



---

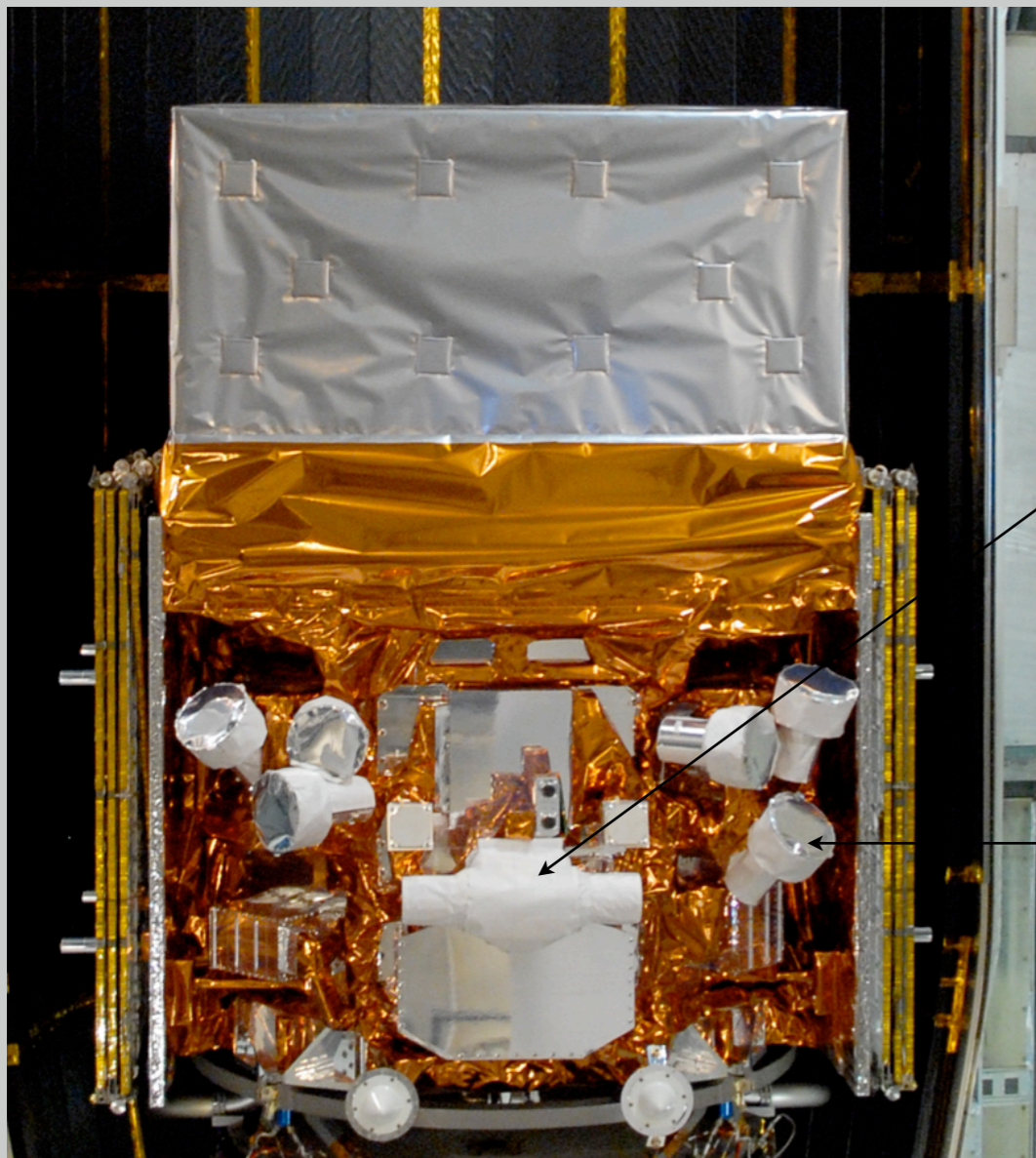
# *GBM Science ... The first 8 months.*

*Valerie Connaughton for the GBM Team.*



## 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.



BGO detector.

200 keV -- 40 MeV

Spectroscopy

Bridges gap between NaI and LAT.

NaI detector.

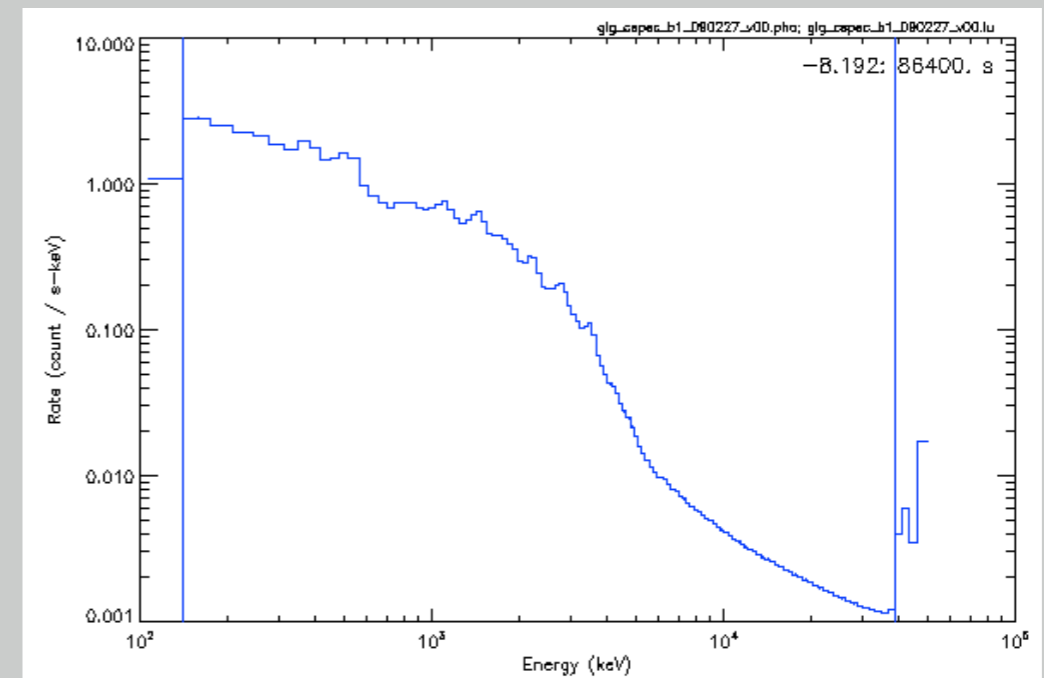
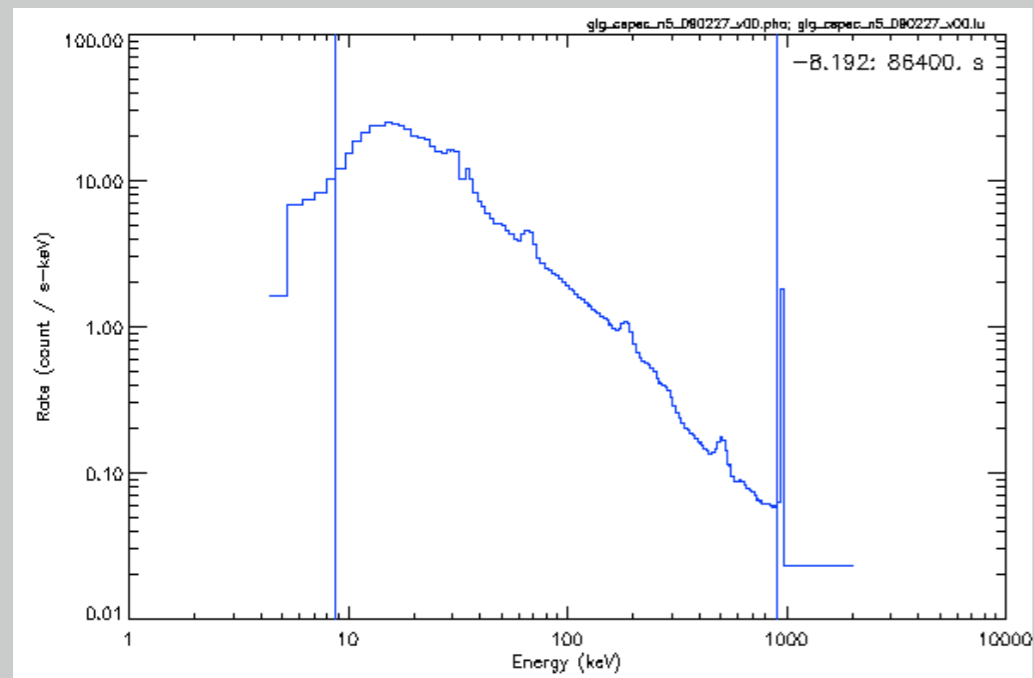
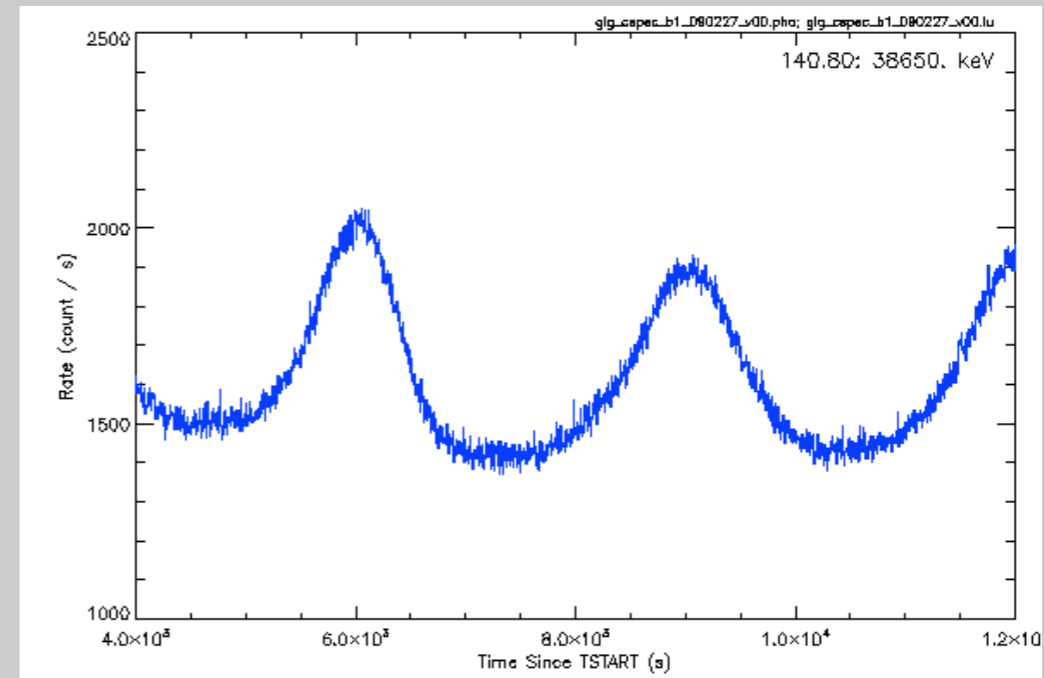
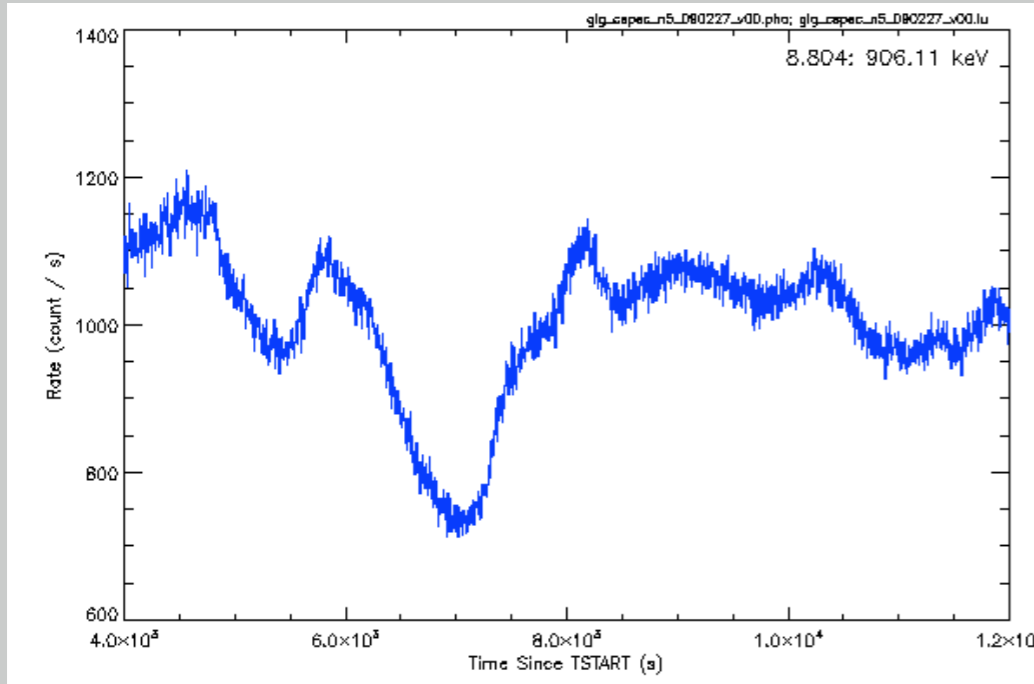
8 keV -- 1000 keV.

Triggering, localization,  
spectroscopy.



# What does GBM see?

\* Continuous data: CSPEC (4.096 s, 128 energy channels), CTIME (0.256 s, 8 energy channels).



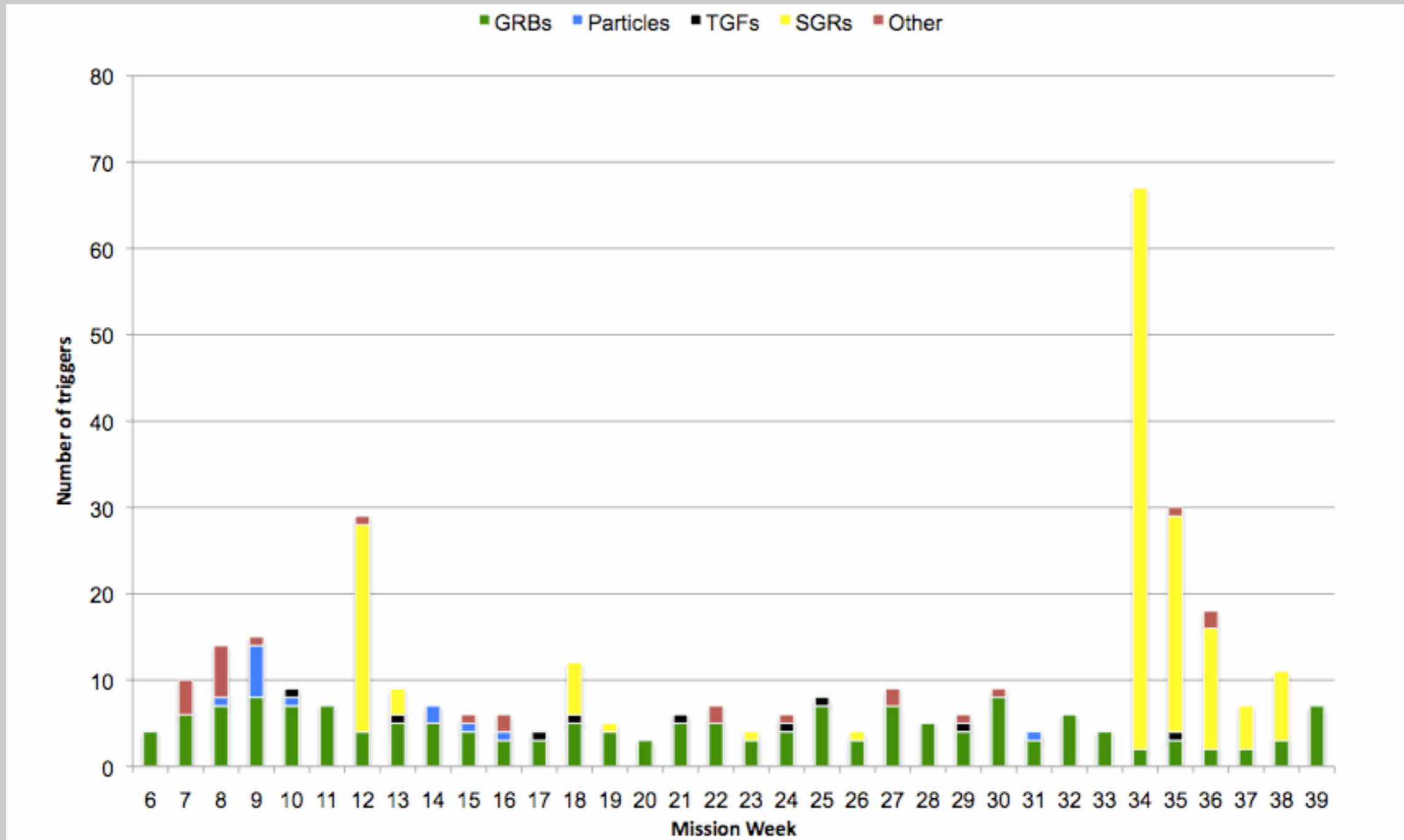


# GBM Triggering

---

- \* *62 algorithms operating simultaneously.*
- \* *Timescales from 16 ms to 8 s (BATSE had 64 ms, 256 ms, 1.024 s).*
- \* *Energy ranges 50 -- 300 keV (BATSE) and softer (25 - 50 keV, 25 - 100 keV), harder (100 - 300 keV, > 300 keV).*
  - ★ *Soft, short : SGR? Yes.*
  - ★ *Hard, short: TGF? Yes.*
  - ★ *Short: GRB? No, no new GRB.*
  - ★ *Long: GRB? Yes, but only very weak ones...*
  - ★ *Hard: GRB? No, no new GRB. Hard GRBs also trigger 50-300 keV.*
  - ★ *Soft: GRB? No, no new GRB. XRFs also trigger 50 - 300 keV.*
- \* *New trigger algorithms buy new triggers from astrophysical sources, but not new population of GRBs.*

# GBM Weekly Triggers





# GBM actions on Triggering

---

## \* On Board:

### ★ Localize

- *Send location to LAT => ~2 sec*
- *Send location to ground => GCN Notice ~5 sec*

### ★ Classify

- *GRB?*

*– Bright & Hard? => Issue Positive Repoint Recommendation to LAT*

### ★ Send TRIGDAT data to ground

## \* On Ground:

### ★ If FSW classifies as GRB

- *Automated Location => GCN Notice ~10 sec*

### ★ Human-in-loop location & spectral analysis

- *GRB? => GCN Circular ~ hours - 1 day*

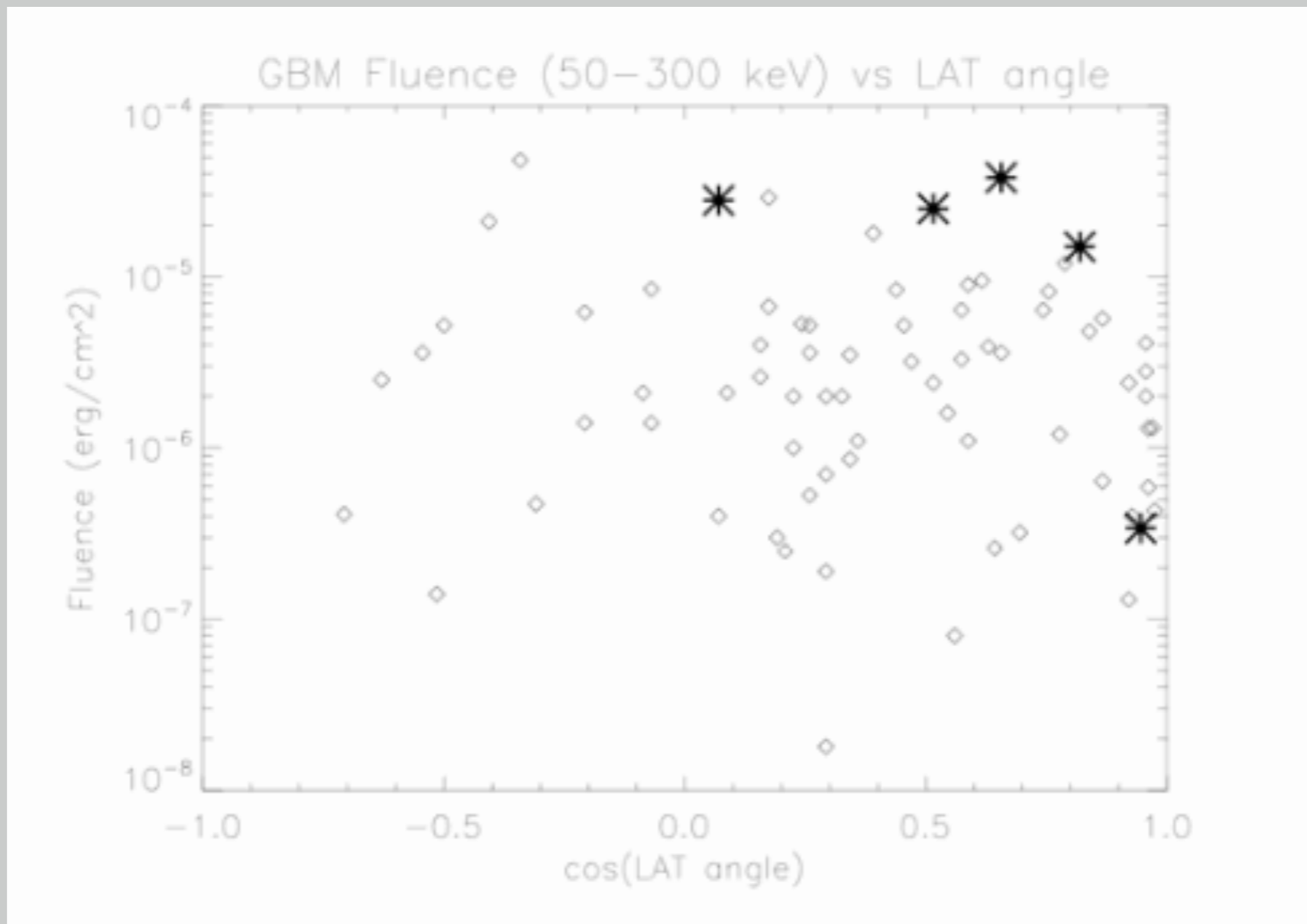
### ★ After pipeline processing => delivery to FSSC

- *<http://fermi.gsfc.nasa.gov/ssc/data/access/>*

\* *All GBM data are public through the FSSC.*

# GBM GRBs

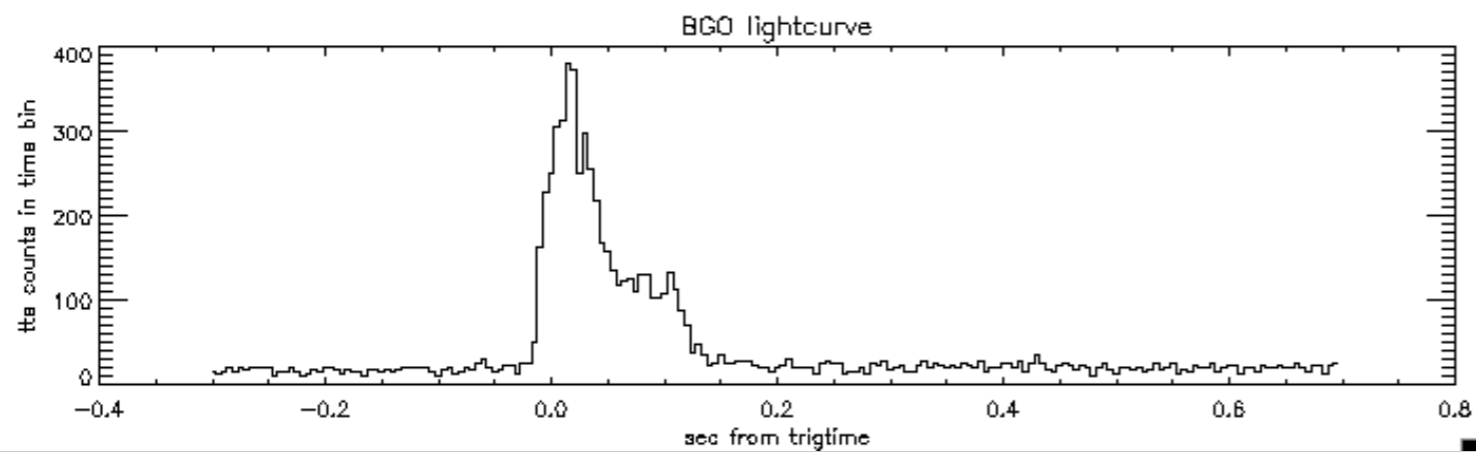
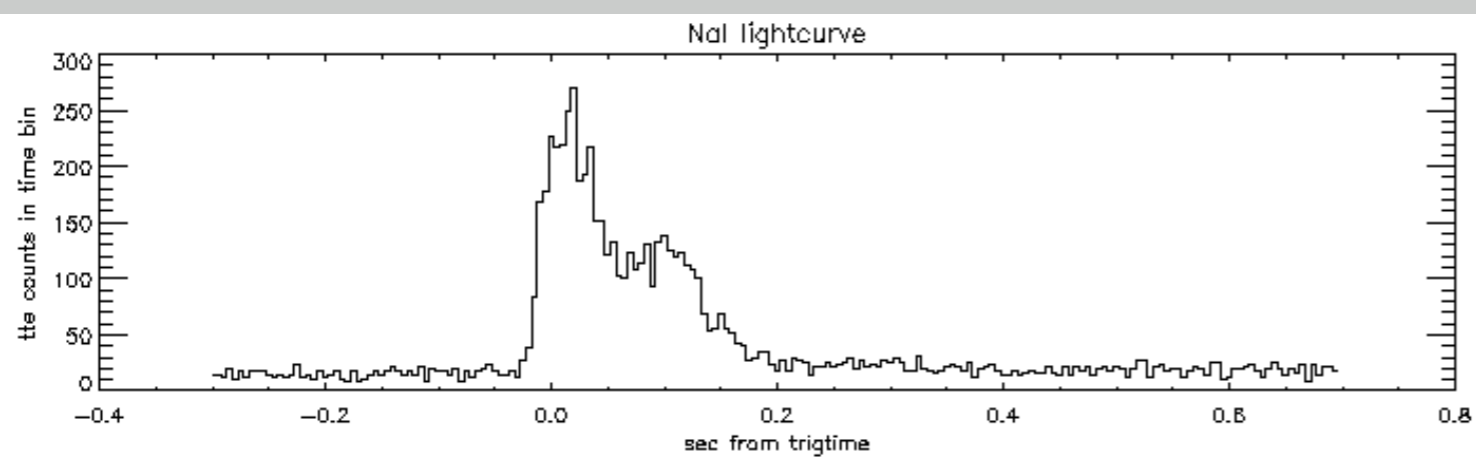
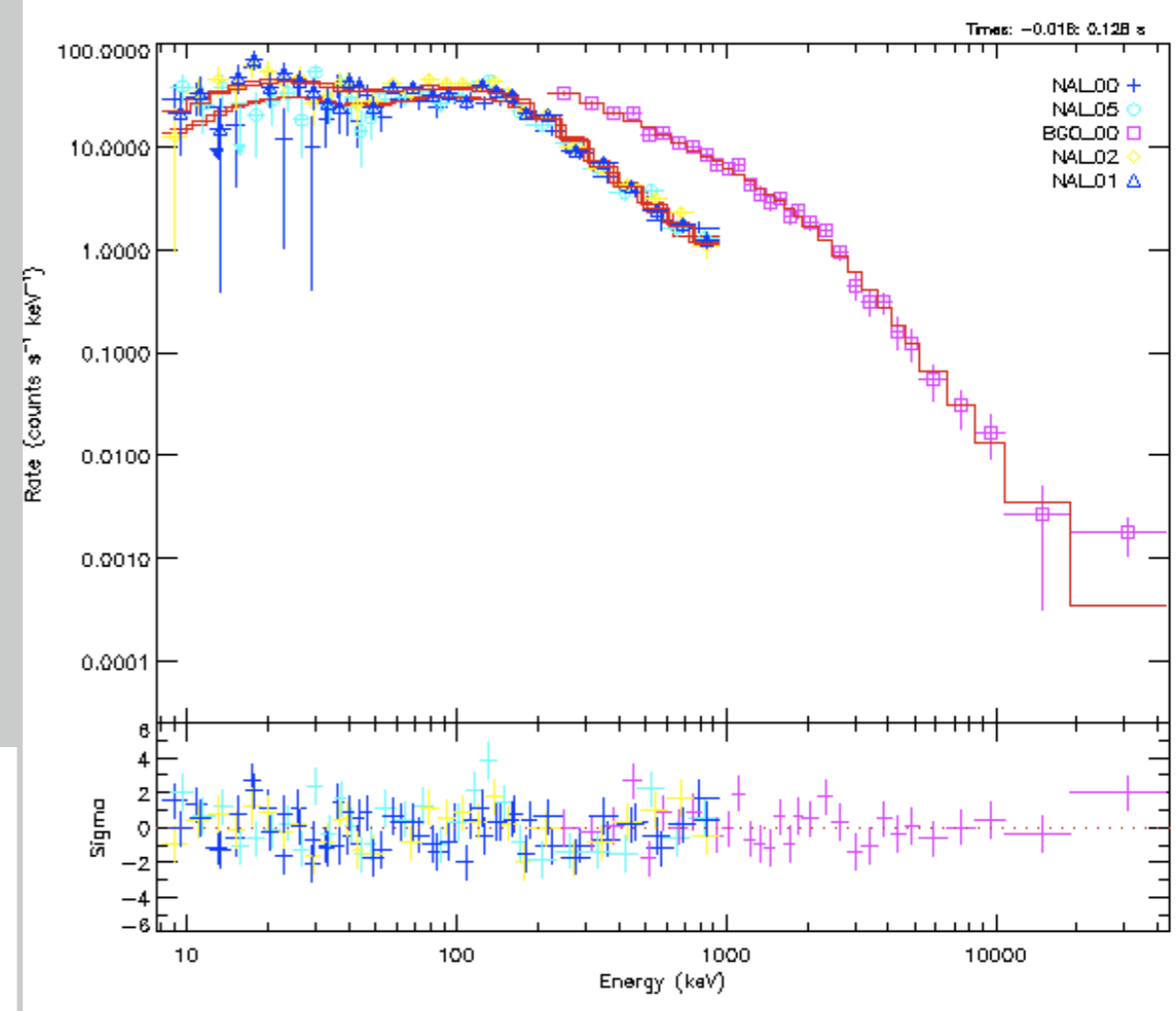
\* ~400 triggers... ~160 GRBs... Annual rate > 250.



\* 72 GRB until end October as function of LAT angle ... with the 5 LAT-detected bursts also shown as thick stars.

# What can GBM GRBs add?

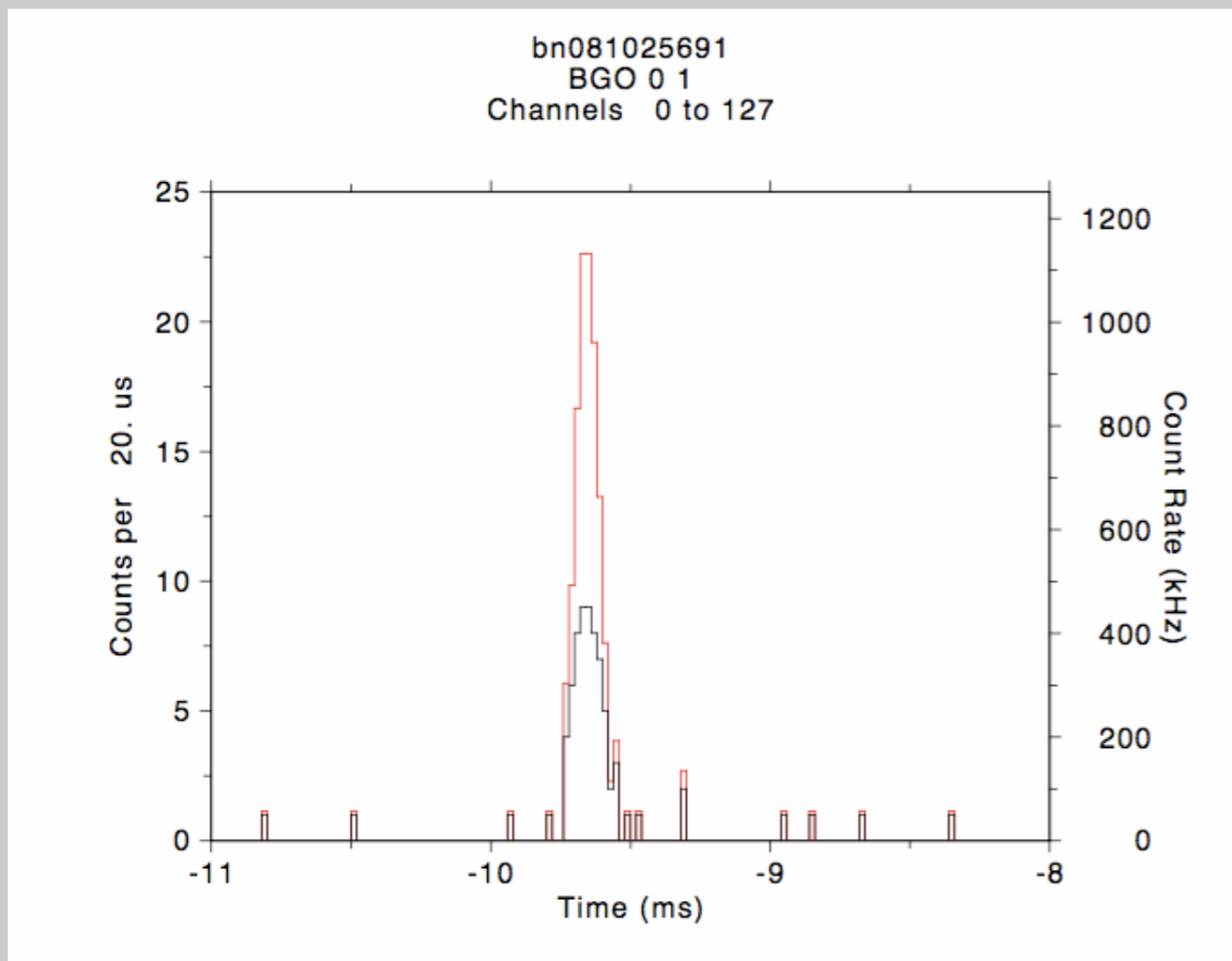
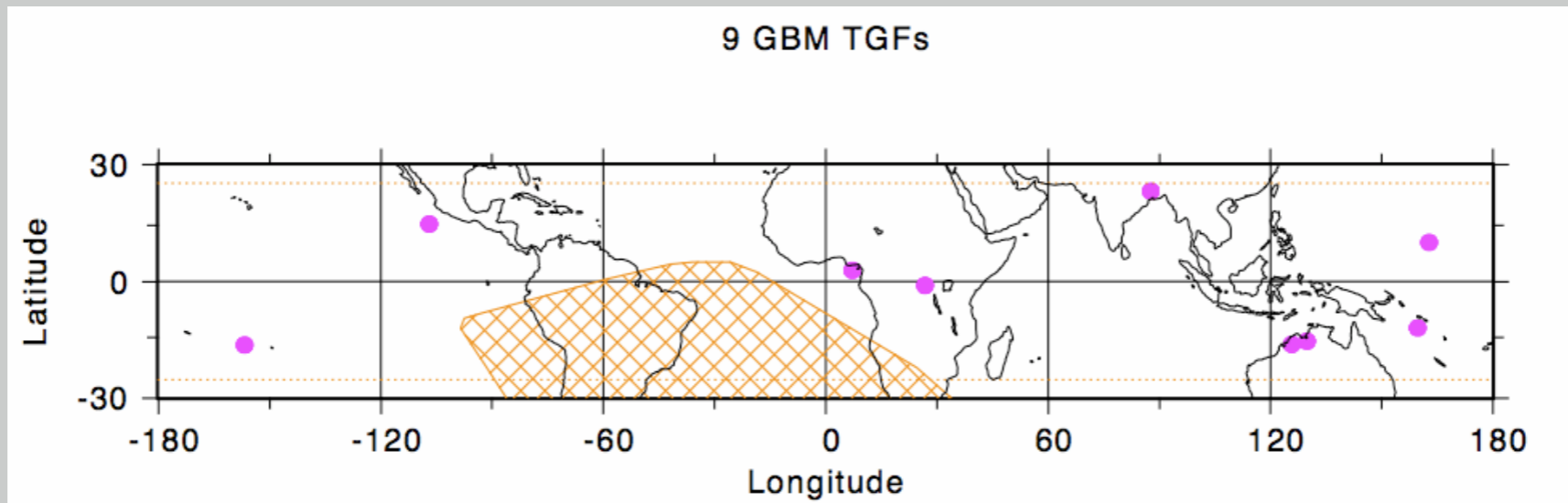
- \* Trigger for LAT & Joint spectral fits.
- \* Most prolific source of triggers.
- \* Source of  $E_{Peak}$  for Swift bursts - spectroscopy from 8 keV -- 40 MeV.
- \* Time-resolved spectra for understanding central engine of GRBs.



GRB 090227B  
 $\alpha = -0.28 \pm 0.02$   
 $\beta = -3.4 \pm 0.2$   
 $E_{Peak} = 1935 \pm 55 \text{ MeV}$



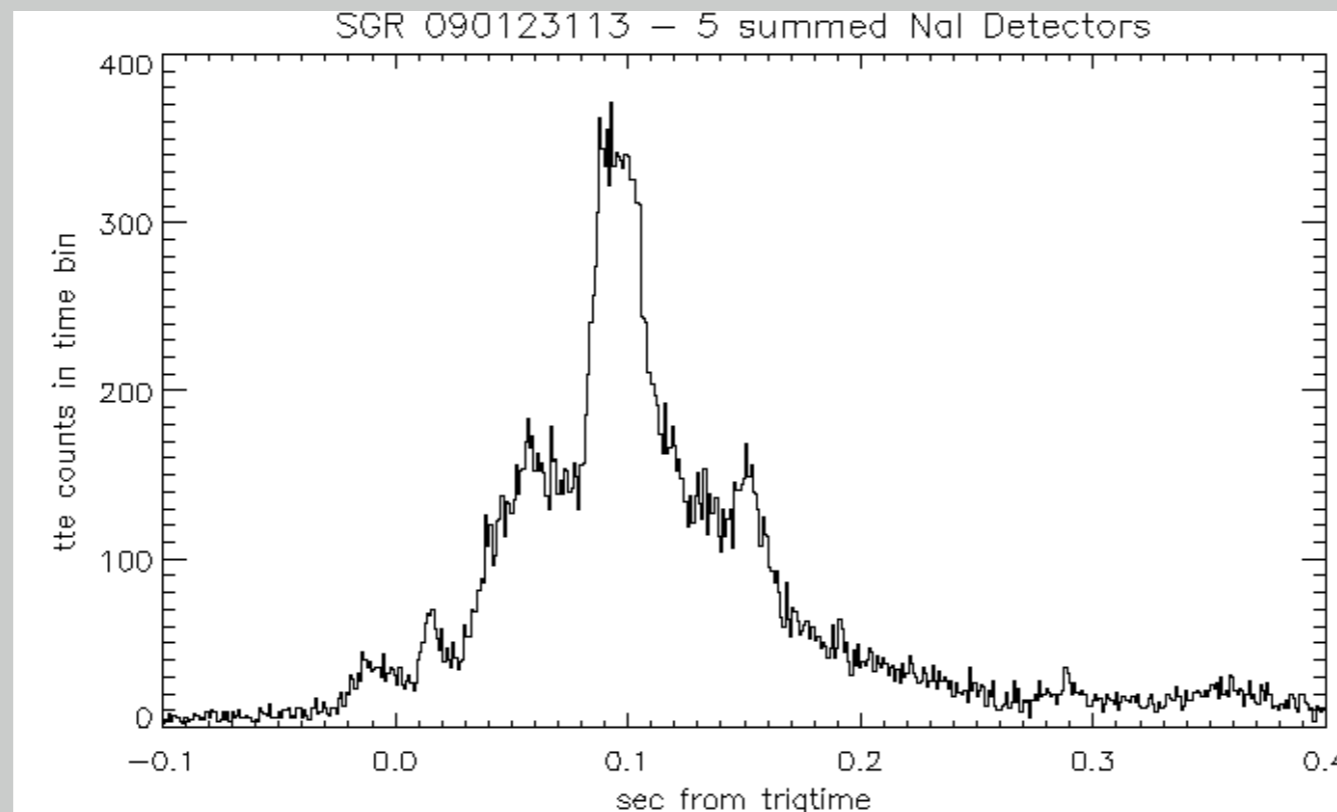
# Terrestrial Gamma-ray Flashes



< 1 - 5 ms duration.  
> 30 MeV  
Associated with thunderstorms.  
“Runaway electron” processes.

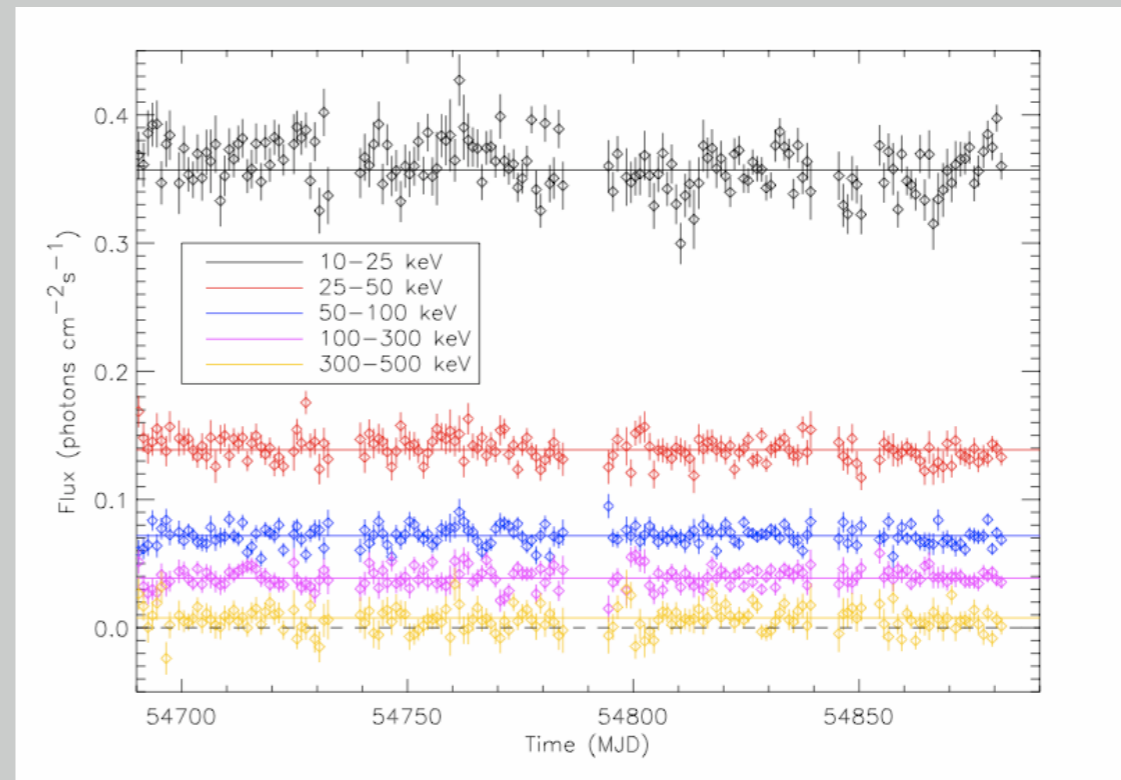
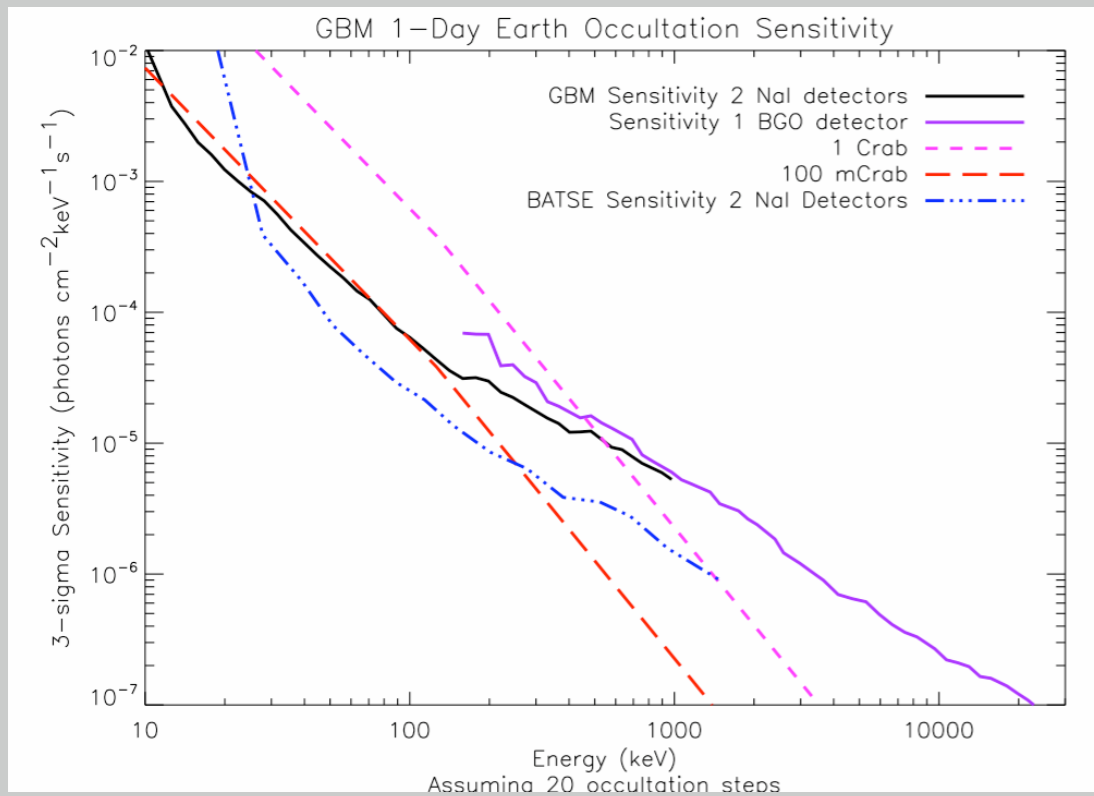
# Soft Gamma-ray Repeaters

- \* *3 different sources, one of them seen in 2 outbursts.*
- \* *Believed to be highly magnetized neutron stars (Magnetars).*
- \* *Outbursts can last days or weeks.*
- \* *typically ~ms long but some events have multiple bursts.*
- \* *spectral and timing analysis in progress.*

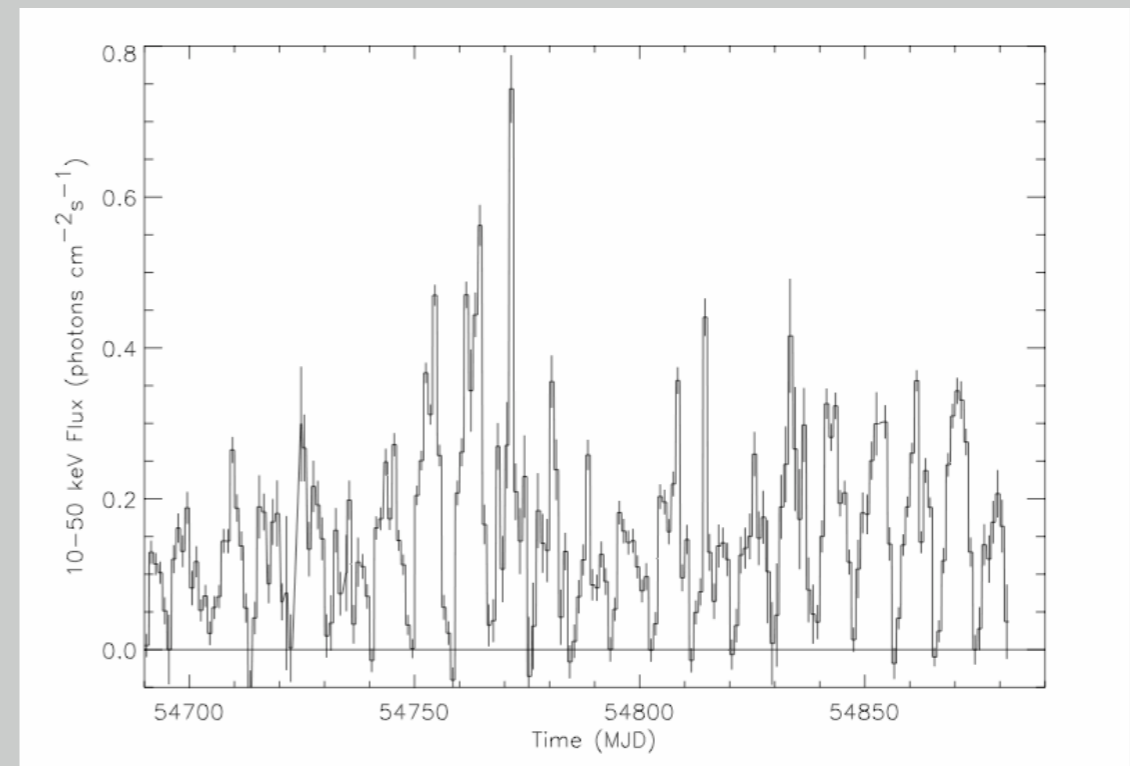
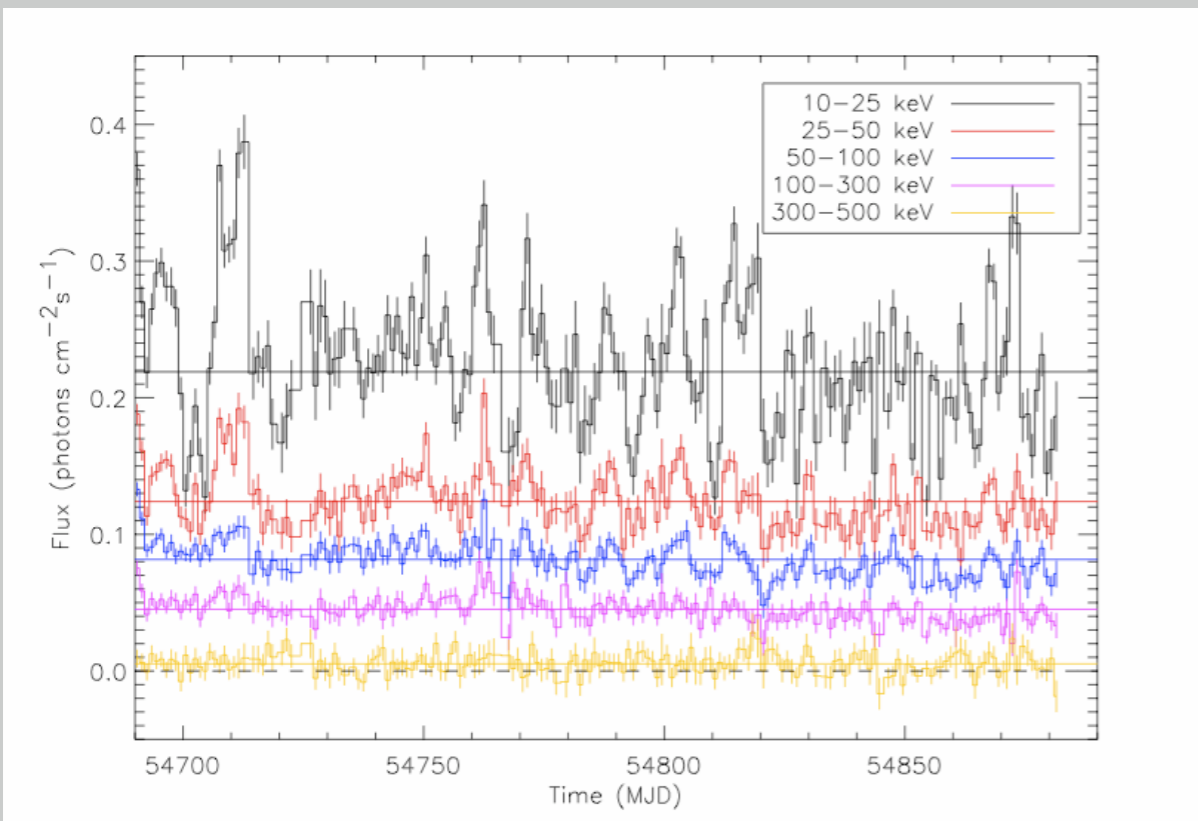




# GBM Occultation Results

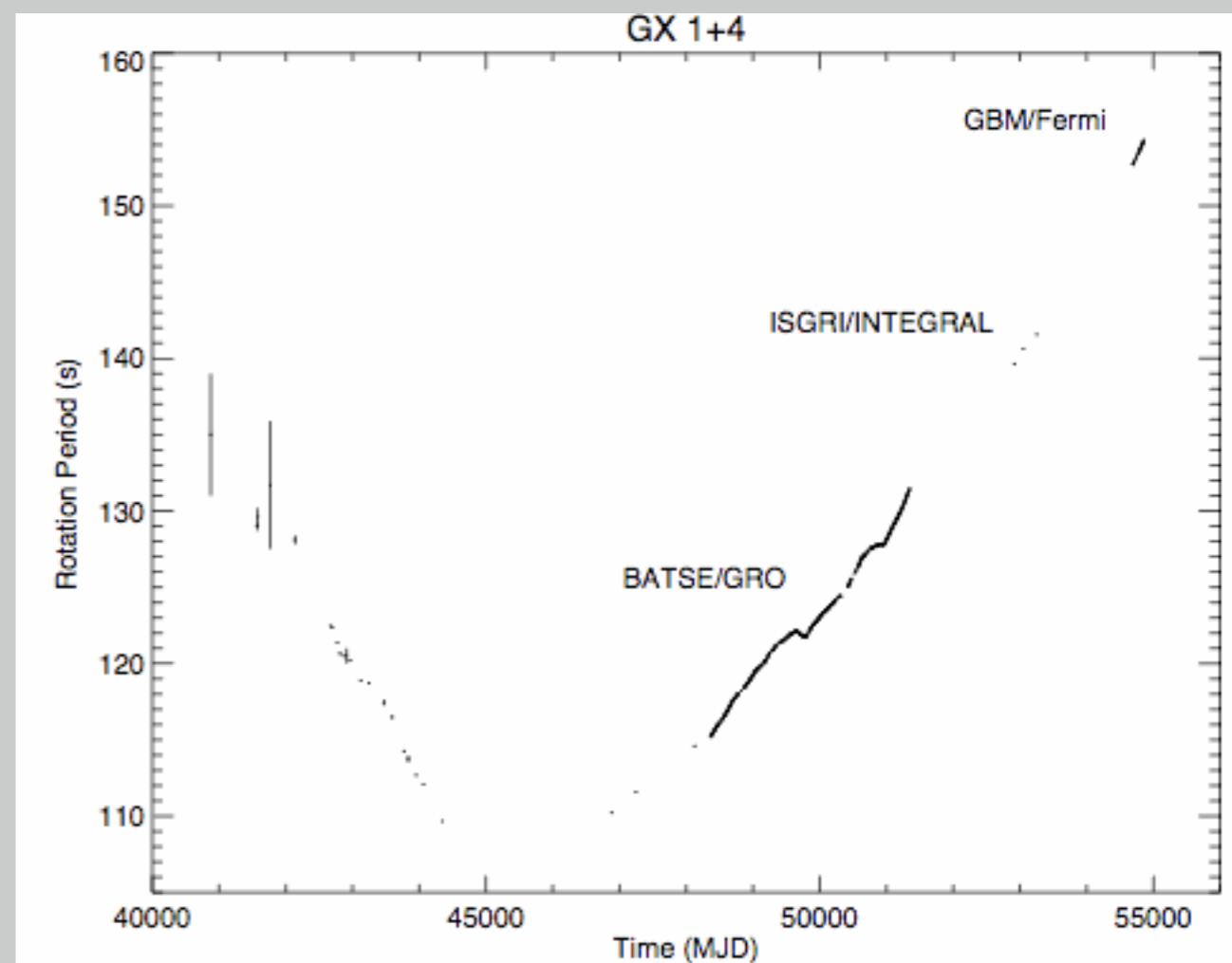
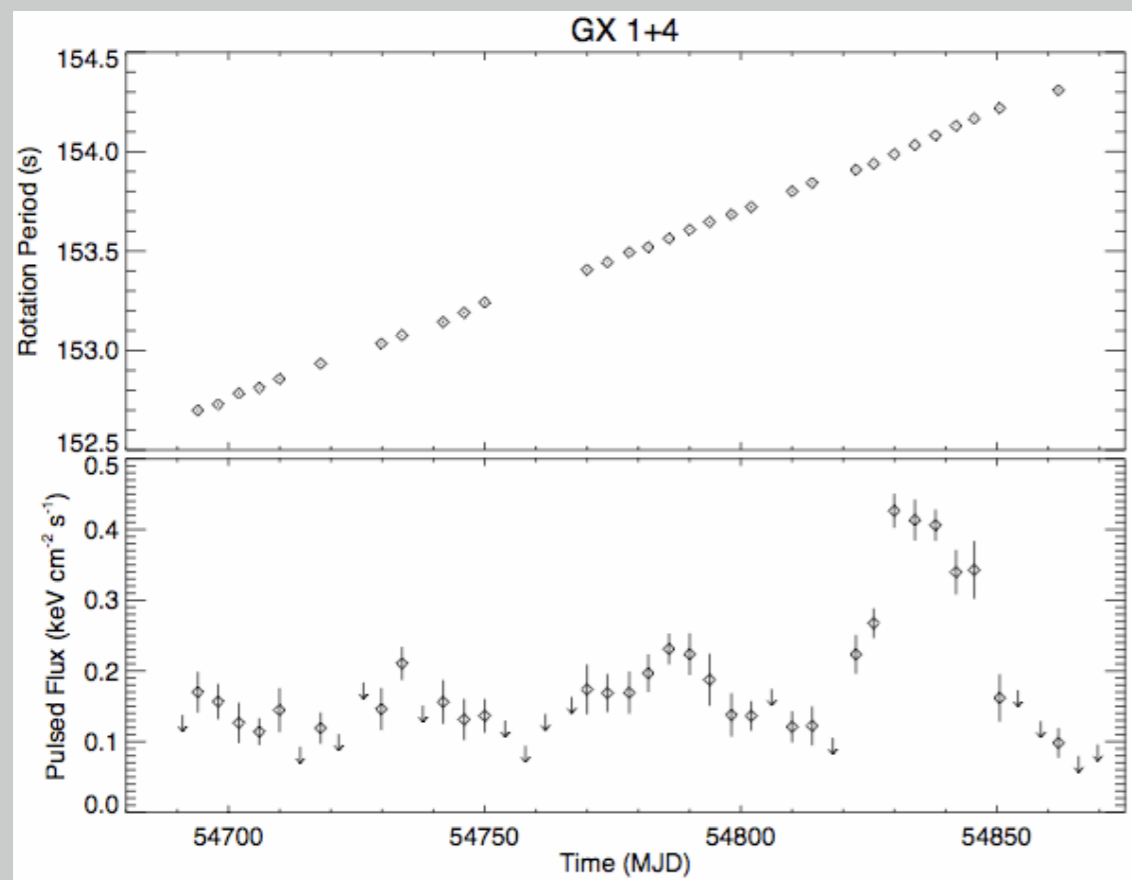


\* *Steady, variable, periodic.....*



# GBM Pulsar Results

- \* Search for pulsars from 1 mHz -- 0.2 Hz in CTIME data.
- \* Several seen routinely: 4U 1626-67, Cen X-3, OAO 1657-415, GX 1+4, Vela X-2, GX 301-2.
- \* Several seen only in parts of orbit: Her X-1.
- \* Several seen in outburst: EXO 2030+375, A 0535+6, A 1118-615.





# GBM is Healthy!

---

- \* *GRB*
- \* *SGR*
- \* *TGF*
- \* *Solar Flares ....1, with more to come.*
- \* *Occultation monitoring ... more sources to be added.*
- \* *Pulsars*
- \* *Many New Projects...*
- \* *Please use our data !!*