

# Absorption spectroscopy of GRB160410A: First complete study of the ISM of a short GRB

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Short gamma-ray bursts are, as we now know, produced as the result of the coalescence of two compact objects. These objects are also known to release large amounts of energy in gravitational waves during the merger. We present our first results on the study of GRB 160410A, an undoubtedly short GRB at  $z=1.717$ , making it one of the farthest short GRBs to date. We observed the afterglow emission starting just 8.2 minutes after the detection with Neil Gehrels Swift Observatory using the Rapid Response Mode from X-Shooter spectrograph mounted in VLT at Paranal Observatory. Our fast reaction gave us high-quality data that show a large number of absorption lines as well as Lyman  $\alpha$ . This allows us the first ever detailed study of chemical properties in the sight-line of a short GRB and the first metallicity measurement for a short GRB in absorption. The environment seems to have an unusually low ionization state compared to long GRBs with all high ionization states such as CIV and SiIV being completely absent while they are frequently observed in long GRBs. The low ionization is consistent with the idea of a neutron star binary coalescence with a long delay time, where the host galaxy would no longer have the very active star formation that is normally seen in long GRB hosts. In addition to the host galaxy features we find several intervening absorbers at lower redshifts. Our spectra is the first ever complete study of the ISM in the host of a short GRB.

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