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A new method for searching for VHE muons in data from Cherenkov water neutrino telescopes

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Measuring the energy spectrum of very high-energy muons (VHE-muons) solves many problems of cosmic rays physics and nucleus-nucleus interactions. The most promising facilities for solving this problem are gigaton neutrino telescopes (IceCube, Baikal-GVD and KM3NeT). However, VHE-muons (E > 30-100 TeV) come into the detector accompanied by muon bundles of various multiplicities. In this case, it is difficult to distinguish muon bundles of large multiplicity from muon bundles of small multiplicity with a high-energy muon. The report is devoted to the development of a new method for distinguishing such events.

The essence of the developed method is the analysis of the longitudinal profile of energy loss and the selection of events according to the exponent index of the fitting function and the magnitude of fluctuations in energy loss.
To develop and adjust the method, simulations of the energy spectrum with a power index of 2.7 were performed in the energy range of $10^{14} - 10^{20}$ eV via the CORSIKA program. The spectrum of EAS muons was obtained. The energy losses of EAS muons and single VHE-muons with fixed energies 10, 31, 100, 316, 1000 TeV were simulated in the PROPOSAL software package. An algorithm has been developed for the muon bundles assembling based on the spectrum of EAS muons.

Various criteria for distinguishing events based on combinations of the exponent index of the longitudinal profile of the energy loss and the residual sum of squares are discussed in the report. The results of separating events with various bins in the longitudinal profile of the energy loss of the EAS muon component are shown.

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