

## LINEAR OPTICAL POLARIZATION OF P Cygni IN 1986-1992

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## 1. INTRODUCTION

Luminous blue variable P Cygni (HD 193237, B1-B2, Ia) has been showing irregular brightness changes and mass loss about  $10^{-5}M_{\odot}$  per year. It has an extended and expanding atmosphere. Undisplaced emission lines are flanked by shortward displaced absorption lines, typical P Cygni-like line profile was first noted in 1888. Because of its brightness, P Cyg was the object frequently studied during more than hundred years.

Polarimetric studies of P Cygni were sporadic till the end of seventies. Hayes (1985) started more intensive polarimetric monitoring of the star by observing linear polarization in B spectral region. During the last decade, polarimetric observations provided the complete wavelength coverage from 1400 to 7600 Å (Taylor *et al.*, 1991). The brightness variations of different time scales exist mainly of an irregular character.

Belgrade linear polarimetric data in V spectral region, collected during seven years, cover the period of time in which many other different observations of P Cyg were done. Belgrade measurements will be useful in the analyses of long-term (years) and short-term (months) variability of the star.

## 2. OBSERVATIONS

The observations of the visual linear polarization of the star P Cyg were performed with the Zeiss 65 cm-refractor and the D.C. one-channel polarimeter at Belgrade Observatory. The observations were done between July 12, 1986 and August 31, 1992. One 8-minute measurement of the Stokes parameters  $Q$  and  $U$  has a typical r.m.s. error not larger than 0.07%.

The observed values of visual linear polarization percentage  $P$  and position angles  $\Theta$  of the star P Cygni during the period 1986-1992 are presented in Figures 1 and 2 respectively. Polarization parameters are on the y-axes and Julian days on the x-axes.

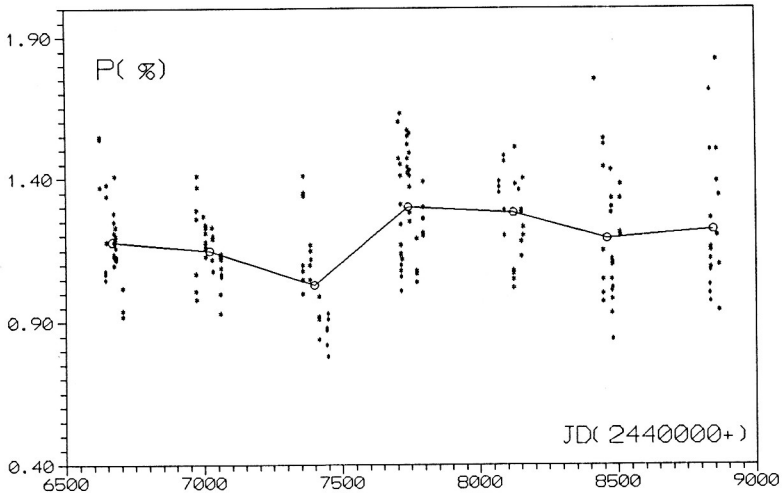


Fig. 1. The observed polarization percentage of P Cyg in V filter during the period 1984-1991.

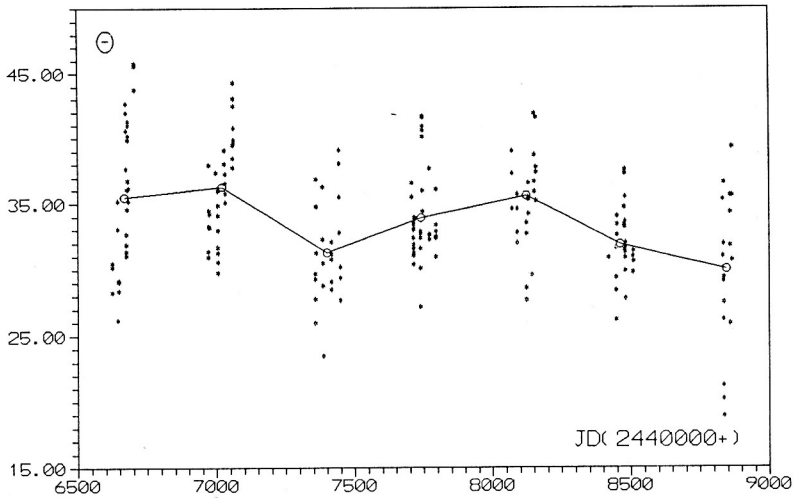


Fig. 2. The position angle of the observed polarization of P Cyg in V filter during the period 1984-1991.

The annual mean values of the observed polarization parameters  $P$ ,  $\Theta$  and Stokes parameters,  $Q$  and  $U$ , are presented in Table 1. Julian days in Table correspond to the middle of the season of the observation. The interstellar component of P Cygni is normally rather high, Taylor *et al.* (1991) derived the interstellar component. But, having in mind many different problems in finding interstellar polarization for one star we prefer using the observed polarization, at least in this kind of work where only time-variability analysis is concerned.

TABLE I

Yearly mean values of polarization percentage ( $P$ ), position angle ( $\Theta$ ), and Stokes parameters ( $Q$ ,  $U$ ) for the star P Cyg.  $n$  - the number of observations per each year.

JD (2440000+)	$P(\%)$	$\Theta(^{\circ})$	$Q(\%)$	$U(\%)$	$n$
6667	$1.18 \pm 0.34$	$35.5 \pm 4.6$	$0.387 \pm 0.244$	$1.118 \pm 0.128$	29
7019	$1.15 \pm 0.23$	$36.3 \pm 3.0$	$0.345 \pm 0.157$	$1.097 \pm 0.096$	32
7398	$1.03 \pm 0.29$	$31.3 \pm 1.3$	$0.475 \pm 0.141$	$0.920 \pm 0.168$	25
7740	$1.30 \pm 0.33$	$33.9 \pm 1.6$	$0.490 \pm 0.152$	$1.205 \pm 0.181$	40
8122	$1.28 \pm 0.28$	$35.6 \pm 1.7$	$0.413 \pm 0.131$	$1.209 \pm 0.157$	23
8473	$1.19 \pm 0.32$	$31.9 \pm 0.4$	$0.525 \pm 0.121$	$1.071 \pm 0.208$	28
8845	$1.22 \pm 0.48$	$30.0 \pm 2.2$	$0.612 \pm 0.244$	$1.060 \pm 0.237$	18

### 3. DISCUSSION

The observed polarization percentage varies with time as does the position angle. The long-term variations (from year to year) are with small amplitudes for both parameters. The amplitude of percentage changes is under 0.3%. For the position angles the changes are not greater than  $5^{\circ}$ . The short-term changes (during one season of observations) are considerably larger. The percentage values are between 0.5 and 1.0%. The position angle varies between  $11^{\circ}$  and  $26^{\circ}$ . The Belgrade observed values of V polarization parameters are in very good agreement with Hayes' (1985) values in B spectral region. This is in accordance with the known polarization wavelength dependence.

During first three years of observations, 1986-1988, the polarization percentage slowly decreases. For the period 1985-1989 Groot (1989) found an increase of visual brightness of P Cygni. So, we could conclude that for the star P Cygni an anticorrelation between long-term visual polarization percentage variation and visual brightness changes exists.

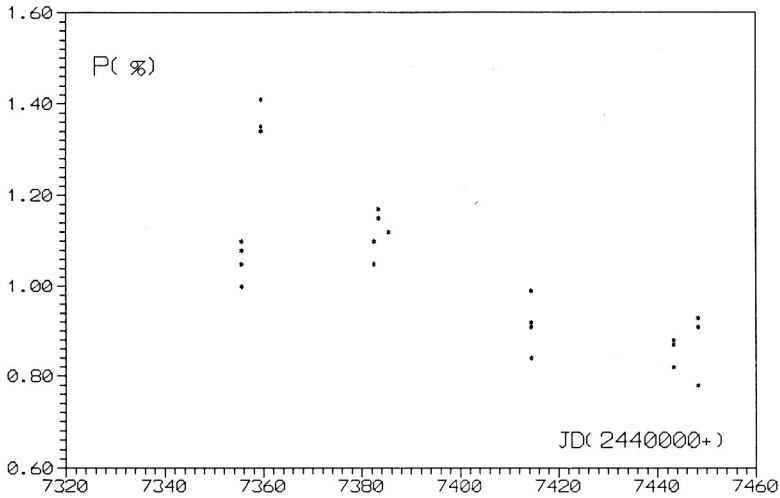


Fig. 3. The observed polarization percentage of P Cyg in V filter during 1988.

As the short-term polarization percentage variations are concerned the situation is the opposite. During 1988, the star varied in brightness (Groot, 1989) and in polarization, Figure 3, but with a positive correlation. Of course, it is seen in the period JD 2447355-7448 when polarimetric and photoelectric observations were done almost simultaneously. The different behaviour of the short-term and long-term polarization percentage variations with respect to the photometric variations should have to be confirmed with a larger quantity of the observed data.

### Acknowledgements

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### References

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