GLAST Sensitivity to Gamma-Ray Bursts and Support for Joint Swift-GLAST Observations

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Relevant GLAST GRB Capabilities

- **LAT (<20 MeV to >300 GeV)**
  - Onboard trigger, ~15 s latency
  - Ground trigger (sensitivity greater because background events filtered out), ~6 hour latency
  - Localization of ~10° about twice a month
    - Small number of counts—sensitive to fluctuations
    - Very dependent on spectrum
  - Spectroscopy
  - Data out to ~65° from LAT axis

- **GBM (<10 keV to 30 MeV)**
  - Rate triggers: ~200 bursts per year
  - Localization: ~10° on board, few degrees on ground
  - Spectroscopy
  - Data down to horizon
Relevant GLAST GRB Capabilities, cont.

• **Spacecraft**
  - Swift-like burst telemetry through TDRSS, connected to GCN
  - Scans sky (default). Strong burst will result in autonomous repoint to burst location for 5 hours (except for Earth occultation)
  - TOO on 6 hour timescale (probably much less)
  - Swift-GLAST FOV overlap for \(~1/6\) of bursts

• **Combinations of Swift, GBM, and LAT observations or detections result in:**
  - Swift localization leading to LAT afterglow observations
  - LAT localization leading to Swift afterglow observations
  - GBM and LAT broadband spectroscopy of Swift bursts
Guest Investigator Program—Overview

- $4M for 40-50 research programs, available starting ~60 days after launch (L > December 14, 2007)

- **In Cycle 1 you can propose for:**
  - Analysis of data released by GLAST mission
  - Support correlated observations relevant to GLAST
  - Theory related to GLAST (~10% of funds)
  - Data analysis techniques relevant to GLAST data
  - ***Time on NRAO telescopes***

- **In Cycle 1 you cannot propose for:**
  - Changing GLAST’s observing plan (possible in Cycles 2+)
  - Analyzing LAT event data (even if you have access)
GI Program, cont.

- **Two phase proposal system**
  - Phase 1—Technical proposals submitted through RPS
  - Phase 2—Budgets for approved technical proposals submitted through NSPIRES

- **Two types of proposals**
  - Regular—1 year research plan. 4 page technical justification
  - Large (legacy)—three year research plan, resubmitted after 1st and 2nd year. 6 page technical justification

- **Foreign scientists:**
  - Can propose but cannot receive NASA funding (NRAO time, useful for funding by other agencies)
  - US co-Is—funding consistent with the level of effort
GI Program, cont.

• Notice of Intent (NOI) should be submitted through GSSC website by July 13

• GLAST science team members (instrument teams, GSSC):
  – Can receive funding for research using publicly available data
  – Cannot propose a research program based on their access to LAT event data in Cycle 1

• Fellows program will be announced and administered separately
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<tr>
<th>Date</th>
<th>Months-L</th>
<th>Event</th>
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<tbody>
<tr>
<td><strong>Cycle 1</strong></td>
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<tr>
<td>Mid June 2007</td>
<td>-6</td>
<td>Proposal materials on GSSC website</td>
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<td>7/13/2007</td>
<td>-5</td>
<td>Notice of Intent due date</td>
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<td>9/7/2007</td>
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<td>GI Cycle 1 proposal deadline</td>
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<td>&gt;12/14/2007</td>
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<td>LAUNCH!!!</td>
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<td>January 2008</td>
<td>1</td>
<td>Results of phase 1 evaluation</td>
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<td>2</td>
<td>Release of GBM SAE Tools</td>
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<td>2</td>
<td>GI Cycle 1 Begins</td>
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<td>March 2008</td>
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<td>Funding decision</td>
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<td><strong>Cycle 2</strong></td>
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<td>Effective NRA Release; Release 0.9 of SAE</td>
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<td>SAE Workshop—Release of preliminary catalog</td>
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<td>GI Cycle 2 Proposal Deadline</td>
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<td>14</td>
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<td>GI Cycle 2 Begins; Release 1.0 of SAE</td>
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Source of All (GLAST GI Program) Knowledge

http://glast.gsfc.nasa.gov/ssc
GLAST-Swift Synergy

- Burst occurs in LAT (GLAST) and BAT FOVs
  - Swift localizes burst
  - Swift and LAT search for afterglow
  - GLAST provides broadband spectroscopy
  - Strong burst: no immediate response necessary (LAT repointed autonomously for 5 hours)
  - Weak burst: consider LAT TOO (but LAT scans position); response time is <6 hours

- Burst occurs in BAT but not LAT FOV
  - Swift localizes burst
  - Swift and LAT search for afterglow
  - GBM (GLAST) may provide 10 keV-30 MeV spectroscopy
  - Consider LAT TOO (but LAT scans position); response time is <6 hours
GLAST-Swift Synergy, cont.

- Burst triggers LAT (GLAST) but not in BAT FOV
  - GLAST provides broadband spectroscopy
  - LAT and possible Swift afterglow searches
  - Strong burst: no immediate GLAST response necessary (LAT repointed autonomously for 5 hours)
  - Weak burst: consider LAT TOO (but LAT scans position); response time is <6 hours
  - GLAST localization may suffice for XRT TOO followup
    - Onboard GLAST position available within ~15 s
    - Ground GLAST position available within ~6 hours
GLAST-Swift Synergy, cont.

- Burst triggers GBM (GLAST) but not in BAT FOV
  - GLAST provides broadband (<30 MeV) spectroscopy
  - LAT and possible Swift afterglow searches
  - Strong burst: no immediate GLAST response necessary (LAT repointed autonomously for 5 hours)
  - Weak burst: consider LAT TOO (but LAT scans position); response time is <6 hours
  - GLAST GBM localization is insufficient for Swift followup
Expected Detection Rate

- Based on BATSE detection rate, the GBM should detect ~200 bursts per year.
- The LAT detection rate depends on the relatively unknown ~GeV emission. Using BATSE data and extrapolating to LAT band, estimate LAT rates.

No EBL abs.

- ~1 burst per year with 1000 counts
- A few bursts per month with 100 counts
Burst Localization

- GBM—dependent on burst strength
  - Statistical:
    - $[15^\circ, 9^\circ, 1.5^\circ]$ for [threshold, brightest 40%, brightest 5%]
  - Systematic:
    - Onboard: $\sim 10^\circ$
    - On ground: 1-2°

- LAT—depends on number of detected counts (& spectrum)

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DC2 Simulations

♦ — difference between ‘true’ and calculated positions

x — calculated uncertainty

![Diagram](image.png)

Error/Uncertainty (Degrees)

LAT Counts

6 arcminutes