Photometry of symbiotic stars - an international campaign

IV. Z And, EG And, R Aqr, UV Aur, TX CVn, T CrB, BF Cyg, CH Cyg, CI Cyg, V 1016 Cyg, AG Dra, CQ Dra (4 Dra), YY Her, V 443 Her, SS Lep, AG Peg, AX Per, FG Sge, V 1017 Sgr, FG Ser (AS 296), PU Vul, AS 338, AS 360, MWC 560, GH Gem, He2-468

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Abstract. We present new observations of 26 symbiotic and symbiotic-like stars. The photoelectric UBV observations were made during the years 1982-92, the photographic in 1989-92 and visual in 1989-92. The most interesting results can be summarized as follows: EG And: There is an apparent increase in all three colours corresponding to the ascending branch of the secondary minimum. UV Aur: The long-term photoelectric photometry supports our earlier identification of the red giant component as the primary cause of light variations. BF Cyg: UBV data cover well the last active phase of the star with

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maximum around 1990 July. CH Cyg: The photoelectric data cover the sudden light brightening starting in Feb-Mar 1992 and decline in Sep 1992. CI Cyg: Long-term UBV observations are presented. AG Dra: UBV photometry cover almost all the interval since the last outburst. CQ Dra: The star's brightness has been decreasing monotonically during the present observational period. AX Per: Our UBV data reveal an outburst (maximum around Nov 1989) with a total of five minima occurring during the observational interval.

Key words: stars - binaries - symbiotic - photometry

1. Introduction

This is the fourth paper of the series presenting the results compiled as a part of the campaign of long-term photometry of symbiotic stars (Hric and Skopal, 1989). It represents the continuation of the previous campaign's contributions (Skopal et al., 1990 - Paper I, Hric et al., 1991 - Paper II, Skopal et al., 1992 - Paper III).

2. Observations

Photoelectric UBV observations were performed at the Skalnaté Pleso Observatory (hereinafter SP in the tables and $*$ in the figures), at the Stará Lesná Observatory (SL, +), at the Sonneberg Observatory (S, ○), , at the Observatory of the Masaryk University in Brno (B2, □), at the N. Copernicus Observatory and Planetarium in Brno (B1, △), at the Serra LaNave station of the Catania Astrophysical Observatory (C, ○), at the Kryonerion Station of the National Observatory of Athens (K, ⊕). Photographic observations were made by Z. Velič at their private station near Považská Bystrica. Visual observations were collected by the members of Association Francaise des Observateurs d'Etoiles Variables - AFOEV (coordinator E. Schweitzer, denoted $*$ in the figures) and by individual observers from Czechoslovakia (+).

The observations carried out at the Skalnaté Pleso Observatory, Observatory of the Masaryk University in Brno, at the N. Copernicus Observatory and Planetárium in Brno, and at the Kryonerion Station were performed in the same way as described in Paper II.

The observations at the Stará Lesná Observatory and at the Catania Astrophysical Observatory were made in the same way as described in Paper III.

New photoelectric observations of the normal campaign period were obtained between October 1, 1991 and the end of September, 1992 but a number of earlier observations (especially those from the Sonneberg Observatory) were included. Only these data are presented in the tables.

The photographic observations at the station near the city of Považská Bystrica were performed as described in Paper II. Some special differences, the use of filters, emulsions and the procedures, are noted in the tables.

The visual observations reported in this paper consist of 2769 (AFOEV) and 366 (Czechoslovak observers) visual magnitude estimates of 20 symbiotic stars.

3. Results

The results for all the observed objects are summarized in the tables (UBV photoelectric and photographic photometry) and depicted in the figures in the cases exhibiting an interesting behaviour and/or having a large amount of data (visual photometry). The individual stars are described and arranged in alphabetical order in the subsections.

3.1. Z Andromedae

Photoelectric observations of this star were carried out at the Skalnaté Pleso Observatory on 2 nights. The standard stars S_1, S_2, S_3 are the same as used in Paper II. The results are compiled in Table 1. Visual observations are displayed in Fig. 1. The star's brightness evidently decreases during the whole observational interval.

Table 1. Photoelectric observations of Z And

Date	JD 2 44. ...	U	B	V	Δ U	Δ B	Δ V
Jan 23, 92	8645.225	12.400	12.461	11.104	4.477*	4.201*	3.750*
Feb 1, 92	8654.277	12.364	12.323	10.000	6.611+	5.403+	4.046+

Observatory: Skalnaté Pleso S_1-S_3 = + , S_1-S_2 = *

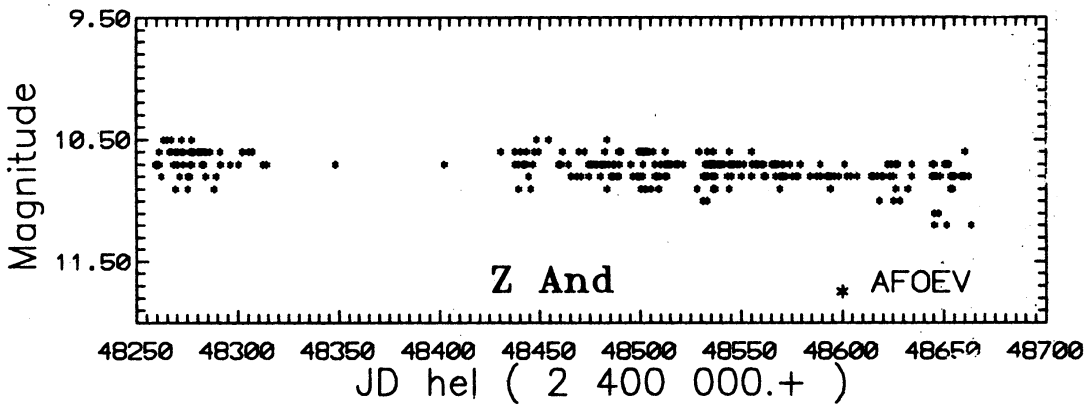


Figure 1. Visual observations of Z And

3.2. EG Andromedae

UBV photoelectric observations were carried out during 18 nights. The standard stars S_1, S_2, S_3 are the same as used in the Paper II, and S_4 is the same as used in Paper III. The results are compiled in Table 2 and shown in Fig. 2. Our data cover the ascending branch of the secondary minimum.

Table 2. Photoelectric observations of EG And

Date	JD 2 44. ...	U	B	V	Δ U	Δ B	Δ V	Obs
Oct 2, 91	8531.586	-1.390	-1.218	-1.299	4.532	2.645	1.645+	SL
Oct 4, 91	8533.587		-1.270	-1.351				K
Oct 7, 91	8537.460	-1.318	-1.216	-1.312	4.408	2.640	1.644+	SL
Nov 5, 91	8566.470	-1.565	-1.329	-1.343				C
Nov 11, 91	8571.510	-1.620	-1.414	-1.418				C
Nov 12, 91	8573.490	-1.620	-1.416	-1.429				C
Dec 2, 91	8593.479	-1.632	-1.389	-1.459	-1.615	-0.058	0.674*	SP
Dec 11, 91	8602.421	-1.538	-1.425	-1.510	-1.435	-0.067	0.648*	SP
Dec 13, 91	8604.420	-1.685	-1.438	-1.448				C
Jan 23, 92	8645.291	-1.638	-1.377	-1.442	-1.564	-0.083	0.662*	SP
Feb 10, 92	8663.300	-1.663	-1.417	-1.462				C
Feb 13, 92	8666.238	-1.703	-1.343	-1.393	-1.878	-0.077	0.646*	SP
Mar 10, 92	8692.261	-1.602	-1.386	-1.453	-1.666	-0.054	0.686*	SP
Aug 5, 92	8839.513		-1.437	-1.499				B1
Aug 7, 92	8841.563		-1.433	-1.475				B1
Aug 20, 92	8855.421	-1.456	-1.283	-1.394				SP
Aug 29, 92	8864.429		-1.483	-1.522				B1
Sep 17, 92	8883.383		-1.405	-1.448				B1

S_1-S_2 = + , S_1-S_4 = *

Obs = observatory : C - Catania,K - Kryonerion, B1 - Brno Observatory, SP - Skalnaté Pleso, SL - Stará Lesná

Table 3. Photographic observations of EG And

Date	JD 2 44. ...	mag	b	Date	JD 2 44. ...	mag	b
Sep 7, 89	7777.361	7.720	1	Sep 13, 91	8513.319	7.600	5
Oct 1, 89	7801.409	7.820	1	Oct 3, 91	8533.394	7.150	4
Oct 24, 89	7824.385	7.640	1	Oct 30, 91	8560.298	6.830	2
Jul 29, 90	8101.543	6.920	3	Oct 30, 91	8560.311	7.750	1
Aug 24, 90	8128.440	7.150	3	Dec 9, 91	8600.349	6.950	2
Oct 15, 90	8180.354	6.870	3	Jan 10, 92	8632.377	6.850	2
Oct 22, 90	8187.354	7.180	3	Jan 24, 92	8646.236	7.020	2
Nov 10, 90	8206.407	7.080	3	Jan 25, 92	8647.197	7.400	5
Jan 14, 91	8271.338	6.820	3	Jul 9, 92	8812.527	6.650	2
Jan 18, 91	8275.271	7.120	3	Jul 29, 92	8833.457	6.900	2
Jul 13, 91	8450.504	7.080	4	Aug 22, 92	8857.421	6.570	2
Aug 8, 91	8477.444	7.230	4	Aug 28, 92	8863.446	7.020	2
Sep 3, 91	8503.316	7.750	5	Sep 18, 92	8884.373	6.680	2
Sep 3, 91	8503.461	7.250	4	Sep 26, 92	8892.391	6.470	2
Sep 10, 91	8510.421	7.120	4				

Sp.bands (b):
1 400-600nm
2 570-650nm
3 570-680nm
4 Agfa 400 + Panchr.G3
5 Orwo NP-27

The photographic observations were taken on 29 nights. The results are summarized in Table 3 and shown in Fig. 3. The photographic observations are in good agreement with the photoelectric data. The visual observations of EG And are displayed in Fig. 4.

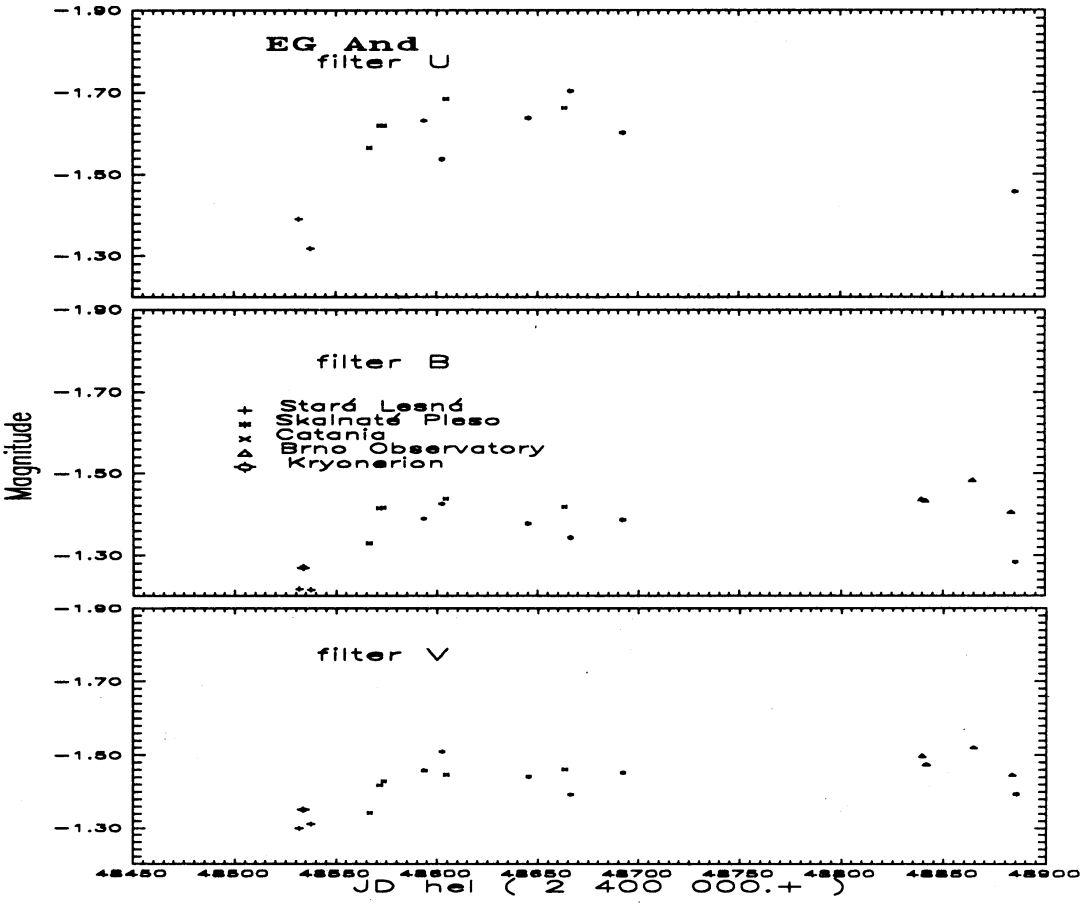


Figure 2. Photoelectric observations of EG And

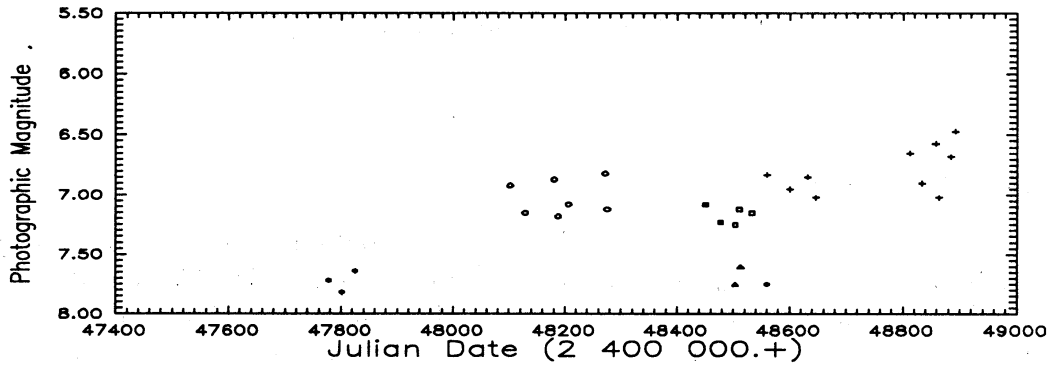


Figure 3. Photographic observations of EG And

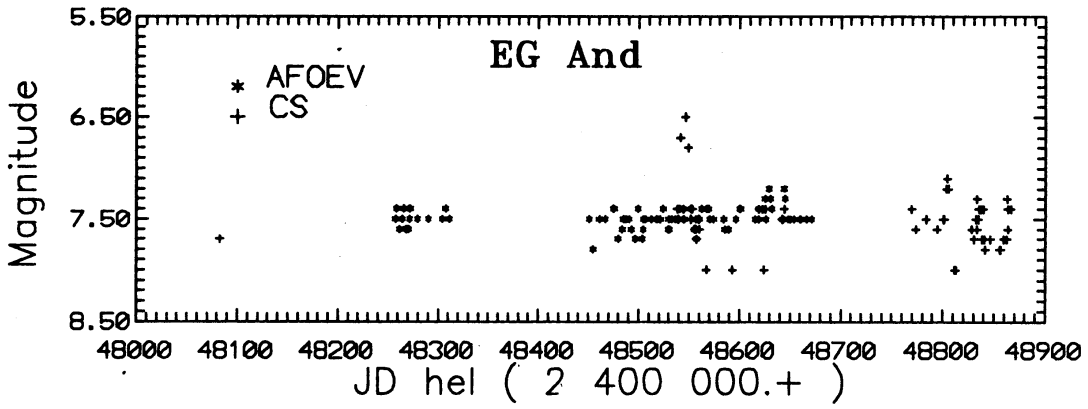


Figure 4. Visual observations of EG And

3.3. R Aquarii

The visual observations are shown in Fig. 5. Our data cover the ascending branch of the Mira-type light curve very well, indicating the presence of a quasi-plateau. This star is also a good candidate for UBV observations.

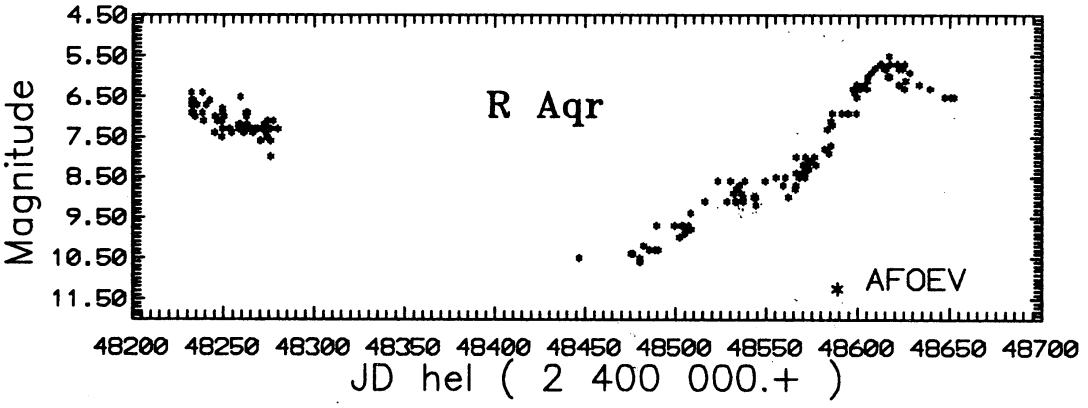


Figure 5. Visual observations of R Aqr

3.4. UV Aurigae

The photoelectric observations of this star were obtained on 46 nights. The standard stars S_1, S_2, S_3 are the same as used in Paper II. The results are compiled in Table 4 and depicted in Fig. 7. The amplitude of light variations in V colour is larger than in B colour. The light variations in U colour are virtually invisible. This is in good agreement with our previous suggestion that the primary cause of the light variations of UV Aur are pulsations of the red giant star. The U data obtained at the Sonneberg Observatory are probably not

correct. The data from SP and SL agree with the data published in Paper II. The photographic observations were taken on 33 nights. The results are summarized in Table 5. and depicted together with the previously obtained photographic observations in Fig. 6.

The visual observations of UV Aur are displayed in Fig. 8.

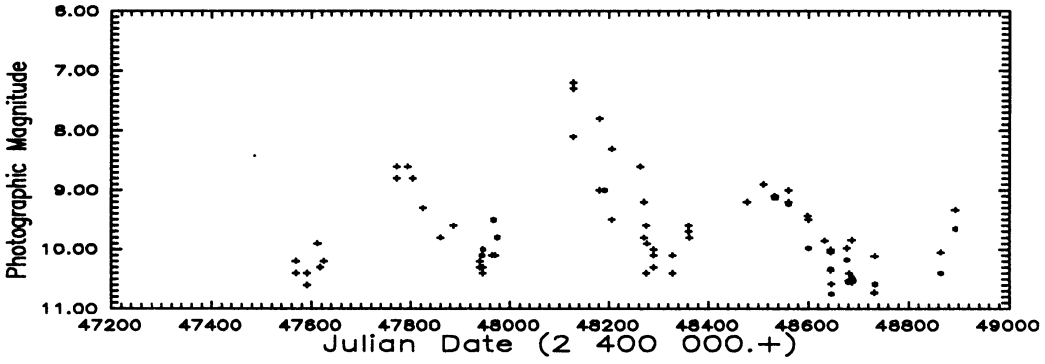


Figure 6. Photographic observations of UV Aur

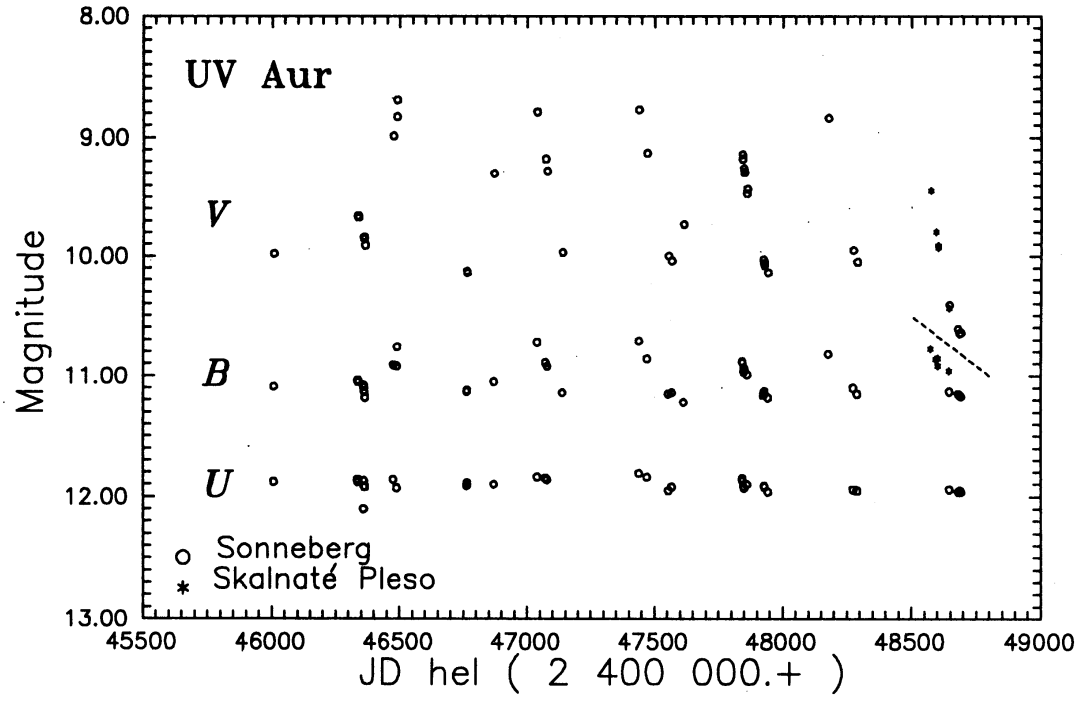


Figure 7. Photoelectric observations of UV Aur

Table 4. Photoelectric observations of UV Aur

Date	JD 2 44. ...	U	B	V	Δ U	Δ B	Δ V	Obs
Nov 2, 84	6006.582	11.880	11.090	9.980				S
Sep 26, 85	6334.660	11.880	11.050	9.670				S
Sep 27, 85	6335.605	11.860	11.040	9.660				S
Sep 30, 85	6338.621	11.870	11.050	9.670				S
Oct 20, 85	6358.595	12.100	11.080	9.840				S
Oct 21, 85	6359.558	11.870	11.090	9.850				S
Oct 22, 85	6360.560	11.920	11.130	9.840				S
Oct 26, 85	6364.560	11.920	11.180	9.910				S
Feb 12, 86	6474.382	11.860	10.910	8.990				S
Feb 27, 86	6488.501	11.930	10.920	8.830				S
Feb 27, 86	6489.468		10.760	8.690				S
Nov 28, 86	6762.555	11.910	11.130	10.130				S
Nov 30, 86	6764.581	11.890	11.120	10.140				S
Mar 14, 87	6869.349	11.900	11.050	9.300				S
Sep 1, 87	7039.588	11.840	10.720	8.790				S
Oct 3, 87	7071.605	11.850	10.890	9.180				S
Oct 10, 87	7078.609	11.860	10.920	9.280				S
Dec 9, 87	7138.573		11.140	9.970				S
Oct 4, 88	7438.607	11.810	10.710	8.770				S
Nov 4, 88	7469.589	11.840	10.860	9.130				S
Jan 27, 89	7554.498	11.950	11.150	10.000				S
Feb 8, 89	7566.467	11.920	11.140	10.040				S
Mar 27, 89	7613.423		11.220	9.730				S
Nov 12, 89	7842.532	11.870	10.880	9.140				S
Nov 13, 89	7843.552	11.850	10.890	9.180				S
Nov 18, 89	7848.535	11.920	10.970	9.260				S
Nov 20, 89	7850.607	11.930	10.940	9.290				S
Nov 29, 89	7859.657			9.470				S
Dec 1, 89	7861.594	11.900	10.990	9.430				S
Feb 2, 90	7924.506		11.160	10.030				S
Feb 5, 90	7928.448	11.910	11.150	10.080				S
Feb 6, 90	7929.459	11.920	11.130	10.060				S
Feb 20, 90	7943.490	11.960	11.180	10.140				S
Oct 13, 90	8177.591		10.820	8.840				S
Jan 16, 91	8273.406	11.940	11.100	9.950				S
Feb 2, 91	8290.411	11.950	11.150	10.050				S
Nov 12, 91	8573.498	10.461	10.775	9.443	0.822	1.174	1.919*	SP
Dec 3, 91	8593.567	10.445	10.862	9.795	2.134	1.603	1.431+	SP
Dec 12, 91	8602.517	10.471	10.916	9.911	0.793	1.139	1.914*	SP
Dec 12, 91	8602.613	10.357	10.852	9.930	0.786	1.174	1.912*	SP
Jan 23, 92	8645.436	10.357	10.957	10.435	2.113	1.617	1.402+	SP
Jan 24, 92	8646.454	11.940	11.130	10.410				S
Feb 28, 92	8681.404	11.960	11.150	10.610				S
Mar 4, 92	8686.407	11.950	11.160	10.650				S
Mar 9, 92	8691.391	11.960	11.170	10.640				S

S_1-S_3 = + , S_1-S_2 = *

Obs = observatory: S - Sonneberg SP - Skalnaté Pleso, SL - Stará Lesná

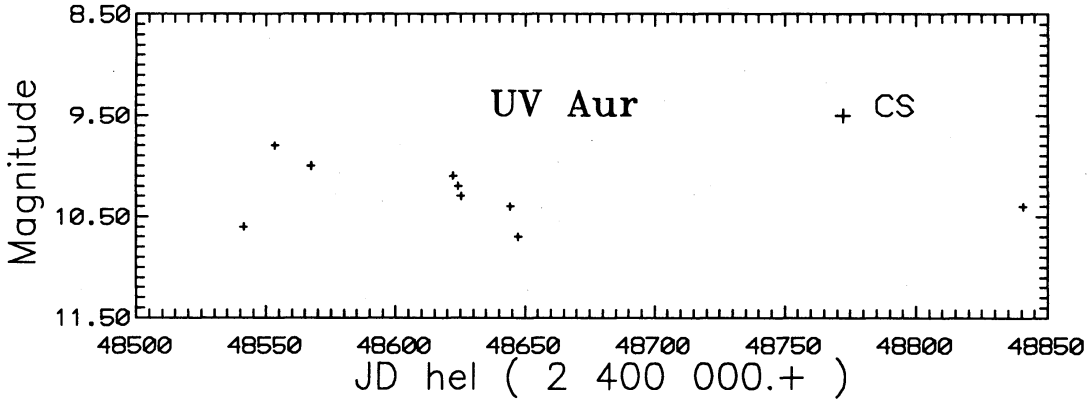


Figure 8. Visual observations of UV Aur

Table 5. Photographic observations of UV Aur

Date	JD 2 44. ...	mag	b	Date	JD 2 44. ...	mag	b
Oct 3, 91	8533.445	9.120	4	Feb 26, 92	8679.407	10.530	2
Oct 30, 91	8560.403	9.230	1	Feb 26, 92	8679.429	10.550	1
Oct 30, 91	8560.425	9.000	2	Feb 28, 92	8681.384	10.400	2
Dec 8, 91	8599.321	9.430	2	Feb 28, 92	8681.404	10.530	1
Dec 9, 91	8600.395	9.500	2	Mar 4, 92	8686.350	10.550	2
Dec 9, 91	8600.411	9.490	2	Mar 4, 92	8686.362	9.840	2
Dec 9, 91	8600.435	9.980	1	Mar 4, 92	8686.393	10.460	1
Jan 10, 92	8632.450	9.850	2	Mar 7, 92	8689.244	10.500	5
Jan 22, 92	8644.256	10.030	2	Apr 18, 92	8731.313	10.730	2
Jan 22, 92	8644.263	10.050	2	Apr 18, 92	8731.326	10.720	2
Jan 22, 92	8644.294	10.350	2	Apr 19, 92	8732.309	10.580	1
Jan 22, 92	8644.316	10.000	2	Apr 19, 92	8732.327	10.110	2
Jan 22, 92	8644.330	10.330	1	Aug 29, 92	8863.575	10.050	2
Jan 24, 92	8646.290	10.580	2	Aug 29, 92	8863.594	10.400	1
Jan 24, 92	8646.312	10.750	1	Sep 27, 92	8892.508	9.330	2
Feb 24, 92	8677.349	9.980	2	Sep 27, 92	8892.537	9.650	1
Feb 24, 92	8677.401	10.180	1				

Sp.bands (b):
1 400-600nm
2 570-650nm
4 Agfa 400 + Panchr.G3
5 Orwo NP-27

3.5. TX Canum Venaticorum

The photoelectric photometry of this star was carried out on 11 nights. The standard stars S_1, S_2, S_3 are the same as used in Paper II. The results are summarized in Table 6. The light curve is without any significant long-term variations.

The visual observations exhibit a long-term decrease in brightness which is indeed very probably a real phenomenon. (Fig. 9).

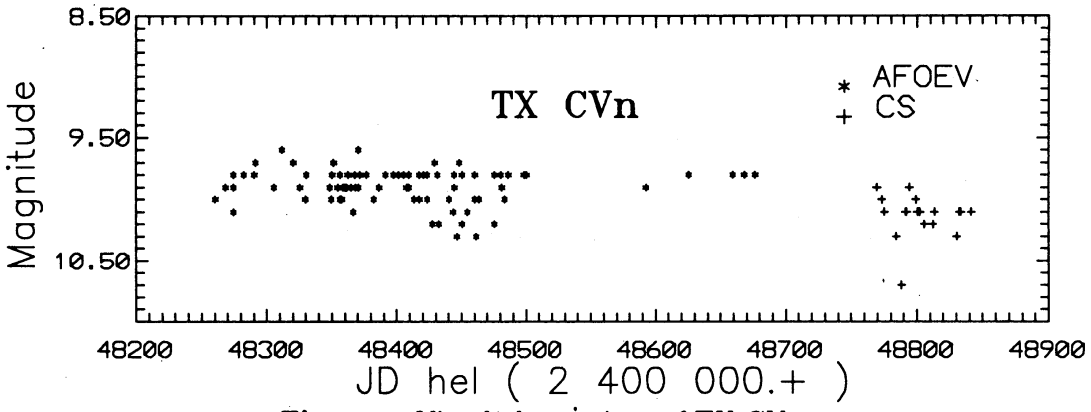


Figure 9. Visual observations of TX CVn

Table 6. Photoelectric observations of TX CVn

Date	JD 2 44. ...	U	B	V	Δ U	Δ B	Δ V	Obs
Jun 30, 91	8438.380		10.380	9.840				B2
Dec 3, 91	8593.692	10.478	10.481	9.906	0.210	0.111	0.165*	SP
Jan 24, 92	8645.510	10.611	10.521	9.903	0.851	-0.139	-0.975+	SP
Jan 26, 92	8647.563	10.611	10.501	9.903	0.877	-0.138	-0.978+	SP
Feb 14, 92	8666.599	10.634	10.501	9.910	0.857	-0.152	-0.983+	SP
Mar 5, 92	8686.540		10.590	9.900				B2
Apr 8, 92	8721.466	10.541	10.453	9.876				K
Apr 20, 92	8733.355	10.690	10.562	9.891				B1
Apr 24, 92	8737.327	10.595	10.589	9.860				B1
Apr 24, 92	8737.406		10.590	9.860				B2
Apr 26, 92	8739.324	10.578	10.628	9.894				B1
May 2, 92	8745.374	10.832	10.580	9.918				B1
May 5, 92	8748.360	10.750	10.570	9.860				B2
May 6, 92	8749.339	10.864	10.621	9.894				B1
May 13, 92	8756.350		10.550	9.850				B2
May 14, 92	8757.349	10.788	10.613	9.857				B1
May 15, 92	8758.370	10.750	10.530	9.840				B2
May 15, 92	8758.403	10.597	10.627	9.908				B1
May 17, 92	8760.407	10.723	10.585	9.796				B1
May 21, 92	8764.350	10.760	10.580	9.870				B2
May 24, 92	8767.350	10.790	10.580	9.850				B2
May 25, 92	8768.350	10.730	10.590	9.860				B2
May 25, 92	8768.359	10.836	10.657	9.886				B1
May 30, 92	8773.350	10.760	10.620	9.850				B2
May 30, 92	8773.374	10.644	10.629	9.902				B1
Jun 26, 92	8800.380	10.560	10.510	9.910				B2
Jun 30, 92	8804.370	10.660	10.500	9.870				B2

S_1-S_3 = + , S_1-S_2 = *

Obs = observatory : K - Kryonerion, B1 - Brno Observatory, B2 - Brno University, SP - Skalnaté Pleso

3.6. T Coronae Borealis

The photoelectric observations of T CrB were obtained on 6 nights. The standard stars S_1, S_2, S_3 are the same as used in Paper II. The results are compiled in Table 7.

Table 7. Photoelectric observations of T CrB

Date	JD 2 44. ...	U	B	V	Δ U	Δ B	Δ V	Obs
Jan 26, 92	8647.700	12.176	11.714	10.277	0.970	0.429	-0.064*	SP
Feb 14, 92	8666.670	12.460	11.855	10.337	0.918	0.382	-0.095*	SP
Feb 29, 92	8681.610	12.631	11.723	10.186	0.900	0.309	-0.220*	SP
Mar 10, 92	8691.510	12.648	11.625	10.103	0.933	0.279	-0.206*	SP
May 5, 92	8748.420	12.236	11.634	10.189	0.967	0.298	-0.197*	SP
Jul 25, 92	8829.429	12.233	11.433	9.990				SP

S_1-S_2 = *

Obs = observatory: SP - Skalnaté Pleso

The photometric behaviour of T CrB is not in good agreement with the ephemeris derived from the visual observations: JD(Min)= 2 435 571 + 227.8E (Paper II). The lack of data does not allow us to discuss this point in more detail.

The photographic observations are compiled in Table 8 and depicted, together with the previously obtained photographic observations, in Fig. 10.

Table 8. Photographic observations of T CrB

Date	JD 2 44. ...	mag	b	Date	JD 2 44. ...	mag	b
Oct 3, 91	8533.276	10.160	4	May 29, 92	8772.414	10.030	2
Feb 27, 92	8679.512	9.870	2	Jun 26, 92	8800.439	9.900	2
Feb 29, 92	8681.623	9.200	2	Jul 9, 92	8813.469	9.890	2
Mar 10, 92	8691.607	9.790	2	Jul 29, 92	8833.369	9.600	2
Apr 4, 92	8717.479	9.730	2	Aug 22, 92	8857.342	9.510	2
May 1, 92	8744.437	9.850	2	Aug 28, 92	8863.329	9.470	2
May 1, 92	8744.452	9.760	2	Sep 18, 92	8884.270	9.970	2
May 1, 92	8744.473	9.950	2	Sep 26, 92	8892.288	10.040	2
May 21, 92	8764.382	10.020	2				

Sp.bands (b): 2 570-650nm
4 Agfa 400 + Panchr.G3

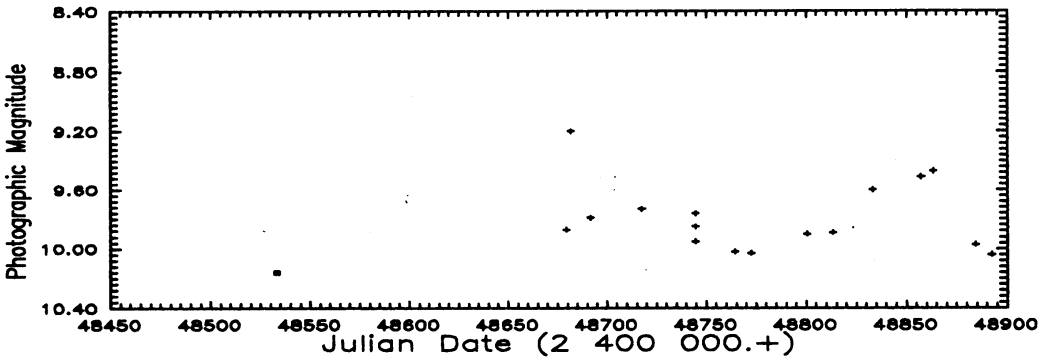


Figure 10. Photographic observations of T CrB

The visual observations are shown in Fig. 11.

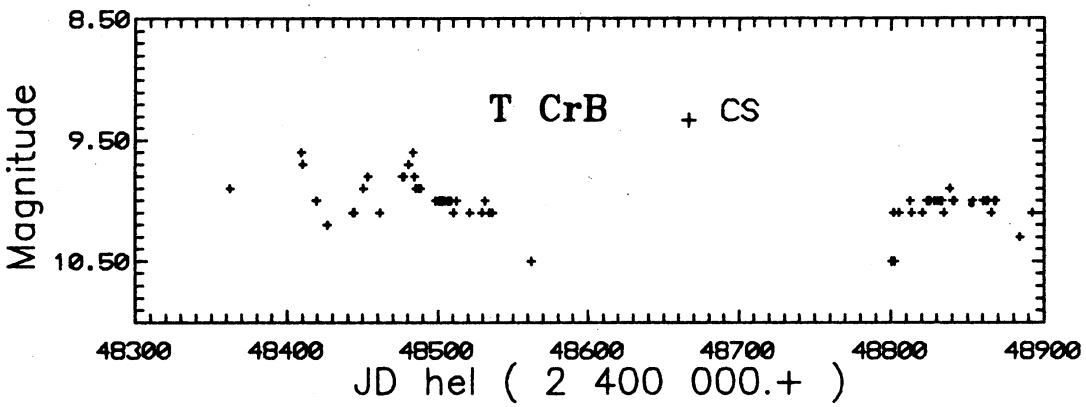


Figure 11. Visual observations of T CrB

3.7. BF Cygni

The photoelectric photometry of BF Cyg was carried out on 66 nights. The standard stars S_1 and S_2 are the same as used in Paper III. The results are compiled in Table 9 and depicted in Fig. 12. The observational data indicate continuation of the active phase of BF Cyg. The behaviour of the light curve

agrees with the description presented in Paper III. This combination of photoelectric data with visual observations gives the centre of a very wide minimum at JD 2 448 439.

The visual observations of BF Cyg are shown in Fig. 13.

Figure 12. Photoelectric observations of BF Cyg

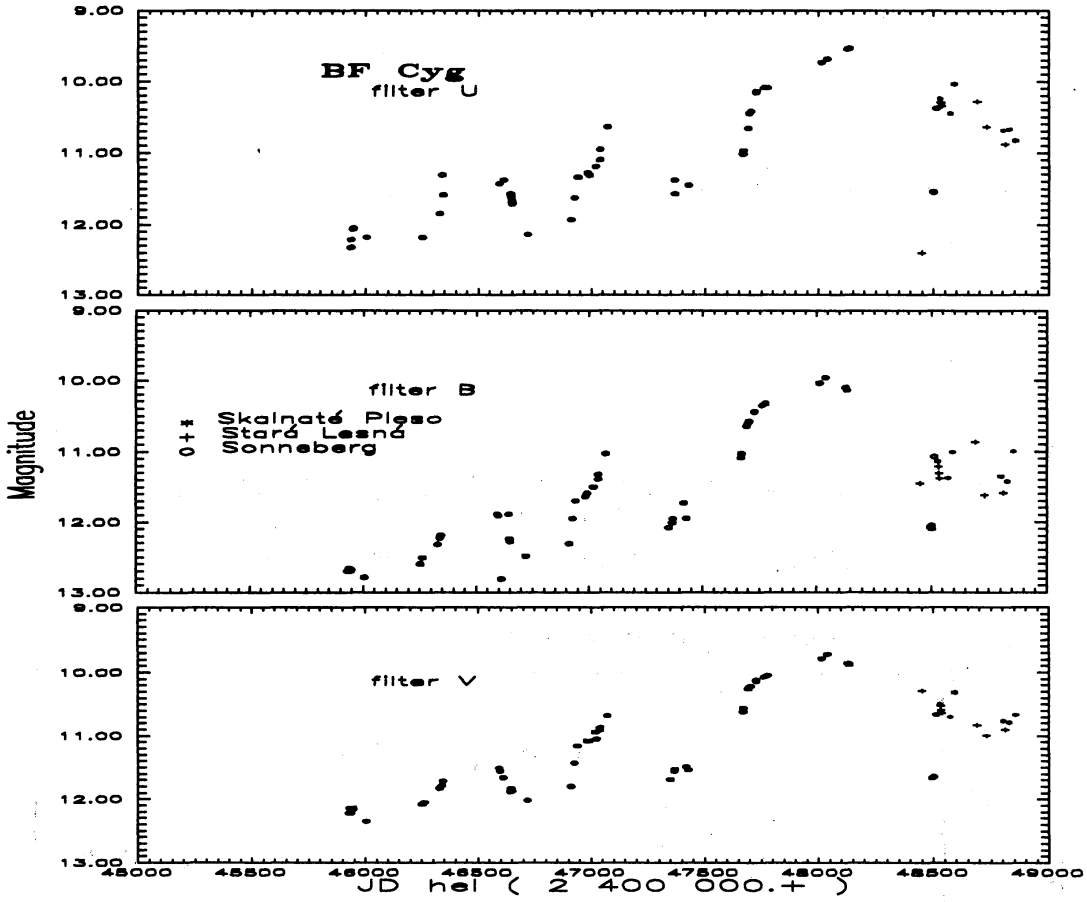


Figure 13. Visual observations of BF Cyg

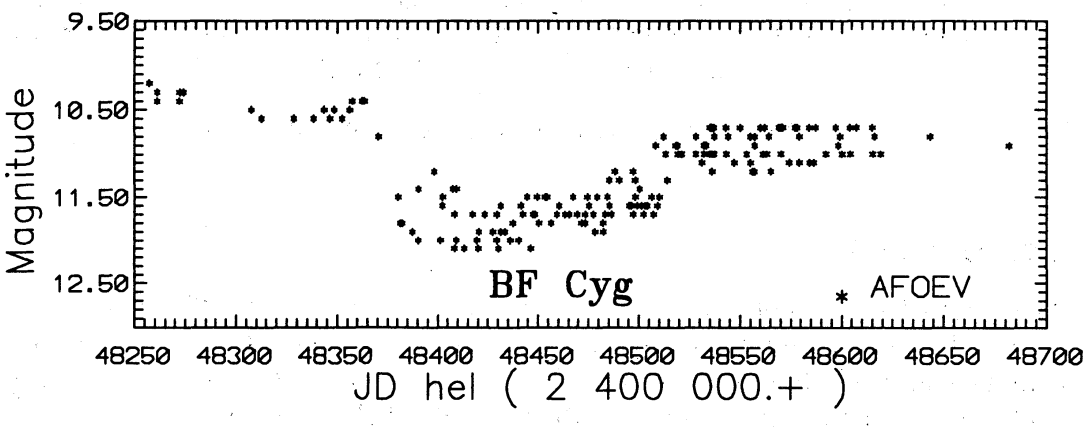


Table 9. Photoelectric observations of BF Cyg

Date	JD 2 44. ...	U	B	V	Δ U	Δ B	Δ V	Obs
Aug 15, 84	5928.444		12.700	12.220				S
Aug 18, 84	5930.530			12.140				S
Aug 22, 84	5935.445	12.320	12.690	12.220				S
Aug 23, 84	5936.439	12.210	12.660	12.200				S
Aug 31, 84	5944.442	12.060	12.700	12.140				S
Sep 2, 84	5946.411	12.050	12.680	12.160				S
Oct 31, 84	6004.760	12.180	12.790	12.350				S
Jul 5, 85	6251.525	12.180	12.600	12.080				S
Jul 15, 85	6261.532		12.510	12.050				S
Sep 19, 85	6328.352	11.850	12.320	11.830				S
Sep 29, 85	6338.385	11.310	12.230	11.790				S
Oct 4, 85	6343.322	11.590	12.190	11.720				S
Jun 11, 86	6592.534	11.430	11.890	11.510				S
Jun 15, 86	6596.516		11.910	11.560				S
Jun 29, 86	6611.466	11.380	12.810	11.660				S
Jul 30, 86	6642.433	11.570	11.890	11.880				S
Aug 2, 86	6645.472	11.610	12.240	11.830				S
Aug 3, 86	6646.447	11.660	12.240	11.830				S
Aug 5, 86	6648.446	11.680	12.240	11.870				S
Aug 6, 86	6649.411	11.710	12.280	11.870				S
Oct 14, 86	6718.406	12.140	12.490	12.020				S
Apr 25, 87	6910.591	11.930	12.310	11.800				S
May 10, 87	6925.521	11.630	11.950	11.430				S
May 24, 87	6939.526	11.340	11.700	11.160				S
Jul 5, 87	6982.491	11.280	11.640	11.080				S
Jul 13, 87	6990.475	11.310	11.590	11.080				S
Aug 10, 87	7018.430	11.190	11.500	10.940				S
Aug 15, 87	7023.478			11.050				S
Aug 30, 87	7038.467	11.100	11.320	10.870				S
Aug 31, 87	7039.372	10.950	11.390	10.910				S
Oct 2, 87	7071.370	10.640	11.030	10.680				S
Jul 6, 88	7349.478		12.080	11.690				S
Jul 23, 88	7366.433	11.380	12.010	11.560				S
Jul 25, 88	7368.479	11.570	11.950	11.530				S
Sep 13, 88	7418.373		11.730	11.490				S
Sep 22, 88	7427.406	11.450	11.950	11.540				S
May 23, 89	7669.540	11.020	11.090	10.620				S
May 24, 89	7670.511	10.970	11.030	10.560				S
Jun 13, 89	7691.480	10.660	10.650	10.260				S
Jun 18, 89	7696.448	10.450	10.620	10.230				S
Jun 26, 89	7703.502	10.420	10.580	10.220				S
Jul 18, 89	7726.487	10.160	10.450	10.120				S
Jul 20, 89	7727.551	10.140	10.440	10.140				S
Aug 23, 89	7762.428	10.090	10.360	10.070				S
Sep 6, 89	7776.476	10.090	10.330	10.050				S
May 2, 90	8013.517	9.730	10.040	9.790				S
May 27, 90	8038.518	9.680	9.960	9.720				S
Aug 23, 90	8127.484	9.540	10.100	9.860				S
Aug 29, 90	8133.414	9.530	10.140	9.880				S
Jul 12, 91	8450.472	12.394	11.451	10.293	3.808	3.197	2.485*	SL
Aug 25, 91	8494.412		12.070	11.660				S
Aug 30, 91	8499.362	11.540	12.050	11.650				S
Sep 1, 91	8501.381	11.550	12.100	11.640				S
Sep 12, 91	8512.387	10.380	11.070	10.660				S
Oct 1, 91	8531.352	10.297	11.217	10.525	4.695	3.237	2.626*	SL
Oct 3, 91	8533.325	10.304	11.309	10.592	4.649	3.261	2.629*	SL
Oct 7, 91	8537.241	10.348	11.377	10.641	4.775	3.688	2.628*	SL
Nov 12, 91	8573.331	10.448	11.373	10.700	4.657	3.313	2.626*	SP
Dec 1, 91	8592.243	10.036	11.008	10.313	4.618	3.345	2.626*	SP
Mar 8, 92	8689.636	10.285	10.867	10.827	3.012	3.197	2.551*	SL
Apr 19, 92	8731.553	10.638	11.623	10.998				SL
Jun 28, 92	8802.446	10.685	11.351	10.763	3.214	3.255	2.518*	SP
Jul 8, 92	8812.459	10.879	11.586	10.900	3.437	3.420	2.635*	SL
Jul 25, 92	8829.468	10.674	11.418	10.785	3.258	3.234	2.511*	SP
Aug 20, 92	8855.347	10.829	10.998	10.666	3.266	3.026	2.497*	SP

S_1-S_3 = + , S_1-S_2 = *

Obs = observatory: S - Sonneberg, SP - Skalnaté Pleso, SL - Stará Lesná

3.8. CH Cygni

This star was observed photoelectrically on 68 nights. The standard stars S_1, S_2, S_3 are the same as used in Paper II and S_4 is the same as in Paper III. The results are compiled in Table 10 and shown in Fig. 14.

The star suddenly brightened by about 2.0 mag in U, about 1.1 mag in B and 0.2 mag in V colour some time before March 8, 1992 but not prior to February 4, 1992. An example of the rapid brightness variability exhibited by CH Cyg is compiled in Table 11 and depicted in Fig. 16 (bottom). In this case the standard stars were observed at the same time the variable star was observed at the neighbouring observatory (B1). Fig. 16 (top) shows the differential photometry of the rapid variability of the star obtained at the Stará Lesná Observatory.

The visual observations of CH Cyg are shown in Fig. 15.

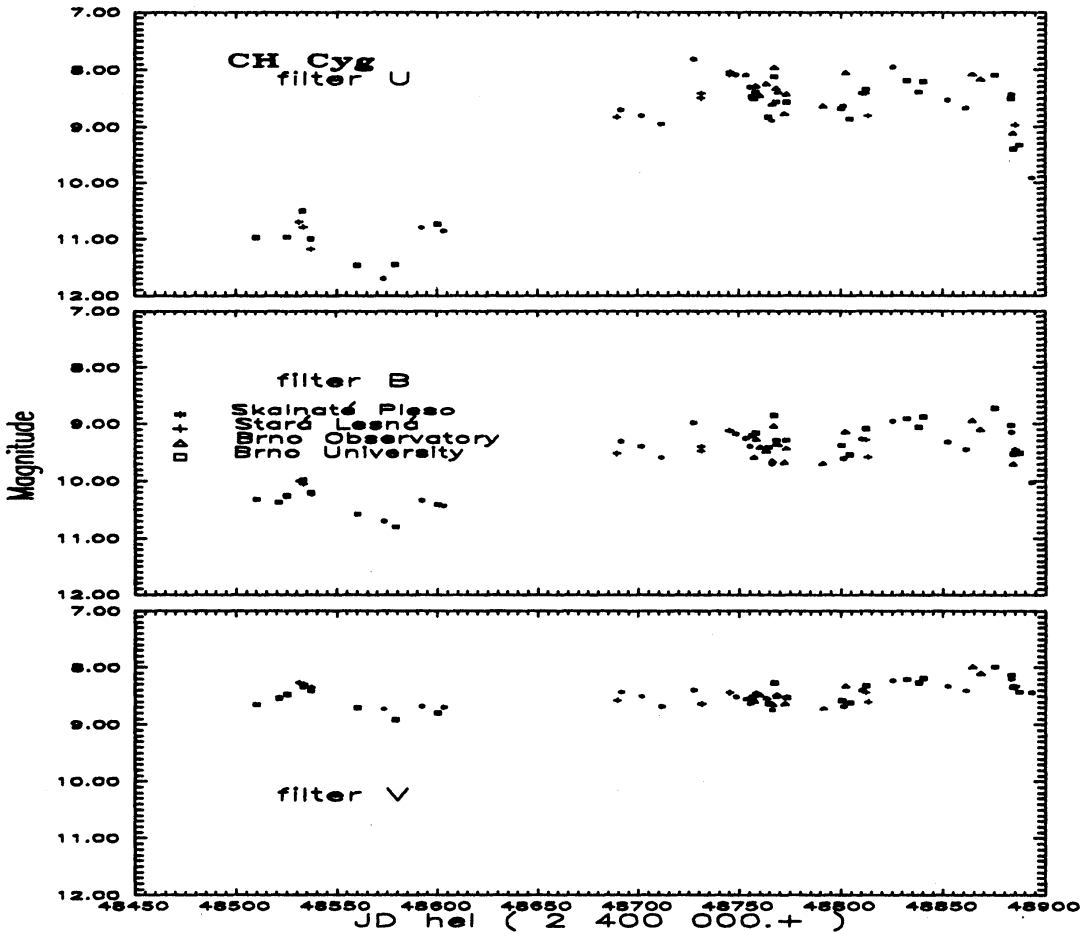


Figure 14. Photoelectric observations of CH Cyg

Table 10. Photoelectric observations of CH Cyg

Date	JD 2 44. ...	U	B	V	Δ U	Δ B	Δ V	Obs
Sep 10, 91	8510.321	10.980	10.320	8.650				B2
Sep 21, 91	8521.291		10.370	8.540				B2
Sep 25, 91	8525.294	10.970	10.260	8.480				B2
Oct 1, 91	8531.406	10.705	9.996	8.269	2.607	2.378	1.877*	SL
Oct 3, 91	8533.261	10.510	9.980	8.330				B2
Oct 3, 91	8533.390	10.788	10.051	8.297	2.586	2.378	1.877*	SL
Oct 7, 91	8537.250	11.000	10.210	8.410				B2
Oct 7, 91	8537.339	11.186	10.229	8.347	2.598	2.381	1.875*	SL
Oct 30, 91	8560.244	11.470	10.580	8.710				B2
Nov 12, 91	8573.363	11.704	10.704	8.730	2.634	2.413	1.894*	SP
Nov 18, 91	8579.227	11.460	10.800	8.920				B2
Dec 1, 91	8592.293	10.801	10.336	8.687	2.626	2.425	1.902*	SP
Dec 9, 91	8600.237	10.740	10.410	8.800				B2
Dec 12, 91	8603.289	10.854	10.434	8.696	2.607	2.413	1.898*	SP
Mar 8, 92	8689.566	8.822	9.523	8.574	2.626	2.355	1.827*	SL
Mar 10, 92	8691.544	8.696	9.308	8.430	2.620	2.418	1.882*	SP
Mar 20, 92	8701.577	8.799	9.403	8.508	2.624	2.425	1.896*	SP
Mar 30, 92	8711.614	8.949	9.590	8.683	2.619	2.427	1.907*	SP
Apr 15, 92	8727.598	7.814	8.986	8.394	2.580	2.385	1.844*	SP
Apr 18, 92	8731.399	8.494	9.475	8.644	2.639	2.345	1.840*	SL
Apr 18, 92	8731.462	8.411	9.399	8.631				SL
May 2, 92	8745.373	8.085	9.131	8.443	2.635	2.337	1.810*	SL
May 2, 92	8745.425	8.032	9.114	8.438	2.635	2.343	1.848*	SL
May 5, 92	8748.468	8.084	9.178	8.512	2.572	2.390	1.830*	SP
May 11, 92	8753.508	8.093	9.261	8.548	2.592	2.379	1.848*	SP
May 13, 92	8755.542	8.307	9.399	8.632	2.594	2.388	1.839*	SP
May 13, 92	8756.410	8.480	9.210	8.520				B2
May 15, 92	8757.505	8.509	9.590	8.595				B1
May 15, 92	8758.439	8.400	9.170	8.480				B2
May 15, 92	8758.465	8.285	9.273	8.443				B1
May 17, 92	8760.430	8.447	9.413	8.473				B1
May 21, 92	8763.503	8.242	9.474	8.534				B1
May 21, 92	8764.441	8.830	9.420	8.630				B2
May 23, 92	8766.362	8.886	9.706	8.743	2.604	2.387	1.869*	SP
May 24, 92	8766.553	8.599	9.645	8.645				B1
May 24, 92	8767.406	7.958	9.037	8.275				B1
May 24, 92	8767.413	8.120	8.850	8.270				B2
May 25, 92	8768.453	8.322	9.345	8.480				B1
May 25, 92	8768.496	8.560	9.290	8.510				B2
May 26, 92	8769.456	8.392	9.365	8.492				B1
May 29, 92	8772.430	8.768	9.675	8.635				B1
May 30, 92	8773.432	8.570	9.290	8.530				B2
May 30, 92	8773.436	8.427	9.431	8.514				B1
Jun 17, 92	8791.381	8.633	9.693	8.715				B1
Jun 26, 92	8800.457	8.680	9.380	8.580				B2
Jun 27, 92	8801.426	8.635	9.608	8.684	2.513	2.355	1.815*	SP
Jun 28, 92	8802.388	8.051	9.140	8.324				B1
Jun 30, 92	8804.446	8.860	9.540	8.620				B2
Jul 6, 92	8810.489	8.415	9.274	8.399	2.566	2.400	1.827*	SP
Jul 8, 92	8812.376	8.415	9.287	8.434	2.642	2.376	1.822*	SL
Jul 8, 92	8812.434	8.340	9.090	8.320				B2
Jul 9, 92	8813.437	8.804	9.578	8.600	2.623	2.359	1.832*	SL
Jul 22, 92	8825.534	7.959	8.958	8.225	2.561	2.380	1.836*	SP
Jul 28, 92	8832.415	8.190	8.910	8.210				B2
Aug 3, 92	8838.360	8.390	9.060	8.270				B2
Aug 5, 92	8840.389	8.200	8.880	8.190				B2
Aug 17, 92	8852.331	8.530	9.324	8.328	2.569	2.393	1.842*	SP
Aug 26, 92	8861.403	8.668	9.455	8.405	2.718	2.598	1.850*	SP
Aug 29, 92	8864.386	8.080	8.947	7.982				B1
Sep 2, 92	8868.396	8.160	9.099	8.101				B1
Sep 9, 92	8875.295	8.090	8.720	7.990				B2
Sep 17, 92	8883.296	8.510	9.030	8.130				B2
Sep 17, 92	8883.395	8.440	9.153	8.204	2.704	2.626	1.777*	SP
Sep 18, 92	8884.327	9.400	9.530	8.350				B2
Sep 18, 92	8884.336	9.117	9.703	8.337				B1
Sep 19, 92	8885.286	8.966	9.456	8.331	2.603	2.353	1.810*	SL
Sep 21, 92	8887.300	9.330	9.520	8.430				B2
Sep 27, 92	8893.291	9.916	10.023	8.436	2.618	2.386	1.832*	SP

S_1-S_3 = + , S_1-S_2 = *

Obs = observatory : SP - Skalnaté Pleso, SL - StaráLesná,
B1 - Brno Observatory, B2 - Brno University

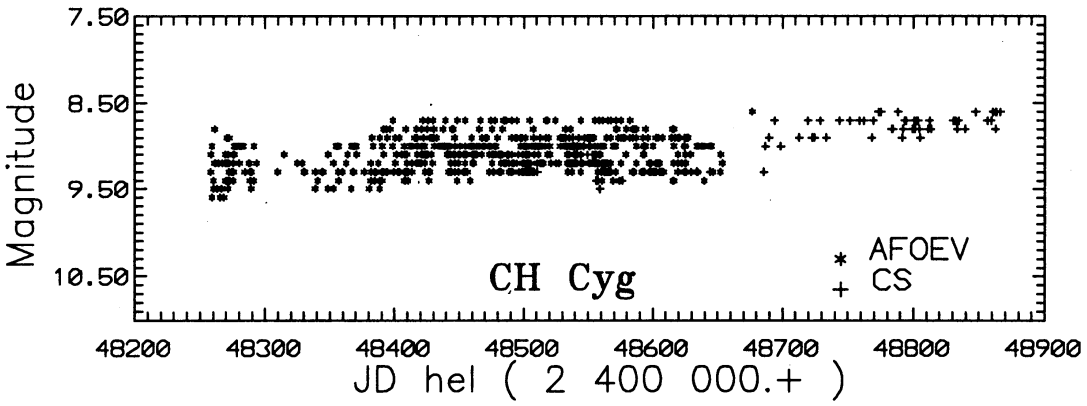


Figure 15. Visual observations of CH Cyg

Table 11. Rapid variations of the CH Cyg brightness; (observer: Papoušek)

U		B		V		U		B		V	
Time	mag	Time	mag	Time	mag	Time	mag	Time	mag	Time	mag
0.4410	8.799	0.4409	9.445	0.4409	8.544	0.4627	8.702	0.4626	9.383	0.4625	8.560
0.4415	8.822	0.4414	9.475	0.4413	8.551	0.4632	8.685	0.4631	9.330	0.4630	8.513
0.4419	8.718	0.4418	9.488	0.4417	8.542	0.4635	8.754	0.4634	9.406	0.4634	8.520
0.4427	8.825	0.4426	9.515	0.4425	8.583	0.4639	8.907	0.4638	9.432	0.4637	8.541
0.4430	8.881	0.4429	9.521	0.4428	8.594	0.4643	8.749	0.4643	9.475	0.4642	8.577
0.4434	8.800	0.4433	9.477	0.4432	8.575	0.4648	8.775	0.4647	9.451	0.4646	8.550
0.4439	8.861	0.4438	9.524	0.4437	8.585	0.4656	8.815	0.4655	9.447	0.4650	8.604
0.4442	8.936	0.4441	9.536	0.4441	8.591	0.4662	8.751	0.4660	9.450	0.4659	8.549
0.4446	8.849	0.4445	9.526	0.4444	8.607	0.4666	8.778	0.4665	9.500	0.4664	8.564
0.4450	8.960	0.4450	9.532	0.4448	8.550	0.4670	8.868	0.4669	9.571	0.4669	8.602
0.4458	9.005	0.4457	9.587	0.4456	8.607	0.4675	8.849	0.4674	9.520	0.4673	8.593
0.4461	8.964	0.4460	9.605	0.4459	8.627	0.4683	8.931	0.4682	9.582	0.4681	8.623
0.4465	8.893	0.4464	9.554	0.4463	8.575	0.4687	8.817	0.4686	9.539	0.4685	8.655
0.4469	8.840	0.4468	9.494	0.4467	8.595	0.4691	8.803	0.4690	9.510	0.4689	8.623
0.4472	8.934	0.4471	9.528	0.4470	8.582	0.4695	8.787	0.4694	9.419	0.4693	8.562
0.4476	8.880	0.4475	9.539	0.4474	8.596	0.4699	8.729	0.4698	9.415	0.4697	8.570
0.4481	8.974	0.4480	9.592	0.4479	8.616	0.4703	8.804	0.4702	9.443	0.4701	8.551
0.4489	8.897	0.4488	9.526	0.4487	8.596	0.4706	8.760	0.4705	9.428	0.4704	8.549
0.4493	8.893	0.4492	9.553	0.4491	8.611	0.4711	8.822	0.4709	9.474	0.4708	8.583
0.4497	8.906	0.4496	9.468	0.4495	8.583	0.4714	8.922	0.4713	9.547	0.4712	8.622
0.4501	8.821	0.4500	9.494	0.4499	8.577	0.4718	8.992	0.4717	9.572	0.4716	8.616
0.4505	8.880	0.4504	9.525	0.4503	8.609	0.4722	8.872	0.4721	9.548	0.4720	8.607
0.4510	8.859	0.4509	9.569	0.4508	8.616	0.4730	8.826	0.4729	9.438	0.4728	8.527
0.4514	8.902	0.4513	9.535	0.4512	8.604	0.4734	8.795	0.4733	9.489	0.4732	8.537
0.4522	8.898	0.4521	9.520	0.4520	8.614	0.4738	8.827	0.4737	9.519	0.4736	8.590
0.4527	8.849	0.4525	9.537	0.4525	8.575	0.4742	8.908	0.4741	9.561	0.4740	8.606
0.4531	8.880	0.4529	9.507	0.4528	8.599	0.4746	8.980	0.4745	9.620	0.4744	8.637
0.4537	8.832	0.4536	9.530	0.4533	8.593	0.4757	8.999	0.4756	9.687	0.4749	8.623
0.4542	8.771	0.4541	9.500	0.4540	8.579	0.4761	9.097	0.4760	9.702	0.4759	8.660
0.4547	8.713	0.4546	9.431	0.4545	8.586	0.4766	9.076	0.4765	9.586	0.4764	8.654
0.4551	8.785	0.4550	9.442	0.4549	8.575	0.4770	8.982	0.4769	9.560	0.4768	8.628
0.4560	8.815	0.4559	9.508	0.4558	8.607	0.4774	9.079	0.4773	9.606	0.4772	8.633
0.4565	8.914	0.4564	9.466	0.4563	8.588	0.4778	9.141	0.4777	9.632	0.4776	8.653
0.4570	8.899	0.4569	9.500	0.4568	8.605	0.4783	8.984	0.4781	9.567	0.4780	8.627
0.4574	8.951	0.4573	9.552	0.4572	8.610	0.4787	9.040	0.4786	9.631	0.4784	8.633
0.4578	8.935	0.4577	9.589	0.4576	8.622	0.4792	8.949	0.4791	9.638	0.4790	8.621
0.4583	8.990	0.4582	9.580	0.4580	8.647	0.4796	8.897	0.4795	9.598	0.4794	8.612
0.4587	8.840	0.4586	9.542	0.4585	8.628	0.4804	8.827	0.4803	9.553	0.4802	8.584
0.4595	8.906	0.4594	9.489	0.4593	8.628	0.4808	8.887	0.4807	9.552	0.4806	8.612
0.4599	8.905	0.4598	9.444	0.4597	8.589	0.4812	8.970	0.4811	9.571	0.4810	8.598
0.4603	8.840	0.4602	9.451	0.4601	8.581	0.4816	8.930	0.4815	9.564	0.4814	8.628
0.4608	8.855	0.4607	9.392	0.4606	8.598	0.4819	8.980	0.4818	9.615	0.4817	8.622
0.4612	8.763	0.4611	9.476	0.4610	8.544	0.4824	9.089	0.4823	9.691	0.4822	8.660
0.4615	8.664	0.4614	9.394	0.4613	8.568	0.4828	9.103	0.4827	9.655	0.4826	8.674
0.4619	8.870	0.4618	9.421	0.4617	8.571	0.4835	9.098	0.4834	9.771	0.4833	8.680

Time = JD - 2 448 804

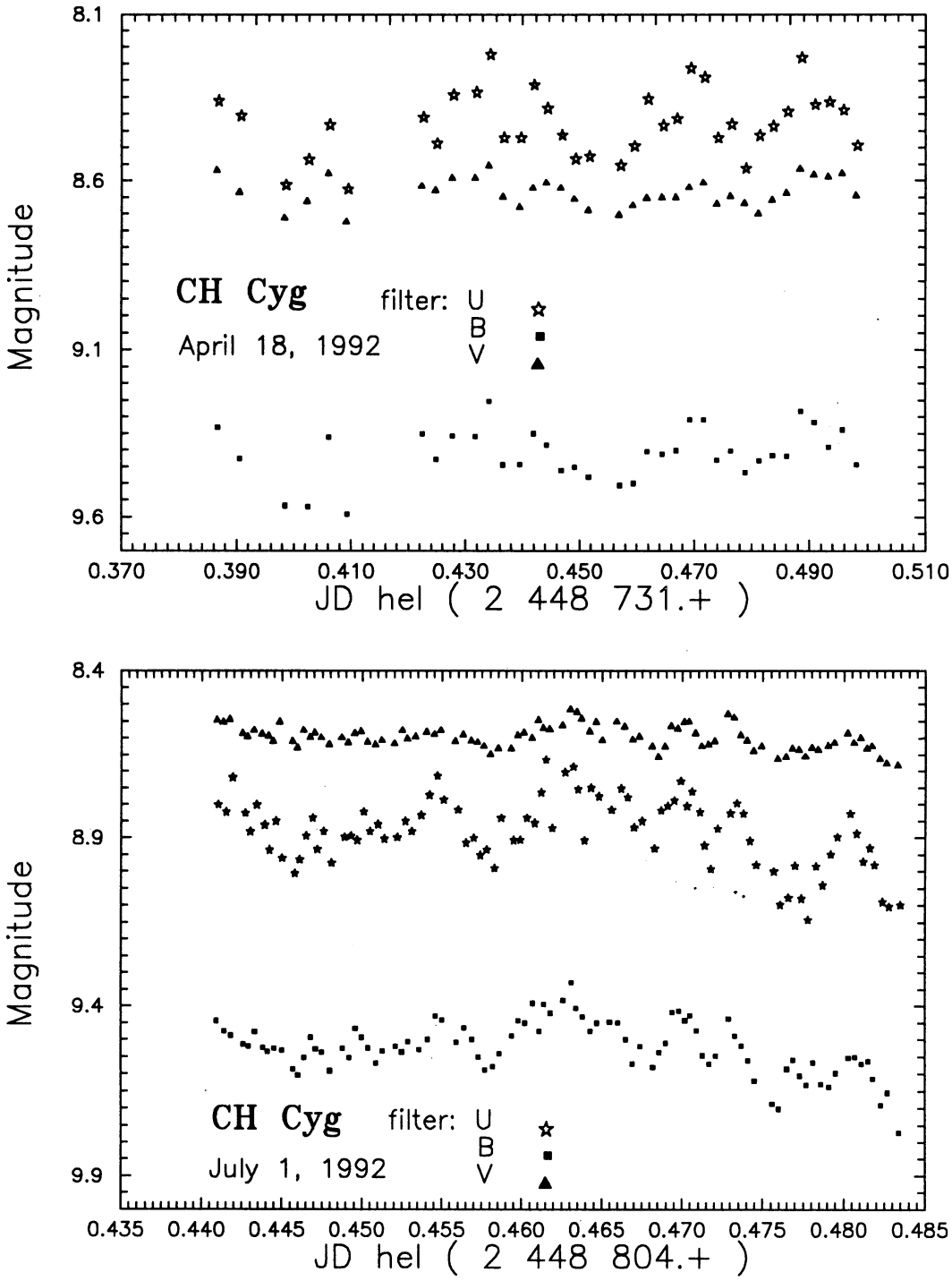


Figure 16. Rapid variations of the CH Cyg brightness

3.9. CI Cygni

The star was observed photoelectrically in 44 individual runs. The results are summarized in Table 12 and shown in Fig. 18.

The visual observations of CI Cyg are displayed in Fig. 17.

Table 12. Photoelectric observations of CI Cyg

Date	JD 2 44. ...	U	B	V	Date	JD 2 44. ...	U	B	V
Aug 20, 84	5933.480	12.120	12.130	10.840	Oct 2, 87	7071.425	12.250	12.270	11.080
Aug 23, 84	5936.468	12.170	12.130	10.870	Oct 9, 87	7078.419	12.320	12.260	11.050
Sep 2, 84	5946.436	12.100	12.140	10.890	May 22, 88	7304.478	11.680	11.890	10.760
Oct 30, 84	6004.283	12.340	12.360	11.020	Jul 10, 88	7353.491	11.640	11.930	10.760
May 27, 85	6212.577		12.420	11.200	Jul 23, 88	7366.455	11.700	11.910	10.770
Jul 5, 85	6251.548	12.080	12.200	11.000	Jul 25, 88	7368.459	11.650	11.920	10.780
Oct 4, 85	6343.302	11.720	11.970	10.800	Sep 15, 88	7420.373	11.860	11.960	10.830
Jun 14, 86	6596.494	11.790	12.060	10.980	Sep 22, 88	7427.382	11.690	11.980	10.830
Jun 26, 86	6607.509	11.740	12.080	11.020	May 19, 89	7665.526	12.310	12.270	10.910
Aug 5, 86	6648.483	11.750	12.040	10.940	May 24, 89	7670.529	12.280	12.300	10.950
Oct 14, 86	6718.439	11.900	12.030	10.880	Jun 19, 89	7696.503	12.370	12.350	11.000
Mar 14, 87	6868.665	12.320	12.290	11.070	Aug 4, 89	7743.482	12.640	12.460	11.040
May 10, 87	6925.546	12.630	12.490	11.180	Aug 23, 89	7762.479		12.670	11.210
May 24, 87	6939.552	12.660	12.460	11.150	Aug 31, 89	7770.440	12.940	12.730	11.260
Jul 6, 87	6982.521	12.600	12.640	11.350	Sep 9, 89	7779.444	12.870	12.700	11.280
Jul 6, 87	6983.415	12.610	12.580	11.320	May 3, 90	8014.559	11.940	12.130	10.910
Jul 12, 87	6989.477	12.690	12.660	11.330	May 27, 90	8038.533	11.750	11.990	10.630
Jul 13, 87	6990.494	12.620	12.550	11.300	Aug 24, 90	8127.522	11.740	11.950	10.730
Jul 14, 87	6991.431	12.450	12.600	11.300	Aug 29, 90	8133.466	11.730	11.990	10.760
Aug 10, 87	7018.450	12.280	12.530	11.320	Aug 30, 91	8499.408	12.290	12.270	10.950
Aug 15, 87	7023.463	12.410	12.530	11.310	Sep 12, 91	8512.433	12.350	12.200	10.790
Aug 31, 87	7039.396	12.320	12.340	11.090	Sep 14, 91	8514.379	12.360	12.160	10.770

Observatory: Sonneberg

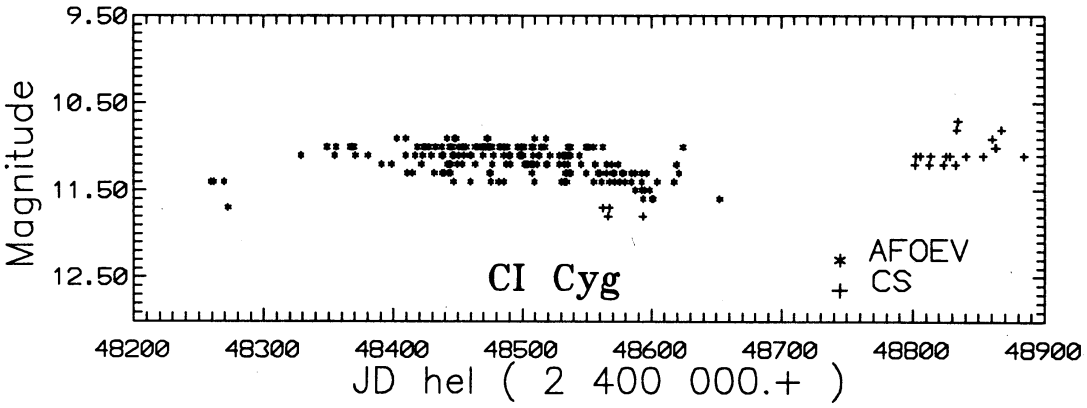


Figure 17. Visual observations of CI Cyg

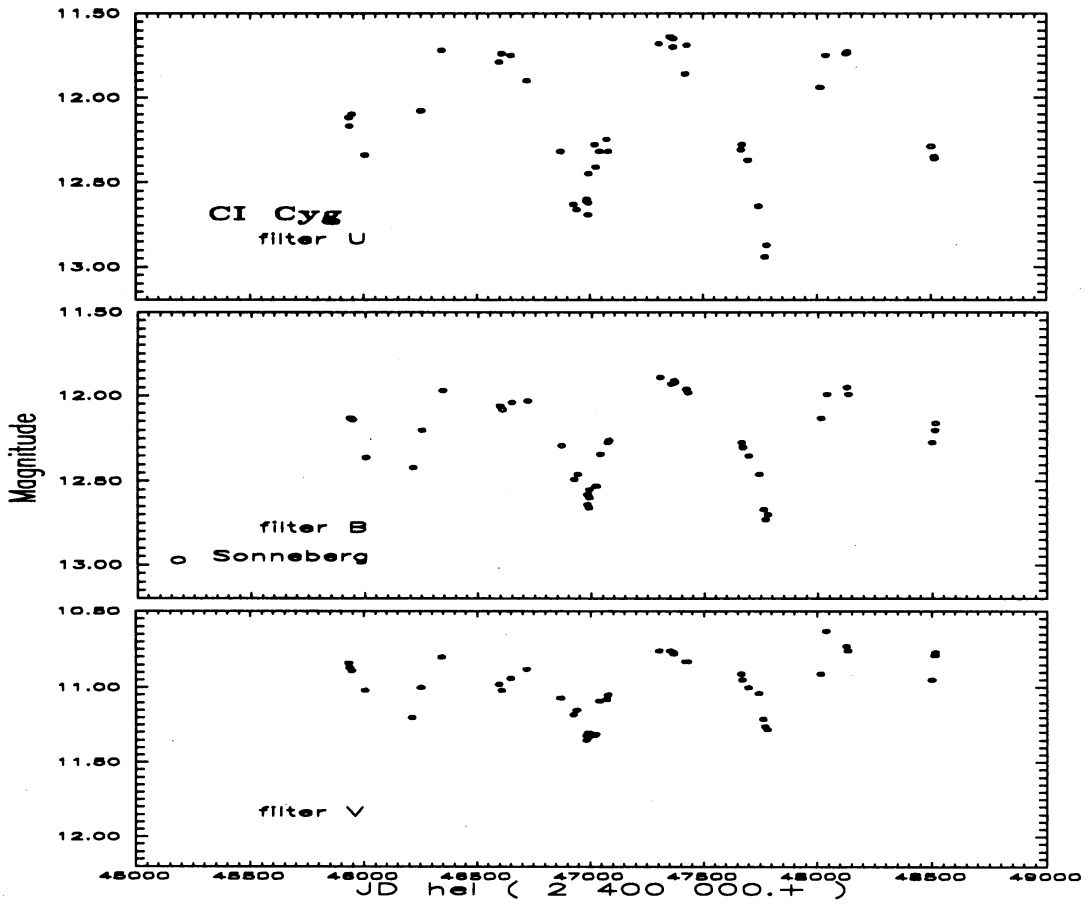


Figure 18. Photoelectric observations of CI Cyg

3.10. V 1016 Cygni

This star was measured photoelectrically on 2 nights. The standard stars S_1, S_2 and S_3 are the same as used in Paper III. The results are compiled in Table 13.

Table 13. Photoelectric observations of V 1016 Cyg

Date	JD 2 44. ...	U	B	V	Δ U	Δ B	Δ V
Dec 2, 91	8593.270	10.559	11.449	10.845	2.116	1.468	1.131
Jul 26, 92	8829.502	10.366	11.449	10.805	2.129	1.463	1.128

S_1-S_3 = *

Observatory: Skalnaté Pleso

The visual observations are shown in Fig. 19.

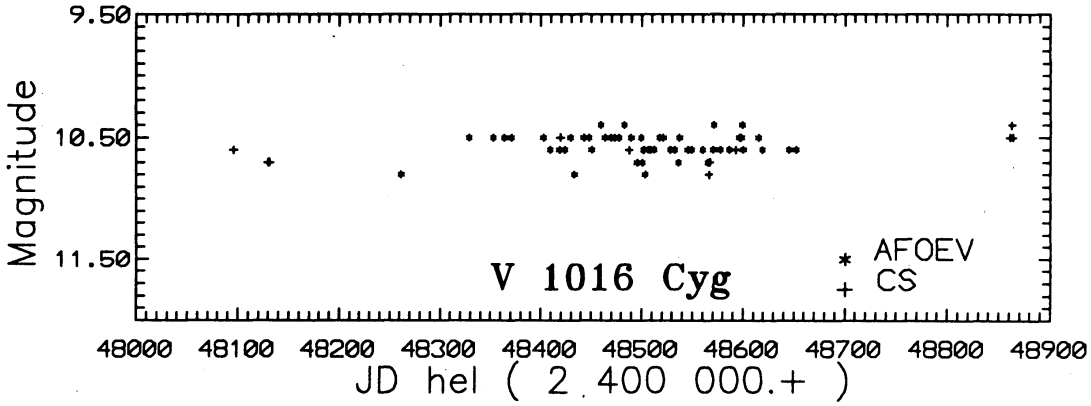


Figure 19. Visual observations of V 1016 Cyg

3.11. AG Draconis

The photoelectric observations were obtained on 193 nights. The standard stars S_1 and S_2 are the same as used in Paper II. The results are summarized in Table 14 and displayed in Fig. 20.

Figure 20. Photoelectric observations of AG Dra

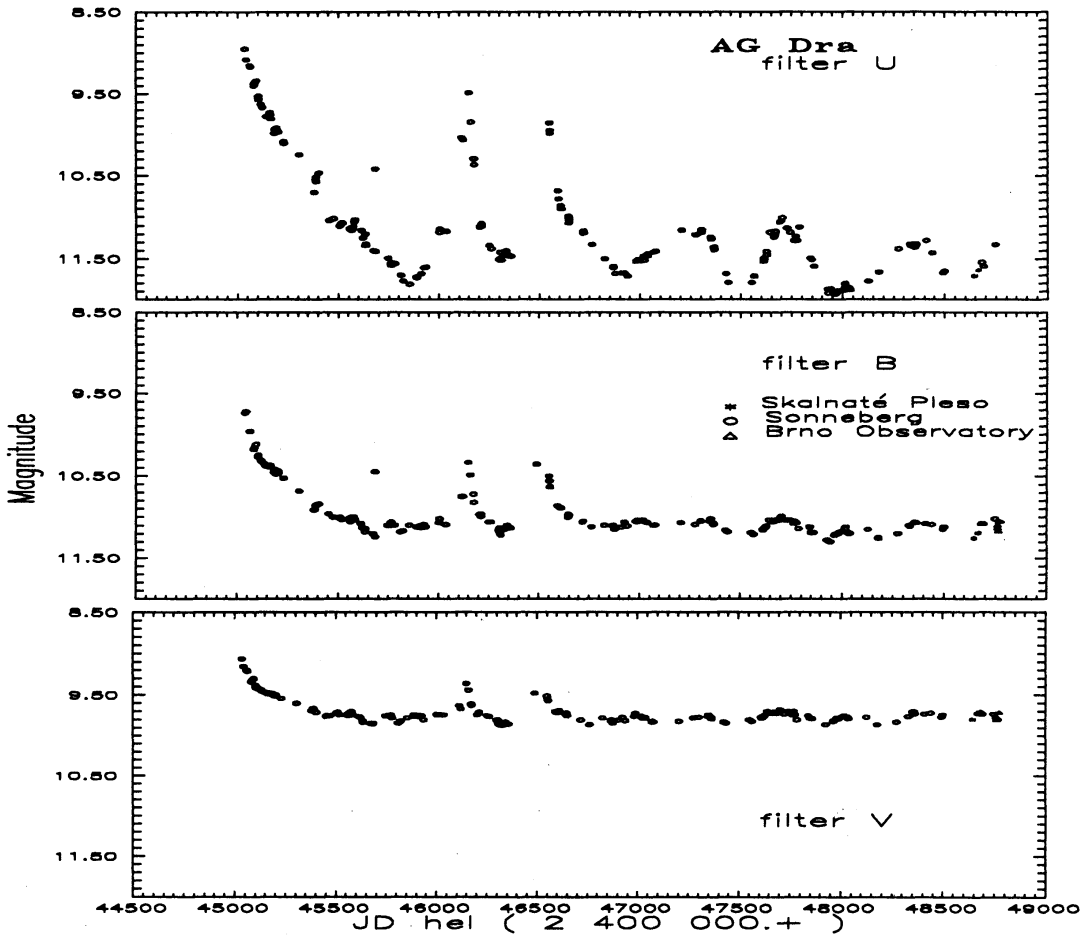


Table 14. Photoelectric observations of AG Dra

Date	JD 2 44. ...	U	B	V	Obs	Date	JD 2 44. ...	U	B	V	Obs
Mar 8, 82	5037.456	8.95	9.74	9.06	S	Oct 28, 84	6002.427	11.18	11.07	9.74	S
Mar 15, 82	5044.454	9.08	9.72	9.15	S	Oct 30, 84	6004.358	11.14	11.02	9.73	S
Apr 1, 82	5061.453	9.15	9.96	9.20	S	Dec 1, 84	6036.337	11.17	11.09	9.74	S
Apr 4, 82	5064.483	9.17	9.96	9.21	S	Feb 17, 85	6113.587	10.04	10.75	9.63	S
Apr 22, 82	5082.492	9.40	10.18	9.34	S	Feb 25, 85	6121.620	10.07	10.75	9.67	S
Apr 25, 82	5085.481	9.37	10.16	9.32	S	Mar 23, 85	6148.401	9.49	10.34	9.36	S
May 3, 82	5093.481	9.34	10.12	9.30	S	Apr 4, 85	6159.514	9.85	10.49	9.44	S
May 14, 82	5103.553	9.53	10.25	9.38	S	Apr 17, 85	6173.425	10.30	10.72	9.61	S
May 15, 82	5104.501	9.57	10.27	9.41	S	Apr 20, 85	6175.508	10.37	10.82	9.63	S
May 26, 82	5116.461	9.63	10.31	9.42	S	May 17, 85	6203.435	11.12	10.97	9.74	S
Jun 2, 82	5123.467	9.67	10.33	9.43	S	May 25, 85	6211.401	11.08	10.96	9.72	S
Jun 10, 82	5130.501		10.35	9.44	S	May 26, 85	6212.410	11.11	10.96	9.72	S
Jun 20, 82	5141.432	9.78	10.38	9.46	S	May 26, 85	6212.456	11.11	10.99	9.71	S
Jul 8, 82	5159.452	9.75	10.39	9.47	S	Jul 4, 85	6251.444	11.34	11.06	9.75	S
Jul 9, 82	5160.413	9.76	10.39	9.48	S	Jul 14, 85	6261.459	11.38	11.06	9.76	S
Jul 10, 82	5161.406	9.73	10.37	9.47	S	Aug 21, 85	6299.371	11.51	11.16	9.80	S
Jul 11, 82	5162.417	9.76	10.37	9.47	S	Aug 27, 85	6305.418	11.42	11.13	9.80	S
Jul 15, 82	5165.542	9.81	10.38	9.49	S	Aug 29, 85	6307.407	11.49	11.19	9.83	S
Aug 1, 82	5183.492	9.99	10.46	9.49	S	Sep 2, 85	6311.419	11.52	11.22	9.86	S
Aug 5, 82	5186.515	9.94	10.42	9.48	S	Sep 19, 85	6327.524	11.45	11.15	9.87	S
Aug 11, 82	5193.481	9.92	10.48	9.50	S	Sep 26, 85	6335.463	11.40	11.13	9.86	S
Aug 13, 82	5194.513			9.51	S	Sep 29, 85	6338.417	11.44	11.13	9.86	S
Aug 21, 82	5203.492	9.96	10.44	9.51	S	Oct 4, 85	6343.462	11.46	11.10	9.83	S
Aug 22, 82	5204.468	9.97	10.47	9.50	S	Oct 20, 85	6359.435	11.47	11.13	9.85	S
Sep 16, 82	5229.483	10.09	10.53	9.54	S	Feb 27, 86	6488.644		10.36	9.48	S
Sep 18, 82	5231.448	10.11	10.53	9.54	S	Apr 29, 86	6550.476	9.86	10.50	9.51	S
Dec 3, 82	5306.587	10.25	10.68	9.60	S	May 2, 86	6552.558	9.95	10.56	9.55	S
Feb 16, 83	5381.542	10.70	10.91	9.69	S	May 3, 86	6553.587	9.99	10.56	9.56	S
Feb 23, 83	5388.535	10.56	10.86	9.67	S	May 4, 86	6555.464		10.63	9.57	S
Feb 24, 83	5389.544	10.52	10.85	9.66	S	Jun 10, 86	6592.400	10.68	10.86	9.70	S
Feb 25, 83	5390.527	10.57	10.85	9.66	S	Jun 14, 86	6596.446	10.78	10.87	9.71	S
Mar 10, 83	5403.506	10.47	10.84	9.71	S	Jun 25, 86	6607.446	10.86	10.89	9.71	S
Apr 27, 83	5452.428			9.76	S	Jun 28, 86	6610.427	10.90	10.89	9.69	S
Apr 28, 83	5453.392	11.04	10.96	9.75	S	Aug 1, 86	6644.384	10.99	10.98	9.74	S
May 20, 83	5474.523	11.02	11.00	9.75	S	Aug 2, 86	6645.420	11.07	11.00	9.72	S
Jun 19, 83	5505.399	11.11	11.01	9.72	S	Aug 3, 86	6646.414	11.03	10.96	9.74	S
Jun 23, 83	5509.436	11.09	11.00	9.71	S	Aug 5, 86	6648.411	11.02	10.98	9.74	S
Jul 2, 83	5518.490	11.07	11.03	9.74	S	Aug 6, 86	6649.388	11.05	10.97	9.75	S
Aug 9, 83	5555.507	11.14	11.02	9.74	S	Oct 14, 86	6718.376	11.17	11.06	9.80	S
Aug 15, 83	5561.501	11.13	11.06	9.75	S	Oct 15, 86	6719.356	11.19	11.05	9.80	S
Aug 19, 83	5566.485	11.16	11.00	9.72	S	Nov 28, 86	6762.679	11.33	11.12	9.86	S
Aug 25, 83	5572.481	11.12	11.00	9.72	S	Jan 31, 87	6826.660	11.50	11.10	9.78	S
Aug 30, 83	5577.438	11.06	11.00	9.70	S	Mar 14, 87	6868.551	11.61	11.11	9.81	S
Sep 5, 83	5583.322	11.03	11.03	9.74	S	Mar 15, 87	6869.541	11.59	11.10	9.80	S
Oct 5, 83	5613.447	11.16	11.08	9.76	S	Mar 23, 87	6877.616	11.68	11.15	9.84	S
Oct 14, 83	5621.581	11.25	11.13	9.77	S	Apr 25, 87	6910.505	11.67	11.12	9.80	S
Oct 24, 83	5632.356	11.20	11.14	9.81	S	May 9, 87	6925.457	11.67	11.06	9.77	S
Oct 26, 83	5634.491	11.34	11.18	9.83	S	May 23, 87	6939.436	11.71	11.11	9.81	S
Oct 27, 83	5635.373	11.32	11.14	9.83	S	Jul 5, 87	6982.409	11.53	11.05	9.76	S
Dec 5, 83	5673.683	11.40	11.20	9.84	S	Jul 12, 87	6989.454	11.53	11.06	9.72	S
Dec 14, 83	5683.000	10.42	10.45	9.85	S	Jul 14, 87	6991.405	11.51	11.03	9.75	S
Dec 16, 83	5684.687	11.41	11.24	9.84	S	Aug 10, 87	7018.397	11.47	11.03	9.75	S
Feb 16, 84	5746.548	11.49	11.10	9.75	S	Aug 15, 87	7023.442	11.52	11.05	9.78	S
Feb 29, 84	5759.599	11.56	11.10	9.75	S	Aug 30, 87	7038.332	11.47	11.06	9.78	S
Mar 2, 84	5761.656	11.55	11.07	9.75	S	Aug 31, 87	7039.338	11.44	11.07	9.77	S
Mar 4, 84	5763.559	11.58	11.06	9.75	S	Oct 2, 87	7071.349	11.42	11.10	9.82	S
Mar 11, 84	5770.524	11.57	11.10	9.74	S	Oct 9, 87	7078.374	11.41	11.10	9.83	S
Mar 20, 84	5780.476	11.56	11.10	9.78	S	Feb 14, 88	7205.681	11.16	11.07	9.82	S
Apr 19, 84	5810.372	11.70	11.18	9.84	S	Apr 24, 88	7276.378	11.21	11.09	9.78	S
May 1, 84	5822.483	11.77	11.17	9.82	S	May 22, 88	7304.449	11.18	11.04	9.77	S
Jun 2, 84	5854.448	11.81	11.10	9.78	S	May 23, 88	7305.452	11.15	11.05	9.77	S
Jul 7, 84	5889.419	11.72	11.12	9.74	S	Jul 6, 88	7349.425	11.24	11.05	9.76	S
Jul 8, 84	5890.390	11.73	11.12	9.76	S	Jul 10, 88	7353.434	11.26	11.02	9.74	S
Jul 23, 84	5905.473		11.11	9.74	S	Jul 23, 88	7366.406	11.36	11.07	9.77	S
Jul 30, 84	5912.412	11.68	11.13	9.76	S	Jul 25, 88	7368.404	11.39	11.09	9.79	S
Aug 13, 84	5926.438	11.61	11.09	9.75	S	Sep 22, 88	7427.355	11.68	11.16	9.83	S
Aug 23, 84	5936.381	11.60	11.12	9.80	S	Oct 4, 88	7438.522	11.79	11.18	9.84	S

Table 14. - continued

Date	JD 2 44. ...	U	B	V	Δ U	Δ B	Δ V	Obs
Jun 16, 89	7694.409			9.72				S
Jun 18, 89	7696.408	11.05	11.01	9.70				S
Jun 25, 89	7703.406	11.01	10.99	9.68				S
Jul 19, 89	7727.420	11.13	11.04	9.73				S
Aug 4, 89	7743.459	11.18	11.03	9.70				S
Aug 24, 89	7763.419	11.28	11.08	9.74				S
Aug 31, 89	7770.420	11.23	11.05	9.70				S
Sep 6, 89	7776.457	11.28	11.07	9.74				S
Sep 17, 89	7787.393	11.12	11.14	9.80				S
Nov 11, 89	7842.417	11.49	11.12	9.75				S
Nov 19, 89	7849.655	11.51	11.19	9.78				S
Dec 1, 89	7861.661	11.59	11.19	9.79				S
Feb 6, 90	7928.548	11.87	11.28	9.86				S
Jan 28, 89	7554.575	11.79	11.19	9.80				S
Feb 9, 89	7566.555	11.71	11.21	9.82				S
Mar 25, 89	7611.433	11.53	11.15	9.77				S
Mar 28, 89	7613.505	11.49	11.16	9.78				S
Mar 31, 89	7616.546	11.50	11.14	9.78				S
Apr 9, 89	7626.463	11.41	11.12	9.75				S
Apr 12, 89	7628.594	11.45	11.11	9.76				S
Apr 25, 89	7642.457	11.18	11.03	9.70				S
May 15, 89	7662.397	11.24	11.06	9.72				S
May 16, 89	7663.464	11.23	11.06	9.72				S
May 21, 89	7668.410	11.21	11.03	9.71				S
May 23, 89	7670.430	11.17	11.04	9.72				S
Jun 13, 89	7691.444	11.06	11.04	9.72				S
Feb 7, 90	7929.545	11.92	11.28	9.86				S
Feb 21, 90	7943.655	11.86	11.30					S
Mar 15, 90	7965.523	11.93	11.22	9.82				S
Mar 18, 90	7968.589	11.92	11.21	9.81				S
Apr 1, 90	7982.581	11.89	11.20	9.78				S
Apr 9, 90	7990.525	11.89	11.18	9.79				S
May 1, 90	8012.501	11.85	11.16	9.76				S
May 1, 90	8013.494	11.80	11.14	9.76				S
May 6, 90	8018.457	11.88	11.12	9.75				S
May 20, 90	8032.427	11.85	11.19	9.77				S
May 27, 90	8039.425	11.88	11.20	9.79				S
Aug 23, 90	8127.391	11.77	11.15	9.77				S
Oct 14, 90	8179.360	11.66	11.26	9.86				S
Jan 18, 91	8274.638	11.38	11.20	9.83				S
Mar 14, 91	8329.621	11.32	11.10	9.76				S
Mar 17, 91	8332.584	11.34	11.11	9.76				S
Apr 7, 91	8353.532	11.36	11.06	9.70				S
Apr 13, 91	8359.508	11.32	11.07	9.71				S
Apr 16, 91	8362.543	11.33	11.07	9.73				S
Jun 1, 91	8409.449	11.28	11.08	9.73				S
Jul 2, 91	8440.476	11.43	11.09	9.72				S
Aug 25, 91	8494.392	11.67	11.15	9.77				S
Aug 31, 91	8500.421	11.65	11.12	9.74				S
Jan 24, 92	8645.568	11.71	11.26	9.79	2.560	0.655	-0.288*	SP
Feb 14, 92	8666.534	11.64	11.20	9.73	2.630	0.648	-0.315*	SP
Feb 28, 92	8681.473	11.54	11.08	9.71				S
Mar 10, 92	8691.610	11.59	11.08	9.73				S
May 4, 92	8747.470	11.33	11.02	9.73				S
May 16, 92	8759.477		11.09	9.76				B1
May 17, 92	8760.377		11.13	9.79				B1
May 20, 92	8763.406		11.17	9.80				B1
May 24, 92	8767.363		11.05	9.78				B1
May 30, 92	8773.408		11.05	9.71				B1

S_1-S_3 = + , S_1-S_2 = *

Obs = observatory : SP - Skalnaté Pleso,
S - Sonneberg, B1 - Brno Obsevatory

The behaviour of the light curve agrees well with the visual observations published in a previous paper (Skopal et al., 1992). The visual observations are shown in Fig. 21.

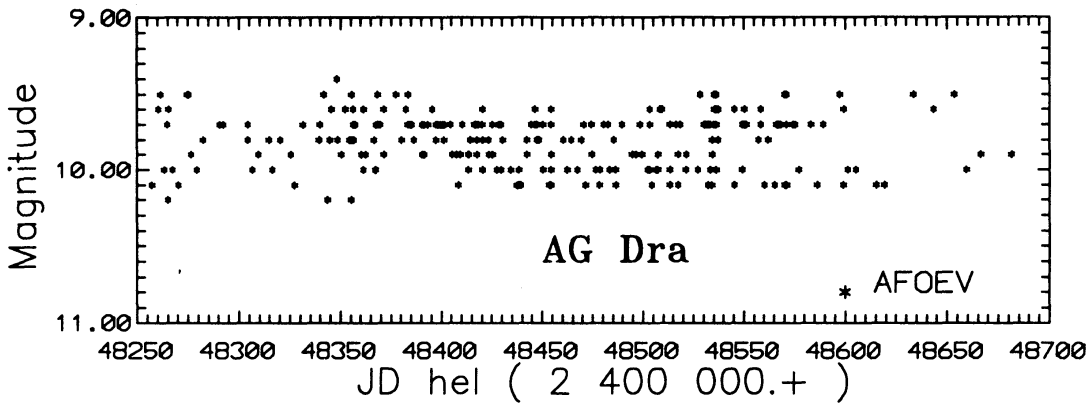


Figure 21. Visual observations of AG Dra

3.12. CQ Draconis (4 Draconis)

The star was measured photoelectrically on 15 nights. The same comparison stars as described in Paper II were used. The results are compiled in Table 15 and depicted, together with all the measurements of the star we have obtained as yet, in Fig. 22. The star showed only erratic variability during the given interval, with the amplitudes and time scales similar to those described in our previous papers. Nevertheless, it seems probable that the brightness of the star has been decreasing monotonically in all three colours during the interval, this phenomenon being most conspicuous in U colour.

Table 15. Photoelectric observations of CQ Dra (= 4 Dra)

Date	JD 2 44. ...	U	B	V	n
Nov 12, 91	8573.432	8.331	6.552	4.973	12
Nov 24, 91	8584.679	8.390	6.555	4.953	16
Dec 2, 91	8592.586	8.338	6.505	4.926	4
Dec 3, 91	8593.626	8.341	6.495	4.897	16
Dec 12, 91	8602.679	8.391	6.553	4.949	24
Jan 24, 92	8645.634	8.334	6.498	4.897	24
Jan 26, 92	8647.617	8.341	6.495	4.892	12
Feb 13, 92	8666.334	8.439	6.616	5.016	24
Mar 11, 92	8692.509	8.374	6.530	4.933	16
Mar 19, 92	8701.444	8.453	6.649	5.047	10
Apr 21, 92	8734.477	8.425	6.567	4.964	12
Apr 24, 92	8737.483	8.446	6.589	4.996	12
Jul 21, 92	8825.429	8.446	6.627	5.028	16
Aug 28, 92	8863.315	8.524	6.685	5.092	8
Sep 18, 92	8883.612	8.456	6.583	4.980	8

Observatory : Skalnaté Pleso

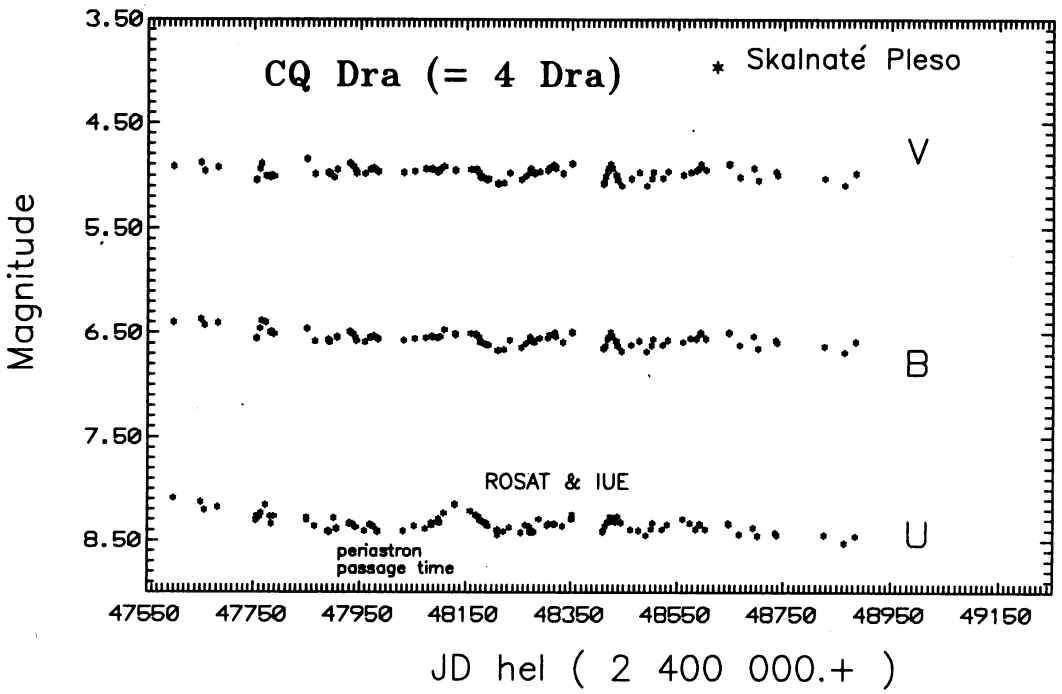


Figure 22. Photoelectric observations of CQ Dra (= 4 Dra)

3.13. YY Herculis

The visual brightness estimates of this star are shown in Fig. 23.

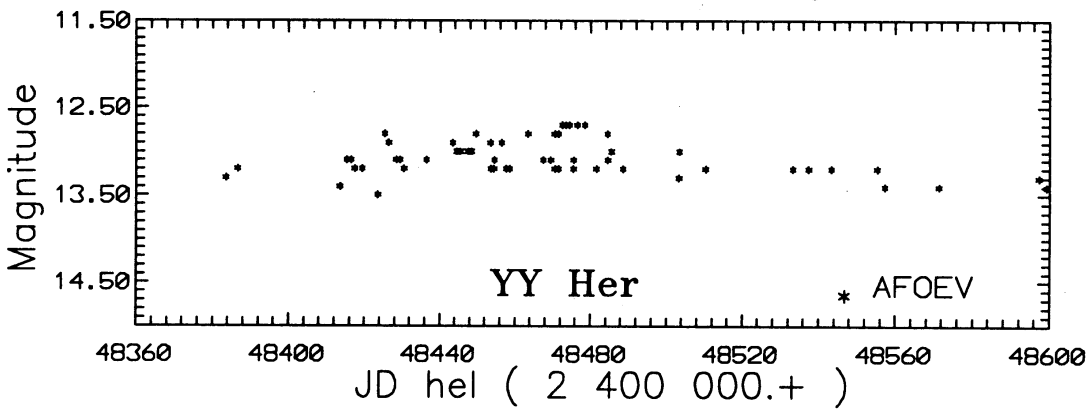


Figure 23. Visual observations of YY Her

3.14. V 443 Herculis

Photoelectric observations of this star were carried out on 2 nights. The standard stars S_1, S_2 are the same as used in Paper II and S_3 is the same as used in Paper III. The results are compiled in Table 16.

Table 16. Photoelectric observations of V 443 Her

Date	JD 2 44. ...	U	B	V	Δ U	Δ B	Δ V
Dec 2, 91	8593.202	11.733	12.296	10.845	5.601	3.285	1.751*
Jul 24, 92	8828.370	11.494	12.334	10.805	2.667	1.952	1.768+

Observatory: Skalnaté Pleso S_1-S_3 = + , S_1-S_2 = *

The photographic photometry includes 19 measurements (Table 17). The results are depicted together with our previous data in Fig. 24. The visual observations are shown in Fig. 25.

Table 17. Photographic observations of V 443 Her

Date	JD 2 44. ...	mag	b	Date	JD 2 44. ...	mag	b
Oct 3, 91	8533.338	12.020	4	Jun 26, 92	8800.481	11.200	2
Oct 7, 91	8537.243	11.620	1	Jun 27, 92	8800.527	10.920	2
Oct 30, 91	8560.229	11.400	2	Jul 9, 92	8812.503	10.980	2
Oct 30, 91	8560.248	11.620	1	Jul 29, 92	8833.406	11.300	2
Feb 29, 92	8681.673	11.100	2	Aug 28, 92	8863.370	11.130	2
Feb 29, 92	8681.680	11.150	2	Aug 28, 92	8863.394	11.000	2
May 1, 92	8744.497	11.320	2	Sep 18, 92	8884.306	11.020	2
May 2, 92	8744.517	10.950	2	Sep 26, 92	8892.311	11.170	2
May 21, 92	8764.438	10.820	2	Sep 26, 92	8892.338	10.900	2
May 29, 92	8772.444	10.920	2				

Sp.bands (b): 1 400-600nm
2 570-650nm
4 Agfa 400 + Panchr.G3

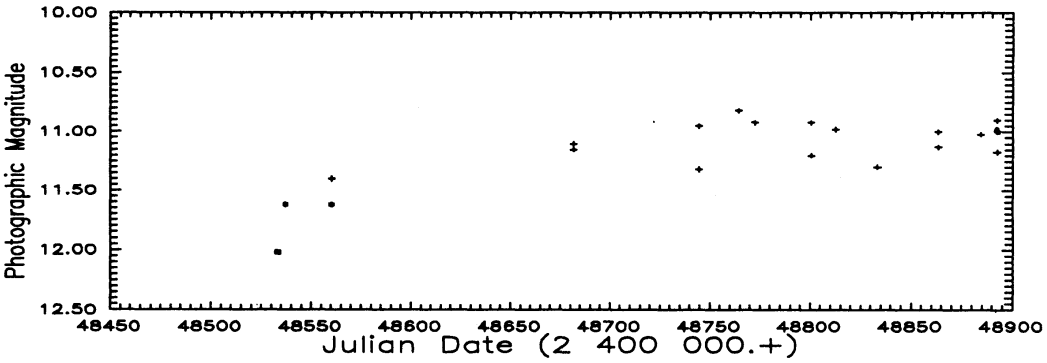


Figure 24. Photographic observations of V 443 Her

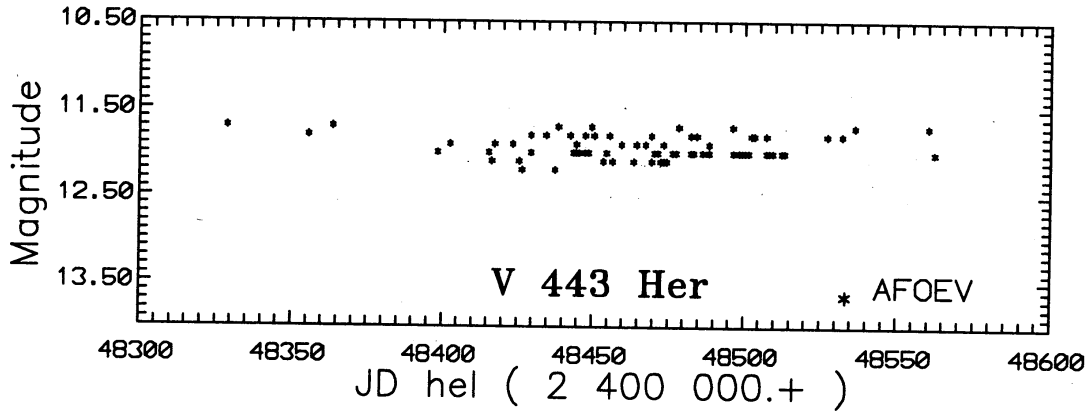


Figure 25. Visual observations of V 443 Her

3.15. SS Leporis

Visual observations are shown in Fig. 26.

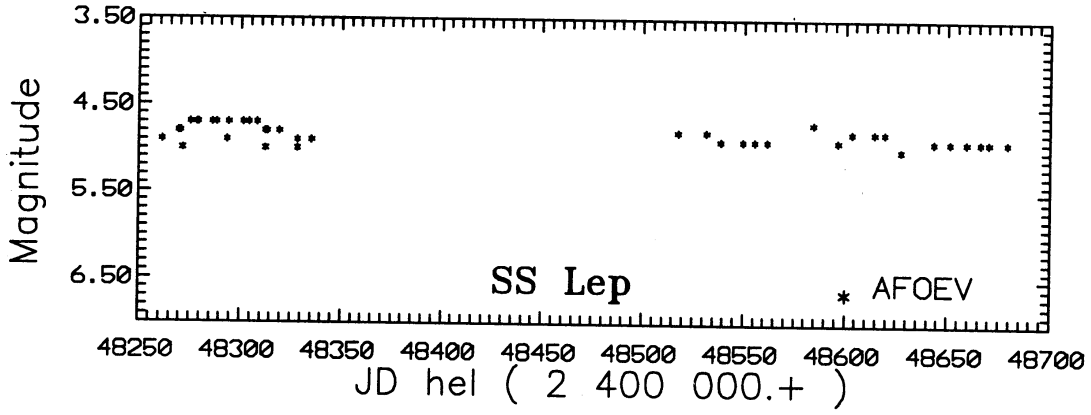


Figure 26. Visual observations of SS Lep

3.16. AG Pegasi

This star was observed photoelectrically on 1 night. The standard stars S_1, S_2 and S_3 are the same as used in Paper III. The result is in Table 18.

The photographic photometry includes 26 measurements (Table 19) which are depicted in Fig. 27.

Table 18. Photoelectric observations of AG Peg

Date	JD 2 44. ...	B	V	Obs
Oct 3, 91	8533.484	9.706	8.603	Kryonerion

The visual observations of AG Pegasi are shown in Fig. 28.

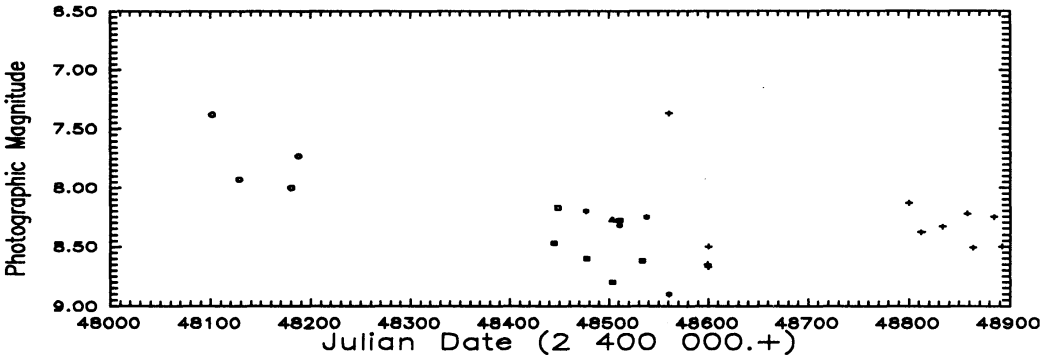


Figure 27. Photographic observations of AG Peg

Table 19. Photographic observations of AG Peg

Date	JD 2 44. ...	mag	b	Date	JD 2 44. ...	mag	b
Jul 28, 90	8101.491	7.380	3	Oct 7, 91	8537.431	8.250	1
Aug 24, 90	8128.410	7.930	3	Oct 30, 91	8560.267	8.900	1
Oct 15, 90	8180.330	8.000	3	Oct 30, 91	8560.279	7.370	2
Oct 22, 90	8187.363	7.730	3	Dec 8, 91	8599.265	8.650	2
Jul 6, 91	8444.480	8.470	4	Dec 9, 91	8600.232	8.500	2
Jul 10, 91	8448.489	8.170	4	Dec 9, 91	8600.245	8.670	2
Aug 8, 91	8476.554	8.200	1	Jun 27, 92	8800.505	8.130	2
Aug 8, 91	8477.416	8.600	4	Jul 8, 92	8812.447	8.380	2
Sep 3, 91	8503.298	8.270	5	Jul 29, 92	8833.441	8.330	2
Sep 3, 91	8503.361	8.800	4	Aug 22, 92	8857.398	8.220	2
Sep 10, 91	8510.364	8.280	4	Aug 28, 92	8863.424	8.510	2
Sep 10, 91	8510.449	8.320	1	Sep 18, 92	8884.355	8.250	2
Oct 3, 91	8533.479	8.620	4	Sep 26, 92	8892.368	8.500	2

Sp.bands (b):
1 400-600nm
2 570-650nm
3 570-680nm
4 Agfa 400 + Panchr.G3
5 Orwo NP-27

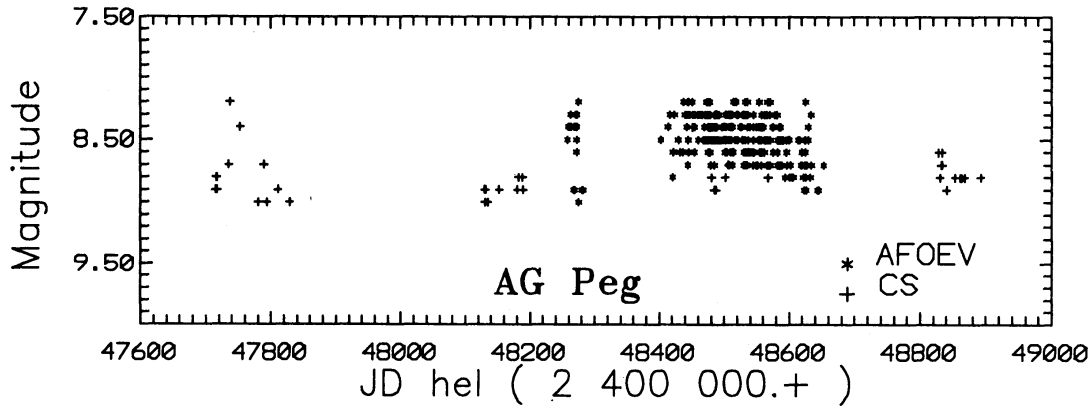


Figure 28. Visual observations of AG Peg

3.17. AX Persei

The photoelectric observations of this star were obtained on 56 nights. The standard stars S_1, S_2 are the same as used in Paper II and S_3 is the same as in Paper III. The results are summarized in Table 20 and depicted in Fig. 29.

Table 20. Photoelectric observations of AX Per

Date	JD 2 44. ...	U	B	V	Δ U	Δ B	Δ V	Obs
Oct 30, 84	6004.464	12.230	12.580	11.410				S
Nov 2, 84	6006.542	12.280	12.610	11.440				S
Dec 1, 84	6036.464		12.700	11.520				S
Sep 26, 85	6334.613	12.500	12.700	11.630				S
Sep 27, 85	6335.579	12.500	12.710	11.610				S
Sep 30, 85	6338.595	12.450	12.700	11.620				S
Oct 21, 85	6359.528	12.430	12.700	11.710				S
Feb 12, 86	6474.350		12.310	11.250				S
Oct 15, 86	6718.540	12.260	12.490	11.490				S
Nov 28, 86	6762.528	11.970	12.240	11.240				S
Nov 29, 86	6764.480	11.860	12.200	11.230				S
Jul 5, 87	6982.449		12.700	11.690				S
Sep 1, 87	7039.568	12.120	12.330	11.280				S
Oct 3, 87	7071.583	11.890	12.180	11.140				S
Oct 10, 87	7078.566	11.790	12.220	11.180				S
Dec 9, 87	7138.547		11.980	10.990				S
Oct 4, 88	7438.545	9.890	10.400	9.810				S
Nov 4, 88	7469.520	10.230	10.800	10.180				S
Feb 8, 89	7566.392	11.120	10.110	10.360				S
Aug 31, 89	7769.613	9.470	9.960	9.420				S
Sep 10, 89	7779.554	9.400	9.790	9.300				S
Sep 19, 89	7788.530	9.230	9.680	9.150				S
Sep 22, 89	7791.549	9.230	9.680	9.180				S
Nov 12, 89	7842.505	9.270	9.700	9.230				S
Nov 17, 89	7847.560	9.190	9.590	9.140				S
Nov 19, 89	7849.545	9.160	9.580	9.130				S
Nov 20, 89	7850.532	9.170	9.580	9.130				S
Nov 20, 89	7851.493		9.570	9.120				S
Nov 29, 89	7859.535	9.210	9.620	9.120				S
Dec 1, 89	7861.521	9.250	9.660	9.170				S
Feb 5, 90	7928.373	9.500	10.000	9.410				S
Feb 6, 90	7929.434	9.590	10.000	9.430				S
Mar 17, 90	7968.390	9.920	10.140	9.480				S
Aug 30, 90	8133.615	10.500	10.900	10.180				S
Sep 17, 90	8151.625	10.690	11.170	10.420				S
Oct 12, 90	8177.499	10.950	11.410	10.690				S
Dec 7, 90	8233.455	12.400	12.810	11.930				S
Jan 14, 91	8271.379		11.710	10.960				S
Sep 1, 91	8500.576	11.280	11.610	10.750				S
Sep 15, 91	8514.546	11.140	11.520	10.630				S
Oct 7, 91	8537.404	11.125	11.666	10.747	3.054	2.414	2.093+	SL
Nov 24, 91	8584.591	11.309	11.711	10.783	3.184	2.480	2.031+	SP
Dec 1, 91	8592.479	10.970	11.390	10.680				S
Dec 3, 91	8593.522	11.182	11.646	10.828	2.901	2.421	2.101+	SP
Dec 11, 91	8602.480	11.116	11.654	10.875	3.111	2.449	2.099+	SP
Jan 3, 92	8625.268	10.997	11.468	10.628	2.904	2.401	2.073+	SL
Jan 11, 92	8633.268	11.072	11.515	10.683	3.060	2.401	2.068+	SL
Jan 22, 92	8644.265	11.096	11.540	10.692	2.987	2.379	2.060+	SL
Jan 23, 92	8645.352	11.090	11.526	10.673	3.024	2.452	2.109+	SP
Feb 13, 92	8666.280	11.191	11.674	10.813	2.907	2.437	2.091+	SP
Feb 28, 92	8681.325	11.262	11.654	10.767	2.982	2.445	2.096+	SP
Mar 7, 92	8689.330	11.271	11.793	10.900	3.100	2.415	2.115+	SP
Mar 9, 92	8691.318	11.274	11.638	10.780	2.944	2.429	2.106+	SP
Aug 18, 92	8853.461	11.830	12.117	11.225	3.114	2.420	2.085+	SP
Sep 17, 92	8883.473	12.445	12.834	11.623	3.018	2.427	2.102+	SP
Sep 27, 92	8893.374	12.640	12.993	11.883	3.006	2.435	2.101+	SP

S_1-S_3 = + , S_1-S_2 = *

Obs = observatory : SP - Skalnaté Pleso, SL - Stará Lesná, S - Sonneberg

The light curves show an outburst with maximum around November, 1989 and 5 minima in all three colours.

The photographic photometry includes 31 measurements (Table 21, Fig. 30). The visual observations are shown in Fig. 31.

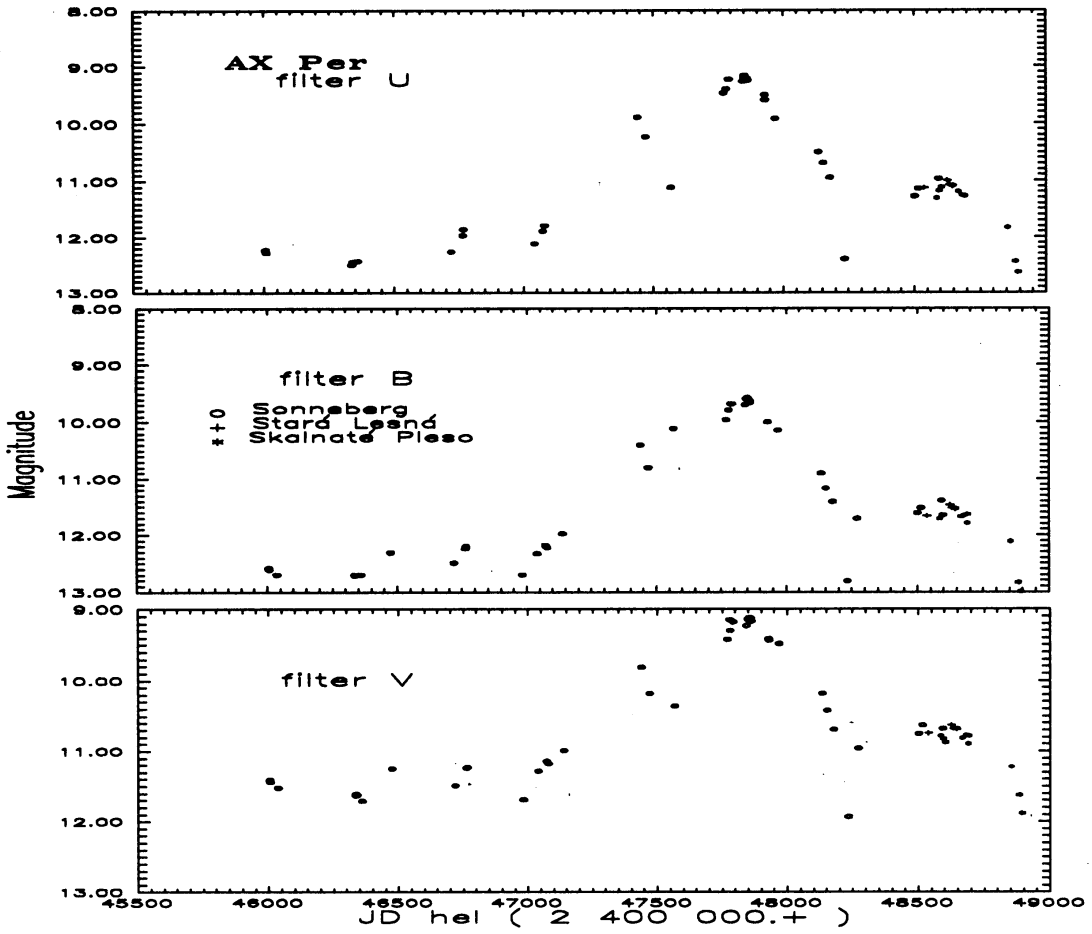


Figure 29. Photoelectric observations of AX Per

Table 21. Photographic observations of AX Per

Date	JD 2 44. ...	mag	b	Date	JD 2 44. ...	mag	b
Sep 6, 89	7776.485	9.350	1	Oct 30, 91	8560.356	10.230	2
Oct 5, 89	7805.408	9.130	1	Dec 9, 91	8600.269	10.030	2
Oct 24, 89	7824.358	9.150	1	Dec 9, 91	8600.372	9.800	2
Nov 29, 89	7860.362	9.330	1	Jan 10, 92	8632.409	9.750	2
Mar 19, 90	7970.292	9.530	1	Jan 24, 92	8646.257	10.900	2
Oct 15, 90	8180.387	9.980	3	Feb 24, 92	8677.271	10.170	2
Oct 22, 90	8187.391	9.930	3	Feb 24, 92	8677.294	9.830	2
Nov 10, 90	8206.336	10.420	3	Feb 26, 92	8679.348	9.530	2
Jan 14, 91	8271.370	9.950	3	Feb 28, 92	8681.348	9.920	2
Jan 19, 91	8276.266	10.050	3	Mar 4, 92	8686.297	9.850	2
Mar 12, 91	8328.315	9.920	3	Jul 9, 92	8812.538	11.020	2
Jul 11, 91	8448.516	10.600	4	Jul 29, 92	8833.492	10.670	2
Sep 3, 91	8503.435	10.250	4	Aug 28, 92	8863.491	10.450	2
Sep 10, 91	8510.454	10.300	4	Sep 18, 92	8884.390	11.100	2
Oct 3, 91	8533.373	10.150	4	Sep 26, 92	8892.412	11.380	2
Oct 30, 91	8560.332	10.150	1				

Sp.bands (b):
1 400-600nm
2 570-650nm
3 570-680nm
4 Agfa 400 + Panchr.G3

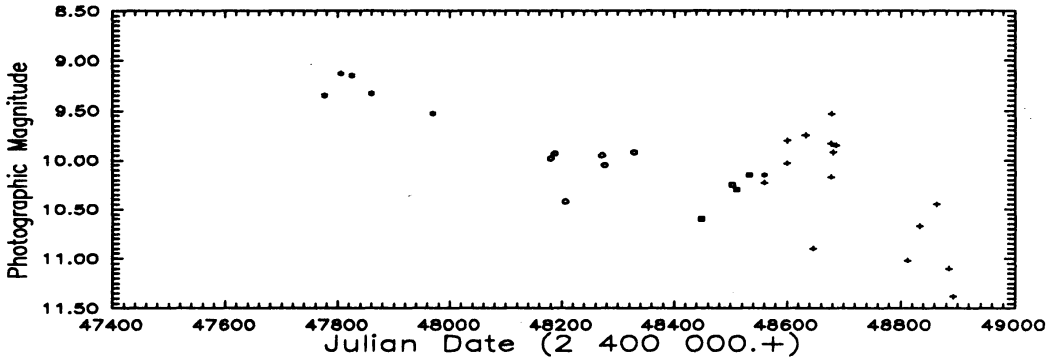


Figure 30. Photographic observations of AX Per

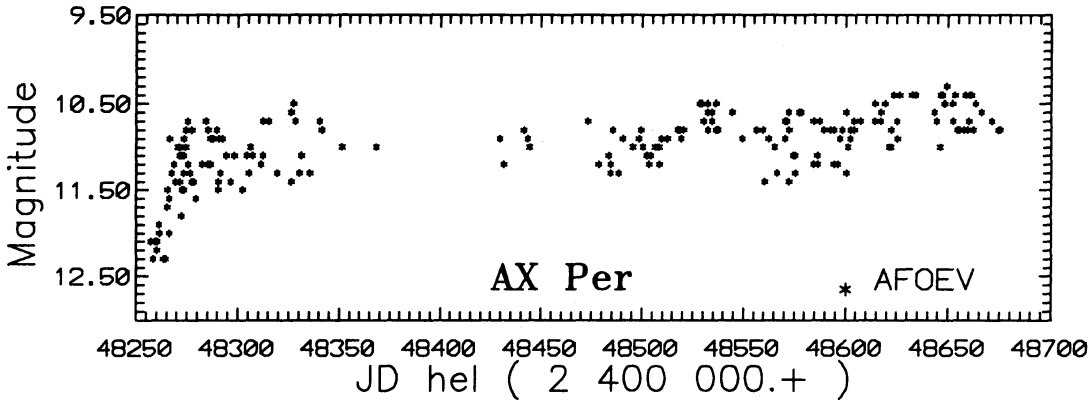
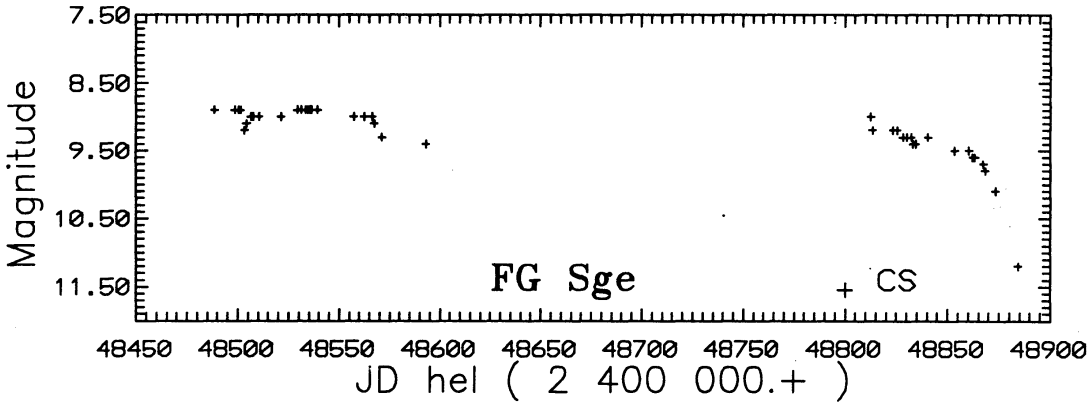


Figure 31. Visual observations of AX Per

3.18. FG Sagittae

Visual observations of this star are shown in Fig. 32. FG Sge probably represents a new symbiotic-like object.

Figure 32. Visual observations of FG Sge



3.19. V 1017 Sagittarii

The visual observations of V 1017 Sgr are shown in Fig. 33.

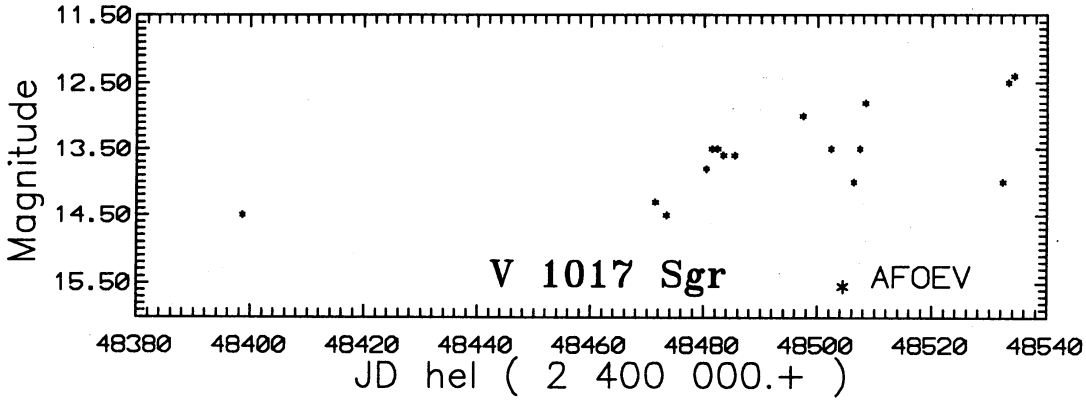


Figure 33. Visual observations of V 1017 Sgr

3.20. FG Serpentis

The visual observations of this star are depicted in Fig. 34.

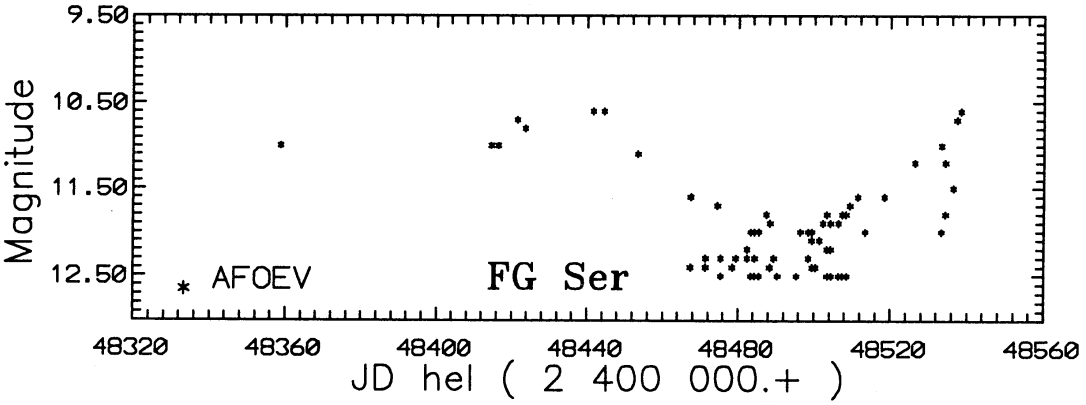


Figure 34. Visual observations of FG Ser

3.21. PU Vulpeculae

The photoelectric observations of PU Vul were made in 23 individual runs. The list of standard stars was presented in Paper II. The results are summarized in Table 22. During our observational period, the brightness of PU Vul slowly decreased.

Table 22. Photoelectric observations of PU Vul

Date	JD 2 44. ...	U	B	V	Δ U	Δ B	Δ V	Obs
Sep 25, 91	8525.307	10.461	11.259	10.972	1.798	-0.288	-1.260+	SL
Oct 1, 91	8531.450	10.550	11.319	10.963	1.730	-0.303	-1.270+	SL
Oct 7, 91	8537.294	10.424	11.213	10.834	1.755	-0.288	-1.264+	SL
Dec 1, 91	8592.197	10.548	11.254	10.961				SP
May 26, 92	8768.550	10.620	11.440	11.340				B2
May 30, 92	8773.490	10.655	11.400	11.280				B2
Jun 4, 92	8777.532		11.332	11.179				K
Jun 5, 92	8778.580		11.333	11.231				K
Jun 27, 92	8800.550	10.670	11.420	11.280				B2
Jun 29, 92	8802.508	10.584	11.444	11.159	1.789	-0.326	-1.419+	SP
Jul 1, 92	8804.570	10.700	11.430	11.130				B2
Jul 9, 92	8812.520	10.660	11.420	11.260				B2
Jul 9, 92	8812.523	10.705	11.354	11.178	3.738	1.413	-0.340*	SL
Jul 9, 92	8813.498	10.766	11.408	11.248	3.726	1.416	-0.348*	SL
Jul 11, 92	8815.431		11.222	11.078				K
Jul 12, 92	8816.365		11.212	11.010				K
Jul 26, 92	8829.536	10.558	11.474	11.164	1.758	-0.351	-1.429+	SP
Jul 28, 92	8832.480	10.683	11.435	11.265				B2
Aug 5, 92	8840.440	10.700	11.460	11.280				B2
Sep 2, 92	8868.400	10.740	11.560	11.440				B2
Sep 17, 92	8883.350	10.730	11.460	11.300				B2
Sep 18, 92	8884.350	10.720	11.470	11.430				B2
Sep 21, 92	8887.360	10.680	11.540	11.460				B2

S_1-S_3 = + , S_1-S_2 = *

Obs = observatory : SP - Skalnaté Pleso, SL - Stará Lesná, B2 - Brno University, K - Kryonerion

3.22. AS 338, AS 360, MWC 560, GH Gem, He 24-67

The visual observations of these stars are shown in Fig. 35 & Fig. 36.

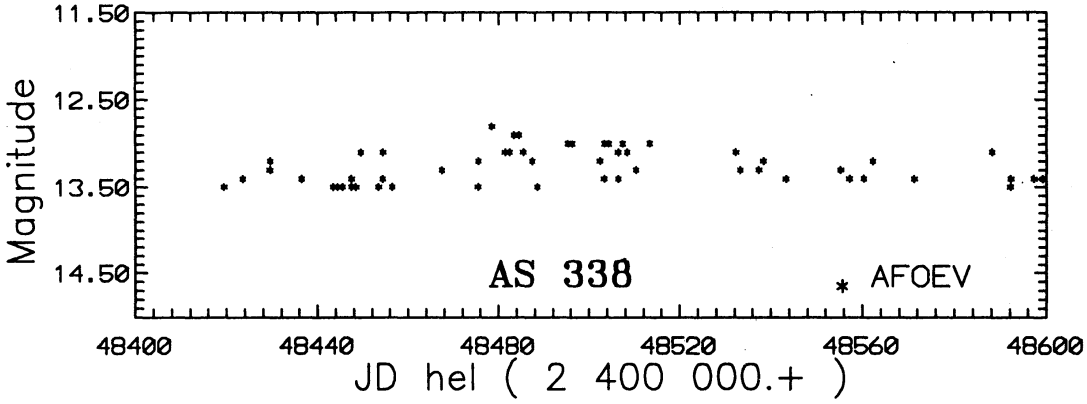


Figure 35. Visual observations of AS 338

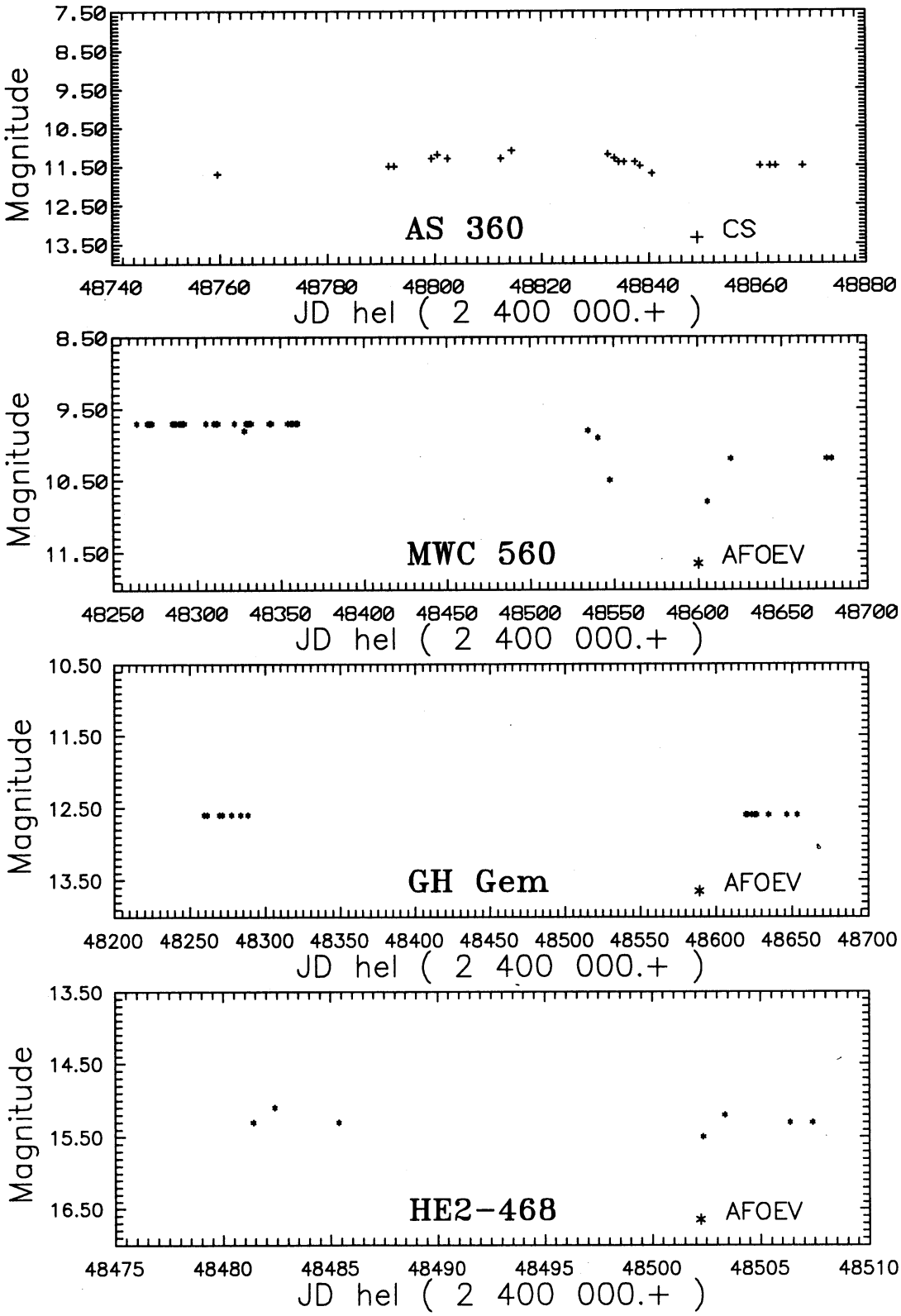


Figure 36. Visual observations of AS 360, MWC 560, GH Gem, He2-468

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Erratum. In the last paper of this series (Paper III), in Table 8. Photoelectric Observations of BF Cygni (page 146) the right values of the U magnitudes on 25 Oct 91 and 29 Oct 91 are 10.338 and 10.410, respectively. This error was caused by misprint during the preparation.

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