Swift X-ray Telescope Status & Observations of the Afterglow of GRB 041223

David Burrows - PSU

University Partners:
PSU  UL  OAB

13 January 2005, AAS meeting, San Diego
The Swift Observatory

- Launched: 20 November 2004
- XRT turned on: 23 November 2004
- XRT First Light: 11 December 2004
- First BAT Burst: 17 December 2004
- First XRT Afterglow: 23 December 2004
Beginning XRT Thermal Control

Heating CCD

TEC Power

XRT Thermal Tests

UVOT Activation

13 January 2005, AAS meeting, San Diego
XRT First Light Observations

Cas A:
(13 ks)

M. Goad, UL

Mkn 421:

A. Moretti, OAB

2% shift in gain

Focus is perfect!!

13 January 2005, AAS meeting, San Diego
Preliminary Crab spectral fit

\[ N_H = 0.35 \pm 0.04 \]
\[ \Gamma = 2.10 \pm 0.01 \]
GRB 041223

• Discovered by BAT at 14:06:18 on 23 December 2004
• XRT was in midst of thermal tests, taking data in PC mode
• Slewed to GRB 4.6 hrs after burst as ToO
• Observed on 3 consecutive orbits for total of about one hour on-target

XRT position:
RA(J2000) = 06:40:47.5
Dec (J2000) = -37:04:22.5
SWIFT J064047.5-370423

Offset from BAT position:
50 arcseconds

Offset from optical transient:
2.1 arcseconds
Lightcurve

X-ray source was uncatalogued.

X-ray source faded rapidly.

Data extracted with ximage from 20” radius circle. Background extracted from 47” radius circle.

Only used times when pointing was stable and background was low.

520 counts in 3504 seconds.
Spectrum

\[ N_H = (1.5 \pm 0.5) \times 10^{21} \]
\[ \Delta = 2.02 \pm 0.21 \text{ (90\%)} \]
\[ \Delta^2 / \Delta = 15.4 / 22 \]
\[ F_x = 6.5 \times 10^{-12} \text{ (0.5-10 keV)} \]
For $F(t) = t^-$ and $F(\_\_) = \_\_\_\_\_\$.

<table>
<thead>
<tr>
<th>Band</th>
<th>_ _</th>
<th>_ _</th>
<th>$t - t_0$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$J$</td>
<td>1.14 ± 0.08</td>
<td>0.40 ± 0.03</td>
<td>16 – 87</td>
</tr>
<tr>
<td>0.5–10 keV</td>
<td>1.72 ± 0.20</td>
<td>1.02 ± 0.07</td>
<td>4.6 – 7.9</td>
</tr>
</tbody>
</table>

(68% confidence errors)

Spectral break suggests that cooling frequency lies between the X-ray and optical bands.

(VLT observations from MISTICI collaboration)

13 January 2005, AAS meeting, San Diego
If $x$ and $NIR$ are constant, then $NIR < c < x$ and $c \propto t^{-}$, where $c = 1.0 \pm 0.2$ to fit data.
Conclusions

• NIR and X-ray data are consistent with the following scenario:
  • Jet has two components: narrow component that produces X-rays and broader component that produces optical
  • Jet break of narrow component occurs before X-ray observations
  • Produces self-consistent model with electron power-law index of about 1.9 – 2.0

• XRT is working well and producing excellent data in spite of higher operating temperature
  • Images are spectacular
  • Spectroscopy is better than Chandra at beginning of GTO phase
  • Spectroscopy expected to remain better than ASCA over life
  • High resolution timing available (up to 140 microseconds)
Co-Authors

Penn State:
- David Burrows
- Joanne Hill
- Judith Racusin
- Shiho Kobayashi
- Peter Meszaros
- John Nousek
- Jamie Kennea
- David Morris
- Claudio Pagani

OAB:
- Guido Chincarini
- Gianpiero Tagliaferri
- Sergio Campana
- Alberto Moretti
- Patrizia Romano
- Daniele Malesani
- Stefano Covino
- Paolo D’Avanzo

UL:
- Paul O’Brien
- Alan Wells
- Julian Osborne
- Tony Abbey
- Andy Beardmore
- Mike Goad
- Kim Page
- Dick Willingale

GSFC:
- Neil Gehrels
- Lorella Angelini

UNLV:
- Bing Zhang

OAR (Rome):
- Luigi Stella
- Angelo Antonelli

ASDC:
- Paolo Giommi
- Milvia Capalbi
Centroiding

Her X-1
On-board calculation

Cyg X-3
Pipeline processing

Cyg X-1
10” x 10” box, centered on source position