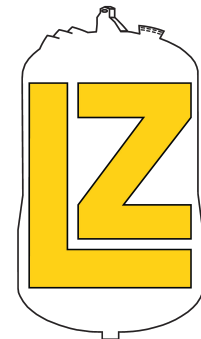




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PMT Monitoring and Measurements at LZ and 30-Ton

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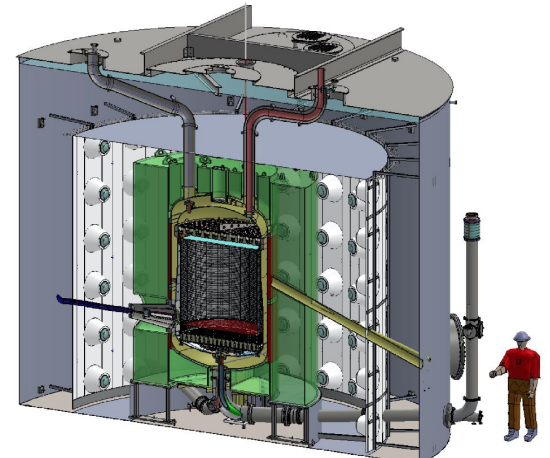
LUX - ZEPLIN

LUX-ZEPLIN is a Dark Matter direct detection experiment looking to detect Weakly Interacting Massive Particles, WIMPs.

- Based a mile underground at SURF in South Dakota
- Employs a cylindrical dual-phase time projection chamber (TPC) containing 7 active tons of liquid xenon at its centre.
 - **Primary aim of detecting WIMP-LXe scattering interactions**

Surrounding the TPC are two secondary detectors that work to veto signals from background sources:

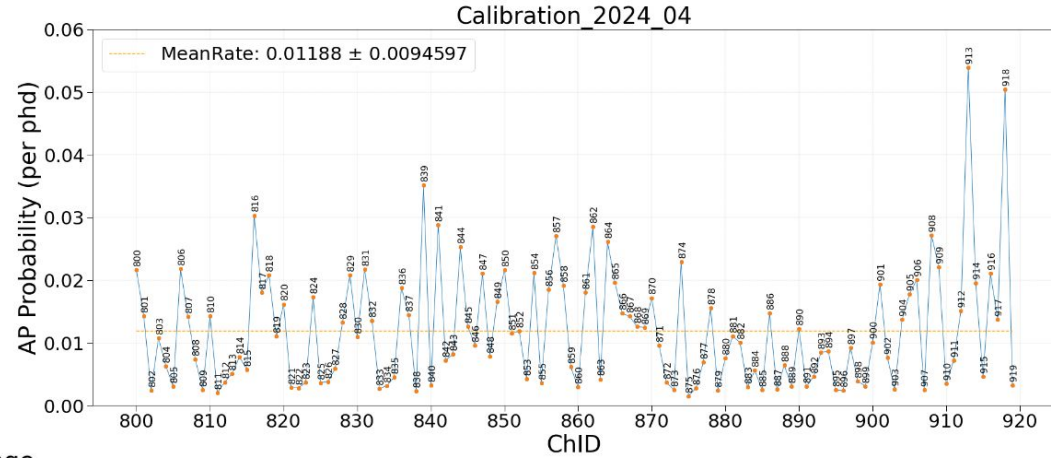
- **The Xe Skin**
- **The Outer Detector (OD):**
 - Tags events caused by neutrons



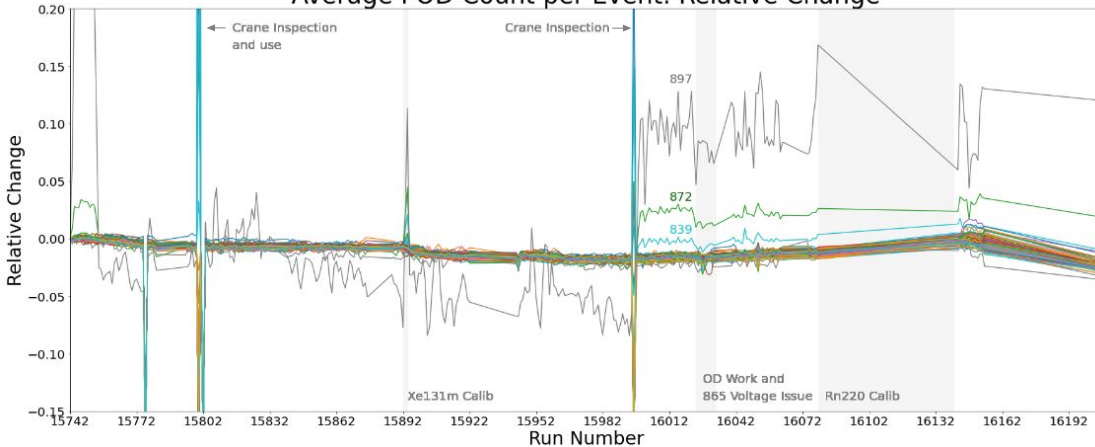
PMT Monitoring in the OD

Afterpulsing Rates

- Monitored monthly using pulses produced by LZ's Optical Calibration System (OCS), built by Liverpool.



Average POD Count per Event: Relative Change



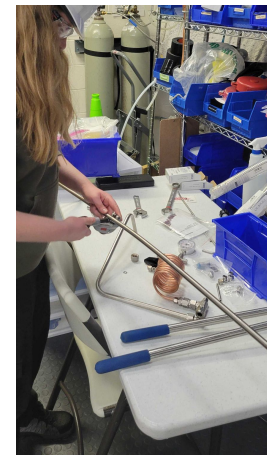
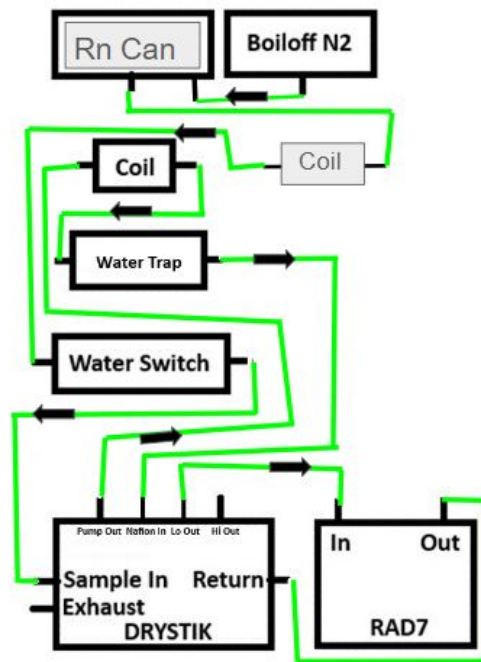
POD (Pulse Only Digitisation) Rates

- Tracking changes in POD rates and other POD features
- Recent rate changes in some PMTs are currently being investigated.

SURF / OD Radon Monitoring

On site we have been installing a system to monitor Radon levels in the Outer Detector.

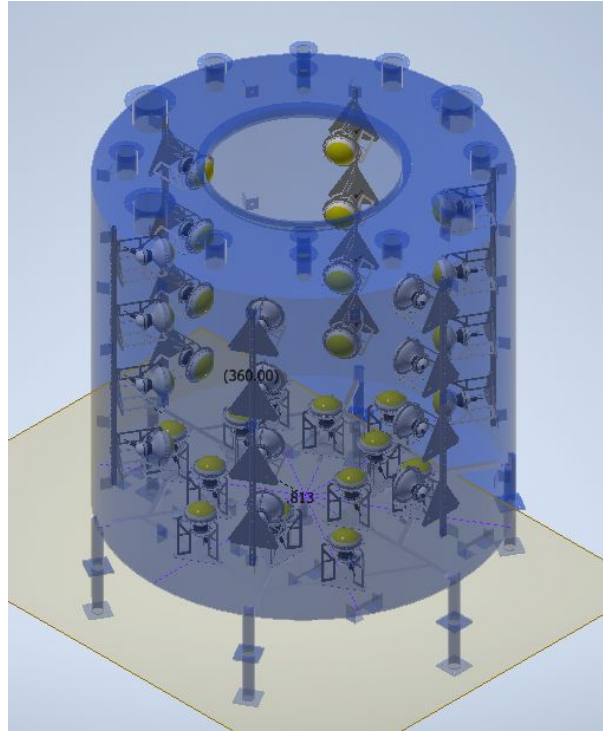
- The system makes use of a Radon Can, water trap, DRYSTIK and a Rad7 radon monitor.
- The install was finished a few weeks ago and is currently taking data, plan to compare Radon levels to POD rates.



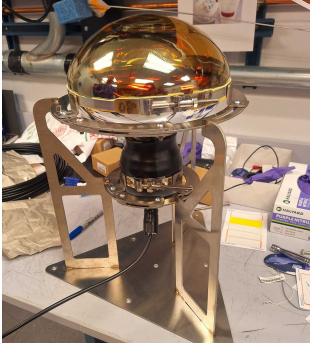
BNL 30Ton - WbLS Testing

30-Ton optical detector currently being built at Brookhaven National Lab

- Main purpose is to demonstrate and test large-scale WbLS deployment.
- Follows the successful commissioning of a 1-ton detector testbed.
- Equipped with 36 Hamamatsu 10" PMTs, currently being installed. With initial filling of the tank set to be completed within the next 2 weeks.



PMT Measurements



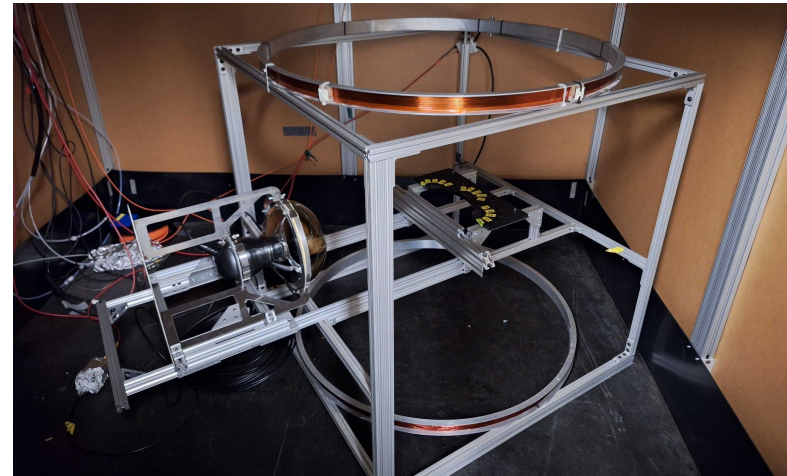
PMT Testing prior to Installation

A number of tests were carried out on the Hamamatsu 10" PMTs over the past couple months including: **Gain** measurements, as well as **Soak Tests** to see how they would cope being submerged in WbLS for long periods of time.

Proposal to Install a Coil around 30Ton:

It is known that magnetic fields, (including the earth's magnetic field) can impact the performance of PMTs.

- A Helmholtz coil was used to vary the z component of the Earth's magnetic field and measurements taken to determine the gain and relative performance of the PMTs as the field changes.



Field Effect on Sensitivity

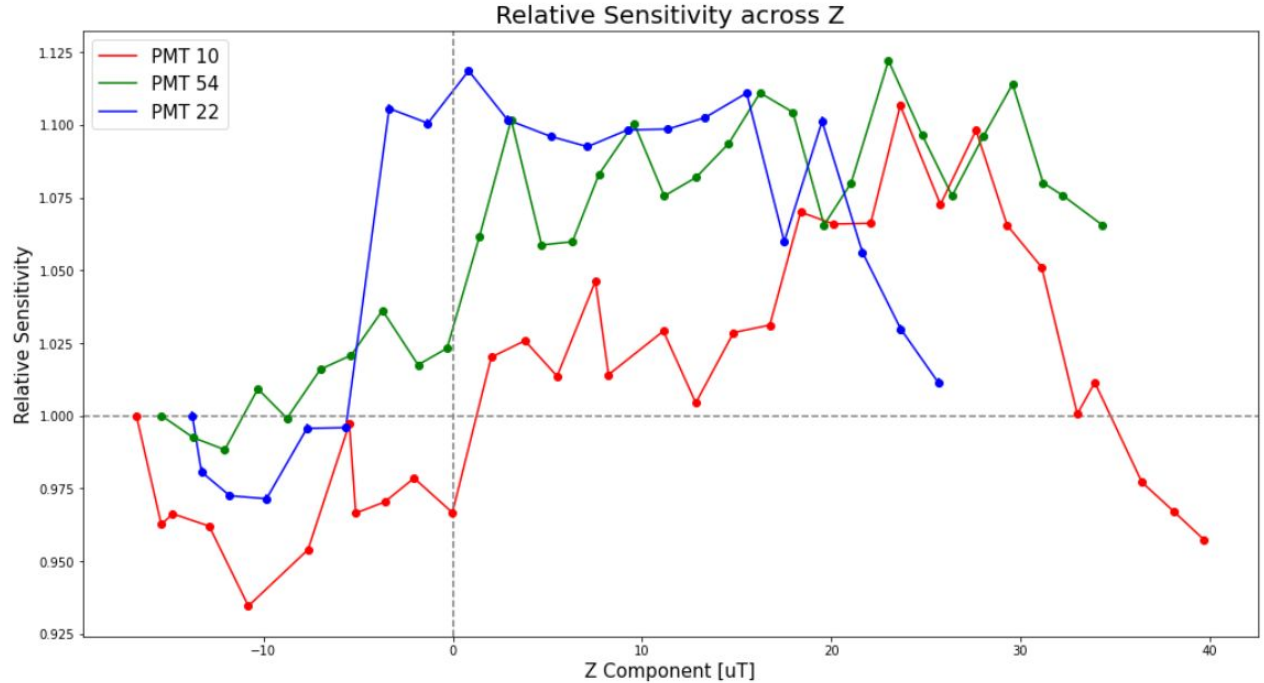
Two see the fields strength effect on the PMTs sensitivity two measurements were taken:

- **Measurement 1: SPE**

This was used to calculate the gain of the PMT

- **Measurement 2: Multi-PE**

The amplitude was raised by a set amount and a second measurement taken



Given that Charge \propto Detection Efficiency * Gain

We have divided the charge by gain to get a relative sensitivity measurement to compare between field strengths.

After LTA: EFT

Future Work: Plan on looking into different DM models that can be used to compare results from different dark matter detection experiments.

In particular looking into the group of next generation DM models, known as the 2HDM (two-Higgs-doublet) models, provide some of the simplest theoretically consistent extensions of the DM pseudoscalar simplified model.

2HDM+a:

- One of the simplest examples of such models
- Dark Matter couples to the SM through the mixing of a mediator and second Higgs doublet.

