The colliding-wind massive binary WR140: observing the 2016 Dec 18 periastron passage

Background

Massive stars are so luminous that they produce very strong winds during their whole lifetimes right up to the ultimate wind as a core-collapse supernova. The high level of radiation (especially in the UV, since these stars are very hot) and the expulsion of energetic particles provides a crucial impact on the ecology of the Universe ever since the first stars appeared some 200 million years after the Big Bang. Furthermore, massive stars tend to form in binaries in which their strong winds interact via a violent collision that produces copious high-energy (mainly X-ray) radiation, due to their high speed and density. The most famous colliding-wind binary system is WR140. Indeed, many astronomers label it the Rosetta Stone of colliding-wind systems.

The orbit of WR140 lasts 7.94 years in a highly elongated (elliptical, e = 0.9) orbit such that the wind collision is enhanced by more than an order of magnitude in X-rays at and during the several weeks on either side of periastron passage. It is during this stage that a lot of things happen rapidly in addition to the increased X-ray flux, such as enhanced carbon-dust formation (the Wolf-Rayet component of the binary is rich in carbon atoms), greater non-thermal radio-emission, and spectral-line variability especially among low-ionization lines in the UV, optical and IR.

The previous periastron passage occurred on 9 Jan 2009, during which we organized a major optical spectroscopic observing campaign involving professionals and amateurs alike. This led to many new and improved results of great importance, as documented in the published paper by Fahed et al. in 2011 - http://adsabs.harvard.edu/abs/2011MNRAS.418....2F . The next periastron passage will occur soon, on 18 Dec 2016, during which a small consortium of professional astronomers are organizing another big campaign involving large and small X-ray satellites, NIR spectrographs, high spatial-resolution NIR imagers and polarimeters. However, we still need repeated optical spectroscopy, especially of the CIII 5696 and HeI 5876 lines. These lines are the most sensitive in the optical to the colliding wind phenomenon and we need to know whether their behaviour repeats from one cycle to the next.

The amateur program

We are asking all interested amateurs to join in this effort by obtaining high-quality spectra covering these two optical lines during the several weeks before and after periastron. One or two spectra with the same equipment outside this time interval would also be useful as a reference. However, it would be a waste of time to obtain more than this number of optical spectra outside periastron, since nothing much happens in the optical at that time! We realize that observing a Cygnus star during late November through mid January is a challenge from two

standpoints: observing at high airmass low in the sky after sunset and it's a holiday period. However, who wants to wait another 50 years before this phenomenon becomes observable in late summer when Cygnus is better placed?

In addition to optical spectroscopy, we also need copious high-precision (5 mmag, using comparison stars on timescales of days) photometry to follow WR140 starting just after periastron for about 6 months. During this period we have seen dips in the light curve lasting about a week, but unclear whether they repeat from one cycle to the next. They must be caused by dust absorption, the same dust that is seen in emission in the IR. The best filters to observe in are UBV, since the amplitude of the dips increases towards shorter wavelengths, as a result of the small dust grains that are formed in the colliding-wind compression. However, if the U-band poses problems, we would also be happy with BVR or even VRI photometry.

If you are interested in any aspect of this program, please contact Thomas Eversberg <thomas.eversberg at dlr.de>, who will coordinate the effort with the professionals, including his old thesis supervisor, Tony Moffat, retired but still popping up like an eager Jack-in-the-Box!

This page provided by Dr. Noel Richardson and colleagues relevant to the 2016-2017 multiwavelength campaign on V1687 Cyg (WR 140) discussed in *AAVSO Alert Notice 546* (https://www.aavso.org/aavso-alertl-notice-546). and *AAVSO Special Notice 419* (https://www.aavso.org/aavso-special-notice-419).