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The short GRB 051210 observed by Swift(*)

V. La Parola([1]), V. Mangano([2]), B. Zhang([3]), G. Cusumano([2]), T. Mineo([2]), E. Troja([2]), D. N. Burrows([4]), S. Campana([5]), M. Capalbi([6]), G. Chincarini([6]), P. Giommi([6]), A. Moretti([5]), M. Perri([6]), P. Romano([5]) and G. Tagliaferri([6])

([1]) *Dipartimento di Fisica, Università degli Studi di Milano-Bicocca - Milan, Italy*
([2]) *INAF, Istituto di Astrofisica Spaziale e Fisica Cosmica di Palermo - Palermo, Italy*
([3]) *Department of Physics, University of Nevada - Las Vegas, USA*
([4]) *Department of Astronomy and Astrophysics, Pennsylvania State University - USA*
([5]) *INAF, Osservatorio Astronomico di Brera - Merate (LC), Italy*
([6]) *ASI Science Data Center - Frascati (Roma), Italy*

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Summary. — We report on the short GRB 051210 detected by the *Swift*-BAT. The light curve, on which we focus mainly, shows a hint of extended emission in the BAT energy range, a steep decay of the X-ray emission, without any flattening or break, and two small flares in the first 300 s. The emission fades out after ~ 1000 s.

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

GRB 051210 was classified as short after the onground analysis of the BAT data [1] which revealed a $T_{90} = 1.27 \pm 0.05$ s. Moreover, both its spectral lag [1] and its position on a T_{90} *vs.* hardness plot are typical of short GRBs [2]. No optical counterparts were identified by any ground-based or space telescope. A detailed analysis and discussion of the temporal and spectral behaviour of this burst is in [3].

Figure 1 shows the light curve of GRB 051210. The rapid fading of the source and the lack of any flattening in the light curve after the initial decay may indicate that the GRB occurred in an extremely low-density medium (naked GRB [4]) where the radiation emitted by the forward shock is expected to be undetectable. The steep decay of the X-ray emission is fully consistent with the hypothesis that we are observing a low-energy tail of the prompt emission from an internal shock through the so-called curvature effect [5]. Under this hypothesis the emission would decay as $t^{-\alpha} = t^{(-\Gamma+1)}$, where Γ is the photon index of the GRB emission. In this case we get $\Gamma + 1 = 2.54$, in very good agreement with the observed slope (2.58 ± 0.11). We can derive an estimation for the density of the interstellar medium n in the vicinity of the burst from the expression of the expected afterglow flux according to the standard models [6]. Assuming reasonable values for the redshift, the electron index and the total energy of the burst, we get $n < 3 \times 10^3\,\mathrm{cm}^{-3}$, confirming the trend that short GRBs tend to be located in low-density environments [7].

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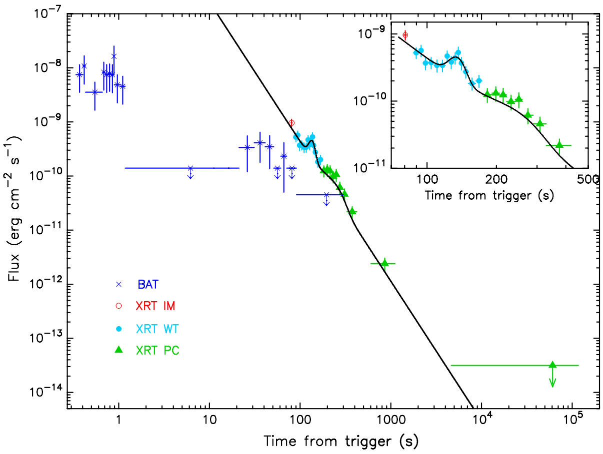

Fig. 1. – XRT light curve decay of GRB 051210. The XRT and BAT count rates were converted into flux units (0.2–10 keV) by applying a conversion factor derived from the relevant spectral analysis. The solid line represents the best-fit model to the XRT data.

The extrapolation of the XRT light curve back to the burst onset does not match the BAT points by a few decades. This can be explained if the XRT light curve is the tail of a flare peaking at a time before the XRT observation and too weak to be detected by the BAT. Within such an interpretation, the zero time point of the rapid decay component should be shifted to the beginning of the rising segment of the relevant flare [5], which marks the reactivation of the central engine. The few marginally significant points in the BAT light curve starting at $\sim T + 20$ s suggest that this could be the case of extended emission, as reported by [8] for a few short bursts observed with BATSE.

Two small flares are visible in the first 300 s after the onset in the XRT light curve. Delayed activity from the inner engine as an origin for flares (*e.g.* [9]) can hardly be applied to short GRBs, if they originate in the merger of two compact objects in a binary system (NS-NS or NS-BH): hydrodynamical simulations suggest that the central engine activity of merger events cannot last more than a few seconds [10]. Some alternative hypotheses: gravitational instability can lead to the fragmentation of the accretion disc, creating blobs of infalling material that produces the observed flares [11]. [12] suggest that magnetic fields may build up near the black hole and form a magnetic barrier that can turn on and off the accretion episodes, leading to erratic X-ray flares at late epochs.

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