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BVI_c Observations of 64 Classical Cepheids

L. N. Berdnikov[1], A. Yu. Kniazev[1,2,3], A. K. Dambis[1], V. V. Kravtsov[1]

[1] Sternberg Astronomical Institute, Moscow State University, Universitetskij pr. 13, Moscow 119234, Russia; berdnik@sai.msu.ru

[2] South Africa Astronomical Observatory, Cape Town, South Africa

[3] Southern African Large Telescope, Cape Town, South Africa

A total of 9128 B-, V-, and I_c-band photometric measurements were acquired for 64 classical Cepheids in 1982–2014. For these stars, 1384 times of maximum light are determined and O–C diagrams constructed based on available photoelectric and CCD observations. The data are used to compute the current ephemerides and the normalized Fourier coefficients (cosine expansion), whose analysis confirmed that all the 64 variables were correctly classified as classical Cepheids.

1 Introduction

High luminosities and reliable absolute-magnitude calibration make classical Cepheids highly important distance indicators. As rather young objects (no older than $2 \cdot 10^8$ years), they concentrate toward the Galactic plane and therefore serve as ideal tracers of the Galactic disk structure.

We showed in our recent paper (Berdnikov et al., 2014) CCD observations to be preferred over photoelectric photometry for determining Cepheid distances, because the former allow systematic observation errors to be reduced substantially. It therefore appears obvious that CCD observations should be performed for all Cepheids (or, at least, for the faint ones). In this paper, we report the results of such B-, V-, and I_c-band observations for 64 classical Cepheids and also present the results of our yet unpublished photoelectric observations of these Cepheids.

2 Observations

We carried out our CCD observations during 11 observing seasons in 2005–2014 (JD 2453483–56791) with the 76-cm telescope of the South African Astronomical Observatory (SAAO) in South Africa and with the 40-cm telescope of Observatorio Cerro Armazones of Universidad Catolica del Norte (OCA, Chile). We used a SBIG CCD ST-10XME camera equipped with Kron–Cousins BVI_c filters (Cousins, 1976).

Photoelectric observations were carried out using a single-channel photometer mounted on the 60-cm telescope of Mount Maidanak Observatory in 1982 and 76-cm SAAO telescope in 1998–2008. A description of the technique of the reductions of photoelectric observations can be found in Berdnikov and Turner (2004).

When reducing CCD data, we first reduced the observations obtained using "all-sky" technique during photometric nights exclusively to obtain a catalog of positions and PSF magnitudes of all objects found on the best CCD frames. We then selected, from this catalog, the constant stars, which we used for differential photometry of all stars in all CCD frames including those acquired during non-photometric nights. For a complete description of the observation and reduction technique employed, see Berdnikov et al. (2011).

3 Results and Discussion

We acquired a total of 8225 CCD frames and 903 photoelectric measurements for 64 Cepheids. The results of our reductions are presented in Table 1 (its complete version is available in the file attached to the html version of this paper) and shown graphically in Figs. 1–4, where open and filled circles denote photoelectric and CCD observations, respectively. The scatter of data points in the plots shows that observational errors are close to 0.01^m.

Small changes of Cepheid periods, which have practically no effect on their computed distances, are often conspicuous even on short time scales of several years (Berdnikov, 1994; Berdnikov & Pastukhova, 1994ab,1995); as a result, for most of the Cepheids the times of maximum light deviate appreciably from the zero-phase times given by published light elements (ephemerides) of most of the Cepheids including those reported in recent catalogs. That is why, for plots in Figs. 1–4, we used the current light elements from Table 2, which we determined based on the times of maximum light computed using the Hertzsprung (1919) method whose computer implementation is described in Berdnikov (1982). We determined the current light elements from an analysis of B- and V-band observations from this paper combined with published photoelectric and CCD observations including the data acquired in Hipparcos (ESA, 1997), ASAS-3 (Pojmanski, 2002), ASAS-SN (Yayasinghe et al., 2018), and INTEGRAL-OMC (Alfonso-Garcon et al., 2012). All light elements in Table 2 refer to the V-band filter.

Figures 5–7 show the O–C diagrams for all the 64 Cepheids. These diagrams can be used to determine the corrections to the ephemerides from Table 2 and, in particular, compute the phases of spectroscopic observations of Cepheids or when determining the γ velocity from a single velocity measurement.

Table 3 lists the normalized Fourier coefficients (cosine expansion) (Petersen 1986) for Cepheid light curves, and in Fig. 8, we plot ϕ_{31} as a function of period for the 547 Cepheids that we observed; the circles show the data from Table 3.

4 Conclusions

(1) A total of 9128 magnitude measurements were made for 64 Cepheids in 1982–2014 in the B-, V-, and I_c-band filters.

(2) We analyzed our data combined with all published photoelectric and CCD observations of these Cepheids using the Hertzsprung method and constructed the O–C diagrams based on 1384 times of maximum light. These diagrams can be used to compute the corrections to ephemerides in Table 2, e.g., in order to determine the phases of spectroscopic

observations of Cepheids or when determining the γ velocity from a single radial-velocity measurement for a Cepheid.

(3) We fitted the light curves of 64 Cepheids by Fourier series (cosine expansion) and computed the corresponding normalized Fourier coefficients R_{21}, R_{31}, R_{41}, ϕ_{21}, ϕ_{31}, and ϕ_{41}. The plot of ϕ_{31} vs. period is used to validate the classification of a variable as a classical Cepheid. Figure 8 shows such a plot for the 547 Cepheids that we observed earlier. Here the positions of the circles, which correspond to the data from Table 3, corroborate the correctness of the classification of the 64 Cepheids.

We will use our new data to study the structure and kinematics of the Galactic disk and the properties of the Cepheids, in particular, to search for evolutionary changes of their periods.

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Table 1: Photometric observations of Cepheids

HJD 2400000+	Filter	Magnitude	HJD 2400000+	Filter	Magnitude	HJD 2400000+	Filter	Magnitude
				T Ant				
51248.4724	B	10.487	51248.4724	V	9.638	51248.4724	I_c	8.732
51249.3539	B	9.383	51249.3539	V	8.894	51249.3539	I_c	8.287
51249.4128	B	9.360	51249.4128	V	8.867	51249.4128	I_c	8.261
51250.3115	B	9.705	51250.3115	V	9.084	51250.3115	I_c	8.353
51251.3119	B	10.085	51251.3119	V	9.320	51251.3119	I_c	8.475
51251.4307	B	10.115	51251.4307	V	9.340	51251.4307	I_c	8.495
51252.3111	B	10.320	51252.3111	V	9.491	51252.3111	I_c	8.577
51252.4725	B	10.379	51252.4725	V	9.526	51252.4725	I_c	8.612
51253.3039	B	10.581	51253.3039	V	9.680	51253.3039	I_c	8.734
51253.4425	B	10.604	51253.4425	V	9.694	51253.4425	I_c	8.745
51254.3556	B	10.467	51254.3556	V	9.649	51254.3556	I_c	8.756
51254.4321	B	10.404	51254.4321	V	9.599	51254.4321	I_c	8.721
51255.2894	B	9.368	51255.2894	V	8.876	51255.2894	I_c	8.272
51255.3876	B	9.363	51255.3876	V	8.872	51255.3876	I_c	8.272
51256.2955	B	9.715	51256.2955	V	9.075	51256.2955	I_c	8.343
51256.4213	B	9.768	51256.4213	V	9.119	51256.4213	I_c	8.356
51258.3243	B	10.324	51258.3243	V	9.498	51258.3243	I_c	8.591
51258.3704	B	10.381	51258.3704	V	9.536	51258.3704	I_c	8.620
51259.3288	B	10.588	51259.3288	V	9.686	51259.3288	I_c	8.725
51260.2600	B	10.474	51260.2600	V	9.651	51260.2600	I_c	8.751
51260.3590	B	10.383	51260.3590	V	9.591	51260.3590	I_c	8.724
51275.2864	B	10.174	51275.2864	V	9.391	51275.2864	I_c	8.502
51276.3338	B	10.461	51276.3338	V	9.583	51276.3338	I_c	8.643
51276.3688	B	10.489	51276.3688	V	9.591	51276.3688	I_c	8.657
51279.2395	B	9.448	51279.2395	V	8.920	51279.2395	I_c	8.283
51279.3080	B	9.503	51279.3080	V	8.969	51279.3080	I_c	8.309
51279.3458	B	9.523	51279.3458	V	8.979	51279.3458	I_c	8.315
51280.2397	B	9.862	51280.2397	V	9.169	51280.2397	I_c	8.390
51280.2962	B	9.895	51280.2962	V	9.198	51280.2962	I_c	8.404
51280.3493	B	9.910	51280.3493	V	9.200	51280.3493	I_c	8.405
51281.2456	B	10.150	51281.2456	V	9.361	51281.2456	I_c	8.494
51281.2706	B	10.164	51281.2706	V	9.373	51281.2706	I_c	8.490
51281.3119	B	10.175	51281.3119	V	9.385	51281.3119	I_c	8.514
51281.3484	B	10.191	51281.3484	V	9.395	51281.3484	I_c	8.510
51282.2617	B	10.497	51282.2617	V	9.604	51282.2617	I_c	8.683
51282.3621	B	10.475	51282.3621	V	9.603	51282.3621	I_c	8.663
51284.2644	B	9.919	51284.2644	V	9.279	51284.2644	I_c	8.504
51286.2524	B	9.906	51286.2524	V	9.210	51286.2524	I_c	8.411
51286.3255	B	9.940	51286.3255	V	9.232	51286.3255	I_c	8.416

Table 2: Ephemerides of Cepheid light variations

Cepheid	Right ascension $h\ m\ s$	Declination $\circ\ '\ ''$	Initial epoch HJD	Period days
T Ant	09 33 50.86	–36 36 56.7	2454157.3370 ± 0.0020	5.89836670 ± 0.00000796
V733 Aql	19 57 33.02	+11 02 37.2	2454812.6897 ± 0.0060	6.17876776 ± 0.00003047
V1803 Aql	19 20 06.94	+12 47 42.9	2454467.0241 ± 0.0071	8.62834987 ± 0.00005543
V922 Ara	16 41 20.04	–47 39 38.8	2454433.6164 ± 0.0171	13.01791882 ± 0.00015462
V384 CMa	07 03 55.07	–17 52 47.7	2454160.4594 ± 0.0069	4.20597866 ± 0.00002373
V434 CMa	07 13 42.42	–17 37 13.0	2454261.7573 ± 0.0078	7.51172944 ± 0.00004879
II Car	10 48 49.12	–60 03 47.2	2455758.9580 ± 0.0519	64.65113243 ± 0.00386174
V656 Car	10 36 27.07	–62 11 33.0	2454383.2567 ± 0.0229	24.22633478 ± 0.00045283
V690 Car	09 48 26.80	–58 01 05.5	2454237.3035 ± 0.0040	4.15056019 ± 0.00001637
V708 Car	10 15 37.88	–59 33 04.6	2455529.2793 ± 0.0432	51.37631049 ± 0.00249981
V850 Car	09 48 19.86	–57 48 37.7	2454367.7668 ± 0.0055	5.21712047 ± 0.00002542
V854 Car	10 10 36.82	–58 17 46.8	2454273.0349 ± 0.0049	5.07068718 ± 0.00002331
V1253 Cen	12 38 03.82	–38 31 24.6	2454758.5718 ± 0.0048	4.32098155 ± 0.00002190
V1372 Cen	11 20 39.12	–61 49 52.5	2454553.7016 ± 0.0100	13.36877922 ± 0.00009933
V1384 Cen	13 14 00.18	–62 29 54.4	2454335.5631 ± 0.0228	6.37904808 ± 0.00013139
EV Cir	15 05 46.47	–58 22 55.1	2454090.0874 ± 0.0141	16.70159336 ± 0.00021275
FL Cir	15 20 21.31	–58 07 20.1	2454399.2584 ± 0.0164	10.51851030 ± 0.00012643
FQ Cru	12 22 40.16	–62 09 35.8	2454300.9987 ± 0.0110	13.77676524 ± 0.00015479
V508 Mon	06 47 09.40	+03 58 01.6	2449999.3585 ± 0.0039	4.13363963 ± 0.00000301
V510 Mon	06 47 26.90	+02 31 00.8	2454739.0842 ± 0.0474	7.45748754 ± 0.00025720
V911 Mon	06 40 37.56	+11 43 38.9	2454484.9367 ± 0.0135	4.97820496 ± 0.00005795
V981 Mon	06 48 29.18	–10 14 17.6	2454369.2157 ± 0.0047	4.51439309 ± 0.00001809
V397 Nor	16 15 55.55	–51 07 14.7	2454205.4750 ± 0.0054	6.81274252 ± 0.00002788
V539 Nor	16 20 54.23	–53 33 16.5	2455311.9580 ± 0.0038	2.64360940 ± 0.00001248
V620 Pup	07 57 49.89	–29 23 02.6	2454702.2680 ± 0.0055	2.58609332 ± 0.00001343
V622 Pup	07 59 12.20	–26 41 56.0	2454986.5635 ± 0.0047	3.71650952 ± 0.00001856
V729 Pup	08 05 11.03	–34 21 36.9	2454586.1485 ± 0.0043	4.08870325 ± 0.00001781
V730 Pup	08 10 24.78	–38 28 25.4	2454162.6137 ± 0.0047	3.57897053 ± 0.00001414
V731 Pup	08 10 25.88	–32 31 16.9	2454884.7901 ± 0.0081	5.46478167 ± 0.00004784
DX Pyx	08 34 26.07	–35 59 06.6	2454127.8063 ± 0.0031	3.73723995 ± 0.00000962
V367 Sge	19 19 53.15	+17 14 25.6	2454567.5289 ± 0.0079	4.84260751 ± 0.00003589
V5567 Sgr	18 21 05.53	–18 27 19.6	2454730.6752 ± 0.0073	9.76281790 ± 0.00008112
V5738 Sgr	18 03 41.74	–22 10 58.5	2454449.1257 ± 0.0994	42.61937034 ± 0.00265430
V636 Sco	17 22 46.48	–45 36 51.4	2451402.7145 ± 0.0036	6.79699218 ± 0.00001440
V1622 Sco	17 32 53.11	–35 54 41.1	2454104.4122 ± 0.0061	8.44676116 ± 0.00004669
V412 Ser	18 14 15.82	–09 20 20.7	2455145.7686 ± 0.0029	5.12173266 ± 0.00002188
V1256 Tau	05 27 06.50	+16 56 11.1	2454665.1351 ± 0.0050	4.43855466 ± 0.00001889
V520 Vel	08 36 11.36	–39 03 42.5	2455197.0944 ± 0.0060	12.95873402 ± 0.00009012
V527 Vel	09 04 35.72	–46 33 13.1	2454349.9543 ± 0.0168	6.62826288 ± 0.00008789
V530 Vel	09 09 32.02	–53 59 15.8	2454288.0318 ± 0.0026	3.59055812 ± 0.00000908
V532 Vel	09 22 49.81	–51 51 38.7	2454340.9247 ± 0.0231	11.20753666 ± 0.00022781
V536 Vel	09 27 57.81	–52 18 58.4	2453485.8813 ± 0.0160	7.64343628 ± 0.00014805
V537 Vel	09 30 05.09	–51 37 25.1	2454332.0850 ± 0.0022	3.36803616 ± 0.00000526

Table 2: (Continued)

Cepheid	Right ascension h m s	Declination ° ′ ″	Initial epoch HJD	Period days
ASAS052610+1151.3	05 26 09.63	+11 51 13.2	2454537.9037 ± 0.0030	4.23199632 ± 0.00001068
ASAS062939–1840.5	06 29 39.22	–18 40 26.7	2455034.3158 ± 0.0258	16.94052234 ± 0.00060080
ASAS064001–0754.8	06 40 01.19	–07 54 51.0	2454297.0457 ± 0.0036	1.60386979 ± 0.00000444
ASAS071705–2849.4	07 17 04.69	–28 49 24.7	2454222.4823 ± 0.0093	3.96997244 ± 0.00003094
ASAS071850–3238.7	07 18 50.62	–32 38 38.4	2455005.9658 ± 0.0038	1.16324185 ± 0.00000544
ASAS073113–2811.0	07 31 12.11	–28 10 58.5	2455505.0251 ± 0.0081	4.71128567 ± 0.00005391
ASAS073453–2651.3	07 34 53.40	–26 51 20.9	2454292.7123 ± 0.0073	3.55246978 ± 0.00001866
ASAS073502–3554.9	07 35 02.07	–35 54 46.8	2454805.9108 ± 0.0034	4.24359673 ± 0.00001533
ASAS074925–3814.4	07 49 25.25	–38 14 21.7	2454210.0353 ± 0.0033	10.50339556 ± 0.00002713
ASAS075840–3330.2	07 58 39.87	–33 30 14.6	2454161.1972 ± 0.0052	4.40296963 ± 0.00001853
ASAS082117–3845.3	08 21 16.82	–38 45 15.7	2454874.2838 ± 0.0063	5.03039779 ± 0.00003488
ASAS082127–3825.3	08 21 26.61	–38 25 18.2	2454122.3090 ± 0.0050	3.96115588 ± 0.00001652
ASAS083130–4429.3	08 31 30.22	–44 29 17.7	2455257.6189 ± 0.0068	4.21817714 ± 0.00003716
ASAS084127–4353.6	08 41 26.86	–43 53 34.5	2455311.5259 ± 0.0216	25.36450082 ± 0.00085200
ASAS091933–5137.4	09 19 32.18	–51 37 13.6	2455139.1434 ± 0.0034	3.35494562 ± 0.00001418
ASAS094809+0000.1	09 48 09.43	+00 00 08.2	2454471.1556 ± 0.0011	0.83391125 ± 0.00000083
ASAS115701–6218.7	11 57 00.51	–62 18 42.5	2454793.8982 ± 0.0179	26.52275125 ± 0.00098763
ASAS140742–6315.4	14 07 42.01	–63 15 15.6	2454426.1237 ± 0.0101	7.79738700 ± 0.00006029
ASAS165857–4312.3	16 58 57.07	–43 12 19.2	2455085.8650 ± 0.0120	10.99158402 ± 0.00010540
ASAS182714–1507.1	18 27 13.44	–15 07 04.5	2454125.6351 ± 0.0080	5.54569029 ± 0.00003579
ASAS193206+1132.9	19 32 04.73	+11 32 59.2	2455792.4759 ± 0.0072	6.69752564 ± 0.00005874

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Table 3: Normalized Fourier coefficients (cosine expansion)

Cepheid	Period	R_{21} Error	R_{31} Error	R_{41} Error	ϕ_{21} Error	ϕ_{31} Error	ϕ_{41} Error
T Ant	5.89837	0.43466	0.17856	0.09721	3.02859	5.93388	2.67123
		0.00256	0.00256	0.00256	0.00779	0.01624	0.02820
V733 Aql	6.17877	0.28866	0.05211	0.02262	3.00693	5.08899	5.69551
		0.00170	0.00170	0.00170	0.00681	0.03307	0.07558
V1803 Aql	8.62840	0.18317	0.06604	0.04292	4.24798	1.07380	2.66997
		0.00331	0.00331	0.00331	0.01923	0.05107	0.07821
V922 Ara	13.01802	0.15645	0.10984	0.09845	2.52184	3.98195	0.39758
		0.00612	0.00612	0.00612	0.04101	0.05869	0.06684
V384 CMa	4.20598	0.35630	0.13467	0.03284	2.83002	5.65080	3.08131
		0.00002	0.00002	0.00002	0.00006	0.00014	0.00055
V434 CMa	7.51176	0.27270	0.10845	0.08889	3.55704	0.35793	2.02948
		0.00250	0.00250	0.00250	0.01045	0.02425	0.02986
II Car	64.65113	0.39070	0.14702	0.05357	3.32189	0.26629	3.50931
		0.00033	0.00033	0.00033	0.00106	0.00242	0.00621
V656 Car	24.22676	0.33927	0.19363	0.13982	2.99339	5.58062	2.17902
		0.01126	0.01126	0.01126	0.04011	0.06725	0.09227
V690 Car	4.15057	0.33433	0.12346	0.01395	2.70648	5.49845	2.73730
		0.00082	0.00082	0.00082	0.00297	0.00712	0.05918
V708 Car	51.37631	0.31891	0.11208	0.04079	3.27095	0.39554	3.69158
		0.00126	0.00126	0.00126	0.00469	0.01188	0.03134
V850 Car	5.21710	0.26549	0.09964	0.00496	2.76531	5.88181	4.45445
		0.00002	0.00002	0.00002	0.00007	0.00016	0.00316
V854 Car	5.07068	0.36302	0.11271	0.04136	2.73992	5.69162	2.04094
		0.00179	0.00179	0.00179	0.00610	0.01677	0.04388
V1253 Cen	4.32099	0.40937	0.17705	0.09150	2.77162	5.48196	2.19516
		0.00095	0.00095	0.00095	0.00301	0.00611	0.01111
V1372 Cen	13.36880	0.12488	0.12718	0.12751	2.41633	3.81192	0.51562
		0.00806	0.00806	0.00806	0.06653	0.06784	0.07097
V1384 Cen	6.37921	0.21906	0.01352	0.00002	2.83492	5.48606	5.02852
		0.00002	0.00002	0.00002	0.00009	0.00129	0.91299
EV Cir	16.70155	0.30223	0.19015	0.13056	2.69490	5.21295	1.62879
		0.00889	0.00889	0.00889	0.03435	0.05380	0.07678
FL Cir	10.51847	0.05036	0.06198	0.03101	0.88861	2.71348	0.24531
		0.00023	0.00023	0.00023	0.00465	0.00383	0.00758
FQ Cru	13.77710	0.22282	0.12695	0.13161	2.88705	4.50576	0.77853
		0.01115	0.01115	0.01115	0.05479	0.09400	0.09576
V508 Mon	4.13364	0.33862	0.12438	0.02167	2.70730	5.46179	1.77991
		0.00061	0.00061	0.00061	0.00219	0.00527	0.02845
V510 Mon	7.45749	0.26443	0.04804	0.06271	3.52735	5.32972	1.22577
		0.00057	0.00057	0.00057	0.00243	0.01193	0.00933
V911 Mon	4.97819	0.35405	0.09303	0.00002	2.83242	5.65007	1.12892
		0.00002	0.00002	0.00002	0.00006	0.00020	1.11889
V981 Mon	4.51439	0.46651	0.24670	0.11577	2.80891	5.75995	2.37802
		0.00362	0.00362	0.00362	0.01062	0.01826	0.03447
V397 Nor	6.81267	0.25535	0.07101	0.01170	3.15503	5.38820	6.25672
		0.00051	0.00051	0.00051	0.00226	0.00739	0.04391
V539 Nor	2.64342	0.27244	0.10450	0.02401	3.09057	5.97416	2.35483
		0.00001	0.00001	0.00001	0.00006	0.00014	0.00060
V620 Pup	2.58611	0.37153	0.12382	0.03992	2.52797	5.34839	1.21653
		0.00183	0.00183	0.00183	0.00615	0.01579	0.04649

Table 3: (Continued)

Cepheid	Period	R_{21} Error	R_{31} Error	R_{41} Error	ϕ_{21} Error	ϕ_{31} Error	ϕ_{41} Error
V622 Pup	3.71652	0.34098	0.14672	0.05206	2.59010	5.05446	1.23582
		0.00001	0.00001	0.00001	0.00005	0.00011	0.00028
V729 Pup	4.08867	0.34464	0.12141	0.04024	2.82168	5.64332	2.93519
		0.00030	0.00030	0.00030	0.00107	0.00266	0.00765
V730 Pup	3.57896	0.35507	0.15501	0.07422	2.73734	5.49882	1.77879
		0.00262	0.00262	0.00262	0.00906	0.01867	0.03688
V731 Pup	5.46481	0.32944	0.09914	0.05335	2.85359	6.00515	2.43213
		0.00104	0.00104	0.00104	0.00379	0.01098	0.02000
DX Pyx	3.73724	0.38182	0.15831	0.06815	2.62392	5.40340	1.92246
		0.00252	0.00252	0.00252	0.00829	0.01759	0.03825
V367 Sge	4.84262	0.41567	0.16115	0.03056	2.92912	5.92214	1.91637
		0.00001	0.00001	0.00001	0.00003	0.00007	0.00034
V5567 Sgr	9.76278	0.18850	0.10866	0.07983	4.03515	0.87648	2.51650
		0.00365	0.00365	0.00365	0.02070	0.03534	0.04800
V5738 Sgr	42.61349	0.35614	0.14451	0.06729	2.69506	5.49527	2.00308
		0.00268	0.00268	0.00268	0.00924	0.02021	0.04124
V636 Sco	6.79699	0.30404	0.05360	0.01693	3.19879	5.72969	6.08239
		0.00124	0.00124	0.00124	0.00476	0.02337	0.07320
V1622 Sco	8.44680	0.23312	0.14013	0.09002	3.71060	0.77894	2.32352
		0.00386	0.00386	0.00386	0.01827	0.02988	0.04558
V412 Ser	5.12172	0.32632	0.13335	0.03898	2.85167	5.76317	1.93589
		0.00001	0.00001	0.00001	0.00003	0.00007	0.00022
V1256 Tau	4.43857	0.36412	0.16508	0.07751	2.73907	5.68386	1.96398
		0.00265	0.00265	0.00265	0.00900	0.01790	0.03577
V520 Vel	12.95930	0.17481	0.09862	0.07629	2.50316	3.33784	4.98075
		0.00314	0.00314	0.00314	0.01901	0.03317	0.04299
V527 Vel	6.62817	0.35218	0.10226	0.02575	3.30419	6.20784	5.00996
		0.00063	0.00063	0.00063	0.00219	0.00645	0.02460
V530 Vel	3.59059	0.36468	0.08753	0.01715	2.76352	5.52861	0.46646
		0.00269	0.00269	0.00269	0.00912	0.03175	0.15708
V532 Vel	11.20749	0.19003	0.06026	0.02692	2.56248	4.06213	5.44797
		0.00080	0.00080	0.00080	0.00449	0.01344	0.02977
V536 Vel	7.64343	0.33728	0.13042	0.06836	3.60475	6.23821	0.97791
		0.00150	0.00150	0.00150	0.00535	0.01233	0.02270
V537 Vel	3.36803	0.35853	0.14937	0.09061	2.64673	5.32839	1.66540
		0.00352	0.00352	0.00352	0.01208	0.02583	0.04133
ASAS 052610+1151.3	4.23200	0.38097	0.14721	0.05489	2.81627	5.73339	2.26705
		0.00090	0.00090	0.00090	0.00297	0.00668	0.01678
ASAS 062939–1840.5	16.94061	0.17584	0.12666	0.14309	2.90862	4.57736	1.17694
		0.00978	0.00978	0.00978	0.05897	0.08262	0.07877
ASAS 064001–0754.8	1.60386	0.18954	0.00001	0.00002	2.60592	3.92781	0.28421
		0.00002	0.00002	0.00002	0.00009	1.40503	0.78809
ASAS 071705–2849.4	3.96998	0.26442	0.07491	0.02350	2.77116	5.42853	3.70762
		0.00085	0.00085	0.00085	0.00362	0.01158	0.03617
ASAS 071850–3238.7	1.16324	0.26378	0.07441	0.02905	2.34076	5.08130	0.40225
		0.00086	0.00086	0.00086	0.00368	0.01181	0.02971
ASAS 073113–2811.0	4.71130	0.34164	0.11486	0.05832	2.67541	5.41323	1.55280
		0.00100	0.00100	0.00100	0.00355	0.00922	0.01762

Table 3: (End)

Cepheid	Period	R_{21} Error	R_{31} Error	R_{41} Error	ϕ_{21} Error	ϕ_{31} Error	ϕ_{41} Error
ASAS 073453–2651.3	3.55246	0.39797	0.15488	0.05604	2.73927	5.53746	2.09260
		0.00172	0.00172	0.00172	0.00552	0.01224	0.03143
ASAS 073502–3554.9	4.24359	0.31245	0.18085	0.05802	2.75262	5.81921	2.79011
		0.00089	0.00089	0.00089	0.00336	0.00560	0.01576
ASAS 074925–3814.4	10.50338	0.21831	0.11639	0.15787	3.15016	4.63562	1.12799
		0.01142	0.01142	0.01142	0.05709	0.10394	0.08556
ASAS 075840–3330.2	4.40295	0.37593	0.13292	0.05738	2.86139	5.47616	1.34509
		0.00001	0.00001	0.00001	0.00004	0.00009	0.00020
ASAS 082117–3845.3	5.03030	0.40140	0.15192	0.04111	2.92431	5.89859	2.81249
		0.00123	0.00123	0.00123	0.00392	0.00888	0.03026
ASAS 082127–3825.3	3.96115	0.34009	0.14422	0.06632	2.67464	5.45142	2.18184
		0.00208	0.00208	0.00208	0.00738	0.01569	0.03240
ASAS 083130–4429.3	4.21809	0.24829	0.06951	0.02369	2.63446	5.25950	4.46774
		0.00163	0.00163	0.00163	0.00733	0.02395	0.06909
ASAS 084127–4353.6	25.36446	0.36384	0.25604	0.19245	2.78559	5.43950	2.07293
		0.01060	0.01060	0.01060	0.03603	0.05221	0.06951
ASAS 091933–5137.4	3.35495	0.40927	0.20327	0.10319	2.62148	5.25363	1.53919
		0.00603	0.00603	0.00603	0.01906	0.03477	0.06327
ASAS 094809+0000.1	0.83391	0.37686	0.15392	0.06393	2.73443	5.79240	2.70284
		0.00105	0.00105	0.00105	0.00349	0.00751	0.01695
ASAS 115701–6218.7	26.52275	0.34927	0.20868	0.16297	2.86669	5.45840	1.97179
		0.01114	0.01114	0.01114	0.03891	0.06299	0.08160
ASAS 140742–6315.4	7.79737	0.25445	0.11804	0.06596	3.40520	6.07425	0.95556
		0.00217	0.00217	0.00217	0.00957	0.01951	0.03404
ASAS 165857–4312.3	10.99179	0.17804	0.12013	0.04372	4.44211	2.08225	4.83661
		0.00199	0.00199	0.00199	0.01187	0.01762	0.04625
ASAS 182714–1507.1	5.54570	0.32296	0.12180	0.03777	2.82010	5.61583	1.85331
		0.00001	0.00001	0.00001	0.00004	0.00009	0.00027
ASAS 193206+1132.9	6.69762	0.33599	0.03866	0.00003	3.08309	6.21039	3.14578
		0.00001	0.00001	0.00001	0.00004	0.00030	0.35783

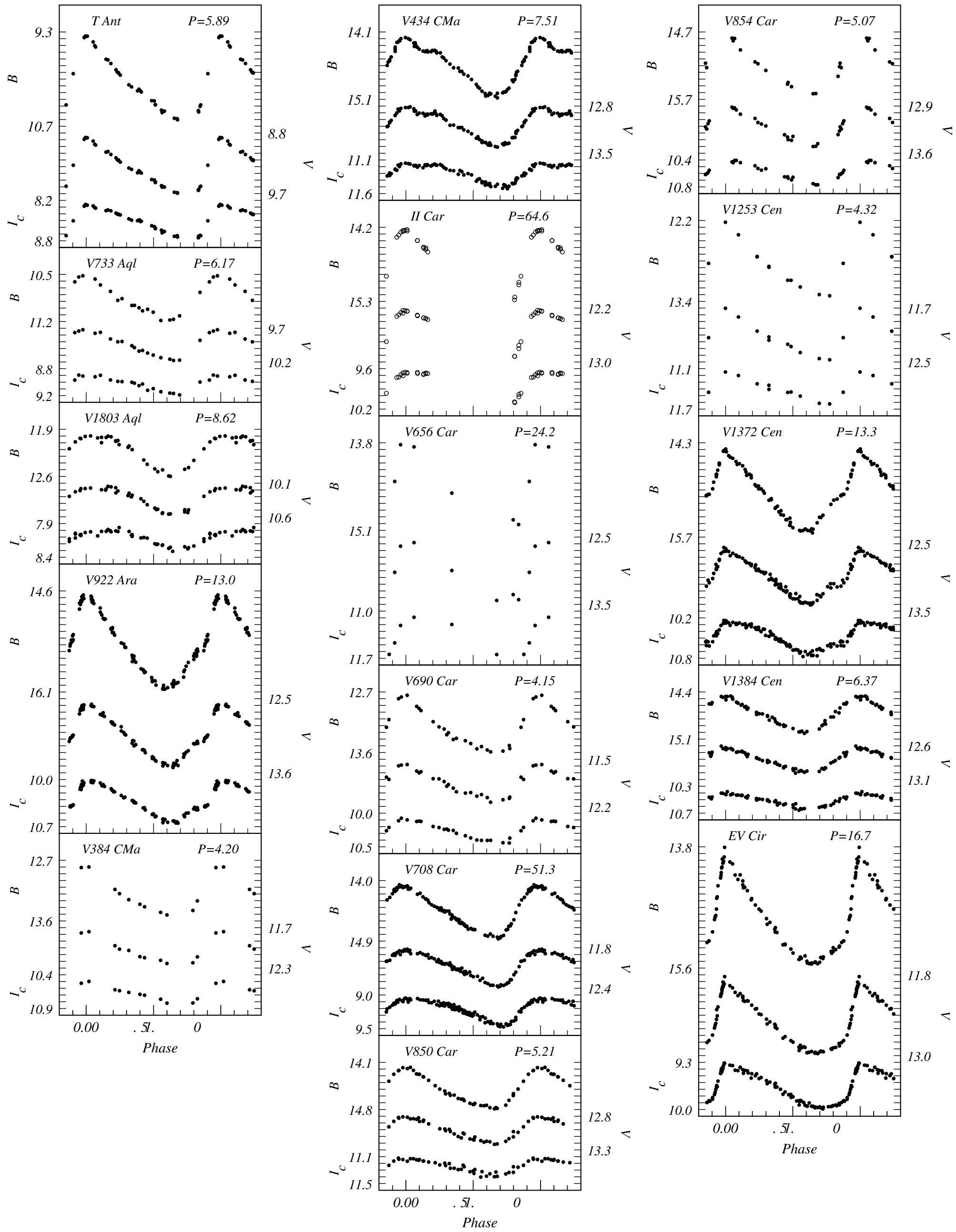

Figure 1. Light curves of the Cepheids T Ant, V733 Aql, V1803 Aql, V922 Ara, V384 CMa, V434 CMa, II Car, V656 Car, V690 Car, V708 Car, V850 Car, V854 Car, V1253 Cen, V1372 Cen, V1384 Cen, and EV Cir.

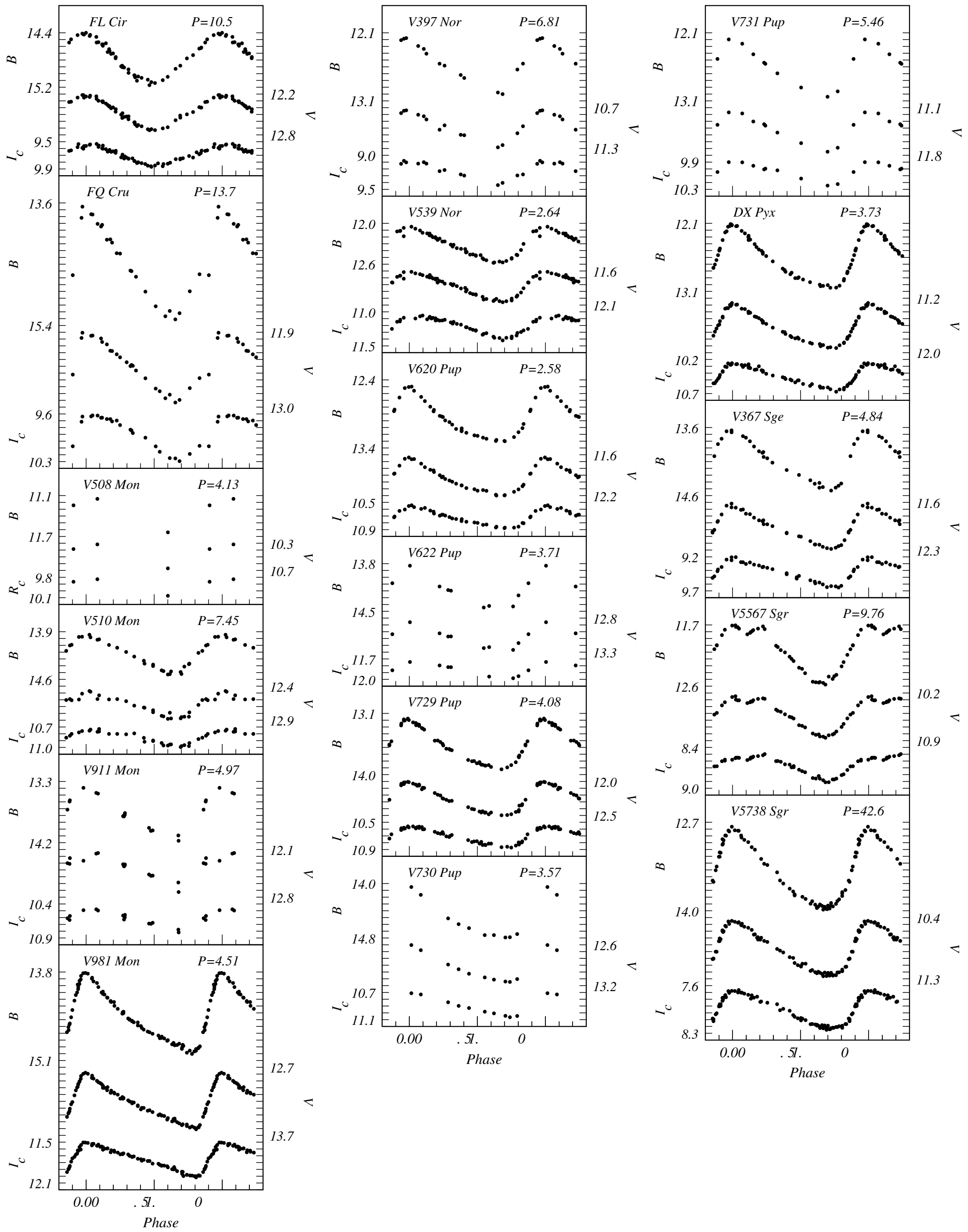

Figure 2. Light curves of the Cepheids FL Cir, FQ Cru, V508 Mon, V510 Mon, V911 Mon, V981 Mon, V397 Nor, V539 Nor, V620 Pup, V622 Pup, V729 Pup, V730 Pup, V731 Pup, DX Pyx, V367 Sge, V5567 Sgr, and V5738 Sgr.

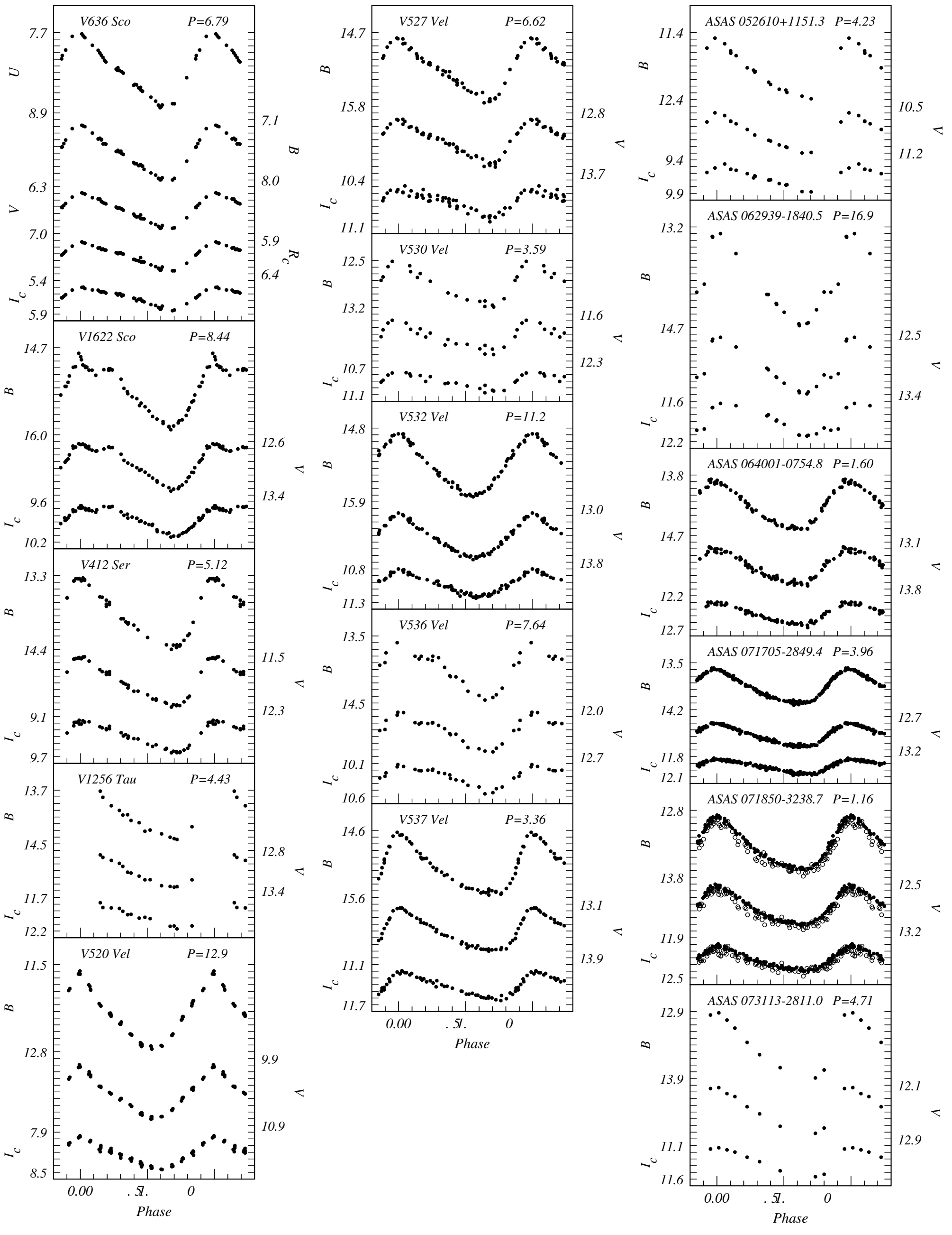

Figure 3. Light curves of the Cepheids V636 Sco, V1622 Sco, V412 Ser, V1256 Tau, V520 Vel, V527 Vel, V530 Vel, V532 Vel, V536 Vel, V537 Vel, ASAS 052610+1151.3, ASAS 062939–1840.5, ASAS 064001–0754.8, ASAS 071705–2849.4, ASAS 071850–3238.7, and ASAS 073113–2811.0.

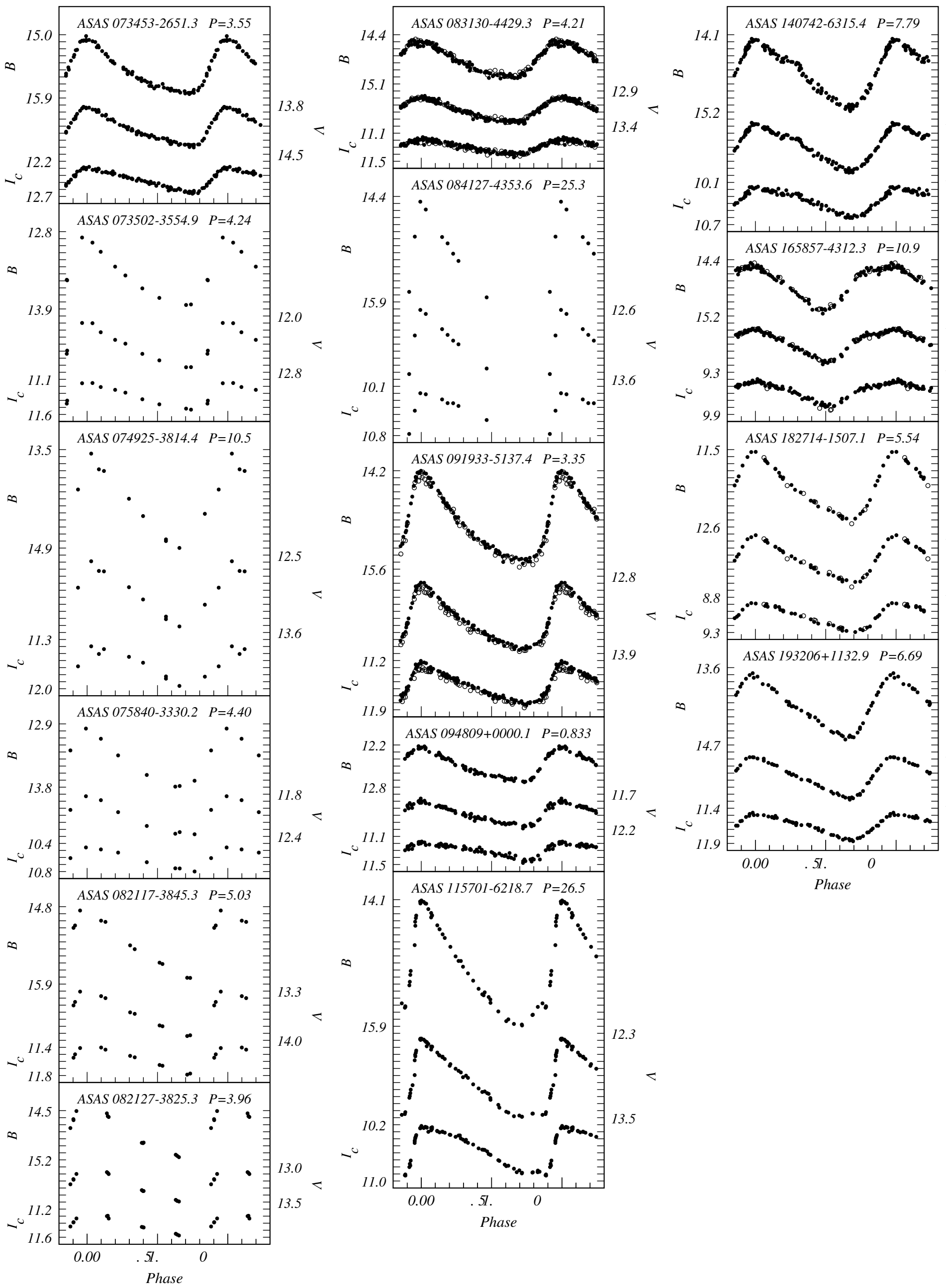

Figure 4. Light curves of the Cepheids ASAS 073453–2651.3, ASAS 073502–3554.9, ASAS 074925–3814.4, ASAS 075840–3330.2, ASAS 082117–3845.3, ASAS 082127–3825.3, ASAS 083130–4429.3, ASAS 084127–4353.6, ASAS 091933-5137.4, ASAS 094809+0000.1, ASAS 115701–6218.7, ASAS 140742–6315.4, ASAS 165857–4312.3, ASAS 182714–1507.1, and ASAS 193206+1132.9.

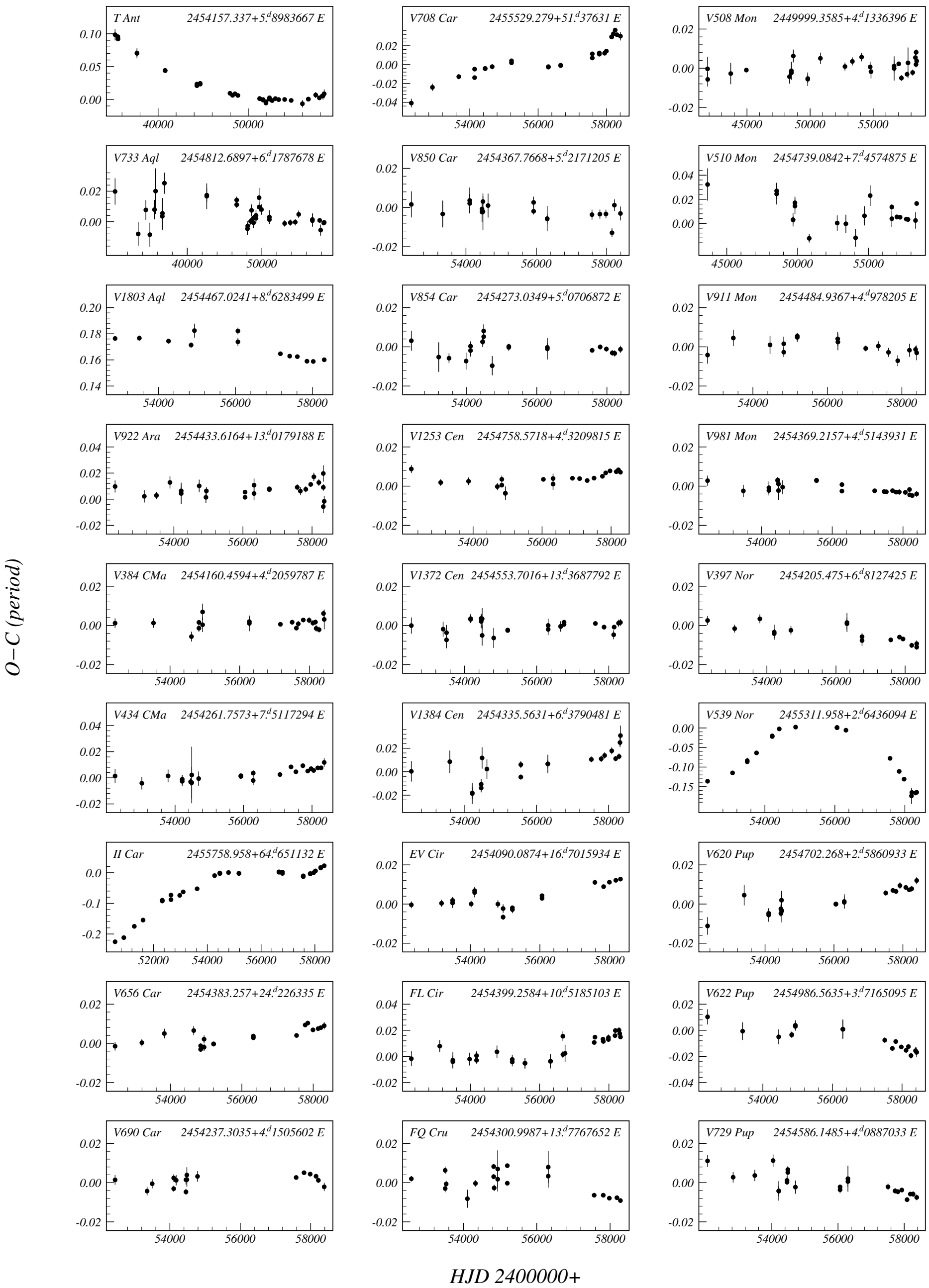

Figure 5. The O–C diagrams for T Ant, V733 Aql, V1803 Aql, V922 Ara, V384 CMa, V434 CMa, II Car, V656 Car, V690 Car, V708 Car, V850 Car, V854 Car, V1253 Cen, V1372 Cen, V1384 Cen, EV Cir, FL Cir, FQ Cru, V508 Mon, V510 Mon, V911 Mon, V981 Mon, V397 Nor, V539 Nor, V620 Pup, V622 Pup, and V729 Pup.

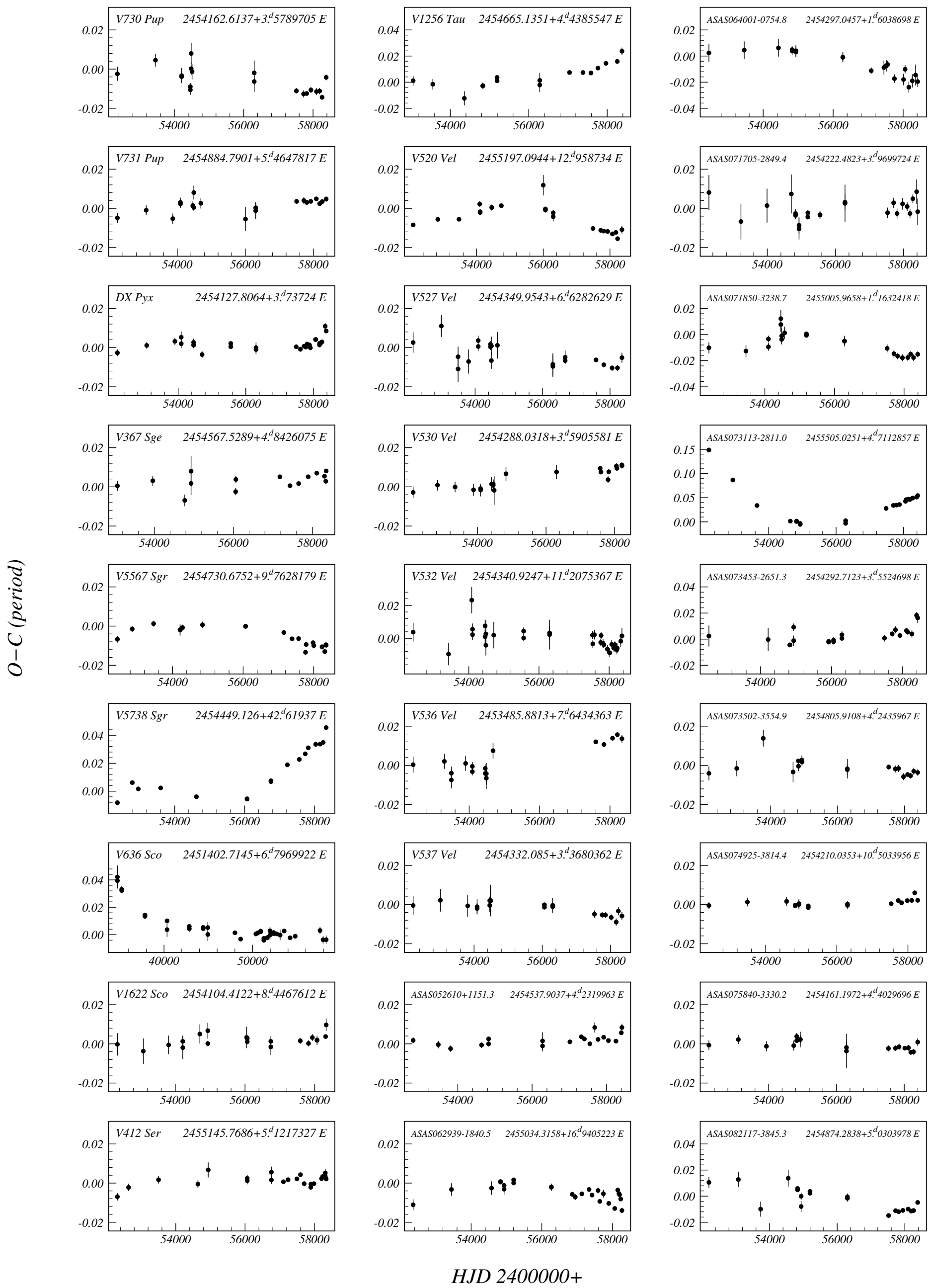

Figure 6. The O–C diagrams for V731 Pup, DX Pyx, V367 Sge, V5567 Sgr, V5738 Sgr, V636 Sco, V1622 Sco, V412 Ser, V1256 Tau, V520 Vel, V527 Vel, V530 Vel, V532 Vel, V536 Vel, V537 Vel, ASAS 052610+1151.3, ASAS 062939–1840.5, ASAS 064001–0754.8, ASAS 071705–2849.4, ASAS 071850–3238.7, ASAS 073113–2811.0, ASAS 073453–2651.3, ASAS 073502–3554.9, ASAS 074925–3814.4, ASAS 075840–3330.2, and ASAS 082117–3845.3.

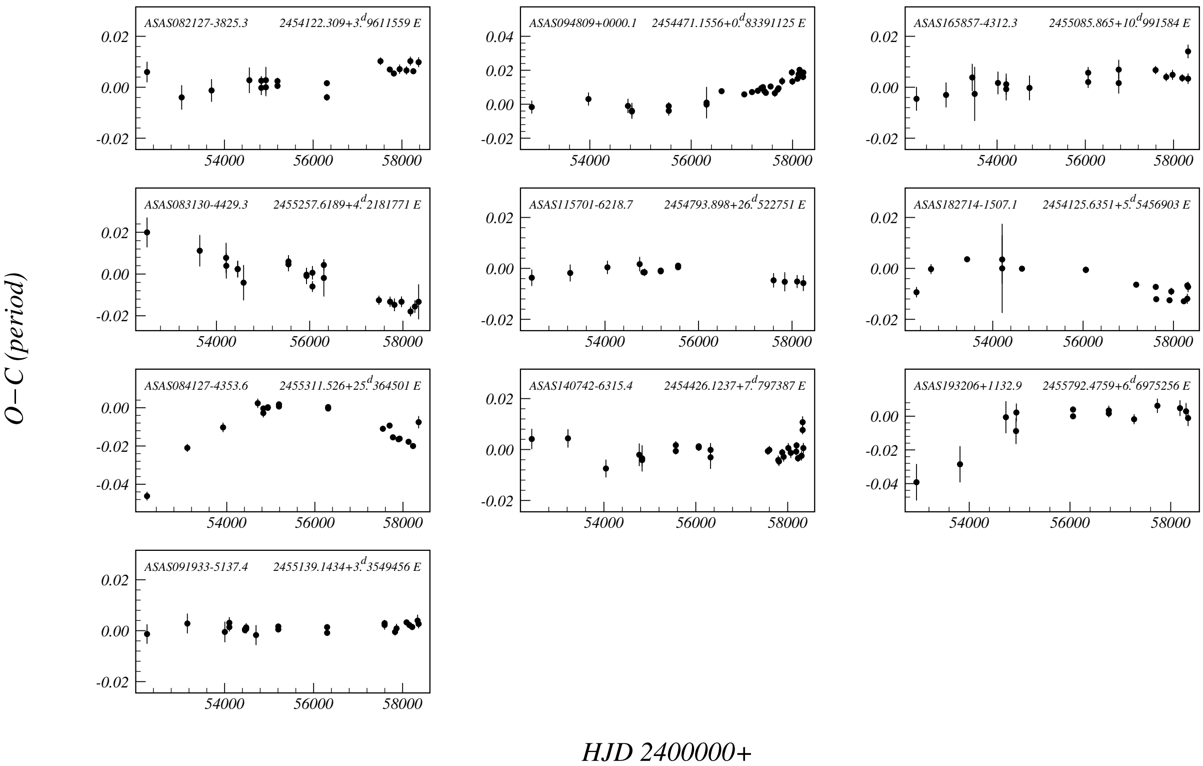

Figure 7. The O–C diagrams for ASAS 082127–3825.3, ASAS 083130–4429.3, ASAS 084127–4353.6, ASAS 091933-5137.4, ASAS 094809+0000.1, ASAS 115701–6218.7, ASAS 140742–6315.4, ASAS 165857–4312.3, ASAS 182714–1507.1, and ASAS 193206+1132.9.

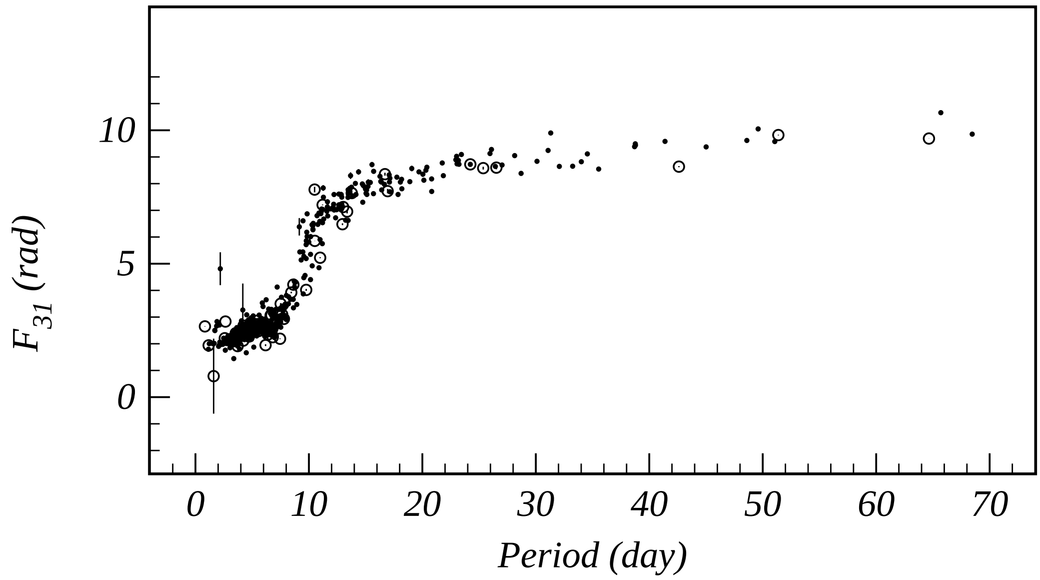

Figure 8. The period–ϕ_{31} diagram for classical Cepheids. The open circles show the data from Table 3.