Fermi GBM: Results from the First Year +

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**Spacecraft Partner:** General Dynamics

**Large Area Telescope (LAT)**
- 20 MeV - >300 GeV

**Gamma-ray Burst Monitor (GBM)**
- NaI and BGO Detectors
  - 8 keV - 40 MeV

**KEY FEATURES**
- **Huge field of view**
  - LAT: 20% of the sky at any instant; in sky survey mode, expose all parts of sky for ~30 minutes every 3 hours. GBM: whole unocculted sky at any time.
- **Huge energy range,** including largely unexplored band 10 GeV - 100 GeV. **Total of >7 energy decades!**
- **Large leap in all key capabilities.** Great discovery potential.
GBM Science

Techniques

- **Short transients detected by on-board trigger algorithm**
  - trigger timescales 16 ms – 16 s (currently longest is 8 s)
- **Pulsed sources detected by power spectral analysis and/or epoch folding**
- **Longer-term transients and persistent sources detected by Earth occultation**

Triggered Sources

- **Gamma-ray bursts (GRBs)** – 353
- **Soft Gamma Repeaters (SGRs)** – 168
- **Terrestrial Gamma Flashes (TGFs)** – 18
- **Solar flares** - 1

Non-triggered Sources

- **X-ray binaries: HMXBs, LMXBs, Be binaries, microquasars**
- **AGNs**
Gamma Ray Bursts

Fermi GRBs as of 091026

327 GBM GRBs
12 LAT GRBs
Fine Time-Resolved Spectroscopy of Short GRBs

- Similar to long GRBs (Ford et al.), but
  - Contracted in time
  - Shifted to higher energies
- Epeak tracks lightcurves like long GRBs
- Hardest park is not always at the beginning
- Most intense peaks are not always hardest
Fermi / GBM Detection of Pulsed Hard X-ray Emission from SGR 1550-5418


- Pulsation at spin period (50-100 keV)
- Thermal component $\rightarrow R \sim 120$ m
  size of “trapped fireball” in twisted $B$?

$P = 2.07 \text{ s}$

Blackbody $kT \sim 17$ keV

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Terrestrial Gamma Flashes (TGF)

- BGO detectors and TTE excellent
- 18 TGF triggers to date
- Shorter than GRBs
- Higher average photon energy
- Much higher count rates
- New TGF specific triggers!

$t_{90} = 0.22$ ms
GBM Pulsar Analysis

- Search for pulsars from 1 mHz -- 2 Hz in CTIME data.
- Several seen only in parts of orbit: Her X-1.
- Several seen in outburst: EXO 2030+375, A 0535+6, A 1118-615.
- Sensitivity ~5 mCrab in 3 days

http://gammaray.nsstc.nasa.gov/gbm/science/pulsar/

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GBM Earth Occultation Monitoring

- Catalog of 60 sources
  - X-ray binaries, Crab, Cen A
  - 7 sources detected above 100 keV
  - Complements Swift/BAT

[Cyg X-1 graphs]

XTE J1752-223

http://gammaray.nsstc.nasa.gov/gbm/science/occultation/

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Summary

- GBM has performed well in the first year+
- GBM triggers
  - 353 GRBs
  - 168 SGR events
  - 18 TGFs
  - 1 solar flare to date.
- Short GRBs appear contracted in time and shifted to higher energy than long GRBs.
- Pulsed persistent emission from SGR 1550-5418 detected
- TGFs are shorter, have higher average photon energies, and much higher count rates than GRBs
- GBM monitoring of accreting pulsars provides long-term spin-histories.
- GBM Earth occultation monitoring complements Swift
GBM Detectors

- Placement of detectors to view entire sky while maximizing sensitivity to events seen in common with the LAT.
- 4 x 3 NaI Detectors with different orientations.
- 2 x 1 BGO Detector either side of spacecraft.

The Large Area Telescope (LAT)

GBM BGO detector.
- 200 keV -- 40 MeV
- 126 cm², 12.7 cm
- Spectroscopy
- Bridges gap between NaI and LAT.

GBM NaI detector.
- 8 keV -- 1000 keV
- 126 cm², 1.27 cm
- Triggering, localization, spectroscopy.