

Statistical study of the ISM of GRB hosts

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Abstract. Gamma-ray burst (GRB) afterglows shine, during a brief period of time as the most luminous objects that can be detected in the Universe. They have been observed at almost any redshift, from our nearby environment (the nearest one, at $z = 0.08$) to the very distant Universe (the current record holder at $z = 9.4$). Their optical spectra are well reproduced by a clean, simple power law, making them ideal light houses to probe the interstellar medium of their host galaxies at any redshift. We have used the largest sample of GRB afterglow spectra collected to date to perform a statistical study of the interstellar medium in their host galaxies. By analysing the distribution of equivalent widths of the most prominent absorption features we evaluate the different types of environments that host GRBs and study their diversity.

Keywords. gamma rays: bursts, galaxies: ISM

This work is based on the sample presented by Fynbo *et al.* (2009) and published by de Ugarte Postigo *et al.* (2012). We analyse the distribution of rest-frame equivalent widths (EWs), which is only possible for the most prominent absorption features in GRB afterglow spectra. Our sample is limited to those absorption features that have a rest-frame EW of at least 0.5 \AA in the composite spectrum of Christensen *et al.* (2011), which add to a total of 22 features.

To compare an individual GRB with the sample, we develop *EW diagrams* as a graphical tool. We introduce a *line strength parameter (LSP)* that allows us to quantify the strength of the absorption features in a GRB spectrum as compared to the sample by a single number. Using the distributions of EWs of single-species features, we derive the distribution of their column densities through a curve of growth (CoG) fit.

We find correlations between the *LSP* and the extinction of the GRB, the UV brightness of the host galaxies and the neutral hydrogen column density. However, we see no significant evolution of the *LSP* with the redshift. There is a weak correlation between the ionisation of the absorbers and the energy of the GRB, indicating that galaxies with high-ionisation media produce more energetic GRBs. Features in GRB spectra are, on average, 2.5 times stronger than those seen in QSO intervening damped Lyman- α (DLA) systems and slightly more ionised. In particular we find a larger excess in the EW of CIV $\lambda\lambda 1549$ relative to QSO DLAs, which could be related to an excess of Wolf-Rayet stars in the environments of GRBs. From the CoG fitting we obtain an average number of components in the absorption features of GRBs of $6.00^{+1.00}_{-1.25}$. The most extreme ionisation ratios in our sample are found for GRBs with low neutral hydrogen column density, which could be related to ionisation by the GRB emission.

References

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