Gamma-ray Burst Events Observed by SZ2/XD in 2001

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Abstract

SZ2/XD is a small hard x-ray detector system, which was built for monitoring of the transient radiations, such as GRBs and solar flares. It had operated successfully on the Chinese spacecraft SZ2 for about 6 months since Jan. 2001. Hundreds burst-like events were observed, which include tens of GRBs, near hundred of Solar Flares and area-related particle precipitation events. This paper will give brief introduction of the detector system, and observation result of GRBs. The result shows more fraction of the GRBs having shorter duration.

1. Introduction

Since the discovery of the gamma-ray burst(GRB) in 1972 [1], great progress has been achieved by many observations and theoretical studies [2-9]. But, there are still many suspended questions which challenge further investigations. An GRB monitor system composing a soft-xray detector in energy band of 0.2-2 keV, a x-ray detector covering 100-800 keV, and a gamma-ray detector in the energy band above 300 keV, had been built for measuring the GRB spectrum in wide energy band by fine time resolution. It had been successfully operated on SZ2 Chinese spacecraft. The X-ray detector covered the main energy band of GRBs and provided the trigger of the burst signals for the whole monitor system. It was also sensitive for studying other transient radiations.

2. The X-ray detector system

The X-ray detector(XD) is composed of two NaI scintillators by the dimension of ϕ125mm $\times$ 6mm and ϕ125mm $\times$ 15mm to cover 10-200 keV and 40-800 keV, with the name of XD1 and XD2 respectively. Each of the sub-detector has their independent signal amplifying and data acquisition circuits. A common communication circuit for two sub-detectors provides the data buffering, data transferring, tele-command processing and the trigger controlling. Fig. 1 is the schematic diagram of the detector system.

pp. 2765–2768

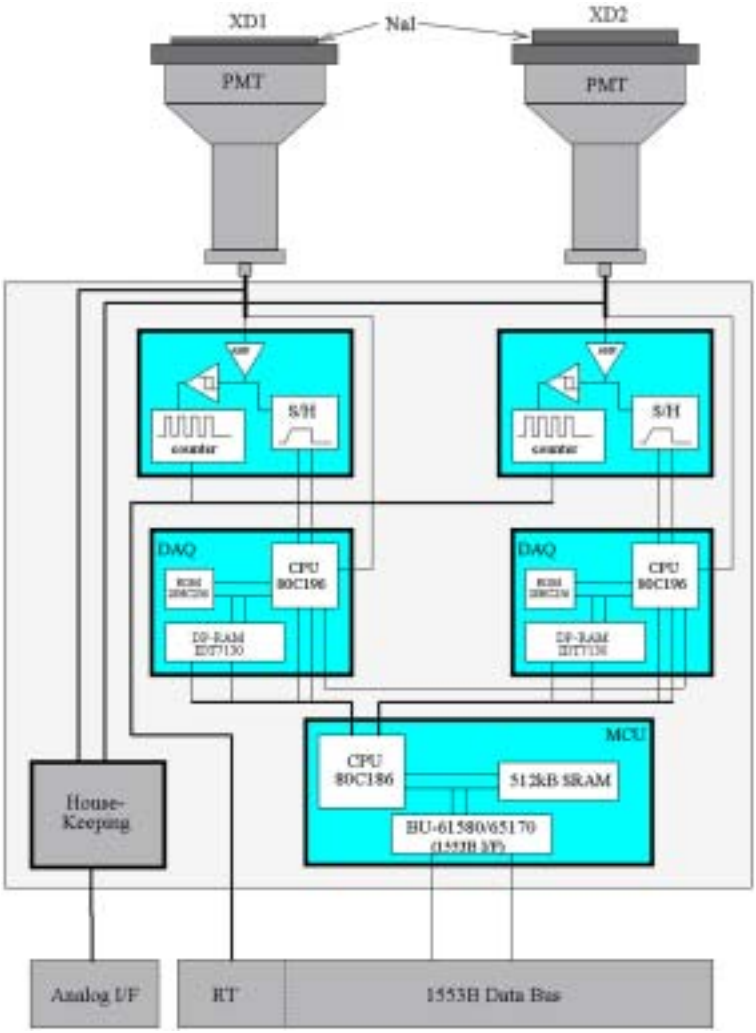

Fig. 1. The schematic diagram of the SZ2 X-ray detector system.

3. On-board observation

SZ2 was launched at local time of 1:00 AM, 10 Jan. 2001, with the inclination of 42°. It reached to the orbit of 400 km with the period of 92 minutes.

XD started its observation in 6 days later when the orbital module was separated from the descent module. Just one day later, in 17 Jan. XD observed its first gamma-ray burst (see Fig. 2). Then XD was kept its observation well until the orbital module switch off on 25 June and totally obtained 600 excess above to the instant background. Following SZ2 attitude control, The axis of XD has two pointing modes: pointing to the sky(in anti-earth center direction), or pointing to the Sun.

The detector was operated in 3 working modes: "waiting" mode, "burst" mode and SAA (South Atlantic Anomaly) mode. In "waiting" mode, around

3000 second of background data could be accumulated by the time resolution of 1 second and 64 energy bands. The "Burst" mode was switched with trigger logic of XD1"OR"XD2 for the criteria of 6 sigma above the background on the time scale of 40 ms, 200 ms and 1 s respectively. The data would be stored for total 128 second with time resolution of 1s for background and 40ms for the burst, and all in 64 energy channels. There is another independent data channel which only collect the integral counts for each second, around 10 hours data maximum could be recorded every day. In SAA mode the high voltage of PMTs would be switched off.

4. Results and discussions

As it was just in peak time 23rd cycle of solar activity, many solar flares as well as the Particle Precipitation Events(PPE) had been observed. The Solar Flares was mainly be recognized by comparing the time coincidence between XD and GOES-8 result, most PPEs were recorded in waiting mode and may occurred repeatedly at several certain geometric coordination. After the analysis, around 30 GRB candidates obtained, about 10 GRBs were confirmed from other observations, for example, BeppoSAX, Konus, Yohkoh and so on. An example with spectrum fit result are shown in Fig. 3. Table 1 shows a list of confirmed GRBs. Their duration distribution is shown in Fig.4. It implicated that, more short GRBs observed.

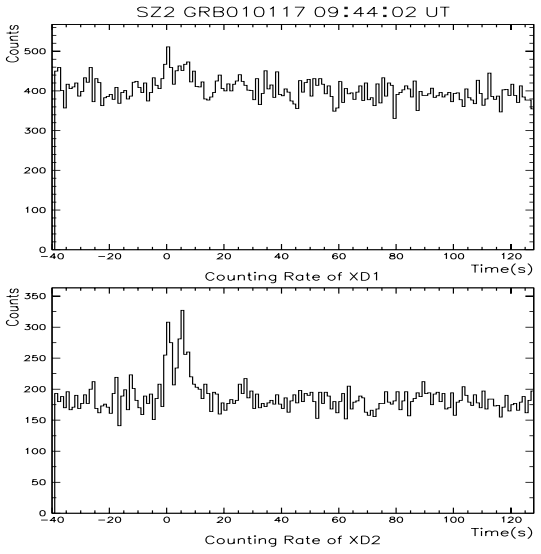

Fig. 2. The first Gamma-ray Burst observed by SZ2/XD.

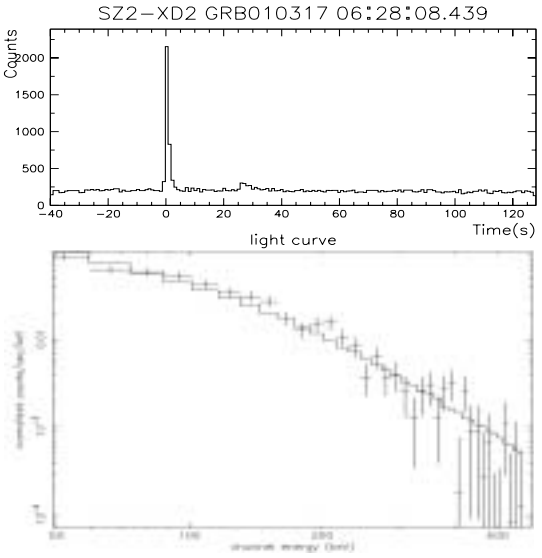

Fig. 3. The light curve of GRB010317 and its spectrum fitted by a power law function with index of 1.8.

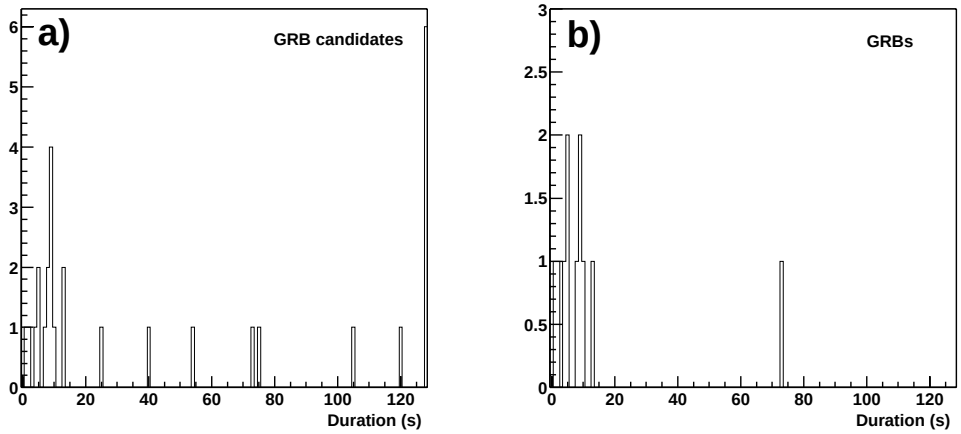

Fig. 4. Duration distributions for 28 GRB candidates (a), where 75% of them with $T < 20$ s; for 11 GRB events (b), where 90% of them with $T < 20$ s

Table 1. Confirmed GRBs and fit results of the spectrum

Trig. No.	Date	Start Time (UT)	Duration (s)	Fluence(50-200keV) (10^{-7}erg/cm^2)	Power law Index
1	GRB010117	09:37:24.6	9	14.5	3.7
3	GRB010118	22:54:56.3	1.2	6.1	3.3
7	GRB010206	06:31:00.6	13.4	0	3.7
10	GRB010209	05:11:01.6	10	60	2.5
21	GRB010222	19:43:01.3	5	6.2	1.4
33	GRB010309	12:33:54.5	5	2.1	1.9
35	GRB010312	02:30:55.4	8	11.4	3.8
39	GRB010317	06:28:08.3	1.8	16.3	1.8
64	GRB010327	05:58:51.0	9	13.1	1.5
191	GRB010526	17:55:04.2	73	110	2.1
215	GRB010611	22:06:08.4	4	18.4	1.1

5. References

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