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COMPTEL's solar flare catalog

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COMPTEL'S SOLAR FLARE CATALOG

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ABSTRACT

COMPTEL, the imaging gamma-ray telescope, capable of detecting gamma rays in the range of 0.1-30 MeV, is one of four instruments aboard NASA's Compton Gamma-Ray Observatory. The Comptel burst detectors (single Detector Mode) have a field of view of ~2.5π sr. These detectors of COMPTEL permit measurements of energy spectra and time histories of solar flare gamma-ray emission. A search through the Single Detector Mode's data is being conducted. We summarize the preliminary results of this search.

INTRODUCTION

The COMPTEL Solar Flare Catalog was obtained using the data generated in the single detector mode. The BATSE trigger flare list was used as the primary reference source. This catalog includes almost every trigger in the Burst Processor. The particular intensity threshold of solar flares needs no defining. The data from the high range of the Single Detector Mode (June 1991 to February 1992) has been processed and thirty flares have been confirmed. For each processed flare, energy spectrum and several time history plots, were produced for different energy bands. Such plots include (0.6-1) MeV for the 0.847 MeV line from ^{56}Fe, (2-2.4) MeV for the 2.223 MeV line from neutron capture on hydrogen, (3-7) MeV for the 4.44 and 6.13 MeV lines due to ^{12}C and ^{16}O deexcitation, and finally (8-10) MeV.

BURST DETECTOR

The imaging Compton Telescope, COMPTEL, uses 2 out of the 14 NaI cells in the lower (D2) detector (Fig. 1) to accumulate burst spectra upon receiving a trigger signal

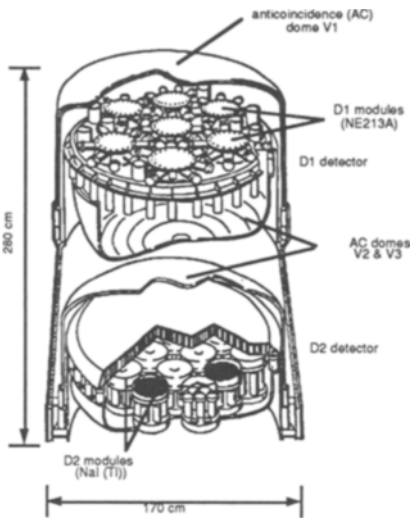


Figure 1. Schematic view of the COMPTON telescope COMPTEL. The burst detectors are shaded in black.

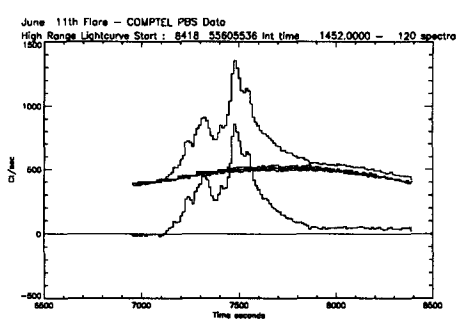
from BATSE. Each NaI(TI) crystal of the Single Detector Mode has a diameter of 28 cm, and a height of 7.5 cm. Each is viewed from below by 7 photomultipliers. The two modules measure energy in two different ranges: low range (0.1 MeV to ~0.6 MeV) and high range (~0.6 MeV to ~10.7 MeV). The threshold (0.1 MeV) in the low range is mostly due to the absorption of gamma-rays in the veto domes and the aluminum sandwich plate sheltering the (D2) assembly (see Fig. 1). The detector modules are supplied with dedicated ADC's and an electronic subsystem (Burst Spectrum Analyzer 'BSA')[1].

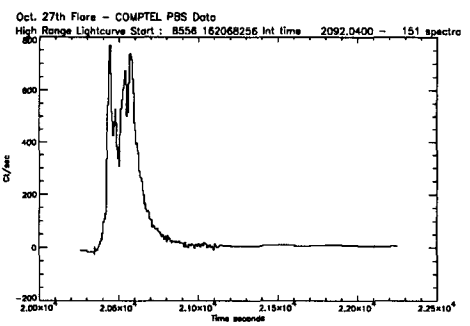
DATA and ANALYSIS

An extensive search is being conducted in the data of the BSA. If a trigger is found, then it is cross checked with BATSE and GOES data, to determine if it is a flare. If such a flare shows good statistics then further analysis is performed. The method of finding the background-subtracted flare is to subtract the average of 15 orbits before and after each flare. In the first analysis only the flares within the field of view of COMPTEL telescope mode were processed, but by taking advantage of the wider field of the single detector mode other flares were found. Approximately 30 flares were found and 26 flares have been excluded due to poor statistics.

RESULTS

In figure 2 we display the raw time profiles of 5 solar flares (not dead time corrected).





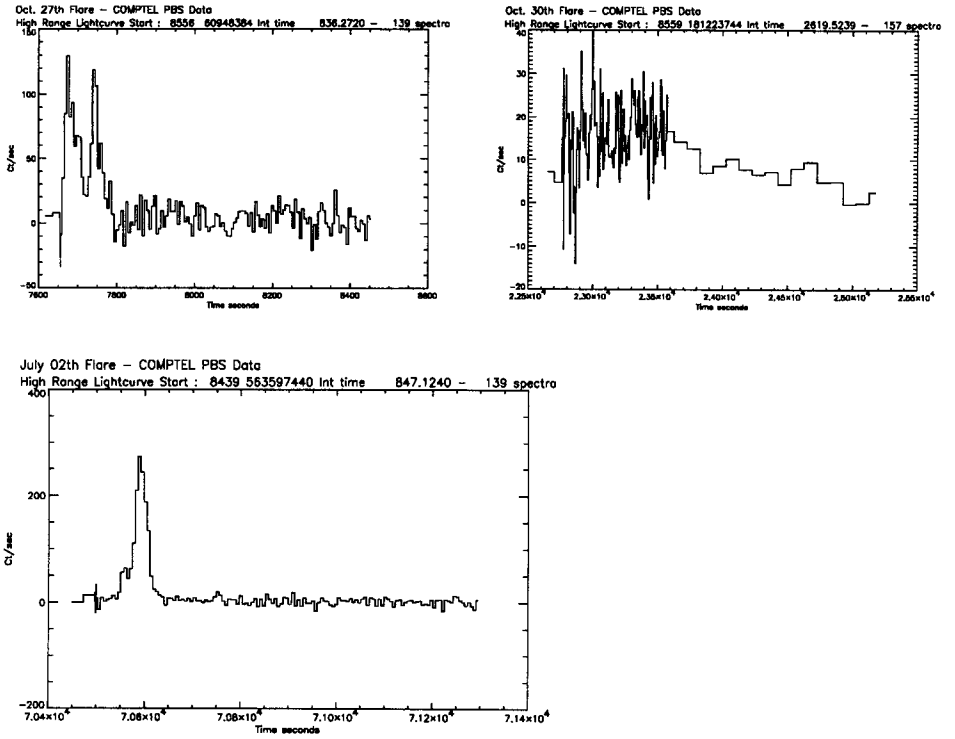


Figure 2. Time profiles of 5 solar flares detected in COMPTEL's burst mode. The first one includes the flare with the background, the middle lines are the background before and after and their average, and the flare minus background.

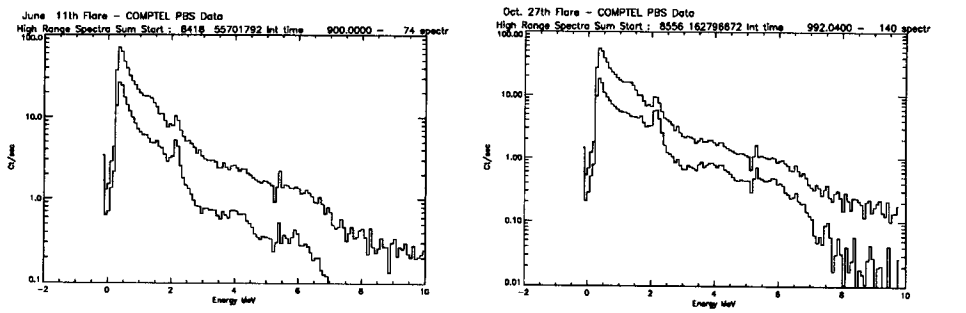


Figure 3. Energy spectra of solar flares. Top plot is the flare with background while the bottom is the flare minus the background.

We show some of the processed solar flares in Table 1. For each flare the onset time and the background subtracted

counts in the energy range of 0.6 to ~10 MeV are given.

Table 1. Summary of some of the observed solar flares

Flare Date	Onset time (UT)	Batse Event	Batse's Counts	Comptel's Counts	Class
12/15/91	18:32:20	2102	1.00E+07	8.44E+03	M1.4
02/02/92	09:05:25	2551	1.36E+06	8.60E+03	M2.8
02/04/92	07:53:52	2596	6.65E+04	1.01E+03	C3.7
01/26/92	14:50:25	2511	8.39E+04	5.31E+04	C5.3
07/02/91	19:34:30	684	2.54E+07	1.90E+05	M4.6
07/17/91	06:25:00	786	5.24E+07	5.27E+04	X1.1
06/04/91	03:37:00	387	1.05E+09	1.61E+06	X12.0
06/09/91	01:39:00	419	6.02E+08	7.15E+04	X10.0
06/11/91	01:56:00	485	8.06E+08	3.49E+05	X12.0
06/30/91	02:55:00	665	1.50E+07	3.21E+05	M5.0
10/07/91	10:14:35	1436	4.30E+05	1.65E+03	C9.9
10/14/91	17:33:42	1491	9.50E+06	9.59E+03	M6.6
10/15/91	09:13:20	1498	1.36E+06	1.91E+04	C7.7
10/24/91	02:36:21	1551	6.54E+07	1.59E+04	X2.1
10/27/91	05:38:20	1648	4.29E+08	2.06E+06	X6.1
10/27/91	02:07:30	1643	3.40E+07	1.29E+05	X1.9
10/30/91	06:18:20	1723	7.13E+07	1.76E+05	X2.5
10/30/91	19:11:42	1743	7.30E+06	2.30E+04	M4.3
10/30/91	22:24:10	1749	2.70E+05	1.24E+04	C5.3

SUMMARY

This paper reports on the preliminary results of the construction of the COMPTEL Solar Flare Catalog. The data presented in this paper are from the COMPTEL burst mode. Results from spectral studies and neutron analysis, from COMPTEL's telescope mode, for some of the flares in June and October of 1991, can be found in these proceedings[2,3].

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