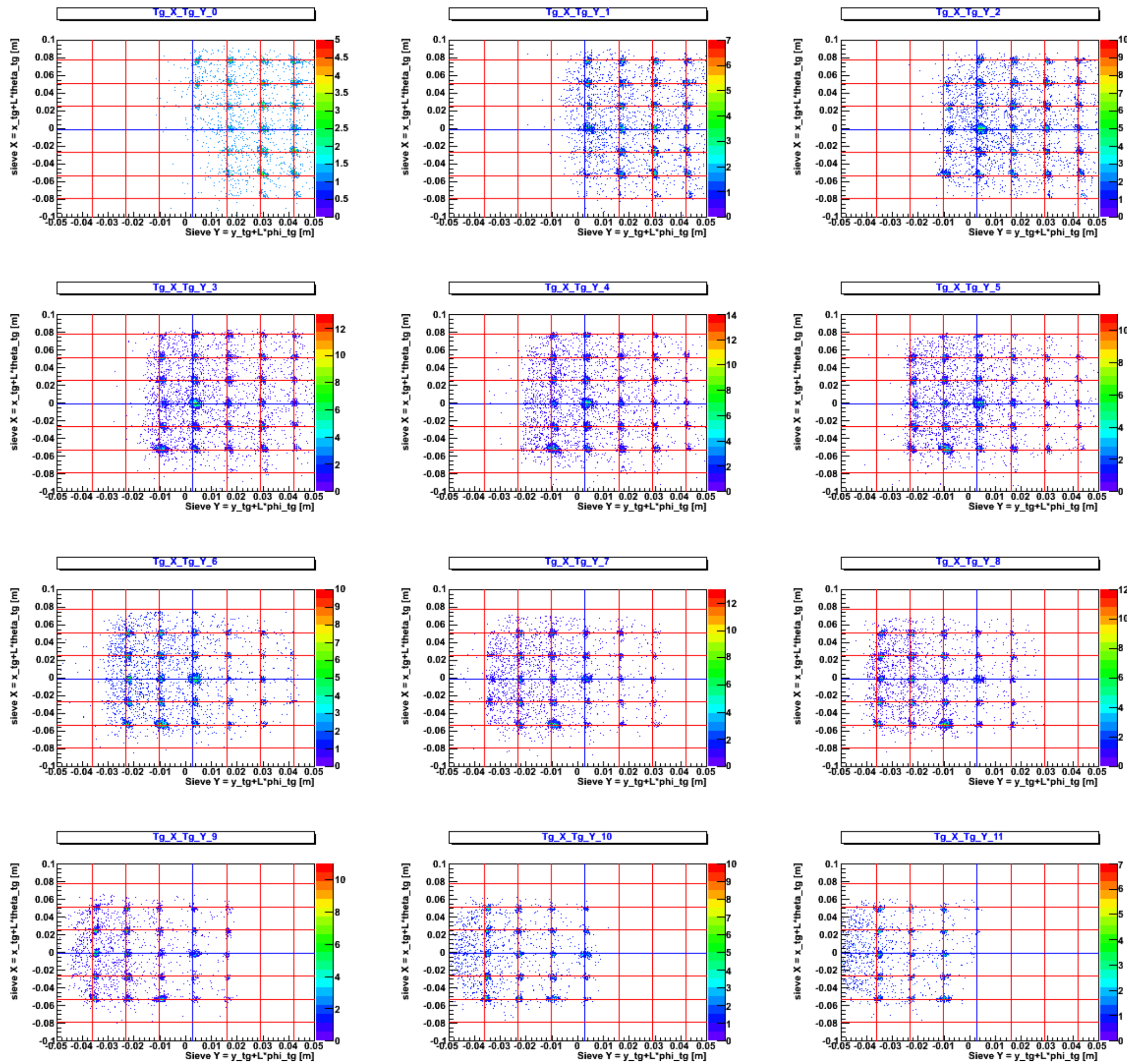
Sieve In

Sieve X Y, per foil before calibration

Run 1238

C12- 13foils

At 16.5 degree



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TIMING FOR BOTH HRSS

Timing

- Define
  - TOF = s2.time - path_length /(beta *c)
- Using the high relativistic electron run to eliminate the beta.
- Controversial for this method.
- Good for making a coincidence time with other spectrometers.

Left Timing

Top left : S2 TOF vs x

Top right: S2 time vs x

Bottom left: s2 TOF

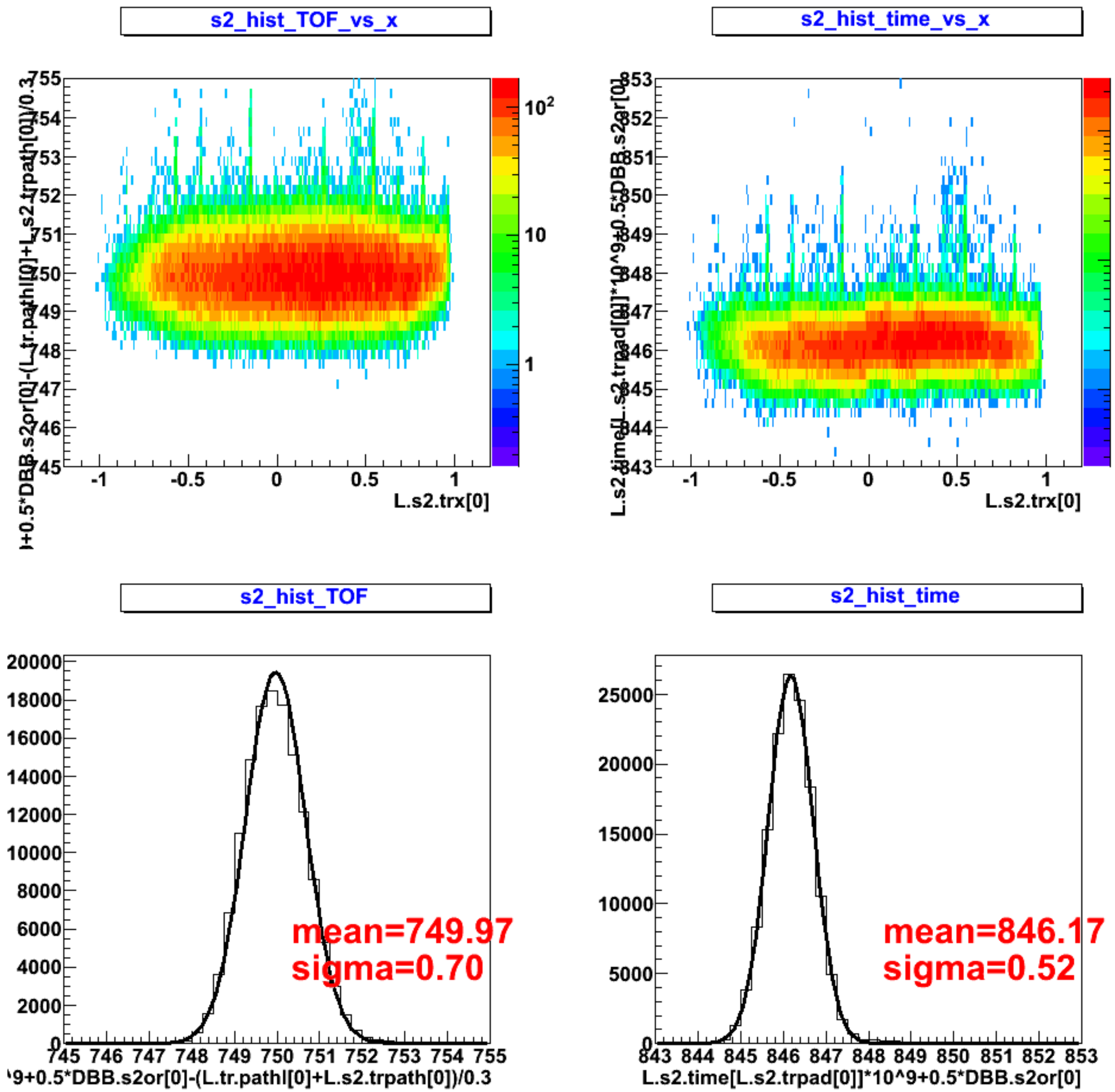
Bottom right: s2 time

All units are in ns and meter

The calibration is done using **the alignment of the TOF**

TOF = s2.time - path_length /(beta *c)

The s2 time is the self timing (no meaning)



Right Timing

Top left : S2 TOF vs x

Top right: S2 time vs x

Bottom left: s2 TOF

Bottom right: s2 time

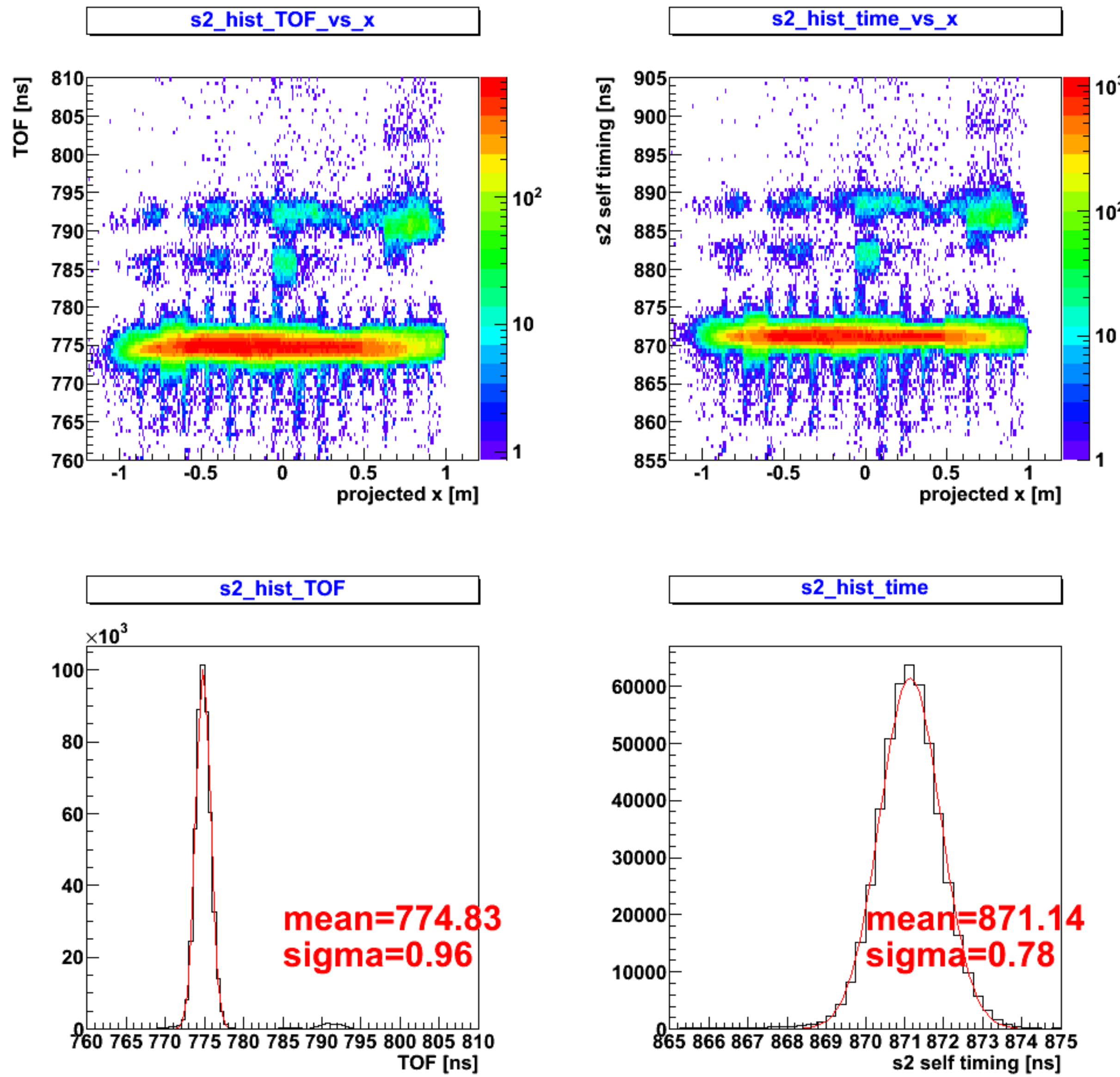
Run 1380 (electron)

All units are in ns and meter

The calibration is done using **the alignment of the TOF**

TOF = s2.time - path_length /(beta *c)

The s2 time is the self timing (no meaning)



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Right Timing

- I don't have an explanation for the other stuff at 10 ns at 16 ns.
- Any idea?

PRL EFFICIENCY

PID: Pion Rejecter Efficiency

- In general, we can use either Pion Rejecter or Cherenkov or both to make electron selection.
- However, we only have the Cherenkov fixed for the overflow in the kinematic 3 only.
- Thus, we can only use Pion Rejecter for the electron-PID.
- Using Cherenkov to study Pion Rejecter Efficiency in the following 5 plots

Pion Rejecter Efficiency

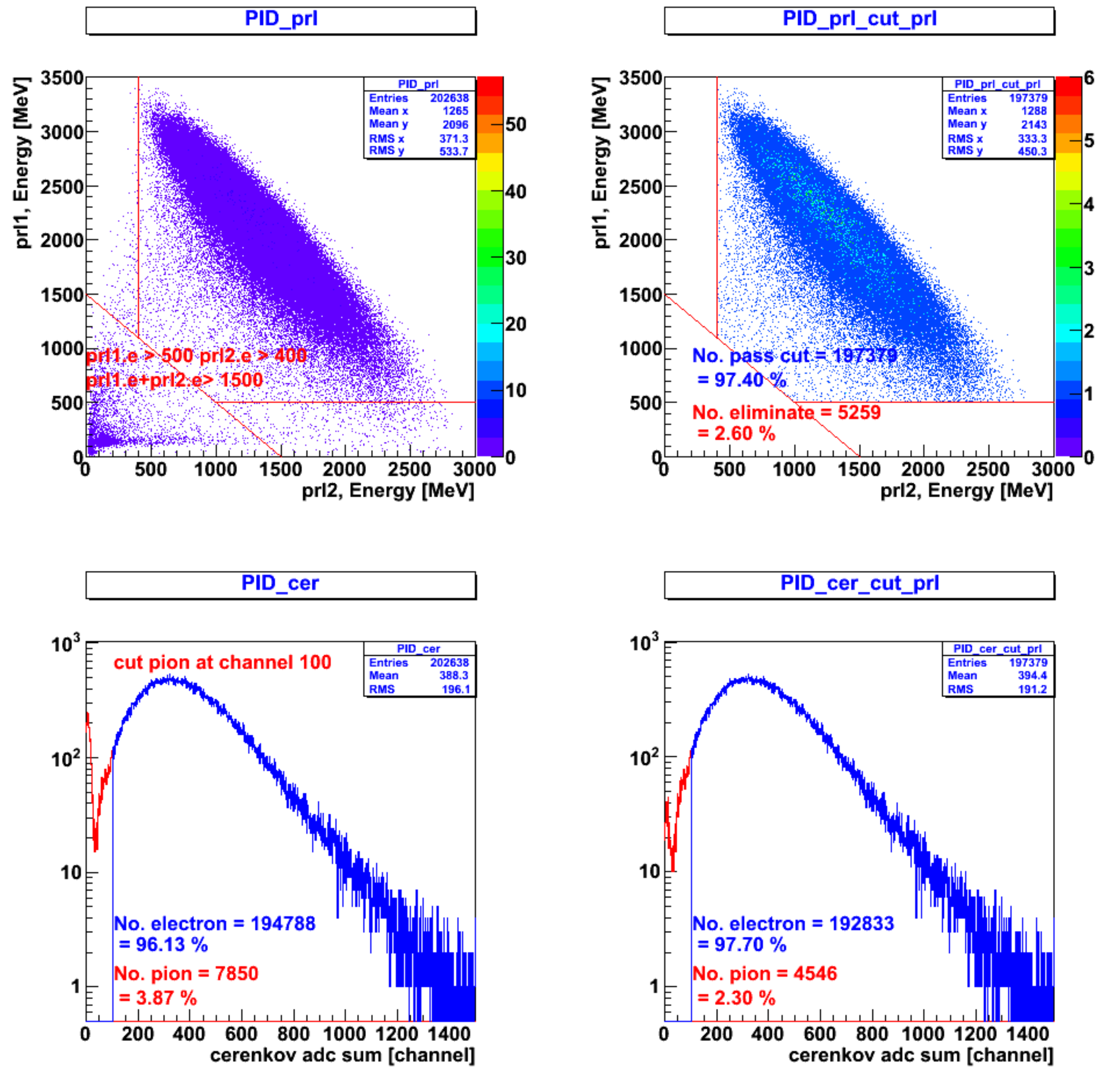
All plots has cut on abs(vertex) < 0.8 m ,

abs(theta)<0.07,

abs(phi)<0.04,

abs(dp)<0.05

No edtm, and Trigger 3



Top left: prl1 vs prl2

Bottom left: cer with identify pion and electron

Top right: prl1 vs prl2 with cut on prl1 > 500, prl2>400 & prl1+prl2> 1500

Bottom right: cer with all prl cut.

With this cut, we have 97.70% electron 2.30% pion contamination. Lost 2.60% of data

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Pion Rejecter Efficiency

All plots has cut on abs(vertex) < 0.8 m , abs(theta)<0.07, abs(phi)<0.04, abs(dp)<0.05

No edtm, and Trigger 3

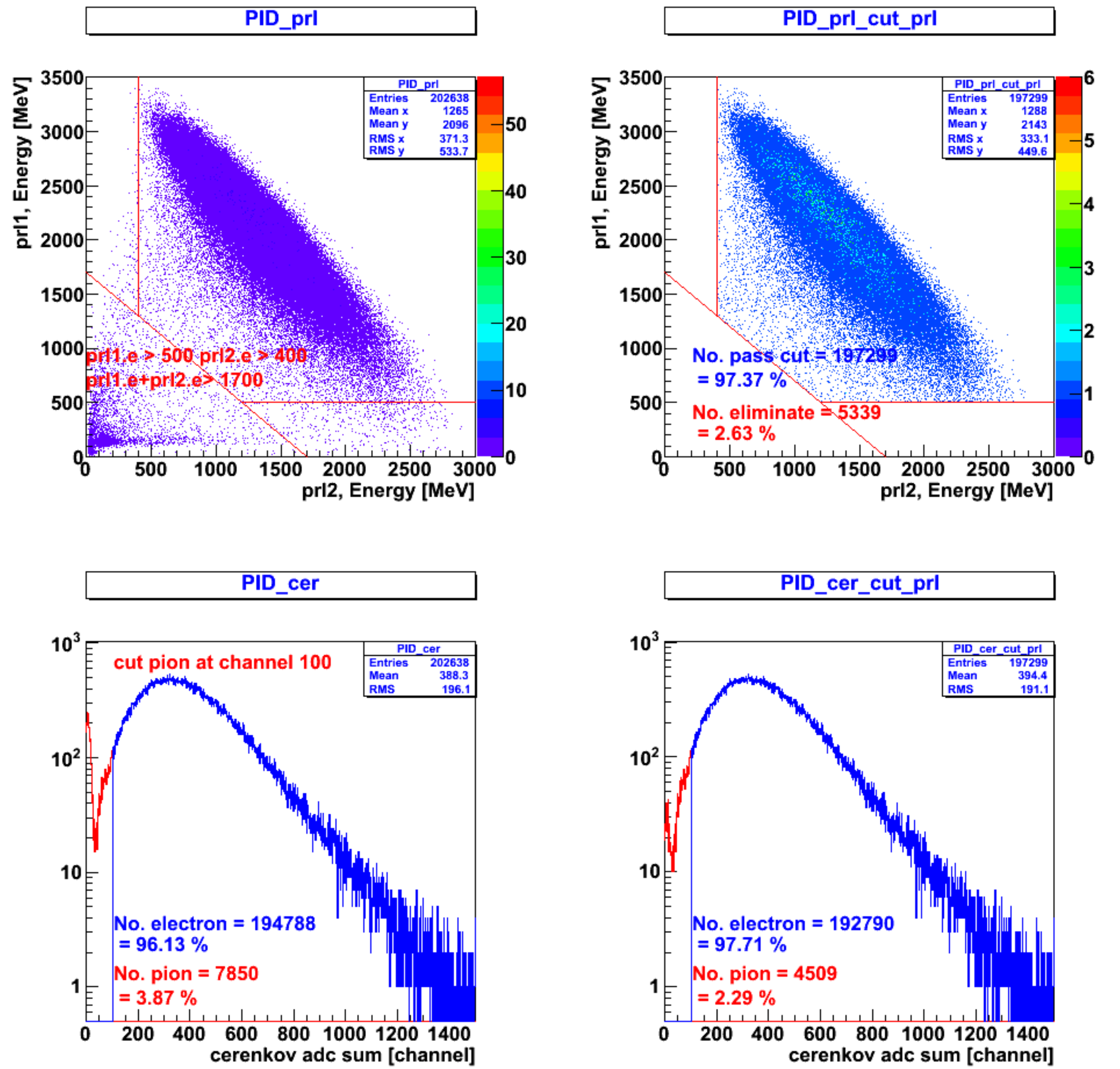
Top left: prl1 vs prl2

Bottom left: cer with identify pion and electron

Top right: prl1 vs prl2 with cut on prl1 > 500, prl2>400 & **prl1+prl2> 1700**

Bottom right: cer with all prl cut.

With this cut, we have **97.71% electron 2.29% pion contamination. Lost 2.63% of data**



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Pion Rejecter Efficiency

All plots has cut on abs(vertex) < 0.8 m ,

abs(theta)<0.07,

abs(phi)<0.04,

abs(dp)<0.05

No edtm, and Trigger 3

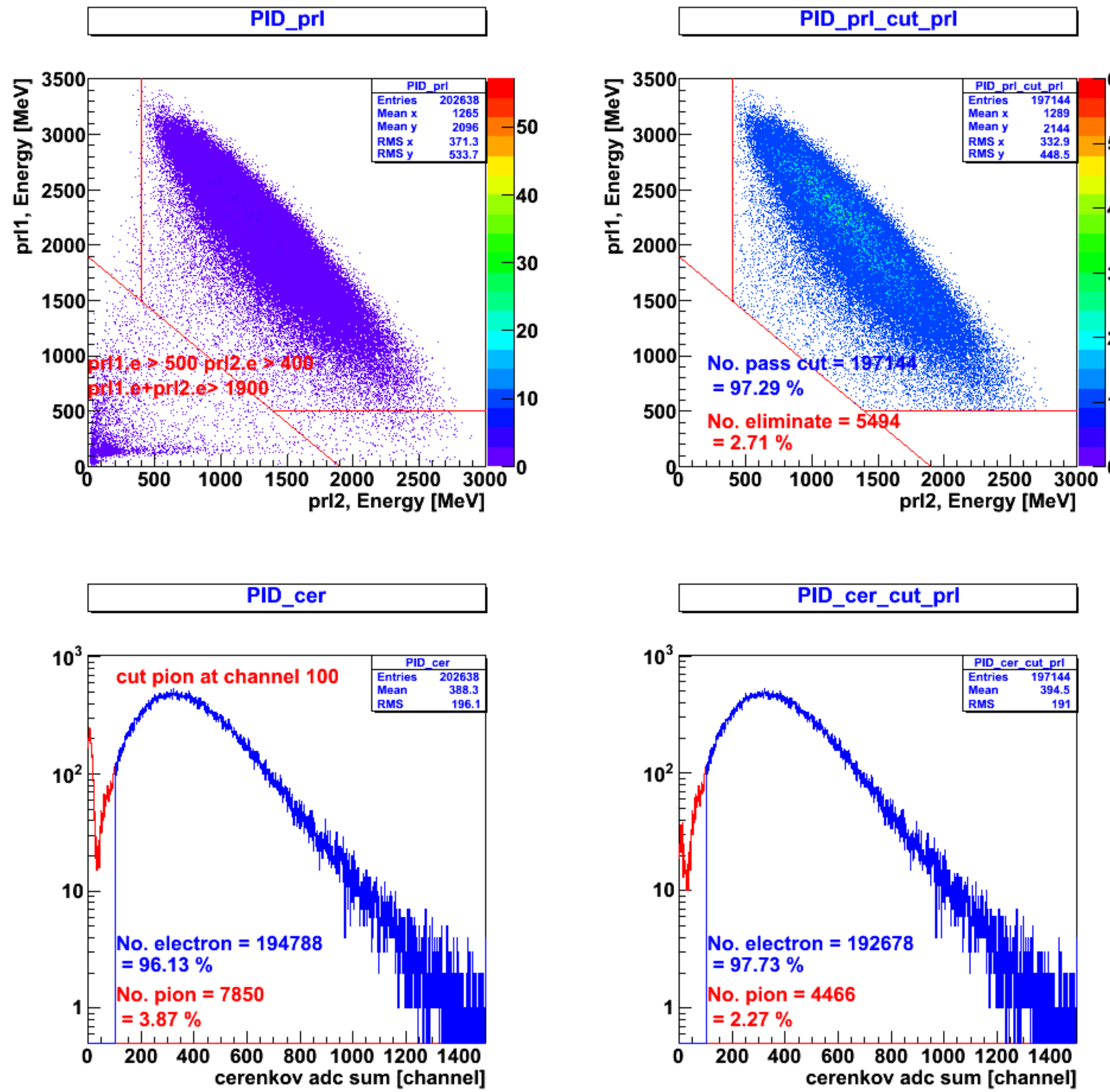
Top left: prl1 vs prl2

Bottom left: cer with identify pion and electron

Top right: prl1 vs prl2 with cut on prl1 > 500, prl2>400 & **prl1+prl2> 1900**

Bottom right: cer with all prl cut.

With this cut, we have **97.73% electron 2.27% pion contamination. Lost 2.71% of data**



Pion Rejecter Efficiency

All plots has cut on abs(vertex) < 0.8 m ,
abs(theta)<0.07,
abs(phi)<0.04,
abs(dp)<0.05
No edtm, and Trigger 3

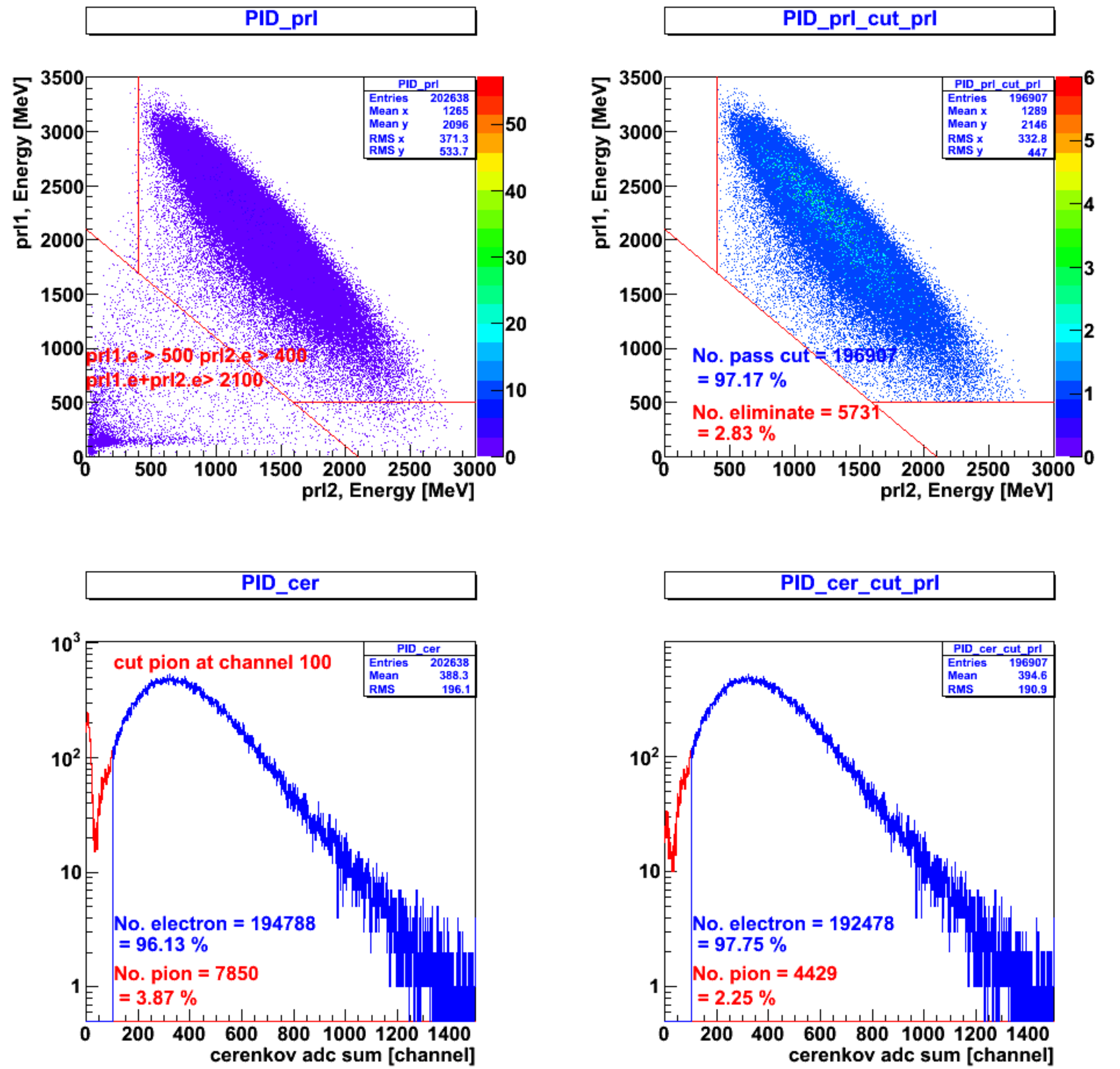
Top left: prl1 vs prl2

Bottom left: cer with identify pion and electron

Top right: prl1 vs prl2 with cut on prl1 > 500, prl2>400 & **prl1+prl2> 2100**

Bottom right: cer with all prl cut.

With this cut, we have **97.75% electron 2.25% pion contamination. Lost 2.83% of data**



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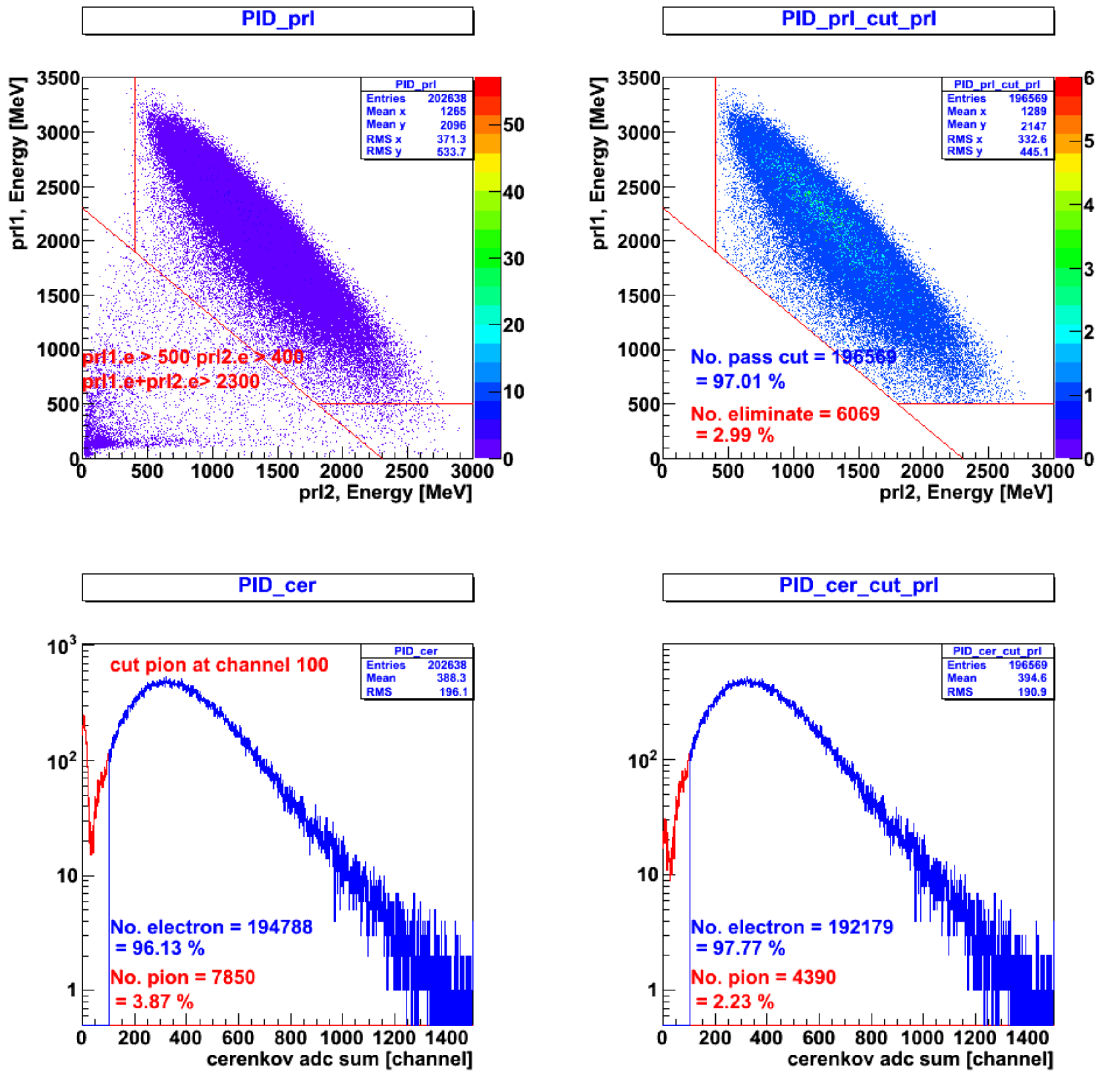
Pion Rejecter Efficiency

All plots has cut on abs(vertex) < 0.8 m ,
abs(theta)<0.07,
abs(phi)<0.04,
abs(dp)<0.05
No edtm, and Trigger 3



Top left: prl1 vs prl2

Bottom left: cer with identify pion and electron

Top right: prl1 vs prl2 with cut on prl1 > 500, prl2>400 & **prl1+prl2> 2300**

Bottom right: cer with all prl cut.

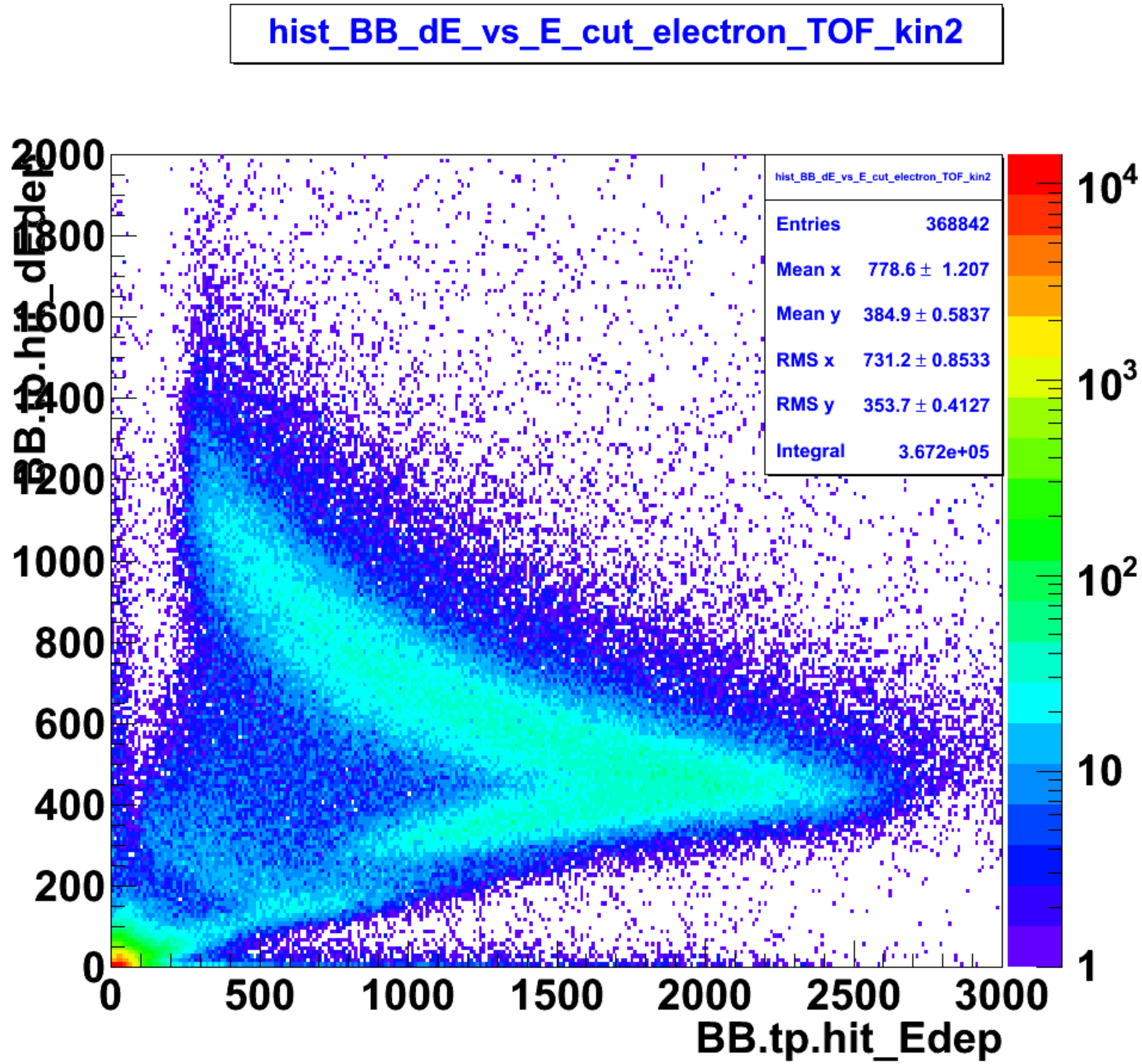
With this cut, we have **97.77% electron 2.23% pion contamination. Lost 2.99% of data**

BigBite

dE vs E
after calibration

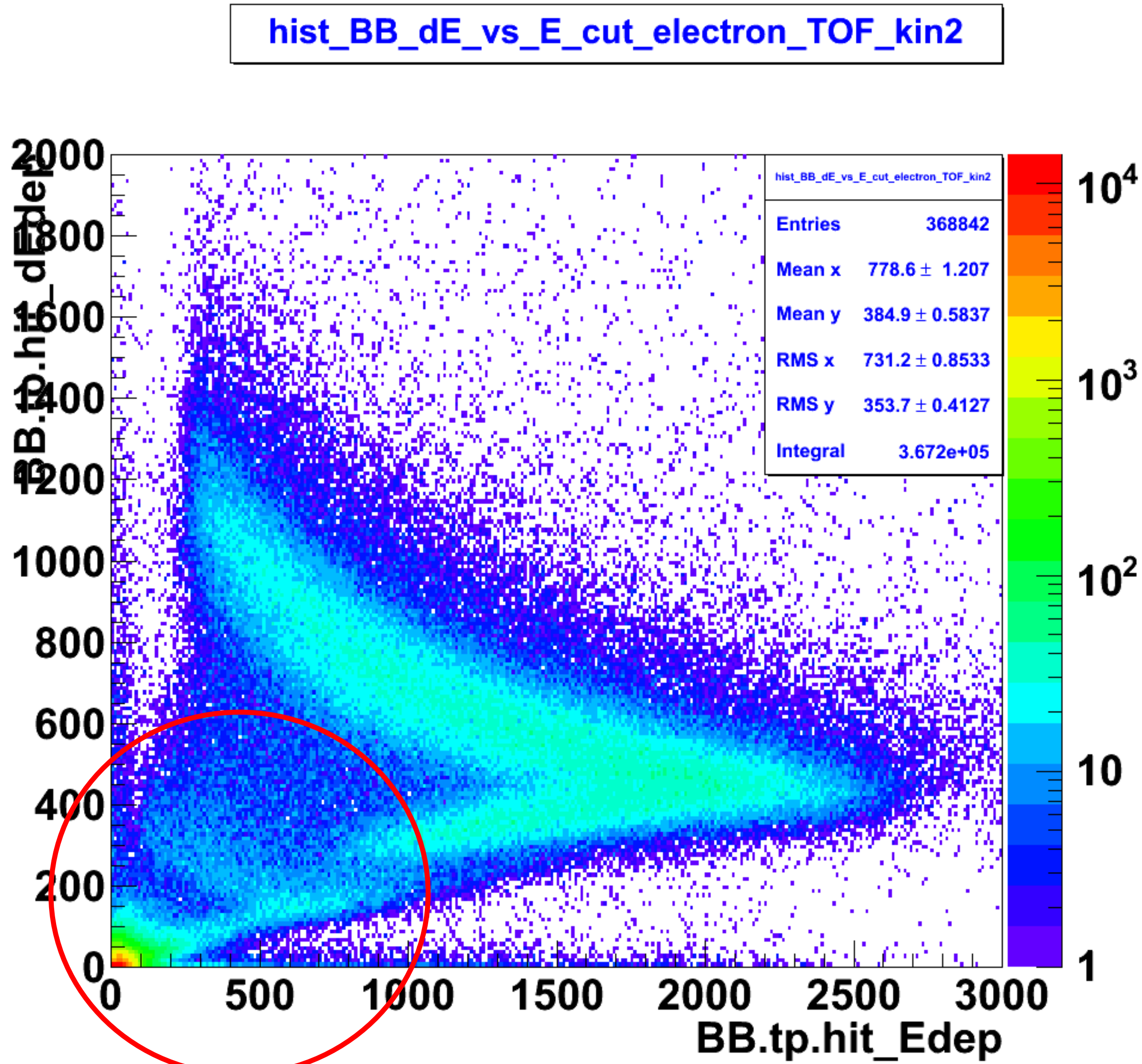
From production data

Within the time window of electron



Pion PID in BB

Within electron tagging we still see the pion in the bigbite.



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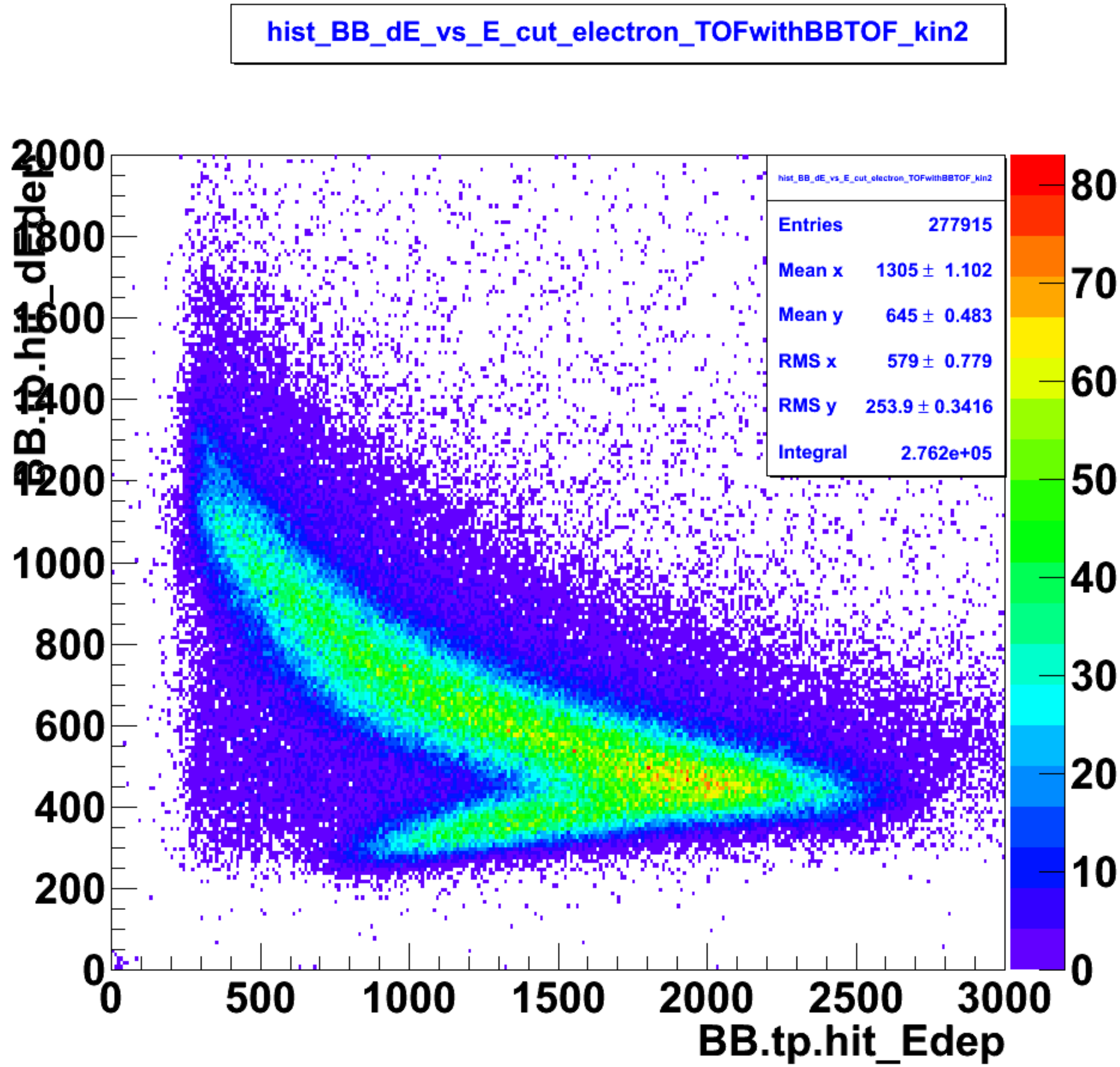
dE vs E

Demand the coincidence time between electron and bigbite.

The MIP is DISAPPEAR.

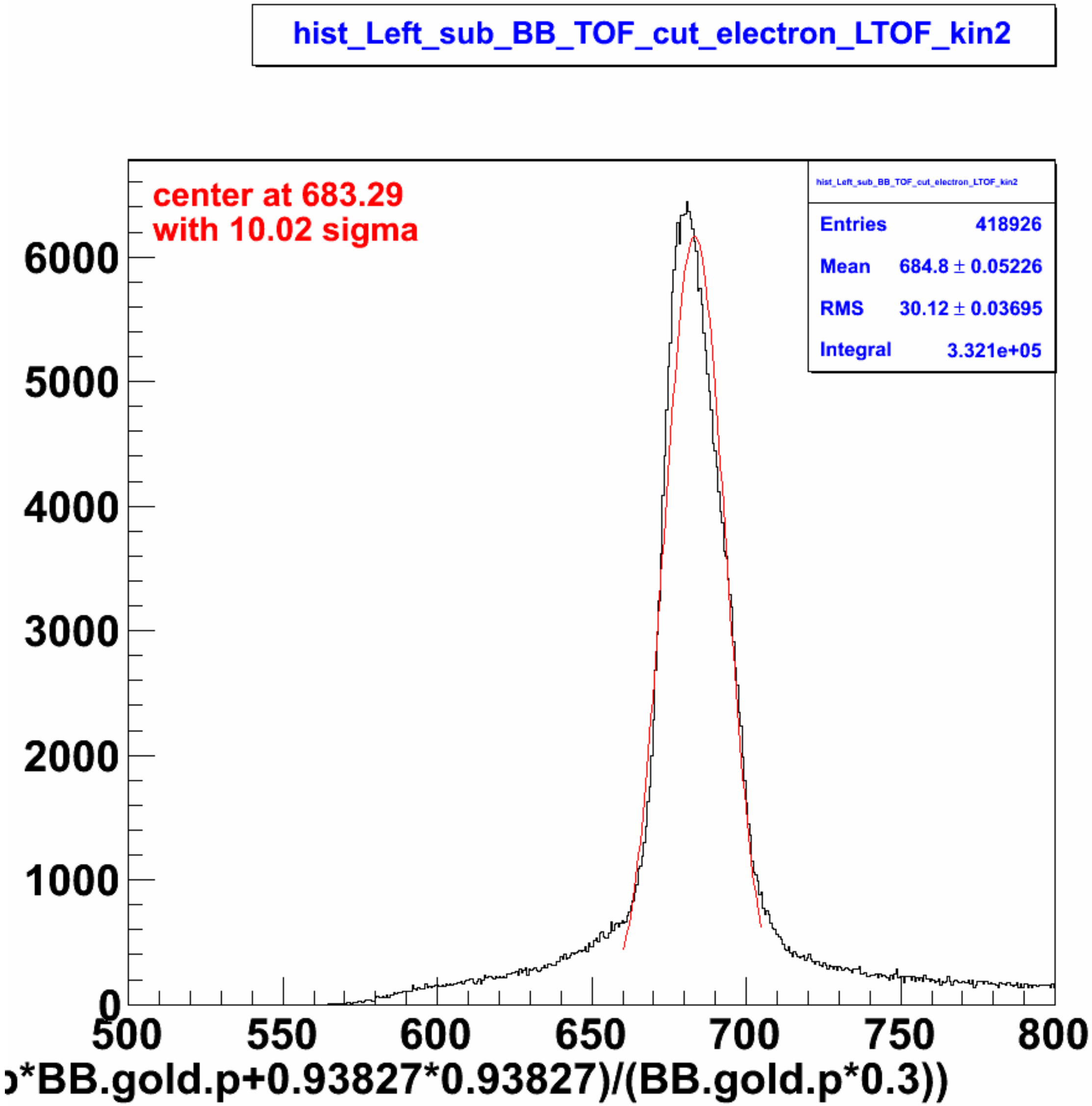
I think this is the case for the Right arm too if we can make the coincidence time between them after the S2 TOF calibration at full path length to the target.



Coincidence time electron & Bigbite

Can be improved with path-length after optics calibration for bigbite.

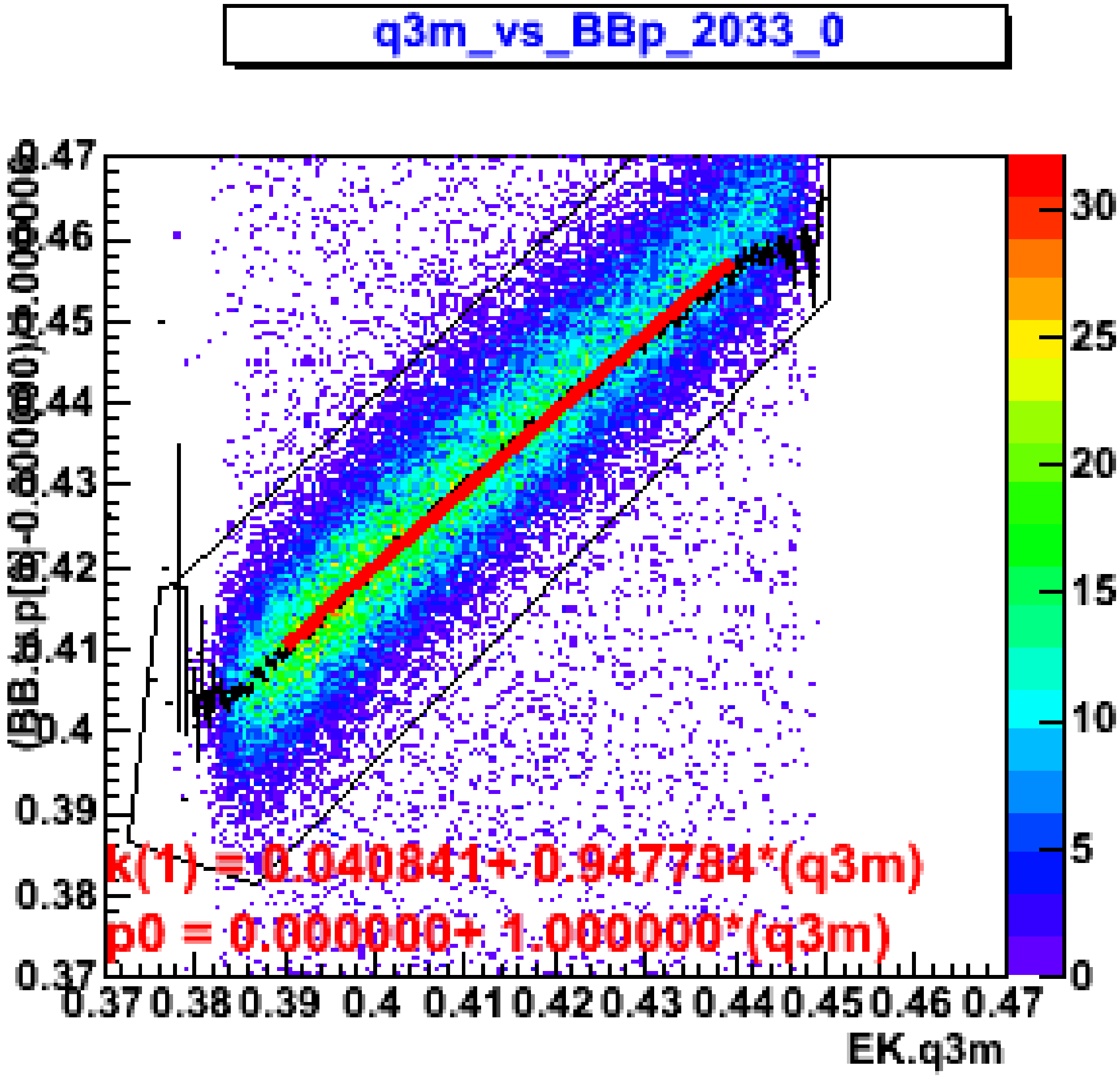
Unfortunately, I erase all my BigBite timing rootfile. So I don't have my timing for BigBite to show. (Next time).



Momentum from Analytical Model

To what error, can we trust this reconstruction?

The plot on the right show the Bigbite Analytical Momentum vs |q3| , for the reaction H(e,e'p)



The fit line shows that the analytical momentum

BB.p = 0.9477*|q3|+0.04

For momentum range **0.38 to 0.45 GeV**

Momentum from Analytical Model

The plot on the right show the Bigbite Analytical Momentum vs |q3| ,

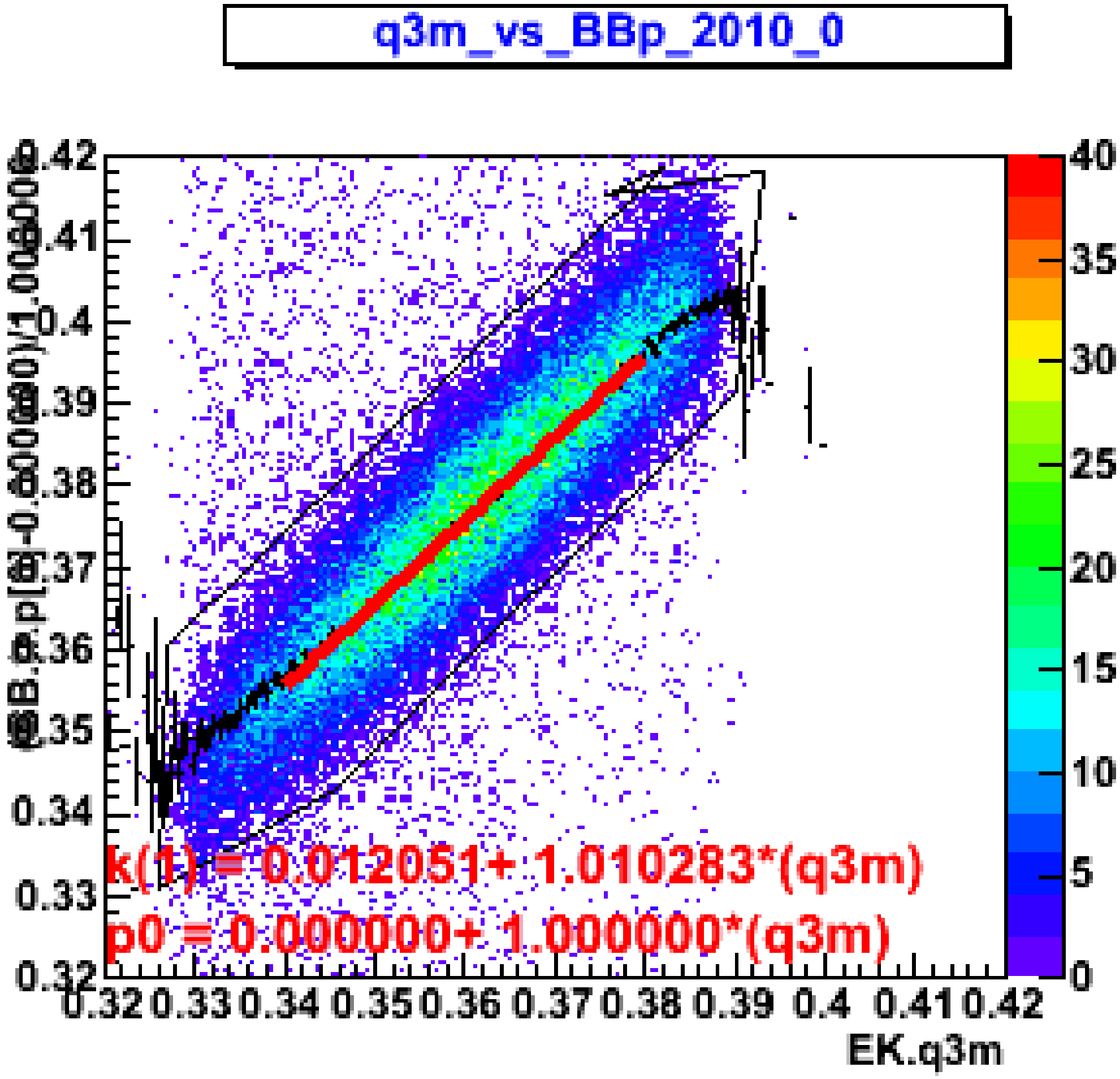
for the reaction H(e,e'p)

The fit line shows that the analytical momentum

BB.p = 1.010283*|q3|+0.01

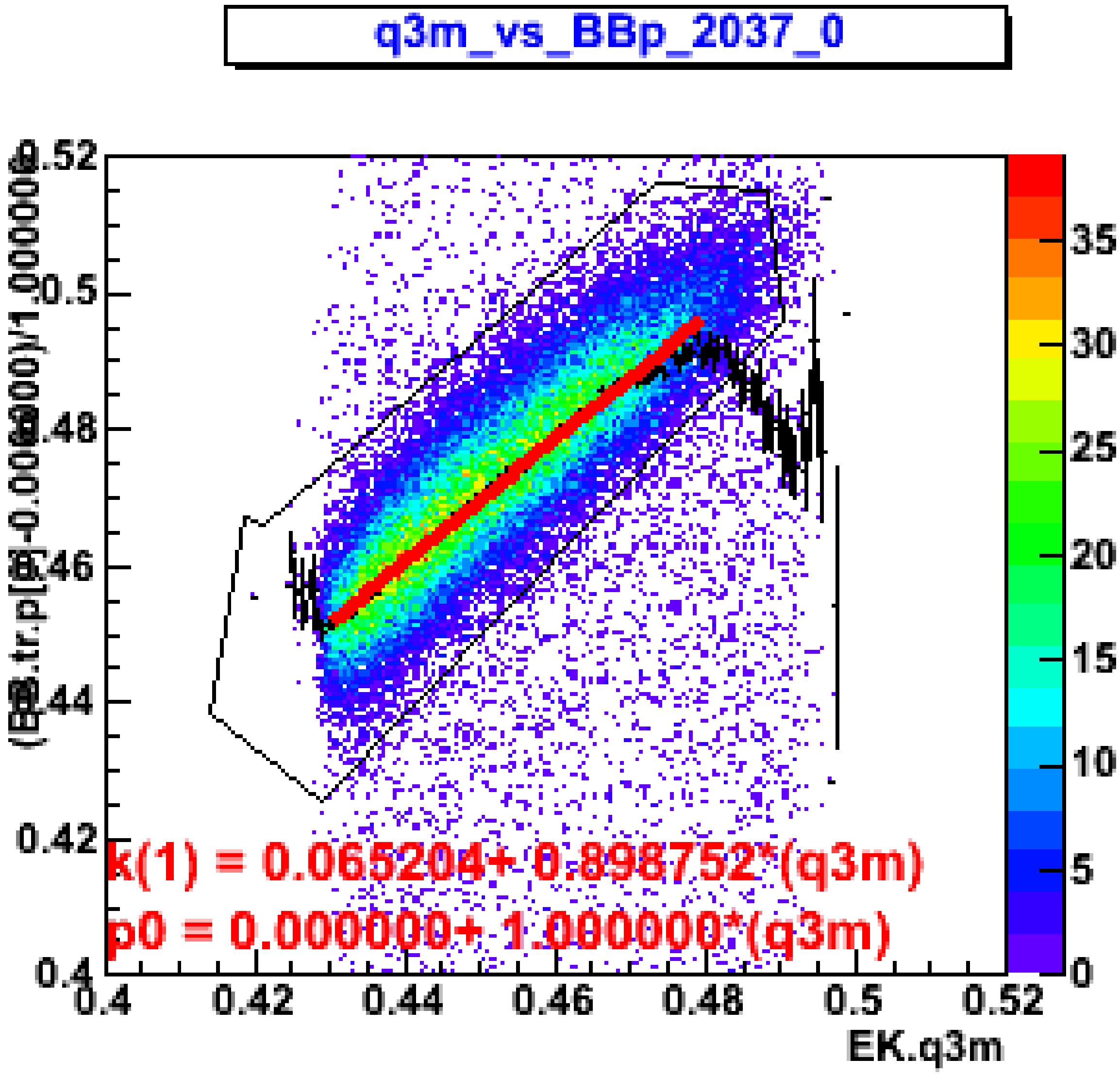
For momentum range

0.33 to 0.39 GeV



Momentum from Analytical Model

The plot on the right show the Bigbite Analytical Momentum vs |q3| , for the reaction H(e,e'p)



The fit line shows that the analytical momentum

BB.p = 0.898752*|q3|+0.06

For momentum range

0.425to 0.48 GeV

BigBite Analytical Model

The Comparison table

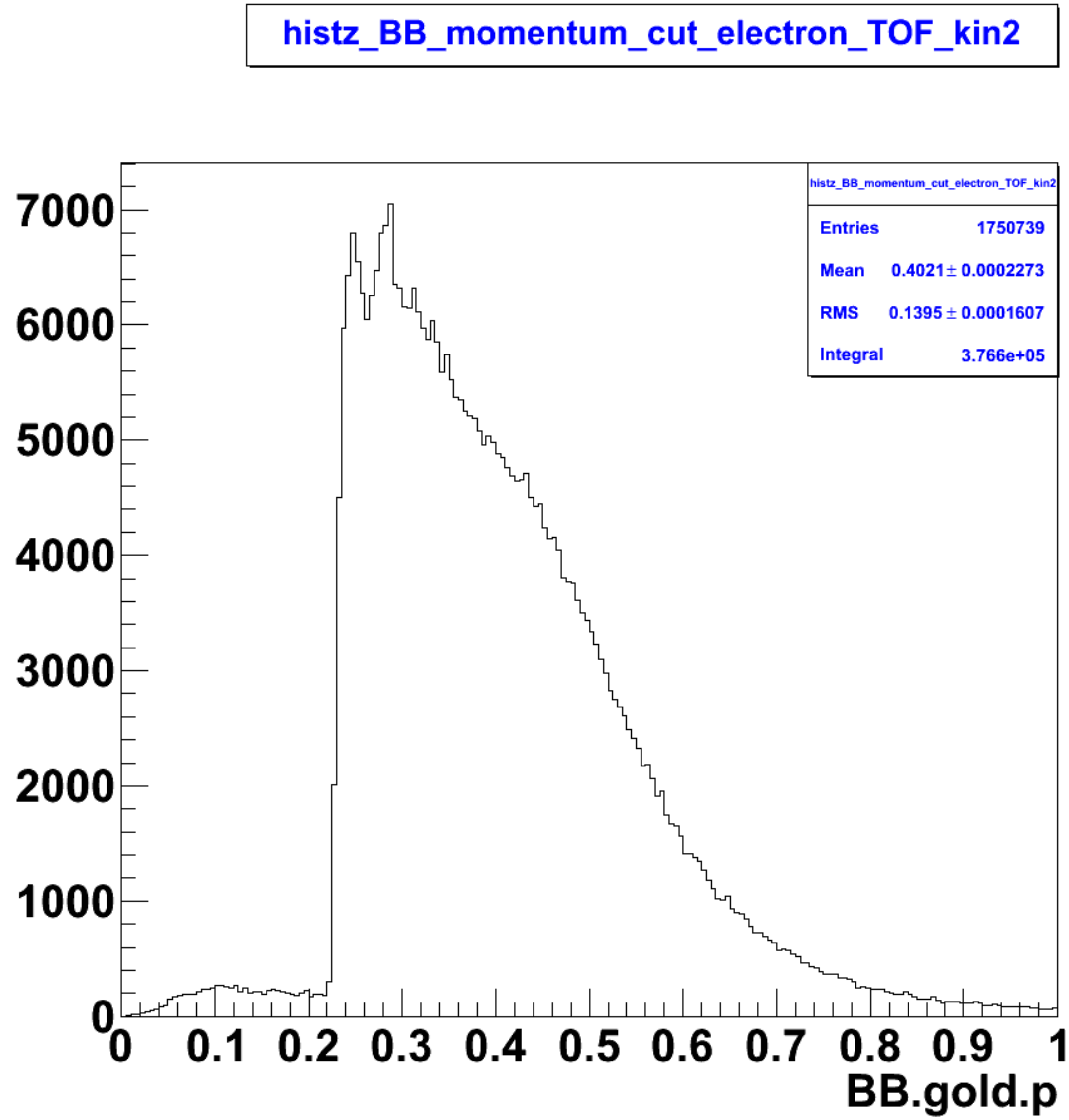
Momentum range (GeV)	Compare to |q3| from electron arm
0.33 to 0.39 GeV	BB.p = 1.010283*|q3|+0.01
0.38 to 0.45 GeV	BB.p = 0.9477*|q3|+0.04
0.425to 0.48 GeV	BB.p = 0.898752*|q3|+0.06

Note that, the energy lost, electron dp error, target cm momentum, and etc. are not take into account.

BB Momentum from Analytical Model

Cut electron TOF window

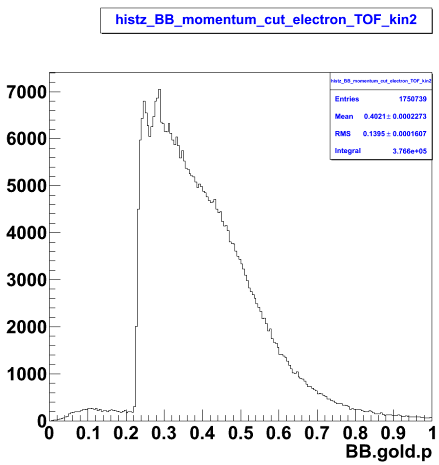
Kinematics 2

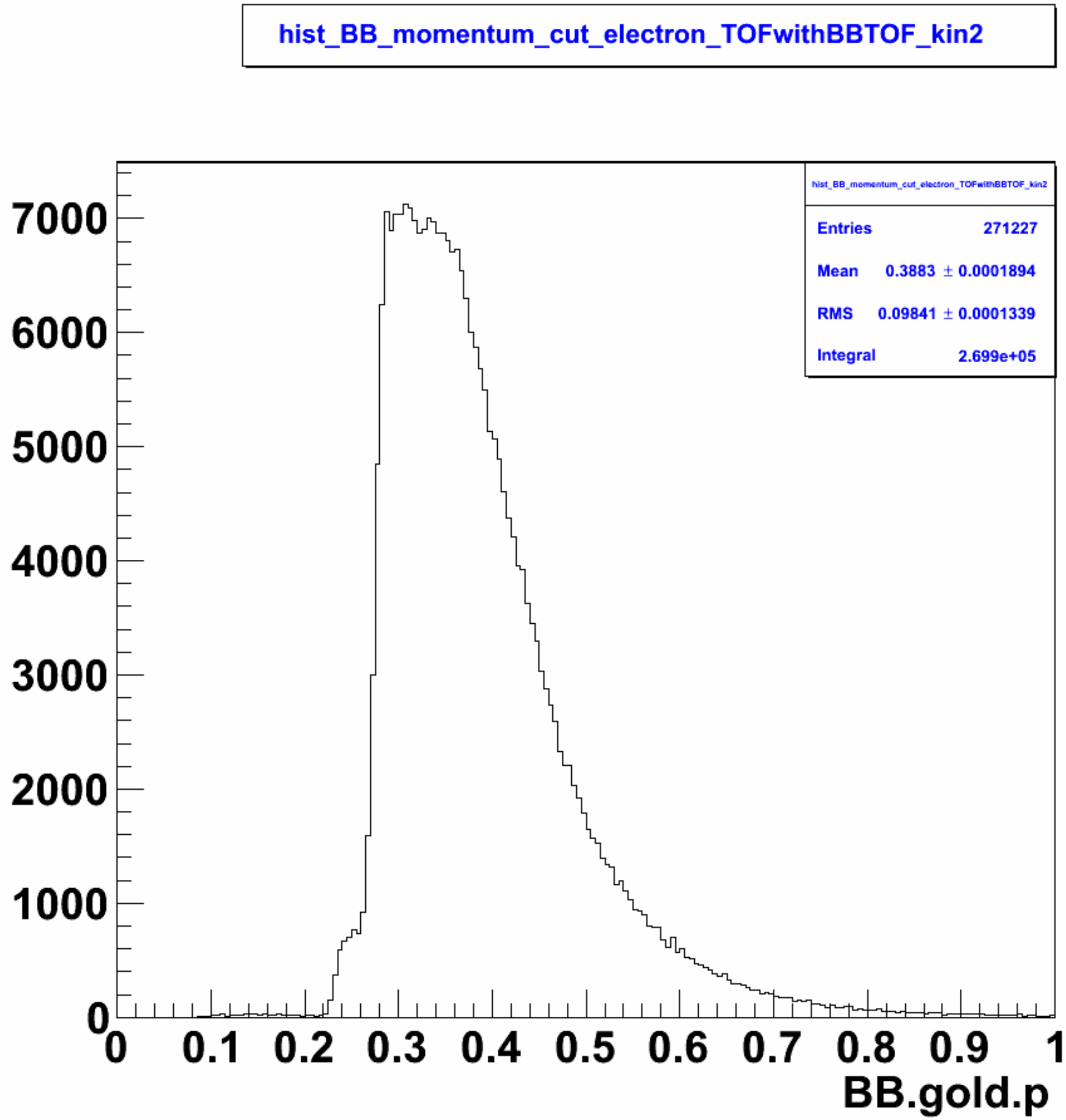


BB Momentum from Analytical Model

With coincidence time between the electron and bigbite

Kinematics 2





MORE FIGURES …. LET TAKE A LOOK?

I THINK I WILL SAVE THEM FOR NEXT TIME…

^___________^

HAVE A NICE DAY…