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Preliminary results of the measurements of the radiation background at Aragats and in Yerevan

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Abstract. The measurements of the gamma radiation background at mount Aragats and in Yerevan, by 3"x3" standard NaI ORTEC detector were performed. The measurements at fair weather conditions show that there are no differences between the forms of the radiation backgrounds at Aragats and Yerevan.

1. INTRODUCTION

The natural background radiation consists of nuclides radiation in the lithosphere, soil, water and air, and in contribution of cosmic rays and technogenic radioactive sources. The cosmic ray impact is expected to be higher on the mountains due to thinner atmosphere that allows penetration of the cosmic rays and radiation from the volcanic rocks. Radioactive nuclides can penetrate from the soil into the atmosphere, mostly radon isotopes (^{222}Rn, ^{220}Rn) and their daughter radionuclides.

Since 2009 hundreds of events of Thunderstorm ground enhancements (TGE), i.e. enhanced fluxes of electrons, gamma rays and neutrons detected by particle detectors located on the Earth's surface and related to the strong thunderstorms above, were observed by the network of particle detectors located at Aragats space-environment centre (ASEC, Chilingarian et al., 2005, 2010, 2011).

In order to measure the natural radiation background possibly influencing in the TGE observations at Aragats (3200 m above sea level) and Yerevan (1000 m above sea level) the background measurements were performed by 3"x3" standard NaI ORTEC detector.

2. MEASUREMENTS AND RESULTS

In the Fig. 1, 2 and 3 there are shown the background radiation spectrums inside the SKL experimental hall (Aragats), outside the SKL hall on territory of Aragats research station and at headquarters of Yerevan Physics Institute (YerPhI) respectively. All measurements were done during 600 s at the fair weather conditions.

In the Table 1 the total counts of the spectrums are shown.

Table 1.

Place of measurement	**Total counts (600 s)**
SKL building inside background, Aragats	381000±617
Outdoor background, Aragats	213000±462
22a building inside background, Yerevan	374000±612

Background radiation measurement in the SKL experimental hall was performed under the roof where five NaI(Tl) detectors of ASEC network are positioned. The gamma spectrometer was located on the concrete layer just below the roof. In the Fig. 1 we show the gamma lines of identified radionuclides of Uranium (^{214}Pb (352 keV) and ^{214}Bi (768; 1120; 1764 keV)), Thorium (^{208}Tl (583; 2614 keV) and ^{228}Ac (911; 969 keV)) series and potassium ^{40}K (1460 keV).

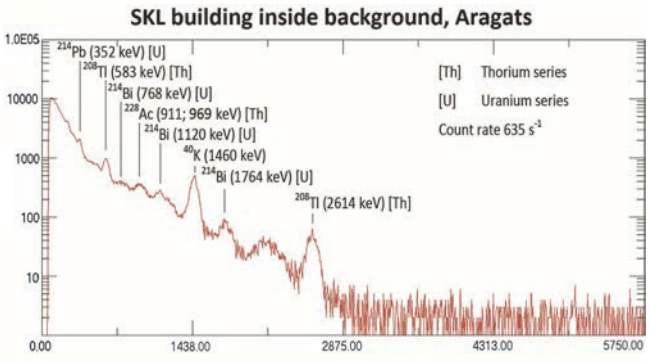

Figure 1. The background spectrum measured inside the SKL building.

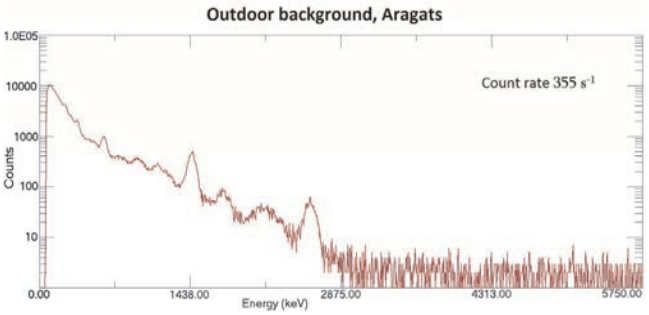

Figure 2. The background spectrum measured outside the SKL building.

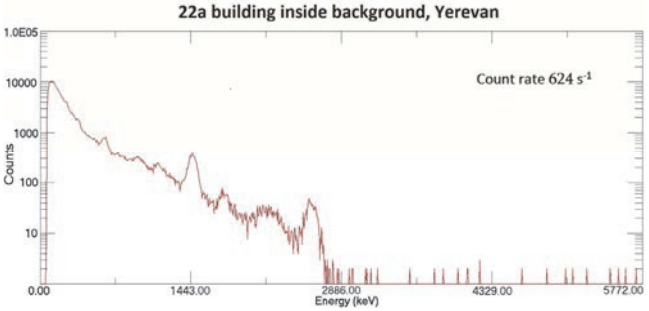

Figure 3. The background spectrum measured in Yerevan.

For the identification of radionuclides the gamma lines of ^{40}K (1460 keV) and ^{208}Tl (2614 keV) were used. For an additional calibration and testing of the energetic resolution of the spectrometer the gamma line of ^{137}Cs isotope (662 keV) was used. The extracted spectrum of ^{137}Cs is shown in Fig. 4. The energetic resolution of 3"x 3" standard NaI ORTEC spectrometer was 100%*FWHM/(Photo-peak en-

ergy) = 7.6 ±1.5 % (Full Width at Half Maximum of photo-peak) at 662 keV when the background is extracted from ^{137}Cs spectrum. The total counts of the extracted spectrum was 2200000±1483 during 600 s.

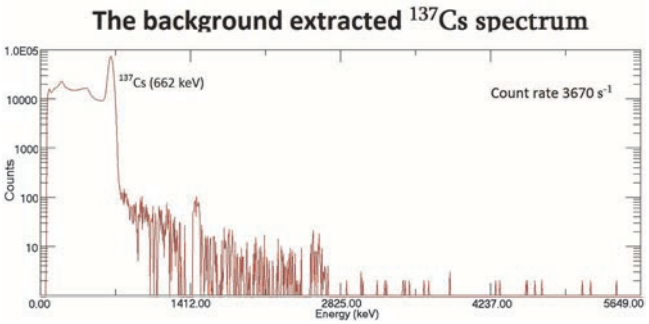

Figure 4. The background extracted spectrum of the ^{137}Cs isotope.

As it shown in the Table 1 total counts of inside the building is about two-fold higher than outdoor, which can be explained by the accumulation of radon gas (^{222}Rn, ^{220}Rn and their daughter radioactive nuclides) in the building and also by the contamination of radionuclides in the construction materials of the building. The measurements in Yerevan were performed by positioning spectrometer on the concrete layer in the building 22a of YerPhI (Fig. 3) for comparison with high-mountain results at Aragats.

3. CONCLUSION

The radiation background measurements were shown that they are gamma lines of radioactive nuclides of Uranium, Thorium series and ^{40}K in the spectrum.

The largest peak was the peak of ^{40}K (1460 keV) and the next one was the peak of ^{208}Tl (583 keV).

The total counts differences between Aragats inside and outdoor spectrums can be explained by the accumulation of radon gas (^{222}Rn, ^{220}Rn and their daughter radioactive nuclides) in the building and also by the contamination of the radionuclides of the constriction materials.

The measurements show that there are no special differences between the forms of the radiation background at Aragats and Yerevan.

More detailed measurements are provisioned during this year to find out the influence of different weather conditions on the local radiation background.

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REFERENCES

- Chilingarian, A., Arakelyan, K., Avakyan, K.et al., 2005. Correlated measurements of secondary cosmic ray fluxes by the Aragats space-environmental center monitors, Nucl. Instrum. Methods A 543 (2–3) 483.
- Chilingarian, A., A. Daryan, K. Arakelyan, A. Hovhannisyan, B. Mailyan, L. Melkumyan, G. Hovsepyan, S. Chilingaryan, A. Reymers, and L. Vanyan L.,2010. Ground-based observations of thunderstorm-correlated fluxes of high-energy electrons, gamma rays, and neutrons, Phys. Rev. D, 82, 043009.
- Chilingarian, A., Hovsepyan, G., Hovhannisyan, A., 2011. Particle bursts from thunderclouds: natural particle accelerators above our heads. Phys. Rev. D: Part. Fields 83 (6), 062001.