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Short and long time-scale variability in magnetic cataclysmic variables: long-term monitoring of polars

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ABSTRACT

We present long-term observations of the magnetic cataclysmic variables AM Her, AN UMa, AR UMa, DP Leo and V1309 Ori. Analyses of both short- and long-period light variations are presented. For the first time, as far as we know, long-period variations of AN UMa and AR UMa have been studied and multiple frequencies obtained. Fourier analysis indicates 170-, 218- and 180-d variations for AM Her, AN UMa and AR UMa, respectively. These periodicities may be due to modulation of the mass-transfer rate resulting from magnetic cycles in the secondary stars. In addition, we collect the physical parameters of polars from the literature and estimate their mass-transfer rates and orbital period variation and give a rough estimation of the donor magnetic fields.

Key words: binaries: general – stars: individual: AM Her – stars: individual: AN UMa – stars: individual: AR UMa – novae, cataclysmic variables.

1 INTRODUCTION

Magnetic cataclysmic variables (mCVs) have an important place in our concept of stellar evolution because of their strong magnetic field intensities and their unpredictable behaviour. Based on the magnetic field intensities of white dwarfs (WDs), magnetic cataclysmic variables are classified as intermediate polars (IPs) and polars (AM Her systems). Polars, consisting of a mass-accreting magnetic WD and a late-type active star, are short-period interacting binary systems. As far as we know, because of the high magnetic field intensities there are no accretion discs around the WDs in polars and components are synchronized. Optical radiation from a polar is mainly from the late-type star. On the other hand, in the energetic part of the electromagnetic spectrum the radiation is due to the WD. The spectra of polars are mainly characterized by cyclotron humps observed at infrared (IR) and optical wavelengths (Wickramasinghe et al. 1991; Cropper et al. 1989; Kalomeni, Pekunlu & Yakut 2005a, and references therein).

The high magnetic fields of WDs in polars are a characteristic feature, as well as a most important parameter that can define most of their observed features. What components create these systems with highly magnetic WDs? The answer to that question has been studied intensively by Tout et al. (2008), and evolutionary stages of polars were studied by Eggleton (1976), Whyte & Eggleton (1980), Paczynski (1981), Patterson (1984) and Howell, Nelson & Rappaport (2001b). The components of polars are usually late-type main-sequence stars. The rotation rate of a component is synchronized with the orbital period, which is less than a quarter of a day in most cases. Therefore, intense magnetic fields can be expected in donors of polars.

Light variations of polars are characterized by long-term variations in which the total brightness of a system can vary by ∼3 mag and by short-term small-amplitude variations. In the literature, especially during the last decade, long stretches of observations of polars that extend over years have been intensively studied (e.g. Hessman, Gänsicke & Mattei 2000; Kalomeni & Yakut 2008; Wu & Kiss 2008; Kafka & Hoard 2009; Sanad 2010). Studies on long-term variations are especially important to reveal any characteristics based on stellar activity and/or mass transfer.

In DQ Her systems, the magnetic field is not as strong as in AM Her systems and this leads to formation of a disrupted accretion disc and asynchronous rotation (see Warner 1995 for details). In contrast to polars, no well-studied IP has been reported to enter into a low state. Low- and intermediate-mass accretion of IPs, however, has been studied in the literature (see Garnavich & Szkody 1988; Bonnet-Bidaud et al. 2001; Warner 2003). Garnavich & Szkody (1988) studied the long-term behaviour of three DQ Her type mCVs and two nova-like non-magnetic CVs to reveal the role of the magnetic field and disc in the mass transfer behaviour. The authors concluded that IPs can show low states, while there are also IPs that show an absence of low accretion rate. The absence of the low state in an IP makes it difficult to study the stellar characteristics of the donor star and the distance estimation that is important to physical models of CVs (see Bailey 1981; Beuermann 2000). Possibly due to the less intense magnetic field intensities of WDs in IPs, they

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Table 1. Coordinates, spectral types of secondaries, minimum times, orbital periods and magnitude ranges of the variable stars studied in this work are shown, with the number of exposures obtained with the ROTSE IIId telescope. References: AM Her – Kalomeni & Yakut (2008); AN UMa – Bonnet-Bidaud et al. (1996); AR UMa – Howell, Gelino & Harrison (2001a); DP Leo – Robinson & Córdova (1994), Beuermann et al. (2011); V1309 Ori – Shafter et al. (1995), Staude et al. (2001).

Star name	Alias (RX)	α_{2000}	δ_{2000}	Sp.T.	T_0	Period (days)	Δm (mag)	N_{obs}
AM Her	J1816.2+4952	18 16 13.25	+49 52 04.9	M4.5	24443014.7136	0.12892704	11.5–15	3384
AN UMa	J1104.4+4503	11 04 25.69	+45 03 13.9		2443191.0204	0.07975274	15.2–17.3	485
AR UMa	J1115.6+4258	11 15 44.60	+42 58 22.6	M4	2450470.4309	0.08050075	14.2–16.5	678
DP Leo	J1117.2+1757	11 17 16.00	+17 57 41.1	M6	2454914.8322	0.06236285	–	53
V1309 Ori	J0515.6+0104	05 15 41.41	+01 04 40.5	M0/M1	2450339.4363	0.33261194	–	257

have high mass accretion rates and tend not to show low states as polars. Hence, because of the insignificant influence of the WD on the secondary, IPs are not expected to show high and low states similar to AM Her systems (Wu & Kiss 2008).

In polars, unlike systems with discs, any modulation in mass accretion rate is generally attributed to the donor star (e.g. Warner 1988; Richman, Applegate & Patterson 1994). Applegate & Patterson (1987) discussed the possibility that, because of the change in the quadrupole moment, magnetic activity leads to orbital period variation. The quadrupole moment depends on the rotation rate of the outer regions. In the case of angular momentum variation due to the activity cycle, the rotational oblateness of a star varies regularly and via gravity this will lead to orbital period variations (Applegate 1992). This variation in turn modulates the mass-transfer rate on the magnetic activity time-scale. The luminosity variation time-scale is the same as that of the orbital period variation (Applegate 1992). Other mechanisms like angular momentum loss may cause secular period changes. Applegate & Patterson (1987) therefore suggested continued observations of times of minima in order to understand the evolution of CVs better. Warner (1988) discussed magnetic activity of the donor as a cause of the observed long-term variations. Kotze & Charles (2010) also discussed the possibility that stellar activity of the donor leads to orbital period variations, which in turn cause long-term mass-transfer variations. Bianchini (1992) found no relation between the lengths of stellar activity cycles and orbital periods of interacting semi-detached binaries like novae.

In this paper, we study the long-term light variations of the first detected polar AM Her, the next discovered polar AN UMa, the polar with highest magnetic field AR UMa, the first discovered eclipsing polar DP Leo and the longest-period polar V1309 Ori. In Sections 2 and 3 we present the data and our observation and reduction techniques. In Section 4 we present the analysis. In the last section we discuss the results. Time-dependent variation of polars can be important to understand their physical and geometric properties and to impose constraints on the behaviour and evolution of a system.

2 OBSERVATIONS AND DATA REDUCTION

Polars are relatively faint systems. The brightest one among them is AM Her with a brightness variation range of 11.5–15 mag. Automatic telescopes are particularly useful to observe systems like polars that show unpredictable variations over the years. To study the long-term light variations of selected polars, therefore, we mostly used the Robotic Optical Transient Search Experiment (ROTSE) IIId telescope at the Scientific and Technological Research Council of Turkey (TÜBİTAK) National Observatory (TUG), and to study small-amplitude variations we observed AM Her (Kalomeni, Pekunlu & Yakut 2005b; Kalomeni & Yakut 2008) and V1309 Ori with the TUG RTT150 telescope.

We have conducted long-term observations of AM Her, AN UMa, AR UMa, DP Leo and V1309 Ori between 2005 and 2011 (Table 1). ROTSE IIId is equipped with a 2048 × 2048 pixel detector with a field of view $1\overset{\circ}{.}85 \times 1\overset{\circ}{.}85$. For further details of the ROTSE telescopes we refer the reader to Akerlof et al. (2003).

During ROTSE data reduction we used reduced frames. For the extracted magnitudes of stars we used a PHP script developed by V. Keskin that follows the data-reduction steps of Akerlof et al. (2003). We have reduced separately all the frames obtained with the RTT150 telescopes. The reduction of the CCD frames has been performed using the IRAF (DIGIPHOT/APPHOT) packages. We observed the selected polars over almost 6 yr (544 nights, most of which are successive). The light curves of systems are shown in Fig. 1 and Figs 3–6 and the 33-yr American Association of Variable Star Observers (AAVSO) data of AM Her are shown in Fig. 2. Observations for AM Her between 2005 and 2008 have been studied in Kalomeni & Yakut (2008).

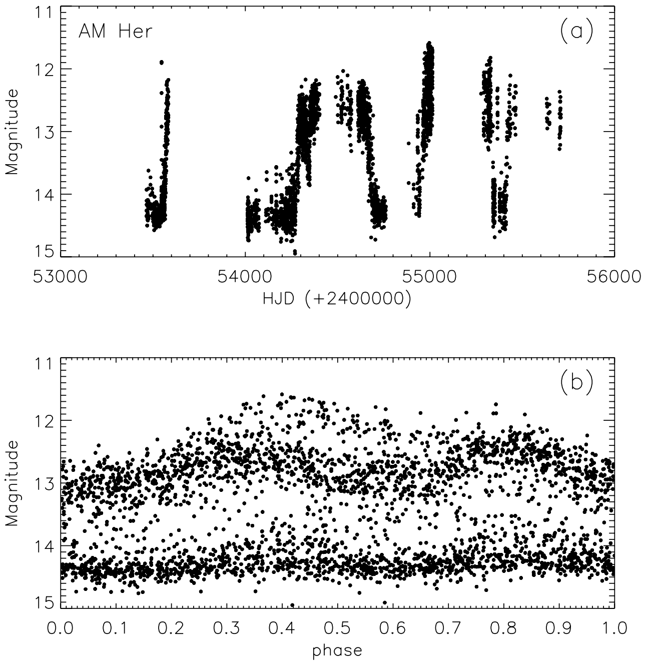

Figure 1. (a) Long-term light variation of AM Her obtained between 2005 and 2011 in HJD. (b) The same as (a) but in the phase domain. During the high state, the amplitude of light variation is higher than in the low state as well as showing two different patterns, one with a single maximum and one with two maxima.

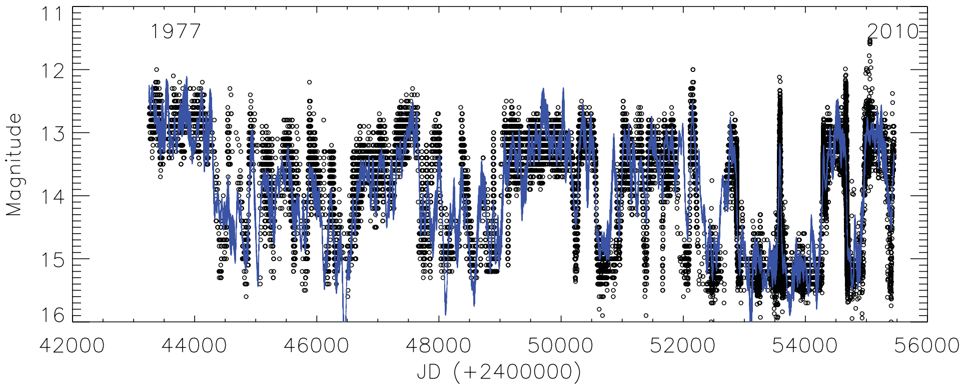

Figure 2. AVSAO data used in the frequency analysis for 33 yr of AM Her.

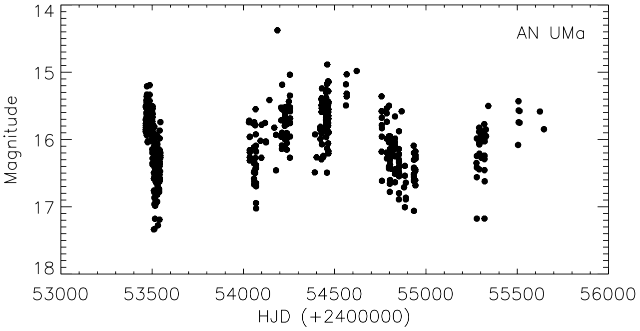

Figure 3. Long-term light variation of AN UMa.

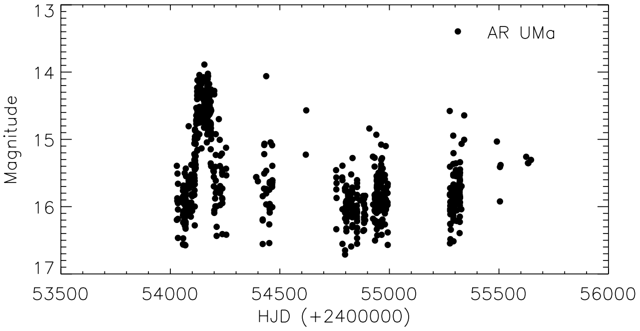

Figure 4. Long-term light variation of AR UMa.

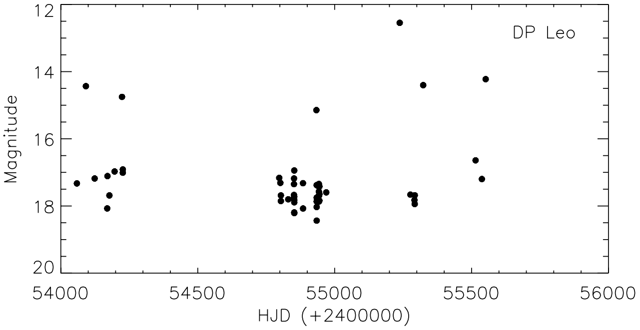

Figure 5. Long-term light variation of DP Leo.

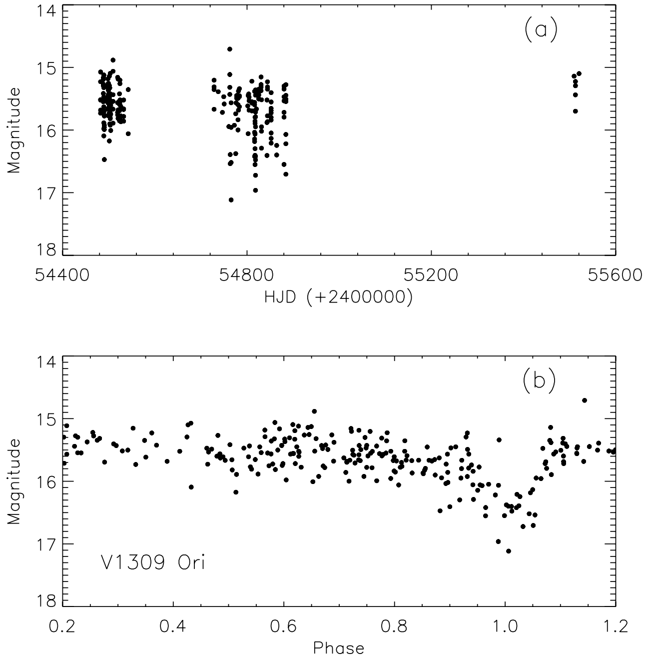

Figure 6. (a) Long-term light variation of V1309 Ori and (b) its light variation in the phase diagram.

3 SELECTED POLARS AND THEIR LIGHT VARIATION

3.1 AM Her

Tapia (1976) discovered AM Her as a system showing large and variable circular and linear polarization. The duration of low and high states is apparently not periodic. The unpredictable behaviour of the system is apparent in more than 5 yr of observation totalling 3384 data points, shown in Fig. 1(a) and (b). Each night, 8–10 data points are obtained with mean errors of ∼0.007 mag. Folding the data for successive nights, the light variation during one orbital period was obtained. During the transition from low-to-high state and high state, both double and single maxima are observed. The same behaviour is also apparent in Fig. 1(b), where the light curve of the system shows both single and double maxima during the high state. Even during the same state, AM Her's light variation can show differences. In addition, we analysed 33-yr AAVSO data of AM Her. More than 90 frequencies were obtained during the analyses. Using these frequencies, the solid line shown in Fig. 2 is plotted. On the other hand, most of these frequencies are combination frequencies. These non-periodic variations are most probably related to the magnetic activity of the secondary star, its interaction with the highly magnetic WD and any variation in mass-transfer rate. Apart from the orbital period, some of the detected periods are 178, 1836, 830 and 1520 d.

3.2 AN UMa

Hearn & Marshall (1979), by using SAS3 data obtained in 1975, detected the AM Her like properties of the AN UMa system for the first time. The light variation of AN UMa obtained in this study is shown in Fig. 3. Although there are gaps, the data extending over 2000 d show almost sinusoidal variations. However, the system needs observations to see if this path continues. AAVSO data of the system covering almost 15 yr give ~6 yr quasi-cyclic variations; however, more extensive data collection is required for a detailed analysis.

3.3 AR UMa

Wenzel (1993), by studying AR UMa's light variations extending over 32 yr, concluded this system to be a cataclysmic variable. Remillard et al. (1994) identified AR UMa as a soft X-ray source in the Einstein survey and from ellipsoidal variations they identified its orbital period. In Fig. 4 we show the variation detected in AR UMa. Its brightness variation seems to be higher than AM Her and AN UMa. The errors in the data are ~0.09 mag. Period analysis of more than 11 yr of data obtained from the AAVSO data base indicates multiple frequencies and suggests a ~4 yr variation. Unlike AM Her, in the phase domain AR UMa does not display significant differences between low and high states.

Table 2. Computed frequencies, amplitudes and phase shifts of the ROTSEIIId data solution.

ID	Frequency (d^{-1})	Amplitude (mag)	Sig.
AM Her			
f_1	0.0059	0.343	158.74
f_2	2.0041	0.390	85.73
f_3	16.5154	0.119	61.75
f_4	0.0186	0.173	43.37
f_5	8.7594	0.092	28.03
f_6	6.0084	0.085	20.46
$f_7 = f_{orb}$	7.753	0.109	13.94
f_8	0.8761	0.034	12.55
AR UMa			
f_1	0.0056	0.382	60.90
f_2	0.0103	0.181	9.06
f_3	3.0536	0.107	5.51
f_4	6.5465	0.096	4.91
$f_5 = f_{orb}$	12.4212	0.093	4.82
AN UMa			
f_1	0.0092	0.400	35.80
f_2	0.0248	0.249	9.62
f_3	1.0603	0.150	6.61
$f_4 = f_{orb}$	12.5373	0.127	6.21
f_5	0.9771	0.151	5.56
f_6	2.0493	0.115	5.37

3.4 DP Leo

DP Leo (E1114+182) was the first eclipsing polar to be discovered (Biermann et al. 1985). This binary system is one of the interesting and important polars, since it is a member of the post-common-envelope binary group with known/suspected planet companions (Beuermann et al. 2011, and references therein). Because of the faintness of the system and even though it was given long exposure time, we could not gather accurate long-term light variation (Fig. 5); the errors are ~0.2 mag. AAVSO data of the system also do not provide us with the opportunity to study it.

3.5 V1309 Ori

V1309 Ori (RXJ0515.6+0105) was discovered as a soft X-ray source with *ROSAT* (Beuermann & Thomas 1993) and classified as a magnetic cataclysmic variable by Garnavich et al. (1994). V1309 Ori, with a ~8 h orbital period, is the longest-period polar detected so far. It is an eclipsing binary, which makes it easier to determine the

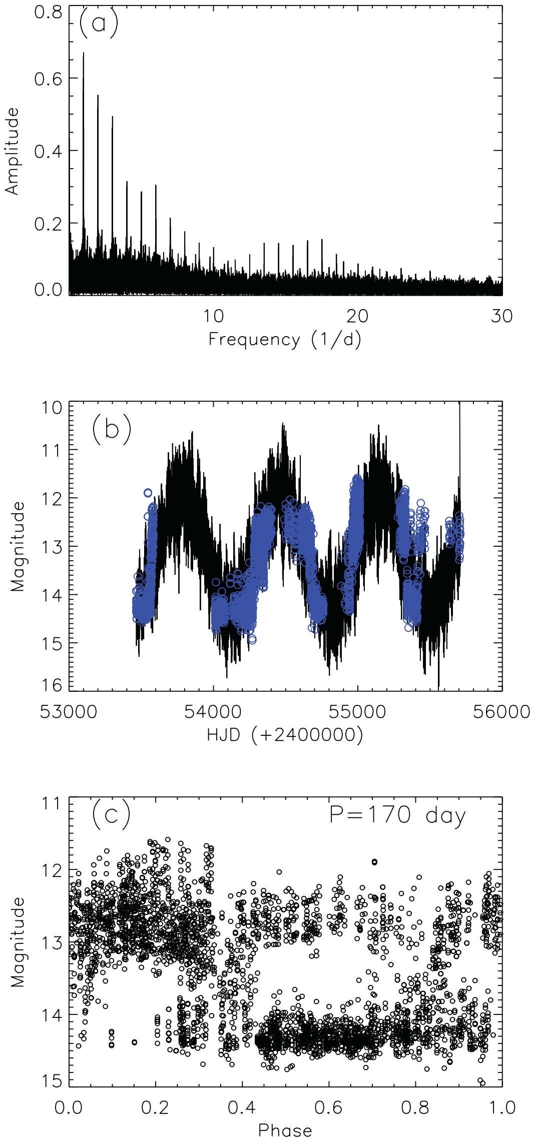

Figure 7. ROTSE data used in the frequency analysis for AM Her. (a) shows the spectral window of the data, (b) observation data and (c) the phase diagram for $P = 170$ d.

orbital parameters and the physical parameters. Staude, Schwope & Schwarz (2001) revised the parameters of V1309 Ori by using both photometric and spectroscopic studies. The light variation of V1309 Ori obtained in this study is shown in Fig. 6(a) and (b). The ephemeris given by Staude et al. (2001) is used in Fig. 6(b). As well as using ROTSE IIId, we also observed the system during two nights in 2006 with RTT150 at TUG using the Cousins *R* band. However, we could not obtain the full light curve. Period analysis of these light variations indicates non-periodic light variations with periods varying between ∼10 and ∼17 min.

Polars are known to show occasional high and low accretion states. An important difference between the light curves of AM Her (Fig. 1b) and V1309 Ori (Fig. 6b), however, is that AM Her shows variations around (i) 14.5 mag and (ii) 12.5 mag, one with single peak and one with double peaks; on the other hand, long-term data of V1309 Ori show a single pattern of light variation. Schwarz et al. (2005) reported V1309 Ori to show a permanently high accretion rate. The AAVSO data of the system are also insufficient to study it in detail.

4 TIME SERIES ANALYSIS

A frequency analysis was performed on all available data points of AM Her, AN UMa and AR UMa obtained with ROTSE IIId. DP Leo and V1309 Ori have limited data points, therefore we excluded them from the time series analysis. The analysis was performed using the software PERIOD04 (Lenz & Breger 2005) and SIGSPEC (Reegen 2007), which is based on classical Fourier analysis. We searched for significant peaks in the frequency interval from 0 d^{-1} to the Nyquist frequencies.

The analysis resulted in the detection of 8, 5 and 6 frequencies for AM Her, AR UMa and AN UMa, respectively. Table 2 lists the obtained frequency, amplitude and signal-to-noise ratio (S/N) values sorted by decreasing values of amplitude. Possible combinations

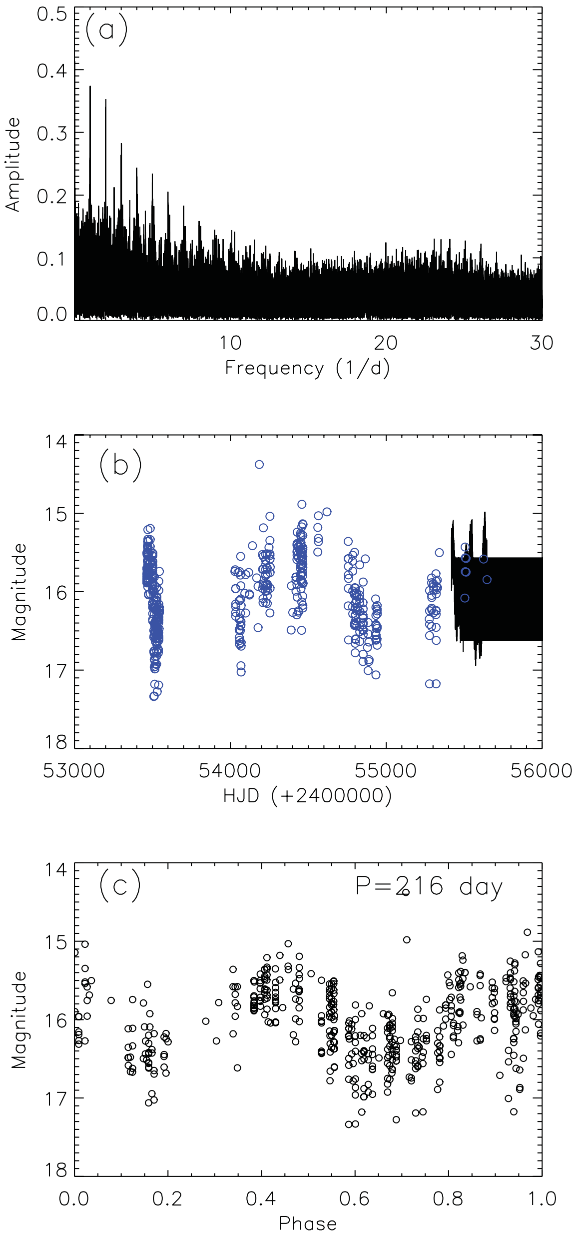

Figure 8. Same as Fig. 7 but for AN UMa.

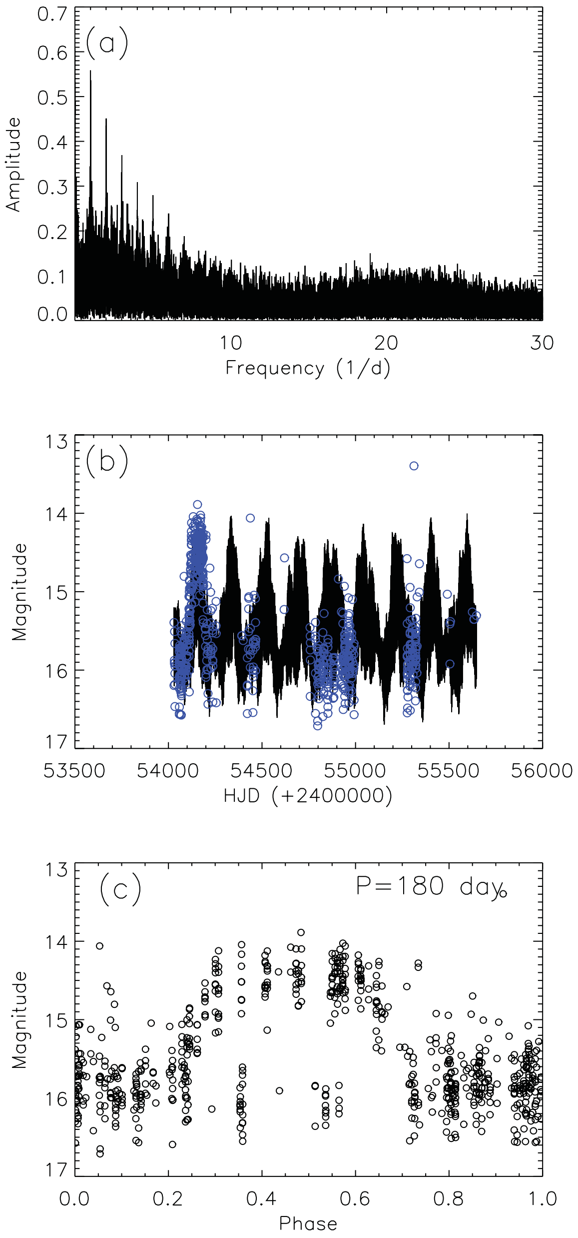

Figure 9. Same as Fig. 7 but for AR UMa.

Table 3. Orbital period, masses and magnetic field intensities of polars used in Fig. 10. See text for details.

System	P (h)	M_{wd} ($\mathrm{M}_\odot$)	M_{donor} ($\mathrm{M}_\odot$)	B (MG)	References
EV UMa	1.328	≈1	0.1	≈30–40	Osborne et al. (1994), Ramsay & Cropper (2003)
GG Leo	1.331	1.13	0.09	23	Burwitz et al. (1998), Ramsay et al. (2004)
EF Eri	1.35	0.6	0.045	16, 21	Wickramasinghe & Ferrario (2000), Howell et al. (2006a)
FL Cet	1.452	≈0.5	≈0.07	29	Schmidt et al. (2005), O'Donoghue et al. (2006)
DP Leo	1.497	0.71	0.106	30, 59	Robinson & Córdova (1994), Schwope (1996), Pandel et al. (2002)
HS Cam	1.637	0.85	0.21		Tovmassian et al. (1999)
VV Pup	1.667	0.73	0.1	30	Howell et al. (2006b)
V834 Cen	1.692	0.66	0.13	23	Schwope (1996), Mauche (2002)
EP Dra	1.743	0.43	0.133	16	Schwope & Mengel (1997), Remillard et al. (1991)
V2301 Oph	1.884	1	0.15	≈7	Silber et al. (1994), Ramsay & Cropper (2007)
MR Ser	1.891	0.62	0.153	24.6	Cropper et al. (1989), Schwope et al. (1993)
BL Hyi	1.894	1	0.15	23, 12	Mennickent, Diaz & Arenas (1999), Wickramasinghe & Ferrario (2000)
ST LMi	1.898	0.76	0.17	12	Wickramasinghe & Ferrario (2000), Ritter & Kolb (2003)
AN UMa	1.913	1	0.22–0.24	≈36	Krzemiński & Serkowski (1977), Cropper et al. (1989)
WW Hor	1.925	0.9–1.3	0.19		Pandel et al. (2002), Ritter & Kolb (2003)
AR UMa	1.932	0.6	0.18	≈200	Schmidt et al. (1996), Howell et al. (2001b), Ferrario, Wickramasinghe & Schmidt (2002)
HU Aqr	2.083	0.61	0.15	36	Glenn et al. (1994), Ritter & Kolb (2003), Gänsicke (1999)
AP CrB	2.531	0.39–0.57	0.24		Gänsicke et al. (2004)
HY Eri	2.855	0.45	0.36	≈25	Burwitz et al. (1999), Reinsch, Kim & Beuermann (2006)
AM Her	3.09	0.77–0.97	0.2–0.4	≈15	Bailey, Hough & Wickramasinghe (1988), Schwope (1996), Hessman et al. (2000)
QQ Vul	3.709	0.58	0.346		Mukai & Charles (1986, 1987)
V1043 Cen	4.19	0.4	0.45	56	Thomas et al. (2000), Gänsicke et al. (2000)
V1309 Ori	7.983	0.7	0.46	61	Shafter et al. (1995), Staude et al. (2001)

are also specified. S/N were computed in the interval of 5 d^{-1}. In Fig. 7, spectral windows, calculated frequencies and observational data are pictured for AM Her. Similarly, Figs 8 and 9 have been plotted using the frequencies obtained from the data analysis of AN UMa and AR UMa. Periodicities the source of which we believe to be the secondary star and/or its interaction with highly magnetic WDs in the system have been detected for all three polars. These periods are 170, 217 and 180 d, respectively. The variations that correspond to these periods are shown in phase diagrams (Figs 7–9).

5 DISCUSSION AND CONCLUSIONS

Any variation in the outer shell of the mass-losing star affects the orbital period and therefore its Roche-lobe size, and in turn these variations will modulate the mass-transfer rate (Richman et al. 1994 and references therein). These modulations are given as

$$\frac{\Delta\dot{M}}{\dot{M}} = -\frac{1}{3}\left(\frac{a}{R_2}\right)^2 \frac{R_2}{H}\frac{M_2}{M_{\mathrm{s}}}\frac{\Delta P}{P}, \tag{1}$$

where H is the photospheric height, R_2 is the radius of the secondary and a is the separation between the components (Richman et al. 1994). Assuming a Roche-lobe-filling secondary, we used the relation given by Eggleton (1983) to estimate the radius of the secondary. M_{s} is the mass of a thin shell with $M_{\mathrm{s}}/M_2 = 0.1$. Fractional changes in orbital period are estimated using equation (12) of Richman et al. (1994) with Eggleton's (1983) relation for the radius of the secondary. The estimated modulation in mass-transfer rate for AM Her is $\sim$ 30 per cent.

The polars studied in this work indicate that at short orbital periods the accretion rate is largest (see also Kotze & Charles 2010), while brightness variation is large. Recently, Kotze & Charles (2010) applied the relation given by Richman et al. (1994) to some low-mass X-ray binaries (LMXBs) and concluded that light variations in LMXBs originate from stellar activity cycles of the donor star.

Applegate (1992) proposed a relation to determine the subsurface field intensity of the active star by using the period of orbital period modulation. The modified version of the relationship according to Applegate (1994), given in Robinson & Córdova (1994), is

$$B^2 P_{\mathrm{cyc}} \sim \frac{GM_2^2}{R_2^4}\left(\frac{a}{R_2}\right)^2 \Delta P. \tag{2}$$

We collected the data of polars listed in Table 3 to estimate the magnetic fields of secondary stars. However, since the period of orbital period modulation is not well-determined for most cases, we plotted $P_{\mathrm{cyc}}B$ versus their orbital periods in Fig. 10. We found a semi-empirical relation between these parameters of form

$$\log(B_2 \times P_{\mathrm{cyc}}^{1/2}) = -0.09012P + 8.46577, \tag{3}$$

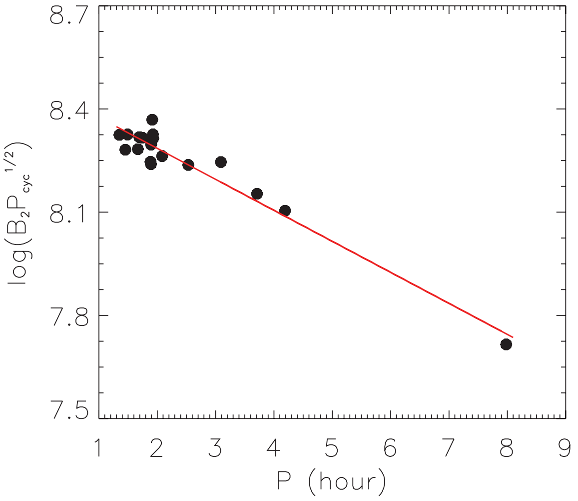

Figure 10. Estimated mean subsurface magnetic fields of secondaries in polars versus orbital period in hours. See text for details.

where P is the orbital period in hours and P_{cyc} is the orbital period variation cycle in units of seconds. As expected, high-rotation systems show high magnetic fields while systems with long orbital periods show low magnetic fields. The magnetic fields of WD and secondary star apparently show no relationship.

Because of stellar activity, the Sun and solar-like stars show modulations over decades with a quasi-periodic activity cycle. On the other hand, unlike single stars the dependence of stellar activity cycles on physical parameters in binary systems is not clearly defined. In this study, long-period variations obtained with the ROTSE IIId telescope indicate aperiodic 170-, 180- and 217-d variations for three polars. These variations can depend on the physical parameters of the secondary stars in polars and/or their interactions with the magnetic WDs or any other physical phenomena that we are as yet unaware of. Studying these variations will extend our knowledge of not only mCV evolution but also stellar activity and dynamos.

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REFERENCES

Akerlof C. W. et al., 2003, PASP, 115, 132
Applegate J. H., 1992, ApJ, 385, 621
Applegate J. H., Patterson J., 1987, ApJ, 322, L99
Bailey J., 1981, MNRAS, 197, 31
Bailey J., Hough J. H., Wickramasinghe D. T., 1988, MNRAS, 233, 395
Beuermann K., 2000, New Astron. Rev., 44, 93
Beuermann K., Thomas H.-C., 1993, Adv. Space Res., 13, 115
Beuermann K. et al., 2011, A&A, 526, 53
Bianchini A., 1992, in Vogt N., ed., ASP Conf. Ser. Vol. 29, Vina del Mar Workshop on Cataclysmic Variable Stars. Astron. Soc. Pac., San Francisco, p. 284
Biermann P. et al., 1985, ApJ, 293, 303
Bonnet-Bidaud J. M., Mouchet M., Somova T. A., Somov N. N., 1996, A&A, 306, 199
Bonnet-Bidaud J. M., Mouchet M., de Martino D., Matt G., Motch C., 2001, A&A, 374, 1003
Burwitz V. et al., 1998, A&A, 331, 262
Burwitz V., Reinsch K., Beuermann K., Thomas H.-C., 1999, in Hellier C., Mukai K., eds, ASP Conf. Ser. Vol. 157, Annapolis Workshop on Magnetic Cataclysmic Variables. Astron. Soc. Pac., San Francisco, p. 127
Cropper M. et al., 1989, MNRAS, 236, 29
Eggleton P. P., 1976, in Eggleton P., Mitton S., Whelan J., eds, IAU Symp. Vol. 73, Structure and Evolution of Close Binary Systems. Reidel, Dordrecht, p. 209
Eggleton P. P., 1983, ApJ, 268, 368
Ferrario L., Wickramasinghe D. T., Schmidt G., 2002, in Gänsicke B. T., Beuermann K., Reinsch K., eds, ASP Conf. Ser. Vol. 261, The Physics of Cataclysmic Variables and Related Objects. Astron. Soc. Pac., San Francisco, p. 149
Gänsicke B. T., 1999, in Hellier C., Mukai K., eds, ASP Conf. Ser. Vol. 157, Annapolis Workshop on Magnetic Cataclysmic Variables. Astron. Soc. Pac., San Francisco, p. 261
Gänsicke B. T., Beuermann K., de Martino D., Thomas H.-C., 2000, A&A, 354, 605
Gänsicke B. T., Jordan S., Beuermann K., de Martino D., Szkody P., Marsh T. R., Thorstensen J., 2004, ApJ, 613, L141
Garnavich P., Szkody P., 1988, PASP, 100, 1522
Garnavich P. M., Szkody P., Robb R. M., Zurek D. R., Hoard D. W., 1994, ApJ, 435, L141
Glenn J., Howell S. B., Schmidt G. D., Liebert J., Grauer A. D., Wagner R. M., 1994, ApJ, 424, 967
Hearn D. R., Marshall F. J., 1979, ApJ, 232, L21
Hessman F. V., Gänsicke B. T., Mattei J. A., 2000, A&A, 361, 952
Howell S. B., Gelino D. M., Harrison T. E., 2001a, AJ, 121, 482
Howell S. B., Nelson L. A., Rappaport S., 2001b, ApJ, 550, 897
Howell S. B., Walter F. M., Harrison T. E., Huber M. E., Becker R. H., White R. L., 2006a, ApJ, 652, 709
Howell S. B., Harrison T. E., Campbell R. K., Córdova F. A., Szkody P., 2006b, AJ, 131, 2216
Kafka S., Hoard D. W., 2009, PASP, 121, 1352
Kalomeni B., Yakut K., 2008, AJ, 136, 2367
Kalomeni B., Pekünlü E. R., Yakut K., 2005a, A&A, 439, 823
Kalomeni B., Pekünlü E. R., Yakut K., 2005b, Ap&SS, 296, 477
Kotze M. M., Charles P. A., 2010, MNRAS, 402, 16
Krzemiński W., Serkowski K., 1977, ApJ, 216, L45
Lenz P., Breger M., 2005, Comm. Asteroseismol., 146, 53
Mauche C. W., 2002, ApJ, 578, 439
Mennickent R. E., Diaz M. P., Arenas J., 1999, A&A, 352, 167
Mukai K., Charles P. A., 1986, MNRAS, 222, 1
Mukai K., Charles P. A., 1987, MNRAS, 226, 209
O'Donoghue D. et al., 2006, MNRAS, 372, 151
Osborne J. P., Beardmore A. P., Wheatley P. J., Hakala P., Watson M. G., Mason K. O., Hassall B. J. M., King A. R., 1994, MNRAS, 270, 650
Paczynski B., 1981, Acta Astron., 31, 1
Pandel D., Córdova F. A., Shirey R. E., Ramsay G., Cropper M., Mason K. O., Much R., Kilkenny D., 2002, MNRAS, 332, 116
Patterson J., 1984, ApJS, 54, 443
Ramsay G., Cropper M., 2003, MNRAS, 338, 219
Ramsay G., Cropper M., 2007, MNRAS, 379, 1209
Ramsay G., Cropper M., Mason K. O., Córdova F. A., Priedhorsky W., 2004, MNRAS, 347, 95
Reegen P., 2007, A&A, 467, 1353
Reinsch K., Kim Y., Beuermann K., 2006, A&A, 457, 1043
Remillard R. A., Silber A., Stroozas B. A., Tapia S., 1991, ApJ, 379, 715
Remillard R. A., Schachter J. F., Silber A., Slane P., 1994, ApJ, 426, 288
Richman H. R., Applegate J. H., Patterson J., 1994, PASP, 106, 1075
Ritter H., Kolb U., 2003, A&A, 404, 301 (update RKcat7.9)
Robinson C. R., Córdova F. A., 1994, ApJ, 437, 436
Sanad M. R., 2010, Ap&SS, 330, 337
Schmidt G. D., Szkody P., Smith P. S., Silber A., Tovmassian G., Hoard D. W., Gänsicke B. T., de Martino D., 1996, ApJ, 473, 483
Schmidt G. D. et al., 2005, ApJ, 620, 422
Schwarz R., Reinsch K., Beuermann K., Burwitz V., 2005, A&A, 442, 271
Schwope A. D., 1996, in Evans A., Wood J. H., eds, Astrophys. Space Sci. Libr. Vol. 208, Cataclysmic Variables and Related Objects. Kluwer, Dordrecht, p. 189
Schwope A. D., Mengel S., 1997, Astron. Nachr., 318, 25
Schwope A. D., Beuermann K., Jordan S., Thomas H.-C., 1993, A&A, 278, 487
Shafter A. W., Reinsch K., Beuermann K., Misselt K. A., Buckley D. A. H., Burwitz V., Schwope A. D., 1995, ApJ, 443, 319
Silber A. D., Remillard R. A., Horne K., Bradt H. V., 1994, ApJ, 424, 955
Staude A., Schwope A. D., Schwarz R., 2001, A&A, 374, 588
Tapia S., 1976, BAAS, 8, 511

Thomas H.-C., Beuermann K., Burwitz V., Reinsch K., Schwope A. D., 2000, A&A, 353, 646

Tout C. A., Wickramasinghe D. T., Liebert J., Ferrario L., Pringle J. E., 2008, MNRAS, 387, 897

Tovmassian G. H. et al., 1999, in Hellier C., Mukai K., eds, ASP Conf. Ser. Vol. 157, Annapolis Workshop on Magnetic Cataclysmic Variables. Astron. Soc. Pac., San Francisco, p. 133

Warner B., 1988, Nat, 336, 129

Warner B., 1995, Cataclysmic Varible Stars, Cambridge Astrophysics Series. Cambridge Univ. Press, Cambridge

Warner B., 2003, preprint (astro-ph/0310243)

Wenzel W., 1993, Inf. Bull. Var. Stars, 3890, 1

Whyte C. A., Eggleton P. P., 1980, MNRAS, 190, 801

Wickramasinghe D. T., Ferrario L., 2000, New Astron. Rev., 44, 69

Wickramasinghe D. T., Cropper M., Mason K. O., Garlick M., 1991, MNRAS, 250, 692

Wu K., Kiss L. L., 2008, A&A, 481, 433

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