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UBVRI PHOTOMETRY OF THE SOUTHERN CHROMOSPHERICALLY
ACTIVE STAR - HD 139084*

HD 139084 was listed by Bopp and Hearnshaw (1983) as one of the most chromospherically active southern stars. It shows strong $H\alpha$ - line emission filling the absorption feature (Bopp and Hearnshaw, 1983). The $H\&K/CaII$ - lines are also in emission (Bidelman and MacConnell, 1973). The spectral type of HD 139084 is K1 III + F according to Houk and Cowley (1975). The discovery of its optical variability was recently reported by Udalski and Geyer (1984). In this paper we present the light - and colour curves of HD 139084.

UBVRI photometry of HD 139084 was carried out during 10 nights from 14 April, 1984 on, at the European Southern Observatory - La Silla. The ESO 50 cm telescope was used. It is equipped with single beam photometer, and a thermoelectrically cooled gallium-arsenide RCA 31034 photomultiplier. The standard Cousins-Bessell system is reproduced by the standard set of filters defined by Bessell (1979).

HD 139070 served as the primary comparison star and HD 139002 as a check star. Both comparison stars were constant during the observing run within $0^m.01$. The UBVRI-values of the comparison stars were obtained during 8 nights under the best weather conditions by observing up to at least 30 standards per night to tie in the comparison stars into the standard UBVRI system. The magnitudes and colours obtained in this manner are listed in Table I. The observations of HD 139084 were made differentially in the usual way, the differential magnitudes were corrected for differential extinction and transformed to the relevant system. The typical standard errors for the individual observations are $0^m.015$, $0^m.008$, $0^m.007$, $0^m.006$ and $0^m.005$ for UBVRI colours, respectively.

HD 139084 turned out to be photometrically variable. During our observing run the star changed its brightness within the range of $0^m.12$ in V. We tried to derive a photometric period of HD 139084 using the "phase dispersion minimization" method (PDM) described by Stellingwerf (1978).

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

HD 139084

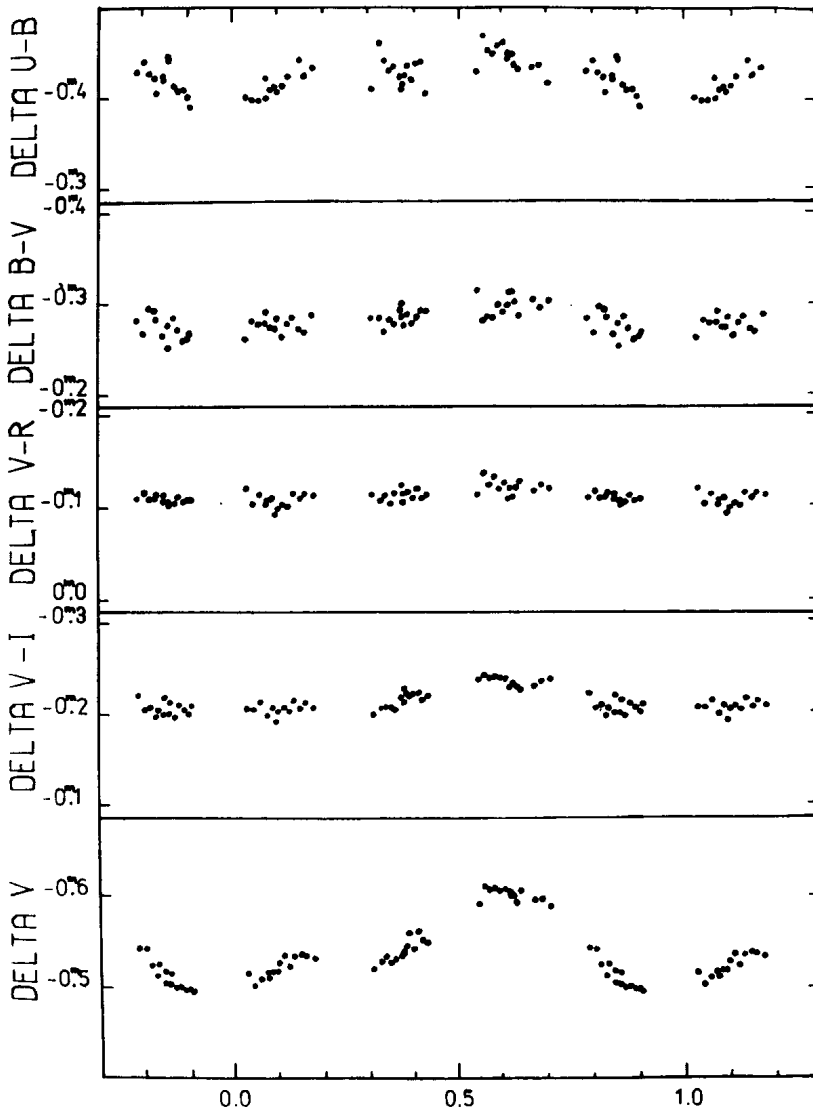


Figure 1

Table I. V magnitudes and colours of the comparison stars for HD 139 084

Star	V	B-V	U-B	V-R	V-I
HD 139 070	8 ^m .681	1 ^m .113	0 ^m .796	0 ^m .593	1 ^m .153
m.e.	.011	.009	.019	.006	.007
HD 139 002	8.270	1.750	2.013	1.001	2.181
m.e.	.014	.011	.030	.007	.008

Table II. The average colours and V magnitudes of HD 139 084 and the observed light and colour variation 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 .14	0 ^m .12	0 ^m .83	0 ^m .06	0 ^m .38	0 ^m .07	0 ^m .48	0 ^m .04	0 ^m .94	0 ^m .06

Table III. Minimum and maximum time instants of the 1984 light curve of HD 139 084 in J.D. hel.

Min. = 2445811.2 Max. = 2445813.8

The PDM method yielded 4^d.20 for a photometric period. This result should be considered as preliminary, on account of the too short duration of our observing run, with the result that the PDM method yields an accuracy only about 20%. However, the visual inspection of the light and colour curves plotted with the light ephemeris:

$$\text{Min (J.D.hel.)} = 2445802.9 + 4.2 \text{ E,}$$

which is shown in Figure 1, suggests that the period is determined fairly well. Yet further photometry is desirable for the object.

The mean V values and the colours of HD 139084 are listed in Table II while the time instants of the extreme values of the light curve are given in Table III. The magnitude and colour differences of Figure 1 have the sense "variable minus comparison". The V light curve is asymmetric with a small hump near the phase 0.15. The variations of all colour indices and their correlation with the V luminosity seem to be well established. Such a correlation, namely that the star is redder near the minimum light seems to be characteristic for chromospherically active stars. It suggests that dark and cool photospheric areas are responsible for light variations. Such an interpretation is most likely also for the HD 139084. The large amplitudes of colour indices indicate that the star is very "spotted" and active. The relatively large scatter of the (U-B)-colour curve could be caused by chromospheric Calcium plages appearing and disappearing at the stellar limb. Unfortunately the lack of spectroscopic observations does not allow to classify accurately HD 139084 among the chromospherically active

stars. It seems most probable that HD 139084 is a member of the RS CVn group of chromospherically active stars, on account of its spectral type (Houk and Cowley, 1975). Yet spectroscopic rv-observations are essential for the proper classification of the star. If HD 139084 is indeed an RS CVn candidate, the spectroscopic period should be similar to the photometric period (4.2^d) due to almost synchronized rotation commonly observed in this class of stars.

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