Swift Observations of GRB 090529A

T. Sakamoto (GSFC/UMBC), H. A. Krimm (GSFC/USRA),
B. Sbarufatti (INAF-IASFPA), P. Schady (MSSL-UCL)

1. INTRODUCTION

At 14:12:35 UT, the Swift Burst Alert Telescope (BAT) triggered and located GRB 090529 (trigger=353540) (Sakamoto et al., GCN Circ. 9430). Swift slewed immediately to the burst. The burst was detected during a pre-planned slew. The XRT began observing the field at 14:15:52.3 UT, 197.1 seconds after the BAT trigger. Using promptly downlinked data we find a bright, fading, uncatalogued X-ray source located at (RA, Dec) =(212.46882, 24.45889) or (14h 09m 52.52s, +24d 27' 32.0") with an uncertainty of 3.7 arcseconds (radius, 90% containment). This location is 80 arcseconds from the BAT onboard position. The Swift/UVOT began settled observations of the field of GRB 090529 206s after the BAT trigger and no new source was detected within the XRT position in the first white finding chart. However, a new source is detected within the refined XRT error circle in a second white finding chart, taken at 883s after the BAT trigger, as well as in a co-added b-band exposure at (RA, Dec) = (212.46892, 212.46892) or (14h 09m 52.56s, +24d 27' 32.2") with an estimated uncertainty of 0.7 arcsec (radius, 90% confidence, statistical + systematic).

The optical afterglow has been also observed by the Xinglong TNT telescope (Xin et al., GCN Circ. 9431), the 1.34m TLS telescope (Kann et al., GCN Circ. 9436), the Z-600 telescope of Mt.Terskol observatory (Andreev et al., GCN Circ. 9437), the 1.5m OSN telescope (Gorosabel et al., GCN Circ. 9448), the Nordic Optical Telescope (Leloudas et al., GCN Circ. 9453), the MITSuME 50cm telescope (Yoshida et al., GCN Circ. 9467), and the the Russian-Turkish 1.5-m telescope (Balman et al., GCN Circ. 9485). The spectroscopic redshift of 2.63 has been measured by the ESO Very Large Telescope (Malesani et al., GCN Circ. 9457).

2 BAT OBSERVATION AND ANALYSIS

The BAT mask-weighted light curve shows that the burst was in progress when it came into the BAT field of view at ~T-50 sec, following a pre-planned slew. The detectable part of the light curve shows an exponentially falling rate, which some possible superimposed peaks at ~T-45, ~T-25 and ~T-15 sec. The count rate is down to background by T+50 seconds. Given that we did not observe the start of the burst, we can only provide a lower limit to T90: T90 (15-350 keV) is > 100 sec.

The time-averaged spectrum from T-49.0 to T+39.3 sec is best fit by a simple power-law model. The power law index of the time-averaged spectrum is 2.0 +- 0.3. The fluence in the 15-150 keV band is 6.8 +- 1.7 x 10^{-7} erg/cm2. The 1-sec peak photon flux measured from T-50.0 sec in the 15-150 keV band is 0.4 +- 0.1 ph/cm2/sec. All the quoted errors are at the 90% confidence level.

3. XRT OBSERVATION AND ANALYSIS

The 0.3-10 keV X-ray light curve is best fitted by two broken power-law. The initial decay index is -2.4+-0.1 and the next shallow decay index is 0.1+-0.2 with the break at T+3 ks. The last decay index is -1.1+-0.2 with the break at T+30 ks. Faint flaring activity is detected along the decay.

The average spectrum of the steep decay part of the afterglow (WT + PC from T+203s to T+1.1 ks) is best fit by a power-law with indices 2.5+-0.12 for the WT data and 2.2+-0.15 for the PC data. The column density is NH = 2.3 (-1.5/+1.7) x 10^{20} /cm2 slightly in excess with respect to the Galactic value of 1.61E20 cm^-2 (Kalberla et al. 2005). The average observed (unabsorbed) fluxes are 4.5 (5.1) x 10^{-10} ergs/cm2/s for the WT data and 1.5 (1.6) x 10^{-11} ergs/cm2/s for the PC data.

4. UVOT OBSERVATION AND ANALYSIS

The Swift/UVOT detected the optical afterglow in a second white finding chart, taken at 883s after the BAT trigger, as well as in a co-added b-band exposure. The best UVOT position is (RA, Dec) = (212.46892, +24.45892) or (14h 09m 52.56s, +24d 27' 32.2") with an estimated uncertainty of 0.7 arcsec (radius, 90% confidence, statistical + systematic).

The magnitudes and 3-sigma upper limits are shown in Table 1. The values quoted in the table are not corrected for the Galactic extinction due to the reddening of E(B-V) = 0.02 in the direction of the burst (Schlegel et al. 1998). The photometry is on the UVOT photometric system described in Poole et al. (2008, MNRAS, 383, 627). The UVOT light curve in the white filter is shown in Figure 3.

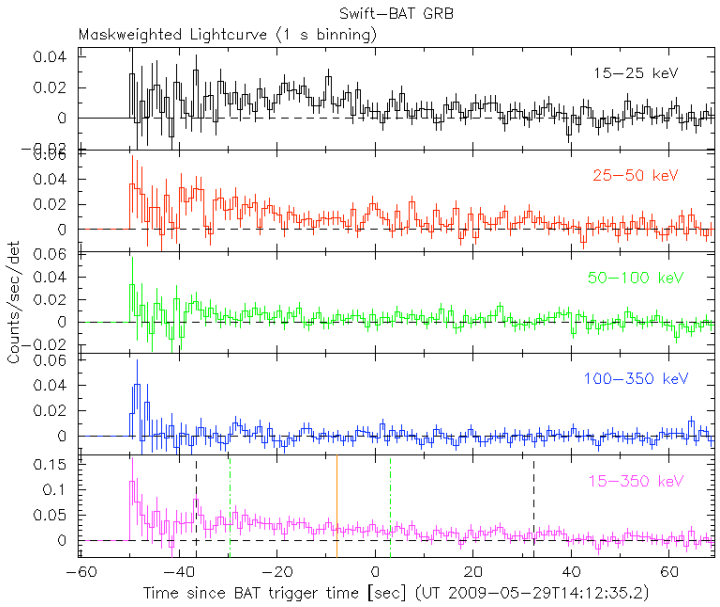

Fig.1: BAT Lightcurve. The light curve in the 4 individual plus total energy bands.

Table 1: UVOT Observations

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Filter	T_mid(s)	Expo(s)	Mag	Error
white_fc1	280.5	147	> 21.08	
white_fc2	957.5	147	20.74	0.21
white	1886	175	21.66	0.39
white	6087	197	>21.21	
white	13140	885	22.39	0.33
white	97075	7271	23.21	0.24
white	348928	9262	>24.03	
v	1500	253	> 20.24	
b	1512.5	233	20.97	0.36
b	2770	107	> 20.70	
u	1563.5	253	> 20.87	
uvw1	1539.5	156	> 20.60	
uvm2	1524	253	> 20.20	
uvw2	1552	253	> 20.65	

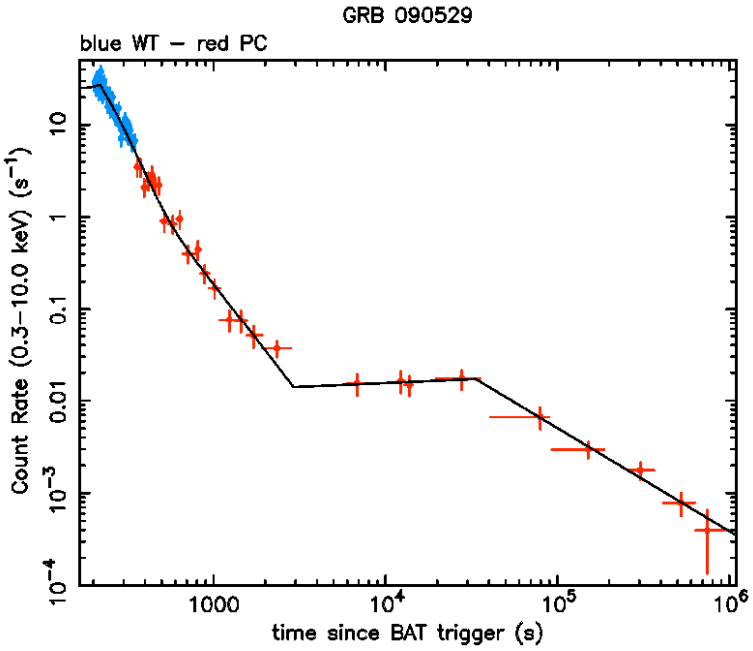

Fig. 2: XRT Lightcurve in the 0.3-10 keV band (WT mode: blue, PC mode red). The count-rate to observed flux conversion factor is 3.3 x 10^{-11} for WT mode and 3.6 x 10^{-11} for PC mode.

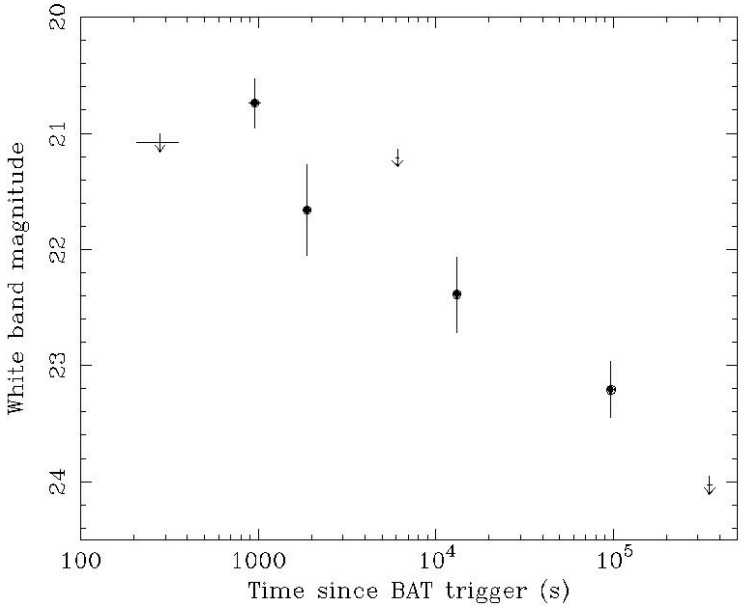

Fig. 3: UVOT Lightcurve in the white filter.