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The Inter-Outburst Behavior of Cataclysmic Variables

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ABSTRACT

We have attempted to use existing IUE and AAVSO archive data to accomplish a large scale study of what happens to the ultraviolet flux of accretions disk systems during the quiescent intervals between outbursts and how it relates to the preceding outburst characteristics of amplitude and width. Our data sample involved multiple IUE observations for 16 dwarf novae and 8 novae along with existing optical coverage.

Our results indicate that most systems show correlated UV flux behavior with interoutburst phase, with 60% of the dwarf novae and 50% of the novae having decreasing flux trends while 33% of the dwarf novae and 38% of the novae showing rising UV flux during the quiescent interval. All of the dwarf novae with decreasing UV fluxes at 1475A have orbital periods longer than 4.4 hrs, while all (except BV Cen) with flat or rising fluxes at 1475A have orbital periods less than 2 hrs. There are not widespread correlations of the UV fluxes with the amplitude of the preceeding outburst and no correlations with the width of the outburst. From a small sample (7) that have relatively large quiescent V magnitude changes during the IUE observations, most show a strong correlation between the UV and optical continuum.

The interpretation of our results is complicated by not being able to determine how much the white dwarf contributes to the ultraviolet flux. However, it is now evident that noticeable changes are occurring in the hot zones in accreting systems long after the outburst, and not only for systems that are dominated by the white dwarf. Whether these differences are due to different outburst mechanisms or to changes on white dwarfs which provide varying contributions to the UV flux remains to be determined.

INTRODUCTION

The International Ultraviolet Explorer (IUE) has had significant impact on the study of cataclysmic variables (close binaries with mass transfer from a late type secondary to a primary white dwarf, usually via an accretion disk). A summary of the major results on all close binaries has recently been compiled by Cordova and Howarth (1987).

For cataclysmic variables (CVs), the primary discoveries have been the time-delay between the UV and optical during the rise of a dwarf novae outburst, which has placed solid constraints on theoretical models for the outburst, and the presence of P Cygni features at outburst, which indicates the occurrence of mass loss. Studies of the decline from outburst have also revealed some interesting results. Several large-scale observational campaigns on WX Hyi and especially VW Hyi have shown that the IUE flux continues to decline during the one and two week intervals between outbursts (Hassall, Pringle and Verbunt 1985; Verbunt *et al.* 1987). Observations of the longer outburst period system U Gem (Szkody and Kiplinger 1985) showed that it continued to decline in the ultraviolet for 108 days past outburst, whereas the optical reached quiescence in 7 days. The longest timescale studied so far has been for WZ Sge, which reached optical quiescence in 4 months, while the UV continued to decline for 8 yrs (Holm 1985; Szkody and Sion 1988; Sion and Szkody 1989).

The presence of absorption features combined with the continuum slopes indicate that a white dwarf dominates the UV flux in VW Hyi, U Gem and WZ Sge (Mateo and Szkody 1984; Panek and Holm 1984; Holm 1988; Sion and Szkody 1989). Interpretations of the declining UV flux involve either the cooling of the white dwarf (Pringle 1988; Sion and Szkody 1989) or a decrease in the accretion rate throughout quiescence (Pringle *et al.* 1987). Further studies of systems that are not dominated by the white dwarf and/or simultaneous X-ray and UV observations throughout the interoutburst interval are necessary to separate the effects of the white dwarf from the disk and boundary layer accretion.

With the wealth of available UV data present in the IUE archives and the corresponding large optical data set available from the AAVSO, we attempted to test whether all disk systems show this long term UV decline or whether it is only present in the white dwarf dominated systems. The ideal data set would consist of several observations throughout a single outburst cycle on several systems with long timescales between outbursts. Since the outbursts are not predictable and most systems with long outburst cycles are faint, there are not many data points which fit these criteria. However, past compilations of available data on WX Hyi, VW Hyi and U Gem have shown that fluxes from different cycles generally differ by about 20% at the same interoutburst phase whereas the total UV flux declines (after the systems had reached optical quiescence) were on the order of factors of 2 (Hassall, Verbunt and Pringle 1985; Schwarzenberg-Czerny *et al.* 1985; Szkody and Kiplinger 1985). Thus, we hoped to be able to use single measurements in different cycles to provide a larger sample. Also, since the AAVSO data contains information on the amplitude and duration of each outburst, we attempted to study the influence of these parameters on the observed UV decline, in a similar fashion as accomplished for the optical alone (Szkody and Mattei 1984).

THE DATA SAMPLE

Our data sample was first selected by compiling a list from the IUE archive (using data available to archive users in 1987 Sept.) of novae, dwarf novae and non-magnetic novalikes (showing a large range of optical variation) that had more than one IUE spectrum obtained when the system was at optical quiescence (as measured by the Fine Error Sensor on the IUE satellite). By using the data after optical quiescence had been reached, we would eliminate the disk changes associated directly with the outburst state. We did not include the systems for which specific studies of the outburst decline already exist in the literature (VW Hyi, U Gem, WX Hyi, WZ Sge).

Our selection resulted in a list of 30 candidates with specific times of observation. The corresponding optical measurements for these times and objects were then obtained from the AAVSO archive, including a) the time of the preceeding outburst b) the peak amplitude and duration of the preceeding outburst and c) the interoutburst phase if the times of the preceeding and following outbursts were available. For 5 of the systems on the list, the outburst record was not available, or the objects were found to be on the rise or near the peak of an outburst. Results could be obtained for 25 systems (16 dwarf novae, 8 novae and 1 novalike *i.e.*, AE Aqr). The IUE data on these 25 systems were then measured for line-free continuum values (50A wide bins centered at 1475A and 2650A) and line strengths (CIV and MgII) at the Goddard Regional Data Analysis Facility (RDAF).

The measured values for the optical and UV are listed in Table 1. This Table summarizes in successive columns: 1) the type of system, its optical outburst range and the typical outburst interval, 2) the AAVSO V magnitude measurement at the time of the IUE data, 3) the days past outburst peak (T), 4) the interoutburst phase (PH), 5) the amplitude of the preceeding outburst, 6) the duration of the outburst as measured from minimum to minimum, 7) the SWP and LWR or LWP number of the IUE spectra, and 8-11) the 1475 and 2650 continuum measurements and the CIV and MgII line flux measurements.

The error bars on the optical magnitudes are generally on the order of 0.2 magnitudes (as assessed by comparisons of various observers on the same object). The accuracy of the IUE measurements is dependent on the uncertainties in the calibration, the sensitivity degredations and most of all on the limitations involved in exposures on faint sources that are much less than the optimum exposure levels (Oliverson 1984; Sonneborn and Garhart 1986). Except for very low exposure levels, these uncertainties are within 10%.

RESULTS

Of the 25 systems in Table 1, 9 had more than 1 measurement during a single interoutburst cycle (data within a single cycle are marked s, s2, etc in the T column). Table 2 lists the results of the correlations of the interoutburst phase with the continuum and line fluxes.

The best data exist for the dwarf nova SS Cygni (14 different measurements with 3 subsets of more than one measurement during a single interval). Table 2 shows that the fluxes from the entire data set are not correlated with interoutburst phase, but that individual measurements within a single interoutburst interval are correlated, with decreasing flux as the interoutburst phase progresses. Figure 1 shows the plot of these fluxes with different symbols for each particular interval. It is apparent that the spread between different outburst cycles at a particular interoutburst phase can be as much as ±33%, whereas the individual cycles have a much smaller range in the declining fluxes. This means that data from different cycles must be used with much caution.

The other dwarf novae with several data points are EX Hya (5 SWP and 6 LWP measurements with 4 LWP during a single cycle); and RU Peg and SU UMa with 5 measurements. EX Hya shows no correlation with outburst behavior, either from the whole data set or the single cycle. However, since this system may not be a typical dwarf nova system due to its DQ Her nature (see Hellier *et al.* 1989 for a recent discussion), the inner part of the accretion disk (where the UV flux originates) may be disrupted and governed by magnetic field effects. RU Peg is similar to SS Cyg in showing no correlation with the entire data, while the two points from a single cycle show a declining trend. Figure 2 shows the plotted points of RU Peg. The measurements near phase 0.23 are significantly different from the decreasing trend evident from all the other data points, but it is not clear what causes this difference. The preceeding outburst was not drastically different in amplitude nor width from the rest of the outbursts.

The measurements of SU UMa are all from different outbursts so that no correlation would be expected (on the basis of the results from SS Cyg and RU Peg). However, the short wavelength continuum and the CIV fluxes are correlated, but with an increasing trend as the interoutburst phase progresses. Other dwarf novae which show an increasing flux throughout the time between outburst are OY Car, YZ Cnc, BV Cen, TY Psc and TY Psc, but only BV Cen has more than 2 data points (4 and 3 points in the SWP and LWP respectively) in order to provide a good estimate of a trend.

The two systems Z Cha and T Leo show no change in the SWP fluxes (within the uncertainties), but the long wavelength UV fluxes show a well correlated decline through the interoutburst cycle. Figure 3 shows the T Leo data. Both of these systems have ultrashort orbital periods (85 min and 107 min). This decreasing effect is also seen in the long wavelength UV flux of the ultrashort period system SU UMa. Since the longer UV wavelengths may be affected by the hot spot from the mass transfer stream (*e.g.*, the hot spot in U Gem is near 12000K and contributes to the LWR but not the SWP, Panek and Holm 1984), systems with different changes in the SWP and LWR/P may be affected by a hot spot.

In summary, of the 15 dwarf novae with interoutburst phase available (V2051 Oph showed no outbursts during the years of the IUE measurements), 7 have downward flux trends in both short and long wavelength continuum, 2 more show decreasing trends in the long wavelength and no change in the SWP (Z Cha and T Leo); 3 show increasing flux throughout the cycle in both wavelengths (BV Cen, TY Psc and YZ Cnc), OY Car has increasing flux for the SWP (no LWP data available), SU UMa shows increasing flux in the SWP and decreasing flux in the LWP, and EX Hya shows no correlations. The 6 dwarf novae with data within the same cycle all show decreasing flux trends except for EX Hya which is not correlated.

The strongest emission lines in each wavelength region (CIV and MgII) in general are correlated with the continuum changes. Of the 9 systems with decreasing continuum fluxes throughout the cycle, five show decreasing line strength (RX And, SS Aur, SS Cyg, RU Peg, T Leo), while 2 have increasing line flux as the continuum decreases (Z Cam and AH Her) and 2 have line fluxes too small to determine a reliable change (KT Per and Z Cha). Of the 4 systems showing increasing continua, only YZ Cnc shows a clear increase in the line fluxes (BV Cen has no correlation and OY Car and TY Psc have low line strength). In SU UMa, the line fluxes follow the continuum changes with the CIV increasing and the MgII decreasing, while EX Hya shows no obvious trends.

The novae systems have the advantage that the timescales between outburst are very long so that the sampling is generally within one cycle. However, GK Per has dwarf nova-like small outbursts every few years, so the observations span three of these cycles and the recurrent short period nova RS Oph had a nova outburst in 1985 so that the IUE spans 2 cycles. Three systems have a moderate size data base during quiescence with IUE (GK Per with 7 measurements, RS Oph with 6 and V603 Aql with 5 SWP and 3 long wavelength). Table 1 shows that the dwarf novae type outbursts of GK Per show similar effects to those in SS Cyg and RU Peg *i.e.*, there is not an overall correlation of the entire data, but the individual cycles are correlated with a decreasing flux trend. RS Oph shows no correlation in the total data but this cannot be checked with the individual cycles since they are not well-sampled in phase coverage. V603 Aql shows no variation in the SWP but the LWR points are well-correlated in a decreasing fashion (Figure 4 shows the data).

Of the 8 novae in our sample, 4 show decreasing flux trends at long times past the outburst, three show increasing fluxes (T Pyx in both short and long wavelength, T Aur and HR Del in long wavelength only), while RS Oph shows no obvious correlation. The line fluxes of novae are generally too small for accurate measurements of changes but 4 systems had measurable lines. The lines in RR Pic, V603 Aql and T Pyx follow the continuum trends (decreasing for RR Pic and V603 Aql and increasing for T Pyx). The lines in RS Oph are more correlated than the continuum and show a decreasing trend during the cycle.

In order to investigate the flux correlations with other factors (amplitude and width of the preceeding outburst), we restricted the data samples to those objects which showed outbursts differing by more than the 0.2 mag uncertainty in the optical measurement and/or more than 2 day spread in the width. This gave 6 dwarf novae to investigate the amplitude vs. flux correlations (OY Car, BV Cen, AH Her, EX Hya, RU Peg, and SU UMa) and 7 dwarf novae (OY Car, BV Cen, SS Cyg, AH Her, RU Peg, TY Psc, and SU UMa) along with 2 novae (GK Per and RS Oph) to investigate the width correlations.

There were no obvious correlations evident between the width of the previous outburst and the UV fluxes. The results for the amplitude versus flux correlations are given in Table 3.

Most of the objects show no significant correlation, with the exception of OY Car, AH Her, the SWP in SU UMa and the line fluxes in BV Cen. It is interesting that these correlations are negative *i.e.*, the UV fluxes are lower when previous outbursts have a higher amplitude. This could be understood for the line fluxes, since a stronger outburst may result in a longer time for the emission line regions to recover from the optically thick disk. Since AH Her and OY Car only involve two measurements, the results on the continuum may not be significant.

In order to check if the UV flux changes are connected to the optical in an observable way, we ran the correlations of the V magnitudes with the UV fluxes for the 7 systems which showed more than 0.2 mag changes in optical measurements. The results are shown in Table 4. The correlations in this case are very high, except for V2051 Oph, EX Hya and RS Oph (which are the systems which show no correlation with time since outburst). This implies that careful optical monitoring should be able to detect the changes that are evident in the UV.

CONCLUSIONS

Our study of the UV and optical fluxes of 25 cataclysmic variables has shown the strongest correlations between interoutburst phase and UV fluxes and between optical and UV fluxes.

The majority (60%) of our sample of 15 dwarf novae show decreasing UV fluxes after optical quiescence has been reached. This number becomes even larger (83%) if the sample is restricted only to those measurements obtained within a single outburst cycle. The nova GK Per with its dwarf nova type of outbursts also shows this effect. Another 33% of the dwarf novae show rising UV flux during quiescence. For the 8 novae in our sample, 50% show decreasing flux trends in the time after outburst, while 38% reveal rising fluxes. Only the peculiar dwarf nova EX Hya and the recurrent nova RS Oph show uncorrelated UV flux behavior with interoutburst phase. Our results indicate that there are changes in the hot emitting zones during the quiescent intervals in systems which are not obviously dominated by white dwarfs.

Current theories of dwarf novae outbursts (reviewed in Smak 1984; Verbunt 1986; Pringle *et al.* 1987) involve instabilities in the disk or on the secondary in order to modulate the mass accretion onto the white dwarf. In general, the disk instability models require an increase in the disk density during quiescence, which results in an increased disk and boundary layer luminosity. The mass transfer instability predicts a decrease in disk luminosity until the disk reaches an equilibrium value with the low mass transfer rate and then is at a steady luminosity until the next burst of mass transfer.

At first glance, it would appear that our results indicate that most dwarf novae follow a mass transfer model, while a lower percentage go along with the disk instability scenario. However, the situation is complicated by the unknown contribution of the white dwarf. Since the decreasing trend is evident in all systems which are known to be dominated by the white dwarf (VW Hyi, U Gem and WZ Sge) and preliminary models of the disk and white dwarf contribution in the UV have shown that the mass of the white dwarf significantly affects the UV fluxes (Verbunt 1987), it is possible that the majority of our sample have large contributions from a cooling white dwarf. However, these white dwarfs would have to provide a significant contribution to the UV luminosity without showing any spectral signature (such as Lyman α absorption or broad Balmer absorption in the optical).

Alternatively, the changes could be the result of adjustments in the size of the inner regions of emission, but this explanation would have some problems with the general observance of a larger flux change in the short wavelength UV as compared to the long. The difference in flux change with wavelength has its own attendant problems, since the hot spot (where the mass transfer stream intersects the disk) can have a measurable effect on the long wavelength IUE spectrum (Panek and Holm 1984).

If we only consider the SWP fluxes, it is interesting that of the 7 dwarf novae with decreasing SWP fluxes, all have long orbital periods (>4.4 hr; the period of KT Per is unknown), while 6 of the 7 dwarf novae that have flat or increasing SWP fluxes have orbital periods below the period gap (BV Cen is the exception). The spectrum of BV Cen has been analyzed by Williger *et al.* 1988 with the conclusion that the disk is likely to be optically thick (hence consistent with disk instability models) and the white dwarf does not dominate the UV flux. Perhaps the cause of outburst or the effect of the white dwarf vs the disk is period dependent. However, bear in mind that the results on WX Hyi and VW Hyi show decreasing trends and these are ultrashort period systems.

A better understanding of the causes of the flux changes will be evident when further long term X-ray monitoring programs during quiescent intervals are accomplished. This direct monitoring of the accretion rate will help to discriminate between the disk and white dwarf contributions.

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FIGURE CAPTIONS

Figure 1. The continuum binned fluxes at 1475A and 2650A and the line fluxes of CIV and MgII for the dwarf nova SS Cyg as a function of interoutburst phase. Each symbol corresponds to data within the same quiescent cycle (Table 1) where triangles are s, squares are s2 and circles are s3. The dots are the random measurements during different cycles.

Figure 2. The data for the dwarf nova RU Peg with the same notation as Figure 1.

Figure 3. The data for the dwarf nova T Leo with the same notation as Figure 1.

Figure 4. The data for the nova V603 Aql with the same notation as Figure 1.

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TABLE 1

IUE and AAVSO Measurements

OBJECT[a]	V	T[b]	PH	AMP	WIDTH	SWP/LWR(P)	1475A	2650A	CIV[c]	MgII
RX And	13.5	17	0.94	3.4	13	7896/R6879	1.0E-13	5.2E-14	43	8
DN	13.0	8s	0.62	3.1	11	17594/R13865	1.4	7.2	36	9
10.3-14.0	13.4	12s	0.93	3.1	11	17642/R13906	1.2	4.9	29	9
13d										
V603 Aql	11.4	22302	----	3.3	3908	5678/-----	1.0E-12	---	138	--
N 1918	11.4	22326	----	3.3	3908	5919/R5162	1.1	3.5E-13	140	15
-1.1-11.9	11.3	22592	----	3.3	3908	8756/-----	1.1	---	105	--
	11.4	22649	----	3.3	3908	9253/R8002	0.9	3.1	79	6
	11.4	22699	----	3.3	3908	9639/-----	1.1	---	92	--
	11.5	23008	----	3.3	3908	----/R10780	---	2.6	--	7
AE Aqr	11.4	-----	----	---	--	2658/R2367	3.0E-14	3.5E-14	11	65
NL	11.3	-----	----	---	--	7300/P6292	2.5	4.3	3	85
9.8-11.6	11.3	-----	----	---	--	9007/P7765	1.5	1.2	0	35
	11.4	-----	----	---	--	14598/P11194	2.2	2.9	2	93
SS Aur	14.8	36	0.47	4.5	16	7951/R6926	2.2E-14	1.0E-14	12	5
DN	14.5	87	0.77	4.3	14	16036/P12334	1.4	0.52	7	3
10.5-15.0										
53d										
T Aur	----	91y	---	11.0	--	17635/R13902	1.0E-14	3.7E-15	1	0
N 1891	----	92y	---	11.0	--	21544/P2268	1.1	7.7	0	1
4.2-15.1*										
Z Cam	13.0	14	0.88	2.5	12	18844/R14861	1.0E-13	0.5E-13	41	10
DN	12.9	10	0.50	2.9	10	26815/P6835	3.4	1.1	11	5
10.2-13.5										
23d										
YZ Cnc	14.8	5	0.56	2.1	3	7312/P6301	3.0E-14	1.5E-14	18	3
DN	14.9	7	0.99	2.4	4	7914/P6894	5.4	1.8	25	6
10.2-15.5										
12d										
OY Car	>14.1	112	0.45	3.5	11+	21565/------	0.5E-14	---	0	-
DN	>13.2	86s	0.75	3.0	2	28263/------	1.6	---	2	-
12.4-15.3*	>13.2	87s	0.76	3.0	2	-----/R17890	---	3.3E-15	-	1
35d										
BV Cen	12.7	161	0.76	1.5	35	3857/R3434	1.3E-13	0.9E-14	9	3
DN	13.2	134	0.89	1.1	13	15927/P12262	2.6	1.1	4	4
10.5-13.3	12.3	226	0.47	2.1	22	24867/-----	1.3	---	11	-
150d	13.0	446	0.93	2.1	22	26623/P6685	2.7	1.4	11	3
Z Cha	15.5	16	0.29	2.5	<40	6385/R5511	1.4E-14	3.7E-15	1	1
DN	15.0	42	0.82	2.6	<24	10919/-----	1.6	---	0	-
12.4-15.3*	15.9	36	0.56	2.7	<3	28262/R17889	1.4	2.9	1	1
82d										

OBJECT	V	T	PH	AMP	WIDTH	SWP/LWR(P)	1475A	2650A	CIV	MgII
SS Cyg	11.8	15	0.32	4.0	13	3884/P3456	2.2E-13	1.4E-13	134	40
DN	12.0	28	0.46	4.1	18	5271/-----	2.4	---	147	--
8.6-12.4	11.7	21s	0.53	4.1	14	17339/R13587	2.2	1.6	191	46
40d	11.8	28s	0.70	4.1	14	17388/P13639	2.1	1.3	186	60
	11.7	32s	0.80	4.1	14	17414/P13668	2.0	1.5	219	39
	11.8	22s2	0.47	4.2	22	23696/P4000	2.0	0.9	87	21
	12.0	37s2	0.79	4.2	22	23828/P4115	1.6	0.8	73	18
	12.0	38	0.72	4.1	38	24532/P4862	0.9	0.8	48	28
	11.9	25	0.61	4.1	25	28215/-----	1.6	---	102	--
	11.8	25s3	0.42	4.2	14	29930/P9744	1.7	0.9	100	40
	11.8	39s3	0.65	4.2	14	30017/P9853	1.6	1.2	105	40
	11.9	47s3	0.78	4.2	14	30078/P9911	1.8	0.8	53	29
	11.9	56s3	0.93	4.2	14	30136/P9978	1.5	0.7	74	31
	12.0	28	0.48	4.1	23	31355/P11236	1.5	0.7	49	25
HR Del	11.7	4117	----	8.4	3320	2983/R2606	8.6E-13	1.4E-13	33P	0
N 1967	11.8	4505	----	8.4	3320	7108/P6044	7.4	2.2	23P	0
3.5-11.9	11.7	4793	----	8.4	3320	9860/P8575	7.3	2.4	32P	0
AH Her	14.5	22	0.99	3.7	14	8089/8R7057	4.4E-14	1.6E-14	3	2
DN	14.1	9	0.91	3.2	9	10037/P8736	6.5	2.7	1	1
10.2-14.7										
18d										
DQ Her	14.4	16335	----	13.2	8216	6358/-----	9.4E-15	---	15	-
N 1934	14.3	16376	----	13.2	8216	6848/-----	1.2E-14	---	19	-
1.3-14.5*	14.2	16438	----	13.2	8216	7408/-----	1.1	---	20	-
	14.0	16560	----	13.2	8216	----/R7500	---	9.6E-15	--	1
	14.0	16612	----	13.2	8216	9201/-----	1.1	---	21	-
	14.4	17403	----	13.2	8216	----/R13864	---	9.3	--	0
EX Hya	12.5	173	0.75	1.8	<20	3858/-----	1.4E-14	---	105	-
DN	13.0	91	0.31	1.4	<12	9346/P8102	2.3	5.9E-14	64	9
11.7-14.1	13.5	358s	0.18	1.4	<12	15926/P12261	1.2	7.8	60	20
574d	13.7	577s	0.29	1.4	<12	-----/P13903	---	7.4	--	9
	13.0	1121s	0.55	1.4	<12	22202/P2739	3.2	5.6	19	8
	13.0	1669s	0.82	1.4	<12	-----/P6582	---	6.6	--	12
	13.0	2	0.01	4.3	6	28858/P8851	2.4	6.9	46	16
T Leo	----	10s	0.03	5.6	4	-----/R13597	---	1.4E-14	-	5
DN	----	152s	0.50	5.6	4	18629/R14696	1.3E-13	1.1	9	4
11.0-15.7	>14.9	238	0.59	5.7	4	27683/------	1.2	---	7	-
90d	>13.7	68	0.89	5.9	3	31303/P11155	1.2	0.6	10	3
RS Oph	11.6	4349s	0.69	7.0	140	6608/R5665	4.5E-15	0.7E-14	0	0
N 1898,	11.9	4661s	0.74	7.0	140	9640/P8338	3.6	1.5	1	0
1933,1958,	11.8	4945s	0.78	7.0	140	13954/P10566	4.8	1.7	0	0
1967,1985	12.1	253s2	0.03	6.6	120	26883/P6860	11.1	0.9	3	5
4.3-12.3	11.0	554s2	0.07	6.6	120	28825/P8825	4.0	1.6	0	1
	11.0	614s2	0.08	6.6	120	29351/P9232	6.4	1.6	2	1

OBJECT	V	T	PH	AMP	WIDTH	SWP/LWR(P)	1475A	2650A	CIV	MgII
V2051 Oph	14.5	-----	----	---	--	20525/R16471	5.5E-15	0.8E-14	13	5
DN	15.0	-----	----	---	--	24058/P4280	8.4	1.1	22	5
13.0-15.0*	14.9	-----	----	---	--	27811/-----	5.6	---	13	-
	14.9	-----	----	---	--	-----/P7733	---	0.6	--	3
RU Peg	12.5	79	0.75	2.6	(18)	5756/R4992	4.1E-14	4.0E-14	45	11
DN	12.8	36	0.50	3.0	12	17664/R13924	7.2	5.3	79	14
9.0-13.1	12.7	101s	0.73	3.1	(15)	28294/P8181	3.1	1.8	20	7
80d	12.7	127s	0.92	3.1	(15)	-----/P8353	---	1.5	--	5
	12.7	128s	0.93	3.1	(15)	28449/-----	2.6	---	11	-
	12.6	28	0.23	3.0	16	28683/P8632	3.6	1.3	11	4
GK Per	13.2	1709s	0.77	3.5	50	6623/R5685	5.8E-15	7.5E-15	2	2
DN	13.2	2066s	0.93	3.5	50	10133/-----	1.5	---	0	-
10.2-14.0	13.2	2175s	0.98	3.5	50	10943/R9622	9.3	7.6	0	1
	13.0	225s2	0.26	3.6	72	15098/R11622	5.6	7.5	2	2
N 1901	13.2	256s2	0.29	3.6	72	15331/R11849	4.3	6.6	2	1
0.2-14.0	13.1	599s2	0.69	3.6	72	-----/R14335	---	6.6	-	2
	13.2	601s2	0.69	3.6	72	18226/------	3.1	---	1	-
	13.0	605s2	0.69	3.6	72	-----/R14377	---	5.2	-	2
	13.2	110	0.09	3.7	75	21326/P2110	4.6	6.2	1	1
KT Per	>14.7	12	0.36	3.6	11	7415/R6397	1.8E-14	5.7E-15	0	0
DN	>14.7	16	0.70	3.3	10	17616/R13884	1.5	4.1	1	0
10.7-15.0										
26d										
TY Psc	>16.0	27	0.66	4.6	15	18613/R14681	4.7E-15	2.4E-15	1	0
DN	>16.0	5	0.71	4.4	2+	21016/R16767	9.6	2.6	0	0
10.8-16.3										
24d										
RR Pic	12.0	19755	----	11.5	14089	5775/R5010	8.4E-13	2.3E-13	44	0
N 1925	12.2	19830	----	11.5	14089	6625/P5687	8.1	2.7	48	0
1.0-12.5	12.0	20631	----	11.5	14089	15633/P12073	6.8	2.3	39	0
	12.0	20894	----	11.5	14089	-----/P13996	---	4.7	--	0
T Pyx	>14.0	4755s	0.54	8.5	111	7411/-----	1.1E-14	---	0	-
NR 1890,	>14.0	4903s	0.56	8.5	111	8973/R7724	2.7	0.9E-14	2	0
1902,1920	>13.6	7233s	0.83	8.5	111	9318/P9204	2.7	1.1	3	0
1944,1966										
6.5-15.3										
SU UMa	13.8	5	0.38	2.2	6	7302/R6294	4.7E-14	1.6E-14	33	3
DN	(13.0)	5	0.33	2.6	7	7417/R6398	6.8	4.2	36	5
11-14.5	(14.3)	40	0.40	2.3	5	----/R9462	---	1.6	--	4
19d	14.4	8	0.11	2.8	5	18845/-----	2.0	---	15	-
	14.1	(19)	0.18	(2.5)	24	21032/R16782	4.8	3.6	29	5
	14.5	32	0.37	2.0	5	27684/P7641	4.6	2.9	34	6

Notes to Table 1

a

For dwarf novae (DN), the magnitudes refer to the outburst and quiescent values

Objects with asterisks have eclipses with lower magnitudes

b

Data during a single cycle are designated with the same letter s,s2,etc.

c

Line fluxes are given in units of E-13 ergs/cm**2/s

TABLE 2

INTEROUTBURST PHASE VS FLUX CORRELATIONS

Object	Wavelengths[a]				No. Points	
	1475	2650	CIV	MgII	SWP	LWR/P
RX And	-0.97	-6.80	1.06	-3.26	3	3
	-0.88	-0.99	0.03	-0.71		
V603 Aql	-4E-5	-1E-3	-0.14	-0.01	5	3
	-0.10	-1.00	-0.96	-0.81		
AE Aqr	6.00	4.50	50.0	190.	4	4
	0.55	0.20	0.60	0.42		
SS Aur	-2.67	-1.60	-16.7	-6.67	2	2
T Aur	0.10	4.00	-1.00	1.00	2	2
Z Cam	-6.32	-1.47	78.4	12.4	2	2
YZ Cnc	5.58	0.70	16.3	6.98	2	2
OY Car	3.80	----	4.33	----	2	1
BV Cen	3.08	2.59	-6.76	-2.47	4	3
	0.82	0.92	-0.41	-0.58		
Z Cha	0.37	-2.96	-0.56	-1.11	3	2
	0.86	----	-0.71	----		
SS Cyg(all)	-0.94	-0.44	-33.3	-7.59	14	12
	-0.43	-0.25	-0.11	-0.12		
SS Cyg(s)	-0.72	-0.52	89.5	-14.4	3	3
	-0.99	-0.46	0.69	-0.18		
SS Cyg(s3)	-0.24	-0.49	-73.7	-28.8	4	4
	-0.41	-0.49	-0.66	-0.81		
HR Del	-2E-3	2E-3	-3E)3	----	3	3
	-0.93	0.97	-0.18	----		
AH Her	-26.3	-13.8	26.3	12.5	2	2
DQ Her	-0.02	-4E-4	0.02	-2E-3	4	2
	-0.58	----	0.78	----		

Object	Wavelengths				No. Points	
	1475	2650	CIV	MgII	SWP	LWP/R
EX Hya(all)	-0.05	-1.30	41.8	-6.14	5	6
	-0.02	-0.44	0.39	-0.39		
EX Hya(s)	5.41	-2.29	-111	-8.53	2	4
	----	-0.67	----	-0.45		
T Leo	-0.19	-0.92	4.86	-2.45	3	3
	-0.68	-0.98	0.55	-1.00		
RS Oph(all)	-0.69	-1E-3	-1.70	-3.00	6	6
	-0.36	-1E-3	-0.53	-0.63		
RS Oph(s)	2.46	7.81	-10.9	----	3	3
	0.18	0.73	0.90	----		
RS Oph(s2)	-117	15.0	-20.7	-83.0	3	3
	-0.86	0.98	-0.39	-0.99		
RU Peg(all)	-2.58	-0.20	-12.8	0.75	5	5
	-0.39	-0.03	-0.12	0.05		
RU Peg(s)	-2.50	-1.58	-46.5	-10.5	2	2
GK Per(all)	0.84	0.58	-0.95	-0.18	7	7
	0.12	0.21	-0.44	-0.16		
GK Per(s)	0.17	0.48	-8.20	-5.71	3	2
	0.17	----	-0.97	----		
GK Per(s2)	-4.60	-2.90	-0.51	-0.15	3	4
	-0.89	-0.70	-0.80	-0.28		
KT Per	-0.88	-4.71	1.47	-0.88	2	2
TY Psc	98.0	4.00	-14.0	----	2	2
RR Pic	-2E-3	-1E-3	-0.01	----	3	4
	-1.00	0.66	-0.87			
T Pyx	3.15	5.56	7.62	----	3	2
	0.55	----	0.85	----		
SU UMa	9.13	-8.25	61.7	-1.25	5	5
	0.65	-0.63	0.87	-0.13		

Notes to Table 2

[a] The first line of entry in each column is the slope of the best fit linear relation between the phase and the flux. The second line is the correlation coefficient (if there are more than 2 points in the data set).

For non-recurrent novae, the correlations are done vs time instead of phase.

TABLE 3

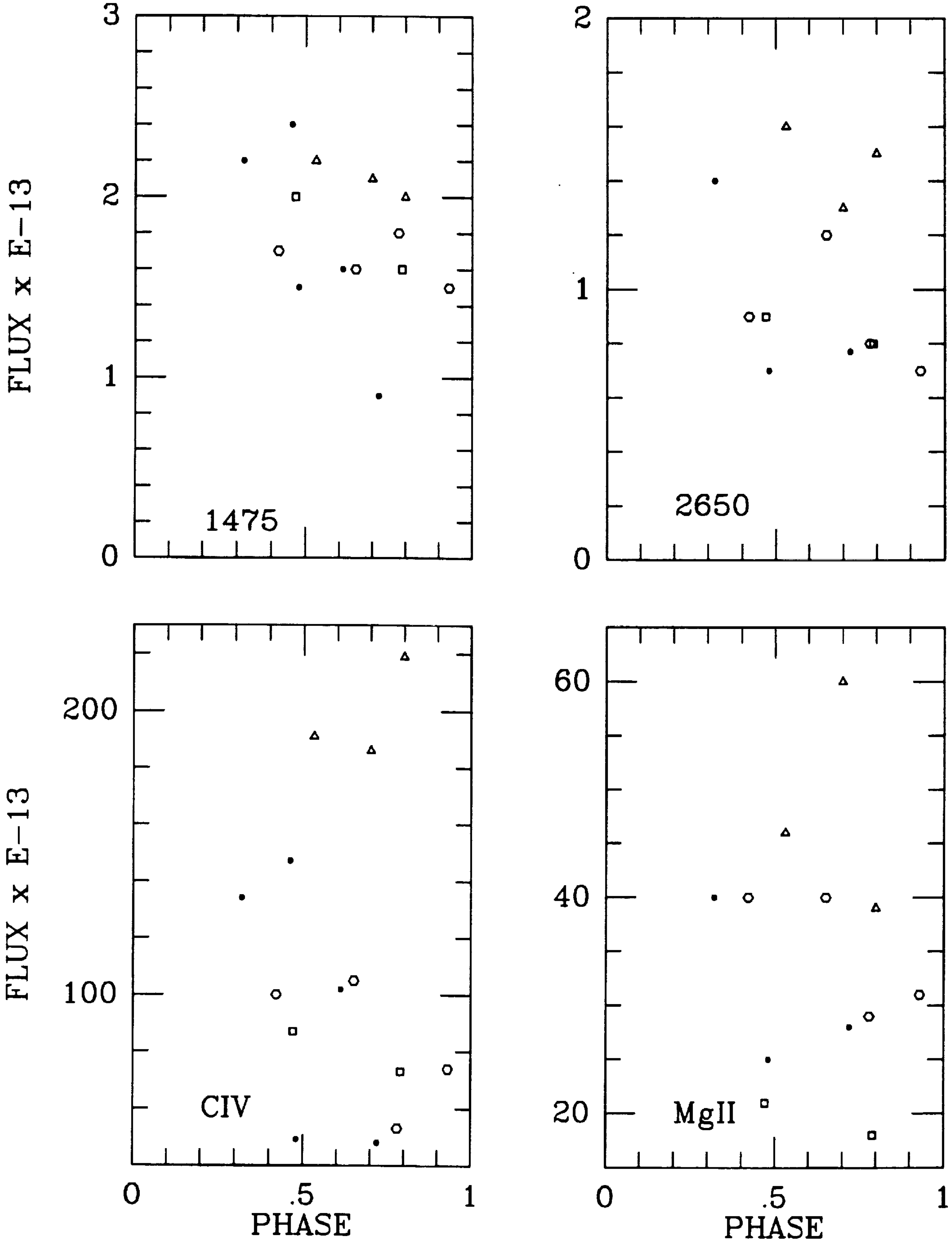
AMPLITUDE VS FLUX CORRELATIONS

Object	1475	2650	CIV	MgII	No.	Points
OY Car	-2.20	----	-2.60	----	2	2
BV Cen	-0.31	0.34	6.86	-0.72	4	3
	-0.19	0.68	0.98	-0.96		
RU Peg	-1.43	-4.20	-47.1	-9.10	5	5
	-0.16	-0.48	-0.34	-0.45		
SU UMa	-2.23	1.50	-7.70	0.11	5	5
	-0.79	0.16	-0.54	0.08		
EX Hya	-0.20	0.08	-45.0	1.52	5	7
	-0.09	0.12	-0.51	0.38		
AH Her	-4.20	-2.20	4.20	2.00	2	2

TABLE 4

V MAG VS FLUX CORRELATIONS

Object	1475	2650	No. Points	
RX And	-0.71	-4.50	3	3
	-0.94	-0.95		
BV Cen	1.74	0.50	4	3
	0.87	0.50		
Z Cha	-0.23	-2.00	3	2
	-0.90			
EX Hya	-0.20	-2.08	5	6
	-0.09	0.78		
RS Oph	2.28	-0.38	6	6
	0.38	-0.42		
V2051 Oph	4.21	0.29	3	3
	0.68	0.30		
SU UMa	-2.23	1.50	5	5
	-0.79	0.16		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3
2
1
0
1475
2
1
0
2650
FLUX x E−13
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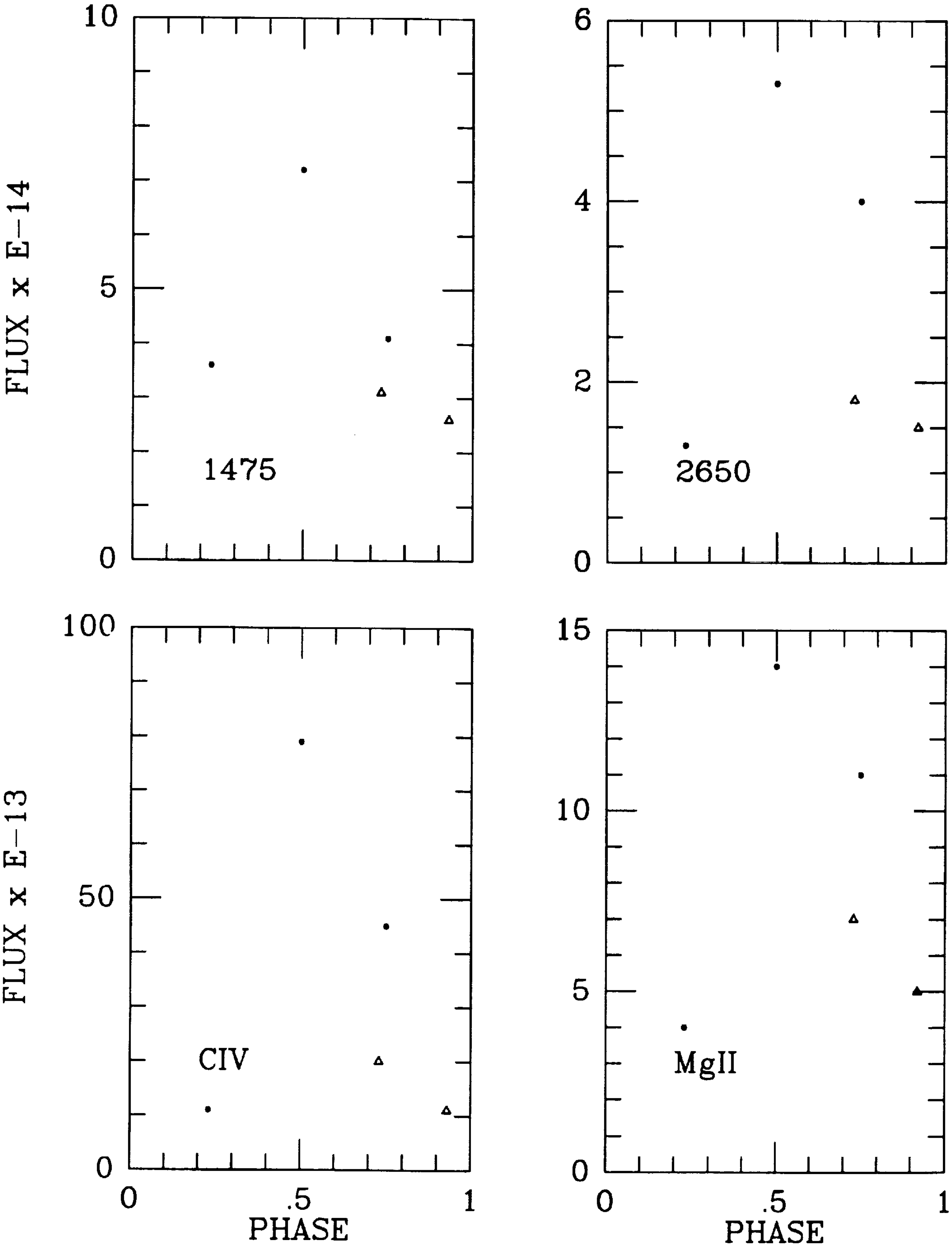
100
CIV
60
40
20
MgII
0
.5
1
PHASE
0
.5
1
PHASE


FLUX x E−14
FLUX x E−13
1475
2650
CIV
MgII
10
5
0
6
4
2
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100
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15
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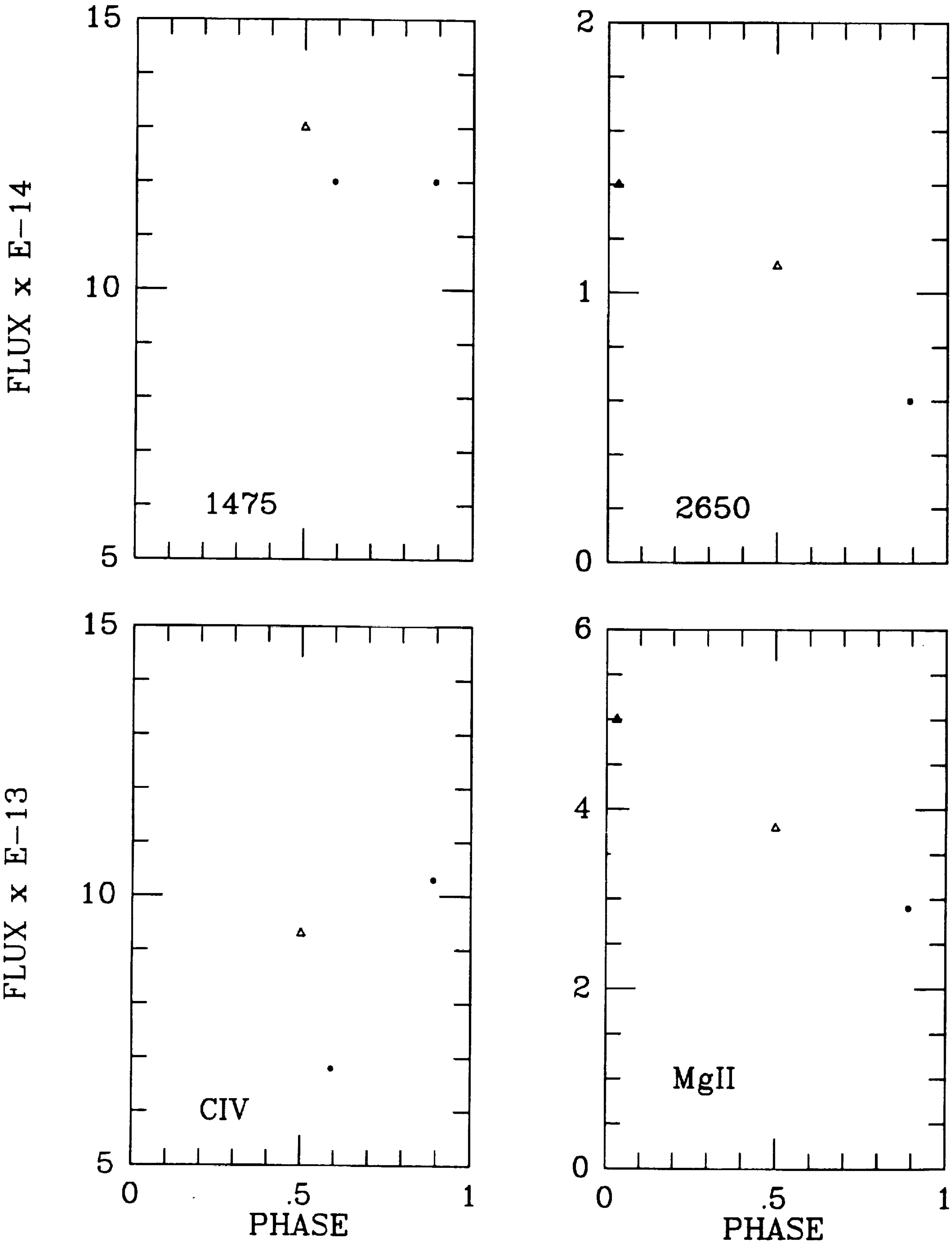
Figure 3



FLUX x E−14
15
10
5
1475
2
1
0
2650
FLUX x E−13
15
10
5
CIV
6
4
2
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MgII
0
.5
1
PHASE
0
.5
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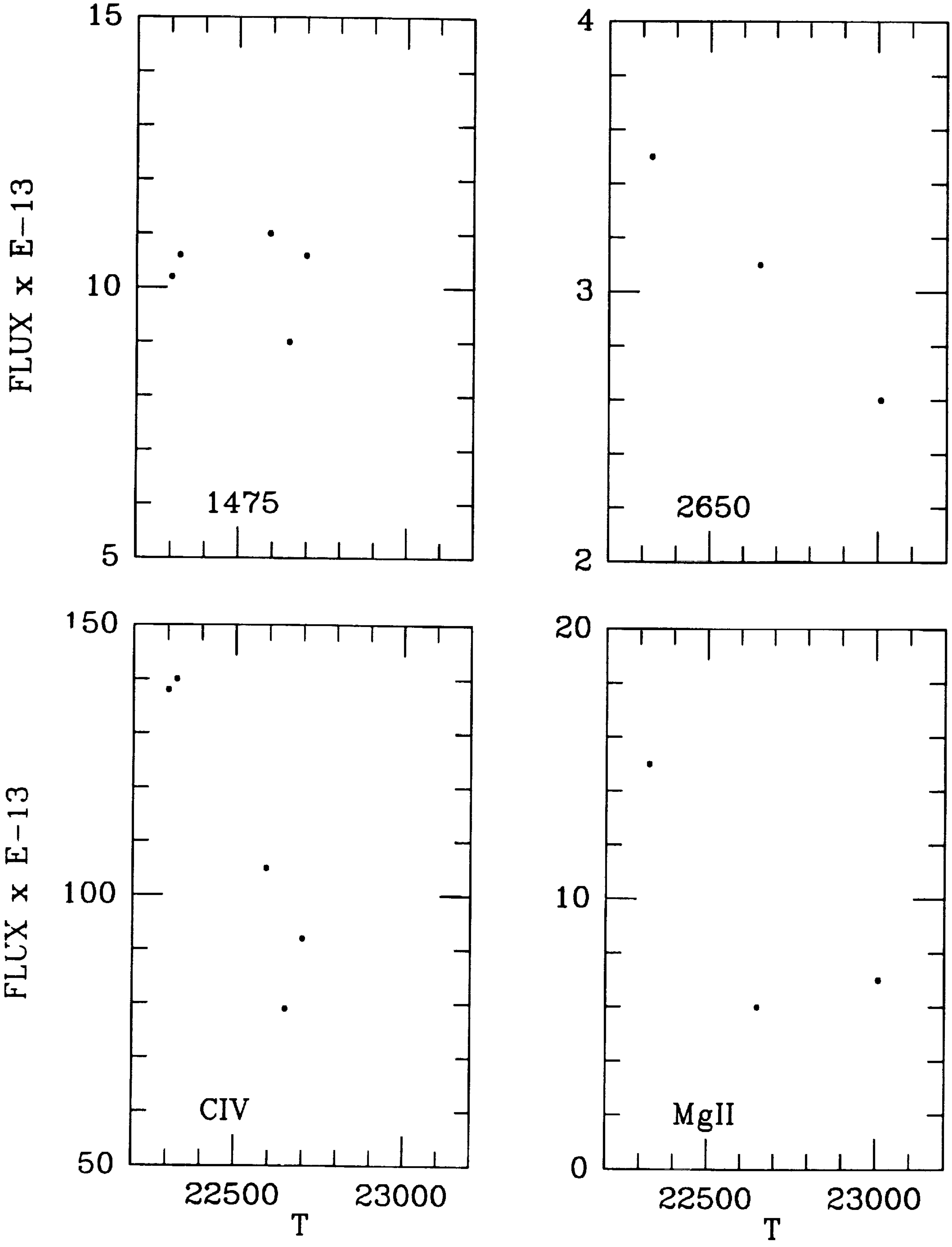
PHASE


FLUX x E-13
15
10
5
1475
4
3
2
2650
FLUX x E-13
150
100
50
CIV
22500
23000
T
20
10
0
MgII
22500
23000
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14 May 90
269647

ABSTRACT

International Ultraviolet Explorer American Association of Variable Star Observers

~~We have attempted to u~~se existing (IUE) and (AAVSO) archive data was used to accomplish a large scale study of what happens to the ultraviolet flux of accretion~~s~~ disk systems during the quiescent intervals between outbursts and how it relates to the preceding outburst characteristics of amplitude and width. ~~Our~~ The data sample involved multiple IUE observations for 16 dwarf novae and 8 novae along with existing optical coverage.

~~Our~~ results indicate that most systems show correlated ultraviolet (UV) flux behavior with interoutburst phase, with 60% of the dwarf novae and 50% of the novae having decreasing flux trends while 33% of the dwarf novae and 38% of the novae show~~ing~~ rising UV flux during the quiescent interval. All of the dwarf novae with decreasing UV fluxes at 1475A have orbital periods longer than 4.4 hrs, while all (except BV Cen) with flat or rising fluxes at 1475A have orbital periods less than 2 hrs. There are not widespread correlations of the UV fluxes with the amplitude of the prece~~e~~ding outburst and no correlations with the width of the outburst. From a small sample (7) that have relatively large quiescent V magnitude ~~visual magnitude~~ changes during the IUE observations, most show a strong correlation between the UV and optical continuum.

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~~The~~ interpretation of ~~our~~ the results is complicated by not being able to determine how much the white dwarf contributes to the ultraviolet flux. However, it is now evident that noticeable changes are occurring in the hot zones in accreting systems long after the outburst, and not only for systems that are dominated by the white dwarf. Whether these differences are due to different outburst mechanisms or to changes on white dwarfs which provide varying contributions to the UV flux remains to be determined.

I couldn't find an expansion or explanation of this. Is it a star name? leave as is