

National Aeronautics and Space Administration



Fermi

Gamma-ray Space Telescope

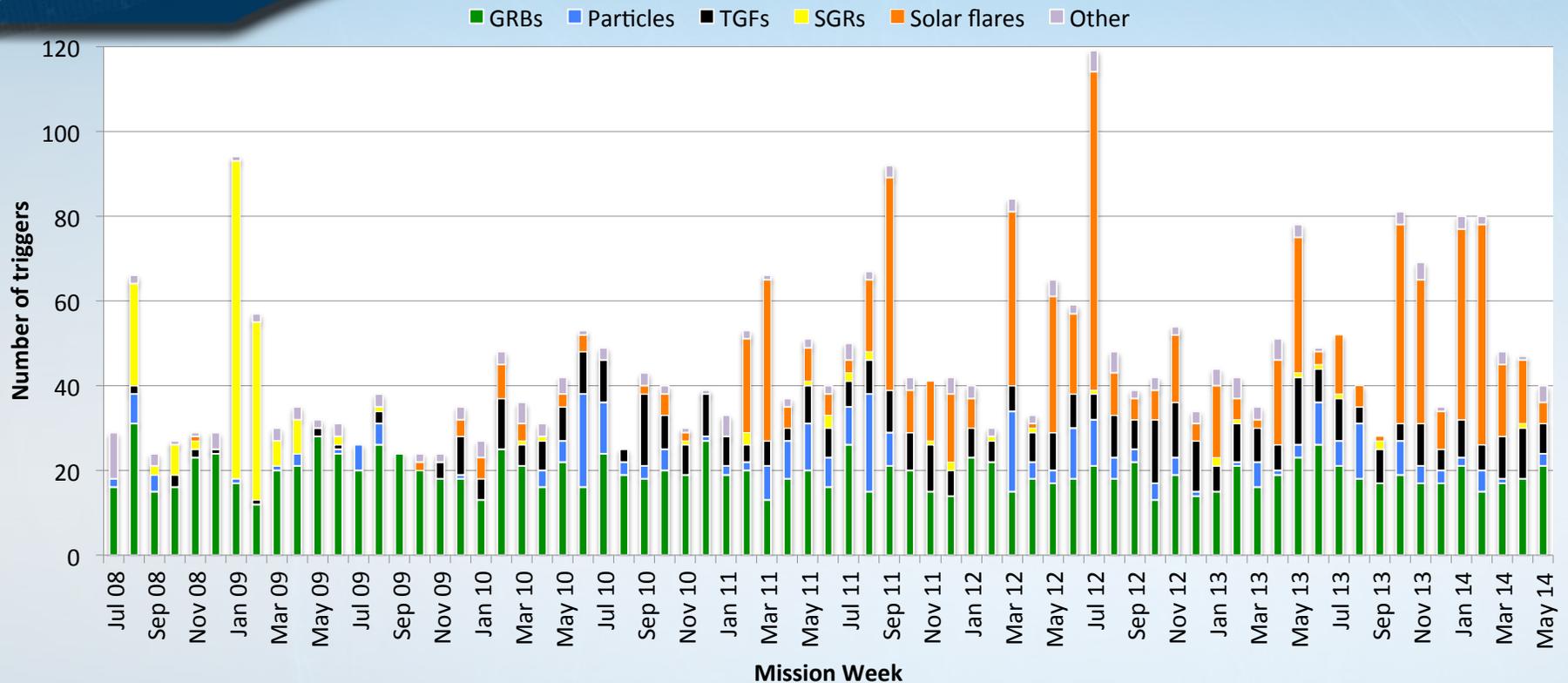
[www.nasa.gov/fermi](http://www.nasa.gov/fermi)

## Fermi GBM Status, Results, Plans

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USRA/STI

Fermi Users Group  
5 June 2014

# GBM Trigger Rate



3279 triggers as of May 31, 2014 (excluding commanded)

Gamma-ray bursts (GRBs): 1371 (triggered twice on each of two long GRBs)

Soft gamma repeaters (SGRs) aka magnetars: 198 (from 5 sources)

Terrestrial gamma flashes (TGFs): 459 (at least 600 additional untriggered)

Solar Flares: 768

Others (particles, galactic XRBs, accidental, uncertain): 481

121 positive Autonomous Report Recommendations



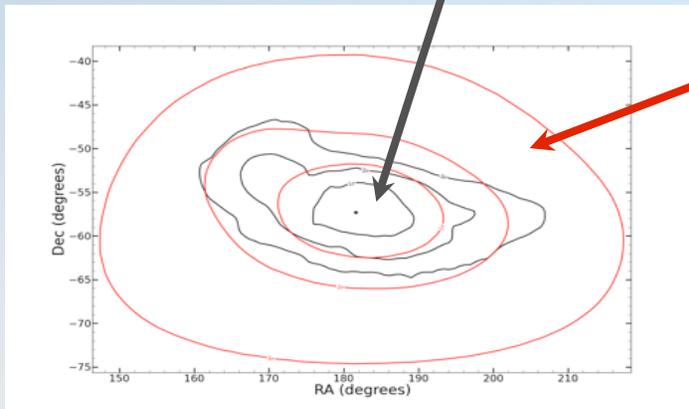
# Operational Changes & Improvements

- Weekends & periods of high solar activity:
  - Continuing to disable soft energy (22–50 keV) trigger algorithms
- Improvements to location contours data product
  - Additional file formats
  - Distribution of ground-automated localizations (BAP modification under development)
- Ground-based search for short GRB's
  - Work in progress (next talk by M. Briggs)
- Konus cross-calibration
  - Need data from Konus
  - Person identified to work on this has left the GBM team
  - No significant progress since last meeting

# GRB Localization & Follow-up

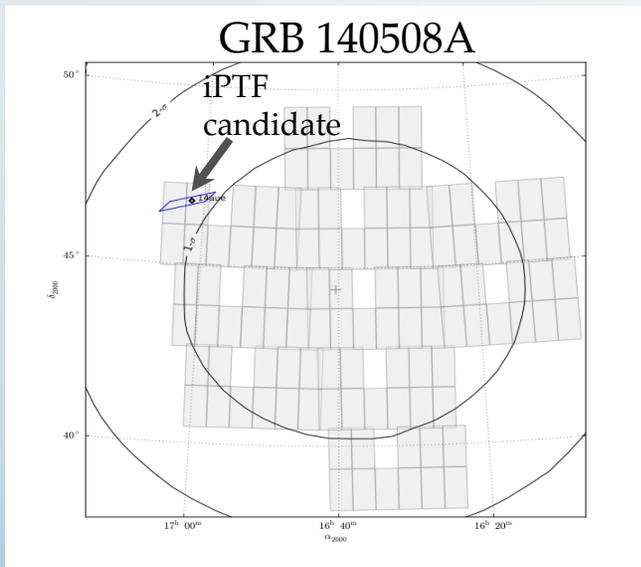
Statistical Uncertainty

Total Uncertainty



- Files created when a final position GCN notice is sent (since Jan. 2014)
- FSSC delivery latency down to few minutes
- Developing FITS probability maps
- Already 4 successful follow-ups (~25 attempts) with iPTF using the contour files (130702A, 131011A, 131231A, & 140508A)
- 140508A - rare VLA radio detection of the afterglow
- Building collaborations with iPTF, IPN, FIGARO, RAPTOR, MASTER, aLIGO, IceCube, Swift

GRB 140508A





# GBM Team Science Activity

- Papers in refereed journals (since Jan 2014)
  - The First Pulse of the Extremely Bright GRB 130427A: A Test Lab for Synchrotron Shocks (Science)
  - Fermi LAT Observations of the Extraordinary Gamma-ray Burst GRB 130427A (Science)
  - The Bright Optical Flash and Afterglow from the Extraordinary Gamma-Ray Burst GRB 130427A (Science)
  - The 2<sup>nd</sup> Fermi GBM Gamma-Ray Burst Catalog: The First Four Years (ApJS)
  - The Fermi GBM Gamma-ray Burst Spectral Catalog: Four Years Of Data (ApJS)
  - Time-resolved Analysis of Fermi Gamma-Ray Bursts with Fast- and Slow-cooled Synchrotron Photon Models (ApJ)
  - An Observed Correlation between Thermal and Non-thermal Emission in Gamma-Ray Bursts (ApJ)
  - How Long does a Burst Burst? (ApJ)
  - Earth Occultation Imaging of the low energy sky with GBM (A&A)
  - Quasi-periodic Oscillations in Short Recurring Bursts of the Soft Gamma Repeater J1550-5418 (ApJ)
  - Time Resolved Spectroscopy of SGR J1550-5418 Bursts Detected with Fermi/Gamma-Ray Burst Monitor (ApJ)
  - Prompt emission of GRB 121217A from gamma-rays to the near-infrared (A&A)



# GBM Team Science Activity

- Papers in press or submitted
  - Pulse Properties of Terrestrial Gamma-ray Flashes detected by the Fermi Gamma-ray Burst Monitor (JGR)
  - Localization of Gamma-Ray Bursts using the Fermi Gamma-Ray Burst Monitor (ApJS)
  - Fermi Gamma-ray Burst Monitor Detector Performance at Very High Counting Rates (ExA)
  - GROND coverage of the main peak of Gamma-Ray Burst 130925A (A&A)
  - GRB 130925A: an ultra-long Gamma Ray Burst with a dust-echo afterglow, and implications for the origin of the ultra-long GRBs. (MNRAS)
- Conferences with presentations
  - 9th IACHEC Meeting, Warrenton, VA
  - APS April Meeting, Savannah, GA
  - European Geophysical Union, Vienna



# GBM Team Science Activity

- Papers in preparation
  - Testing the Compton Scattering Hypothesis in Terrestrial Gamma-ray Flashes detected by the Fermi Gamma-ray Burst Monitor
  - The 5-year GBM magnetar Catalog
  - GBM GRB time-resolved spectral catalog
  - Energy-dependent spectral lags of Fermi GBM GRBs
  - A new method to extract the minimum variability time scale for GRBs
  - Discovery of a Sub-Dominant Photospheric Component in the Prompt Emission of GRB 140508A
  - Synchrotron Cooling in the Hardest Gamma-Ray Bursts Observed by the Fermi GBM
  - Quantifying the detection rates of merger GRBs with population studies of GBM and Swift BAT short GRB triggers
  - Monitoring of Cygnus X-1 During the 2010-14 State Transitions with the Fermi GBM
  - Fermi GBM Observations of the Hard X-ray Spectrum of TeV Blazars
  - Long Term Variability of Hard X-Ray Sources Detected by BATSE and GBM
  - A large sample of TGF and radio associations using Fermi GBM and ENTLN data



# Other GBM-Related Papers

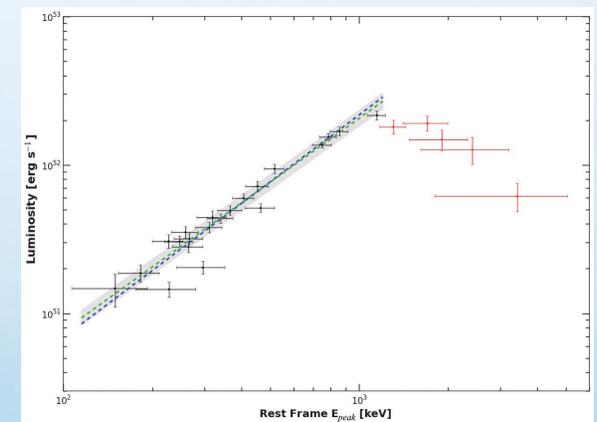
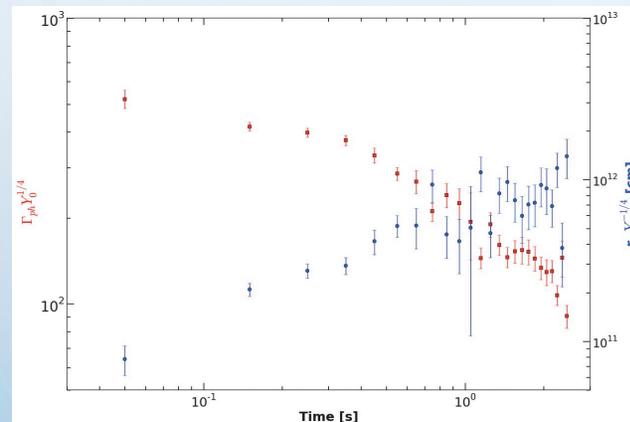
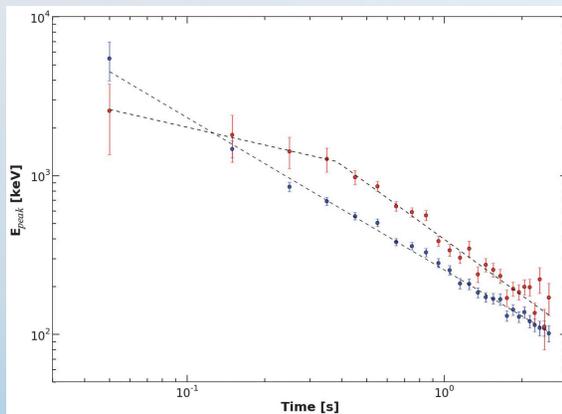
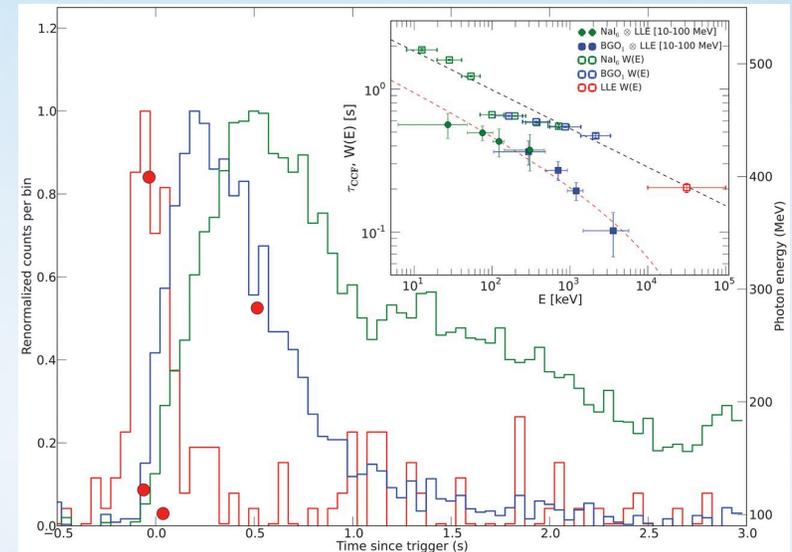
- Time delays between Fermi-LAT and GBM light curves of gamma-ray bursts (A&A)
- Observations of Gamma-ray Bursts with the Fermi Large Area Telescope (NIM)
- High Energy Emission of GRB 130821A: Constraining the Density Profile of the Circum-burst Medium as Well as the Initial Lorentz Factor of the Outflow (ApJ)
- Time-resolved spectral analysis of prompt emission from long gamma-ray bursts with GeV emission (RAA)

# First Pulse of GRB 130427A

## A Test Lab for Synchrotron Shocks

Preece et al 2014

- Highest fluence GRB ever detected
- Time-resolved spectroscopy with physical models
- Consistent with synchrotron shock model for energy dependence of pulse width and lag
- $E_{\text{peak}} \propto t^{-1}$  during decay
- Photospheric radius ( $\sim 10^{12}$  cm) incompatible with internal shock radius ( $\sim 10^{15}$  cm)
- $L_{\text{iso}} \propto E^{3/2}$
- Difficult to explain behaviors with single model





# Summary & Near-term Plans

- GBM operations and performance are nominal
  - Full-time untriggered TTE data collection proceeding smoothly
- No significant operational changes planned for next few months
- Work on ground-based search for short GRBs
- Continue distribution of GRB localization contours
  - Areas for improvements: ground-automated localizations, file formats
- Additional science catalog efforts
  - GRB time-resolved spectroscopy
  - TGF ground-search