

Status report of APD+FADC readout for pureCsl

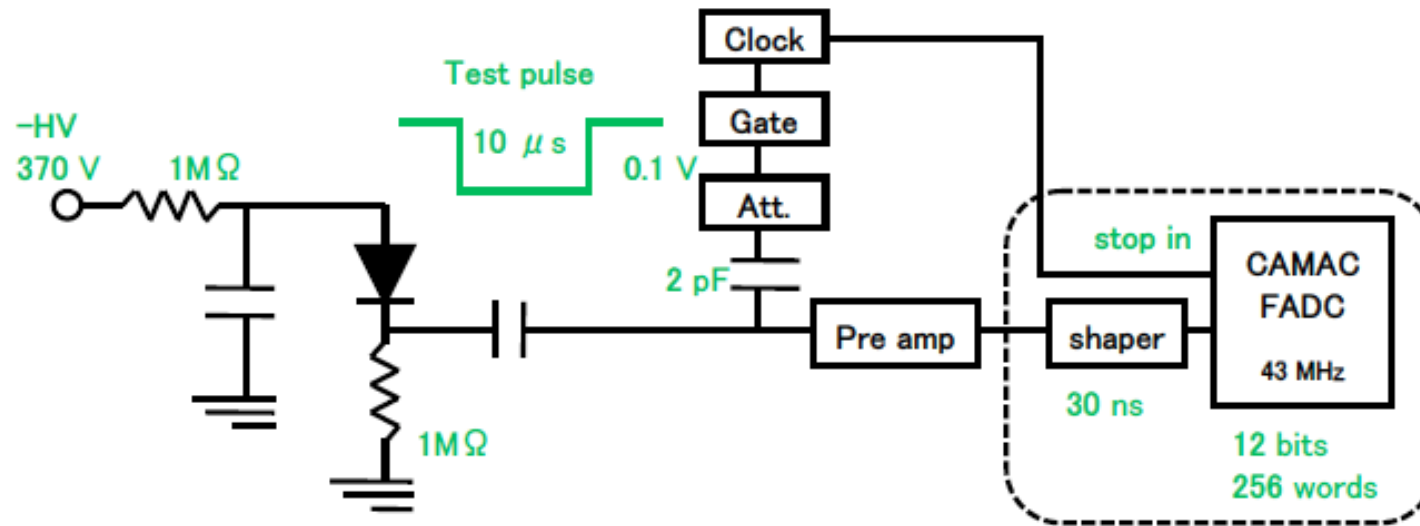
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2008/Dec./11th

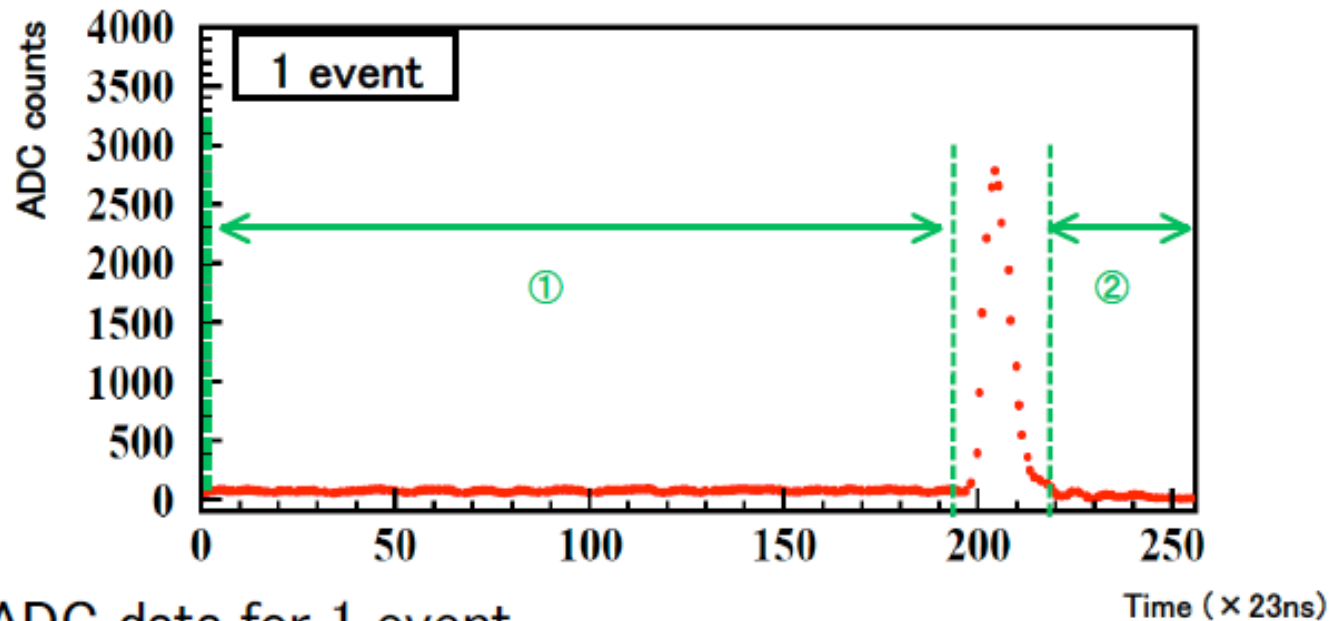
SuperBelle Calorimeter meeting

Setup



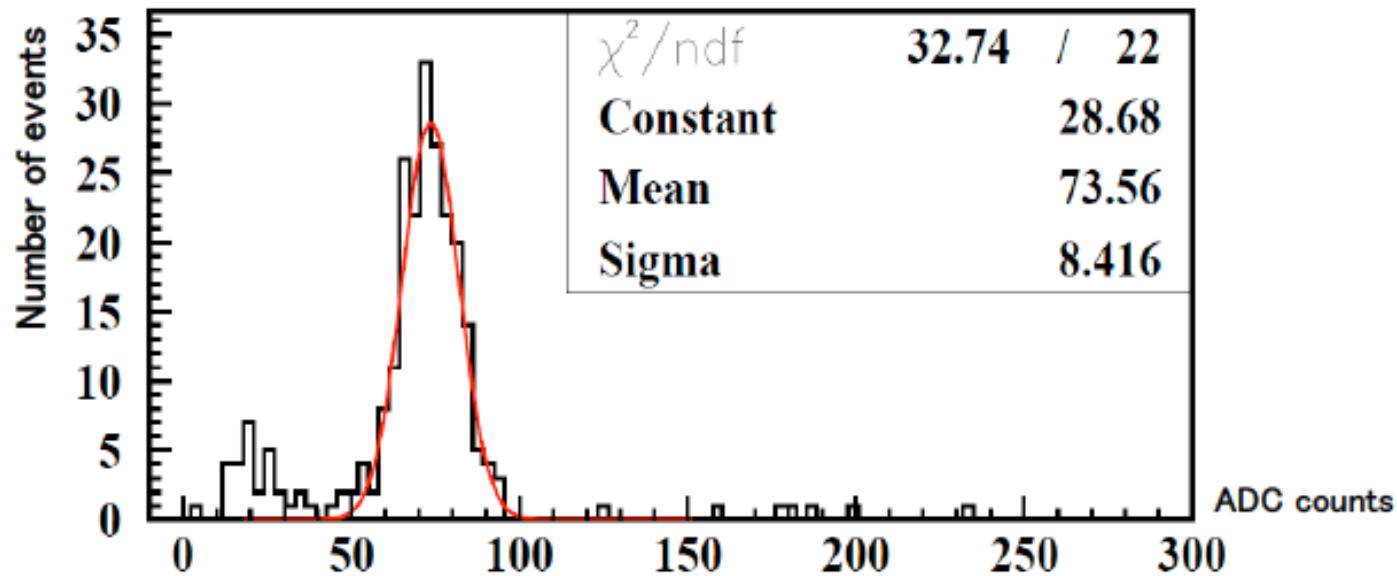
- APD : Hamamatsu S8664-1010
 - 1cmX1cm, Typical Gain=50 at 350V, C=270pF.
- Preamp is the modified version from the existent one for Csl(TI).
 - For PureCsl+Phototetrode beamtest.
 - One preamp daughter board is replaced by differential driver circuit.

Response for test pulse



- FADC data for 1 event.
- Input 0.2pC of test pulse.
- The pulse is around 200 (460 nsec) i.e. consistent with the stop signal (trigger) timing.
- In order to estimate noise, FADC data in ① and ② region are projected and fitted with Gaussian(See next page).

FADC pedestal distribution

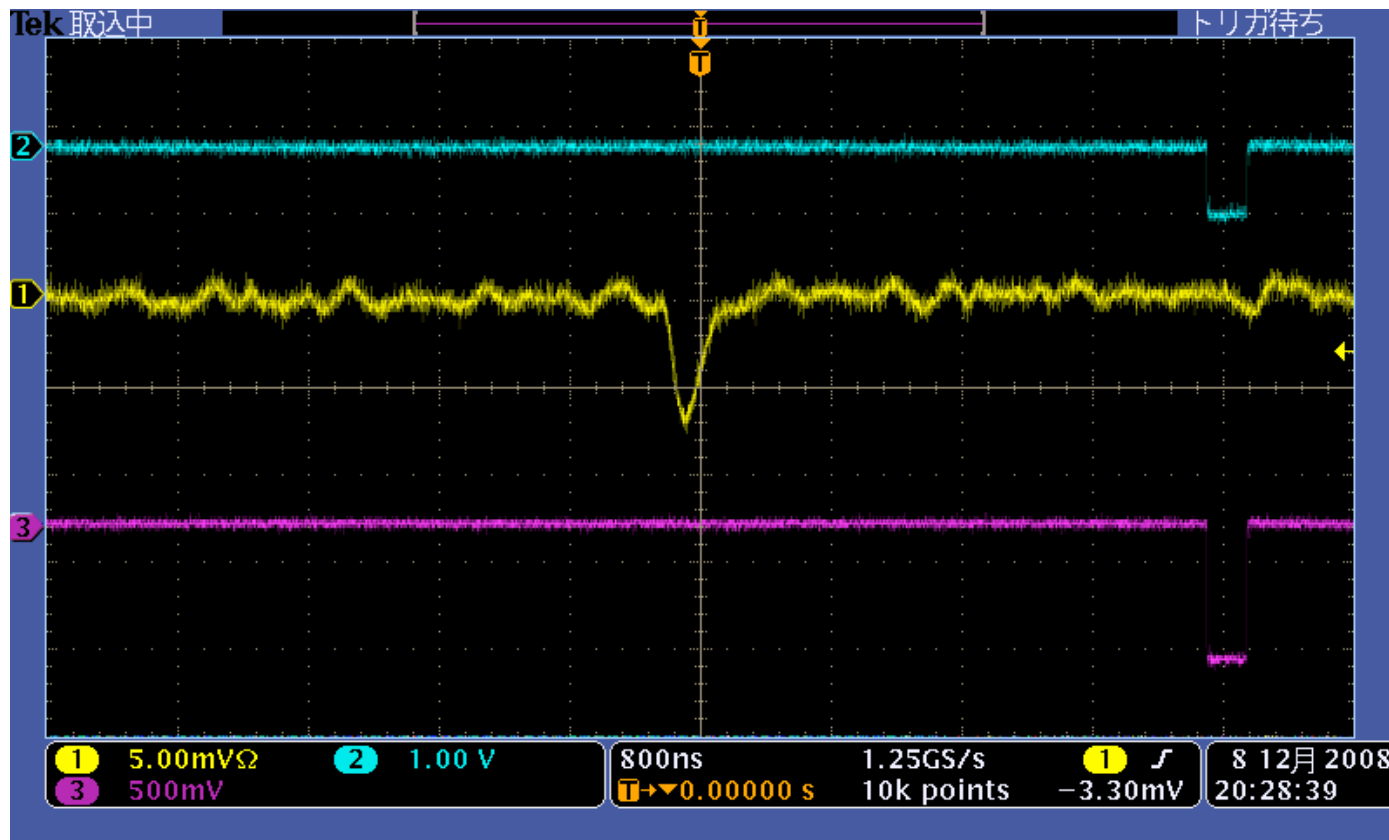


- Typical example of FADC pedestal distribution in 1 event.
- σ is about 9 FADC counts.
- Note that the test pulse(0.2pC) corresponds to 1.2×10^6 e-h pairs, FADC count=2800 at peak.
- The Equivalent Noise e-h pairs(ENe) is ;
 $(1.2 \times 10^6) \times (9/2800)=3860$,
i.e. typically ENe = 4000 e-h/(APD piece).

Rough estimation of equivalent noise energy

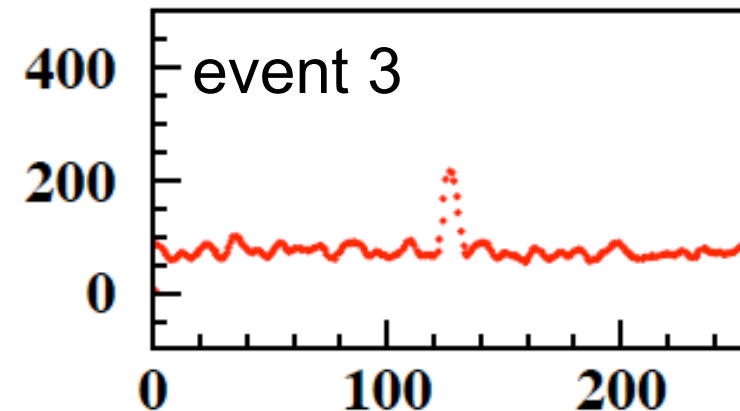
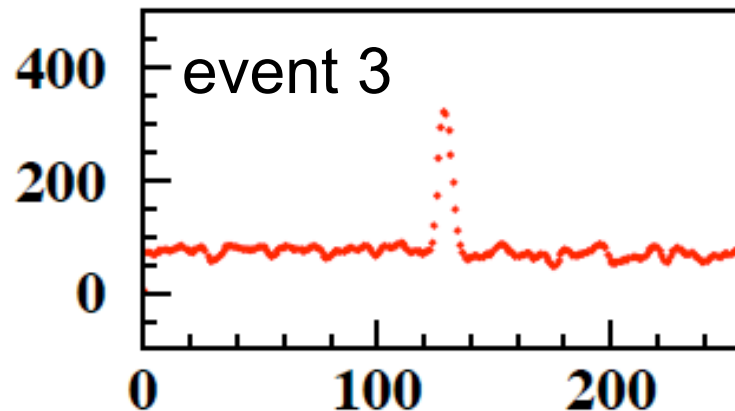
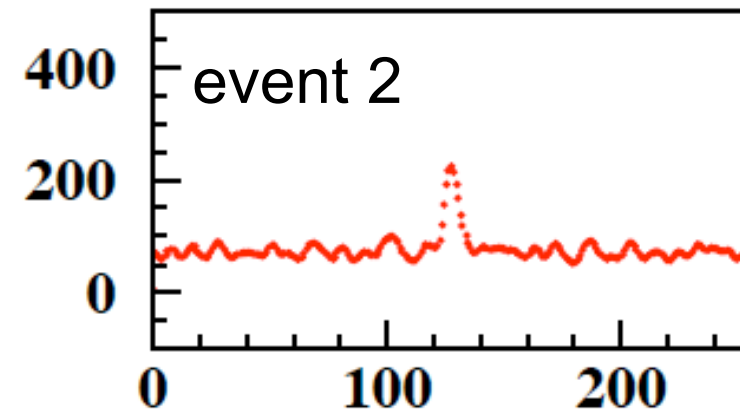
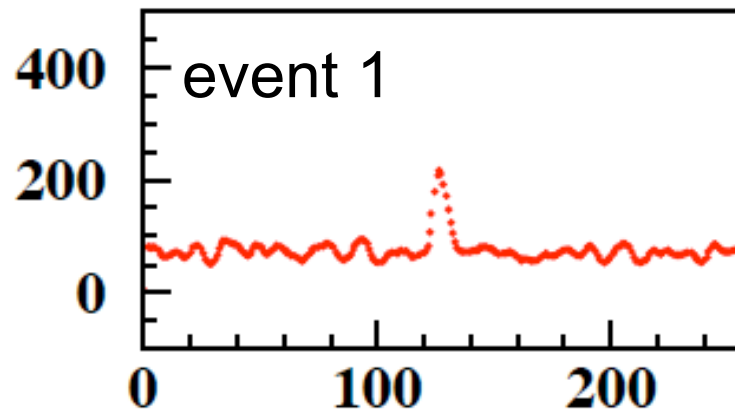
- CsI(T_l) with $2 \times 2 \text{ cm}^2$ PIN-PD = 5000 e-h/MeV .
- Attaching 1 piece of S8664-1010;
 - L.O. = $1/10$, QE = $40\%/80\%$, Area = $1/4$, Gain = 50 would result in 3100 e-h/MeV
- Current noise level = 4000 e-h .
- Equivalent noise energy = 1.2 MeV .
- Some ideas to improve factor $3 \sim 4$, comparable with the existent ECL (0.2 MeV).

Direct irradiation by ^{241}Am



60keV X-ray incident to S8664-1010 APD.
As seen, S/N is good enough to be taken by FADC.

FADC data for ^{241}Am



Readout software was modified from “polling” to “waiting for interrupt from CAMAC”.

Estimation of charge collection

- $60\text{keV}/3.6\text{eV} = 1.7 \times 10^4$ e-h originally created.
- In rough average, 250 FADC counts at peak.
- Test pulse($0.2\text{pC} = 1.2 \times 10^6$ e) : 2800 FADC counts at peak.
- $1.2 \times 10^6 \times 250/2800 = 1.1 \times 10^5$ e-h.
- Assuming that APD gain=50, charge collection would be $1.1 \times 10^5/50/1.7 \times 10^4 = 0.13$.
- We're afraid it is too low(!?).

Further check needed

- Setup carefully to be revisited.
- Resister($1\text{M}\Omega$) too big? \rightarrow change(try&error).
- Pulse height should be obtained by fit to FADC data(currently picking up maximum FADC count at peak).

Plan to see response for cosmic; 30cm long pureCsI given

- Attach APD, setup trigger counters
- Take cosmic data to see traversing muon's signal($\sim 30\text{MeV}$ deposit).

Summary

- Setup to see 1cmx1cm APD read out by FADC has been build up.
 - It took time to do
 - Noise reduction by finding proper grounding.
 - Change CAMAC software code from “polling” to “waiting for ADC interrupt”, etc.
 - By test pulse and pedestal distributions, noise level is estimated to be 4000 e-h.
- 60KeV X-ray(^{241}Am) direct irradiation signal seen.
 - Charge collection factor to be revisited.
- Plan to see cosmic ray signal.
 - Trigger counters and so on in preparation.
 - 30cm long pureCsI crystal gotten.