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Recent photometry of symbiotic stars – XIII⋆

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We present new multicolour ($UBVR_CI_C$) photometric observations of classical symbiotic stars, EG And, Z And, BF Cyg, CH Cyg, CI Cyg, V1329 Cyg, TX CVn, AG Dra, Draco C1, AG Peg and AX Per, carried out between 2007.1 and 2011.9. The aim of this paper is to present new data of our monitoring programme, to describe the main features of their light curves (LC) and to point problems for their future investigation. The data were obtained by the method of the classical photoelectric and CCD photometry.

1 Introduction

Symbiotic stars are interacting binary systems comprising a cool giant as the donor star and a compact star, mostly a white dwarf, as the accretor. The accretion process from the giant's wind heats up the accretor to $T_{\rm acc} \gtrsim 10^5$ K and makes it as luminous as $L_{\rm acc} \approx 10^2 - 10^4\,L_\odot$. Such the hot and luminous source of radiation ionizes the circumstellar matter in the binary giving rise to a strong nebular emission. This basic composition of symbiotic binaries, containing radiative sources of extremely different temperatures makes the symbiotic phenomenon observable within a very large range of the electromagnetic spectrum, from X-rays to the radio. This general view have been originally pointed out by, e.g., Boyarchuk (1967), Allen (1984), Kenyon (1986), Nussbaumer & Vogel (1987) and most recently was discussed during the Asiago workshop on symbiotic stars (Siviero & Munari, 2011).

During *quiescent phase*, when the symbiotic system releases its energy approximately at a constant rate and temperature, the symbiotic nebula is represented predominantly by the ionized fraction of the wind from the giant (e.g. Seaquist et al. 1984). A typical signature of the quiescent phase is a wave-like orbitally related variation in the LCs. Originally, Boyarchuk (1966), Belyakina (1970a) and Kenyon (1986) suggested a reflection/heating effect as being responsible for this type of the light variability. Later, Skopal (2001) interpreted the wave-like variability within the ionization model of symbiotic stars during quiescent phases. According to Skopal (2006), during *active phases*, the enhanced wind from the hot star becomes a vital source of the nebular radiation in the system. In addition, an optically thick warm ($1 - 2 \times 10^4$ K) source develops during the active phases around the hot star (e.g. Kenyon & Webbink, 1984; Skopal, 2005a). Location of both the radiative sources in the vicinity of the hot star makes them a subject to the eclipse by the giant in highly inclined orbits. As a result, narrow minima (eclipses) can be observed in the LC (e.g. Belyakina 1979).

The observed spectrum of symbiotic stars composes of three basic components of radiation – two stellar and one nebular. Their contributions in the optical rival each other and are different for different objects and variable due to activity and/or the orbital phase (see Figs. 2–22 of Skopal, 2005a). Therefore, the LCs of symbiotic binaries bear a great deal of information about properties of the radiative sources in the system. Their disentangling into the individual components of radiation aid us in understanding responsible physical processes acting in these systems (Cariková & Skopal, 2010; Fig. 8 of Skopal et al. 2011). They represents an important complement to observations carried out at other wavelengths, from X-rays to the radio. Their systematic monitoring plays an important role in discoveries of unpredictable outbursts of symbiotic stars, providing thus an alert for observation with other facilities.

In this paper we present results of our long-term monitoring programme of photometric observations of selected symbiotic stars, originally launched by Hric & Skopal (1989). It continues the work of Skopal et al. (2007, hereafter Paper I) by collecting new data obtained during the period

⋆ Tables 2-16 are available at the CDS via http://cdsarc.u-strasbg.fr/cgi-bin/qcat?J/AN/333/242 or http://www.ta3.sk/~astrskop/symbphot/

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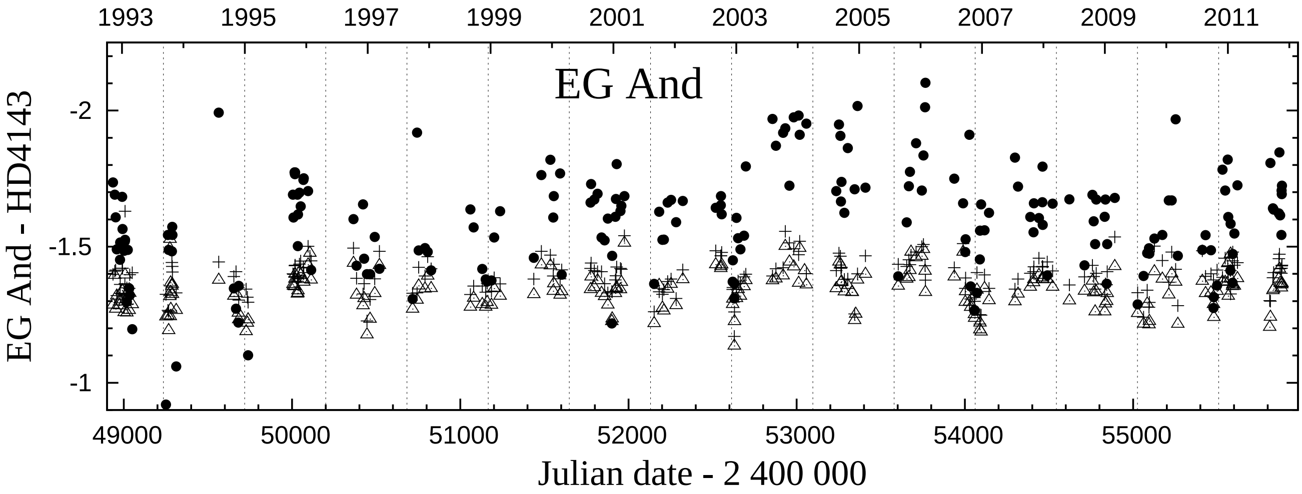

Fig. 1 $\Delta U(\bullet)$, $\Delta B(\triangle)$, $\Delta V(+)$ light curves of EG And from 1993. Vertical dotted lines mark times of the inferior conjunction of the giant according to the ephemeris (1). Data are from Table 2 and previous papers of this series (see Paper I and references therein).

2007 January to 2011 November. Their acquisition and reductions are introduced in Sect. 2. In Sect. 3 we describe the most interesting features of the LCs that deserve further investigation. Conclusions are found in Sect. 4.

2 Observations and reductions

Photoelectric *UBV* observations were carried out by single-channel photometers at the Skalnaté Pleso and Hvar observatories. The photoelectric measurements were done in the *UBV* filters of the Johnson's photometric system with a 10 second integration time. Observations made at the Skalnaté Pleso observatory was described by Skopal et al. (2004).

At the Hvar observatory, classical photoelectric *UBV* observations were carried out by a single-channel photometer mounted in the Cassegrain focus of a 0.65-m reflector. The measurements were carefully reduced to the standard Johnson system via non-linear transformation formulae (Harmanec et al. 1994) using the latest release 17 of the program HEC22 [1]

CCD photometry was obtained at the Stará Lesná and the National Astronomical Observatory Rozhen, Bulgaria. At the Stará Lesná observatory, the SBIG ST10 MXE CCD camera with the chip 2184×1472 pixels and the $UBV(RI)_C$ Johnson-Cousins filter set were mounted at the Newtonian focus of a 0.5-m telescope. The size of the pixel is 6.8 μm and the scale 0.56″/pixel, corresponding to the field of view of a CCD frame about of 24×16 arcmin.

At the Rozhen observatory, CCD observations were made mostly with the 50/70/172 cm Schmidt telescope. A CCD camera SBIG ST-8 and a Johnson-Cousins set of filters were used. The chip of the camera is KAF 1600 (16 bit), with dimensions of 13.8×9.2 mm or 1530×1020 pixels. The pixel size is 9×9 μm and the scale 1”.1/pixel. The readout noise was 10 ADU/pixel and the gain 2.3 e-/ADU. All frames were dark subtracted and flat fielded. Photometry was made with DAOPHOT routines. Observations of V1329 Cyg and Draco C1 in the standard Johnson-Cousins system were made with the VersArray 1300 B CCD camera (1340 × 1300 px, pixel size: 20 μm ×20 μm, scale: 0.258 arcsec/px) on the 2-m and 1.3-m telescopes.

Fast CCD photometry was performed at the Stará Lesná observatory (CH Cyg) and at the Astronomical Observatory on the Kolonica Saddle (Z And) with a WATEC 902-H2/FLI PL1001E CCD camera with the chip 1024x1024 pixels attached to the Ritchey-Chretien telescope 300/2400 mm. The scale was 2.06″/pixel corresponding to the field of view of a CCD frame about of 35.2×32.5 arcmin.

We measured our targets with respect to the same standard stars as in our previous papers (Paper I and references therein). For a better availability, we summarize them here in Table 1. Results are summarized in Tables 2–16 and shown in Figs. 1–16. Each value represents the average of the observations during a night. This approach reduced the *inner* uncertainty of this night-means to of a few times 0.01 mag in the *B*, *V*, R_C and I_C bands, and up to 0.05 mag in the *U* band.

3 Light curves of the measured objects

3.1 EG And

EG And is a bright symbiotic binary (V∼ 7.5), whose optical spectrum is dominated by the radiation from the cool giant (see Fig. 2 of Skopal, 2005a). It contains a low-luminosity white dwarf powered by the accretion from the giant's wind

[1] The whole package containing the program HEC22 and other programs for complete photometric reductions, sorting and archiving the data, together with a very detailed User manual, is freely available at *http://astro.troja.mff.cuni.cz/ftp/hec/PHOT.*

Table 1 Magnitudes of the comparison stars used for our targets

Name	V	$B-V$	$U-B$	$V-R_C$	$V-I_C$	Table	Refs.
Comparison stars in the field of EG And							
HD 4143	8.574	1.540	1.965	0.819	1.578	2,11	1
HD 3914[a]	7.00	0.44	–	–	–	2,11	2
HD 4322[a]	7.55	0.47	–	–	–	2,11	2
Comparison stars in the field of Z And							
SAO 53150	8.985	0.410	0.138	0.091	–	3	3
SAO 53150	9.082	0.392	0.095	0.292	0.494	4[b],11	1
SAO 53133[a]	9.169	1.360	1.106	–	–	3	3
SAO 53133[a]	9.229	1.320	1.229	0.744	1.425	11	1
Comparison stars in the field of BF Cyg							
HD 183650	6.96	0.71	0.34	–	–	5	2
BD+30 3594[a]	9.54	1.20	1.70	–	–	5	2
TYC 2137-847-1[c]	11.159	0.290	0.091	0.173	0.381	6	1
Comparison stars in the field of CH Cyg							
HD 183123	8.353	0.479	-0.025	0.312	–	7	4
HD 182691[a]	6.525	-0.078	-0.240	0.000	–	7	2
BD+49 3005	9.475	0.546	0.079	0.349	0.642	8,11	1
Comparison stars in the field of CI Cyg							
HD 187458	6.660	0.426	-0.056	–	–	9	5
HD 226107[a]	8.638	-0.053	-0.314	–	–	9	6
TYC 2861-1332-1	11.722	0.274	0.198	0.159	0.332	10,11	1
Comparison star in the field of V1329 Cyg							
”b”	12.092	1.353	1.285	0.724	1.370	11	1
Comparison stars in the field of TX CVn							
SAO 63223	9.36	0.30	0.03	–	–	12	2
SAO 63189[a]	9.18	0.38	-0.07	–	–	12	7
BD+37 2314	11.335	1.018	0.873	0.555	1.014	11	8
Comparison stars in the field of AG Dra							
SAO 16952	9.88	0.56	-0.04	–	–	13	2
SAO 16935[a]	9.46	1.50	1.89	–	–	13	7
TYC 4195-369-1	10.459	0.559	0.015	0.333	–	11,14	1
”b”	11.124	0.734	0.183	0.416	0.746	11,14	1
”c”	11.699	0.545	-0.042	0.335	0.629	11,14	1
Comparison stars in the field of Draco C1							
”4”	15.363	0.965	0.620	0.517	0.998	11	9
”7”	17.447	0.791	0.298	0.465	0.895	11	9
”9”	17.974	1.007	0.309	0.585	1.166	11	9
”11”	19.339	0.784	0.114	0.445	1.014	11	9
”12”	19.787	0.800	–	0.407	1.050	11	9
Comparison stars in the field of AG Peg							
HD 207933	8.10	1.05	0.97	–	–	15	2
HD 207860[a]	8.73	0.42	–	–	–	15	2
TYC 1130-577-1	10.428	0.631	0.178	0.374	0.682	11	1
LP 518-54	10.672	0.832	0.528	0.508	0.938	11	1
Comparison stars in the field of AX Per							
BD+54 331	7.427	1.016	0.632	–	–	16	2
BD+53 340[a]	9.482	1.369	1.199	–	–	16	7
TYC 3671-791-1	10.201	0.089	-0.177	0.023	0.066	11	1
β	11.156	1.167	0.993	0.608	1.139	11	1

Refs.: 1 – Henden & Munari (2006), 2 – Blanco et al. (1970), 3 – Skopal et al. (2000a), 4 – Skopal et al. (2000b), 5 – Harmanec et al. (1994), 6 – this paper, 7 – Skopal et al. (2004), 8 – Henden & Munari (2001), 9 – Henden & Munari (2000)
[a] – a chech star, [b] – for R_C, I_C filters, [c] – variable star of δ Sct type

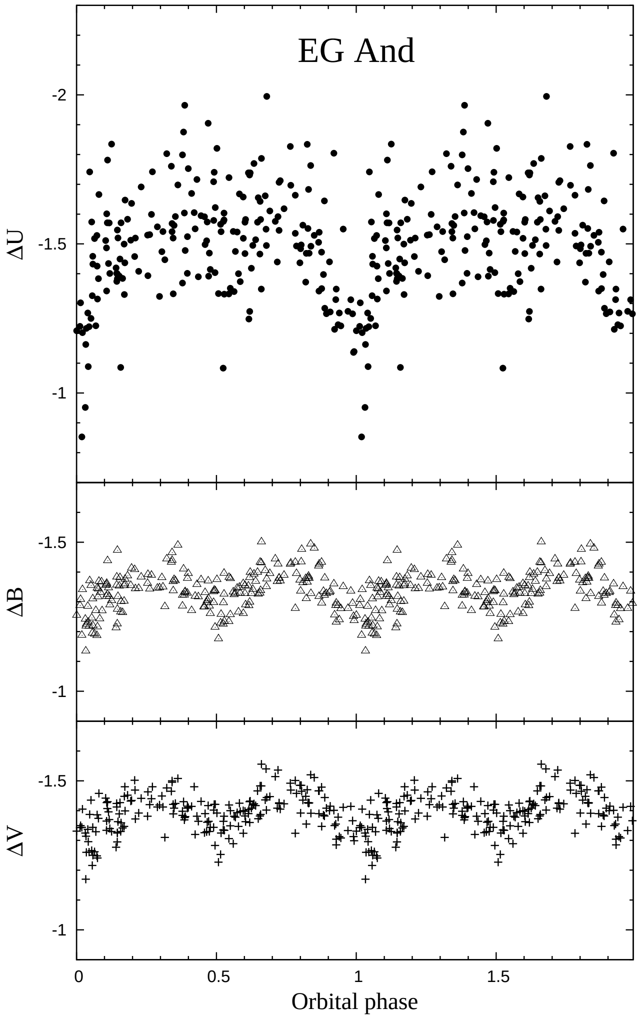

Fig. 2 Phase diagrams for the data in Fig. 1 folded with the ephemeris (1).

at a rate of a few times $10^{-8}\,M_{\odot}\,\mathrm{yr}^{-1}$ (Skopal, 2005b). To date, no outburst has been recorded. EG And is the eclipsing binary, whose eclipses can be measured in the far-UV, where the hot star dominates the spectrum (e.g. Vogel, 1991; Pereira, 1996; Crowley et al. 2008). It is a near star (d = 0.59 kpc, Skopal, 2005a) with a small interstellar absorption on the line of sight to it ($E_{\mathrm{B-V}}$ = 0.08, Mürset et al. 1991). It is bright in the far-UV, containing a strong HeII 1640 Å emission line, when viewing the binary from its hot component (e.g. Crowley et al. 2008). These properties makes EG And a good target for the X-ray detection around the orbital phase 0.5.

New photometric measurements are listed in Tables 2 and 11. Figure 1 shows evolution in the *UBV* LCs during the last 18 years, from 1993. Basically, two main types of the brightness variations can be recognized. A very slow brightening in *U* on the time-scale of years with a maximum between 2003 and 2007, and shorter variations indicated on the time-scale of the orbital period (see Fig. 1). To demonstrate the orbitally-related variation, we folded the data from Fig. 1 into a phase diagram according to the ephemeris of the inferior conjunction of the giant (Fekel et al. 2000),

$$JD_{\mathrm{sp.\ conj.}} = 2\,450\,683.2(\pm 2.3) + 482.57(\pm 0.53) \times E. \quad (1)$$

Figure 2 shows the result. The *B* and *V* band LCs display two waves throughout the orbit with the minima around the giant's conjunctions, while the secondary minimum in *U* is only putative due to a large scatter in the data. Wilson & Vaccaro (1997) interpreted this LC profile in the *B* and *V* band by the ellipsoidal distortion of the cool giant filling its Roche lobe. However, Jurdana-Šepić & Munari (2010), using 257 photographic measurements of EG And between 1958.7 and 1993.0, did not find a pronounced minimum around the phase 0.5 in the *B* LC (see their Fig. 4). Therefore they preferred an irradiation effect to the ellipsoidal distortion of the giant as a possible cause of the LC profile along the orbit. However, the problem is more complex, because of an intrinsic variability of both the giant and the nebula, which affects significantly the LC profile (Fig. 2).

(i) Variations from the nebula are measured mainly in the *U* band, where the nebular continuum dominates the spectrum. The scatter in the observed data is as large as ~0.5 mag, far beyond their uncertainties. A putative secondary minimum around the phase 0.5 can be caused by a partially optically thick nebula between the binary components as proposed by Skopal (2001) for this type of the variability seen in LCs of symbiotic stars (see also Skopal, 2008). It is of interest to compare the phase diagram for the *U* magnitudes obtained before ~ 1993, where the secondary minimum in *U* was much more pronounced (see Fig.1 of Skopal (1997)).

(ii) Intrinsic variability of the giant is best indicated in the phase diagrams of the *B* and *V* LC, where a shift of ≈ 0.1 mag is measured between the data obtained at the same orbital phases, but different orbital cycles (Fig. 2). Therefore, to understand the LC profile of EG And, the intrinsic variation of the giant and the nebula has to be subtracted to isolate the net effect causing the double-wave variability throughout the orbit.

Additional problem in explaining the LC behaviour is connected with finding by Jurdana-Šepić & Munari (2010), whose archival data between 1958 and 1993 suggested a 479.28-day orbital period. This value is by ~ 3.3 days shorter than the preset value derived from a more recent data (Fekel et al. 2000). A detailed analysis in this respect with the aim to identify possible real change of the orbital period should be performed.

Finally, with respect to the above mentioned results and problems, a future work should continue mainly the monitoring the stars's brightness in the *U* band. To understand the fast variability in *U*, we also suggest to continue the X-ray observations (see Mürset at al. 1997) around the orbital phase 0.5.

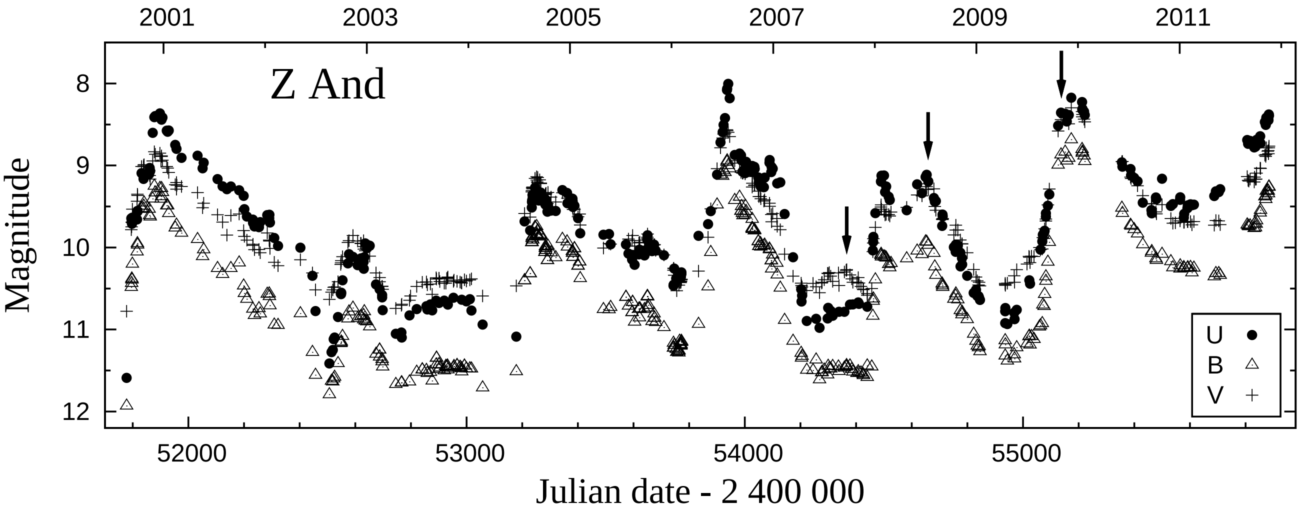

Fig. 3 The *UBV* light curves of Z And covering its recent active phase from 2000.7. New data are from 2007.115. Arrows mark dates, when the high-time-resolution photometry was performed (Fig. 4).

3.2 Z And

Z And is considered a prototype symbiotic star. Its historical light curve from 1900 was recently discussed by Leibowitz & Formiggini (2008). The current active phase of Z And started from 2000 September (Skopal et al. 2000a), and continues to the present in a form of around one-year-lasting bursts with brightening by 1-3 mag in *U* (e.g. Tomov et al. 2004; Sokoloski et al. 2006; Skopal et al. 2006; Fig. 3).

Our new photometry of Z And is listed in Tables 3, 4 and 11. Figure 3 shows *UBV* LCs from its recent active phase from 2000. The star BD+47 4192 was used as the comparison. We adopted its brightness and colours within the *UBV* bands as in the Paper I, while for the R_C and I_C filters we used colours according to Henden & Munari (2006) (i.e. V = 8.985, $B - V$ = 0.410, $U - B$ = 0.138, $V - R_C$ = 0.195, $R_C - I_C$ = 0.202).

New observations revealed two new eruptions. The first one appeared during 2008 with two peaks in January and July ($U \sim 9.2$). After the second maximum, the star's brightness was decreasing to 2009 May ($U \sim 10.9$). The second major eruption began in 2009 August and peaked during 2009 December to 2010 January at $U \sim 8.2$. Then a fading to 2011 January ($U \sim 9.6$) and a slow gradual increasing to our last observations ($U \sim 8.5$ on 2011/11/18) was indicated.

We also performed a high-time-resolution photometry (Fig. 4). During a low-level stage of the star's brightness, we indicated only a noise-like fluctuations within 0.02 mag, which was comparable to that of the standard star during the night on 2007/09/21. During the smaller, 2008 burst, we observed light variations within an interval of $\Delta m \sim 0.025$ mag on the time-scale of 1–2 hours, whereas at the maximum of the major 2009 outburst, the light variations increased in the amplitude to $\Delta m \sim 0.065$ mag, and enlarged its time base to 7–9 hours, throughout the whole night. Here we point that

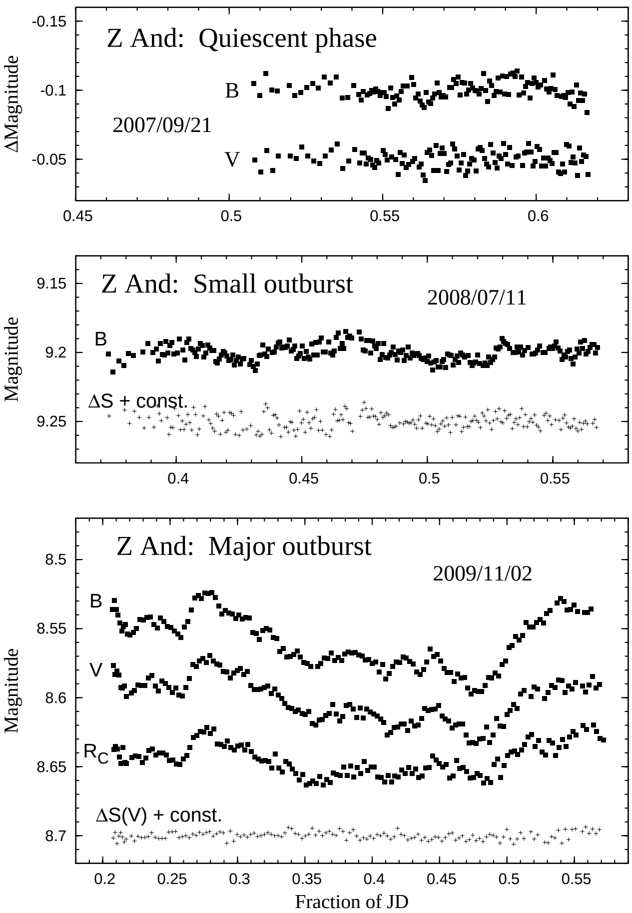

Fig. 4 Examples of high-time-resolution photometry of Z And during its different levels of activity marked in Fig. 3 by arrows.

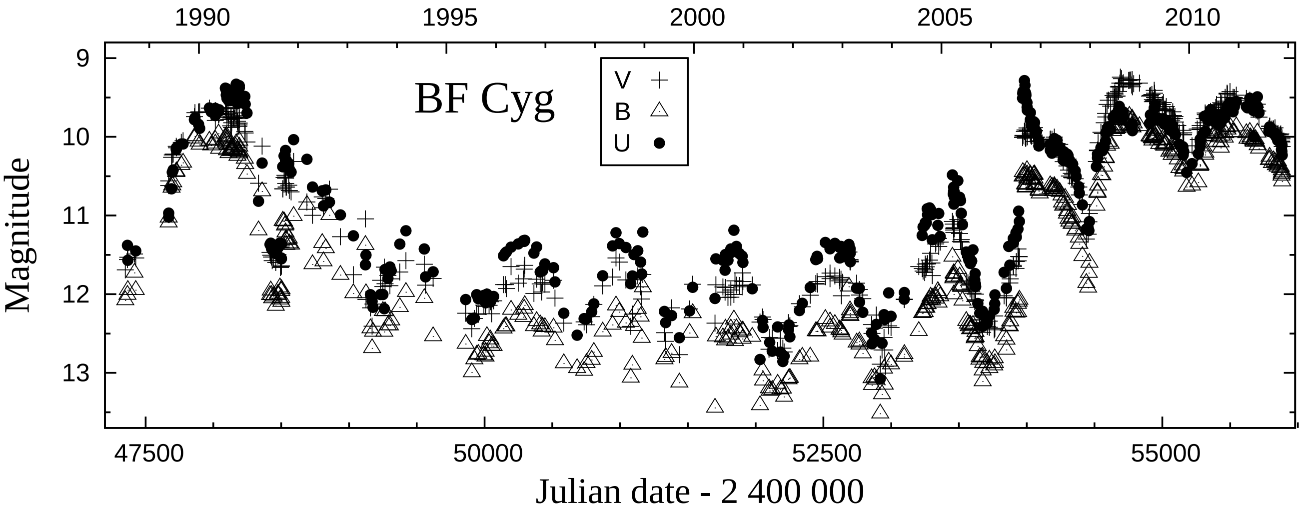

Fig. 5 The *UBV* light curves of BF Cyg from 1988 to the present. It covers the last, 1989-93 and the present, 2006-11 active phases with the quiescent phase in between them. New data are from 2007.2 (Tables 5 and 6).

such the fast photometric variation was also observed during the major 2006 outburst (see Fig. 3 of Skopal et al. 2009a), and was interpreted as a result of a disruption of the inner parts of the disk, leading to ejection of collimated mass outflow in a form of bipolar jets. On the other hand, during the maximum of the large 2000-03 outburst, no fast photometric variability was detected (Sokoloski et al. 2006), and no mass outflow in the form of jets was reported.

Therefore, future work should be also targeted to determine a relationship between properties of the rapid variation and the star's brightness for outbursts with jets. This could aid us in understanding instabilities in the disk and possibly the mechanisms of the jet ejection.

3.3 BF Cyg

The first extensive study of the LC of BF Cyg was done by Jacchia (1941), by analyzing Harvard plates between 1890 and 1940. He found a mean period of light variations of 754 days. Pucinskas (1970), studying variations in spectrophotometric parameters, derived a period of 757.3 days. Fekel et al. (2001) determined reliable orbital elements for the cool giant as $T_{\rm sp.conj.} = 2\,451\,395.2 \pm 5.6 + 757.2 \pm 3.9$. Historical light curve of BF Cyg displays more types of brightening. A slow, symbiotic-nova-type outburst (1895–1960), outbursts of the Z And-type (1920, 1989, 2006) and short-term flares (Skopal et al., 1997; Leibowitz & Formiggini, 2006). The last, 1989 Z And-type eruption was described by Cassatella et al. (1992) and Skopal et al. (1997). The most interesting feature in the LC was the development of relatively narrow minimum (eclipse) at the inferior spectroscopic conjunction of the giant, and the emergence of the P-Cyg type of profiles of hydrogen and helium lines. The recent, 2006 outburst of BF Cyg was first reported by Munari et al. (2006). Spectroscopic observations by Sitko et al. (2006) and Iijima (2006a) indicated appearance of P-Cyg type of HI, HeI and some

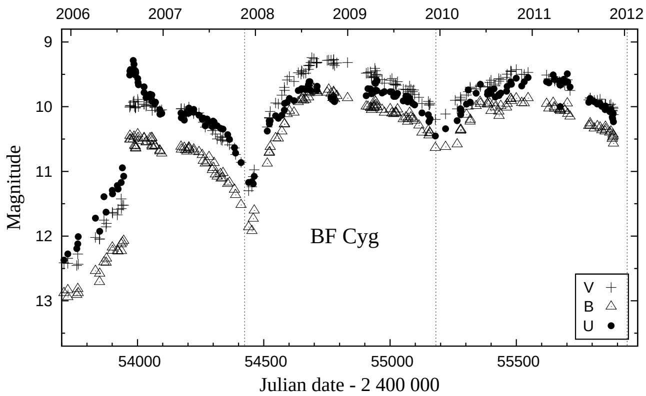

Fig. 6 A detail of the *UBV* light curves of BF Cyg from Fig. 5 covering the current active phase that started in 2006 August. Dotted vertical lines denote times of the inferior conjunction of the giant according to the Fekel's et al. (2001) ephemeris.

FeII line profiles. Dramatic changes in the BF Cyg spectrum at the beginning of its 2006 outburst were described by McKeever et al. (2011).

The resulting night-means of the BF Cyg brightness are given in Tables 5 and 6. For the photoelectric photometry we used the same comparison star as in the Paper I. Our CCD measurements of BF Cyg were linked to the comparison star "a" of Henden & Munari (2006). Figure 5 shows its *UBV* LCs covering the last 11 orbital cycles, from 1989. It shows that the transition from quiescence to the present active phase began in between 2004 and 2005 with a major eruption in 2006 August. There are two main differences in comparison with the previous 1989-93 outburst. (i) During the current active phase the star's brightness keeps ist high level continuously at/around $U \sim 10$ from the eruption (i.e. for >5 years, Fig. 6), while during the previous outburst, the star's brightness was fading gradually from its 1990 maxi-

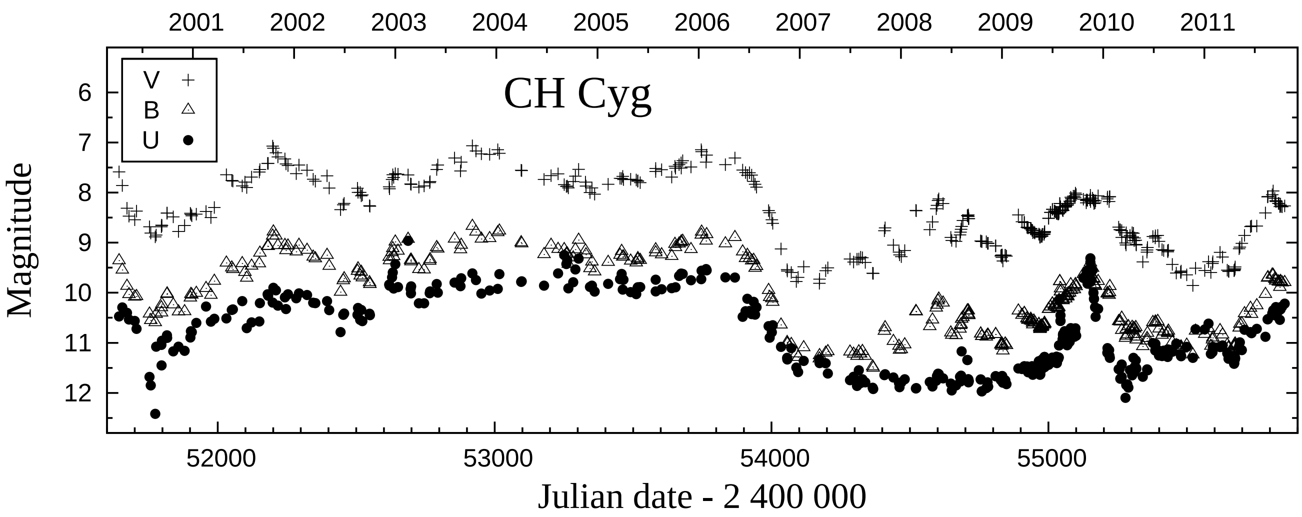

Fig. 7 The *UBV* light curves of CH Cyg covering its quiescent phase from 2000.

mum at $U \sim 9.4$ to quiescent values of $U \gtrsim 11$ in 1993. (ii) The minima (eclipses) at 2007.9 and 2010.0 varied in their depth and were of a V-type, in contrast to the 1991 eclipse, which was narrower and rectangular in the profile. This implies changes in the geometrical structure of the hot component during different active phases. In addition, the light minima of the 2007.9 and 2010.0 eclipses were shifted by $\sim +20$ days with respect to the spectroscopic conjunction of the giant according to the Fekel's et al. (2001) ephemeris.

The abnormally long-lasting high level of the BF Cyg brightness requires continuation of its photometric and spectroscopic monitoring. The minima profiles and evolution in the colour indices should contribute to our understanding the behaviour of the hot components in symbiotic stars during outbursts.

3.4 CH Cyg

CH Cyg belongs to the most intriguing symbiotic stars. Its symbiotic-like activity was recorded from ~1963 (Deutsch (1964); Faraggiana & Hack (1971); Muciek & Mikolajewski (1989)). Following multicolour observations showed that the LC-profile of CH Cyg differs considerably from those of other classical symbiotic stars (e.g. Luud et al. (1986)). The object was recognized as a source of a hard X-rays (e.g. Leahy & Taylor, 1987; Mukai et al. 2009a), producing collimated outflows in the radio (e.g. Taylor et al. 1986; Crocker et al., 2001; Karovska et al. 2007 and 2010), because of a high orbital inclination (e.g. Skopal et al. 1996). CH Cyg is also known as a strong source of a fast photometric variability on a time scale from minutes to hours with the brightness differences of a few times 0.1 mag (e.g. Wallerstein, 1968; Slovak & Africano 1978). Sokoloski & Kenyon, (2003) studied changes in the rapid optical variability around the period of 1996-97, when jets were launched, and proposed that a reduction in the amplitude of the fastest

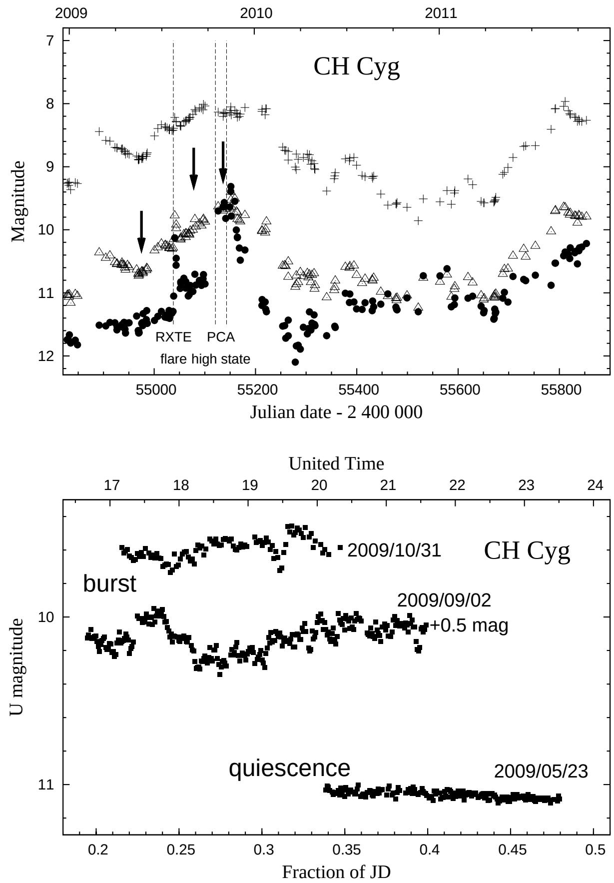

Fig. 8 Top: A detail of the LCs from Fig. 7 covering sudden brightening in *U* during the present low stage of CH Cyg. Vertical dashed lines mark dates with a high level of the 2–10 keV X-ray emission. The arrows mark dates, when a high-time-resolution photometry was performed (bottom panel).

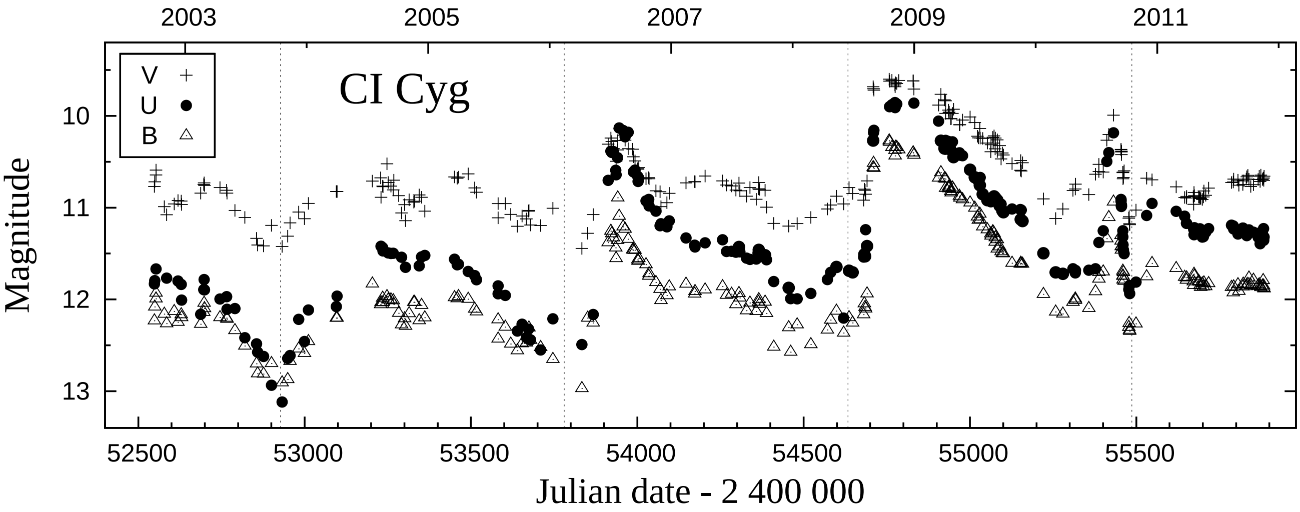

Fig. 9 The *UBV* light curves of CI Cyg from 2003 to the present. Vertical lines denote positions of the inferior conjunction of the giant according to the ephemeris of Fekel et al. (2000).

flickering may be due to disruption of the inner disk in association with a mass ejection event.

Our new photometry of CH Cyg is listed in Tables 7, 8 and 11. On the CCD snaps, CH Cyg was measured with respect to the standard star "b" of Henden & Munari (2006). Figure 7 shows *UBV* LCs from the beginning of 2000, which covers a quiescent phase with a puzzling drop to a very low optical state from ~2006.5 to the present (Paper I; Taranova & Shenavrin, 2007). Just prior to the drop, emission lines in the optical spectrum were single peaked, but broadened at their profile bottoms to $\sim \pm 200\,\mathrm{km\,s^{-1}}$ as observed by Yoo & Yoon (2009) on 2006 June 4. However, during the drop, Burmeister & Leedjärv (2009) and Yoo (2010) observed rather strong double-peaked Hα profile on 2006 October 28 and November 6, respectively. Around one year later, on 2007 December 29, the hydrogen emissions practically disappeared (Wallerstein et al. 2010).

The photometric low state was abandoned by two short-term ~ 1.5 mag brightening, observed during 2009 July and from 2009 September to the end of the year (Fig. 8 top; Skopal et al. 2009b and 2010). The burst was accompanied with appearance of a rapid light variability with $\Delta U \sim 0.2 - 0.3$ mag, while at a low state ($U \sim 11.5$), the fast variations were not present (Fig. 8 bottom). Simultaneous monitoring of CH Cyg with *RXTE* from 2007 July (Mukai et al. 2009a and 2009b) indicated significant brightening in the 2–10 keV X-ray flux during the optical bursts (Fig. 8 top). These independent monitoring campaigns revealed a correlation between the hard 2–10 keV emission and that measured within the *U* passband.

Therefore, further monitoring of CH Cyg at both the X-ray and the optical wavelengths is important to gain a better understanding of its active phases.

3.5 CI Cyg

The last active phase of CI Cyg began in 1975 (Belyakina, 1979). Her photometric observations revealed deep minima in the LC, eclipses, which confirmed unambiguously the eclipsing nature of CI Cyg. From about 1985 the profile of the minima became very broad, indicating transition to a quiescent phase (Belyakina, 1991). Multicolour *UBVRI* observations were continued by Dmitrienko (1996, 2000) from 1991 to 1998. Her observations confirmed quiescent phase of CI Cyg. In addition, her data, complemented with those of other authors, revealed a cyclic variability in the $U - B$ index with an amplitude of 0.3-0.4 mag on a time scale of 10.7 ± 0.6 years. This type of the variability was ascribed to the hot component. The quiescent phase continued to 2006 May, when CI Cyg started a new active phase with brightening by > 2 mag in *U* (Paper I, Fig 9 here).

Our new *UBV* measurements of CI Cyg are summarized in Tables 9, 10 and 11, and are plotted in Fig. 9. The star HR 7550 (HD 187 458) was used as the new comparison star for our photoelectric measurements. Its mean Hvar all-sky values, $V = 6.660$, $B-V = 0.426$, $U-B = -0.056$, were added to the magnitude differences, CI Cyg–HR 7550. We also re-measured the previous comparison star, HD 226 107, with respect to HR 7550 and obtained its new magnitudes as $V = 8.638 \pm 0.004$, $B - V = -0.053 \pm 0.008$, $U - B = -0.314 \pm 0.009$, where the uncertainties represent the rms from 23 night means made between 2011 May 16 and 2011 November 18. CCD $UBVR_{\mathrm{C}}I_{\mathrm{C}}$ magnitudes in Table 10 were obtained using the comparison stars "a" and "b" of Henden & Munari (2006).

After a gradual decrease from $U \sim 10$ in 2006 July to $U \sim 11.7$ in 2008 March, a drop in *U* by ~ 0.5 mag was observed close to the giant's inferior conjunction (Fig. 9). This was probably caused by a partial eclipse of the nebular component of radiation, because it is represented by the ionized

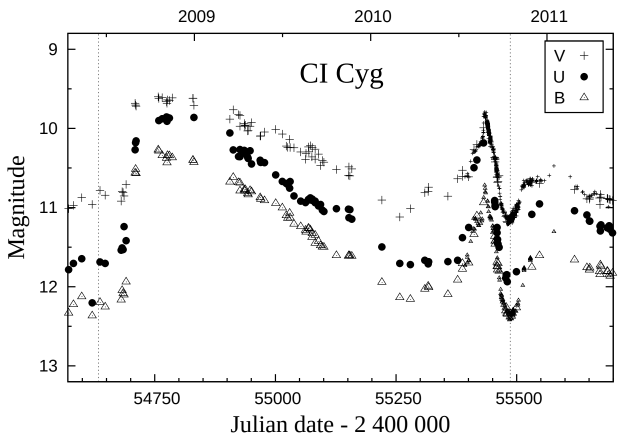

Fig. 10 The *UBV* light curves of CI Cyg covering its recent two eruptions. Vertical dotted lines are at positions of the eclipse timing as given by the ephemeris (2). *B* and *V* data were compared to observations from the AAVSO International Database (small points; Henden, 2010).

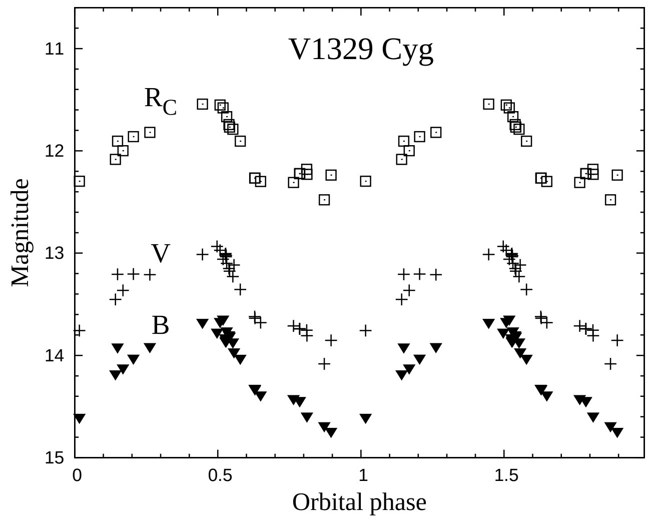

Fig. 11 Our BVR_C magnitudes of V1329 Cyg (Table 11) folded in the phase diagram using the ephemeris for the pre-outburst minima (eclipses) given by Eq. (3).

wind from the hot star during active phases (Skopal, 2006). Following the eclipse-like effect, a strong brightening was measured in the mid 2008 with a maximum in $U \sim 9.8$ during 2008 November (Figs. 9 and 10). This eruption of CI Cyg was reported by Munari et al. (2008a), and confirmed spectroscopically by Munari et al. (2008b) and Siviero et al. (2009). The star's brightness was again gradually decreasing to $U \sim 11.7$ in ~2010.5, when a new fast eruption appeared in the LC. The 2010 bright phase was interrupted by the eclipse of the hot component by the giant (Munari et al. 2010a; Fig. 10 here). Our observations covered a part of the descending branch to the totality with the decrease rate of 0.090, 0.081 and 0.053 mag a day in the *U*, *B* and *V* band, respectively. Our data, complemented with *B* and *V* magnitudes from the AAVSO database (see Fig. 10), allowed us to determine the light minima during the eclipse to Min(B) = JD 2 455 487.6 ± 1 and Min(V) = JD 2 455485.1 ± 1 by simple parabolic fit to observations between JD 2 455 457 and JD 2 455 515. We determined the middle of the eclipse as the average of these values, i.e.,

$$JD_{\rm Ecl.}(2010.8) = 2\,455\,486.4 \pm 1.4\,{\rm d}.$$

Using the well defined timings of previous eclipses,

$$JD_{\rm Ecl.}(1975.8) = 2\,442\,691.6 \pm 0.8,$$
$$JD_{\rm Ecl.}(1978.1) = 2\,443\,544.7 \pm 2.6,$$
$$JD_{\rm Ecl.}(1980.4) = 2\,444\,397.9 \pm 0.8,$$

(see Table 2 of Skopal, 1998) gives their ephemeris as

$$JD_{\rm Ecl.} = 2\,441\,838.8(\pm1.3) + 852.98(\pm0.15) \times E. \qquad (2)$$

The recent observations from $\sim$ 2011.3, show a more or less constant level of the star's brightness at $U \sim 11.3$. The corresponding *UBV* LCs are similar to those observed after the 2006-maximum (Fig. 9).

Further monitoring of CI Cyg will be focused on covering the eclipse profile at different levels of the star's brightness to understand better variations of the hot component radiation during active phases.

3.6 V1329 Cyg

The symbiotic phenomenon of V1329 Cyg developed after its nova-like eruption in 1964. This was discovered by Kohoutek (1969), who found that its spectrum was similar to that of the well-known emission object, V1016 Cyg. Shortly after the eruption, from around 1968, V1329 Cyg peaked at $B \sim 12.0$ mag and developed a wave-like orbitally-related variation in its LC (see the figure in Arkhipova & Mandel, 1973), which represents a typical feature of the LCs of symbiotic stars during quiescent phases. This type of the light variability dominates the LC of V1329 Cyg to the present (e.g. Munari et al. 1988; Arkhipova & Mandel, 1991; Skopal, 1998; Chochol et al. 1999; Jurdana-Šepić & Munari 2010; Fig 11 here). According to the model SED, it is caused by apparent variations in the nebular continuum as a function of the orbital phase (see Fig. 3 of Skopal, 2008).

Our new observations of V1329 Cyg are given in Table 11, and the corresponding phased LC is plotted in Fig. 11. Here we used the ephemeris for the pre-outburst minima (eclipses) as derived by Schild & Schmid (1997),

$$JD_{\rm Min} = 2\,427\,687(\pm20) + 958.0(\pm1.8) \times E. \qquad (3)$$

Figure 11 shows that the light minimum occurred prior to the time of the spectroscopic conjunction. As the nebular continuum dominates the near-UV/optical, the position and the profile of the light minimum are given by the shaping of the optically thick part of the nebula in the binary. Its central crossbar will be probably extended between the binary components, but placed asymmetrically with respect to the binary axis so to satisfy the minimum position preceding the inferior conjunction of the giant. To explain this effect, Skopal (1998) suggested that such the dense nebula can be a result of the colliding stellar winds from binary components as given by hydrodynamical calculations of Walder (1995).

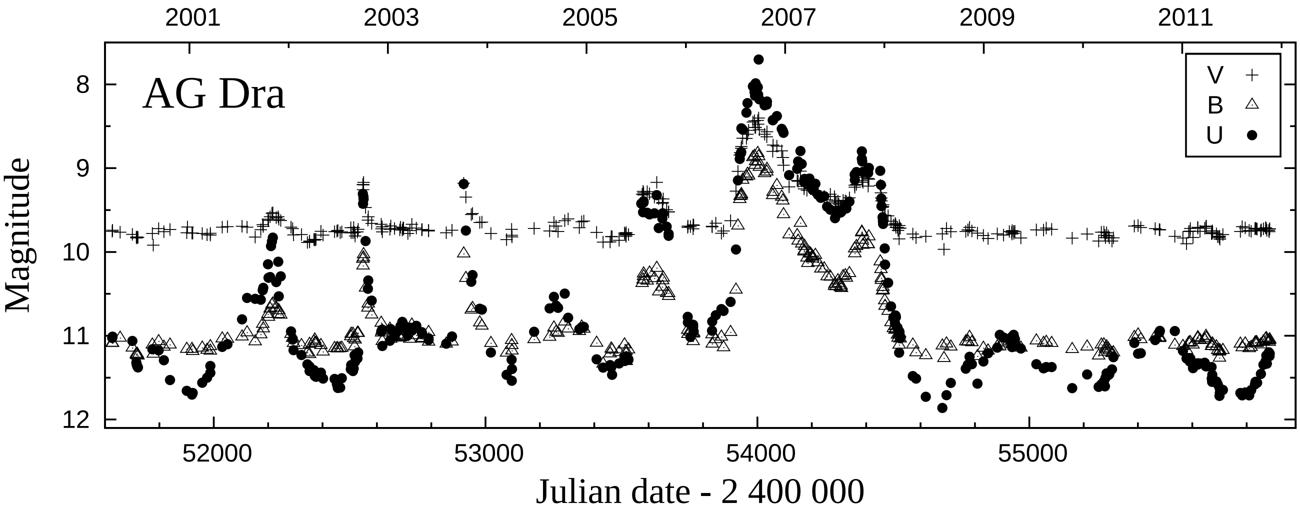

Fig. 12 The *UBV* light curves of AG Dra from 2000 to the present.

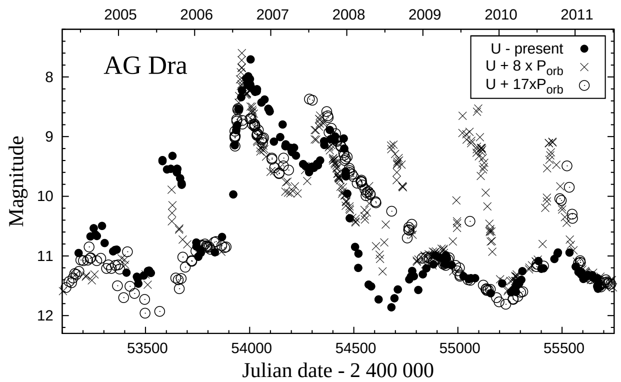

Fig. 13 Comparison of the major outbursts of AG Dra that started during 1980 (○), 1994 (×) and 2006 (•).

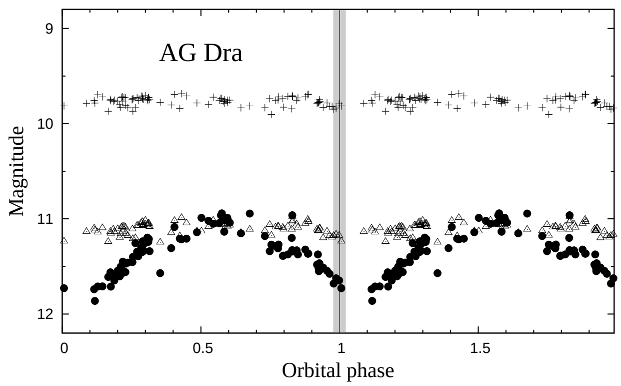

Fig. 14 Phase diagram of the *UBV* measurements during the current quiescent phase from 2008 February 24 to our last observation on 2011 November 18 (Table 13). The width of the grey band represents uncertainties in the position of the inferior conjunction of the giant as given by elements of Fekel et al. (2000).

Figure 11 further shows that the orbital variation is well pronounced in all passbands ($\Delta B \sim 1.1$, $\Delta V \sim 0.9$ and $\Delta R_C \sim 0.7$), whose amplitude is modulated by the increasing contribution from the red giant at longer wavelengths. The brightness maximum at the phase $\sim$ 0.5, a rapid decrease to $\sim$ 0.65 followed with a relatively flat minimum peaked at $\sim$ 0.9, and finally a gradual increase to the maximum (see Fig. 11), could be produced by a higher density structure in the binary seen at different orbital phases (see e.g. Fig. 5 of Bisikalo et al. 2006).

Further monitoring should be pointed to measure the precise profile of the LC in different colours as a function of the orbital motion to map the structure of the inner optically thick part of the nebula. Repeating X-ray observations, as recently performed by Stute et al. (2011), should help to locate the X-ray source in the binary.

3.7 TX CVn

Observations of TX CVn are summarized in Tables 11 and 12. Since 2008.5, monitoring of TX CVn was finished at the Skalnaté Pleso Observatory.

3.8 AG Dra

The LC of the symbiotic star AG Dra often shows multiple brightening by 1–3 mag, depending on the wavelength, which are abandoned with large periods of quiescent phases. First recorded activity began from 1927 with a major eruption ($\Delta m_{pg} \sim 2$ mag) in 1951, showing a typical double-peaked profile (Robinson, 1964). First *UBV* photoelectric observations revealed another major outburst around the mid of 1960’ (Belyakina, 1970b). From 1974, AG Dra was intensively monitored by multicolour photometry (Meinunger, 1979; Kaler, 1987; Kaler et al. 1987). From that time to the present, 3 major outbursts were recorded. They started in 1980, 1994 and 2006 (e.g. Kaler, 1980; Leedjärv et al. 2004;

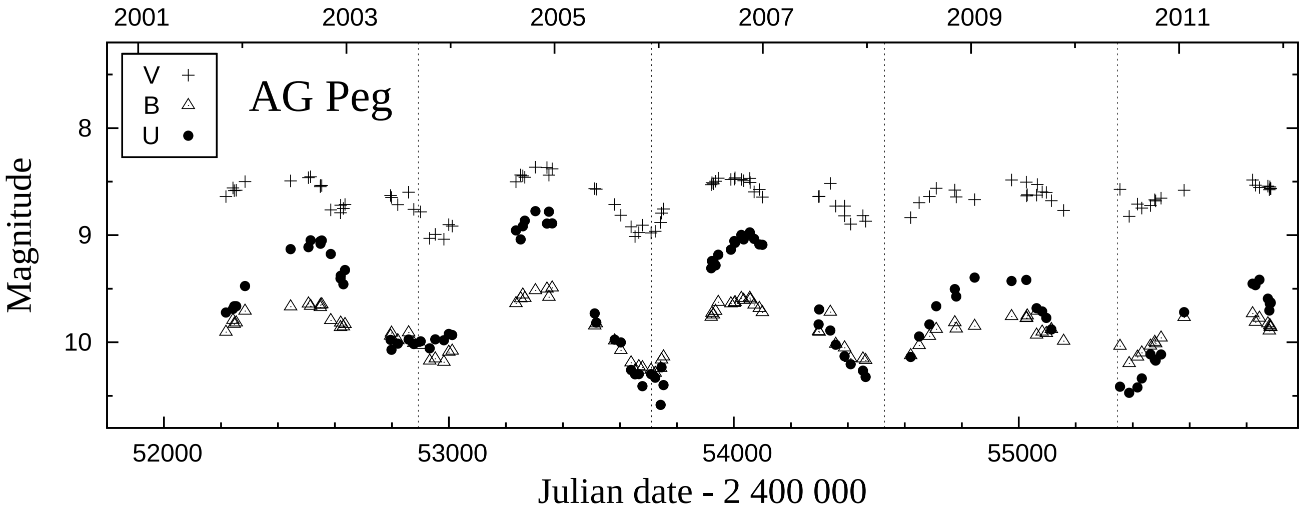

Fig. 15 The *UBV* light curves of AG Peg from 2002 to the present. New observations (Table 15) start from 2007.2. Vertical dashed lines denote positions of the inferior conjunction of the giant according to the orbital elements published by Fekel et al. (2000).

Paper I). The latest one began at the beginning of 2006 July (Moretti et al. 2006; Iijima, 2006b). The spectroscopic evolution of the recent, 2006-08, outburst of AG Dra was described by Munari et al. (2009a) and Shore et al. (2010).

Our new photometry (Tables 11, 13 and 14) covers the second bright maximum of the 2006 outburst, which peaked during 2007 October, being followed by a rapid decrease to quiescent magnitudes during 2007 December 20-th to the end of 2008 January (Fig. 12). Transition to the quiescent phase was the fastest from all 3 recent outbursts. Another interesting feature of the AG Dra major outbursts, is their beginning at nearly the same orbital phase with a very similar rate of the brightness increase (Fig. 13). The present quiescent phase was established immediately, from 2008 February, by displaying typical wave-like orbitally-related variation, best pronounced in the *U* band (Fig. 14). However, the position of the light minimum occurred by $\sim 0.05\,P_{\rm orb}$ after the position of the inferior giant conjunction. Maximum uncertainty in the position of the spectroscopic conjunction at the time of our observations in Fig. 14 is as large as $\sim 0.02\,P_{\rm orb}$. It is given by uncertainties of the Fekel et al. (2000) ephemeris,

$$JD_{\rm sp.conj.} = 2\,450\,775.34(\pm4.1) + 548.65(\pm0.97) \times E, \quad (4)$$

and the average shift of 8 orbital cycles of our photometric observations in Fig. 14. This is in contrast to the eclipsing systems, where the light minima during quiescent phases precede the time of the inferior conjunction of the giant (see Skopal, 1998).

3.9 Draco C1

B, V, $R_{\rm C}$, $I_{\rm C}$ magnitudes of Draco C1 are in Table 11. We used the same standard stars as in the Paper I (see Table 1).

3.10 AG Peg

AG Peg is classified as a symbiotic nova. In mid-1850s it rose in brightness from ~ 9 to ~ 6 mag and afterwards followed a gradual decline to the present brightness of 8.7 mag in *V*. From around 1940 the LC developed the orbitally related wave-like variation (Meinunger 1983). Currently, it displays all signatures of a classical symbiotic star in a quiescent phase (e.g. Mürset & Nussbaumer, 1994). The spectral energy distribution in the UV/near-IR continuum shows a strong nebular component dominating the near-UV/U domain (Skopal, 2005a).

Our new photometric observations of AG Peg are summarized in Tables 11 and 15 and depicted in Fig. 15. The figure also compares positions of the measured light minima with times of the inferior conjunction of the cool giant in the binary, $JD_{\rm sp.conj.} = 2\,447\,165.3(\pm48) + 818.2(\pm1.6) \times E$, as given by the elements of the spectroscopic orbit determined by Fekel et al. (2000). Variations in the minima position and their profile as well as the decreasing level of the star's brightness during the maxima suggest that the symbiotic nebula is variable in both the shape and the emissivity. For example, the *U*-LC shows a marked decrease from ~ 9 to ~ 9.5 mag from the 2004.8, 2007.0 maxima to the recent, 2009.2, 2011.5 maxima (see Fig. 15). This reflects a decrease in the emission measure (EM) of the nebular component of radiation by a factor of ~ 2. Using the method of Cariková & Skopal (2010), we derived $EM(2004.8) \sim 6.7 \times 10^{59}\,{\rm cm}^{-3}$, $EM(2007.0) \sim 6.6 \times 10^{59}\,{\rm cm}^{-3}$, $EM(2009.2) \sim 3.7 \times 10^{59}\,{\rm cm}^{-3}$ and $EM(2011.5) \sim 3.5 \times 10^{59}\,{\rm cm}^{-3}$ from *UBV* magnitudes measured during the maxima. The magnitudes were dereddened with $E_{\rm B-V}$=0.10 (Kenyon et al. 1993) and corrected for emission lines, $\Delta U_{\rm l} = 0.20$ mag, $\Delta B_{\rm l} = 0.40$ mag, and $\Delta V_{\rm l} = 0.12$ mag (Skopal, 2007). Average values of other fitting parameters, the electron tempera-

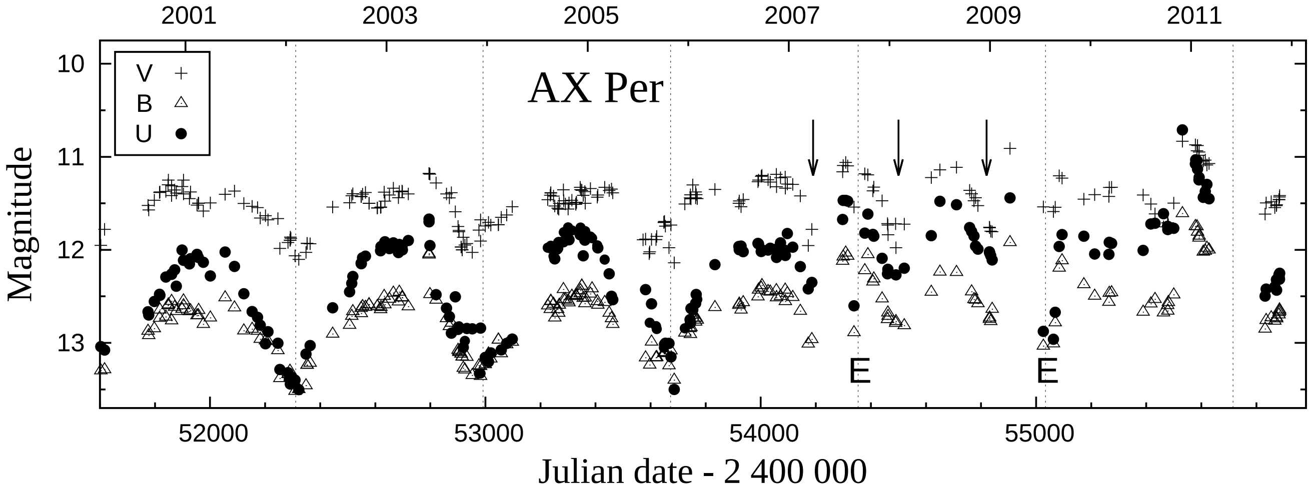

Fig. 16 The *UBV* light curves of AX Per from 2000 to the present. New observations (Table 16) are from 2007.2. Vertical dotted lines denote positions of eclipses according to their ephemeris (5) and arrows denote the minima of a wave that appeared in the LC during the 2007-10 active phase.

ture of ≈ 20 000 K and the intrinsic magnitude of the giant, $V_g = 8.47 \pm 0.04$, were also derived.

Further investigation of AG Peg should include also its soft and super-soft X-ray domain as previously performed by Mürset et al. (1997). The small value of the interstellar absorption to AG Peg and a very high level of its far-UV continuum, as measured by the FUSE and HST satellites, makes AG Peg a suitable target for detection of the super-soft X-rays.

3.11 AX Per

AX Per is an eclipsing symbiotic binary, whose eclipses in the multicolour LC were recorded for the first time during its major 1988-95 active phase (Skopal, 1991). Transition to quiescence happened during 1995, when the LC profile changed to the wave-like orbitally related variation (Skopal et al. 2001). The binary comprises a M4.5 III giant (Mürset & Schmid 1999) and a WD on a 680-d orbit (e.g. Fekel et al. 2000).

The recent measurements of AX Per are introduced in Tables 11 and 16, and are displayed in Fig. 16. The main change in the LC profile, covered by our new observations, happened at ∼2007.5, when the broad wave-like minimum transformed into a narrow minimum placed at the inferior conjunction of the giant (Fig. 16 here; Skopal et al. 2011). This sudden and significant change in the minimum profile reflects a strong change in the ionization structure of the binary as a consequence of a new active phase. It is interesting to note that this change was connected with only a small, a few times 0.1 mag, increase in the optical brightness (see Fig. 16). Later on during 2009 March, a rapid increase in the star's brightness by ∼1 mag in *B* was reported by Munari et al. (2009b). They also pointed out that the observed increase of the nebular continuum, indicated in their spectra, was responsible for the increase in the star's brightness and the bluer colour indices. This finding confirmed that AX Per was inhering in the active phase. Unfortunately, our scanty *UBV* observations during that time (near to the season gap) did not allowed us to measure the corresponding brightness in *U*. The brightening was interrupted by the eclipse in the middle of 2009, when *U* decreased to ∼ 13, and continued at *U* ∼ 11.7 after it (see Fig. 16). An additional rise in the AX Per brightness during 2010 November was reported on by Munari et al. (2010b). Our observations confirmed the brightening by indicating a maximum at *U* = 10.7 on 2010 November 30-th and the following gradual fading to *U* ∼ 11.45 on 2011 March 3. The last observations from 2011 September – November, indicates a gradual increase from *U* ∼ 12.5 to ∼ 12.2.

In addition, a pronounced light wave with a period of $\sim 0.5\,P_{\rm orb}$, broad minima located around the orbital phases 0.2 and 0.7 and amplitude of ∼ 0.6 – 0.8 mag, modulated the LC during the 2007-10 active phase (Fig. 16 here and Fig. 2 of Skopal et al. 2011). It was seen in all filters. This feature was observed in a symbiotic system for the first time. Understanding the nature of such type of variability requires a detailed analysis of colour indices and spectroscopic observations, which is out of the scope of this paper.

Finally, the profile of the 2009 eclipse, closely covered by multicolour measurements obtained within the Asiago Novae and Symbiotic Stars Collaboration, allowed Skopal et al. (2011) to determine the ephemeris for eclipses in AX Per as,

$$JD_{\rm Ecl.} = 2\,447\,551.26(\pm0.3) + 680.83(\pm0.11) \times E. \quad (5)$$

Further photometric and spectroscopic monitoring is important to map the current active phase, whose evolution of the LC is unusual in comparison with other active symbiotic stars.

4 Conclusions

In this paper we presented new multicolour photometry of selected classical symbiotic stars (Tables 2–16, Figures 1–16). Main results of our monitoring programme can be summarized as follows.

UBV LCs of **EG And** display a double-wave throughout the orbit with the minima around the giant's conjunctions. The variation are strongly affected by an intrinsic variability from the giant and the nebula. For future work we suggest to continue monitoring the star mainly in the U band, and to carry out X-ray observations covering the supersoft part of the spectrum (Sect. 3.1).

The LC of **Z And** showed two new eruptions that peaked at $U \sim 9.2$ during 2008 January and July, and at $U \sim 8.2$ in 2009 December. During 2011 Z And was again gradually brightening up. Our last observations indicated $U \sim 8.5$. The short-term variations with $\Delta m \sim 0.025$ mag on the time-scale of 1–2 hours during the smaller outburst changed to $\Delta m \sim 0.065$ mag through a night during the major 2009 outburst (Fig. 4). Future work should include the high-time-resolution photometry with the aim to determine a relationship between the properties of the rapid variations and the star's brightness (Sect. 3.2).

BF Cyg keeps a high level of its brightness at $U \sim 10$ from the main eruption in 2006 August. The LC was wave-like in the profile with minima (eclipses) of different depth in 2007.9 and 2010.0. Owing to the nearly rectangular profile of the 1991 eclipse, current evolution in the LC implies changes in the geometrical structure of the hot component during different active phases. Therefore, continuation of the photometric and spectroscopic monitoring of BF Cyg is important to understand better the behaviour of the hot components in symbiotic stars during outbursts.

CH Cyg persisted at a low level of its brightness with $U \sim 10.8 - 11.8$. The low state was abandoned with two short-term, $\Delta U \sim 1.5$ mag bursts, measured in 2009 July and 2009 September – December. The U-LC correlates with that measured in the 2–10 keV X-ray fluxes. Further monitoring of CH Cyg at both the X-ray and the optical wavelengths is important to gain a better understanding of its active phases.

CI Cyg continued its active phase from 2006. A strong brightening was measured in the middle of 2008 with a maximum in $U \sim 9.8$ during 2008 November and additional smaller eruption that peaked at $U \sim 10.0$ in 2010 September. After 12 orbital cycles ($\sim$ 28 years), a new eclipse of the hot component by its giant companion, appeared in the LC during 2010 October. We determined a new ephemeris of eclipses (Eq. (2)). CI Cyg continues its active phase at $U \sim 11.3$.

The phased BVR_C LCs of **V1329 Cyg** showed a well pronounced orbital variation with a complicated profile. Monitoring the precise profile of the LC along the orbit and its variation during the following orbital cycles will map the structure of the inner optically thick part of the nebula and its evolution.

Our new photometry of **AG Dra** covered the second bright maximum of the 2006 outburst, which peaked during 2007 October. A rapid decrease happened between 2007 December 20-th and the end of 2008 January, after which a quiescent phase was established. From 2008 February to 2011 November, the LC displayed the wave-like orbitally-related variation – a signature for quiescent phase of symbiotic stars.

AG Peg LC continues the wave-like variation as a function of the orbital phase. The maximum brightness at $U \sim 9.0$, measured during 2004.8 and 2007.0, decreased to $U \sim 9.5$ during 2009.2 and 2011.5 maxima. This change was caused by a decrease in the emission measure of the nebula, from $EM \sim 6.7$ to $\sim 3.5 \times 10^{59}$ cm^{-3}.

AX Per entered a new active phase from $\sim$ 2007.5, when narrow eclipses around 2007.7 and 2009.5 were observed in the LC. However, the star's brightness increased by only a few times 0.1 mag. In addition, a pronounced light wave with a period of $\sim 0.5\,P_{\rm orb}$ and minima located around the orbital phases 0.2 and 0.7 modulated the LC. This anomalous type of active phase requires urgently further photometric and spectroscopic monitoring.

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Table 2 Photoelectric U, B, V, R_C observations of EG And (Δm = EG And – HD4143) from the Skalnaté Pleso observatory

Date	JD 24...	ΔU	ΔB	ΔV	ΔR_C
Feb 11, 2007	54143.254	-1.624	-1.302	-1.347	-1.448
Jul 16, 2007	54297.510	-1.827	-1.298	-1.344	-1.510
Aug 3, 2007	54315.565	-1.721	-1.326	-1.381	-1.503
Oct 15, 2007	54388.619	-1.609	-1.351	-1.402	-1.480
Nov 2, 2007	54407.480	-1.553	-1.368	-1.408	-1.534
Nov 5, 2007	54410.428	-1.659	-1.379	-1.426	-1.546
Dec 5, 2007	54440.443	-1.605	-1.395	-1.458	-1.566
Dec 25, 2007	54460.415	-1.663	-1.380	-1.427	-1.545
Dec 26, 2007	54461.316	-1.794	-1.386	-1.425	-1.528
Dec 27, 2007	54462.353	-1.580	-1.379	-1.426	-1.535
Jan 23, 2008	54489.334	-1.394	-1.380	-1.444	–
Feb 24, 2008	54521.275	-1.658	-1.351	-1.411	–
Jun 3, 2008	54620.500	-1.674	-1.301	-1.359	–
Sep 1, 2008	54710.557	-1.431	-1.337	-1.389	–
Oct 19, 2008	54758.538	-1.690	-1.374	-1.431	–
Oct 26, 2008	54765.559	-1.593	-1.331	-1.390	–
Nov 4, 2008	54774.504	-1.509	-1.261	-1.344	–
Nov 9, 2008	54780.396	-1.673	-1.334	-1.402	–
Dec 30, 2008	54831.401	-1.610	-1.261	-1.324	–
Jan 3, 2009	54835.309	-1.673	-1.290	-1.363	–
Jan 10, 2009	54842.391	-1.364	-1.299	-1.360	–
Jan 13, 2009	54845.373	-1.509	-1.328	-1.408	–
Feb 28, 2009	54891.283	-1.679	-1.427	-1.536	–
Jul 14, 2009	55026.504	-1.288	-1.255	-1.331	–
Aug 18, 2009	55062.483	-1.392	-1.216	-1.241	–
Sep 9, 2009	55083.591	-1.476	-1.290	-1.340	–
Sep 19, 2009	55094.424	-1.494	-1.213	-1.277	–
Sep 22, 2009	55096.562	-1.474	-1.226	-1.295	–
Oct 21, 2009	55126.466	-1.530	-1.408	-1.502	–
Dec 7, 2009	55173.470	-1.543	-1.381	-1.449	–
Jan 15, 2010	55212.353	-1.670	-1.323	-1.369	–
Feb 1, 2010	55229.326	-1.670	-1.400	-1.480	–
Feb 25, 2010	55253.287	-1.968	-1.370	-1.417	–
Mar 9, 2010	55265.281	-1.466	-1.215	-1.283	–
Aug 3, 2010	55411.516	-1.488	-1.373	-1.485	–
Aug 22, 2010	55430.559	-1.542	-1.328	-1.391	–
Sep 23, 2010	55462.548	-1.487	-1.331	-1.400	–
Oct 8, 2010	55477.504	-1.275	-1.288	-1.378	–
Oct 10, 2010	55479.574	-1.314	-1.240	-1.313	–
Oct 29, 2010	55499.497	-1.357	-1.336	-1.414	–
Nov 30, 2010	55531.434	-1.783	-1.371	-1.387	–
Dec 16, 2010	55547.420	-1.706	-1.369	-1.458	–
Dec 31, 2010	55562.433	-1.820	-1.438	-1.430	–
Jan 3, 2011	55565.303	-1.609	-1.318	-1.370	–
Jan 16, 2011	55578.303	-1.412	-1.383	-1.412	–
Jan 17, 2011	55579.301	-1.584	-1.473	-1.326	–
Jan 29, 2011	55591.288	-1.367	-1.354	-1.448	–
Jan 30, 2011	55592.272	-1.473	-1.360	-1.480	–
Feb 9, 2011	55602.308	-1.548	-1.355	-1.432	–
Feb 27, 2011	55620.274	-1.725	-1.383	-1.441	–
Sep 7, 2011	55811.554	–	-1.204	-1.302	–
Sep 11, 2011	55816.451	-1.807	-1.241	-1.300	–
Sep 26, 2011	55831.453	-1.641	-1.339	-1.386	–
Oct 1, 2011	55835.579	-1.636	-1.344	-1.405	–
Nov 1, 2011	55866.549	-1.622	-1.382	-1.456	–
Nov 3, 2011	55869.440	-1.846	-1.418	-1.472	–
Nov 8, 2011	55873.502	-1.615	-1.366	-1.419	–
Nov 16, 2011	55881.500	-1.543	-1.349	-1.402	–
Nov 16, 2011	55882.493	-1.706	-1.360	-1.421	–
Nov 18, 2011	55883.508	-1.693	-1.363	-1.429	–
Nov 19, 2011	55884.560	-1.724	-1.365	-1.432	–

Table 3 Photoelectric U, B, V, R_C observations of Z And from the Skalnaté Pleso observatory.

Date	JD 24...	U	B	V	ΔR_C
Mar 14, 2007	54173.597	10.118	11.141	10.349	0.158
Apr 12, 2007	54202.586	10.510	11.288	10.434	0.153
Apr 13, 2007	54203.579	10.660	11.348	10.463	0.219
Apr 15, 2007	54205.585	10.587	11.327	10.482	0.231
May 2, 2007	54222.537	10.895	11.495	10.525	0.320
Jun 5, 2007	54256.523	10.870	11.371	10.480	0.325
Jun 17, 2007	54268.514	10.980	11.612	10.551	0.433
Jul 15, 2007	54297.371	10.865	11.552	10.315	0.240
Jul 17, 2007	54299.423	10.736	11.446	10.319	–
Jul 26, 2007	54308.465	10.774	11.479	10.349	–
Aug 2, 2007	54315.480	10.832	11.450	10.414	0.306
Aug 25, 2007	54338.476	10.785	11.511	10.464	0.337
Sep 14, 2007	54357.559	10.784	11.468	10.298	0.207
Oct 4, 2007	54377.631	10.696	11.442	10.334	0.228
Oct 15, 2007	54388.543	10.694	11.517	10.424	0.288
Nov 2, 2007	54407.443	10.670	11.512	10.367	0.249
Nov 5, 2007	54410.390	10.687	11.530	10.433	0.307
Dec 5, 2007	54440.369	10.722	11.584	10.562	0.407
Dec 25, 2007	54460.359	10.036	10.836	10.051	0.165
Dec 26, 2007	54461.277	9.932	10.654	9.946	0.096
Dec 27, 2007	54462.315	9.871	10.625	9.893	0.065
Jan 23, 2008	54489.291	9.194	10.096	9.507	–
Jan 24, 2008	54490.218	9.197	10.081	9.480	–
Jan 25, 2008	54491.207	9.124	10.114	9.532	–
Feb 7, 2008	54504.324	9.324	10.120	9.603	–
Feb 24, 2008	54521.239	9.421	10.246	9.617	–
Apr 25, 2008	54581.582	9.546	10.137	9.510	–
Jun 2, 2008	54619.525	9.229	10.042	9.359	–
Jul 2, 2008	54649.513	9.139	9.930	9.223	–
Aug 1, 2008	54679.532	9.397	10.071	9.285	–
Aug 7, 2008	54686.488	9.435	10.338	9.545	–
Aug 31, 2008	54710.441	9.599	10.465	9.661	–
Sep 1, 2008	54711.461	9.621	10.485	9.648	–
Oct 18, 2008	54758.498	9.966	10.565	9.729	–
Oct 25, 2008	54765.492	9.973	10.638	9.789	–
Nov 3, 2008	54774.452	10.063	10.768	9.908	–
Nov 4, 2008	54775.394	10.231	0.000	0.000	–
Nov 9, 2008	54780.358	10.130	10.819	9.955	–
Dec 30, 2008	54831.299	10.516	11.142	10.360	–
Jan 3, 2009	54835.262	10.590	11.201	10.406	–
Jan 8, 2009	54840.284	10.594	11.220	10.456	–
Jan 10, 2009	54842.343	10.610	11.206	10.423	–
Jan 13, 2009	54845.284	10.640	11.270	10.469	–
Apr 14, 2009	54935.593	10.922	11.321	10.451	–
Apr 15, 2009	54936.595	10.738	11.185	10.462	–
Apr 14, 2009	54935.593	10.778	11.136	10.437	–
Apr 22, 2009	54943.521	10.934	11.384	10.434	–
May 17, 2009	54968.533	10.795	11.307	10.344	–
May 18, 2009	54969.508	10.875	11.357	10.423	–
May 26, 2009	54977.529	10.760	11.220	10.270	–
Jul 10, 2009	55022.511	10.400	11.080	10.120	–
Jul 12, 2009	55025.496	10.441	11.189	10.185	–
Aug 18, 2009	55062.442	10.027	10.954	10.026	–
Aug 26, 2009	55069.521	9.926	10.927	10.018	–

Table 3 Continued

Date	JD 24...	*U*	*B*	*V*	ΔR_C
Sep 1, 2009	55075.510	9.820	10.719	9.890	–
Sep 7, 2009	55082.470	9.583	10.357	9.654	–
Sep 19, 2009	55094.463	9.352	9.937	9.288	–
Oct 31, 2009	55136.266	8.356	8.870	8.441	–
Nov 22, 2009	55157.520	8.463	8.945	8.418	–
Nov 28, 2009	55164.353	8.385	8.911	8.492	–
Dec 7, 2009	55173.403	8.174	8.686	8.297	–
Jan 15, 2010	55212.262	8.226	8.803	8.344	–
Jan 16, 2010	55213.278	8.311	8.835	8.377	–
Jun 7, 2010	55355.470	8.961	9.520	8.954	–
Jun 9, 2010	55357.478	9.015	9.584	8.952	–
Jul 8, 2010	55386.475	9.043	9.729	9.143	–
Jul 10, 2010	55388.384	9.121	9.740	9.159	–
Jul 21, 2010	55399.417	9.150	9.780	9.175	–
Aug 2, 2010	55411.471	9.192	9.833	9.248	–
Aug 21, 2010	55430.416	9.453	9.966	9.368	–
Sep 22, 2010	55461.513	9.543	10.068	9.464	–
Sep 23, 2010	55462.585	9.584	10.048	9.470	–
Oct 7, 2010	55477.457	9.391	10.137	9.565	–
Oct 10, 2010	55479.529	9.409	10.157	9.589	–
Oct 30, 2010	55499.565	9.161	10.082	9.479	–
Nov 30, 2010	55531.396	9.493	10.171	9.646	–
Dec 7, 2010	55538.322	9.472	10.246	9.703	–
Dec 16, 2010	55547.314	0.000	0.000	9.700	–
Jan 2, 2011	55564.289	9.419	10.261	9.676	–
Jan 3, 2011	55565.254	9.389	10.223	9.644	–
Jan 16, 2011	55578.250	9.637	10.243	9.692	–
Jan 17, 2011	55579.250	9.589	10.255	9.692	–
Jan 29, 2011	55591.245	9.521	10.253	9.681	–
Jan 30, 2011	55592.227	9.487	10.246	9.686	–
Feb 9, 2011	55602.257	9.473	10.241	9.684	–
Feb 14, 2011	55607.262	9.484	10.307	9.723	–
Feb 21, 2011	55614.245	9.478	10.250	9.685	–
May 6, 2011	55687.538	9.372	10.357	9.728	–
May 12, 2011	55693.518	9.316	10.316	9.671	–
May 21, 2011	55703.495	9.324	10.316	9.675	–
May 27, 2011	55708.514	9.290	10.338	9.722	–
Sep 1, 2011	55805.580	8.689	9.724	9.136	–
Sep 4, 2011	55809.404	8.736	9.738	9.182	–
Sep 7, 2011	55811.502	8.730	9.745	9.191	–
Sep 11, 2011	55816.411	8.700	9.735	9.167	–
Sep 26, 2011	55831.408	8.780	9.768	9.201	–
Sep 27, 2011	55832.446	8.725	9.711	9.141	–
Oct 1, 2011	55835.527	8.771	9.758	9.169	–
Oct 3, 2011	55838.488	8.730	9.716	9.166	–
Oct 4, 2011	55839.489	8.688	9.673	9.094	–
Oct 18, 2011	55852.529	8.643	9.578	9.032	–
Oct 19, 2011	55853.520	8.729	9.547	9.037	–
Nov 3, 2011	55869.392	8.470	9.382	8.875	–
Nov 6, 2011	55872.325	8.506	9.415	8.889	–
Nov 7, 2011	55873.463	8.485	9.371	8.868	–
Nov 8, 2011	55874.413	8.417	9.314	8.785	–
Nov 13, 2011	55879.465	8.420	9.307	8.825	–
Nov 15, 2011	55881.452	8.430	9.314	8.820	–
Nov 16, 2011	55882.435	8.448	9.345	8.856	–
Nov 17, 2011	55883.447	8.377	9.265	8.785	–
Nov 18, 2011	55884.498	8.392	9.260	8.765	–

Table 4 CCD U, B, V, R_C, I_C observations of Z And from the Stará Lesná observatory.

Date	JD 24...	U	B	V	R_C	I_C
May 25, 2007	54245.506	–	11.500	10.438	9.049	7.723
Jun 25, 2007	54276.510	–	11.526	10.432	–	–
Jun 26, 2007	54277.514	–	11.521	10.425	–	–
Jul 3, 2007	54285.366	–	11.493	10.393	9.042	7.744
Jul 22, 2007	54303.578	–	11.475	10.306	9.008	7.711
Aug 23, 2007	54336.390	–	11.456	10.309	9.004	7.750
Sep 21, 2007	54364.521	–	11.455	10.278	–	–
Sep 22, 2007	54365.524	–	11.438	10.276	8.978	7.710
Sep 22, 2007	54366.443	–	11.447	10.271	8.979	7.707
Oct 10, 2007	54384.308	–	11.486	10.382	9.059	7.773
Oct 29, 2007	54403.354	–	11.534	10.423	9.078	7.771
Nov 12, 2007	54417.246	–	11.528	10.474	9.147	7.803
Nov 20, 2007	54425.290	–	11.549	10.510	9.162	7.825
Nov 21, 2007	54426.383	–	11.561	10.514	9.167	7.826
Dec 5, 2007	54440.300	–	11.442	10.583	9.228	7.873
Dec 21, 2007	54456.270	–	11.456	10.500	9.254	7.839
Jan 3, 2008	54469.279	9.580	10.394	9.754	8.793	7.675
Feb 3, 2008	54500.204	9.123	10.112	9.559	8.716	7.664
Feb 11, 2008	54508.208	9.257	10.128	9.596	8.754	7.705
Feb 20, 2008	54517.217	9.382	10.207	9.598	8.741	7.663
Feb 28, 2008	54525.232	–	10.193	9.568	8.674	7.608
Jun 19, 2008	54636.514	9.337	10.085	9.370	8.508	7.423
Jul 6, 2008	54653.511	9.113	9.935	9.258	8.447	7.382
Jul 11, 2008	54659.378	9.195	9.972	9.293	8.442	7.402
Aug 3, 2008	54682.496	9.440	10.235	9.500	8.588	7.470
Aug 31, 2008	54709.630	9.738	10.443	9.655	8.685	7.536
Oct 11, 2008	54751.489	9.997	10.631	9.846	8.832	7.594
Oct 18, 2008	54758.195	10.053	10.591	9.787	8.796	7.578
Nov 10, 2008	54781.172	10.206	10.789	9.956	8.914	7.677
Nov 28, 2008	54799.369	10.346	10.879	10.065	8.989	7.771
Dec 21, 2008	54822.366	10.553	11.056	10.268	9.172	7.930
Jul 1, 2009	55014.442	-	11.172	10.202	8.963	7.673
Jul 8, 2009	55021.425	–	11.088	10.109	8.915	7.624
Jul 17, 2009	55030.448	–	11.085	10.105	8.907	7.659
Jul 27, 2009	55039.593	–	11.121	10.111	–	7.685
Aug 15, 2009	55058.571	–	10.969	10.001	8.823	7.604
Aug 27, 2009	55071.463	9.844	10.700	9.879	8.804	7.618
Sep 2, 2009	55077.414	9.796	10.571	9.773	8.774	7.571
Sep 7, 2009	55082.420	9.624	10.410	9.677	8.708	7.558
Sep 14, 2009	55089.446	9.490	10.178	9.481	8.607	7.500
Oct 21, 2009	55126.418	8.514	8.996	8.581	8.069	7.229
Nov 15, 2009	55151.398	8.369	8.837	8.417	7.906	7.141
Jan 16, 2010	55213.202	8.321	8.850	8.407	7.868	7.117
Jan 22, 2010	55219.192	8.344	8.882	8.436	7.861	7.094
Jan 25, 2010	55222.197	8.384	8.952	8.469	7.898	7.111

Table 5 Photoelectric U, B, V, R_C observations of BF Cyg from the Skalnaté Pleso observatory.

Date	JD 24...	U	B	V	ΔR_C
Mar 13, 2007	54172.593	10.098	10.619	10.033	2.788
Mar 14, 2007	54173.526	10.172	10.663	10.028	2.792
Apr 5, 2007	54195.542	10.087	10.693	10.091	2.807
Apr 12, 2007	54202.544	10.100	10.665	10.085	2.792
Apr 12, 2007	54203.499	10.096	10.644	10.048	2.775
May 1, 2007	54222.450	10.086	10.691	10.107	2.831
Jun 4, 2007	54256.449	10.194	10.747	10.172	2.889
Jun 16, 2007	54268.459	10.295	10.878	10.316	3.090
Jul 1, 2007	54283.464	10.241	10.777	10.241	3.037
Jul 14, 2007	54296.476	10.310	10.979	10.370	3.077
Jul 17, 2007	54299.398	10.222	10.946	10.329	–
Jul 26, 2007	54308.443	10.280	11.046	10.422	–
Aug 2, 2007	54315.439	10.295	11.080	10.499	3.145
Aug 15, 2007	54328.495	10.334	11.039	10.464	3.177
Aug 25, 2007	54338.417	10.346	11.024	10.476	3.212
Sep 13, 2007	54357.328	10.432	11.193	10.533	3.260
Oct 14, 2007	54388.286	10.716	11.364	10.739	3.370
Nov 5, 2007	54410.206	10.864	11.518	10.860	3.457
Dec 5, 2007	54440.248	11.171	11.861	11.299	3.765
Dec 18, 2007	54453.176	11.160	11.920	11.238	3.750
Dec 27, 2007	54462.193	11.077	11.604	10.975	3.641
Feb 25, 2008	54521.598	10.219	10.715	10.168	–
Feb 26, 2008	54522.638	10.266	10.702	10.176	–
Apr 14, 2008	54571.467	10.132	10.382	9.821	–
Apr 24, 2008	54581.467	10.054	10.274	9.701	–
Jun 1, 2008	54619.463	9.907	10.091	9.610	–
Jul 1, 2008	54649.468	9.722	9.870	9.442	–
Jul 28, 2008	54676.417	9.664	9.774	9.363	–
Jul 31, 2008	54679.424	9.614	9.791	9.367	–
Aug 7, 2008	54686.414	9.750	9.721	9.317	–
Aug 31, 2008	54710.317	9.748	9.759	9.321	–
Sep 1, 2008	54711.353	9.684	9.786	9.313	–
Oct 26, 2008	54766.256	9.860	9.798	9.279	–
Nov 3, 2008	54774.215	9.897	9.865	9.343	–
Nov 4, 2008	54775.211	9.904	9.861	9.330	–
Nov 5, 2008	54776.302	9.839	9.771	9.275	–
Nov 9, 2008	54780.208	9.921	9.882	9.363	–
Mar 15, 2009	54905.582	9.830	9.995	9.482	–
Apr 5, 2009	54926.520	9.800	10.050	9.552	–
Apr 14, 2009	54935.535	9.757	10.017	9.549	–
Apr 15, 2009	54936.571	9.769	10.008	9.543	–
Apr 16, 2009	54937.570	9.756	9.985	9.540	–
Apr 20, 2009	54942.490	9.639	9.927	9.445	–
Apr 21, 2009	54943.486	9.744	9.973	9.501	–
Apr 26, 2009	54947.541	9.752	10.008	9.524	–
May 16, 2009	54968.456	9.788	10.049	9.579	–
May 25, 2009	54977.452	9.768	10.093	9.636	–
Jul 9, 2009	55022.437	9.807	10.085	9.649	–
Jul 12, 2009	55025.421	9.825	10.103	9.667	–
Aug 18, 2009	55062.385	9.839	10.165	9.737	–
Aug 25, 2009	55069.389	9.925	10.233	9.788	–
Sep 7, 2009	55082.281	9.918	10.165	9.730	–
Sep 18, 2009	55093.344	–	–	9.740	–
Oct 21, 2009	55126.291	10.096	10.400	9.952	–
Nov 18, 2009	55154.213	10.231	10.443	9.974	–
Dec 13, 2009	55179.202	10.452	10.637	10.197	–
Mar 10, 2010	55265.570	10.215	10.581	10.033	–
Mar 23, 2010	55278.629	10.031	10.372	9.854	–

Table 5 Continued

Date	JD 24...	U	B	V	ΔR_C
Mar 25, 2010	55280.588	10.062	10.361	9.884	–
Apr 16, 2010	55302.551	9.960	10.125	9.820	–
Apr 23, 2010	55309.527	9.740	9.997	9.768	–
Apr 30, 2010	55316.528	9.930	10.230	9.698	–
May 1, 2010	55317.500	9.937	10.203	9.717	–
May 24, 2010	55340.518	9.792	9.989	9.726	–
Jun 8, 2010	55356.381	0.000	9.925	9.676	–
Jun 9, 2010	55357.439	9.655	9.956	9.689	–
Jul 8, 2010	55385.509	9.810	9.951	9.694	–
Jul 8, 2010	55386.430	9.773	9.966	9.689	–
Jul 17, 2010	55394.530	9.749	9.951	9.626	–
Jul 21, 2010	55399.480	9.794	10.066	9.590	–
Aug 2, 2010	55411.370	9.724	9.946	9.651	–
Aug 7, 2010	55416.411	9.851	10.009	9.676	–
Aug 21, 2010	55430.485	9.811	10.073	9.567	–
Aug 22, 2010	55431.470	9.827	10.141	9.605	–
Aug 29, 2010	55438.369	9.789	9.988	9.578	–
Sep 21, 2010	55461.310	9.760	10.012	9.547	–
Sep 23, 2010	55463.375	9.686	9.956	9.497	–
Oct 7, 2010	55477.260	9.613	9.880	9.454	–
Oct 8, 2010	55478.266	9.641	9.878	9.446	–
Oct 10, 2010	55480.312	9.653	9.911	9.457	–
Oct 29, 2010	55499.233	9.559	9.870	9.425	–
Nov 20, 2010	55521.216	9.680	9.941	9.499	–
Nov 30, 2010	55531.217	9.616	9.947	9.500	–
Dec 15, 2010	55546.205	9.550	9.868	9.470	–
Feb 27, 2011	55619.615	9.614	9.955	9.511	–
Mar 8, 2011	55628.629	9.631	10.026	9.569	–
Mar 25, 2011	55645.590	9.509	9.940	9.534	–
Mar 30, 2011	55650.533	9.578	10.008	9.570	–
Mar 31, 2011	55651.574	9.570	10.031	9.603	–
Apr 19, 2011	55670.536	9.600	10.050	9.608	–
Apr 21, 2011	55672.522	9.664	10.050	9.632	–
Apr 21, 2011	55673.496	9.999	10.035	9.624	–
Apr 23, 2011	55674.519	9.664	10.066	9.649	–
May 5, 2011	55687.495	9.577	10.032	9.623	–
May 9, 2011	55691.469	9.613	10.063	9.662	–
May 20, 2011	55701.563	9.492	9.949	9.585	–
May 21, 2011	55703.452	9.617	10.110	9.671	–
May 31, 2011	55712.515	9.695	10.152	9.749	–
Aug 12, 2011	55786.352	0.000	10.297	9.894	–
Aug 18, 2011	55791.526	9.874	10.256	9.867	–
Aug 19, 2011	55792.514	9.876	10.289	9.864	–
Sep 3, 2011	55808.327	9.923	10.335	9.901	–
Sep 15, 2011	55820.366	9.958	10.301	9.899	–
Sep 26, 2011	55831.361	9.950	10.321	9.884	–
Oct 3, 2011	55838.309	9.994	10.363	9.954	–
Oct 16, 2011	55851.271	10.045	10.382	9.976	–
Oct 17, 2011	55852.303	9.989	10.311	9.966	–
Oct 18, 2011	55853.291	10.011	10.350	9.960	–
Nov 3, 2011	55869.219	10.075	10.400	9.975	–
Nov 8, 2011	55874.198	10.040	10.384	9.962	–
Nov 13, 2011	55879.223	10.160	10.496	10.054	–
Nov 15, 2011	55881.251	10.185	10.473	10.066	–
Nov 16, 2011	55882.213	10.100	10.428	10.007	–
Nov 17, 2011	55883.222	10.107	10.454	10.024	–
Nov 18, 2011	55884.203	10.232	10.569	10.122	–

Table 6 CCD U, B, V, R_C, I_C observations of BF Cyg from the Stará Lesná observatory.

Date	JD 24...	U	B	V	R_C	I_C
Aug 10, 2004	53228.385	11.253	12.242	11.675	10.370	9.227
Aug 29, 2004	53247.478	11.126	12.230	11.724	10.401	9.463
Sep 6, 2004	53255.400	–	12.173	11.683	10.370	9.393
Sep 19, 2004	53268.330	10.990	12.128	11.613	10.429	9.357
Oct 3, 2004	53282.397	10.903	12.073	11.567	10.341	9.537
Oct 21, 2004	53300.322	10.987	12.083	11.604	10.431	9.519
Mar 31, 2005	53460.627	10.690	11.737	11.184	10.039	9.173
Apr 4, 2005	53464.597	10.699	11.745	11.166	10.002	9.060
May 14, 2005	53504.547	10.769	11.778	11.228	10.071	9.078
Jul 3, 2005	53554.569	11.464	12.343	11.834	10.449	9.442
Jul 14, 2005	53566.333	11.518	12.377	11.855	10.468	9.411
Jul 20, 2005	53572.360	11.565	12.410	11.886	10.574	9.332
Jul 27, 2005	53579.405	11.540	12.391	11.873	10.535	9.373
Aug 1, 2005	53584.397	11.610	12.394	11.870	10.528	9.324
Aug 11, 2005	53594.420	11.579	12.440	11.964	10.627	9.451
Sep 2, 2005	53616.338	11.819	12.562	12.094	10.765	9.465
Sep 5, 2005	53619.288	11.738	12.543	12.070	10.726	9.487
Sep 8, 2005	53622.334	11.904	12.549	12.082	10.662	9.371
Oct 31, 2005	53675.260	12.410	12.972	12.485	11.069	9.674
Dec 19, 2005	53724.197	–	12.942	12.421	11.052	9.539
Jan 24, 2006	53759.657	12.193	12.909	12.453	11.058	9.639
Apr 25, 2006	53850.530	11.926	12.580	12.047	10.742	9.390
May 19, 2006	53875.478	11.630	12.411	11.857	10.651	9.356
Jun 14, 2006	53901.466	11.348	12.226	11.647	10.501	9.297
Aug 21, 2006	53969.415	9.510	10.506	10.008	9.401	8.661
Aug 22, 2006	53970.410	9.450	10.449	9.990	9.395	8.663
Sep 7, 2006	53986.324	9.344	10.464	9.912	9.157	8.560
Oct 17, 2006	54026.203	9.693	10.483	9.960	9.308	8.719
Nov 10, 2006	54050.183	9.808	10.486	9.938	9.371	8.660
Nov 17, 2006	54057.215	9.818	10.481	9.883	9.298	8.561
Dec 18, 2006	54088.165	10.045	10.676	10.079	9.429	8.615
Mar 26, 2007	54185.607	10.208	10.636	10.032	9.341	8.508
Mar 31, 2007	54190.561	10.108	10.671	10.076	9.420	8.522
Apr 13, 2007	54203.552	10.022	10.629	10.004	9.349	8.586
May 2, 2007	54222.579	10.042	10.661	10.083	9.478	8.626
May 23, 2007	54243.571	10.131	10.701	10.095	9.515	8.659
Jun 9, 2007	54260.530	10.177	10.836	10.240	9.553	8.626
Jun 24, 2007	54275.510	10.191	10.861	10.259	9.594	8.791
Jul 22, 2007	54303.560	10.238	10.870	10.284	9.661	8.840
Aug 23, 2007	54335.503	–	11.104	10.521	9.856	9.229
Sep 20, 2007	54364.340	10.505	11.173	10.589	9.923	9.259
Oct 10, 2007	54384.250	10.634	11.283	10.637	10.010	9.254
Dec 23, 2007	54458.174	11.191	11.732	11.080	10.241	9.285
Feb 17, 2008	54513.678	10.376	10.879	10.313	9.669	8.788
Feb 29, 2008	54525.623	10.218	10.621	10.074	9.466	8.658
Mar 21, 2008	54546.637	10.140	10.487	9.941	9.470	8.682
Apr 1, 2008	54557.527	10.178	10.492	9.957	9.413	8.605
Apr 25, 2008	54582.457	9.949	10.267	9.747	9.211	8.486
May 6, 2008	54592.601	9.931	10.115	9.587	9.120	8.362
May 14, 2008	54601.449	9.872	10.065	9.534	9.107	8.412
Jun 18, 2008	54636.458	9.751	9.929	9.475	9.135	8.484
Jun 29, 2008	54647.333	9.737	9.902	9.497	9.085	8.493
Jul 3, 2008	54651.349	–	9.888	9.456	9.034	8.438
Jul 10, 2008	54658.402	9.726	9.904	9.485	9.133	8.403
Jul 18, 2008	54666.462	9.735	9.891	9.481	9.117	8.402

Table 6 Continued

Date	JD 24...	U	B	V	R_C	I_C
Jul 29, 2008	54677.356	9.661	9.856	9.422	8.975	8.435
Aug 3, 2008	54682.430	9.613	9.771	9.359	9.017	8.439
Aug 11, 2008	54690.300	–	9.696	9.241	8.952	8.293
Aug 19, 2008	54698.494	–	9.722	9.259	8.956	8.353
Aug 29, 2008	54707.524	–	9.761	9.325	8.908	8.403
Oct 11, 2008	54751.233	–	9.782	9.284	8.970	8.304
Oct 17, 2008	54757.192	–	9.735	9.281	8.906	8.218
Nov 6, 2008	54777.175	–	9.789	9.271	8.848	8.201
Nov 18, 2008	54789.152	–	9.833	9.323	8.940	8.229
Dec 31, 2008	54831.727	–	9.867	9.317	8.918	8.269
Mar 22, 2009	54912.569	9.721	10.001	9.472	9.046	8.261
Apr 1, 2009	54922.563	9.726	10.017	9.462	8.966	8.246
Apr 5, 2009	54926.570	9.746	10.023	9.527	9.047	8.337
Apr 18, 2009	54939.617	9.634	9.908	9.408	8.961	8.378
Apr 27, 2009	54948.523	9.598	10.004	9.503	9.101	8.329
Jun 18, 2009	55000.539	9.770	10.038	9.590	9.127	8.454
Jun 24, 2009	55007.342	9.771	10.102	9.564	9.190	8.437
Jul 1, 2009	55014.370	9.840	10.115	9.650	9.205	8.527
Jul 8, 2009	55021.367	9.841	10.100	9.661	9.264	8.464
Jul 17, 2009	55029.512	9.794	10.042	9.614	9.194	8.575
Aug 8, 2009	55052.292	9.910	10.192	9.729	9.347	8.615
Aug 27, 2009	55071.377	9.845	10.186	9.763	9.371	8.629
Sep 2, 2009	55077.377	9.866	10.096	9.681	9.243	8.723
Sep 14, 2009	55089.410	9.951	10.188	9.768	9.355	8.762
Sep 22, 2009	55097.288	9.972	10.215	9.811	9.385	8.782
Nov 15, 2009	55151.255	10.124	10.365	9.918	9.529	8.913
Nov 22, 2009	55158.198	10.188	10.411	9.948	9.501	8.835
Jan 23, 2010	55219.708	10.341	10.621	10.113	9.569	8.674
Mar 2, 2010	55257.666	–	–	9.901	9.418	8.663
Mar 24, 2010	55279.528	10.124	10.354	9.907	9.374	8.587

Table 7 Photoelectric U, B, V, R_C observations of CH Cyg from the Skalnaté Pleso observatory.

Date	JD 24...	U	B	V	ΔR_C
Mar 12, 2007	54172.496	11.329	11.319	9.813	-0.278
Mar 13, 2007	54173.482	11.404	11.254	9.729	-0.440
Apr 4, 2007	54195.470	11.408	11.202	9.558	-0.620
Apr 12, 2007	54203.369	11.614	11.173	9.503	-0.686
Jul 1, 2007	54283.494	11.747	11.180	9.327	-0.832
Jul 14, 2007	54296.438	11.678	11.223	9.386	-0.801
Jul 26, 2007	54308.383	11.861	11.268	9.329	–
Aug 2, 2007	54315.389	11.550	11.178	9.325	-0.880
Aug 15, 2007	54328.379	11.728	11.172	9.299	-0.917
Aug 25, 2007	54338.400	11.790	11.269	9.394	-0.829
Nov 2, 2007	54407.406	11.646	10.769	8.762	-1.308
Nov 5, 2007	54410.352	11.626	10.697	8.702	-1.435
Dec 5, 2007	54440.230	11.693	10.968	9.048	-1.163
Dec 25, 2007	54460.268	11.800	11.065	9.188	-1.043
Dec 27, 2007	54462.266	11.885	11.146	9.244	-1.020
Jan 3, 2008	54468.705	11.790	11.136	9.278	-1.037
Jan 15, 2008	54480.702	11.730	11.036	9.156	-1.132
Feb 25, 2008	54521.558	11.910	10.372	8.354	–
Feb 26, 2008	54522.588	11.906	10.378	8.363	–
Apr 14, 2008	54571.429	11.783	10.675	8.738	–
Apr 24, 2008	54581.421	11.872	10.542	8.586	–
May 7, 2008	54594.494	11.758	10.304	8.321	–
Jun 1, 2008	54619.421	11.712	10.204	8.218	–
Jul 2, 2008	54650.390	11.953	10.847	8.954	–
Aug 1, 2008	54680.456	11.678	10.726	8.843	–
Aug 7, 2008	54686.373	11.170	10.528	8.674	–
Aug 31, 2008	54710.395	11.770	10.359	8.446	–
Sep 1, 2008	54711.423	11.788	10.455	8.520	–
Sep 2, 2008	54712.422	11.763	10.451	8.519	–
Nov 4, 2008	54775.284	11.903	10.883	8.980	–
Nov 9, 2008	54780.281	11.789	10.847	9.012	–
Dec 31, 2008	54831.673	11.759	11.068	9.295	–
Jan 3, 2009	54835.219	11.795	11.161	9.366	–
Jan 17, 2009	54848.650	11.824	11.052	9.267	–
Mar 1, 2009	54891.529	11.513	10.363	8.443	–
Mar 14, 2009	54904.547	11.525	10.449	8.583	–
Apr 4, 2009	54926.479	11.588	10.548	8.697	–
Apr 13, 2009	54935.455	11.536	10.560	8.725	–
Apr 14, 2009	54936.437	11.502	10.526	8.716	–
Apr 15, 2009	54937.438	11.537	10.558	8.718	–
Apr 20, 2009	54942.418	11.577	10.603	8.757	–
Apr 21, 2009	54943.401	11.637	10.637	8.801	–
Apr 25, 2009	54947.401	11.480	10.564	8.787	–
May 16, 2009	54968.414	11.598	10.702	8.886	–
May 17, 2009	54969.397	11.638	10.733	8.892	–
May 18, 2009	54970.363	11.630	10.713	8.882	–
May 25, 2009	54977.395	11.519	10.692	8.871	–
Jul 9, 2009	55022.391	11.356	10.246	8.366	–
Jul 12, 2009	55025.382	11.391	10.259	8.384	–
Jul 17, 2009	55030.465	11.405	10.295	8.391	–
Jul 30, 2009	55043.451	10.452	9.921	8.290	–
Aug 8, 2009	55052.396	10.827	10.157	8.360	–
Aug 18, 2009	55062.347	10.925	10.119	8.285	–
Aug 25, 2009	55069.321	10.929	10.082	8.248	–
Sep 18, 2009	55093.486	10.881	9.936	8.070	–
Sep 21, 2009	55096.499	10.777	9.850	8.099	–
Oct 31, 2009	55136.208	9.637	9.699	8.203	–
Nov 15, 2009	55151.327	9.313	9.529	8.109	–

Table 7 Continued

Date	JD 24...	*U*	*B*	*V*	ΔR_C
Nov 28, 2009	55164.299	10.116	9.833	8.217	–
Dec 13, 2009	55179.248	10.321	9.770	8.062	–
Jan 16, 2010	55212.659	11.199	10.014	8.123	–
Mar 9, 2010	55264.623	11.681	10.751	8.894	–
Mar 22, 2010	55278.496	12.099	10.909	9.006	–
Mar 24, 2010	55280.456	0.000	10.866	9.045	–
Mar 28, 2010	55284.489	11.830	10.835	8.884	–
Apr 7, 2010	55294.451	11.546	10.739	8.854	–
Apr 15, 2010	55302.423	11.650	10.690	8.800	–
Apr 17, 2010	55304.450	11.566	10.758	8.884	–
Apr 22, 2010	55309.417	11.590	10.833	8.960	–
Apr 30, 2010	55316.501	11.501	10.940	9.033	–
May 1, 2010	55317.521	11.521	10.882	9.044	–
May 23, 2010	55340.455	11.679	11.074	9.385	–
Jun 7, 2010	55355.417	–	10.962	9.190	–
Jun 8, 2010	55356.428	11.530	10.911	9.145	–
Jun 10, 2010	55357.519	11.549	10.808	9.095	–
Jun 29, 2010	55377.403	11.006	10.592	8.876	–
Jul 7, 2010	55385.453	11.153	10.607	8.906	–
Jul 8, 2010	55386.379	11.018	10.582	8.862	–
Jul 16, 2010	55394.478	11.144	10.570	8.854	–
Jul 22, 2010	55399.536	11.255	10.720	8.975	–
Aug 2, 2010	55410.522	11.263	10.848	9.138	–
Aug 7, 2010	55416.352	11.157	10.780	9.158	–
Aug 21, 2010	55430.341	11.283	10.794	9.159	–
Aug 22, 2010	55431.350	11.130	10.810	9.183	–
Aug 24, 2010	55433.327	11.221	10.766	9.148	–
Sep 7, 2010	55447.470	11.179	10.986	9.433	–
Sep 21, 2010	55461.360	11.016	11.055	9.608	–
Oct 7, 2010	55477.310	11.227	11.089	9.588	–
Oct 8, 2010	55478.384	11.260	11.122	9.594	–
Oct 9, 2010	55479.476	11.269	11.081	9.568	–
Oct 29, 2010	55499.290	11.080	11.045	9.644	–
Nov 20, 2010	55521.269	–	11.240	9.856	–
Nov 30, 2010	55531.328	10.729	10.765	9.510	–
Jan 2, 2011	55564.227	10.731	10.829	9.557	–
Jan 16, 2011	55578.205	10.617	10.714	9.379	–
Jan 25, 2011	55586.689	11.222	11.066	9.595	–
Jan 31, 2011	55592.649	11.187	10.941	9.417	–
Feb 1, 2011	55593.638	11.081	10.900	9.378	–
Feb 27, 2011	55619.558	11.085	10.755	9.194	–
Mar 8, 2011	55628.577	11.053	10.840	9.286	–
Mar 24, 2011	55645.490	11.211	11.044	9.550	–
Mar 29, 2011	55650.462	11.317	11.111	9.571	–
Mar 30, 2011	55651.490	11.281	11.089	9.574	–
Apr 18, 2011	55670.436	11.418	11.059	9.561	–
Apr 19, 2011	55671.404	11.404	11.080	9.552	–
Apr 20, 2011	55672.424	11.258	11.033	9.538	–
Apr 21, 2011	55673.407	11.324	11.075	9.520	–
Apr 22, 2011	55674.421	11.307	11.018	9.485	–
May 6, 2011	55688.392	11.084	10.704	9.120	–
May 9, 2011	55691.354	10.992	10.627	9.090	–
May 16, 2011	55698.416	11.146	10.618	9.012	–
May 26, 2011	55708.375	10.741	10.415	8.854	–
Jun 16, 2011	55729.497	10.787	10.308	8.680	–
Jun 20, 2011	55733.397	10.806	10.430	8.668	–
Jul 9, 2011	55752.423	10.720	10.259	8.666	–

Table 7 Continued

Date	JD 24...	U	B	V	ΔR_C
Aug 10, 2011	55783.524	10.880	10.030	8.406	–
Aug 17, 2011	55791.426	10.529	9.708	8.084	–
Aug 18, 2011	55792.390	10.528	9.695	8.077	–
Sep 3, 2011	55808.481	10.413	9.641	8.042	–
Sep 6, 2011	55811.312	10.352	9.649	7.966	–
Sep 12, 2011	55817.488	10.389	9.729	8.113	–
Sep 15, 2011	55820.429	10.456	9.765	8.159	–
Sep 16, 2011	55821.485	10.286	9.736	8.179	–
Sep 25, 2011	55830.422	10.364	9.782	8.213	–
Sep 27, 2011	55832.388	10.341	9.787	8.219	–
Sep 30, 2011	55835.480	10.541	9.891	8.281	–
Oct 3, 2011	55838.439	10.333	9.771	8.248	–
Oct 4, 2011	55839.440	10.285	9.786	8.276	–
Oct 9, 2011	55844.360	10.274	9.799	8.283	–
Oct 18, 2011	55853.470	10.218	9.793	8.264	–
Oct 31, 2011	55866.396	10.338	9.843	8.285	–
Nov 3, 2011	55869.303	10.334	9.847	8.246	–
Nov 8, 2011	55874.360	10.097	9.662	8.105	–
Nov 13, 2011	55879.357	10.143	9.558	7.959	–
Nov 15, 2011	55881.364	10.009	9.472	7.872	–
Nov 16, 2011	55882.321	10.143	9.492	7.873	–
Nov 17, 2011	55883.332	10.125	9.464	7.840	–
Nov 18, 2011	55884.361	9.964	9.381	7.768	–

Table 8 CCD U, B, V, R_C observations of CH Cyg from the Stará Lesná observatory.

Date	JD 24...	U	B	V	R_C
Aug 8, 2007	54321.380	11.805	11.220	9.239	6.749
Sep 21, 2007	54365.400	11.899	11.476	9.561	–
Sep 23, 2007	54367.339	11.923	11.505	9.565	–
May 10, 2008	54597.482	11.664	10.248	8.204	–
May 15, 2008	54601.592	11.618	10.159	8.107	–
May 17, 2008	54603.596	11.625	10.123	8.076	–
Jun 30, 2008	54647.575	11.816	10.800	8.845	–
Jul 18, 2008	54666.496	11.849	10.853	8.922	–
Aug 3, 2008	54682.338	11.772	10.652	8.739	–
Aug 6, 2008	54684.556	11.658	10.634	8.684	–
Aug 12, 2008	54691.292	11.738	10.496	8.505	–
Aug 29, 2008	54707.553	11.345	10.363	8.410	–
Aug 31, 2008	54710.260	11.727	10.425	8.423	–
Oct 15, 2008	54755.442	11.731	10.822	8.917	6.475
Oct 19, 2008	54759.201	11.968	10.871	8.928	6.529
Nov 11, 2008	54782.212	11.874	10.852	8.962	6.548
Dec 8, 2008	54809.261	11.667	10.833	9.013	6.511
Dec 27, 2008	54828.245	11.743	11.040	9.216	–
Dec 29, 2008	54830.245	11.738	11.031	9.202	–
Jan 1, 2009	54832.724	11.665	11.028	9.196	6.588
Jan 12, 2009	54844.161	11.750	11.023	9.200	6.629
Mar 22, 2009	54912.657	11.469	10.411	8.544	6.076
Apr 1, 2009	54922.612	11.474	10.515	8.642	6.169
Apr 5, 2009	54926.613	11.535	10.538	8.654	–
Apr 19, 2009	54940.619	11.468	10.566	8.701	–
Apr 28, 2009	54950.439	11.474	10.594	8.753	6.164
May 13, 2009	54965.382	11.367	10.633	8.780	–
May 18, 2009	54969.588	11.603	10.686	8.798	6.183
May 23, 2009	54975.402	11.485	10.665	8.822	6.215
May 24, 2009	54976.365	11.472	10.666	8.795	6.124
May 26, 2009	54978.323	11.329	10.670	8.783	6.151
Jun 1, 2009	54984.390	11.425	10.643	8.784	–
Jun 2, 2009	54985.351	11.281	10.610	8.752	–
Jun 3, 2009	54986.395	11.485	10.619	8.729	–
Jun 18, 2009	55000.578	11.437	10.331	8.462	5.963
Jun 24, 2009	55007.334	11.373	10.283	8.344	5.880
Jul 1, 2009	55014.353	11.295	10.222	8.285	–
Jul 8, 2009	55021.350	11.384	10.251	8.319	–
Jul 16, 2009	55029.469	11.279	10.285	8.363	–
Jul 17, 2009	55030.378	11.356	10.295	8.367	–
Jul 22, 2009	55035.314	11.322	10.308	8.376	–
Jul 24, 2009	55037.317	11.294	10.288	8.371	–
Jul 25, 2009	55038.425	11.051	10.153	8.339	5.928
Jul 28, 2009	55040.599	10.128	9.777	8.168	5.840
Jul 30, 2009	55043.325	10.562	9.979	8.232	–
Aug 7, 2009	55051.294	10.930	10.152	8.296	5.883
Aug 9, 2009	55052.606	10.846	10.129	8.303	5.890
Aug 15, 2009	55058.546	10.768	10.075	8.239	–
Aug 19, 2009	55062.536	10.824	10.059	8.223	5.781
Aug 19, 2009	55063.356	10.920	10.065	8.213	–
Aug 23, 2009	55067.306	11.050	10.067	8.199	–
Aug 25, 2009	55069.273	11.030	10.066	8.171	5.825
Aug 27, 2009	55071.353	10.883	10.017	8.166	–
Sep 1, 2009	55076.392	10.979	10.003	8.121	–
Sep 5, 2009	55080.348	10.706	9.835	8.044	–
Sep 7, 2009	55082.316	10.877	9.953	8.066	–
Sep 14, 2009	55089.377	10.804	9.903	8.019	–

Table 8 Continued

Date	JD 24...	*U*	*B*	*V*	R_C
Sep 22, 2009	55097.255	10.711	9.832	7.961	–
Sep 25, 2009	55100.368	10.859	9.875	7.987	–
Oct 21, 2009	55126.297	9.702	9.633	8.083	5.797
Oct 31, 2009	55136.277	9.639	9.628	8.107	–
Nov 2, 2009	55138.323	9.568	9.593	8.094	5.792
Nov 5, 2009	55141.249	9.820	9.679	8.102	5.806
Nov 13, 2009	55149.288	9.638	9.665	8.090	5.786
Nov 15, 2009	55151.233	9.392	9.402	8.001	5.747
Nov 16, 2009	55152.269	9.783	9.640	8.130	5.771
Nov 23, 2009	55159.332	9.548	9.509	8.059	5.763
Nov 26, 2009	55162.214	10.003	9.714	8.099	–
Nov 28, 2009	55164.218	10.125	9.730	8.110	–
Dec 2, 2009	55168.279	10.289	9.850	8.154	5.797
Dec 4, 2009	55170.161	10.482	9.872	8.115	5.840
Jan 16, 2010	55213.191	11.106	10.024	8.040	5.829
Jan 22, 2010	55219.179	11.145	10.047	8.127	5.811
Jan 23, 2010	55220.179	11.260	9.995	8.030	5.799
Jan 25, 2010	55221.730	11.300	9.871	8.031	–
Feb 26, 2010	55253.694	11.527	10.573	8.640	6.333
Mar 2, 2010	55257.687	11.520	10.567	8.690	6.410
Mar 4, 2010	55259.686	11.719	10.581	8.693	6.374
Mar 9, 2010	55264.684	11.433	10.505	8.709	6.466
Mar 25, 2010	55280.654	11.843	10.729	8.749	–
Apr 2, 2010	55288.642	11.892	10.676	–	6.404
Apr 20, 2010	55306.613	11.301	10.712	8.761	6.460
Apr 25, 2010	55311.603	11.479	10.721	8.856	6.535
Apr 29, 2010	55315.604	11.349	10.694	8.900	6.591

Table 9 Photoelectric U, B, V, R_C observations of CI Cyg from the Skalnaté Pleso and Hvar observatories.

Date	JD 24...	U	B	V	ΔR_C
Feb 15, 2007	54146.569	11.331	11.833	10.731	0.515
Mar 13, 2007	54172.557	11.408	11.941	10.717	0.515
Mar 14, 2007	54173.561	11.429	11.914	10.719	0.555
Apr 13, 2007	54203.541	11.384	11.896	10.656	0.510
Jun 4, 2007	54256.484	11.351	11.860	10.708	0.533
Jun 16, 2007	54268.490	11.477	11.955	10.754	0.591
Jul 2, 2007	54283.525	11.476	11.942	10.763	0.593
Jul 15, 2007	54296.500	11.486	12.056	10.808	0.672
Jul 26, 2007	54308.415	11.482	11.983	10.816	9.000
Aug 15, 2007	54328.444	11.550	12.122	10.876	0.584
Aug 25, 2007	54338.445	11.563	12.038	10.782	0.709
Sep 13, 2007	54357.445	11.560	12.130	10.908	0.756
Oct 14, 2007	54388.406	11.568	12.152	10.994	0.841
Nov 5, 2007	54410.280	11.806	12.519	11.172	1.070
Dec 26, 2007	54461.228	11.991	12.575	–	1.200
Jan 15, 2008	54480.663	11.993	12.276	11.174	0.940
Feb 25, 2008	54521.642	11.935	12.492	11.107	–
Apr 15, 2008	54571.507	11.784	12.332	11.015	–
Apr 25, 2008	54581.510	11.705	12.225	10.972	–
Jun 2, 2008	54620.376	12.203	12.367	10.959	–
Aug 2, 2008	54680.507	11.539	12.167	10.918	–
Aug 7, 2008	54686.452	11.241	12.104	10.853	–
Aug 31, 2008	54710.358	10.180	10.517	9.705	–
Sep 1, 2008	54711.393	10.158	10.571	9.719	–
Oct 18, 2008	54758.381	9.901	10.286	9.621	–
Oct 25, 2008	54765.403	9.878	10.343	9.611	–
Nov 3, 2008	54774.374	9.856	10.376	9.663	–
Nov 4, 2008	54775.250	9.911	10.435	9.683	–
Nov 5, 2008	54776.343	9.862	10.342	9.640	–
Nov 9, 2008	54780.246	9.870	10.344	9.647	–
Dec 30, 2008	54831.215	9.862	10.429	9.708	–
Mar 15, 2009	54905.543	10.058	10.678	9.883	–
Apr 5, 2009	54926.560	10.267	10.789	9.973	–
Apr 13, 2009	54935.498	10.278	10.778	9.937	–
Apr 15, 2009	54936.529	10.315	10.792	9.968	–
Apr 16, 2009	54937.514	10.304	10.773	9.959	–
Apr 20, 2009	54942.451	10.365	10.822	10.032	–
Apr 21, 2009	54943.444	10.379	10.838	10.029	–
Apr 25, 2009	54947.475	10.283	10.785	9.973	–
May 17, 2009	54968.500	10.402	10.875	10.097	–
May 17, 2009	54969.476	10.429	10.894	10.096	–
May 25, 2009	54977.496	10.433	10.913	10.045	–
Jul 9, 2009	55022.474	10.696	11.101	10.223	–
Jul 12, 2009	55025.460	10.708	11.136	10.240	–
Jul 18, 2009	55030.534	10.671	11.131	10.242	–
Aug 18, 2009	55062.412	10.937	11.286	10.390	–
Aug 25, 2009	55069.459	10.903	11.266	10.296	–
Aug 31, 2009	55075.462	10.908	11.376	10.360	–
Sep 7, 2009	55082.356	10.939	11.450	10.388	–
Sep 18, 2009	55093.448	10.962	11.480	10.470	–
Oct 21, 2009	55126.397	11.014	11.606	10.520	–
Nov 15, 2009	55151.280	11.020	11.614	10.592	–
Nov 18, 2009	55154.270	11.027	11.610	10.600	–
Apr 22, 2010	55309.470	11.666	12.031	10.813	–

Table 9 Continued

Date	JD 24...	U	B	V	ΔR_C
Apr 29, 2010	55316.483	11.711	11.993	10.797	–
Apr 30, 2010	55317.423	11.684	12.010	10.743	–
Jun 9, 2010	55357.379	11.682	12.098	10.857	–
Jun 29, 2010	55377.488	11.666	11.915	10.636	–
Jul 9, 2010	55387.448	11.380	11.778	10.607	–
Jul 10, 2010	55387.500	–	11.705	10.528	–
Jul 22, 2010	55400.393	11.252	11.699	10.612	–
Aug 2, 2010	55411.426	10.496	11.339	10.265	–
Aug 8, 2010	55417.394	10.400	11.106	10.202	–
Aug 22, 2010	55431.419	10.184	10.938	9.992	–
† Sep 14, 2010	55454.300	10.911	11.302	10.365	–
† Sep 14, 2010	55454.302	10.930	11.363	10.368	–
† Sep 15, 2010	55455.367	10.988	11.461	10.393	–
† Sep 15, 2010	55455.369	10.984	11.421	10.384	–
† Sep 15, 2010	55455.370	10.970	11.424	10.423	–
† Sep 19, 2010	55459.345	11.251	11.744	10.618	–
† Sep 19, 2010	55459.347	11.318	11.691	10.614	–
† Sep 20, 2010	55460.312	11.404	11.746	10.685	–
† Sep 20, 2010	55460.313	11.452	11.788	10.614	–
Sep 21, 2010	55461.408	11.461	11.705	10.671	–
Sep 23, 2010	55463.432	11.502	11.802	10.598	–
Oct 7, 2010	55477.356	11.891	12.304	11.114	–
Oct 8, 2010	55478.325	11.853	12.260	11.099	–
Oct 9, 2010	55479.431	11.849	12.335	11.175	–
Oct 10, 2010	55480.359	11.937	12.346	11.186	–
Oct 29, 2010	55499.343	11.811	12.266	11.026	–
Nov 30, 2010	55531.273	11.086	11.752	10.680	–
Dec 16, 2010	55547.248	10.954	11.607	10.697	–
Feb 27, 2011	55619.656	11.041	11.662	10.773	–
Mar 25, 2011	55645.547	11.093	11.759	10.890	–
Mar 30, 2011	55650.575	11.170	11.789	10.894	–
Mar 31, 2011	55651.535	11.172	11.763	10.877	–
Apr 19, 2011	55671.474	–	11.807	10.880	–
Apr 20, 2011	55672.470	11.235	11.847	10.963	–
Apr 21, 2011	55673.452	11.296	11.725	10.834	–
Apr 22, 2011	55674.467	11.218	11.747	10.869	–
May 5, 2011	55687.450	11.254	11.804	10.885	–
May 6, 2011	55688.437	11.257	11.810	10.884	–
May 9, 2011	55691.421	11.230	11.849	10.894	–
May 11, 2011	55693.456	11.276	11.867	10.901	–
May 16, 2011	55698.471	11.320	11.829	10.911	–
May 20, 2011	55701.509	11.317	11.863	10.884	–
May 21, 2011	55703.407	11.263	11.818	10.818	–
May 26, 2011	55708.454	11.268	11.861	10.866	–
Jun 4, 2011	55717.499	11.229	11.826	10.787	–
Aug 12, 2011	55786.403	11.191	11.868	10.726	–
Aug 17, 2011	55791.479	11.198	11.926	10.721	–
Aug 18, 2011	55792.473	11.232	11.863	10.689	–
Sep 1, 2011	55805.539	11.287	11.839	10.700	–
Sep 3, 2011	55808.407	11.275	11.912	10.755	–
Sep 15, 2011	55820.304	11.222	11.862	10.747	–
Sep 16, 2011	55821.419	11.224	11.832	10.709	–
Sep 25, 2011	55830.379	11.271	11.860	10.689	–
Sep 27, 2011	55832.334	11.304	11.842	10.664	–
Sep 30, 2011	55835.437	11.285	11.834	10.647	–

Table 9 Continued

Date	JD 24...	U	B	V	ΔR_C
Oct 3, 2011	55838.400	11.242	11.766	10.690	–
Oct 9, 2011	55844.320	–	11.848	10.770	–
Oct 17, 2011	55852.421	11.267	11.790	10.750	–
Oct 31, 2011	55866.349	11.322	11.852	10.693	–
Nov 3, 2011	55869.261	11.277	11.838	10.657	–
Nov 6, 2011	55872.262	11.394	11.858	10.714	–
Nov 8, 2011	55874.234	11.299	11.870	10.645	–
Nov 13, 2011	55879.288	11.285	11.852	10.693	–
Nov 15, 2011	55881.321	11.326	11.793	10.679	–
Nov 16, 2011	55882.268	11.229	11.853	10.678	–
Nov 17, 2011	55883.281	11.355	11.875	10.702	–
Nov 18, 2011	55884.254	11.320	11.884	10.657	–

† – Observations obtained at the Hvar observatory

Table 10 CCD U, B, V, R_C, I_C observations of CI Cyg from the Stará Lesná observatory.

Date	JD 24...	U	B	V	R_C	I_C
Jul 23, 2007	54305.381	11.428	11.935	10.732	9.303	7.708
Sep 20, 2007	54364.386	11.495	12.029	10.794	9.365	7.657
Sep 21, 2007	54365.439	11.459	12.002	10.727	9.314	7.675
Sep 23, 2007	54367.373	11.508	12.053	10.801	9.361	7.662
Oct 10, 2007	54384.279	11.518	12.028	10.811	9.373	7.666
Dec 20, 2007	54455.216	11.874	12.308	11.201	9.723	7.886
May 12, 2008	54598.557	11.646	12.126	10.875	9.435	7.627
Jun 18, 2008	54636.489	11.687	12.198	10.782	9.362	7.564
Jun 29, 2008	54647.340	11.705	12.256	10.845	9.400	7.637
Aug 3, 2008	54682.470	11.509	12.047	10.798	9.327	7.634
Aug 5, 2008	54684.463	11.531	12.085	10.810	9.320	7.607
Aug 11, 2008	54690.498	11.418	11.939	10.708	9.295	7.602
Aug 30, 2008	54709.265	10.270	10.564	9.683	8.759	7.372
Oct 17, 2008	54757.244	–	10.271	9.600	8.700	7.459
Nov 15, 2008	54786.162	–	10.370	9.614	8.755	7.437
Dec 28, 2008	54829.159	–	10.402	9.620	8.736	7.387
Dec 28, 2008	54829.159	–	10.402	9.618	8.736	7.387
Mar 22, 2009	54912.581	10.272	10.618	9.765	8.769	7.433
Apr 2, 2009	54923.553	10.356	10.685	9.826	8.790	7.425
Apr 5, 2009	54926.591	10.357	10.689	9.836	8.787	7.422
Apr 28, 2009	54950.467	10.449	10.801	9.927	8.884	7.493
Jun 18, 2009	55000.565	10.587	10.948	10.012	8.918	7.525
Jul 1, 2009	55014.384	10.669	11.004	10.072	8.966	7.558
Jul 16, 2009	55029.484	10.755	11.070	10.138	9.016	7.598
Jul 25, 2009	55038.350	10.853	11.209	10.245	9.078	7.578
Aug 9, 2009	55052.503	10.918	11.240	10.297	9.105	7.638
Aug 19, 2009	55063.334	–	11.309	10.315	9.106	7.621
Aug 24, 2009	55068.403	10.897	11.261	10.233	9.025	7.570
Aug 28, 2009	55072.379	10.878	11.282	10.218	8.982	7.562
Sep 1, 2009	55076.411	10.893	11.327	10.242	8.997	7.561
Sep 7, 2009	55082.393	10.918	11.348	10.262	8.982	7.536
Sep 14, 2009	55089.393	10.980	11.426	10.325	8.993	7.552
Sep 22, 2009	55097.271	11.032	11.499	10.405	9.032	7.576
Sep 25, 2009	55100.387	11.049	11.501	10.426	9.065	7.594
Nov 16, 2009	55152.287	11.129	11.605	10.486	9.083	7.565
Nov 22, 2009	55158.192	11.146	11.615	10.511	9.126	7.593
Jan 24, 2010	55220.708	11.497	11.944	10.905	9.392	7.751
Mar 2, 2010	55257.678	11.706	12.137	11.119	9.612	7.855
Mar 24, 2010	55279.541	11.720	12.158	11.015	9.496	7.764

Table 11 CCD I_C, R_C, V, B, U observations from the Rozhen Observatory.

Date	JD 24...	I_C	R_C	V	B	U	Telescope
				EG And			
Nov 17, 2006	54057.356	–	–	7.283	8.898	–	Schm
Dec 16, 2006	54086.356	–	–	7.246	8.886	–	Schm
Feb 29, 2008	54256.340	–	–	7.166	8.745	10.407	Schm
Nov 20, 2008	54791.496	5.553	6.694	7.524	8.834	–	Schm
Jan 11, 2009	54843.292	5.364	6.496	7.222	8.732	–	Schm
Jul 15, 2009	55028.541	–	–	7.219	8.764	10.428	Schm
				Z And			
Jul 19, 2006	53936.504	–	–	8.634	9.070	–	Schm
Nov 17, 2006	54057.342	–	–	9.458	10.083	–	Schm
Nov 18, 2006	54058.345	–	–	9.445	10.071	–	Schm
Nov 19, 2006	54059.339	–	–	9.471	10.039	–	Schm
Dec 16, 2006	54086.343	–	–	9.461	10.068	–	Schm
Aug 20, 2007	54333.504	7.701	9.227	10.456	11.520	–	Schm
Nov 20, 2008	54791.487	7.831	9.095	10.122	10.932	–	Schm
Jan 11, 2009	54843.285	8.190	9.480	10.514	11.292	–	Schm
Jul 14, 2009	55027.567	7.698	9.112	10.224	11.221	–	Schm
Jul 16, 2009	55029.560	7.695	9.090	10.230	11.210	–	Schm
Aug 21, 2009	55065.450	7.640	9.048	10.216	11.125	–	Schm
Oct 08, 2009	55113.448	7.269	8.134	–	–	–	Schm
Nov 20, 2009	55156.326	7.130	7.863	–	8.870	–	Schm
				CH Cyg			
Apr 23, 2006	53849.428	–	–	7.213	8.760	–	Schm
Jul 19, 2006	53936.356	–	–	7.826	9.380	–	Schm
Nov 17, 2006	54057.180	–	–	9.285	11.040	–	Schm
Nov 18, 2006	54058.164	–	–	9.293	11.052	–	Schm
Jul 14, 2009	55027.350	–	–	8.940	10.232	–	Schm
Jul 16, 2009	55029.373	–	–	8.521	10.242	–	Schm
				CI Cyg			
Nov 19, 2006	54059.201	–	–	10.519	11.696	–	Schm
Jun 28, 2009	55011.433	–	–	10.151	10.985	–	Schm
Jul 15, 2009	55028.358	–	–	10.197	11.067	–	Schm
Jul 16, 2009	55029.362	–	–	10.267	11.083	–	Schm
				V1329 Cyg			
Jul 23, 2006	53940.346	–	12.503	12.503	13.227	12.438	2m RCC
Oct 20, 2006	54029.360	–	–	12.935	13.769	–	Schm
Nov 17, 2006	54057.212	–	–	13.011	13.825	–	Schm
Nov 18, 2006	54058.221	–	–	13.005	13.858	–	Schm
Nov 19, 2006	54059.226	–	–	13.035	13.847	–	Schm
Nov 20, 2006	54060.170	–	–	13.023	13.854	–	Schm
Dec 16, 2006	54086.186	–	–	13.116	13.962	–	Schm
Jul 03, 2007	54285.379	–	12.309	13.712	14.419	–	1.3m RC
Jul 23, 2007	54305.319	10.587	12.222	13.739	14.439	–	1.3m RC
Jul 24, 2007	54306.307	10.589	12.223	13.741	14.439	–	1.3m RC
Aug 16, 2007	54329.307	10.887	12.180	13.754	–	–	2m RCC
Aug 17, 2007	54330.277	10.934	12.230	13.807	14.590	–	2m RCC
Oct 14, 2007	54388.209	10.789	12.479	14.083	14.685	–	Schm
Nov 06, 2007	54411.197	10.965	12.237	13.853	14.740	–	2m RCC
Feb 29, 2008	54526.703	10.889	12.297	13.757	14.602	–	Schm
Jun 29, 2008	54647.327	10.490	12.084	13.453	14.177	–	1.3m RC
Jul 06, 2008	54654.320	10.381	11.906	13.207	13.914	–	1.3m RC
Jul 24, 2008	54672.309	10.399	11.999	13.364	14.120	–	1.3m RC
Aug 28, 2008	54707.267	10.598	11.861	13.205	14.024	–	Schm
Oct 22, 2008	54762.214	10.532	11.820	13.211	13.911	–	Schm
Apr 16, 2009	54938.490	10.559	11.543	13.013	13.674	–	Schm
Jun 14, 2009	54997.579	10.303	11.552	12.972	13.665	–	1.3m RC

Table 11 Continued

Date	JD 24...	I_C	R_C	V	B	U	Telescope
Jun 24, 2009	55007.581	10.466	11.580	13.060	13.642	–	1.3m RC
Jul 06, 2009	55019.500	10.421	11.666	13.100	13.757	–	1.3m RC
Jul 14, 2009	55027.381	10.498	11.743	13.151	13.795	–	Schm
Jul 16, 2009	55029.391	10.512	11.768	13.177	13.807	–	Schm
Jul 27, 2009	55040.418	10.528	11.789	13.229	13.865	13.263	1.3m RC
Aug 21, 2009	55065.266	10.538	11.905	13.356	14.025	–	Schm
Oct 08, 2009	55113.229	10.580	12.266	13.621	14.319	–	Schm
Oct 09, 2009	55114.233	10.571	12.267	13.637	14.325	–	Schm
Oct 28, 2009	55133.205	10.541	12.299	13.680	14.384	–	Schm
				TX CVn			
Apr 21, 2006	53847.343	–	–	9.933	10.473	–	Schm
Apr 23, 2006	53849.337	–	–	9.953	10.490	–	Schm
Feb 29, 2008	54526.593	–	–	9.864	10.500	10.174	Schm
Mar 24, 2009	54915.384	8.630	9.390	9.975	10.700	–	Schm
May 19, 2009	54971.359	8.654	9.425	10.008	10.780	–	Schm
Jul 15, 2009	55028.312	8.579	9.364	9.966	10.737	–	Schm
Nov 21, 2009	55157.604	8.568	9.334	9.966	10.718	–	Schm
				AG Dra			
Apr 23, 2006	53849.364	–	–	9.740	10.845	–	Schm
Aug 19, 2007	54332.310	8.037	8.634	9.410	10.264	–	Schm
Feb 29, 2008	54526.604	–	–	9.662	10.947	11.287	Schm
Mar 26, 2009	54917.446	8.285	8.941	9.812	11.060	–	Schm
May 19, 2009	54971.366	8.344	8.985	9.856	11.072	–	Schm
Jun 27, 2009	55010.350	8.228	8.982	9.797	11.072	–	Schm
Jun 28, 2009	55011.409	8.210	8.938	9.795	11.063	–	Schm
Jul 14, 2009	55027.341	8.200	8.927	9.772	11.040	–	Schm
Jul 16, 2009	55029.324	8.172	8.893	9.757	11.015	–	Schm
Nov 20, 2009	55156.160	8.255	9.000	9.865	11.165	–	Schm
				Draco C1			
Mar 26, 2006	53821.453	15.788	16.402	17.187	18.622	–	2m RCC
Mar 27, 2006	53822.413	15.731	16.357	17.163	18.599	–	2m RCC
Apr 23, 2006	53849.396	15.757	16.414	17.332	18.572	–	Schm
Jul 21, 2006	53938.337	15.761	16.363	17.170		–	2m RCC
Jul 22, 2006	53939.321	15.745	16.355	17.155	18.648	–	2m RCC
Jul 23, 2006	53940.325	15.819	16.410	17.208	18.688	–	2m RCC
Nov 18, 2006	54058.208	15.811	16.434	17.315		–	Schm
Aug 19, 2007	54332.284	15.619	16.283	17.084		–	Schm
Mar 01, 2008	54526.633	15.926	16.402	17.126		–	Schm
Jun 29, 2008	54647.312	15.651	16.325	17.152	18.491	–	1.3m RC
Jul 06, 2008	54654.312	15.674	16.331	17.159		–	1.3m RC
Jul 24, 2008	54672.303	15.687	16.374	17.210		–	1.3m RC
Aug 28, 2008	54707.293	15.691	16.337	17.139		–	Schm
Oct 24, 2008	54764.210	15.803	16.424	17.293		–	Schm
Mar 26, 2009	54917.474	15.676	16.441	17.317	18.832	–	Schm
Apr 16, 2009	54938.422	15.871	16.453	17.379		–	Schm
May 19, 2009	54971.392	15.791	16.437	17.369		–	Schm
Jun 17, 2009	55000.534	15.668	16.336	17.177	18.493	–	1.3m RC
Jun 25, 2009	55007.571	15.669	16.316	17.167		–	1.3m RC
Jul 06, 2009	55019.487	15.685	16.375	17.188	18.475	–	1.3m RC
Jul 27, 2009	55040.403	15.648	16.304	17.137	18.470	–	1.3m RC
				AG Peg			
Oct 14, 2007	54388.322	6.418	7.874	8.819	–	–	Schm
Jul 14, 2009	55027.489	6.370	7.597	8.632	9.774	–	Schm
Jul 16, 2009	55029.519	6.375	7.597	8.623	9.753	–	Schm
Aug 21, 2009	55065.284	6.036	7.439	8.526	9.709	–	Schm
Oct 09, 2009	55114.347	6.347	7.660	8.678	9.880	9.880	Schm
Nov 21, 2009	55157.157	6.412	7.743	8.768	9.989	–	Schm

Table 11 Continued

Date	JD 24...	I_C	R_C	V	B	U	Telescope
			AX Per				
Nov 17, 2006	54057.367	–	–	11.082	12.385	–	Schm
Dec 16, 2006	54086.368	–	–	11.085	12.372	–	Schm
Feb 29, 2008	54526.349	–	–	11.620	12.757	12.647	Schm
Nov 20, 2008	54791.504	8.687	10.338	11.618	12.499	–	Schm
Jan 11, 2009	54843.300	8.788	10.542	11.758	12.630	–	Schm
Jul 15, 2009	55028.555	8.355	10.400	11.603	12.792	–	Schm
Oct 08, 2009	55113.459	8.621	10.352	11.305	11.983	–	Schm
Nov 21, 2009	55157.419	8.517	10.250	11.318	12.048	–	Schm

1) Schm – 50/70 cm Schmidt,

Table 12 Photoelectric U, B, V, R_C observations of TX CVn from the Skalnaté Pleso observatory.

Date	JD 24...	U	B	V	ΔR_C
Feb 14, 2007	54146.417	10.410	10.342	9.782	0.037
Mar 11, 2007	54171.378	10.564	10.481	9.870	0.109
Mar 12, 2007	54172.365	10.543	10.506	9.867	0.127
Mar 13, 2007	54173.353	10.495	10.500	9.876	0.126
Mar 25, 2007	54185.350	–	10.501	9.855	0.088
Apr 4, 2007	54195.320	10.517	10.500	9.895	0.162
Apr 11, 2007	54202.296	10.513	10.527	9.885	0.141
Apr 14, 2007	54205.358	10.508	10.505	9.884	0.139
Nov 3, 2007	54407.555	10.543	10.508	9.876	0.104
Nov 6, 2007	54410.533	10.513	10.492	9.909	0.116
Dec 17, 2007	54451.658	10.539	10.534	9.887	0.123
Dec 26, 2007	54460.694	10.546	10.517	9.871	0.137
Dec 26, 2007	54461.461	10.600	10.561	9.906	0.123
Dec 28, 2007	54462.507	10.528	10.437	9.842	0.067
Feb 24, 2008	54521.371	10.656	10.568	9.954	–
Feb 25, 2008	54522.434	10.721	10.560	9.953	–
May 7, 2008	54594.434	10.771	10.682	9.997	–

Table 13 Photoelectric U, B, V, R_C observations of AG Dra from the Skalnaté Pleso observatory.

Date	JD 24...	U	B	V	ΔR_C
Mar 11, 2007	54171.332	9.162	9.998	9.247	-1.055
Mar 12, 2007	54172.316	9.152	9.985	9.217	-1.115
Mar 13, 2007	54173.308	9.129	9.933	9.191	-1.075
Mar 25, 2007	54185.320	–	10.136	9.186	-1.010
Apr 4, 2007	54195.391	9.187	10.025	9.244	-1.055
Apr 11, 2007	54202.329	9.243	10.053	9.241	-1.052
Apr 12, 2007	54203.323	9.260	10.060	9.257	-1.041
Apr 22, 2007	54213.330	9.186	10.040	9.274	-1.034
May 1, 2007	54222.359	9.317	10.128	9.299	-0.993
Jun 4, 2007	54256.411	9.460	10.295	9.378	-0.963
Jun 16, 2007	54268.416	9.496	10.300	9.312	-1.054
Jul 3, 2007	54285.363	9.596	10.385	9.395	-0.946
Jul 14, 2007	54296.406	9.514	10.342	9.392	-0.963
Jul 17, 2007	54299.356	9.505	10.380	9.429	–
Jul 26, 2007	54308.343	9.524	10.405	9.461	–
Aug 2, 2007	54315.349	9.493	10.294	9.385	-0.972
Aug 14, 2007	54327.496	9.480	10.313	9.397	-0.960
Aug 25, 2007	54338.315	9.399	10.257	9.355	-0.995
Sep 13, 2007	54357.383	9.076	9.963	9.203	-1.060
Sep 14, 2007	54358.378	9.140	10.020	9.227	-1.057
Oct 14, 2007	54388.343	9.044	9.919	9.169	-1.085
Nov 3, 2007	54407.606	9.057	9.913	9.214	-1.030
Nov 5, 2007	54410.246	8.998	9.819	9.132	-1.116
Dec 17, 2007	54451.654	9.031	10.117	9.205	-1.187
Dec 26, 2007	54460.591	9.586	10.465	9.469	-1.103
Dec 26, 2007	54461.409	9.631	10.423	9.458	-1.161
Dec 27, 2007	54462.411	9.666	10.457	9.438	-1.084
Jan 3, 2008	54468.650	9.957	10.582	9.563	-1.045
Jan 15, 2008	54480.628	10.369	10.707	9.568	-0.987
Feb 24, 2008	54521.410	11.201	11.111	9.843	–
Feb 25, 2008	54522.387	10.962	10.975	9.716	–
Apr 14, 2008	54571.391	11.481	11.110	9.786	–
Apr 26, 2008	54583.420	11.512	11.201	9.830	–
Jun 1, 2008	54619.362	11.729	11.236	9.814	–
Aug 1, 2008	54680.413	11.862	11.120	9.784	–
Aug 7, 2008	54686.328	–	11.270	9.968	–
Aug 16, 2008	54695.452	11.710	11.096	9.719	–
Sep 1, 2008	54711.307	11.562	11.134	9.758	–
Oct 26, 2008	54766.375	11.393	11.071	9.756	–
Nov 3, 2008	54774.268	11.346	11.075	9.737	–
Nov 4, 2008	54774.649	11.348	11.071	9.739	–
Nov 9, 2008	54780.480	11.252	11.017	9.707	–
Nov 18, 2008	54788.670	11.340	11.082	9.749	–
Dec 9, 2008	54809.612	11.571	11.247	9.776	–
Dec 31, 2008	54831.578	11.308	11.148	9.804	–
Jan 17, 2009	54848.602	11.208	11.181	9.839	–
Feb 19, 2009	54882.472	11.141	11.130	9.783	–
Feb 28, 2009	54891.336	10.990	11.130	0.000	–
Mar 14, 2009	54905.318	11.021	11.084	9.799	–
Apr 5, 2009	54926.601	11.044	11.064	9.757	–
Apr 13, 2009	54935.394	11.016	11.065	9.766	–
Apr 14, 2009	54936.350	11.135	11.106	9.786	–
Apr 15, 2009	54937.389	11.014	11.046	9.746	–
Apr 20, 2009	54942.377	10.989	11.054	9.754	–
Apr 21, 2009	54943.350	11.010	11.079	9.778	–
Apr 25, 2009	54947.336	11.041	11.068	9.753	–
May 17, 2009	54969.356	11.152	11.146	9.834	–
Jul 13, 2009	55026.376	11.340	11.061	9.737	–
Aug 8, 2009	55052.354	11.389	11.091	9.738	–
Aug 18, 2009	55062.309	11.374	11.078	9.715	–
Sep 7, 2009	55082.315	11.374	11.090	9.730	–

Table 13 Continued

Date	JD 24...	U	B	V	ΔR_C
Nov 22, 2009	55157.640	11.625	11.164	9.836	–
Jan 16, 2010	55212.576	11.462	11.134	9.786	–
Feb 27, 2010	55255.448	11.610	11.240	9.870	–
Mar 9, 2010	55265.467	11.579	11.110	9.765	–
Mar 18, 2010	55274.390	11.545	11.107	9.763	–
Mar 22, 2010	55278.406	11.604	11.196	9.800	–
Mar 24, 2010	55280.323	11.503	11.159	9.828	–
Mar 28, 2010	55284.355	11.450	11.132	9.771	–
Apr 3, 2010	55290.323	11.470	11.154	9.807	–
Apr 7, 2010	55294.362	11.460	11.177	9.832	–
Apr 17, 2010	55304.331	11.401	11.211	9.870	–
Apr 22, 2010	55309.357	11.256	11.201	9.832	–
Jul 9, 2010	55386.526	11.086	11.020	9.692	–
Jul 22, 2010	55400.457	11.215	10.989	9.686	–
Aug 1, 2010	55410.458	11.208	11.045	9.709	–
Sep 23, 2010	55463.291	11.052	11.016	9.722	–
Oct 8, 2010	55478.432	10.962	11.033	9.733	–
Oct 10, 2010	55480.265	10.942	11.024	9.736	–
Jan 3, 2011	55565.464	11.181	11.127	9.833	–
Jan 16, 2011	55578.422	11.271	11.174	9.903	–
Jan 25, 2011	55586.621	11.287	11.088	9.757	–
Jan 29, 2011	55591.391	11.310	11.079	9.751	–
Jan 30, 2011	55592.378	11.270	11.083	9.719	–
Feb 9, 2011	55602.412	11.386	11.110	9.827	–
Feb 27, 2011	55619.520	11.329	11.035	9.707	–
Feb 27, 2011	55620.390	11.343	11.022	9.715	–
Mar 7, 2011	55628.392	11.331	11.056	9.754	–
Mar 24, 2011	55645.408	11.323	11.049	9.718	–
Mar 29, 2011	55650.337	11.366	11.007	9.697	–
Mar 30, 2011	55651.452	11.365	11.030	9.691	–
Apr 18, 2011	55670.390	11.374	11.127	9.781	–
Apr 19, 2011	55671.315	11.512	11.126	9.780	–
Apr 20, 2011	55672.330	11.550	11.127	9.778	–
Apr 21, 2011	55673.320	11.467	11.099	9.747	–
Apr 22, 2011	55674.380	11.536	11.099	9.765	–
May 6, 2011	55688.352	11.546	11.132	9.783	–
May 11, 2011	55693.371	11.577	11.176	9.818	–
May 16, 2011	55698.360	–	11.194	9.819	–
May 19, 2011	55701.429	11.680	11.177	9.848	–
May 30, 2011	55712.381	11.647	11.175	9.792	–
Aug 2, 2011	55776.446	11.683	11.099	9.756	–
Aug 9, 2011	55783.403	11.711	11.141	9.697	–
Sep 4, 2011	55809.327	11.712	11.153	9.744	–
Sep 11, 2011	55816.329	11.648	11.137	9.753	–
Sep 25, 2011	55830.330	11.579	11.088	9.724	–
Sep 27, 2011	55832.281	11.550	11.083	9.718	–
Sep 30, 2011	55835.311	11.552	11.080	9.723	–
Oct 3, 2011	55838.246	11.560	11.090	9.729	–
Oct 16, 2011	55851.339	–	–	9.749	–
Oct 17, 2011	55852.237	11.455	11.108	9.742	–
Oct 18, 2011	55853.398	–	–	9.736	–
Oct 26, 2011	55861.284	11.345	11.070	9.724	–
Nov 3, 2011	55869.345	11.305	11.041	9.710	–
Nov 6, 2011	55872.220	11.236	11.032	9.719	–
Nov 8, 2011	55874.275	11.334	11.062	9.744	–
Nov 16, 2011	55881.628	11.197	11.057	9.743	–
Nov 17, 2011	55882.627	11.238	11.077	9.758	–
Nov 18, 2011	55883.632	11.243	11.051	9.725	–
Nov 19, 2011	55884.665	11.212	11.048	9.723	–

Table 14 CCD U, B, V, R_C, I_C observations of AG Dra from the Stará Lesná observatory.

Date	JD 24...	U	B	V	R_C	I_C
Mar 3, 2005	53432.504	11.381	11.338	9.883	9.181	8.366
May 21, 2005	53512.335	11.300	11.287	9.788	8.929	8.258
May 25, 2005	53516.338	11.276	11.306	9.782	8.897	8.250
May 26, 2005	53517.337	11.292	11.306	9.769	8.883	8.237
Jul 20, 2005	53572.422	9.423	–	–	8.524	7.870
Jul 24, 2005	53576.335	–	10.375	9.311	8.568	7.943
Jul 27, 2005	53579.367	9.526	10.333	9.276	8.494	7.913
Aug 11, 2005	53594.315	9.533	10.347	9.281	8.439	7.899
Sep 23, 2005	53637.303	9.716	10.475	9.365	8.485	7.958
Jan 27, 2006	53763.329	10.868	11.069	9.676	8.783	8.176
Apr 8, 2006	53833.566	10.830	11.099	9.701	–	8.247
Apr 21, 2006	53847.291	10.755	11.046	9.657	8.818	8.232
May 19, 2006	53875.445	10.704	11.141	9.750	8.854	8.257
Jun 14, 2006	53901.398	10.597	10.959	9.626	8.775	8.182
Jul 24, 2006	53941.340	8.525	9.314	8.741	8.119	7.661
Aug 19, 2006	53967.409	–	9.091	8.548	8.064	7.602
Feb 18, 2007	54149.680	8.920	9.869	9.157	8.471	7.925
Mar 3, 2007	54162.676	8.950	9.905	9.154	8.487	7.898
Mar 22, 2007	54182.372	9.186	10.071	9.265	8.539	7.968
Apr 1, 2007	54191.628	9.124	10.015	9.222	8.518	7.956
Apr 12, 2007	54202.506	9.204	10.083	9.241	8.539	7.967
May 12, 2007	54233.442	9.354	10.203	9.335	8.567	7.999
May 24, 2007	54245.426	9.334	10.201	9.336	8.608	8.017
Jul 8, 2007	54289.545	–	10.413	9.415	8.585	8.057
Jul 23, 2007	54305.345	9.531	10.424	9.457	8.654	8.074
Jul 28, 2007	54309.507	9.515	10.435	9.477	8.667	8.111
Sep 21, 2007	54364.582	9.048	9.935	9.196	8.491	7.961
Oct 10, 2007	54384.213	8.800	9.770	9.110	8.464	7.920
Oct 11, 2007	54385.234	8.920	9.860	9.149	8.489	7.941
Nov 2, 2007	54407.184	9.008	9.910	9.123	8.490	7.941
Dec 20, 2007	54455.493	9.362	10.315	9.356	8.487	7.972
Dec 21, 2007	54456.491	9.452	10.338	9.391	8.470	7.993
Jan 3, 2008	54469.433	10.151	10.647	9.565	8.581	8.130
Jan 25, 2008	54491.457	10.650	10.844	9.633	8.731	8.176
Feb 3, 2008	54500.276	10.783	10.914	9.679	8.767	8.179
Feb 10, 2008	54507.489	10.758	10.881	9.677	8.774	8.171
Feb 11, 2008	54507.520	10.764	10.888	9.662	8.771	8.166
Feb 12, 2008	54508.519	10.764	10.925	9.675	8.844	8.197
Feb 13, 2008	54509.687	10.779	–	9.709	8.777	8.209
Feb 19, 2008	54515.580	10.903	10.991	9.707	8.730	8.163
Feb 21, 2008	54517.677	10.930	11.027	9.744	8.853	8.211
Feb 25, 2008	54521.692	10.948	10.990	9.684	8.824	8.155
Feb 28, 2008	54525.474	11.029	11.037	9.718	8.854	8.219

Table 15 Photoelectric U, B, V, R_C observations of AG Peg from the Skalnaté Pleso observatory.

Date	JD 24...	U	B	V	ΔR_C
Jul 15, 2007	54297.419	9.834	9.899	8.639	-0.020
Jul 17, 2007	54299.457	9.694	9.906	8.638	–
Aug 26, 2007	54338.546	9.890	9.718	8.517	-0.059
Sep 14, 2007	54357.511	10.024	10.018	8.729	0.072
Oct 14, 2007	54388.464	10.131	10.052	8.728	0.095
Nov 5, 2007	54410.318	10.204	10.151	8.896	0.250
Dec 18, 2007	54453.214	10.265	10.154	8.818	0.147
Dec 27, 2007	54462.230	10.324	10.170	8.870	0.232
Jun 2, 2008	54620.466	10.137	10.124	8.836	–
Jul 2, 2008	54650.454	9.945	10.030	8.697	–
Aug 8, 2008	54686.538	9.834	9.944	8.639	–
Aug 31, 2008	54710.491	9.663	9.878	8.562	–
Nov 4, 2008	54775.342	9.503	9.817	8.579	–
Nov 9, 2008	54780.319	9.572	9.875	8.643	–
Jan 13, 2009	54845.203	9.396	9.850	8.668	–
May 22, 2009	54974.489	9.428	9.760	8.485	–
Jul 13, 2009	55026.434	9.418	9.777	8.505	–
Aug 19, 2009	55062.561	9.681	9.932	8.626	–
Sep 7, 2009	55082.435	9.712	9.903	8.595	–
Sep 21, 2009	55096.447	9.772	9.918	8.600	–
Jun 8, 2010	55355.529	10.415	10.037	8.572	–
Jul 10, 2010	55387.513	10.472	10.198	8.824	–
Aug 8, 2010	55416.574	10.421	10.138	8.710	–
Aug 23, 2010	55431.575	10.337	10.098	8.747	–
Sep 22, 2010	55462.443	10.112	10.035	8.723	–
Oct 7, 2010	55477.411	10.161	9.999	8.669	–
Oct 10, 2010	55480.416	10.171	10.013	8.679	–
Oct 29, 2010	55499.395	10.114	9.959	8.655	–
Jan 18, 2011	55580.224	9.718	9.767	8.581	–
Sep 15, 2011	55820.498	9.453	9.732	8.485	–
Sep 25, 2011	55830.491	9.466	9.813	8.533	–
Oct 9, 2011	55844.410	9.417	9.775	8.555	–
Nov 8, 2011	55874.320	9.593	9.827	8.542	–
Nov 13, 2011	55879.416	9.704	9.894	8.575	–
Nov 15, 2011	55881.409	9.639	9.843	8.548	–
Nov 16, 2011	55882.372	9.636	9.856	8.562	–
Nov 17, 2011	55883.392	9.627	9.859	8.565	–
Nov 18, 2011	55884.402	9.631	9.862	8.566	–

Table 16 Photoelectric U, B, V, R_C observations of AX Per from the Skalnaté Pleso observatory.

Date	JD 24...	U	B	V	ΔR_C
Mar 12, 2007	54172.266	12.420	13.012	11.954	3.705
Mar 25, 2007	54185.272	12.350	12.964	11.780	3.440
Jul 15, 2007	54297.463	11.674	12.122	11.161	3.041
Jul 17, 2007	54299.489	11.469	12.076	11.094	–
Jul 26, 2007	54308.498	11.469	12.033	11.061	–
Aug 3, 2007	54315.529	11.477	12.068	11.098	3.000
Aug 26, 2007	54338.600	12.602	12.890	11.540	3.460
Oct 4, 2007	54377.596	11.820	12.222	11.182	2.885
Oct 15, 2007	54388.660	11.616	12.050	11.194	2.907
Nov 3, 2007	54407.518	11.834	12.344	11.367	3.160
Nov 5, 2007	54410.463	11.853	12.311	11.325	3.058
Dec 5, 2007	54440.498	12.092	12.527	11.473	3.206
Dec 25, 2007	54460.495	12.258	12.748	11.718	3.446
Dec 26, 2007	54461.359	12.209	12.677	11.734	3.415
Dec 27, 2007	54462.392	12.242	12.713	11.838	3.460
Jan 23, 2008	54489.378	–	12.790	11.720	–
Jan 25, 2008	54491.243	12.270	12.770	11.977	–
Feb 24, 2008	54521.320	12.198	12.815	11.724	–
Jun 1, 2008	54619.491	11.847	12.455	11.223	–
Jul 3, 2008	54650.506	11.478	12.238	11.141	–
Sep 1, 2008	54710.585	11.515	12.242	11.114	–
Oct 19, 2008	54758.603	11.760	–	11.360	–
Oct 26, 2008	54765.625	11.804	12.451	11.397	–
Nov 4, 2008	54774.555	11.851	12.534	11.472	–
Nov 9, 2008	54780.443	11.959	12.539	11.439	–
Nov 18, 2008	54788.635	11.992	12.579	11.524	–
Dec 30, 2008	54830.520	12.021	12.746	11.757	–
Dec 30, 2008	54831.493	12.033	12.732	11.762	–
Jan 3, 2009	54835.352	12.062	12.770	11.799	–
Jan 8, 2009	54840.339	12.108	12.639	11.805	–
Mar 14, 2009	54905.272	11.441	11.921	10.911	–
Jul 13, 2009	55026.466	12.876	13.035	11.539	–
Aug 19, 2009	55062.523	12.962	13.010	11.589	–
Aug 26, 2009	55069.574	12.671	12.784	11.543	–
Sep 9, 2009	55083.552	11.964	12.195	11.204	–
Sep 19, 2009	55094.353	11.836	12.116	11.229	–
Dec 8, 2009	55173.553	11.853	12.374	11.455	–
Jan 15, 2010	55212.472	12.045	12.497	11.406	–
Mar 8, 2010	55264.338	12.048	12.564	11.427	–
Mar 9, 2010	55265.331	11.920	12.466	11.330	–
Mar 18, 2010	55274.310	11.930	12.460	11.327	–
Jul 10, 2010	55388.440	12.006	12.670	11.411	–
Aug 7, 2010	55416.494	11.722	12.581	11.508	–
Aug 23, 2010	55431.519	11.715	12.532	11.613	–
Sep 23, 2010	55462.594	11.612	12.678	11.754	–
Oct 8, 2010	55477.553	11.747	12.598	11.709	–
Oct 8, 2010	55478.486	11.783	12.657	11.712	–
Oct 10, 2010	55480.468	11.758	12.566	11.732	–
Oct 30, 2010	55499.632	11.768	12.484	11.498	–
Dec 1, 2010	55531.505	10.711	11.609	10.832	–
Jan 16, 2011	55578.354	11.077	11.749	10.871	–
Jan 17, 2011	55579.383	11.031	–	–	–
Jan 22, 2011	55584.296	11.039	11.751	10.936	–
Jan 24, 2011	55586.455	11.132	11.810	10.880	–
Jan 29, 2011	55591.339	11.249	11.872	10.983	–
Jan 30, 2011	55592.324	11.221	11.851	10.949	–
Feb 14, 2011	55607.314	11.435	12.023	11.045	–

Table 16 Continued

Date	JD 24...	*U*	*B*	*V*	ΔR_C
Feb 21, 2011	55614.291	11.372	12.015	11.035	–
Feb 27, 2011	55620.326	11.296	11.982	11.088	–
Mar 7, 2011	55628.328	11.451	12.000	11.073	–
Sep 26, 2011	55831.496	12.498	12.851	11.616	–
Oct 1, 2011	55835.627	12.422	12.759	11.496	–
Oct 19, 2011	55853.642	–	12.730	11.483	–
Nov 1, 2011	55866.639	12.397	12.767	11.547	–
Nov 6, 2011	55872.416	12.321	12.729	11.524	–
Nov 8, 2011	55873.544	12.434	12.741	11.516	–
Nov 16, 2011	55881.551	12.267	12.699	11.459	–
Nov 17, 2011	55882.555	12.289	12.673	11.461	–
Nov 18, 2011	55883.566	12.315	12.644	11.432	–
Nov 19, 2011	55884.617	12.252	12.660	11.417	–