

Bright High-Energy GRBs detected with Fermi GBM - An update -

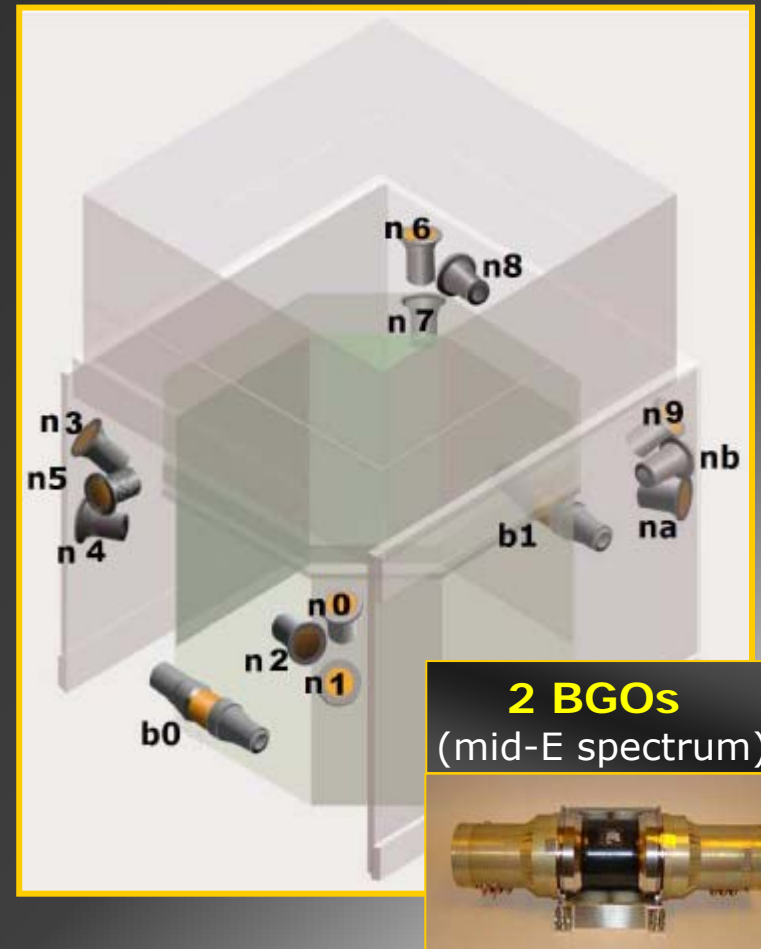
Elisabetta Bissaldi

On behalf of the Fermi GBM and LAT Collaborations

Project Collaborators:

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- Extension of the analysis presented in “First-year Results of Broadband Spectroscopy of the Brightest Fermi-GBM Gamma-Ray Bursts” (Bissaldi et al., 2011, ApJ 733, 97B)
- “BGO bright” bursts
 - Selection criteria
 1. Detection of more than **80 counts/s** over background in the raw counts of at least one BGO detector over its full energy range (**250 keV–40 MeV**)
 2. Detection of more than **4 sigma** over background of the maximum or "peak" count rate (PCR) of the TTE lightcurves on various timescales (64ms, 128ms, 256ms and 512ms) in the **500-1000 keV** energy band

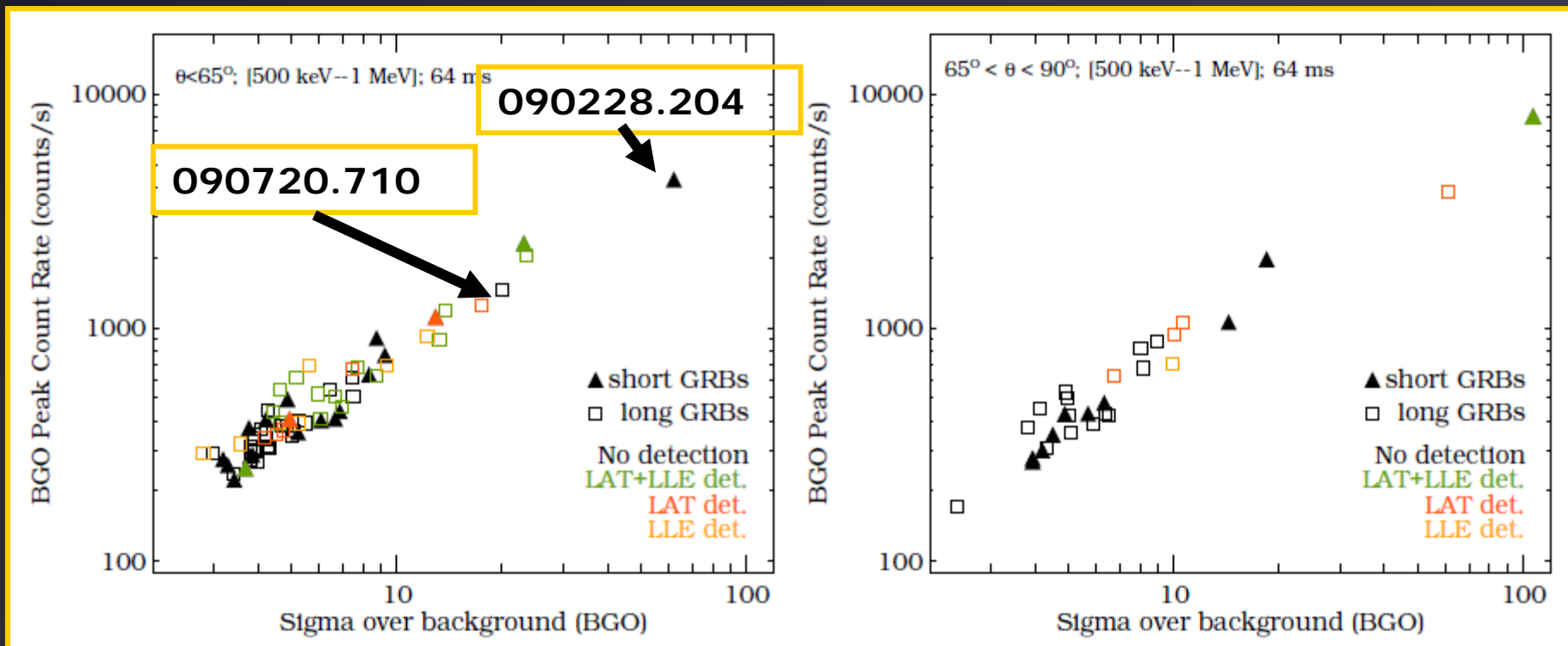


- Previous analysis: 52 bursts (year 1)
- Current analysis: 134 bursts (years 1, 2 and 3)
 - 40 short, 94 long **1/3 short**
 - 68 in LAT FoV, 29 at the edge of the FoV **1/2 in LAT FoV**
 - 34 bursts in the official LAT catalog are included
 - 5 short, 29 long **~1/7 short**
 - 16 LAT+LLE, 7 LAT only, 11 LLE only

➔ Can we confirm earlier results of BGO predictability for LAT bursts?

- Peak Count Rate vs. Sigma in BGO
- 500 keV – 1 MeV, 64ms timescale

In LAT FoV

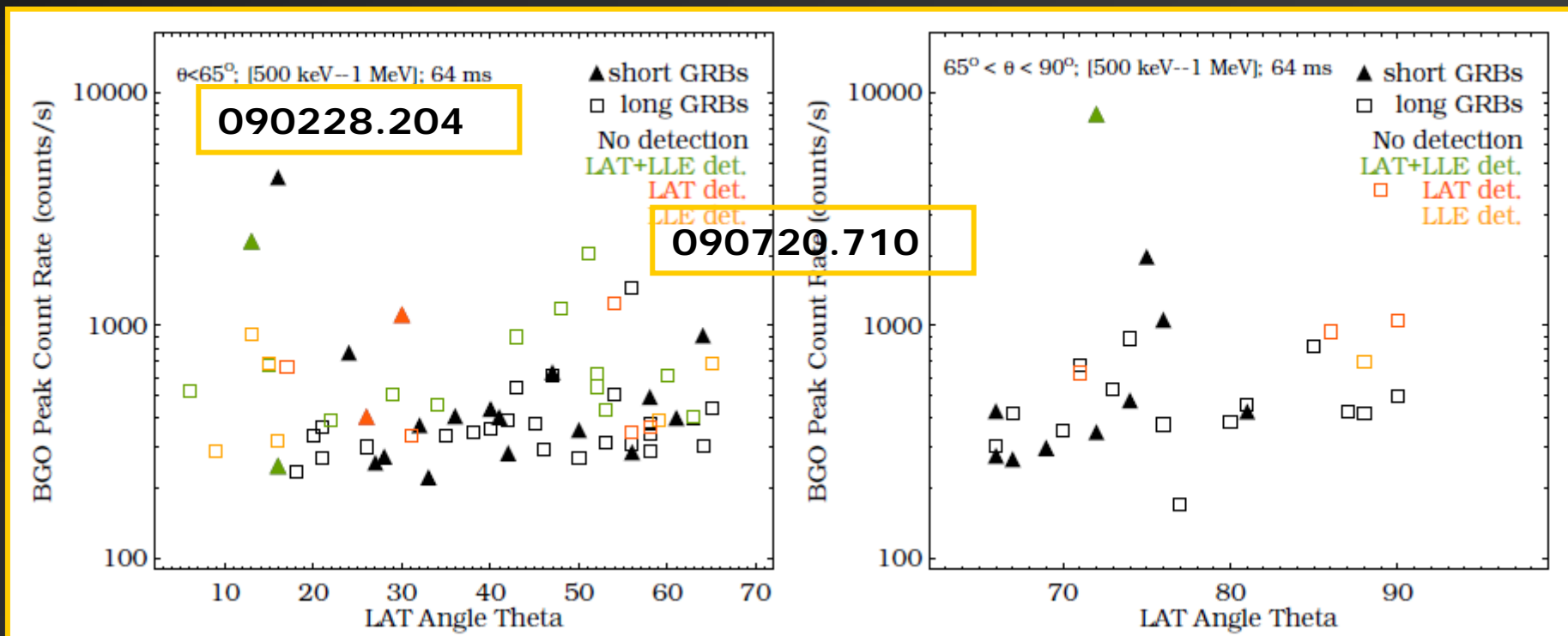


Edge of LAT FoV

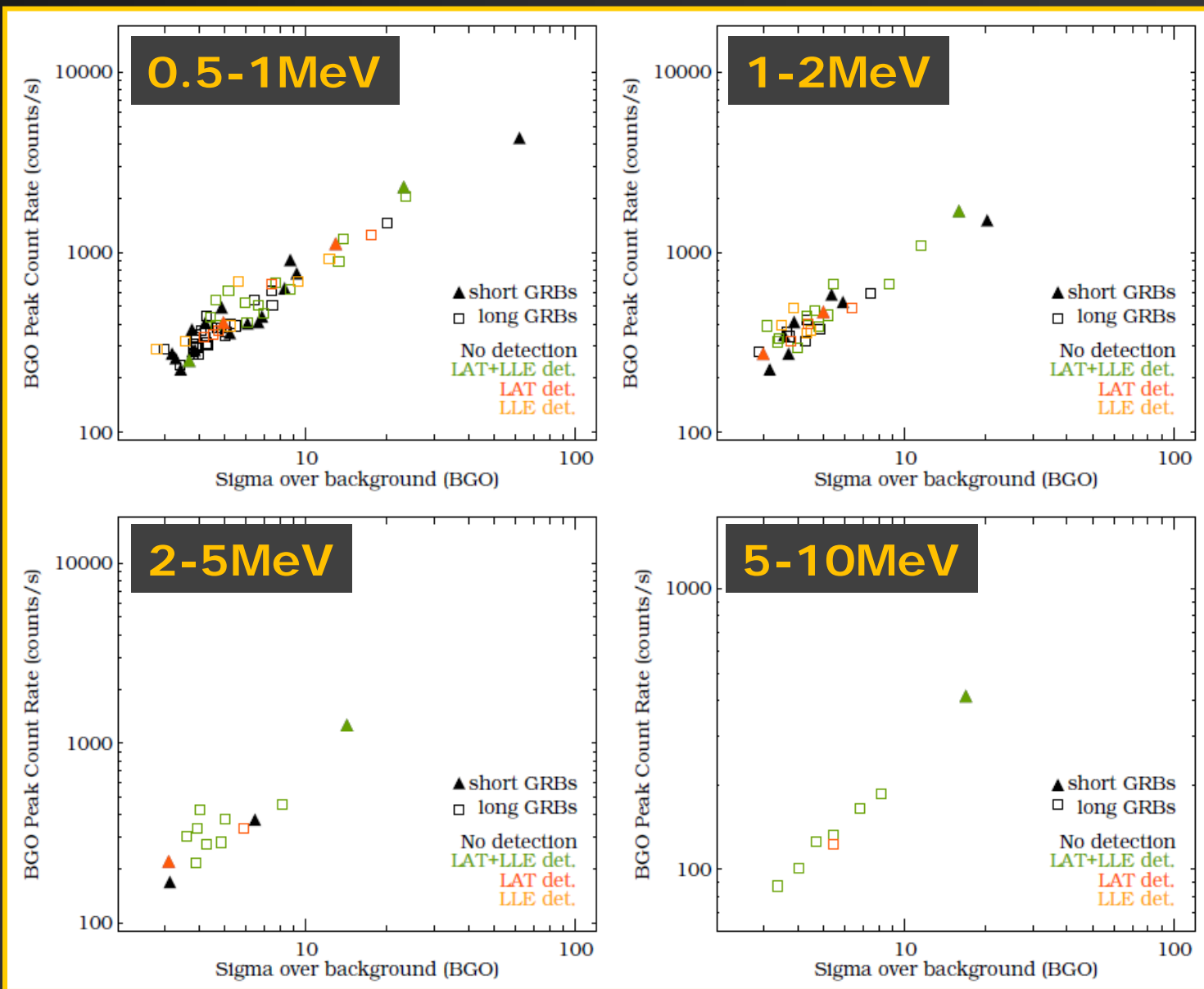
- Peak Count Rate vs. LAT angle
- 500 keV – 1 MeV MeV, 64ms timescale

In LAT FoV

Edge of LAT FoV



PCR analysis at higher energies



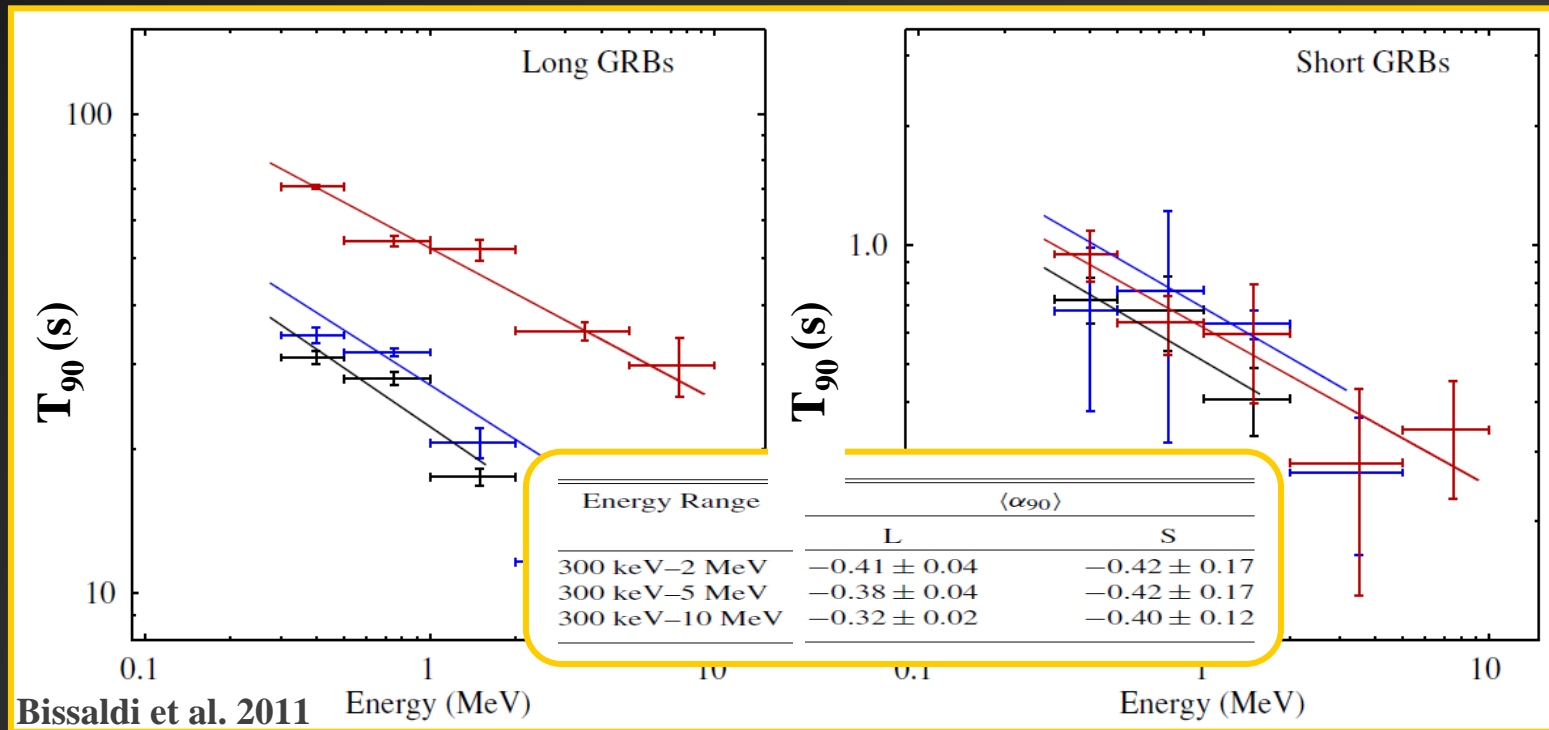
- Systematic analysis of **T90** calculated in counts space over all NaI and BGO energy bands
 - Changing background model selection
 - Changing interval selection
 - Changing binning selection
- Using 4 long and 6 short GRBs as calibration sample
 - 2 “Strong” (8 keV-10MeV)
 - 4 “Medium” (8keV-2MeV)
 - 2 “Weak” (8 keV-1MeV)

- Results:

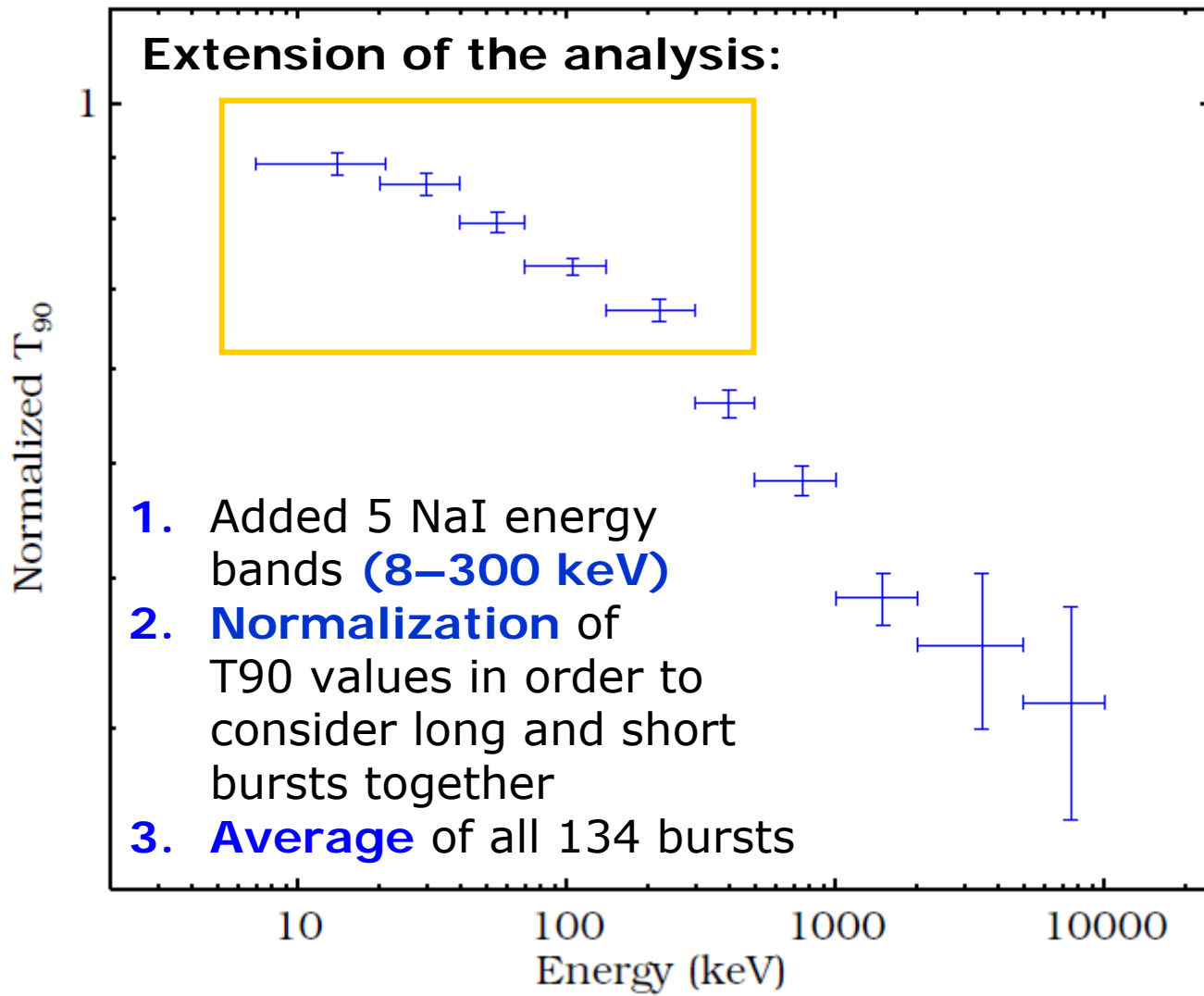
Long GRBs	
Energy band	Syst. error
8–140 keV	10%
140–1000 keV	20%
1 - 2 MeV	30%
2 - 10 MeV	60%

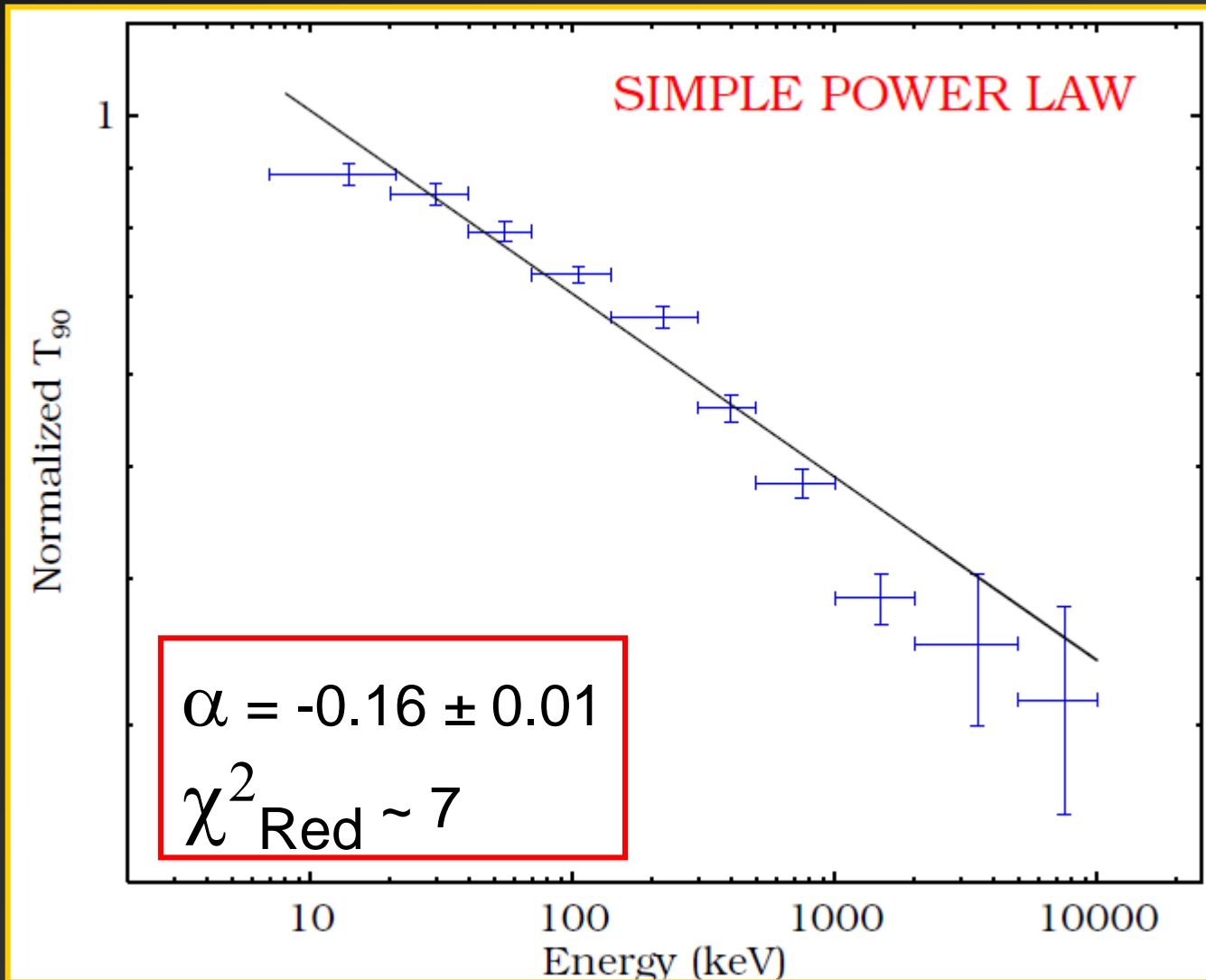
Short GRBs	
Energy band	Syst. error
8–70 keV	30%
70–1000 keV	20%
1–2 MeV	30%
2–10 MeV	60%

Previous analysis results:

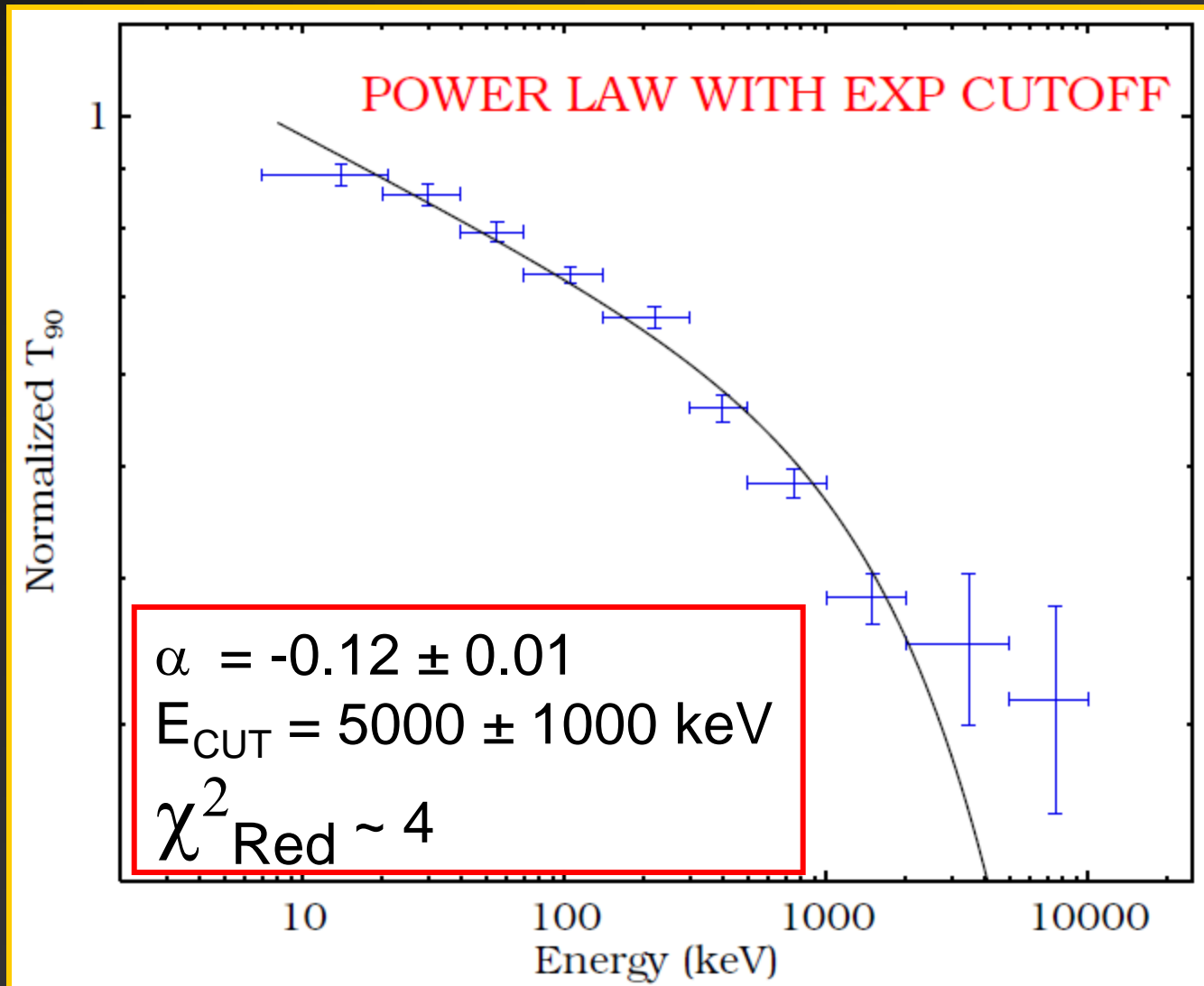


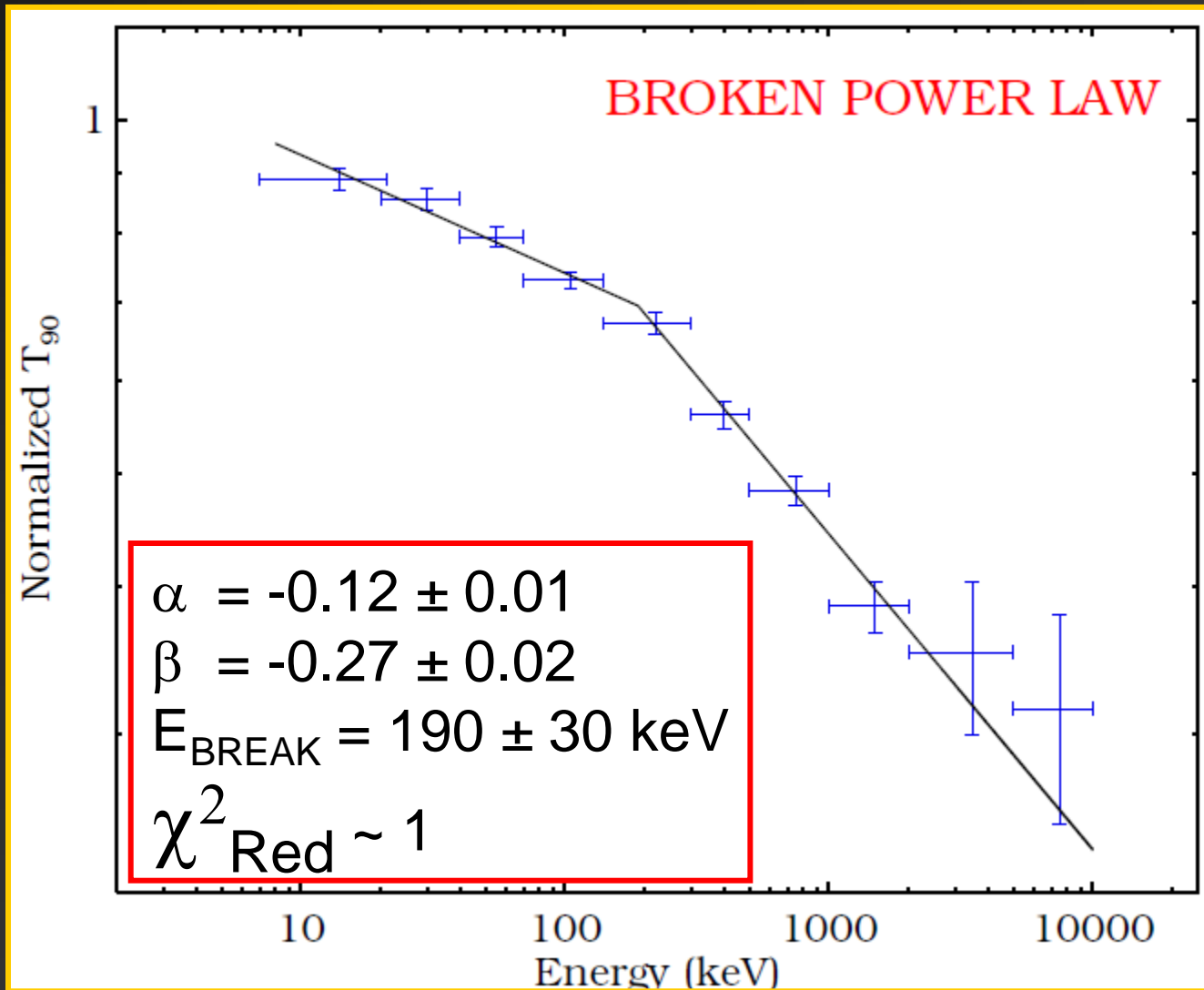
- Evolution of the T90 duration with respect to energy
 - **Divided** long from short GRBs
 - Used **only BGO data** in various energy bands
 - Fitted only with a simple power law (PL) model
 - PL Index α_{90} compatible to earlier results





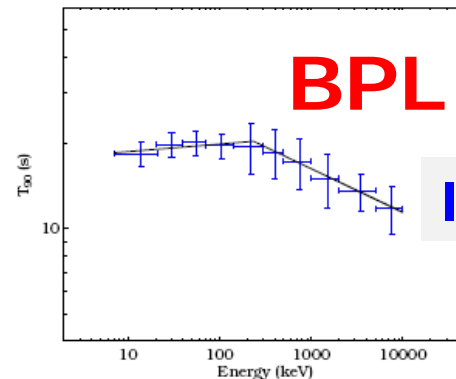
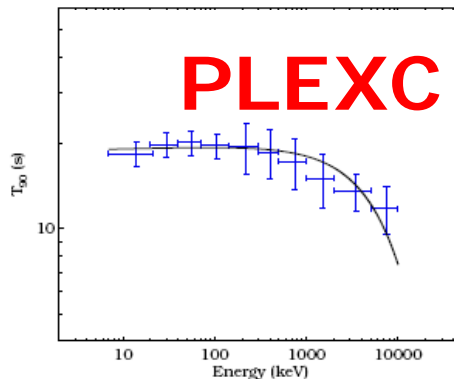
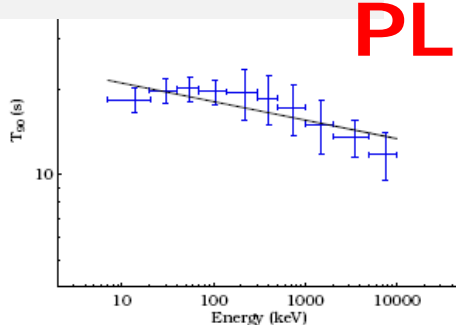
Evolution of duration with energy





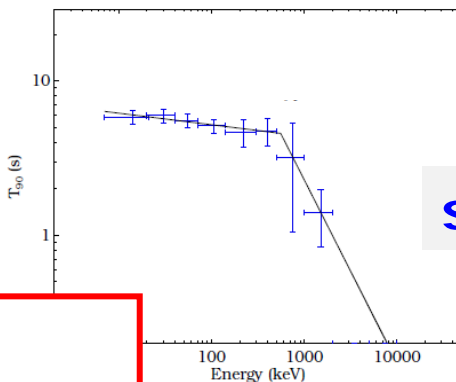
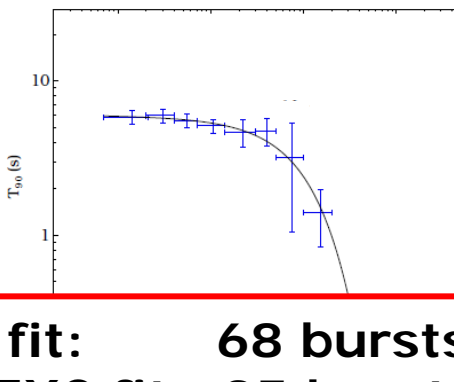
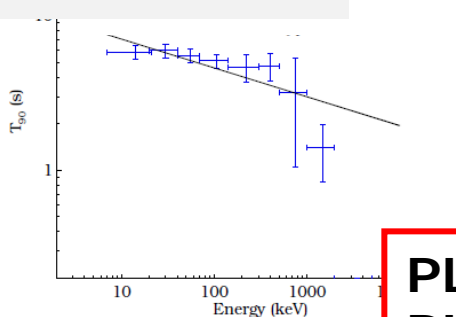
Evolution of duration with energy

GRB 090902B



long

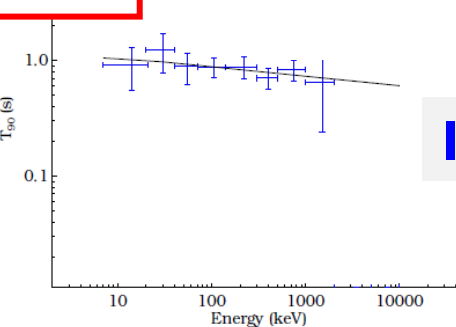
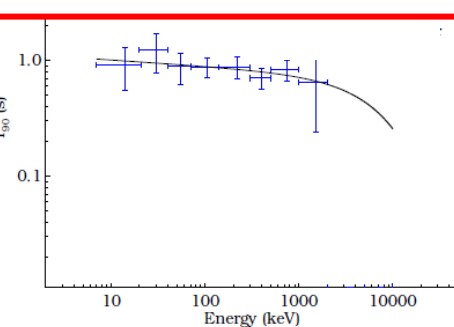
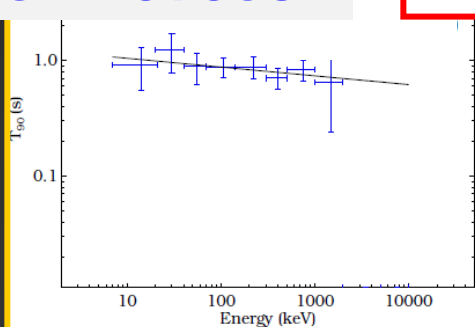
GRB 110428



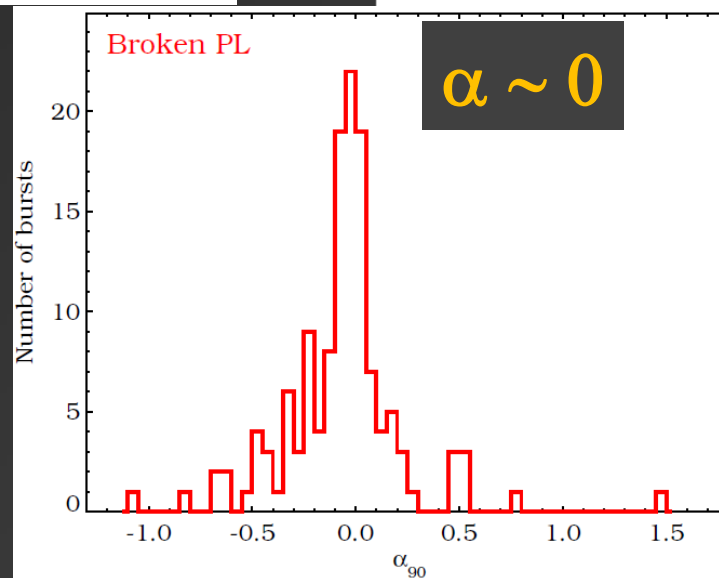
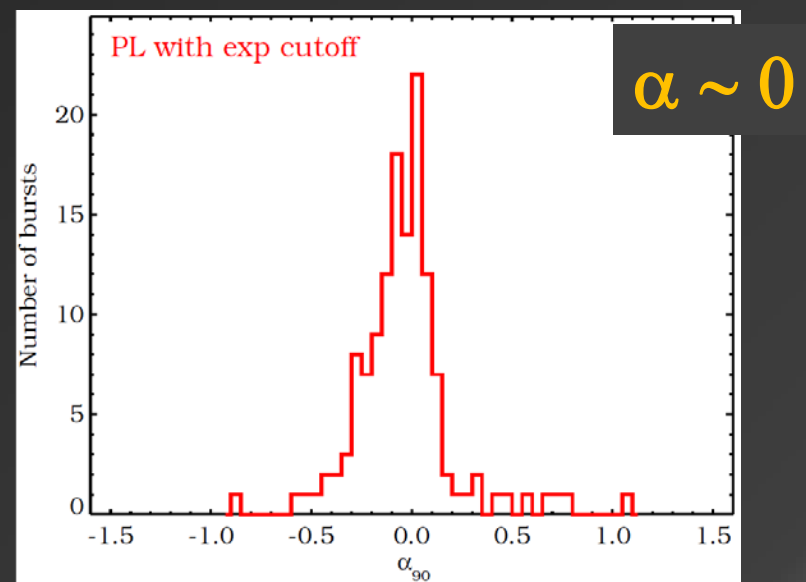
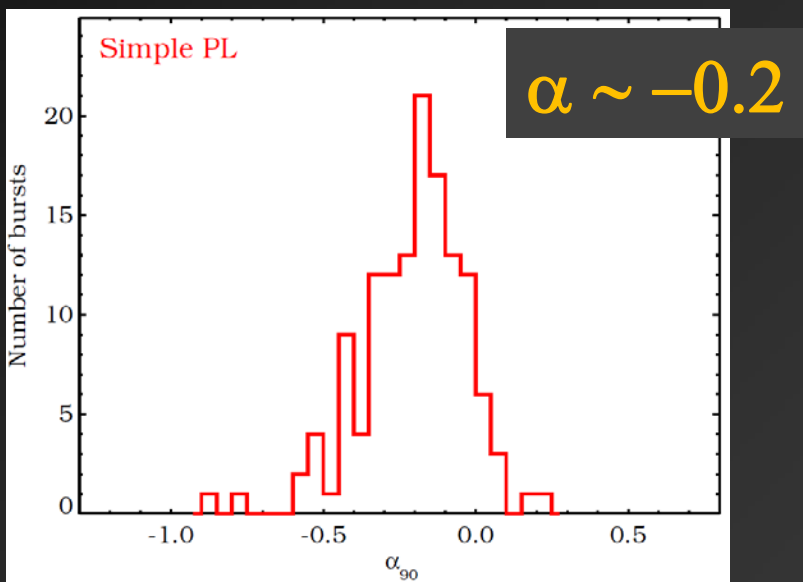
short

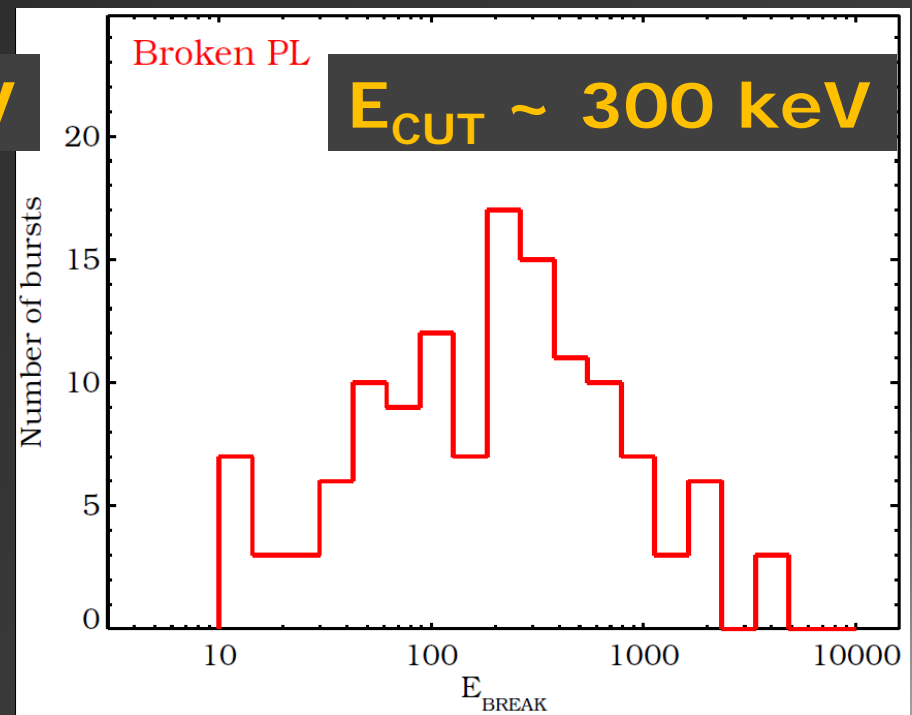
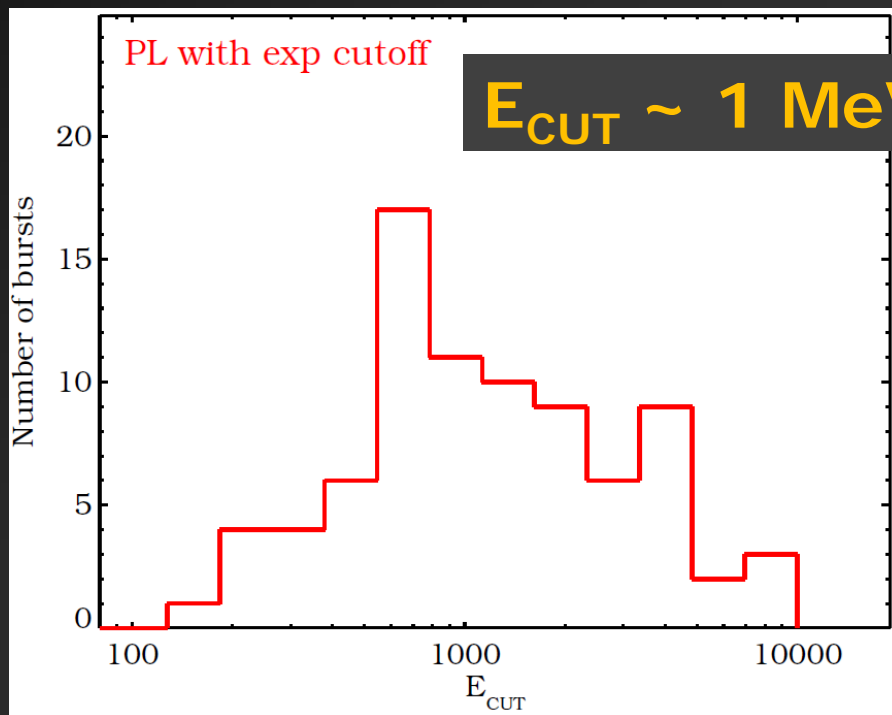
PL fit: 68 bursts
PLEXC fit: 35 bursts
BPL fit: 30 bursts

GRB 090531



long

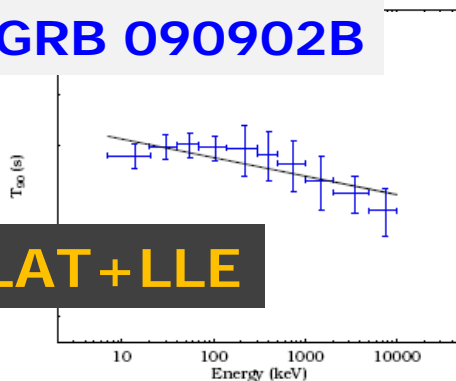




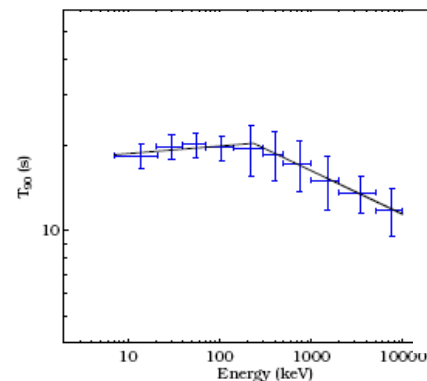
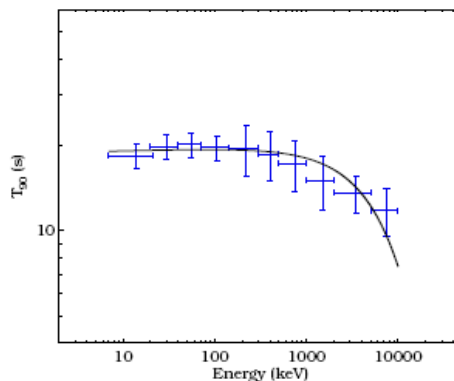
→ Can we relate this properties with the spectral Epeaks of each burst?

Evolution of duration with energy

GRB 090902B

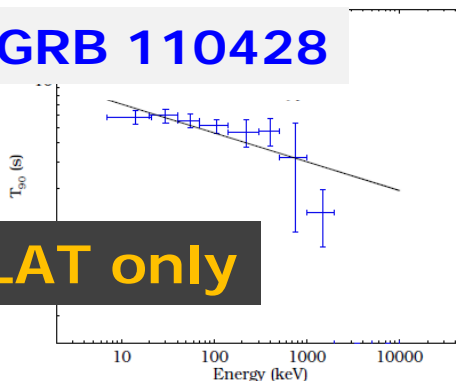


LAT+LLE

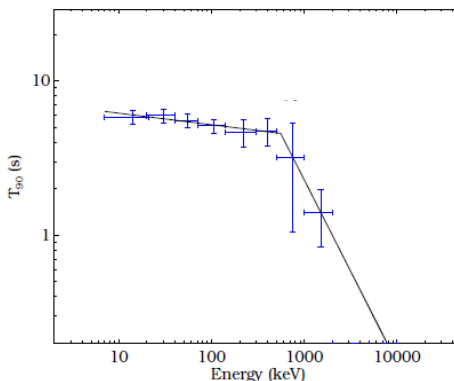
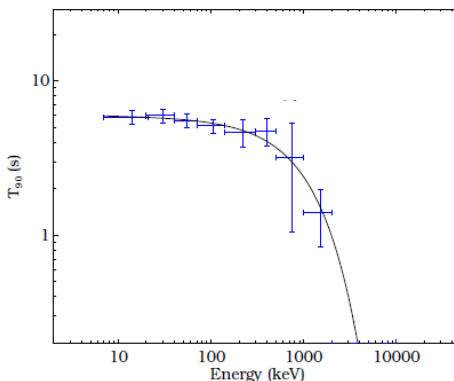


?

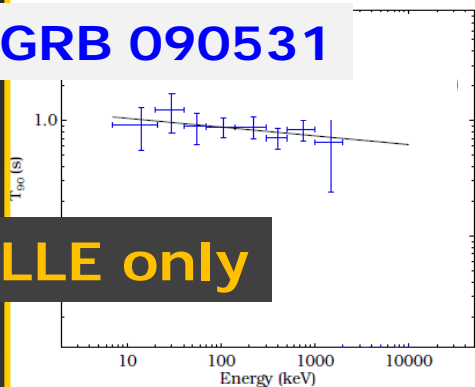
GRB 110428



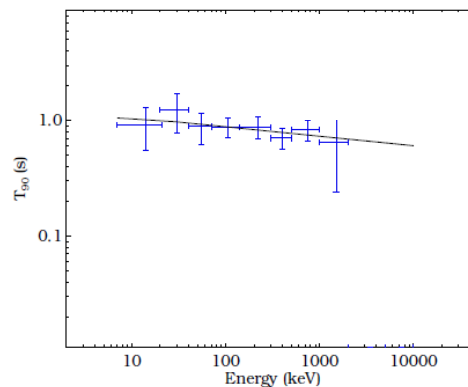
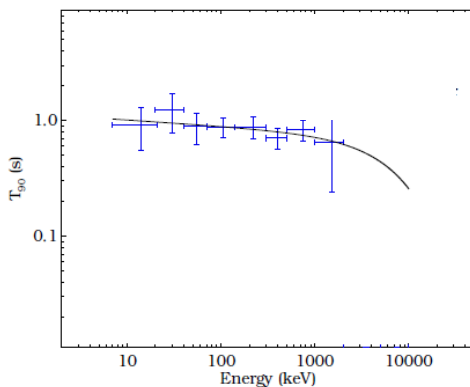
LAT only



GRB 090531



LLE only

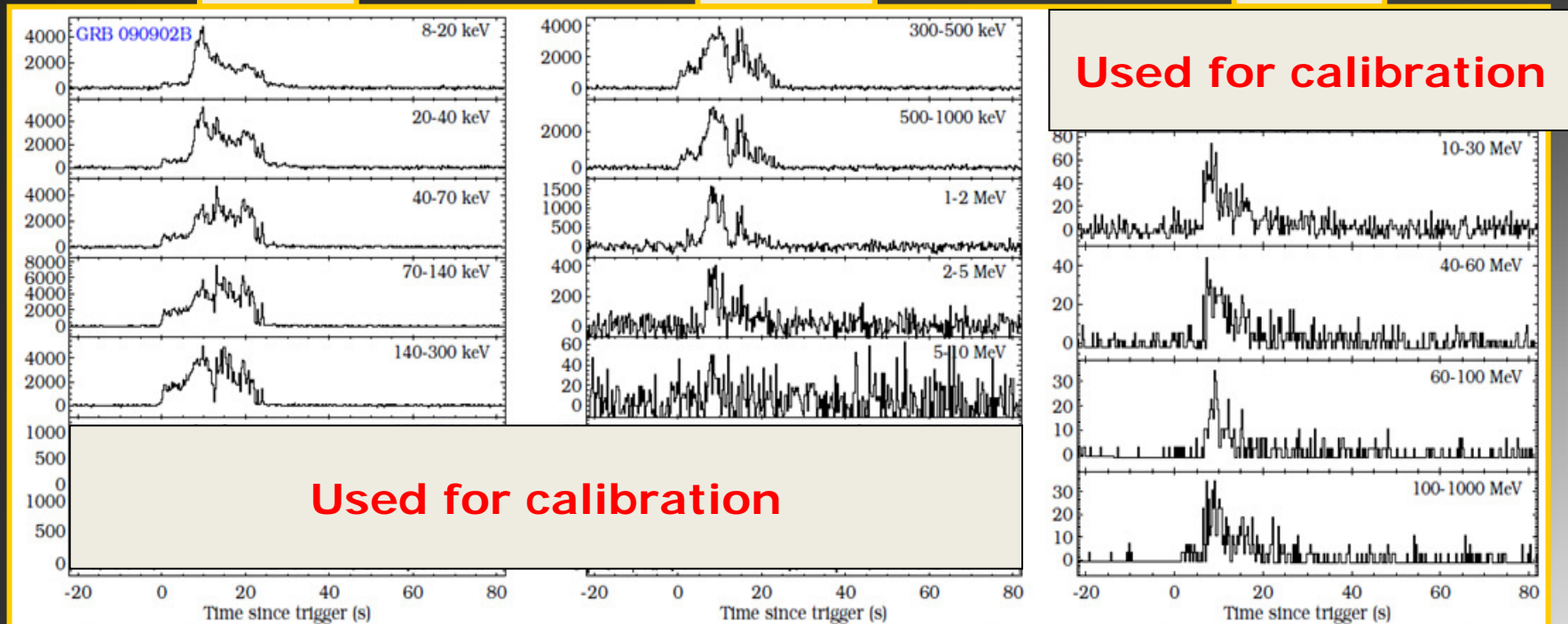


- For the strongest bursts, analysis of TTE-type data from LAT measurements
- Going down to 1 MeV, up to 1 GeV
 - Cross-calibration BGO-LLE
- LLE analysis for T90 estimation starting at 10 MeV

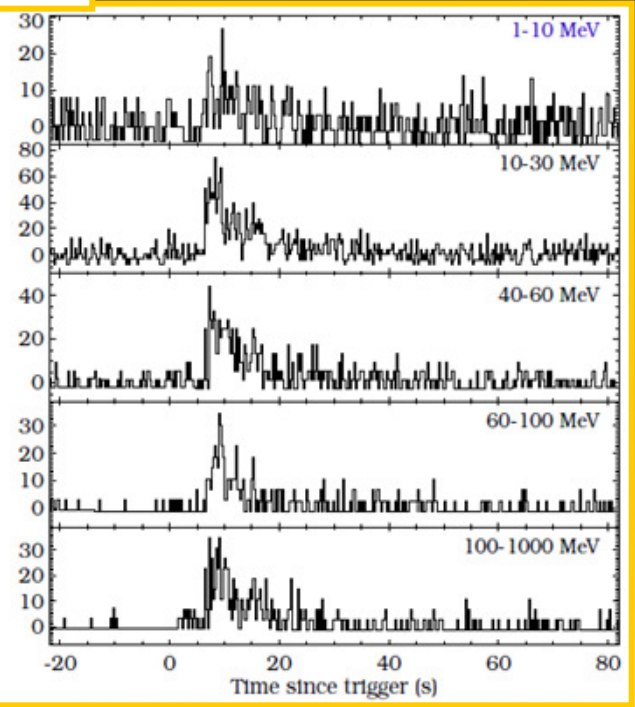
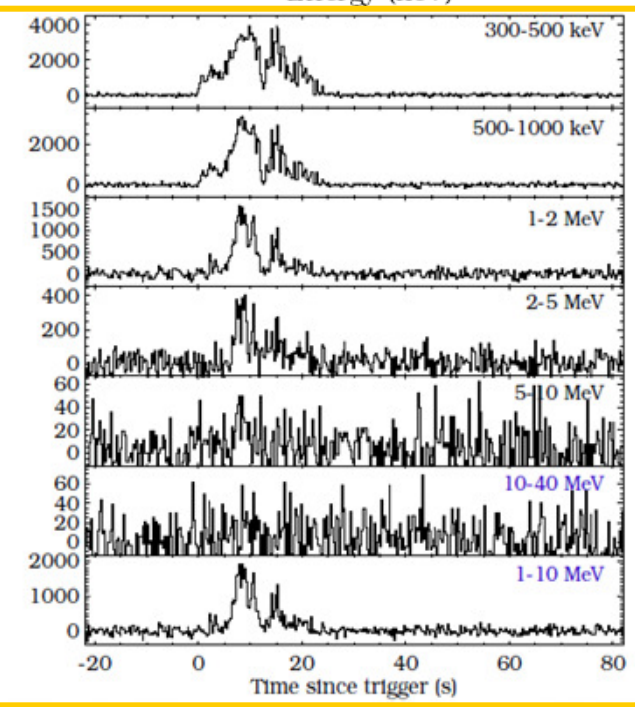
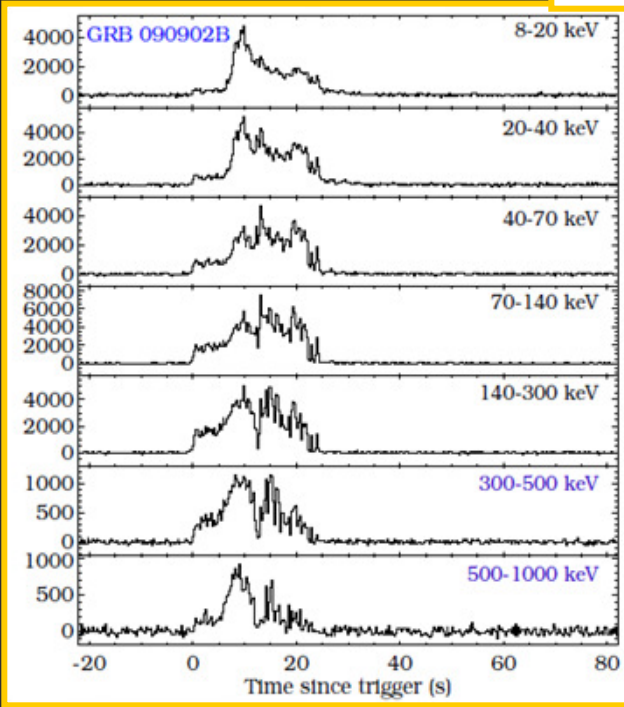
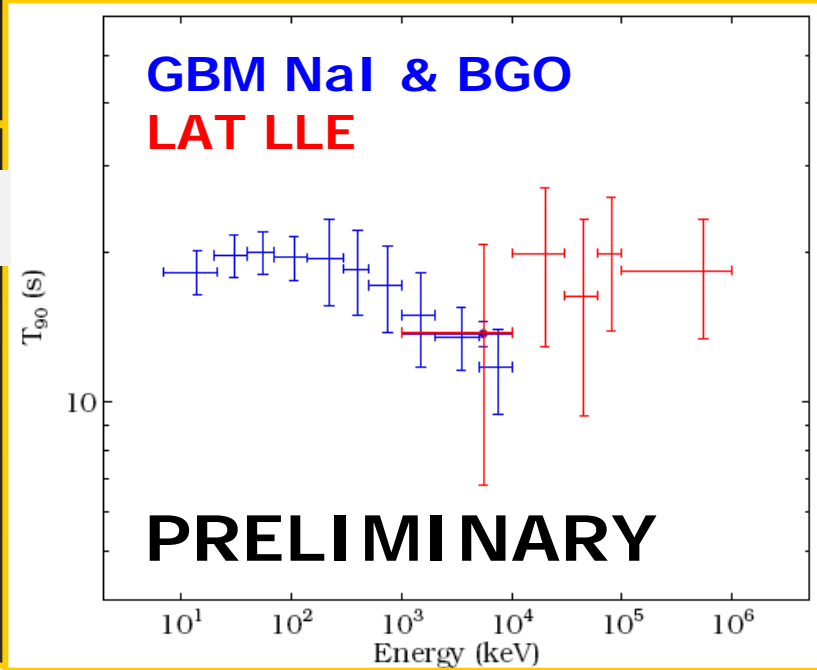
NaI

BGO

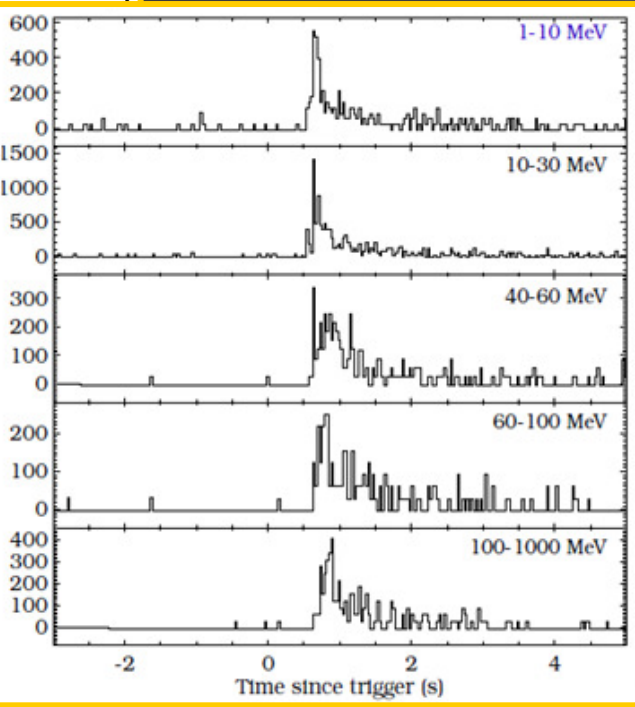
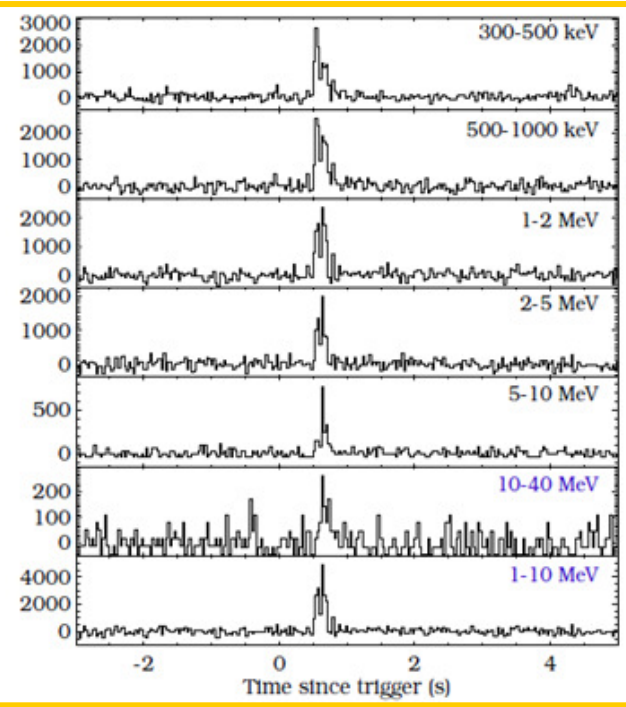
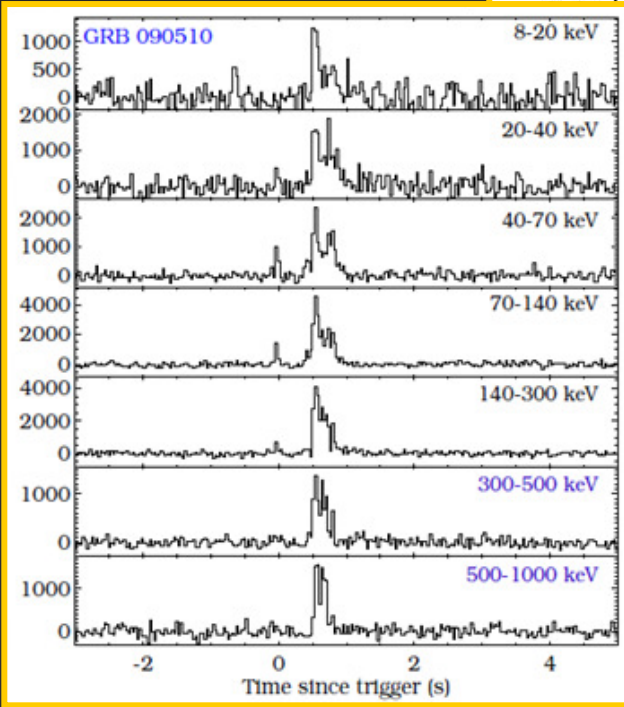
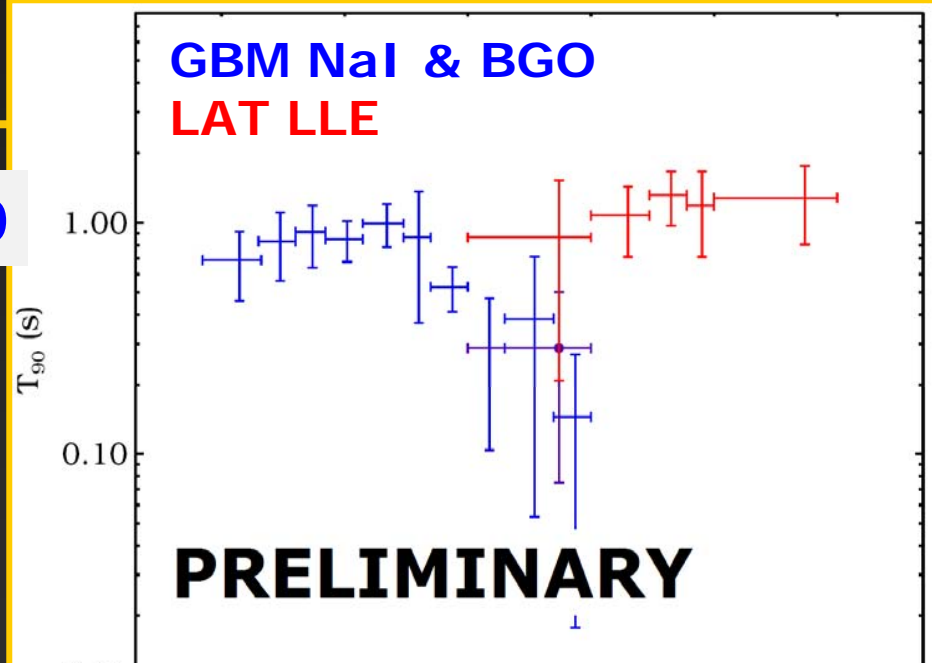
LLE



GRB 090902B



GRB 090510



- Analysis of a big sample of 3 years of data
- 3 functional forms for T90 vs energy
 - GBM data follows a different index (-0.1 – -0.2)
 - This points to expectation at even higher energies
- Analysis of 10 MeV-1 GeV data
 - Possible break and/or continuation in the LAT domain
 - Extension of the analysis at energies >1 GeV
- Different component or systematic effect? A lot of caveats!!!
 - Cross calibration? Systematics? Energy dispersion
- Investigation of T90 starts vs energy analysis
- Relating temporal to spectral properties
- Simulations