Status report

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CIDeR-ML collaboration meeting

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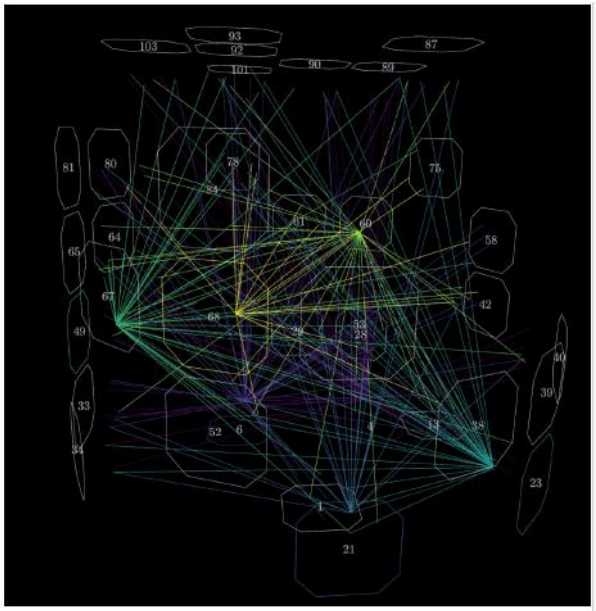
LED data to calibrate LUCiD

- WCTE have several calibration sources.
- LUCiD and Siren can be calibrated by the souces.
- WCTE calibration sources:
  - LEDs
  - Laser diffuser ball
  - NiCf source
  - AmBe source (for Neutron tagging)
  - Cosmic muon
- I focused on understanding the LED data.

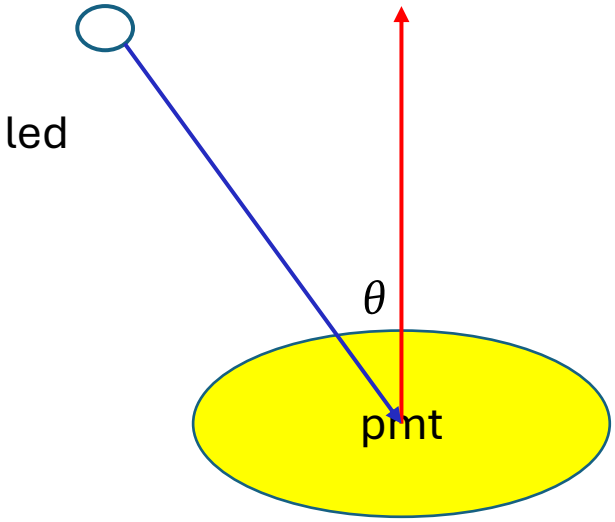
WCTE LED data

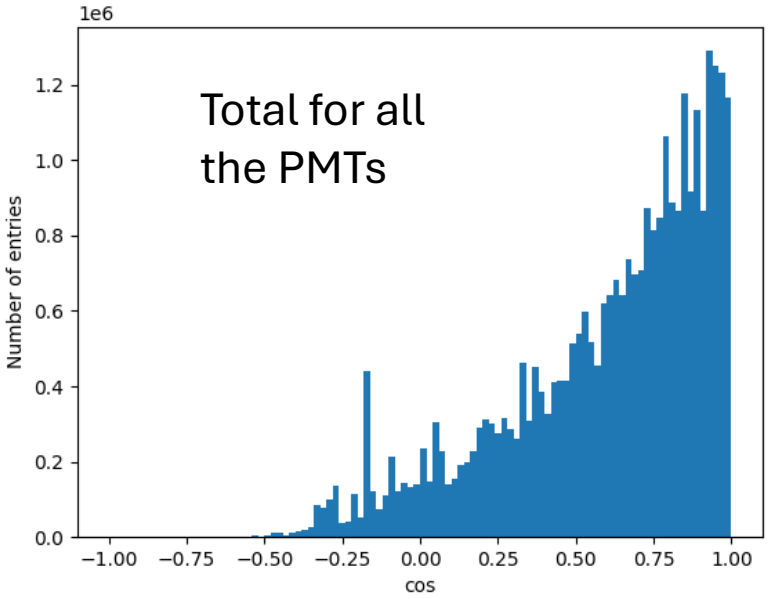
- Three LEDs in each mPMT.
  - Wave length: 365 nm, 405 nm, 470 nm
- There are 2 types of mPMTs:
  - Ex-situ: two 15° collimated, one diffuse
  - In-situ: two 30° collimated, one diffuse
- Calibrate:
  - PMT relative timing
  - 1 p.e. gain, charge distribution (this study)



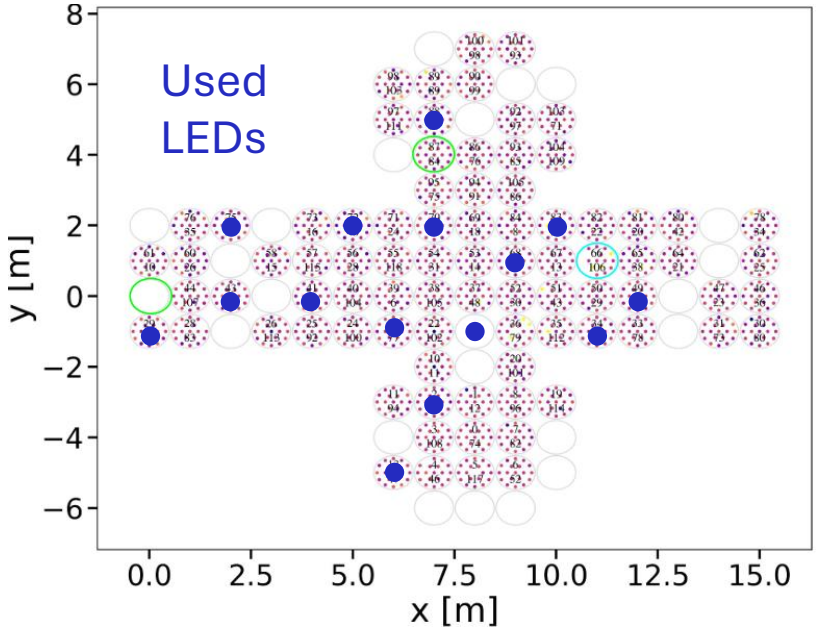
- LEDs fire at ~2 kHz.
- mPMTs measure the signals from each LED.
  - Most data: self-trigger
  - Some data: software trigger, hardware trigger
- We can use source positions and wave shapes for each fire.

LED data check

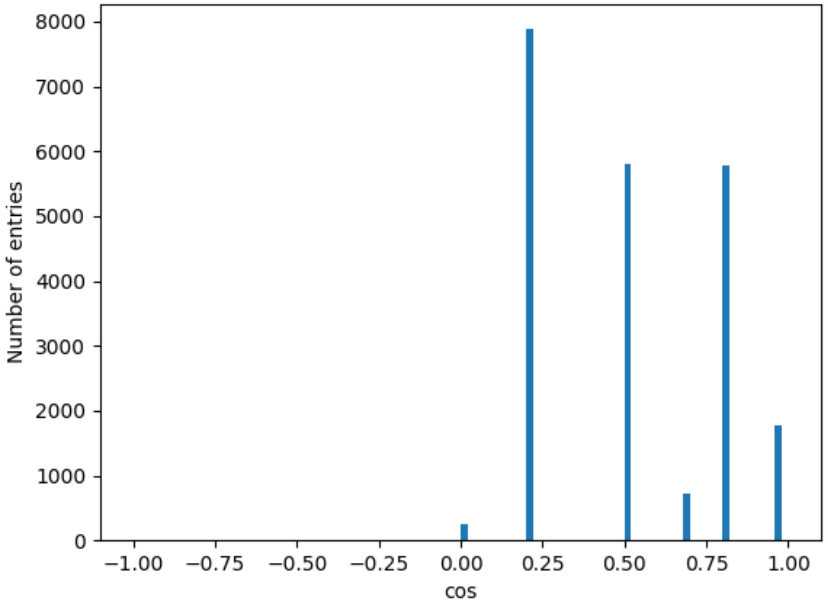




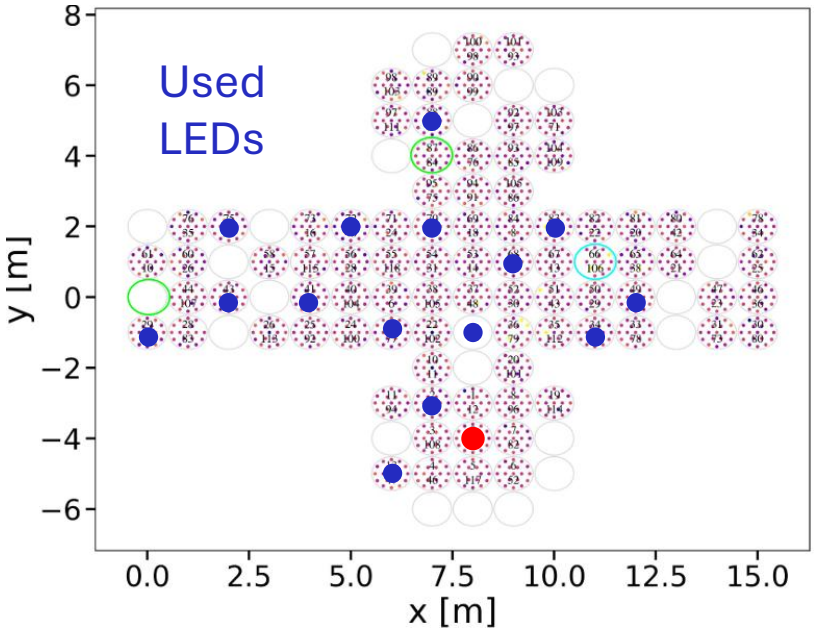
- I am checking software trigger data of one run.
  - We have only 470 nm data in the software trigger runs…
- To check the angular coverages of all the PMTs, I am making the distribution for each PMT.
- 15 LEDs × 10000 triggers.



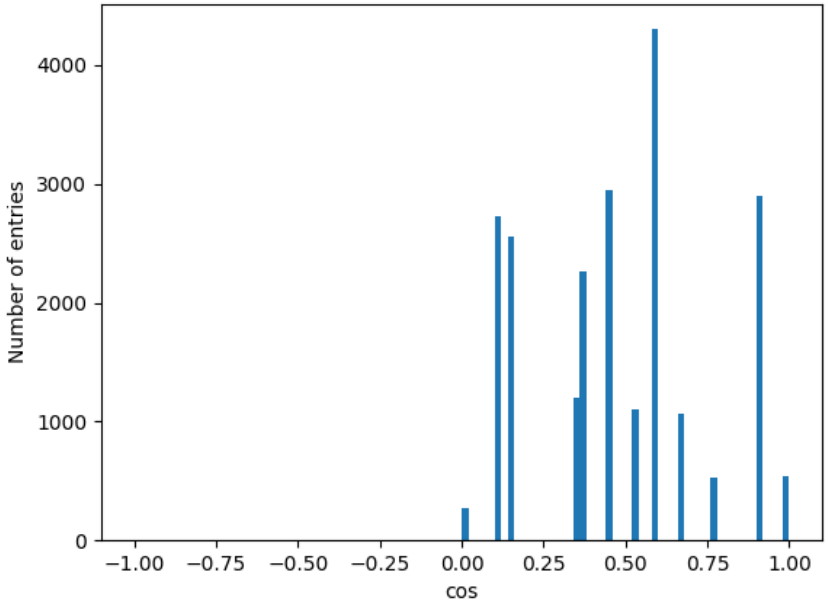
LED data check



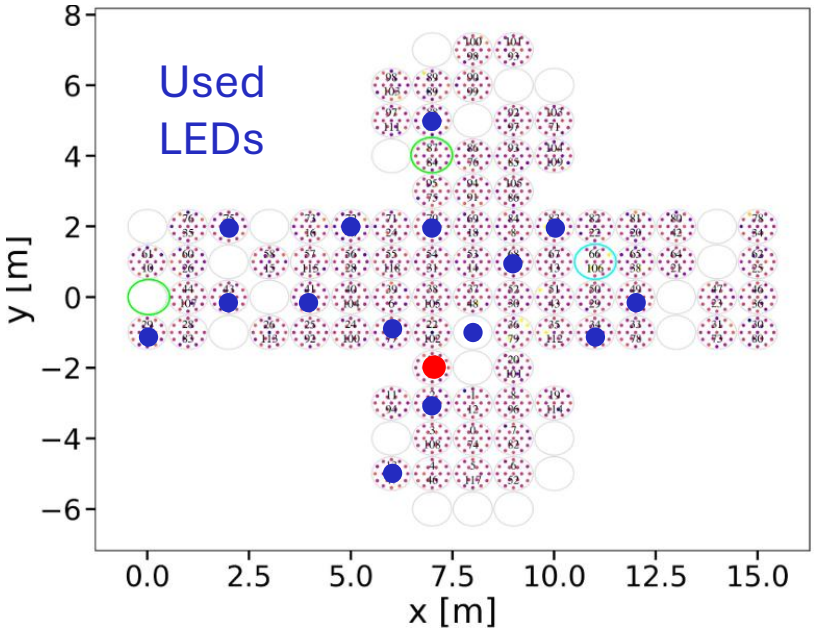
- PMT0 in mPMT0



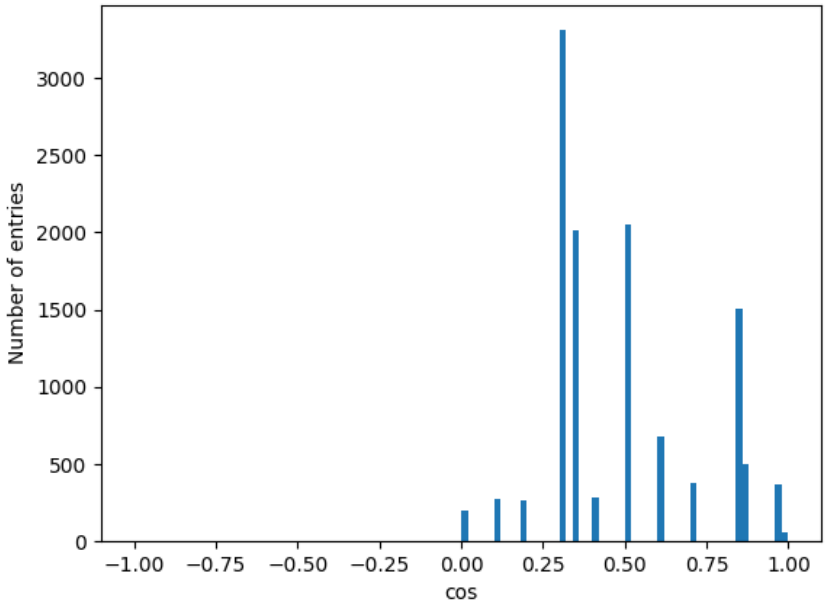
LED data check



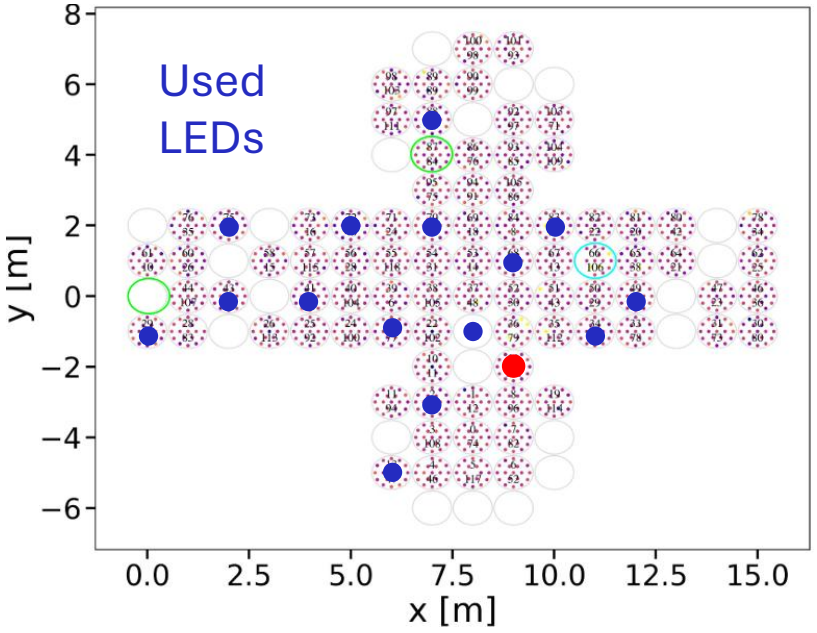
- PMT0 in mPMT10



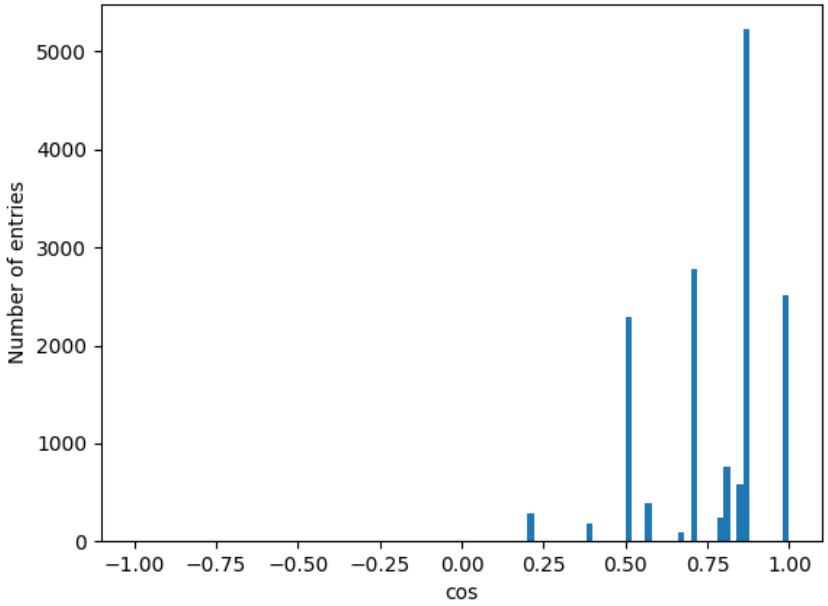
LED data check



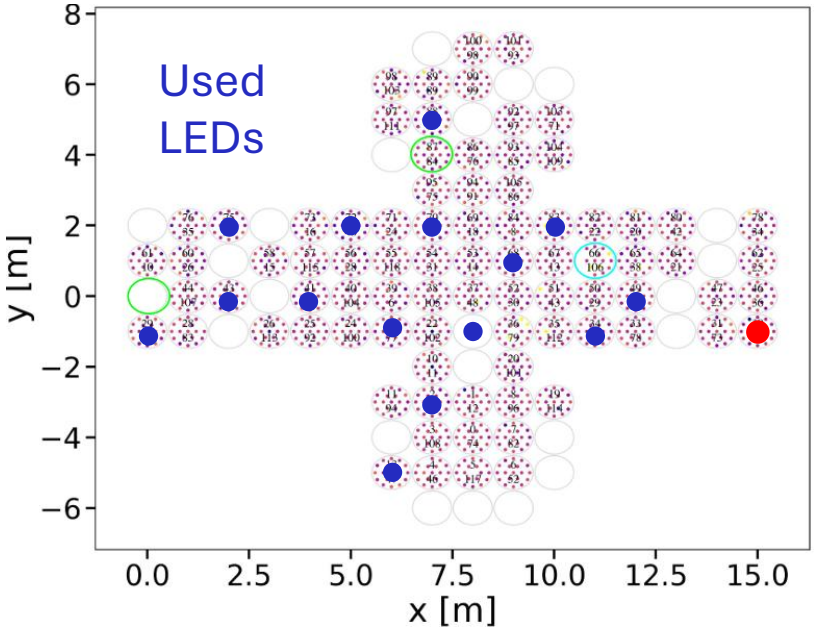
- PMT0 in mPMT20



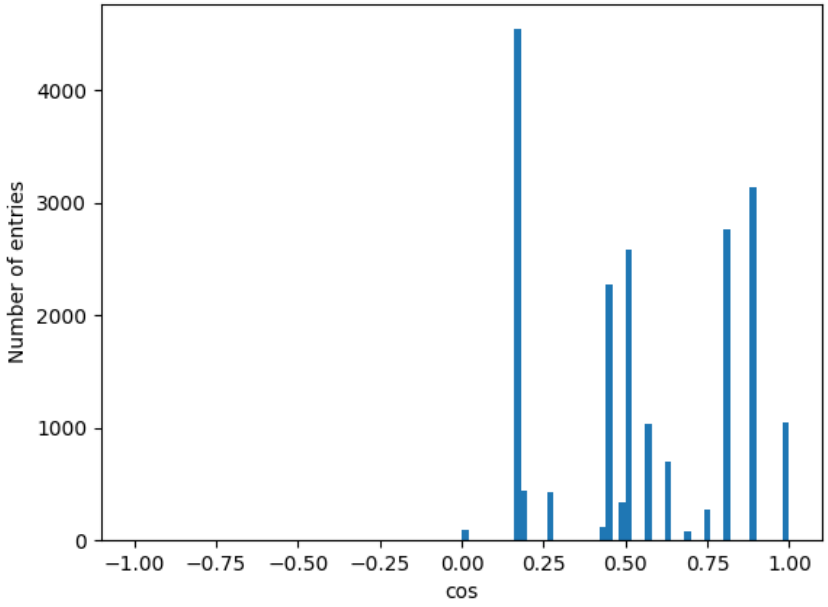
LED data check



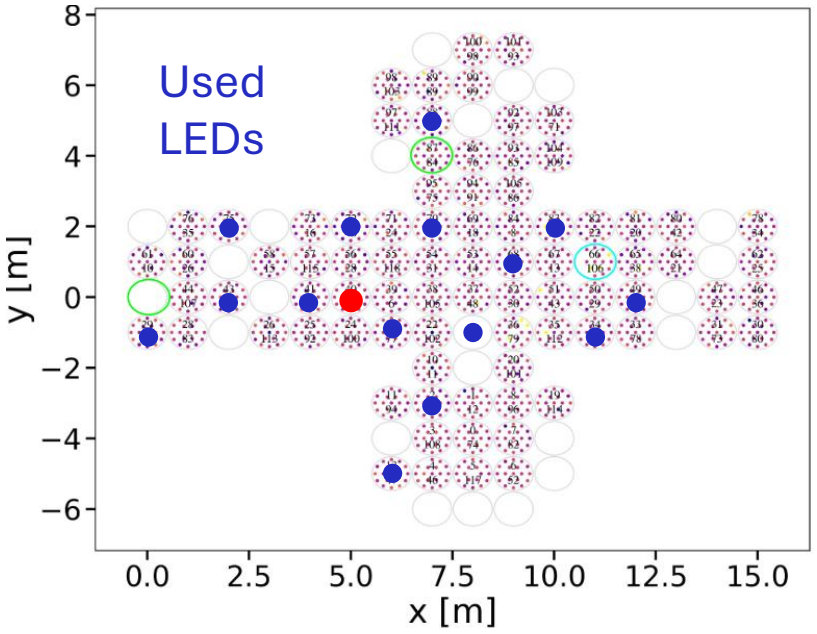
- PMT0 in mPMT30



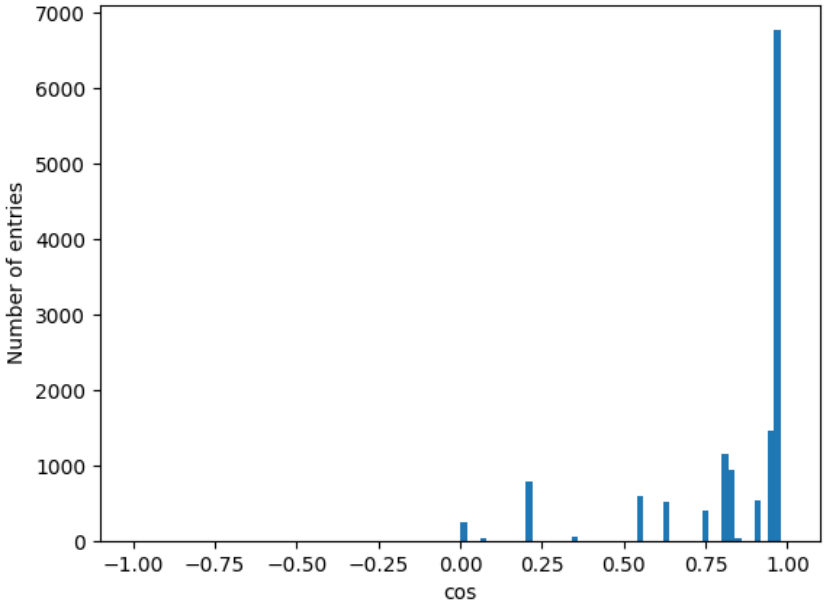
LED data check



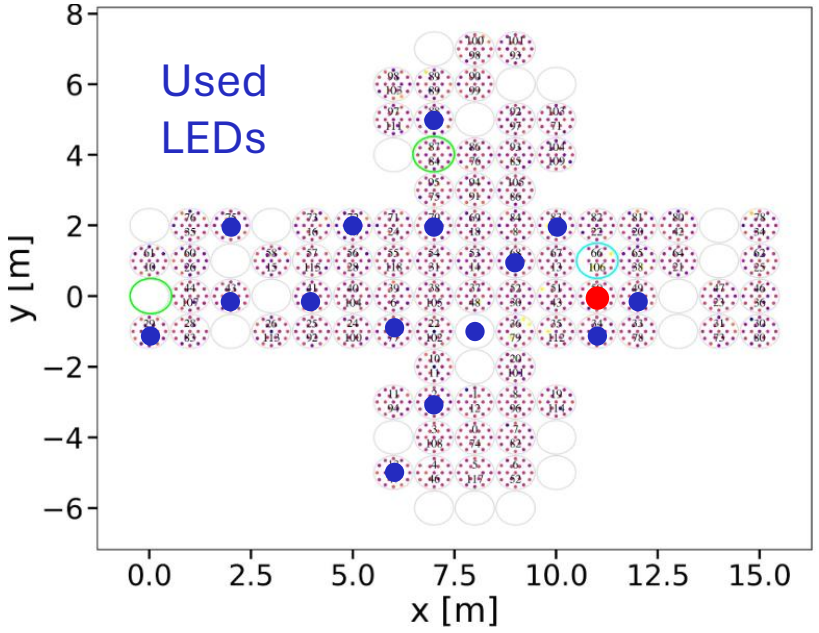
- PMT0 in mPMT40



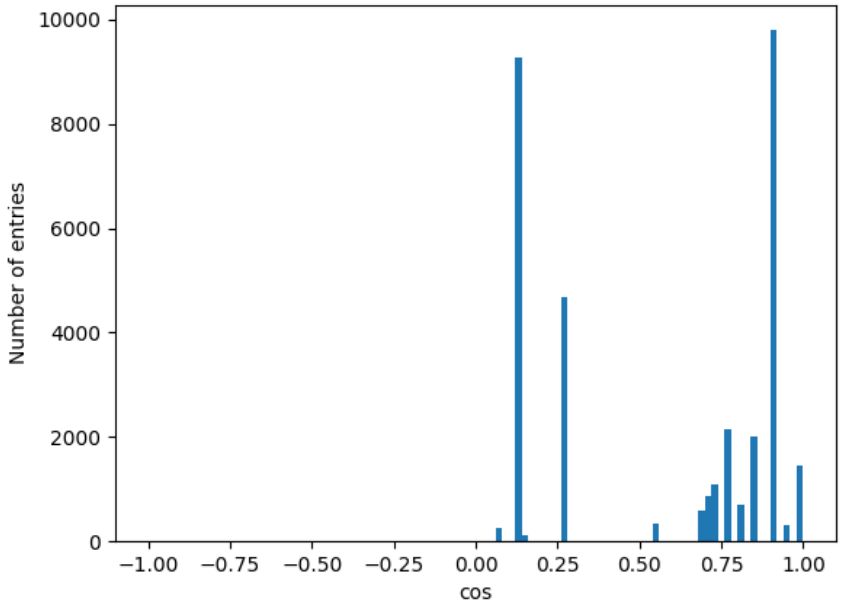
LED data check



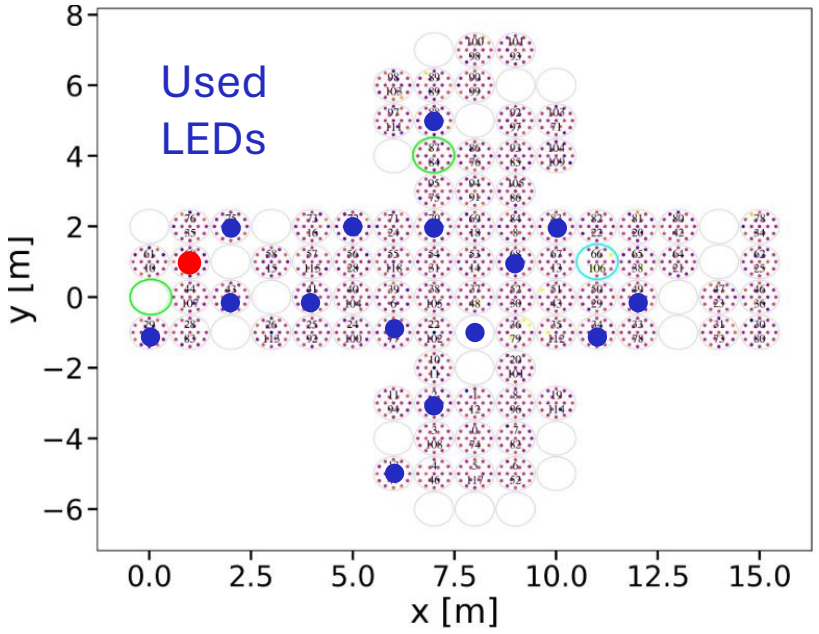
- PMT0 in mPMT50



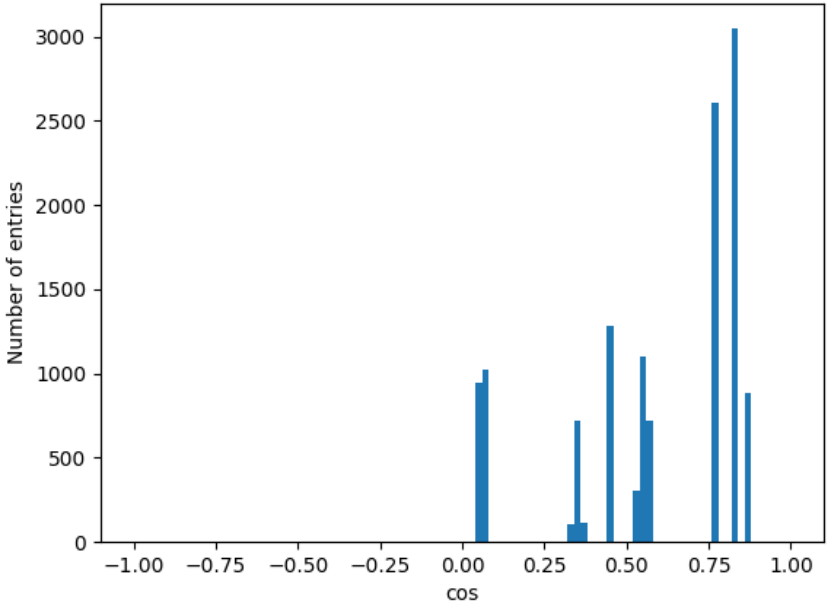
LED data check



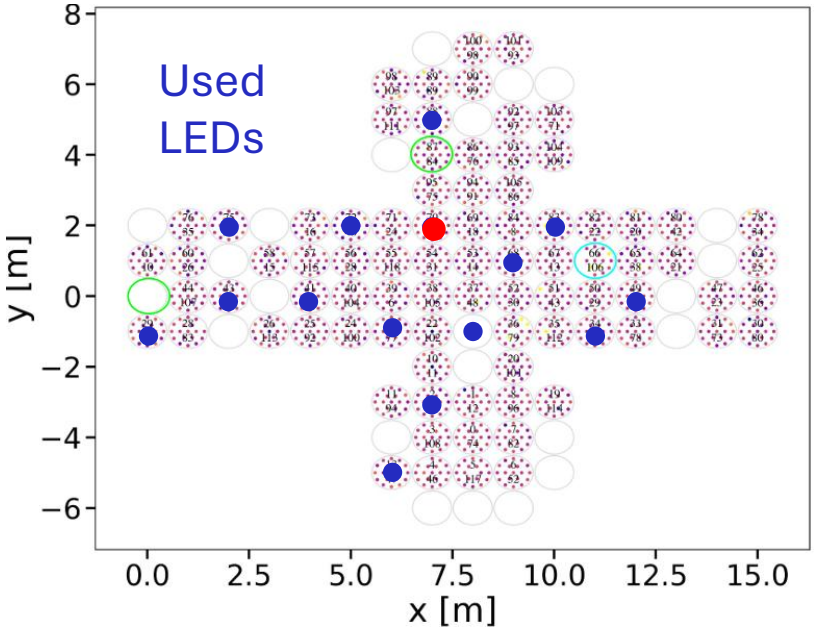
- PMT0 in mPMT60



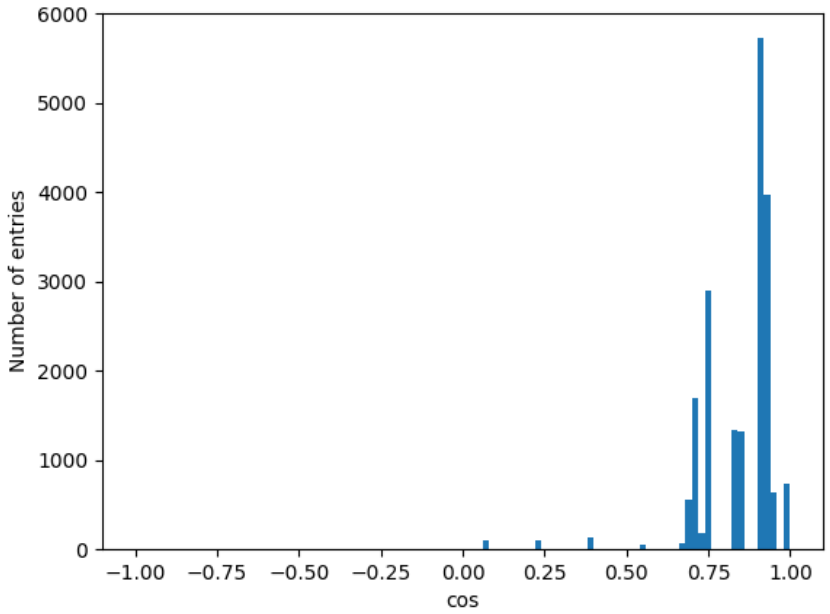
LED data check



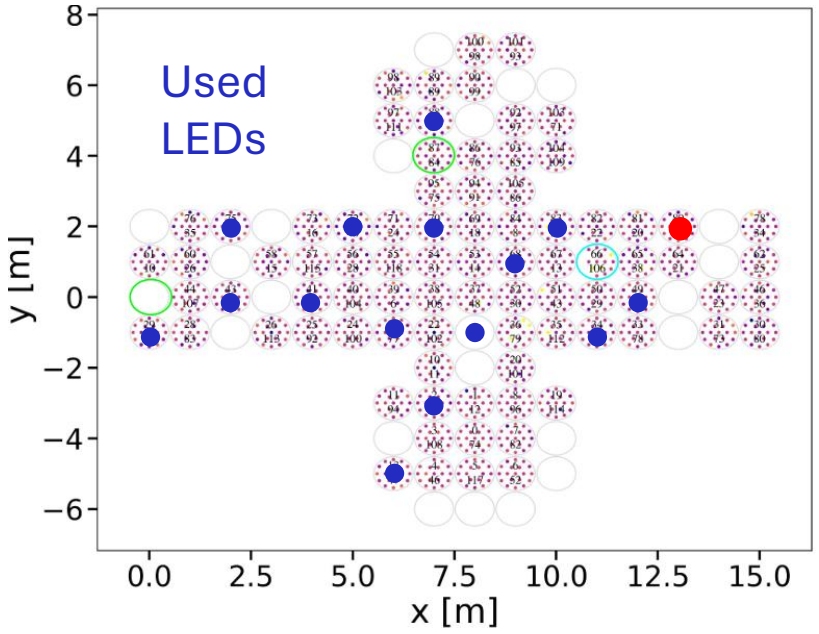
- PMT0 in mPMT70



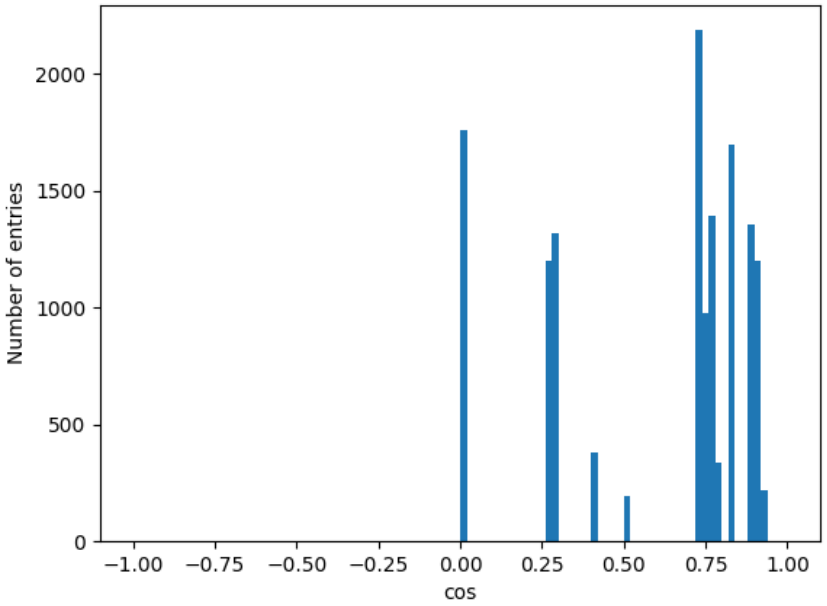
LED data check



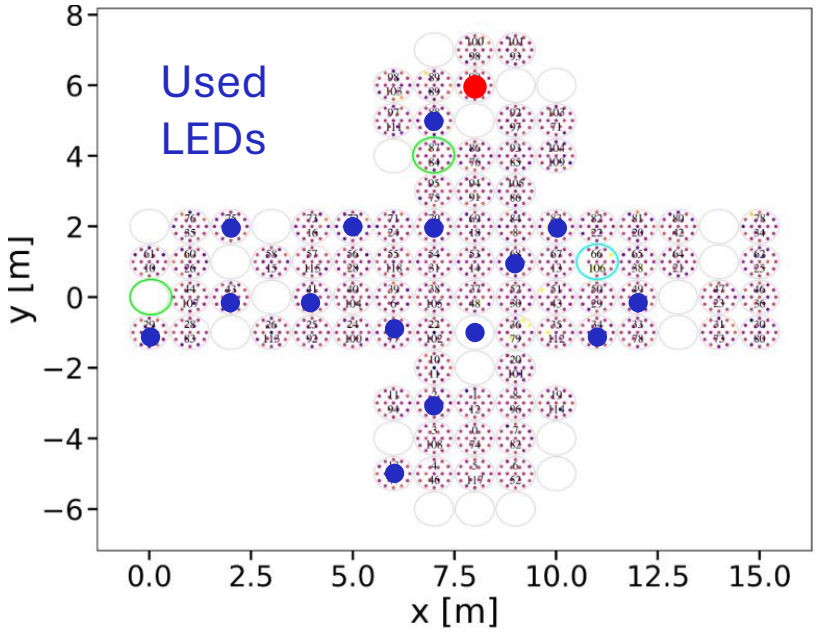
- PMT0 in mPMT80



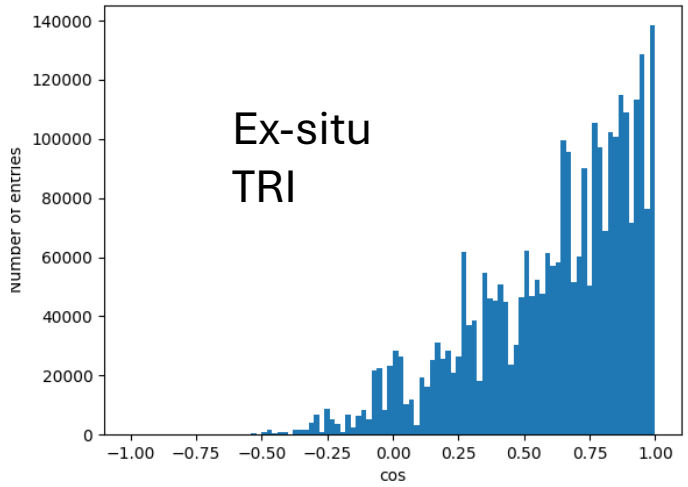
LED data check

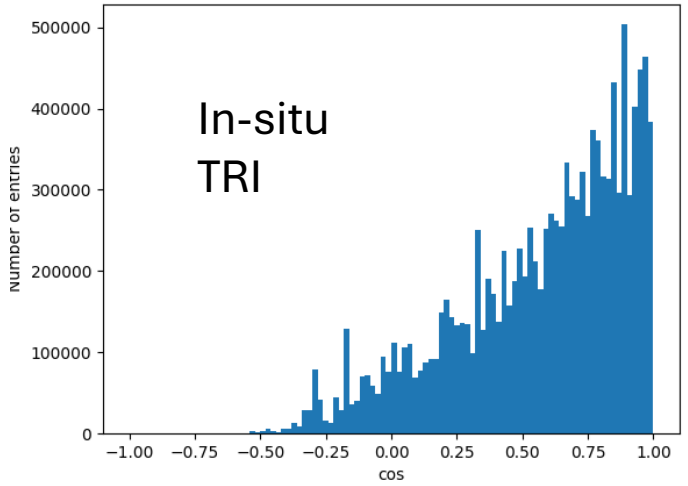


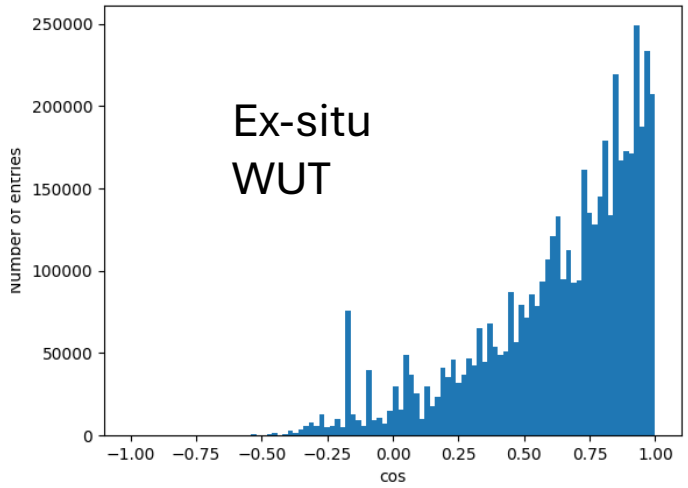
- PMT0 in mPMT90

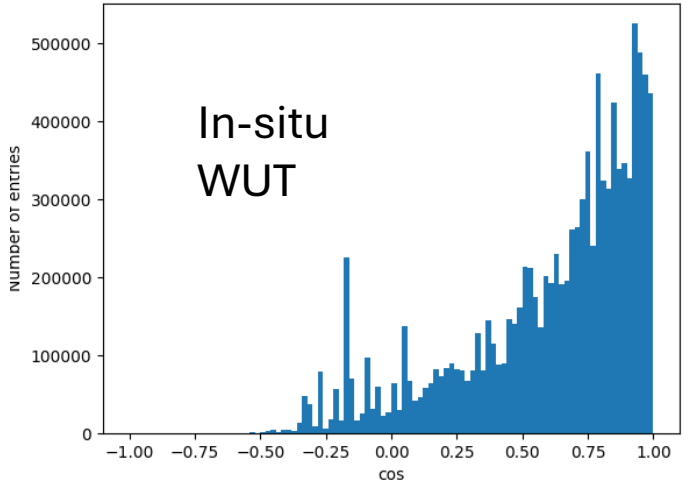


LED data check



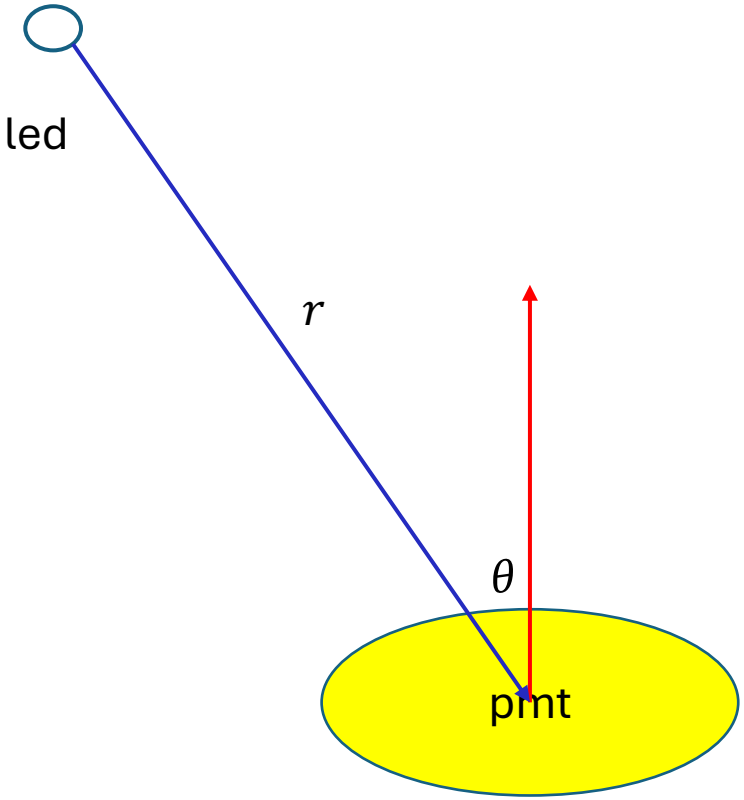






- Summed the distributions for each of the four pmt categories

Expected number of photons



- I calculate the expected numbers of photons as the correction factors by the simple model.

$$\mathrm{corr} = \left(\frac{r_0^2}{r^2}\right) \times \frac{\cos\theta}{\cos\theta_0}$$

  $r_0 = 1\ \mathrm{m}, \cos\theta_0 = 1$: reference
- Divided by this factor and filled.
- Did not consider where the photons entered the PMT.
  - However, it can estimate the relative angular responses assuming isotropic led intensity.
- Now processing…

Summary

- We can use LED data for calibration
- I am focusing on the software trigger data.
  - I have 15 LEDs × 10000triggers. (×several (>2) runs)
- I checked how is the hit angular coverage for each PMT.
  - Seems enough.

- ToDo:
  - Evaluate the angular responses and LED intensity (include how isotropic diffuser LEDs are).