THE ABSORPTION LENGTH FOR SOLAR PARTICLES IN THE EARTH'S ATMOSPHERE. SOLAR PROTON EVENT NOVEMBER 18, 1968

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When studying the variations of the secondary nucleon component of cosmic rays (CR), it is necessary to correct the measured intensity for an atmospheric pressure. The correction is made accordind to the formula in which the exponential absorption of the nucleon cascade in the Earth's atmosphere forms the basis:

$$N_c = N_u \exp[(P - \overline{P})/\lambda],$$

where N_c, N_u — corrected and uncorrected intensity of the secondary component of CR, P — atmospheric pressure, $\overline{P}$ — reference atmospheric pressure (usually an averaged atmospheric pressure), λ — absorption length of the secondary nucleon component of CR in the atmosphere.

The values of λ are found experimentally for each station and they lie in the interval of 130—140 mbar.

The situation is substantially more complicated when registering additional radiation from a solar source (solar CR). The energetic spectrum of the solar CR is steeper and softer than that of the galactic CR and consequently we can expect that the absorption length in the atmosphere will be smaller for the nucleon component of the solar CR than the equivalent of the absorption length for the hard galactic CR [1].

There is described a method in a paper by Wilson [2] how to determine the absorption length of the nucleon component of CR in the atmosphere directly by using the data from supermonitors of those stations which are located at different altitudes but which have the same cutoff rigidity and approximately equal asymptotic cones of receipt of the detected particles.

Emission of the solar cosmic rays caused by the November 18, 1968 flare (position 22° N, 87° W, imp. 2n, phase Y 10.28 — 10.35 UT — emission of very fast particles) [3] was registered by supermonitors at the Sulphur Mountain and Calgary, station fulfilling the above-mentioned conditions (Fig. 1).

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Using equation [2]

$$\Delta I_s(\mathrm{SM})/\Delta I_s(\mathrm{Cal}) = \exp[(\alpha - \beta)\Delta p],$$

where α, β are the absorption lengths in the Earth's atmosphere for the solar and galactic components of CR and $\Delta I_s(\mathrm{SM})/\Delta I_s(\mathrm{Cal})$ is the ratio of percentual increases of solar CR intensities, and supposing that during the time when the phenomenon was studied the galactic component of CR was not disturbed, we receive for α the value of (106 ± 2)g cm^{-2}. During the isotropic stage of the phenomenon the ratio of the percentual increases was equal to 1.31 ± 0.23.

Regarding the fact that when calculating the rigidity spectrum, the diffusion coefficient and other parameters characterizing the complex solution of the problems connected with the solar CR the percentual increases at different station must be used, it is necessary to take into account the effective absorption length

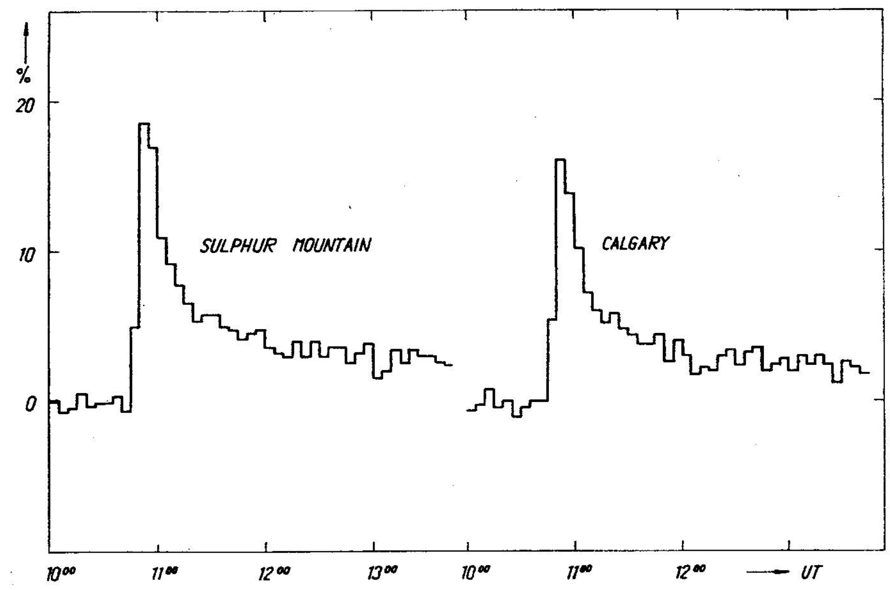

Fig. 1. Solar-flare increase as observed by supermonitors at Sulphur Mountain and Calgary of November 18, 1968.

$$1/\lambda = 1/\alpha - 1/\beta$$

and to calculate the percentual increases by a method of double absorption lengths.

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