The GLAST Burst Monitor

Chip Meegan
NASA/MSFC
The goal of the GLAST Burst Monitor (GBM) is to enhance the science return of the Gamma Ray Large Area Space Telescope (GLAST) mission in the study of gamma-ray bursts. GBM will measure the spectra of bursts over a wide energy band and with high temporal resolution. The GBM will also detect bursts over a large solid angle. It will determine the directions to the bursts, to allow optional repointing of the main instrument.
GBM Collaboration

National Space Science & Technology Center

University of Alabama in Huntsville

NASA Marshall Space Flight Center

Max-Planck-Institut für extraterrestrische Physik

Michael Briggs
William Paciesas
Robert Preece
Narayana Bhat

Charles Meegan (PI)
Gerald Fishman
Chryssa Kouveliotou
Robert Wilson

Giselher Lichti (Co-PI)
Andreas von Keinlin
Volker Schönfelder
Roland Diehl
Jochen Greiner

On-board processing, flight software, systems engineering, analysis software, and management

Detectors, power supplies, calibration, and analysis software

GLAST User’s Committee

22 October 2003
GBM Component Placement
## GBM Requirements and Capabilities

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Requirement</th>
<th>Goal</th>
<th>Current Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy resolution</td>
<td>20% FWHM at 511 keV</td>
<td>(no stated goal)</td>
<td>~12% FWHM at 511 keV</td>
</tr>
<tr>
<td>Time resolution</td>
<td>10 microsecond</td>
<td>2 microsecond</td>
<td>2 microsecond</td>
</tr>
<tr>
<td>On-board GRB locations</td>
<td>20° accuracy (1σ radius) within 2 seconds</td>
<td>15° within 1 second</td>
<td>&lt;15°; 1.8 seconds</td>
</tr>
<tr>
<td>Rapid ground GRB locations</td>
<td>5° accuracy (1σ radius) within 5 seconds</td>
<td>3° within 1 second</td>
<td>TBD by analysis (scattering influenced)</td>
</tr>
<tr>
<td>Final GRB locations</td>
<td>3° accuracy (1σ radius) within 1 day</td>
<td>(no stated goal)</td>
<td>TBD by analysis (scattering influenced)</td>
</tr>
<tr>
<td>GRB sensitivity (on ground)</td>
<td>0.5 photons cm(^{-2}) s(^{-1}) (peak flux, 50–300 keV)</td>
<td>0.3 photons cm(^{-2}) s(^{-1}) (peak flux, 50–300 keV)</td>
<td>0.35 photons cm(^{-2}) s(^{-1}) (peak flux, 50–300 keV)</td>
</tr>
<tr>
<td>GRB on-board trigger sensitivity</td>
<td>1.0 photons cm(^{-2}) s(^{-1}) (peak flux, 50–300 keV)</td>
<td>0.75 photons cm(^{-2}) s(^{-1}) (peak flux, 50–300 keV)</td>
<td>0.76 photons cm(^{-2}) s(^{-1}) (peak flux, 50–300 keV)</td>
</tr>
<tr>
<td>Field of view</td>
<td>8 steradians</td>
<td>10 steradians</td>
<td>8.8 steradians</td>
</tr>
<tr>
<td>Deadtime</td>
<td>&lt;10 µs/count</td>
<td>&lt;3 µs/count</td>
<td>~2.5 µs/count</td>
</tr>
</tbody>
</table>
Simulated GBM and LAT response to time-integrated flux from bright GRB 940217
Data Types

♠ At All Times:
- CTIME: 8 energy channels – 256 ms – all detectors
- CSPEC: 128 energy channels – 8.192 s – all detectors

♠ During Bursts:
- TTE: Time tagged events, 128 channels
  - Pre-trigger: 500,000 events
  - Post-trigger: ~300s, selected detectors
- Alert Messages: real-time location, peak flux, fluence
Engineering Hardware

Data Processing Unit

Nal Detector
Science Investigations

▲ GBM Team Proposal:
   - Time-resolved Spectroscopy of GRBs
   - Rapid Burst Locations
   - Burst Catalog, inc. Spectroscopy Catalog

▲ Other Possibilities (GI Program)
   - Solar Flares
   - SGRs
   - Occultation Sky Survey
   - Long Period X-Ray Pulsars
Expected Detector Performance

**Nal Detector**
\[ \theta = 15^\circ \]

- 5 keV - 1 MeV

**BGO Detector**
\[ \theta = 30^\circ \]

- 150 keV - 30 MeV

**Energy Resolution (FWHM, keV)**

- Nal
- BGO

**Effective Area [cm²]**

- Total
- Full energy peak
- Full energy + escape peaks

**Effective Area [cm²]**

- Total
- Full energy peak
- Full energy + escape peaks

**Incidence Angle [deg]**

- BGO (300–2000 keV)
- Nal (50–300 keV)
GBM Burst Alerts

GBM

Trigger

Quick Test?

Classification, Location, Hardness, Initial Flux

Flux, Fluence, Hardness (Running Updates)

Parameters

Science Repoint Candidate

S/C

Direct link

< 5ms

Begin R/T downlink

< 2 s

Continue R/T, 5 - 10 min.

LAT

Mode Change?

Information packet

2 to ~60 s

Repoint request

S/C Repoint Decision

GBM

LAT

GBM/LAT

S/C