

Milagro Search for VHE Emission from GRBs in the Swift Era

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Summary. — Since its launch, in late 2004, Swift has been locating gamma-ray bursts (GRBs) at a rate of ~ 100 per year. Very high energy (VHE) emission (> 100 GeV) is predicted by several models. Here, we present the results of a search for VHE emission from the most recent GRBs to fall within the Milagro field of view.

PACS 98.70.Rz – gamma-ray sources; gamma-ray bursts.

Milagro is a wide field (2 sr), high duty cycle ($> 90\%$), ground-based water Cherenkov gamma-ray telescope which monitors the northern sky almost continuously from 0.1–100 TeV [1]. At these energies, gamma rays are attenuated by the redshift-dependent extragalactic background light (EBL) [2], making GRBs above $z > 0.5$ very hard to detect. Milagro has been operating (and searching for VHE emission from GRBs) since 2000 [3].

The launch of *Swift* has increased greatly the number of well-localized GRBs. Here we present the results of a search for an excess of events above those due to the background for 39 GRBs detected by several satellites (primarily *Swift*) between December 2004 and May 2006. Table I lists the GRBs in the sample and summarizes the results. The number of events falling within a 1.6 degree bin is summed for the relevant duration (column 2 of Table I) and the number of background events is estimated from two hours of data surrounding the burst, using a technique known as “direct integration” [4]. No significant emission was detected from any of the locations. We present upper limits on the fluence in column 7 of Table I. For those bursts with known redshift, we compute the effect of EBL absorption, according to the model of ref. [2] and print the upper limits in bold.

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GRB	T90/Dur.	Zenith angle, θ	z	Instrument	σ	99% UL(flueunce)
041219a	520	26.9	...	INTEGRAL	+1.7	5.8e-6
050124	4	23.0	...	Swift	-0.8	3.0e-7
050319	15	45.1	3.24	Swift	+0.6	...
050402	8	40.4	...	Swift	+0.6	2.1e-6
050412	26	37.2	...	Swift	-0.6	1.7e-6
050502	20	42.7	3.793	INTEGRAL	+0.6	...
050504	80	27.6	...	INTEGRAL	-0.8	1.3e-6
050505	60	28.9	4.3	Swift	+1.2	...
050509b	0.128	10.0	0.226	Swift	-0.9	1.1e-6
050522	15	22.9	...	INTEGRAL	-0.6	5.1e-7
050607	26.5	29.3	...	Swift	-0.9	8.9e-7
050712	35	38.8	...	Swift	-0.1	2.5e-6
050713b	30	44.2	...	Swift	-0.3	4.0e-6
050715	52	36.9	...	Swift	-1.5	1.7e-6
050716	69	30.3	...	Swift	-0.5	1.6e-6
050820	20	21.9	2.612	Swift	+0.2	...
051103	0.17	49.9	0.001	IPN	-0.2	4.2e-6
051109	36	9.7	2.346	Swift	-1.1	4.3e-3
051111	20	43.7	1.55	Swift	+0.7	3.8e-2
051211b	80	33.3	...	INTEGRAL	+0.4	2.6e-6
051221	1.4	41.8	0.55	Swift	+0.6	9.8e-4
051221b	61	25.9	...	Swift	+1.5	1.8e-6
060102	20	39.9	...	Swift	-0.9	2.0e-6
060109	10	22.4	...	Swift	-1.3	4.1e-7
060110	15	43.0	...	Swift	-0.3	3.0e-6
060111b	59	36.5	...	Swift	-0.6	2.3e-6
060114	100	40.6	...	INTEGRAL	+0.5	5.1e-6
060204b	134	30.5	...	Swift	+0.3	2.7e-6
060210	5	43.4	3.91	Swift	+0.6	2.9e-6
060218*	10	44.6	0.03	Swift	+2.4	3.8e-5
060306	30	46.2	...	Swift	+1.0	7.2e-6
060312	30	43.6	...	Swift	-1.0	3.3e-6
060313	0.7	46.7	...	Swift	-0.5	2.7e-6
060403	25	27.6	...	Swift	-0.1	1.0e-6
060427b	0.2	16.4	...	IPN	+0.6	1.7e-7
060428b	58	26.6	...	Swift	-1.1	1.1e-6
060507	185	47.1	...	Swift	+0.4	1.6e-5
060510b	300	42.8	4.9	Swift	+1.9	...
060515	52	41.5	...	Swift	-0.3	9.6e-6

TABLE I. – List of GRB in the field of view of Milagro in the Swift Era (December 2004 – May 2006), with preliminary 99% confidence upper limits on the fluence (0.2–20 TeV), in ergs cm^{-2} . * This burst, due to its long duration of more than 2000 s left Milagro's field of view while in progress. The limit presented here is for the 10 s hard spike reported by the instrument team.

REFERENCES

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