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Short, long and ultra-long MeV transients

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**2nd International conference on the Physics of the Two Infinities
Tokyo, 19 November 2025**

(1) GRBs

(2) Dichotomy

(3) long GRBs

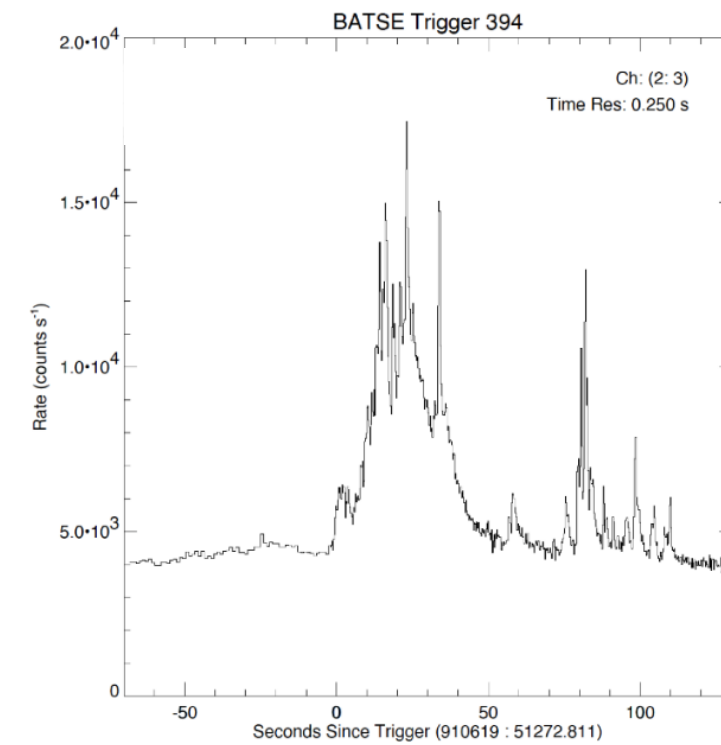
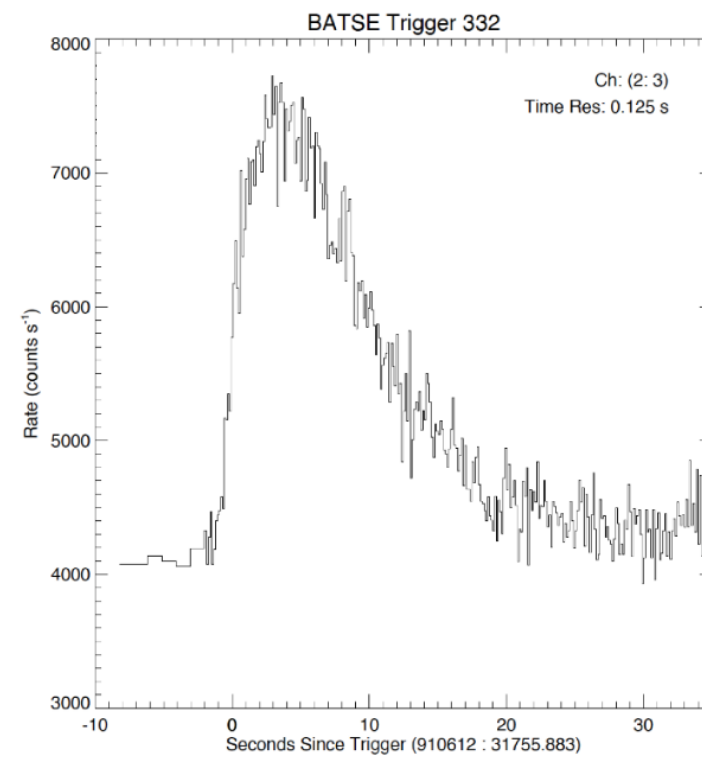
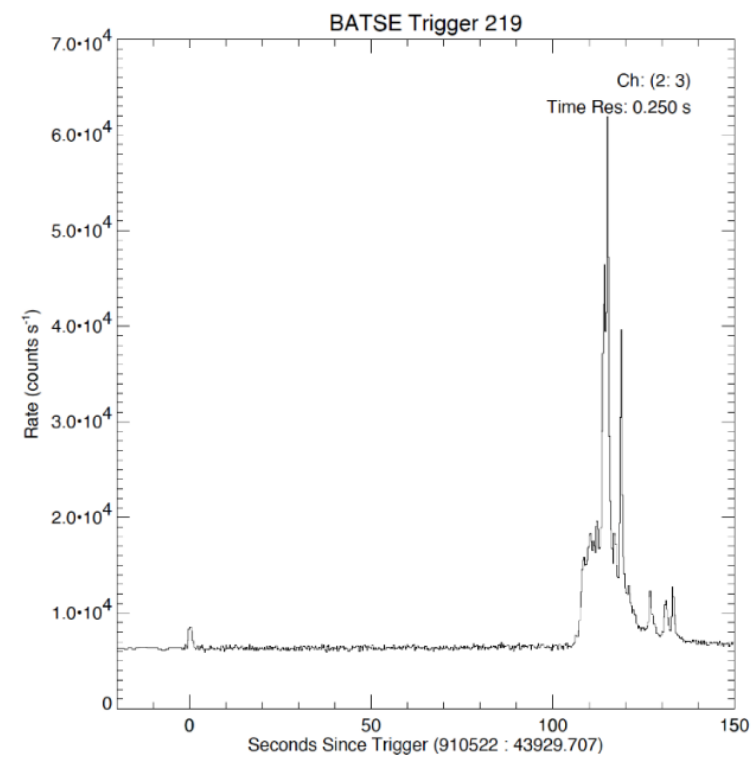
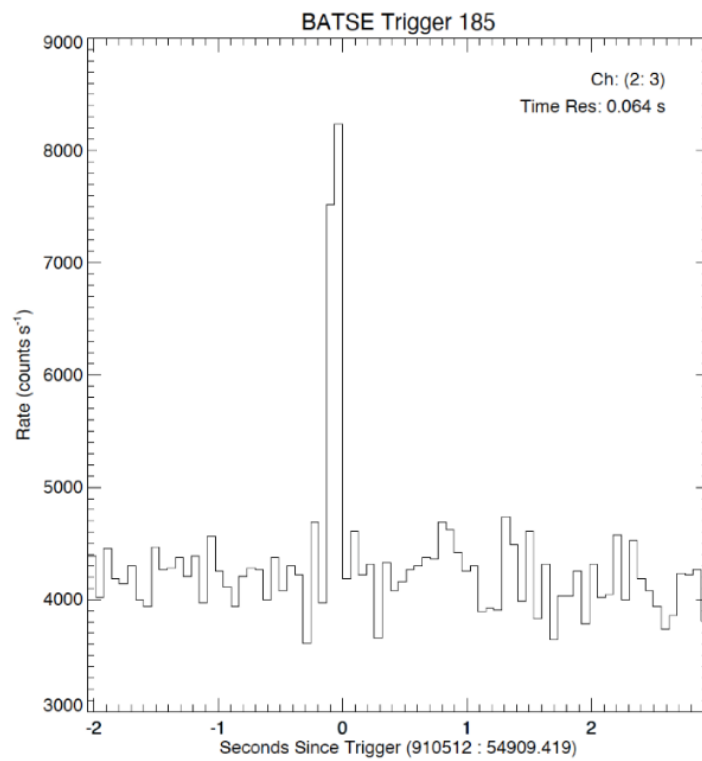
(3) classical short GRBs

(4) special (very different) short GRB 170817A/GW 170817A

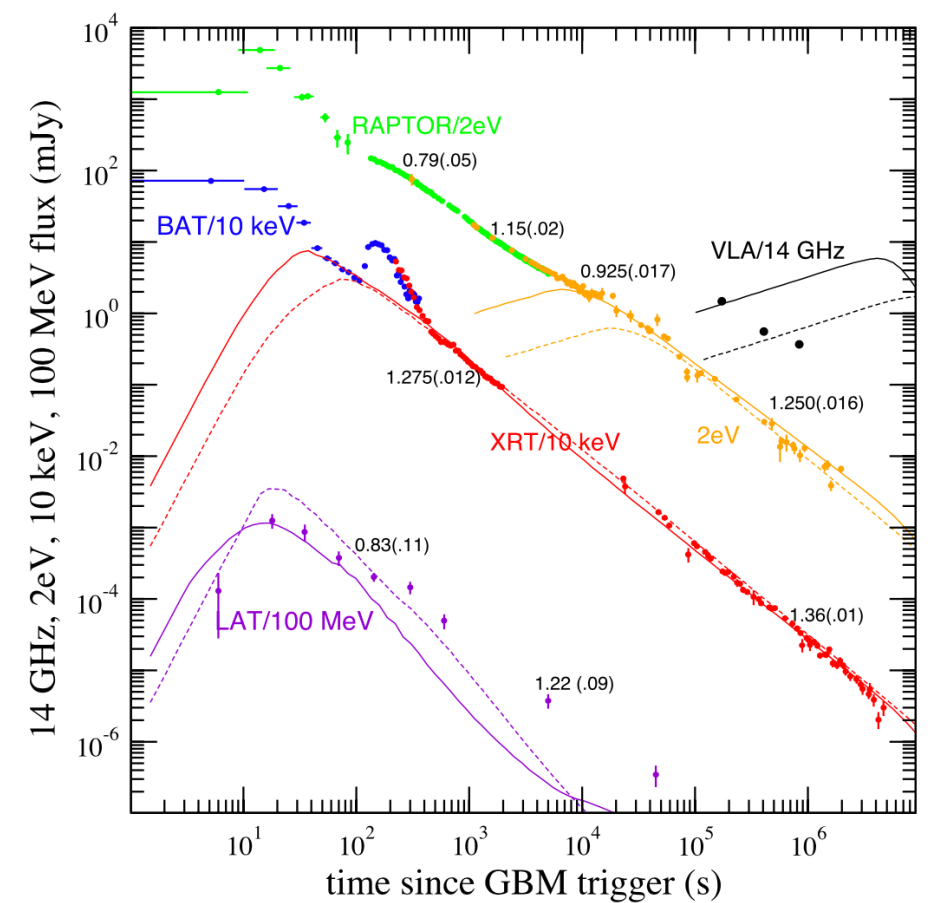
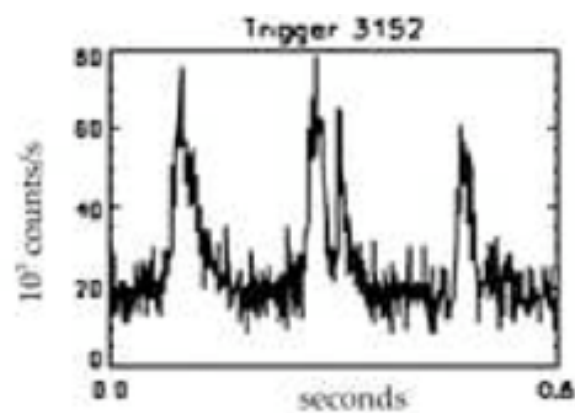
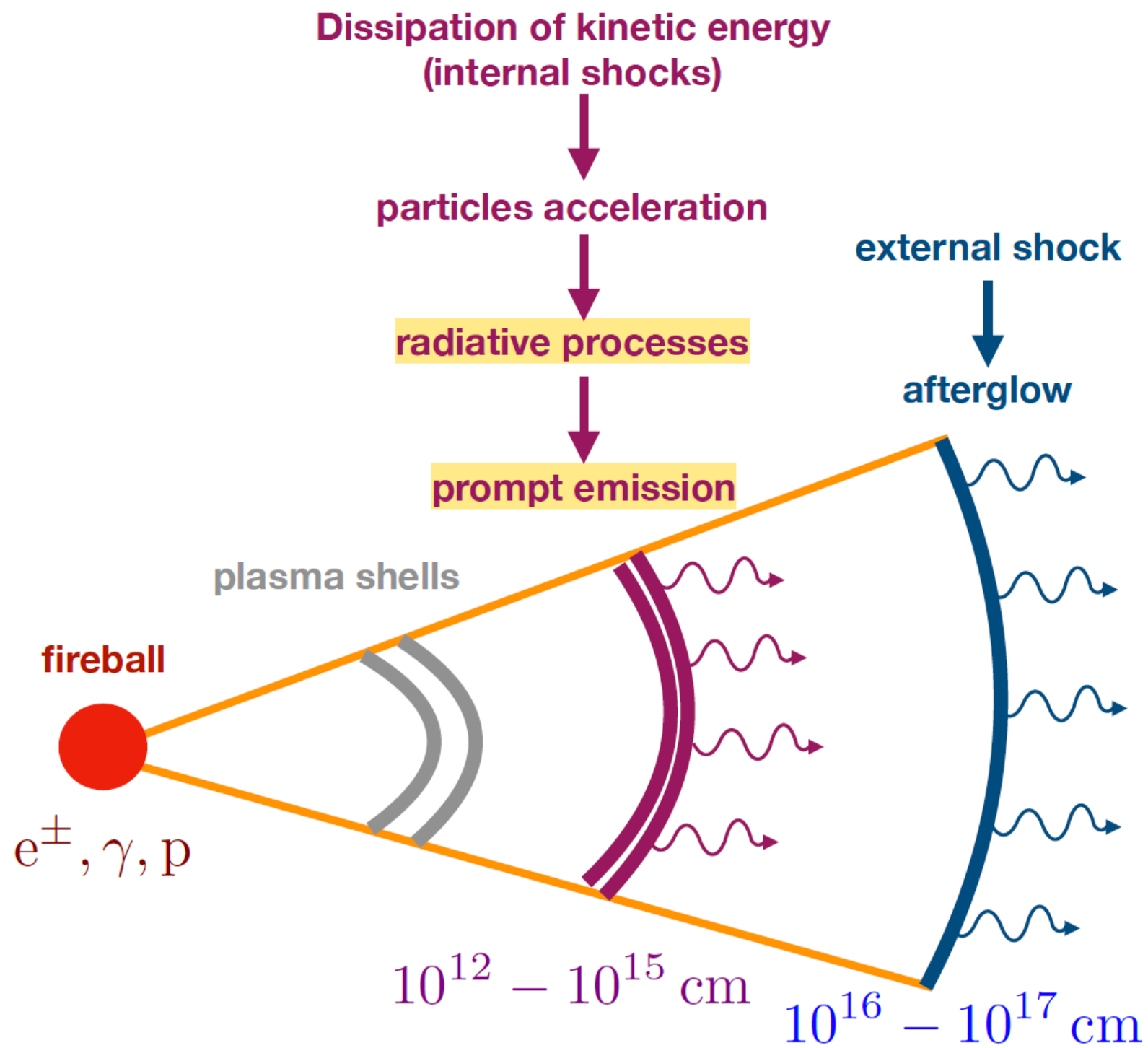
(5) short GRBs and next gen GW instruments

(6) Ultra-long GRBs and 250702B

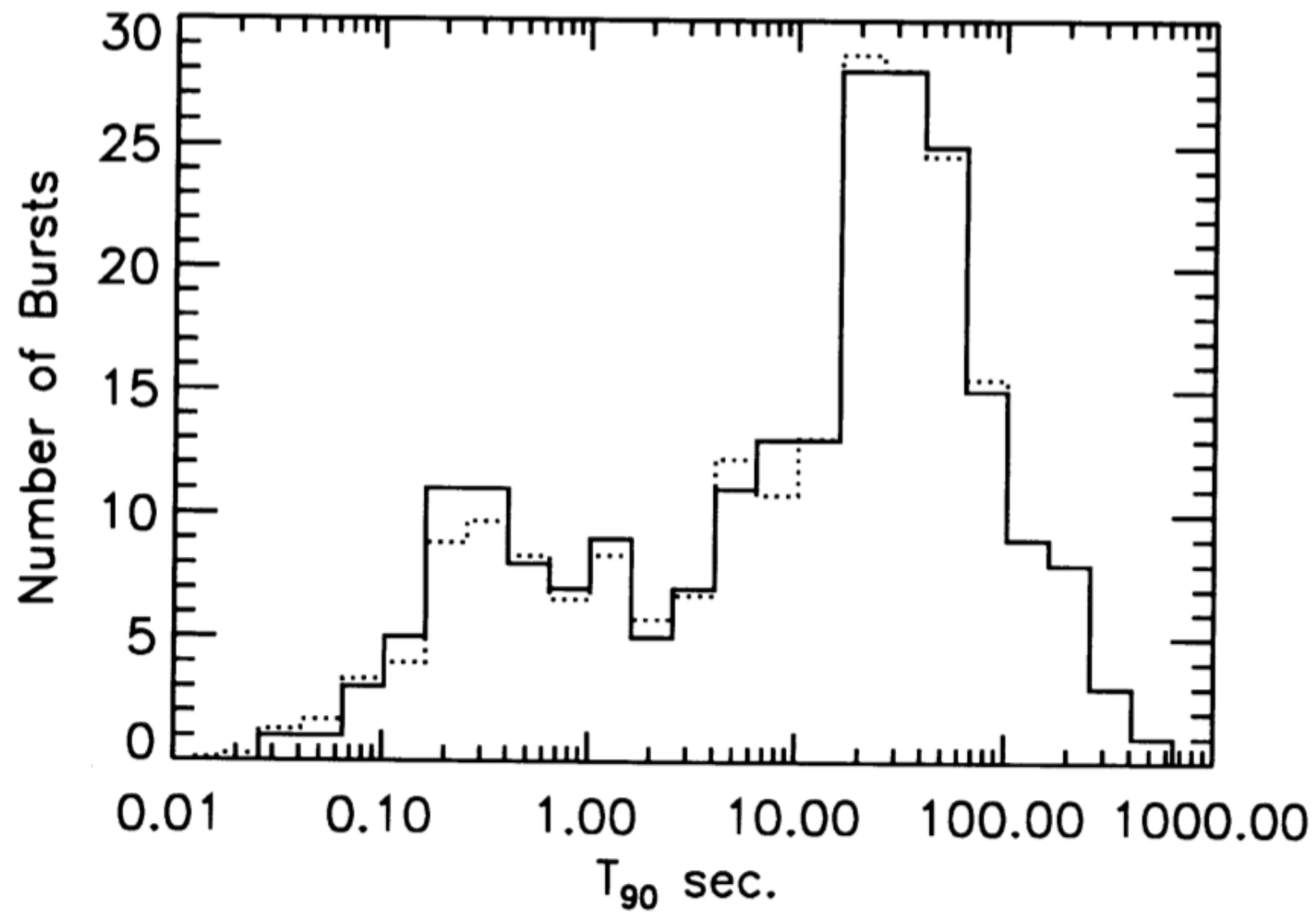
(1) GRBs



MeV gamma-rays + duration (0.1-100 s) + high z + energetic



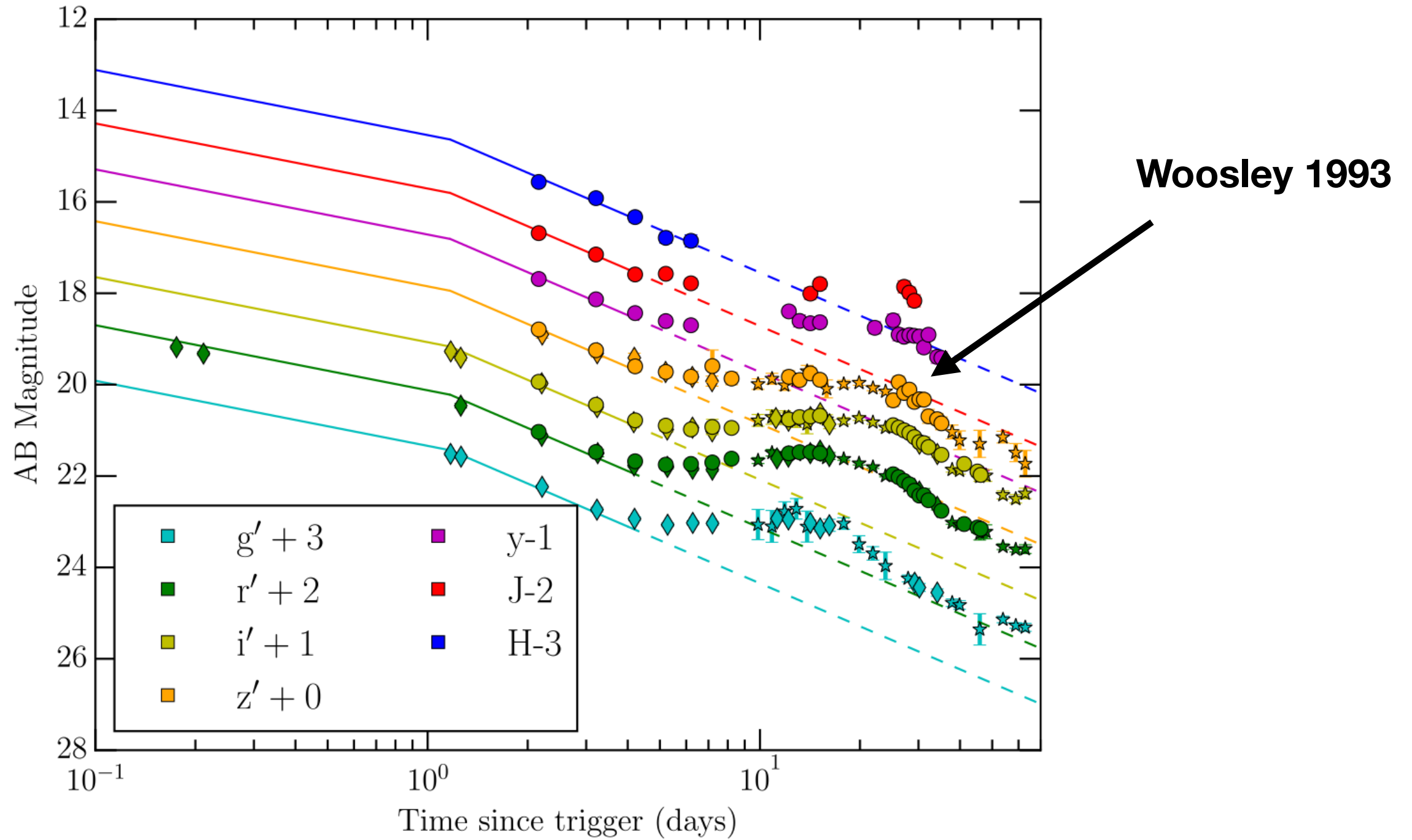
(2) Dichotomy



Kouveliotou+ 1993, ApJ

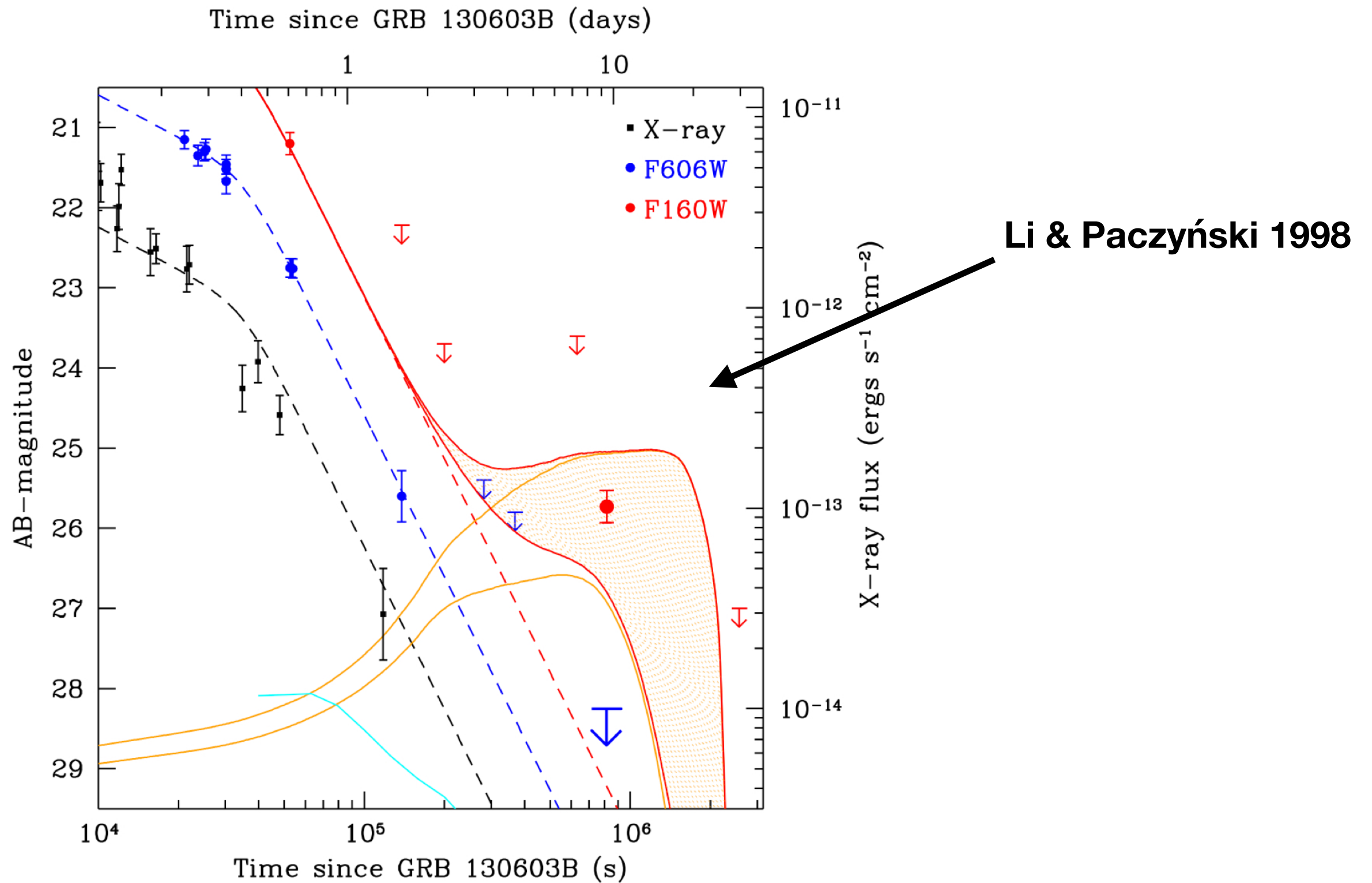
see Masetz+1981 for earlier evidences

(3) long GRBs



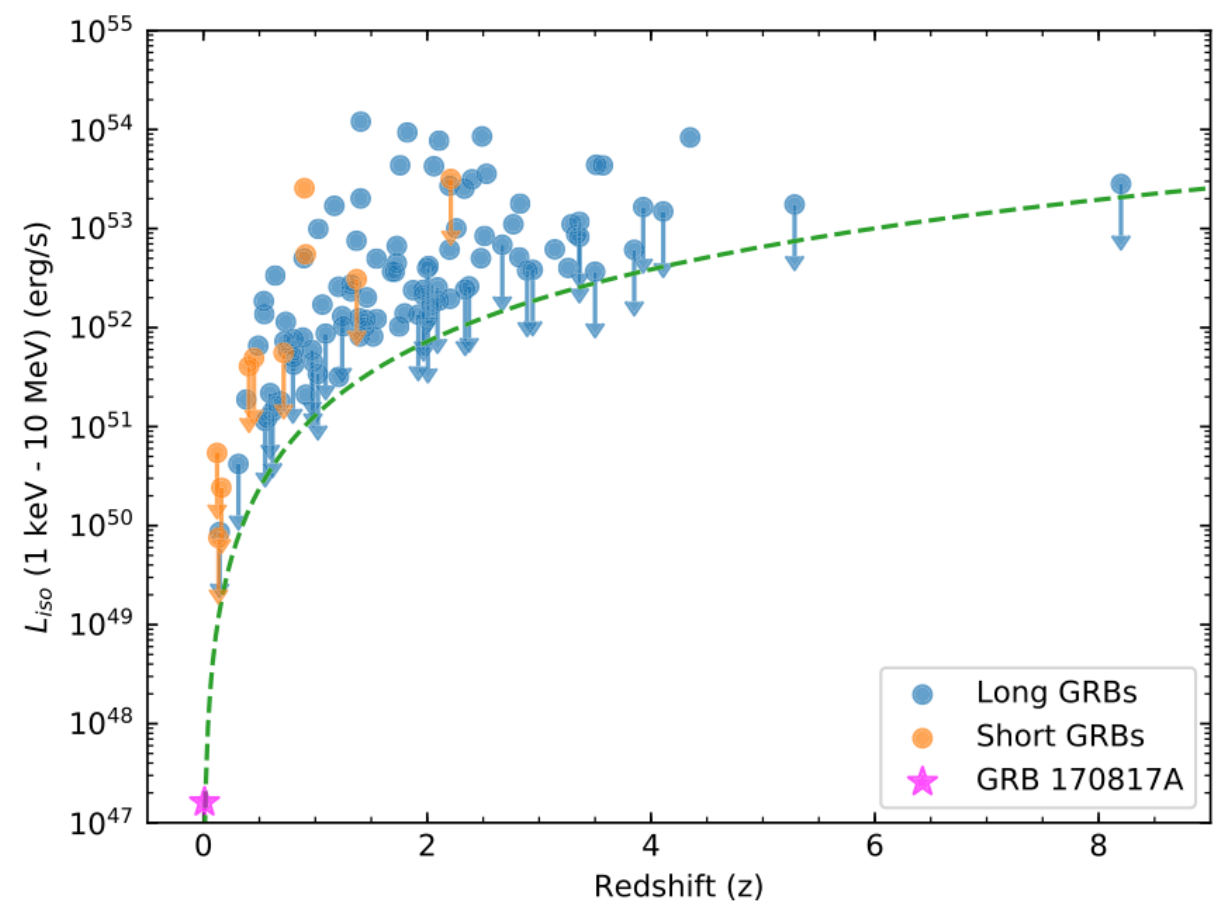
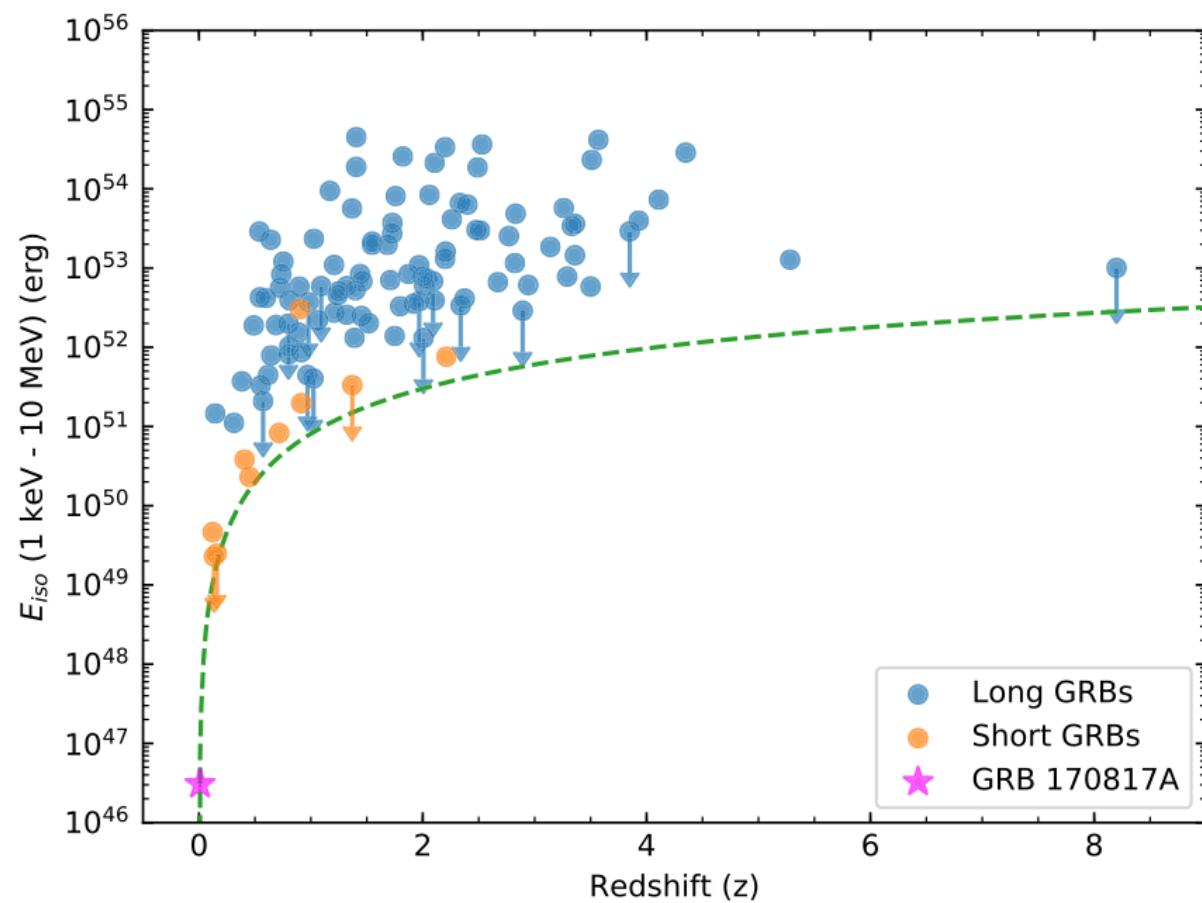
Example from Toy+2016 ApJ, 2016

(3) classical short GRBs

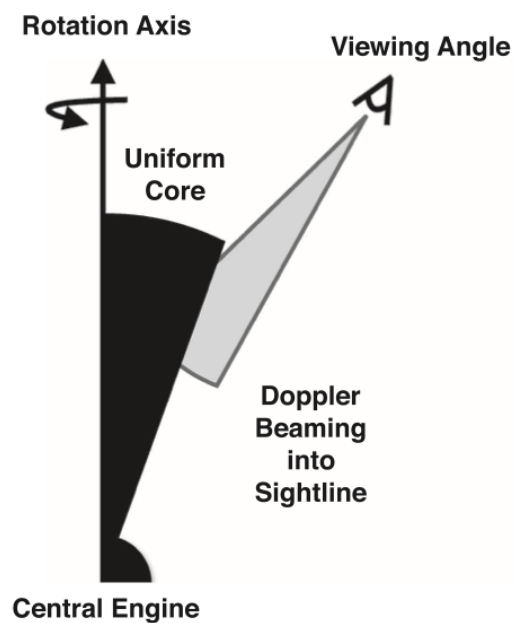


Tanvir+2013, Nature see also Berger+ 2013, ApJL

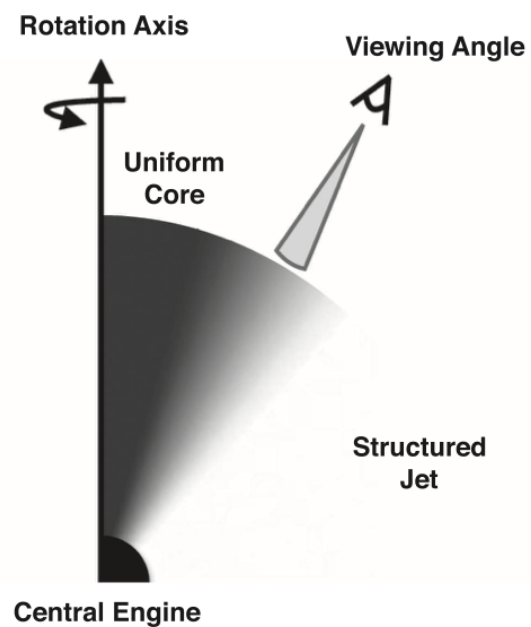
(4) special (very different) short GRB 170817A/GW 170817



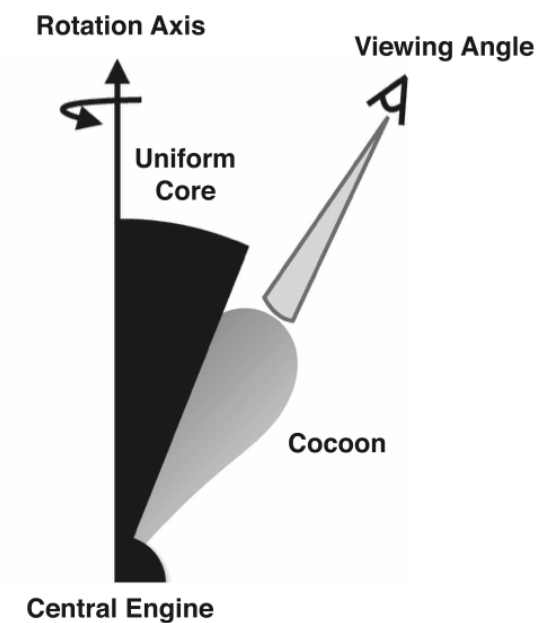
Scenario i: Uniform Top-hat Jet



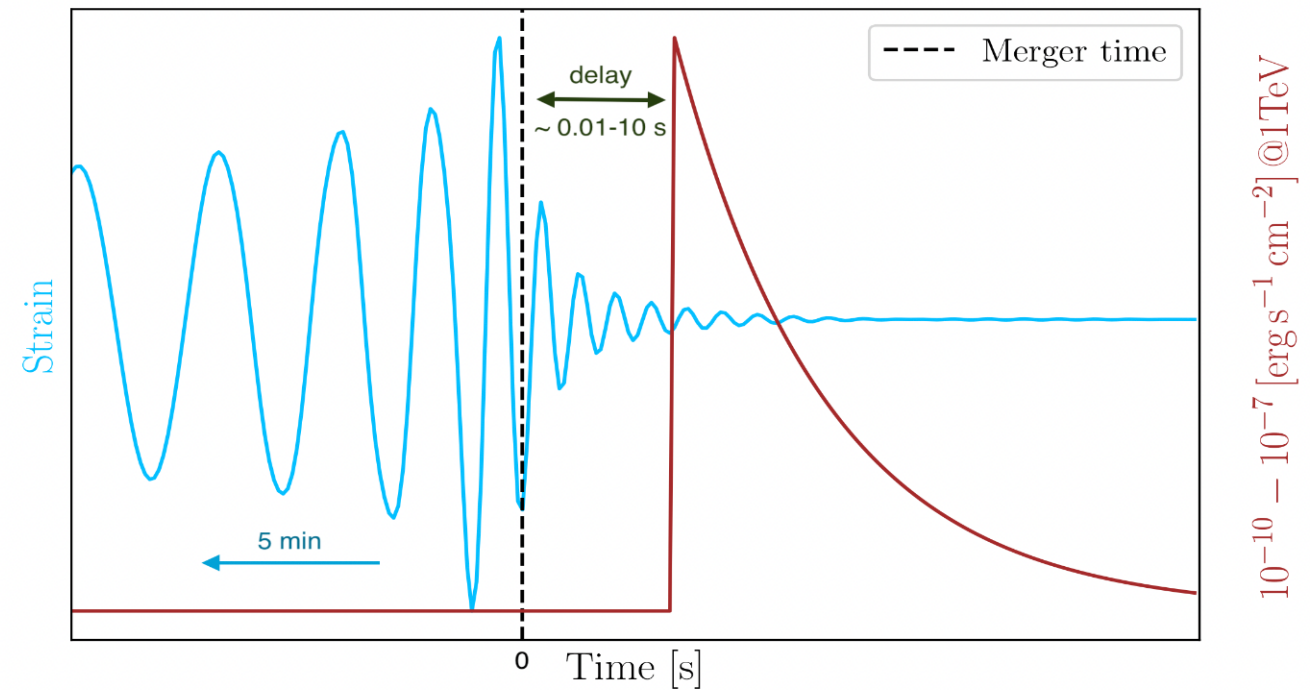
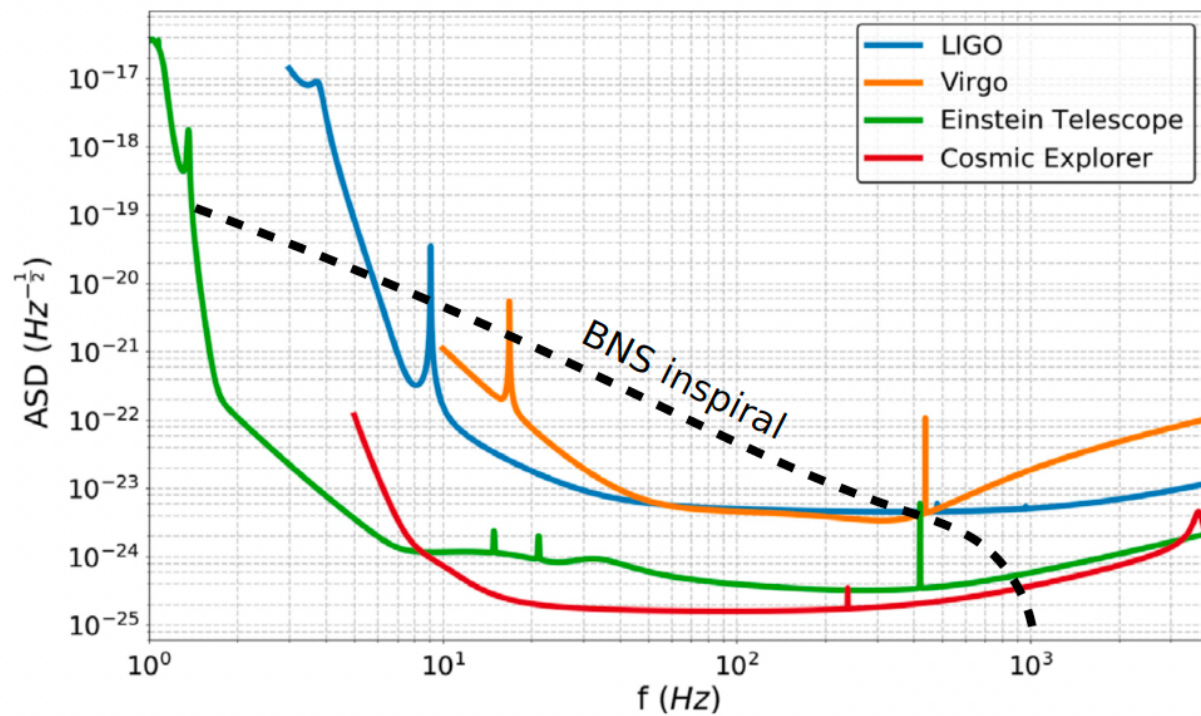
Scenario ii: Structured Jet



Scenario iii: Uniform Jet + Cocoon



(5) short GRBs and next gen GW instruments



Banerjee+ 2023, A&A

GW Parameter estimation



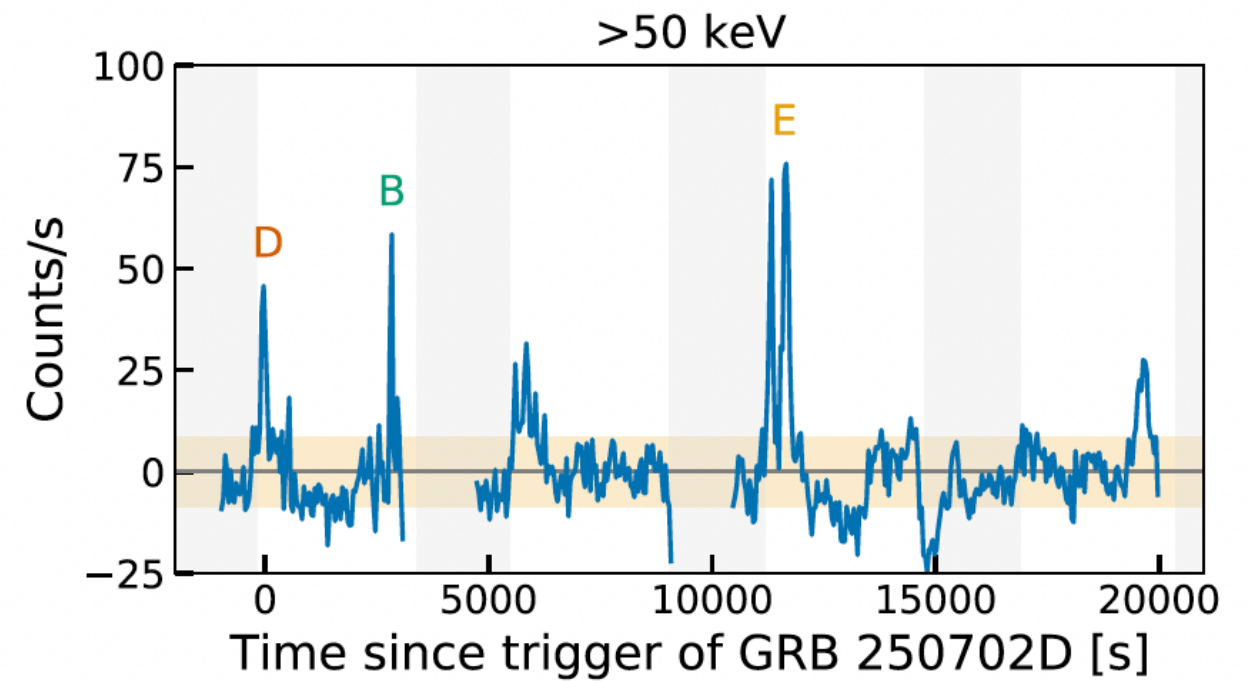
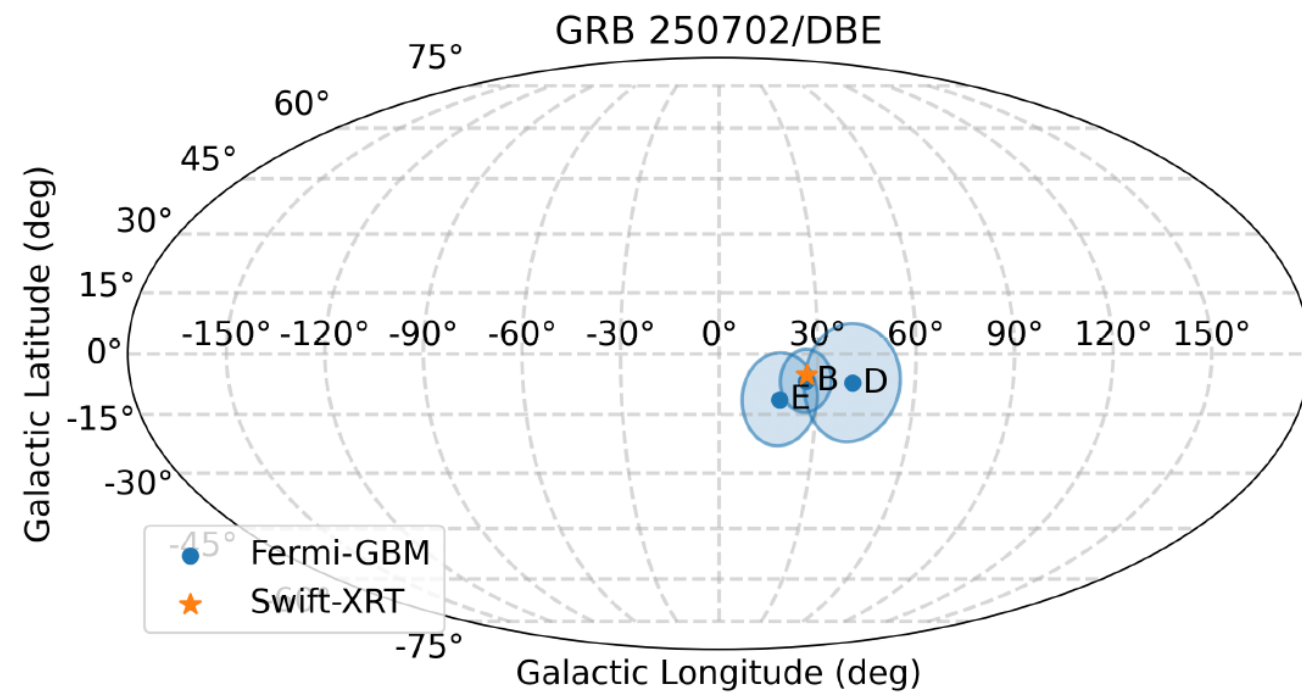
Harms et al. 2022
arXiv:2205.02499

BNS x fraction with jets x jets looking at you

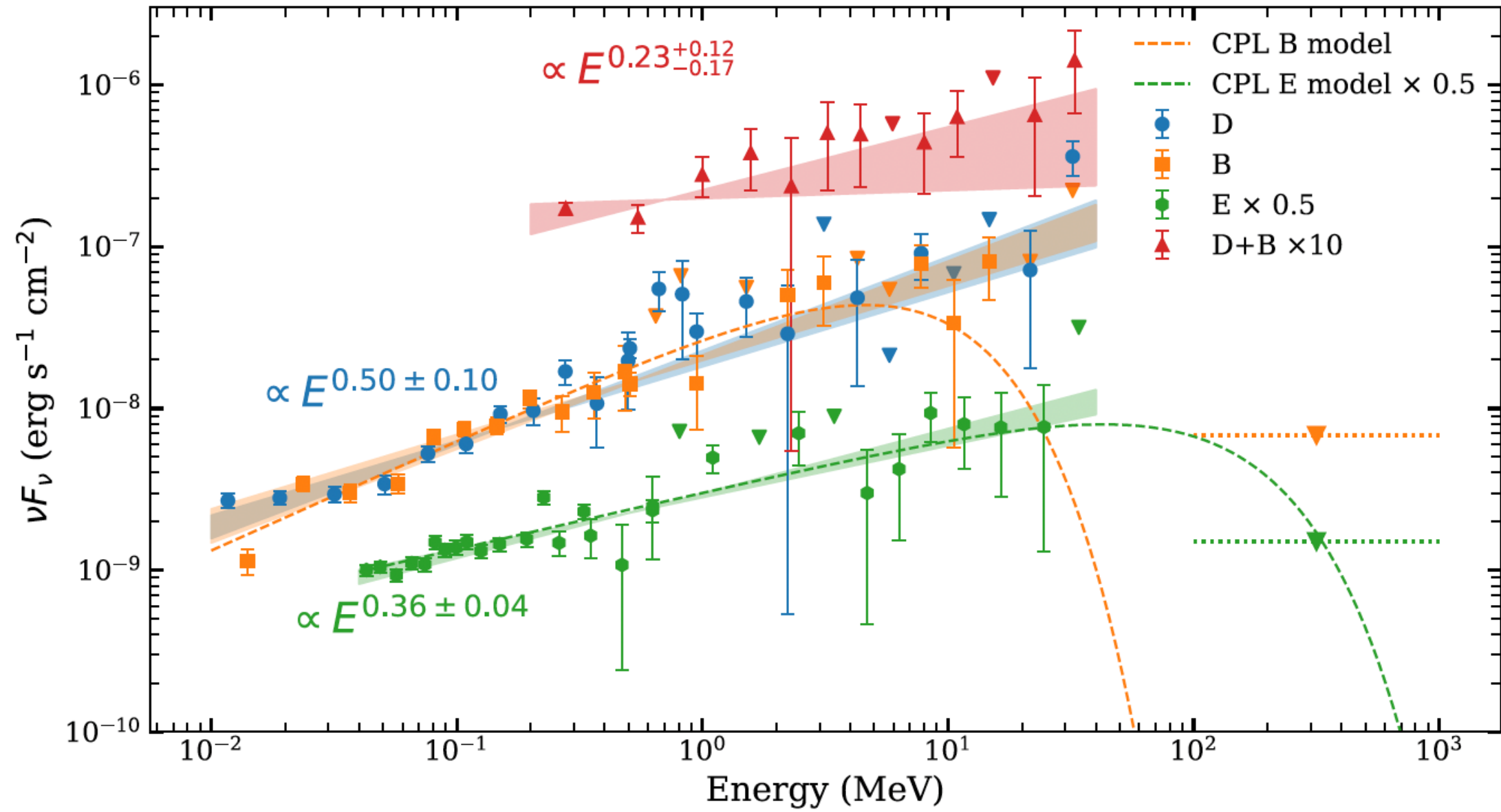
see Ronchini+2022 for joint GW+EM rates

(6) Ultra-long GRBs and 250702B

GRB 250702D/B/E = **250702B**

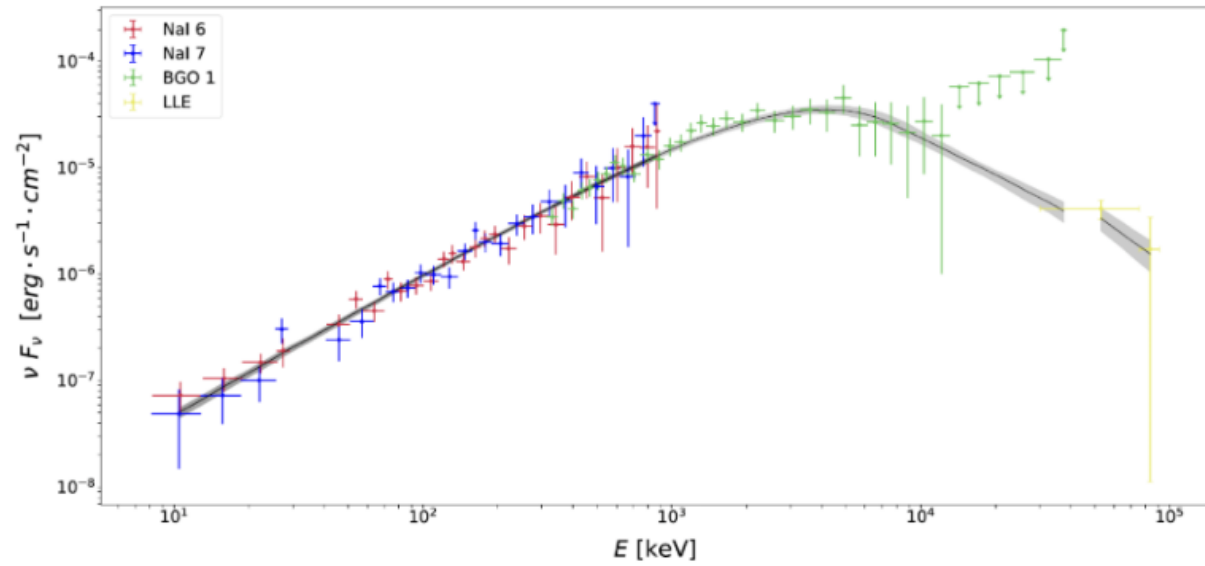
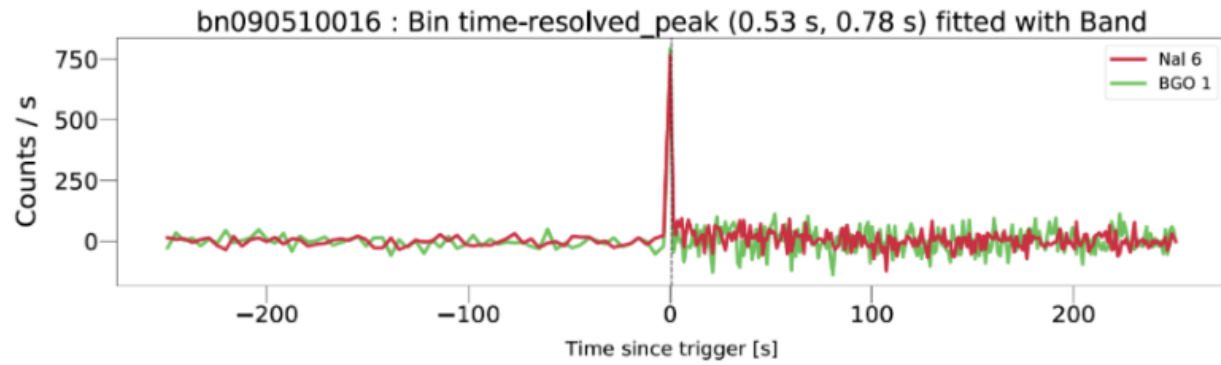


GRB 250702D/B/E = **250702B**

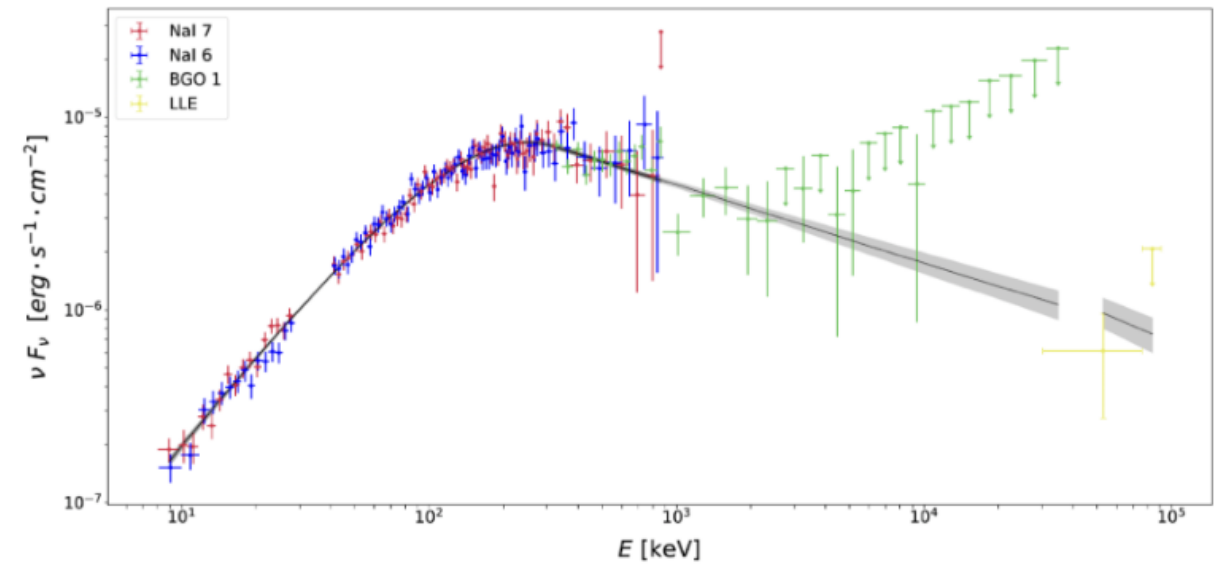
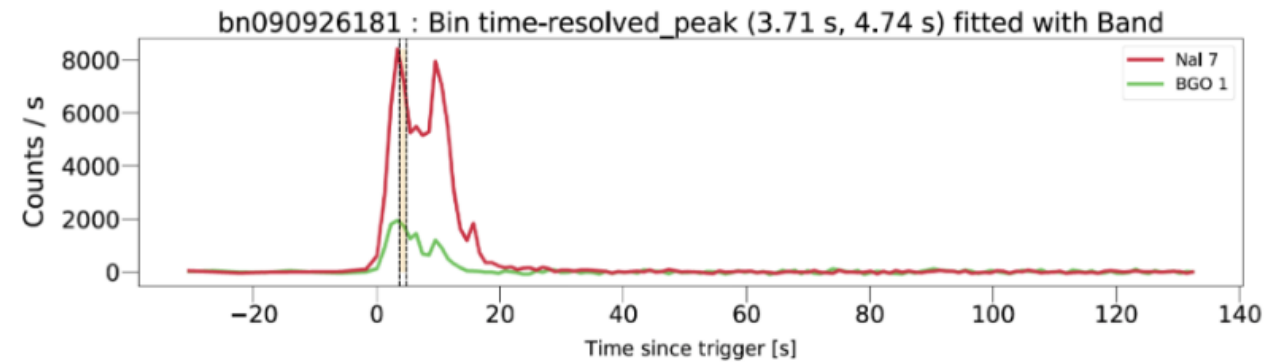


Classical short (~1 s) and long GRBs (~ 20 s)

GRB 090510A

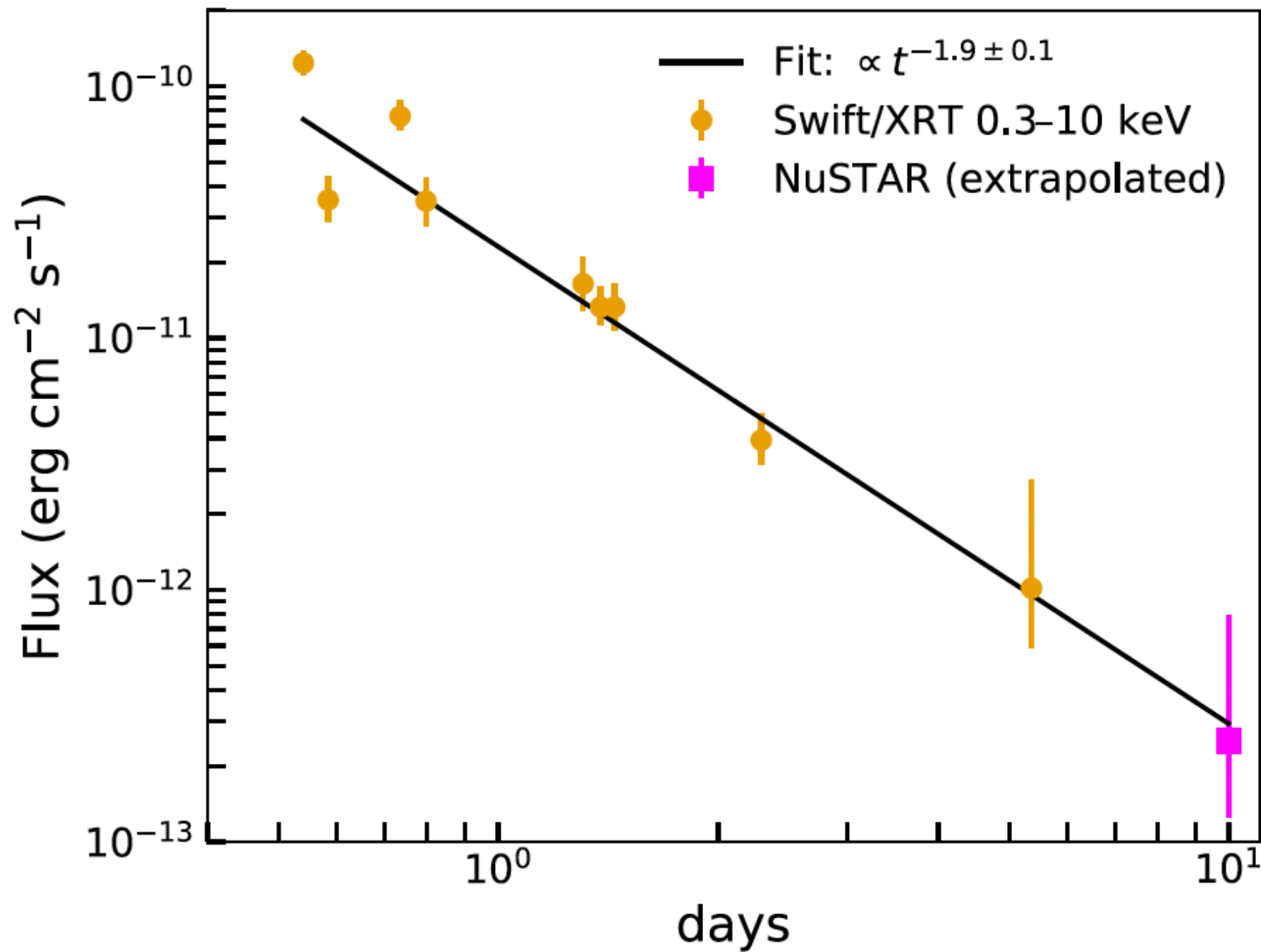


GRB 090926A



Examples taken from Mei+ 2025, A&A

GRB 250702D/B/E = 250702B



Rhoads 1997, ApJ

$$1/\Gamma \ll \theta_j$$

$$\propto t^{-1} \text{ or so}$$

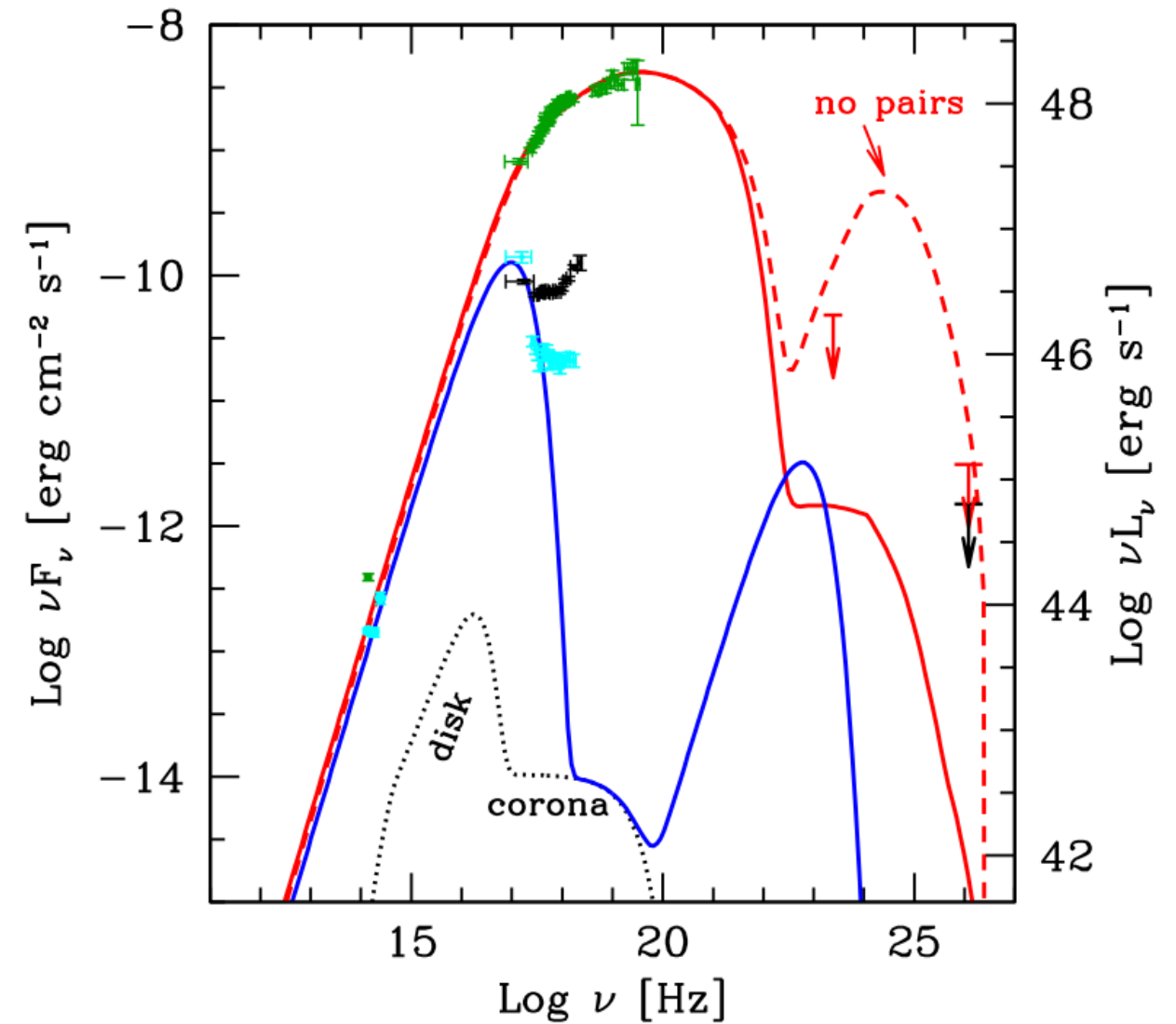
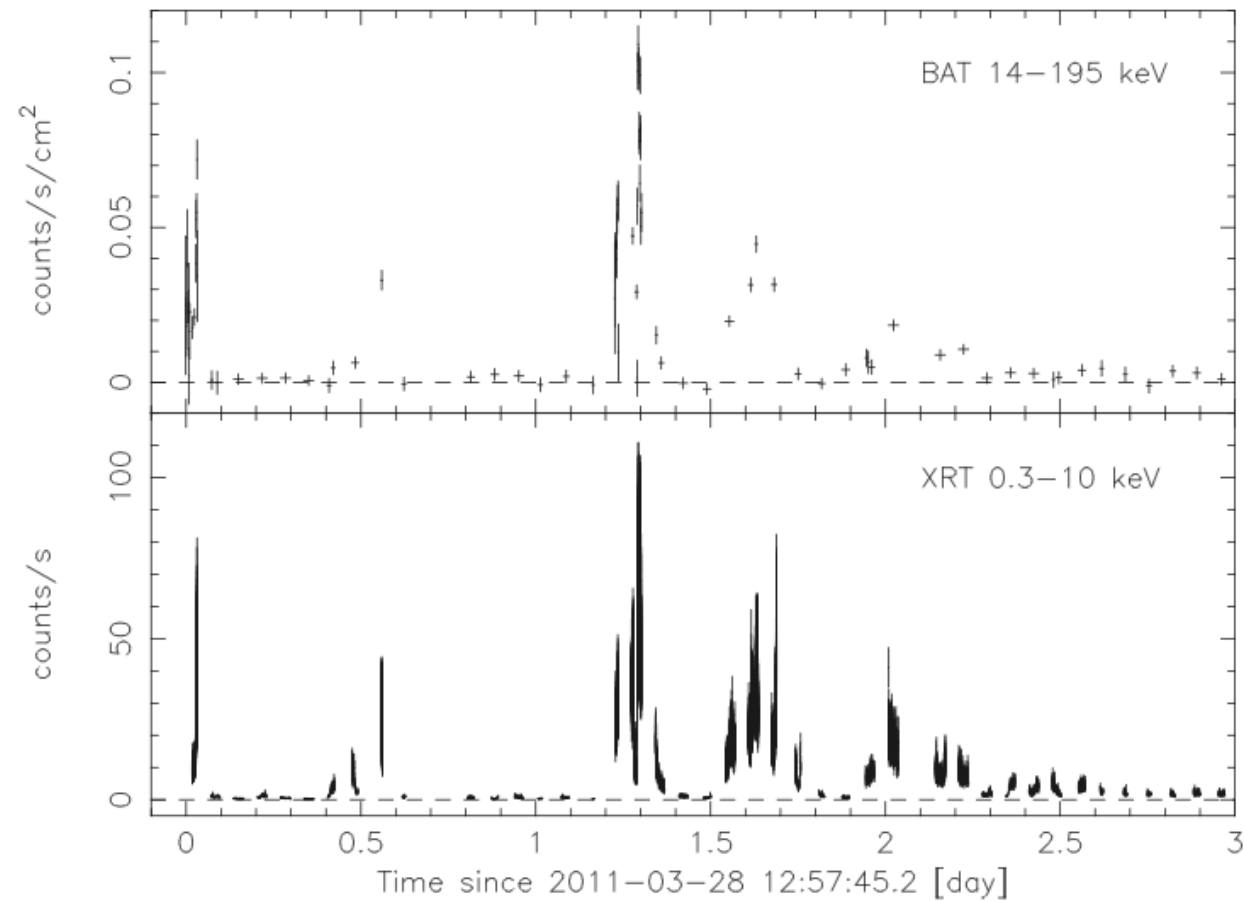
$$1/\Gamma > \theta_j$$

$$\propto t^{-2} \text{ or so}$$

Oganesyan, Kammoun, Ierardi+ *A&A Letter*, 2025

Any similarity to known sources?

Swift J164449.3+573451



Burrows+ 2011, Nature

see also Bloom+2011 Science, Levan+2011 Science

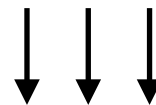
Comparison with other rTDE candidates

Source	$t^{-\alpha_X}$	Γ_X	$L_{X,\text{iso}}$ (erg s ⁻¹)	$E_{X,\text{iso}}$ (erg)	t_v (s)	Γ	z
Swift J1644+57	agree with $t^{-5/3}$ (1)	1.62 ± 0.05 (★,2)	3×10^{48} (2,3)	2×10^{53} (3)	~ 100 (2) ~ 105 (3)	$2 < \Gamma < 20$	0.35
Swift J2058+05	$t^{-2.2}$ (4)	1.61 ± 0.12 (4) 1.47 ± 0.08 (5)	3×10^{47} (4)	$\approx 10^{54}$ (4) $\approx 4 \times 10^{53}$ (5)	$< 10^4$ (4) ~ 500 (5)	> 2.1 (4)	1.19
Swift J1112-82	$t^{-1.1}$ (★★,6)	1.33 ± 0.08 (6)	$\geq 10^{47}$ (6)	—	—	—	0.89
AT2020cmc	$t^{-2 \pm 0.1}$ (7)	1.4 ± 0.2 (7) 1.45 ± 0.06 (8)	$\approx 2.4 \times 10^{47}$ (7) $\geq 10^{48}$ (8)	—	$\sim 4 \times 10^3$ (7) $\leq 10^3$ (8)	≈ 12 (7) ≈ 86 (8, ★ ★ ★)	1.19
DBE	$t^{-1.9 \pm 0.1}$	$\Gamma_X \sim 1.4-1.6$ $\Gamma_\gamma \sim 1.5$	$\approx 4 \times 10^{47} d_{L,100 \text{ Mpc}}^2$	$\approx 10^{50} d_{L,100 \text{ Mpc}}^2$	≤ 100	$10 < \Gamma < 40$	—

References. (1) [Burrows et al. \(2011\)](#); (2) [Levan et al. \(2011\)](#); (3) [Bloom et al. \(2011\)](#); (4) [Cenko et al. \(2012\)](#); (5) [Pasham et al. \(2015\)](#); (6) [Brown et al. \(2015\)](#); (7) [Andreoni et al. \(2022\)](#); (8) [Pasham et al. \(2023\)](#).

Oganessian, Kammoun, Ierardi+ *A&A Letter*, 2025

variability (Rees 1988) $\rightarrow$ IMBH+WD? Krolik & Piran 2011



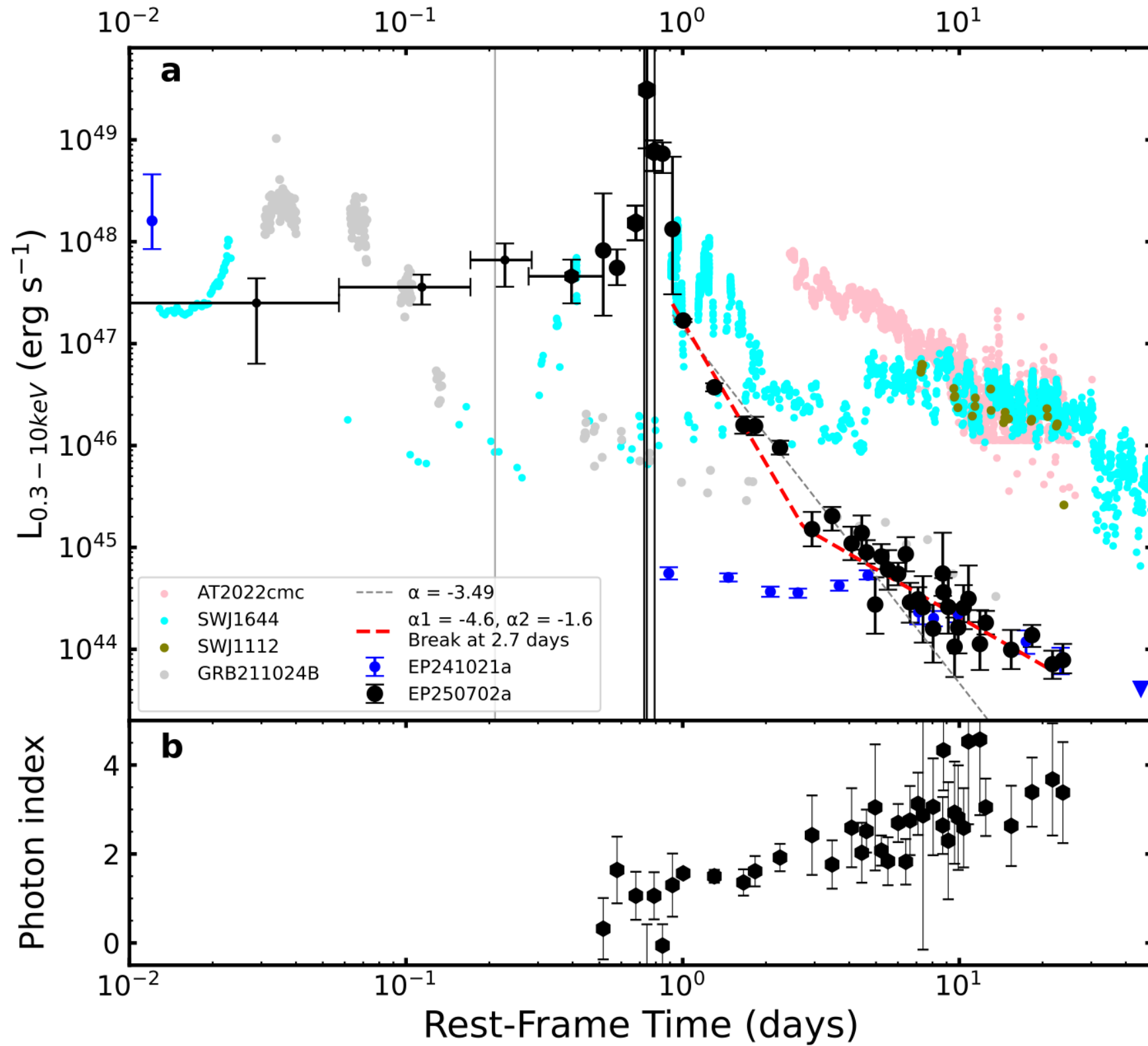
LGWA Science case Ajith+ 2024

see Toscani+2020

Classical GRBs vs 250702B

MeV duration	0.1-100 s	~ 3 hours see Levan+2014, ApjL for ULGRBs
MeV spectrum	hard index & ~ 1 MeV as max. energy	soft index & multiple MeV see Neights+ 2025 for differences
spectral-energy relations	Amati, Yonetoku, Ghirlanda	X
afterglow	t^{-1} or so	t^{-2}
thermal transients	Long GRBs (> 2 s) - SN Short GRBs (< 2 s) - KN	none Gompertz+2025

250702B (250702A in EP) uncovered by Einstein Probe



Progenitors

Levan+ 2025, ApjL

extragalactic origin
unusual collapsar or rTDE (IMBH+WD)

Oganesyan, Kammoun, Ierardi+ 2025, A&A

rTDE

Gompertz+2025, arXiv 2509.22778

$z=1.036\pm0.004$ (JWST)
no supernova
large, dusty, massive host galaxy

Neights+ 2025 arXiv 2509.22792

Fermi/GBM in depth analysis
BH fall into stripped star

O'Connor+2025, arXiv 2509.22787
Beniamini+2025, arXiv 2509.22779

micro TDE

Li+2025,
arXiv 2509.25877

Einstein Probe
soft X-ray -1 + 10 days
rTDE (IMBH+WD)

+ see also Carney+2025 arXiv:2509.22784; Zhang+2025, arXiv:2509.26283

Thank you!