Contribution ID: **34** Type: **Overview**

Temperature effect of muons in the atmosphere and diagnostics of the thermobaric regime of the atmosphere using cosmic rays

Thursday, 10 June 2021 11:35 (25 minutes)

Variations in the intensity of cosmic rays observed in the depth of the atmosphere include the atmospheric component of the variations. Muon telescopes of cosmic rays, along with the barometric effect, have a significant temperature effect due to the instability of the detected particles. These variations, caused by changes in atmospheric temperature, are superimposed on continuous observations of muon telescopes. Therefore, their exclusion is extremely necessary, especially in the data of modern muon telescopes, the statistical accuracy of which is very high. The contributions of different layers of the atmosphere to the total temperature effect for muons are not the same. This contribution is characterized by the distribution of the density of temperature coefficients for muons in the atmosphere. To correctly take into account the temperature effect in the data of muon telescopes, it is necessary to know the distribution of the density of temperature coefficients for muons in the atmosphere and data on the altitude profile of the atmospheric temperature. Temperature coefficients have been found by now using calculations that contain a number of assumptions and do not take into account many geometric and design features of telescopes. The availability of upper-air sounding data is limited. The estimation of the meteorological coefficients of the intensity of muons recorded in the depth of the atmosphere was carried out according to the data of long-term continuous observations using various methods of factor analysis: correlation-regression analysis and the method of principal components. The temperature component of variations in the intensity of muons was found using spectrographic analysis of data from a complex of observations of the nuclear-active, common ionizing and muon components of cosmic rays. The results obtained from the experimental data are compared with the results of theoretical calculations. Based on the data of the multichannel complex in Novosibirsk, which provides registration of the nuclear-active, common ionizing and muon components, temperature variations at various isobaric levels of the atmosphere over a long period have been found. The results obtained are compared with the data of aerological sounding. As a result, there is no need for aerological sounding data for muon telescopes. In the near future, it is planned to solve a similar problem for the Yakut cosmic ray spectrograph. Thus, cosmic ray stations with muon telescopes can also provide information on the temperature regime of the atmosphere.

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Session Classification: Cosmo- and geophysical aspects of cosmic rays

Track Classification: Cosmo- and geophysical aspects of cosmic rays