Cosmic test @ KRISS

TEST MATERIAL

Trigger

19 X 5 cm

Size : 19 X 5 cm (a thickness of 0.7 cm)
PMT : H7195
Distance between two triggers = 21.5 cm
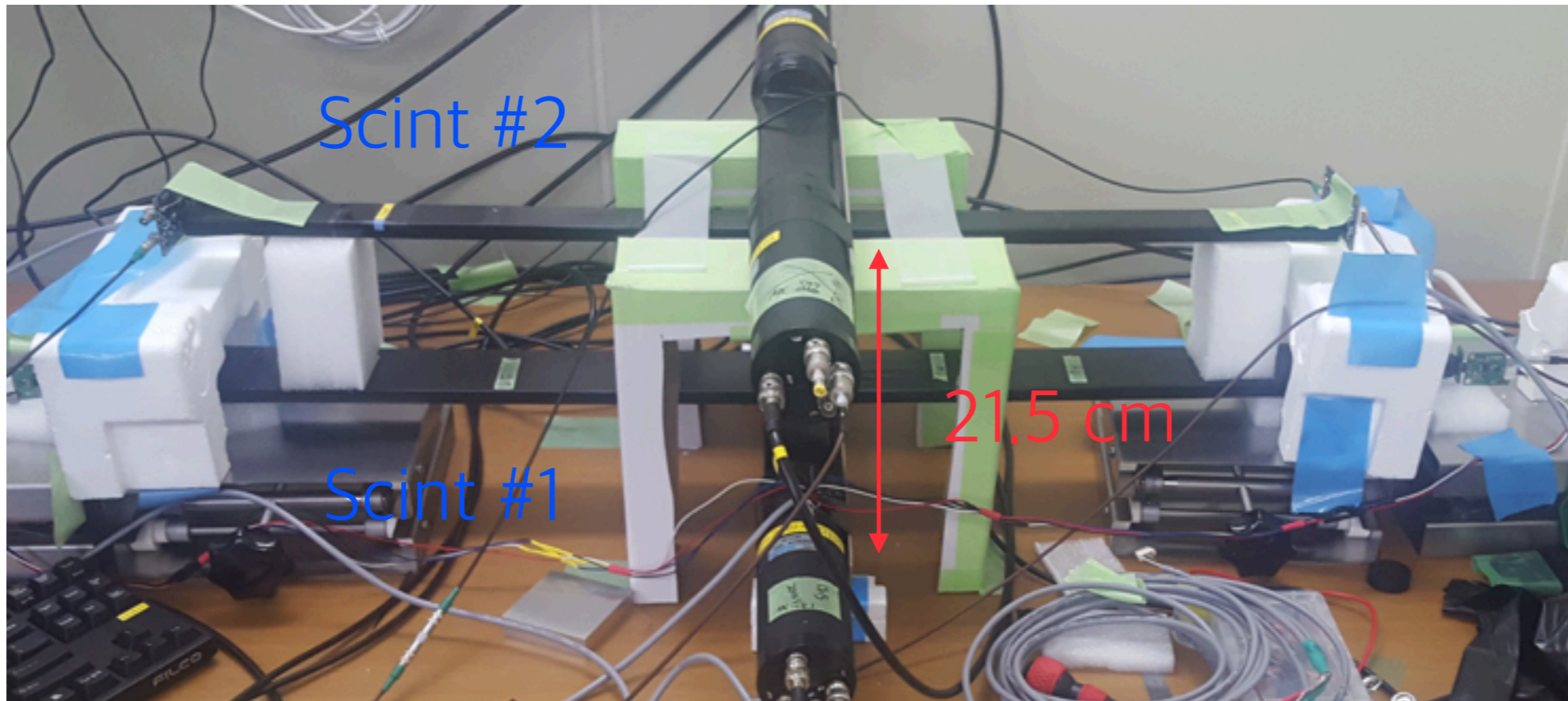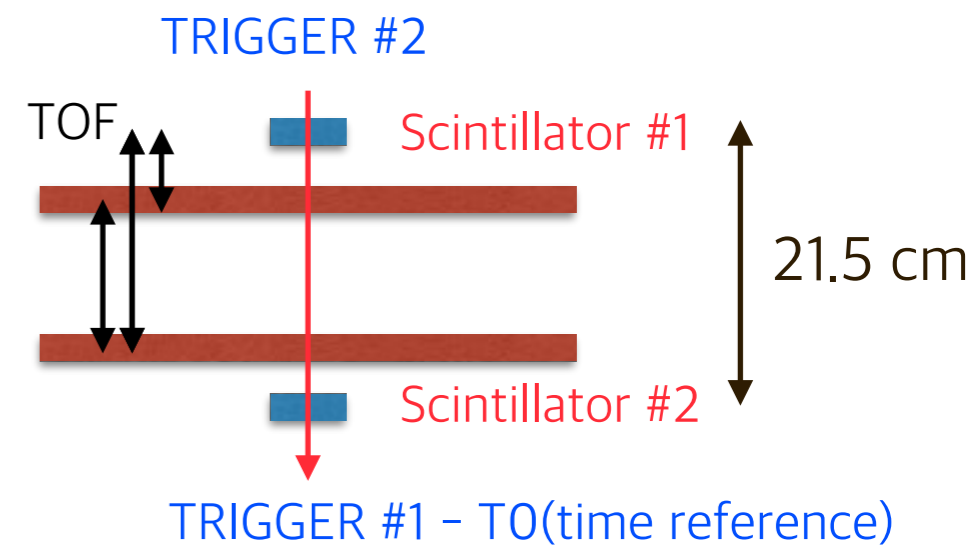
Hodoscope scintillator #1
    Size : 80 X 7 X 1 cm

Hodoscope scintillator #2
    Size : 80 X 4 X 1 cm

SET UP

ANALYSIS

part1. raw data correction

1. For each channel, make a correction for ADC & TDC with pedestal mean and T_0 as references (TDC[4] is T_0)
2. Trigger event selection (ADC cut)
3. slewing correction
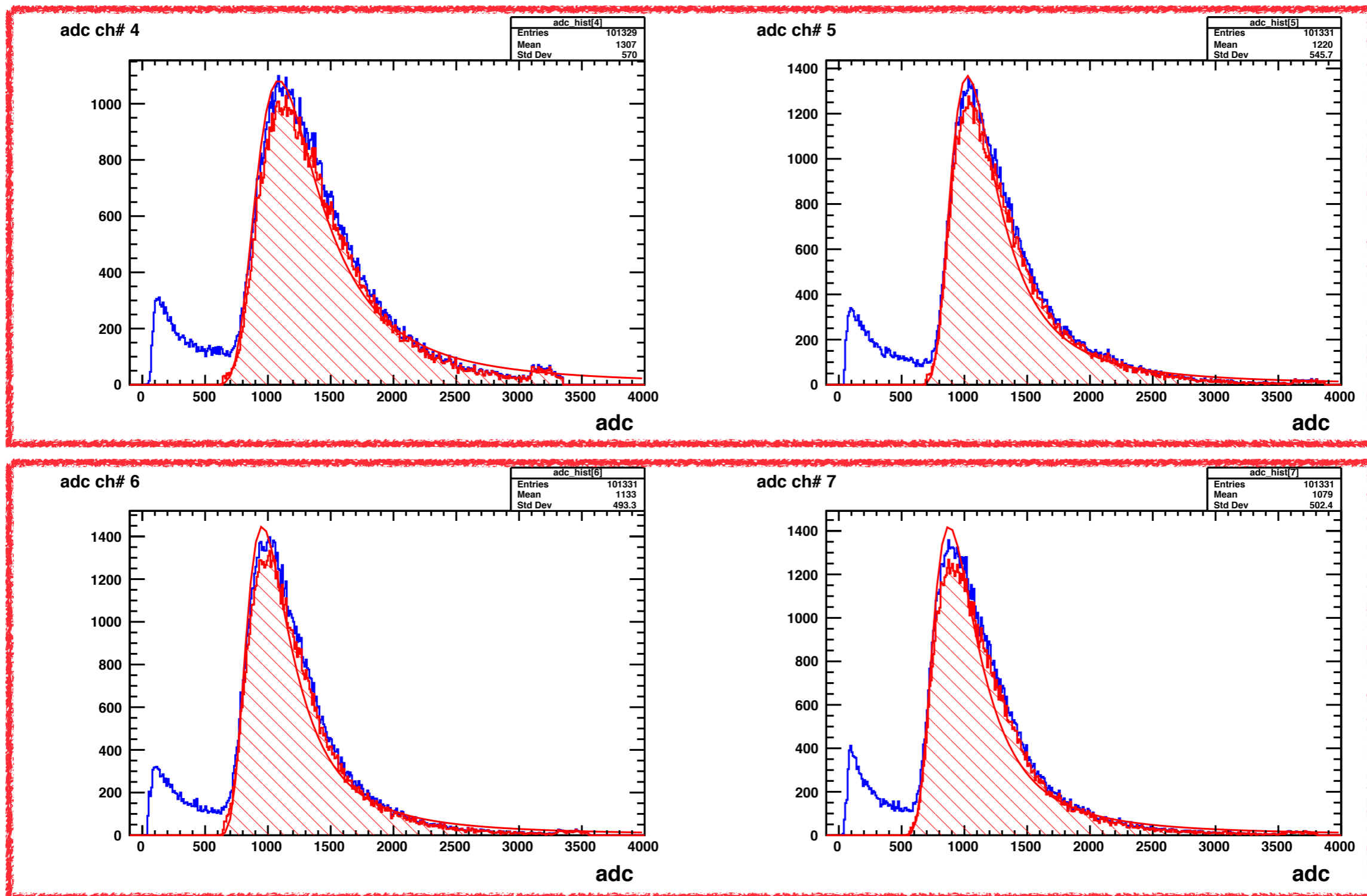4. make a new root file which has selected events with corrected ADC,TDC

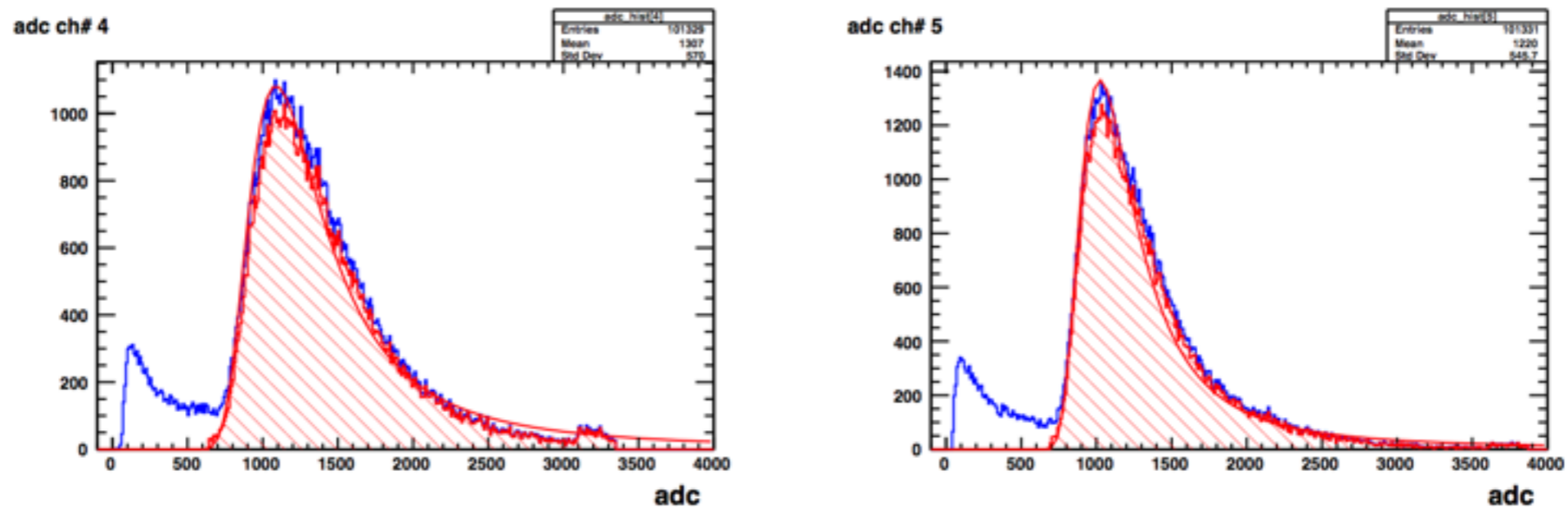part2. get resolution correction
(starting from corrected root file)

1. Draw TOF distribution
2. Get time resolution of trigger and scintillators

TRIGGER ADC

total event number 101329

TRIGGER ADC

1. histogram ADC(blue line) -> fit landau(red line)
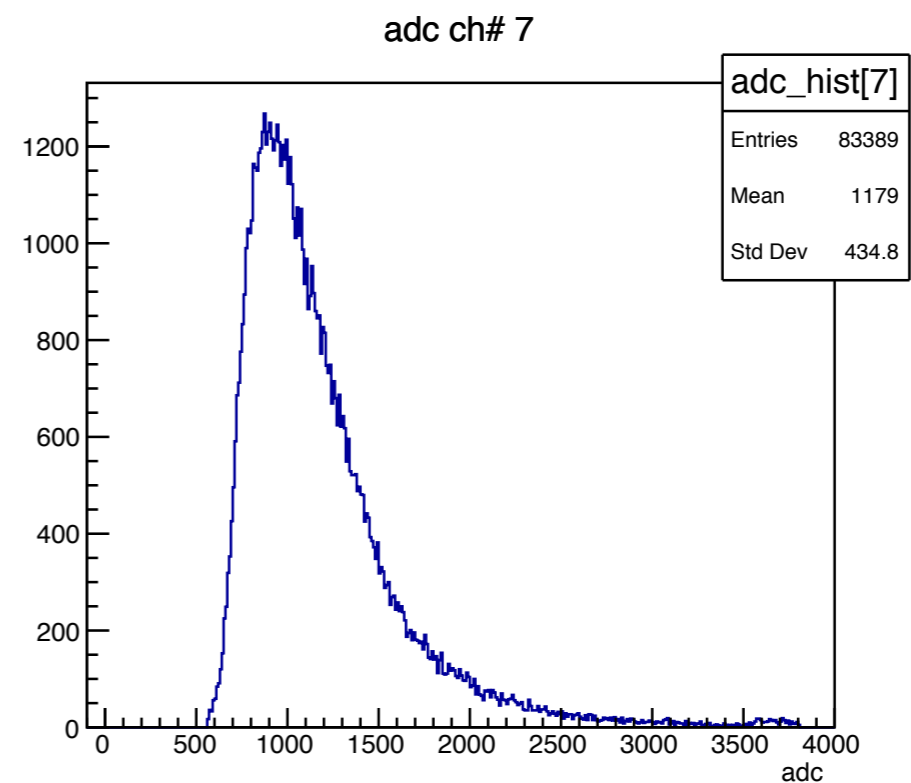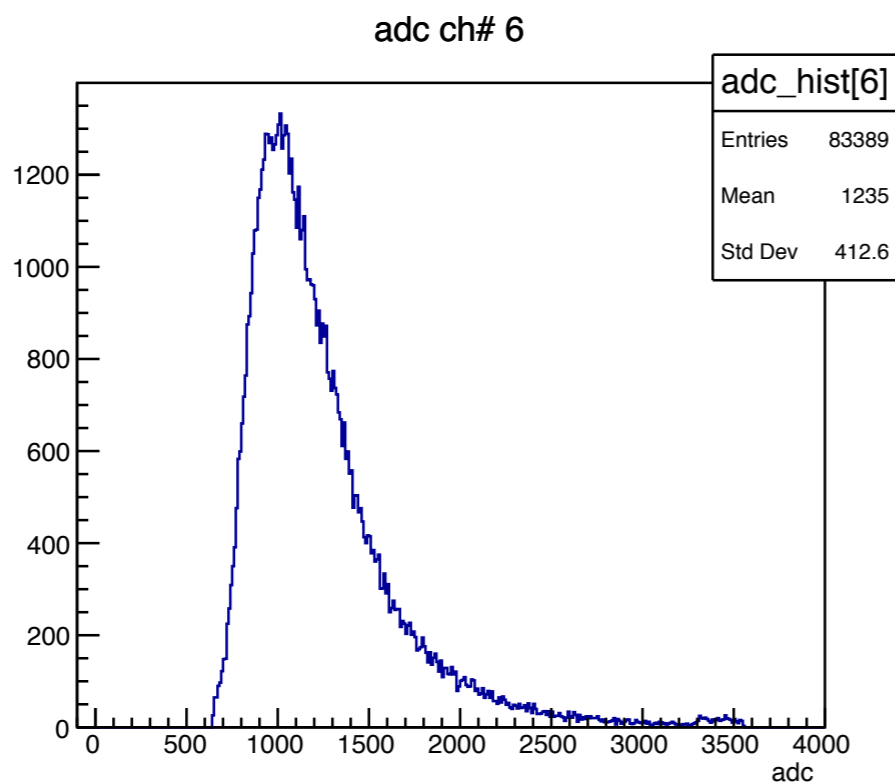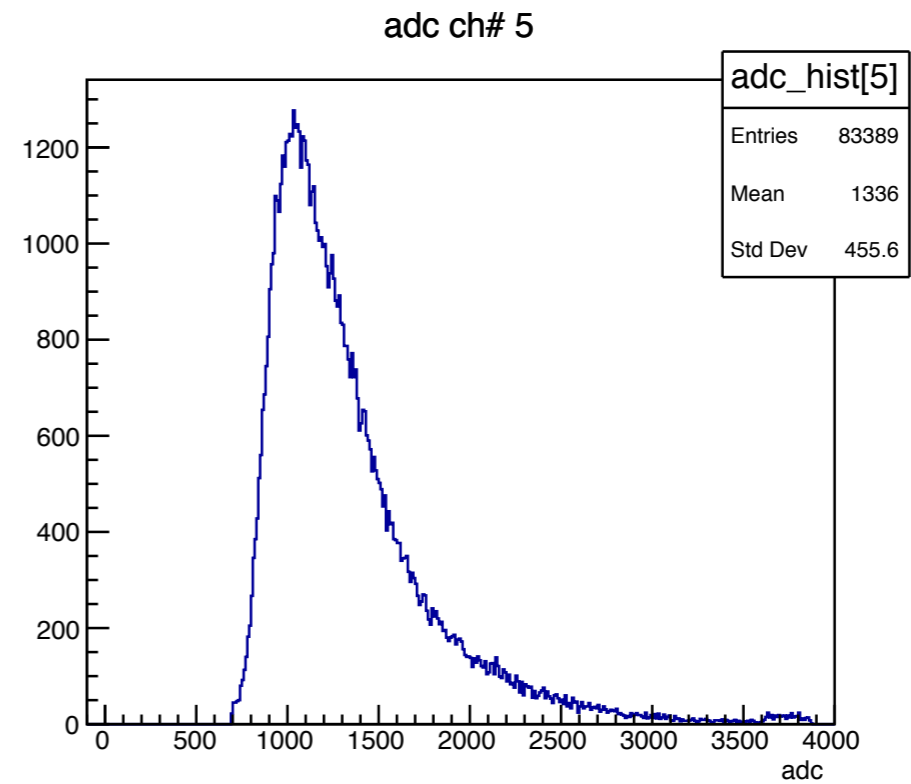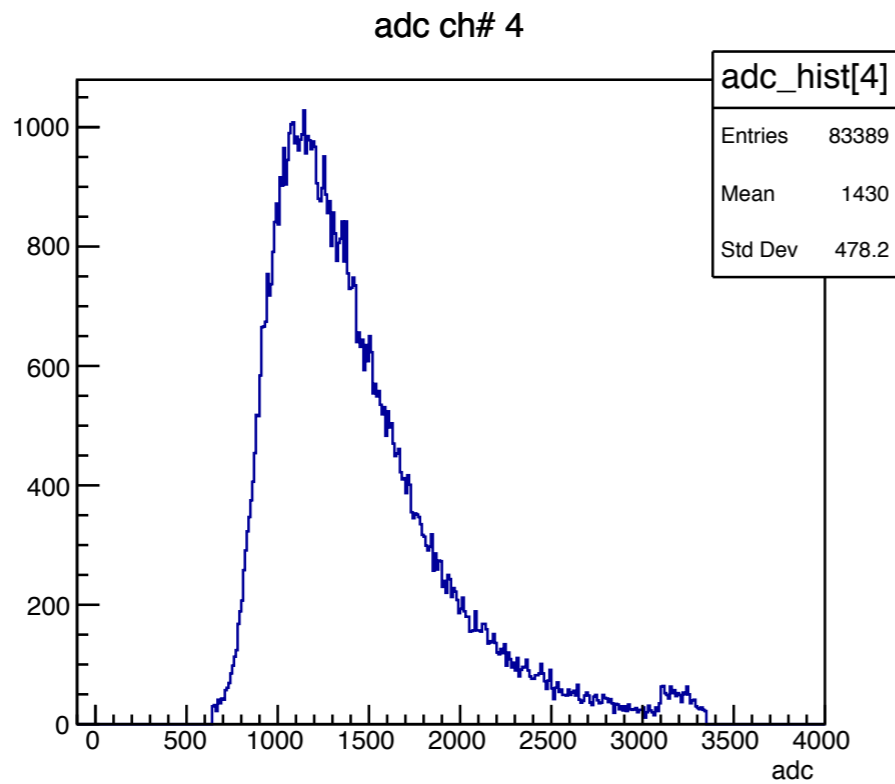2. event selection (red area)
   cut condition : (MPV − 3*σ < ADC)

ch4   ch5

ex) (MPV − 3*σ < ADC) ⊗ (MPV − 3*σ < ADC)
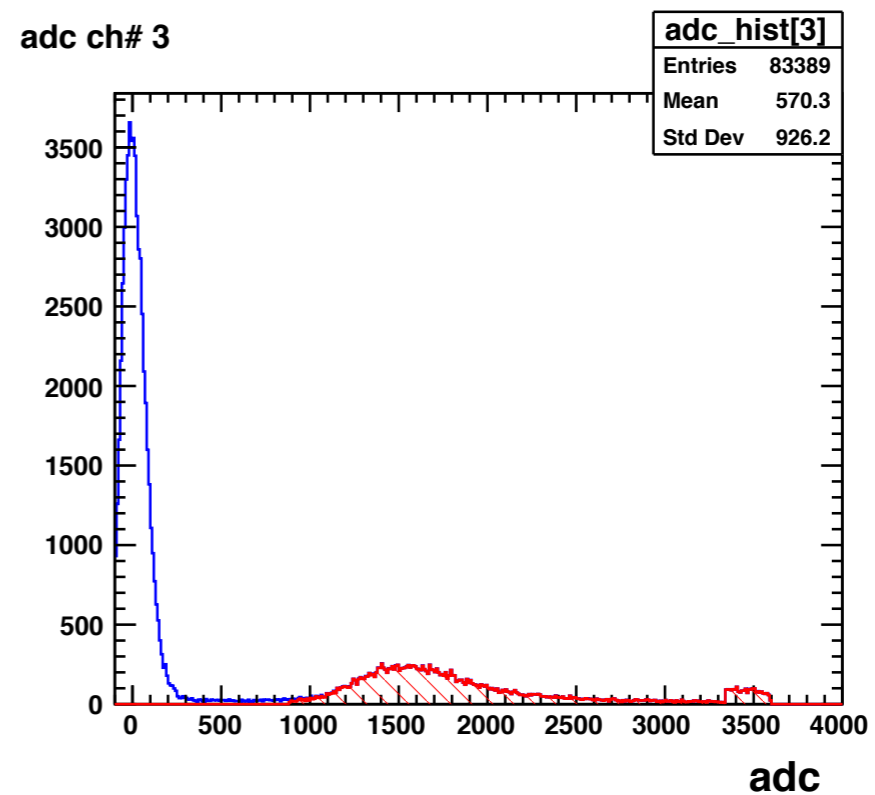
TRIGGER ADC

after event selection(event number 101329 -> 83389)

SCINTILLATOR ADC

red area : selected events

adc ch# 0	adc_hist[0]	
	Entries	83389
	Mean	380.6
	Std Dev	525.8

adc ch# 1	adc_hist[1]	
	Entries	83389
	Mean	472.8
	Std Dev	609

adc ch# 2	adc_hist[2]	
	Entries	83389
	Mean	419.2
	Std Dev	721.5

adc ch# 3	adc_hist[3]	
	Entries	83389
	Mean	570.3
	Std Dev	926.2

Slewing correction

time walk function
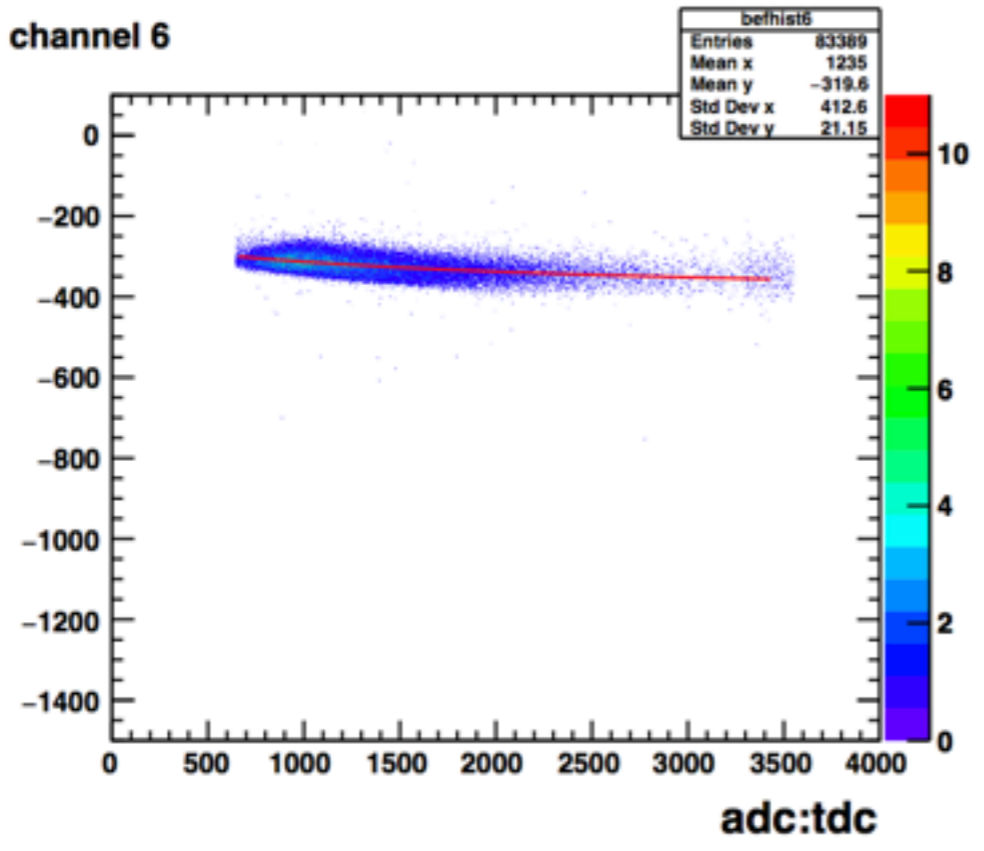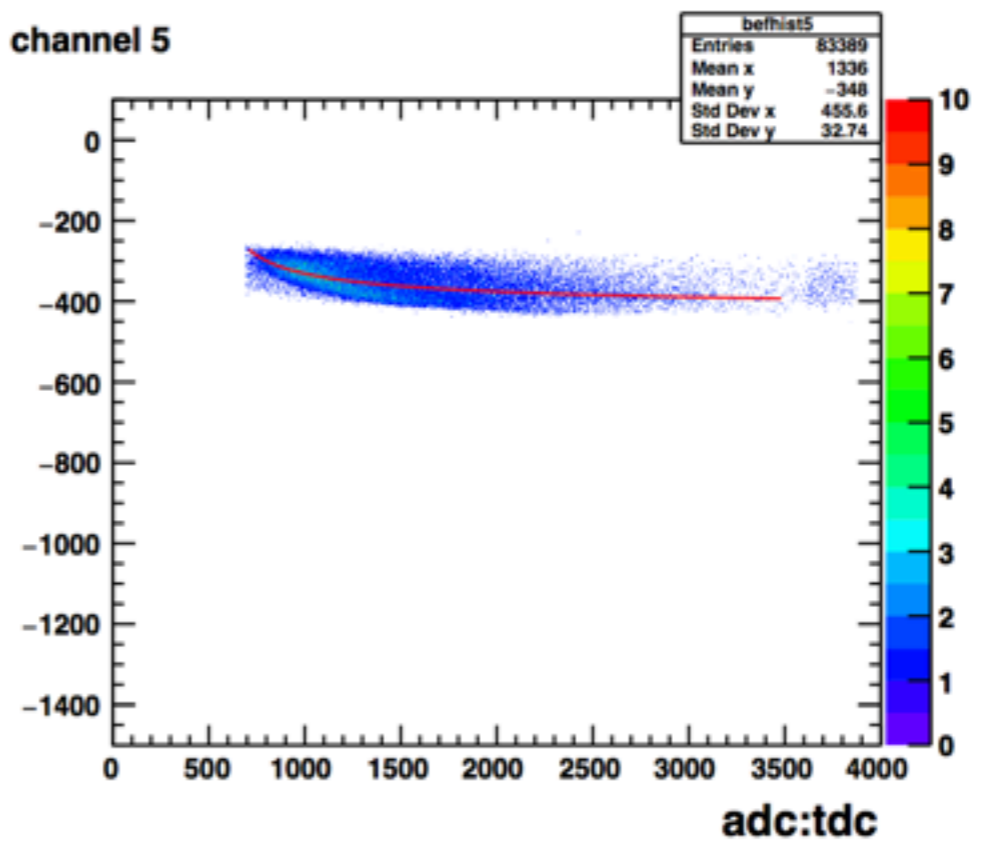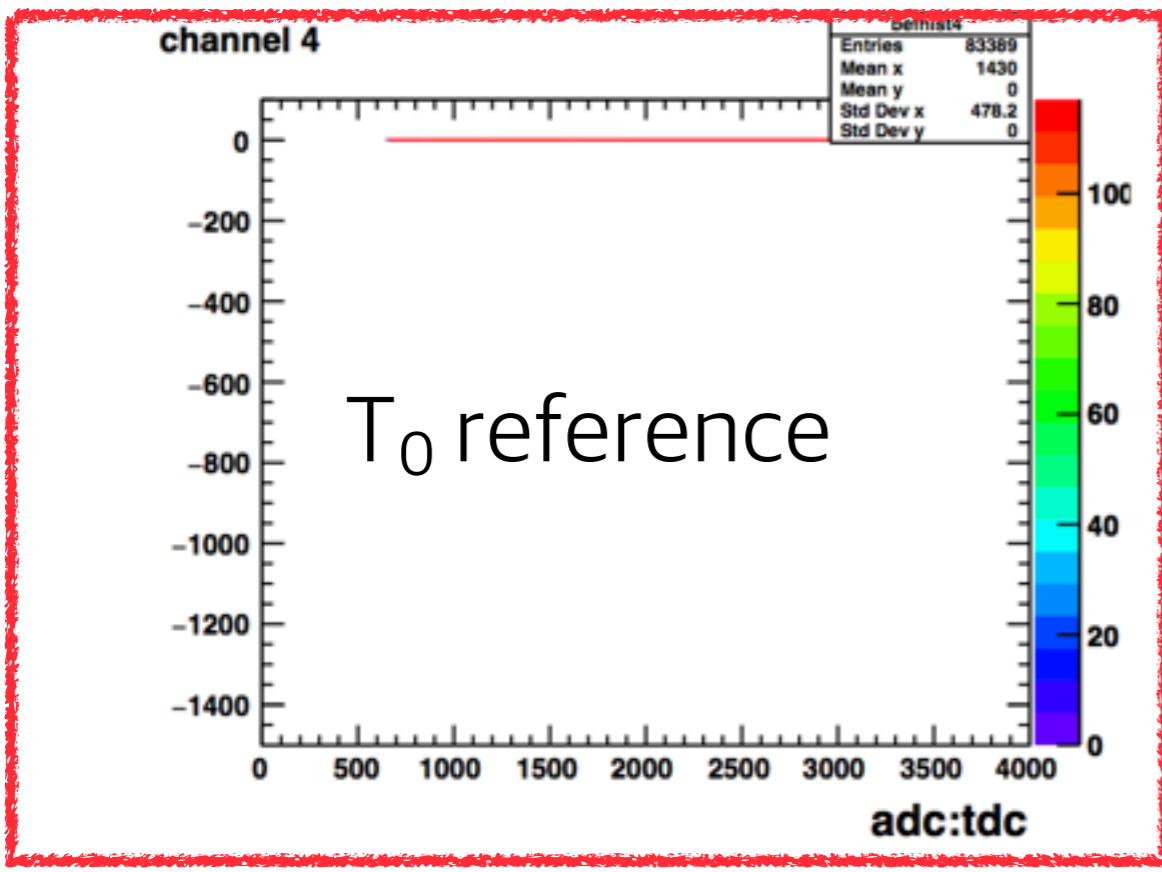
for Scintillator(MPPC)

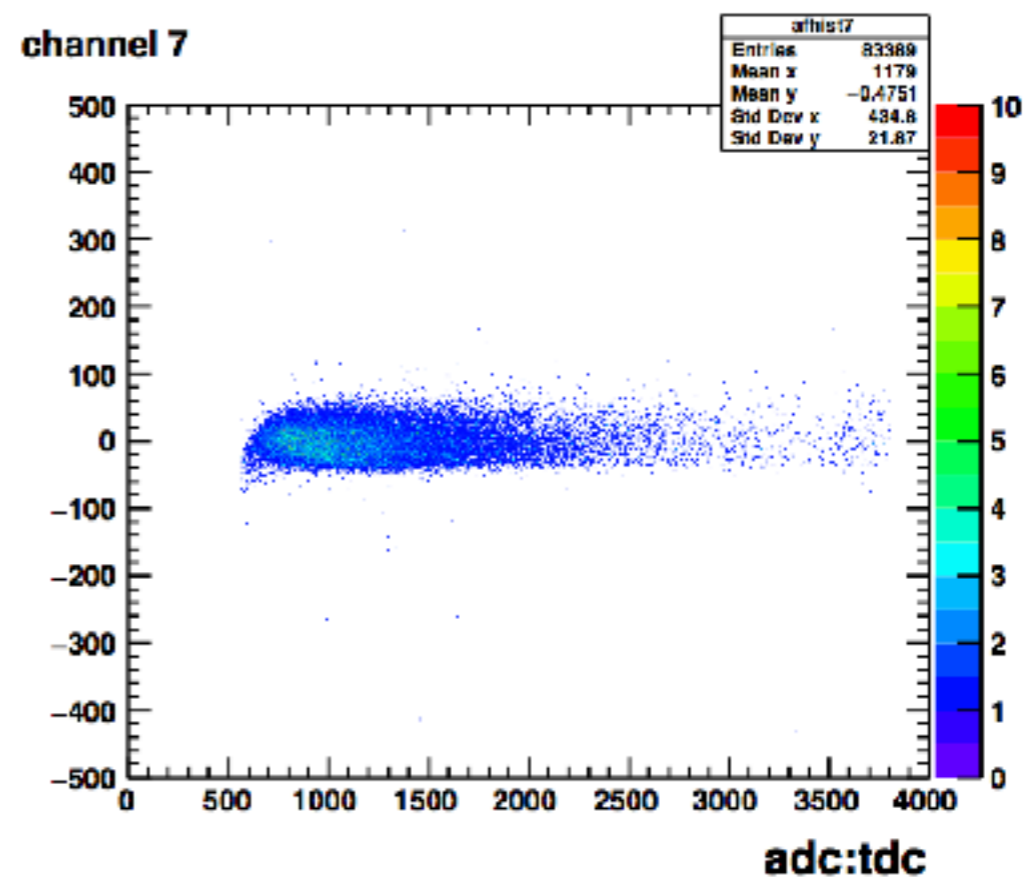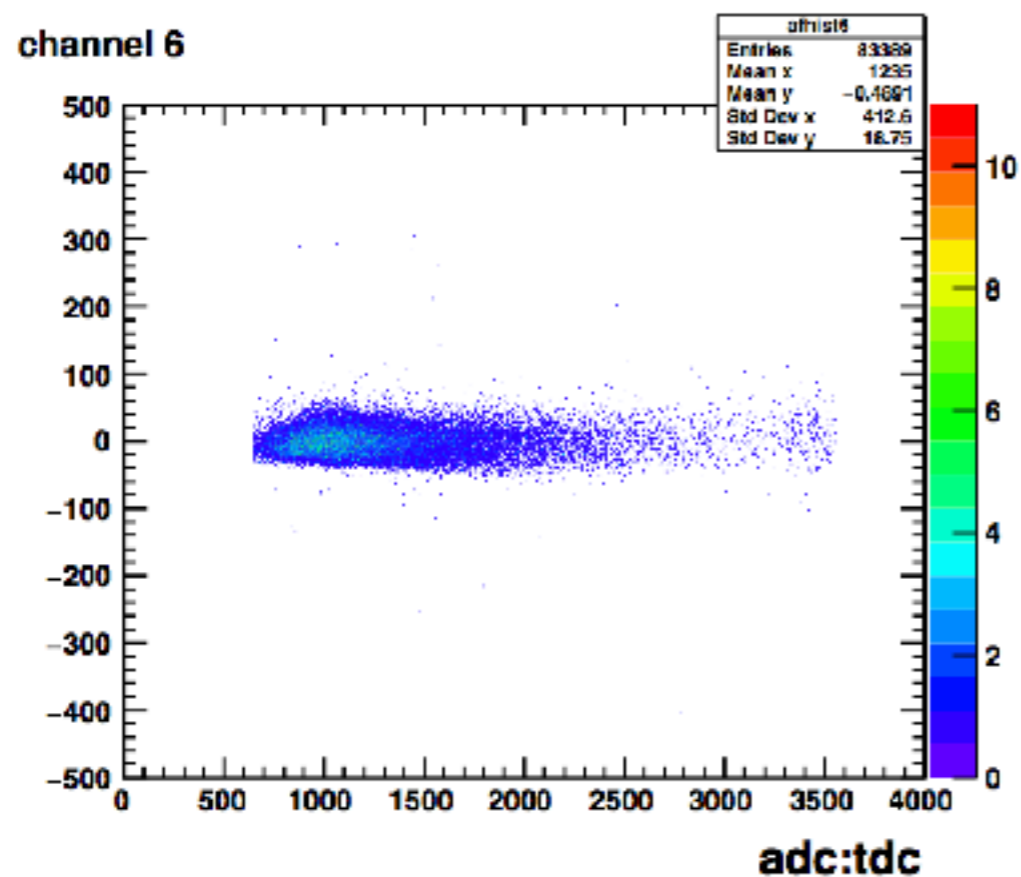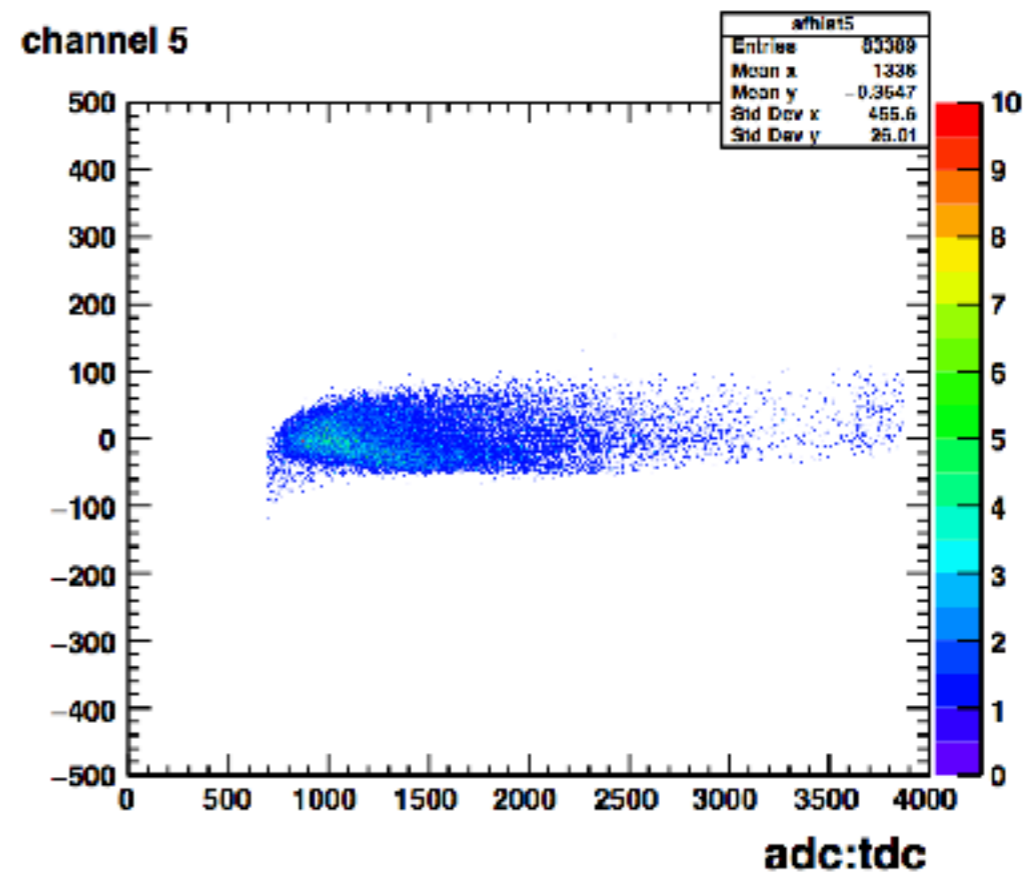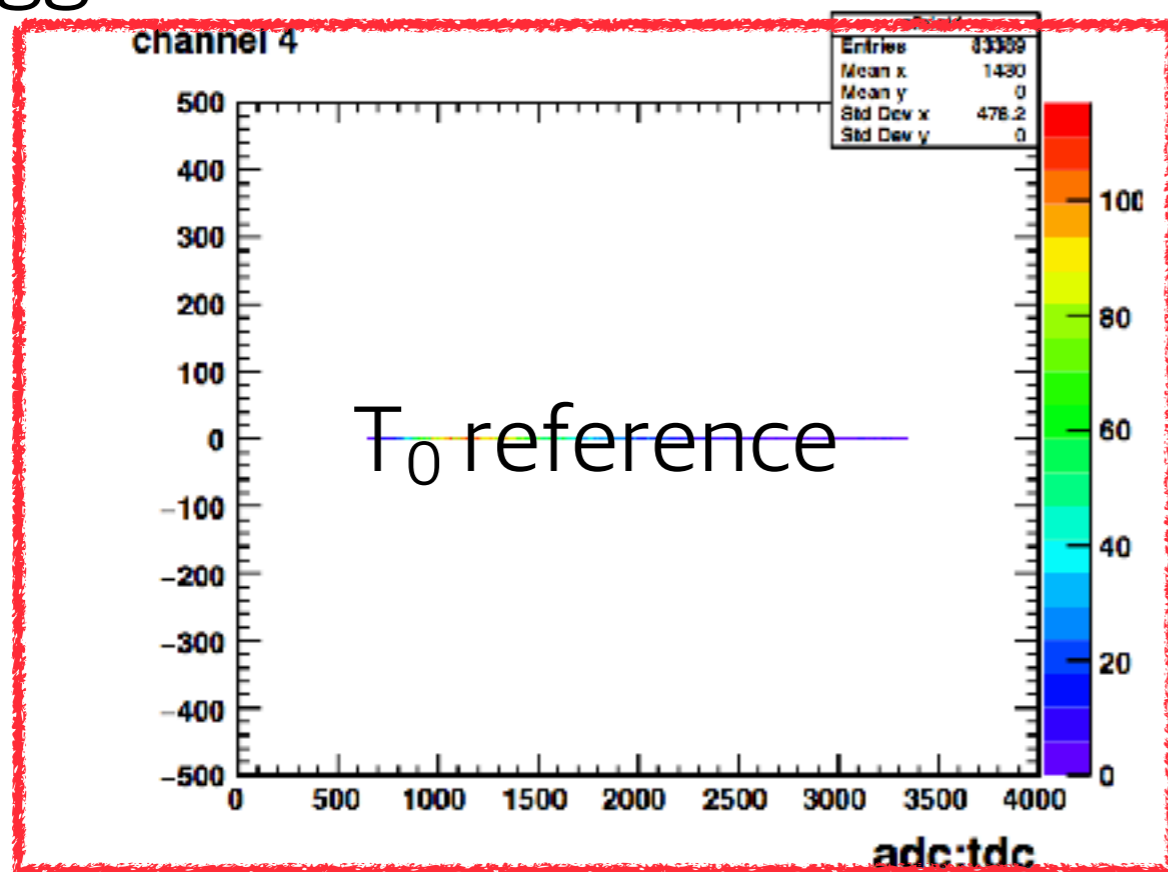$[0]+[1]/(QDC-[3])^{0.5}+[2]/(QDC-[3])$ ($[0]$, $[1]$, $[2]$, $[3]$: paramaters)
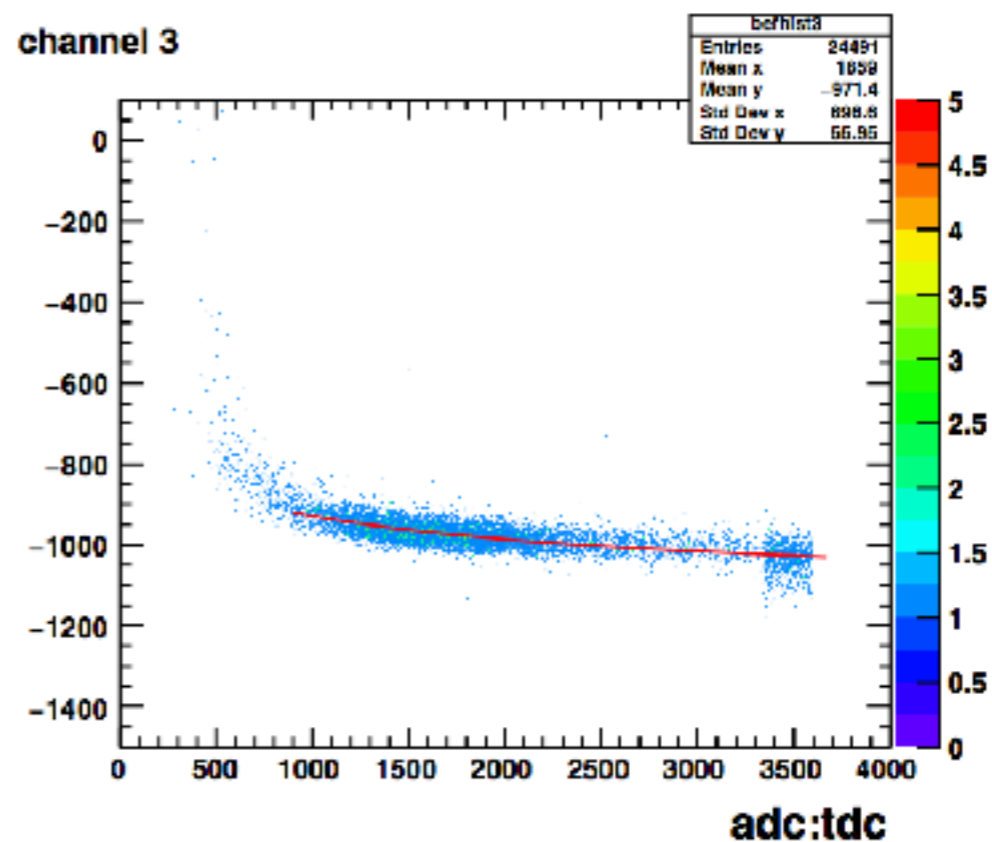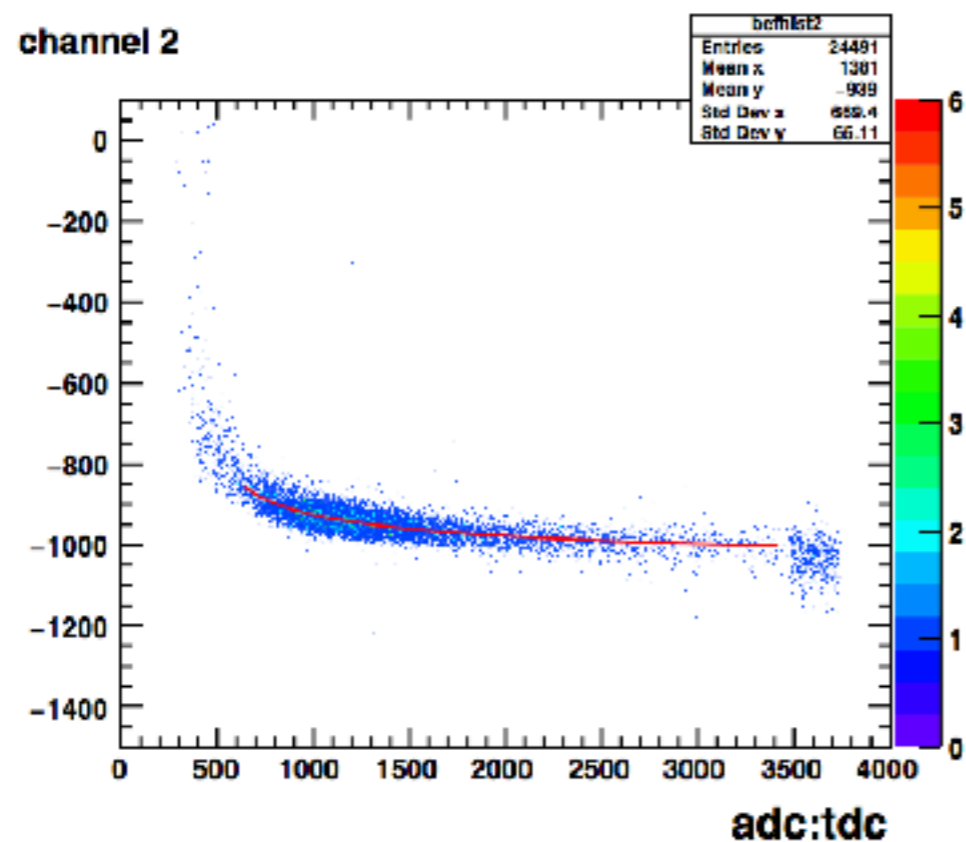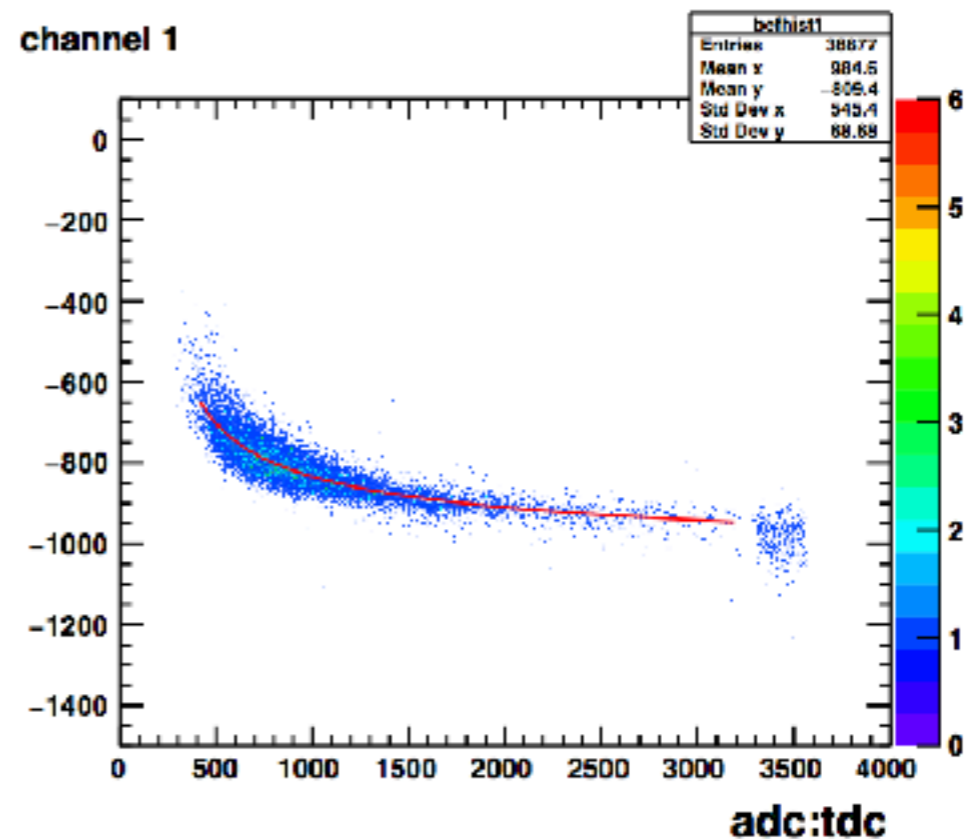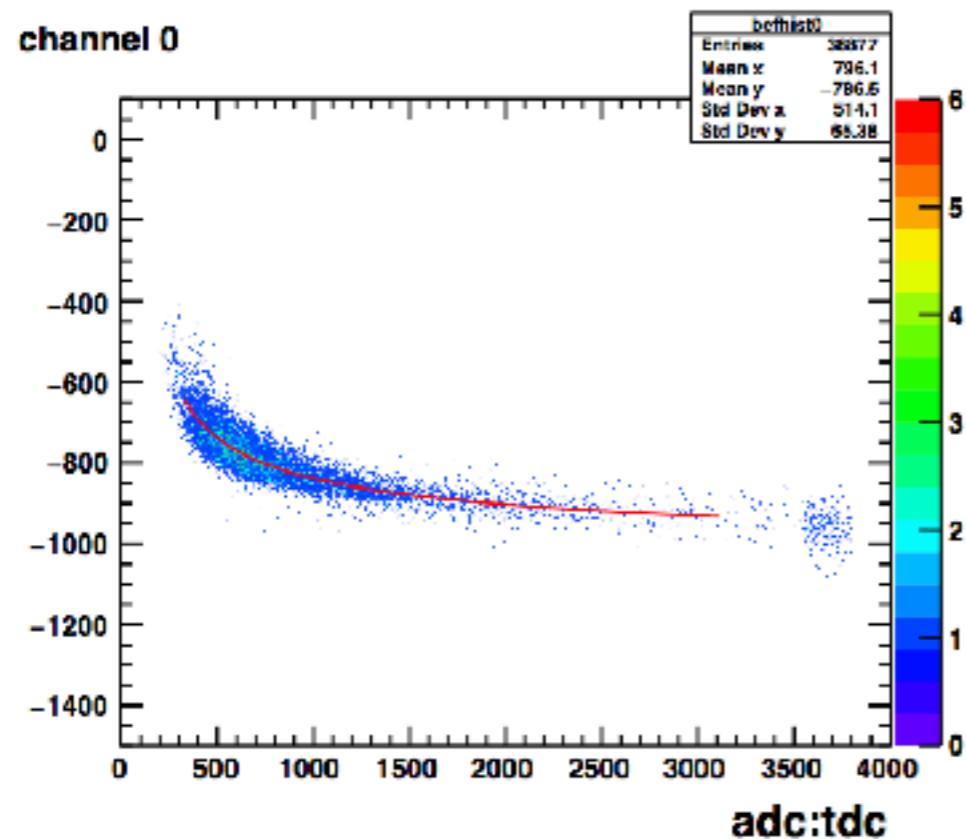
for Trigger(PMT)
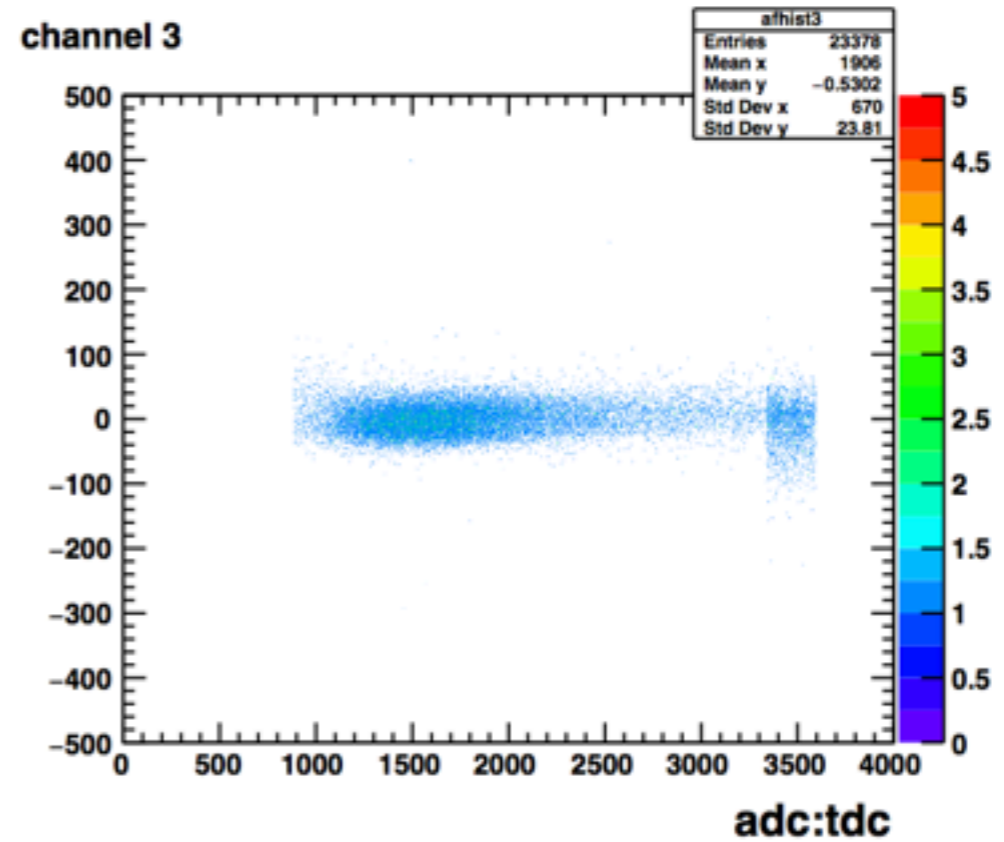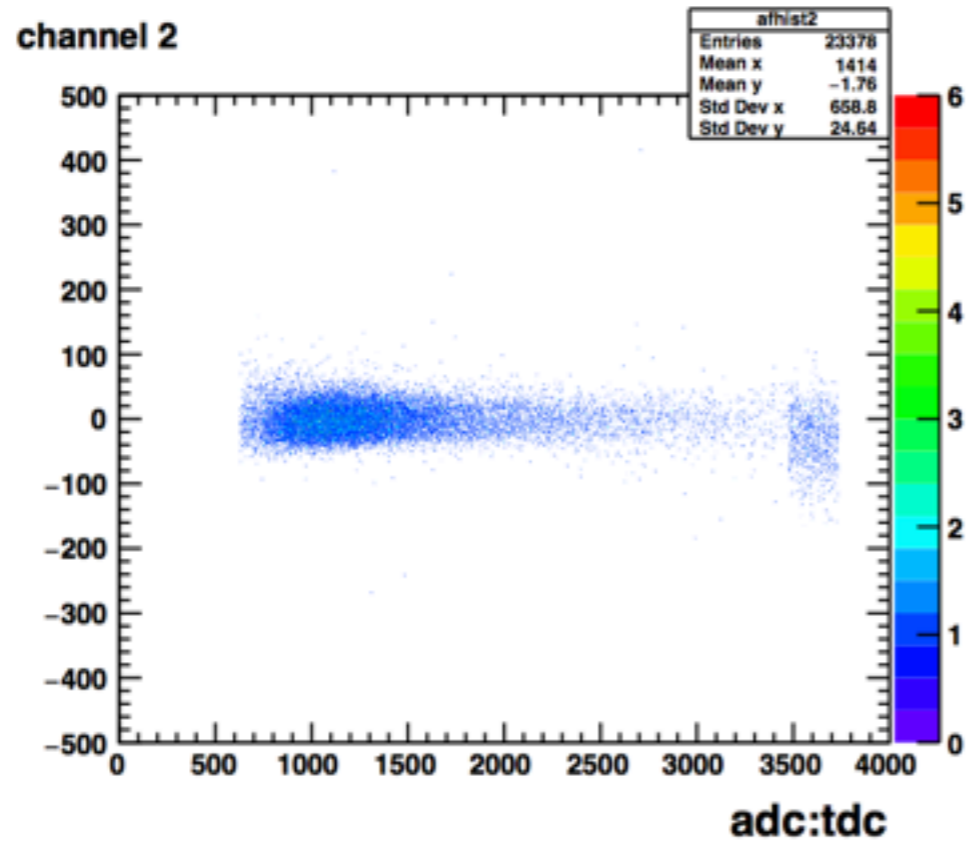
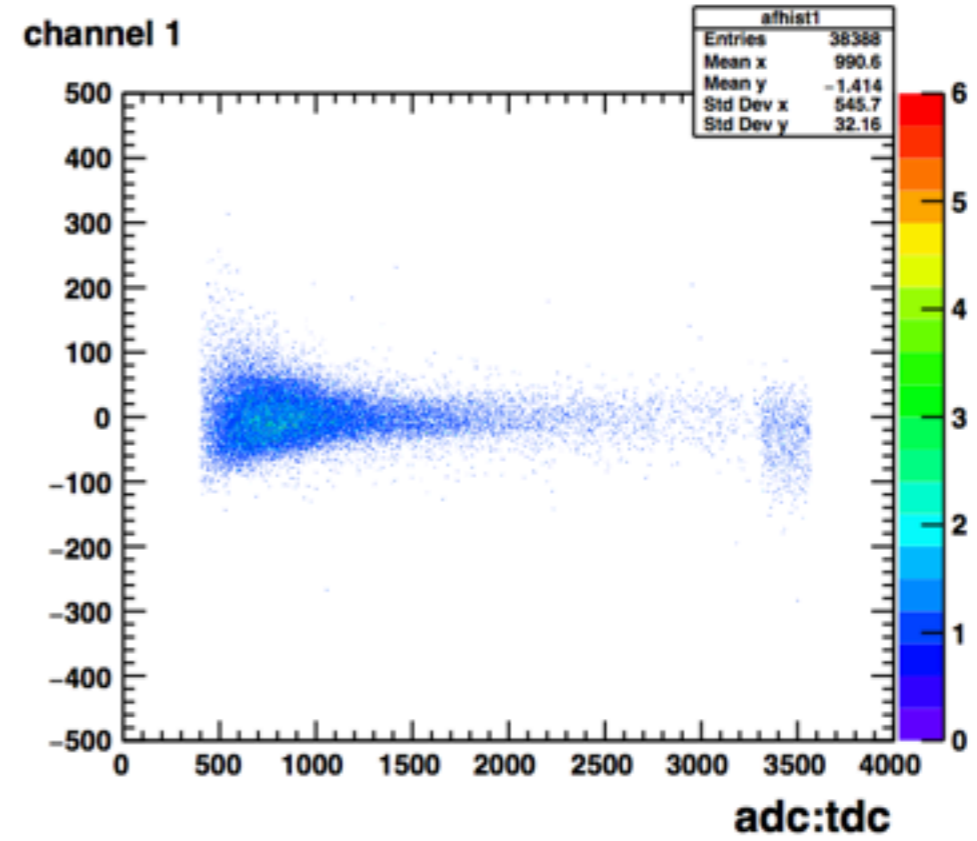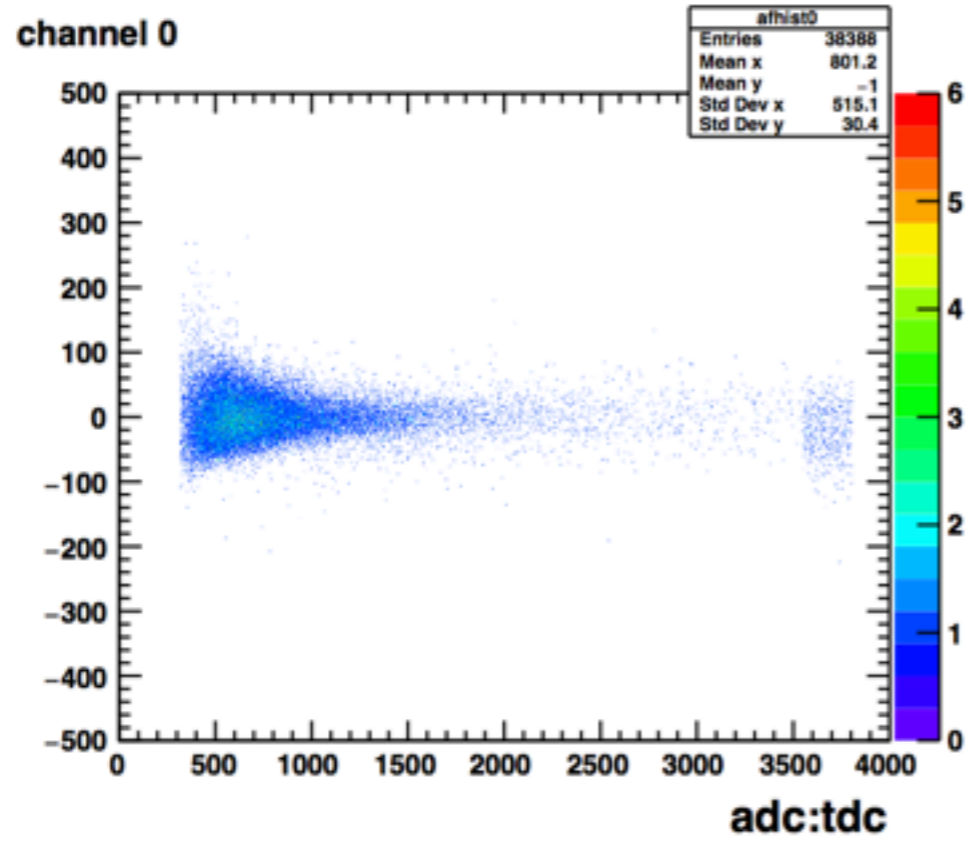$[0]+[1]/(QDC-[2])^{0.5}$ ($[0]$, $[1]$, $[2]$: paramaters)

Triggers – Before correction

Triggers – After correction

Scintillators – Before correction

Scintillators – After correction

Raw TDC

slewing corrected TDC

TIME RESOLUTION

It is impossible for Trigger #1 to do slewing correction(it is time reference)

So, tof between Trigger #2, and two scintillators are used

(Tof between Trigger #1 and the others are not included)
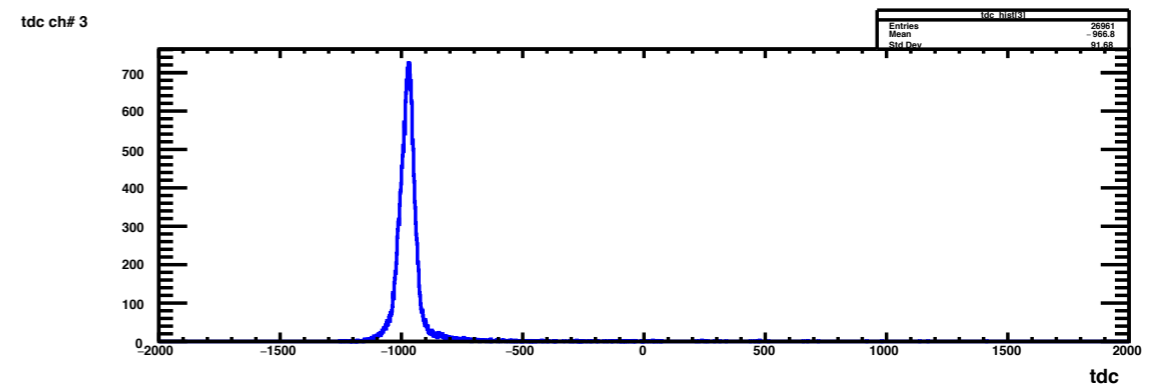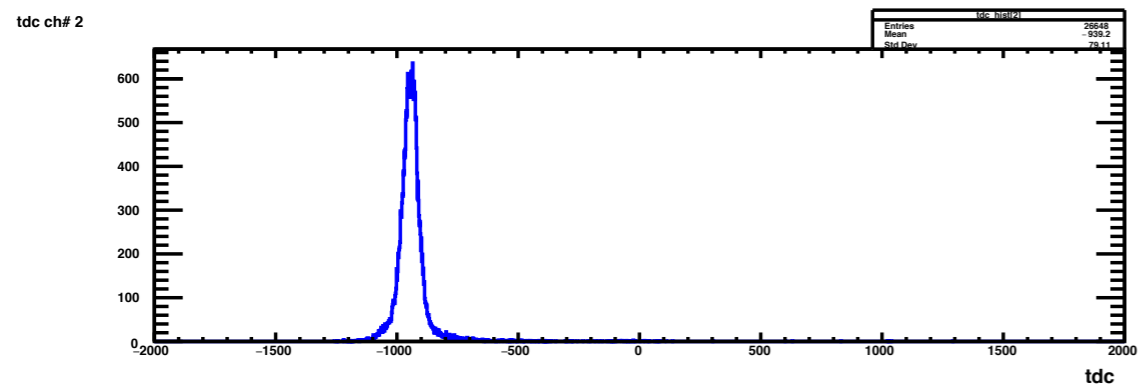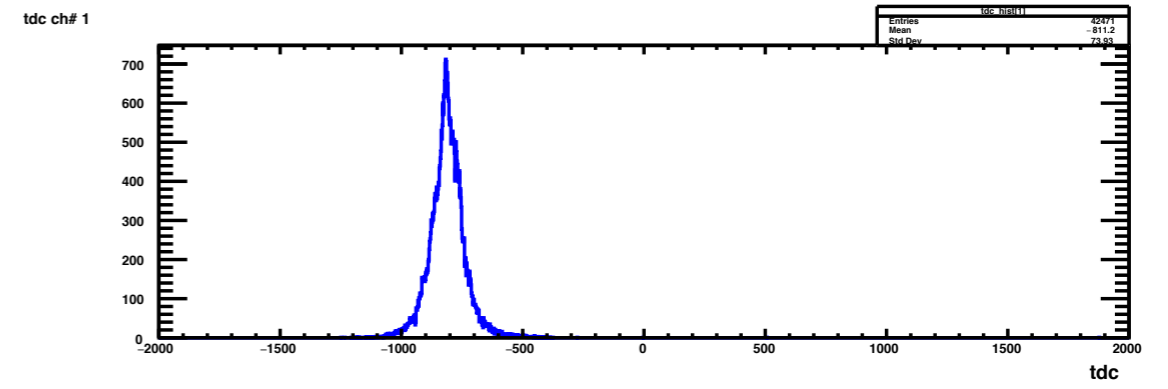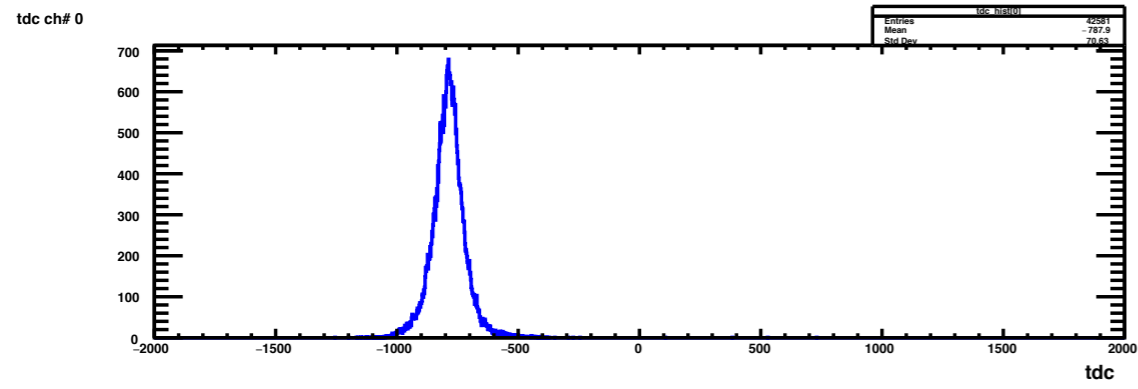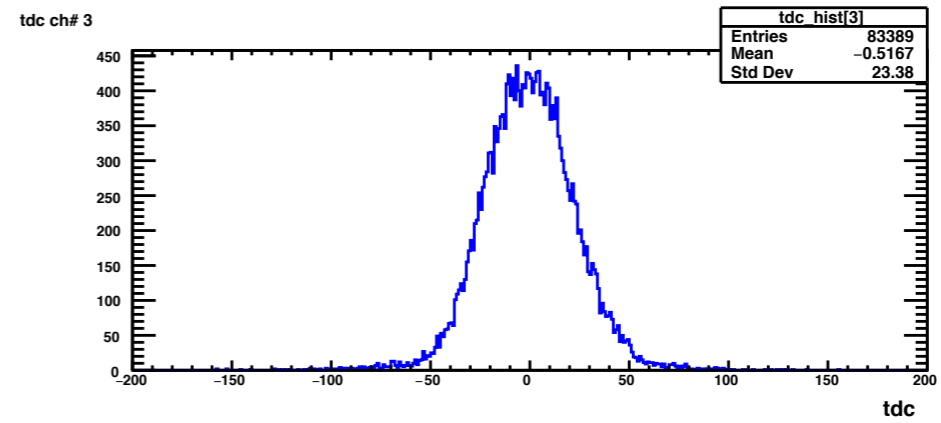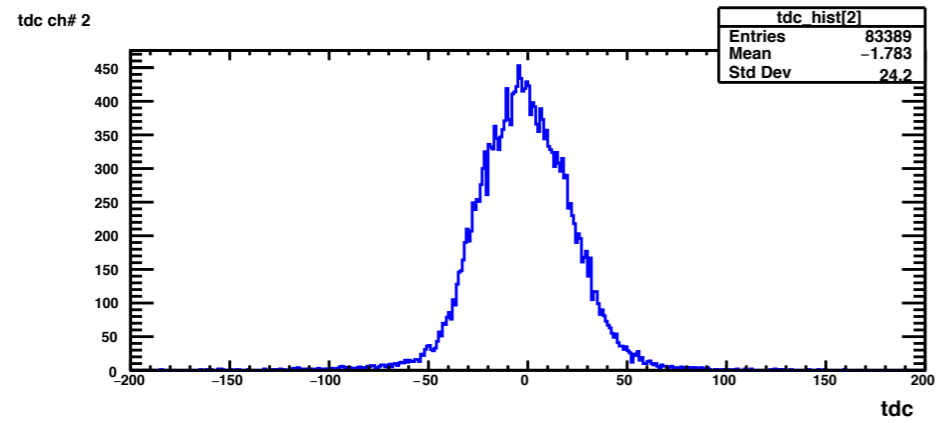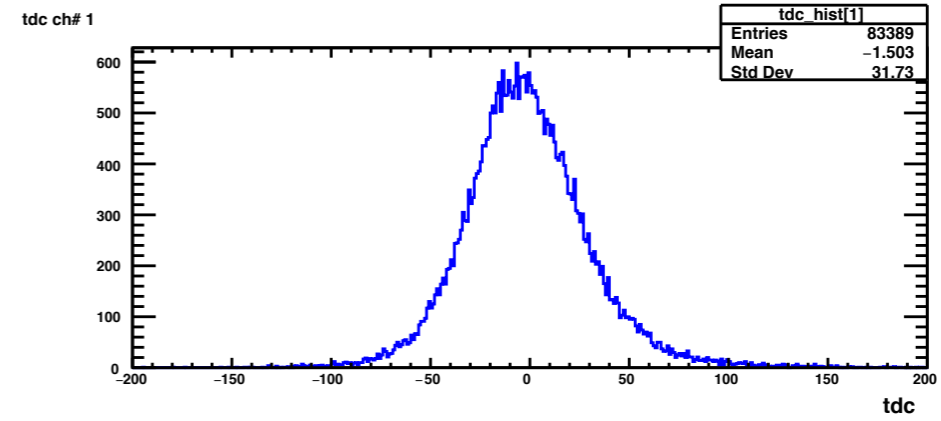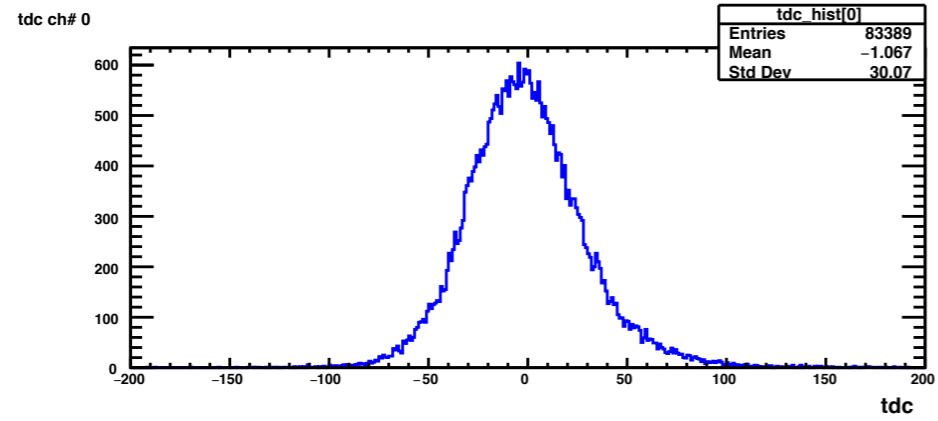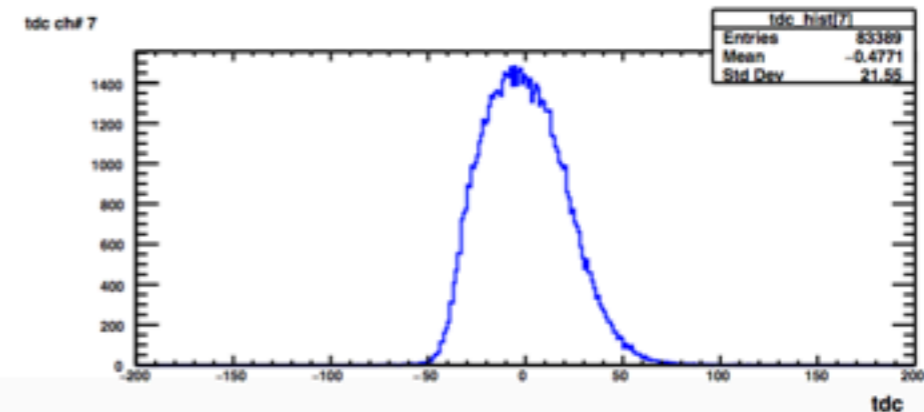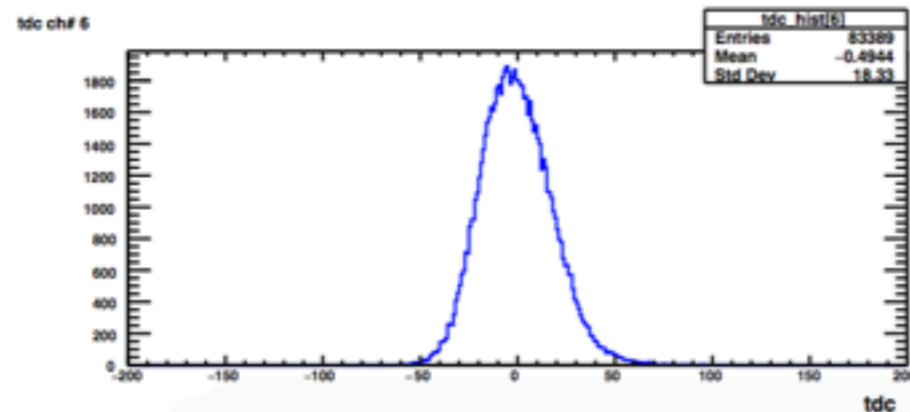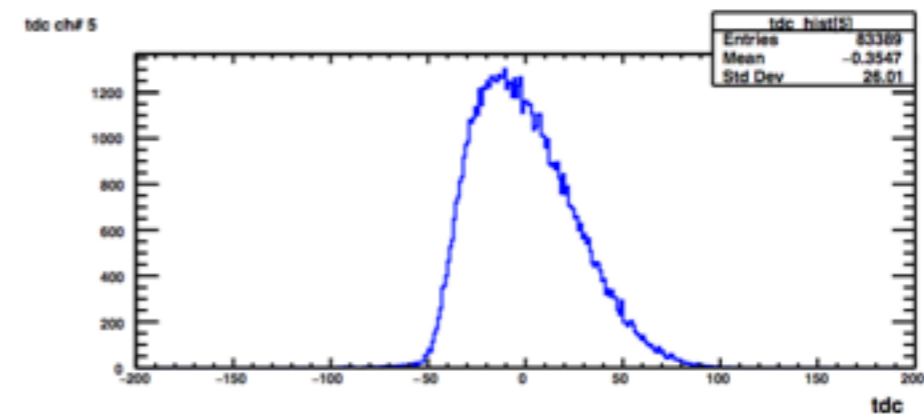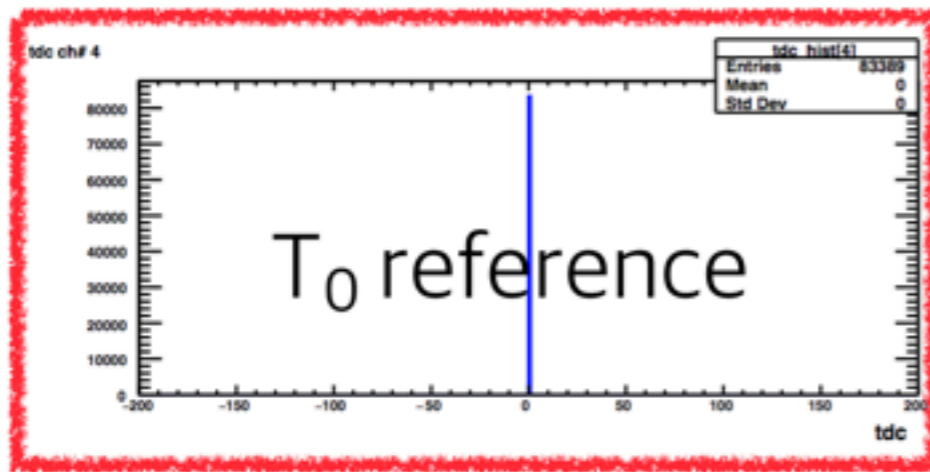
TIME RESOLUTION

tof, scint # 1 ~ trigger #2

tof_hist[0]	
Entries	38388
Mean	−0.1706
Std Dev	21.36
χ^2 / ndf	118.6 / 28
Prob	4.028e−13
Constant	1720
Mean	−2.538
Sigma	16.49

tof, scint # 2 ~ trigger #2

tof_hist[1]	
Entries	23378
Mean	−1.894
Std Dev	14.39
χ^2 / ndf	70.19 / 28
Prob	1.751e−05
Constant	1610
Mean	−1.273
Sigma	11.24

TRIGGER #2

TOF

Scintillator #1

Scintillator #2

TRIGGER #1 – T0(time reference)

tof, scint #1 - scint #2

scint_tof_hist	
Entries	14537
Mean	−1.358
Std Dev	22.56
χ^2 / ndf	29.42 / 28
Prob	0.3914
Constant	590.7
Mean	0.8799
Sigma	18.33

$$\sigma^2_{tof,scint1\sim trig} = \sigma^2_{scint1} + \sigma^2_{trig}$$

$$\sigma^2_{tof,scint1\sim scint2} = \sigma^2_{scint1} + \sigma^2_{scint2}$$

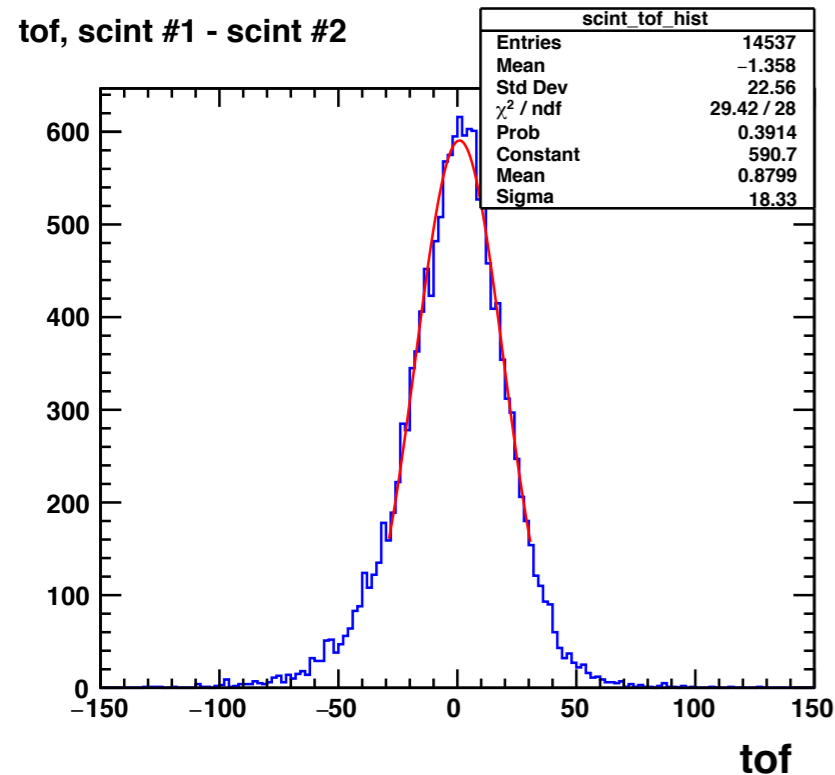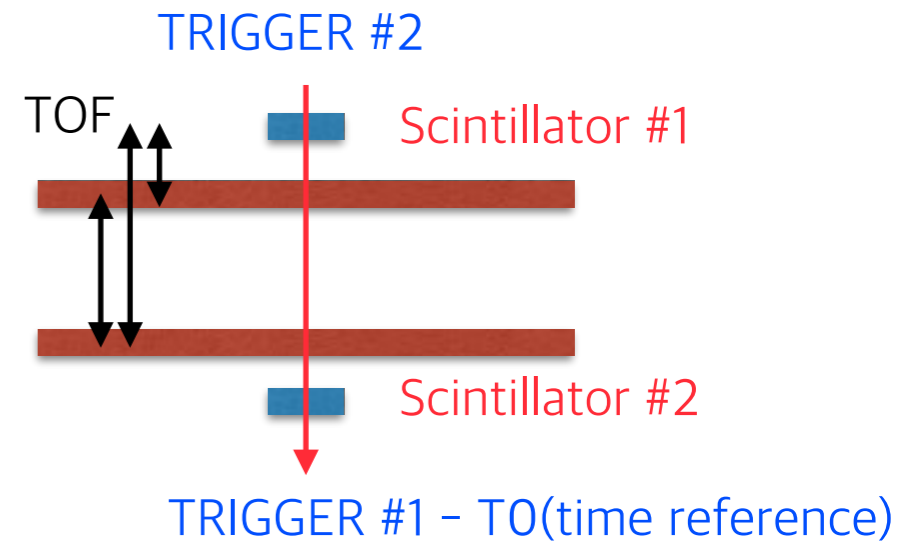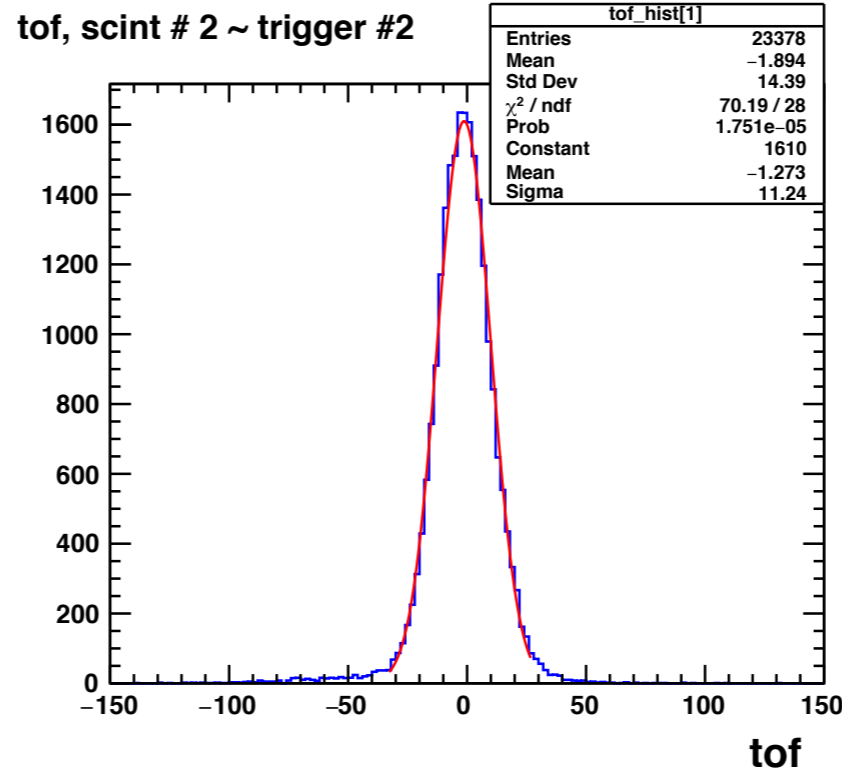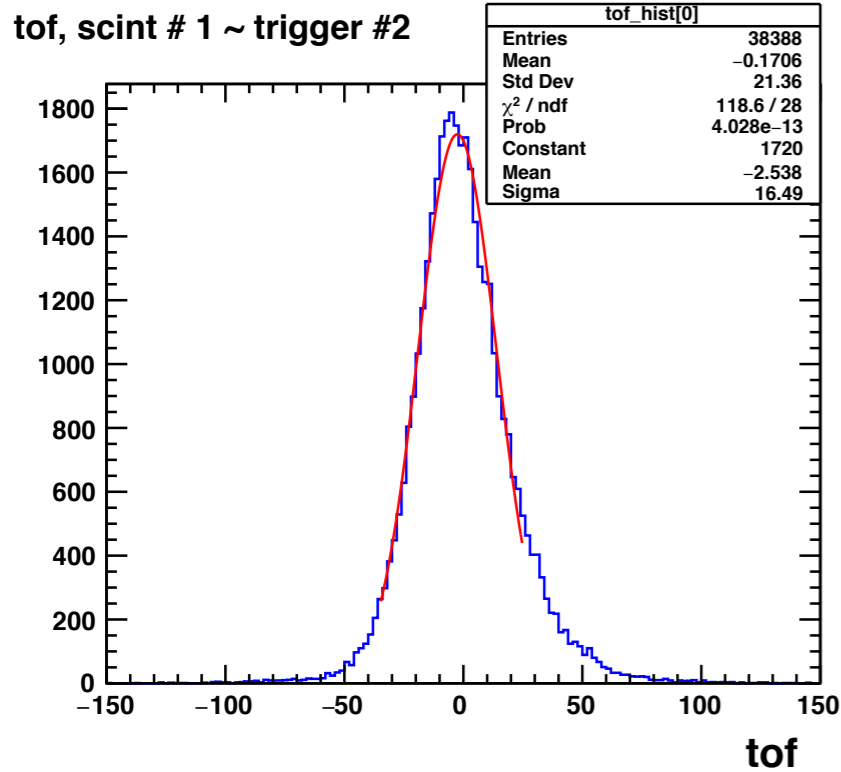$$\sigma^2_{tof,scint2\sim trig} = \sigma^2_{scint2} + \sigma^2_{trig}$$

$$\sigma_{scint1} = \sqrt{(\sigma^2_{tof,scint1\sim trig} + \sigma^2_{tof,scint1\sim scint2} - \sigma^2_{tof,scint2\sim trig})}$$

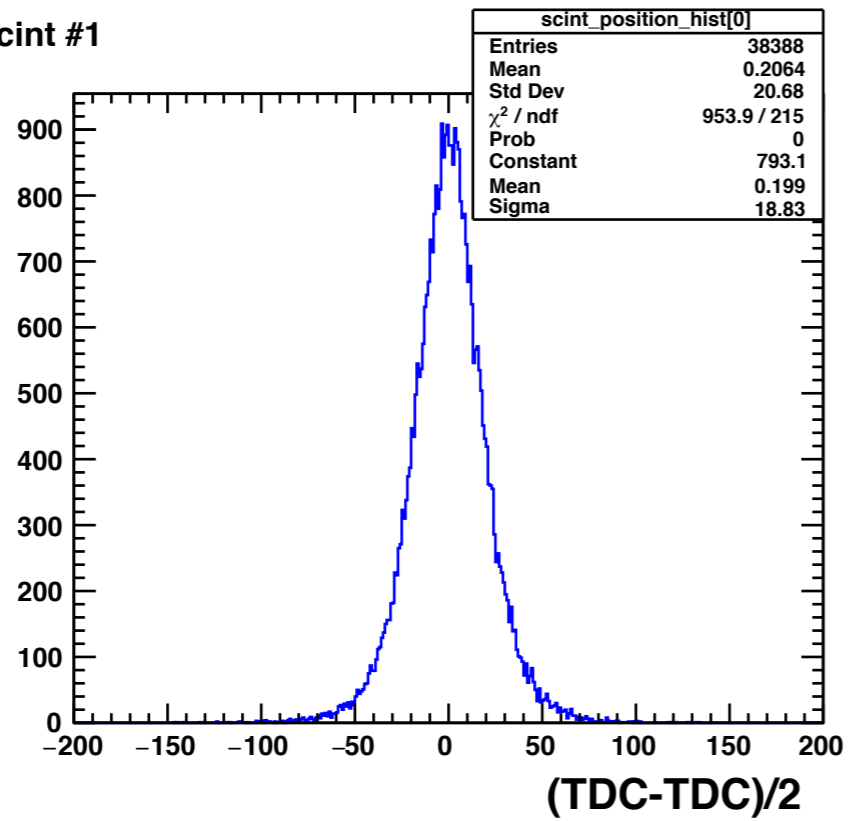**Result (Time resolution)**

Scintillator 1 : 543 ± 5 ps (width 7cm)

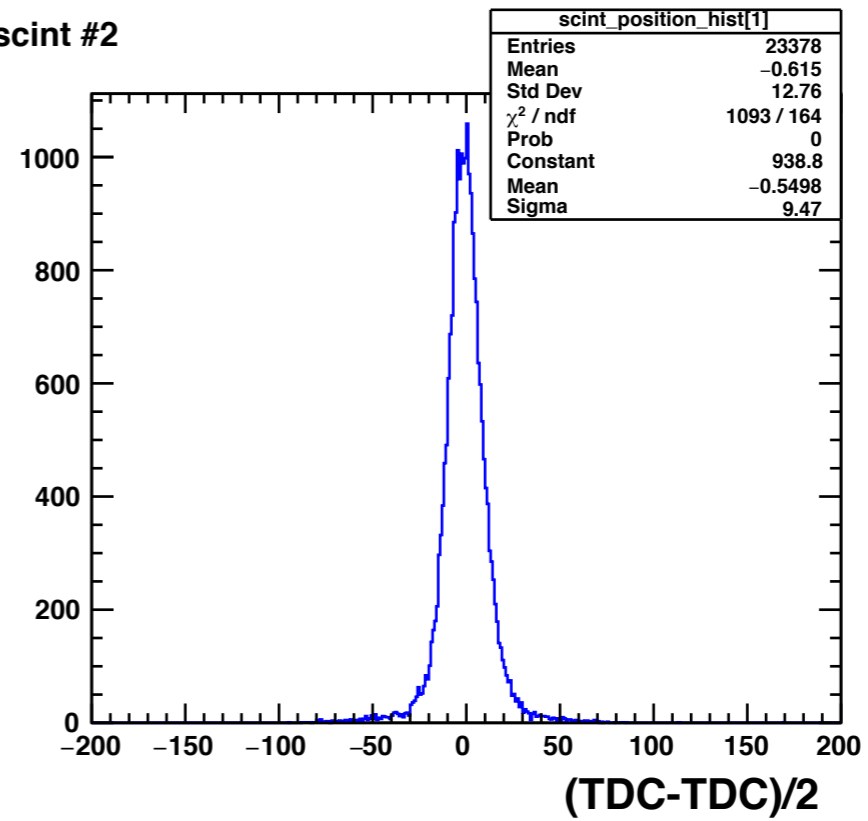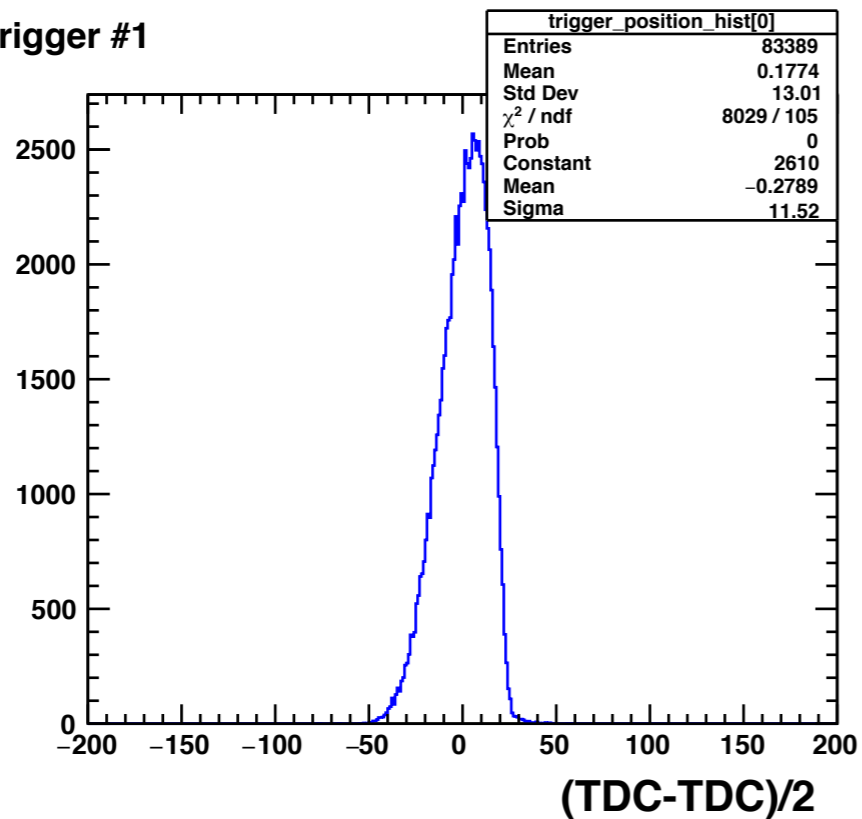**Scintillator 2 : 342 ± 9 ps (width 4cm) trigger : 195 ± 15 ps**

BACKUP

Position

Timing

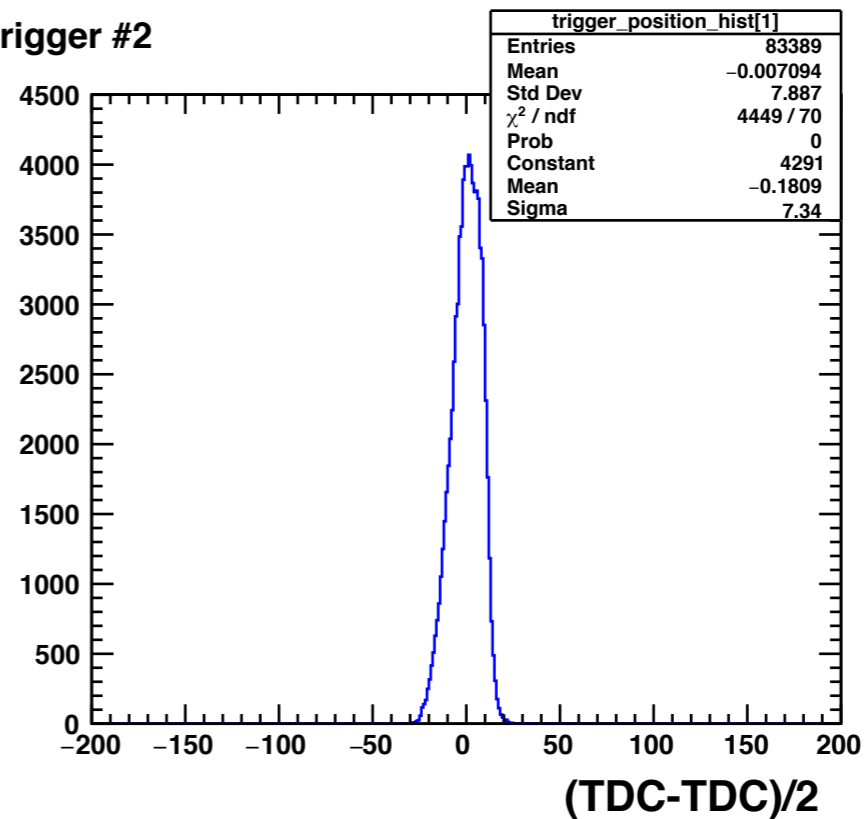**trigger timing # 1**

trigger_hist[0]	
Entries	83389
Mean	−0.1774
Std Dev	13.01
χ^2 / ndf	8029 / 105
Prob	0
Constant	2610
Mean	0.2789
Sigma	11.52

(TDC+TDC)/2

trigger timing # 2

trigger_hist[1]	
Entries	83389
Mean	−0.484
Std Dev	18.41
χ^2 / ndf	5940 / 170
Prob	0
Constant	1880
Mean	0.5896
Sigma	16.42

(TDC+TDC)/2