VARIABLE FLUX OF P CYGNI IN CONTINUUM AND SPECTRAL LINES

Indrek Kolka
W. Struve Astrophysical Observatory
202444 Tartu, Estonia, USSR

1. INTRODUCTION

Recently, cyclic variations have been discovered both photometrically in the continuum flux of P Cygni (Percy et al. 1988) and by position measurements of different components in spectral lines of this star (Kolka 1983, Markova, Kolka 1985, Lamers et al. 1985). Additionally, more stochastic polarimetric (Hayes 1985) and radio flux (van den Oord et al. 1985) variations were discovered, too. It has recurrently been stressed that simultaneous multiwavelength observations are badly needed. Fortunately, we had a possibility to complement our own observational data from 1982 with some additional data of the same year from astronomical literature to compare the B, V-filter flux with the behavior of spectral lines having two flux estimates for this period, too.

2. OBSERVATIONAL DATA

Our sample of observational data consists of

1) 14 spectrograms of P Cygni (from 9 June, 1982 to 5 November, 1982) on the Kodak IIaO plates covering a region 3600 Å - 3970 Å, photographed with the Cassegrain spectrograph ASP-32 attached to the 1.5 m telescope of Tartu Astrophysical Observatory giving dispersion of about 12 *Å/mm* in this region,

2) the results of radial velocity measurements and the profiles of selected lines, published by Markova (1986) and Markova, Kolka (1988),

3) the results of B, V-photometry by Percy and Welch (1983) with an additional B, V-estimate by the author, obtained on 6 April, 1982 parallel to the program of checking of the secular variations in the Tartu Observatory UBV-photometric system (Luud et al. 1977),

4) two radio flux estimates at 6 cm wavelength adopted from the compilation by van den Oord et al. (1985).

We present our data in Fig. 1. The left-hand part of this figure (Fig. 1a) shows the photometric behavior of P Cygni in B- and V-bands along with the results of two radio flux measurements (moments of radio observations estimated from Fig. 1 by van den Oord et al. 1985) and peak intensities relative to the continuum in emission components of three

K. Davidson et al. (eds.), Physics of Luminous Blue Variables, 265–267.

lines noted in the figure. The results obtained by the author are marked with filled symbols, open symbols denote the data from literature. We have preferred the peak intensities rather than the equivalent widths bearing in mind the difficulties with the rectification of P Cygni-type profiles (van Blerkom 1970). (The random error in these peak-intensities was estimated ±0.03 F_c (1σ) on the basis of continuum level fluctuations.)

The right-hand part of Fig. 1 allows a comparison of photometric variations in V-filter with the behavior of parameters, characterizing absorption components in spectral lines. Again, we have measured the "peak intensity", i.e. the flux relative to the continuum at the deepest point in the absorption component, and the position of this deepest point on the wavelength scale, giving the v_{rad} - picture in Fig 1b, based on four lines: H9 (circles), *He I* 3965 Å (quadrates), *He I* 3820 Å (triangles) and *O II* 3727 Å (rhombuses). As one can see the accordance of different measurements (open and filled symbols) is acceptable, allowing a reliable analysis of data.

3. CONCLUSIONS

It has been shown earlier (Percy et al. 1988, van Gent and Lamers 1986, Mařkova, Kolka 1985) that characteristic time-scales are about 40^d ... 60^d for brightness variations and about 100^d ... 120^d for radial velocity variations.

Here we obtained (cf. Fig. 1) for the first time a quite long cycle (200^d or more) in the velocity picture of the Balmer-line H9. In the behavior of other lines a cycle of 50^d - 60^d is possible (cf. the neighbourhood of JD 2445200!). Very interesting is the correlation of the maximum absorption depth with corresponding velocity-variations. This correlation in the 50^d ... 60^d-cycle probably can be extended to the brightness oscillations considering additionally the general similarity of the photometric behavior at different epochs (cf. Fig. 1 and Percy et al. 1988).

As a possible explanation for the variations connected with the brightness-cycle we suggest the cyclically repeated high-density periods in spectrum-forming regions in the wind of P Cygni. Then the higher flux level in continuum (and, consequently, in related emission-peaks) is caused by a geometrical factor - a larger stellar disk, which is opaque at corresponding wavelengths. Greater absorption depths at these moments obviously indicate the higher opacity level in the line-forming region. The displacements on the velocity-scale can be accounted for by varying physical conditions, which are the result of density fluctuations. Longer periods (they may occur also in radio flux (cf. Fig. 1 and van den Oord et al. 1985)) of 100^d ... 200^d may reflect the more smoothed (but cyclic!) changes in wind structure also related (directly or indirectly) to the density of the outflowing gas.

https://doi.org/10.1017/S0252921100004565 Published online by Cambridge University Press

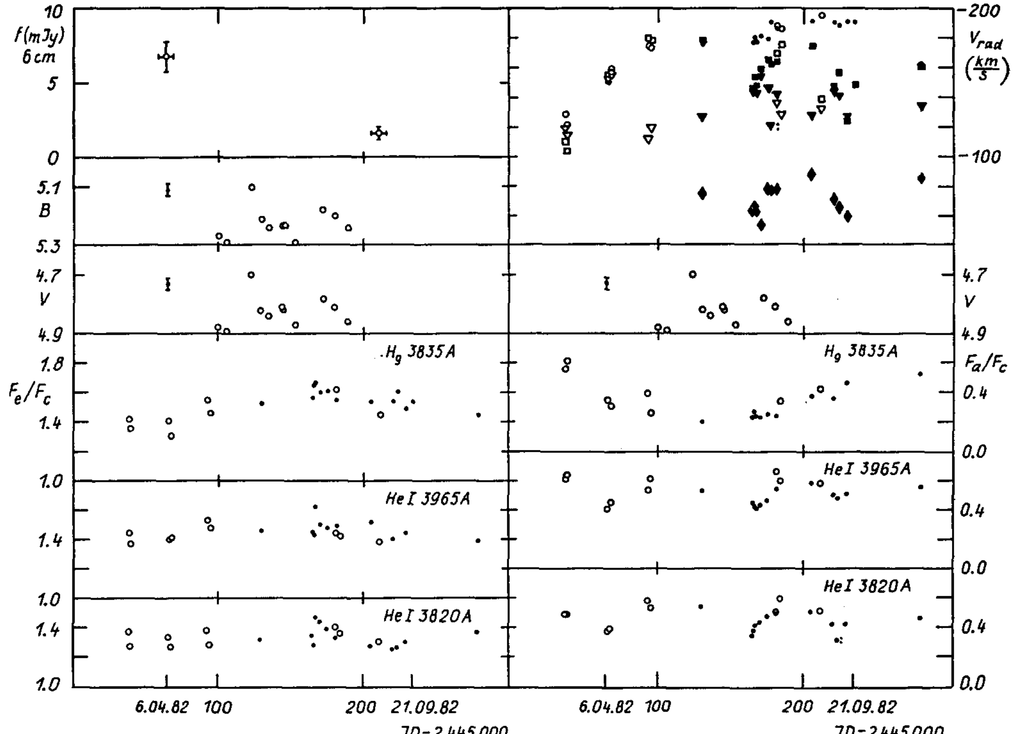

Fig. 1a

Fig. 1b

(See text for explanations)

REFERENCES

Hayes D.P. 1985, *Astrophys. J.* **289**, 726.

Kolka I. 1983, *Publ. Academy of Sci. Estonian SSR* **32**, 51.

Lamers et al. 1985, *Astron. Astrophys.* **149**, 29.

Luud et al. 1977, *Publ. Tartu Astrophys. Obs.* **45**, 113.

Markova N. 1986, *Astrophys. Sp. Sci.* **123**, 5.

Markova N., Kolka I. 1985, *Astrofizika* **23**, 539.

Markova N., Kolka I. 1988, *Atlas of spectral lines of P Cygni in 1981-83* (in press).

Percy J.R., Welch D.L. 1983, *Publ. Astron. Soc. Pac.* **95**, 491.

Percy et al. 1988, *Astron. Astrophys.* **191**, 248.

van Blerkom D. 1970, *Monthly Not. Roy. Astron. Soc.* **149**, 53.

van den Oord et al. 1985, in *Radio Stars* (eds. R.M. Hjellming and D.M. Gibson), p. 111.

van Gent R.H., Lamers H.J.G.L.M. 1986, *Astron. Astrophys.* **158**, 335.

https://doi.org/10.1017/S0252921100004565 Published online by Cambridge University Press