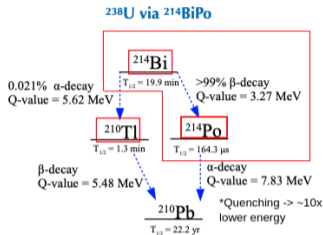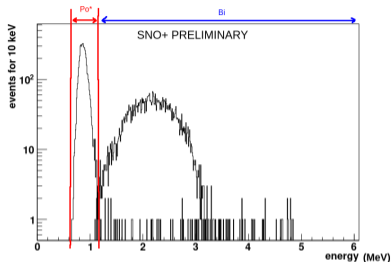# Towards the neutrinoless double-beta decay study with SNO+: radioactive background characterization with SNO+ scintillator data

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Identification of ^{214}Bi events


Efficiency of cuts

$$\epsilon = \frac{N_{cut}}{N_{generated}} = 0.80 \qquad (1)$$

- Obtained from MC simulations

Coincidence analysis (tagging technique)

1. Identify a Po event by an energy cut
2. Go back in time to search for events that are in coincidence with the Po - $\Delta t < 1$ms $\rightarrow 6 \times T_{1/2}$
3. Select events that satisfy criteria (2) and have an energy > 1.2 MeV (Bi candidate)
4. Furthermore ask that the position difference between Po and Bi is < 1 m

Activity
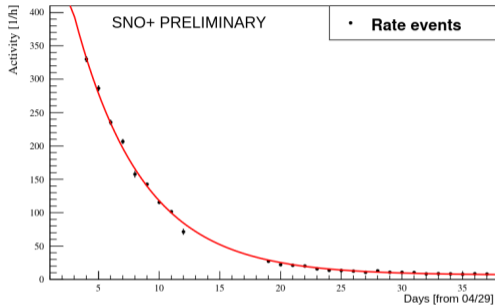
Fiducial Volume → 6m

- Tagged events are converted into an activity by the efficiency: $A = \frac{N_{tag}}{\epsilon}$
- Studied the dependence of the activity with time using the first 40 days of scintillator data after fill.
- Fit the data: $f(x) = \mathsf{p}_0 e^{-\mathsf{p}_1 x} + \mathsf{p}_2$

From the Fit

- Extract half-life from p_1
- $t_{1/2} = (3.81 \pm 0.024)$ days $\rightarrow ^{222}$Rn ($t_{1/2} = 3.82$ days)
- $\mathsf{p}_2 \neq 0 \rightarrow ^{238}$U concentration

^{222}Rn was found to be in the detector following fill operations → Exclude the first 20 days of scintillator in the following analysis.

Results

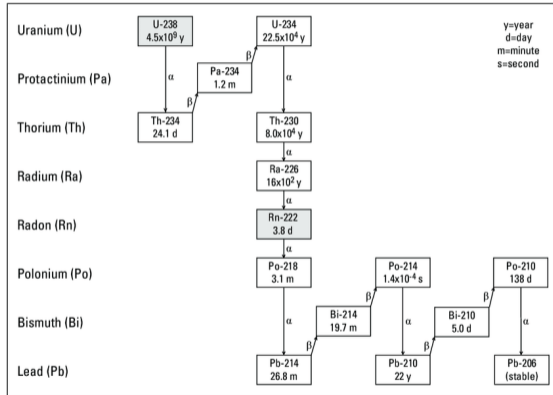The total cumulative sacrifice is 1.3%
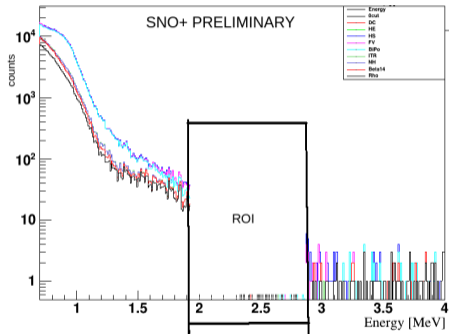
Analysis of events' spatial distribution after all cuts have been applied.
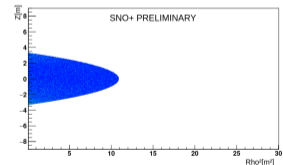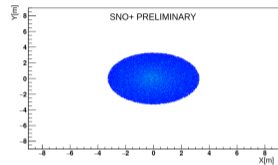
Thank You

Back Up Slides

Uranium chain

All cuts

Cuts	Condition	Description
0cut	nhitsCleaned < 20	Low energy events, not reconstructed
DC	muons flag	Identifies muons
HE	(nhitsCleaned > 3000) + 20s	Rejects high energy events and followers
HS	(nhitsCleaned > 1200) + position	Rejects Hot Spot events and followers
FV	r < 3300	Fiducial Volume
BiPo	BiPo event = true	Rejects BiPo-like events
ITR	itr <= 0.2	In Time Ratio
NH	neckhits > 0	Events from the neck
β_{14}	$\beta_{14} > 0.1$	Isotropic variable

Table 1: Summary of all the cuts applied.

Sacrifice Table

Cuts	Cumulative Sacrifices (%)
BiPo	1.64×10^{-5}
ITR	0.744
neck hits	1.25
β_{14}	1.25

Table 2: Cumulative sacrifices based on Monte Carlo simulations of $0\nu\beta\beta$ events. Cuts are applied in the order shown.