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Selection of optimal parameters of scintillation hodoscope model for the muonography method

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Variations of muon flux on the Earth surface arise as a result of influence of various processes in the heliosphere on primary cosmic ray flux, as well as during the passage of muons through the atmosphere. A high penetrating ability makes muons an attractive tool for muonography [1]. Muonography is the method, for the development of which muon hodoscopes TEMP and URAGAN were first created in MEPhI [2]. The task of this work is to create a model of a new scintillation muon hodoscope for the development of the method of muonography of large-sized objects. The model is based on a scintillation detector [3]. The registration of muon tracks is carried out by several layers of narrow long scintillation strips with fiber-optic light collection on silicon photomultipliers. The model of future scintillation muon hodoscope strip was created in the Geant4 program package [4], and all necessary optical properties were included. Then the model of a muon hodoscope consisting of four coordinate planes was created. Each coordinate plane consists of two layers (128 strips each) with mutually perpendicular strips. The strip model was calibrated according to experimental data, and more exact parameters of muon hodoscope model were obtained from calibration results. For simulation of muon hodoscope response to cosmic-ray particles passing through it, in order to obtain dependences most consistent with the experiment, the spectrum of cosmic-ray particles was simulated, which is close to a real one [5]. The tracks of muons were reconstructed [6] and accuracy of their reconstruction was estimated. The obtained distributions of events in the angle between reconstructed and "real" tracks for various detector parameters and selection of optimal parameters to achieve a highest accuracy and efficiency of reconstruction of muon tracks are discussed. The work was performed at the Unique Scientific Facility "Experimental complex NEVOD".

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