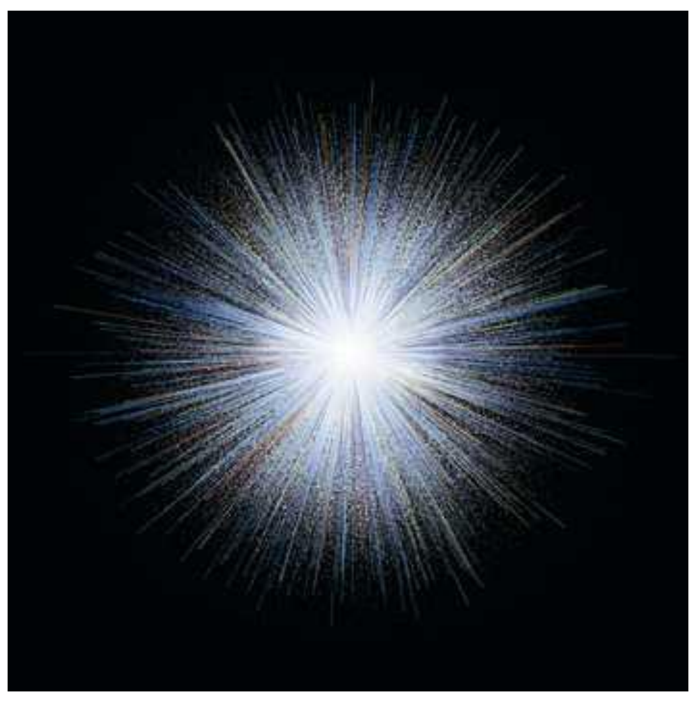

Gamma-Ray Bursts at high redshift

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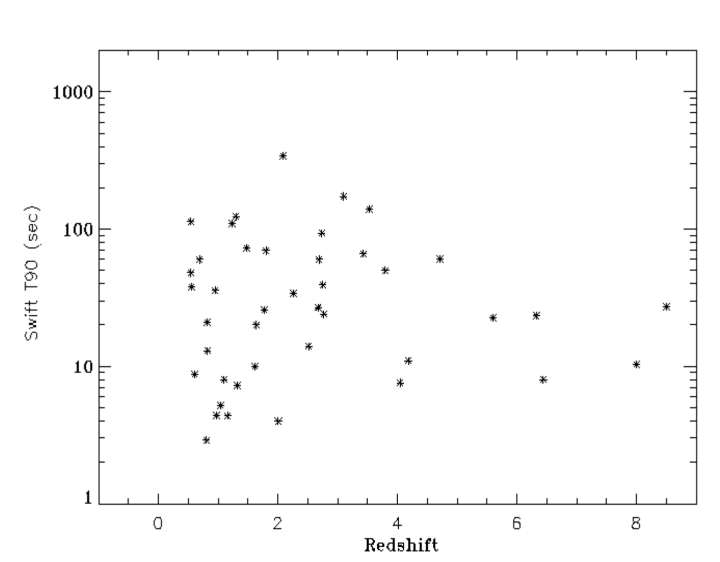
As part of an ongoing search for particular properties the prompt emission of GRBs at high redshift, which might allow us to explore the population of early stars, I now use data taken from a paper by Lin, Li & Chang (2016) on 44 “long” events detected by Swift, with z from 0.347 to ~9.4 . At high z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

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

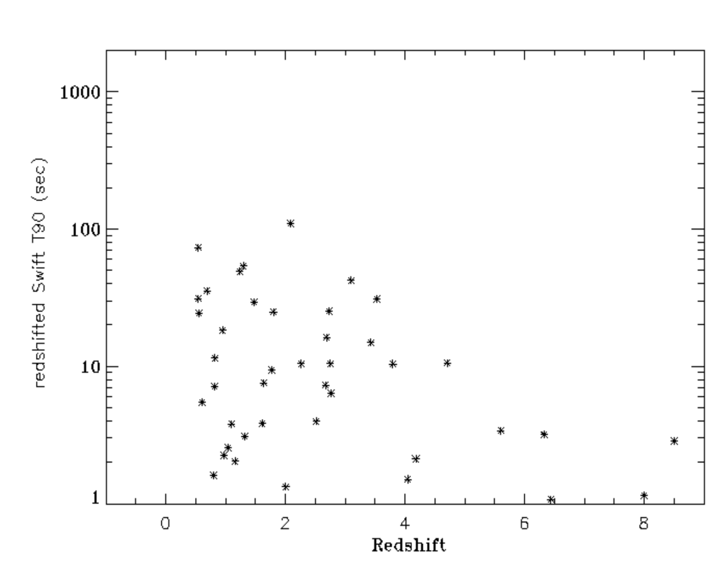
For example, the low energy Swift threshold, 15 keV, may affect determination of the low energy spectral index alpha and, as a consequence, the correlation between alpha and z, obtained from the Yonetoku relation, found by Geng & Huang (2016). T90 in seconds, the time to accumulate the central 90% of 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.

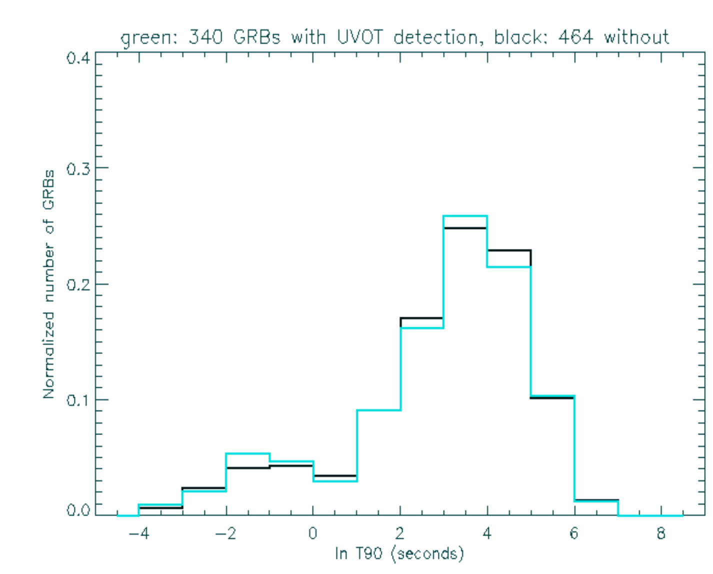
A conversion between T90 in the observer's and the rest frame has been done by Zhang et al. (2013).

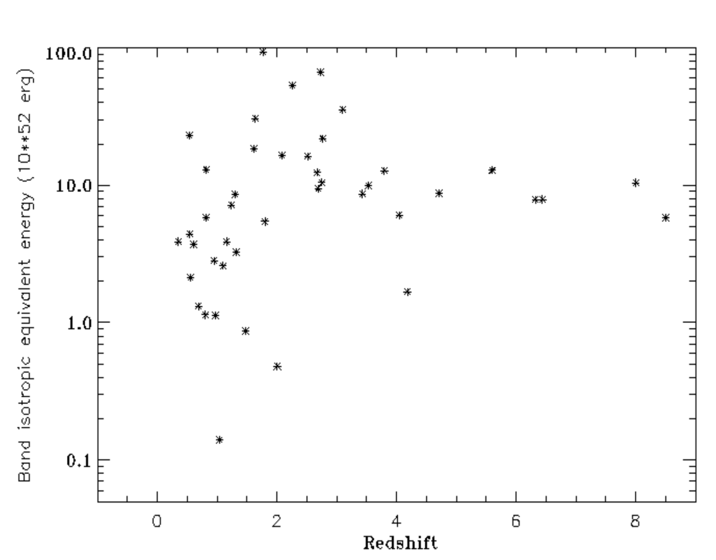
Scatter diagram of the Swift T90 in seconds for all the 44 events.



Redshifted T90 in the observer's frame, but the energy range for T90 in the restframe is also redshifted.

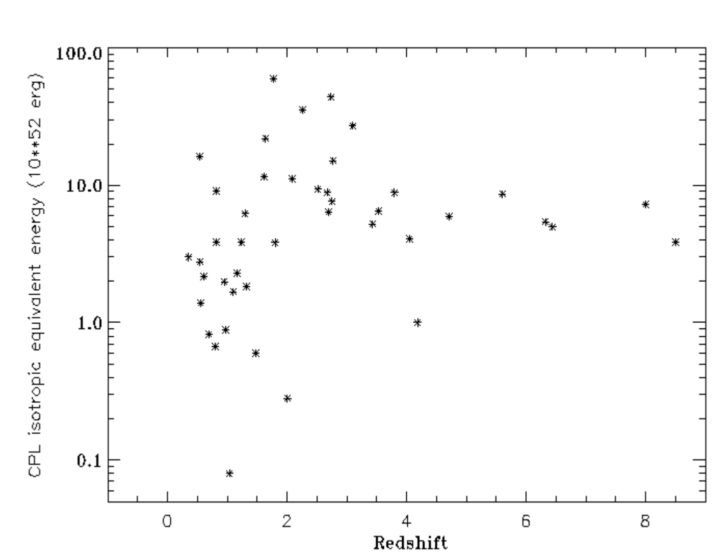




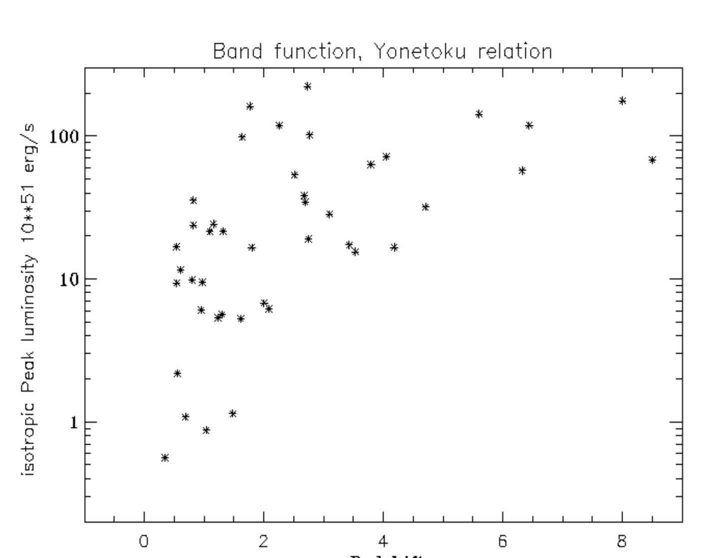


Isotropic equivalent energy

- *Left*: Band function spectra
- *Right*: Cut-off power law spectra

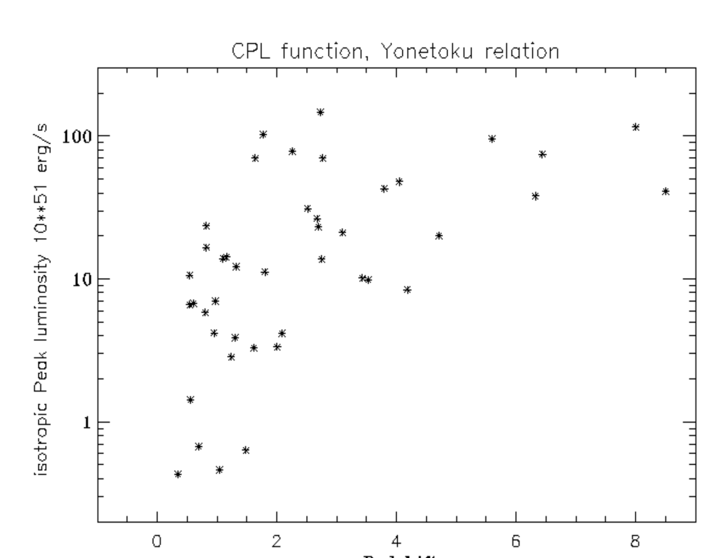


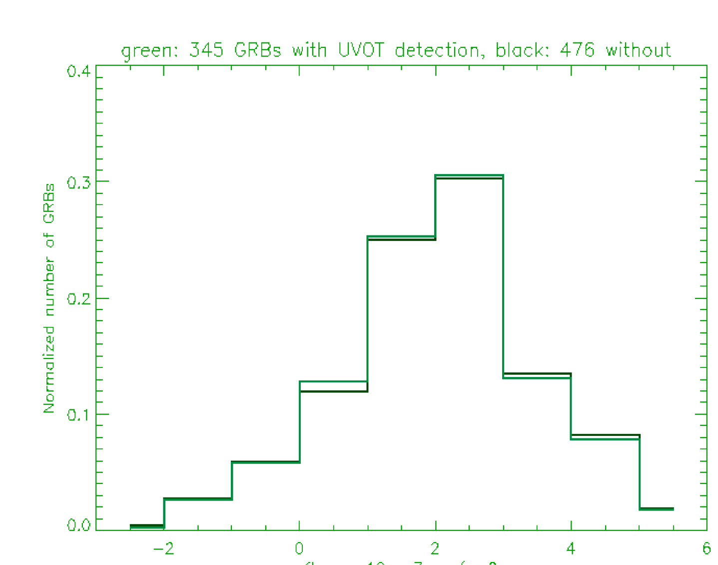
Comparison between observed T90 (*upper panel*) and Fluence (*lower panel*) for GRBs with and without UVOT detection by Swift. Some of the latter might have higher undetected redshift. No difference is found, but often the lack of UVOT detection is due to other causes.



Isotropic peak Luminosity

- *Left*: Band function spectra
- *Right*: CPL function spectra





Conclusion

It is evident that it is not possible to derive any conclusions on GRB energies and durations by just adding them together without considering the effect of redshift, but unfortunately the limited energy intervals and trigger times of the detectors produce very strong selection effects.

At high z only “long” bursts are detected.

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

For the time being, as it has already been observed by us and by other authors, e.g. Salvaterra (2012), observed GRBs 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 Swift 15 keV lower limit.

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Gamma-Ray Bursts at High Redshift

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Since GRBs are observed at high redshifts, we hope that they might allow us to connect them with the characteristcs of the first stars. The poster shows my last unsuccessful attempt at finding any special properties in high redshift, at least z=6 , GRBs . In spite of the very good work done by present day GRB experiments, this lack of distinctive features is possibly due to some interconnected facts: lack of good statistics, lack of deep enough observations, both for GRBs and for the related Optical Transients and observational constraints which bring us to detect only events similar to each other. I also do not find differences between the distribution of bursts with and without optical detection by Swift UVOT, which certainly helps in obtaining the redshift from optical observations.