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Results of modeling of multi-wire drift chamber used in TREK detector

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The world's largest vertical coordinate detector TREK is assembled at MEPHI, it consists of 264 drift chambers and covers an area of 250 m². TREK along with Cherenkov water calorimeter NEVOD can estimate the specific energy deposit in water of muon component in inclined extensive air showers (EAS). This is necessary to resolve the muon puzzle: the deficit in the number of cosmic ray muons calculated using hadron interaction models compared with observations at energies greater than 10¹⁷ eV. The need to study the response of TREK to passing muon bundles necessitated modeling of the multi-wire drift chamber along with its associated amplifier circuit, the building blocks of TREK. First, the drift chamber was modeled, using Geant4 software package which allows simulation of particle passing through both the chamber and the entire detector, including the building. Then the drift chamber's response was simulated using Garfield++. The time-based current response of this drift chamber model was then translated into LTspice, a program based on spice-technology, in which the amplifier circuit AMP-04 was simulated. This sequential modeling showed quite close results, such as the efficiency of the signal channels was shown to be 98.6±0.2%, compared with the corresponding experimental measurement of 97.9±1.1%. This and similar comparison of other parameters will be presented at the conference. This sequence of simulations allows modelling of expected results of cosmic ray muon bundle registration, as well as collection of datasets for reconstruction methods based on machine learning.

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