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Azimuth Asymmetry at the Γ-ray, Hadron and Them Families Flow and the Analysis of the Zenith Angles Distributions for X-ray Emulsion Chambers (Experiment "Hadron")

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ABSTRACT

The analysis of the azimuth and zenith angular distributions at the X-ray emulsion chambers of the experiment "Hadron" (Tien-Shan) is presented. It was received that azimuth angles distributions for single γ-ray, hadrons and them families with relatively small energies $\sum E_\gamma$ = 10–20 Tev had asimmetry form. The search of the methodical reasons of this effect didn't gave a positive results.The form of the zenith angles distributions for different azimuth intervals distinguish from each other. The attempts to describe these distributions by means of the functions $\sin\theta \cos^{m+1}\theta$ give a bad χ^2 coincidence. At last, the comparison of the spectra for the γ-ray super-families with galo received at the experiments "Pamir" and "Hadron" gives too much big value of the attenuation length.

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1.INTRODUCTION

Installation "Hadron" operated beginning from 1985 up to 1991 year. During this time it was exposed two kinds of emulsion chambers (EC), at first two half-year and three one-year expositions of hadron chamber (1985–89) (Shaulov 1986, Abdrashitov *et al.* 1986, Adamov *et al.* 1987) and after that two one-year expositions of thin chamber (1989–91) (Adamov *et al.* 1990). The events detected by the EC have been combined with extensive air showers by means of the statistical criteria (Shaulov 1987) in which the angles θ, φ and coordinates of these events were used. From the beginning we made two times measuring of angles to reduce the number of mistakes. It was clear that azimuth angles distribution must be flat because of the primary cosmic ray flow isotropy , but the first data show different situation. The search of the methodical reasons didn't gave the positive results. On the other hand, this effect examination in EC exposed at the Pamir and m.Chacaltaya show the same results and confirms the physical reasons of this effect soon then methodical.

The main methodical reason of the asymmetry may be systematic deviation from the vertical direction and connected with this passage of the events from one semisphere to another. The number of such events strongly depend on the zenith angles spectra inclination. The analysis of the zenith angles distribution show that it have a number of the distortions. The attempt of the model description this distribution permit to receive the main features, but the difference between theoretical and experimental curves is big enough and the value of χ^2 criteria is bad. The zenith angles distributions for different intervals φ = 0–180° and φ = 180–360° are approximated by the functions $\sin\theta \cos^{m+1}\theta$ with different values of the m and χ^2. It may be reason of the big difference in the length of absorption determination by means of zenith angles distributions at EC.

On the other hand, comparison of the halo super families intensities for different altitudes 600 g/cm^2 (Pamir) and 690 g/cm^2 (Tien-Shan) [6] gives too big value of them absorption length in atmosphere near 500 g/cm^2. The total data permits to suggest that the γ-ray and hadron flow for small energies $\sum E_\gamma$ and halo super is formed by means of the anomal processes.

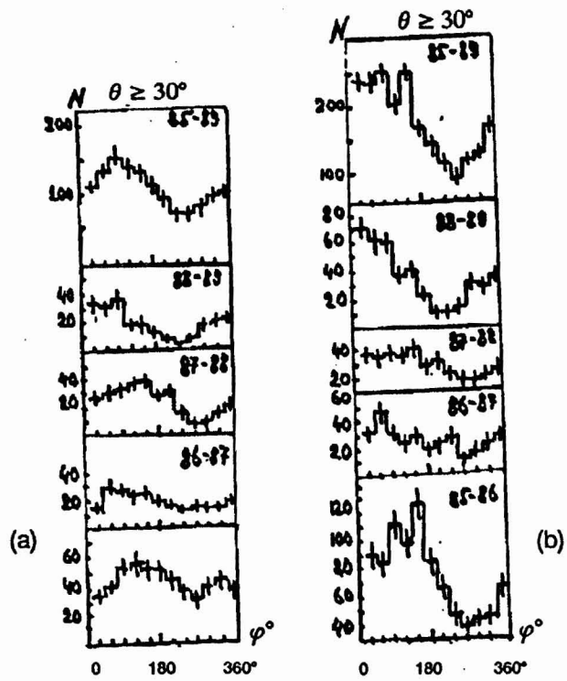

Fig. 1: The differential azimuth angle distributions for different expositions and the sum for four years. (a) - γ-rays, (b) - hadrons.

2.EXPERIMENTAL RESULTS

The experimental distributions of azimuth angles for different expositions presented at Figure 1. One can see that there are asymmetry both at the γ-ray and hadron distributions. This effect is provided statistically. The asymmetry coefficient defined as the ratio of the number of events from azimuth angles interval φ = 0–180° to the one for φ = 180–360° have meanings 1.52±0.12 for γ-rays and 1.78±0.11 for hadrons (zenith angles $\theta \geq 30°$). The asymmetry is detected with accuracy near 6σ. Figure 2 show energy dependence for the asimmetry coefficients.

It was made the next investigations to find the methodical reasons of the asymmetry:

-The search of the measuring systematic mistakes .
-The influence of the stereomicroscope axis deviation from vertical direction.
-The move of the film upper and lower emulsion layers concerning each other.
-The sensibility of the X-ray film in the different azimuth directions.
-It was excluded the influence of the EC edge effects.
-The influence of the EC plane deviation from the horizontal direction.
-The influence of the surrounding mountains.

The result was negative, we couldn't find the methodical explanation of the asymmetry. The next check was to compare the data for EC with different orientation. The effect soon must be connected with film coordinate system for methodic case and with space coordinate system for physical one. The comparison of these two cases show Figure 3. Here N_{V4} is the number of the events in the 90° sector which moves along φ axis. It seems more probable physical explanation of the asymmetry.

Figure 4 show zenith angles distributions in terms of the linear scale divisions λ by which it is measured the distance between density spots on the upper and lower film

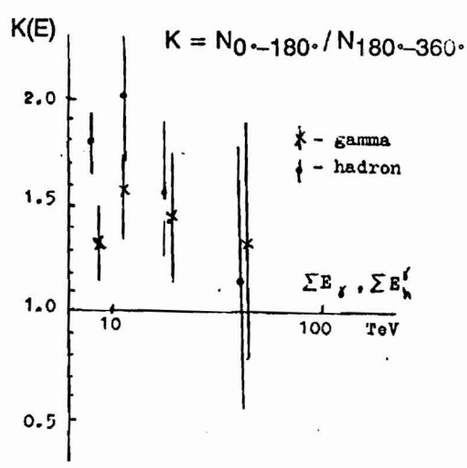

Fig. 2: The energy dependence of the asymmetry coefficient.

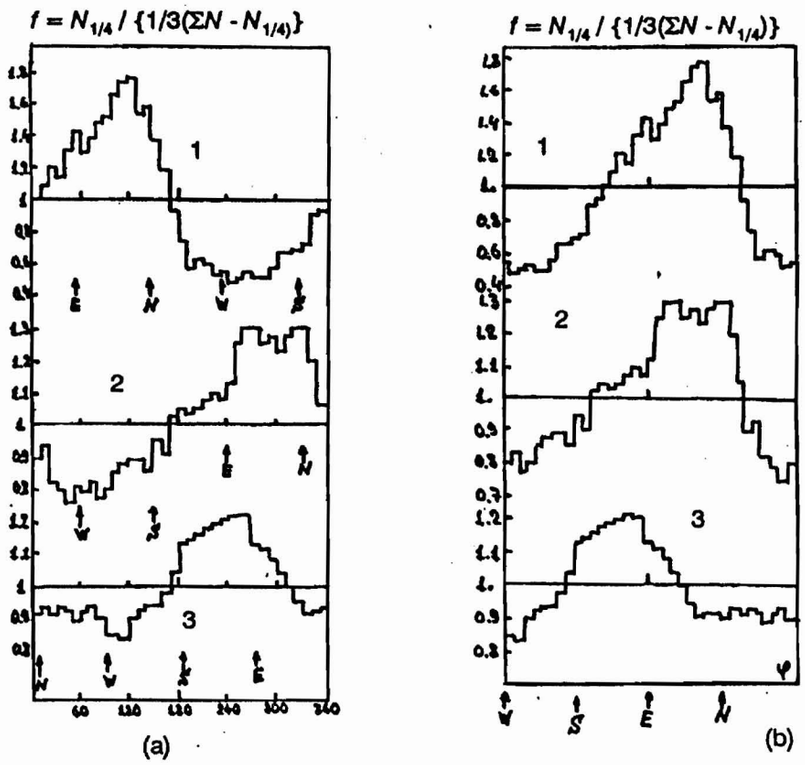

Fig. 3: The f-distributions for different X-ray emulsion chambers exposed at the Tien-Shan, Pamir and m.Chacaltaya. The value of the azimuth angle $\varphi = 0$ corresponds to axis x on the film for (a) and West for (b). The f is the number of events in 90° sector of φ, normalized by average value, which moves along φ. 1 - γ-rays, Tien-Shan, 1987-88; 2 - γ-rays, Pamir, 1988-89; 3 - γ-rays, m. Chacaltaya, 1989-91.

emulsion layers: $\tan\theta = \lambda/d$, where d is film thickness. These distributions were received for azimuth angles intervals φ = 0–180° and φ = 180–360°. Difference between them is connected with azimuth asymmetry in direction East (first interval) – West (second interval). The difference between χ^2 criteria for these distributions (Figure 5) shows that coincidence between theoretical and experimental distributions for East semisphere is much more worse then for West one. The values of the absorption length formal received as a ratio (700 g/cm^2)/m for these semispheres equals $\lambda_E \approx 100$ g/cm^2 and $\lambda_W \approx 80$ g/cm^2. The best approximation for general statistic (φ = 0–360°) has m = 7.8 and λ = 90 g/cm^2. On the other hand, the comparison of the size halo spectra for Pamir altitude (600

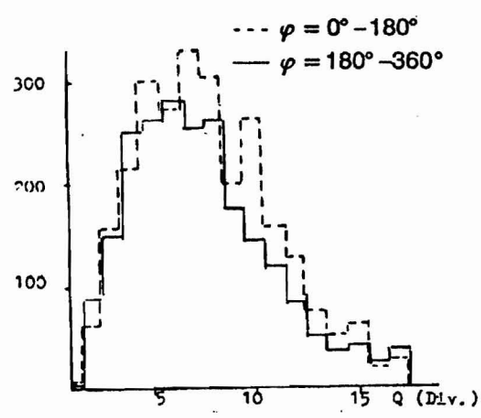

Fig. 4: The azimuth angles distributions for different zenith angles φ = 0–180° and φ = 180–360°. γ-rays, the statistic for four years 1985-89.

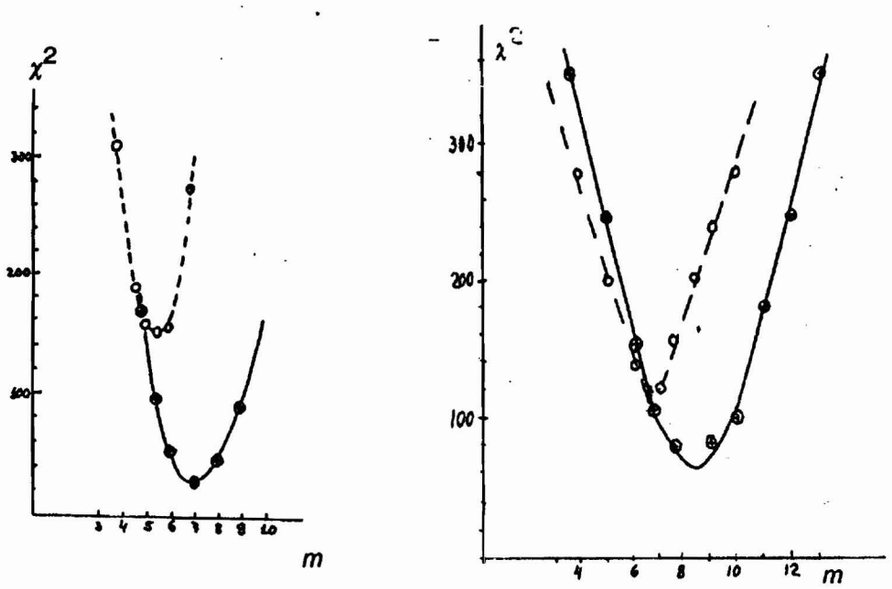

Fig. 5: χ^2 values for different meanings of the m in the approximation function $\sin\theta \cos^{m+1}\theta$: (a) – hadrons, (b) – γ-rays. The number of intervals n=20 (a) and n=11 (b).

g/cm^2) and Tien-Shan one (690 g/cm^2) (Arabkin *et al.* 1990) gives the absorption length value $\lambda \approx 450$ g/cm^2.

3.CONCLUSIONS

The azimuth asymmetry for the γ-ray and hadron flows, difference between the absorption lengths for East and West semispheres and extreme big absorption length value for halo super permits to suppose the existing at the primary cosmic ray radiation the penetrating component with anomal properties (Shaulov 1992).

4.ACKNOWLEDGEMENTS

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