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Investigation of the response of PRISMA-32 and URAN facilities to single hadrons using their models

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Hadrons are one of the main components of EAS, which is formed at the interaction of high-energy primary cosmic rays (CR) with the atmosphere. A new method has been developed for studying the hadron component of EAS. This method is based on registration of thermal neutrons that are generated as a result of interactions of shower hadrons with atomic nuclei in the atmosphere and at the surface of the Earth, and then thermalized. For registration of thermal neutrons, scintillation detectors based on ZnS(Ag) + LiF or ZnS(Ag) + B2O3 are used. The advantages of such detectors are good speed, high efficiency, ease of use and low cost.
At the Scientific and Educational Center NEVOD (MEPhI) in cooperation with INR RAS, PRISMA-32 array (overall area of the facility ⊠ 500 m^2) and URAN array (overall area of the facility is ⊠ 1000 m^2) were created to register the neutron component of EAS corresponding to E ⊠ 10^15 eV energy range of primary particles. To correctly interpret the experimental data obtained from these facilities, it is necessary to carry out model calculations.
For this purpose, the models of PRISMA-32 and URAN arrays were done on the base on the Geant4 simulation toolkit. Installations' geometry is close to real conditions. The thermal neutron detector is a thin layer of inorganic scintillator ZnS(Ag) + LiF for PRISMA-32 and ZnS(Ag) + B2O3 for URAN. The physical processes that are used in the model take into account the peculiarities of the interaction of thermal neutrons with matter. Calculations of the response of the installations to pions and neutrons of various energies generated in the roof of the building were carried out. The time distributions of thermal neutrons detected by the detectors were obtained. The influence of the location of the facilities on the response of the detectors was investigated. The obtained simulation results on the temporal distribution of neutrons show a qualitative agreement with experimental data obtained at PRISMA-32 and URAN.

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