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Photometric variability of some early-type stars (*)

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Summary. — Twelve stars of types B to early F, which had previously been used as comparison stars in studies of photometric variability of CP stars, proved to be variable. Photometric observations of these objects are presented, and the origin of their variations is discussed. Five of them (HD 24587, HD 61429, HD 65270, HD 90994 and HD 103789) seem to vary periodically, with lightcurves similar in shape to those of CP stars. HD 167756 is a Ia-type supergiant showing short-time scale (nightly) variations. HD 178175 is a Be star undergoing rapid light variations with a pseudo-period of about 0.54 d or 1.37 d, in addition to its well known long-term irregular drifts. The eclipsing binary HD 208496 is one of the brightest members of this class; the depth of the primary eclipses is about 0.3 mag and the period is close to 1.464 d. The case of the four remaining stars is less clear. HD 27563 should be either multiperiodic or pseudo-periodic; a « period » of about 4 days (or some alias of it) seems to be present. HD 45431 appears to be an eclipsing binary. HD 224639 is probably a short period variable, possibly a δ Sct star. Our observations are not conclusive for HD 1788. In addition, we confirm the previously published accurate period of the He weak variable HD 28843 : $P = (1.373813 \pm 0.000012)$ d.

Key words : stars : variable — stars : CP — stars : Be — stars : eclipsing binaries — stars : supergiants.

1. Introduction.

In two recent papers (Manfroid and Mathys, 1985; Mathys and Manfroid, 1985), the results of five years of survey (Renson and Manfroid, 1978c, 1981; Manfroid and Renson, 1983a) of the photometric variations of southern upper main sequence chemically peculiar (CP) stars were synthesized. In the course of this survey, several of the comparison stars used proved to be variable. The variability of some of these stars, mistakenly selected as comparisons, could in fact have been expected, for instance from the consideration of their spectral type; but most variable comparison stars encountered could not be suspected *a priori* not to be constant, and some had even been widely employed as photometric standards. The aim of this paper is to present those comparison stars in which we detected variations. Some of them have already been mentioned in previous papers about CP stars, sometimes with a tentative period (see the individual references hereafter), but their measurements have not been fully published up to now.

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2. Observations.

The observations were collected between February 1977 and January 1982 at the European Southern Observatory on La Silla with the Danish 50 cm telescope and the ESO 50 cm telescope. For one star (HD 208496), additional data were obtained in July 1984 with the ESO 1 m telescope. Details about the observing runs are given in table I : date, number of nights between the beginning and the end of the run, telescope and symbols used in the plots of the observations. All the observations were made in the Strömgren *uvby* system. It is not possible to give general information about the sequences of measurements, as the stars discussed here are usually either of two comparison stars of a presumably variable CP star (HD 27563 and HD 28843 are both comparisons for HD 29009) and were not measured for themselves. Let us simply mention that the sequence C_1-V-C_2-V-C_2-V-C_1 (where V is the CP star and C_1 and C_2 the comparisons, any of which can of course be variable) was used in most cases. New careful reductions of the original data were performed with the PHOT2 algorithm (Manfroid and Heck, 1983). This yielded accurate absolute photometry and allowed to confidently decide on the variability of the comparison stars. The accuracy of the photometry for each run is given in table II, in millimagnitudes, as well for differential measurements — the magnitude differences between C_1 and C_2 were used to study the variations whenever it was possible — as for absolute measurements. The accuracy was estimated for constant stars measured in similar conditions. A missing entry in table II means that no stars in the present paper were studied in the corresponding way for the run under consideration (for instance, during run 9, only absolute measurements of HD 208496 were obtained).

The variable comparison stars are presented in table III. Their HD number and another identification are given in Cols. 1 and 2. The observing runs (Table I) are listed in Col. 3, and the corresponding number of observations N and HD numbers of the other (constant) comparison star (if any) in Cols. 4 and 5.

We analyzed the data for each variable comparison star in search of periodicity of the variations. This was done by means of the Deeming algorithm (Deeming, 1975), of Renson's method (Renson, 1978, 1980), of the Stellingwerf algorithm (Stellingwerf, 1978) and of Mathys and Manfroid's programme of least-squares fitting by a sine wave and its first harmonic. Although the latter is particularly appropriate for CP — or CP-like — variations (Manfroid and Mathys, 1985), it also works surprisingly well in much less relevant applications, such as eclipsing binaries (Mathys and Manfroid, in preparation). Obviously, we did not meet with success for all stars, as some are not regular variables; when a frequency could actually be derived, we included its value in Col. 6 of table III. Whenever possible, an estimation of the error was also indicated in Col. 7. *Cols. 6 and 7 should however be read only with reference to the individual description of the star under consideration.* The same is true of Col. 8, where we give a tentative classification of the stars according to the aspect of their variations.

In the next sections, we discuss the properties of the individual stars and attempt to interpret their variability. Therefore, it seemed convenient to distribute the stars among different categories, according to their published spectral type, the aspect of their variations or even, our (un)ability to disentangle their photometric behaviour. Although some cases look quite clear, let us emphasize that our sorting out was primarily intended for practical purposes and that, even if there is hopefully some physical reality underlying it, it should by no means be regarded as absolute and definite classification.

3. CP-like variables.

3.1 INTRODUCTION. — Our first category includes stars with spectral types between B6 and A0, whose variations seem to be periodic, with periods of the order of one to a few days, and whose lightcurves are well fitted by a sine wave and its first harmonic [a prevalent property among CP stars : see North (1984), Mathys and Manfroid (1985)] :

$$m(t) = A_0 + A_1 \cos\left[2\pi f(t-t_0)+\phi_1\right] + A_2 \cos\left[4\pi f(t-t_0)+\phi_2\right]. \quad (1)$$

We give in table IV the values of the constants A_0, A_1, A_2, ϕ_1, ϕ_2, of the uncertainties σ_A affecting the amplitudes A_1 and A_2 and σ_{ϕ_i} $(i = 1, 2)$ on the phases ϕ_i $(i = 1, 2)$, and the time origin t_0 for these stars.

A likely interpretation of the photometric variations of these objects is that they result from the changing aspect of their visible hemisphere with rotation. (In fact, one could hardly imagine another explanation for single stars of such spectral types.) In spite of their CP-like variability, the CP nature of those stars should be confirmed by spectroscopic investigation — or, at least, by photometric measurements of Maitzen's Δa or Geneva $\Delta(V_1\text{-}G)$ indices. The hypothesis that they are « normal » B or A stars cannot in fact be rejected *a priori*. Indeed, Engberg (1983) claims that a number of normal B and A stars are variable, on the basis of a very restricted number of observations per star, however. Here, on the contrary, we present several stars whose variations have been fairly well observed, but with less certain spectral characteristics (i.e. whose peculiarities may have escaped previous detection). Let us also notice that Landstreet (1982) failed to detect any magnetic field in a systematic survey of normal A type stars. Since the surface inhomogeneities believed to be responsible for the variability of the CP stars are thought to be to some extent related to the presence and large scale organization of a magnetic field, the interpretation of similarities in the photometric behaviour of normal A and CP stars could be rather critical.

3.2 HD 24587. — HD 24587 (= HR 1213 = τ^8 Eri) is of spectral type B6V, according to Hiltner *et al.* (1969). Feinstein (1978) uses it as a standard star for his photoelectric measurements of hydrogen lines in He weak stars. This star has in fact been considered as an *uvby* (Garnier, 1972) and β (Strauss and Ducati, 1981) standard. Our observations are listed in table V. We derive a frequency $f = 0.5786$ d^{-1}, corresponding to a period $P = 1.728$ d, from which we obtain the phase diagram of the observations and least-squares fit of the lightcurves (see Table IV) represented in figure 1. The value of the $v \sin i$ (33 km.s^{-1}, Buscombe and Stoeckley, 1975) is quite acceptable if the photometric period is equal to the rotation period. Whatever the actual nature of HD 24587 is, its photometric behaviour quite resembles that of many CP stars; a careful spectroscopic study of this star should be conducted in order to secure its classification.

3.3 HD 61429. — The photometric variability of HD 61429 (= HR 2944 = PU Pup) was first reported by Stift (1979), who derived a period of 2.57895 d. This B8IV star *is not* a He weak star, according to Jaschek *et al.* (1969) and Stift mentions that photometry in the Maitzen system excludes the possibility that it is a CP star of the Si group. On the basis of our data (Table VI) it is difficult to make a definite choice between the period proposed by Manfroid and Renson (1983b), i.e. 1.30 d, and twice this value. However, the V phase diagram published by Stift (1979) clearly favours the latter. The exact value of the frequency that we derive from our observations is $f = (0.3860 \pm 0.008)$ d^{-1}; the corresponding period, $P = (2.59 \pm 0.06)$ d is in good agreement with the result obtained by Stift. The lightcurves look very much like those of many CP stars; they are well represented by a least-squares fit by a sine wave and its first harmonic (Table IV, Fig. 2). Yet the arguments against the CP nature of HD 61429 and the radial velocity variations reported in the *Publ. Lick Obs.* (1928; the quality of the measurements is unfortunately not sufficient to allow a search for a periodicity) led Stift to postulate that the observed variations result from eclipses of this star, which would in fact be a W UMa eclipsing binary. In our opinion, this interpretation is not tenable, because the period of the variations is too long for a W UMa system. Possible explanations are that the star is only mildly peculiar, and could not be detected as such because of its large rotational velocity ($v \sin i = 275$: km.s^{-1}, Uesugi and Fukuda, 1981), or that it is a normal B star varying like a CP star. However the high value of the projected equatorial velocity (which may be somewhat questionable, as a result of the binarity) is hardly compatible with a rotation period of 2.59 d (or even 1.30 d). Another plausible hypothesis is that HD 61429 is an ellipsoidal variable. Additional observations, including a redetermination of the rotational velocity and a study of the radial velocity variations, are obviously necessary.

3.4 HD 65270. — HD 65270 (= CoD − 45° 3574) has been classified B6V from three 49 Å.mm^{-1} spectra by Thackeray *et al.* (1973). They notice : « Very diffuse lines on third plate with large scatter. Possibly unresolved binary ». This sheds some doubt on the reliability of the projected rotational velocity derived by Walker (1973) : $v \sin i = 265$: km.s^{-1}. Walker mentions that out of the two He I lines, λ4026 and λ4471, used in his survey to determine $v \sin i$, only the former could be measured in HD 65270.

The periodic photometric variability of the star was mentioned by Renson and Manfroid (1978a) and the period was estimated to be 0.85 d. In fact, the period derived from the 1977 measurements alone was 0.849 ± 0.003 d. This period is confirmed by additional measurements of December 1978. (The measurements are given in table VII.) The most probable frequencies that we obtain are $f = 1.17735$ d^{-1} or $f = 1.17590$ d^{-1}; there are in fact several other equidistant values that seem almost as likely, so that we write

$$f = (1.17735 \pm 0.0002 + n\, 0.00150)\ \mathrm{d}^{-1},$$

n being a (small) integer. The data have been plotted against the phase for $f = 1.17735$ d^{-1} ($P = 0.84937$ d) in figure 3, together with a least-squares fit whose coefficients are given in table IV. The aspect of the lightcurves is typical of many CP stars, with the largest variation amplitude in the u band. Although it is somewhat questionable, the large value of the $v \sin i$ is not in contradiction with the (short) period. As we have seen, the star could be a spectrum variable; additional studies should thus be of great interest.

3.5 HD 90994. — HD 90994 (= HR 4119 = β Sex) is the best known star in the present paper. It is a primary standard for MK classification, with a spectral type B6V (Lesh, 1968). It is a standard of projected rotational velocity ($v \sin i = 80$ km.s^{-1}, Slettebak *et al.*, 1975). In photometry, it is a *uvby* standard (Grønbech *et al.*, 1976) and a β standard (Crawford and Mander, 1966), which has been used by numerous authors. However, Heck and Manfroid (1982) point out that, probably because of its extreme (*b-y*) value, reduction problems may (and do) occur for this star, so that its use as a photometric standard is not safe. Furthermore, Manfroid and Renson (1983a) mention that HD 90994 is variable possibly with a period of nearly 8 d, or 15-16 d. Improved reduction of the data (table VIII) confirms that the frequency $f = 0.065$ d^{-1} ($P = 15.4$ d) is the most probable; other values, closer to 1 d^{-1} : 0.870 d^{-1} and 1.133 d^{-1} cannot be definitely ruled out but seem less good. As the 15.4 d period is long in comparison with the timebase for the observations, its value cannot be determined with great accuracy. The phase diagram of the data, for the 15.4 d period, is shown in figure 4, together with the lightcurves obtained by least-squares fit (the coefficients of the fit have not been indicated in table IV; indeed, as a result of the high uncertainty of the period, they would not have been very meaningful).

If the 15.4 d period proved to be the correct one, a difficulty would arise to interpret the origin of the variations, as the rotational explanation would be excluded by the high, well established value of the $v \sin i$. This makes new observations of HD 90994 very desirable, all the more because it is a standard star for many purposes.

3.6 HD 103789. — HD 103789 (= HR 4571), of spectral type A0V (Houk, 1982), has not been much studied. Manfroid and Renson (1983a) point out that it is variable; the frequency of the variations is, beyond dispute, $f = 1.481$ d^{-1} ($P = 0.675$ d). The aspect of the lightcurves is typical of CP stars (see Fig. 5; the coefficients of the least-squares fit are given in table IV), with the largest amplitude in u. The observational data are listed in table IX.

3.7 The He weak variable HD 28843. — HD 28843 (= HR 1441 = DZ Eri) was mistakenly used as a comparison star since its He weak character had already been reported by Jaschek *et al.* (1969). It was consequently included in our survey of the photometric variations of CP stars (Mathys and Manfroid, 1985) where the lightcurves were improved by inclusion of data of Pedersen and Thomsen (1977), which had already been used to get an improved value (Manfroid and Mathys, 1984a) of the period previously derived by Pedersen (1979). As a result of the publication of this new period, we were informed that the photometric variability of HD 28843 had been detected by Cousins and Stoy (1966) as soon as 1966. By inclusion of these early measurements, a high accuracy could be achieved in the frequency determination (Manfroid *et al.*, 1984), leading to a best value $f = (0.727901 \pm 0.000006)$ d^{-1} [$P = (1.373813 \pm 0.000012)$ d]. There was still some uncertainty in the choice of the best peak in the periodogram; here we report that the ambiguity could be removed by inclusion of measurements of Dean (1980), which fully confirm the value derived by Manfroid *et al.*; the relevant part of the periodogram is shown in figure 6.

Let us notice here that Dean uses HD 29009 (= HR 1449) as a comparison star for HD 28843. But HD 29009 *is itself a variable CP star*; in fact, in our survey HD 28843 was used as a comparison star for studying the variations of HD 29009 ! Dean apparently does not detect the variations of HD 29009; we believe that this can be attributed to a lack of photometric accuracy : indeed, the V standard deviations of the differences between his two comparison stars (the second is HD 27861 = HR 1383) that he quotes, 0.015 mag, is of the same order as the peak-to-peak variation amplitude of HD 29009 (Mathys and Manfroid, 1985). In our opinion, the same reason explains why Cousins (1984) did not detect either the variability of HD 29009 when he observed it in 1966.

4. The supergiant HD 167756.

HD 167756 (= HR 6839) is a supergiant of type B0.5Ia (Hiltner *et al.*, 1969). As Ia-type supergiants are probably all variable in luminosity (Maeder and Rufener, 1972), it is not surprising that HD 167756 varies. A fairly detailed study of the supergiants led Burki *et al.* (1978) to conclude that they are semiregular variables, those of type B having typical amplitudes of 0.06 mag and semiperiods of 15-20 days. Our timebase is too short to decide on the existence of such a semiperiodicity in HD 167756, but it is clear from figure 7 and table X that the star is also varying on much shorter time intervals. This makes it look like HD 160529, which according to Sterken (1976) varies (irregularly) on a time scale of a few hours with amplitudes up to 0.028 mag in *u-v*. Nevertheless, Sterken (1977) points out that this kind of rapid (nightly) variations probably occur only in the most luminous Ia supergiants, and HD 167756 is not to our knowledge listed as a superluminous supergiant. Thus it appears that the star deserves more observational effort, as well in photometry as in spectroscopy.

5. The Be star HD 178175.

The B2Ve (Lesh, 1968) star HD 178175 (= HR 7249) has been known for more than fifty years to exhibit emission lines (see e.g. Merrill and Burwell, 1933). Its variability was recognized by Walraven *et al.* (1963) from observations in the Walraven system. In fact, as many Be stars, it undergoes large (0.25 mag) irregular magnitude changes, over timescales of years (Feinstein and Marraco, 1979). Here we confirm that the star is also variable on shorter timescales, with an amplitude of the order of 0.04 mag (Renson and Manfroid, 1978b). Although we have few observations (see Table XI), it appears clearly from the consideration of the periodogram that some periodicity (or rather quasi-periodicity) exists in these variations; we derive a value of approximately 0.54 d for the pseudoperiod [perhaps more probable for a Be star than Renson and Manfroid's (1978b) 1.37d]. Such a behaviour has been observed in several other Be stars, e.g. EW Lac (Lester, 1975), and is often compared to the photometric variability, due to nonradial oscillations, of β Cephei stars. Our data are insufficient to draw more conclusions; additional observations are needed.

6. Eclipsing binaries.

6.1 HD 45431. — This star (= BD + 05°1243, HD spectral type F0) was used by Evans (1976) as a *UBV* standard for the observation of cepheids. Yet it appears to undergo eclipses. During, at least, a 30 min interval on JD 2444975, its luminosity dropped by 12 % in all colours. Two independent measurements were taken showing this dimming, while contemporaneous observations of the other stars are quite normal. The lightcurve is otherwise fairly constant so that HD 45431 is probably a well detached eclipsing binary. The observational data are given in table XII.

6.2 HD 208496. — The variability of HD 208496 (= HR 8369 = κ^1 Ind), a star of spectral type F3V (Malaroda, 1975), was mentioned by Manfroid and Renson (1983b); the 1982 edition of the *Bright Star Catalogue* also quotes it as a suspected eclipsing binary. Additional observations obtained at the ESO 1 m telescope in July 1984 confirm its nature (these as well as our earlier measurements are presented in table XIII); it is in fact a very bright eclipsing binary, with a *V* magnitude between eclipses of 6.19 (Philip and Egret, 1983). [According to Herczeg (1982), there are only 62 eclipsing binaries brighter than magnitude 6.] As already reported (Manfroid and Mathys, 1984b), we derive from the observations the frequency :

$$f = (0.683038 + n\,0.000965)\ \mathrm{d}^{-1},$$

the most probable values of n being 0, $\pm$ 1, $\pm$ 2, $\pm$ 3. The y lightcurve corresponding to $f = 0.683038\ \mathrm{d}^{-1}$ (P = 1.464047 d) is presented in figure 8. The phase coverage is obviously not uniform, with a lack of points in the ascending phases, but an asymmetry in the shape of the secondary minimum is suspected. Clearly additional data are needed to confirm it and to allow the derivation of the physical parameters of the system.

7. Stars of miscellaneous types.

7.1 HD 1788. — HD 1788 (= BD − 05°49), whose HD spectral type is A2, shows variations ranging from 0.025 mag in *u* to 0.010 mag in *y*. Due to the small number of points that we have, we were unable to evidence a periodicity; therefore, we only give the observational data in table XIV.

7.2 HD 27563. — HD 27563 (= HR 1363) has been classified B5III by A. Cowley (1972). Although it has been studied for various purposes by different authors, we did not find any indication of peculiarity or variability of this star in the litterature. It was used by Renson and Manfroid (1981) as a comparison star for HD 29009, the other comparison being the aforementioned He weak variable HD 28843. As a result of the large variation amplitude of the latter, the variability of HD 27563 was unnoticed by Renson and Manfroid. Therefore their lightcurves of HD 29009 do in fact include the variations of HD 27563 as well. Our new reduction of the data allowed to detect the variations undergone by HD 27563 and to study HD 29009 and HD 28843 independently (in absolute photometry). Improved periods (Manfroid and Mathys, 1984a; this paper) and lightcurves (Mathys and Manfroid, 1985) were derived for these two stars. Notice how our lightcurves of HD 29009 have smaller amplitude than Renson and Manfroid's and how they show evidence of no bump, contrarily to those of the latter authors.

In spite of the large amplitude of the variations (0.025 mag in *u*, 0.040 in *v*, 0.035 in *b* and 0.030 in *y*), of the large number of points available and of the long timebase of the observations, the analysis of the data is difficult. The periodogram seems very simple, indicating a probable frequency $f \approx 0.26\ \mathrm{d}^{-1}$ or some alias of this value. However, in a frequency analysis performed after prewhitening of the data by f (or any possible alias) some peaks remain.

Additional prewhitening of the data by one of the remaining frequencies does not seem to significantly improve anything. In our opinion, either HD 27563 is a multiperiodic variable, and we are unable to disentangle its variations with the presently available data (the closeness of one of the presumed periods to 4 days is a source of complication) or it is not varying periodically but only quasiperiodically. Our measurements are given in table XV; one of the problems that one meets using them is to bring together the observations of different runs, but the situation is intricate even when the first run is studied alone. Additional observations are needed to settle things more definitely.

7.3 HD 224639. — HD 224639 (= BD − 3°5741), a F0V star (HD spectral type), has been pointed out as variable by Manfroid and Renson (1983b), who suggest a very short period, 0.215 d or 0.177 d. These values do not seem to be the best ones from the present analysis, but short periods of this order appear as very plausible. As a matter of fact, in spite of the fairly large range of the variations (of the order of 0.1 mag), the data (table XVI) are not well suited for the search of such a short periodicity; furthermore, we have the feeling that the star could be multiperiodic or pseudoperiodic. A likely interpretation is that HD 224639 is a δ Scuti variable, but once again, additional points are needed.

8. Conclusion.

We have presented photometric observations of twelve variable early-type stars. For two of them, we were unable to draw any conclusion from our observations and could only publish tables of our data. The main part of the information that we could derive for the ten other stars is summarized in table III, so we shall not repeat it here. This information is however far from complete and, as we have seen, the twelve stars all require additional effort from the observers, all the more because several of them are used as standard stars for some purpose.

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TABLE I. — *The observing runs.*

Run	Date	Number of nights	Telescope	Symbol
1	February 1977	26	Danish 0.5 m	Z
2	July 1977	15	Danish 0.5 m	◇
3	November 1977	20	Danish 0.5 m	×
4	December 1978	21	ESO 0.5 m	✳
5	June 1979	25	Danish 0.5 m	⊡
6	March 1980	27	Danish 0.5 m	⊖
7	September 1981	20	Danish 0.5 m	+
8	January 1982	14	Danish 0.5 m	△
9	July 1984	6	ESO 1m	⧖

TABLE II. — *Accuracy of the measurements (in mmag).*

Run	Absolute				Differential			
	u	*v*	*b*	*y*	*u*	*v*	*b*	*y*
1					5	4	4	3
2					5	4	4	3
3	7	6	6	6	3	3	3	3
4	9	9	7	7	8	8	5	5
5					5	4	4	3
6					5	5	4	4
7	8	7	7	7	3	3	2	2
8					5	4	4	3
9	8	8	8	8				

TABLE III. — *Studied stars.*

HD	Other id.	Run	*N*	Comp.	*f* (d^{-1})	Error (d^{-1})	
1788	BD −5°49	7	15	224945			
24587	HR 1213	3	44	23878	0.5786	0.001	CP?
27563	HR 1363	3	42				
		4	8				
		7	7				
45431	BD +5°1243	8	34	46300			eclipsing binary
61429	HR 2944	8	18	64756	0.3860(/0.7719)	0.008	CP?
65270	CoD −45°3574	1	33	65211	$1.17735 + n\,0.00150$	0.0002	CP?
		4	8	65211			
90994	HR 4119	6	28	90882	0.065/0.870/1.133	0.005	CP?
103789	HR 4571	6	30	101431	1.481	0.005	CP?
167756	HR 6839	5	16	166114			Ia supergiant
178175	HR 7249	2	12	177817	(1.865/0.728)?		Be
208496	HR 8369	7	15	207964	$0.683038 + n\,0.000965$	0.00003	eclipsing binary
		9	96				
224639	BD −3°5741	7	16	224945			δ Scuti??

TABLE IV. — *Parameters of the least squares fits of the lightcurves.*

HD	*f* (d^{-1})	t_0 (2440000. +)		A_0 (mag.)	A_1 (mag.)	A_2 (mag.)	σ_A (mag.)	ϕ_1	σ_{ϕ_1}	ϕ_2	σ_{ϕ_2}
24587	0.5786	3455.622	*u*	−1.60512	0.00313	0.01623	0.00183	5.036	0.585	5.484	0.113
			v	−0.84797	0.00123	0.00856	0.00128	5.501	1.040	5.545	0.149
			b	−0.68122	0.00173	0.00752	0.00108	5.670	0.624	5.593	0.143
			y	−0.59657	0.00219	0.00721	0.00090	5.590	0.410	5.544	0.124
61429	0.386	4972.744	*u*	−2.72899	0.00479	0.03736	0.00224	2.258	0.468	5.123	0.060
			v	−2.13526	0.00361	0.02912	0.00129	2.336	0.356	5.121	0.044
			b	−1.99231	0.00312	0.02689	0.00095	2.818	0.304	5.141	0.035
			y	−1.91613	0.00295	0.02598	0.00111	2.624	0.375	5.130	0.043
65270	1.17735	3170.739	*u*	0.58569	0.01702	0.00470	0.00089	4.382	0.052	2.541	0.190
			v	0.71518	0.01142	0.00399	0.00100	4.343	0.088	2.245	0.252
			b	0.72562	0.00974	0.00407	0.00101	4.293	0.103	2.621	0.247
			y	0.73621	0.00912	0.00389	0.00093	4.326	0.102	2.727	0.238
103789	1.481	4310.567	*u*	1.57761	0.01110	0.00733	0.00158	4.389	0.143	0.503	0.216
			v	1.53572	0.00759	0.00711	0.00125	4.037	0.165	6.141	0.176
			b	1.50706	0.00745	0.00695	0.00115	4.203	0.154	6.046	0.165
			y	1.50952	0.00583	0.00417	0.00103	4.258	0.176	6.228	0.246

TABLE V. — *Observations of HD 24587 (HD 24587-HD 23878).*

HJD (2440000.+)	u	v	b	y
3455.6218	−1.6069	−0.8477	−0.6791	−0.5956
3455.8282	−1.5943	−0.8436	−0.6749	−0.5884
3456.5569	−1.5957	−0.8446	−0.6772	−0.5961
3456.7349	−1.6131	−0.8560	−0.6853	−0.5984
3456.8450	−1.6154	−0.8557	−0.6909	−0.6054
3457.5623	−1.5868	−0.8395	−0.6752	−0.5890
3457.6778	−1.6021	−0.8468	−0.6812	−0.5941
3457.8193	−1.6179	−0.8534	−0.6849	−0.6009
3458.5668	−1.6100	−0.8546	−0.6856	−0.6034
3458.7393	−1.6151	−0.8583	−0.6906	−0.6053
3459.5749	−1.6342	−0.8667	−0.6967	−0.6099
3459.7209	−1.6352	−0.8682	−0.6968	−0.6065
3459.8398	−1.6031	−0.8462	−0.6801	−0.5974
3462.5719	−1.6004	−0.8456	−0.6788	−0.5941
3462.7243	−1.5942	−0.8415	−0.6754	−0.5882
3463.5680	−1.5867	−0.8387	−0.6773	−0.5918
3463.7323	−1.6110	−0.8458	−0.6803	−0.5970
3463.8280	−1.6316	−0.8620	−0.6962	−0.6091
3464.5699	−1.5867	−0.8365	−0.6715	−0.5886
3464.7479	−1.6117	−0.8521	−0.6854	−0.6026
3465.5936	−1.6219	−0.8541	−0.6884	−0.6038
3465.7682	−1.6201	−0.8501	−0.6818	−0.5993
3468.5553	−1.5755	−0.8270	−0.6650	−0.5823
3469.5578	−1.5848	−0.8357	−0.6698	−0.5852
3469.6780	−1.5857	−0.8404	−0.6786	−0.5918
3469.8227	−1.6010	−0.8465	−0.6769	−0.5912
3470.5529	−1.6019	−0.8434	−0.6766	−0.5946
3470.6475	−1.6137	−0.8482	−0.6812	−0.5963
3470.7459	−1.6119	−0.8502	−0.6824	−0.6000
3470.8514	−1.6030	−0.8424	−0.6767	−0.5920
3471.5607	−1.6089	−0.8514	−0.6826	−0.5995
3471.6537	−1.6159	−0.8567	−0.6915	−0.6066
3471.7854	−1.6105	−0.8505	−0.6840	−0.6008
3472.5660	−1.6226	−0.8594	−0.6924	−0.6064
3472.6544	−1.6275	−0.8601	−0.6932	−0.6041
3472.7611	−1.6177	−0.8536	−0.6821	−0.5998
3472.8483	−1.5975	−0.8475	−0.6795	−0.5952
3473.6610	−1.6079	−0.8458	−0.6802	−0.5945
3473.7784	−1.5981	−0.8465	−0.6806	−0.5957
3473.8504	−1.5914	−0.8448	−0.6801	−0.5952
3474.5927	−1.5853	−0.8335	−0.6681	−0.5859
3474.6807	−1.5821	−0.8368	−0.6710	−0.5868
3474.7961	−1.5921	−0.8410	−0.6731	−0.5873
3475.5788	−1.5825	−0.8360	−0.6708	−0.5870

TABLE VI. — *Observations of HD 61429 (HD 61429-HD 64756).*

HJD (2440000.+)	u	v	b	y
4972.7440	−2.7117	−2.1227	−1.9820	−1.9078
4973.7612	−2.7581	−2.1591	−2.0160	−1.9395
4974.7456	−2.7483	−2.1502	−2.0091	−1.9324
4976.6126	−2.7140	−2.1231	−1.9812	−1.9051
4976.8239	−2.6876	−2.1006	−1.9569	−1.8783
4978.7904	−2.7633	−2.1644	−2.0190	−1.9384
4979.5807	−2.7002	−2.1140	−1.9721	−1.8969
4979.7967	−2.7249	−2.1319	−1.9905	−1.9139
4980.6620	−2.7053	−2.1171	−1.9753	−1.8977
4980.8505	−2.7000	−2.1126	−1.9704	−1.8952
4981.6411	−2.7471	−2.1483	−1.9998	−1.9282
4981.8068	−2.7103	−2.1207	−1.9779	−1.9029
4982.6048	−2.7526	−2.1570	−2.0187	−1.9420
4982.8059	−2.7815	−2.1709	−2.0185	−1.9357
4983.8239	−2.7601	−2.1561	−2.0080	−1.9340
4984.6894	−2.6845	−2.1018	−1.9649	−1.8911
4985.5578	−2.7277	−2.1375	−1.9970	−1.9244
4985.7626	−2.7084	−2.1189	−1.9788	−1.9025

TABLE VII. — *Observations of HD 65270 (HD 65270-HD 65211).*

HJD (2440000.+)	u	v	b	y
3170.7390	0.5783	0.7083	0.7157	0.7324
3171.7050	0.5937	0.7157	0.7253	0.7398
3171.8930	0.6065	0.7285	0.7390	0.7458
3172.6400	0.6068	0.7308	0.7422	0.7493
3172.8360	0.5939	0.7159	0.7234	0.7346
3173.7290	0.5858	0.7158	0.7253	0.7329
3174.6320	0.5736	0.7016	0.7149	0.7245
3174.7390	0.5702	0.7042	0.7205	0.7355
3174.8810	0.5735	0.7105	0.7239	0.7343
3175.6990	0.5743	0.7023	0.7187	0.7285
3175.8470	0.5778	0.7098	0.7185	0.7304
3176.6400	0.5718	0.7078	0.7193	0.7324
3176.7420	0.5807	0.7107	0.7221	0.7287
3176.8710	0.6054	0.7254	0.7389	0.7485
3177.6450	0.5945	0.7255	0.7350	0.7454
3177.7820	0.5983	0.7193	0.7338	0.7400
3177.9130	0.5963	0.7263	0.7388	0.7506
3178.6480	0.6082	0.7332	0.7439	0.7528
3178.8060	0.5981	0.7201	0.7337	0.7392
3189.6800	0.6054	0.7294	0.7410	0.7501
3189.8270	0.5906	0.7226	0.7352	0.7419
3190.7660	0.5800	0.7090	0.7224	0.7282
3190.9020	0.5670	0.7010	0.7163	0.7254
3191.6810	0.5777	0.7107	0.7253	0.7352
3191.8550	0.5744	0.7084	0.7220	0.7333
3192.6840	0.5693	0.7013	0.7147	0.7262
3192.8560	0.5785	0.7105	0.7199	0.7303
3193.6690	0.5736	0.7006	0.7102	0.7210
3193.8490	0.6043	0.7273	0.7359	0.7469
3194.6690	0.5930	0.7200	0.7295	0.7401
3194.8480	0.6022	0.7232	0.7326	0.7409
3195.6680	0.6024	0.7294	0.7389	0.7473
3195.7850	0.5873	0.7193	0.7318	0.7435
3843.7904	0.5889	0.7173	0.7151	0.7261
3849.8269	0.5662	0.6970	0.7130	0.7202
3851.8263	0.5596	0.6974	0.7161	0.7136
3854.7267	0.6035	0.7203	0.7240	0.7378
3855.7792	0.5656	0.7014	0.7102	0.7181
3856.7308	0.5671	0.6966	0.7121	0.7216
3857.7259	0.5700	0.7074	0.7090	0.7180
3860.7200	0.5881	0.7145	0.7311	0.7337

TABLE VIII. — *Observations of HD 90994 (HD 90994-HD 90882).*

HJD (2440000.+)	u	v	b	y
4310.5235	−0.7990	−0.2182	−0.1571	−0.1171
4310.7121	−0.7977	−0.2144	−0.1526	−0.1111
4311.5143	−0.8034	−0.2221	−0.1560	−0.1175
4311.7030	−0.8158	−0.2278	−0.1600	−0.1171
4312.5165	−0.7954	−0.2165	−0.1541	−0.1127
4312.7079	−0.7903	−0.2130	−0.1547	−0.1132
4313.5552	−0.7821	−0.2111	−0.1571	−0.1171
4313.7656	−0.7805	−0.2071	−0.1494	−0.1103
4314.7574	−0.7963	−0.2143	−0.1488	−0.1057
4317.7703	−0.7991	−0.2200	−0.1574	−0.1179
4320.5149	−0.7982	−0.2110	−0.1407	−0.0972
4320.7185	−0.7948	−0.2133	−0.1491	−0.1082
4321.5121	−0.7944	−0.2108	−0.1421	−0.1015
4321.7011	−0.7916	−0.2089	−0.1402	−0.1026
4322.5141	−0.7749	−0.2025	−0.1421	−0.1029
4322.6983	−0.7755	−0.2045	−0.1450	−0.1085
4323.5114	−0.7914	−0.2146	−0.1525	−0.1105
4323.6927	−0.7889	−0.2110	−0.1501	−0.1102
4324.5119	−0.8006	−0.2214	−0.1608	−0.1163
4328.5108	−0.7886	−0.2113	−0.1525	−0.1131
4329.5084	−0.7840	−0.2100	−0.1473	−0.1054
4329.7063	−0.7814	−0.2070	−0.1466	−0.1075
4330.5155	−0.7818	−0.2104	−0.1521	−0.1115
4331.5102	−0.7853	−0.2099	−0.1476	−0.1103
4331.7005	−0.7915	−0.2119	−0.1498	−0.1090
4332.6813	−0.7922	−0.2160	−0.1576	−0.1166
4333.4947	−0.7918	−0.2111	−0.1502	−0.1090
4326.6330	−0.8034	−0.2248	−0.1679	−0.1350

TABLE IX. — *Observations of HD 103789 (HD 103789-HD 101431).*

HJD (2440000.+)	u	v	b	y
4310.5674	1.5743	1.5355	1.5094	1.5107
4310.7608	1.5842	1.5352	1.5081	1.5120
4311.5574	1.6050	1.5616	1.5308	1.5275
4311.7674	1.5642	1.5237	1.4946	1.5005
4312.5588	1.5735	1.5329	1.5050	1.5064
4312.7535	1.5856	1.5357	1.5070	1.5106
4313.5798	1.5899	1.5478	1.5152	1.5140
4313.7862	1.5625	1.5210	1.4920	1.5006
4314.7932	1.5827	1.5360	1.5100	1.5170
4320.5631	1.5794	1.5358	1.5056	1.5112
4320.7600	1.5906	1.5470	1.5148	1.5122
4321.5574	1.5800	1.5344	1.5071	1.5094
4321.7414	1.5831	1.5417	1.5111	1.5110
4322.5561	1.5529	1.5184	1.4897	1.4974
4322.7412	1.5829	1.5401	1.5123	1.5151
4323.5538	1.5806	1.5327	1.5014	1.5047
4323.6706	1.5925	1.5450	1.5160	1.5143
4323.8278	1.5601	1.5286	1.5040	1.5069
4324.5526	1.5589	1.5250	1.4939	1.4988
4324.8304	1.5725	1.5313	1.5066	1.5071
4328.5550	1.5748	1.5400	1.5082	1.5073
4328.7017	1.5645	1.5187	1.4897	1.4951
4329.5563	1.5822	1.5387	1.5106	1.5125
4329.7779	1.5841	1.5417	1.5114	1.5125
4330.5643	1.5707	1.5346	1.5043	1.5075
4331.5557	1.5747	1.5385	1.5155	1.5157
4331.7822	1.5857	1.5409	1.5131	1.5170
4332.7935	1.5800	1.5303	1.4992	1.5052
4333.5378	1.5811	1.5398	1.5137	1.5132
4336.7067	1.5542	1.5247	1.4993	1.5027

TABLE XII. — *Observations of HD 45431 (HD 45431-HD 46300).*

HJD (2440000.+)	u	v	b	y
4972.6079	2.9909	2.6593	2.4093	2.2181
4973.5827	2.9931	2.6539	2.4068	2.2179
4973.6038	2.9946	2.6518	2.4063	2.2250
4973.8170	3.0079	2.6623	2.4178	2.2296
4974.6619	3.0058	2.6609	2.4061	2.2179
4974.6841	3.0026	2.6578	2.4054	2.2172
4975.5530	3.0985	2.7761	2.5311	2.3432
4975.5761	3.1146	2.7808	2.5322	2.3441
4976.6701	3.0001	2.6557	2.4033	2.2173
4976.6911	3.0048	2.6618	2.4093	2.2194
4978.6142	3.0053	2.6613	2.4066	2.2290
4978.6420	3.0183	2.6663	2.4133	2.2279
4979.6610	2.9951	2.6562	2.4063	2.2150
4979.6829	2.9919	2.6524	2.4045	2.2183
4980.5463	2.9746	2.6479	2.3988	2.2212
4980.5729	2.9796	2.6496	2.4033	2.2129
4980.7398	2.9957	2.6587	2.4070	2.2186
4981.6800	3.0075	2.6605	2.4086	2.2248
4981.7013	2.9956	2.6542	2.4074	2.2166
4982.5457	2.9984	2.6547	2.3995	2.2158
4982.5679	3.0011	2.6579	2.4079	2.2235
4982.7478	3.0145	2.6616	2.4058	2.2163
4982.7701	3.0071	2.6562	2.3977	2.2110
4983.5489	2.9862	2.6562	2.4072	2.2252
4983.5703	2.9852	2.6515	2.4030	2.2154
4983.7628	3.0090	2.6680	2.4124	2.2170
4983.7845	2.9951	2.6620	2.4086	2.2154
4984.5464	3.0112	2.6619	2.4094	2.2233
4984.5684	3.0038	2.6532	2.4008	2.2060
4984.7750	3.0136	2.6618	2.4052	2.2205
4984.7976	3.0214	2.6691	2.4075	2.2186
4985.6040	2.9930	2.6540	2.4018	2.2156
4985.7814	3.0032	2.6550	2.4006	2.2134
4985.8034	3.0066	2.6614	2.4022	2.2163

TABLE XIIIa. — *Observations of HD 208496 (HD 208496-HD 207964).*

HJD (2440000.+)	u	v	b	y
4862.5478	−0.0124	−0.0026	−0.0004	−0.0054
4863.5590	−0.1232	−0.1180	−0.1148	−0.1156
4863.8151	−0.1172	−0.1155	−0.1174	−0.1195
4866.5479	−0.1368	−0.1266	−0.1233	−0.1232
4870.6654	0.0703	0.0764	0.0806	0.0805
4871.5596	−0.1021	−0.0979	−0.0976	−0.1014
4871.7602	−0.1405	−0.1318	−0.1305	−0.1288
4872.5848	−0.1253	−0.1206	−0.1178	−0.1206
4873.5963	0.0603	0.0667	0.0723	0.0714
4873.7578	−0.1153	−0.1088	−0.1011	−0.1045
4875.7507	0.0690	0.0763	0.0793	0.0745
4876.5682	0.0028	0.0079	0.0126	0.0122
4876.7455	−0.1105	−0.1104	−0.1075	−0.1084
4877.5540	−0.1292	−0.1238	−0.1228	−0.1213
4878.5610	−0.1004	−0.0968	−0.0948	−0.0940

TABLE X. — *Observations of HD 167756 (HD 167756-HD 166114).*

HJD (2440000.+)	u	v	b	y
4025.6204	−1.2746	−0.0659	0.2654	0.4597
4025.7879	−1.2645	−0.0543	0.2769	0.4630
4027.5931	−1.2834	−0.0754	0.2560	0.4448
4027.7123	−1.2844	−0.0780	0.2538	0.4401
4027.8213	−1.2783	−0.0729	0.2562	0.4402
4028.6568	−1.2677	−0.0642	0.2679	0.4601
4029.6572	−1.2732	−0.0646	0.2668	0.4602
4029.8751	−1.2873	−0.0753	0.2590	0.4505
4030.5988	−1.2824	−0.0688	0.2644	0.4500
4032.6217	−1.2753	−0.0718	0.2586	0.4480
4035.7960	−1.2897	−0.0790	0.2618	0.4535
4035.8994	−1.2675	−0.0605	0.2741	0.4584
4036.6269	−1.2809	−0.0793	0.2534	0.4472
4036.9128	−1.2646	−0.0549	0.2808	0.4686
4040.5703	−1.2948	−0.0828	0.2530	0.4474
4049.7833	−1.2858	−0.0745	0.2565	0.4474

TABLE XI. — *Observations of HD 178175 (HD 178175-HD 177817).*

HJD (2440000.+)	u	v	b	y
3342.5590	−1.2140	−0.6350	−0.6400	−0.6760
3342.7920	−1.2190	−0.6450	−0.6490	−0.6820
3343.5800	−1.1850	−0.6130	−0.6250	−0.6630
3348.8480	−1.1630	−0.5920	−0.6060	−0.6460
3349.6130	−1.2130	−0.6430	−0.6540	−0.6900
3349.8680	−1.1790	−0.5980	−0.6070	−0.6430
3350.5770	−1.1910	−0.6190	−0.6290	−0.6660
3350.7650	−1.1990	−0.6210	−0.6310	−0.6680
3351.5750	−1.1830	−0.6070	−0.6200	−0.6600
3351.7910	−1.1980	−0.6250	−0.6290	−0.6660
3356.6260	−1.1820	−0.6120	−0.6320	−0.6770
3356.8620	−1.1880	−0.6040	−0.6170	−0.6540

TABLE XIIIb. — *Observations of HD 208496 (absolute measurements).*

HJD (2440000.+)	u	v	b	y
5904.6168	−0.1303	−0.1301	−0.1331	−0.1278
5904.7165	−0.1191	−0.1200	−0.1222	−0.1169
5904.8444	−0.1032	−0.1026	−0.1023	−0.0957
5904.9149	−0.0865	−0.0815	−0.0849	−0.0800
5905.5789	−0.1084	−0.1023	−0.0957	−0.0973
5905.6488	−0.0915	−0.0927	−0.0838	−0.0881
5905.6762	−0.0442	−0.0427	−0.0440	−0.0418
5905.6850	−0.0263	−0.0258	−0.0250	−0.0226
5905.6927	−0.0084	−0.0061	−0.0067	−0.0037
5905.7024	0.0095	0.0133	0.0133	0.0173
5905.7060	0.0197	0.0201	0.0233	0.0252
5905.7092	0.0251	0.0268	0.0222	0.0287
5905.7130	0.0302	0.0327	0.0324	0.0372
5905.7153	0.0359	0.0386	0.0416	0.0418
5905.7226	0.0452	0.0488	0.0479	0.0506
5905.7246	0.0485	0.0527	0.0518	0.0537
5905.7279	0.0572	0.0516	0.0563	0.0601
5905.7400	0.0689	0.0686	0.0703	0.0721
5905.7438	0.0703	0.0669	0.0711	0.0764
5905.7448	0.0650	0.0709	0.0758	0.0707
5905.7463	0.0678	0.0709	0.0706	0.0716
5905.7472	0.0727	0.0696	0.0769	0.0735
5905.7484	0.0688	0.0677	0.0725	0.0751
5905.7505	0.0674	0.0664	0.0714	0.0738
5905.7531	0.0696	0.0688	0.0701	0.0744
5905.7543	0.0711	0.0675	0.0718	0.0713
5905.7556	0.0721	0.0694	0.0711	0.0723
5905.7569	0.0678	0.0654	0.0687	0.0711
5905.7582	0.0663	0.0667	0.0695	0.0701
5905.7602	0.0663	0.0655	0.0651	0.0697
5905.7615	0.0619	0.0645	0.0619	0.0665
5905.7628	0.0630	0.0640	0.0661	0.0672
5905.7641	0.0612	0.0620	0.0623	0.0666
5905.7653	0.0592	0.0603	0.0618	0.0635
5905.7751	−0.0125	0.0188	0.0400	0.0434
5905.8918	−0.0893	−0.0857	−0.0803	−0.0820
5905.9025	−0.0951	−0.0924	−0.0854	−0.0856
5905.9036	−0.0950	−0.0910	−0.0880	−0.0892
5906.5640	−0.0809	−0.0793	−0.0811	−0.0862
5906.5860	−0.1034	−0.1049	−0.1015	−0.1075
5906.7123	−0.1151	−0.1153	−0.1108	−0.1113
5906.8505	−0.1220	−0.1265	−0.1216	−0.1226
5907.6012	−0.1351	−0.1361	−0.1324	−0.1328
5907.6846	−0.1156	−0.1160	−0.1185	−0.1192
5907.7231	−0.1072	−0.1100	−0.1094	−0.1088
5907.8074	−0.0885	−0.0847	−0.0851	−0.0783
5907.8564	−0.0404	−0.0421	−0.0438	−0.0443
5907.8615	−0.0354	−0.0361	−0.0382	−0.0351

TABLE XIIIb (*Continued*)

HJD (2440000.+)	u	v	b	y
5907.8734	0.0025	−0.0001	−0.0063	−0.0012
5907.8758	0.0097	0.0077	0.0014	0.0023
5907.8774	0.0153	0.0103	0.0074	0.0088
5907.8790	0.0200	0.0136	0.0135	0.0123
5907.8813	0.0259	0.0252	0.0170	0.0180
5907.8829	0.0286	0.0267	0.0236	0.0241
5907.8844	0.0371	0.0285	0.0277	0.0277
5907.8860	0.0429	0.0376	0.0310	0.0318
5907.8876	0.0473	0.0417	0.0358	0.0346
5907.8891	0.0556	0.0481	0.0441	0.0424
5907.8930	0.0632	0.0573	0.0507	0.0497
5907.8966	0.0770	0.0726	0.0654	0.0621
5907.8988	0.0796	0.0762	0.0721	0.0653
5907.9005	0.0858	0.0794	0.0734	0.0708
5907.9025	0.0936	0.0894	0.0796	0.0782
5907.9043	0.0974	0.0909	0.0859	0.0813
5907.9060	0.1021	0.0962	0.0930	0.0871
5907.9082	0.1062	0.1061	0.0965	0.0924
5907.9115	0.1164	0.1103	0.1044	0.1005
5907.9136	0.1210	0.1158	0.1096	0.1061
5907.9175	0.1297	0.1260	0.1162	0.1131
5907.9195	0.1364	0.1294	0.1230	0.1160
5907.9213	0.1387	0.1319	0.1236	0.1204
5907.9232	0.1388	0.1376	0.1272	0.1223
5907.9249	0.1445	0.1417	0.1343	0.1227
5907.9270	0.1469	0.1438	0.1343	0.1276
5907.9288	0.1493	0.1438	0.1372	0.1318
5907.9319	0.1565	0.1474	0.1434	0.1349
5907.9353	0.1603	0.1523	0.1444	0.1365
5907.9392	0.1586	0.1538	0.1497	0.1385
5908.5364	−0.1072	−0.1057	−0.0984	−0.1082
5908.5667	−0.1052	−0.1070	−0.0973	−0.0978
5908.6043	−0.0427	−0.0412	−0.0429	−0.0373
5908.6279	0.0035	0.0036	0.0041	0.0100
5908.6689	0.0675	0.0673	0.0654	0.0705
5908.6933	0.0571	0.0574	0.0587	0.0643
5908.7129	0.0256	0.0261	0.0301	0.0364
5908.7256	0.0059	0.0052	0.0084	0.0104
5908.7519	−0.0506	−0.0475	−0.0479	−0.0409
5908.8041	−0.0797	−0.0796	−0.0765	−0.0688
5908.8462	−0.0901	−0.0911	−0.0861	−0.0795
5908.8974	−0.1042	−0.1078	−0.1038	−0.1003
5909.5204	−0.1034	−0.0919	−0.0879	−0.0965
5909.5954	−0.1122	−0.1110	−0.1079	−0.1099
5909.7260	−0.1251	−0.1265	−0.1266	−0.1200
5909.7795	−0.1283	−0.1335	−0.1322	−0.1263
5909.8113	−0.1250	−0.1290	−0.1244	−0.1237
5909.8498	−0.1196	−0.1221	−0.1195	−0.1195

TABLE XIV. — *Observations of HD 1788 (HD 1788-HD 224945).*

HJD (2440000.+)	u	v	b	y
4861.7735	0.2431	−0.0432	0.0743	0.1761
4863.6271	0.2554	−0.0443	0.0711	0.1776
4866.6721	0.2634	−0.0333	0.0797	0.1850
4870.5769	0.2510	−0.0508	0.0624	0.1728
4871.6348	0.2678	−0.0375	0.0760	0.1814
4871.8171	0.2626	−0.0329	0.0801	0.1808
4872.7204	0.2588	−0.0411	0.0736	0.1809
4873.6526	0.2557	−0.0322	0.0793	0.1852
4875.8054	0.2622	−0.0387	0.0765	0.1787
4876.6367	0.2663	−0.0343	0.0770	0.1818
4876.8092	0.2606	−0.0402	0.0701	0.1803
4877.6135	0.2659	−0.0363	0.0729	0.1795
4877.8022	0.2584	−0.0436	0.0696	0.1750
4878.6318	0.2540	−0.0392	0.0769	0.1823
4878.8001	0.2484	−0.0382	0.0806	0.1852

TABLE XV. — *Observations of HD 27563 (absolute measurements).*

HJD (2440000.+)	u	v	b	y
3455.6420	6.4364	5.8631	5.8179	5.8618
3455.8448	6.4503	5.8616	5.8158	5.8743
3456.5748	6.4461	5.8691	5.8228	5.8678
3456.7475	6.4415	5.8660	5.8206	5.8658
3456.8565	6.4471	5.8622	5.8130	5.8644
3457.5756	6.4370	5.8641	5.8201	5.8641
3457.7227	6.4245	5.8587	5.8122	5.8552
3457.8297	6.4205	5.8428	5.7974	5.8488
3458.5867	6.4221	5.8519	5.8064	5.8543
3458.7518	6.4187	5.8478	5.8045	5.8519
3459.5875	6.4368	5.8634	5.8193	5.8658
3459.7352	6.4334	5.8592	5.8143	5.8626
3459.8510	6.4379	5.8517	5.8052	5.8550
3462.5876	6.4071	5.8428	5.7984	5.8474
3462.7368	6.4268	5.8541	5.8079	5.8538
3463.5812	6.4488	5.8691	5.8233	5.8657
3463.7436	6.4529	5.8699	5.8231	5.8671
3463.8397	6.4448	5.8603	5.8134	5.8625
3464.5840	6.4399	5.8639	5.8183	5.8675
3464.7602	6.4576	5.8757	5.8282	5.8736
3465.6064	6.4269	5.8564	5.8122	5.8602
3465.7798	6.4101	5.8441	5.8007	5.8491
3468.5689	6.4545	5.8652	5.8195	5.8662
3469.5710	6.4287	5.8577	5.8123	5.8575
3469.7214	6.4112	5.8444	5.7999	5.8462
3469.8345	6.4074	5.8344	5.7913	5.8416
3470.5690	6.4310	5.8611	5.8161	5.8623
3470.6603	6.4199	5.8488	5.8045	5.8524
3470.7686	6.4245	5.8501	5.8047	5.8526
3471.5752	6.4593	5.8757	5.8291	5.8722
3471.6659	6.4502	5.8692	5.8240	5.8688
3471.8046	6.4566	5.8640	5.8166	5.8691
3472.5788	6.4484	5.8708	5.8251	5.8695
3472.6652	6.4460	5.8653	5.8193	5.8633
3472.7730	6.4399	5.8596	5.8121	5.8616
3473.5784	6.4220	5.8585	5.8137	5.8589
3473.6735	6.4079	5.8468	5.8033	5.8497
3473.7907	6.4111	5.8398	5.7949	5.8432
3474.6057	6.4334	5.8639	5.8166	5.8604
3474.7220	6.4286	5.8581	5.8117	5.8588
3474.8128	6.4332	5.8525	5.8078	5.8575
3475.5855	6.4340	5.8616	5.8149	5.8607
3843.5691	6.4359	5.8615	5.8163	5.8655
3844.6235	6.4128	5.8486	5.8088	5.8616
3850.5896	6.4108	5.8567	5.8463	5.8915
3857.6157	6.4192	5.8597	5.8154	5.8650
3858.6488	6.3933	5.8387	5.7973	5.8517
3859.6418	6.4166	5.8549	5.8115	5.8634
3860.6393	6.4248	5.8582	5.8153	5.8623
3862.6762	6.4041	5.8468	5.8010	5.8516
4862.8906	6.4090	5.8493	5.8046	5.8573
4863.8819	6.4318	5.8594	5.8157	5.8640
4870.8154	6.4037	5.8411	5.7970	5.8481
4872.7875	6.4231	5.8547	5.8088	5.8631
4873.8821	6.3814	5.8277	5.7863	5.8419
4876.8631	6.4109	5.8462	5.8022	5.8567
4877.8844	6.3765	5.8237	5.7805	5.8346

TABLE XVI. — *Observations of HD 224639 (HD 224639-HD 224945).*

HJD (2440000.+)	u	v	b	y
4861.7498	0.3903	0.2240	0.2131	0.1904
4862.6100	0.3968	0.2016	0.1870	0.1652
4863.6049	0.3775	0.1871	0.1822	0.1655
4866.6515	0.3852	0.2082	0.1997	0.1806
4870.5583	0.3771	0.1930	0.1839	0.1691
4871.6167	0.3939	0.2174	0.2046	0.1825
4871.7994	0.3682	0.1845	0.1766	0.1623
4872.7035	0.4043	0.2266	0.2115	0.1915
4873.6348	0.4263	0.2604	0.2437	0.2143
4875.7862	0.4280	0.2552	0.2352	0.2046
4876.6186	0.3712	0.1851	0.1759	0.1618
4876.7866	0.3992	0.2175	0.2007	0.1816
4877.5944	0.3421	0.1434	0.1432	0.1315
4877.7809	0.3688	0.1783	0.1708	0.1581
4878.6130	0.4014	0.2306	0.2181	0.1960
4878.7852	0.4248	0.2614	0.2483	0.2215

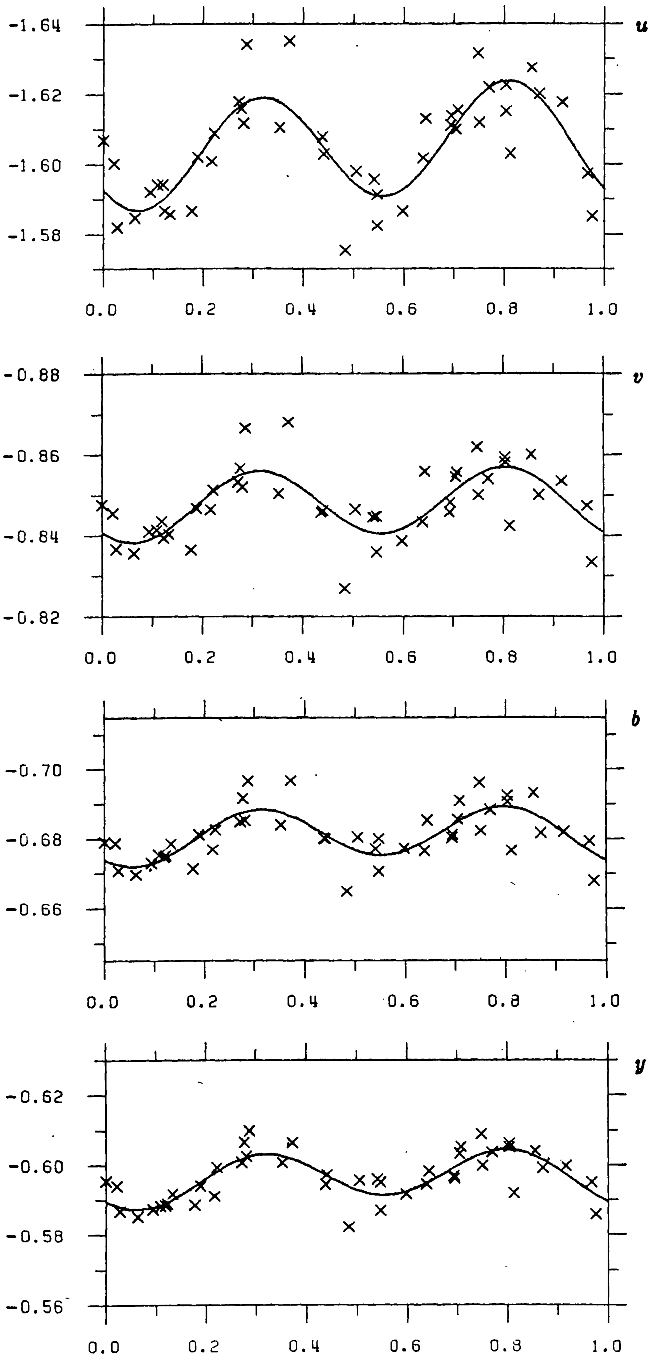

FIGURE 1. — *uvby* lightcurves of HD 24587, with $P = 1.728$ d. Phase origin is at HJD 2443455.622.

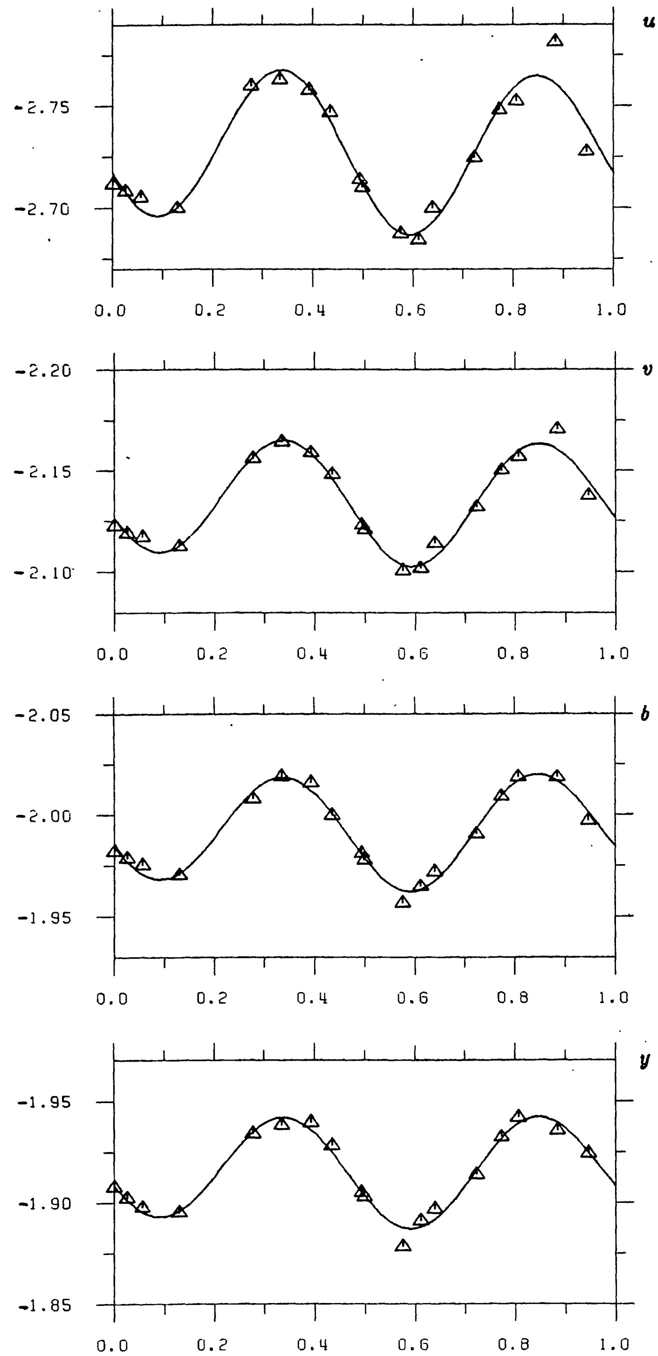

FIGURE 2. — *uvby* lightcurves of HD 61429, with $P = 2.59$ d. Phase origin is HJD 2444972.744.

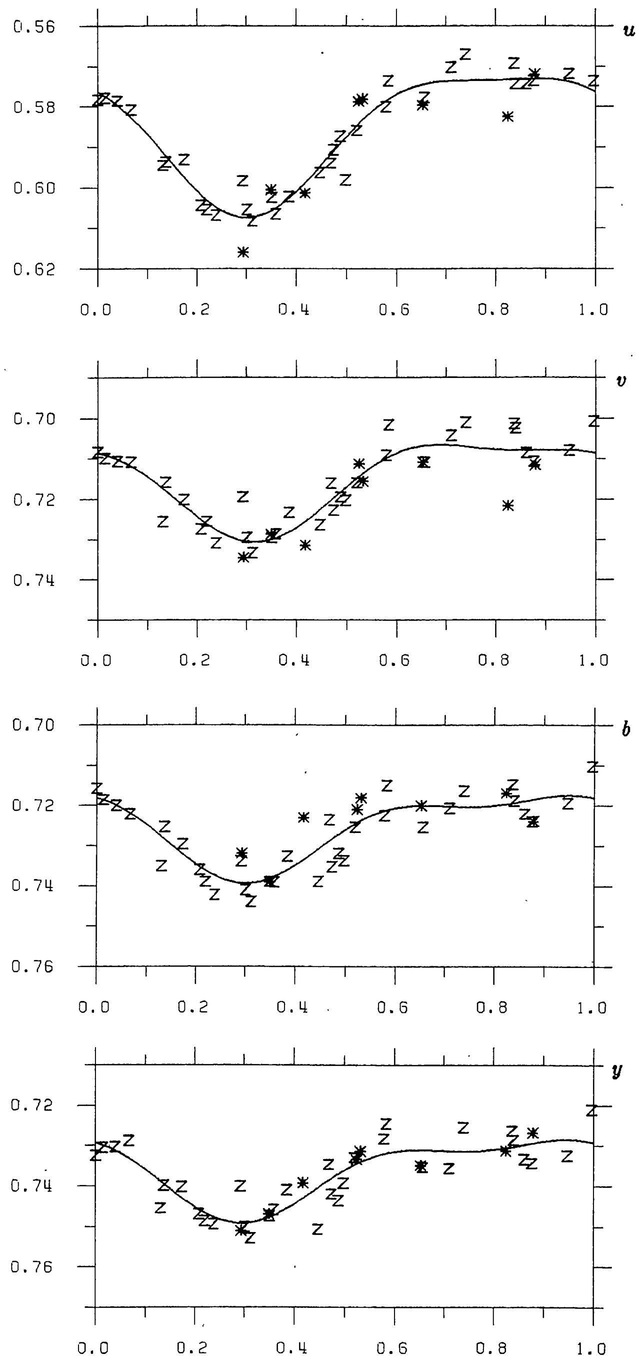

FIGURE 3. — *uvby* lightcurves of HD 65270, with $P = 0.84937$ d. Phase origin is at HJD 2443170.739.

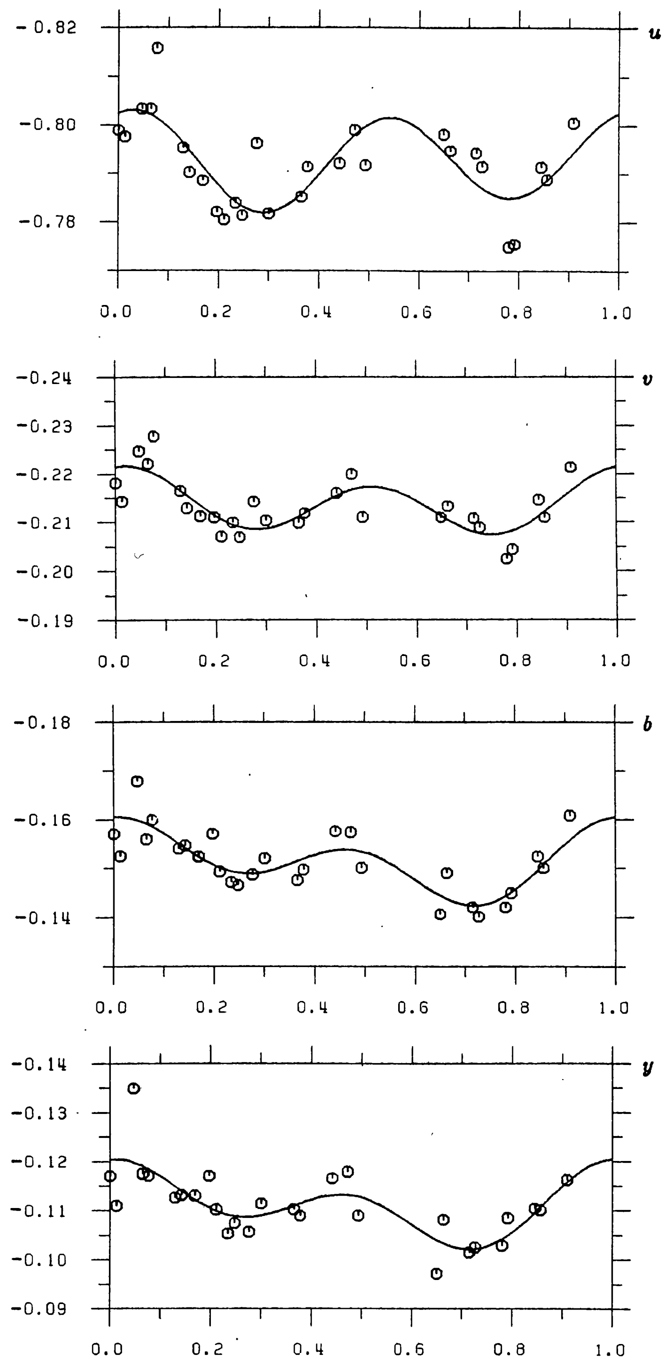

FIGURE 4. — *uvby* lightcurves of HD 90994, with $P = 15.4$ d. Phase origin is at HJD 2444310.523.

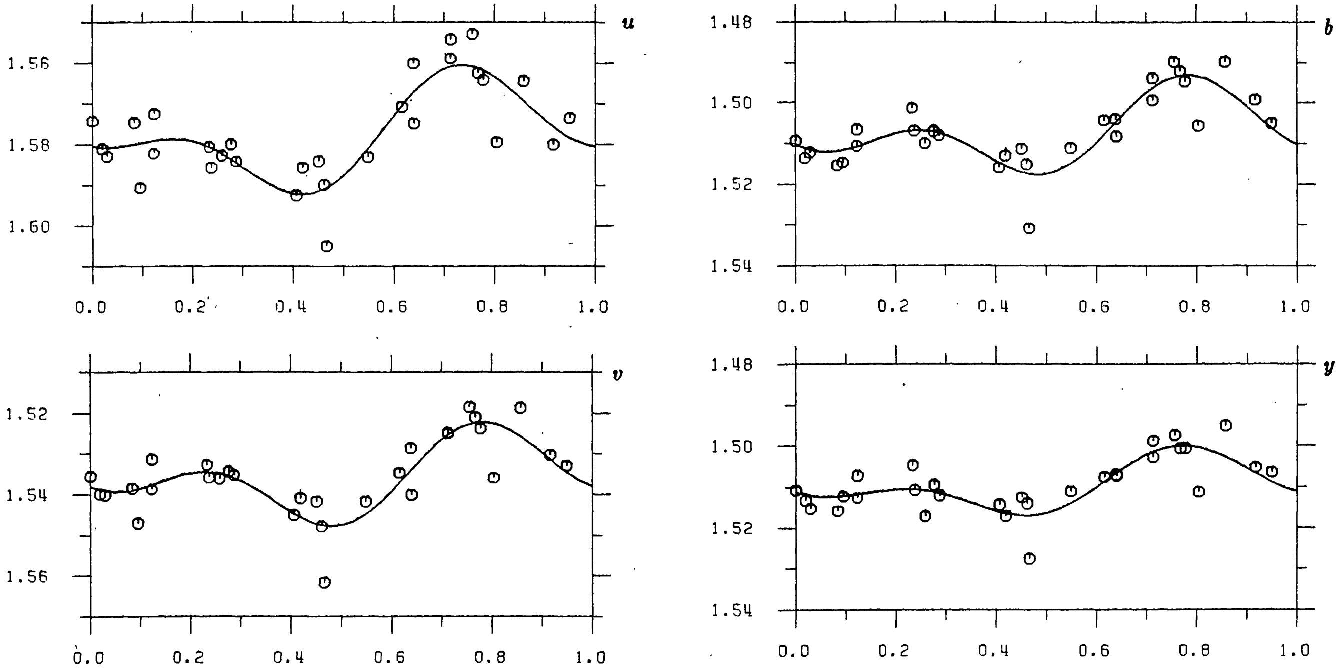

FIGURE 5. — *uvby* lightcurves of HD 103789, with $P = 0.675$ d. Phase origin is at HJD 2444310.567.

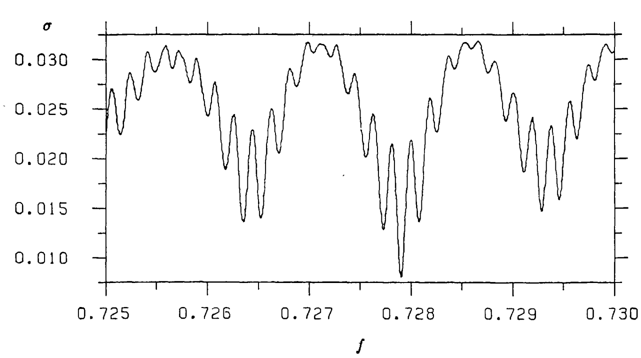

FIGURE 6. — Periodogram of HD 28843, from our observations, Cousins and Stoy's (1966), Pedersen and Thomsen's (1977), and Dean's (1980) data (Johnson V band). Abscissa is the frequency, in d^{-1}, and ordinate the standard deviation of the observations from a least-squares fit by a cosine wave and its first harmonic, in magnitudes.

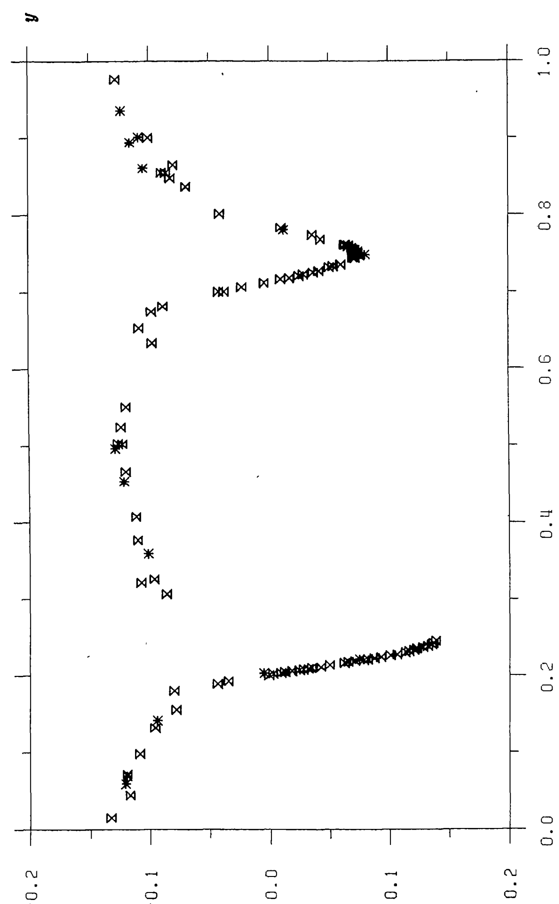

FIGURE 8. — y phase diagram of the eclipsing binary HD 208496, with P = 1.464047d. Phase origin is at HJD 2444862.25.

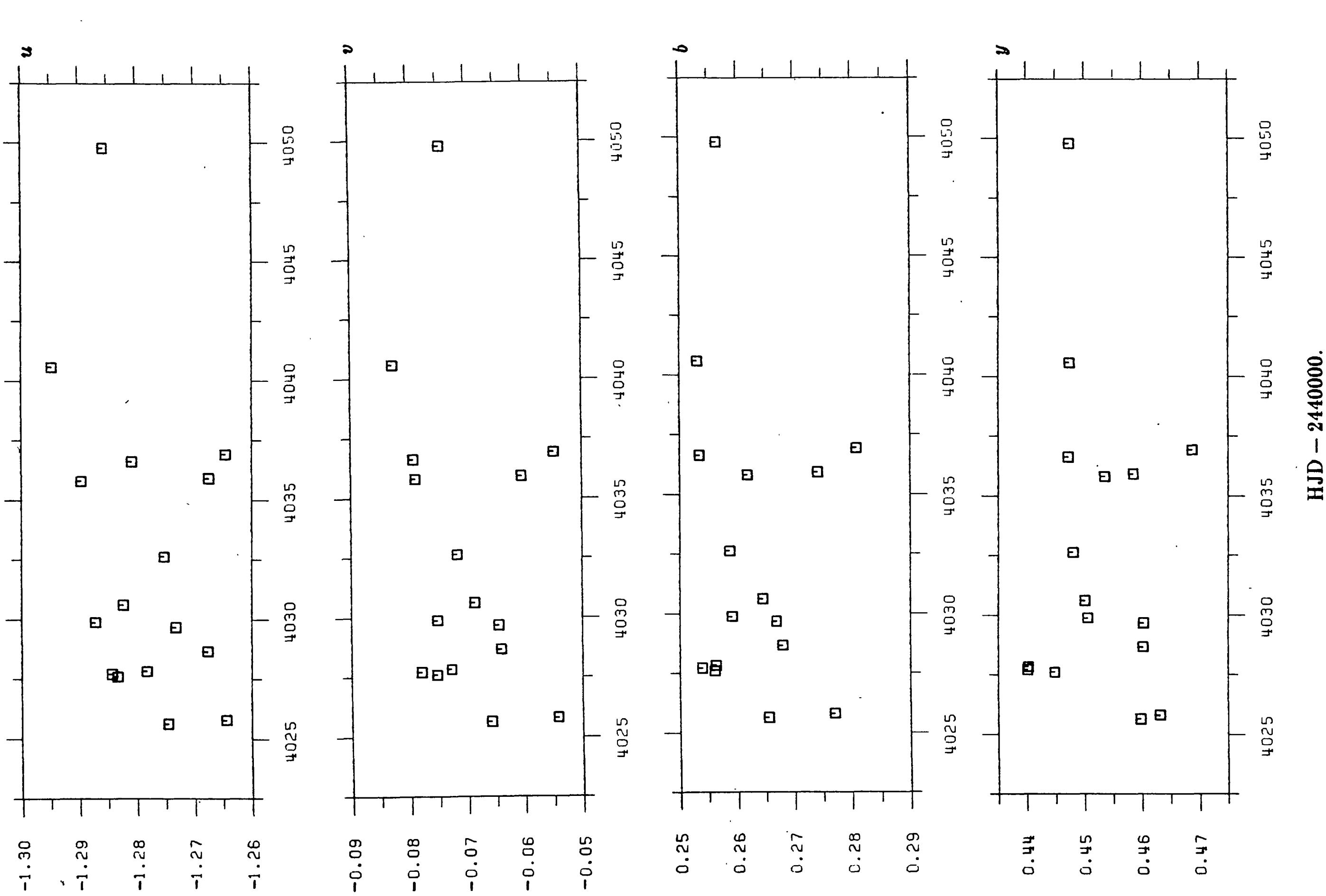

FIGURE 7. — *uvby* observations of HD 167756.