Modeling a core collapse supernova

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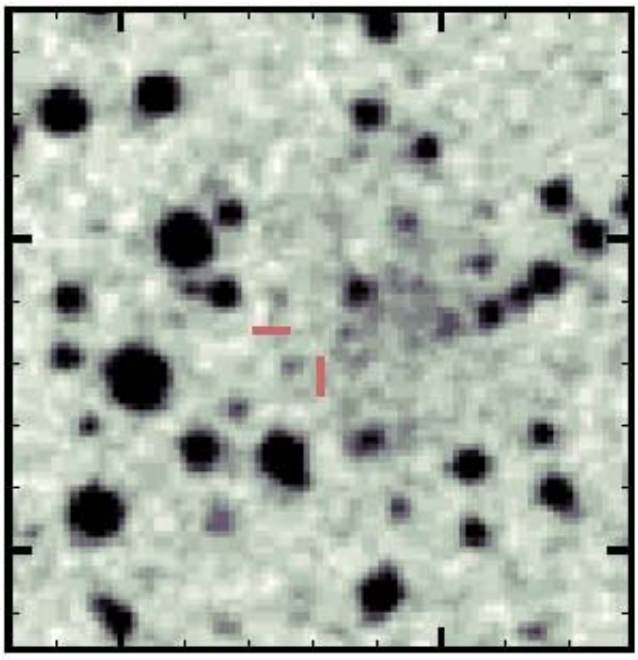

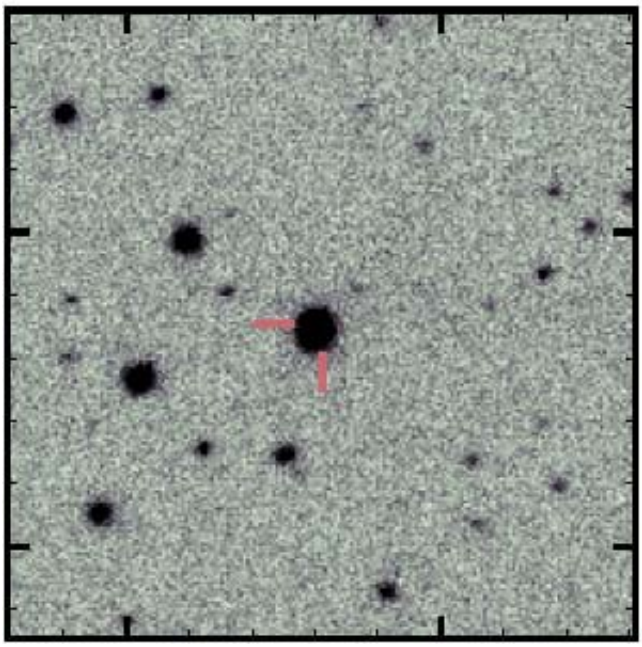

Before and after – optical images of the field of stars around the core collapse supernova ASASSN-15oz in the relatively nearby galaxy HIPASSJ1919-33. Astronomers studying the photometric and spectral lightcurves have concluded that the progenitor star was a red supergiant star with a substantial shell of previously ejected material. Credit: Bostroem et al. 2019

Stars greater than eight solar-masses end their lives spectacularly—as supernovae. These single-star supernovae are called core collapse supernovae because when their dense cores (at this stage composed primarily of iron) are no longer able to withstand the inward pressure of gravity they collapse inward before exploding. Core collapse supernovae with strong hydrogen emission lines are thought to result from the explosions of red supergiant stars, massive stars that have evolved beyond their principle hydrogen burning stage and grown in radius. Until recently, astronomers thought these stars were relatively quiescent until their final demise, but evidence has been accumulating that they actually experience strong mass loss before exploding. In some models, emission resulting when ejecta from the supernovae encounter these envelopes produces the observed variations in core collapse supernova.

CfA astronomer Griffin Hosseinzadeh was a member of a team of astronomers testing these ideas by studying the core collapse supernova ASASSN-15oz. He assisted in the multiband observations, which included X-ray, UV, optical, infrared, and radio measurements. ASASSN-15oz exploded almost exactly four years ago, around 31 August 2015, and is located in the relatively nearby galaxy HIPASSJ1919-33, about one hundred million light-years away. The astronomers were able to obtain spectra and photometric lightcurves of the object over a period of about 750 days. They successfully modeled

the event as the explosion of a red supergiant star that had ejected material in a wind for most of its later evolution and underwent an extreme eruption just prior to its demise. They estimate that about 1.5 solar-masses of material was ejected in total. The new analysis is consistent with the idea that this class of core collapse supernova is indeed surrounded by a substantial circumstellar shell that was the result of eruptive mass loss from the red supergiant progenitor.

More information: K Azalee Bostroem et al. Signatures of circumstellar interaction in the Type IIL supernova ASASSN-15oz, *Monthly Notices of the Royal Astronomical Society* (2019). DOI: 10.1093/mnras/stz570

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