PRELIMINARY RESULTS OF THE CERENKOV EAS FLASHES OBSERVATIONS ON THE MULTI-MIRROR INSTALLATION OF THE CRIMEAN ASTROPHYSICAL OBSERVATORY

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Abstract

A short description of the facility designed for the study of angular resolution of light in the EAS flashes is communicated. The threshold energy of the facility is about $3x10^{12}$ eV. The data on the angular distribution of light in a flash and the ratio of the flux in the UV ($\lambda < 300$ nm) and visual region as a function of the distance to the axis of a shower are given. Obtained results are compared to the published computations.

1. Introduction.

It is commonly assumed, that the main obstacle to increase the sensitivity of Cerenkov EAS detectors for gamma-quanta registration is the charged particles background.

It was Grindlay [1] who made the first attempts to reduce the registered background of cosmic rays. Turver [2] suggested to reduce the background by using spaced detectors. The experiments in Tata institute, India, showed, that spaced detectors permit to determine the direction of the primary particle (or quantum) on the sky with the accuracy up to $0\overset{\circ}{.}3$ [3] .

In [4] we proposed a method of discrimination of gamma-showers from proton-showers. This method is based in principle on different angular dimentions of these showers. But since the difference is rather scanty, it needs an optical system which allows to obtain the image of the flash with high (minimum $0\overset{\circ}{.}1$) angular resolution. Besides, we suggested in [4] to use the difference in UV region of shower ligh spectrum ($\lambda < 300$ nm) for gamma and proton showers.

2. Description of the facility located at the Crimean observatory.

The facility was described in short in the Proceedings of Bangalore Conference [5] . The results given hereafter are obtained on the installation consisting of six similar elements. Each of them comprizes 4 spherical mirrors 1.2-m in diameter. Nineteen PMs are located in the focal plane of each of the four elements (see Fig.1). The light is transmitted to the photocathodes by means of light conductors. The signals from 4 elements being directed in parallel are summarized within each channel, digitized and then stored in the computer memory. Any 2-channel coincidence from 7 central was adopted as a muster-pulse.

Two other telescopes also being directed in parallel were used for UV region of flash spectrum with solar-blind PM. Summarized signal yeild from these two elements is also digitized and recorded in the computer memory. The diameter of the light spot from the point source at the focal plane is $0^\circ.1$.

3. <u>The results of the observations.</u>

The observations of the EAS flashes were carried out in November - December, 1984. More than 1000 Cerenkov flashes have been registrated. But for the further analysis only those were selected whose maximal amplitude coincided with one of 7 central pixels. The final sampling constituted 644 events. The energies of primary particles responsible for a flash lie, according to estimations within the range (3-6)x10^{12}eV.

We have calculated the values of

$$a^2=\sum_{i=1}^{19}(x_i-\bar{x})^2A_i \quad \text{and} \quad b^2=\sum_{i=1}^{19}(y_i-\bar{y})^2A_i$$

where A_i is the amplitude of flash in the i-channel, x is the coordinate axis directed along the large axis of ellipsoid of Cerenkov flash, and y is the coordinate axis along the small axis; that gives

$$\bar{x}=\sum_{i=1}^{19} x_i\frac{A_i}{\sum A_i} \quad \text{and} \quad \bar{y}=\sum_{i=1}^{19}\bar{y}_i\frac{A_i}{\sum A_i}$$

Fig.2a shows the frequency distribution with respect to a and Fig.2b gives the value of b/a. The mean value of a equals to $0^\circ.40\pm0^\circ.02$ and $(b/a)=0.69\pm0.01$.

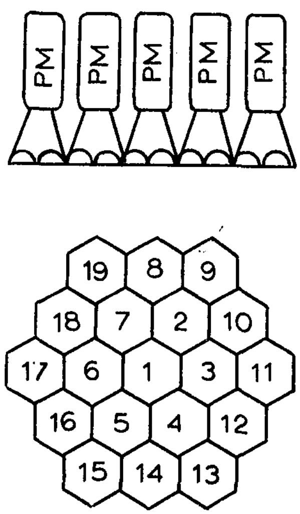

Figure 1.
The configuration of pixels with PM at the focal plane.

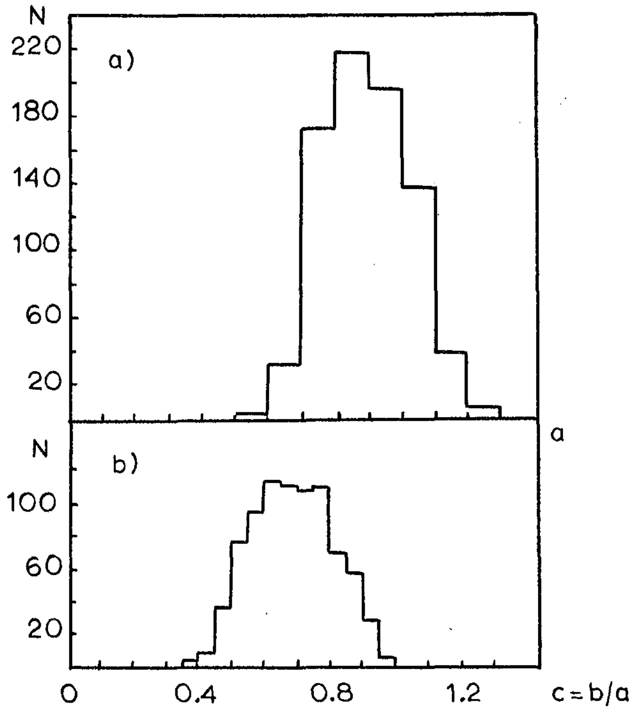

Figure 2.

Frequency distribution :

a) of the effective dimension of the large semiaxis of the flash ellipsoid,

b) of the semiaxis ratio. "N" corresponds to the number of flashes.

For the given values of b/a the flashes amplitudes ratios were obtained for the rim Ae zone to central Ac zone. Here the central zone is adopted as a pixel with maximum amplitude together with the adjucent pixel having the highest amplitude. All other pixels are considered as "rim". Therefore Ae/Ac parameter can be considered as a characteristic of angular distribution of light in a flash. It approaches to "y" computed in [4] .

The obtained distribution is presented on Fig.3a. According to this distribution, the mean value of Ae/Ac depends on b/a variation. The value b/a is distance-dependent: the larger the distance from detector to the axis, the smaller the value of b/a. Here one can see the magnitude of dispersion D(Ae/Ac) of individual estimates. It corresponds to (30-40)% of the estimated value.

Fig.3b shows the ratio of the UV flux Au to the flux in visual region Av as a function of b/a. The dispersion of Au amplitude is high and compatible with the mean value within the given interval. The error of the mean value of Au/Av is presented here.

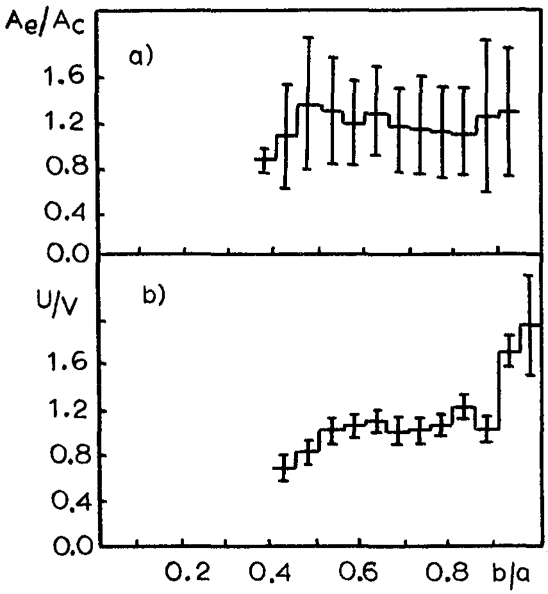

Figure 3.
The dependence of the semiaxes ratio b/a :

a) the amplitude ratio Ae/Ac

b) the ratios of amplitudes in UV and "visible" flashes at random units.

Near the axis the UV flux is much stronger than at large distances. We should note, that detailed information on UV flashes needs further enlargement of mirror surfaces detecting UV-light.

4. Discussion and results.

The obtained data on flash angular dimension are in good agreement with our earlier calculations [4] . These measurements are compatible with the data of Plyasheshnikov and Bignami [6] , the accord is rather high. For instance, according to [6] $a=0.^{\circ}42$ and in our computations $a-0.^{\circ}40$, although our data is still crude.

As far as we know, the UV flashes have never been registrated so far. So, just the fact of their registration seems to be of importance. We think, that the perspective of gamma and proton showers discrimination is realistic.

References.

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