

Design and Integration of JUNO-OSIRIS

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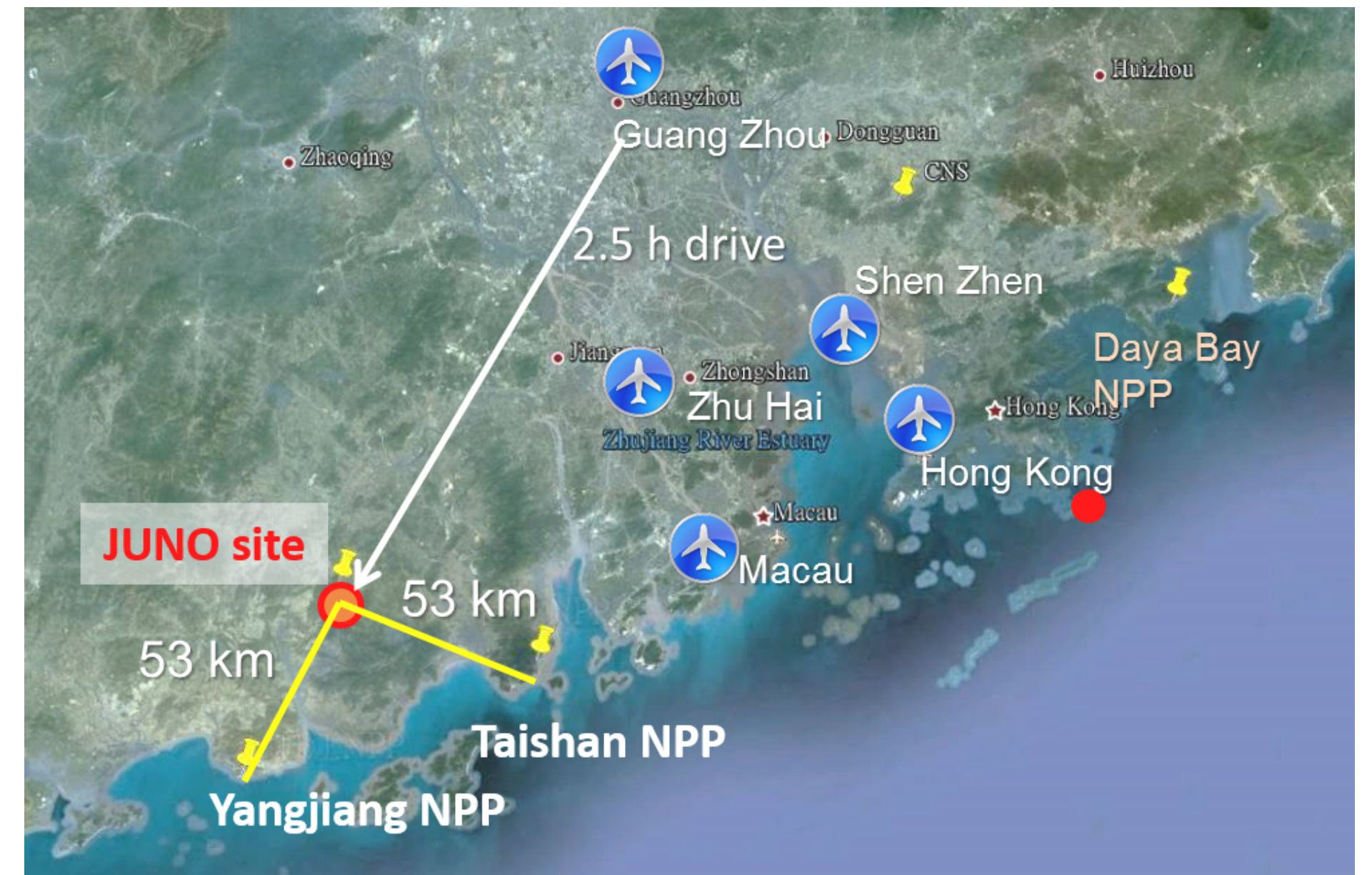
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The NuPhys2023: Prospect in Neutrino Physics Conference

King's College London, UK, 18-20 December 2023

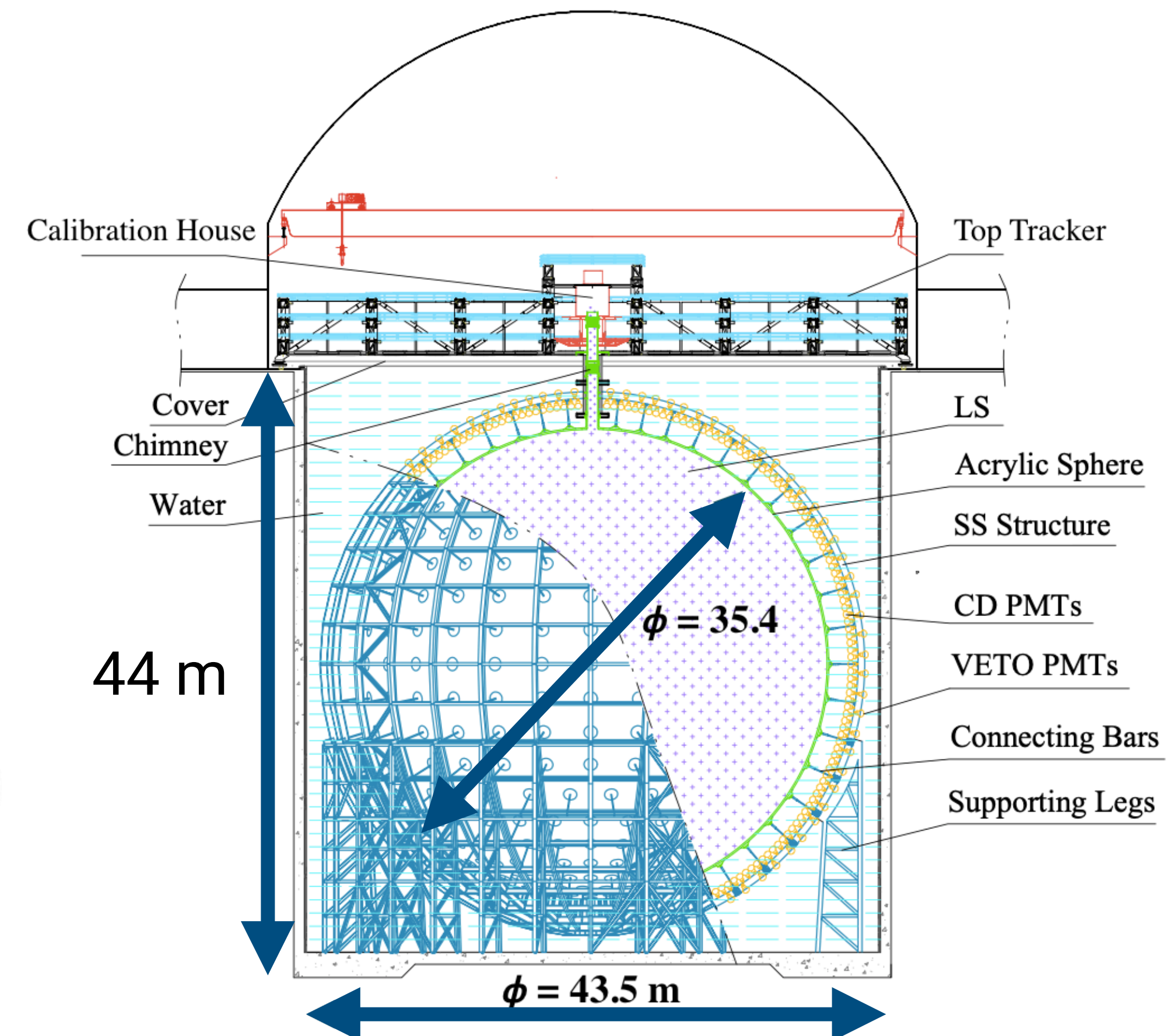
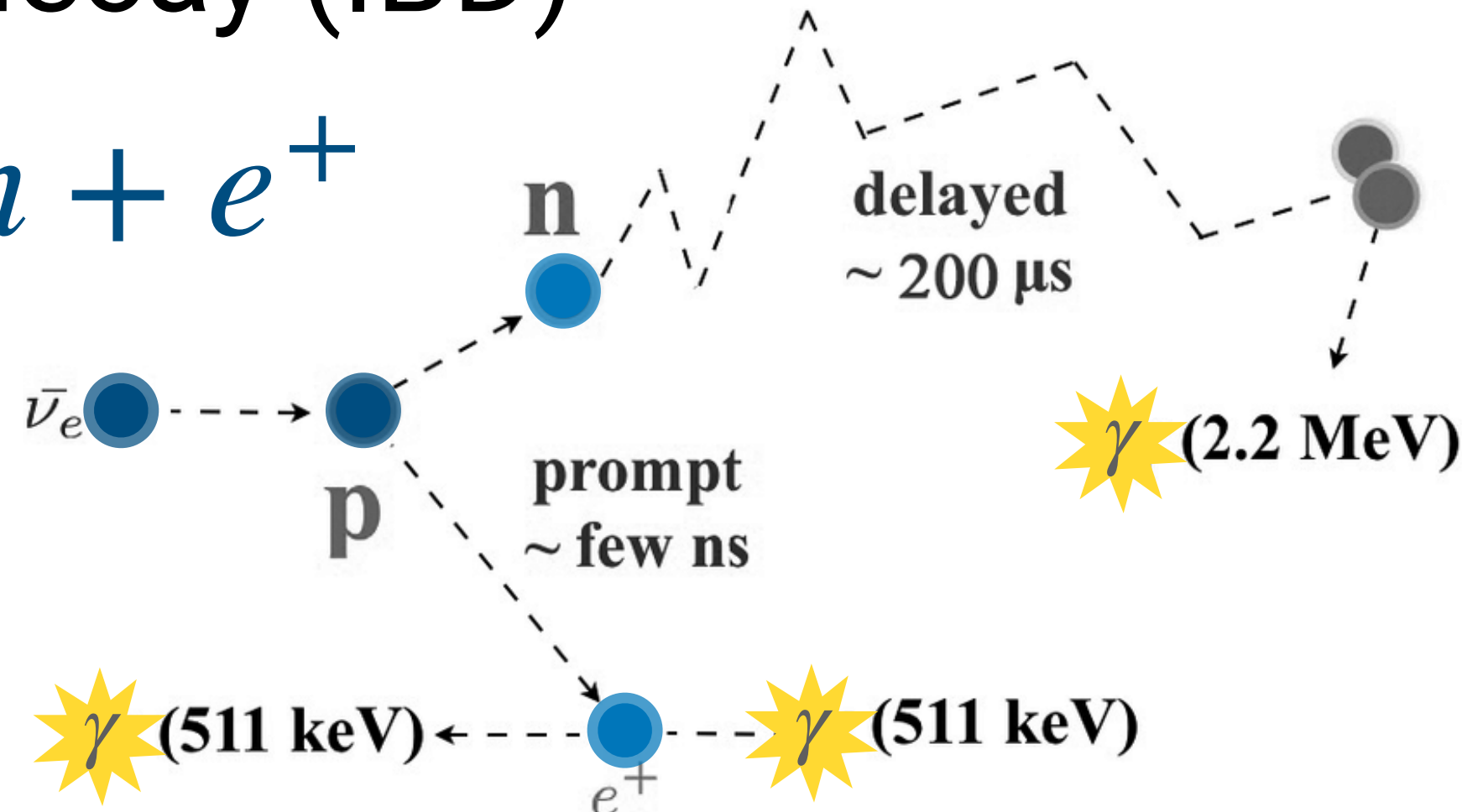
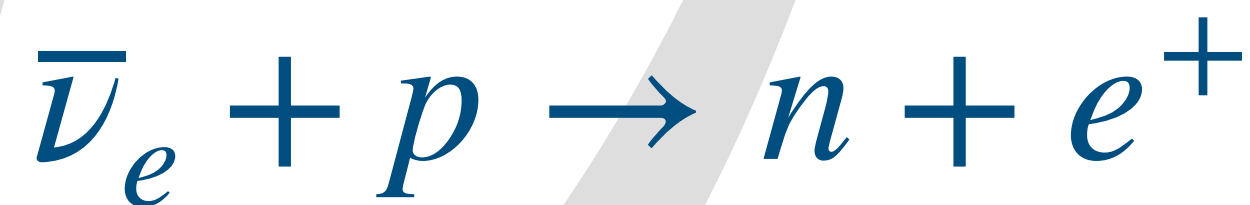
Jiangmen JUNO Underground Neutrino Observatory

- Under construction, located in Jiangmen, Guangdong
- World largest liquid scintillator detector with high energy resolution of 3% at 1 MeV



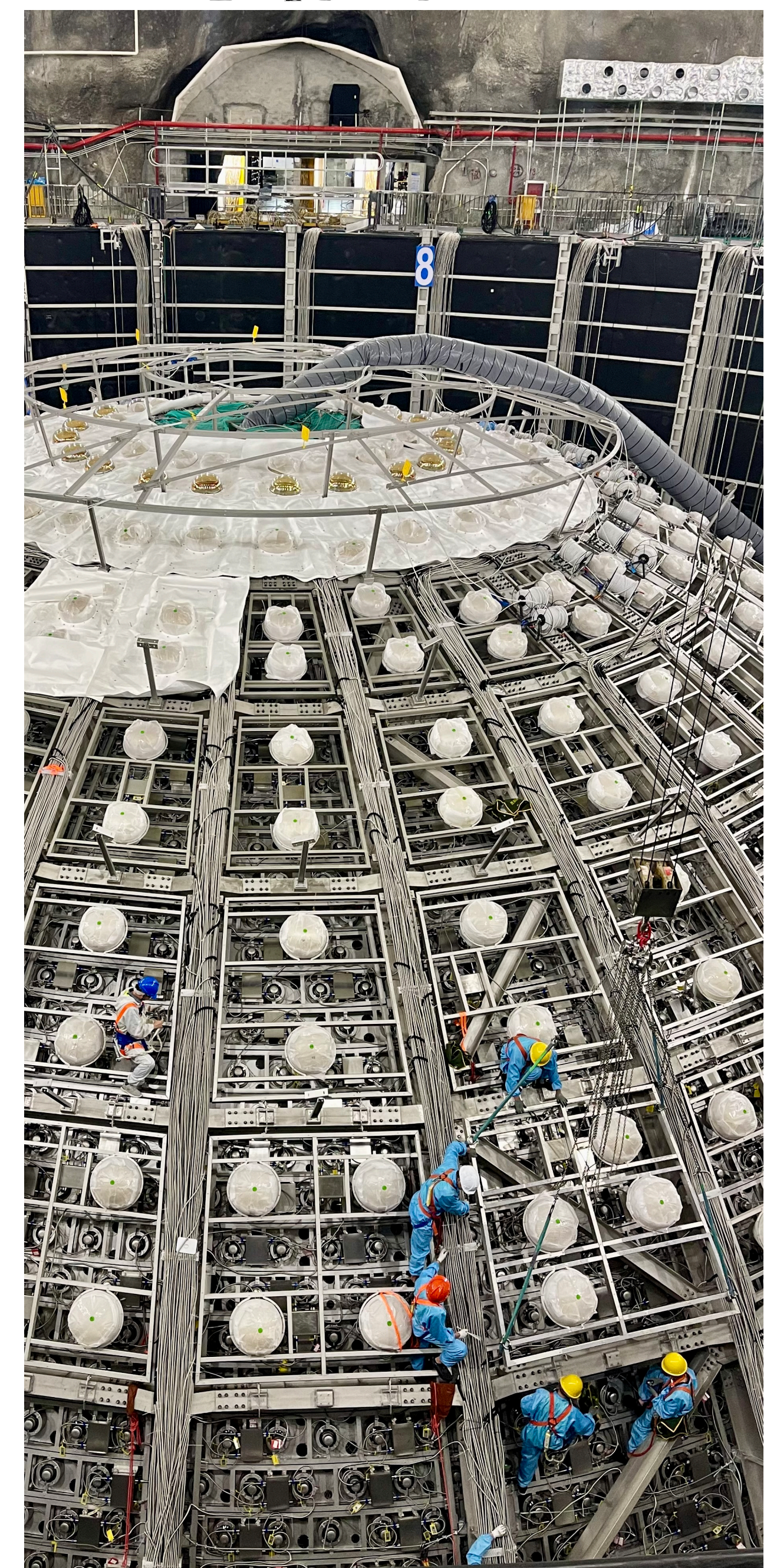
JUNO Experiment

- Multipurpose detector with various detection sources
- Neutrino mass hierarchy and neutrino oscillation parameters, etc.
- 20 ktons of LS in the acrylic sphere in the cylindrical water pool (35 ktons)
- Inverse beta decay (IBD)



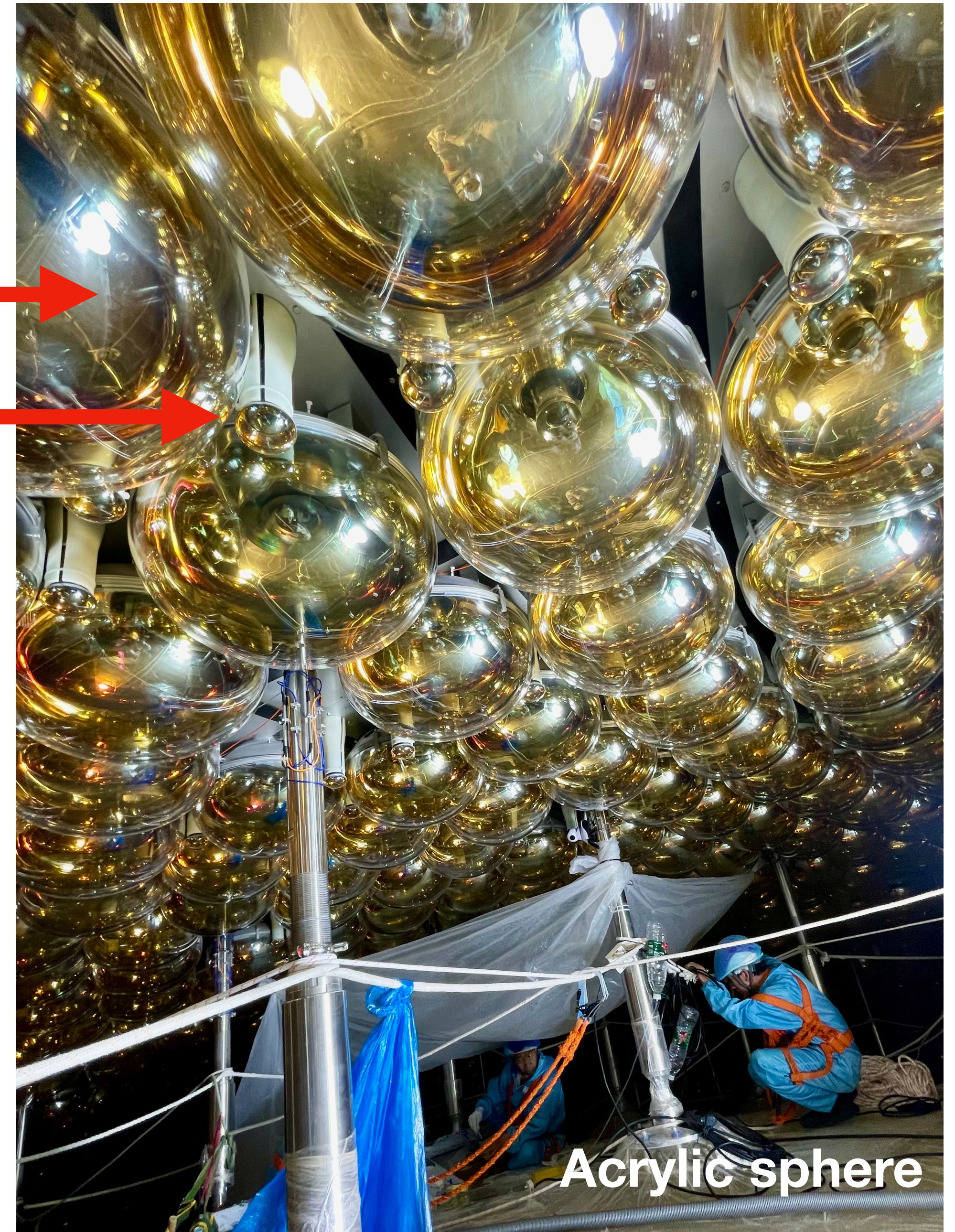


JUNO

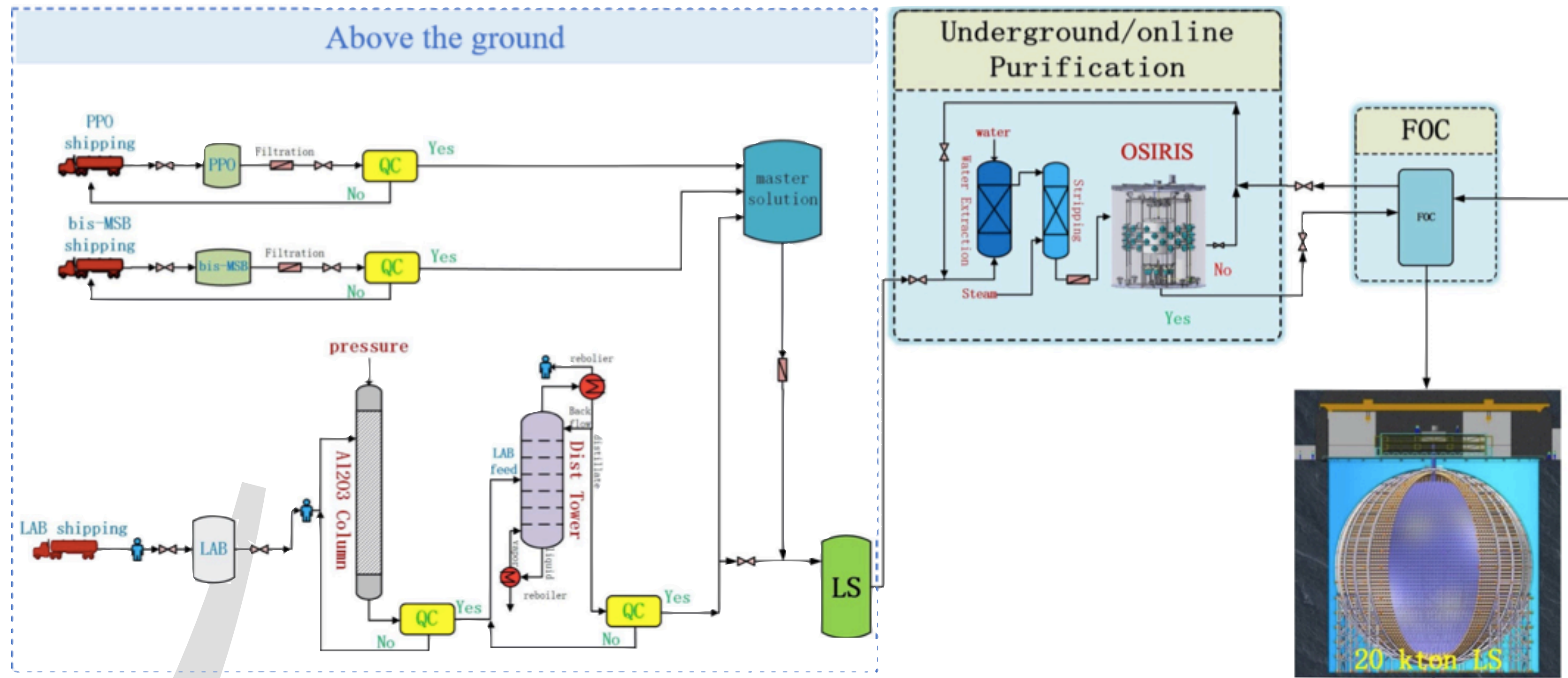


Light is the Key!

- 77.9% coverage
- 17,600 of 20-inch PMTs
- 25,600 of 3-inch PMTs
- Liquid Scintillator
 - High light yield: $\sim 1,200$ p.e./MeV
 - Long attenuation length: >20 m
 - Low radio-impurity:
 - $^{238}\text{U}/^{232}\text{Th} < 10^{-17}$ g/g



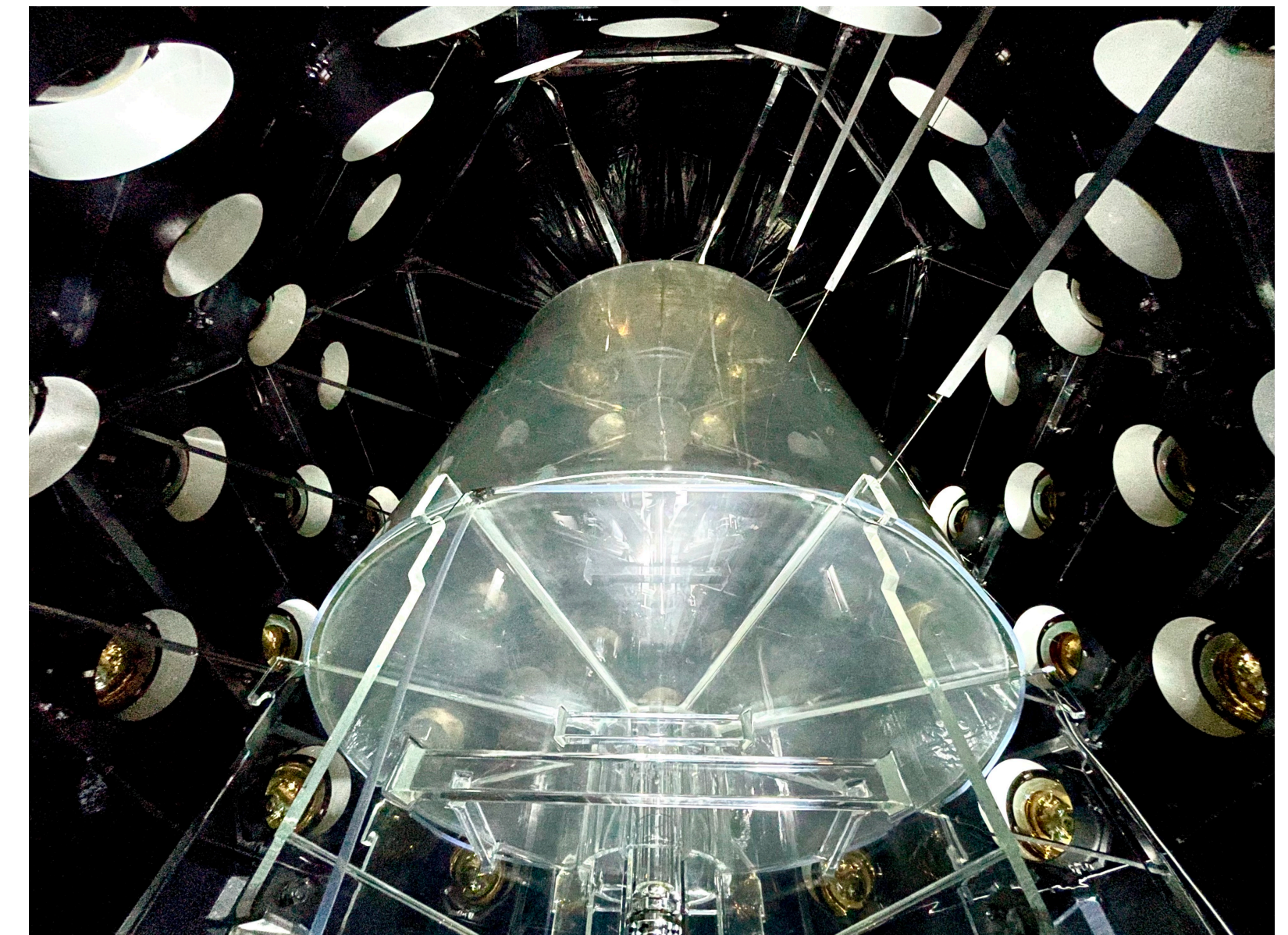
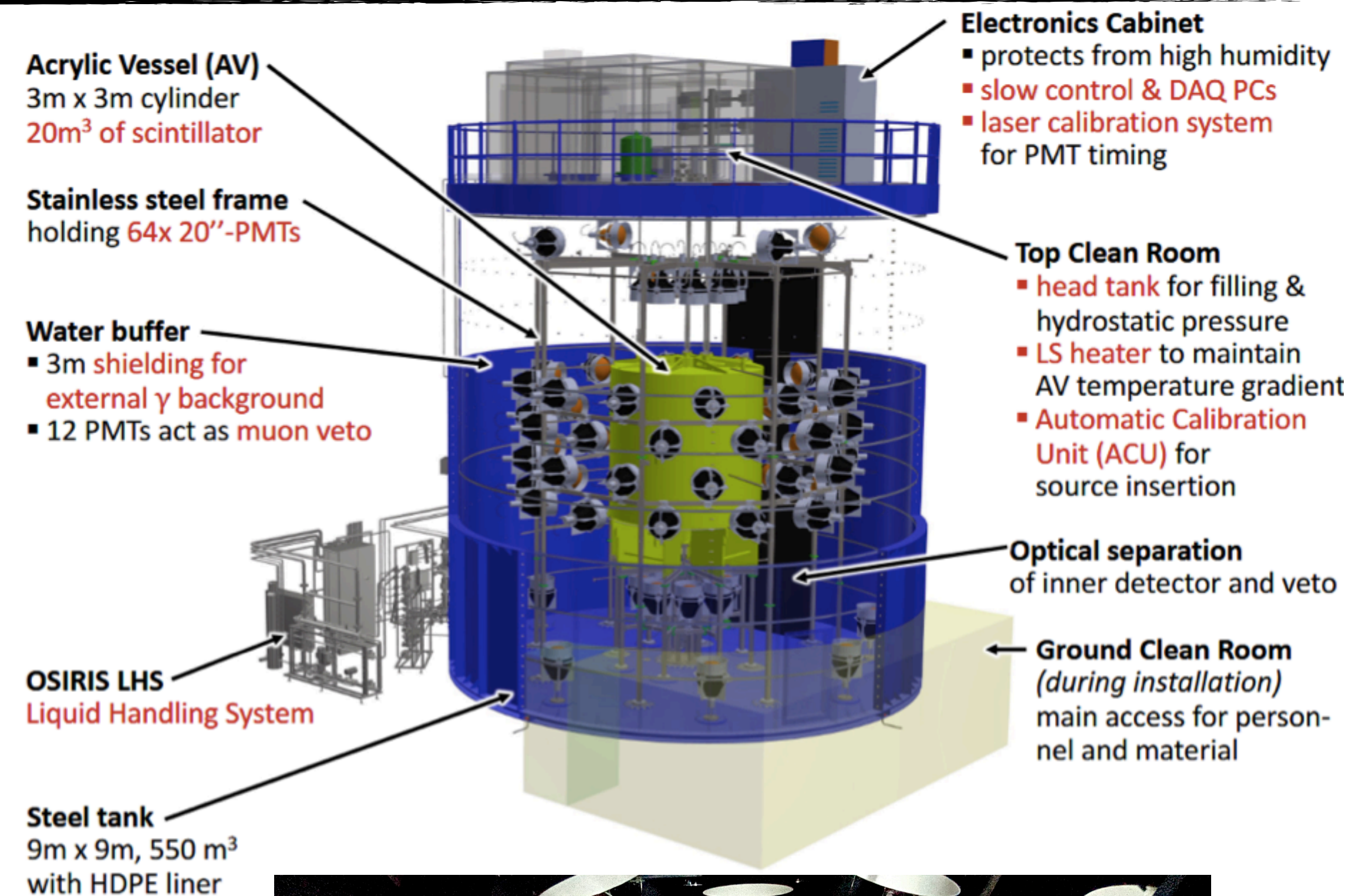
Liquid Scintillator Production



- Linear alkyl benzene (LAB) + 2.5 g/L PPO + 3 mg/L bisMB
- LS control: Water extraction and gas stripping systems before transferring to the **Online Scintillator Internal Radioactivity Investigation System (OSIRIS)** detector

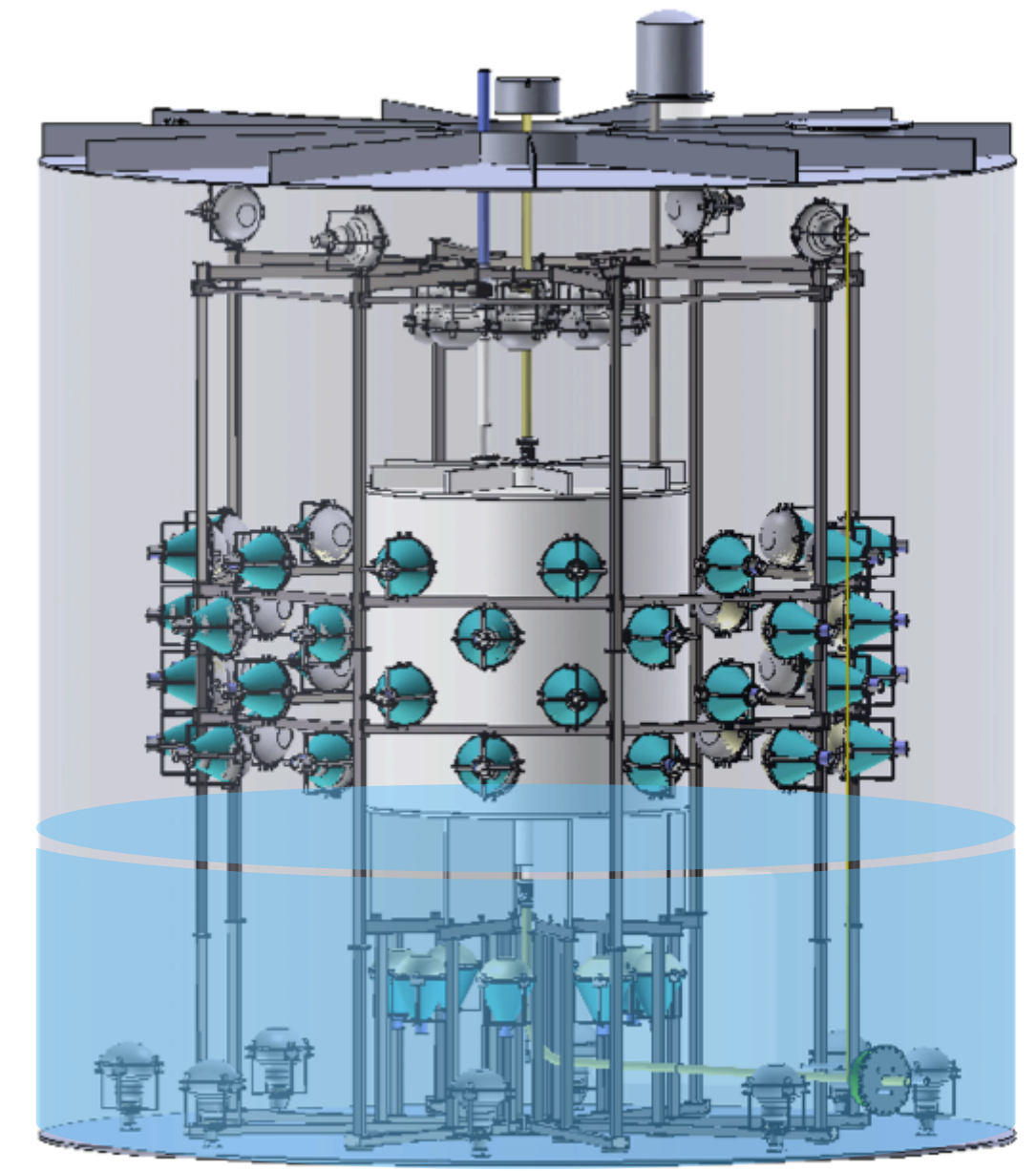
OSIRIS Detector

- 3 m acrylic vessel inside 9 m cylindrical tank
- 64+12 of 20-inch PMTs
- Searching for the fast coincidence decays of ^{214}Bi — ^{214}Po and ^{212}Bi — ^{212}Po in the decay chains of ^{238}U and ^{232}Th
- 10^{-16} g/g sensitivity to radiopurity level

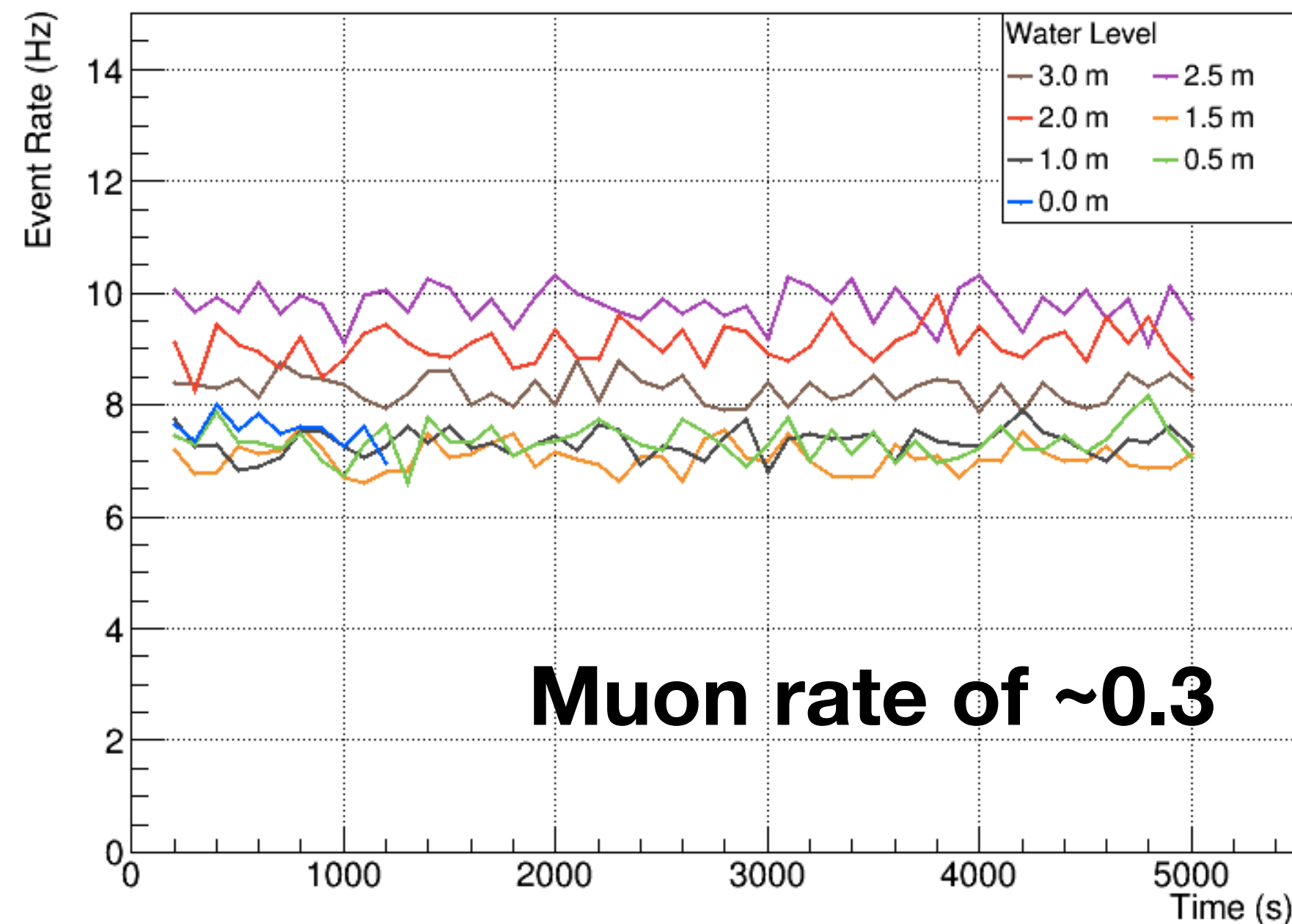


OSIRIS Water Filling Process

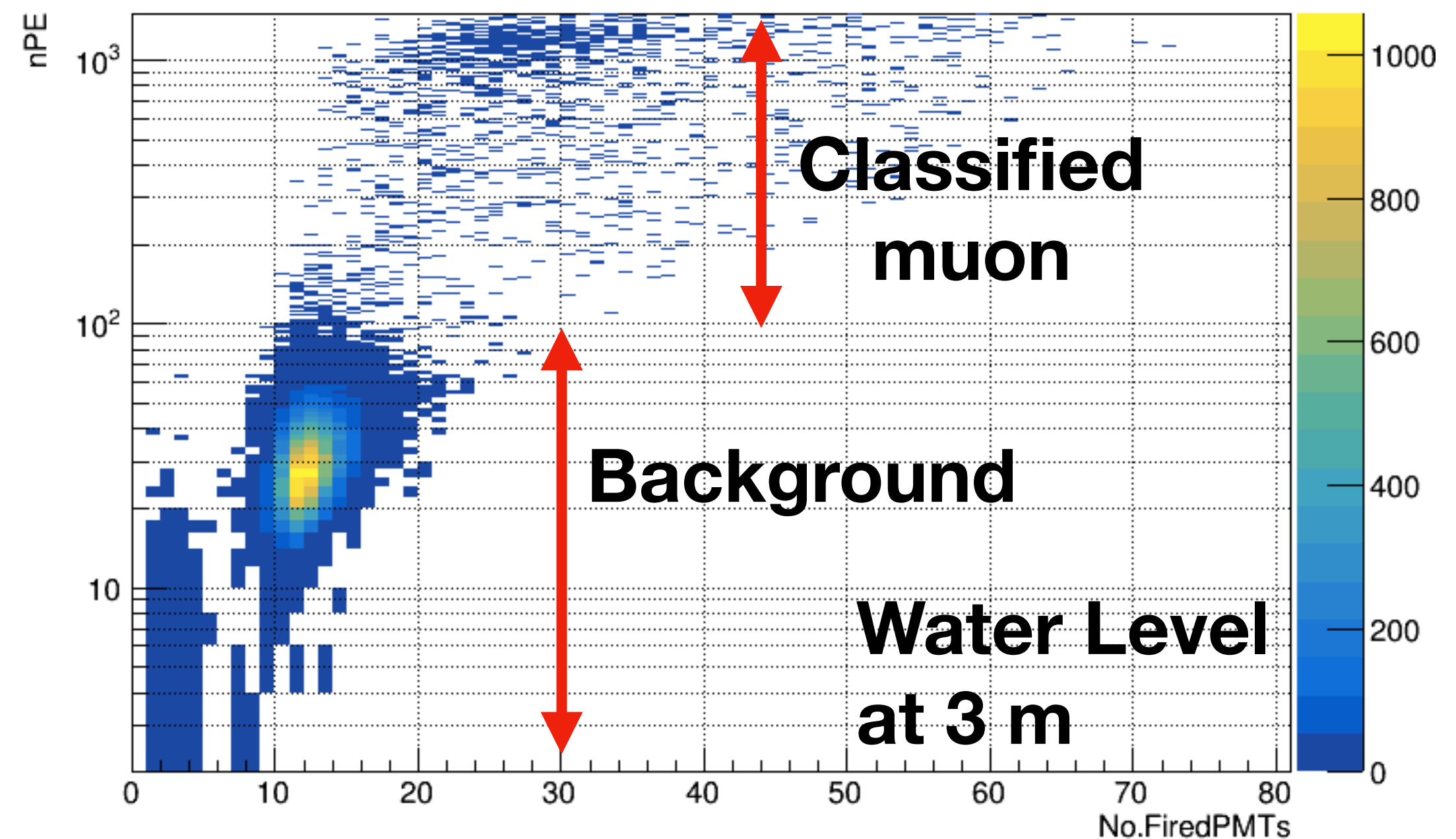
- Filling the 1st pure water batch of 185 tons, reaching 3 m height with 16 PMTs were submerged
- Data taking with a threshold of 11 PMTs fired in 64 ns out of 76 PMTs in total



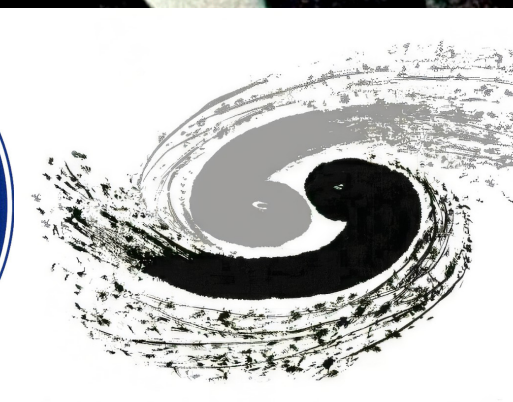
Event Trigger Rate



nPE Spectrum and No. FiredPMTs Threshold



JUNO-OSIRIS



Reference

- [1] JUNO collaboration. (2022). JUNO physics and detector. *Progress in Particle and Nuclear Physics*, 123, 103927.
- [2] Abusleme, A., Adam, T., Ahmad, S., Ahmed, R., Aiello, S., ... & Hor, Y. (2021). The design and sensitivity of JUNO's scintillator radiopurity pre-detector OSIRIS. *The European Physical Journal C*, 81(11), 973.
- [3] Abusleme, A., Adam, T., Ahmad, S., Ahmed, R., Aiello, S., ... & Hou, S. (2022). Mass testing and characterization of 20-inch PMTs for JUNO. *The European Physical Journal C*, 82(12), 1168.

Thank you