

Search for GeV gamma-ray emission from X-ray binaries

Masaki Mori¹, Yoshihiro Umeda¹, Kenji Nakagawa¹, and Taku Ohmori¹

¹ Department of Physical Sciences, Ritsumeikan University, Kusatsu, 525-8577, Japan

Introduction

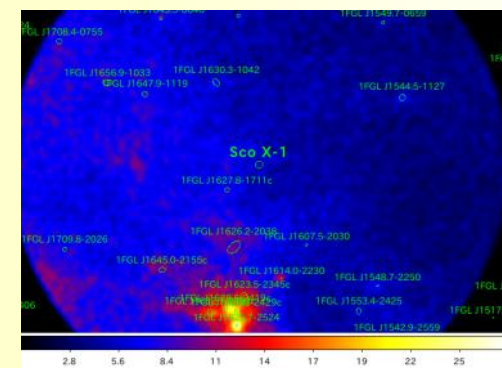
- X-ray binaries are rather common Galactic X-ray objects and about 300 sources are catalogued [1]. At gamma-ray energies, LS5039 [2], LSI+61° 303 [3], PSR 1259-63/LS2883 [4], Cyg X-1 [5], Cyg X-3 [6], and recently 1FGL J1018.6-5856 [7] have been reported to emit gamma-rays of GeV and/or TeV energies which are modulated in their orbital periods.
- Thus a new category of *gamma-ray binaries* is emerging, but their emission mechanism is not understood well. It is clear that we need more samples for the detailed study of these objects.
- In this study, gamma-ray emissions from some other well-known X-ray binaries have been searched for using the *Fermi-LAT* data in the GeV energy range.

Analysis

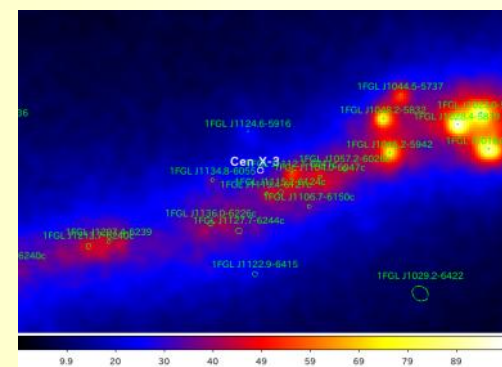
In the table below are listed four objects analyzed in this study. *Fermi-LAT* archival data were extracted from Fermi Science Support Center and analyzed using tools provided by FSSC (Fermi Science Tools v9r17p0). Energy ranges used in the present analysis are from 200 MeV to 100 GeV. Only *diffuse* class events detected at zenith angles smaller than 105° were used for analysis, assuming 'P6_V3_DIFFUSE' instrument response function along with the standard analysis pipeline suggested by FSSC. Significance of gamma-ray signal has been estimated by maximum likelihood method with a help of the *gtlike* program (we used it in the *binned* mode) included in the tools. The data periods are more than two years as shown in the Table.

Object	α (deg)	δ (deg)	Orbital period	Distance	Observation period
Sco X-1	244.979	-15.640	18.9hr	2.8 kpc	Aug. 04, 2008 – Oct 28, 2010
Cen X-3	170.316	-60.623	2.09d	8–10 kpc	Aug. 04, 2008 – Nov 18, 2010
Vela X-1	135.529	-40.555	8.96d	1.9 kpc	Aug. 04, 2008 – Nov 18, 2010
Her X-1	245.548	35.342	1.70d	6.6 kpc	Aug. 04, 2008 – Nov 18, 2010

Results

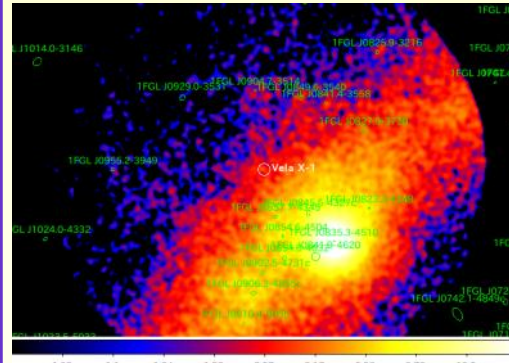


200MeV-10GeV gamma-ray countmap for Sco X-1. No significant excess is seen, and 95% C.L. upper limit is $1.03 \times 10^{-9} \text{cm}^{-2} \text{s}^{-1}$.

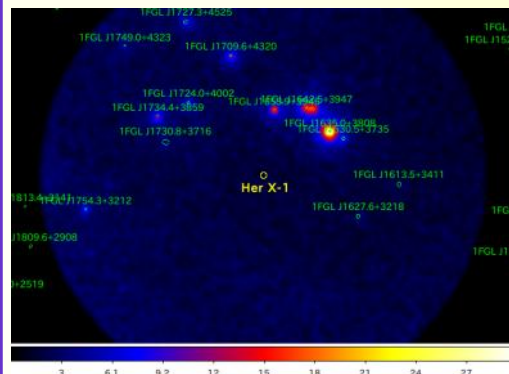


200MeV-10GeV gamma-ray countmap for Cen X-3. No significant excess is seen, and 95% C.L. upper limit is $4.28 \times 10^{-9} \text{cm}^{-2} \text{s}^{-1}$.

Results (cont.)



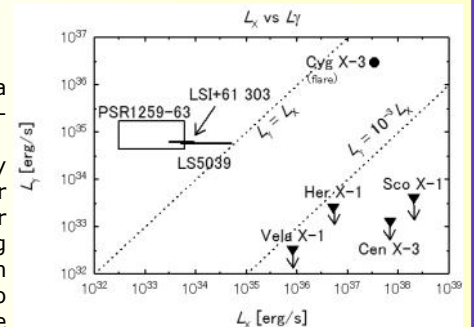
200MeV-10GeV gamma-ray countmap for Vela X-1. No significant excess is seen, and 95% C.L. upper limit is $2.41 \times 10^{-7} \text{cm}^{-2} \text{s}^{-1}$.



200MeV-10GeV gamma-ray countmap for Her X-1. No significant excess is seen, and 95% C.L. upper limit is $1.51 \times 10^{-9} \text{cm}^{-2} \text{s}^{-1}$.

Discussion

Right figure shows a relation between X-ray luminosities and gamma-ray luminosity upper limits of four sources assuming distances shown in the left Table. Also plotted are the points for the flare activity of Cyg X-3 [5] and other gamma-ray binaries [8]. Gamma-ray emitters, with $L_X \approx L_\gamma$, and non-emitters analyzed here, with $L_\gamma < 10^{-3} L_X$, might be in the different categories.



Summary

We have searched for GeV gamma-ray emission from some of selected X-ray binaries using the *Fermi-LAT* data. No significant signal was found from any of four sources analyzed here (Sco X-1, Cen X-3, Vela X-1 and Her X-1) and upper limits on gamma-ray fluxes were given.

References

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