SEARCH FOR THE GAMMA-RAY FLUXES WITH ENERGIES ABOVE 10^{15} eV FROM VARIOUS OBJECTS

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ABSTRACT

The experimental data obtained with the EAS array of the Moscow State University are analyzed with a view to searching for the superhigh-energy gamma-rays from various objects and regions of the Galaxy.

Introduction

In recent years, in connection with the activities of the Kiel group /1/, considerable interest has developed in the search for local sources of superhigh-energy γ-rays. An excess of the 2×10^{15}eV γ -rays from the CygX-3 source was found in /1/. The Haverah Park group /2/ has confirmed the results of the Kiel group. The pulsar in the Crab nebula is another object attracting the researchers' attention. The Lodz group have detected an excessive γ-ray flux from the pulsar /3/. However, the Akeno array observations failed to corroborate this result /4/.

Experiment

We have made an attempt to detect an excessive γ-ray flux from the direction to CygX-3 ($\alpha_0 = 307^\circ.8$, $\delta_0 = 40^\circ.9$). The EAS array of the Moscow State University is located at an altitude of 192 m above sea level at a $55^\circ.7$ latitude and has been designed for detecting the showers initiated by the primaries with energies above 10^{15}. The shower axis orientation (the zenith angle θ and the azimuthal angle φ) was determined using a system of seven scintillators one of which (of 1 m^2 area) was located at the array center and the remaining six (of a 0.5 m^2 area each) are located at distances of 60 m from the array center and form a regular hexagen. The accuracy in determining the angles was 3^o for θ and 6^o for φ. The shower arrival time was recorded to within Imin.

The observations were carried out from May to July, I982. The total observation time was 890 hours. Of all the showers detected, II000 showers with sizes $Ne \geq IO^5$ and $\theta < 40^o$ were selected, which made it possible to observe the declination region $\delta > I6^o$.

To search for the γ-showers from CygX-3, the showers were selected whose declinations were within the interval $\delta_o \pm 5^o$. This declination band was divided into IO^o intervals of α throughout the range of right ascensions starting from the bin $\alpha_o \pm 5^o$. With such a division, the coordinates of the source prove to appear at the center of one of the bins. After that, we calculated the number of showers and the observation times for each of the bins. Since there times are different for different bins, we compared between the fluxes, i.e. between the ratios of the number of showers to the time of their observation.

Results

Fig. I shows the dependence of the fluxes on α in the examined declination band. The dashed line indicates the value of the mean flux. It is seen that no excessive flux from the source was detected.

Fig. 2 shows the phase distribution of showers for the $IO^o x IO^o$ bin at the center of which the Cyg X-3 source is located. The moment t_o = 2440,949.9I76 JD was taken to be the beginning of the period (the zero phase); the period p = 0.I9968I4 day ($\dot{p}$ = 0) according to the X-ray measurement data /5/. The dashed line indicate the number of the showers calculated on the basis of the mean flux. From the figure it is seen that there does not exist a singled-out phase where the Cyg X-3 emission maximum would be observed.

Although we have not found any excessive γ-flux from Cyg X-3, we estimated the upper limit of the IO^{I5}eV γ-rays from the source to be $I < 3xIO^{-I3}$ $cm^{-2}s^{-I}$, which not contradict the results of /I/.

It is of interest to compare between the cosmic ray fluxes from the regions located near the galactic plane and in high galactic latitudes. Fig. 3 shows the result obtained for all showers on the assumption that the value of the flux is independent of galactic longitude in the observed interval $\ell = 45^{o}-2I0^{o}$. Since it should be expected that the γ-ray-produced showers are "older", we plotted the same dependence for the showers with $S \geqslant I.4$ (Fig. 4).

As seen from Figs. 3 and 4, our tentative data does not seen to contradict the assumption of cosmic ray isotropy. Further analysis of the experimental data is, however, necessary. It should be noted that the same conclusion was arrived at in /6/, true, at a poorer statistical strength.

References

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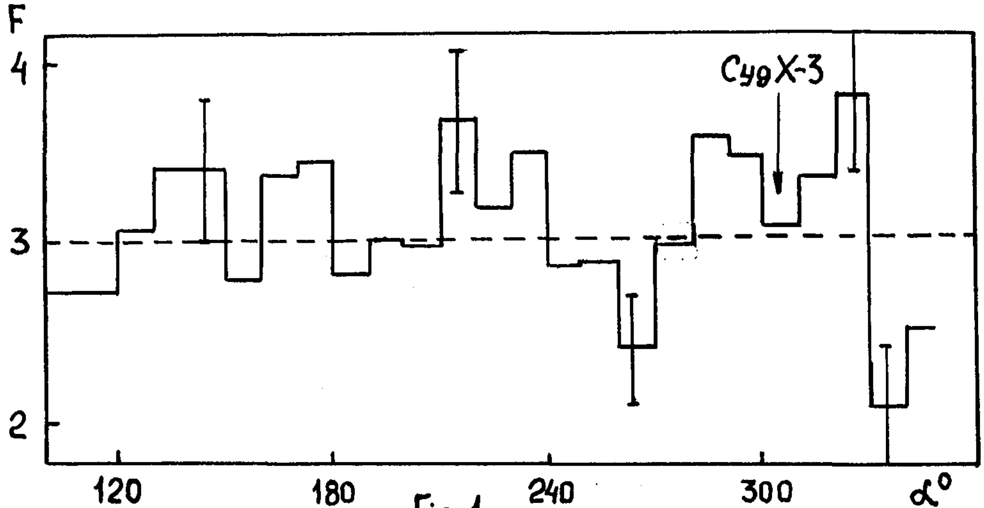

Fig.1

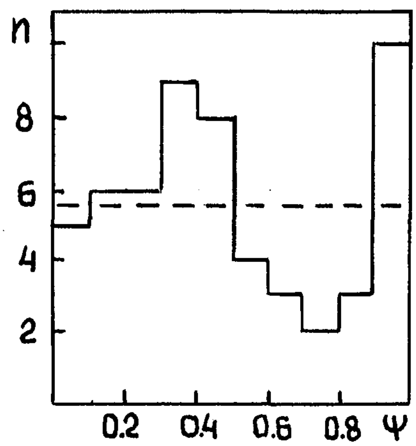

Fig.2

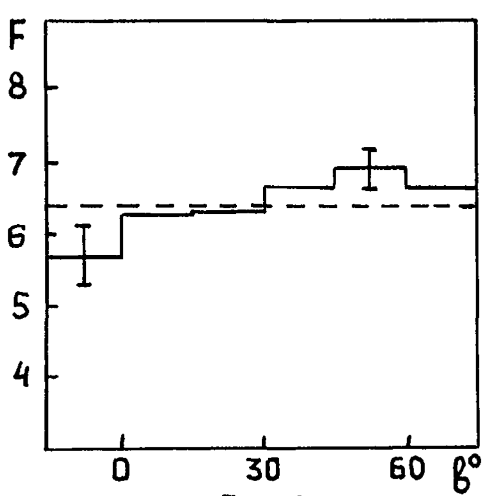

Fig.3

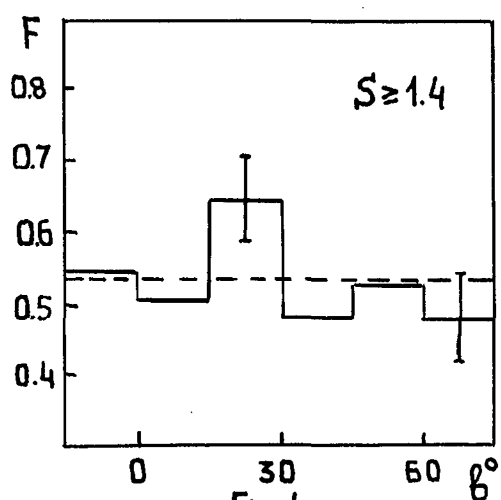

Fig.4