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LIGHT VARIATION OF AN R CrB STAR IN SCULPTOR

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SUMARIO

Las variaciones en la luminosidad de la estrella SPC 4 estudiadas en placas fotográficas están presentadas. El material observacional cubre un intervalo de 60 años. En los años 1962-1968 el material fotográfico, bien amplio se obtuvo con la cámara Schmidt de Tonantzintla. Los datos anteriores se obtuvieron de la colección de placas del Observatorio de Harvard. Los resultados confirman la sugestión previa de que esta variable azul de alta temperatura pertenece a la clase R CrB. Un ciclo de 600 días en la variación de la luminosidad está de acuerdo con los últimos 4 mínimos. Los mínimos parecen ser dobles. La luminosidad en el máximo muestra una variación errática cuya amplitud puede llegar hasta a 0.70 magnitudes.

ABSTRACT

The variations of the luminosity of the star SPC 4 estimated from photographic plates are here presented. The observational material covers an interval of about 60 years. From 1962 to 1968 the ample photographic material is taken with the Schmidt camera at Tonantzintla. Earlier estimates are made using the plate collection of the Harvard College Observatory. The results confirm the previous suggestion that this blue, hot variable is of the R CrB type. A cycle of 600 days in the light variation is shown by the four last minima. The minima seem to be double. The luminosity at the maxima shows an erratic variation which may reach to 0.70 magnitudes.

I. Introduction

In the course of a search and study of blue stars in the region of the South Galactic Polar Cap, Haro and Luyten (1962) discovered a number of variable stars, one of which, designated as SPC Var. 4, will be dealt with here. The variable, in the constellation Sculptor, is at 23^h23^m7, $-30°12'$ (1900). Among some 20 observations of this star by Haro and Chavira (1960) on Tonantzintla Schmidt plates, mostly in the interval 1951 to 1959, one deep minimum is observed. The authors conclude that this hot blue star is probably a variable of the R CrB type. As will be shown later, this conclusion is supported by subsequent photographic data.

II. Spectral Properties

Information on the spectral characteristics of SPC Var 4, rests on four Crossley spectra obtained by G. H. Herbig upon the request of G. Haro and communicated to him privately. Based on two spectrograms taken on Sept. 8 and 11, 1961, at maximum light, Herbig writes: "The spectrum is not like that of any R CrB star that I have seen. The hydrogen lines are rather strong in emission and the continuum is that of a blue star. I can see no absorption spectrum". Further, from the spectrogram taken on December 4, 1961 when the variable was at minimum light Herbig found that "The hydrogen emission lines were very much stronger with respect to the continuum at maximum light; they could be seen to about H 10. In addition, emission He I 4471 and Ca II 3933 appeared". On December 30, 1961, the spectrum was much the same although the star appeared somewhat brighter.

III. Light Variation: Photographic Material

During a brief stay at the Harvard College Observatory I estimated the brightness of Var. 4 on Harvard Series A, B and MF. Several minima were detected although the limiting magnitudes of the plates were not faint enough to reach the very minimum. The variable was further pursued on plates taken with the Tonantzintla Schmidt telescope.

Figure 1 is a chart where Var. 4 and the stars used for comparison are marked. The magnitudes of the comparison stars are determined from a pair of Schmidt plates taken successively on Selected Area 68 and the variable star field. Table 1 gives the photographic magnitudes which are means of three independent measurements of the pair on an Eichner Astrophotometer.

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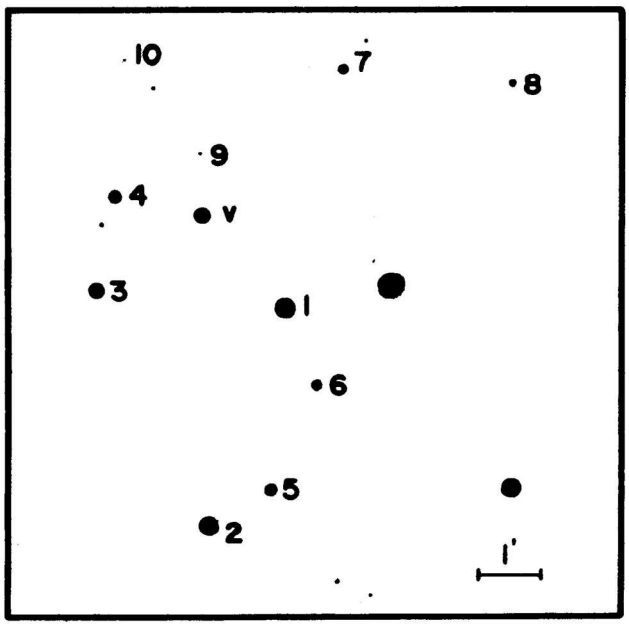

Fig. 1. *Chart showing SPC Var 4 —coord. 23h23m7; —30°12' (1900)— and the stars used for comparison. North is at top and east is at left.*

TABLE 1

Magnitudes of the Comparison Stars

Star	*pg magnitude*	*Star*	*pg magnitude*
1	12.45	6	16.22
2	13.65	7	16.56
3	14.92	8	17.21
4	15.25	9	17.34
5	15.37	10	17.55

The brightness estimates of the variable on Harvard plates prior to 1946 are rather scanty; these estimates are plotted in Figure 2 on a very small scale in the Julian Days. The remaining

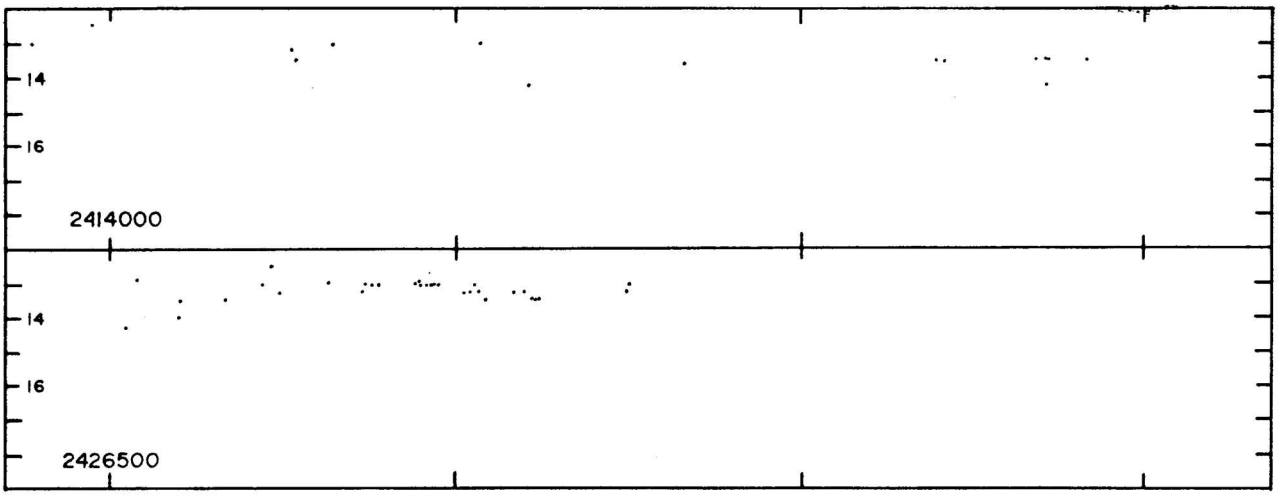

Fig. 2. *Light variation of SPC Var 4 from Harvard plates prior to 1942. The scale of the abscissa in J. D. is 2500 days per division. Ordinates are the photographic magnitudes.*

estimates on the Harvard material are plotted on a larger scale in Figure 3. Four minima are deteced in Figures 2 and 3.

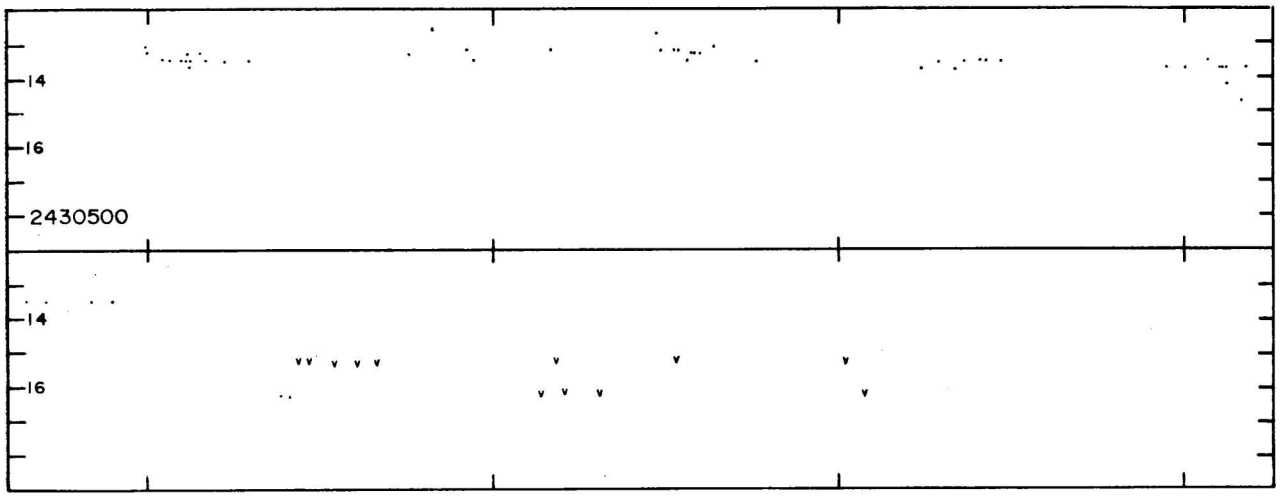

Fig. 3. *Light variation of SPC Var 4 from Harvard plates between 1942 and 1950. The scale of the abscissa in J. D. is 500 days per division. Arrows indicate that the star was fainter than the corresponding magnitude.*

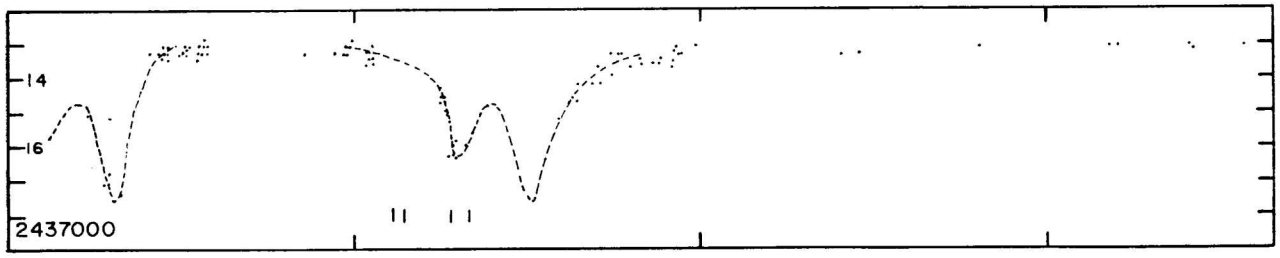

Fig. 4. *Light variation of SPC Var 4 from Tonantzintla Schmidt plates. The vertical segments mark the epochs of Herbig's spectra. The scale of the abscissa is 500 days per division.*

Figure 4 depicts the light variation from a series of 103aO plates taken by E. Chavira specifically for the study of the variable with the Tonantzintla Schmidt telescope between 1960 to 1967. Two consecutive minima are well defined. An overall discussion of the light variation shown by Figures 2, 3 and 4 may be given as follows:

1. The amplitude of the principal minimum is at about four magnitudes; it is probably variable. The last minimum, that occuring around J. D. 2437565, may not represent the deepest phase. It is quite likely that the complete variation of the minima runs as shown by the broken lines in Figure 4. Similar variations during minimum phase are exhibited by other RCrB type variables (cf. MV Sgr, GU Sgr, Hoffleit 1959). The wide minima in Figure 3 are compatible with this characteristic.

2. The minima, as "retouched" in Figure 4, suggest a cyclic activity of about 600 days' length; however, this cycle is not satisfied by earlier observations. It appears thus that the length of the cycle is also variable.

3. As regards the maximum phase, there is definite evidence that the brightness of the star is not constant. A large number of Schmidt plates covering two sample maxima were measured at the Astrophotometer. The results, plotted in Figure 5, indicate that the variation of brightness at the

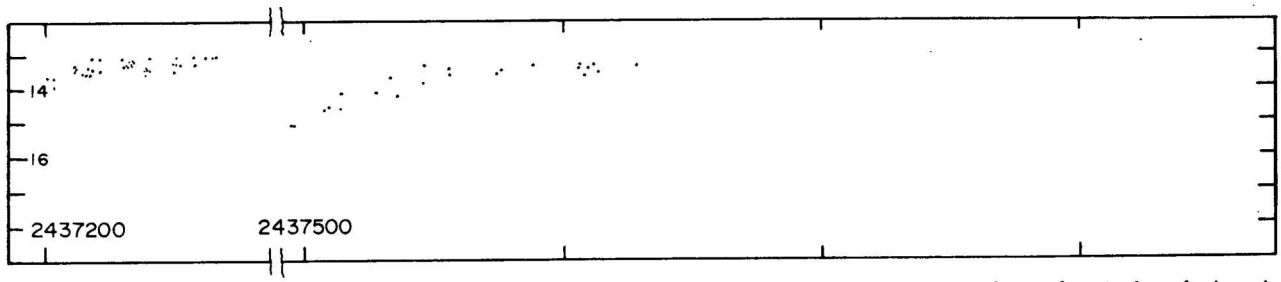

Fig. 5. *Light variation at sample maxima of Var 4 measured on the Astrophotometer. The scale of the abscissa is 200 days per division.*

maxima is undoubtedly real and at times as large as 0.75 magnitudes but that it shows no periodicity. Further observations are planned for the near future of this variable; however, on the basis of the light variations, there remains hardly any doubt that the star is of type RCrB.

IV. Location in the Galaxy

The galactic longitude and latitude of Var 4 are 18° and −75° respectively. The apparent photographic magnitude at average maximum light is 13.25. Assuming that the absolute photographic magnitude is −4 at maximum, the total photographic absorption, 0.3 magnitudes and the distance of the Sun to the galactic center 10 kpc., we find that the variable is at a distance of 24500 pc. from the sun, 23500 pc. from the galactic plane and 24000 pc. from the galactic center. The Star is thus a truly halo object. For the sake of comparison, if we assume the absolute magnitude to be −2 at maximum, the distance of the object from the sun, from the galactic plane and from the galactic center would be: 9800 pc., 9400 pc. and 12000 pc. respectively.

It is my pleasure to thank Dr. G. Haro for calling my attention to SPC Var 4, for providing me with the complete set of Schmidt plates, and to Dr. L. Goldberg for permission to use the Harvard plate collection.

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