

Background Reduction of N-type Ge Detector

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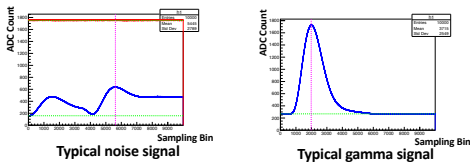
1. Motivation

The material screening is important for searching rare event.
Ge detector has high energy resolution of gamma ray and measure the RI in sample.

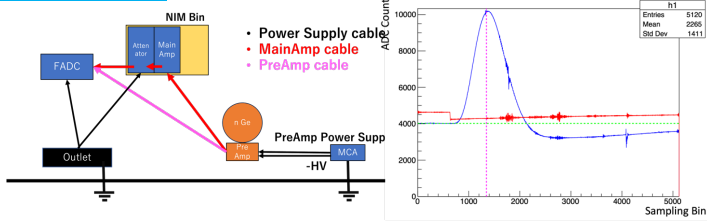
The N-type Ge detector have more sensitive in low energy gamma ray than P-type.



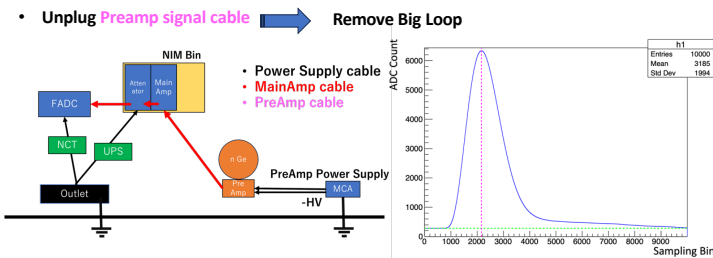
Problem
It is difficult to distinguish low energy gamma ray signal event and noise signal event.
→ Save waveform and distinguish the noise from waveform.



DAQ Improve

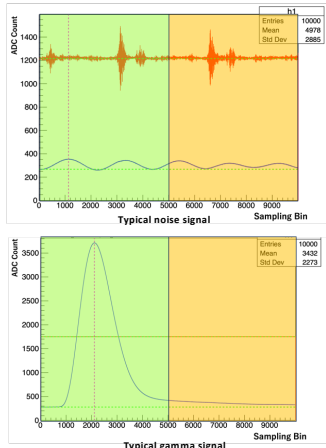


- install UPS → Remove Ground Loop
- Unplug Preamp signal cable → Remove Big Loop



Noise Removing by software

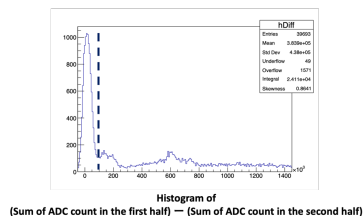
Method 1



The trigger position is 1000th bin, so sum of the first half bigger than second half.

1. Sum of ADC Count in the first half (A)
2. Sum of ADC Count in the second half (B)
3. Compare and judge as noise if the value of (A - B) is less than 100,000.

The number of events increases when the value of A-B is smaller than 100000.(below graph)



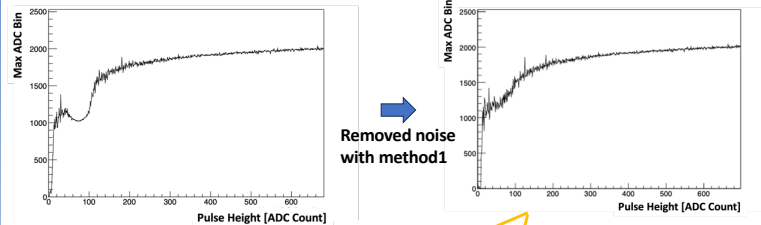
Noise Removing by software

Method 2

How to save waveform information

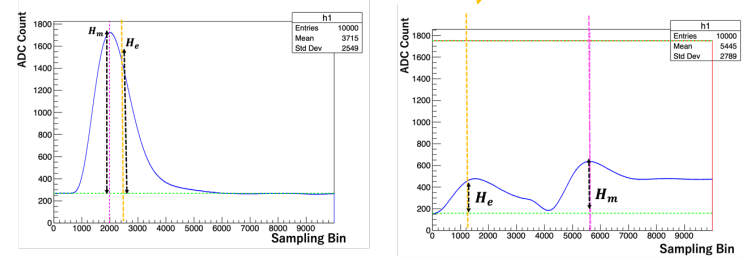
Save waveforms so that the Sampling Bin at which ADC Count exceeds the threshold value is the 1000th Bin. The bin begin to rise of waveform is fixed

Max ADC Bin is predicted from the size of the waveform.(below graph)



The estimated Max ADC Ch by pulse height

The estimated Max ADC Ch by pulse height without considering noise removed by method1

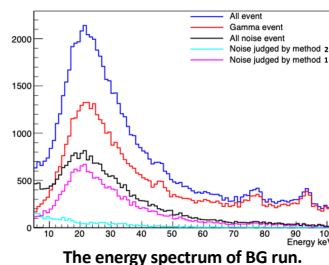


H_m : Max pulse height

H_e : Pulse Height at the bin which estimated from the template base on pulse height

Compare H_m and H_e , and judge as noise if H_e is less than half of H_m .

BG run analysis



The energy spectrum of BG run.

Check if the method works, take data of BG of Ge detector for 31.62 day.

Noise rate was found to be high at lower energies.

Energy	(noise event)/(all event)
5 ~ 60 keV	38.0 %
60 ~ 80 keV	18.8 %
80 ~ 100 keV	11.9 %
100 ~ 3000 keV	1.5 %

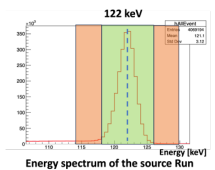
Check if the method is valid

Objective: To confirm that noise rejection does not remove the gamma ray signal

- Put the source into the Ge detector
- A. Measured count rate with noise rejection
- B. Estimated count rate by simulation

The agreement between A and B confirms that the gamma-ray signal has not been removed.

Source : ^{57}Co (122 keV gamma ray)



A. Measured count rate with noise rejection
→ 32.42 event/sec

B. Estimated count rate by simulation

The event rate is predicted from the radioactivity intensity and Ge detector Efficiency.
→ 44.78 ± 0.03 event/sec (Error is statistical error of MC)

Discrepancy rate

$$\frac{B-A}{A} = 27.6 \%$$

According to previous studies, MC has +30%,-10% systematic error[1]

↓
Within the error range

This is evidence that normal gamma events are not being dropped as noise events

[1]市村 晃一, "Lab-CのGe検出器", 東京大学 宇宙線研究所, 第3回極低放射能技術研究会発表資料(2017)