Status Report: at MEMPYNO

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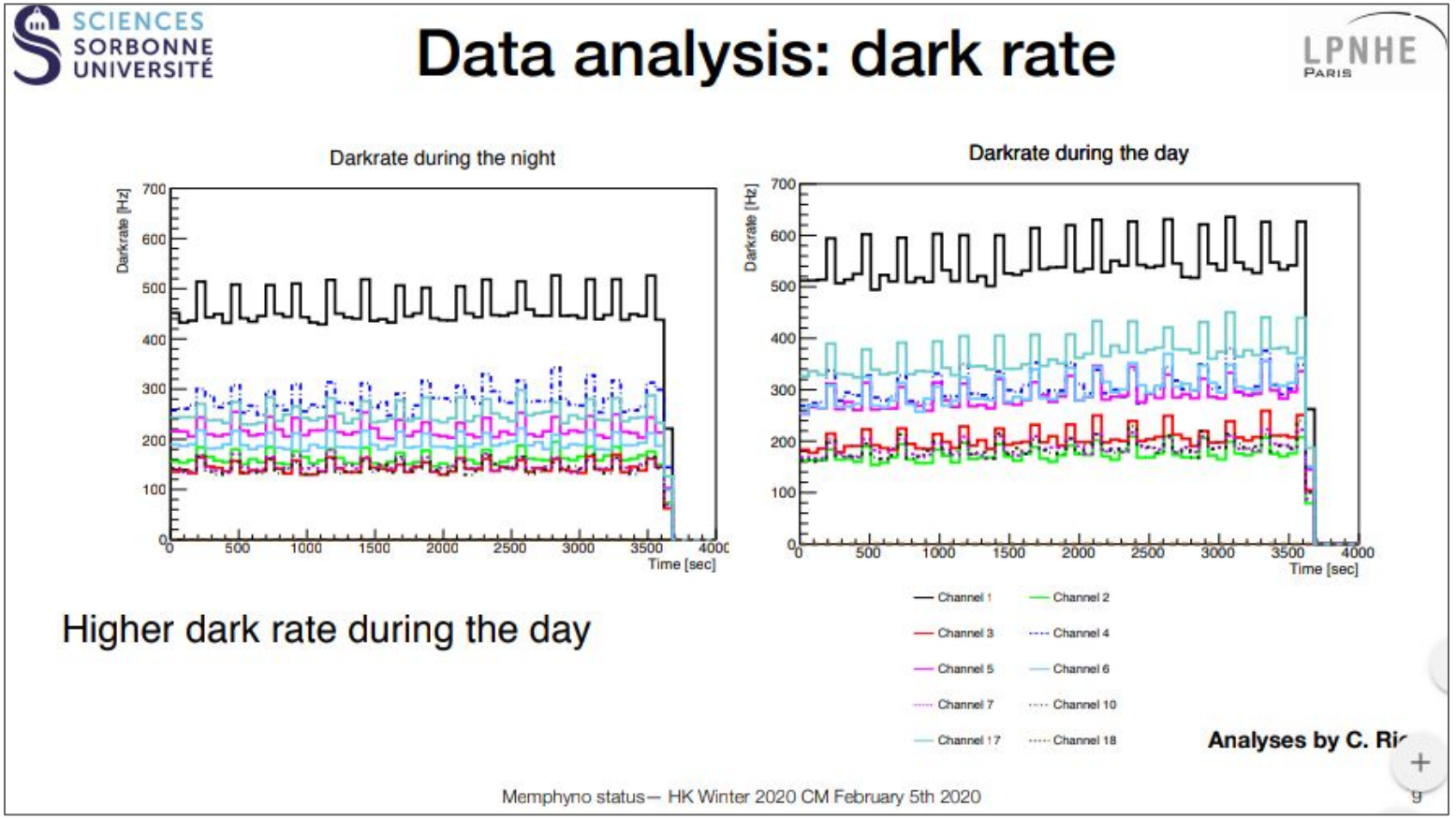
Goal at MEMPYNO test

- To understand behaviour of the darkrate
  - Decreasing the dark rate along time
  - Dependencies with the temperature of the environment



↑Slide of MEMPHYNO status from 10th HKPCM

MEMPHYNO setup

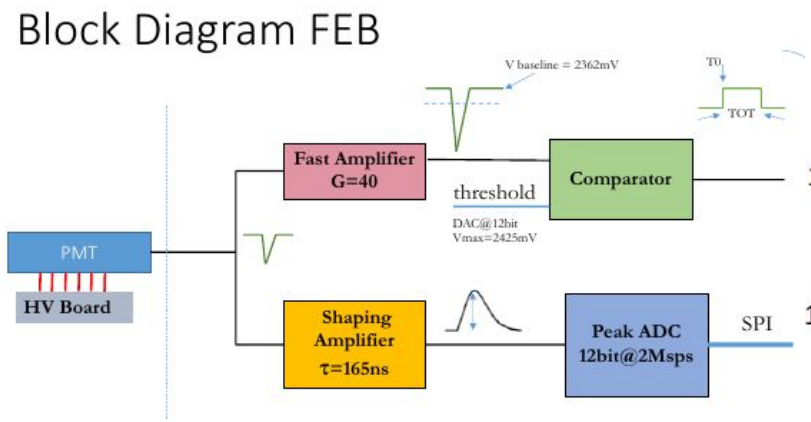
- 1 Italian mPMT (and 1 KM3Net dom) in MEMPYNO water tank of 2 x 2 x 2 m with hodo-scope

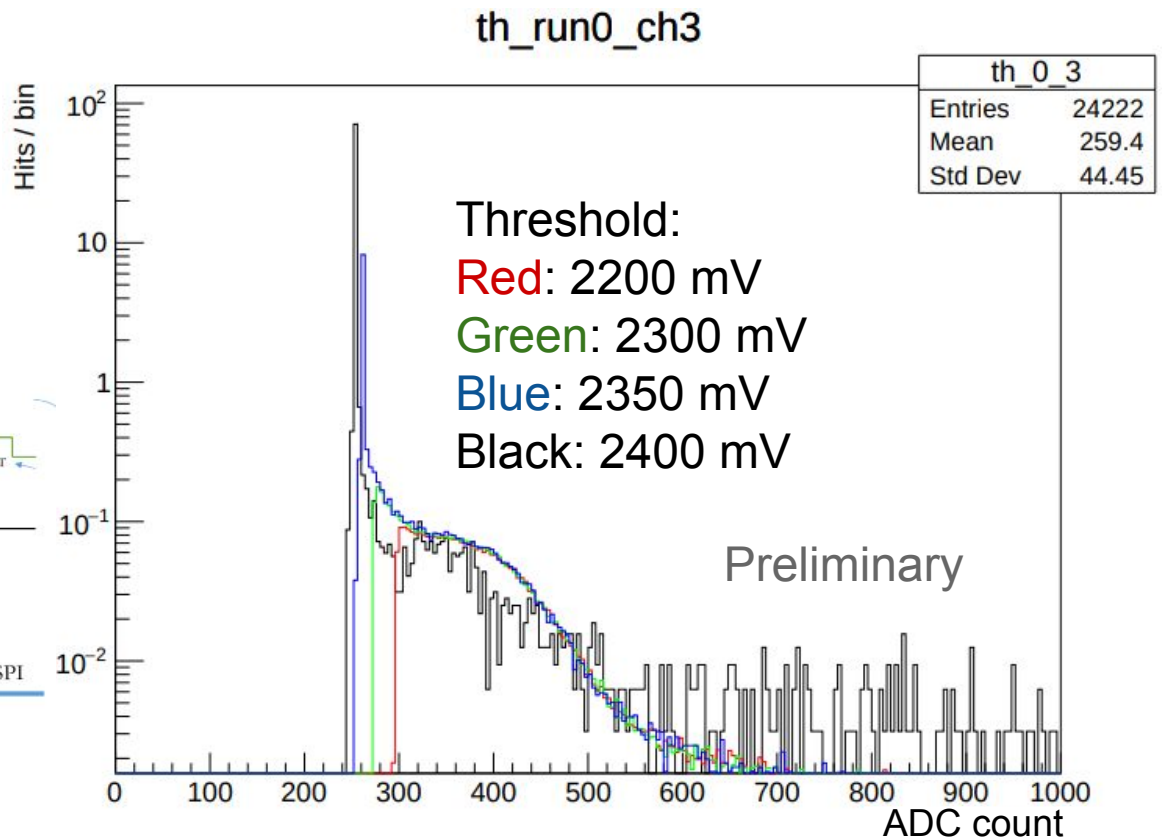
Status for now

- Understanding the electronics of MEMPYNO
  - There are several points that should be understand: especially about threshold
  - Necessary to tune the gain of 3-inch PMTs
- Gain tuning
  - Now trying to fitting the 1-pe and pedestal shape with Morikawa-kun function
- Took data to investigate the light leakage in the water tank
  - Illuminate the tank with the light source, but it is not analyzed for now

Understanding the threshold

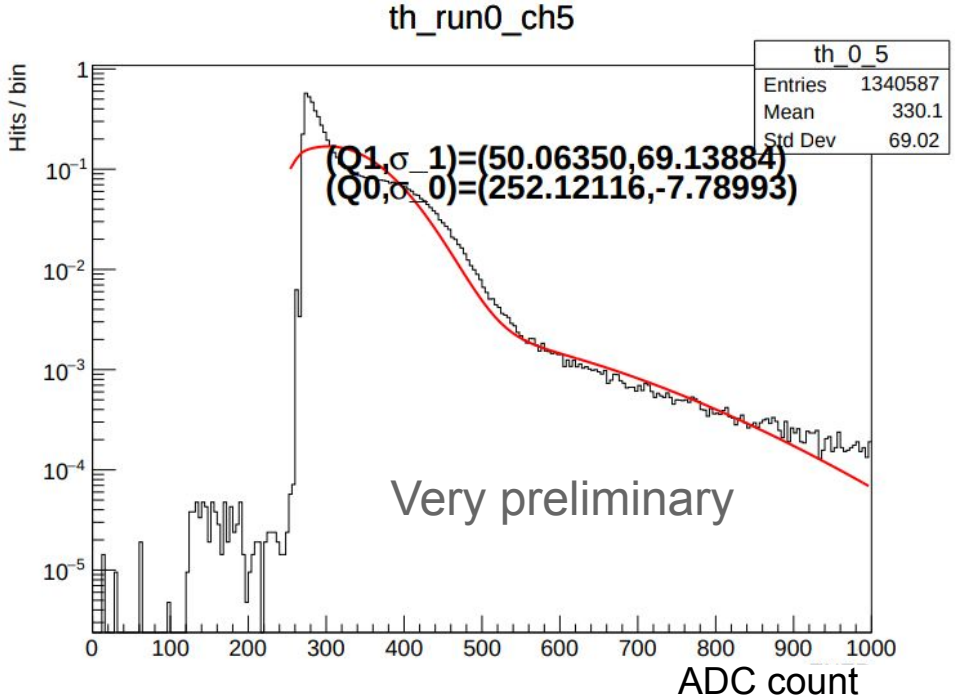
- Required to get full pedestal in order to calculate the gain
  → Need for tuning the threshold
- However the behaviour of the threshold is strange
  - We think this is came from the electronics → asked the expert of MEMPYNO
- Difficult to get full pedestal





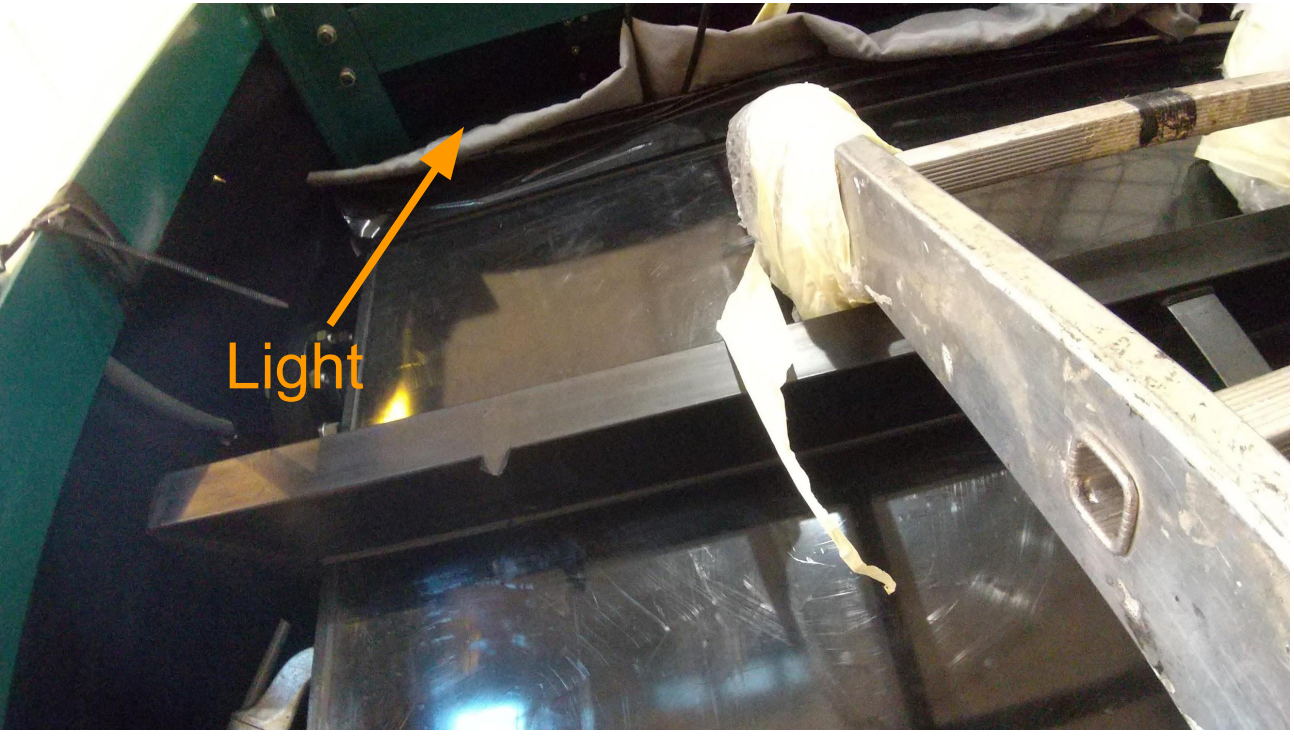
Gain tuning

- Found that it is difficult to get full pedestal due to the problem about the threshold
  → Trying to fit the charge distribution with pedestal and 1-p.e. peak gaussian even if the pedestal shape is not complete
- Now analyzing the data to find the dependency of the gain against the HV.

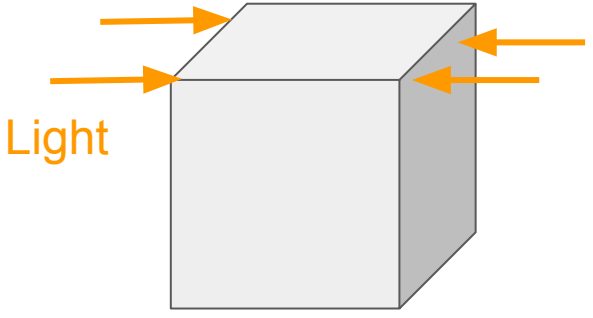


Light leakage

- At last HKPCM, the dark rate is correlated with day/night time → seems to be the light leakage
- Checking the light leakage point with light source.
  - Investigating the light leakage from the 4 corners of MEMPHYNO.
- Took the date, then we are analyzing it.



❑ Light source directions



To do

- Gain tuning
  - Complete the analysis of the fitting
  - Understand the dependency of the gain against the HV
  - Tune the gain to be alinged
- Light leakage
  - Find some relationship between the direction of the light source and the hit rate

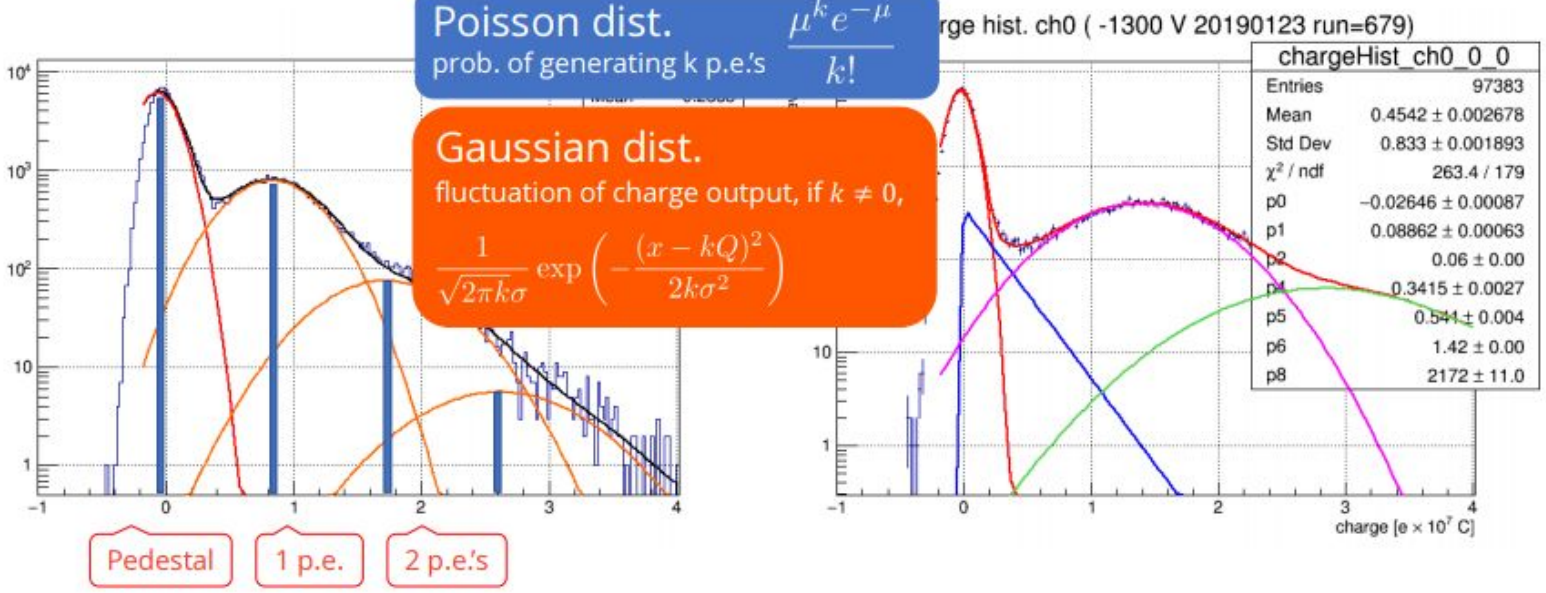
Back up:
Morikawa-kun's slide of 8th HKPCM

Charge histogram: distribution

Poisson dist. $\frac{\mu^k e^{-\mu}}{k!}$
prob. of generating k p.e.'s

Gaussian dist.
fluctuation of charge output, if $k \neq 0$,

$$\frac{1}{\sqrt{2\pi k}\sigma} \exp\left(-\frac{(x-kQ)^2}{2k\sigma^2}\right)$$



- charge distribution = Poisson dist. ∗ Gaussian dist.
  - Poisson dist. : prob. of generating k (≥ 0) photoelectrons on photocathode
  - Gaussian dist. : fluctuation of charge output at each event
  - 0 p.e. distribution (so-called "pedestal") has different σ from k ($\neq 0$) p.e.'s distribution. (σ is Gaussian's σ.)

Back up:
Morikawa-kun's slide of 8th HKPCM

Fitting function: Charge histogram

- Number of photoelectron: Poisson distribution
- Output fluctuation: Gaussian distribution

$$arg = x - Q_0$$

$$S_{\mathrm{ped}} = \frac{1-W}{\sqrt{2\pi}\sigma_0} \exp\left(-\frac{1}{2}\left(\frac{arg}{\sigma_0}\right)^2 - \mu\right)$$

p0	p1	p2	p3	p4
Q_0	σ_0	W	α	μ

p5	p6	p7	p8
σ_1	Q_1	Q_{sh}	Norm

$$S_{\mathrm{noise}} = \alpha W \exp\left(-\alpha \cdot arg - \mu\right),\ 0\ (\text{if } arg < 0)$$

$$S_{\mathrm{sig1}} = \frac{\mu^k e^{-\mu}}{\sqrt{2\pi}\sigma_1} \exp\left(-\frac{1}{2}\left(\frac{arg - Q_1 - Q_{\mathrm{sh}}}{\sigma_1}\right)^2\right)$$

$$S_{\mathrm{sigN}} = \sum_{n=2}^{10} \frac{\mu^k e^{-\mu}}{n!} \cdot \frac{1}{\sqrt{2\pi n}\sigma_1} \exp\left(-\frac{1}{2n}\left(\frac{arg - nQ_1 - Q_{\mathrm{sh}}}{\sigma_1}\right)^2\right)$$

$$\sigma_1 \to \sqrt{\sum_{k=1}^{n} \sigma_1} = \sqrt{n}\sigma_1$$