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CALCULATION OF FLUCTUATIONS OF THE LATERAL DISTRIBUTION OF EXTENSIVE ATMOSPHERIC SHOWER PARTICLES

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The "age" (S) distribution of showers is calculated for showers containing a given number of particles N at a given depth in the atmosphere. The calculations are performed for N = 10^5, 10^6, and 10^7.

THE study of the characteristics of extensive air showers has become widespread in recent years. It has been observed, along with other facts, that even in showers having the same number of particles, the lateral particle distribution can vary greatly from case to case.[1,2]

In an earlier paper[3] we consider the development of extensive air showers in the case when the inelasticity coefficient in the interaction between high-energy particles and light nuclei varies over a wide range. To simplify the calculation we assumed there that extensive air showers are generated in interactions characterized by large values of the inelasticity coefficient (close to unity). It was also assumed that interactions with large energy loss cause all the particle energy to be transferred to a single photon and that the shower develops subsequently as a pure electron-photon cascade. The calculations performed have shown that this mechanism for the development of extensive air showers leads to large fluctuations of the lateral particle distribution (cascade parameter S). The calculations in [3] pertained to showers with 10^4 particles. In the present note we report the results of analogous calculations for the distribution of extensive air showers with 10^5—10^7 particles with respect to the magnitude of the cascade parameter S.

The calculations were made for two observation levels—sea level (depth of atmosphere 1000 g/cm^2) and mountain altitude (depth of atmosphere 640 g/cm^2), for showers containing 10^5, 10^6, and 10^7 particles. Figures 1 and 2 show the S-distribution of showers consisting of 10^5 (solid line) 10^6 (dashed line) and 10^7 (dots) particles. The abscissas represent the parameter S, the ordinates the relative number of showers (in per cent), characterized by values of the parameter S within the corresponding interval.

The calculations show that as the size of the shower and the height of the observation level increase, the fluctuations in the lateral distribution of the particles decrease. For showers with 10^6—10^7 particles registered at mountain altitudes, the fluctuations in the lateral distribution of the particles are small.

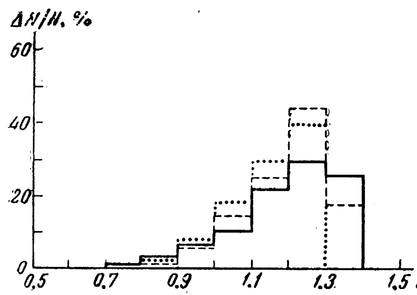

FIG. 1. Distribution of showers with 10^5, 10^6, and 10^7 particles with respect to the cascade parameter S at sea level (depth of the atmosphere 1000 g/cm^2).

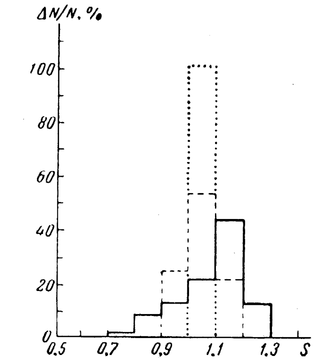

FIG. 2. Distribution of showers with 10^5, 10^6, and 10^7 particles relative to the cascade parameter S at mountain altitudes (depth of atmosphere 640 g/cm^2).

[1] Vernov, Goryunov, Dmitriev, Kulikov, Nechin, Solov'eva, Strugal'skiĭ, and Khristiansen, Proceedings of International Conference on Cosmic Rays, IUPAP, vol. 2, AN SSSR, 1960, p. 117.

[2] Miyake, Hinotani, Kazumato, and Kaneko, ibid, p. 66.

[3] N. L. Girgorov, and V. Ya. Shestoperov, JETP **34**, 1539 (1958), Soviet Phys. JETP **7**, 1061 (1958).

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