Astronomers investigate a curious case of a supernova connected with gamma-ray burst

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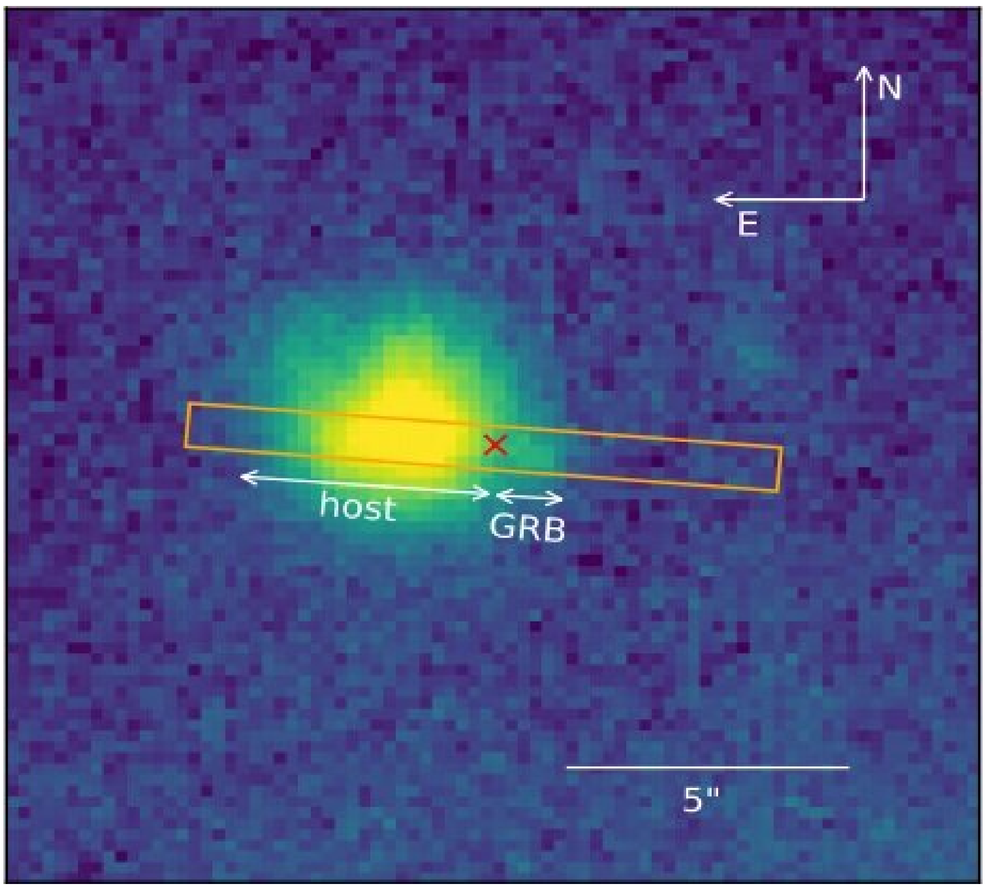

LBT r-band image of the host galaxy of GRB 171010A. The radio position of the GRB is marked with a red cross. Credit: Melandri et al., 2019.

Using a set of space and ground-based telescopes, an international team of astronomers has conducted a detailed study of the supernova SN

2017htp associated with the gamma-ray burst GRB 171010A. Results of the study, presented in a paper published October 26 on arXiv.org, could shed more light on the nature of such phenomena.

Astronomers generally agree that long-duration gamma ray bursts (GRBs) coincide with powerful supernovae (SNe), dubbed hypernovae, occurring when a massive star collapses to a black hole. The first conclusive evidence for the SN-GRB connection came in 2003, when an SN-like spectrum emerged from the spectrum of the optical transient of GRB 030329.

However, the link between GRBs and SNe is still not fully understood. Studies show that not all powerful supernovae produce gamma-ray bursts, hence some GRBs may not be connected with deaths of massive stars at all. Therefore, detailed investigations of SN-GRB associations could be helpful in determining the true nature of these phenomena.

Now, a group of astronomers led by Andrea Melandri of the Brera Observatory in Italy reports the detection of a new GRB-SN connection. They found that GRB 171010A, a long-duration gamma-ray burst identified in October 2017 at a redshift of 0.33, is associated with the Type Ib/c core-collapse supernova SN 2017htp detected in November 2017 at a similar redshift.

"We present a new case of such a liaison at z = 0.33 between GRB 171010A and SN 2017htp (...) We analyzed the optical photometry and spectroscopy of GRB 171010A and SN 2017htp spanning nearly four months since its discovery," the astronomers wrote in the paper.

Investigating the properties of the new GRB-SN connection, the astronomers found that approximately 0.33 solar masses of nickel is required to reproduce the peak luminosity of SN 2017htp, with an ejecta mass of about 4.1 solar masses and a kinetic energy of some 8.1

sexdecillion erg. These results are consistent with other previously observed GRB-SN associations.

Furthermore, the study revealed the properties of the GRB 171010A region and the part of GRB's host galaxy. It was found that the galaxy has a diameter of about half of that of the Milky Way, making it the second biggest GRB host known to date. The researchers noted that although the GRB 171010A's host is bigger in size than most GRB host galaxies, its spectral properties are typical for such objects.

The star-formation rate of the GRB star-forming region was calculated to be about 0.2 solar masses per year, while its metallicity (12 + log(O/H)) was measured to be at a level of approximately 8.15. According to the paper, these values are consistent with those reported for other GRB-SN connections.

"The observed properties of the GRB star-forming region are similar to those of the star-forming regions hosting other GRBs with an associated Type Ic-BL SN and with available spatially resolved observations," the paper reads.

In concluding remarks, the astronomers emphasized that their study seems to confirm that in general, the metallicity of the GRB environment is low, even in high-metallicity host galaxies.

More information: GRB 171010A / SN 2017htp: a GRB-SN at z=0.33, arXiv:1910.14160 [astro-ph.HE] arxiv.org/abs/1910.14160 curious-case-supernova-gamma-ray.html