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Spectrophotometric observations of γ^2 Velorum

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Abstract. The spectrophotometric observations of the (WC 8 + 09 I) spectroscopic binary γ^2 Vel are reported The emission line flux measurements of the C III line at 5696 Å show phase-dependant variation The fluxes of He II at 4686 Å and C III C IV at 4650 Å also show variations on smaller scale. The possible implications on the line emitting regions are discussed

Key words : Wolf Rayet stars -γ^2 Vel

1. Introduction

γ^2 Vel, the brightest among the WR stars, is a spectroscopic binary (WC 8 + 09 I) with an orbital period of 78.5 d (Ganesh & Bappu 1968). Recent radial velocity measurements by Niemela & Sahade (1980) have revised the period to be 78.5002 d. Spectroscopic and photometric variations of smaller periods have been reported by Rajamohan (1972), Moffat (1977) and Haefner *et al.* (1977). The possibility of a neutron star component making it a triple system was proposed and eliminated (Jaffers *et al.* 1985; Moffat *et al.* 1986).

The spectroscopic observations were obtained with the single channel spectrum scanner at the 102 cm telescope of Vainu Bappu Observatory. A 600 lines mm^{-1} grating blazed at 7600 Å was used in the second order to get a resolution of 10 Å. The region covered was 4500 to 6000 Å, ζ Pup, 27 CMa, γ Gem and η CMa were used as comparison stars.

The emission line fluxes were measured for the strong 4650 Å, 5696 Å, and 4686 Å emission lines. The variation of the monochromatic magnitudes also could be obtained comparing it with 27 CMa at 5000 Å. The measured fluxes are shown in figure 1 and the magnitudes in figure 2. The phases are calculated with JD 2445768.96 as phase 0.0, corresponding to WR passing in front (Moffat *et al.* 1986).

All the emission line fluxes show general intrinsic scatter. A small decrease in flux at phase ~0.5 is noticeable : There is no corresponding decrease in the continuum.

The variation of magnitude in figure 2 also shows intrinsic scatter, except on two occasions when there is a sharp decrease of about 0.02 mag. Any short period variation may be responsible for this. One of the possibilities is 0.93 d, which is of the order of the period reported after a continuous 36 hr run from Antarctica (Taylor 1988).

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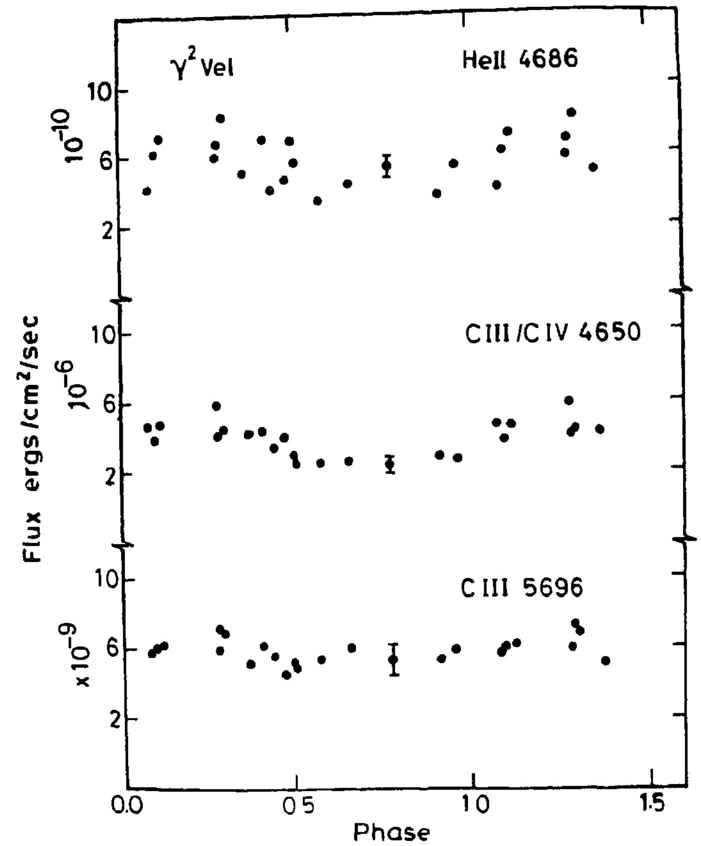

Figure 1. The variation of the flux of the emission lines at 4686Å, 4650 Å and 5696 Å

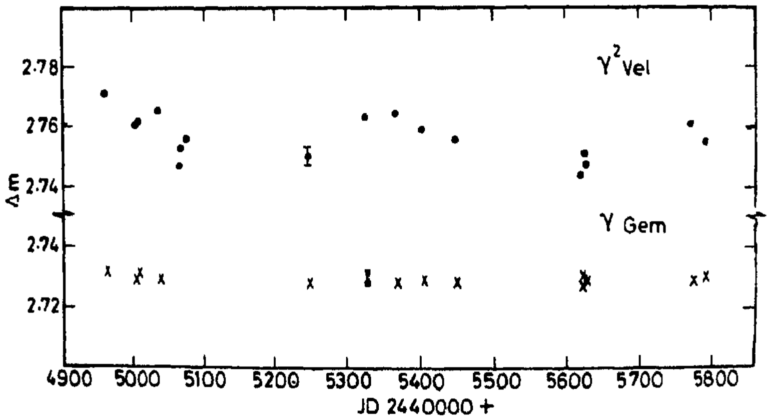

Figure 2. The variation of monochromatic magnitudes of γ^2 Vel (dots) and γ Gem (crosses) at 5000 Å relative to 27CMa.

γ^2 Vel is the only WR for which interferometric measurements are available (Brown *et al.* 1970). This shows that the 4650 Å emission region is larger in size (compared to the continuum emitting region) and is comparable to orbital dimensions (0.25 *a*, where *a* is the separation). Thus the extended atmospheric structure is large enough to show atmospheric eclipses as in the case of HD 152270 (Shylaja 1988).

The type of stratification present in these atmospheres puts higher excitation lines closer to the photosphere. Thus C IV lines are expected to show pronounced eclipse effects compared to C III. From figure 1 we see that all the emission lines show eclipse effects, although the angle of inclination is not favourable. The difference between 5696 Å (CIII) and 4650 Å is not apparent because the latter is a blend of CIII and CIV.

The violet wing of the He II line at 4686 Å is distorted by the strong 4650 Å feature. Further, the O star can contribute to the total flux, whether in absorption or emission. The lower ionization potential puts their formation in the outer regions of the envelope and therefore the extent of tidal distortion also is more. Thus there are many contributors to the line and this explains the scatter. The He I lines (not observed here) are likely to show more scatter since they are formed in the outermost regions

Moffat (1977) observed a marginal decrease in line emission at a phase corresponding to the passage of WR in front. This is defined as 0.5 in his paper, whereas here the same phase is defined as 0.0. The suggested causes of the dip are (i) grazing occultation of the gas streaming through the inner Lagrangian point and (ii) the tidal distortion of WR envelope by the O companion. These two factors can cause decrease in flux at both phases 0.0 and 0.5. However, the absence of the dip at phase 0.0 is not confirmed because our observations do not cover this phase (passage of WR in front) extensively. Further the photometric measurements of Moffat (1977) itself can be taken to represent the decrease at this phase. Both put together imply that there is a decrease in line emission at phases 0.0 and 0.5. The distribution of line emitting material becomes asymmetric because of the tidal distortion. A concentration towards the inner Lagrangian point causes a decrease in observed flux even when there is a grazing occultation.

In spite of its apparent brightness, the variability of line emissions, the blends and short scale variability of magnitude prevent a good model fit for the system. Narrow-band photometry of blend free emission lines and the orbital parameters thus derived can throw light on this problem more efficiently.

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