

Method of cosmic ray investigations in the wide energy range 10^{15} – 10^{19} eV by means of inclined EAS detection

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The new approach to investigations of inclined muon bundles, based on the local muon density spectra (LMDS) phenomenology allows to study primary cosmic rays in a wide energy interval from 10^{15} up to 10^{19} eV. The features of the proposed method for studying EAS are discussed. The transverse dimensions of EAS rapidly increase with increasing of the zenith angle and, hence, EAS in a wide energy interval can be explored by means of a relatively small coordinate-tracking detector, since in this case possibilities of EAS detection are determined not by array size, but by shower cross section area. In the paper, results of the analysis of the data on inclined muon bundles accumulated from 2002 to 2016 in the NEVOD-DECOR experiment are presented. For the first time, these results demonstrate with more than 3σ significance the existence of the second knee in the EAS muon component spectrum around 10^{17} eV of primary energy. An excess of muon bundles at energies about 1 EeV found earlier in DECOR data has been confirmed and analyzed in detail. One of possible explanations of obtained outcomes indicates the appearance of new processes of muon generation. To solve this “muon puzzle”, a long-term experiment on investigation of the energy loss of muon bundles at large zenith angles was started at the experimental complex combining the Cherenkov water calorimeter (2000 m³) and the coordinate-tracking detector DECOR; the preliminary results are discussed.

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