# A SEARCH FOR GAMMA-RAY POINT SOURCES WITH "THE CARPET" SHOWER ARRAY

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An experiment aiming at search for super-high energy gamma-ray point sources has been put into operation at Baksan Valley, Northern Caucasus. The well known source Cyg X-3 was observed first and preliminary results of data analysis are presented. There is no positive excess of showers from the source region, but phase analysis discovers a small pulse at phase 0.6 which corresponds to the integral flux $(6\pm3)\cdot10^{-14}cm^{-2}sec^{-1}$ at $E_\gamma>3\cdot10^{14}$eV.

The X-ray source Cygnus X-3 was observed with Cerenkov light technique in TeV energy range (for a brief review see /1/). Recently results obtained with classical EAS method/2,3,4/ have pointed out that spectrum of Cyg X-3 gamma-rays, probably, extends up to $10^{15}$ eV. In this paper we try to confirm this result observing the source in energy range where up to now there were no data.

Baksan air shower array consists of "the Carpet" in the centre and 6 outside detectors at distances 30 and 40m (fig. 1). Four hundred 0.5 $m^2$ scintillators of the Carpet are divided in four groups ($\overline{I}$-$\overline{IV}$) feeding the four-fold coincidence circuit with output counting rate 50 per sec. This signal is used as starting pulse for time measurement of delays of outside detectors. Time measurement system has a compensation of pulse hight dependence of delays. The step of delay measurements is 1 nsec.

Each outside detector consists of 18 scintillators (total area 9 $m^2$). Four of them (1,2,5,6 in fig.1) in coincidence with four-fold signal of the Carpet give trigger pulse for the recording. The energy thresholds are: 0.3 of the pulse hight of a penetrating particle for each quarter of the Carpet $\overline{I}$ - $\overline{IV}$, and ~1 penetrating particle for outside detectors 1,2,5,6. The counting rate of the trigger ~0.8 per sec.

Fig.2 presents calculated energy spectra of showers for this trigger and for different indices of power law gamma-ray spectrum: $\gamma$=2.71 and $\gamma$=2.0. Median energies of distributions of fig.2 are indicated by arrows. They are equal to 75 and 300 TeV.

Angular resolution of shower arrival direction measurements was estimated using the distribution of experimental value $\Delta$=(T1-T2)-(T5-T6), where Ti - the delay of detector number i. Fig.3 presents this distribution for one day of observation, r.m.s. of it $\sigma$=5.2 nsec corresponds to angular resolution $\Delta\theta$~1.2°.

The Cyg X-3 observations have started in July 1984 and

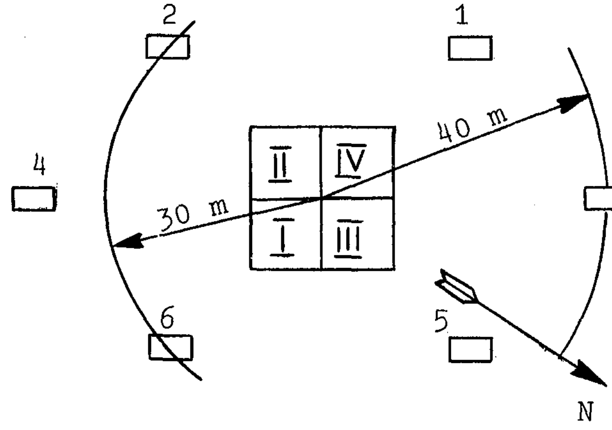


Fig.1 Plan view of Baksan array

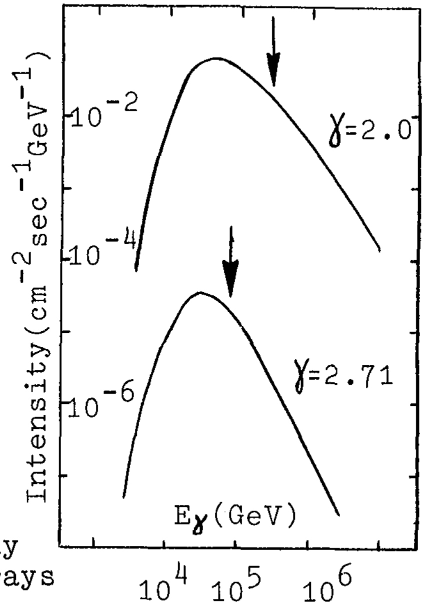


Fig.2 Response functions of the array for different energy spectra of $\gamma$-rays

in this paper we present preliminary results of analysis of 242 days data sample.The source was observed 5 hours per day ($\pm$2.5 h from culmination) and total number of registered showers exceeds $3\cdot10^6$.Counting rate from the cell centered on the source position and having the form of a circle with radius 2.5° in equatorial coordinates was compared with the rate of 4 off-source cells of the same form and size,but shifted by $\pm5°$ along $\alpha$ and $\delta$ .After correction of data for atmospheric pressure and angular distribution of showers,the signal $N_{cyg}$ and mean background $N_b$(a quarter of total counting rate of four off-source cells) were determined.Both were phase-analysed then using ephemeris from /5/.

The ratio $N_{cyg}/N_b$ is presented versus phase in fig.4.It can be easily seen, that there is no absolute excess from the Cygnus cell,mean value of $N_{cyg}/N_b$ is equal to 0.992$\pm$.008. Nevertheless,there is slight positive excess (3.6 $\sigma$ in 12th bin) in phase curve (fig.4) near the phase 0.6.

The value of gamma-ray flux and typical energy of recorded showers both depend in our case on the proposed spectral index of the source.As extreme values we used $\gamma$=2.71,typical for cosmic rays near the Earth,and $\gamma$=2.0,which seems to be in approximate accordance with different experimental data (see,for example,/4/).For both of them we present in fig.5 upper limits of gamma-ray flux derived at 95% confidence level from the fact of absence of absolute excess without phase analysis.

Also shown in fig.5 is the point estimated from phase 0.6 excess using $\gamma$=2.0 only (median energy 300 TeV).The obtained flux is $I_\gamma(>E)$ = ( 6 $\pm$ 3)$\cdot10^{-14}$ cm$^{-2}$sec$^{-1}$.This point seems to be in disagreement with the results of other experimental groups,especially that of Kiel group /3/,where the threshold energy is by an order of magnitude larger,but the value of flux is of the same order as ours.

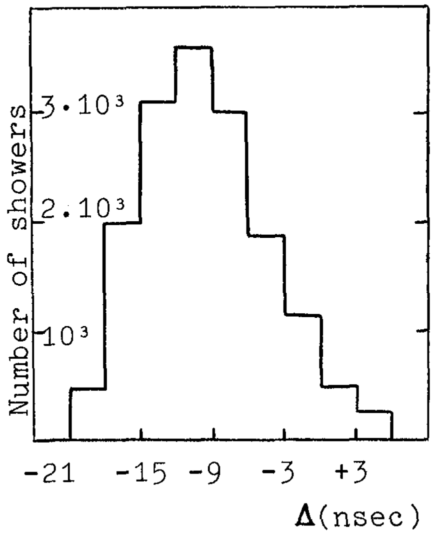


Fig.3 Distribution of difference of differences of delays for one day of observation

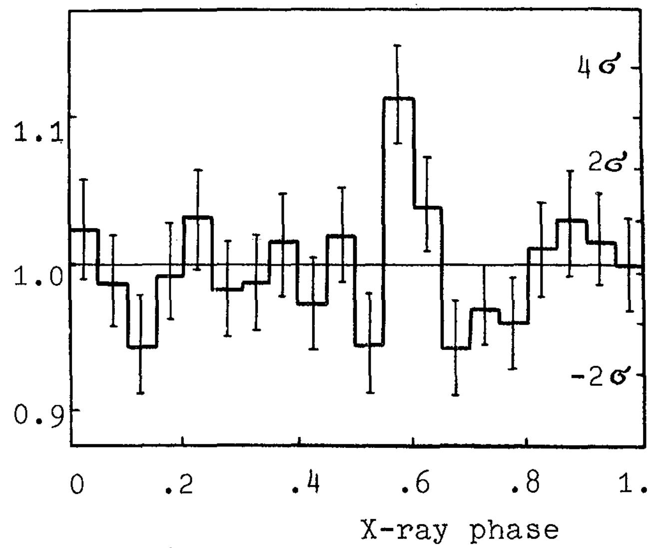


Fig.4
The ratio of counting rate in Cyg X-3 cell to the mean of 4 "off-source" cells versus phase

Taking into account the absence of absolute excess we have to conclude that obtained so far Baksan experimental data do not give a good confirmation of the very existence of high energy gamma-ray flux from Cygnus X-3.

We plan to accumulate more data on Cyg X-3 and to look at other potential sources also.

## References

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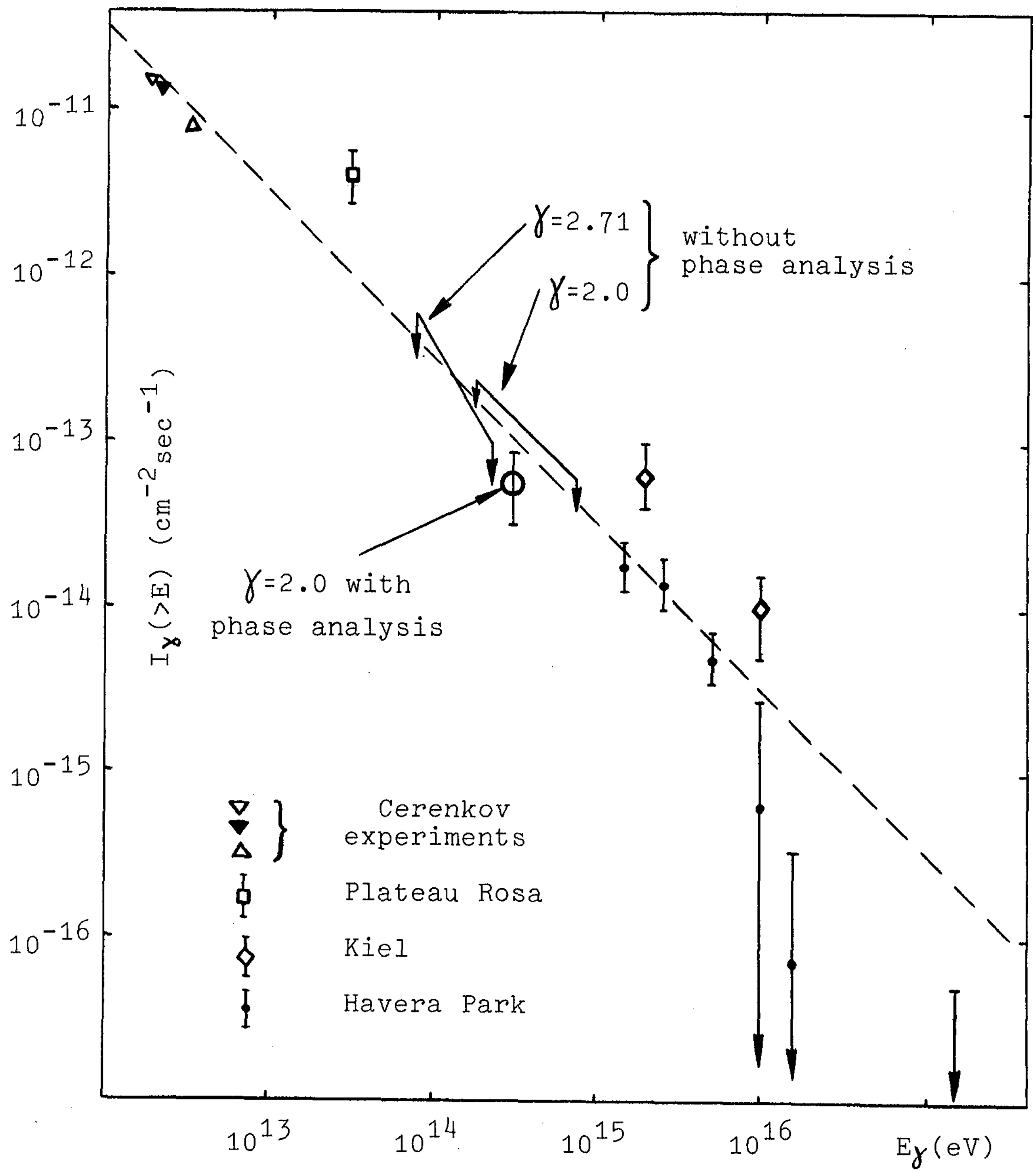


Fig.5

Integral gamma-ray flux from Cyg X-3