Dark rate measurement status report

Tokyo University of Science

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20th December, 2019

mPMT meeting

List of the PMTs


R14374

XP72B2F

XP82B20

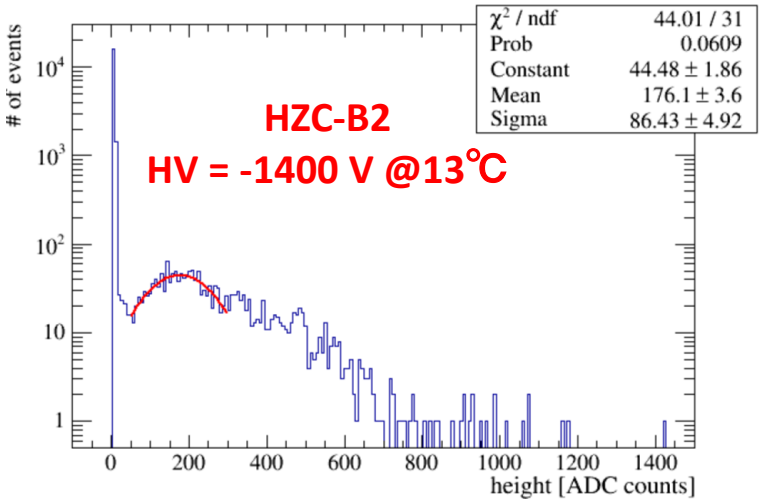
	ID	Type	HV	Negative	Positive
Hamamatsu	HPK	R14374	1250	✓	-
HZC new PMT	HZC-B1	XP72B2F	-	-	-
	HZC-B2	XP72B2F	Tuned HV	✓ (this week)	-
HZC old PMT	HZC-A1	XP82B20	-	-	-
	HZC-A2	XP82B20	-	-	-

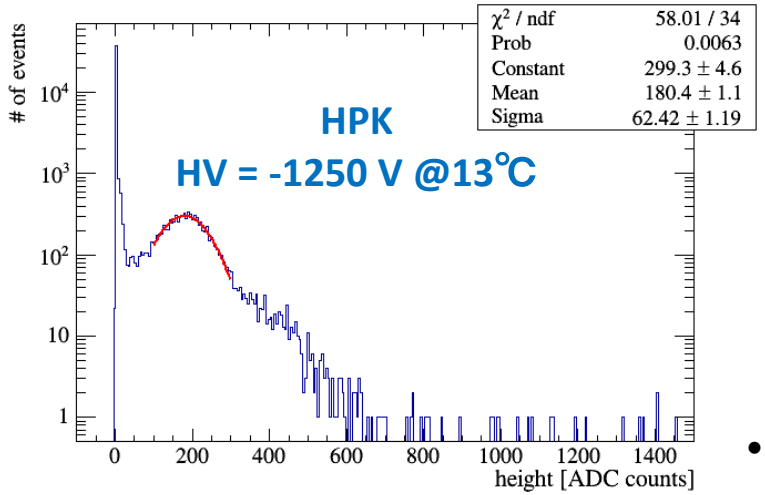
This week...

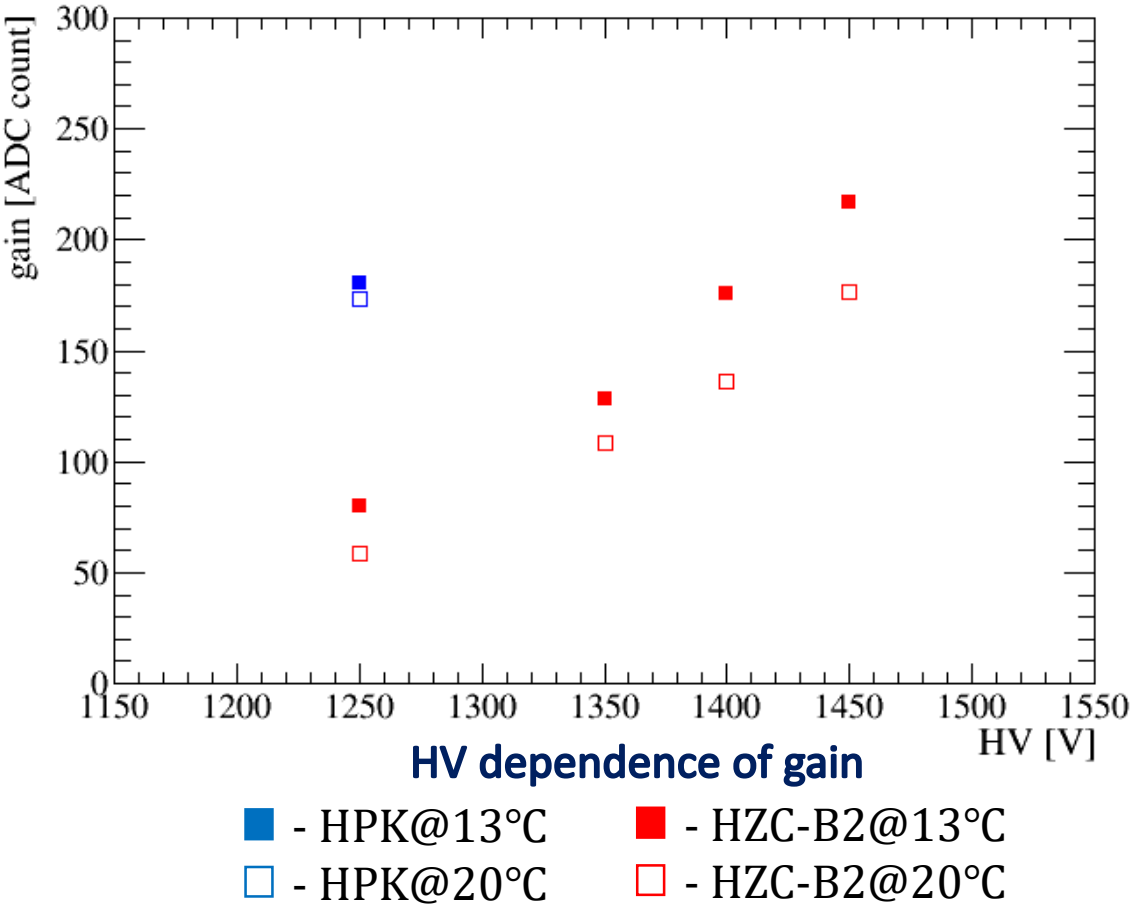
- I tuned HV value of HZC-B2 to give almost the same gain with HPK, then measured the dark rate.

HV dependence of gain

- Changing HV supplied to Chinese PMT, I measured 1 p.e. pulse height by illuminating low intensity laser.
- Right graph shows the HV dependence of gain at 13 and 20 degree Celsius.







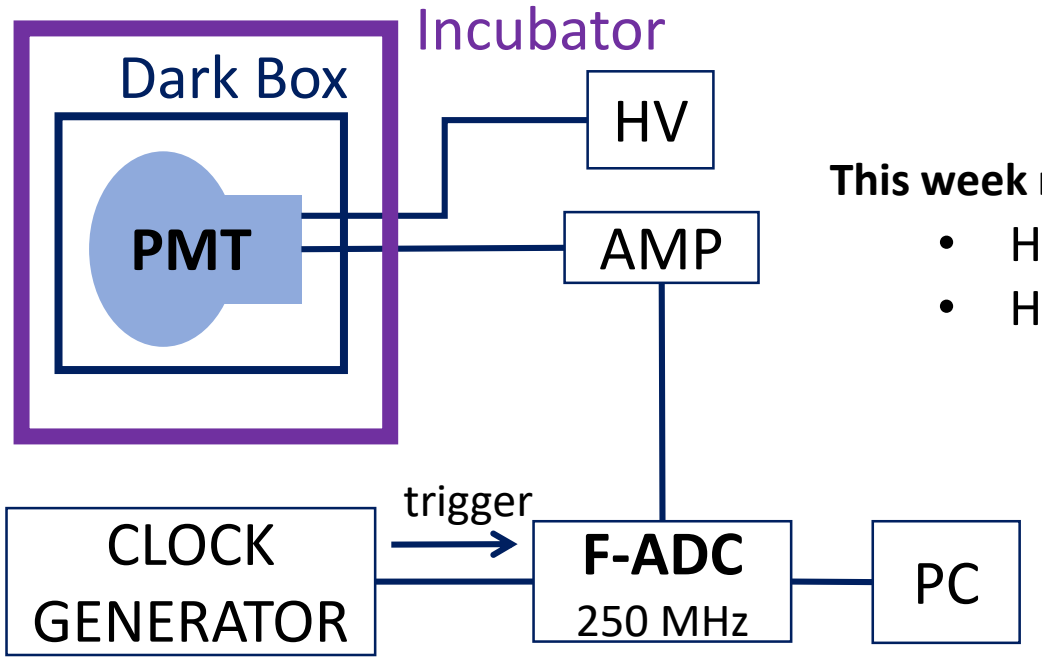
- -1400V at 13℃ and -1450V at 20℃ give almost the same gain with HPK.

Dark rate measurement

- We measured dark rate by F-ADC, keeping the temperature at 13 and 20 ℃ with incubator.
- We counted the dark noise signals above the threshold 0.3 p.e. and 0.4 p.e.

- To check the consistency, I took the data twice for each PMT.

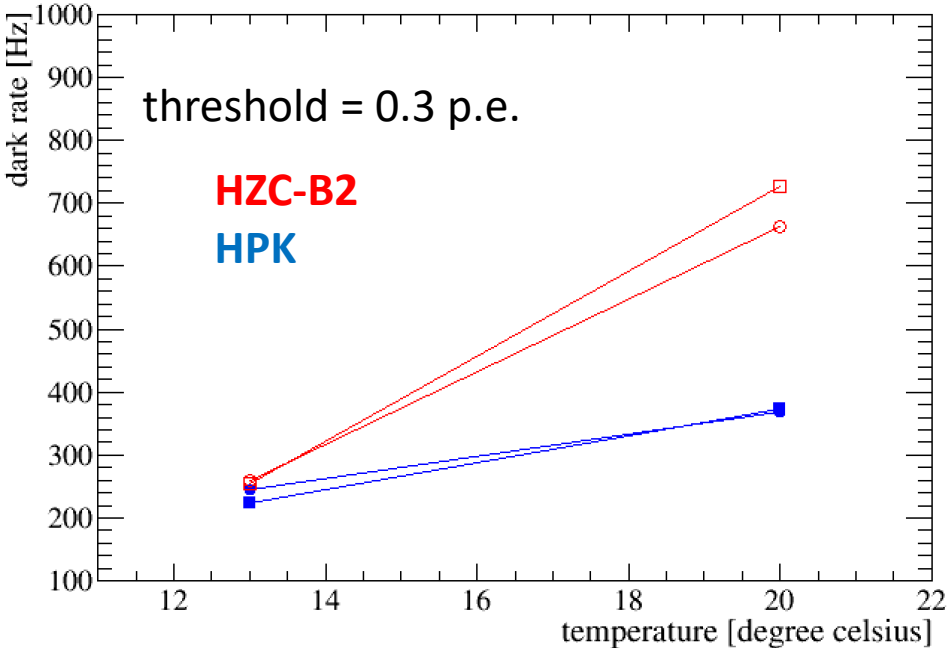
Setup for dark rate measurement

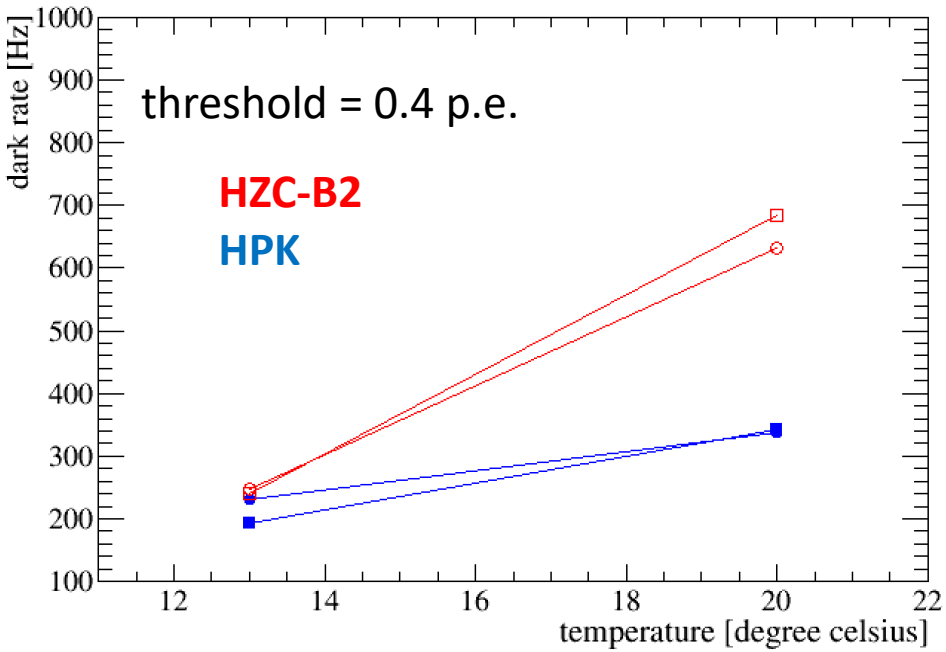


This week measurement

- HV = -1400 V for HZC-B2 at 13 ℃
- HV = -1450 V for HZC-B2 at 20 ℃

Dark rate measurement





The temperature dependence of dark rate

■ - HPK 1st time (negative)
● 2nd time

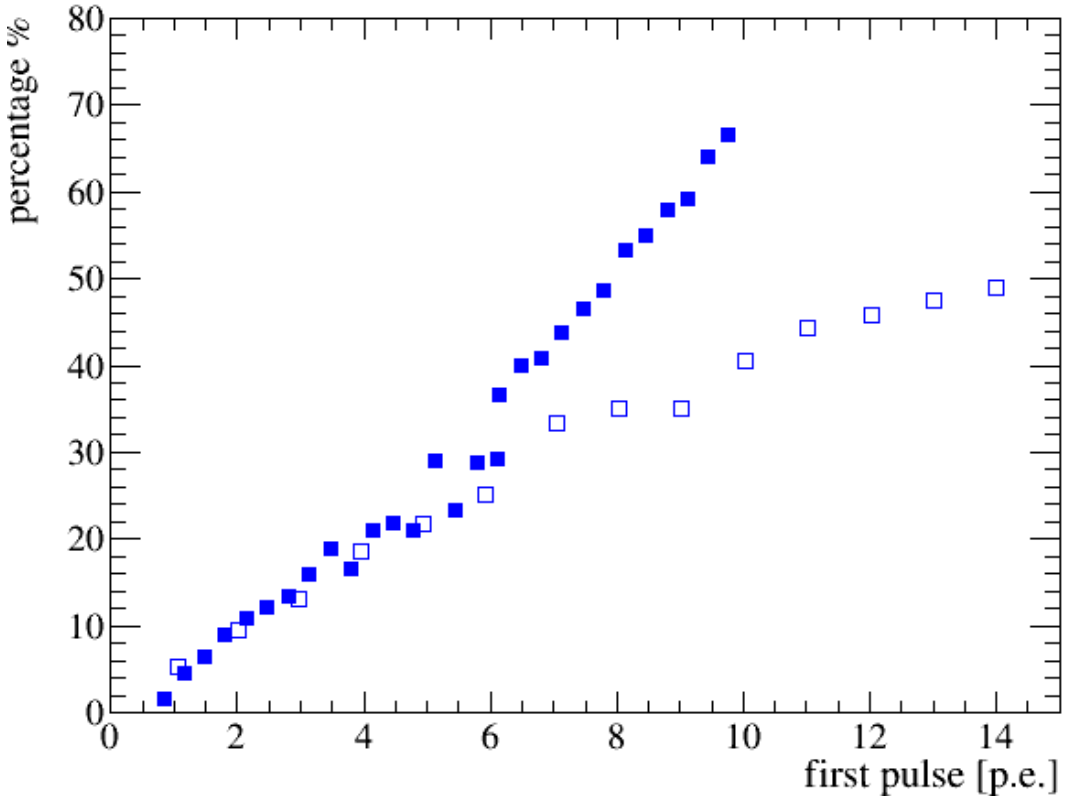
□ - HZC-B2 1st time (negative)
○ 2nd time

- The rates of HZC-B2 were 200-800 Hz.

Next week...

- I will measure dark rate of another HZC PMT (HZC-B1) with positive HV.

After pulse occurrence



HPK

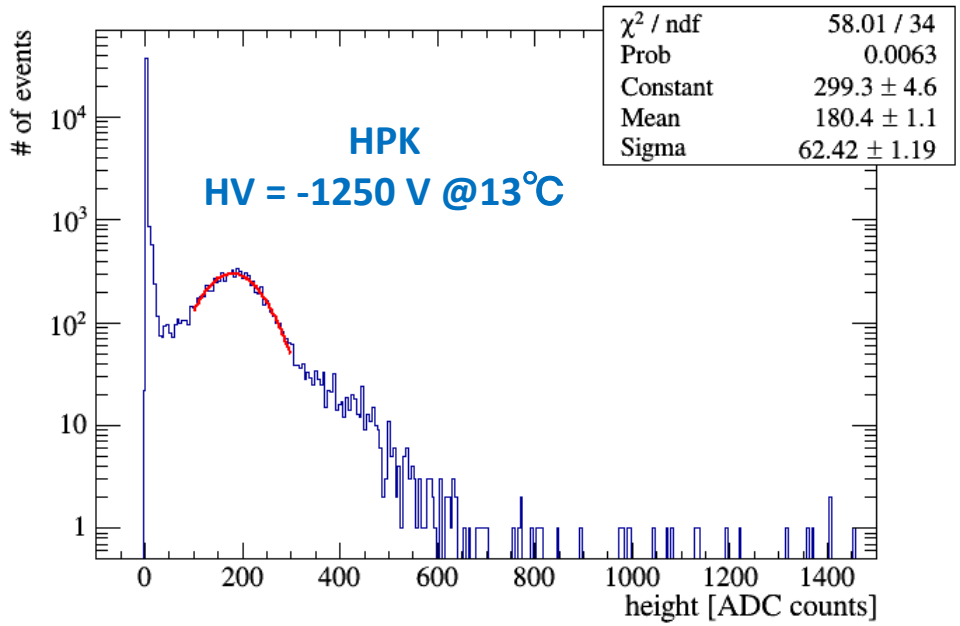
■ **pulse height**

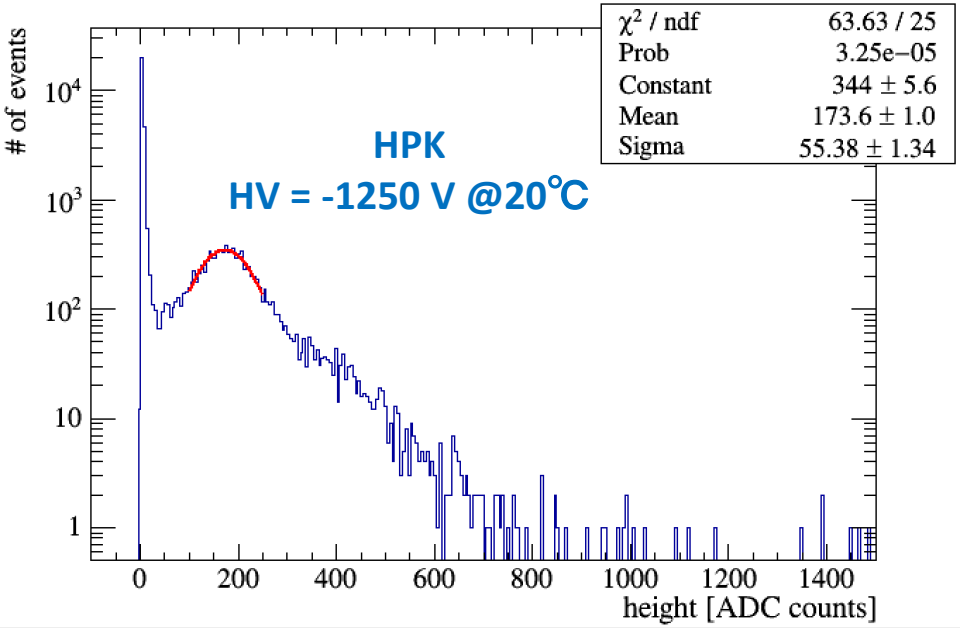
□ **integrated charge**

Fraction of after pulse occurrence

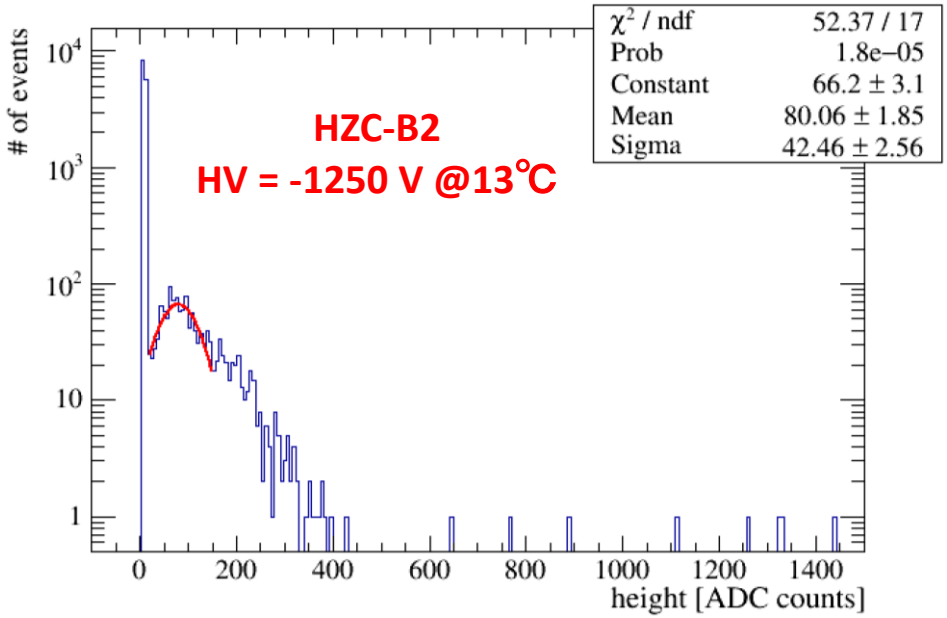
- The filled plot shows the fraction of events with after pulse as a function of the first pulse heights, and opened plot shows that of integrated charge.
- Unlike the fraction with the pulse height, the fraction with integrated charge increased slowly over 6-7 p.e.

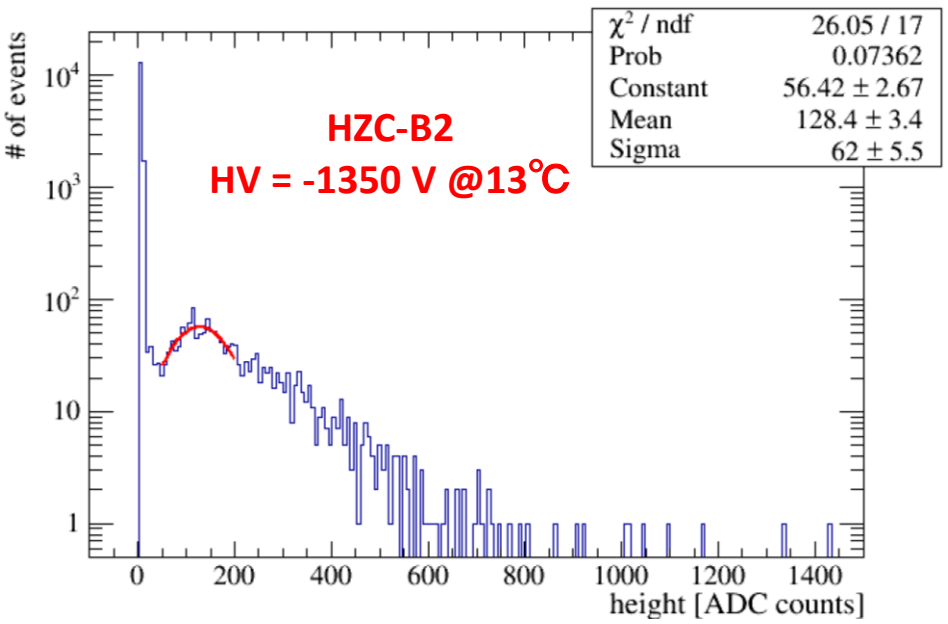
Gain (HPK)

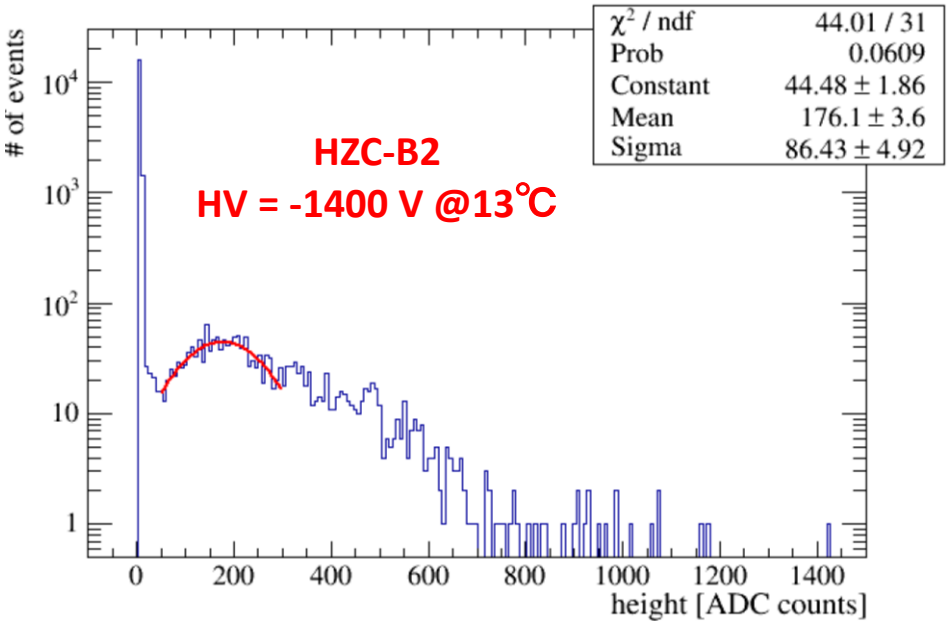

HPK
HV = -1250 V @13℃
χ² / ndf 58.01 / 34
Prob 0.0063
Constant 299.3 ± 4.6
Mean 180.4 ± 1.1
Sigma 62.42 ± 1.19
# of events
height [ADC counts]

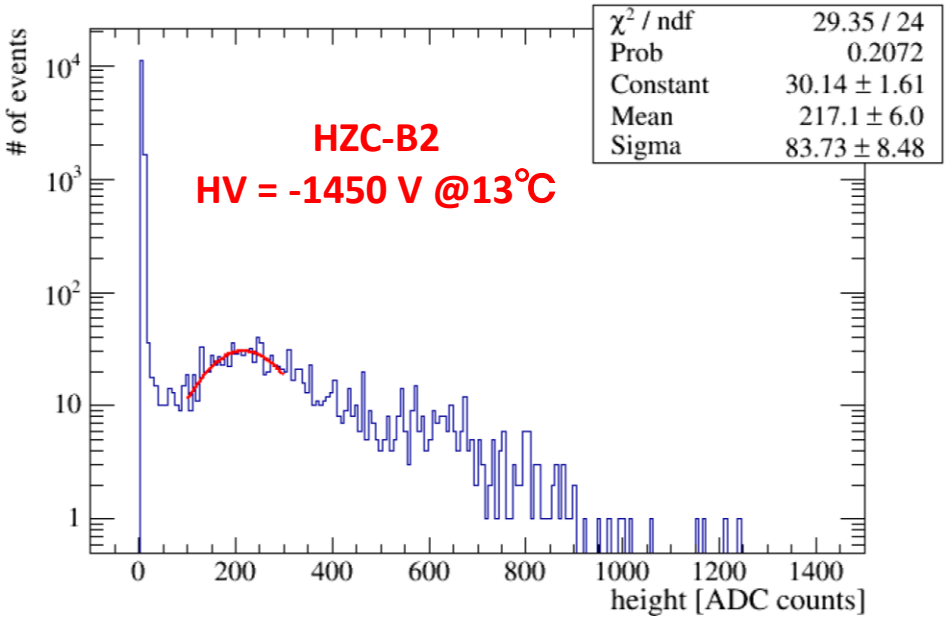

HPK
HV = -1250 V @20℃
χ² / ndf 63.63 / 25
Prob 3.25e−05
Constant 344 ± 5.6
Mean 173.6 ± 1.0
Sigma 55.38 ± 1.34
# of events
height [ADC counts]

Gain at 13 degree Celsius

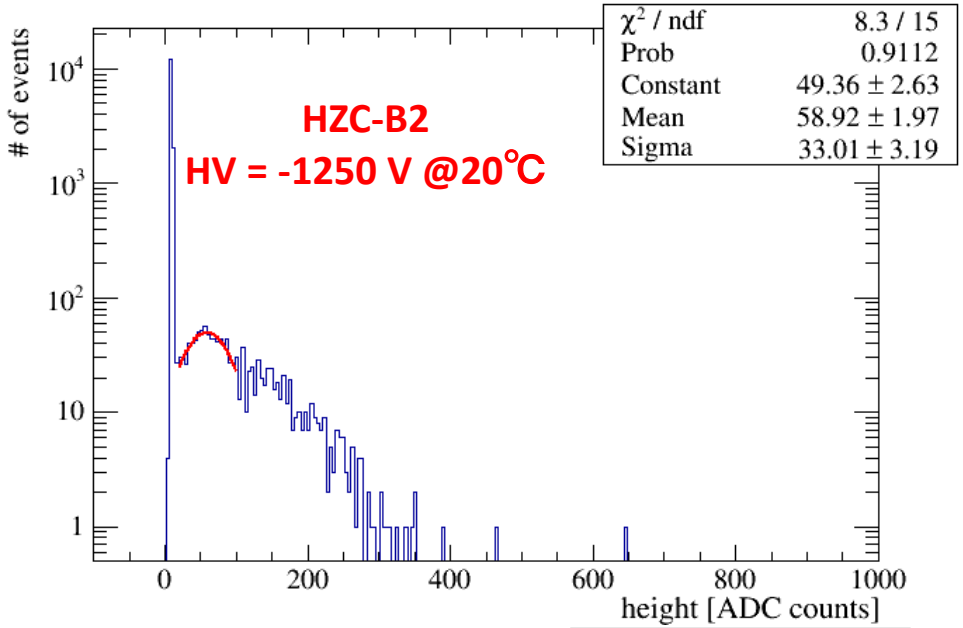


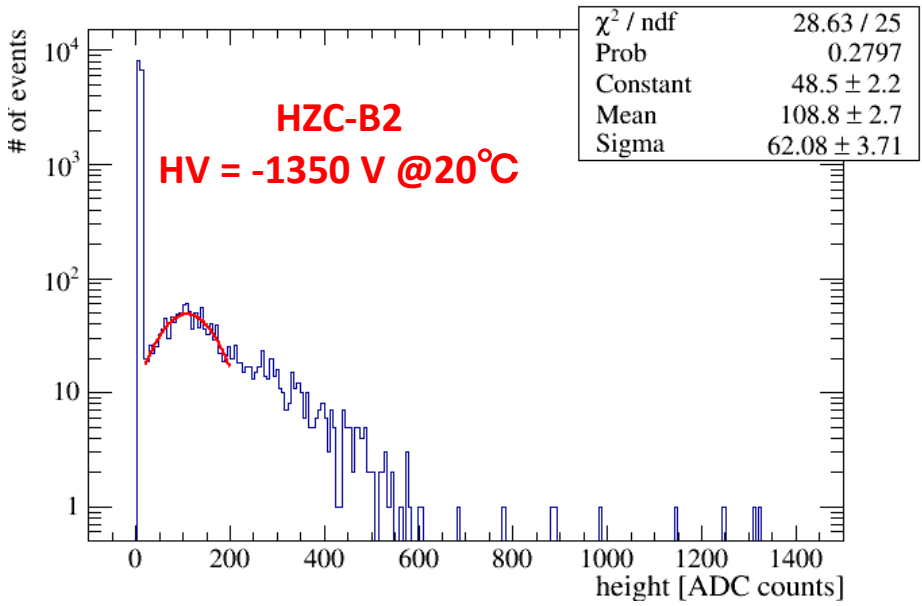


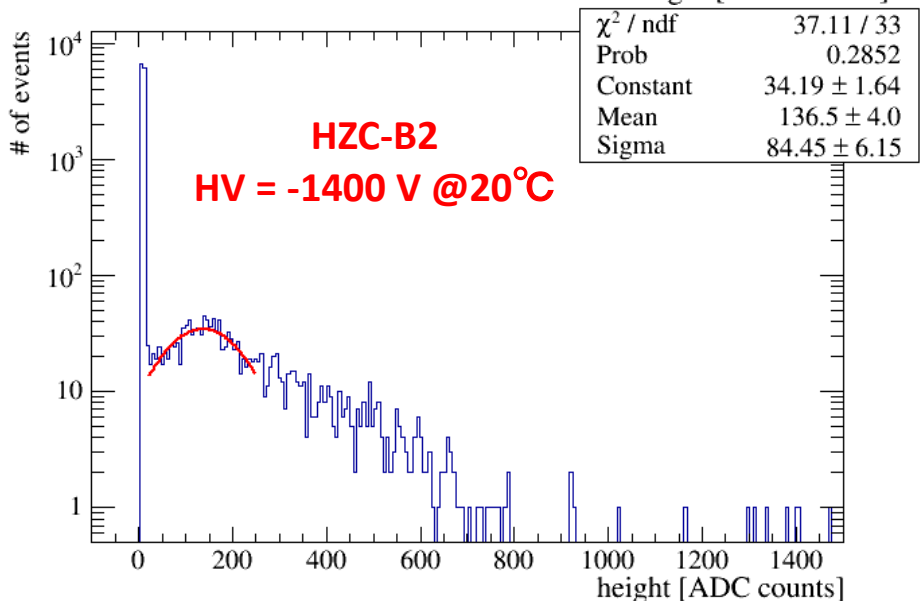


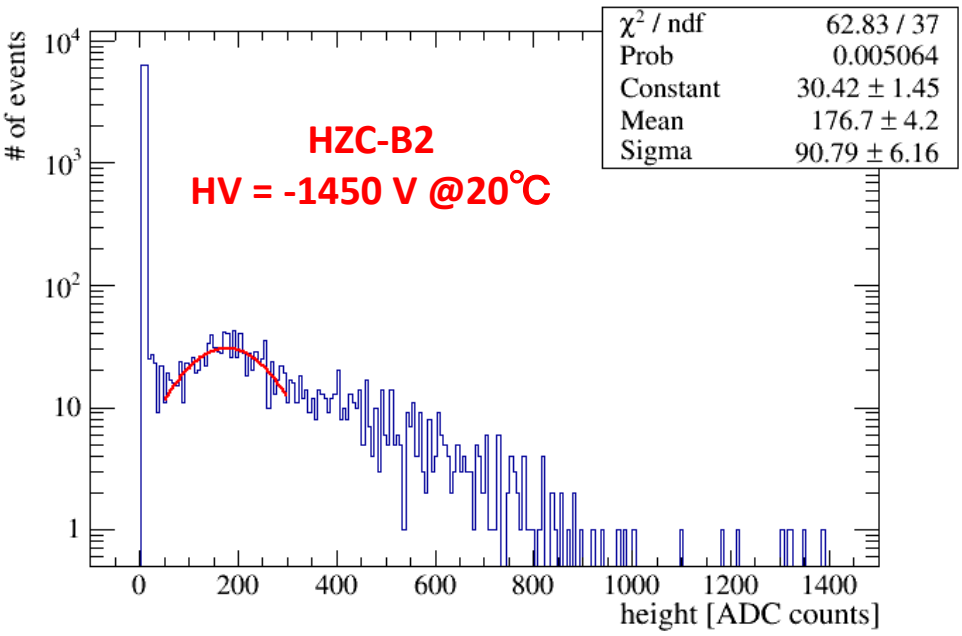


Gain at 20 degree Celsius

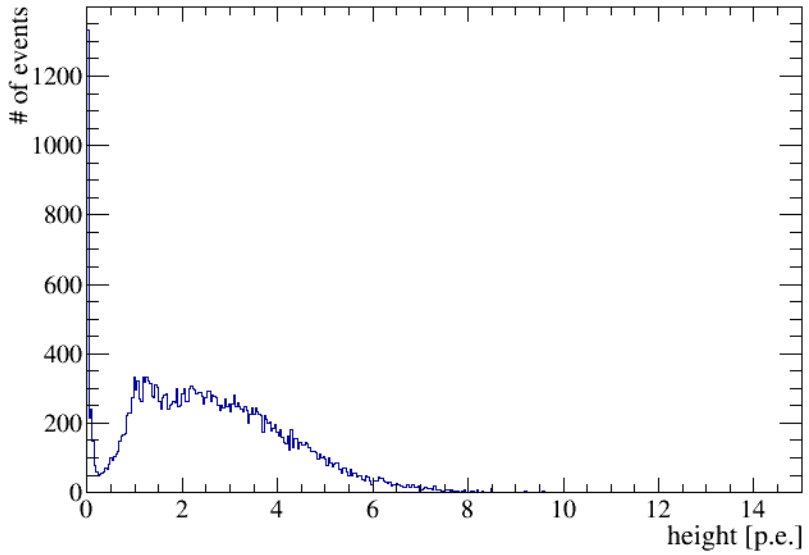


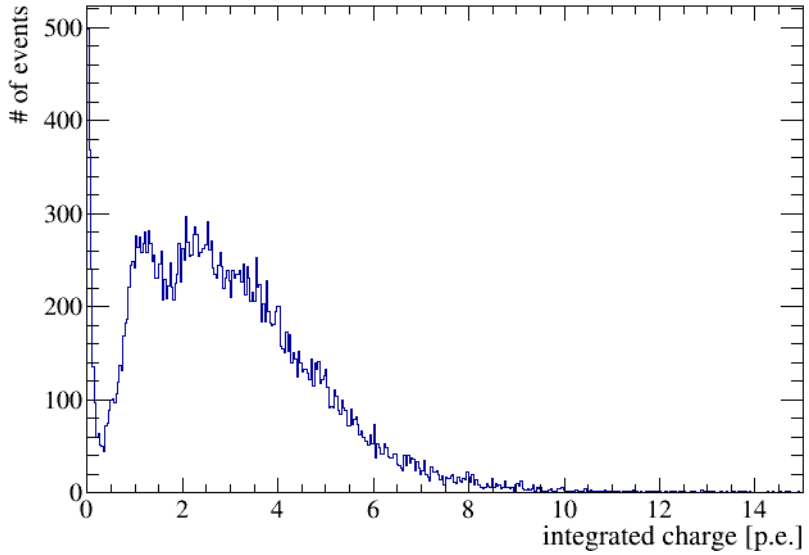




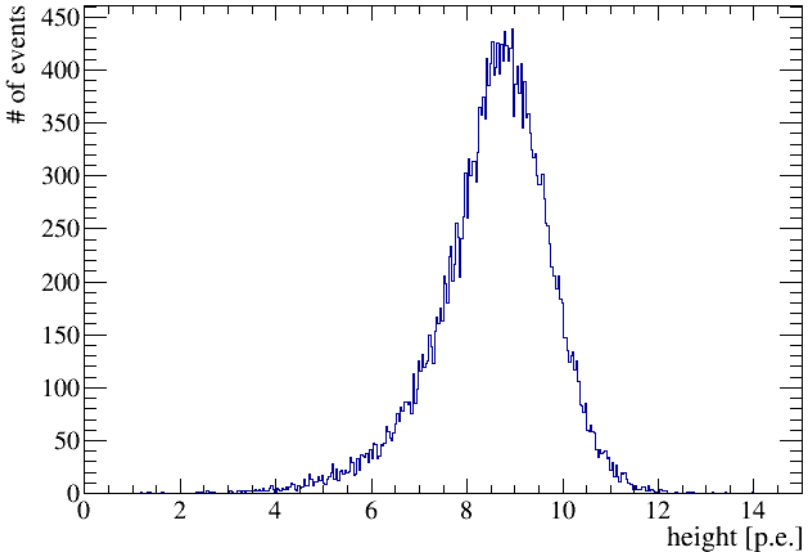


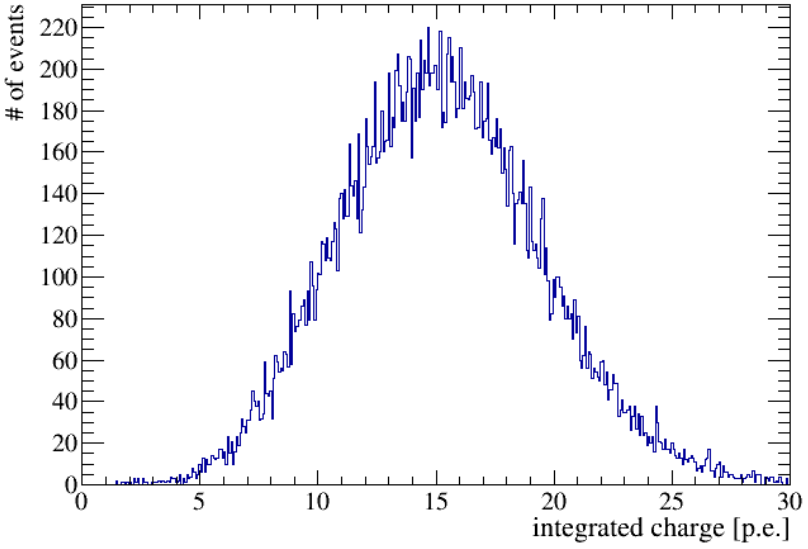
First pulse (from laser)





Low intensity





High intensity