COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 2593

Konkoly Observatory
Budapest
26 September 1984
HU ISSN 0374 - 0676

FIVE COLOUR PHOTOMETRY OF THE CHROMOSPHERICALLY ACTIVE SOUTHERN STAR HD 155 555*

HD 155 555 was found by Bennett et al. (1962) to be a double line spectroscopic binary with an orbital period $P_o = 1^d.6817$. The components seem to have similar mass. Optical and IUE spectra show strong Ca II H and K and Mg II h and k emission coming from both components of the system (Stacy et al., 1980). The Hα emission fills entirely the relevant absorption line (Hearnshaw, 1979). The spectral type of HD 155 555 is G5 IV + K0 or K1 Vp according to Bennett et al. (1962) or Houk and Cowley (1975), respectively. HD 155 555 is also a soft X-ray source (Walter et al., 1980). In spite of its relatively large apparent visual brightness ($V \sim 6^m.7$) very few photometric observations of the star have been obtained up to now: Eggen (1978) reported two measurements and cited another one suspecting the star's variability. The confirmation of the optical variability of HD 155 555 was independently found by Collier (1982) and by Udalski and Geyer (1984). We give in this short communication more details about the complete light and colour curves.

UBVRI observations of HD 155 555 were collected at the European Southern Observatory / La Silla during 12 consecutive nights from April 13, 1984 on. The 50 cm ESO telescope equipped with a single beam photometer and an RCA 31034 thermoelectrically cooled gallium-arsenide photomultiplier was used. The standard UBVRI system was reproduced by the relevant colour filters as described by Bessell (1979). HD 156 427 served as primary and HD 154 775 as a secondary comparison star. Both comparison stars were constant during the observations. The observations of HD 155 555 were made differentially in the usual way. The magnitude differences were corrected for differential extinction and transformed to the standard UBVRI system, after having established the transformation equations from the instrumental into the standard system by observing more than 30 UBVRI standard stars on 9 nights of high photometric quality. The standard errors of one single observation turned out to be

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

$0^m.015$, $0^m.008$, $0^m.007$, $0^m.006$, and $0^m.005$ in the U, B, V, R, and I colour bands, respectively. The results obtained for the colours and magnitudes of the comparison stars are summarized in Table I.

Table I. Magnitude and colours of the comparison stars for HD 155 555

Star	V	B-V	U-B	V-R	V-I
HD 156 427	$7^m.395$	$1^m.494$	$1^m.656$	$0^m.805$	$1^m.543$
m.e.	.011	.007	.017	.006	.006
HD 154 775	7.589	1.587	1.962	0.865	1.744
m.e.	.013	.010	.029	.006	.005

After a few nights of observations it was realized that HD 155 555 is photometrically variable and the period of its brightness variations is close to the orbital one. We determined the photometric period P_p of HD 155 555 using the "phase dispersion minimization" (PDM) method described by Stellingwerf (1978). The PDM-analysis yielded $P_p = 1^d.66$. It seems to be somewhat smaller than the orbital period ($P_o = 1^d.68$). As the observational run was not long enough, the PDM-method gives an accuracy of about 7% for the period determination. Hence the difference found between P_p and P_o is not significant statistically. Therefore, synchronization of rotation with orbital revolution seems to be fulfilled for the system, if we suppose that the photometric variations are caused by the rotation of the G5 component with unequal brightness distribution on its photosphere. In order to determine the periods more precisely, additional photometric and spectroscopic rv-observations are necessary.

Figure 1 shows the light and colour curves of HD 155 555 based on the elements:

$$\text{Min. (J.D.hel.)} = 2445803.07 + 1^d.66 \cdot E$$

The shown magnitude differences have the sense 'variable minus comparison'. The shape of the V light curve is completely symmetrical and sinusoidal with an amplitude of $0^m.08$. The colour changes are noticeable only in the (V-I)-index and the star is redder near the minimum light.

We tend to interpret this small amplitude light and colour variation to be caused by the rotation of the chromospheric active G5-component with subluminous photospheric areas. The reasons for this interpretation are threefold. Firstly, the coincidence of the light curve minimum with that of the (V-I)-curve is typical for chromospheric active stars. Secondly, the large scatter of the (U-B)-colour curve indicates that chromospheric calcium 'plages' are appearing and/or disappearing at the limb of the stellar disc.

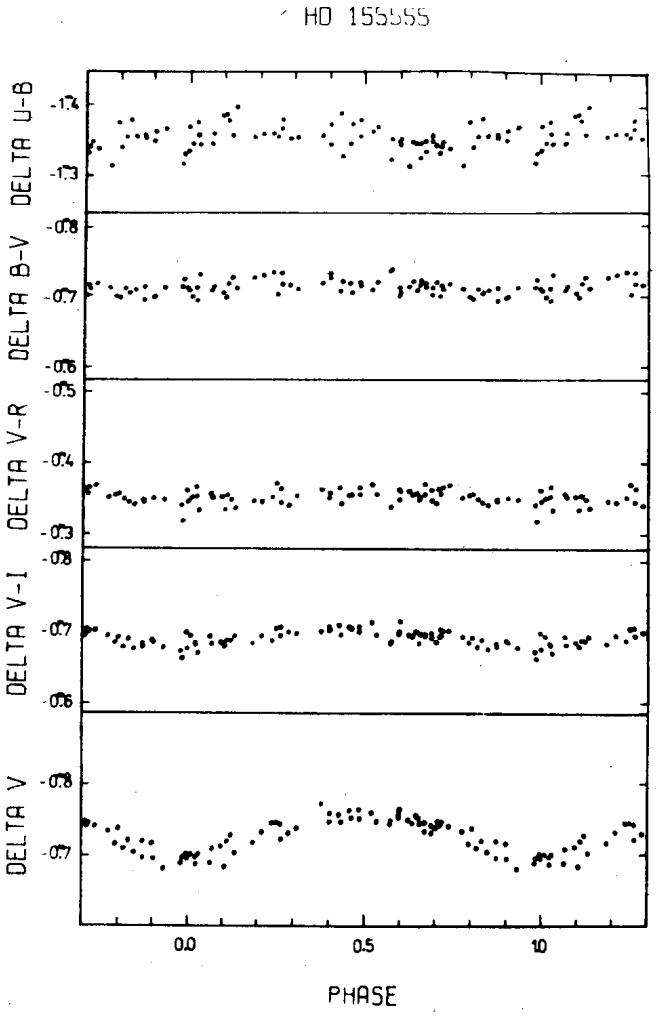
HD 155555
DELTA U-B
DELTA B-V
DELTA V-R
DELTA V-I
DELTA V
-0.8
-0.7
-0.6
0.0
0.5
1.0
PHASE

Figure 1

Table II. The average colours and V magnitudes of HD 155 555 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}
$6^m.67$	$0^m.08$	$0^m.78$	-	$0^m.30$	-	$0^m.45$	-	$0^m.85$	$0^m.04$

Table III. Minimum and maximum time instants of the 1984 light curve of HD 155 555 in J.D.hel.

Min.	Max.
2445804.73	2445808.85
2445809.71	2445813.83

Finally, comparing the average V-magnitude and colours of HD 155 555 listed in Table II, with those cited by Eggen (1978) and Collier (1982) we find indications of changes on a time scale of several years: at the beginning of the 1960's the V-magnitude and the (B-V)-colour of HD 155 555 were similar to the present one, while in 1973 the star was about $0^m.1$ fainter in V and the (B-V)-colour was larger by $0^m.05$. Again, in the late 1970's the colour and light curve amplitudes were almost identical with those of 1984, though the system brightness remained $0^m.1$ fainter.

As was shown long ago by Russell (1906) a great variety of distribution of brightness on a rotating sphere may give rise to the same light curve, this model of a chromospherical active component in the HD 155 555 binary system can fully explain the photometric phenomenology. Since also the spectroscopic properties are similar to the RS CVn variables, HD 155 555 can be considered as a typical member of this class.

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