SPECTRUM HIGH ENERGY GAMMA-QUANTA FROM GALACTIC SOURCES CRAB NEBULA AND CYGNUS X-3.

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ABSTRACT.

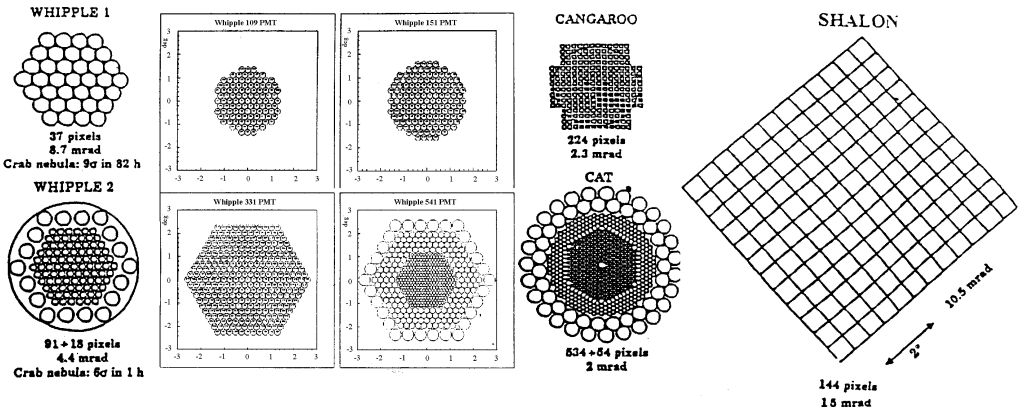
Four years of TeV observations by means of telescope SHALON on SHALON-ALATOO mountain observatory are received data on the fluxes of gamma-quanta with energy 10^{12}-10^{13} Galactic objects (Crab Nebula, Supernova Remnant Tycho and binary source in our Galactic Cygnus X-3). Observed fluxes from already known sources at about equal: $10^{-12}cm^{-2}s^{-1}$.

More than twelve years ago one was proposed the plan of the mirror Cherenkov telescope SHALON (Sinitsyna, 1987) and the first observations were begun in 1992 on the ALATOO mountain observatory (Sinitsyna, 1992-1998). The distinctive feature of telescope is large full angle, that is achieved by for relatively large size of photomultypliers matrix (fig. 1). This allows the registration of extensive air showers that are coming at distance up to 120 m from the optical axis of telescope, that increase the obtaining of the statistics data from the sources of gamma-quanta of very high energies. In addition to these large angular dimensions of the imaging matrix will enable to research for isotropic background extensive air showers from charged particles of cosmic rays simultaneously with the observation of the local sources of gamma-quanta, that is at the same optical characteristics of atmosphere. It is particularly important because of in our research of gamma-sources the extensive air showers generating by the gamma-quanta are selected not only in accordance with the exceeding of flux of showers in small angle, but also as long as the differences of the evaluation in the depth atmospheres of the electron-photon cascades generated by protons and by nuclei of the cosmic rays.

Cherenkov imaging telescope SHALON equipped with a very high definition camera (144 pixels, full angle 8°) takes data from of 1993 at the mountain altitude 3338 m. We discuss some results of the observations of the indicated gamma-ray sources and the discrimination methods between gamma-rays and protons. Selection of showers produced by gamma-quanta from a background of showers produced by protons (fig.2):

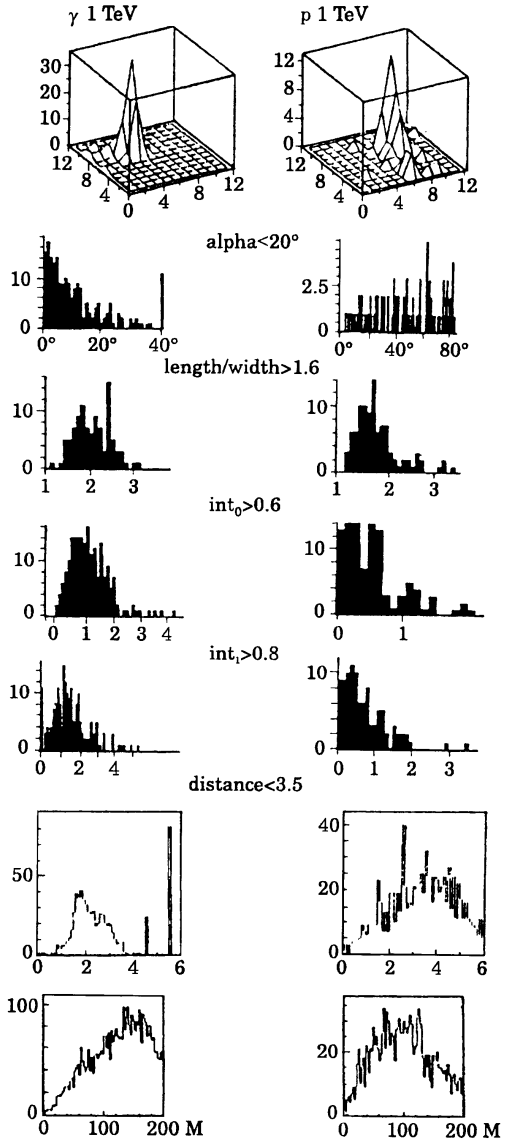
1. $\alpha<20°$
2. length/width>1.6 for γ
3. Cherenkov light intensity in pixels with max light to the light in the eight pixels near around is for $\gamma>0.6$
4. Cherenkov light intensity in pixels with max light to all light in imaging except nine in center is for $\gamma>0.8$
5. distance for $\gamma<3.5$ pixels.

The intensity of the different sources E>0.8 TeV is following (fig. 3,4): $I_{Crab}=(1.1\pm0.30)\bullet10^{-12}cm^{-2}s^{-1}$, $I_{Mrk421}= (1.09\pm0.41) \bullet10^{-12}cm^{-2}s^{-1}$, $I_{Mrk501}=(1.32\pm0.30)\bullet10^{-12}cm^{-2}s^{-1}$, $I_{NGC1275}=(1.10\pm0.40)\bullet10^{-12}cm^{-2}s^{-1}$, $I_{Cyg\ X-3} = (4.2\pm0.80)\bullet10^{-13}cm^{-2}s^{-1}$ $I_{Geminga}=(5,7\pm4.0)\bullet10^{-13}cm^{-2}s^{-1}$ and $I_{Tycho} < 2\bullet10^{-13}cm^{-2}s^{-1}$ upper limit. Observations Crab Nebula and Geminga (fig. 4), Markarian 421 and Markarian 501 (fig. 2 OG 2.1.12) compare with dates of other experiments including the data form observations on satellites in an



Pixel distribution the focal plan of the 10m reflector: top left: 109 pixels (1993-1996); top right: 151 pixels (Dec.,1996); 331 pixels (Oct., 1997); 541 pixels (planned).

Fig. 1. *Evolution of photomultyplier arrays to record images seen in Cherenkov light.*

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    7    5    6    7    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0
    0    0   18   21   10    0    0    0    0    0    0    0
    0    0   10   76    0    0    0    0    0    0    0    0
    0   11   15   19    0    0    0    0    0    0    0    0
    0    8   16    7    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0
  Length =  1.6116 Width =  0.8397 Length/Width =  1.9193
 Azwidth =  0.8815 Alpha = 11.2448
Distance =  1.8385  Miss =  0.3585
X_MEAN =  1.8248 Y_MEAN = -0.2242   0/1 =  0.8037  0/2 =
0.8958
Total code =   236

D:\NGC99\TEXT\s130299.012 EVENT No    34
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    6    6    0    6    0    5    0    0    0    0    0    0
    0    0    0    5    0    7    0    0    6    0    5    0
    0    0    0   10    0    6    5    5   10    8    0    0
    0    9    0    0   10    0   11   18    0    0    0    0
    6    0   10   19   15   12   12   14   14   14   13    8
    6    9   11   22   20    0   48  113  130   83   73   15
   12   17   39   38   89  235  823  369  163   29    5    0
   28    0  233  393  775  871  224   80   40    0    6    0
  221  352  692  154  181   54   97   28   29   30    0    0
    0   81  106   34   17   26   10    6    0    0    0    0
    0    0    0    0    0    0    0    0    7    0    6    0
Total code =  7410
Azwidth =  1.0466 Alpha =  6.0700
Length =  2.4352 Width =  1.0201 Length/Width =  2.3872
X_MEAN = -1.2165 Y_MEAN =  2.4614   0/1 =  0.7986  0/2 =
0.8441
Distance =  2.7456  Miss =  0.2903
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Fig. 3. *Example of gamma - quanta events in telescope SHALON.*

Fig. 2. *Monte Carlo distribution of image parameters for proton and gamma showers of 1TeV.*

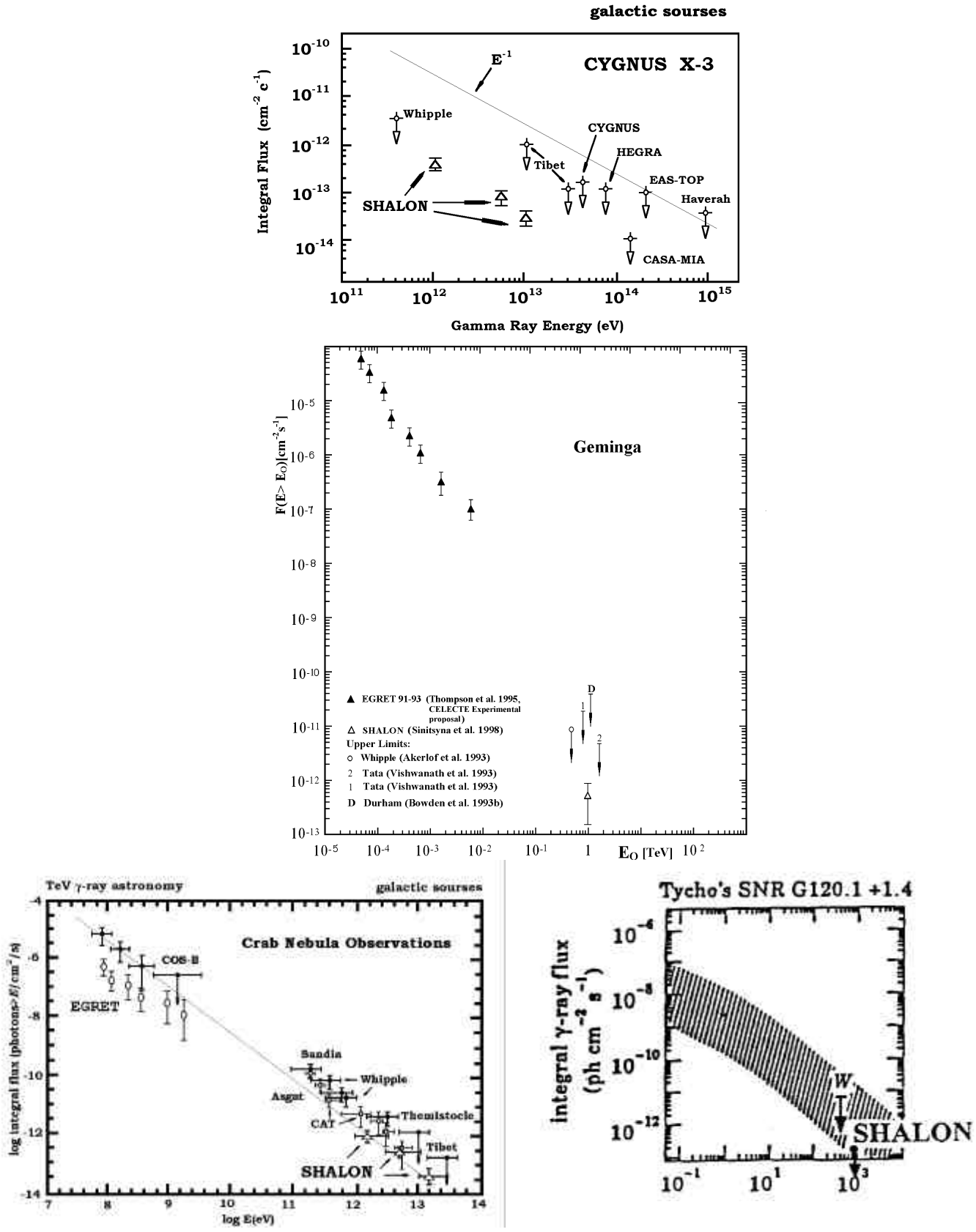

Fig. 4. *Galactic high energy gamma-ray spectrum from CYGNUS X-3, GIMINGA, CRAB NEBULAR and TYCHO BRAHE.*

energy range of 10^8-10^9 eV. Experimental data may be represented by energy spectrum $F(>E)\sim E^{-\gamma}$ in energy interval 10^8-10^{13} eV, but with different indexes: $\gamma\sim1.5$ for Crab Nebula and $\gamma\sim1.1$-1.3 for Markarian 421. May be Crab Nebula is typical source of Galactic cosmic rays and Markarian 421 is a typical source of Extragalactic cosmic rays.

CONCLUSION.

The flux of gamma-quanta from sources in a high degree is parallel. The direction of Cherenkov radiation results to effective observation of sources up to distance £ 100 ? from an axis of a shower. It means, that one telescope can observe showers on area 10^5 ? ^{2}. However, if with the objective selection of an observable shower with a shower from gamma-quanta from a source to increase angular resolution is lost width of a corner of the review, that provides the large square of registration of showers. If the angular resolution become rough is necessary to use the analysis of development of the cascade in atmosphere for distinguish of showers generated by gamma-quanta

Among different methods of search of local sources of gamma-quanta most important is observations of Cherenkov radiation of electron - photon cascades generated in atmosphere in very high energy gamma - quanta. Thus the trend of Cherenkov radiation determines a direction on a source, that is coordinate of an observable source. The approximately equality observable of intensity of sources is connected to limitation of time observation of a assumed point source. Distance from Earth to Galactic and Extragalactic Sources differs for about 10^4 times of means, that detected in Extragalactic sources have large in 10^8 times a radiation possibilities.

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