

Radon Gas Assays for the SNO+ Experiment

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Background



- The SNO+ detector requires low backgrounds and is therefore important to continuously monitor these conditions
- Radon is overly abundant in mines
- Radon is not desirable in the detector due to the creation of daughter nuclei that fall within the ROI of neutrinoless double-beta decay

How do we monitor these conditions?

- Monitoring is done by performing assays, a technique developed by SNO along with a Mobile Radon Board, so measure the amount of ^{222}Rn
- Radon is trapped in the board and cryogenically cooled, concentrated, then heated to encourage the atoms to move along a specific path that leads to a Lucas Cell
- The assay is done over a measured amount of time so that the total volume measured is known



- Following the extraction, the Lucas Cell is placed into a PMT counter in order to count the number of alphas
- This counting allows for us to determine the number of radon atoms in the total volume, thereby determining if the area in question is within safe limits



A number of important assays were performed



LN₂ Plant

Newly built LN₂ plant
Ensure that SNO+ could attach this to the International Dewar that can then be used for cover gas purposes

UI

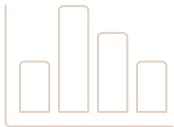
UI is the only 'entryway' to the detector, and the covergas is an effective way to determine the state of the detector

UI + Radon Monitor

Radon Monitor is meant to measure radon in the detector, if results are comparable then we know the Radon Monitor is working effectively

LN₂ Plant Results

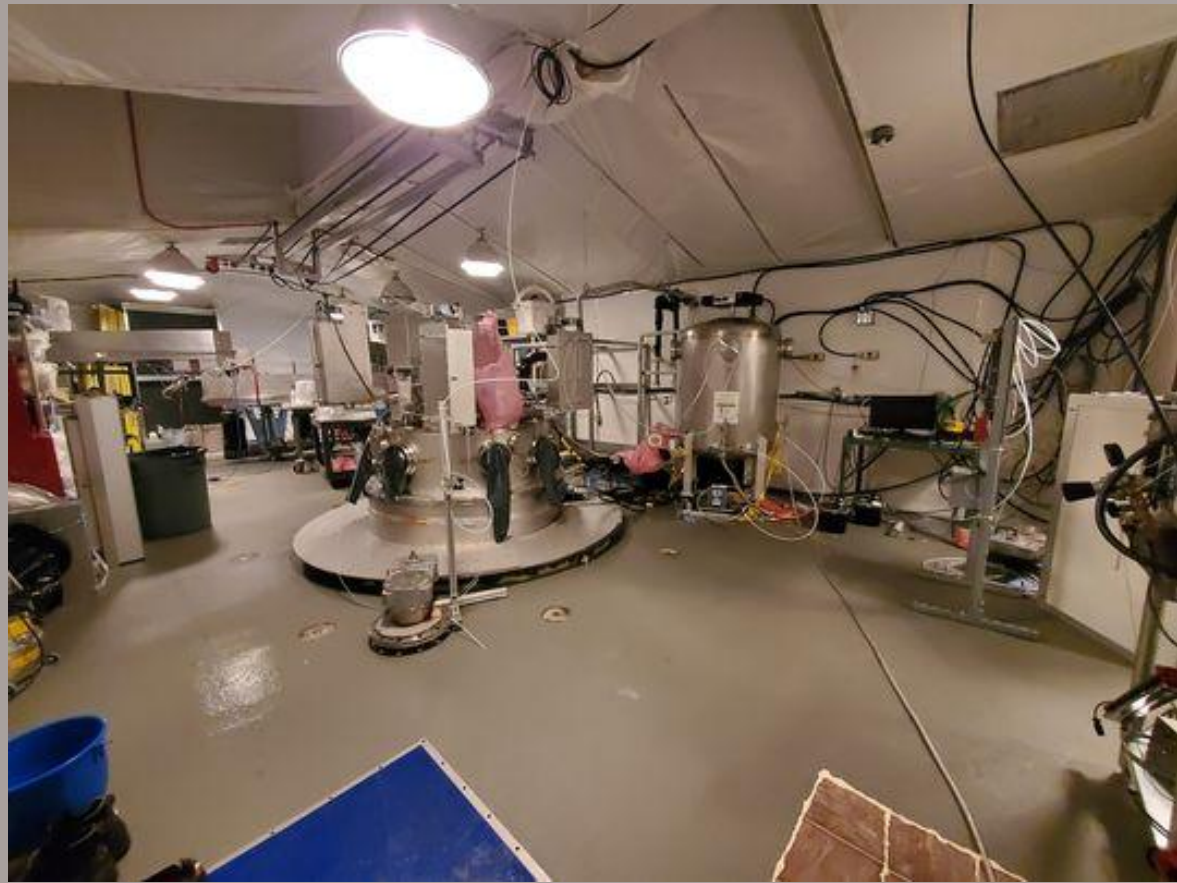
Date	LC ID	Assay Time	Alphas	Time counting (days)	Rn/sample LN2	C [rel. To mine air]
April 21, 2022	LC23	30min	120	6.08	275±15.1	1.45 x 10 ⁻⁴
April 27, 2022	LC23	30min	157	11.61	210±11.5	1.09 x 10 ⁻⁴
May 5, 2022	LC13	30min	145	8.075	333.3±18.3	1.74 x 10 ⁻⁴
May 17, 2022	LC13	30min	139	8	312.1±17.1	1.63 x 10 ⁻⁴



UI Assay Results

Date	LC ID	Assay Time	Alphas	Time counting (days)	Rn/sample UI	C [rel. To mine air]
June 23, 2022	LC21	30min	90	4.846	308.32	1.61×10^{-4}
June 30, 2022	LC21	30min	369	18.417	853.48	4.45×10^{-4}
July 21, 2022	LC28	30min	296	13.125	611.39	3.18×10^{-4}
July 22, 2022	LC21	30min	369	12.125	958.821	4.99×10^{-4}





UI + Radon Monitor Assay Results



Date	LC ID	Assay Time	Alphas	Time counting (days)	Rn/sample Rn Monitor	C [rel. To mine air]
July 26, 2022	LC18	30min	254	8.125	667.19	3.47×10^{-4}
July 27, 2022	LC17	30min	113	7.125	163.16	8.50×10^{-5}

What should we do in the future?

- Regular testing of the UI
- Perform an assay on the cover gas
- Perform more assays on the UI and the UI + Radon Monitor the get a more clear picture of what is going on



Questions?

