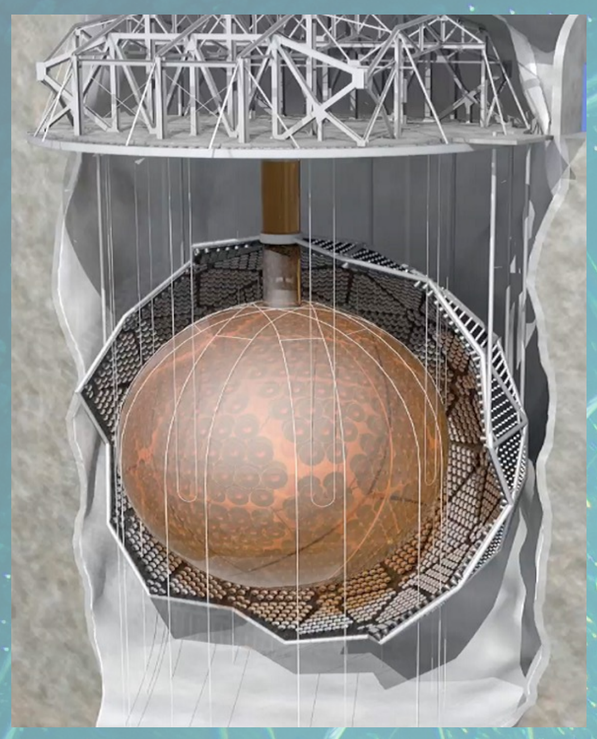
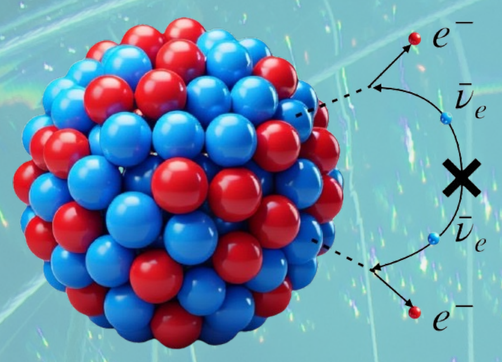
SNO+ Calibration Hardware

Ryan Bayes & Matt Depatie, For the SNO+ Collaboration

SNO+ Detector

- 2 km underground, suppress atmospheric muon flux by 2×10^8
- 12 m diameter acrylic vessel
- 780 tonnes liquid scintillator, linear alkyl benzene (LAB)
- ~9300 inward facing PMTs on a 17 m diameter geodesic support structure (PSUP)
- UPW shielding fills surrounding cavity (external veto)
- Will deploy ^{130}Te in scintillator for neutrinoless double beta decay search

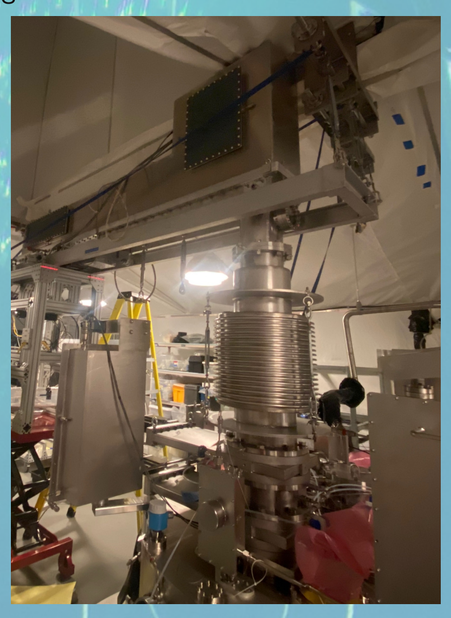


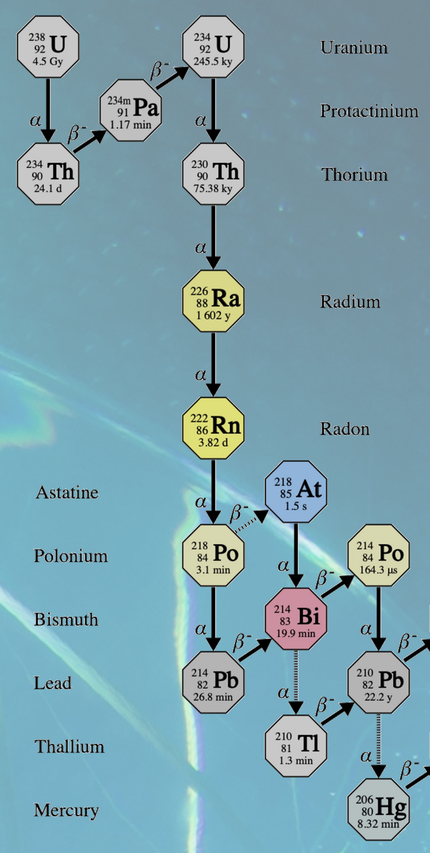


JINST 16 P08059

Backgrounds

- Enter the detector as gas (Rn) or dust (Th)
- Detector hermetically sealed, N_2 blanket above scintillator, 3 bags allow N_2 volume to react to pressure changes
- ^{222}Rn level monitored in N_2 volume
- Background suppression efforts; all parts cleaned
- Steel parts electropolished or passivated, use vacuum rated fittings



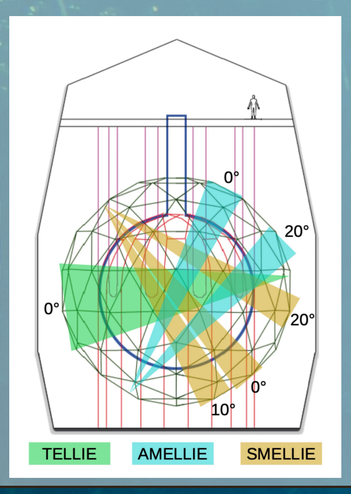


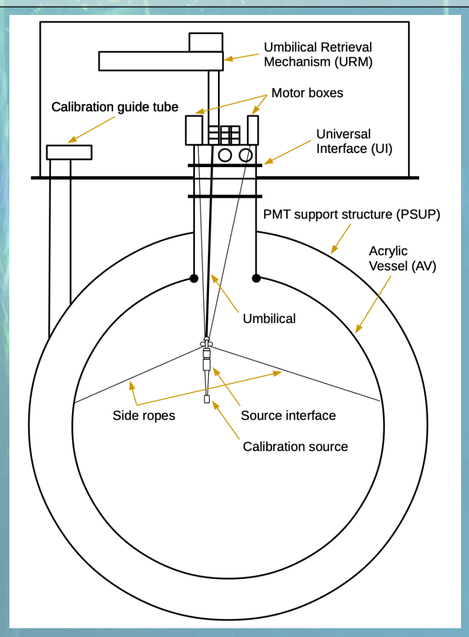
- ^{238}U background level of $6.2 \pm 0.1 \times 10^{-17}$ g(U)/g(LAB)
- ^{232}Th background level of $7.5 \pm 0.7 \times 10^{-17}$ g(U)/g(LAB)

Calibration Hardware

- Redesign of calibration equipment required
- Calibration system must be able to interface with the sealed SNO+ detector without impacting backgrounds
- New materials and methods needed to be tested for scintillator compatibility
- Construction completed July 2025, system operational October 2025
- Collected data throughout commissioning







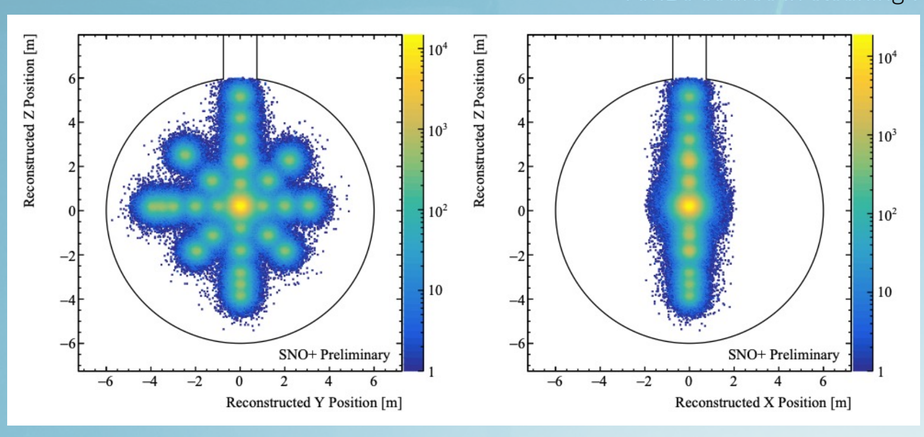
- Radioactive (AmBe) and Optical (laser driven) sources available
- Can move in xz or yz plane
- Embedded light injection system installed on PSUP, operated regularly

AmBe

- Neutron source encapsulated in several layers (Delron, lead, stainless steel, acrylic)
- Following the α-decay of ^{241}Am:
  $\alpha + {}^9\mathrm{Be} \rightarrow {}^{12}\mathrm{C} + n$
- Prompt signal: 4.4MeV gamma from ^{12}C deexcitation
- Delayed signal: 2.2MeV gamma from neutron capture on H

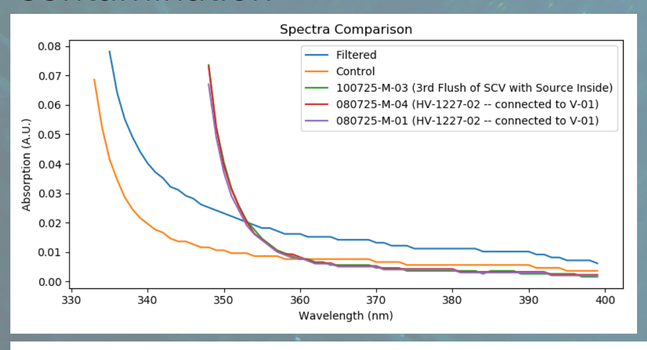


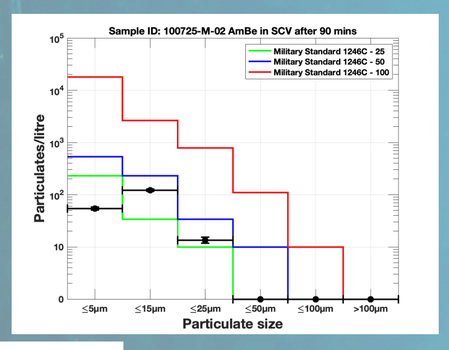
AmBe source in cleaning vessel

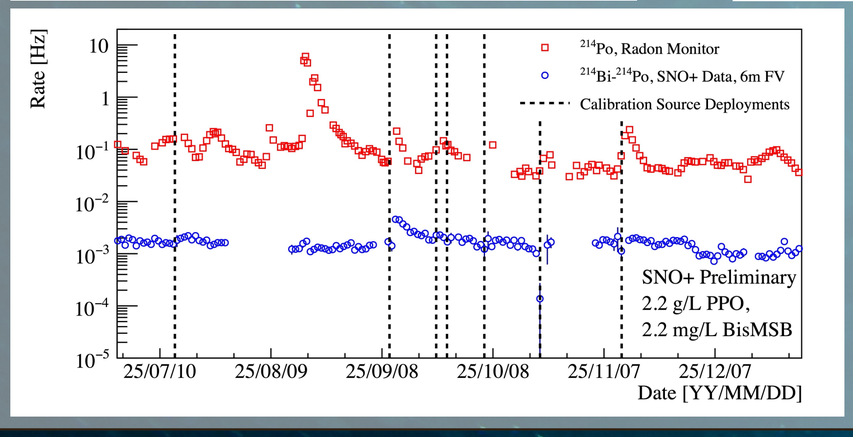


Deployment Cleanliness

- Internal source cleaned with detector grade scintillator
- Cleanliness quality determined by checking for chemical (UV-Vis spectroscopy) and radiogenic (liquid particle counting) contamination





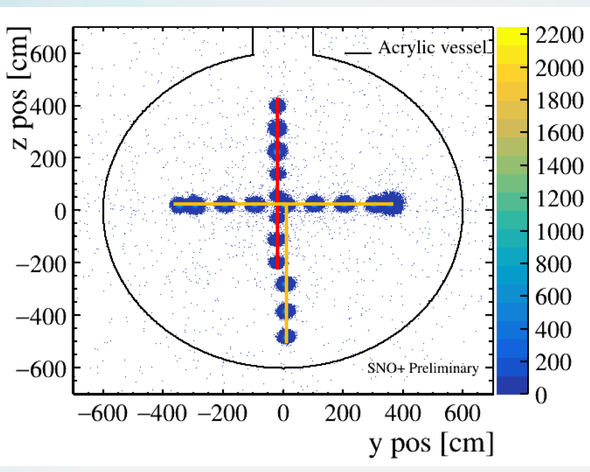


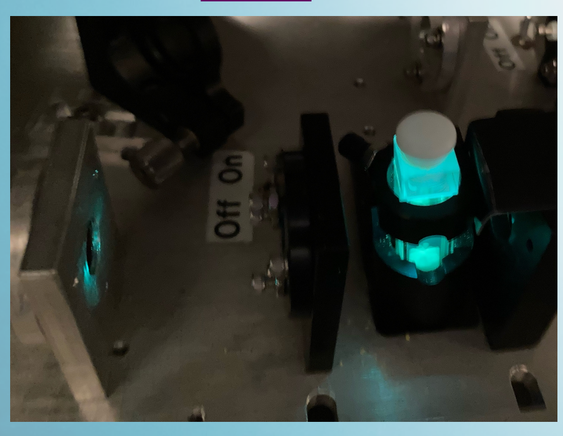
No significant Radon ingress into detector from deployments (single incidental ingress from scintillator recirculation otherwise known)

Laserball

- Laser injected optical source
- Laser dye cells allow multiple wavelengths for source
- Multiple wavelengths taken for each source position

500nm
440nm
420nm
405nm
385nm
337nm







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