COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS

Number 5807

Konkoly Observatory
Budapest
14 December 2007

HU ISSN 0374 – 0676

EARLY SPECTRAL EVOLUTION OF NOVA Vul 2007=V458 Vul

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The star has been discovered as a bright nova on 2007 August 8.54 UT with the coordinates $\alpha = 19^{\rm h}54^{\rm m}24\overset{\rm s}{.}64$, $\delta = +20^\circ 52' 51\overset{''}{.}9$ J2000 and had brightness of about V = 8 mag (Abe, 2007; Nakamura et al. 2007). The nova has been given the official name V458 Vul (Samus, 2007). The light curve of V458 Vul based on AAVSO data (Henden, 2007a) is shown in Fig. 1. During the light fading the nova showed local flares up to 8th magnitude, and then declined to 11th magnitude (Nakano et al. 2007; Buil & Fujii, 2007).

We obtained five spectra on the 8th, 9th, 12th, 22nd and 24th day after the outburst (i.e. observed maximum magnitude) when the nova was at magnitude V=10.1, 10.2, 10.5, 11.2 and 11.3 respectively. The dates of our spectroscopic observations are marked on the light curve by arrows (see Fig.1).

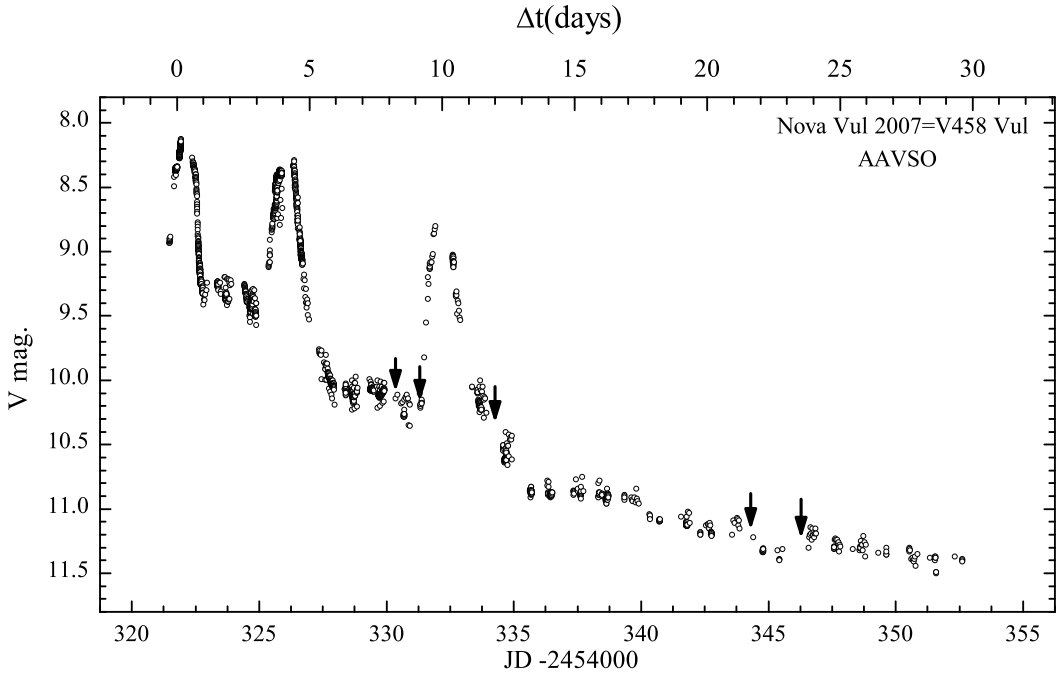

Figure 1. Light curve of V458 Vul based on AAVSO data. Arrows indicated the time of our spectral observations

The spectral observation was carried out at the Crimean Astrophysical Observatory with the 2.6m Shajn telescope. The low resolution spectra, characterized by a dispersion

of 2 Å pix^{-1}, were observed in the wavelength ranges 3700-6190 Å and 5600 -7600 Å and were combined. The medium resolution spectrum, obtained on Aug 17th, has a dispersion of 0.75 Å pix^{-1} and covers the spectral range 4200 - 5300 Å. The data were processed following standard procedures for CCD frames, including bias subtraction, flat field correction, wavelength calibration. The spectrophotometric standard HR 7679 (Kharitonov et al. 1988) was used for flux calibration of the observed star. Four short time exposures of the standard star have been obtained just before and after the nova observations.

All our spectra are shown in Fig. 2. The spectra are separated vertically by a constant offset. The first two spectra were obtained before the second maximum, the third spectrum was obtained at the end of the second maximum and the last two were taken during the phase of slow decline.

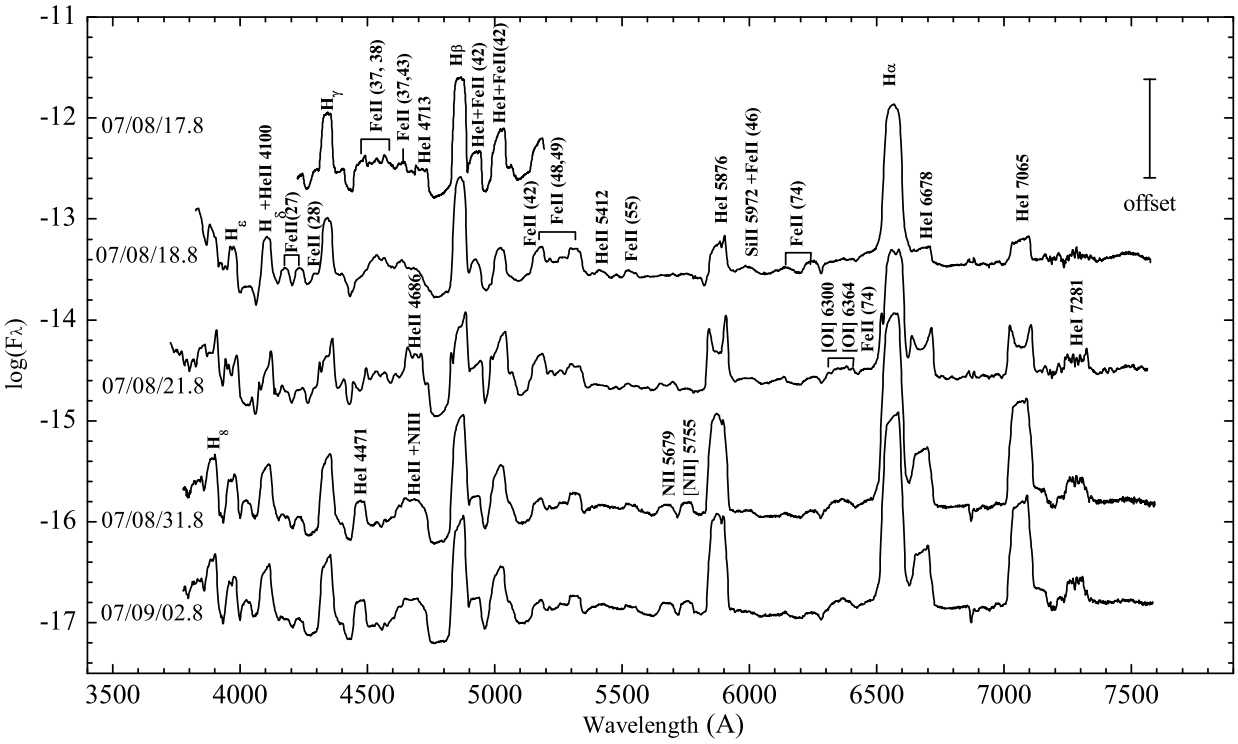

Figure 2. Spectroscopic evolution of V458 Vul. The lower four spectra are shifted downwards by one - four units respectively in log (flux). Flux F_λ is in units of $erg\,cm^{-2}s^{-1}\AA^{-1}$

Data analysis shows that the first two spectra, obtained during two consecutive nights are quite similar. The H, FeII emission lines of the 27, 28, 37, 38, 42, 49, 74 multiplets, and HeI 5876, 6678, 7065 Å dominate the spectrum of the nova. The expansion velocity (FWHM) is about 2700 $km\,s^{-1}$ for H and about 3000 $km\,s^{-1}$ for HeI lines. The line profiles of H and FeII lines have the rounded-topped form. The profiles of the HeI lines (but the HeI 4471) are different as they show "flat-top" profiles with some "jags".

On the third spectrum the strongest lines are the same as in the previous ones. But the line profiles differ noticeably from two previous and subsequent spectra. The H emission lines have a complex profile showing a clear P Cyg absorption and a multicomponent emission. While, the HeI line profile has evolved in asymmetric saddle shaped profiles. It is possible that the profile of the H emission lines is also saddle shaped and that the multicomponent appearance results from blend with HeII multiplets (2 and 3). However, we discard this hypothesis as the flux of the isolated line HeII 5412Å is lower than that of the assumed blends. The analysis of the line profiles will be realized in detail in a

subsequent paper. The width of the H lines is FWHM $\approx$ 2600 $km\,s^{-1}$, the HeI lines are wider, FWHM $\approx$ 4000 $km\,s^{-1}$. The flux of the H and HeI lines has also evolved differently with time. In particular, the flux of the H lines decreased by a factor of 2, while that of the HeI lines increased by a similar factor in the time between our second and third observation.

The last two spectra were obtained within two days and are very similar to each other. However, they differ noticeably from the previous spectrum. The line profiles of the HeI lines 5876, 6678, 7065 Å evolved back to "flat-top" with "jags" as in our first and second observations. While the profile of the H lines became very similar to that of the HeI lines. The width of the H and the HeI lines are FWHM $\approx$ 2900 $km\,s^{-1}$ and FWHM $\approx$ 3000 $km\,s^{-1}$, respectively. The flux of the Hα lines became again almost same as on the first two spectra (increased by almost a factor of two). The flux of the other Balmer lines has practically not changed. The flux of the HeI 5876 and 7065 Å lines became noticeably greater than on the previous spectra while the flux of HeI 6678 Å line is almost not changed. The intensity of the metal emission lines decreased. The lines NI 5679 Å and [NII] 5755 Å , visible as weak emissions since the beginning of our observation, increased on the last spectrum. The blend of the [OI] 6300 Å and 6364 Å became appreciable on the last spectra also. The HeII 4686 Å line and the blend of the NIII 4640 Å lines became stronger and formed the broad blend centered at 4670 Å.

The nova showed several maxima near 8th magnitude, with minima near 10th magnitude between them. The spectra of the nova showed P Cyg profiles of Balmer and FeII lines when the magnitude was at maximum (see, for example, Henden, 2007b). Therefore, this star has been classified as a standard FeII-type nova in the Tololo system (Williams, 1992). However, our spectra, obtained between the 8th - 24th days after the outburst, show that the nova better fits in the He/N class. This is consistent with the observations by Skoda et al. (2007) and Kiss & Sarneczky (2007), who report broad and "flat-top" emission lines. We, thus, conclude that nova V458 Vul belongs to the hybrid nova class according to Williams' spectroscopic classification.

Acknowledgements: This work was partially supported by the Ukrainian Fund of Fundamental Research F25.2/139. I am grateful to the referee Dr. E. Mason for very useful comments.

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