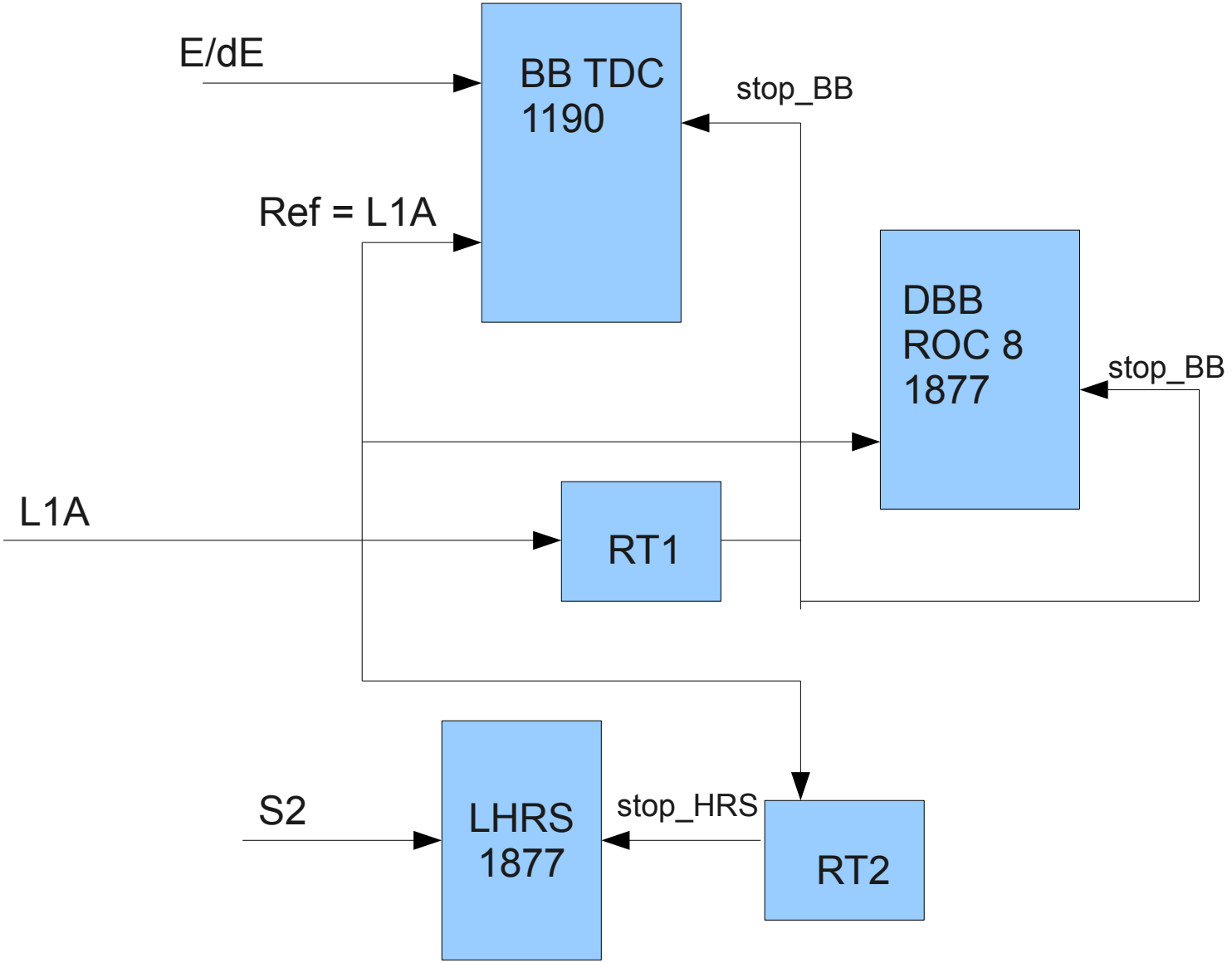
BigBite Timing

1) Elastic runs:

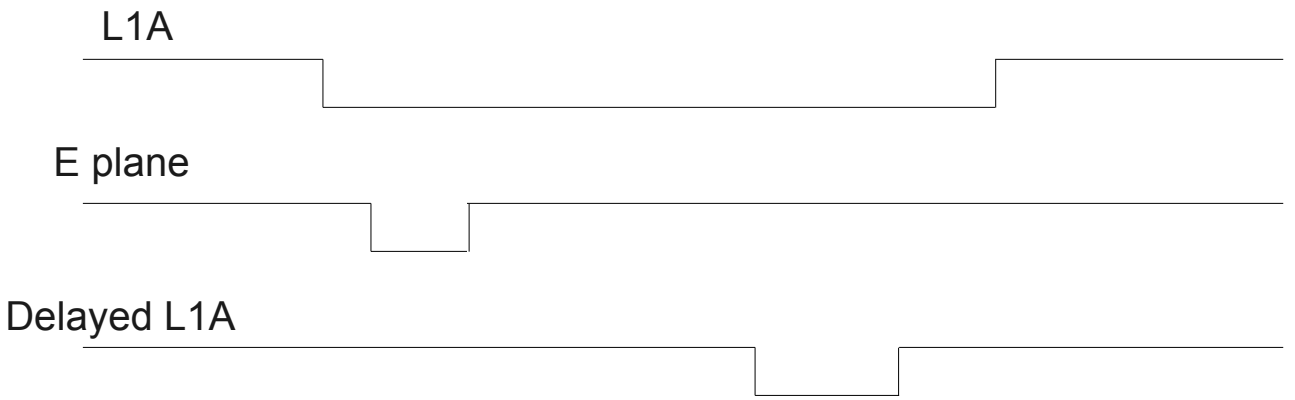


Notice: electronic was changed between the elastic runs (showed above) and the production runs

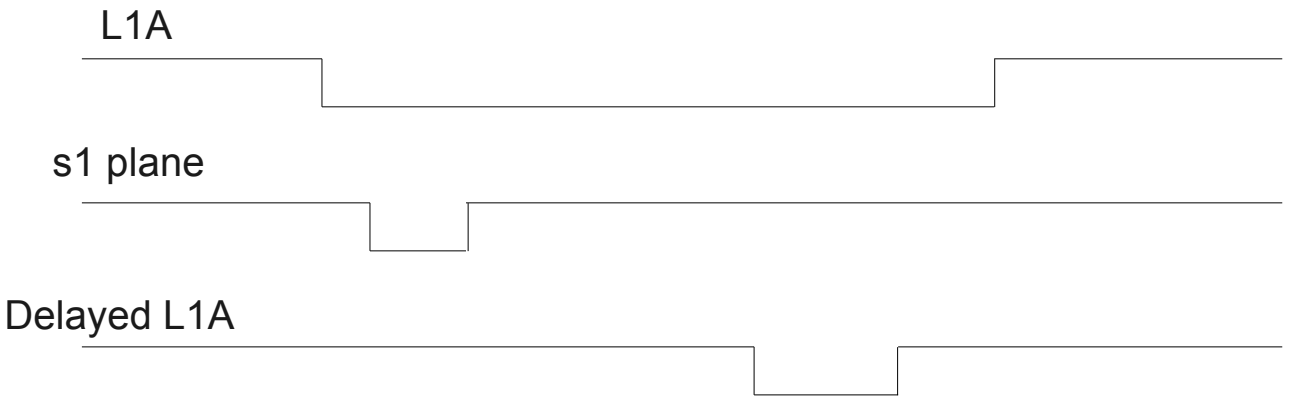
What is RT1 and RT2 ?

RT: Re – timing

RT 1:



RT 2:



Problem – RT2 should be retimed from s2 plane!

1877 TDC

The time information is the difference between the common stop and the start signal
Resolution **0.5** ns

1190 TDC (or F1 TDCs)

The time information is the difference between the start and the ref signal
Resolution **0.1** ns
The purpose of the stop signal is to clear the event.

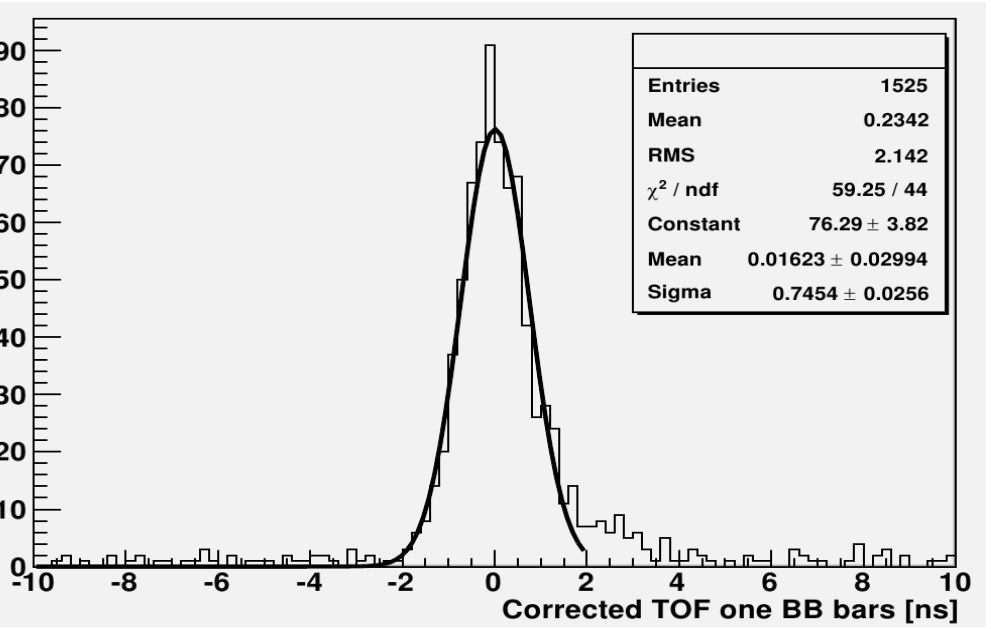
Usually the stop signal for ALL TDCs must be the same. Moreover, the reference signal must be equal to the stop (with some constant offset)!!!

If the setup was correct than (same stop and ref=stop) the proton TOF in respect to LHRS was:

$$-(BB-HRS)=-[-(E-ref)-(STOP-s2)]=-[-E+ref-STOP+s2]=-(s2-E)=E-s2$$

Not in our case ...

What DATA says:



Elastic scattering:

If we calculate in the naive way:
Resolution: **0.75 ns** for one bar

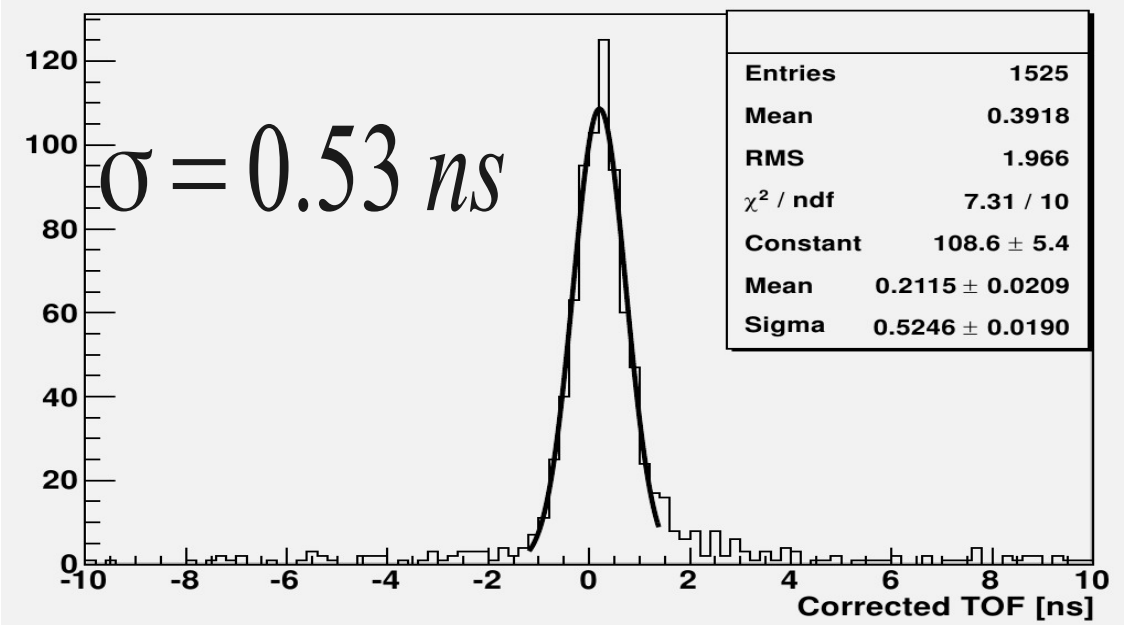
If we calculate in the "correct" way

$$BB + HRS - DBB_L = (E - ref) + (STOP - s2) - (STOP - L1A) = E - s2 - ref + L1A$$

DBB_L = STOP -L1A

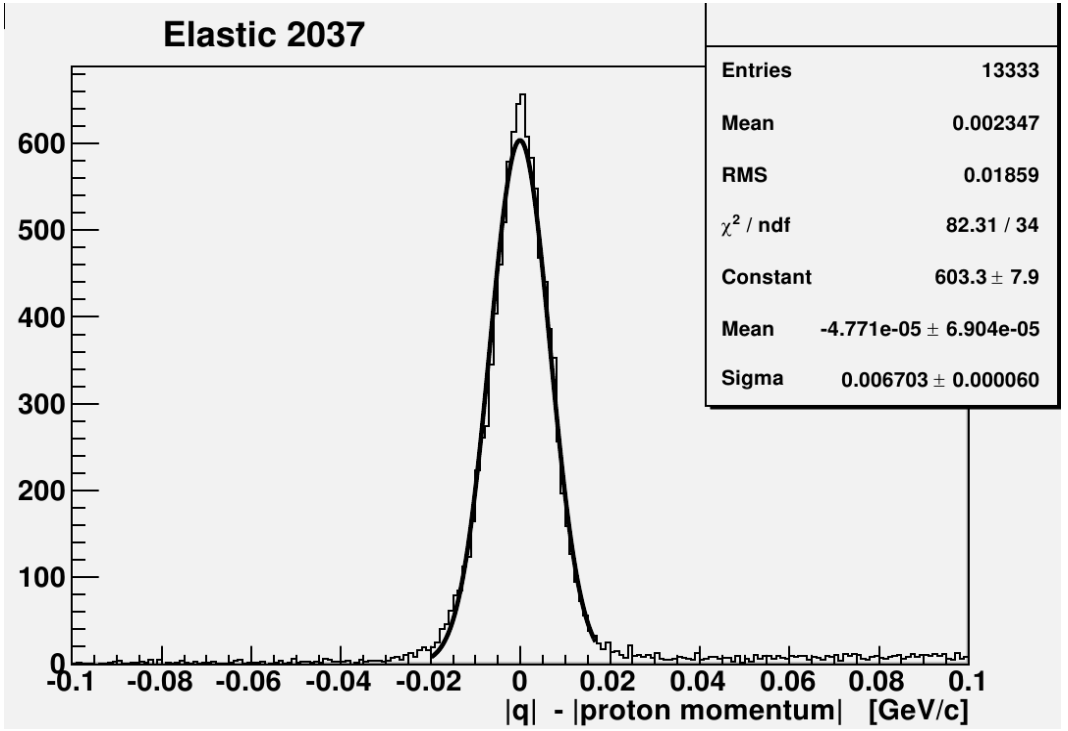
$$ref = L1A$$

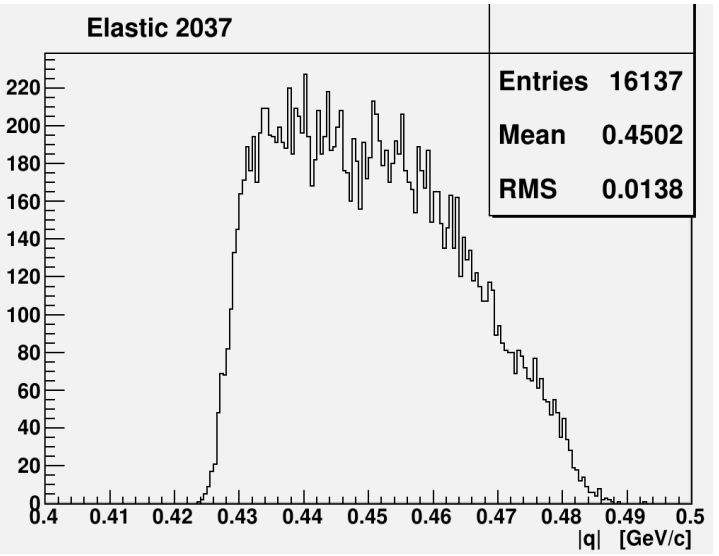
TOF = $$E - s2$$



What about momentum resolution?

Using the Analytical model from the online database (calibrated Optics, see Tai's presentation):



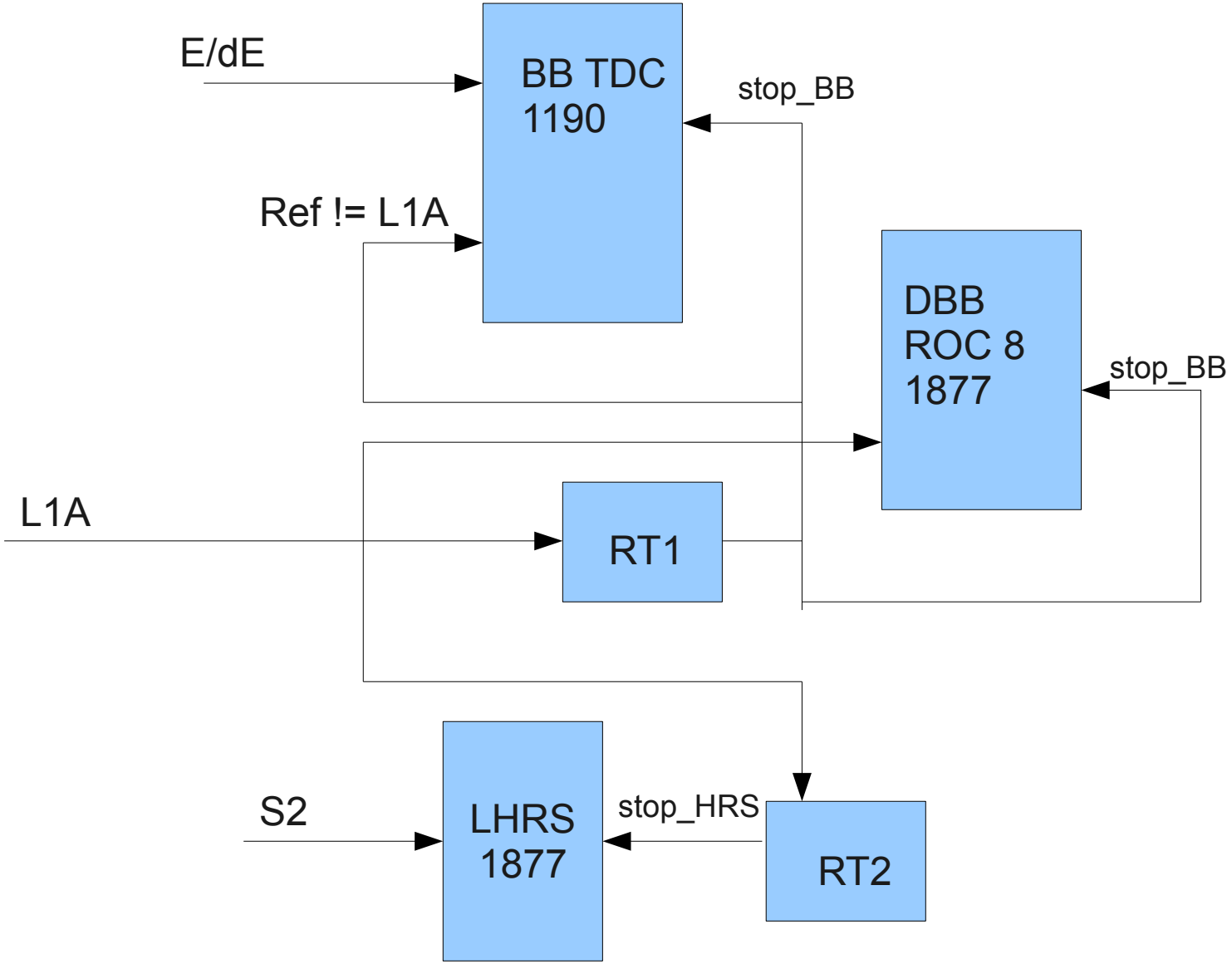


$$\frac{(\Delta p)}{p} = \frac{6.7}{450} \approx 1.5\ \%$$

Compared to Ran: $$\frac{(\Delta p)}{p} = \frac{10}{(250-400)} \approx 2.5-4\ \%$$

2) **Production** :

Timing diagram is "*almost*" identical to the calibration... **But** the Ref signal is after the RT1 circuit

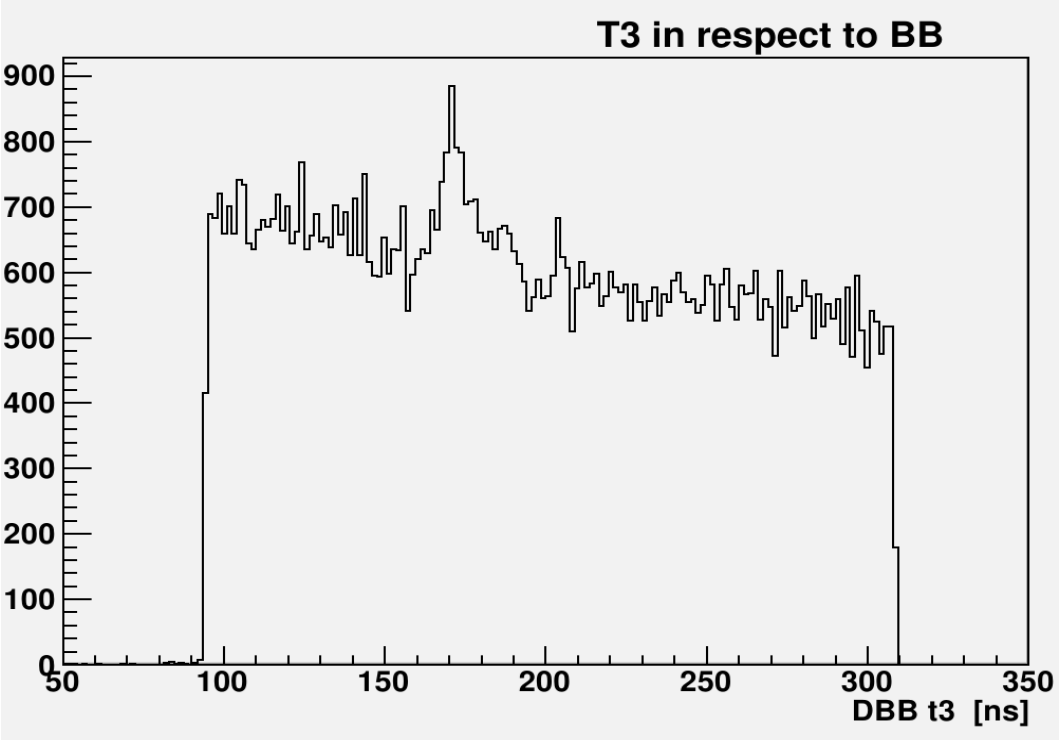


Question: How we should calculate the TOF in this case?

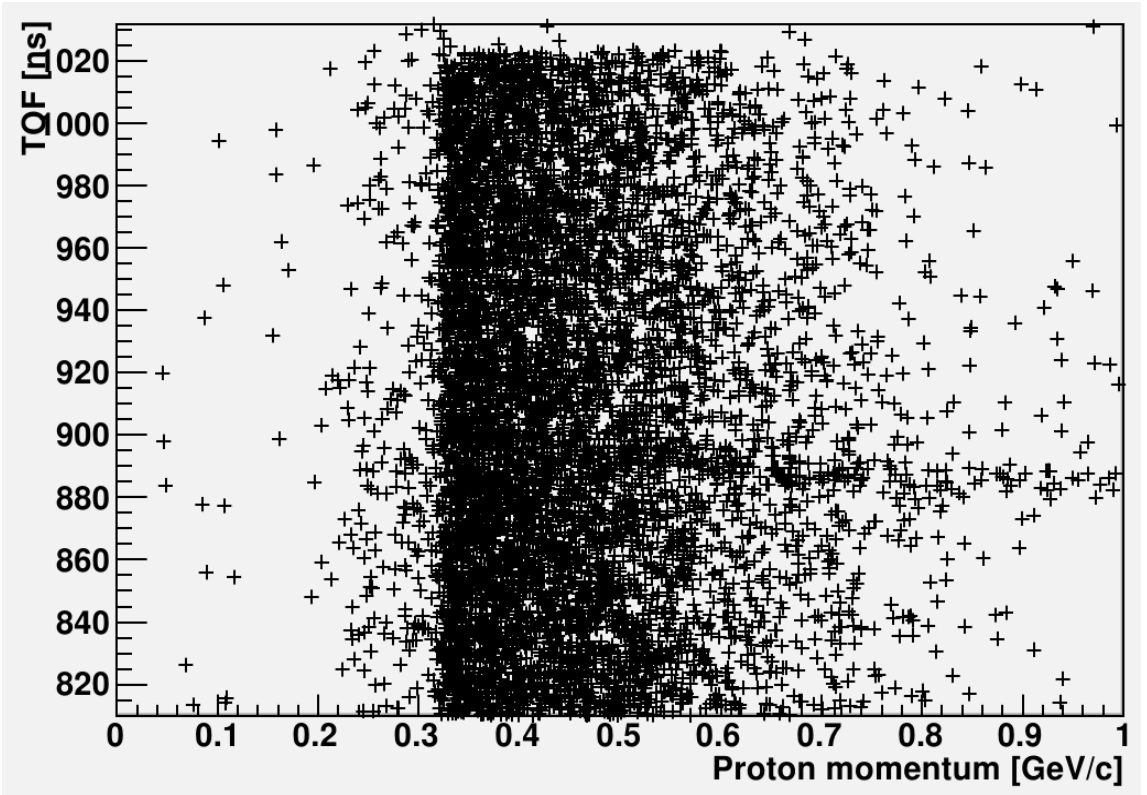
Problem: We don't have clean peak in production case (compared to elastic case).

Do we expect peak in the production (recoil)?

Yes! We see recoil on the electronic level (run # 3222)

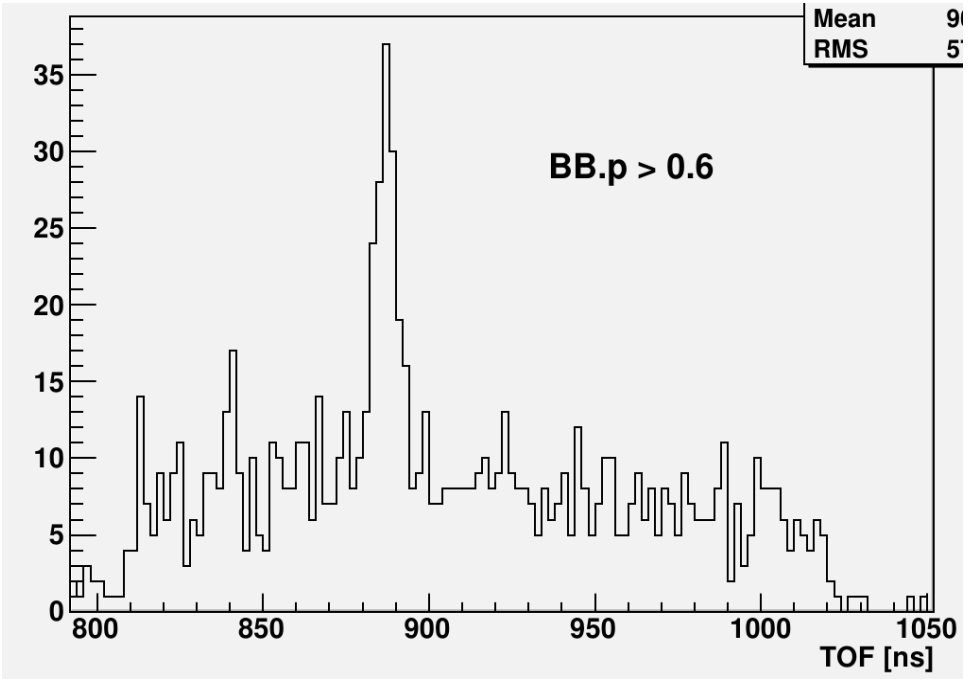


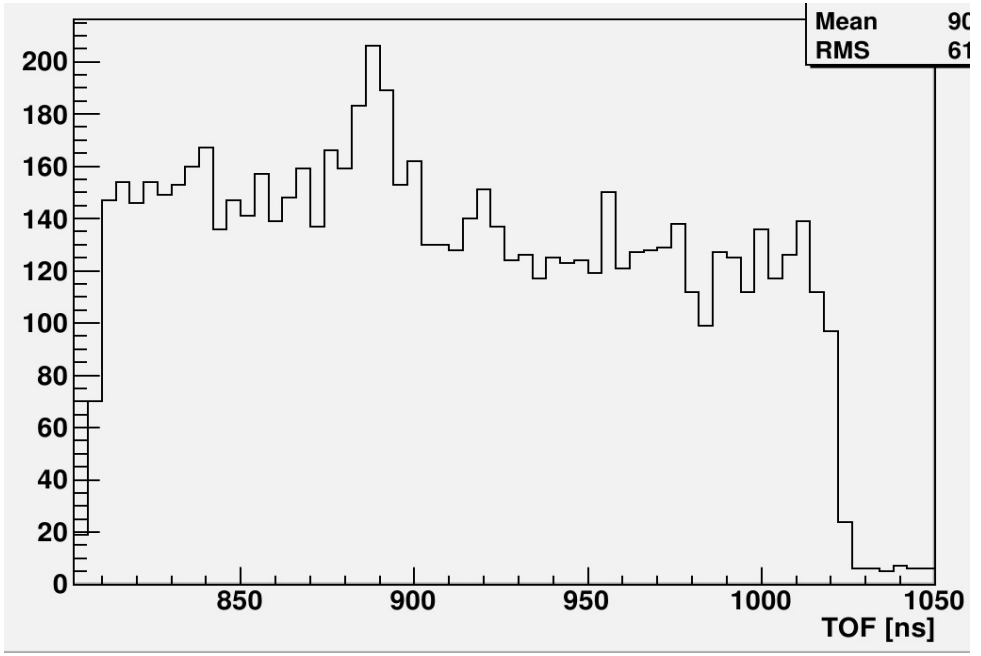
This is without PID and timing calibration



Time difference between one paddle from E plane in BB and electronic trigger time.

- (BB – DBB.l1a)





How it's calculated:

$$-(BB-DBB.L1A)=-[E-ref-(STOP-L1A)]$$

This means

$$-E-L1A+2\mathrm{STOP}$$???

(Reference signal is identical to the STOP)

Let's us remember the retiming circuit...

$$ref=E-L1A$$

Is it correct?

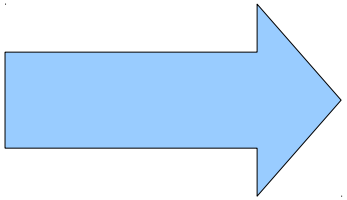
$$E-3*L1A$$

BB = E - L1A'

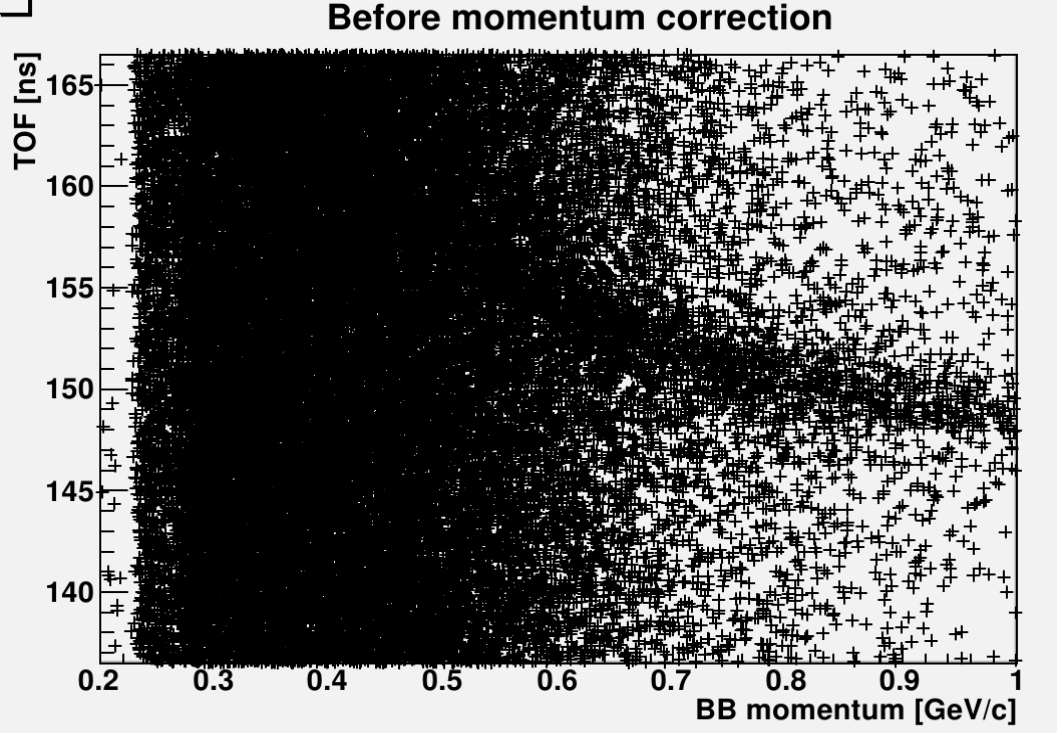
HRS = L1A" - s2

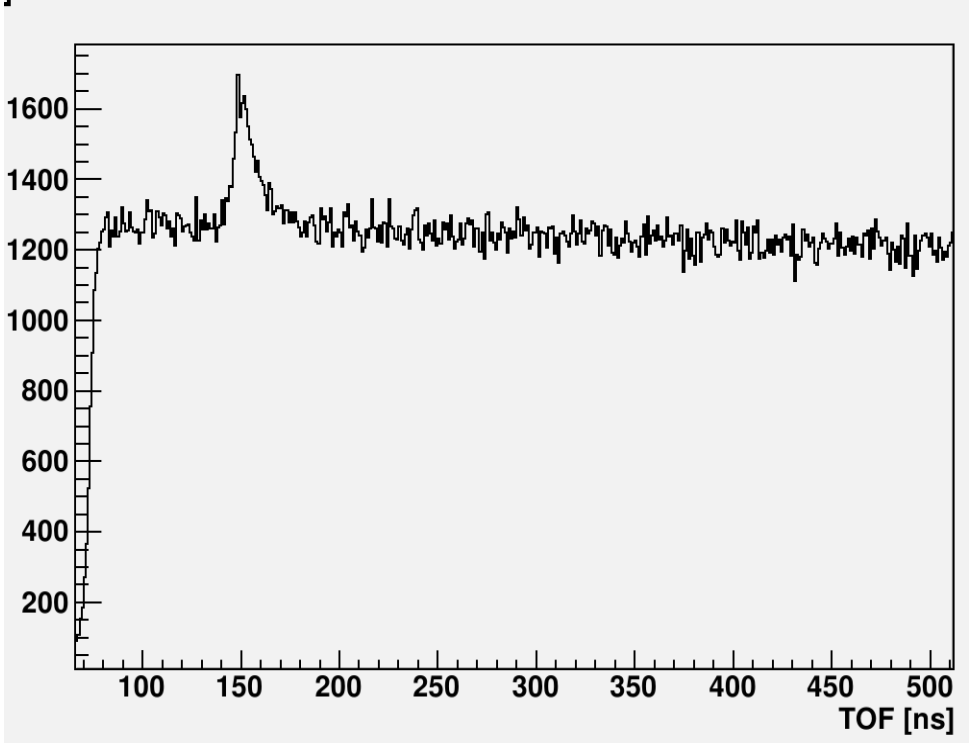
DBB.l1a = L1A' - L1A

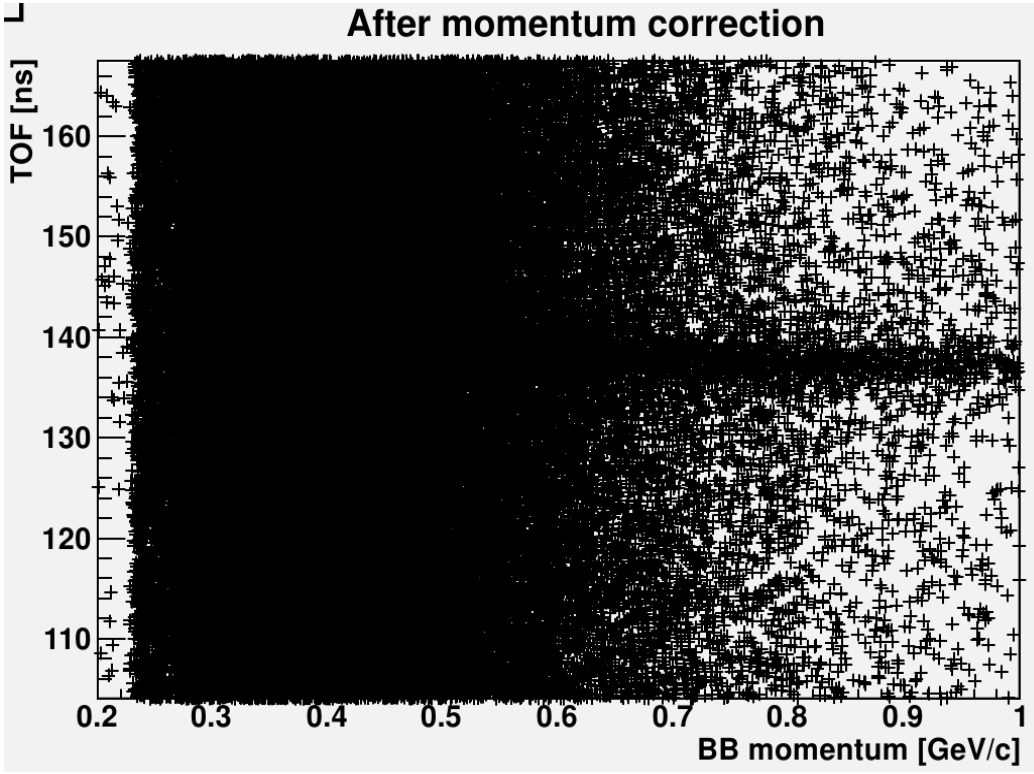
DBB.l1a_L = L1A" - L1A

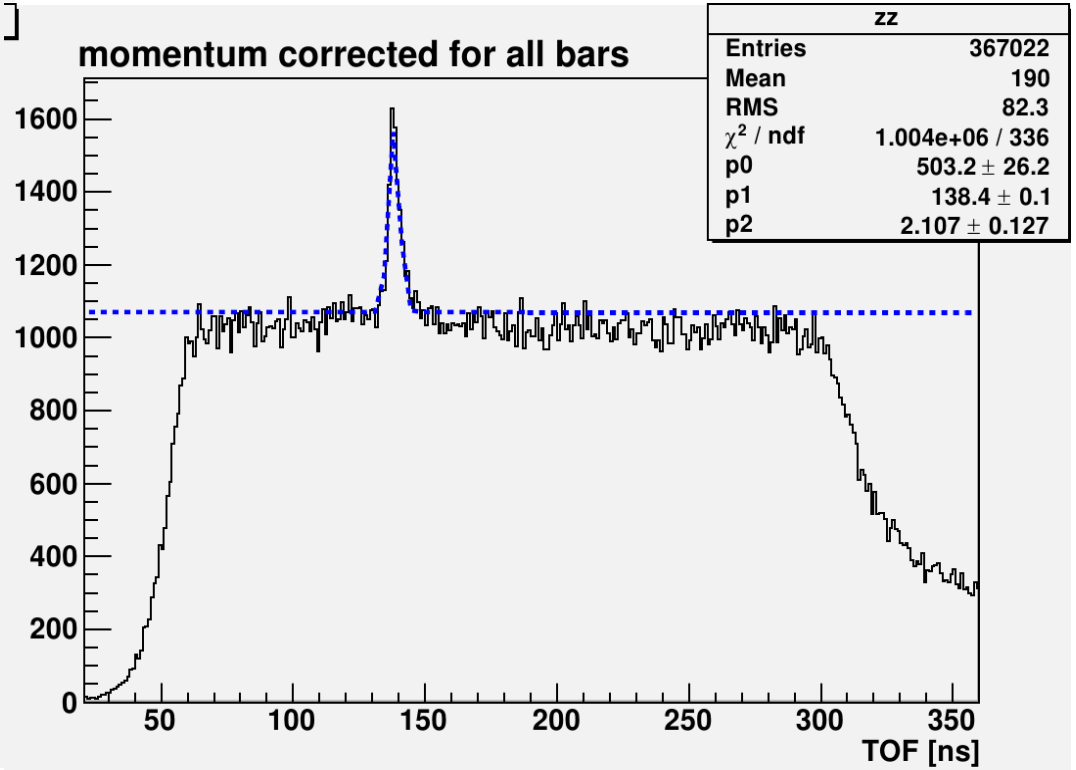


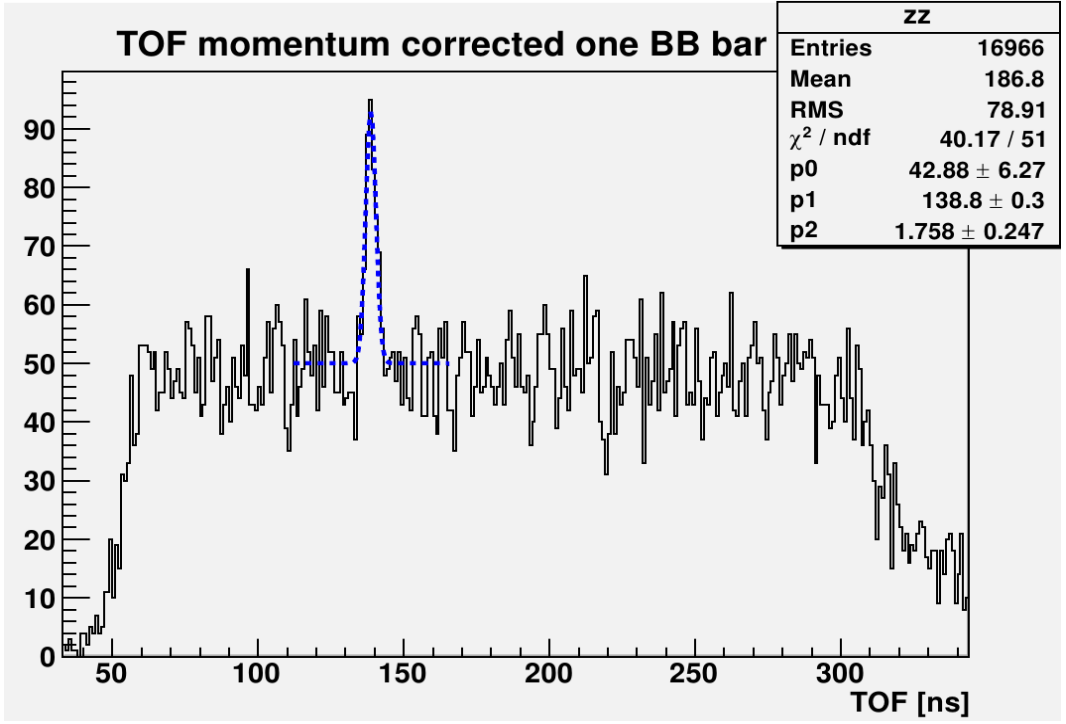
BB + HRS + DBB.l1a – DBB.l1a_L = E - s2

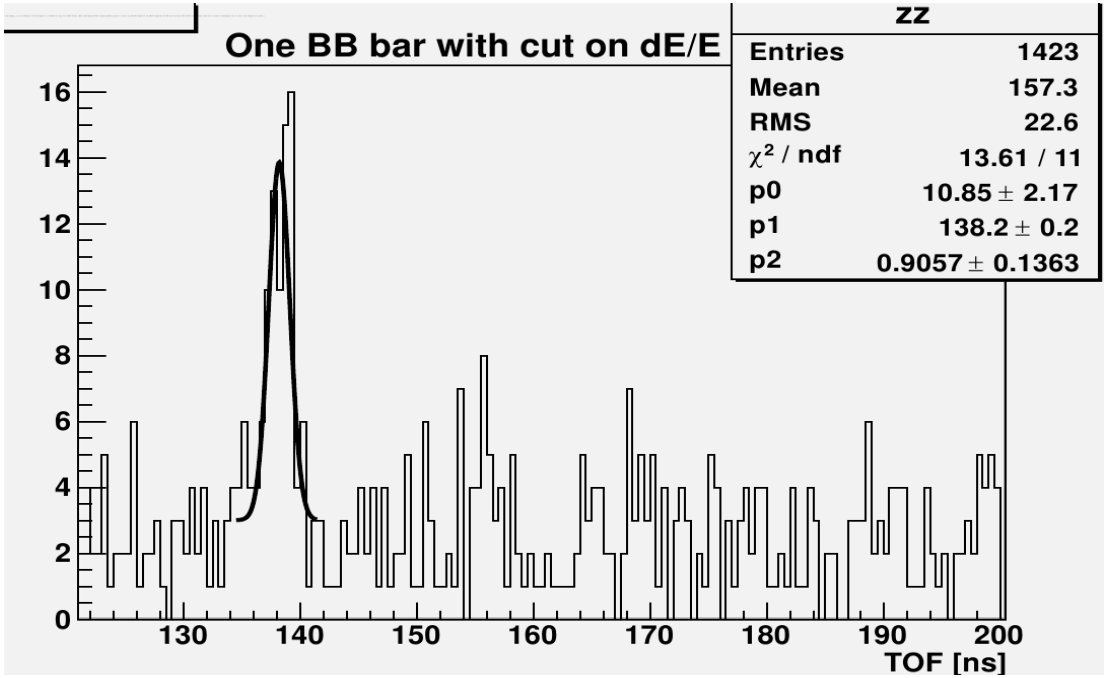

Before momentum correction
TOF [ns]
BB momentum [GeV/c]

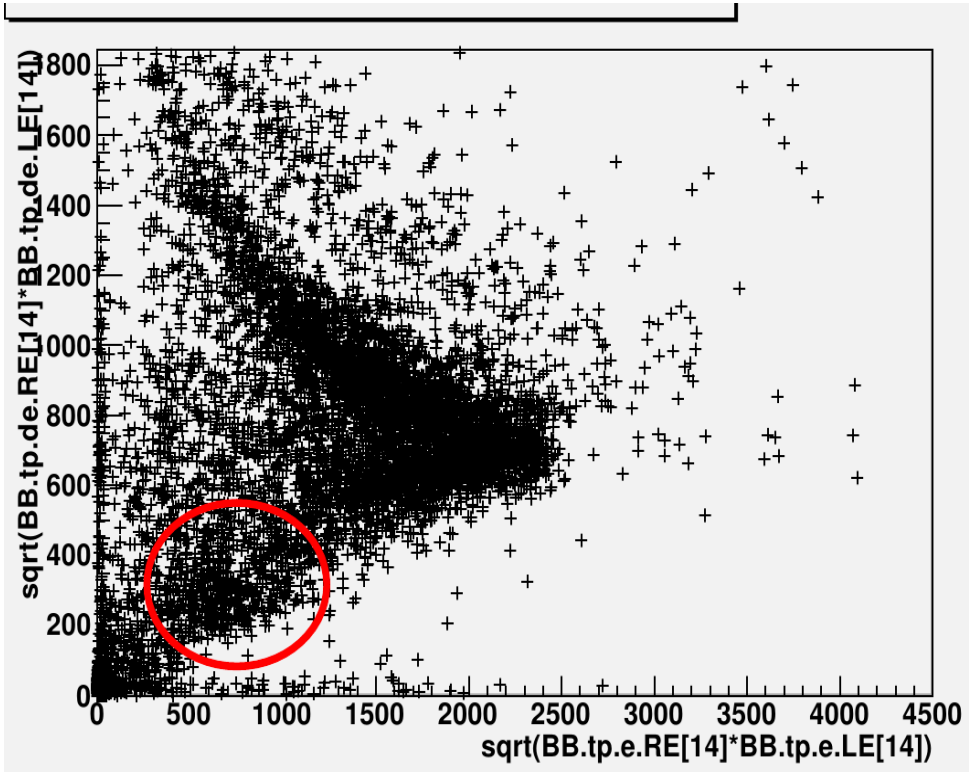

TOF [ns]


After momentum correction
TOF [ns]
BB momentum [GeV/c]


momentum corrected for all bars
zz
Entries 367022
Mean 190
RMS 82.3
χ² / ndf 1.004e+06 / 336
p0 503.2 ± 26.2
p1 138.4 ± 0.1
p2 2.107 ± 0.127
TOF [ns]


TOF momentum corrected one BB bar
zz
Entries 16966
Mean 186.8
RMS 78.91
χ² / ndf 40.17 / 51
p0 42.88 ± 6.27
p1 138.8 ± 0.3
p2 1.758 ± 0.247
TOF [ns]


One BB bar with cut on dE/E
zz
Entries 1423
Mean 157.3
RMS 22.6
χ² / ndf 13.61 / 11
p0 10.85 ± 2.17
p1 138.2 ± 0.2
p2 0.9057 ± 0.1363
TOF [ns]


sqrt(BB.tp.de.RE[14]*BB.tp.de.LE[14])
sqrt(BB.tp.e.RE[14]*BB.tp.e.LE[14])