Fermi GBM Team Update

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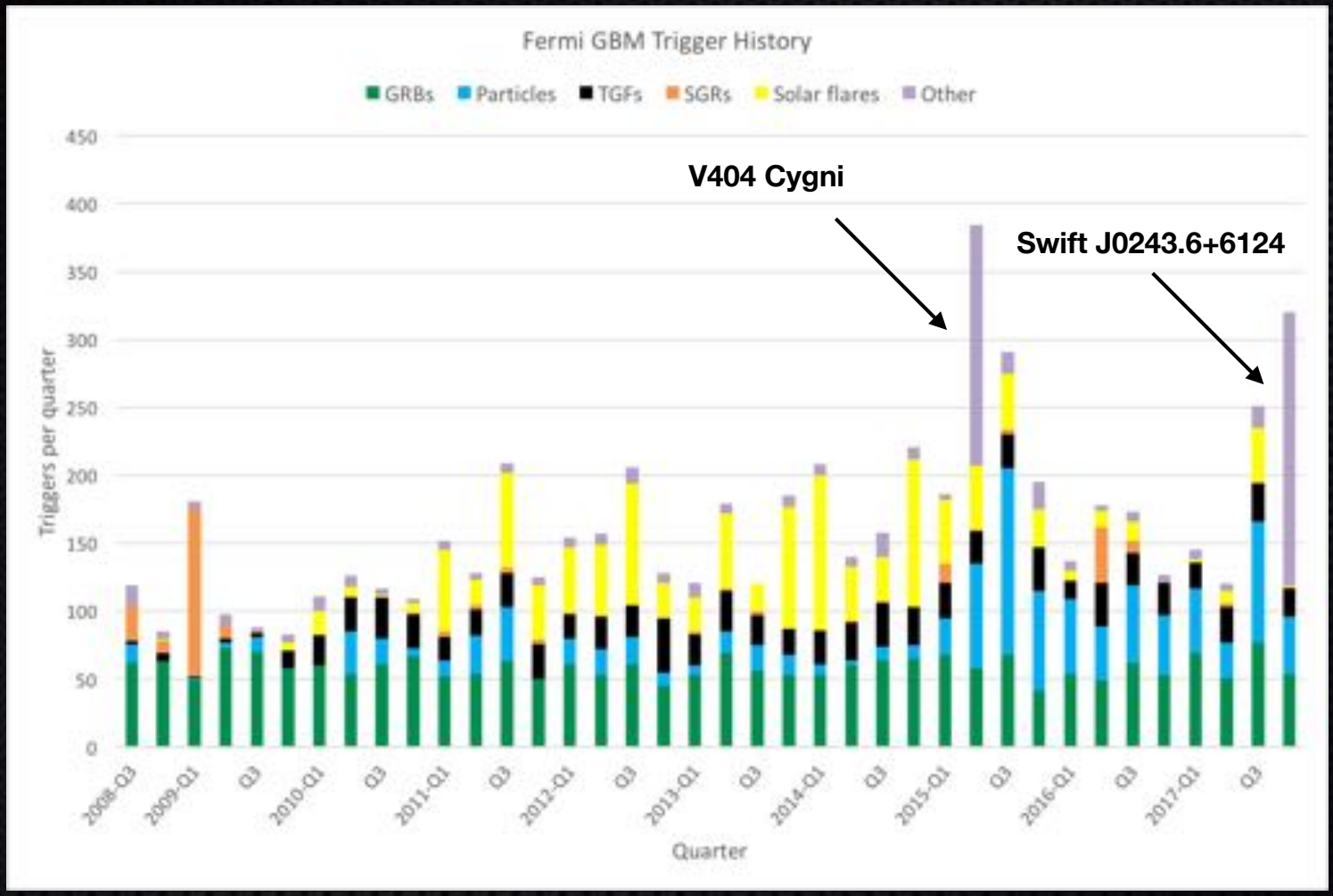
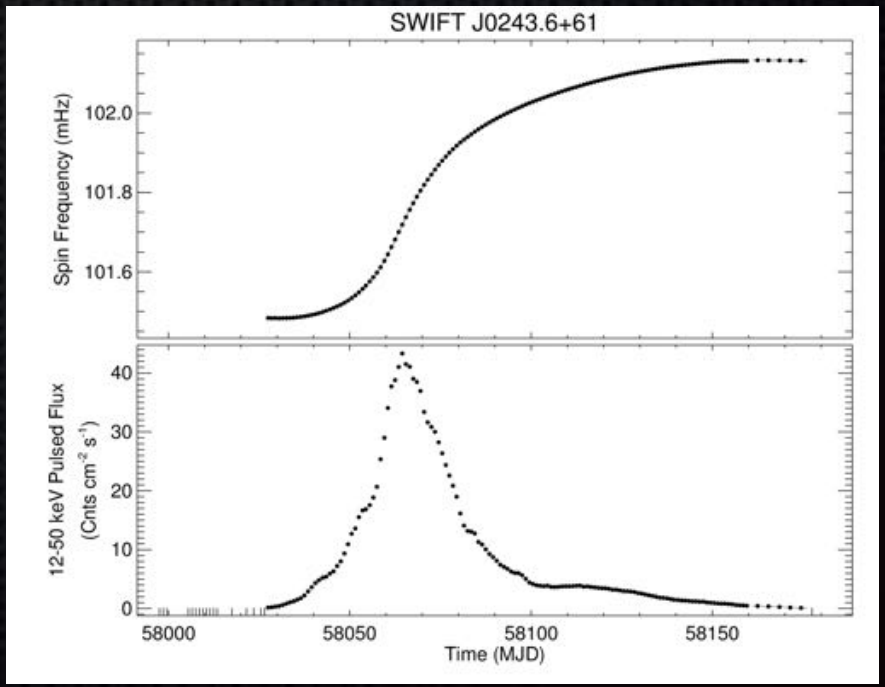
GBM Trigger Rate



9 years	All	GRBs	SGRs	TGFs	Solar	Particles	Other
Triggers	6291	2276	278	835	1177	1053	672

Swift J0243.6+6124

- First detected by Swift/BAT on Oct 3, 2017
- Source is an accreting X-ray pulsar @ 2.5 kpc
  - Neutron star orbiting a Be star
- Resulted in hundreds of GBM triggers
  - Flares reached x10 the Crab
  - Suppressed by deactivating several longer timescale triggering algorithm
- Periodicity readily apparent in XRT and GBM data
  - Period ~ 9.86 seconds
- Analysis of GBM/NICER data soon to be submitted by C. Wilson-Hodge and P. Jenke
- No conclusive evidence of emission in the LAT



Wilson-Hodge et al. in prep

GRB 170817A

- Detected on 17th Aug 2017, but publicly announced on Oct 16th, 2017
- Resulted in three highly cited papers
- MMA Paper (Abbot et al. 2017)
- GBM Team paper (Goldstein et al. 2017)
  - Summarized GBM observations
- Joint GBM/LIGO paper (Abbot et al. 2017)
  - Focused on joint EM-GW science
  - GRB theory, Speed of gravity, NES
- The detection was named the 2017 breakthrough of the year by Science
- Colleen Wilson-Hodge and the GBM team received the AAS 2018 Rossi price for the work

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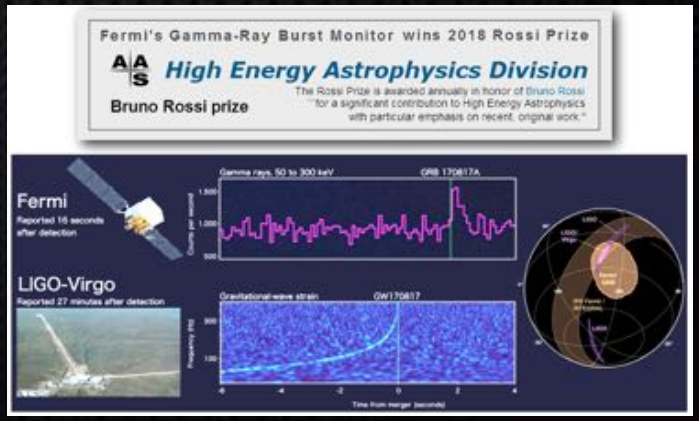
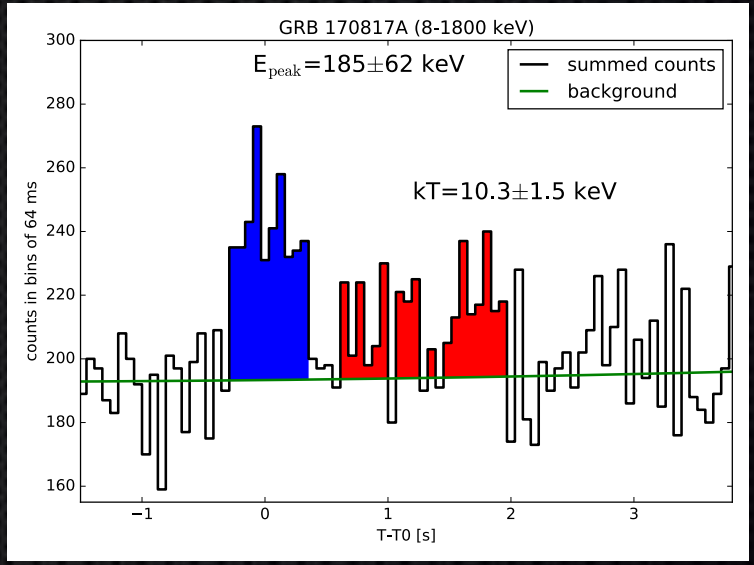


Additional Work on GRB 170817A

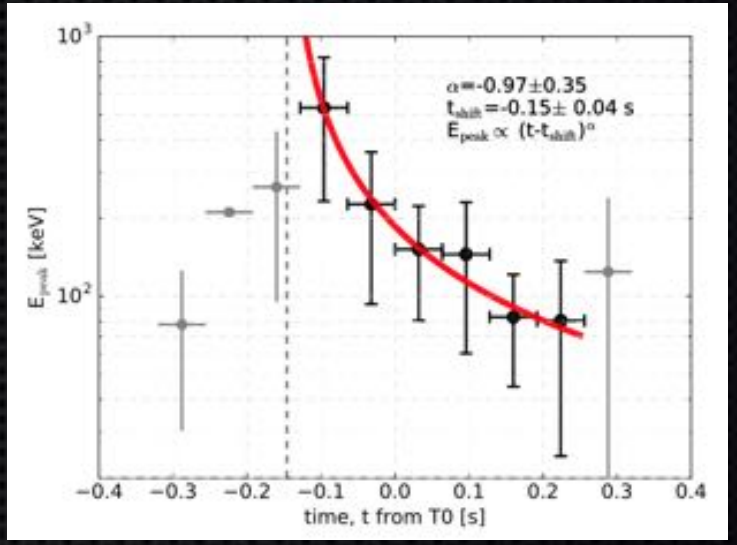
- How common are sGRBs like GRB 170817?
  - The burst was nearby and under-luminous
  - There was also a prominent thermal component
- Leading interpretations include a sGRB viewed off-axis
- Mildly-relativistic shock breakout from cocoon material
  - Should be more isotropic and could dominate rates
- Andreas von Kienlin is leading an effort to identify similar SGRBs in the GBM catalog
  - A preliminary search has revealed obvious evidence of similar behavior in GBM detected SGRB
- Dan Kocevski is leading an effort to look at the x-ray properties of these bursts (when available)
  - Do any of them have early time X-ray observations?

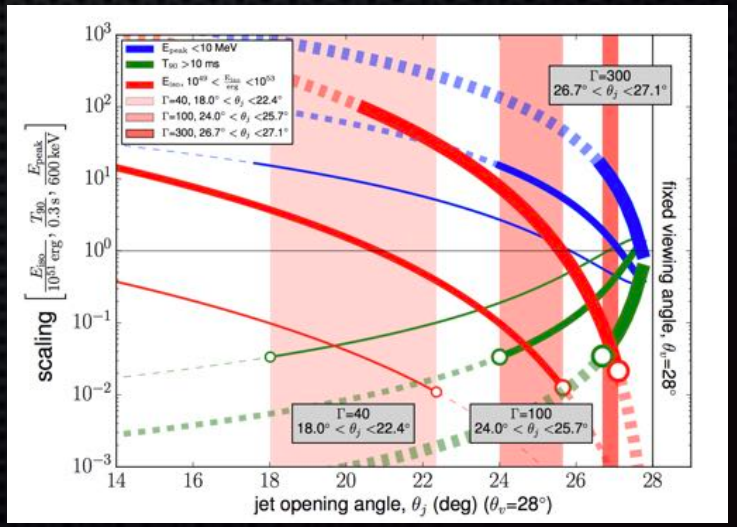


Goldstein et al. 2017

GRB Models vs GRB 170817A Observations

- Peter Veres published a more extensive comparison of GRB 170817A observations and GRB emission models
  - Veres et al. (2018) arXiv:1802.07328
- Combined Epk, T90, and Eiso observations to test various GRB models
- Photospheric models have difficulty explaining the observed properties
- Finds that internal shocks best describe the observed peak energy, viewing angle, and total energy.
- Surprisingly, the external shock model with reasonable parameters can reproduce the prompt emission
- A simple cocoon shock breakout model is in mild tension with the observed spectral evolution

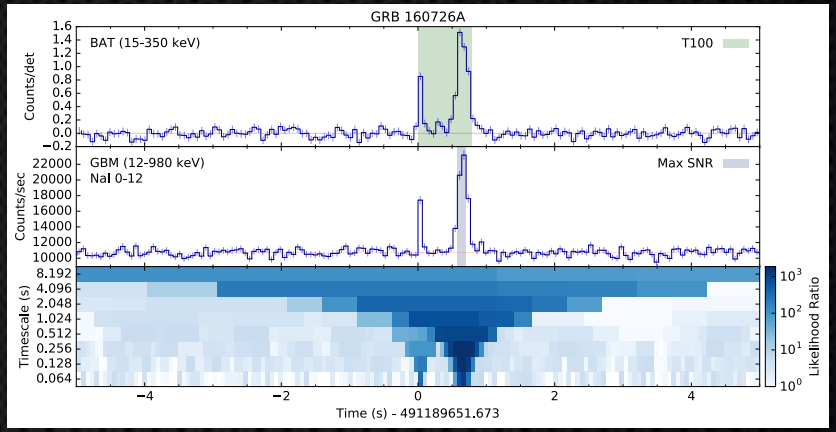


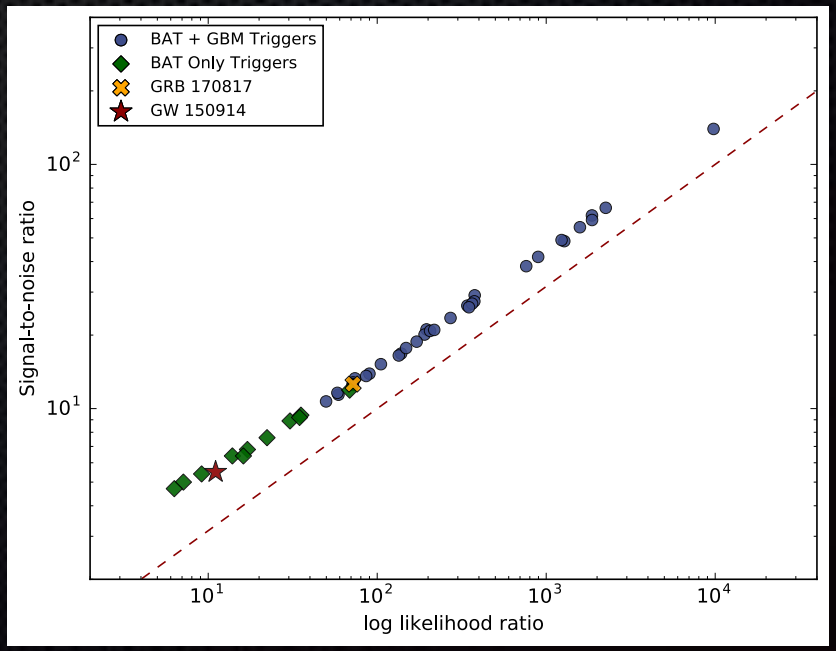


Veres et al. 2018, arXiv:1802.07328

Sub-Threshold SGRB Analysis

- D. Kocevski examined a sample of sub-threshold SGRBs detected by Swift that were in the GBM FOV
- The bursts provide a control sample to characterize the response of the GBM targeted search of CTTE data
- Total of 44 sGRBs
  - 33 sGBS detected by Swift BAT and triggered GBM
  - 11 sGRBs detected only by Swift BAT
- The search can recover 95% (42/44) of the population at >3σ (likelihood ratio > 9)
- GRB 170817A could still have been detected at 60% of its observed brightness
- Increases the volume of the Universe in which GRB 170817A could be detected by factor of 5
- To be submitted within a few weeks

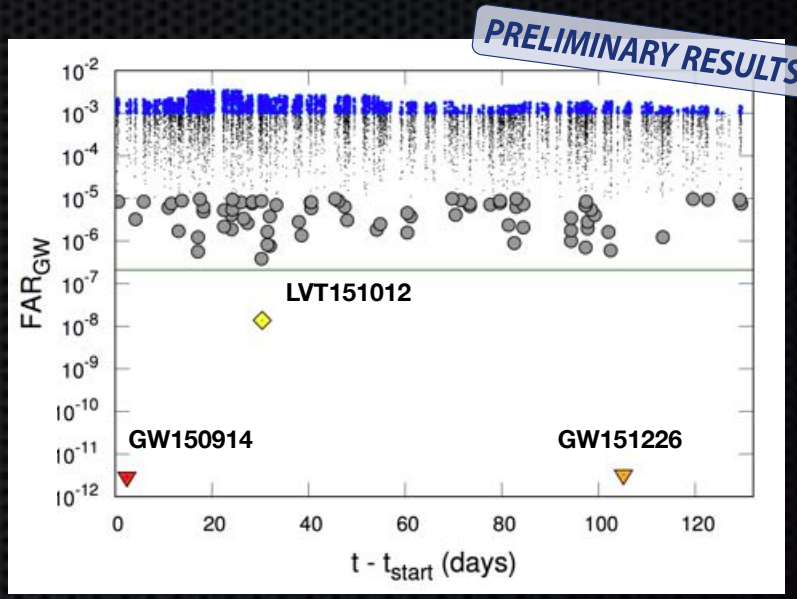




Kocevski et al. in prep

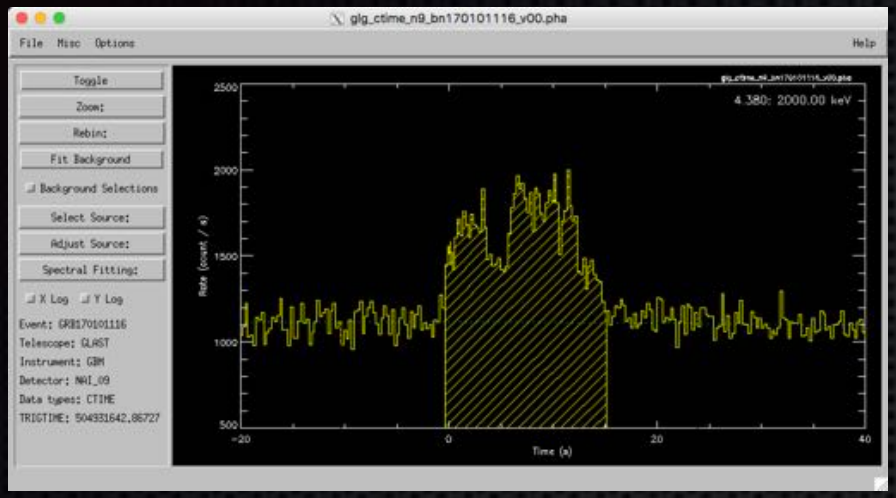
O1 Paper and Preparations for O3

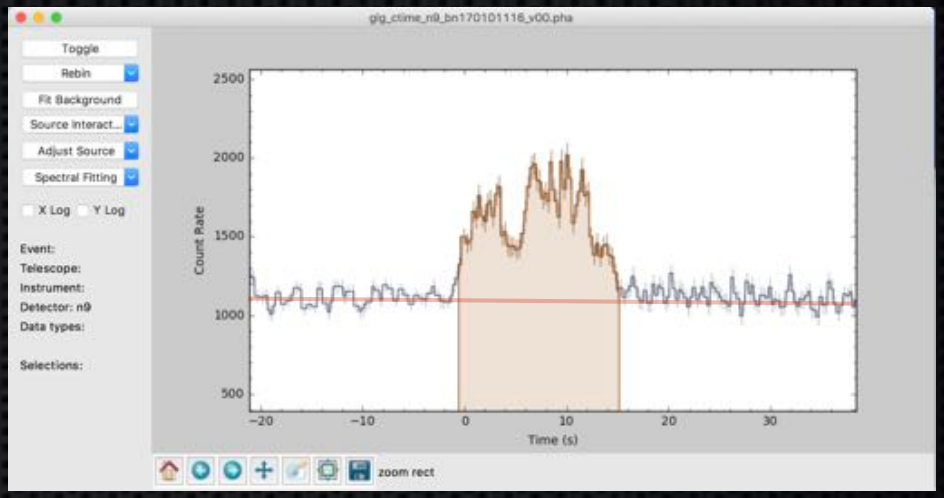
- Re-analysis of GBM data for final LIGO O1 candidates
  - Led by T. Littenberg, A. Goldstein, E. Burns
  - Candidates found by GstLAL and PyCBC pipelines with FAR < 1e-5 Hz
  - No firm detections (GW150914-GBM is marginal)
  - Finishing LIGO technical review, should be submitted within the next few weeks
- O3 Preparations
  - Implement a thermal template for the targeted search
  - Low-latency distribution of joint LIGO-GBM sky maps
  - Recalculation of the FAR distribution
  - Overall optimization of the targeted search (best timescales and bin phases to use)



GBM/LIGO Teams et al. 2018

GSPEC





- GSPEC is a python based replacement of RMfit
- Being developed by A. Goldstein, R. Preece, B. Cleveland, and D. Kocevski
- Fully developed command line API and GUI with an interface (and backend) to XSPEC
- GSPEC will allow users to fit background and make source selections interactively
- Enable efficient time-resolved spectral fitting using GBM data with XSPEC and scripted catalog re-analysis
- New software is now being beta tested within the GBM team

Conclusions

- GBM has had a very productive and successful six months!
- Swift J0243.6+6124 is a nice example of non-GRB science enabled by GBM
- GRB 170817A has given GBM, and Fermi in general, very favorable exposure
- Continue to capitalize on science related to GRB 170817A
  - Looking for other sGRBs that look like GRB 170817A
  - Examining the X-ray properties of such bursts
  - Confronting GRBs models with GRB 170817A observations
  - Using sub-threshold sGRBs to characterize the targeted search
- O1 Re-analysis paper almost ready and O3 preparations underway
- GSPEC should be available in Q2 of 2018
- The LIGO-GBM synergy has yielded exciting results that will hopefully continue into O3