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HR 1362: A CHROMOSPHERICALLY ACTIVE VARIABLE WITH A 5-MONTH PERIOD

The bright ($V = 6^m.3$) star HR 1362 = HD 27536 was put on a list of suspected variables (Hall 1983) because it had appeared in a table of stars showing Ca II H and K emission (Bidelman and MacConnell 1973). Although they had noted the emission as "uncertain", Walter and Bowyer (1981) later detected x-ray emission, another signature of the chromospherically active stars. The spectral type was given as G8 IV by Bidelman and MacConnell (1973) and as G8 IV: by Cowley and Bidelman (1979). The absolute magnitude of $M_V = 0^m.65$ given by Eggen (1978), however, is even brighter than that typical for a G8 III star (Allen 1963), so we might question the subgiant classification. Five photoelectric measures of HR 1362 by Lake (1964) showed a range of $0^m.07$ in V, $0^m.05$ in B-V, and $0^m.04$ in U_c-B.

Between December 1979 and December 1984 six observers used seven different telescopes to obtain 140 mean differential magnitudes on 121 nights. Most were made in all three bandpasses of the UBV system and all used HR 1332 = HD 27179 as the comparison star. See Table I. Each mean includes 2-to-4 individual measures between variable and comparison, corrected for differential atmospheric extinction and transformed differentially to the UBV system. Most of the Boyd data have been published already (Boyd, Genet, Hall 1984, 1985); the rest will be published later.

It is clear from Figure 1 that HR 1362 is variable with a long period. Because parts of the light curve are missing, we tried several different techniques to estimate the period: comparison of times at corresponding levels on the rising branch, comparison of the two relatively well defined minima at JD 2445690 and 2445995, determination of the period which gives the smallest residuals and largest amplitude after a Fourier fit by least squares, and application of the period-finding algorithm of Lafler and Kinman (1965). All the techniques gave values between 152 and 156 days, with an average of P = 154 days. For that reason the break in the abscissa of Figure 1 has been made exactly 154 days, so the probable shape of the light curve can be apparent. It seems we have covered 3/4 of a complete cycle, with only the maximum and top half of the falling branch absent.

TABLE I

Tally of Observations

Observer	Observatory	Location	Telescope	Nights	Means	λ
Boyd	Fairborn	Arizona	10-inch	86	105	VBU
Barksdale	Barksdale	Florida	14-inch	13	13	V
Fried	Braeside	Colorado	16-inch	2	2	VBU
Henry	Dyer	Tennessee	24-inch	1	1	V
Henry	Kitt Peak	Arizona	16-inch	13	13	VB
Pearsall	Beech Hill	Tennessee	8-inch	4	4	V
Wasson	Sunset Hills	California	8-inch	2	2	V

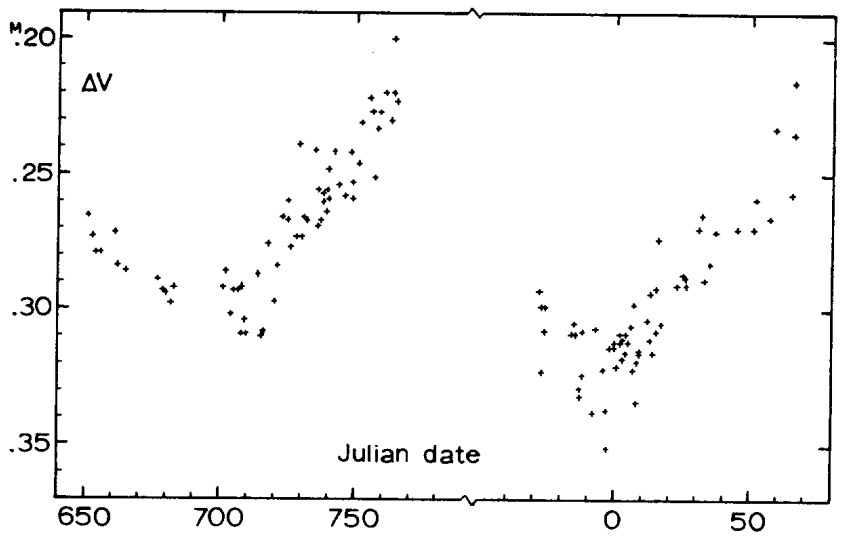

Figure 1

The 1983 and 1984 light curve of HR 1362 in V, where Δ is in the sense variable minus comparison. The amplitude is 0.10 magnitude, or more if the very top has not been reached. The abscissa is Julian date with 2445000 subtracted from the left side and 2446000 from the right; the break is exactly one cycle of the 154-day period.

We suggest

$$JD = 2445995 + 154^{d}\ n \qquad (1)$$

as an approximate ephemeris for predicting times of minimum light. The total amplitude is $0^{m}.10$ in V, or perhaps a bit more. Linear regression analysis indicates the amplitudes in the three bandpasses are in the ratios

$$\Delta V\ /\ \Delta B\ /\ \Delta U = 1.00\ /\ 1.21\ /\ 1.52\ , \qquad (2)$$
$$\pm.04 \quad \pm.07$$

telling us that HR 1362 does change significantly in color as it varies in brightness, consistent with what Lake (1964) had found.

Differential measures between the comparison star and a check star, made on the 86 nights when Boyd observed HR 1362, showed no trace of a $0^{m}.10$ variability with a 154-day periodicity, thus demonstrating that HR 1362 really is the variable. The 1982 edition of the Yale Bright Star Catalogue does list Boyd's check star (ξ Eri = HR 1383) as a suspected variable, possibly of the delta Scuti type. His check-minus-comparison measures may reflect a small variation but, having been made only once each night, are not able to define the light curve of a short-period delta Scuti-type variable.

To our knowledge this 154-day period is considerably longer than for any other known chromospherically active variable. Until now the longest were $71^{d}.7$ for 93 Leo, $77^{d}.65$ for 39 AY Cet, and $82^{d}.8$ for 12 BM Cam. At this point we cannot call HR 1362 a long-period RS CVn binary because there is no evidence of duplicity: a composite spectrum, double lines, or radial velocity variations. This new variable, of potential interest for a number of reasons, deserves more attention.

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