An Analysis of C14 for SNO+

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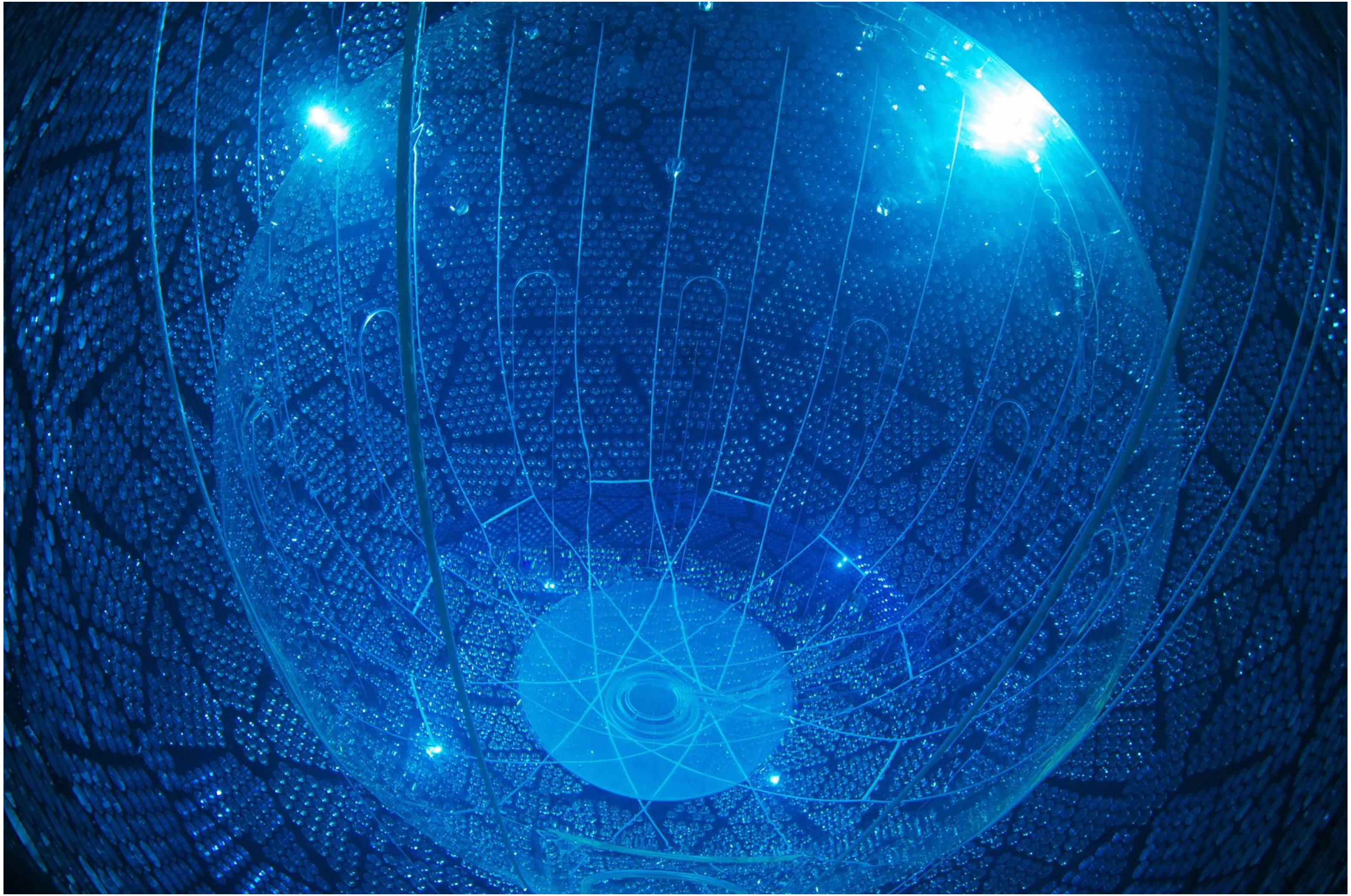


Phases of the Experiment

Phase 1
"Water Phase"

Detector filled with light water.

Phase 2
"Scintillator Phase"

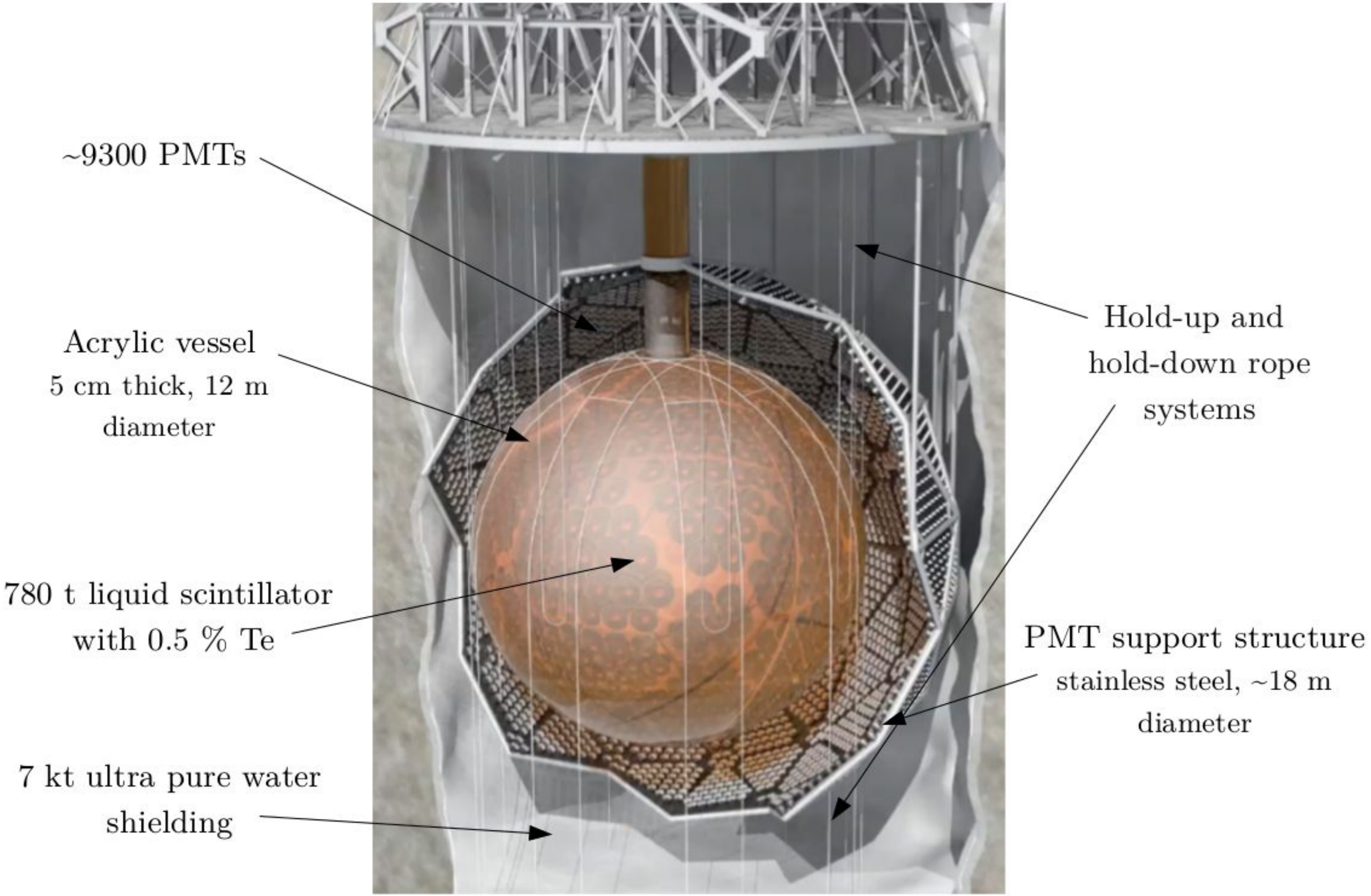
Light water replaced with scintillator.

Phase 3
"Tellurium Phase"

3.9 tonnes of natural tellurium added into scintillator.

Goals of the Experiment

- Search for the neutrinoless double beta decay.
- Measure the lifetime of the two-neutrino double beta decay.
- Measuring of geoneutrinos.
- Observation of reactor antineutrino oscillations.
- Supernova neutrino monitoring.
- Searching for exotic physics.


~9300 PMTs
Acrylic vessel
5 cm thick, 12 m diameter
780 t liquid scintillator with 0.5 % Te
7 kt ultra pure water shielding
Hold-up and hold-down rope systems
PMT support structure
stainless steel, ~18 m diameter

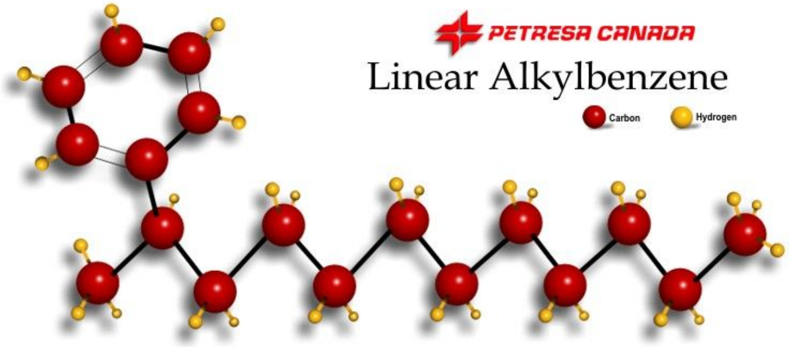
How Does SNO+ Detect Neutrinos?

- For an observable neutrino to occur, it must first interact to produce a charged particle.
- Interactions can be with particles such as electrons and nuclei.
- Once the interaction has occurred, light is produced as the charged particle passes through the scintillator.
- This light is detected by the PMTs.

What I did this summer...

Scintillator

- The detector is currently full of scintillator.
- The specific type of scintillator being used is linear alkylbenzene (LAB).
- There is plenty of carbon in LAB.

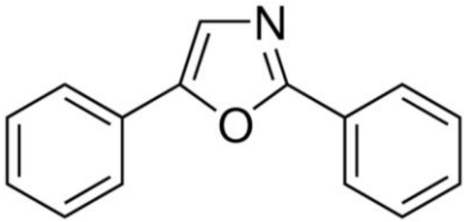


What is C14?

- Carbon-14 is a uniform background within the detector that comes from the scintillator.
- Because of it’s uniform nature, it can be used to determine the global detector efficiency and is good for calibration purposes.
- It can also be used to track PPO loading with respect to time.
- Tracking the PPO with respect to time allows the effect it has on light yield to be observed.
- C14 levels are important to know because they are in the same energy region as solar neutrinos.
- If C14 levels are too high, it can completely hide the signal being searched for.

What is Observed?

- When tracking C14 in terms of time, there should be an increase in the decay rate as time goes on.
- This is caused by more PPO being added into the scintillator.
- More PPO means more light will be given off by the C14.
- Tracking can be useful because it can help to see the effect on light yield as well as how it could affect physics because the decay rate makes us less sensitive to low energy physics in the detector.
- It can help with the understanding of physics processes that can be detected.

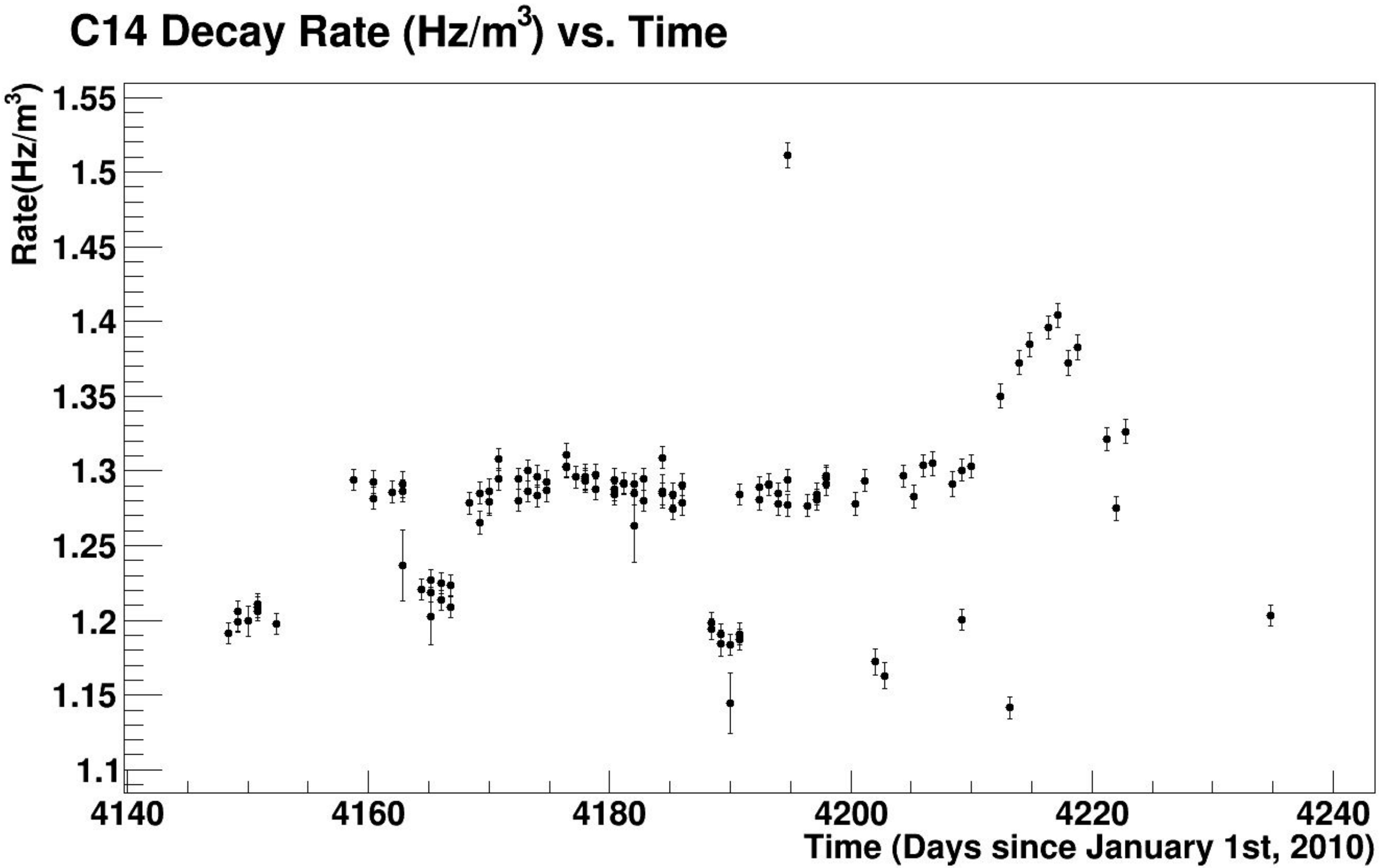


PPO

My Code

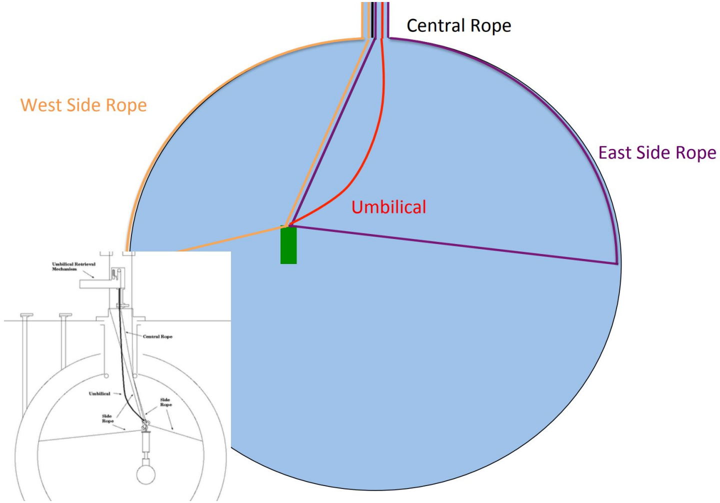
- This summer the code I worked on was focused on creating a histogram that takes in multiple files and graphs the decay rate of C14 in Hz/m^3 over time since the beginning of the experiment.
- This histogram can then be observed and the PPO can be tracked through it.
- It should be seen that as time goes on, the rate of decay increases as there is more PPO in the scintillator.

Example Histogram



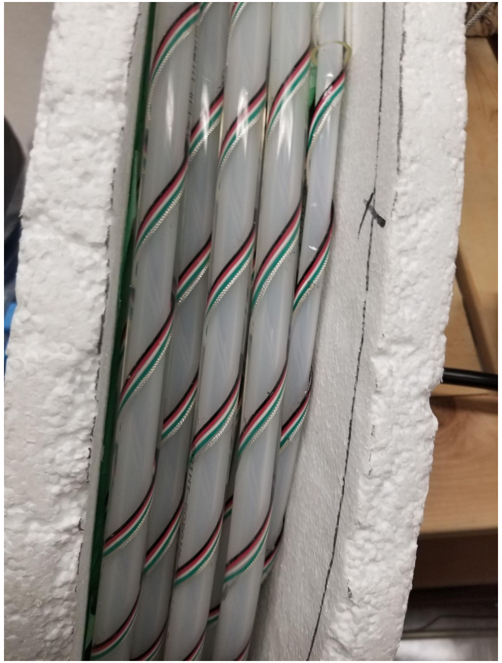
Calibration

- SNO+ attempted to utilize SNO calibration.
- Materials needed to be changed however because of the change from water to scintillator.
- LAB is not compatible with plastic for example.
- The new calibration system needs to reduce backgrounds and maintain cleanliness.



URM Dummy Source

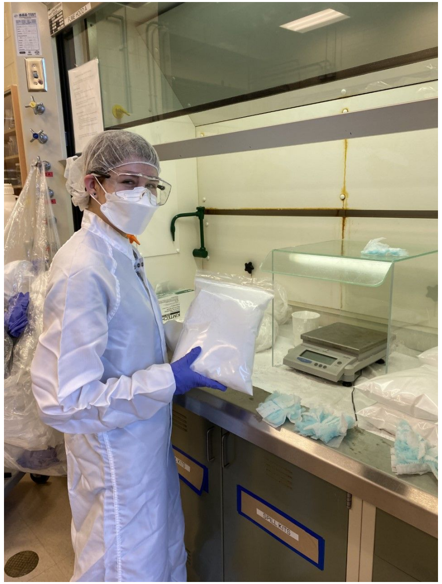
- Design on the URM dummy source was also worked on this summer.
- The dummy source allows for the testing of the URM while it's in the AV.
- This has not yet been done.
- Currently the dummy source is mostly assembled.
- A blank for the bottom needed to be ordered, a suitable one with holes for the bolts was not found so one without was substituted.
- The holes will be drilled into the blank and then it can be added to the dummy source.



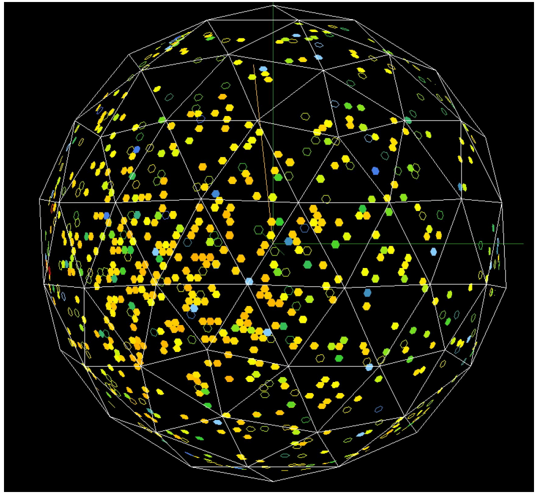
Other Activities

QA Shifts

PPO Packing



URM Assembly



Detector Shifts

Thank you for listening!