S-2S meeting

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16 Oct 2014

Contents

TOF detector test @ Kyoto University

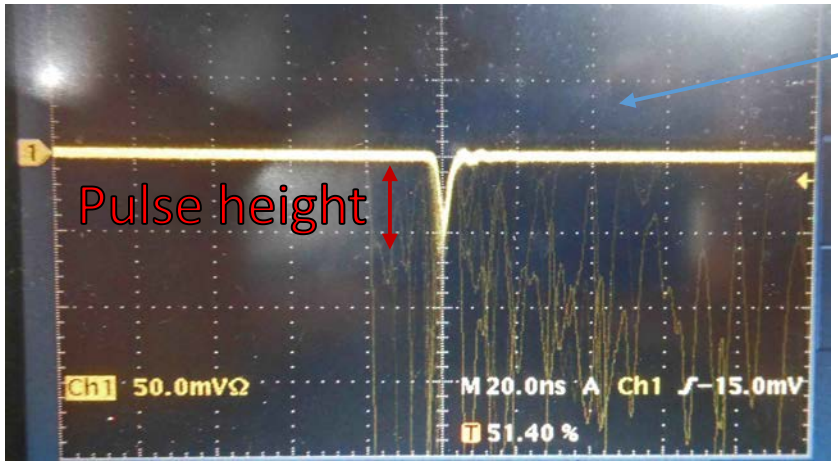
TOF detector performance test

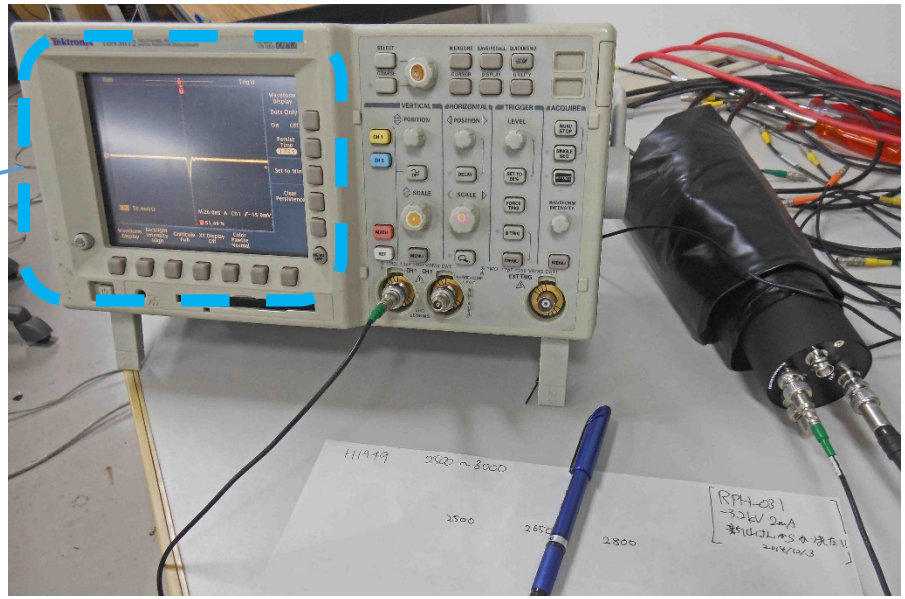
Want to see

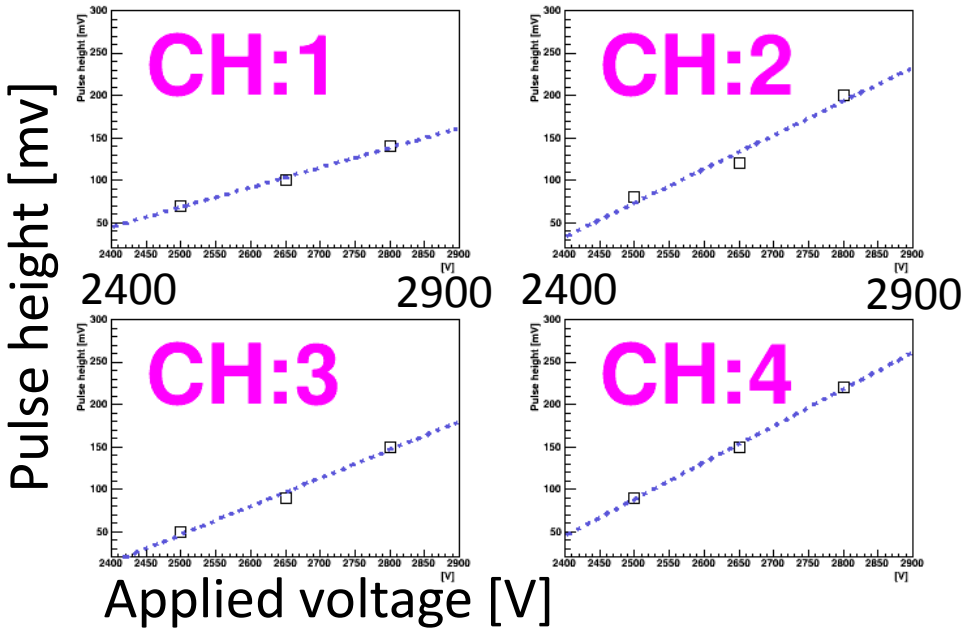
TOF resolution → Timing resolution

PMT's gain scan

Hamamatsu H1940-50





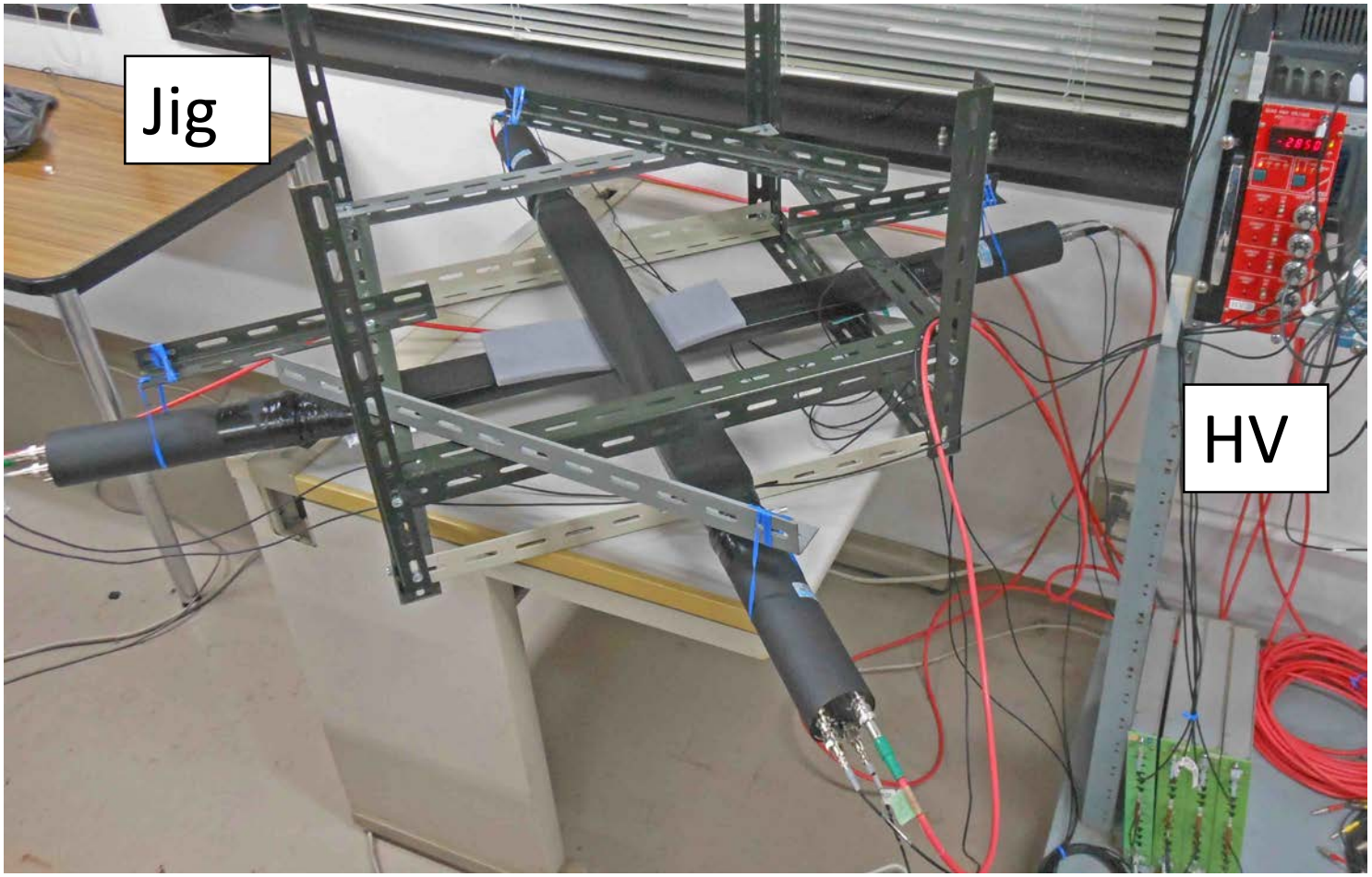


Pulse height: 150 mV

- CH1: 2850 [V]
- CH2: 2690 [V]
- CH3: 2810 [V]
- CH4: 2640 [V]

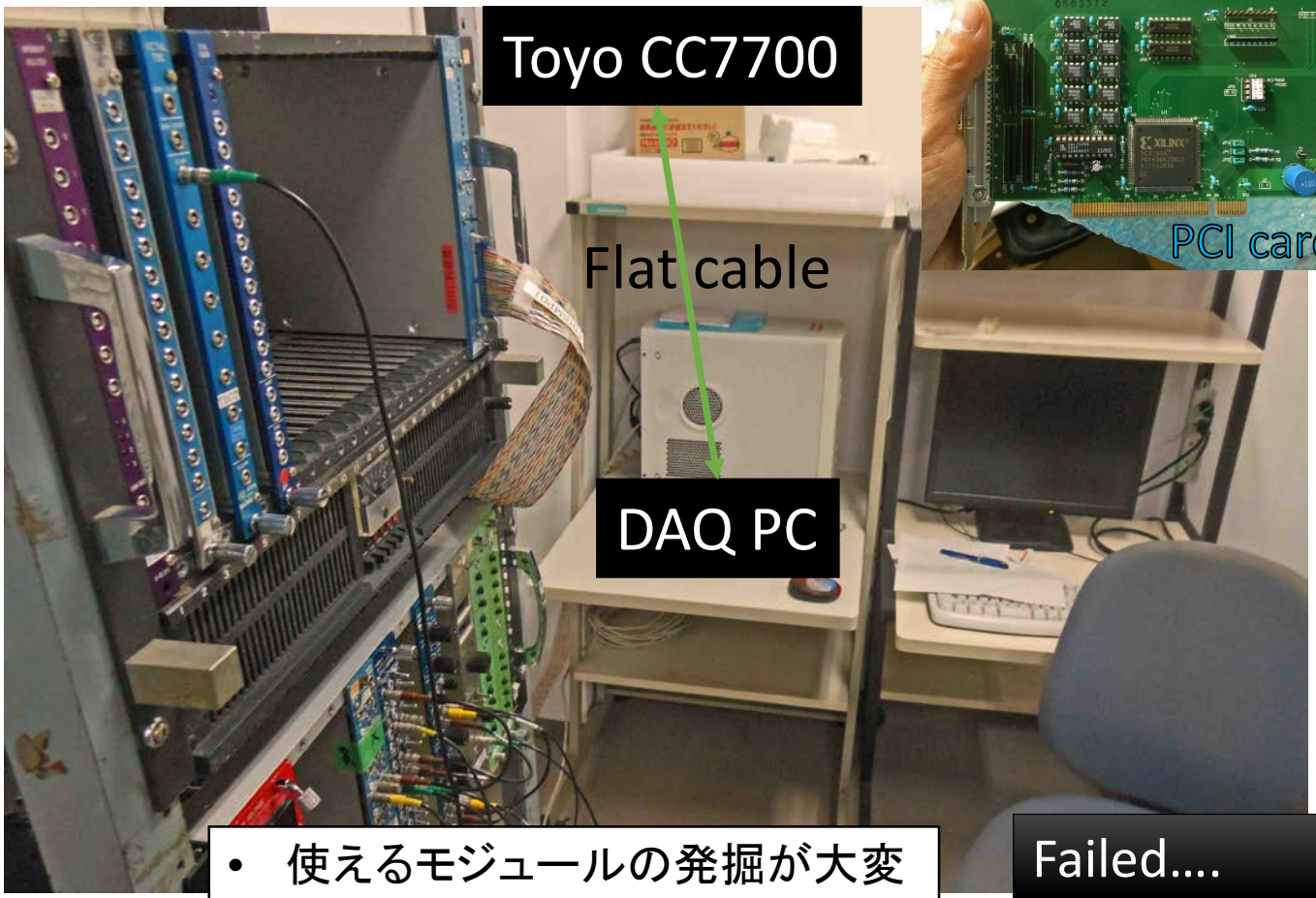
PMT + scintillator with light guide

Lighttight check @1F exp. room



Lighttight check → OK

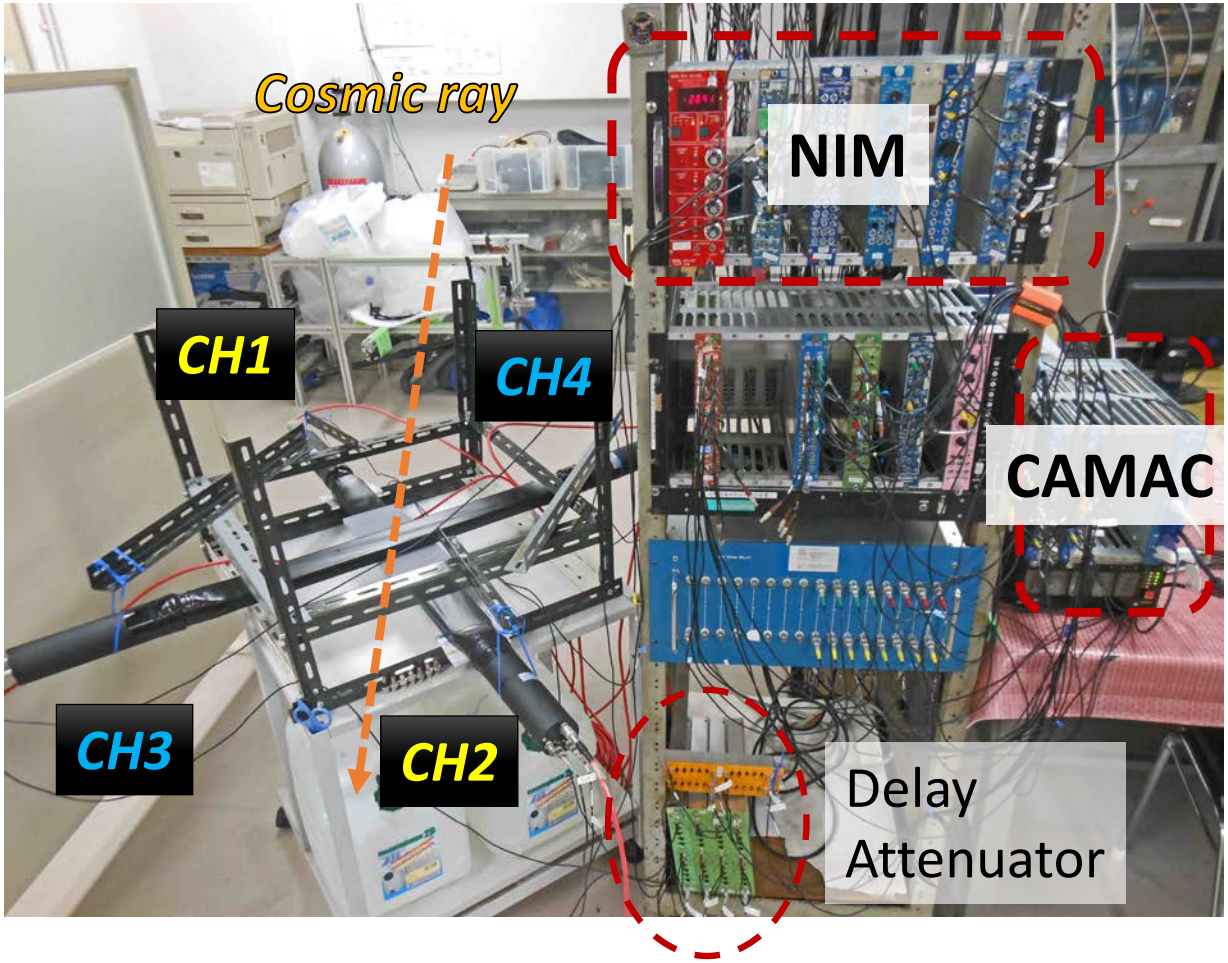
DAQ preparation @ 1F experimental room



- 使えるモジュールの発掘が大変
- 問題の切り分けに時間がかかる

Failed….
So, moved to 3F !!

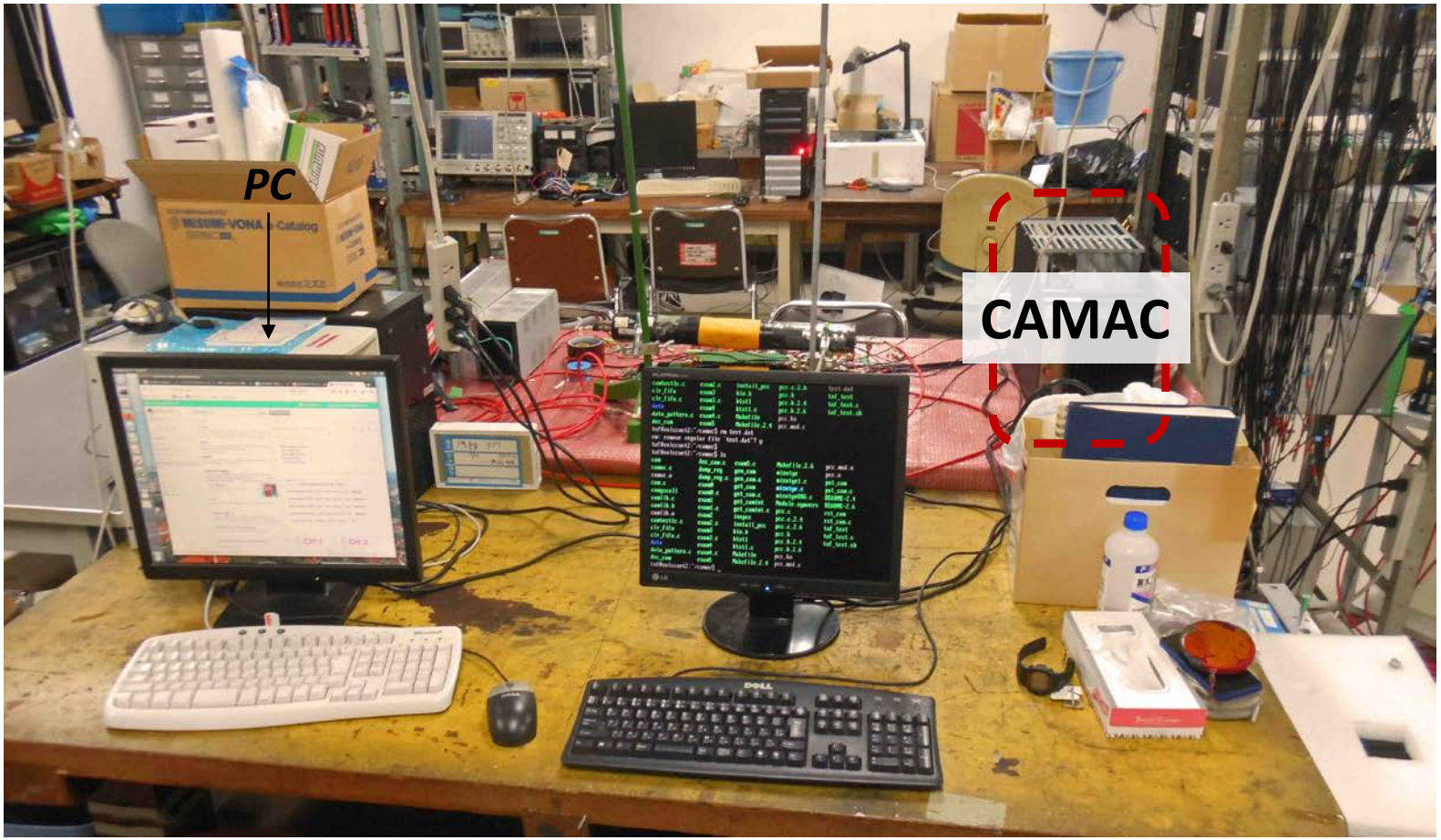
Test bench in 3F exp. room



Crate controller:
Toyo CC/NET

Circuit diagram
→ *K.Kato*

DAQ and ANALYSIS machines @ 3F experimental room



ANALYSIS
sts@172.16.1.202

CC/NET (DAQ)
tof@172.16.1.173

Experimental conditions

- Trigger: TOF1 & TOF2 & TOF3 & TOF4
- Discriminator threshold: 400 mV
- Rate: 8 Hz
- Attenuations for signals of ADC: 16 db / 24 db
- ADC gate: 100 ns

Directory structure of DAQ machine (Toyo CC/NET)

- /home/tof/
  - camac/
    - README_TOFTEST (Instruction)
    - tof_test.c (main source code)
    - tof_test.sh
    - data/
      - *.dat (output data)
      - tof_test.log (Log file)

How to

① ./tof_test.sh (Number of events) (Output data file)

② ./data/*.dat

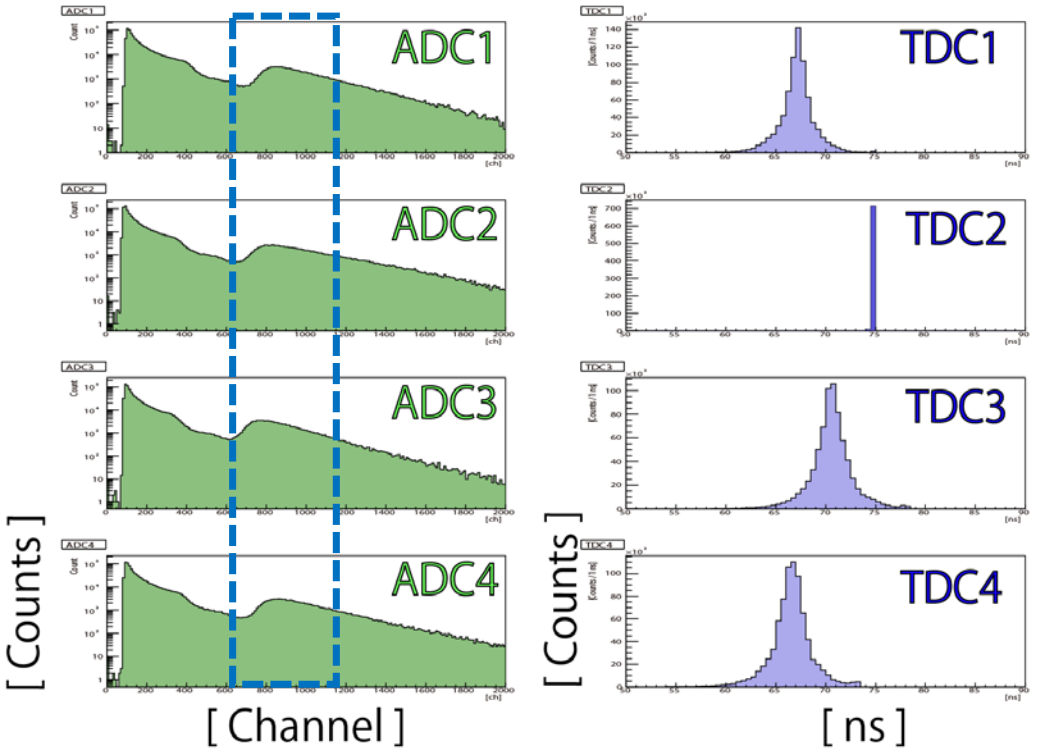
ADC1 ADC2 ADC3 ADC4 TDC1 TDC2 TDC3 TDC4

③ tof_test.log

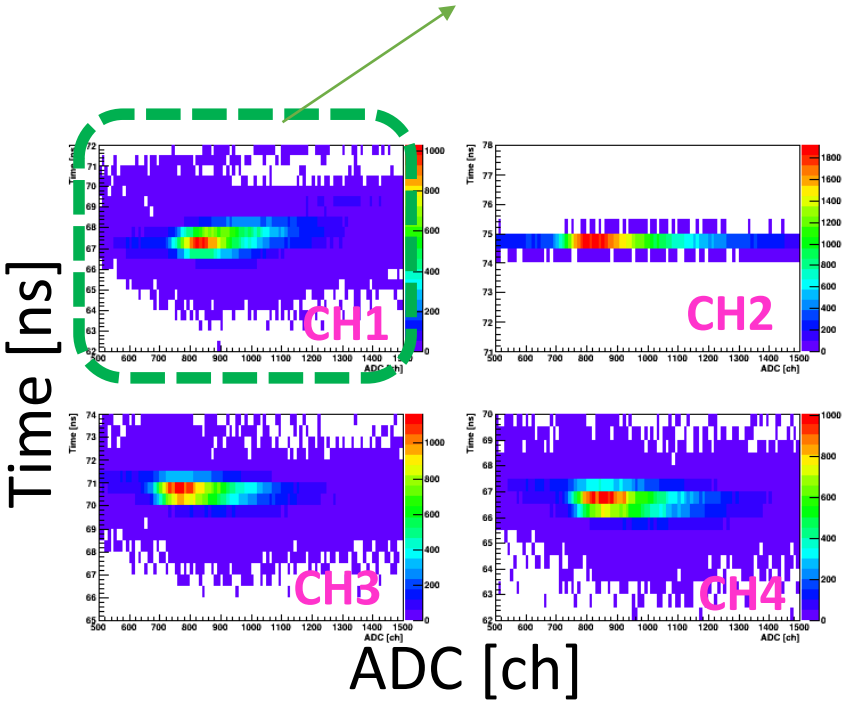
Log note.

ADC and TDC histograms

Data of ~ 36 hours

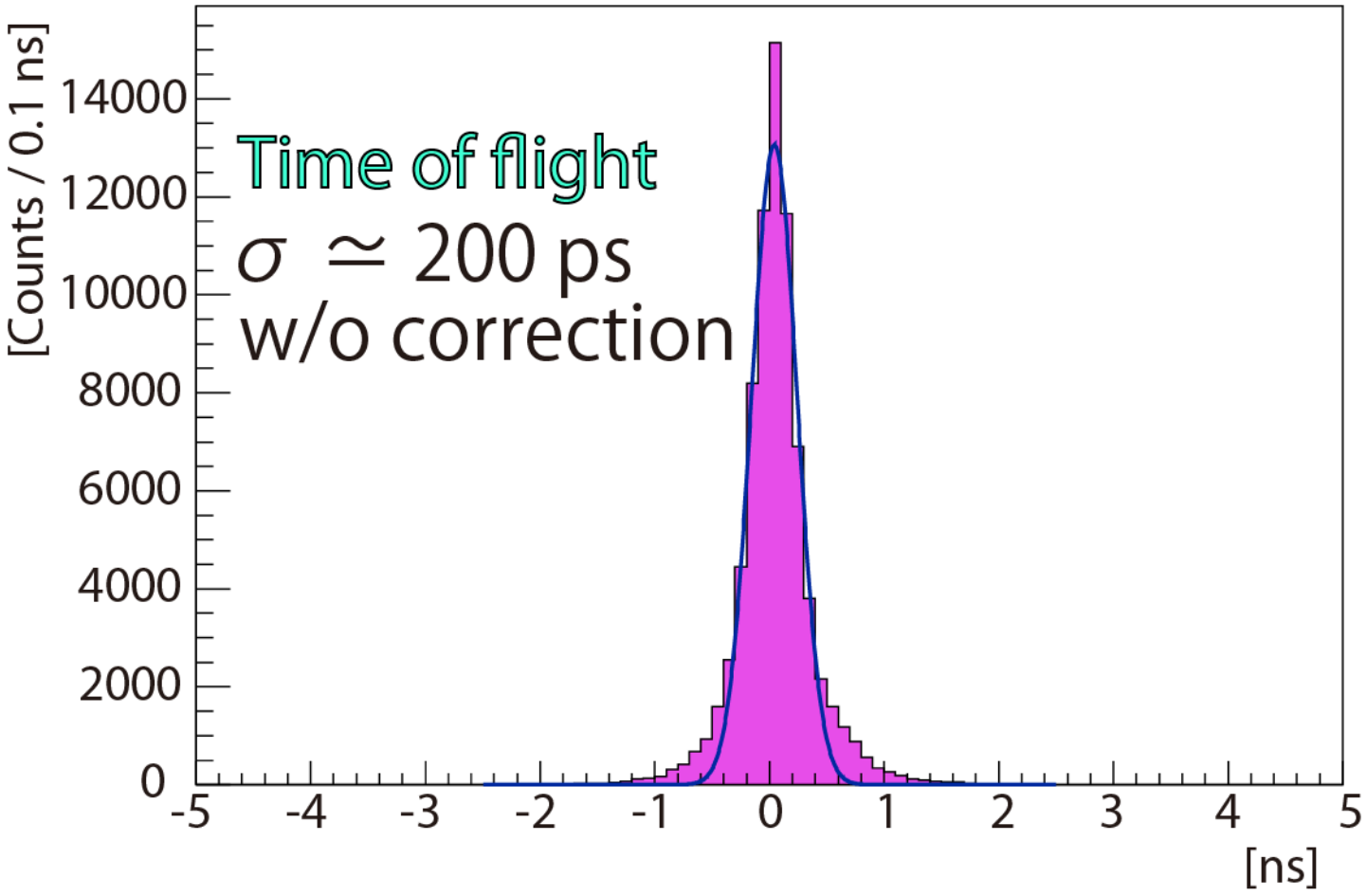


Something wrong



ADC vs. TDC

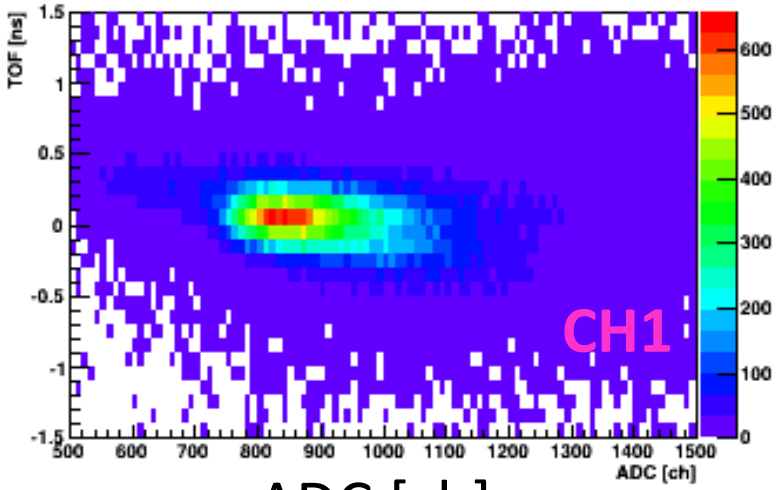
TOF resolution w/o correction

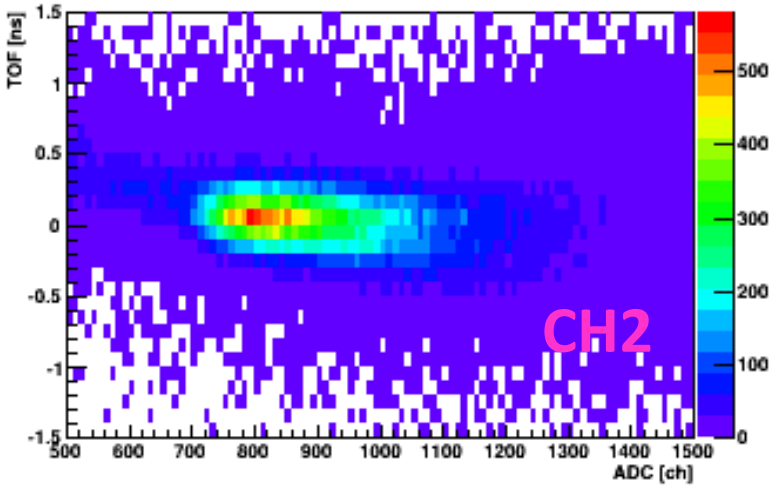


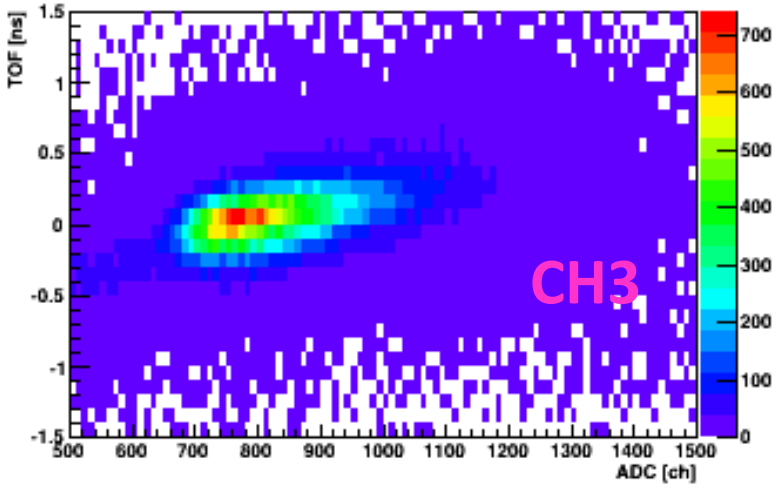
($TOF = T_1 - T_2$)

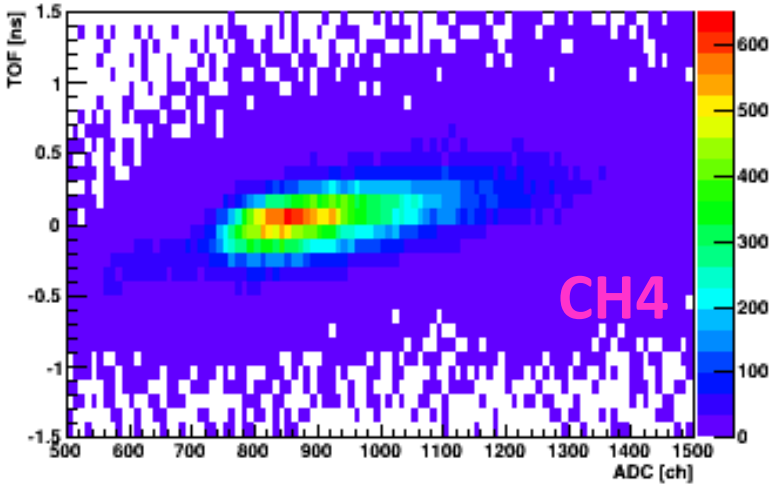
TOF vs. ADC

TOF [ns]

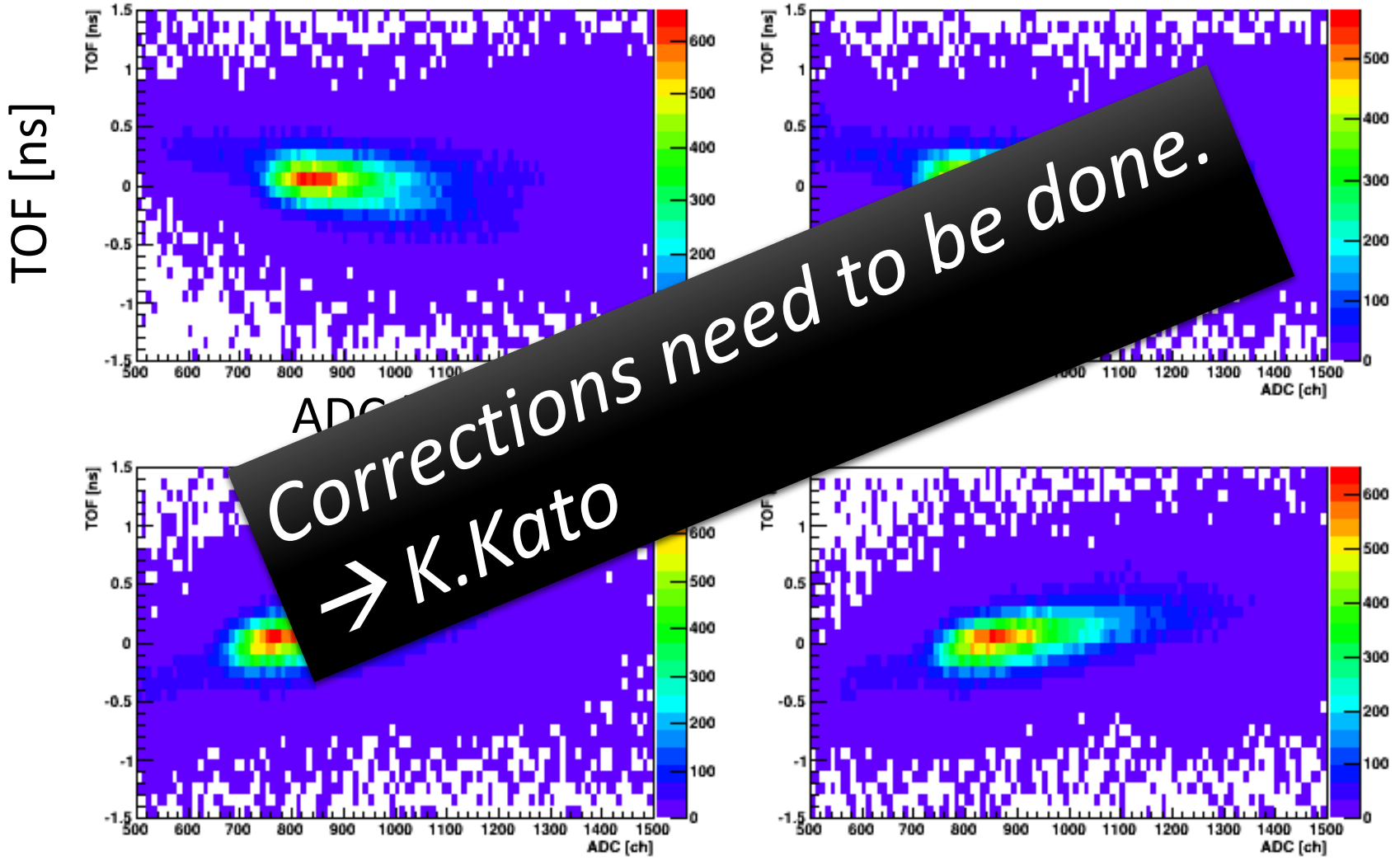






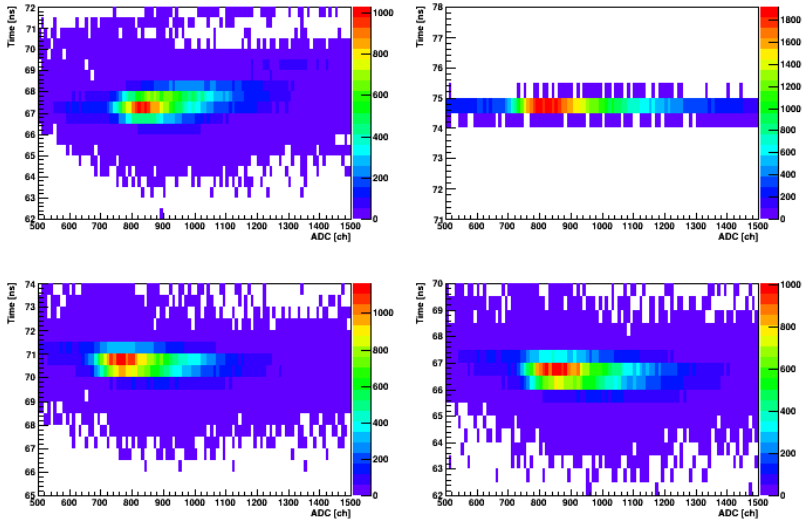


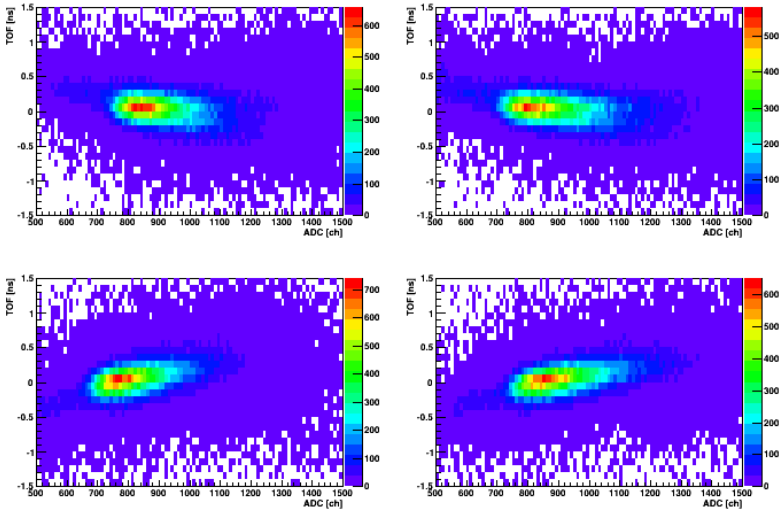
TOF vs. ADC



ラフに補正

Pulse height correction



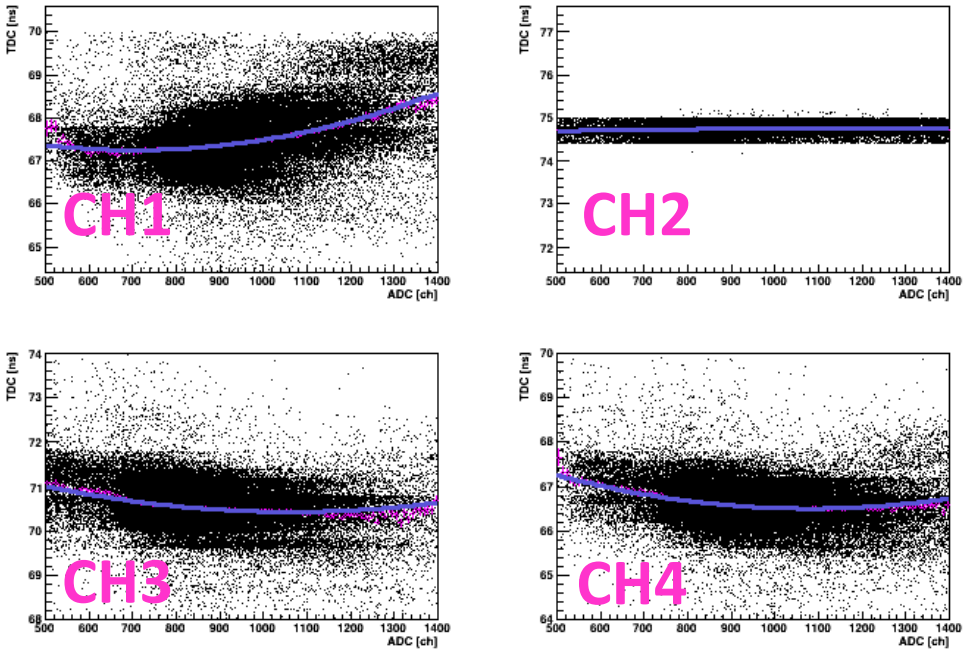


Push off these correlation !!!!

$$Time' = Time - f(ADC)$$

2nd order polynomial function

Pulse height correction



① Profile

② Fitting

→ Initial parameters

(3 params. for each channel)

(12 params. in total)

$$Time' = Time - f(ADC)$$

Definition of chi-square

$$T_{ref}^{Time} = 0.0\ [\mathrm{ns}],\quad T_{ref}^{TOF} = 0.0\ [\mathrm{ns}]$$

$$\chi^2_{Time} = \frac{1}{N}\sum_{i=0}^{N}\frac{(Time'_i - T_{ref}^{Time})^2}{\sigma^2_{Time}}$$

$$\chi^2_{TOF} = \frac{1}{N}\sum_{i=0}^{N}\frac{(TOF_i - T_{ref}^{TOF})^2}{\sigma^2_{TOF}}$$

Minimize !

$$\chi^2 = w_1\chi^2_{Time}(1) + w_2\chi^2_{Time}(2) + w_3\chi^2_{Time}(3) + w_4\chi^2_{Time}(4) + w_{TOF}\chi^2_{TOF}$$

Iteration

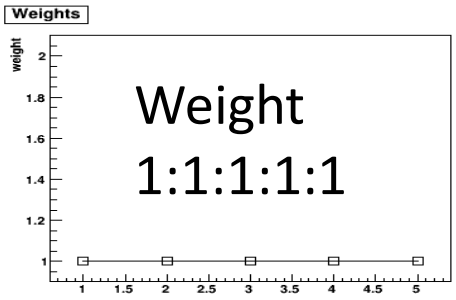
for (i=0 ; i<nite ; i++){

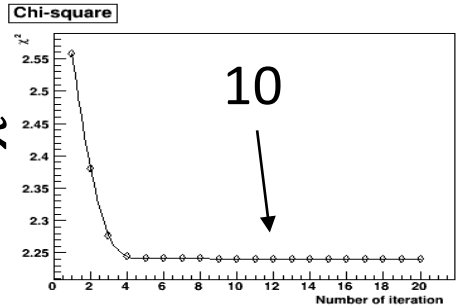
12個のパラメータをχ^2が小さくなるようにいじる

(インプットパラメータ ± 5%の範囲で)

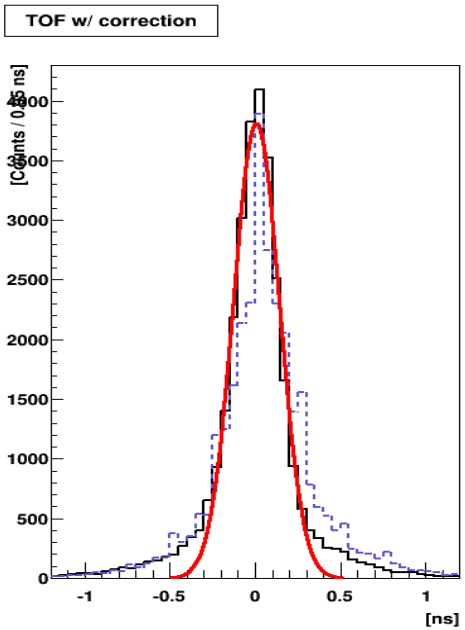
}

Results (weight=1:1:1:1:1)



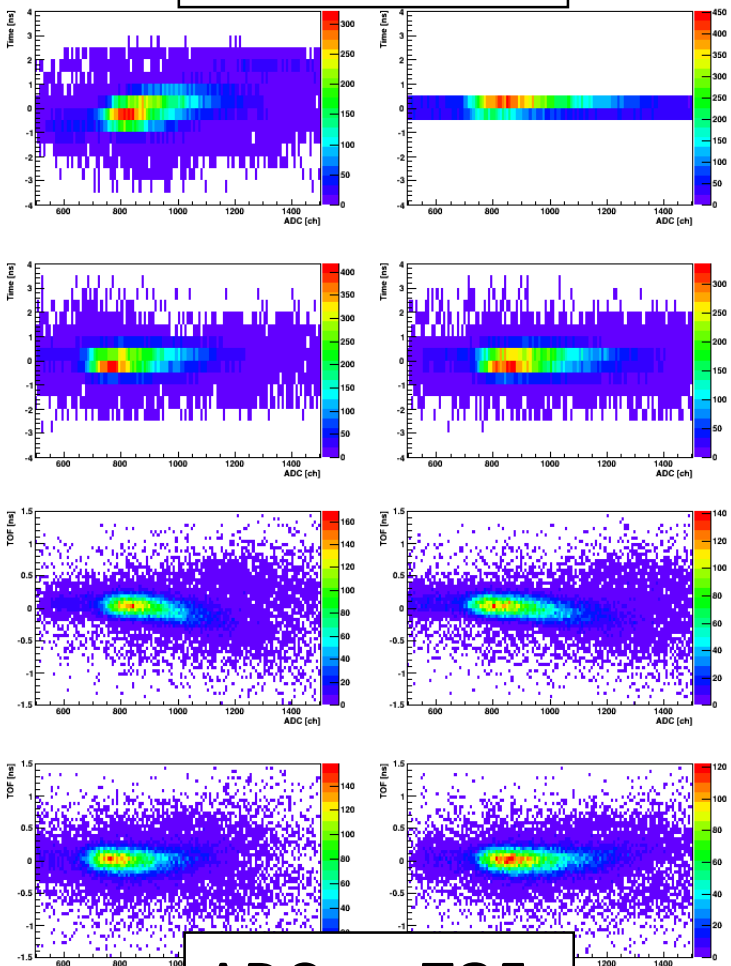


# of Iteration



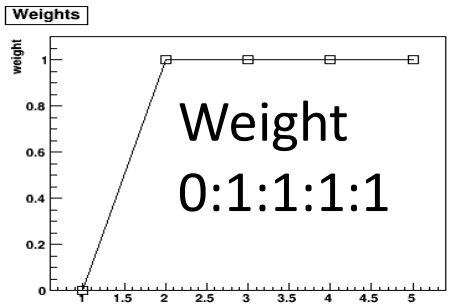
$\sigma = 135 \pm 1$ ps

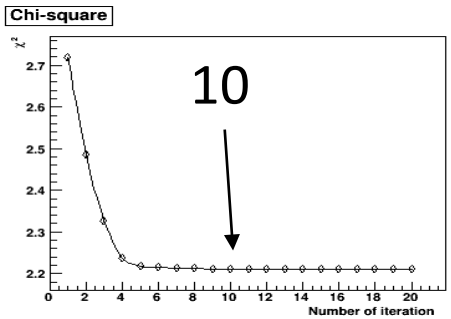
ADC vs. TDC



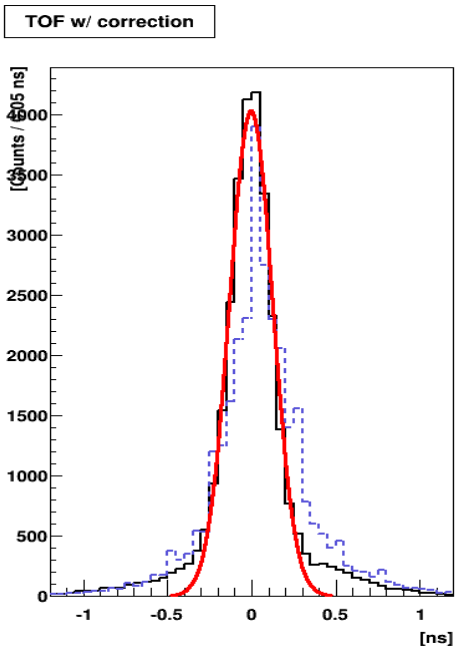
ADC vs. TOF

Results (weight=1:1:1:1:1)



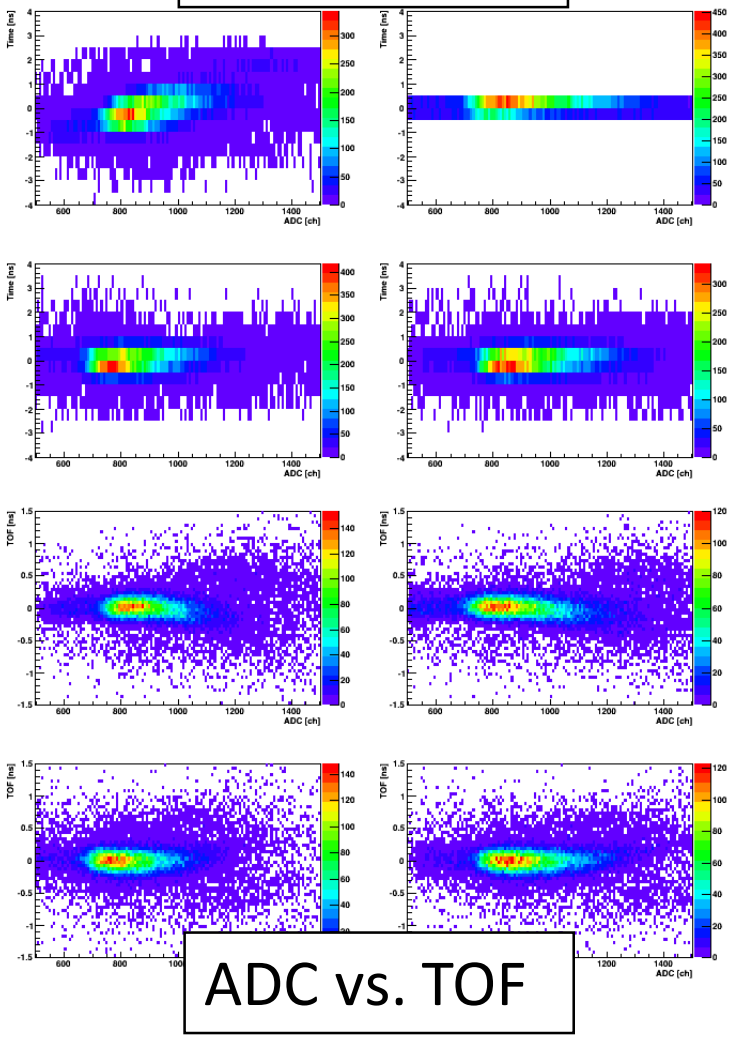


# of Iteration



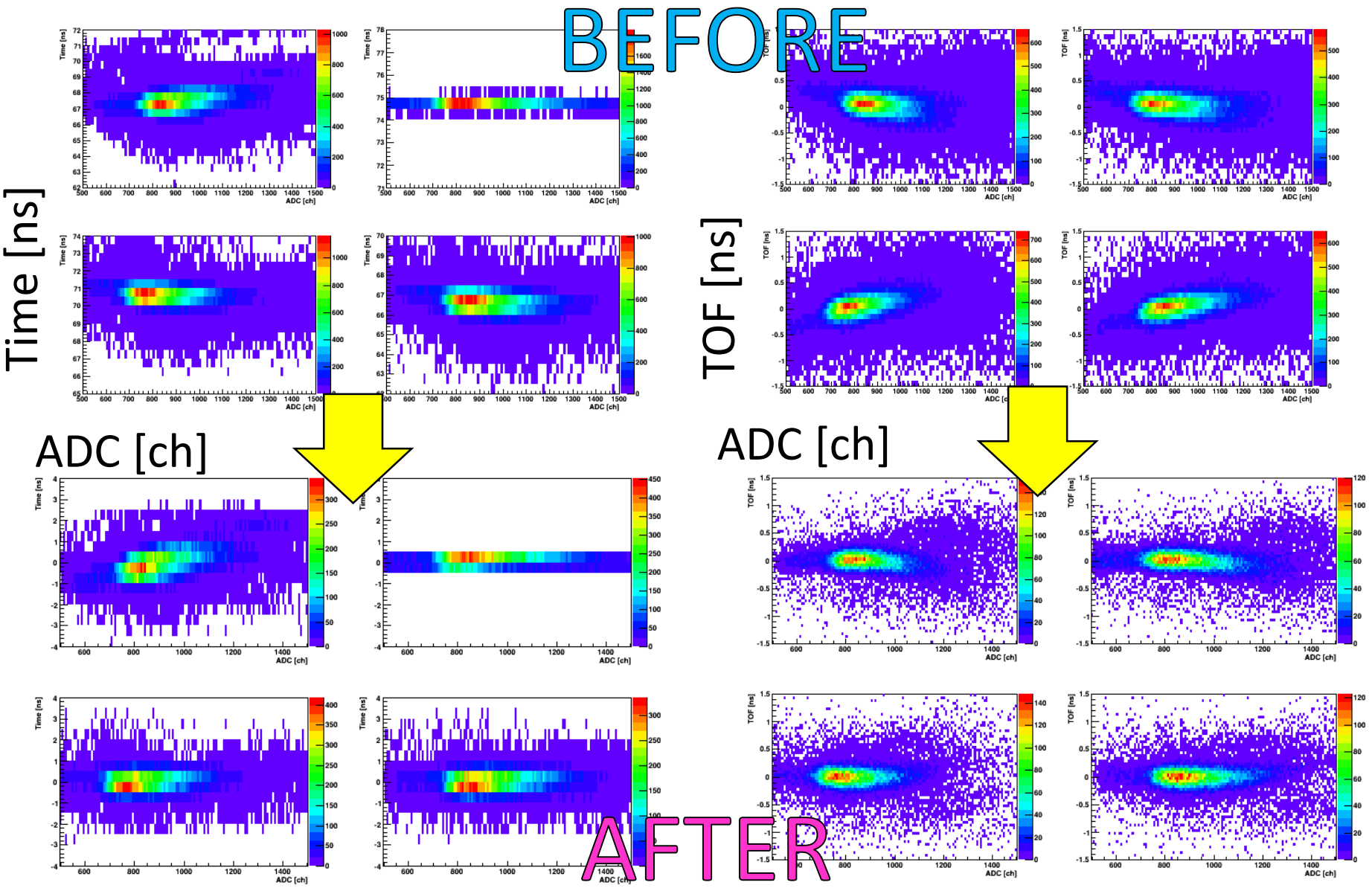
$\sigma = 128 \pm 1$ ps

ADC vs. TDC



ADC vs. TOF

Pulse height correction



Pulse height correct

Time [ns]

ADC

- CH1 ADC
  - Attenuator (or delay) is suspicious.
- Assumed function
  - 2nd order polynomial function was used this time.
  - Maybe better to use others.

Source code of the pulse height correction

phCorrection.zip

Summary

TOF detector test @ 3F experimental room in Kyoto Univ.

TOF σ = **200 ps** without correction.
TOF σ = **130 ps** with correction.

→ **Timing resolution ≅ 90 ps**

Outlook

- TOF test (K.Kato)
  - Confirmation of the time resolution
  - Circuit diagram
  - Position dependence
  - Light speed in the plastic scintillator
- TOF configuration and frame
  - Design
  - Angular distribution at TOF wall. (S.Kanatsuki)
- Water Cerenkov
  - Design (K.Takenaka) → Cosmic ray test (in a month)

END