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Status of the large-scale coordinate detector TREK for investigation of muon bundles in inclined extensive air showers

An excess of extensive air showers (EAS) muons was found in several experiments at energies above 10¹⁷ eV compared to estimates assuming even heavy composition of primary cosmic rays (PCR). Presently, the explanations for this excess are being explored, including both the potentially new physical phenomena and states of matter in EAS development, along with the efforts to modify existing models of nuclear-physical interactions. Among these experiments, the NEVOD-DECOR covers the record energy interval from 10¹⁵ to 10¹⁸ eV and has possibility to measure not only the local density of muons but also their energy deposit, that should clearly separate different reasons of muon excess.

However, the existing coordinate detector DECOR does not cover the entire aperture of the Cherenkov water detector (CWD) and does not exclude the possibility of passing of the part of muons through the gaps between the individual modules of the detector; besides, its granularity limits the ability to separate two or more particle tracks with a distance of less than 3 cm.

The new large-scale coordinate detector TREK is developed in MEPhI to increase the possibilities of the experimental complex in investigation of inclined muon bundles. The detector allows to increase the resolution of close tracks by the order of magnitude and provides the possibility of muon track recording with a resolution of 3 mm. It is based on 264 multiwire drift chambers, developed in IHEP for experiments at the neutrino channel of the U-70 accelerator, and has 250 m² of continuous effective area.

The detector's inner plane was launched into operation in 2023, and in 2025 the full configuration of the detector was ready for measurements in conjunction with the Cherenkov water detector and the DECOR coordinate detector. The talk describes the design of the TREK and its data acquisition system, the principle of synchronization and selection of joint events with other installations of the Experimental complex NEVOD, as well as the examples of recorded muon bundles of inclined EAS initiated by the ultra-high energy primary cosmic rays.

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