

Horizon-T experiment and detection of Extensive air showers with unusual structure

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Horizon-T is a newly completed (Oct. 2016) innovative detector system constructed to study temporary structure of Extensive Air Showers (EAS) in the energy range above $\sim 10^{16}$ eV coming from a wide range of zenith angles (0 - 80 degrees). The system is located at Tien Shan high-altitude Science Station of Lebedev Physical Institute of the Russian Academy of Sciences at approximately 3340 meters above the sea level. It consists of eight charged particle detection points separated by the distance up to one kilometer as well as optical detector subsystem to view the Vavilov-Cherenkov light from the EAS. The time resolution of charged particles passage of the detector system is a few ns. This level of resolution allows conducting research of atmospheric development of individual EAS.

The total of ~ 7200 Extensive Air Showers (EAS) with the energy above 10^{16} eV have been detected during the ~ 3500 hours of Horizon-T detectors system operations since October 24, 2016. Among these EAS, a large amount had a spatial and temporary structure that showed the pulses with several maxima (modals or modes) from several detection points of the Horizon-T at the same time. These modes are separated in time from each other starting from tens to thousands of ns. These EAS are called multi-modal. Some are further classified as unusual.

Analysis shows that the multi-modal EAS that have been detected by Horizon-T have the following properties:

- 1) Multi-modal EAS have energy above $\sim 10^{17}$ eV;
- 2) Pulses with several modes are detectable at large distances from EAS axis.

The presentation will briefly overview a general performance of the detector system, then the latest results from the collected data including the multi-modal and unusual EAS events will be presented.

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