Astron. Astrophys. 364, 694–700 (2000)

ASTRONOMY
AND
ASTROPHYSICS

Activity of DX Andromedae – the dwarf nova with a very long recurrence time of outbursts*

V. Šimon

Academy of Sciences, Astronomical Institute, 251 65 Ondřejov, Czech Republic (simon@asu.cas.cz)

Received 9 August 2000 / Accepted 9 October 2000

Abstract. An analysis of the historical light curve of the dwarf nova DX And, spanning over 18 years, is presented. The typical recurrence time T_C of the outbursts 270–330 days is one of the longest among CVs above the period gap. The $O-C$ diagram for T_C displays both smaller cycle-to-cycle variations and large occasional changes. The maximum brightness of the respective outbursts is variable by 1.3 $\mathrm{mag}_\mathrm{vis}$. There is a correlation between the maximum brightness of outburst and the length of the preceding cycle but no correlation with the length of the following cycle. While the slope of the rising branches of the outbursts is largely dependent on the maximum brightness (brighter outbursts having steeper rise) the decay branches remain very similar for most outbursts. The activity is discussed in the framework of the thermal instability model and implications of the different values of α for the lengths of the respective cycles and the shapes of the outburst light curves are presented.

Key words: stars: activity – stars: binaries: close – stars: binaries: general – stars: circumstellar matter – stars: novae, cataclysmic variables – stars: individual: DX And

1. Introduction

DX And with its orbital period $P_\mathrm{orb} = 10.6$ hours (Drew et al. 1993) belongs to the cataclysmic variables (CVs) near the upper limit of the range of the orbital period lengths. It was discovered as a dwarf nova by Weber (1962). The K1 secondary which dominates the visible region in quiescence is evolved off the main sequence and must have lost a substantial amount of its mass (Drew et al. 1993; Sproats et al. 1996). The orbital modulation in quiescence is caused by the ellipsoidal variations of this star, superposed smaller night-to-night fluctuations may be caused by its magnetic activity (Hilditch 1995).

The outbursts in DX And are infrequent, with the cycle-length about 300 days (Warner 1995). Only two outbursts have been studied in detail. Ultraviolet spectra, obtained with *IUE* satellite by Drew et al. (1991) in November 1989, showed that the lines of N V λ1240 and C IV λ1549 are wind-dominated and suggest a lower limit to the mass loss rate of the order of 10^{-11} to 10^{-10} $\mathrm{M}_\odot$ yr^{-1}. Change of the shape of the spectrum during the rise suggests an inside-out outburst (Warner 1995). The photometric CCD observations of Spogli et al. (1998) revealed that the steady-state accretion disk does not represent well the optical continuum during the decline of outburst in September 1994.

The orbital period of DX And is not very different from that of another long-period dwarf nova CH UMa (8.23 hr; Friend et al. 1990). Both systems also appear to have secondaries evolved off the main sequence. They therefore can be taken as the representatives of dwarf novae near the upper limit of the distribution of CVs. It is interesting and desirable to compare also the character of their activity and the morphology of their outbursts.

2. Sources of the data

Monitoring of dwarf novae is almost entirely the domain of the associations of amateur observers due to the character of the long-term activity of these objects (often relatively short outbursts separated by long intervals of quiescence). The observations are mostly visual but they are quite numerous and come from a large number of observers; the objectivity of the features on the light curve can therefore be assessed. Visual data, if treated carefully, can be very useful for analysis of long-term activity (Percy et al. 1985; Richman et al. 1994). Accuracy even better than 0.1 mag can be achieved by averaging the data. This is quite sufficient for analyses of these large-amplitude variable stars.

The data used in this analysis of DX And were obtained from the database of Association Francaise des Observateurs d'Etoiles Variables (AFOEV), operated at CDS, Strasbourgh, France, and Variable Star Network (VSNET), Japan. The data in the merged files covered the years 1981–1999. The light curve was plotted and submitted to a visual inspection. The observations already marked as unreliable in the original files were rejected in most cases. Further, several observations, largely deviating from the neighbouring points on the light curve, were rejected. In order to smooth the light curve, the positive observations (2269) were then binned into one-day means (1660). The negative observations (1936) were used to constrain the number of possible missing outbursts and duration of some not fully

---

Send offprint requests to: simon@asu.cas.cz

[*] This research has made use of the AFOEV database, operated at CDS (France), and VSNET database (Japan).

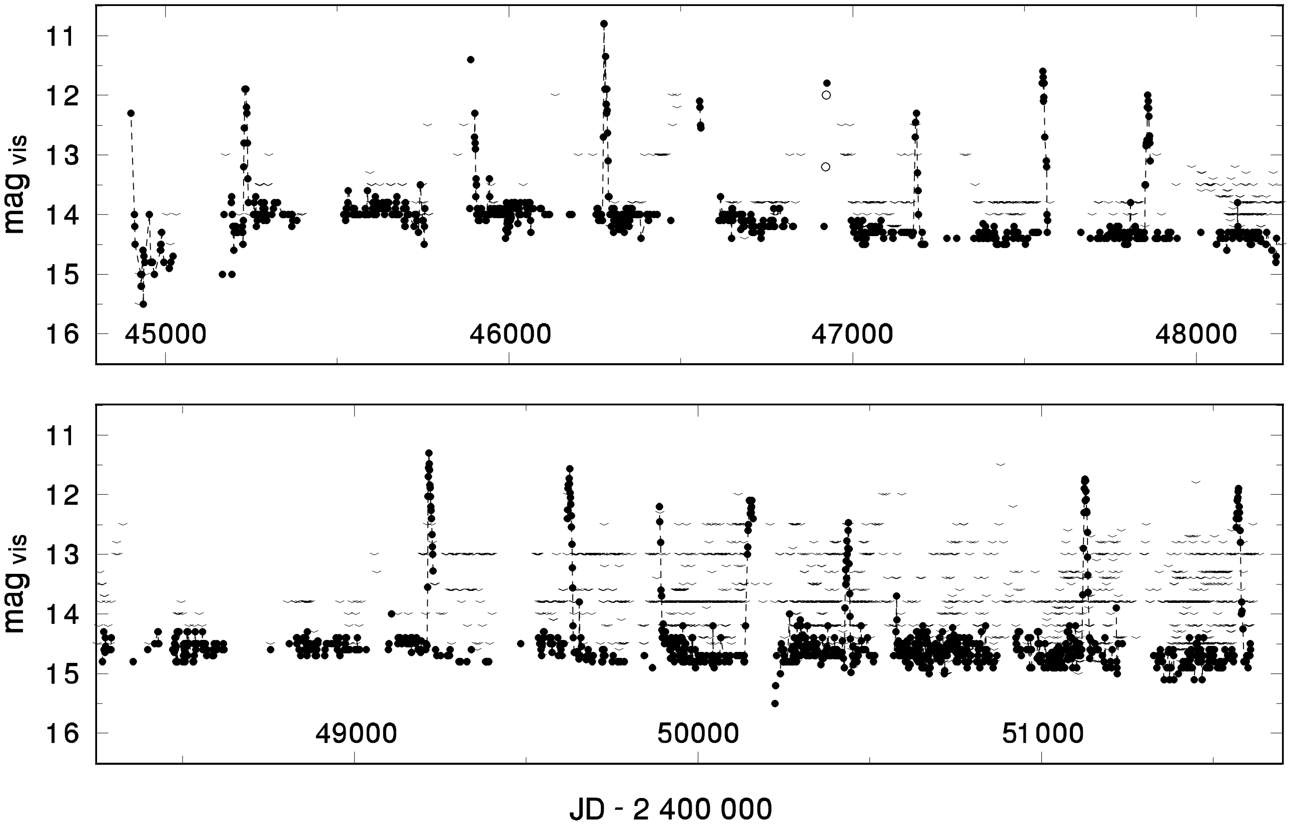

Fig. 1. The outburst history of DX And over the years 1981–1999. The points denote the positive observations and are connected by line for the densely covered intervals. The empty circles denote the observations reported by Mattei et al. (1987). The V symbols mark the upper limits of brightness and can be used to constrain the possibly missed outbursts. See Sect. 3.1 for details.

covered events. Only the outbursts defined by multiple observations from several nights were considered for further analysis. Although the outburst with the maximum around JD = 2 446 924 is represented by just a single point it is also confirmed by another two observations in IAUC (Mattei et al. 1987); these points are included in Fig. 1.

Two outbursts, having maxima in JD = 2 449 624 and 2 450 436, respectively, were also partly covered by CCD observations (mainly their decay branches). The CCD data come from Spogli et al. (1998) in the former case and from Ouda station (Kyoto University, VSNET) in the later one. In both cases the CCD observations were slightly shifted in brightness to improve the match of the visual light curve. We preferred to shift the CCD data because they are much less numerous than the visual ones and because they cover just short segments of the light curve. This slight shift by -0.07 mag(V) for Spogli's et al. (1998) data and -0.05 mag(V) for Ouda station is quite understandable because the visual and the CCD data (mostly V-band) may not be quite identical.

3. Analysis of the data

3.1. General description

The light curve of DX And, spanning over the years 1981–1999, can be seen in Fig. 1. In order to assess the total coverage and constrain the possibly missed outbursts, we also display the upper limits of brightness. The observations are not quite uniformly distributed due to relatively short but noticeable seasonal gaps. The amount of observations and the coverage of the light curve improved after JD = 2 449 500. Owing to the very long recurrence time $T_{\rm C}$ (see Sect. 3.2) only 16 outbursts have been observed by AFOEV and VSNET observers over the covered interval. The brightest outbursts reach up to about 11.5 mag$_{\rm vis}$ from the quiescent level (14.0–14.7 mag$_{\rm vis}$). Although the outbursts are infrequent they are of a long duration (about 20 days) and allow a study of the properties of their rising and declining branches. The examples are shown in Fig. 2; they are aligned according to their decay branches for the purposes discussed in Sect. 3.4.

The moment of the maximum light and the level of the peak brightness mag(max) were determined by fitting a polynomial (the 2$^{\rm nd}$ – 4$^{\rm th}$ degree) to the upper part of the outburst light curve. The typical errors of the determination of the moment of the maximum light and mag(max) are 1–2 days and 0.1 mag$_{\rm vis}$, respectively. Even in the case of incompletely covered outbursts the negative observations allow to constrain this moment to within about 10 days. This error is much smaller than $T_{\rm C}$ and is reflected in the weights, listed in Table 1. The respective well covered outbursts were also plotted on the separate graphs and examined in detail.

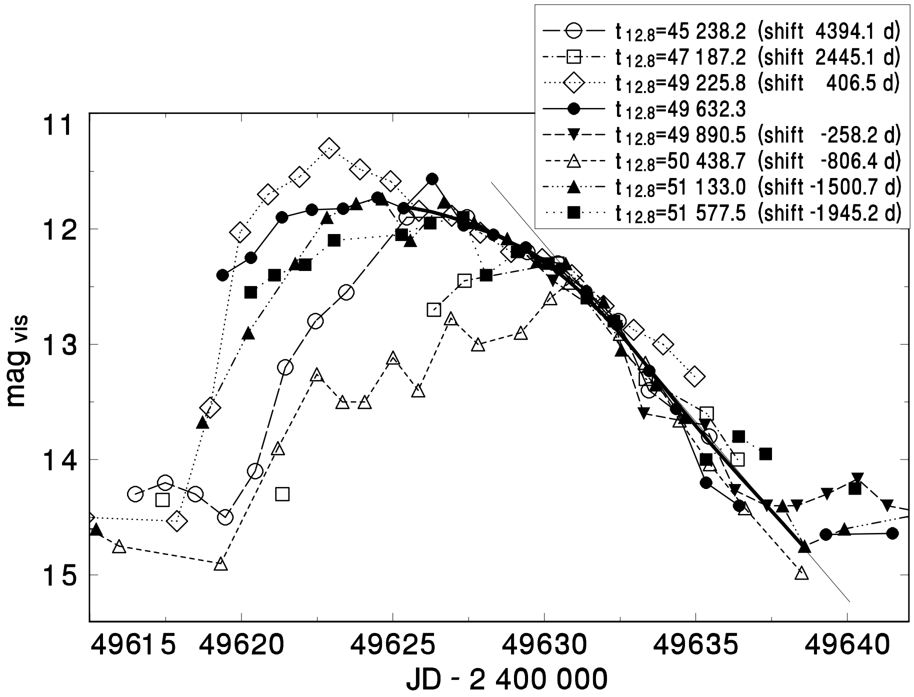

Fig. 2. The appearance of the well covered outbursts in DX And. The points represent one-day means and were connected by line in densely covered parts of the light curves for convenience. The respective outbursts were shifted along the time axis to match the decay branch of the template – the time of crossing 12.8 $\mathrm{mag_{vis}}$ and the shifts with respect to the template are listed in the figure. The thick line represents the smoothed decay curve while the thin straight line denotes its exponential part. See Sect. 3.4 for details.

Table 1. Parameters of the outbursts in DX And. $T_{\max}$ refers to the maximum brightness in JD–2 400 000. The epoch number and $O-C$ (days) are calculated according to Eq. (1). Weight refers to the accuracy of determination of $T_{\max}$. Maximum brightness of outburst is abbreviated as mag(max). RE denotes the relative energy of outburst (see Sect. 3.2). The rate of rise to the outburst maximum τ_{R} is expressed in days $\mathrm{mag_{vis}^{-1}}$.

$T_{\max}$JD	Epoch	$O-C$	Weight	mag(max)	RE	τ_{R}
44900	-13	-52	1/5	<12.3		
45233	-12	-47	1	11.9	47	2.27
45890	-10	-46	2/3			
46280	-9	16	2/3	11.5	68	
46550	-8	-42	1/3	<12.1		
46924	-7	4	1/5			
47184	-6	-64	1	12.2	28	3.26
47553	-5	-23	2/3	11.7	>56	
47859	-4	-45	1	12.1	39	4.55
49216	0	0	1	11.45	85	1.54
49624	1	80	1	11.7	69	
49887	2	15	2/3	<12.2		
50154	3	-46	2/3	12.1	67	5.00
50436	4	-92	1	12.7	19	6.25
51126	6	-58	1	11.8	62	2.33
51571	7	59	1	12.0	53	

3.2. The outburst cycle-length and its variations

The method of determination of the recurrence time T_{C} of outbursts in dwarf novae using the $O-C$ residuals from some reference period (e.g. Vogt 1980) removes the drawbacks of the widely used approach based on the measurements of separation of the neighbouring outbursts. The method of the $O-C$ residuals is not sensitive to the exact length of the reference period and the $O-C$ diagram can be constructed even if there are gaps in the data. A more detailed discussion of this method was given in Šimon (2000, hereafter Paper I).

The reference period for DX And was determined from the mean separation of several neighbouring outbursts and was found to be about 330 days. The negative observations were used to constrain the number of possible missing outbursts and to confirm that on average T_{C} cannot be shorter. A set of the $O-C$ curves for slightly different reference periods was generated to obtain the mean slope of the $O-C$ values as small as possible. The final $O-C$ diagram is displayed in Fig. 3a. The reference period of 328 days (Eq. (1)) was proven to show the course of the $O-C$ values of the outbursts with the best clarity.

$$T_{\max} = 2\,449\,216 + 328\,E \tag{1}$$

In most cases the error bars in Fig. 3a would be smaller than the symbols used. It can be seen that the method of residuals enabled to determine T_{C} in spite of several missing outbursts which mostly fall into intervals of a weak coverage of the light curve. The only one insecure case is the interval between the outbursts at $E=4$ and $E=6$ because the coverage is relatively dense and makes large inserted outburst unlikely. However, a considerable decrease of mag(max) and RE occurred for the outbursts $E=0$ to $E=4$ (see Fig. 3a and below). If this trend continued then a possible smaller outburst at $E=5$ might escape detection.

Both smaller cycle-to-cycle variations and occasional large $O-C$ changes can be resolved. The linear fits (straight lines in Fig. 3a) of the segments in the $O-C$ curve during which the mean cycle-length may be regarded as approximately constant were made using the weights from Table 1. The linear fit to the interval of epochs $E=-13$ to -4 yielded the mean $T_{\mathrm{C}} = 328$ days with the standard deviation $\sigma = 24$ days. The $O-C$

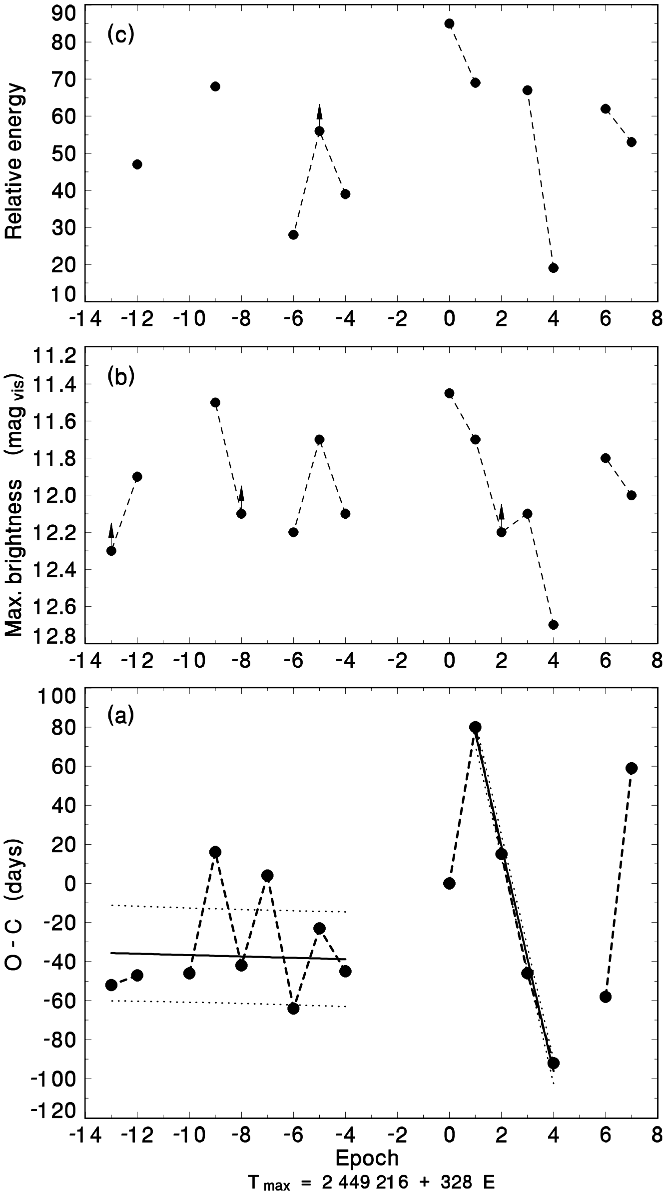

Fig. 3a–c. The $O-C$ diagram for the moments of the maxima (**a**), variations of the maximum brightness (**b**) and the relative energy (**c**) of the respective outbursts in DX And. The $O-C$ values were calculated according to Eq. (1). The neighbouring outbursts are connected by dashed line for clarity. The straight lines in Fig. a denote the linear fits of the segments in the curve during which the mean cycle-length may be regarded as approximately constant; the standard deviation of the linear fit is marked by dotted lines. The arrows in Figs. bc denote the lower limits. See Sect. 3.2 for details.

diagram displays a large change at $E=1$. The fit within $E=1$ to 4 gives a significantly shorter $T_{\rm C}=270$ days with a small $\sigma=5$ days.

The maximum brightness and the relative energy of the respective outbursts versus epoch are included in Fig. 3bc. The so called relative energy (RE) of outburst allows a comparison of the energy output of the respective outbursts in a given dwarf nova. RE was defined and determined in the same way as described in Paper I, the intensity being normalized to unity at 14.0 mag$_{\rm vis}$. Since we are interested just in comparing the relative outputs of outbursts in a given binary, RE may be expressed in dimensionless units. Both mag(max) and RE of the respective outbursts are highly variable but no long-term trend is apparent.

3.3. Relation between the maximum brightness and $T_{\rm C}$

It can be seen from Fig. 3b that the maximum brightness of outbursts is largely variable by 1.3 mag$_{\rm vis}$ and that there may be some similarity between the course of mag(max) and the current value of $T_{\rm C}$ (Fig. 3a). We therefore searched for a relation between mag(max) of $E_{\rm i}$ th outburst and the length of the preceding cycle $\Delta t(E_{\rm i}-E_{\rm i-1})$ and also between mag(max) and the length of the following cycle $\Delta t(E_{\rm i+1}-E_{\rm i})$. Only the outbursts for which both mag(max) and Δt could be determined were used. Fig. 4a shows that a correlation exists between mag(max) and the length of the preceding cycle: the longer the preceding cycle, the brighter the outburst. Most outbursts in Fig. 4a follow a linear dependence with the correlation coefficient $r=0.66$. On the other hand, there is no correlation between mag(max) and the length of the following cycle – Fig. 4b displays only a large scatter with no apparent trend. Examination of the dependence of RE on the cycle-lengths gave similar results, that is positive correlation of RE on $\Delta t(E_{\rm i}-E_{\rm i-1})$. However, RE could be measured for smaller number of outbursts than mag(max).

3.4. Morphology of the outburst light curves

Although just a relatively small number of outbursts of DX And have been observed due to the very long $T_{\rm C}$, the respective outbursts are quite wide and typically last for about 20 days. They therefore allow to resolve features on their light curves. Several outbursts, having a very good coverage by the visual and in two cases also by the CCD observations, enable a detailed study. Again, the procedure was similar to that applied for CH UMa in Paper I. The outburst having maximum in JD = 2 449 624 was chosen as the template because its decay branch is well covered by both the visual and CCD data (its light curve was made of the merged visual means and CCD data which were usually given weighs 1 and 4, respectively). The remaining outbursts were shifted along the time axis to match the decay branch of the template because – as it will be shown below – the decay branches of the respective outbursts are much more similar each to other than the rising parts. The level of brightness of 12.8 mag$_{\rm vis}$ was chosen as the reference level in the vicinity of which the match was attempted. The result is shown in Fig. 2. The decay branches of the respective outbursts were then merged into a common file and smoothed by the program HEC13 (author Dr. P. Harmanec), based on the method of Vondrák (1969, 1977). This method can fit a smooth curve no matter what the course of the data is. The input parameters of the fit $\epsilon=10^{-2}$ (the length of the bin $\Delta T\ =0.5$ day) were found to satisfy the course of the decay. The input ϵ parameter determines how "tight" the fit will be (if just the main course or if also the high-frequency variations are

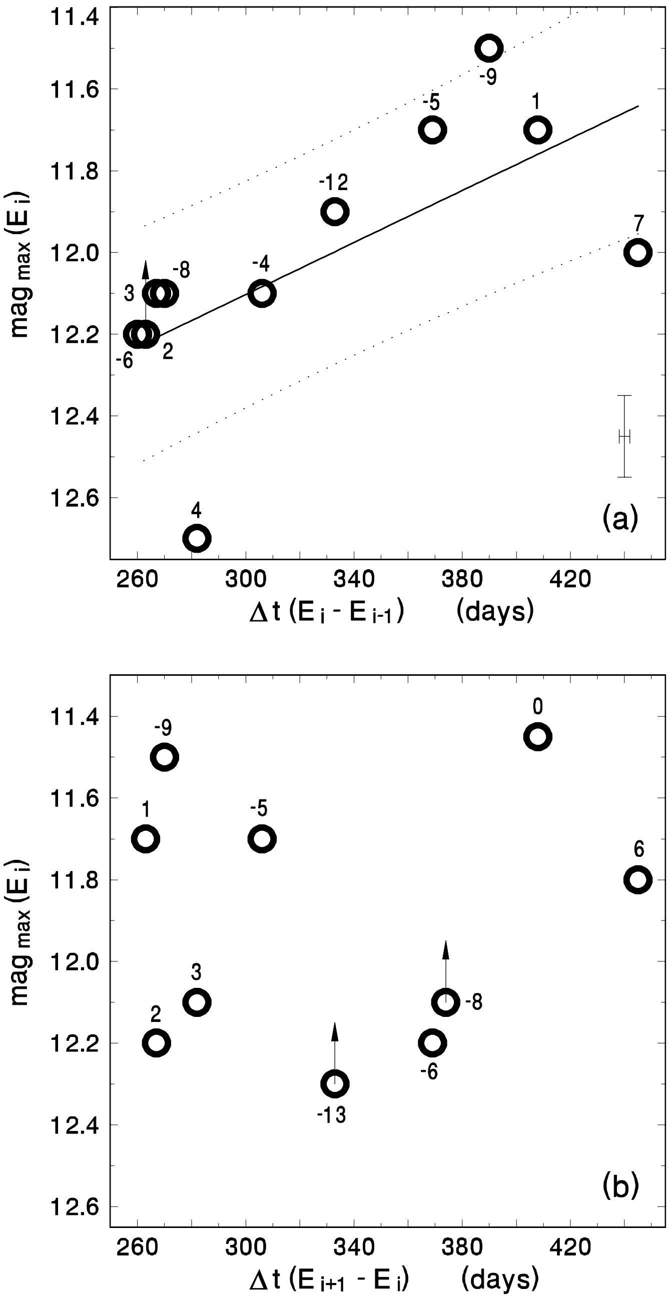

Fig. 4. a Relation of the maximum brightness mag(max) of the outburst to the length of the preceding cycle in DX And. **b** Relation of mag(max) to the length of the following cycle. The number of each outburst refers to the epoch according to Eq. (1) (Table 1). The arrows denote the lower limits. Typical 2σ errors are marked in the corner of Fig. a. See Sect. 3.3 for details.

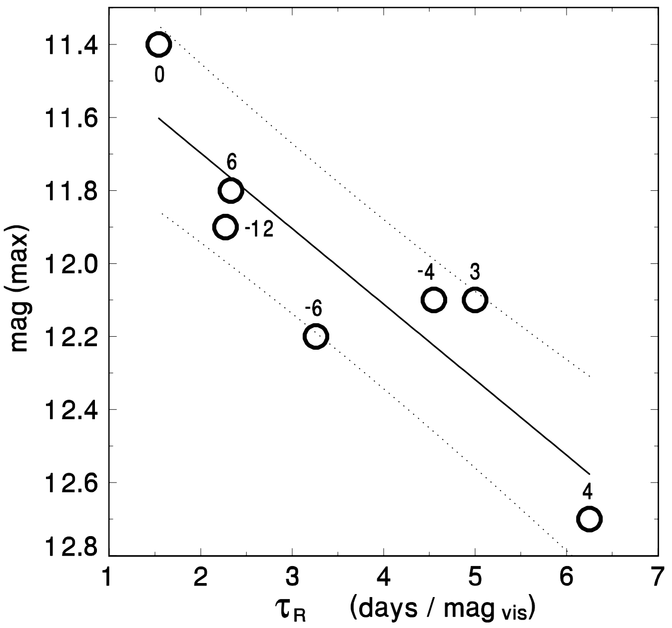

Fig. 5. Relation between the maximum brightness mag(max) of the outburst and the slope of its rising branch in DX And. The slope (rate of rise τ_R) is expressed in days $\mathrm{mag}_\mathrm{vis}^{-1}$. See Sect. 3.4 for details.

to be reproduced). In our case ϵ was chosen so that the fit reproduces just the main course of the decay. The standard deviation of the residuals of this fit is 0.17 $\mathrm{mag}_\mathrm{vis}$. The smoothed decay light curve is plotted as the thick solid line in Fig. 2.

The result in Fig. 2 clearly shows the fact that although the respective outbursts largely differ in their maximum brightness and the course of the rising parts, their decay branches are remarkably similar. The smoothed course reveals that the decay from 12.4 $\mathrm{mag}_\mathrm{vis}$ down to the quiescent level is exponential with the decay rate $\tau_\mathrm{D} = 3.24$ days $\mathrm{mag}_\mathrm{vis}^{-1}$.

Notice that the duration (width) of the individual outbursts in Fig. 2, measured just above the quiescent level, does not differ by more than about 20 % for the respective events although the brighter outbursts are slightly longer.

Fig. 2 also shows a well defined shift of the position of the peak brightness with varying mag(max) of the individual outbursts. The fainter outbursts possess slower rise, the peak therefore occurs significantly later than in the brighter outbursts if the respective events are aligned according to their decay branches. The shift of the position of the peak may reach 7 or 8 days. In order to quantify these variations of the rises, a linear fit of the rising branch of each outburst with a sufficient coverage was made. Although the linear fit may seem to be an oversimplified approach in some cases, we preferred a fit as simple as possible to emphasize the main course of the rise. The result is shown in Fig. 5 where mag(max) is plotted as a function of the rate of rise τ_R, expressed in days $\mathrm{mag}_\mathrm{vis}^{-1}$. We added two outbursts ($E = -4$ and $E = 3$) which are not shown in Fig. 2 because only their rises and tops were covered. Clear correlation emerges from Fig. 5, confirming that brighter outbursts tend to have faster rises. A linear fit with the correlation coefficient $r = 0.89$ can be made.

At this point, a note about the influence of the shift of the peak brightness on the $O - C$ diagram should be made. This shift may reach 7 or 8 days while the range of the $O-C$ values in Fig. 3a achieves about 160 days and typically amounts to tens of days. We can therefore conclude that the smearing, imposed by the shifts of the maxima, does not alter significantly the overall course of the $O - C$ variations in Fig. 3a.

4. Discussion

We have presented an analysis of the long-term activity of the dwarf nova DX And. The mean $T_{\rm C}$ of the outbursts over the last 18 years is shown to be about 330 days. DX And along with CH UMa (Paper I) therefore represent dwarf novae with $P_{\rm orb}$ above the period gap but shorter than 1 day which have exceptionally long $T_{\rm C}$. Both DX And and CH UMa appear to have secondaries evolved off the main sequence; this is a common feature that they share with GK Per; ($P_{\rm orb} = 2$ days; $T_{\rm C} = 885$ days) and V 1017 Sgr ($P_{\rm orb} = 5.7$ days; $T_{\rm C} \approx$ years) (Warner 1995). The long $T_{\rm C}$ in DX And suggests a very low mass transfer rate $\dot{m}$. The normalized $\dot{m}$ versus $T_{\rm C}$ (Fig. 3.33 in Warner 1995) even predicts that DX And as well as CH UMa falls beyond the allowed $T_{\rm C}$ unless its α is very low.

We point to a difference between otherwise similar light curves of DX And and CH UMa. While CH UMa displays several well observed small outbursts (referred to as "faint" outbursts in Paper I) which are more narrow and fainter by about 2 $\rm mag_{vis}$ than the ordinary outbursts, DX And appears to be free of them (at least none was detected over the last about 18 years of observations).

The decay branches remain remarkably similar for the individual outbursts of DX And. The decline from 12.4 $\rm mag_{vis}$ down to the quiescent level is exponential with the decay rate $\tau_{\rm D} = 3.24$ days $\rm mag_{vis}^{-1}$. Eq. (3.5) in Warner (1995) predicts just a slightly slower $\tau_{\rm Dpred} = 3.85$ days $\rm mag_{vis}^{-1}$. In the framework of the thermal instability model (e.g. Smak 1984) the cooling front always starts in the outer part of the disk (more precisely in the outermost region which the heating front had reached) and moves inwards. The properties of this front in DX And therefore do not differ much for the outbursts with largely different mag(max). Since the respective events only differ in the point where the rising branch switches to decay and not much in the shape of the decay (Fig. 2), it means that the velocity of the cooling front does not significantly depend on the radius in which the heating front is switched into the cooling front. The shape of the decay branches in DX And is quite similar to the *fast type* of CH UMa.

The computations by Cannizzo (1994), making use of the viscosity parameter α as a function of the disk radius in the form $\alpha = \alpha_0 (r/r_{\rm outer})^\beta$, can serve as a guide line for a study of the decay. β gives the degree of dependence of α on the disk radius and Cannizzo's models were computed for β between -0.3 and 0.6. The upper part of the decay of the bright outbursts which is curved downwards may be accounted for by the radial dependence of α, having $\beta < 0$, in the outer part of the disk where the cooling front starts. The fainter outbursts have a sharp maximum and the rise immediately turns into decay; these outbursts are faint enough to start decay on the fast part of the decay curve.

The course of the light curve, especially its rise, can help to resolve the type of outburst (A versus B) which were defined by the models of Smak (1984). The onset of the thermal instability, giving rise to the outburst, occurs in the outer part of the disk in type A (outside-in outburst) and the light curve is largely asymmetric (rapid rise and slow decay). The instability of the B type outburst, starting in the inner parts of the disk and propagating outwards (inside-out outburst), produces a rather symmetric light curve with a slow rise. The B type is typical for systems with a low mass transfer rate $\dot{m}$ while A type occurs for higher $\dot{m}$ (Smak 1984).

The slope of the rise to the outburst maximum in DX And is correlated with mag(max) (Figs. 2 and 5). While the slow rise of the fainter outbursts is typical for the case B (inside-out) outbursts, the shape of the brighter outbursts more and more resembles the case A (outside-in). In the framework of the models for thermal instability (e.g. Smak 1984) it suggests that the heating front starts at a different radial distance from the center of the disk. According to the light curves the brighter outbursts of DX And tend to be more and more outside-in. It can be explained if the distance from the center of the disk where the critical density is reached first is larger in the case of the brighter outbursts. The correlation in Fig. 4a then suggests that better conditions for case A occur for the outbursts with longer preceding cycle. This is in contradiction with the models which show that case A occurs for $T_{\rm C}$ shorter than in case B, reflecting thus a higher $\dot{m}$ for the former case (Hameury et al. 1998; Ichikawa & Osaki 1994). We therefore need to suggest that the mass and angular momentum transport through the disk undergo variations during the respective quiescent intervals. For example $T_{\rm C}$ in a given CV is inversely proportional to the quiescent viscosity parameter $\alpha_{\rm cool}$ (e.g. Warner 1995). The contradiction between the type of outburst and the length of the preceding cycle in DX And can be then reconciled if $\alpha_{\rm cool}$ is allowed to have a slightly different value in the respective quiescent intervals. On the other hand, the models are calculated just for a given input value of $\alpha_{\rm cool}$.

Lower $\alpha_{\rm cool}$ also implies a lower viscous drift through the disk during quiescence, more matter therefore can accumulate in the outer disk region instead of drifting inwards. During a shorter preceding cycle, caused by a higher $\alpha_{\rm cool}$, matter accumulates predominantly in the inner disk region and it gives rise to the outburst of type B. On the other hand, during a longer preceding cycle more matter accumulates in the outer disk region due to a lower viscous drift – it leads to type A outburst. Provided that the mass outflow rate from the secondary is constant, this scenario can also explain the relation between the length of the preceding cycle and mag(max) (Fig. 4a) because more matter accumulated during a longer cycle can power a brighter outburst. Notice that the correlation between $\Delta t(E_{\rm i} - E_{\rm i-1})$ and mag(max) holds quite well for intervals where the *mean* $T_{\rm C}$ can be regarded as constant – it resembles the Kukarkin-Parenago relation. However, this correlation may be violated by occasional large changes in $T_{\rm C}$ (compare the deviating position of outburst $E = 7$ in Fig. 4a and its large $O - C$ in Fig. 3a).

The cycle-to-cycle variations of $T_{\rm C}$ in DX And often appear to be relatively small in comparison with the full amplitude of the $O - C$ variations. The course of the $O - C$ curve is therefore the net result (sum) of the often much smaller variations of $T_{\rm C}$ between the neighbouring outbursts. Segments within which the outbursts follow a linear course (that is they have a constant $T_{\rm C}$ for several epochs) can be identified in the $O - C$ diagram.

This feature is similar to that seen for the bright outbursts in CH UMa. However, while CH UMa displays a long-term trend in shortening T_{C}, correlated with general decrease of mag(max) and RE, DX And is free of these trends.

The decreasing mag(max) in the sequence of outbursts with $E = 1$ to 4 (all having the same $T_{\mathrm{C}} \approx 270$ days – much shorter than the average) can hardly be explained by variations of the mass transfer rate $\dot{m}$ (Fig. 3). Although the recent models by Schreiber et al. (2000) have shown that the accretion disk in dwarf nova is able to react rapidly to decrease of $\dot{m}$, the invoked decrease of mag(max) is expected to be accompanied by increase of T_{C}. On the contrary, DX And displayed rather constant and quite short T_{C} in this interval. This episode is more consistent with increase of the efficiency of the removal of the angular momentum from the disk, invoked for example by the magnetic field of the star spots on the secondary star (Meyer-Hofmeister et al. 1996).

Acknowledgements. This research has made use of the AFOEV database, operated at CDS (France), VSNET database (Japan) and NASA's Astrophysics Data System Abstract Service. I thank Dr. Hudec for reading the manuscript and for the comments. I am also indebted to Dr. Harmanec for providing me with the program HEC13. Naturally, my thanks also to numerous amateur observers worldwide whose decades of observations made this analysis possible. This analysis was supported by the post-doctoral grant 205/00/P013 of the Grant Agency of the Czech Republic and by the Project KONTAKT ME 137 by the Ministry of Education and Youth of the Czech Republic.

References

Cannizzo J.K., 1994, ApJ 435, 389
Drew J.E., Hoare M.G., Woods J.A., 1991, MNRAS 250, 144
Drew J.E., Jones D.H.P., Woods J.A., 1993, MNRAS 260, 803
Friend M.T., Martin J.S., Smith R.C., Jones D.H.P., 1990, MNRAS 246, 654
Hameury J.-M., Menou K., Dubus G., Lasota J.-P., Huré J.-M., 1998, MNRAS 298, 1048
Hilditch R.W., 1995, MNRAS 273, 675
Ichikawa S., Osaki Y., 1994, In: Duschl W.J. (ed.) Theory of Accretion Disks II, Kluwer Academic Publishers, Dordrecht, p. 169
Mattei J.A., Langhans T., Dyck G., 1987, IAU Circ. 4387
Meyer-Hofmeister E., Vogt N., Meyer F., 1996, A&A 310, 519
Percy J.R., Fabro V.A., Keith D.W., 1985, J. AAVSO 14, 1
Richman H.R., Applegate J.H., Patterson J., 1994, PASP 106, 1075
Schreiber M.R., Gänsicke B.T., Hessman F.V., 2000, A&A 358, 221
Smak J., 1984, Acta Astron. 34, 161
Spogli C., Fiorucci M., Tosti G., 1998, A&AS 130, 485
Sproats L.N., Howell S.B., Mason K.O., 1996, MNRAS 282, 1211
Šimon V., 2000, A&A 354, 103 (Paper I)
Vogt N., 1980, A&A 88, 66
Vondrák J., 1969, Bull. Astron. Inst. Czechosl. Vol. 20, 349
Vondrák J., 1977, Bull. Astron. Inst. Czechosl. Vol. 28, 84
Warner B., 1995, Cataclysmic Variable Stars. Cambridge Univ. Press, Cambridge
Weber R., 1962, Mem. Soc. Astron. Ital. Vol. 33, p. 39