

IceCube-Gen2 : 新型検出器の試作機開発と性能評価

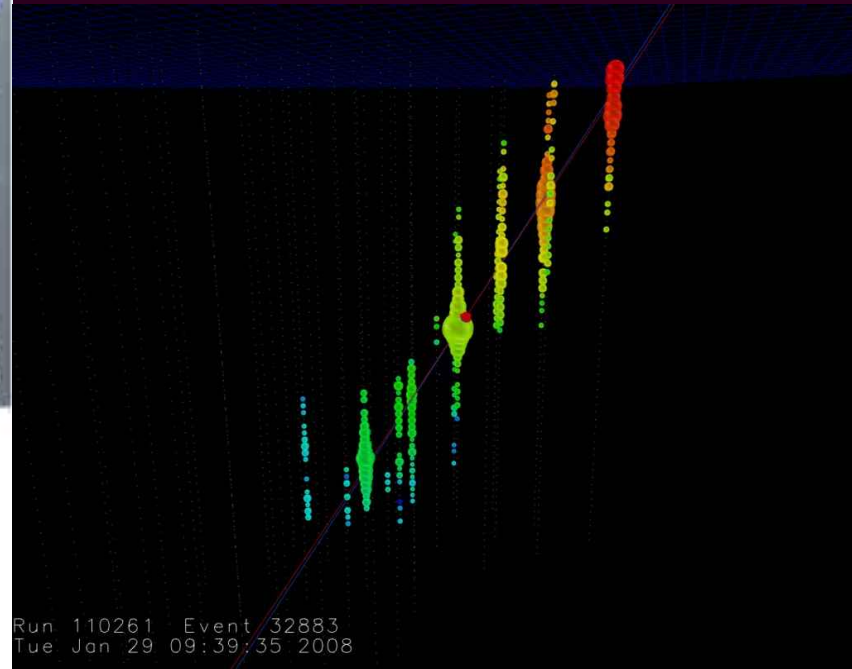
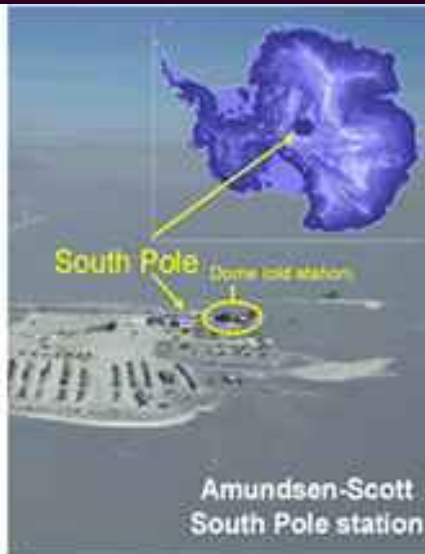
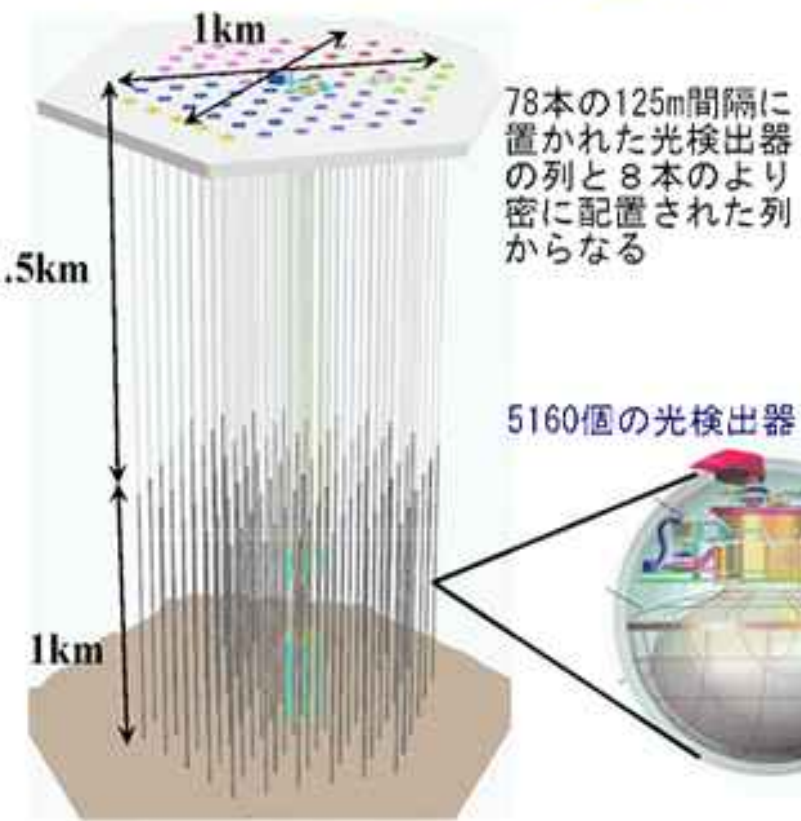


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2016.02.29

Introduction : IceCube

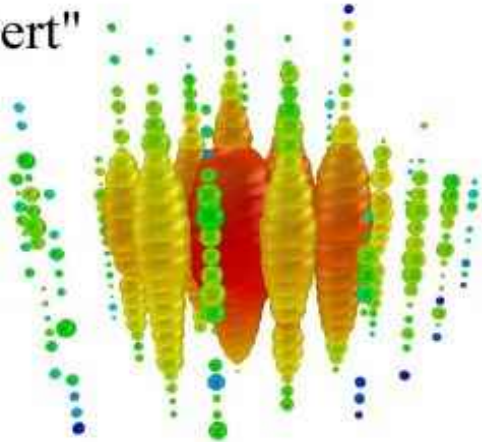


アイスクューブ検出器

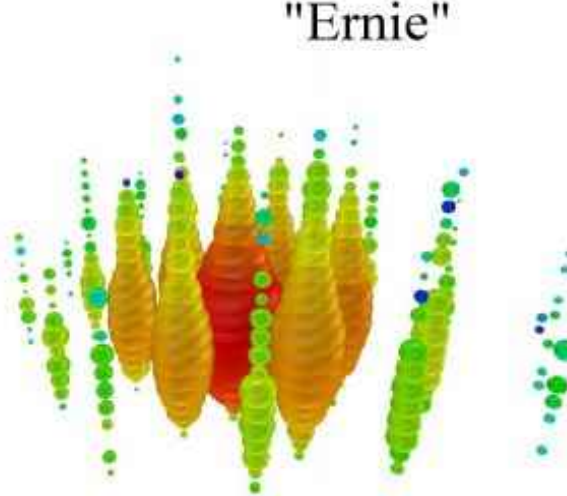


Introduction : IceCube

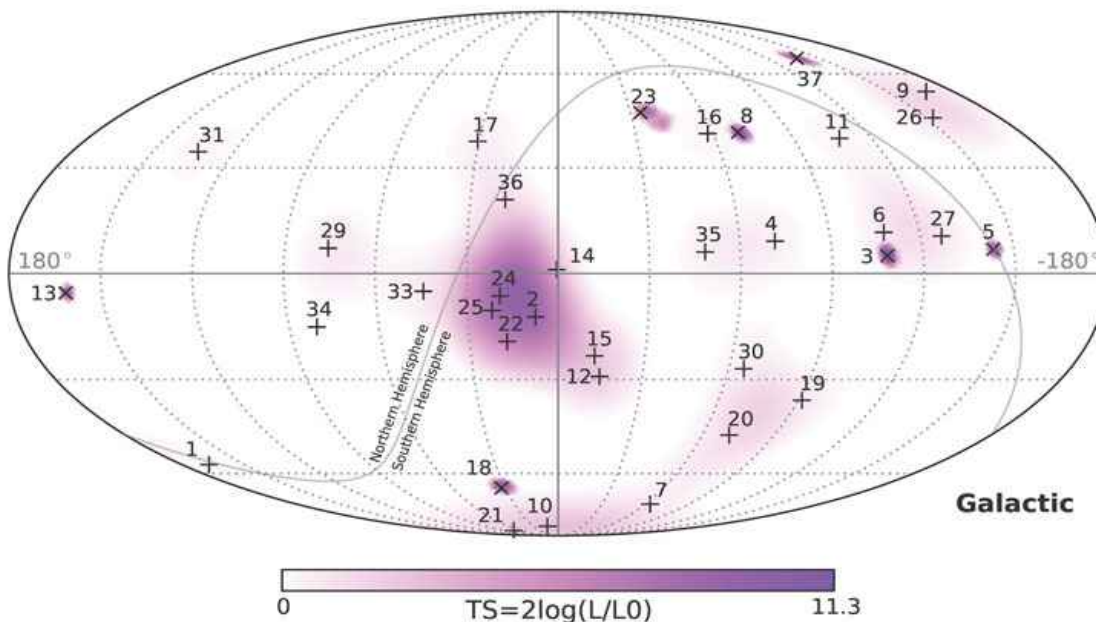
"Bert"



"Ernie"



2012 :
PeV neutrino was detected

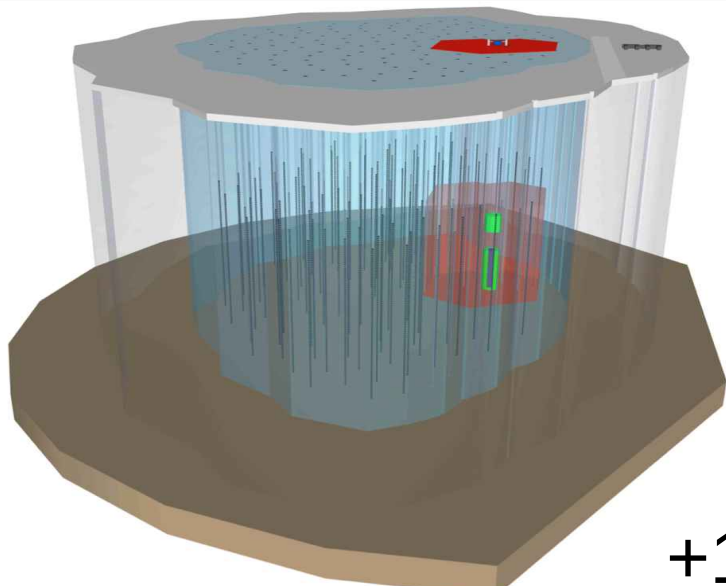


Motivation :
Search for the origin of
UHE neutrino

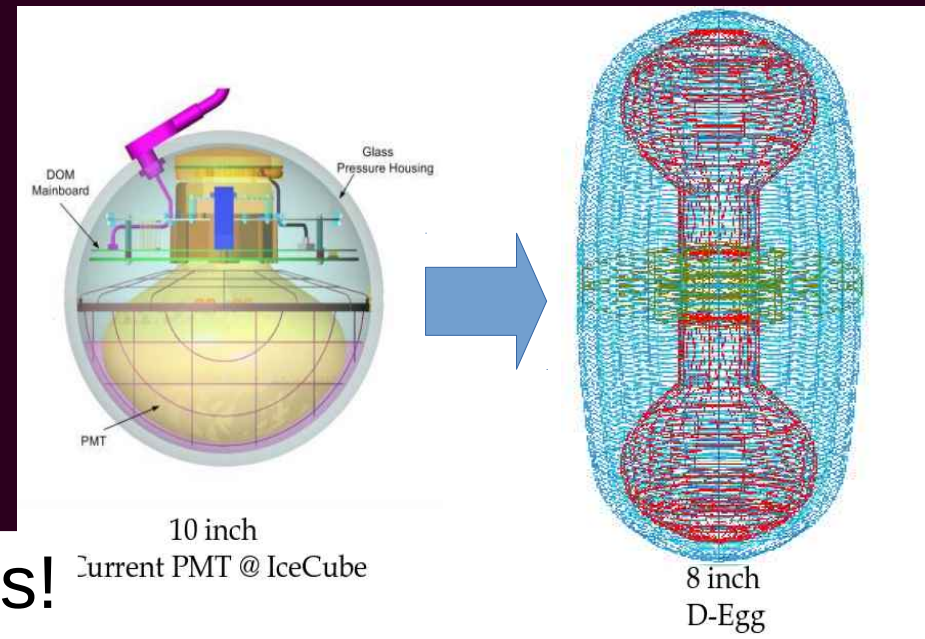
>> need to more statistics

Introduction : IceCube-Gen2

Geometry



+120 strings!
× 5 volume!



10 inch

Current PMT @ IceCube

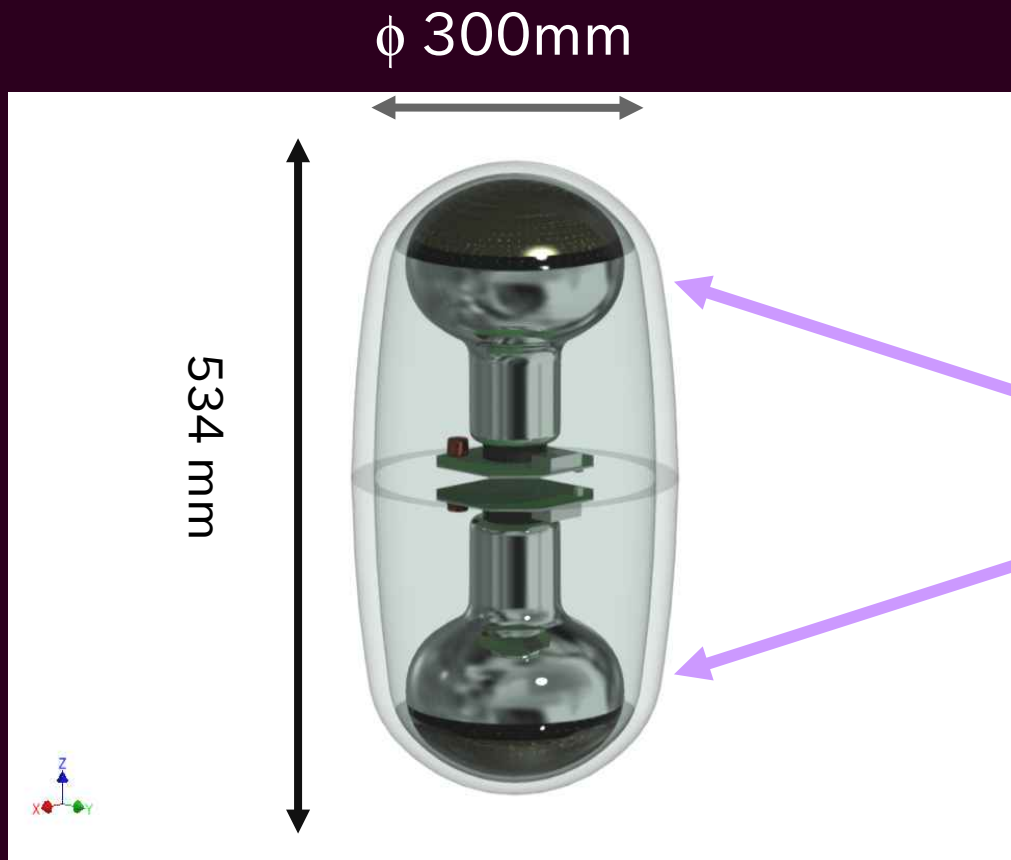
8 inch
D-Egg

Need to improve

- More statistics
- Better angler resolution
- Remove the background down-going muon
- Better detection for UV photons
- Reduce cost

Introduction : D-Egg

D-Egg = Dual optical sensors in an Ellipsoid Glass for Gen2

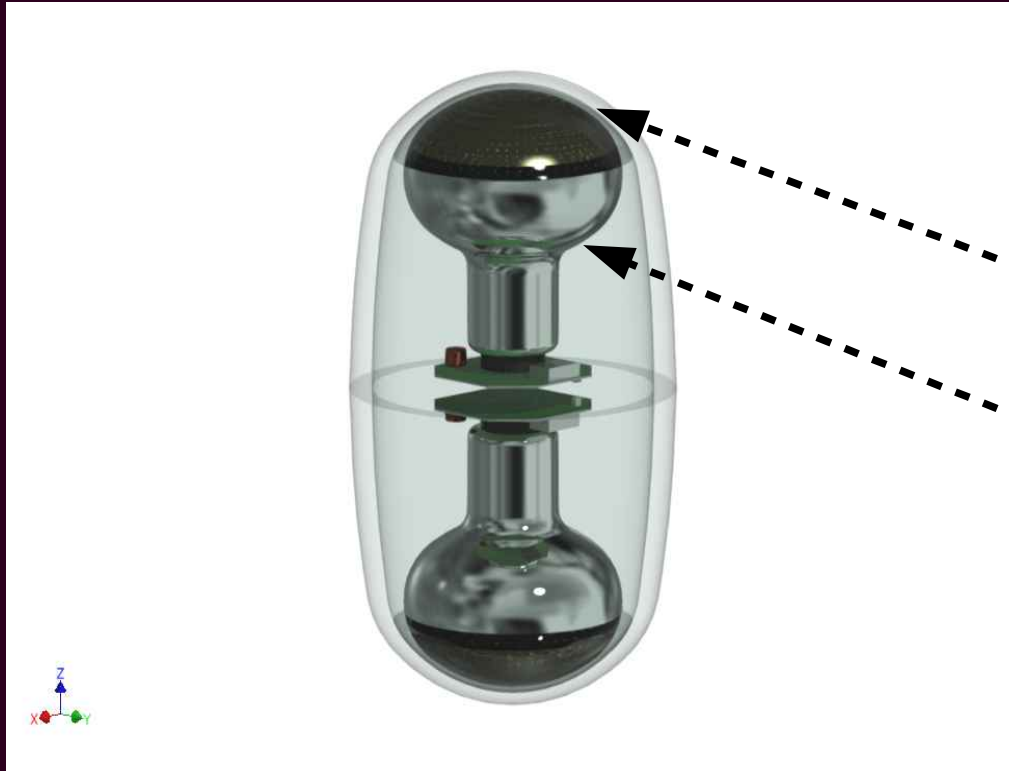


8inch SBA PMT R5912-100
(made by Hamamatsu)

- Up & Down PMTs in 1 elliptical glass
 - capture down-going muon
- New glass & gel can transmit UV photons
- Smaller than DOM , so the drill cost is reduced

Introduction : D-Egg

D-Egg = Dual optical sensors in an Ellipsoid Glass for Gen2

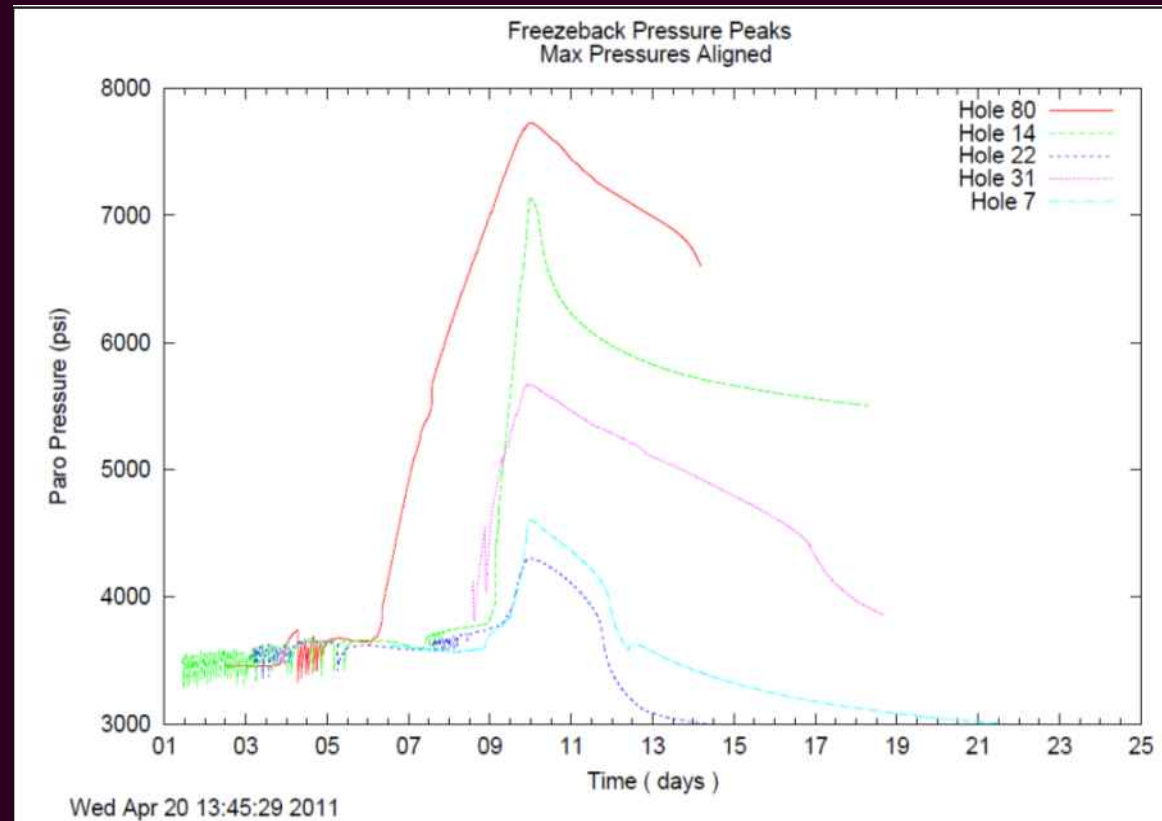
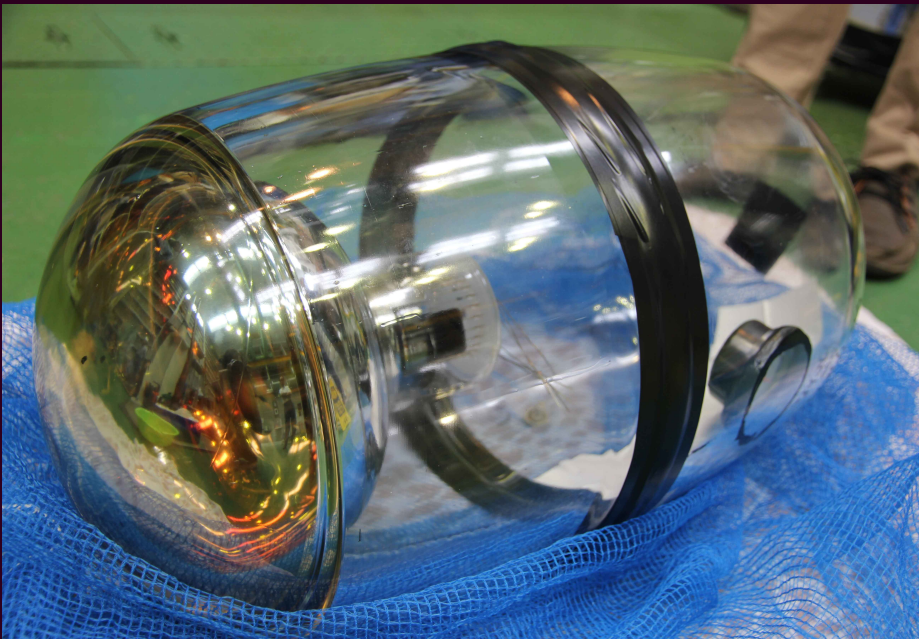


- 1 : Mechanical durability
 - to stand the pressure of ice
- 2 : Photon transmission of Glass & Gel
 - measure the QE of D-Egg
- 3 : PMT response
 - noise rate , collection efficiency

Pressure test

- In Antarctic ice , D-Egg is pressed during freezeback. The maximum pressure is 8000psi (=50MPa) So need to check durability.

Dummy for pressure test



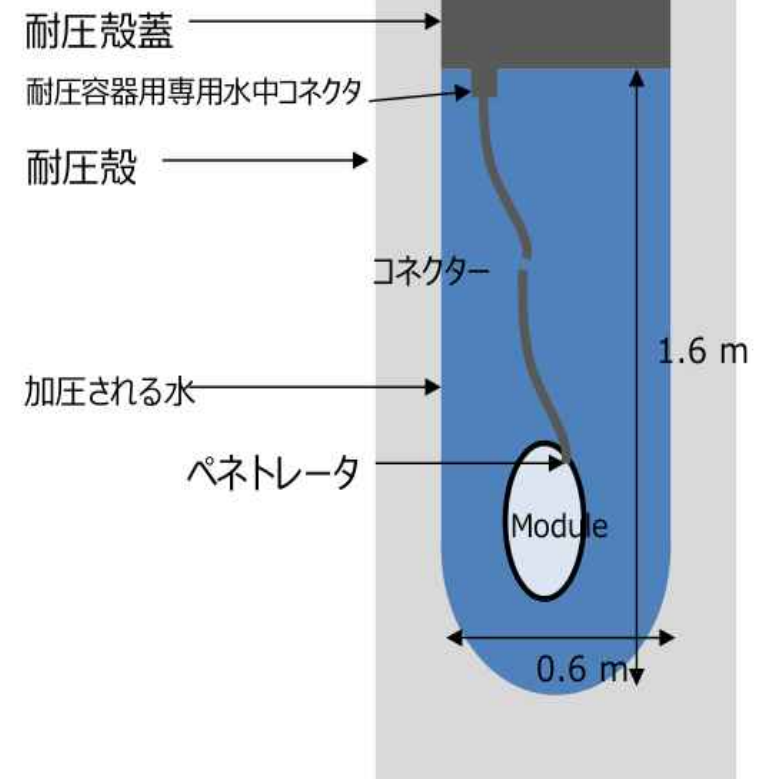
Process

- We use high presser tank at Jamstec and press the D-egg in 70 MPa for 3 hours



High pressure tank

High pressure system @jamstec



Result

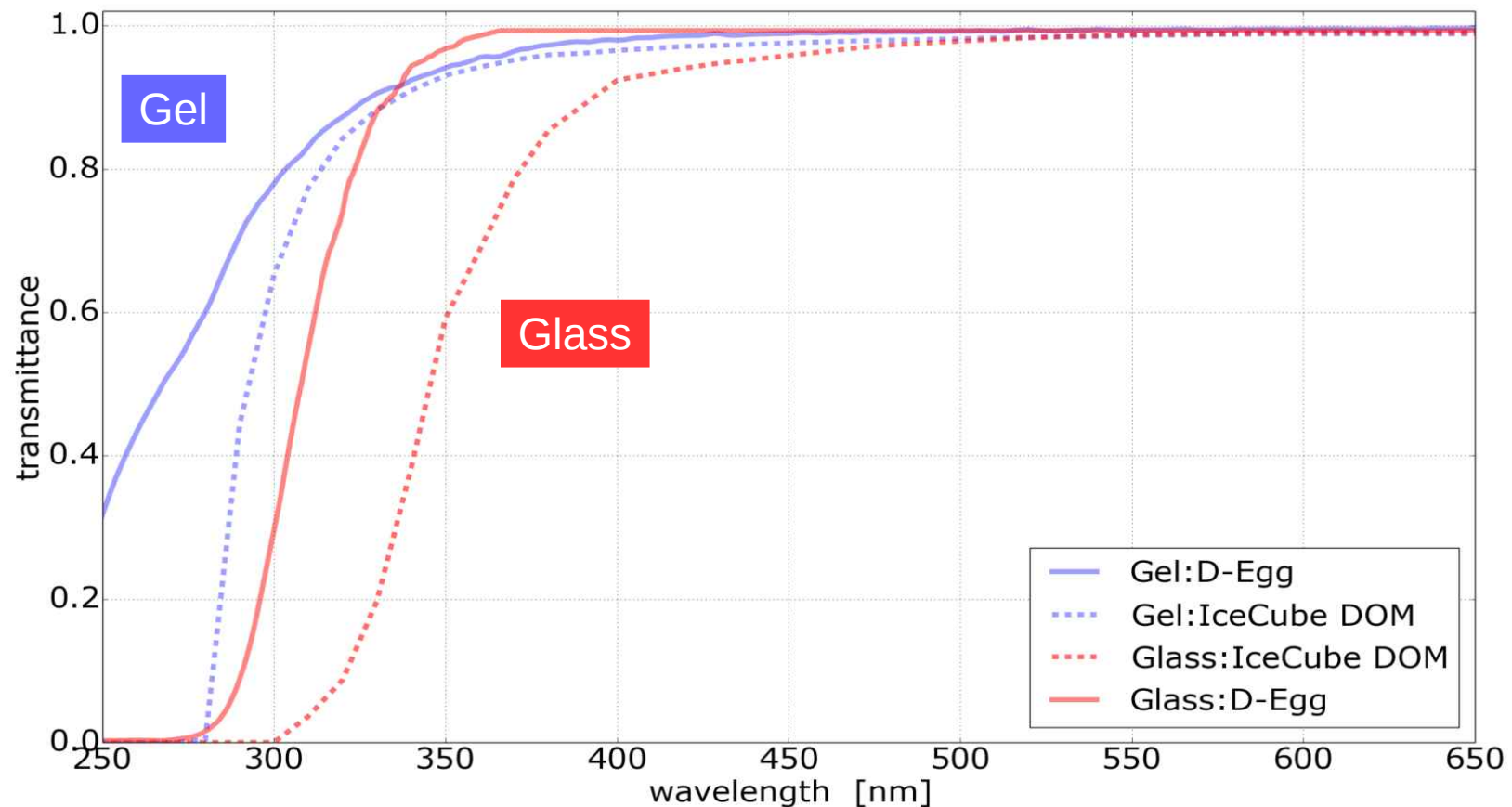
- Not Breaking.
but some bubbles between glass and gel.
→ need to change the gel softer
- Next : checking the signal can read out

bubbles

After pressed D-egg →

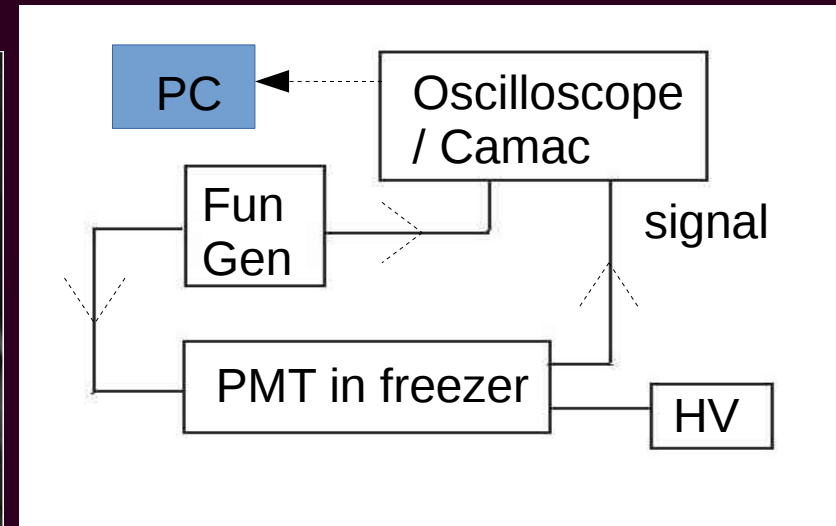
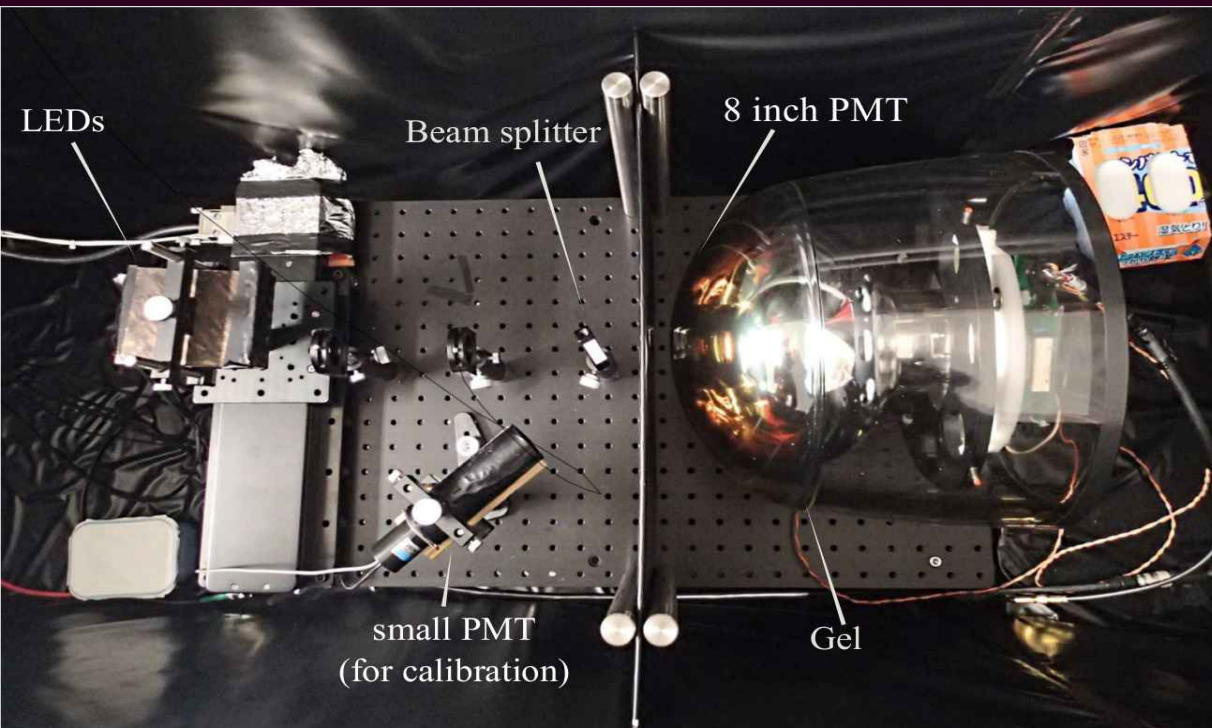


Transmission of Glass & Gel



* data from company

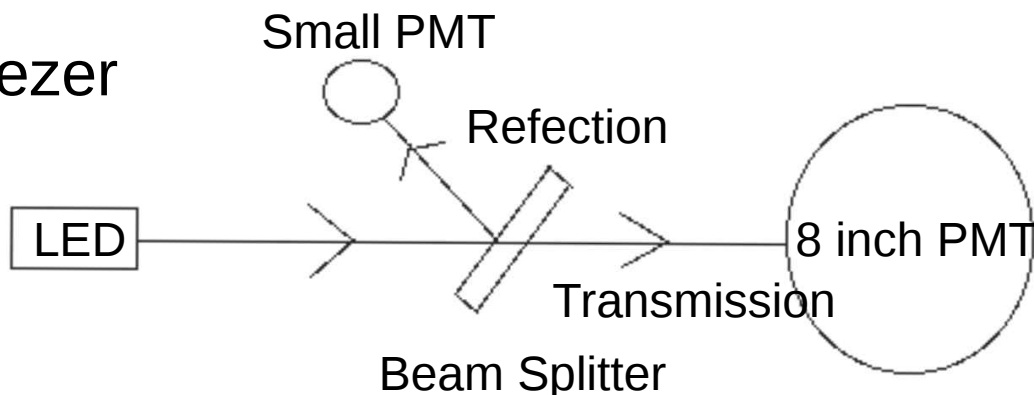
Set up for measurement



In advance Reflect and transmit ratio and gain is measured.

Light is observed by 8inch PMT and small PMT simultaneously.

IN
freezer



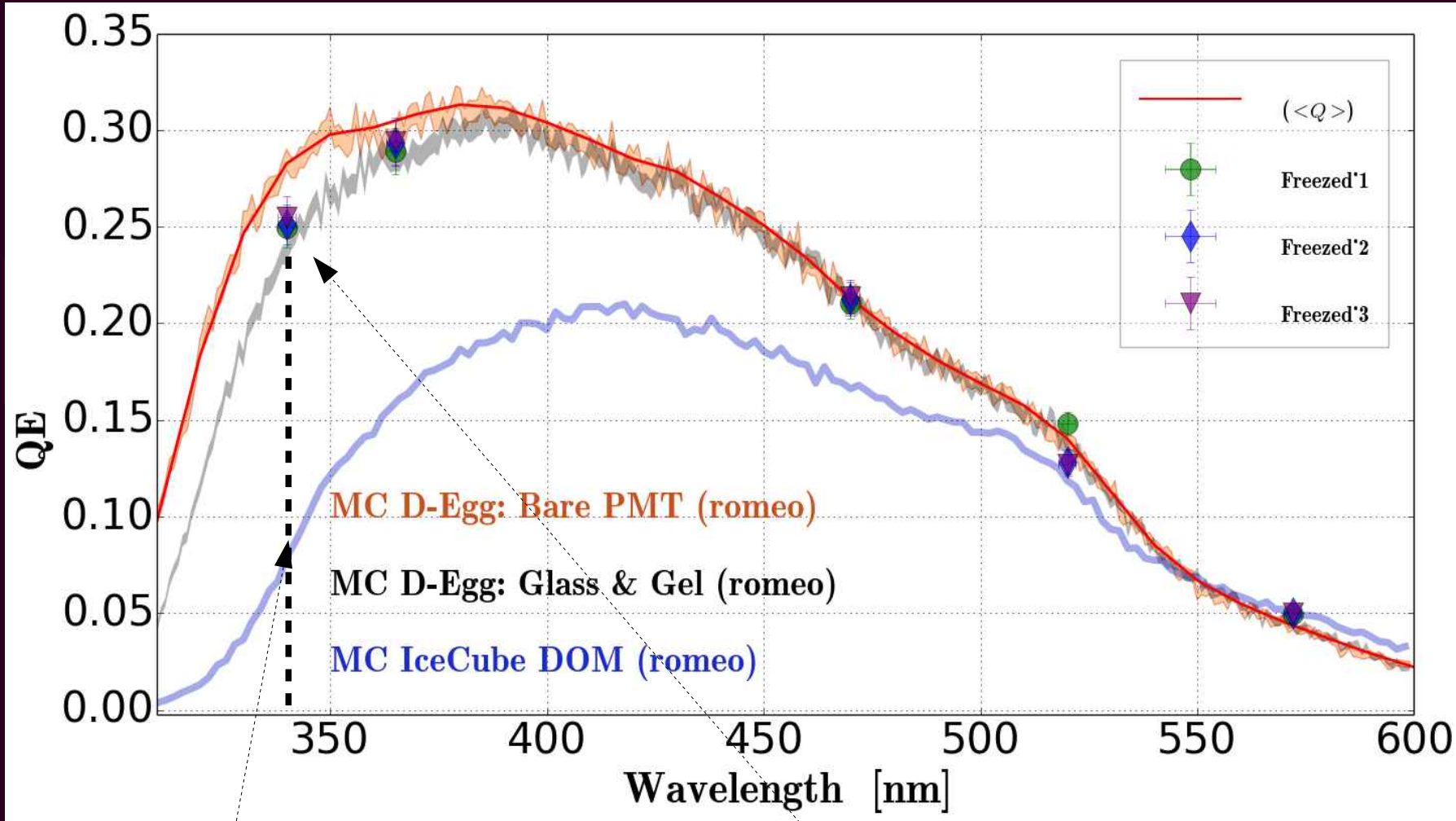
$$\epsilon_{Degg} = \frac{R}{T} \times \frac{G_{ref}}{G_{Degg}} \times \frac{Q_{Degg}}{Q_{ref}} \times \epsilon_{ref}$$

QE measurement



This time, we use the prototype of D-Egg (a Half of D-Egg).

Result



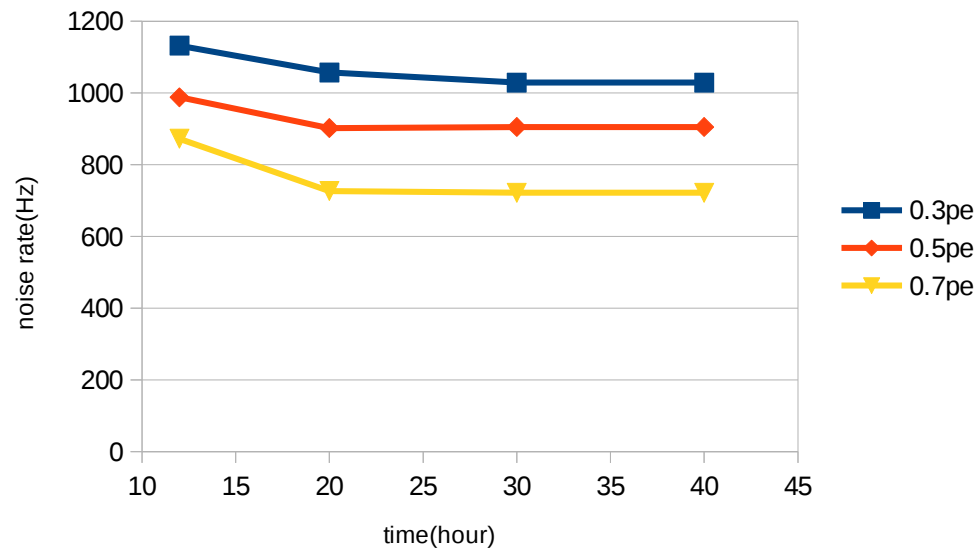
8% QE @ 340nm
(IceCube DOM)

25% @ 340nm
(Gen2 D-Egg)

Noise rate in -45 °C

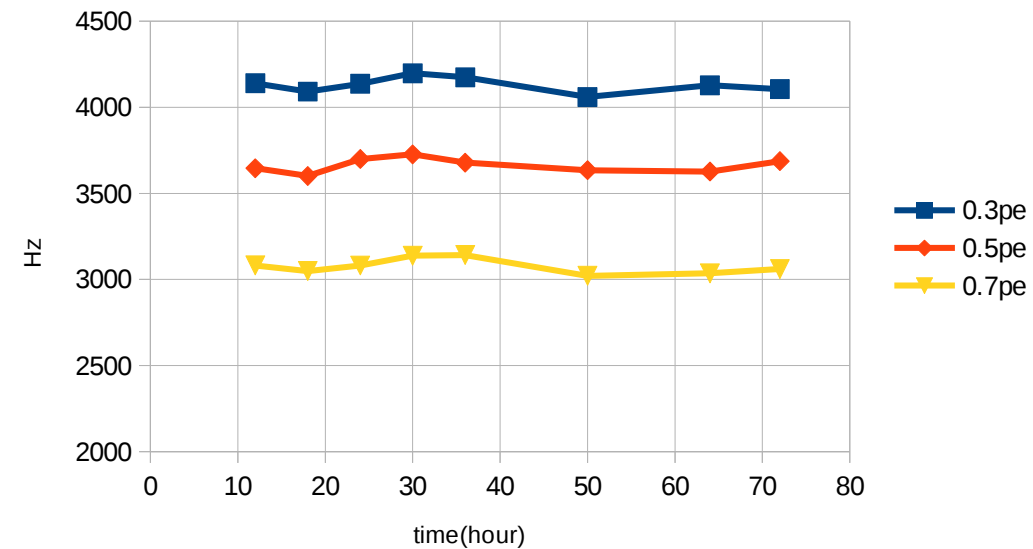
wo Glass & Gel

capacitor noise rate



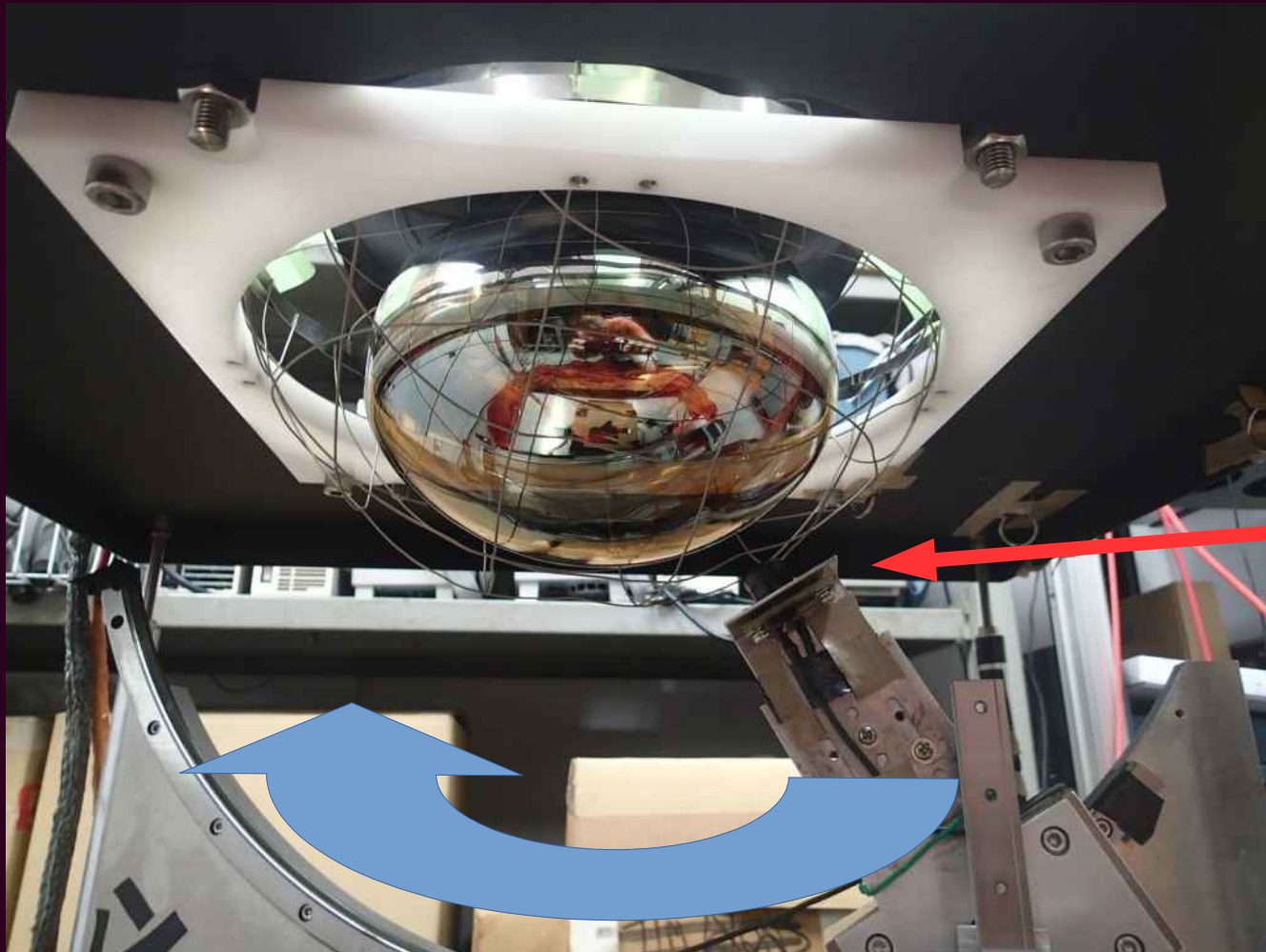
with Glass & Gel

noise rate capacitor



Same gain , 10^7

Collection Efficiency : Setting

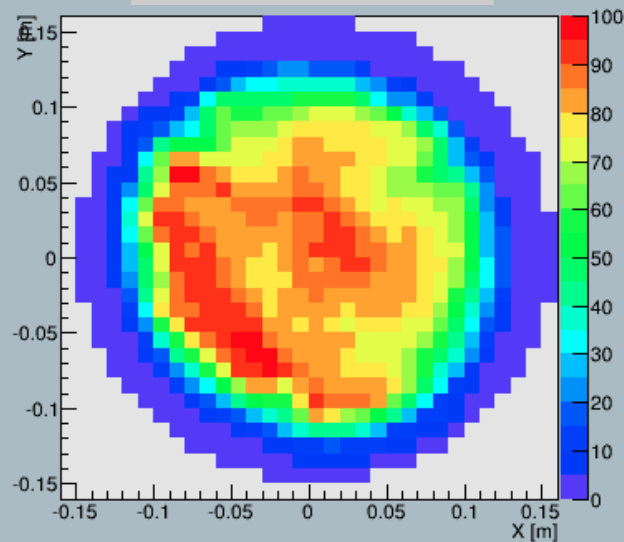


LED

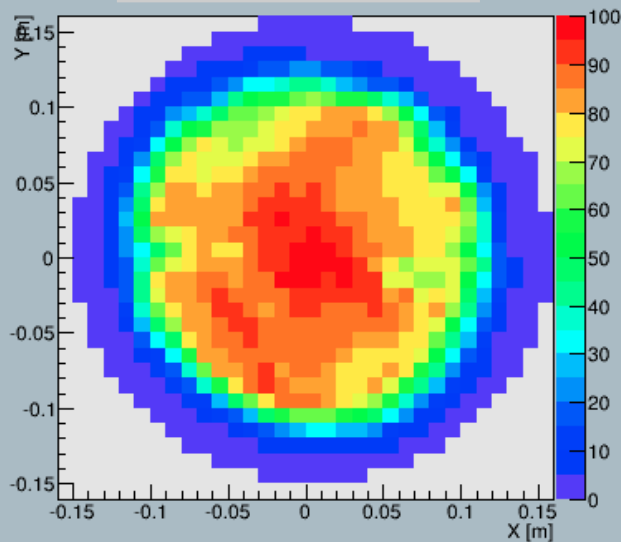
LED is slide and rotate
Then take the signal each point.

Uniformity (preliminary)

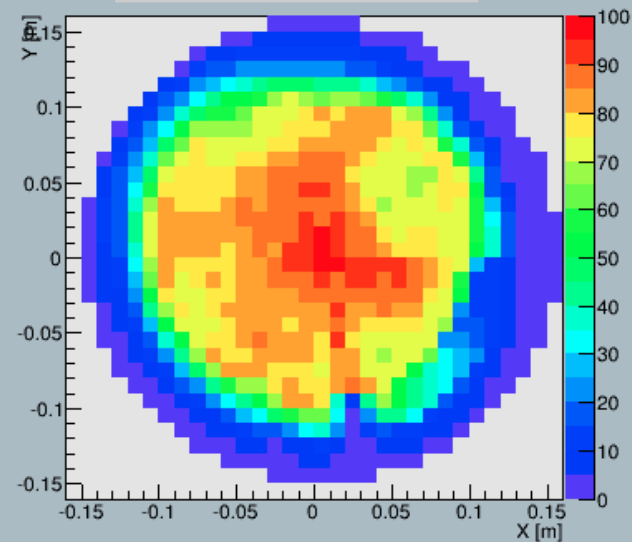
SQ0237



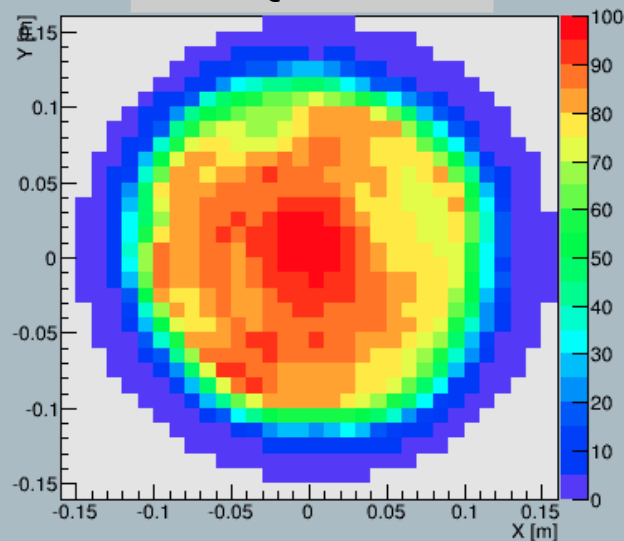
SQ0238



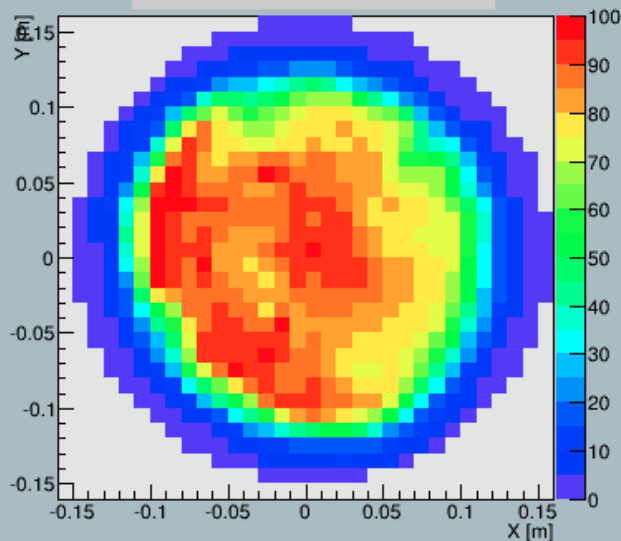
SQ0239



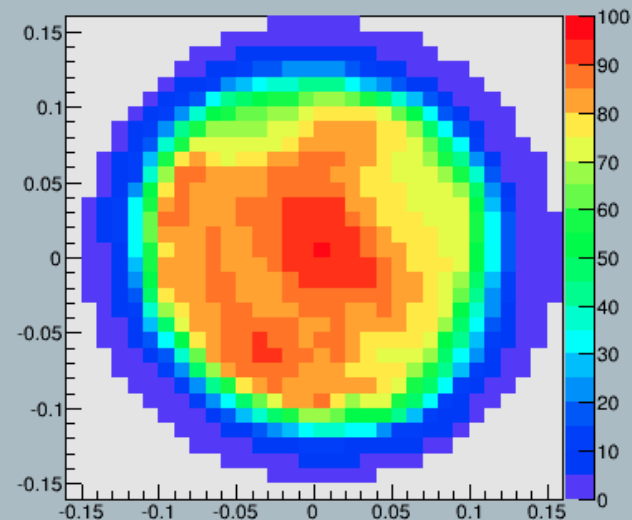
SQ0241



SQ0242



Averaged



Summary & Plan

- Pressure test
 - ゲルの硬さを変える、信号読み出す
- Optical
 - 紫外光の透過性が確かめられた
 - 試作機を更に作り、実験を行う(noise , Uniformity の評価)
 - Divider circuit の設計

IceCube-Gen2 で採用されることを目指す。

END

Back Up

HOPE: NEW LIGHT SENSORS

- current DOM works *pretty good* – certainly the lowest risk option would be to make minor tweaks to this design
- New light sensors might help with muon-veto, event reconstruction and bring physics gains



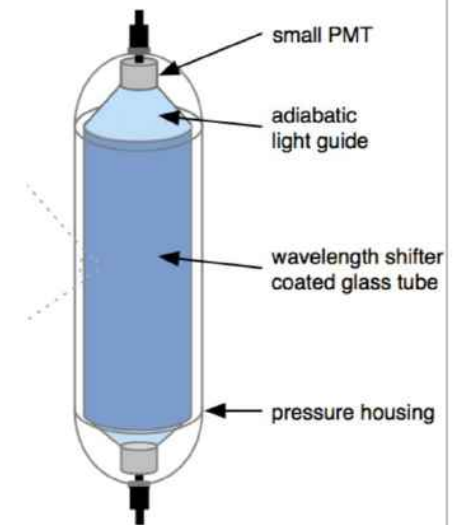
Current IceCube DOM



D-Egg (Chiba)



mDOM
(Erlangen, Germany)



WOM
(DESY, Germany)