BACKGROUND IDENTIFICATION AND MONITORING FOR SNOPLUS

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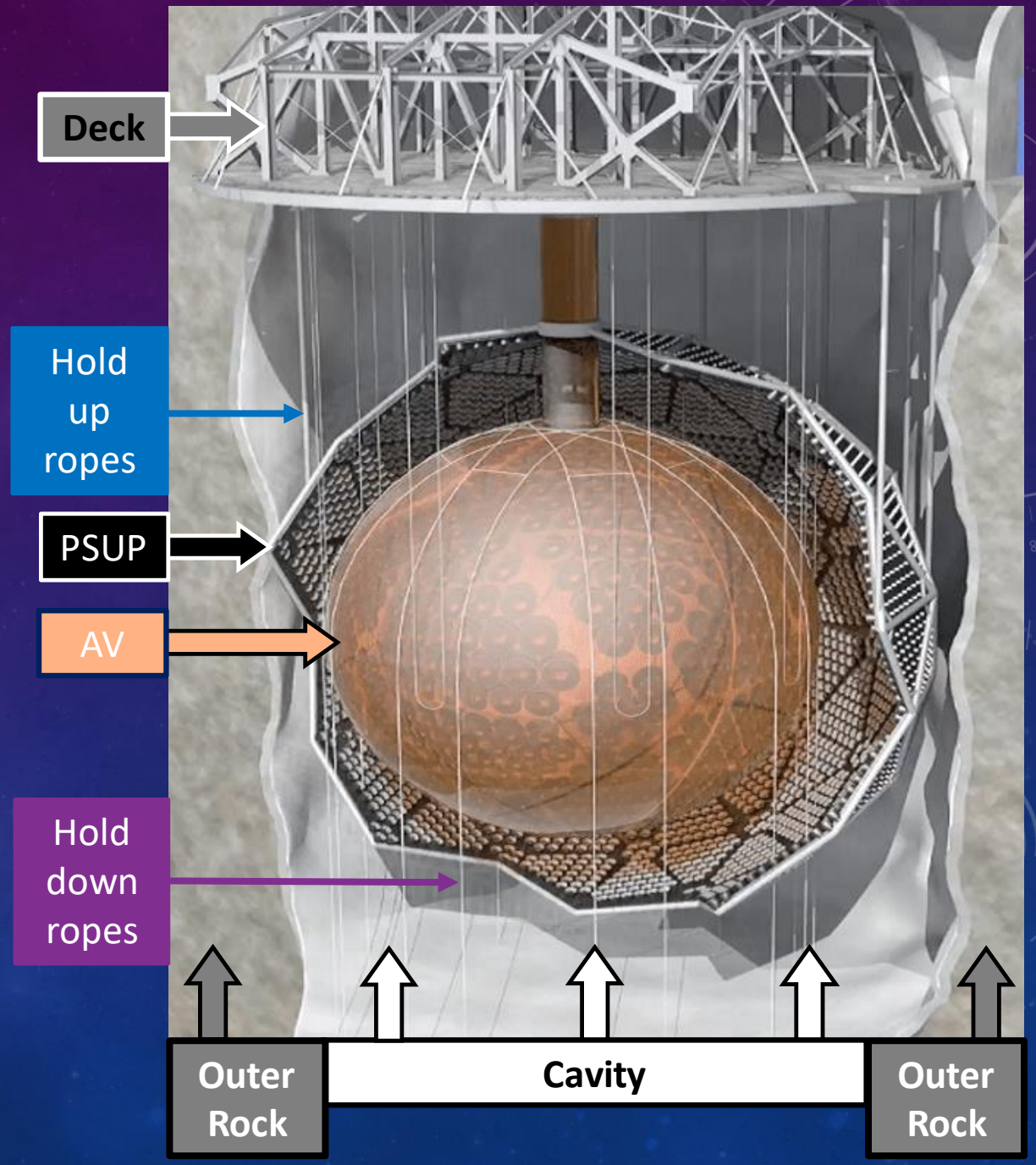
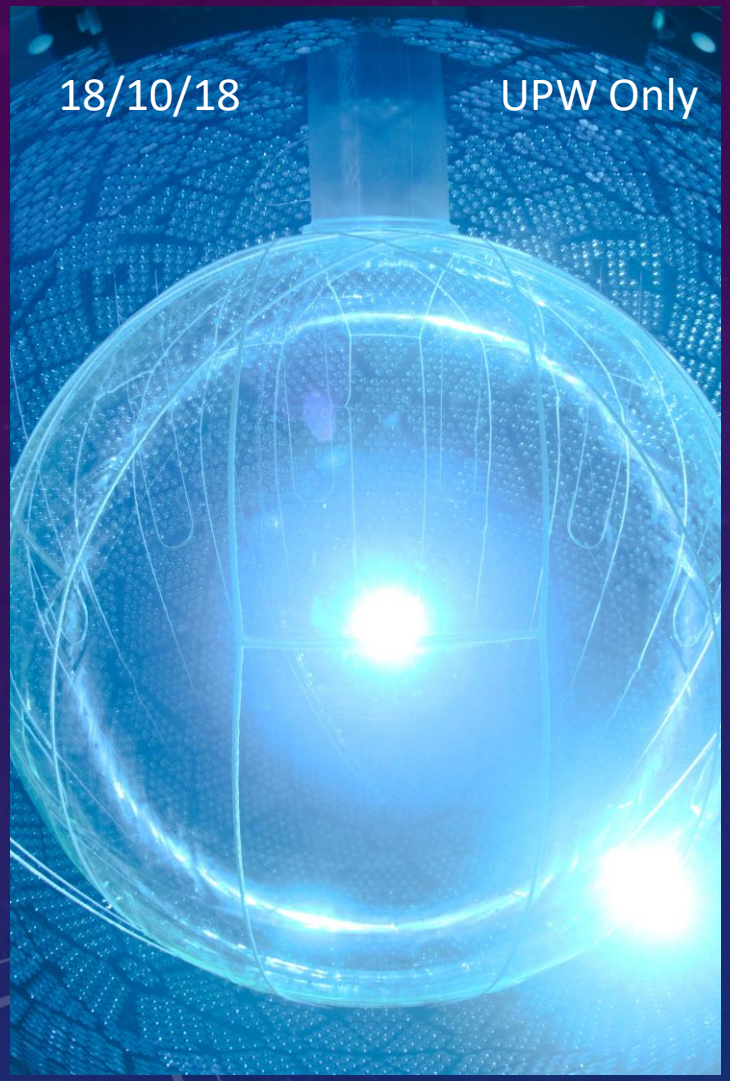
SNOPLUS OVERVIEW

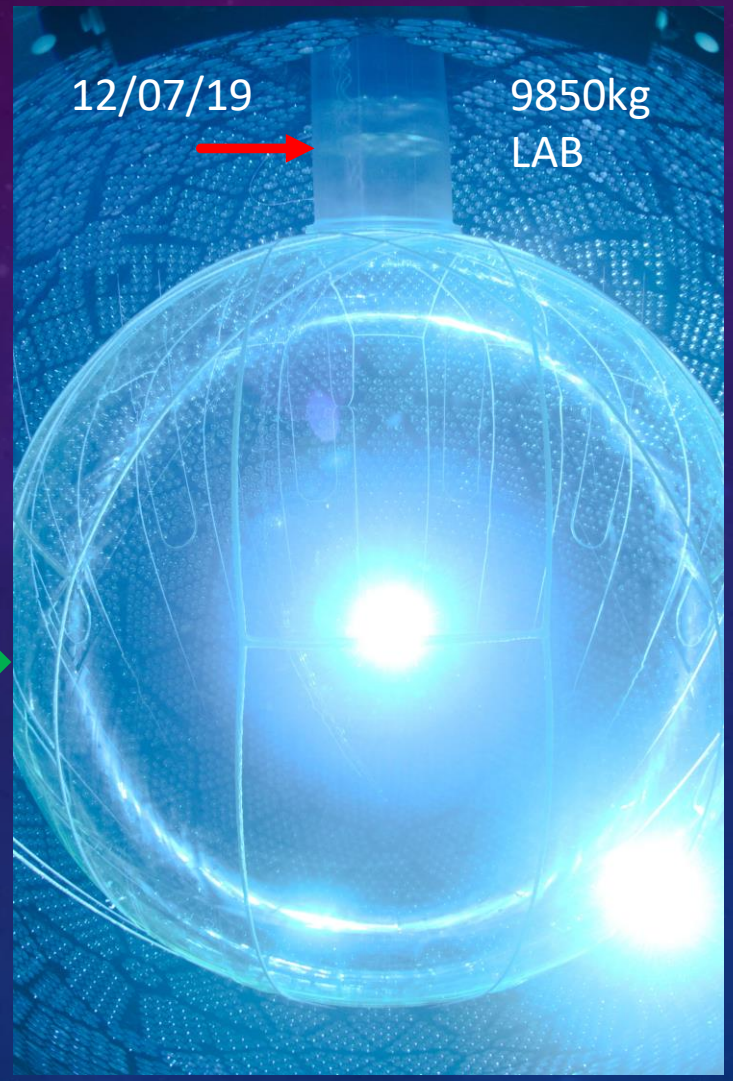
- SNO+ is a neutrino detector based 2km underground in a Canadian mine
- Upgraded from SNO (Nobel prize winning) experiment
- Three phases to SNO+:
  - Water Cherenkov (UPW)
  - Pure Liquid Scintillator (LAB + Fluor PPO)
  - ^{130}Te Doped Liquid Scintillator
- Several scientific goals:
  - Supernova & Solar neutrino observations
  - Invisible nucleon decay (ND) studies
  - Antineutrino studies
- Main scientific goal:
  - **Neutrinoless double beta decay (0νββ)**

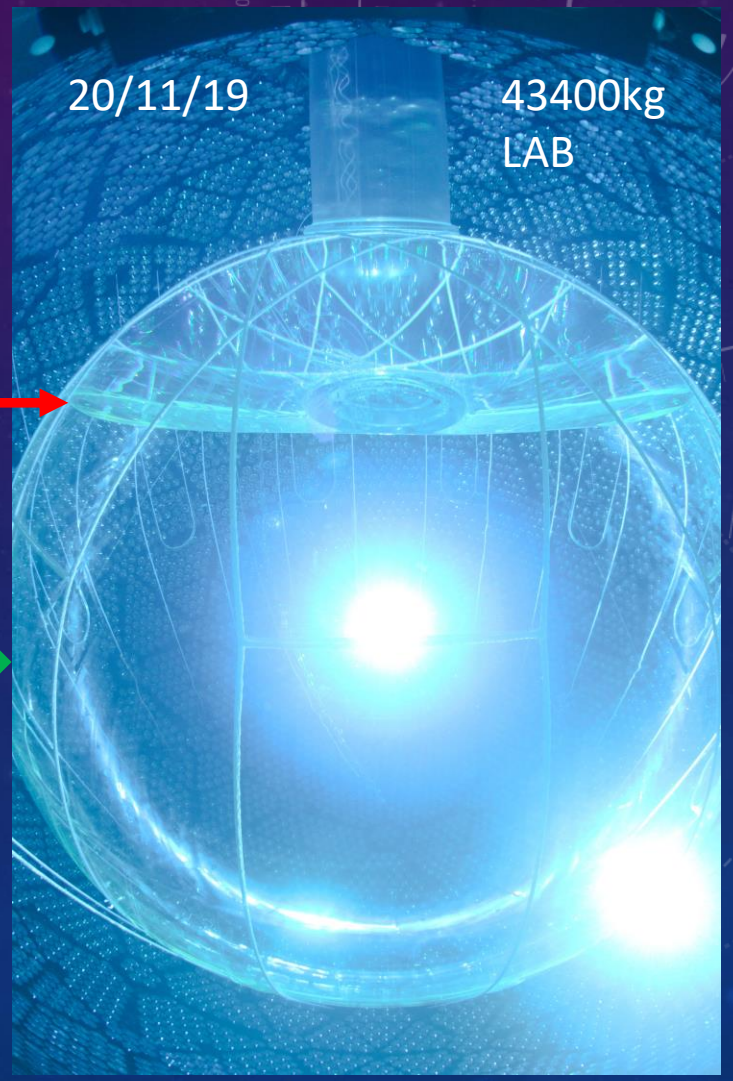


SNOPLUS TRANSITIONAL PHASE

→ Arrow Denotes interface between Ultra Pure Water (UPW) and scintillator (LAB)

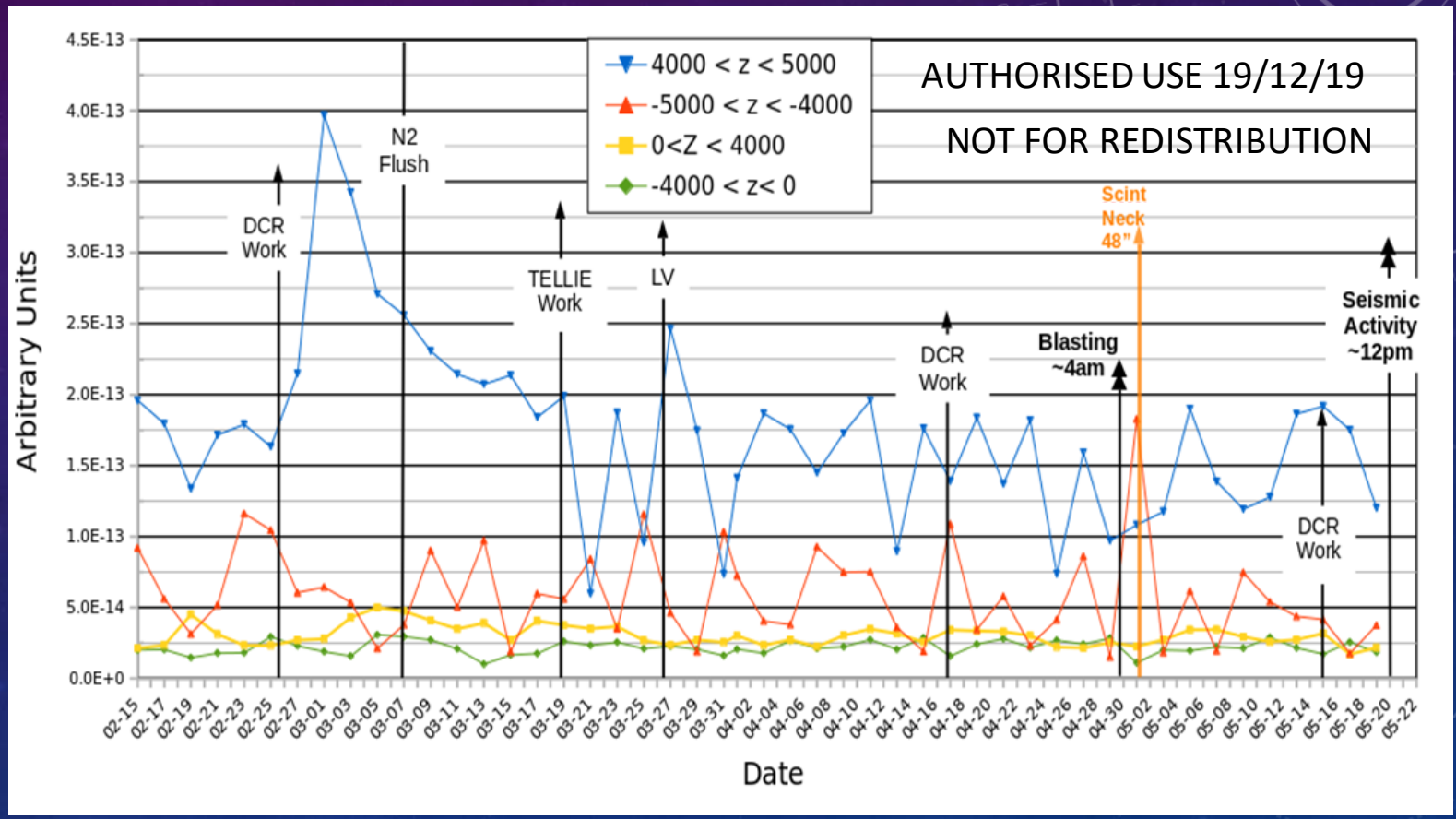




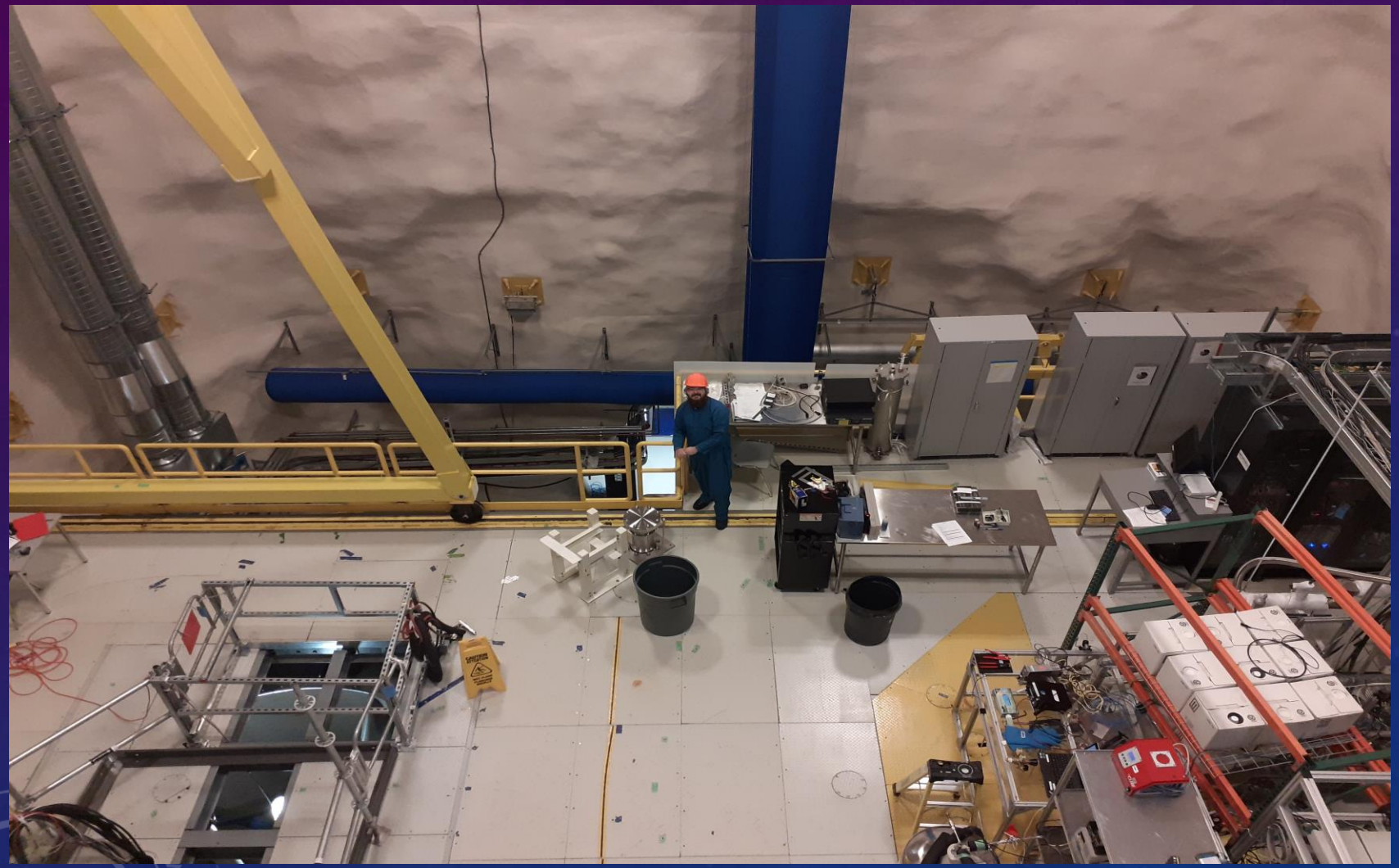


BACKGROUNDS MONITORING/ANALYSIS (LIVERPOOL)

- Radon daughters are a major background for ND and low energy ^{8}B-nu studies during water phase
  - Dominant background is ^{214}Bi
  - 130 Bq of Radon per cubic metre in mine air
- Radon ingress could also cause backgrounds in future studies
- ➢ **Hence, minimisation of Radon ingress is vital**
- Day-by day analysis was personally performed to monitor and suppress detector Radon levels
  - Algorithms used to identify ^{214}Bi decays
  - Events compared to MC simulations
  - Water purity plotted, graphs' spectra monitored and crosschecked with detector activity
  - Radon levels reported to collaboration weekly
  - Any major increases reported immediately, investigated and addressed

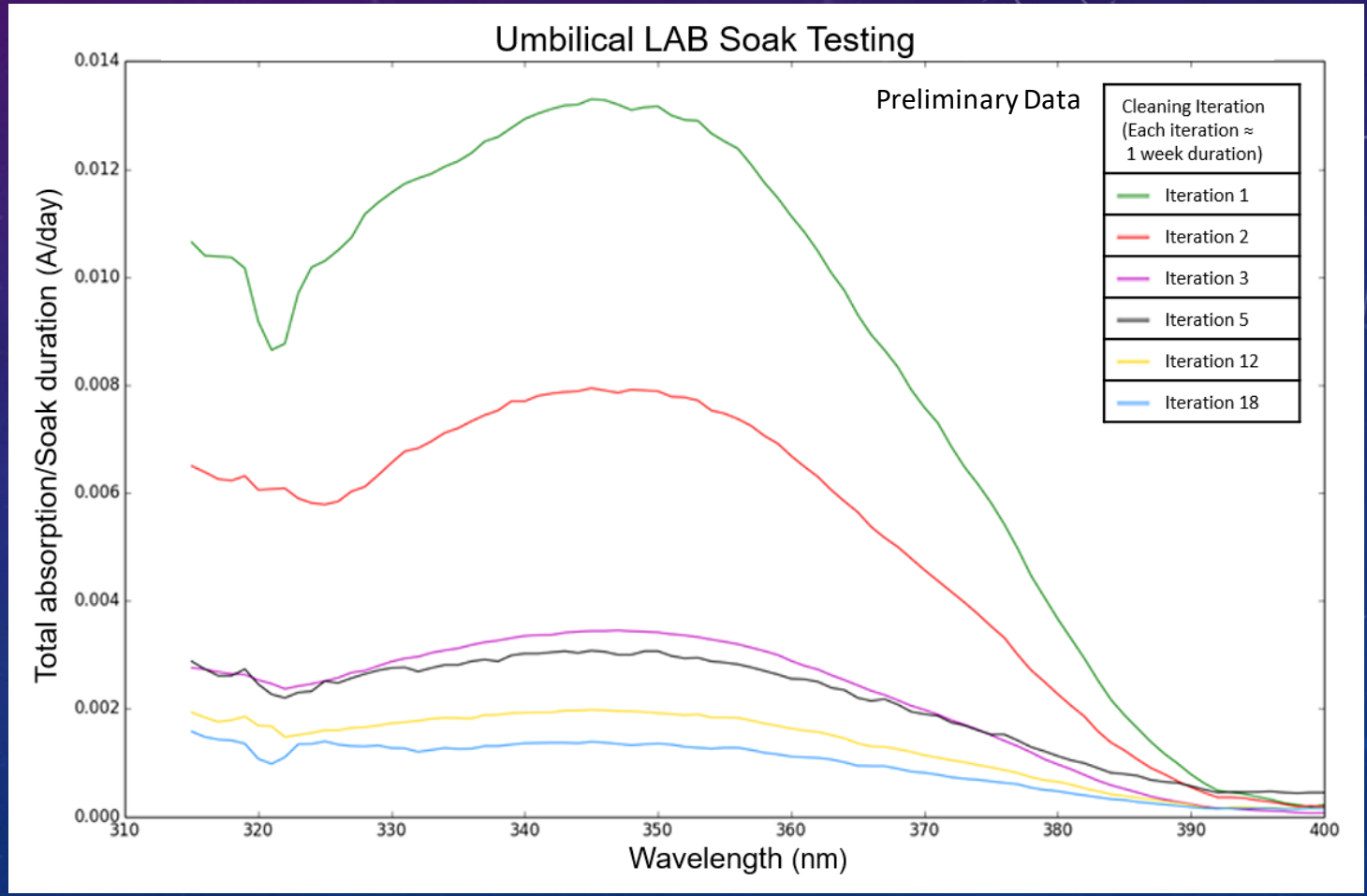


4 MONTH LONG TERM ATTACHMENT AT SNOLAB



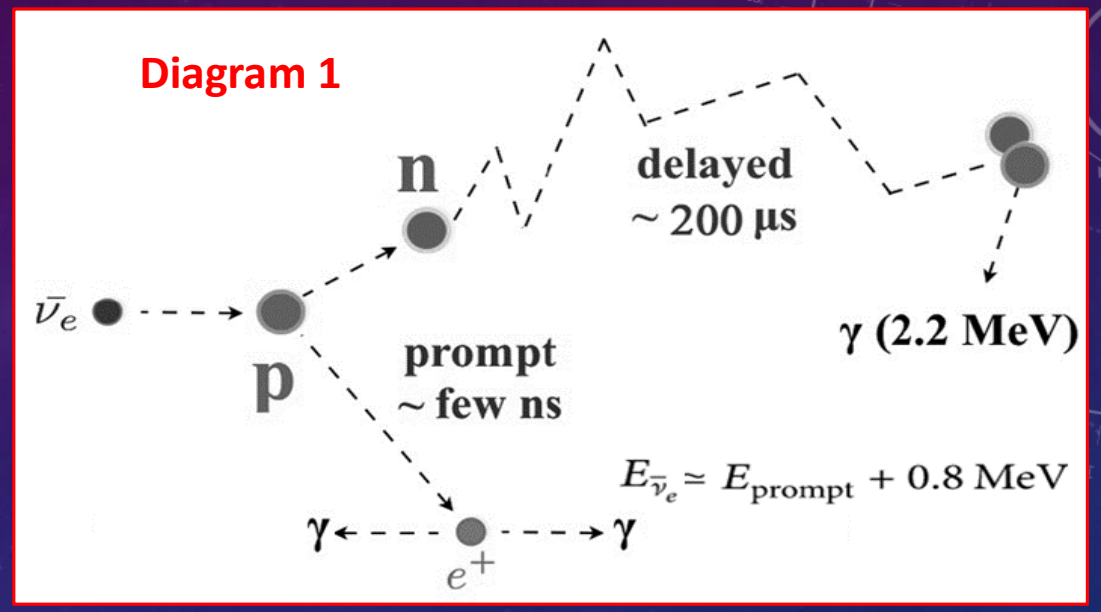
LONG TERM ATTACHMENT (SNOLAB)

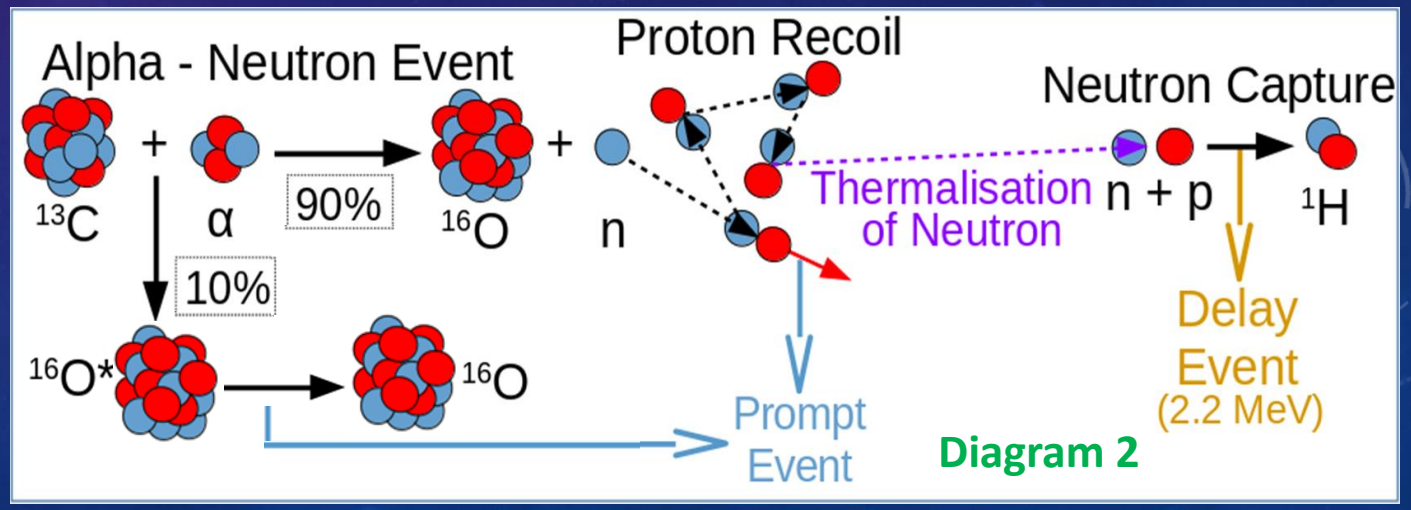
- Umbilicals used to house cables and feeds during calibration source deployment
  - Contaminants can potentially leach from the umbilical surface into the scintillator
- Testing undertaken to determine an appropriate pre-deployment cleaning method
  - Umbilical submerged in LAB and left to soak for approx. 1 week
  - LAB absorbance measured weekly with UV-vis
  - Umbilical re-submerged into fresh LAB
- Conclusions:
  - Leaching still present after 18 soak iterations
  - After 35 days (iteration 3) leaching is highly reduced
- Experimentation performed in collaboration with Rachel Richardson



ALPHA-NEUTRON REACTIONS (LIP – PORTUGAL)

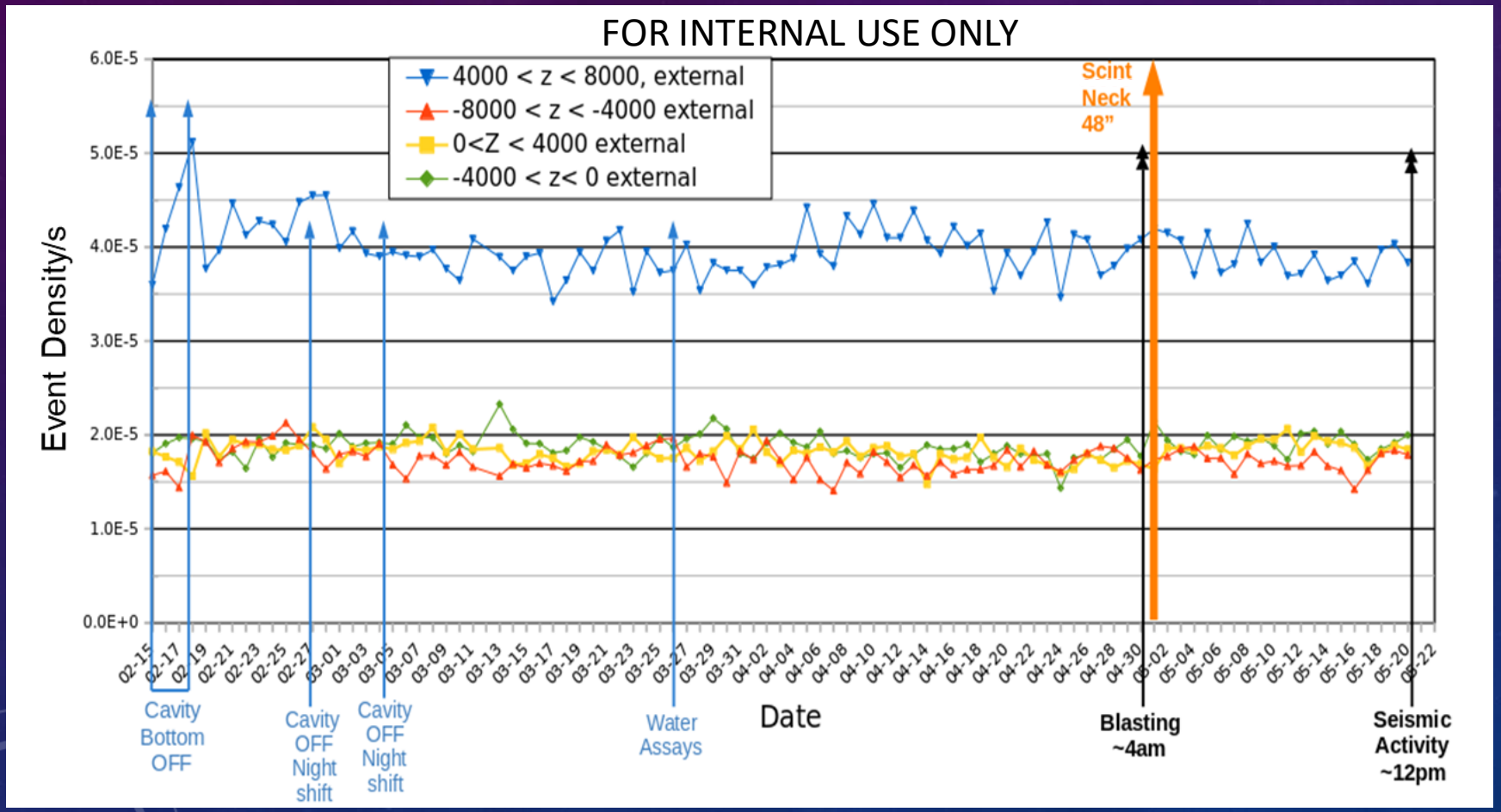
- Antineutrinos produce inverse beta decay prompt and delay signals (**Diagram 1**)
- Alpha-Neutron (AlphaN) events replicate this prompt-delay signal (**Diagram 2**)
  - Source of Alpha particles is ^{210}Po
  - Significant background for antineutrino and 0νββ studies
- Monte Carlo simulations used to develop an AlphaN tagging technique
  - Technique is currently being tested
  - Further testing and refining of technique during SNOPLUS' transitionary phase
- This tagging technique will be used in scintillator
- This analysis work will make up part of my thesis

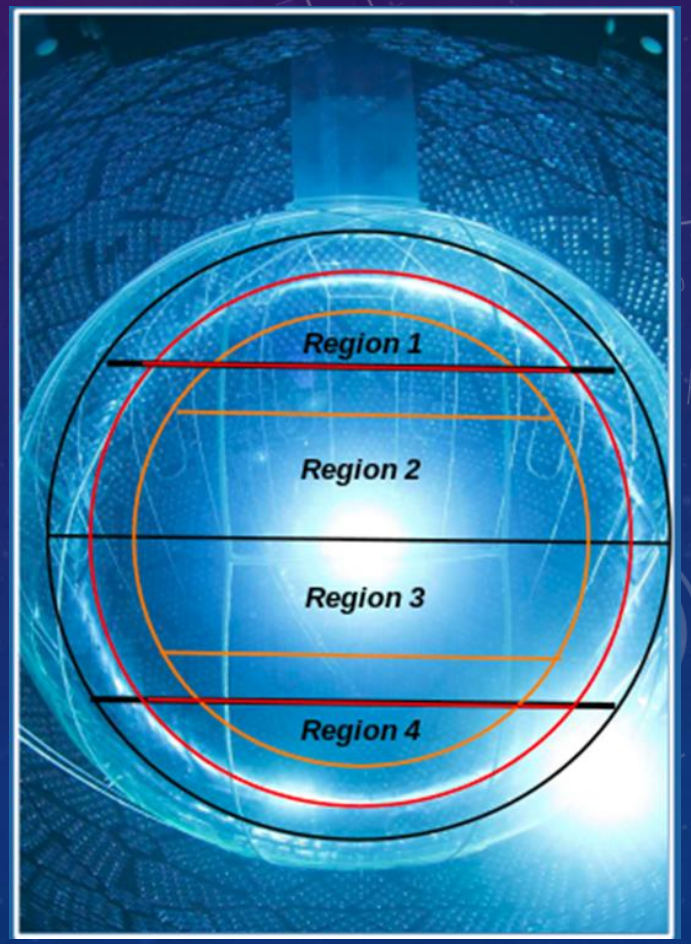




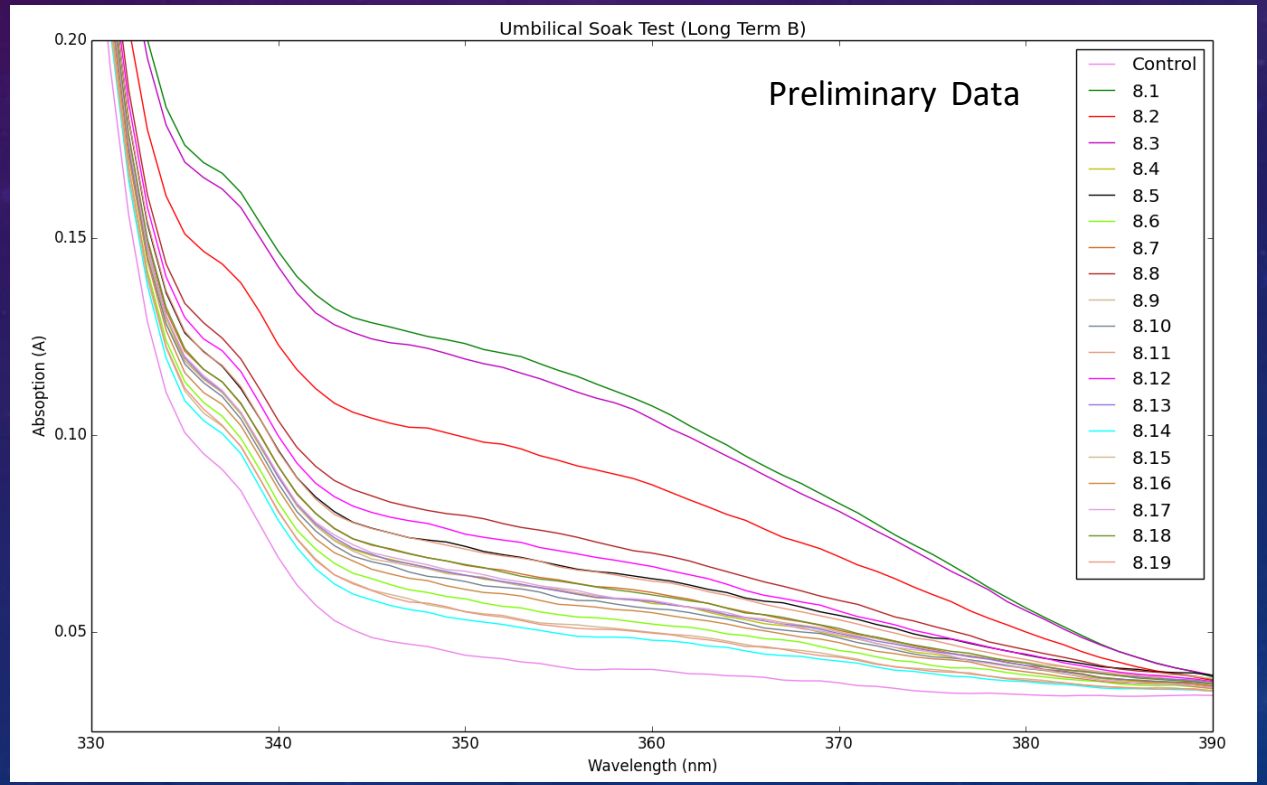
VOILA! QUESTIONS?

BACK-UP: EXTERNAL ANALYSIS PLOT & FV/REGIONS DIAGRAM





BACKUP: LONG-TERM UMBILICAL TESTING RAW DATA



BACKUP: ALPHA-NEUTRON MC CUTS