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AN ATLAS OF LIGHT AND COLOUR CURVES OF FIELD RR LYRAE STARS*

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An Atlas is presented of light and colour curves in the Walraven *VBLUW* photometric system for 90 field RR Lyrae and short-period variables. The observational programme and the reduction procedure are briefly described. Tables are presented containing the colours at mean and minimum light.

Key words: RR Lyrae stars – variable stars – photometry

1. INTRODUCTION

This paper presents the results of an extensive programme of photoelectric photometry of RR Lyrae and short-period variable stars. The measurements were obtained by several Leiden observers during the years 1966 to 1976 with Walraven's simultaneous five-channel photometer attached to the 90 cm Light Collector at the Leiden Southern Station near Hartebeespoortdam, South Africa.

The initiative for this project was taken by Dr. G. van Herk. In his work on the proper motions of RR Lyrae stars (van Herk 1965) he found that, especially in the Southern Hemisphere, the lack of good photometric data, in particular (*B-V*) and light amplitude, as well as population criteria made a meaningful subdivision of his material very difficult. Therefore he asked the Leiden photometrists to extend the already available measurements of only a few RR Lyrae stars in the Walraven *VBLUW* system (Ponsen and Oosterhoff 1966; Oosterhoff and Walraven 1966) to more variables.

The first *VBLUW* observations were very fragmentary and unevenly distributed in phase as compared with the present data and are not presented here. However, they proved to be sufficiently interesting to continue the programme. As a first result Van Herk found that a correlation exists between the strength of the bumps that "type a" RR Lyrae lightcurves exhibit near minimum light, and Preston's ΔS parameter, which is an indicator of metal-line strength. He presented this result at the IAU in Brighton, 1970 (van Herk 1971).

As it was judged very important to be able to derive from the lightcurve alone a reddening-free population criterion, a major survey of *VBLUW* photometry of about 100 field RR Lyrae stars was started. Its aim was to obtain a continuous coverage of each lightcurve, including the bumps near minimum light. This new programme required a very considerable observing effort, which task has rested largely upon the shoulders of Dr. A.M. van Genderen, resident astronomer at the Leiden Southern Station.

In the beginning of 1973, after the retirement of Dr. van Herk in 1972, the author took over the project. In the meantime it had become evident, however, that the *VBLUW* data on RR Lyrae stars show, apart from their original purpose (*i.e.* the study of the secondary maxima as a population criterion), many other interesting aspects. The present observations (complete lightcurves in five simultaneous channels) and the properties of the *VBLUW* photometric system (a good separation of abundance, temperature and gravity effects for A, F and G stars) are well suited for a detailed study of the variation of effective temperature and gravity over the whole pulsation cycle for a large number of RR Lyrae and related variables. Up till now such a study has been done for only a few RR Lyrae stars (Oke and Bonsack 1960, Oke *et al.* 1962, Oke 1966, van Albada and de Boer 1975).

The last two authors also discuss the possibility of deriving the physical properties of the equilibrium state of a variable star from photometry over the whole cycle. This provides an important test of the theoretical pulsation models.

* Based on observations mainly by Dr. A.M. van Genderen.

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During the last decade our knowledge of the colours of RR Lyrae stars has much improved due to the large surveys of Fitch *et al.* (1966), Sturch (1966) and Clube *et al.* (1969), who used *UBV* photometry, as well as Epstein (1969, 1973) and Jones (1973), who used Strömgren photometry or a modification thereof. Most of these data, however, are either not very well suited for a study of the pulsation behaviour of RR Lyrae stars (*UBV* photometry) or cover only particular phases of the light variation.

With the *VBLUW* photometer, J.W. Pel has recently observed a large number of Cepheids in the Southern Milky Way (Pel 1976a and 1976b). In many ways this study of cepheids and the present RR Lyrae programme are supplementary especially with respect to the determination of the physical parameters that characterize the stellar photosphere. Several aspects of the *VBLUW* photometry which are of importance to both studies were therefore discussed in a common paper (Lub and Pel 1977). That paper includes a calibration of the *VBLUW* photometry in terms of physical parameters for intermediate type stars, using the grid of model atmospheres by Kurucz (1975). This calibration will be the basis for the interpretation of the RR Lyrae material.

Section 2 of the present paper first describes the observing programme; section 3 discusses the observing procedure; section 4 summarizes the reduction and section 5 contains details on the atlas of lightcurves, a description of the tables and a list of remarks on individual variables. Following papers will deal with the derivation of line-blanketing, interstellar reddening and physical parameters for RR Lyrae stars. We shall study the physical behaviour of RR Lyrae stars over their pulsation cycle, as well as the form of their lightcurves and compare this with the large number of theoretical pulsation computations now available (*e.g.* Christy 1966, Stellingwerf 1974). A separate article is planned to present and discuss extensive measurements of several short period (RRs) variables.

For the construction of the instrument and the general properties of the *VBLUW* photometric system we refer to Walraven and Walraven (1960), Rijn *et al.* (1969) and Lub and Pel (1977). One remark is in order here: in *VBLUW* photometry it is usual to express all quantities in units of $^{10}\log$ (intensity) rather than in magnitudes.

2. THE PROGRAMME

The initial observing list, which was selected by Dr. G. van Herk and A.A. Schoenmaker, consisted of RR Lyrae stars South of declination $+15^\circ$ and with visual magnitudes at minimum light brighter than $V_J \sim 12^m.5$. Here V_J is the visual magnitude on the *UBV* photometric system. Care was taken to choose the stars in such a way that a good coverage of the (period – ΔS) plane was obtained. No attempt was made to be “complete” in any respect.

The author has added a few bright variables to the programme after 1973, because these would allow a higher accuracy to be obtained in the ultraviolet channels. At the beginning of 1973 the state of the programme was reviewed and several fainter stars were deleted from the list. This left a total of 90 variables. The distribution of the variables in the (period – ΔS) plane is not affected by this choice.

The final measurements presented in this paper were done in summer 1974, but during 1975 and 1976 several interesting stars were reobserved or newly added to the programme. These additional data will be published separately.

Periods and epochs for the variables were taken first from the Second Edition of the General Catalogue of Variable Stars (Kukarkin *et al.* 1958) and later from the third edition and its supplements (Kukarkin *et al.* 1969, 1970, 1972, 1974, hereinafter referred to as the GCVS). Identification charts for the majority of the variables were found in the Odessa atlas of identification charts (Tsevevich and Kazanasmas 1963). Each variable was observed relative to a nearby reference star, which during the initial stages of the project usually was taken to be the comparison star indicated on the Odessa chart. As the latter star was often not very well suited with respect to brightness or spectral type, we soon decided to use only stars of spectral type A or F within $30'$ from the variable, chosen from the Henry Draper catalogue.

In 1973 a programme of bright stars of spectral types A, F and G was observed by Dr. A.M. van Genderen, along with the variable star programme. A discussion of these measurements and their application to the calibration of the *VBLUW* photometric system has already been given by Lub and Pel (1977). Similar programmes were carried out during the following observing seasons, but are as yet unreduced.

3. THE OBSERVATIONS

Long continuous runs of observations were made in order to cover the lightcurves in as few nights as possible. Ideally a lightcurve should be completed in one observing run, because of the possibility of variations in the form and the amplitude of the lightcurve, the so-called Blazhko effect. In practice this was feasible only for the variables with the shorter periods.

The observations were much facilitated by the use of time-tables prepared by Mr. A.A. Schoenmaker. For all variables and every night these give phases and air masses for each hour of South African Standard Time. In this way it proves easy to fill in gaps in the lightcurves caused by bad weather conditions or an unfavourable period.

No fixed observing sequence was used; instead, the way in which the measurements were alternated between variable, reference star and sky was adjusted to their relative brightness and to the quality of the night. The basic integration time of the photometer was fixed at 30 seconds; longer integrations were made by repeating the measurements. Typically the RR Lyrae measurements were made with two integrations *i.e.* 1 minute, but in the case of fainter variables or stars with long periods more integrations were made for a single measurement.

Before accepting a reference star a check was made for optical companions. Normally a 23" diaphragm was used for the observations, so in general it is expected also that the light of the variable star is not contaminated by optical companions. (For a few typical cases see the discussion by Jones (1973)).

At Hartebeespoortdam the sky conditions have been slowly deteriorating during the last decade, mainly due to smog from the nearby cities. However, it appeared that by rapidly alternating between variable and reference star it was possible to continue observing on many "non-photometric" nights. Exceptionally clear nights were selected to observe the reference stars together with the standard stars and so tie them to the *VBLUW* standard system.

The observers who took part in observing the programme are: A.M. van Genderen in 1966, W. Wamsteker in 1968, J.W. Pel in 1970, during 1971 to 1974 again A.M. van Genderen, and in the spring of 1974 C.J. van Houten and W. van Vliet. Additional observations in 1975 and 1976 were made by A.M. van Genderen, F. van Leeuwen and W. Bijleveld.

4. REDUCTION

Considering the fact that we had to process more than a hundred thousand integrations, each in five channels, the whole reduction had to be done by computer—it should be remarked here that these data are the equivalent of 200 or more observing nights of eight hours. Initially this was done by Mr. A.A. Schoenmaker, during the later stages Mr. J. Schafgans provided much assistance. Mrs. M. Wisse took part in the tedious task of finding all punching errors in the raw data. The various reduction procedures are well described by Pel (1976a) and need not be fully repeated here. In the following only a few details are given.

4.1. The Variables

The variables are reduced differentially with respect to the reference stars. In the computer programmes the amount of smoothing applied to the sky background and the reference star could be prescribed such that the effects of variations in either this background or the sensitivity of the instrument would be as small as

possible. To account for the difference in airmass between the variable and the reference star a mean extinction coefficient is used. This might only in some very extreme cases—airmass differences greater than 0.010—cause an error larger than 0.001 in $^{10}\log$ (intensity) in the derived colours. The table below gives the equivalent wavelengths of the photometric passbands as well as the standard extinction coefficients κ_s (in units of $^{10}\log$ (intensity)) that were used.

	<i>V</i>	<i>B</i>	<i>L</i>	<i>U</i>	<i>W</i>
$\lambda_{\text{eff}} (\text{\AA})$	5470	4325	3840	3630	3260
κ_s	0.102	0.173	0.240	0.286	0.459

Finally Heliocentric Julian days and phases are calculated for the measurements and the data are plotted. Using these plots it is possible to study the quality of the observations and decide from the internal accuracy of the data which data points have to be deleted (see section 5.2.). In no case was any smoothing applied to the variable star data. Also it was possible in this way to find improvements of the light elements (see the following section).

4.2. The Reference Stars

The reference stars were brought unto the standard *VBLUW* photometric system using the extinction and instrumental zeropoints obtained from the standard stars by the relation:

$$I = i + a + \kappa(m-1)$$

where i is the measured $^{10}\log$ (intensity), I the corresponding value on the standard system, a the correction for instrumental sensitivity, κ the extinction coefficient and m the airmass through which the star has been observed. No colour terms are necessary in this determination, as discussed by Pel (1976b) and Lub and Pel (1977).

5. PRESENTATION OF THE DATA

It was already indicated in section 4 that the amount of data collected is quite formidable. Therefore we had to decide upon the best way in which to present the measurements: extensive tables have distinct disadvantages as compared with a graphical representation, especially in the case of lightcurves. The data are presented in the form of an atlas with accompanying tables that give certain mean quantities characterizing the light and colour curves of each variable. The complete data will be made available on magnetic tape.

5.1. The Atlas

Figures 1,1 to 1,45 show the light and colour curves. Two variables are presented per figure. For each variable are given the lightcurves in *V* and *B*, as well as the colour curves *V*–*B*, *B*–*U*, *B*–*L* and in several cases *U*–*W*. The *B* lightcurve is displayed because it shows the secondary maxima most clearly.

The variables are ordered by type: short-period (RRs), RRC and RRab respectively. Within each type the variables are ordered by increasing period.

For the fainter variables the signal in the *W* channel is so weak that it is not worthwhile to publish the (*U*–*W*) curve. As a quality criterion the rms scatter in the (*U*–*W*) curve around minimum light is used: whenever this scatter exceeds 10% (or 0.040 in $^{10}\log$ (intensity) units) the (*U*–*W*) curve is not displayed. A further discussion of the accuracy of the measurements will be found in part 5.2 of this section.

In most cases it was judged to be sufficient to derive only a new maximum epoch from our measurements. New light elements were determined only if the GCVS period is manifestly in error; in that case the new light elements are given in part 5.3. of this section: Remarks on Individual Variables. Usually our own

measurements were sufficient for the determination of a new period by making use of the information that is contained in the slopes of the separate but continuous pieces that make up each lightcurve (this was done for RZ Cet, U Pic, CG Lib, V494 Sco and AO Tuc). Such new periods are expected to be accurate to one part in 10^5 or 10^6 (when rising branches are fitted).

New heliocentric epochs were determined from the B lightcurves as follows. For stars of type c, *i.e.* with symmetric lightcurves, we took the epoch of the point halfway between median light on the rising and descending part of the lightcurves. In the case of variables with asymmetric lightcurves, *i.e.* mainly stars of the ab-type, epochs of maximum were used. This was done in the following way: mean tangents were drawn along the rising and falling part of the lightcurve. The bisectrix of the angle between these two lines was constructed, and the phase of maximum light was taken as the intersection of this bisectrix and the level of maximum light. Epochs derived in this way are accurate to within 0.002.

5.2. The Tables

Information on the variables and their reference stars can be found in tables 1 and 2 respectively. Sturch (1966) has shown the usefulness of observations made over the phase interval 0.50–0.80 (minimum light) for the determination of metal line blanketing in RRab type stars. Mean colours for the variable stars at minimum light are therefore given in table 3 (for other types these minimum light colours have been determined at phase 0.50). Also given in tables 2 and 3 are accuracies of the colours which they contain. The stars have been ordered by right ascension in all tables (for the epoch 1900.0).

The accuracy of the colours given in these three tables must now be further discussed, as this is the foundation upon which much of the further work will be built. For the reference stars the accuracy was derived from the number of nights on which they were observed together with the standard stars and the standard deviation from the measurements, whereas for the variables we determined the accuracy by considering the colours near minimum light, where all light and colour curves change very slowly, if at all. Here it was possible to derive this accuracy from the standard deviation of a single observation for several groups of 8 observed points. By going back again to the original observations, we checked that the scatter within a group is mainly due to observational scatter. The accuracy of the minimum light colours is therefore given in table 3 as the standard deviation of a single observation divided by the square root of the number of points contributing to the average colours at minimum light.

Average colours over the whole lightcurve are more accurate by a factor of two or more. The average colours in table 1 have been obtained by a simple integration of the light and colour curves in $^{10}\log$ (intensity) units over the period.

Also contained in table 1 is Preston's ΔS parameter for each variable as calculated by van Herk and Schoenmaker from the general literature on that subject (van Herk 1971) or else taken from the GCVS.

For the calculation of the visual brightness of the reference stars on the UBV system, V_J , given in table 2 the formula given by Pel (1976a) was used, *i.e.*: $V_J = 6^m874 - 2.5 \{V + 0.065(V-B)\}$.

5.3. Remarks on Individual Variables

In this subsection information is given on those variables for which new lightelements have been obtained or which show peculiarities in their lightcurves. As in the tables the stars are ordered by right ascension.

SS For: The behaviour of the reference star has been carefully checked and it has to be concluded that the variations near minimum light are real. In September 1975 further observations were obtained near minimum light, but these are as yet unreduced.

RZ Cet: New lightelements were derived by fitting the 1968 and 1973 measurements together; the lightcurve contains all points. The new elements are: $\max = \text{Hel.J.D. } 2442014.369 + 0.5106077 \times E$.

U Pic: New lightelements were derived from our measurements and the GCVS epoch: $\max = \text{Hel.J.D. } 2441666.449 + 0.4403710 \times E$.

- RY Col:** This RR Lyrae star shows strong Blazhko effect. The new epoch is only valid for the one maximum observed.
- HH Pup:** The peculiar shoulder on the descending part of the lightcurve is present in observations on two consecutive nights. However the *UBV* lightcurve by Warren (1966) does not show it and also its form is much more characteristic of low ΔS , high amplitude RR Lyrae stars.
- WY Ant:** New lightelements were derived from our data and the GCVS epoch: $\max = \text{Hel.J.D. } 2440645.303 + 0.57433095 \times E$.
- SS Leo:** New lightelements were obtained from the present data and additional measurements by Pel (in 1970): $\max = \text{Hel.J.D. } 2441781.406 + 0.6263432 \times E$.
- AP Ser:** The lightcurve shown here was observed by van Genderen in 1973. Observations by van Genderen in 1966 show a lightcurve much more characteristic of a c-type variable. In order to study the lightcurve variations additional measurements were made in 1975 (as yet unreduced).
- TV Lib:** The present observations were obtained by van Genderen in 1973. Van Genderen in 1966 and Pel in 1970 also observed this variable. From all *VBLUW* data at hand the following new lightelements are found: $\max = \text{Hel.J.D. } 2441809.396 + 0.2696242 \times E$.
- FW Lup:** This variable was in Pel's survey of Cepheids (Pel 1976a); he found however, that it is an RR Lyrae star. The present observations were obtained by van Houten in 1974. The lightelements given here are derived from all available *VBLUW* data: $\max = \text{Hel.J.D. } 2442171.377 + 0.4841712 \times E$.
- AR Ser:** Due to the very strong Blazhko effect the epoch given is valid only for the one maximum observed. In order to derive a better lightcurve and study the amplitude variations further observations were made in 1975 (as yet unreduced).
- CG Lib:** Schoenmaker found from an analysis of the *VBLUW* data that only a period of 0.3067 satisfied the observations instead of 0.443050 as given by Clube *et al.* (1969). This is in accordance with the period of 0.3068674 derived by Cacciari (1975) from the observations of Clube *et al.* With this period the lightcurve is a characteristic c-type lightcurve.
- UV Oct:** The epoch given for this variable with Blazhko effect is a mean maximum epoch from two maxima at differing amplitude, and is useful solely for plotting the data points.
- V494Sco:** New lightelements were derived from our epoch and the GCVS epoch: $\max = \text{Hel.J.D. } 2441126.388 + 0.4273326 \times E$. With these new lightelements all parts of the lightcurve fit very well together. However our *B* amplitude, 1^m27 , is much lower than the value of 1^m66 by Kinman (1961); also its colours are very similar to those of RV Cap, so it is very probable that V494 Sco also shows the Blazhko effect.
- V703Sco:** Extensive *VBLUW* observations by Ponsen have been discussed by Oosterhoff (1966). This star shows very strong modulations of the lightcurve and unfortunately our measurements were done at very low amplitude. Therefore no new maximum epoch was derived.
- S Ara:** New lightelements were derived from our measurements and the old GCVS epoch: $\max = \text{Hel.J.D. } 2441152.417 + 0.451883 \times E$.
- V 675 Sgr:** New lightelements were derived from our measurements and the old GCVS epoch: $\max = \text{Hel.J.D. } 2441180.370 + 0.6422895 \times E$.
- V 455 Oph:** New lightelements derived from our measurements and the old GCVS epoch: $\max = \text{Hel.J.D. } 2441833.389 + 0.4539182 \times E$.
- V 440 Sgr:** From all available *VBLUW* data (complete lightcurves have been measured both in 1968 and 1971) new lightelements were derived: $\max = \text{Hel.J.D. } 2441509.445 + 0.47747883 \times E$. The lightcurve contains all available data points.
- DN Pav:** Using two complete lightcurves from 1968 and 1971–1972, new lightelements were derived: $\max = \text{Hel.J.D. } 2441183.397 + 0.46844376 \times E$.

The lightcurve contains all available points; for the L band, the minimum observed in 1972 was not used in forming the averages.

- V 341 Aql:** From all available $VBLUW$ data (complete lightcurves from 1971 and 1968) new lightelements were derived: $\max = \text{Hel.J.D. } 2441196.251 + 0.57802054 \times E$. The lightcurve contains all data points.
- DX Del:** A few measurements near minimum light fit poorly, possibly due to real variations.
- RV Cap:** A mean maximum epoch from two maxima at differing amplitude was determined, useful only for plotting the lightcurve.
- YZ Cap:** The present lightcurve was obtained by van Genderen in 1973; he has observed also a complete lightcurve in 1966. New lightelements were derived from all available $VBLUW$ data:
 $\max = \text{Hel.J.D. } 2441872.444 + 0.27345698 \times E$.
- SX Aqr:** New lightelements were derived using also a maximum observed by van Genderen in 1966:
 $\max = \text{Hel.J.D. } 2441868.445 + 0.53571386 \times E$.
- RT Gru:** As for other stars which show the Blazhko effect, a mean maximum epoch was derived, useful only for plotting the data points.
- SX Phe:** No new epoch was derived. Extensive $VBLUW$ observations by Wamsteker in 1968 will be presented and discussed separately.
- AO Tuc:** New lightelements were derived using the present observations and those of Ponsen (Ponsen and Oosterhoff, 1966): $\max = \text{Hel.J.D. } 2441948.542 + 0.3332332 \times E$.

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Table 3 Minimum light colours of the RR Lyrae stars.

STAR	V-B	B-U	U-W	B-L	N	STAR	V-B	B-U	U-W	B-L	N	STAR	V-B	B-U	U-W	B-L	N												
RY PSC	.167	1	.355	3	.206	17	.175	2	48	RV OCT	.219	1	.386	2	.233	12	.175	1	63	V455 OPH	.204	2	.396	4	.193	25	.186	3	40
W TUC	.162	1	.378	3	.210	8	.161	2	63	FY HYA	.167	2	.364	4	.174	14	.142	3	90	V413 CRA	.206	1	.384	2	.223	6	.180	1	40
AM TUC	.128	2	.375	3	.152	13	.153	2	32	V499 CEN	.182	1	.384	2	.189	6	.168	1	56	MT TEL	.109	1	.402	2	.180	7	.145	1	64
RR CET	.169	1	.367	1	.187	4	.171	1	42	UY BOO	.168	1	.331	2	.198	6	.149	2	56	V440 SGR	.200	1	.396	1	.208	4	.183	1	54
SV SCL	.108	1	.401	3	.197	11	.159	2	24	XX VIR	.183	2	.373	4	.236	18	.161	3	48	DN PAV	.174	1	.374	4	.198	16	.168	3	99
SS FOR	.157	1	.369	1	.186	3	.164	1	54	TY APS	.215	2	.418	4	.237	17	.183	3	40	V341 AQL	.179	1	.386	1	.202	4	.181	1	180
RZ CET	.164	1	.366	3	.202	9	.170	2	54	AP SER	.120	2	.395	5	.179	18	.161	3	16	AA AQL	.183	2	.422	4	.195	14	.202	3	48
BB HYI	.113	2	.424	5	.189	30	.168	3	28	TV LIB	.178	2	.408	6	.205	28	.211	5	16	DX DEL	.209	1	.433	1	.194	5	.242	1	64
BY ERI	.110	2	.401	4	.179	16	.165	3	28	FW LUP	.216	1	.418	1	.234	8	.229	1	56	RV CAP	.166	2	.396	3	.190	9	.172	2	38
X ARI	.223	1	.378	1	.211	4	.166	1	63	VY SER	.185	1	.359	1	.208	4	.164	1	48	V IND	.179	1	.366	2	.193	8	.172	2	42
SV ERI	.183	1	.379	2	.189	5	.163	1	16	AR SER	.172	1	.374	2	.200	17	.164	1	36	CP AQR	.183	1	.403	3	.245	18	.201	2	40
U PIC	.180	1	.392	2	.220	8	.200	2	56	CG LIB	.188	3	.391	6	.185	18	.170	4	24	SW AQR	.175	1	.383	3	.216	10	.172	2	48
U LEP	.166	1	.367	4	.181	20	.157	2	15	VY LIB	.235	2	.408	4	.248	20	.202	3	49	Z MIC	.218	2	.399	4	.265	11	.191	2	36
RY COL	.171	1	.385	2	.208	6	.193	2	32	AM SER	.210	1	.437	2	.214	9	.251	1	49	YZ CAP	.135	2	.444	4	.160	14	.172	3	25
IU CAR	.210	1	.365	4	.203	18	.172	3	40	AT SER	.164	1	.356	3	.213	9	.155	2	54	SX AQR	.171	1	.356	3	.195	16	.156	2	42
HH PUP	.210	2	.405	4	.233	17	.203	3	35	AV SER	.231	2	.412	3	.209	3	.188	2	40	RT GRU	.154	2	.370	5	.190	20	.160	3	80
BB PUP	.208	2	.434	4	.223	16	.214	3	40	UV OCT	.199	1	.373	1	.189	4	.173	1	64	TZ AQR	.188	2	.368	5	.241	14	.180	3	40
VZ CNC	.152	1	.392	1	.163	3	.207	1	15	V445 OPH	.299	1	.456	3	.336	11	.274	2	40	DH PEG	.139	1	.456	1	.185	3	.183	1	32
T SEX	.123	1	.432	2	.178	6	.173	2	16	VX HER	.182	1	.384	3	.229	13	.171	2	42	CY AQR	.132	2	.370	4	.205	8	.186	4	16
AF VEL	.209	2	.394	4	.165	11	.179	3	42	RW TRA	.230	2	.433	8	.197	35	.248	4	21	RW GRU	.157	2	.349	4	.195	18	.157	3	32
TV LEO	.175	2	.368	3	.197	15	.157	3	58	V452 OPH	.241	1	.411	4	.260	25	.190	3	35	BH PEG	.211	1	.383	3	.221	10	.181	2	64
WY ANT	.173	1	.361	1	.227	4	.169	2	28	V487 SCO	.247	2	.481	5	.246	20	.213	3	24	BO AQR	.180	2	.372	3	.210	17	.162	2	40
W CRT	.181	1	.413	3	.239	10	.206	2	32	ST OPH	.248	2	.441	6	.179	25	.203	3	36	YY TUC	.164	1	.359	3	.179	14	.153	2	42
SS LEO	.166	1	.366	2	.159	6	.161	1	56	V494 SCO	.216	1	.432	3	.210	10	.207	2	48	DN AQR	.172	1	.361	2	.199	5	.163	1	72
ST LEO	.173	1	.387	2	.221	7	.180	1	120	V703 SCO	.145	1	.409	1	.178	3	.200	1	16	RV PHE	.172	1	.358	3	.236	12	.167	2	40
X CRT	.173	1	.352	2	.189	6	.161	2	48	TY PAV	.203	2	.353	4	.235	15	.158	3	40	BR AQR	.175	1	.396	3	.243	11	.199	2	56
UU VIR	.172	1	.386	1	.207	5	.186	1	35	V690 SCO	.215	2	.398	4	.208	15	.211	3	36	SX PHE	.100	1	.363	2	.147	2	.170	1	8
SV HYA	.174	1	.378	1	.205	5	.170	1	56	S ARA	.195	1	.390	2	.209	8	.179	1	45	BS AQR	.145	1	.405	2	.177	4	.214	1	32
AV VIR	.182	1	.372	2	.187	10	.181	1	42	V567 OPH	.247	2	.488	5	.157	16	.252	3	16	UU CET	.178	1	.361	3	.156	14	.169	2	54
AU VIR	.116	1	.411	3	.171	14	.163	2	24	V675 SGR	.189	1	.362	1	.196	4	.158	1	56	AO TUC	.109	1	.399	4	.182	16	.157	2	16

Each colour is followed by its accuracy in units of 0.001 in $10\log$ (intensity). The number of measured points contributing to the average is found in the column marked N. For a discussion see section 5.2. in the text.

Table 1 General information on the RR Lyrae variables

NO	STAR	TYPE	PERIOD	EPOCH	l	b	ΔS	V_{max}	A_V	$\langle V \rangle$	$\langle V-B \rangle$	$\langle U-W \rangle$	$\langle B-U \rangle$	$\langle B-L \rangle$	R
56	AV	SR	ab	0.4875571	41508.361	011.30	+56.81	6	-1.583	0.460	-1.888	-1.594	.441	.203	.184
57	UV	OCT	ab	0.5426620	41079.547	308.40	-23.54	9	-0.753	0.517	-1.098	.164	.408	.191	.163
58	V445	OPH	ab	0.3970228	41181.264	007.90	+28.46	2	-1.464	0.958	-1.686	.251	.468	.323	.257
60	VX	HER	ab	0.4553728	41446.593	335.22	+39.09	5	-1.210	0.540	-1.572	.142	.422	.220	.159
61	RW	TRA	ab	0.3740351	41489.292	034.20	-14.77	1	-1.622	0.312	-1.808	.195	.444	.233	.225
62	V452	OPH	ab	0.5571623	41825.359	032.53	+25.73	5	-1.919	0.403	-2.185	.210	.444	.216	.186
63	V487	SCO	c	0.3291385	41556.569	354.19	+00.99	1	-1.712	0.199	-1.812	.221	.517	.195	.212
64	ST	OPH	ab	0.4509564	41853.359	002.84	+16.45	6	-1.806	0.545	-2.161	.170	.467	.219	.191
65	V454	SCO	ab	0.4273256	41126.388	357.24	-00.48	2	-1.564	0.401	-1.826	.179	.471	.203	.198
66	V703	SCO	s	0.1152179	39279.530	356.56	-01.26	1	-0.405	.145	.409	.178	.200	2	
67	TY	PAV	ab	0.7104425	41532.333	330.55	-17.10	10	-2.096	0.361	-2.310	.176	.384	.221	.151
68	V650	SCO	ab	0.5925558	41797.592	351.19	+08.00	4	-1.572	0.556	-1.854	.179	.439	.205	.196
69	s	ARA	ab	0.4510830	41152.417	343.38	-12.44	3	-1.240	0.537	-1.599	.158	.426	.210	.170
70	V557	OPH	s	0.1307029	41134.467	027.80	+42.29	0	-1.843	0.140	-1.783	.238	.507	.190	.248
71	V675	SR	ab	0.6422895	41800.370	358.35	+07.82	11	-1.173	0.392	-1.418	.162	.390	.195	.154
72	V455	OPH	ab	0.4539182	41833.369	000.04	+13.55	5	-1.576	0.337	-2.200	.170	.434	.214	.175
73	V413	CRA	ab	0.5893240	41500.360	358.10	-15.56	6	-1.347	0.285	-1.513	.178	.404	.220	.173
102	MT	TEL	c	0.316899	42206.350	350.25	-21.12	-	-0.737	0.229	-0.858	.087	.435	.174	.152
75	V440	SR	ab	0.4775783	41509.445	015.31	-19.19	7	-1.091	0.506	-1.430	.161	.431	.204	.175
76	DN	PAV	ab	0.4684376	41183.397	332.82	-30.80	8	-1.915	0.510	-2.280	.137	.409	.213	.148
77	V941	AQL	ab	0.5788204	41196.251	045.62	-22.03	3	-1.311	0.515	-1.634	.142	.422	.200	.171
78	AA	AQL	ab	0.3617869	41127.440	043.08	-24.98	0	-1.663	0.534	-2.021	.143	.437	.195	.185
111	DX	DEL	ab	0.4726329	39367.340	058.46	-18.84	0	-1.086	0.299	-1.260	.176	.445	.178	.223
79	RW	CAP	ab	0.4475502	41209.270	033.12	-35.13	8	-1.487	0.371	-1.719	.128	.434	.194	.166
116	V	IND	ab	0.4795910	41018.393	355.34	-33.33	3	-1.672	0.522	-2.004	.143	.432	.199	.185
80	CP	AQR	ab	0.4634070	41511.498	008.73	+31.33	3	-1.672	0.522	-2.004	.143	.432	.199	.185
81	SV	AQR	ab	0.4530329	41208.347	051.31	-31.47	8	-1.416	0.524	-1.776	.137	.422	.224	.164
82	Z	MIC	ab	0.5863340	41597.376	015.69	+43.16	4	-1.780	0.261	-1.929	.194	.416	.261	.182
83	VZ	CAP	c	0.2734698	41872.444	035.37	-39.50	9	-1.681	0.209	-1.788	.109	.472	.171	.174
84	SX	AQR	ab	0.5357139	41868.445	057.89	-34.00	9	-1.690	0.461	-1.994	.128	.402	.190	.154
85	RT	GRU	ab	0.512208	41151.555	352.66	-50.00	7	-2.093	0.445	-2.412	.129	.401	.185	.160
86	TZ	AQR	ab	0.5711943	41568.399	053.24	-44.32	5	-1.930	0.340	-2.133	.160	.393	.202	.170
87	DM	PEG	c	0.255510	41134.546	069.13	-39.24	1	-0.984	0.202	-1.087	.113	.487	.179	.183
88	CY	AQR	ab	0.0613840	41126.596	069.22	-46.92	2	-1.433	0.301	-1.630	.111	.400	.186	.186
89	RW	GRU	ab	0.550273	41215.512	351.09	-58.99	7	-1.951	0.444	-2.248	.120	.386	.190	.151
90	BH	PEG	ab	0.6410009	41236.391	085.60	-38.36	6	-1.292	0.278	-1.450	.183	.405	.190	.175
91	BO	AQR	ab	0.6940186	41621.252	055.38	-58.82	6	-1.984	0.444	-2.151	.148	.408	.197	.156
92	YY	TUC	ab	0.6350210	41894.497	325.32	-52.20	8	-1.782	0.489	-2.085	.129	.394	.168	.153
93	DN	AQR	ab	0.6337525	41148.509	035.73	-69.05	8	-1.578	0.318	-1.763	.147	.388	.196	.161
94	RW	PHE	ab	0.5964182	41915.525	336.03	-63.99	8	-1.888	0.283	-2.052	.147	.374	.200	.162
95	BR	AQR	ab	0.4819785	41400.534	075.45	-65.24	3	-1.569	0.466	-1.858	.139	.425	.205	.189
96	SX	PHE	s	0.0548645	34200.039	341.42	-70.36	10	-0.818	.095	.378	.138	.177	2	
97	BS	AQR	s	0.1978228	41617.301	081.99	-65.90	0	-0.926	0.186	-1.028	.121	.423	.172	.208
98	UU	CET	ab	0.606081	41208.576	073.22	-75.08	4	-1.939	0.281	-2.098	.159	.380	.180	.161
99	AO	TUC	c	0.3332332	41948.542	313.85	-56.62	5	-1.619	0.198	-1.715	.081	.446	.179	.164

NO	STAR	TYPE	PERIOD	EPOCH	l	b	ΔS	V_{max}	A_V	$\langle V \rangle$	$\langle V-B \rangle$	$\langle U-W \rangle$	$\langle B-U \rangle$	$\langle B-L \rangle$	R
1	RY	PSC	ab	0.5297291	41538.476	100.66	-62.89	7	-2.020	0.332	-2.229	.137	.393	.204	.166
4	M	TUC	ab	0.6422259	41242.414	301.66	-53.72	4	-1.587	0.453	-1.867	.130	.396	.210	.156
6	AM	TUC	c	0.405689	41960.387	299.06	-49.00	4	-1.833	0.375	-1.917	.107	.410	.165	.152
7	RR	CET	ab	0.5530253	41942.471	143.53	-59.90	5	-0.924	0.189	-1.166	.141	.395	.183	.164
8	SV	SCL	c	0.37760	41918.555	230.16	-77.89	7	-1.725	0.207	-1.725	.079	.433	.181	.155
9	SS	FOR	ab	0.4954320	41964.552	216.44	-73.00	8	-0.994	0.555	-1.360	.118	.404	.186	.155
12	RZ	CET	ab	0.5106077	42014.369	178.21	-60.35	4	-1.750	0.387	-2.003	.131	.405	.206	.164
13	BB	HYI	c	0.287131	41993.430	293.59	-41.62	7	-1.969	0.201	-2.079	.085	.443	.180	.170
11	BY	ERI	c	0.31134900	41633.419	262.48	-58.81	4	-2.115	0.205	-2.214	.092	.433	.188	.165
15	X	ARI	ab	0.6511336	41300.299	169.08	-39.85	10	-0.802	0.402	-1.098	.193	.412	.213	.159
16	SV	ERI	ab	0.713759	42063.360	194.26	-53.49	7	-1.080	0.270	-1.255	.158	.406	.195	.162
20	U	PIC	ab	0.440371	41666.449	257.68	-39.61	3	-1.525	0.504	-1.811	.139	.421	.212	.185
22	U	LEP	ab	0.5814738	41712.289	221.11	-34.78	8	-1.240	0.445	-1.530	.133	.397	.189	.149
23	RY	COL	ab	0.4788571	41694.367	246.46	-35.05	3	-1.468	0.284	-1.650	.145	.414	.211	.185
24	IU	CAR	ab	0.737108	41695.359	269.59	-22.96	9	-1.810	0.384	-2.057	.180	.402	.199	.162
25	HH	PUP	ab	0.3907463	41361.296	258.24	-14.74	1	-1.433	0.567	-1.833	.174	.445	.234	.190
26	BB	PUP	ab	0.480544	41362.472	241.29	+10.26	3	-1.890	0.415	-2.146	.175	.449	.217	.197
28	VZ	CNC	s	0.1783645	41698.362	216.50	+28.73	0	-0.149	0.264	-0.319	.122	.412	.156	.201
30	T	SEX	c	0.3246980	41384.300	235.63	+40.60	3	-1.198	0.181	-1.281	.098	.463	.179	.172
112	MY	ANT	ab	0.57433095	40645.303	266.92	+22.08	6	-1.387	0.372	-1.621	.145	.390	.211	.162
31	AF	VEL	ab	0.527984	41432.367	284.16	+08.60	7	-1.603	0.379	-1.856	.175	.421	.179	.169
32	TV	LEO	ab	0.6728430	41424.348	262.98	+49.06	10	-1.815	0.490	-2.126	.138	.404	.205	.149
33	V	CRT	ab	0.4120134	41451.387	275.99	+40.46	2	-1.568	0.540	-1.913	.141	.444	.206	.191
34	SS	LEO	ab	0.6263432	41781.406	265.29	+57.06	8	-1.407	0.459	-1.697	.133	.397	.183	.154
113	ST	DEL	ab	0.4775843	40648.498	353.42	+46.15	7	-1.546	0.530	-1.890	.132	.424	.220	.171
36	X	CRT	ab	0.7328332	41798.339	278.86	+49.49	10	-1.715	0.254	-1.857	.149	.375	.190	.158
37	UU	VIR	ab	0.4750663	41797.461	280.72	+40.53	2	-1.216	0.472	-1.506	.132	.420	.197	.174
38	SV	HVA	ab	0.4785439	41102.346	297.07	+36.59	6	-1.147	0.514	-1.498	.134	.421	.197	.163
39	AV	VIR	ab	0.6560800	41790.283	324.99	+70.84	6	-1.814	0.314	-2.004	.155	.394	.202	.172
40	AV	CIR	c	0.3432302	41795.332	317.44	+54.96	6	-1.802	0.199	-1.909	.086	.442	.176	.161
41	RV	OCT	ab	0.5711300	41070.286	304.37	-21.67	10	-1.376	0.465	-1.674	.185	.418	.217	.168
42	FY	HVA	ab	0.6366510	41089.311	318.77	+31.38	7	-2.014	0.440	-2.310	.138	.397	.199	.136
43	V499	CEN	ab	0.5217100	41126.248	315.09	+18.13	6	-1.395	0.495	-1.727	.147	.419	.194	.165
44	UY	BOO	ab	0.6508446	41420.466	354.25	+48.62	10	-1.361	0.476	-1.670	.135	.375	.196	.143
45	XX	VIR	ab	1.348051	41459.329	337.79	+50.73	9	-1.888	0.492	-2.196	.147	.404	.224	.152
46	TY	APS	ab	0.5016935	41488.235	312.12	-10.57	3	-1.771	0.425	-2.043	.186	.436	.223	.179
47	AP	SER	c	0.2541180	41811.360	012.88									

Table 2 The reference stars

VARIABLE	HD	α_{1900}	δ_{1900}	SP	V_J	YEAR	V	V-B	B-U	U-W	B-L	N
RV Pic	746	00 06.7	-02 20	F8	9.41	71,72	-1.029 4	.224 1	-.314 4	.165 8	.248 3	3
W Tuc	5648	00 53.0	-63 49	A2	9.01	71,72	-0.861 5	.089 1	-.409 5	.143 1	.197 4	3
AN Tuc	8298	01 17.1	-68 36	F2	8.71	73	-0.744 3	.157 2	-.333 2	.149 4	.207 1	2
RR Cnc	9387	01 27.2	+01 04	A3	8.11	73	-0.502 2	.091 1	-.415 2	.119 5	.212 2	3
SV Scl	13168	01 42.0	-30 06	A5	10.14	73	-1.324 2	.246 2	-.312 5	.190 7	.258 4	3
SS For	13168	02 03.6	-28 03	A5	7.24	73	-0.154 1	.097 1	-.414 1	.137 1	.205 1	2
RZ Cet	13168	02 03.6	-28 03	A5	7.24	73	-0.154 1	.097 1	-.414 1	.137 1	.205 1	2
RZ Cet	13168	02 03.6	-28 03	A5	7.24	73	-0.154 1	.097 1	-.414 1	.137 1	.205 1	2
BB Hvi	16330	02 33.9	-74 27	A2	7.49	73	-0.248 2	.056 2	-.459 3	.129 1	.198 2	1
BY Eri	17936	02 47.8	-48 23	F5	9.41	71	-1.028 2	.174 2	-.319 2	.165 3	.224 1	3
X Ari	19504	03 03.0	+10 25	F5	7.29	71,72	-0.175 2	.165 1	-.334 2	.157 4	.195 2	3
SV Eri	19825	03 06.2	-11 29	A3	8.63	73,74	-0.711 2	.122 2	-.355 3	.133 5	.189 2	1
U Pic	31050	04 45.1	-51 00	F8	9.86	72	-1.203 1	.166 1	-.328 2	.167 1	.214 2	2
U Lep	31415	04 50.6	-21 20	A0	9.13	72,73	-0.909 1	.101 1	-.435 1	.146 3	.212 3	3
RV Col	51210	06 51.3	-59 13	A2	6.41	73	-0.183 2	.063 1	-.440 1	.133 1	.195 1	3
RY Car	51210	06 51.3	-59 13	A2	6.41	73	-0.183 2	.063 1	-.440 1	.133 1	.195 1	3
HH Pup	97143	11 05.8	-05 28	F2	9.68	72	-1.134 1	.174 1	-.322 1	.143 2	.214 2	3
HH Pup	97143	11 05.8	-05 28	F2	9.68	72	-1.134 1	.174 1	-.322 1	.143 2	.214 2	3
VZ Cnc	73316	08 32.7	+09 56	A0	6.53	73	-0.139 2	.007 1	-.400 1	.072 1	.149 4	2
T Sex	85517	09 47.2	+02 46	F2	9.39	72	-1.019 2	.216 2	-.362 2	.184 6	.254 3	3
MT Ant	10117	-29 20			10.09	70	-1.300 2	.233 2	-.335 3	.197 3	.263 2	3
AF Vel	10494	-49 19			11.53	72	-1.870 1	.150 1	-.373 4	.124 10	.180 4	4
TV Leo	99423	11 21.3	-17 33	F5	8.32	72	-0.589 2	.168 1	-.315 1	.144 2	.206 2	3
W Crt	99423	11 21.3	-17 33	F5	8.32	72	-0.589 2	.168 1	-.315 1	.144 2	.206 2	3
SS Leo	100269	11 27.2	+00 09	F8	8.08	73	-0.495 1	.206 1	-.301 1	.157 3	.229 1	3
ST Leo	102574	11 43.3	-09 45	G0	9.85	70	-1.202 4	.210 2	-.322 3	.180 4	.236 2	3
X Crt	102574	11 43.3	-09 45	G0	9.85	70	-1.202 4	.210 2	-.322 3	.180 4	.236 2	3
UV Vir	105390	12 03.0	+00 11	F5	9.27	73	-0.971 3	.169 2	-.311 4	.145 5	.199 2	3
SV Hya	108631	12 23.6	-25 28	F8	9.76	71	-1.167 2	.217 1	-.326 2	.173 6	.234 2	6
AV Vir	115994	13 15.7	+09 28	K5	8.57	72	-0.865 1	.421 1	-.543 2	.252 10	.481 1	6
AD Vir	116638	13 19.8	-06 34	K2	9.29	66	-0.996 3	.449 2	-.597 2	.341 10	.520 2	4
AU Vir	116638	13 19.8	-06 34	K2	9.29	66	-0.996 3	.449 2	-.597 2	.341 10	.520 2	4
RV Oct	117709	13 26.9	-83 57	G	9.48	71	-1.045 3	.168 2	-.315 2	.135 7	.186 2	4
FP Hya	120367	13 45.7	-28 39	A2	9.93	73	-1.228 1	.089 2	-.444 3	.106 9	.197 1	2
V499 Cen	121538	13 49.8	-42 42	A2	8.12	71	-0.501 1	.052 1	-.463 1	.142 1	.180 1	3
UY Boo	13537	14 11.2	-06 09	A3	6.44	72	-0.166 2	.109 1	-.393 1	.134 2	.200 1	4
XX Vir	124915	14 39.9	-70 55	A0	9.57	72	-1.082 2	.053 1	-.479 1	.122 5	.162 1	3
TY Aps	129885	15 09.8	+10 41	G5	9.31	66,73	-0.983 2	.157 1	-.308 2	.143 4	.185 1	3
AP Ser	136010	15 13.2	-08 02	K0	7.49	73	-0.282 1	.535 1	-.729 2	.383 7	.615 2	3
TV Lib	136010	15 13.2	-08 02	K0	7.49	73	-0.282 1	.535 1	-.729 2	.383 7	.615 2	3
FW Lup	136334	15 15.0	-00 24	A2	6.19	74	-0.027 1	.027 1	-.441 1	.102 2	.179 1	2
SV Ser	137898	15 23.6	+02 12	A5	5.16	72	0.682 1	.089 2	-.414 1	.132 1	.205 1	5
AR Ser	138644	15 28.2	+03 40	K0	7.37	72	-0.229 2	.472 3	-.644 1	.325 4	.559 2	2
CG Lib	141130	15 42.3	-15 29	A3	9.76	71	-1.167 2	.171 1	-.455 4	.165 7	.250 4	3
VT Lib	141130	15 42.3	-15 29	A3	9.76	71	-1.167 2	.171 1	-.455 4	.165 7	.250 4	3
AN Ser	142267	15 48.5	+13 31	G0	6.10	72	0.294 1	.243 2	-.295 1	.171 1	.245 1	3
AT Ser	142267	15 48.5	+13 31	G0	6.10	72	0.294 1	.243 2	-.295 1	.171 1	.245 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	73	0.232 1	.057 1	-.436 1	.134 1	.193 1	3
AV Ser	144172	15 49.8	+08 52	A0	6.28	7						

In several cases a variable has had more than one reference star (*e.g.* in different years). In the first column is indicated the variable star to which the reference star belongs; if available, its HD number is given in column 2. Coordinates are for the epoch 1900.0. The following three columns contain the HD spectral type, the brightness on the Johnson *UBV* system (V_J), and the years in which observations of the variable were made. The next ten columns contain the $V/BLUW$ brightness and colours, each followed by their accuracy which is in units of 0.001 in $^{10}\log$ (intensity). The last column (N) contains the number of nights in which the star was tied to the standard system.

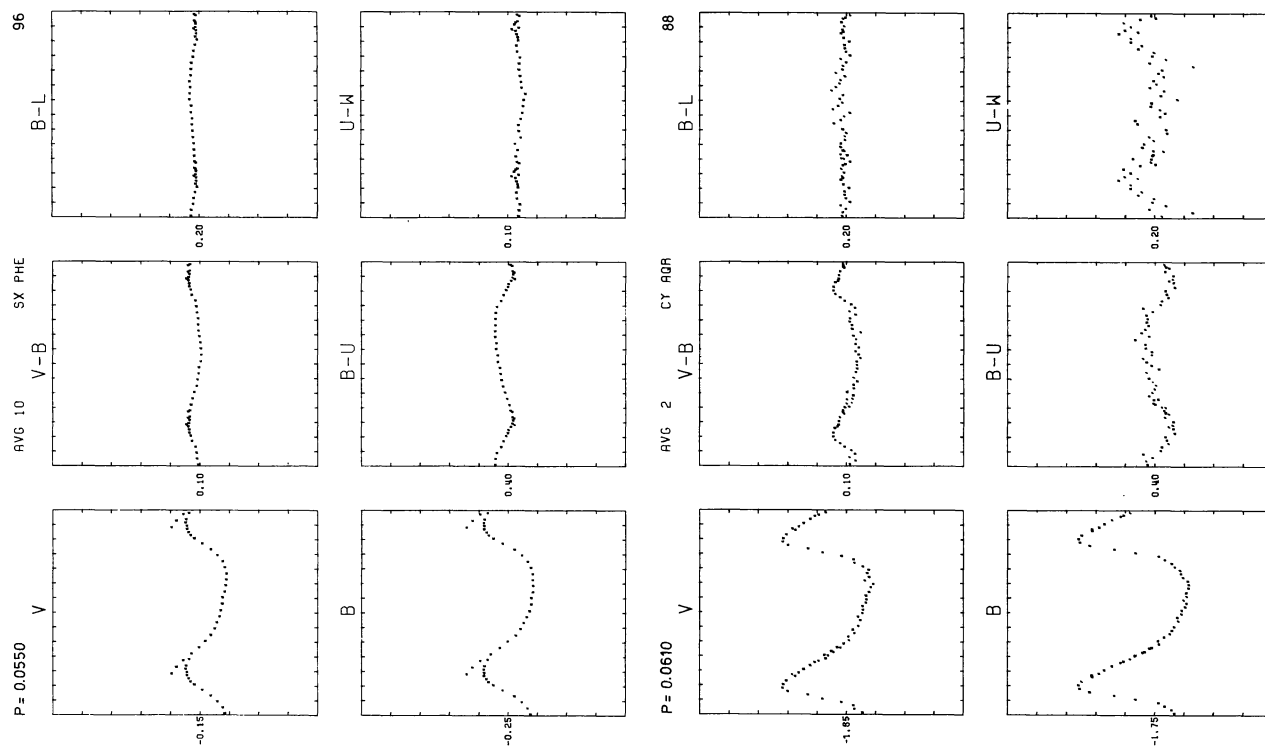


Figure 1

Figures 1 to 45. Light and colour curves in V , B , $(V-B)$, $(B-U)$, $(B-L)$ and in several cases $(U-W)$ for the variables. Two stars are shown per page. Above the light and colour curves for each variable are given: the period in four decimals, a code for the observer, ΔS , the name of the variable and the identification number in the data file.

The abscissa is the phase, from 0.8 to 0.2 including one complete cycle. The ordinate is brightness or colour on the standard $VBLUW$ system in units of $10 \log(\text{intensity})$; brightness or blueness increasing upwards. The subdivisions along abscissa and ordinate are set at intervals of 0.10. For the brightness and the colours the average value is indicated to the left of each graph.

The observer codes are: AVG for van Genderen, P70 for Pel (1970), H74 for van Houten (1974), W68 for Wamsteker (1968).

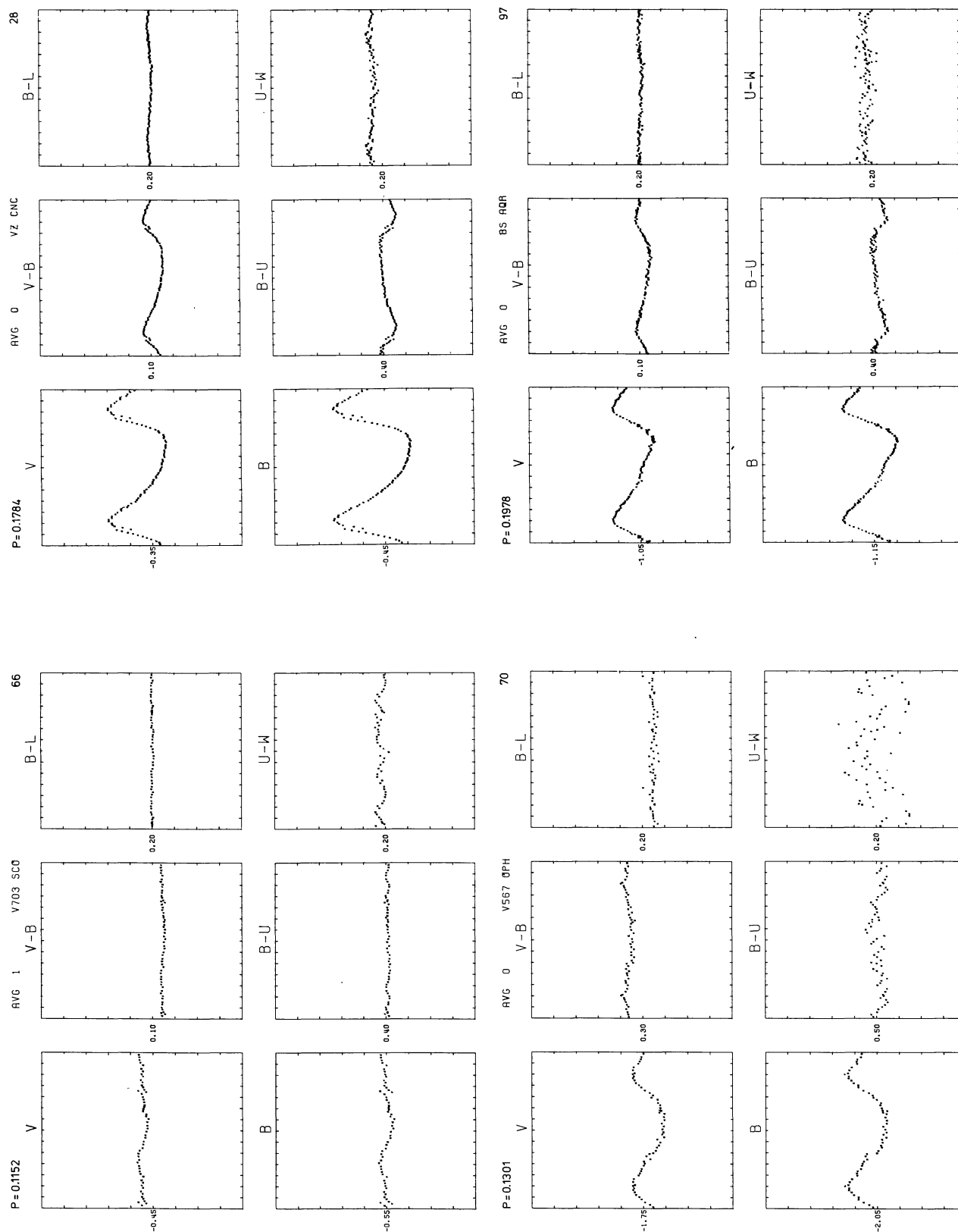


Figure 3

Figure 2

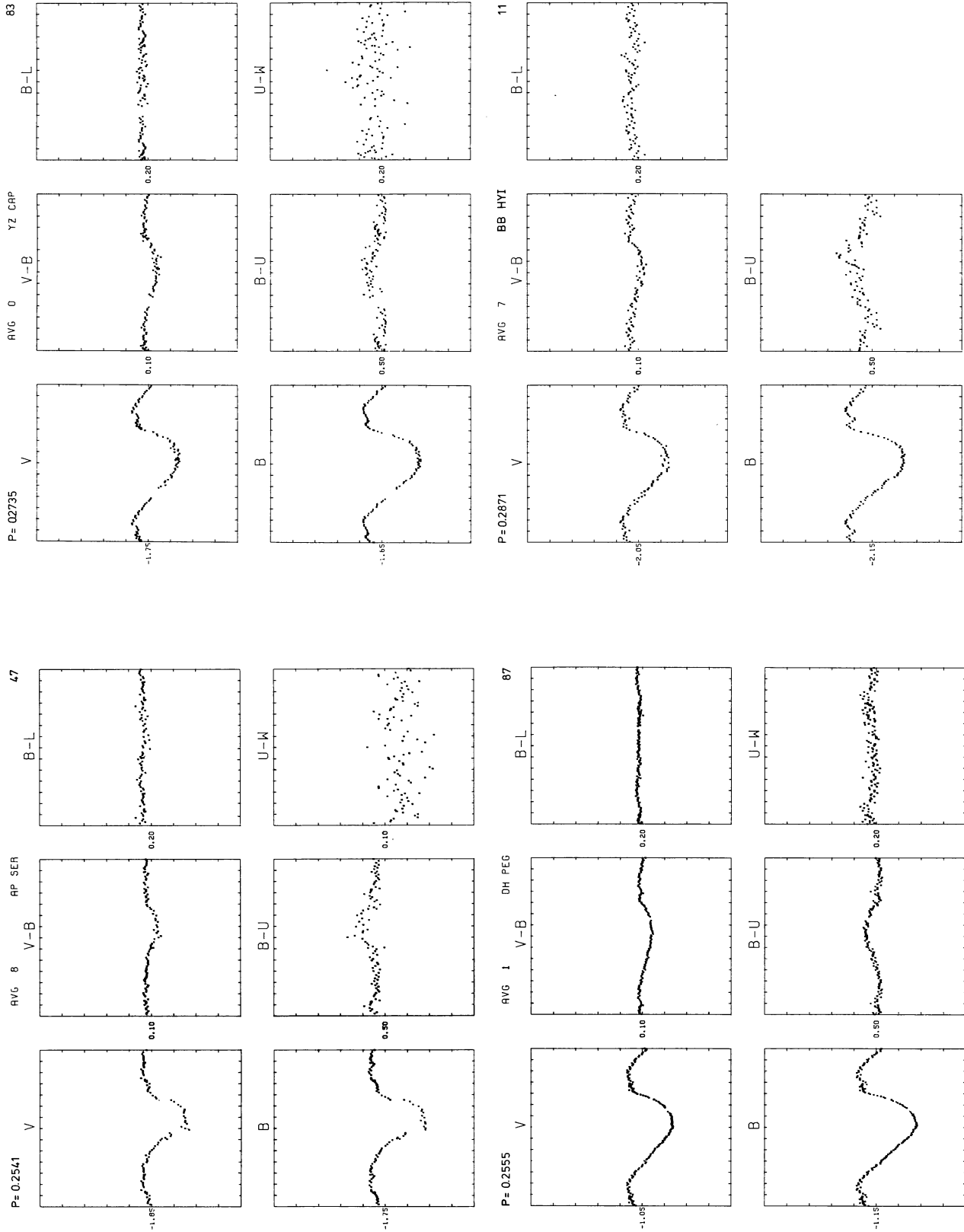


Figure 5

Figure 4

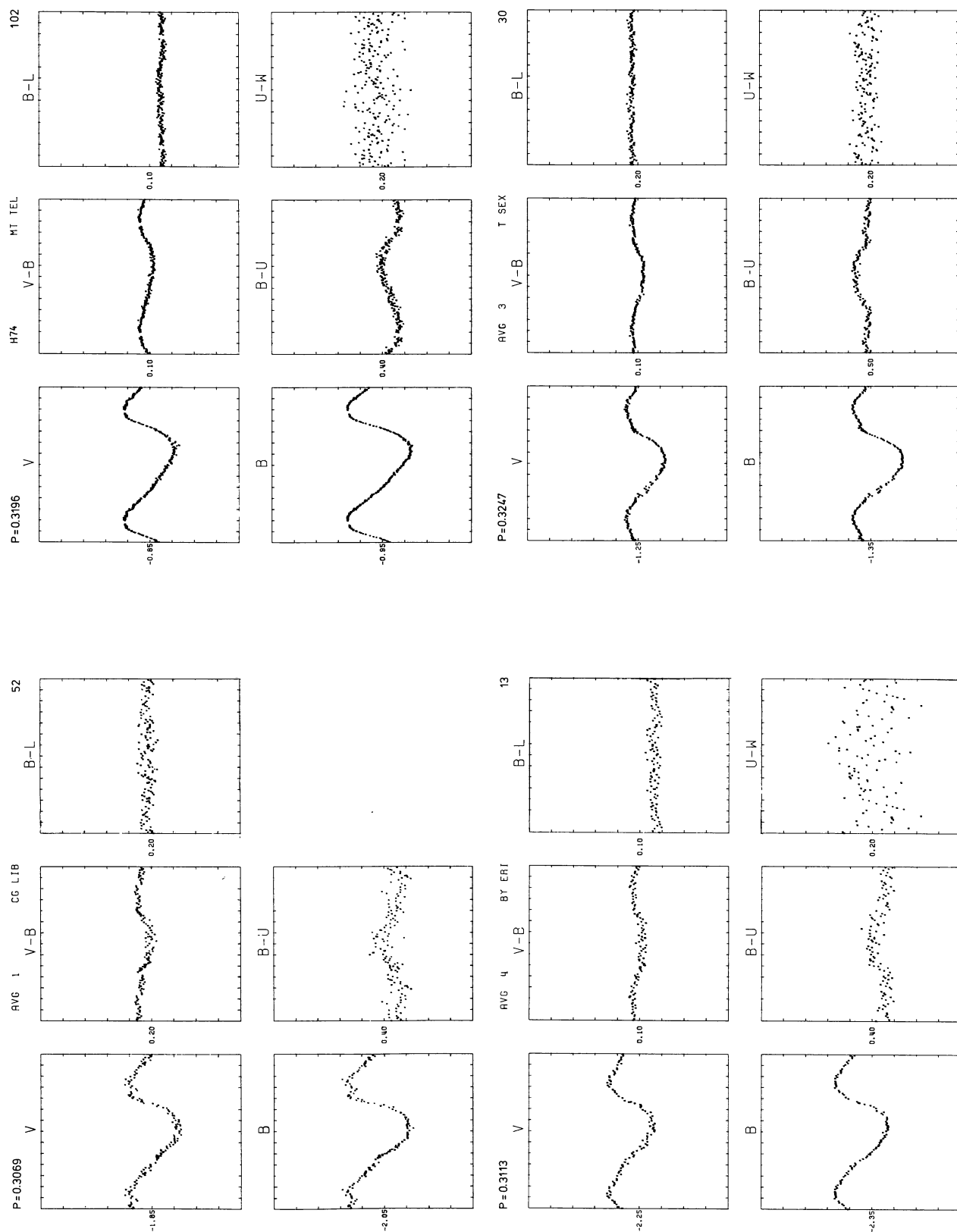


Figure 7

Figure 6

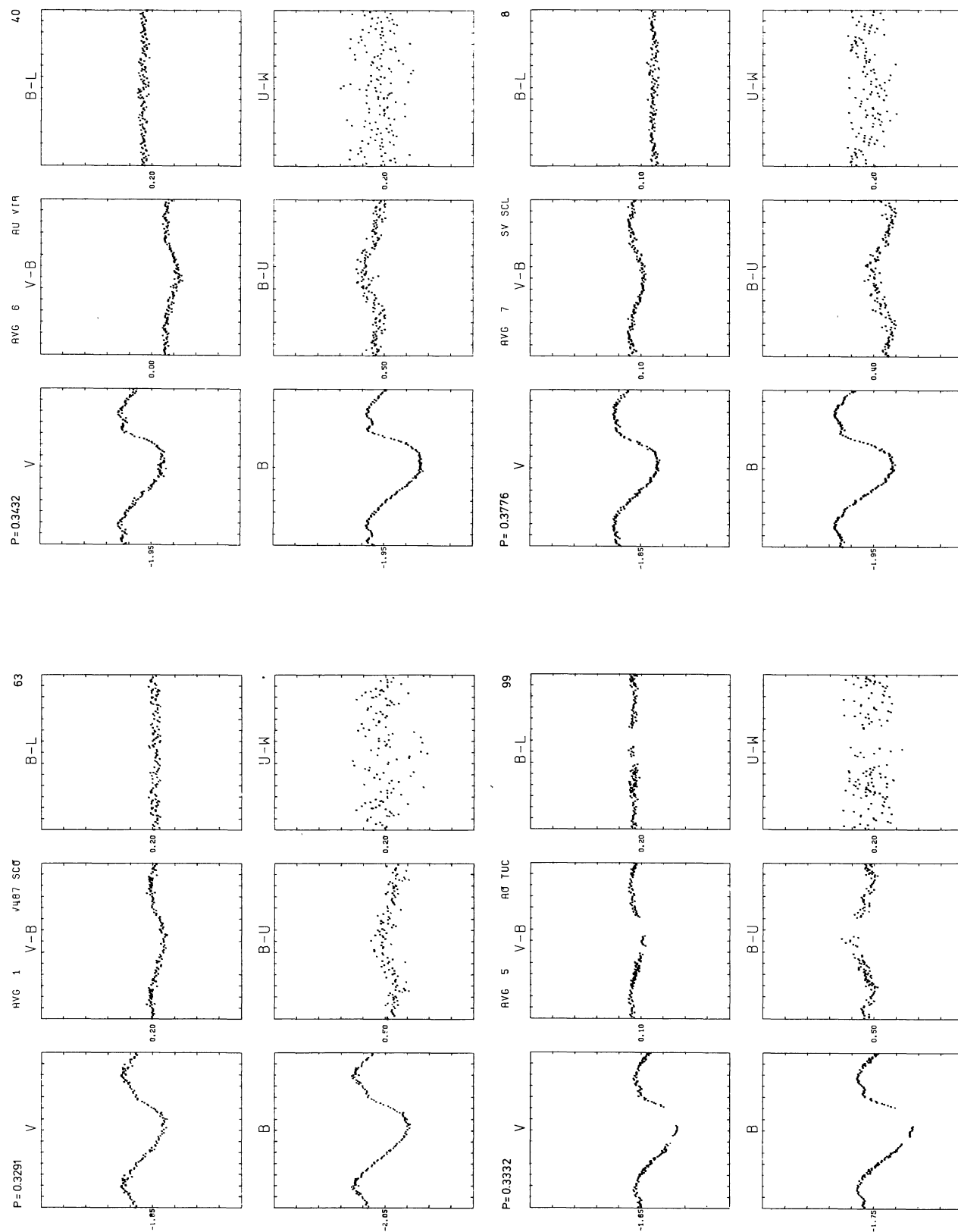


Figure 9

Figure 8

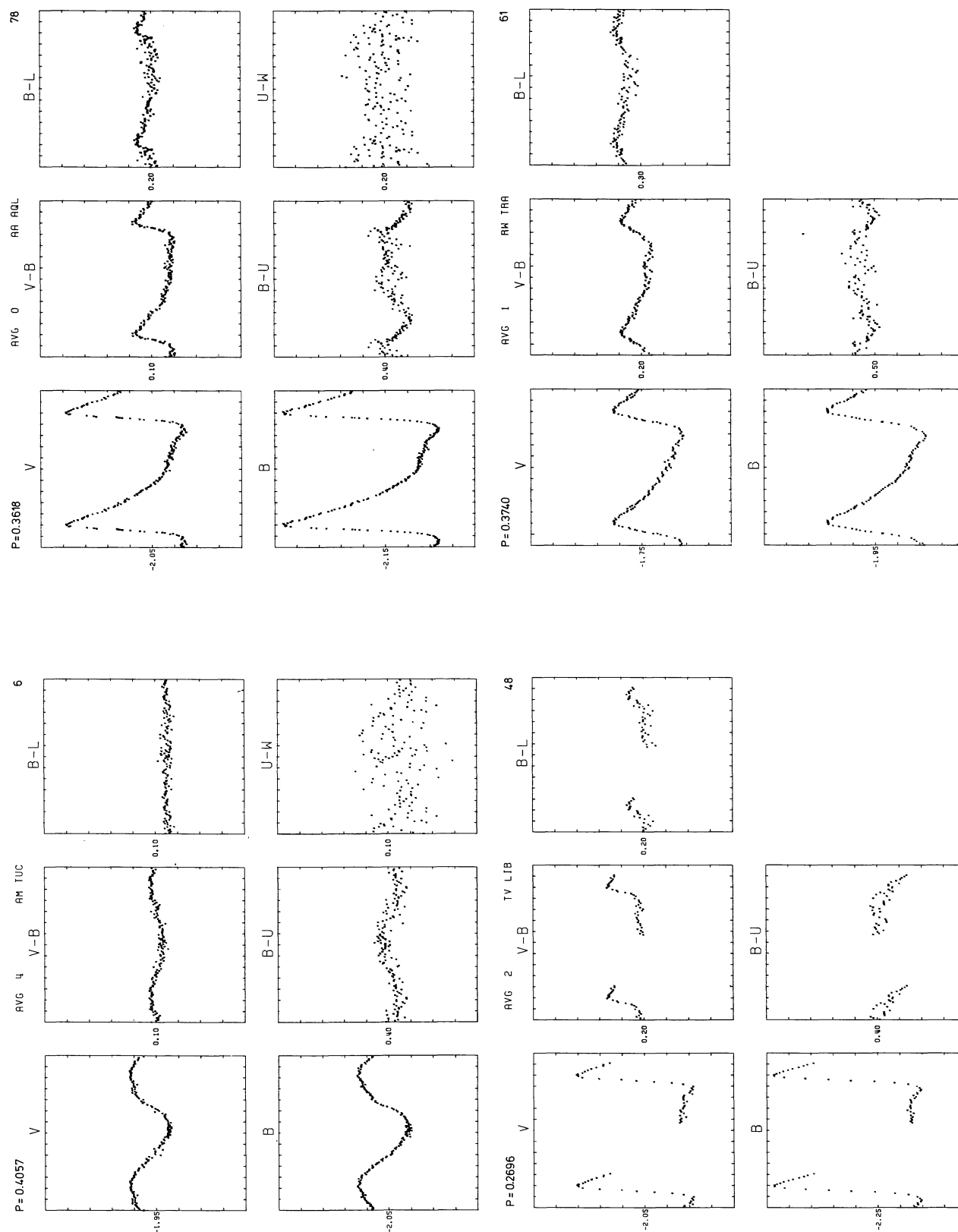


Figure 10

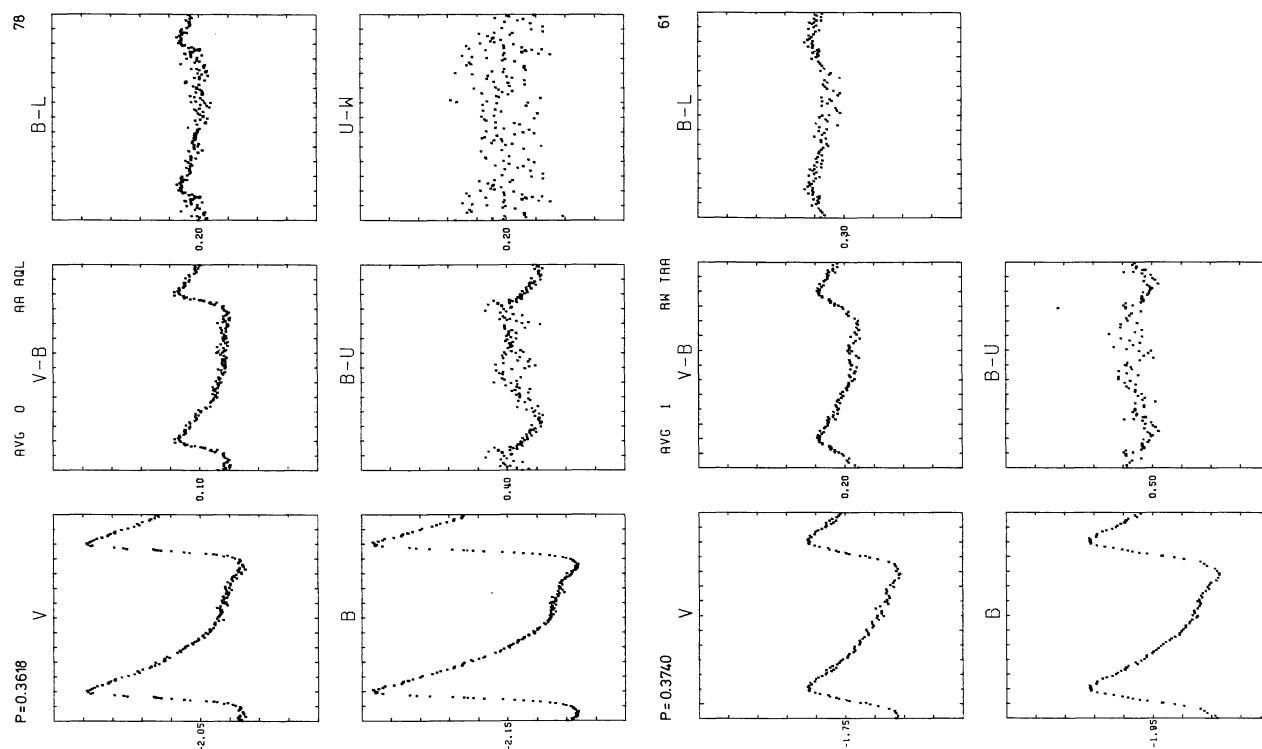


Figure 11

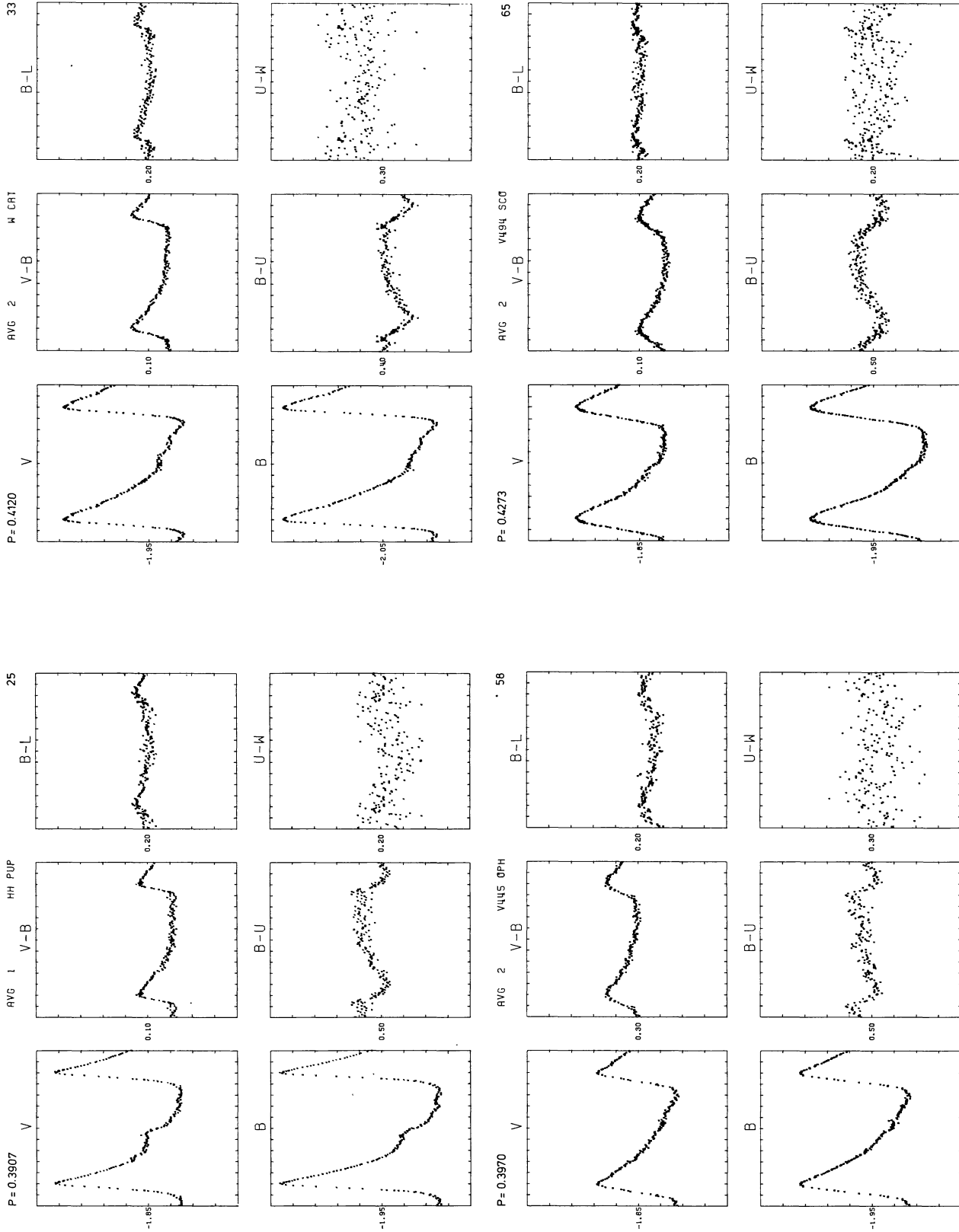


Figure 13

Figure 12

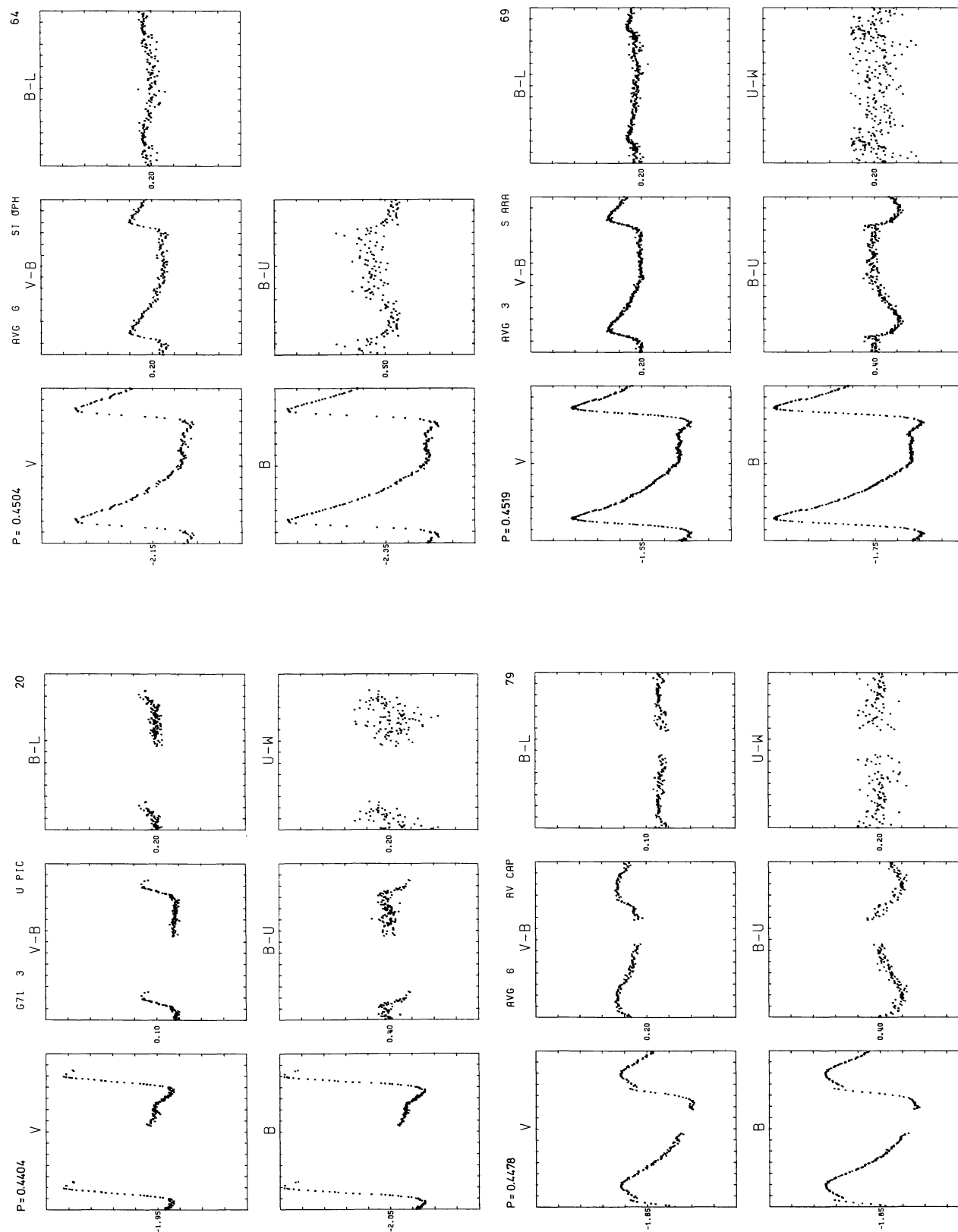


Figure 15

Figure 14

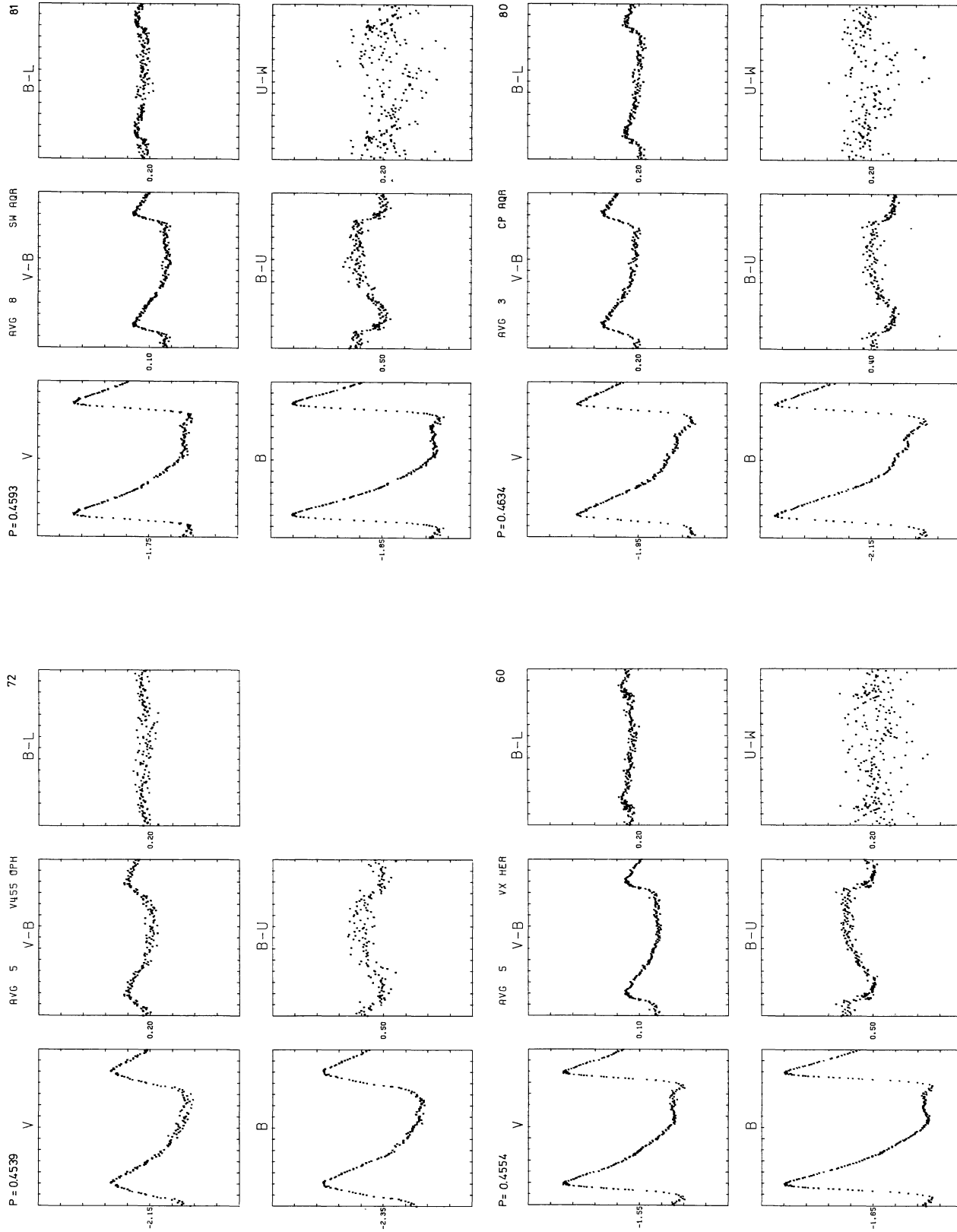


Figure 17

Figure 16

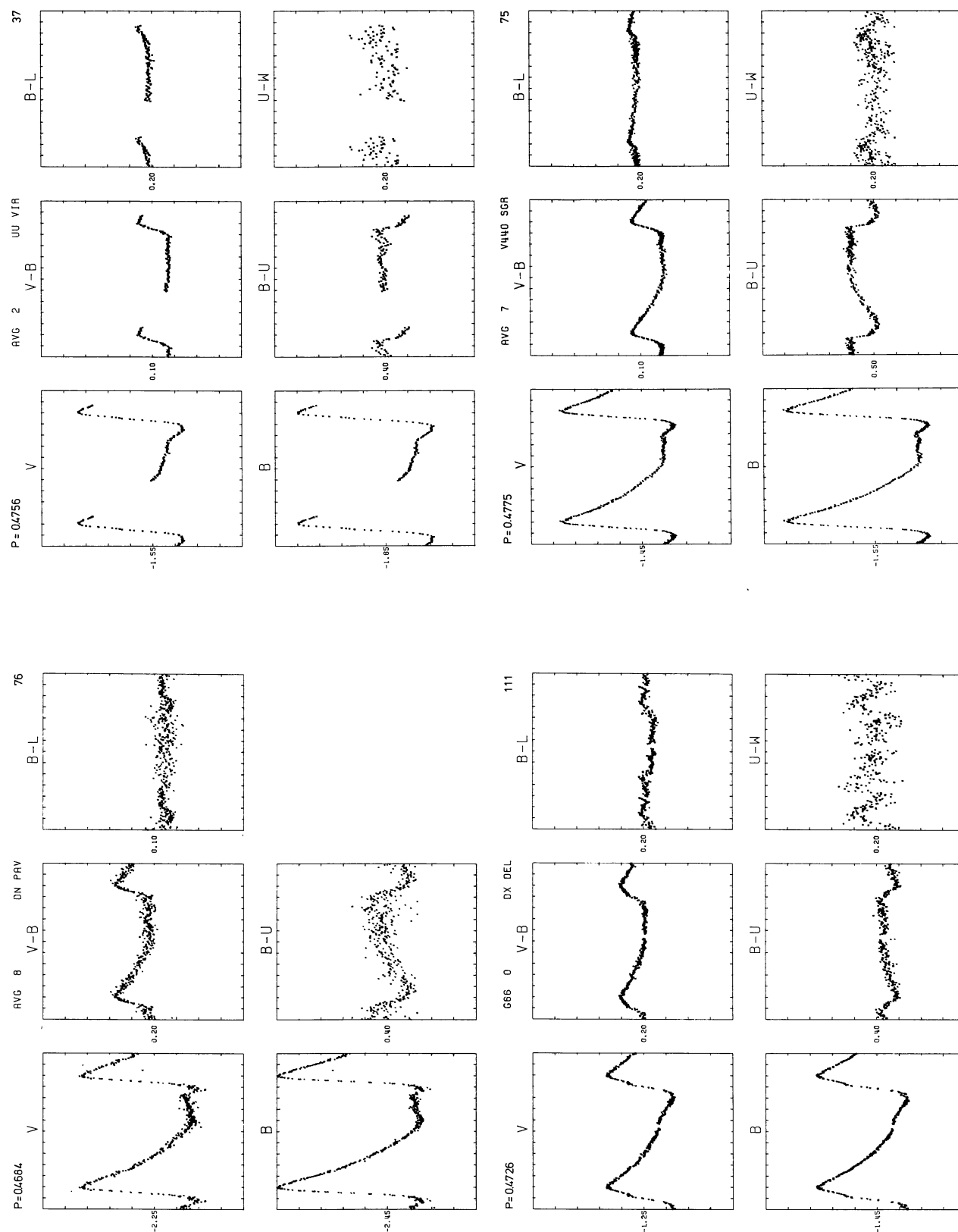


Figure 19

Figure 18



Figure 20

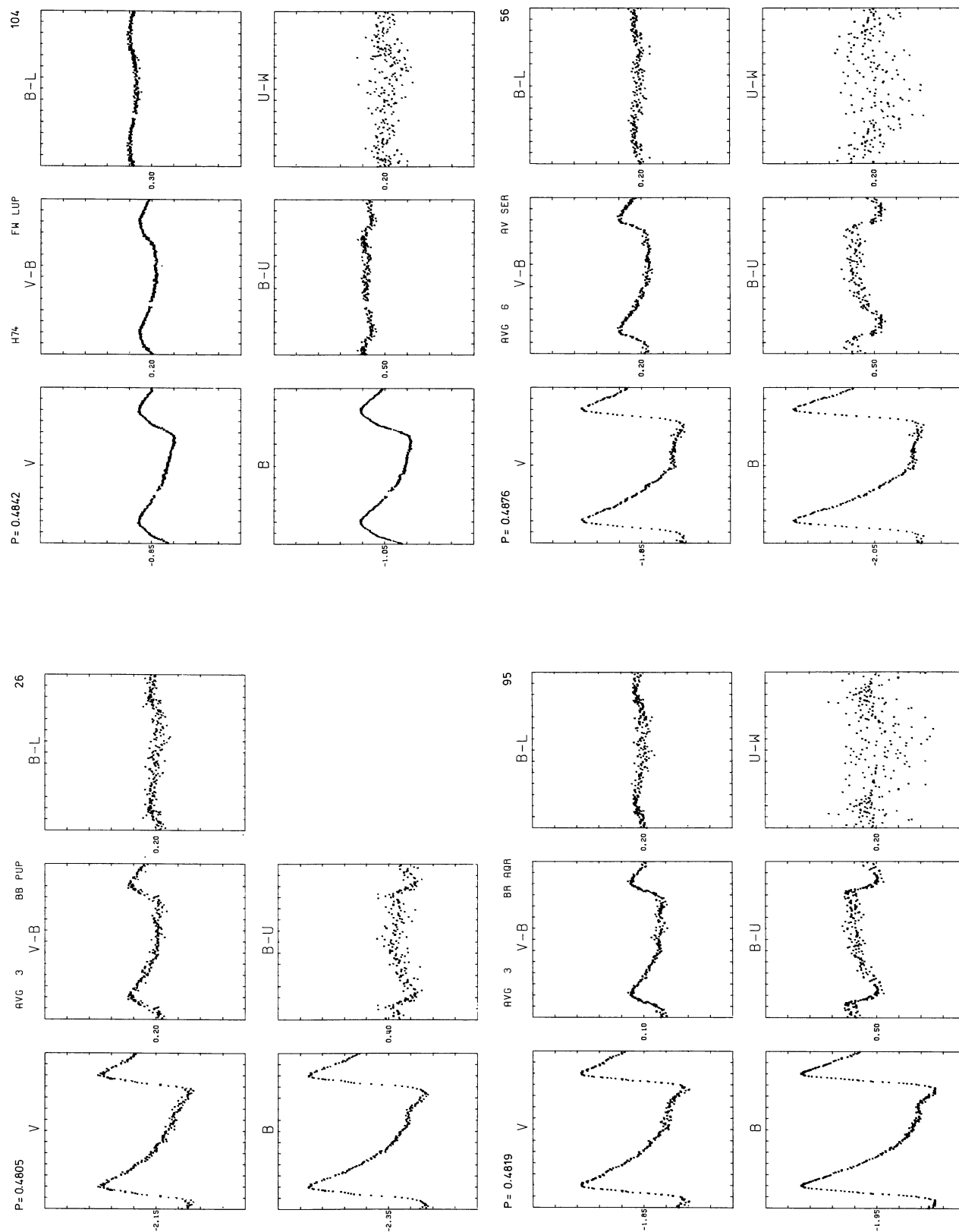


Figure 23

Figure 22

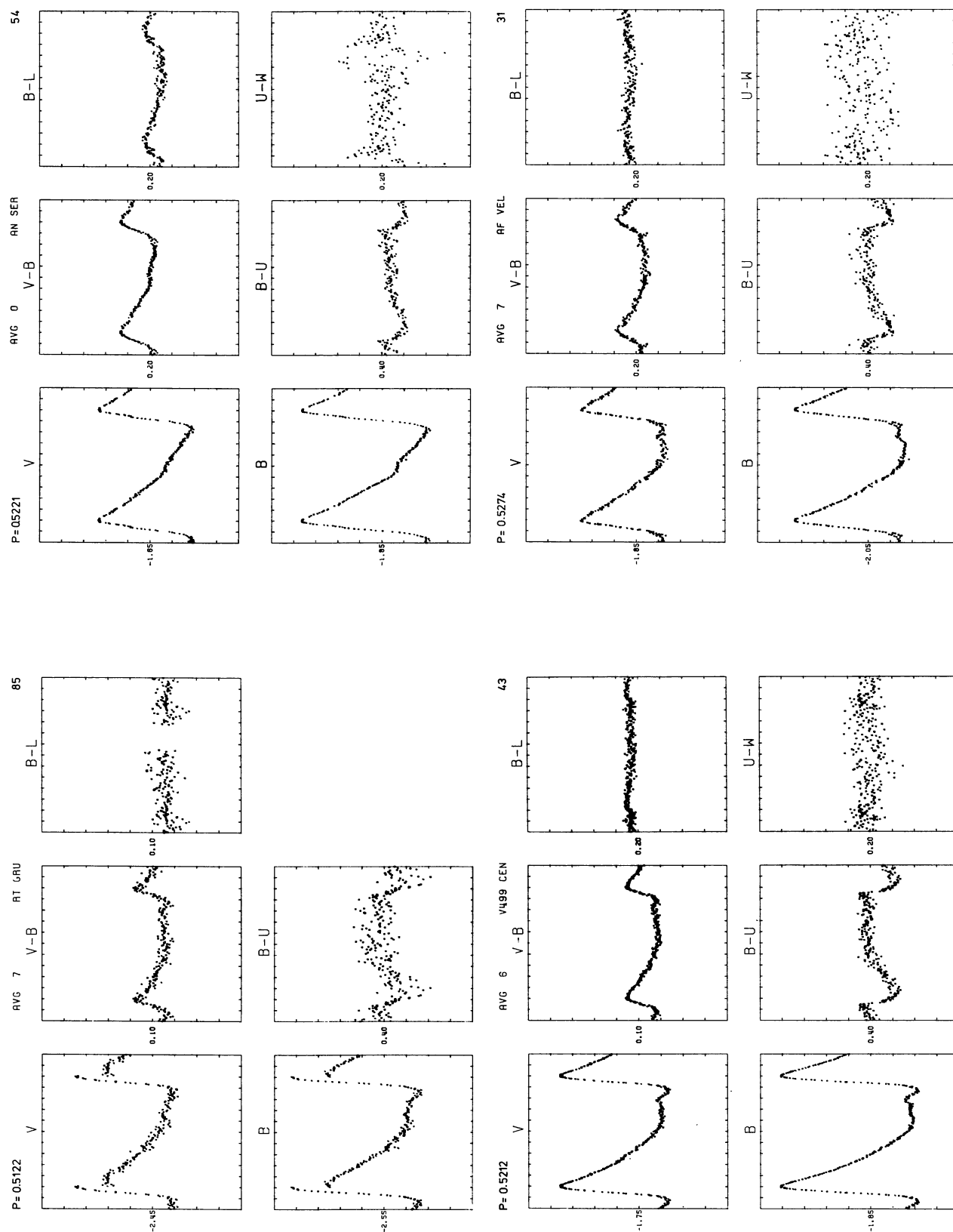


Figure 27

Figure 26

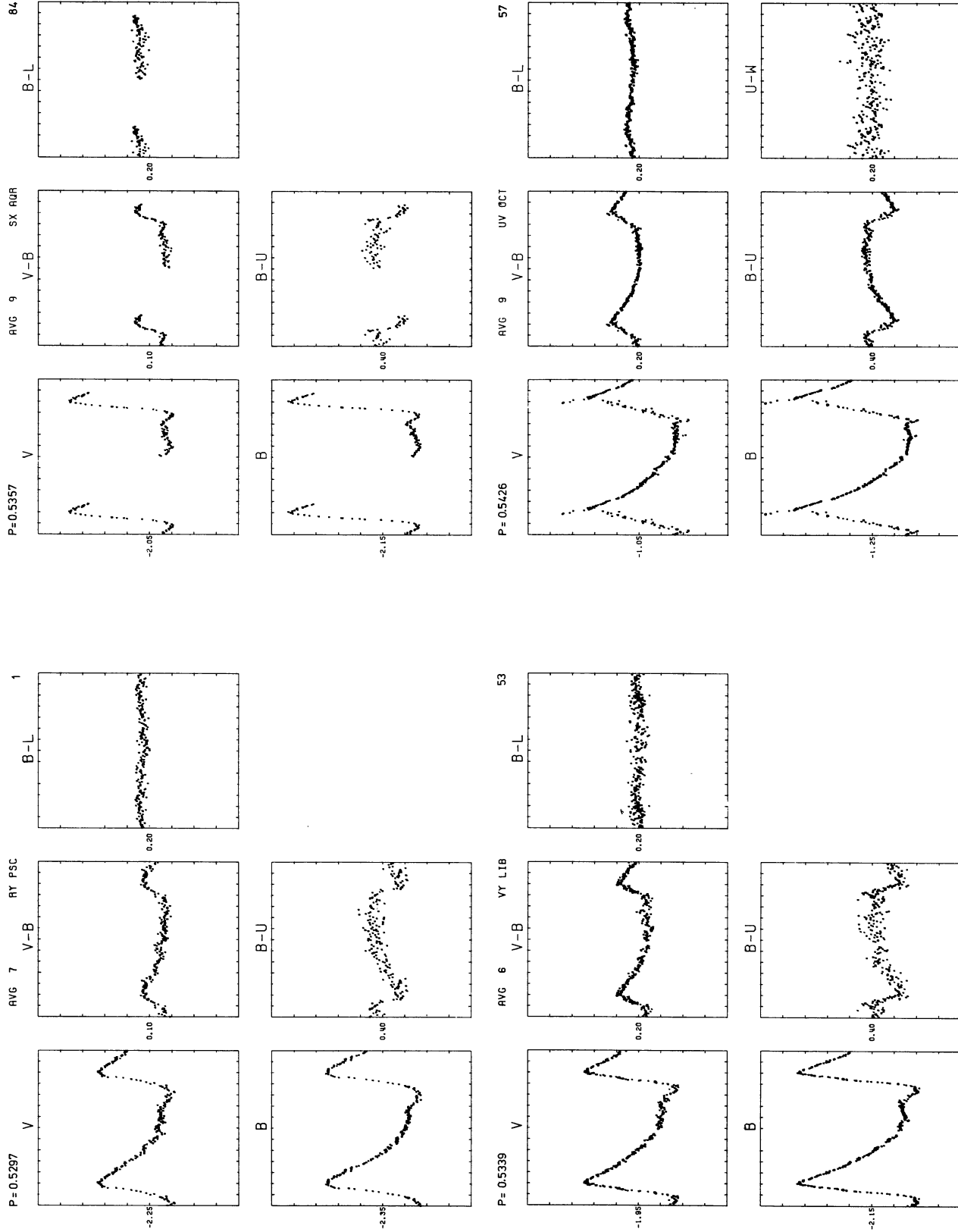


Figure 29

Figure 28

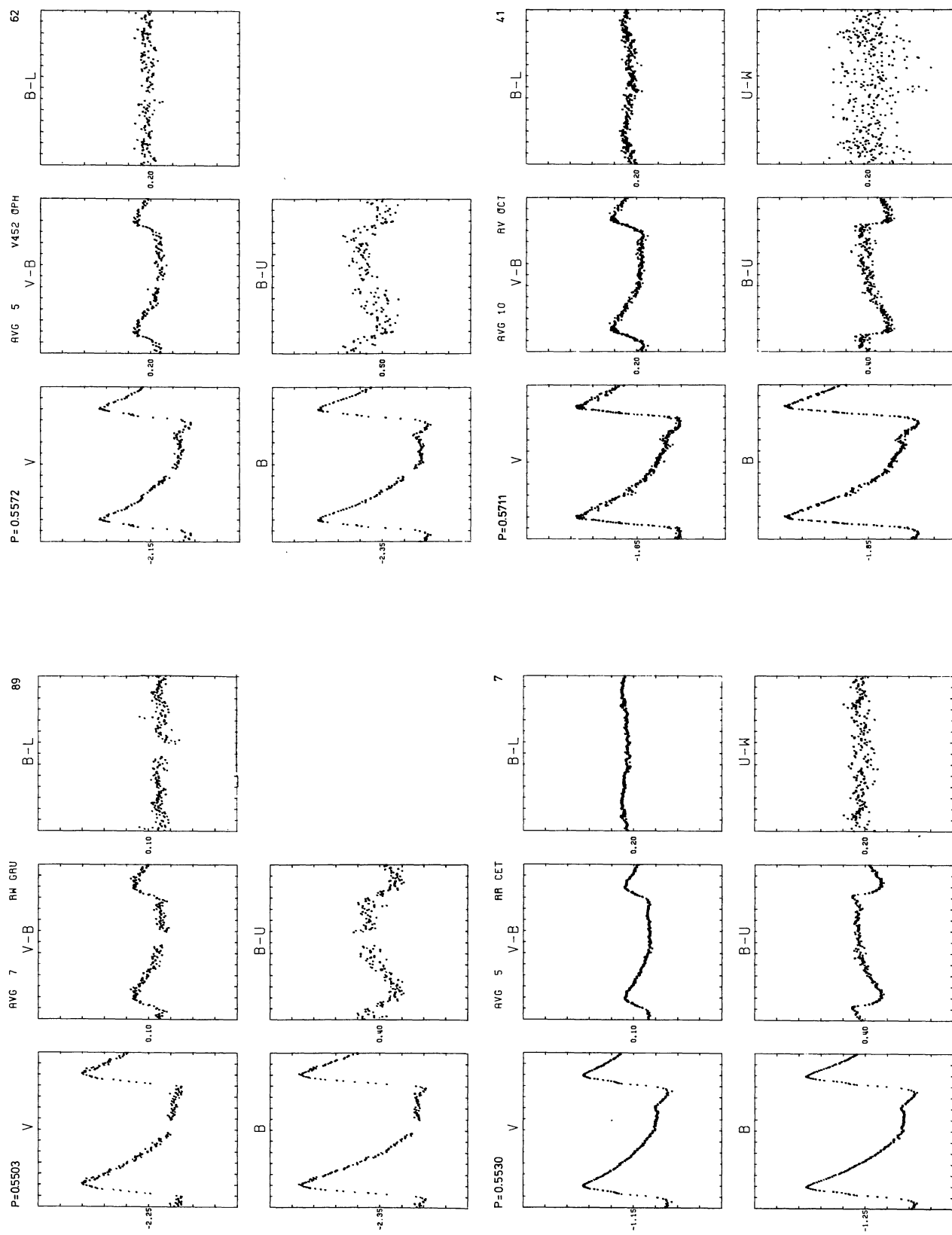


Figure 31

Figure 30

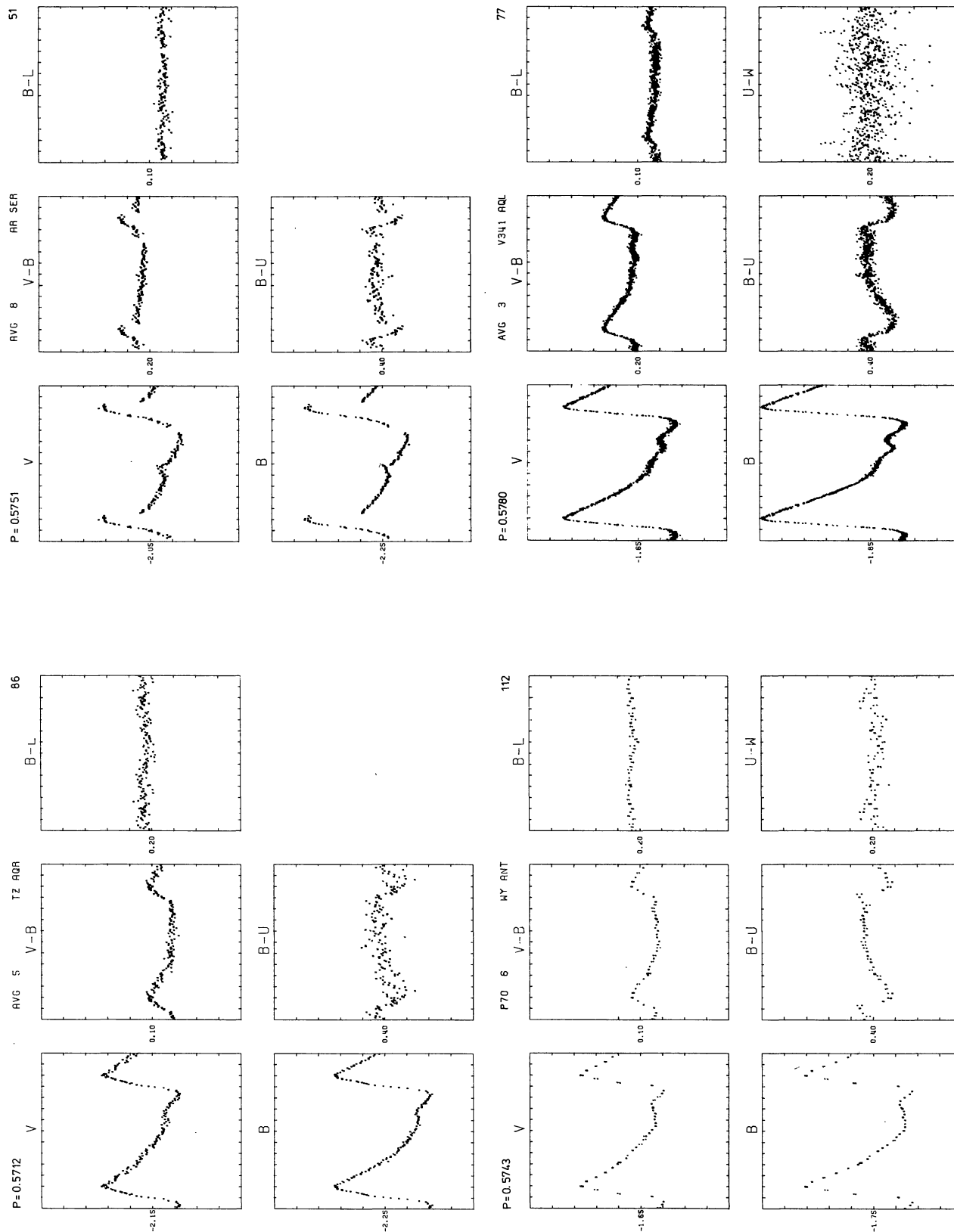


Figure 33

Figure 32

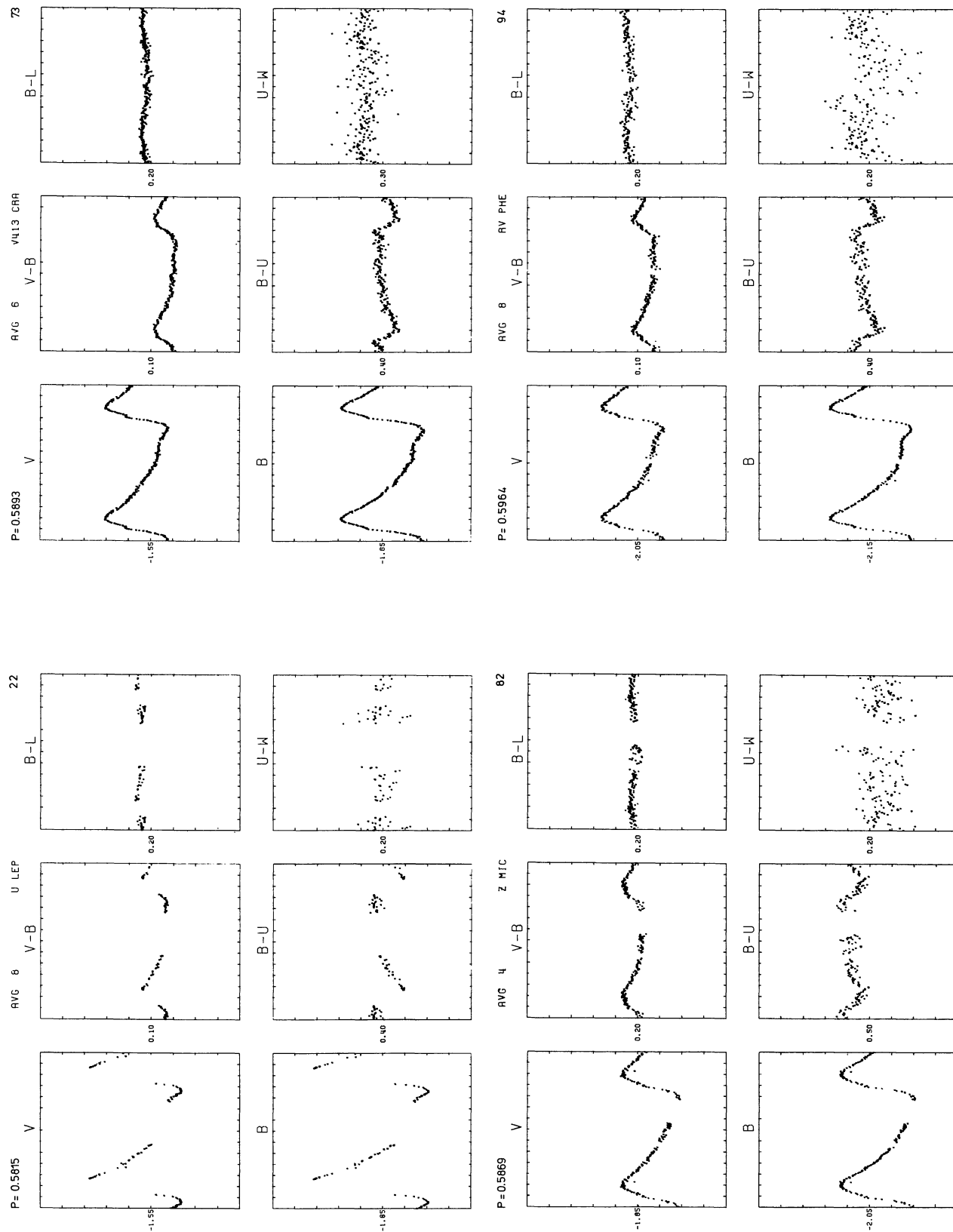


Figure 35

Figure 34

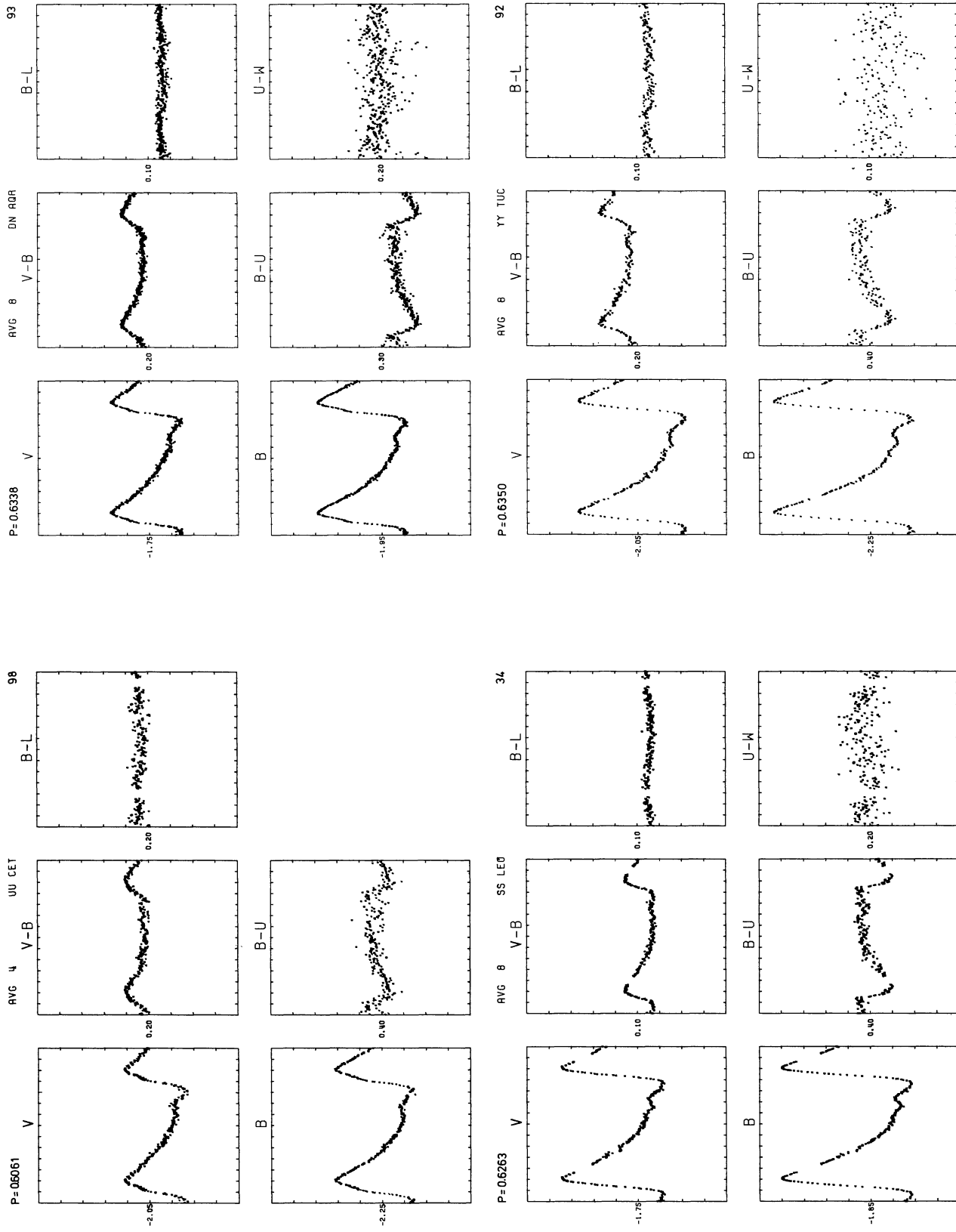


Figure 37

Figure 36

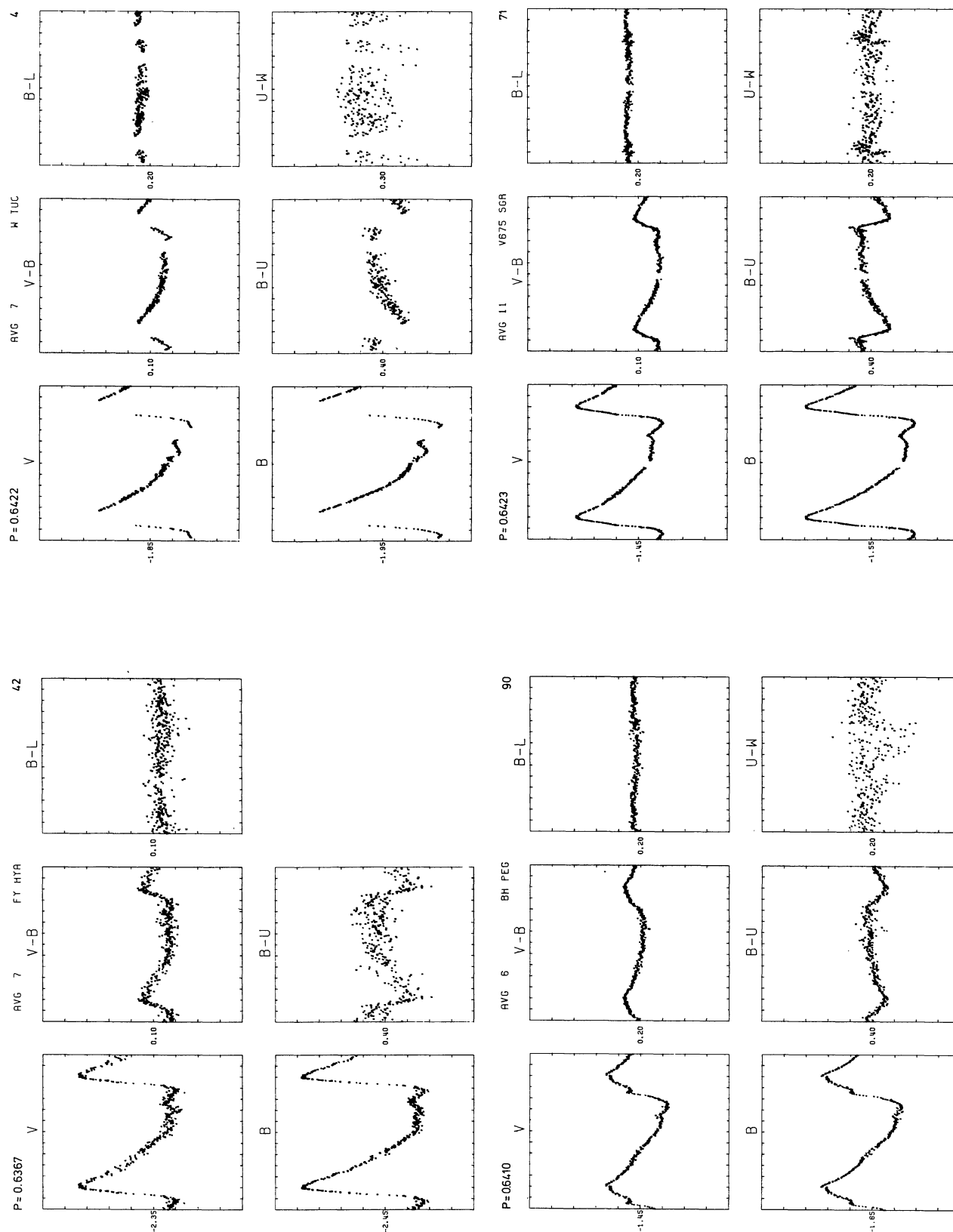


Figure 39

Figure 38

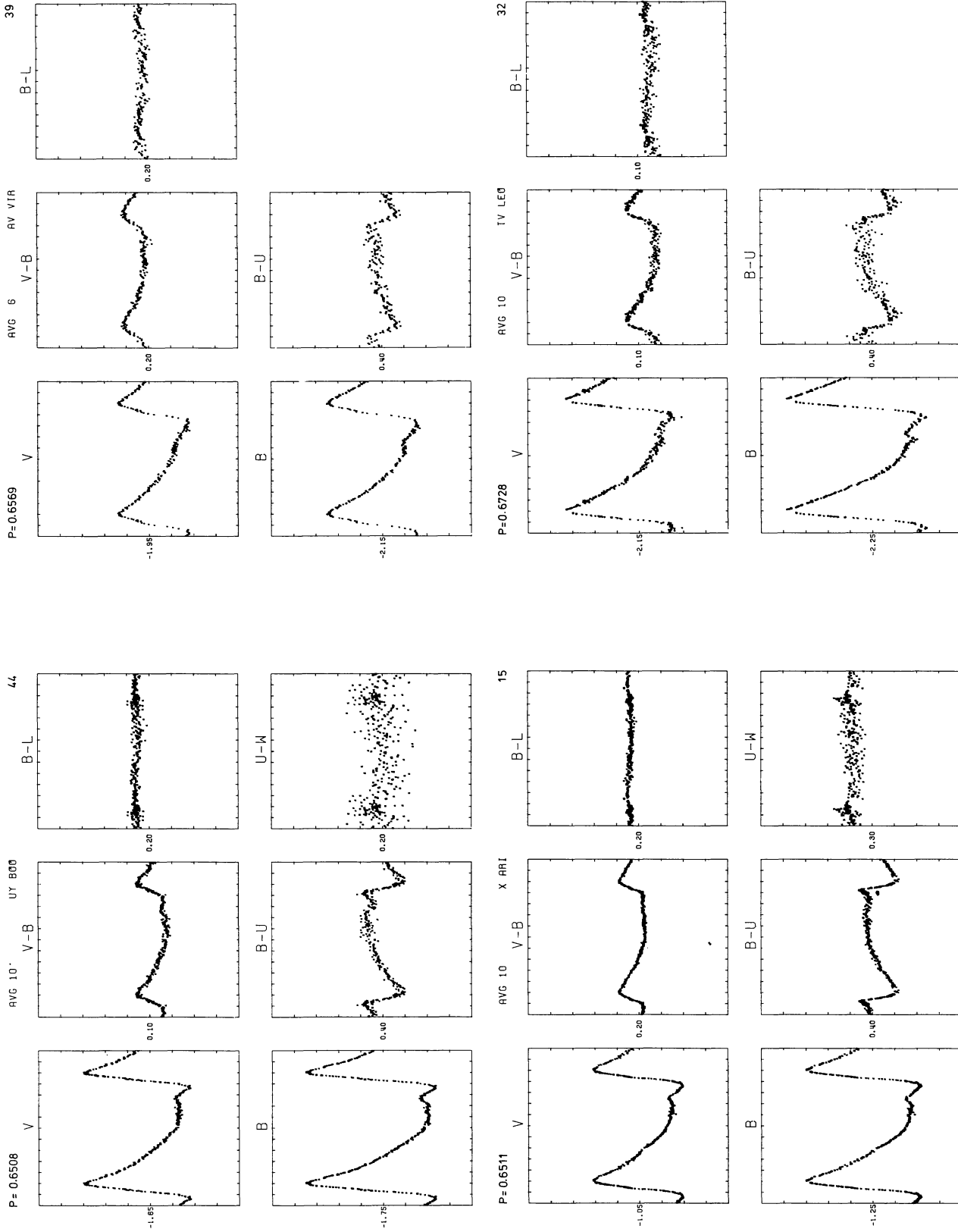


Figure 41

Figure 40

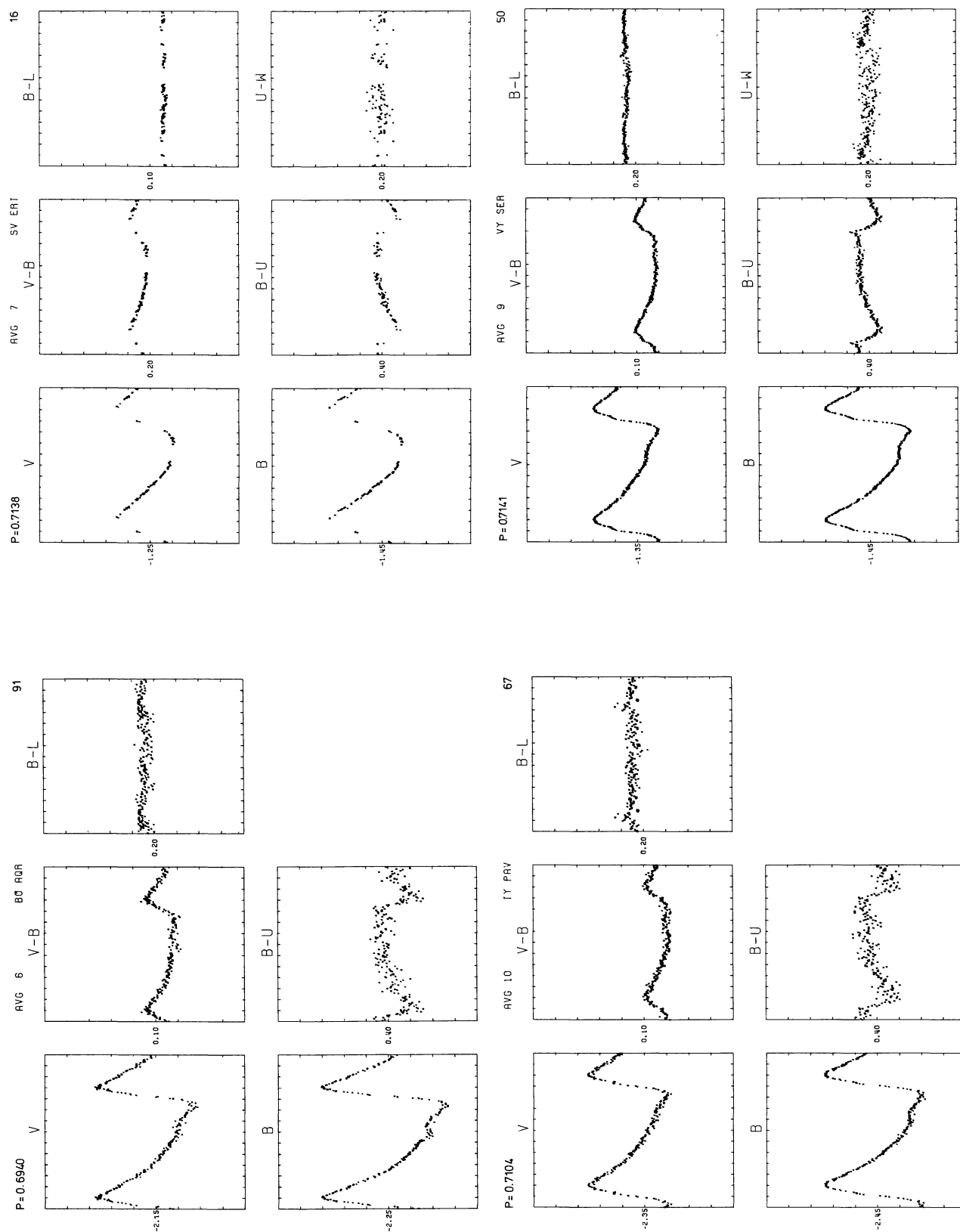


Figure 43

Figure 42

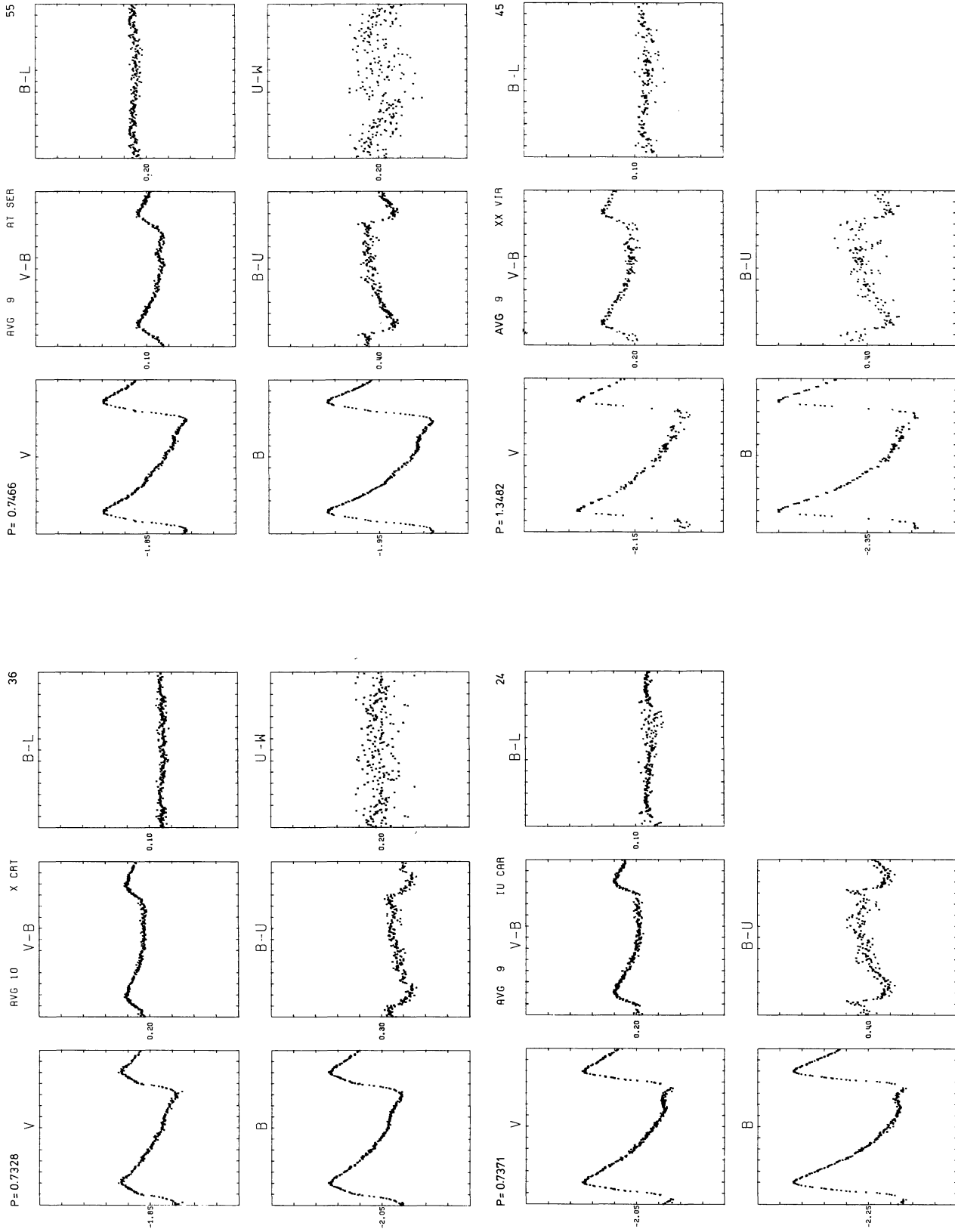


Figure 45

Figure 44

NOTE ADDED IN PROOF

It has been found that in table 1, for DN PAV, $\langle B-L \rangle$ should be .155 instead of .148.