

# SNO+ Measurements and the Po210 Background

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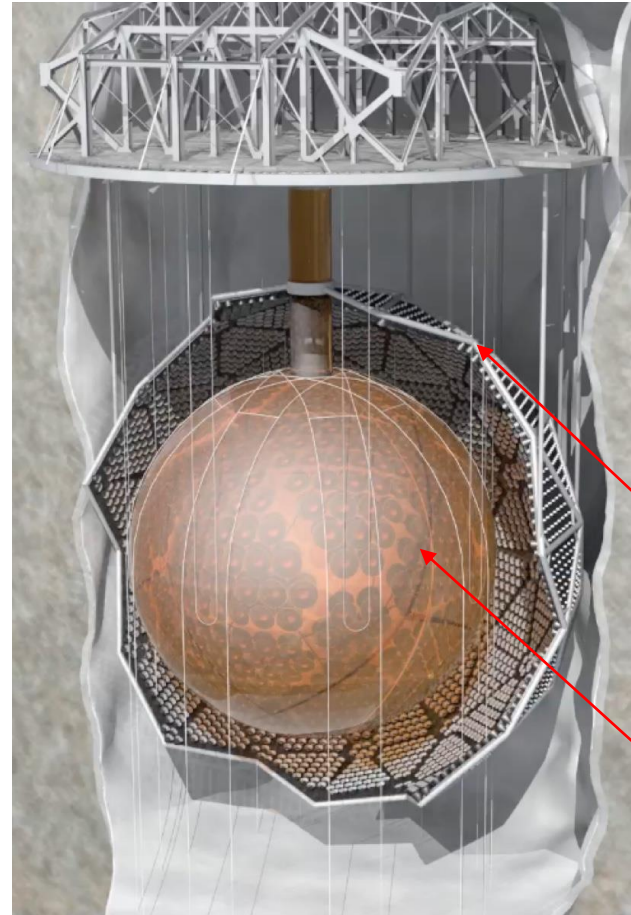
Aug 13, 2021

# About me

- Physics graduate student at Laurentian University
- Supervisor: Christine Kraus
- Research area: background in the SNO+ detector
  - Po210 background analysis
  - Rn gas assay
- Sport before covid: basketball, now: going underground for Rn assay

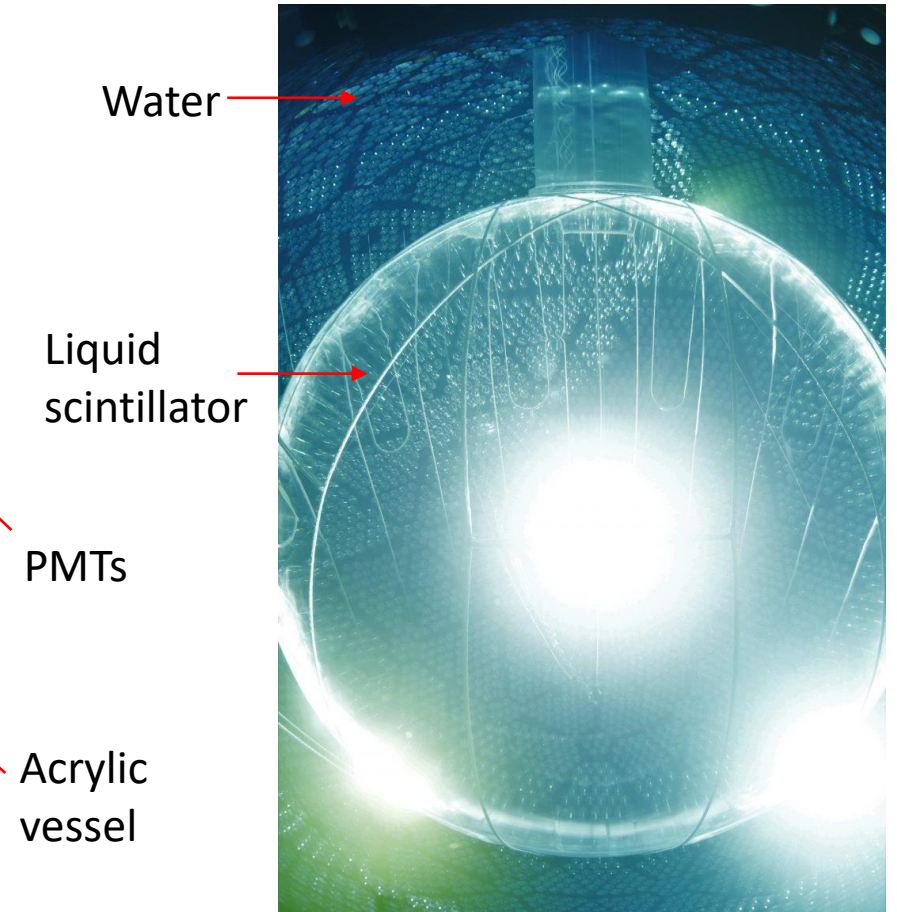
# SNO+

- Liquid scintillator detector, upgrade from SNO (heavy water detector)
- 2km underground
- 12m diameter acrylic sphere, 800 ton of Liquid scintillator
- About 10,000 PMTs
- Hold-down rope to cancel buoyant force in water



Source: SNO+ Collaboration

Liquid scintillator fill  
completed on March 27, 2021!



Source: SNO+ Collaboration

# The background from radioactive decay

- Uranium chain: Secular equilibrium with the top part of the chain is assumed
- Hard to prevent the leaking of Radon gas into detector:
- Break secular equilibrium at Po210
- Most daughter decay before reaching the center
- Long-live Pb210 can deposit on the AV

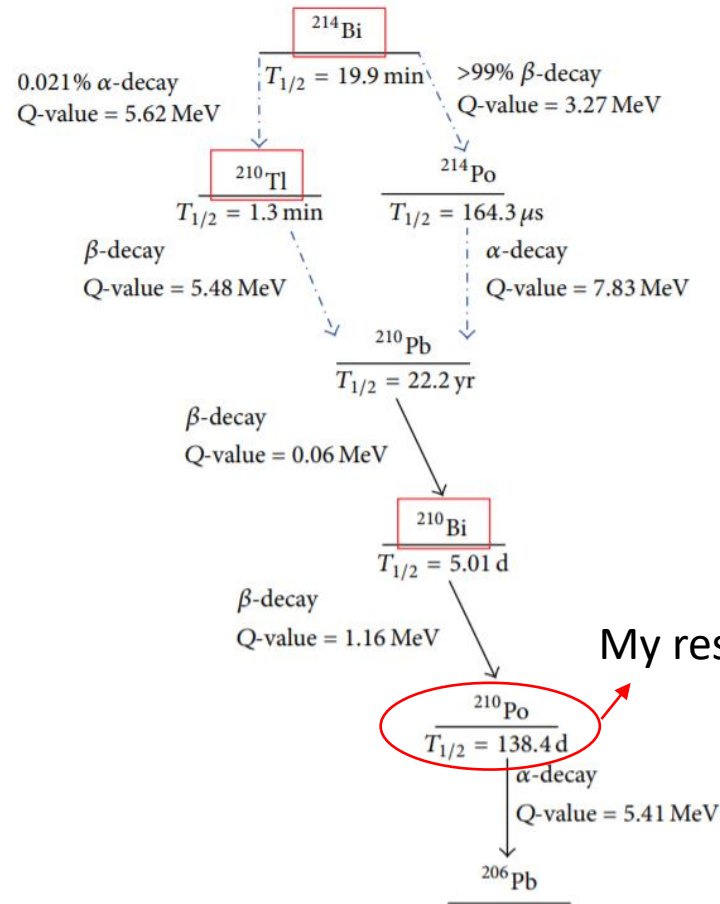


Figure 4: Part of  $^{238}\text{U}$ -decay chain relevant for SNO+

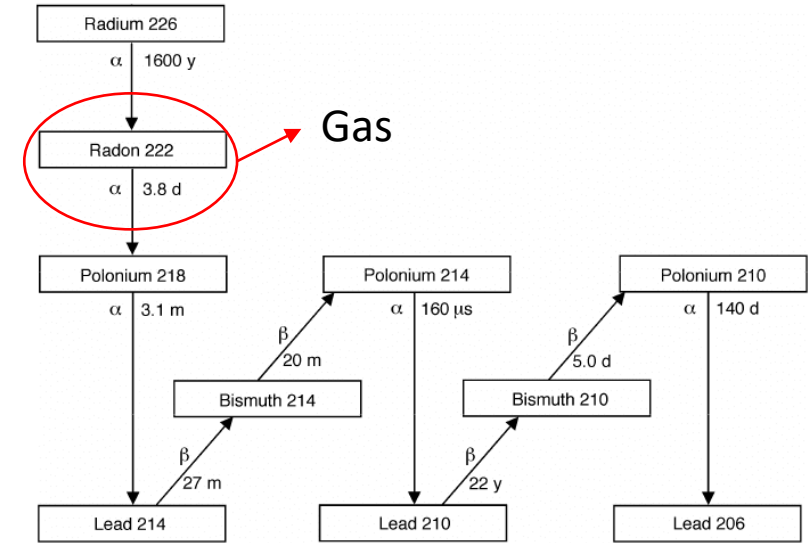
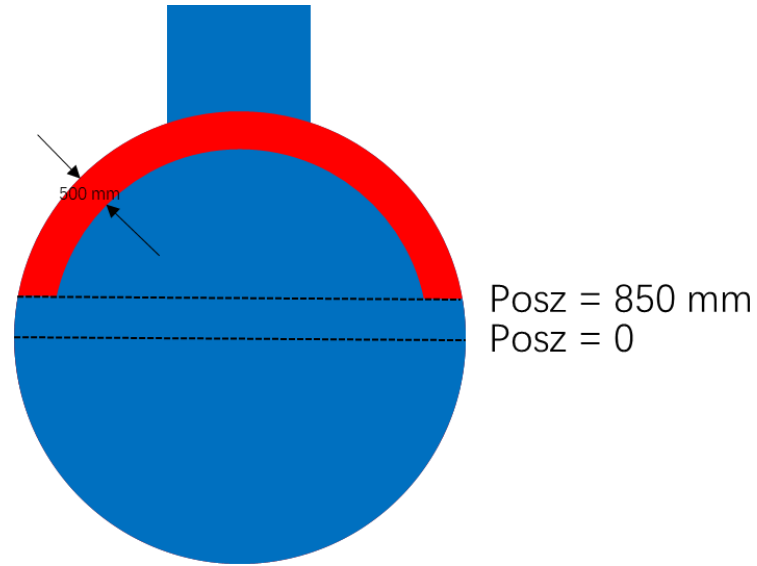


Figure 5: Ra222 decay chain

Source: IGCP Project 571: Radon, Health and Natural Hazards

# The region of my analysis

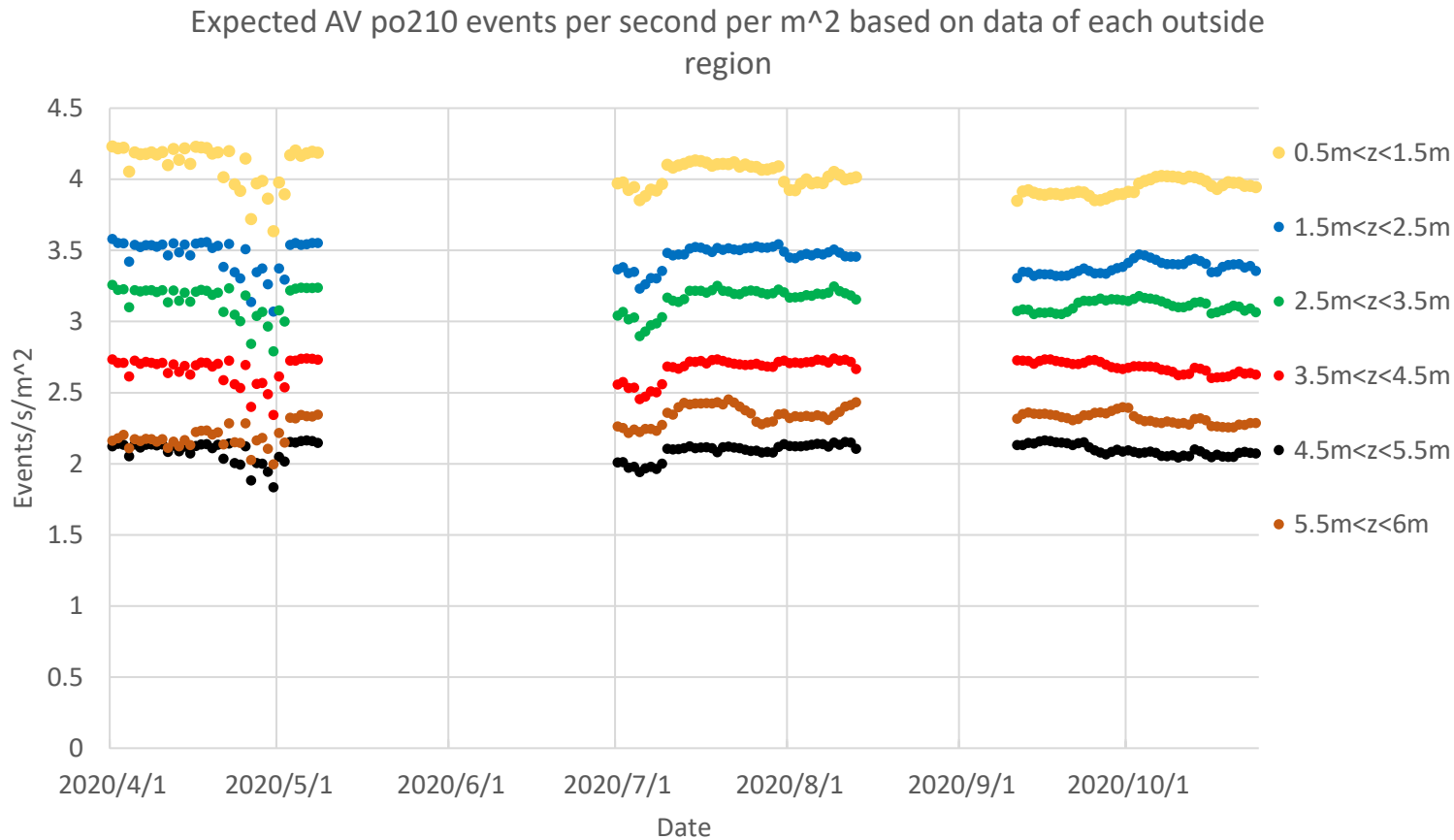
Inner regions	Outer Regions	Range in Z (mm)
11	12	5500-6000
9	10	4500-5500
7	8	3500-4500
5	6	2500-3500
3	4	1500-2500
1	2	850-1500



- Pb210 is expected to be on the AV sphere
- Pb210 then decay in to Po210 and enter the detector
- More events of Po210 expected at the top of detector
- Analysis is for the data in partial fill period (top half detector filled with scintillator and bottom half with water)

region	Volume(m <sup>3</sup> )	Area(m <sup>2</sup> )
1	5.743224	24.50442
2	5.998478	24.50442
3	8.835729	37.69911
4	9.228428	37.69911
5	8.835729	37.69911
6	9.228428	37.69911
7	8.835729	37.69911
8	9.228428	37.69911
9	8.835729	37.69911
10	9.228428	37.69911
11	1.112647	15.68584
12	3.468842	15.68584
sum	88.57982	381.9734

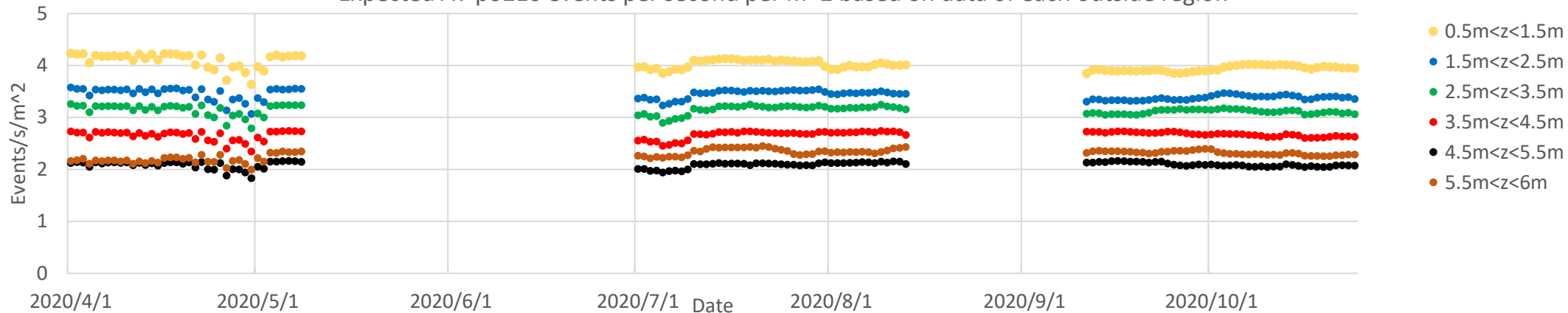
# Po210 result



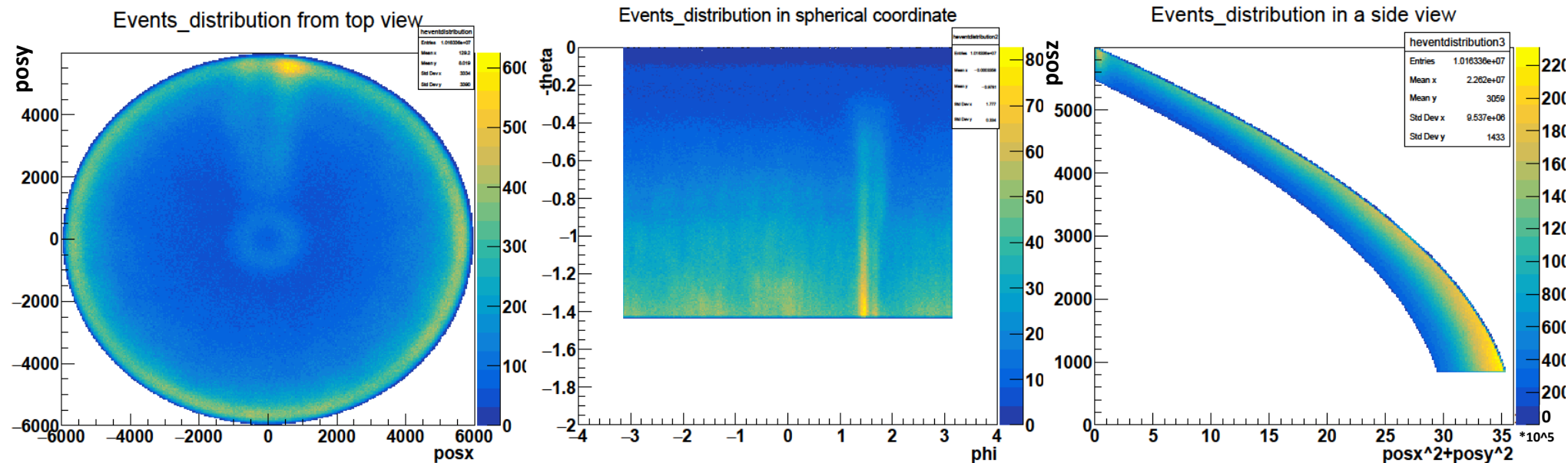
- The closer the region to the water, the more po210 events seen
- This is opposite of what we expect
- The reason for this pattern is yet to be understood. It is supposed to be due to diffusion of contaminants (Uranium chain) from water to scintillator
- Stable level of Po210 in the period

# Po210 result

Expected AV po210 events per second per m<sup>2</sup> based on data of each outside region



Apr01 2020, with the pipe region



# Summary and Questions?

- Radon gas break the secular equilibrium of Po210
- Pb210 deposited on AV can leach off into scintillator
- More Po210 events are found for regions near water
- Level of Po210 in the near AV region in scintillator is stable from April 2020 to Oct 2020