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Photometric variations and period determination of eight southern CP stars (*)

C. Waelkens (**)

Astronomisch Instituut Katholieke Universiteit Leuven, Celestijnenlaan 200 B, B-3030 Heverlee, Belgium

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Summary. — We discuss the photometric variations in the Geneva System of eight southern CP stars. Improved values for the periods of HD 28843, HD 56455, HD 81009, and HD 175362 are determined; the periods of HD 34797, HD 98457, HD 133880, and HD 191287 are derived for the first time. Both HD 98457 and HD 191287 present variations of exceptionally large amplitude. HD 133880 is a remarkable CP star in view of its short period, its large magnetic field, and the extreme variability of its peculiarity index. The stars HD 28843, HD 34797, and HD 56455 also have a variable peculiarity index.

Key words : CP stars — photometry — stellar rotation — magnetic fields.

1. Introduction.

Mostly as a result of the many systematic surveys carried out over the last two decades, the photometric variability of the chemically peculiar stars is now well documented in the literature (see Catalano and Renson, 1984, and the references therein). The behaviour of these stars is to be understood within the framework of the oblique rotator model : for virtually all CP stars, the variations are strictly periodic, and the periods are the rotation periods of these stars.

In view of the wealth of data already available, the astrophysical interest of adding new objects to the list of known variable CP stars may be questioned. Current surveys are mostly motivated by interest in the distribution of the rotation periods. The study of CP stars in clusters and associations (e.g. North, 1984; Maitzen, 1982) gives clues for our understanding of the dependence of angular momentum on stellar age, and so of the breaking mechanism at work in CP stars. Other recent research focuses on the long-period tail of the distribution (Hensberge *et al.*, 1984).

The stars we discuss in the present paper were not selected for such specific purposes. Our decision to monitor some of the stars stemmed from the large scatter of their previous measurements in the Geneva Photometric System. The two other stars, HD 56455 and HD 81009, have been used for some time as standard stars in this system. The periods of four of the program stars were already known, but we could slightly improve their values; the variability of the remaining four stars has, to our knowledge, not been studied in detail before. Some of these objects turned out to be of exceptional interest, so that their relevance merits special discussion.

2. Observations

All observations were obtained with the Geneva Photometer attached at the Swiss Telescope, La Silla Observatory, Chile, mostly from 1981 to 1983. All eight stars had already been observed at earlier opportunities with the same equipment. We observed these stars as part of a broader program concerning the photometric variability of early-type stars. We did not work with fixed comparison stars but instead increased the number of standard star measurements in order to improve the precision.

We are planning to discuss the observational techniques and the accuracy that could be achieved in a forthcoming paper. The following short overview will suffice for our present purposes. The typical scatter of the V-magnitude data in the Geneva Catalogue (Rufener, 1981) is 0.008 mag (Rufener and Bartholdi, 1982). This scatter is partly caused by instrumental error sources on a long time scale and is lowered to about 0.006 mag when only the data of a few subsequent seasons, taken with the same instrument, are considered (e.g. HD 56455 below). It must also be realized that the average program carried out in the Geneva photometry does not require better precision; the attained accuracy of the data is a compromise between the astrophysical relevance of high precision and the efficiency of data acquisition. It is clear that an enlargement of the number of standard star measurements results in a significant improvement of the precision. Such an approach is desirable for the study of variable stars and has been followed by us. For most of the data considered here, the uncertainties are of the order of 0.003-0.004 mag.

(*) Based on observations made with the Swiss Telescope at the European Southern Observatory, Chile.

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3. Analysis of the observations.

The eight program stars are listed in table I. We give the names and the HR and HD numbers. The reddening-free parameters X, Y, and Z that are of interest for the description of the B stars (Cramer and Maeder, 1979) can be written as

$$\left\{\begin{aligned} X &= \quad 0.3788 + 1.3764\,(U\text{-}B1) + 0.1602\,(B1\text{-}B2) - \\ &\qquad - 0.6896\,(B2\text{-}V1) - 0.8450\,(V1\text{-}G) \\ Y &= -\,0.8288 + 0.3235\,(U\text{-}B1) - 1.9993\,(B1\text{-}B2) + \\ &\qquad + 0.3370\,(B2\text{-}V1) + 1.0865\,(V1\text{-}G) \\ Z &= -\,0.4572 + 0.0255\,(U\text{-}B1) - 0.1485\,(B1\text{-}B2) + \\ &\qquad + 0.3211\,(B2\text{-}V1) - 0.7994\,(V1\text{-}G)\,. \end{aligned}\right.$$

In the context of the Bp stars, the parameter Z is of importance, since it is an estimator of the 5300 Å-feature, and so of the magnetic field (Cramer and Maeder, 1980) : it differs from zero only for the magnetic CP stars. We also list in table I the mean values of the parameters X, Y, and Z, the MK spectral type as inferred from the colors, and the mean visual brightness of each star.

For A-F stars, changes in physical parameters affect all color indices in an intricate way, so that it is impossible to develop for them a formalism similar to the XYZ-formalism, which allows a clear-cut distinction between different physical effects (Golay, 1980; Nicolet and Cramer, 1983). Still, Ap stars like HD 81009 can be recognized in the Geneva system by means of the parameter $\Delta(V1\text{-}G)$, defined (Hauck and North, 1982) as

$$\Delta(V1\text{-}G) = (V1\text{-}G) - 0.289\,(B2\text{-}G) + 0.302\,.$$

The periods are listed in the last column of table I. They have been determined in two steps : first, we applied Deeming's (1975) and Stellingwerf's (1978) methods on the new observations, and, second, we used the older data in order to refine the value of the period. Our estimates of the errors on the periods are given in the next section, the accuracy of the periods depending in each case on the accuracy of the data and especially on that of the oldest data.

4. Discussion of the individual stars.

The individual data for all the stars are listed in tables II to IX. The phase diagrams for the mB- and mV-variations are shown in figure 1, and the variations of the color indices are plotted in figure 2.

HD 28843

The photometric and spectroscopic variability of HD 28843 was first studied by Pedersen and Thomsen (1977) and by Pedersen (1979), who derived a period of 1.37375 days. The time base of our data is much longer, and an improved value for the period of 1.37381 $\pm$ 0.00001 days could be derived. This period fits into the error box given by Manfroid and Mathys (1984). An epoch of maximum visual brightness is JD 2445287.35 $\pm$ 0.02. The color and light curves are not in phase. Maximum light in the U-band occurs later than maximum visual light (at phase 0.07) while maximum blue light occurs earlier (at phase 0.98).

Borra *et al.* (1983) claim that if a magnetic field is present on the surface of HD 28843 it is likely not to exceed a few hundred Gauss. Their statement is confirmed by the mean value of the Z-parameter, which does not deviate strongly from zero.

HD 34797

The peculiarity of HD 34797 is not well documented in the literature. This star is classified « λ Boo ? » in the Bright Star Catalogue. However, the Z-parameter of HD 34797 is clearly that of a magnetic star, which was already noted by Hauck and North (1982).

The most significant period in our data for HD 34797 is 2.28704 $\pm$ 0.00004 days. An epoch of maximum light is JD 2445257.70 $\pm$ 0.02. The light and color variations are in phase and the amplitude is largest in the U-band.

The remaining scatter is somewhat larger than expected for observations that were all gathered during the same season. It cannot be excluded that some part of the residual scatter is due to stray light from HD 34798, another sixth magnitude (variable) B star, which forms a visual pair with HD 34797 with a mutual separation of 39 arcseconds.

HD 56455

Light and color variations of HD 56455 were first observed by Renson *et al.* (1976); these authors derived a period of 2.24 days. The Geneva data cannot be represented with a period near that value. The most significant period is 1.9346 $\pm$ 0.0001 days. An epoch of maximum brightness is JD 2444549.77 $\pm$ 0.03.

The photometric variations of HD 56455 are similar to those of HD 34797. Also, both stars are close to each other in the HR diagram. The residual scatter of the light and color curves of HD 56455, 0.006 mag, is quite typical for data obtained in three subsequent observation seasons.

HD 81009

HD 81009 is the only A star in our sample. It was last discussed by Hensberge *et al.* (1981), who found a period of 33.97 days in their own and the published four-color data. The most significant period in the Geneva data, 33.96 $\pm$ 0.01 days, fits into the error box determined by Hensberge *et al.* (1981). An epoch of maximum brightness (in the $B1$-band, see below) is JD 2444480.7 $\pm$ 0.5.

The wavelength dependence of the variability of HD 81009 is striking. This star is only slightly variable in the U-band and hardly varies at all in the visual band; the amplitude is maximal in the $B1$-band, near the 4100 Å-feature caused by the rare earth elements. It would probably be of much interest to monitor HD 81009 in the near UV or redwards of the V-band.

HD 98457

Although rather faint, HD 98457 is an interesting object for further investigation. Its period of 11.535 $\pm$ 0.002 days, is fairly long, so that even long exposures would hardly be smeared out over the phase. An epoch of maximum brightness is JD 2445019.0 $\pm$ 0.2.

The amplitude amounts to 0.12 mag in the visual, and to 0.21 mag in the U-band, one of the largest values for any known CP star. The dependence of the amplitude on the wavelength is rather exceptional : between the U-band (mean wavelength = 3460 Å) and the $B1$-band (4020 Å) the amplitude drops by 0.19 mag ! A detailed spectral analysis of this wavelength region might prove worthwhile, especially since the lines must be very sharp.

HD 133880

HD 133880 is classified as an « Ap Si 4200 » star in the Bright Star Catalogue, and it is noted there that it has a magnetic field. This last remark is probably based on the appearance of HD 133880 in Babcock's (1958) list of magnetic stars. It is largely confirmed by the record value of the peculiarity parameter, $Z = -0.074$. Application of Cramer and Maeder's *Z-versus-Hs* calibration gives a value of 5.4 kG for the mean surface field of this star. Even this value could be only a lower limit, since saturation of Z sometimes occurs for large values of the magnetic field strength. Borra and Landstreet (1975) determined three values for the effective field, which show a range of about 6 kG, between − 2.8 kG and + 3.7 kG.

The period of HD 133880 is short, 0.87746 ± 0.00001 days. An epoch of maximum visual brightness is JD 2445472.07 ± 0.01 ; the maximum in the B-band then occurs at the phase 0.90.

The shortness of the period is probably why HD 133880 has not been studied intensively previously, despite its apparent visual brightness, the large value of its magnetic field, the amplitude of its variations, and its possible membership to the Scorpius-Centaurus association. The spectral lines must indeed be quite broad, so that the peculiarities are somewhat smeared out. Variations with such large amplitudes (0.15 mag in the U-band) are in fact exceptional for broad-lined CP-stars and can perhaps only be explained by the presence of a very strong magnetic field.

HD 175362

HD 175362 is a well-known He abnormal star. It is one of the best studied cases, since it is one of the hottest magnetic helium-weak stars known (Borra *et al.*, 1983). Borra *et al.* derived a period of 3.6740 ± 0.0015 days from He line strength maxima and magnetic field measurements. Our data have enabled us to refine the value of the period to 3.6733 ± 0.0001 days. An epoch of maximum light is JD 2445509.6 ± 0.1.

HD 191287

HD 191287 is another example of a large amplitude variable with a rather short period of 1.62345 ± 0.00002 days. An epoch of maximum visual brightness is JD 2445504.12 ± 0.02.

The amplitude in the visual band exceeds 0.2 mag, and is thus larger than that of any known variable CP star. The amplitude in the U-band amounts to 0.23 mag. The wavelength dependence of the amplitude and the shape of the curves are similar to those observed for HD 98457 ; the (U-$B1$)-variation has an amplitude of 0.15 mag peak-to-peak. The amplitude is smallest in the $B1$-band, and we conjecture that the spectrum of HD 191287 has a pronounced depletion at 4200 Å. This feature would also explain the anomalously low value of the parameter Y, which places this star about 0.07 mag below the reference sequence of class V stars in the X-Y-diagram, even though the parameters X and Y normally are hardly affected by the peculiarities (Cramer and Maeder, 1979).

5. Discussion.

5.1 INTERPRETATION OF THE PHOTOMETRIC VARIATIONS. — The explanation for the photometric variations of the CP stars has been discussed frequently in the recent literature ; it has last been reviewed by Schöneich (1981). The now classical hypothesis, first proposed by Peterson (1970), is the so-called line blocking-backwarming hypothesis. It is assumed that the bolometric energy radiated through each surface element is constant over the star. The non-homogeneous distribution of the different elements over the surface, however, causes different parts of the stellar surface to have a different spectral appearance ; in particular, the radiation is blocked at the specific wavelengths corresponding to the lines of the enhanced elements, and is radiated away at other wavelengths. The hypothesis gained some support from UV photometry (Molnar, 1973 ; Leckrone, 1974) : it was discovered that the variations of some stars changed sign for wavelengths shorter than some « null wavelength », so that it seemed indeed possible that the variability of the bolometric brightness was vanishingly small for these stars.

The line blocking-backwarming hypothesis has been challenged by authors who performed detailed model atmosphere calculations (e.g. Muthsam and Stepién, 1981). It would seem that at least for some stars the abundance variations alone cannot explain the observed photometric behaviour, so that additional effects, such as effective temperature variations and the influence of the magnetic field, must be invoked.

It is evident that ultraviolet observations are needed in order to test these ideas for early type stars : these stars radiate most of their energy in the UV, and most of the interesting lines occur short of 3000 Å. The interest of optical observations, such as ours, is that of selecting the best candidates for further study. We feel that at least three large amplitude stars deserve further attention : HD 133880 because of its large field, and HD 98457 and HD 191287 because of the remarkable behaviour of their amplitudes with wavelength. For the latter two stars, the variations do not change sign in the optical region, but the amplitude rises sharply towards shorter and longer wavelengths. For the sake of completeness, we list in table X the amplitudes for the five intermediate passbands of the Geneva System for all eight program stars.

5.2 THE VARIABILITY OF THE PECULIARITY INDEX. — We mentioned in section 3 above that, in the Geneva system, the early type stars are best described with the XYZ-formalism. For normal stars, the parameters X and Y are indicators of the effective temperature and the luminosity ; the calibrations apply reasonably well to the peculiar B stars, unless the peculiarities are extreme, as in the case of HD 191287. However, even when the mean values of these photometric parameters may be interpreted in physical terms, it is highly unlikely that the variations of X and Y for Bp stars may be interpreted as variations of the temperature and of the gravity. Were that the case, the spectral type of HD 98457 would vary from B6V at maximum to B8III at minimum : the absolute magnitude would remain roughly constant, while the effective temperature would vary with an amplitude of 2600 K !

One should then also be cautious when interpreting variations of Z in terms of variations of the surface magnetic field strength. For most of the stars considered here, the variations of ($V1$-G) have lower amplitudes than those of the other indices, so the terms in the other colors also play their role in the variation of Z, which is then not so easily interpreted as a variation of the 5300 Å-feature. To settle this point, it might be useful to compare the behaviour of some CP stars in the Geneva system with their behaviour in Maitzen's Δa-photometric system (Maitzen, 1982).

Unfortunately, surface field measurements are not available for our program stars. Effective fields have been measured for HD 133880 (Borra and Landstreet, 1975), HD 28843 and HD 175362 (Borra *et al.*, 1983). The effective fields of HD 133880 and HD 175362 are variable. We present the phase diagrams for the parameter Z of the seven B stars and the phase diagram for $\Delta(V1$-$G)$ of HD 81009 in figure 3. It is striking that the variation of Z is negligibly small for both large amplitude variables HD 98457 and HD 191287. As a matter of fact, for these stars, the term in ($V1$-G) is almost exactly canceled by the term in ($B2$-$V1$). The Z-variations are also vanishingly small for the effective field variable HD 175362. On the other hand, slight Z-variations are observed for HD 28843 and also for HD 34797 and HD 56455.

The most interesting object again appears to be HD 133880. A pronounced variability of Z, with an amplitude slightly exceeding 0.04 mag, is observed for this star. If this variability could be interpreted as a variability of the field strength, it would indicate a range of 3.8 to 7.8 kG for the surface field. In this reasoning, we have ignored saturation effects, an assumption which could be realistic because of the important rotational broadening of the lines. As to the effective field, our ephemeris and Borra and Landstreet's data indicate that it reaches its most negative value at the maximum of Z and of the visual brightness.

6. Concluding remarks.

The sample of CP stars discussed here was constructed merely as a byproduct of other investigations and is, as such, quite heterogeneous. It is worthwhile to consider the reasons why some of these stars were not studied more intensively before and why their variability was detected in the Geneva system. These reasons, indeed, illustrate different aspects of the usefulness of a photometric approach to the CP phenomenon.

(1) HD 34797 had not been recognized previously as a CP star and was detected as such by purely photometric means.

(2) The definitely interesting object HD 133880 has only now been saved from a relative anonymity, since its large rotational velocity acts as a counter-selection effect in spectroscopic methods of detection.

(3) Photometry is an effective tool for selecting the more spectacular objects among the fainter CP stars, such as HD 98457 and HD 191287.

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TABLE I. — *Identifications of the program stars, mean photometric parameters, inferred spectral types, and periods.*

Name	HR	HD	X	Y	Z	SP(X,Y)	mV	P(days)
DZ Eri	1441	28843	.768	.028	-.012	B5III	5.747	1.37381
	1754	34797	.913	-.017	-.019	B6V	6.523	2.28704
PR Pup	2761	56455	.943	.028	-.009	B7III	5.718	1.9346
KU Hya	3724	81009	Δ(V1-G) = .006				6.520	33.96
		98457	1.075	.020	-.025	B7III	7.930	11.5355
	5624	133880	1.024	.036	-.074	B7III	5.779	.87746
V686 CrA	7129	175362	.550	-.003	-.024	B3IV	5.354	3.6733
		191287	1.078	-.070	-.039	B7?	8.203	1.62346

TABLE X. — *Peak-to-peak amplitudes of the program stars for the five intermediate bands of the Geneva system.*

HD \ λ (Å)	3458	4022	4480	5408	5814
28843	.15	.13	.12	.09	.09
34797	.10	.05	.05	.04	.05
56455	.09	.02	.02	.03	.04
81009	.02	.06	.04	.01	.00
98457	.21	.02	.05	.11	.13
133880	.14	.10	.09	.05	.08
175362	.10	.07	.07	.06	.06
191287	.22	.07	.13	.19	.21

TABLE II. — *The data for HD 28843. The time is expressed in Heliocentric Julian Days. The phases are computed with the ephemeris given in the text.*

JD - 2400000	Phase	mB	mV	U-B1	B1-B2	B2-V1	V1-G	Z
41259.594	.186	4.614	5.745	-.096	-.772	-.222	-.537	.013
289.471	.933	4.565	5.697	-.087	-.764	-.268	-.505	-.028
671.425	.958	4.578	5.714	-.077	-.771	-.259	-.518	-.014
44534.795	.213	4.652	5.762	-.098	-.762	-.226	-.517	-.006
544.756	.464	4.686	5.798	-.066	-.756	-.223	-.521	-.002
890.779	.335	4.669	5.778	-.083	-.757	-.229	-.513	-.010
890.827	.370	4.678	5.781	-.080	-.755	-.220	-.521	-.001
891.738	.033	4.562	5.699	-.089	-.762	-.252	-.525	-.008
891.896	.148	4.595	5.717	-.097	-.760	-.244	-.509	-.018
45219.894	.899	4.578	5.727	-.056	-.766	-.261	-.516	-.016
244.837	.055	4.581	5.709	-.089	-.762	-.254	-.513	-.018
245.861	.800	4.585	5.729	-.030	-.760	-.263	-.516	-.017
246.852	.521	4.687	5.786	-.059	-.755	-.224	-.517	-.005
247.855	.251	4.646	5.750	-.091	-.753	-.226	-.518	-.006
270.777	.936	4.568	5.709	-.067	-.767	-.260	-.513	-.018
273.768	.114	4.589	5.720	-.101	-.766	-.246	-.519	-.010
274.722	.808	4.581	5.726	-.030	-.763	-.261	-.519	-.014
274.749	.828	4.580	5.724	-.040	-.764	-.261	-.515	-.017
275.753	.559	4.680	5.783	-.053	-.754	-.225	-.512	-.010
275.796	.590	4.684	5.793	-.052	-.751	-.231	-.517	-.008
276.758	.290	4.659	5.770	-.078	-.757	-.228	-.518	-.006
276.809	.327	4.682	5.781	-.078	-.752	-.214	-.515	-.005
277.772	.028	4.563	5.702	-.084	-.770	-.249	-.515	-.013
278.772	.756	4.609	5.747	-.023	-.761	-.257	-.519	-.012
279.766	.480	4.690	5.789	-.072	-.755	-.221	-.516	-.005
280.755	.199	4.624	5.738	-.095	-.756	-.232	-.512	-.013
314.631	.858	4.571	5.720	-.050	-.764	-.270	-.512	-.022
315.657	.605	4.672	5.786	-.056	-.759	-.232	-.522	-.003
322.614	.669	4.630	5.763	-.047	-.763	-.248	-.519	-.010
322.681	.718	4.621	5.768	-.036	-.762	-.254	-.514	-.016
356.562	.380	4.691	5.794	-.085	-.756	-.227	-.522	-.003

TABLE III. — *The data for HD 34797.*

JD - 2400000	Phase	mB	mV	U-B1	B1-B2	B2-V1	V1-G	Z
42743.772	.794	5.423	6.506	.036	-.721	-.220	-.497	-.023
753.707	.138	5.411	6.508	.022	-.715	-.232	-.501	-.024
766.697	.818	5.385	6.486	.029	-.733	-.228	-.514	-.010
43569.572	.872	5.405	6.501	.034	-.734	-.231	-.510	-.014
795.858	.815	5.422	6.506	.032	-.726	-.227	-.498	-.023
813.831	.673	5.440	6.524	.048	-.719	-.240	-.496	-.030
44890.733	.545	5.439	6.533	.077	-.728	-.227	-.506	-.016
45244.854	.383	5.457	6.543	.083	-.728	-.224	-.504	-.016
244.887	.398	5.455	6.543	.087	-.726	-.225	-.511	-.011
245.804	.799	5.429	6.509	.043	-.727	-.224	-.496	-.024
245.854	.820	5.418	6.509	.036	-.720	-.236	-.499	-.026
245.887	.835	5.424	6.514	.037	-.727	-.227	-.503	-.019

TABLE III (*continued*).

JD - 2400000	Phase	mB	mV	U-B1	B1-B2	B2-V1	V1-G	Z
45246.802	.235	5.443	6.527	.068	-.723	-.229	-.509	-.015
246.853	.257	5.443	6.527	.067	-.723	-.227	-.501	-.021
247.856	.696	5.430	6.514	.049	-.726	-.225	-.502	-.019
248.836	.124	5.418	6.507	.045	-.725	-.223	-.497	-.023
270.768	.714	5.431	6.521	.044	-.726	-.226	-.502	-.020
273.762	.023	5.401	6.499	.030	-.735	-.227	-.508	-.014
274.723	.443	5.452	6.537	.068	-.724	-.227	-.509	-.014
274.736	.449	5.453	6.541	.069	-.723	-.226	-.507	-.015
274.750	.455	5.450	6.531	.068	-.723	-.228	-.510	-.014
275.725	.881	5.415	6.499	.033	-.728	-.224	-.503	-.018
275.760	.897	5.408	6.499	.034	-.729	-.226	-.497	-.023
275.797	.913	5.409	6.501	.039	-.729	-.233	-.497	-.025
275.836	.930	5.410	6.508	.038	-.728	-.235	-.502	-.022
275.865	.943	5.409	6.505	.032	-.728	-.236	-.499	-.025
276.734	.323	5.445	6.537	.082	-.729	-.229	-.519	-.005
276.773	.340	5.463	6.545	.090	-.722	-.225	-.506	-.015
276.827	.363	5.457	6.549	.086	-.723	-.229	-.509	-.014
276.866	.380	5.468	6.554	.071	-.725	-.224	-.514	-.009
277.728	.757	5.424	6.513	.041	-.725	-.235	-.496	-.027
277.806	.791	5.424	6.514	.043	-.723	-.230	-.498	-.024
278.776	.215	5.433	6.521	.064	-.724	-.229	-.509	-.015
278.844	.245	5.452	6.545	.074	-.730	-.223	-.509	-.012
279.720	.628	5.429	6.516	.055	-.731	-.222	-.508	-.012
279.846	.683	5.444	6.531	.052	-.725	-.229	-.498	-.024
280.740	.074	5.404	6.498	.039	-.728	-.229	-.499	-.023
280.798	.100	5.412	6.508	.038	-.729	-.236	-.500	-.024
280.851	.123	5.425	6.519	.042	-.729	-.232	-.499	-.023
311.689	.606	5.443	6.533	.058	-.724	-.223	-.509	-.013
312.707	.052	5.408	6.502	.039	-.720	-.240	-.499	-.027
312.758	.074	5.423	6.521	.033	-.731	-.235	-.500	-.024
312.790	.088	5.433	6.524	.030	-.725	-.236	-.503	-.022
313.622	.452	5.464	6.548	.074	-.727	-.227	-.505	-.017
313.709	.490	5.437	6.535	.070	-.735	-.227	-.509	-.012
313.787	.524	5.452	6.541	.068	-.732	-.220	-.510	-.010
314.626	.891	5.401	6.497	.028	-.731	-.234	-.507	-.018
314.769	.953	5.411	6.502	.026	-.729	-.235	-.499	-.025
315.672	.348	5.447	6.541	.074	-.729	-.234	-.507	-.017
315.778	.394	5.471	6.557	.075	-.724	-.216	-.513	-.007
316.633	.768	5.417	6.510	.032	-.736	-.226	-.503	-.018
322.615	.384	5.444	6.529	.077	-.733	-.225	-.507	-.013
330.596	.874	5.426	6.520	.035	-.732	-.228	-.505	-.017
330.685	.912	5.409	6.503	.034	-.735	-.231	-.499	-.022
330.756	.943	5.405	6.500	.023	-.725	-.239	-.504	-.023
330.808	.966	5.409	6.503	.032	-.728	-.231	-.501	-.022
331.552	.292	5.458	6.543	.073	-.728	-.223	-.506	-.014
331.631	.326	5.460	6.544	.076	-.720	-.228	-.513	-.011
331.706	.359	5.450	6.540	.080	-.724	-.229	-.506	-.017
331.770	.387	5.456	6.549	.081	-.729	-.233	-.503	-.020
332.572	.738	5.449	6.532	.037	-.724	-.229	-.496	-.026
332.651	.772	5.427	6.522	.035	-.728	-.227	-.500	-.021
332.776	.827	5.428	6.518	.038	-.728	-.226	-.501	-.020
356.561	.227	5.449	6.537	.056	-.725	-.230	-.507	-.017
357.538	.654	5.445	6.527	.046	-.723	-.223	-.510	-.013
357.629	.694	5.439	6.531	.041	-.730	-.222	-.505	-.015
357.709	.729	5.433	6.525	.040	-.726	-.233	-.494	-.028
358.596	.116	5.432	6.520	.046	-.731	-.233	-.494	-.027
358.679	.153	5.443	6.530	.050	-.732	-.223	-.501	-.018

TABLE III (*continued*).

JD - 2400000	Phase	mB	mV	U-B1	B1-B2	B2-V1	V1-G	Z
45359.547	.532	5.440	6.534	.068	-.730	-.227	-.504	-.017
359.628	.568	5.446	6.536	.058	-.728	-.231	-.501	-.021
360.544	.968	5.418	6.509	.027	-.738	-.226	-.495	-.024
360.607	.996	5.416	6.510	.027	-.727	-.235	-.500	-.024
360.696	.035	5.417	6.511	.034	-.732	-.232	-.495	-.026
361.550	.408	5.464	6.551	.084	-.730	-.222	-.507	-.013
361.637	.446	5.458	6.546	.072	-.727	-.226	-.512	-.011
362.548	.844	5.429	6.520	.036	-.732	-.230	-.496	-.025
362.662	.894	5.420	6.510	.032	-.723	-.235	-.499	-.026
365.542	.154	5.436	6.528	.046	-.729	-.230	-.499	-.023
365.639	.196	5.444	6.534	.051	-.724	-.230	-.506	-.018
366.584	.609	5.450	6.538	.045	-.727	-.228	-.501	-.021
366.690	.655	5.449	6.535	.039	-.727	-.226	-.507	-.016
367.543	.028	5.413	6.506	.037	-.725	-.228	-.503	-.020
367.602	.054	5.415	6.509	.033	-.730	-.230	-.503	-.020
413.526	.134	5.442	6.536	.029	-.729	-.228	-.507	-.016

TABLE IV. — *The data for HD 56455.*

JD - 2400000	Phase	mB	mV	U-B1	B1-B2	B2-V1	V1-G	Z
44203.837	.186	4.603	5.703	.045	-.736	-.233	-.500	-.022
226.769	.040	4.614	5.697	.028	-.733	-.230	-.506	-.017
235.756	.685	4.631	5.722	.074	-.723	-.239	-.526	-.004
240.737	.260	4.639	5.728	.058	-.729	-.229	-.508	-.015
243.722	.803	4.616	5.715	.047	-.725	-.234	-.513	-.013
254.763	.510	4.668	5.760	.109	-.739	-.232	-.517	-.006
264.700	.647	4.635	5.730	.113	-.737	-.237	-.512	-.012
266.669	.664	4.639	5.739	.091	-.727	-.242	-.526	-.004
268.682	.705	4.631	5.727	.097	-.739	-.223	-.520	-.001
286.677	.007	4.614	5.697	.032	-.738	-.236	-.502	-.021
298.647	.194	4.614	5.710	.042	-.735	-.235	-.505	-.019
299.648	.712	4.628	5.723	.098	-.737	-.223	-.528	.005
302.645	.260	4.612	5.707	.049	-.746	-.222	-.516	-.004
307.561	.802	4.614	5.716	.056	-.749	-.229	-.517	-.005
323.516	.049	4.613	5.697	.044	-.748	-.219	-.505	-.012
543.869	.950	4.604	5.702	.042	-.745	-.226	-.509	-.011
573.846	.445	4.636	5.731	.083	-.739	-.227	-.523	.000
586.806	.144	4.603	5.706	.047	-.741	-.228	-.510	-.011
592.753	.218	4.621	5.713	.060	-.726	-.236	-.501	-.023
614.798	.613	4.633	5.731	.106	-.729	-.240	-.526	-.003
615.790	.126	4.609	5.710	.030	-.745	-.232	-.503	-.018
616.810	.653	4.626	5.728	.112	-.748	-.230	-.527	.004
627.710	.287	4.628	5.726	.064	-.742	-.226	-.519	-.003
629.703	.318	4.630	5.729	.070	-.741	-.227	-.515	-.007
635.678	.406	4.640	5.735	.088	-.735	-.226	-.518	-.004
638.703	.970	4.644	5.732	.051	-.730	-.230	-.517	-.008
639.676	.473	4.631	5.736	.101	-.735	-.239	-.520	-.007
649.637	.622	4.639	5.738	.109	-.733	-.224	-.523	.001
650.637	.138	4.615	5.707	.034	-.734	-.228	-.514	-.010
654.652	.214	4.610	5.707	.046	-.736	-.228	-.508	-.014
668.629	.439	4.630	5.731	.080	-.731	-.223	-.524	.001
670.621	.468	4.632	5.734	.086	-.740	-.227	-.519	-.003

TABLE IV *(continued)*.

JD - 2400000	Phase	mB	mV	U-B1	B1-B2	B2-V1	V1-G	Z
44675.637	.061	4.615	5.705	.031	-.738	-.225	-.516	-.007
677.548	.049	4.622	5.700	.042	-.737	-.224	-.505	-.015
678.557	.570	4.635	5.733	.117	-.733	-.231	-.520	-.004
710.505	.084	4.610	5.700	.048	-.738	-.224	-.501	-.018
712.505	.119	4.608	5.706	.046	-.739	-.225	-.512	-.009
714.494	.146	4.611	5.697	.051	-.737	-.224	-.502	-.017
938.855	.119	4.607	5.703	.037	-.735	-.229	-.512	-.011
941.783	.633	4.625	5.724	.090	-.731	-.236	-.520	-.006
942.767	.141	4.618	5.710	.050	-.741	-.225	-.518	-.004
943.783	.666	4.621	5.719	.087	-.736	-.233	-.515	-.009
944.802	.193	4.609	5.708	.048	-.740	-.235	-.519	-.007
950.792	.289	4.624	5.719	.063	-.733	-.225	-.519	-.004
959.756	.923	4.601	5.697	.041	-.735	-.230	-.510	-.013
973.744	.153	4.617	5.702	.043	-.731	-.228	-.508	-.015
981.746	.290	4.619	5.711	.059	-.728	-.228	-.507	-.016
982.739	.803	4.624	5.708	.060	-.727	-.228	-.513	-.011
995.676	.490	4.636	5.735	.084	-.733	-.230	-.522	-.003
45004.670	.139	4.611	5.710	.041	-.742	-.225	-.517	-.005
005.663	.652	4.636	5.735	.101	-.736	-.234	-.516	-.008
015.613	.796	4.620	5.715	.054	-.737	-.224	-.512	-.009
053.509	.384	4.634	5.728	.102	-.738	-.231	-.513	-.009
057.504	.449	4.620	5.721	.102	-.738	-.238	-.513	-.011

TABLE V. — *The data for HD 81009.*

JD - 2440000	Phase	mB	mV	U-B1	B1-B2	B2-V1	V1-G	Δ(V1-G)
43929.680	.704	5.825	6.522	.519	-.455	-.001	-.418	.005
936.686	.910	5.807	6.524	.540	-.470	-.006	-.423	.003
941.639	.056	5.800	6.522	.545	-.467	-.016	-.397	.024
948.609	.261	5.833	6.524	.520	-.455	.007	-.413	.006
952.616	.379	5.837	6.524	.518	-.459	.007	-.408	.010
969.577	.879	5.804	6.521	.542	-.472	-.003	-.417	.006
979.556	.172	5.805	6.516	.535	-.456	-.007	-.415	.009
44231.829	.601	5.831	6.521	.510	-.443	.012	-.424	-.003
243.814	.954	5.804	6.517	.537	-.461	-.005	-.434	-.005
246.847	.043	5.805	6.526	.542	-.457	-.015	-.422	.006
247.857	.073	5.805	6.518	.538	-.460	-.004	-.423	.002
255.807	.307	5.825	6.521	.527	-.454	.010	-.425	-.003
256.794	.336	5.823	6.518	.516	-.456	.002	-.410	.010
258.798	.395	5.833	6.523	.512	-.451	.014	-.423	-.003
274.734	.864	5.800	6.527	.539	-.457	-.011	-.422	.005
275.709	.893	5.804	6.523	.531	-.459	-.011	-.428	.001
276.731	.923	5.803	6.520	.552	-.468	-.018	-.411	.015
280.721	.041	5.804	6.533	.537	-.456	-.015	-.410	.015
301.722	.659	5.829	6.520	.512	-.448	.005	-.416	.005
307.634	.833	5.819	6.520	.535	-.464	.000	-.412	.009
311.624	.951	5.803	6.518	.536	-.463	-.007	-.419	.006
313.620	.009	5.804	6.526	.544	-.465	-.008	-.419	.006
322.609	.274	5.816	6.510	.524	-.455	.002	-.412	.008
323.601	.303	5.820	6.512	.528	-.464	.010	-.413	.005
583.840	.966	5.795	6.507	.538	-.459	-.022	-.424	-.006
584.853	.996	5.800	6.526	.540	-.464	-.015	-.418	.009

TABLE V *(continued)*.

JD - 2440000	Phase	mB	mV	U-B1	B1-B2	B2-V1	V1-G	Δ(V1-G)
44588.855	.114	5.808	6.517	.542	-.464	-.016	-.406	.018
593.853	.261	5.811	6.522	.538	-.466	.000	-.422	.002
594.826	.290	5.816	6.522	.534	-.465	.008	-.419	.002
601.876	.498	5.851	6.520	.502	-.435	.015	-.406	.009
625.787	.202	5.812	6.520	.531	-.460	-.003	-.430	-.003
629.747	.318	5.826	6.525	.535	-.455	.007	-.417	.003
630.762	.348	5.816	6.520	.510	-.454	-.003	-.420	.004
631.714	.376	5.828	6.523	.523	-.452	.005	-.412	.008
633.721	.435	5.836	6.520	.507	-.440	.001	-.409	.011
634.739	.465	5.838	6.523	.513	-.448	.011	-.420	.000
643.688	.729	5.824	6.520	.525	-.446	-.002	-.419	.005
645.697	.788	5.816	6.520	.536	-.462	.004	-.429	-.004
649.720	.906	5.800	6.514	.540	-.461	-.007	-.424	.003
672.651	.582	5.839	6.516	.506	-.437	.012	-.411	.006
674.706	.642	5.836	6.519	.512	-.434	.001	-.401	.017
681.679	.847	5.807	6.524	.541	-.462	-.011	-.410	.014
694.690	.231	5.812	6.519	.543	-.456	-.013	-.413	.012
702.561	.462	5.843	6.521	.504	-.444	.015	-.401	.013
715.552	.845	5.816	6.524	.543	-.454	-.004	-.424	.002
749.483	.844	5.809	6.516	.551	-.455	-.003	-.423	.002
926.852	.067	5.808	6.523	.548	-.464	-.007	-.421	.005
927.851	.096	5.808	6.523	.545	-.463	-.012	-.417	.009
928.850	.126	5.805	6.522	.542	-.462	-.007	-.420	.005
929.855	.155	5.814	6.524	.548	-.462	-.007	-.415	.009
930.848	.185	5.810	6.520	.540	-.454	-.006	-.425	.002
966.824	.244	5.808	6.519	.532	-.455	-.004	-.414	.009
973.809	.450	5.843	6.517	.512	-.437	.011	-.409	.008
982.777	.714	5.818	6.505	.517	-.444	.004	-.415	.006
985.734	.801	5.814	6.521	.542	-.457	-.003	-.416	.007
994.757	.066	5.801	6.515	.541	-.447	-.015	-.424	.005
995.742	.095	5.799	6.515	.528	-.460	-.018	-.410	.016
45007.775	.450	5.849	6.522	.515	-.436	.016	-.410	.006
048.622	.653	5.837	6.519	.517	-.442	.009	-.421	.000
049.623	.682	5.828	6.519	.517	-.452	.007	-.409	.009
050.584	.710	5.830	6.527	.521	-.456	.004	-.423	.000
051.609	.741	5.819	6.514	.527	-.451	-.001	-.416	.007
053.580	.799	5.819	6.523	.539	-.464	-.002	-.419	.005
055.585	.858	5.813	6.522	.542	-.466	-.001	-.420	.004
056.596	.887	5.811	6.523	.544	-.458	-.009	-.419	.007
058.593	.946	5.790	6.514	.552	-.468	-.015	-.414	.012
095.484	.033	5.788	6.509	.541	-.465	-.008	-.419	.006

TABLE VI. — *The data for HD 98457.*

JD - 2400000	Phase	mB	mV	U-B1	B1-B2	B2-V1	V1-G	Z
43925.722	.225	6.898	7.940	.204	-.690	-.216	-.475	-.039
932.772	.836	6.882	7.909	.172	-.687	-.182	-.487	-.020
952.699	.564	6.906	7.982	.275	-.711	-.231	-.491	-.026
44625.809	.915	6.882	7.886	.122	-.686	-.162	-.495	-.009
649.790	.994	6.865	7.865	.084	-.682	-.164	-.482	-.021
654.769	.425	6.923	8.001	.275	-.705	-.220	-.509	-.009
655.790	.514	6.921	7.974	.281	-.706	-.228	-.497	-.021

TABLEAU VI (continued).

JD - 2400000	Phase	mB	mV	U-B1	B1-B2	B2-V1	V1-G	Z
44659.838	.865	6.900	7.910	.143	-.677	-.188	-.490	-.022
672.675	.977	6.879	7.876	.097	-.671	-.167	-.491	-.016
696.769	.066	6.879	7.880	.099	-.683	-.170	-.472	-.031
738.548	.688	6.893	7.955	.256	-.696	-.224	-.481	-.035
45008.837	.119	6.876	7.892	.131	-.680	-.198	-.482	-.031
047.715	.489	6.908	7.975	.273	-.713	-.219	-.499	-.016
089.656	.125	6.885	7.903	.137	-.681	-.186	-.479	-.029
094.586	.552	6.909	7.974	.271	-.705	-.213	-.496	-.017
101.565	.157	6.896	7.913	.165	-.683	-.188	-.487	-.023
359.716	.536	6.916	7.978	.252	-.692	-.233	-.488	-.033
359.835	.547	6.899	7.976	.272	-.709	-.229	-.483	-.032
360.748	.626	6.896	7.967	.268	-.705	-.226	-.495	-.023
360.871	.636	6.897	7.959	.270	-.706	-.228	-.487	-.029
361.721	.710	6.902	7.953	.246	-.716	-.197	-.502	-.007
361.864	.723	6.892	7.938	.230	-.694	-.218	-.496	-.022
362.848	.808	6.882	7.914	.199	-.691	-.194	-.487	-.022
365.710	.056	6.890	7.889	.074	-.675	-.176	-.474	-.033
366.841	.154	6.887	7.901	.157	-.689	-.185	-.483	-.024
366.866	.156	6.882	7.912	.158	-.689	-.194	-.481	-.029
367.751	.233	6.902	7.951	.208	-.698	-.203	-.493	-.019
370.776	.495	6.901	7.970	.273	-.702	-.221	-.503	-.015
397.629	.823	6.896	7.924	.185	-.691	-.191	-.478	-.029
398.646	.911	6.880	7.884	.116	-.671	-.183	-.481	-.029
398.818	.926	6.875	7.883	.109	-.685	-.174	-.473	-.030
399.800	.011	6.874	7.871	.086	-.683	-.156	-.484	-.017
402.671	.260	6.904	7.954	.218	-.691	-.217	-.475	-.039
403.788	.357	6.905	7.972	.265	-.700	-.228	-.500	-.020

TABLE VII. — *The data for HD 133880.*

JD - 2400000	Phase	mB	mV	U-B1	B1-B2	B2-V1	V1-G	Z
43584.855	.230	4.647	5.779	.116	-.715	-.285	-.477	-.067
585.860	.375	4.676	5.811	.148	-.721	-.273	-.481	-.050
617.857	.840	4.594	5.759	.122	-.720	-.310	-.457	-.081
943.869	.381	4.684	5.802	.128	-.711	-.271	-.480	-.052
45398.800	.498	4.684	5.809	.129	-.715	-.276	-.467	-.063
399.812	.651	4.634	5.777	.133	-.712	-.301	-.454	-.082
402.828	.088	4.605	5.758	.103	-.715	-.308	-.449	-.088
403.858	.262	4.646	5.783	.118	-.708	-.292	-.467	-.069
409.864	.107	4.616	5.758	.108	-.707	-.303	-.452	-.085
444.673	.777	4.611	5.769	.122	-.714	-.315	-.452	-.088
444.817	.941	4.593	5.753	.104	-.713	-.314	-.440	-.098
450.771	.727	4.608	5.765	.130	-.713	-.313	-.456	-.084
451.636	.712	4.615	5.769	.128	-.714	-.310	-.456	-.083
451.743	.834	4.600	5.759	.128	-.716	-.317	-.445	-.094
456.618	.390	4.691	5.810	.126	-.709	-.274	-.473	-.059
456.744	.534	4.660	5.791	.131	-.710	-.288	-.463	-.071
456.810	.609	4.632	5.774	.129	-.715	-.302	-.462	-.075
478.695	.550	4.651	5.788	.128	-.718	-.286	-.467	-.066
483.524	.054	4.608	5.756	.087	-.711	-.305	-.444	-.092
483.567	.103	4.617	5.765	.099	-.710	-.310	-.446	-.092
483.614	.156	4.622	5.772	.112	-.713	-.307	-.458	-.081

TABLE VII (continued).

JD - 2400000	Phase	mB	mV	U-B1	B1-B2	B2-V1	V1-G	Z
45483.674	.224	4.626	5.767	.113	-.713	-.298	-.459	-.077
483.743	.303	4.656	5.788	.120	-.709	-.287	-.472	-.064
484.542	.214	4.627	5.771	.113	-.713	-.300	-.464	-.074
484.586	.264	4.643	5.780	.120	-.711	-.297	-.465	-.072
484.639	.324	4.665	5.795	.122	-.709	-.284	-.471	-.063
484.691	.384	4.685	5.803	.131	-.707	-.277	-.469	-.063
485.552	.365			.126	-.710	-.281	-.475	-.059
485.584	.401	4.692	5.808	.141	-.711	-.273	-.469	-.061
485.622	.445	4.693	5.811	.140	-.710	-.271	-.470	-.059
485.662	.490	4.683	5.799	.140	-.713	-.275	-.462	-.067
485.728	.565	4.652	5.789	.131	-.713	-.291	-.457	-.076
533.483	.990	4.597	5.754	.093	-.713	-.320	-.443	-.098
533.525	.037	4.600	5.751	.101	-.714	-.313	-.442	-.096
533.587	.108	4.609	5.760	.105	-.712	-.309	-.450	-.088
534.525	.177	4.620	5.768	.113	-.715	-.299	-.459	-.077
535.554	.350	4.673	5.799	.127	-.714	-.278	-.474	-.058
535.576	.375	4.679	5.798	.129	-.709	-.275	-.475	-.057

TABLE VIII. — *The data for HD 175362.*

JD - 2400000	Phase	mB	mV	U-B1	B1-B2	B2-V1	V1-G	Z
42908.859	.070	4.183	5.333	-.241	-.785	-.252	-.506	-.023
935.822	.410	4.239	5.374	-.226	-.768	-.249	-.510	-.021
968.660	.349	4.228	5.366	-.219	-.766	-.254	-.510	-.023
44748.915	.997	4.183	5.332	-.247	-.774	-.269	-.506	-.030
834.579	.317	4.221	5.362	-.223	-.771	-.252	-.509	-.022
45183.639	.344	4.232	5.369	-.229	-.769	-.247	-.512	-.019
451.854	.361	4.230	5.372	-.223	-.766	-.259	-.512	-.023
456.932	.744	4.234	5.374	-.217	-.768	-.255	-.512	-.021
458.920	.285	4.209	5.354	-.227	-.772	-.263	-.512	-.024
483.874	.078	4.171	5.323	-.241	-.777	-.264	-.511	-.024
484.766	.321	4.213	5.353	-.228	-.767	-.260	-.508	-.027
484.866	.348	4.226	5.362	-.228	-.764	-.257	-.511	-.024
485.791	.600	4.239	5.377	-.211	-.770	-.252	-.510	-.021
485.886	.626	4.245	5.382	-.211	-.776	-.257	-.508	-.024
488.733	.401	4.235	5.372	-.219	-.767	-.251	-.507	-.024
488.891	.444	4.236	5.376	-.220	-.769	-.250	-.517	-.016
491.730	.217	4.197	5.342	-.231	-.775	-.254	-.507	-.024
491.850	.250	4.201	5.343	-.229	-.770	-.257	-.511	-.023
493.834	.790	4.217	5.362	-.226	-.767	-.259	-.512	-.023
498.843	.153	4.181	5.332	-.239	-.775	-.261	-.513	-.022
533.579	.610	4.241	5.384	-.209	-.767	-.258	-.510	-.024
533.670	.634	4.236	5.378	-.211	-.769	-.255	-.507	-.025
533.747	.655	4.240	5.380	-.213	-.764	-.256	-.517	-.018
534.590	.885	4.198	5.343	-.241	-.773	-.265	-.507	-.028
534.661	.904	4.184	5.337	-.237	-.783	-.264	-.507	-.026
534.741	.926	4.181	5.334	-.246	-.777	-.263	-.511	-.024
541.573	.786	4.225	5.365	-.221	-.772	-.254	-.511	-.021
541.741	.832	4.213	5.360	-.230	-.774	-.254	-.514	-.019
542.563	.055	4.181	5.327	-.240	-.773	-.260	-.507	-.027
542.646	.078	4.175	5.324	-.240	-.771	-.262	-.509	-.026
542.738	.103	4.185	5.327	-.242	-.772	-.261	-.507	-.027

TABLE VIII *(continued)*.

JD - 2400000	Phase	mB	mV	U-B1	B1-B2	B2-V1	V1-G	Z
45546.583	.150	4.186	5.329	-.240	-.773	-.260	-.507	-.027
546.716	.186	4.195	5.336	-.243	-.766	-.263	-.511	-.026
548.651	.713	4.232	5.376	-.217	-.770	-.252	-.513	-.019
564.497	.027	4.173	5.328	-.246	-.779	-.264	-.512	-.023
564.579	.049	4.175	5.326	-.242	-.777	-.262	-.507	-.027
566.618	.604	4.241	5.381	-.212	-.768	-.254	-.515	-.018

TABLE IX. — *The data for HD 191287.*

JD - 2400000	Phase	mB	mV	U-B1	B1-B2	B2-V1	V1-G	Z
44022.859	.590	7.341	8.277	.307	-.618	-.144	-.452	-.043
044.821	.118	7.297	8.142	.192	-.557	-.086	-.442	-.045
061.771	.559	7.347	8.277	.318	-.626	-.139	-.451	-.040
062.771	.175	7.323	8.186	.235	-.579	-.111	-.451	-.040
403.834	.259	7.349	8.238	.273	-.619	-.086	-.461	-.017
778.799	.213	7.339	8.232	.263	-.602	-.108	-.446	-.039
808.720	.656	7.360	8.250	.273	-.617	-.106	-.449	-.034
810.716	.885	7.277	8.123	.188	-.575	-.080	-.443	-.039
45444.914	.531	7.335	8.272	.316	-.626	-.133	-.436	-.050
450.918	.229	7.343	8.233	.267	-.603	-.100	-.449	-.034
451.910	.840	7.300	8.159	.232	-.585	-.095	-.443	-.041
456.917	.924	7.265	8.094	.188	-.570	-.079	-.419	-.058
458.929	.164	7.322	8.184	.227	-.577	-.090	-.452	-.033
483.866	.524	7.332	8.274	.306	-.625	-.140	-.442	-.048
483.922	.559	7.342	8.284	.312	-.627	-.143	-.454	-.039
484.857	.135	7.304	8.170	.219	-.577	-.092	-.441	-.043
485.878	.764	7.323	8.216	.258	-.611	-.099	-.444	-.037
485.930	.796	7.309	8.187	.239	-.602	-.101	-.444	-.040
488.909	.631	7.341	8.279	.312	-.630	-.144	-.453	-.040
491.784	.401			.312	-.622	-.141	-.452	-.040
491.889	.466	7.333	8.267	.310	-.627	-.136	-.443	-.046
493.849	.673	7.345	8.272	.303	-.616	-.145	-.441	-.044
493.896	.702	7.344	8.263	.297	-.633	-.120	-.462	-.025
498.784	.713	7.339	8.251	.290	-.626	-.112	-.462	-.023
498.838	.746	7.332	8.228	.264	-.609	-.115	-.442	-.044
498.899	.784	7.323	8.209	.250	-.600	-.107	-.448	-.038
499.773	.322	7.357	8.266	.290	-.616	-.121	-.453	-.035
500.776	.940	7.264	8.096	.177	-.575	-.070	-.423	-.052
530.738	.396	7.347	8.274	.305	-.624	-.130	-.451	-.038
531.645	.955	7.264	8.089	.172	-.554	-.078	-.432	-.052
531.691	.983	7.261	8.084	.161	-.561	-.066	-.434	-.044
531.738	.012	7.261	8.083	.161	-.559	-.065	-.440	-.039
531.774	.034	7.260	8.087	.176	-.559	-.068	-.434	-.045
531.823	.064	7.280	8.115	.180	-.569	-.073	-.437	-.042
533.654	.192	7.337	8.203	.237	-.590	-.094	-.457	-.036
533.686	.212	7.337	8.217	.254	-.598	-.106	-.442	-.043
533.725	.236	7.342	8.233	.263	-.602	-.111	-.455	-.033
533.754	.254	7.347	8.245	.257	-.604	-.112	-.451	-.036
534.676	.822	7.294	8.167	.234	-.606	-.091	-.436	-.042
534.785	.889	7.277	8.126	.190	-.576	-.073	-.447	-.033
548.602	.400	7.352	8.279	.300	-.618	-.136	-.448	-.043
564.673	.299	7.367	8.263	.280	-.615	-.104	-.457	-.027

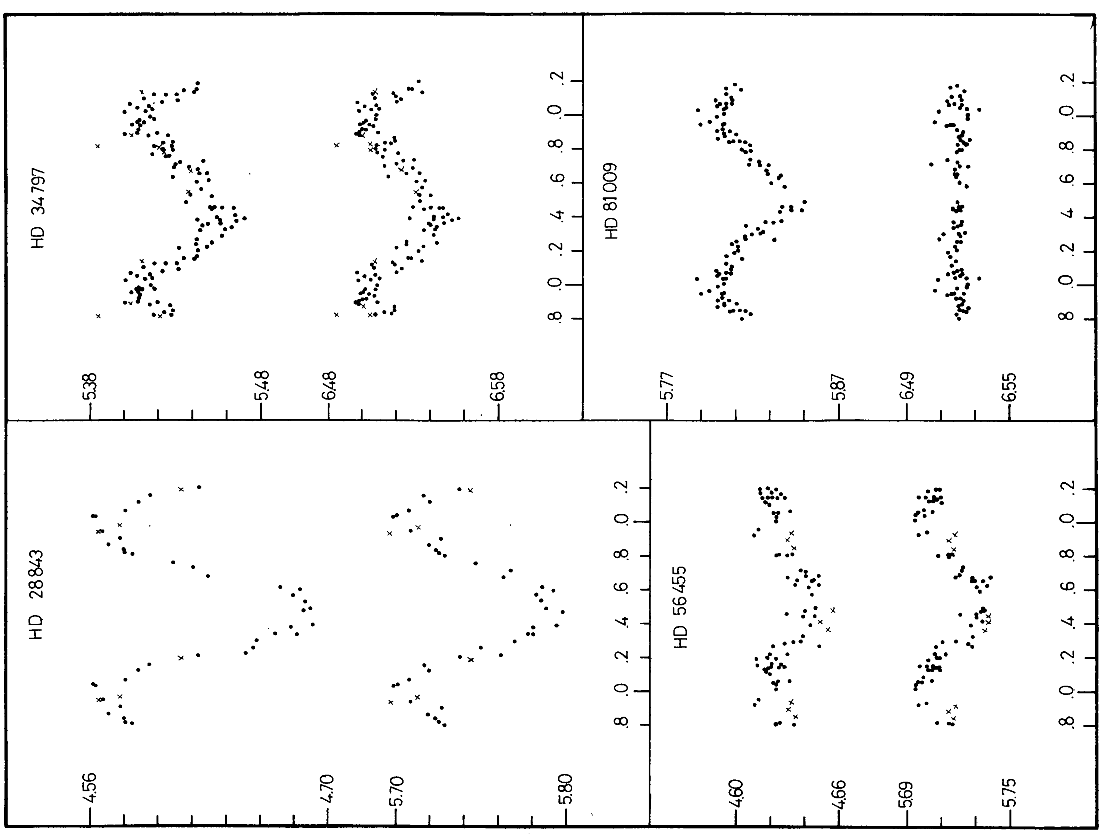

FIGURE 1a. — Phase diagrams for the blue and visual brightness variations of four program stars.

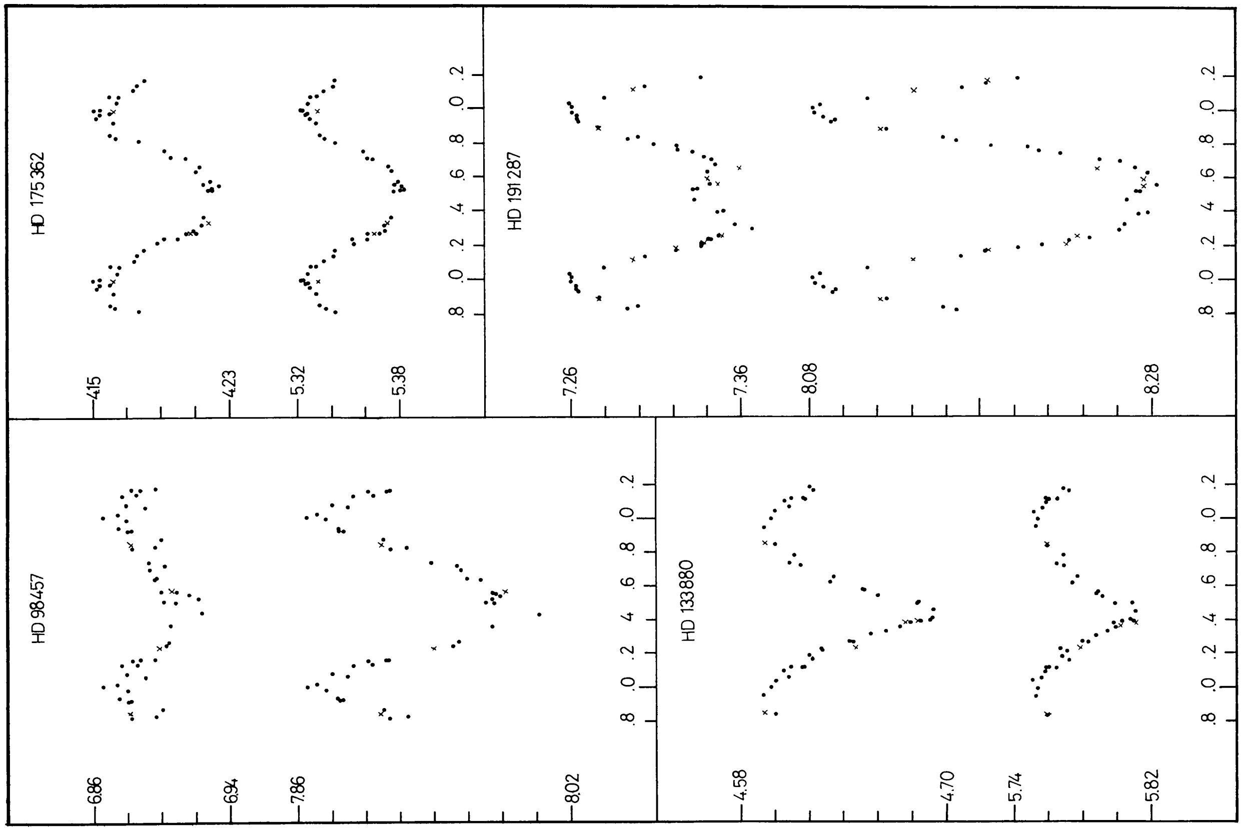

FIGURE 1b. — Phase diagrams for the blue and visual brightness variations of four program stars.

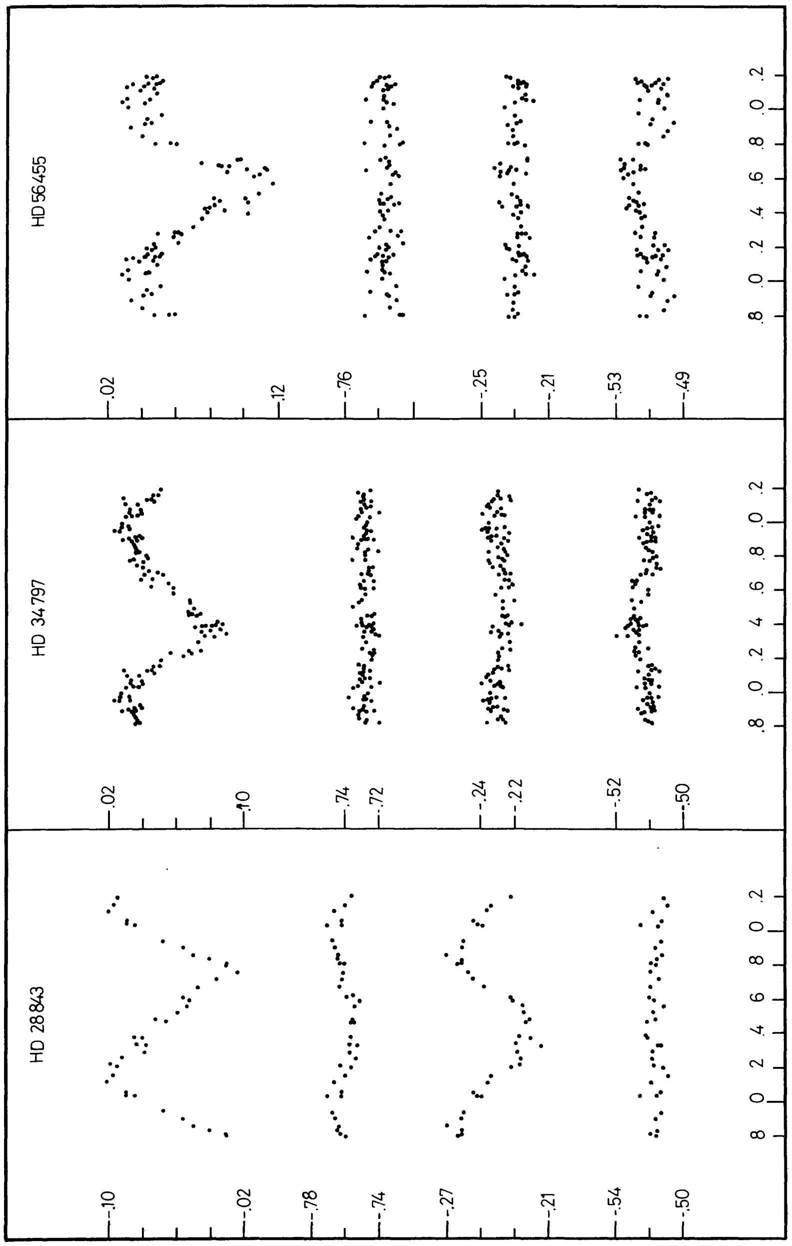

FIGURE 2a. — The color variations of HD 28843, HD 34797, and HD 56455. Shown are, respectively, the phase diagrams for the indices *U-B1*, *B1-B2*, *B2-V1*, and *V1-G*.

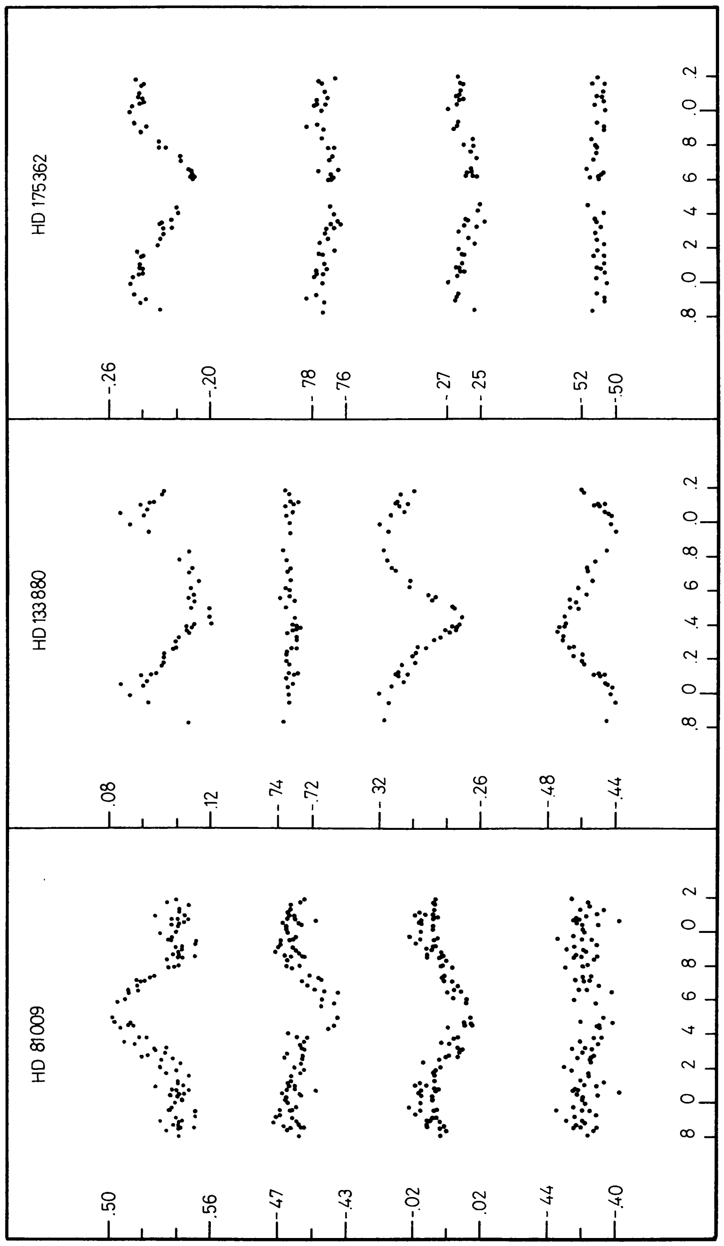

FIGURE 2b. — The same as figure 2a for HD 81009, HD 133880, and HD 175362.

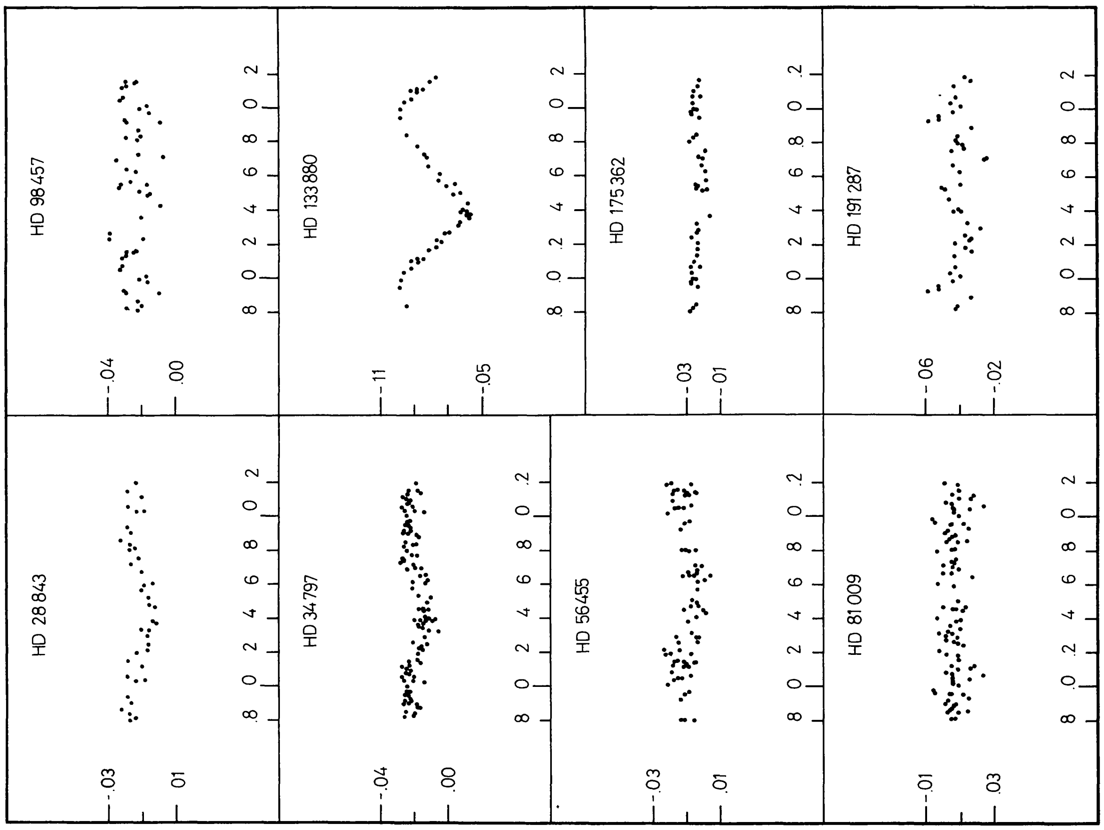

FIGURE 3. — The variability of the peculiarity indices of the program stars.

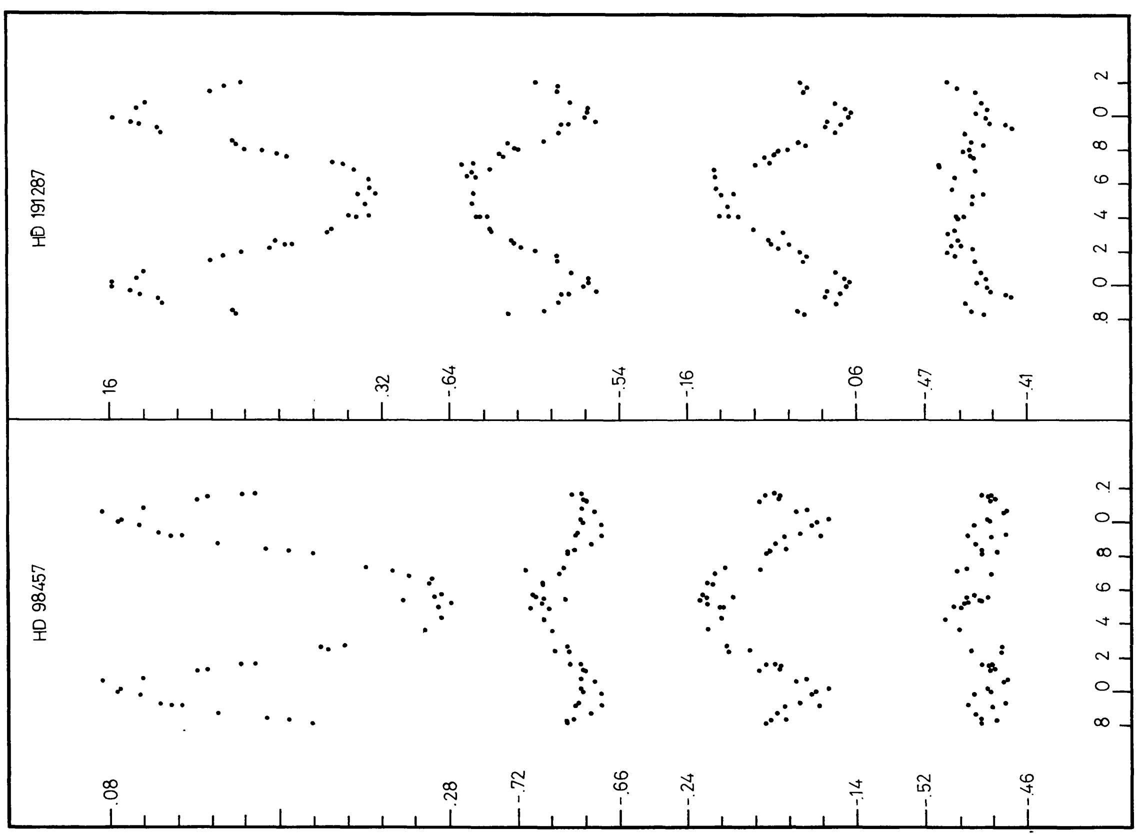

FIGURE 2c. — The same as figure 2a for HD 98457 and HD 191287.