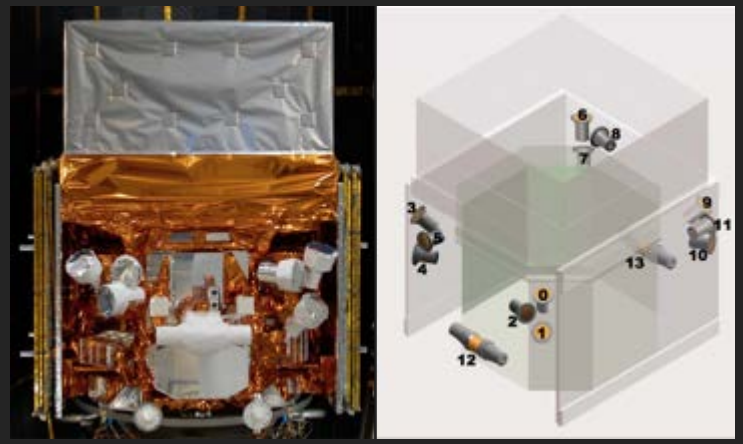
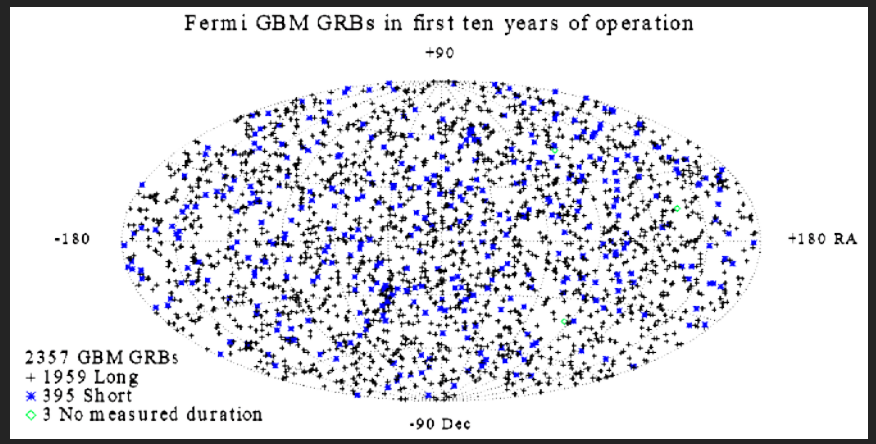
A Decade of Gamma-ray Bursts observed by Fermi-GBM

4th GRB Catalog: von Kienlin, A., et al., 2020, ApJ, 893, 46

3rd GRB Spectral Catalog: Poolakkil, S., et al., 2021 ApJ accepted, arXiv:2103.13528v1





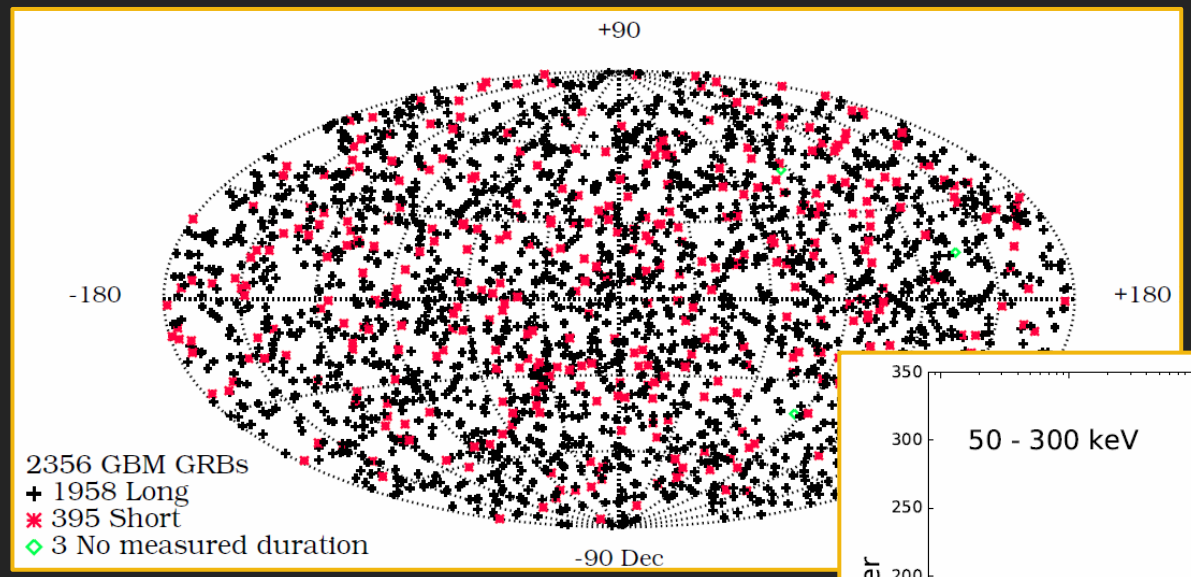
Andreas von Kienlin - on behalf of the Fermi-GBM team

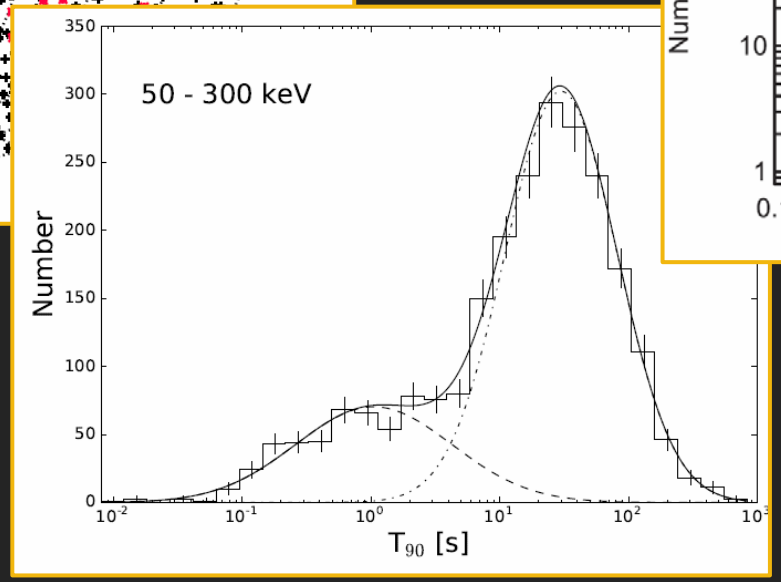
Max-Planck-Institut für extraterrestrische Physik (MPE), Garching

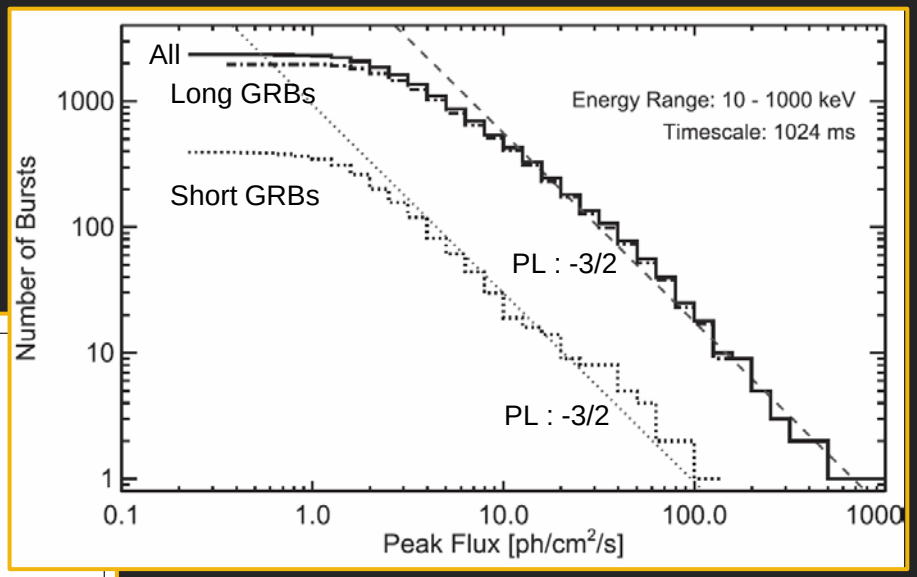
4th GBM GRB Catalog - 10 years of data

von Kienlin et al., 2020

- 1st, 2nd, 3rd catalog: 2 , 4, 6 years ⇨ Paciesas et al. 2012, von Kienlin et al. 2014, Bhat et al. 2016
- for each GRB: location, duration, peak flux & fluence (50 – 300 keV, 10 – 1000keV) ⇨ standard tables
- + information on triggering criteria, exceptional operational conditions, GCN products



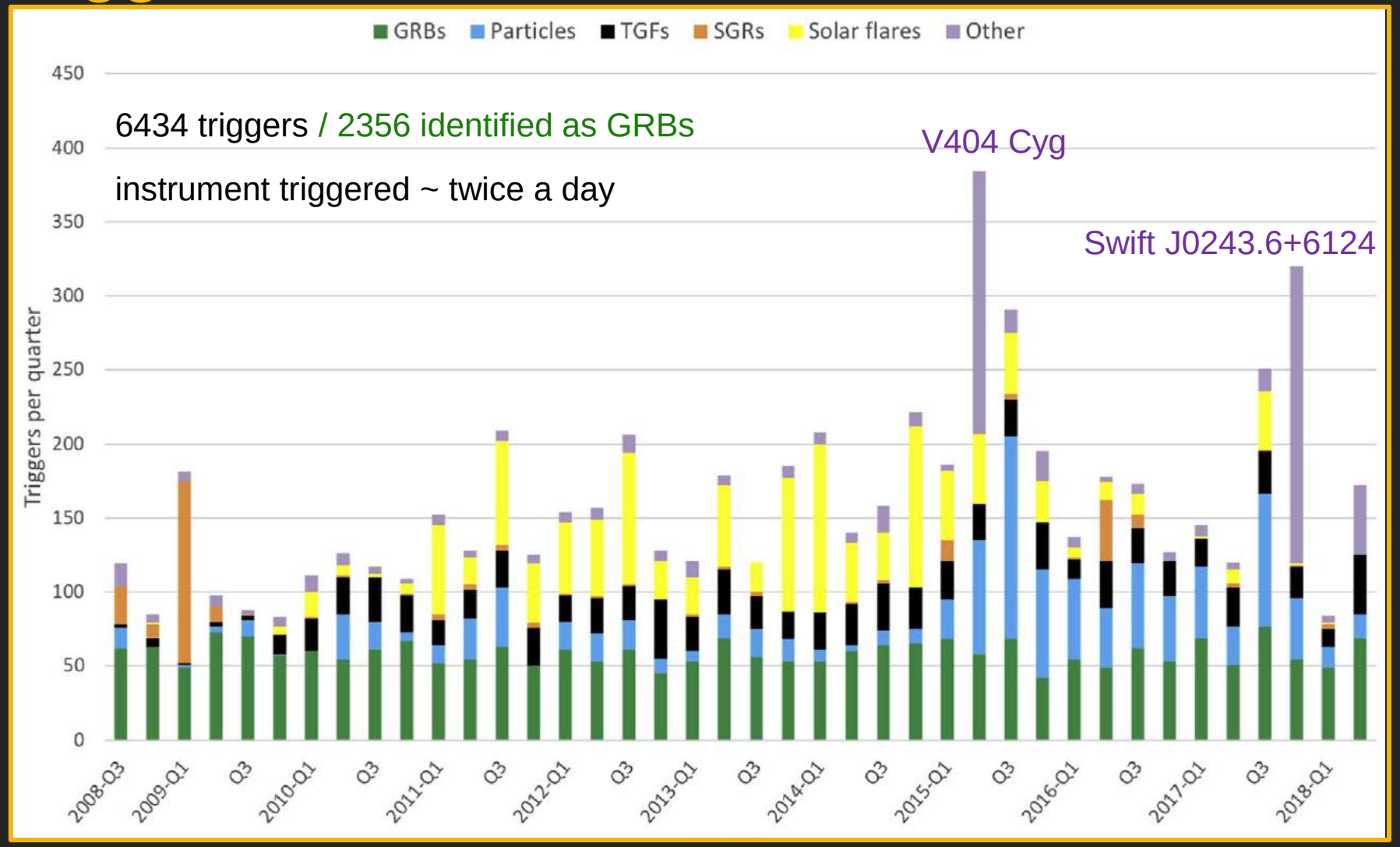




2008 July 12 – 2018 July 11

complete results available @ HEASARC

10 Year Trigger Statistics



GBM Triggers:

GRBs	SGRs	TGFs	SFs	Galactic	CPs	Other	Sum	ARRs	LAT GRBs
2360*	258	880	1176	407	1023	331	6434	220	186

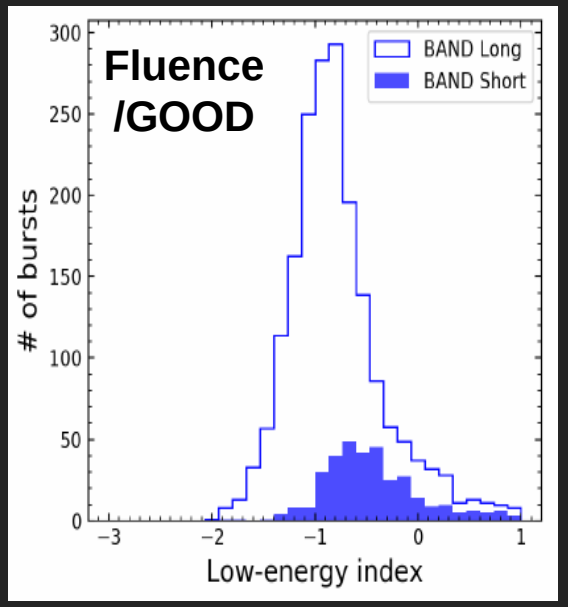
GRB Spectral Catalog - 10 years of data

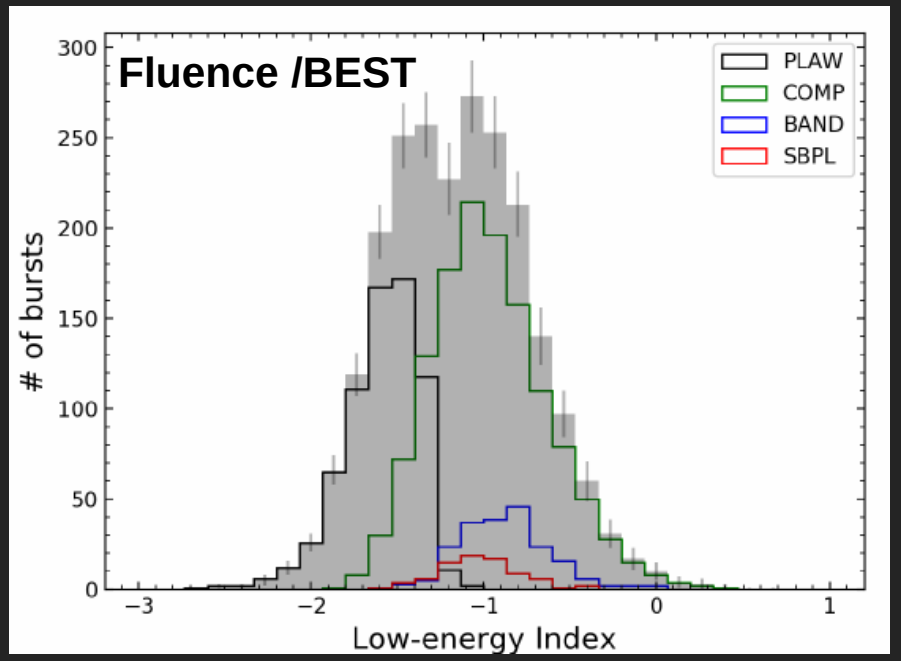
Poolakkil, S., et al., 2021

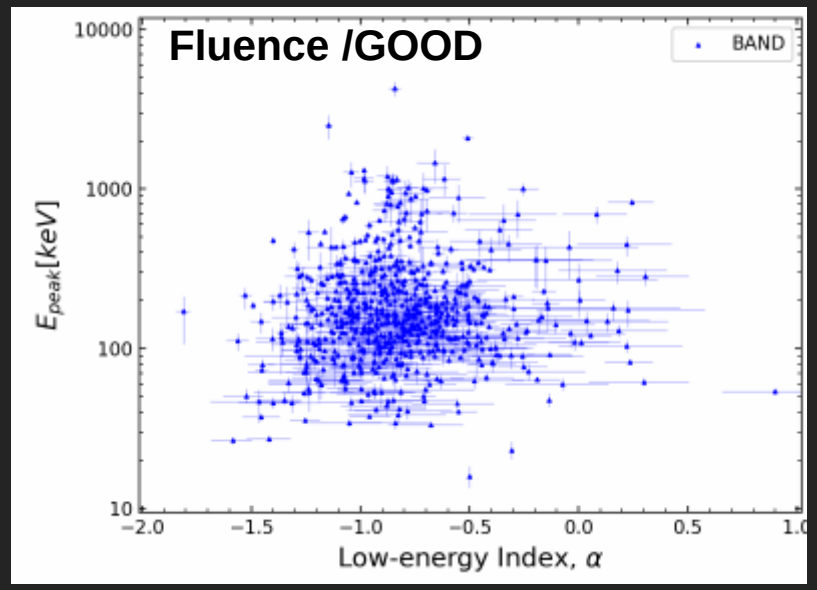
- Systematic spectral analysis of 2297 GRBs, two types of spectra:
  - time-integrated spectral fits ⇨ 'fluence' spectrum
  - spectral fits at the brightest time bin (1.024s / 64 ms) ⇨ 'peak flux' spectrum
  - ⇨ resulting in a compendium of over 18000 spectra!
  - Update of 2-yr (Goldstein et al. 2012) and 4-yr (Gruber et al. 2014) catalogs (data at HEASARC)
- 4 different empirical spectral models
  - PLAW (A, λ) , COMP (A, α, E_{peak}), BAND (A, α, β, E_{peak}), SBPL (A, λ_1, λ_2, E_{break}, Δ)
  - New: two-sided uncertainties!
  - Fit ratings:
    - GOOD: parameter error of all model parameters are within certain limits
    - BEST: best representation model, based upon goodness of fit criteria

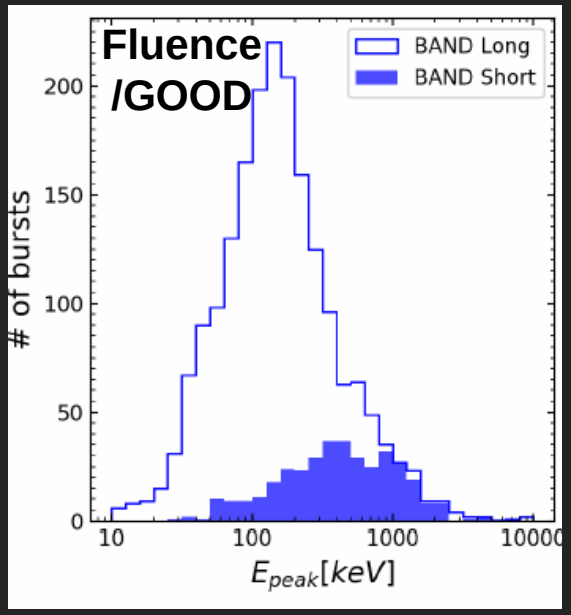
Parameter Distributions (extract)

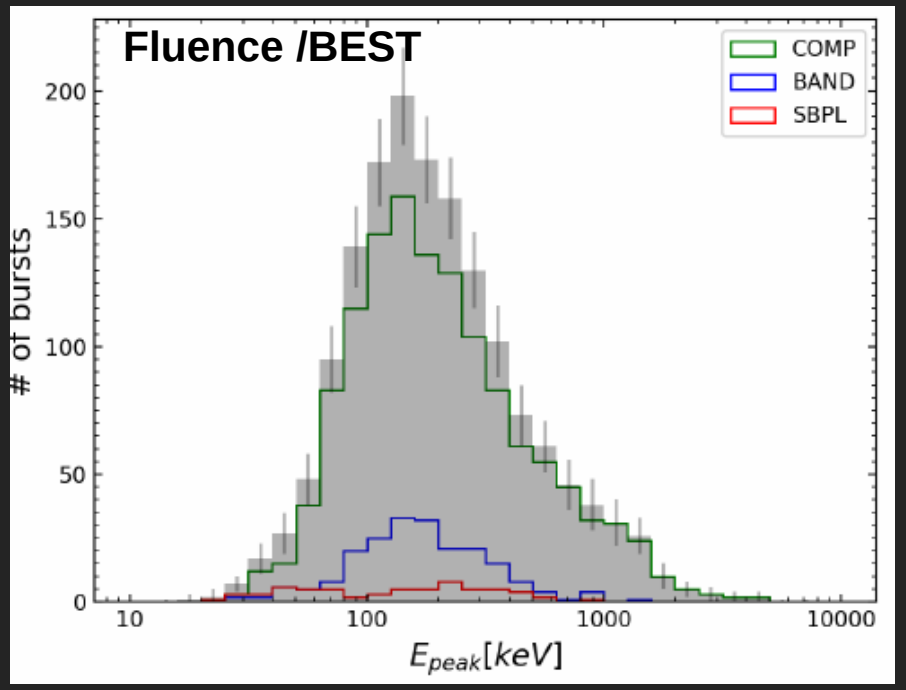
- All parameters: fluence- / peak flux spectra
- GOOD / BEST categories
- Observer frame
- Histogrammed probability density plots





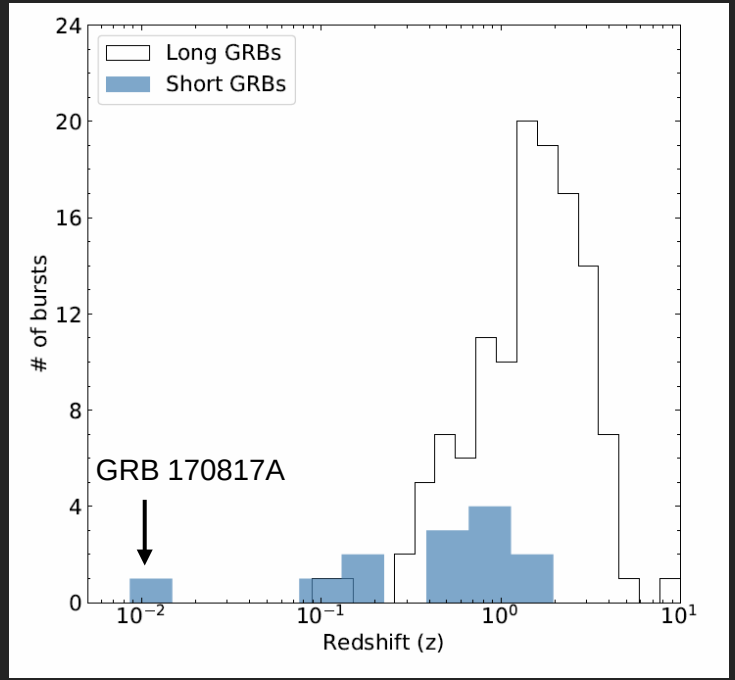


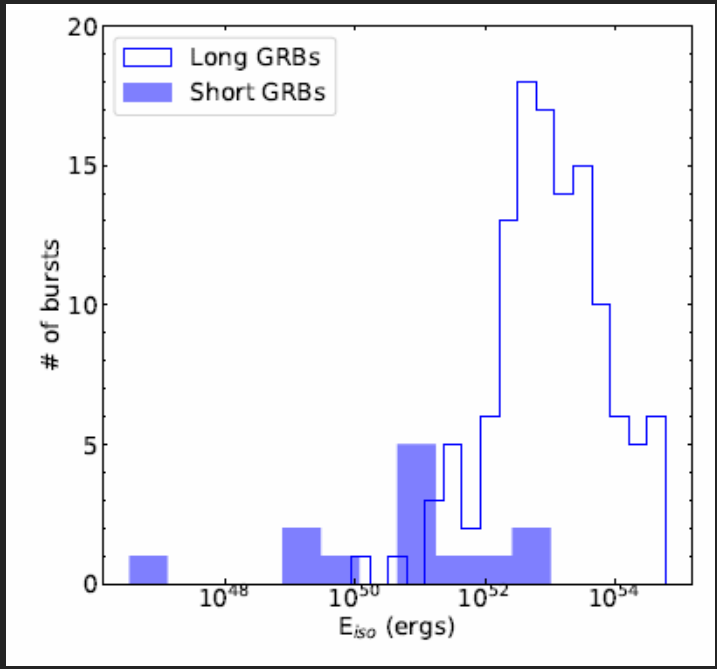


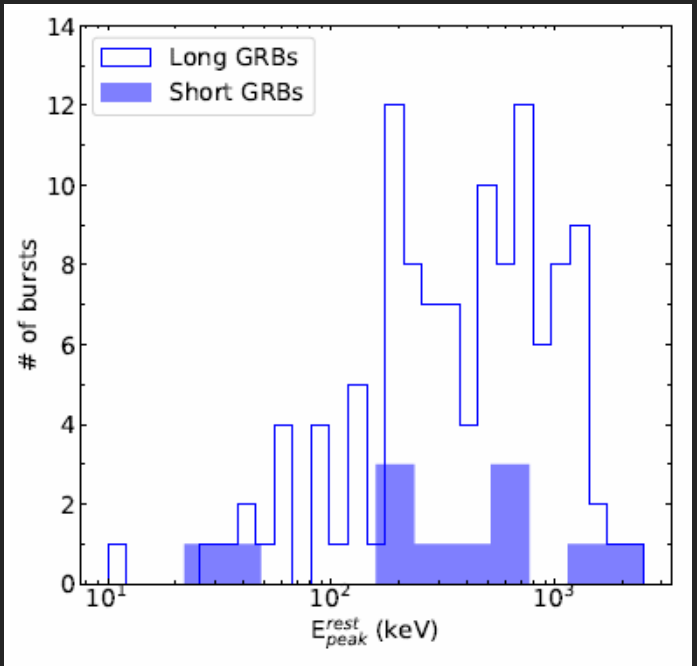


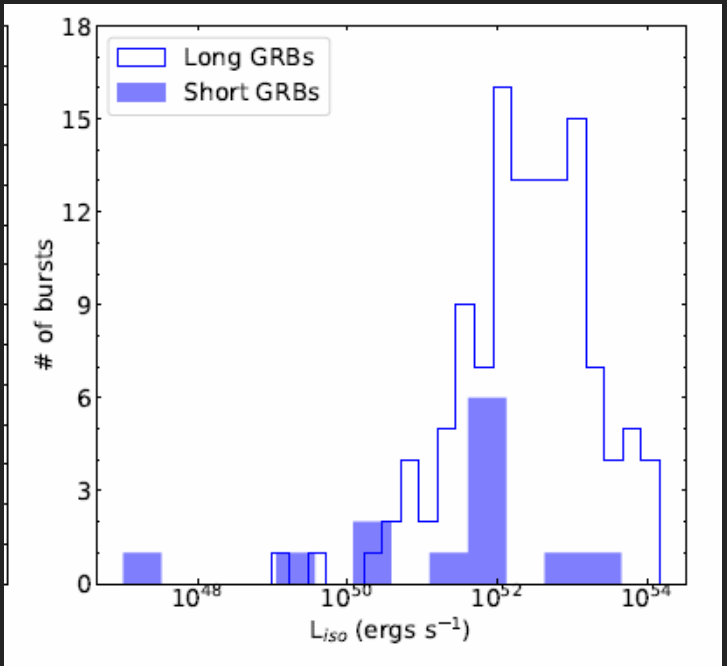
Spectral Catalog: Rest-Frame Properties

- Redshift sample: 13 short / 122 long GRBs
- Rest frame energetics: E_{iso}, E^{rest}_{peak} , L_{iso}
  - long GRBs: E_{iso} centered around 10^{53} erg
  - Neither short nor long GRBs exhibit a preference in E_{peak} , L_{iso}

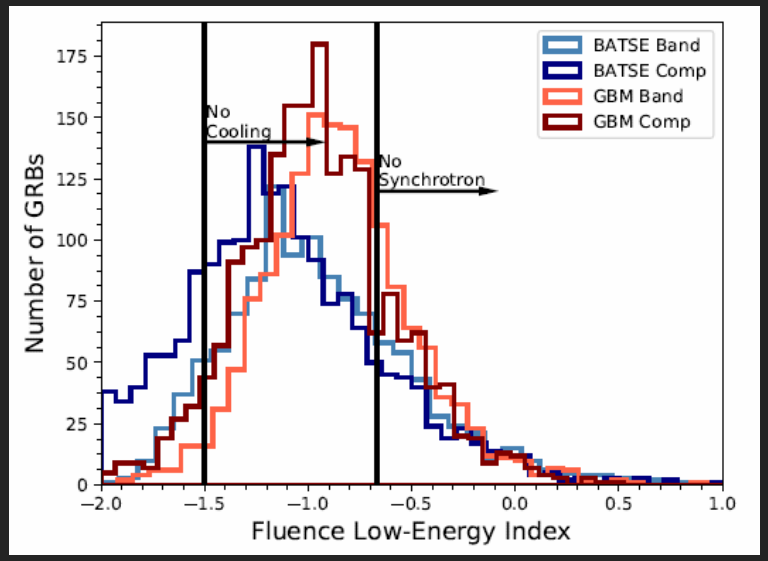


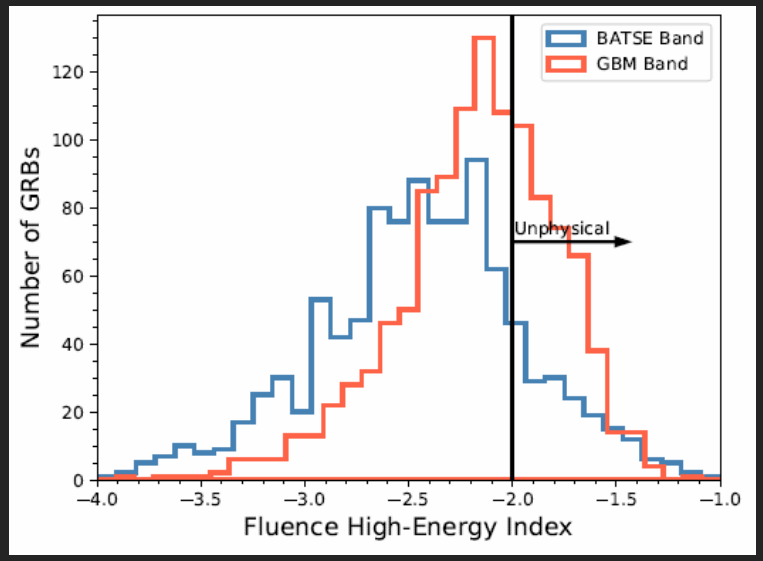


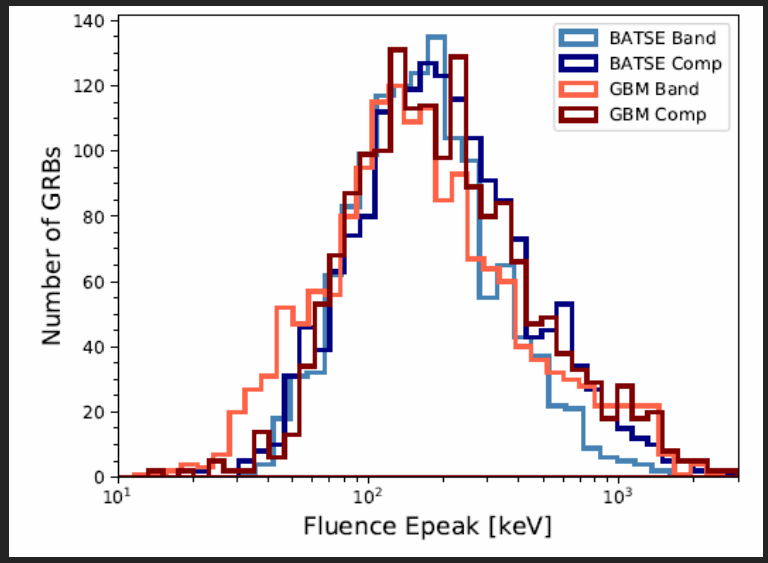




Comparison to previous Analysis – BATSE 5B



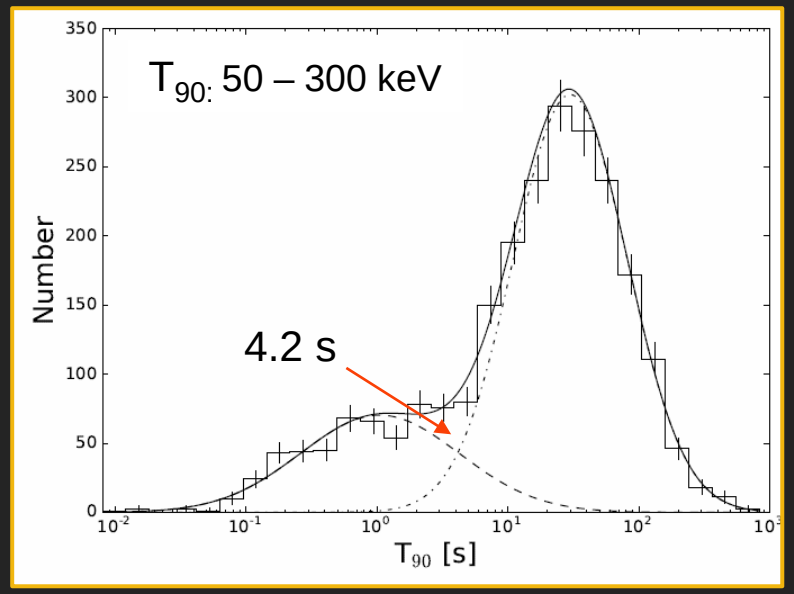


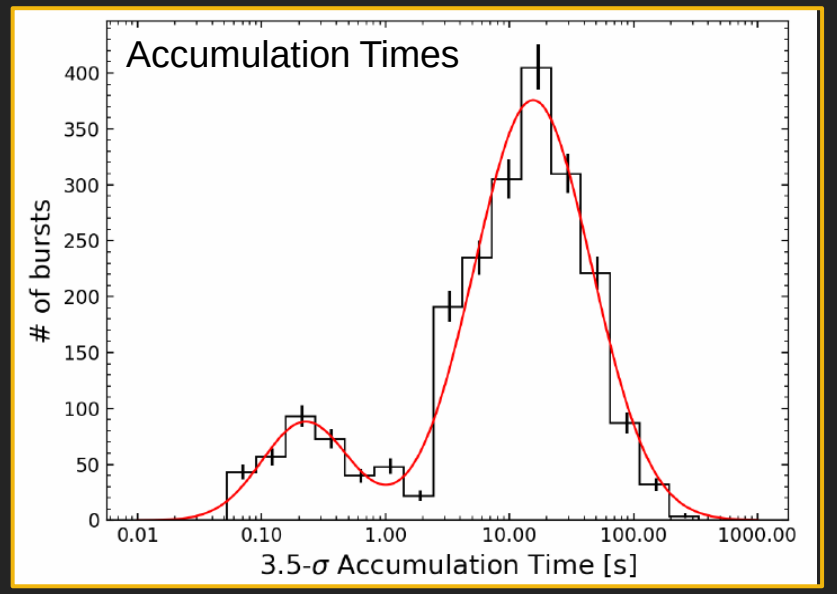


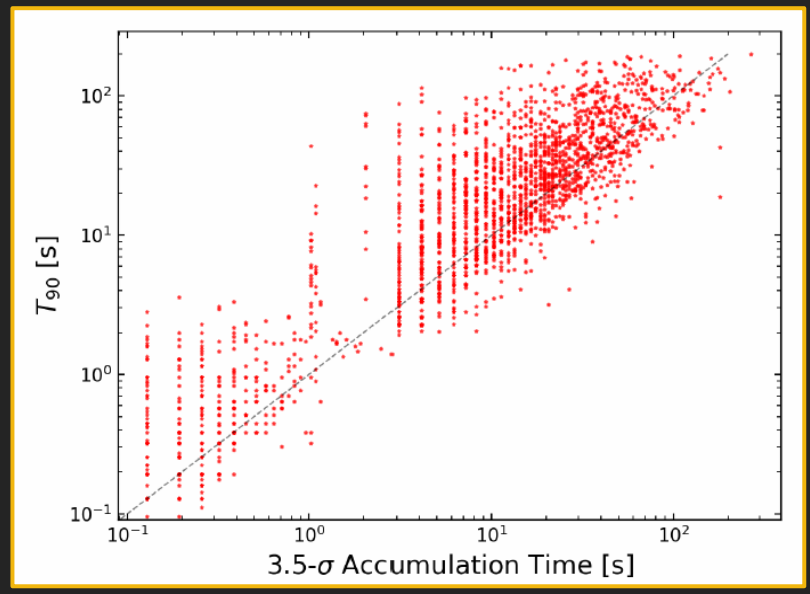
- Low-energy photon index α: for synchrotron radiation:
  - α < - 2/3 in the case of non-adiabatic cooling
  - α < - 3/2 in the case of adiabatic cooling
  - ➢ Significant fraction violate these conditions ⇨ synchrotron `line-of-death' problem
  - ➢ GBM measures a slightly harder index than BATSE
- High-energy index β: GBM measurements are generally harder
  - ➢ β ≥ -2 - unphysical - leads to an infinite flux if extrapolated in energy
- E_{peak}: both distributions broadly agree

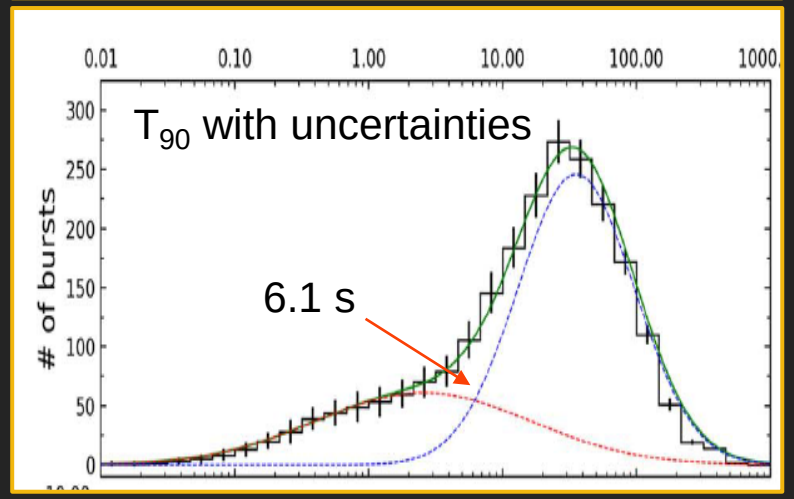
GRB Duration Analysis

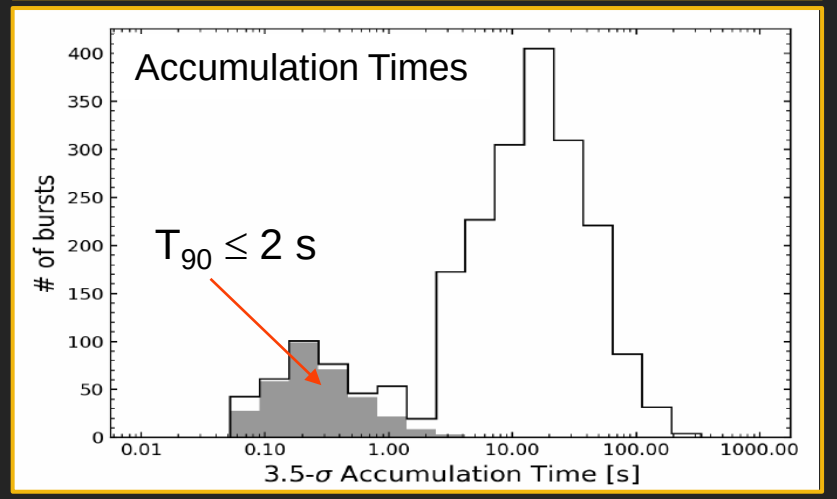
- GRB catalog ⇨ T_{90} Durations
- Spectral catalog ⇨ Accumulation times based on the 3.5σ S/N selections







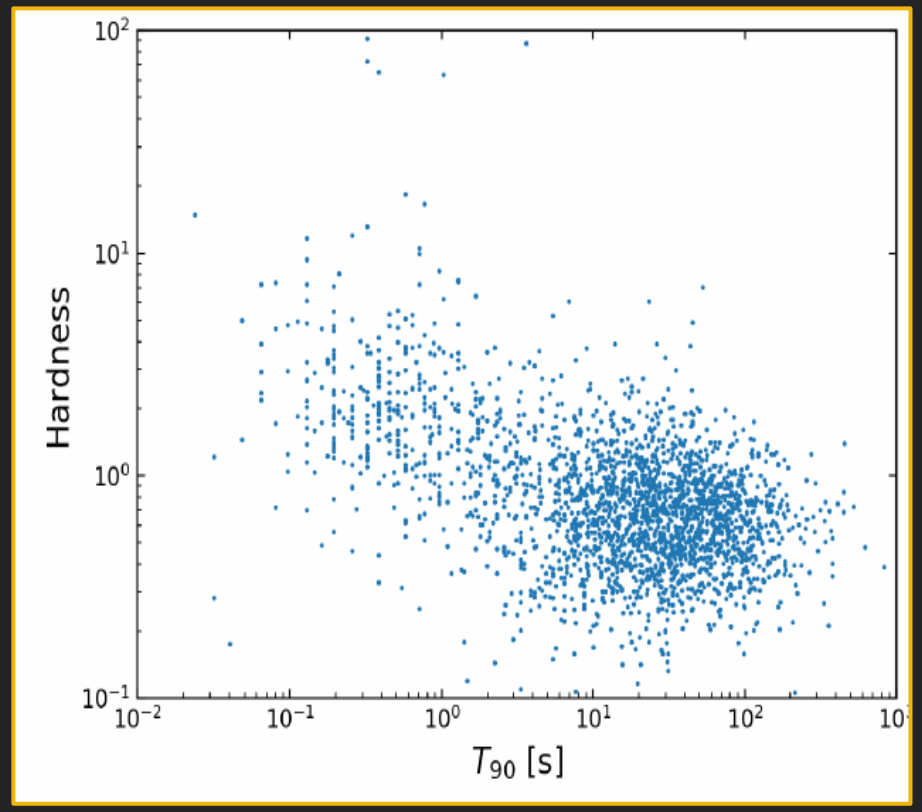


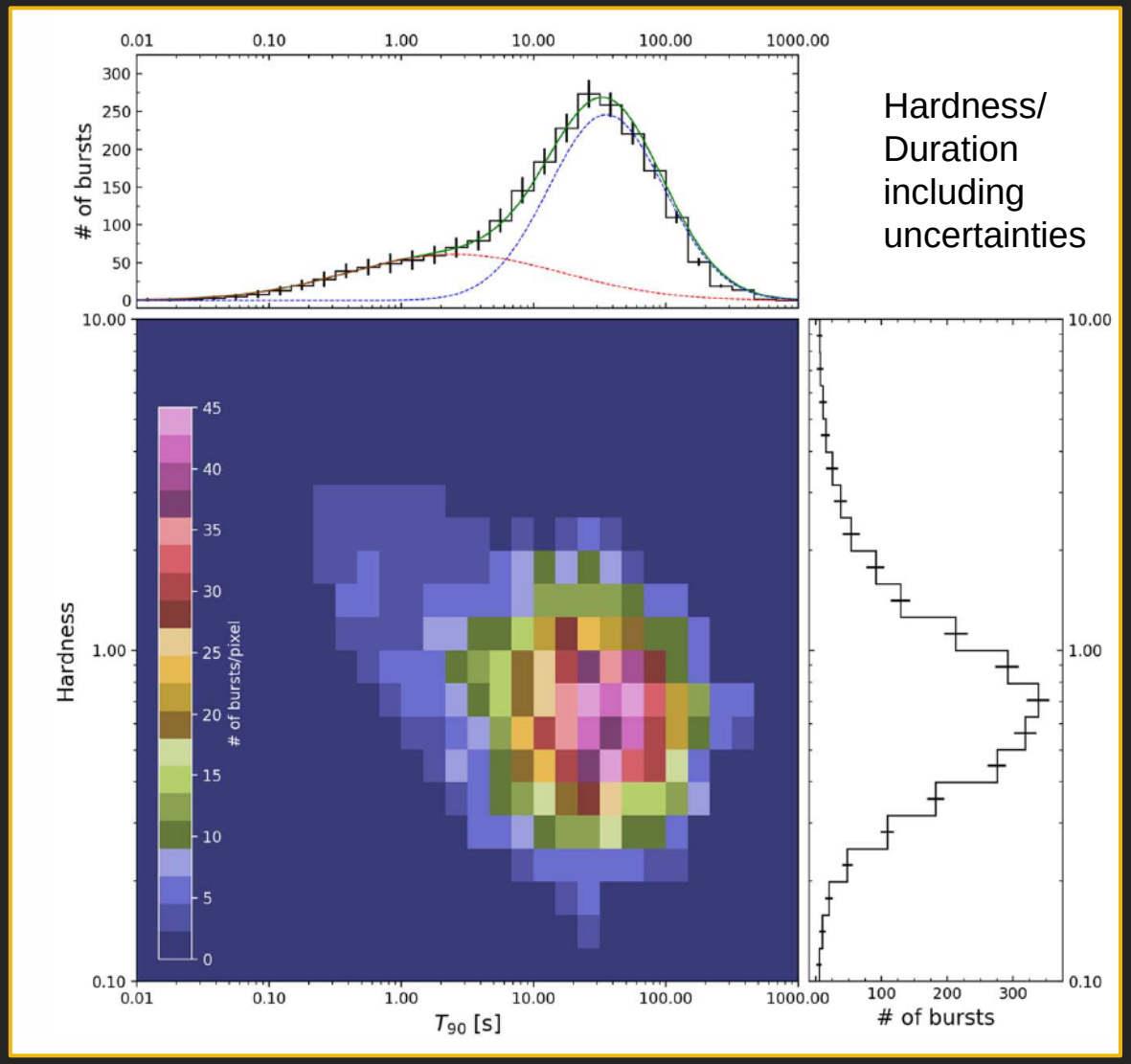


Spectral Hardness vs. Duration

Hardness, ratio of flux density:

50–300 keV / 10–50 keV





Conclusion:

4th GRB catalog: 2365 GRBs ⇨ Localization, T90, peak flux & fluence

3rd spectral catalog: 2297 GRBs ⇨ 18000 peak flux & fluence spectra (4 models)

! Huge database and reference for catalog-based follow-up analysis

⇨ “Fermi-GBM GRBs with Characteristics Similar to GRB 170817A”