Discussion: GRBs

Christopher. M. Irwin

The Tokyo University, Japan)
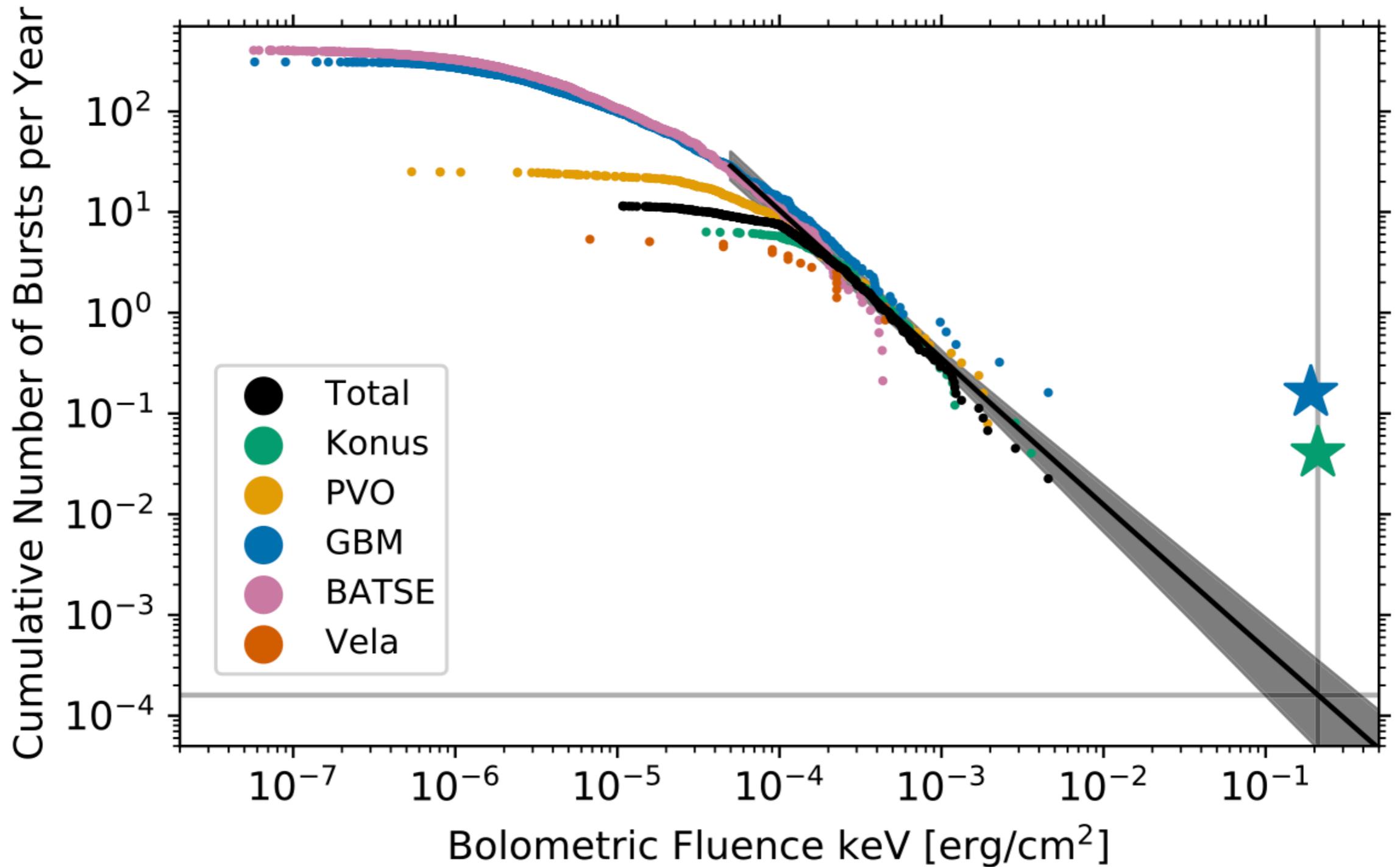
Hamid Hamidani

(Tohoku University, Japan)
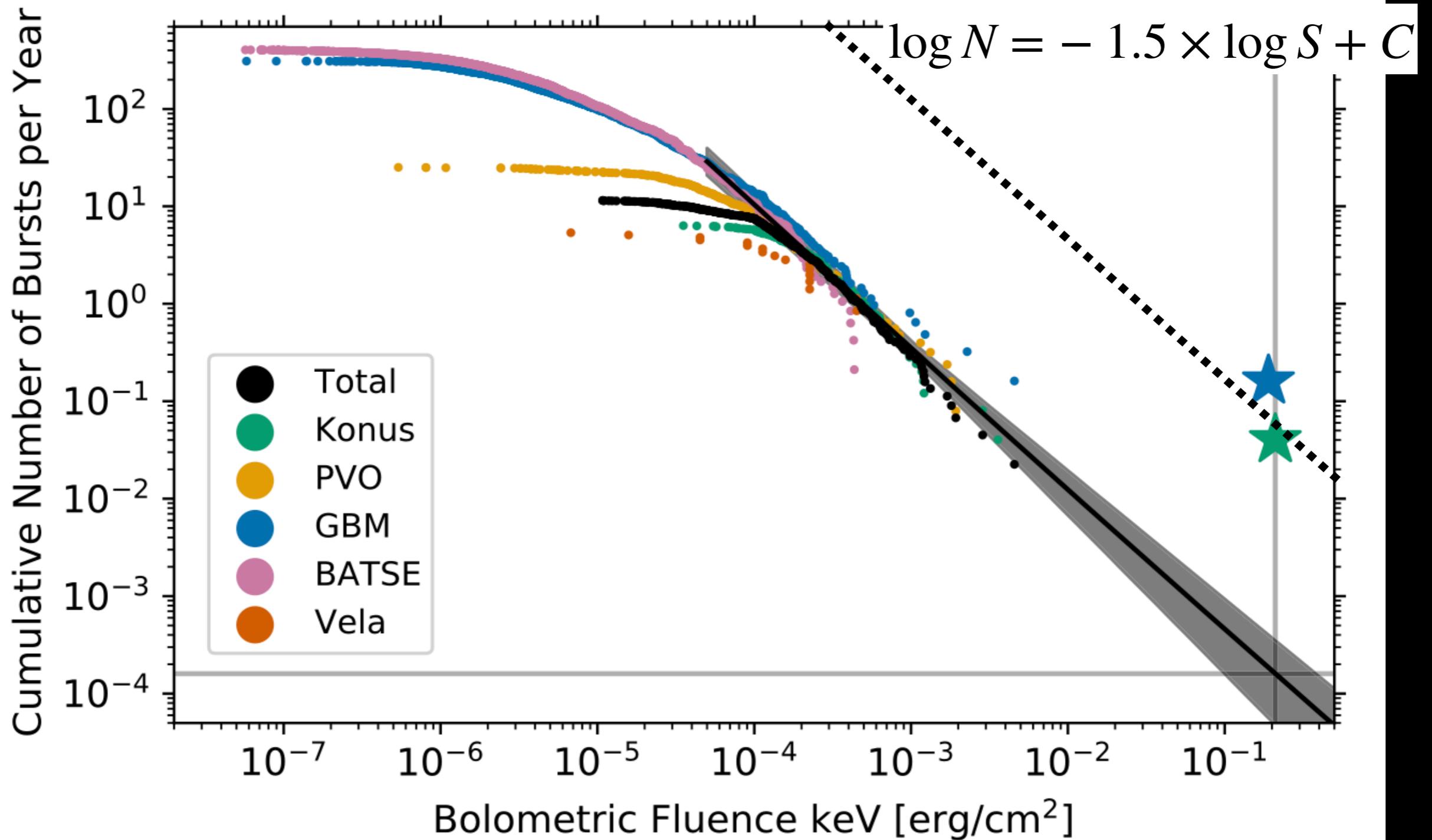
GRB 221009A

GRB 221009A

GRB 221009A

$$\log N = -1.5 \times \log S + C$$

Credit: Burns+23

TeV Emission
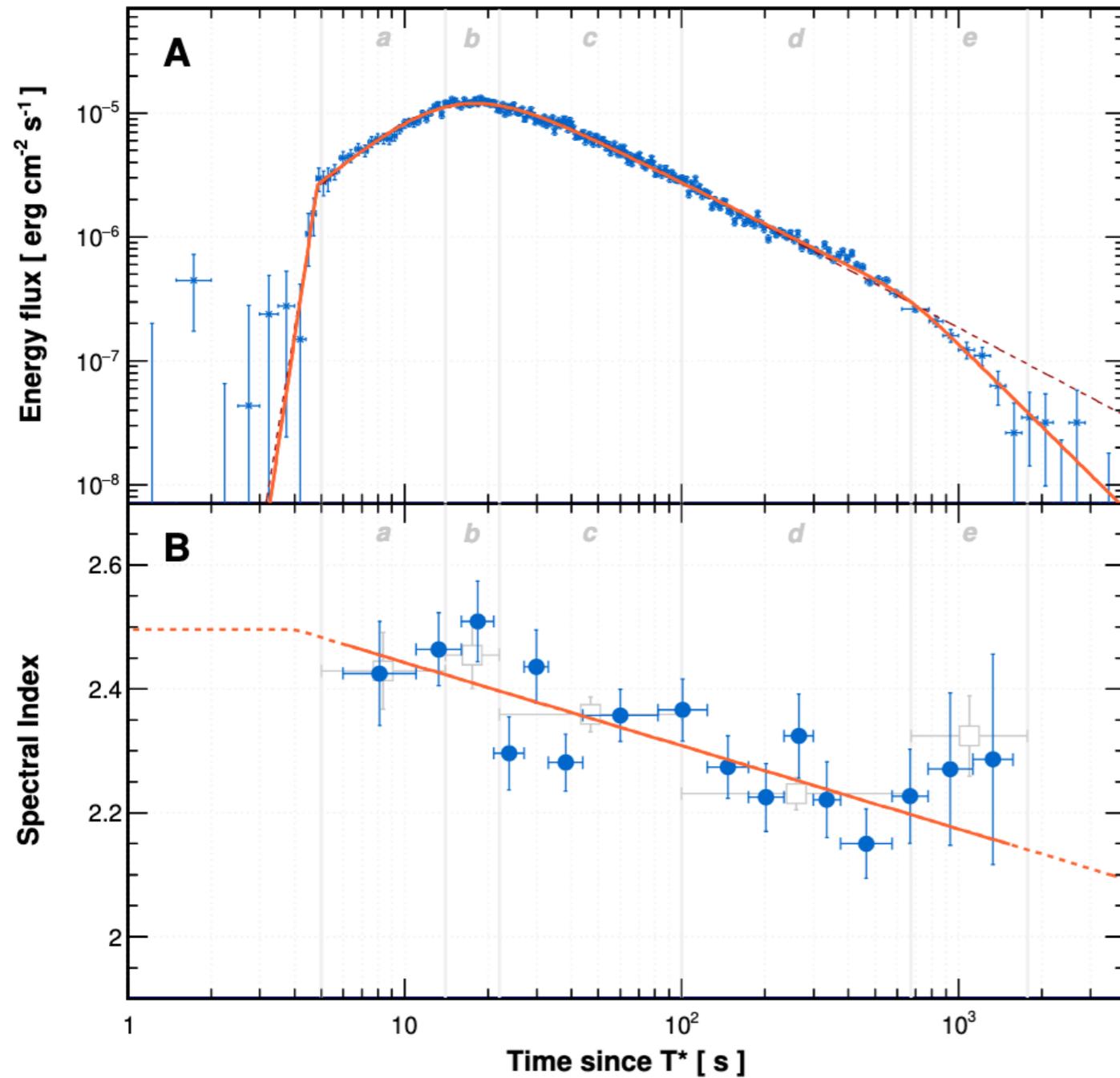
$$\theta_0 \sim 0.6° E_{k,55}^{-1/8} n_0^{1/8} \left(\frac{t_{\mathrm{b,2}}}{670\,\mathrm{s}} \right)^{3/8},$$

Credit: LHAASO+23

The line

GRB 221009A - Fermi/GBM
[290-295 s]
Fit with SBPL+Gaussian

[300-320 s]
Fit with SBPL

[290-295 s]
Fit with SBPL+Gaussian

[300-320 s]
Fit with SBPL+Gaussian

At ~10MeV
Width ~1MeV!

Credit: Ravasio+24

The line

Credit: Salafia+26
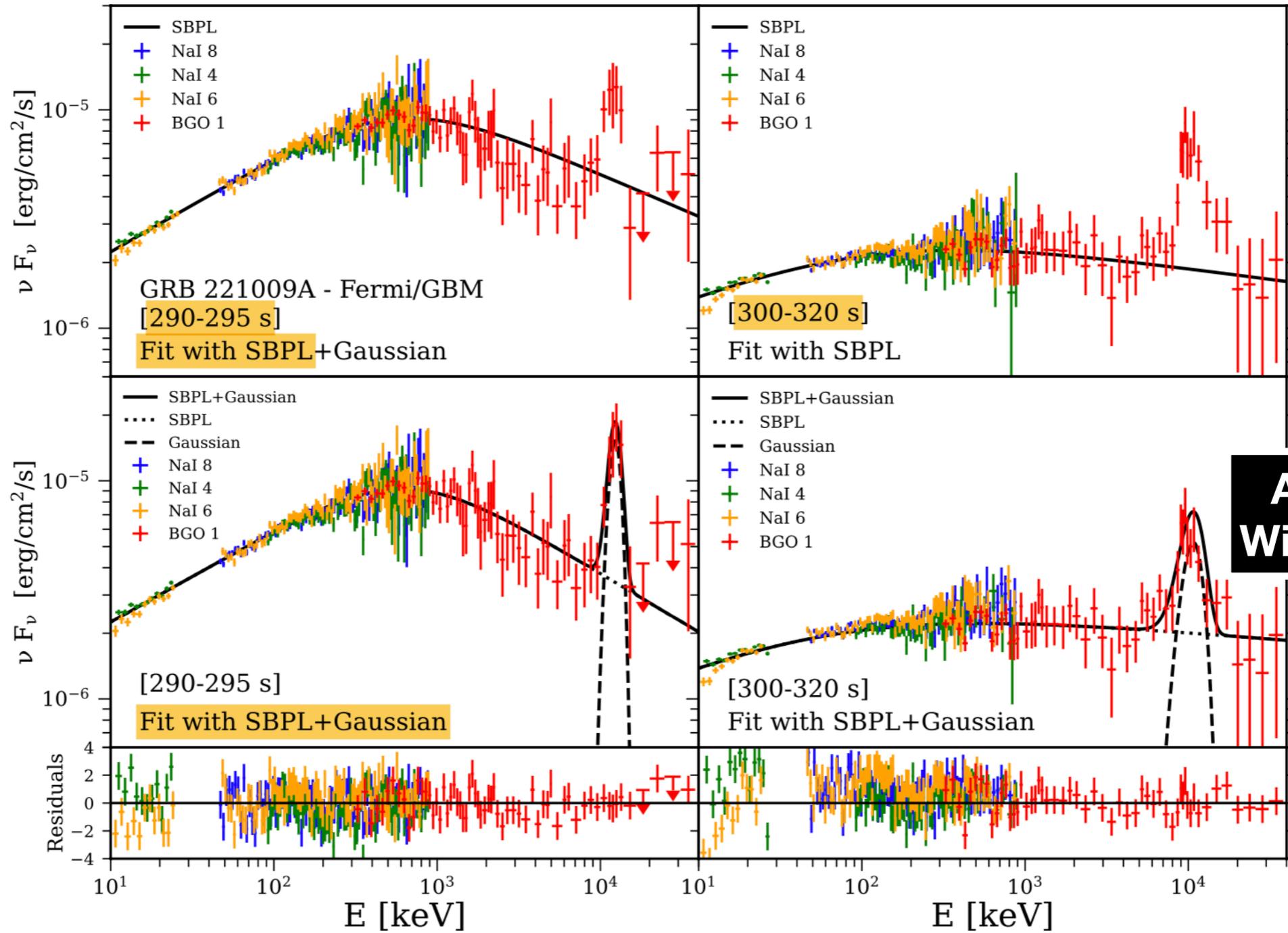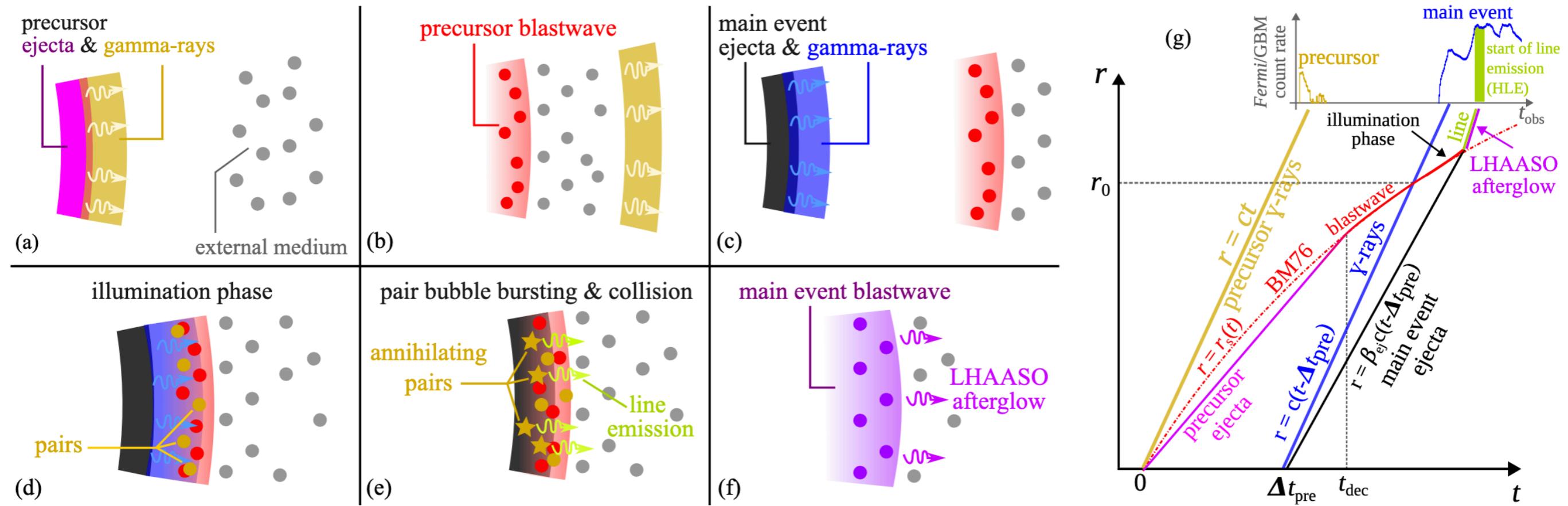
EP

Event rates

Credit: Li+07

Event rates

Estimates: ~a few $\times 2$
Detection: 0

Estimates: ~1
Detection: ~1

SVOM GRB 250314A at $z \simeq 7.3$:
An exploding star in the era of re-ionization

B. Cordier[1,*], J. Y. Wei[2,3,*], N. R. Tanvir[4,*], S. D. Vergani[5,6], D. B. Malesani[7,8,9], J. P. U. Fynbo[7,8],
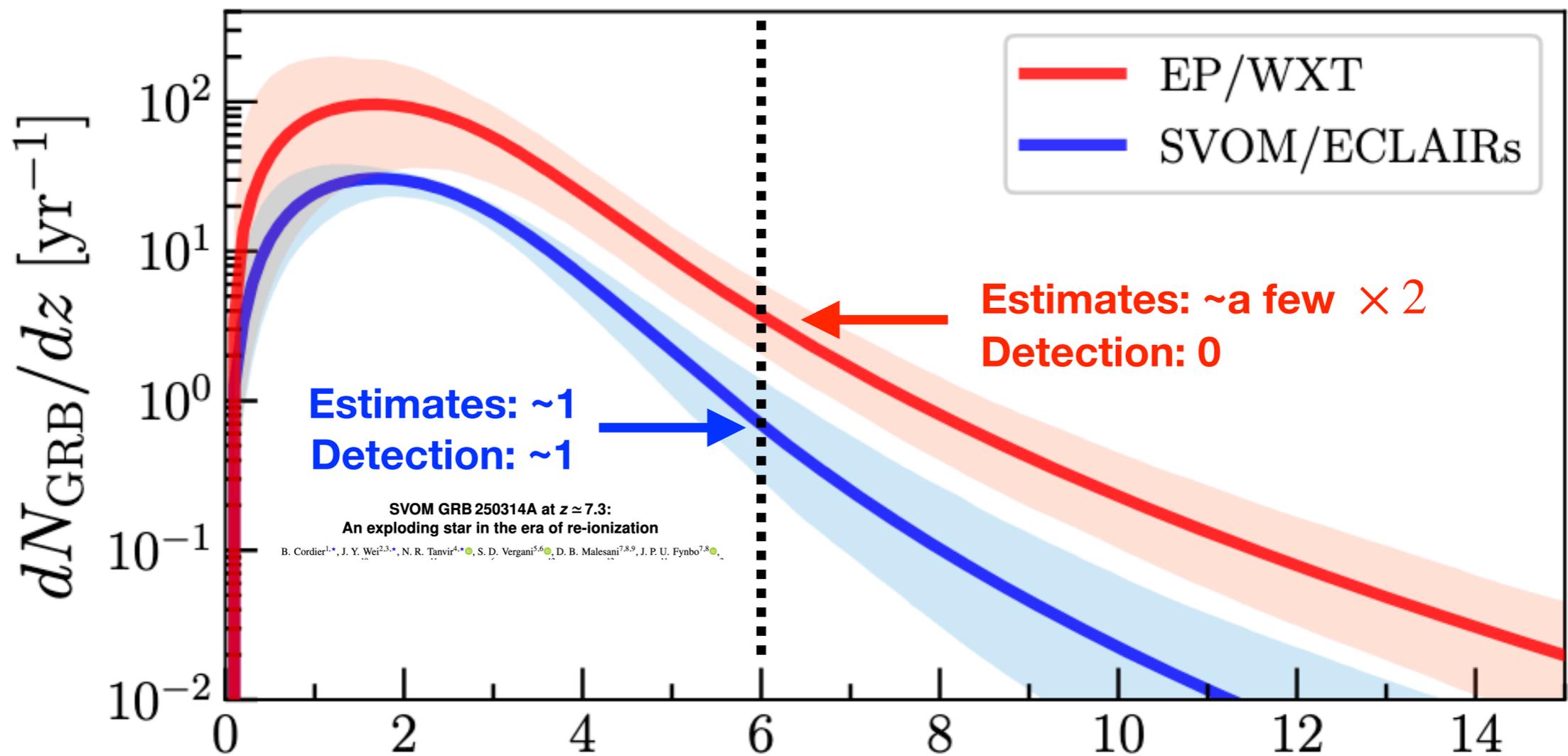
Credit: Wei+25

Soft X-ray - Gamma-rays

Liu+2024
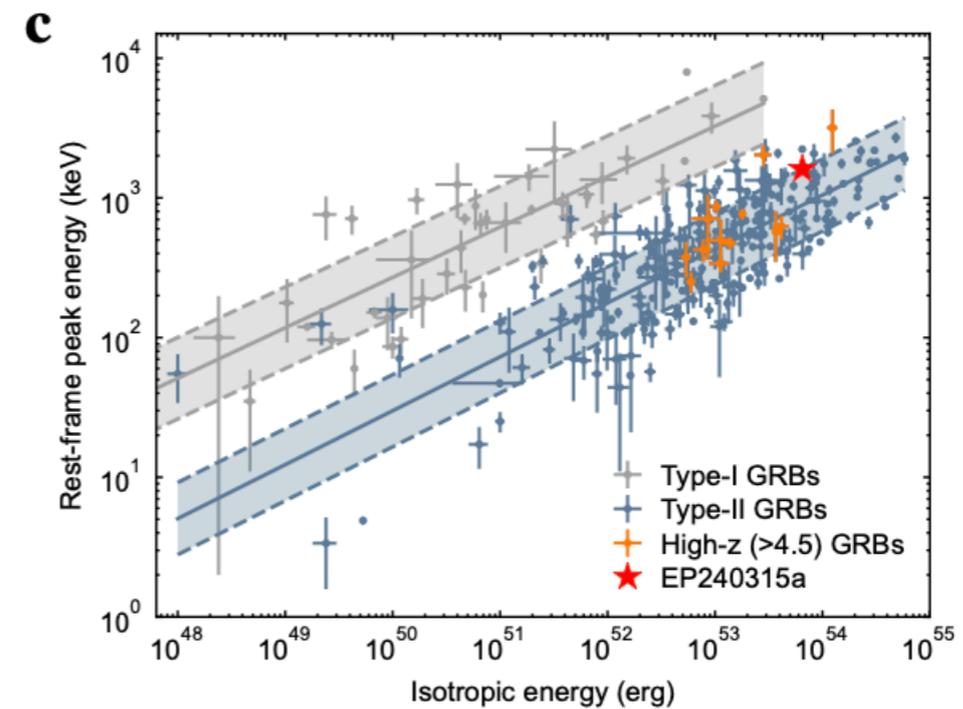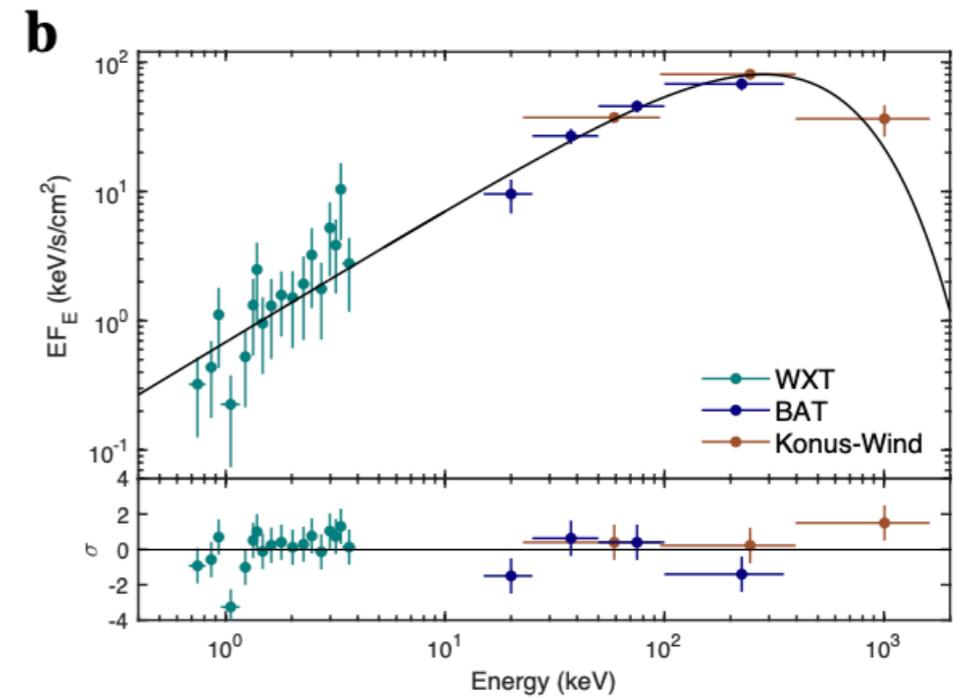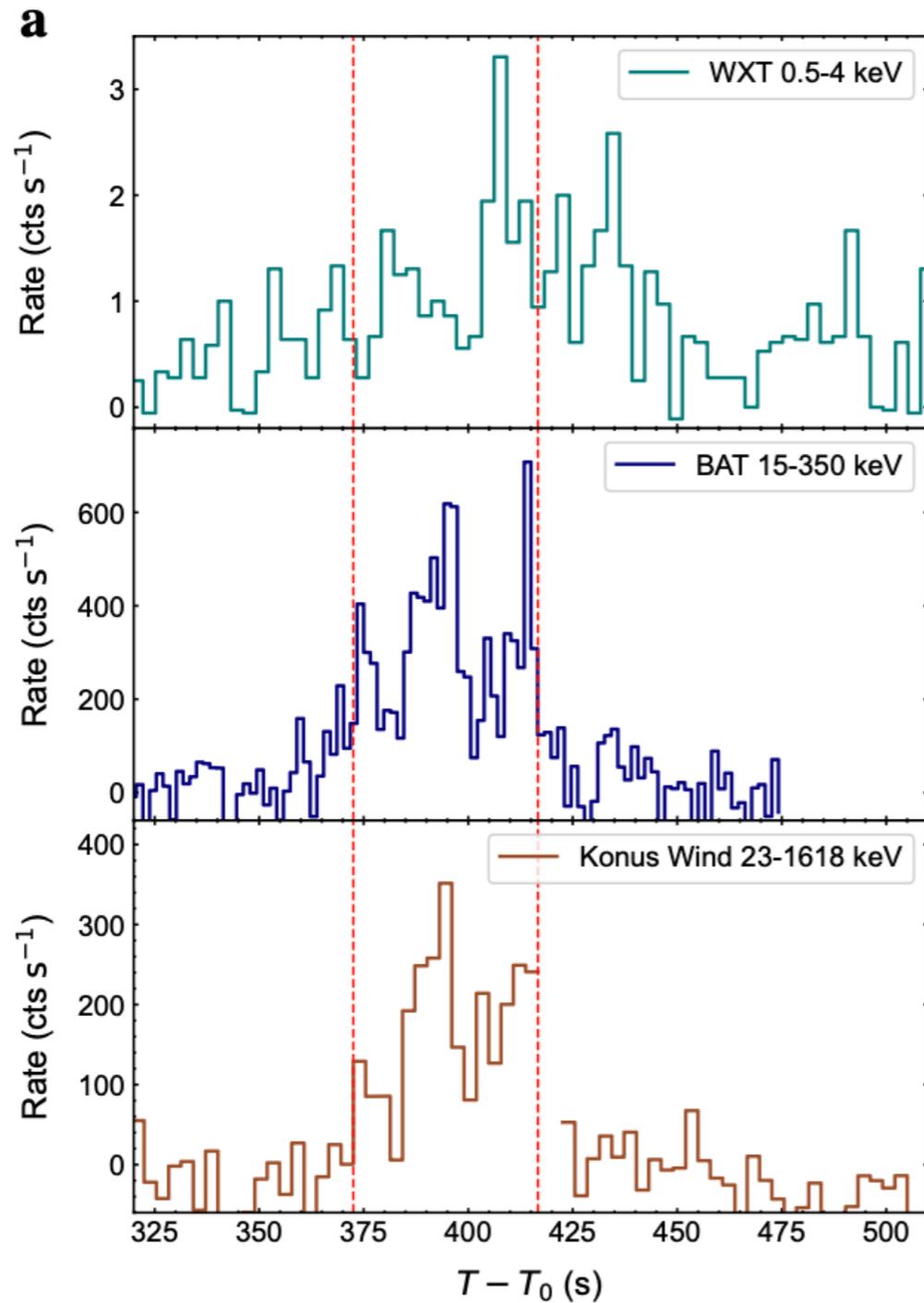
State of observations

- A wide field survey like EP changes the GRB science we can do

    - Better rates, population studies, finding weirdos, etc.

- However, EP provides significantly less spectral information than Swift or SVOM

    - Supplemental multiwavelength observations are crucial (e.g. ZTF copointed stares, robotic telescopes, gamma rays, …)

    - LSST & EP?

    - What are the most important wavelengths/epochs to target?

    - What can we learn from events without counterparts in other wavelengths?

State of observations

- A wide field survey like EP changes the GRB science we can do

  - Better rates, population studies, finding weirdos, etc.

- Howe... EP ... significantly ... information than Swift or
  SVOM...

GRB	High-energy discoverer	Optical discoverer	Discovery $T - T_0$ (h)^a	GOTO internal name	RA (^{h}:^{m}:^{s})	Dec ($^\circ$:$'$:$''$)	Discovery L-band mag	$E(B-V)^b$ (mag)	Redshift^c
240122A	*MAXI*/GSC	GOTO-S	0.73	GOTO24eu	06:12:12.91	−19:08:38.81	17.58 ± 0.04	0.0651	3.1634 ± 0.0003
240225B	*MAXI*/GSC	GOTO-N	1.50	GOTO24tz	08:33:26.67	+27:04:32.71	17.12 ± 0.04	0.0354	0.9462 ± 0.0002
240619A	*Fermi*/GBM	GOTO-S	4.69	GOTO24cvn	10:49:34.70	+17:16:58.07	17.17 ± 0.17	0.0253	0.3960 ± 0.0001
240910A	*Fermi*/GBM	GOTO-S	9.43	GOTO24fvl	01:36:23.45	−00:12:17.86	19.33 ± 0.13	0.0247	1.4605 ± 0.0007
240916A	*Fermi*/GBM	GOTO-S	7.73	GOTO24fzn	15:43:39.23	−07:45:53.21	17.80 ± 0.06	0.1359	2.6100 ± 0.0002
241002B	*Fermi*/GBM	GOTO-S	3.05	GOTO24gpc	21:53:16.56	−58:56:51.98	19.53 ± 0.09	0.0268	–
241228B	*Fermi*/GBM	GOTO-N	0.32	GOTO24jmz	08:31:05.46	+06:50:54.07	14.54 ± 0.01	0.0290	2.6745 ± 0.0004

Notes. ^{a}For *MAXI* GRBs, T_0 denotes the *MAXI*/GSC trigger time; for *Fermi* GRBs, T_0 denotes the *Fermi*/GBM trigger time.
^{b}Galactic extinction values are estimated following recalibrated dust maps of E. F. Schlafly & D. P. Finkbeiner (2011).
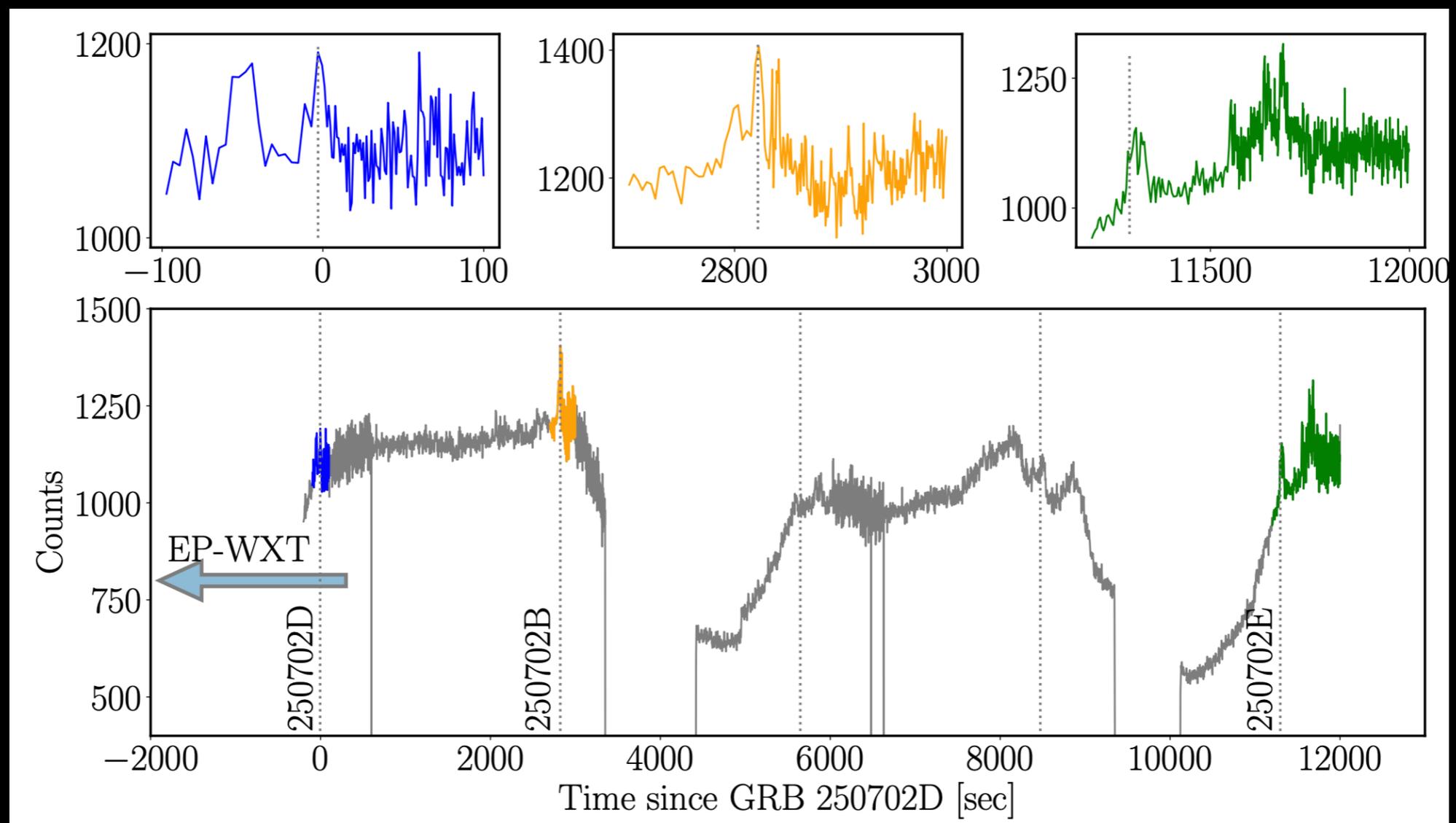^{c}see Section 6.3.

  - S...
    c...

  - L...

- What are the most important wavelengths/epochs to target?

- What can we learn from events without counterparts in other
  wavelengths?

GRB 250702B

& ULGRBs

Is this a GRB?

Similarity to the "gang of four"?
(Comment from K.Ioka)

Yet Another Model of Gamma-Ray Bursts

J. I. KATZ

Racah Institute of Physics, Hebrew University, Jerusalem 91904, Israel; and Department of Physics and McDonnell Center for the Space Sciences, Washington University, St. Louis, MO 63130; katz@wuphys.wustl.edu

GRBs with durations as long as $\sim 10^4$ s (GRB 940217; Hurley et al. 1994) may be explained by the coalescence of millisecond pulsars with $B_r \sim 10^9$ G, and even longer durations are possible (e.g., the $\sim 10^5$ s required to explain the "Gang of Four" apparent repetitions of 1996 October 27–29 as a single event; Meegan et al. 1996; Connaughton et al. 1997). In the present model, long durations pose no intrinsic difficulty and need not be associated with unusually soft spectra, in contrast to external shock models, in which they imply low Lorentz factors and low radiative efficiency. Very long GRBs are faint, on average, in any model in which the total energy of a GRB is limited and are therefore difficult to detect. They may be more frequent than is apparent from intensity-selected (or rate of rise–selected) samples.

## GAMMA-RAY BURSTS AND THE FIREBALL MODEL

Tsvi PIRAN[a]

The definition of duration is, of course, not unique. BATSE's team characterizes it using T_{90} (T_{50}) the time needed to accumulate from 5% to 95% (from 25% to 75%) of the counts in the 50–300 keV band. The shortest BATSE burst had a duration of 5 ms with structure on scale of 0.2 ms [66]. GRB920229 has a spike with a rise time of 0.22 ms and a decay time of 0.4 ms [67]. The longest so far, GRB940217, displayed GeV activity one and a half hours the main burst [68]. The bursts GRB961027a, GRB961027b, GRB961029a and GRB961029b occurred from the same region in the sky within two days [69] if this "gang of four" is considered as a single very long burst then the longest duration so far is two days! These observations may indicate that some sources display a continued activity (at a variable level) over a period of days [70]. It is also possible that the observed afterglow is an indication of a continued activity [36].
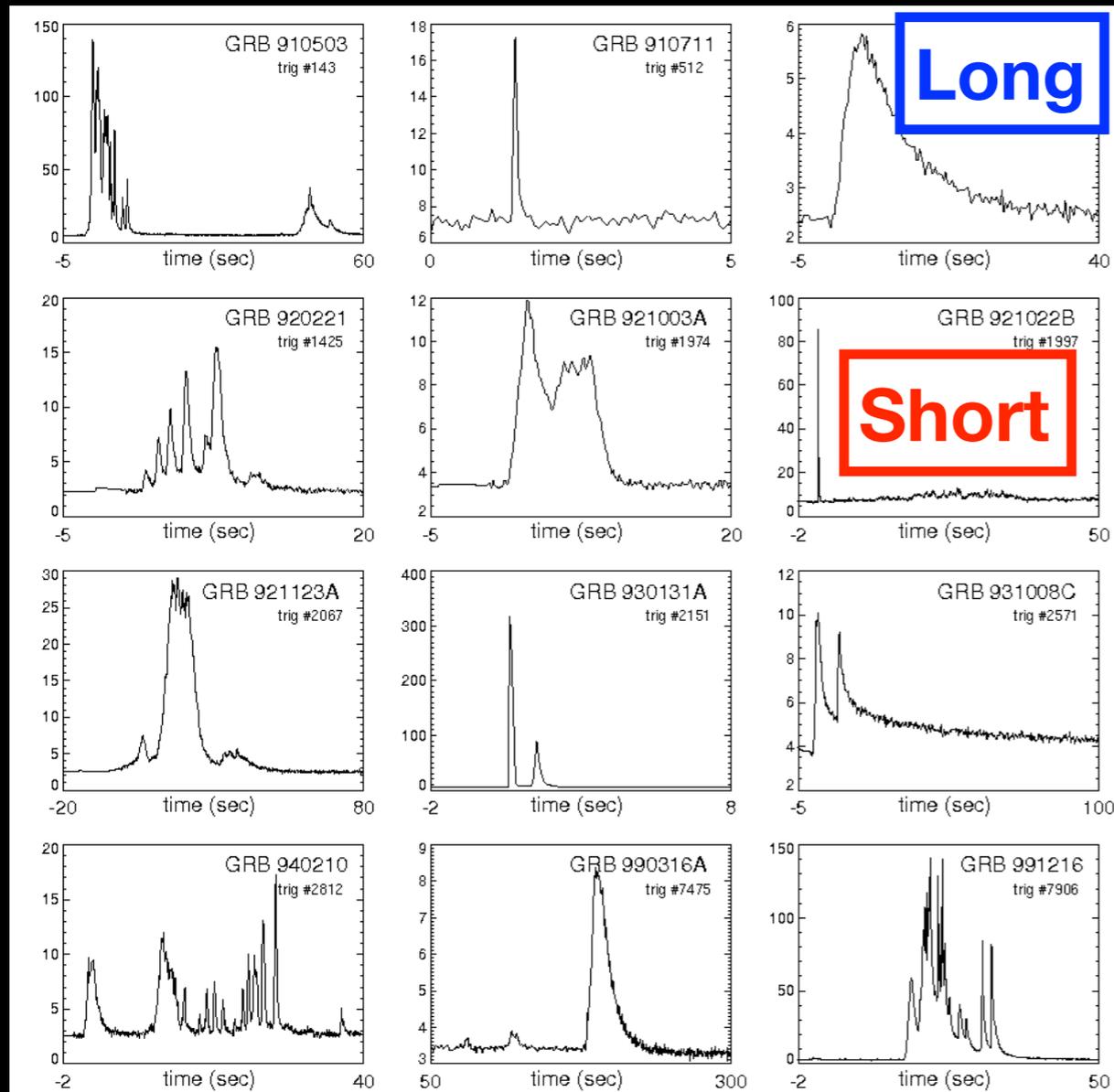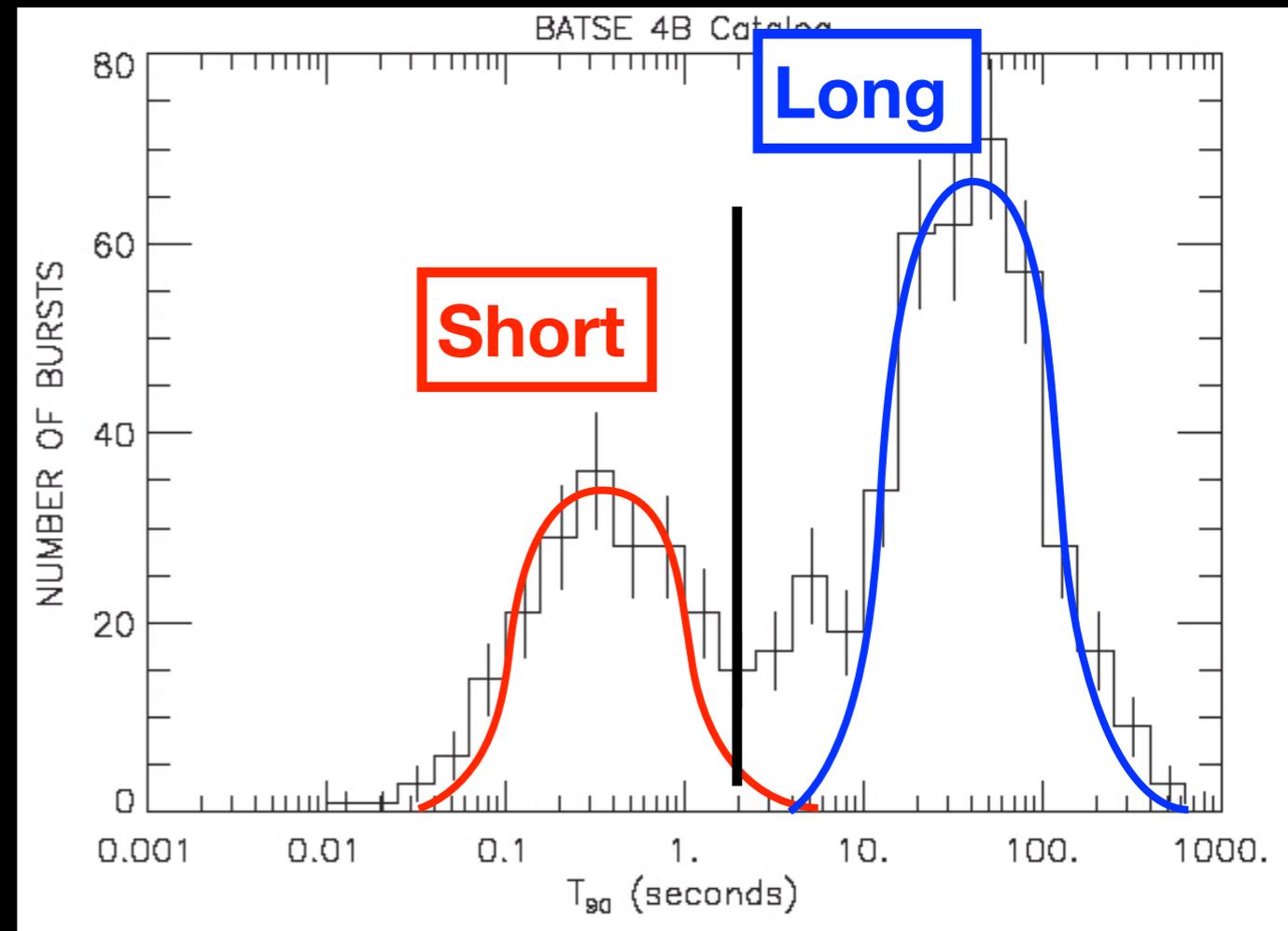
GW170817

GW170817

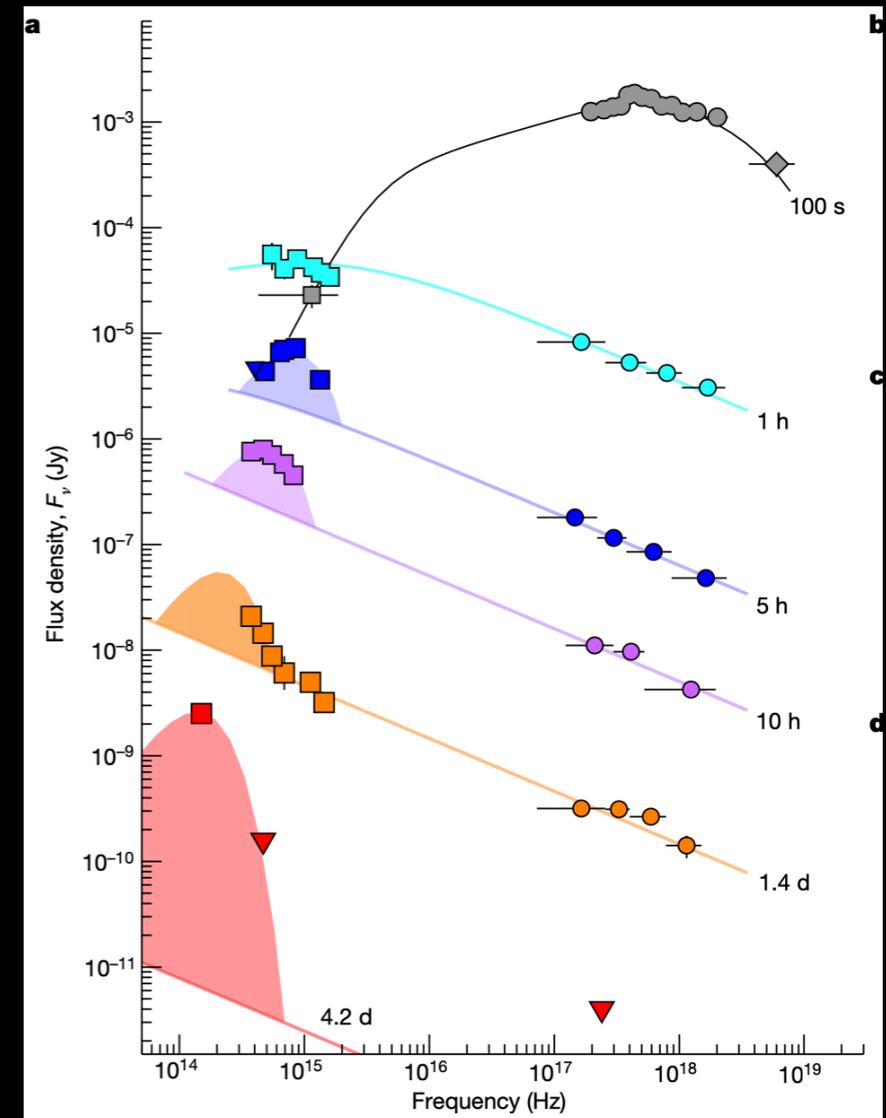Ioka+2018
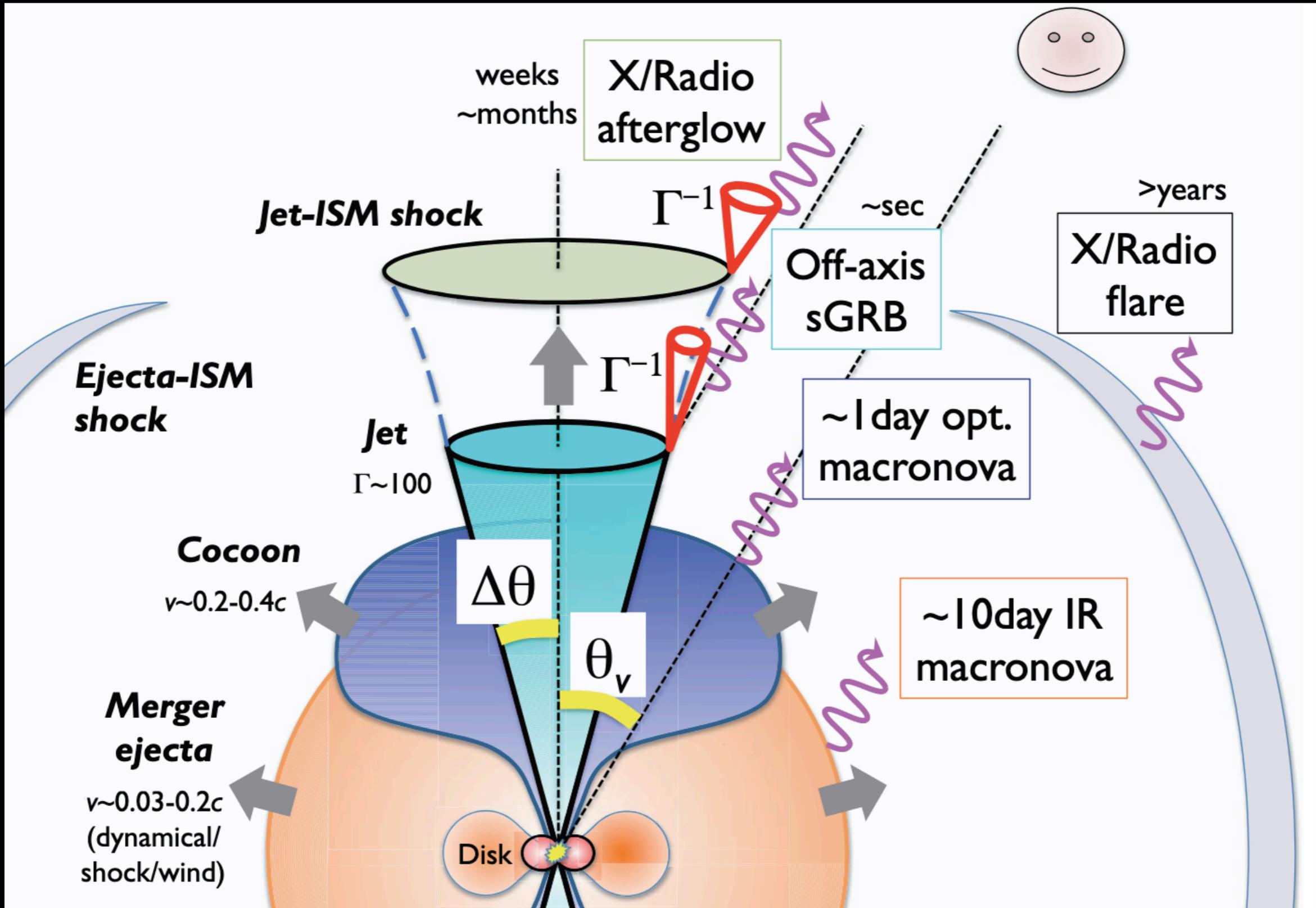
Event rate
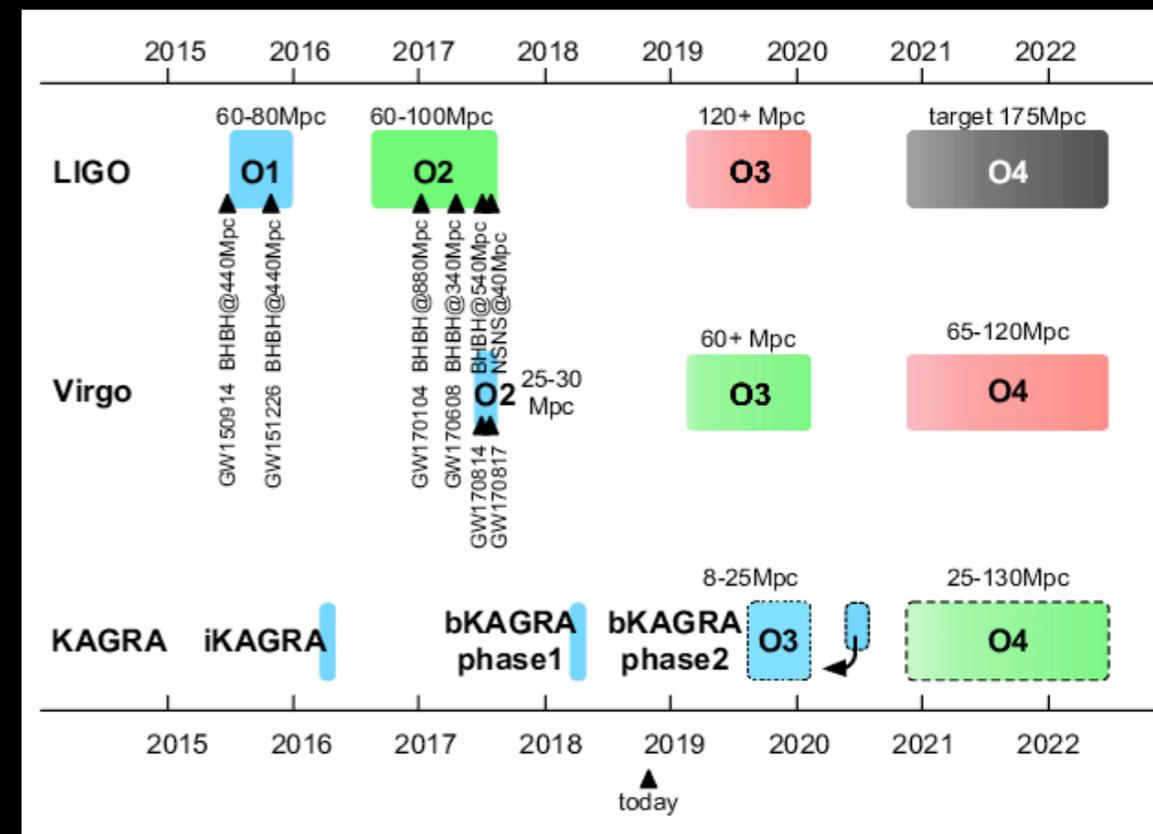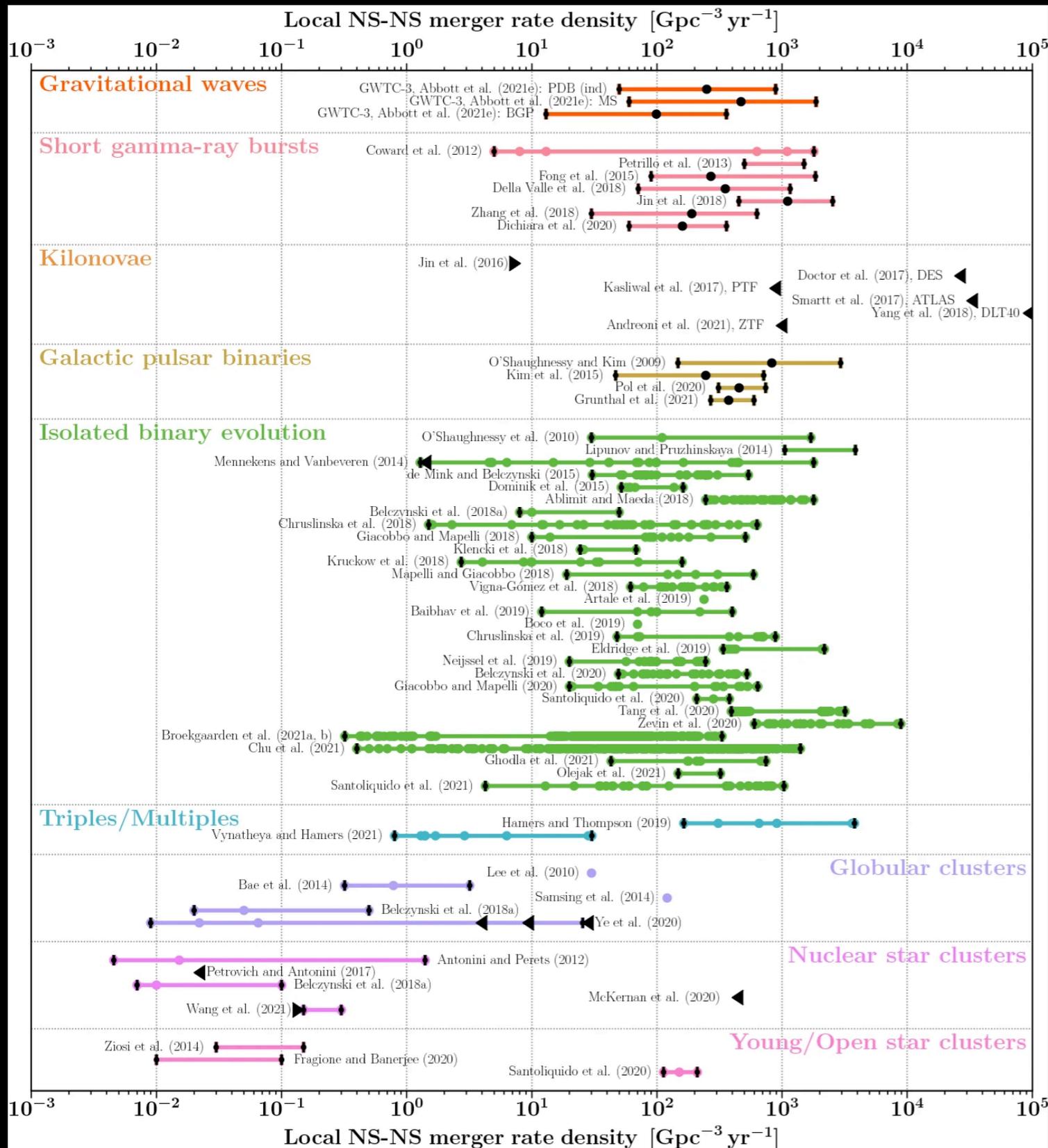
LIGO-VIRGO-KAGRA
collaboration
Mandel+2022

Long Vs. Short GRBs

Old Paradigm

Credit: BATSE/NASA

Credit: Kouveliotou et al. 1993

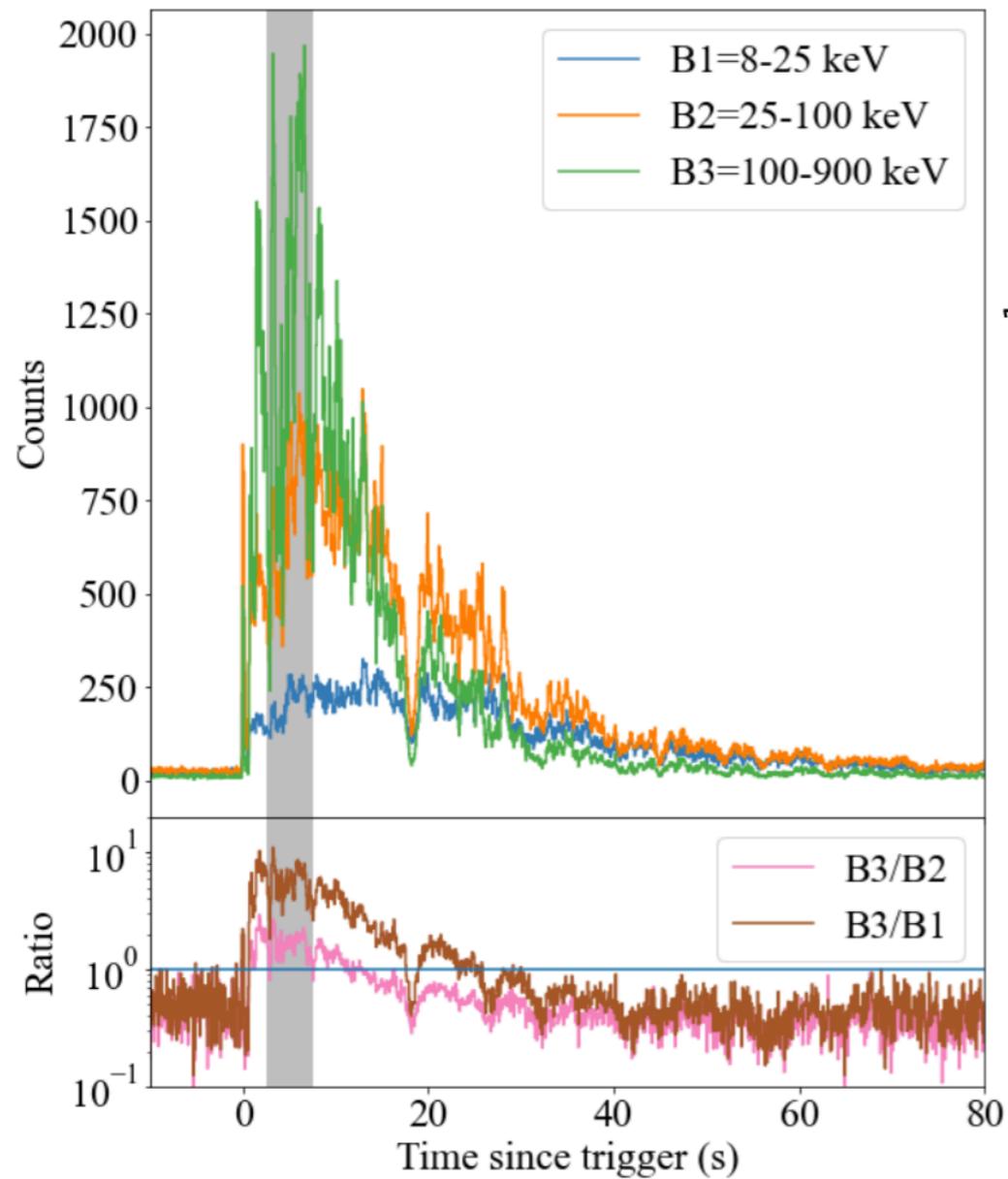# Long Duration Merger?
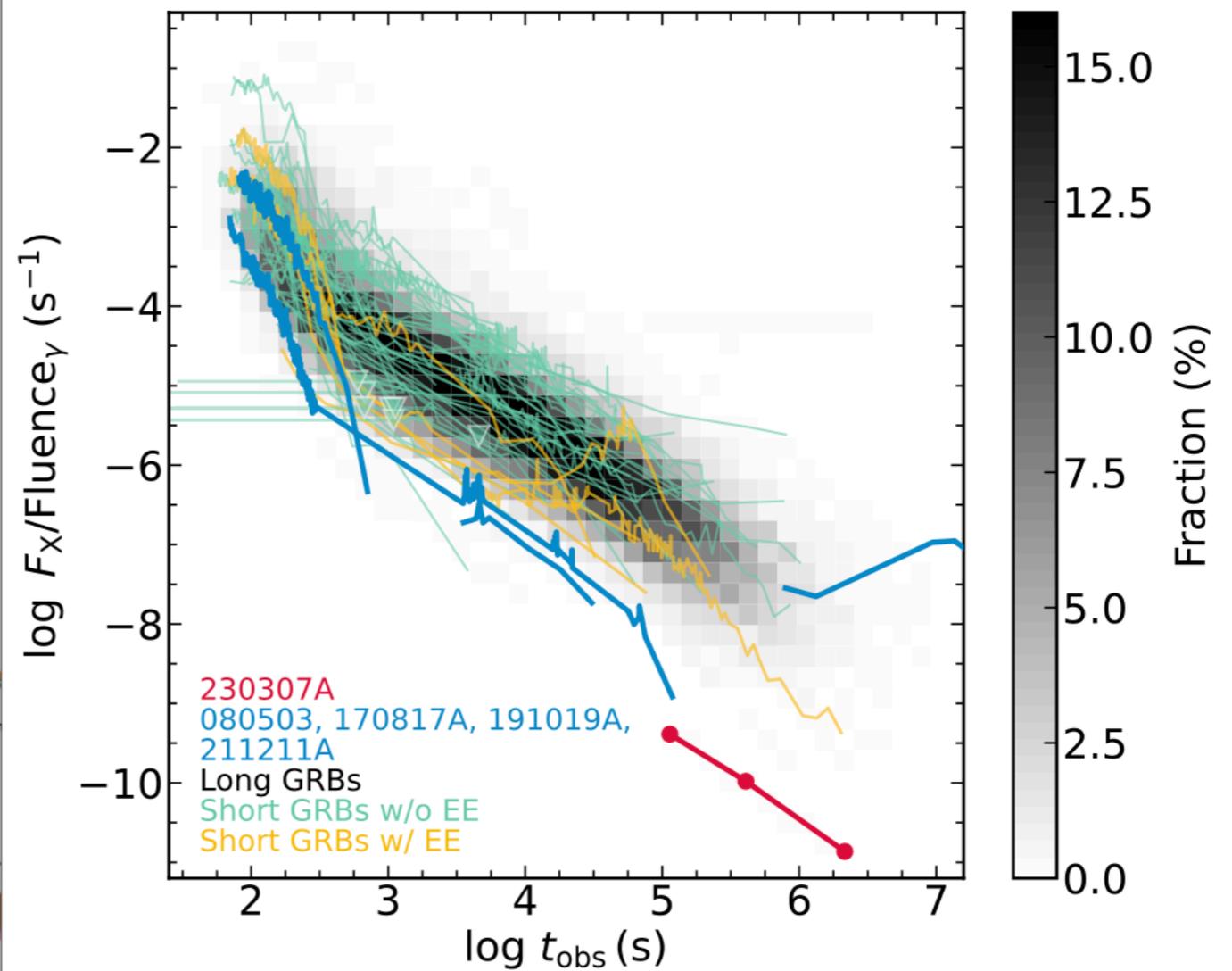
Rastinejad+2023; Troja+2023

GRB w/ KN => Weak afterglow?

Levan+2023

Long vs. Short GRBs: Poll

- Some recent LGRBs show evidence for a kilonova (Gavin's talk)

- Do you believe that these observations can be explained with the 2 classical GRB formation channels (i.e. collapsars and BNS mergers)?

- Do you think they can be explained by only two populations? Or is a third population necessary?

- If not, what are other candidate progenitor channels?

- How many Swift LGRBs might have been accompanied by (missed) kilonovae?

Long vs. Short GRBs: Poll

- Some recent LGRBs show evidence for a kilonova (Gavin's talk)

- Do you believe that these observations can be explained with the 2 classical GRB formation channels (i.e. collapsars and BNS mergers)?

- Do you think they can be explained [is a third population necessary?]

- If not, what are other candidate prog[enitors?]

- How many Swift LGRBs might have [missed] kilonovae?

- At z<0.3 there are 24 bursts detected by Swift

- 5 are short (T90 < 2s)

- 19 are long (T90 > 2s)

- 7 are long but with no supernova emission or in ancient galaxies (**050219A**, **050724**, *060505*, *060614*, 111005A, **191019A**, *211211A*).

- Selection effects (mostly faint afterglows) mean merger GRBs more likely to be missed than collapsar GRBs.

Levan talk, 2023