The Afterglows of Type I (Short) and Type II (Long) Gamma-Ray Bursts - a comparison

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Ringberg Workshop on Short Gamma-Ray Bursts
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Type I and Type II GRBs – a new classification scheme

Zhang et al. 2007, Zhang 2006

Type II GRBs:
- temporally long
- spectrally soft
- long spectral lag, evolution
- Associated with Type Ic SNe
- Hosts are late-type (dwarfs)
- Location: "Brightest pixel"

Progenitor: Collapsar (WR star)

Type I GRBs:
- temporally short (but soft tails)
- spectrally hard
- negligible spectral lag
- No SNe to deep limits
- Hosts are all types
- Location: Halo

Progenitor: Binary Compact Object Merger (?)
Afterglows of Type II GRBs

GRB 990510,
Data compilation:
Zeh et al. 2006,
Kann et al. 2006

Typically quite bright, show achromatic jet break and evolution

Secure derivation of colors and thus SED
Spectral Energy Distributions of Afterglows

Kann et al. 2006

Derivation of intrinsic slope $\beta$, extinction $A_\nu$, and knowledge of redshift $z$

All afterglows can be transformed to one redshift and compared intrinsically
Type I GRB afterglows

Bad data situation:
- Much is unpublished/GCN only
- Little amount of data for each GRB
- Upper limits only in many cases
- Missing redshifts

Temporary solution:
- Transform all filters to $R$ band assuming $\beta=0.6$, no dust
- In case of upper limits, choose consecutively deepest ones
- Assume $z=0.5$ for missing redshift cases ($z=1$ for two cases with extremely faint hosts)

Consider the afterglows as an ensemble and worry about the details later!!
Type I and Type II GRB afterglows – observed

Step 1: Take the Kann et al. 2006 sample of Type II GRB afterglows
Type I and Type II GRB afterglows – observed

Step 1: Take the Kann et al. 2006 sample of Type II GRB Afterglows

Step 2: Add Swift era Type II GRB afterglows
Galactic extinction corrected and host subtracted $R_c$ magnitude

$t$ (days after burst in the observer frame)
Type I and Type II GRB afterglows – observed

Step 1: Take the Kann et al. 2006 sample of Type II GRB Afterglows

Step 2: Add Swift era Type II GRB afterglows

Step 3: Add Type I GRB afterglows with detections
Type I and Type II GRB afterglows – observed

Step 1: Take the Kann et al. 2006 sample of Type II GRB afterglows

Step 2: Add *Swift* era Type II GRB afterglows

Step 3: Add Type I GRB afterglows with detections

Step 4: To make the mess complete, add the Type I GRB afterglow upper limits
Type I and Type II GRB afterglows – intrinsic

Perform the cosmological shifting, and repeat steps 1 to 4…
Extinction corrected and host subtracted

$R_c$ magnitude assuming $z=1$
Absolute Magnitude $M_B$ at one Day after the GRB assuming $z=1$
And the results are in…

Result # 1: Type I GRB afterglows are intrinsically faint

5 magnitudes mean difference  ➔  Factor 100 in flux density!

Result # 2: Type I GRB afterglows are intrinsically much less clustered than Type II GRB afterglows (Kann et al. 2006, Liang & Zhang 2005, Nardini et al. 2006)

Result # 3: Our Swift era afterglows resemble those of the bygone Beppo-SAX age

CAVEAT: Faint Swift afterglows are not included due to our sampling criteria!!!
Limits on $^{56}\text{Ni}$-powered SNe

No supernovae contributions to deep limits have been found by many groups:

- GRB 050509B: Hjorth et al. 2005
- GRB 050709: Fox et al. 2005
- GRB 050813: Ferrero et al. 2007
- GRB 060505: Fynbo et al. 2006, Ofek et al. 2007

So the following is merely a compilation…

With one additional result.
Extinction corrected and host subtracted $R_c$ magnitude assuming $z=0.1$

$t$ (days after burst in the observer frame assuming $z=0.1$)

- $k=0.6$, $M_R > -18.62$
- $k=0.29$, $M_R > -17.83$
- $k=0.0060$, $M_R > -13.62$
- $k=0.0038$, $M_R > -13.12$
- $k=0.0025$, $M_R > -12.66$
- $k=0.0015$, $M_R > -12.11$
- $k=0.00033$, $M_R > -10.46$
Thinks to Ting about

- Why are the afterglows so faint? (Prediction from Panaitescu, Kumar & Narayan 2001)

- Why are they spread much wider than Type II afterglows?

- What do we learn from the limits on the Mini-SN?

- How can the observational situation be improved in the future? (Sylvio‘s talk)
Thank you for your attention!

Type II Telescope

Type I Telescope

Lyman Forest