Type II supernova SN 2020jfo investigated in detail

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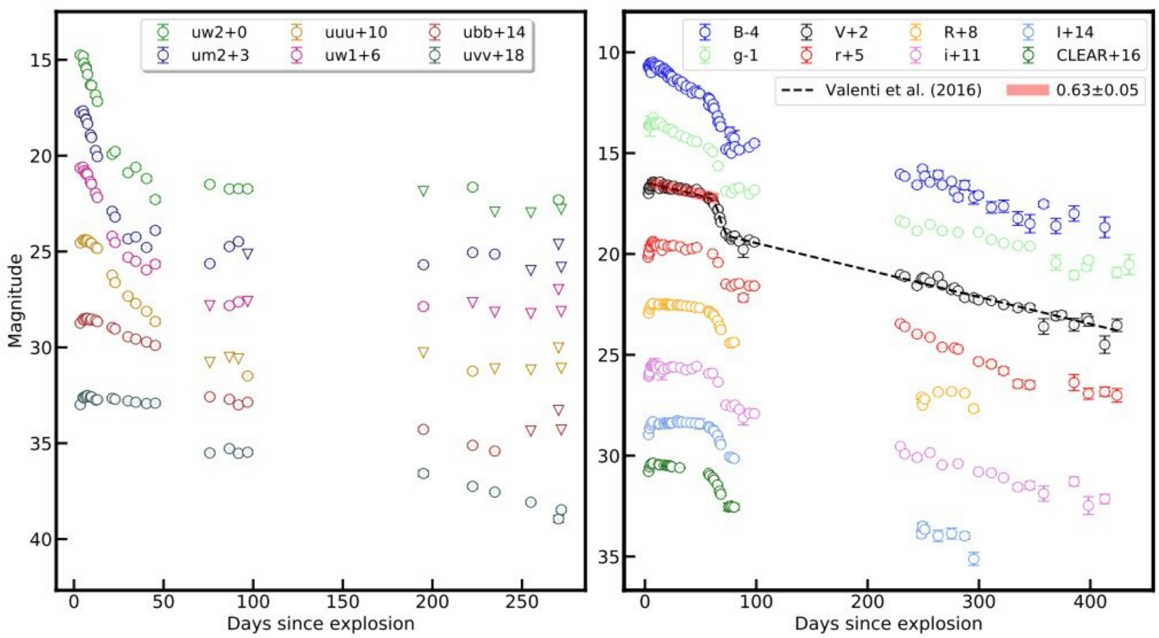

The Swift UVOT and optical light curves of SN 2020jfo since the date of explosion. The inverted triangles represent upper limits in the UVOT light curves. The light curves are offset by arbitrary numbers for display clarity. The dashed line represents the best fit to the ? band using Valenti et al. (2016b). Credit: Ailawadhi et al, 2022

An international team of researchers have performed high-cadence photometric and spectroscopic observations of a Type II supernova known as SN 2020jfo. Results of the observational campaign, presented November 5 on arXiv.org, deliver important insights into the nature and properties of this supernova.

Type II supernovae (SNe) are the results of rapid collapse and violent explosion of massive stars (with masses above 8.0 solar masses). They are distinguished from other SNe by the presence of hydrogen in their spectra. Based on the shape of their light curves, they are usually divided into Type IIL and Type IIP. Type IIL SNe show a steady (linear) decline after the explosion, while Type IIP exhibit a period of slower decline (a plateau) that is followed by a normal decay.

SN 2020jfo (also known as ZTF20aaynrrh) was detected with the Palomar Schmidt 48-inch Samuel Oschin telescope on May 6, 2020, as part of the Zwicky Transient Facility (ZTF) survey. It exploded in the outskirts of the face-on spiral galaxy M61, located some 47.3 million light years away. SN 2020jfo was classified as a Type II SN based on spectra from the Liverpool Telescope (LT) and the Nordic Optical Telescope (NOT), acquired 17 hours after the detection.

In order to shed more light on the nature of SN 2020jfo, a group of astronomers led by Bhavya Ailawadhi of the Aryabhatta Research Institute of Observational Sciences in India, commenced a high-cadence photometric and spectroscopic observations of this SN in ultraviolet, optical and near-infrared bands, three days after the explosion. For this purpose, they used NASA's Swift spacecraft and a set of various ground-based observing facilities worldwide.

"We present high-cadence photometric and spectroscopic observations of SN 2020jfo in ultraviolet and optical/near-infrared bands starting from ~ 3 to ~ 434 days after the explosion, including the earliest data with the 10.4 m GTC [Gran Telescopio Canarias]," the researchers wrote in the paper.

The observations found that the plateau phase after the explosion was relatively short as it lasted approximately 67 days. It was noted that unlike other SNe II with shorter plateau duration, SN 2020jfo is fainter, with a peak absolute V-band magnitude of −16.90 mag.

The results indicate that despite the shorter plateau duration in SN 2020jfo, the neutral atomic hydrogen (HI) absorption features in its plateau-phase spectra are remarkably strong, suggesting a relatively high hydrogen-envelope mass. Moreover, the spectra of SN 2020jfo show strong metal lines when compared with other SNe II at similar epochs and with comparable plateau lengths.

According to the researchers, the progenitor mass of SN 2020jfo is most likely between 12 and 15 solar masses, while its ejecta mass, at a level of 13.6 solar masses, turned out to be much higher than that of the Type II SNe. All in all, the authors of the study concluded that although SN 2020jfo has a short plateau length, its parameters are more similar to those of normal SNe IIP.

More information: B. Ailawadhi et al, Photometric and spectroscopic analysis of the Type II SN 2020jfo with a short plateau, *arXiv* (2022). DOI: 10.48550/arxiv.2211.02823