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On the study of the muon energy spectrum in the Baikal-GVD neutrino telescope

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The muon component of the extensive atmospheric showers (EAS) is widely used in high-energy physics as a tool to study the processes of nucleus-nucleus interactions and decays of secondary particles. Information about muons with energies above 100 TeV can carry information about cosmic ray sources, as well as elements of "new physics", so the task of measuring the energy spectrum of such muons is promising. The only instrument for measuring the energy of ultrahigh-energy muons above 100 TeV are currently the gigaton neutrino telescopes (IceCube, Baikal-GVD). Very High Energy muons (VHE-muons), being born in the EAS, arrive at the facility accompanied by low multiplicity bundles. Such events are difficult to distinguish from events with large multiplicity bundles but without VHE-muon, since the total energy and energy release may be similar for such large bundles and single VHE-muons accompanied by small bundles. From this feature of VHE-muons, the necessity arises to develop a universal method to separate such events in gigaton neutrino telescopes. VHE-muons tend to lose their energy stochastically, sometimes in large portions, while the energy release of low-energy muons has a less expressed stochastic character. The peak-median ratio of the longitudinal energy release profile of an event allows us to exploit this feature and identify muon bundles with ultrahigh energy muons. In this work, we analyze the spectrum of EAS muon bundles and evaluate the possibility of registering and identifying muon bundles with VHE-muons using the peak-median ratio of the longitudinal energy release profile.

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