GRB hosts through cosmic time

We present data and initial results from VLT/X-shooter emission line spectroscopy of 96 galaxies selected by long γ-ray bursts (GRBs) at $0.1 < z < 3.6$ detected by *Swift*. This is the largest sample of GRB host spectra available to date. We find a strong change in the typical properties of GRB-selected galaxies with redshift. With increasing redshift, they have higher star-formation rates and ionization parameters. Typical metallicities of GRB hosts are 12+log(O/H) = 8.5 (or two thirds of the solar value). The fraction of galaxies with super solar metallicities is 20% at $z < 1$. This is much higher than originally thought, but much lower than the fraction of star-formation in similar environments. This shows that a very high metallicity efficiently suppresses the formation of a GRB.

We have used the largest and most comprehensive sample of GRB host spectroscopy available to date to trace the evolution of galaxies selected by GRBs through cosmic time.

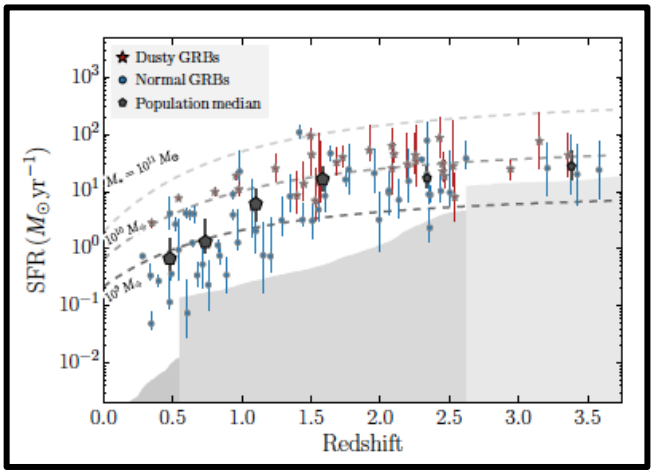
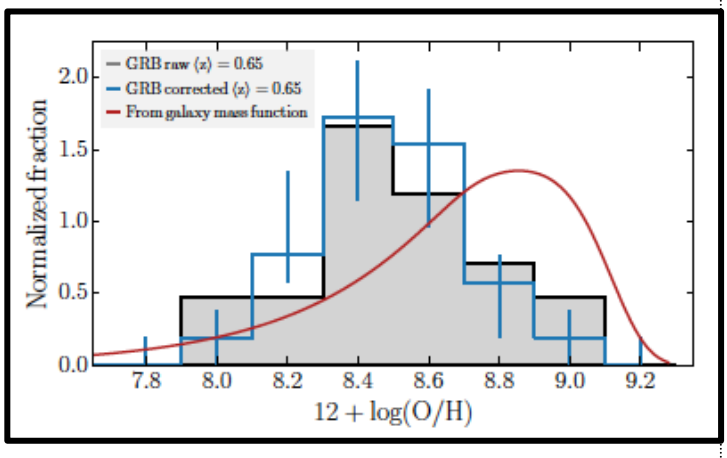


Figure 1 to the left shows the evolution of the star-formation rates of our galaxies. The blue and red data denote normal and dusty GRB hosts, respectively. Dusty GRBs are more abundant at higher redshift, and are typically hosted by galaxies with a higher SFR. Bigger symbols show the population median, which increases by a factor 20 from 0.6 $M_\odot$/yr at $z \sim 0.5$ to 15 $M_\odot$/yr at $z \sim 2$. The evolution of field galaxies is indicated by the dashed grey lines for galaxies with different stellar mass. The grey areas are the sensitivity limits of our observations, constraining our measurements at the highest redshifts.

Figure 2 to the right shows the distribution of oxygen abundances from the sample of $z < 1$ GRB hosts. The black histogram shows the raw data on which we have applied a completeness and selection function correction (blue data). Most GRB hosts have a metallicity between 12+log(O/H) = 8.2 and 8.6, corresponding to 20% and 80% of the solar value. The red line is the expectation from the galaxy mass function at a similar redshift if GRBs would show no preference for a specific type of environment. It is clear, that GRBs avoid galaxies that have a very high metallicity.



These properties of GRB hosts and their evolution with redshift can be understood in the context of cosmic evolution of galaxies and star-formation and a picture in which the hosts' properties at low redshift are influenced by the tendency to avoid the most metal-rich environments.

References:

• Krühler et al., 2015, A&A, 581, 125

T. Krühler for the X-shooter GRB collaboration