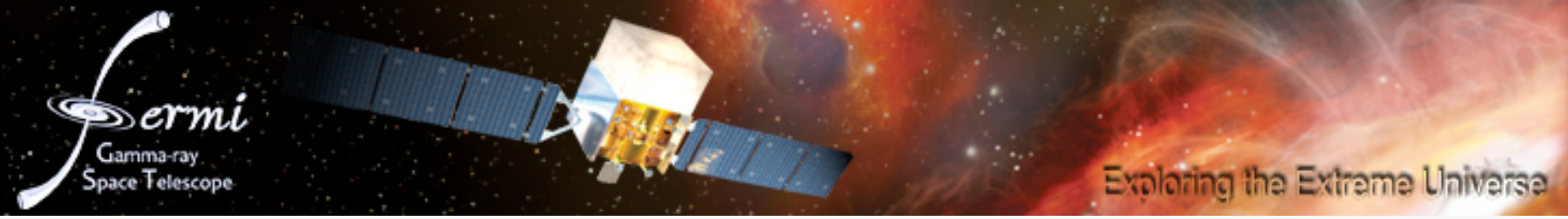


The First GBM GRB Catalogs

Rob Preece
(for the Fermi GBM Team)
UAHuntsville

Two Catalogs:

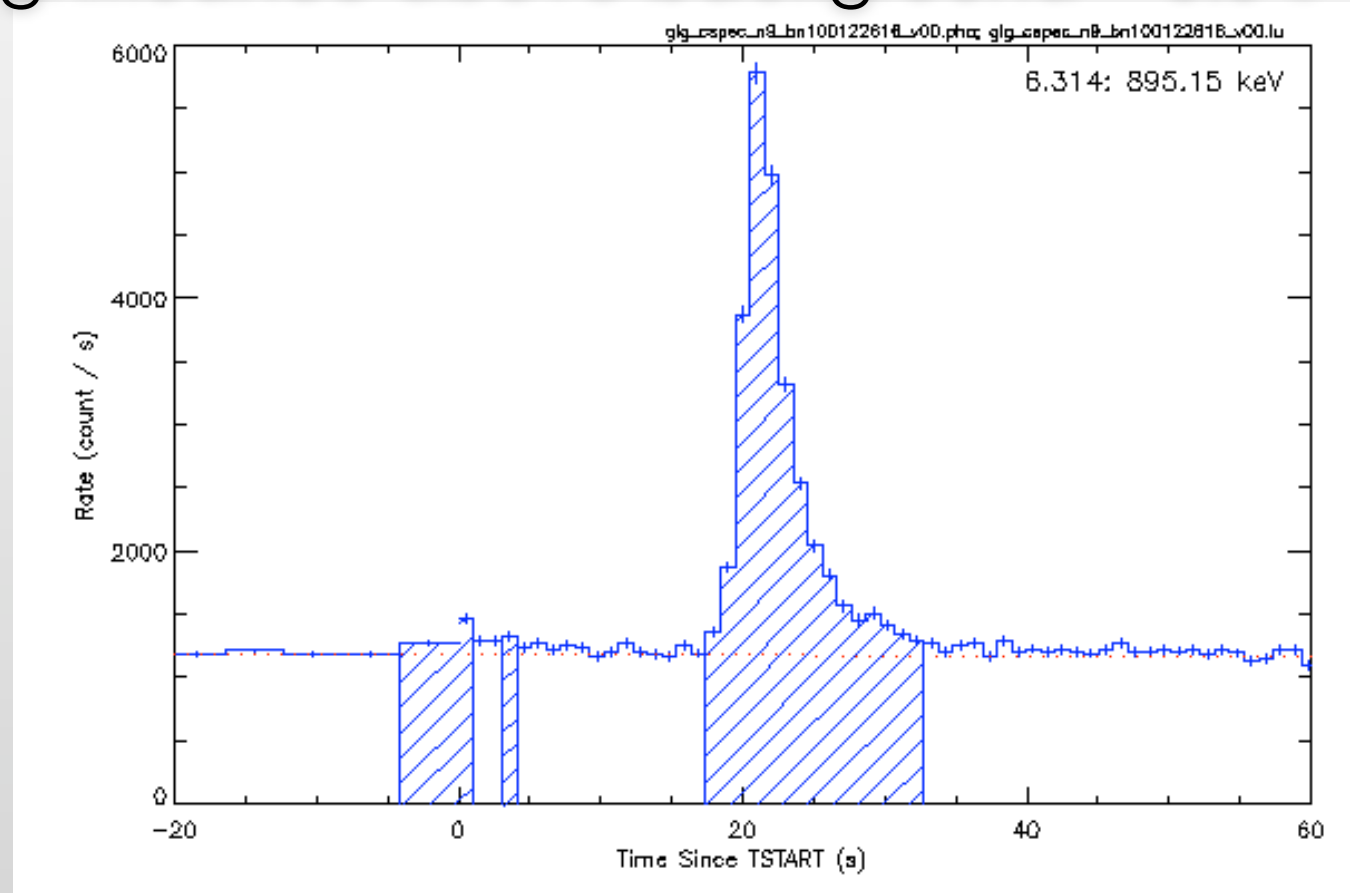
- GBM was designed as a context instrument: a series of GRB catalogs was proposed to augment LAT observations by placing them "in context"
  - Compare and contrast with, e.g.: BATSE
  - Be comprehensive and useful to the community
- "Burst Global Properties" and "Peak Flux / Fluence Spectroscopy"

Spectroscopy Catalog

- The "Peak Flux and Fluence" Spectral Catalog:
  - 486 bursts for the first two years
  - Select brightest NaI detectors; subtract backgrounds
  - Two Spectra from all but the weakest GRBs:
    - 2.048 s Peak Flux Spectrum
    - > 3.5 sigma integrated Fluence Spectrum
  - Four Spectral Models Fit to each spectrum:
    - Power Law: A & α
    - Exponentially-attenuated Power Law ("Comptonized"): A, α & E_{peak}
    - Band function: A, α, β & E_{peak}
    - Smoothly-Broken Power Law: A, α, β, Δ & E_{break}
- BATSE Heritage: Mallozzi et al. 1995; Goldstein et al. 2010; Preece et al. 2011 (in prep.)

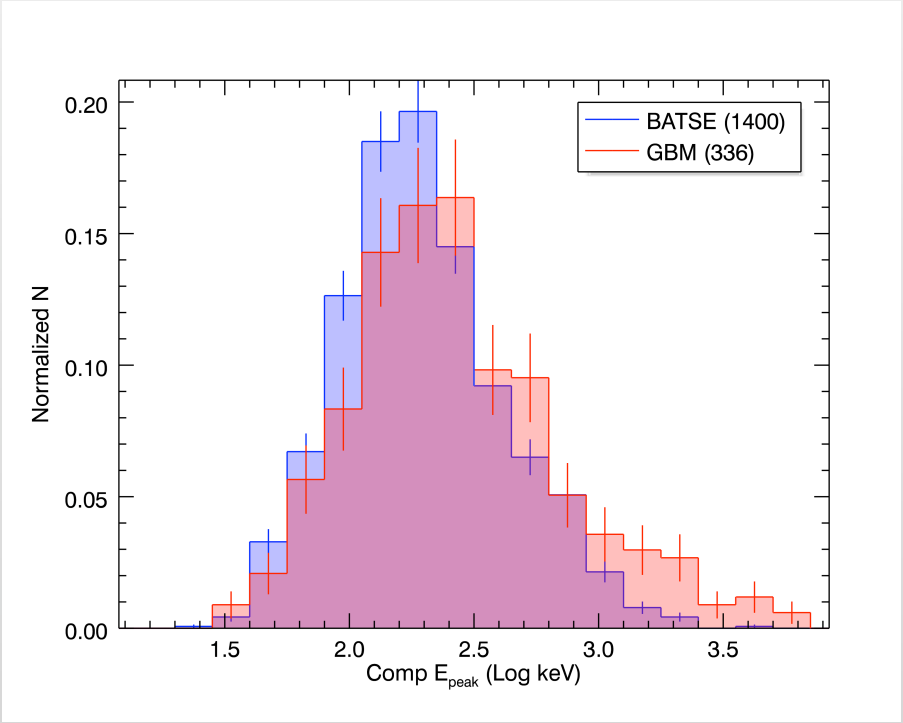
Data Selection

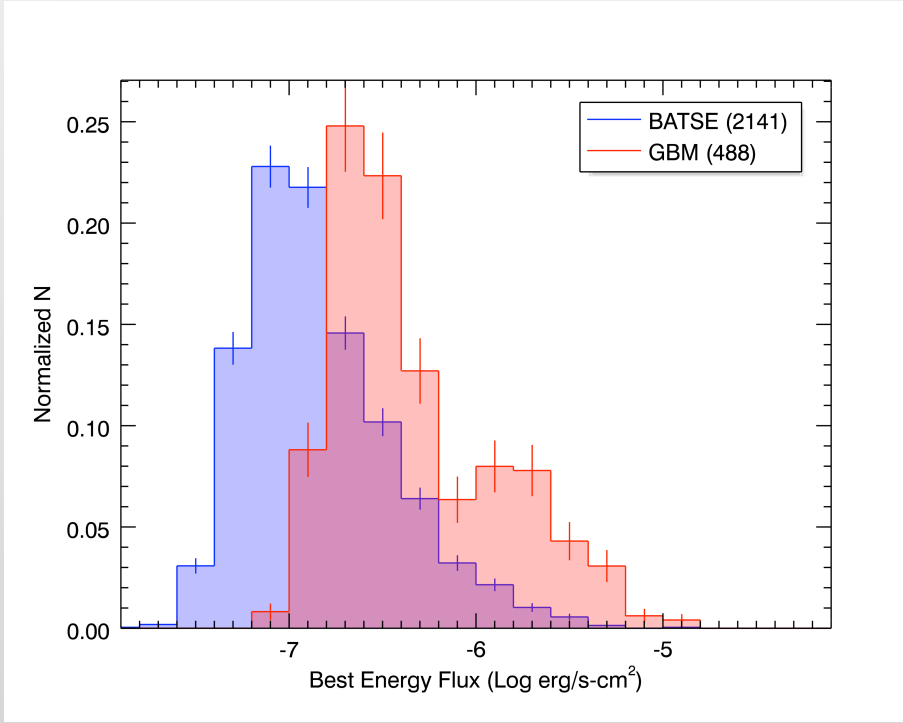
- Fluence spectra are selected by significance above background > 3.5 σ



GBM & BATSE Catalogs:

- E_{peak} from the "BATSE 5B Flux and Fluence Catalog" (Preece et al.) compared with the 2 year GBM Catalog (Goldstein et al.)
  - All spectral parameters and models selected for goodness of fit
  - Fluence Integrated Fluxes over 3.5 σ selection (*left-normalized*)
- GBM 1.024 s Peak Fluxes from the Burst Catalog (*right-normalized*)
  - BATSE 2.048 second Peak Fluxes: photon s^{-1} cm^{-2}

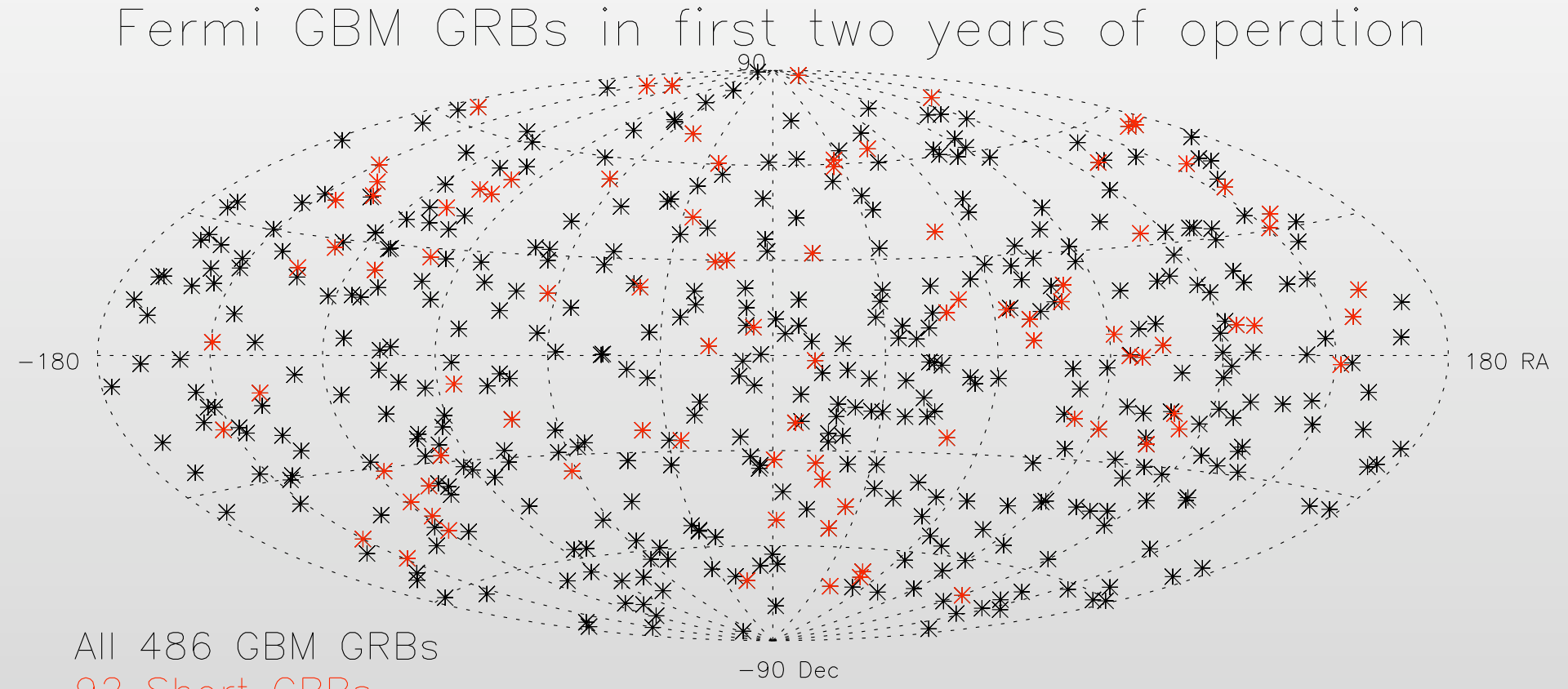




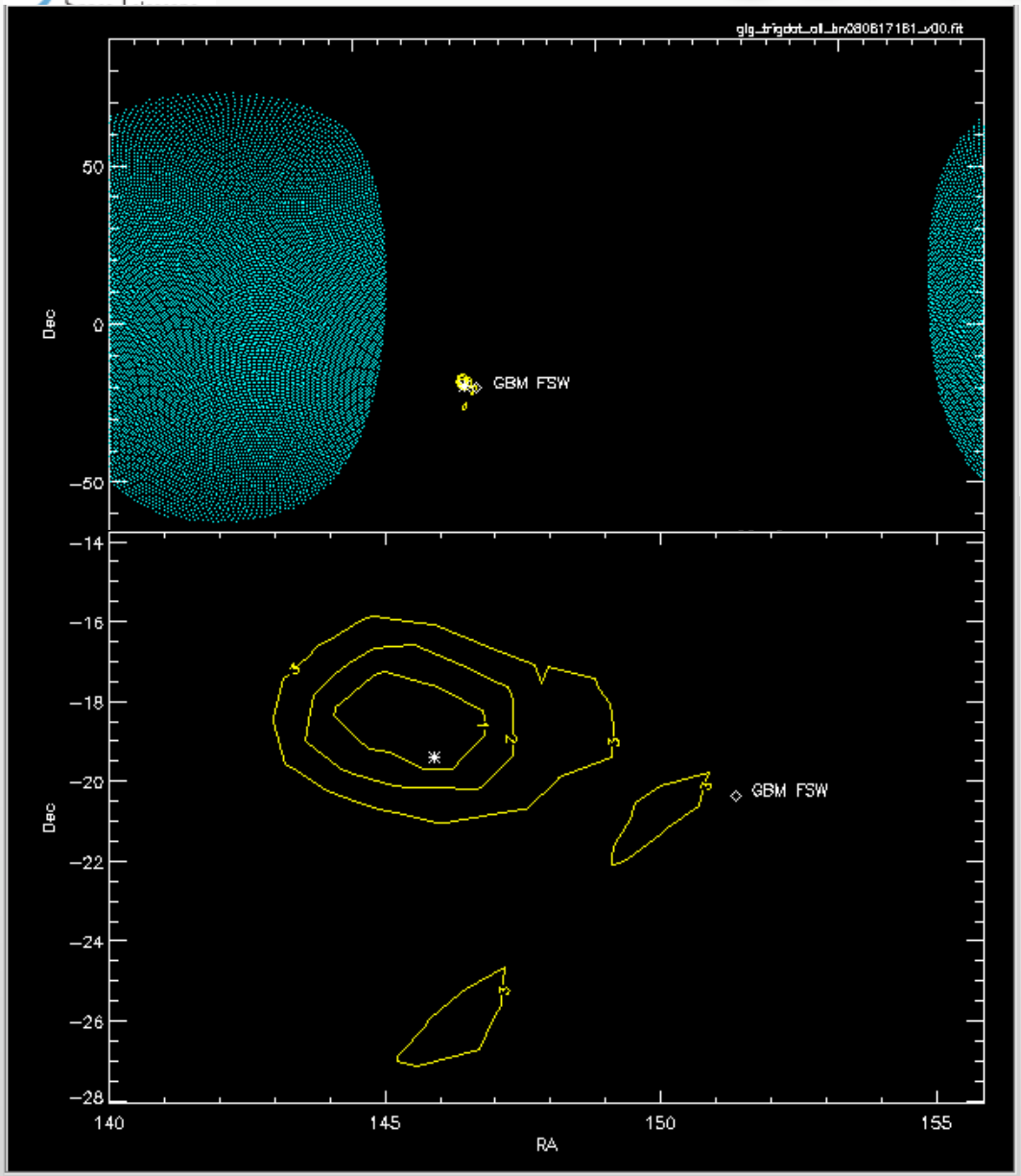
Burst Catalog (Paciesas et al.)

- 492 GRBs in the first two years
- Global properties:
  - Localization
  - Peak Fluxes and Fluences for several timescales and energy bands
  - Photon-derived durations
    - Based on time series of spectral fits
    - Background-subtracted photon lightcurves
- Most results can be directly compared with those of BATSE

GBM Bursts: Localizations



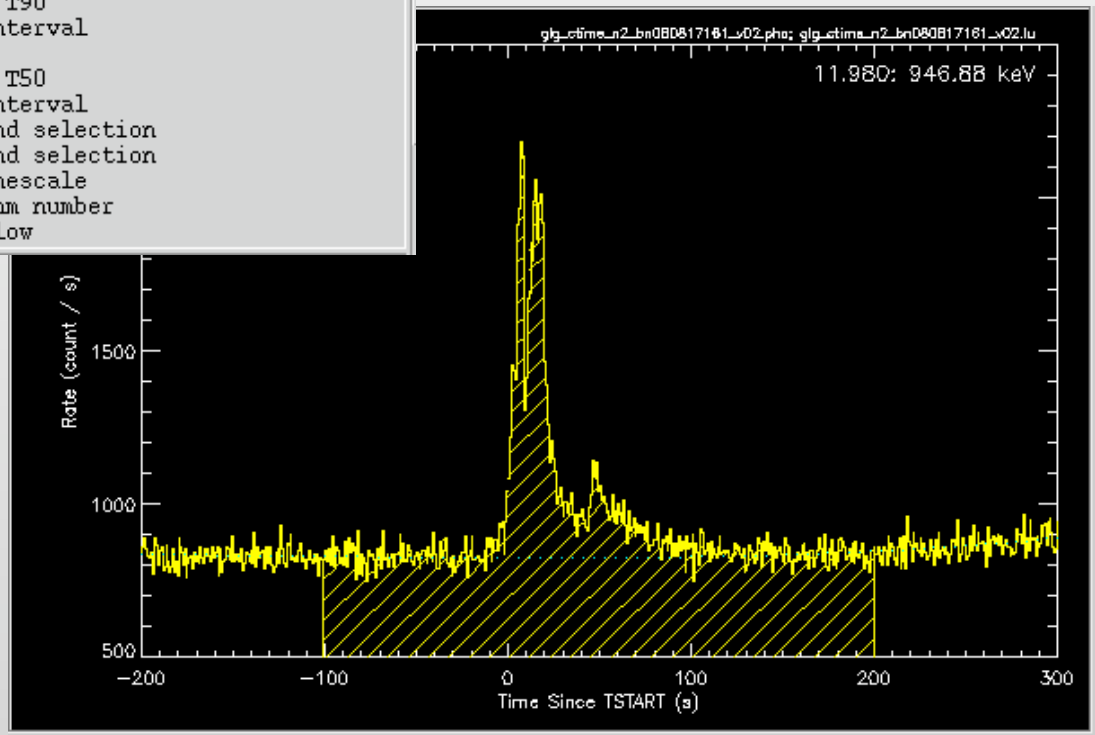
GBM Localization



- The systematic error for the human-in-the-loop localizations is 2.8º (70%) + 8.4° (30%)
- The systematic error for the automated ground localizations is similar (for rapid response telescopes)
- The statistical error for most bright bursts is 1°, RMS with the systematic error

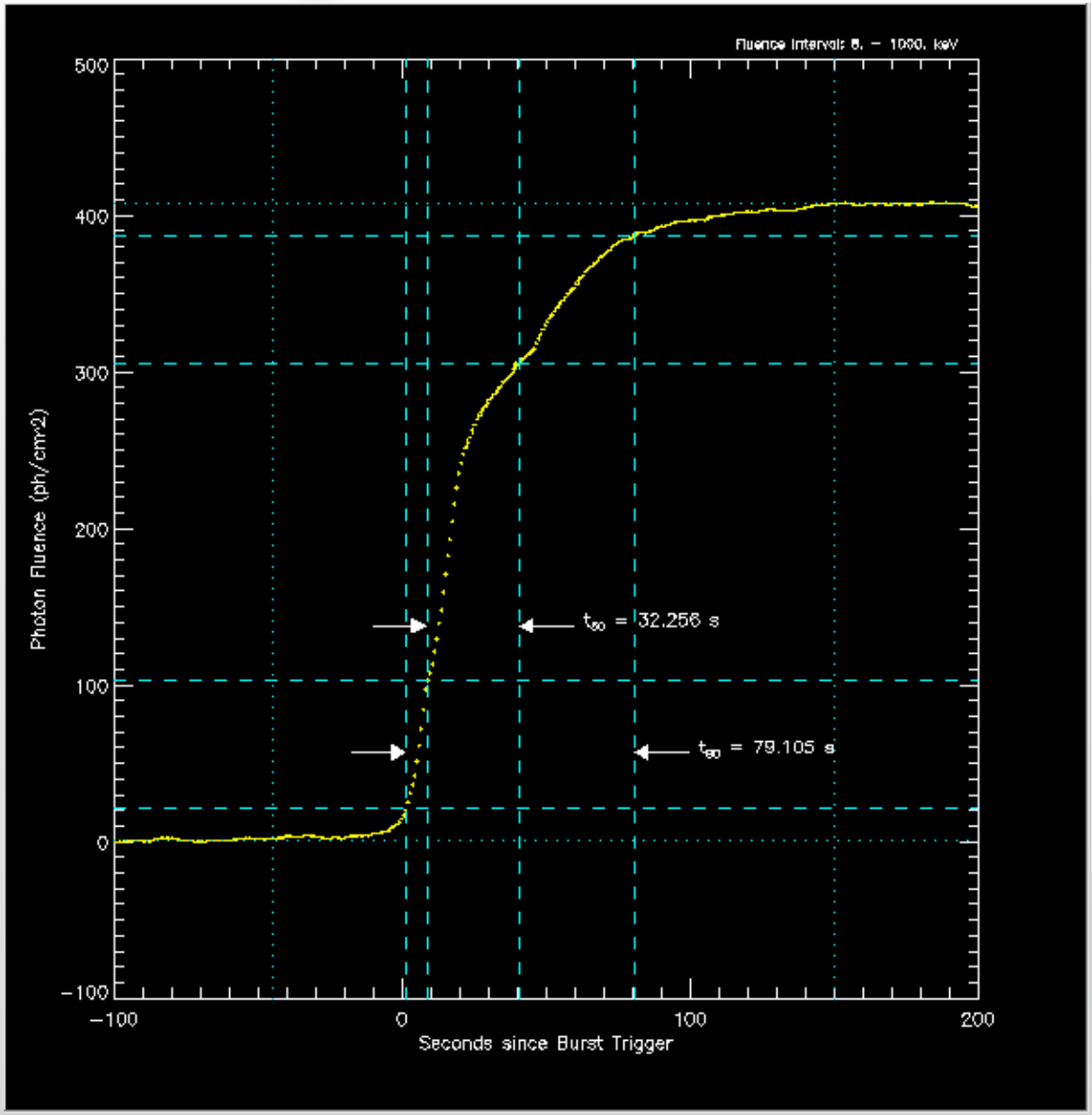
Peak Flux & Fluence

```
RADECSYS= 'FK5     '           /Stellar reference frame
EQUINOX =              2000.00 /Equinox for RA and Dec
RA_OBJ  =            151.35000 / Calculated RA of burst
DEC_OBJ =            -20.350000 / Calculated Dec of burst
CLASS   = 'GRB     '           / Classification of trigger.
RELIABLT=             0.949000 / Reliability of classification.
FLU     =          6.55112E-05 /[erg/cm^2]  8- 1000 keV fluence
FLU_ERR =          6.19366E-08 /[erg/cm^2] Uncertainty on fluence
PFLX_INT=             0.768014 /[s] Time interval for peak flux
PFLX    =              16.4433 /[ph/(s cm^2)]  8- 1000 keV peak flux
PFLX_ERR=              1.19711 /[ph/(s cm^2)] Uncertainty on peak flux
PFLXB   =              7.89684 /[ph/(s cm^2)] 50-300 keV peak flux
PFLXBERR=             0.574906 /[ph/(s cm^2)] Uncertainty on peak flux
T90     =              79.1051 /[s] T90 duration
T90_ERR =             0.768014 /[s] Uncertainty on T90
T90START=              1.53600 /[s] Start of t90 interval
T50     =              32.2565 /[s] T50 duration
T50_ERR =             0.768014 /[s] Uncertainty on T50
T50START=              8.44809 /[s] Start of t50 interval
LOBCKINT= '(-85.42, -44.79)'   /[s] Lower background selection
HIBCKINT= '(150.00, 192.71)'   /[s] Upper background selection
TRIGSCAL=                  512 / [ms] Triggered timescale
TRIG_ALG=                   10 / Triggered algorithm number
CHAN_LO =                    3 / Trigger channel: low
```



Burst Catalog Calculations

- Using CTIME data, we do a batch fit of all the background-subtracted spectra.
- Select 2 ‘plateaus’ well before and well after the burst emission.
- Accumulate the fluence for the T90 and T50 calculations.
- We also calculate peak fluxes and total fluences.



Common Data Format

- GBM Catalog Data will have the same FITS format:
  - Primary Header contains global burst-related keywords
    - "Burst" Catalog contains the Duration, Peak Flux & Fluence
  - DETECTOR DATA Extension:
    - Detectors and data types used
    - Energy Edges per channel per detector
    - Deconvolved Data per channel per time bin per detector:
      - Photon 'Count' Rate, Model and Errors
  - FIT PARAMS Extension (Model info in Header):
    - Time Bin boundaries for the spectral fit(s):
      - One each for "Peak Flux / Fluence" Catalog
    - Spectral Fit Parameters per time bin
    - Photon and Energy Fluxes and cumulative Fluences per time bin, integrated over several energy ranges

Conclusions

- GBM Spectroscopy Catalogs benefit from rich BATSE inheritance
- First Catalog releases required extensive refinement of techniques to ensure uniform quality
- Data to be publicly available as FITS files at FSSC, HEASARC, within next two months; publications in prep.
- Expect bi-yearly updates

GRB080817: Localization