Strip response stability of sc-ecal

Beta ray response with simultaneous p.e. measurements

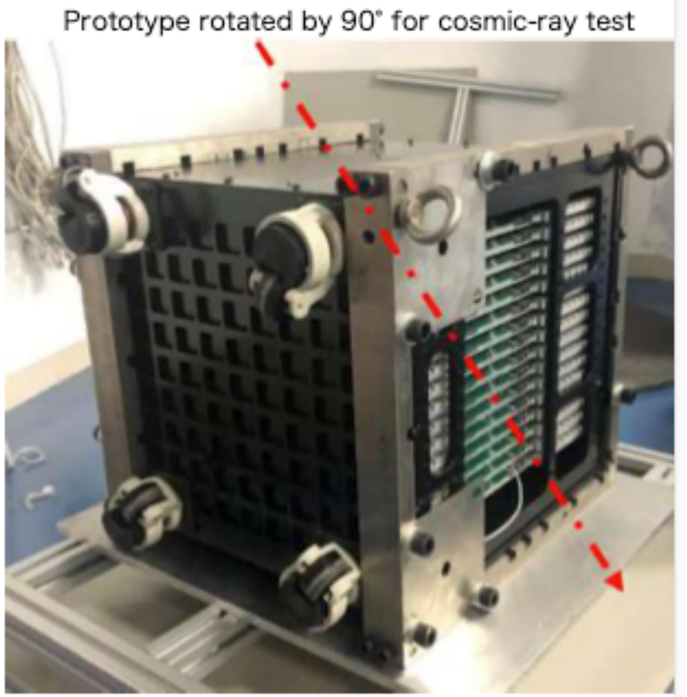
scintillator (Injection molded) and PS stability must be tested

T.Takeshita 12Apr2022 for CALICE 2022

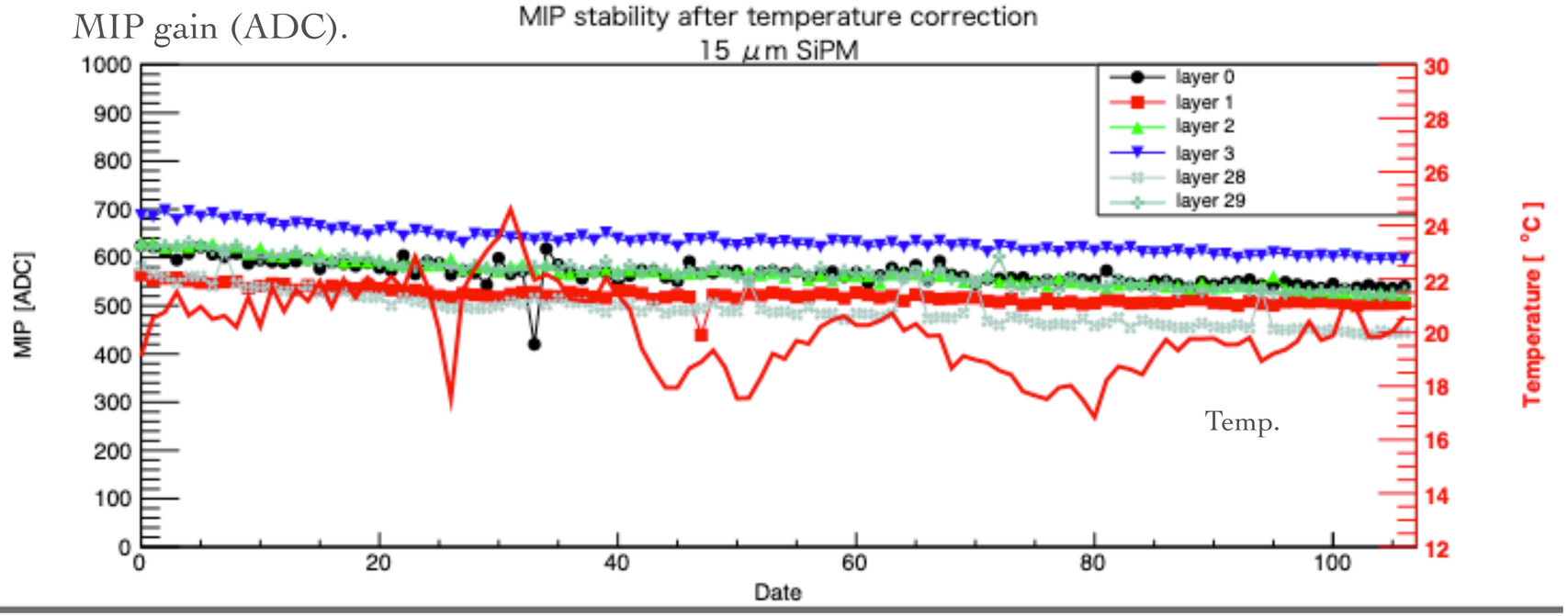
response stability of sc-ecal

Strip stability by cosmic rays

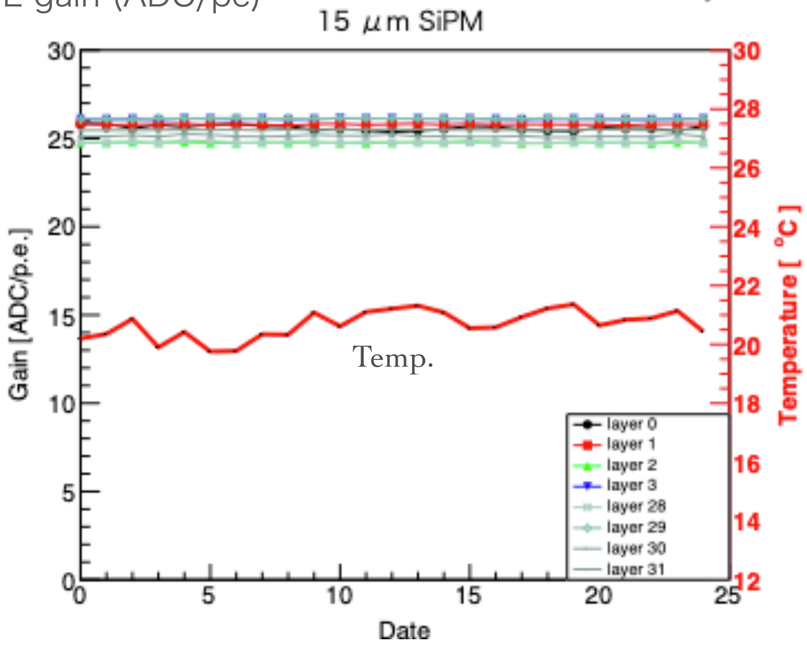
- gain decreased by -5%/3months (-20%/year) at Cosmic Rays of CJ-ECAL
- stable PE response of PS (MPPC) for a month



MIP gain (ADC).



PE gain (ADC/pe)



response stability of sc-ecal

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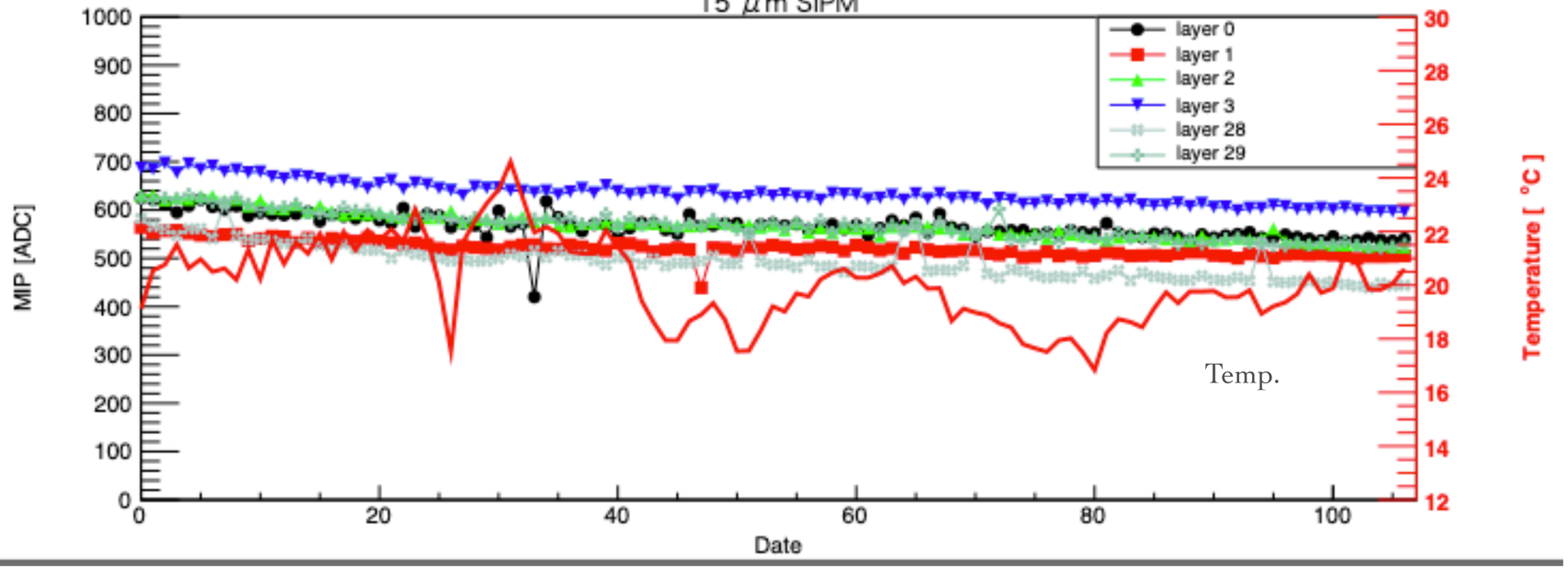
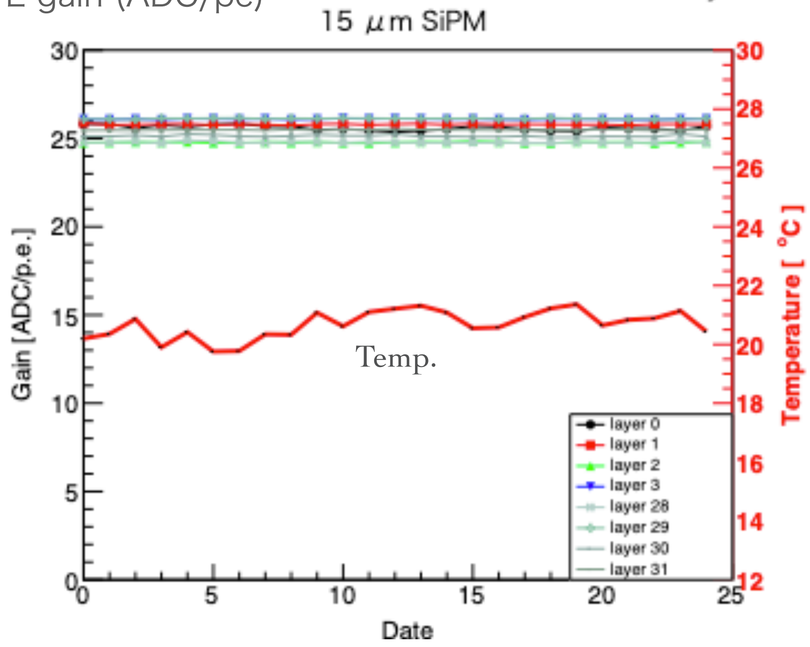


PE gain (ADC/pe)



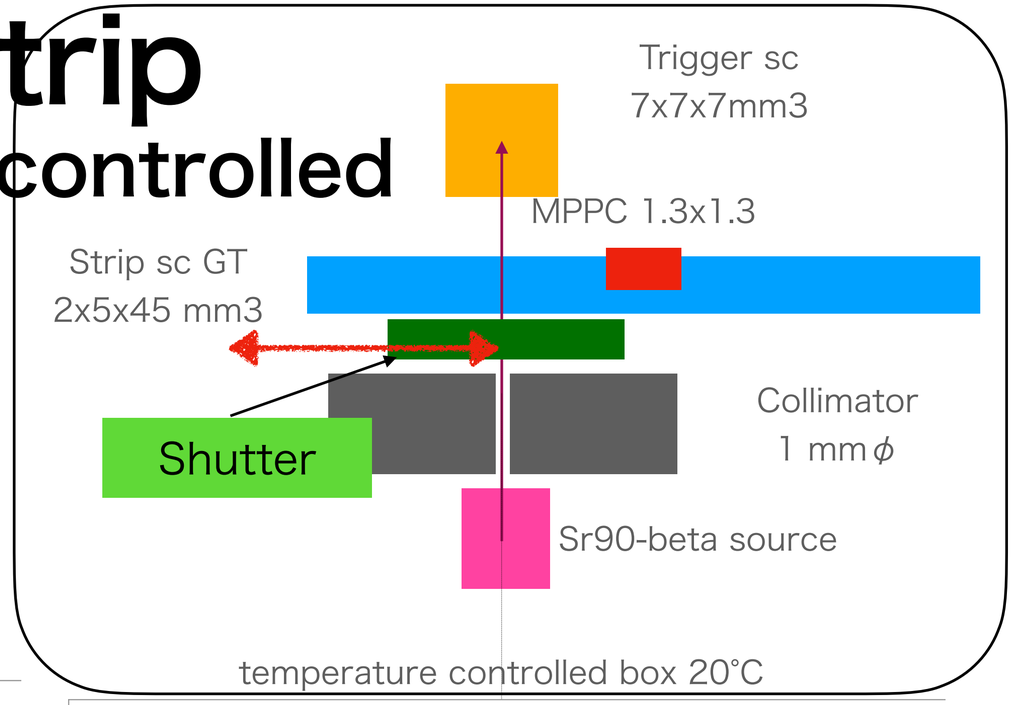
response stability of a strip

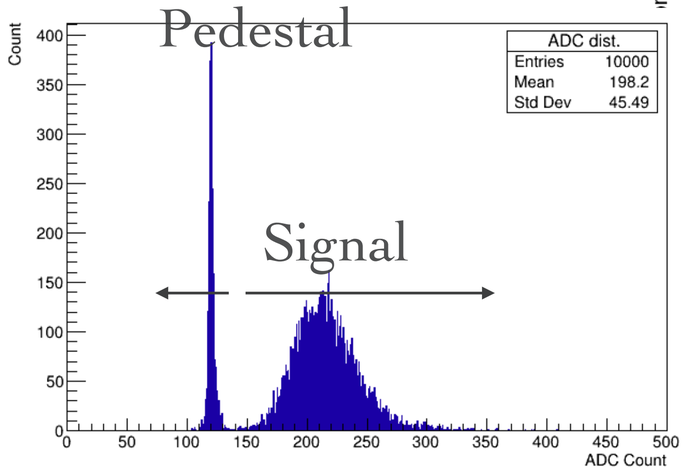
stability test with beta rays in temp. controlled

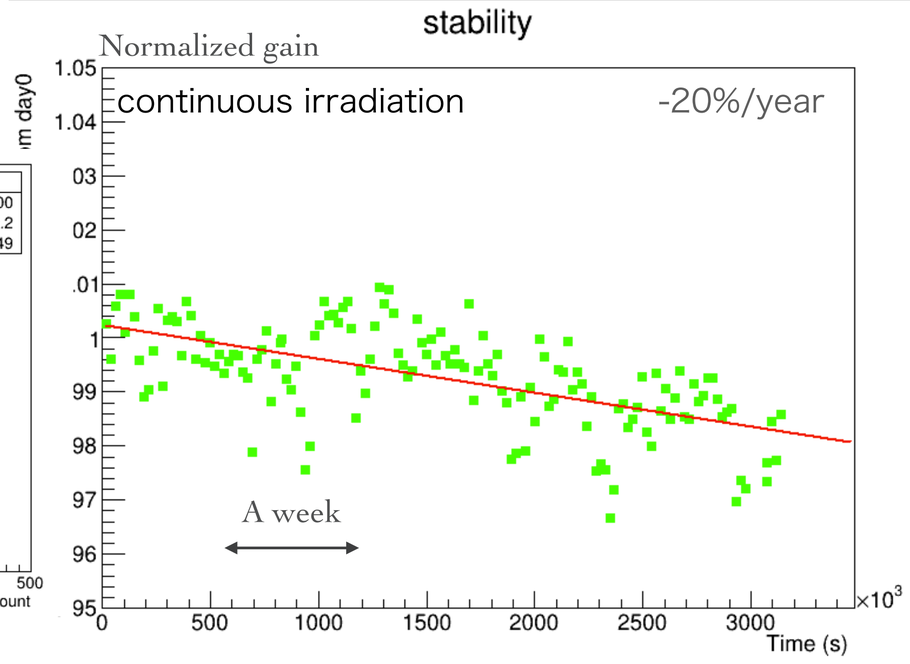
(1) continuous beta irradiation

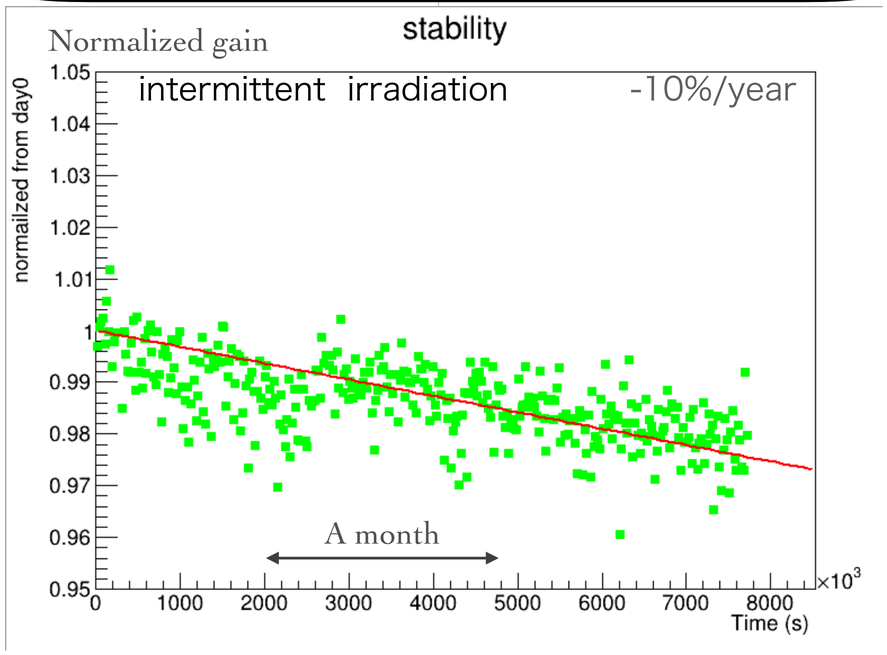
(without shutter) > -20%/year ! ~100Hz beta rays

(2) intermittent beta irradiation (with shutter) > -10%/year 4min/6hs





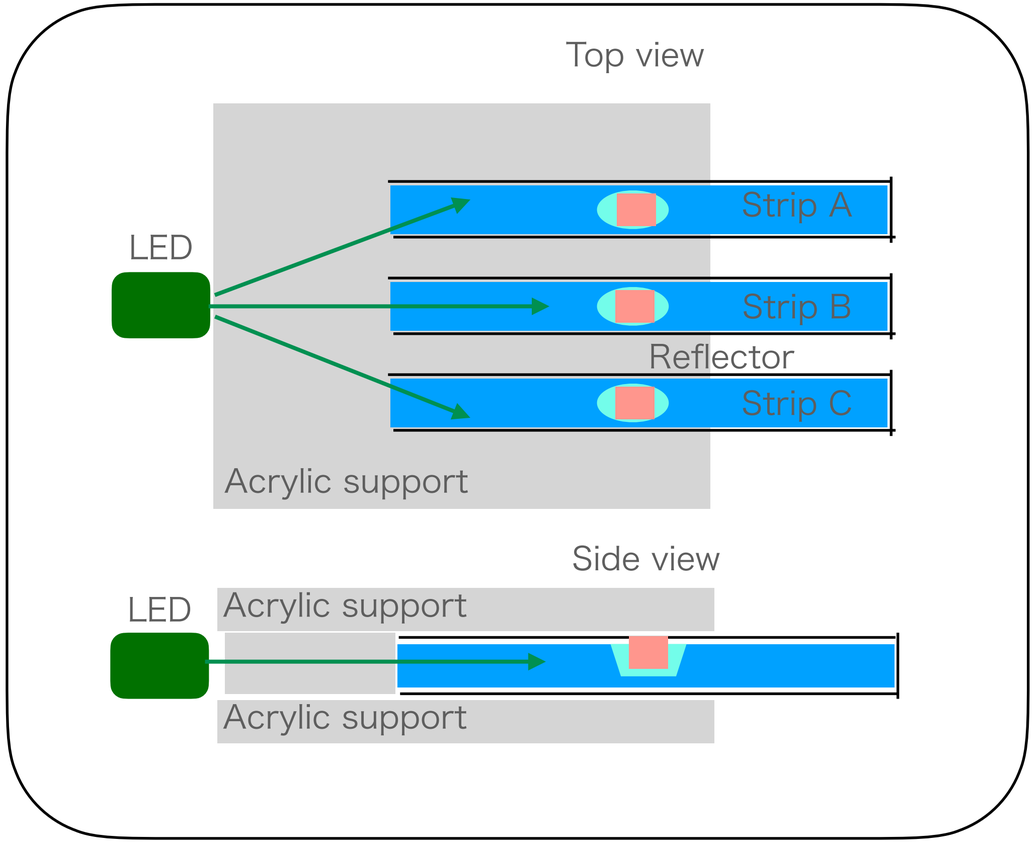




Introducing p.e. monitor

With three different strips simultaneously

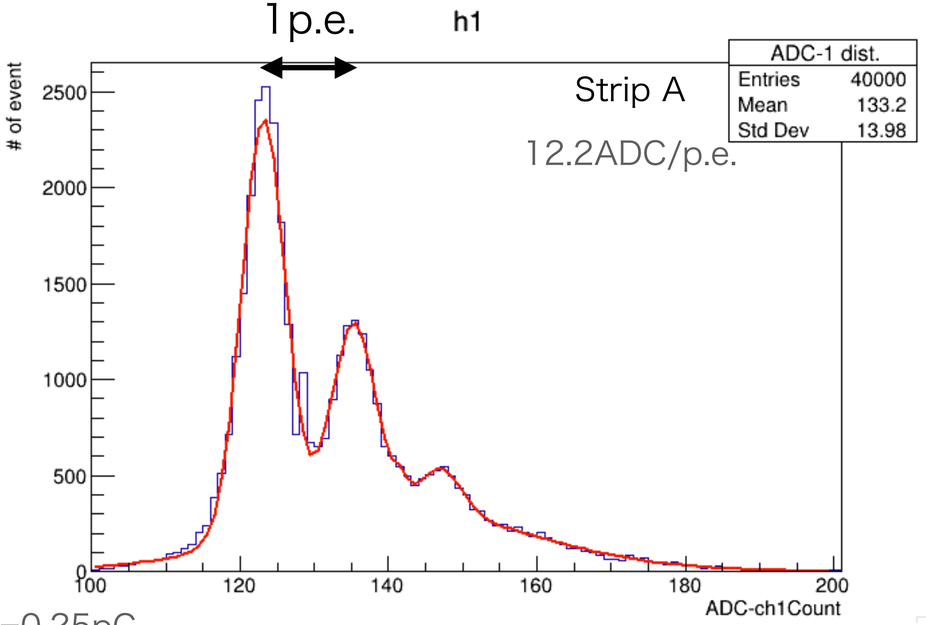
- LED photons from side of strips
- Strip A: injection molded with ICEPP dimple
- Strip B: Kuraray SCSN38 with Shinshu dimple
- Strip C: EJ204 with Shinshu dimple
- PS: MPPC: S14160-1315CS
- HVcommon=-51V, Isum~0.3uA



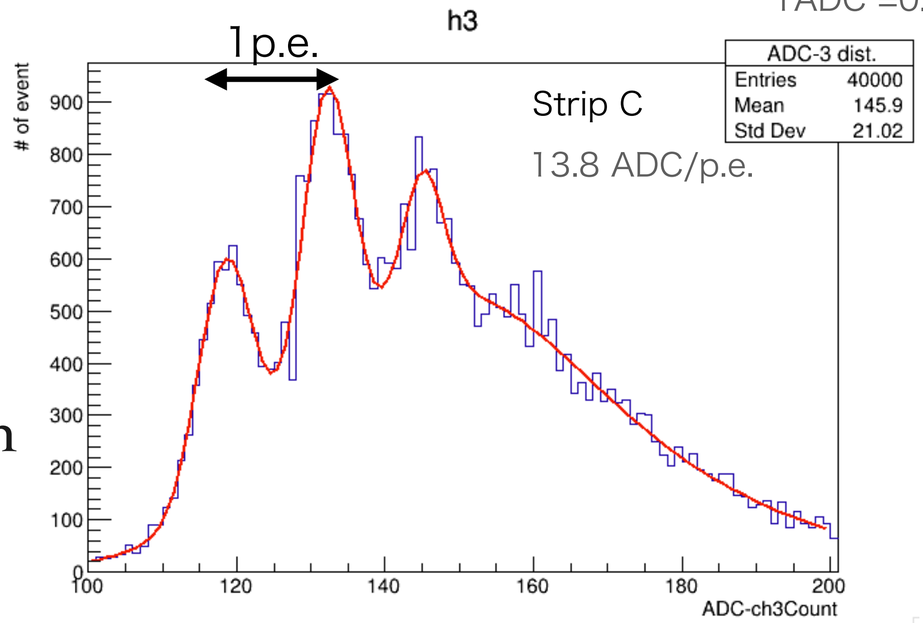
temperature controlled box <± 0.1°C

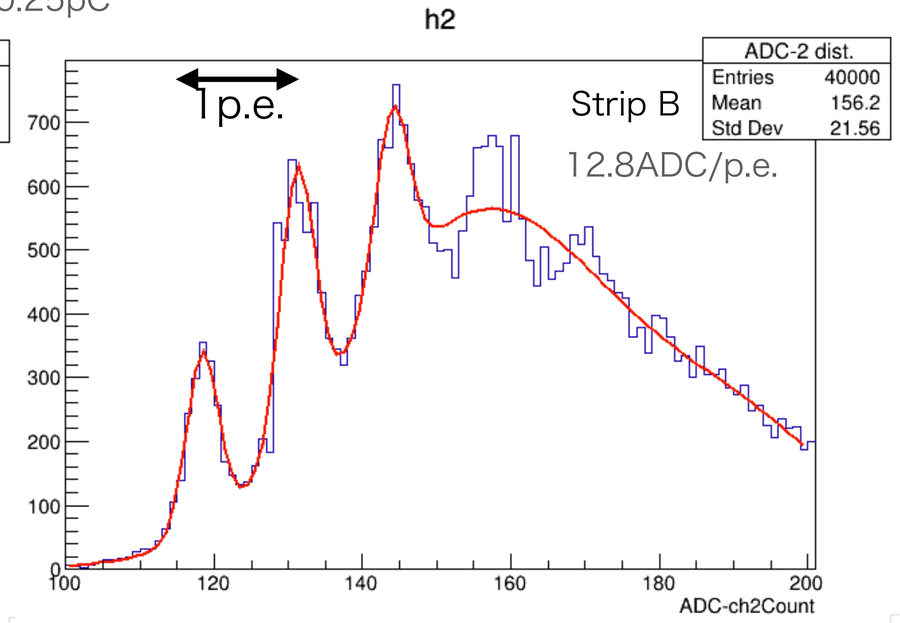
p.e. peaks by an LED

- An LED is flickering with 10Hz
- Histograms show ADC dist's at very beginning
- Fitting with sum of five gaussian functions between 100 and 200 ADC counts
- P.e.'s are calculated from the first(0p.e.) and second(1p.e.) peaks



1ADC =0.25pC

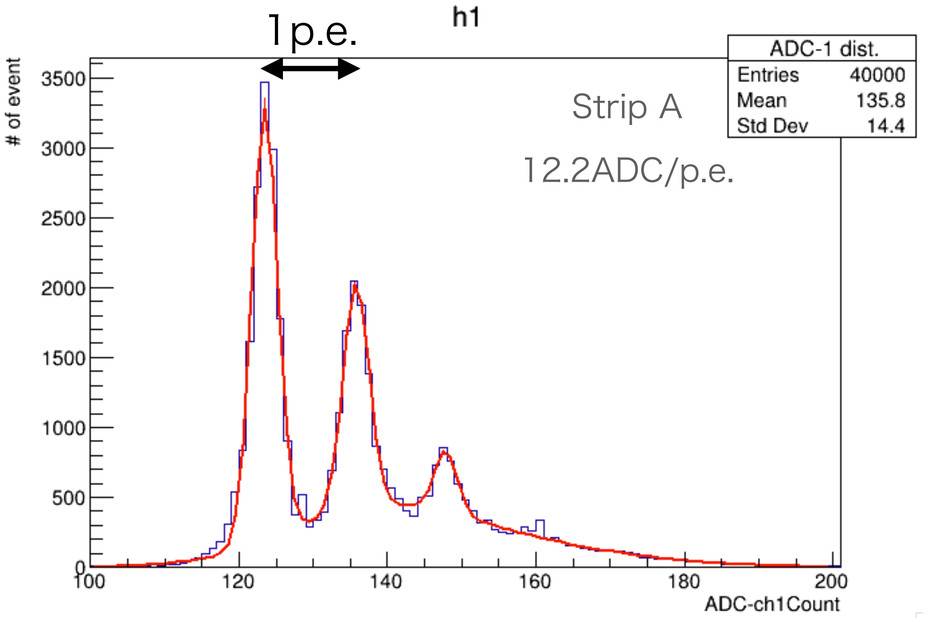


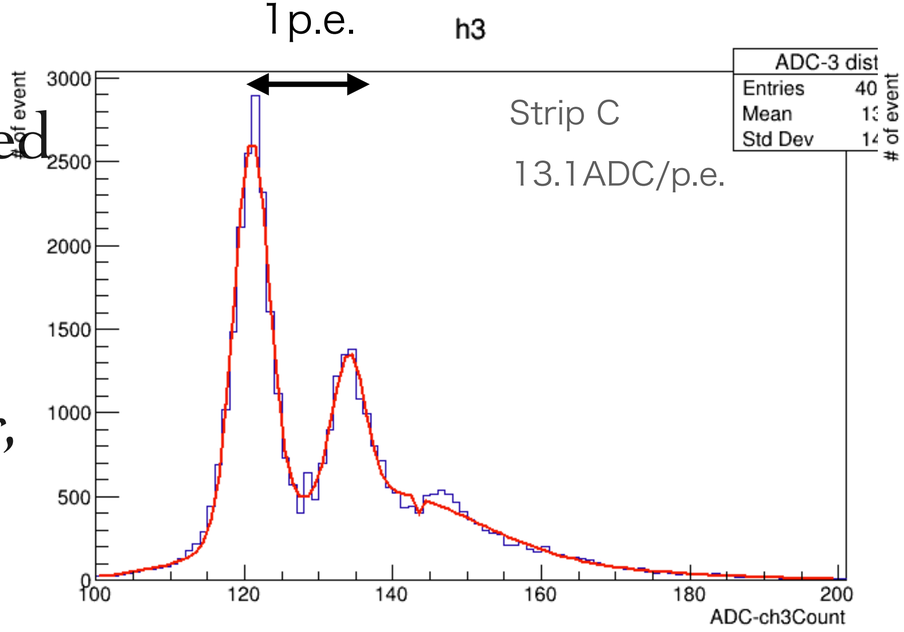


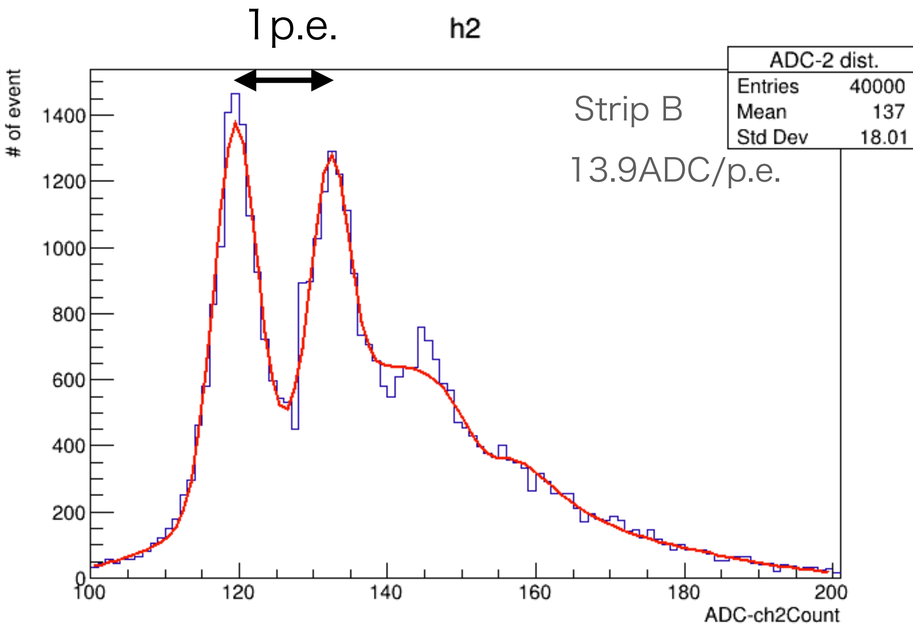
p.e. peaks by LED

a week later : shape changed

- Histograms show ADC dist's at 7.5days passed
- Distribution shape changed
- known fact: LED LY is stabler when applied voltage is higher, however, this is NOT







Pe stability result by LED trigger

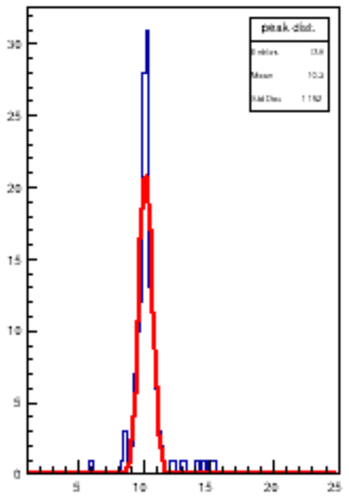
as of 28March2022 : started 28Jan2022 ~ 2months for stripA

3.9±2.4 ADC/year :

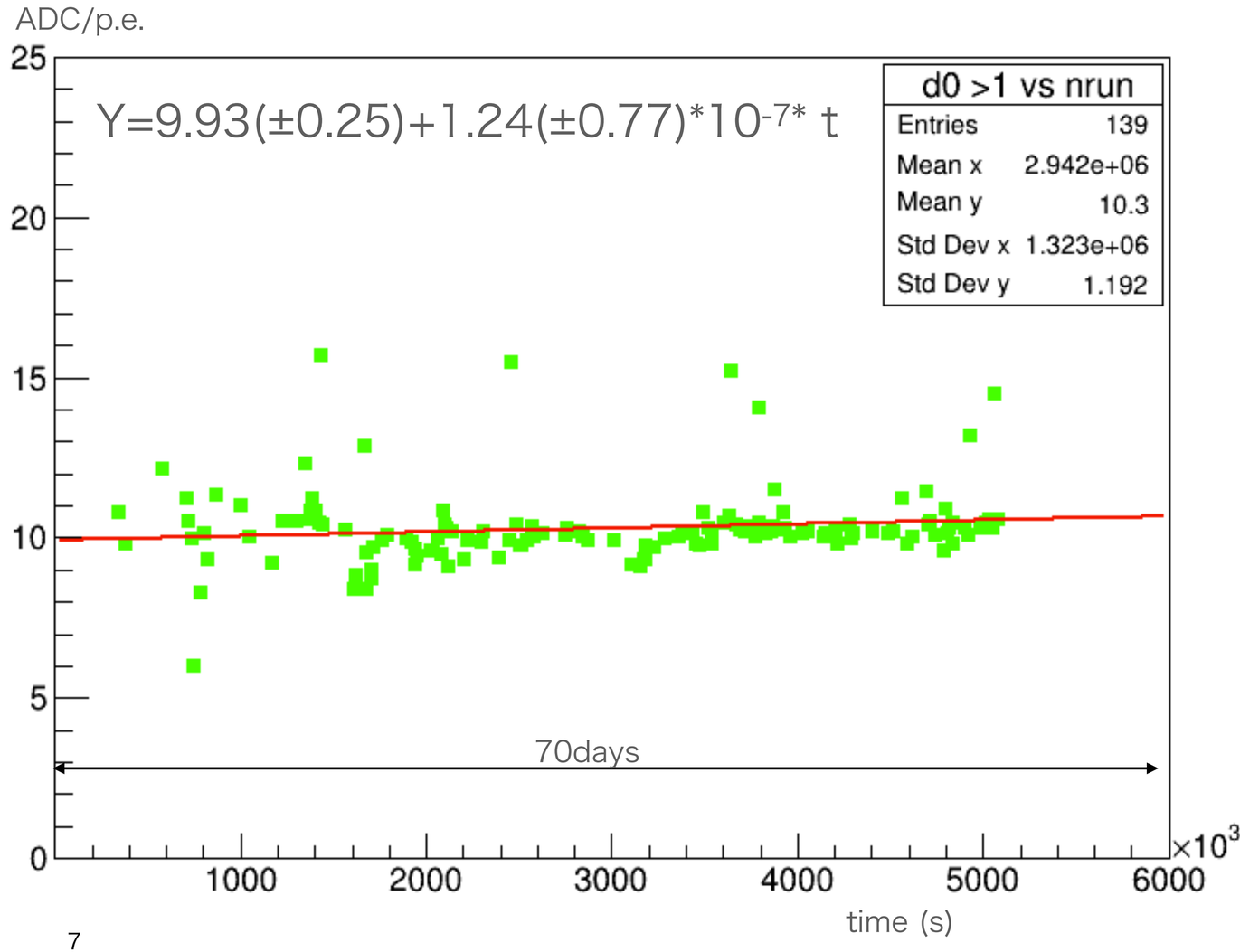
consistent with 0

9.93±0.25 ADC/pe :

stability ~2.5%




```
Minimizer is Linear
Chi2                      =      3154.66
NDf                       =          137
p0                        =      9.92962   +/-   0.248029
p1                        =   1.23894e-07   +/-   7.68957e-08
 FCN=22.8855 FROM MIGRAD    STATUS=CONVERGED     100 CALLS         101 TOTAL
                     EDM=1.92796e-08    STRATEGY= 1      ERROR MATRIX ACCURATE
  EXT PARAMETER                                   STEP         FIRST
  NO.   NAME      VALUE            ERROR          SIZE      DERIVATIVE
   1  Constant     2.12022e+01   2.77383e+00   4.69645e-03  -2.94933e-05
   2  Mean         1.01325e+01   4.96050e-02   1.18064e-04   1.96368e-03
   3  Sigma        5.25973e-01   4.97981e-02   3.44462e-05   4.69780e-03
```



Pe stability by LED

as of 28March2022 : started 28Jan2022 ~ 2months for stripB

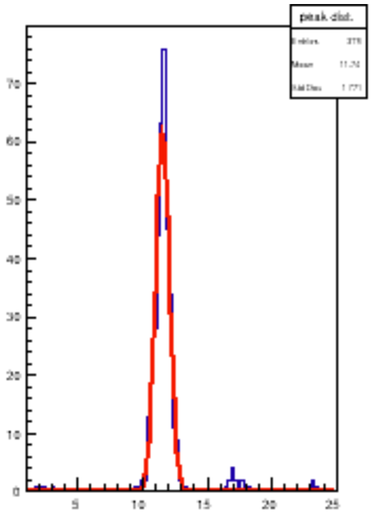
6.1±2.3 ADC/year :

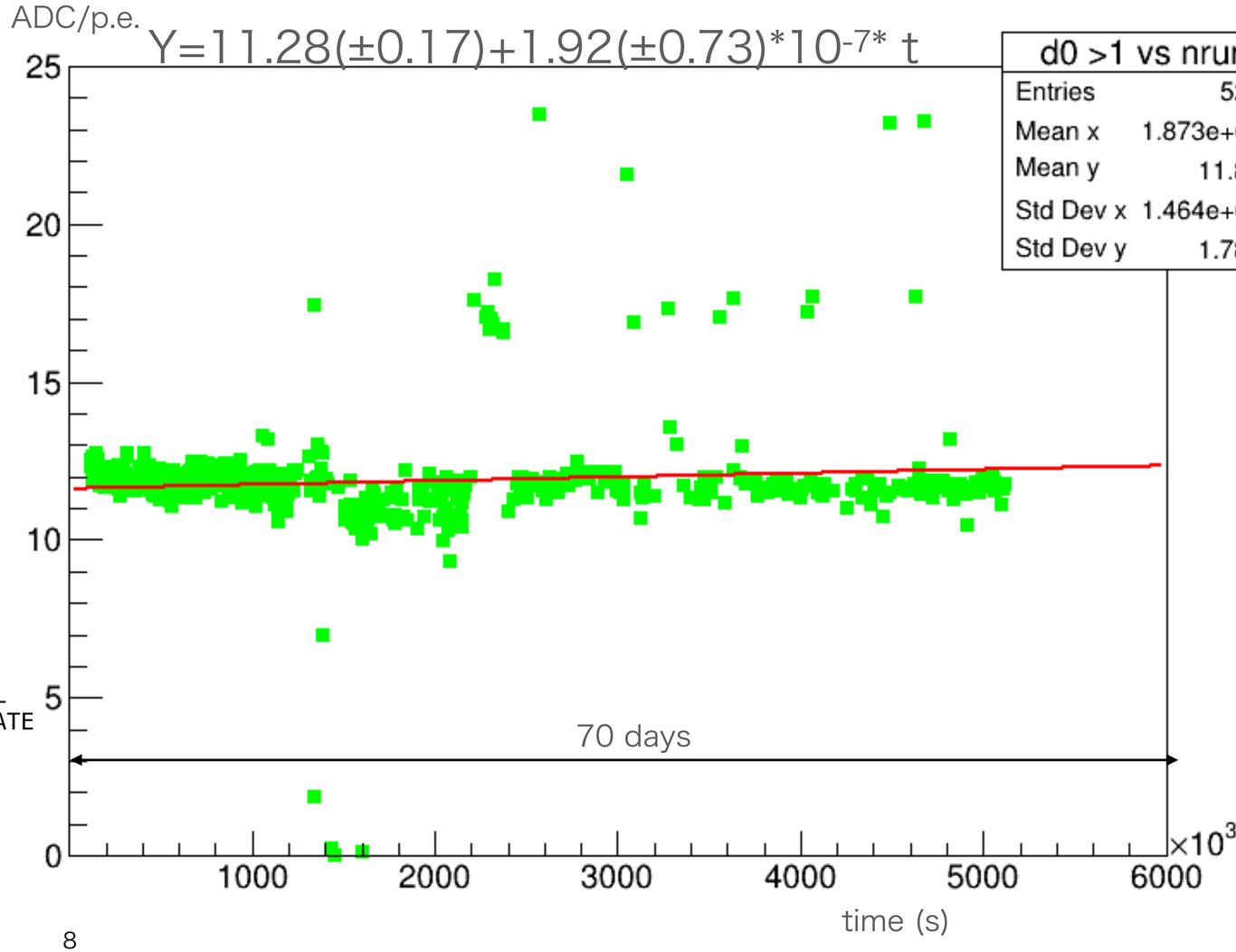
consistent with 0

need to remove bad fits

gain: 11.28±0.17 ADC/pe

stability ~2.5%





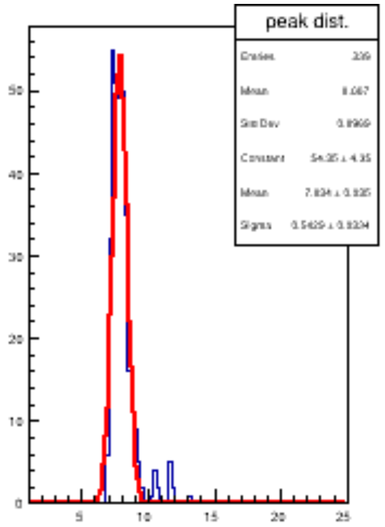

```
Minimizer is Linear
Chi2                      =      30943.6
NDf                       =          430
p0                        =      11.2803   +/-   0.174295
p1                        =   1.9234e-07   +/-   7.25223e-08
 FCN=34.6458 FROM MIGRAD    STATUS=CONVERGED      88 CALLS          89 TOTAL
                     EDM=8.11377e-07    STRATEGY= 1      ERROR MATRIX ACCURATE
  EXT PARAMETER                                   STEP         FIRST
  NO.   NAME      VALUE            ERROR          SIZE      DERIVATIVE
   1  Constant     6.22185e+01   4.34846e+00   9.81845e-03   2.92855e-04
   2  Mean         1.15327e+01   2.87674e-02   8.31017e-05   2.80841e-02
   3  Sigma        5.25373e-01   2.32614e-02   1.74158e-05   1.05486e-01
```

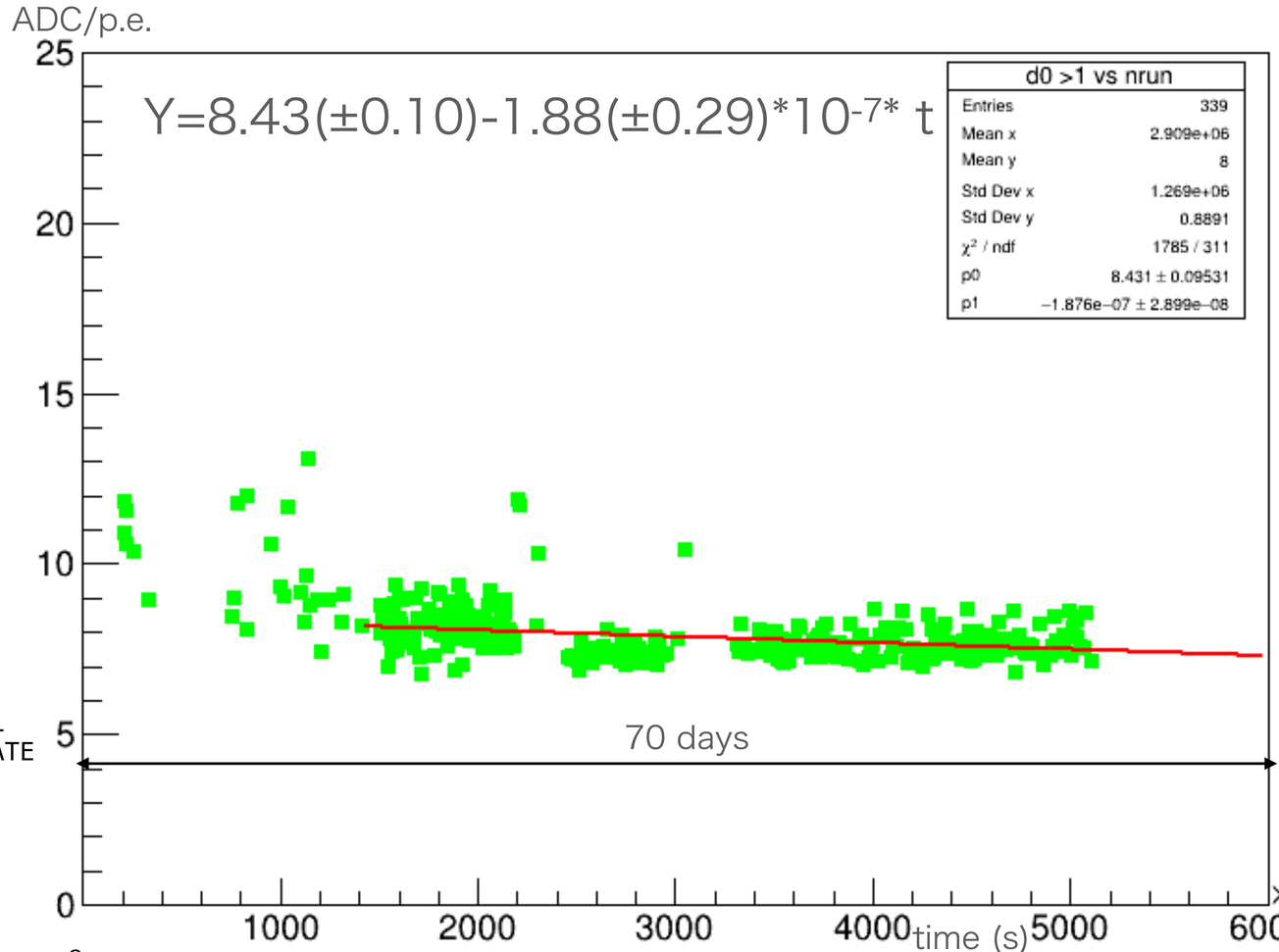
Pe stability by LED

as of 28March2022 : started 28Jan2022 ~ 2months for stripC

5.9±0.91 ADC/year :
slightly decreasing

gain: 8.43±0.10 ADC/pe
stability ~7%



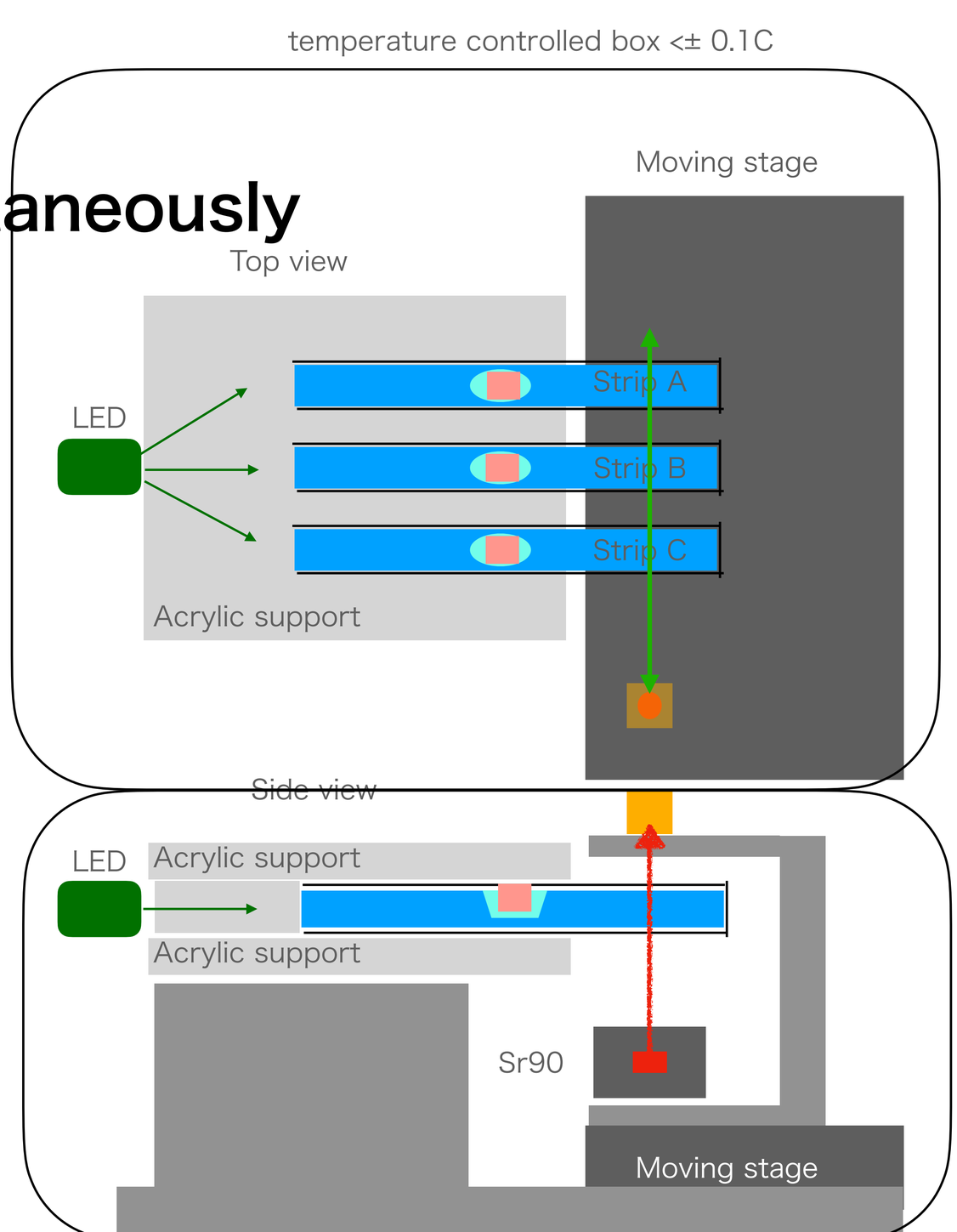



```
Minimizer is Linear
Chi2                      =      1784.86
NDf                       =          311
p0                        =      8.43137   +/-   0.0953126
p1                        = -1.87556e-07   +/-   2.89948e-08
 FCN=38.0555 FROM MIGRAD    STATUS=CONVERGED      82 CALLS          83 TOTAL
                     EDM=5.70404e-08    STRATEGY= 1      ERROR MATRIX ACCURATE
  EXT PARAMETER                                   STEP         FIRST
  NO.   NAME      VALUE            ERROR          SIZE      DERIVATIVE
   1  Constant     5.43528e+01   4.34610e+00   9.55907e-03   8.57848e-05
   2  Mean         7.83354e+00   3.50201e-02   1.01723e-04   1.80995e-03
   3  Sigma        5.42883e-01   3.33772e-02   3.37628e-05   2.50924e-03
```

beta ray response

With three different strips simultaneously

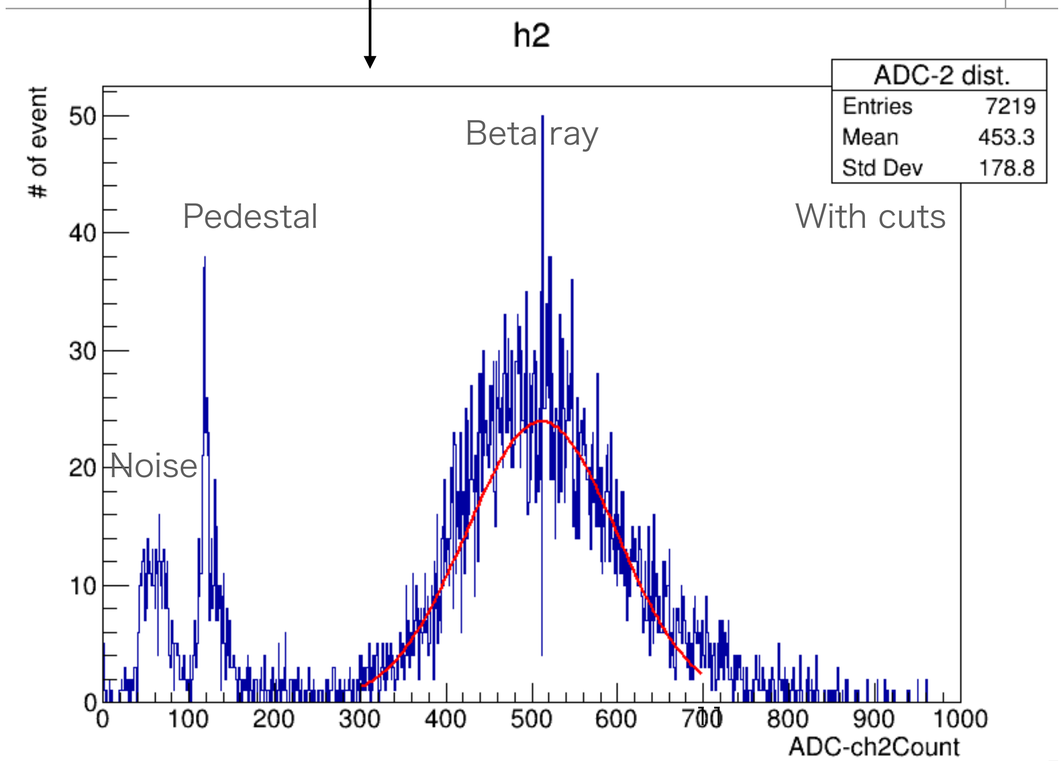
- Fixing LED and Strips
- Beta ray source and a trigger counter move with a moving stage
- DAQ triggered both LED(10Hz) and beta ray(50Hz)
- Moving stage (stepping motor) generates serious electric noise!

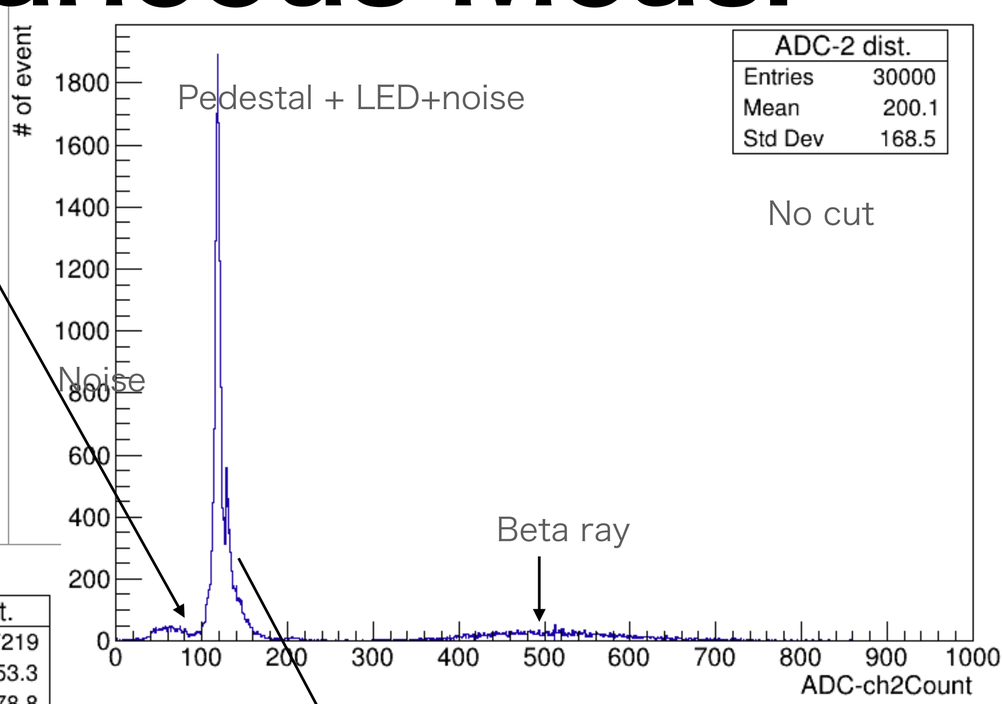


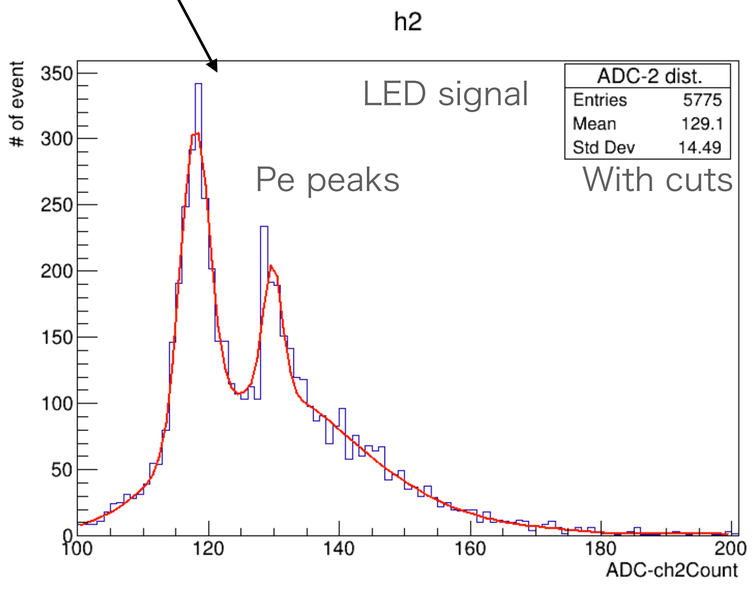
Beta ray and LED simultaneous Meas.

DAQ with beta trigger + 10Hz LED

- Due to serious noise from moving stage, funny peaks in strip ADC distribution
- By using trigger counter information (ADC and TDC), some noise events are removed and enhanced at pe and MIP peaks



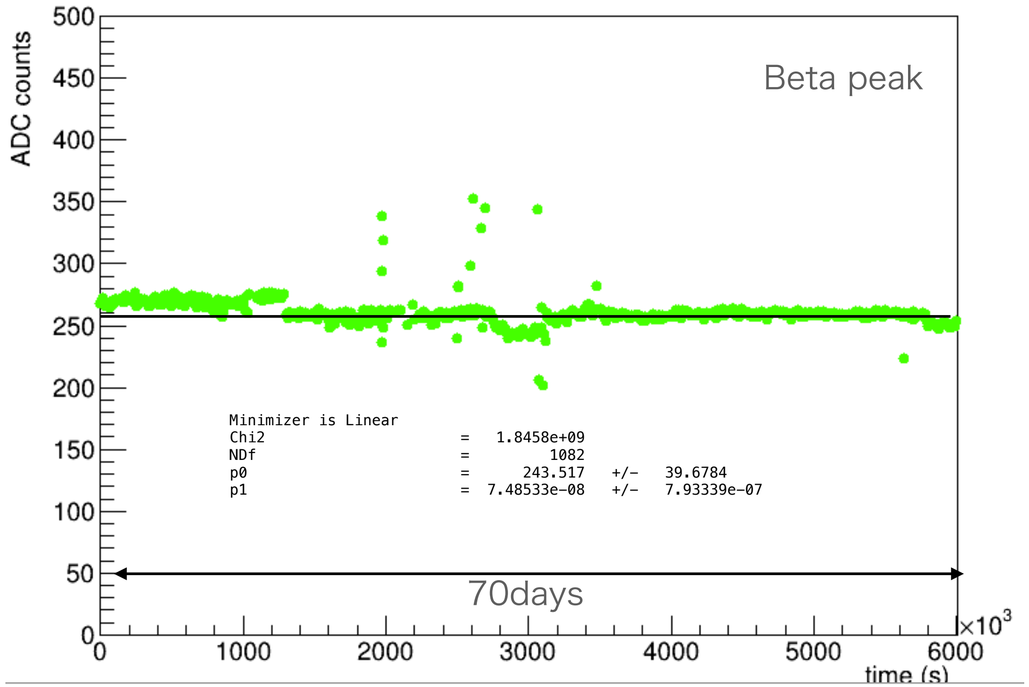


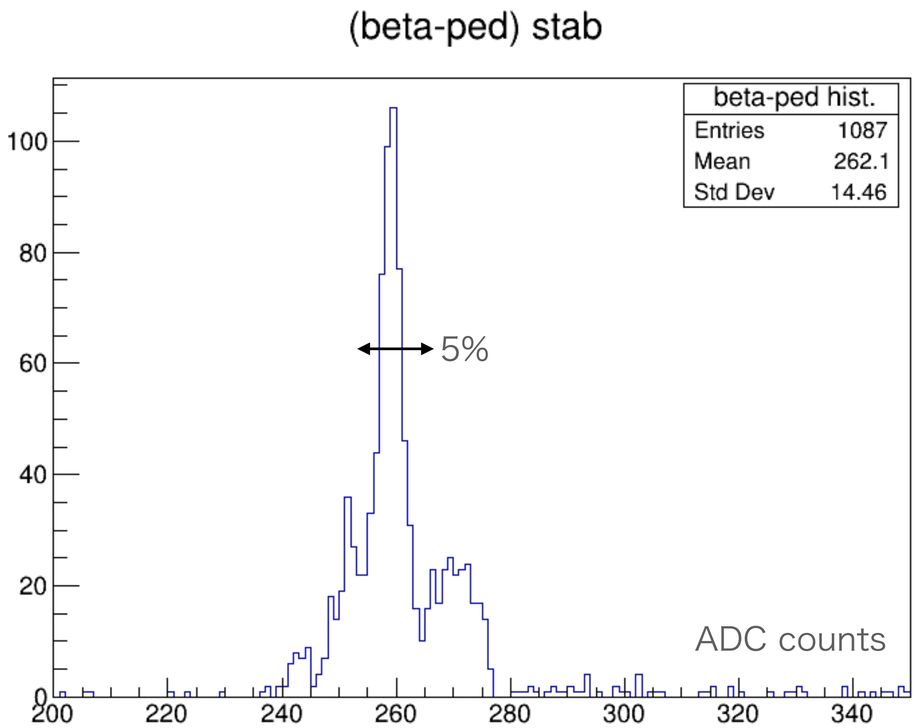


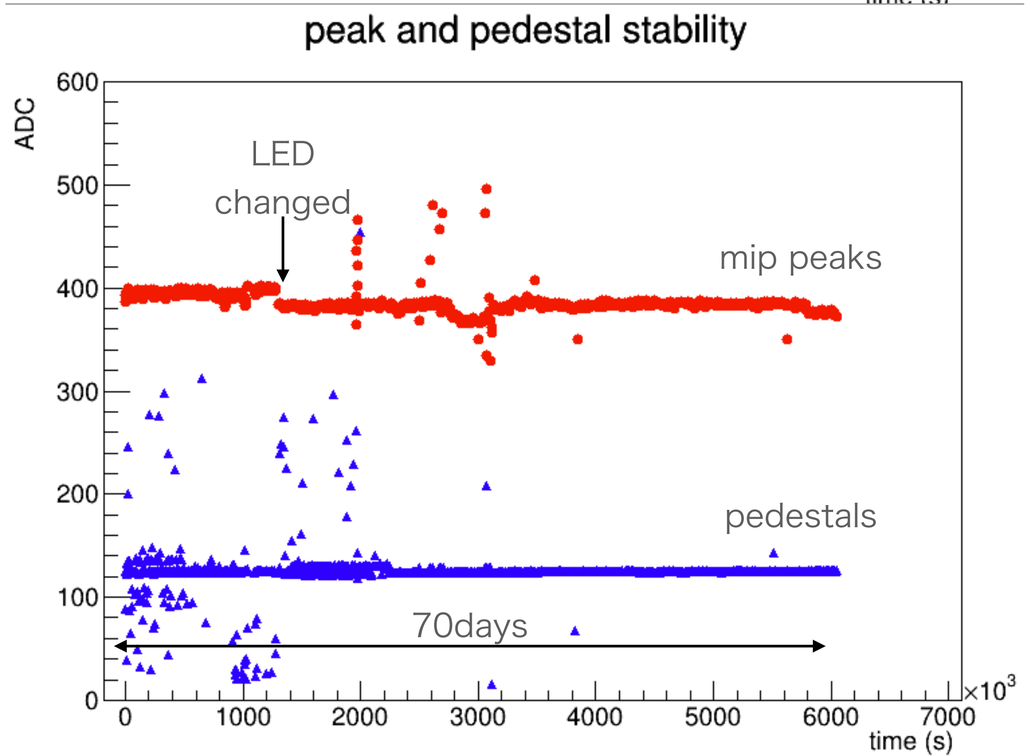
Stability : beta rays

stripA : injection molded strip

- For 2.5 months : almost no gain change
- Good stability



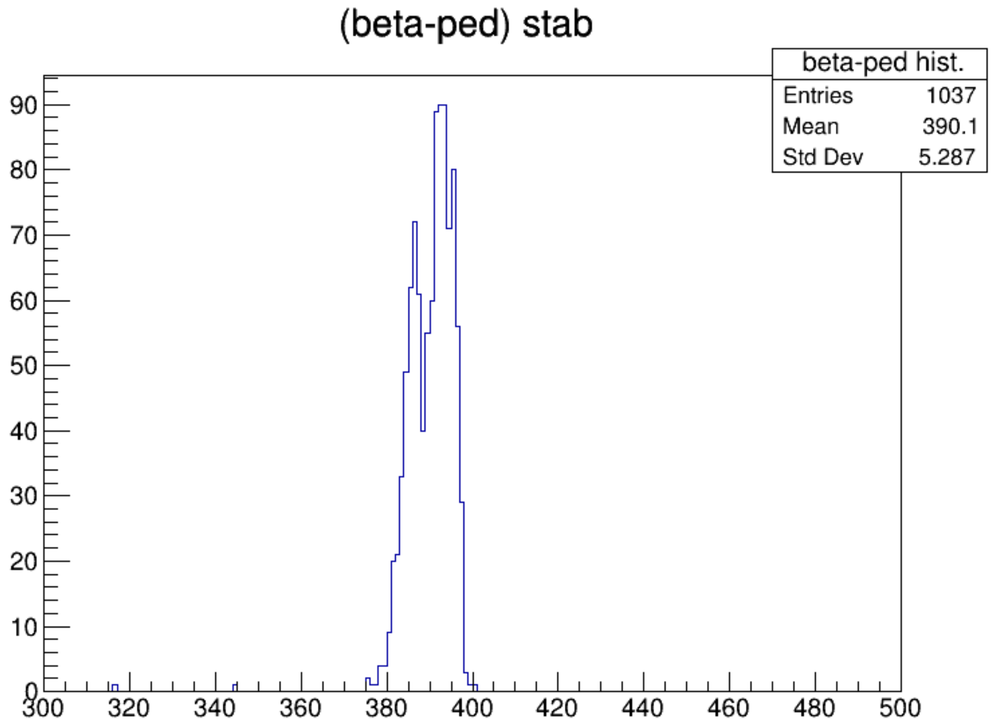


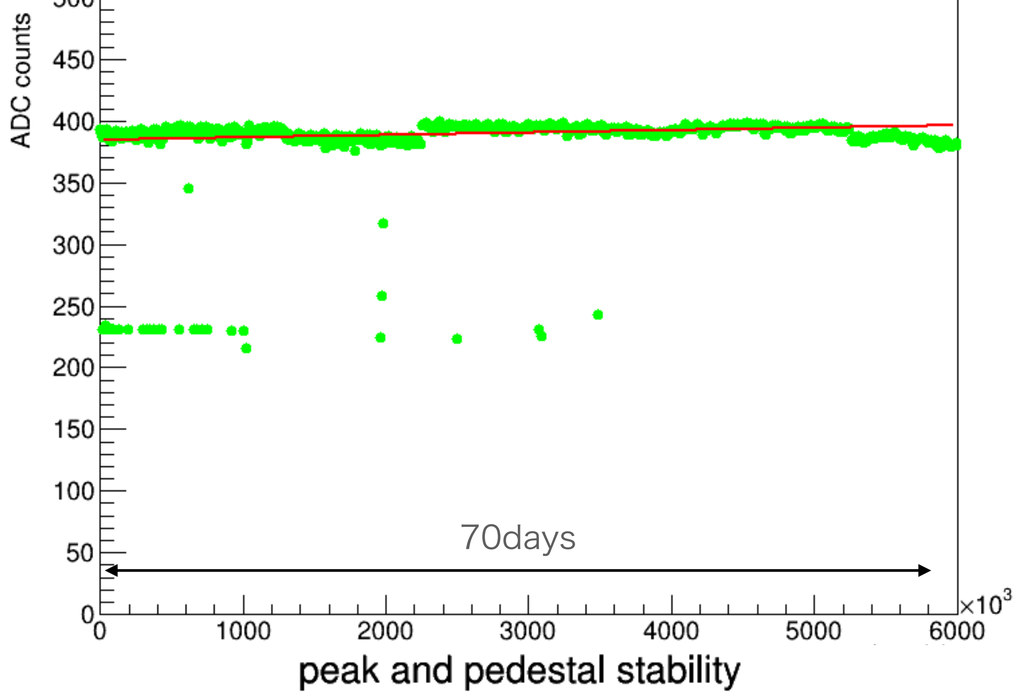


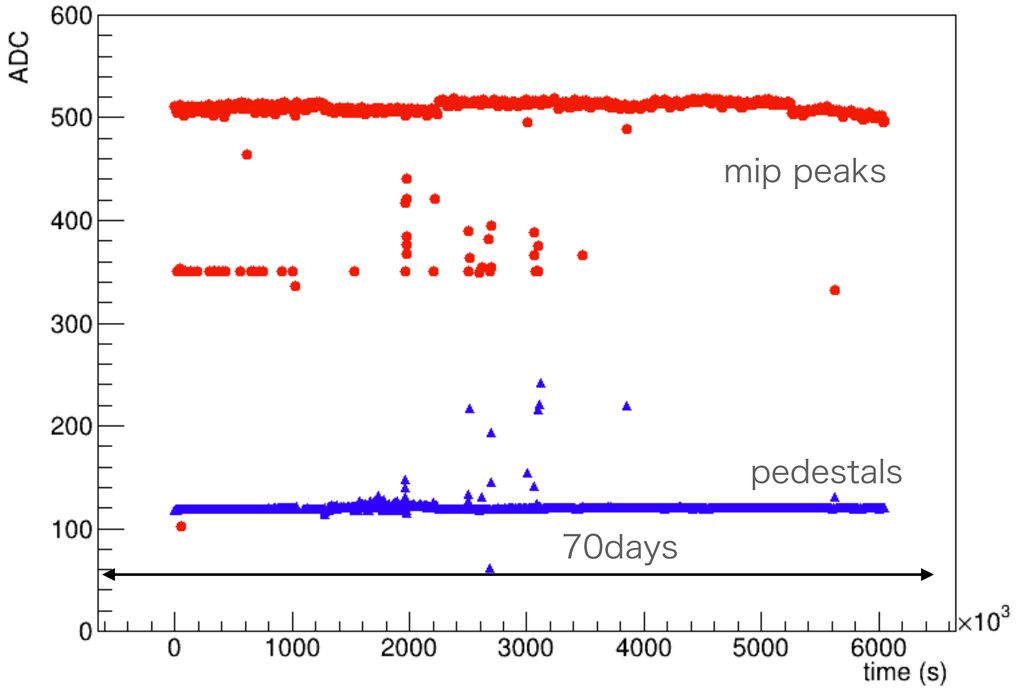
Stability : beta rays

stripB: Kuraray SCSN38

- For 70 days: no gain change
- stable enough < 1.5%





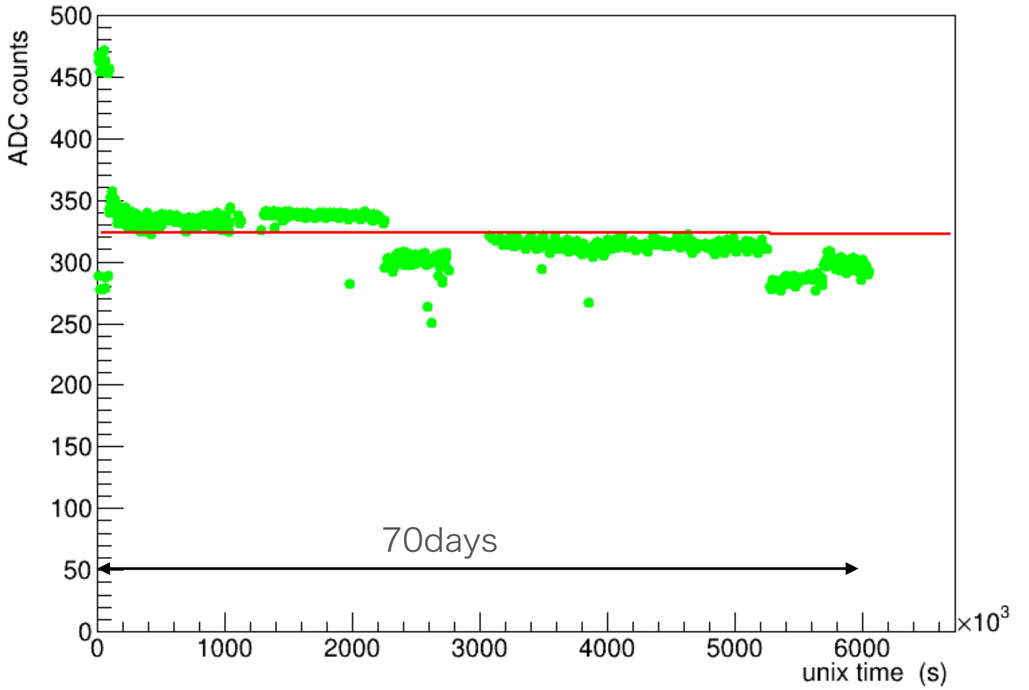


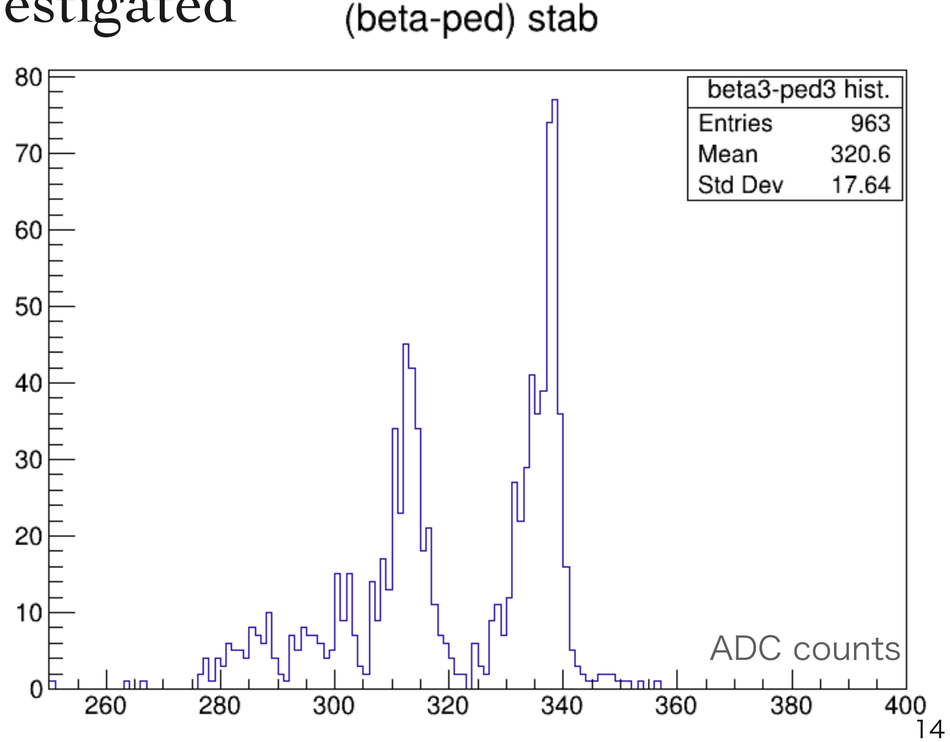
ADC counts

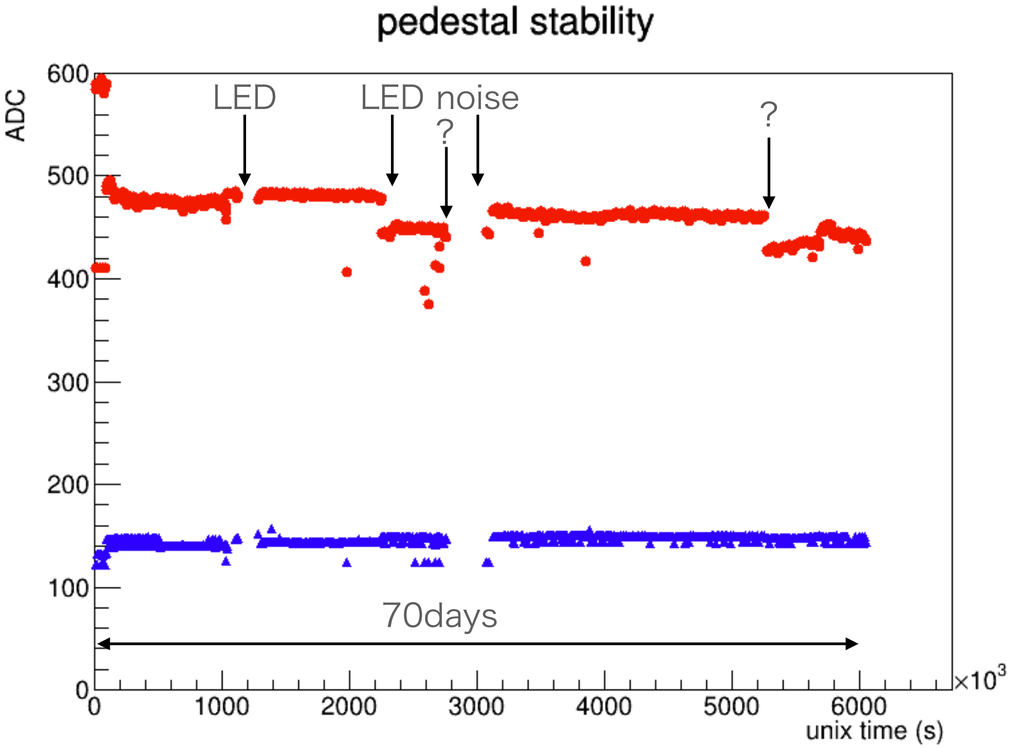
Stability : beta rays

stripC: EJ204

- systematic gain shifts detected
  - LED system modified and noise from moving stage
- Good beta peak stability ~ 1%
- being investigated







Summary and outlook as of April2022
Strip/ PPD stability test

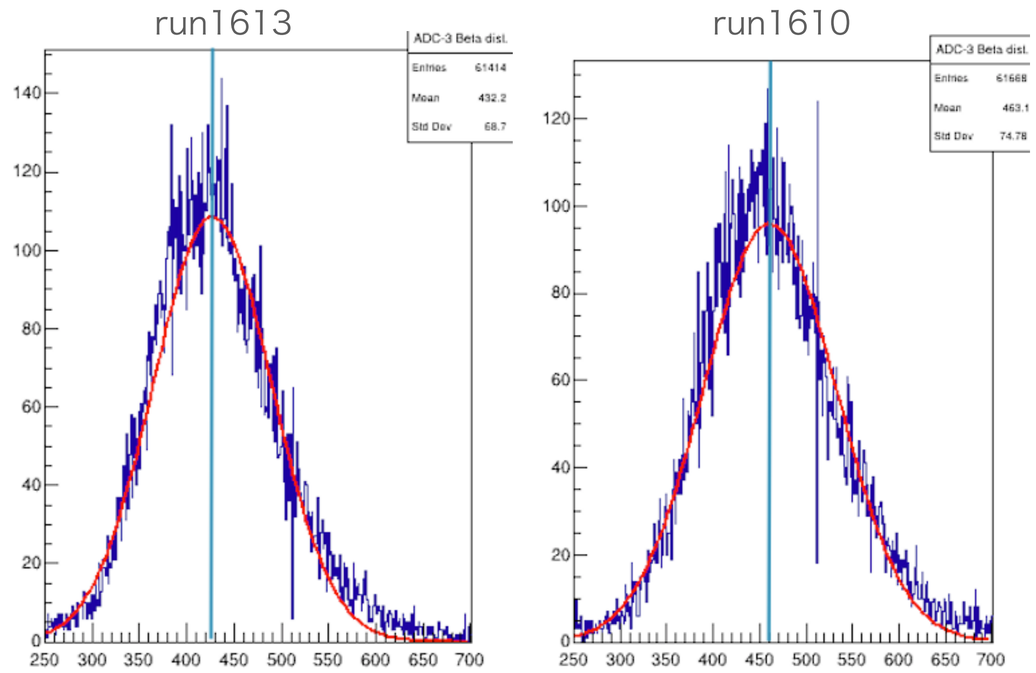
- in order to verify the stability of scintillator strip system
- set up to measure the stability of beta response with simultaneous photo-electron detection is established and started DAQ for two months
- on the whole, stable responses with beta rays for three strips include photosensors
- some little issues (gain shift and bad peak fittings)
- continue for more months
- next measurements: accelerated with higher temperature

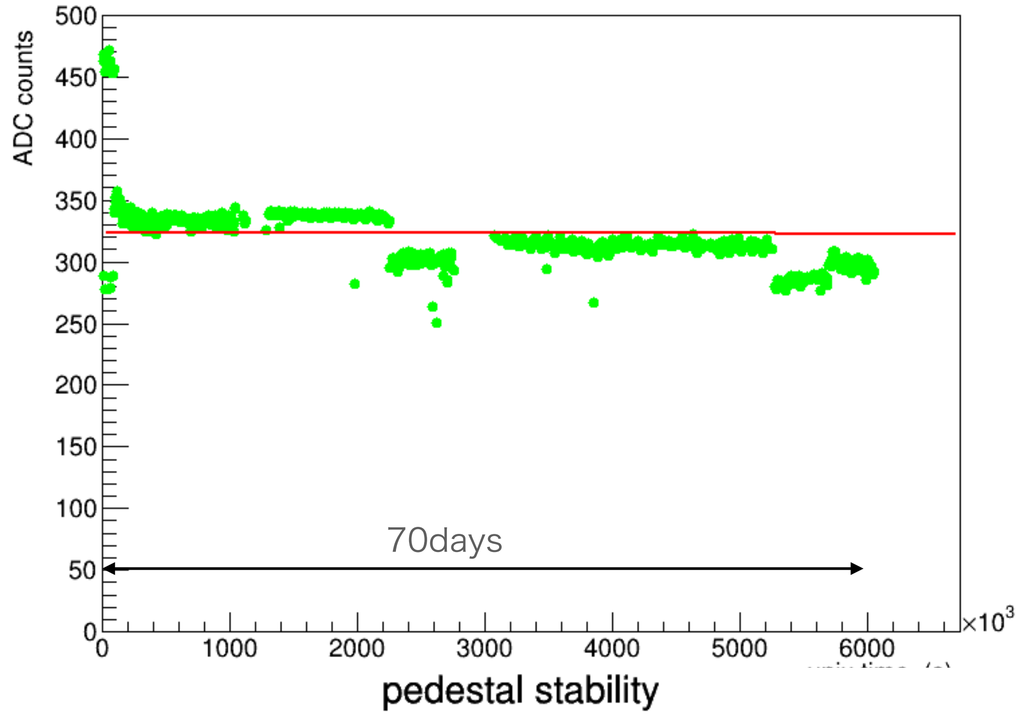
Stability : beta rays

stripC: EJ204

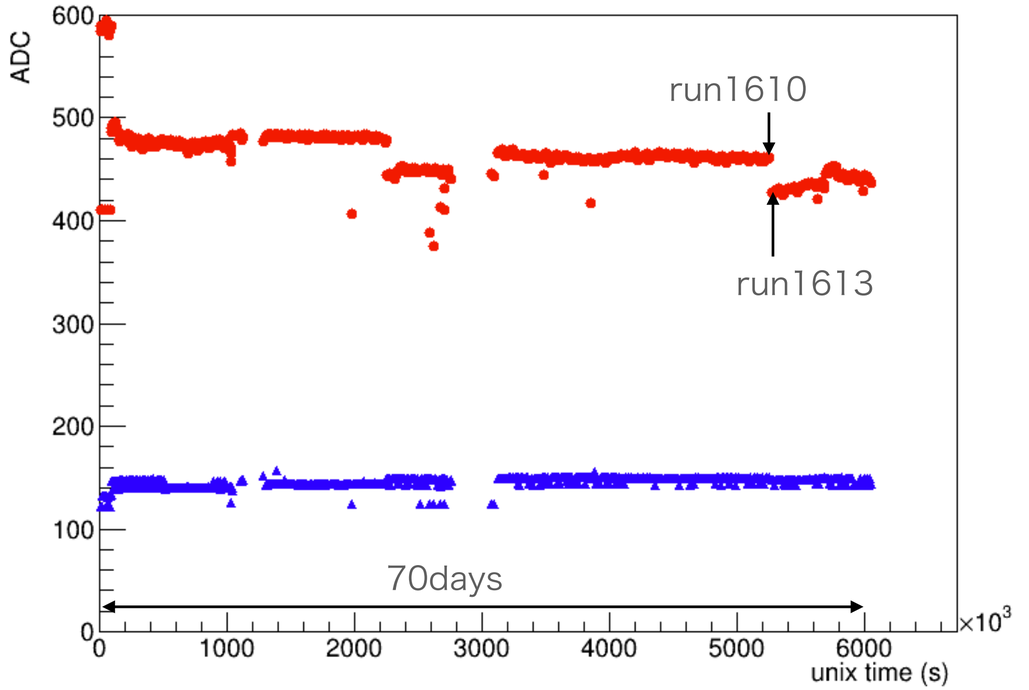
gain shift between run1610 and 1613

similar results with different bin width





pedestal stability



Pe stability by LED

as of 28March2022 : started

28Jan2022 ~ 2months for stripC

peak finding/
fitting does
not work
properly