# Offline searches for short GRBs using a new GBM data product

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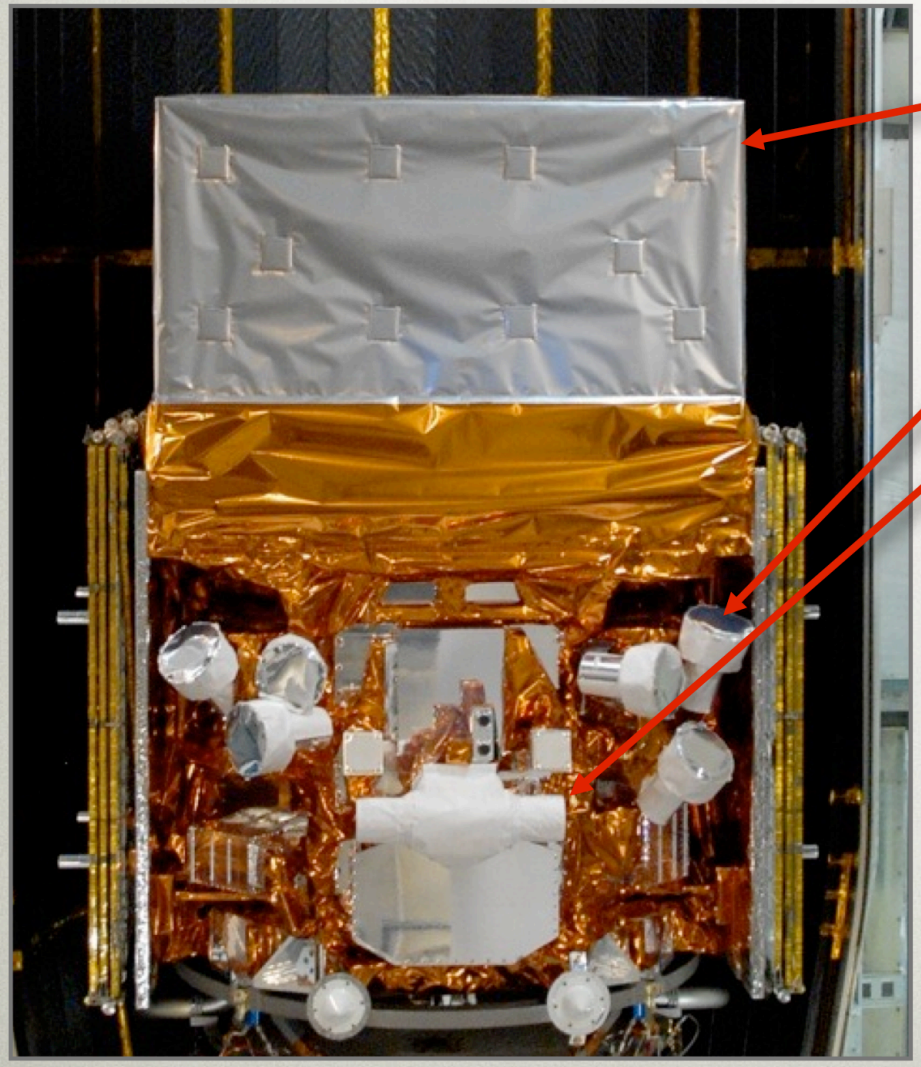
# The Fermi Spacecraft



Large Area Telescope (LAT
30 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.
  - –Decreased detection dead time 2.6 μs
- Huge energy range, including largely unexplored band 10 GeV - 100 GeV. Total of >7 energy decades!

Advantage:
Very large Field of View
Ability to detect & localize GRBs over that FoV

Disadvantages:
High and variable / complicated background
Low-accuracy localizations

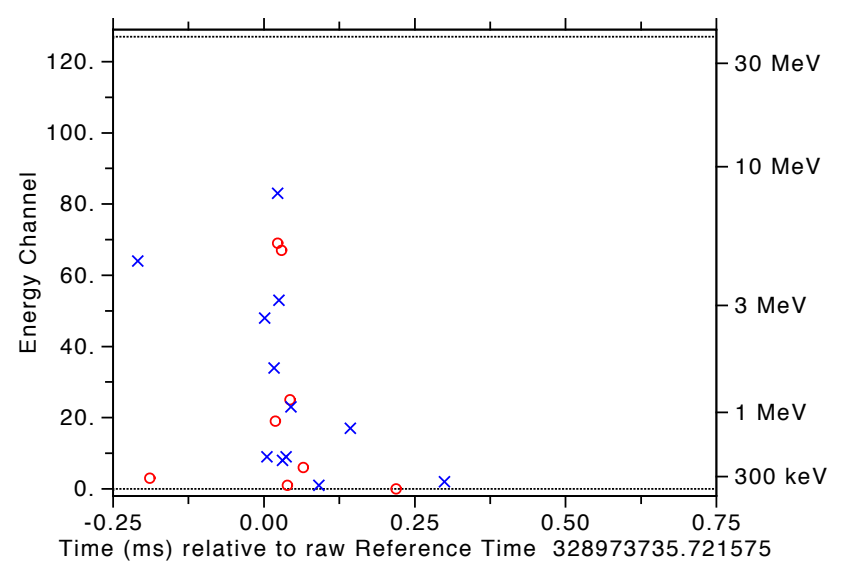
On-board GRB detection by the flight software: ``triggering''"

- statistically significant rate increase in two or more detectors
- examination of data at various time binnings, 16 ms to 4 s
- Causes production of higher-resolution data.

Why two detectors:
Increases required statistical significance
and suppresses single detector artifacts.

At launch in 2008 only triggering was possible – continuous data was limited to ¼ s resolution.

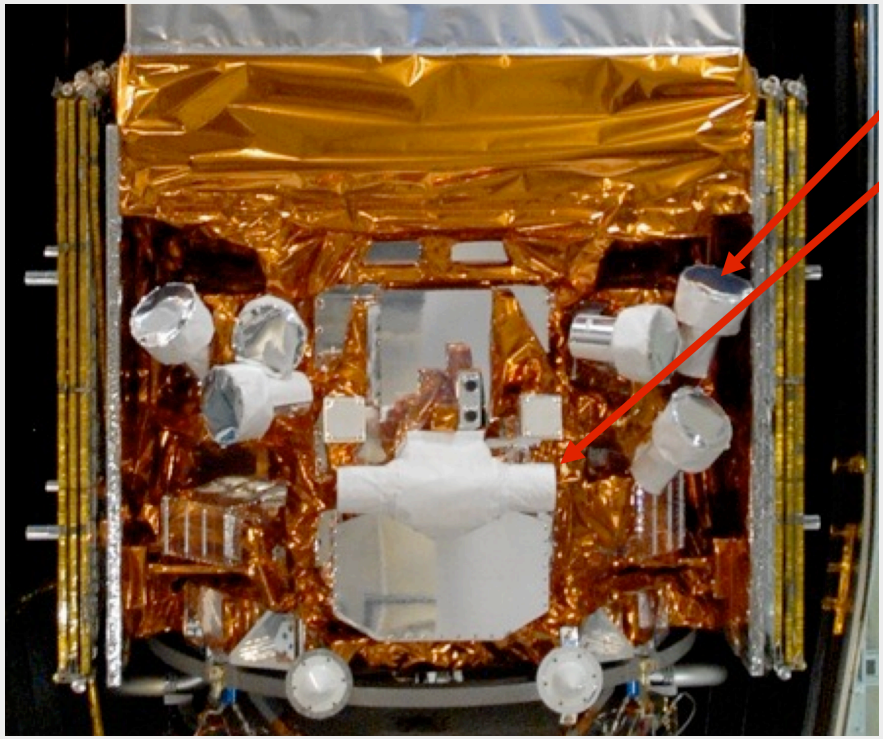
Since 2010 July (partial coverage) or 2012 November (full coverage):
Continuous Time-Tagged Events (CTTE)
telemetry of every energy deposit (photon, cosmic ray, ...) in a GBM detector.



reasons to expect more sGRBs:

fainter:
find with more sophisticated algorithm
lower threshold
tolerate more false positives

``blind spot'' underneath Fermi
➔ Accept single-detector GRBs
Especially with the unexpected
Fermi observing profile



This new GBM datatype enables ground-analyses:

1) Seeded / directed / targeted search
[to GRB community, “trigger” has a different meaning]

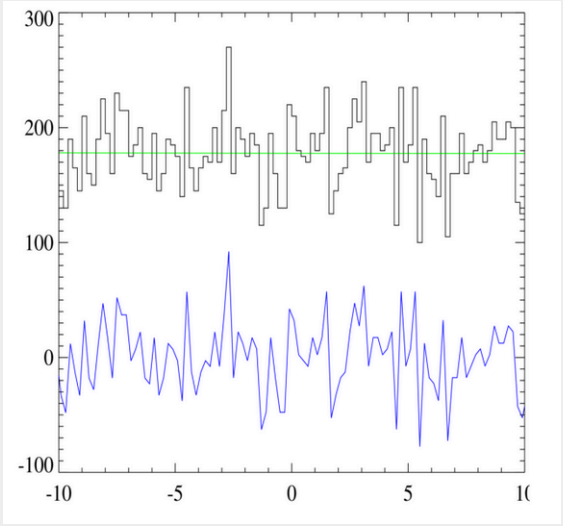
Developed by Lindy Blackburn (Jordan Camp)
use knowledge of time & position as prior to improve sensitivity of GBM search

2) untriggered / blind / offline / sub- [trigger-] threshold search

with Binbin Zhang and Valerie Connaughton

# Blind offline search

- Bayesian Matched Pattern technique, developed by Binbin Zhang (UAH)
- Test candidates by spectra and localization
- Finding ~100 additional SGRB  per year.  cf. 45 GBM triggered sGRBs,
- Finds 3 of 4 SwiftsSGRBs that didn't trigger GBM, for which CTTE is available.




Weakest Swift SGRB that did not trigger GBM and that was found by the offline search: GRB 140516A.
At 30% of Swift fluence distribution.

As Binbin sets the search threshold lower, he can find many candidates.

We are not sure of the reliability of these candidates: how to test?

How many lower significance candidates does LIGO/Virgo want for their externally directed searches?