



# Prototype test of Water Surface Detector for future UHE gamma ray detection

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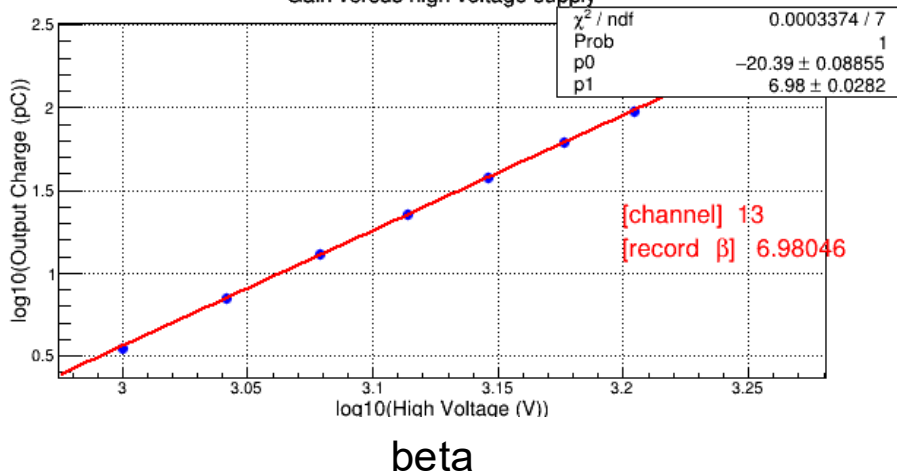
2026.4.27

# Experiment Setup

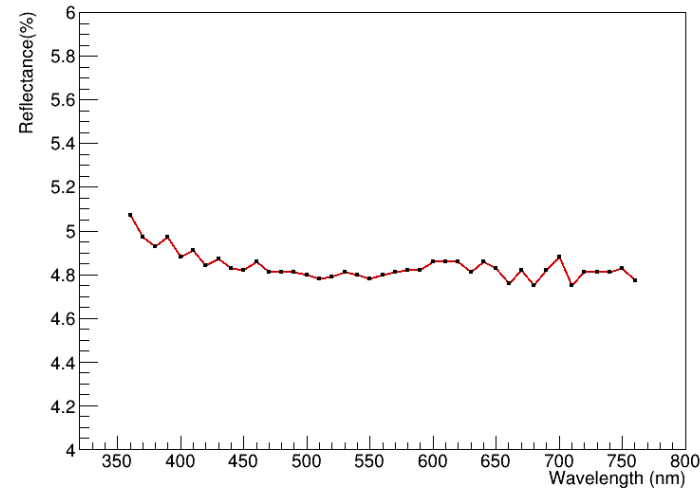


Unit detector

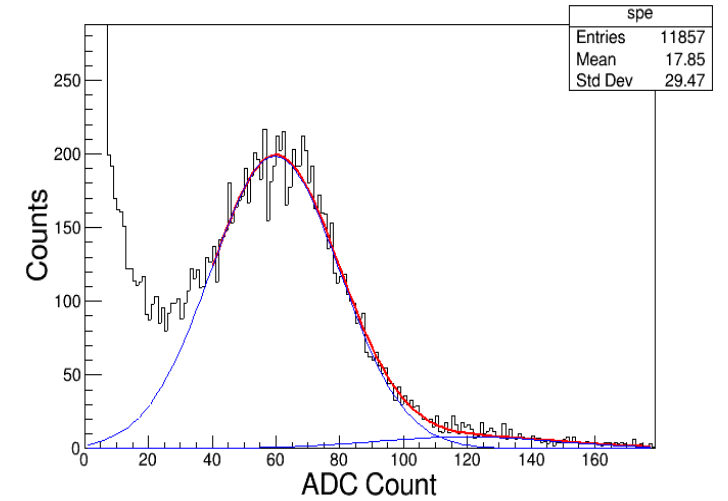
Gain versus high voltage supply



double-layer



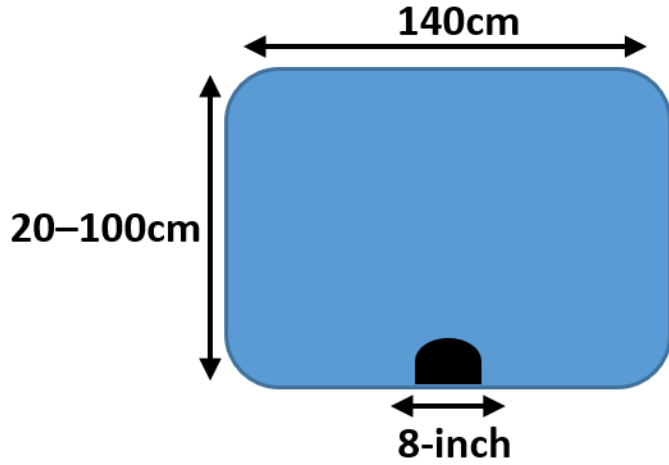
Reflectivity of inner layer



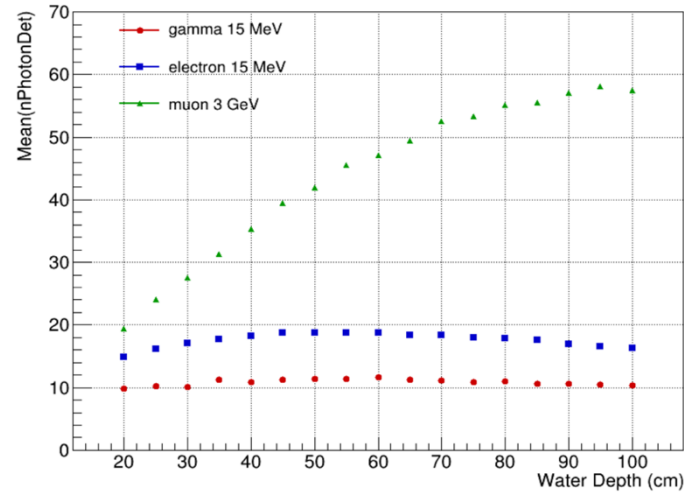
SPE

- Bladder: 1.4 m (diameter) & 0.8/1 m (depth)
- Reflectivity of inner layer : < 5% @ 400- 700 nm
- Taggers (Top & Bottom): 100 cm<sup>2</sup>
- CAEN V1743: 12-bit @ 3.2 GS/s
- PMT: Hamamatsu R5912, 8-inch
- Gain:  $3.35 \cdot 10^6$  @ 1208 V

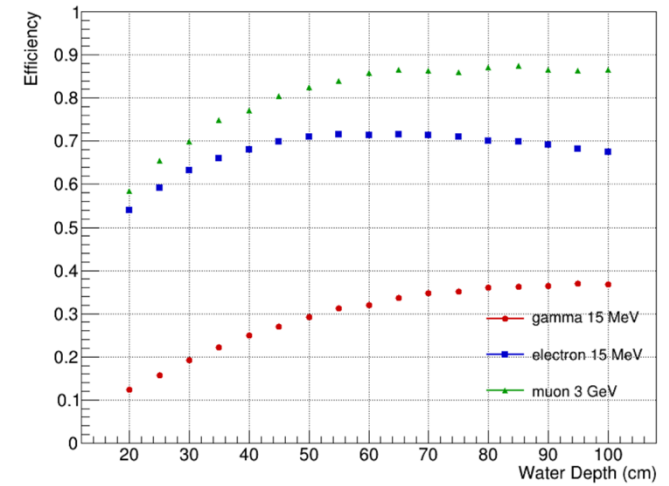
# Depth of water simulation by Geant4



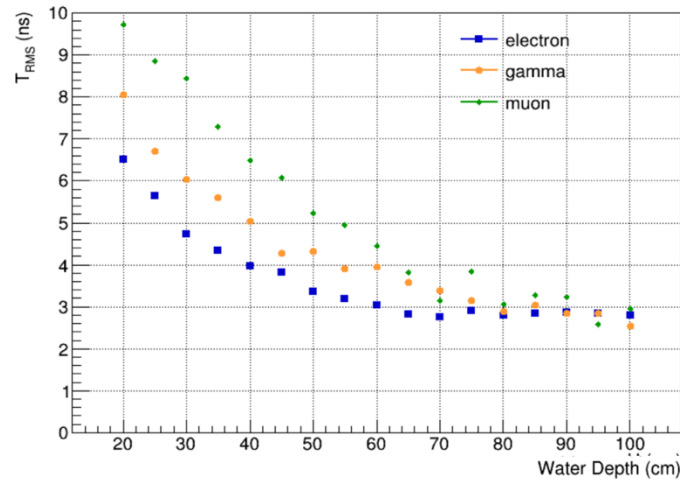
$\mu^-$ : 3 GeV     $e^-/\gamma$ : 15 MeV



NPE



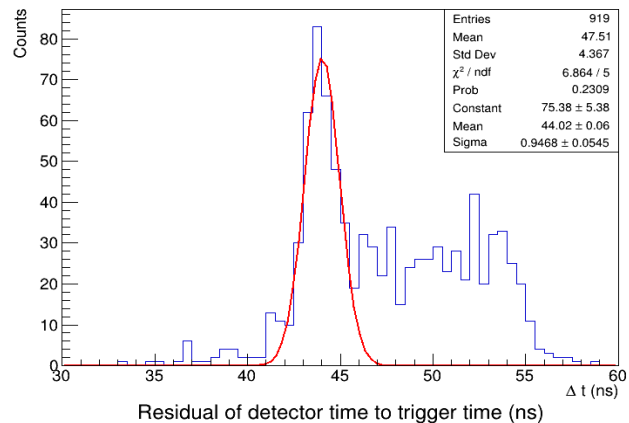
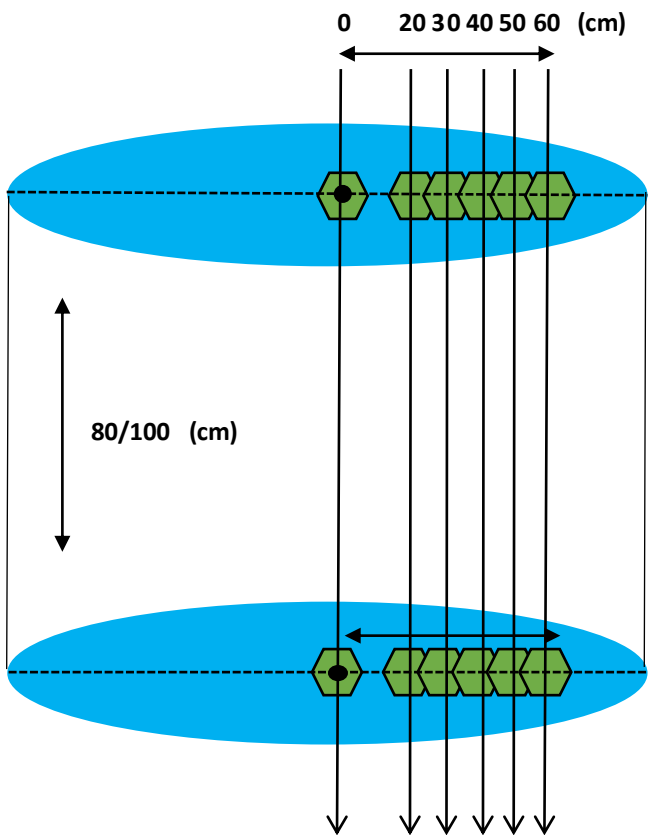
Detection Efficiency



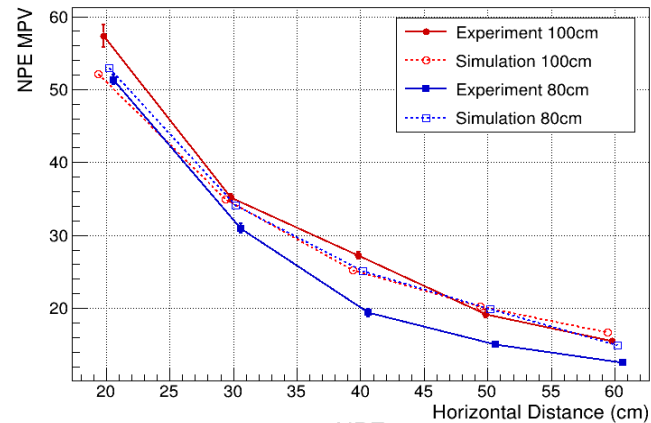
Time Resolution

➤ 80–100 cm was determined as the optimal water depth for the prototype test.

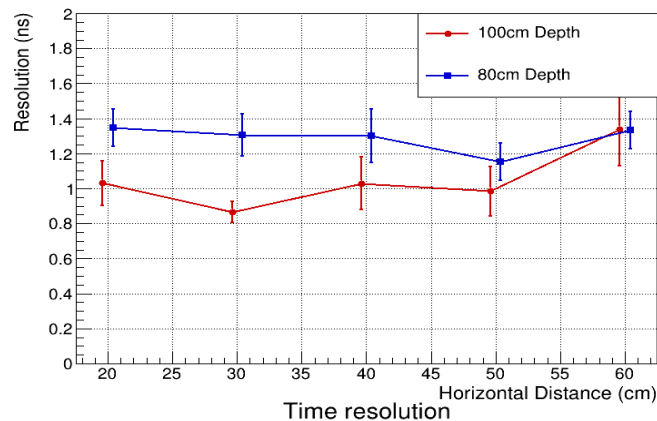
# Vertical muons test



Time difference distribution



NPE

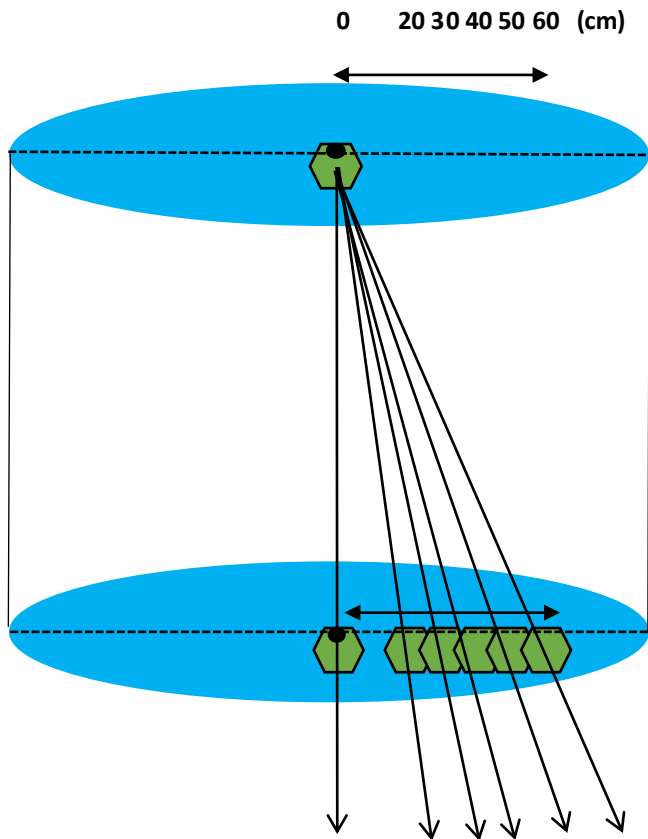


Time resolution

- At 100 cm depth, NPE is ~57 at the center and maintains >10 p.e. even at the edge (detection efficiency: 98% to 57%).
- Time resolution can be better than 1.6 ns at different positions.

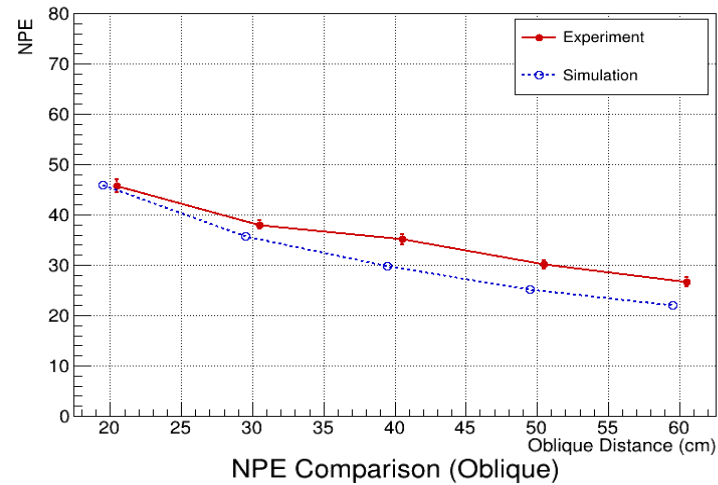
- Water depth: 80cm/100cm
- Horizontal distance: 20/30/40/50/60 cm

# Oblique muons test

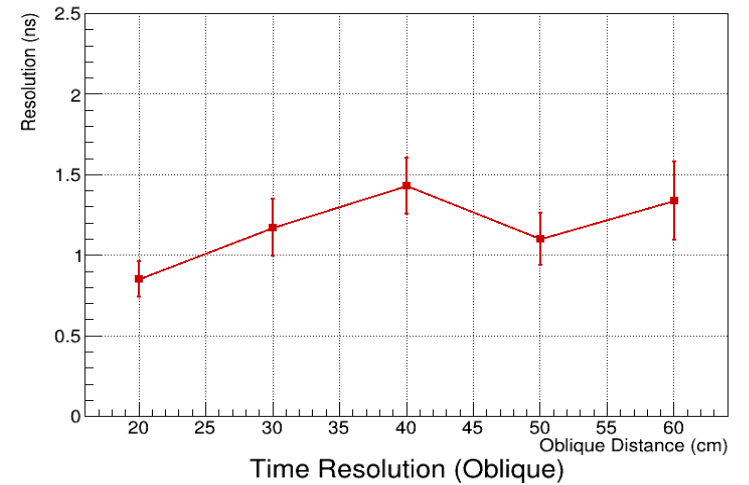


➤ Water depth: 100cm

➤ Horizontal distance: 20/30/40/50/60 cm



NPE



Time resolution

- Consistent Light Yield
- Stable time resolution: < 1.6 ns, showing no significant change across different incident angles.

# Summary

- A water depth of  $>80$  cm was established as the balance between light yield and time resolution.
- Without the reflective layer, the detector can also collect  $>10$  p.e. for cosmic muons at the edge and yields a stable time resolution  $< 1.6$  ns.
- Further studies will be done to identify the response to EM components.

Thank you!