ON THE 1983 OBSERVATIONS OF THE GAMMA-RAY SOURCE 2CG 195+4

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Abstract

The source 2CG 195+4 (Geminga) was observed at $E_\gamma \geq 2 \times 10^{12}$ eV in December, 1983 with the Tien Shan high altitude facility. The mean gamma-flux was equal to $(7.0 \pm 4.5) \times 10^{-11}$ quanta/cm^{2}sec. Probably the gamma-ray flux is varying with the time with a period 59.49 s.

Gamma-ray source 2CG 195+4 is one of the most fascinating objects and attracts continuous attention of the investigators. A number of theoretical papers dedicated to this object propose its models or discuss probable mechanisms of energy generation, as in [1-2]. Meanwhile, the works dealing with the observational data treatment are rather controversial : alongside with the results confirming the variations of the flux [3] , the reality of ~ 59 sec gamma-flux periodicity [4] , there exist some works that are rather sceptical about the reliability of such results [7] . All this predetermins the undubitable importance of further observations of the gamma-source 2CG 195+4.

We carried out the observations of 2CG 195+4 earlier (in 1979 and 1981) with the equipment located at the Tien Shan High Altitude Station of Lebedev Institute [8] . The 1979 observations did not yeild any reliable results, whereas 1981 observations showed the presence of gamma-flux variability at $E_\gamma \geq 2 \times 10^{12}$ eV with a period T=59.28 sec. The 1983 observations were carried out during the interval from the 9-th till the 27-th of December in the energy range $E_\gamma \geq 2 \times 10^{12}$ eV with the facilities and techniques of the observations and preliminary data sampling being practically the same as adopted for 1979 and 1981 observations and described in [9] . A scanning

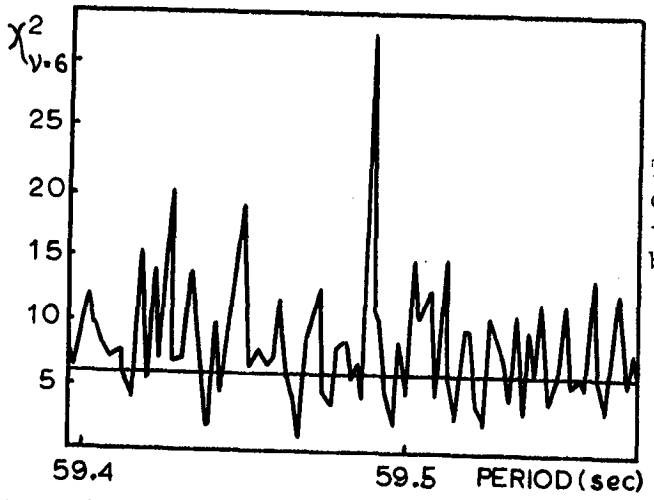

Figure 1.
The dependence of χ^2-value on the trial period according to the 1983 data (number of bins N=7).

technique was employed involving the reading of the source and the background in the vicinity of the source.

Sampled material constituted of 12 scannings or 4320 values of Cerenkov flashes intensities, the overall exposure time of the source was equal to the total background exposure, i.e. 144 minutes. The mean value of Cerenkov flashes intensities processed was 24.88 events per minute for the source and 24.03 - for the background observations. The mean amplitude of the effect (the excess of Cerenkov flashes counting rate in the direction to the source) is A=3.5±2.4%

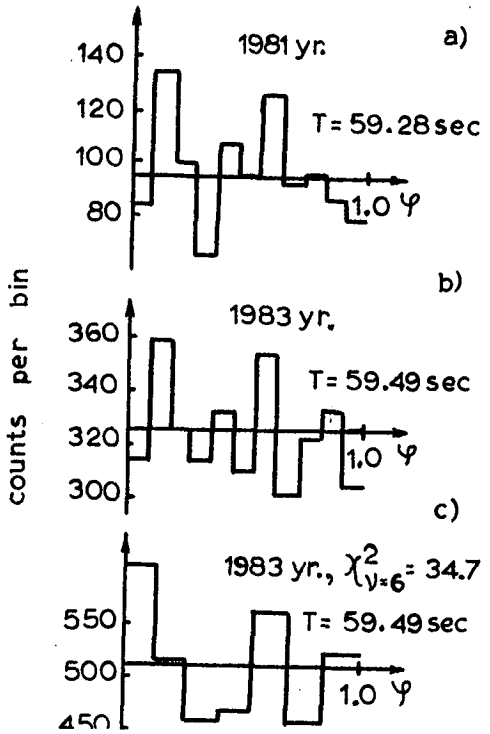

Figure 2.
The light curve of 2CG 195+4
a - represents 1981 data,
b, c - 1983 data(for"b" the number of bins N=11, for"c" N=7).

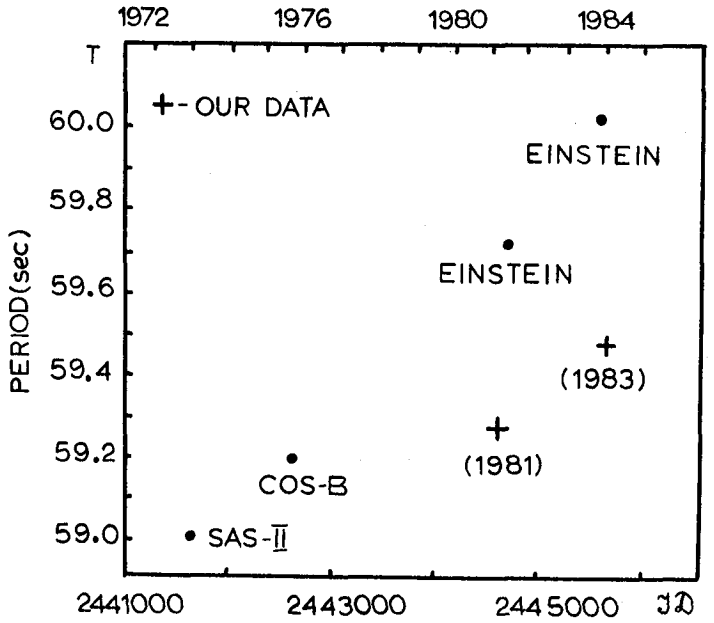

Figure 3.

The dependence of T periods on time for the gamma-ray source 2CG 195+4.

that corresponds to the value of the mean gamma-ray flux from the source $\varphi_\gamma = (7.0 \pm 4.5) \times 10^{-11}$ quanta/cm^{2}sec.

The whole material was subjected to tests so as to search for time variability of the emission, the range of the trial period being limited as 59 sec $\leq T \leq$ 61 sec. Since the periodicity could be contaminated by instrumental or procedure origin, the background observations were also sampled. A fragment of the obtained periodogram is shown in Fig. 1. In the indicated range the only statistically significant peak has been found corresponding to the value of period T=59.488 sec ($\chi^2_{\nu=6}=34.8$, which is the probability of random deviation $\rho \simeq 5 \times 10^{-6}$ being multiplied by the number of independent trials gives $n \cdot \rho \sim 0.01$). Figure 2 shows the light curve that would correspond to this value of period. The run of the curve has a strong similarity with the one obtained in the 1981 observations [8]. The obtained period being conjuncted with the value T=59.28 sec (according to 1981 data) yeilds the derivative of the period equal to $\dot{T}=2.3 \times 10^{-9}$ sec/sec (see Fig. 3).

The results, we hope, might constitute an additional evidence in favour of the reality of gamma-flux variations at very high energies with a period around 59 sec, as observed from the source

2CG 195+4.

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