TOF Calibration and Development

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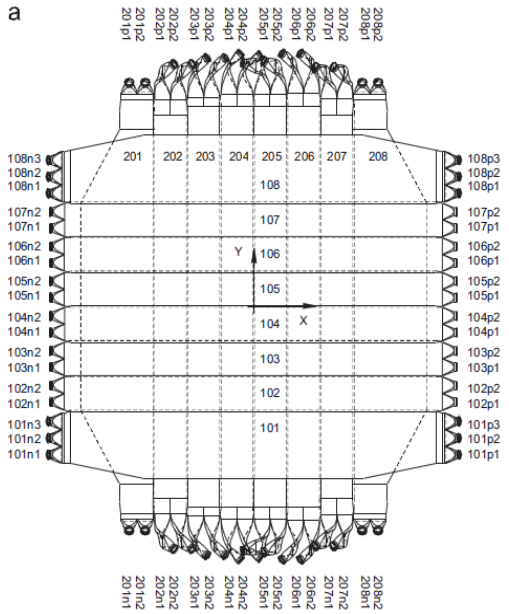
Outline

- 1: Introduction
- 2: Time Calibration
- 3: Coo Calibration
- 4: Software Development
- 5: Summary and Outlook

Geometry



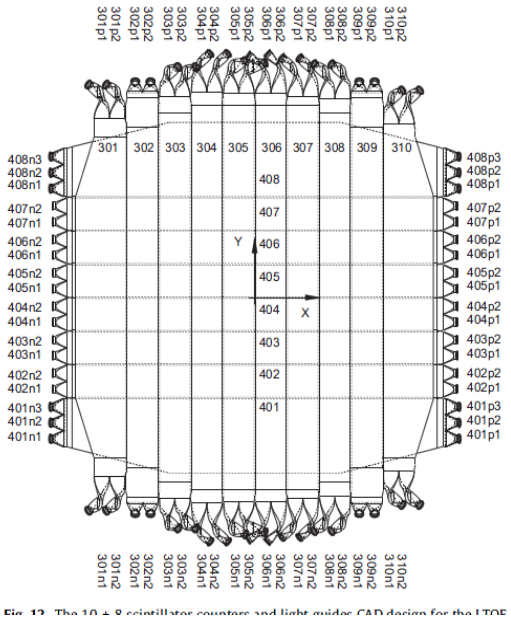
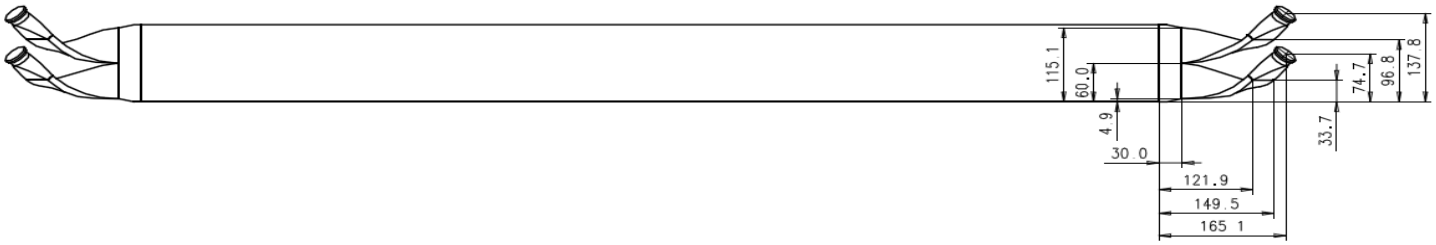
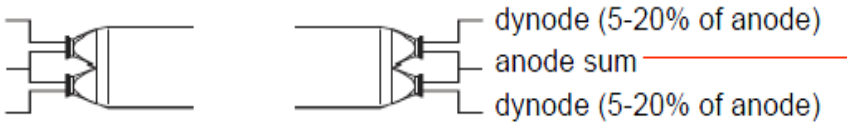


Fig. 12. The 10 + 8 scintillator counters and light guides CAD design for the LTOF.

- 1: TOF 4 Planes
- 2 UTOF+LTOF 8 8 10 8 Counters
- 3 UTOF Z 61~66cm LTOF Z -66~-61cm
- 4 Counters Length 110~135cm
- 5 Counters Width 12cm(18~26cm)
- 6 0.5cm overlap with nearby Counters



TOF Readout



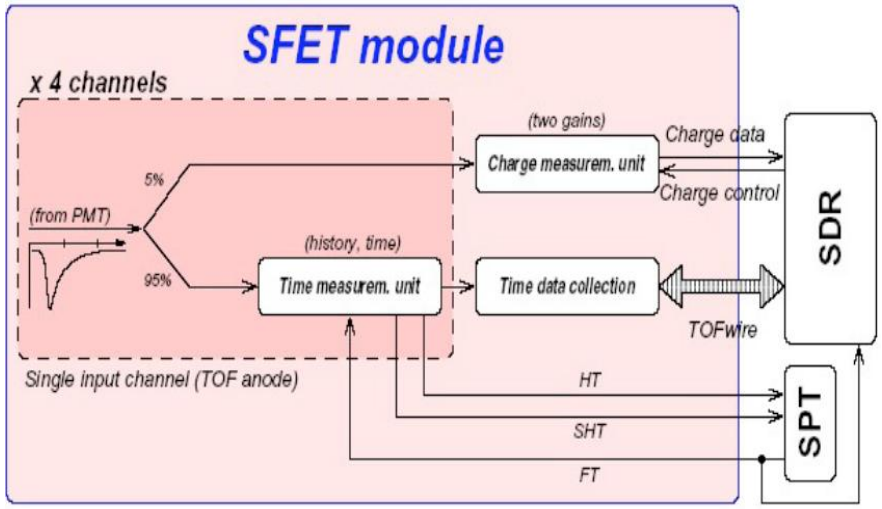
1: each side combine 2(3)PMTs to get anode signal .

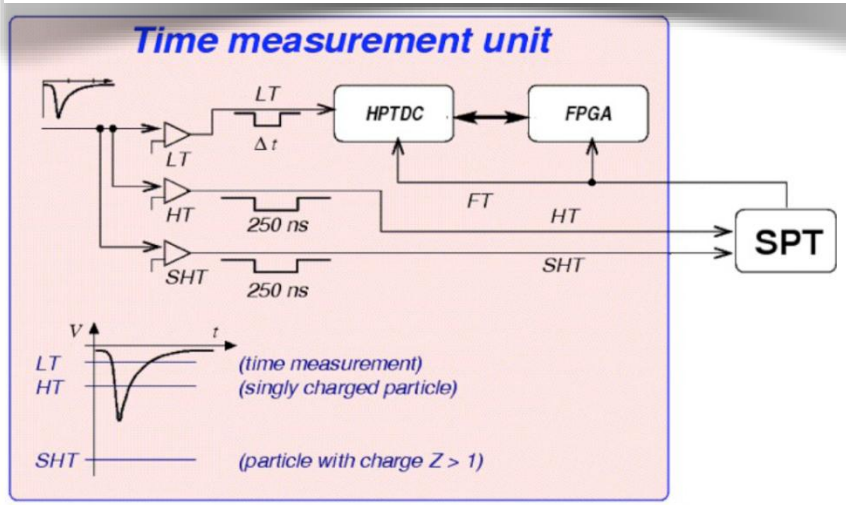
95% for Time measurement,

5% for charge measurement

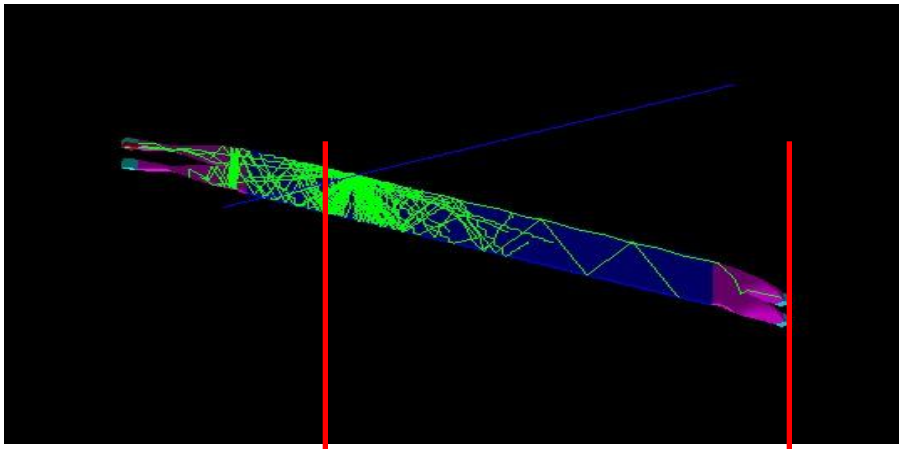
2:Pulse go to different Threshold LT HT SHT. LT mainly for Time measurement

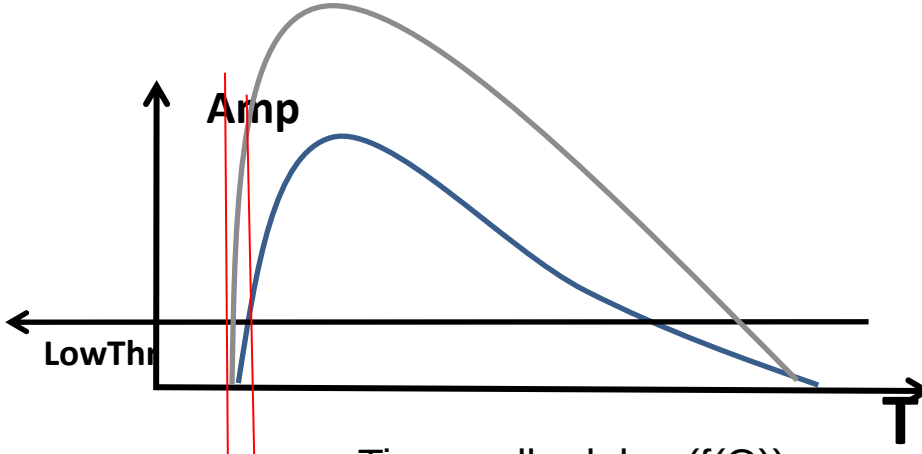
3:TDC chip ~25ps count resolution





Time Measurement





Time walk delay (f(Q))

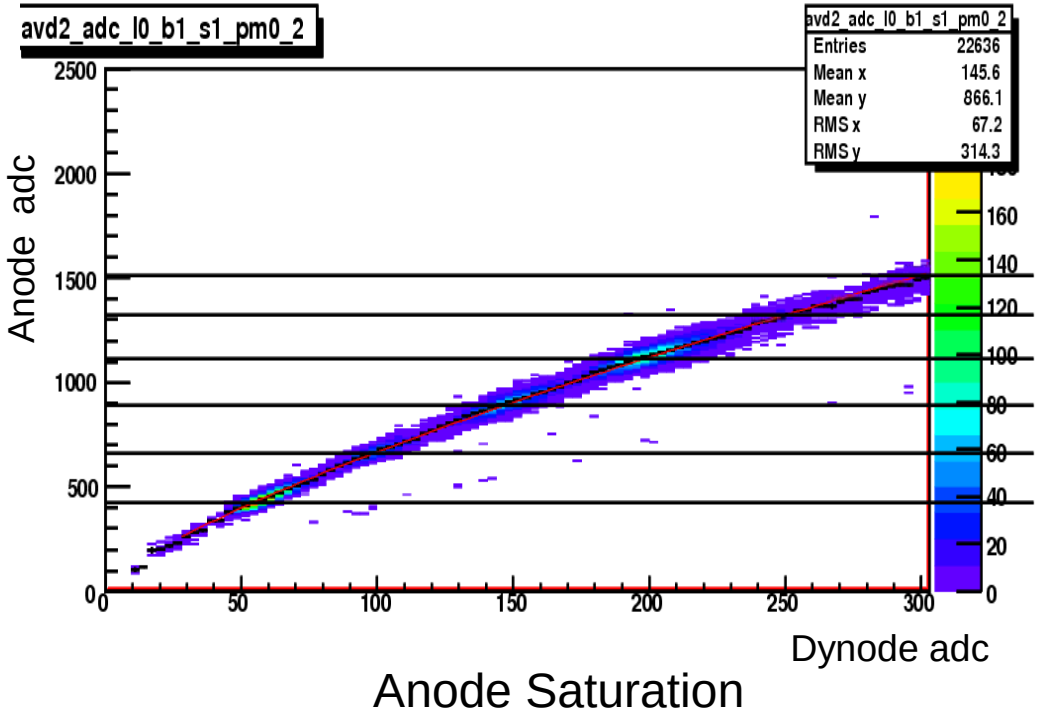
Transmit delay(x/v)

cable electronic delay(tdel)

$$Tmes = FT - LT = -(Traw + x/v + tdel + f(Q)) + TTrig$$

Time Calibration

Time walk delay



Anode Saturation

- 1: Different pulse has different Time Delay f(Q) , need ADC correction.
- 2: Anode ADC behave strange. Non-linear saturation come very soon.
- 3 Assume saturation due to ADC electronic. Integral Time measurement pulse will not proportion to charge ADC
- 4 This saturation can be describe by Anode=(Dynode) ^{a}

Tmes=FT- LT =-(Traw+x/v +tdel+f(Q))+TTrig

f(Q)=S/sqrt(Q) => f(Q)=S/Q^{p}(According to saturation curve)

Calibration Algorithm

-Tmes=Traw+x/v+tdel+S/Q^p-Trig

How to calibrate TDC readout 34PMT × 2Side => v tdel S p ??

Procedure of Chi2:

1: Mean Time of Same Counter Two Side(Assuming two side v0=v1=v p0=p1=p)

-Tm0=Traw+(L-x)/v0 +tdel0+S0/Q^{p0} –Ttrig

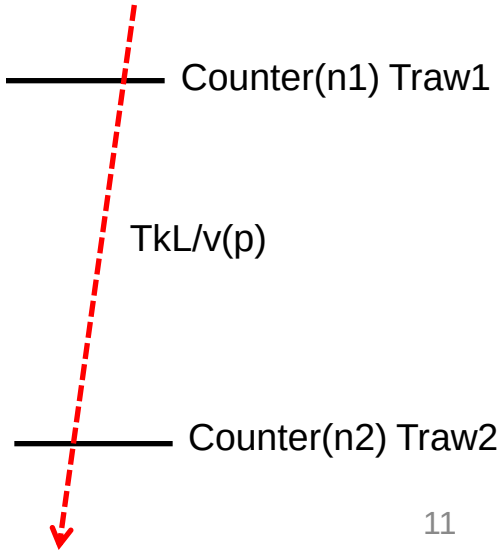
-Tm1=Traw+ x/v1 +tdel1+S1/Q^{p1} –Ttrig

-Traw=((T0m+T1m)+L/v +(S0/Q^p +S1/Q^p))/2-Ttrig+Tdel

2: For 2 Layer Counter n1 n2(Fixed):

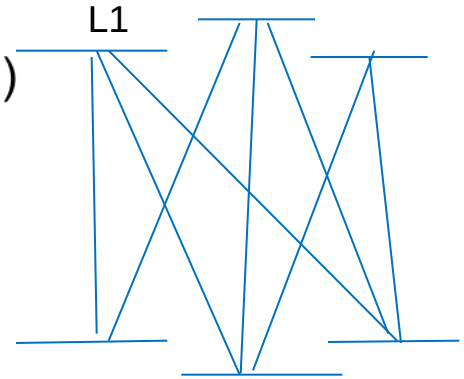
(Traw2-Traw1) =f(2Tdel, 4S, p)=TkL /v(p) (expect dt)

$X|_{n1n2}{}^2$=$\sum_{n1n2}$ (Traw$|_{n2}$-Traw$|_{n1}$ –TkL$|_{n12}$/v(p)))^2



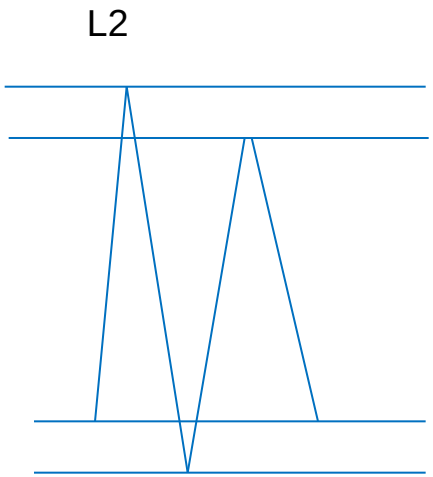
3: For Fixed 2 Layer: L1 L2 (sum all 2 bars pattern $A^1_{n1}A^1_{n2}$ Chi2)

$X|_{l1l2}{}^2 = \sum_{Cn1n2} X^2_{l1n1l2n2}$



4: For 4 Layers (pattern $C_4{}^2$- 2)

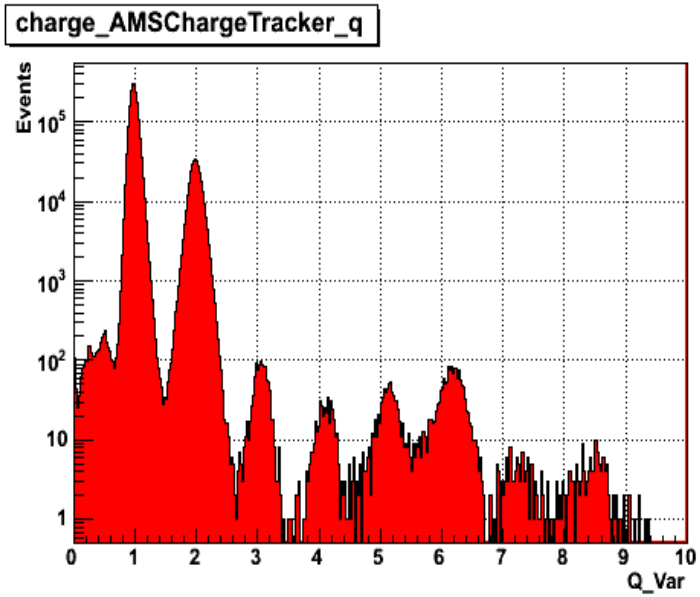
$X|_{global}{}^2 = X^2|_{l0l2} + X^2|_{l0l3} + X^2|_{l1l3} + X^2|_{l1l4}$



5: Final Minimization (68 S+ 34C +1p-1=102 Par)

Minimize this complicate $X|_{global}{}^2$ to do all Calibration once

Calibration Events Selection



1： 1 Track && 1 Particle && 1 TrdTrack

2: Track ChisX<50 ChisY<10 && YHit>=5 XHit>=4

3： 4 TOF Cluster&&all used by Beta

4： no glue TOFRawCluster && both sides are has signal

5: Rigidity>20GeV
proton beta>0.998(Z/m=1) nucleus beta>0.995(Z/m=0.5)

Data: B550+B584(Comparesion): 2011/05/19->2012/05/16

Pulse Shape Tracing and Data Sample

1： Time walk delay relate to pulse shape

-Tmes=Traw+x/v+tdel+S/Q^p-Trig

p and S->Relate to pulse shape(saturation)

2: Should select proper sample to do calibration, to follow unknown pulse shape for different charge

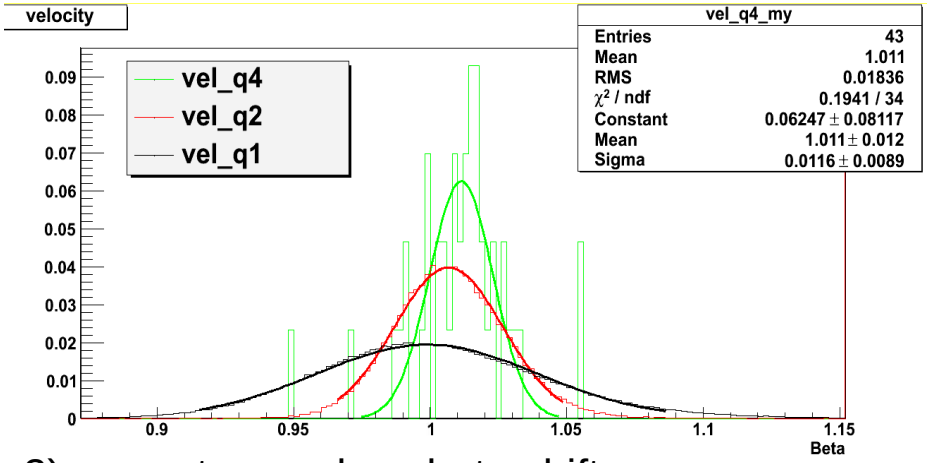
3: Most Cosmic ray is proton, very low pulse. However high rigidity nucleus is too rare to do dynamic calibration

In order to balance this unbalance, Introduce some trick

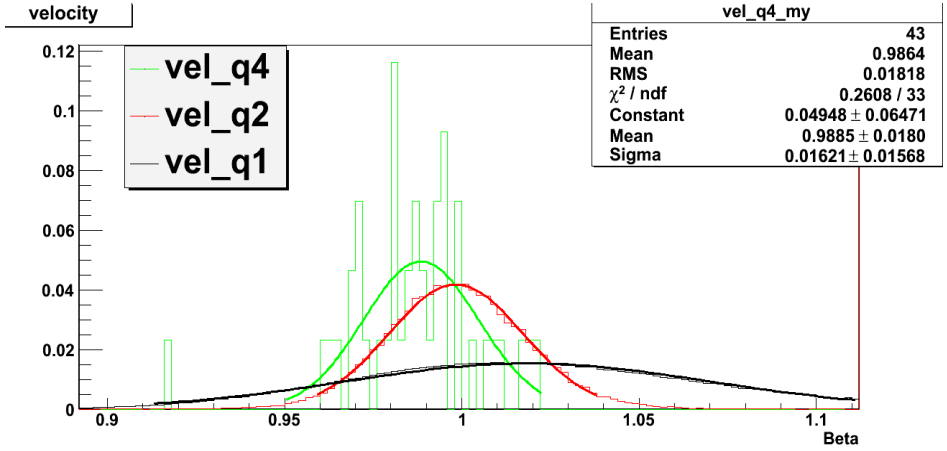
Calibration Sample and Testing

Natural Cosmic ray sample(8 days data for testing)

- 1:Proton+Helium+Nucleus(Z>2): =>nucleus beta shift （proton dominate）

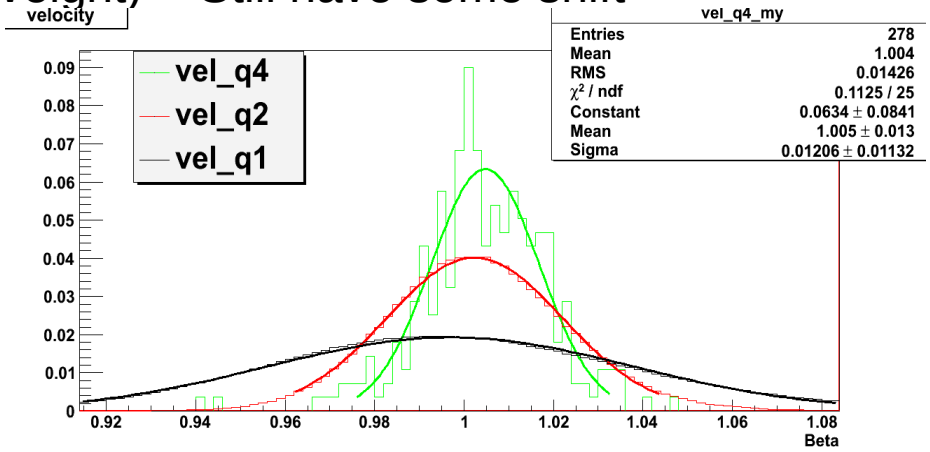


2:Helium+Nucleus(Z>2): =>proton nucleus beta shift

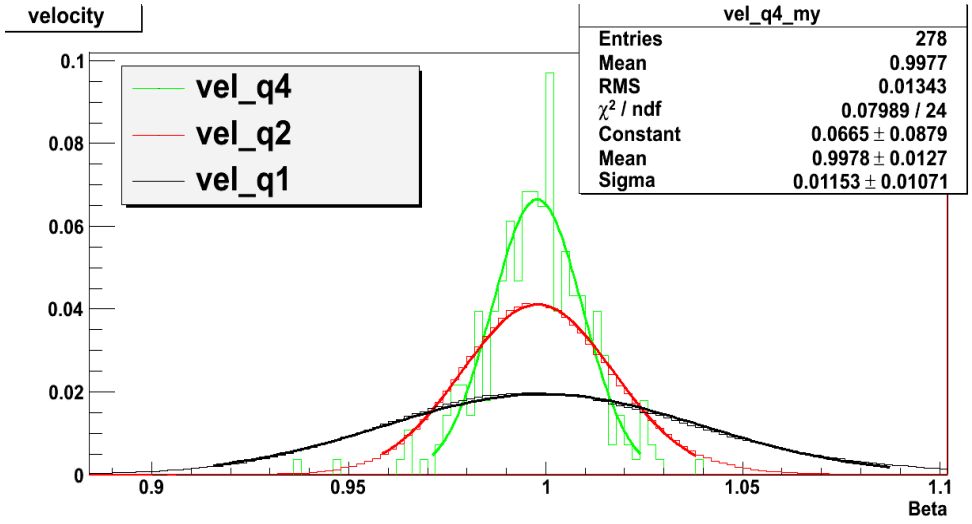


Final Flavoring

3: Proton+Helium(+Weight)=>Still have some shift



4: Proton+Helium(+Weight1)+Nucleus(+Weight2)=>OK

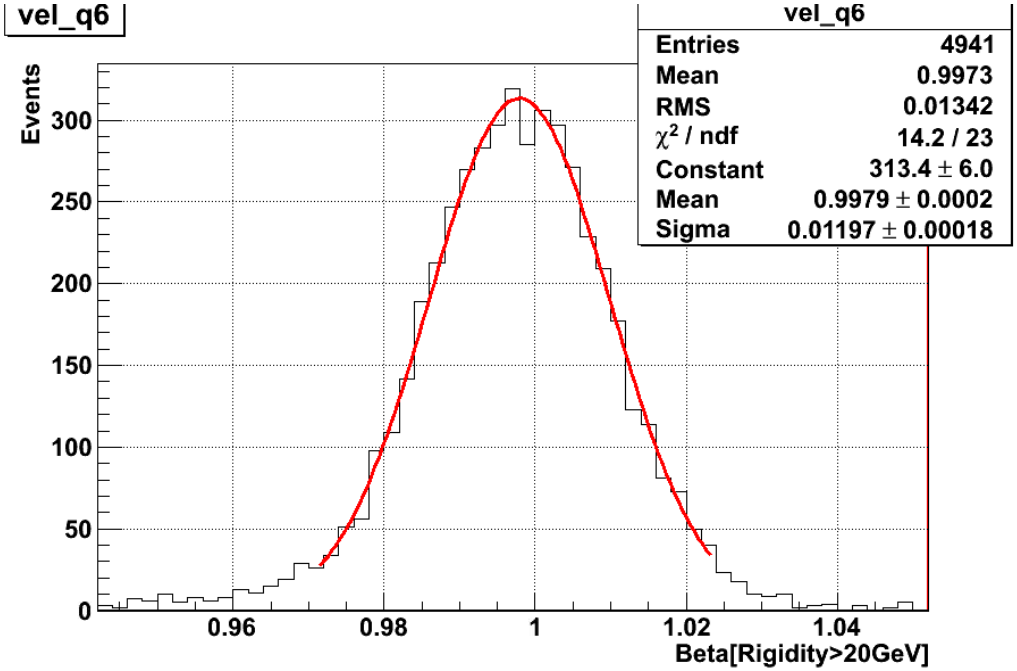


Calibration Time Windows and Result

8days per calibration

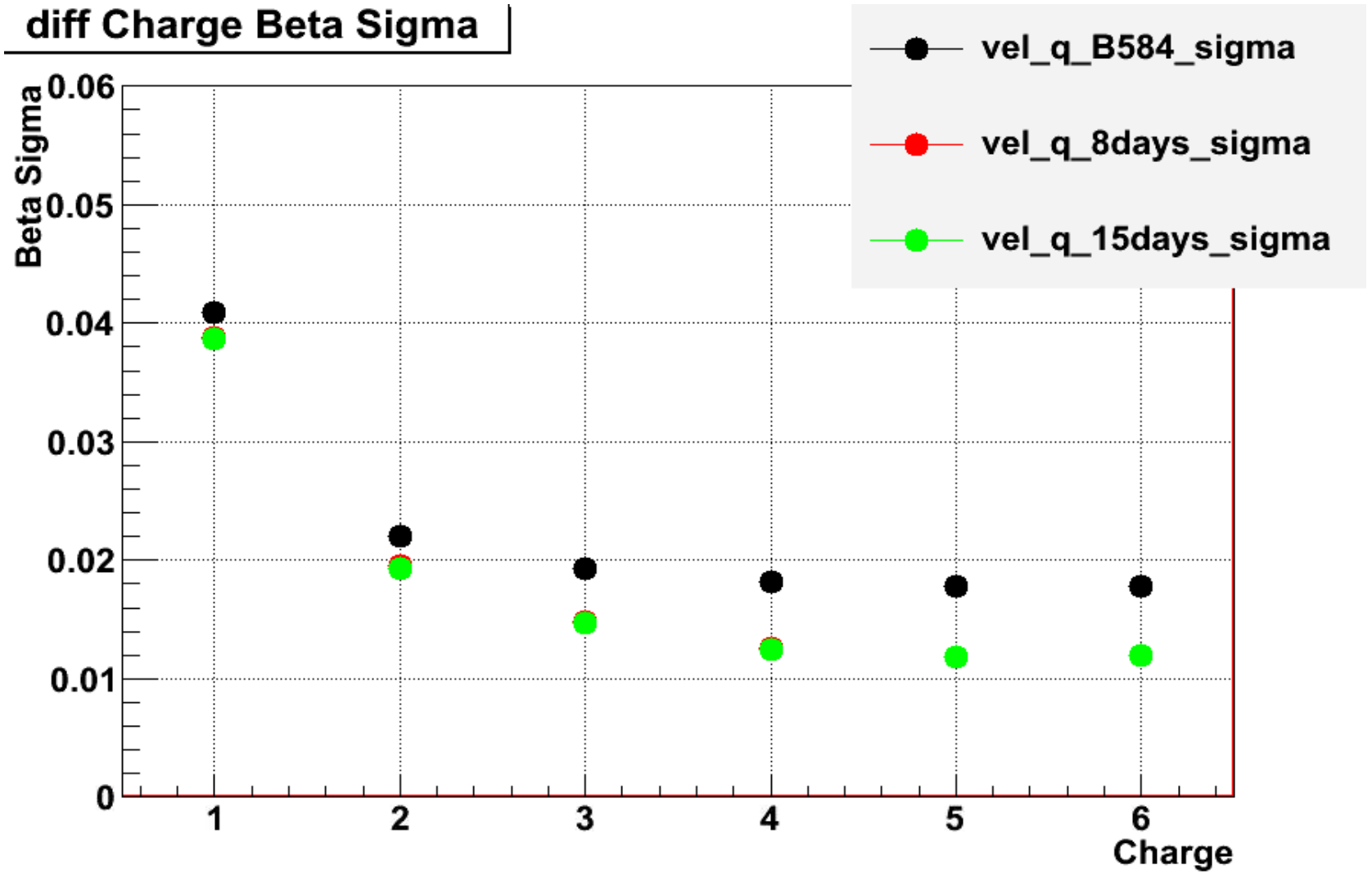
15days per calibration

=>2011/05/19->2012/05/16

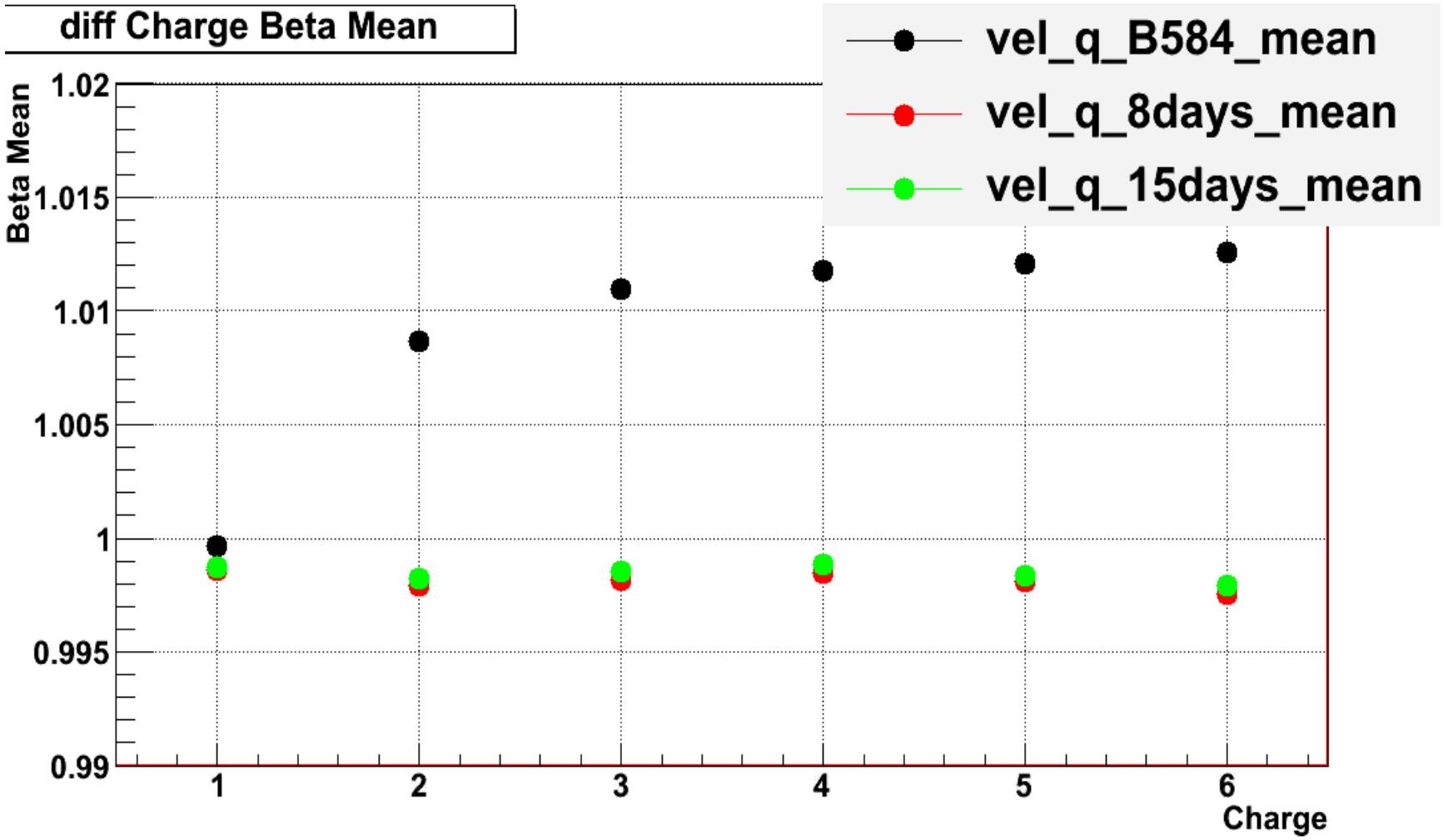


Carbon beta resolution 1.2%~48ns（15days per calibration）

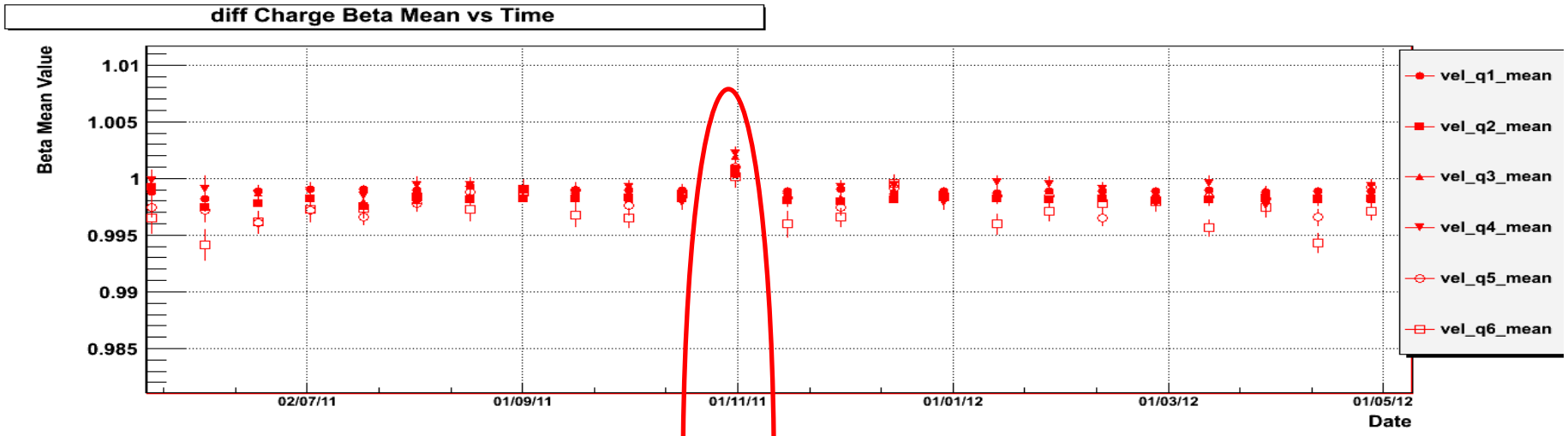
Beta Sigma for Different Charge

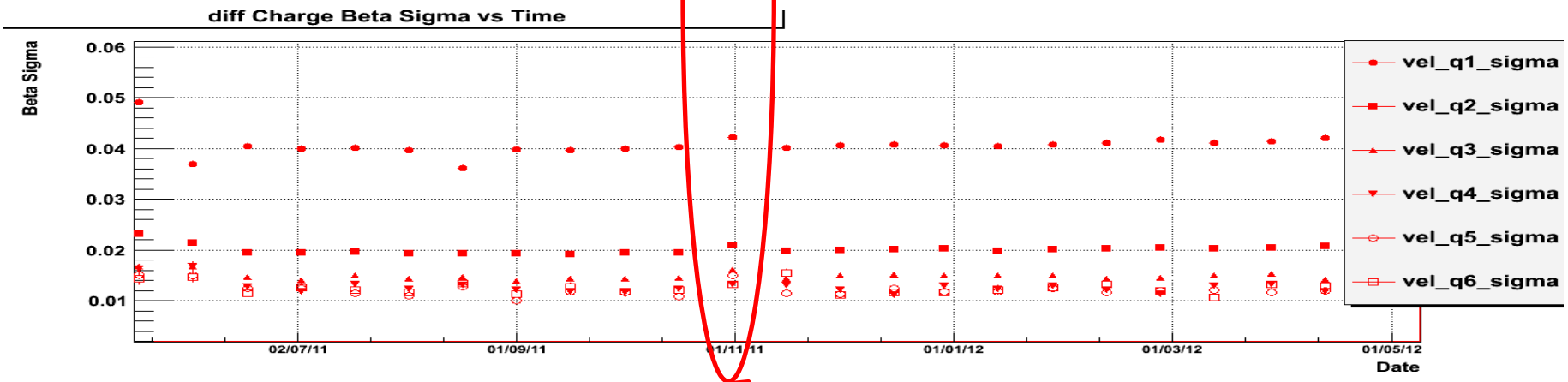


Beta Mean for Different Charge



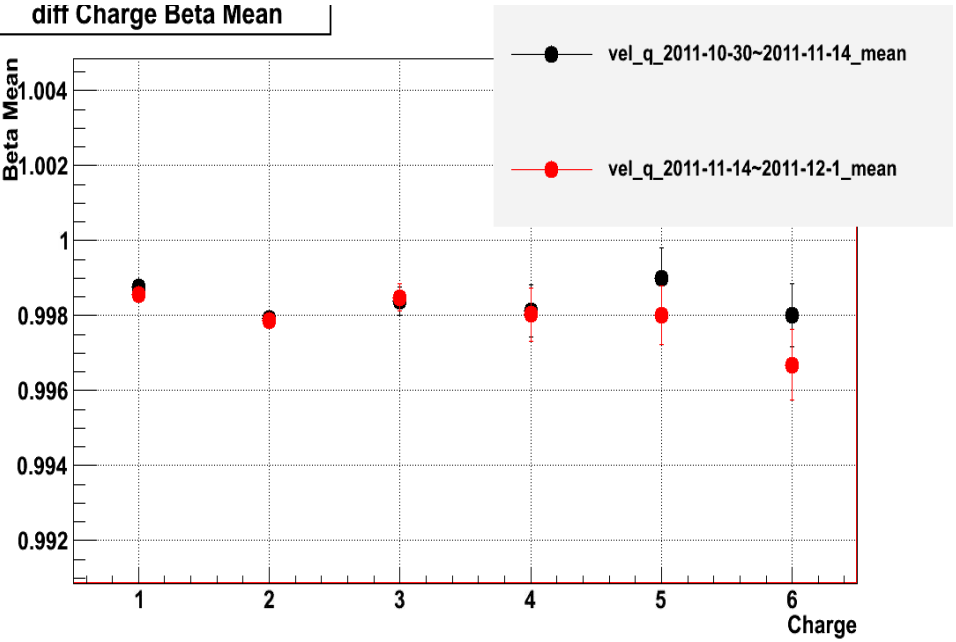
Calibration VS Date（15days per）

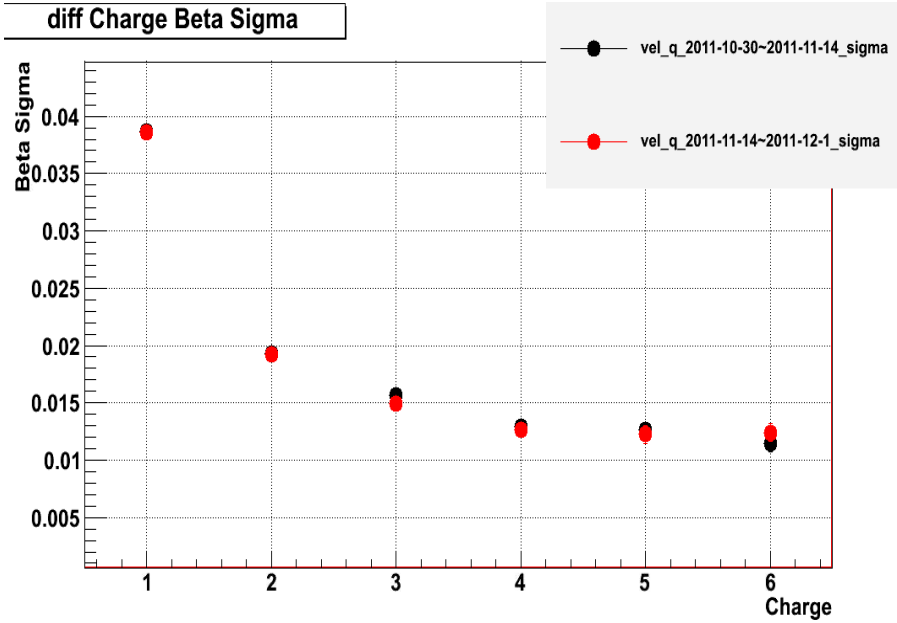




board change point: run1321288304

Change Board point has been Fix





Coo Calibration

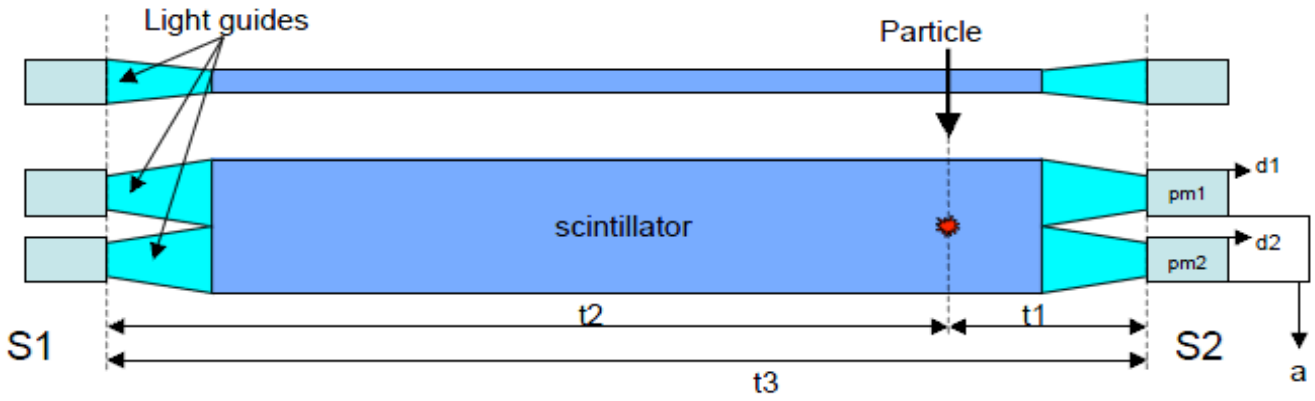
Time for Longitude Coo Measurement

1: TOF Counter 2side Time different can be used for longitude Coo Measurement.

2: This measurement can be used for Tracker X identification….

3: For Beta measurement, This is also important to match with tracker, This imply two side time coherence measurement quality(Chi2C)

4: Can be used for recover bad side information if one side lost, or refind LT if it's Bad (No HT association or wrong LT finding(~30ns dead time) for one side)



Calibration algorithm

One Counter 2 side:

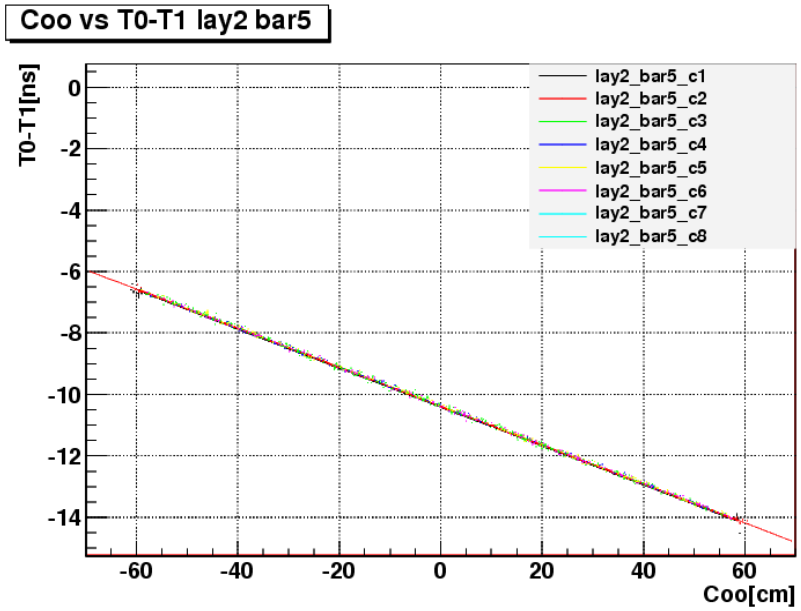
-Tm0=Traw+(L-x)/v0 +tdel0+S0/Q^{p0} −Ttrig

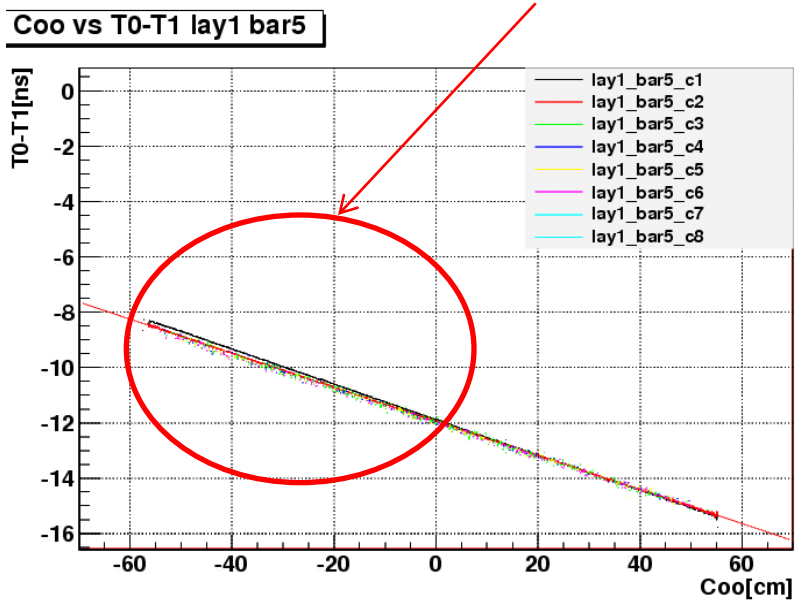
-Tm1=Traw+ x/v1 +tdel1+S1/Q^{p1} −Ttrig

x= ((tm0+ S0/Q^{p0}-tm1-S1/Q^{p1})/2.+C)*v= vdt+C1 (v=2 v0*v1/(v0+v1))

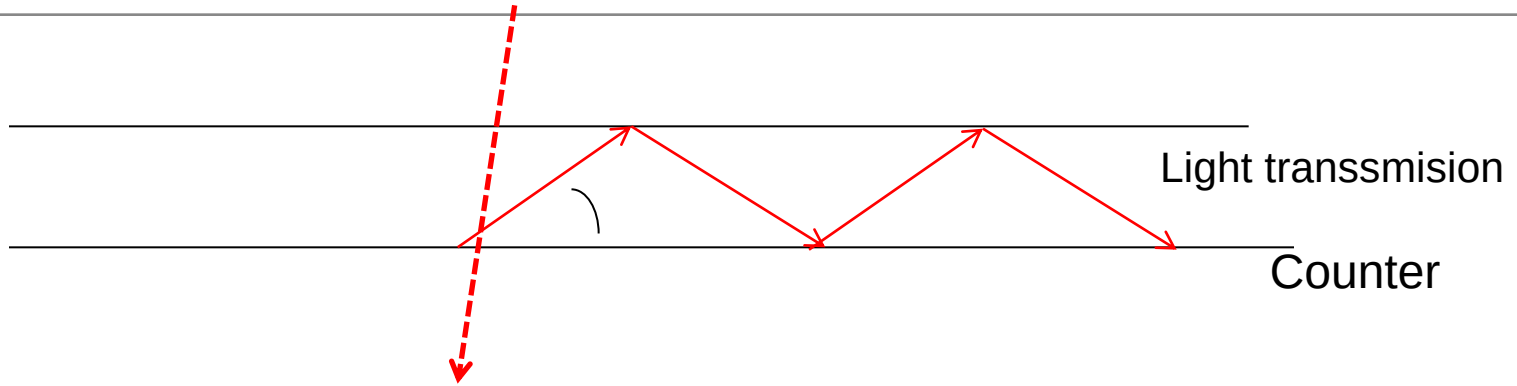
X^2= ∑ (x/v-(Tm0-Tm1+ S0/Q^{p0}-S1/Q^{p1})/2.-C) ^{2} (S0 S1 p from T Calib)

Slope shift a bit with charge





Adding Compensate Item



Seems Large ADC amplitude More photon has big angle, light speed increase

Charge Fit Function to balance:

X^2= (x-v0-(Tm0-Tm1+ (S0-dS)/Q^{p0}-(S1-dS)/Q^{p1})/2.-C) ^{2}

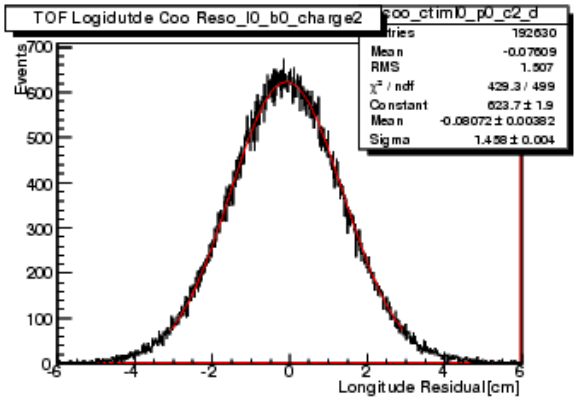
=> x= ((tm0+ (S0-dS) /Q^{p0}-(tm1-S1)/Q^{p1})/2.+C)*v

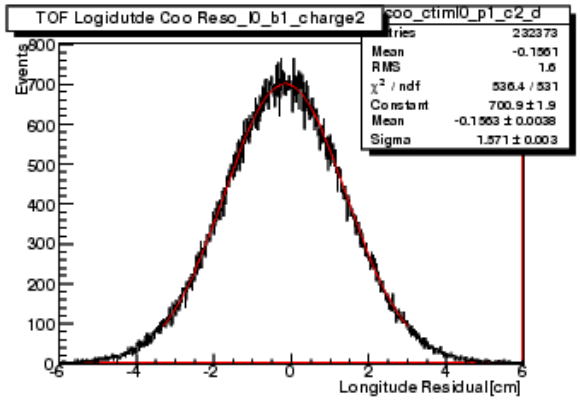
Light Speed compensate item

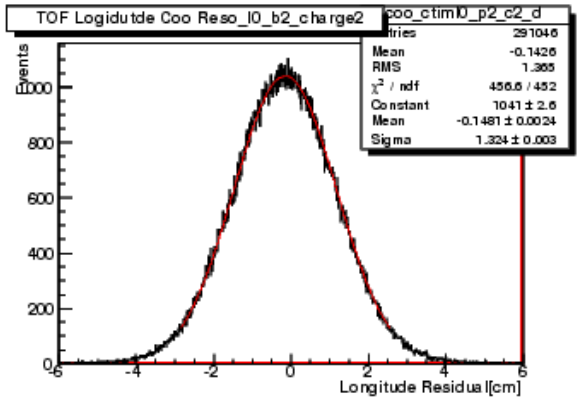
Sample :Still Use Proton+Helium(+Weight1)+Nucleus(+Weight2)

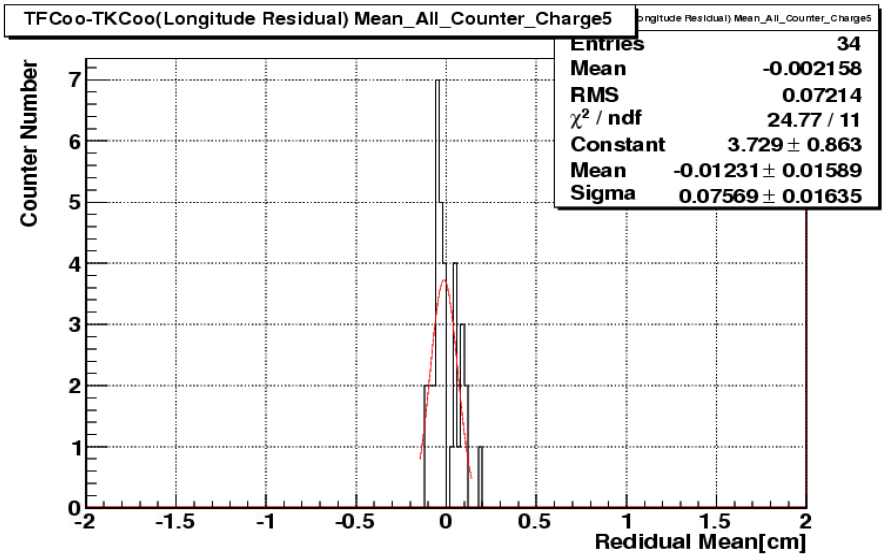
Minimization Chi2 to get parameters

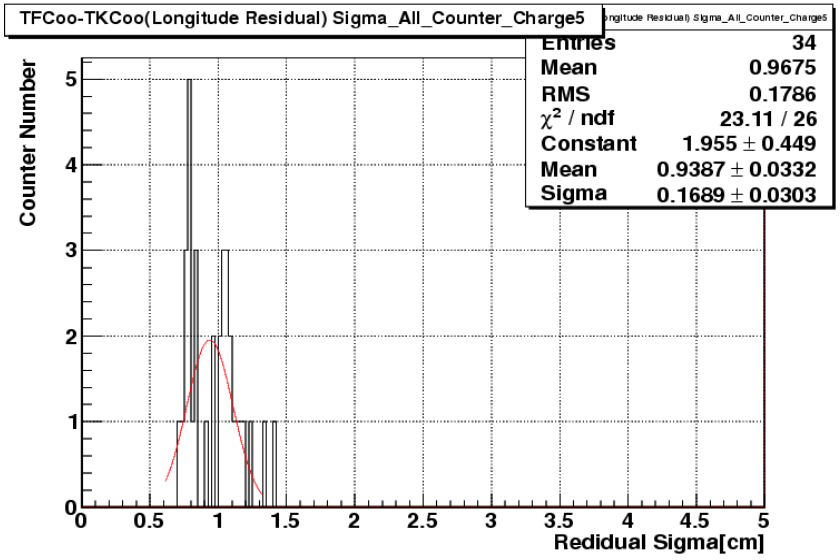
Longitude TCoo Resolution



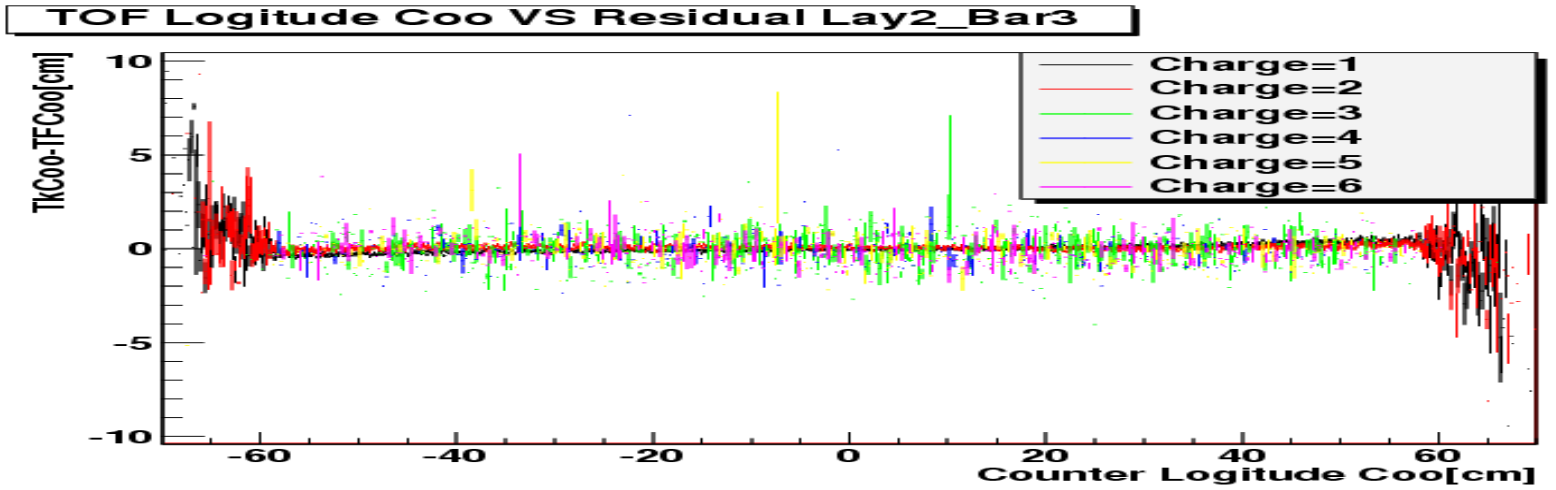




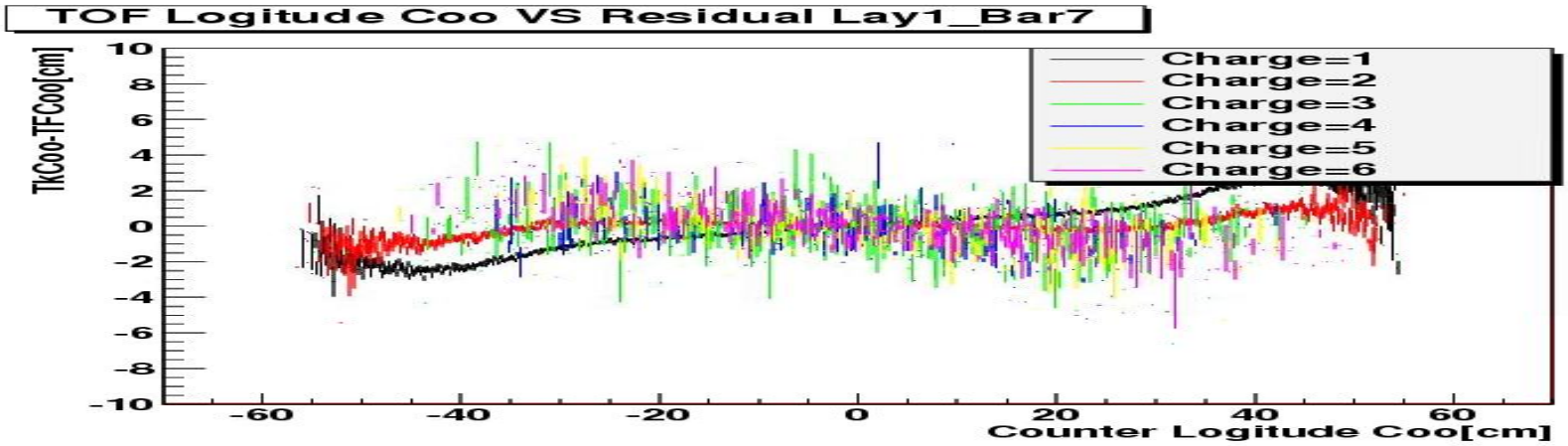




Longitude Coo Residual

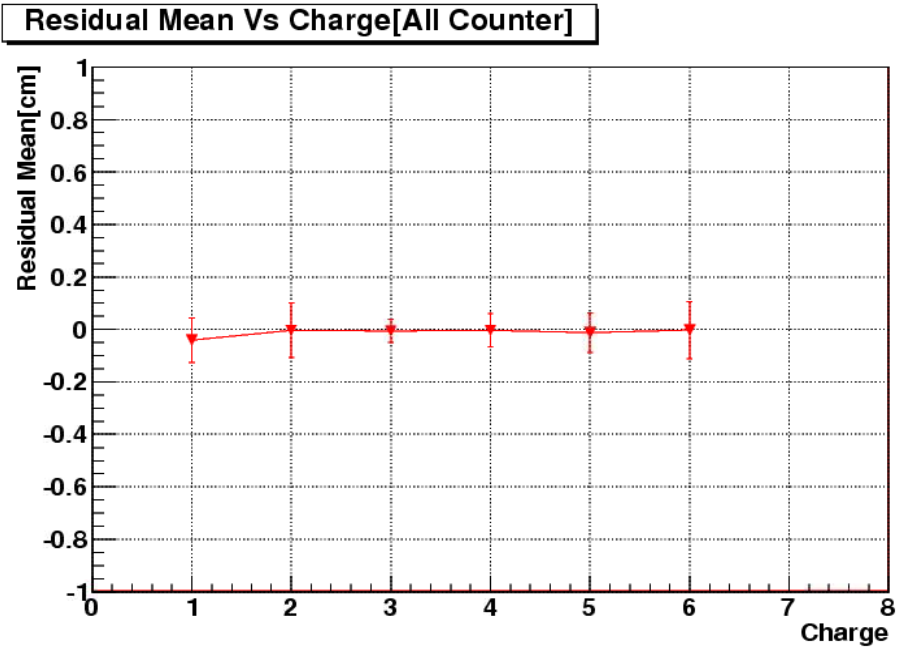


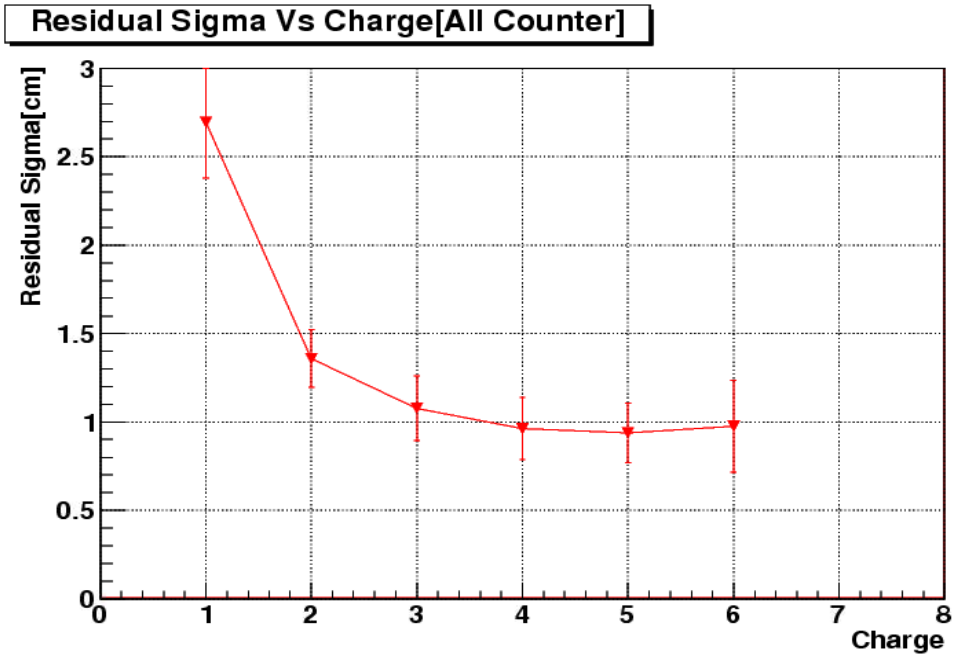
Normal Counter



Trapezoid Counter

Longitude TCoo Resolution VS Charge





Efficient Light speed in scintillator ~16cm/ns for one counter

Time resolution 160ps(proton)~48ps(carbon)

$\Delta s = v\Delta t$= 2.6cm(proton)~0.8cm(carbon) coherent with TCoo resolution

Software Development

New TOF Software Introduction

AMS New TOF Independent Software(BetaH version)

New TOF Software based TOF new calibration and new feature

1: Version 1.2 and TDV 1.0 was released, which already be used for B592 z>1 production for testing. Mainly for Time Calibration

2: Version 1.3 and TDV 1.1 was released, which updated Calibration(Coo+Time)

3: Version 1.3N was released this week, which expand production and lib dynamic rebuild in the same framework. Therefore user can use B584 or much lower version production data to do rebuild with the new software and new calibration.

4: Charge Part calibration and reconstruction will be integrated to the software for the following months.

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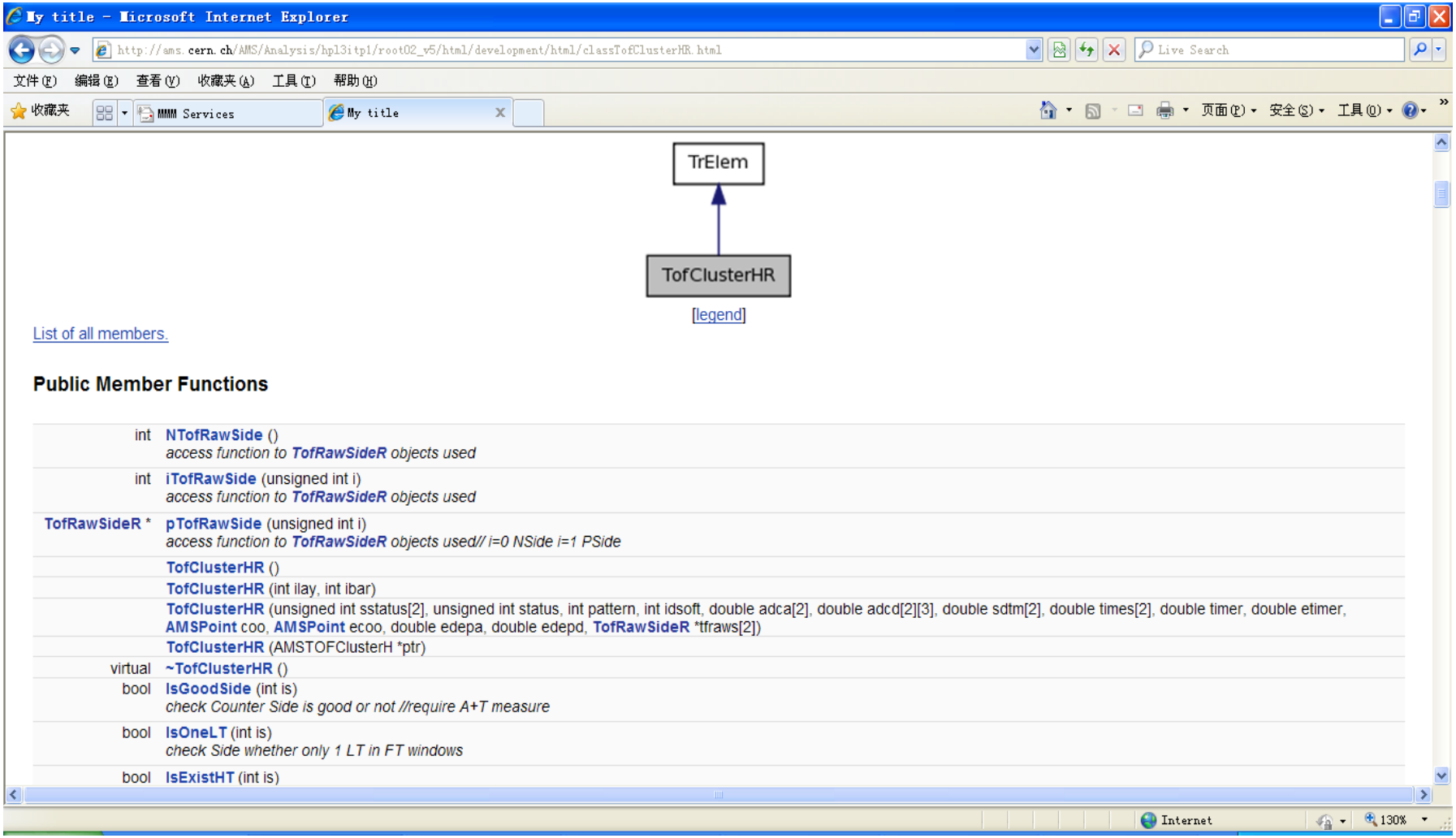
- **Reconstruction Procedure**

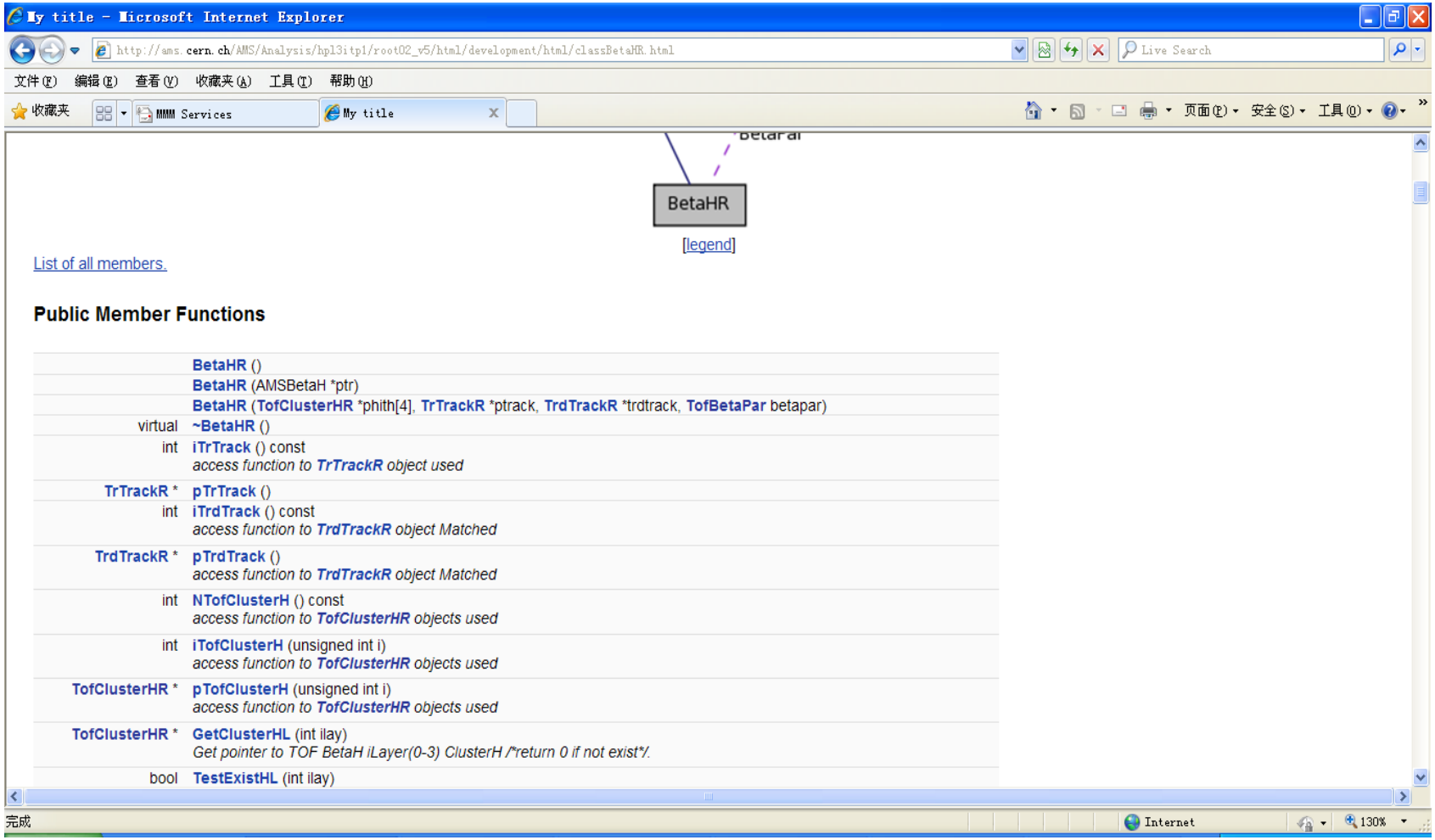
- TofRawSide(1side ADC TDC)->TofClusterH(1 Fired Counter Time Edep…)->BetaH (Pattern Finding , Beta Mass…). ParticleR and ChargeR has index to access

New Feature:

1: Provide abundant tool for analysis base on beta measurement. Time interpolate, time recover, Beta refit….
2: Tag many Low Level reconstruction information in ClusterH and BetaH. Those information can be used for different kind of analysis.
4: Include TOF flexible Geometry Interface and TOFLocal-Global conversion
5: Mass calculation module
6: Support dynamic rebuild , which means rebuild can be redone with the newest calibration and newest software development
7: Easy to use

Class Reference




My title - Microsoft Internet Explorer
http://ams.cern.ch/AMS/Analysis/hpl3itp1/root02_v5/html/development/html/classBetaHR.html
Live Search
文件(F) 编辑(E) 查看(V) 收藏夹(A) 工具(T) 帮助(H)
收藏夹
MMM Services
My title
页面(P) 安全(S) 工具(O)
BetaHR
[legend]
List of all members.
Public Member Functions
BetaHR ()
BetaHR (AMSBetaH *ptr)
BetaHR (TofClusterHR *phith[4], TrTrackR *ptrack, TrdTrackR *trdtrack, TofBetaPar betapar)
virtual ~BetaHR ()
int iTrTrack () const
access function to TrTrackR object used
TrTrackR * pTrTrack ()
int iTrdTrack () const
access function to TrdTrackR object Matched
TrdTrackR * pTrdTrack ()
access function to TrdTrackR object Matched
int NTofClusterH () const
access function to TofClusterHR objects used
int iTofClusterH (unsigned int i)
access function to TofClusterHR objects used
TofClusterHR * pTofClusterH (unsigned int i)
access function to TofClusterHR objects used
TofClusterHR * GetClusterHL (int ilay)
Get pointer to TOF BetaH iLayer(0-3) ClusterH /*return 0 if not exist*/.
bool TestExistHL (int ilay)
完成
Internet
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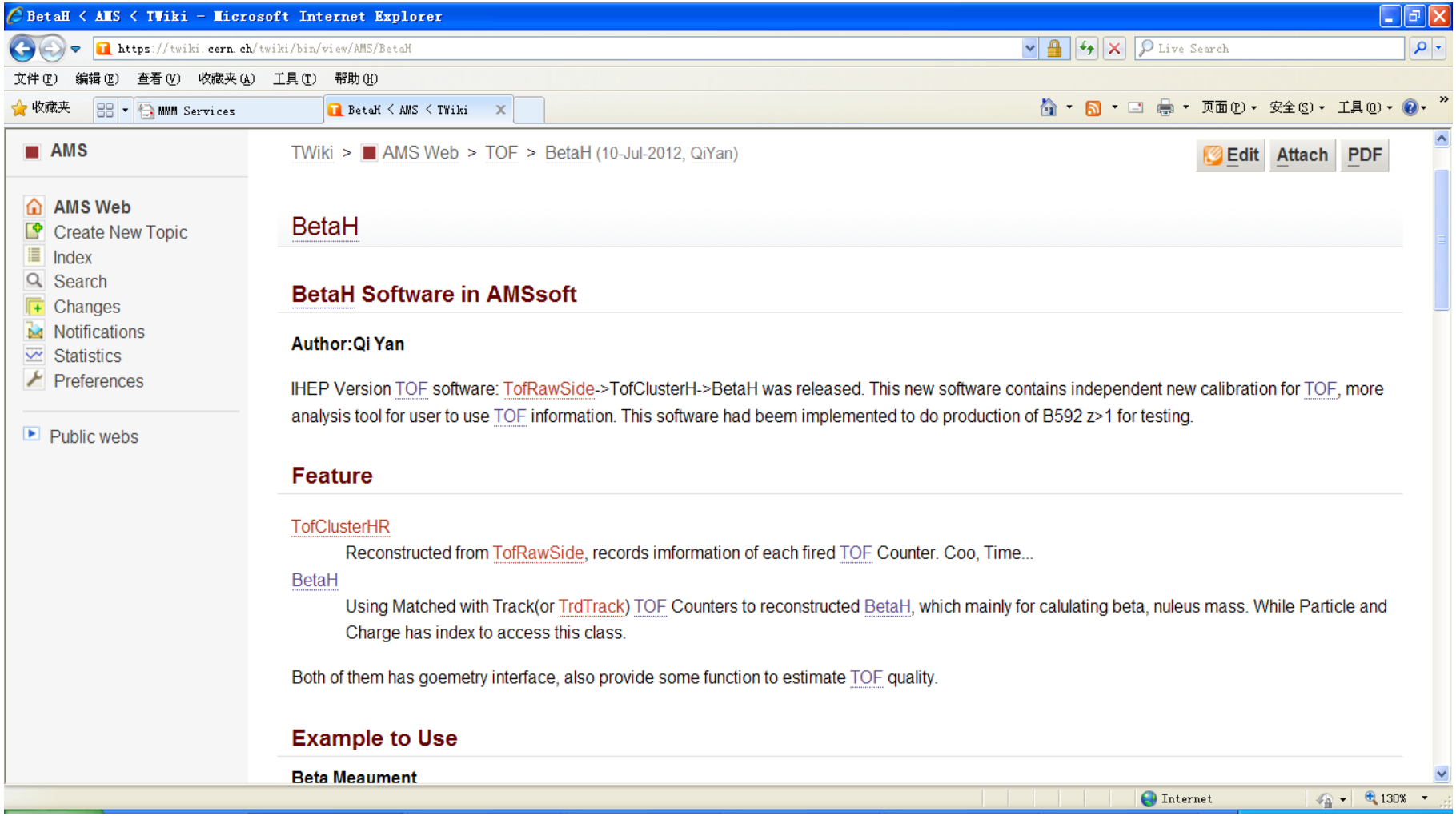
AMSTwiki Introduction



How to Rebuild BetaH(Refit)

1:Software requirement: latest AMSsoft

2: Data requirement: ISS data

3: Build Procedure:

Process each events using this Function:
->TofRecH::Rebuild()
->Then relate class will be rebuild, and ParticleR and ChargeR will create index to this class.

4: Limitation:

Further testing and optimization is on going.

Summary and Outlook

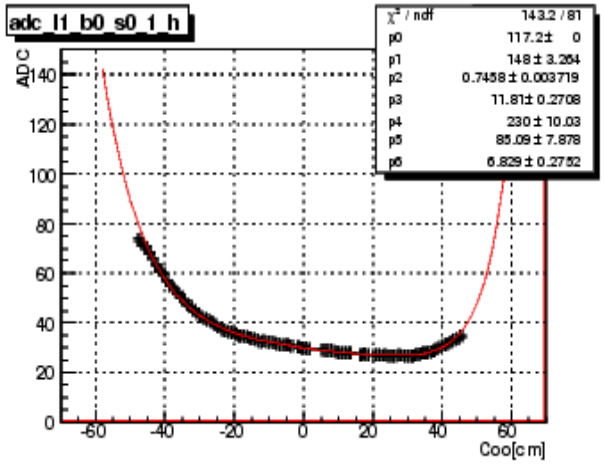
- 1: The TOF new beta and longitude coo calibration of one year data is available with the new software.

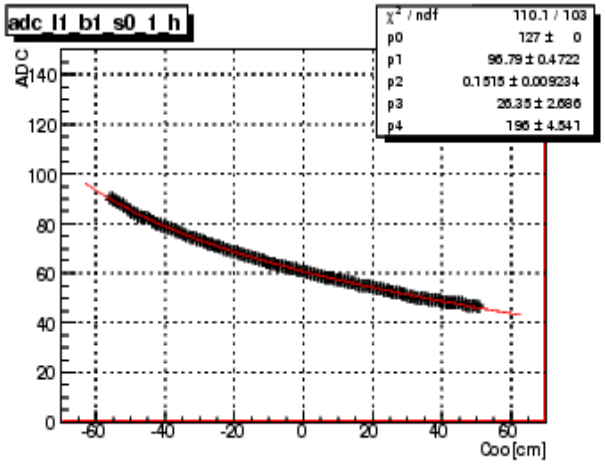
2: New calibration: TOF beta resolution 4% for proton, ~1.2% for carbon(4Layer Hit). Longitude coo resolution: 2.8cm for proton, 0.9cm for carbon.

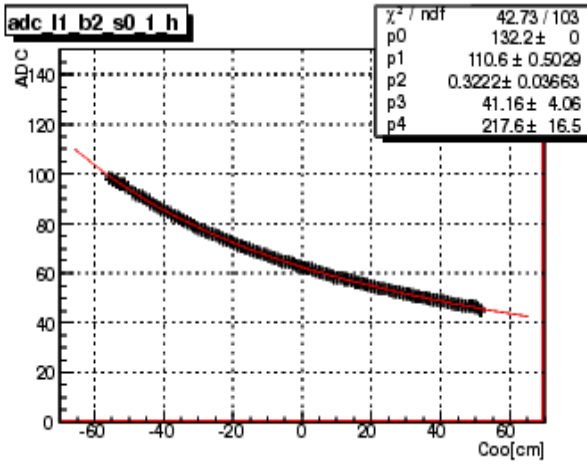
- 3: New software has been release with new feature, which is available to user.

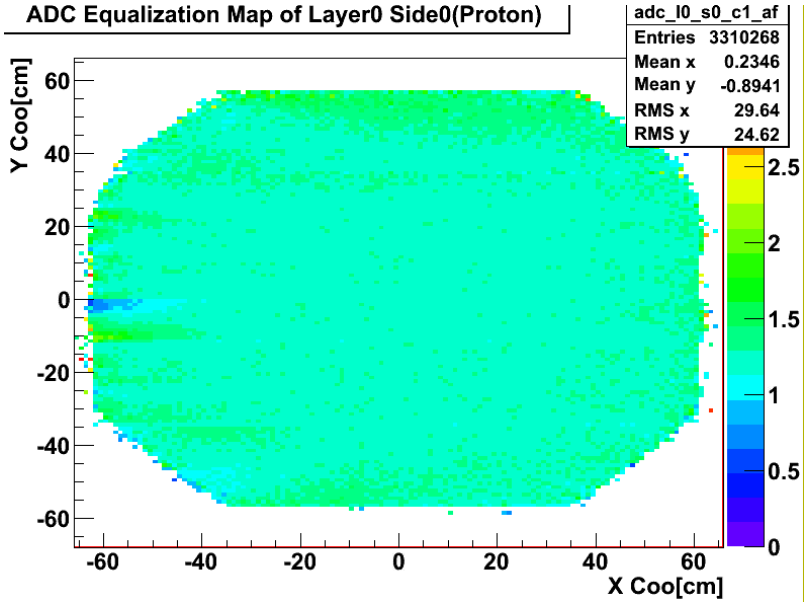
4: TOF Charge calibration for this software(Hai Chen also take part) is in progress, and also new MC calibration will be done later.

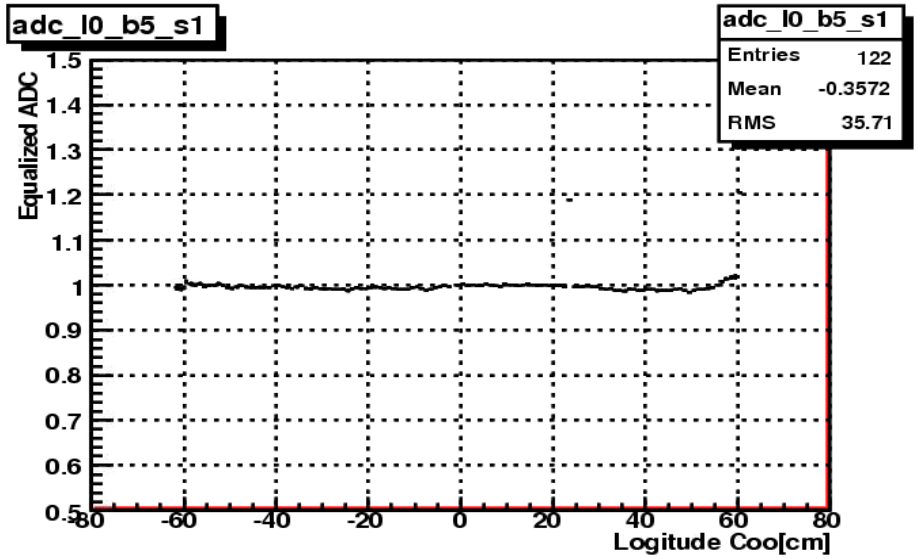
Charge Part Work Introduction



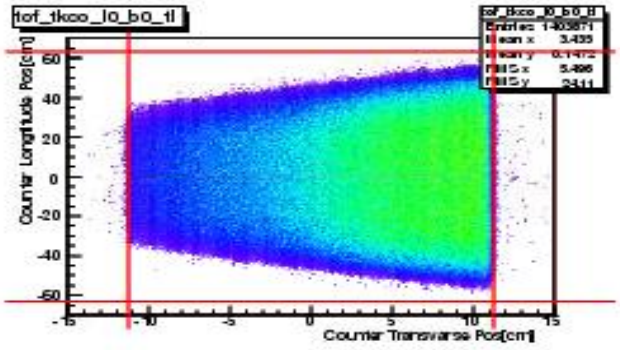


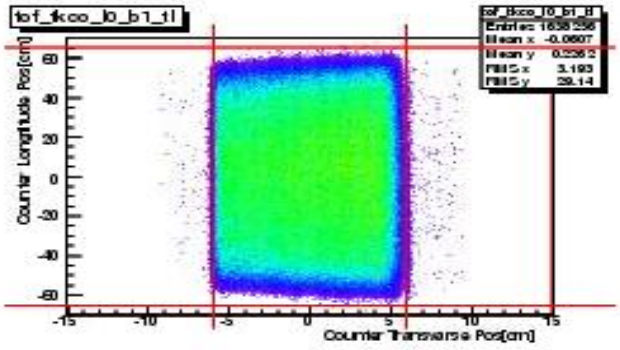


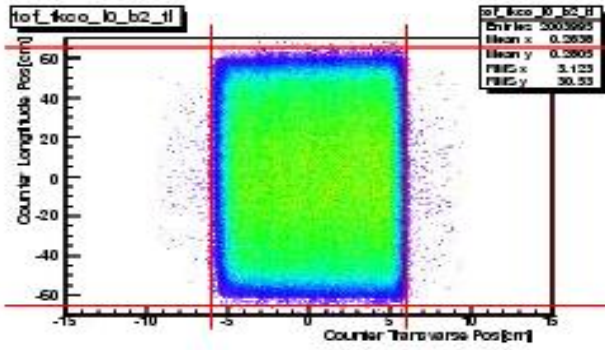


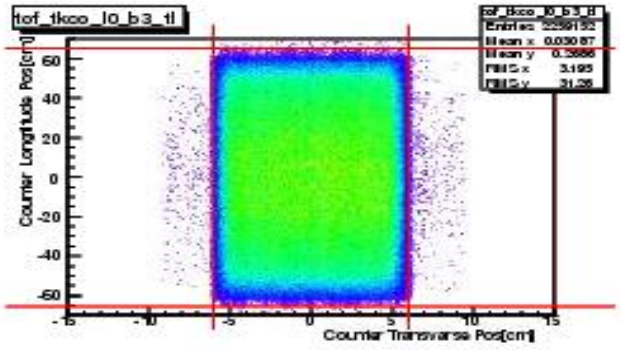


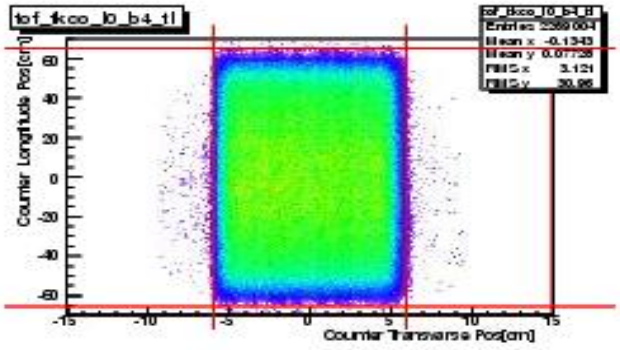
Transverse Coo Shift

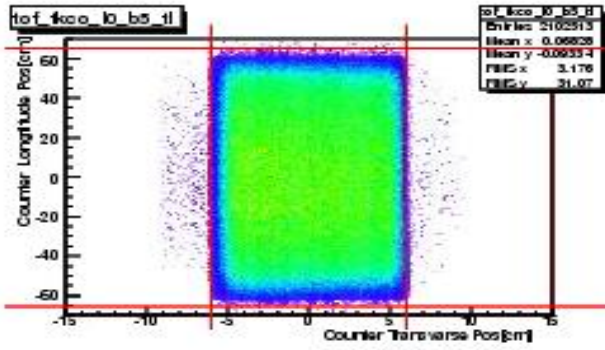


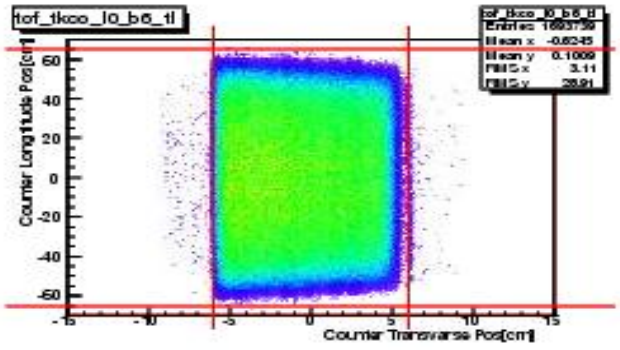


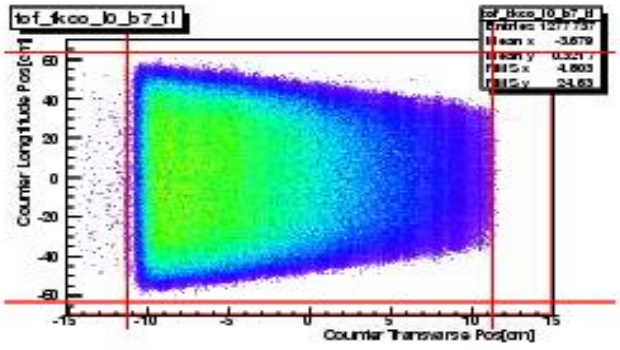












First Layer all Counter

Hard to Calibrate Shift due to Boundary Factor