THE ENERGY SPECTRUM OF THE COSMIC RAY EMISSION ON 28 JANUARY 1967

PAVEL CHALOUPKA, JOZEF ILENČÍK, Košice

On the 28th of January 1967 there occured an emission of cosmic rays from the Sun. In this article we deal with the time dependence of the particles emitted from the Sun on the exponent of the energy spectrum. We used data obtained at 16 stations, the list of which is given in Table 1.

The values of the neutron component intensity were plotted against those of the cutoff rigidity R on the basis of obtained data. The values of R used here have been calculated by Finch and Leaton [1]. Figures 1a, b, c give the time dependence of the relative changes of the intensity of the neutron component on 28th and 29th January 1967 at *Alert*, *Leeds* and *Pic du Midi*.

The dependence of the maximum amplitude of the variation $\left|\frac{\delta N}{N}\right|_{max}$ (in per cents) of the neutron component on the cutoff rigidity is shown in Fig. 2. (The stations are denoted according to Table 1.)

Table 1

		geographic lattitude	geographic longitude	altitude above see level [m]	cutoff rigidity [GV]
1. *Alert*	(Canada)	82,50	— 62.33	66	0.05
2. *Churchill*	(Canada)	58.75	— 94.09	39	0.21
3. *Dallas*	(USA)	32.78	— 96.80	208	4.35
4. *Deep River*	(Canada)	46.10	— 77.50	145	1.02
5. *Denver*	(USA)	39.75	—105.00	0	2.91
6. *Goose Bay*	(Canada)	53.33	— 60.42	46	0.52
7. *Inuvik*	(Canada)	68.35	—133.73	21	0.18
8. *Ottava*	(Canada)	45.40	— 75.60	0	1.08
9. *Kiel*	(Germany)	54.33	10.13	0	2.29
10. *Leeds*	(England)	53.82	— 1.55	100	2.20
11. *Lomnický štít*	(Czechoslovakia)	49.20	20.22	2634	4.00
12. *London*	(England)	51.53	— 0.09	45	2.73
13. *Roma*	(Italy)	41.90	12.52	60	6.31
14. *Oulu*	(Finland)	65.01	25.30	0	0.81
15. *Uppsala*	(Sweden)	59.85	17.92	0	1.43
16. *Pic du Midi*	(France)	42.93	0.25	2860	5.36

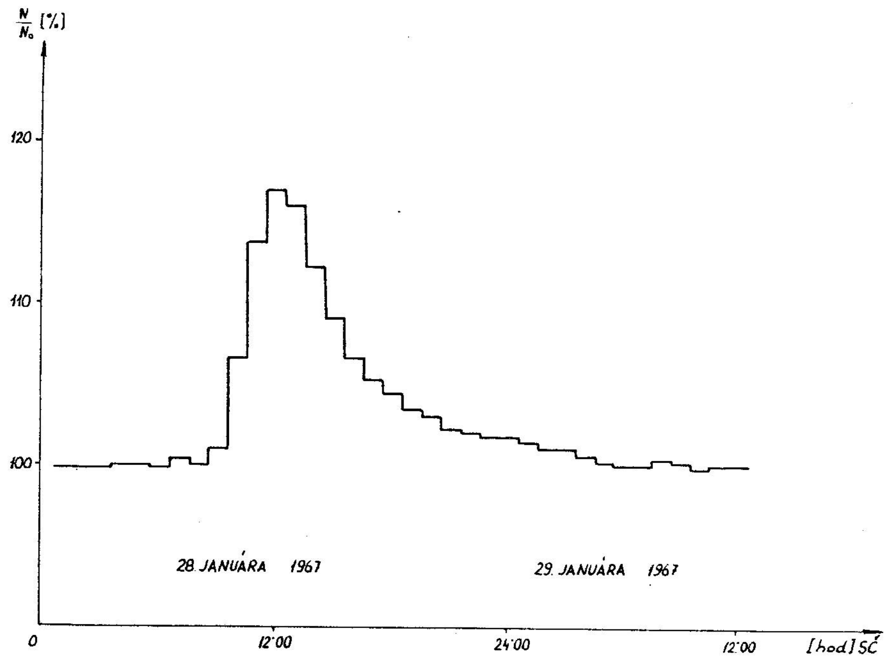

Fig. 1a.

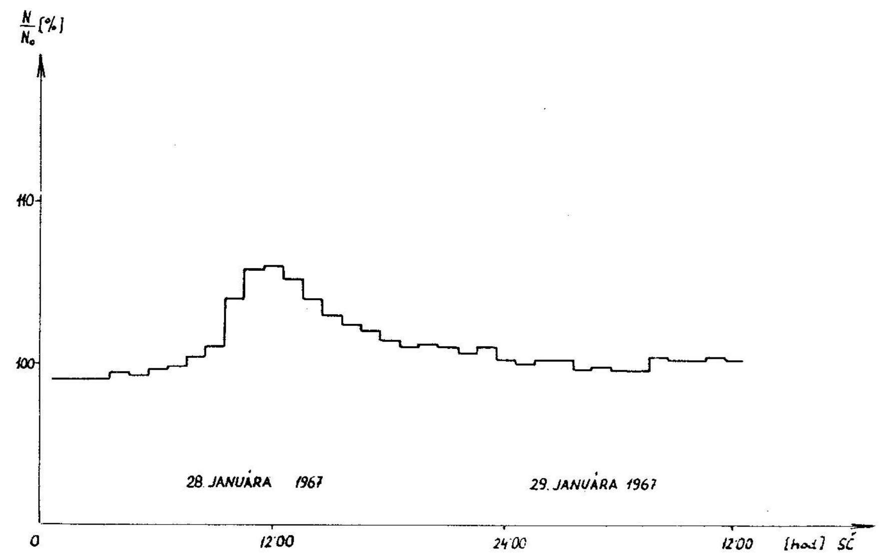

Fig. 1b.

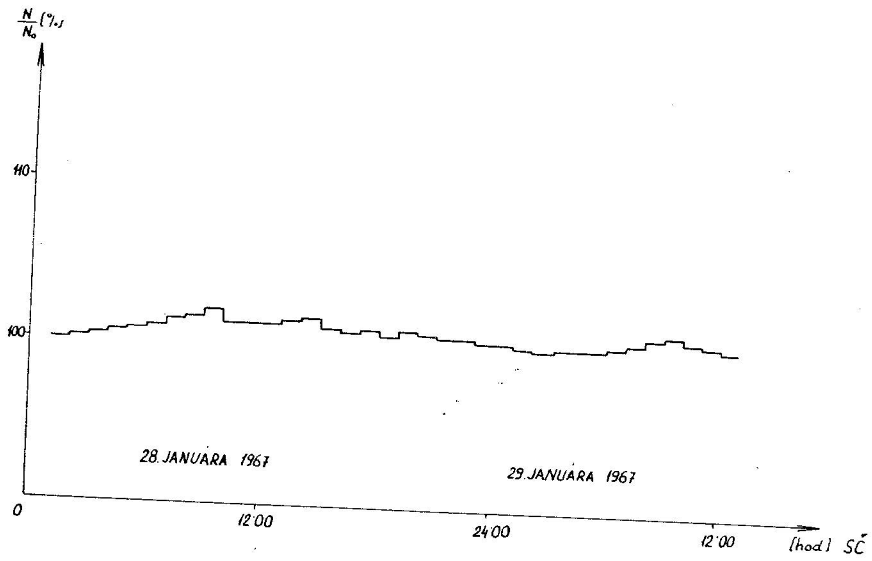

Fig. 1c.

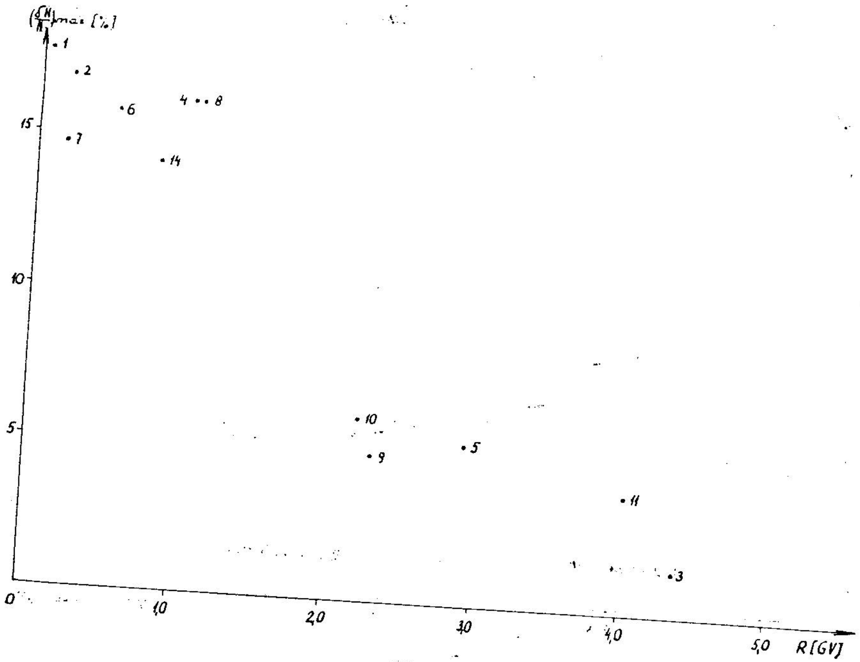

Fig. 2.

The energy spectrum of the emission on 28th January 1967 was determined by means of the method of coupling coefficients [2]. The intensity given by *Alert* was used as the normal level of the neutron intensity. The ratio $\left|\frac{\delta D}{D}\right|$ was calculated for the range of the cutoff rigidity R from 0.05 GV to 4.35 GV, and for the time from 10.00 UT to 15.00 UT on 28th January 1967 (see Figs. 3a, b, c, d, e, f).

From the time dependence of the energy spectrum of the particles we may draw the following conclusions:

a) At the beginning of the event the energy spectrum is flat till $R \leqslant 1$ GV, and then decreases according to the power law $R^{-\alpha}$, α being 1.6 ± 0.5 (Fig. 3a).

b) During the maximum of the effect the spectrum is flat till $R = 0.5$ GV and then decreases with the exponent $\alpha = 1.5 \pm 0.3$ (Fig. 3b). This is due to the fact that the increase is slower in the lower regions of the energy spectrum than the increase of the high-energy end in the spectrum.

c) After 12.00 UT there is a break of the energy spectrum at $R = 1$ GV

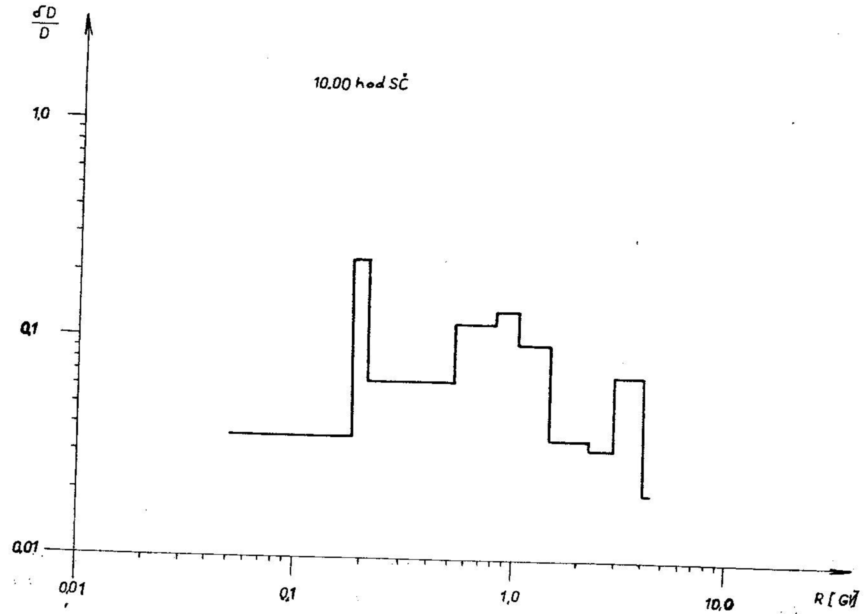

Fig. 3a.

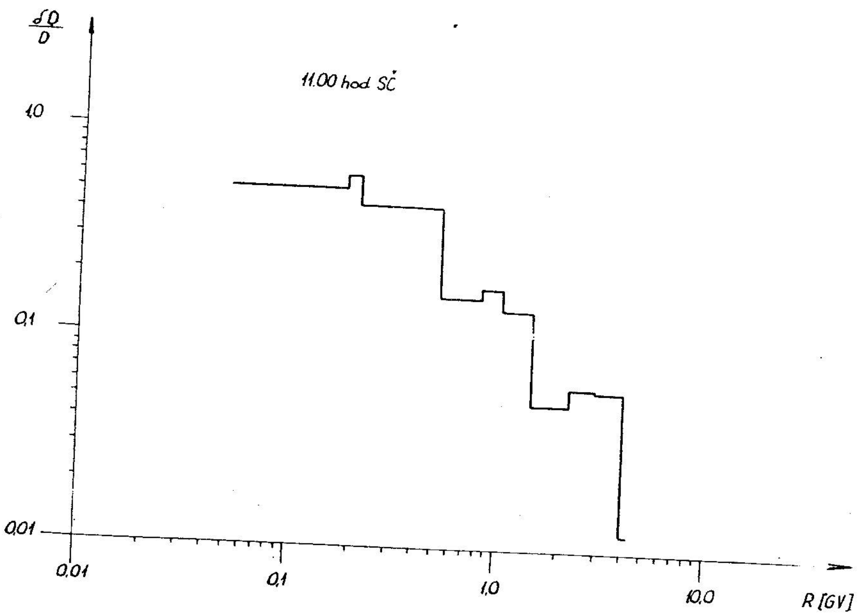

Fig. 3b.

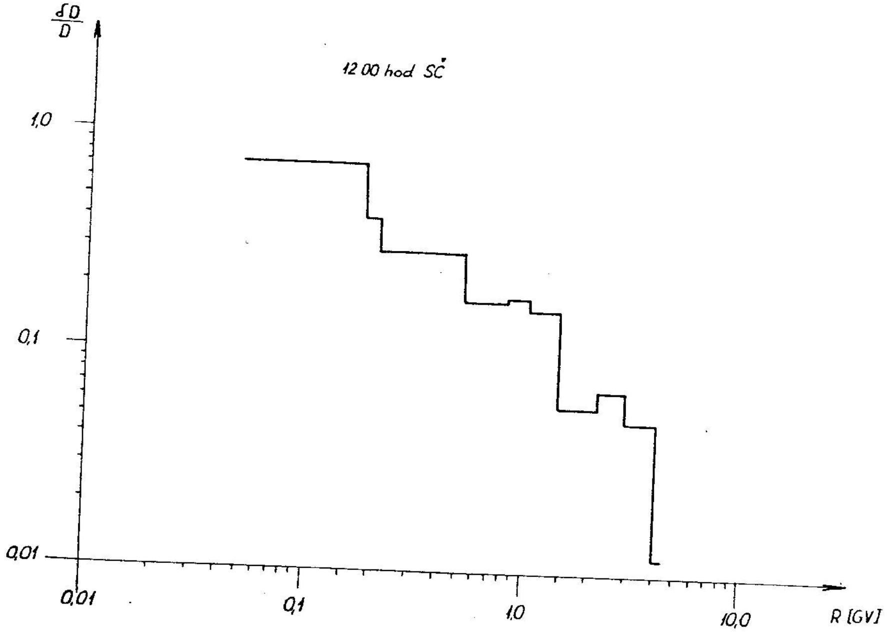

Fig. 3c.

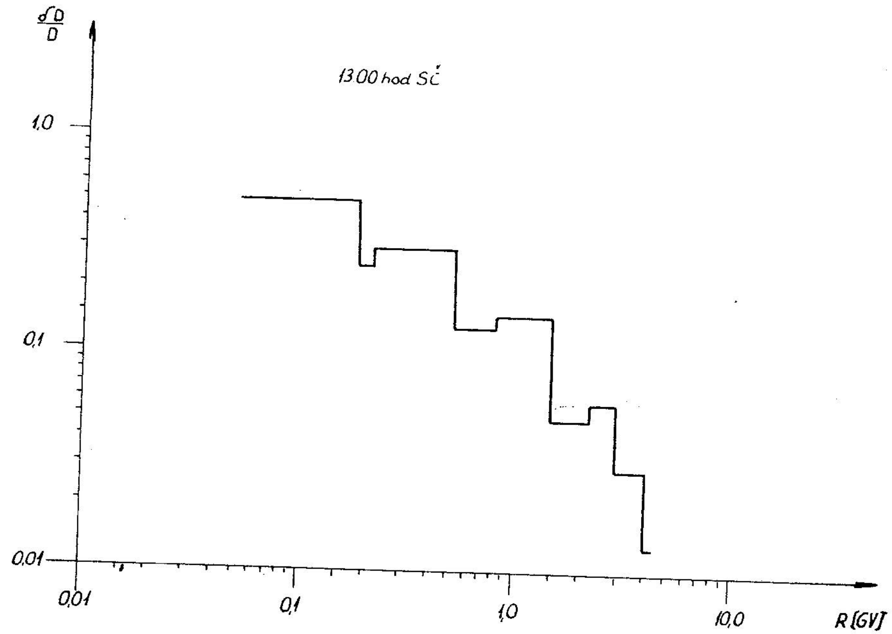

Fig. 3d.

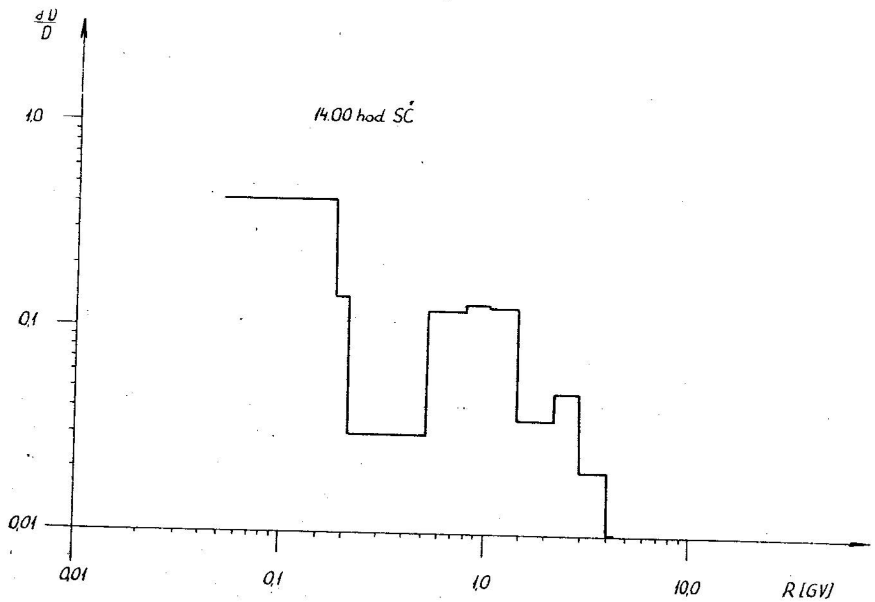

Fig. 3e.

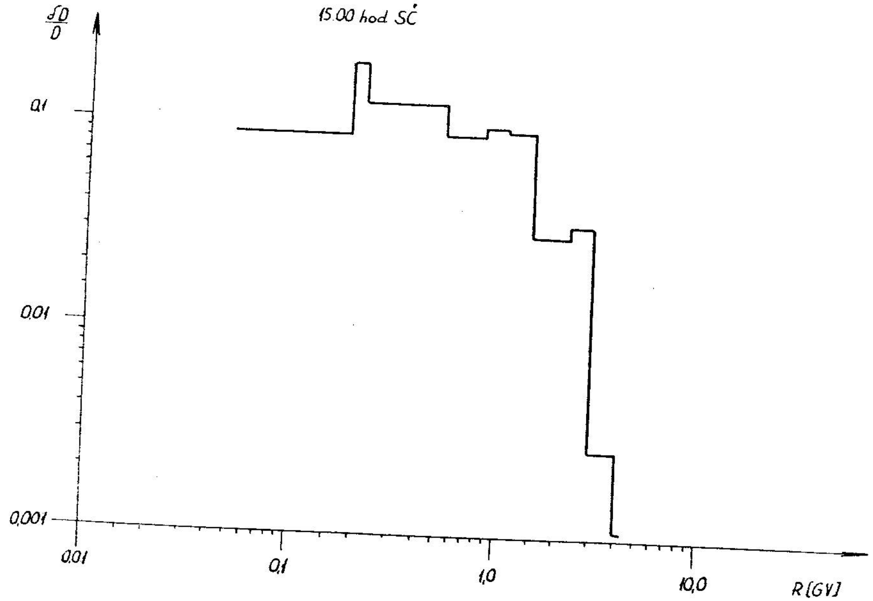

Fig. 3f.

(Fig. 3c). The exponent in the power law $R^{-\alpha}$ is for $0.05\ \mathrm{GV} \leqslant R < 1\ \mathrm{GV}$ equal to 0.35 ± 0.09 and for $1\ \mathrm{GV} \leqslant R \leqslant 4.35$ the exponent equals to 1.5 ± 0.3.

d) At the end of the event the energy spectrum is flat again for $R = 1$ GV and then decreases sharply with the exponent $\alpha = 2.2 \pm 0.4$ (Fig. 3f).

The fact that the values measured both in the American and European zone lie on the same smooth curve $\frac{\delta D}{D} = f(R)$ irrespectively of the time at which the ratio $\frac{\delta D}{D}$ is determined shows that in the given case the observed effect was isotropic.

From this and from the time dependence of the energy spectrum we may conclude that the particles either were trapped for some time in a magnetic trap, or difunded perpendicularly in the direction of the radial magnetic field in the interplanetary space [3]. In both cases it will be very difficult to localize the region of the Sun, where these particles were accelerated.

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Ústav experimentálnej fyziky SAV,
Košice