

## Optical counter-parts of Gamma Ray Bursts

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**Abstract.** Gamma Ray Bursts (GRB'S) being the most energetic astronomical phenomena known to date still pose a formidable challenge to astronomers. The BATSE on board the Compton Observatory (CGRO) launched in 1991, has shown that GRB's are unlikely to be of galactic origin. More recently, the launching of the X-ray satellites viz. Beppo SAX and RXTE enabled astronomers to locate GRB's rapidly and accurately leading to the discovery of their counter-parts in other wavelengths like X-ray, optical and radio. This has been a breakthrough in understanding the origin of GRB's. These observations led to the possibility of GRB's being extra-galactic in origin, the farthest source being at a redshift of  $\sim 5.0$ . The optical counter-parts of GRB's have been very faint and fading rapidly with time. This necessitates the use of a large optical telescope like the proposed 10m telescope (GTC). In this paper we will discuss the need for a large telescope for GRB astronomy which can lead to discoveries resulting in the complete understanding of the origin of GRB's.

*Key words:* Gamma Ray Bursts, optical counter-parts

### 1. Introduction

Even though about one burst is recorded every day the exact nature of their progenitors could not be studied because their positions were poorly determined. After the launch of Beppo SAX and Rossi X-ray Timing Explorer, follow up observations following the occurrence of GRB's could be carried out. So far, five GRB's (GRB 970228, GRB 970508, GRB 971214, GRB 971227 & GRB 990123) have been detected in the optical while the host galaxy of one GRB (GRB 971214) was detected in the optical and its redshift has been estimated to be 3.4 (Kulkarni et al., 1998). More recently, another burst GRB 980329) was detected in the radio and its red shift has been estimated to be around 5 (Glanz, 1998). So far six GRB's have been shown to be having X-ray afterglows associated with them (McNamara & Harrison, 1998). The large redshift when combined with the measured flux of  $\gamma$ -rays from the burst implies an energy of  $3 \times 10^{53}$  ergs in  $\gamma$ -rays alone. Further, its location in a star forming galaxy support the idea that the GRB's mark the deaths of very first stars that were ever formed and thus enable us to learn

about a period in the history of our universe that we cannot see in any other way.

## 2. Optical counter-parts of GRB's

The first optical detection of a transient and fading source in the error box of the GRB 970228 was carried out within 21 hrs after the burst (van Paradijs et al., 1997). The counter-part seemed to be associated with a host galaxy. This was the first direct evidence that the GRB's are likely to be of extra-galactic origin.

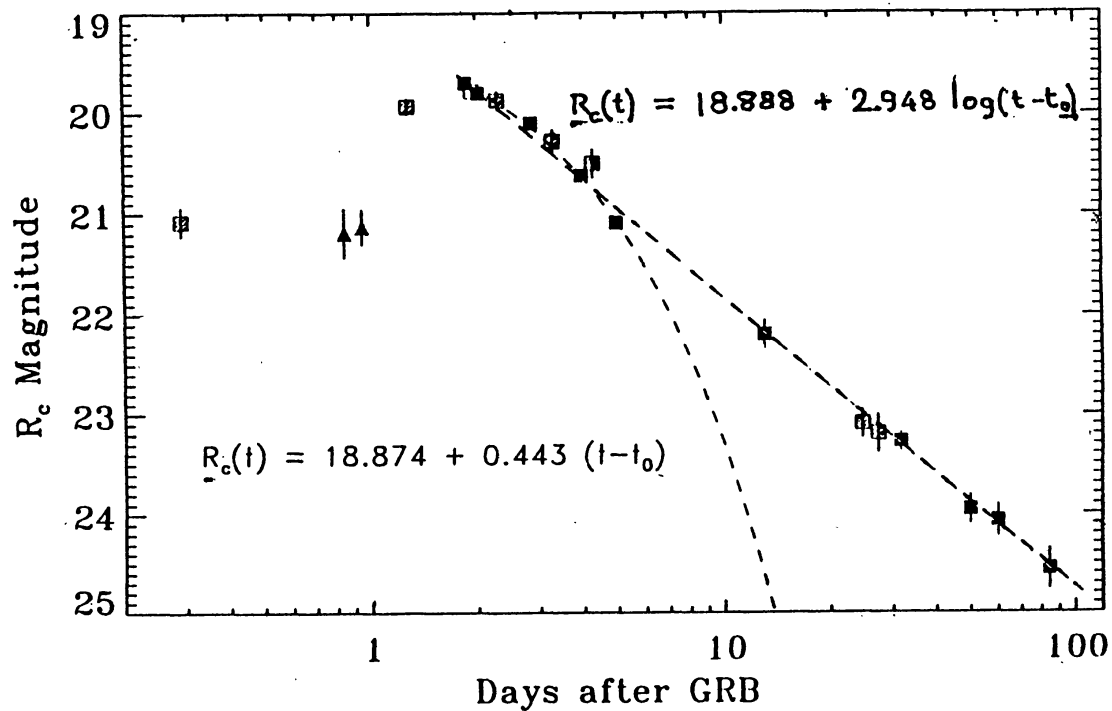


Figure 1.  $R_c$  light curve of GRB 970508; Optical remnant upto 85 days after the burst

The following figure (fig.1) shows the fading characteristics of the GRB 970508 over 100 days after the burst (Sokolov et al., 1997). It can be seen that the optical counter-parts of GRB's are, in general, very faint ( $m_v > 21$ ) and hence needs large mirrors to detect the fading counter-part in many broad band colors and to detect spectral lines from the possible host galaxy.

## 3. Conclusion

The detection and study of the integrated light curve of a GRB counter-part is essential to study the yet unknown phenomena of GRB's. The fading rate leads to the understanding of the energy dissipation mechanisms in the fireball, the acceleration mechanisms and the variation in the optical depth during the expansion phase of the fireball. The detection of the faint host galaxy will lead to the understanding of the environs of a GRB source. The spectroscopy of the optical transient will lead to the distance estimate and the energetics of the phenomena. The optical

counter-part of a GRB is generally very faint and hence requires a ten metre class optical telescope like the proposed GTC.

### References

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