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Preliminary results from EGRET phase 3 observations of the Virgo region

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Abstract. During phase 3 of the COMPTON Observatory mission (August 93 - October 94), the Virgo region (containing the quasars 3C 279 and 3C 273) has been observed for a total of about 8 weeks by the EGRET instrument which is sensitive to photons with energies in the range of 30 MeV to about 20 GeV. The quasars 3C 279 and 3C 273 have been detected again. In addition, several more sources have been detected by EGRET during these observations. In this paper preliminary results on 3C 273, 3C 279, 1219+285 and PKS 1222+216 are presented.

Key words: gamma rays: observations — galaxies: active — quasars: individual: 3C 273, 3C 279, ON 231=1219+285, PKS 1222+216

1. Introduction

The high energy instrument EGRET aboard the Compton Gamma-ray Observatory (CGRO) has observed the Virgo region for about 8 weeks during phase 3 of the CGRO mission. Here, we present preliminary results on four of the sources (3C 273, 3C 279, 1219+285 (=ON 231) and PKS 1222+216) detected during those observations. Final results will be published by Hartman et al. (1997), von Montigny et al. (1997) and Mukherjee et al. (1997).

The dates of the observations are given in Table 1. The interruptions between viewing period (VP) 308.0 and VP 308.6 as well as between VP 311.0 and VP 311.6 were due to reboost manoeuvres of the satellite. During those times no data are available from the EGRET instrument. The interruption between VP 308.6 and VP 311.0 was due to a change of the pointing direction in order to observe the anticenter region.

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2. Results

To avoid the broad pointspread function below 100 MeV ($>5^\circ$) only photons with $E > 100$ MeV were used for the maximum likelihood analysis. Table 1 lists the fluxes of the sources and the 1σ errors when the source had a formal significance of $\geq 3\sigma$ (determined from the square root of the test statistic value of the likelihood analysis (Mattox et al. 1996; Eadie et al. 1971)). When the source has a formal significance of $< 3\sigma$ only 2σ upper limits are given.

2.1. 3C 273

3C 273 was detected with a formal significance of 9.4σ in the sum of viewing periods 304.0 through 308.6. The highest significance in a single viewing period was reached in VP 308.6, 7.0σ . In γ -rays the flux of 3C 273 increased from about $23 \cdot 10^{-8} \text{cm}^{-2} \text{s}^{-1}$ to approximately $62 \cdot 10^{-8} \text{cm}^{-2} \text{s}^{-1}$ between 19. October 1993 and 1. December 1993. This is an increase by about a factor of 3 within 43 days and it is the first time that EGRET has seen 3C 273 to be at the same flux level ($60 \cdot 10^{-8} \text{cm}^{-2} \text{s}^{-1}$) as during the COS-B observations (Bignami et al. 1981). Unfortunately, EGRET could not observe 3C 273 during 1.-13. December 1993. It might be that EGRET missed a flare in this quasar since it was quiet again from VP 311.0 on. A more detailed analysis and discussion will be published by von Montigny et al. (1996).

2.2. 3C 279

The quasar 3C 279 was also detected again although at a relatively low flux level. The average flux for VP 304.0 through VP 308.6 was $F(> 100 \text{ MeV}) = (48.1 \pm 0.6) \cdot 10^{-8} \text{cm}^{-2} \text{s}^{-1}$ with a formal significance of 10.6σ and no evidence for strong variability. A more detailed analysis

Table 1. EGRET fluxes for $E > 100$ MeV for 3C 279, 3C 273, 1219+285 and PKS 1222+216 in Phase 3

Viewing Period	Time of Observation	3C 279 ($10^{-8}\text{cm}^{-2}\text{s}^{-1}$)	3C 273 ($10^{-8}\text{cm}^{-2}\text{s}^{-1}$)	1219+285 ($10^{-8}\text{cm}^{-2}\text{s}^{-1}$)	PKS 1222+216 ($10^{-8}\text{cm}^{-2}\text{s}^{-1}$)
304.0	10/19/93 - 10/25/93	< 47.8	< 42.8	< 50.2	25.1 ± 11.1
305.0	10/25/93 - 11/02/93	55.2 ± 12.7	24.3 ± 8.6	...	26.0 ± 10.9
306.0	11/02/93 - 11/09/93	44.2 ± 14.3	< 40.6	...	< 59.4
304.0 ... 306.0	10/19/93 - 11/09/93	41.0 ± 7.4	23.0 ± 5.5	< 21.4	24.4 ± 6.9
307.0	11/09/93 - 11/16/93	35.4 ± 16.3	40.0 ± 12.9	< 34.7	< 15.6
308.0	11/16/93 - 11/19/93	105.6 ± 33.4	< 66.1	< 24.3	< 13.6
307.0 ... 308.0	11/09/93 - 11/19/93	56.5 ± 15.8	35.5 ± 10.3	< 21.8	< 9.2
308.6	11/23/93 - 12/01/93	$64. \pm 15.9$	62.6 ± 13.1	32.2 ± 10.3	< 28.5
311.0	12/13/93 - 12/15/93	98.4 ± 39.7	< 37.5	< 98.0	< 36.9
311.6	12/17/93 - 12/20/93	< 50.8	< 67.4	< 58.8	48.4 ± 19.6
311.0 ... 311.6	12/13/93 - 12/20/93	< 79.2	< 31.8	< 57.8	29.1 ± 12.8
312.0	12/20/93 - 12/27/93	65.4 ± 16.5	< 24.1	< 26.7	< 22.4
313.0	12/27/93 - 01/03/94	56.7 ± 19.5	< 25.5	< 32.7	25.7 ± 9.3
311.0 ... 313.0	12/13/93 - 01/03/94	...	< 15.7	< 22.3	25.7 ± 9.3
311.6 ... 312.0	12/17/93 - 12/27/93	50.9 ± 13.4	< 18.9	< 27.1	37.9 ± 10.1

and discussion of 3C 279 will be published by Hartman et al. (1996).

2.3. 1219+285(ON 231; W COMAE)

This radio loud, optically variable BL Lac object with a flat radio spectrum was detected with a formal significance of 5.8σ in the sum of all viewing periods 304.0 through 313.0. The flux was very low though: $F(> 100 \text{ MeV}) = (19 \pm 4) 10^{-8} \text{cm}^{-2} \text{s}^{-1}$. As seen in Table 1 this source was in a quiescent state (upper limits) except during VP308.6 where it reached a formal significance of 4.6σ for a flux of $F(> 100 \text{ MeV}) = (32.2 \pm 10.3) 10^{-8} \text{cm}^{-2} \text{s}^{-1}$.

2.4. PKS 1222+216

The highest significance with which this flat-spectrum radio quasar was detected was 6.3σ in the sum of VP 311.0 through 313.0. The most significant detection in a single viewing period was in VP 313.0 with 3.8σ . However, the highest flux was reached in VP 311.6 with $F(> 100 \text{ MeV}) = (48.4 \pm 19.6) 10^{-8} \text{cm}^{-2} \text{s}^{-1}$ (formal significance = 3.6σ). There was some indication of variability between the individual viewing periods but the significance of this variability is low. This source has also been detected by the COMPTEL instrument during phase 3 (Collmar et al. 1996).

3. Discussion

These observations are important because they establish the temporal behaviour of already known γ -ray emitting

AGN as well as that of those blazars which have not yet been discovered by EGRET as γ -ray emitters. So was 1219+285 detected for the first time above the 5σ significance threshold for a high confidence detection (Fichtel et al. 1994; Thompson et al. 1995) of a source.

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