

SEVAN particle detector response function, purity, efficiency, and response to charged and neutral CR species

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Abstract:

The SEVAN (Space Environmental Viewing and Analysis Network) detector network monitors charged and neutral species of secondary cosmic rays across multiple high-altitude stations worldwide. This study presents a comprehensive analysis of SEVAN detector response functions, detection efficiencies, and purities for various cosmic ray species, including neutrons, protons, muons, electrons, positrons, and gamma rays. Using the GEANT4 simulation toolkit in combination with secondary cosmic ray spectra obtained from the EXPACS online calculator, we quantify the characteristics of the detectors under realistic environmental conditions.

SEVAN detectors record count rates, while the modernized SEVAN-light version additionally registers energy release histograms. The calculated efficiency and purity parameters are essential for recovering the intensity of different secondary cosmic ray species entering the detector's sensitive volume. The results demonstrate that SEVAN detectors effectively register and discriminate between multiple particle types, ensuring reliable recovery of their energy distributions. These findings confirm the robustness of the SEVAN network as a global system for continuous monitoring of cosmic rays for studying the effects of solar, atmospheric, and geomagnetic modulation. For recovering energy spectra, we solve the inverse problem of cosmic rays using the calculation of the energy response of the detector with GEANT 4 simulation, inverting the "dispersion" matrix.

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Key words:

SEVAN detector; Detection efficiency; Cosmic rays

Introduction

Radiation on Earth's surface has been measured for over a century using various particle detectors. These detectors have evolved from electroscopes to sophisticated, thousands-ton Large Hadron Collider (LHC) detectors.

Various types of particle detectors register different types of cosmic rays. However, we aim to refrain from reviewing sensors or discussing how particles interact with the measuring media. Instead, we strive to explain the proper methodology for using acquired data to make physical inferences - in other words, to prove that we have measured a genuine signal from a new physical process. To illustrate this, we will use examples based on measurements taken at the Aragats Cosmic Ray Observatory [1]. We will provide only minimal information on the detector's operation and refer to data that can be easily downloaded in graphical and numerical formats from the Cosmic Ray Division (CRD) database of the Yerevan Physics Institute (YerPhI) [2]. In Fig. 1, we show the SEVAN detector [3], which is constructed from standard plastic scintillators measuring 50 x 50 x 5 cm³ in size. Between two identical assemblies of 100 x 100 x 5 cm³ scintillators (four standard slabs arranged horizontally) are located two 100 x 100 x 5 cm³ lead absorbers and a thick 50 x 50 x 25 cm³ scintillator stack (5 standard slabs arranged vertically). Light capture cones and photomultipliers (PMTs) are positioned over scintillator

layers. In the upper 5 cm-thick scintillator, charged particles are effectively registered; however, more substance must be used to register neutral particles. When a neutral particle traverses the upper scintillator, usually, no signal is produced. Incoming neutral particles undergo nuclear reactions in the thick 25 cm plastic scintillator, creating charged particles. The absence of the signal in the upper scintillators, coinciding with the signal in the middle scintillator, indicates neutral particle traversal (gamma-ray or neutron). DAQ electronics register and store all logical combinations of the detector signals for further offline analysis and the issuance of online alerts. If we denote by "1" the signal from a scintillator and by "0" the absence of a signal, then the following combinations of the 3-layered detector output are possible: "111" and "101"—traversal of high energy muon; "010"—traversal of a neutral particle; "100"—traversal of low energy charged particle that stopped in the upper scintillator or the first lead absorber (energy less than ≈100 MeV). "110"—traversal of a charged particle of higher energy, which stopped in the second lead absorber. "001"—registration of inclined charged particles or very high-energy gamma rays. DAQ electronics allow the remote control of the PMT high voltage and other parameters. The total weight of the SEVAN detector, including the steel frame and detector housings, is approximately 1.5 tons. Ten SEVAN detectors operate in Armenia, on the mountain tops of Eastern Europe, and in Germany.

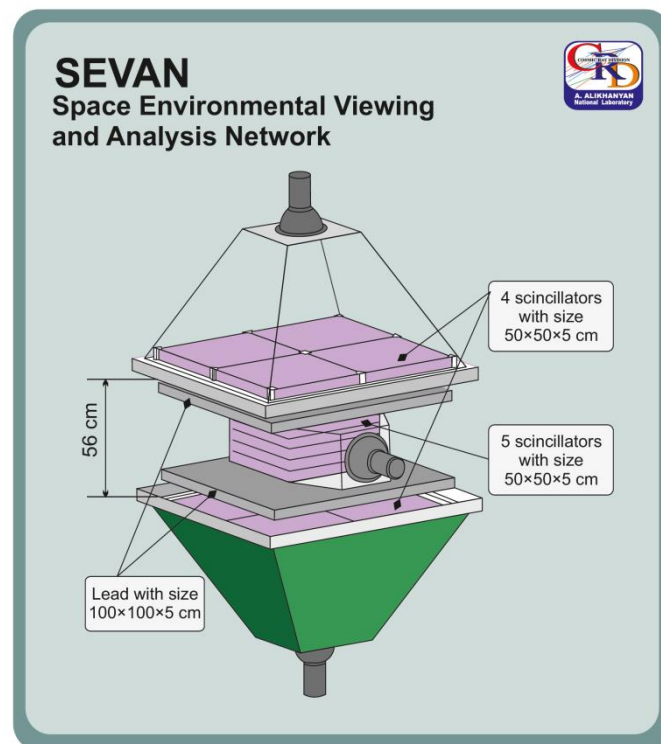


Figure 1. SEVAN detector measuring charged and neutral species of secondary cosmic rays

In April 2023, the SEVAN detector relocated from DESY Zeuthen to the Umwelt-Forschungs-Station Schneefernerhaus (UFS, 2650 m a.s.l.) and was required to be smaller in size and weight to comply with building regulations see Figure 2. As a result, the lower third scintillator setup and lead filters were removed. However, the newly developed electronics board has added a new capability to the SEVAN detector. It now measures the energy spectra of charged and neutral particle fluxes. In this way, the SEVAN at Zugspitze became an advanced detector for solar and high-energy atmospheric physics research. [4]. The SEVAN detector, previously measuring only count rates, has been transformed into a powerful spectrometer capable of measuring different species of secondary cosmic rays from galactic and atmospheric accelerators thanks to the modernized DAQ board. The list of available information from modernized SEVAN will be as follows:

- 1-minute count rates of stacked 5 and 25-cm thick scintillators.

- 1-minute count rates of the coincidences "01", signal only in 25 cm scintillator; "10" – signal only in 5 cm scintillator; "11" – coincidences mentioned above. 1-minute histograms of energy releases stored continuously.

A coincidence of "10" identifies particles that generate a signal in the upper scintillator while bypassing the lower scintillator. Thus, the particle samples and energy release histograms selected by the "10" coincidence will experience an enrichment of charged particles. In contrast, the samples and histograms selected by the "01" coincidence will be enriched by neutral particles. In addition in the upper 5-cm thick scintillator, and "11" – signal in both scintillators.

- Histograms of energy releases in both scintillators. Histograms corresponding to the coinc, the "11" coincidence will select high-energy charged particles, specifically muons and TGE electrons.

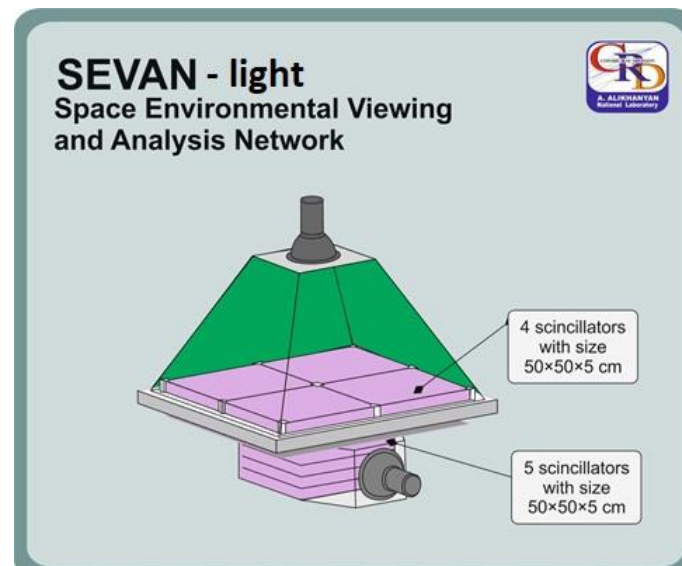


Figure 2. SEVAN_light detector measuring charged and neutral species of secondary cosmic rays and their energy releases

The detector's count rate is affected by various factors, such as its size, location, and registration efficiency. Atmospheric pressure, temperature, NSEF, geomagnetic field, and solar wind also impact the count rate. Additionally, the count rate could be influenced by power supply oscillations, diurnal and seasonal variations, and the random nature of physical processes utilized for particle detection, such as PMT noise. To derive parameters with physical meaning, we must deconvolute the measured count rate to be independent of the detector's specific characteristics, estimate different particle fluxes and energy spectra as they existed before entering the detector, and estimate measurement errors. Analyzing how the particle detector registers elementary particles is essential to ensure accurate results. Without understanding the detector's response, particle flux measurements will be arbitrary, and any physical inference drawn from them will be unreliable. This is known as the direct problem of CR. The ideal approach to solving this issue is through particle beam calibrations on artificial accelerators; however, this option is not always readily available. Alternatively, we can utilize CR flux generators, such as EXPACS (Excel-based Program for calculating Atmospheric Cosmic-ray secondaries Spectrum, <http://phits.jaea.go.jp/expacs/>) [5], to obtain flux data for all CR species across all latitudes, longitudes, and altitudes, in conjunction with the GEANT4 code [6] for particle tracking. However, it's important to remember that the inevitable simplification of a model will affect the recovered particle fluxes and could impact the reliability of any physical inferences drawn from it.

The tables present the purity of the SEVAN detectors obtained using EXPACS and GEANT4 packages. EXPACS provides the flux of all cosmic ray species at the observation point, while GEANT4 follows all particles that enter the detector setup. To determine the particle frequencies, we need to solve the inverse cosmic ray problem by using the measured composition to recover the true one.

Purity and Efficiency in Secondary Cosmic Ray Detection

In this study, the response of SEVAN detectors to different secondary cosmic ray species — including neutrons, protons, muons, electrons, positrons, and gamma rays — was simulated using the **GEANT4** package [7]. The input particle spectra were obtained from the **EXPACS** model, which provides approximate fluxes of secondary cosmic rays for specific geographic locations and atmospheric depths.

The performance of the simulated detector system was evaluated using two standard quantitative parameters: **efficiency** and **purity**.

- **Detection Efficiency** represents the fraction of incoming secondary particles that interact with the detector and produce a measurable signal. It is defined as:

$$\text{Efficiency} = N_{\text{registered}} / N_{\text{hit}} \text{ted}$$

A higher efficiency indicates that a greater proportion of the incident flux is successfully detected and recorded.

- **Purity** describes how accurately the detector identifies the desired particle type among all registered events. It is defined as:

$$\text{Purity} = N_{\text{true}} / N_{\text{total}}$$

where N_{true} is the number of correctly identified particles of a given type, and N_{total} is the total number of registered events.

The purity tables present the percentage of each detected signal type, with each row normalized to 100%. These values, obtained from GEANT4 simulations, provide insight into the contribution of different particle species to each detector signal and coincidence channel.

Beyond characterizing detector performance, the efficiency and purity parameters play a key physical role: they are used to reconstruct the intensity of the various secondary cosmic ray species entering the detector's sensitive volume. Although SEVAN detectors

directly measure count rates (and, in the SEVAN-light version, energy release histograms), the derived efficiency and purity values make it possible to recover the true intensity of incident particles.

By evaluating both purity and efficiency, we ensure that SEVAN detectors provide reliable, quantitatively interpretable data under real environmental conditions and can be used for precise cosmic ray and space weather monitoring across the globe.

The GEANT4 simulations were made by using the following conditions:

1. The particles are dropped at a distance of 10 cm from the center of the detector.
2. The zenith angles are simulated according to $\cos^2.5(\theta)$ and azimuth-uniform in $0 - 2\pi$.
3. The energy range of Secondary Cosmic Rays (SCR) is 1.13 MeV to 1130 MeV.
4. As the GEANT4 input, spectra of secondary cosmic rays, calculated by EXPACS, are used at the incident on the top of the detector or building where the detector is located. These spectra provide a realistic approximation of particle fluxes at the observation level of the detector sites.
5. All particles are then tracked through the detector according to the GEANT4 geometry, and all interactions with the sensitive volumes are analyzed and recorded.
6. For almost all species of secondary cosmic rays (electrons, positrons, positive and negative muons,

gamma rays, protons, and neutrons), 10000 events were simulated for each.

The tables below contain information about registration efficiencies and purities for secondary CRs by (%) for SEVAN detectors located in Armenia, Eastern Europe and Germany.

Information is crucial for understanding of composition and energies of short particle bursts. For instance, from Table 10, we can see that coincidence 111 (signals in all three layers of the detector) is associated with high confidence with the registration of muons with an energy greater than 200 MeV. The purity of the "111" selection is as follows: neutrons (0,1%), protons (0,1%), muons (sum of μ^+ and μ^-) $\sim 98,5\%$, sum of electrons and positrons $\sim 1,1\%$, and gamma rays $\sim 0,1\%$. For minimum-ionizing particles for muons in the relativistic range, the mean energy loss in plastic scintillator is roughly and equal to ≈ 2 MeV per g/cm², so a muon passing through all three layers ("111" coincidence, signals in all layers) means deposits ~ 60 MeV in total only in scintillators and by taking into account the iron housing of the scintillators, aluminum base under 5cm thick scintillators, two layers of lead absorber under 1st and 2nd scintillators each by 4cm thick enable the selection of muons with energy thresholds more than 200MeV. The results obtained by GEANT 4 simulation (described above) are in good agreement with the expectation from predefined energy threshold.

SEVAN Aragats, Armenia, altitude - 3200 m

The materials used in GEANT4 simulation for Aragats station

Iron Roof (Fe) --- 2.5mm (including both iron cover and iron construction)

Wood (brevno) --- 2.0cm

Perlit --- 5.0cm

Iron housing of the scintillator --- 1.0mm

Aluminum base under 5cm thick scintillator --- 6.5mm

Lead absorber --- two layers by 4.0cm each

Table 1. SEVAN Aragats upper 5cm detector efficiency for secondary CRs (%)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.07	0	3.17	2.85	0	0	0
1.42	0.03	0	3.06	3.24	0	0	0
1.79	0.12	0	3.43	3.92	0	0	0
2.25	0.13	0	4.15	4.86	0	0	0
2.84	0.18	0	6.4	2.05	0	0	0
3.57	0.09	0	7.43	1.11	0	0	0
4.5	0.22	0	7.55	1.05	0	0	0.12
5.66	0.77	0	6.9	1.13	0	0.01	0.64
7.13	1.13	0	7.24	1.02	0.01	0	1.41
8.97	1.31	0	7.63	0.98	0.03	0.1	1.97
11.3	1.32	0	8.04	1.16	0.04	0.13	2.51
14.2	1.79	0	8.69	1.06	0.18	0.3	2.79
17.9	1.87	0	8.69	7.27	1.85	2.24	3.99
22.5	2.02	0	9.57	8.71	13.98	12.96	4.43
28.4	2.51	0	10.66	6.33	22.69	21.88	5
35.7	3.04	0.01	23.34	20.47	27.49	26.82	6.25

45	3.28	0.05	36.02	35.63	30.93	28.68	6.79
56.6	4.31	0.03	35.52	35.56	31.85	30.45	7.75
71.3	5.77	0	36.44	34.95	32.54	32.1	8.6
89.7	6.19	21.57	34.91	35.93	33.1	32.16	9.08
113	8.23	33.69	34.58	34.83	34.67	32.91	8.83
142	10.91	35.27	33.96	35.45	33.89	33.72	9.51
179	13.18	34.64	33.93	34.51	34.27	34.62	9.75
225	16.65	35.09	34.22	33.86	34.84	34.75	10.21
284	19.41	35.65	34.2	34.13	35.12	34.77	10.22
357	20.02	34.91	34.1	34.49	35.04	35.1	10.05
450	23.09	36.67	33.96	34.42	36.09	35.6	10
566	26.41	35.58	34.74	33.96	35.87	35.68	10.66
713	29.1	35.91	34.15	33.01	35.22	36.05	10.84
897	31.15	35.99	33.24	34.34	36.21	34.71	11.14
1130	34.33	35.58	34.11	34.62	35.69	35.27	10.58

Table 1. SEVAN Aragats upper 5cm detector purity for secondary CRs (%)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	1.15	0.00	52.05	46.80	0.00	0.00	0.00
1.42	0.47	0.00	48.34	51.18	0.00	0.00	0.00
1.79	1.61	0.00	45.92	52.48	0.00	0.00	0.00
2.25	1.42	0.00	45.40	53.17	0.00	0.00	0.00
2.84	2.09	0.00	74.16	23.75	0.00	0.00	0.00
3.57	1.04	0.00	86.10	12.86	0.00	0.00	0.00
4.5	2.46	0.00	84.45	11.74	0.00	0.00	1.34
5.66	8.15	0.00	73.02	11.96	0.00	0.11	6.77
7.13	10.45	0.00	66.98	9.44	0.09	0.00	13.04
8.97	10.90	0.00	63.48	8.15	0.25	0.83	16.39
11.3	10.00	0.00	60.91	8.79	0.30	0.98	19.02
14.2	12.09	0.00	58.68	7.16	1.22	2.03	18.84
17.9	7.22	0.00	33.54	28.06	7.14	8.65	15.40
22.5	3.91	0.00	18.52	16.86	27.06	25.08	8.57
28.4	3.63	0.00	15.43	9.16	32.85	31.68	7.24
35.7	2.83	0.01	21.73	19.06	25.59	24.97	5.82
45	2.32	0.04	25.48	25.20	21.88	20.29	4.80
56.6	2.96	0.02	24.42	24.44	21.89	20.93	5.33
71.3	3.84	0.00	24.23	23.23	21.63	21.34	5.72
89.7	3.58	12.47	20.19	20.77	19.14	18.59	5.25
113	4.38	17.94	18.42	18.55	18.47	17.53	4.70
142	5.66	18.30	17.62	18.39	17.58	17.49	4.93
179	6.76	17.76	17.39	17.69	17.57	17.75	5.00
225	8.33	17.55	17.12	16.94	17.43	17.38	5.11
284	9.49	17.43	16.72	16.68	17.17	16.99	5.00
357	8.74	15.25	14.89	15.06	15.30	15.33	4.39
450	9.40	14.93	13.82	14.01	14.69	14.49	4.07
566	10.55	14.22	13.88	13.57	14.33	14.26	4.26
713	11.54	14.24	13.54	13.09	13.96	14.29	4.30
897	12.25	14.15	13.07	13.50	14.24	13.65	4.38
1130	13.28	13.76	13.19	13.39	13.80	13.64	4.09

Table 2. SEVAN Aragats middle 20cm detector efficiency for secondary CRs (%)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0	0	0.03	0.01	0	0	0
1.42	0	0	0.01	0.02	0	0	0
1.79	0	0	0.03	0	0	0	0

2.25	0.01	0	0.05	0.02	0	0	0
2.84	0	0	0.02	0.05	0	0	0
3.57	0	0	0.04	0.01	0	0	0
4.5	0.02	0	0.04	0.08	0	0	0
5.66	0.11	0	0.03	0.08	0	0	0.07
7.13	0.2	0	0.05	0.07	0	0	0.18
8.97	0.24	0	0.01	0.06	0	0.02	0.21
11.3	0.31	0	0.05	0.07	0	0.01	0.2
14.2	0.37	0	0.06	0.07	0.01	0.03	0.27
17.9	0.35	0	0.05	0.08	0.03	0.06	0.3
22.5	0.4	0	0.05	0.11	0.04	0.1	0.32
28.4	0.78	0	0.02	0.07	0.02	0.13	0.56
35.7	0.86	0	0.08	0.18	0.1	0.14	0.71
45	0.99	0.01	0.1	0.13	0.26	0.24	0.91
56.6	1.43	0.01	0.09	0.65	0.33	0.39	1.36
71.3	1.85	0.02	0.16	1.15	0.67	0.82	1.93
89.7	1.9	0.02	0.7	1.78	1.07	1.13	2.5
113	1.72	0.05	4.21	4.65	2.12	2.29	3.27
142	2.37	0.17	9.85	10.12	2.99	3.27	4.85
179	2.75	0.33	9.64	8.97	4.75	4.74	6.45
225	3.14	1.12	9.64	8.93	6.12	6.11	7.66
284	4.51	8.89	9.37	9.12	7.77	8.05	9.48
357	5.05	8.94	9.39	8.96	9.71	9.83	10.57
450	6.86	10.72	9.17	9.62	11.37	11.35	12.08
566	7.93	10.54	9.65	8.88	12.68	12.62	12.76
713	9.41	11.43	9.4	8.65	13.8	14.15	14.44
897	11.5	11.66	8.71	9.4	15.67	15.07	15.48
1130	13.27	12.69	9.32	9.03	16.28	16.51	16.76

Table 3. SEVAN Aragats middle 20cm detector purity for secondary CRs (%)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.00	0.00	75.00	25.00	0.00	0.00	0.00
1.42	0.00	0.00	33.33	66.67	0.00	0.00	0.00
1.79	0.00	0.00	100.00	0.00	0.00	0.00	0.00
2.25	12.50	0.00	62.50	25.00	0.00	0.00	0.00
2.84	0.00	0.00	28.57	71.43	0.00	0.00	0.00
3.57	0.00	0.00	80.00	20.00	0.00	0.00	0.00
4.5	14.29	0.00	28.57	57.14	0.00	0.00	0.00
5.66	37.93	0.00	10.34	27.59	0.00	0.00	24.14
7.13	40.00	0.00	10.00	14.00	0.00	0.00	36.00
8.97	44.44	0.00	1.85	11.11	0.00	3.70	38.89
11.3	48.44	0.00	7.81	10.94	0.00	1.56	31.25
14.2	45.68	0.00	7.41	8.64	1.23	3.70	33.33
17.9	40.23	0.00	5.75	9.20	3.45	6.90	34.48
22.5	39.22	0.00	4.90	10.78	3.92	9.80	31.37
28.4	49.37	0.00	1.27	4.43	1.27	8.23	35.44
35.7	41.55	0.00	3.86	8.70	4.83	6.76	34.30
45	37.50	0.38	3.79	4.92	9.85	9.09	34.47
56.6	33.57	0.23	2.11	15.26	7.75	9.15	31.92
71.3	28.03	0.30	2.42	17.42	10.15	12.42	29.24
89.7	20.86	0.22	7.68	19.54	11.75	12.40	27.44
113	9.39	0.27	22.98	25.38	11.57	12.50	17.85
142	7.05	0.51	29.29	30.09	8.89	9.72	14.42
179	7.30	0.88	25.60	23.82	12.62	12.59	17.13

225	7.35	2.62	22.57	20.90	14.33	14.30	17.93
284	7.88	15.53	16.37	15.94	13.58	14.07	16.56
357	8.06	14.27	14.99	14.30	15.50	15.69	16.87
450	9.58	14.97	12.81	13.44	15.88	15.85	16.87
566	10.33	13.73	12.57	11.57	16.52	16.44	16.62
713	11.13	13.52	11.12	10.23	16.32	16.73	17.08
897	12.38	12.55	9.38	10.12	16.87	16.22	16.66
1130	12.38	11.83	8.69	8.42	15.18	15.40	15.63

Table 4. SEVAN Aragats upper 5cm detector efficiency for secondary CRs by (%) for coincidence (100)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.07	0	3.14	2.85	0	0	0
1.42	0.03	0	3.05	3.23	0	0	0
1.79	0.12	0	3.41	3.92	0	0	0
2.25	0.13	0	4.12	4.86	0	0	0
2.84	0.18	0	6.38	2.04	0	0	0
3.57	0.09	0	7.39	1.11	0	0	0
4.5	0.22	0	7.53	1.05	0	0	0.12
5.66	0.77	0	6.88	1.12	0	0.01	0.64
7.13	1.13	0	7.22	1.02	0.01	0	1.41
8.97	1.31	0	7.62	0.97	0.03	0.1	1.97
11.3	1.32	0	8	1.16	0.04	0.13	2.51
14.2	1.78	0	8.67	1.06	0.18	0.3	2.79
17.9	1.85	0	8.65	7.24	1.85	2.24	3.99
22.5	2.02	0	9.53	8.67	13.98	12.96	4.42
28.4	2.46	0	10.65	6.3	22.68	21.86	5
35.7	3.01	0.01	23.3	20.4	27.45	26.75	6.23
45	3.22	0.04	35.92	35.52	30.76	28.51	6.76
56.6	4.25	0.03	35.43	34.94	31.59	30.16	7.7
71.3	5.54	0	36.29	33.81	31.98	31.43	8.49
89.7	5.89	21.57	34.22	34.22	32.16	31.24	8.95
113	7.91	33.67	30.9	30.61	32.83	30.94	8.54
142	10.33	35.15	24.74	25.55	31.19	30.8	8.98
179	12.41	34.36	17.92	18.83	29.8	30.43	8.64
225	15.3	34.33	14.93	15.11	29.15	29.09	9.03
284	17.05	27.07	15.28	15.13	27.67	27.27	8.32
357	17.01	20.21	14.8	15.23	25.62	25.78	7.61
450	18.42	18.89	15.19	15.34	24.87	24.56	7.26
566	20.65	17.94	15.26	15.1	23.27	23.03	7.14
713	21.2	17.28	15.27	14.49	21.25	21.94	6.94
897	20.87	16.41	14.83	15.02	20.13	19.07	6.7
1130	20.55	15.61	14.92	15.09	18.5	18.23	5.87

Table 5. SEVAN Aragats upper 5cm detector purity for secondary CRs by (%) for coincidence (100)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	1.16	0.00	51.82	47.03	0.00	0.00	0.00
1.42	0.48	0.00	48.34	51.19	0.00	0.00	0.00
1.79	1.61	0.00	45.77	52.62	0.00	0.00	0.00
2.25	1.43	0.00	45.23	53.35	0.00	0.00	0.00
2.84	2.09	0.00	74.19	23.72	0.00	0.00	0.00
3.57	1.05	0.00	86.03	12.92	0.00	0.00	0.00
4.5	2.47	0.00	84.42	11.77	0.00	0.00	1.35
5.66	8.17	0.00	73.04	11.89	0.00	0.11	6.79
7.13	10.47	0.00	66.91	9.45	0.09	0.00	13.07
8.97	10.92	0.00	63.50	8.08	0.25	0.83	16.42

11.3	10.03	0.00	60.79	8.81	0.30	0.99	19.07
14.2	12.04	0.00	58.66	7.17	1.22	2.03	18.88
17.9	7.16	0.00	33.50	28.04	7.16	8.68	15.45
22.5	3.92	0.00	18.48	16.81	27.10	25.13	8.57
28.4	3.57	0.00	15.45	9.14	32.89	31.70	7.25
35.7	2.81	0.01	21.75	19.04	25.62	24.97	5.81
45	2.29	0.03	25.52	25.24	21.86	20.26	4.80
56.6	2.95	0.02	24.59	24.25	21.92	20.93	5.34
71.3	3.75	0.00	24.60	22.92	21.68	21.30	5.75
89.7	3.50	12.82	20.34	20.34	19.11	18.57	5.32
113	4.51	19.20	17.62	17.45	18.72	17.64	4.87
142	6.20	21.08	14.84	15.32	18.71	18.47	5.39
179	8.14	22.55	11.76	12.36	19.56	19.97	5.67
225	10.41	23.36	10.16	10.28	19.84	19.80	6.15
284	12.37	19.65	11.09	10.98	20.08	19.79	6.04
357	13.47	16.01	11.72	12.06	20.29	20.42	6.03
450	14.79	15.17	12.20	12.32	19.97	19.72	5.83
566	16.87	14.66	12.47	12.34	19.01	18.82	5.83
713	17.91	14.60	12.90	12.24	17.95	18.54	5.86
897	18.46	14.52	13.12	13.29	17.81	16.87	5.93
1130	18.89	14.35	13.72	13.87	17.01	16.76	5.40

Table 6. SEVAN Aragats middle 25cm detector efficiency for secondary CRs by (%) for coincidence (010)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0	0	0	0.01	0	0	0
1.42	0	0	0	0.02	0	0	0
1.79	0	0	0.01	0	0	0	0
2.25	0.01	0	0.02	0.02	0	0	0
2.84	0	0	0.01	0.04	0	0	0
3.57	0	0	0.01	0.01	0	0	0
4.5	0.02	0	0.02	0.08	0	0	0
5.66	0.11	0	0.02	0.07	0	0	0.07
7.13	0.2	0	0.03	0.07	0	0	0.18
8.97	0.24	0	0	0.05	0	0.02	0.21
11.3	0.31	0	0.01	0.07	0	0.01	0.2
14.2	0.36	0	0.04	0.07	0.01	0.03	0.27
17.9	0.33	0	0.02	0.05	0.03	0.06	0.3
22.5	0.4	0	0.01	0.07	0.04	0.1	0.31
28.4	0.73	0	0.01	0.04	0.02	0.11	0.56
35.7	0.83	0	0.04	0.11	0.06	0.07	0.69
45	0.92	0	0.01	0.03	0.1	0.07	0.88
56.6	1.37	0.01	0.01	0.05	0.1	0.1	1.31
71.3	1.55	0.02	0.02	0.04	0.13	0.15	1.82
89.7	1.59	0.02	0.04	0.1	0.16	0.26	2.35
113	1.35	0.03	0.56	0.48	0.32	0.37	2.96
142	1.73	0.07	0.72	0.66	0.36	0.42	4.28
179	2	0.06	0.72	0.61	0.48	0.66	5.31
225	1.73	0.41	0.19	0.17	0.54	0.61	6.39
284	2.11	0.41	0.02	0.06	0.53	0.75	7.45
357	1.93	0.43	0.05	0.04	0.54	0.9	7.82
450	2.3	0.27	0.07	0.1	0.65	0.67	8.68
566	2.4	0.27	0.12	0.11	0.78	0.63	8.51
713	2.07	0.27	0.12	0.19	0.66	0.82	9.12

897	2.19	0.23	0.13	0.11	0.68	0.73	8.83
1130	1.47	0.21	0.11	0.1	0.45	0.72	8.48

Table 7. SEVAN Aragats middle 25cm detector purity for secondary CRs by (%) for coincidence (010)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.00	0.00	0.00	100.00	0.00	0.00	0.00
1.42	0.00	0.00	0.00	100.00	0.00	0.00	0.00
1.79	0.00	0.00	100.00	0.00	0.00	0.00	0.00
2.25	20.00	0.00	40.00	40.00	0.00	0.00	0.00
2.84	0.00	0.00	20.00	80.00	0.00	0.00	0.00
3.57	0.00	0.00	50.00	50.00	0.00	0.00	0.00
4.5	16.67	0.00	16.67	66.67	0.00	0.00	0.00
5.66	40.74	0.00	7.41	25.93	0.00	0.00	25.93
7.13	41.67	0.00	6.25	14.58	0.00	0.00	37.50
8.97	46.15	0.00	0.00	9.62	0.00	3.85	40.38
11.3	51.67	0.00	1.67	11.67	0.00	1.67	33.33
14.2	46.15	0.00	5.13	8.97	1.28	3.85	34.62
17.9	41.77	0.00	2.53	6.33	3.80	7.59	37.97
22.5	43.01	0.00	1.08	7.53	4.30	10.75	33.33
28.4	49.66	0.00	0.68	2.72	1.36	7.48	38.10
35.7	46.11	0.00	2.22	6.11	3.33	3.89	38.33
45	45.77	0.00	0.50	1.49	4.98	3.48	43.78
56.6	46.44	0.34	0.34	1.69	3.39	3.39	44.41
71.3	41.55	0.54	0.54	1.07	3.49	4.02	48.79
89.7	35.10	0.44	0.88	2.21	3.53	5.74	51.88
113	22.20	0.49	9.21	7.89	5.26	6.09	48.68
142	20.97	0.85	8.73	8.00	4.36	5.09	51.88
179	20.28	0.61	7.30	6.19	4.87	6.69	53.85
225	17.23	4.08	1.89	1.69	5.38	6.08	63.65
284	18.56	3.61	0.18	0.53	4.66	6.60	65.52
357	16.33	3.64	0.42	0.34	4.57	7.61	66.16
450	17.90	2.10	0.54	0.78	5.06	5.21	67.55
566	18.40	2.07	0.92	0.84	5.98	4.83	65.26
713	15.44	2.01	0.89	1.42	4.92	6.11	68.01
897	16.45	1.73	0.98	0.83	5.11	5.48	66.34
1130	12.34	1.76	0.92	0.84	3.78	6.05	71.20

Table 8. SEVAN Aragats upper 5cm detector efficiency for secondary CRs by (%) for coincidence (111)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
89.7	0	0	0	0	0	0	0
113	0.01	0	0	0.01	0	0.01	0
142	0	0	0.01	0.06	0.02	0.01	0
179	0	0	0.17	0.4	0.01	0.01	0
225	0.01	0.01	5.22	5.07	0.06	0.06	0.02
284	0.04	0.02	8.22	7.95	0.07	0.1	0.03
357	0.09	0.52	8.05	7.62	0.13	0.21	0.09
450	0.29	4.86	7.7	8.33	0.44	0.37	0.07
566	0.54	5.4	8.4	7.47	0.61	0.71	0.1
713	1.02	6.11	8.11	7.19	0.94	1.15	0.29
897	1.84	6.6	7.4	7.85	1.82	1.93	0.49
1130	3.18	7.44	7.91	7.98	3.17	2.73	0.73

Table 9. SEVAN Aragats upper 5cm detector purity for secondary CRs by (%) for coincidence (111)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
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89.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00
113	33.33	0.00	0.00	33.33	0.00	33.33	0.00
142	0.00	0.00	10.00	60.00	20.00	10.00	0.00
179	0.00	0.00	28.81	67.80	1.69	1.69	0.00
225	0.10	0.10	49.95	48.52	0.57	0.57	0.19
284	0.24	0.12	50.03	48.39	0.43	0.61	0.18
357	0.54	3.11	48.17	45.60	0.78	1.26	0.54
450	1.31	22.03	34.90	37.76	1.99	1.68	0.32
566	2.32	23.25	36.16	32.16	2.63	3.06	0.43
713	4.11	24.63	32.69	28.98	3.79	4.64	1.17
897	6.59	23.63	26.49	28.11	6.52	6.91	1.75
1130	9.60	22.45	23.87	24.08	9.57	8.24	2.20

SEVAN Aragats (without lead), Armenia, altitude - 3200 m

The materials used in GEANT4 simulation for Aragats station

Iron Roof (Fe) --- 2.5mm (including both iron cover and iron construction)

Wood (brevno) --- 2.0cm

Perlit --- 5.0cm

Iron housing of the scintillator --- 1.0mm

Aluminum base under 5cm thick scintillator --- 6.5mm

Table 10. SEVAN Aragats (without lead) upper 5cm detector efficiency for secondary CRs (%)

Energy	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.01	0	3.36	2.58	0	0	0
1.42	0	0	3.35	2.61	0	0	0
1.79	0	0	3.8	2.99	0	0	0
2.25	0	0	4.36	3.81	0	0	0
2.84	0.02	0	4.96	1.85	0	0	0
3.57	0.03	0	5.34	0.86	0	0	0
4.5	0.01	0	5.32	0.67	0	0	0
5.66	0.04	0	5.08	0.49	0	0	0.03
7.13	0.28	0	5.93	0.64	0	0	0.22
8.97	0.65	0	5.76	0.57	0	0.01	0.9
11.3	0.68	0	6.43	0.79	0	0.01	1.26
14.2	0.82	0	6.8	1.29	0.04	0.05	2.1
17.9	1.04	0	7.7	5.31	0.26	0.22	2.93
22.5	1.28	0	8.02	7.13	5.6	5.83	3.81
28.4	1.97	0	8.35	6.49	16.04	15.67	4.48
35.7	2.28	0	19.95	14.46	23.27	22.54	5.56
45	3.04	0.01	40.84	38.18	26.64	24.56	6.83
56.6	3.47	0	38.32	37.9	29.18	27.41	7.9
71.3	4.2	0.02	37.4	37.41	29.92	27.49	8.21
89.7	5.56	11.76	36.31	36.15	31.3	29.54	8.37
113	6.7	36.64	35.04	34.33	30.98	30.28	9.12
142	9.03	38.35	33.45	32.85	32.68	31.15	9.19
179	11.81	37.51	32.1	32.64	33.02	31.47	9.48
225	15.07	38.31	31.2	30.76	32.79	32.48	9.8
284	16.34	36.8	30.13	30.92	32.63	32.64	10.48
357	19.04	38.81	31.34	30.97	33.35	33.26	9.97
450	20.98	38.21	30.29	29.36	33.31	33.11	10.5
566	23.85	36.64	29.49	30.59	33.97	33.92	10.96
713	27.53	35.89	31.01	29.28	34.86	33.14	11.08
897	30.43	35.5	31.23	31.63	33.46	34.1	10.95
1130	33.14	35.59	30.25	30.92	34.03	34.46	11.63

Table 11. SEVAN Aragats (without lead) upper 5cm detector purity for secondary CRs (%)

Energy	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.17	0.00	56.47	43.36	0.00	0.00	0.00
1.42	0.00	0.00	56.21	43.79	0.00	0.00	0.00
1.79	0.00	0.00	55.96	44.04	0.00	0.00	0.00
2.25	0.00	0.00	53.37	46.63	0.00	0.00	0.00
2.84	0.29	0.00	72.62	27.09	0.00	0.00	0.00
3.57	0.48	0.00	85.71	13.80	0.00	0.00	0.00
4.5	0.17	0.00	88.67	11.17	0.00	0.00	0.00
5.66	0.71	0.00	90.07	8.69	0.00	0.00	0.53
7.13	3.96	0.00	83.88	9.05	0.00	0.00	3.11
8.97	8.24	0.00	73.00	7.22	0.00	0.13	11.41
11.3	7.42	0.00	70.12	8.62	0.00	0.11	13.74
14.2	7.39	0.00	61.26	11.62	0.36	0.45	18.92
17.9	5.96	0.00	44.10	30.41	1.49	1.26	16.78
22.5	4.04	0.00	25.32	22.51	17.68	18.41	12.03
28.4	3.72	0.00	15.75	12.25	30.26	29.57	8.45
35.7	2.59	0.00	22.66	16.42	26.43	25.60	6.31
45	2.17	0.01	29.15	27.25	19.01	17.53	4.88
56.6	2.41	0.00	26.58	26.28	20.24	19.01	5.48
71.3	2.90	0.01	25.85	25.86	20.68	19.00	5.68
89.7	3.50	7.40	22.83	22.73	19.68	18.58	5.26
113	3.66	20.01	19.13	18.75	16.92	16.53	4.98
142	4.84	20.54	17.91	17.59	17.50	16.68	4.92
179	6.28	19.94	17.06	17.35	17.55	16.73	5.04
225	7.90	20.08	16.36	16.12	17.19	17.03	5.14
284	8.56	19.28	15.78	16.20	17.09	17.10	5.49
357	8.95	18.24	14.73	14.55	15.67	15.63	4.68
450	8.93	16.26	12.89	12.49	14.18	14.09	4.47
566	9.94	15.26	12.29	12.74	14.15	14.13	4.57
713	11.28	14.71	12.71	12.00	14.28	13.58	4.54
897	12.26	14.30	12.58	12.74	13.48	13.74	4.41
1130	13.15	14.12	12.00	12.27	13.50	13.67	4.61

Table 12. SEVAN Aragats (without lead) middle 20cm detector efficiency for secondary CRs (%)

Energy	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.01	0	0.24	0.21	0	0	0
1.42	0.01	0	0.42	0.29	0	0	0
1.79	0.01	0	0.41	0.23	0	0	0
2.25	0	0	0.51	0.35	0	0	0
2.84	0.01	0	0.59	0.17	0	0	0
3.57	0	0	0.68	0.12	0	0	0
4.5	0.03	0	0.58	0.07	0	0	0
5.66	0.05	0	0.49	0.08	0	0	0.14
7.13	0.07	0	0.65	0.16	0	0	0.37
8.97	0.15	0	0.63	0.04	0.02	0	1.01
11.3	0.24	0	0.79	0.07	0.01	0.01	1.44
14.2	0.35	0	0.87	0.21	0.05	0.08	1.83
17.9	0.45	0	0.78	0.63	0.09	0.18	2.06
22.5	0.39	0	1.14	0.77	0.09	0.17	2.29
28.4	0.73	0	1.34	0.79	0.49	0.44	2.27
35.7	1.04	0	2.56	1.26	1.34	1.69	2.55
45	1.36	0.02	3.41	3.18	4.55	4.74	3.17
56.6	1.59	0.01	7.14	5.54	6.73	6.47	3.36

71.3	1.97	0	10.05	9.47	8.16	7.51	3.97
89.7	2.03	0.04	9.86	9.49	8.92	8.01	4.56
113	2.65	0.45	9.79	9.61	8.51	8.83	4.49
142	2.78	5.96	9.47	9.51	9.22	9.31	4.72
179	3.48	8.72	9.33	9.88	9.23	8.93	4.92
225	4.21	9.56	9.34	9.05	9.75	9.59	4.74
284	5.43	9.18	9.25	9.41	9.96	9.54	4.83
357	5.96	9.89	9.72	10.13	9.78	9.2	4.76
450	7.31	9.99	9.29	9.42	9.79	10.16	5.1
566	8.8	9.27	9.52	9.33	10.14	9.63	5.21
713	10.5	9.76	9.74	9.31	10.2	9.84	4.93
897	11.88	10.33	9.48	9.96	9.83	10.02	5.07
1130	30.04	95.3	99.98	100	99.48	99.18	52.74

Table 13. SEVAN Aragats (without lead) middle 20cm detector purity for secondary CRs (%)

Energy	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	2.17	0.00	52.17	45.65	0.00	0.00	0.00
1.42	1.39	0.00	58.33	40.28	0.00	0.00	0.00
1.79	1.54	0.00	63.08	35.38	0.00	0.00	0.00
2.25	0.00	0.00	59.30	40.70	0.00	0.00	0.00
2.84	1.30	0.00	76.62	22.08	0.00	0.00	0.00
3.57	0.00	0.00	85.00	15.00	0.00	0.00	0.00
4.5	4.41	0.00	85.29	10.29	0.00	0.00	0.00
5.66	6.58	0.00	64.47	10.53	0.00	0.00	18.42
7.13	5.60	0.00	52.00	12.80	0.00	0.00	29.60
8.97	8.11	0.00	34.05	2.16	1.08	0.00	54.59
11.3	9.38	0.00	30.86	2.73	0.39	0.39	56.25
14.2	10.32	0.00	25.66	6.19	1.47	2.36	53.98
17.9	10.74	0.00	18.62	15.04	2.15	4.30	49.16
22.5	8.04	0.00	23.51	15.88	1.86	3.51	47.22
28.4	12.05	0.00	22.11	13.04	8.09	7.26	37.46
35.7	9.96	0.00	24.52	12.07	12.84	16.19	24.43
45	6.66	0.10	16.69	15.57	22.27	23.20	15.52
56.6	5.16	0.03	23.15	17.96	21.82	20.98	10.89
71.3	4.79	0.00	24.43	23.02	19.84	18.26	9.65
89.7	4.73	0.09	22.98	22.12	20.79	18.67	10.63
113	5.98	1.01	22.08	21.67	19.19	19.91	10.13
142	5.45	11.69	18.58	18.66	18.09	18.27	9.26
179	6.38	16.00	17.12	18.13	16.93	16.38	9.03
225	7.48	16.98	16.59	16.07	17.31	17.03	8.42
284	9.41	15.91	16.03	16.31	17.26	16.53	8.37
357	9.98	16.56	16.27	16.96	16.37	15.40	7.97
450	11.71	16.00	14.88	15.09	15.68	16.27	8.17
566	12.66	13.34	13.70	13.43	14.59	13.86	7.50
713	14.00	13.01	12.99	12.41	13.60	13.12	6.57
897	15.30	13.30	12.21	12.82	12.66	12.90	6.53
1130	16.54	13.48	11.95	11.63	12.45	12.24	6.69

Table 14. SEVAN Aragats (without lead) upper 5cm detector efficiency for secondary CRs by (%) for coincidence (100)

Energy	neutron	proton	Mu+	Mu-	electron	positron	gamma
0.01	0	3.04	2.3	0	0	0	0
0	0	2.9	2.37	0	0	0	0
0	0	3.29	2.72	0	0	0	0
0	0	3.93	3.47	0	0	0	0
0.02	0	4.46	1.74	0	0	0	0
0.03	0	4.75	0.79	0	0	0	0

0.01	0	4.81	0.66	0	0	0	0
0.04	0	4.6	0.44	0	0	0.03	0.1
0.28	0	5.28	0.58	0	0	0.22	0.96
0.65	0	5.16	0.51	0	0.01	0.9	2.44
0.68	0	5.66	0.74	0	0.01	1.26	4.33
0.81	0	5.74	1.12	0.04	0.05	2.1	6.31
1.04	0	6.69	4.6	0.26	0.22	2.92	7.8
1.26	0	6.72	6.04	5.6	5.82	3.74	9.7
1.94	0	6.76	5.5	16.01	15.62	4.3	10.24
2.22	0	16.61	12.62	22.44	21.65	4.83	10.5
2.99	0.01	36.11	33.62	21.18	19.67	5.46	8.68
3.37	0	28.2	31.1	19.33	17.94	5.57	5.6
3.98	0.02	16.18	16.62	16.93	15.94	5.12	3.53
5.25	11.76	14.56	14.78	16.17	15.39	4.29	1.78
6.26	36.61	15.01	14.13	15.27	14.77	4.24	0.92
8.19	30.65	14.14	13.97	15.02	14.6	3.9	0.46
10.12	17.86	14.08	13.99	14.46	14.1	4.13	0.35
11.84	17.43	13.62	13.49	14.28	14.02	3.88	0.29
11.97	15.78	12.77	13.39	13.51	14.43	4.33	0.22
13.28	16.76	13.58	13.43	13.98	14.31	3.82	0.11
13.67	16.33	13.01	12.88	13.3	13.65	4.02	0.14
14.7	15.88	12.97	13.42	13.86	14.21	4.15	0.08
15.2	15.23	13.23	12.15	14.32	13.43	4.47	0.05
15.28	14.5	13.39	13.53	13.36	13.57	4.3	0.03
15.16	14.55	12.65	13.31	13.65	14.12	4.18	0.03

Table 15. SEVAN Aragats (without lead) upper 5cm detector purity for secondary CRs by (%) for coincidence (100)

Energy	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.19	0.00	56.82	42.99	0.00	0.00	0.00
1.42	0.00	0.00	55.03	44.97	0.00	0.00	0.00
1.79	0.00	0.00	54.74	45.26	0.00	0.00	0.00
2.25	0.00	0.00	53.11	46.89	0.00	0.00	0.00
2.84	0.32	0.00	71.70	27.97	0.00	0.00	0.00
3.57	0.54	0.00	85.28	14.18	0.00	0.00	0.00
4.5	0.18	0.00	87.77	12.04	0.00	0.00	0.00
5.66	0.78	0.00	90.02	8.61	0.00	0.00	0.59
7.13	4.40	0.00	83.02	9.12	0.00	0.00	3.46
8.97	8.99	0.00	71.37	7.05	0.00	0.14	12.45
11.3	8.14	0.00	67.78	8.86	0.00	0.12	15.09
14.2	8.22	0.00	58.22	11.36	0.41	0.51	21.30
17.9	6.61	0.00	42.53	29.24	1.65	1.40	18.56
22.5	4.32	0.00	23.03	20.70	19.19	19.95	12.82
28.4	3.87	0.00	13.48	10.97	31.94	31.16	8.58
35.7	2.76	0.00	20.67	15.70	27.92	26.94	6.01
45	2.51	0.01	30.33	28.24	17.79	16.52	4.59
56.6	3.19	0.00	26.72	29.47	18.32	17.00	5.28
71.3	5.32	0.03	21.63	22.22	22.63	21.31	6.84
89.7	6.38	14.30	17.71	17.97	19.66	18.72	5.22
113	5.89	34.43	14.12	13.29	14.36	13.89	3.99
142	8.15	30.50	14.07	13.90	14.95	14.53	3.88
179	11.39	20.11	15.85	15.75	16.28	15.87	4.65
225	13.32	19.60	15.32	15.17	16.06	15.77	4.36
284	13.74	18.12	14.66	15.37	15.51	16.57	4.97
357	12.65	15.96	12.93	12.79	13.32	13.63	3.64

450	10.96	13.10	10.44	10.33	10.67	10.95	3.22
566	12.39	13.38	10.93	11.31	11.68	11.98	3.50
713	14.38	14.40	12.51	11.49	13.54	12.70	4.23
897	14.60	13.85	12.79	12.92	12.76	12.96	4.11
1130	14.56	13.98	12.15	12.78	13.11	13.56	4.01

Table 16. SEVAN Aragats (without lead) middle 20cm detector efficiency for secondary CRs by (%) for coincidence (010)

Energy	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.01	0	0.09	0.09	0	0	0
1.42	0.01	0	0.19	0.13	0	0	0
1.79	0.01	0	0.11	0.07	0	0	0
2.25	0	0	0.23	0.16	0	0	0
2.84	0.01	0	0.25	0.1	0	0	0
3.57	0	0	0.26	0.08	0	0	0
4.5	0.03	0	0.19	0.06	0	0	0
5.66	0.05	0	0.24	0.05	0	0	0.14
7.13	0.07	0	0.17	0.13	0	0	0.37
8.97	0.15	0	0.28	0.01	0.02	0	1.01
11.3	0.24	0	0.25	0.05	0.01	0.01	1.44
14.2	0.35	0	0.24	0.1	0.05	0.08	1.83
17.9	0.44	0	0.21	0.22	0.09	0.17	2.03
22.5	0.37	0	0.23	0.25	0.09	0.17	2.19
28.4	0.7	0	0.25	0.2	0.49	0.41	2.01
35.7	0.96	0	0.41	0.22	0.69	1.04	1.82
45	1.25	0.02	0.28	0.23	1.31	1.66	1.81
56.6	1.47	0.01	0.43	0.37	1.77	1.8	1.5
71.3	1.74	0	0.63	0.66	1.85	1.71	1.22
89.7	1.7	0.04	0.8	0.68	1.58	1.44	0.9
113	2.14	0.42	0.39	0.28	0.99	1.01	0.47
142	1.92	0.52	0.11	0.12	0.75	0.89	0.3
179	2.19	0.4	0.15	0.16	0.54	0.59	0.36
225	1.99	0.43	0.21	0.26	0.37	0.39	0.19
284	2.46	0.3	0.23	0.23	0.31	0.27	0.13
357	2.08	0.28	0.24	0.33	0.3	0.17	0.15
450	2.22	0.24	0.31	0.26	0.22	0.23	0.07
566	2.34	0.26	0.26	0.34	0.21	0.16	0.04
713	2.01	0.27	0.27	0.33	0.11	0.19	0.05
897	1.77	0.34	0.24	0.27	0.17	0.19	0.06
1130	1.66	0.42	0.31	0.32	0.11	0.1	0.03

Table 17. SEVAN Aragats (without lead) middle 20cm detector purity for secondary CRs by (%) for coincidence (010)

Energy	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	5.26	0.00	47.37	47.37	0.00	0.00	0.00
1.42	3.03	0.00	57.58	39.39	0.00	0.00	0.00
1.79	5.26	0.00	57.89	36.84	0.00	0.00	0.00
2.25	0.00	0.00	58.97	41.03	0.00	0.00	0.00
2.84	2.78	0.00	69.44	27.78	0.00	0.00	0.00
3.57	0.00	0.00	76.47	23.53	0.00	0.00	0.00
4.5	10.71	0.00	67.86	21.43	0.00	0.00	0.00
5.66	10.42	0.00	50.00	10.42	0.00	0.00	29.17
7.13	9.46	0.00	22.97	17.57	0.00	0.00	50.00
8.97	10.20	0.00	19.05	0.68	1.36	0.00	68.71
11.3	12.00	0.00	12.50	2.50	0.50	0.50	72.00

14.2	13.21	0.00	9.06	3.77	1.89	3.02	69.06
17.9	13.92	0.00	6.65	6.96	2.85	5.38	64.24
22.5	11.21	0.00	6.97	7.58	2.73	5.15	66.36
28.4	17.24	0.00	6.16	4.93	12.07	10.10	49.51
35.7	18.68	0.00	7.98	4.28	13.42	20.23	35.41
45	19.05	0.30	4.27	3.51	19.97	25.30	27.59
56.6	20.00	0.14	5.85	5.03	24.08	24.49	20.41
71.3	22.28	0.00	8.07	8.45	23.69	21.90	15.62
89.7	23.81	0.56	11.20	9.52	22.13	20.17	12.61
113	37.48	7.36	6.83	4.90	17.34	17.69	8.23
142	41.65	11.28	2.39	2.60	16.27	19.31	6.51
179	49.77	9.09	3.41	3.64	12.27	13.41	8.18
225	50.90	11.00	5.37	6.65	9.46	9.97	4.86
284	61.19	7.46	5.72	5.72	7.71	6.72	3.23
357	56.68	7.63	6.54	8.99	8.17	4.63	4.09
450	54.68	5.91	7.64	6.40	5.42	5.67	1.72
566	56.52	6.28	6.28	8.21	5.07	3.86	0.97
713	55.99	7.52	7.52	9.19	3.06	5.29	1.39
897	52.52	10.09	7.12	8.01	5.04	5.64	1.78
1130	51.71	13.08	9.66	9.97	3.43	3.12	0.93

Table 18. SEVAN Aragats (without lead) upper 5cm detector efficiency for secondary CRs by (%) for coincidence (111)

Energy	neutron	proton	Mu+	Mu-	electron	positron	gamma
89.7	0.02	0	1.85	1.84	1.72	1.44	0.53
113	0.01	0	6.05	5.93	2.84	2.98	0.83
142	0.01	0.03	7.34	7.38	4.22	4.23	1.44
179	0.01	0.42	6.95	7.34	5.37	4.98	1.75
225	0.11	1.94	6.63	6.48	6.03	6.1	1.95
284	0.56	6.79	6.54	6.59	6.73	6.21	2.06
357	0.82	7.71	6.84	6.89	6.99	6.37	2.37
450	1.06	7.88	6.43	6.44	7.26	7.29	2.59
566	2.13	7.18	6.35	6.04	7.78	7.46	2.69
713	3.19	7.72	6.98	6.33	7.86	7.31	2.75
897	4.53	7.88	6.72	7.08	7.75	7.97	2.51
1130	5.83	8.26	6.88	6.47	8.1	7.66	2.93

Table 19. SEVAN Aragats (without lead) upper 5cm detector purity for secondary CRs by (%) for coincidence (111)

Energy	neutron	proton	Mu+	Mu-	electron	positron	gamma
89.7	0.27	0.00	25.00	24.86	23.24	19.46	7.16
113	0.05	0.00	32.46	31.81	15.24	15.99	4.45
142	0.04	0.12	29.78	29.94	17.12	17.16	5.84
179	0.04	1.57	25.91	27.37	20.02	18.57	6.52
225	0.38	6.63	22.67	22.16	20.62	20.86	6.67
284	1.58	19.14	18.43	18.57	18.97	17.50	5.81
357	2.16	20.29	18.00	18.14	18.40	16.77	6.24
450	2.72	20.20	16.48	16.51	18.61	18.69	6.64
566	5.31	17.89	15.82	15.05	19.39	18.59	6.70
713	7.17	17.36	15.70	14.24	17.68	16.44	6.19
897	9.14	15.90	13.56	14.29	15.64	16.08	5.07
1130	10.34	14.65	12.20	11.48	14.37	13.59	5.20

SEVAN Nor-Amberd, Armenia, altitude - 2000 m

The materials used in GEANT4 simulation for Nor-Amberd station

Iron Roof --- 0.5mm

Wood --- 4.0cm

Iron housing of the scintillator --- 1mm

Aluminum base under 5cm thick scintillator --- 6.5mm

Lead absorber --- two layers by 4.5cm each

Table 20. SEVAN Nor-Amberd upper 5cm detector efficiency for secondary CRs (%)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0	0	2.21	2.24	0	0	0
1.42	0	0	2.31	2.34	0	0	0
1.79	0.01	0	2.38	2.52	0	0	0
2.25	0.04	0	2.71	2.95	0	0	0
2.84	0.03	0	3.43	1.31	0	0	0
3.57	0.05	0	4.01	0.52	0	0	0
4.5	0.02	0	4.12	0.42	0	0	0
5.66	0.06	0	4.44	0.52	0	0	0.06
7.13	0.24	0	4.44	2.15	0	0.01	0.35
8.97	0.32	0	4.56	3.89	0	0	0.62
11.3	0.46	0	4.53	3.61	0.01	0.03	0.84
14.2	0.5	0	4.32	4.35	1.68	1.82	1.26
17.9	0.52	0	4.99	4.34	6.9	7.03	1.45
22.5	0.67	0	4.79	4.66	11.81	11.59	1.67
28.4	1.12	0.01	7.62	7.64	13.7	12.64	1.75
35.7	1.45	0	17.07	16.52	14.05	13.16	1.75
45	1.94	0	16.13	16.18	14.51	14.23	2.26
56.6	1.95	0	16.6	16.92	14.72	14.33	2.38
71.3	2.91	3.38	16.41	16.27	15.08	14.83	2.25
89.7	3.61	14.89	15.54	16.05	15.65	15.26	2.53
113	4.15	16.66	16.71	16.21	15.75	15.29	2.4
142	5.54	16.55	15.37	15.01	15.87	15.35	2.66
179	6.57	16.21	15.73	15.12	15.39	15.15	2.45
225	7.89	17.34	15.31	14.95	14.97	15.73	2.67
284	8.98	16.8	15.24	14.3	15.8	15.65	2.71
357	9.29	16.11	15.23	14.81	16.12	16.17	2.6
450	11.34	16.85	15.37	15.1	15.58	15.79	2.96
566	12.52	16.66	15.09	15.08	15.17	14.9	2.51
713	14.23	16.2	16.12	14.94	15.86	16.22	2.65
897	15.14	15.97	15.11	15.93	16.15	15.61	2.72
1130	17.36	16.24	15.18	14.52	15.81	15.94	2.91

Table 21. SEVAN Nor-Amberd upper 5cm detector purity for secondary CRs (%)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.00	0.00	49.66	50.34	0.00	0.00	0.00
1.42	0.00	0.00	49.68	50.32	0.00	0.00	0.00
1.79	0.20	0.00	48.47	51.32	0.00	0.00	0.00
2.25	0.70	0.00	47.54	51.75	0.00	0.00	0.00
2.84	0.63	0.00	71.91	27.46	0.00	0.00	0.00
3.57	1.09	0.00	87.55	11.35	0.00	0.00	0.00
4.5	0.44	0.00	90.35	9.21	0.00	0.00	0.00
5.66	1.18	0.00	87.40	10.24	0.00	0.00	1.18
7.13	3.34	0.00	61.75	29.90	0.00	0.14	4.87
8.97	3.41	0.00	48.56	41.43	0.00	0.00	6.60

11.3	4.85	0.00	47.78	38.08	0.11	0.32	8.86
14.2	3.59	0.00	31.01	31.23	12.06	13.07	9.05
17.9	2.06	0.00	19.78	17.20	27.35	27.86	5.75
22.5	1.90	0.00	13.61	13.24	33.56	32.94	4.75
28.4	2.52	0.02	17.13	17.18	30.80	28.42	3.93
35.7	2.27	0.00	26.67	25.81	21.95	20.56	2.73
45	2.97	0.00	24.72	24.80	22.24	21.81	3.46
56.6	2.91	0.00	24.81	25.29	22.00	21.42	3.56
71.3	4.09	4.75	23.07	22.87	21.20	20.85	3.16
89.7	4.32	17.83	18.60	19.21	18.74	18.27	3.03
113	4.76	19.11	19.17	18.60	18.07	17.54	2.75
142	6.42	19.17	17.80	17.38	18.38	17.78	3.08
179	7.58	18.70	18.15	17.44	17.75	17.48	2.83
225	8.85	19.45	17.17	16.77	16.79	17.64	2.99
284	9.56	17.89	16.23	15.23	16.82	16.66	2.89
357	8.73	15.15	14.32	13.92	15.16	15.20	2.44
450	10.30	15.31	13.96	13.72	14.15	14.35	2.69
566	11.50	15.31	13.86	13.86	13.94	13.69	2.31
713	12.48	14.20	14.13	13.10	13.90	14.22	2.32
897	13.25	13.97	13.22	13.94	14.13	13.66	2.38
1130	14.97	14.00	13.09	12.52	13.63	13.75	2.51

Table 22. SEVAN Nor-Amberd middle 20cm detector efficiency for secondary CRs (%)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0	0	0.01	0.02	0	0	0
1.42	0	0	0	0	0	0	0
1.79	0	0	0.01	0	0	0	0
2.25	0	0	0	0	0	0	0
2.84	0	0	0.02	0.01	0	0	0
3.57	0	0	0.02	0.02	0	0	0
4.5	0	0	0	0.04	0	0	0
5.66	0.02	0	0.01	0.03	0	0	0.02
7.13	0.07	0	0.01	0.02	0	0	0.01
8.97	0.11	0	0.01	0	0	0	0.02
11.3	0.07	0	0.01	0.02	0.01	0	0.06
14.2	0.11	0	0	0.01	0	0	0.06
17.9	0.06	0	0	0	0	0	0.04
22.5	0.17	0	0	0.01	0	0.01	0.07
28.4	0.22	0	0.04	0.02	0	0.02	0.09
35.7	0.4	0	0.04	0.02	0.04	0	0.14
45	0.48	0	0.02	0.04	0.02	0.04	0.18
56.6	0.51	0	0.01	0.21	0.12	0.05	0.2
71.3	0.56	0	0.03	0.28	0.07	0.13	0.37
89.7	0.81	0	0.13	0.37	0.23	0.26	0.54
113	0.85	0.02	0.77	1.05	0.4	0.42	0.86
142	0.89	0.05	3.79	4	0.54	0.62	1.53
179	0.94	0.18	4.18	4.43	1.1	0.81	1.66
225	1.32	0.44	4.23	3.89	1.25	1.45	1.95
284	1.52	3.52	4.38	3.9	1.98	2.21	2.57
357	1.99	3.69	4.1	4.14	2.97	2.83	3.31
450	2.37	4.53	4.12	4.24	3.66	3.93	4.47
566	3.54	4.99	4.24	4.43	4.7	4.31	5.24
713	3.68	5	4.47	4.43	5.11	5.66	5.73

897	4.39	5.1	4.24	4.43	6.11	5.85	6.33
1130	5.76	5.92	4.15	3.87	7.19	6.81	6.99

Table 23. SEVAN Nor-Amberd middle 20cm detector purity for secondary CRs (%)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.00	0.00	33.33	66.67	0.00	0.00	0.00
1.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.79	0.00	0.00	100.00	0.00	0.00	0.00	0.00
2.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.84	0.00	0.00	66.67	33.33	0.00	0.00	0.00
3.57	0.00	0.00	50.00	50.00	0.00	0.00	0.00
4.5	0.00	0.00	0.00	100.00	0.00	0.00	0.00
5.66	25.00	0.00	12.50	37.50	0.00	0.00	25.00
7.13	63.64	0.00	9.09	18.18	0.00	0.00	9.09
8.97	78.57	0.00	7.14	0.00	0.00	0.00	14.29
11.3	41.18	0.00	5.88	11.76	5.88	0.00	35.29
14.2	61.11	0.00	0.00	5.56	0.00	0.00	33.33
17.9	60.00	0.00	0.00	0.00	0.00	0.00	40.00
22.5	65.38	0.00	0.00	3.85	0.00	3.85	26.92
28.4	56.41	0.00	10.26	5.13	0.00	5.13	23.08
35.7	62.50	0.00	6.25	3.13	6.25	0.00	21.88
45	61.54	0.00	2.56	5.13	2.56	5.13	23.08
56.6	46.36	0.00	0.91	19.09	10.91	4.55	18.18
71.3	38.89	0.00	2.08	19.44	4.86	9.03	25.69
89.7	34.62	0.00	5.56	15.81	9.83	11.11	23.08
113	19.36	0.46	17.54	23.92	9.11	9.57	19.59
142	7.79	0.44	33.19	35.03	4.73	5.43	13.40
179	7.06	1.35	31.40	33.28	8.26	6.09	12.47
225	9.07	3.02	29.07	26.74	8.59	9.97	13.40
284	7.57	17.52	21.80	19.41	9.86	11.00	12.79
357	8.60	15.94	17.71	17.88	12.83	12.22	14.30
450	8.57	16.37	14.89	15.32	13.23	14.20	16.15
566	11.07	15.60	13.25	13.85	14.69	13.47	16.38
713	10.53	14.31	12.79	12.68	14.63	16.20	16.40
897	11.38	13.22	10.99	11.48	15.83	15.16	16.40
1130	12.66	13.01	9.12	8.50	15.80	14.96	15.36

Table 25. SEVAN Nor-Amberd upper 5cm detector efficiency for secondary CRs by (%) for coincidence (100)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0	0	2.2	2.22	0	0	0
1.42	0	0	2.31	2.34	0	0	0
1.79	0.01	0	2.37	2.52	0	0	0
2.25	0.04	0	2.71	2.95	0	0	0
2.84	0.03	0	3.42	1.31	0	0	0
3.57	0.05	0	4.01	0.52	0	0	0
4.5	0.02	0	4.12	0.42	0	0	0
5.66	0.06	0	4.44	0.52	0	0	0.06
7.13	0.24	0	4.44	2.15	0	0.01	0.35
8.97	0.32	0	4.55	3.89	0	0	0.62
11.3	0.46	0	4.52	3.6	0.01	0.03	0.84
14.2	0.5	0	4.32	4.34	1.68	1.82	1.26
17.9	0.52	0	4.99	4.34	6.9	7.03	1.45
22.5	0.67	0	4.79	4.65	11.81	11.59	1.67
28.4	1.11	0.01	7.62	7.64	13.7	12.64	1.75

35.7	1.43	0	17.04	16.52	14.03	13.16	1.73
45	1.92	0	16.13	16.16	14.5	14.2	2.25
56.6	1.91	0	16.59	16.7	14.6	14.3	2.37
71.3	2.84	3.38	16.38	16.01	15.05	14.74	2.23
89.7	3.46	14.89	15.43	15.69	15.45	15.03	2.51
113	4.02	16.64	15.97	15.23	15.38	14.95	2.33
142	5.32	16.51	11.8	11.24	15.38	14.82	2.59
179	6.36	16.04	10.48	9.56	14.4	14.41	2.35
225	7.42	16.86	6.37	6.51	13.78	14.4	2.51
284	8.29	13.3	6.18	5.71	14.03	13.67	2.51
357	8.37	10.91	6.09	5.83	13.3	13.47	2.28
450	9.82	8.7	6.62	5.99	12.07	12.12	2.33
566	10.09	8.14	6.22	5.77	10.6	10.92	1.88
713	11.39	7.4	6.27	5.82	10.86	10.76	1.81
897	11.19	6.79	6.16	6.38	10.14	9.78	1.75
1130	11.64	6.74	5.83	5.71	8.45	9.21	1.74

Table 26. SEVAN Nor-Amberd upper 5cm detector purity for secondary CRs by (%) for coincidence (100).

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.00	0.00	49.77	50.23	0.00	0.00	0.00
1.42	0.00	0.00	49.68	50.32	0.00	0.00	0.00
1.79	0.20	0.00	48.37	51.43	0.00	0.00	0.00
2.25	0.70	0.00	47.54	51.75	0.00	0.00	0.00
2.84	0.63	0.00	71.85	27.52	0.00	0.00	0.00
3.57	1.09	0.00	87.55	11.35	0.00	0.00	0.00
4.5	0.44	0.00	90.35	9.21	0.00	0.00	0.00
5.66	1.18	0.00	87.40	10.24	0.00	0.00	1.18
7.13	3.34	0.00	61.75	29.90	0.00	0.14	4.87
8.97	3.41	0.00	48.51	41.47	0.00	0.00	6.61
11.3	4.86	0.00	47.78	38.05	0.11	0.32	8.88
14.2	3.59	0.00	31.03	31.18	12.07	13.07	9.05
17.9	2.06	0.00	19.78	17.20	27.35	27.86	5.75
22.5	1.90	0.00	13.62	13.22	33.57	32.94	4.75
28.4	2.50	0.02	17.14	17.18	30.81	28.42	3.94
35.7	2.24	0.00	26.66	25.85	21.95	20.59	2.71
45	2.95	0.00	24.75	24.80	22.25	21.79	3.45
56.6	2.87	0.00	24.96	25.12	21.96	21.51	3.57
71.3	4.02	4.78	23.19	22.66	21.31	20.87	3.16
89.7	4.20	18.06	18.71	19.03	18.74	18.23	3.04
113	4.76	19.69	18.89	18.02	18.20	17.69	2.76
142	6.85	21.26	15.19	14.47	19.80	19.08	3.34
179	8.63	21.77	14.23	12.98	19.55	19.56	3.19
225	10.89	24.74	9.35	9.55	20.22	21.13	3.68
284	12.17	19.52	9.07	8.38	20.59	20.06	3.68
357	10.98	14.32	7.99	7.65	17.45	17.68	2.99
450	13.19	11.69	8.89	8.05	16.22	16.28	3.13
566	14.41	11.63	8.89	8.24	15.14	15.60	2.69
713	16.00	10.39	8.81	8.17	15.25	15.11	2.54
897	16.59	10.07	9.13	9.46	15.03	14.50	2.59
1130	18.80	10.89	9.42	9.22	13.65	14.88	2.81

Table 24. SEVAN Nor-Amberd middle 20cm detector efficiency for secondary CRs by (%) for coincidence (010)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0	0	0	0	0	0	0

1.42	0	0	0	0	0	0	0
1.79	0	0	0	0	0	0	0
2.25	0	0	0	0	0	0	0
2.84	0	0	0.01	0.01	0	0	0
3.57	0	0	0.02	0.02	0	0	0
4.5	0	0	0	0.04	0	0	0
5.66	0.02	0	0.01	0.03	0	0	0.02
7.13	0.07	0	0.01	0.02	0	0	0.01
8.97	0.11	0	0	0	0	0	0.02
11.3	0.07	0	0	0.01	0.01	0	0.06
14.2	0.11	0	0	0	0	0	0.06
17.9	0.06	0	0	0	0	0	0.04
22.5	0.17	0	0	0	0	0.01	0.07
28.4	0.21	0	0.04	0.02	0	0.02	0.09
35.7	0.38	0	0.01	0.02	0.02	0	0.13
45	0.46	0	0.02	0.02	0.01	0.02	0.17
56.6	0.45	0	0	0.01	0.01	0.02	0.19
71.3	0.49	0	0	0.02	0.04	0.04	0.36
89.7	0.66	0	0.02	0.02	0.04	0.03	0.52
113	0.7	0.01	0.06	0.09	0.05	0.09	0.8
142	0.64	0.01	0.27	0.3	0.06	0.13	1.45
179	0.69	0.02	0.28	0.3	0.16	0.11	1.56
225	0.85	0	0.16	0.15	0.13	0.13	1.79
284	0.9	0.11	0.03	0.01	0.24	0.28	2.33
357	1.06	0.09	0.06	0.01	0.24	0.22	2.94
450	0.89	0.1	0.04	0	0.24	0.43	3.79
566	1.19	0.15	0.05	0.05	0.3	0.51	4.5
713	1.09	0.08	0.02	0.05	0.4	0.41	4.66
897	0.94	0.15	0.02	0.03	0.39	0.41	5.02
1130	0.94	0.09	0.08	0.02	0.26	0.45	5.07

Table 25. SEVAN Nor-Amberd middle 20cm detector purity for secondary CRs by (%) for coincidence (010)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.84	0.00	0.00	50.00	50.00	0.00	0.00	0.00
3.57	0.00	0.00	50.00	50.00	0.00	0.00	0.00
4.5	0.00	0.00	0.00	100.00	0.00	0.00	0.00
5.66	25.00	0.00	12.50	37.50	0.00	0.00	25.00
7.13	63.64	0.00	9.09	18.18	0.00	0.00	9.09
8.97	84.62	0.00	0.00	0.00	0.00	0.00	15.38
11.3	46.67	0.00	0.00	6.67	6.67	0.00	40.00
14.2	64.71	0.00	0.00	0.00	0.00	0.00	35.29
17.9	60.00	0.00	0.00	0.00	0.00	0.00	40.00
22.5	68.00	0.00	0.00	0.00	0.00	4.00	28.00
28.4	55.26	0.00	10.53	5.26	0.00	5.26	23.68
35.7	67.86	0.00	1.79	3.57	3.57	0.00	23.21
45	65.71	0.00	2.86	2.86	1.43	2.86	24.29
56.6	66.18	0.00	0.00	1.47	1.47	2.94	27.94
71.3	51.58	0.00	0.00	2.11	4.21	4.21	37.89
89.7	51.16	0.00	1.55	1.55	3.10	2.33	40.31

113	38.46	0.55	3.30	4.95	2.75	4.95	43.96
142	22.38	0.35	9.44	10.49	2.10	4.55	50.70
179	22.04	0.64	8.95	9.58	5.11	3.51	49.84
225	26.32	0.00	4.95	4.64	4.02	4.02	55.42
284	23.02	2.81	0.77	0.26	6.14	7.16	59.59
357	22.75	1.93	1.29	0.21	5.15	4.72	63.09
450	15.84	1.78	0.71	0.00	4.27	7.65	67.44
566	17.47	2.20	0.73	0.73	4.41	7.49	66.08
713	16.17	1.19	0.30	0.74	5.93	6.08	69.14
897	13.35	2.13	0.28	0.43	5.54	5.82	71.31
1130	13.47	1.29	1.15	0.29	3.72	6.45	72.64

Table 26. SEVAN Nor-Amberd upper 5cm detector efficiency for secondary CRs by (%) for coincidence (111)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
89.7	0	0	0	0	0	0	0
113	0	0	0	0	0	0	0
142	0	0	0	0.01	0	0	0
179	0	0	0.04	0.09	0	0	0
225	0.01	0	1.15	1.18	0.01	0	0
284	0.02	0	3.38	2.9	0.01	0	0
357	0.01	0.09	3.47	3.41	0.03	0.03	0
450	0.08	1.65	3.35	3.4	0.02	0.04	0
566	0.23	2.35	3.4	3.67	0.08	0.08	0
713	0.48	2.47	3.66	3.64	0.16	0.12	0.01
897	0.66	2.64	3.48	3.65	0.33	0.18	0.05
1130	1.06	3.13	3.35	3.27	0.54	0.39	0.08

Table 27. SEVAN Nor-Amberd upper 5cm detector purity for secondary CRs by (%) for coincidence (111)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
89.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00
113	0.00	0.00	100.00	0.00	0.00	0.00	0.00
142	0.00	0.00	0.00	75.00	0.00	25.00	0.00
179	0.00	0.00	11.11	88.89	0.00	0.00	0.00
225	0.00	0.00	49.89	49.68	0.43	0.00	0.00
284	0.33	0.07	51.56	47.52	0.26	0.26	0.00
357	0.38	1.09	50.10	47.40	0.38	0.64	0.00
450	1.30	21.42	37.97	37.91	0.54	0.70	0.16
566	1.99	23.46	37.55	35.01	0.60	1.25	0.15
713	3.39	25.65	34.95	31.65	2.15	2.06	0.14
897	6.33	25.17	30.83	30.71	3.13	3.42	0.42
1130	9.18	25.94	26.99	27.50	4.77	5.20	0.43

SEVAN Lomnitsky Stit (LS), Slovakia, altitude - 2634 m

The materials used in GEANT4 simulation for the Lomnitsky Stit station

Iron Roof --- 1.2mm

Iron housing of the scintillator --- 1.0mm

Aluminum base under 5cm thick scintillator --- 6.5mm

Lead absorber --- two layers by 4.5cm each

Table 31. SEVAN Lomnitsky Stit upper 5cm detector efficiency for secondary CRs (%)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.07	0	3.97	3.96	0	0	0
1.42	0.08	0	3.61	4.3	0	0	0
1.79	0.09	0	4.1	4.76	0	0	0
2.25	0.09	0	5.23	2.5	0	0	0

2.84	0.15	0	7.45	1.14	0	0	0
3.57	0.11	0	7.35	1.1	0	0	0
4.5	0.12	0	7.58	0.87	0	0	0.01
5.66	0.74	0	7.8	0.96	0	0	0.2
7.13	1.52	0	7.56	1.11	0	0.09	0.88
8.97	2.2	0	7.26	0.92	2.37	3.2	1.38
11.3	2.66	0	15.14	5.28	13.55	13.69	2.06
14.2	3.61	0	17.3	3.72	22.62	22.43	2.86
17.9	3.55	0	25.18	28.22	28.22	26.52	2.96
22.5	3.74	0	34.71	36.3	29.81	28.86	3.94
28.4	4	0.01	35.78	35.3	30.58	29.61	3.6
35.7	4.03	0.01	35.42	36.89	31.28	30.92	4.12
45	5.09	33.76	35.78	35.84	30.61	31	4.32
56.6	5.06	35.34	33.79	34.87	32.05	30.89	4.68
71.3	6	35.28	35.61	34.4	31.98	31.12	4.88
89.7	6.95	35.4	34.52	33.52	32.13	31.21	4.91
113	8.62	35.51	32.68	33.53	32.53	32.33	4.85
142	11.79	35.47	33.26	33.26	32.54	31.6	4.88
179	13.67	35.16	32.2	32.01	32.46	31.82	5.33
225	15.95	35.46	32.34	32.24	32.67	32.27	5.57
284	16.68	36.11	32.45	32.36	33.39	32.93	5.49
357	18.25	34.74	32.04	31.79	32.8	33.19	5.6
450	17.93	35.06	31.94	31.64	32.91	32.6	5.85
566	20.86	34.32	31.95	31.29	32.76	33.36	6.21
713	22.59	34.45	31.47	31.23	33.39	33.13	6.02
897	23.25	34.38	32.11	31.6	33.38	32.4	6.44
1130	24.63	33.88	30.67	32.66	33.92	33.45	6.31

Table 28. SEVAN Lomnitsky Stit upper 5cm detector purity for secondary CRs (%)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.88	0.00	49.63	49.50	0.00	0.00	0.00
1.42	1.00	0.00	45.18	53.82	0.00	0.00	0.00
1.79	1.01	0.00	45.81	53.18	0.00	0.00	0.00
2.25	1.15	0.00	66.88	31.97	0.00	0.00	0.00
2.84	1.72	0.00	85.24	13.04	0.00	0.00	0.00
3.57	1.29	0.00	85.86	12.85	0.00	0.00	0.00
4.5	1.40	0.00	88.34	10.14	0.00	0.00	0.12
5.66	7.63	0.00	80.41	9.90	0.00	0.00	2.06
7.13	13.62	0.00	67.74	9.95	0.00	0.81	7.89
8.97	12.69	0.00	41.89	5.31	13.68	18.47	7.96
11.3	5.08	0.00	28.90	10.08	25.87	26.14	3.93
14.2	4.98	0.00	23.85	5.13	31.18	30.92	3.94
17.9	3.10	0.00	21.96	24.61	24.61	23.13	2.58
22.5	2.72	0.00	25.27	26.43	21.70	21.01	2.87
28.4	2.88	0.01	25.76	25.42	22.02	21.32	2.59
35.7	2.82	0.01	24.83	25.86	21.92	21.67	2.89
45	2.89	19.14	20.28	20.32	17.35	17.57	2.45
56.6	2.86	20.00	19.12	19.74	18.14	17.48	2.65
71.3	3.35	19.68	19.86	19.19	17.84	17.36	2.72
89.7	3.89	19.81	19.32	18.76	17.98	17.47	2.75
113	4.78	19.71	18.14	18.61	18.06	17.95	2.69
142	6.44	19.37	18.16	18.16	17.77	17.26	2.67
179	6.26	16.10	14.75	14.66	14.87	14.57	2.44

225	7.15	15.89	14.49	14.45	14.64	14.46	2.50
284	7.38	15.98	14.36	14.32	14.77	14.57	2.43
357	8.15	15.51	14.30	14.19	14.64	14.82	2.50
450	8.02	15.68	14.28	14.15	14.72	14.58	2.62
566	9.17	15.08	14.04	13.75	14.40	14.66	2.73
713	9.88	15.07	13.77	13.67	14.61	14.50	2.63
897	10.08	14.91	13.93	13.70	14.48	14.05	2.79
1130	10.62	14.61	13.22	14.08	14.62	14.42	2.72

Table 29. SEVAN Lomnitsky Stit middle 25cm detector efficiency for secondary CRs (%)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0	0	0.03	0.01	0	0	0
1.42	0	0	0.01	0.01	0	0	0
1.79	0	0	0	0.03	0	0	0
2.25	0.01	0	0.02	0.04	0	0	0
2.84	0.01	0	0.04	0.05	0	0	0
3.57	0.01	0	0.04	0.05	0	0	0
4.5	0.05	0	0.01	0.11	0	0	0
5.66	0.14	0	0.01	0.02	0	0.01	0.03
7.13	0.66	0	0.01	0.05	0	0	0.1
8.97	0.63	0	0.02	0.02	0	0	0.13
11.3	0.56	0	0.02	0.27	0	0	0.14
14.2	0.69	0	0.03	0.21	0	0.03	0.12
17.9	1.08	0	0.06	0.08	0.02	0	0.12
22.5	1.1	0	0.04	0.09	0.02	0.02	0.14
28.4	1.39	0	0.04	0.09	0.06	0.1	0.34
35.7	1.58	0	0.02	0.05	0.14	0.12	0.39
45	1.95	0	0.1	0.55	0.14	0.13	0.6
56.6	2.06	0	0.06	0.77	0.26	0.29	0.96
71.3	2.34	0.02	0.2	1.16	0.38	0.42	1.22
89.7	2.57	0.04	0.52	1.6	0.84	0.85	1.98
113	3	0.14	5.24	4.62	1.48	1.22	2.18
142	2.85	0.15	9.79	10.05	2.04	2.24	3.71
179	3.36	0.32	9.36	9.31	3.04	3.09	5.04
225	4.21	1.46	9.06	9.44	4.76	5.21	6.34
284	4.85	8.86	9.55	9.6	6.46	6.29	7.54
357	6.27	9.2	9.18	8.83	7.91	8.78	9.34
450	6.89	10.19	9.47	8.78	9.64	9.76	10.23
566	8.14	10.54	9.39	9.07	11.08	11.44	11.8
713	9.42	11.52	9.54	8.79	12.26	11.74	12.99
897	11.09	12.22	9.23	9.28	13.03	13.19	13.85
1130	12.86	12.51	8.73	9.54	14.19	14.79	14.66

Table 34. SEVAN Lomnitsky Stit middle 25cm detector purity for secondary CRs (%)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.00	0.00	75.00	25.00	0.00	0.00	0.00
1.42	0.00	0.00	50.00	50.00	0.00	0.00	0.00
1.79	0.00	0.00	0.00	100.00	0.00	0.00	0.00
2.25	14.29	0.00	28.57	57.14	0.00	0.00	0.00
2.84	10.00	0.00	40.00	50.00	0.00	0.00	0.00
3.57	10.00	0.00	40.00	50.00	0.00	0.00	0.00
4.5	29.41	0.00	5.88	64.71	0.00	0.00	0.00
5.66	66.67	0.00	4.76	9.52	0.00	4.76	14.29
7.13	80.49	0.00	1.22	6.10	0.00	0.00	12.20

8.97	78.75	0.00	2.50	2.50	0.00	0.00	16.25
11.3	56.57	0.00	2.02	27.27	0.00	0.00	14.14
14.2	63.89	0.00	2.78	19.44	0.00	2.78	11.11
17.9	79.41	0.00	4.41	5.88	1.47	0.00	8.82
22.5	78.01	0.00	2.84	6.38	1.42	1.42	9.93
28.4	68.81	0.00	1.98	4.46	2.97	4.95	16.83
35.7	68.70	0.00	0.87	2.17	6.09	5.22	16.96
45	56.20	0.00	2.88	15.85	4.03	3.75	17.29
56.6	46.82	0.00	1.36	17.50	5.91	6.59	21.82
71.3	40.77	0.35	3.48	20.21	6.62	7.32	21.25
89.7	30.60	0.48	6.19	19.05	10.00	10.12	23.57
113	16.77	0.78	29.29	25.82	8.27	6.82	12.19
142	9.24	0.49	31.74	32.59	6.61	7.26	12.03
179	10.02	0.95	27.91	27.76	9.06	9.21	15.03
225	10.38	3.60	22.34	23.28	11.74	12.85	15.64
284	9.11	16.64	17.94	18.03	12.13	11.81	14.16
357	10.47	15.36	15.33	14.74	13.21	14.66	15.59
450	10.47	15.49	14.39	13.34	14.65	14.83	15.55
566	11.19	14.49	12.91	12.47	15.23	15.72	16.22
713	11.87	14.51	12.02	11.07	15.44	14.79	16.36
897	12.69	13.99	10.57	10.62	14.92	15.10	15.85
1130	12.91	12.56	8.77	9.58	14.25	14.85	14.72

Table 30. SEVAN Lomnitsky Stit upper 5cm detector efficiency for secondary CRs by (%) for coincidence (100)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.07	0	3.94	3.95	0	0	0
1.42	0.08	0	3.6	4.29	0	0	0
1.79	0.09	0	4.1	4.76	0	0	0
2.25	0.09	0	5.22	2.5	0	0	0
2.84	0.15	0	7.42	1.14	0	0	0
3.57	0.11	0	7.34	1.1	0	0	0
4.5	0.12	0	7.58	0.87	0	0	0.01
5.66	0.74	0	7.78	0.96	0	0	0.2
7.13	1.52	0	7.55	1.11	0	0.09	0.88
8.97	2.2	0	7.24	0.92	2.37	3.2	1.38
11.3	2.66	0	15.14	5.26	13.55	13.69	2.06
14.2	3.6	0	17.28	3.67	22.62	22.43	2.86
17.9	3.53	0	25.16	28.14	28.22	26.52	2.96
22.5	3.69	0	34.67	36.21	29.81	28.84	3.94
28.4	3.96	0.01	35.76	35.23	30.55	29.57	3.6
35.7	3.95	0.01	35.4	36.86	31.19	30.85	4.12
45	5.01	33.76	35.65	35.32	30.49	30.92	4.31
56.6	4.93	35.34	33.72	34.14	31.85	30.65	4.66
71.3	5.68	35.27	35.43	33.31	31.63	30.77	4.83
89.7	6.62	35.39	34.05	32	31.43	30.49	4.87
113	8.13	35.38	28.17	29.51	31.24	31.25	4.69
142	11.1	35.28	24.5	24.01	30.76	29.53	4.61
179	12.65	34.88	21.49	21.22	29.86	29.05	4.96
225	14.37	34.32	14.66	13.79	28.48	27.6	5
284	14.52	27.49	13.83	13.97	27.76	27.3	4.75
357	14.73	19.96	14.01	13.9	25.69	25.27	4.44
450	13.71	18.47	14.05	13.88	23.91	23.74	4.47
566	14.98	17.03	14.48	13.95	22.64	23.01	4.24

713	15.03	15.64	13.99	14.01	22.12	21.89	4.15
897	13.53	15.31	14.49	14.2	21.04	19.76	4.24
1130	12.83	14.78	13.46	14.2	20.27	19.49	3.88

Table 31. SEVAN Lomnitsky Stit upper 5cm detector purity for secondary CRs by (%) for coincidence (100)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.88	0.00	49.50	49.62	0.00	0.00	0.00
1.42	1.00	0.00	45.17	53.83	0.00	0.00	0.00
1.79	1.01	0.00	45.81	53.18	0.00	0.00	0.00
2.25	1.15	0.00	66.84	32.01	0.00	0.00	0.00
2.84	1.72	0.00	85.19	13.09	0.00	0.00	0.00
3.57	1.29	0.00	85.85	12.87	0.00	0.00	0.00
4.5	1.40	0.00	88.34	10.14	0.00	0.00	0.12
5.66	7.64	0.00	80.37	9.92	0.00	0.00	2.07
7.13	13.63	0.00	67.71	9.96	0.00	0.81	7.89
8.97	12.71	0.00	41.83	5.31	13.69	18.49	7.97
11.3	5.08	0.00	28.92	10.05	25.88	26.15	3.93
14.2	4.97	0.00	23.85	5.06	31.22	30.96	3.95
17.9	3.08	0.00	21.97	24.57	24.64	23.16	2.58
22.5	2.69	0.00	25.28	26.40	21.73	21.03	2.87
28.4	2.86	0.01	25.79	25.40	22.03	21.32	2.60
35.7	2.77	0.01	24.86	25.89	21.91	21.67	2.89
45	2.86	19.24	20.32	20.13	17.38	17.62	2.46
56.6	2.81	20.16	19.24	19.48	18.17	17.49	2.66
71.3	3.21	19.94	20.03	18.83	17.88	17.39	2.73
89.7	3.79	20.24	19.47	18.30	17.98	17.44	2.79
113	4.83	21.01	16.73	17.53	18.55	18.56	2.79
142	6.95	22.08	15.33	15.03	19.25	18.48	2.89
179	8.21	22.63	13.94	13.77	19.38	18.85	3.22
225	10.40	24.83	10.61	9.98	20.60	19.97	3.62
284	11.20	21.21	10.67	10.78	21.42	21.06	3.66
357	12.48	16.92	11.87	11.78	21.77	21.42	3.76
450	12.22	16.46	12.52	12.37	21.30	21.15	3.98
566	13.58	15.44	13.12	12.64	20.52	20.86	3.84
713	14.07	14.64	13.10	13.11	20.71	20.49	3.88
897	13.19	14.93	14.13	13.84	20.51	19.26	4.13
1130	12.97	14.94	13.61	14.36	20.49	19.70	3.92

Table 32. SEVAN Lomnitsky Stit middle 25cm detector efficiency for secondary CRs by (%) for coincidence (010)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0	0	0	0	0	0	0
1.42	0	0	0	0	0	0	0
1.79	0	0	0	0.03	0	0	0
2.25	0.01	0	0.01	0.04	0	0	0
2.84	0.01	0	0.01	0.05	0	0	0
3.57	0.01	0	0.03	0.05	0	0	0
4.5	0.05	0	0.01	0.11	0	0	0
5.66	0.14	0	0	0.02	0	0.01	0.03
7.13	0.66	0	0	0.05	0	0	0.1
8.97	0.63	0	0	0.02	0	0	0.13
11.3	0.56	0	0.02	0.25	0	0	0.14
14.2	0.68	0	0.01	0.16	0	0.03	0.12
17.9	1.07	0	0.04	0	0.02	0	0.12
22.5	1.05	0	0	0.01	0.02	0	0.14

28.4	1.34	0	0.02	0.02	0.03	0.06	0.34
35.7	1.51	0	0	0.02	0.06	0.05	0.39
45	1.87	0	0.01	0.03	0.03	0.06	0.59
56.6	1.92	0	0	0.08	0.07	0.06	0.94
71.3	2.01	0.01	0.02	0.08	0.04	0.09	1.17
89.7	2.22	0.03	0.06	0.09	0.16	0.16	1.94
113	2.47	0.01	0.78	0.62	0.21	0.18	2.01
142	2.08	0	1.12	1.01	0.33	0.26	3.45
179	2.28	0.06	1.19	1.03	0.51	0.42	4.64
225	2.53	0.35	0.81	0.72	0.63	0.61	5.77
284	2.48	0.34	0.08	0.11	0.93	0.78	6.68
357	2.58	0.37	0.14	0.11	0.9	0.94	8.08
450	2.59	0.2	0.11	0.2	0.92	1.15	8.62
566	2.45	0.2	0.22	0.16	1.3	1.29	9.44
713	1.89	0.22	0.21	0.15	1.3	1.08	10.53
897	1.95	0.22	0.25	0.21	1.3	1.21	10.43
1130	1.7	0.21	0.13	0.23	1.29	1.33	10.21

Table 33. SEVAN Lomnitsky Stit middle 25cm detector purity for secondary CRs by (%) for coincidence (010)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.79	0.00	0.00	0.00	100.00	0.00	0.00	0.00
2.25	16.67	0.00	16.67	66.67	0.00	0.00	0.00
2.84	14.29	0.00	14.29	71.43	0.00	0.00	0.00
3.57	11.11	0.00	33.33	55.56	0.00	0.00	0.00
4.5	29.41	0.00	5.88	64.71	0.00	0.00	0.00
5.66	70.00	0.00	0.00	10.00	0.00	5.00	15.00
7.13	81.48	0.00	0.00	6.17	0.00	0.00	12.35
8.97	80.77	0.00	0.00	2.56	0.00	0.00	16.67
11.3	57.73	0.00	2.06	25.77	0.00	0.00	14.43
14.2	68.00	0.00	1.00	16.00	0.00	3.00	12.00
17.9	85.60	0.00	3.20	0.00	1.60	0.00	9.60
22.5	86.07	0.00	0.00	0.82	1.64	0.00	11.48
28.4	74.03	0.00	1.10	1.10	1.66	3.31	18.78
35.7	74.38	0.00	0.00	0.99	2.96	2.46	19.21
45	72.20	0.00	0.39	1.16	1.16	2.32	22.78
56.6	62.54	0.00	0.00	2.61	2.28	1.95	30.62
71.3	58.77	0.29	0.58	2.34	1.17	2.63	34.21
89.7	47.64	0.64	1.29	1.93	3.43	3.43	41.63
113	39.27	0.16	12.40	9.86	3.34	2.86	31.96
142	25.18	0.00	13.56	12.23	4.00	3.15	41.77
179	22.46	0.59	11.72	10.15	5.02	4.14	45.71
225	22.12	3.06	7.08	6.29	5.51	5.33	50.44
284	21.74	2.98	0.70	0.96	8.15	6.84	58.55
357	19.63	2.82	1.07	0.84	6.85	7.15	61.49
450	18.77	1.45	0.80	1.45	6.67	8.33	62.46
566	16.25	1.33	1.46	1.06	8.62	8.55	62.60
713	12.20	1.42	1.36	0.97	8.39	6.97	67.98
897	12.30	1.39	1.58	1.32	8.20	7.63	65.76
1130	11.04	1.36	0.84	1.49	8.38	8.64	66.30

Table 34. SEVAN Lomnitsky Stit upper 5cm detector efficiency for secondary CRs by (%) for coincidence (111)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
89.7	0	0	0	0	0	0	0
113	0	0.01	0	0	0	0.01	0
142	0	0	0.01	0.04	0.01	0	0
179	0.02	0	0.03	0.21	0	0.01	0
225	0.02	0.02	2.48	3	0.02	0.04	0.01
284	0.04	0.05	7.81	7.88	0.08	0.04	0
357	0.07	0.31	7.33	6.94	0.09	0.11	0
450	0.23	4.61	7.44	6.99	0.08	0.15	0.01
566	0.35	5.16	7.12	7	0.22	0.27	0.07
713	0.83	5.65	7.11	6.89	0.5	0.42	0.1
897	1.6	6.29	7.08	6.97	0.6	0.67	0.13
1130	2.81	7.22	6.89	7.48	1.27	1.18	0.14

Table 35. SEVAN Lomnitsky Stit upper 5cm detector purity for secondary CRs by (%) for coincidence (111)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
89.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00
113	0.00	50.00	0.00	0.00	0.00	50.00	0.00
142	0.00	0.00	16.67	66.67	16.67	0.00	0.00
179	7.41	0.00	11.11	77.78	0.00	3.70	0.00
225	0.36	0.36	44.36	53.67	0.36	0.72	0.18
284	0.25	0.31	49.12	49.56	0.50	0.25	0.00
357	0.47	2.09	49.36	46.73	0.61	0.74	0.00
450	1.18	23.63	38.13	35.83	0.41	0.77	0.05
566	1.73	25.56	35.26	34.67	1.09	1.34	0.35
713	3.86	26.28	33.07	32.05	2.33	1.95	0.47
897	6.86	26.95	30.33	29.86	2.57	2.87	0.56
1130	10.41	26.75	25.53	27.71	4.71	4.37	0.52

SEVAN Milesovka, Czech Republic, altitude - 837 m

The materials used in GEANT4 simulation for the Milesovka station

Iron Roof --- 1.2mm

Iron housing of the scintillator --- 1.0mm

Aluminum base under 5cm thick scintillator --- 6.5mm

Lead absorber --- two layers by 4.5cm each

Table 41. SEVAN Milesovka upper 5cm detector efficiency for secondary CRs (%)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.07	0	3.55	3.54	0	0	0
1.42	0.08	0	3.84	4.07	0	0	0
1.79	0.09	0	4.36	4.97	0	0	0
2.25	0.09	0	4.92	2.56	0	0	0
2.84	0.15	0	6.9	1.05	0	0	0
3.57	0.11	0	7.37	1.13	0	0	0
4.5	0.12	0	7.78	1.01	0	0	0.01
5.66	0.74	0	7.65	1.01	0	0	0.19
7.13	1.52	0	7.31	1.03	0	0.05	0.81
8.97	2.2	0	7.59	0.8	2.29	2.89	1.3
11.3	2.66	0	15.96	5.19	13.26	14.18	2.32
14.2	3.61	0	16.8	3.74	23.42	23.78	2.61
17.9	3.55	0	25.05	28.31	27.63	25.68	2.99
22.5	3.74	0	35.43	36.13	29.78	28.76	3.61
28.4	4	0	37.39	36.04	30.88	29.41	3.58
35.7	4.03	0.02	35.97	35.54	31.29	30	3.88

45	5.09	33.89	35.19	34.89	31.69	31.02	3.96
56.6	5.06	35.62	34.85	33.92	32.26	31.62	4.58
71.3	6	35.33	35.14	35.02	32.11	31.42	4.66
89.7	6.95	35.84	34.27	34	32.85	32.08	5.2
113	8.62	35.52	33.18	33.22	31.55	31.7	4.58
142	11.01	35.63	33.39	32.81	33.4	32.2	4.84
179	13.71	34.94	33.4	31.9	32.05	31.9	5.67
225	15.76	34.94	32.95	32.34	33.32	32.17	6.01
284	16.37	35.98	31.96	31.6	33.23	32.68	5.71
357	18.01	34.57	31.28	32.26	33.2	32.12	6.18
450	18.33	35.13	31.36	31.75	32.83	32.52	5.63
566	20.24	33.6	30.25	32.13	33.11	33.31	6.36
713	21.82	35.12	32.4	31.36	32.51	33.81	6.16
897	23.24	34.43	31.81	31.09	32.61	32.48	6.32
1130	24.67	33.96	31.98	31.79	34.12	33.49	6.68

Table 36. SEVAN Milesovka upper 5cm detector purity for secondary CRs (%)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.98	0.00	49.58	49.44	0.00	0.00	0.00
1.42	1.00	0.00	48.06	50.94	0.00	0.00	0.00
1.79	0.96	0.00	46.28	52.76	0.00	0.00	0.00
2.25	1.19	0.00	64.99	33.82	0.00	0.00	0.00
2.84	1.85	0.00	85.19	12.96	0.00	0.00	0.00
3.57	1.28	0.00	85.60	13.12	0.00	0.00	0.00
4.5	1.35	0.00	87.22	11.32	0.00	0.00	0.11
5.66	7.72	0.00	79.77	10.53	0.00	0.00	1.98
7.13	14.18	0.00	68.19	9.61	0.00	0.47	7.56
8.97	12.89	0.00	44.46	4.69	13.42	16.93	7.62
11.3	4.97	0.00	29.79	9.69	24.75	26.47	4.33
14.2	4.88	0.00	22.71	5.06	31.67	32.15	3.53
17.9	3.14	0.00	22.13	25.01	24.41	22.68	2.64
22.5	2.72	0.00	25.78	26.29	21.67	20.92	2.63
28.4	2.83	0.00	26.46	25.51	21.85	20.81	2.53
35.7	2.86	0.01	25.56	25.25	22.23	21.32	2.76
45	2.90	19.29	20.03	19.85	18.03	17.65	2.25
56.6	2.84	20.02	19.59	19.07	18.13	17.77	2.57
71.3	3.34	19.66	19.56	19.49	17.87	17.49	2.59
89.7	3.84	19.78	18.91	18.76	18.13	17.71	2.87
113	4.83	19.91	18.60	18.62	17.69	17.77	2.57
142	6.01	19.44	18.22	17.90	18.22	17.57	2.64
179	7.47	19.03	18.19	17.38	17.46	17.38	3.09
225	8.41	18.64	17.57	17.25	17.77	17.16	3.21
284	8.73	19.19	17.04	16.85	17.72	17.43	3.04
357	9.60	18.43	16.67	17.19	17.70	17.12	3.29
450	9.77	18.73	16.72	16.93	17.50	17.34	3.00
566	10.71	17.78	16.01	17.00	17.52	17.62	3.37
713	11.30	18.18	16.77	16.23	16.83	17.50	3.19
897	12.11	17.93	16.57	16.19	16.99	16.92	3.29
1130	12.54	17.27	16.26	16.16	17.35	17.03	3.40

Table 37. SEVAN Milesovka middle 25cm detector efficiency for secondary CRs (%)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0	0	0.02	0.01	0	0	0
1.42	0	0	0	0.03	0	0	0

1.79	0	0	0	0.02	0	0	0
2.25	0.01	0	0.05	0.03	0	0	0
2.84	0.01	0	0.01	0.05	0	0	0
3.57	0.01	0	0.06	0.05	0	0	0
4.5	0.05	0	0.02	0.06	0	0	0.01
5.66	0.14	0	0.01	0.06	0	0	0.01
7.13	0.66	0	0	0.09	0	0	0.14
8.97	0.63	0	0.02	0.02	0	0	0.08
11.3	0.56	0	0.06	0.3	0.01	0	0.1
14.2	0.69	0	0.02	0.29	0.02	0.03	0.18
17.9	1.08	0	0.01	0.06	0.02	0	0.2
22.5	1.1	0	0.02	0.07	0.06	0.02	0.24
28.4	1.39	0	0.05	0.05	0.02	0.07	0.29
35.7	1.58	0	0.05	0.08	0.07	0.12	0.58
45	1.95	0	0.09	0.53	0.21	0.28	0.64
56.6	2.06	0	0.12	0.69	0.24	0.28	0.76
71.3	2.34	0.01	0.22	1.12	0.52	0.54	1.08
89.7	2.57	0.02	0.47	1.6	0.86	0.86	1.72
113	3	0.14	5.35	4.47	1.3	1.45	2.51
142	2.91	0.13	9.92	10	2.2	2.38	3.58
179	3.32	0.38	9.25	9.33	3.46	3.29	4.79
225	4.39	1.38	9.42	9.11	4.67	4.4	6.49
284	4.96	9.02	8.96	8.97	6.38	6.09	7.5
357	6.01	9.06	8.75	8.65	8.34	8.21	9.74
450	7.12	10.28	8.96	9.15	9.63	9.66	10.3
566	7.84	10.29	8.67	9.43	11.01	10.86	11.65
713	9.17	11.73	9.02	9.14	11.88	12.12	12.14
897	10.91	11.96	9.34	8.76	13.12	12.26	13.39
1130	12.63	12.17	8.99	8.89	14.82	14.83	14.94

Table 44. SEVAN Milesovka middle 25cm detector purity for secondary CRs (%)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.00	0.00	66.67	33.33	0.00	0.00	0.00
1.42	0.00	0.00	0.00	100.00	0.00	0.00	0.00
1.79	0.00	0.00	0.00	100.00	0.00	0.00	0.00
2.25	11.11	0.00	55.56	33.33	0.00	0.00	0.00
2.84	14.29	0.00	14.29	71.43	0.00	0.00	0.00
3.57	8.33	0.00	50.00	41.67	0.00	0.00	0.00
4.5	35.71	0.00	14.29	42.86	0.00	0.00	7.14
5.66	63.64	0.00	4.55	27.27	0.00	0.00	4.55
7.13	74.16	0.00	0.00	10.11	0.00	0.00	15.73
8.97	84.00	0.00	2.67	2.67	0.00	0.00	10.67
11.3	54.37	0.00	5.83	29.13	0.97	0.00	9.71
14.2	56.10	0.00	1.63	23.58	1.63	2.44	14.63
17.9	78.83	0.00	0.73	4.38	1.46	0.00	14.60
22.5	72.85	0.00	1.32	4.64	3.97	1.32	15.89
28.4	74.33	0.00	2.67	2.67	1.07	3.74	15.51
35.7	63.71	0.00	2.02	3.23	2.82	4.84	23.39
45	52.70	0.00	2.43	14.32	5.68	7.57	17.30
56.6	49.64	0.00	2.89	16.63	5.78	6.75	18.31
71.3	40.14	0.17	3.77	19.21	8.92	9.26	18.52
89.7	31.73	0.25	5.80	19.75	10.62	10.62	21.23
113	16.47	0.77	29.36	24.53	7.14	7.96	13.78
142	9.35	0.42	31.88	32.13	7.07	7.65	11.50

179	9.82	1.12	27.35	27.59	10.23	9.73	14.16
225	11.01	3.46	23.63	22.85	11.72	11.04	16.28
284	9.56	17.39	17.27	17.29	12.30	11.74	14.46
357	10.23	15.42	14.89	14.72	14.19	13.97	16.58
450	10.94	15.79	13.76	14.06	14.79	14.84	15.82
566	11.24	14.75	12.43	13.52	15.78	15.57	16.70
713	12.19	15.60	11.99	12.15	15.80	16.12	16.14
897	13.68	15.00	11.71	10.99	16.45	15.37	16.79
1130	14.47	13.95	10.30	10.19	16.98	16.99	17.12

Table 38. SEVAN Milesovka upper 5cm detector efficiency for secondary CRs by (%) for coincidence (100)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.07	0	3.53	3.52	0	0	0
1.42	0.08	0	3.84	4.04	0	0	0
1.79	0.09	0	4.36	4.96	0	0	0
2.25	0.09	0	4.88	2.56	0	0	0
2.84	0.15	0	6.9	1.05	0	0	0
3.57	0.11	0	7.35	1.13	0	0	0
4.5	0.12	0	7.76	1.01	0	0	0.01
5.66	0.74	0	7.65	1.01	0	0	0.19
7.13	1.52	0	7.31	1.03	0	0.05	0.81
8.97	2.2	0	7.57	0.8	2.29	2.89	1.3
11.3	2.66	0	15.94	5.15	13.26	14.18	2.32
14.2	3.6	0	16.79	3.71	23.42	23.78	2.61
17.9	3.53	0	25.04	28.26	27.62	25.68	2.99
22.5	3.69	0	35.41	36.09	29.75	28.75	3.61
28.4	3.96	0	37.37	35.99	30.87	29.39	3.57
35.7	3.95	0.02	35.92	35.49	31.23	29.91	3.88
45	5.01	33.89	35.1	34.38	31.49	30.83	3.94
56.6	4.93	35.62	34.72	33.25	32.08	31.39	4.52
71.3	5.68	35.32	34.93	34	31.67	30.96	4.61
89.7	6.62	35.84	33.85	32.48	32.1	31.32	5.15
113	8.13	35.4	28.57	29.23	30.39	30.39	4.53
142	10.37	35.49	24.54	23.77	31.44	30.12	4.65
179	12.75	34.58	22.62	21.39	28.94	29.03	5.25
225	14.2	33.84	14.37	14.16	29.13	28.29	5.36
284	14.24	27.25	14.15	14.13	27.53	27.11	4.88
357	14.74	20.1	13.94	14.54	25.71	24.77	4.94
450	14	18.62	14.13	14.4	23.89	23.86	4.4
566	14.65	16.7	13.89	14.12	22.97	23.17	4.35
713	14.76	15.98	14.74	13.86	21.55	22.26	4.25
897	13.97	15.56	14.16	13.65	20.4	20.86	4.15
1130	12.56	14.6	14.64	14.14	19.66	19.34	3.89

Table 39. SEVAN Milesovka upper 5cm detector purity for secondary CRs by (%) for coincidence (100)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.98	0.00	49.58	49.44	0.00	0.00	0.00
1.42	1.01	0.00	48.24	50.75	0.00	0.00	0.00
1.79	0.96	0.00	46.33	52.71	0.00	0.00	0.00
2.25	1.20	0.00	64.81	34.00	0.00	0.00	0.00
2.84	1.85	0.00	85.19	12.96	0.00	0.00	0.00
3.57	1.28	0.00	85.56	13.15	0.00	0.00	0.00
4.5	1.35	0.00	87.19	11.35	0.00	0.00	0.11
5.66	7.72	0.00	79.77	10.53	0.00	0.00	1.98

7.13	14.18	0.00	68.19	9.61	0.00	0.47	7.56
8.97	12.90	0.00	44.40	4.69	13.43	16.95	7.62
11.3	4.97	0.00	29.79	9.62	24.78	26.50	4.34
14.2	4.87	0.00	22.72	5.02	31.69	32.17	3.53
17.9	3.12	0.00	22.14	24.98	24.42	22.70	2.64
22.5	2.69	0.00	25.79	26.29	21.67	20.94	2.63
28.4	2.81	0.00	26.48	25.50	21.87	20.82	2.53
35.7	2.81	0.01	25.58	25.28	22.24	21.30	2.76
45	2.87	19.41	20.10	19.69	18.03	17.65	2.26
56.6	2.79	20.18	19.67	18.84	18.17	17.78	2.56
71.3	3.21	19.94	19.72	19.19	17.88	17.47	2.60
89.7	3.73	20.21	19.09	18.31	18.10	17.66	2.90
113	4.88	21.24	17.14	17.54	18.24	18.24	2.72
142	6.47	22.13	15.30	14.82	19.60	18.78	2.90
179	8.25	22.37	14.64	13.84	18.72	18.78	3.40
225	10.19	24.28	10.31	10.16	20.90	20.30	3.85
284	11.01	21.08	10.94	10.93	21.29	20.97	3.77
357	12.41	16.93	11.74	12.25	21.65	20.86	4.16
450	12.36	16.43	12.47	12.71	21.09	21.06	3.88
566	13.34	15.20	12.64	12.85	20.91	21.09	3.96
713	13.74	14.88	13.72	12.91	20.07	20.73	3.96
897	13.60	15.14	13.78	13.28	19.85	20.30	4.04
1130	12.71	14.77	14.81	14.31	19.89	19.57	3.94

Table 40. SEVAN Milesovka middle 25cm detector efficiency for secondary CRs by (%) for coincidence (010)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0	0	0	0	0	0	0
1.42	0	0	0	0	0	0	0
1.79	0	0	0	0.01	0	0	0
2.25	0.01	0	0.01	0.03	0	0	0
2.84	0.01	0	0.01	0.05	0	0	0
3.57	0.01	0	0.04	0.05	0	0	0
4.5	0.05	0	0	0.06	0	0	0.01
5.66	0.14	0	0.01	0.06	0	0	0.01
7.13	0.66	0	0	0.09	0	0	0.14
8.97	0.63	0	0	0.02	0	0	0.08
11.3	0.56	0	0.04	0.26	0.01	0	0.1
14.2	0.68	0	0.01	0.26	0.02	0.03	0.18
17.9	1.07	0	0	0.01	0.01	0	0.2
22.5	1.05	0	0	0.04	0.03	0.01	0.24
28.4	1.34	0	0.03	0	0.02	0.05	0.28
35.7	1.51	0	0	0.03	0.02	0.04	0.57
45	1.87	0	0	0.02	0.01	0.1	0.62
56.6	1.92	0	0	0.03	0.06	0.05	0.7
71.3	2.01	0	0.01	0.11	0.09	0.1	1.03
89.7	2.22	0.02	0.06	0.12	0.12	0.13	1.67
113	2.47	0.02	0.78	0.52	0.19	0.18	2.45
142	2.27	0	1.12	1.15	0.29	0.33	3.39
179	2.31	0.04	1.1	1.12	0.44	0.48	4.36
225	2.71	0.33	0.71	0.63	0.55	0.61	5.78
284	2.61	0.41	0.08	0.09	0.81	0.61	6.58
357	2.65	0.46	0.13	0.13	0.95	1	8.42
450	2.85	0.23	0.22	0.19	0.91	1.25	8.9

566	2.46	0.23	0.14	0.15	1.1	1.05	9.38
713	2.38	0.3	0.17	0.14	1.24	0.97	9.46
897	2.08	0.2	0.29	0.17	1.4	1.19	10.14
1130	1.61	0.18	0.16	0.2	1.06	1.24	10.33

Table 41. SEVAN Milesovka middle 25cm detector purity for secondary CRs by (%) for coincidence (010)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.79	0.00	0.00	0.00	100.00	0.00	0.00	0.00
2.25	20.00	0.00	20.00	60.00	0.00	0.00	0.00
2.84	14.29	0.00	14.29	71.43	0.00	0.00	0.00
3.57	10.00	0.00	40.00	50.00	0.00	0.00	0.00
4.5	41.67	0.00	0.00	50.00	0.00	0.00	8.33
5.66	63.64	0.00	4.55	27.27	0.00	0.00	4.55
7.13	74.16	0.00	0.00	10.11	0.00	0.00	15.73
8.97	86.30	0.00	0.00	2.74	0.00	0.00	10.96
11.3	57.73	0.00	4.12	26.80	1.03	0.00	10.31
14.2	57.63	0.00	0.85	22.03	1.69	2.54	15.25
17.9	82.95	0.00	0.00	0.78	0.78	0.00	15.50
22.5	76.64	0.00	0.00	2.92	2.19	0.73	17.52
28.4	77.91	0.00	1.74	0.00	1.16	2.91	16.28
35.7	69.59	0.00	0.00	1.38	0.92	1.84	26.27
45	71.37	0.00	0.00	0.76	0.38	3.82	23.66
56.6	69.57	0.00	0.00	1.09	2.17	1.81	25.36
71.3	60.00	0.00	0.30	3.28	2.69	2.99	30.75
89.7	51.15	0.46	1.38	2.76	2.76	3.00	38.48
113	37.37	0.30	11.80	7.87	2.87	2.72	37.07
142	26.55	0.00	13.10	13.45	3.39	3.86	39.65
179	23.45	0.41	11.17	11.37	4.47	4.87	44.26
225	23.94	2.92	6.27	5.57	4.86	5.39	51.06
284	23.32	3.66	0.71	0.80	7.24	5.45	58.80
357	19.29	3.35	0.95	0.95	6.91	7.28	61.28
450	19.59	1.58	1.51	1.31	6.25	8.59	61.17
566	16.95	1.59	0.96	1.03	7.58	7.24	64.65
713	16.23	2.05	1.16	0.95	8.46	6.62	64.53
897	13.45	1.29	1.87	1.10	9.05	7.69	65.55
1130	10.89	1.22	1.08	1.35	7.17	8.39	69.89

Table 49. SEVAN Milesovka upper 5cm detector efficiency for secondary CRs by (%) for coincidence (111)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
89.7	0	0	0	0	0	0	0
113	0	0.02	0	0	0	0	0
142	0	0	0	0.05	0.01	0	0
179	0.01	0	0.06	0.18	0	0.01	0
225	0.01	0.03	2.67	2.71	0	0.02	0
284	0.05	0.05	7.27	7.25	0.04	0.02	0
357	0.09	0.25	6.99	6.85	0.1	0.14	0.02
450	0.28	4.55	7.07	6.92	0.14	0.1	0.02
566	0.28	4.97	6.69	7.42	0.22	0.26	0.05
713	0.82	5.57	7	7.1	0.31	0.35	0.08
897	1.49	6.15	7.22	6.55	0.65	0.66	0.04
1130	2.39	6.71	7.01	6.91	1.27	1.34	0.23

Table 50. SEVAN Milesovka upper 5cm detector purity for secondary CRs by (%) for coincidence (111)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
89.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00
113	0.00	100.00	0.00	0.00	0.00	0.00	0.00
142	0.00	0.00	0.00	83.33	16.67	0.00	0.00
179	3.85	0.00	23.08	69.23	0.00	3.85	0.00
225	0.18	0.55	49.08	49.82	0.00	0.37	0.00
284	0.34	0.34	49.52	49.39	0.27	0.14	0.00
357	0.62	1.73	48.41	47.44	0.69	0.97	0.14
450	1.47	23.85	37.05	36.27	0.73	0.52	0.10
566	1.41	24.99	33.63	37.31	1.11	1.31	0.25
713	3.86	26.24	32.97	33.44	1.46	1.65	0.38
897	6.55	27.02	31.72	28.78	2.86	2.90	0.18
1130	9.24	25.95	27.11	26.72	4.91	5.18	0.89

SEVAN Musala, Bulgaria, altitude – 2925 m

The materials used in GEANT4 simulation for the Musala station

Iron Roof --- 1.2mm

Iron housing of the scintillator --- 1.0mm

Aluminum base under 5cm thick scintillator --- 6.5mm

Lead absorber --- two layers by 4.5cm each

Table 42. SEVAN Musala upper 5cm detector efficiency for secondary CRs (%)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.07	0	3.55	3.54	0	0	0
1.42	0.08	0	3.84	4.07	0	0	0
1.79	0.09	0	4.36	4.97	0	0	0
2.25	0.09	0	4.92	2.56	0	0	0
2.84	0.15	0	6.9	1.05	0	0	0
3.57	0.11	0	7.37	1.13	0	0	0
4.5	0.12	0	7.78	1.01	0	0	0.01
5.66	0.74	0	7.65	1.01	0	0	0.19
7.13	1.52	0	7.31	1.03	0	0.05	0.81
8.97	2.2	0	7.59	0.8	2.29	2.89	1.3
11.3	2.66	0	15.96	5.19	13.26	14.18	2.32
14.2	3.61	0	16.8	3.74	23.42	23.78	2.61
17.9	3.55	0	25.05	28.31	27.63	25.68	2.99
22.5	3.74	0	35.43	36.13	29.78	28.76	3.61
28.4	4	0	37.39	36.04	30.88	29.41	3.58
35.7	4.03	0.02	35.97	35.54	31.29	30	3.88
45	5.09	33.89	35.19	34.89	31.69	31.02	3.96
56.6	5.06	35.62	34.85	33.92	32.26	31.62	4.58
71.3	6	35.33	35.14	35.02	32.11	31.42	4.66
89.7	6.95	35.84	34.27	34	32.85	32.08	5.2
113	8.62	35.52	33.18	33.22	31.55	31.7	4.58
142	11.01	35.63	33.39	32.81	33.4	32.2	4.84
179	13.71	34.94	33.4	31.9	32.05	31.9	5.67
225	15.76	34.94	32.95	32.34	33.32	32.17	6.01
284	16.37	35.98	31.96	31.6	33.23	32.68	5.71
357	18.01	34.57	31.28	32.26	33.2	32.12	6.18
450	18.33	35.13	31.36	31.75	32.83	32.52	5.63
566	20.24	33.6	30.25	32.13	33.11	33.31	6.36
713	21.82	35.12	32.4	31.36	32.51	33.81	6.16
897	23.24	34.43	31.81	31.09	32.61	32.48	6.32

1130	24.67	33.96	31.98	31.79	34.12	33.49	6.68
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Table 43. SEVAN Musala upper 5cm detector purity for secondary CRs (%)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.98	0.00	49.58	49.44	0.00	0.00	0.00
1.42	1.00	0.00	48.06	50.94	0.00	0.00	0.00
1.79	0.96	0.00	46.28	52.76	0.00	0.00	0.00
2.25	1.19	0.00	64.99	33.82	0.00	0.00	0.00
2.84	1.85	0.00	85.19	12.96	0.00	0.00	0.00
3.57	1.28	0.00	85.60	13.12	0.00	0.00	0.00
4.5	1.35	0.00	87.22	11.32	0.00	0.00	0.11
5.66	7.72	0.00	79.77	10.53	0.00	0.00	1.98
7.13	14.18	0.00	68.19	9.61	0.00	0.47	7.56
8.97	12.89	0.00	44.46	4.69	13.42	16.93	7.62
11.3	4.97	0.00	29.79	9.69	24.75	26.47	4.33
14.2	4.88	0.00	22.71	5.06	31.67	32.15	3.53
17.9	3.14	0.00	22.13	25.01	24.41	22.68	2.64
22.5	2.72	0.00	25.78	26.29	21.67	20.92	2.63
28.4	2.83	0.00	26.46	25.51	21.85	20.81	2.53
35.7	2.86	0.01	25.56	25.25	22.23	21.32	2.76
45	2.90	19.29	20.03	19.85	18.03	17.65	2.25
56.6	2.84	20.02	19.59	19.07	18.13	17.77	2.57
71.3	3.34	19.66	19.56	19.49	17.87	17.49	2.59
89.7	3.84	19.78	18.91	18.76	18.13	17.71	2.87
113	4.83	19.91	18.60	18.62	17.69	17.77	2.57
142	6.01	19.44	18.22	17.90	18.22	17.57	2.64
179	7.47	19.03	18.19	17.38	17.46	17.38	3.09
225	8.41	18.64	17.57	17.25	17.77	17.16	3.21
284	8.73	19.19	17.04	16.85	17.72	17.43	3.04
357	9.60	18.43	16.67	17.19	17.70	17.12	3.29
450	9.77	18.73	16.72	16.93	17.50	17.34	3.00
566	10.71	17.78	16.01	17.00	17.52	17.62	3.37
713	11.30	18.18	16.77	16.23	16.83	17.50	3.19
897	12.11	17.93	16.57	16.19	16.99	16.92	3.29
1130	12.54	17.27	16.26	16.16	17.35	17.03	3.40

Table 44. SEVAN Musala middle 25cm detector efficiency for secondary CRs (%)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0	0	0.02	0.01	0	0	0
1.42	0	0	0	0.03	0	0	0
1.79	0	0	0	0.02	0	0	0
2.25	0.01	0	0.05	0.03	0	0	0
2.84	0.01	0	0.01	0.05	0	0	0
3.57	0.01	0	0.06	0.05	0	0	0
4.5	0.05	0	0.02	0.06	0	0	0.01
5.66	0.14	0	0.01	0.06	0	0	0.01
7.13	0.66	0	0	0.09	0	0	0.14
8.97	0.63	0	0.02	0.02	0	0	0.08
11.3	0.56	0	0.06	0.3	0.01	0	0.1
14.2	0.69	0	0.02	0.29	0.02	0.03	0.18
17.9	1.08	0	0.01	0.06	0.02	0	0.2
22.5	1.1	0	0.02	0.07	0.06	0.02	0.24
28.4	1.39	0	0.05	0.05	0.02	0.07	0.29
35.7	1.58	0	0.05	0.08	0.07	0.12	0.58

45	1.95	0	0.09	0.53	0.21	0.28	0.64
56.6	2.06	0	0.12	0.69	0.24	0.28	0.76
71.3	2.34	0.01	0.22	1.12	0.52	0.54	1.08
89.7	2.57	0.02	0.47	1.6	0.86	0.86	1.72
113	3	0.14	5.35	4.47	1.3	1.45	2.51
142	2.91	0.13	9.92	10	2.2	2.38	3.58
179	3.32	0.38	9.25	9.33	3.46	3.29	4.79
225	4.39	1.38	9.42	9.11	4.67	4.4	6.49
284	4.96	9.02	8.96	8.97	6.38	6.09	7.5
357	6.01	9.06	8.75	8.65	8.34	8.21	9.74
450	7.12	10.28	8.96	9.15	9.63	9.66	10.3
566	7.84	10.29	8.67	9.43	11.01	10.86	11.65
713	9.17	11.73	9.02	9.14	11.88	12.12	12.14
897	10.91	11.96	9.34	8.76	13.12	12.26	13.39
1130	12.63	12.17	8.99	8.89	14.82	14.83	14.94

Table 45. SEVAN Musala middle 25cm detector purity for secondary CRs (%)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.00	0.00	66.67	33.33	0.00	0.00	0.00
1.42	0.00	0.00	0.00	100.00	0.00	0.00	0.00
1.79	0.00	0.00	0.00	100.00	0.00	0.00	0.00
2.25	11.11	0.00	55.56	33.33	0.00	0.00	0.00
2.84	14.29	0.00	14.29	71.43	0.00	0.00	0.00
3.57	8.33	0.00	50.00	41.67	0.00	0.00	0.00
4.5	35.71	0.00	14.29	42.86	0.00	0.00	7.14
5.66	63.64	0.00	4.55	27.27	0.00	0.00	4.55
7.13	74.16	0.00	0.00	10.11	0.00	0.00	15.73
8.97	84.00	0.00	2.67	2.67	0.00	0.00	10.67
11.3	54.37	0.00	5.83	29.13	0.97	0.00	9.71
14.2	56.10	0.00	1.63	23.58	1.63	2.44	14.63
17.9	78.83	0.00	0.73	4.38	1.46	0.00	14.60
22.5	72.85	0.00	1.32	4.64	3.97	1.32	15.89
28.4	74.33	0.00	2.67	2.67	1.07	3.74	15.51
35.7	63.71	0.00	2.02	3.23	2.82	4.84	23.39
45	52.70	0.00	2.43	14.32	5.68	7.57	17.30
56.6	49.64	0.00	2.89	16.63	5.78	6.75	18.31
71.3	40.14	0.17	3.77	19.21	8.92	9.26	18.52
89.7	31.73	0.25	5.80	19.75	10.62	10.62	21.23
113	16.47	0.77	29.36	24.53	7.14	7.96	13.78
142	9.35	0.42	31.88	32.13	7.07	7.65	11.50
179	9.82	1.12	27.35	27.59	10.23	9.73	14.16
225	11.01	3.46	23.63	22.85	11.72	11.04	16.28
284	9.56	17.39	17.27	17.29	12.30	11.74	14.46
357	10.23	15.42	14.89	14.72	14.19	13.97	16.58
450	10.94	15.79	13.76	14.06	14.79	14.84	15.82
566	11.24	14.75	12.43	13.52	15.78	15.57	16.70
713	12.19	15.60	11.99	12.15	15.80	16.12	16.14
897	13.68	15.00	11.71	10.99	16.45	15.37	16.79
1130	14.47	13.95	10.30	10.19	16.98	16.99	17.12

Table 46. SEVAN Musala upper 5cm detector efficiency for secondary CRs by (%) for coincidence (100)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.07	0	3.53	3.52	0	0	0
1.42	0.08	0	3.84	4.04	0	0	0

1.79	0.09	0	4.36	4.96	0	0	0
2.25	0.09	0	4.88	2.56	0	0	0
2.84	0.15	0	6.9	1.05	0	0	0
3.57	0.11	0	7.35	1.13	0	0	0
4.5	0.12	0	7.76	1.01	0	0	0.01
5.66	0.74	0	7.65	1.01	0	0	0.19
7.13	1.52	0	7.31	1.03	0	0.05	0.81
8.97	2.2	0	7.57	0.8	2.29	2.89	1.3
11.3	2.66	0	15.94	5.15	13.26	14.18	2.32
14.2	3.6	0	16.79	3.71	23.42	23.78	2.61
17.9	3.53	0	25.04	28.26	27.62	25.68	2.99
22.5	3.69	0	35.41	36.09	29.75	28.75	3.61
28.4	3.96	0	37.37	35.99	30.87	29.39	3.57
35.7	3.95	0.02	35.92	35.49	31.23	29.91	3.88
45	5.01	33.89	35.1	34.38	31.49	30.83	3.94
56.6	4.93	35.62	34.72	33.25	32.08	31.39	4.52
71.3	5.68	35.32	34.93	34	31.67	30.96	4.61
89.7	6.62	35.84	33.85	32.48	32.1	31.32	5.15
113	8.13	35.4	28.57	29.23	30.39	30.39	4.53
142	10.37	35.49	24.54	23.77	31.44	30.12	4.65
179	12.75	34.58	22.62	21.39	28.94	29.03	5.25
225	14.2	33.84	14.37	14.16	29.13	28.29	5.36
284	14.24	27.25	14.15	14.13	27.53	27.11	4.88
357	14.74	20.1	13.94	14.54	25.71	24.77	4.94
450	14	18.62	14.13	14.4	23.89	23.86	4.4
566	14.65	16.7	13.89	14.12	22.97	23.17	4.35
713	14.76	15.98	14.74	13.86	21.55	22.26	4.25
897	13.97	15.56	14.16	13.65	20.4	20.86	4.15
1130	12.56	14.6	14.64	14.14	19.66	19.34	3.89

Table 47. SEVAN Musala upper 5cm detector purity for secondary CRs by (%) for coincidence (100)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.98	0.00	49.58	49.44	0.00	0.00	0.00
1.42	1.01	0.00	48.24	50.75	0.00	0.00	0.00
1.79	0.96	0.00	46.33	52.71	0.00	0.00	0.00
2.25	1.20	0.00	64.81	34.00	0.00	0.00	0.00
2.84	1.85	0.00	85.19	12.96	0.00	0.00	0.00
3.57	1.28	0.00	85.56	13.15	0.00	0.00	0.00
4.5	1.35	0.00	87.19	11.35	0.00	0.00	0.11
5.66	7.72	0.00	79.77	10.53	0.00	0.00	1.98
7.13	14.18	0.00	68.19	9.61	0.00	0.47	7.56
8.97	12.90	0.00	44.40	4.69	13.43	16.95	7.62
11.3	4.97	0.00	29.79	9.62	24.78	26.50	4.34
14.2	4.87	0.00	22.72	5.02	31.69	32.17	3.53
17.9	3.12	0.00	22.14	24.98	24.42	22.70	2.64
22.5	2.69	0.00	25.79	26.29	21.67	20.94	2.63
28.4	2.81	0.00	26.48	25.50	21.87	20.82	2.53
35.7	2.81	0.01	25.58	25.28	22.24	21.30	2.76
45	2.87	19.41	20.10	19.69	18.03	17.65	2.26
56.6	2.79	20.18	19.67	18.84	18.17	17.78	2.56
71.3	3.21	19.94	19.72	19.19	17.88	17.47	2.60
89.7	3.73	20.21	19.09	18.31	18.10	17.66	2.90
113	4.88	21.24	17.14	17.54	18.24	18.24	2.72
142	6.47	22.13	15.30	14.82	19.60	18.78	2.90

179	8.25	22.37	14.64	13.84	18.72	18.78	3.40
225	10.19	24.28	10.31	10.16	20.90	20.30	3.85
284	11.01	21.08	10.94	10.93	21.29	20.97	3.77
357	12.41	16.93	11.74	12.25	21.65	20.86	4.16
450	12.36	16.43	12.47	12.71	21.09	21.06	3.88
566	13.34	15.20	12.64	12.85	20.91	21.09	3.96
713	13.74	14.88	13.72	12.91	20.07	20.73	3.96
897	13.60	15.14	13.78	13.28	19.85	20.30	4.04
1130	12.71	14.77	14.81	14.31	19.89	19.57	3.94

Table 48. SEVAN Musala middle 25cm detector efficiency for secondary CRs by (%) for coincidence (010)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0	0	0	0	0	0	0
1.42	0	0	0	0	0	0	0
1.79	0	0	0	0.01	0	0	0
2.25	0.01	0	0.01	0.03	0	0	0
2.84	0.01	0	0.01	0.05	0	0	0
3.57	0.01	0	0.04	0.05	0	0	0
4.5	0.05	0	0	0.06	0	0	0.01
5.66	0.14	0	0.01	0.06	0	0	0.01
7.13	0.66	0	0	0.09	0	0	0.14
8.97	0.63	0	0	0.02	0	0	0.08
11.3	0.56	0	0.04	0.26	0.01	0	0.1
14.2	0.68	0	0.01	0.26	0.02	0.03	0.18
17.9	1.07	0	0	0.01	0.01	0	0.2
22.5	1.05	0	0	0.04	0.03	0.01	0.24
28.4	1.34	0	0.03	0	0.02	0.05	0.28
35.7	1.51	0	0	0.03	0.02	0.04	0.57
45	1.87	0	0	0.02	0.01	0.1	0.62
56.6	1.92	0	0	0.03	0.06	0.05	0.7
71.3	2.01	0	0.01	0.11	0.09	0.1	1.03
89.7	2.22	0.02	0.06	0.12	0.12	0.13	1.67
113	2.47	0.02	0.78	0.52	0.19	0.18	2.45
142	2.27	0	1.12	1.15	0.29	0.33	3.39
179	2.31	0.04	1.1	1.12	0.44	0.48	4.36
225	2.71	0.33	0.71	0.63	0.55	0.61	5.78
284	2.61	0.41	0.08	0.09	0.81	0.61	6.58
357	2.65	0.46	0.13	0.13	0.95	1	8.42
450	2.85	0.23	0.22	0.19	0.91	1.25	8.9
566	2.46	0.23	0.14	0.15	1.1	1.05	9.38
713	2.38	0.3	0.17	0.14	1.24	0.97	9.46
897	2.08	0.2	0.29	0.17	1.4	1.19	10.14
1130	1.61	0.18	0.16	0.2	1.06	1.24	10.33

Table 49. SEVAN Musala middle 25cm detector purity for secondary CRs by (%) for coincidence (010)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.79	0.00	0.00	0.00	100.00	0.00	0.00	0.00
2.25	20.00	0.00	20.00	60.00	0.00	0.00	0.00
2.84	14.29	0.00	14.29	71.43	0.00	0.00	0.00
3.57	10.00	0.00	40.00	50.00	0.00	0.00	0.00
4.5	41.67	0.00	0.00	50.00	0.00	0.00	8.33
5.66	63.64	0.00	4.55	27.27	0.00	0.00	4.55

7.13	74.16	0.00	0.00	10.11	0.00	0.00	15.73
8.97	86.30	0.00	0.00	2.74	0.00	0.00	10.96
11.3	57.73	0.00	4.12	26.80	1.03	0.00	10.31
14.2	57.63	0.00	0.85	22.03	1.69	2.54	15.25
17.9	82.95	0.00	0.00	0.78	0.78	0.00	15.50
22.5	76.64	0.00	0.00	2.92	2.19	0.73	17.52
28.4	77.91	0.00	1.74	0.00	1.16	2.91	16.28
35.7	69.59	0.00	0.00	1.38	0.92	1.84	26.27
45	71.37	0.00	0.00	0.76	0.38	3.82	23.66
56.6	69.57	0.00	0.00	1.09	2.17	1.81	25.36
71.3	60.00	0.00	0.30	3.28	2.69	2.99	30.75
89.7	51.15	0.46	1.38	2.76	2.76	3.00	38.48
113	37.37	0.30	11.80	7.87	2.87	2.72	37.07
142	26.55	0.00	13.10	13.45	3.39	3.86	39.65
179	23.45	0.41	11.17	11.37	4.47	4.87	44.26
225	23.94	2.92	6.27	5.57	4.86	5.39	51.06
284	23.32	3.66	0.71	0.80	7.24	5.45	58.80
357	19.29	3.35	0.95	0.95	6.91	7.28	61.28
450	19.59	1.58	1.51	1.31	6.25	8.59	61.17
566	16.95	1.59	0.96	1.03	7.58	7.24	64.65
713	16.23	2.05	1.16	0.95	8.46	6.62	64.53
897	13.45	1.29	1.87	1.10	9.05	7.69	65.55
1130	10.89	1.22	1.08	1.35	7.17	8.39	69.89

Table 50. SEVAN Musala upper 5cm detector efficiency for secondary CRs by (%) for coincidence (111)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
89.7	0	0	0	0	0	0	0
113	0	0.02	0	0	0	0	0
142	0	0	0	0.05	0.01	0	0
179	0.01	0	0.06	0.18	0	0.01	0
225	0.01	0.03	2.67	2.71	0	0.02	0
284	0.05	0.05	7.27	7.25	0.04	0.02	0
357	0.09	0.25	6.99	6.85	0.1	0.14	0.02
450	0.28	4.55	7.07	6.92	0.14	0.1	0.02
566	0.28	4.97	6.69	7.42	0.22	0.26	0.05
713	0.82	5.57	7	7.1	0.31	0.35	0.08
897	1.49	6.15	7.22	6.55	0.65	0.66	0.04
1130	2.39	6.71	7.01	6.91	1.27	1.34	0.23

Table 51. SEVAN Musala upper 5cm detector purity for secondary CRs by (%) for coincidence (111)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
89.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00
113	0.00	100.00	0.00	0.00	0.00	0.00	0.00
142	0.00	0.00	0.00	83.33	16.67	0.00	0.00
179	3.85	0.00	23.08	69.23	0.00	3.85	0.00
225	0.18	0.55	49.08	49.82	0.00	0.37	0.00
284	0.34	0.34	49.52	49.39	0.27	0.14	0.00
357	0.62	1.73	48.41	47.44	0.69	0.97	0.14
450	1.47	23.85	37.05	36.27	0.73	0.52	0.10
566	1.41	24.99	33.63	37.31	1.11	1.31	0.25
713	3.86	26.24	32.97	33.44	1.46	1.65	0.38
897	6.55	27.02	31.72	28.78	2.86	2.90	0.18
1130	9.24	25.95	27.11	26.72	4.91	5.18	0.89

SEVAN Zugspitze, Germany, altitude - 2650 m

The materials used in GEANT4 simulation for the Zugspitze station

Iron Roof --- 0.7mm

Wood --- 2.0cm

Iron housing of the scintillator --- 0.7mm

Aluminum base under 5cm thick scintillator --- 6.5mm

Table 52. SEVAN Zugspitze upper 5cm detector efficiency for secondary CRs (%)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.03	0	3.74	3.87	0	0	0
1.42	0.03	0	4.05	4.32	0	0	0
1.79	0.08	0	4.36	4.68	0	0	0
2.25	0.06	0	5.12	6.78	0	0	0
2.84	0.11	0	8.28	2.63	0	0	0
3.57	0.07	0	9.41	1.39	0	0	0
4.5	0.07	0	8.78	1.02	0	0	0.01
5.66	0.24	0	9.56	6.03	0	0	0.18
7.13	0.9	0	9.9	8.9	0.5	1.16	0.63
8.97	0.92	0	9.84	9.58	9.48	10	1.42
11.3	0.89	0	9.63	8.99	22.91	22.16	1.89
14.2	1.21	0	14.52	10.59	28.82	27.45	2.21
17.9	1.49	0	36.42	35.33	30.6	30.06	2.14
22.5	1.71	0	36.88	35.42	31.87	30.76	2.49
28.4	2.33	0	35.63	35.95	32.14	31.52	2.32
35.7	3.56	0	35.01	36.63	32.21	32.04	2.46
45	4.56	35.62	35.89	35.49	32.65	31.53	2.3
56.6	4.7	35.78	35.15	34.68	32.83	31.51	2.92
71.3	6.43	35.9	34.76	34.48	32.4	32.48	2.56
89.7	7.83	35.4	34.2	34.01	33.01	32.11	2.77
113	9.67	37.24	34.08	34.37	32.52	31.67	2.7
142	12.51	35.96	33.97	33.34	32.07	32.31	3.06
179	15.09	36.37	33.07	32.79	32.35	32.46	3.14
225	17.33	35.72	32.88	32.52	33.21	33.09	3.36
284	19.7	35.6	32.83	32.88	32.33	31.53	2.92
357	21.24	35.79	32.05	32.2	33.26	32.98	3.44
450	23.26	34.8	31.52	32.82	32.35	32.13	3.68
566	25.47	34.7	31.56	32.12	32.79	32.27	3.3
713	29.38	35.58	31.16	31.16	33.19	32.87	3.2
897	31.07	34.47	32.33	31.93	33.28	31.97	3.62
1130	33.2	34.15	32.31	32.49	32.37	31.61	3.41

Table 53. SEVAN Zugspitze upper 5cm detector purity for secondary CRs (%)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.39	0.00	48.95	50.65	0.00	0.00	0.00
1.42	0.36	0.00	48.21	51.43	0.00	0.00	0.00
1.79	0.88	0.00	47.81	51.32	0.00	0.00	0.00
2.25	0.50	0.00	42.81	56.69	0.00	0.00	0.00
2.84	1.00	0.00	75.14	23.87	0.00	0.00	0.00
3.57	0.64	0.00	86.57	12.79	0.00	0.00	0.00
4.5	0.71	0.00	88.87	10.32	0.00	0.00	0.10
5.66	1.50	0.00	59.71	37.66	0.00	0.00	1.12
7.13	4.09	0.00	45.02	40.47	2.27	5.28	2.86
8.97	2.23	0.00	23.86	23.23	22.99	24.25	3.44
11.3	1.34	0.00	14.49	13.52	34.47	33.34	2.84
14.2	1.43	0.00	17.12	12.49	33.99	32.37	2.61

17.9	1.10	0.00	26.77	25.97	22.49	22.10	1.57
22.5	1.23	0.00	26.51	25.46	22.91	22.11	1.79
28.4	1.67	0.00	25.47	25.70	22.98	22.53	1.66
35.7	2.51	0.00	24.67	25.81	22.70	22.58	1.73
45	2.56	20.01	20.16	19.93	18.34	17.71	1.29
56.6	2.65	20.15	19.80	19.53	18.49	17.75	1.64
71.3	3.59	20.05	19.42	19.26	18.10	18.14	1.43
89.7	4.37	19.74	19.07	18.97	18.41	17.91	1.54
113	5.31	20.43	18.70	18.86	17.84	17.38	1.48
142	6.83	19.63	18.54	18.20	17.50	17.63	1.67
179	8.14	19.63	17.85	17.70	17.46	17.52	1.69
225	9.21	18.99	17.48	17.29	17.65	17.59	1.79
284	10.49	18.96	17.48	17.51	17.22	16.79	1.55
357	11.12	18.74	16.78	16.86	17.42	17.27	1.80
450	12.21	18.26	16.54	17.22	16.98	16.86	1.93
566	13.25	18.05	16.42	16.71	17.06	16.79	1.72
713	14.95	18.10	15.85	15.85	16.89	16.72	1.63
897	15.64	17.35	16.27	16.07	16.75	16.09	1.82
1130	16.64	17.11	16.19	16.28	16.22	15.84	1.71

Table 54. SEVAN-Zugspitze lower 25cm detector efficiency for secondary CRs. Without any coincidence

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.01	0	0.66	0.72	0	0	0
1.42	0.01	0	0.7	0.78	0	0	0
1.79	0.01	0	0.8	0.91	0	0	0
2.25	0.02	0	0.94	1.09	0	0	0
2.84	0.02	0	1.46	0.47	0	0	0
3.57	0.08	0	1.48	0.35	0	0	0
4.5	0.01	0	1.25	0.1	0	0	0.02
5.66	0.11	0	1.72	1.1	0	0	0.25
7.13	0.4	0	1.5	1.52	0	0.01	0.89
8.97	0.33	0	1.83	1.61	0	0.03	1.82
11.3	0.35	0	1.76	1.7	0.03	0.08	2.13
14.2	0.66	0	3.1	1.81	0.16	0.17	2.17
17.9	0.74	0	3.44	3.2	0.47	0.43	2.37
22.5	0.83	0	3.08	2.54	1.2	1.34	2.72
28.4	1.21	0	3.97	3.54	5.81	6.01	3.07
35.7	1.45	0	4.61	4.27	7.81	7.38	3.37
45	1.8	0	8.37	9.53	8.57	8.49	3.11
56.6	1.95	0.01	9.27	9.54	8.95	8.67	3.32
71.3	2.04	0.36	9.28	9.1	9	8.83	3.73
89.7	2.14	0.53	8.92	9.05	9.33	9	3.69
113	2.09	8.68	9.7	9.25	9.09	8.67	3.69
142	2.99	8.76	8.84	9.07	9.08	9.32	3.6
179	3.67	9.38	9.59	9.24	9.24	8.61	3.61
225	4.37	9.57	9.89	9.16	9.54	9.41	3.67
284	5.22	9.66	9.31	9.43	9.01	8.6	3.59
357	5.6	9.57	9.05	8.98	9.66	9.52	3.88
450	6.57	9.31	8.63	9.29	9.28	9.8	4.05
566	7.32	9.7	9.44	9.26	9.65	8.73	3.92
713	8.97	10.22	9.15	9.24	9.54	9.76	3.95
897	10.53	9.29	9.15	9.21	9.05	9.32	3.75
1130	11.65	10.18	9.25	9.5	9.01	8.87	4.16

Table 55. SEVAN-Zugspitze lower 25cm detector purity for secondary CRs. Without any coincidence

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.72	0.00	47.48	51.80	0.00	0.00	0.00
1.42	0.67	0.00	46.98	52.35	0.00	0.00	0.00
1.79	0.58	0.00	46.51	52.91	0.00	0.00	0.00
2.25	0.98	0.00	45.85	53.17	0.00	0.00	0.00
2.84	1.03	0.00	74.87	24.10	0.00	0.00	0.00
3.57	4.19	0.00	77.49	18.32	0.00	0.00	0.00
4.5	0.72	0.00	90.58	7.25	0.00	0.00	1.45
5.66	3.46	0.00	54.09	34.59	0.00	0.00	7.86
7.13	9.26	0.00	34.72	35.19	0.00	0.23	20.60
8.97	5.87	0.00	32.56	28.65	0.00	0.53	32.38
11.3	5.79	0.00	29.09	28.10	0.50	1.32	35.21
14.2	8.18	0.00	38.41	22.43	1.98	2.11	26.89
17.9	6.95	0.00	32.30	30.05	4.41	4.04	22.25
22.5	7.09	0.00	26.30	21.69	10.25	11.44	23.23
28.4	5.12	0.00	16.81	14.99	24.61	25.46	13.00
35.7	5.02	0.00	15.96	14.78	27.03	25.55	11.66
45	4.51	0.00	20.99	23.90	21.49	21.29	7.80
56.6	4.68	0.02	22.22	22.87	21.46	20.79	7.96
71.3	4.82	0.85	21.92	21.49	21.26	20.85	8.81
89.7	5.02	1.24	20.91	21.21	21.87	21.10	8.65
113	4.08	16.96	18.96	18.08	17.76	16.94	7.21
142	5.79	16.96	17.11	17.56	17.58	18.04	6.97
179	6.88	17.59	17.98	17.32	17.32	16.14	6.77
225	7.86	17.21	17.78	16.47	17.16	16.92	6.60
284	9.52	17.62	16.98	17.20	16.44	15.69	6.55
357	9.95	17.01	16.09	15.96	17.17	16.92	6.90
450	11.54	16.35	15.16	16.32	16.30	17.21	7.11
566	12.62	16.72	16.27	15.96	16.63	15.05	6.76
713	14.75	16.80	15.04	15.19	15.68	16.04	6.49
897	17.46	15.41	15.17	15.27	15.01	15.46	6.22
1130	18.60	16.26	14.77	15.17	14.39	14.16	6.64

Table 56. SEVAN Zugspitze upper 5cm detector efficiency for secondary CRs by (%) for coincidence (10)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.03	0	3.22	3.24	0	0	0
1.42	0.03	0	3.5	3.7	0	0	0
1.79	0.08	0	3.68	3.94	0	0	0
2.25	0.06	0	4.31	5.83	0	0	0
2.84	0.11	0	6.98	2.25	0	0	0
3.57	0.07	0	8.14	1.2	0	0	0
4.5	0.07	0	7.7	0.97	0	0	0.01
5.66	0.24	0	8.06	5.13	0	0	0.18
7.13	0.9	0	8.61	7.54	0.5	1.16	0.63
8.97	0.92	0	8.27	8.25	9.48	10	1.42
11.3	0.89	0	8.12	7.54	22.91	22.16	1.89
14.2	1.2	0	11.82	9.18	28.82	27.45	2.2
17.9	1.49	0	33.72	32.86	30.54	30.02	2.14
22.5	1.66	0	34.13	33.05	31.34	29.96	2.38
28.4	2.26	0	32.09	32.78	27.46	26.73	2.1
35.7	3.49	0	30.66	32.76	25.72	25.86	2.12
45	4.48	35.62	28.02	26.37	25.41	24.22	1.86

56.6	4.62	35.78	26.38	25.68	25.1	24.03	2.15
71.3	6.21	35.89	26.05	25.91	24.59	25.04	2.01
89.7	7.5	35.31	26.02	25.64	25.05	24.29	2
113	9.13	29.07	25.15	26.03	24.79	24.25	1.9
142	11.41	27.7	25.95	25.36	24.17	24.31	2.33
179	13.42	27.47	24.71	24.65	24.44	24.95	2.37
225	14.94	26.69	24.26	24.51	24.88	24.96	2.55
284	16.42	26.57	24.72	24.57	24.57	24.3	2.11
357	17.77	26.61	24.19	24.55	24.88	24.79	2.66
450	18.7	26.05	24.15	24.84	24.31	23.58	2.66
566	20.17	25.66	23.48	24.49	24.39	24.76	2.51
713	22.14	26.07	23.37	23.37	24.97	24.36	2.33
897	22.64	25.92	24.52	24	25.4	23.91	2.78
1130	23.47	24.94	24.38	24.41	24.64	24.02	2.53

Table 57. SEVAN Zugspitze upper 5cm detector purity for secondary CRs by (%) for coincidence (10)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.46	0.00	49.61	49.92	0.00	0.00	0.00
1.42	0.41	0.00	48.41	51.18	0.00	0.00	0.00
1.79	1.04	0.00	47.79	51.17	0.00	0.00	0.00
2.25	0.59	0.00	42.25	57.16	0.00	0.00	0.00
2.84	1.18	0.00	74.73	24.09	0.00	0.00	0.00
3.57	0.74	0.00	86.50	12.75	0.00	0.00	0.00
4.5	0.80	0.00	88.00	11.09	0.00	0.00	0.11
5.66	1.76	0.00	59.22	37.69	0.00	0.00	1.32
7.13	4.65	0.00	44.52	38.99	2.59	6.00	3.26
8.97	2.40	0.00	21.57	21.52	24.73	26.08	3.70
11.3	1.40	0.00	12.79	11.87	36.07	34.89	2.98
14.2	1.49	0.00	14.65	11.38	35.73	34.03	2.73
17.9	1.14	0.00	25.79	25.13	23.35	22.96	1.64
22.5	1.25	0.00	25.75	24.94	23.65	22.61	1.80
28.4	1.83	0.00	26.00	26.56	22.25	21.66	1.70
35.7	2.89	0.00	25.42	27.16	21.32	21.44	1.76
45	3.07	24.40	19.19	18.06	17.41	16.59	1.27
56.6	3.21	24.89	18.35	17.87	17.46	16.72	1.50
71.3	4.26	24.63	17.88	17.78	16.88	17.19	1.38
89.7	5.14	24.22	17.85	17.58	17.18	16.66	1.37
113	6.51	20.72	17.92	18.55	17.67	17.28	1.35
142	8.08	19.61	18.37	17.96	17.11	17.21	1.65
179	9.45	19.34	17.40	17.36	17.21	17.57	1.67
225	10.46	18.69	16.99	17.17	17.42	17.48	1.79
284	11.46	18.55	17.26	17.15	17.15	16.96	1.47
357	12.22	18.29	16.63	16.88	17.11	17.04	1.83
450	12.96	18.05	16.74	17.22	16.85	16.34	1.84
566	13.87	17.64	16.14	16.84	16.77	17.02	1.73
713	15.10	17.78	15.94	15.94	17.03	16.62	1.59
897	15.18	17.38	16.44	16.09	17.03	16.03	1.86
1130	15.82	16.81	16.43	16.45	16.60	16.19	1.70

Table 58. SEVAN Zugspitze upper 5cm detector efficiency for secondary CRs by (%) for coincidence (11)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
89.7	0.33	0.09	8.18	8.37	7.96	7.82	0.77
113	0.54	8.17	8.93	8.34	7.73	7.42	0.8
142	1.1	8.26	8.02	7.98	7.9	8	0.73

179	1.67	8.9	8.36	8.14	7.91	7.51	0.77
225	2.39	9.03	8.62	8.01	8.33	8.13	0.81
284	3.28	9.03	8.11	8.31	7.76	7.23	0.81
357	3.47	9.18	7.86	7.65	8.38	8.19	0.78
450	4.56	8.75	7.37	7.98	8.04	8.55	1.02
566	5.3	9.04	8.08	7.63	8.4	7.51	0.79
713	7.24	9.51	7.79	7.79	8.22	8.51	0.87
897	8.43	8.55	7.81	7.93	7.88	8.06	0.84
1130	9.73	9.21	7.93	8.08	7.73	7.59	0.88

Table 59. SEVAN Zugspitze upper 5cm detector purity for secondary CRs by (%) for coincidence (11)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
89.7	0.98	0.27	24.40	24.97	23.75	23.33	2.30
113	1.29	19.48	21.30	19.89	18.44	17.70	1.91
142	2.62	19.67	19.10	19.00	18.81	19.05	1.74
179	3.86	20.57	19.33	18.82	18.28	17.36	1.78
225	5.27	19.92	19.02	17.67	18.38	17.94	1.79
284	7.37	20.28	18.21	18.66	17.43	16.24	1.82
357	7.62	20.17	17.27	16.81	18.41	18.00	1.71
450	9.86	18.91	15.93	17.25	17.38	18.48	2.20
566	11.34	19.34	17.28	16.32	17.97	16.06	1.69
713	14.50	19.05	15.60	15.60	16.46	17.04	1.74
897	17.03	17.27	15.78	16.02	15.92	16.28	1.70
1130	19.02	18.01	15.50	15.80	15.11	14.84	1.72

Table 69. SEVAN Zugspitze lower 25cm detector efficiency for secondary CRs by (%) for coincidence (01)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.01	0	0.14	0.09	0	0	0
1.42	0.01	0	0.15	0.16	0	0	0
1.79	0.01	0	0.12	0.17	0	0	0
2.25	0.02	0	0.13	0.14	0	0	0
2.84	0.02	0	0.16	0.09	0	0	0
3.57	0.08	0	0.21	0.16	0	0	0
4.5	0.01	0	0.17	0.05	0	0	0.02
5.66	0.11	0	0.22	0.2	0	0	0.25
7.13	0.4	0	0.21	0.16	0	0.01	0.89
8.97	0.33	0	0.26	0.28	0	0.03	1.82
11.3	0.35	0	0.25	0.25	0.03	0.08	2.13
14.2	0.65	0	0.4	0.4	0.16	0.17	2.16
17.9	0.74	0	0.74	0.73	0.41	0.39	2.37
22.5	0.78	0	0.33	0.17	0.67	0.54	2.61
28.4	1.14	0	0.43	0.37	1.13	1.22	2.85
35.7	1.38	0	0.26	0.4	1.32	1.2	3.03
45	1.72	0	0.5	0.41	1.33	1.18	2.67
56.6	1.87	0.01	0.5	0.54	1.22	1.19	2.55
71.3	1.82	0.35	0.57	0.53	1.19	1.39	3.18
89.7	1.81	0.44	0.74	0.68	1.37	1.18	2.92
113	1.55	0.51	0.77	0.91	1.36	1.25	2.89
142	1.89	0.5	0.82	1.09	1.18	1.32	2.87
179	2	0.48	1.23	1.1	1.33	1.1	2.84
225	1.98	0.54	1.27	1.15	1.21	1.28	2.86
284	1.94	0.63	1.2	1.12	1.25	1.37	2.78
357	2.13	0.39	1.19	1.33	1.28	1.33	3.1
450	2.01	0.56	1.26	1.31	1.24	1.25	3.03

566	2.02	0.66	1.36	1.63	1.25	1.22	3.13
713	1.73	0.71	1.36	1.45	1.32	1.25	3.08
897	2.1	0.74	1.34	1.28	1.17	1.26	2.91
1130	1.92	0.97	1.32	1.42	1.28	1.28	3.28

Table 60. SEVAN Zugspitze lower 25cm detector purity for secondary CRs by (%) for coincidence (01)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	4.17	0.00	58.33	37.50	0.00	0.00	0.00
1.42	3.13	0.00	46.88	50.00	0.00	0.00	0.00
1.79	3.33	0.00	40.00	56.67	0.00	0.00	0.00
2.25	6.90	0.00	44.83	48.28	0.00	0.00	0.00
2.84	7.41	0.00	59.26	33.33	0.00	0.00	0.00
3.57	17.78	0.00	46.67	35.56	0.00	0.00	0.00
4.5	4.00	0.00	68.00	20.00	0.00	0.00	8.00
5.66	14.10	0.00	28.21	25.64	0.00	0.00	32.05
7.13	23.95	0.00	12.57	9.58	0.00	0.60	53.29
8.97	12.13	0.00	9.56	10.29	0.00	1.10	66.91
11.3	11.33	0.00	8.09	8.09	0.97	2.59	68.93
14.2	16.50	0.00	10.15	10.15	4.06	4.31	54.82
17.9	13.75	0.00	13.75	13.57	7.62	7.25	44.05
22.5	15.29	0.00	6.47	3.33	13.14	10.59	51.18
28.4	15.97	0.00	6.02	5.18	15.83	17.09	39.92
35.7	18.18	0.00	3.43	5.27	17.39	15.81	39.92
45	22.02	0.00	6.40	5.25	17.03	15.11	34.19
56.6	23.73	0.13	6.35	6.85	15.48	15.10	32.36
71.3	20.16	3.88	6.31	5.87	13.18	15.39	35.22
89.7	19.80	4.81	8.10	7.44	14.99	12.91	31.95
113	16.77	5.52	8.33	9.85	14.72	13.53	31.28
142	19.54	5.17	8.48	11.27	12.20	13.65	29.68
179	19.84	4.76	12.20	10.91	13.19	10.91	28.17
225	19.24	5.25	12.34	11.18	11.76	12.44	27.79
284	18.85	6.12	11.66	10.88	12.15	13.31	27.02
357	19.81	3.63	11.07	12.37	11.91	12.37	28.84
450	18.86	5.25	11.82	12.29	11.63	11.73	28.42
566	17.92	5.86	12.07	14.46	11.09	10.83	27.77
713	15.87	6.51	12.48	13.30	12.11	11.47	28.26
897	19.44	6.85	12.41	11.85	10.83	11.67	26.94
1130	16.74	8.46	11.51	12.38	11.16	11.16	28.60

SEVAN Hamburg, Germany, altitude - 8 m

The materials used in GEANT4 simulation the same as for Nor-Amberd station

Iron Roof --- 0.5mm

Wood --- 4.0cm

Iron housing of the scintillator --- 1.0mm

Aluminum base under 5cm thick scintillator --- 6.5mm

Lead absorber --- two layers by 4.5cm each

Table 61. SEVAN Hamburg upper 5cm detector efficiency for secondary CRs (%)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.03	0	3.27	3.48	0	0	0
1.42	0.01	0	3.73	3.64	0	0	0
1.79	0.07	0	4.16	4.02	0	0	0
2.25	0.05	0	4.99	5.55	0	0	0
2.84	0.08	0	7.51	2.76	0	0	0

3.57	0.03	0	8.44	1.34	0	0	0
4.5	0.05	0	8.61	1.14	0	0	0.02
5.66	0.26	0	8.33	1.04	0	0	0.23
7.13	0.71	0	8.78	4.97	0	0	0.51
8.97	0.68	0	8.66	7.69	0	0	1.25
11.3	0.89	0	8.52	7.98	0.1	0.18	1.74
14.2	1.14	0	8.8	8.43	4.86	5.28	2.14
17.9	1.22	0	9.19	8.69	17.49	17.3	2.51
22.5	1.7	0	9.63	8.85	24.52	23.1	3.46
28.4	2.25	0	18.75	19.87	27.01	25.31	3.44
35.7	2.93	0	33.99	33.66	28.41	26.7	3.19
45	3.61	0	32.63	32.66	28.9	27.72	3.83
56.6	4.26	0.01	32.68	31.89	29.22	28.01	3.75
71.3	5.2	11.15	30.71	31.81	29.41	29.07	4.37
89.7	6.26	31.75	31.1	31.63	29.12	28.23	4.36
113	8.76	31.91	30.97	30.84	29.67	29.24	4.26
142	10.54	31.69	29.92	31.67	30.07	29.45	4.54
179	13.14	32.15	28.8	29.83	29.89	29.89	4.67
225	15.41	31.88	28.81	29.87	30.4	30.29	4.84
284	17.44	32.08	28.89	28.23	30.22	29.45	4.75
357	19.64	31.81	30.3	28.74	30.32	30.4	4.55
450	21.19	31.8	29.09	28.66	30.57	29.67	5.13
566	23.04	32.06	28.99	28.96	30.15	30.13	5.06
713	26.76	32.34	29.54	29.85	30.17	29.94	5.19
897	29.04	32.38	28.64	28.98	30.1	30.33	5.4
1130	31.36	32.14	29.68	29.14	30.52	30.33	5.57

Table 62. SEVAN Hamburg upper 5cm detector purity for secondary CRs (%)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.44	0.00	48.23	51.33	0.00	0.00	0.00
1.42	0.14	0.00	50.54	49.32	0.00	0.00	0.00
1.79	0.85	0.00	50.42	48.73	0.00	0.00	0.00
2.25	0.47	0.00	47.12	52.41	0.00	0.00	0.00
2.84	0.77	0.00	72.56	26.67	0.00	0.00	0.00
3.57	0.31	0.00	86.03	13.66	0.00	0.00	0.00
4.5	0.51	0.00	87.68	11.61	0.00	0.00	0.20
5.66	2.64	0.00	84.48	10.55	0.00	0.00	2.33
7.13	4.74	0.00	58.65	33.20	0.00	0.00	3.41
8.97	3.72	0.00	47.37	42.07	0.00	0.00	6.84
11.3	4.59	0.00	43.89	41.11	0.52	0.93	8.96
14.2	3.72	0.00	28.71	27.50	15.86	17.23	6.98
17.9	2.16	0.00	16.29	15.41	31.01	30.67	4.45
22.5	2.39	0.00	13.51	12.42	34.41	32.42	4.86
28.4	2.33	0.00	19.40	20.56	27.95	26.19	3.56
35.7	2.27	0.00	26.37	26.12	22.04	20.72	2.48
45	2.79	0.00	25.23	25.25	22.34	21.43	2.96
56.6	3.28	0.01	25.17	24.56	22.51	21.58	2.89
71.3	3.67	7.87	21.67	22.45	20.75	20.51	3.08
89.7	3.85	19.54	19.14	19.47	17.93	17.38	2.68
113	5.29	19.26	18.70	18.62	17.91	17.65	2.57
142	6.28	18.88	17.82	18.86	17.91	17.54	2.70
179	7.80	19.09	17.11	17.72	17.75	17.75	2.77
225	8.99	18.59	16.80	17.42	17.73	17.66	2.82
284	10.20	18.75	16.89	16.50	17.67	17.22	2.78

357	11.17	18.10	17.24	16.35	17.25	17.30	2.59
450	12.03	18.06	16.52	16.27	17.36	16.85	2.91
566	12.92	17.97	16.25	16.23	16.90	16.89	2.84
713	14.56	17.60	16.07	16.24	16.42	16.29	2.82
897	15.71	17.52	15.49	15.68	16.28	16.41	2.92
1130	16.62	17.03	15.73	15.44	16.17	16.07	2.95

Table 63. SEVAN Hamburg 25cm detector efficiency for secondary CRs (%)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0	0	0.01	0.01	0	0	0
1.42	0.01	0	0.04	0.02	0	0	0
1.79	0	0	0.03	0.03	0	0	0
2.25	0	0	0.02	0.02	0	0	0
2.84	0	0	0.05	0	0	0	0
3.57	0	0	0.01	0.03	0	0	0
4.5	0.01	0	0.01	0.02	0	0	0.01
5.66	0.03	0	0.03	0.07	0	0	0
7.13	0.12	0	0.03	0.04	0	0	0.07
8.97	0.19	0	0.01	0.04	0	0	0.1
11.3	0.22	0	0.02	0	0	0.01	0.14
14.2	0.18	0	0.01	0.03	0.01	0.02	0.14
17.9	0.19	0	0.05	0.06	0	0	0.14
22.5	0.39	0	0.03	0.05	0	0	0.14
28.4	0.5	0	0.02	0.07	0.04	0.03	0.23
35.7	0.75	0	0.07	0.11	0.05	0.11	0.45
45	0.97	0	0.03	0.15	0.1	0.06	0.6
56.6	1.19	0.01	0.08	0.54	0.18	0.29	0.92
71.3	1.23	0	0.09	0.83	0.3	0.39	1.13
89.7	1.19	0.03	0.33	1.14	0.71	0.73	1.59
113	1.61	0.02	4.05	4.26	1.18	1.02	2.4
142	1.86	0.17	9.17	9.53	2.05	1.89	3.49
179	2.03	0.4	8.41	8.6	2.92	2.8	4.52
225	2.74	1.74	7.83	8.36	4.06	4.76	5.76
284	3.25	7.81	8.14	7.95	6.02	5.83	7.18
357	3.85	8.09	8.44	8.03	7.59	7.52	8.64
450	5.26	8.99	8.29	7.64	9.04	8.78	9.57
566	6.46	9.1	7.88	7.95	9.83	9.8	10.6
713	7.73	9.74	8.14	8.36	10.98	11.29	11.85
897	9.2	10.87	7.9	8.3	12.19	12.11	13.3
1130	11.2	10.97	7.83	8.43	13.38	13.87	14.35

Table 64. SEVAN Hamburg 25cm detector purity for secondary CRs (%)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.00	0.00	50.00	50.00	0.00	0.00	0.00
1.42	14.29	0.00	57.14	28.57	0.00	0.00	0.00
1.79	0.00	0.00	50.00	50.00	0.00	0.00	0.00
2.25	0.00	0.00	50.00	50.00	0.00	0.00	0.00
2.84	0.00	0.00	100.00	0.00	0.00	0.00	0.00
3.57	0.00	0.00	25.00	75.00	0.00	0.00	0.00
4.5	20.00	0.00	20.00	40.00	0.00	0.00	20.00
5.66	23.08	0.00	23.08	53.85	0.00	0.00	0.00
7.13	46.15	0.00	11.54	15.38	0.00	0.00	26.92
8.97	55.88	0.00	2.94	11.76	0.00	0.00	29.41
11.3	56.41	0.00	5.13	0.00	0.00	2.56	35.90

14.2	46.15	0.00	2.56	7.69	2.56	5.13	35.90
17.9	43.18	0.00	11.36	13.64	0.00	0.00	31.82
22.5	63.93	0.00	4.92	8.20	0.00	0.00	22.95
28.4	56.18	0.00	2.25	7.87	4.49	3.37	25.84
35.7	48.70	0.00	4.55	7.14	3.25	7.14	29.22
45	50.79	0.00	1.57	7.85	5.24	3.14	31.41
56.6	37.07	0.31	2.49	16.82	5.61	9.03	28.66
71.3	30.98	0.00	2.27	20.91	7.56	9.82	28.46
89.7	20.80	0.52	5.77	19.93	12.41	12.76	27.80
113	11.07	0.14	27.85	29.30	8.12	7.02	16.51
142	6.61	0.60	32.56	33.84	7.28	6.71	12.39
179	6.84	1.35	28.34	28.98	9.84	9.43	15.23
225	7.77	4.94	22.21	23.72	11.52	13.50	16.34
284	7.04	16.91	17.63	17.22	13.04	12.62	15.55
357	7.38	15.51	16.18	15.39	14.55	14.42	16.56
450	9.14	15.62	14.40	13.27	15.70	15.25	16.62
566	10.48	14.77	12.79	12.90	15.95	15.90	17.20
713	11.35	14.30	11.95	12.28	16.13	16.58	17.40
897	12.45	14.72	10.69	11.24	16.50	16.39	18.00
1130	13.99	13.71	9.78	10.53	16.72	17.33	17.93

Table 65. SEVAN Hamburg upper 5cm detector efficiency for secondary CRs by (%) for coincidence (100)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.03	0	3.26	3.47	0	0	0
1.42	0.01	0	3.69	3.63	0	0	0
1.79	0.07	0	4.15	4	0	0	0
2.25	0.05	0	4.97	5.55	0	0	0
2.84	0.08	0	7.46	2.76	0	0	0
3.57	0.03	0	8.44	1.34	0	0	0
4.5	0.05	0	8.61	1.14	0	0	0.02
5.66	0.26	0	8.3	1.04	0	0	0.23
7.13	0.71	0	8.77	4.97	0	0	0.51
8.97	0.68	0	8.64	7.68	0	0	1.25
11.3	0.89	0	8.5	7.98	0.1	0.18	1.74
14.2	1.14	0	8.8	8.42	4.86	5.28	2.14
17.9	1.22	0	9.15	8.66	17.49	17.3	2.51
22.5	1.7	0	9.61	8.83	24.52	23.1	3.45
28.4	2.22	0	18.73	19.86	27	25.31	3.43
35.7	2.92	0	33.95	33.58	28.37	26.62	3.18
45	3.52	0	32.6	32.52	28.85	27.67	3.83
56.6	4.17	0.01	32.6	31.38	29.05	27.79	3.74
71.3	5.07	11.15	30.62	31.04	29.17	28.74	4.29
89.7	6.15	31.75	30.8	30.5	28.5	27.62	4.28
113	8.35	31.89	27.28	27	28.7	28.41	4.14
142	10.06	31.56	21.66	22.79	28.27	27.8	4.37
179	12.49	31.82	18.63	18.81	27.28	27.4	4.39
225	14.36	30.35	12.68	13.52	26.9	26.04	4.35
284	15.91	24.58	13.04	12.46	24.92	24.4	4.03
357	17.46	20.86	13.74	13.13	23.64	23.59	3.56
450	17.61	17.2	12.9	13.36	22.13	21.54	3.8
566	18.52	16.71	13.33	13.16	20.95	21.16	3.76
713	20.26	16.37	13.44	13.76	19.9	19.29	3.46
897	20.76	14.94	12.98	12.59	18.73	18.53	3.57
1130	20.36	14.14	13.97	12.96	17.46	17.05	3.38

Table 66. SEVAN Hamburg upper 5cm detector purity for secondary CRs by (%) for coincidence (100)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.44	0.00	48.22	51.33	0.00	0.00	0.00
1.42	0.14	0.00	50.34	49.52	0.00	0.00	0.00
1.79	0.85	0.00	50.49	48.66	0.00	0.00	0.00
2.25	0.47	0.00	47.02	52.51	0.00	0.00	0.00
2.84	0.78	0.00	72.43	26.80	0.00	0.00	0.00
3.57	0.31	0.00	86.03	13.66	0.00	0.00	0.00
4.5	0.51	0.00	87.68	11.61	0.00	0.00	0.20
5.66	2.64	0.00	84.44	10.58	0.00	0.00	2.34
7.13	4.75	0.00	58.62	33.22	0.00	0.00	3.41
8.97	3.73	0.00	47.34	42.08	0.00	0.00	6.85
11.3	4.59	0.00	43.84	41.16	0.52	0.93	8.97
14.2	3.72	0.00	28.72	27.48	15.86	17.23	6.98
17.9	2.17	0.00	16.24	15.37	31.05	30.71	4.46
22.5	2.39	0.00	13.50	12.40	34.43	32.44	4.84
28.4	2.30	0.00	19.40	20.57	27.96	26.21	3.55
35.7	2.27	0.00	26.40	26.11	22.06	20.70	2.47
45	2.73	0.00	25.27	25.21	22.37	21.45	2.97
56.6	3.24	0.01	25.32	24.37	22.56	21.59	2.91
71.3	3.62	7.96	21.86	22.16	20.82	20.52	3.06
89.7	3.85	19.89	19.30	19.11	17.86	17.31	2.68
113	5.36	20.47	17.51	17.33	18.42	18.24	2.66
142	6.87	21.54	14.78	15.56	19.30	18.97	2.98
179	8.87	22.60	13.23	13.36	19.37	19.46	3.12
225	11.20	23.67	9.89	10.55	20.98	20.31	3.39
284	13.33	20.60	10.93	10.44	20.88	20.45	3.38
357	15.05	17.99	11.85	11.32	20.38	20.34	3.07
450	16.22	15.85	11.89	12.31	20.39	19.85	3.50
566	17.21	15.53	12.39	12.23	19.47	19.67	3.49
713	19.03	15.37	12.62	12.92	18.69	18.12	3.25
897	20.33	14.63	12.71	12.33	18.34	18.15	3.50
1130	20.50	14.24	14.07	13.05	17.58	17.17	3.40

Table 67. SEVAN Hamburg 25cm detector efficiency for secondary CRs by (%) for coincidence (010)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0	0	0	0	0	0	0
1.42	0.01	0	0	0.01	0	0	0
1.79	0	0	0.02	0.01	0	0	0
2.25	0	0	0	0.02	0	0	0
2.84	0	0	0	0	0	0	0
3.57	0	0	0.01	0.03	0	0	0
4.5	0.01	0	0.01	0.02	0	0	0.01
5.66	0.03	0	0	0.07	0	0	0
7.13	0.12	0	0.02	0.04	0	0	0.07
8.97	0.19	0	0	0.03	0	0	0.1
11.3	0.22	0	0	0	0	0.01	0.14
14.2	0.17	0	0.01	0.02	0.01	0.02	0.14
17.9	0.19	0	0.02	0.03	0	0	0.14
22.5	0.39	0	0.01	0.03	0	0	0.13
28.4	0.47	0	0.01	0.06	0.03	0.03	0.23
35.7	0.74	0	0.03	0.03	0.01	0.03	0.44
45	0.88	0	0	0.01	0.05	0.01	0.6
56.6	1.09	0.01	0	0.04	0.04	0.07	0.91

71.3	1.1	0	0	0.06	0.07	0.09	1.06
89.7	1.05	0.03	0.05	0.05	0.09	0.15	1.51
113	1.17	0.01	0.4	0.44	0.22	0.2	2.27
142	1.42	0.04	0.99	0.82	0.27	0.3	3.3
179	1.39	0.07	0.93	0.99	0.41	0.35	4.24
225	1.61	0.26	0.64	0.68	0.64	0.6	5.23
284	1.71	0.43	0.05	0.05	0.83	0.85	6.42
357	1.73	0.54	0.05	0.1	1.03	0.81	7.44
450	1.89	0.18	0.14	0.12	0.86	0.88	7.91
566	2.06	0.29	0.13	0.26	0.86	1.07	8.96
713	1.77	0.28	0.18	0.16	1.07	0.96	9.5
897	1.78	0.21	0.2	0.19	1.24	0.83	10.25
1130	1.51	0.21	0.1	0.13	1.03	1.07	10.13

Table 68. SEVAN Hamburg 25cm detector purity for secondary CRs by (%) for coincidence (010)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.42	50.00	0.00	0.00	50.00	0.00	0.00	0.00
1.79	0.00	0.00	66.67	33.33	0.00	0.00	0.00
2.25	0.00	0.00	0.00	100.00	0.00	0.00	0.00
2.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.57	0.00	0.00	25.00	75.00	0.00	0.00	0.00
4.5	20.00	0.00	20.00	40.00	0.00	0.00	20.00
5.66	30.00	0.00	0.00	70.00	0.00	0.00	0.00
7.13	48.00	0.00	8.00	16.00	0.00	0.00	28.00
8.97	59.38	0.00	0.00	9.38	0.00	0.00	31.25
11.3	59.46	0.00	0.00	0.00	0.00	2.70	37.84
14.2	45.95	0.00	2.70	5.41	2.70	5.41	37.84
17.9	50.00	0.00	5.26	7.89	0.00	0.00	36.84
22.5	69.64	0.00	1.79	5.36	0.00	0.00	23.21
28.4	56.63	0.00	1.20	7.23	3.61	3.61	27.71
35.7	57.81	0.00	2.34	2.34	0.78	2.34	34.38
45	56.77	0.00	0.00	0.65	3.23	0.65	38.71
56.6	50.46	0.46	0.00	1.85	1.85	3.24	42.13
71.3	46.22	0.00	0.00	2.52	2.94	3.78	44.54
89.7	35.84	1.02	1.71	1.71	3.07	5.12	51.54
113	24.84	0.21	8.49	9.34	4.67	4.25	48.20
142	19.89	0.56	13.87	11.48	3.78	4.20	46.22
179	16.59	0.84	11.10	11.81	4.89	4.18	50.60
225	16.67	2.69	6.63	7.04	6.63	6.21	54.14
284	16.54	4.16	0.48	0.48	8.03	8.22	62.09
357	14.79	4.62	0.43	0.85	8.80	6.92	63.59
450	15.78	1.50	1.17	1.00	7.18	7.35	66.03
566	15.11	2.13	0.95	1.91	6.31	7.85	65.74
713	12.72	2.01	1.29	1.15	7.69	6.90	68.25
897	12.11	1.43	1.36	1.29	8.44	5.65	69.73
1130	10.65	1.48	0.71	0.92	7.26	7.55	71.44

Table 69. SEVAN Hamburg upper 5cm detector efficiency for secondary CRs by (%) for coincidence (111)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
113	0	0	0	0	0	0	0
142	0.02	0	0.03	0.04	0	0.02	0
179	0	0	0.11	0.18	0	0	0
225	0.01	0	2.7	2.95	0.01	0.01	0

284	0.03	0	6.8	6.59	0.05	0.01	0
357	0.05	0.32	6.85	6.49	0.07	0.08	0.02
450	0.16	3.05	6.57	5.97	0.12	0.11	0.03
566	0.38	4.27	6.11	6.01	0.29	0.31	0.06
713	0.82	4.77	6.14	6.44	0.34	0.5	0.01
897	1.33	5.79	6.16	6.3	0.73	0.67	0.05
1130	2.34	5.9	6.05	6.44	1.38	1.17	0.12

Table 70. SEVAN Hamburg upper 5cm detector purity for secondary CRs by (%) for coincidence (111)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
113	0.00	0.00	0.00	0.00	0.00	0.00	0.00
142	18.18	0.00	27.27	36.36	0.00	18.18	0.00
179	0.00	0.00	37.93	62.07	0.00	0.00	0.00
225	0.18	0.00	47.54	51.94	0.18	0.18	0.00
284	0.22	0.00	50.45	48.89	0.37	0.07	0.00
357	0.36	2.31	49.35	46.76	0.50	0.58	0.14
450	1.00	19.05	41.04	37.29	0.75	0.69	0.19
566	2.18	24.50	35.05	34.48	1.66	1.78	0.34
713	4.31	25.08	32.28	33.86	1.79	2.63	0.05
897	6.32	27.53	29.29	29.96	3.47	3.19	0.24
1130	10.00	25.21	25.85	27.52	5.90	5.00	0.51

SEVAN Zagreb, Croatia, altitude 600m

The materials used in GEANT4 simulation for Zagreb station

Roof tiles --- 7.5mm

roof construction wood --- 1.0cm, gips – 1.0cm

Iron housing of the scintillator --- 3.0mm

Iron base under 5cm thick scintillators --- 3.0mm

Lead absorber --- two layers by 4.8cm and 4.6cm

Table 81. SEVAN Zagreb upper 5cm detector efficiency for secondary CRs (%)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.01	0	5.88	3.6	0	0	0
1.42	0.03	0	6.1	3.69	0	0	0
1.79	0.03	0	6.17	3.56	0	0	0
2.25	0.01	0	6.33	3.42	0	0	0
2.84	0.04	0	5.97	3.57	0	0	0
3.57	0.02	0	6.19	3.82	0	0	0
4.5	0.08	0	5.96	3.36	0	0	0.01
5.66	0.27	0	6.62	3.59	0	0	0.14
7.13	0.57	0	6.03	3.54	0	0	0.63
8.97	0.9	0	6.2	3.88	0.01	0.01	1.39
11.3	0.82	0	6.71	3.82	0.02	0.02	2.22
14.2	1.38	0	6.87	3.84	0.07	0.08	2.87
17.9	1.76	0	7.69	5.4	0.55	0.79	4.14
22.5	2.16	0	8.19	6.11	8.28	8.77	5.12
28.4	2.66	0.01	9.28	4.81	21.03	20.41	6.09
35.7	2.58	0	23.14	12.57	28.28	26.48	6.75
45	3.77	0	39.91	39.96	31.13	29	7.22
56.6	3.98	0.01	39.01	39.58	32.67	31.15	8.71
71.3	4.63	0.03	38.21	38.76	33.64	33.89	9.53
89.7	5.67	11.8	37.44	37.2	35.3	34.06	9.21
113	8.29	36.64	37.47	37.9	36.42	34.47	9.99
142	11.9	38.24	36.94	36.66	35.84	34.82	10.06
179	13.8	37.73	35.55	35.36	36.2	35.48	10.36

225	16.38	38.49	35.34	35.41	36.75	35.94	10.81
284	18.41	39.17	35.17	35	37.05	37.17	11.65
357	20.47	38.88	34.25	35.8	36.98	37.57	11.36
450	22.49	38.96	34.61	35.17	36.99	36.07	11.33
566	24.33	39.13	35.23	34.89	38.07	37.35	11.42
713	26.17	37.7	35.53	34.93	38.75	37.02	11.73
897	29.54	38.01	34.99	35.43	37.32	37.96	11.83
1130	31.39	39.13	36	34.81	39.07	37.4	11.58

Table 71. SEVAN Zagreb upper 5cm detector purity for secondary CRs (%)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.11	0.00	61.96	37.93	0.00	0.00	0.00
1.42	0.31	0.00	62.12	37.58	0.00	0.00	0.00
1.79	0.31	0.00	63.22	36.48	0.00	0.00	0.00
2.25	0.10	0.00	64.86	35.04	0.00	0.00	0.00
2.84	0.42	0.00	62.32	37.27	0.00	0.00	0.00
3.57	0.20	0.00	61.71	38.09	0.00	0.00	0.00
4.5	0.85	0.00	63.34	35.71	0.00	0.00	0.11
5.66	2.54	0.00	62.34	33.80	0.00	0.00	1.32
7.13	5.29	0.00	55.99	32.87	0.00	0.00	5.85
8.97	7.26	0.00	50.04	31.32	0.08	0.08	11.22
11.3	6.02	0.00	49.30	28.07	0.15	0.15	16.31
14.2	9.13	0.00	45.47	25.41	0.46	0.53	18.99
17.9	8.66	0.00	37.83	26.56	2.71	3.89	20.36
22.5	5.59	0.00	21.20	15.82	21.43	22.70	13.25
28.4	4.14	0.02	14.43	7.48	32.71	31.75	9.47
35.7	2.59	0.00	23.19	12.60	28.34	26.53	6.76
45	2.50	0.00	26.43	26.47	20.62	19.21	4.78
56.6	2.57	0.01	25.15	25.52	21.06	20.08	5.62
71.3	2.92	0.02	24.08	24.42	21.20	21.36	6.01
89.7	3.32	6.91	21.94	21.80	20.68	19.96	5.40
113	4.12	18.21	18.62	18.84	18.10	17.13	4.97
142	5.82	18.70	18.06	17.93	17.53	17.03	4.92
179	6.75	18.44	17.38	17.28	17.69	17.34	5.06
225	7.82	18.38	16.87	16.91	17.55	17.16	5.16
284	8.57	18.23	16.37	16.29	17.25	17.30	5.42
357	8.87	16.85	14.84	15.51	16.03	16.28	4.92
450	8.83	15.29	13.59	13.81	14.52	14.16	4.45
566	9.35	15.03	13.53	13.40	14.62	14.35	4.39
713	9.98	14.38	13.55	13.32	14.78	14.12	4.47
897	11.08	14.26	13.13	13.29	14.00	14.24	4.44
1130	11.59	14.45	13.29	12.85	14.42	13.81	4.28

Table 72. SEVAN Zagreb middle 25cm detector efficiency for secondary CRs (%)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0	0	0	0.04	0	0	0
1.42	0	0	0.01	0.04	0	0	0
1.79	0	0	0.02	0.06	0	0	0
2.25	0	0	0.04	0	0	0	0
2.84	0	0	0.02	0.04	0	0	0
3.57	0	0	0.01	0.01	0	0	0
4.5	0.01	0	0.01	0.05	0	0	0
5.66	0.08	0	0.01	0.03	0	0	0.02
7.13	0.13	0	0.03	0.02	0	0	0.08

8.97	0.23	0	0	0.04	0	0	0.13
11.3	0.33	0	0.04	0.02	0	0.01	0.15
14.2	0.21	0	0.02	0.02	0	0.01	0.13
17.9	0.33	0	0	0.03	0	0	0.08
22.5	0.49	0	0.01	0.02	0.01	0.03	0.23
28.4	0.63	0	0.04	0.02	0.04	0.03	0.22
35.7	0.96	0	0.04	0.13	0.1	0.06	0.31
45	1.35	0	0.04	0.09	0.08	0.06	0.5
56.6	1.56	0.01	0.11	0.48	0.18	0.23	0.75
71.3	1.59	0	0.04	0.81	0.33	0.38	0.91
89.7	1.86	0.02	0.22	1.19	0.6	0.49	1.59
113	2.01	0.05	1.09	2.3	1.05	0.8	1.79
142	2.61	0.14	10.14	9.66	1.48	1.59	3
179	3.1	0.4	11.15	10.35	2.39	2.46	3.95
225	3.34	0.73	10.49	10.13	3.8	3.5	5.27
284	4.55	7.23	10.27	9.89	5.68	5.49	7.35
357	5.73	10.01	9.81	10.26	7.82	7.86	9.41
450	6.78	11.41	9.56	10.87	9.17	8.9	10.61
566	7.89	11.93	9.64	10.26	11.03	11.17	11.88
713	9.23	12.37	10.5	9.65	12.89	11.97	13.32
897	11.59	12.75	9.92	10.63	13.45	14.08	13.95
1130	12.68	14.56	10.29	10.05	15.54	15.42	16.33

Table 73. SEVAN Zagreb middle 25cm detector purity for secondary CRs (%)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.00	0.00	0.00	100.00	0.00	0.00	0.00
1.42	0.00	0.00	20.00	80.00	0.00	0.00	0.00
1.79	0.00	0.00	25.00	75.00	0.00	0.00	0.00
2.25	0.00	0.00	100.00	0.00	0.00	0.00	0.00
2.84	0.00	0.00	33.33	66.67	0.00	0.00	0.00
3.57	0.00	0.00	50.00	50.00	0.00	0.00	0.00
4.5	14.29	0.00	14.29	71.43	0.00	0.00	0.00
5.66	57.14	0.00	7.14	21.43	0.00	0.00	14.29
7.13	50.00	0.00	11.54	7.69	0.00	0.00	30.77
8.97	57.50	0.00	0.00	10.00	0.00	0.00	32.50
11.3	60.00	0.00	7.27	3.64	0.00	1.82	27.27
14.2	53.85	0.00	5.13	5.13	0.00	2.56	33.33
17.9	75.00	0.00	0.00	6.82	0.00	0.00	18.18
22.5	62.03	0.00	1.27	2.53	1.27	3.80	29.11
28.4	64.29	0.00	4.08	2.04	4.08	3.06	22.45
35.7	60.00	0.00	2.50	8.13	6.25	3.75	19.38
45	63.68	0.00	1.89	4.25	3.77	2.83	23.58
56.6	46.99	0.30	3.31	14.46	5.42	6.93	22.59
71.3	39.16	0.00	0.99	19.95	8.13	9.36	22.41
89.7	31.16	0.34	3.69	19.93	10.05	8.21	26.63
113	22.11	0.55	11.99	25.30	11.55	8.80	19.69
142	9.12	0.49	35.43	33.75	5.17	5.56	10.48
179	9.17	1.18	32.98	30.61	7.07	7.28	11.68
225	8.96	1.96	28.13	27.17	10.19	9.39	14.13
284	9.00	14.30	20.31	19.56	11.23	10.86	14.54
357	9.37	16.36	16.04	16.77	12.78	12.85	15.38
450	10.01	16.85	14.12	16.05	13.54	13.14	15.67
566	10.53	15.92	12.86	13.69	14.72	14.90	15.85
713	11.18	14.98	12.71	11.68	15.61	14.49	16.13

897	12.69	13.96	10.86	11.64	14.73	15.42	15.27
1130	11.83	13.59	9.60	9.38	14.50	14.39	15.24

Table 74. SEVAN Zagreb upper 5cm detector efficiency for secondary CRs by (%) for coincidence (100)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.01	0	5.88	3.6	0	0	0
1.42	0.03	0	6.09	3.69	0	0	0
1.79	0.03	0	6.15	3.56	0	0	0
2.25	0.01	0	6.31	3.42	0	0	0
2.84	0.04	0	5.96	3.56	0	0	0
3.57	0.02	0	6.19	3.82	0	0	0
4.5	0.08	0	5.95	3.36	0	0	0.01
5.66	0.27	0	6.61	3.59	0	0	0.14
7.13	0.57	0	6.03	3.53	0	0	0.63
8.97	0.9	0	6.2	3.87	0.01	0.01	1.39
11.3	0.81	0	6.7	3.82	0.02	0.02	2.22
14.2	1.37	0	6.86	3.83	0.07	0.08	2.87
17.9	1.76	0	7.69	5.4	0.55	0.79	4.14
22.5	2.15	0	8.19	6.11	8.28	8.77	5.12
28.4	2.61	0.01	9.27	4.81	21.03	20.4	6.09
35.7	2.54	0	23.11	12.52	28.23	26.46	6.74
45	3.73	0	39.87	39.88	31.09	28.96	7.22
56.6	3.89	0.01	38.9	39.14	32.54	31.04	8.65
71.3	4.45	0.03	38.17	37.99	33.4	33.67	9.43
89.7	5.44	11.8	37.23	36.04	34.79	33.63	9.06
113	7.99	36.64	36.59	35.8	35.58	33.77	9.91
142	11.27	38.19	27.98	27.97	34.62	33.46	9.74
179	13.17	37.36	25.5	25.59	34.13	33.3	9.85
225	15.23	37.82	17.31	17.53	33.32	32.91	9.99
284	16.61	32.28	15.8	15.93	31.98	32.44	10.33
357	17.35	27.87	15.77	16.37	29.85	30.65	9.27
450	18.24	21.14	15.77	15.8	28.78	28.14	8.98
566	18.58	20.57	16.46	15.7	27.84	27.03	8.65
713	18.68	18.52	16.26	16.07	26.5	25.7	8.31
897	19.1	18.04	15.72	15.63	24.52	24.68	8.08
1130	19.19	17.17	16.57	15.43	23.99	22.78	7.06

Table 75. SEVAN Zagreb upper 5cm detector purity for secondary CRs by (%) for coincidence (100)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.11	0.00	61.96	37.93	0.00	0.00	0.00
1.42	0.31	0.00	62.08	37.61	0.00	0.00	0.00
1.79	0.31	0.00	63.14	36.55	0.00	0.00	0.00
2.25	0.10	0.00	64.78	35.11	0.00	0.00	0.00
2.84	0.42	0.00	62.34	37.24	0.00	0.00	0.00
3.57	0.20	0.00	61.71	38.09	0.00	0.00	0.00
4.5	0.85	0.00	63.30	35.74	0.00	0.00	0.11
5.66	2.54	0.00	62.30	33.84	0.00	0.00	1.32
7.13	5.30	0.00	56.04	32.81	0.00	0.00	5.86
8.97	7.27	0.00	50.08	31.26	0.08	0.08	11.23
11.3	5.96	0.00	49.30	28.11	0.15	0.15	16.34
14.2	9.08	0.00	45.49	25.40	0.46	0.53	19.03
17.9	8.66	0.00	37.83	26.56	2.71	3.89	20.36
22.5	5.57	0.00	21.21	15.82	21.44	22.71	13.26
28.4	4.06	0.02	14.43	7.49	32.75	31.77	9.48

35.7	2.55	0.00	23.20	12.57	28.34	26.57	6.77
45	2.47	0.00	26.45	26.45	20.62	19.21	4.79
56.6	2.52	0.01	25.23	25.39	21.11	20.13	5.61
71.3	2.83	0.02	24.29	24.18	21.25	21.43	6.00
89.7	3.24	7.02	22.16	21.45	20.71	20.02	5.39
113	4.07	18.67	18.64	18.24	18.13	17.20	5.05
142	6.15	20.84	15.27	15.26	18.89	18.26	5.31
179	7.36	20.87	14.25	14.30	19.07	18.60	5.50
225	9.26	23.00	10.53	10.66	20.26	20.01	6.08
284	10.61	20.62	10.09	10.18	20.43	20.72	6.60
357	10.68	17.15	9.71	10.08	18.37	18.87	5.71
450	10.39	12.04	8.98	9.00	16.39	16.02	5.11
566	10.70	11.85	9.48	9.04	16.03	15.57	4.98
713	11.15	11.05	9.70	9.59	15.82	15.34	4.96
897	11.79	11.13	9.70	9.65	15.13	15.23	4.99
1130	12.74	11.40	11.00	10.24	15.92	15.12	4.69

Table 76. SEVAN Zagreb middle 25cm detector efficiency for secondary CRs by (%) for coincidence (010)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0	0	0	0.04	0	0	0
1.42	0	0	0	0.04	0	0	0
1.79	0	0	0	0.06	0	0	0
2.25	0	0	0.02	0	0	0	0
2.84	0	0	0.01	0.03	0	0	0
3.57	0	0	0.01	0.01	0	0	0
4.5	0.01	0	0	0.05	0	0	0
5.66	0.08	0	0	0.03	0	0	0.02
7.13	0.13	0	0.03	0.01	0	0	0.08
8.97	0.23	0	0	0.03	0	0	0.13
11.3	0.32	0	0.03	0.02	0	0.01	0.15
14.2	0.2	0	0.01	0.01	0	0.01	0.13
17.9	0.33	0	0	0.03	0	0	0.08
22.5	0.48	0	0.01	0.02	0.01	0.03	0.23
28.4	0.58	0	0.03	0.02	0.04	0.02	0.22
35.7	0.92	0	0.01	0.08	0.05	0.04	0.3
45	1.3	0	0.01	0.01	0.04	0.02	0.5
56.6	1.47	0.01	0.02	0.04	0.05	0.12	0.7
71.3	1.42	0	0	0.05	0.1	0.17	0.81
89.7	1.61	0.02	0.02	0.04	0.11	0.08	1.45
113	1.68	0.05	0.21	0.22	0.21	0.11	1.71
142	1.93	0.09	1.23	1.05	0.3	0.27	2.69
179	2.39	0.04	1.38	1.21	0.37	0.33	3.43
225	2.17	0.08	1.1	1.18	0.47	0.54	4.44
284	2.55	0.42	0.18	0.19	0.64	0.83	6
357	2.41	0.54	0.23	0.1	0.82	0.99	7.2
450	2.72	0.36	0.22	0.22	1.02	1.1	8.2
566	2.34	0.3	0.18	0.23	1.04	1.04	8.87
713	2.14	0.33	0.24	0.17	0.98	0.83	9.66
897	2.12	0.34	0.25	0.26	1	1.13	9.82
1130	1.84	0.33	0.28	0.39	1.01	1.24	10.98

Table 77. SEVAN Zagreb middle 25cm detector purity for secondary CRs by (%) for coincidence (010)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
1.13	0.00	0.00	0.00	100.00	0.00	0.00	0.00

1.42	0.00	0.00	0.00	100.00	0.00	0.00	0.00
1.79	0.00	0.00	0.00	100.00	0.00	0.00	0.00
2.25	0.00	0.00	100.00	0.00	0.00	0.00	0.00
2.84	0.00	0.00	25.00	75.00	0.00	0.00	0.00
3.57	0.00	0.00	50.00	50.00	0.00	0.00	0.00
4.5	16.67	0.00	0.00	83.33	0.00	0.00	0.00
5.66	61.54	0.00	0.00	23.08	0.00	0.00	15.38
7.13	52.00	0.00	12.00	4.00	0.00	0.00	32.00
8.97	58.97	0.00	0.00	7.69	0.00	0.00	33.33
11.3	60.38	0.00	5.66	3.77	0.00	1.89	28.30
14.2	55.56	0.00	2.78	2.78	0.00	2.78	36.11
17.9	75.00	0.00	0.00	6.82	0.00	0.00	18.18
22.5	61.54	0.00	1.28	2.56	1.28	3.85	29.49
28.4	63.74	0.00	3.30	2.20	4.40	2.20	24.18
35.7	65.71	0.00	0.71	5.71	3.57	2.86	21.43
45	69.15	0.00	0.53	0.53	2.13	1.06	26.60
56.6	61.00	0.41	0.83	1.66	2.07	4.98	29.05
71.3	55.69	0.00	0.00	1.96	3.92	6.67	31.76
89.7	48.35	0.60	0.60	1.20	3.30	2.40	43.54
113	40.10	1.19	5.01	5.25	5.01	2.63	40.81
142	25.53	1.19	16.27	13.89	3.97	3.57	35.58
179	26.09	0.44	15.07	13.21	4.04	3.60	37.45
225	21.70	0.80	11.00	11.80	4.70	5.40	44.40
284	23.42	3.86	1.65	1.74	5.88	7.62	55.10
357	19.34	4.33	1.85	0.80	6.58	7.95	57.78
450	19.53	2.58	1.58	1.58	7.32	7.90	58.87
566	16.62	2.13	1.28	1.63	7.39	7.39	63.00
713	14.82	2.29	1.66	1.18	6.79	5.75	66.90
897	13.98	2.24	1.65	1.72	6.60	7.45	64.78
1130	11.17	2.00	1.70	2.37	6.13	7.53	66.67

Table 78. SEVAN Zagreb upper 5cm detector efficiency for secondary CRs by (%) for coincidence (111)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
89.7	0	0	0	0	0	0	0
113	0	0	0	0	0	0	0
142	0.01	0	0	0	0	0	0
179	0	0	0.01	0.09	0	0.01	0.01
225	0.02	0.03	1.26	1.16	0	0	0
284	0.03	0	7.75	7.59	0	0.01	0
357	0.07	0.15	7.56	8.01	0.01	0.07	0
450	0.14	2.63	7.16	8.02	0.06	0.06	0.02
566	0.48	5.03	7.42	7.77	0.08	0.15	0.04
713	0.63	5.5	7.98	7.2	0.24	0.25	0.06
897	1.46	6.12	7.3	7.9	0.35	0.35	0.06
1130	2.14	7.36	7.67	7.33	0.5	0.46	0.21

Table 79. SEVAN Zagreb upper 5cm detector purity for secondary CRs by (%) for coincidence (111)

Energy (MeV)	neutron	proton	Mu+	Mu-	electron	positron	gamma
89.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00
113	0.00	0.00	0.00	0.00	0.00	0.00	0.00
142	100.00	0.00	0.00	0.00	0.00	0.00	0.00
179	0.00	0.00	8.33	75.00	0.00	8.33	8.33
225	0.81	1.21	51.01	46.96	0.00	0.00	0.00
284	0.20	0.00	50.39	49.35	0.00	0.07	0.00

357	0.44	0.95	47.64	50.47	0.06	0.44	0.00
450	0.77	14.54	39.58	44.33	0.33	0.33	0.11
566	2.29	23.98	35.37	37.04	0.38	0.71	0.19
713	2.87	25.03	36.32	32.77	1.09	1.14	0.27
897	6.12	25.65	30.60	33.11	1.47	1.47	0.25
1130	8.03	27.61	28.77	27.49	1.88	1.73	0.79

Conclusion

Comprehensive GEANT4 simulations, combined with realistic secondary cosmic ray spectra from EXPACS, were performed for all 10 SEVAN detectors operating in Armenia, Eastern Europe, and Germany. The resulting efficiency and purity coefficients quantify the response of each detector layer and coincidences to different particle species, while accounting for the attenuation of cosmic rays in building materials. These results provide the necessary correction factors for transforming measured count rates into particle intensities in the atmosphere above the detector roofs.

The newly generated tables allow direct comparison of particle fluxes between stations. This refined calibration transforms the SEVAN network from a particle-counting system into a high-precision network for space-weather and cosmic-ray studies. Future work will focus on applying these corrections to long-term datasets and validating the reconstructed spectra with upgraded SEVAN-Light detectors, which feature improved spectral and temporal resolution.

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