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THE LIGHT AND COLOUR CURVES OF THE VERY ACTIVE SOUTHERN RS CVn-SYSTEM HD 127 535 IN 1984*

HD 127 535 was classified as a southern RS CVn candidate by Weiler and Stencel (1979) on account of the strong Ca II H and K emission in the spectra of this object. Collier et al. (1982) found also Hα in emission. Furthermore, Collier (1982) reported radial velocity variations with a period of $6^{d}.01$ confirming the spectroscopic binary nature. The spectral type of the system is K2 IV/Ve according to Houk and Cowley (1975). Photometric variability of HD 127 535 was discovered by Collier (1982) and independently by Udalski and Geyer (1984). In this paper we present the light and colour curves of this star observed in 1984.

UBVRI photometry of HD 127 535 was carried out at the European Southern Observatory / La Silla during 12 consecutive nights from 1984 April 13 on. The observations were obtained using the ESO 50 cm telescope with a single beam photometer equipped with a thermoelectrically cooled gallium-arsenide RCA 31034 photomultiplier. The pulse counting technique and UBVRI filters approximating the Cousins / Bessel system (Bessel, 1979) were used. HD 128 227 served as a primary comparison and HD 128 618 as a check supplementary star. The magnitude differences of these comparison stars were constant within $0^{m}.01$ in all colours during the total observational run. On 9 nights under the best sky conditions the transformation equations from the instrumental colour and magnitude system into the standard UBVRI system were obtained by observing more than 30 standard stars. The UBVRI magnitudes of the comparison stars are listed in Table I. Observations of HD 127 535 were made differentially in the usual way and corrected for differential extinction. The standard errors for the individual observations in UBVRI colour bands are $0^{m}.015$, $0^{m}.008$, $0^{m}.007$, $0^{m}.006$, and $0^{m}.005$, respectively. They are due to the combined errors of the observations and those of the transformation equations into the standard system.

* Based on observations collected at the European Southern Observatory, La Silla, Chile.

Table I. Magnitudes and colours of the comparison stars for HD 127 535

Star	V	B-V	U-B	V-R	V-I
HD 128 227	$8^m.321$	$1^m.066$	$0^m.810$	$0^m.570$	$1^m.095$
m.e.	.013	.009	.013	.007	.007
HD 128 618	8.024	1.460	1.594	0.774	1.465
m.e.	.018	.008	.021	.006	.006

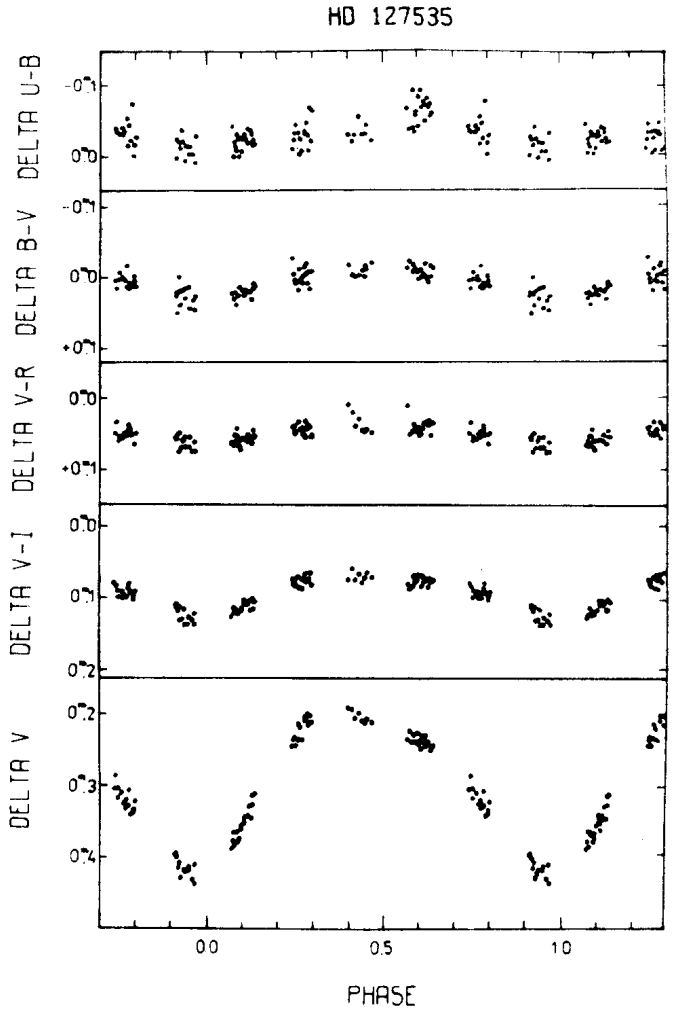

Figure 1

The photometric variability of HD 127 535 was now established beyond any doubt: during our observations the star showed a light curve amplitude $A_V = 0^m.25$. We could derive a light curve period of $P_p = 5^d.97$ by using a "phase dispersion minimization" method (PDM) as described by Stellingwerf (1978). Due to the fact that only two cycles were covered during our observational run, the PDM-method yields an accuracy of about 25% for the period which thus should be considered preliminary. On the other hand the inspection of the light and colour curves (see Figure 1) derived with the light elements:

$$\text{Min. (J.D.hel.)} = 2445804.10 + 5^d.97 \cdot E$$

indicates that the error of the thus derived period is smaller than the PDM-method yields. Within the limits of accuracy the photometric period is identical with the orbital one given by Collier (1982), which suggests synchronized rotation if the light variations are interpreted due to the rotation of one or both components covered with subluminous photospheric areas. The photometric period which was given by Collier (1982) is $6^d.03$, also close to our value. Unfortunately he does not list the time instants of the minimum or maximum, so it is impossible to improve the photometric period, which would be possible if the subluminous areas were stationary in size and position on the stellar photosphere. Further photometric observations could therefore solve this problem.

The magnitude and colour differences in Figure 1 have the sense 'variable minus comparison'. The mean values of V and colours of HD 127 535 as well as the light and colour curve amplitudes are listed in Table II, and time instants of the extreme values of the light curve in Table III.

Table II. The average colours and V magnitudes of HD 127 535 and the observed light and colour curve amplitudes in 1984

V	A_V	B-V	A_{B-V}	U-B	A_{U-B}	V-R	A_{V-R}	V-I	A_{V-I}
$8^m.63$	$0^m.25$	$1^m.07$	$0^m.07$	$0^m.77$	$0^m.09$	$0^m.62$	$0^m.06$	$1^m.19$	$0^m.08$

Table III. Minimum and maximum time instants of the 1984 light curve of HD 127 535 in J.D. hel.

Min.	Max.
2445810.07	2445806.25

The V-light curve is asymmetrical with a steeper rising branch and has an amplitude of $0^m.25$. Variations of all observed colour indices are well established and are correlated with the V luminosity, i.e. the star is redder near the minimum light. Such a correlation is supposed to be common to spotted stars suggesting that the dark and cooler photospheric areas which are responsible for the light variations, due to rotation are pointing towards

the observer. Furthermore, the larger scatter of the (U-B)-colour curve indicates that we observe individual chromospheric calcium 'plages' appearing and/or disappearing at the limb of the stellar disc. Thus the photometric properties of HD 127 535 resemble the characteristics of the RS CVn group of chromospherically active stars. The star shows also all other RS CVn characteristics like duplicity, emission of the Ca II H and K and the Hα Balmer lines, and the location above the main sequence in the HR diagram. The chromospheric activity level in RS CVn stars differs from star to star and depends on the rotational angular momentum (Geyer, 1981). For most of such active stars the spotted areas change in size and position. Therefore the light curve is changing itself on time scales of years or even months. If our interpretation of the photometric behaviour of HD 127 535 is right, it must be considered as one of the most active stars of the RS CVn-group. Collier (1982) reports that the amplitude of the V light curve was only $0^m.06$ in 1981. Thus the amplitude increase from this value to our 1984 value by $0^m.19$ has taken place within only three years. Furthermore, the total brightness of the system dropped by about $0^m.2$ in V within this time interval. Better insight into the activity phenomenon of this star might be gained only by future multicolour photometric and especially spectroscopic observations of the H and K line profiles, above all for possible activity cycle which might have a length of about 6 years.

Finally it should be noted that the northern RS CVn star II Peg (=HD 224 085) shows a similar behaviour for the strong light curve variations on a three year time scale (Bohusz and Udalski, 1981; Ramsey and Nations, 1984). The observed properties of HD 127 535 resemble so much II Peg that we may call HD 127 535 "the southern twin of II Peg".

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