TAIGA-HiSCORE is an extensive air shower array of 121 Cherenkov detectors spread over an area of 1 km². It is designed to detect cosmic rays with energies from 50 TeV to 1000 PeV. Also TAIGA-HiSCORE is planned to use for gamma-ray astronomy in cooperation with the other setups of the TAIGA observatory.

This work is dedicated to the analysis of the TAIGA-HiSCORE single-mode data. We consider a possibility to detect gamma-ray point source with excess of events from the source direction. For this purpose we propose a method for estimating the signal significance. It takes into account the angular acceptance of the TAIGA-HiSCORE setup. The method is tested on the Monte-Carlo toy model.

### Analysis of the TAIGA-HiSCORE data

#### 1. Optical detector

A PMT is a metal box (size of 15×15×1 m³) with a rear-end window to protect against sunlight, atmosphere, precipitation, and dust. The rear-end window contains the optical transducer, photomultiplier with a phototube and photomultiplier. Each optical station contains four large area photodiodes with a 20 or 25 cm diameter, namely, INDM-5, INDM-4, and INDM-6 [1].

#### 2. Signal estimation method

It is assumed that events coming from a point source are recorded by the setup with a certain error due to its angular resolution. Let the spread of events be a Gaussian distribution with standard deviations $d_x$, $d_y$, $d_z$, and angular distance $\theta$ from the source to an event.

$$f(\theta) = \frac{1}{\sqrt{2\pi d_x d_y d_z}} e^{-\frac{1}{2} \left(\frac{\theta - \theta_0}{d_x d_y d_z}\right)^2}$$

Then the probability of an event falling into a circle of radius $R$ is

$$P(R) = \int_{-\infty}^{\infty} f(\theta) d\theta$$

It is proposed to move along the coordinate grid around the source with a given step and to summarize the events from the area with radius $R$ at each point, applying weights $w(R)$ to the events. Thus, we get a hyperbolic angular signal level $S(R)$, found by:

$$S(R) = \sum_{i} w(R_i)$$

where $w(R_i)$ - normalization factor, $\sigma_i$ - event distribution law.

In the case of a point source, $N$ registered events are distributed as

$$N = \sum_{i} \frac{1}{\sqrt{2\pi d_x d_y d_z}} e^{-\frac{1}{2} \left(\frac{\theta - \theta_0}{d_x d_y d_z}\right)^2}$$

- we propose a method for detecting a gamma-ray source by exceeding the number of events from the source direction above the level of background CR
- an estimate was obtained for the ratio of the number of events from the source to the background to detect the source
- the method is applied on the TAIGA-HiSCORE experimental data. The data were prepared for the application of the method by leveling the distribution of events around the source using the weighting functions obtained from their distributions of events in the zenith angle and radial distribution in the field of view of the installation
- the obtained results demonstrate the alignment of distributions towards the normal distribution in the range close to $(-3\sigma, +3\sigma)$
- at the moment, this method has not been able to detect the signal from the Crab Nebula due to the insufficient number of registered events

### References


3) V. Samoliga and A. Pakhovskov. Correction for angular acceptance of the TAIGA-HiSCORE. IOP Publishing 15 (2020) no 7, C07010-C07010

---

**Acknowledgements:**

This work is supported by the Russian Science Foundation (grant 19-72-20067), Russian Foundation for Basic Research (grants № 19-52-44002, 19-32-00003) and the Russian Federation Ministry of Science and High Education (agreement №075-15-2019-1631)