A CASE OF A SHARP INCREASE IN COSMIC-RAY INTENSITY IN THE STRATOSPHERE

N. P. RYMKO, V. F. TULINOV, and A. N. CHARAKHCH'YAN

P. N. Lebedev Physics Institute, Academy of Sciences U.S.S.R.

Submitted to JETP editor January 16, 1959

J. Exptl. Theoret. Phys. (U.S.S.R.) **36**, 1687-1689 (June, 1959)

An increase in the intensity of cosmic radiation was observed in the stratosphere on July 8, 1958 at a latitude of 64° N. At an altitude of 30 km, the intensity was more than twice the normal value. On the other hand, no increase was observed at latitudes of 51° and 41°.

ON July 8, 1958, an anomalously large increase in the intensity of cosmic radiation was observed during measurements in the stratosphere at 64° geomagnetic latitude at the Loparskaya Station (the Northern Scientific Station of the Academy of Sciences U.S.S.R.). The measurements were carried out by means of a single Geiger counter, using the cosmic-ray radio-sonde RK-1 described in reference 1.

Results of measurements carried out on July 8, 1958 are shown in Fig. 1. The statistical accuracy of the data amounts to ~ 2% for pressures greater than 250 g/cm^2, and to 1 — 0.5% for higher altitudes. For a comparison, the average altitude dependence obtained in measurements conducted on July 1, 3, and 7, 1958, is given in the figure.

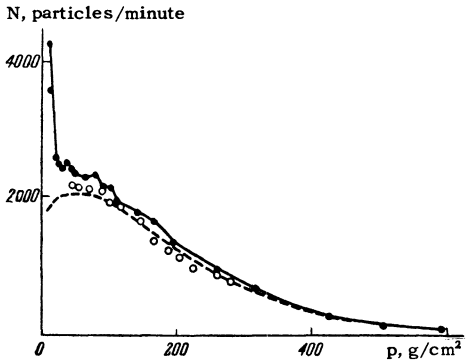

FIG. 1. Number of particles per minute as a function of the atmospheric pressure at the latitude of 64°N: ● and ○ — results of measurements on July 8, 1958 during the ascent and descent of the apparatus respectively (time of start: 10 am Moscow time); dotted curve — average value of the number of particles obtained in measurements on July 1, 3 and 7, 1958.

As can be seen from Fig. 1, the greatest increase of the intensity of cosmic radiation was observed at the highest altitude. An especially fast increase in the number of particles occurred at pressures < 20 g/cm^2, which is clearly due to the increased intensity of primary particles of low energies. The range of these particles, judging from the absorption curve is smaller than 15 — 20 g/cm^2.

On July 8, 5 hr 35 min after the first series of measurements, a second series of measurements was carried out in the stratosphere, during which the apparatus attained higher altitudes. However, no increase of intensity was observed in this case. On the contrary, the measured number of particles was lower than the normal by about 10%. Data corresponding to the time when the flare ended can clearly be obtained from the results of the first flight. From the data of Fig. 1 (light points) it can be seen that, during the descent of the apparatus, the measured intensity almost approached the normal at a pressure of ~ 100 g/cm^2, which corresponds to about 12:30 p.m.

Analogous measurements of intensity of cosmic radiation in the stratosphere on July 8 were carried out near Moscow (Dolgroprudnaya Scientific Station of the Physical Institute of the Academy of Sciences U.S.S.R.) and in Simeiz (Crimean Scientific Station of the Physical Institute of the Academy of Sciences). The RK-1 radiosonde sent to the stratosphere at Dolgroprudnaya did not attain large altitudes. However, data up to the altitude of 19 — 20 km at which the measurements were carried out showed that, at the time of the measurements at the Loparskaya Station, the intensity of cosmic rays was 8 or 10% less than normal. The results of measurements made in Simeiz on July 8 coincide with the data obtained on July 4, 3, and 7 at the same place with an accuracy of ±1.5% in the maximum of intensity curve. In the Report on Cosmic Data of the Scientific Institute for the Research of Magnetism, Ionosphere and Propagation of Radio Waves,[2] data on the observation of a very large magnetic storm and ionospheric disturbances are reported for July 8, 1958. Results of measurements of the intensity

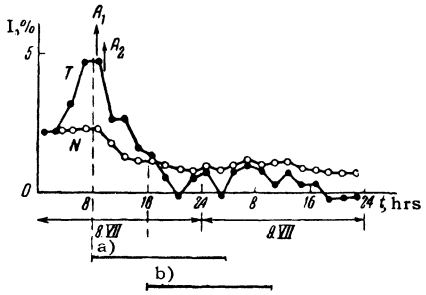

FIG. 2. Intensity of cosmic rays at the surface of the earth (Moscow) on July 8, 1958. ● – for μ meson and o – for neutron components (World Time). a) Very large magnetic storm; b) Large ionospheric disturbance.

of cosmic rays on the surface of the earth on July 8 and 9, according to the report are shown in Fig. 2. The y-axis represents the intensity expressed as the percentage of a constant value. The x-axis represents the time of measurement (World Time). Curve T refers to measurements using a cubic telescope, and curve N to measurements of a neutron monitor. Data on the measurement of the neutron monitor (N) for the first hour of measurements on July 8 are normalized to the corresponding data of the cubic telescope (T). The duration of magnetic storms and ionospheric disturbances are also indicated in the figure. A_1 in the figure denotes the time during which the sharpest increase in the number of particles in the atmosphere was recorded at the altitude of ~ 30 km, and A_2 indicates the time when, according to the data taken in the stratosphere, the intensity of the cosmic radiation returned to approximately the normal value.

Attention is drawn to the fact that during a period of about 3 to 9 hours the curves obtained with the telescope indicate an increase in the intensity of cosmic rays on the surface of the earth, while the neutron monitor shows practically a constant value of intensity.

The intensities of cosmic rays at the surface of earth recorded by the cubic telescope and by the neutron monitor correspond to different parts of the energy spectrum of primary particles. The increase in intensity in the measurements of the cubic telescope (μ mesons) corresponds to the increase in the number of cosmic particles with energies mainly $> 10^{10}$ ev. The neutron monitor records the nucleonic component due also to primary particles of lower energies. One should expect, therefore, a stronger deviation of the measurements of the neutron monitor in the same direction as the cubic telescope. Consequently, to make the readings of the various instruments consistent for the period of measurements from 3 to 9 hours, one should evidently draw the following conclusion: together with the increase of the intensity of primary particles in the range of sufficiently high energies ($> 10^{10}$ev), a decrease occurred in the intensity of primary particles in the range of low energies. The latter is in agreement with the data of stratospherical measurements at a latitude of 51° given above.

Hence, from the preliminary analysis of the experimental data in the stratosphere at geomagnetic latitudes of 64, 51, and 41° and also of data obtained at the surface of earth, one can draw the following conclusion on the intensity variation of the primary cosmic radiation on July 8, 1958:

A large increase in the intensity of cosmic radiation in the stratosphere occurred due to primary cosmic particles with energy smaller than 1.5×10^9 ev (for protons). The increase in the number of low-energy primary particles was accompanied by a decrease in the intensity of primary particles of moderate energy ($10^{10} > E > 1.5 \times 10^9$ ev) and an increase in intensity of primary particles of higher energies ($> 10^{10}$ ev).

The authors would like to express their deep gratitude to S. N. Vernov for his interest in the work and discussion of the results, and to A. G. Bednyakov for help in carrying out the measurements.

[1] Vernov, Tulinov, and Charakhch'yan, Dokl. Akad. Nauk SSSR **122**, 788 (1958), Soviet Phys. "Doklady" **3**, 980 (1958).

[2] Космические данные (Cosmic Data) (monthly report), 7 (29), Moscow, Gidrometeizdat, 1958.

Translated by H. Kasha
348