

After pulse and dark rate measurement status report

11/21/2019

Tokyo University of Science

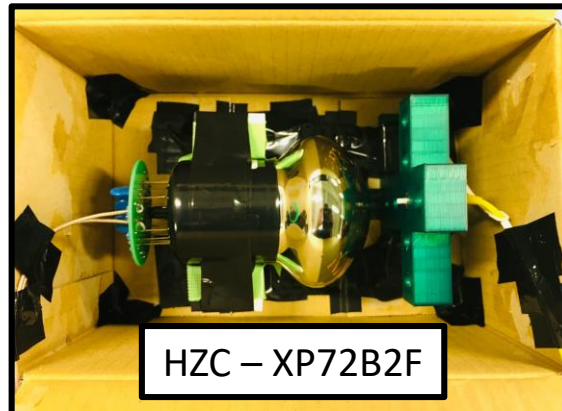
Tatsushi Kinoshita

Until this week...

- I measured the after pulse and dark rate for another Chinese PMT (XP82B20).
- compared with Hamamatsu's PMT and two Chinese PMTs.



non-HA coated PMT

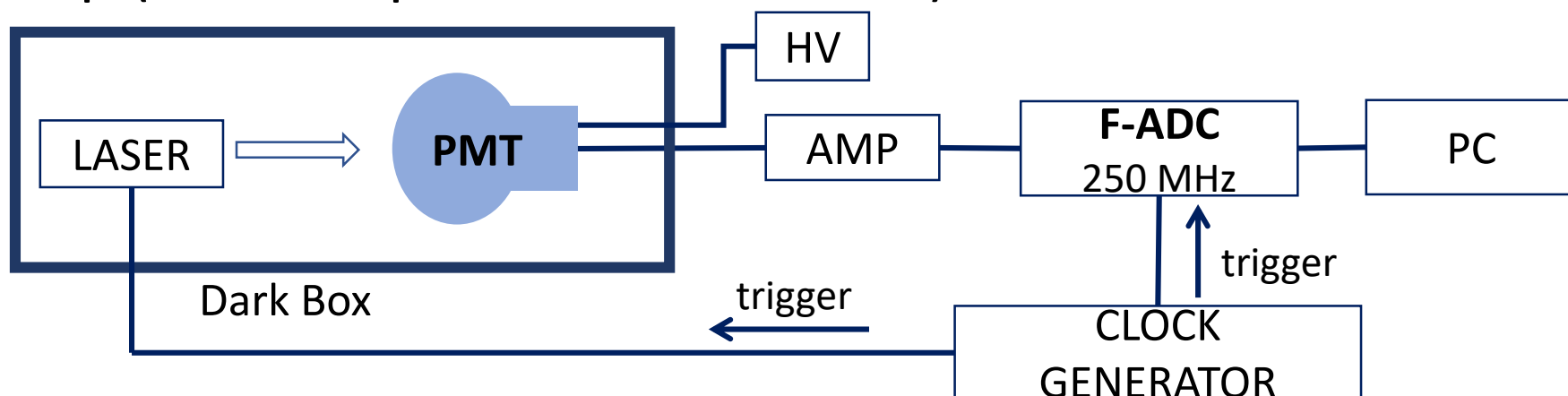


After pulse measurement

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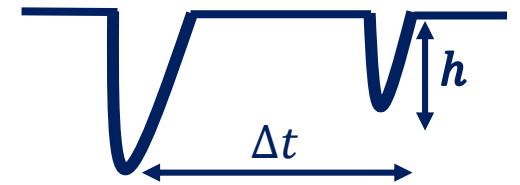
- We measured after pulse by F-ADC.
- We analyze,
 - the heights and time intervals.
 - the relations between the probability of after pulse occurrence and the first pulse heights.

Setup (for after pulse measurement)

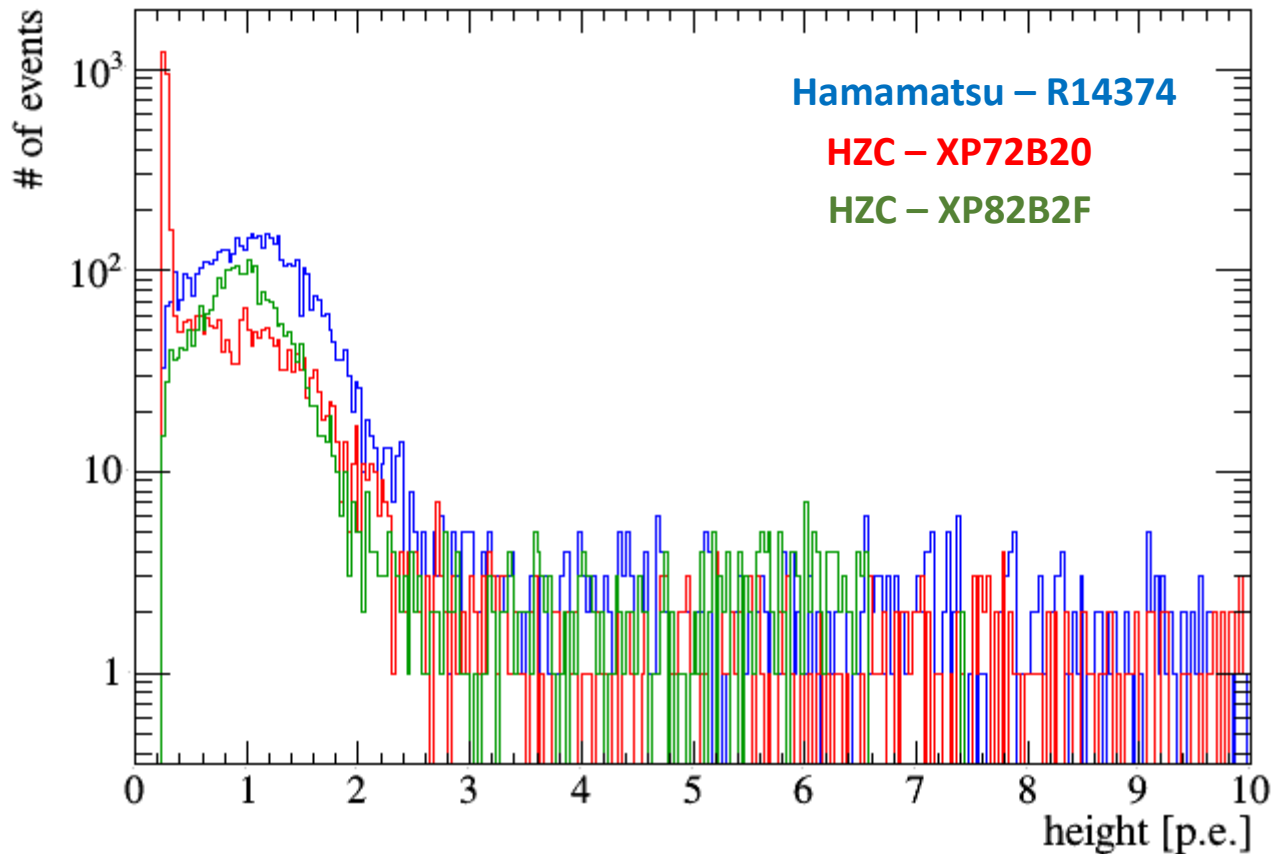


- HV = -1250 V for Hamamatsu
- HV = +1060 V for XP72B2F
- HV = -1100 V for XP82B20

After pulse measurement



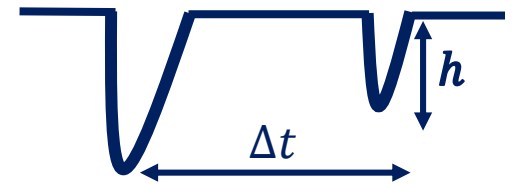
4



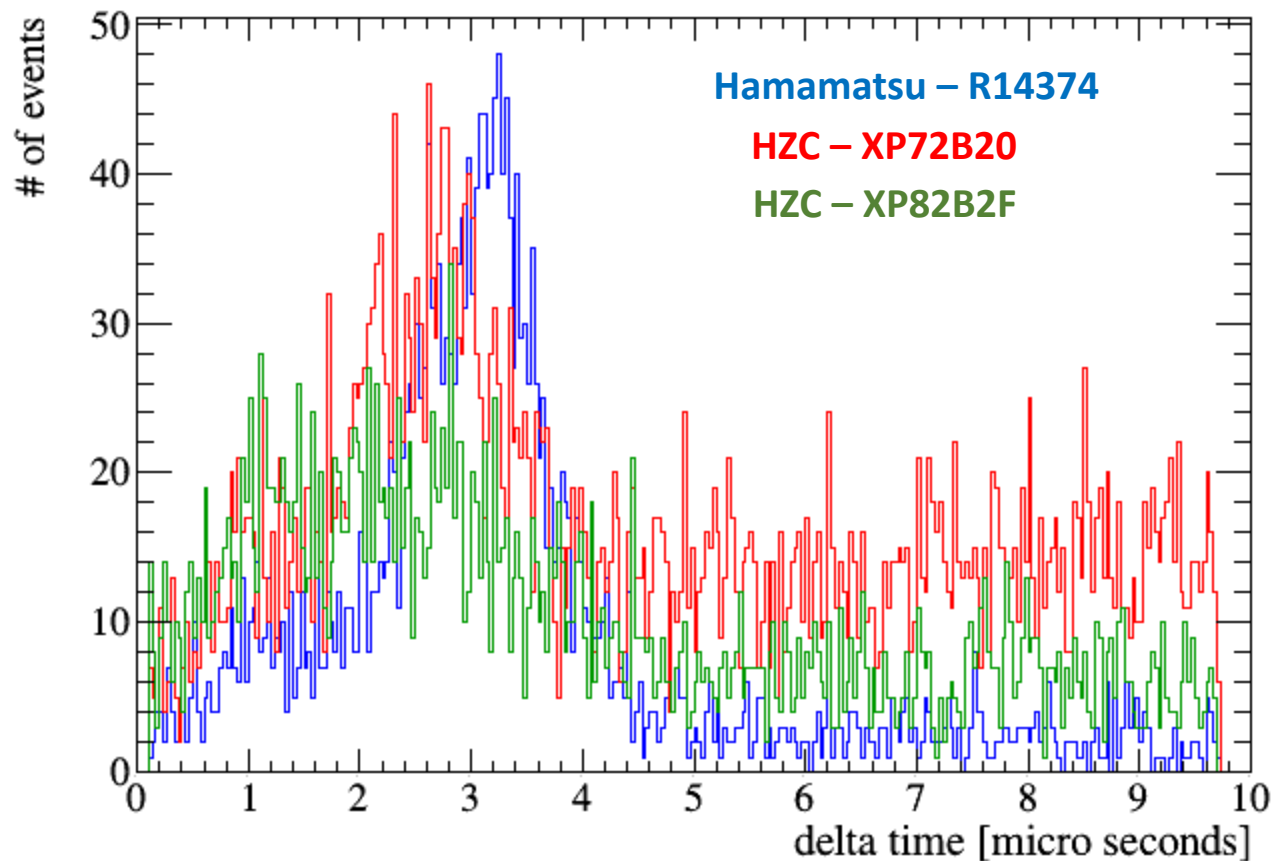
The height of after pulse h

- Each histogram shows the heights of after pulse.
- Although we couldn't see clearly for XP72B20, each types of PMT has one p.e. level signals.

After pulse measurement



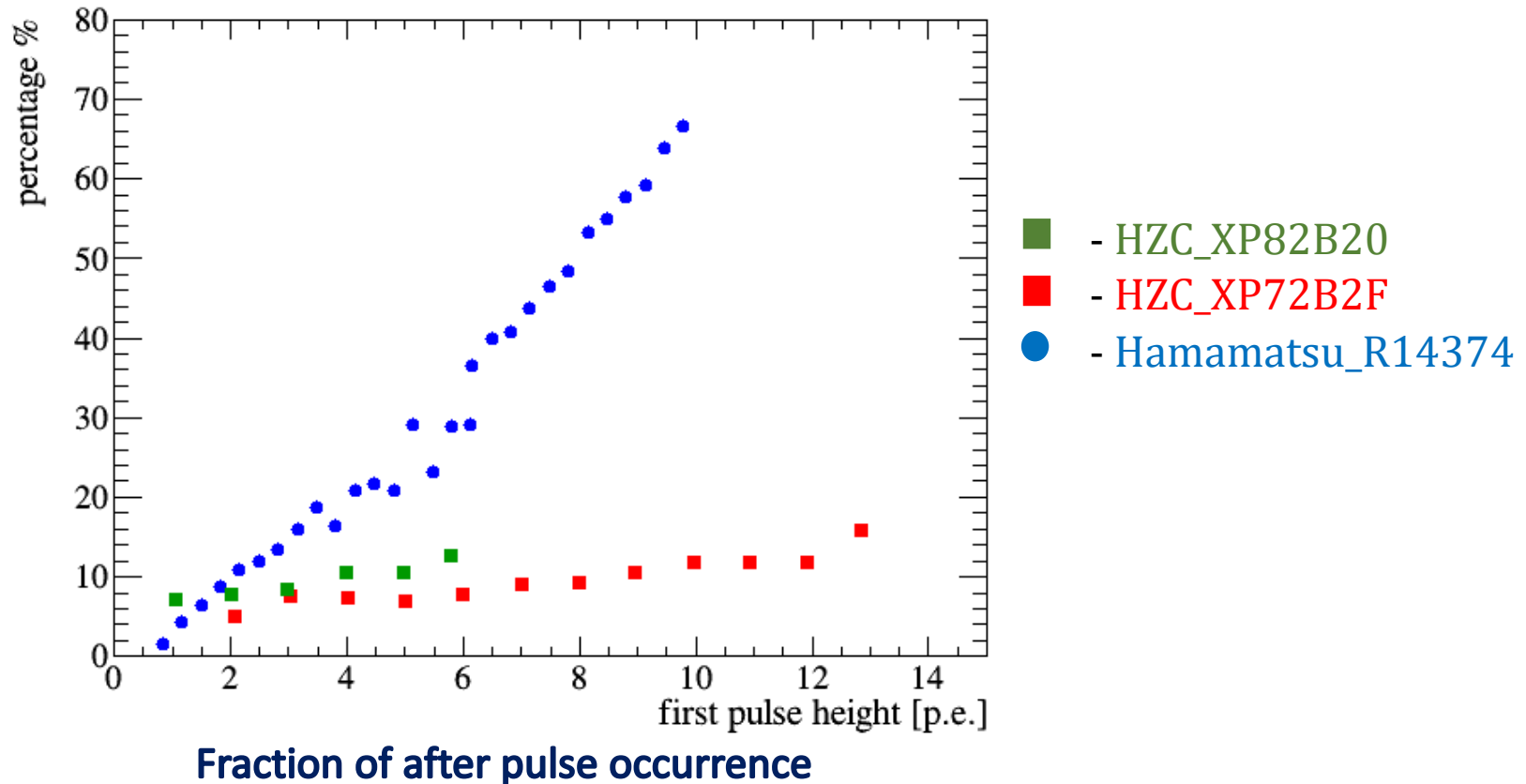
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The time intervals Δt

- Each histogram shows the time intervals between the first pulse and after pulse.
- The after pulses (one p.e. signals) were found at around 2~3 μs for each PMT.

After pulse measurement



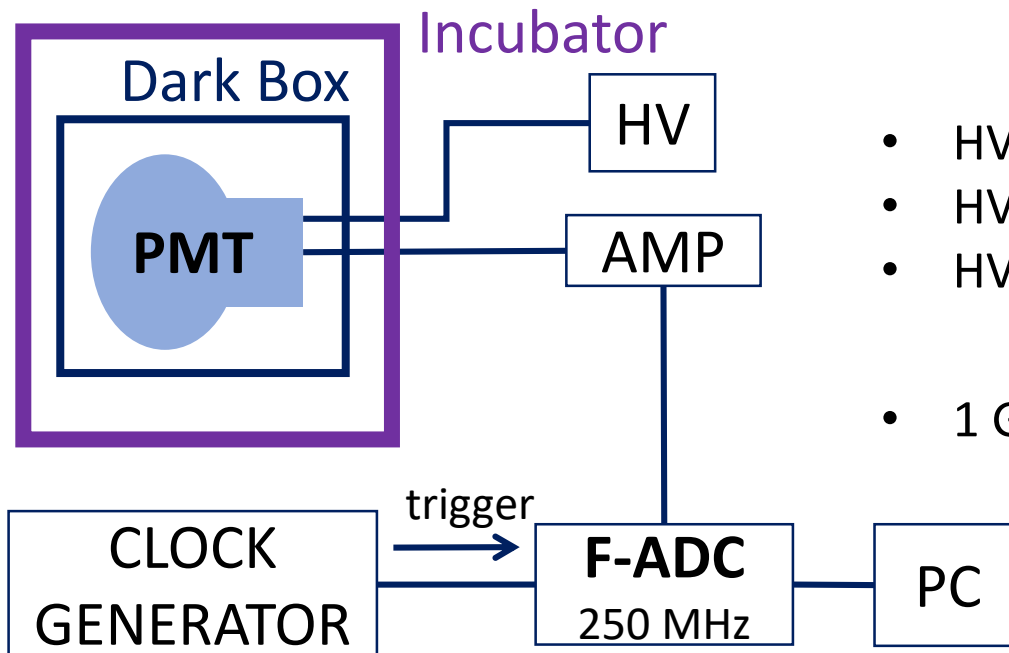
- The plot shows the fraction of events with after pulse as a function of the heights of the first pulses.
- The fraction of Hamamatsu's was increased, but that of Chinese was not increased.

Dark rate measurement

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- We measured dark rate by F-ADC, keeping the temperature at 13 and 20 °C with incubator.
- Trigger is generated by clock signals, and we counted the PMT signals synchronized with them (40 μ s time window).
- We counted the dark noise signals above the threshold 0.25 p.e. and 0.4 p.e.

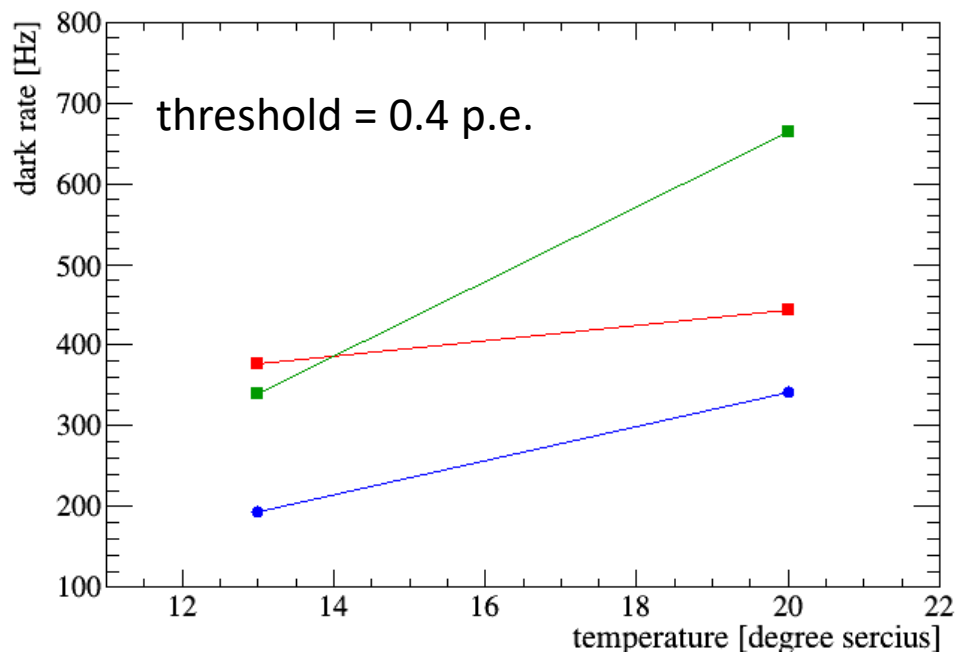
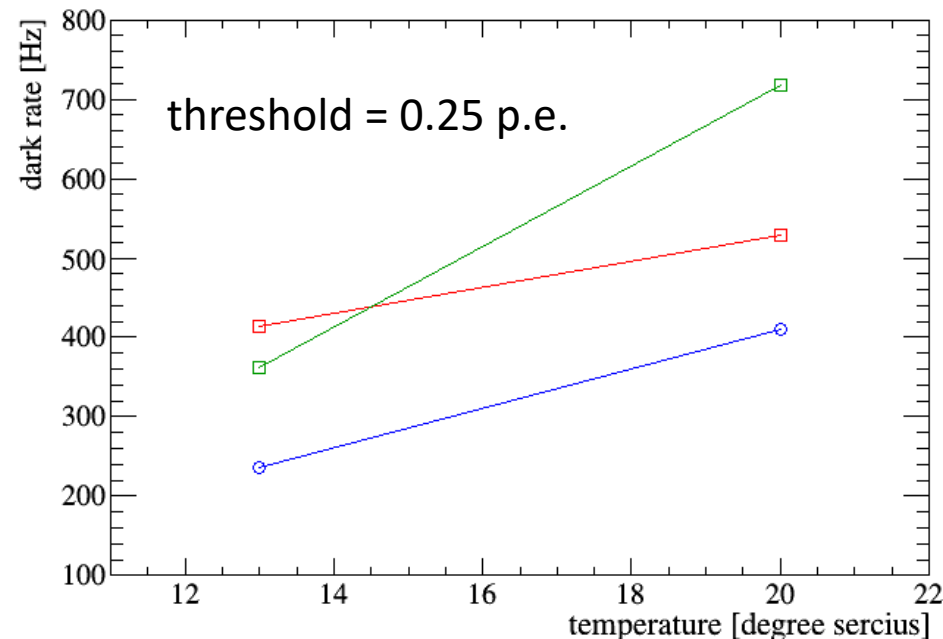
Setup (for dark rate measurement)



- HV = -1250 V for Hamamatsu
- HV = +1060 V for XP72B2F
- HV = -1100 V for XP82B20
- 1 GHz F-ADC for XP72B2F

Dark rate measurement

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The temperature dependence of dark rate

□ - HZC_XP82B20
□ - HZC_XP72B2F
○ - Hamamatsu_R14374

■ - HZC_XP82B20
■ - HZC_XP72B2F
● - Hamamatsu_R14374

- The dark rate of Hamamatsu's PMT were lower than that of Chinese PMTs at both 13°C and 20°C.
- Same rates were confirmed when we took the data again.

Summary

After pulse

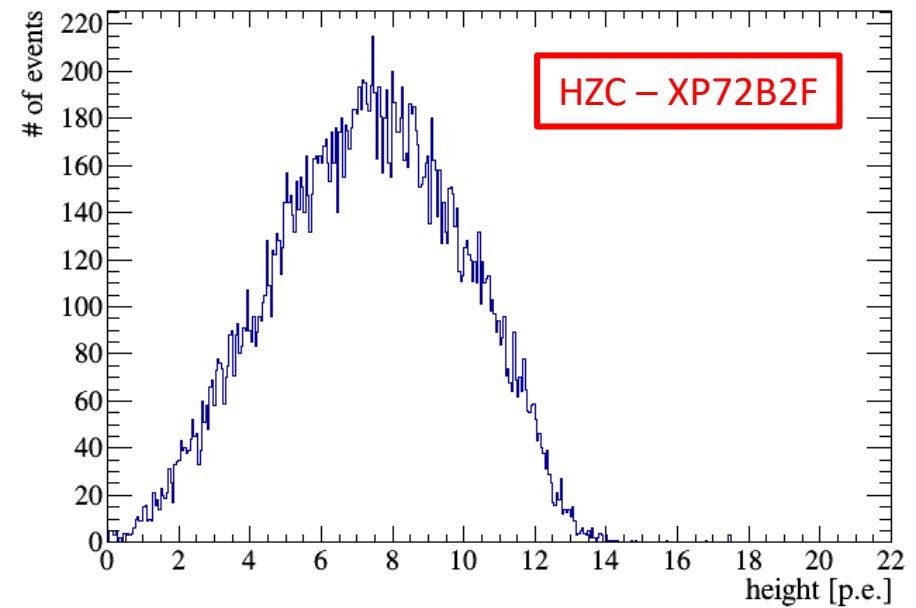
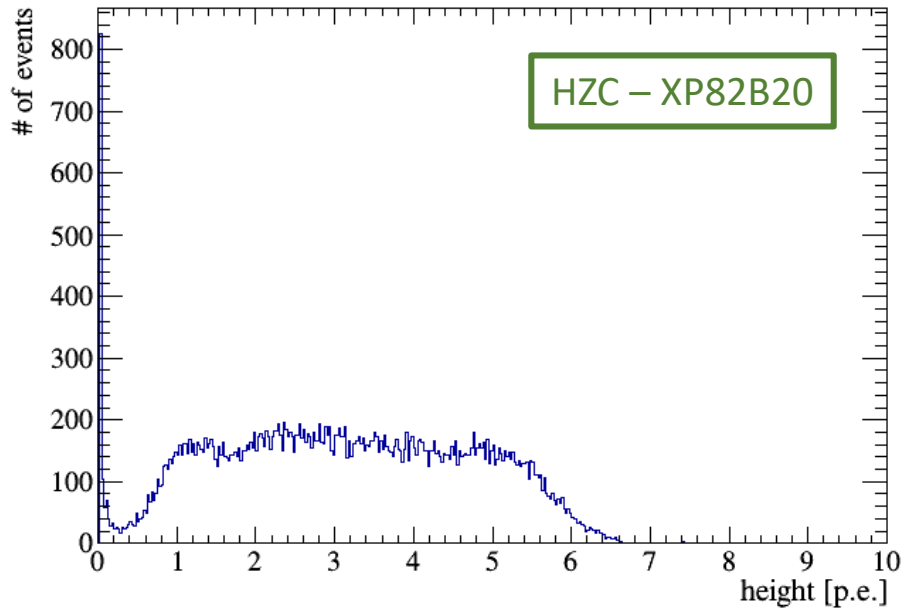
- We found both Hamamatsu and Chinese PMT had same height and time intervals of after pulse.
- The probability of after pulse was different for Hamamatsu and HZC.
 - Hamamatsu: ~30% after 5 p.e. level signals
 - HZC: ~10%

Dark rate

- The rate of Hamamatsu's was lower than that of two Chinese PMT's.

Back up

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The height of first pulse h'

- Each graph shows the heights of first pulse which synchronized with laser.