# Background Evaluation from Radon in Open Space of ELEGANT V


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The measurement of double beta decays and searching for WIMPs, which is one of the most promising candidate of dark matters, are of current interest from view points of astroparticle and nuclear physics. The ultra-low background high sensitive detector ELEGANT V has been applied for these studies and details of the whole detector system are given in ref.[2].

The daughters of $^{222}$Rn can be one of the most serious background origin for the measurement of these nuclear rare processes. In order to reduce the background events from Rn in the vicinity of the detectors, the pure nitrogen gas (8.4mBq/m$^3$) is introduced into the air tight box.

For the measurement of neutrinoless double beta decay, background contributions from $^{214}$Bi ($Q_\beta$=3.28MeV) is one of the most serious background among the daughters of $^{222}$Rn. As the first step, the amount of $^{214}$Bi were evaluated from the single electron event rates in coincidence with $\gamma$-rays characteristic of the decay of $^{214}$Bi. On the basis of the estimated $^{214}$Bi contents, Monte Carlo calculations were carried out to evaluate the BG (fake) event rates caused by this isotope, which may survive after the $\beta\beta$ selections [3]. The obtained $^{214}$Bi content in open space and the number of the estimated BG counts are listed in table 1.

On the other hands, the decays from the daughters of $^{222}$Rn also suffer the the low energy background for WIMPs search with NaI(Tl) scintillators. Especially, the seasonal variation and the ambiguity of the Rn concentration in open space make the sensitivity of the WIMPs annual modulation worse. For that reason, the circulated nitrogen gas into ELEGANT V is extracted from air tight and introduced into high sensitive Rn monitor [1]. The Rn concentration in the extracted gas was continuously monitored on real time, and the nitrogen flow was controlled in order to eliminate the seasonal variation of background from Rn. Because of monitoring of that, the seasonal variation of Rn concentration in open space was suppressed less than 80mBq/m$^3$. The expected difference of energy spectrum were calculated by the Monte Carlo simulation as shown in Fig. 1. The obtained contribution caused by the seasonal variation of $^{222}$Rn in the analyzing energy window of annual modulation(8keV-15keV)[4] is $1.6\times10^{-3}$ counts/day/kg. This value is two orders of magnitude smaller than the statistical error of the count rate of NaI detectors, and satisfied with the requirement of WIMPs search by the annual modulation The change of the Rn concentration in ELEGANT V with the Rn monitor is also shown in Fig. 2.

Table 1: The amount of $^{214}$Bi in the air around plastic scintillators, and the expected background yield in analyzing energy window for $0\nu\beta\beta$ evaluated in Oto measurement together with in Kamioka measurement.

| Laboratory | $^{214}$Bi in Open Space(mBq/m$^3$) | Expected BG(counts/year) |
|---|---|---|
| Oto | $2.80 \pm 0.14$ | 0.86 |
| Kamioka | $6.5\pm1.5\times10^{-2}$ | 0.12 |

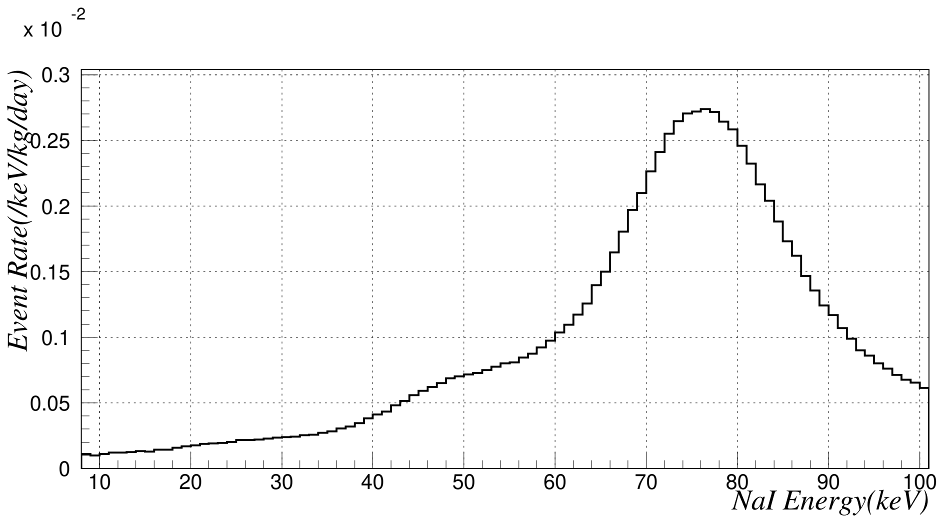


Figure 1: The contribution from the difference of $^{222}$Rn in open space between June and December. The large bump around 80keV is due to X-rays of the daughters of the $^{222}$Rn

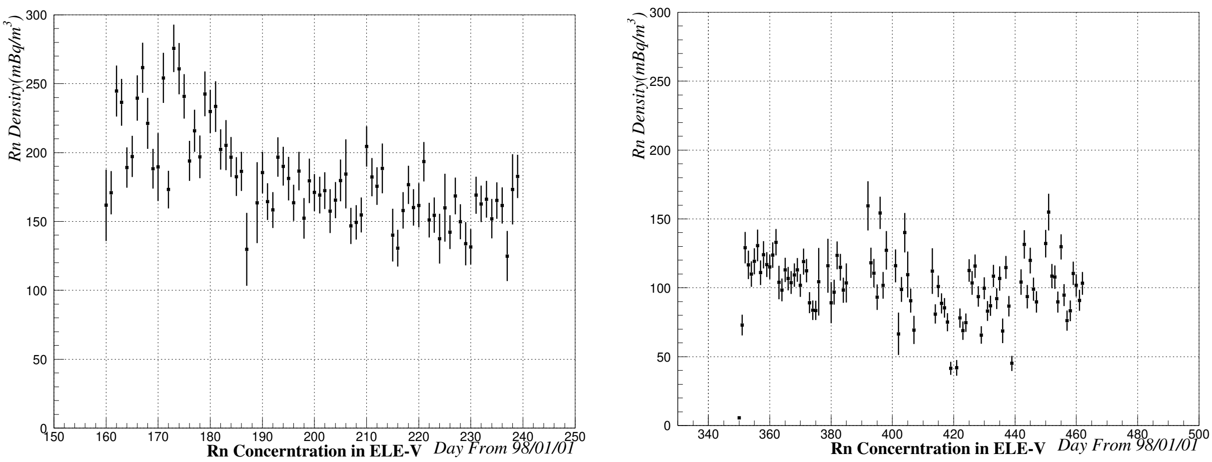


Figure 2: The seasonal Rn concentration in open space measured by the high sensitive Rn Monitor. The horizontal axis indicates that the day from January 1st, 1998. The quoted errors show only the statistical errors, not include the systematic error(5%).

## References


[1] E. Choi *et al.*, reference therein.

[2] H. Ejiri *et al.*, Nucl. Instrum. Methods A**302** (1991) 304.

[3] N. Kudomi *et al.*, Proceedings of the International Symposium on Nuclear Electro-Weak Spectroscopy for Symmetry in Electro-Weak in Nuclear-Processes, to be published.

[4] S. Yoshida, Master Thesis, Osaka University, 1998, and reference therein.