Preliminary COMPTEL Results from the CGRO Deep Virgo Survey

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Introduction

During Phase III (August 1993 - October 1994) of the Compton Gamma-Ray Observatory (CGRO) mission a coordinated observation of the Virgo region of the sky was carried out by the OSSE, COMPTEL, and EGRET instruments aboard CGRO, spanning more than 5 decades of gamma-ray energy. The main objectives of this deep Virgo Survey are (1) to contemporaneously study the high energy properties of the prominent quasars 3C 273 and 3C 279 over a broad energy range (50 keV - 20 GeV), (2) to continue the long-term γ-ray monitoring of these two quasars, which have been detected before by the different CGRO experiments (e.g. McNaron-Brown et al. 1994, Hartman et al. 1992, von Montigny et al. 1993, Williams et al. 1995) and (3) to search for new, previously unknown, gamma-ray sources using the large exposure collected. The CGRO Phase III Virgo survey consists of a set of 10 observational periods with 8 different pointings. It lasted from October 19, 1993 to January 3, 1994 and was interrupted only by a Geminga observation (12 days) and by 2 CGRO reboost manoeuvres (6 days in total). Overall an observation time of 58 days was collected by COMPTEL.

In this paper we present preliminary COMPTEL results from these Virgo observations.

Data Analysis and Results

The COMPTEL data (covering 0.75 - 30 MeV) acquired during the deep Virgo exposure are currently being analysed. So far, the analysis has followed the COMPTEL standard analysis procedures. Significance -, flux -, and flux error maps for the complete Virgo Survey in the four standard COMPTEL energy ranges (0.75 - 1 MeV, 1 - 3 MeV, 3 - 10 MeV, and 10 - 30 MeV) have been generated by applying a maximum-likelihood method and a background modelling technique as described by Bloemen et al. (1994). As a first step to search for time variability of potential γ-ray sources, the survey was subdivided into three parts covering roughly equal amounts of observing time, which were subsequently analysed individually.

Only the skymaps of the complete Virgo Survey generated in the 1-3 MeV and in the 3-10 MeV energy band show indications for sources with detection significances larger than 3σ. The maps are shown in figure 1. The significance contours drawn in these maps were derived from maximum likelihood-ratios, adopting a χ^2 distribution with 3 degrees of freedom (as is appropriate for a search). The 0.75-1 MeV map and the 10-30 MeV map do not contain excesses above the 3σ-threshold.

For the quasar 3C 273, most prominently present in previous COMPTEL observations of the Virgo region, good evidence for detection can be seen in both the 1-3 and 3-10 MeV maps. The detection significance for the combined energy bands is about 6σ, assuming that the maximum-likelihood ratio at the position of 3C 273 can be interpreted in terms of a χ^2 distribution with 1 degree of freedom (as is appropriate for a selected object). The spectrum is shown in figure 2. For the other quasar in the Virgo region previously observed by COMPTEL (3C 279), only evidence at the 3σ-level is obtained in the 1-3 MeV range.

Of the remaining features in figure 1, most remarkable is the excess near $\alpha \approx 205°$ and $\delta \approx 5°$ in the 1-3 MeV map. A detailed study is in progress. The significances of the other features that can be seen in figure 1 drop below the 3σ-level if the number of trials is taken into accout (note that we have effectively searched for sources in four sky maps, containing each of the order of 100 independent pixels).

No significant time variability has yet been seen for any of the sources or possible sources. Although 3C 273 was only detected during the first two parts of the survey, the derived 2σ upper limit on the flux for the third part does not exclude a constant intensity (see figure 2).

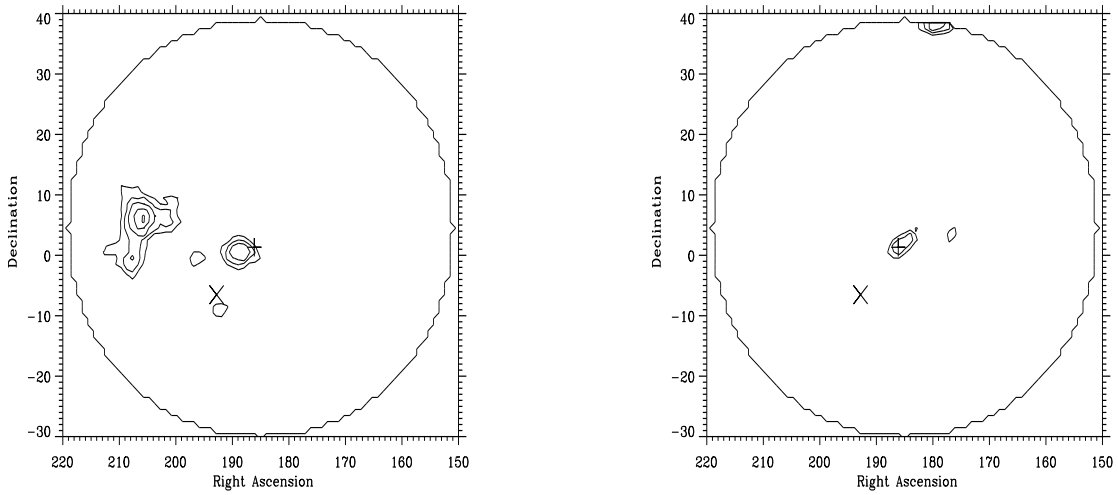

Figure 1: COMPTEL skymaps (detection significances - see text) of the deep Virgo survey (58 days of observation time). The contour lines start at a detection significance level of 3σ with a step of 0.5σ. The maps are generated in the 1-3 MeV band (left) and the 3-10 MeV band (right). The locations of 3C 273 (**+**) and 3C 279 (**x**) are marked.

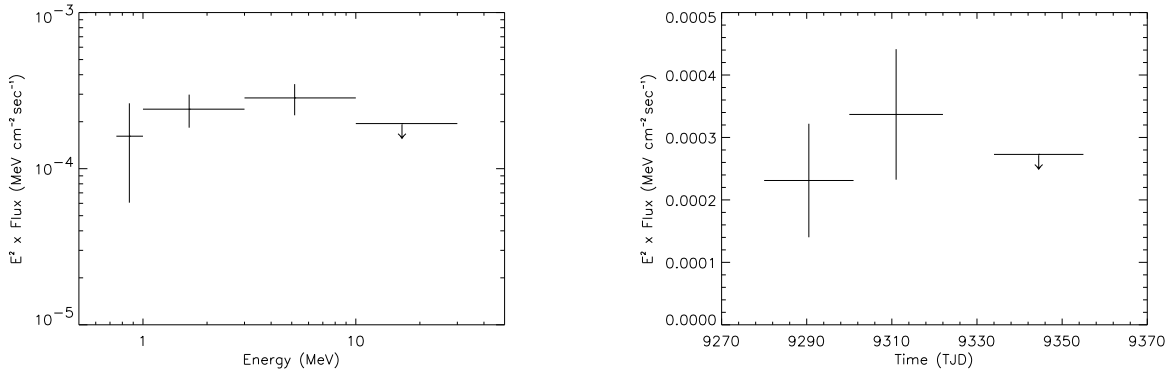

Figure 2: Flux spectrum $* E^2$ (left) and light curve (right) of 3C273 during the Virgo survey. The error bars are ±1σ and 2σ upper limits are indicated.

Conclusion

The COMPTEL data of the CGRO Phase III deep Virgo survey observations (58 days of observation time) are currently being investigated. The main results so far can be summarized as follows:

- The quasar3C273 is detected with a significance of ~6σ in the energy band from 1 to 10 MeV.
- There is evidence for the quasar 3C279 at a significance level of about 3σ in the 1-3 MeV band.
- Taking into account the number of trials carried out in the search for further γ-ray sources, there remains only one candidate. Further investigations of this candidate source are underway.

References

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