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CCD Observations of Type CW Cepheids and RV Tau Stars

L. N. Berdnikov[1], A. Y. Kniazev[1,2,3], A. K. Dambis [1], V. V. Kravtsov[1], E. N. Pastukhova[4]

[1] Sternberg Astronomical Institute, Moscow State University, Universitetskij pr. 13, Moscow 119992, Russia; leonid.berdnikov@gmail.com

[2] South African Astronomical Observatory, P.O. Box 9, Observatory, Cape Town, 7935 South Africa

[3] Southern African Large Telescope, P.O. Box 9, Observatory, Cape Town, 7935 South Africa

[4] Institute of Astronomy, Russian Academy of Sciences, ul. Pyatnitskaya 48, Moscow, 119017, Russia

In 2005–2014, we obtained 16568 photometric measurements in the BVI_c photometric system for 64 type II Cepheids and 54 RV Tau stars using the 76-cm telescope of the South African Astronomical Observatory (SAAO, South Africa) and the 40-cm telescope of the Cerro Armazones Observatory of the Universidad Catolica del Norte (OCA, Chile). The tables of observations and the plots of light curves are presented.

From April 2005 through May 2014, we used the 76-cm telescope of South African Astronomical Observatory (SAAO, Republic of South Africa) for photoelectric and CCD observations, while the 40-cm telescope of Cerro Armazones Observatory (OCA) of the Universidad Catolica del Norte in Chile was used for CCD observations only. The B, V, and I_c filters of the Kron–Cousins system (Cousins, 1976) were used. The observation and reduction techniques were described by Berdnikov et al. (2004, 2011), respectively for photoelectric and CCD observations.

We acquired a total of 10384 photometric measurements for 64 type II Cepheids and 6184 photometric measurements for 54 RV Tau-type variables. All light curves, constructed with the elements from Tables 1–2, are presented in Figures 1–12. Three-color observations are given in text files (Tables 3–4) in the html version of the paper.

The scatter of data points in the plots indicates that observational errors are close to 0.01^m. Observations of three Cepheids – ASAS 115302-2313.0, ASAS 174134-4854.6, and ASAS 185152-1333.6 – do not fit into a single light curve because of abrupt changes of their periods; in Fig. 7, we repeat these light curves taking into account the shifts of seasonal light curves for these Cepheids.

The light curves of most of the RV Tau type stars are highly unstable, resulting in times of minima deviating from the ephemerides reported in the GCVS and ASAS-3 variable-star catalogs (Table 2).

The new data obtained in this study will be used to study the structure and kinematics of the old disk and Galactic halo and also to study the properties of Cepheids and RV Tau type stars and, particular, to search for evolutionary changes in their periods.

References:

Berdnikov, L.N., Kniazev, A.Yu., Sefako, R. et al., 2011, *Astron. Rep.*, **55**, 816
Berdnikov, L.N., Turner, D.G., 2004, *Astron. Astrophys. Trans.*, **23**, 253
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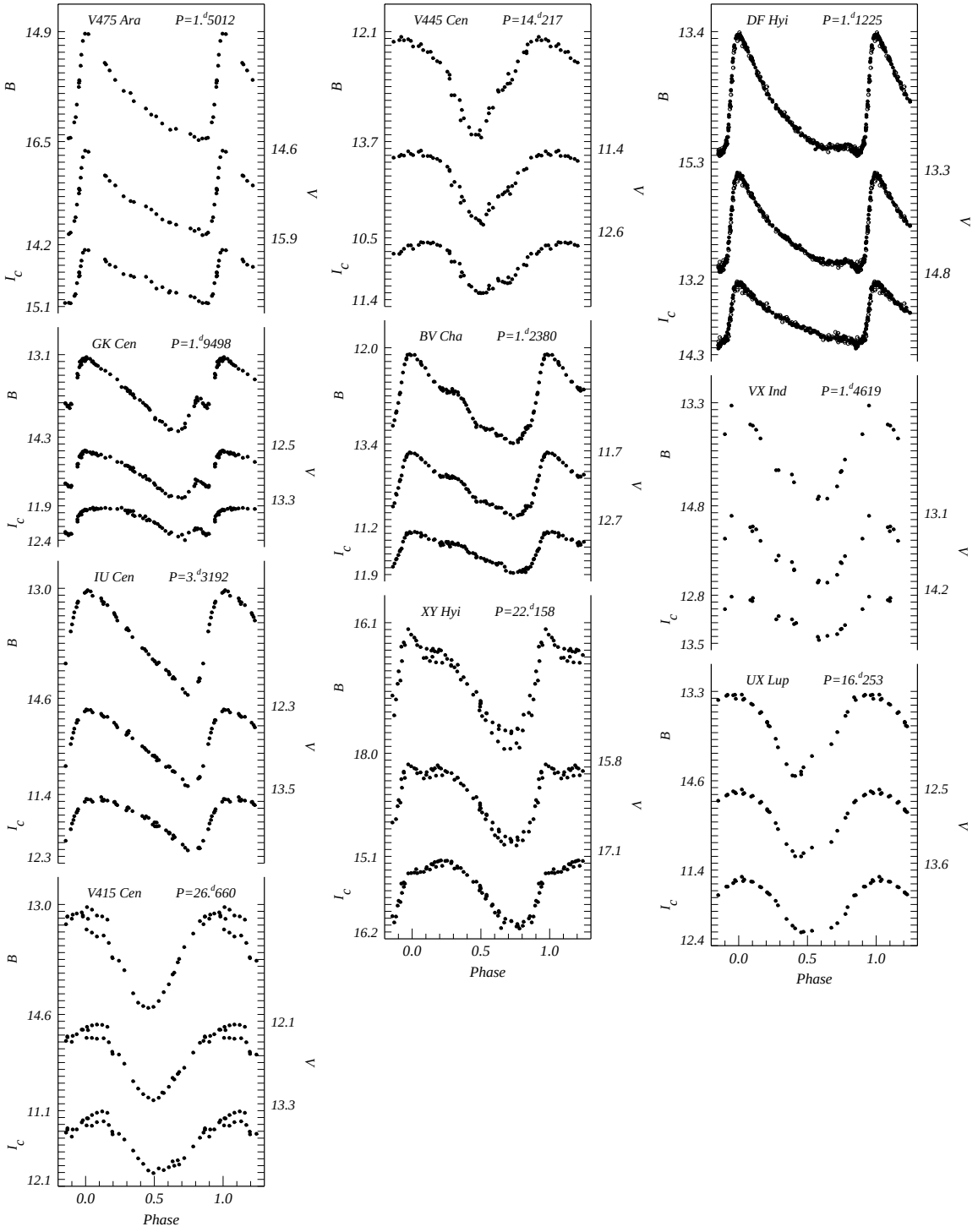

Figure 1: Light curves of type II Cepheids: V475 Ara, GK Cen, IU Cen, V415 Cen, V445 Cen, BV Cha, XY Hyi, DF Hyi, VX Ind, and UX Lup. The circles and dots show photoelectric and CCD observations, respectively.

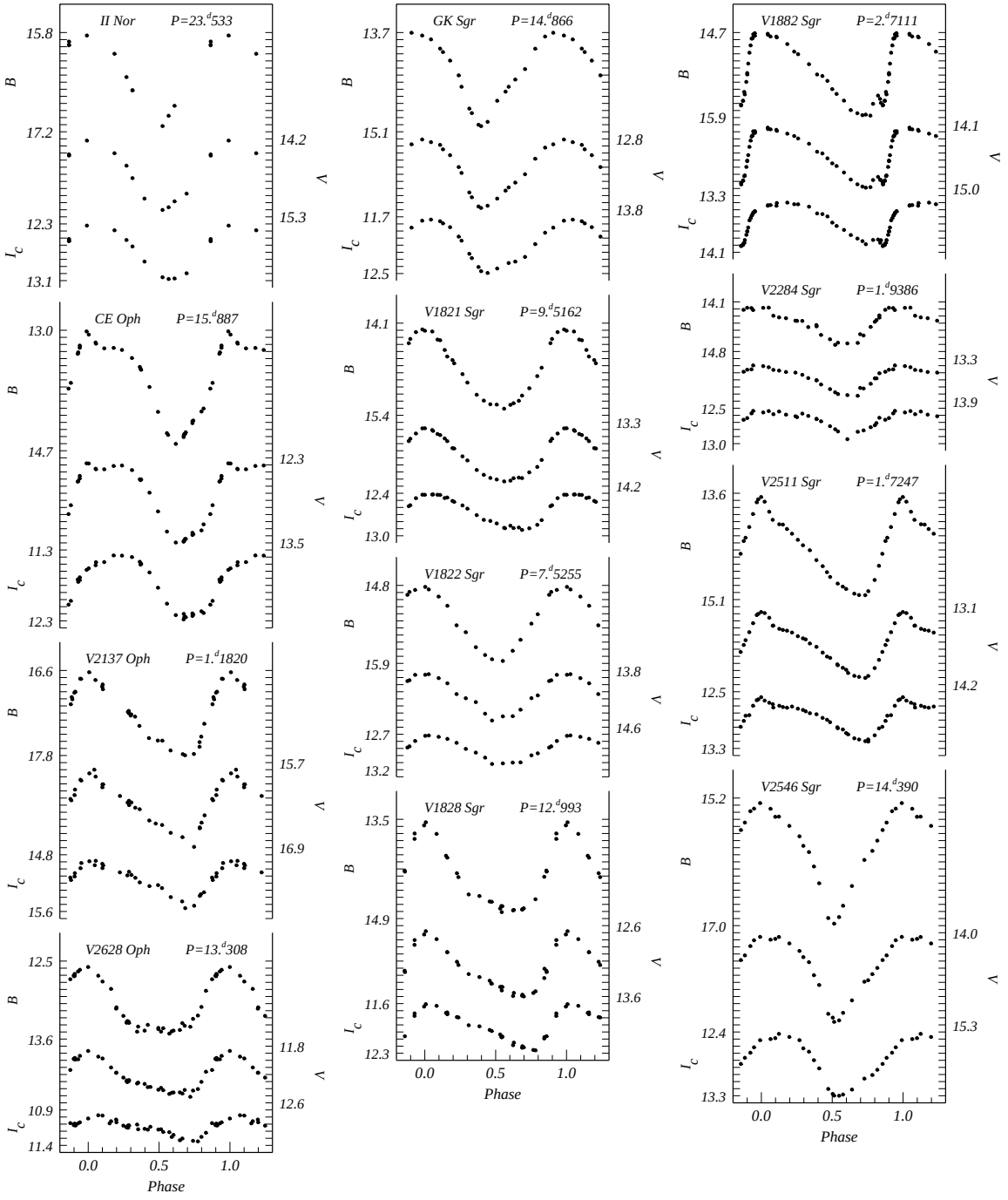

Figure 2: The same as in Fig. 1 but for II Nor, CE Oph, V2137 Oph, V2628 Oph, GK Sgr, V1821 Sgr, V1822 Sgr, V1828 Sgr, V1882 Sgr, V2284 Sgr, V2511 Sgr, and V2546 Sgr.

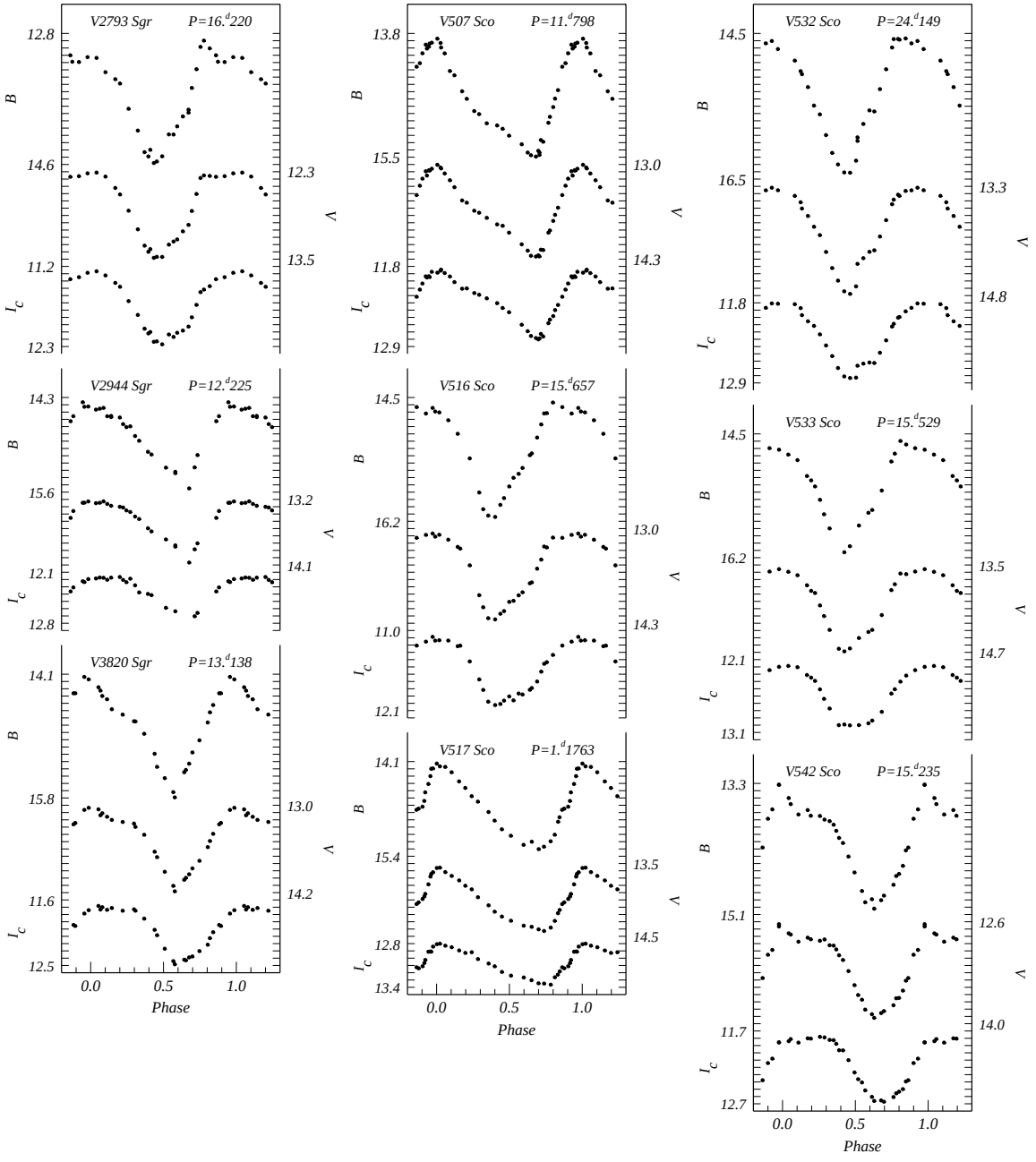

Figure 3: The same as in Fig. 1 but for V2793 Sgr, V2944 Sgr, V3820 Sgr, V507 Sco, V516 Sco, V517 Sco, V532 Sco, V533 Sco, and V542 Sco.

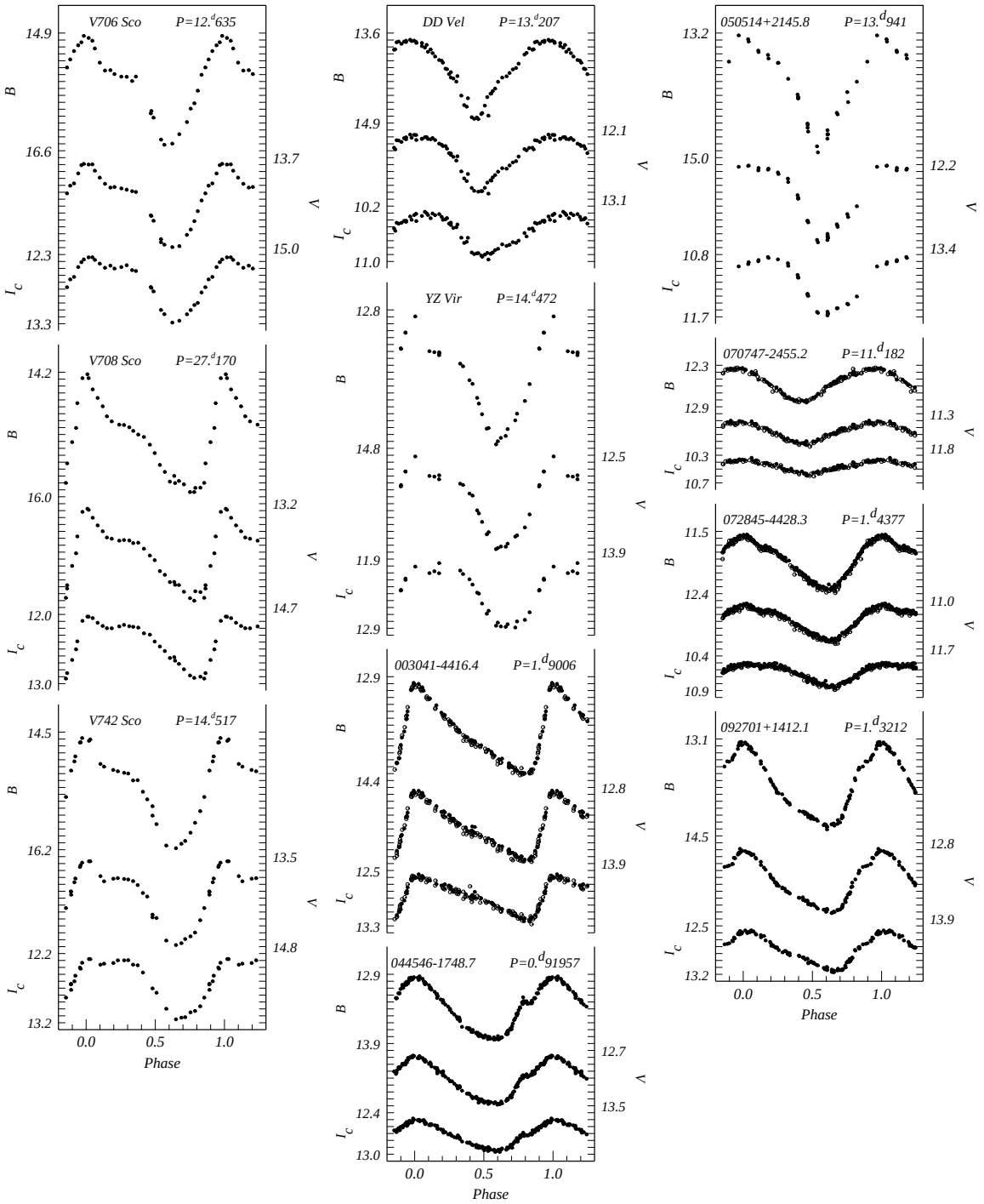

Figure 4: The same as in Fig. 1 but for V706 Sco, V708 Sco, V742 Sco, DD Vel, YZ Vir, ASAS 003041-4416.4, ASAS 044546-1748.7, ASAS 050514+2145.8, ASAS 070747-2455.2, ASAS 072845-4428.3, and ASAS 092701+1412.1.

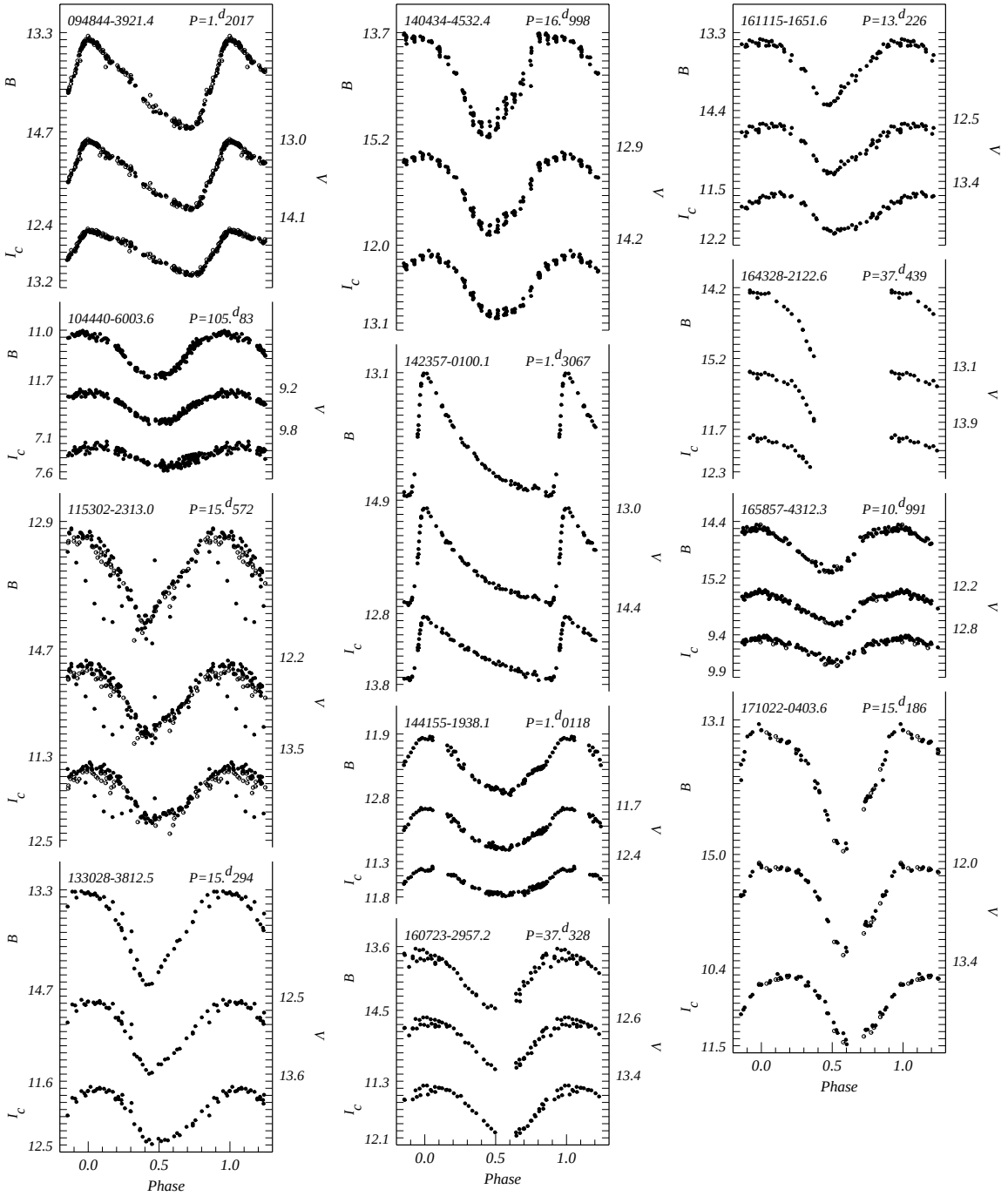

Figure 5: The same as in Fig. 1 but for ASAS 094844-3921.4, ASAS 104440-6003.6, ASAS 115302-2313.0, ASAS 133028-3812.5, ASAS 140434-4532.4, ASAS 142357-0100.1, ASAS 144155-1938.1, ASAS 160723-2957.2, ASAS 161115-1651.6, ASAS 164328-2122.6, ASAS 165857-4312.3, and ASAS 171022-0403.6.

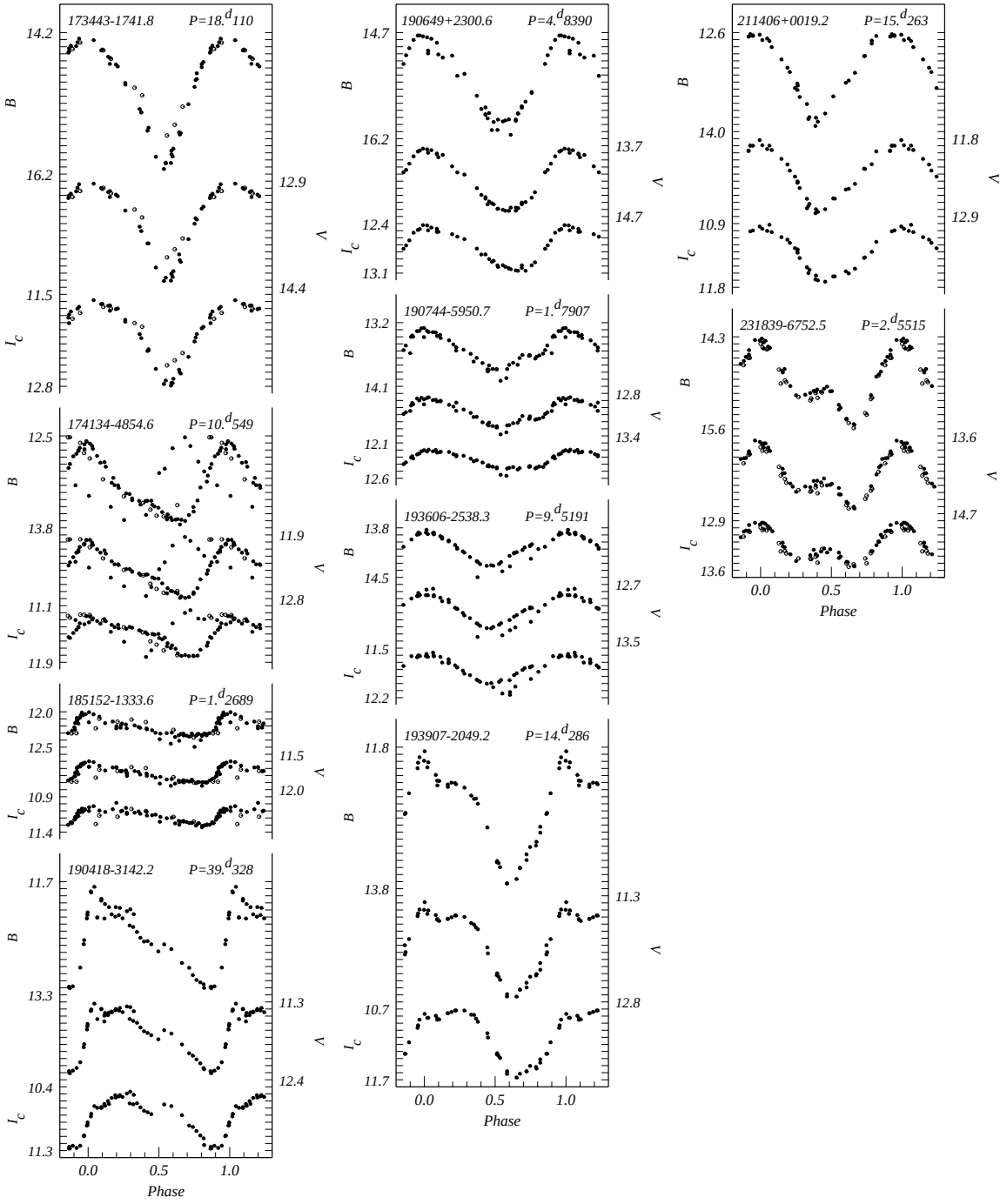

Figure 6: The same as in Fig. 1 but for ASAS 173443-1741.8, ASAS 174134-4854.6, ASAS 185152-1333.6, ASAS 190418-3142.2, ASAS 190649+2300.6, ASAS 190744-5950.7, ASAS 193606-2538.3, ASAS 193907-2049.2, ASAS 211406+0019.2, and ASAS 231839-6752.5.

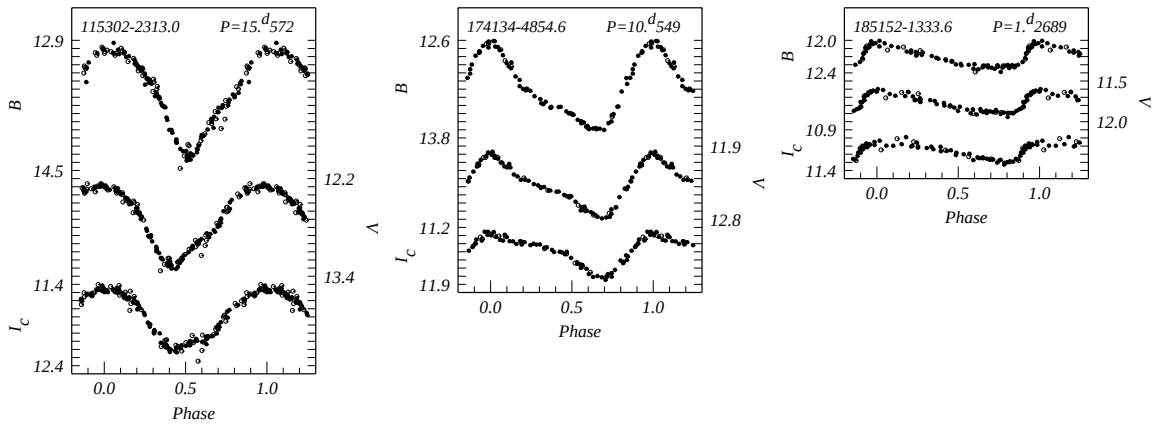

Figure 7: The same as in Fig. 1 but for ASAS 115302-2313.0, ASAS 174134-4854.6, and ASAS 185152-1333.6 with seasonal light-curve shifts taken into account.

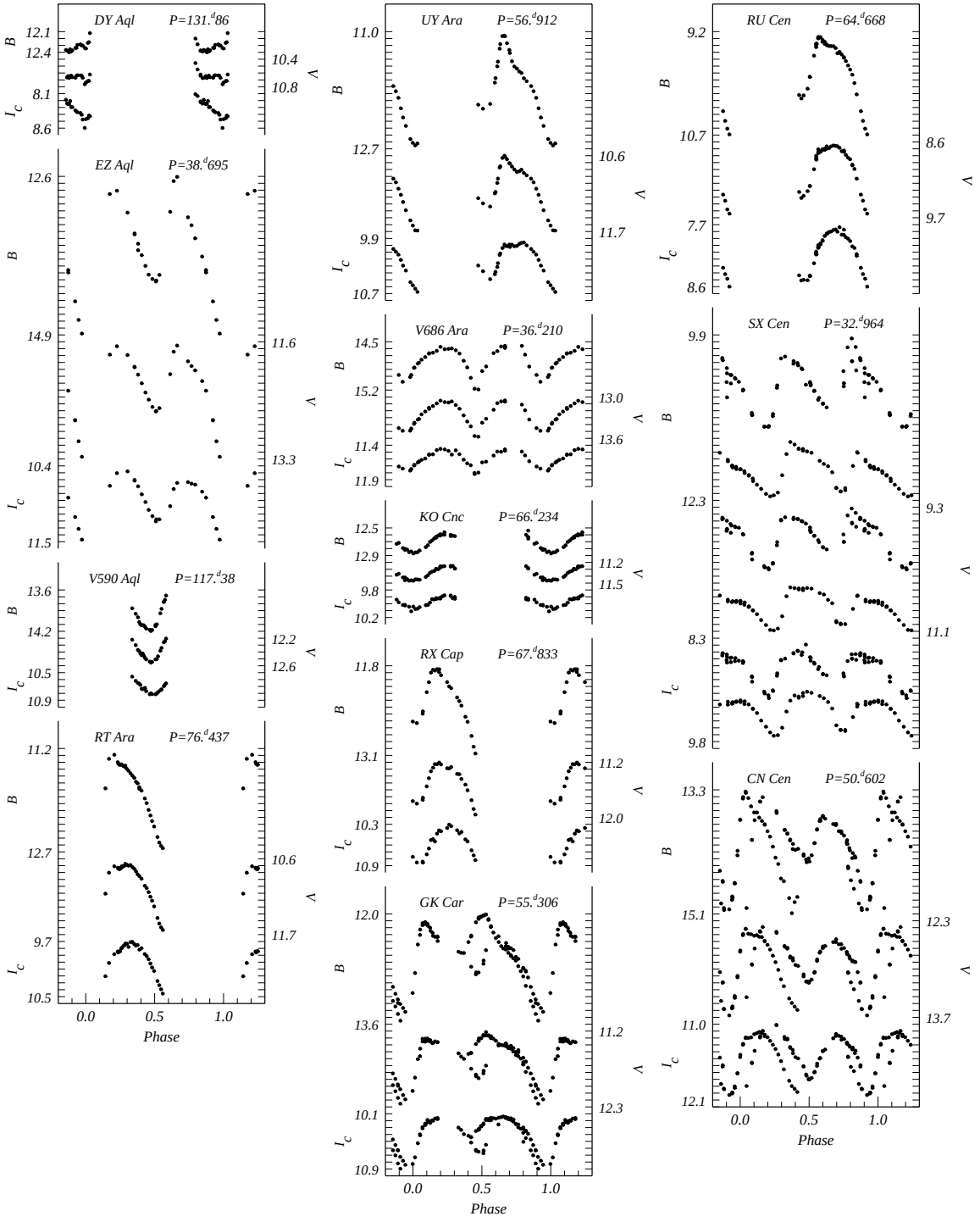

Figure 8: Light curves of RV Tau-type stars: DY Aql, EZ Aql, V590 Aql, RT Ara, UY Ara, V686 Ara, KO Cnc, RX Cap, GK Car, RU Cen, SX Cen, and CN Cen.

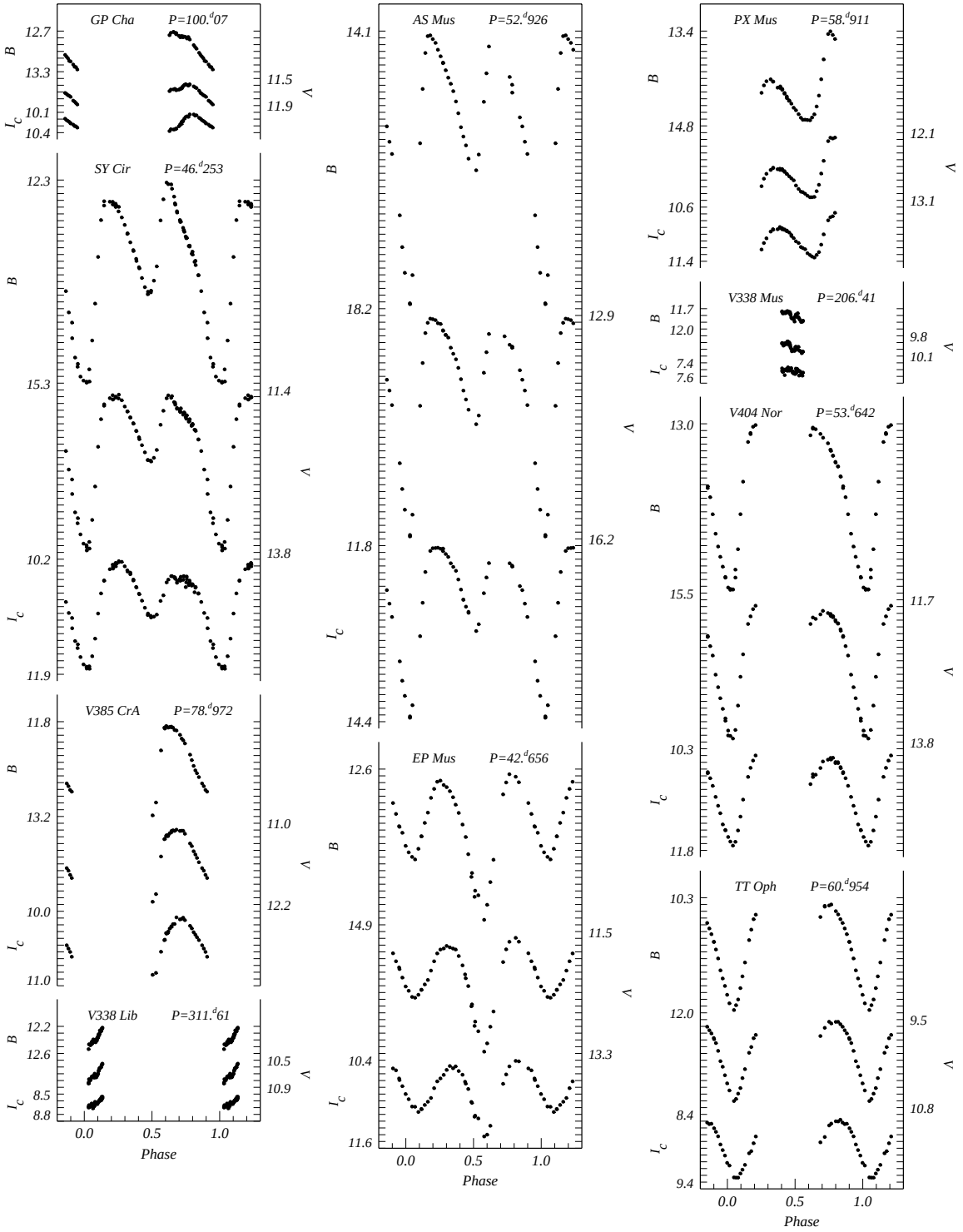

Figure 9: The same as in Fig. 8 but for GP Cha, SY Cir, V385 CrA, V338 Lib, AS Mus, EP Mus, PX Mus, V338 Mus, V404 Nor, and TT Oph.

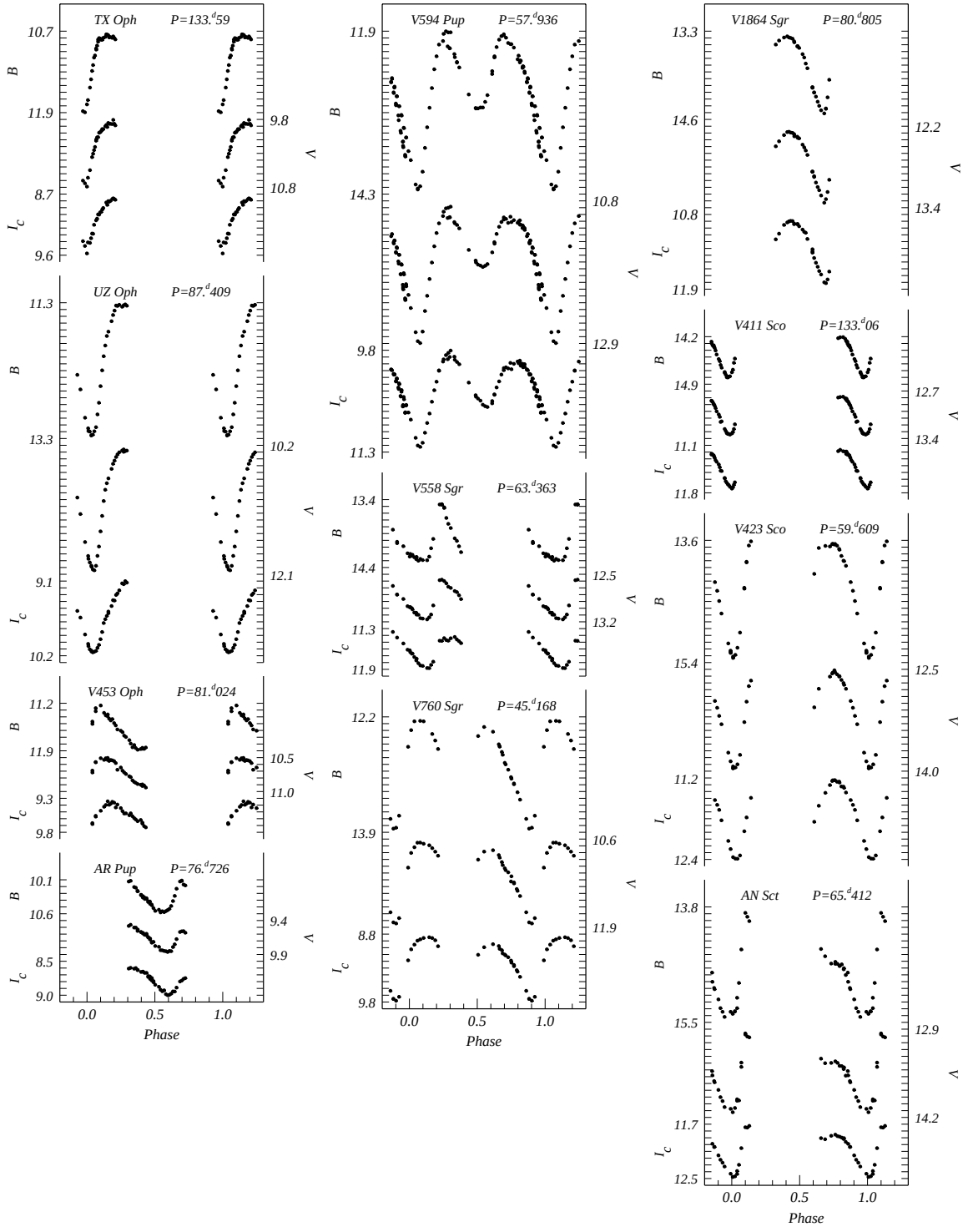

Figure 10: The same as in Fig. 8 but for TX Oph, UZ Oph, V453 Oph, AR Pup, V594 Pup, V558 Sgr, V760 Sgr, V1864 Sgr, V411 Sco, V423 Sco, and AN Sct.

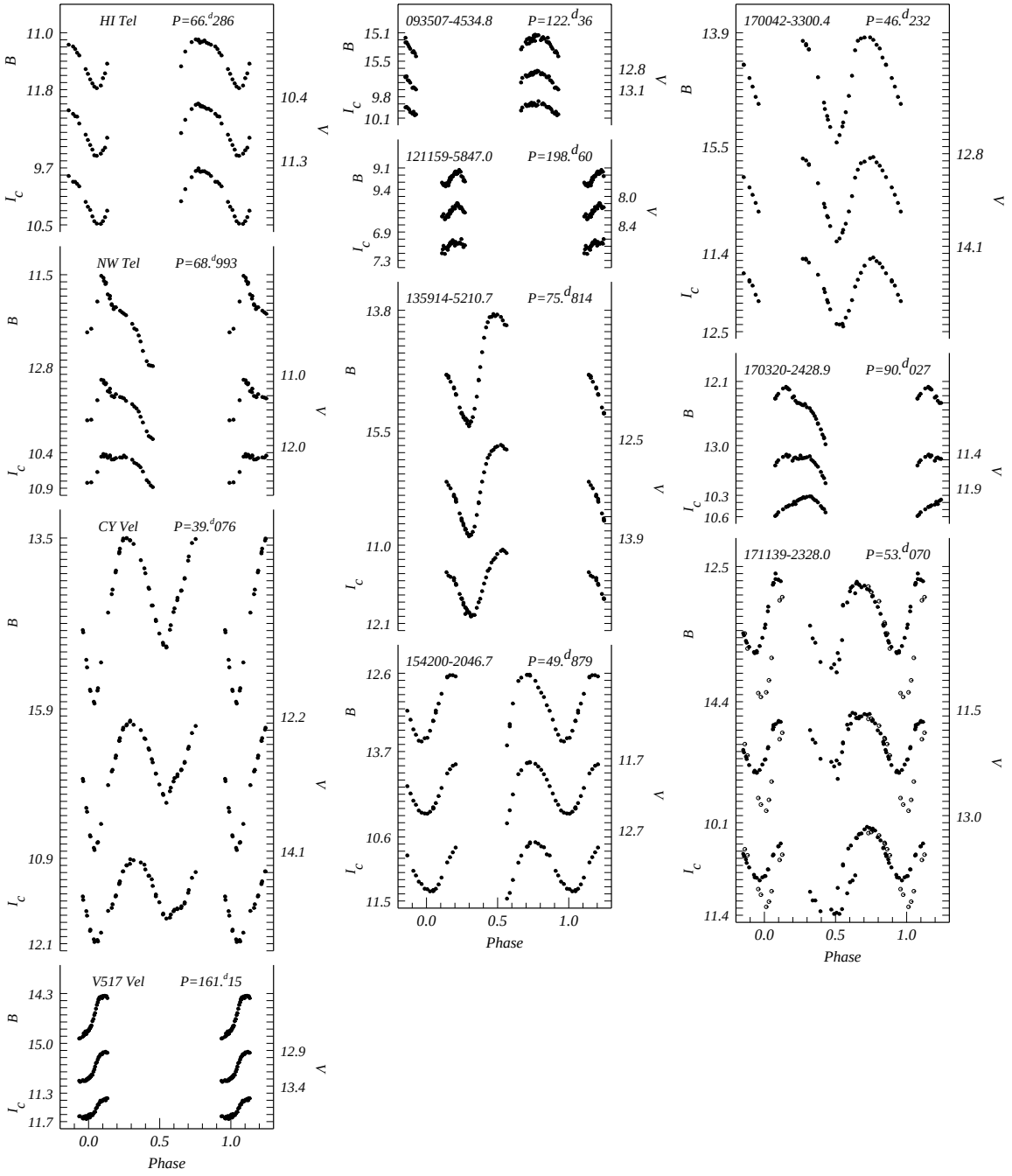

Figure 11: The same as in Fig. 8 but for HI Tel, NW Tel, CY Vel, V517 Vel, ASAS 093507-4534.8, ASAS 121159-5847.0, ASAS 135914-5210.7, ASAS 154200-2046.7, ASAS 170042-3300.4, ASAS 170320-2428.9, and ASAS 171139-2328.0.

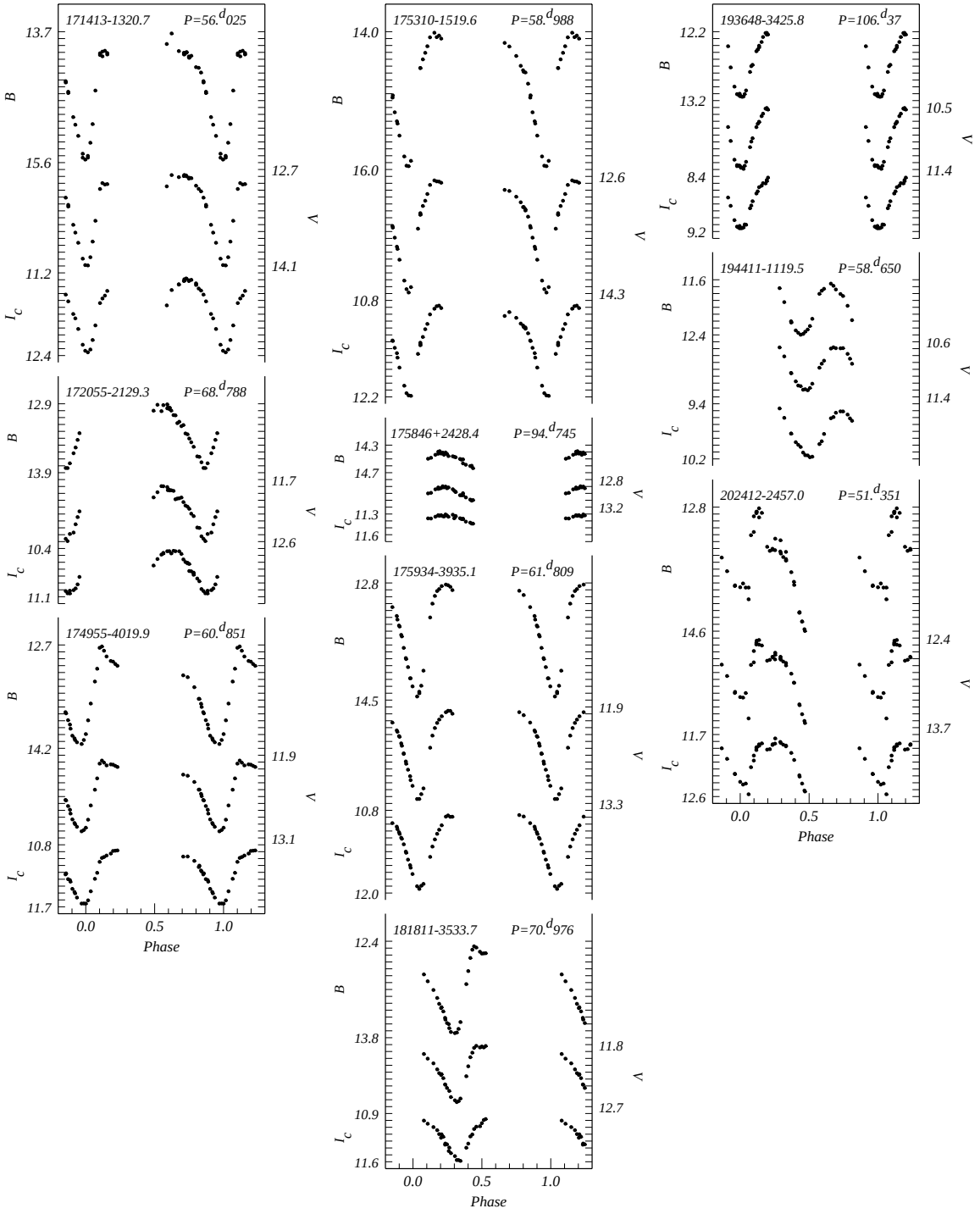

Figure 12: The same as in Fig. 8 but for ASAS 171413-1320.7, ASAS 172055-2129.3, ASAS 174955-4019.9, ASAS 175310-1519.6, ASAS 175846+2428.4, ASAS 175934-3935.1, ASAS 181811-3533.7, ASAS 193648-3425.8, ASAS 194411-1119.5, and ASAS 202412-2457.0.

Table 1. Ephemerides for CW-type Cepheids

Cepheid	Epoch, JD hel 24...	Period days	Cepheid	Epoch, JD hel 24...	Period days
V475 Ara	36721.6336	1.50120000	V708 Sco	55182.329	27.1700
GK Cen	55412.1963	1.949833	V742 Sco	55005.93	14.51770
IU Cen	53336.0704	3.3192516	DD Vel	55045.72	13.2075
V415 Cen	54236.79	26.6603	YZ Vir	54790.187	14.47271
V445 Cen	55470.70	14.2172	ASAS 003041-4416.4	54205.2546	1.90068
BV Cha	54161.9961	1.23803885	ASAS 044546-1748.7	55164.4719	0.9195727
XY Hyi	55907.484	22.1587	ASAS 050514+2145.8	53824.124	13.9410
DF Hyi	54267.0129	1.1225989	ASAS 070747-2455.2	54154.920	11.18265
VX Ind	53590.2859	1.4619446	ASAS 072845-4428.3	54526.8885	1.4377536
UX Lup	54740.410	16.25356	ASAS 092701+1412.1	55566.9273	1.3212185
II Nor	50207.66	23.5333	ASAS 094844-3921.4	54667.2918	1.2017308
CE Oph	54407.253	15.88766	ASAS 104440-6003.6	54349.02	105.833
V2137 Oph	56777.5075	1.18202240	ASAS 115302-2313.0	53855.360	15.5727
V2628 Oph	54487.34	13.3088	ASAS 133028-3812.5	53593.49	15.2940
GK Sgr	55555.692	14.86662	ASAS 140434-4532.4	55623.797	16.99892
V1821 Sgr	56784.6324	9.51627060	ASAS 142357-0100.1	55579.8951	1.3067458
V1822 Sgr	54863.00	7.52557	ASAS 144155-1938.1	55259.9049	1.0118964
V1828 Sgr	56783.50	12.99325	ASAS 160723-2957.2	55424.186	37.3283
V1882 Sgr	54908.3355	2.71119248	ASAS 161115-1651.6	54941.23	13.2261
V2284 Sgr	54688.573	1.938658	ASAS 164328-2122.6	53655.88	37.439
V2511 Sgr	56767.0966	1.72475700	ASAS 165857-4312.3	55085.865	10.99158
V2546 Sgr	54580.82	14.3905	ASAS 171022-0403.6	54780.795	15.1863
V2793 Sgr	54641.989	16.22011	ASAS 173443-1741.8	54974.20	18.1107
V2944 Sgr	54649.727	12.22564	ASAS 174134-4854.6	55456.358	10.54989
V3820 Sgr	50804.12	13.13825	ASAS 185152-1333.6	55500.7640	1.268903
V507 Sco	55021.85	11.79856	ASAS 190418-3142.2	54136.70	39.328
V516 Sco	55296.726	15.65785	ASAS 190649+2300.6	54738.974	4.839092
V517 Sco	55209.189	1.176306	ASAS 190744-5950.7	54812.2021	1.790798
V532 Sco	55131.2527	24.1493	ASAS 193606-2538.3	55434.182	9.51917
V533 Sco	56745.8888	15.52900	ASAS 193907-2049.2	55442.829	14.2869
V542 Sco	54546.653	15.23567	ASAS 211406+0019.2	55168.146	15.2634
V706 Sco	55253.224	12.63584	ASAS 231839-6752.5	55362.3226	2.5515796

Table 2. Ephemerides for RV Tau stars

Star	Epoch, JD hel 24...	Period days	Star	Epoch, JD hel 24...	Period days
DY Aql	55149.47	131.86	V558 Sgr	2455102.80	63.36
EZ Aql	55148.87	38.69	V760 Sgr	2455164.45	45.16
V590 Aql	55186.41	117.38	V1864 Sgr	2455130.53	80.80
RT Ara	55117.38	76.43	V411 Sco	2455142.85	133.06
UY Ara	55107.99	56.91	V423 Sco	2455115.17	59.60
V686 Ara	55111.62	36.21	AN Sct	2455217.62	65.41
KO Cnc	55129.78	66.23	HI Tel	2455207.04	66.28
RX Cap	55163.93	67.83	NW Tel	2455218.33	68.99
GK Car	55197.39	55.30	CY Vel	2455193.97	39.07
RU Cen	55112.28	64.66	V517 Vel	2455088.95	161.15
SX Cen	55165.19	32.96	ASAS093507-4534.8	2455352.13	122.36
CN Cen	55145.43	50.60	ASAS121159-5847.0	2455427.81	198.60
GP Cha	55181.69	100.07	ASAS135914-5210.7	2455049.04	75.81
SY Cir	55094.23	46.25	ASAS154200-2046.7	2455119.34	49.87
V385 CrA	55137.00	78.97	ASAS170042-3300.4	2455108.36	46.23
V338 Lib	55100.66	311.61	ASAS170320-2428.9	2454868.31	90.02
AS Mus	55125.04	52.92	ASAS171139-2328.0	2454850.62	53.07
EP Mus	55075.43	42.65	ASAS171413-1320.7	2455060.13	56.02
PX Mus	55028.92	58.91	ASAS172055-2129.3	2455186.22	68.78
V338 Mus	54929.83	206.41	ASAS174955-4019.9	2455150.58	60.85
V404 Nor	55100.52	53.64	ASAS175310-1519.6	2455180.44	58.98
TT Oph	55089.32	60.95	ASAS175846+2428.4	2454803.51	94.74
TX Oph	54980.78	133.59	ASAS175934-3935.1	2455194.35	61.80
UZ Oph	55090.23	87.40	ASAS181811-3533.7	2455117.27	70.97
V453 Oph	55070.00	81.02	ASAS193648-3425.8	2455097.67	106.37
AR Pup	55254.36	76.72	ASAS194411-1119.5	2455149.13	58.65
V594 Pup	55132.62	57.93	ASAS202412-2457.0	2455179.57	51.35