Fermi/GBM Observations of SGR J0501+4516

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On behalf of the GBM Magnetar team
SGR J0501+4516

Discovered 2008 August 22, with *Swift/BAT*

RXTE ToO program triggered ~4 hours after the first Swift trigger for 600 s

A period was found and reported ~ 9 hours after the first Swift trigger!

\[
P = 5.7620 \text{ s} \\
\dot{P} = 7.4980 \times 10^{-12} \\
B = 2.1 \times 10^{14} \text{ G} \\
RA. = 05h01m06.756s \\
Dec. = +45d16m33.92s (0.1'' error)
\]

Fermi/GBM triggered on 26 events from SGR 0501+4516

XRT 0.3-10 keV

Gogus et al 2010
Earlier Activity of the source

- Two BATSE events on 1993 July 25
- Two BeppoSAX/GRBM events on 2000 Oct. 11

All four events had locations consistent with SGR J0501+4516 but with large error circles.

They also show similar temporal and spectral properties.
Fermi/GBM Observations

29 events with TTE data=
   26 triggered + 3 untriggered
2 saturated events
Untriggered event search for 1 day before and 12 days after revealed no additional events
Spectral & Temporal Analyses Overview

(Detectors with angle <50° to the source and without blockage)
Temporal Analysis
Duration Distribution

\[ \langle T_{90} \rangle \approx 93 \text{ ms} \]  
(FWHM = 197 ms)

\[ \langle T_{50} \rangle \approx 24 \text{ ms} \]  
(FWHM = 21 ms)

\[ \langle \tau_{90} \rangle \approx 53 \text{ ms} \]  
(FWHM = 132 ms)

\[ \langle \tau_{50} \rangle \approx 17 \text{ ms} \]  
(FWHM = 31 ms)

Duty cycle \( \approx 68\% \)
Duration Comparison

- **SGR 1900+14**: 93.4 ms
- **SGR 1806-20**: 161.8 ms
- **SGR J1550-5418**: 143.68 ms
- **SGR J0501+4516**: 92.8 ms

*T90* and *τ90* values as per Gogus et al. 2001 and Van der Horst et al. 2010.
Time Integrated Spectral Analysis

- 8-200 keV, excluding K-edge 30-40 keV
- Over $T_{90}$
- OTTB
- BB
- **COMPT**
- BB + BB
- BB + PL

Index $\sim -0.41 \pm 0.08$
Total energy fluence:

\[ 3.75 \times 10^{-5} \text{ erg/cm}^2 \]

If the distance is 2 kpc,
The total energy > \[ 1.8 \times 10^{40} \text{ ergs} \]
Correlations for the Compt model parameters

$E_{\text{peak}}$ v.s. energy fluence  

$E_{\text{peak}}$ follows a Gaussian distribution with mean of 35.8 keV and 1σ=9 keV

Index v.s. energy fluence

Index ~ 0, for bursts with High energy fluence

$\sim 5 \times 10^{-7}$ erg/cm$^2$
Correlations for the BB+BB model parameters

Emission area* v.s. kT  Emission area* evolution

*Assuming a distance of 2 kpc

The surface area of a NS ~ 100 km²
Time resolved spectra

$\sim 5 \times 10^{-7} \text{erg/cm}^2$
Summary

• 29 bursts observed by Fermi/GBM, most active during first 4 days

• Temporal properties are comparable to other SGRs, $<T_{90}> \sim 93$ ms

• The Comptonized model fits the integrated spectra best. SGR J0501+4516 has a harder spectrum than SGR J1550-5418.

• $E_{\text{peak}}$ follows different trends with fluence below and above a certain fluence level.

• SGR J0501+4516 could be undergoing outbursts every 7-8 years