Test Result for the bar-type Neutron Detector with a modified electronic set-up.

Lab Meeting
2013/06/21
Friday

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Synopsis

- Second test result for the bar-type neutron detector with a modified electronic set-up.

  (Fig.1 on slide 4).

Objective

With a modified electronic circuit, we aimed to study the performance of the neutron detector in terms of:

- Time resolution
- Position resolution
- Time of flight distributions.

Modified electronic set-up

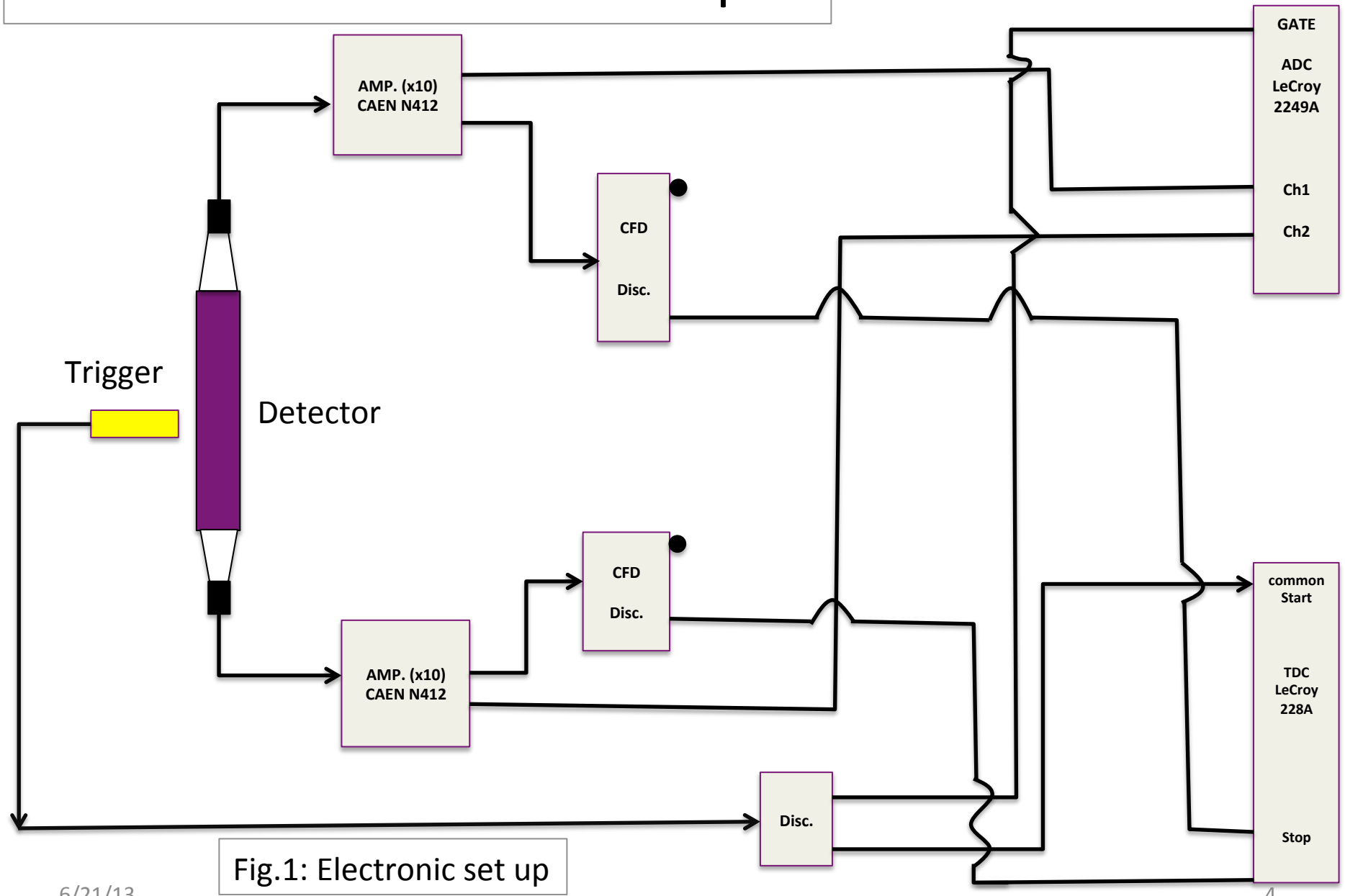


Fig.1: Electronic set up

^{60}Co source experimental set-up

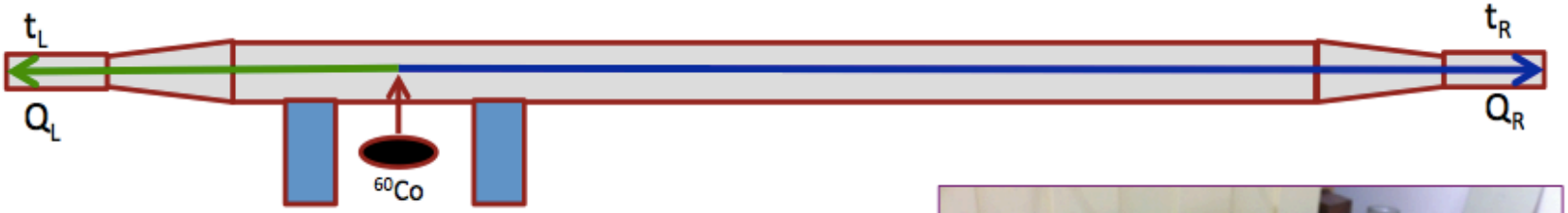


Fig.2: 2 m-long neutron detector bar

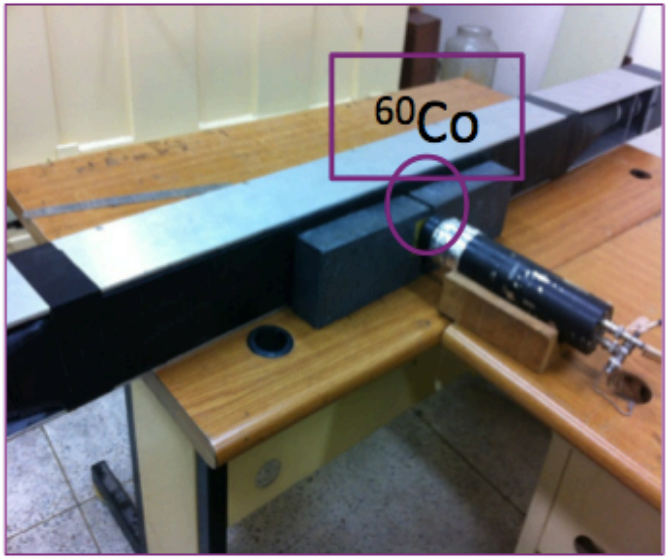


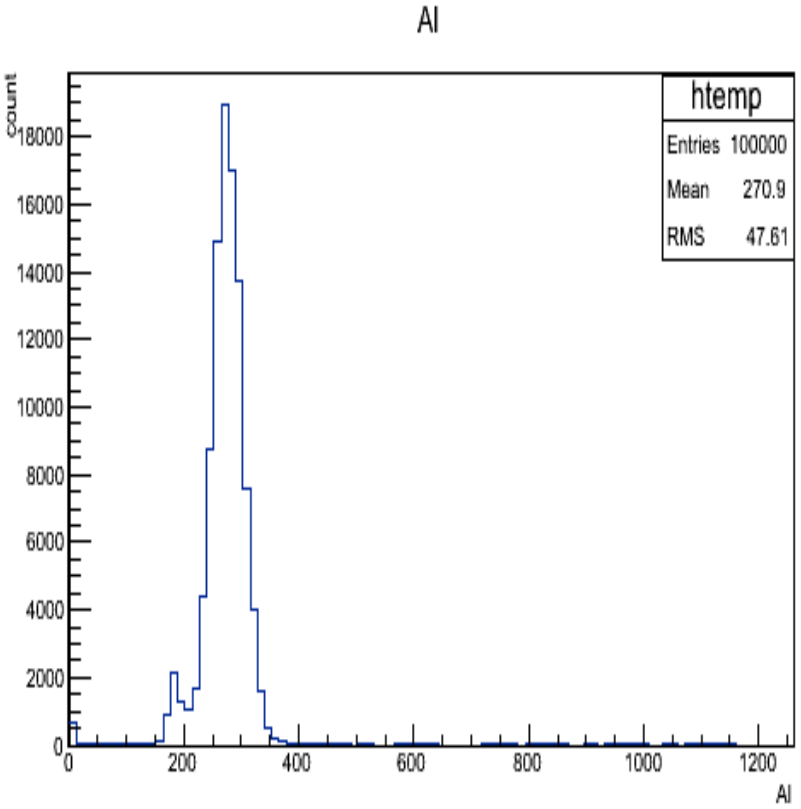
Fig. 3: Expt. set-up with ^{60}Co

- Determine hit position using time difference of two signals.

- Measurements carried out at 10 cm step from left.

Test results with ^{60}Co source

Ch1 (2090 V): ADC raw data



Ch2 (2160 V): ADC raw data

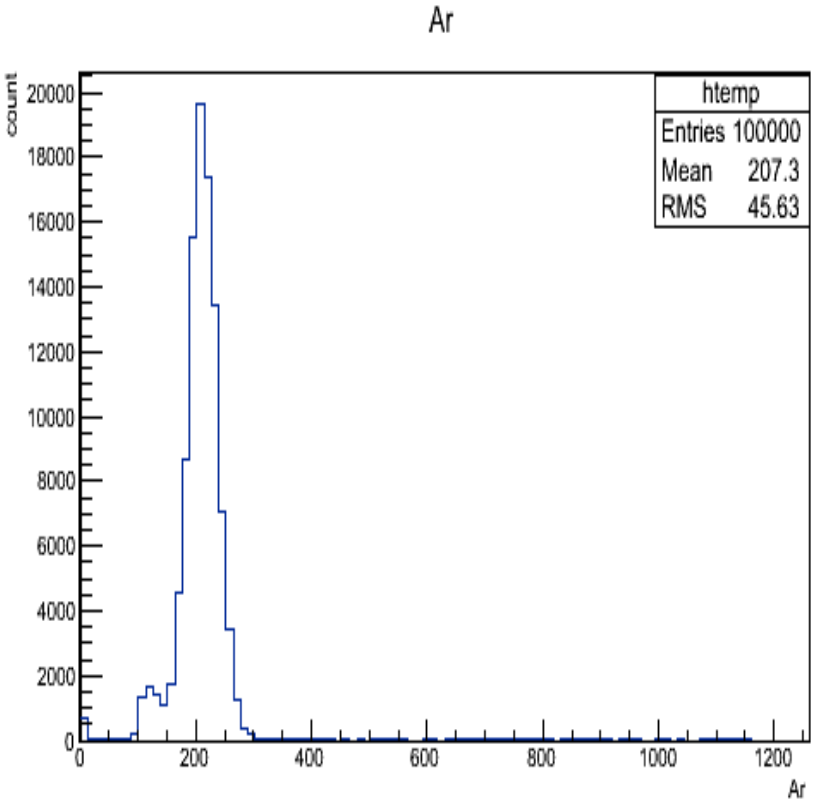
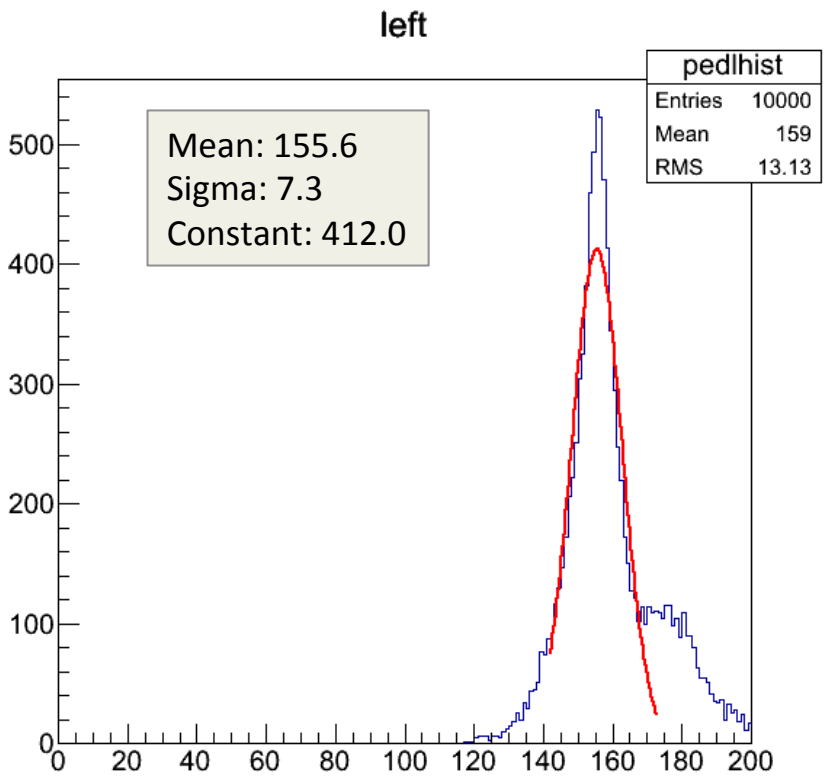


Fig.4: ADC raw data

Test result with ^{60}Co source

Ch1 (2090 V): pedestal left

Ch2 (2160 V): pedestal right



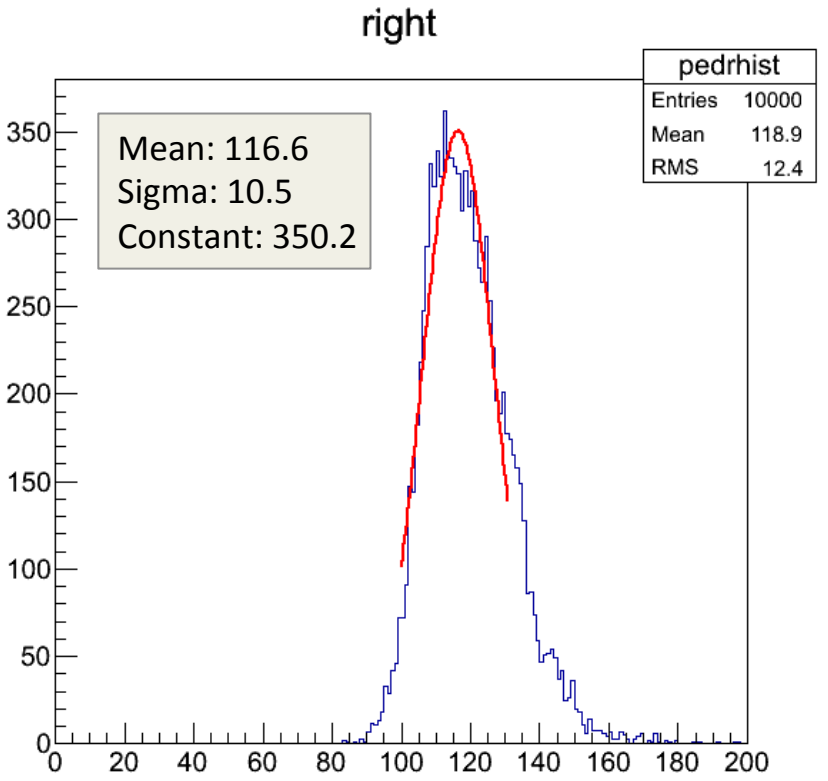
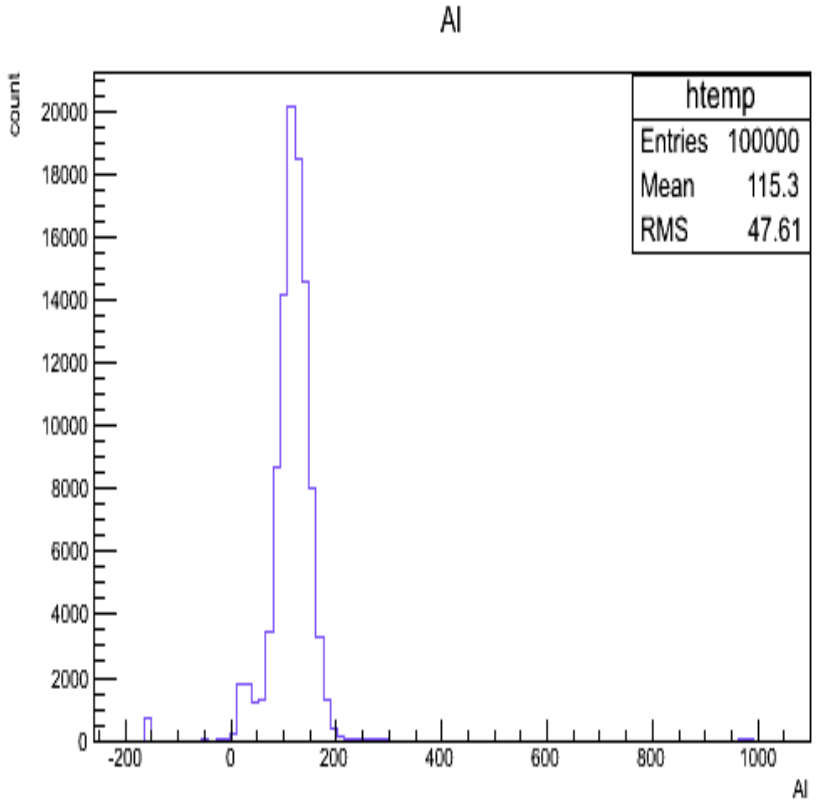


Fig.5: Pedestal data

Test result with ^{60}Co source

Ch1 (Left-2090 V): After pedestal subtraction

Ch2 (Right-2160 V); After pedestal subtraction



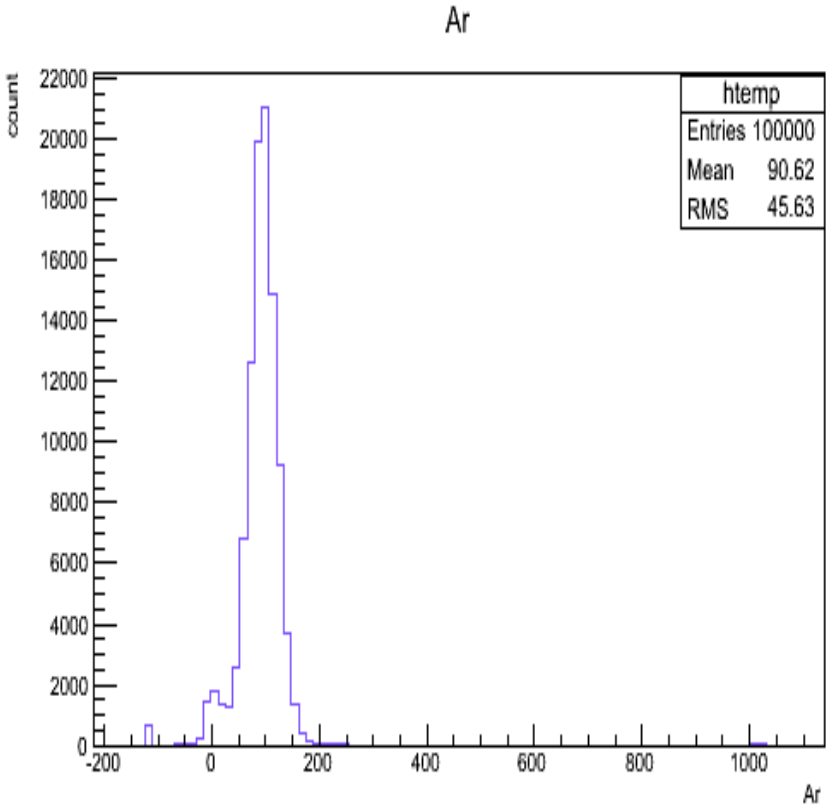
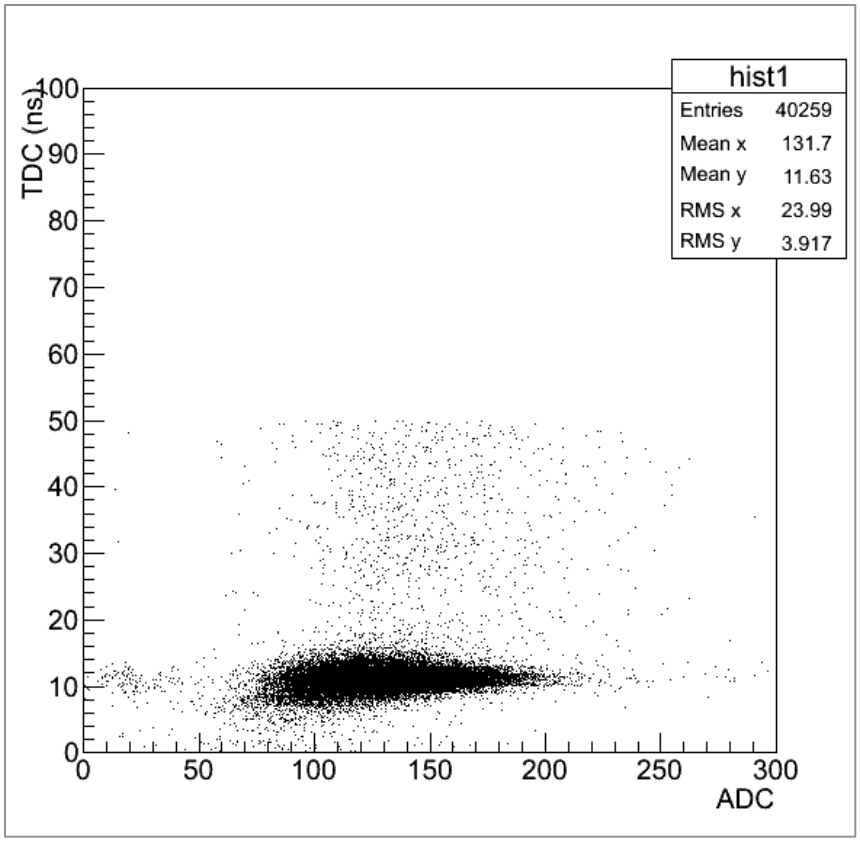


Fig.6: ADC channels after pedestal subtraction

Test results with ^{60}Co source

Ch1 (Left: 2090 V) TDC vs ADC



Ch2 (Right:2160 V) TDC vs ADC

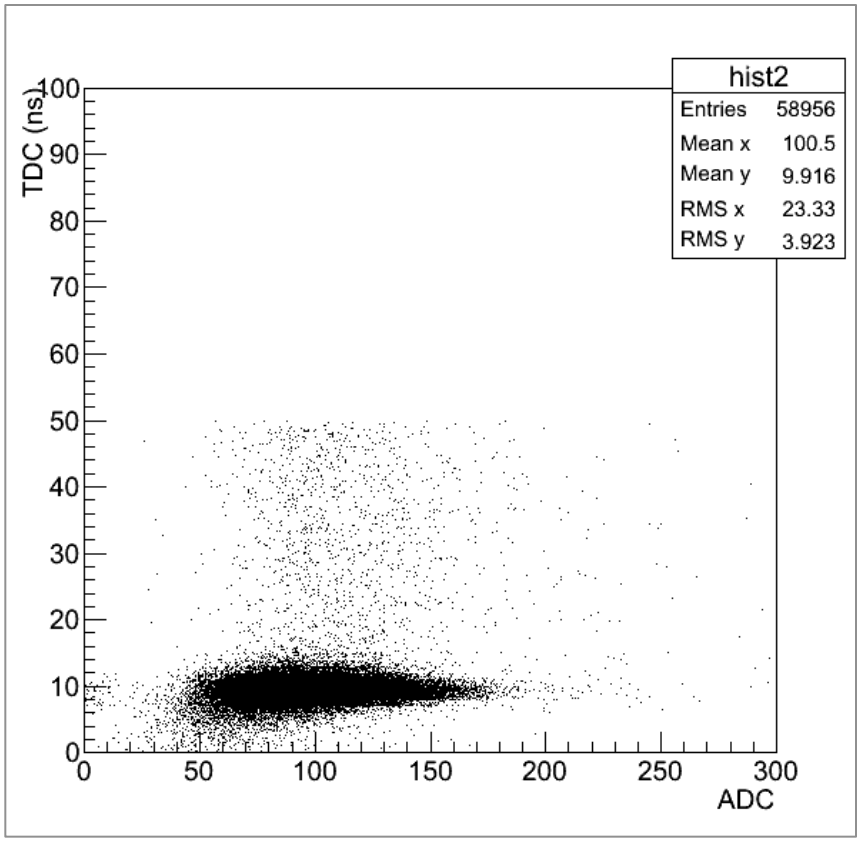
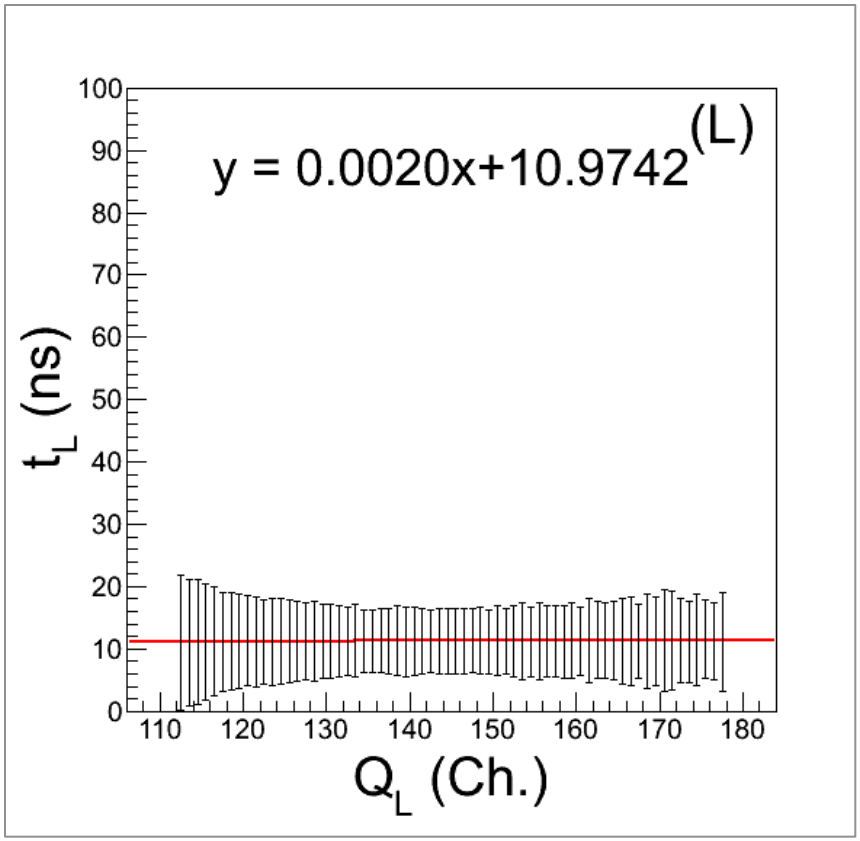


Fig.7: Charge distribution in channels 1 and 2

Test result with ^{60}Co source

Ch1 (Left: 2090 V) Time walk



Ch2 (Right:2160 V) Time walk

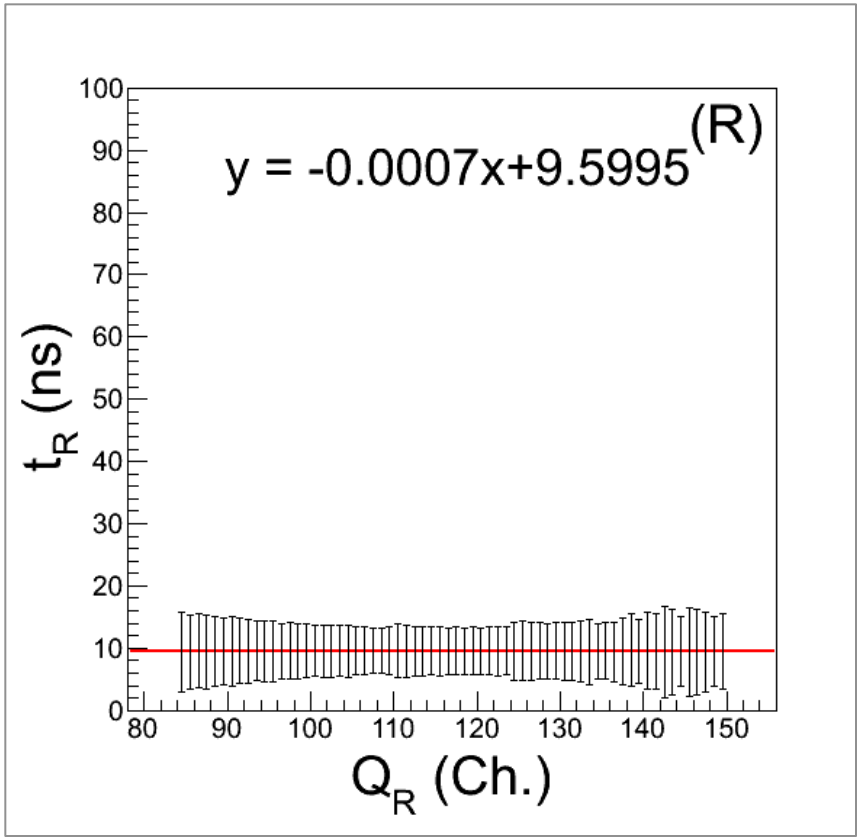
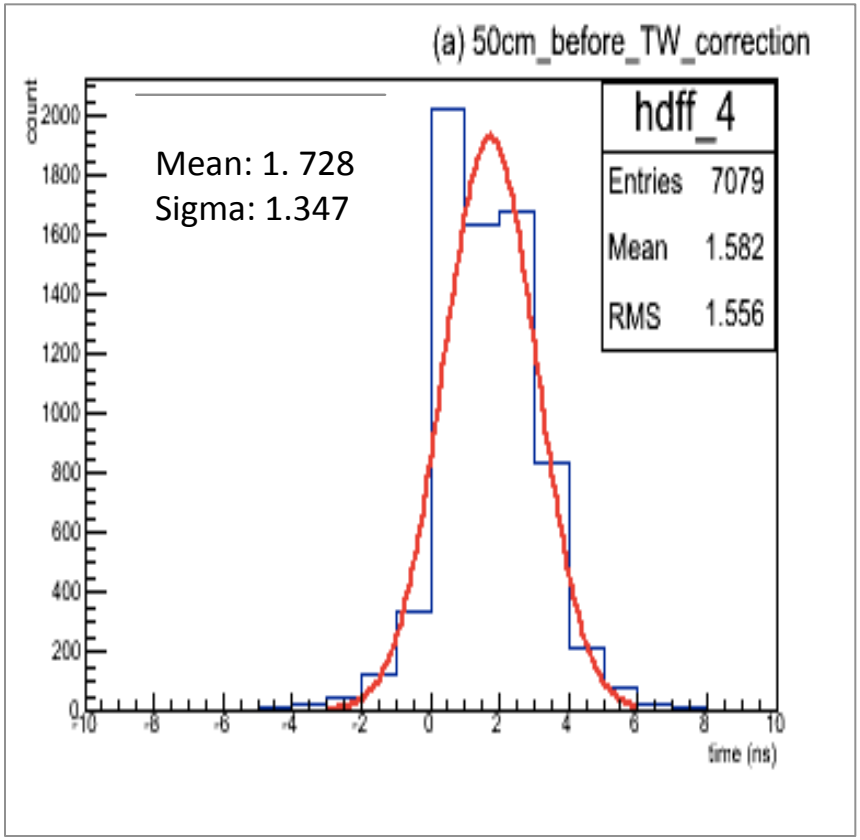


Fig. 9 : Correlations between time and charge values of two scintillator PMTs

Test result with ^{60}Co source

Time resolution before



Time resolution after

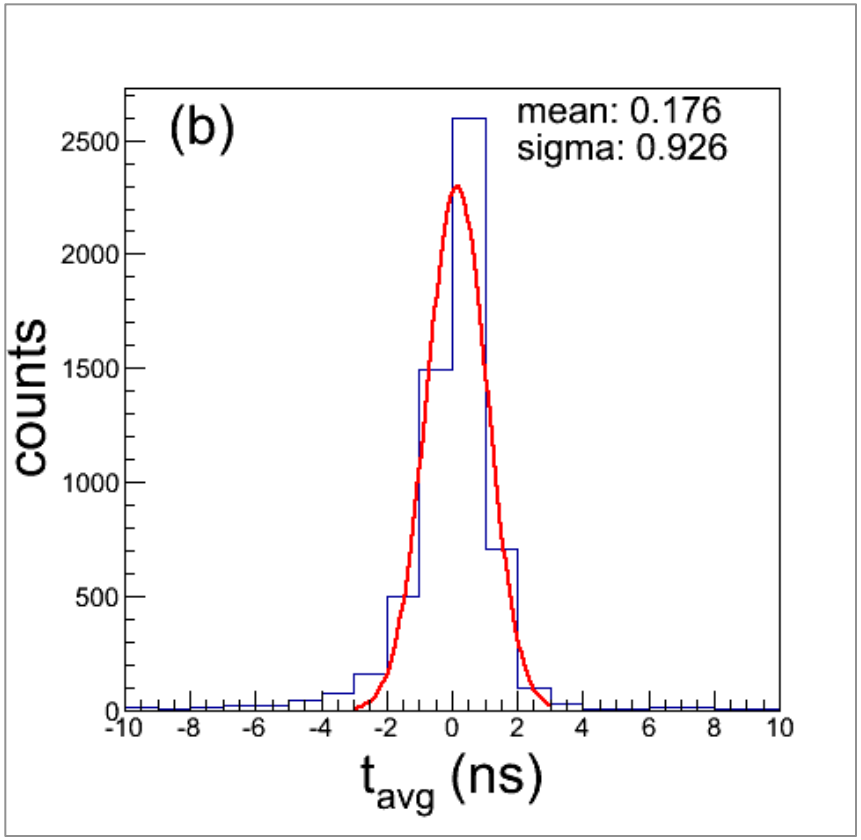
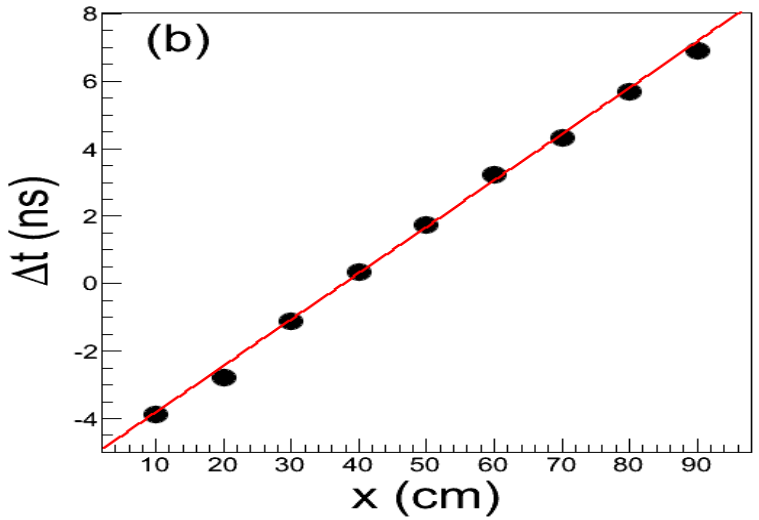


Fig. 10: Average time distributions of two scintillator PMTs before and after slewing effect was corrected.

Test results with ^{60}Co source

Position resolution before

Position resolution after



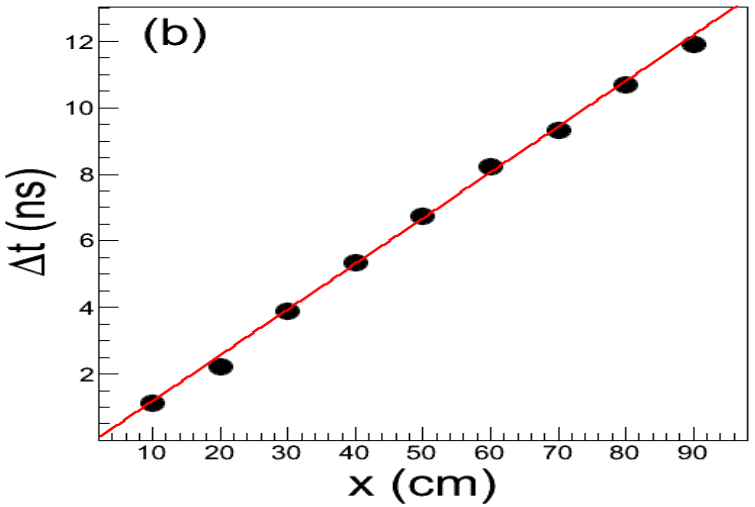


Fig. 8: Time difference between two scintillator PMTs

	α (cm/ns)	β (cm)	σ_x (cm)
CFD result	7.28±0.03	1.53±0.22	9.81

Table 1: Fitting parameters for the linear functional form ($x = \alpha\Delta t + \beta$) in figure 8.

^{252}Cf experimental set-up

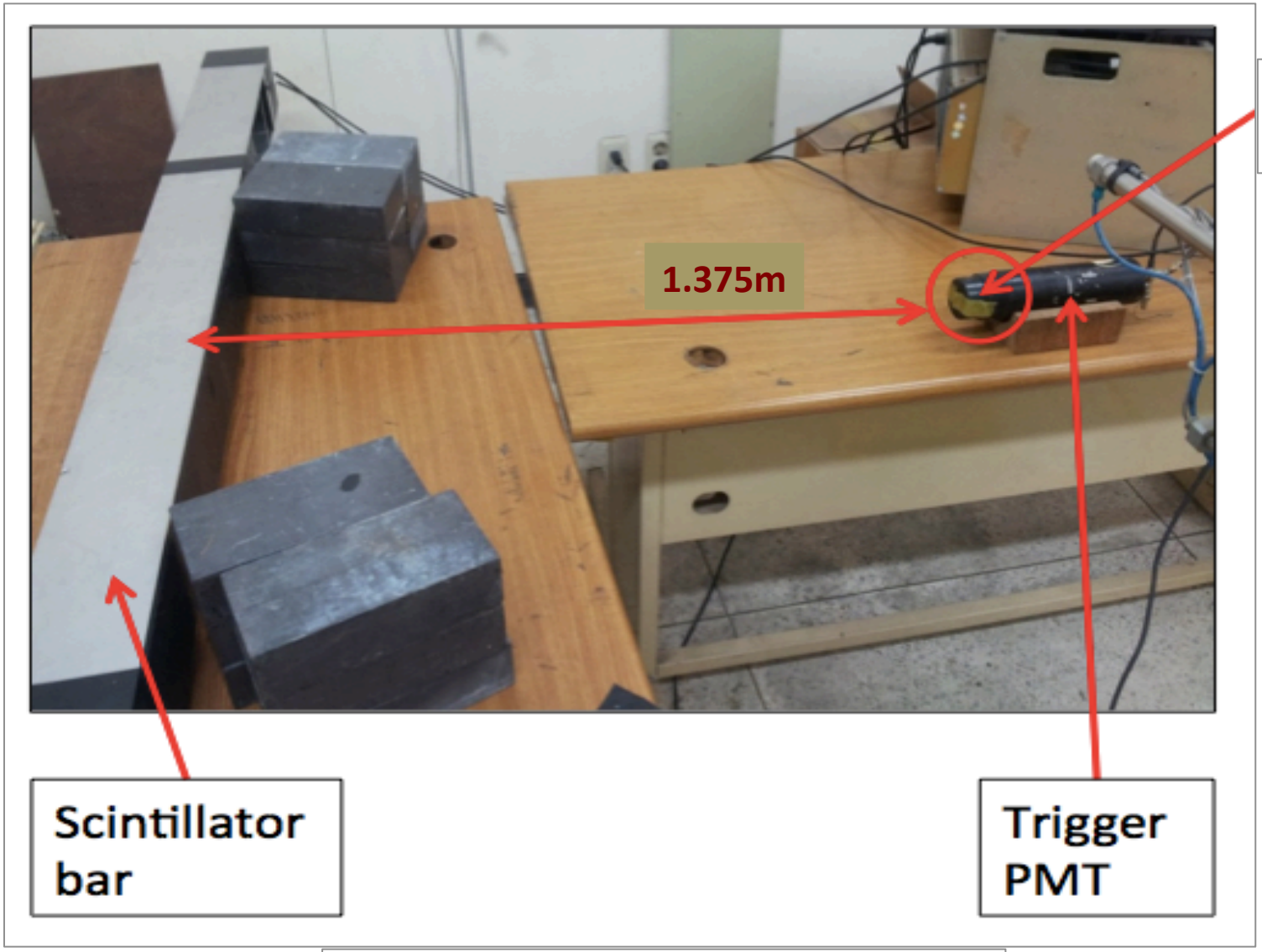
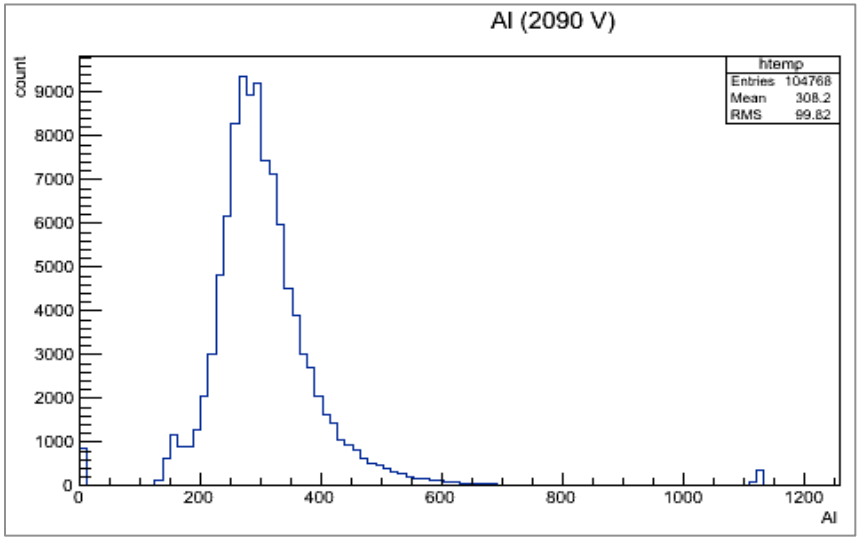
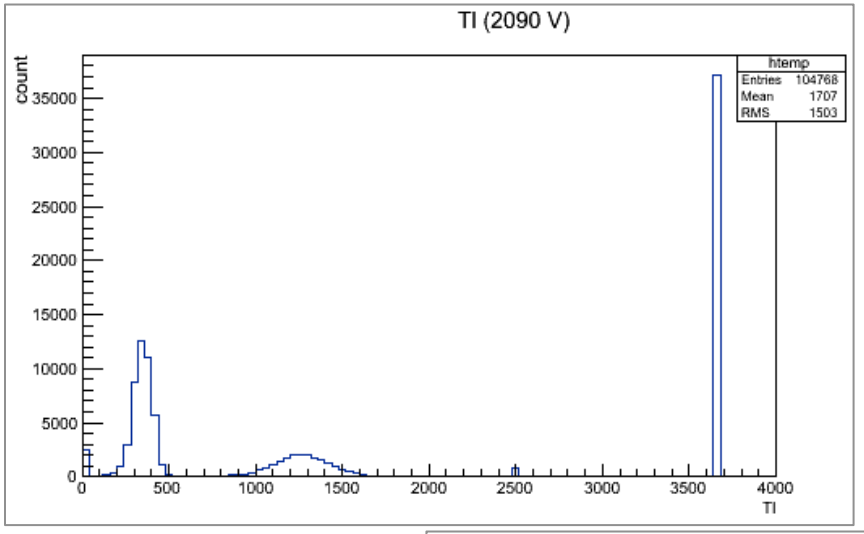


Fig.11: Californium experimental set up

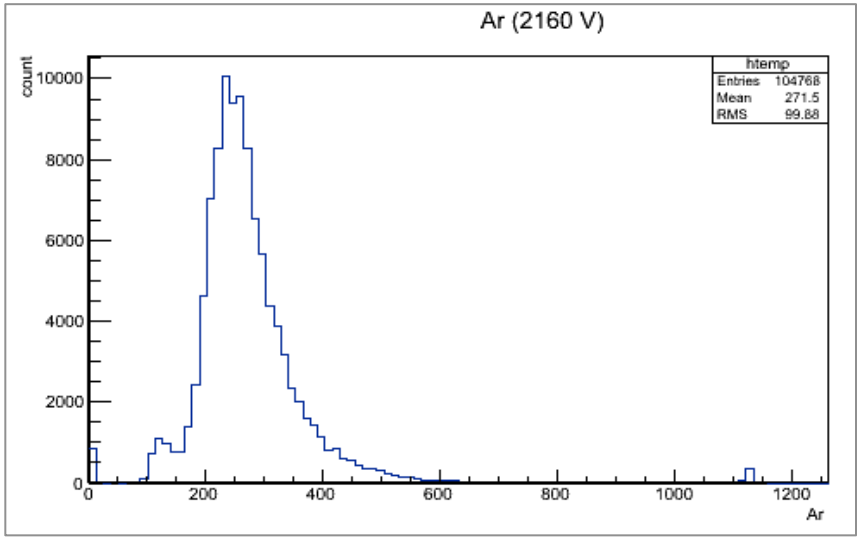
Test results with ^{252}Cf source

Raw data for adc and tdc (left)





Raw data for adc and tdc (right)



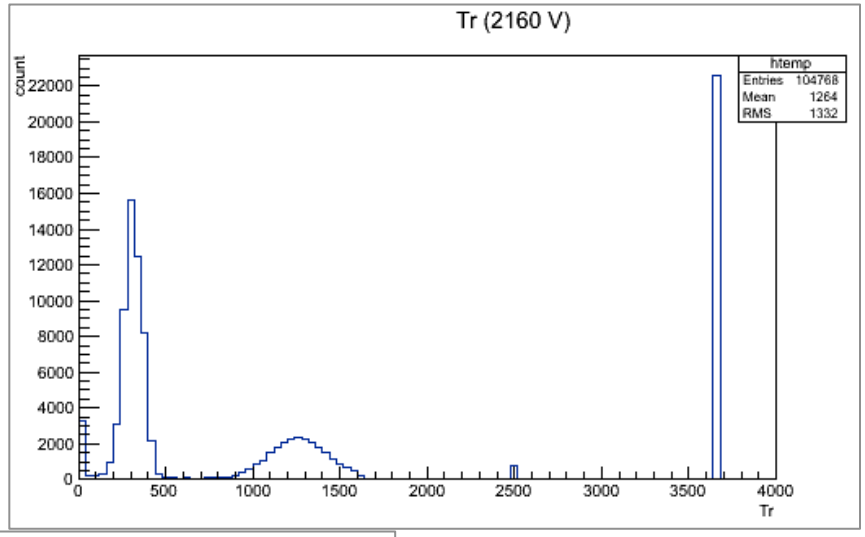
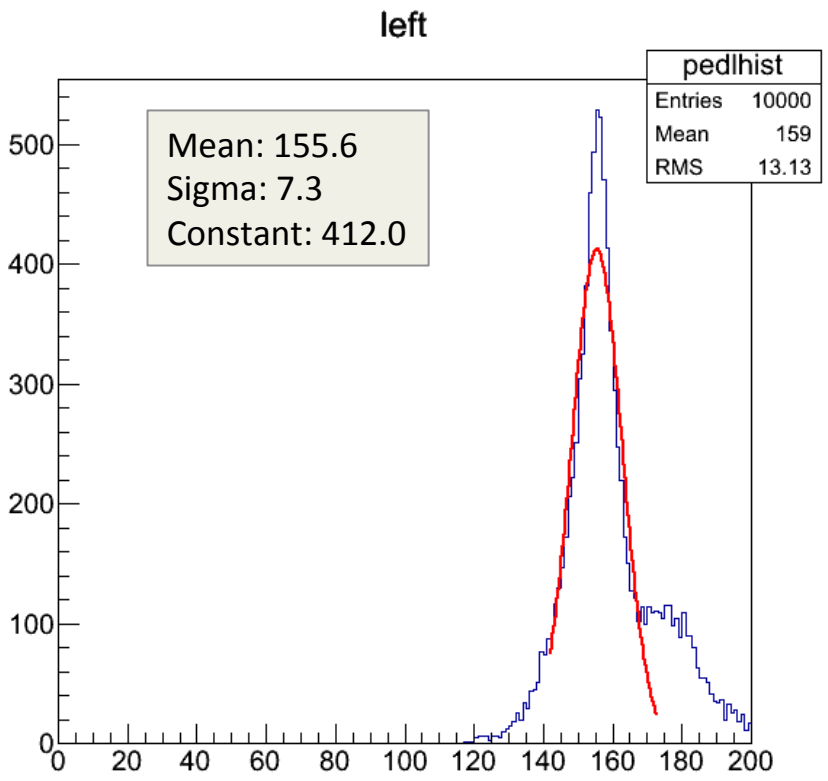


Fig.12: Californium adc and tdc raw data

Test result with ^{60}Co source

Ch1 (2090 V): pedestal left

Ch2 (2160 V): pedestal right



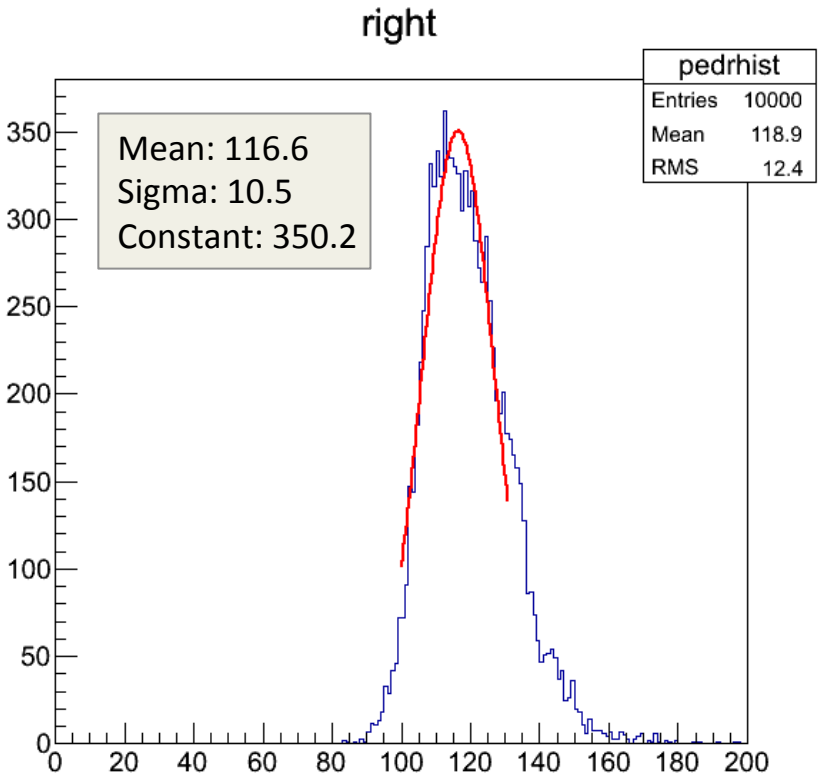
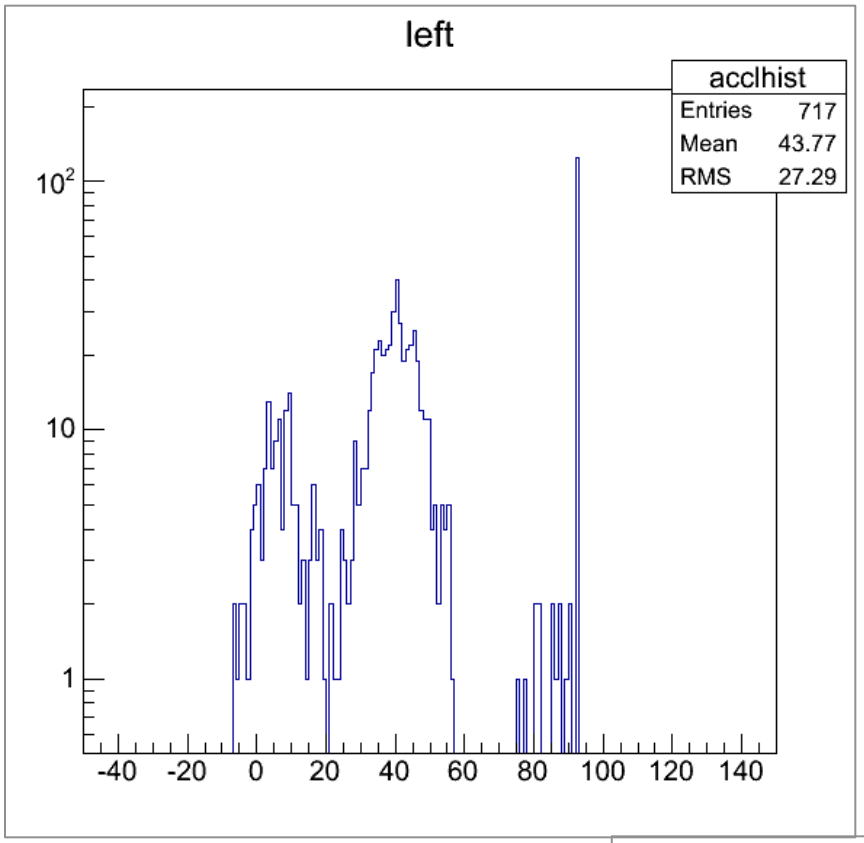


Fig.13: Pedestal data

Test results with ^{252}Cf source

CFD_accidental_left

CFD_accidental_right



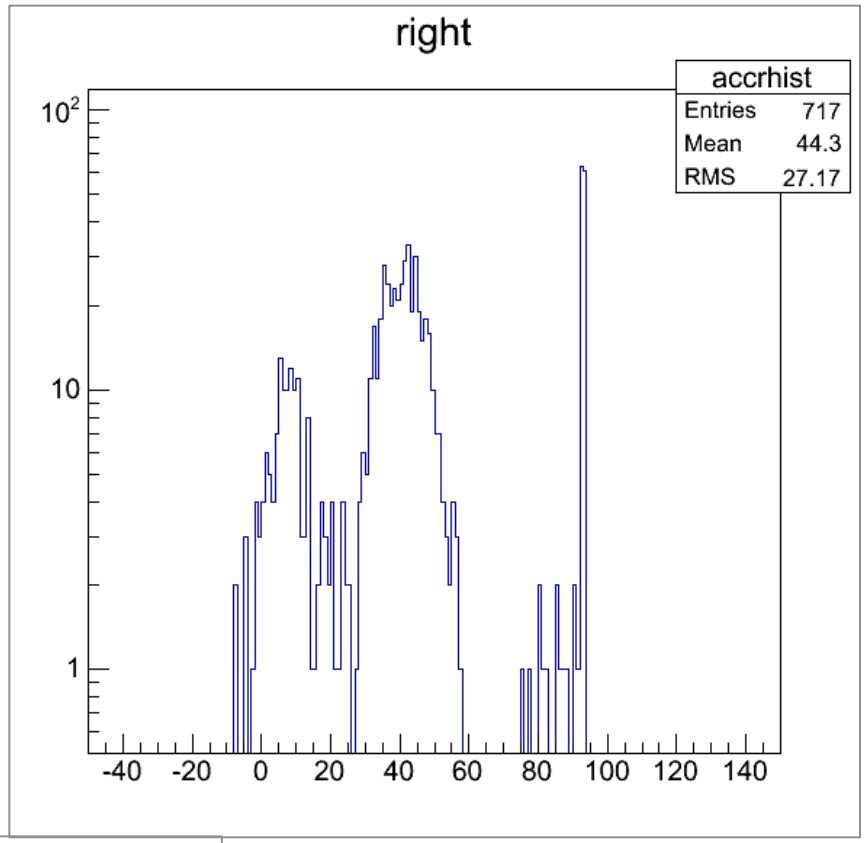
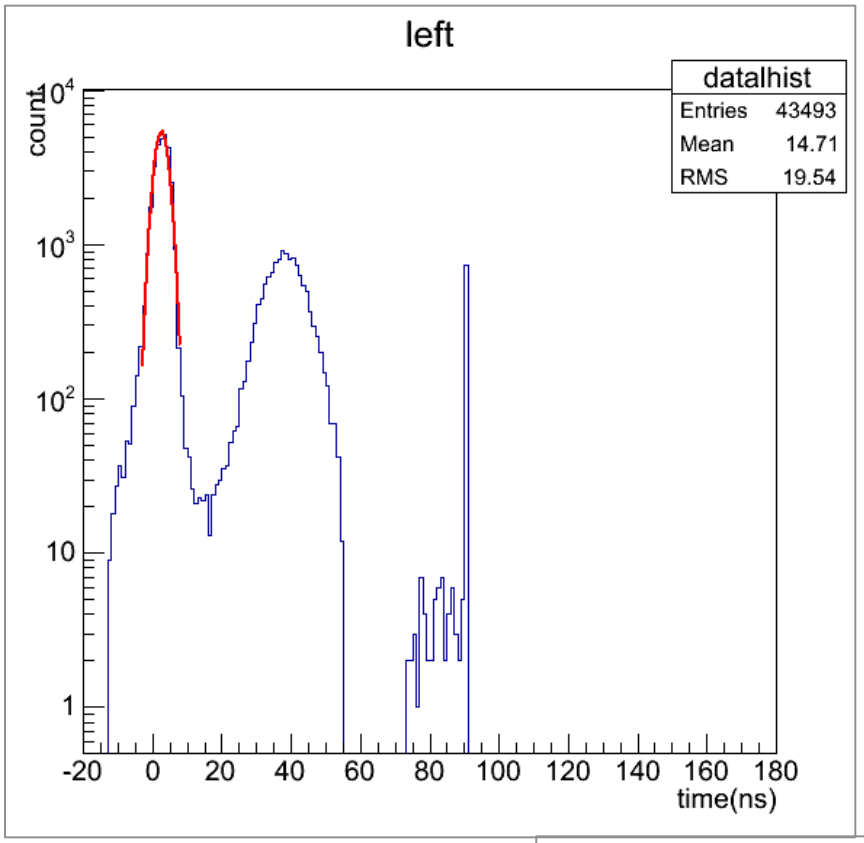


Fig. 14:Accidental data

Test results with ^{252}Cf source

CFD_data_t0_fit (Left)

CFD_data_t0_fit (Right)



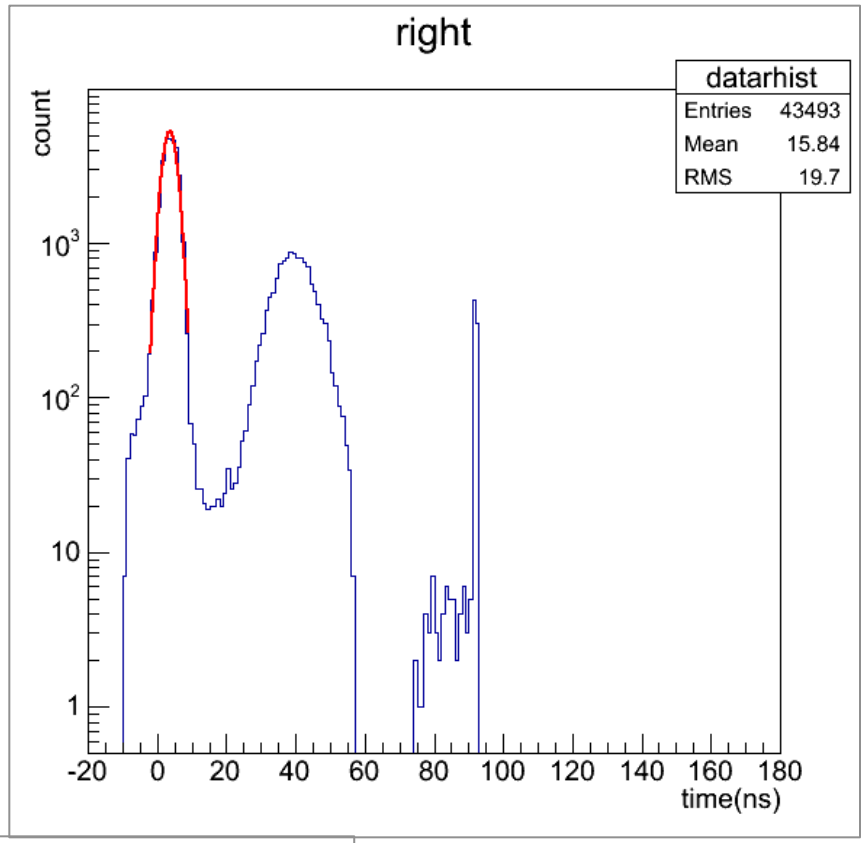


Fig. 15: Zero base time of gamma

Test result with ^{252}Cf

Time of flight distributions

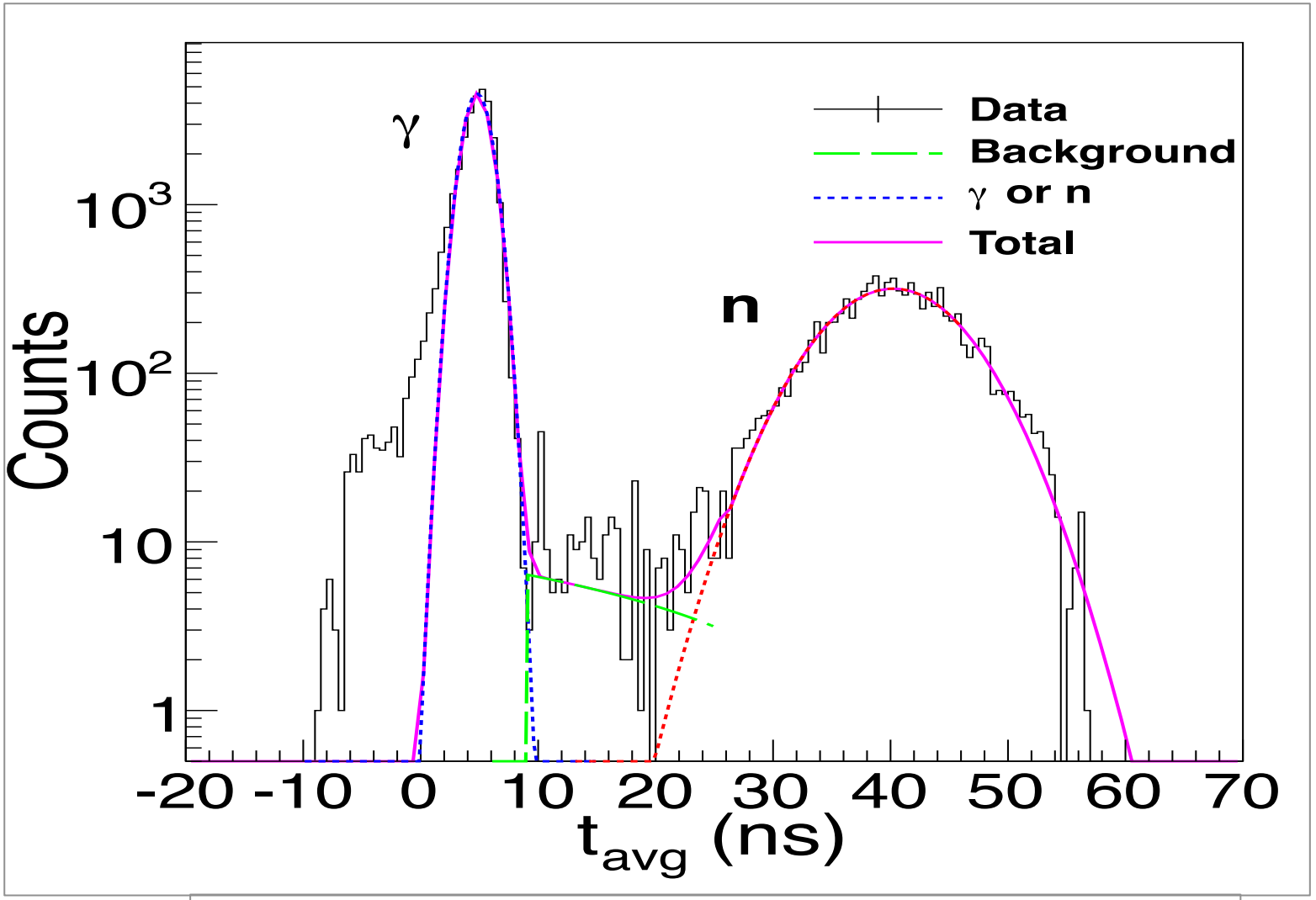


Fig. 16: Time of flight distributions for neutrons and gammas

Test result with ^{252}Cf source

Final neutron energy distribution

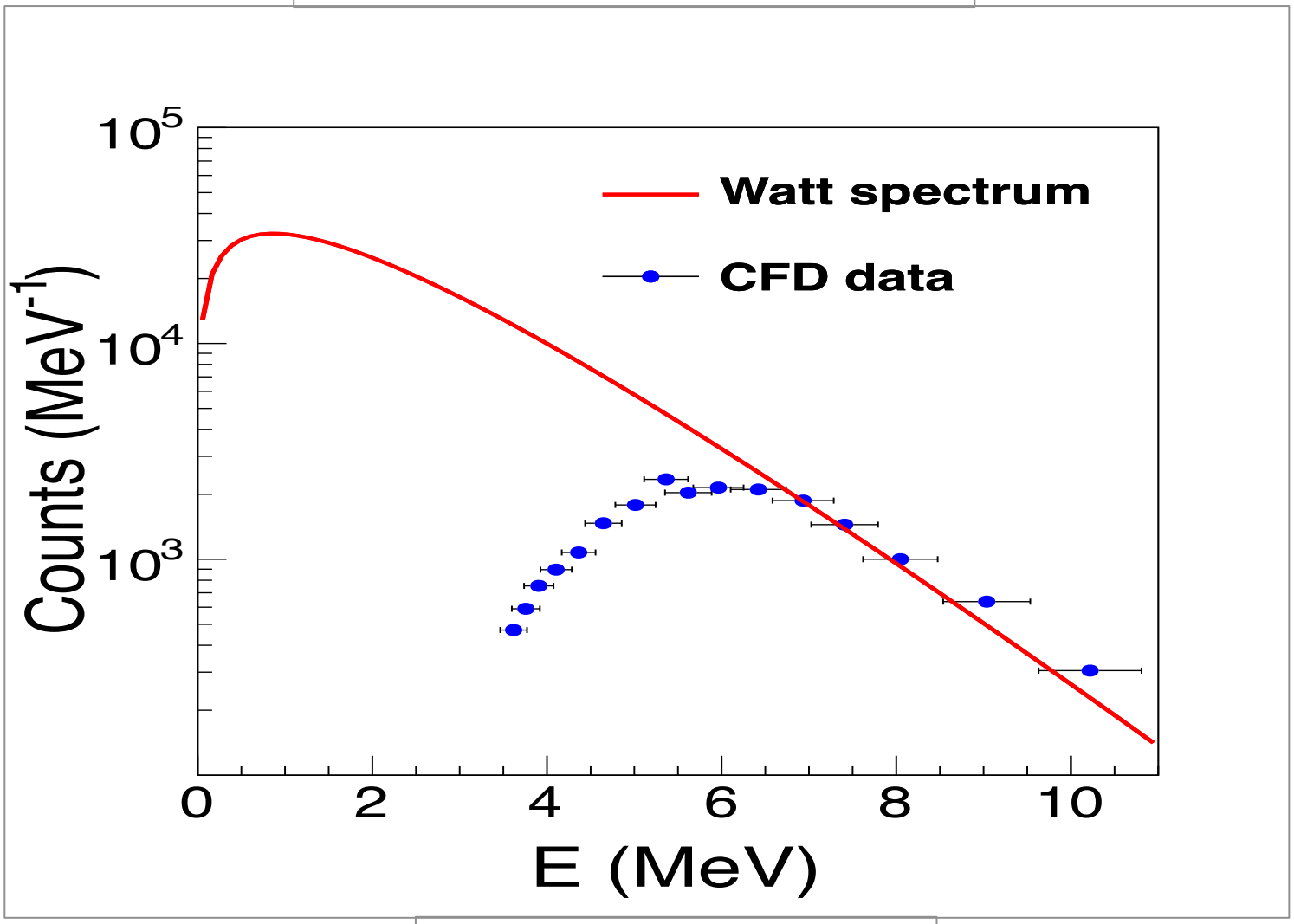
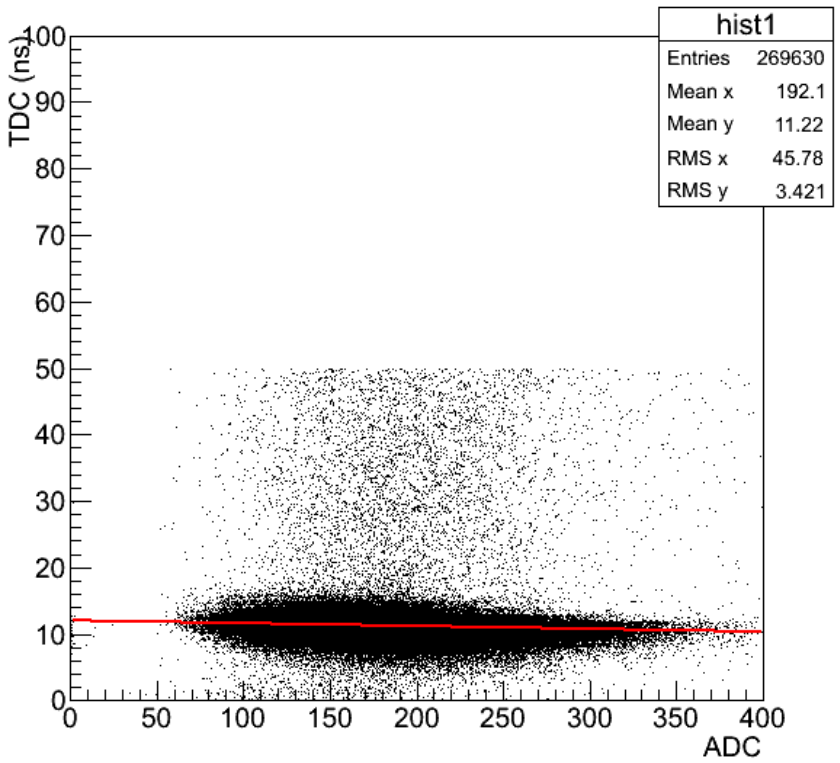


Fig. 17: Final neutron energy

BACK UP

CH1 (2100 V) TDC vs ADC



CH2 (2187 V) TDC vs ADC

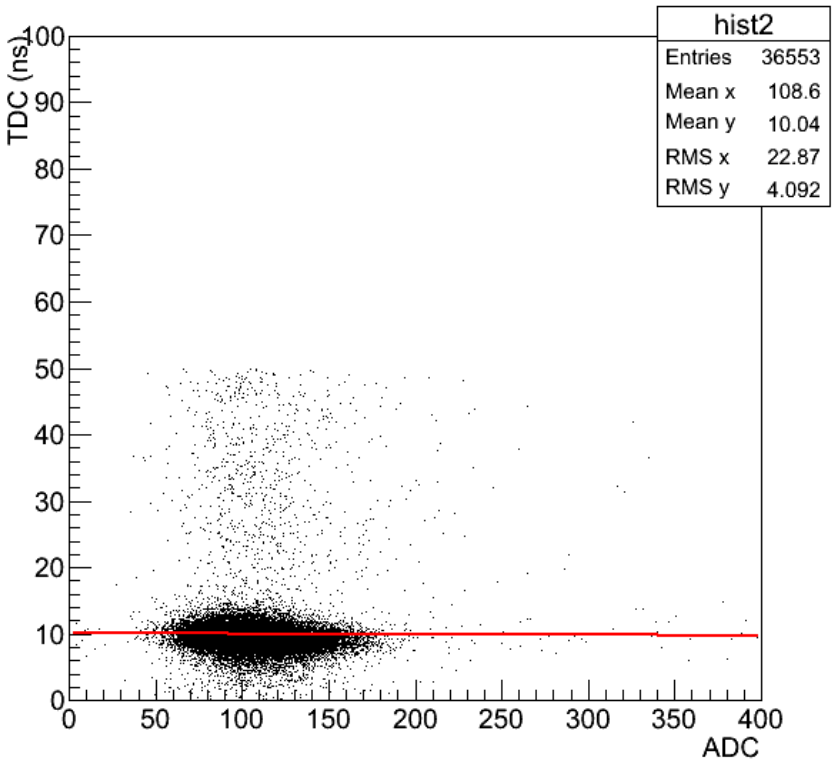


Fig.1: Huge difference in the number of charge entries in the two channels

TIMING RESOLUTION AND TIME WALK

Claus &Boris, Particle Detector 2, 417

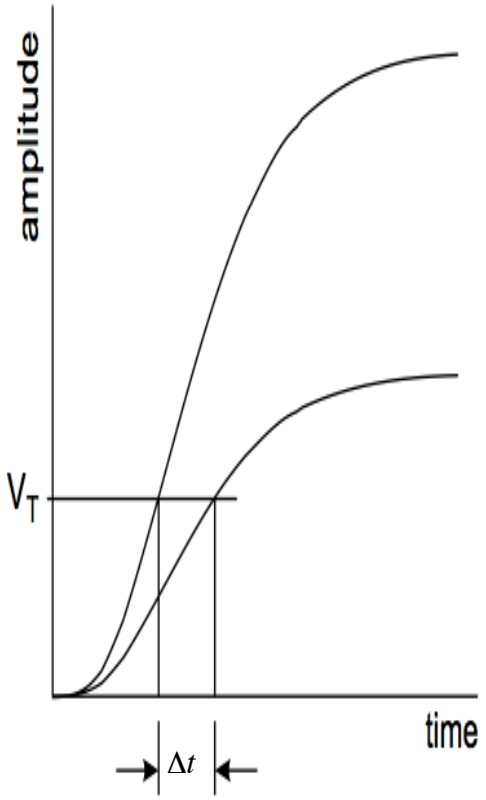


Fig.12: Time Walk depends on Amplitude

- **Time walk** is time shift (Δt) depending on signal amplitude.
- **Limits** Time Resolution.
- **Discriminator** produces logic output signal when charge input **crosses threshold.**
- **Measured time** is time at **crossing point** and happens a **little later** than incidence of particle.
- This time difference is **Time Walk.**

Experimental setup

- VTD(C.A.E.N. Mod. N844) - Coincidence measurement - Threshold for signal: 140 mV - Threshold for trigger: 20 mV	- CFD(C.A.E.N. Mod. N415A) - Coincidence measurement - Threshold for signal: 35 mV/ns - Threshold for trigger: 5 mV/ns