LIGHT-VARIATION OF THE SPECTRUM VARIABLE HD 124224

ROBERT HARDIE
Arthur J. Dyer Observatory, Vanderbilt University
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ABSTRACT

The peculiar A star, HD 124224, has been found to be variable in light Fifty-four observations in three colors reveal amplitudes of 0.07, 0 08, and 0.15 mag. in V, B, and U, respectively. The $B-V$ color index changes by less than 0.02 mag , while the $U-B$ color index changes about 0.07 mag On the basis of this behavior the star is concluded to have no appreciable reddening The star is faintest when the He I lines are strongest, and brightest when the Si II lines are strongest.

The star HD 124224 has been described by Deutsch (1952) as a peculiar A star in the spectrum of which the lines of Si II are abnormally strong and which vary out of phase with the lines of He I. The period of these variations, established by him to be 0.52 day, is the shortest known for a spectrum variable. The spectral lines are broad and shallow, indicative of relatively high rotation, which seems to be characteristic of these stars (Deutsch 1956). Apparently, there is good correlation between the period of variability and the period of rotation as inferred from line breadths. Moreover, there is strong evidence that the stars possess magnetic areas which are carried around with the rotation and which account for the peculiar spectral variability. A number of these stars are known to be variable in light, chiefly through the work of Provin (1953*a*, *b*, *c*). The range of variation is, in general, small, and in some instances the light-curve has a varying shape.

TABLE 1

MAGNITUDES AND COLORS OF COMPARISON STARS

Star	V	$B-V$	$U-B$
HD 122408	4 26	0 10	0 12
HD 124115	6 44	48	05
Probable errors	±0 01	±0 01	±0 02

Acting upon a suggestion of Deutsch that the star HD 124224 may be variable in light like other stars of its kind, the writer secured observations on several nights during the spring of 1955 and found that the star was indeed variable. Measures were made with the Lowell 20-inch telescope in three colors, which were reduced to the U, B, V system in order to facilitate easy and relevant comparison with the characteristics of the many stars already measured in that system. The star HD 122408 was used for comparison, while the star HD 124115 served as a control star to be referred to occasionally during the observations. These two stars were compared with several of the standard U, B, V stars and were found to have the magnitudes and colors contained in Table 1.

In Table 2 are grouped the observations of the variable in which the headings are self-explanatory. The variations are illustrated in Figure 1, for which purpose the phases were computed through the use of Deutsch's ephemeris (1952):

$$\text{He I max.} = \text{JD } 2434144.05 + 0^{d}52067E\,.$$

TABLE 2

MAGNITUDES AND COLORS OF HD 124224

Cycle	V	B-V	U-B	Cycle	V	B-V	U-B
1987.574	4.989	-.134	-.448	2137.040	5.055	-.113	-.390
.582	.984	-.123	-.452	.092	.053	-.122	-.377
.591	.988	-.127	-.456	.101	.054	-.122	-.380
.612	.991	-.129	-.455	.122	.056	-.127	-.387
.622	.992	-.131	-.448	.135	.053	-.130	-.393
.632	.986	-.121	-.443	.157	.048	-.129	-.391
.639	.990	-.128	-.438	.167	.049	-.131	-.381
.657	.987	-.122	-.445	.188	.046	-.137	-.387
.668	.991	-.125	-.447	.199	.042	-.127	-.379
.678	.997	-.133	-.452	.219	.035	-.124	-.389
.687	.995	-.134	-.438	.228	5.035	-.130	-.390
1997.159	5.047	-.124	-.375	2144.597	4.985	-.130	-.440
.167	.041	-.128	-.375	.713	5.001	-.134	-.432
.175	.032	-.119	-.382	.725	.004	-.135	-.435
.188	.033	-.122	-.388	.744	.002	-.127	-.444
.197	.037	-.132	-.385	.756	.008	-.128	-.436
.204	.035	-.130	-.386	.809	.012	-.119	-.420
.212	.040	-.141	-.376	2175.314	.005	-.131	-.399
.227	.032	-.136	-.384	.322	.007	-.133	-.408
.234	.033	-.141	-.390	.339	.004	-.135	-.398
.243	.022	-.129	-.400	.346	.006	-.143	-.392
2136.886	.032	-.115	-.405	2177.224	.026	-.122	-.393
.897	.036	-.121	-.411	.238	.028	-.128	-.393
.923	.041	-.118	-.402	.250	5.018	-.123	-.402
.948	.040	-.116	-.390				
.964	.043	-.118	-.385				
.985	.047	-.115	-.393				
.996	.051	-.114	-.395				
2137.017	.052	-.113	-.388				
.029	5.055	-.113	-.392				

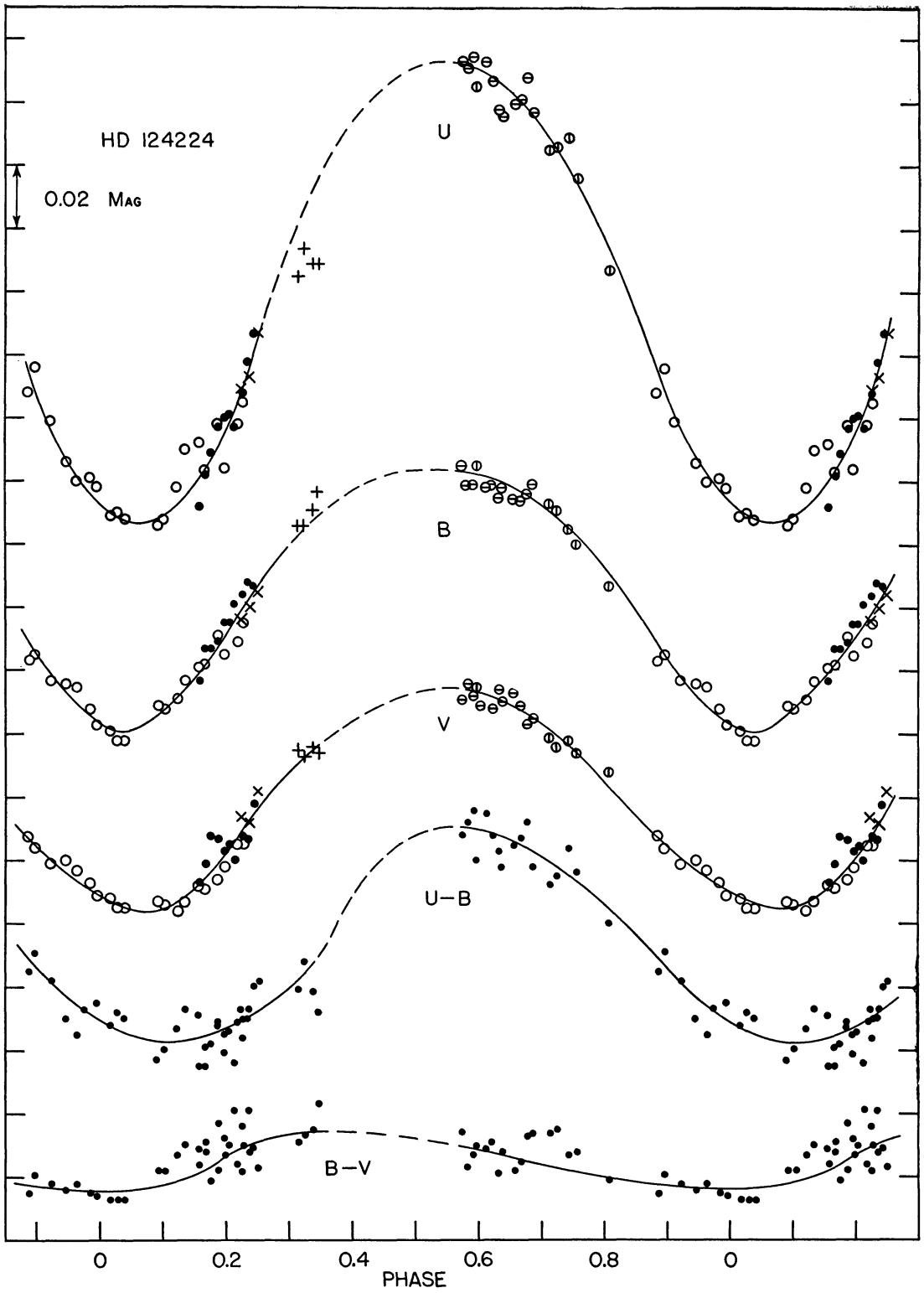

FIG. 1.—Variations in magnitude and color index of HD 124224

Accordingly, the time of He maximum corresponds to zero phase in the figure (around minimum light), provided that the ephemeris stated is adequate when extrapolated over a period of about 3 years. That this is the case is confirmed by observations made by Deutsch (1957) later than those reported here and which confirm his original ephemeris. The photometric material covers a relatively short interval of time and does not permit any improvement or revision of the ephemeris. The internal probable errors of

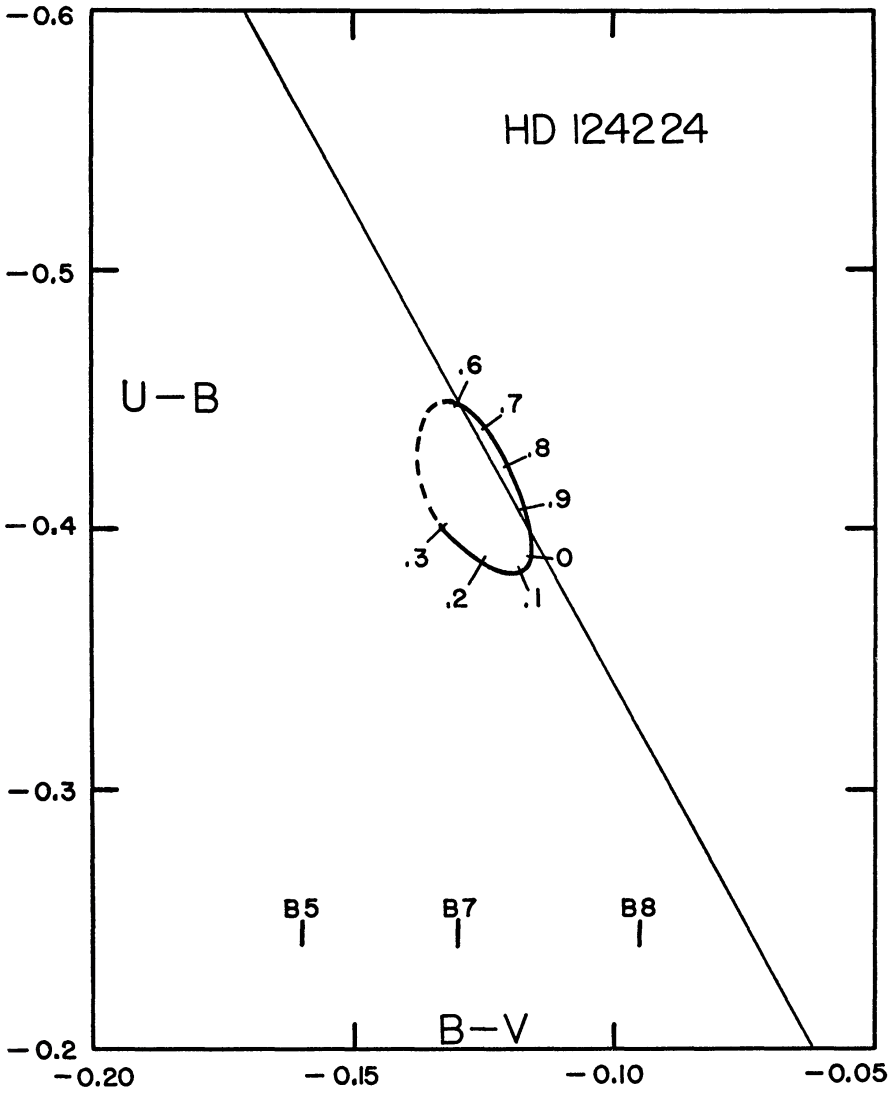

FIG 2.—Three-color diagram, showing the positions occupied by HD 124224 at various phases The line represents the main sequence

each measure are of the order of 0.003 mag. in V and B, 0.004 mag. in U, and 0.005 mag. in the color indices, $B-V$ and $U-B$. It will be seen that the star is both faint and late in color during He maximum.

The mean values of V, $B-V$, and $U-B$ are 5.02, −0.12, and −0.42 mag., respectively, and comparison with the data of Johnson and Morgan (1953) indicates that the star has color characteristics close to B7 V. This is in keeping with the data of Provin (1953),

who concluded that peculiar A stars have colors substantially the same as normal main-sequence stars but bluer than expected from their apparent spectral types.

The color-index variation-curves in Figure 1 indicate that the $B-V$ color variation is slight, of the order of 0.02 mag., while the $U-B$ variation has a range of about 0.07 mag. The color-index variations are also shown in another form in Figure 2, a three-color diagram. It will be evident that the path followed by the star is generally parallel and close to the main-sequence line This would suggest that the star is unreddened unless such a star's intrinsic colors placed it well to the left of the main-sequence line.

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