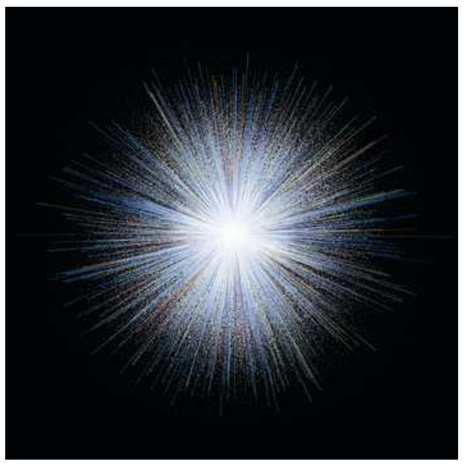

Gamma-Ray Bursts at high redshift

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As part of an ongoing search for particular properties in the prompt emission of GRBs at high redshift, which might allow us to explore the population of early stars, I now use data taken from a paper by Lin, Li & Chang (2016) on 44 “long” events detected by Swift, with z from 0.347 to ~9.4. At high z only long GRBs have been detected.

I show scatter plots of the isotropic equivalent energy and peak luminosity from tables in the said paper. The authors fit the GRB spectra, both by the Band function and by the cut-off power law and obtain quantities in the source rest frame. But it is still possible that strong instrumental selection effects in burst detection limit those quantities.

For example, the low energy Swift threshold, 15 keV, may affect determination of the low energy spectral index alpha and, as a consequence, the correlation between alpha and z, obtained from the Yonetoku relation, found by Geng & Huang (2016).

T90 in seconds, the time to accumulate the central 90% of the flux, is taken from the Swift catalog, but we must always take into account that the energy intervals in the observer’s frame must be multiplied by (1 + z) in the rest frame, therefore they change with redshift.

A conversion between T90 in the observer's and the rest frame has been done by Zhang et al. (2013).

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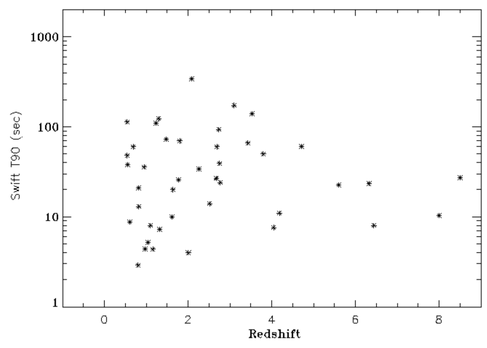
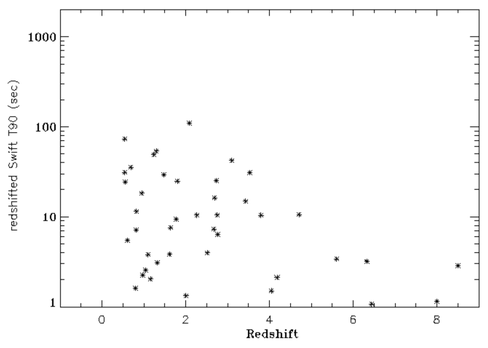
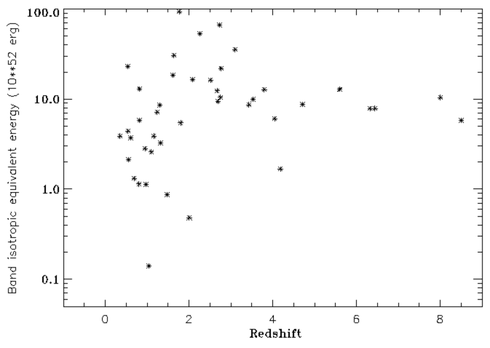
Scatter diagram of the Swift T90 in seconds for all the 44 events.

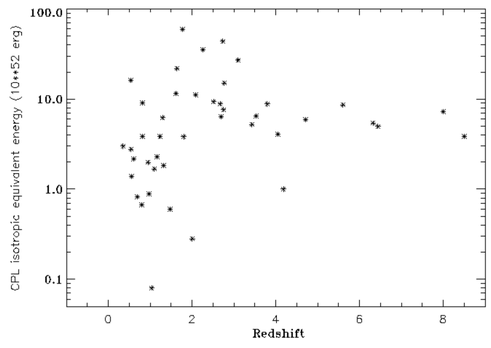


Redshifted T90 in the rest frame, but the energy range for T90 in the restframe is also redshifted.to higher energies

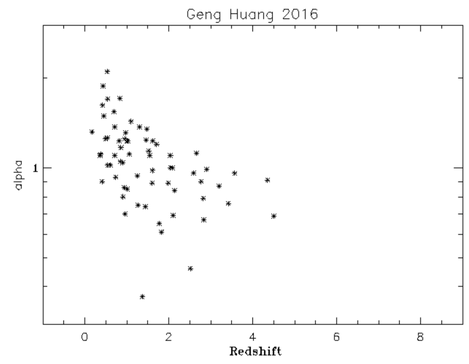


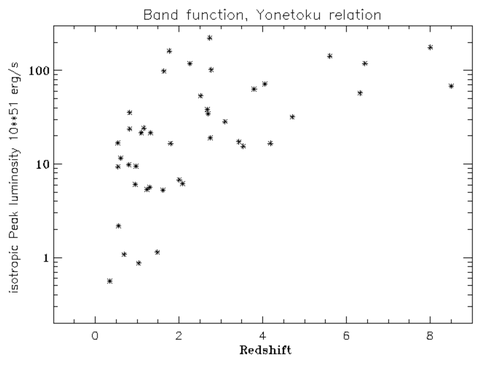


Isotropic equivalent Energy by Band function (left) and Cut-off power law spectra (right)

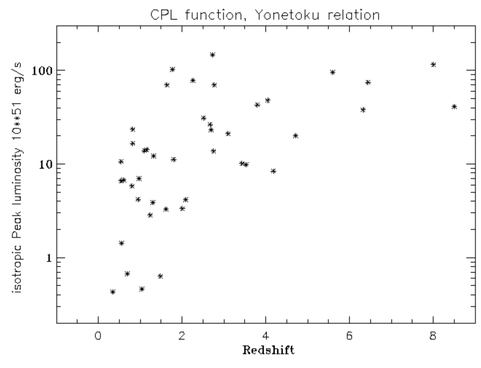


On the right, restframe alpha from Geng & Huang.

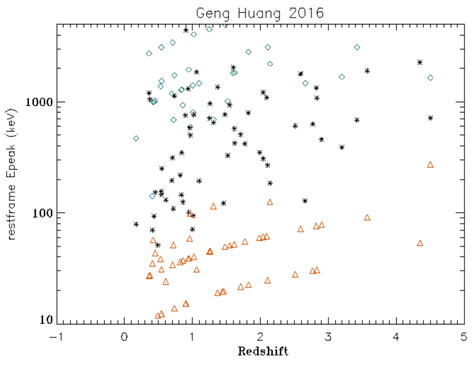




Isotropic peak Luminosity by Band function (left) and CPL function Spectra (right)



On the right: restframe Epeak from Geng & Huang and detection energy limits, which show how both alpha and Epeak are limited by them.



Conclusion

It is evident that in order to derive any conclusions on GRB energies and durations it is necessary to consider the effect of redshift, but unfortunately the limited energy intervals and trigger times of the detectors produce very strong selection effects.

The only changes with redshft can be easily attribuited to instrumental selection effects. Here I plot the isotropic equivalent energy Eiso and isotropic peak luminosity L , both restframe quantities derived by Lin, Li & Chang by using the redshifted spectrum of the events. For T90 it would be necessary to redshift the energy range which originates the T90 flux, as done by Zhang et al., 2013.

As already observed by Salvaterra(2012) and other authors, GRBs observed at high z are similar to the closest ones.

A correlation between z, obtained from the Yonetoku relation, and the low energy spectral index alpha has been found by Geng & Huang, but good estimation of alpha is hampered by the detectors' energy lower limit.

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