How to collect data

Japan Atomic Energy Agency

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What is a data collection device?

→ A device that selects and records the necessary information from the signals output from the detector A device that selects and records the necessary information

In this exercise, in addition to the elastic scattering monitor installed in the target scattering tank , installed at the focus of the JAEA-RMS,

MCP detector

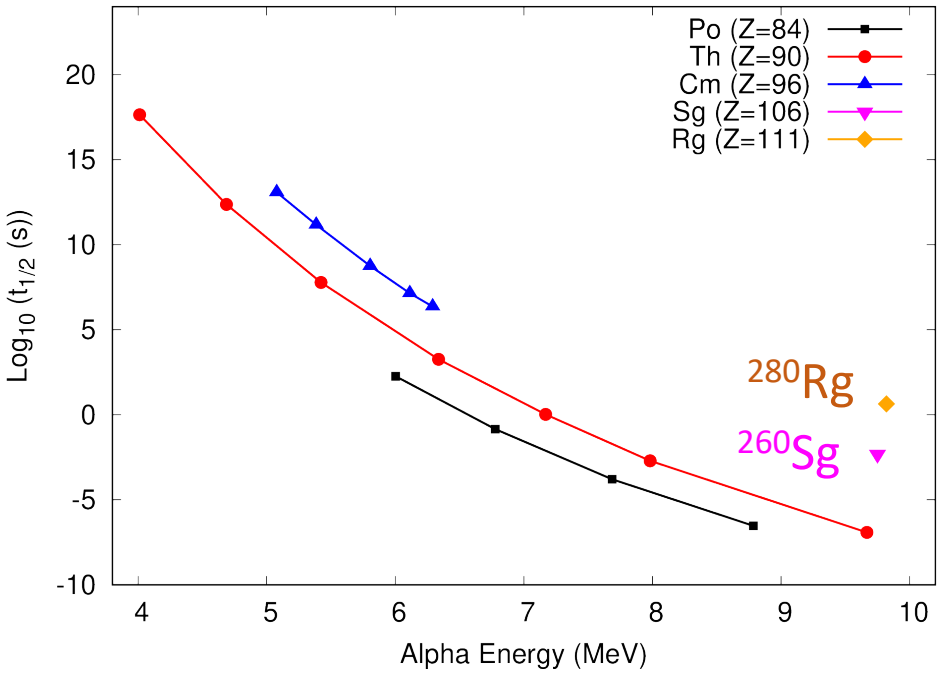
- Si Strip detector

The information necessary to identify what nuclei (isotopes) and how many of them were formed by the evaporated residual nuclei that flew by processing the analog signal from the I will record the information needed to determine what kind of nuclei (isotopes) were created by the evaporated residuals.

Let us consider what information is actually needed.

What information do you need for this exercise?

Systematics of alpha decay (from Ricardo's data)



As indicated in the previous lecture, there is a correlation between the energy and half-life of the emitted α-particles, which we would like to exploit.

Energy of emitted alpha particles

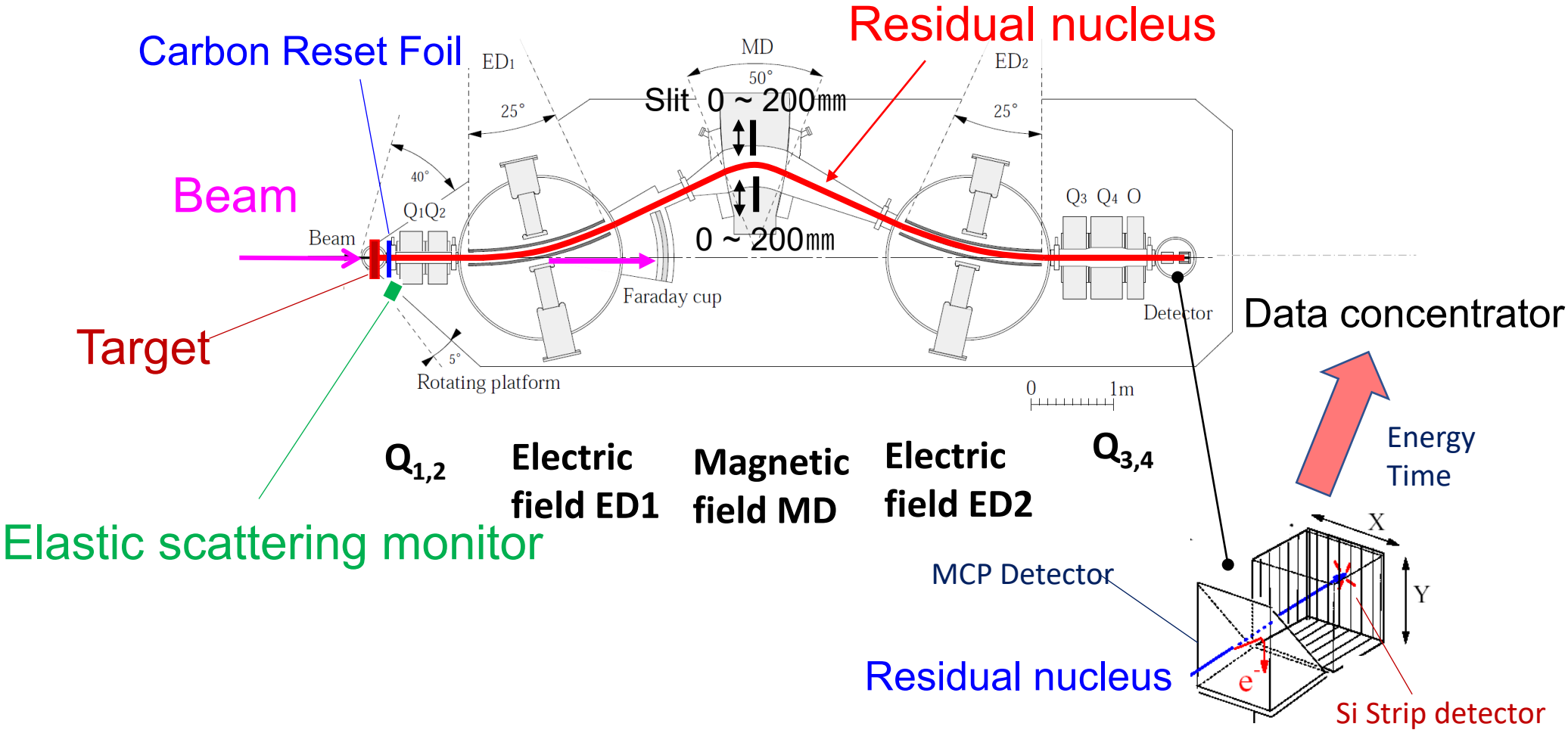
Elapsed time until emitted

From this information, it is possible to estimate what nuclides (isotopes) were produced in the reaction.

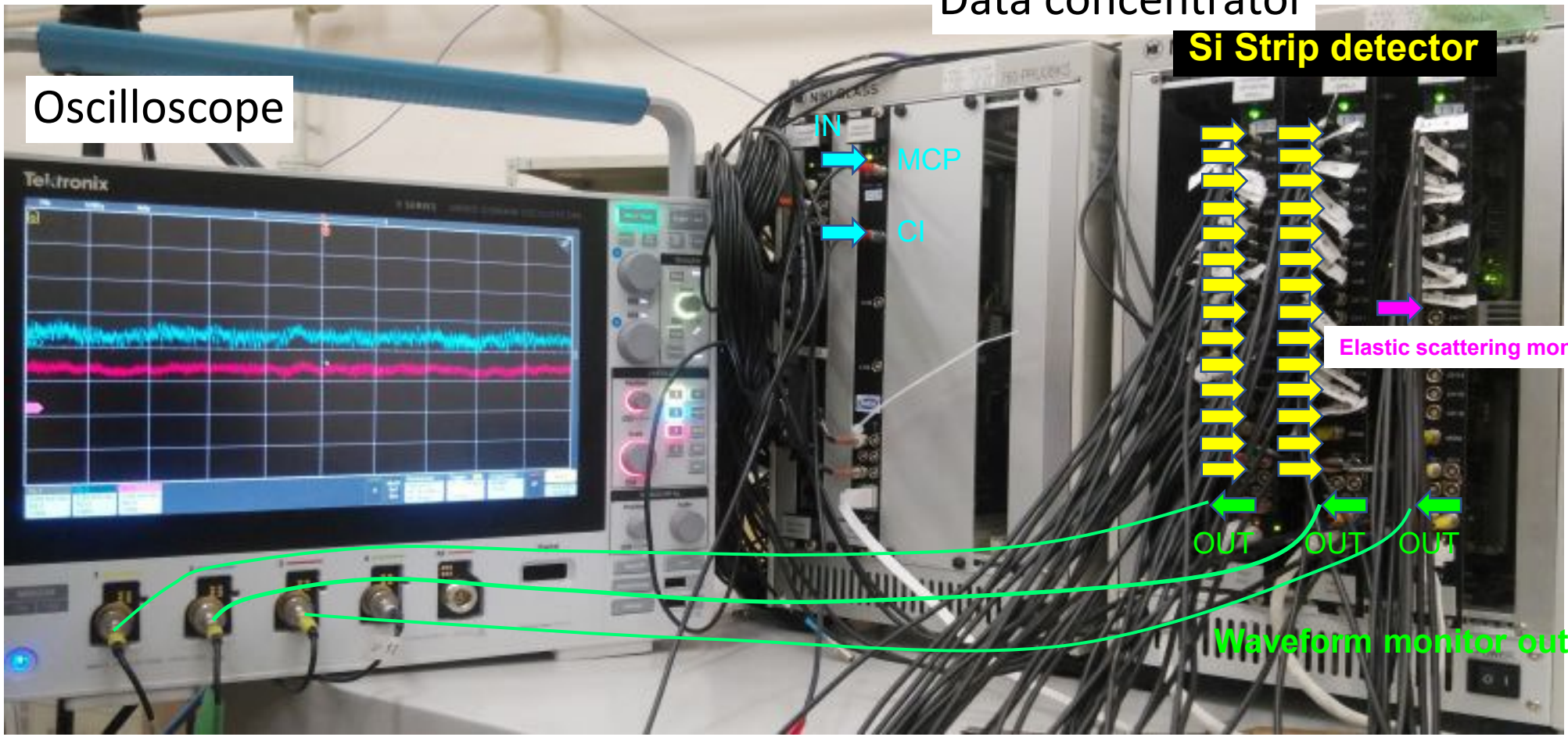
The energy and time information of the alpha particles emitted by the residual nuclei and their daughter nuclei separated by the JAEA-RMS are recorded to find out what kind and how many nuclei were produced.

JAEA-RMS

Residual nuclei produced in the reaction being separated by JAEA-RMS

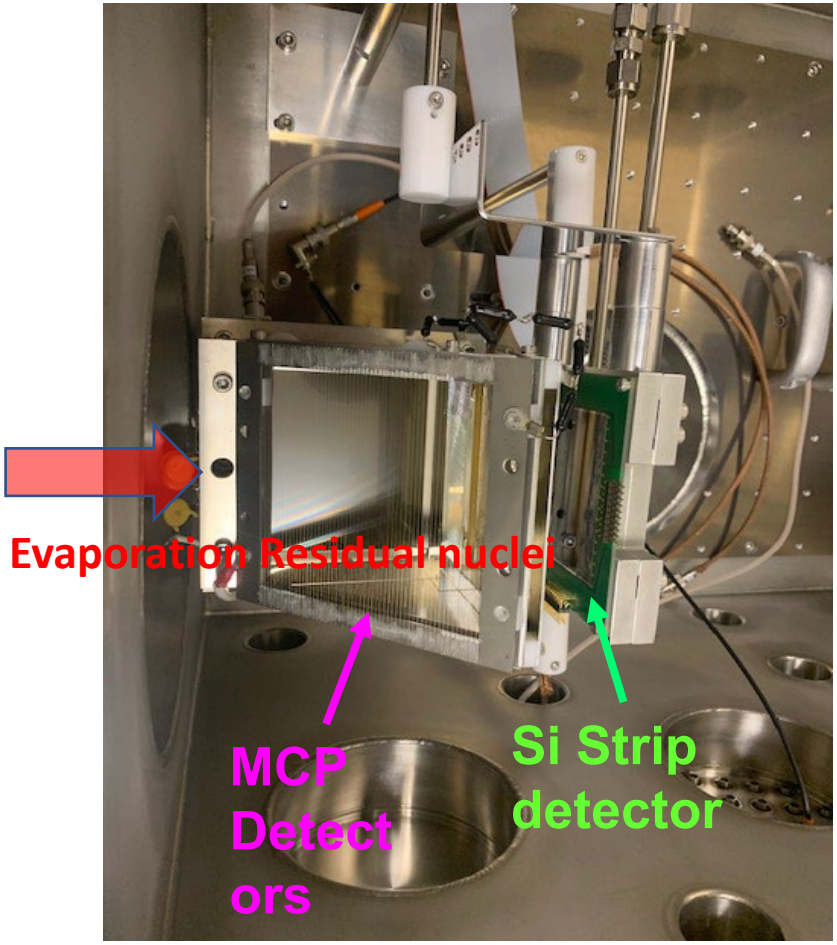


Data Acquisition Equipment - Appearance

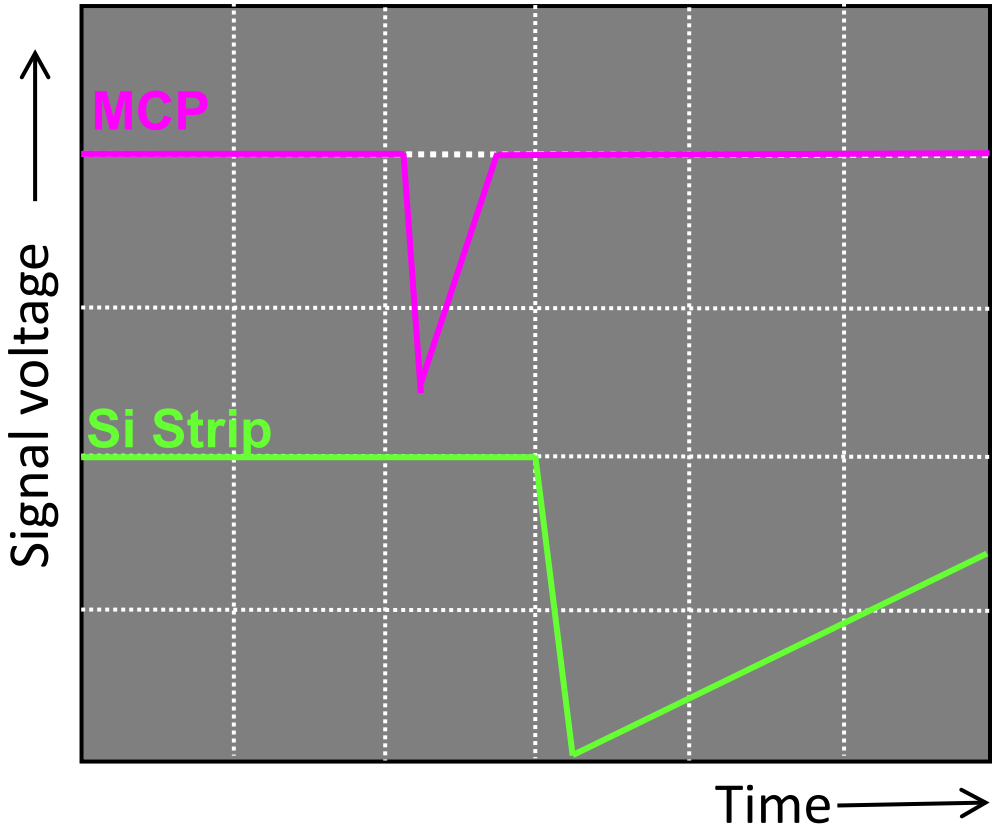


Focus Detector - "Striking Event"

MCP Detector + Si Strip detector



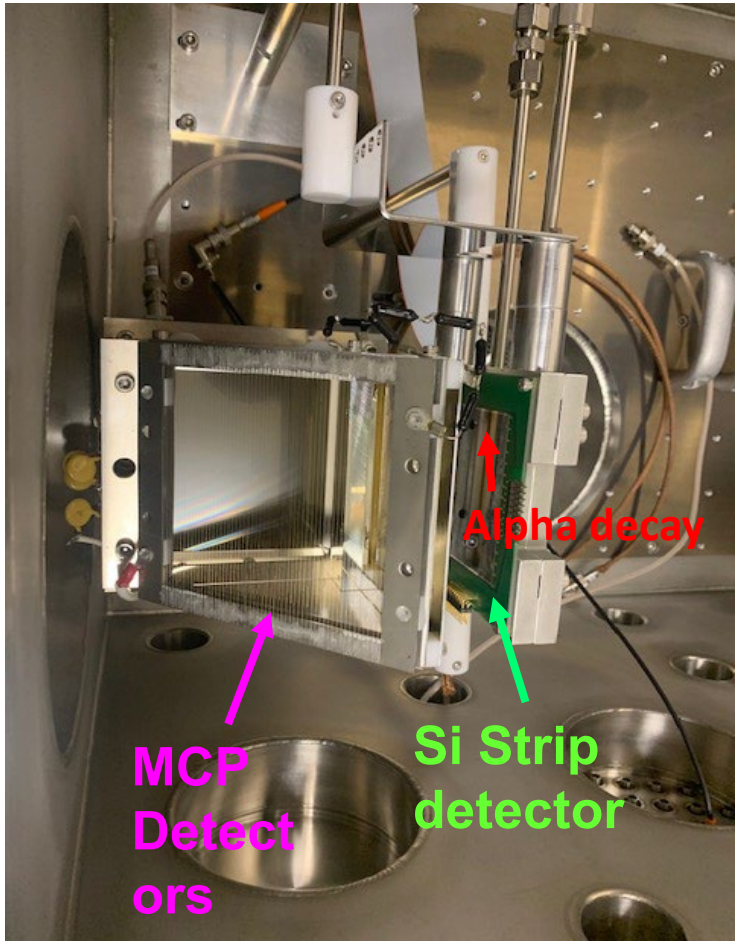
Observing the signal output with an oscilloscope...



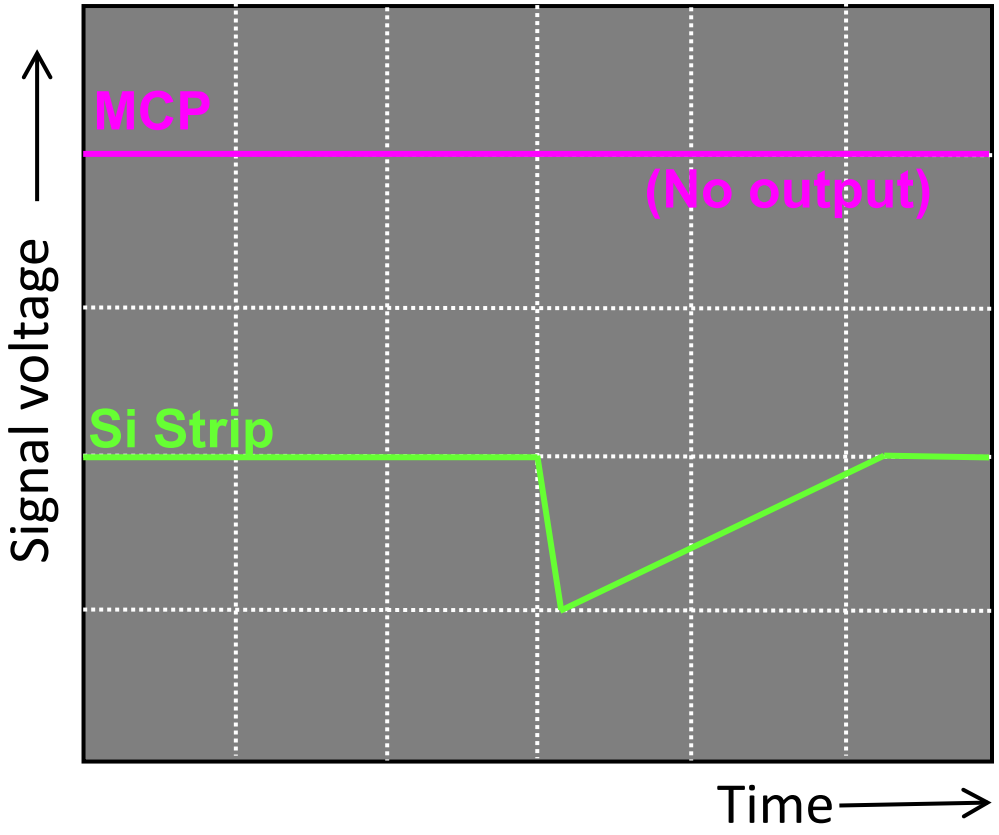
Actual waveforms may be seen at the time of measurement...

Focus Detector - "Alpha Decay Event"

MCP Detector + Si Strip detector

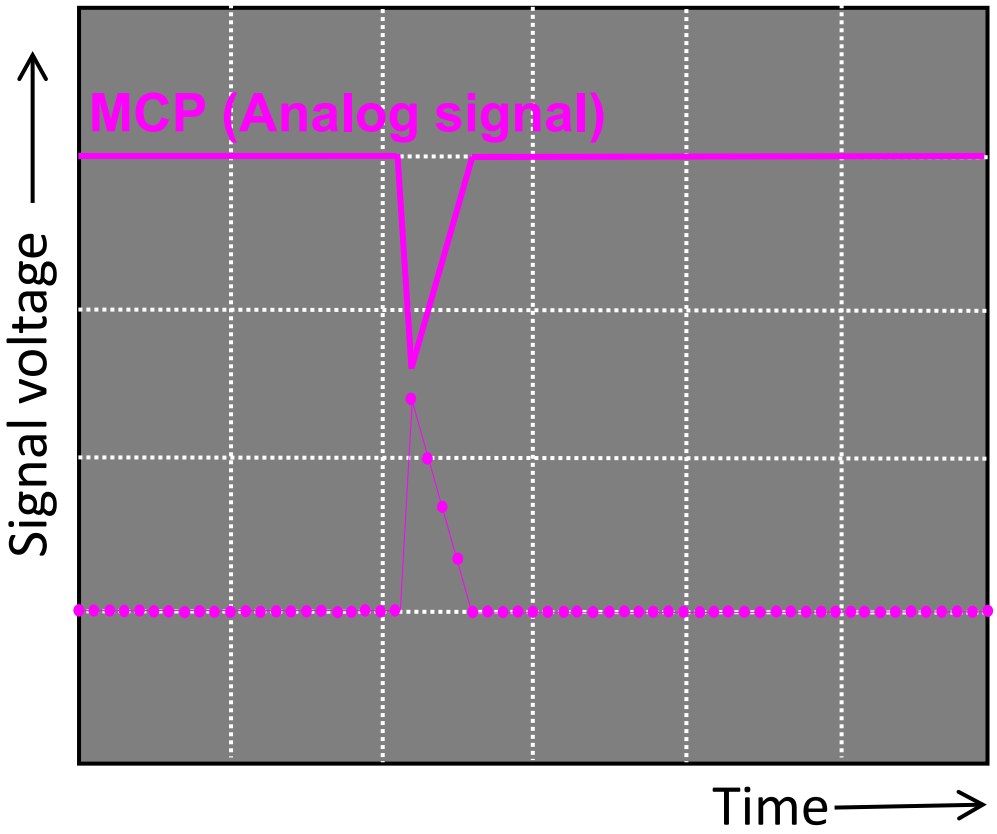


信号出力をオシロスコープで観察すると…



Data Acquisition Equipment - Signal Processing (Input)

For MCP detector (just need to know if there is a signal...)



Input analog signals, Convert to digital data

↓

The input voltage is measured every

1 nanosecond and stored in memory.

※ 1 nanosecond: one billionth of a second

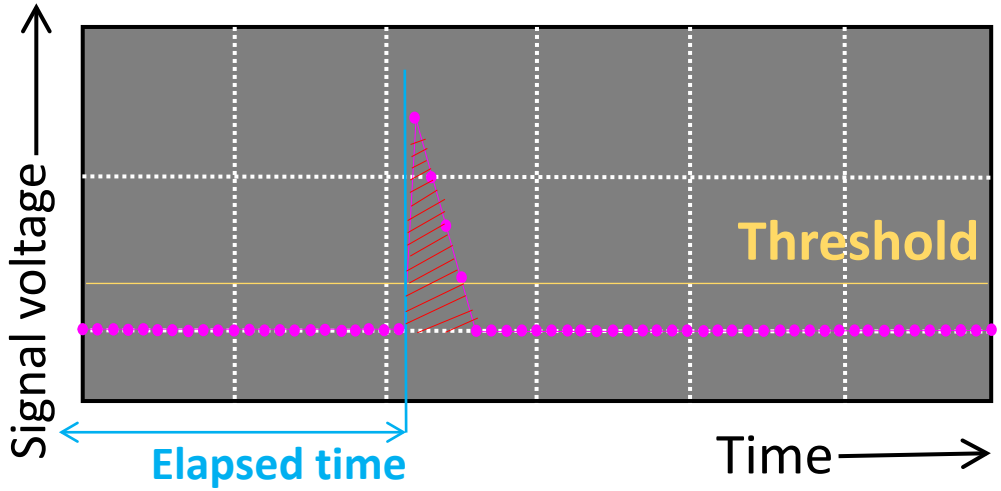
↓

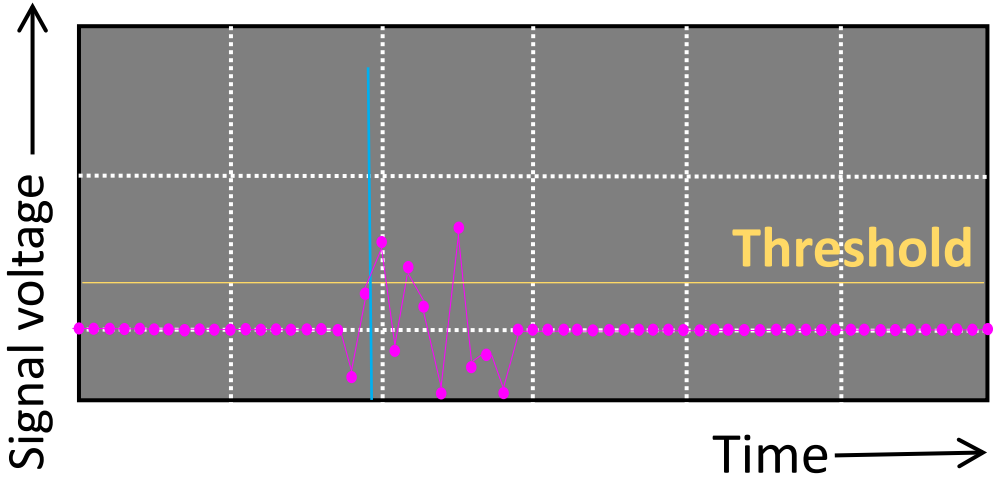
Processes analog circuits in memory

to simulate analog circuits.

Data Acquisition Equipment - Signal Processing (Information Extraction)

For MCP detector (just need to know if there is a signal...)





Of the input whose voltage exceeds the **threshold** value is recorded

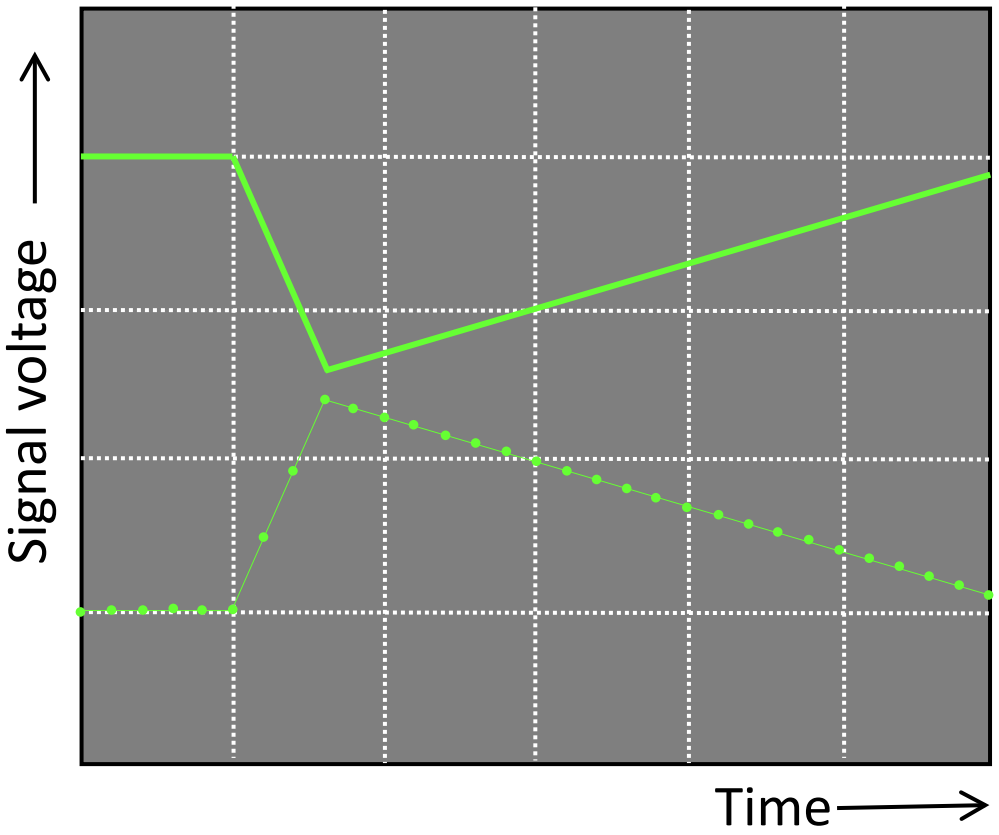
- **Elapsed time from the start of measurement** (**Time stamp**)
- **The area of the waveform** (**Energy information**) is recorded.

The area of the waveform is recorded to distinguish between noise and signal that cannot be removed by simply setting the threshold.

←Noise signal area is small.

Data Acquisition Equipment - Signal Processing (Input)

Si Strip detector - I want to obtain energy information with high accuracy.



To improve energy accuracy, the signal decay time is increased.

Inputs analog signals and converts them to digital data

↓

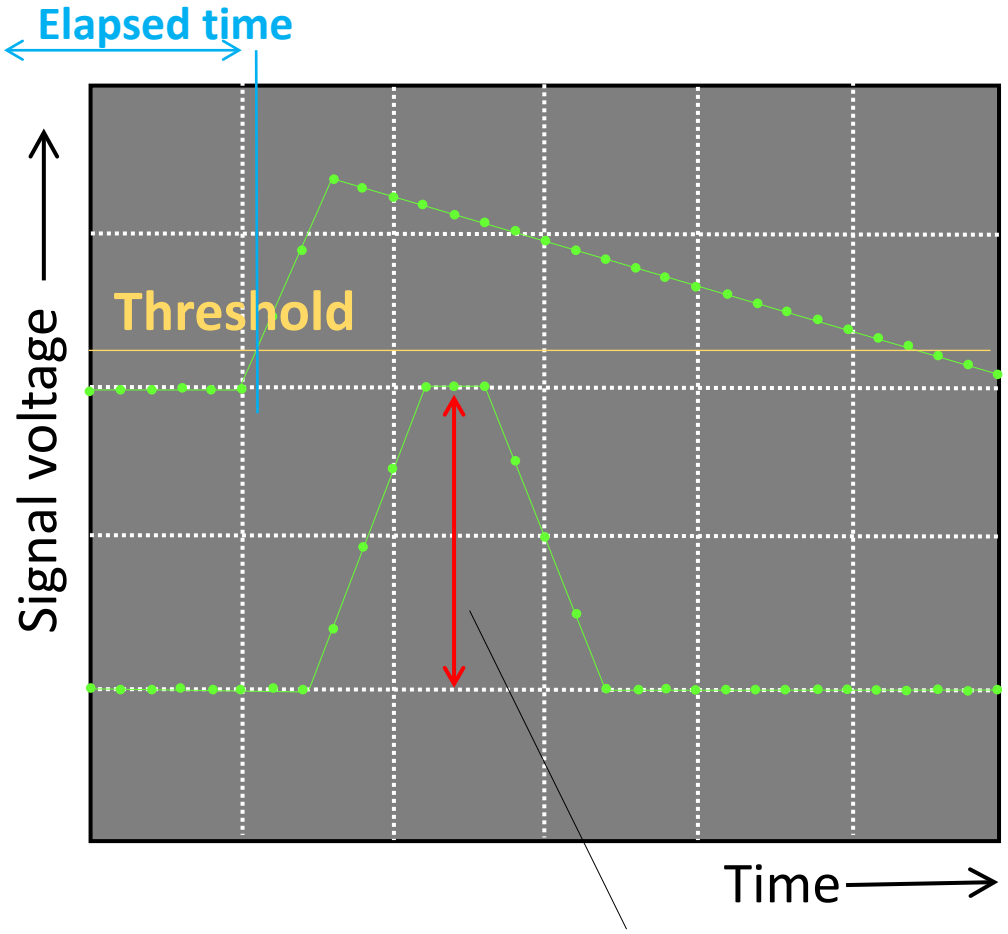
The input voltage is measured every **10** nanoseconds and stored in memory.

↓

Signal processing in memory

Data Acquisition Equipment - Signal Processing (Signal Processing)

Si Strip detector - I want to obtain energy information with high accuracy.



To improve energy accuracy,
the signal decay time is increased.

Since signal processing is time-consuming as it is, it is converted to pseudo-triangular waveform pulses.

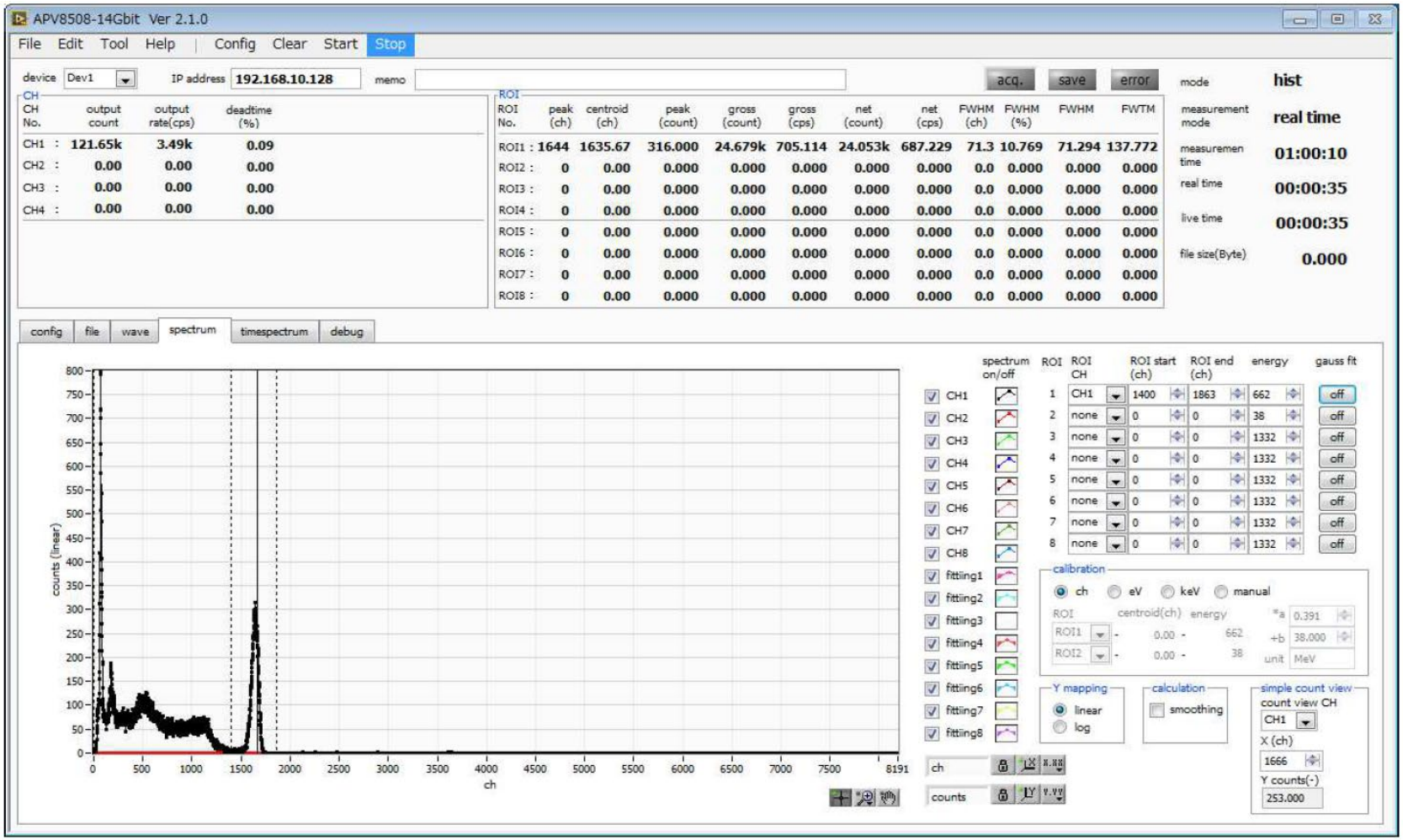
↓

Energy information is recorded from the height of the triangular waveform together with the acquisition **time stamp**.

Height of triangular waveform is proportional to energy

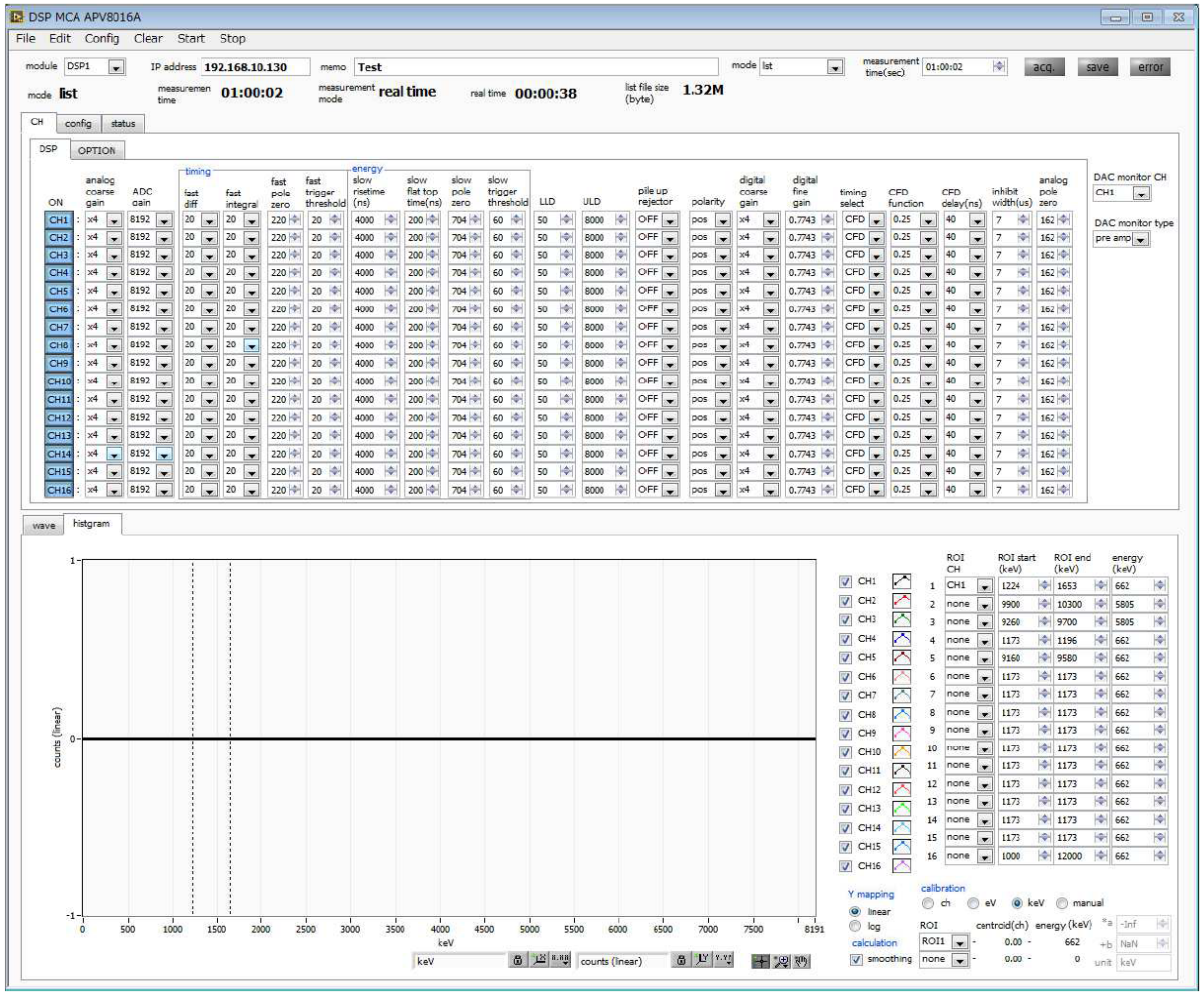
Data Acquisition Equipment - Software

For MCP detector (for specific use, etc., in actual measurement.)



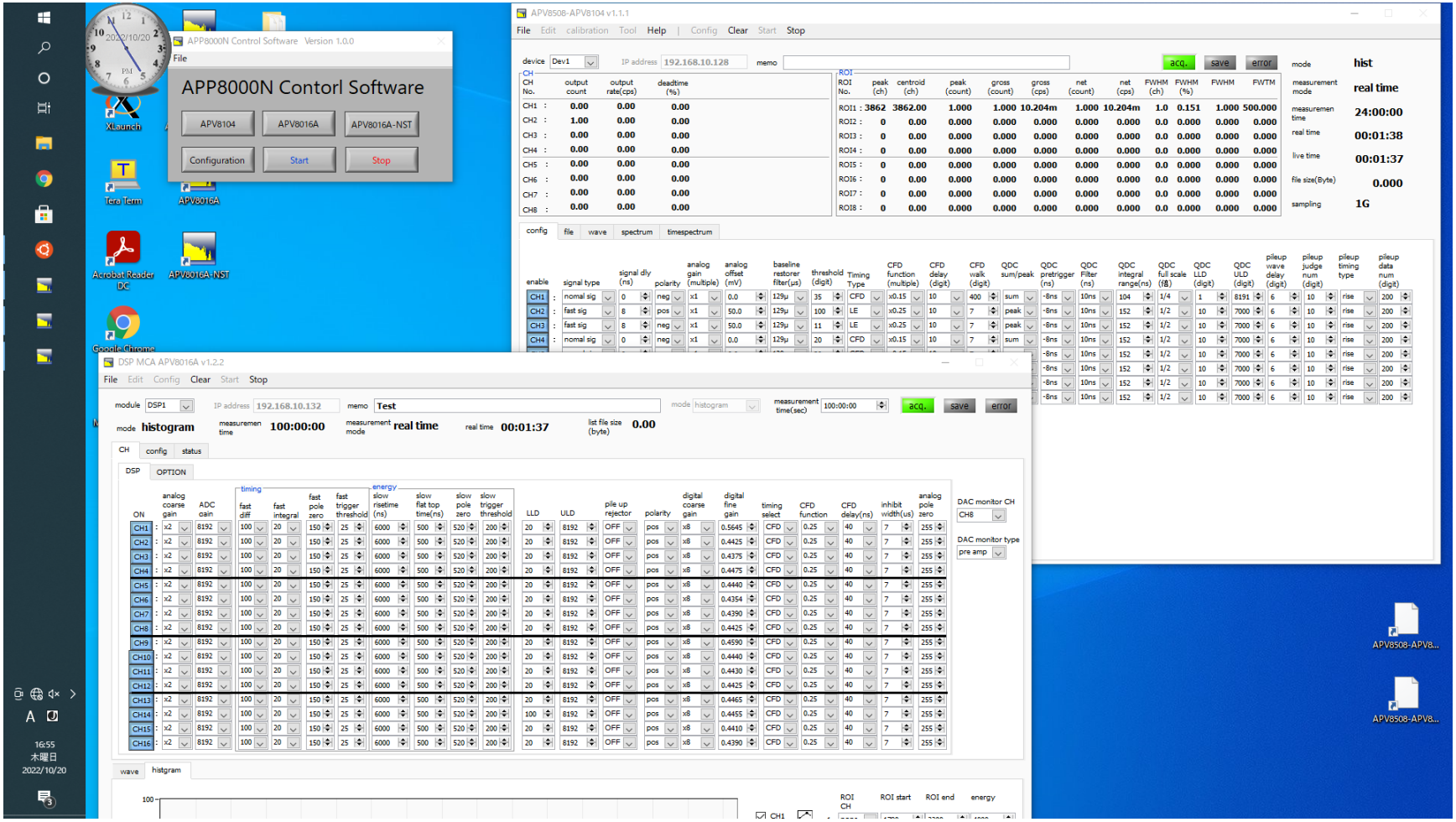
Data Acquisition Equipment - Software

For Si strip detector (for specific use, etc., in actual measurement.)



Data Acquisition Equipment - Software

At the time of measurement



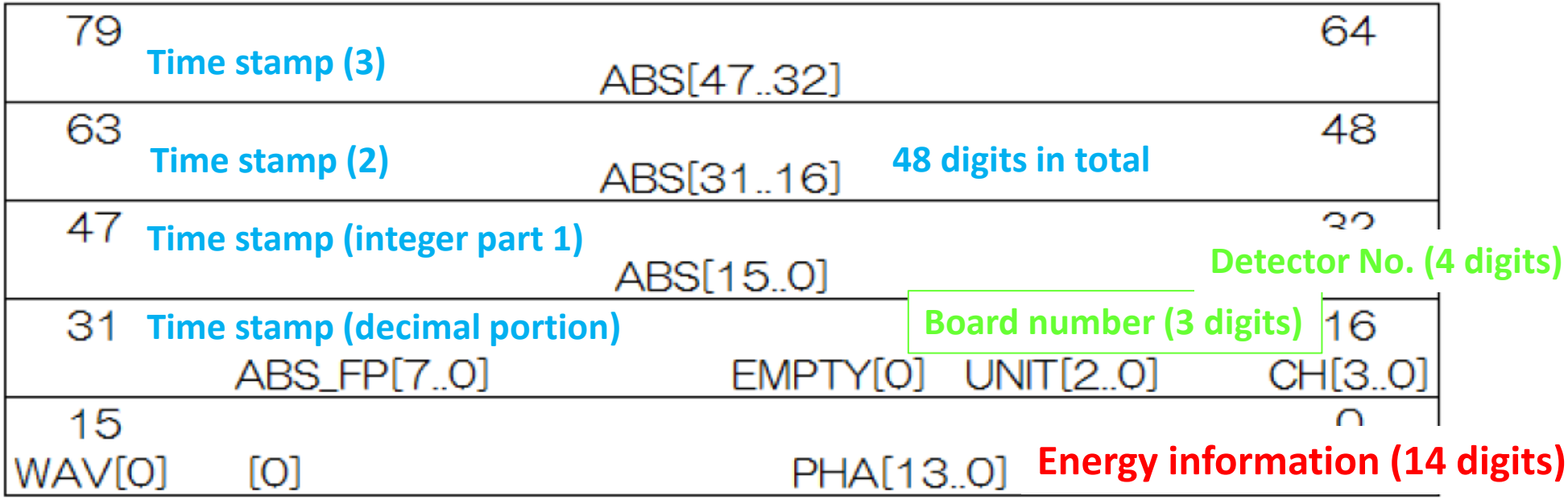
Data Acquisition Equipment - Examples of data to be acquired

Record energy and time stamps for each detector

Have the PC record the list data including information on which detector it is.

Data is expressed in binary numbers (one event is 80 binary digits)

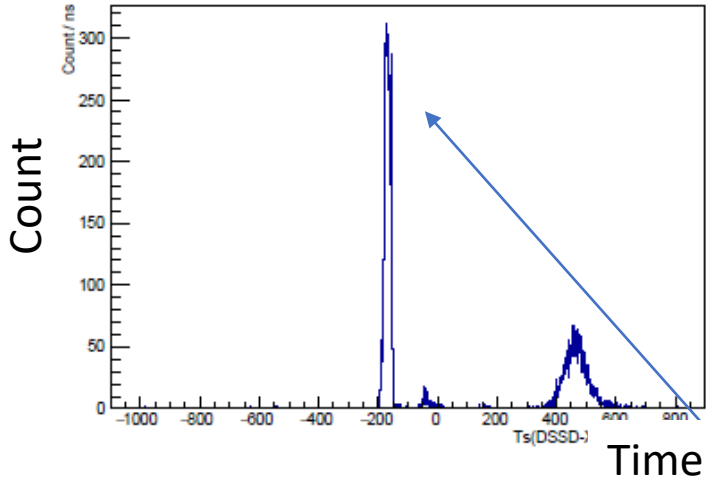
80 bits per event （10Byte、5WORD）



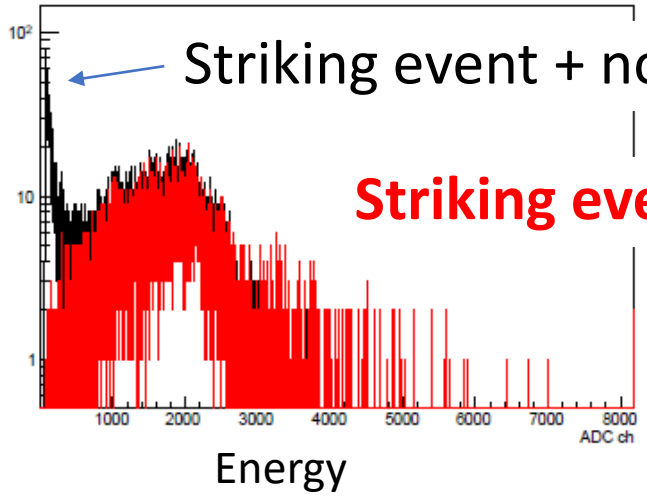
(Reading the list data is difficult, so I will omit it this time...)

Data Collection Equipment - Examples of Information Obtained

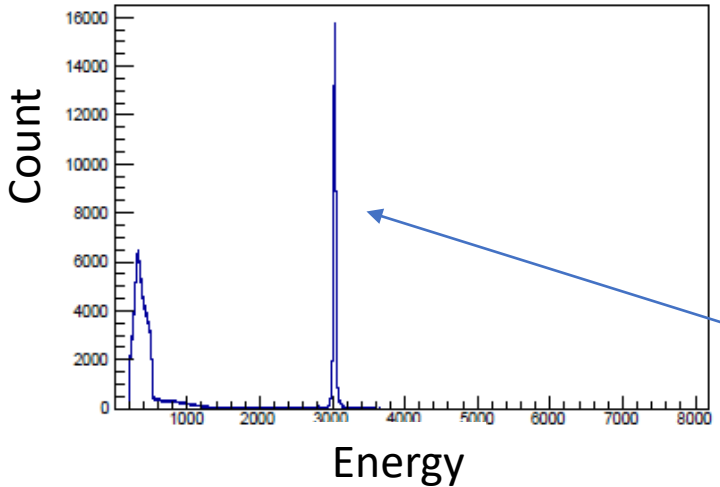
Time difference between MCP and strip detector



Wave Height Distribution of MCP



Wave height distribution of elastic scattering monitor



※ Sharp peaks strike event

Sharp peaks are elastic scattering events

Data Collection Equipment - Examples of Information Obtained

We will give you the information obtained by organizing the list data.

Striking event
(5.4 seconds after the start of measurement)

Time until alpha particles are emitted (ns)

Strip No.

The strip detector is always 1.

	A	B	C	D	E
1	TimeStamp(ns)	Mod	Ch	Adc	
2	-5394778686.56	1	9	4067	
3	180442687.66	1	9	3305	
4					
5	-5983555329.26	1	9	4216	
6	95841212.50	1	9	3600	
7					
8	-13918182010.08	1	9	3722	
9	142534564.14	1	9	3706	
10					
11	-15044722119.02	1	9	460	
12	268347222.73	1	9	3479	
13					
14	-15522956964.26	1	9	3592	
15	420321848.48	1	9	3716	

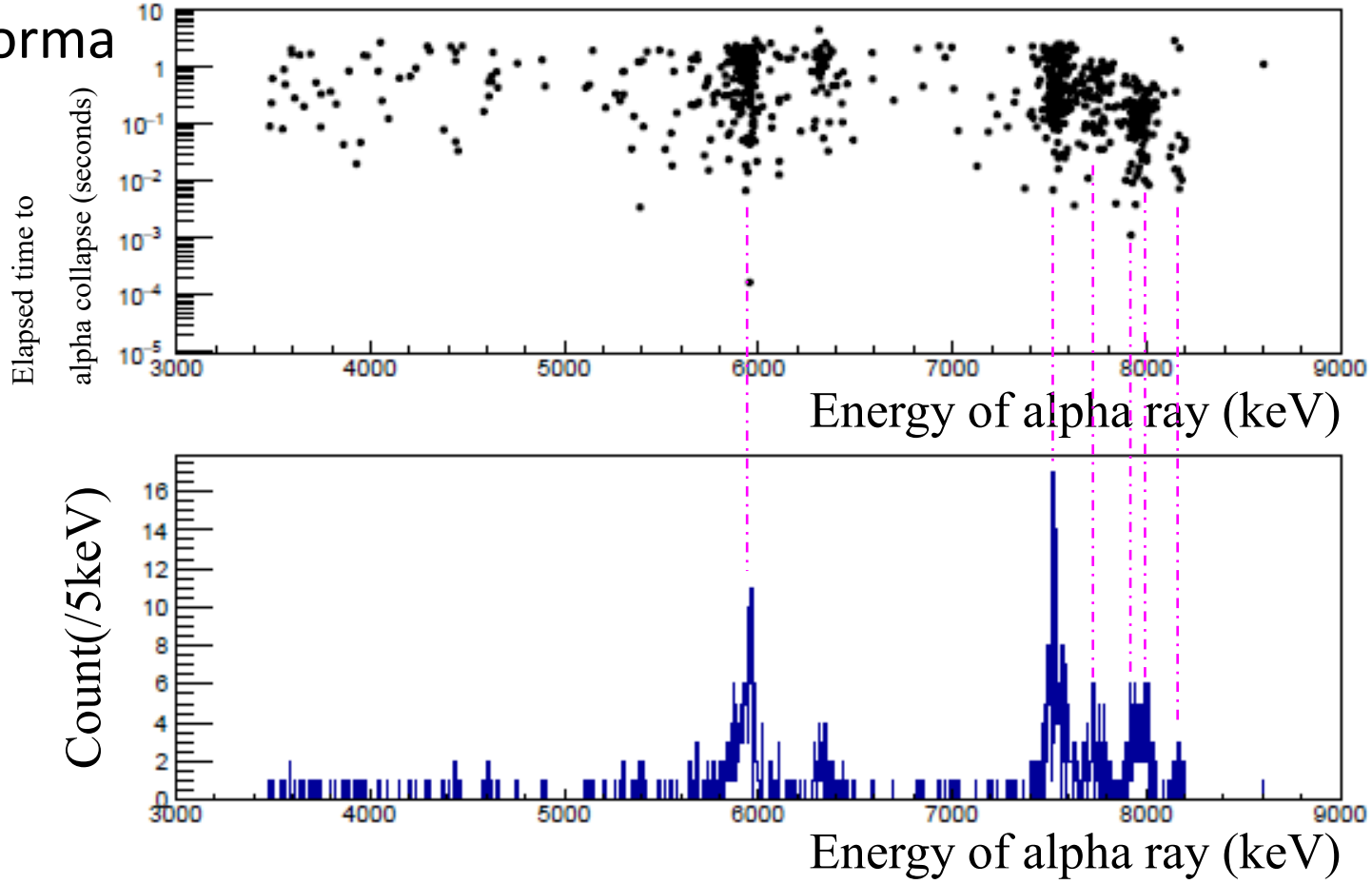
Evaporation Residual Nucleus Launch (Next event)

Evaporation Residual Nucleus Launch (Next event)

Energy Information (Digital value)

Data Acquisition Equipment - Example of Data Analysis

A good organization of the data you have given us will provide the following informa



Let's count how many nuclei of any kind were made in the actual measurement.