

Photometry of symbiotic stars – an international campaign VIIa.

Z And, EG And, V1413 Aql (AS 338), UV Aur, TX CVn,
T CrB, BF Cyg, CH Cyg, V 1016 Cyg, V 1329 Cyg,
AG Dra

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Abstract. We present new observations of 11 symbiotic and symbiotic-like stars. The photoelectric UBV(R) observations described here cover the period spanning from 1994.75 to 1996.0. Some CCD VRI and photographic data were obtained also during the earlier times. The main results obtained during this campaign period can be summarized as follows:

Z And: The UBV light curves (LC) indicate a small brightening of the star around JD 2 449 750. EG And: Standard phase dependent behaviour – an increase in the star's brightness from orbital phase $\varphi \sim 0$ (around JD 2 449 700) to $\varphi \sim 0.7$ (\sim JD 2 450 050) – is apparent in our light curves. UV Aur: Two \sim 390-day cycles were covered by our observations. Variations in the V and R bands are similar. TX CVn: Very slow brightness decline from the previous active stage has continued during the present period. BF Cyg: A minimum around JD 2 449 900 was observed – in agreement with the ephemeris given by Pucinskas (1970). CH Cyg: During the period Oct. 15th 1994 – Jan 16th 1995 a minimum corresponding to the eclipse of the hot component by the red giant occurred. The sudden fading of the star in the U and B colours suggests that the 1992 outburst is over. AG Dra: The present data cover a major part of the recent (1994) outburst. A second maximum has been observed during

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the summer of 1995. Afterwards, the system's brightness has been declining towards the quiescence.

Key words: stars – binaries – symbiotic – symbiotic-like – photometry

1. Introduction

This is the first part of the seventh paper of the series aimed at the presentation of the observational data compiled as a part of the campaign of long-term photometry of symbiotic stars (Hric & Skopal, 1989). The division of this paper into two parts resulted from the large amount of the material presented. The editor of the CAOSP journal has thus recommended us to adopt such an solution. The previous results of our observational campaign were published in Skopal et al., 1990 - Paper I, Hric et al., 1991 - Paper II, Skopal et al., 1992 - Paper III, Hric et al., 1993 - Paper IV, Hric et al., 1994 - Paper V, Skopal et al., 1995 - Paper VI.

2. Observations

Photoelectric UBV(R) observations were performed at the Skalnaté Pleso Observatory (hereafter SP in Tables), at the Stará Lesná Observatory (SL), at the Hlohovec Observatory (H), at the Kryonerion Station of the National Observatory of Athens (KN – observer Niarchos, KR – observer Rovithis) and at the N. Copernicus Observatory and Planetarium in Brno (B1). The observations carried out at the Skalnaté Pleso Observatory, at the Stará Lesná Observatory, at the Kryonerion Station of the National Observatory of Athens, at the Hlohovec Observatory and at the Brno Observatory were performed in the same way as described in Paper II, III and VI.

New photoelectric observations were obtained during the normal campaign period between October 1, 1994 and December 31, 1995 but numerous earlier observations were included.

All the CCD observations were performed at the Považská Bystrica Observatory (PB) with the Newton 180/700 telescope equipped with an originally constructed CCD camera based on Texas Instruments chip TC 211 and using V (540 nm), R (680 nm), I (825 nm) filters for modified Johnson-Kron-Cousins system. The magnitudes of the comparison stars for CCD photometry were obtained through the calibration on the basis of the standard stars published in Landolt (1973, 1983, 1992).

Photographic observations at the Trnava Observatory (T) were obtained by the Sonnar 4/300 equipped by filter Panchromar G3 on the emulsion OR-WOPAN 400. This combination of filter and emulsion enables to cover spectral region from 570 to 650 nm.

3. Results

The photoelectric UBVR data for all the observed objects have been summarized in tables. The data were displayed in figures in those cases when the stars involved exhibited some kind of interesting behavior or, especially for the visual photometry, the data represented sufficiently extensive collection of observations. Individual stars are arranged in alphabetic order and the relevant results are briefly discussed in subsections.

3.1. Z Andromedae

Table 1. UBV observations of Z And

JD_{hel}	U	B	V	Obs
-2 400 000				
49653.609	12.289	11.932	10.798	SP
49734.315	11.283	11.658	10.650	SP
49738.263	11.223	11.891	10.797	SP
49762.246	10.691	11.571	10.647	SP
49771.259	11.127	11.895	10.602	SP
49955.46	"*"	12.44	11.12	KR
49970.46	"*"	13.17	11.32	KR
49971.43	"*"	13.14	11.41	KR

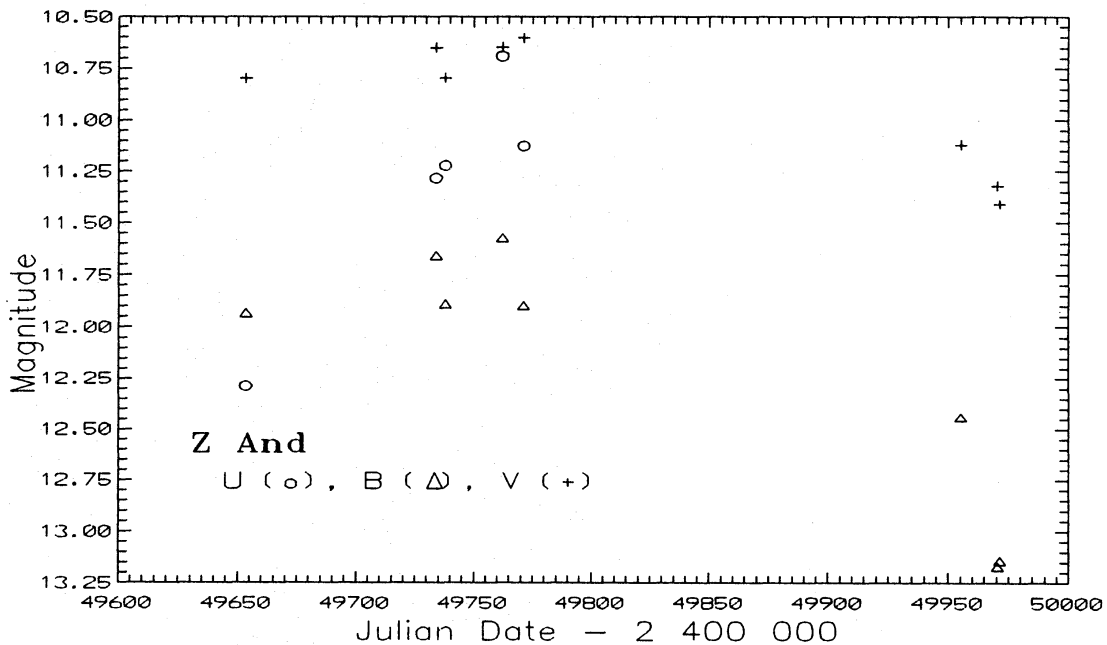


Figure 1. UBV observations of Z And.

Z And was observed photoelectrically on 8 nights. The standard stars are the same as used in Paper II. The data are presented in Table 1 and shown in Figure 1. The LC displays small brightening around JD 2449750. The visual LC depicted in Figure 2 is in a very good agreement with such behaviour. This indicates that the star is still in a quiet stage.

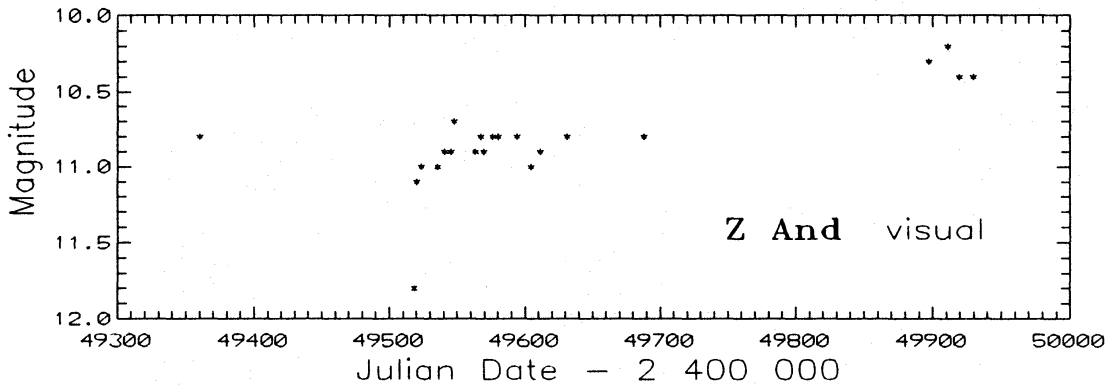


Figure 2. Visual observations of Z And.

3.2. EG Andromedae

The UBV(R) photoelectric observations were carried out during 29 nights. The comparison stars S_1 , S_2 , S_3 are the same as used in the Paper II, and S_4 as in the Paper III. The UBV data are compiled in Table 2 containing the differential

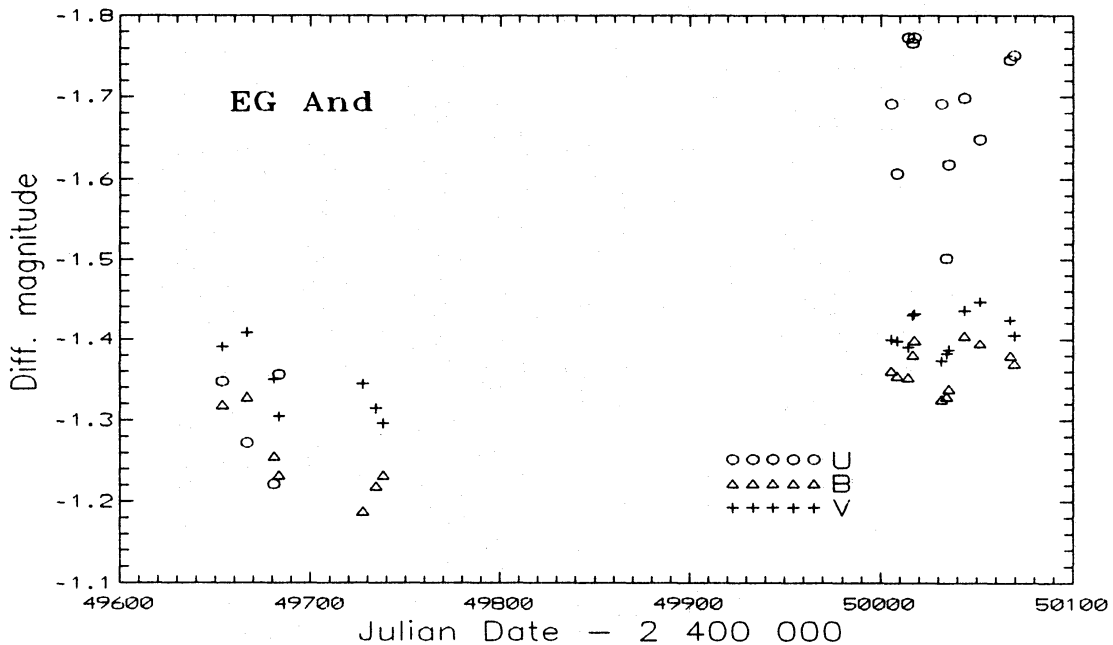


Figure 3. UBV Observations of EG And

magnitudes. The UBVR observations are depicted in Figure 3 and visual estimates are shown in Figure 4.

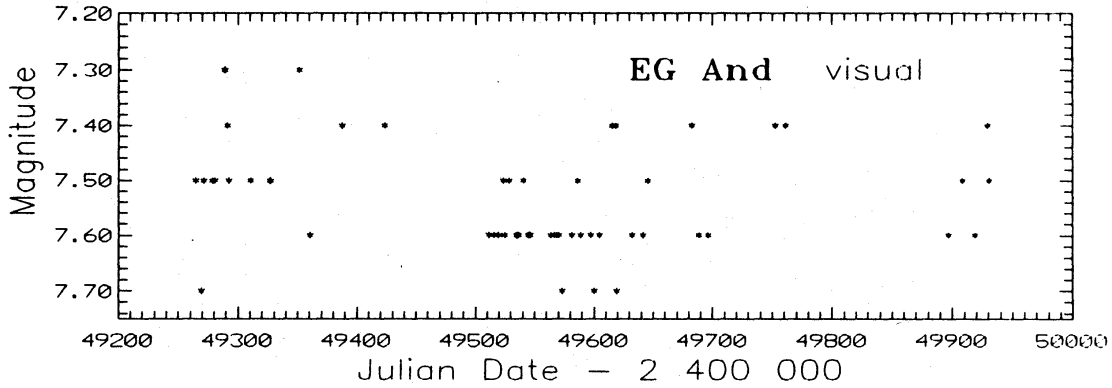


Figure 4. Visual Observations of EG And

Table 2. UBVR Observations of EG And

JD_{hel}	ΔU	ΔB	ΔV	ΔR	Obs
-2 400 000					
49600.546	""	0.85	-1.32	""	KN *
49602.609	""	0.86	-1.36	""	KN *
49603.603	""	0.88	-1.33	""	KN *
49604.636	""	0.83	-1.37	""	KN *
49653.556	-1.347	-1.318	-1.390	-1.496	SP
49657.465	""	0.83	-1.32	""	KN *
49658.453	""	0.84	-1.33	""	KN *
49659.539	""	0.82	-1.36	""	KN *
49660.459	""	0.86	-1.34	""	KN *
49666.550	-1.272	-1.328	-1.408	-1.515	SP
49680.489	-1.221	-1.256	-1.350	-1.459	SP
49683.354	-1.356	-1.232	-1.304	-1.417	SP
49727.223	-0.864	-1.188	-1.344	-1.418	SP
49734.374	-0.675	-1.219	-1.314	-1.397	SP
49738.311	-1.101	-1.232	-1.296	-1.420	SP
49955.500	""	+0.46	-1.35	""	KR *
49971.470	""	+1.20	+0.51	""	KR **
50005.453	-1.691	-1.361	-1.400	-1.507	SP
50008.528	-1.607	-1.355	-1.398	-1.507	SP
50014.436	-1.773	-1.353	-1.390	-1.502	SP
50016.586	-1.766	-1.381	-1.430	-1.537	SP
50017.538	-1.773	-1.399	-1.432	-1.535	SP
50031.520	-1.691	-1.326	-1.373	-1.475	SP
50034.366	-1.502	-1.329	-1.382	-1.496	SP
50035.502	-1.618	-1.338	-1.387	-1.495	SP

Table 2. UBVR Observations of EG And (continued)

JD_{hel}	ΔU	ΔB	ΔV	ΔR	Obs
-2400 000					
50043.438	-1.698	-1.405	-1.436	-1.543	SP
50051.486	-1.648	-1.395	-1.447	-1.550	SP
50067.345	-1.745	-1.380	-1.424	-1.532	SP
50069.460	-1.751	-1.370	-1.405	-1.526	SP

* = Diff. mags EG And - S3

** = Diff. mags EG And - S2

3.3. V 1413 Aquilae (AS 338)

The UBV photoelectric observations of this star, obtained only in 3 nights, are compiled in Table 3.

Table 3. UBV observations of V 1413 Aql

JD_{hel}	U	B	V	Obs
-2400 000				
49955.43	**"	14.47	12.75	KR
49970.37	**"	14.68	12.95	KR
49971.41	**"	14.64	12.83	KR

3.4. UV Aurigae

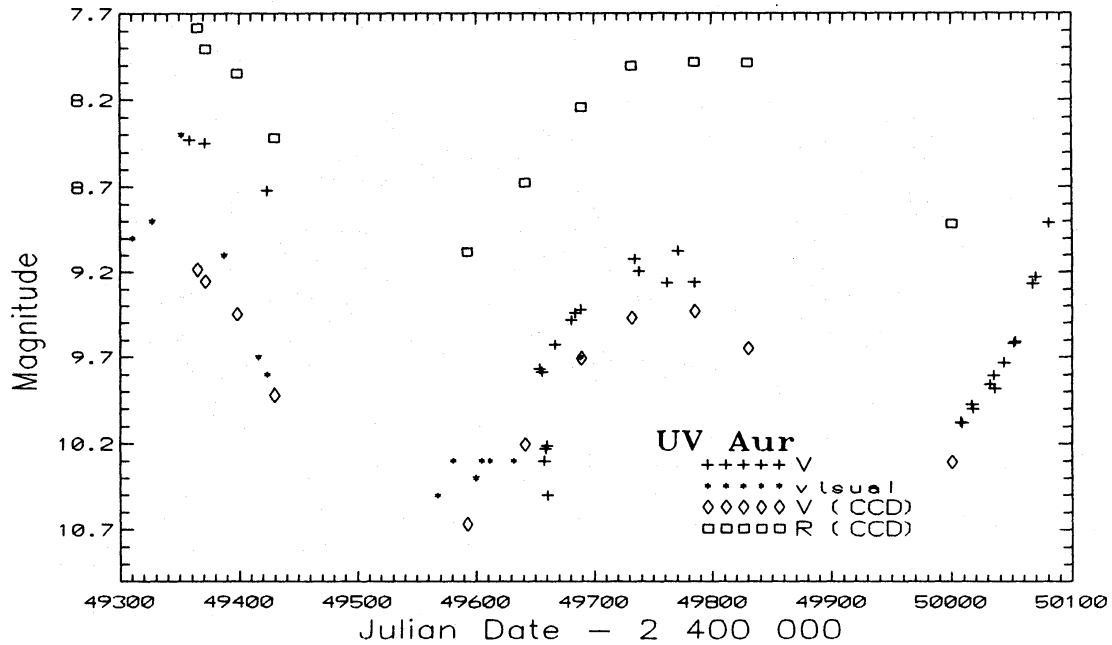
The photoelectric UBVR, CCD VRI and photographic photometry of this star was obtained on 42 nights. The results are summarized in Tables 4 and 5. The data in selected colours (VR photoelectric, VR CCD and visual estimates) are depicted in Figure 5. The LC shows variations in all colours which correspond to two cycles of the basic period. The amplitude of sinusoidal variations in R colour has almost the same value as in V filter. The period analysis of the data confirms the same changes of the periodicity of the brightness variations we have mentioned in the previous campaign paper (Paper VI).

Table 4. VRI CCD observations of UV Aur

JD_{hel}	V	R	I	Obs
-2400 000				
49365.350	9.183	7.782	**"	PB
49372.228	9.254	7.904	**"	PB
49398.429	9.446	8.048	**"	PB

Table 4. VRI CCD observations of UV Aur (continued)

JD _{hel}	V	R	I	Obs
-2 400 000				
49429.403	9.919	8.419	"*"	PB
49592.591	10.667	9.080	7.386	PB
49641.418	10.203	8.673	7.031	PB
49689.388	9.706	8.243	6.634	PB
49732.225	9.467	8.005	6.444	PB
49785.376	9.430	7.983	6.293	PB
49830.342	9.648	7.988	6.474	PB
50000.448	10.307	8.913	7.222	PB

**Figure 5.** Photoelectric and CCD VR and Visual Observations of UV Aur**Table 5.** UBVR observations of UV Aur

JD _{hel}	U	B	V	ΔR	Obs
-2 400 000					
49358.273	"*"	"*"	8.43	"*"	T
49371.262	"*"	"*"	8.45	"*"	T
49423.300	"*"	"*"	8.72	"*"	T
49653.502	10.221	10.924	9.766	-1.019	SP
49655.572	"*"	10.937	9.784	"*"	SP
49657.545	"*"	11.05	10.30	"*"	KN

Table 5. UBVR observations of UV Aur (continued)

JD _{hel}	U	B	V	ΔR	Obs
-2 400 000					
49658.523	***	10.97	10.23	***	KN
49659.621	***	11.00	10.21	***	KN
49660.515	***	11.08	10.50	***	KN
49666.605	10.196	10.930	9.628	-1.146	SP
49680.551	10.266	10.845	9.482	***	SP
49683.475	10.205	10.925	9.439	***	SP
49688.659	10.64	11.12	9.42	***	H
49734.437	10.344	10.946	9.123	-1.658	SP
49738.429	10.152	10.862	9.195	***	SP
49762.324	10.287	10.799	9.261	***	SP
49771.380	10.019	10.841	9.074	***	SP
49785.325	11.03	11.05	9.26	***	H
50007.438	10.233	10.953	10.075	-0.655	SP
50008.571	10.255	10.974	10.080	-0.672	SP
50016.648	10.217	10.892	9.974	-0.767	SP
50017.650	***	10.981	9.997	-0.745	SP
50031.680	10.359	11.003	9.859	***	SP
50034.582	10.229	10.933	9.805	-0.949	SP
50035.551	10.620	11.108	9.883	-0.880	SP
50043.621	10.311	10.958	9.732	***	SP
50051.557	10.232	10.914	9.616	-1.093	SP
50052.544	10.231	10.904	9.609	-1.095	SP
50067.481	10.246	10.836	9.269	***	SP
50069.545	10.231	10.833	9.228	***	SP
50080.624	10.072	10.619	8.910	-1.699	SP

3.5. TX Canum Venaticorum

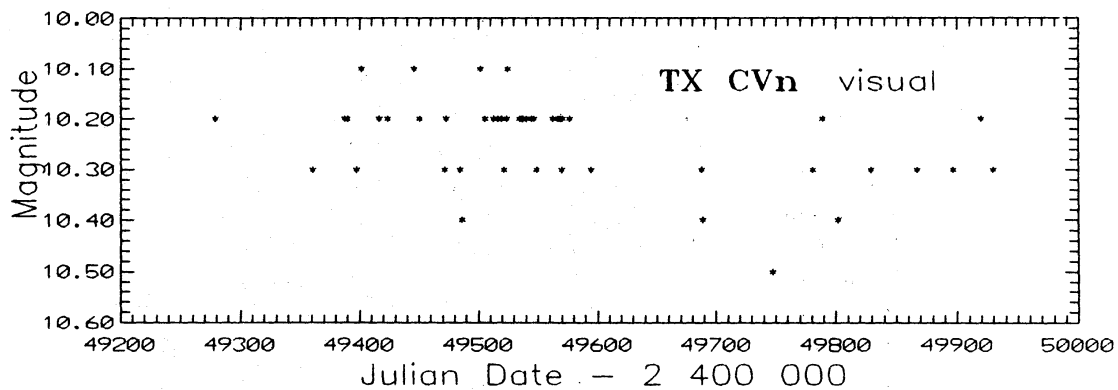
Both UBVR photoelectric and visual observations have been obtained for this star. The data covering the period of almost 2 years are shown in Figure 6. On the basis of the visual LC presented here as well as of the relevant LCs published in the previous campaign paper (Paper VI), we can see very slow decline of brightness from an active stage.

Table 6. UBVR observations of TX CVn

JD _{hel}	U	B	V	ΔR	Obs
-2 400 000					
49688.702	10.37	10.77	10.63	***	H
49762.519	11.098	10.740	9.985	0.240	SP

Table 6. UBVR observations of TX CVn (continued)

JD_{hel}	U	B	V	ΔR	Obs
-2 400 000					
49770.588	10.859	10.622	10.153	0.308	SP
49782.649	11.11	10.69	10.03	"**"	H
49804.572	"**"	10.440	9.702	"**"	KN
49805.379	"**"	10.516	9.744	"**"	KN
49812.310	"**"	10.65	9.89	"**"	KR
50051.608	11.051	10.823	10.146	0.358	SP
50052.584	11.074	10.863	10.182	0.381	SP
50069.635	11.067	10.839	10.144	0.370	SP

**Figure 6.** Visual observations of TX CVn

3.6. T Coronae Borealis

The photoelectric data obtained for this star are presented in Table 7. The visual observations are depicted in Figure 7. The LC is in a good agreement with the following ephemeris: $JD_{min} = 2435571 + 227.8 \times E$ (Paper II).

Table 7. UBVR observations of T CrB

JD_{hel}	U	B	V	Obs
-2 400 000				
49505.393	"**"	"**"	9.83	T
49804.599	"**"	11.46	10.14	KN
49889.522	"**"	11.31	10.01	KN
49890.334	"**"	11.41	10.28	KN
49891.321	"**"	11.39	10.22	KN
49892.336	"**"	11.38	10.22	KN

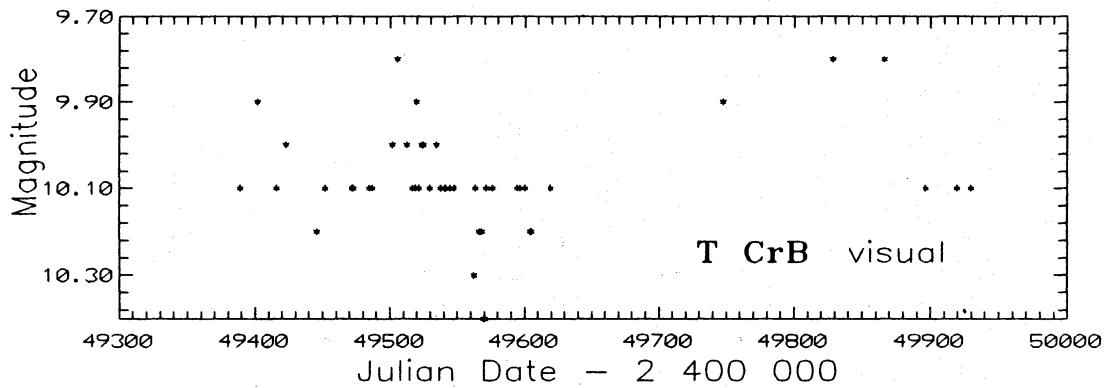


Figure 7. Visual Observations of T CrB

3.7. BF Cygni

The photoelectric measurements of this star were performed on 14 nights. The same standard stars were used as in Paper III. The results of UBVR photometry are compiled in Table 8. The UBVR data are depicted in Figure 8. Our data indicate a minimum around JD 2 449 900 whose position agrees well with the ephemeris for the photometric minima suggested by Pucinskas (1970): $\text{Min} = 2415065 + 757.3 \times E$.

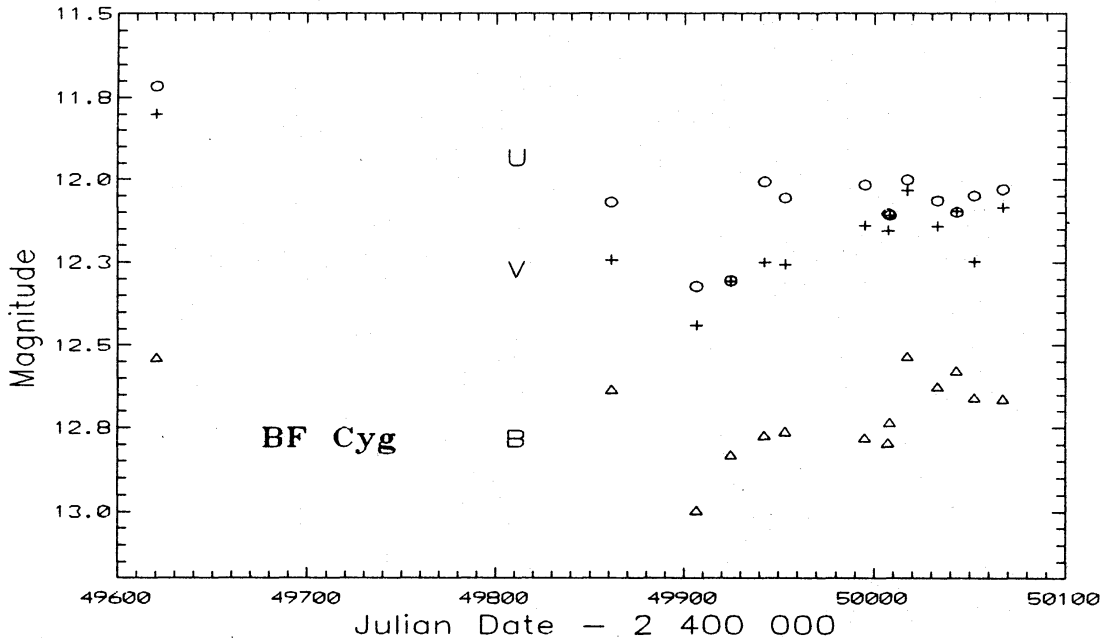
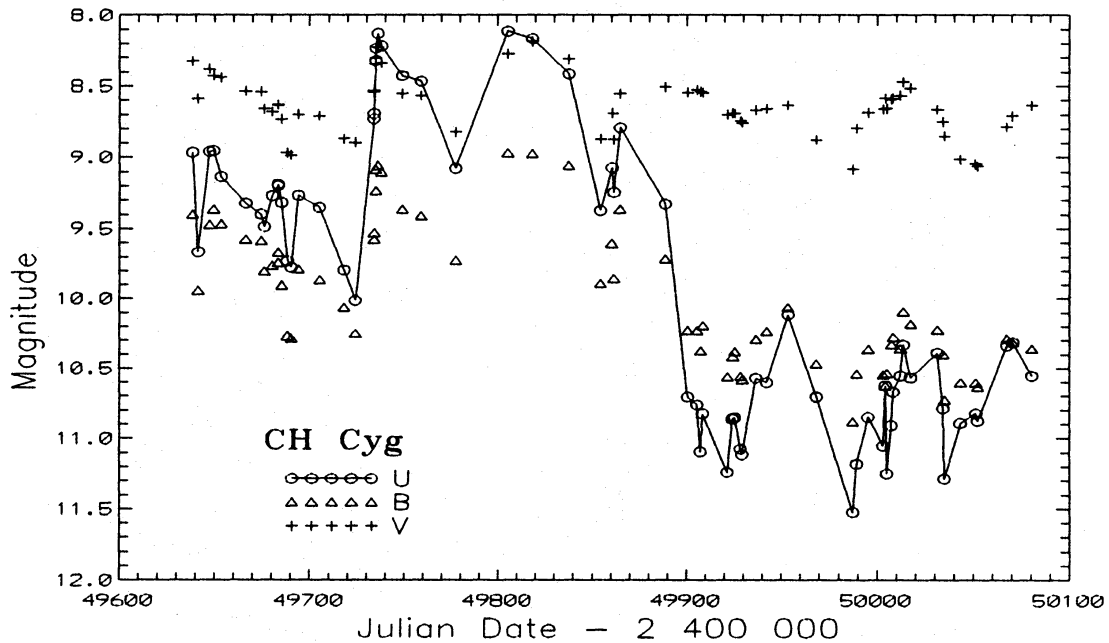


Figure 8. UBVR Observations of BF Cyg

Table 8. UBVR observations of BF Cyg

JD _{hel}	U	B	V	ΔR	Obs
-2 400 000					
49620.388	11.715	12.537	11.800	3.874	SP
49861.450	12.069	12.634	12.243	4.666	SP
49906.377	12.322	12.996	12.439	4.698	SP
49924.500	12.305	12.831	12.308	4.649	SP
49942.389	12.007	12.773	12.250	4.620	SP
49953.390	12.056	12.761	12.256	4.556	SP
49995.300	12.016	12.780	12.139	4.492	SP
50007.298	12.104	12.795	12.155	4.490	SP
50008.300	12.109	12.734	12.109	4.438	SP
50017.285	12.000	12.534	12.032	4.457	SP
50033.277	12.063	12.626	12.142	4.517	SP
50043.196	12.100	12.578	12.096	4.486	SP
50052.244	12.048	12.658	12.248	4.537	SP
50067.217	12.029	12.662	12.084	4.427	SP

3.8. CH Cygni

**Figure 9.** UBVR Observations of CH Cyg

The UBVR photoelectric observations of this star were obtained in 68 nights. The star HD 182691 (SAO 31623; $V = 6.525$, $B - V = -0.078$, $U - B = -0.24$, $V - R$

= 0.00, spectrum B9) was used as the basic comparison. The other standard stars are the same as in Papers II and III. The results are compiled in Table 9 and shown in Figure 9. The U data in this figure were connected by solid line in order to distinguish them from the B data which show similar course (we use this approach also in the case of PU Vul). During the period Oct. 15th 1994 – Jan. 16th 1995, a minimum corresponding to the eclipse of the hot component by the red giant in the symbiotic pair of the triple CH Cyg system occurred (see Skopal et al., 1996 for more details). The star's brightness in the U and B bands suddenly faded around JD 2 449 880, indicating thus that the 1992 outburst of CH Cyg is over.

The visual observations are shown in Figure 10. The minimum observed around JD 2 449 700 is in accord with the UBVR data.

Table 9. UBVR observations of CH Cyg

JD _{hel}	U	B	V	ΔR	Obs
-2 400 000					
49638.370	8.966	9.401	8.324	0.072	SP
49641.300	9.667	9.942	8.589	"**"	SL
49647.235	8.960	9.470	8.381	"**"	SL
49649.384	8.953	9.365	8.425	"**"	SP
49653.379	9.136	9.469	8.440	"**"	SP
49666.331	9.322	9.575	8.536	"**"	SP
49674.345	9.401	9.586	8.541	"**"	SL
49676.202	9.487	9.803	8.661	"**"	SL
49680.217	9.268	9.764	8.682	"**"	SP
49683.197	9.198	9.741	8.635	"**"	SL
49683.236	9.189	9.670	8.630	"**"	SP
49685.218	9.318	9.905	8.733	"**"	SL
49688.188	9.733	10.267	8.968	"**"	SL
49690.173	9.777	10.285	8.986	"**"	SL
49694.167	9.267	9.787	8.701	"**"	SL
49705.173	9.352	9.868	8.713	"**"	SL
49718.193	9.796	10.063	8.870	"**"	SL
49724.185	10.015	10.252	8.897	"**"	SL
49734.180	8.729	9.576	8.530	"**"	SL
49734.198	8.695	9.529	8.542	"**"	SP
49735.186	8.322	9.233	8.344	"**"	SL
49735.208	8.233	9.081	8.305	"**"	SP
49736.185	8.131	9.056	8.226	"**"	SL
49738.209	8.219	9.102	8.340	"**"	SP
49749.203	8.427	9.365	8.553	"**"	SL
49759.226	8.465	9.412	8.567	"**"	SL

Table 9. UBV observations of CH Cyg (continued)

JD_{hel}	U	B	V	ΔR	Obs
-2 400 000					
49777.618	9.078	9.725	8.822	"**"	SP
49805.441	8.113	8.971	8.274	"**"	SP
49818.438	8.165	8.975	8.186	"**"	SP
49837.568	8.413	9.055	8.310	"**"	SP
49854.461	9.373	9.893	8.872	0.561	SP
49860.363	9.072	9.604	8.690	0.517	SP
49861.407	9.246	9.858	8.874	0.585	SP
49864.540	8.791	9.364	8.553	0.462	SP
49888.464	9.327	9.718	8.507	0.255	SP
49900.409	10.707	10.231	8.545	0.152	SP
49905.460	10.761	10.230	8.527	0.130	SP
49907.366	11.095	10.373	8.539	0.132	SP
49908.414	10.825	10.194	8.546	0.102	SP
49921.433	11.239	10.562	8.702	"**"	SL
49924.357	10.863	10.415	8.689	0.217	SP
49925.487	10.853	10.380	8.692	0.212	SP
49928.547	11.072	10.554	8.744	"**"	SL
49929.370	11.115	10.580	8.759	"**"	SL
49936.390	10.572	10.289	8.671	0.226	SP
49942.336	10.600	10.234	8.659	0.255	SP
49953.328	10.116	10.062	8.635	0.264	SP
49968.286	10.705	10.466	8.877	0.410	SP
49987.475	11.525	10.883	9.082	0.651	SP
49989.434	11.180	10.539	8.796	0.306	SP
49995.386	10.850	10.362	8.687	0.227	SP
50003.222	11.052	10.543	8.662	"**"	SL
50004.366	10.625	10.625	8.585	0.138	SP
50005.215	11.249	10.534	8.658	"**"	SL
50007.345	10.908	10.327	8.592	0.143	SP
50008.390	10.670	10.274	8.586	0.138	SP
50012.205	10.553	10.360	8.566	"**"	SL
50013.405	10.332	10.094	8.470	-0.013	SP
50017.395	10.568	10.184	8.515	0.070	SP
50031.377	10.391	10.224	8.666	0.170	SP
50034.210	10.789	10.401	8.750	0.234	SP
50035.173	11.286	10.724	8.851	"**"	SL
50043.318	10.894	10.602	9.014	0.448	SP
50051.346	10.824	10.600	9.047	0.458	SP
50052.332	10.878	10.632	9.062	0.475	SP
50067.304	10.337	10.288	8.786	0.254	SP
50070.291	10.314	10.314	8.710	0.209	SP
50080.188	10.553	10.357	8.637	"**"	SL

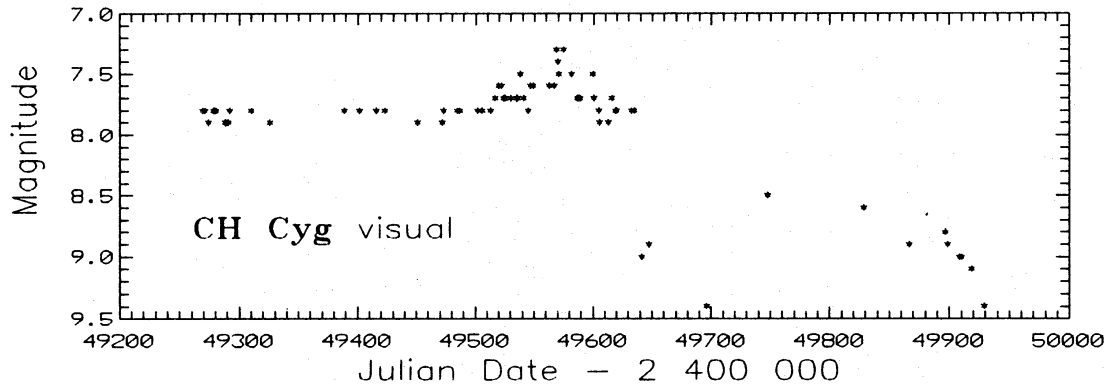


Figure 10. Visual observations of CH Cyg

3.9. V 1016 Cygni

The UBVR photoelectric observations of this star were carried out on 16 nights. The standard stars are the same as in Paper III. The results are compiled in Table 10 and depicted in Figure 11. There are no significant changes in U,B,V and R colour in the LC.

Table 10. UBVR observations of V 1016 Cyg

JD_{hel}	U	B	V	ΔR	Obs
-2 400 000					
49854.516	10.577	11.438	11.140	2.593	SP
49862.521	10.539	11.401	11.130	2.619	SP
49905.494	10.567	11.495	11.223	2.649	SP
49908.361	10.587	11.562	11.332	2.576	SP
49925.518	10.511	11.390	11.124	2.598	SP
49987.308	10.497	11.378	11.115	2.616	SP
50008.342	10.567	11.436	11.168	2.667	SP
50014.364	10.564	11.443	11.171	2.665	SP
50017.346	10.575	11.446	11.154	2.663	SP
50031.346	10.539	11.428	11.103	2.645	SP
50033.332	10.559	11.413	11.111	2.639	SP
50035.365	10.571	11.429	11.137	2.658	SP
50043.287	10.566	11.437	11.123	2.660	SP
50052.292	10.590	11.477	11.214	2.695	SP
50067.262	10.576	11.452	11.183	2.682	SP
50070.256	10.627	11.476	11.171	2.664	SP

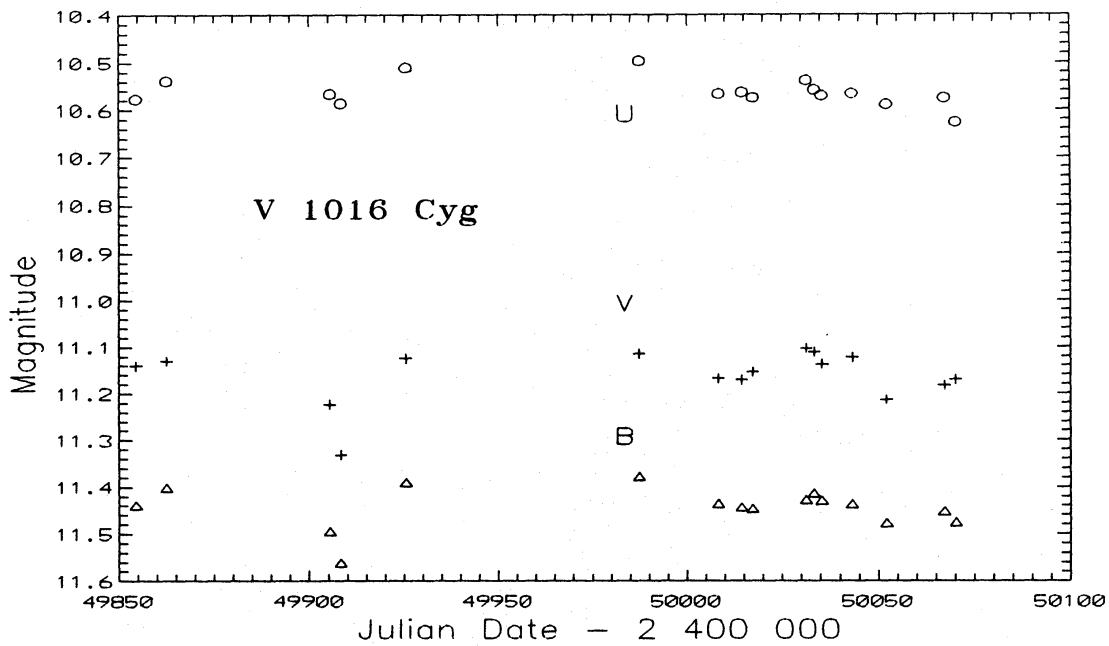


Figure 11. UB observations of V 1016 Cyg

3.10. V 1329 Cygni

The VRI CCD photometric data for this star were obtained only in 3 nights. The results are compiled in Table 11. The brightness of the star increased in agreement with the following ephemeris derived by Hric *et al.* (1993): $JD_{min} = 2446784.862 (\pm 2.4) + 963^d.306 (\pm 0.772)E$.

Table 11. VRI observations of V 1329 Cyg

JD_{hel}	V	R	I	Obs
-2 400 000				
49906.427	13.664	11.849	10.472	PB
49935.497	13.603	11.841	10.476	PB
50000.363	13.486	11.572	10.400	PB

3.11. AG Draconis

The UBVR photoelectric observations of this star were performed in 70 nights. The standard stars are the same as in Paper II. The results are compiled in Table 12. The U, B and V data are shown in Figure 12. The observations presented here cover a major part of the recent (1994) outburst of AG Dra. The second maximum occurred during the summer of 1995 in accordance with the prediction made by Skopal and Chochol (1994). Behaviour in the UBVR light curves

after \sim JD 2 450 000 indicates that the system gradually declines to quiescence.

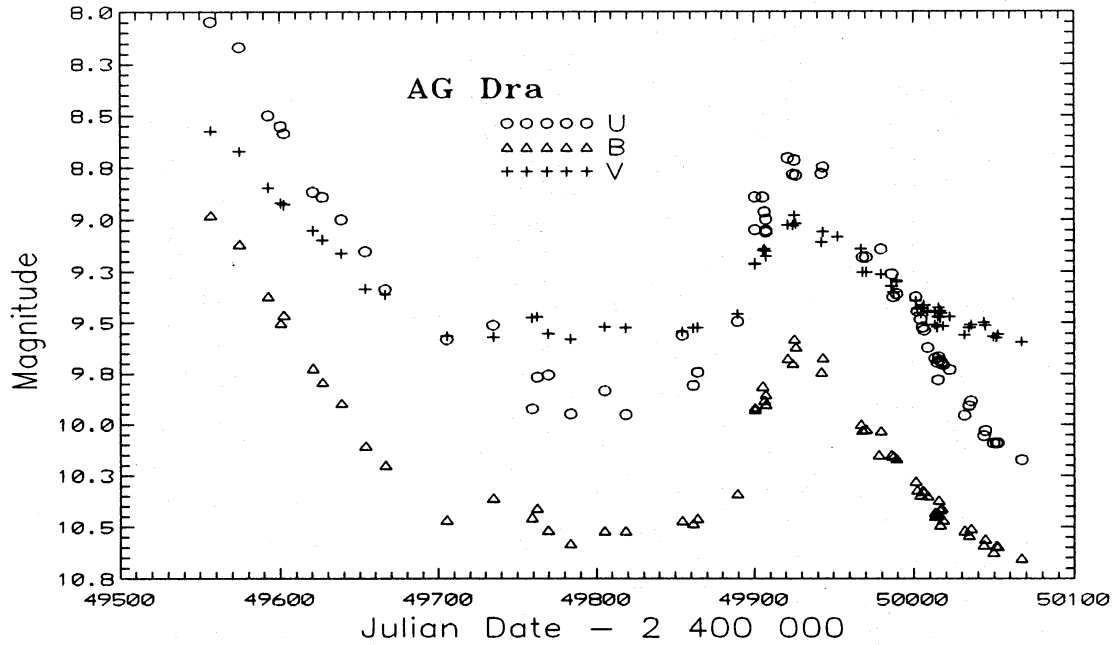


Figure 12. UBVR Observations of AG Dra

Table 12. UBVR observations of AG Dra

JD_{hel}	U	B	V	ΔR	Obs
-2 400 000					
49556.520	8.045	8.977	8.574	""	SP
49574.476	8.168	9.116	8.673	""	SP
49592.528	8.500	9.370	8.845	""	SP
49600.498	8.551	9.499	8.919	""	SP
49602.517	8.586	9.462	8.926	""	SP
49620.610	8.865	9.723	9.051	""	SP
49626.559	8.889	9.793	9.094	-1.126	SP
49638.538	8.998	9.896	9.161	-1.082	SP
49653.650	9.150	10.104	9.333	-0.973	SP
49666.415	9.335	10.200	9.361	-0.937	SP
49705.228	9.581	10.467	9.564	""	SL
49734.565	9.510	10.360	9.569	-0.781	SP
49759.268	9.923	10.453	9.475	""	SL
49762.459	9.767	10.407	9.470	-0.803	SP
49769.534	9.756	10.514	9.552	-0.802	SP
49783.613	9.950	10.580	9.580	""	H
49805.315	9.834	10.52	9.52	""	SL

Table 12. UBVR observations of AG Dra (continued)

JD_{hel}	U	B	V	ΔR	Obs
-2 400 000					
49818.584	9.953	10.519	9.524	-0.794	SP
49854.366	9.561	10.468	9.542	-0.794	SP
49861.371	9.808	10.483	9.524	"**"	SP
49864.372	9.744	10.459	9.523	-0.848	SP
49889.511	9.493	10.337	9.457	-0.862	SP
49900.414	8.890	9.929	9.215	"**"	SL
49900.464	9.047	9.917	9.208	-1.073	SP
49905.419	8.892	9.812	9.146	-1.143	SP
49906.469	8.961	9.88	9.140	"**"	B1
49907.439	8.997	9.903	9.150	"**"	B1
49907.471	9.051	9.854	9.175	-1.098	SP
49921.393	8.704	9.676	9.023	"**"	SL
49924.544	8.783	9.700	9.027	-1.193	SP
49925.432	8.715	9.579	8.979	-1.228	SP
49926.448	8.788	9.618	9.019	-1.123	SP
49942.320	8.781	9.741	9.108	"**"	SL
49943.485	8.748	9.671	9.058	-1.223	SP
49952.378	"**"	"**"	9.08	"**"	H
49967.331	"**"	10.00	9.14	"**"	H
49968.329	9.179	10.027	9.251	-1.069	SP
49970.329	9.180	10.022	9.251	"**"	SP
49978.384	"**"	10.15	"**"	"**"	H
49979.610	9.141	10.030	9.262	-1.068	SP
49986.350	9.26	10.15	9.32	"**"	H
49987.343	9.373	10.154	9.350	-1.004	SP
49989.371	"**"	"**"	9.29	"**"	H
49989.377	9.358	10.168	9.300	-1.039	SP
49996.640	9.464	10.149	9.359	-1.037	SP
50001.423	9.373	10.278	9.393	"**"	SL
50002.361	9.444	10.320	9.431	"**"	SL
50004.396	9.484	10.343	9.454	"**"	SL
50005.633	9.523	10.323	9.426	-0.997	SP
50006.596	9.537	10.326	9.411	-1.021	SP
50008.634	9.622	10.349	9.442	-0.989	SP
50013.370	9.675	10.448	9.509	"**"	SL
50013.401	"**"	10.43	9.45	"**"	H
50014.655	9.695	10.443	9.521	-0.896	SP
50015.317	9.78	10.44	9.47	"**"	H

Table 12. UBVR observations of AG Dra (continued)

JD _{hel}	U	B	V	ΔR	Obs
-2400 000					
50015.536	9.668	10.369	9.425	-1.022	SP
50016.308	9.686	10.415	9.475	-0.966	SP
50016.366	***	10.49	9.44	***	H
50017.462	9.696	10.410	9.452	-0.950	SP
50018.439	9.708	10.464	9.516	***	SL
50022.413	9.73	***	9.47	***	H
50031.578	9.957	10.517	9.559	***	SP
50034.637	9.924	10.529	9.534	-0.912	SP
50035.662	9.849	10.507	9.495	-0.929	SP
50043.660	9.990	10.535	9.504	-0.919	SP
50044.619	9.978	10.519	9.477	-0.942	SP
50049.680	10.087	10.602	9.566	-0.856	SP
50051.660	10.097	10.584	9.559	-0.858	SP
50052.625	10.076	10.568	9.532	-0.885	SP
50067.267	10.172	10.651	9.593	***	SL

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