Real-Time Digital Signal Processors with radiation detectors produced by TechnoAP

Lunch time Exhibitor presentation

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1. Information on our new products.

2. Outline of our company (Techno AP)

1. New product information (DSP)

For several scintillation detectors

- APV8508-14 (8CH, 500MSPS, 14bit-ADC)
- APV8104-14 (4CH, 1GSPS, 14bit-ADC)
- APV8516-8 (16CH, 500MSPS, 8bit-ADC)
- APV8702-8 (2CH, 3GSPS, 8bit-ADC)

For Ge semiconductor detector, SDD, Si(Li), etc.

- APV8016(X) (16CH, 100MSPS, 14bit-ADC)

* Other models are also available.

* Our products can be customized.

1. New product information (Digitizer)

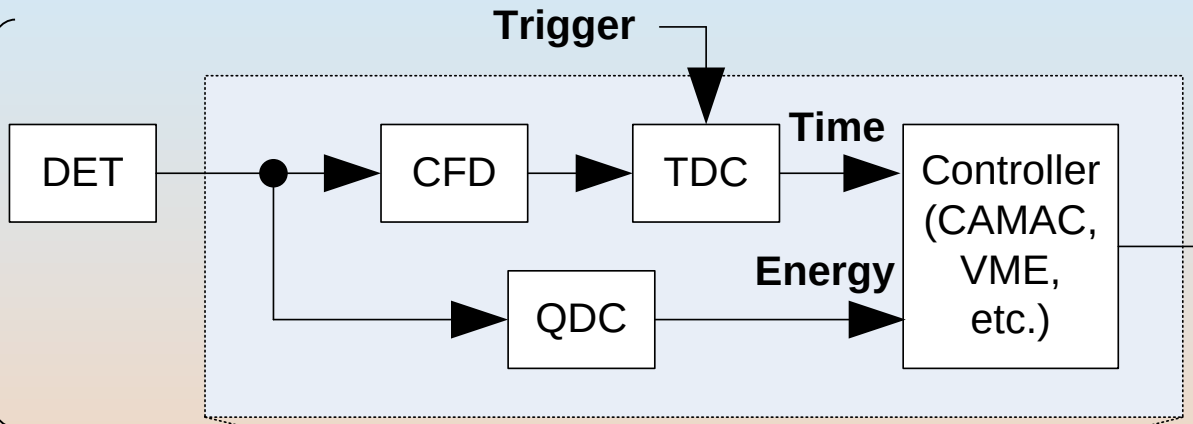
- APV7302-8 (3GSPS, 2CH, 8bit, GbEther)
- APV7104-14 (1GSPS, 4CH, 14bit, GbEther)
- APV7516-8 (500MSPS, 16CH, 8bit, GbEther)
- APV7508-14 (500MSPS, 8CH, 14bit, GbEther)

* Other models are also available.
* Our products can be customized.

APV8508-14 (8CH, 500MHz, 14bit-ADC)

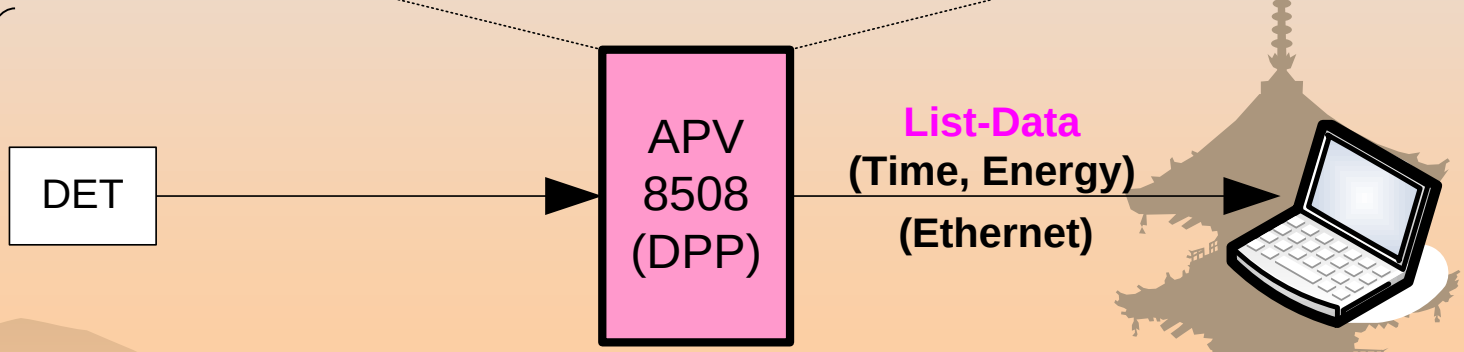
Previous method

The measurement is combination of several modules.



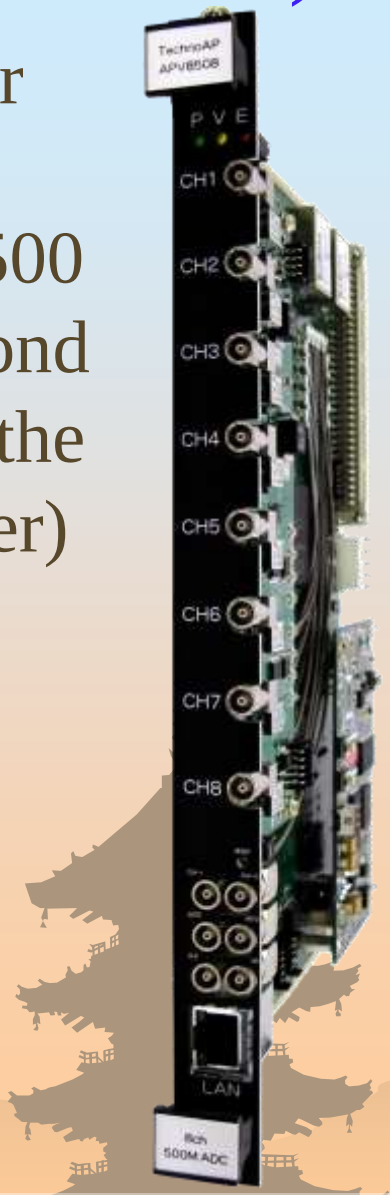
APV8508

Functions of several modules have been unified.



APV8508-14 (8CH, 500MHz, 14bit-ADC)

The APV8508-14 is a waveform analysis board for scintillation detectors. Each channel (8 CH) is equipped with high-speed, high resolution ADC (500 MHz, 14 bit). The APV8508-14 is able to correspond to the high rates of more than 100 kcps per CH in the list mode with using the Gigabit Ethernet (Gb Ether) connection.



[Functions]

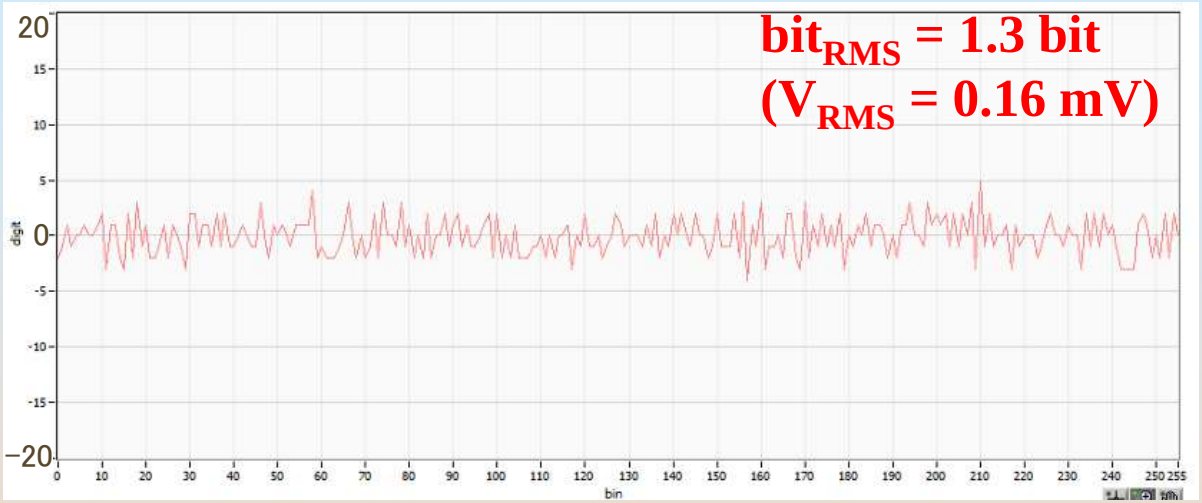
(Digital) CFD, TDC, QDC,
(Optional) Digital PSA, Digital Coincidence

[Usage Example]

The signal analysis of several high-speed scintillation detectors.

ADC Performance

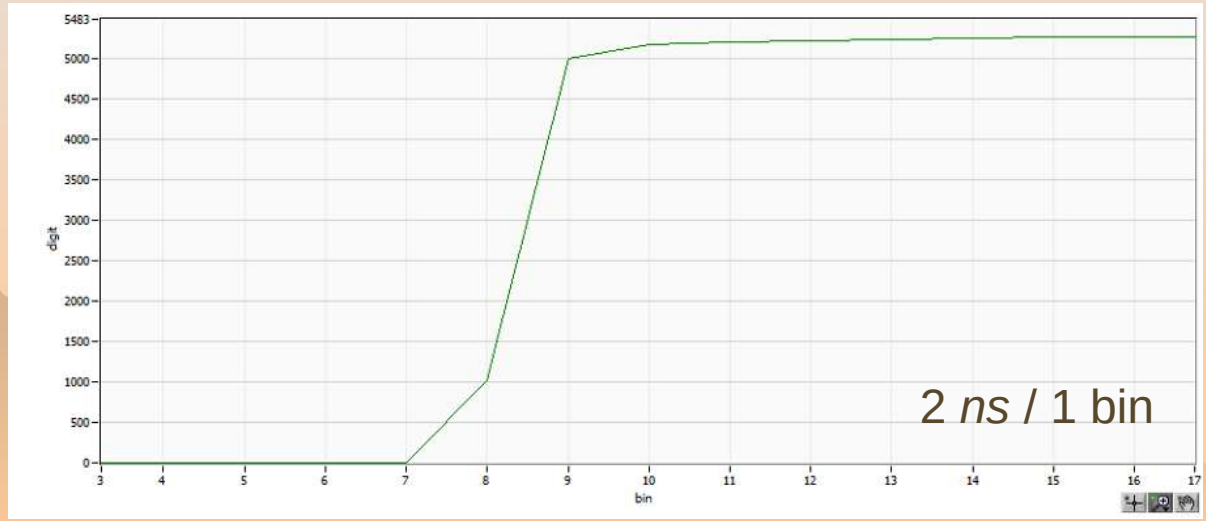
500 MSPS 14bit (APV8508-14)



$bit_{RMS} = \sqrt{((\Sigma(x_i - \bar{x})^2) / i)}$

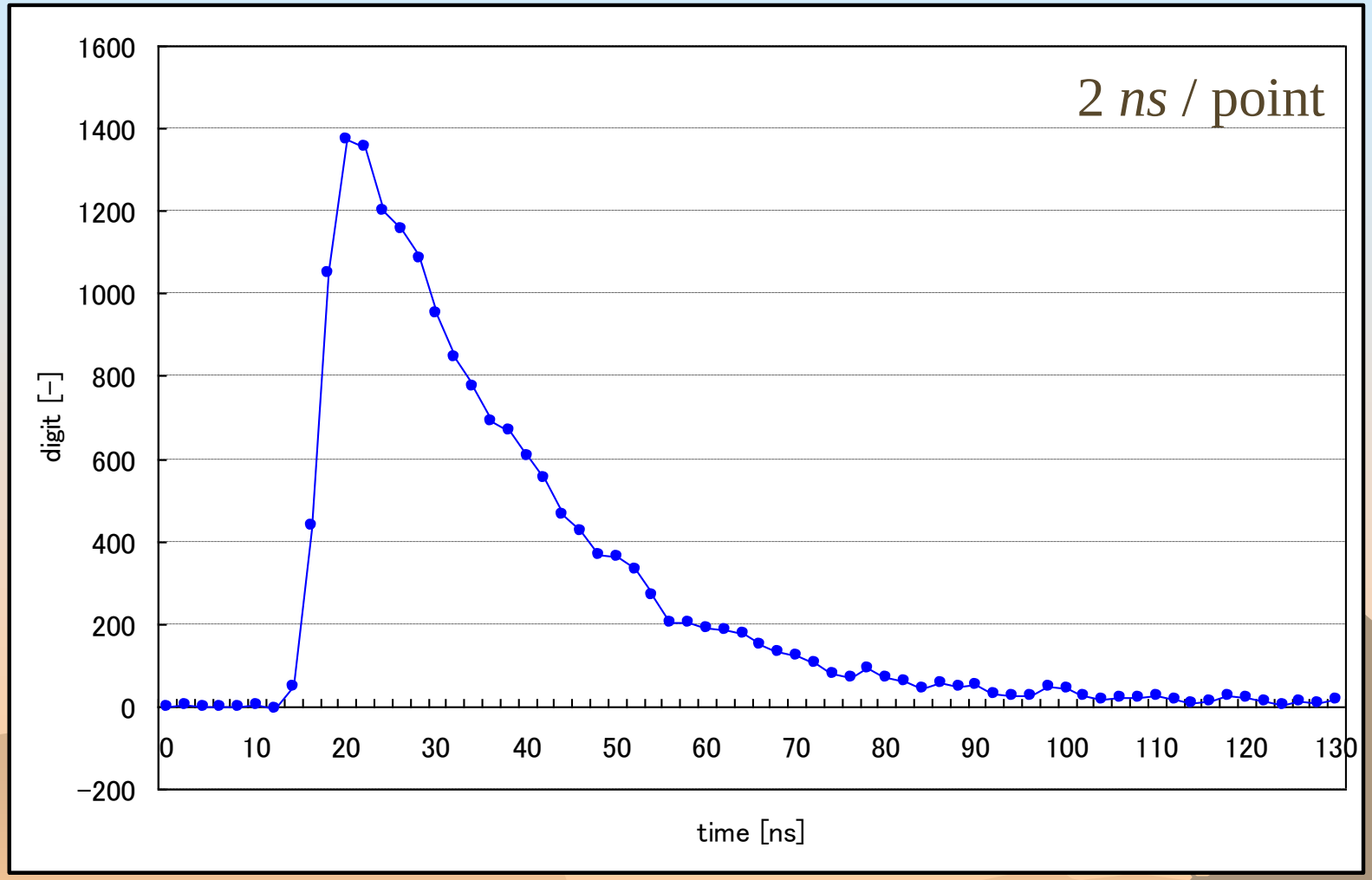
x_i : Outputted Data

$\bar{x}$: Average



APV8508-14 (8CH, 500MHz, 14bit-ADC)

Analog-to-Digital Converter



$LaBr_3$ @ 662 keV (^{137}Cs), The sampling interval is 2 *ns*.

APV8508-14 (8CH, 500MHz, 14bit-ADC)

Functions;

(Digital) CFD, TDC, QDC,

(Optional) Digital PSA, Digital Coincidence

Outputted the list data

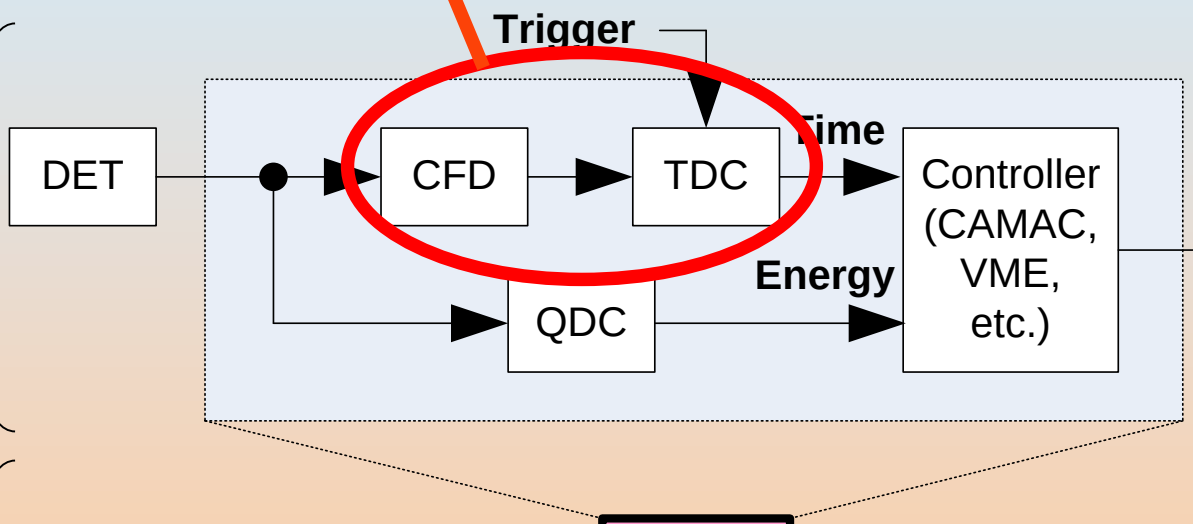
TDC[55..40]
TDC[39..24]
TDC[23..8]
TDC[7..0], TDCFP[7..0]
CH[2..0], QDC[12..0]

These data is transferred to the PC via Ethernet.

I'll explain about the APV8508 functions; CFD and the TDC.

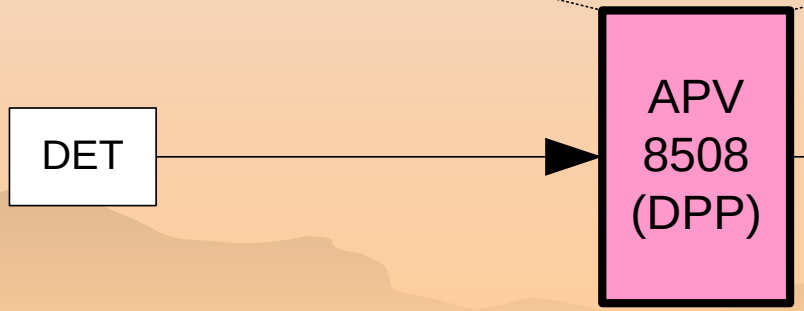
Previous method

The measurement is combination of several modules.



APV8508

Functions of several modules have been unified.



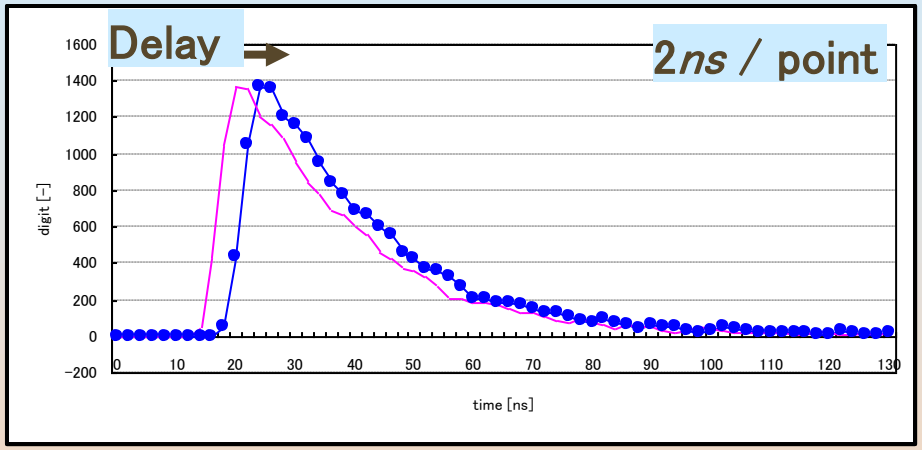
APV8508-14 (8CH, 500MHz, 14bit-ADC)

CFD and TDC

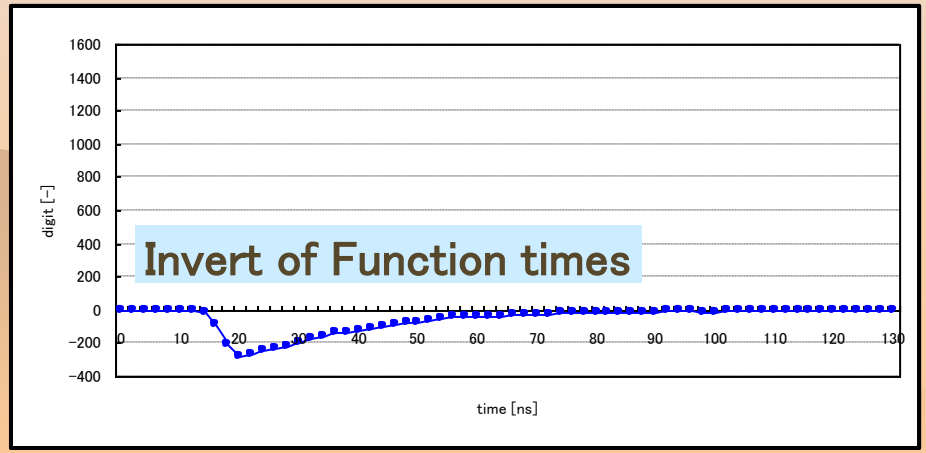
List Format

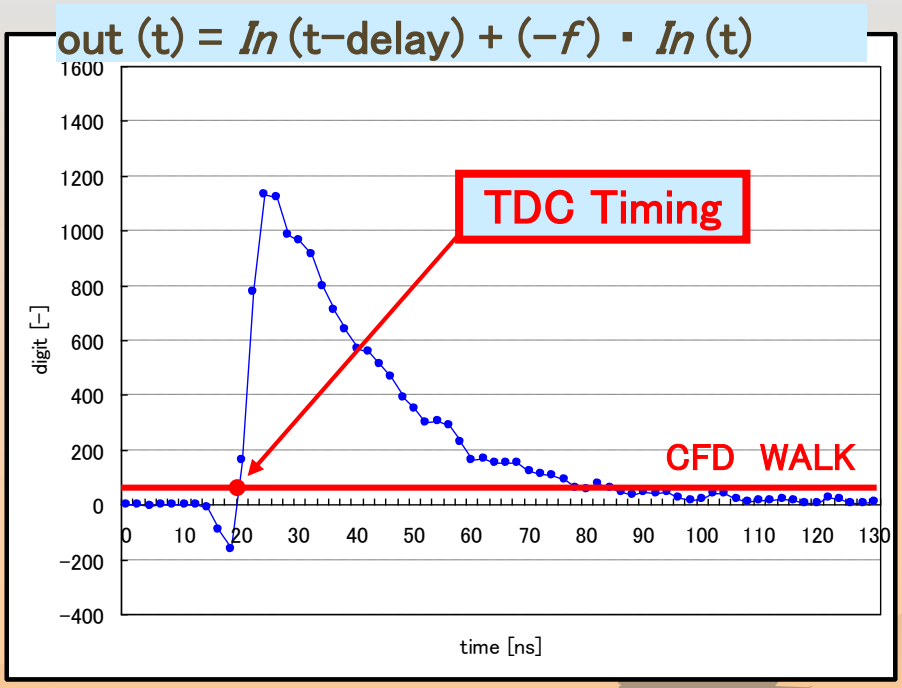
TDC[55..40]
TDC[39..24]
TDC[23..8]
TDC[7..0], TDCFP[7..0]
CH[2..0], QDC[12..0]

Time stamp timing by CFD waveform



+





APV8508-14 (8CH, 500MHz, 14bit-ADC)

CFD and TDC

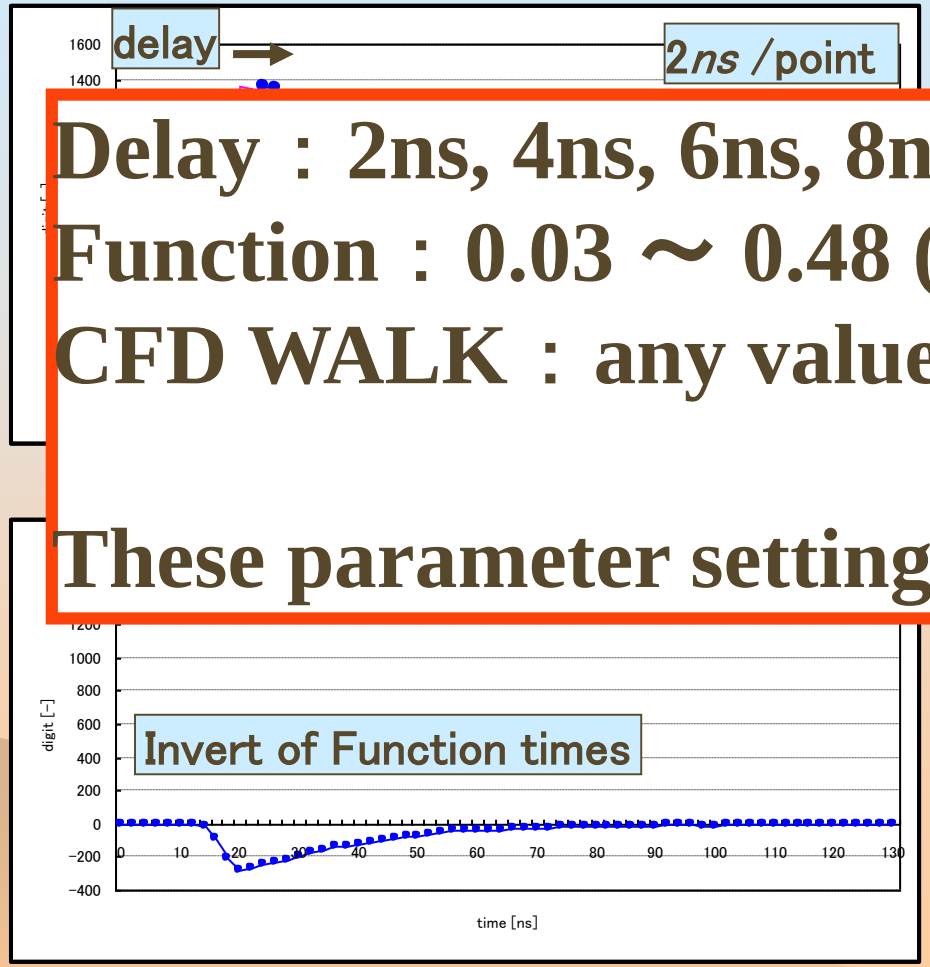
Time stamp timing by CFD waveform

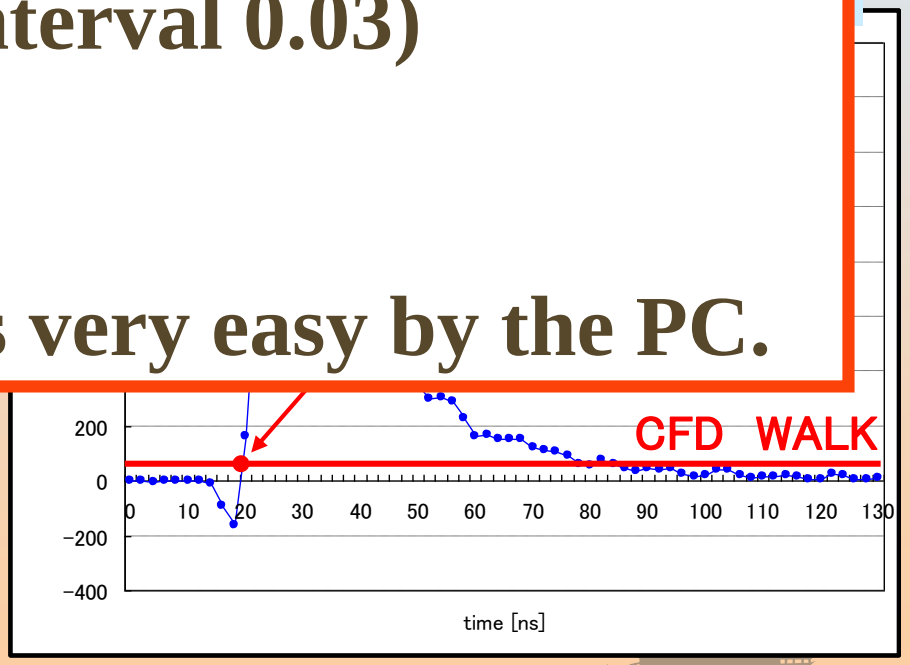
Delay : 2ns, 4ns, 6ns, 8ns, 10ns, 16ns, 22ns, 28ns

Function : 0.03 ～ 0.48 (interval 0.03)

CFD WALK : any value

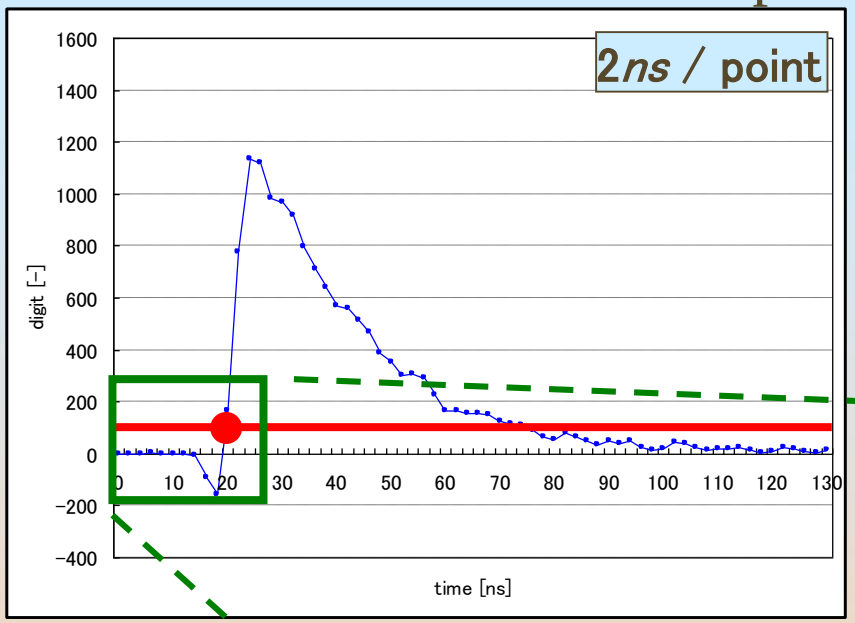
These parameter setting is very easy by the PC.





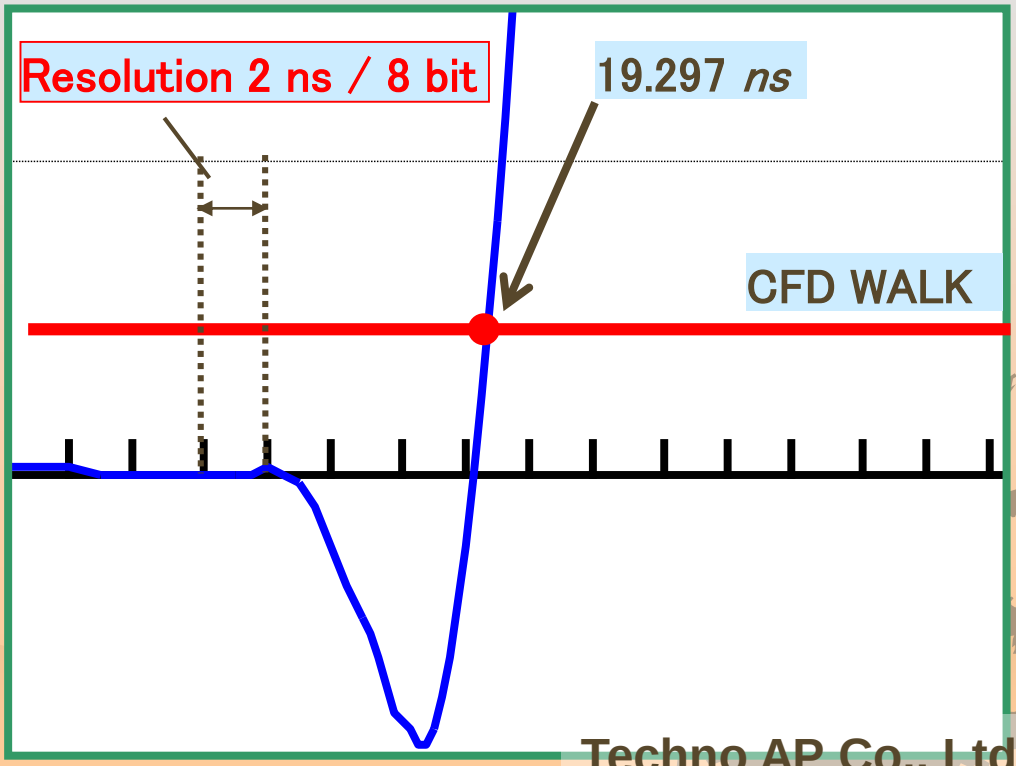
CFD and TDC

It can calculate the time stamp in less than 2 *ns*.



List Format

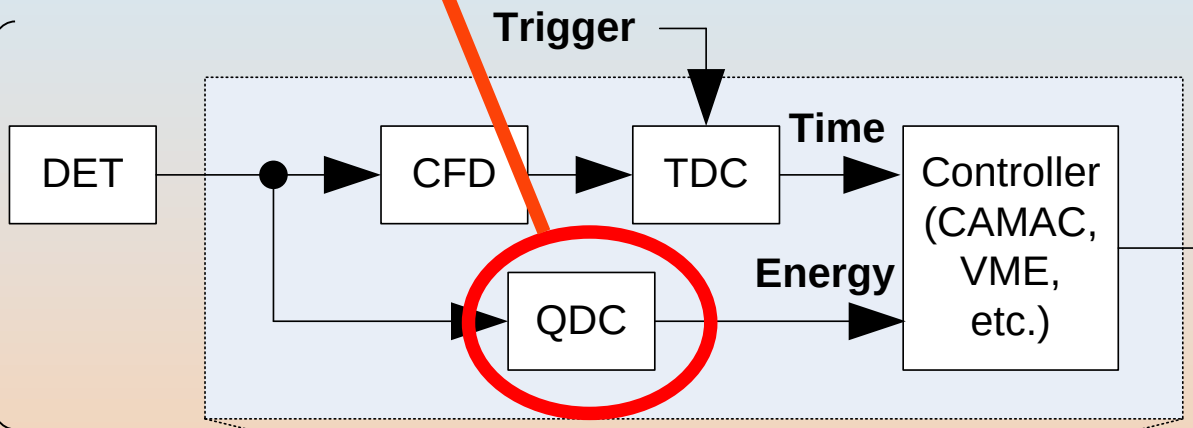
TDC[55..40]
TDC[39..24]
TDC[23..8]
TDC[7..0], **TDCFP [7..0]**
CH[2..0], QDC[12..0]



I'll explain about the APV8508 function; QDC.

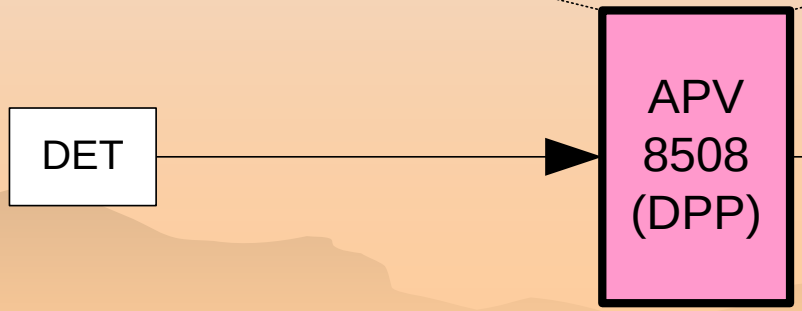
Previous method

The measurement is combination of several modules.



APV8508

Functions of several modules have been unified.

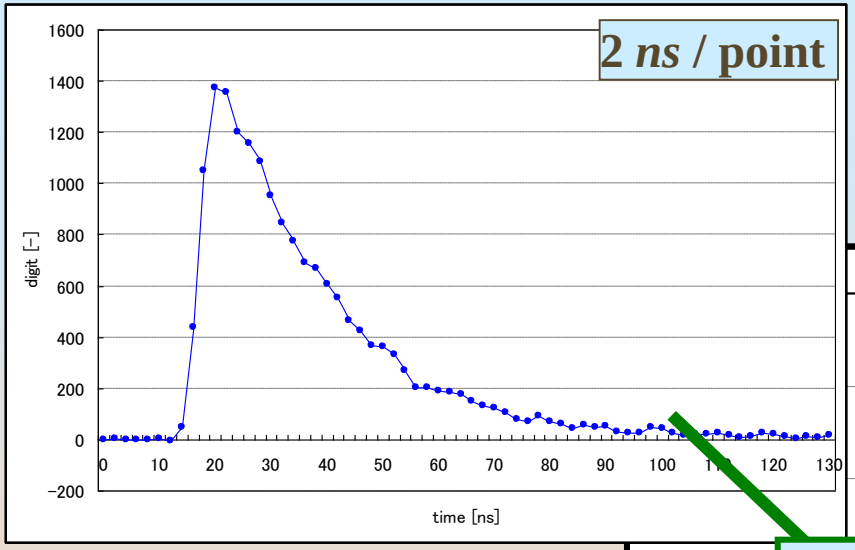


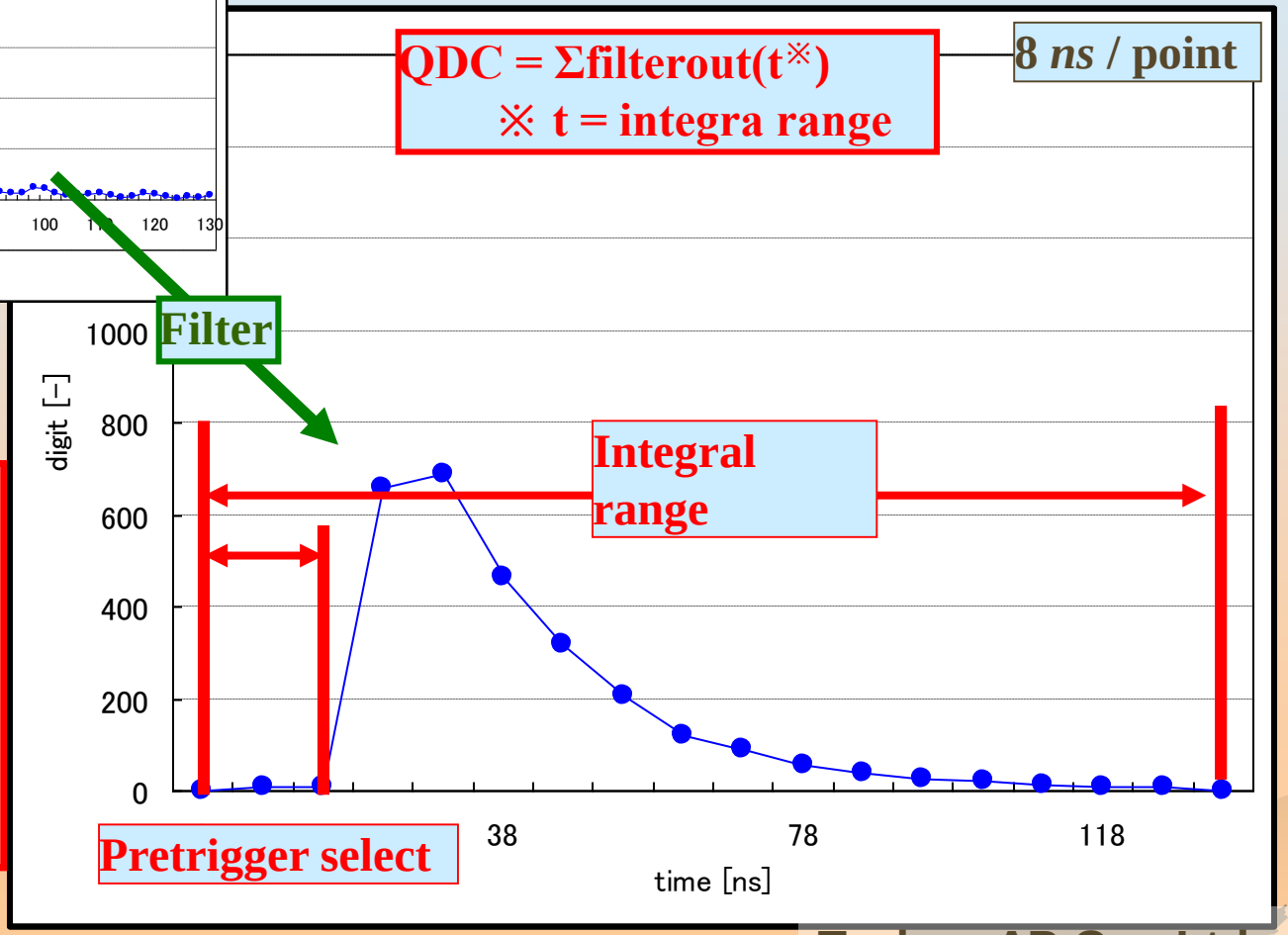
QDC (Charge to Digital Converter)

QDC : Integral Mode

List Format

TDC[55..40]
TDC[39..24]
TDC[23..8]
TDC[7..0], TDCFP[7..0]
CH[2..0], **QDC[12..0]**





Setting;
Pretrigger sel :
-8ns, -16ns, -24ns, -32ns, -40ns

Integral range :
0ns ～ 32 μs (8ns interval)

Filter :
Ext, 8ns, 16ns, 24ns, 32ns, 48ns, 64ns

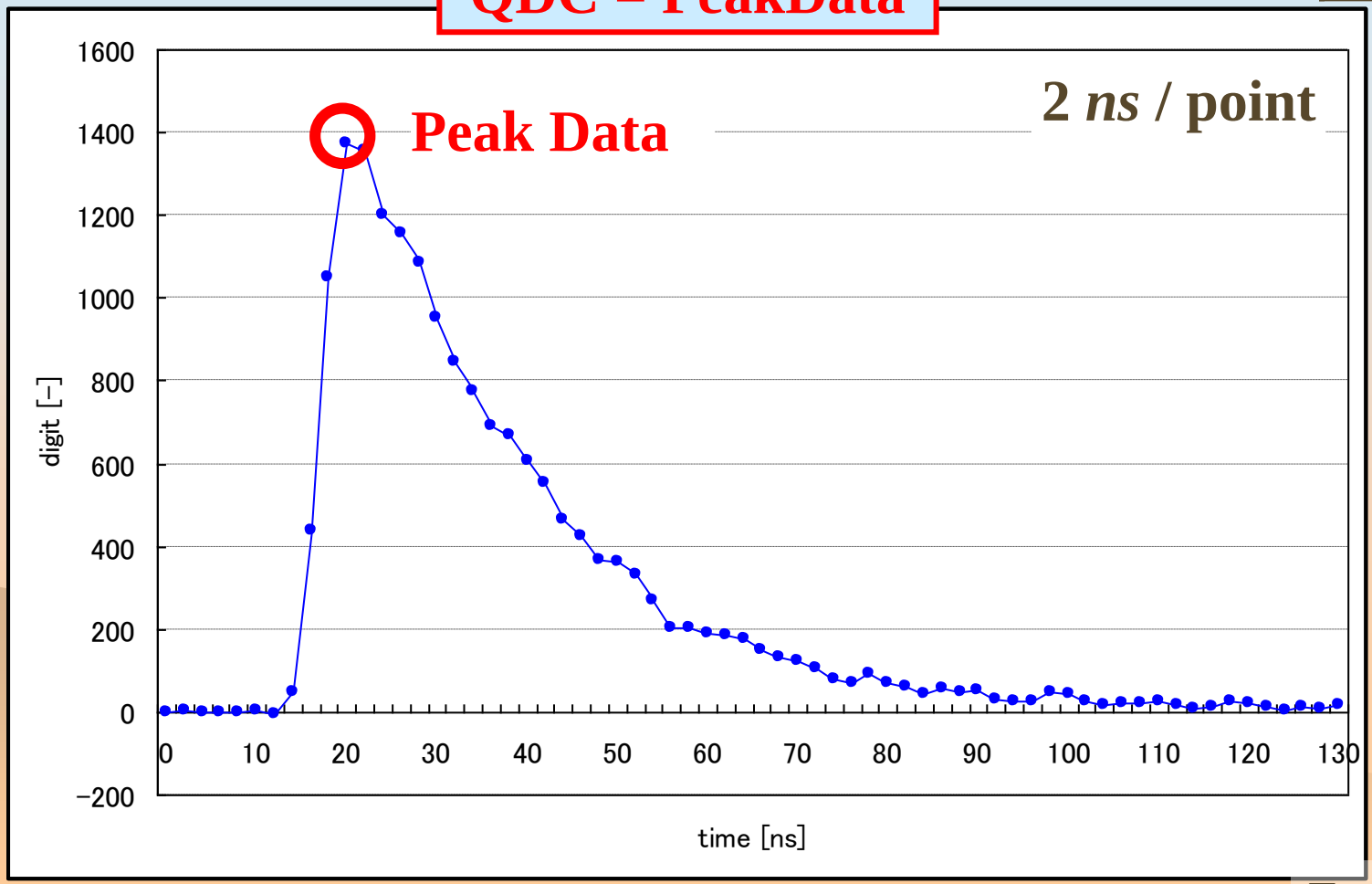
QDC (Charge to Digital Converter)

QDC : Peak Mode

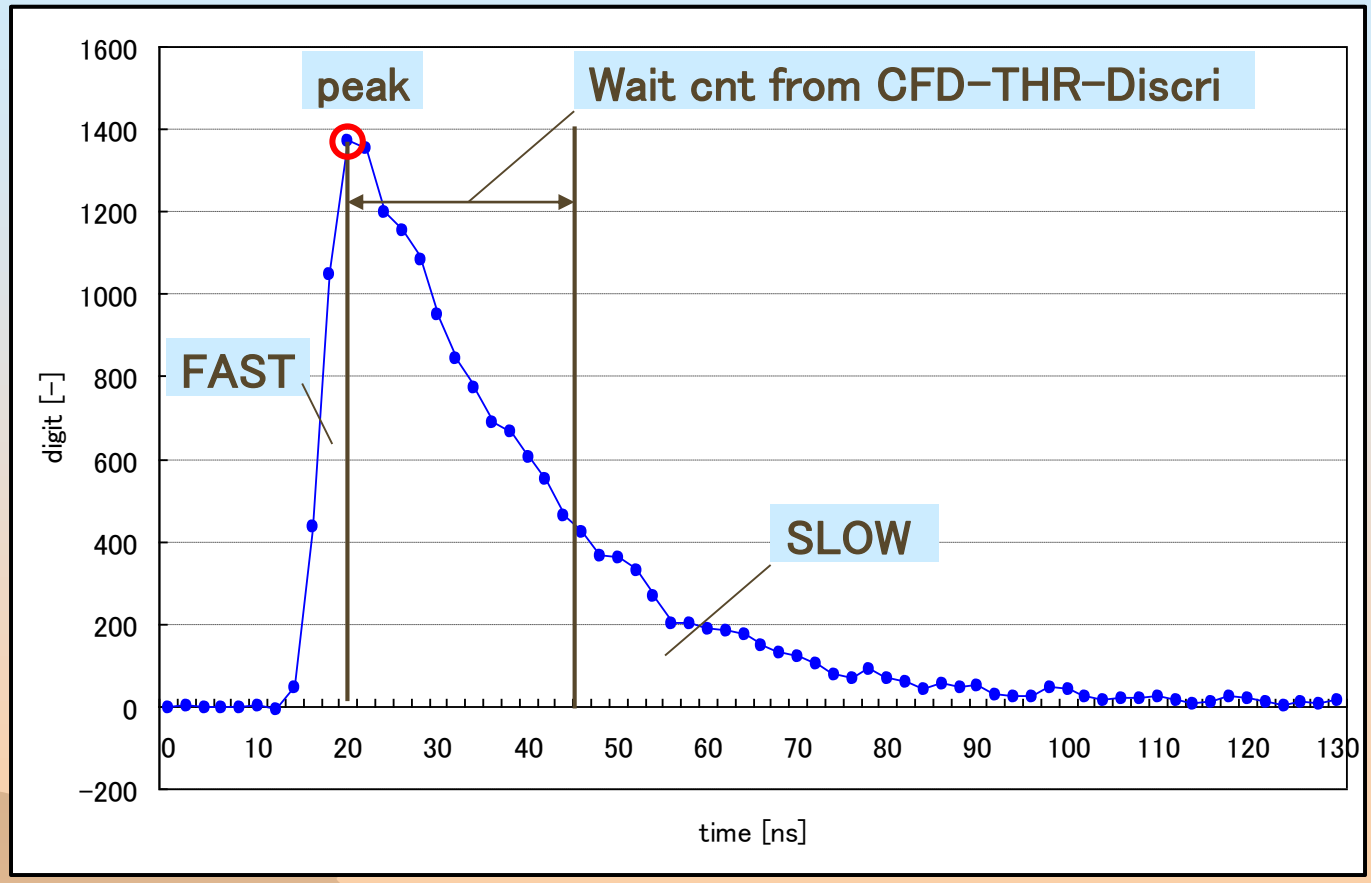
List Format

TDC[55..40]
TDC[39..24]
TDC[23..8]
TDC[7..0], TDCFP[7..0]
CH[2..0], **QDC[12..0]**

QDC = PeakData



PSA (Pulse Shape Analysis)



List Format

PSA FAST[12..0]※option
PSA SLOW[12..0]※option
TDC[55..40]
TDC[39..24]
TDC[23..8]
TDC[7..0], TDCFP[7..0]
CH[2..0], QDC[12..0]

APV8508-14 (8CH, 500MHz, 14bit-ADC)

Summary 1

1. The APV8508 is a multichannel, 8 CH.
2. The APV8508 has the multifunction, such as CFD, TDC, QDC etc.
3. The APV8508 can also measure a high-count rate.
4. The APV8508 is using the Gigabit Ethernet (GbEther).

APV8508-14 (8CH, 500MHz, 14bit-ADC)

Summary 2

5. The APV8508 can display the waveform on the PC. Therefore, the user is able to set very easily, such as the threshold and WALK etc.
6. The APV8508 can save a waveform. Therefore, the user can analyze the data.
7. The APV8508 can hold a time information at a long time in the LIST mode.
   (This was impossible to do with the previous TAC and TDC functions.)

APV8104-14 (4CH, 1GSPS, 14bit-ADC)

The APV8104-14 is a waveform analysis board. Each channel (4 CH) is equipped with ADC (1 GHz, 14 bit). The characteristic of this board is using a 1 GHz, 14 bit ADC. The APV8104 is able to correspond to the high rates of more than 100 kcps per CH in the list mode with using the Gigabit Ethernet (Gb Ether) connection.

Functions;

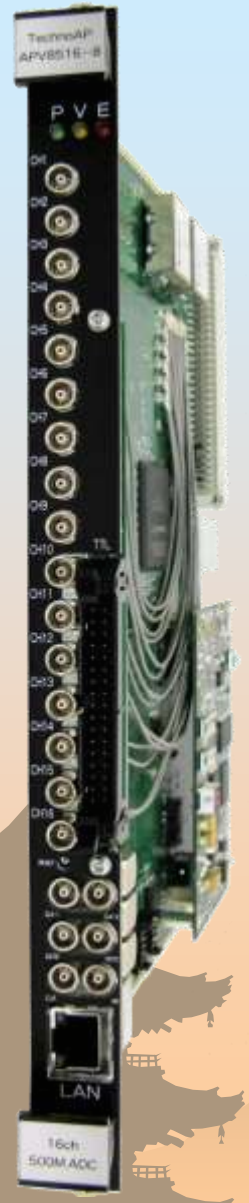
(Digital) CFD, TDC, QDC,
(Optional) Digital PSA, Digital Coincidence

Usage Example：

The signal analysis of several high-speed scintillation detectors.

APV8516-8 (16CH, 500MSPS, 8bit-ADC)

The APV8516-8 is a waveform analysis board. The characteristic of this board is 16 CH. Each channel (16 CH) is equipped with ADC (500 MHz, 8 bit). The APV8516-8 is able to correspond to the high rates of more than 100 kcps per CH in the list mode with using the Gigabit Ethernet (Gb Ether) connection.



Functions;

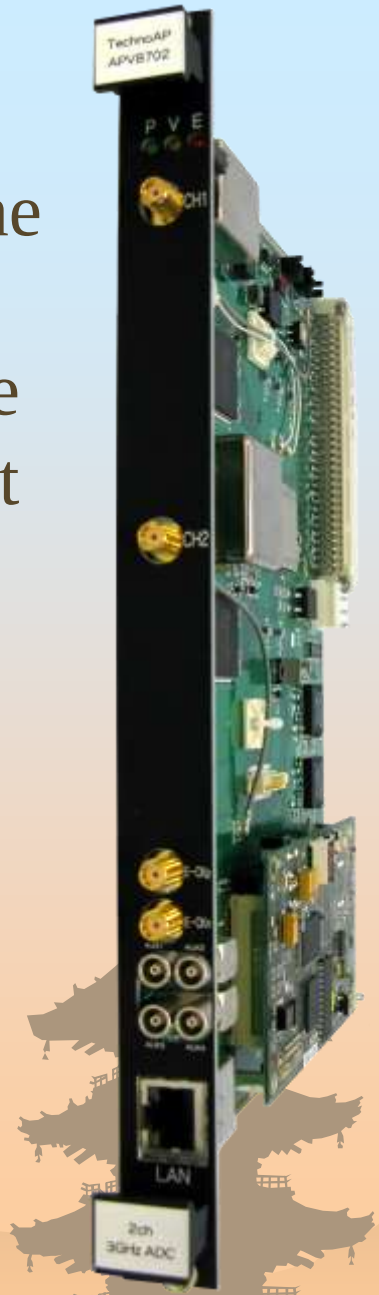
(Digital) CFD, TDC, QDC,
(Optional) Digital PSA, Digital Coincidence

Usage Example：

The signal analysis of several high-speed scintillation detectors.

APV8702-8 (2CH, 3GSPS, 8bit-ADC)

The APV8702-8 is a waveform analysis board. The characteristic of this board is using 3 GSPS, 8 bit-ADC. The APV8702-8 is able to correspond to the high rates of more than 100 kcps per CH in the list mode with using the Gigabit Ethernet (Gb Ether) connection.



Functions;

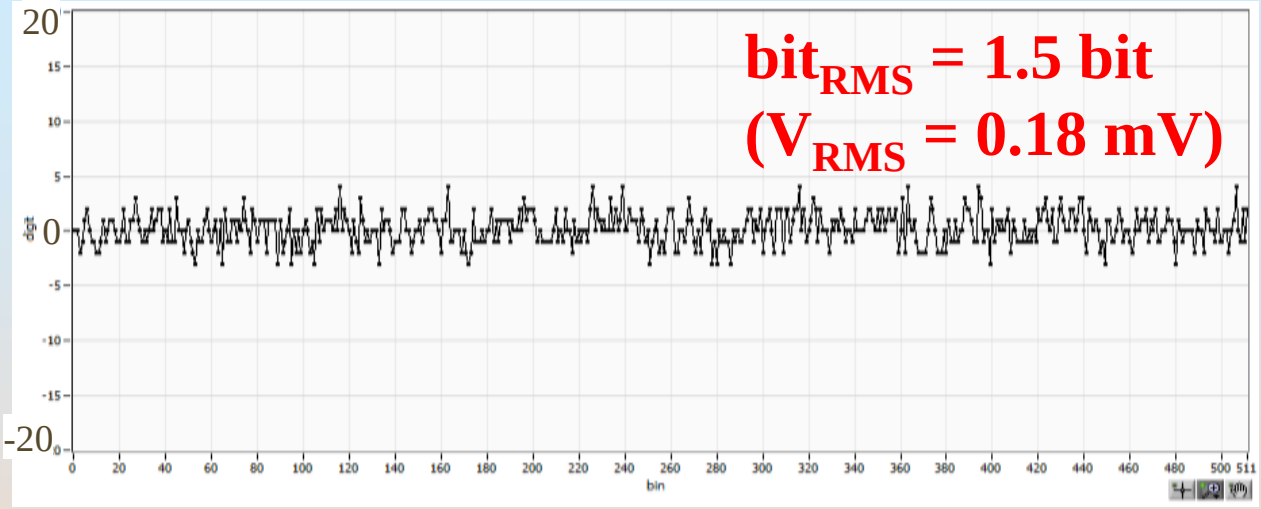
(Digital) CFD, TDC, QDC,
(Optional) Digital PSA, Digital Coincidence

Usage Example：

The signal analysis of several high-speed scintillation detectors.

ADC Performance (APV8104)

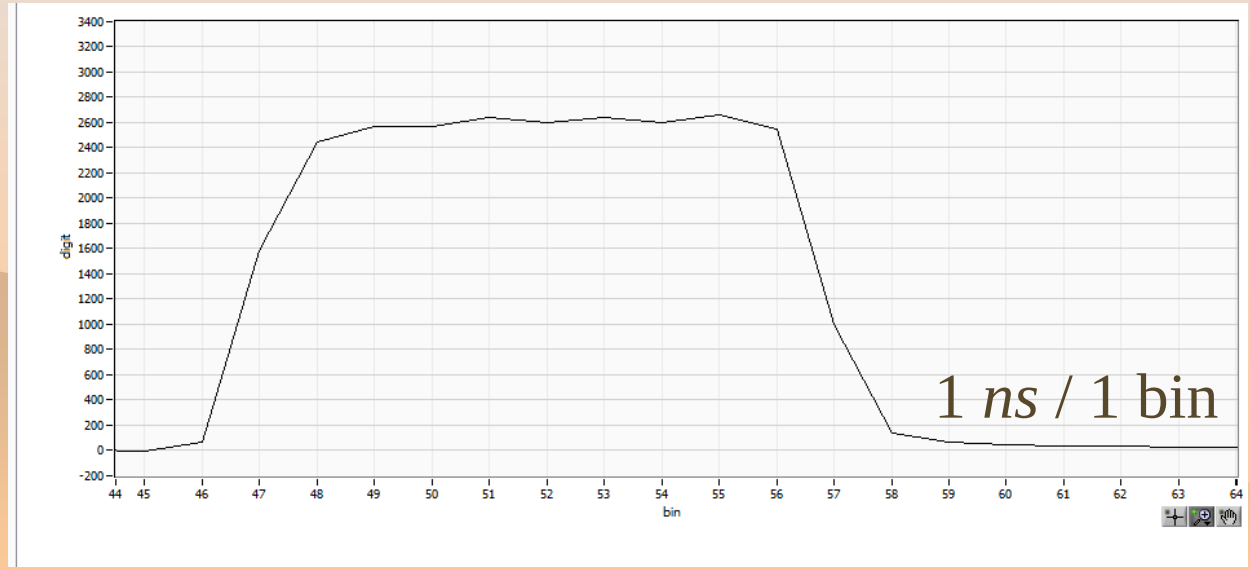
1 GSPS 14bit



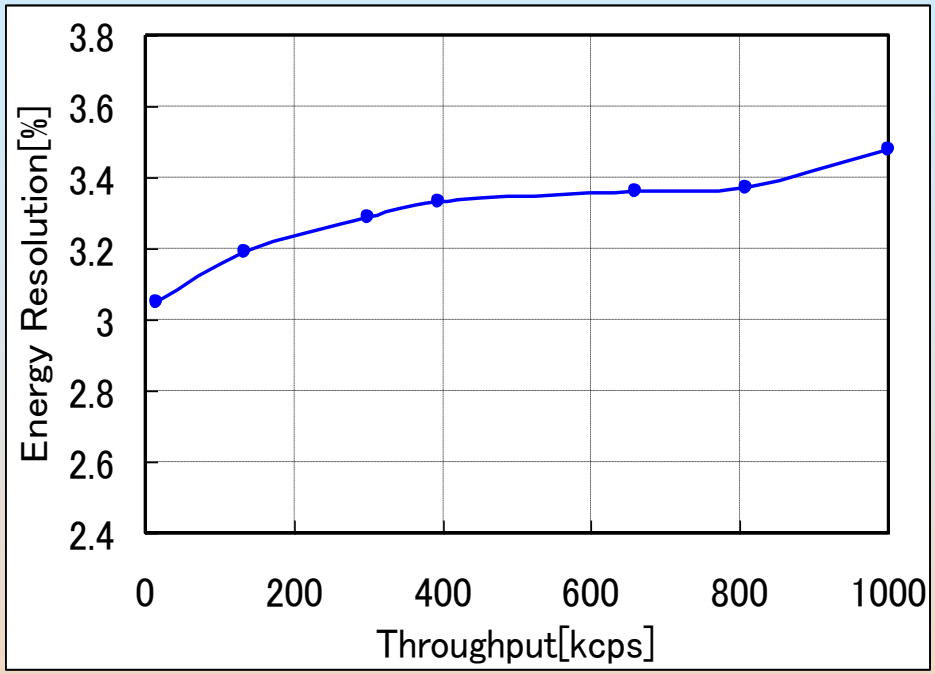
$$bit_{RMS} = \sqrt{(\Sigma(x_i - \overline{x})^{2/i})}$$

x_i : Outputted Data

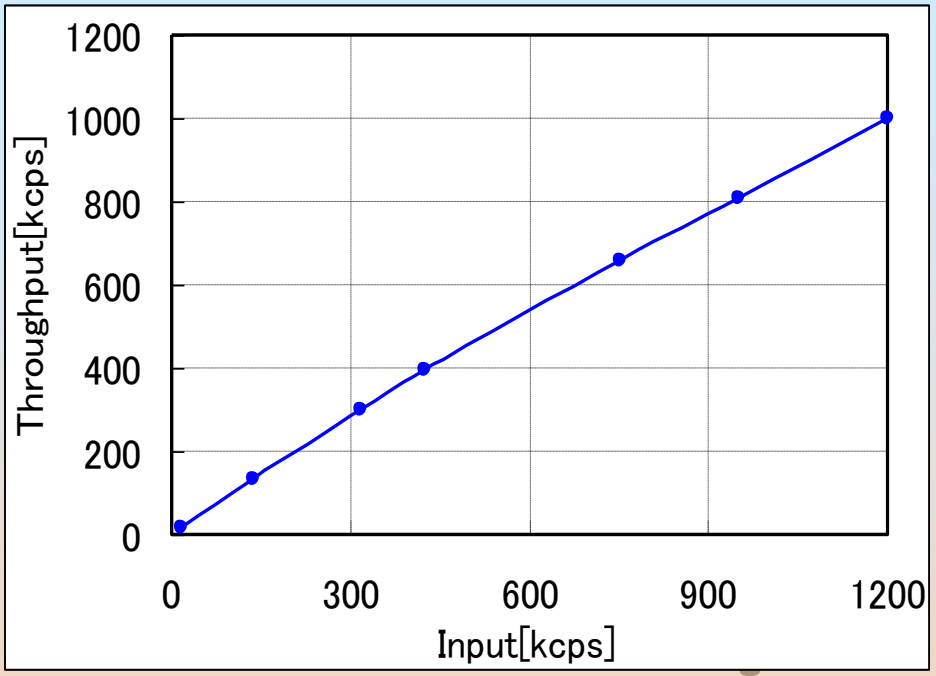
$\overline{x}$: Average



Energy Resolution and Throughput (APV8104)



Throughput vs Energy resolution



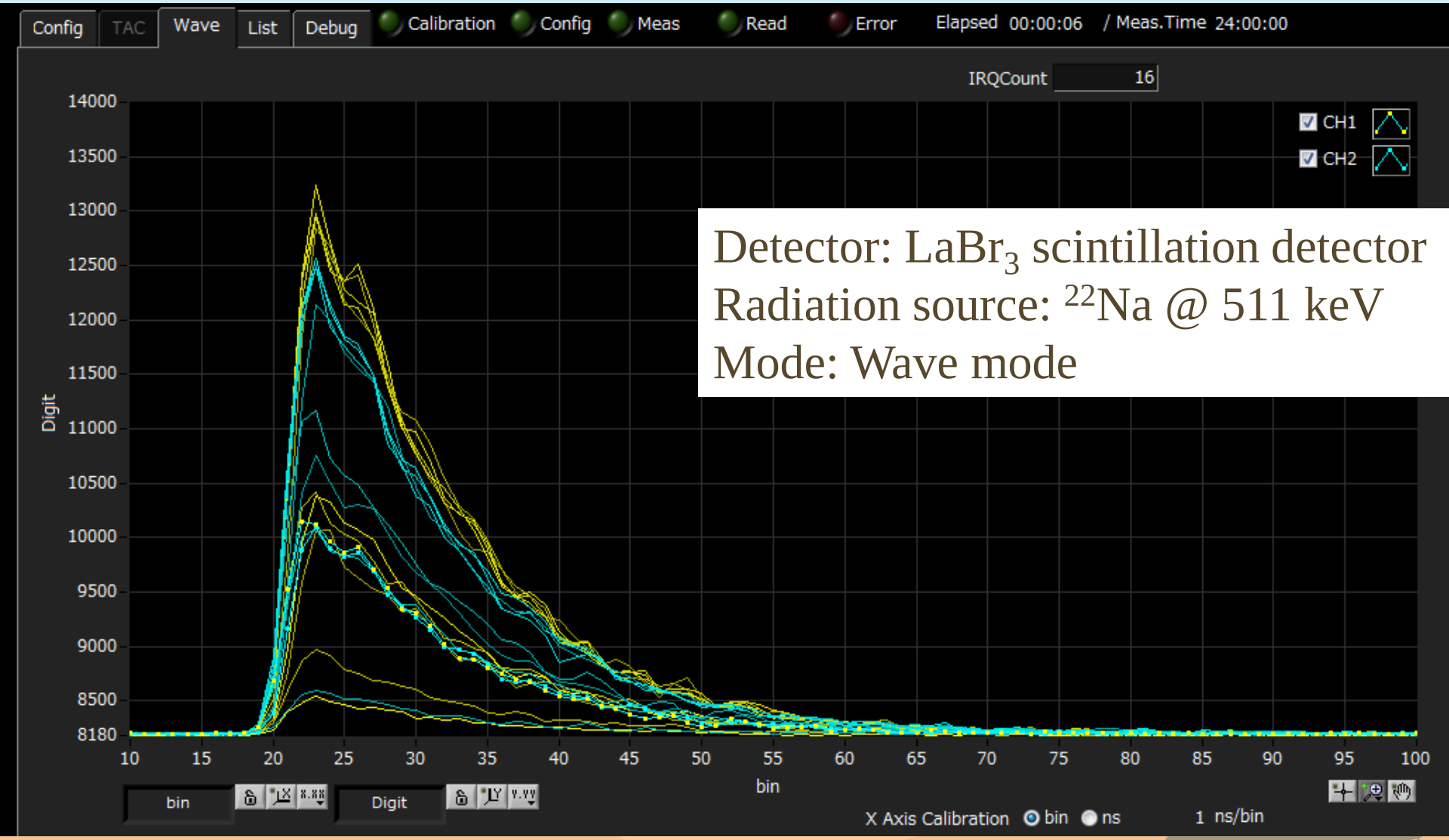
Input vs Throughput

Detector: $LaBr_3$ scintillation detector

Radiation source: ^{137}Cs (10 MBq), ^{60}Co (2 MBq)

Usage Examples

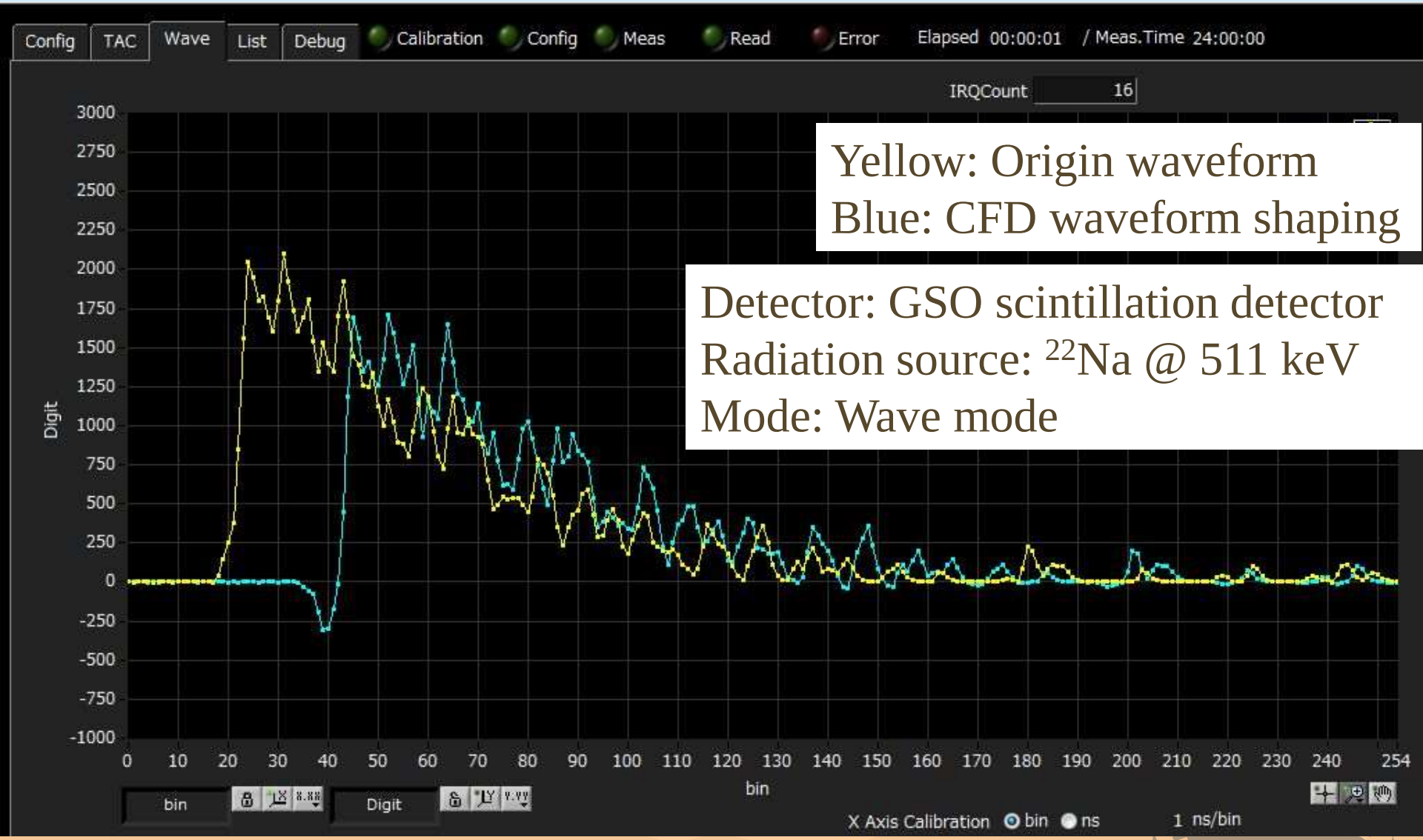
APV8508-14 (8CH, 500MHz, 14bit-ADC)



Detector: $LaBr_3$ scintillation detector
Radiation source: ^{22}Na @ 511 keV
Mode: Wave mode

Inputted waveform can confirm on the PC.

APV8508-14 (8CH, 500MHz, 14bit-ADC)

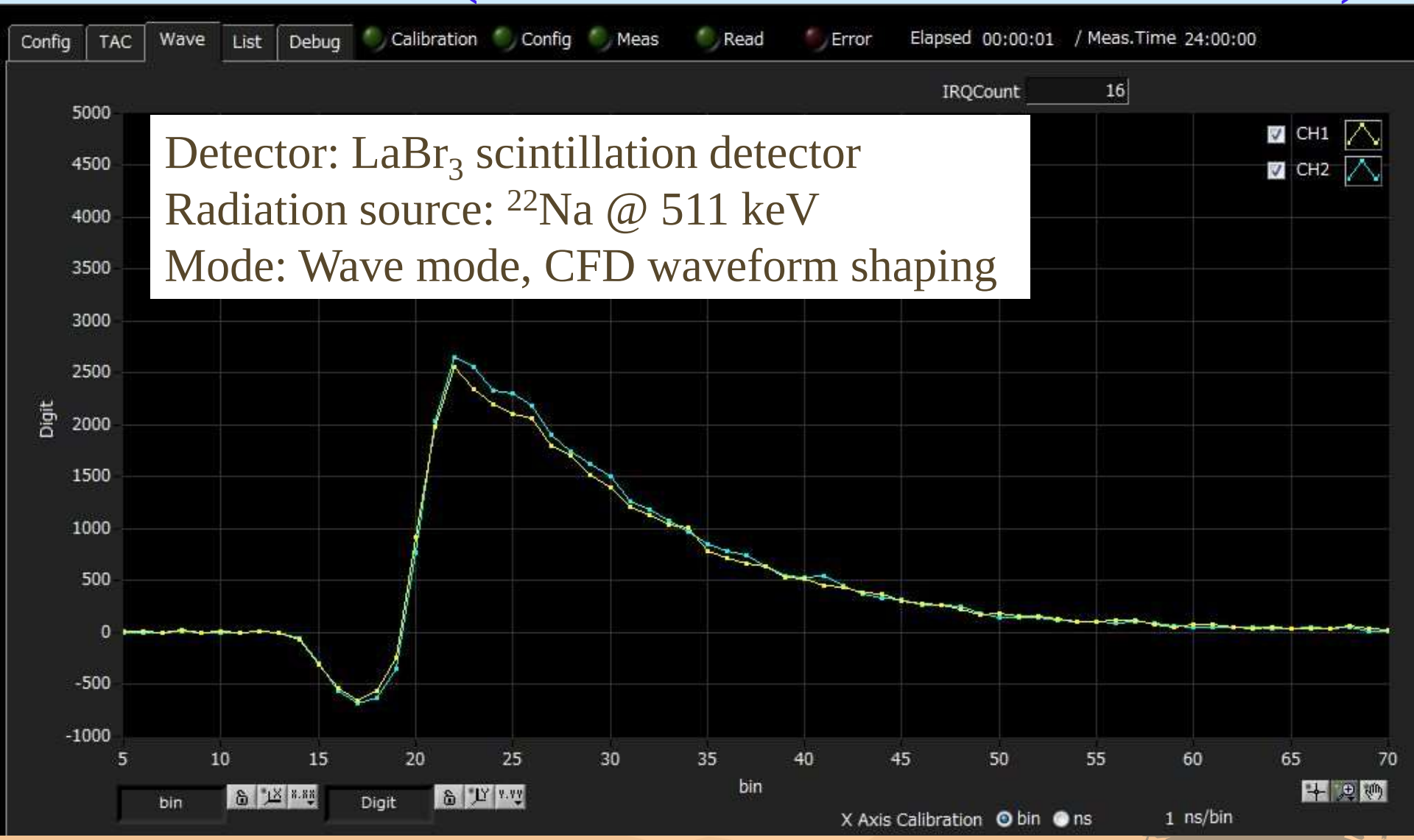


Yellow: Origin waveform
Blue: CFD waveform shaping

Detector: GSO scintillation detector
Radiation source: ^{22}Na @ 511 keV
Mode: Wave mode

It can measure early rise time and characteristic fall time like the $LaBr_3$ detector.

APV8508-14 (8CH, 500MHz, 14bit-ADC)



Detector: $LaBr_3$ scintillation detector
Radiation source: ^{22}Na @ 511 keV
Mode: Wave mode, CFD waveform shaping

You can check the CFD waveform shaping.

APV8508-14 (8CH, 500MHz, 14bit-ADC)

List data

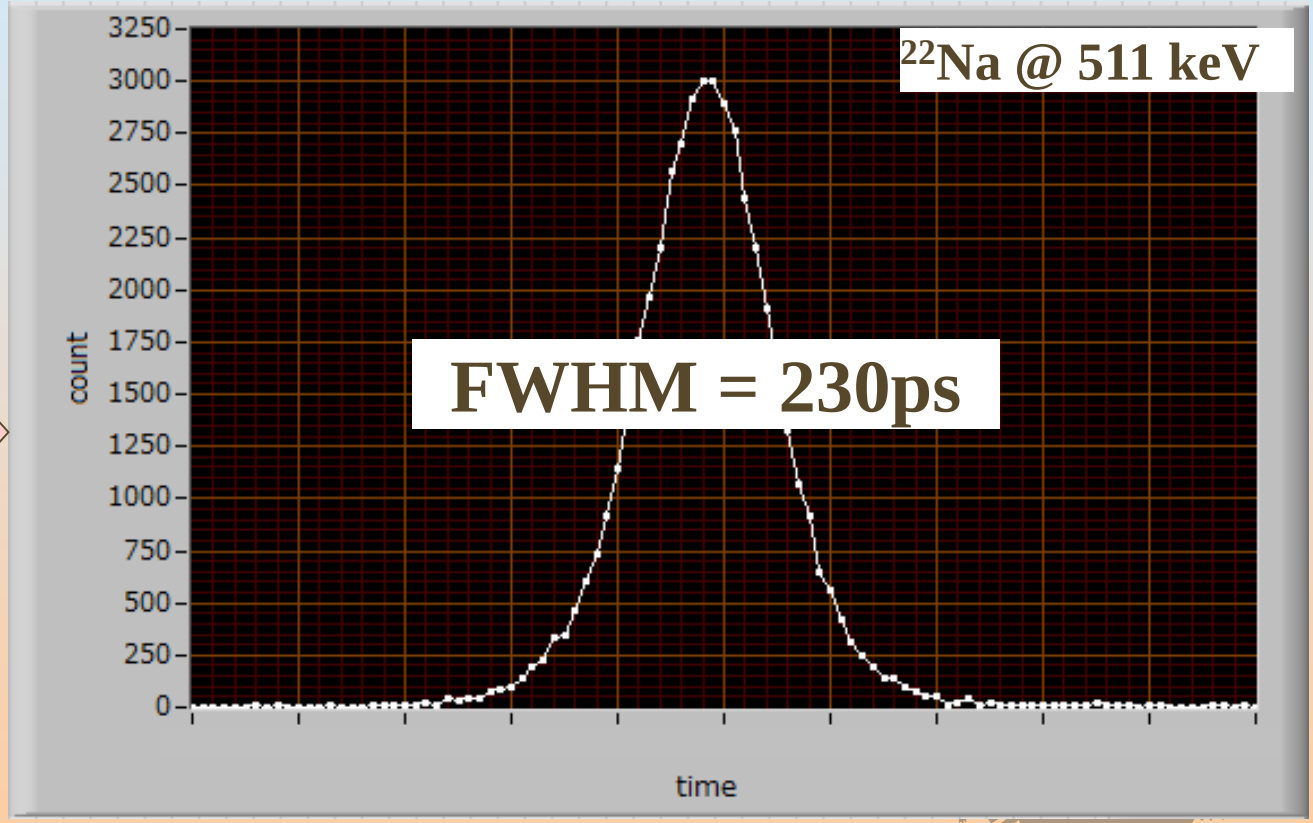
TDC[55..0]

5687407143
5687452095
5687512849
5687829373
5687914953
5687918551
5687954008

TDCFP[7..0]

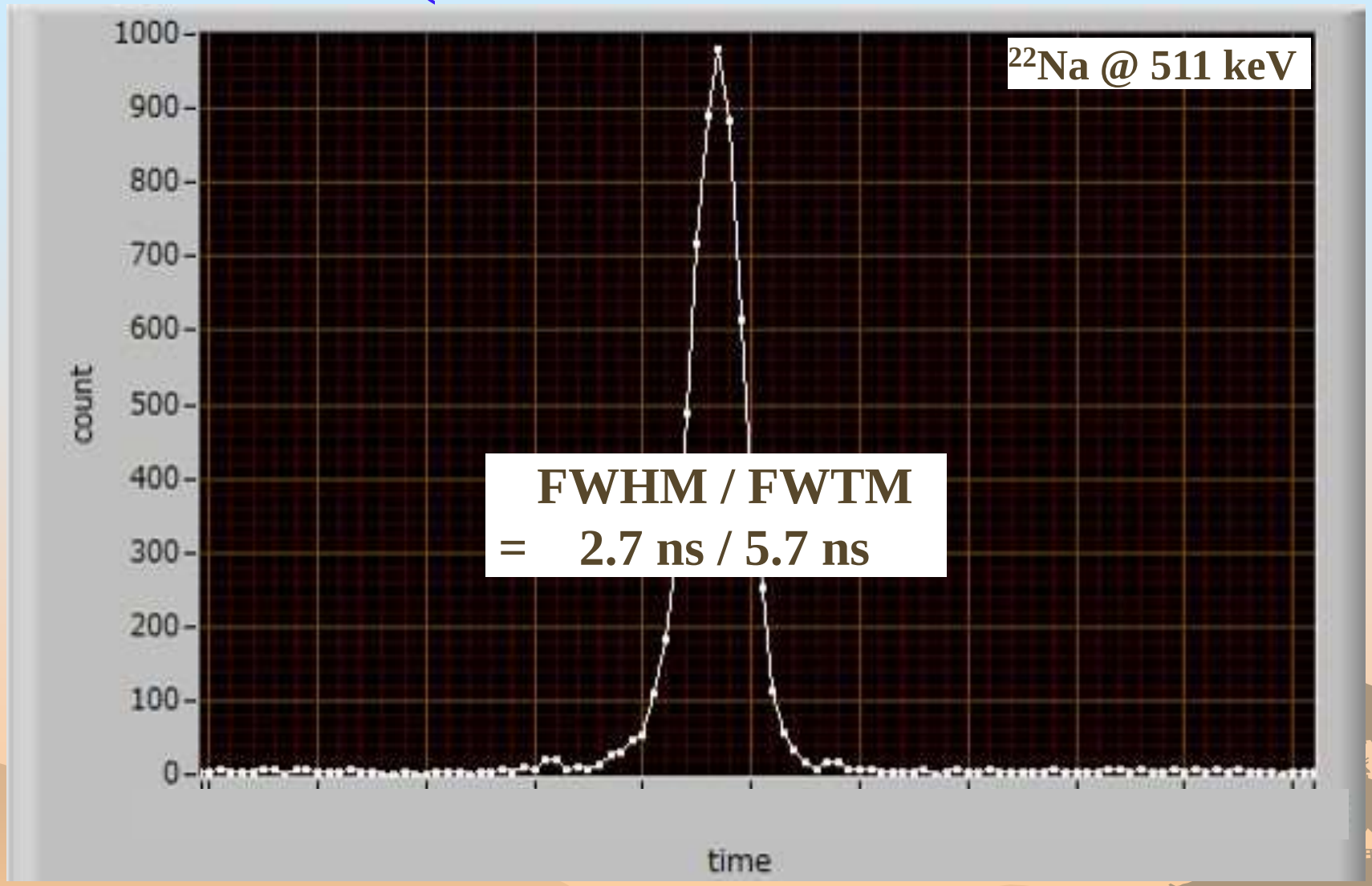
146
206
124
182
46
40
190

Inputted TDC of 2 CH is used to the measurement of time resolution.



$LaBr_3(Ce)$ scintillation detector
vs $LaBr_3(Ce)$ scintillation detector

APV8508-14 (8CH, 500MHz, 14bit-ADC)



The time resolution of the GSO scintillation detector

APV8508-14 (8CH, 500MHz, 14bit-ADC)

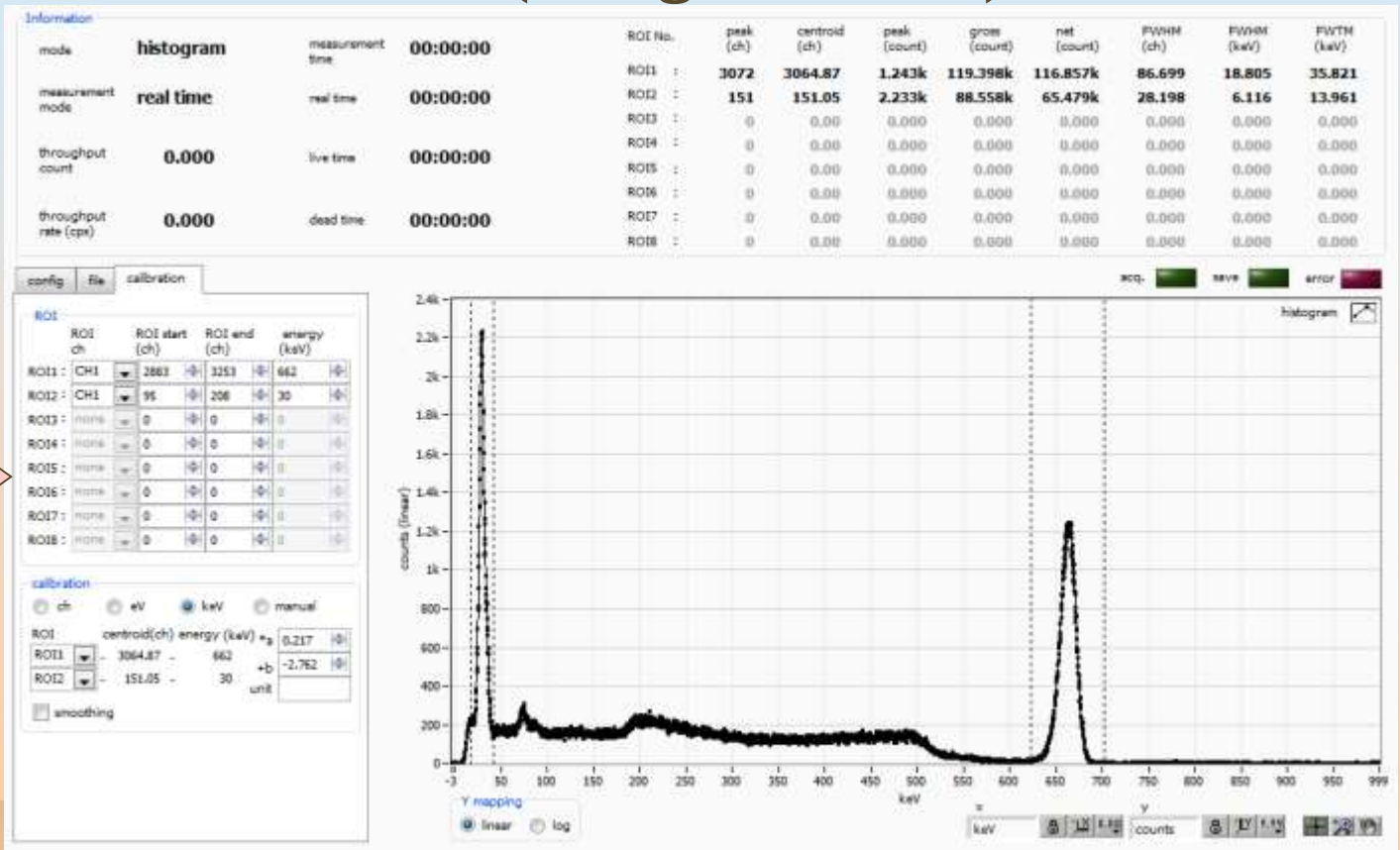
An energy spectrum of $LaBr_3(Ce)$ scintillation detector. The histogram used the QDC (Integral Mode) list data.

List data

QDC[12..0]

575
579
517
579
579
462
557
462
558

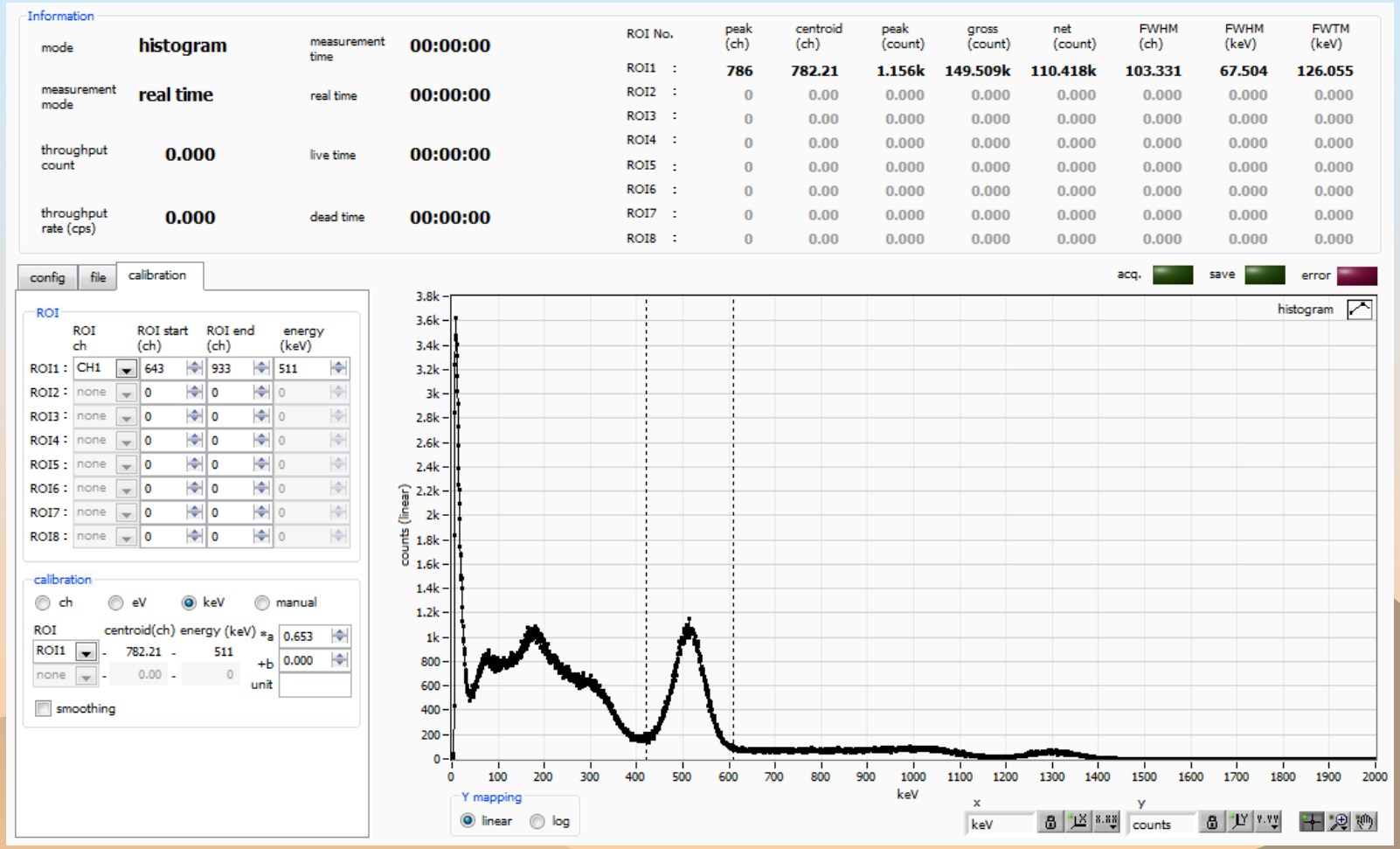
Real-time



^{137}Cs energy resolution: 2.9 % @ 662 keV

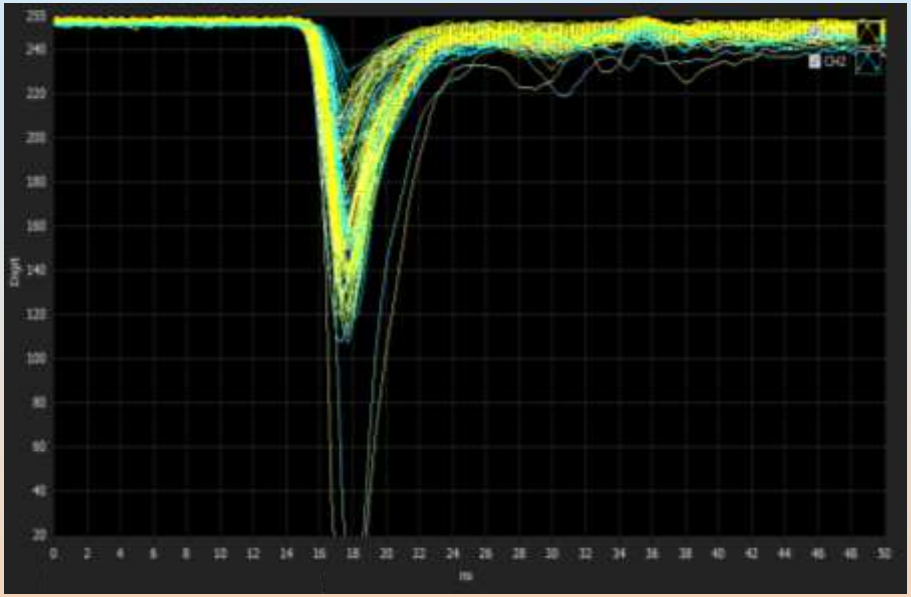
APV8508-14 (8CH, 500MHz, 14bit-ADC)

An energy spectrum of GSO scintillation detector.

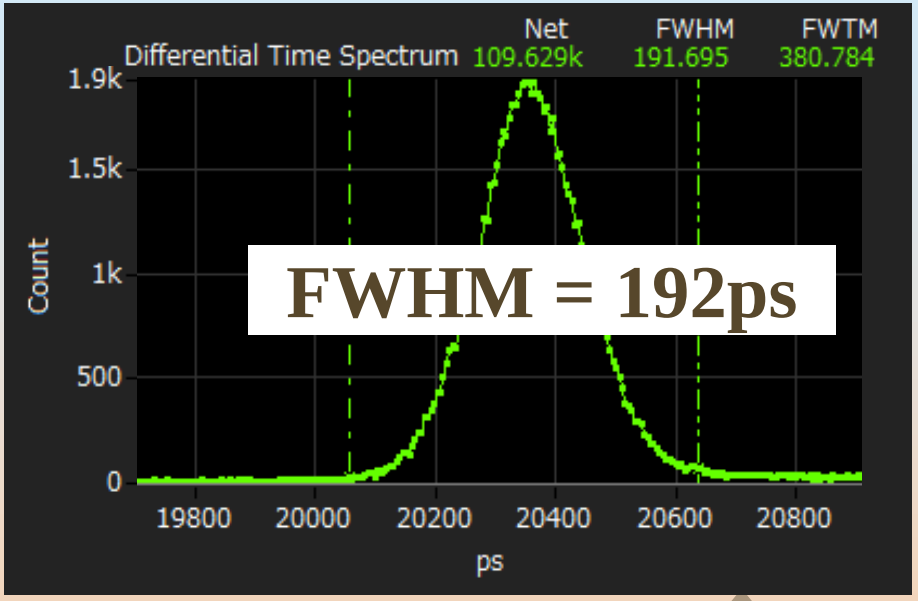


^{22}Na energy resolution: 13 % @ 511 keV

APV8702 (2CH, 3GHz, 8bit-ADC)



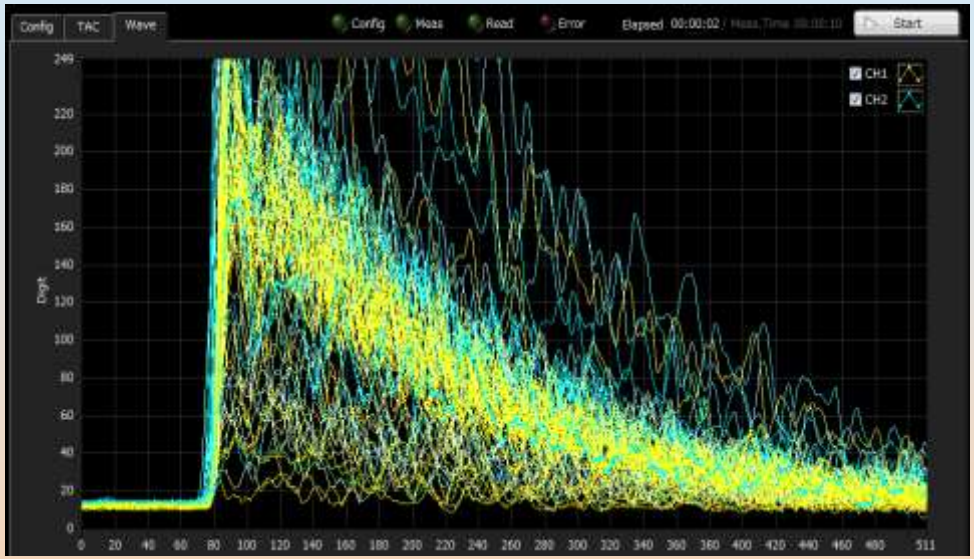
Waveform Mode



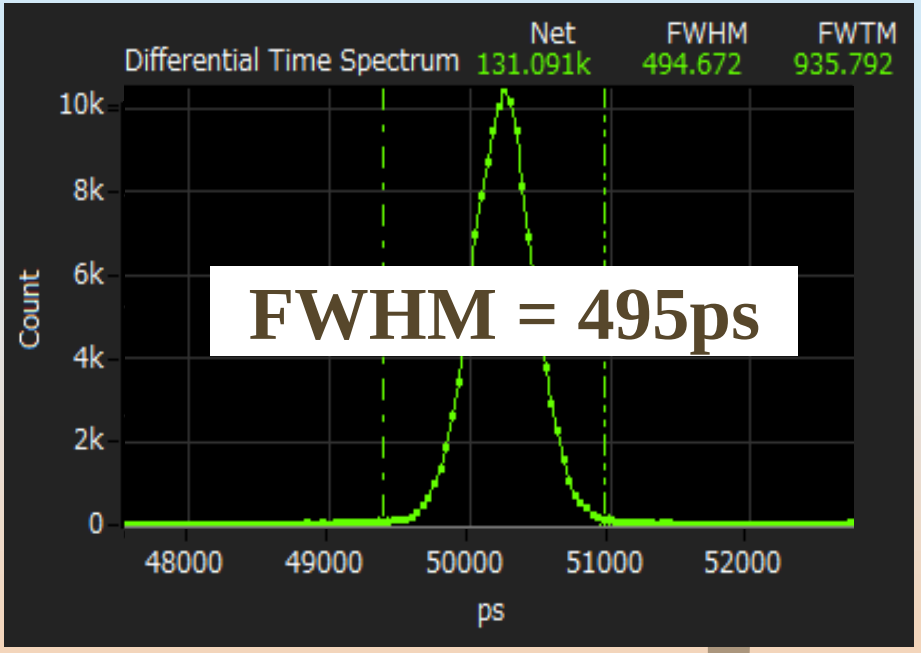
Time resolution Mode

(BaF_2 scintillation detector, ^{22}Na @ 511 keV)

APV8702 (2CH, 3GHz, 8bit-ADC)



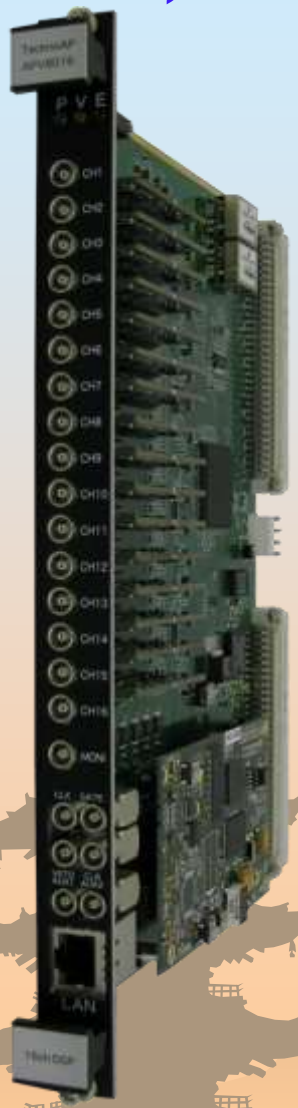
Waveform Mode



Time resolution Mode

(LYSO scintillation detector, ^{22}Na @ 511 keV)

APV8016(X) (16CH, 100MSPS, 14bit-ADC)

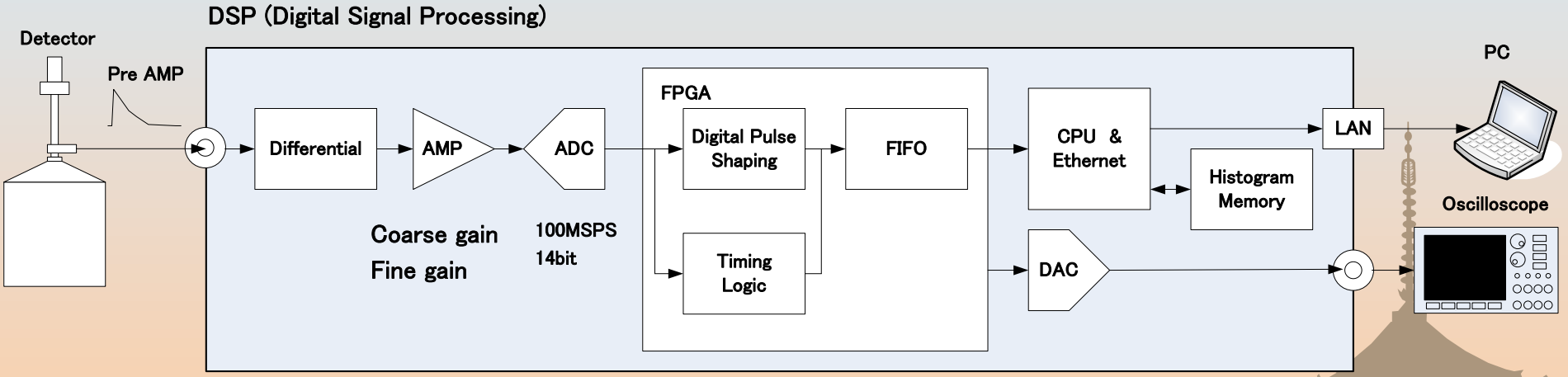


The APV8016 is a digital signal processor for gamma-ray. The APV8016 can input a direct pre-amp signal from the Ge semiconductor detector. The inputted signal is converted to digital signal processing by high-speed ADC (100 MHz, 14bit) and highly-integrated FPGA. The measurement data is a histogram, an event and a waveform. That data is transferred to the PC via Ethernet.

※ The APV8016X model is used for X-ray. The APV8016X can input a direct pre-amp signal from the detector, such as SDD, Si(Li), SSD, SiPin etc.

DSP (Digital Signal Processor)

Our DSP is a Multi Channel Analyzer (MCA) equipped with a real-time digital signal processing function.

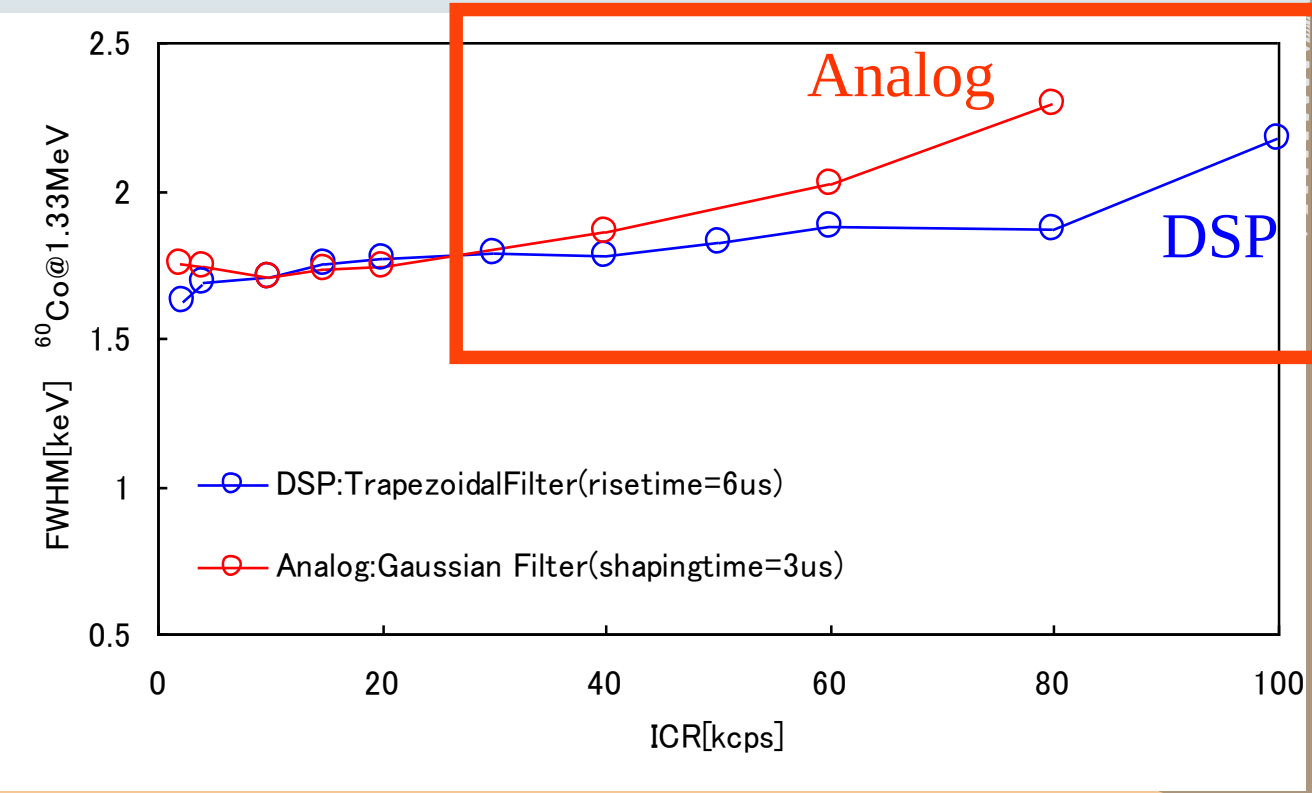


The block diagram of the DSP circuit board

The data collect mode is a histogram mode, an event mode, and a wave mode.

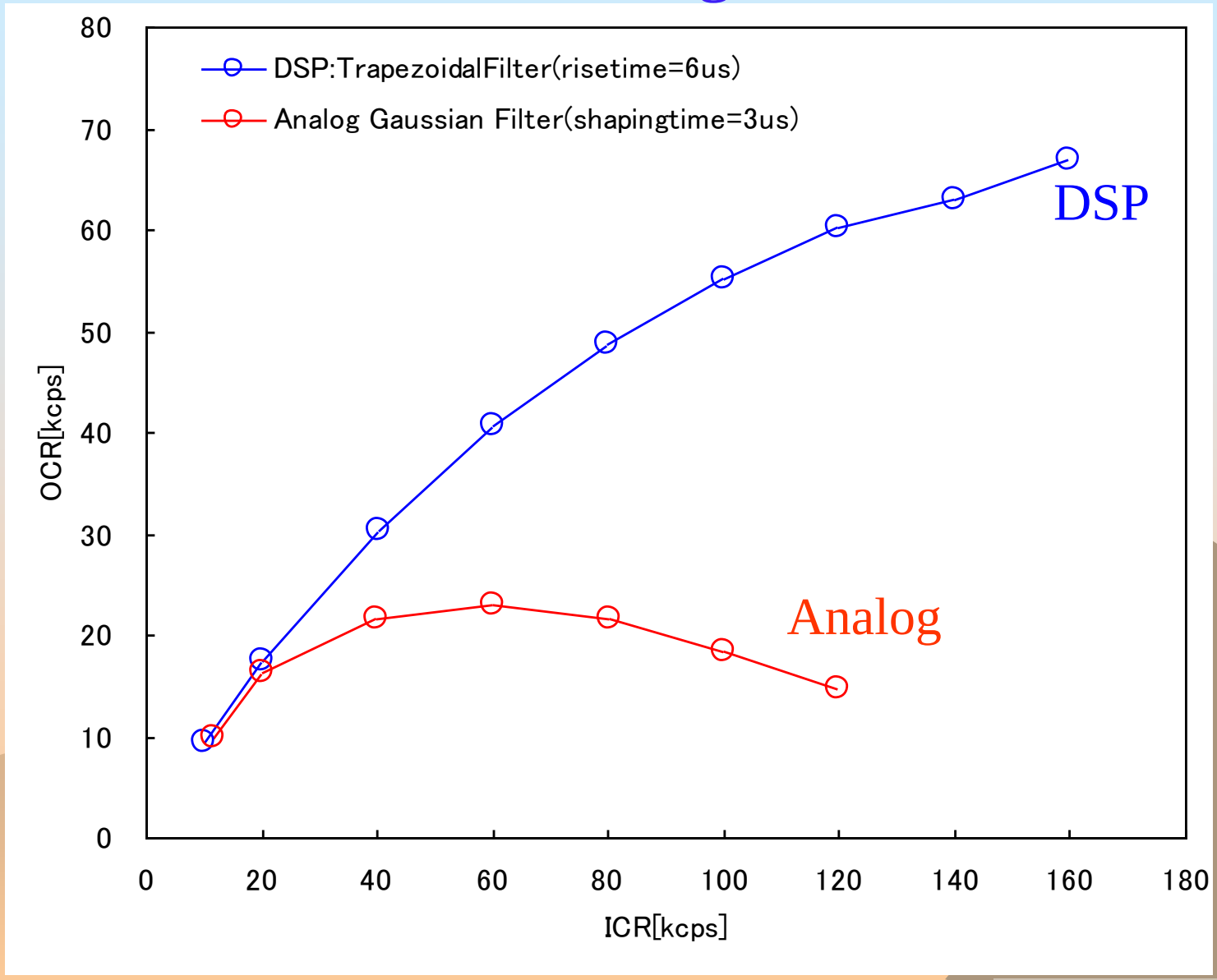
Characteristic test of DSP using HPGe detector

Detector	PGT Coaxial P-type HPGe size:10% nominal energy resolution:1.8keV@1.33MeV	
High Voltage	+2000V	
Source	^{60}Co	
Pulse Shaping	(1)DSP Trapezoidal Filter	(2)Analog Gaussian Filter
MCA	APV8016 internal MCA	TechnoAP AnalogMCA typ.APV7400

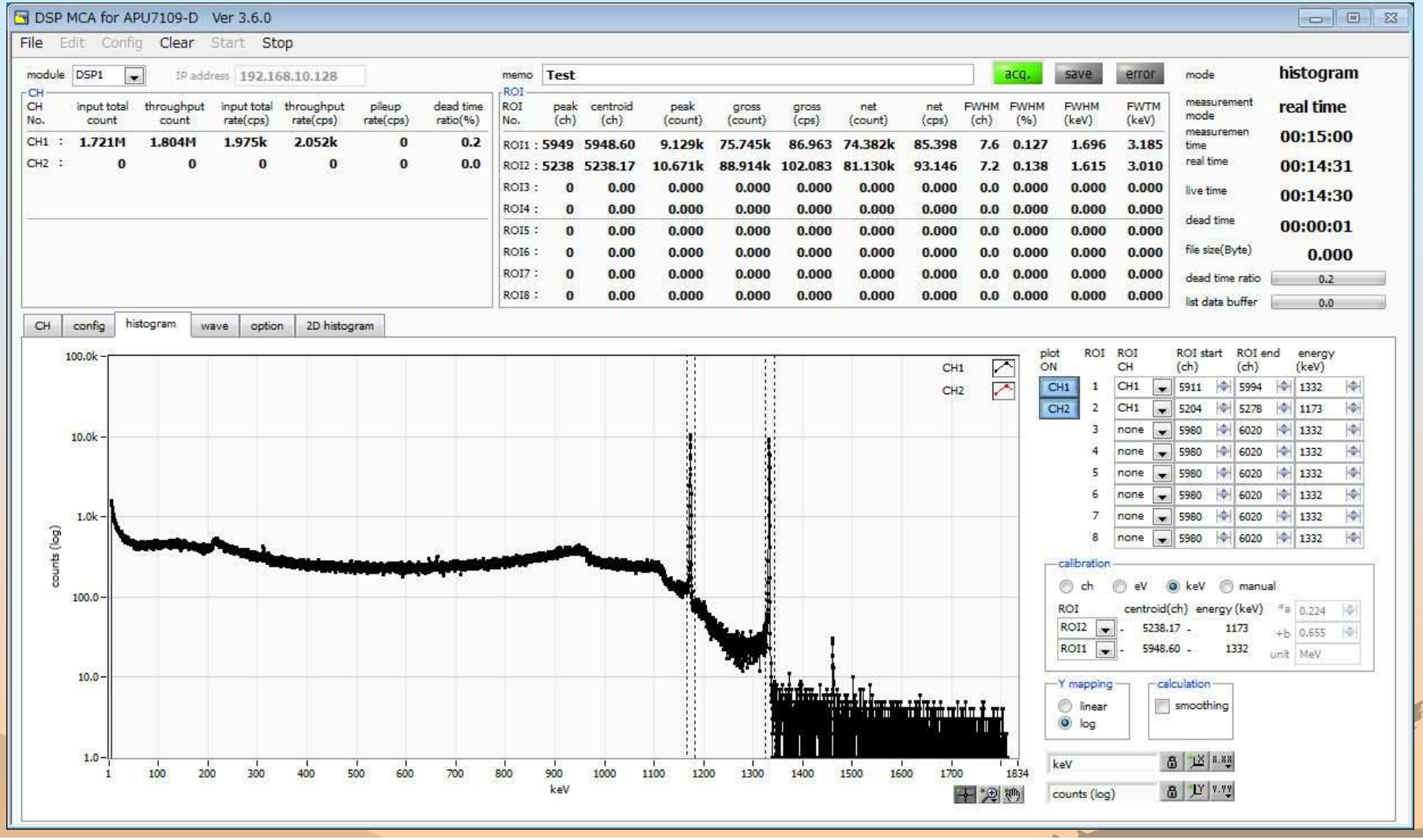


Characteristic of energy resolution

Characteristic test of DSP using HPGe detector

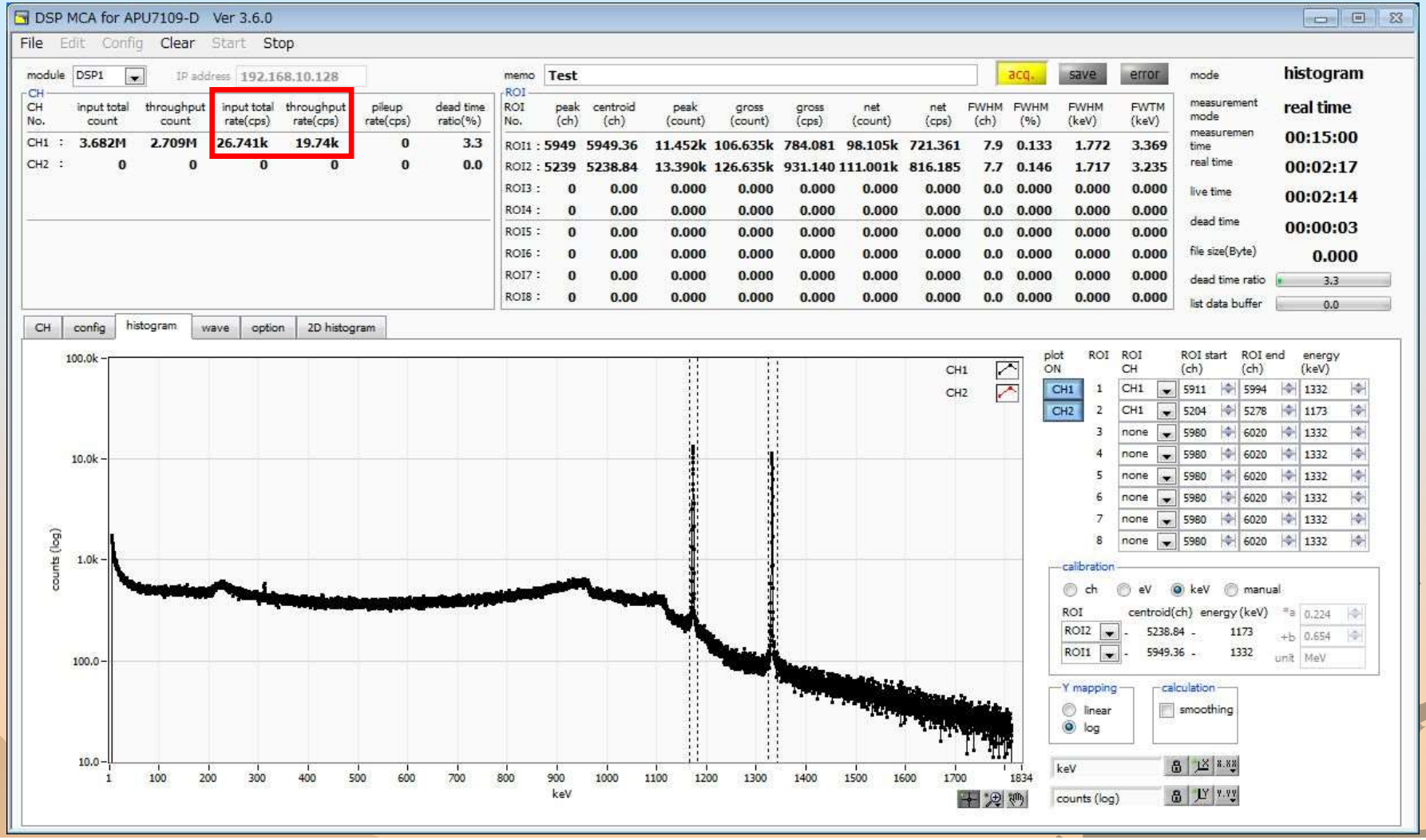


DSP resolution 1.7 keV @ ^{60}Co, 1.33MeV



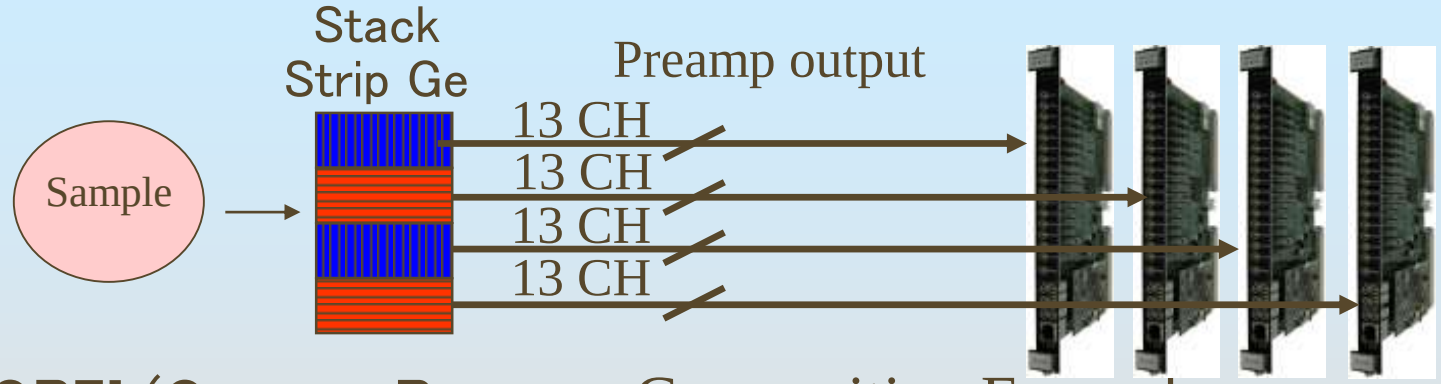
Energy spectrum (detector: HPGe detector, radiation source: ^{60}Co, **count rate: 2 kcps**, shaping time: 6 micro seconds, measurement time: 15 min, detection efficiency: 10 %)

With the high count rate the energy resolution is 1.76 keV.



Energy spectrum (detector: HPGe detector, radiation source: ^{60}Co, **count rate: 20 kcps**, measurement time: 15 min, detection efficiency: 10 %)

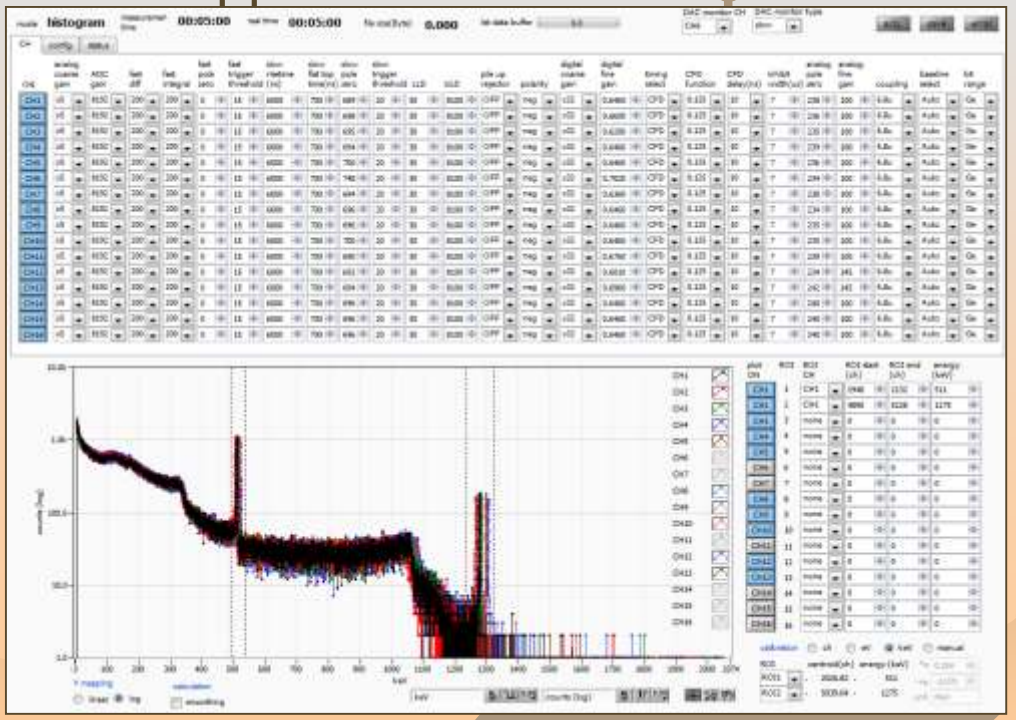
Usage Example 1: Ge semiconductor Compton camera



GREI (Gamma-Ray Emission Imaging) Composition Example

External

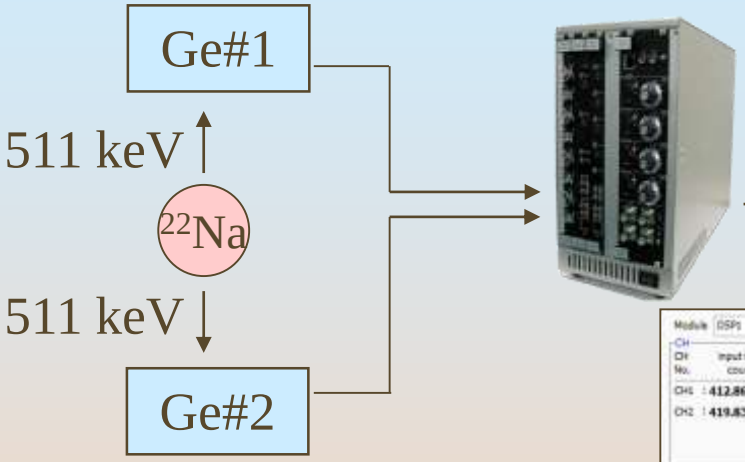
Application for APV8013A



From RIKEN Next-generation Imaging Team.

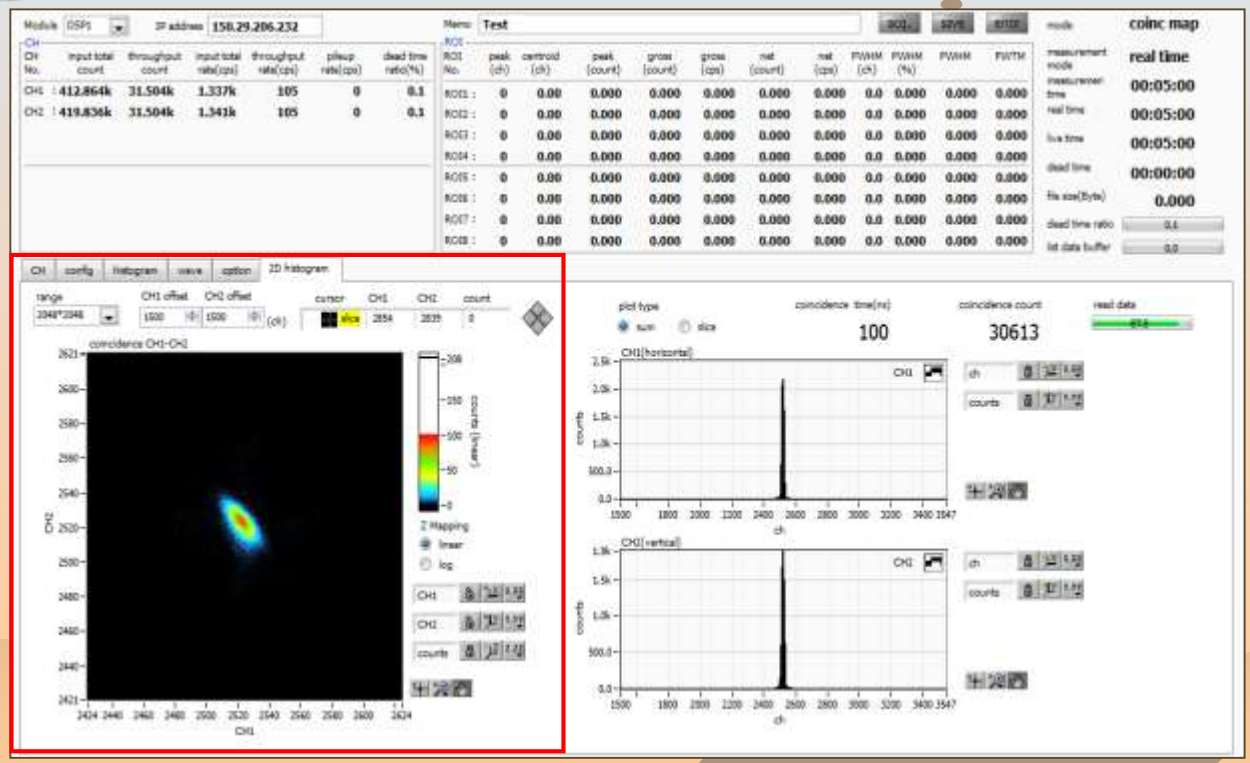
Usage Example 2: Coincidence Doppler Broadening Measurement of Positron Annihilation (CDB)

<Composition Example>



It is able to support the coincidence processing using several detectors.

In the position annihilation field, the Coincidence Doppler Broadening Measurement of Positron Annihilation for the detection of micro-void of the materials, such as semiconductor etc.



<Coincidence 2D-Map>

Digitizers

- APV7302-8 (2CH, 3GSPS, 8bit)
- APV7104-14 (4CH, 1GSPS, 14bit)
- APV7104-12 (4CH, 1GSPS, 12bit)
- APV7108-8 (8CH, 1GSPS, 8bit)
- APV7508-14 (8CH, 500MSPS, 14bit)
- APV7508-12 (8CH, 500MSPS, 12bit)
- APV7516-8 (16CH, 500MSPS, 8bit)
- APV7016-14 (16CH, 100MSPS, 14bit)

At this time, we have showed all of our products in VME-type.
You can choose between the VME-type or the Unit-type because our products can be customized.

Please contact us if you need further information.

Contact us: order@techno-ap.com

Our other products:

- Gamma Imaging Module
- Spectrometers
- MCA (Multi Channel Analyzer)
- High-Voltage Power Supply
- Power Supply for Preamp
- Preamps
- Detectors ($LaBr_3$, BaF_2, GSO, LFS, etc)
- NIM module

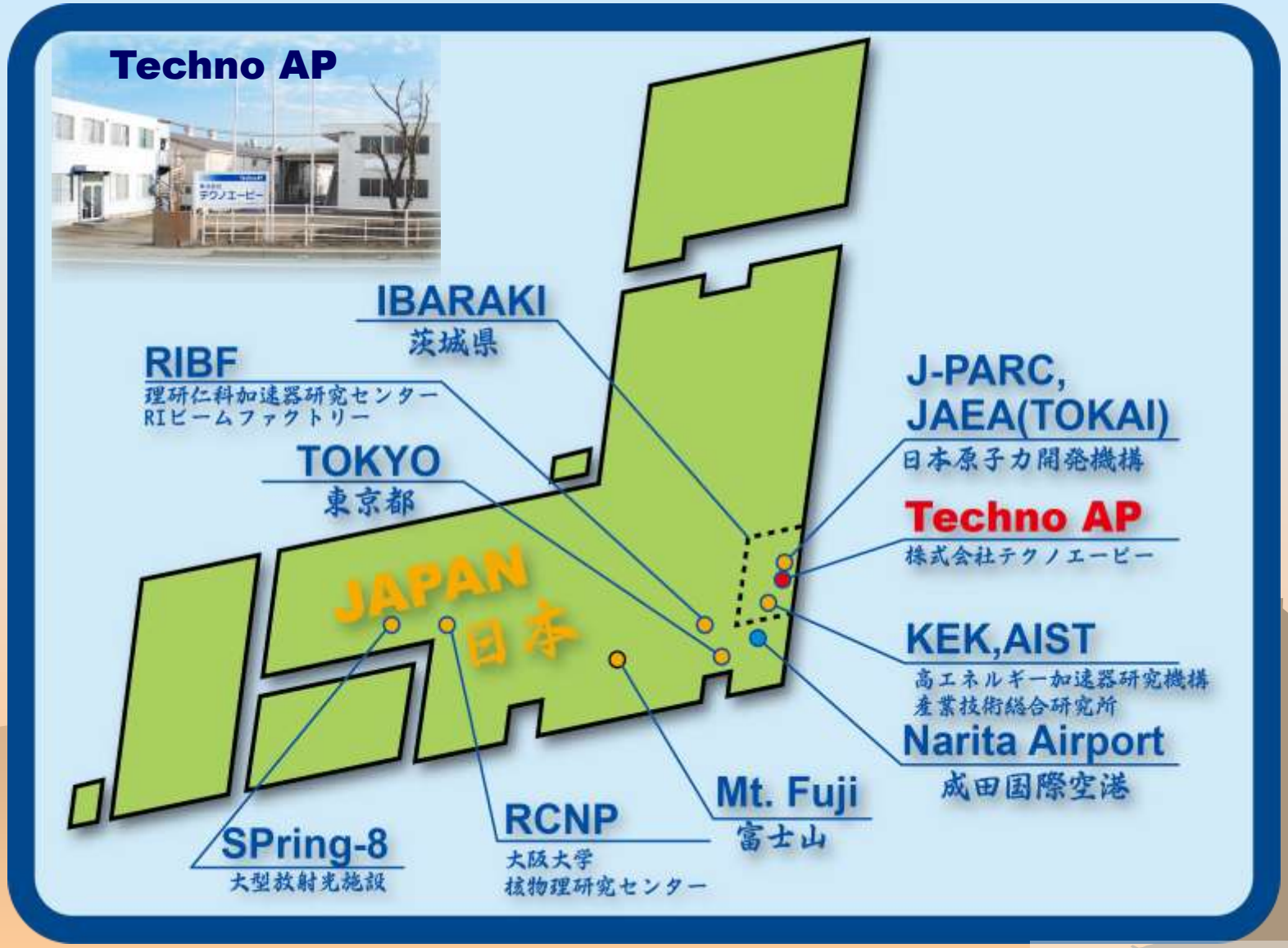
For more information, please visit our booth.

2. Techno AP outline

Techno AP is specialized in development, manufacturing and sales in the radiation measurement field. All of our products are developed by our company.
We are also doing the commissioned development from the research facilities and the universities.

Main clients: Major companies,
Public research organizations,
Universities.

2. Techno AP outline



2. Techno AP outline

[Business lineup]
(1) Sale of radiation measuring instrument, and radiation counter.
(2) Development of radiation measuring device, and radiation counter.
(3) Development of research and development device, measurement controlling system, and inspection apparatus.

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2. Techno AP outline

Thank you for your time and for your attention.

The End.