SEARCH FOR INFRARED COUNTERPARTS OF GAMMA-RAY BURSTERS

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ABSTRACT

We report here the result of two searches for infrared counterparts of Gamma-ray Bursters (GRB's). The first search was made using data from the IRAS satellite and covered 23 positions. The second search was made with the Kitt Peak 1.5 m telescope and covered 3 positions. In neither of these two searches was any infrared candidate detected.

1. Introduction. Despite the decade of intense gamma-ray observations since their discovery, nothing positive is known about the nature of GRB's; however, there is a suspicion that neutron stars are somehow involved. It has become apparent that gamma-ray observations alone cannot determine the nature of the GRB system.

Currently, one of the best hopes for a breakthrough is the discovery of a quiescent low energy counterpart. A quiescent counterpart would allow for very deep studies at many wavelengths with high angular resolution. In addition, radiation from the quiescent system will be more diagnostic of the system's components than burst radiation. Low energy observations are cheaper, easier, more sensitive, and easier to interpret than high energy observations. Already many searches have been made for optical counterparts--but the searches have only demonstrated that the GRB's are very faint. So it seems that the vital search for a counterpart may profitably shift to other frequencies.

At infrared wavelengths, there are reasons to believe that the quiescent GRB counterpart will be bright enough for a reasonable observing program. Many leading models require the neutron star to have a companion (e.g., Woosley and Wallace, 1982; Van Buren, 1981; Ventura et al., 1983). The existence of the campanion is further supported by Wood et al. (1981) on the basis of the 8-second period in GB790305. In addition, Schaefer and Ricker (1983) have demonstrated that a large and cool companion to the neutron star is required to explain the optical flashes. The optical flashes are readily explained by reprocessing off a small companion star with a 10^3K temperature at a distance of 100 pc (Rappaport and Joss, 1985).

2. Results. The IRAS satellite has completed an all sky survey in four broad bandpass filters between 12 and 100 μ (Neugebauer et al., 1984). We have used the resulting point source catalog to search for any

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infrared sources associated with any of 23 known burst positions. These burst positions were chosen solely for their small size, so that it is unlikely that a background source will appear inside the error box. With one exception, no IRAS source was found in any of the boxes. The sensitivity limits vary widely with position on the sky, but typically are 0.25, 0.4, 0.6, and 1.0 Janskys for the 12, 25, 60, and 100 μ filters, respectively.

The GB790305 proves to be the one exception, as it often is. The IRAS point source catalog indicates that a source is located within 14" of (1950) 5h 25m 59.5s -66° 7' 3", which is consistent with the best error box of Cline et al. (1982). The 12 μ flux is 0.45 Jansky and the 25 μ flux is 1.54 Janskys. The 60 and 100 μ filters provide uninteresting upper limits. The region of the sky is extremely confused with background point sources and diffuse emission. The distribution of this background makes it problematic whether the point source is real. Even if it is real, we unfortunately conclude that the emission would undoubtedly be from the N49 supernova remnant itself: (1) The IRAS spectral shape is indistinguishable from all other detected LMC and SMC supernova remnants. (2) The X-ray brightnesses of all LMC and SMC supernova remnants (Mathewson et al., 1983) are well correlated with the IRAS detections. N49 is comparatively bright in the X-rays and, hence, should provide infrared emission detectible by IRAS (at the observed flux level) whether or not a GRB is along the line of sight.

Our second search for infrared counterparts was made with a 1.5m telescope at Kitt Peak National Observatory in Arizona. We searched the error boxes associated with the 18 April (Hurley, 1984, private communication), 23 March (Laros et al., 1985), and 13 June (Barat et al., 1984) 1979 GRB's. The search was accomplished by raster scanning a 11.3" diameter aperture over the entire error box with typically 30 seconds of integration time per pixel. We looked in the K filter ($\lambda \sim 2.2\ \mu$) to a magnitude of 13.6 which equals 0.0023 Jansky. We found only one infrared source in any of the three error regions. Subsequent UBVRIJHK photometry shows that this source is a $m_V = 13$ G-type star, and, hence, is unlikely to be the counterpart.

It is disappointing that both our searches failed to identify any likely candidates. However, the potential for high scientific returns suggests that infrared searches should continue.

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