W55a Why Are Some Gamma-Ray Bursts Hosted by Oxygen-rich Galaxies?

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Theoretically long Gamma-Ray Bursts (GRB) are expected to happen in the low-metallicity environments, because in a single-massive star scenario, low iron abundance prevents loss of angular momentum through stellar wind, resulting in ultra-relativistic jets and the burst. In this sense, not just a simple metallicity measurement, but low iron abundance ([Fe/H]$\lesssim$-1.0) is essentially important.

Observationally, however, oxygen abundance has been measured more often due to stronger emission. In terms of the oxygen abundance, some GRBs have been reported to be hosted by high-metallicity star-forming galaxies, in tension with theoretical predictions.

We here compare iron and oxygen abundances, for the first time for GRB host galaxies (GRB 980425 and 080517) based on the emission-line diagnostics. The estimated total iron abundances, including iron both in gas and dust, are well below the solar value. The total iron abundances can be explained by the typical value of theoretical predictions ([Fe/H]$\lesssim$-1.0), despite high oxygen abundance in one of them. According to our iron abundance measurements, the single-massive star scenario still survives even if the oxygen abundance of the host is very high such as the solar value. Relying only oxygen abundance could misguide us on the origin of the GRBs.