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Determination of Neutron Monitor Barometric Effect on the Base of the Altitude Cosmic Ray Intensity Dependence as Measured by the Israelo-Italian Mobile Laboratory

L.I. Dorman[1], N. Iucci[2], L. Pustilnik[3], G. Villoresi[4], and I.G. Zukerman[3]

[1]*IZMIRAN, 142092 Troitsk, Moscow, Russia; Technion, Haifa & Israel Cosmic Ray Center of Tel Aviv University, Qazrin 12900, Israel*

[2]*Dipartimento di Fisica "E. Amaldi", Università "Roma Tre", 00146 Rome, Italy*

[3]*Israel Cosmic Ray Center of Tel Aviv University, P.O.Box 2217, Qazrin 12900, Israel*

[4]*IFSI/CNR, c/o Dipartimento di Fisica, Università "Roma Tre", 00146 Rome, Italy*

Abstract

In the way of transferring the Israelo-Italian moving laboratory with 6NM-64 neutron monitor from Italy to the place of stationary operation we did measurements of total neutron intensity, air pressure and intensities of neutron multiplicities $m=1, m=2, m=3, m=4, m=5, m=6, m=7$ and $m \geq 8$ in Haifa port (sea level, air pressure about 750 *mm*Hg), in some intermediate points (about 626 *mm*Hg), and in the final position of Emilio Segre' Observatory (33°18.3′N, 35°47.2′E, 2025 m above sea level, $R_c = 10.8\,GV$). By these data we determined first approximation cosmic ray barometric coefficients for total neutron component and for different neutron multiplicities (information on primary cosmic ray variations on the basis of Rome neutron monitor data have been taken into account).

1 Introduction:

The Mobile Cosmic Ray Neutron Monitor (6NM-64) was prepared in the frame of the Israel-Italy Collaboration in Rome, and transferred to Israel in June 1998 (see short description of Mobile Neutron Monitor in Dorman et al., 1999a). We did measurements of air pressure, total neutron monitor counting rate and intensities of neutron multiplicities ≥1, ≥2, ≥3, ≥4, ≥5, ≥6, ≥7 and ≥8 in Haifa port (sea level), in one intermediate point (626 *mm*Hg), and in the final position of Emilio Segre' Observatory (33°18.3′N, 35°47.2′E, 2025 *m* above sea level, $R_c = 10.8\,GV$). By these data we determined approximately cosmic ray barometric coefficients for total neutron monitor counting rate, as well as for multiplicities 1, 2, 3, 4, 5, 6, 7, by taking into account information on primary cosmic ray variations from the Rome neutron monitor data.

2 Results of Measurements in Haifa Port:

The Israelo-Italian Cosmic Ray Observatory arrived to Haifa port in the morning of June 15, 1998 and after few hours we started to measure total neutron monitor counting rate and neutron multiplicities: between 11.57-12.20 UT and between 12.25-13-25 UT. In Haifa Port it was not allowed to do continuous measurements; in June 16 we did measurements between 11.59-15.03 UT. Results of neutron monitor total counting rate and of multiplicities 1, 2, 3, 4, 5, 6 and 7 at one-minute sampling rate are shown in Table 1.

Table 1: Results of measurements in Haifa port during 15-16 June, 1998. Natural logarithms of total counting rate and of multiplicities 1 to 7 at one-minute sampling rate are shown.

Day	Time, UT	P, *mm* Hg	Total	$m=1$	$m=2$	$m=3$	$m=4$	$m=5$	$m=6$	$m=7$
15.06	11.57-12.20	759.96	7.754	7.157	5.595	4.377	3.348	2.465	1.713	1.135
15.06	12.25-13.25	759.93	7.753	7.160	5.578	4.387	3.378	2.532	1.787	1.077
16.06	11.59-15.03	759.04	7.760	7.167	5.598	4.402	3.373	2.521	1.726	1.084

3 Results of Measurements in the Intermediate Point:

The intermediate point with air pressure about 626 *mm*Hg was reached by the Mobile Cosmic Ray Observatory on 19 June 1998 in early morning. We could do measurements only for about one hour.

Table 2: Results of measurements in the intermediate point on 19 June, 1998. Natural logarithms of total counting rate and of multiplicities 1 to 7 at one-minute sampling rate are shown.

Day	Time, UT	P, mm Hg	Total	$m=1$	$m=2$	$m=3$	$m=4$	$m=5$	$m=6$	$m=7$
19.06	08.49-09.57.	625.98	9.020	8.289	6.933	5.815	4.851	4.007	3.304	2.661

4 Results of Measurements in the Final Position of Emilio Segre' Observatory:

The final position of Emilio Segre' Observatory was reached about one hour after leaving the intermediate point; immediately we did measurements for about 1.5 hours. Results of measurements of neutron monitor total counting rate and of multiplicities 1, 2, 3, 4, 5, 6 and 7 at one-minute sampling rate are shown in Table 3.

Table 3: Results of measurements in the final position of Emilio Segre' Observatory on 19 June, 1998. Natural logarithms of total counting rate and of multiplicities 1 to 7 at one-minute sampling rate are shown.

Day	Time, UT	P, mm Hg	Total	$m=1$	$m=2$	$m=3$	$m=4$	$m=5$	$m=6$	$m=7$
19.06	10.59-12.25	598.02	9.267	8.487	7.198	6.122	5.160	4.342	3.637	2.997

5 Results of Simultaneous Measurements by the Rome Neutron Monitor:

To correct data of Mobile Cosmic Ray Observatory for primary variations we used data of Rome 17NM-64 neutron monitor corrected for barometric effect (see Table 4).

Table 4: Results of simultaneous measurements by the Rome 17NM-64 neutron monitor on 15, 16 and 19 June, 1998. Natural logarithms of uncorrected and corrected total 5-minute counting rate are shown.

Day	Time UT	*P* *mm*Hg	Total uncorrected	Total corrected
15.06	11.57-12.20	763.02	8.225	8.216
15.06	12.25-13.25	763.02	8.225	8.216
16.06	11.59-15.03	763.14	8.211	8.203
19.06	08.49-09.57	765.67	8.187	8.202
19.06	10.59-12.25	765.31	8.193	8.205

6 Determination of First-Approximation Attenuation Coefficients for Total Counting Rate and Multiplicities *m*=1,2,3,4,5,6,7 between Sea-Level and Intermediate Point, and between Intermediate Point and Final Position of Emilio Segre' Observatory:

After correction of data listed in Tables 1-3 for primary variations by data of Table 4, we used the obtained results to determine first-approximation attenuation coefficients for total counting rate and multiplicities $m=1,2,3,4,5,6,7$ between sea level and intermediate point according to:

$$\beta_{tot}^{(1)}(sl \div ip) = \frac{\ln\left(I_{tot}^{ip}\right) - \ln\left(I_{tot}^{sl}\right)}{h_{sl} - h_{ip}};\ \beta_{m}^{(1)}(sl \div ip) = \frac{\ln\left(I_{m}^{ip}\right) - \ln\left(I_{m}^{sl}\right)}{h_{sl} - h_{ip}},\ (1)$$

and between intermediate point and final position of Emilio Segre' Observatory according to:

$$\beta_{tot}^{(1)}(ip \div fp) = \frac{\ln\left(I_{tot}^{fp}\right) - \ln\left(I_{tot}^{ip}\right)}{h_{ip} - h_{fp}};\ \beta_{m}^{(1)}(ip \div fp) = \frac{\ln\left(I_{m}^{fp}\right) - \ln\left(I_{m}^{ip}\right)}{h_{ip} - h_{fp}}\ .\ (2)$$

Results are listed in Table 5.

Table 5: Attenuation coefficients for total counting rate and multiplicities $m = 1, 2, 3, 4, 5, 6, 7$ between sea level and intermediate point $(sl \div ip)$ and between intermediate point and final position of Emilio Segre' Observatory $(ip \div fp)$ in units of $(mm\ \mathrm{Hg})^{-1}$.

Levels	Total	$m=1$	$m=2$	$m=3$	$m=4$	$m=5$	$m=6$	$m=7$
$(sl \div ip)$	0.00946	0.00844	0.01005	0.01067	0.01111	0.01123	0.01168	0.01169
$(ip \div fp)$	0.00886	0.00707	0.00950	0.01097	0.01106	0.01197	0.01192	0.01201

We will use these results in Dorman et al. (1999b) for first approximation correction for barometric effect of observation data at the Emilio Segre' Observatory during the period June-December 1998. After correction for primary variations it will be possible to determine attenuation coefficients for the total counting rate and multiplicities *m*=1,2,3,4,5,6,7 with much more accuracy by the method of correlation with air pressure data.

References

Dorman, L.I. et al. 1999a, Proc. 26th ICRC, Paper SH 3.6.43
Dorman, L.I. et al. 1999b, Proc. 26th ICRC, Paper SH 3.6.23