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II-3B-15. Short-Term Increases of the Cosmic-Ray Nuclei Intensity Associated with the Solar Activity*

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Cherenkov counters for the detection of the cosmic-ray nuclei were installed on the board the space probes and space ships (Sputniks). Counters on the second Soviet space probe (Lunik II, 1959) had detected nuclei with the charge $Z \geq 2$ (Z more or equal to 2) (the first counter) and with $Z \geq 5$ and $Z \geq 15$ (the second counter). The counting rate, got by averaging over the great time intervals was practically constant after the probe had passed the outer radiation belt. But one observed sometimes counting rate being during the separate short time intervals considerably above the mean values. Four of such events are listed in the table.

The event registered on the 12-th of September at 11.27 UT is the most prominent. Fig. 1 gives some data about the time dependence of the fluxes of nuclei with $Z \geq 2$, $Z \geq 5$ and $Z \geq 15$ and there are also some information about the solar flares and solar radio outbursts (frequency 810 and 208 Mc/sec) in Fig. 1. (We give Universal Time/U.T./along the axis). The counting rates increased in the all three canals (during the 17 minutes' interval) and were 1.3 ± 0.3, 0.5 ± 0.3 and 11.8 ± 3.7 times the mean value (dashed line in Fig. 1 in each of slide) in each of the 3 canals correspondingly.

The analysis showed such increases could not be statistical fluctuations (the probability of this was less than 10^{-5} for the canal $Z \geq 2$ and by some orders less for the canal $Z \geq 15$).

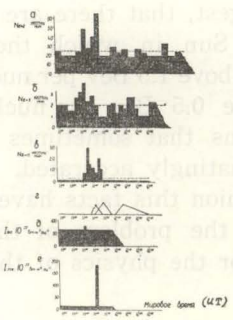

Fig. 1.

Another example of the counting rate increase for the canal $Z \geq 2$ is shown in Fig. 2. This event had place on the 13-th of September at 7.05 U.T. Unfortunately, we had no information about the counting rates in the canals $Z \geq 5$ and $Z \geq 15$ at the same time.

This event and two others listed in the table cannot also be explaned by the statistical fluctuations. They all must be considered as the events of the cosmic-ray intensity variations.

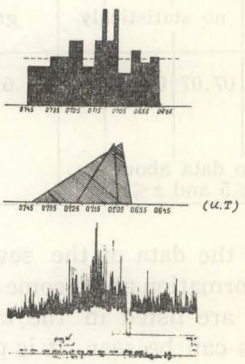

Fig. 2.

The variations of the cosmic-ray heavy nuclei fluxes naturally have to give rise to the ionization created by cosmic rays. For instance, in the event shown in Fig. 1 the increase of the fluxes of the nuclei with $Z \geq 2$ and $Z \geq 15$ would be accompanied by the short-term increase of the ionization at 3 ± 1 and 19.5 ± 6 percents correspondingly. Unfortunately, we did not make such ionization measurements simultaneously.

The short-term character of the observed intensity increases suggests the connection with the transient processes on the Sun, for instance, with the solar flares and radio outbursts. In order to make such comparison

* This paper was read by. N. A. Dobrotin.

Table I.

Date	Cosmic ray nuclei					Optical solar flares					Unusual phenomena in the solar radioemission					
		time of increase				time of flace					time					
Sept. 1959	charge	beginning h, m	end h, m	duration m	ratio to the average intensity	beginning h, m	end h, m	maximum of the intensity h, m	duration m	importance	beginning h, m	end h, m	maximum of the intensity h, m	frequency Mc/sec	intensity 10^{-22} watt m^{-2} (c/sec)$^{-1}$	main features
12	$z \leqq 2$				1.3											Lonely outburst duration
	$z \leqq 5$	11.27	11.44	17	1.5	11.36	11.45	11.39	9	1^-	11.29	11.29	11.29	810	74	<0.3min
	$z \leqq 15$				11.8	11.39	11.54	—	15	1^-	06.00	12.00	11.37	208	170	Short outburst (<1min) on the backgrou- nd of long noise storm. Long noise storm
											06.40	13.17	06.50	231	65	
	$z \leqq 2$	no statistically grounded increase														
	$z \leqq 5$															
	$z \leqq 15$	12.57	13.10	13	6	12.45	13.40	—	55	1^-	06.40	13.17	06.50	236	65	
	$z \leqq 2$				1.3											
	$z \leqq 15$	15.23	15.48	25	4	15.08	15.20	—	>12	1^-						
	$z \leqq 5$	no statisticaly				grounded increase										
13	$z \leqq 2$	07.07	07.14	7	1.6	07.04	07.22	07.06	18	1	06.00	12.00	07.13	208	169	Long noise storm
						06.58	07.42	07.03	44	1	06.05	15.10	13.20	231	70	
		no data about $z \leqq 5$ and $z \leqq 15$									07.00	11.30	10.06	178	136	

we studied the data of the several observatories. Information about some accompanying phenomena are listed in the table (colums 3 and 4). As can be seen, it is possible to find out a time-correlated flare (but having comparatively small importance: 1 or 1^-) in all cases and for two of four events one detects close-correlated radio bursts and for one event only a long noise storm. The probability of the random coincidence of the discussed increases with the solar flares is comparatively high, but in case with the relatively rare phenomenon like a great radioburst it is sufficiently low (not higher than 10^{-2}).

A similar counter on the 3 space ship (Sputnik VI, 1960 ρ) on the 1-st of December also detected a short-time increase of the flux of the cosmic-ray nuclei with $Z \geq 13 \simeq 14$ (2.8 ± 1.4 times). This increase correlated with the solar flare (importance 1^+) and radioburst.

So the existence of the short-term variations of intensity of cosmic-ray nuclei detected by Cherenkov counters and the connection of these variations with the solar activity suggest, that there are some processes on the Sun in which the nuclei are accelerated above 1.5 Bev per nucleon (kinetic energy above 0.5 Bev per nucleon). There are indications that sometimes heavy nuclei are predominatingly accerated.

In our opinion this facts have a sufficient interest for the problem of the cosmic-ray origin and for the physics of the Sun.