

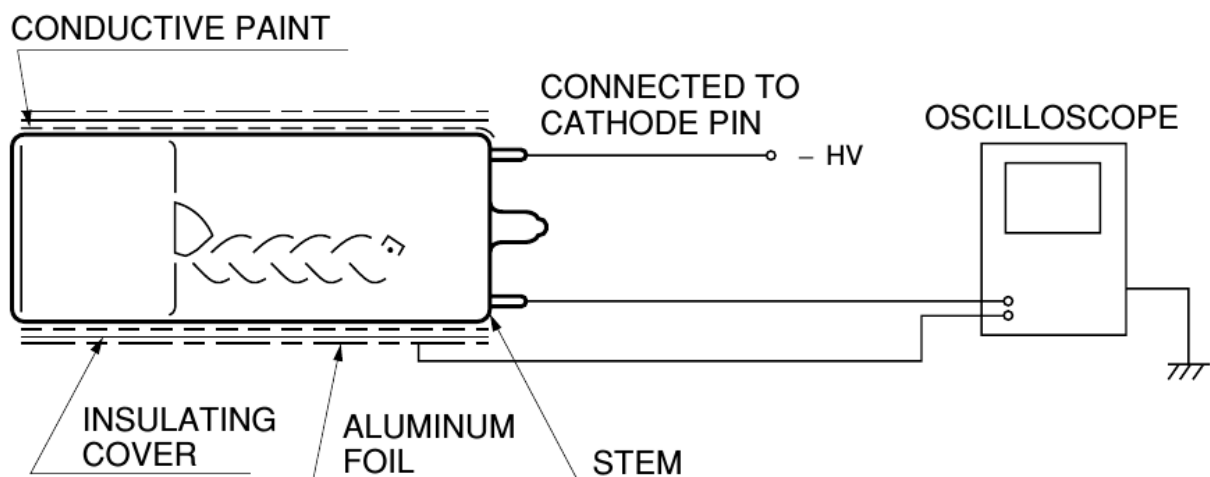
Measurements for 3'' PMTs characteristics for E61 and Hyper-Kamiokande

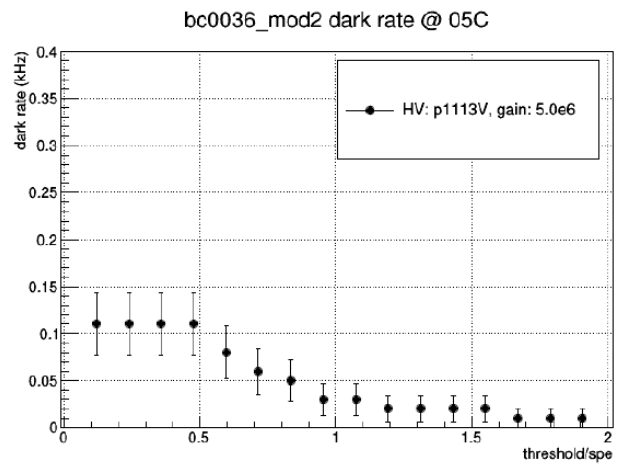
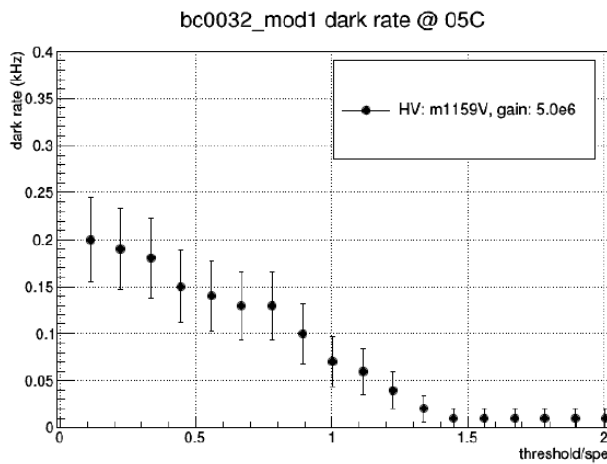
I. Diffuse fixed light source (current situation) :

1. Gain and TTS in positive and negative high voltage mode → Done by Morikawa-san
→ Confirm/Infirm the 1.4ns TTS.
2. Measure TTS dependency as a function of the input charge (1 → 10 p.e) → Precious input for simulation → Done by Morikawa-san.
3. Measure the stability in time of Gain/TTS → Use monitor PMT. If possible, monitor the temperature/humidity
→ First study done. Needs to be understood, especially, the possible unstability of our monitor.
→ Who ?

Note : negative HV → Dark rate higher due to photo-cathode at negative HV → Attract positive ions / electrostatique effect → Photo-electric effect → amplification → Signal.

To negate this effect : HA coating → Insulating cover on the side of the PMT (do not cover the photo-cathode





4. Additional task :

-Measure the peak to valley ratio as a function of HV → Mimic the signal / noise ratio of the PMT → Done by Morikawa-san

-Can we find a « functioning-point » i.e. a point where Peak/Valley is maximal ? → Done by Morikawa-san.

II. Motorized light source :

1. Repeat the measurements of I. but as a function of the position on photo-cathode (orthogonal incidence to photo-cathode) → Show the uniformity of gain/TTS.

→ We found previously some hints of non-uniformity. It would be also crucial to test if the TTS does not increase for hits on the edges of the photo-cathode.

→ First result done by Izumi-san.

→ Needs check with smaller binning in position & correction for angle wrt photo-cathode.

→ Who : Izumi-san ?

→ When : April / May → Finished for June ?

2. Measurements as a function of angle wrt photo-cathode

→ First measurements done by Izumi-san from -30 to 30 degrees.

→ Needs check with higher angle.

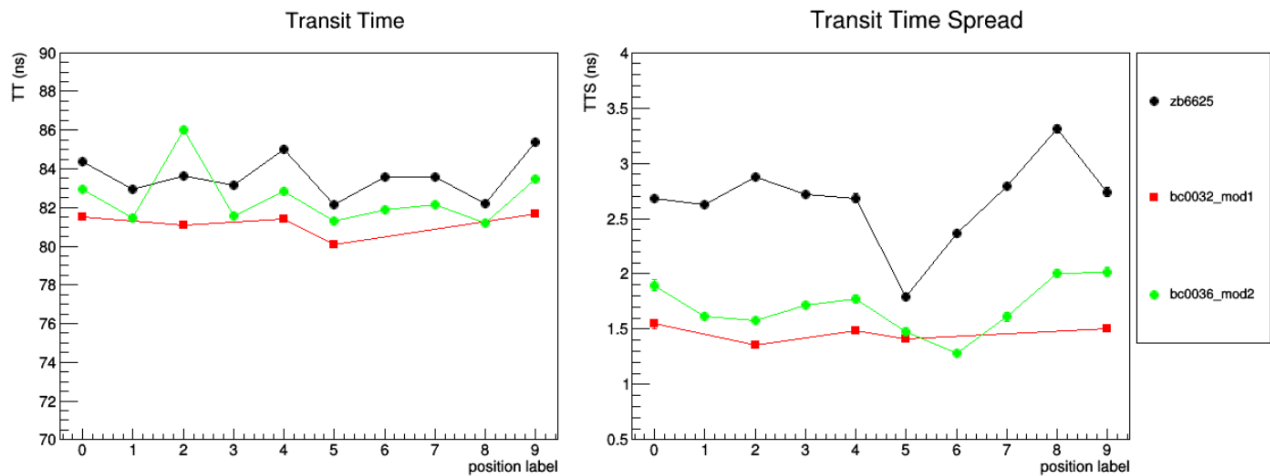
→ Who : Izumi-san ?

→ When : April / May → Finished for June ?

PMT R14374 SN: BC0032, Base: E1198 Mod1 (negative HV)

PMT R14374 SN: BC0036, Base: E1198 Mod2 (positive HV)

PMT R12199 SN: ZB6625, Base: UofA base (positive HV)



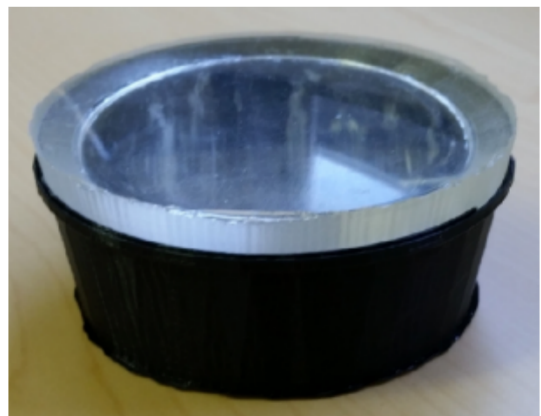
Requirements :

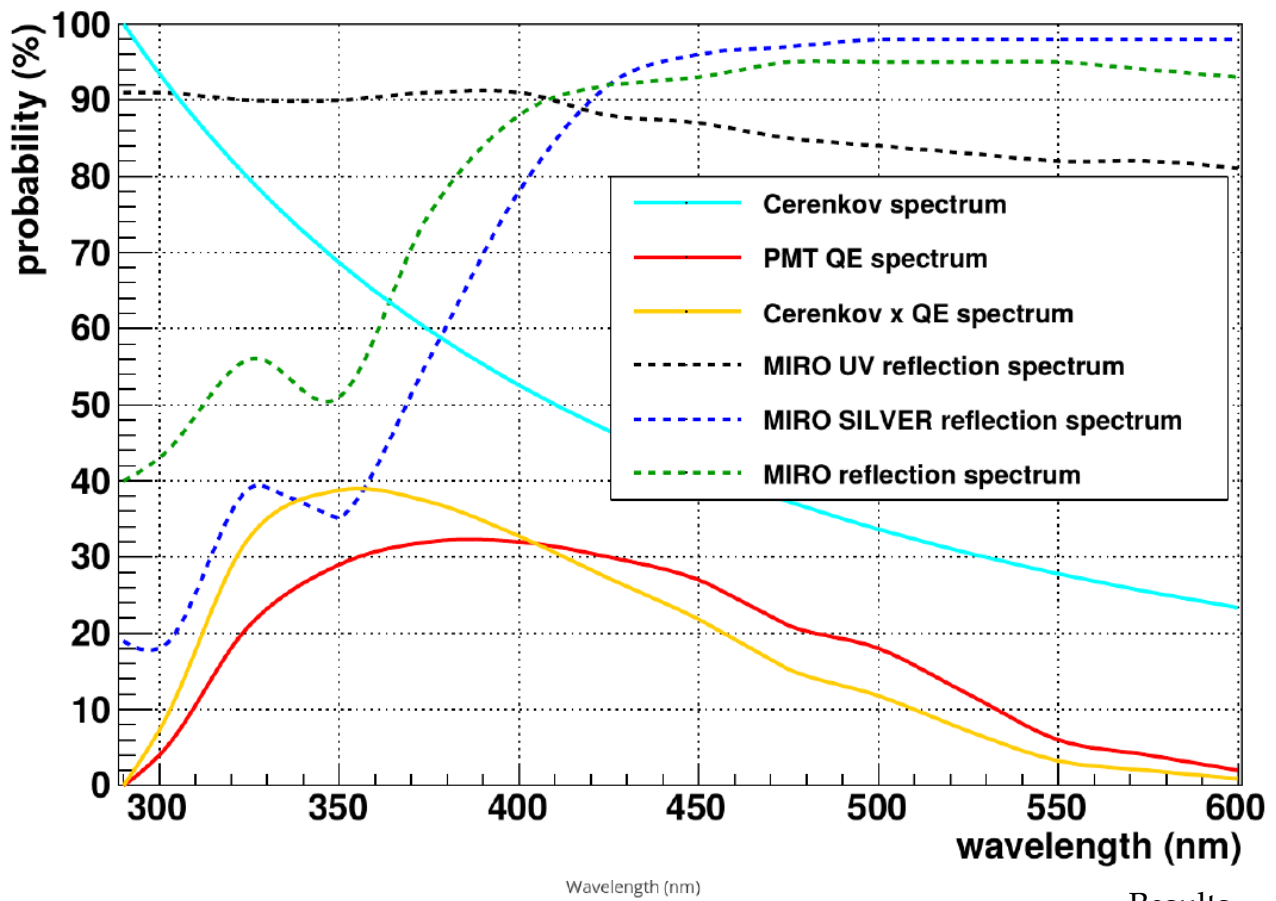
- Install motor on table & create a new (bigger) dark box → done by Izumi-san.
- Fix the PMT in the muMetal → 3D print a fixation system → done by Izumi-san.
- Add a fixation bar to muMetal from the table to avoid rotation → done by Izumi-san.

Bonus :

3. Measurement for different wavelength → Buy 2 additional laser diode (now 402nm).

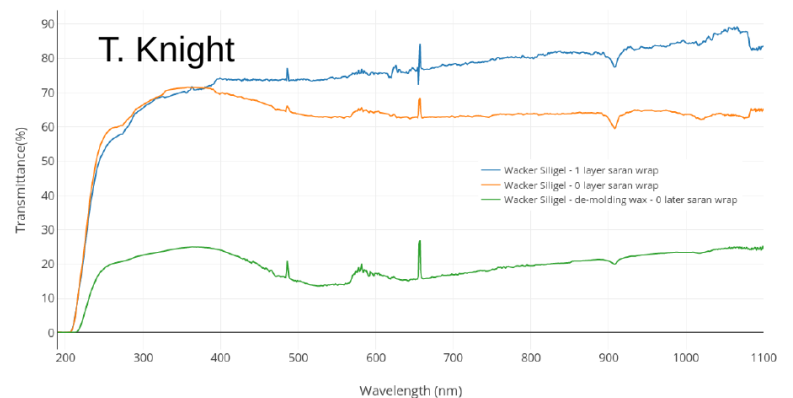
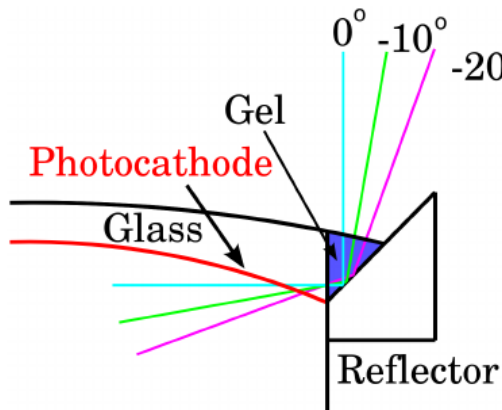
III. PMT with reflector :



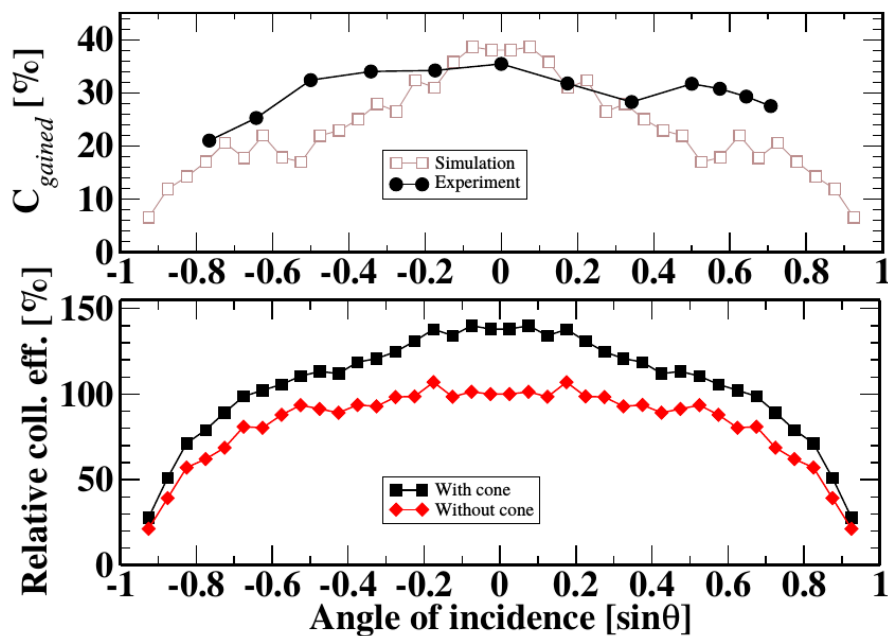


Results

Acrylic gel to increase transmittance between reflector and PMT :



from Km3Net (we want to update w/ our IPMU results) :



1. Measure the total gain increase w/ reflector → Compare w/ simulation.

→ Diffuse light source

→ First results by Morikawa-san.

→ Update the light pattern uniformity → Directly plug splitter on first diffuser, do not use fiber in between.

→ Compare different reflectors.

→ Compare different reflector length, position and angles.

→ Who : Timothe ?

→ When : from end of April → Finished at the end of June.

→ Ask Mark : when do we need the answer for the prototype ?

2. Measure the total TTS enlargement w/ reflector → Check if negligible or not.

→ Who : Timothe ?

→ When : from end of April → Finished at the end of June.

3. Reproduce these measurements w/ angular and position dependency wrt PMT → Precious input in the simulation.

→ Who : Izumi-san and Timothe together ? Izumi-san ?

→ When : from end of April → Finished in July.

→ Ask Mark : when do we need the answer for the prototype ?

4. If several laser diodes (see II. 3.) → Repeat these measurements @different wavelength.

IV. Dark noise measurements at IPMU ? → Do them at TUS.

1. Measure dark rate in positive and negative HV.

→ Who ?

→ When ? Actually, quite urgent to decide if we should tackle development of HV>0 base.

2. Check variations wrt temperature → Is it possible ?

→ Who ?

→ When ? Actually, quite urgent to decide if we should tackle development of HV>0 base.

V. Compare negative HV w/ and w/o HA coating.

1. Measurement of QE, TTS

→ We received HA-coated mPMT at IPMU. Tests can be undertaken. Not urgent.

2. Measure Dark rate → at TUS ?

→ Would be very interesting and urgent.

VI. Measure the effect of B-field on PMT response.

1. Measure the effect of B-field on QExCE at PMT center
→ Done by Inomoto-san.
2. Measure how this result varies as a function of position on the PMT.
→ Who : Inomoto-san.
→ When ? For June ?
3. Measure the possible impact on TT at different point on the photo-cathode.
→ We can extract the potential impact on TTS
→ Who : Inomoto-san.
→ When ? For June ?

VII. Reproducing all results for HZC PMTs ?

1. For HK far detector, I do not think we can use them.
2. For E61, it may be an option ?
→ Most important is to measure QE and TTS w/o reflector.
→ Wait for HZC to reach ~2.0/1.5 ns TTS before going to more intensive measurements ?
Otherwise, I guess it may not satisfies our needs for E61.

Conclusions :

1. A lot of work has been already done
→ Well done, and thank you to Morikawa-san, Izumi-san and Inomoto-san.
2. Now, most urgent items to me :
 - a. Dark rate measurement with $HV > 0$, $HV < 0$ and $HV < 0$ w/ HA-coating → Is Arthuro working on this, or shall we focus on it ?
 - b. Reflector tuning → we should take care of this.
3. What are our goals in long terms ?
 - a. HK Technical Report → End of April.
→ Not many additional items required. We already know we cannot use HZC PMT for far detector. Do we need HZC PMT measurements for nuPRISM ?
→ Dark rate ?
 - b. PMT prototype in Canada (and Japan?) to send to France
→ Should be ready by the end of summer.
→ Finalize results on reflector and motorized results for July ?
 - c. Produce a paper
→ We can target to finalize our results by the end of this year.

