

# Search for nearby galaxies in BATSE/IPN short GRB error boxes

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**Abstract.** Recent observations have shown an apparent association of short duration gamma-ray bursts with a variety of host galaxies at moderate redshifts. However, statistical analysis with large sample of BATSE GRB indicates that at least some fraction of short GRBs originates in the local Universe. We have considered pre-Swift well-localized short GRBs to examine a possible association of these bursts with galaxies at low redshifts. We have used BATSE/IPN localizations of short bursts and SDSS DR5/PSCz catalogs as galaxies surveys.

**Keywords:** Gamma-Ray Bursts, Data analysis

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## INTRODUCTION

The origin of short GRBs (S-GRBs) has been remained mysterious until recently due to their poor localization. In pre-Swift era several hundreds of these events were detected in the Burst And Transient Source Experiment (BATSE)[1] with a typical accuracy of few degrees and few dozen were localized by the Interplanetary Network (IPN)[2] with arcminute accuracy. Swift, HETE-2, Chandra and follow-up observations have shown an apparent association of S-GRBs with a variety of host galaxies at moderate redshifts [3, 4].

On the other hand, Tanvir et al.[5] have found a correlation between locations of S-GRBs and positions of galaxies in the local Universe, indicating that between 10 and 25 per cent of S-GRBs originate at redshifts  $z < 0.025$ . They have used the BATSE GRB catalog and the PSCz catalog of galaxies.

We have considered IPN data on S-GRBs to examine possible association of the bursts with galaxies at low redshifts.

## SEARCH FOR NEARBY GALAXY HOSTS OF SHORT GRBS

The IPN data in the 1990-2000 are available for 39 S-GRBs. Most of the bursts in the sample were detected by BATSE with all bursts in the sample much brighter than the BATSE threshold. 8 error boxes in the sample are less than  $0.003 \text{ deg}^2$ , 5 boxes are  $0.003 - 0.1 \text{ deg}^2$ , 20 boxes are  $0.1 - 1 \text{ deg}^2$ , 6 boxes are  $1 - 10 \text{ deg}^2$ .

We have used the SDSS DR5 [6] and the PSCz catalogs [7] as galaxies surveys. The SDSS DR5 represents the most deep galaxies survey with estimated redshifts up

**TABLE 1.** The PSCz galaxies found in the IPN short GRB errorboxes.

GRB date yymmdd	Time of day	Error box, deg <sup>2</sup>	Found Galaxy	Redshift of galaxy	Probab.of chance coin.
950210	02h20m21s	0.187	H/061/505 J/078/801	0.015 0.0087	0.017 0.008
961017	11h16m43s	0.94	G/015/005	0.07	0.29
991007	01h49m27s	1.104	F/093/007	0.028	0.21
991211	04h34m41s	9.244	E/107/018 E/107/028 E/110/019	0.02 0.025 0.027	0.75 0.82 0.85
000513	11h21m35s	3.055	K/177/013	0.0099	0.15
000525	10h24m13s	4.571	J/139/011 K/147/006	0.046 0.017	0.75 0.42

to  $z \sim 0.5$  covering  $\sim 1/4$  of the sky. The PSCz provides redshifts for galaxies up to  $z \sim 0.1$  over 84% of the sky.

None of 39 GRBs error boxes are fully covered by the SDSS DR5. The number of partly covered error boxes is 10 while only 3 boxes have a coverage more than 50%. Hence we cannot search for hosts of a particular GRB with the SDSS.

34 of 39 GRBs error boxes are fully covered by the PSCz catalog. We have searched for galaxies appearing in the error boxes. We have estimated that the probability of chance coincidence for a galaxy at  $z \sim 0.025$  is  $\leq 2 \times 10^{-3}$  provided that the error box is not larger than  $\sim 0.1$  deg<sup>2</sup>. For a closer galaxy an error box can be larger.

First, we have considered the error boxes with  $S_{errorbox} \leq 0.1$  deg<sup>2</sup>. 9 of 13 boxes are covered by the PSCz. We have found no galaxies. Then we have considered the error boxes with  $S_{errorbox} \leq 1.0$  deg<sup>2</sup> and the full sample of 34 GRBs. We have found 3 and 10 galaxies respectively. They are listed in Table 1.

Table contains GRB time identifier, size of error box, galaxy name and redshift and the estimated probability of chance coincidence. The lowest estimated probabilities of chance coincidence are 0.008 and 0.017 for 2 galaxies found in the error box of GRB950210 (the redshifts are  $z=0.0087$  and 0.015,  $S_{errorbox} = 0.187$  deg<sup>2</sup>). In most cases the estimated probability of chance coincidence for a galaxy at given redshift is  $\gg 2 \times 10^{-3}$ . Moreover, the found number of galaxies is less than expected in the case of chance coincidence (3.4 and 12.8 respectively).

## CONCLUSIONS

1. We have found **no host** candidate among nearby PSCz galaxies in each of 34 IPN short GRBs error boxes.
2. We have found **no excess of nearby galaxies** in IPN short GRBs error boxes. The 90% upper limit corresponds to 7% of GRBs originating in nearby galaxies of PSCz catalog. Taking into account the redshift distribution of PSCz galaxies the fraction of galaxies at  $z \leq 0.025$  among GRBs hosts is less than several per cent.

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