STRUCTURE OF THE ENVELOPE OF 48 LIB

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Abstract. From line and continuun data of the ultraviolet and visible spectrum of 48 Lib, the fundamental parameters of the circumstellar envelope are derived.

1. Introduction

48 Lib (HD 142983) is a $B3Ve$ star that presents cyclic V/R variations in the photographic region. In order to investigate the physical properties of its circumstellar envelope we have studied the continuum spectrum around the Balmer discontinuity and the UV spectral regions.

2. Parameters of the envelope of 48 Lib

Assuming that the regions contributing to the continuum and line spectrum can be represented by a thin slab-like envelope, we derived physical parameters such as continuum and line optical depths (τ_λ), excitation and electron temperatures, atom columns, and the distance from the central star (R_e/R_*) to the continuum and line forming-regions.

Taking into account the 13-color photometry from Schuster and Guichard (1984) and the calibration in absolute fluxes of Johnson and Mitchell (1975), we derived physical parameters assuming that the luminosity L_λ emitted by the star-envelope system may be represented by:

$$L_\lambda = 4\pi R_*^2 \pi F_\lambda^* exp(-\tau_\lambda) + \alpha B_\lambda(T_\epsilon)[1 - exp(-2\tau_\lambda)],$$

where $\alpha \propto (R_e/R_*)^2$ depends on the geometry of the envelope (Cidale and Ringuelet 1989); F_λ^* is the stellar flux, and B_λ is the Planck function at the excitation temperature $T_\epsilon = \epsilon T_{eff}$. The photosphere of the star was characterized with the BCD parameters; $T_{eff} = 17300$ K and $\log g = 3.8$.

Table 1 gives the values of τ_u and τ_v ($\lambda_u = 0.37\mu$; $\lambda_v = 0.55\mu$), T_ϵ and the ratio R_e/R_* as it can be obtained when the envelope is supposed to be spherical. From this table, it can be seen that the changes responsible for the observed photometric variations may be due to variations in the value of T_ϵ and in the size of the envelope.

From IUE images of 48 Lib (SWP 3842, LWR 3425; January 1979, and SWP 14479, LWR 11065, July 1981) we selected Fe II lines with large gf

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TABLE I

Parameters of the envelope derived from the continuum spectrum

Date	$F^{obs}_{0.37\mu}/F^{*}_{0.37\mu}$	τ_u	τ_v	T_ϵ(K)	$(R_e/R_*)_{spher.}$
22.03.1981	0.604	1.04	0.89	8397	1.47
26.03.1981	0.622	0.71	0.56	7170	1.70
15.04.1983	0.473	0.87	0.44	5150	3.21
18.04.1983	0.447	0.95	0.59	5118	3.47

values and a collision-dominated line source function. The physical and geometrical parameters of the line-forming region were derived applying Cidale and Ringuelet (1989) method. We found that from 1979 to 1981 there was an enhancement of the line optical depths and of the atom columns, and the distance, R_e/R_*, of the *Fe* II line-forming region decreased from 14.5 to 2.4 stellar radii, respectively, keeping the same electron temperature at a value of 8200 K.

3. Conclusions

From the R_e/R_* ratios obtained from the line and continuum spectrum, we see that for 1981 it is roughly $(R_e/R_*)^{lines} \sim 2\,(R_e/R_*)^{continuum}$. This should imply that the temperature of the continuum forming region is expected to be higher than that obtained here. However, the excitation temperature T_ϵ is related to the electronic temperature T_e by the relation $B_\lambda(T_\epsilon) = B_\lambda(T_e)/b$, where b is the non-LTE deviation coefficient. These results also show that the canonical value $T_\epsilon = 10^4$ K currenly used to study the circumstellar properties of Be stars may not always be the best approximation.

On the other hand, the distances of the regions of line-formation deduced from the *UV* data are consistent with the distances of regions of similar density obtained introducing the polarization value of 48 Lib (0.95 %) into Fox's (1993) results. Therefore, we may suggest that cyclic variations of a weak magnetic field could explain the variations in the V/R ratio, the radial velocity, and the geometric extension of the envelope.

References

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