REST-FRAME PROPERTIES OF GBM GAMMA-RAY BURSTS

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SCIENTIFIC RATIONALE

- rest-frame properties crucial in understanding GRBs
- many rough correlations between various rest-frame properties already exist
- ultimate goals:
  - using GRBs for cosmology
  - having a luminosity indicator for every GRB

THE GBM INSTRUMENT

Strengths

- whole unocculted sky
- 8 keV - 40 MeV
- great temporal resolution for triggered GRBs

Weakness

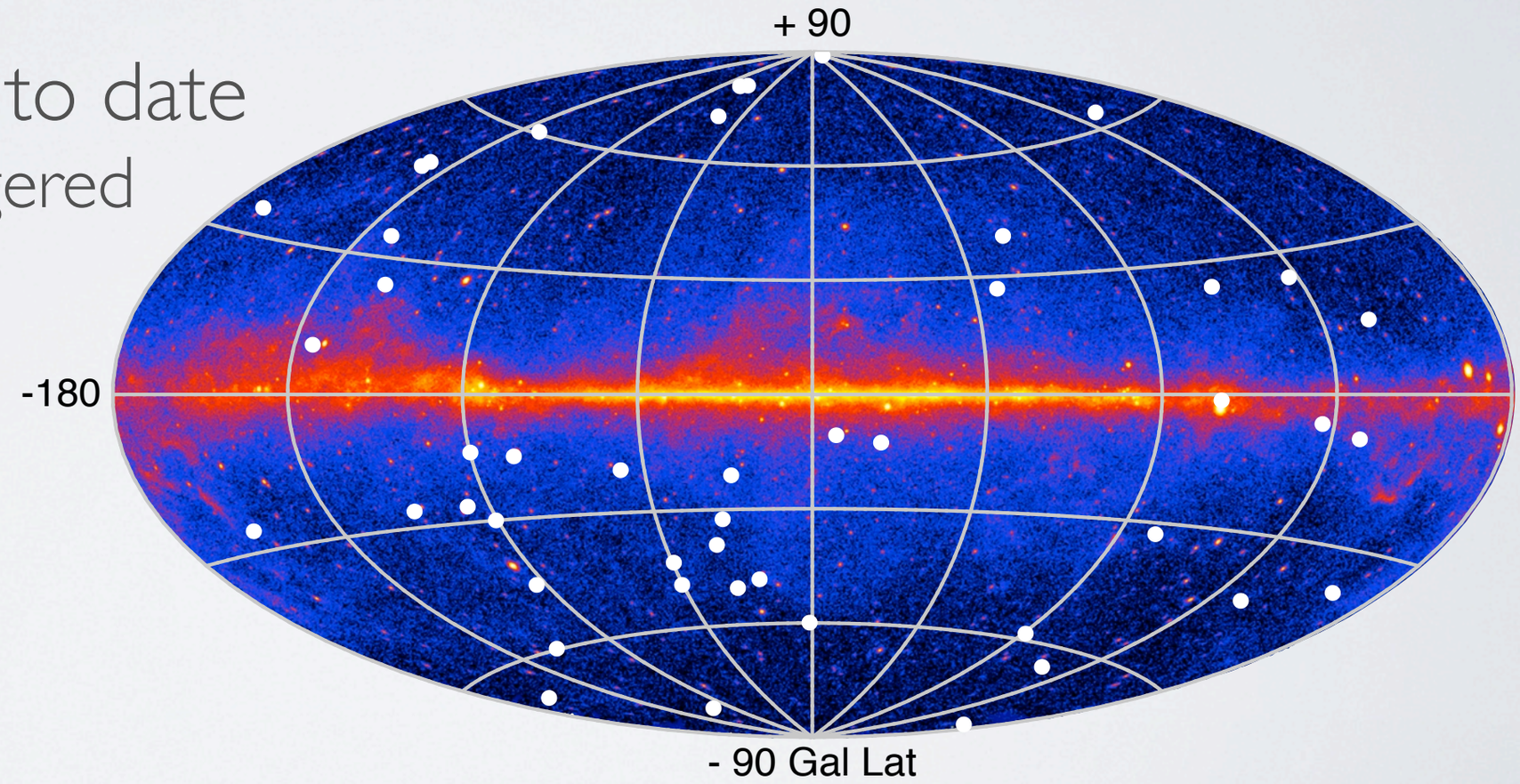
- large localization uncertainties

GBM-GRBS IN NUMBERS

- 917 GRBs detected to date (plus at least 16 untriggered GRBs. See **P-II-15**)

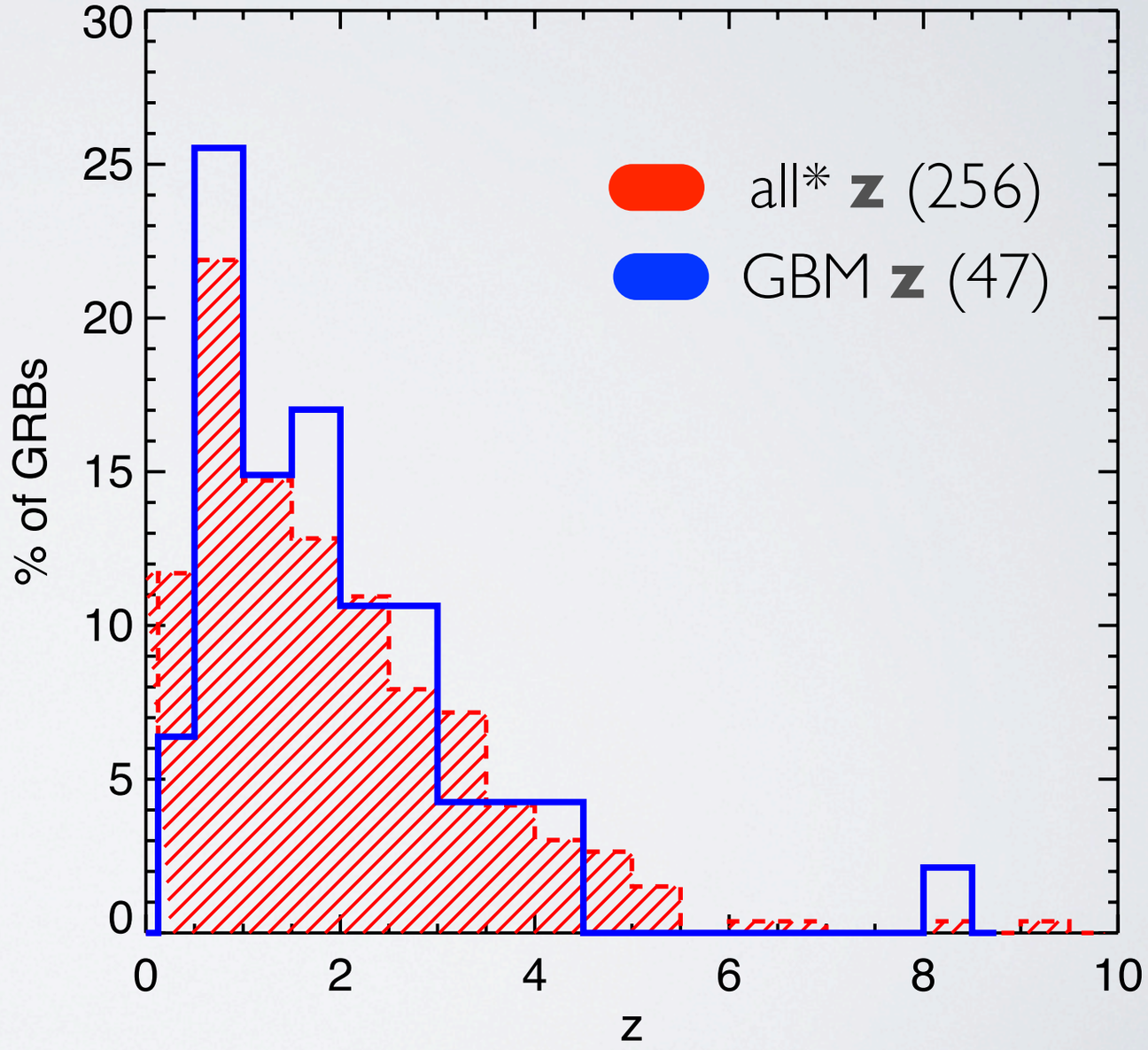
- ~ 0.70 GRBs/day or ~ 1 GRB/1.5 days

- 47 GRBs with *z* ≙ 5% of full sample



REDSHIFT DISTRIBUTION

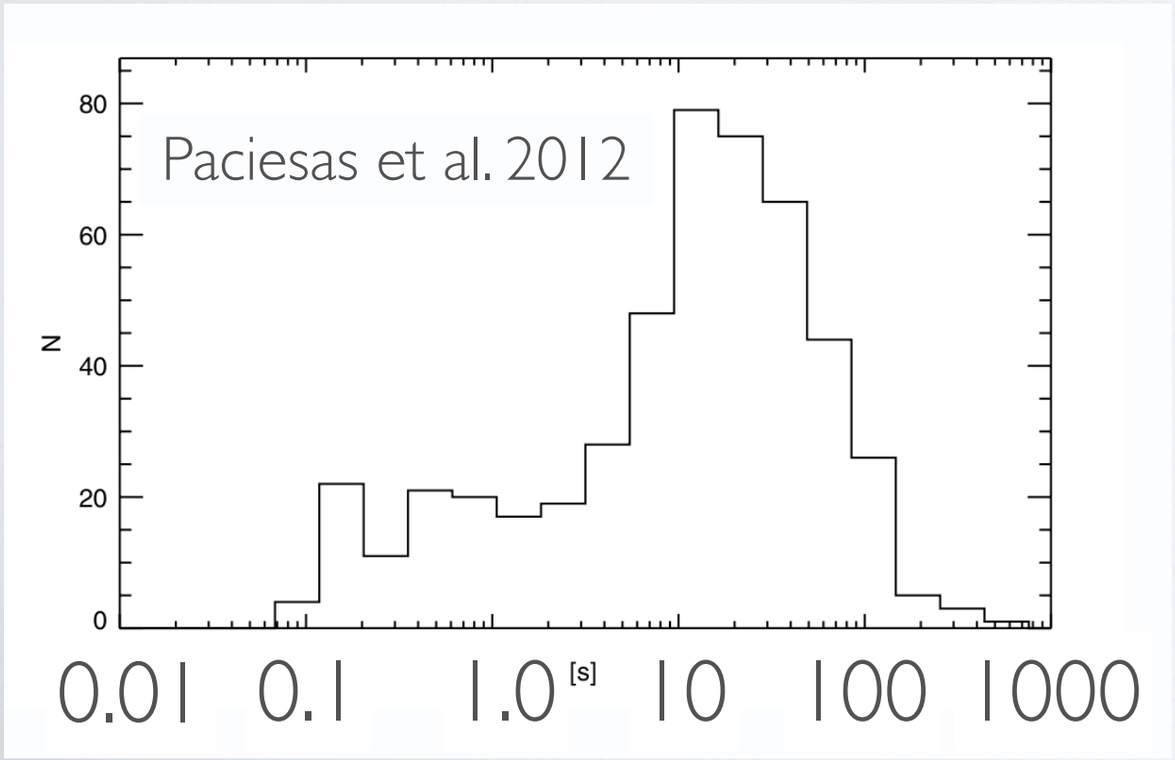
- selection only based on *z* determination
- GBM sample consistent with full sample

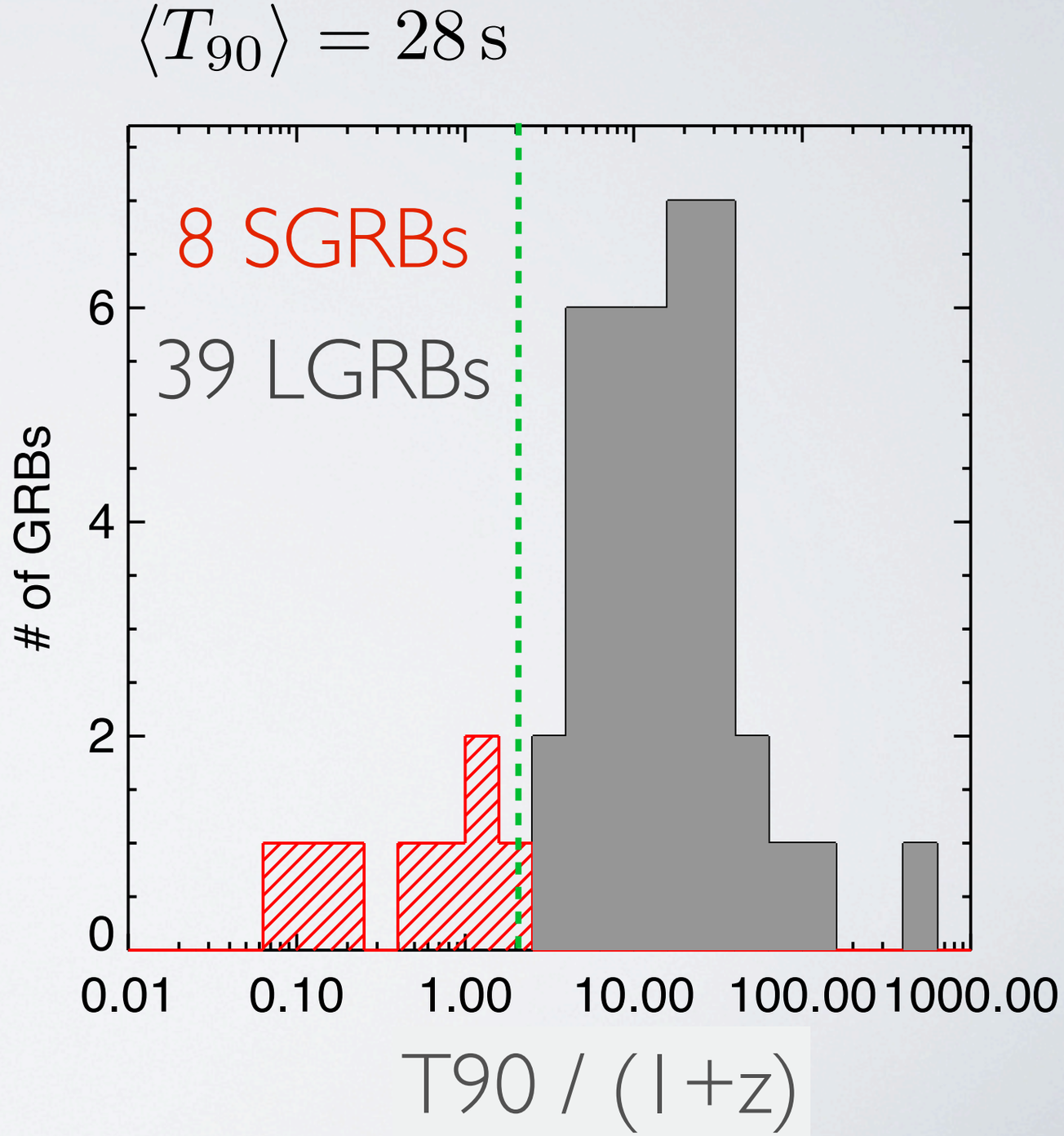


*http://www.mpe.mpg.de/~jcg/grbgen.html

THE DURATION

- T_{90} method
- count space
- 100/(1+z) - 500/(1+z) keV



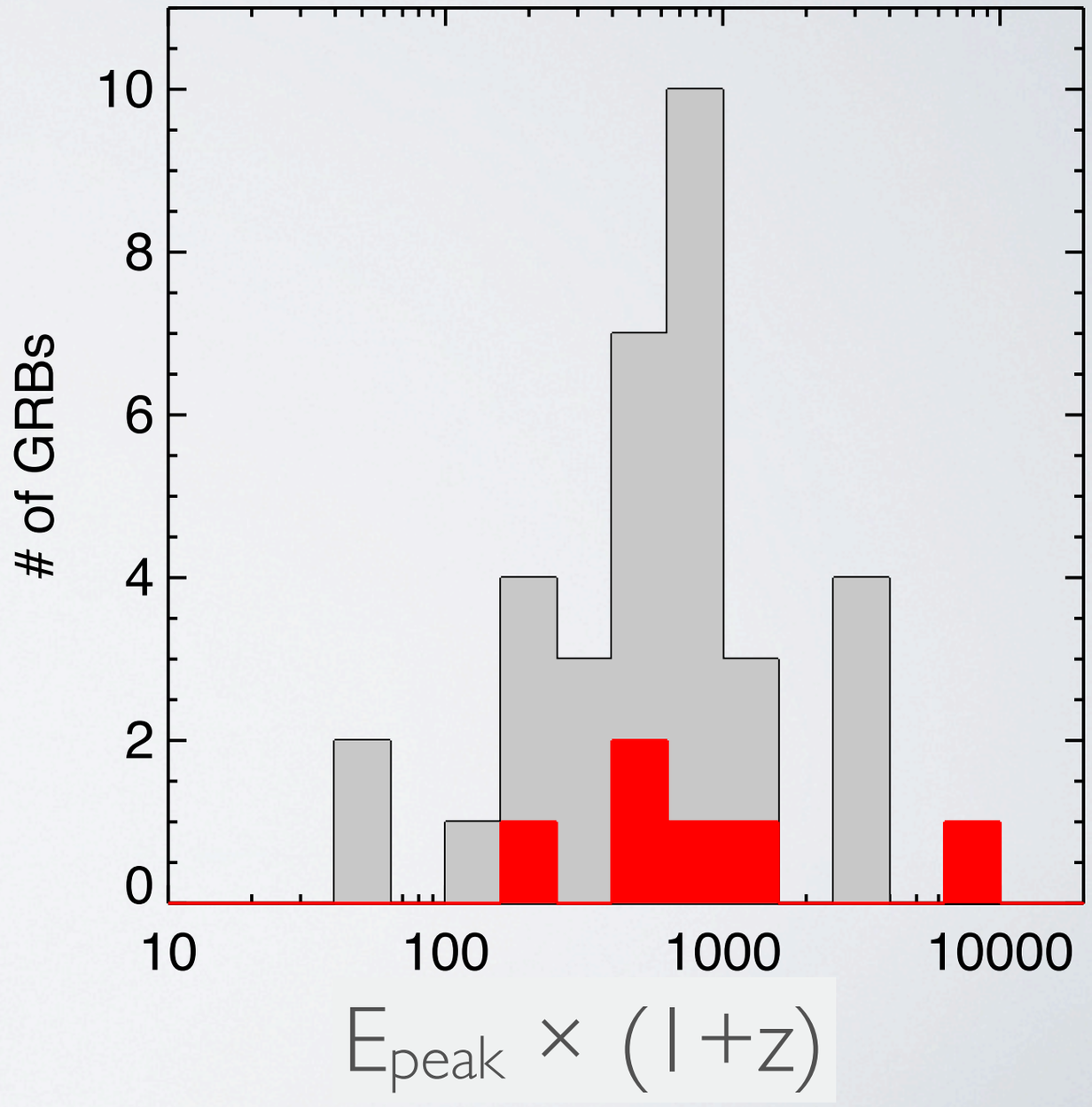


THE PEAK ENERGY

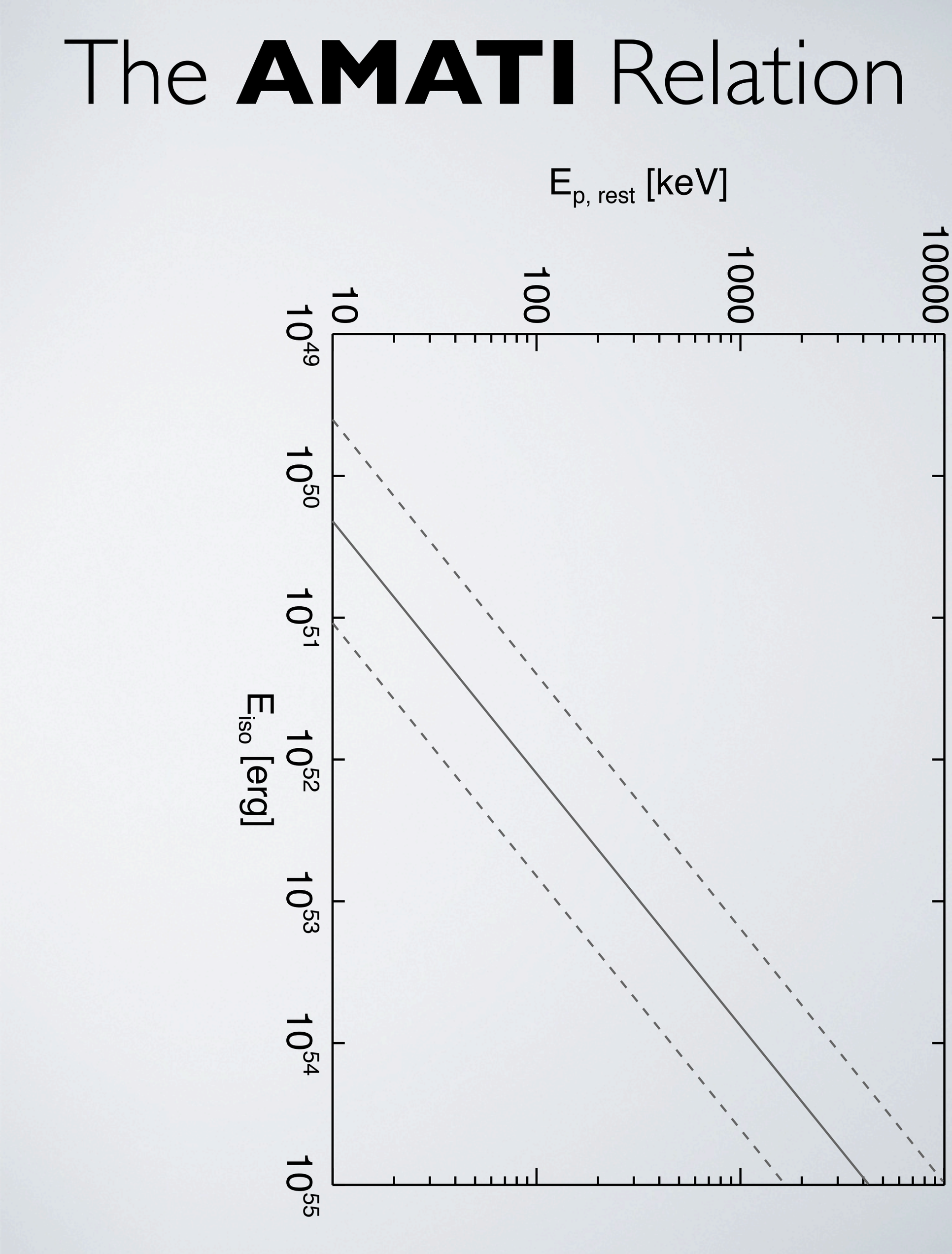
- data taken from, and addtional analysis consistent with, *Goldstein et al. 2012*

- PL (7), COMP (25), BAND, (10), SBPL (5)

- mean $E_{peak} \approx 700$ keV



The **AMATI** Relation



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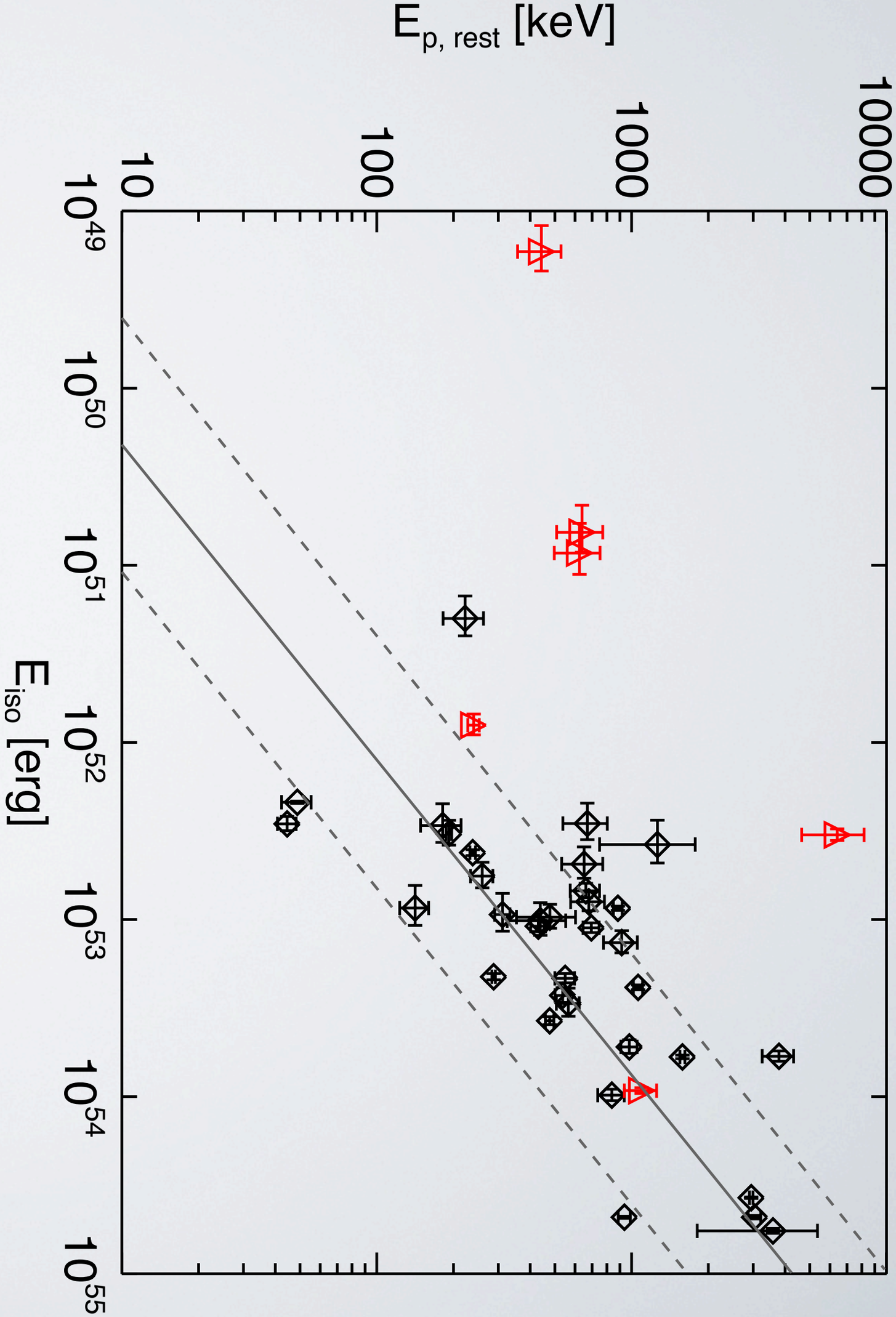

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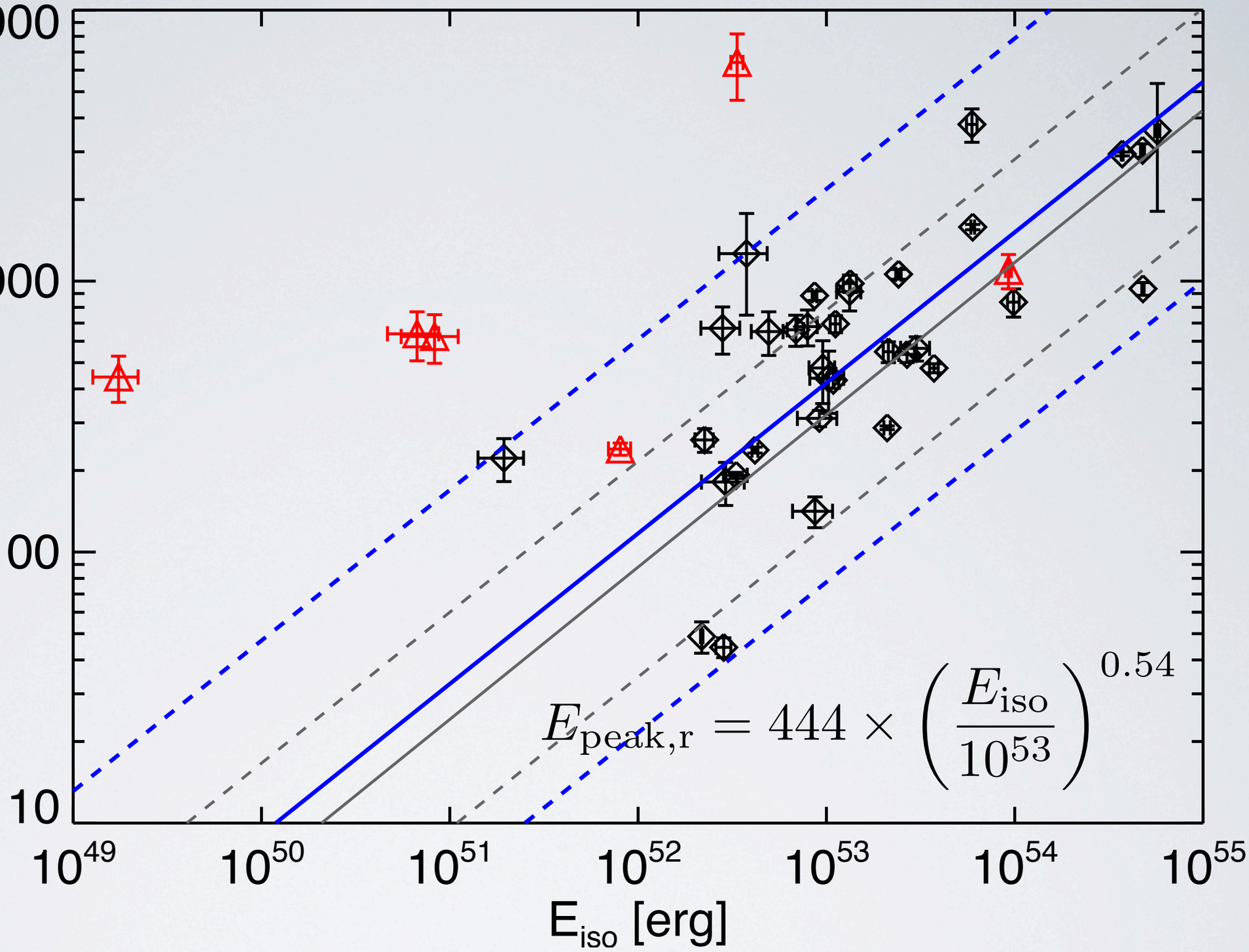
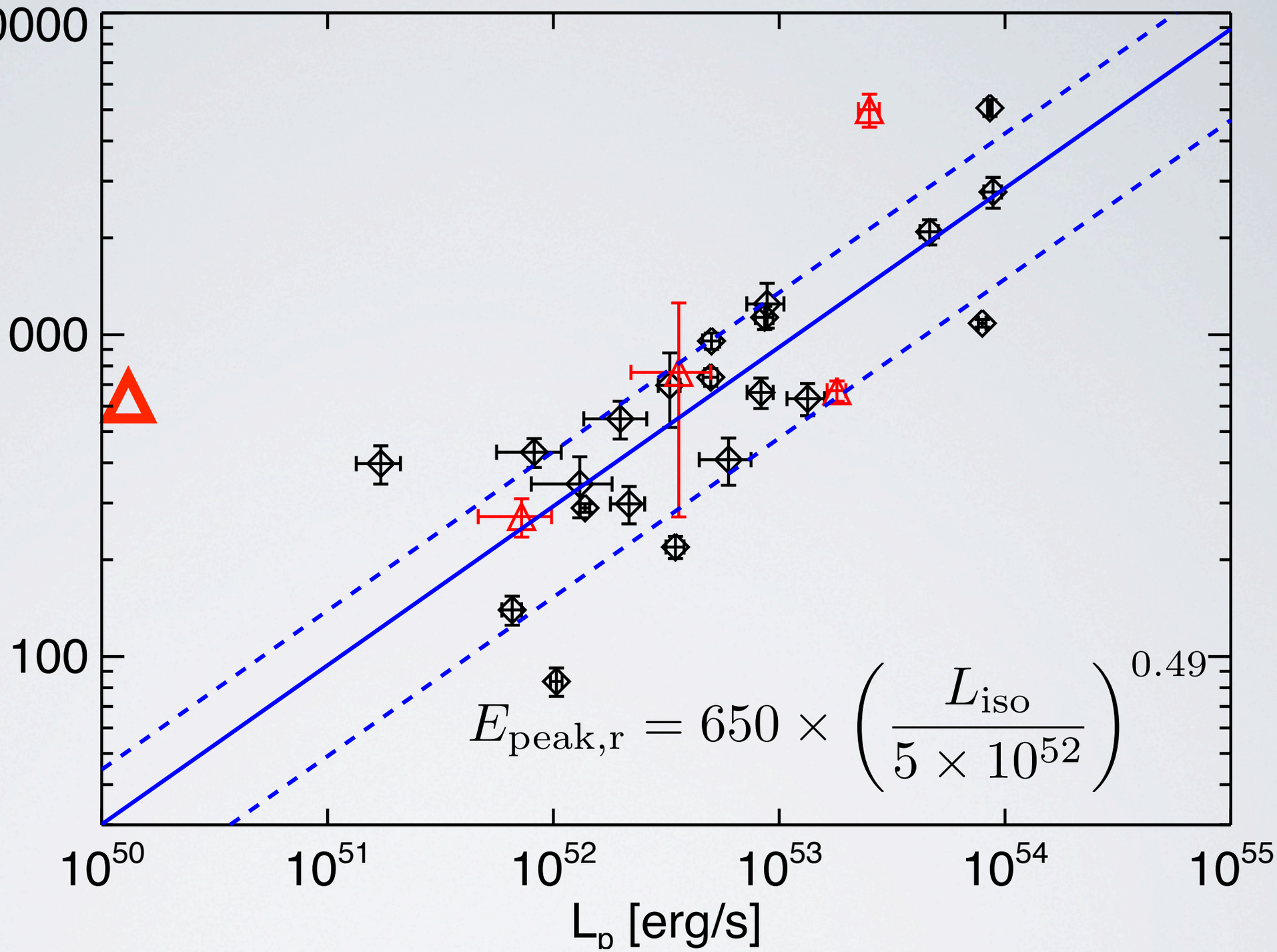


- scatter is considerably larger as in *Amati et al. 2009*
- confirmed by *Virgili et al. 2012*

The **YONETOKU** Relation



- L_p was determined on a 1.024 s and 0.064 s time scale for LGRBs and SGRBs, respectively

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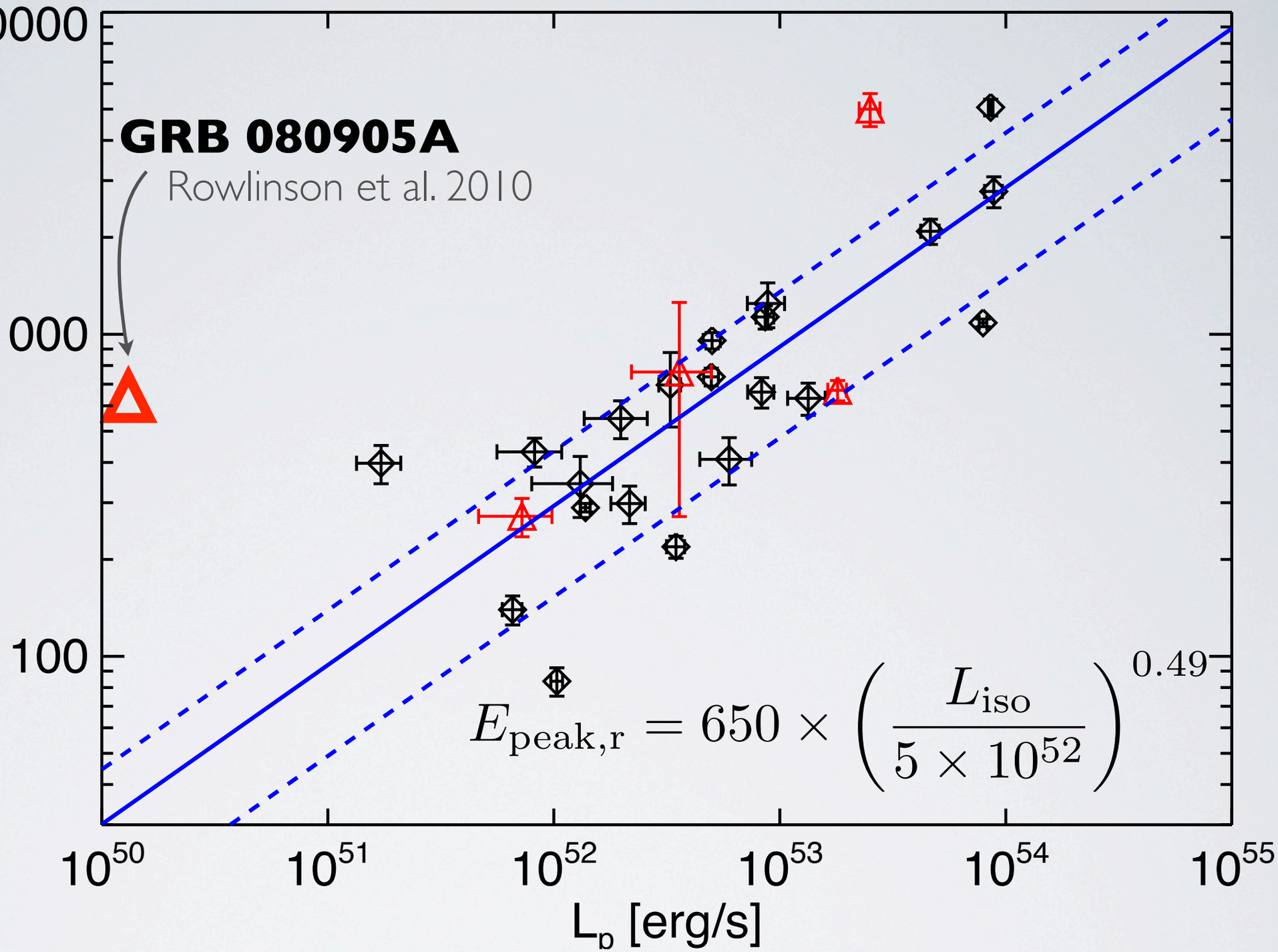

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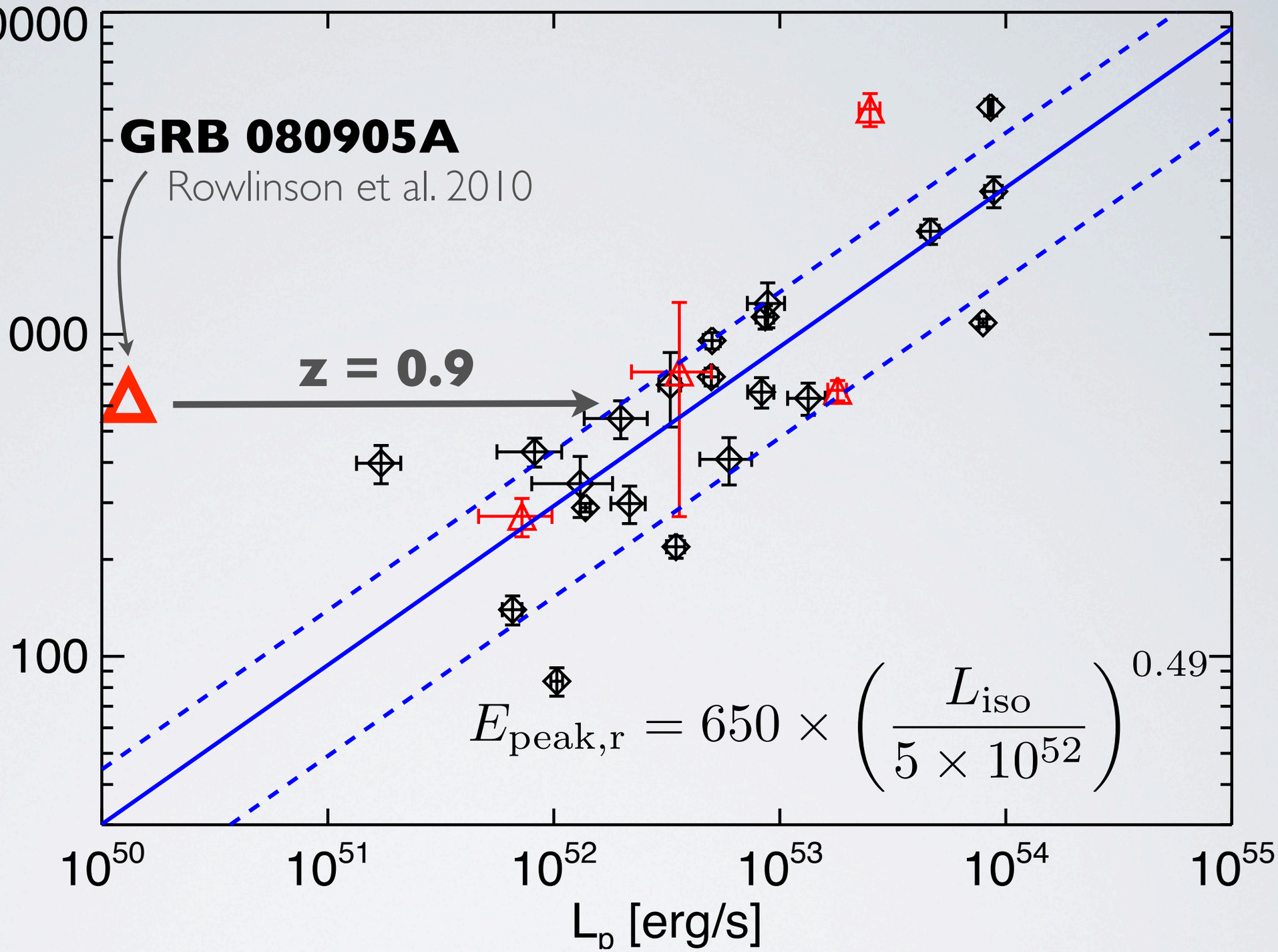

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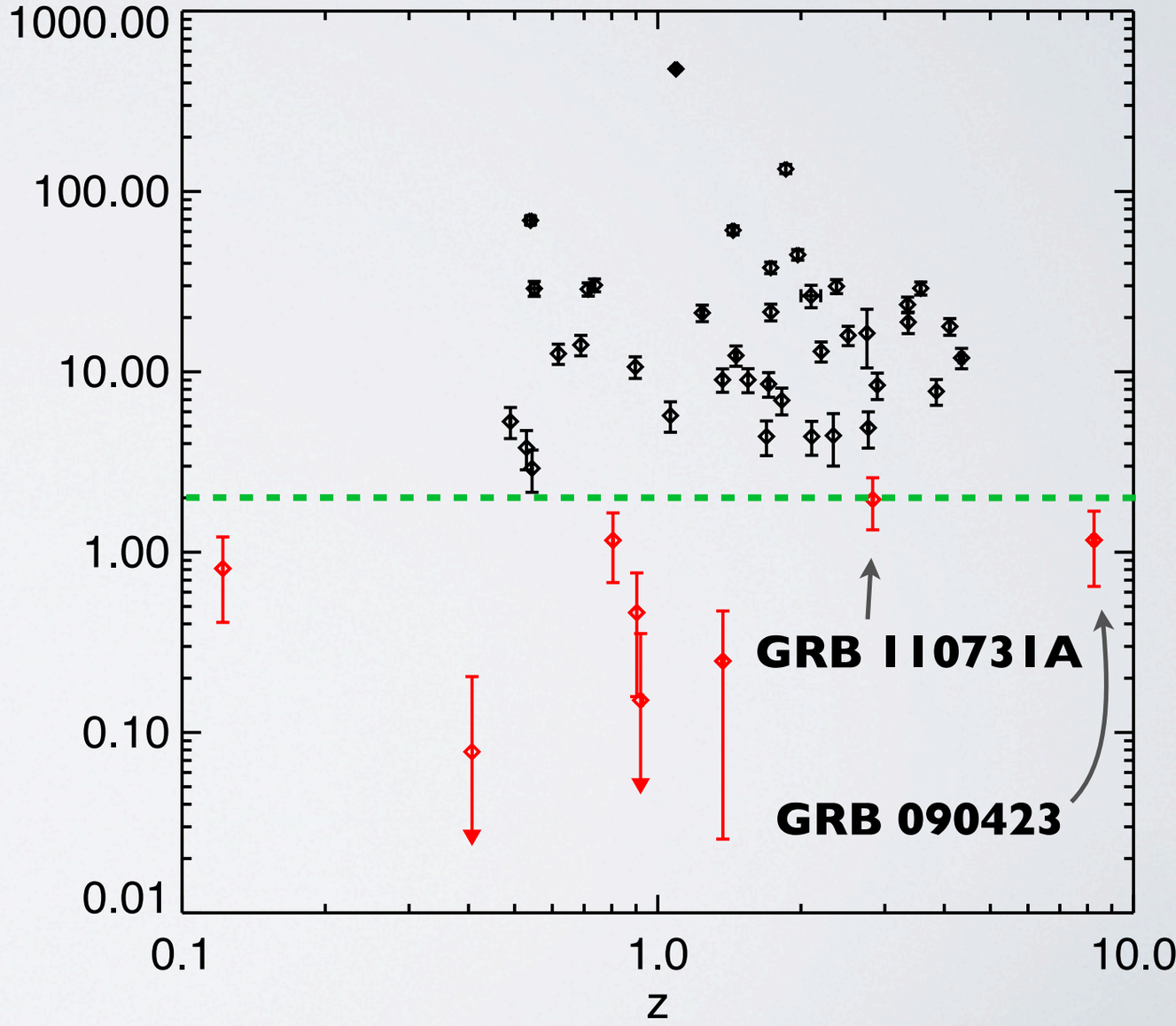
T90 REDSHIFT (NON) EVOLUTION

- No redshift evolution observed
- detector sensitivity? (*Kocevski & Petrosian 2012*)
  - duration and energetics are only lower limits!
  - determining **S** and **L** cannot be done using temporal properties alone

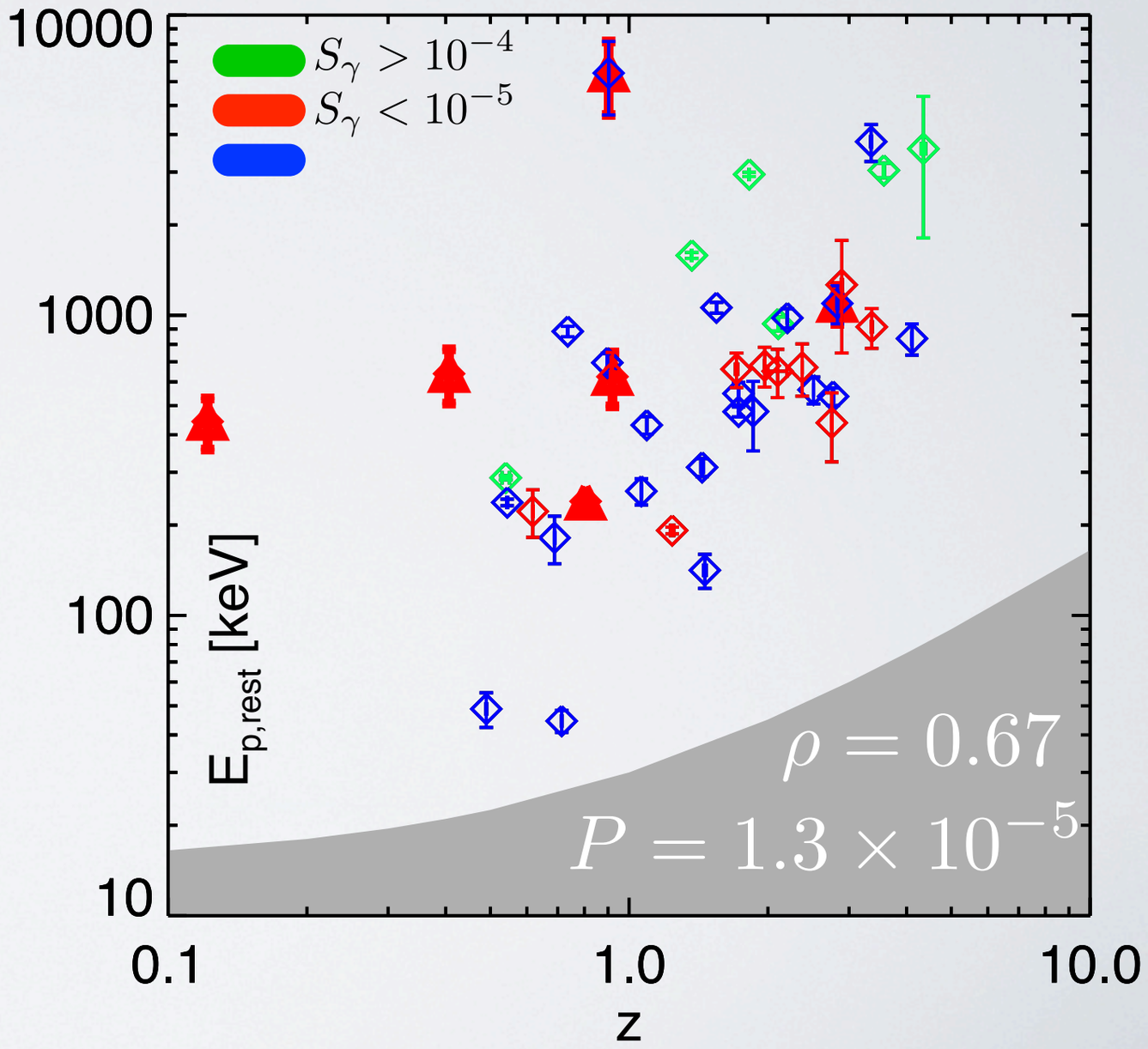


E_{peak} REDSHIFT EVOLUTION

- not entirely unexpected
- to explain detection rate at high-z ⇒ GRBs have higher L

  (Salvaterra+2009)

  - if true and Yonetoku is true ⇒ positive correlation
- **selection effects not negligible**



TAKE HOME MESSAGES

- 47 GBM-GRBs with redshift
- Larger scatter of Amati relation
- short GRB 080905B is very interesting
- redshift evolution
  - T_{90}: no
  - E_{peak}: maybe

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BACKUP

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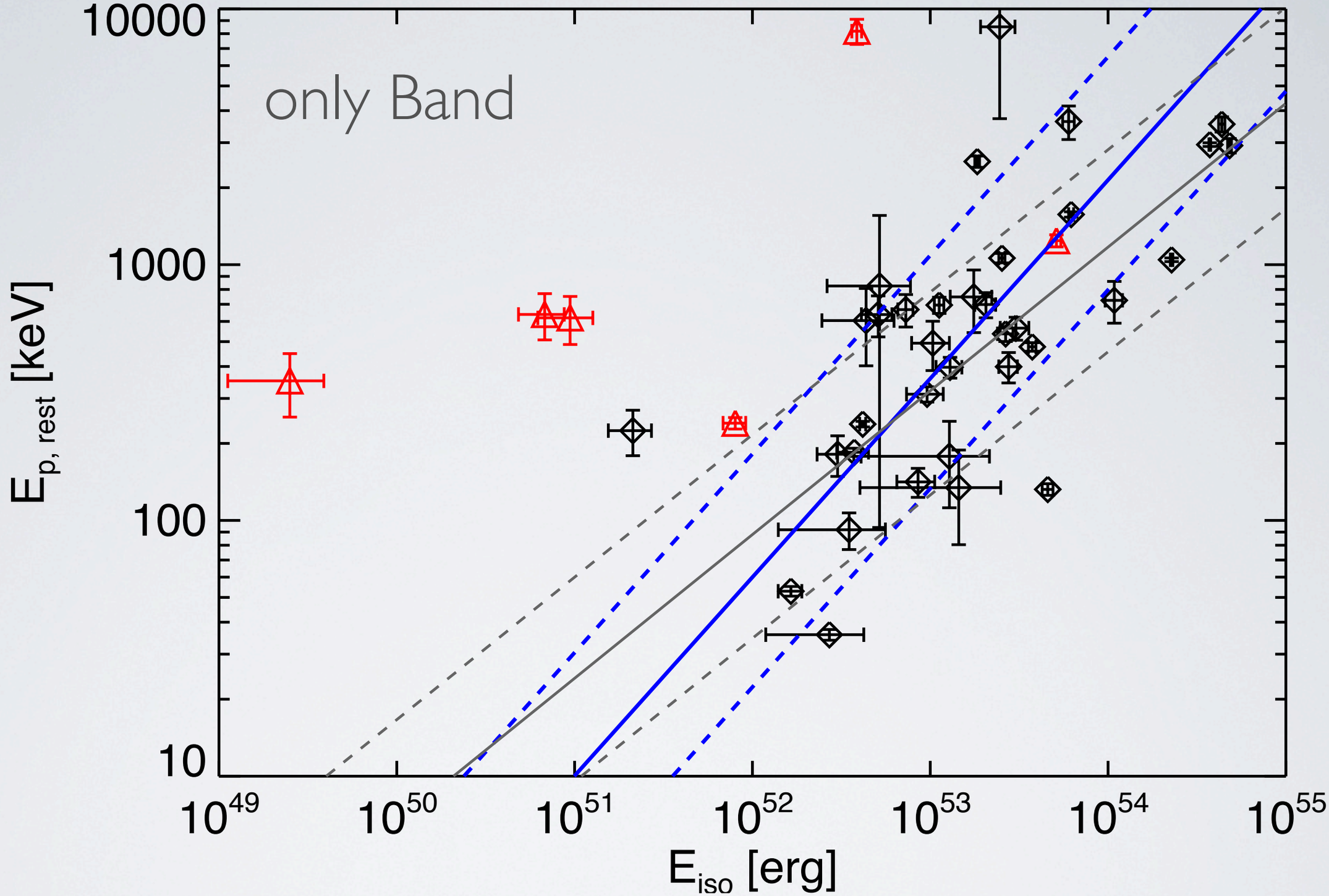

$$E_{\rm peak,r} = 477 \times \left(\frac{E_{\rm iso}}{1.4 \times 10^{53}} \right)^{0.78}$$

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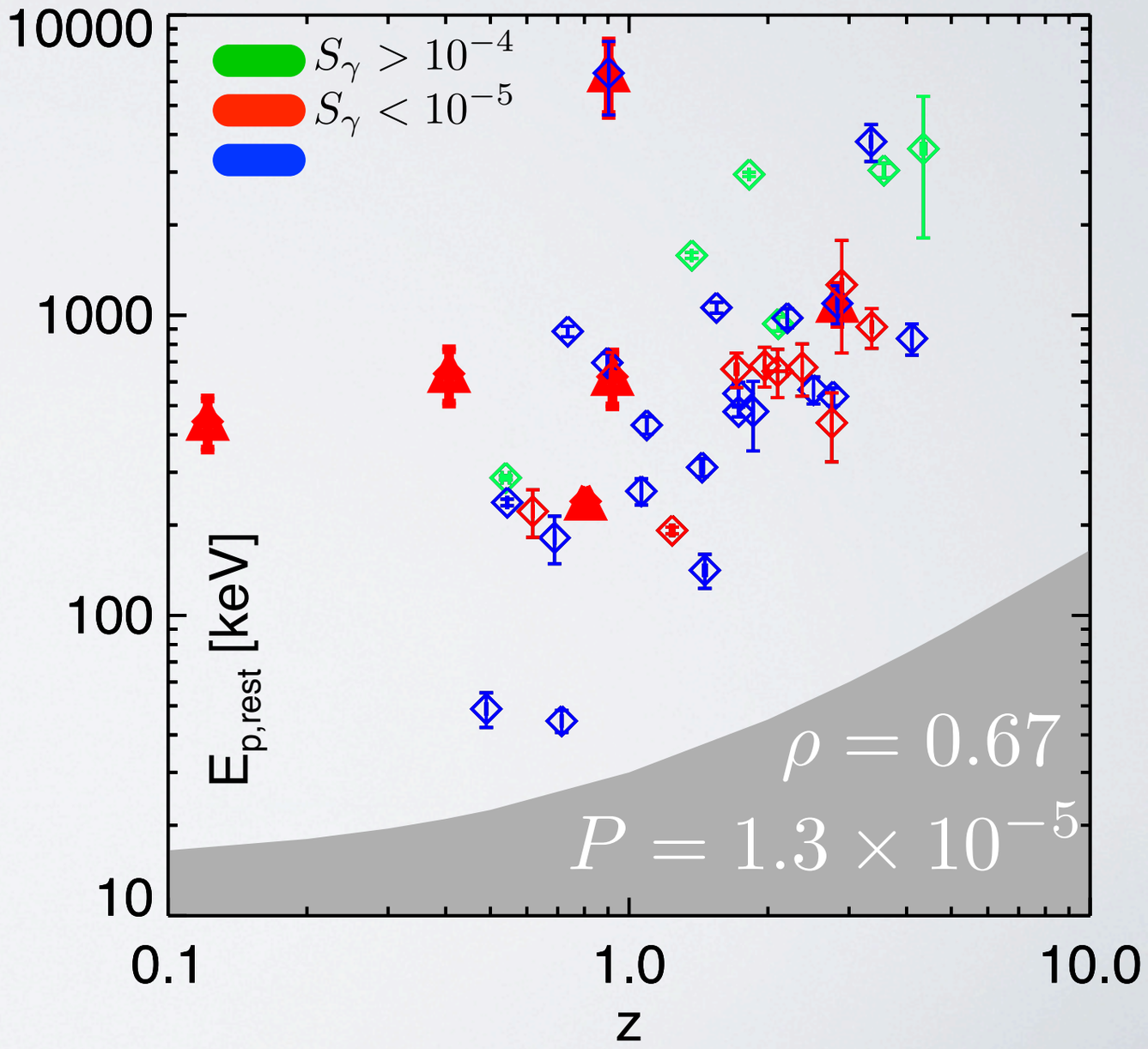

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