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AN INTERESTING EPISODE IN THE LINEAR POLARIZATION BEHAVIOUR OF WW VUL

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During seven years of photopolarimetric monitoring of Herbig Ae star WW Vul 4 deep ($\Delta m >$ 2 mag) brightness minima were observed. During each of them the degree of linear polarization increased up to 6%. Such a dependence of observed polarization on stellar magnitude agrees well with the now accepted model of variable circumstellar screening. During 1994–1995 WW Vul shown unusual variability of brightness and linear polarization: a change of positional angle of almost 90° with insignificant changes of polarization degree and brightness. Our analysis shows that this behaviour can be explained within the framework of the model mentioned above. It is assumed that part of the polarized radiation arises from scattering on dense circumstellar dust clouds moving close to the star without crossing the line of sight.

KEY WORDS Herbig Ae/Be stars, linear polarization, WW Vul

1 INTRODUCTION

Photopolarimetric monitoring of young Herbig Ae/Be stars with non-periodic Algol-type minima has been carried out at the Crimean Astrophysical Observatory since 1986. All observations are simultaneous *UBVRI* photometry and polarimetry with the 1.25-m AZT-11 telescope.

During the course of the programme it has been shown (Grinin *et al.*, 1991; Grinin, 1992) that: (1) fading brightness is caused by the screening of the star by circumstellar (CS) dust clouds[†]; (2) the CS discs of most photometrically active young stars are oriented edge-on or under the small angle to the line-of-sight. The assumption that at least some circumstellar dust clouds are proto-comets, moving

[†]This hypothesis was offered for the first time by Wenzel but until the mid-1980s it was considered improbable (see the review paper by Herbst, 1986).

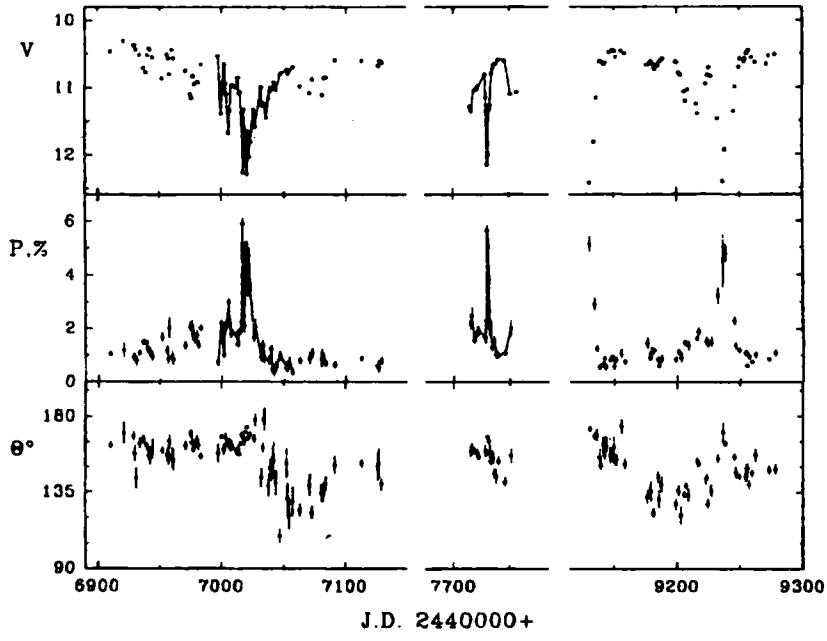

Figure 1 Variability of brightness, linear polarization degree and positional angle of WW Vul in the V passband according to the observational data of 1987, 1989 and 1993.

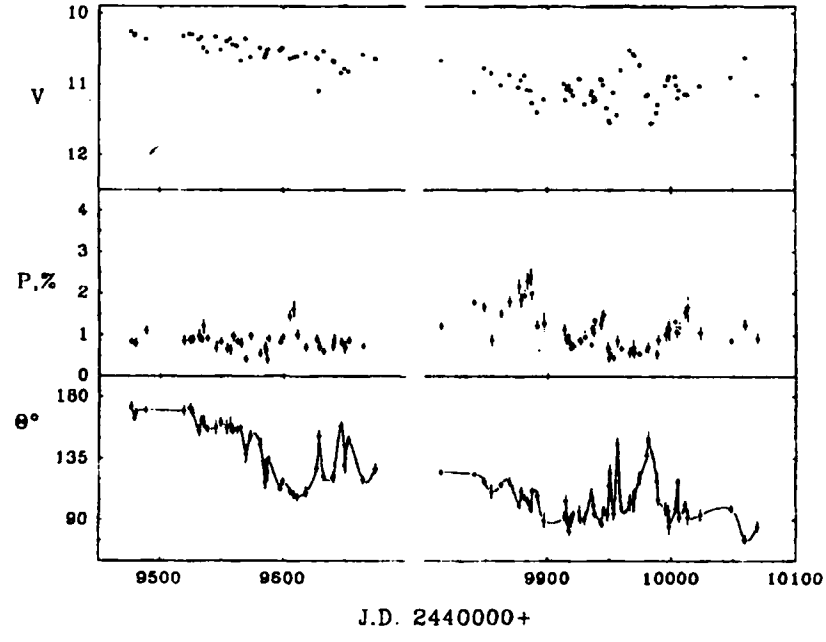

Figure 2 The same as in Figure 1 but for 1994–1995.

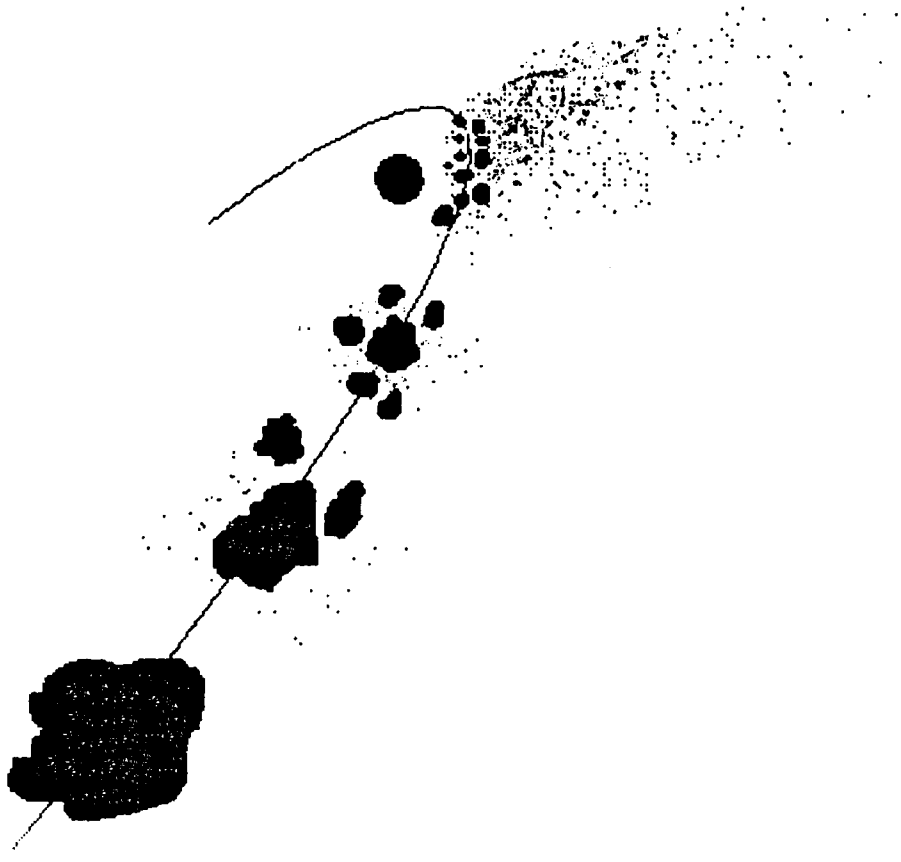

Figure 3 The scheme of movement of a dust cloud (proto-comet) around a star.

on eccentric orbits, which are dissipated completely or partially near the periastron was suggested also. Recently, this assumption has received important inderect confirmation during spectral observations of the Na I resonance doublet lines (Grinin *et al.*, 1994, 1996).

In this paper we present the results of photopolarimetric monitoring of isolated Herbig Ae star WW Vul for the last two observational seasons during which the polarization of star varied unusually.

2 RESULTS

During the previous years of the photopolarimetric observations of WW Vul (Grinin *et al.*, 1988; Grinin, 1994) four deep ($\Delta m > 2$ mag) minima have been registered for this star. Each of them was accompanied by increased linear polarization up to 6% (Figure 1). Such linear polarization behaviour agrees well with the prediction

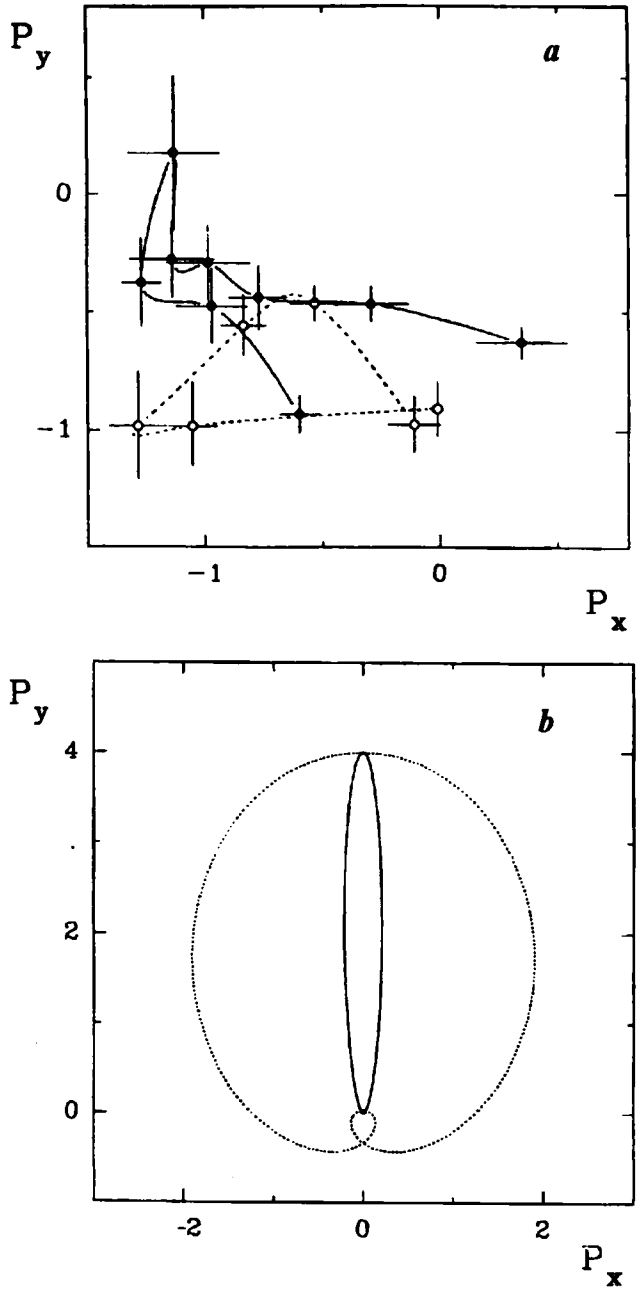

Figure 4 *a*, The observed behaviour of Stokes' parameters on the P_x versus P_y plane in two episodes (JD 24... 49588–49627, 49981–50005); *b*, model simulation of the variation of Stokes' parameters due to the motion of a small optically thin dust cloud around the star on a parabolic orbit. The inclination of the plane of orbit to the line-of-sight is 5° (solid line) and 45° (dashed line).

based on the variable CS extinction model (Grinin, 1986) in which the scattered radiation of the protoplanetary discs is taken into account. In that model the scattered radiation was assumed to be *conservative* and did not change with time.

Later some deviations from this model were found and interpreted to result from dissipation of the proto-comets (having highly eccentric orbits) in the vicinity of the young stars (Grinin *et al.*, 1994).

In this poster paper we present the results of the photopolarimetric observations of WW Vul made during the observational seasons 1994–1995 when the star demonstrated very unusual brightness and linear polarization changes (Figure 2). One can see that the long-lasting fading of brightness in 1994–1995 was accompanied by small-amplitude changes of linear polarization degree and rapid variations of the position angle θ by almost 90°.

The preliminary analysis shows that such behaviour of WW Vul can be explained by the occurrence of an additional source of polarized radiation: radiation scattered on dust clouds appearing in the vicinity of the star due to dissipation of the swarm of planetesimal bodies moving along a highly eccentric orbit (Figure 3).

This suggestion is also confirmed by modelling of Stokes' parameters of polarized radiation (Figure 4). Taking into account that the given model assumes the destruction of fragments and probably their complete evaporation while they approach the periastron (Grinin *et al.*, 1996), one should see a rather complex picture of the brightness variability as well as of the behaviour of the polarized radiation parameters.

A more detailed article on this subject is being prepared for publication.

Acknowledgments

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