ON THE STRUCTURE OF THE CEPHEID INSTABILITY STRIP

N. N. YAKIMOVA
Sternberg Astronomical Institute, Moscow, U.S.S.R.
and
N. S. NIKOLOV and G. R. IVANOV
Dept. of Astronomy, Bulgarian Academy of Sciences and University of Sofia, Bulgaria

Abstract. Using rich photometric material on the Cepheids in the Galaxy and the Large and Small Magellanic Clouds, the structure of the instability strip in the HR diagram is investigated. The method of the δ-δ diagrams is used, δ being the difference of certain Cepheid characteristics from the means for a given period. The Cepheids in the three galaxies, studied separately, show the same relationship: the light amplitude increases toward the low temperature limit of the instability strip and is also related with the temperature at maximum in the sense that Cepheids with a given period and fixed mean temperature have a greater light amplitude for a higher temperature at maximum. Our results do not coincide with those by Sandage and Tammann, probably because they have studied the Cepheids in the different star systems as one single complex.

1. Introduction

The importance of the knowledge of the Cepheid instability strip in the HR diagram is well known, after Sandage (1958) showed the natural dispersion of the P, L relation, because of the temperature differences of the Cepheids with a given period. It is not surprising that one of the main subjects of Cepheid investigations during the last 15 years relates to Sandage's assumption of the possibility that the shape of the light curves is related to the luminosity. The first investigations (Sandage, 1958; Arp, 1960; Kraft, 1961) showed that the Cepheids located at different places in the strip possess different amplitudes, namely small amplitude Cepheids lie in the neighbourhood of the temperature instability strip limits. As a result the following concept was accepted: "When a supergiant enters the instability strip in the HR diagram, it pulsates with small amplitude. As the evolution proceeds, the amplitude increases to a maximum value close to the centre of the strip, after which the amplitude again decreases (Kraft, 1961).

About ten years later Sandage and Tammann made an extensive study of this problem, considering the galactic Cepheids and those of the SMC, LMC and M31 as one single complex. These authors came to the conclusion, that the pulsation amplitude of Cepheids in different period intervals has a different behaviour: it increases toward the low temperature limit of the strip, for Cepheids in the period interval of $0.86 < \log P < 1.3$ and toward the high temperature limit for Cepheids with $0.4 < \log P < 0.86$ and perhaps for those with $\log P > 1.3$.

We have also investigated the problem of the Cepheid instability strip structure, but we have studied the Cepheids in the different systems separately. In the present paper we summarize our results.

Sherwood and Plaut (eds.), Variable Stars and Stellar Evolution, 201–222.

2. Method

We have made use of the usual method of the δ-differences of a certain Cepheid characteristic $x(P)$ from the mean $x(P)$ for a given period P:

$$\delta(x) = \overline{x(P)} - x(P).$$

Some authors (Arp, 1960; Kraft, 1961; etc.) have used the δ-differences not only from the mean $\overline{x(P)}$, but also from the maximum $x^{\max}(P)$ of characteristics x; for example, the light amplitude. Such a δ-difference is Kraft's value 'amplitude defect' f_B, used also by Sandage and Tammann (1970). We prefer, however, to use the δ-differences from the mean only, because:

(1) the unity of all $\delta(x)$ is preserved and

(2) the mean $\overline{x(P)}$ are always more precisely determinable than the maximum $x^{\max}(P)$.

We have made use of a wide spectrum of Cepheid characteristics x: maximum, mean and minimum intrinsic $B-V$ and $U-B$ colours, colour amplitudes, light amplitudes A_B, mean radii $\bar{R}$ and radius amplitudes ΔR, as well as absolute magnitudes $\langle M_V \rangle$.

3. Analyzed Material

For the galactic Cepheids we have made use of all the above characteristics.

The observed $B-V$ colours were obtained from the catalogue of Mitchell *et al.* (1964); the $U-B$ data were taken from Nikolov *et al.* (1973), where a more precise reduction of Irwin's (1961) observations $(U-B)_c$ to the $U-B$ system of the catalogue of Mitchell *et al.*, was made.

The E_{B-V} excesses for about 160 Cepheids were determined by Tsarevsky and Yakimova (1970). These excesses were obtained as mean ones from those obtained with the help of the data by these authors from mean maximum and minimum spectra in Kraft's Γ-system (Gusseva and Tsarevsky, 1968) and with the help of other spectral determinations, mainly by Bahner *et al.* (1962), as well as excesses by Kron and Svolopoulos (1959), Mianes (1961) and Williams (1966). In determining the intrinsic $B-V$ colours from spectral data by means of the recalibrated 'spectrum-$(B-V)_0$' relation and the E_{B-V} (Tsarevsky and Yakimova, 1970; Yakimova, 1970) one has taken into account the dependence of the Cepheid colour excesses on the spectral type (Fernie, 1963; Nikolov, 1967).

The E_{U-B} excesses of about 140 Cepheids and the intrinsic $U-B$ colours of about 140 galactic classical Cepheids were obtained by means of analogously calibrated 'spectrum-$(U-B)_0$' relation by Nikolov and Ivanov (1973a, b), who have taken into account this dependence too. The new calibrated 'spectrum-intrinsic colour' relations are given in Table I. The mean excesses E_{B-V} and E_{U-B} are given in Table II. The intrinsic colours $B-V$ and $U-B$ are given also in Table II. On using the mean Cepheid radii by Kurochkin (1966) and Oke-Kraft's (Kraft, 1961) temperature scale from the formula (Arp, 1960)

$$M_V = 96.57 - 5\log R - 10\log T_{\text{eff}} + \Delta m_{\text{bol}},$$

we obtained the absolute magnitudes of Cepheids $\langle M_V \rangle$, given in Table II.

In Figure 1 we present the X-log$P$ diagrams and the adopted smoothed mean $x(P)$ relations for the colours, the light amplitudes etc. The peculiarities of the runs of the characteristics x with the period are evident. Because of these peculiarities we have

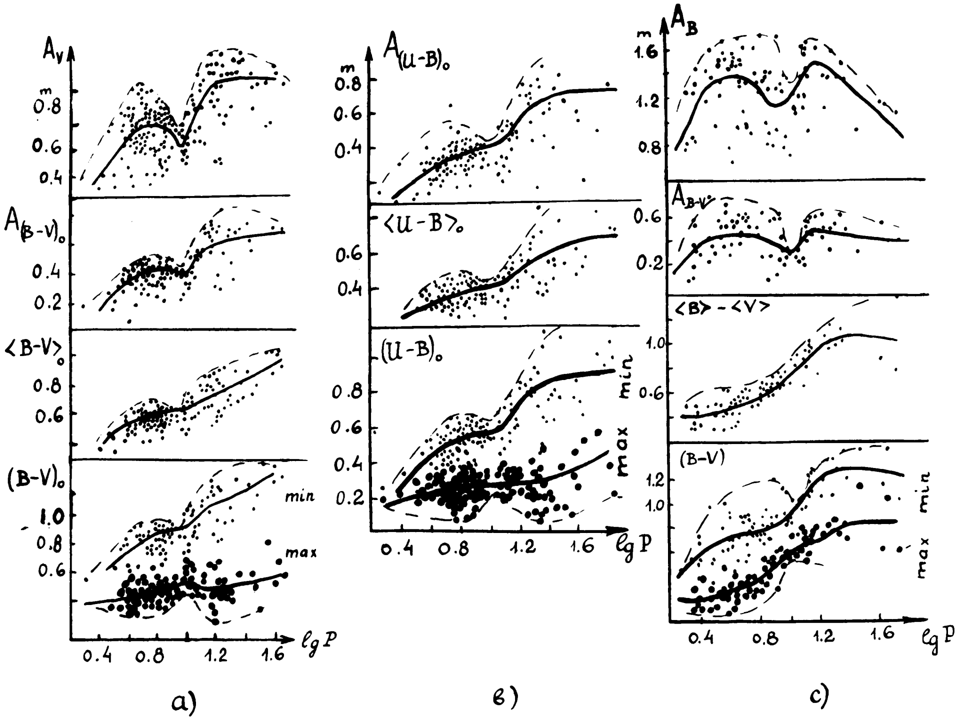

Fig. 1. (a)–(b) The intrinsic colours of the classical galactic Cepheids and the light and colour amplitude depending on log$P$. (c) Colour and amplitude of the central part of SMC depending on log$P$.

adopted more complex (neither linear nor quadratic) x-log$P$ relations, especially for the '$(B-V)$-log$P$' relation for which one usually adopts a linear or a quadratic one.

In Table III are listed the δ-differences for the investigated characteristics of classical galactic Cepheids.

The diagrams for the same B, V Cepheid photometric characteristics were constructed in the same way for the central region of the SMC using data by van Genderen (1969), for the peripheral regions of the SMC using the data by Gascoigne (1969), and for the peripheral regions of the LMC using data by Woolley *et al.* (1962). Tables IV, V and VI present the δ-differences for the investigated characteristics x for LMC Cepheids, for central SMC Cepheids and peripheral SMC Cepheids, respectively.

4. Results

We have investigated a great number of δ-δ diagrams for more than 300 classical Cepheids in the Galaxy and the Magellanic Clouds (Yakimova, 1970, 1972a, b, c; Ivanov, 1974). Each group of stars was investigated separately, as well as the galactic Cepheids with P smaller than and greater than 10 days. The general result is, that in all cases the instability strip structure is identical.

In Figure 2 are plotted the δ-differences of the light amplitude against the δ-differences of the intrinsic $B-V$ and $U-B$ colours at maximum, minimum and mean

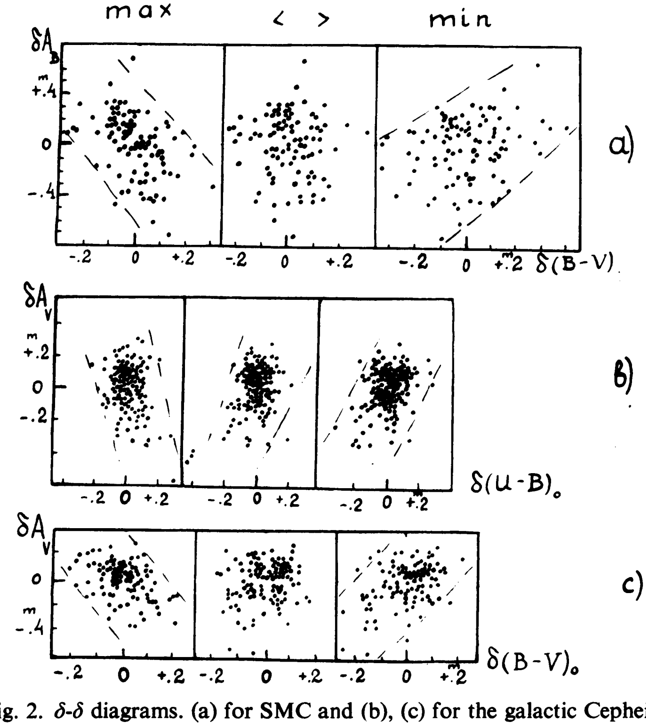

Fig. 2. δ-δ diagrams. (a) for SMC and (b), (c) for the galactic Cepheids.

phase for the galactic Cepheids. The correlations show that the light amplitude increases with the decrease of the minimum and/or mean temperature (the temperatures are expressed with $(B-V)_0$ or $(U-B)_0$). But one can see also that the light amplitude decreases with the decrease of the temperature at maximum. Therefore the light amplitude depends not only on the mean temperature, as is usually adopted; it is related to the temperature at maximum too. This double dependence of the light amplitude is clearly demonstrated in Figure 3, which is taken from Yakimova (1971), and in which the Cepheids with different temperature at maximum (with different

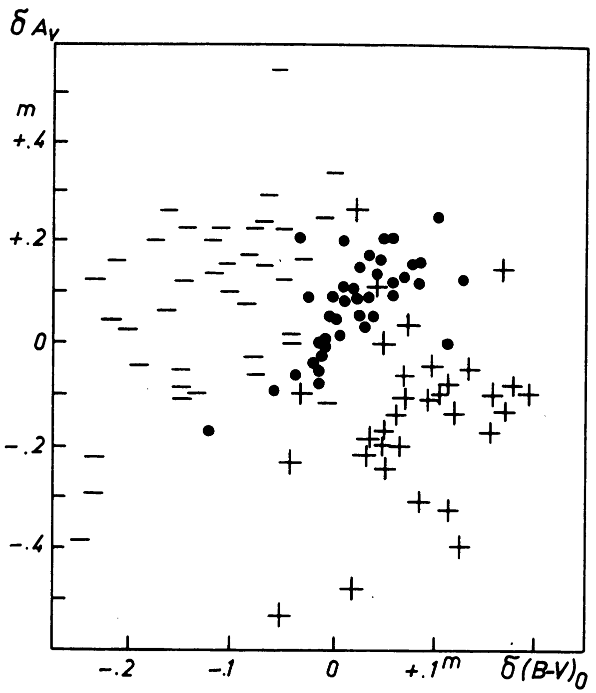

Fig. 3. δ-δ diagram: V-amplitude vs colour at maximum. Dots: $\delta(B-V) \leqq 10.021$; plus signs: $\delta(B-V) \geqq +0.10$; minus signs: $\delta(B-V) \leqq -0.10$.

$(B-V)_0^{\max}$) are denoted with different symbols on the δA, $\delta(B-V)$ diagram. Figure 3 shows that Cepheids with a given period and a fixed mean temperature have the greater light amplitude, the greater their temperature at maximum is. In all cases it was possible to obtain, by least squares relations in the following form:

$$\delta A = K_1\, \delta \langle \mathrm{C\,I} \rangle - K_2\, \delta (\mathrm{C\,I})^{\max}$$

and

$$\delta A = K_3\, \delta (\mathrm{C\,I})^{\min} - K_4\, \delta (\mathrm{C\,I})^{\max}$$

with sufficiently confident coefficients K_i. We present some of these relations:

$$\delta A_V = \underset{\pm 0.19}{2.66}\, \delta \langle B-V \rangle_0 - \underset{\pm 0.17}{2.74}\, \delta (B-V)_0^{\max}$$
$$\delta A_V = \underset{\pm 0.21}{2.02}\, \delta \langle U-B \rangle_0 - \underset{\pm 0.19}{2.24}\, \delta (U-B)_{\max}$$

from 76 and 79 (respectively) galactic Cepheids with $\log P < 1$

$$\delta A_V = \underset{\pm 0.21}{1.71}\, \delta \langle B-V \rangle_0 - \underset{\pm 0.24}{1.81}\, \delta (B-V)_0^{\max}$$
$$\delta A_V = \underset{\pm 0.17}{1.32}\, \delta \langle U-B \rangle_0 - \underset{\pm 0.32}{1.40}\, \delta (U-B)_0^{\max}$$

from 37 and 47 (respectively) galactic Cepheids with $\log P > 1$

https://doi.org/10.1017/S0074180900010299 Published online by Cambridge University Press

$$\delta\bar{R} = -\underset{\pm 31}{165}\,\delta A_R - \underset{\pm 18}{31}\,\delta(B-V)_0^{\max}$$ from 52 galactic Cepheids with all periods

$$\delta A_V = -\underset{\pm 0.29}{0.26}\,\delta(\langle B\rangle - \langle V\rangle) - \underset{\pm 0.28}{0.45}\,\delta(B-V)^{\max}$$

$$\delta A_B = \underset{\pm 0.34}{0.85}\quad \delta(\langle B\rangle - \langle V\rangle) \pm \underset{\pm 0.33}{0.91}\,\delta(B-V)^{\max}$$ from 93 Cepheids in the central part of SMC

$$\delta\langle B\rangle = \underset{\pm 0.16}{0.46}\,\delta A_B + \underset{\pm 0.33}{0.80}\,\delta(B-V)^{\max}$$ from 35 Cepheids in peripheral regions of LMC

It is evident that for all stellar systems there are qualitatively identical relations: but numerically the coefficients K_i differ. In this sense the Cepheids from the central part of the SMC differ significantly from those in the peripheral regions of the Magellanic Clouds and the Galaxy. Maybe, this difference is due to the difference in the chemical composition (Yakimova, 1971).

It is very interesting and important to notice that the same result was obtained even on using the δ-differences between the simple mean and the smoothed mean relations x-log$P$ and not only on using the individual δ-differences from the smoothed mean relations (Yakimova, 1970b). This means that the fluctuations of the mean x-log$P$ diagrams for different systems of cepheid characteristics show the same feature: the light amplitude increases toward the low temperature limit of the instability strip.

We would also like to mention, that if we examine the δM_V against $\delta(U-B)_0$, as well as against δA_V, the M_V of the galactic Cepheids being derived from

$$M_V = -\underset{\pm 0.16}{2.55}\,\log P - \underset{\pm 0.15}{2.00},$$

the same result is obtained (Ivanov, 1974): the amplitude of a star with a given period and maximum temperature increases with the decrease of the luminosity, i.e. toward the low temperature Cepheid strip limit.

5. A Comparison between Our Results and those Found by Sandage and Tammann, and Some Comments

Our results do not coincide with those by Sandage and Tammann (1971). The latter authors came to the conclusion that the pulsation amplitude of Cepheids in different period intervals has a different behaviour. According to these authors the amplitudes increase toward the low temperature limit of the instability strip, perhaps only for Cepheids in the period interval of $0.86 < \log P < 1.3$ and not for all Cepheids, as our results show. From Sandage and Tammann's investigation of Cepheids in the interval of $0.4 < \log P < 0.86$, and perhaps those with $\log P > 1.3$, the amplitude increases toward the high, and not toward the low, temperature instability strip limit.

There are some differences between Sandage and Tammann's method and ours, as well as between the materials used by them and by us. But the main difference, which, according to our opinion, causes the discrepancy in the results of both investigations, is the fact that Sandage and Tammann have not studied the Cepheids in the different systems separately, as it was done by us, but as one single complex. In this case however, the individual δ-difference of a single Cepheid is a superposition of two differences: the δ-difference of this Cepheid from the mean $\overline{x(P)}$ for its stellar system, and the difference of this mean $\overline{x(P)}$ from the general one for all stellar systems – our Galaxy, the Magellanic Clouds and M31. And since the difference between the galactic Cepheid mean colours and the SMC ones are the greatest for $\log P \lesssim 1$ and $\log P \gtrsim 1.3$, it is not surprising, that Sandage and Tammann's result is contrary to ours, especially for the period intervals of $0.4 < \log P < 0.86$ and for $\log P > 1.3$.

Therefore a principle problem arises once more: is it correct to consider the Cepheids belonging to different stellar systems as an unique complex? Is it not wrong to impute to all these stars general features in advance, before we are certain that it is indeed so?

In the case of the problem of the instability strip structure we believe, since the opposite is not proved, that the differences between the mean $\overline{x(P)}$ relations for the different stellar systems are real and are not to be neglected. Therefore an integration of all Cepheids and their $\overline{x(P)}$-relation is not well-grounded and may lead to incorrect results. According to our opinion the 'diversity' itself in Sandage and Tammann's results for the different period intervals also marks, that our point of view and our results are more correct. At least it appears, that the important problem of the instability strip structure is not resolved definitely and needs new efforts in the future.

TABLE I

Sp	$(B-V)_0$	$(U-B)_0$	Sp	$(B-V)_0$	$(U-B)_0$
F0	$0\overset{m}{.}25$:	$0\overset{m}{.}07$:	G2	$0\overset{m}{.}824$	$0\overset{m}{.}534$
F3	0.30:	0.11:	G3	0.97	0.686
F6	0.464	0.18	G4	1.04	0.75
F7	0.536	0.246	G5	1.11	0.82
F8	0.61	0.32	G6	1.184	0.894
F9	0.68	0.396	G8	1.27:	1.04:
G0	0.75	0.467	K0	1.29:	1.15:
G1	0.824	0.534			

TABLE II

Star	$\log P$	E_{B-V}	E_{U-B}	$(B-V)_0$ max	$(B-V)_0$ min	$\langle B-V\rangle_0$	$(U-B)_0$ max	$(U-B)_0$ min	$\langle U-B\rangle_0$	$\langle M_V\rangle$	A_V
1	2	3	4	5	6	7	8	9	10	11	12
SU Cas	0^{m}290	0^{m}28	0^{m}29	0^{m}36	0^{m}52	0^{m}44	0^{m}12	0^{m}25	0^{m}20	−2^{m}99	0^{m}37
DT Cyg	0.398	0.11	0.08	0.37	0.51	0.43	0.16:	0.24:	0.21:	−3.17	0.31
AY Cas	0.458	0.74:		0.34	0.70	0.55					0.69
EV Sct	0.490	0.62		0.46:	0.60:	0.29:					0.29
BY Cas	0.508	0.87	0.66	0.33	0.52	0.42	0.11	0.23	0.18	−4.40	0.38
R TrA	0.530	0.13	0.09	0.44	0.73	0.63	0.16	0.46	0.34	−4.45	0.54
DW Per	0.562	0.60		0.38	0.72	0.58					0.70
SS Sct	0.565	0.32	0.26	0.50	0.76	0.66	0.25	0.52	0.38		0.53
UX Car	0.566	0.05	0.04	0.40	0.80	0.65	0.13	0.53	0.36	−2.56	0.82
RT Aur	0.571	0.06	0.06	0.36	0.74	0.60	0.21:	0.43:	0.33:	−3.43	0.75
DF Cas	0.583	0.51	0.53	0.45	0.77	0.67	0.17:	0.48:	0.32:		0.60
SU Cyg	0.585	0.10	0.13	0.30	0.62	0.50	0.12:	0.25:	0.19:		0.72
Y Aur	0.587	0.36	0.32	0.35	0.74	0.62	0.19	0.38	0.30		0.83
CS Ori	0.590	0.34	0.38	0.40	0.72	0.57	0.20:	0.40:	0.28:		0.85
α UMi	0.598	0.03		0.53	0.58	0.56					0.09
BF Oph	0.609	0.30	0.14	0.38	0.74	0.60	0.23:	0.57	0.42	−4.12	0.66
SY Cas	0.610	0.45	0.44	0.33	0.72	0.57	0.15	0.36:	0.28		0.81
X Sct	0.623	0.50	0.52	0.45	0.87	0.72	0.25:	0.54	0.40		0.96
UZ Cas	0.629	0.40	0.36	0.45	0.89	0.71	0.24:	0.53:	0.38:		0.79
VW Pup	0.632	0.54	0.47	0.41	0.72	0.60	0.16:	0.44:	0.34:		0.67
Y Lac	0.636	0.17	0.12	0.39	0.73	0.61	0.24	0.41	0.34		0.66
CG Cas	0.640	0.72	0.49	0.28	0.71	0.56	0.15:	0.38	0.31		0.84
V Vel	0.641	0.20:	0.16	0.40:	0.76:	0.62:	0.13	0.46	0.34	−3.16	0.74
T Vul	0.647	0.09	0.09	0.37	0.73	0.58	0.19:	0.38	0.29	−4.41	0.70
FF Aql	0.650	0.25	0.26	0.44	0.61	0.53	0.20	0.30	0.26	−3.78	0.35
DF Lac	0.651	0.59		0.43	0.72	0.61					0.63
XY Cas	0.653	0.46	0.41	0.51	0.83	0.70	0.27	0.52	0.40		0.57
V482 Sco	0.656	0.39	0.35	0.44	0.76	0.62				−3.66	0.64
T Vel	0.666	0.32	0.30	0.42:	0.77:	0.62:	0.13	0.48	0.34	−4.04	0.62
WW Mon	0.668	0.56:	0.53	0.31:	0.76:	0.62:	0.10	0.43:	0.28		0.95
TV CMa	0.669	0.56:		0.47:	0.83:	0.69:					0.76:
RY CMa	0.670	0.24	0.24	0.42	0.81	0.66	0.15:	0.49	0.34		0.76
S Cru	0.671	0.14	0.12	0.44	0.82	0.68	0.16:	0.52	0.38	−3.27	0.77
SX Car	0.687	0.24	0.25	0.45	0.90	0.72	0.21:	0.61	0.44		0.75

VZ	Cyg	0.687	0.32	0.32	0.40	0.77	0.62	0.18	0.45	0.33		0.67
CF	Cas	0.688	0.52	0.50	0.52	0.80	0.70	0.16	0.44	0.32	−3.47	0.57
CR	Ori	0.691	0.53:	0.48	0.47:	0.70:	0.63:	0.14:	0.44	0.30:		0.60:
AS	Per	0.697	0.66:	0.62	0.49:	0.90:	0.74:	0.30	0.57:	0.44		0.92
V	Lac	0.697	0.31	0.35	0.36	0.83	0.66	0.16	0.41	0.30		0.98
DW	Cas	0.699	0.79		0.51	0.80	0.69					0.59
WZ	Pup	0.701	0.15:	0.15	0.45:	0.85:	0.67:	0.14:	0.65:	0.40:		0.90:
AP	Sgr	0.704	0.20	0.22	0.38	0.82	0.66	0.12:	0.49	0.34		0.79
AP	Pup	0.706	0.39:	0.35	0.27:	0.63:	0.49:	0.03	0.37	0.23	−3.82	0.60:
V350	Sgr	0.712	0.32	0.28	0.39	0.81	0.63	0.09	0.51	0.34		0.66
WY	Pup	0.720	0.40:	0.28	0.18:	0.85:	0.52:	0.02:	0.65:	0.34:		0.84:
V386	Cyg	0.721	1.00	0.85	0.38	0.74	0.59	0.15	0.50	0.32	−4.43	0.69:
BG	Lac	0.727	0.33	0.26	0.49	0.79	0.67	0.24	0.53	0.40		0.66
UY	Per	0.730	0.95		0.38	0.85	0.65					0.88
δ	Cep	0.730	0.09	0.14	0.35	0.80	0.63	0.17	0.51	0.34	−3.44	0.84
CV	Mon	0.731	0.80	0.69	0.38	0.71	0.58					0.71
SW	Cas	0.736	0.46	0.43	0.47	0.81:	0.69	0.24	0.50	0.37		0.66
X	Lac	0.736	0.34	0.32	0.47	0.70	0.60	0.23	0.40	0.31		0.38
XX	Mon	0.737	0.61:	0.60	0.39:	0.82:	0.63:	0.10:	0.58	0.30		0.70
V	Cen	0.740	0.26	0.22	0.41	0.82	0.66	0.12	0.53	0.36	−4.18	0.80
WW	Pup	0.742	0.36:	0.33	0.30:	0.76:	0.58:	0.08	0.47	0.30		0.96
RZ	Gem	0.743	0.50	0.39	0.39	0.75	0.61	0.17:	0.39	0.22:		0.80:
VY	Per	0.743	1.05		0.39:	0.72	0.59					0.80:
CZ	Cas	0.753	0.75		0.46	0.85	0.69					0.82
Y	Sgr	0.761	0.22	0.25	0.46	0.85	0.68	0.16	0.50	0.34		0.75
AB	Cam	0.763	0.75:		0.19:	0.70:	0.50:					0.97
FM	Cas	0.764	0.26	0.26	0.61	0.92	0.78	0.29	0.60	0.45		0.57
R	Cru	0.765	0.13	0.12	0.45	0.88	0.70	0.20:	0.56	0.40	−3.43	0.84
MW	Cyg	0.775	0.63:	0.58	0.55:	0.92:	0.77:	0.25	0.62	0.48	−3.91	0.72:
VW	Cas	0.778	0.56	0.41	0.48	0.87	0.70	0.29:	0.58	0.45:		0.68
RV	Sco	0.783	0.39	0.32	0.37	0.80	0.63	0.11	0.55	0.37	−4.45	0.82
EM	Aql	0.787	0.77	0.66	0.34	0.74	0.57	0.10	0.46	0.29		0.74
VV	Cas	0.793	0.47	0.38	0.44	0.87	0.70	0.27	0.54	0.42		0.89
X	Cru	0.794	0.33:	0.26	0.53:	0.83:	0.69:	0.27	0.56	0.44	−3.42	0.56
CR	Cep	0.795	0.73		0.63	0.85	0.75					0.39
BP	Cas	0.797	0.90:	0.78	0.42:	0.84:	0.66:	0.18	0.45	0.27		0.77
RS	Cas	0.799	0.80	0.70	0.47	0.89	0.71	0.22	0.60	0.43		0.76
X	Vul	0.801	0.86	0.82	0.39	0.81	0.64	0.09	0.51	0.30		0.79
S	TrA	0.801	0.08	0.06	0.48	0.90	0.71	0.19	0.63	0.43	−4.01	0.81
RR	Lac	0.808	0.27	0.22	0.45	0.87	0.67	0.22	0.58	0.40		0.80

Table II (Continued)

Star	log*P*	E_{B-V}	E_{U-B}	$(B-V)_0$ max	$(B-V)_0$ min	$\langle B-V\rangle_0$	$(U-B)_0$ max	$(U-B)_0$ min	$\langle U-B\rangle_0$	$\langle M_V\rangle$	A_V
1	2	3	4	5	6	7	8	9	10	11	12
XX Sgr	$0^m.808$	$0^m.49$	$0^m.41$	$0^m.46$:	$0^m.88$	$0^m.70$	$0^m.29$	$0^m.61$	$0^m.44$		$0^m.75$
AW Per	0.810	0.48	0.35	0.44	0.76	0.64	0.24	0.40	0.32		0.80
AY Sgr	0.817	0.91	0.75	0.39	0.85	0.65	0.16	0.52	0.39		0.85
BB Sgr	0.822	0.34	0.32	0.49	0.83	0.69	0.23	0.58	0.41		0.58
AT Pup	0.824	0.14:	0.12	0.44:	0.92:	0.72:	0.18	0.62	0.43	−4.36	0.92:
V Car	0.826	0.18	0.14	0.52	0.90	0.74		0.64		−2.88	0.80
T Cru	0.828	0.28	0.25	0.50	0.80	0.66	0.24:	0.53	0.40	−3.88	0.47
U Sgr	0.829	0.45	0.45	0.46	0.86	0.70	0.15	0.55	0.36	−3.59	0.76
V496 Aql	0.833	0.56	0.53	0.52	0.72	0.62	0.13:	0.37:	0.33:	−3.11	0.40
AP Cas	0.836	0.85		0.40	0.70	0.57					0.60
TW CMa	0.845	0.50	0.54	0.32	0.67	0.52	0.06	0.40	0.22		0.61
X Sgr	0.846	0.15	0.13	0.44	0.79	0.63	0.15	0.50	0.34	−4.18	0.63
U Aql	0.847	0.38	0.34	0.46	0.87	0.70	0.20	0.59	0.40		0.85
η Aql	0.856	0.16	0.17	0.43	0.88	0.68	0.18	0.59	0.40	−4.29	0.82
AK Cep	0.859	0.65:	0.60	0.49:	0.87:	0.71:	0.26:	0.60:	0.44		0.67
V336 Aql	0.863	0.70:	0.62	0.44:	0.86:	0.69:	0.22:	0.57:	0.40:		0.79
TZ Mon	0.871	0.52	0.57	0.45:	0.83	0.66	0.17	0.53	0.34		0.70
R Mus	0.876	0.08	0.09	0.46	0.93	0.72	0.16:	0.63	0.42	−3.68	0.86
RS Ori	0.879	0.38	0.37	0.39	0.82	0.64	0.14	0.51	0.32		0.82
W Sgr	0.880	0.16	0.20	0.37	0.84	0.64	0.14:	0.53	0.32	−4.49	0.80
CD Cas	0.892	0.78	0.70	0.47	0.89	0.71:	0.20:	0.60:	0.42:		0.78
GH Cyg	0.893	0.68	0.58	0.40	0.78	0.64	0.21	0.48	0.34		0.76
VY Cyg	0.895	0.66	0.63	0.37	0.84	0.64	0.14	0.52	0.30	−4.67	0.82
RX Cam	0.898	0.60	0.58	0.45	0.89	0.69:	0.21:	0.53	0.37		0.78
W Gem	0.899	0.31	0.37	0.38	0.85	0.67	0.13:	0.54:	0.30:		0.81
U Vul	0.902	0.61	0.55	0.49	0.91	0.74	0.24:	0.61	0.43	−4.92	0.75
DL Cas	0.903	0.51	0.43	0.52	0.87	0.71	0.29	0.57	0.42		0.58
AC Mon	0.904	0.61:		0.41:	0.81:	0.61:					0.70:
S Sge	0.923	0.15	0.20	0.43	0.89	0.69	0.19	0.57	0.38	−4.74	0.76
TX Mon	0.940	0.51		0.49	0.86	0.67					0.71:
WX Pup	0.951	0.40	0.39	0.42	0.83	0.64	0.13:	0.53	0.34	−4.06	0.57
FN Aql	0.977	0.54	0.51	0.56	0.87	0.72	0.30:	0.60:	0.40:		0.67
YZ Sgr	0.980	0.33	0.31	0.54	0.92	0.73	0.27:	0.68	0.46:		0.74
S Mus	0.985	0.27	0.21	0.47	0.71	0.58	0.20	0.44	0.32	−4.47	0.52

S	Nor	0.989	0.18		0.67	0.98	0.81				−4.40	0.67
DD	Cas	0.992	0.55	0.55	0.51	0.90	0.69	0.11	0.62	0.40		0.61
β	Dor	0.993	0.19	0.17	0.47	0.82	0.64	0.13	0.53	0.38	−4.86	0.66
BZ	Cyg	1.006	0.86	0.80	0.61	0.91	0.76	0.33	0.61:	0.44	−5.78	0.52
ζ	Gem	1.006	0.08	0.20	0.62	0.90	0.76	0.26	0.60	0.42	−4.34	0.49
SY	Aur	1.006	0.51	0.53	0.41	0.72	0.57	0.12	0.32:	0.21		0.61
AN	Aur	1.013	0.69	0.58	0.40	0.76	0.56	0.13:	0.47	0.28		0.64
Y	Sct	1.015	0.82	0.73	0.53	1.05	0.82	0.23:	0.71	0.50:		0.83
Z	Lac	1.037	0.40	0.43	0.47	1.07	0.80	0.20:	0.72	0.45		0.90
VX	Per	1.037	0.60	0.58	0.44	0.83	0.65	0.17	0.52	0.33		0.76
XX	Cen	1.040	0.25	0.22	0.49	0.99	0.79	0.20	0.71	0.50	−4.13	0.90
TY	Sct	1.043	1.00	0.79	0.48	0.98	0.78	0.24:	0.78:	0.56:		0.87
SV	Per	1.046	0.34	0.14	0.46:	0.88	0.73	0.29	0.55	0.44		0.80
AA	Gem	1.053	0.48	0.33	0.42	0.87:	0.66	0.19:	0.65	0.45		0.65
RX	Aur	1.064	0.33	0.31	0.47	0.82	0.67	0.19	0.58	0.40		0.71
RY	Cas	1.084	0.66	0.70	0.42	0.96	0.74	0.16	0.64:	0.39:		0.98
SS	CMa	1.091	0.57	0.51	0.41	0.90	0.69	0.14	0.61	0.43		1.10:
U	Nor	1.101	0.78	0.66	0.55	1.05	0.88	0.25	0.82	0.57		1.00
Z	Sct	1.111	0.56	0.62	0.53	1.07	0.85	0.16:	0.85:	0.54:		1.05
AD	Pup	1.133	0.43:	0.37	0.30:	0.98:	0.72:	0.02:	0.77:	0.47:		0.96
TT	Aql	1.138	0.53	0.60	0.44	1.09	0.85	0.14:	0.83	0.52:		1.15
SV	Vel	1.149	0.31	0.30	0.45	1.10	0.88	0.20	0.79	0.53	−4.67	1.25
CY	Cas	1.158	1.03		0.36	0.99	0.73					1.10
TX	Cyg	1.168	1.20	1.12	0.30	1.04:	0.74	0.11	0.81:	0.52:	−5.93	1.23
UZ	Sct	1.168	1.00	1.05	0.63	1.15	0.95	0.35:	0.78	0.62	−5.21	0.89
RW	Cas	1.170	0.45	0.51	0.43	1.14	0.87	0.17	0.86	0.63		1.17
SZ	Cyg	1.179	0.62	0.73	0.63	1.20	0.96	0.27	0.93	0.68		0.88
CH	Cas	1.179	1.11		0.23	0.83	0.60					1.11
SV	Mon	1.182	0.30	0.49	0.43	1.11	0.85	0.05:	0.79	0.44		1.10
SZ	Mon	1.214	0.02	0.01	0.65	0.94	0.80	0.20:	0.62	0.41:		0.92:
X	Cyg	1.215	0.32	0.49	0.51	1.17	0.92	0.12:	0.90	0.57		1.02
RW	Cas	1.215	0.78	0.43	0.42	0.79	0.64	0.29	0.45	0.37		0.81
CD	Cyg	1.232	0.52	0.53	0.45	1.15:	0.90	0.21	1.06:	0.71:	−4.76	1.15
Y	Oph	1.233	0.71	0.74	0.52	0.79	0.68	0.22	0.48	0.34	−5.24	0.51
SZ	Aql	1.234	0.55	0.48	0.47	1.27	0.99	0.41	1.14	0.84		1.23
CP	Cep	1.251	0.82	0.85	0.60:	1.12:	0.88	0.05	0.64:	0.38		0.79
YZ	Aur	1.260	0.72	0.66	0.40	0.92	0.72	0.15	0.61	0.40		0.74
VY	Car	1.277	0.41:	0.51	0.43:	1.10:	0.84:	0.15:	0.76:	0.52:	−4.76	1.10
RU	Sct	1.294	1.01	0.90	0.38	1.02	0.79	0.12:	0.77:	0.52:		1.11
VX	Cyg	1.304	0.99:	1.00	0.44:	1.06:	0.81:	0.07	0.80:	0.55		1.00

Table II (Continued)

Star		$\log P$	E_{B-V}	E_{U-B}	$(B-V)_0$ max	$(B-V)_0$ min	$\langle B-V\rangle_0$	$(U-B)_0$ max	$(U-B)_0$ min	$\langle U-B\rangle_0$	$\langle M_V\rangle$	A_V
1		2	3	4	5	6	7	8	9	10	11	12
RY	Sco	$1\overset{m}{.}308$	$0\overset{m}{.}74$	$0\overset{m}{.}69$	$0\overset{m}{.}48$	$0\overset{m}{.}94$	$0\overset{m}{.}74$	$0\overset{m}{.}24$	$0\overset{m}{.}63$	$0\overset{m}{.}43$	$-6\overset{m}{.}15$	$0\overset{m}{.}87$
WZ	Sgr	1.339	0.52	0.50	0.56	1.22	0.97	0.30	1.11:	0.79:		1.10
VZ	Pup	1.365	0.51	0.45	0.30:	0.97:	0.77:	0.08	0.75:	0.52:		1.25
X	Pup	1.414	0.53:	0.65:	0.31:	1.03:	0.81:	0.01:	0.75:	0.46:		1.21
T	Mon	1.432	0.31	0.41	0.57	1.17:	0.97	0.26:	0.86:	0.61:	−5.01	1.00
RY	Vel	1.449	0.60	0.56	0.48	1.01	0.82	0.19	0.74:	0.52		0.85:
AQ	Pup	1.475	0.63	0.62	0.32	1.11	0.87	0.46:	0.66:	0.56:	−6.24	1.02
l	Car	1.551	0.22	0.26	0.78		1.10	0.53:	1.02	0.83:	−5.50	0.76
U	Car	1.558	0.34	0.32	0.50	1.19	0.96		0.96		−5.51	1.16
RS	Pup	1.617	0.45	0.54	0.65	1.29	1.07	0.31:	1.08	0.74		1.10
SV	Vul	1.654	0.55	0.63	0.55	1.23	1.00	0.14	1.00	0.72	−6.17	1.02

TABLE III

Star	log$P$	$\delta(B-V)$ max	$\delta\langle B-V\rangle$	$\delta(B-V)$ min	$\delta(U-B)$ max	$\delta(U-B)$ min	$\delta\langle U-B\rangle$	δM_V	δA_V	δR 10^6 km	δA_R
1	2	3	4	5	6	7	8	9	10	11	12
SU Cas	$0\overset{m}{.}290$				$0\overset{m}{.}00$	$+0\overset{m}{.}03$	$0\overset{m}{.}00$	$-0\overset{m}{.}2$		0	$-0\overset{m}{.}01$
DT Cyg	0.398				+0.02	−0.06	0.00	−0.1		−1	−0.03
AY Cas	0.458	$-0\overset{m}{.}04$	$+0\overset{m}{.}04$	$+0\overset{m}{.}09$							
EV Sct	0.490	+0.11	−0.01	−0.04					$-0\overset{m}{.}19$	−9	−0.02
BY Cas	0.508	−0.06	−0.14	−0.13	−0.04	−0.015	−0.08	−1.0	−0.18	+8	−0.02
R TrA	0.530	+0.04	+0.06	+0.05	0.00	+0.06	+0.06	−1.1	−0.02	+16	−0.04
DW Per	0.562	−0.02	−0.01	+0.02	+0.09	+0.10	+0.09		+0.10		
UX Car	0.566	0.00	+0.06	+0.09	−0.03	+0.11	+0.08	+0.8	+0.21	−10	+0.04
RT Aur	0.571	−0.04	0.00	+0.03	+0.05	0.00	+0.04	0.0	+0.14	−2	+0.005
DF Cas	0.583	+0.05	+0.06	+0.05	+0.01	+0.04	+0.02		−0.02		
SU Cyg	0.585	−0.10	−0.10	−0.10	−0.04	−0.19	−0.19		+0.10		
Y Aur	0.587	−0.06	+0.02	+0.02	+0.03	−0.06	0.00		+0.20		
CS Ori	0.590	0.00	−0.04	−0.00	+0.04	−0.02	−0.04		+0.21		
α UMi	0.598	+0.12	−0.05	−0.15					−0.54		
BF Oph	0.609	−0.03	−0.01	0.00	+0.07	+0.11	+0.12	−0.6	0.00	−8	+0.005
SY Cas	0.610	−0.08	−0.04	−0.02	−0.01	−0.10	−0.02		+0.15		
X Sct	0.632	+0.04	+0.10	+0.12	+0.09	+0.7	+0.09		+0.30		
UZ Cas	0.629	+0.04	+0.09	+0.14	+0.08	+0.06	+0.07		+0.11		
VW Pup	0.632	0.00	−0.02	−0.04	0.00	−0.03	+0.03		0.00		
Y Lac	0.636	−0.02	−0.02	−0.04	+0.08	−0.06	+0.02		−0.03		
CG Cas	0.640	−0.13	−0.06	−0.06	−0.01	−0.09	0.00		+0.15		
V Vel	0.641	0.00	0.00	0.00	−0.03	−0.01	+0.03	+0.4	+0.05	−5	+0.04
T Vul	0.647	−0.04	−0.04	−0.04	+0.02	−0.10	−0.03	0.0	0.00	+14	−0.03
FF Aql	0.650	+0.02	−0.04	−0.16	+0.03	−0.18	−0.06	−0.1	−0.34	0	−0.05
DF Las	0.651	+0.02	−0.02	−0.05					−0.06		
XY Cas	0.653	+0.10	+0.07	+0.06	+0.10	+0.04	+0.07		−0.12		
V482 Sco	0.656	+0.02	−0.01	−0.02				0.0	−0.06	+2	−0.01
T Vel	0.666	0.00	−0.02	−0.01	−0.04	0.00	0.00	−0.4	−0.08	+7	−0.02
WW Mon	0.668	−0.10	−0.02	−0.02	−0.06	−0.06	−0.04		+0.25		
TV CMa	0.669	+0.06	+0.06	+0.05					+0.06		

Table III (Continued)

Star	log*P*	δ(*B*−*V*) max	δ⟨*B*−*V*⟩	δ(*B*−*V*) min	δ(*U*−*B*) max	δ(*U*−*B*) min	δ⟨*U*−*B*⟩	δM_V	δA_V	δ*R* (10^6 km)	δA_R
1	2	3	4	5	6	7	8	9	10	11	12
RY CMa	$0^{m}.670$	$0^{m}.00$	$+0^{m}.02$	$+0^{m}.03$	$-0^{m}.02$	$0^{m}.00$	$+0^{m}.02$		$+0^{m}.06$		
S Cru	0.671	+0.02	+0.04	+0.04	0.00	+0.03	+0.04	$+0^{m}.4$	+0.06	−3	$+0^{m}.02$
SX Car	0.687	+0.03	+0.08	+0.10	+0.04	+0.12	0.00		+0.05	−3	+0.02
VZ Cyg	0.687	−0.02	−0.02	−0.02	+0.01	−0.04	−0.01		−0.04		
CF Cas	0.688	+0.10	+0.06	+0.03	−0.01	−0.05	−0.01	+0.2	−0.14	+1	−0.02
CR Ori	0.691	+0.03	−0.01	−0.10	−0.03	−0.05	−0.04		−0.11		
AS Per	0.697	+0.07	+0.10	+0.10	+0.13	+0.07	+0.10		+0.21		
V Lac	0.697	−0.06	+0.02	+0.04	−0.01	−0.09	−0.04		+0.27		
DW Cas	0.699	+0.09	+0.04	0.00					−0.12		
WZ Pup	0.701	+0.03	+0.02	+0.05	−0.03	+0.15	+0.06		+0.19		
AP Sgr	0.704	−0.04	+0.02	−0.02	−0.05	−0.01	0.00		+0.08		
AP Pup	0.706	−0.15	−0.16	−0.17	−0.14	−0.13	−0.11	0.0	−0.11	−2	0.00
V350 Sgr	0.712	−0.04	−0.02	0.00	−0.08	0.00	0.00		−0.05		
WY Pup	0.720	−0.25	−0.15	+0.05	−0.15	+0.14	−0.02		+0.12		
V386 Cyg	0.721	−0.04	−0.06	−0.06	−0.02	−0.01	−0.02	−0.6	−0.01	+12	−0.02
UY Per	0.730	−0.04	0.00	+0.04	+0.07	+0.02	+0.05		+0.17		
δ Cep	0.730	−0.08	−0.02	0.00	0.00	0.00	−0.02	+0.4	+0.13	−5	+0.02
CV Mon	0.731	−0.04	−0.07	−0.10	+0.07	−0.01	+0.01		0.00		
SW Cas	0.736	+0.04	+0.04	0.00					−0.05		
X Lac	0.736	+0.04	−0.06	−0.11	+0.06	−0.11	−0.05		−0.33		
XX Mon	0.737	−0.04	−0.02	+0.01	−0.07	−0.16	−0.06		−0.01		
V Cen	0.740	−0.02	0.00	+0.01	−0.05	+0.01	0.00	−0.3	+0.09	+6	−0.01
VW Pup	0.742	−0.13	−0.08	−0.05	−0.09	−0.09	−0.06		+0.24		
RZ Gem	0.743	−0.04	−0.04	−0.06	−0.13	−0.14	−0.03		0.00		
VY Per	0.743	−0.04	−0.06	−0.09	−0.02	−0.02	−0.04		+0.11		
CZ Cas	0.753	+0.03	+0.04	+0.04	+0.11	+0.08	−0.03		+0.11		
Y Sgr	0.761	+0.03	+0.02	+0.04	+0.02	+0.03	+0.03		+0.03		
AB Cam	0.763	−0.24	−0.16	−0.12					+0.26		
FM Cas	0.764	+0.18	+0.12	+0.10	+0.11	+0.08	+0.08		−0.14		
R Cru	0.765	+0.02	+0.04	+0.06	+0.02	+0.03	+0.03	+0.5	+0.13	−4	+0.02
MW Cyg	0.775	+0.11	+0.10	+0.07	+0.09	+0.11	+0.10	0.0	0.00	+4	0.00
VW Cas	0.778	+0.04	+0.04	+0.04	+0.11	+0.05	+0.07		−0.03		
RV Sco	0.783	−0.06	+0.04	−0.02	−0.07	+0.02	−0.01	−0.4	+0.10	+8	−0.02
FM Aql	0.787	−0.10	−0.10	−0.08	−0.08	−0.07	−0.09		+0.03		

VV	Cas	0.793	0.00	+0.04	+0.04	+0.09	0.00	+0.04		+0.17		
X	Cru	0.794	+0.10	+0.02	0.00	+0.09	+0.06	+0.02	+0.6	−0.15	−8	0.00
CR	Cep	0.795	+0.20	+0.08	+0.02	+0.12	+0.02	+0.06		−0.32		
BP	Cas	0.797	−0.02	0.00	+0.01	0.00	−0.09	−0.07		+0.05		
RS	Cas	0.799	+0.04	+0.04	+0.06	+0.04	+0.06	+0.05		+0.04		
X	Vul	0.801	−0.05	−0.03	−0.02	−0.09	−0.03	−0.08		+0.06		
S	TrA	0.801	+0.04	+0.04	+0.07	+0.01	+0.09	+0.05	0.0	+0.09	+2	+0.02
RR	Lac	0.808	+0.01	0.00	+0.04	+0.04	+0.02	+0.04		+0.09		
XX	Sgr	0.808	+0.02	+0.03	+0.05					+0.04		
AW	Per	0.810	−0.03	0.00	−0.07	+0.06	−0.14	−0.06		+0.09		
AY	Sgr	0.817	−0.05	−0.02	+0.02	−0.02	−0.02	+0.01		+0.13		
BB	Sgr	0.822	+0.05	+0.02	0.00	+0.05	+0.04	+0.03		−0.13		
AT	Pup	0.824	0.00	+0.05	+0.08	0.00	+0.08	+0.05	−0.3	+0.21	+6	−0.02
V	Car	0.826	+0.08	+0.07	+0.06		+0.10		+1.2	+0.09	−16	+0.06
T	Cru	0.828	+0.06	−0.01	−0.04	+0.05	−0.01	+0.02	+0.2	−0.23	−3	0.00
U	Sgr	0.829	0.00	+0.03	−0.09	−0.04	+0.01	−0.02	+0.5	+0.05	−9	+0.02
V496	Aql	0.833	+0.08	−0.05	−0.12				+1.0	−0.29	−15	−0.05
AP	Cas	0.836	−0.05	−0.10	−0.14	−0.06	−0.17	−0.05		−0.10		
TW	CMa	0.845	−0.12	−0.15	−0.17	−0.13	−0.14	−0.16		−0.09		
X	Sgr	0.846	0.00	−0.04	−0.05	−0.04	−0.04	−0.04	0.0	−0.07	−2	−0.02
U	Aql	0.847	+0.02	+0.02	+0.03	+0.01	+0.05	+0.02		+0.15		
η	Aql	0.856	−0.02	0.00	+0.04	−0.01	+0.05	+0.02	−0.1	+0.11	+2	0.00
AK	Cep	0.859	+0.04	+0.04	+0.02	+0.07	+0.06	+0.06		−0.03		
V336	Aql	0.863	0.00	+0.02	+0.02	+0.03	+0.03	+0.02		+0.09		
TZ	Mon	0.871	0.00	−0.02	−0.01	−0.02	−0.01	−0.04		0.00		
R	Mus	0.876	0.00	+0.04	+0.08	−0.03	+0.09	−0.04	+0.5	+0.16	−10	+0.02
RS	Ori	0.879	−0.06	−0.04	−0.04	−0.05	−0.03	−0.06		+0.13		
W	Sgr	0.880	−0.08	−0.04	−0.01	−0.05	−0.01	−0.06	−0.3	+0.10	+1	0.00
CD	Cas	0.892	+0.02	+0.04	+0.04	+0.01	+0.06	+0.04		+0.09		
GH	Cyg	0.893	−0.05	−0.04	−0.08	+0.02	−0.06	−0.04		+0.07		
VY	Cyg	0.895	−0.08	−0.04	−0.02	−0.05	−0.02	−0.06	−0.4	+0.14	+5	−0.02
RX	Cam	0.898	0.00	+0.02	+0.03	+0.02	−0.01	−0.01		+0.10		
W	Gem	0.899	−0.07	0.00	0.00	−0.06	0.00	−0.08		+0.13		
U	Vul	0.902	+0.04	+0.06	+0.06	+0.06	+0.07	+0.05	−0.6	+0.07	+13	−0.05
DL	Cas	0.903	+0.08	+0.04	+0.04	+0.10	+0.03	+0.04		−0.10		
AC	Mon	0.904	−0.04	−0.06	−0.05					+0.02		
S	Sge	0.923	−0.03	+0.01	+0.03	0.00	+0.02	0.00	−0.4	+0.10	+8	−0.02
TX	Mon	0.940	0.00	−0.02	0.00					+0.09		
WX	Pup	0.951	−0.07	−0.05	−0.02	−0.07	−0.02	−0.04	+0.4	−0.04	−14	+0.04
FN	Aql	0.977	−0.06	+0.02	0.00	+0.10	+0.05	+0.02		+0.06		

Table III (Continued)

Star		log*P*	δ(*B* – *V*) max	δ⟨*B* – *V*⟩	δ(*B* – *V*) min	δ(*U* – *B*) max	δ(*U* – *B*) min	δ⟨*U* – *B*⟩	δM_V	δA_V	δ*R* 10^6 km	δA_R
1		2	3	4	5	6	7	8	8	10	11	12
YZ	Sgr	0ᵐ980	+0ᵐ04	+0ᵐ03	+0ᵐ06	+0ᵐ07	+0ᵐ13	+0ᵐ08		+0ᵐ13		
S	Mus	0.985	–0.03	–0.12	–0.15	0.00	–0.11	–0.06	0.0	–0.10	–12	0ᵐ00
S	Nor	0.989	+0.17	+0.10	+0.11				+0.1	+0.06	–4	0.00
DD	Cas	0.992	0.00	–0.02	+0.03	–0.09	+0.07	+0.02		0.00		
β	Dor	0.993	–0.03	–0.06	–0.05	–0.07	–0.03	0.00	–0.3	0.00	–1	+0.01
BZ	Cyg	1.006	+0.12	+0.04	+0.02	+0.13	+0.06	+0.05	–1.2	–0.17	+38	–0.04
ζ	Gem	1.006	+0.12	+0.04	+0.01	+0.06	+0.04	+0.03	+0.2	–0.20	–10	0.00
SY	Aur	1.006	–0.08	–0.14	–0.17	–0.08	–0.24	–0.18		–0.09		
AN	Aur	1.013	–0.10	–0.15	–0.13	–0.07	–0.10	–0.12		–0.05		
Y	Sct	1.015	+0.04	+0.10	+0.15	+0.03	+0.13	+0.11		+0.10		
Z	Lac	1.037	–0.02	+0.08	+0.15	0.00	+0.10	+0.03		+0.13		
VX	Per	1.037	–0.04	–0.08	–0.09	–0.03	–0.10	–0.09		0.00		
XX	Cen	1.040	0.00	+0.06	+0.07	0.00	+0.08	+0.07	+0.4	+0.13	–16	+0.04
TY	Sct	1.043	0.00	+0.06	+0.06	+0.04	+0.14	+0.13		+0.12		
SV	Per	1.046	–0.02	0.00	–0.04	+0.09	–0.09	+0.01		+0.01		
AA	Gem	1.053	–0.06	–0.07	–0.06	–0.01	–0.01	0.00		–0.08		
RX	Aur	1.064	0.00	–0.06	–0.12	–0.01	–0.09	–0.06		–0.10		
RY	Cas	1.084	–0.04	0.00	0.00	–0.04	–0.06	–0.09		+0.12		
SS	CMa	1.091	–0.05	–0.06	–0.06	–0.06	–0.09	–0.05		+0.17		
U	Nor	1.101	+0.09	+0.12	+0.08	+0.05	+0.11	+0.08		+0.09		
Z	Sct	1.111	+0.08	+0.10	+0.09	–0.04	+0.013	+0.05		+0.13		
AD	Pup	1.133	–0.15	–0.04	–0.01	–0.18	+0.03	–0.03		0.00		
TT	Aql	1.138	0.00	+0.08	+0.09	–0.06	+0.08	+0.01		+0.16		
SV	Vel	1.149	0.00	+0.10	+0.09	0.00	+0.04	+0.02	+0.2	+0.25	–8	+0.03
CY	Cas	1.158	–0.09	–0.06	–0.02					+0.10		
TX	Cyg	1.168	–0.15	–0.05	+0.02	–0.09	+0.04	0.00	–1.0	+0.22	+27	–0.01
UZ	Sct	1.168	+0.16	+0.13	+0.15	+0.01	+0.10	–0.10		–0.11		
RW	Cas	1.170	–0.02	+0.08	+0.12	–0.03	+0.09	+0.11		+0.16		
SZ	Cyg	1.179	+0.18	+0.16	+0.18	+0.07	+0.16	+0.15	–0.3	–0.13	+14	–0.10
CH	Cas	1.179	–0.22	–0.20	–0.20					+0.10		
SV	Mon	1.182	–0.02	+0.06	+0.08	–0.15	+0.01	–0.08		+0.10		
SZ	Mon	1.214	+0.20		–0.10	0.00	–0.17	–0.13		–0.10		
X	Cyg	1.215	0.00	+0.11	+0.13	–0.08	+0.11	+0.03		0.00		
RW	Cam	1.215	–0.04	–0.18	–0.24	+0.09	–0.34	–0.17		–0.22		

CD	Cyg	1.232	−0.01	+0.08	+0.10	0.00	+0.26	+0.16	+0.3	+0.12	−14	+0.04
Y	Oph	1.233	+0.06	−0.14	−0.25	+0.01	−0.32	−0.20	−0.2	−0.52	−12	−0.11
SZ	Aql	1.234	0.00	+0.17	+0.22	+0.20	+0.34	+0.29		+0.20		
CP	Cep	1.251	+0.14	+0.05	+0.06	−0.16	−0.17	−0.18		−0.25		
YZ	Aur	1.260	−0.06	−0.12	−0.15	−0.06	−0.20	−0.20		−0.30		
VY	Car	1.277	−0.04	−0.01	+0.02	−0.06	−0.06	−0.04	+0.4	+0.05	−24	+0.12
RU	Sct	1.294	−0.09	−0.06	−0.06	−0.09	−0.05	−0.05		+0.06		
VX	Cyg	1.304	−0.03	−0.05	−0.03	−0.14	−0.03	−0.03		−0.05		
RY	Sco	1.308	0.00	−0.12	−0.15	+0.02	−0.20	−0.15	−1.0	−0.18	+9	−0.08
WZ	Sgr	1.339	+0.08	+0.09	+0.11	+0.08	+0.27	+0.20		+0.05		
VZ	Pup	1.365	−0.18	−0.12	−0.15	−0.14	−0.10	−0.07		+0.20		
X	Pup	1.414	−0.19	−0.10	−0.12	−0.22	−0.10	−0.15		+0.16		
T	Mon	1.432	+0.07	+0.04	+0.02	+0.02	0.00	0.00	+0.6	−0.05	−26	+0.10
RY	Vel	1.449	−0.03	−0.12	−0.16	−0.05	−0.12	−0.10		−0.20		
AQ	Pup	1.475	−0.20	−0.08	−0.07	+0.20	−0.20	−0.06	−0.6	−0.03	+19	−0.14
l	Car	1.551	+0.24	+0.12	+0.10	+0.26	+0.13	+0.19	+0.4	−0.30	−8	−0.02
U	Car	1.558	−0.05	−0.04	−0.05		+0.06		+0.4	+0.11	−24	+0.04
RS	Pup	1.617	+0.09	+0.04	+0.04	+0.03	+0.18	+0.09		+0.05		
SV	Vul	1.654	−0.02	−0.04	−0.04	−0.15	+0.07	+0.09	0.0	−0.03	+15	−0.04

TABLE IV

δ-Differences of Cepheids in the central part of the SMC

Star		log$P$	δA_B	δA_V	$\delta(B-V)^{max}$	$\delta(\langle B\rangle - \langle V\rangle)$	$\delta(B-V)^{min}$	$\delta\langle B\rangle$
1		2	3	4	5	6	7	8
HV	11147	0.195	$+0^m35$	$+0^m54$	$+0^m23$	$+0^m06$	$+0^m02$	$+0^m42$
LV	39	0.235	−0.43	−0.20	+0.08	−0.12	−0.14	−0.90
HV	1403	0.250	+0.20	+0.14	−0.10	−0.13	−0.06	0.00
HV	11126	0.265	−0.23	+0.09	+0.17	+0.11	+0.03	+0.22
HV	11167	0.270	−0.25	−0.47	−0.06	−0.06	+0.15	+0.40
LV	14	0.28	+0.34	+0.14	−0.08	+0.01	+0.10	+0.22
HV	1404	0.28	+0.23	+0.27	0.00	−0.01	−0.06	+0.40
HV	11102	0.315	−0.17	−0.08	−0.10	−0.09	−0.20	+0.12
HV	1660	0.37	+0.17	−0.18	−0.02	+0.23	+0.33	−0.07
HV	1628	0.37	−0.08	+0.11	+0.07	+0.06	−0.12	+0.45
HV	1448	0.395	+0.33	+0.34	−0.11	0.00	−0.12	+0.12
HV	1650	0.41	+0.06	+0.14	−0.10	−0.15	−0.17	−0.50
HV	11151	0.435	−0.38	−0.22	+0.03	+0.05	−0.12	+0.35
HV	1540	0.465	+0.14	+0.02	−0.01	−0.03	+0.11	−0.22
HV	1443	0.475	+0.17	+0.18	−0.04	−0.05	−0.05	+0.02
HV	1472	0.485	−0.15	−0.06	+0.04	−0.03	−0.06	+0.20
LV	28	0.49	−0.02	−0.10	+0.24	+0.19	+0.29	+0.30
HV	1637	0.52	+0.22	+0.14	−0.17	−0.19	−0.09	−0.20
HV	1550	0.525	+0.33	+0.08	−0.04	+0.14	+0.20	+0.30
HV	1508	0.53	+0.17	−0.01	0.00	+0.17	+0.14	+0.05
LV	59	0.54	−0.59	−0.51	+0.08	−0.05	−0.02	−0.55
LV	55	0.565	−0.70	−0.49	+0.14	+0.02	−0.09	−0.55
HV	1445	0.565	+0.09	+0.23	−0.15	−0.11	−0.31	−0.10
LV	9	0.595	+0.20	+0.09	−0.09	+0.04	+0.01	+0.15
HV	1654	0.595	−0.04	+0.18	+0.02	−0.08	−0.22	−0.20
HV	1580	0.595	+0.11	+0.11	−0.02	−0.06	−0.03	−0.20
HV	1634	0.60	+0.13	+0.05	−0.06	+0.02	+0.01	+0.15
HV	1653	0.60	+0.16	+0.27	+0.13	+0.02	+0.01	+0.15
HV	831	0.62	+0.01	−0.10	+0.03	+0.05	+0.14	+0.30
HV	1439	0.62	−0.43	−0.36	+0.04	+0.01	−0.04	+0.20
HV	830	0.64	+0.33	+0.16	−0.06	−0.08	+0.11	0.00
HV	1562	0.64	+0.10	+0.14	−0.04	−0.08	−0.13	−0.25
HV	1551	0.655	−0.04	−0.07	−0.06	−0.02	−0.05	+0.15
HV	1519	0.655	+0.15	+0.13	−0.02	+0.09	−0.01	+0.17
HV	1409	0.655	−0.07	+0.03	+0.23	+0.08	+0.12	+0.45
HV	1598	0.66	+0.13	+0.27	−0.02	−0.13	−0.21	−0.27
HV	1388	0.67	−0.29	−0.18	+0.04	+0.03	−0.07	+0.25
HV	1480	0.685	+0.26	+0.36	+0.01	−0.04	−0.09	−0.30
HV	1683	0.685	−0.04	−0.16	−0.02	+0.03	+0.12	+0.42
HV	1431	0.69	−0.39	−0.55	−0.04	+0.10	+0.13	+0.07
LV	54	0.69	−0.40	−0.33	+0.09	+0.10	+0.02	+0.17
HV	1457	0.71	+0.07	+0.12	+0.08	+0.08	+0.04	+0.40
HV	1626	0.715	+0.07	−0.01	−0.04	−0.02	+0.05	−0.20
LV	62	0.73	−0.46	−0.50	−0.07	−0.05	−0.03	−0.08
LV	22	0.765	+0.28	+0.31	−0.07	−0.04	−0.10	+0.30
HV	1612	0.79	+0.09	+0.05	−0.09	−0.07	−0.06	−0.35
HV	1520	0.805	−0.03	−0.08	−0.01	−0.05	+0.04	+0.15
HV	1561	0.81	+0.06	−0.06	−0.04	+0.05	+0.09	+0.50
HV	1512	0.815	−0.01	+0.13	+0.08	0.00	−0.07	−0.17
HV	826	0.82	+0.06	−0.05	+0.16	+0.10	+0.27	−0.35

Table IV (Continued)

Star		log*P*	δA_B	δA_V	$\delta(B-V)^{\max}$	$\delta(\langle B\rangle-\langle V\rangle)$	$\delta(B-V)^{\min}$	$\delta\langle B\rangle$
1		2	3	4	5	6	7	8
HV	1509	0^m835	$+0^m48$	$+0^m23$	-0^m10	$+0^m03$	$+0^m15$	-0^m02
HV	1527	0.86	+0.17	+0.22	−0.04	−0.05	−0.09	−0.17
HV	1427	0.865	−0.23	−0.20	+0.05	+0.08	+0.03	+0.55
HV	1599	0.875	+0.25	+0.23	+0.05	+0.01	+0.08	+0.07
HV	1592	0.875	−0.37	−0.11	−0.02	−0.11	−0.27	−0.52
HV	1393	0.885	−0.26	−0.20	+0.08	+0.14	0.00	+0.27
HV	1415	0.91	+0.14	−0.11	+0.13	+0.11	+0.37	+0.67
HV	1589	0.92	+0.27	+0.02	−0.22	−0.04	+0.03	−0.17
HV	1437	0.925	−0.35	−0.10	−0.01	−0.06	−0.25	−0.47
HV	1411	0.945	−0.20	+0.06	+0.11	+0.02	−0.15	−0.27
HV	1399	0.96	+0.16	−0.13	−0.04	+0.10	+0.27	+0.90
HV	1486	0.965	+0.60	+0.36	−0.01	+0.06	+0.26	−0.08
HV	1487	0.98	+0.20	+0.10	−0.08	−0.05	+0.04	−0.40
HV	10355	1.00	−0.35	−0.22	+0.03	+0.08	−0.08	+0.05
HV	1426	1.02	+0.20	+0.24	−0.02	−0.01	−0.15	−0.10
HV	1377	1.025	−0.27	−0.20	0.00	−0.07	−0.06	+0.17
LV	8	1.04	+0.12	+0.09	−0.08	−0.06	−0.06	+0.07
HV	1471	1.05	−0.46	−0.45	+0.12	+0.13	+0.08	+0.25
HV	1630	1.055	+0.19	+0.19	−0.08	−0.08	−0.12	−0.42
HV	1682	1.085	0.00	+0.24	−0.07	−0.21	−0.34	−0.60
HV	1553	1.10	−0.12	−0.07	+0.10	+0.02	+0.02	+0.25
HV	1464	1.125	−0.22	−0.13	+0.14	+0.09	+0.01	+0.25
HV	1438	1.135	−0.09	−0.03	+0.02	−0.04	−0.08	−0.20
HV	1387	1.16	+0.05	+0.19	+0.06	+0.03	−0.09	+0.37
HV	1579	1.165	−0.16	+0.02	−0.15	−0.20	−0.33	−0.60
HV	1442	1.185	+0.24	+0.23	−0.06	−0.07	−0.04	−0.07
HV	1560	1.19	+0.06	−0.07	+0.02	+0.05	+0.15	−0.07
HV	1481	1.195	−0.42	−0.42	+0.06	+0.05	+0.06	−0.47
HV	1372	1.20	+0.16	+0.08	−0.10	−0.01	−0.02	+0.57
HV	1472	1.20	+0.18	+0.12	−0.02	−0.02	+0.05	−0.02
HV	828	1.21	+0.24	+0.12	0.00	+0.09	+0.13	+0.55
HV	1533	1.215	−0.05	−0.06	+0.10	+0.13	+0.13	+0.40
HV	1478	1.215	−0.21	−0.19	+0.12	+0.04	+0.11	+0.55
HV	1541	1.285	+0.13	+0.04	−0.24	−0.22	−0.15	−0.95
HV	1543	1.31	−0.02	+0.03	+0.03	0.00	−0.02	+0.07
HV	1522	1.345	−0.08	−0.10	+0.09	+0.06	+0.10	−0.12
HV	1430	1.38	−0.08	+0.09	−0.03	−0.06	−0.19	−0.17
HV	11129	1.39	+0.13	+0.10	+0.08	+0.13	+0.11	+0.52
HV	1501	1.44	−0.02	−0.09	−0.04	−0.06	+0.03	−0.15
HV	1451	1.475	0.00	−0.14	+0.02	+0.06	+0.16	−0.05
HV	10357	1.505	+0.15	+0.12	−0.11	−0.05	−0.08	−0.10
LV	52	1.615	−0.32	−0.18	+0.32	+0.16	+0.17	+0.22
HV	824	1.82	+0.09	−0.05	−0.27	−0.19	−0.12	−0.10
LV	60	1.855	+0.10	+0.09	+0.19	+0.31	+0.21	−0.07
HV	829	1.945	+0.13	+0.12	−0.24	−0.24	−0.22	+0.05

TABLE V

δ-differences of Cepheids in the peripheral regions of SMC

Star		$\log P$	δA_B	$\delta(B-V)^{max}$	$\delta(\langle B\rangle - \langle V\rangle)$	$\delta(B-V)^{min}$	$\delta\langle B\rangle$
HV	1897	0.094	$-0^m_.05$	$+0^m_.02$	$-0^m_.17$	$-0^m_.02$	$-0^m_.37$
HV	1781	0.114	+0.26	0.00	−0.16	+0.03	0.00
HV	1907	0.216	+0.66	−0.10	−0.17	−0.09	−0.13
HV	1779	0.251	−0.45	+0.17	−0.08	−0.15	−0.80
HV	1869	0.391	−0.48	+0.13	0.00	−0.07	+0.40
HV	11114	0.433	+0.11	+0.04	−0.07	−0.18	−0.10
HV	2015	0.458	−0.19	+0.03	+0.03	−0.08	−0.05
HV	1906	0.486	+0.17	−0.01	−0.01	0.00	−0.15
HV	11216	0.494	−0.01	−0.01	−0.08	−0.15	−0.20
HV	11113	0.507	−0.12	−0.02	−0.05	−0.21	+0.08
HV	212	0.591	−0.08	−0.06	−0.15	−0.16	−0.40
HV	214	0.624	+0.09	−0.07	−0.11	−0.16	−0.60
HV	1425	0.658	−0.06	−0.04	−0.14	−0.11	−0.25
HV	1492	0.799	+0.08	−0.21	−0.12	−0.12	−0.55
HV	1400	0.823	−0.21	+0.03	−0.07	−0.14	−0.18
HV	11112	0.826	−0.29	−0.03	−0.02	−0.16	0.00
HV	827	1.129	+0.09	−0.29	−0.25	−0.24	−0.60
HV	1328	1.200	−0.48	−0.26	−0.37	−0.45	−0.85
HV	1342	1.254	−0.49	−0.28	−0.35	−0.57	−0.47
HV	817	1.276	−0.20	−0.29	−0.35	−0.35	−0.93
HV	823	1.504	+0.45	−0.29	−0.19	−0.18	+0.08
HV	2195	1.621	+0.56	−0.40	−0.33	−0.11	−0.72
HV	837	1.629	+0.30	−0.16	−0.20	−0.12	−0.27
HV	824	1.818	+0.54	−0.32	−0.26	−0.10	−0.35
HV	834	1.866	−0.06	−0.22	−0.27	−0.34	−0.28
HV	829	1.942	+0.05	−0.10	−0.20	−0.22	0.00
HV	821	2.104	+0.23	+0.04	+0.04	+0.12	+0.90

TABLE VI

δ-differences of Cepheids in the peripheral regions of LMC

Star		log$P$	δA_B	δA_V	$\delta(B-V)^{max}$	$\delta(\langle B\rangle - \langle V\rangle)$	$\delta(B-V)^{min}$	$\delta\langle B\rangle$
HV	41	0.218	$+0\overset{m}{.}07$	$+0\overset{m}{.}10$	$+0\overset{m}{.}04$	$+0\overset{m}{.}14$	$+0\overset{m}{.}23$	$-0\overset{m}{.}80$
HV	38	0.381	−0.45	−0.30	−0.03	−0.11	−0.11	−0.70
HV	34	0.401	+0.02	+0.13	−0.18	+0.10	0.00	−0.07
HV	44	0.408	+0.20	+0.16	−0.15	−0.03	−0.07	+0.07
HV	122407	0.418	+0.04	−0.15	−0.04	+0.11	+0.22	+0.02
HV	554124	0.429	+0.55	+0.29	−0.11	−0.07	+0.07	−0.15
HV	23	0.429	−0.47	−0.21	−0.05	−0.18	−0.29	−0.55
HV	13	0.462	0.00	−0.08	−0.02	−0.09	+0.01	+0.05
HV	1222533	0.478	−0.40	−0.10	+0.31	+0.18	−0.05	+0.35
HV	48	0.493	−0.04	+0.14	+0.36	+0.17	+0.12	+0.10
HV	1222432	0.495	+0.02	−0.07	0.00	+0.11	+0.04	+0.13
HV	12	0.495	+0.12	+0.24	0.00	−0.07	−0.19	−0.03
HV	1252127	0.497	−0.30	−0.24	+0.26	−0.04	+0.14	−0.20
HV	47	0.504	+0.19	−0.14	0.00	+0.07	+0.025	+0.07
HV	127485	0.506	+0.05	−0.04	−0.07	−0.07	−0.04	0.00
HV	1221917	0.528	+0.28	+0.20	−0.10	−0.18	−0.09	−0.05
HV	25	0.529	−0.27	−0.28	+0.07	0.00	+0.01	+0.15
HV	1274710	0.556	−0.19	−0.08	−0.07	−0.18	−0.23	−0.07
HV	122418	0.562	+0.22	+0.15	−0.04	0.00	0.00	+0.12
HV	553126	0.566	0.00	+0.06	−0.10	−0.17	−0.19	−0.07
HV	1222629	0.569	−0.27	−0.21	+0.14	+0.06	+0.05	+0.20
HV	1223716	0.572	+0.20	+0.11	+0.00	+0.06	+0.06	0.00
HV	43	0.583	+0.16	+0.15	+0.05	+0.08	+0.07	+0.03
HV	42	0.583	+0.08	+0.07	−0.02	+0.01	0.00	0.00
HV	127499	0.613	−0.37	−0.10	+0.13	−0.03	−0.17	−0.35
HV	30	0.663	0.00	−0.07	−0.13	−0.08	−0.07	0.00
HV	22	0.669	+0.40	+0.12	+0.02	+0.17	+0.29	+0.12
HV	1222035	0.686	−0.10	+0.13	−0.10	−0.12	−0.35	+0.07
HV	18	0.696	−0.30	−0.18	+0.18	+0.16	+0.08	+0.10
HV	37	0.716	+0.26	+0.10	−0.18	+0.17	−0.01	−0.02
HV	14	0.749	+0.40	+0.14	−0.08	+0.16	+0.23	0.00
HV	88621	1.380	+0.31	+0.08	−0.08	0.00	+0.14	+0.05
HV	1	1.385	−0.53	−0.37	−0.04	−0.06	−0.20	−0.40
HV	225140	1.447	+0.06	+0.11	+0.10	+0.04	+0.05	+0.07
HV	229446	1.562	+0.15	+0.18	+0.03	+0.02	+0.01	−0.10

References

Arp, H. C.: 1960, *Astron. J.* **65**, 404.
Fernie, J. D.: 1963, *Astron. J.* **68**, 280.
Fernie, J. D.: 1970, *Astrophys. J.* **161**, 679.
Gascoigne, S. C. B.: 1969, *Monthly Notices Roy. Astron. Soc.* **146**, 1.
Genderen van, A. M.: 1969, *Bull. Astron. Inst. Neth. Suppl.* **3**, 221.
Gusseva, N. N. and Tsarevsky, G. S.: 1968, *Peremen. Zvezdy* **16**, 292.
Irwin, I. B.: 1961, *Astrophys. J. Suppl.* **6**, 253.
Ivanov, G. R.: 1974, Dissertation, University of Sofia.
Kraft, R. P.: 1960, *Astrophys. J.* **131**, 330.
Kraft, R. P.: 1961, *Astrophys. J.* **134**, 616.
Kron, G. E. and Svolopoulos, S. N.: 1959, *Publ. Astron. Soc. Pacific* **71**, 126.
Kurochkin, N. E.: 1966, *Peremen. Zvezdy* **16**, 10.
Mianes, P.: 1963, *Ann. Astrophys.* **26**, 1.
Nikolov, N. S.: 1966, *Astron. Zh.* **43**, 785 = *Soviet Astron. A. J.* **10**, 623.
Nikolov, N. S. and Ivanov, G. R.: 1973a, *Astron. Zh.* **51**, 132.
Nikolov, N. S. and Ivanov, G. R.: 1973b, *Peremen. Zvezdy* **19**, 207.
Nikolov, N. S., Kunchev, P. Z., and Ivanov, G. R.: 1973, *Bull. Sec. Astron. Bulg. Acad. Sci.* **6**, 61.
Oke, J. B.: 1961, *Astrophys. J.* **134**, 314.
Sandage, A.: 1958, *Astrophys. J.* **127**, 513.
Sandage, A. and Tammann, G. A.: 1971, *Astrophys. J.* **167**, 293.
Schmidt, E. G.: 1971, *Astrophys. J.* **165**, 335.
Tsarevsky, G. S. and Yakimova, N. N.: 1970, *Peremen. Zvezdy* **17**, 120.
Williams, J. A.: 1966, *Astron. J.* **71**, 615.
Woolley, R. v. d. R., Sandage, A. R., Eggen, O. J., Alexander, J. B., Mather, L., Epps, E., and Jones, S.: 1962, *Roy. Observ. Bull.* **58**, 31.
Yakimova, N. N.: 1970a, *Peremen. Zvezdy* **17**, 253.
Yakimova, N. N.: 1970b, *Astron. Circ.*, No. 594, 3.
Yakimova, N. N.: 1971, *Astron. Zh.* **48**, 1265 = *Soviet Astron. A. J.* **15**, 1006.
Yakimova, N. N.: 1972a, *Sternberg Inst. Comm.* **177**, 19.
Yakimova, N. N.: 1972b, *Astron. Zh.* **49**, 514.