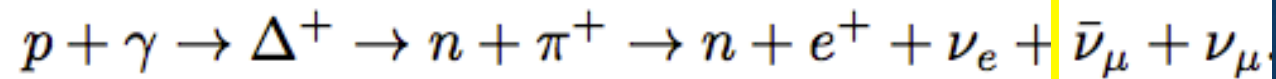


低輝度ガンマ線バーストからの ニュートリノ放射

坂本 貴紀 (青学大)

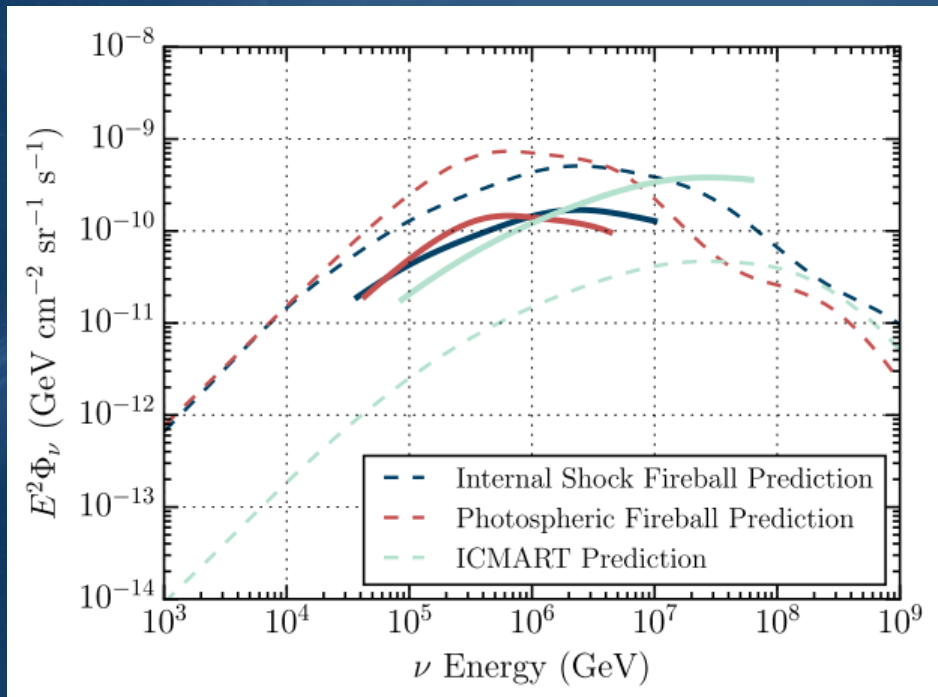
Neutrino from GRBs ?

(Meszaros 2015)



IceCube (Aartsen+ 2017):

508 GRBs (Northern Hemisphere), 664 GRBs (Southern Hemisphere)

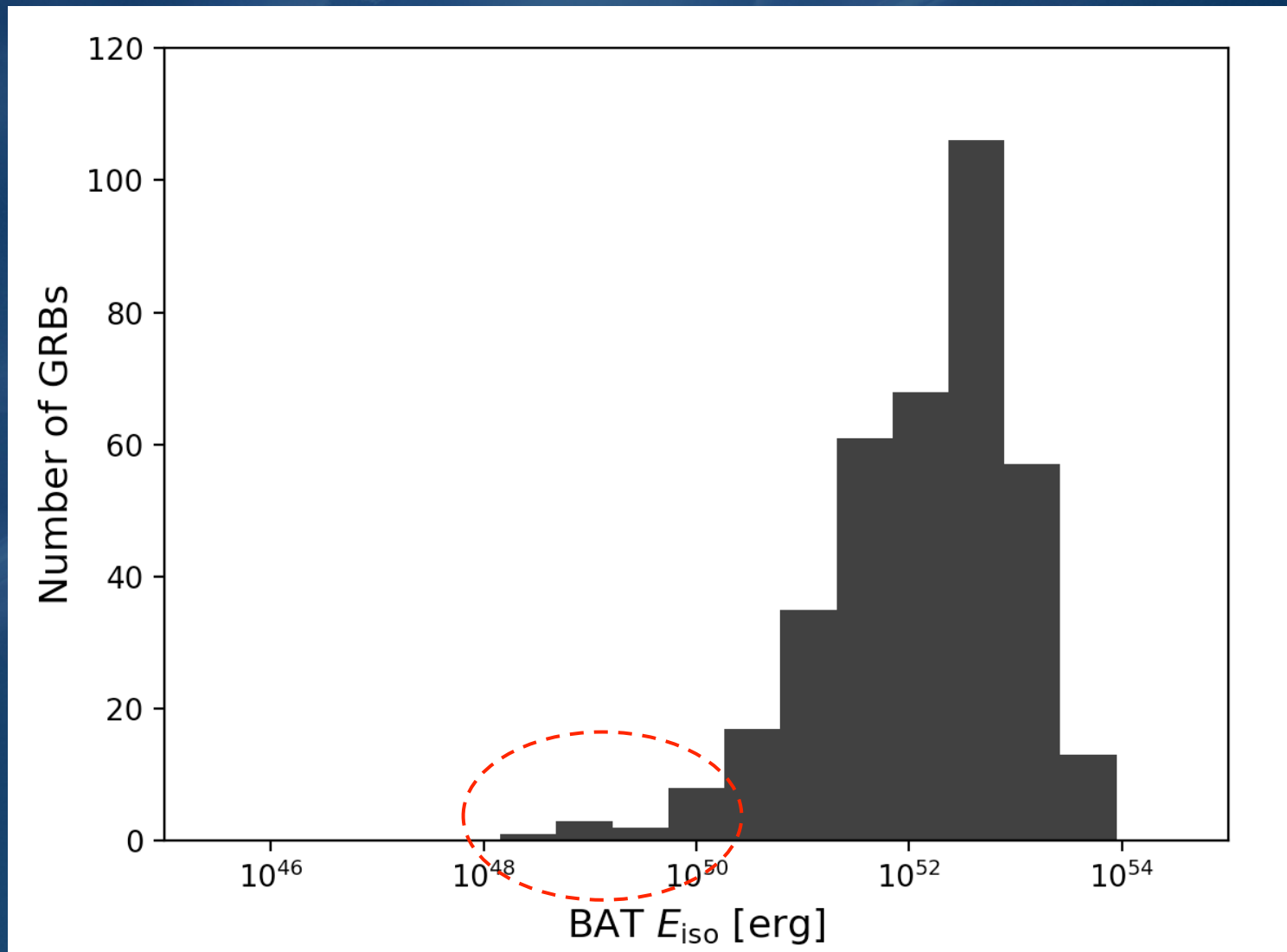


Other type of GRBs with potential ν

- Low-luminosity GRBs (LLGRBs)
- Choked GRBs (failed GRBs)
- Shock breakout GRBs

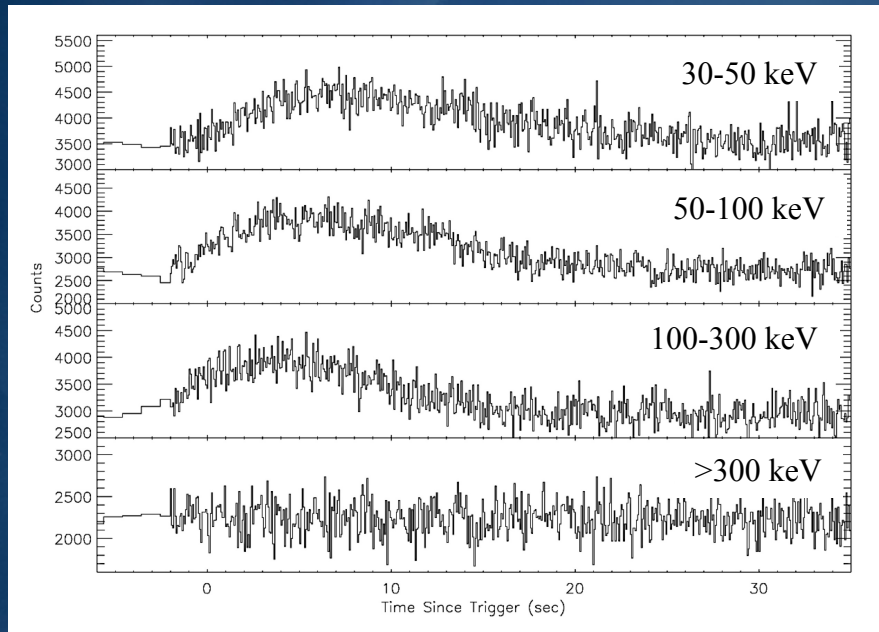
Low-Luminosity GRBs (LLGRBs)

372 known-z Swift/BAT Long GRBs ($T_{90} > 2$ s; BAT 3rd GRB Catalog, Lien et al. 2016)



GRB 980425

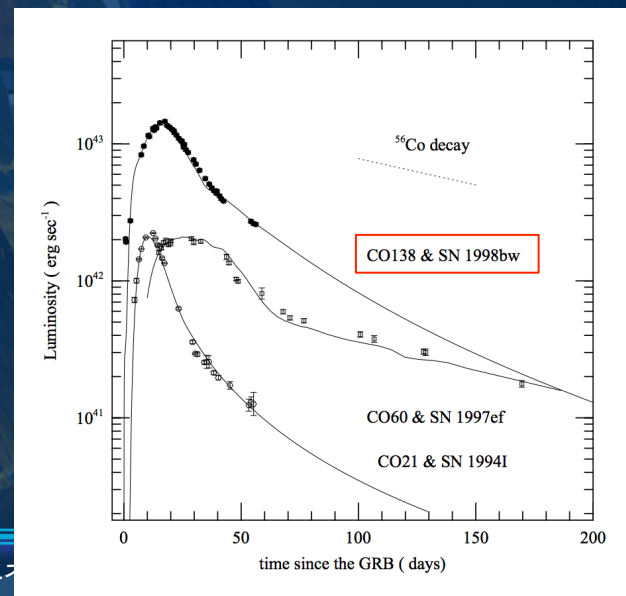
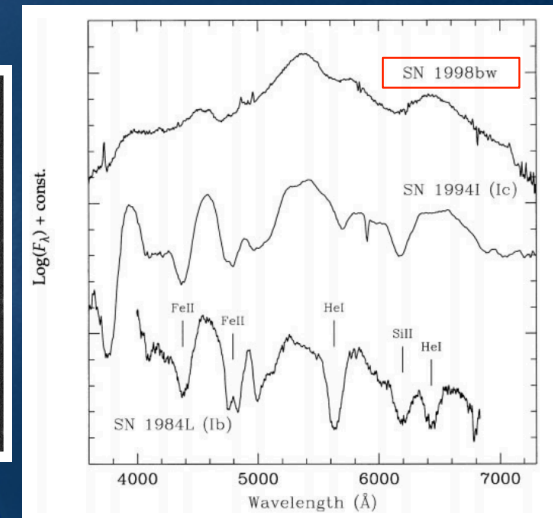
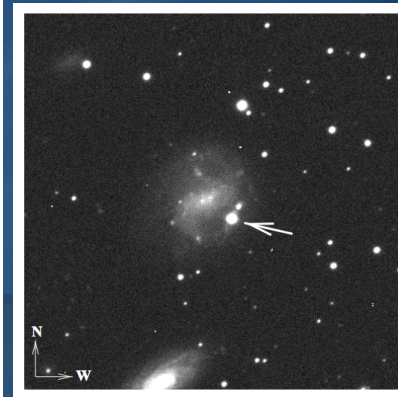
GRB 980425/SN1998bw (BATSE; Bloom et al. 1998)



- $z = 0.0085$
- $E_{\text{iso}} = (1.0 \pm 0.2) \times 10^{48} \text{ erg}$
- $E_{\text{peak}}^{\text{src}} = 55 \pm 21 \text{ keV}$
- Association to SN1998bw

GRB 031203/SN2003lw (INTEGRAL/IBIS; Sazonov et al. 2004)

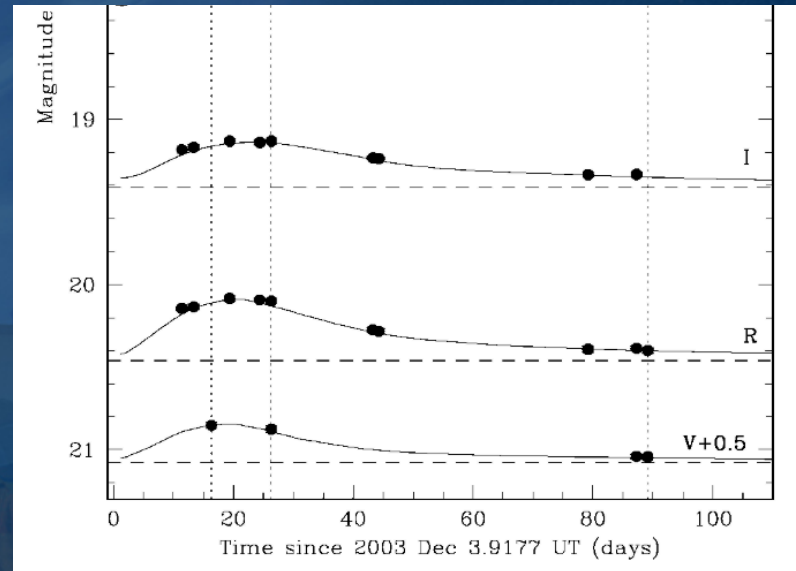
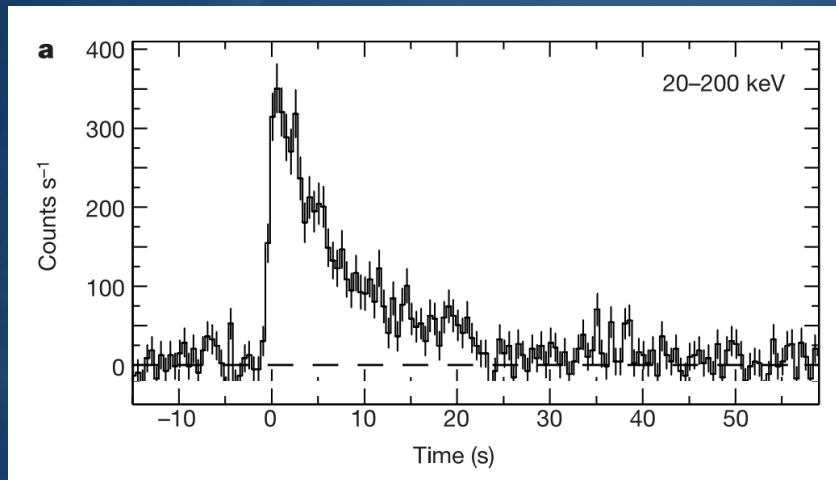
Image, spectrum and light curve of SN 1998bw (Galama et al. 1999; Iwamoto et al. 1998)



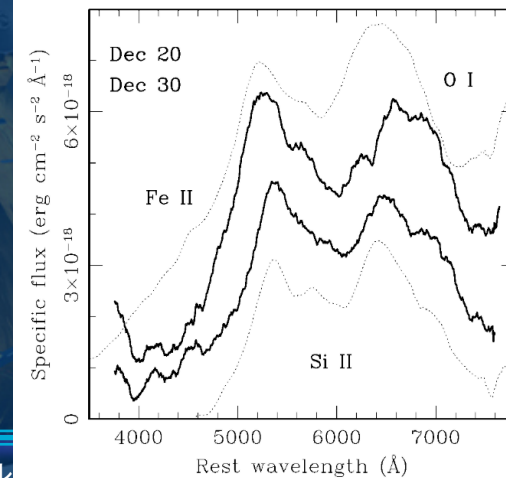
GRB 031203

GRB 031203/SN2003lw
(INTEGRAL/IBIS; Sazonov et al. 2004)

Optical afterglow of GRB 031203
(Malesani et al. 2004)



- $z = 0.1005$
- $E_{\text{iso}} (4 \pm 1) \times 10^{49} \text{ erg}$
- $E_{\text{peak}} = 89 (-56/+171) \text{ keV}$
- Association to SN2003lw



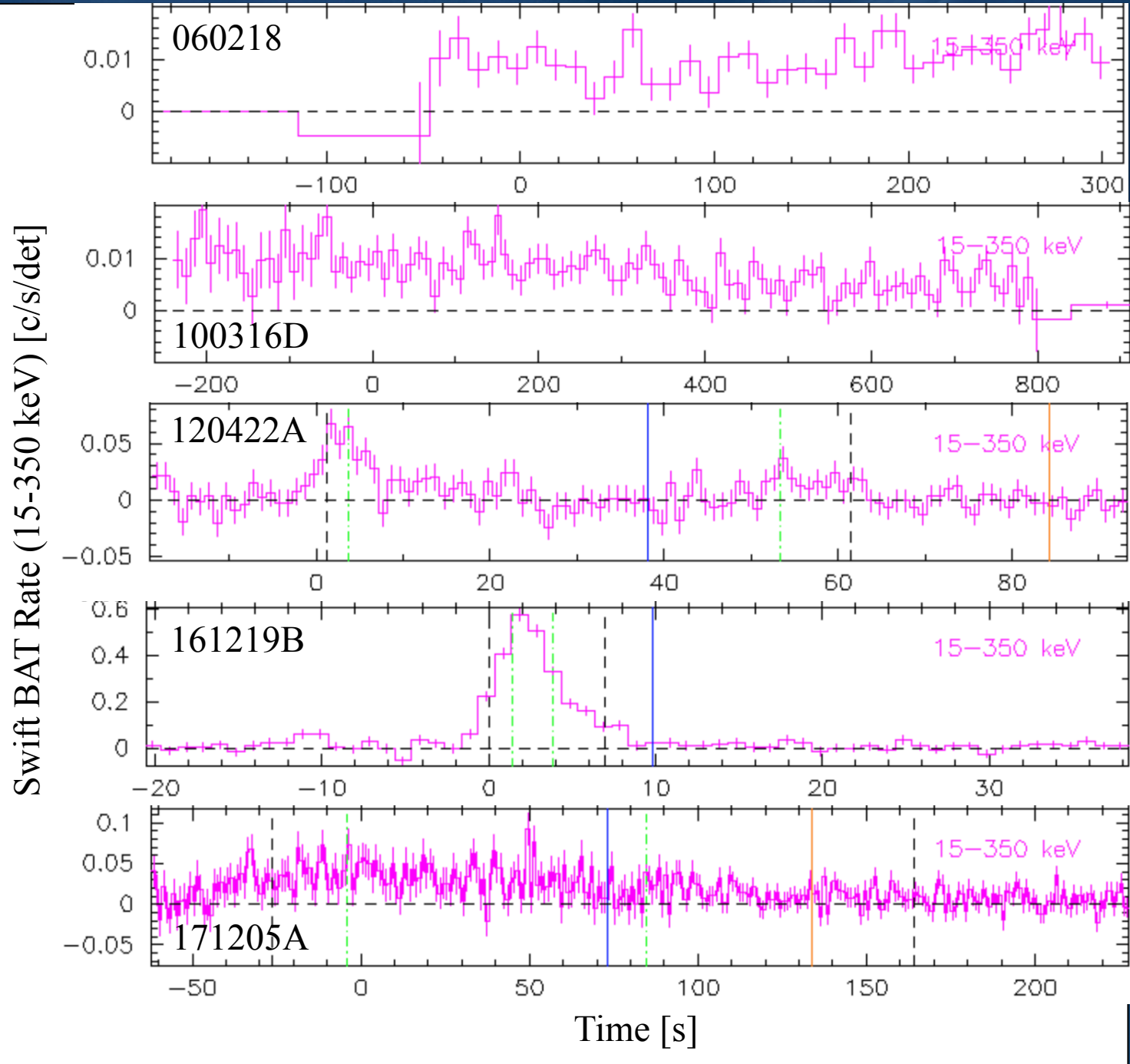
Search for LLGRBs in the BAT 3rd GRB Catalog

- 372 known-z Swift BAT long GRBs ($T_{90} > 2$ s; BAT 3rd GRB Catalog)
- BAT $E_{\text{iso}} < 1 \times 10^{50}$ erg

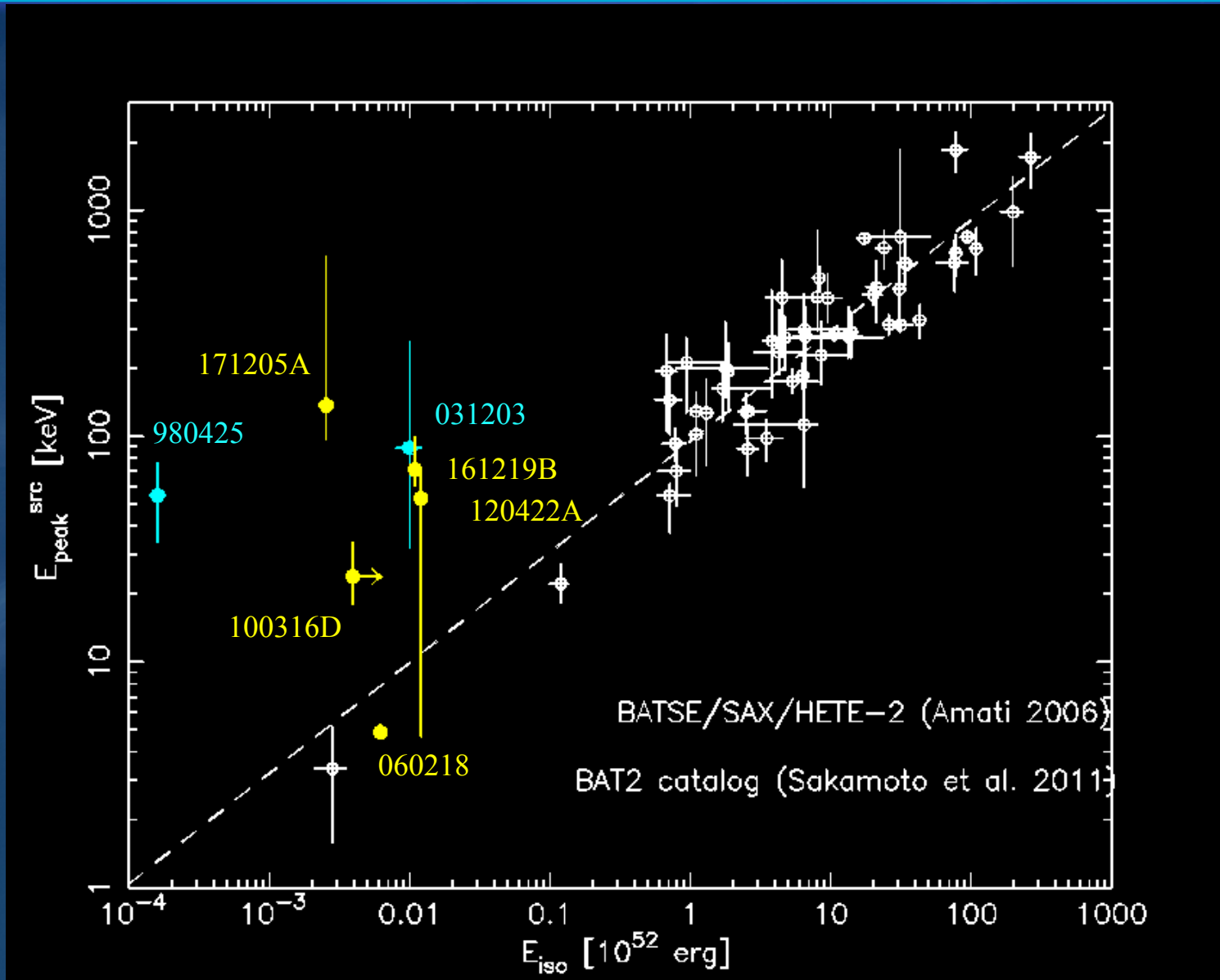
GRB	z	BAT E_{iso} [erg]	SN	AG Detection
060218	0.0331	6.2×10^{49}	2006aj	Radio, Opt, UV, X
100316D	0.0591	2.5×10^{49}	2010bh	Radio, Opt, UV, X
120422A	0.28253	6.2×10^{49}	2012bz	Opt, UV, X
161219B	0.1475	7.7×10^{49}	2016jca	Radio, Opt, UV, X
171205A	0.037	1.0×10^{49}	2017iuk	Radio, Opt, UV, X

- **Low redshift ($z < 0.3$)**
- **Association to supernova**
- **Afterglow detections in multi-wavelengths**

LLGRBs: Prompt Emission



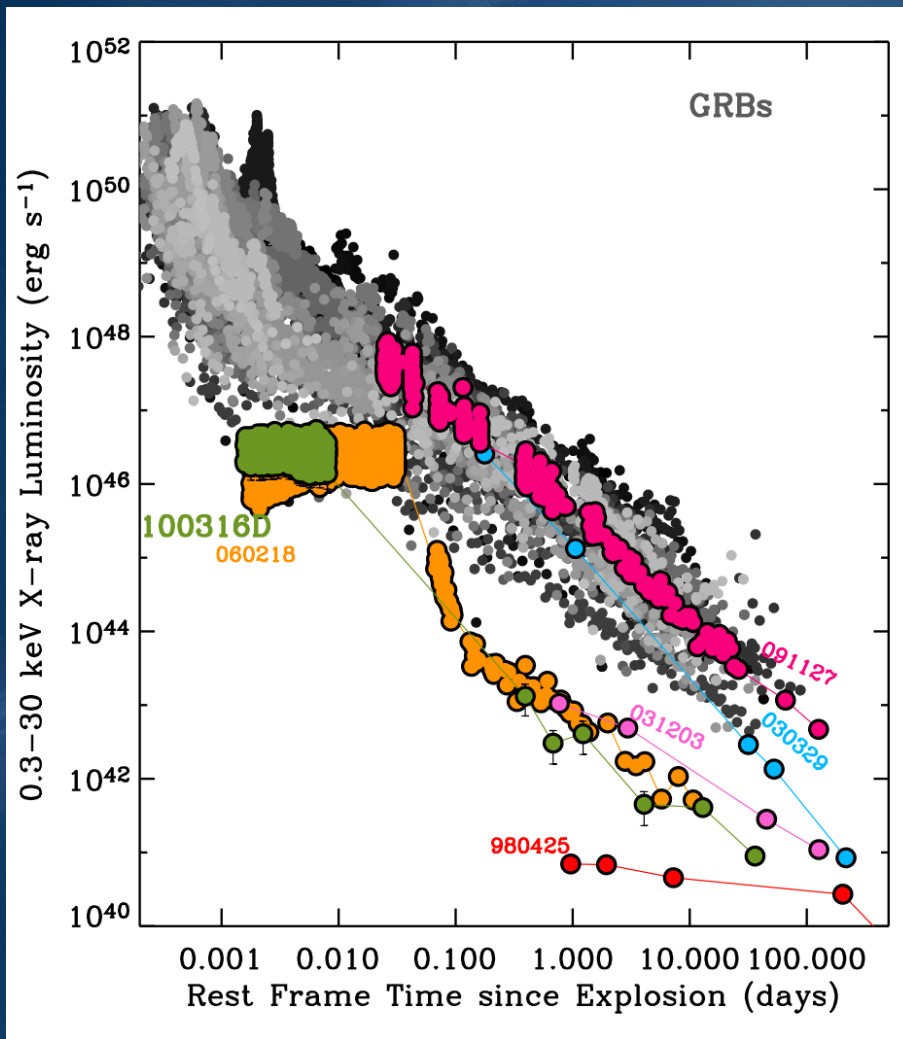
LLGRBs: $E_{\text{peak}} - E_{\text{iso}}$ relation



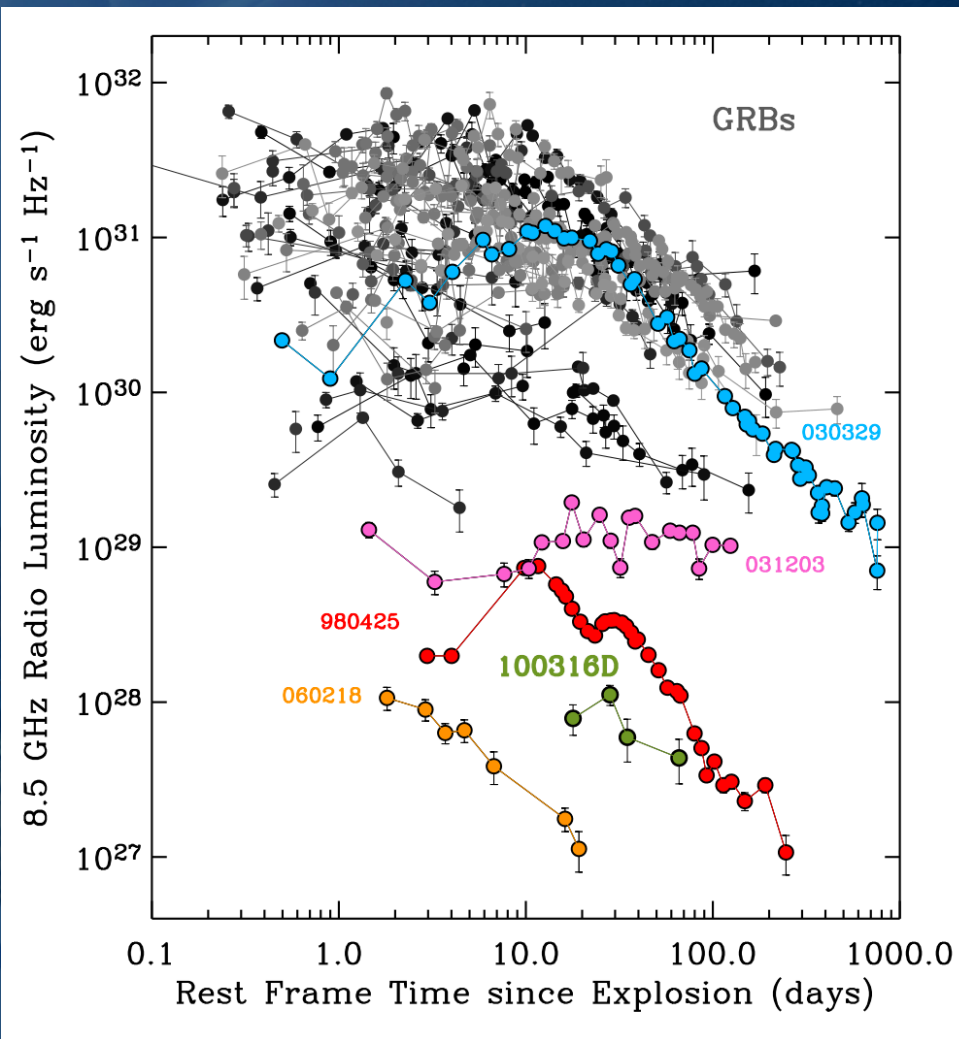
LLGRBs: X-ray and Radio Afterglow

Margutti et al. 2013

X-ray

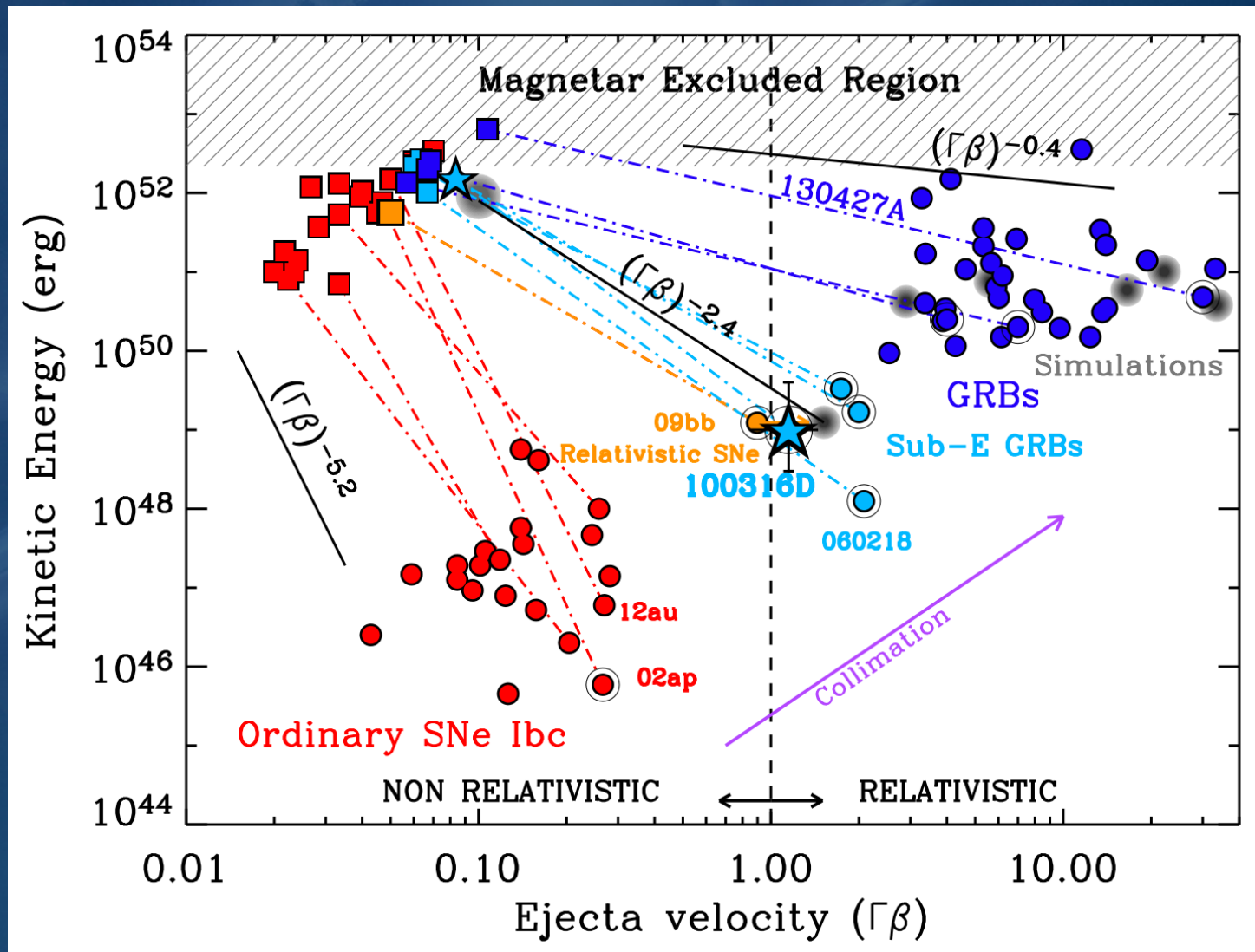


Radio



LLGRBs: Bridge between SNe and GRBs?

Margutti et al. 2013



Summary

- LLGRBs are rare (5 LLGRBs / 372 known-z Swift/BAT GRBs).
- LLGRBs are low-z and associated to supernova.
- Prompt emission of LLGRBs are tend to be smooth and long.
- Many LLGRBs are outlier of $E_{\text{peak}}-E_{\text{iso}}$ relation
- Afterglow of LLGRBs are observed in multi-wavelengths. The luminosity of afterglow is weaker than that of typical GRBs.
- LLGRBs might bridge between ordinary supernova and typical relativistic GRBs.
- Larger number of LLGRBs will detect by future high sensitive wide filed of view soft X-ray survey such as Einstein Probe and HiZ- GUNDAM.

Gamma-ray Bursts in the Gravitational Wave Era 2019

Date: October 28 – November 1, 2019

Venue: Red Brick Warehouse, Yokohama, Kanagawa

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SOC:

L. Amati, J.-L. Atteia, B. Cenko, V. Connaughton, J. Greiner, P. Meszaros, P. O'Brien, T. Piran, J. Racusin, L. Singer, N. Tanvir, E. Troja, W. Xiang-Yu, B. Zhang, K. Asano, K. Ioka, N. Kanda, N. Kawai, K. Toma, Y. Fukazawa, K. Murase, R. Yamazaki, M. Yoshida, D. Yonetoku

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