TPC Hodoscope

Hodoscope cosmic test

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CONTENTS

1. Circuit issues

    -Baseline shift
    -Noise of circuit

2. Cosmic test

    -Event selection
    -Time work correction
    -Result

CIRCUIT ISSUES

1. Baseline shift

Parameter	Test Conditions/Comments	Min	Typ	Max	Unit
DC PERFORMANCE					
Input Offset Voltage			1	10	mV :

The input offset value in the data sheet of the ad8000 is 1 mV. (maximum 10 mV)

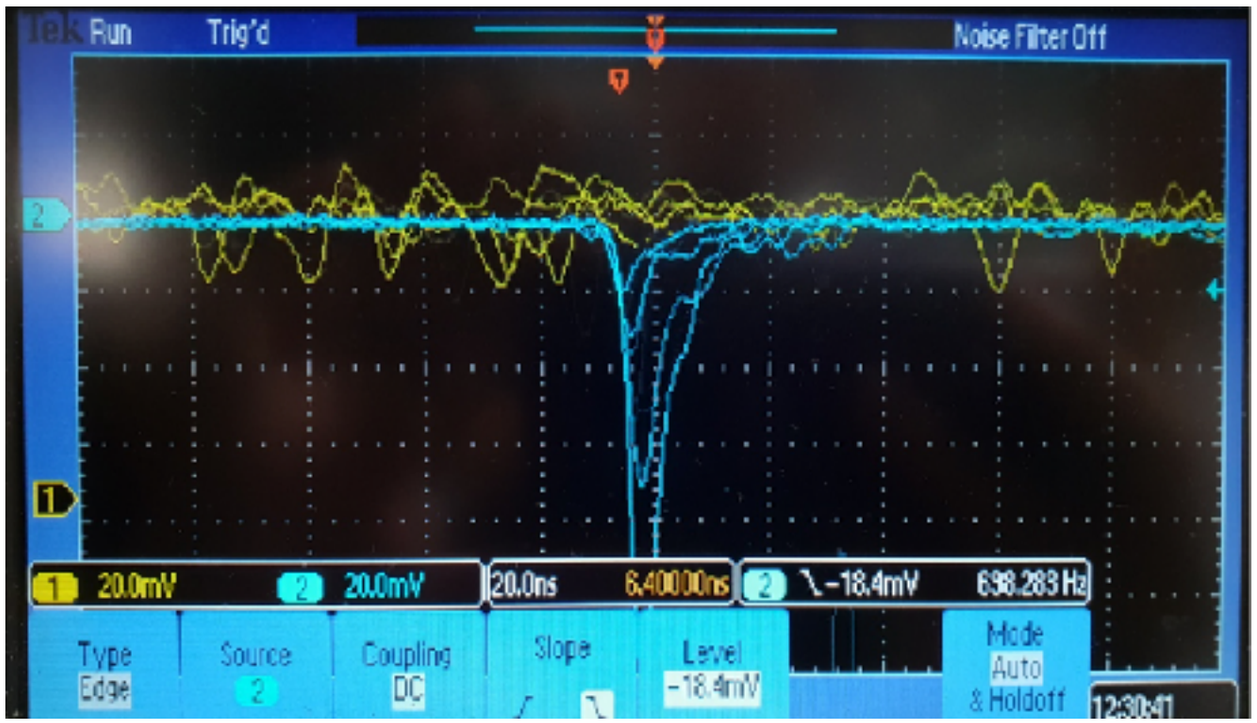
Therefore, each preamplifier has an offset.

And also there is an positive offset in the circuit.

Especially when the circuit amplifier gain is set high(x4), the offset value is + 50 mV

CIRCUIT ISSUES

2. Noise of circuit



(MPPC is turned off)

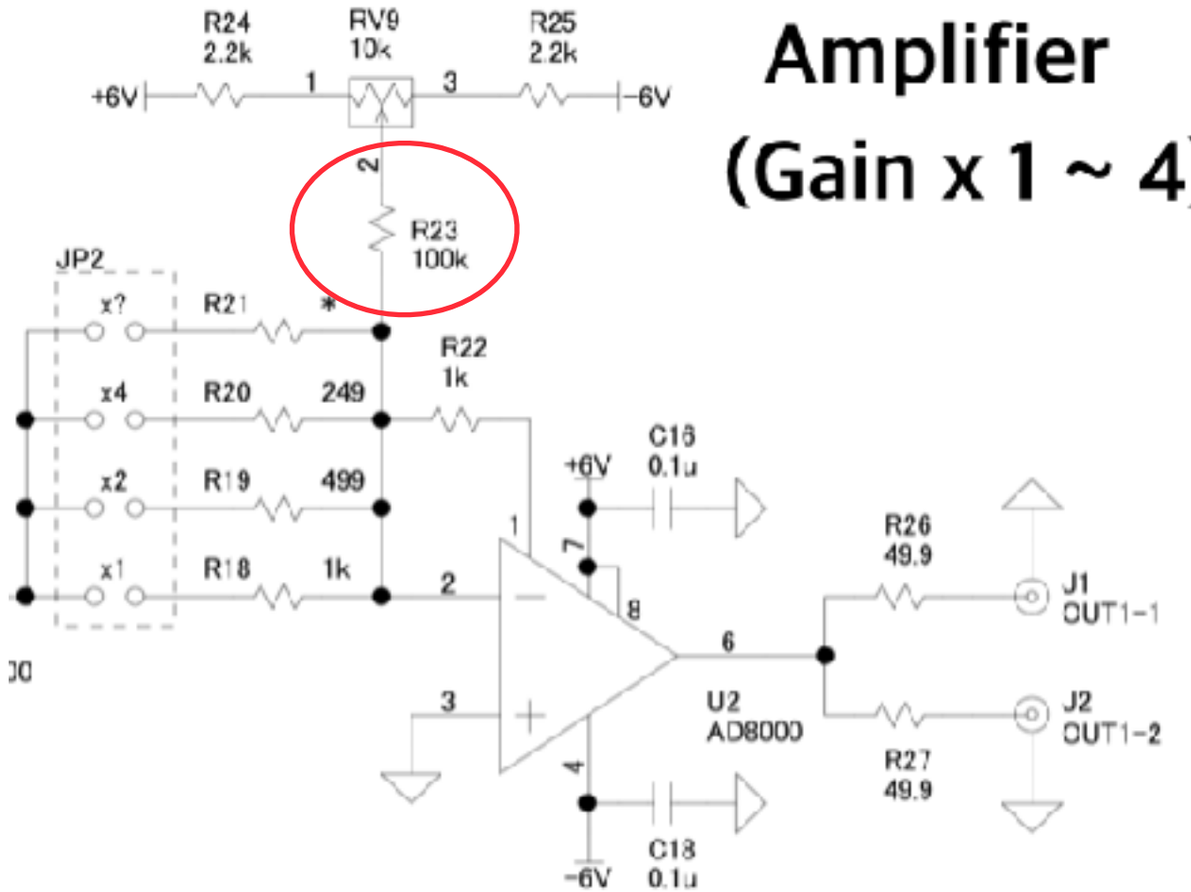
Ch 1(Yellow) - Circuit baseline

Ch 2(Blue) - PMT

There is about 20 mv of noise in the circuit itself.

CIRCUIT ISSUES

Suggestion of Giga Company



Amplifier
(Gain x 1 ~ 4)

for reduce the baseline shift

1. By changing the R23 resistance smaller, we can reduce the baseline shift.

-> But in that way, a stability of gain becomes bad

2. Put a coupling capacitor (0.01 uF) in the circuit to remove a DC offset

After 8/25, we will send boards to GIGA company.

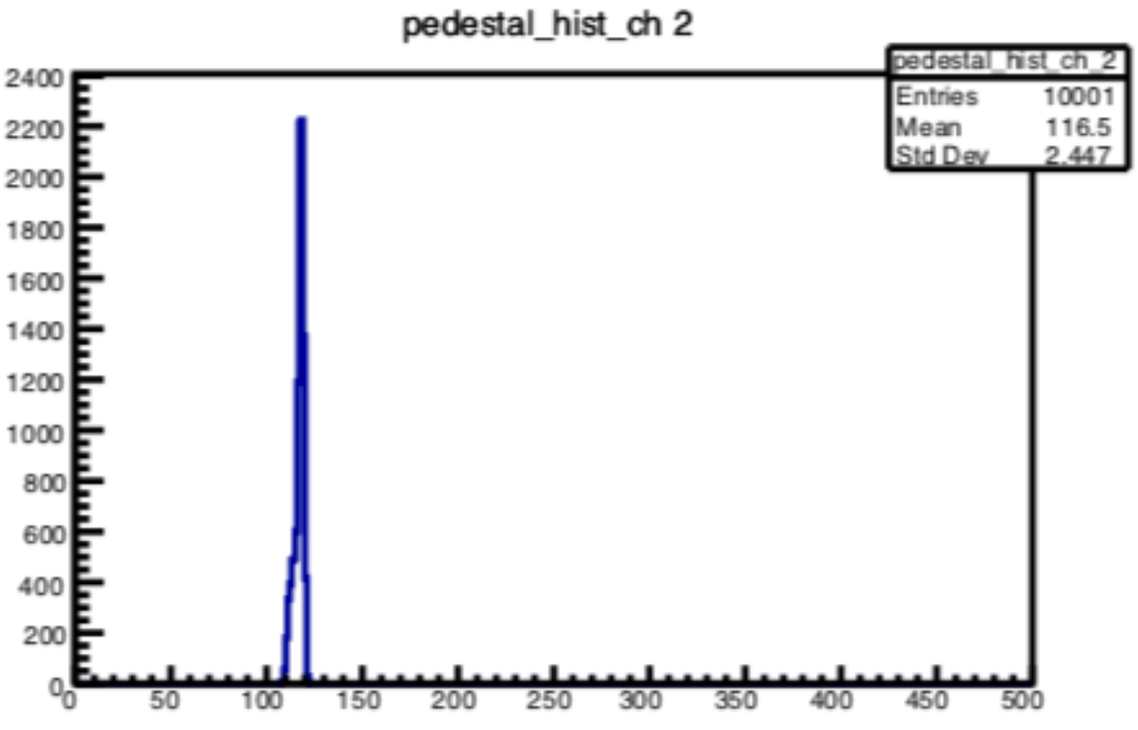
They will try to do the test for improving a S/N ratio.
And also they will check the coupling capacitor effect.

PEDESTAL HISTOGRAMS

The MPPC's pedestal's very thick because of the circuit noise.

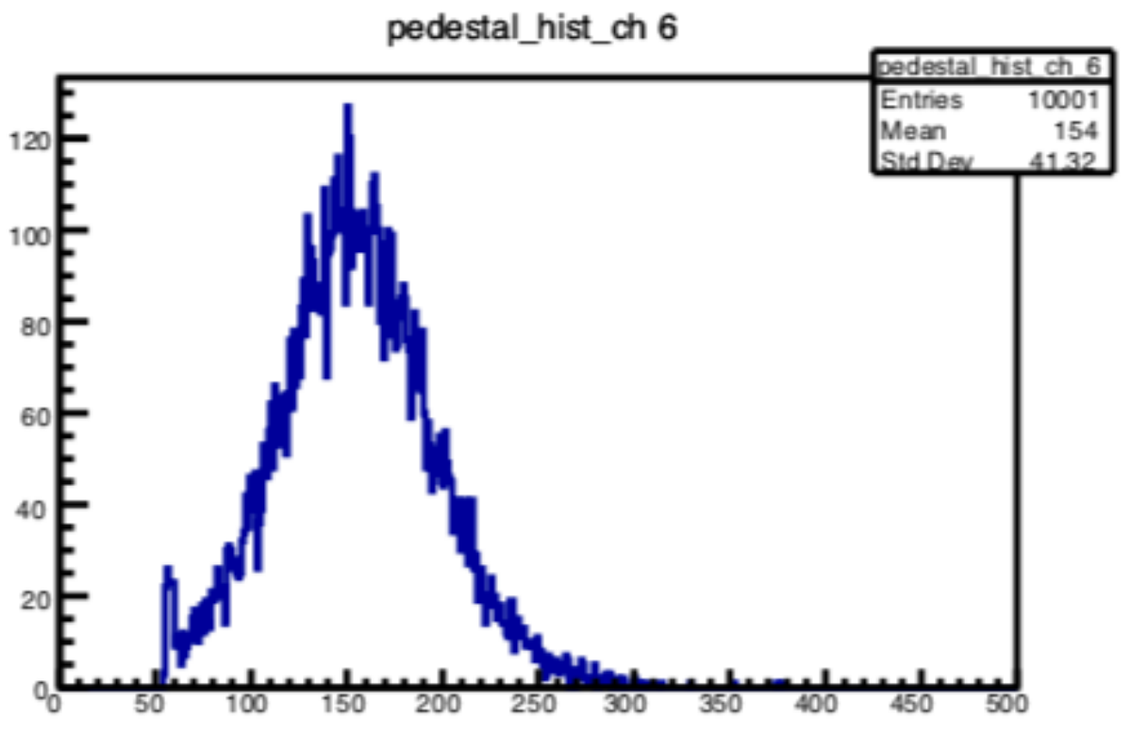
Trigger counter's PMT

Std Dev : 2.447 ch



MPPC

Std Dev : 41.32 ch



EVENT SELECTION

1. Exclude the dummy events

In the ADC_{right} : ADC_{left} 2D distribution of trigger counters, there are dummy events with no correlation.

So, from the ADC_{right} : ADC_{left} 2D distribution, removed the dummy events with ADC cut conditions.

2. Hit position

The bottom counter is 5 cm and the top counter is 12 cm. Select only 3cm on both sides and select only events that pass through the center.

EVENT SELECTION

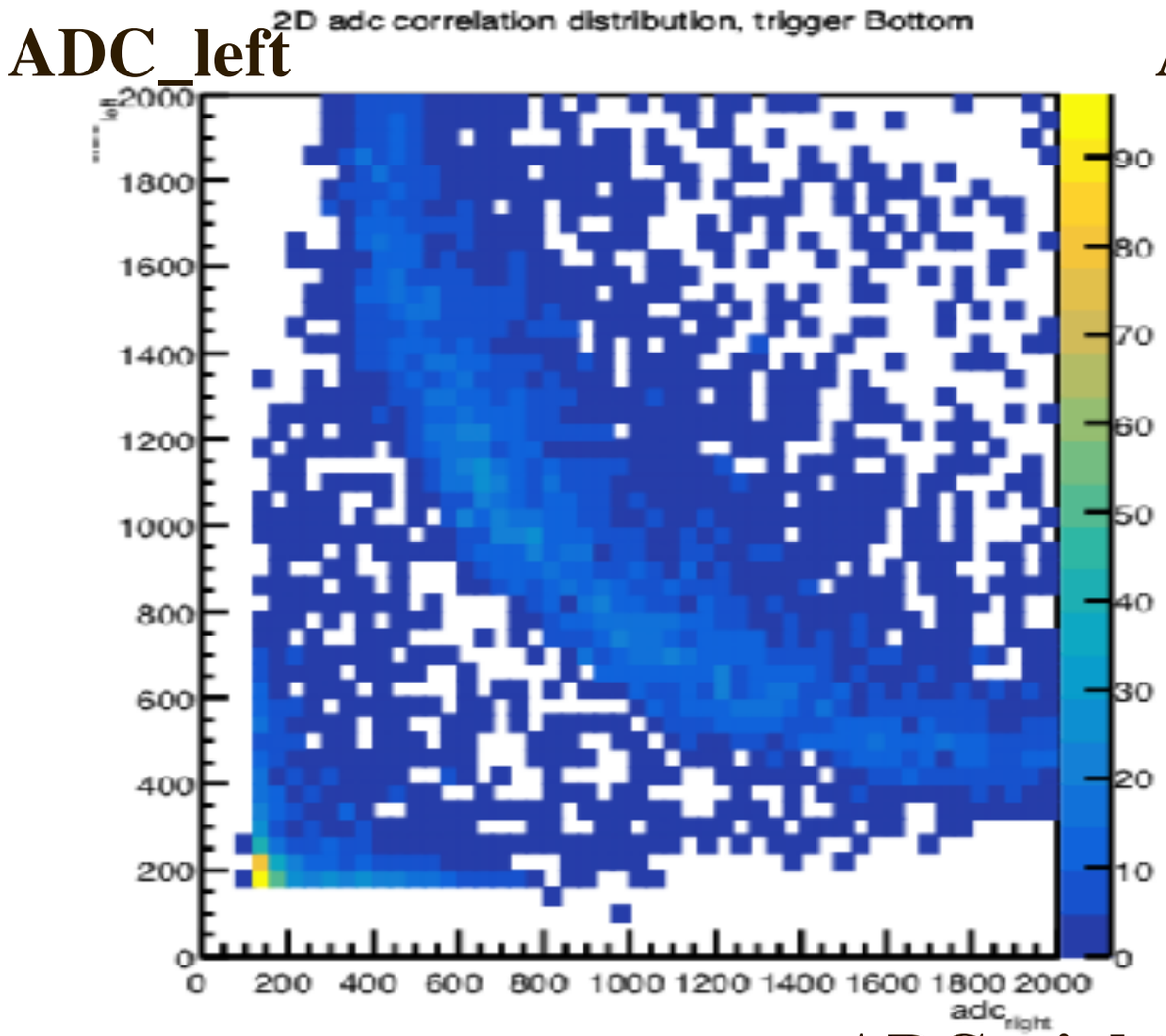
From the ADC_{right} : ADC_{left} 2D distribution, removed the dummy events.

Before event selection

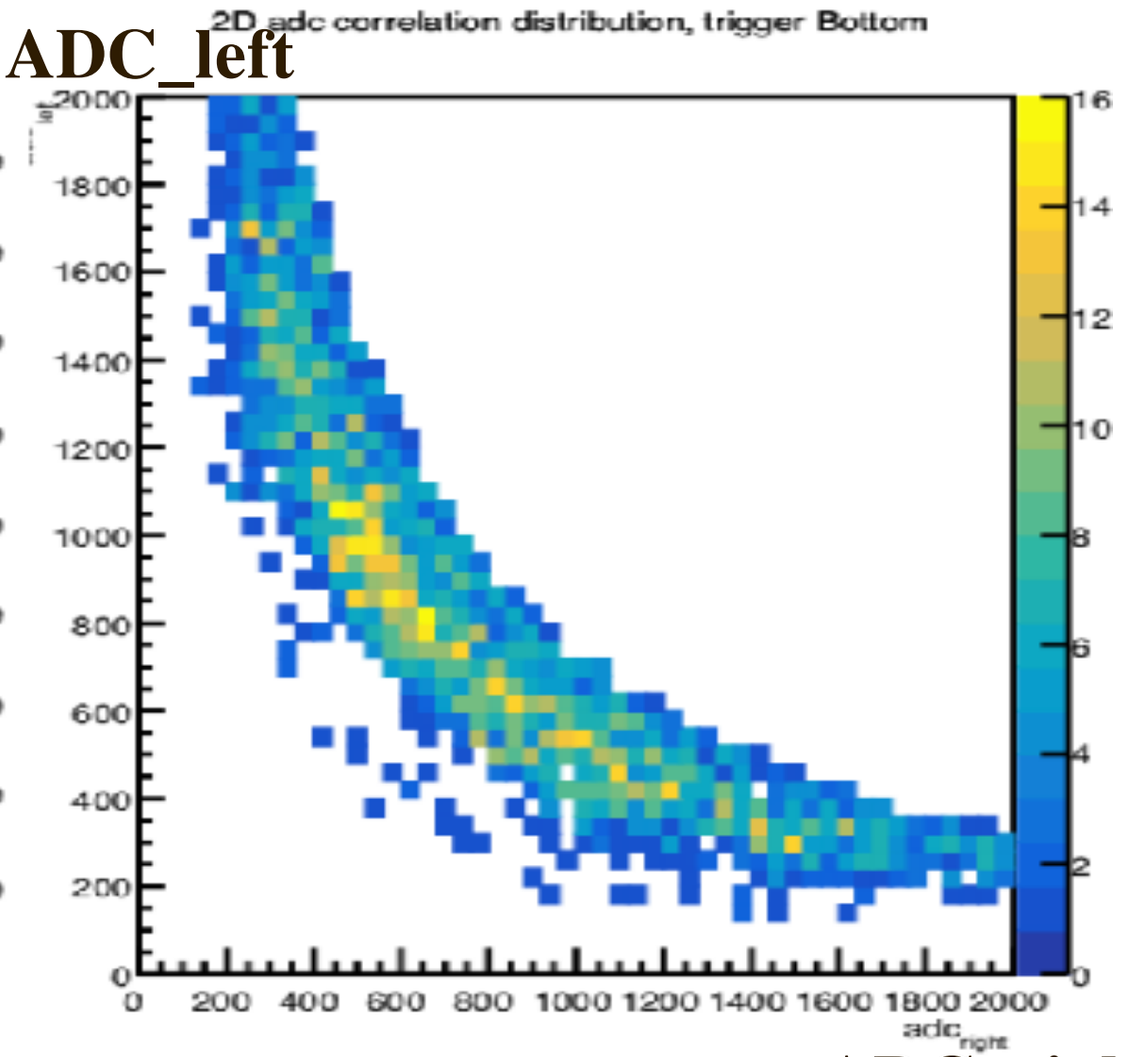
After event selection

600<Sqrt(ADC_left*ADC_right) < 1000

ADC_left



ADC_left



ADC_right

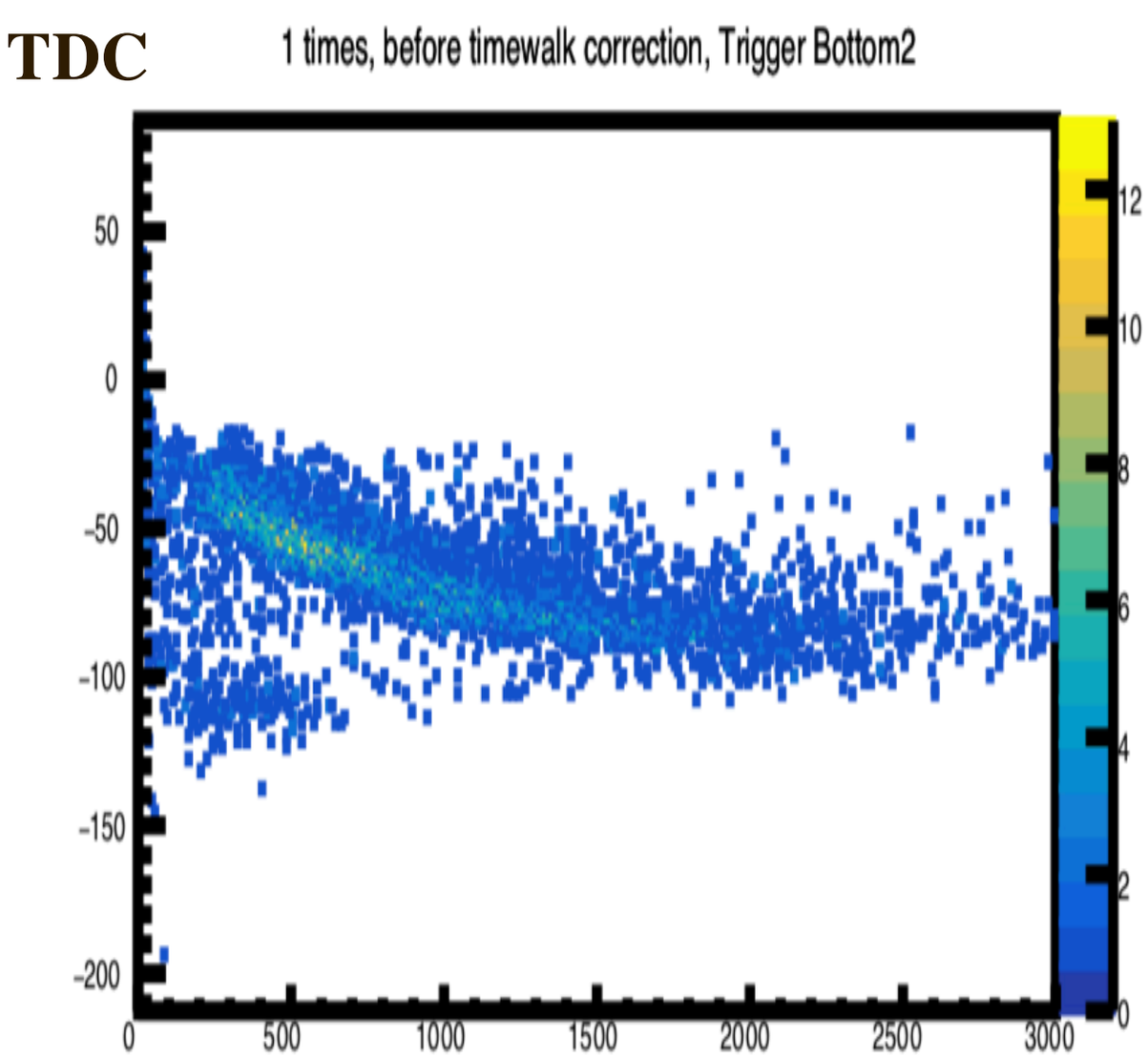
ADC_right

COMPARISON WITH AND WITHOUT EVENT SELECTION

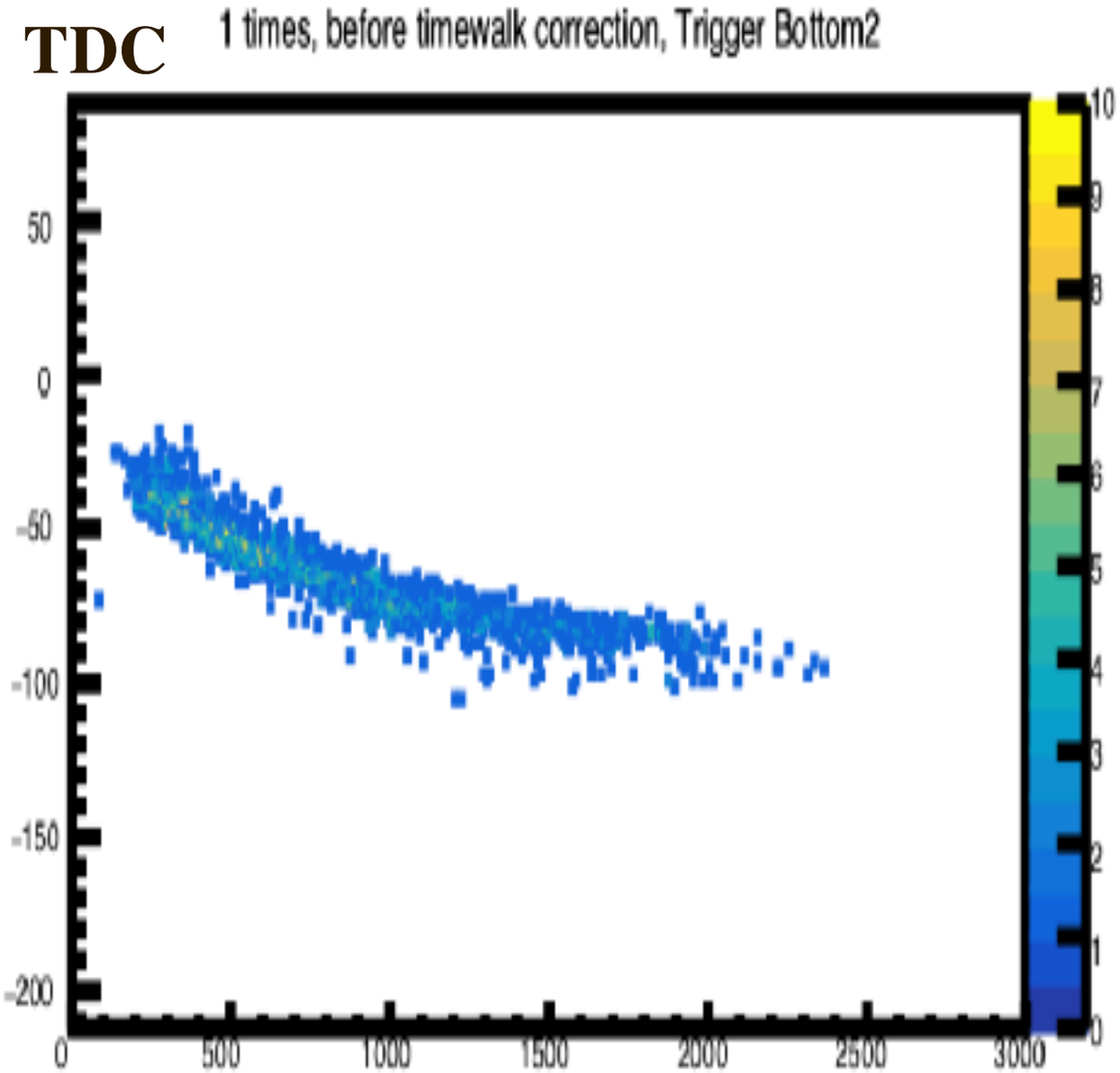
ADC : TDC distribution

without the event selection

with the event selection



ADC

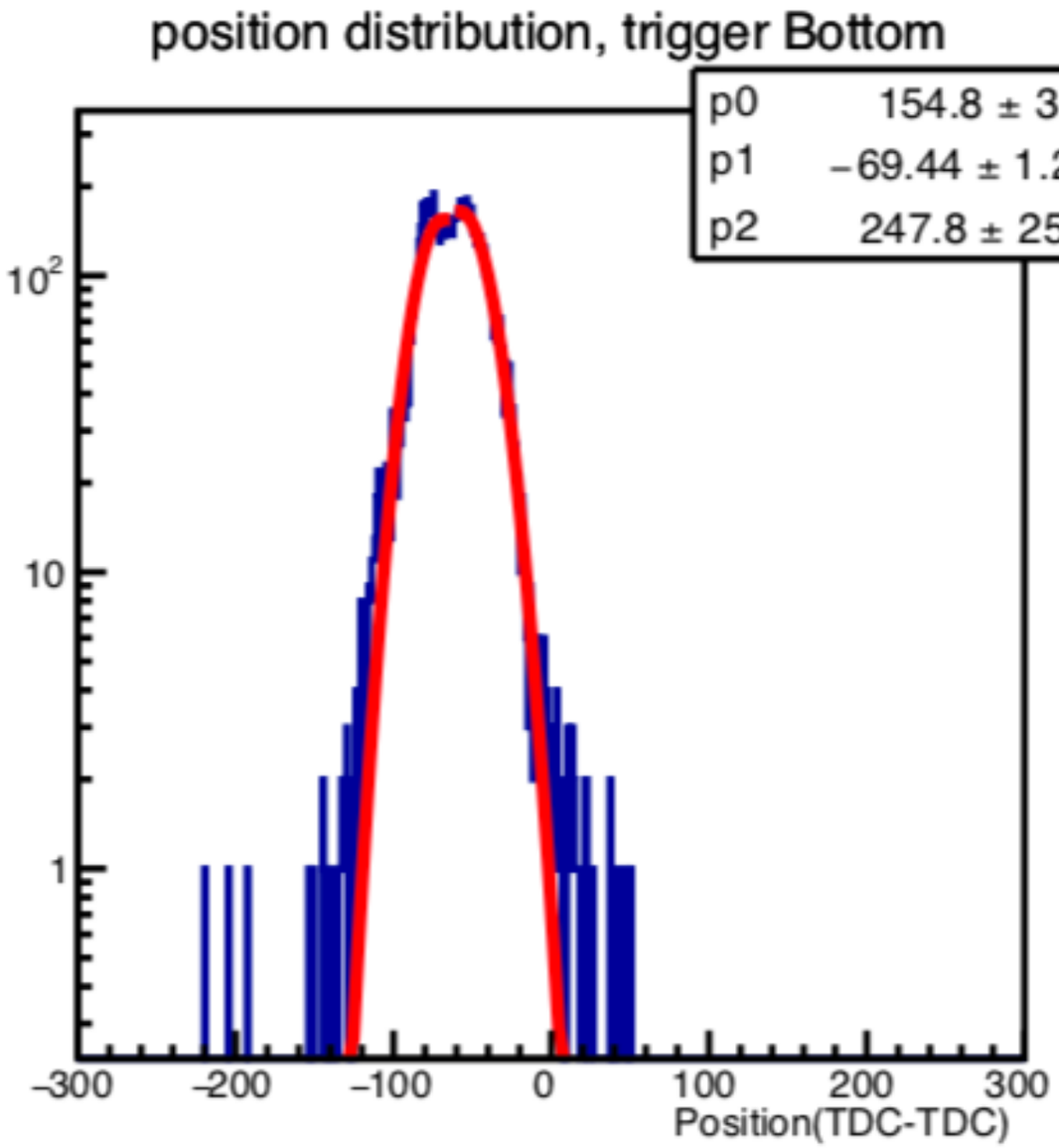


ADC

POSITION DISTRIBUTION

Position distribution

In the position distribution, selected the 3 cm section of the both triggers.



Fitting functions

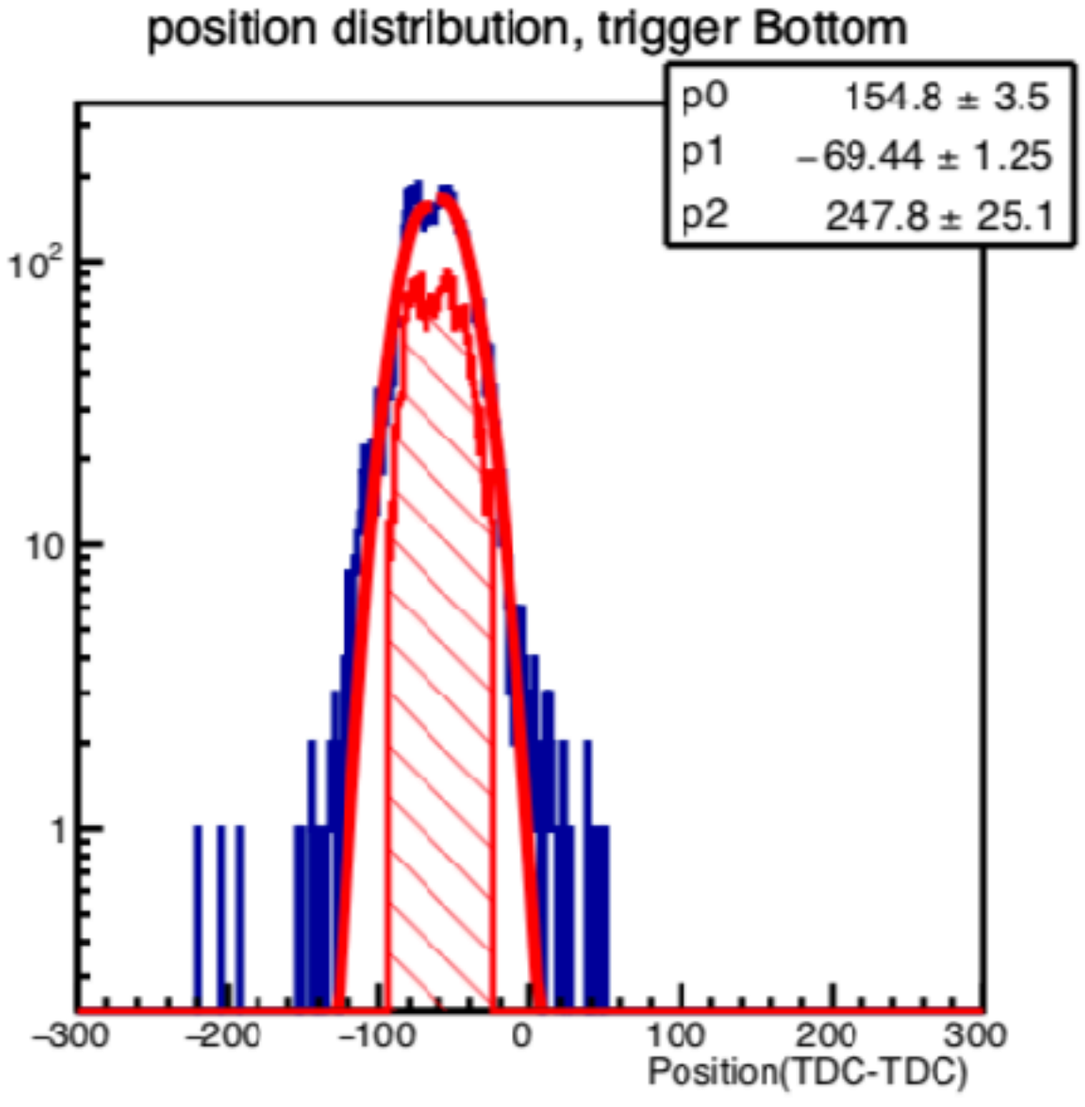
$$p_0 exp[-\frac{(min(z,p_1)-p_1)^2}{2p_2^2}]$$

$$p_0 exp[-\frac{(max(z,p_1)-p_1)^2}{2p_2^2}]$$

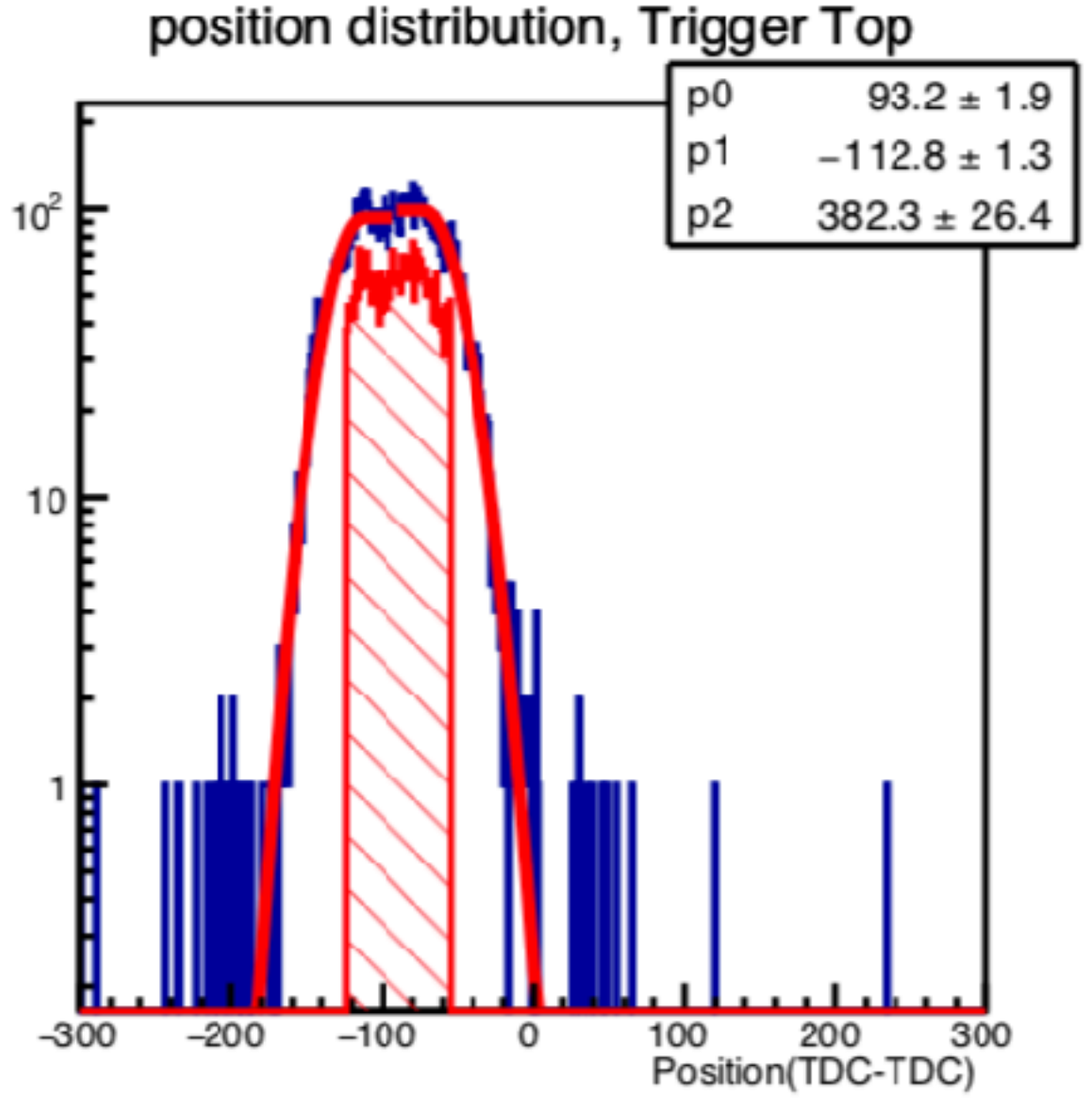
EVENT SELECTION

Red histograms are the selected event

Bottom trigger



Top trigger

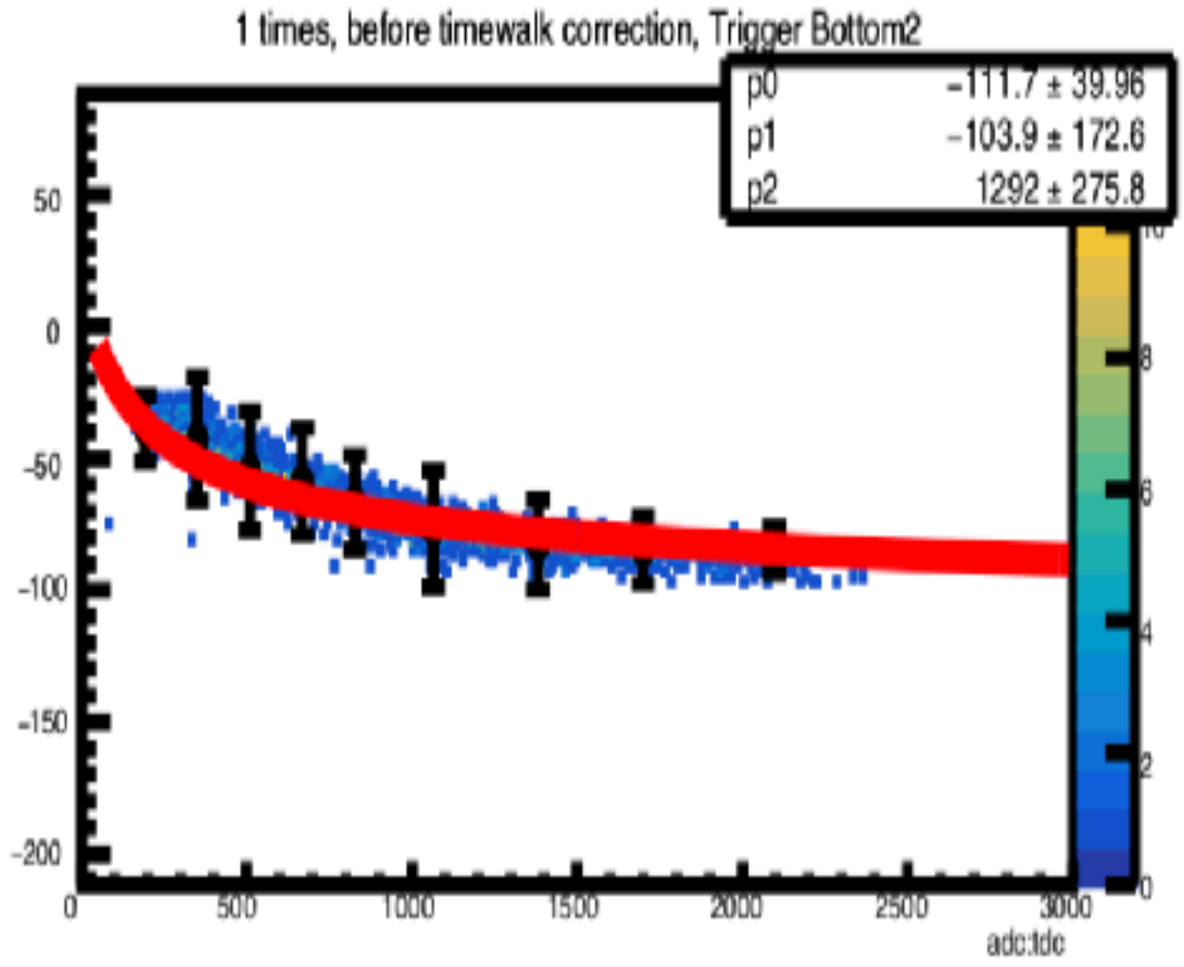


TIME WALK CORRECTION

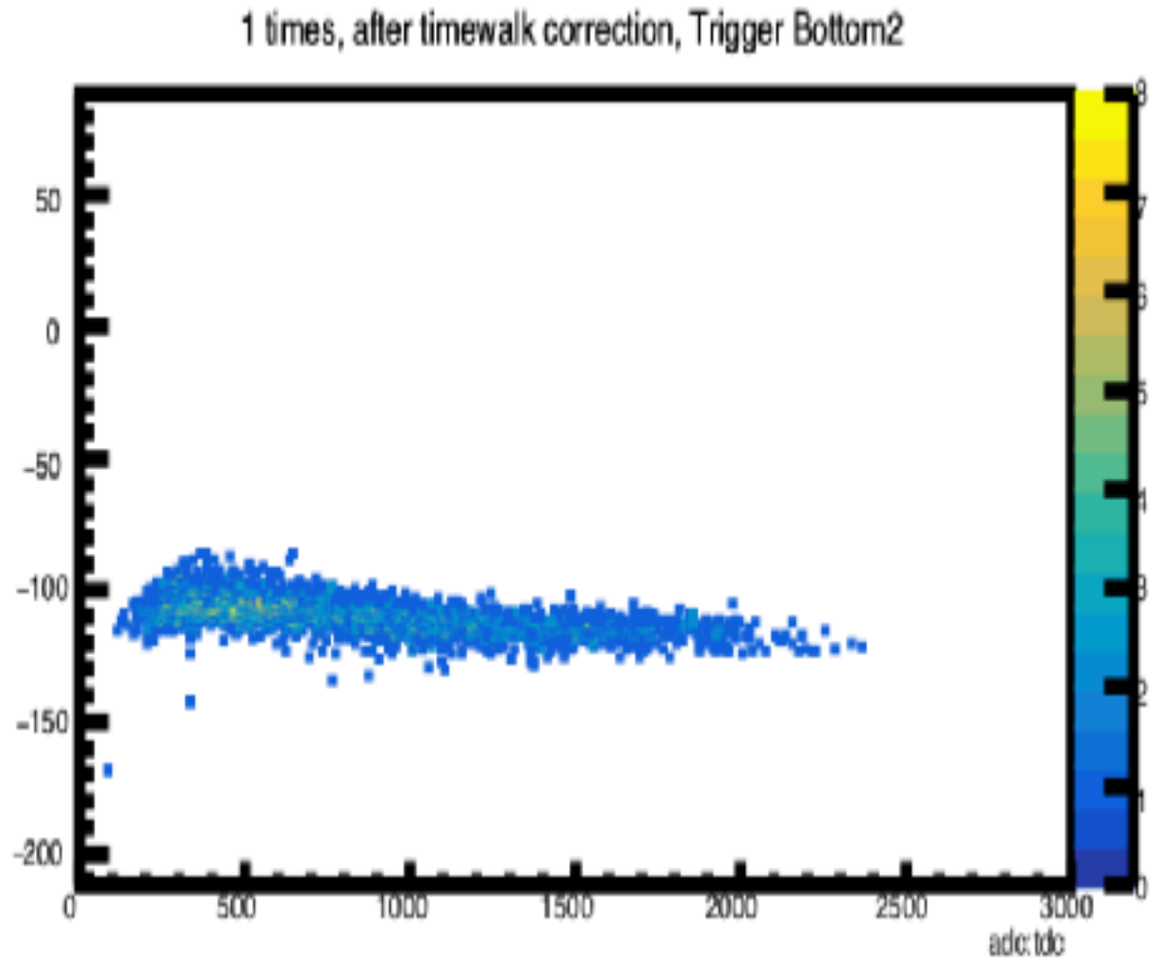
Timewalk correction of trigger counters

$$t' = t + \frac{a}{\sqrt{Q - Q_0}}$$

before



after

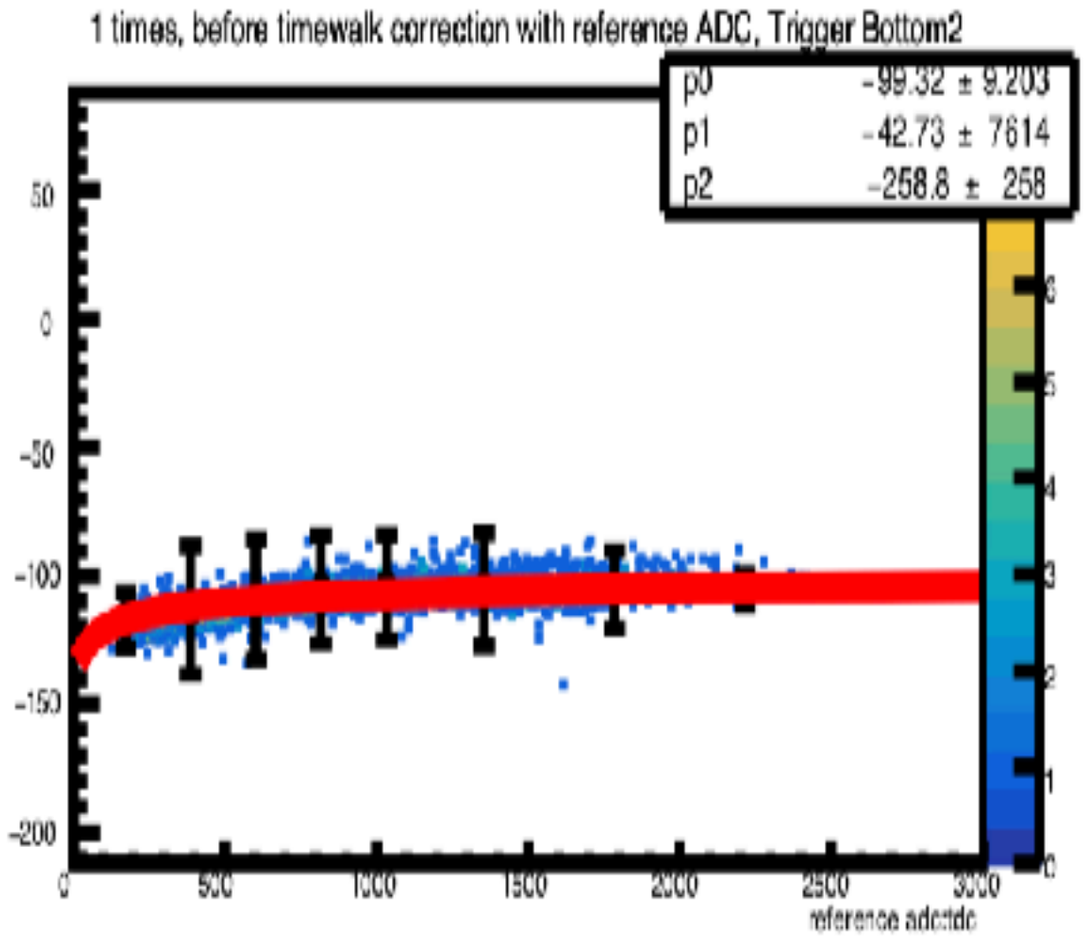


Three times of collections were done in this way.

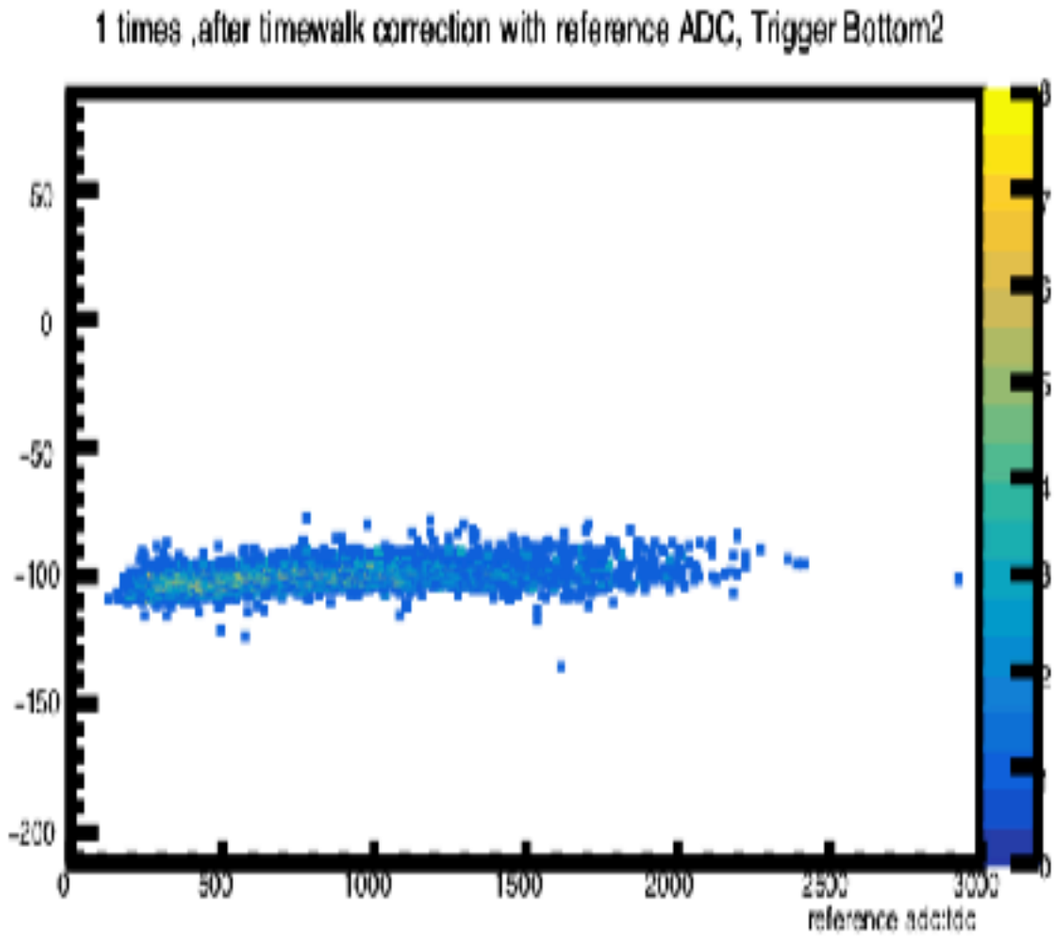
TIME WALK CORRECTION

Timewalk correction of trigger counters with reference counter's ADC

before



after

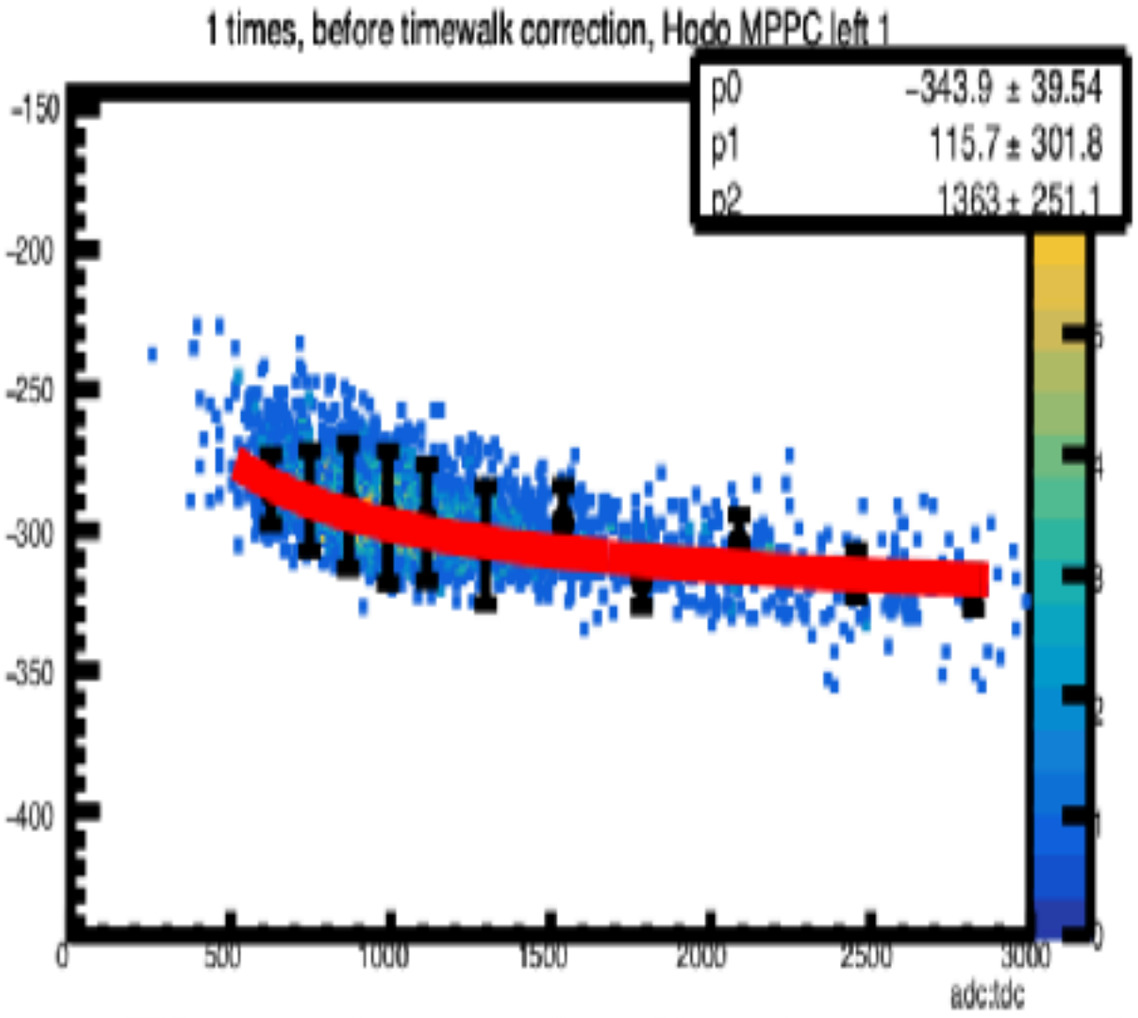


Two times of collections were done in this way.

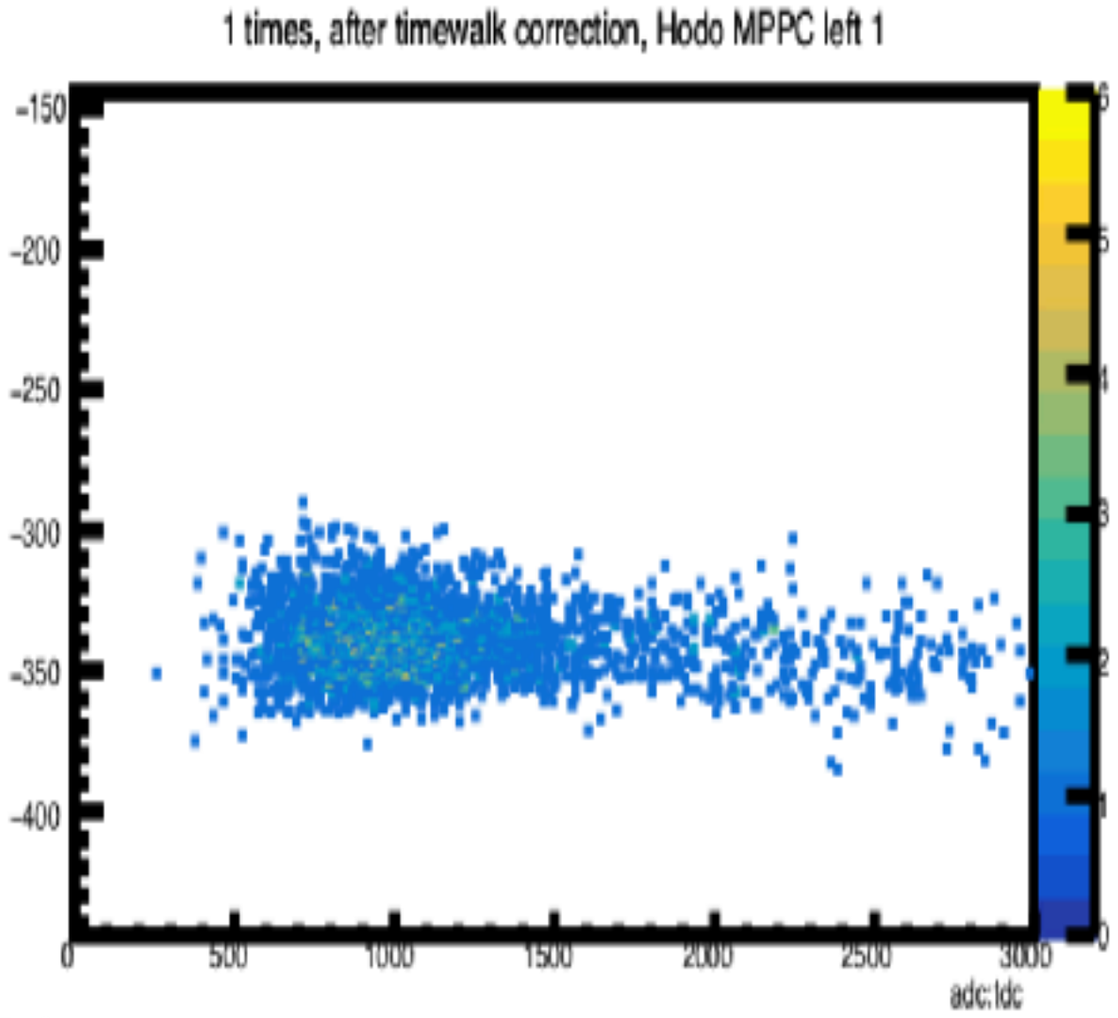
TIME WALK CORRECTION

Timewalk correction of MPPCs

before



after

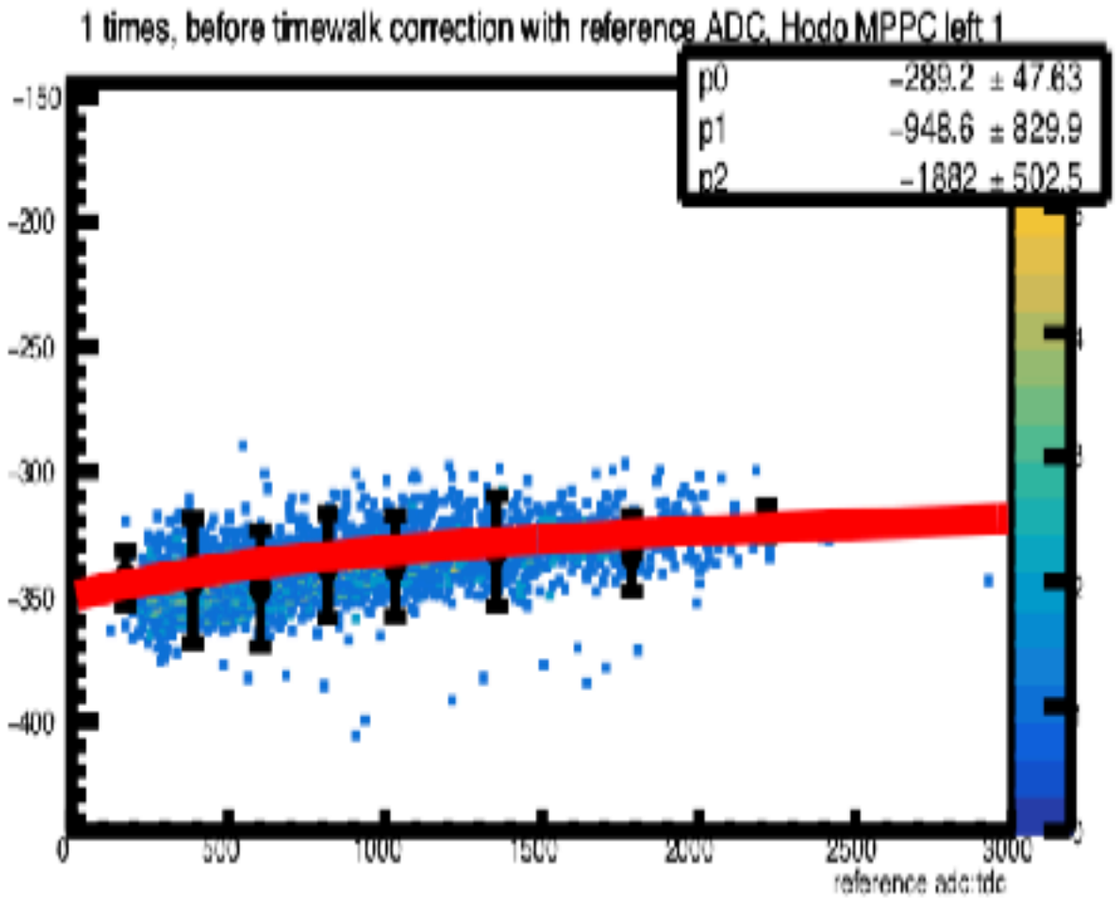


Three times of collections were done in this way.

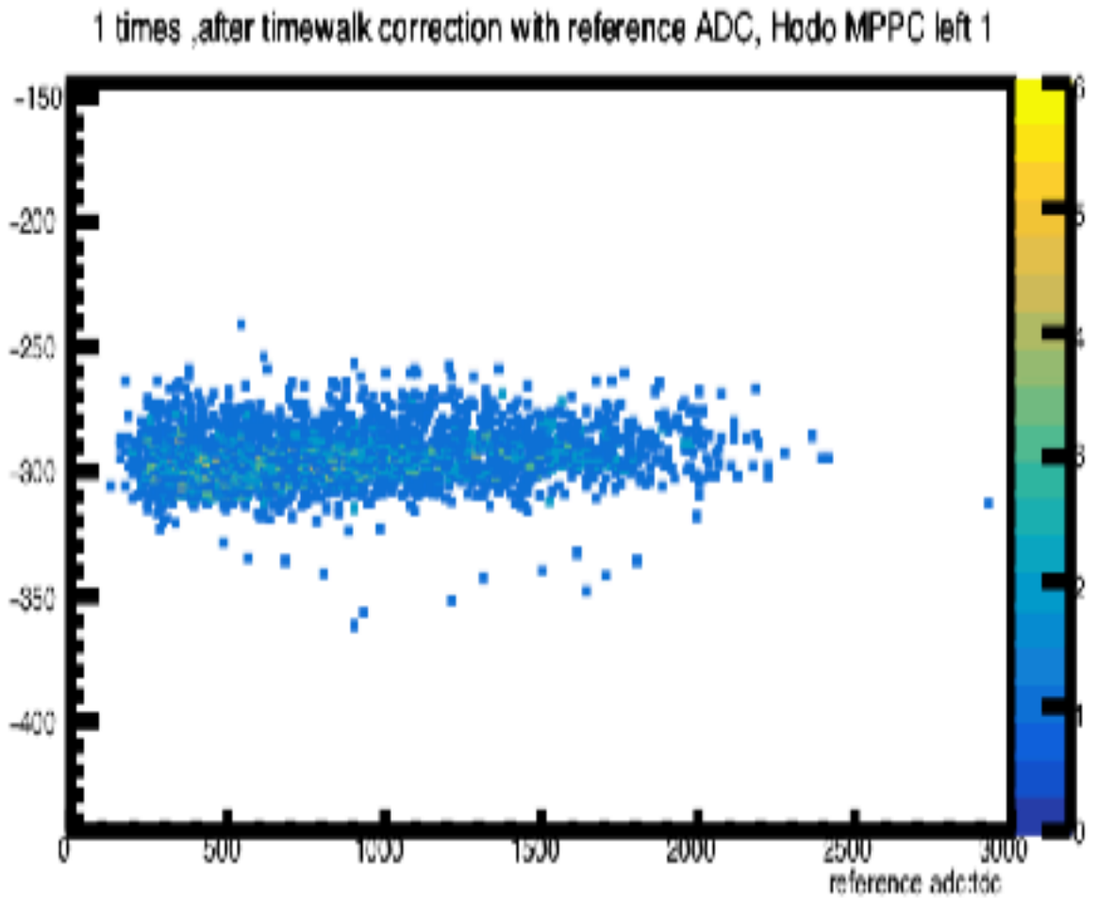
TIME WALK CORRECTION

Timewalk correction of MPPCs with reference counter's ADC

before

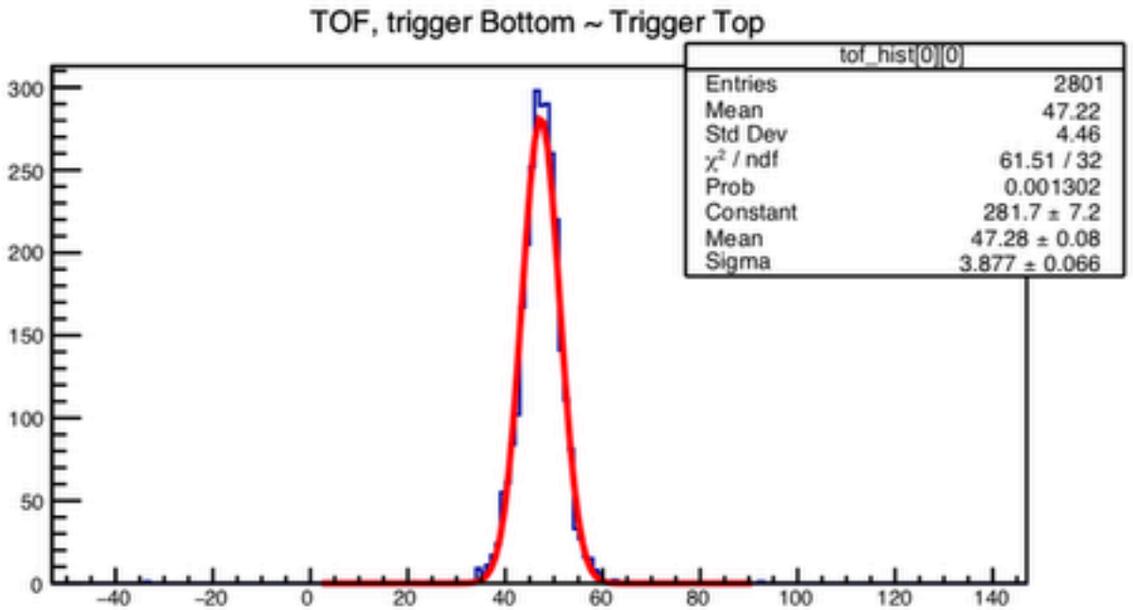


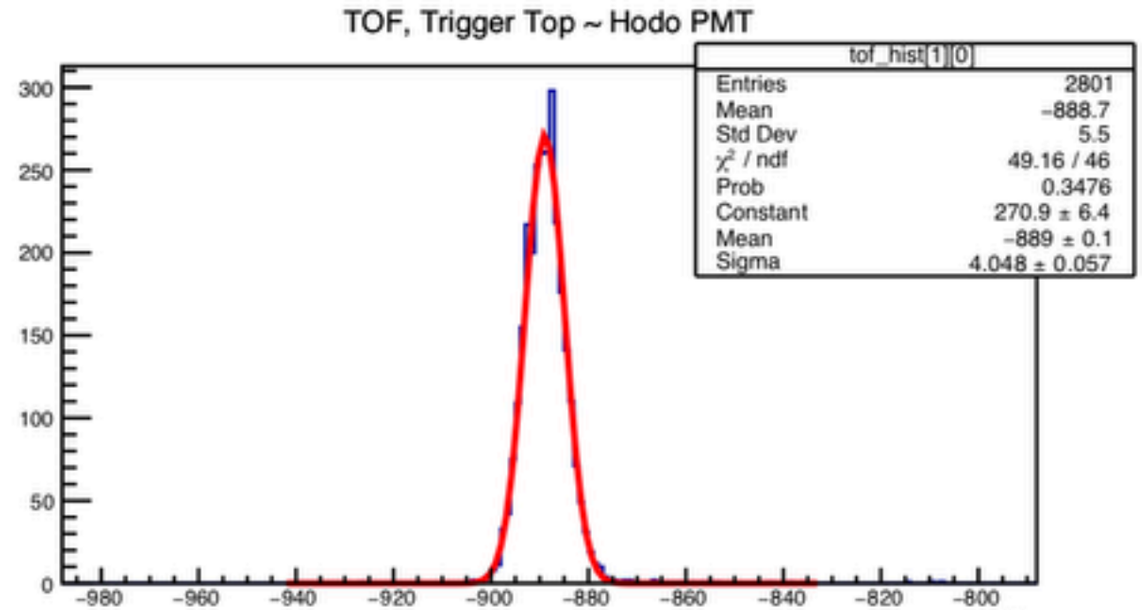
after

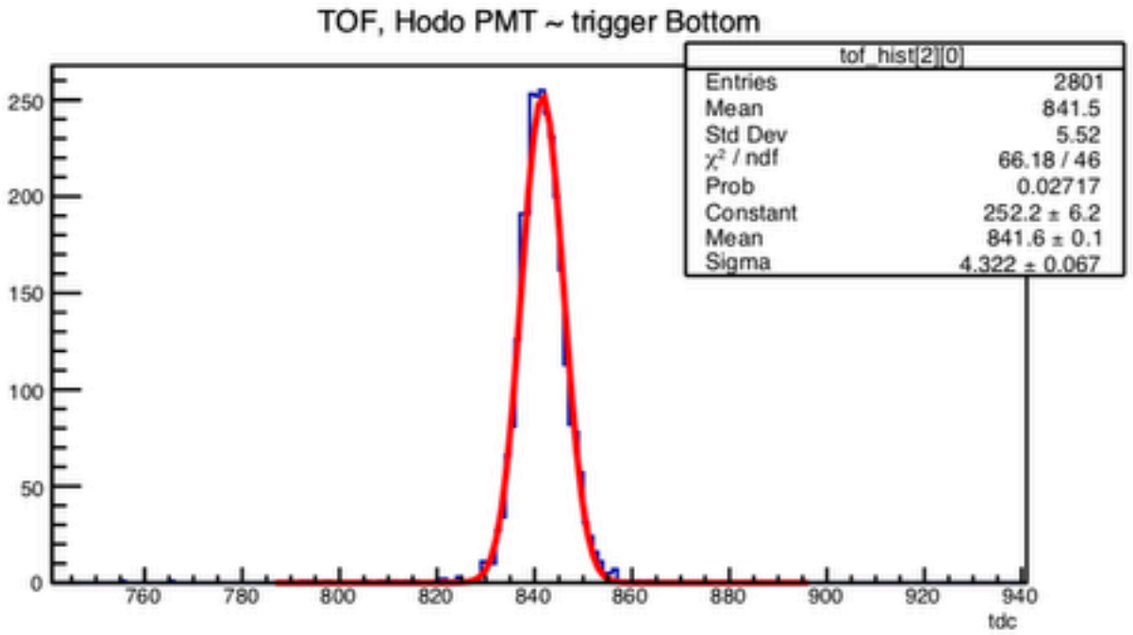


Two times of collections were done in this way.

TRIGGER COUNTER'S TIME RESOLUTION





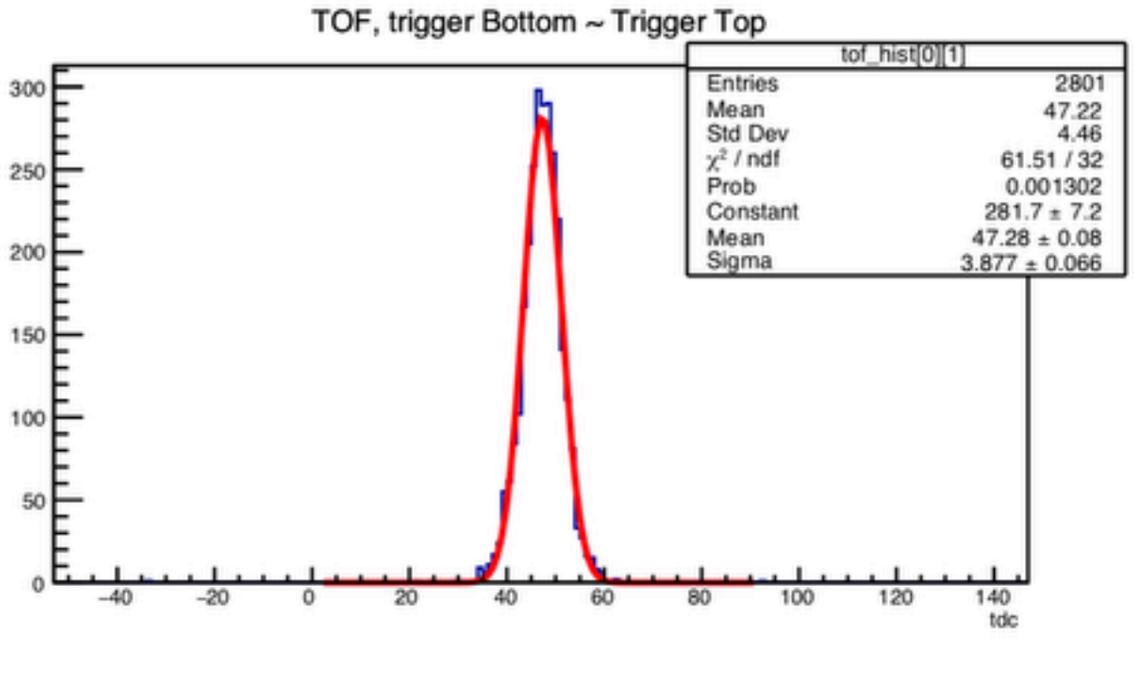


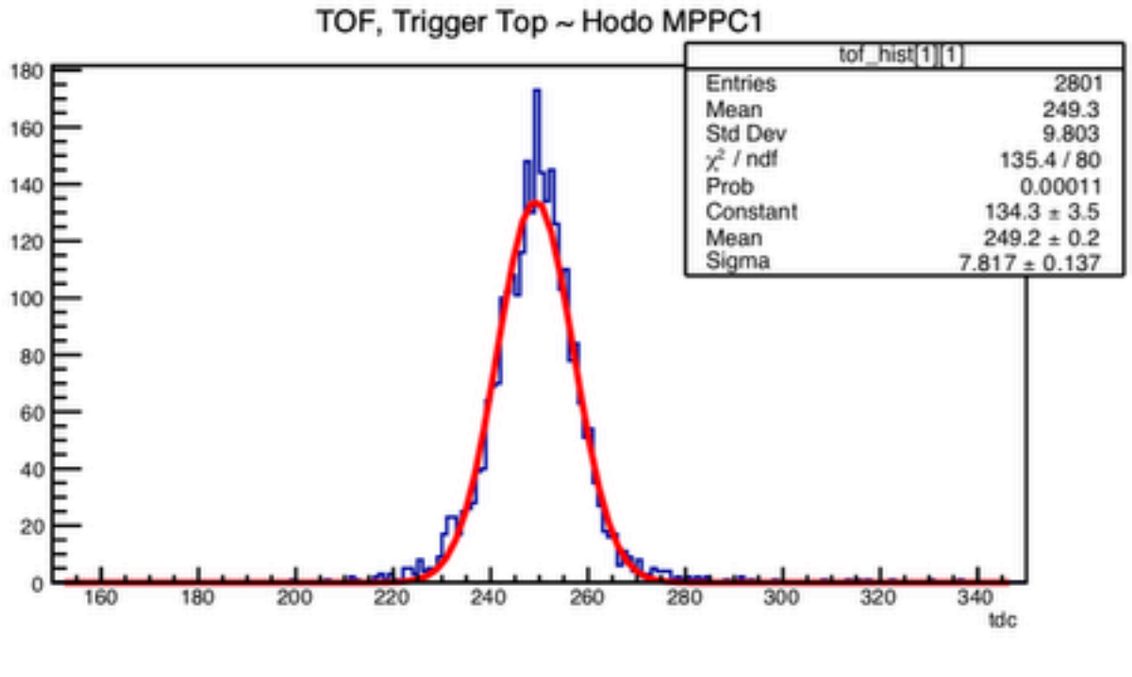
Bottom trigger : 103 +/- 3 ps

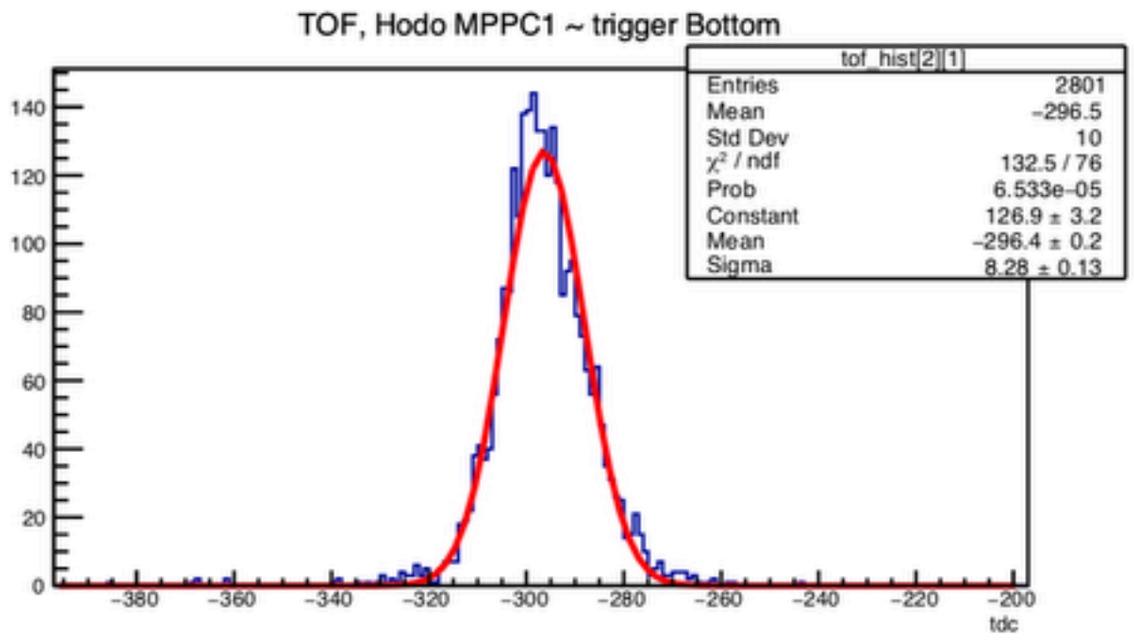
Top trigger : 88 +/- 3 ps

Hodoscope with PMTs : 111 +/- 2

8 MPPCS' TIME RESOLUTION



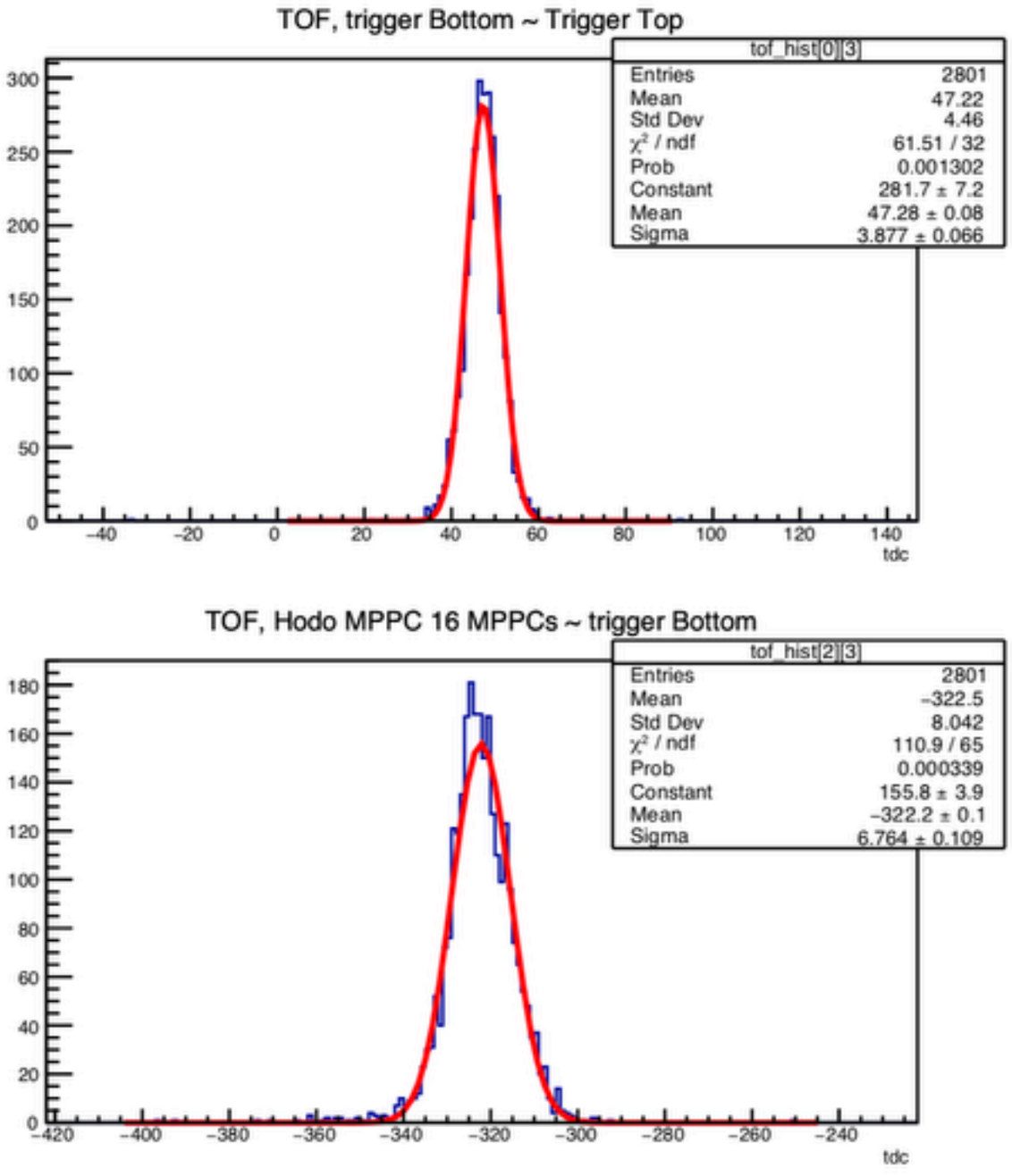




Fix the Top trigger's resolution to 88 ps

Hodoscope with 8 MPPCs : 259 +/- 5 ps

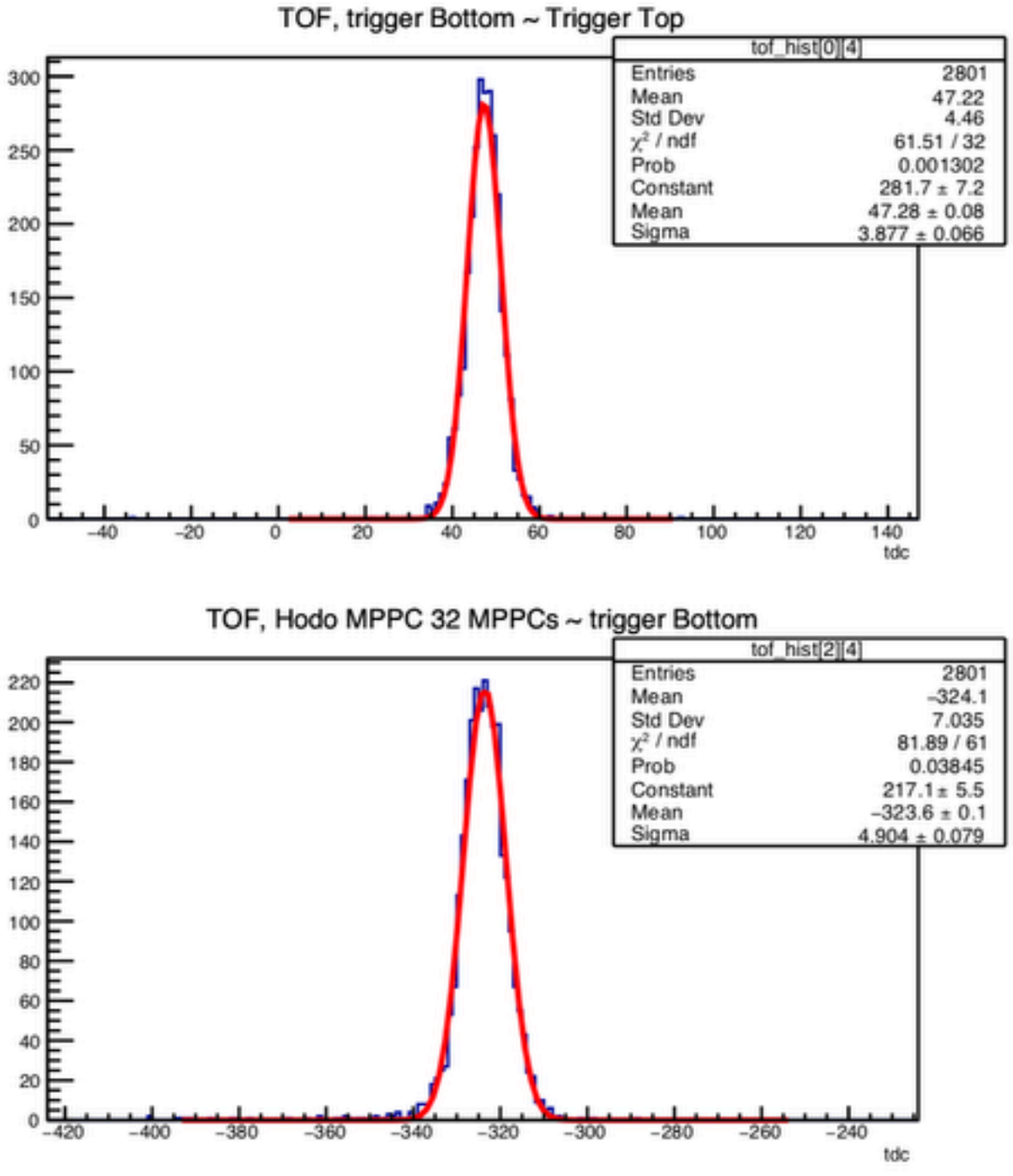
16 MPPCS' TIME RESOLUTION

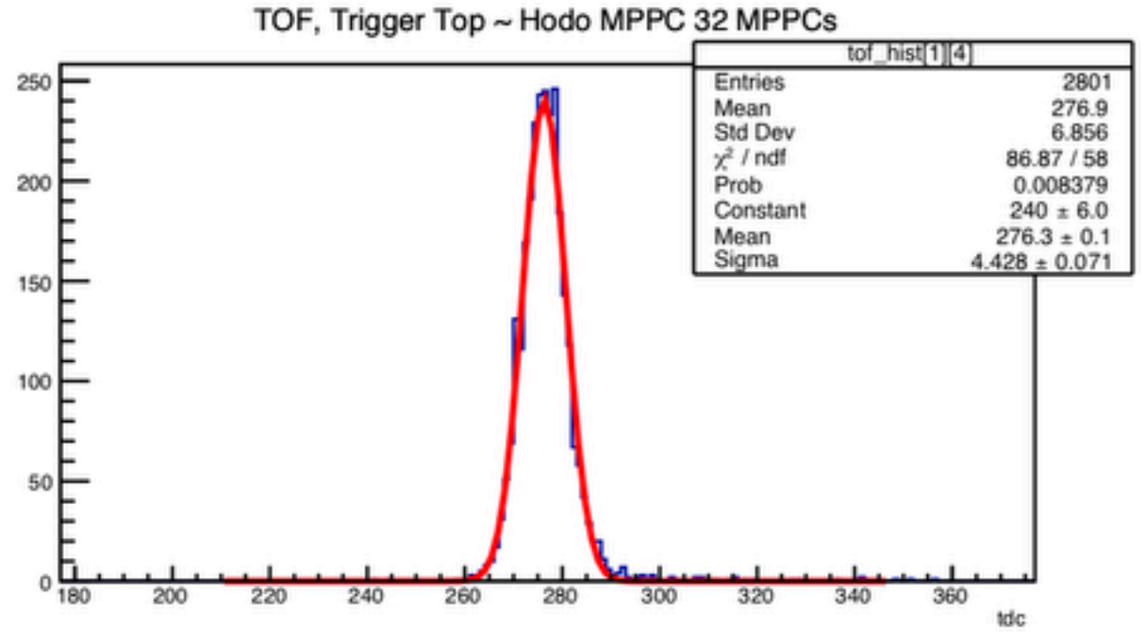


Fix the Top trigger's resolution to 88 ps

Hodoscope with 16 MPPC : 202 +/- 3 ps

32 MPPCS' TIME RESOLUTION





Fix the Top trigger's resolution to 88 ps

Hodoscope with 32 MPPC : 127 +/- 2 ps

BACKUP

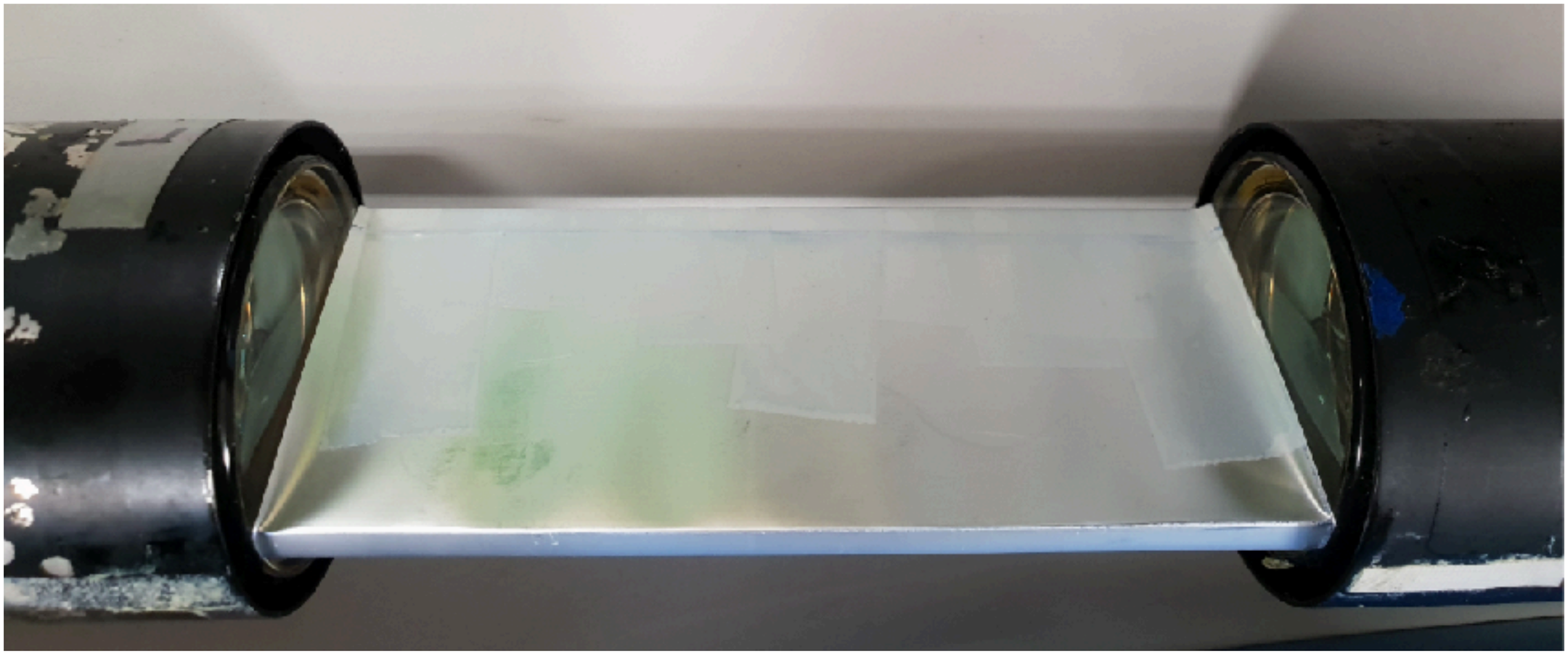
TRIGGER COUNTERS

Wrapped the scintillator with the ESR reflection paper.

(light collection efficiency becomes 1.2 times better)

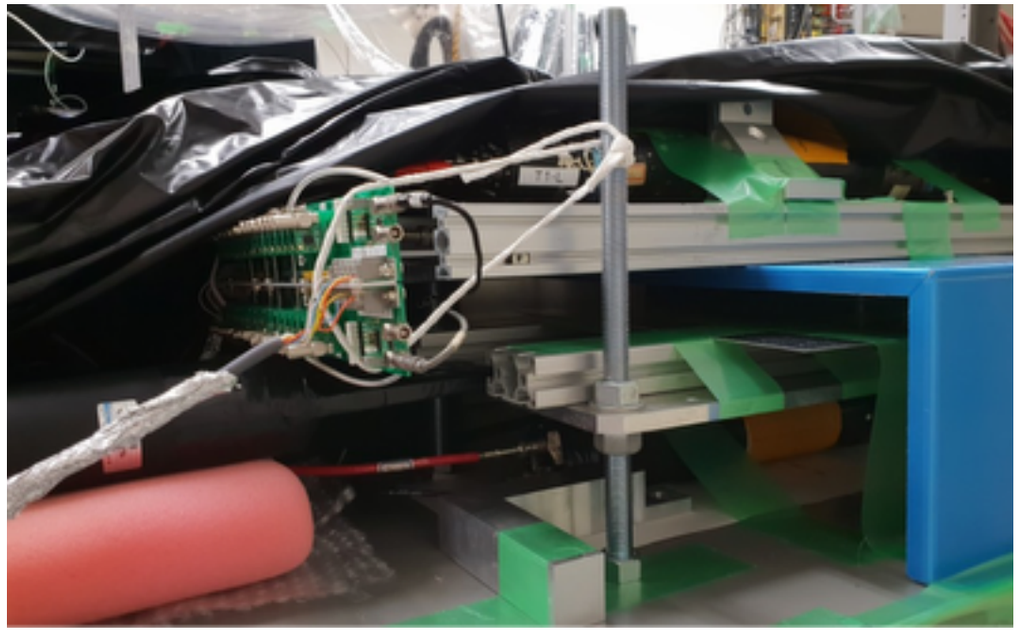
Scintillator size : 5^{L} x $\underline{5^{W}}$ x 0.5^{T} cm (Bottom)

5^{L} x $\underline{12^{W}}$ x 0.5^{T} cm (Top)



TEST BENCH

Four detectors are stacked



Trigger counter

Hodoscope with MPPCs

Hodoscope with PMTs

1 mm thick metal plate

Trigger counter

(time reference)

Adhesive optical tapes were used for coupling between the scintillator and the MPPC.

Optically Clear Adhesive Tape LUCIACS®
CS986 Series (Acrylic adhesive)

AFTER THE TIME WALK CORRECTION