Correlative Analysis of GRBs Detected by *Swift* and *Suzaku-WAM* (a work in progress)

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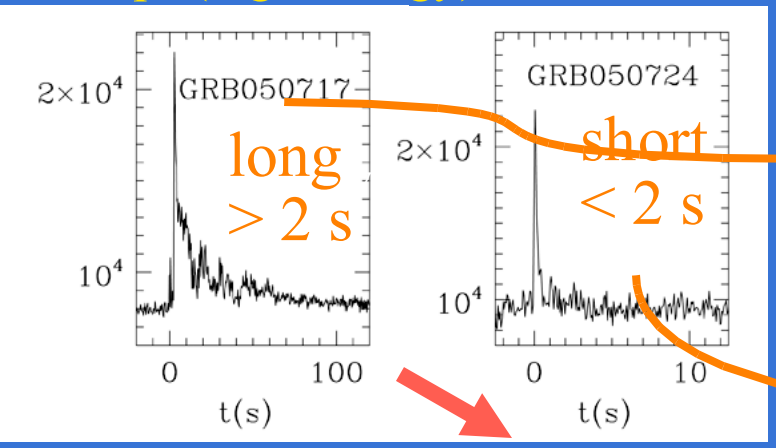
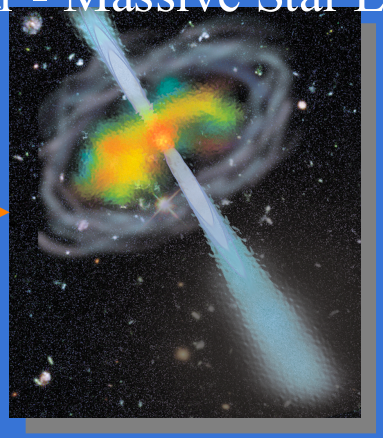
Gamma-Ray Burst Primer

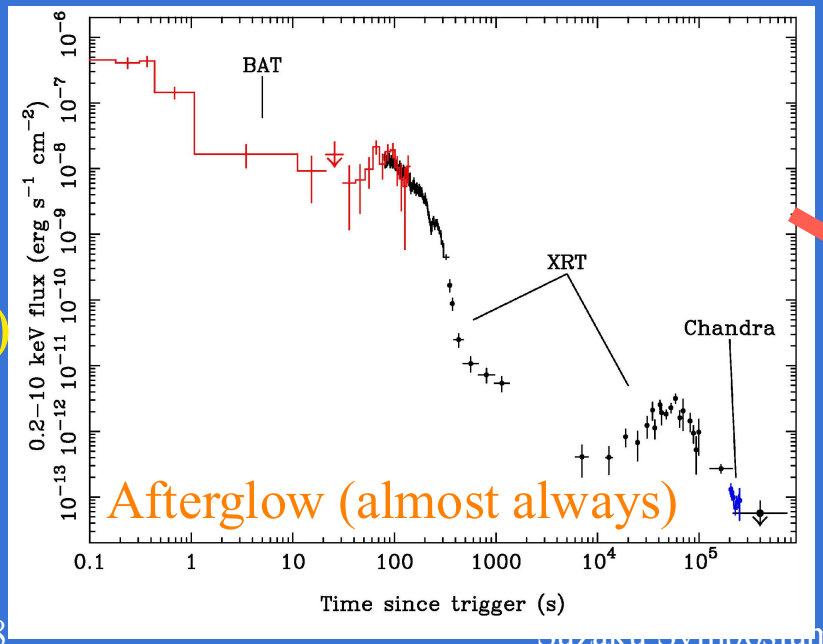
Collapsar - Massive Star Explosion

Neutron Star Merger

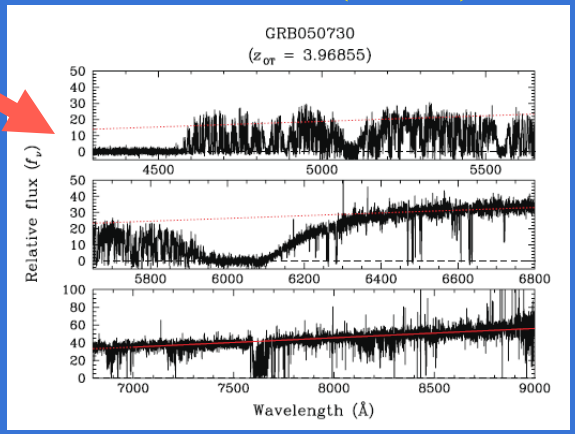
Prompt (high energy) emission







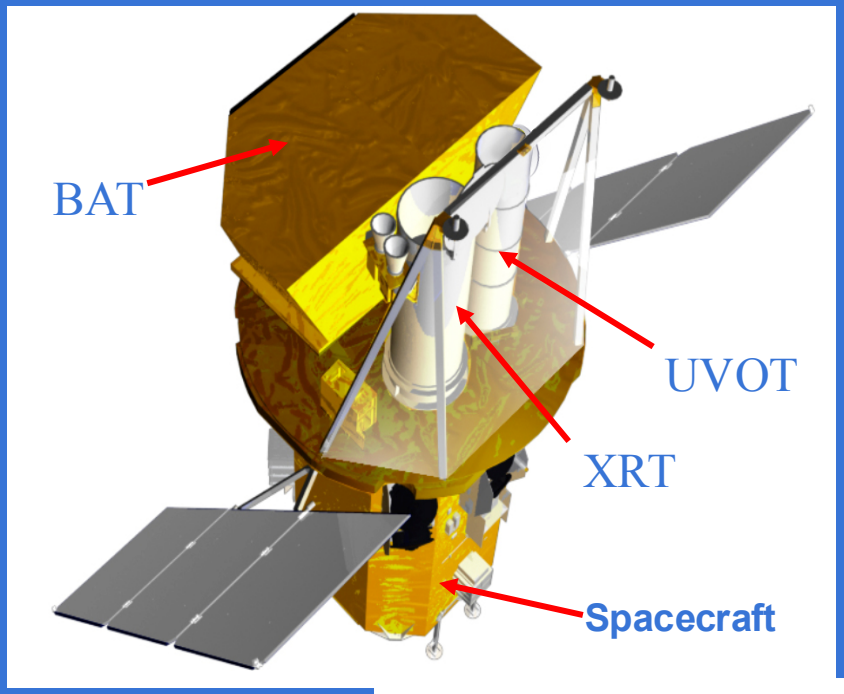
Redshift (often)



Chen et al, *ApJL* **634** 25, 2005

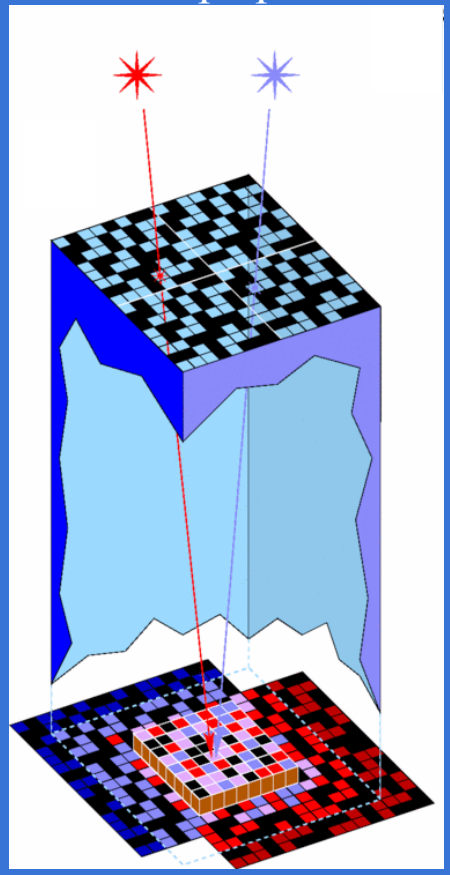
Identified by GRByymmdd(N)

Swift–BAT



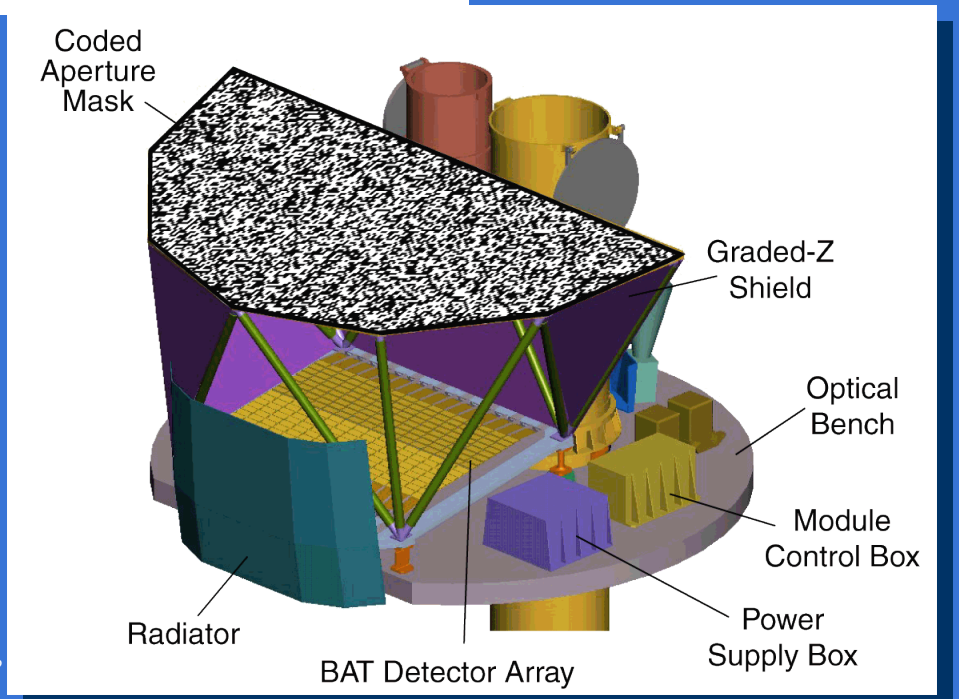
~50,000 1-mm thick lead tiles are opaque to X

Coded Aperture Imaging: 1-3 arcmin resolution

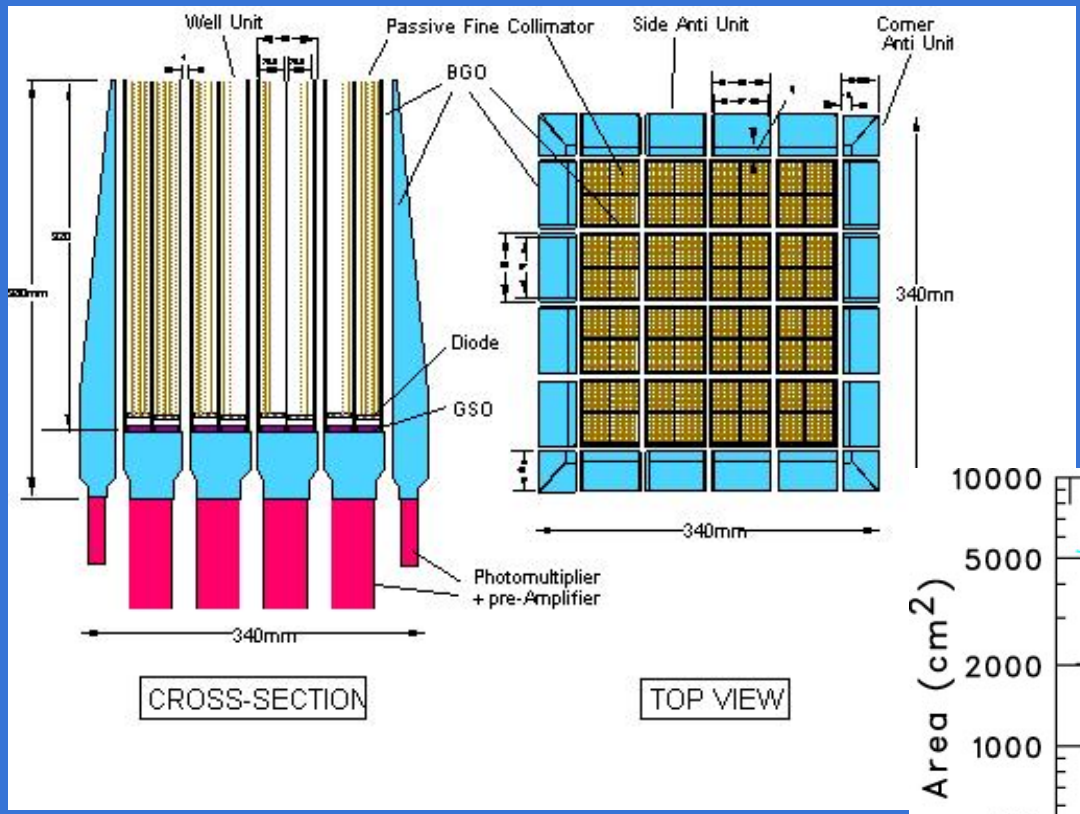


32,768 detectors give finely pixellated array

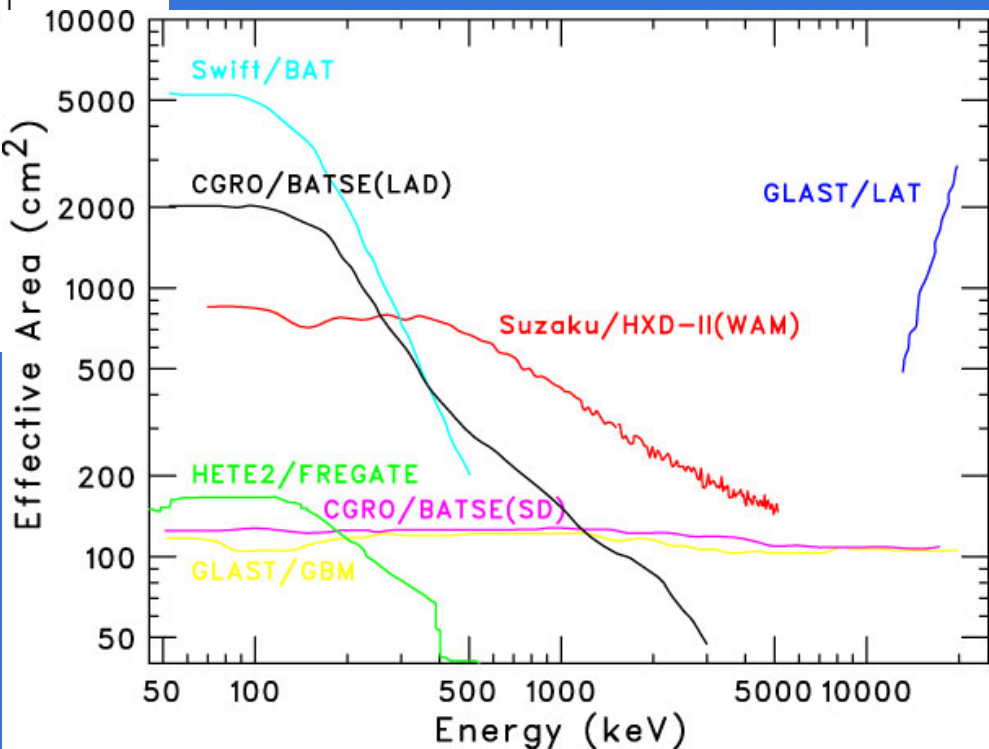
Good compromise -- large field of view with reasonable angular resolution!



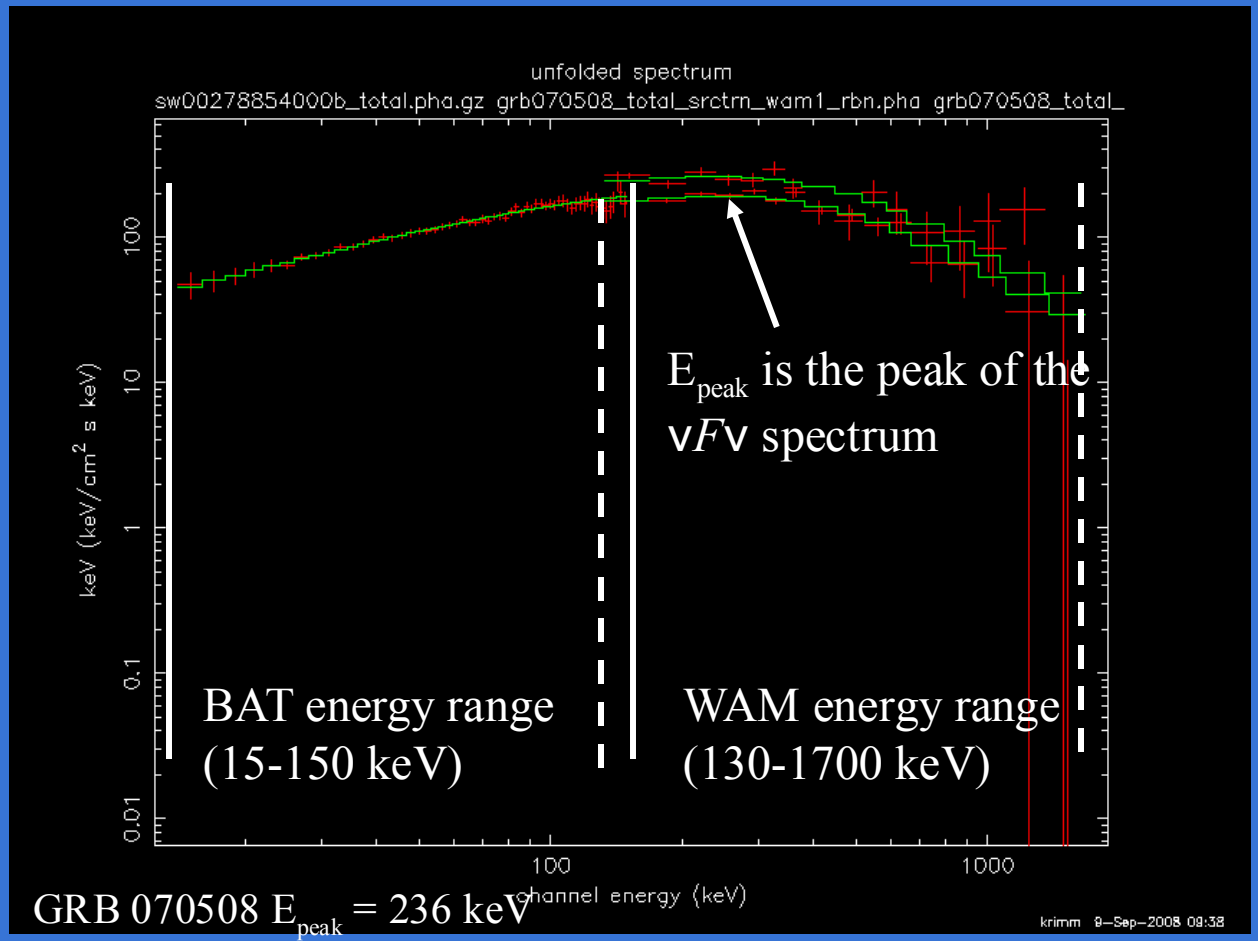
Suzaku-WAM



- Anti-coincidence shield for HXD
- 2π field of view
- Large effective area



Prompt GRB Energetics



GRB 070508 E_{peak} = 236 keV

A model for gamma-ray burst continuum spectra developed by D. Band, et. al., 1993 (**ApJ** 413, 281).

$A(E) = K * (E/100)^{\alpha} \exp(-E/E_0)$
for $E <= (\alpha - \beta)E_0$

$A(E) = K' * (E/100)^{\beta}$
for $E > (\alpha - \beta)E_0$

$E_{peak} = (2+\alpha) E_0$

GRBs and Redshift

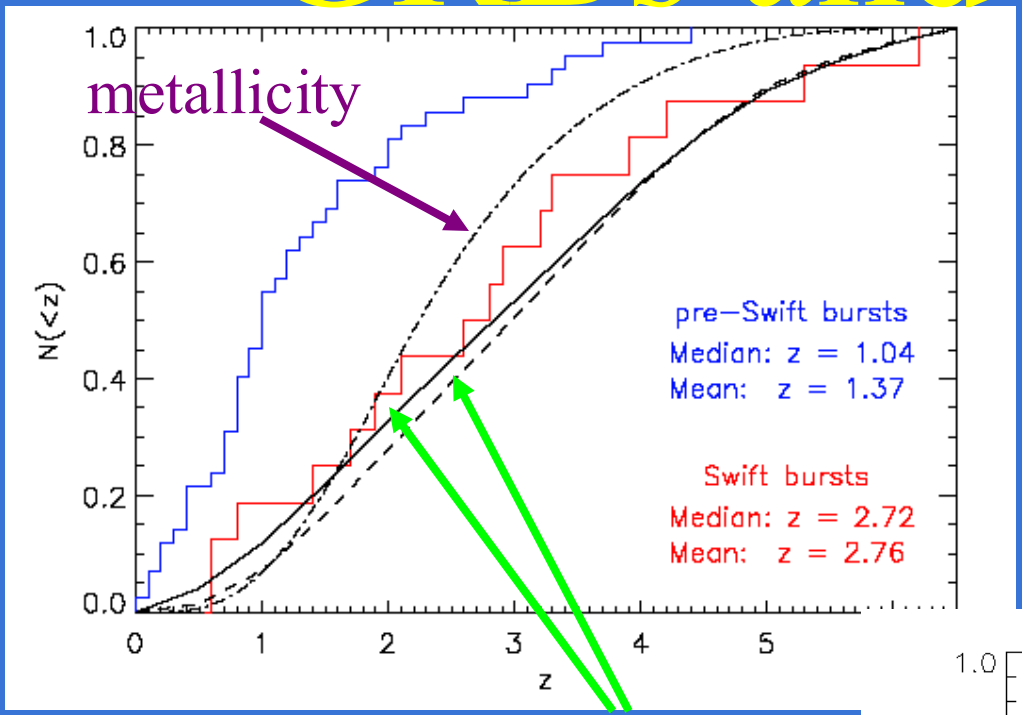
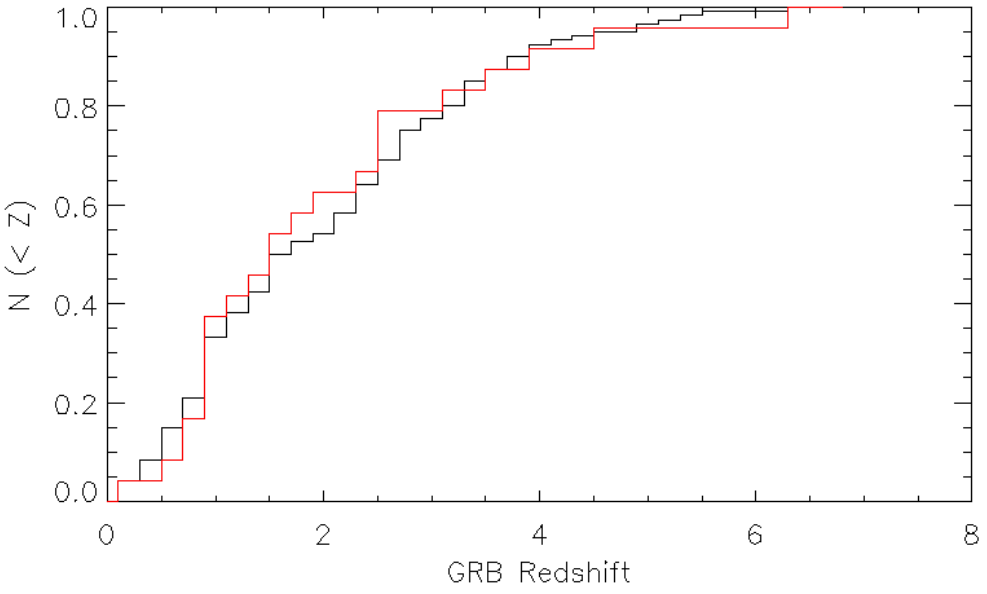


Figure from P. Jakobsson et al,

A&A 447, 897–903 (2006)

- Total Swift count (black): 120 bursts with redshifts (34%)
- Current sample (red): 24 bursts is representative



E_{peak} vs. E_{iso}

Variations on the theme by
- Ghirlanda et al 2004
- Yonetoku et al 2004

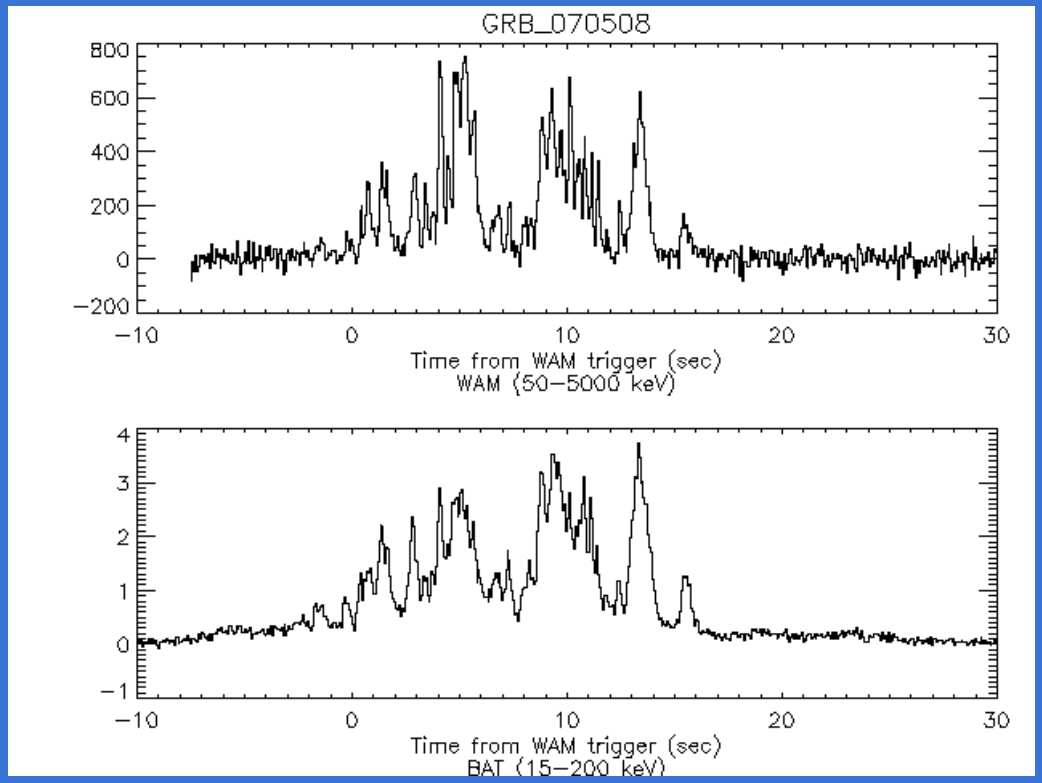
Confirmed by
- Campana et al (Swift) 2007
- Cabrera et al (various) 2007

Disputed by
- Band & Preece (BATSE) 2005
- Butler et al (Swift) 2007

Used for cosmology by
- Schaefer 2007

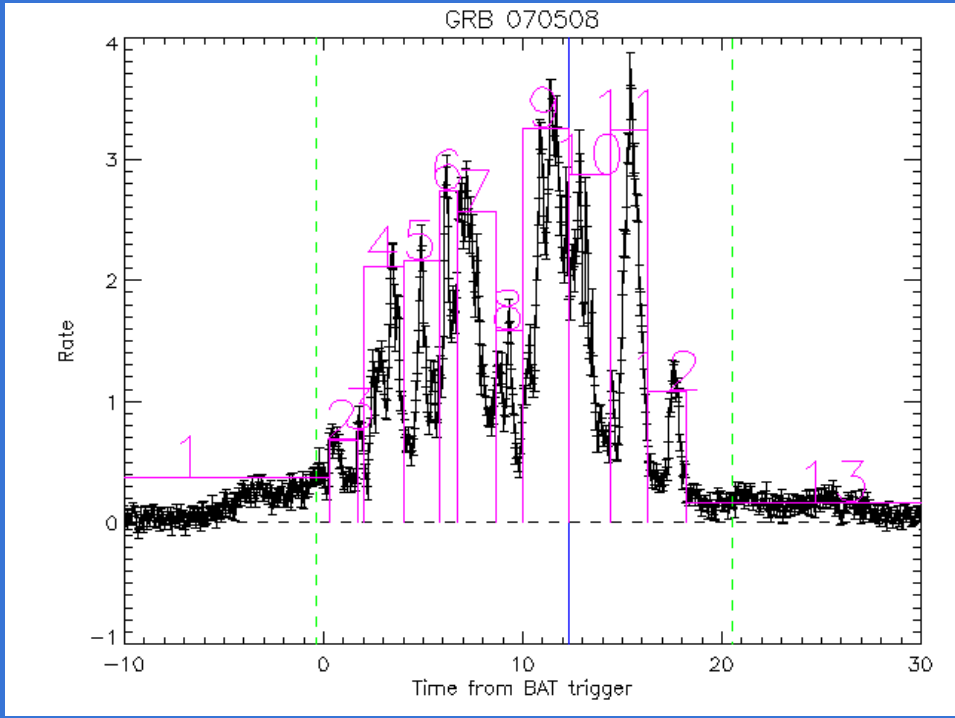
L. Amati, MNRAS, 373, 233 (2006); relationship first proposed in 2002.

Suzaku-WAM and *Swift*-BAT Correlations



- 290 *Swift* bursts since *Suzaku* launch
- 236 *Suzaku* bursts triggered
- 41 joint triggers (~1 per month)
- 37 additional bursts untriggered in WAM
- 29/78 with redshifts (25 used here)

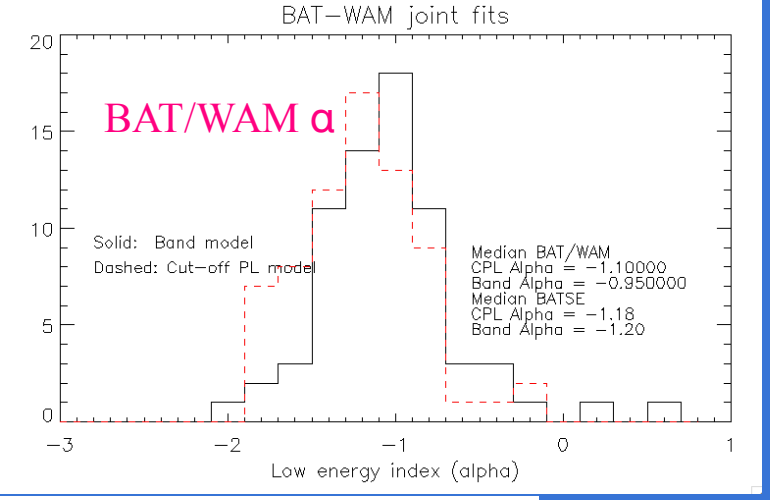
Data Analysis



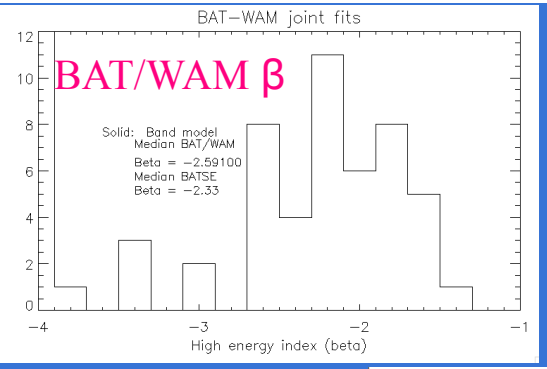
- Bursts divided into significant peaks based on BAT light curves
- Spectral files generated for each instrument for:
  - Total
  - Peak
  - Individual peaks
- Joint fits derived for each time interval and tested against extensive cross-calibrations

Results

BATSE α



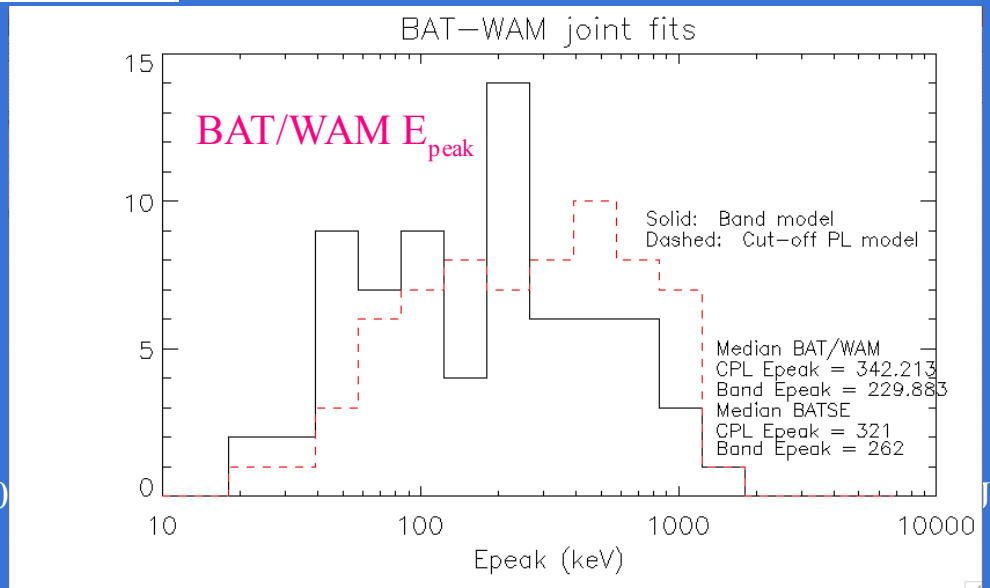
BATSE β



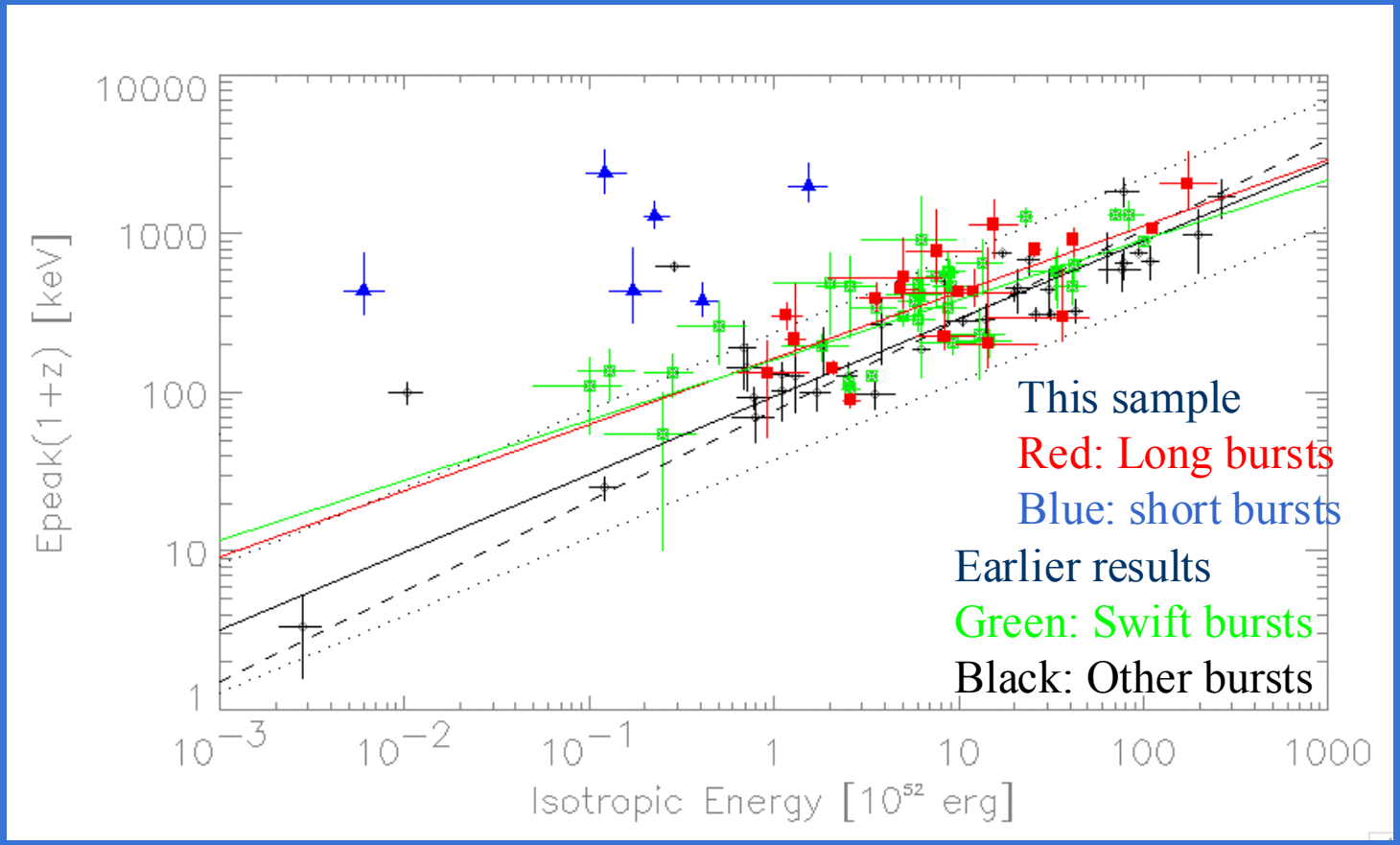
BAT/WAM parameter distributions comparable to BATSE

BATSE plots from Kaneko et al, APJSS 166, 298, 2006

BATSE E_{peak}

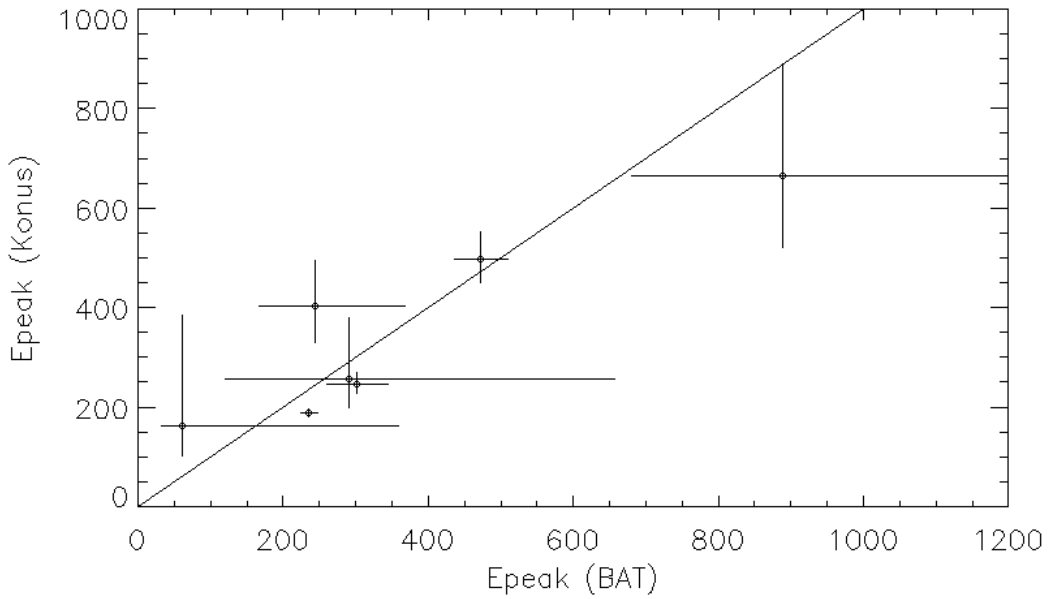


E_{peak} - E_{iso} Plot



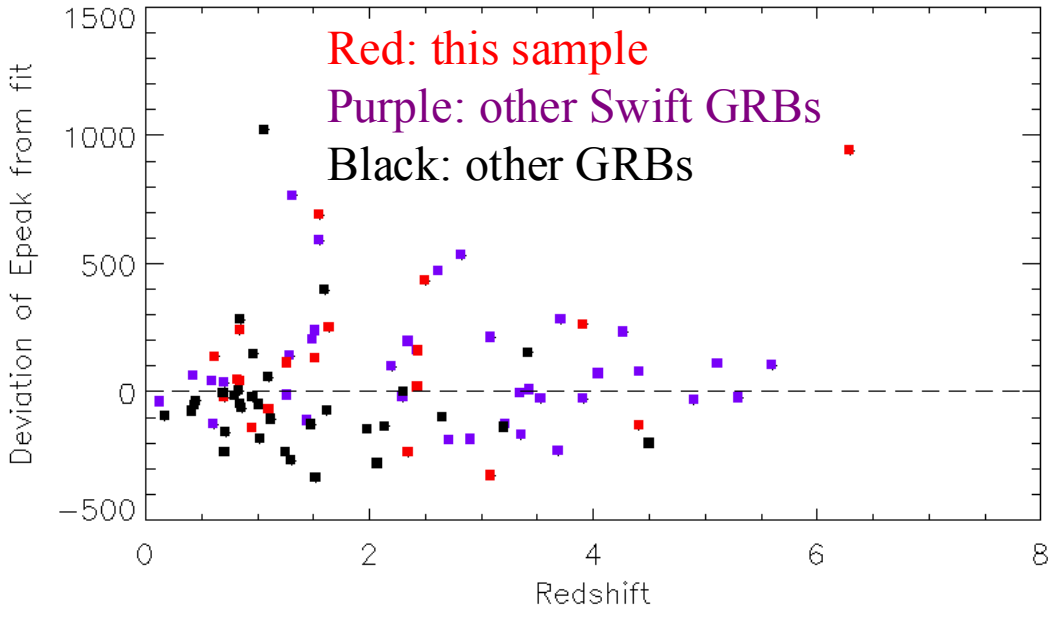
Still see a correlation between E_{peak} and E_{iso}, but not as tight as the Amati relation -- few outliers, but bias to larger Epeak

Checking Results



See no systematic bias of BAT/WAM results relative to Konus/WIND

No trend of deviation from the relationship with redshift



Conclusions/Further Work

- The Epeak-Eiso relation appears to hold for Swift bursts, suggesting that there is some physical basis for the relation.
- However, the large scatter makes it quite problematic as a redshift estimator.
- *Suzaku*/WAM is very important for extending the energy range of *Swift*/BAT.
- Will complete work on individual burst peaks to see if relations hold on shorter time scales.
- We are developing a similar program with Fermi/GBM.