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ΠΡΟΕΔΡΙΑ ΘΕΜΙΣΤΟΚΛΗ ΔΙΑΝΝΕΛΙΔΗ

ΑΣΤΡΟΝΟΜΙΑ.— **Dependence of Flare Activity on BY Dra on the Phase of the Short-term Periodic Light Variation,** by corresponding member *L. N. Mavridis* and *S. I. Avgoloupis, J. H. Seiradakis, P. P. Varvoglis**.

1. Introduction

BY Dra (HDE = 234677) is a spectroscopic binary with an orbital period of 5.976 days derived from radial velocity data by Bopp and Evans (1973). Keenan (1980) proposed the classification K4V+K7.5V which is in agreement with Vogt and Fekel's (1979) luminosity ratio. Other authors proposed slightly different classifications, such as MOVe+MOVe (Rodono and Cutispoto, 1992), M0Ve+M1Ve (Cutispoto and Rodono, 1992), or K5Ve+K7Ve (Pettersen et al., 1992). The eccentricity is equal to e = 0.487 (Oskanyan et al., 1977) or equal to e = 0.30 (Pettersen et al., 1992). The primary makes up for 2/3 of the total light (Pettersen et al., 1992).

BY Dra is the prototype of a group of flare stars showing short-term low amplitude periodic light variability (BY Dra-syndrome), which is attributed to rotational modulation by cool star spots. The mean photometric period of 3.836 days (Chugainov, 1966; Rodono et al., 1983), is interpreted as the rotational period of the flare star(s).

* Λ. Ν. ΜΑΥΡΙΔΗ, Σ. Ι. ΑΥΓΟΛΟΥΠΗ, Ι. Χ. ΣΕΙΡΑΔΑΚΗ, Π. Π. ΒΑΡΒΟΓΛΗ, **Ἐξάρτηση τῆς δραστηριότητας σὲ ἐκλάμψεις τοῦ ἀστέρα BY Dra ἀπὸ τὴ φάση τῆς περιοδικῆς μεταβολῆς βραχείας διαρκείας τῆς λαμπρότητάς του.**

Among the problems referring to BY Dra currently under discussion, one could mention the following:

1) Are both components rotating with the same period?

2) Are their axes of rotation parallel to each other?

3) Are both components active?

Various authors give different answers to these questions. Thus:

a) Most of the authors (Rodono and Cutispoto, 1992; Cutispoto and Rodono, 1992; Pettersen et al., 1992; Rodono et al., 1986) assume that both components are active and rotate with the same rotational period (3.836 days) around parallel axes. The inclination of the axes to the line of sight is equal to 30 degrees. The arguments presented in favour of this assumption are the large long-term variations in the quiet-state luminosity and the large peak-to-peak amplitude of the short-term variability. The fact that the rotational period of the components differs significantly from the orbital period (5.976 days) is interpreted as indicating that the system is young and, therefore, not yet synchronized.

b) Oskanyan et al., (1977), on the contrary, consider that it is very unlikely that the two components should rotate simultaneously, because of the high eccentricity of the system. Furthermore, Oskanyan et al., believe that we are so far dealing always with spot phenomena on one of the components only. The main argument is that physically this assumption is most economical, especially since no secondary period, neither an harmonic nor an unrelated period, has been detected.

2. Long-term Variability of the Flare Activity

Systematic photoelectric monitoring of the flare activity and the quiet-state luminosity in the B and/or U colour of the international U, B, V system of the flare star BY Dra is being carried out since 1973 at the Stephanion Observatory ($\lambda = 22°49'44''$, $\varphi = 37°45'15''$, H = 800m) using the 30-inch Cassegrain reflector of the Department of Geodetic Astronomy, University of Thessaloniki.

The very homogeneous observational material thus obtained is of special importance for the study of the variations of both the flare activity and the quiet-state luminosity of this star.

Here, we would like to stress the fact that the data presented in this paper represent the largest set of data ever used for this star. It comprises observations spanning over 22 years, collected by four observatories.

Tables 1a and 1b give the data referring to the flare activity of BY Dra obtained at the Stephanion Observatory separately for the periods 1973-75 and 1976-92.

The first column of these tables gives the year of observation. The 2nd, 3rd and 4th columns give respectively the total monitoring time in the B-colour, T′(B), the U-colour, T′(U), and in both colours T′= T′(B)+T′(U). The 5th, 6th and 7th columns give respectively the total number of flares observed in the B-colour, n′(B), the U-colour, n′(U), and in both colours n′= n′(B)+n′(U). The 8th and 9th columns give respectively the integrated flare intensity of all the flares observed in the B-colour, P′(B), and the U-colour, P′(U). The values of P′(U) were converted into integrated flare intensities referring to the B-colour P′(B/U) using the empirical relation:

$$P'(B/U) = 0.06\, P'(U). \qquad (1)$$

The values thus obtained are given in the 10th column of Tables 1a and 1b. The 11th column gives the value of the integrated flare intensity referring to the B colour and corresponding to all the flares observed during the year concerned P′= P′(B)+P′(B/U). The 12th column gives the integrated flare intensity per unit for monitoring time $P'_2 = P':T'$ referring to the year concerned. Finally, the 14th column gives the relevant bibliographical references. From this column we see that only part of the observations included in Tables 1a and 1b have been published so far.

Table 2 gives the characteristics of the flares observed during the years 1987, 1989, 1990, 1992, determined with the help of observations carried out at the Stephanion Observatory, which are still unpublished (Avgoloupis et al., 1993b). In this table the following characteristics are given (Andrews et al., 1969) for each flare: a) the date and universal time UT(max) of flare maximum, b) the duration before and after the maximum (t_b and t_a respectively), as well as the total duration of the flare, c) the value of the ratio $(I_f\text{-}I_o)/I_o$ corresponding to the flare maximum, where Io is the intensity deflection less sky background of the quiet star and I_f is the total intensity deflection less sky background of the star plus flare, d) the integrated intensity of the flare over its total duration

$$P = \int \frac{I_f - I_o}{I_o}\, dt, \qquad (2)$$

Table 1. Variation of flare activity on BY Dra from year to year

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Year	T′(B) (hours)	T′(U) (hours)	T′ (hours)	n′(B)	n′(U)	n′	P′(B) (min)	P′(U) (min)	P′(B/U) (min)	P′ (min)	P'_2 (min/h)	Φ	Refs
							Table 1a						
1973	42.04	—	42.04	0	—	0	0.000	—	—	0.000	0.0000	—	1
1974	18.47	—	18.47	2	—	2	0.732	—	—	0.732	0.0396	0.730	1
												0.795	
1975	22.26	—	22.26	1	—	1	0.210	—	—	0.210	0.0094	0.562	2
TOTAL	*82.77*	—	*82.77*	*3*	—	*3*	*0.942*	—	—	*0.942*	*0.0114*	—	—
							Table 1b						
1976	—	—	—	—	—	—	—	—	—	—	—	—	—
1977	5.75	—	5.75	0	—	0	0.000	—	—	0.000	0.0000	—	3
1978	—	—	—	—	—	—	—	—	—	—	—	—	—
1979	19.67	—	19.67	0	—	0	0.000	—	—	0.000	0.0000	—	4
1980	33.32	—	33.32	0	—	0	0.000	—	—	0.000	0.0000	—	5
1981	19.56	—	19.56	0	—	0	0.000	—	—	0.000	0.0000	—	8
1982	39.72	—	39.72	0	—	0	0.000	—	—	0.000	0.0000	—	9
1983	8.01	—	8.01	0	—	0	0.000	—	—	0.000	0.0000	—	10
1984	6.33	9.80	16.13	0	1	1	0.000	1.196	0.072	0.072	0.0045	0.835	6,10
1985	29.13	—	29.13	0	—	0	0.000	—	—	0.000	0.0000	—	7
1986	15.42	—	15.42	0	—	0	0.000	—	—	0.000	0.0000	—	9
1987	—	3.80	3.80	—	1	1	—	0.399	0.024	0.024	0.0063	0.051	11
1988	—	—	—	—	—	—	—	—	—	—	—	—	—
1989	—	37.82	37.82	—	4	4	—	2.002	0.120	0.120	0.0032	0.841	11
												0.904	
												0.415	
												0.024	
1990	13.71	—	13.71	1	—	1	0.127	—	—	0.127	0.0093	0.639	11
1991	2.12	—	2.12	0	—	0	0.000	—	—	0.000	0.0000	—	10
1992	13.74	—	13.74	1	—	1	0.241	—	—	0.241	0.0175	0.417	11
TOTAL	*206.48*	*51.42*	*257.90*	*2*	*6*	*8*	*0.368*	*3.579*	*0.216*	*0.584*	*0.0023*	—	—

Table 1c

1971	3.07	19.20	22.27	0	2	2	0.000	0.050	0.003	0.003	0.0001	0.933	12
												0.933	
1972	8.57	155.02	163.59	0	8	8	0.000	22.970	1.378	1.378	0.0084	0.963	12
												0.248	
												0.604	
												0.425	
												0.179	
												0.206	
												0.439	
												0.544	
1973	264.17	—	264.17	6	—	6	22.260	—	—	22.260	0.0843	0.621	1,12
												0.887	
												0.421	
												0.221	
												0.551	
												0.371	
1974	181.20	—	181.20	8	—	8	58.252	—	—	58.252	0.3215	0.730	1,12
												0.795	
												0.531	
												0.774	
												0.795	
												0.945	
												0.579	
												0.844	
1975	202.66	—	202.66	4	—	4	11.940	—	—	11.940	0.0589	0.562	2,12
												0.101	
												0.878	
												0.071	
TOTAL	*659.67*	*174.22*	*833.89*	*18*	*10*	*28*	*92.452*	*23.020*	*1.381*	*93.833*	*0.1125*	—	—

References:

1. Contadakis et al. (1976).
2. Mavridis and Varvoglis (1980).
3. Mavridis and Varvoglis (1982a).
4. Mavridis and Varvoglis (1982b).
5. Asteriadis et al. (1982).
6. de Jager et al. (1986).
7. Avgoloupis et al. (1987).
8. Mavridis and Varvoglis (1993).
9. Avgoloupis et al. (1993a).
10. Avgoloupis and Mavridis (1993).
11. Avgoloupis et al. (1993b).
12. Melkonyan et al. (1980).

Table 2. Characteristics of the flares observed during the years 1987, 1989, 1990 and 1992

Flare No	Date	UT max	t_b min	t_a min	Duration min	$\frac{I_f-I_0}{I_0}$ max	P min	Δm mag	σ mag	Air mass	Filter
	1987										
1	20-10	$18^h38.^m70$	0.96	0.94	1.90	0.214	0.399	0.210	0.03	1.286	U
	1989										
1	24-6	$23^h14.^m26$	1.00	2.00	3.00	0.180	0.210	0.180	0.02	1.030	U
2	26-6	$22^h19.^m58$	1.04	1.00	2.04	0.140	0.100	0.140	0.02	1.030	U
3	13-7	$21^h49.^m80$	1.44	9.84	11.28	0.598	1.392	0.509	0.05	1.031	U
4	25-8	$19^h23.^m84$	>0.20	2.66	>2.86	0.220	>0.300	0.220	0.02	1.050	U
	1990										
1	19-7	$21^h58.^m68$	>0.60	4.80	>5.40	0.061	0.127	0.084	0.01	1.041	B
	1992										
1	24-7	$21^h20.^m52$	0.76	7.00	7.76	0.102	0.241	0.105	0.01	1.035	B

e) the increase of the apparent magnitude of the star in the instrumental system, f) the standard deviation of the random noise fluctuation

$$\sigma(\text{mag}) = 2.5 \log(I_0+\sigma)/I_0 \qquad (3)$$

during the quiet-state phase immediately preceding the beginning of the flare, g) the air mass at flare maximum, and h) the colour to which the observation refers.

Besides the observations carried out at the Stephanion Observatory we do have at our disposal additional observational material obtained by Melkonyan et al. (1980) at the Byurakan, Konkoly and Matra Observatories and referring to the years 1971-75. This material has been combined with the corresponding material obtained at the Stephanion Observatory given in Table 1a. The results are given in Table 1c, where columns 2-12 and 14 contain the same quantities with the corresponding columns of Tables 1a and 1b.

From Tables 1b and 1c we see that the total monitoring time of BY Dra at the four Observatories during the period 1971-92 is respectively equal to 866.15 hours for the B-colour, and 225.64 hours for the U-colour, which gives a total of 1091.79 hours for both colours. During this period of monitoring time a total of 36 flares were observed, out of which 20 were observed in the B-colour and 16 in the U-colour From Tables 1b and 1c the average frequency of flares per unit of monitoring time corresponding to the period 1971-1992 can be calculated, which is respectively equal to 0.023 and 0.071 flares per hour of monitoring time for the B and U colours. From these values we conclude that the probability of flare detection on BY Dra in the U-colour is about 3 times higher than in the B-colour.

From Tables 1b and 1c we also see that the values of the integrated flare intensity P'_2 per unit of monitoring time corresponding to each of the years 1971-92 vary considerably from year to year between a minimum equal to 0 and a maximum equal to 0.32 min/hour. The mean value of P'_2 corresponding to the period 1971-92 is equal to 0.0865 min/hour.

Fig. 1 gives the values of the integrated flare intensity P'_2 per unit of monitoring time for each of the years 1971-92 as a function of time. From this figure we see that BY Dra showed very enhanced flare activity during the period 1973-75. As a matter of fact, during the year 1974 a giant flare with P(B) = 35.66 min was observed. From Tables 1a and 1b we see that the same phenomenon is also clear in the very homogeneous observational material obtained at the Stephanion Observatory. Between 1975 and 1986, on the contrary, BY Dra shows very limited flare activity. Finally, from the year 1987 onwards the beginning of a new period of enhanced flare activity is evident.

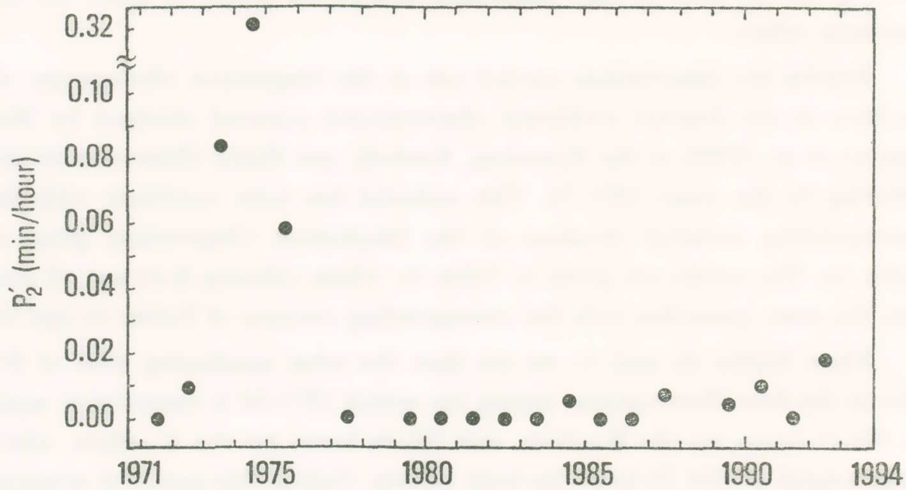

Fig. 1. Values of the integrated flare intensity P'2 per unit of monitoring time of BY Dra for each of the years 1971-92 as a function of time.

3. Dependence of Flare Activity on the Phase of the Short-term Periodic Light Variation

The very homogeneous observational material obtained at the Stephanion Observatory has been also used for a systematic study of the dependence of flare activity on the phase of the short-term periodic light variation of BY Dra (BY Dra-syndrome).

To this purpose, for each of the flares given in Tables 1a and 1b the photometric phase has been computed using the ephemeris given by Chugainov (1966):

$$HJD = 2442819.612 + 3.836E. \qquad (4)$$

The results are given in the 13th column of Table 1a and 1b. During the years 1974 and 1989 more than 1 flares were observed. Therefore, the phases corresponding to each of these flares are given in the corresponding lines of column 13.

At the same time the photometric phases corresponding to the monitoring intervals of BY Dra at the Stephanion Observatory, given in Tables 1a and 1b, have been computed using the same ephemeris (4). With the help of the results thus obtained Table 3 has been prepared. In this table the period of the short-term periodic light variation has been subdivided into ten phase-intervals (0.96-0.05, 0.06-0.15, ..., 0.86-0.95). For each of these phase-intervals the following data are given in Table 3:

The 2nd, 3rd, and 4th columns give respectively the total monitoring times T″(B), T″(U), and T″= T″(B)+T″(U) in the B-colour, the U-colour, and in both colours during the corresponding phase-interval.

The 5th, 6th and 7th columns give respectively the total number of flares n″(B), n″(U), and n″= n″(B)+n″(U) observed in the B-colour, the U-colour and in both colours during the corresponding phase-interval.

The 8th and 9th columns give respectively the integrated intensity P″(B) and P″(U) of the flares observed during the corresponding phase-interval in the B- and the U-colour. The values of P″(U) have been transformed into P″ values corresponding to the B-colour, P″(B/U), with the help of the empirical relation (1) and are given in the 10th column of Table 2. Column No. 11 gives the sum P″= P″(B)+P″(B/U).

Finally, the 12th column of Table 2 gives the integrated flare intensity per unit of monitoring time P''_2 corresponding to the flares observed during the phase-interval concerned, both in the B- and the U-colour, which has been computed with the help of the formula $P''_2 = P'':T''$.

The values of P''_2 thus obtained were plotted as a function of phase in Fig. 2.

From Table 3 and Fig. 2 it is obvious that the largest part of the flare activity of BY Dra is observed during the phase-interval 0.36-0.95. Thus, the mean value of P''_2 during this phase interval is equal to 0.0071 min/hour, while the corresponding value for the rest of the period (phases 0.96-0.35) is equal to 0.0003 min/hour, i.e. 24 times lower.

The above results are based on the very homogeneous observational material obtained at the Stephanion Observatory given in Tables 1a and 1b. The same analysis cannot be performed with the observational material published by Melkonyan et al. (1980). The reason is that these authors published only the total monitoring time per year and not the individual monitoring intervals during each year. Therefore, it is not possible to determine

Table 3. Dependence of the flare activity in BY Dra on the phase of the short-term periodic light variation (Stephanion observations)

1	2	3	4	5	6	7	8	9	10	11	12
Phase	T''(B) (hours)	T''(U) (hours)	T'' (hours)	n''(B)	n''(U)	n''	P''(B) (min)	P''(U) (min)	P''(B/U) (min)	P'' (min)	P''_2 (min/h)
0.96-0.05	35.62	6.98	42.60	0	2	2	0.000	0.699	0.042	0.042	0.0010
0.06-0.15	24.28	6.62	30.90	0	0	0	0.000	0.000	0.000	0.000	0.0000
0.16-0.25	20.18	2.50	22.68	0	0	0	0.000	0.000	0.000	0.000	0.0000
0.26-0.35	30.76	4.71	35.47	0	0	0	0.000	0.000	0.000	0.000	0.0000
0.36-0.45	26.93	3.44	30.37	1	1	2	0.241	0.100	0.006	0.247	0.0081
0.46-0.55	28.42	1.10	29.52	0	0	0	0.000	0.000	0.000	0.000	0.0000
0.56-0.65	23.39	6.02	29.41	2	0	2	0.337	0.000	0.000	0.337	0.0115
0.66-0.75	31.03	6.57	37.60	1	0	1	0.012	0.000	0.000	0.012	0.0003
0.76-0.85	30.26	6.81	37.07	1	2	3	0.720	2.588	0.155	0.875	0.0236
0.86-0.95	38.38	6.67	45.05	0	1	1	0.000	0.210	0.013	0.013	0.0003
TOTAL	*289.25*	*51.42*	*340.67*	*5*	*6*	*11*	*1.310*	*3.597*	*0.216*	*1.526*	*0.0045*
0.36-0.95	178.41	30.61	209.02	5	4	9	1.310	2.898	0.174	1.484	0.0071
0.96-0.35	110.84	20.81	131.65	0	2	2	0.000	0.699	0.042	0.042	0.0003

the distribution of the monitoring time among the ten phase-intervals used in Table 3 and the corresponding values of P''_2.

In order to get some additional relevant information from the observational material published by Melkonyan et al. (1980), the phases of the short-term periodic light variation corresponding to all the flare included in Tables 1b and 1c were calculated with the help of the ephemeris (4). In this way Table 4 could be prepared. The 1st column of this table gives the phase-intervals used

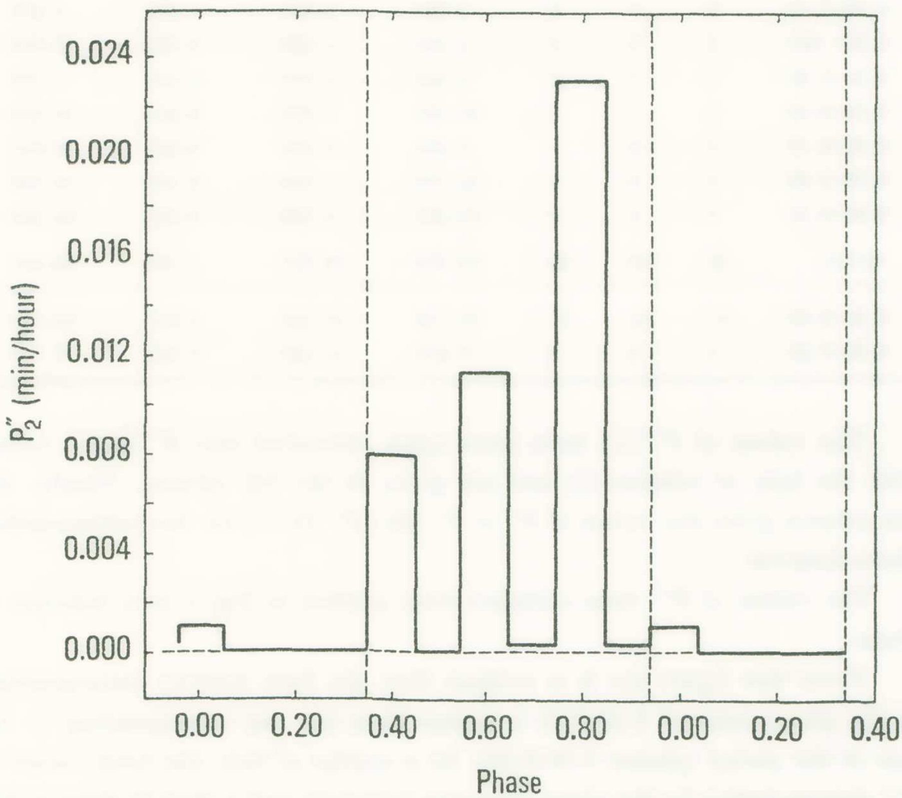

Fig. 2. Values of the integrated flare intensity P''2 per unit of monitoring time for the successive phase-intervals of the short-term periodic light variation of BY Dra.

already in Table 3. The 2nd, 3rd and 4th columns give respectively the total number of flares n'''(B), n'''(U), and n'''=n'''(B)+n'''(U) in the B-colour, the U-colour and in both colours during the corresponding phase interval. The 5th and 6th columns give respectively the integrated intensity P'''(B), P'''(U) of the flares observed in the B-colour and the U-colour during the corresponding phase interval.

Table 4. Dependence of the flare activity on BY Dra on the phace of the short-term periodic light variation (All available observations)

1	2	3	4	5	6	7	8
Phase	n‴(B)	n‴(U)	n‴	P‴(B) (min)	P‴(U) (min)	P‴(B/U) (min)	P‴ (min)
0.96-0.05	0	3	3	0.000	2.269	0.136	0.136
0.06-0.15	2	0	2	8.600	0.000	0.000	8.600
0.16-0.25	1	3	4	0.470	9.140	0.548	1.018
0.26-0.35	0	0	0	0.000	0.000	0.000	0.000
0.36-.045	3	3	6	5.451	1.830	0.110	5.561
0.46-0.55	2	1	3	1.040	2.670	0.160	1.200
0.56-0.65	4	1	5	10.197	7.860	0.472	10.669
0.66-0.75	1	0	1	0.012	0.000	0.000	0.012
0.76-0.85	4	2	6	14 710	2.588	0.155	14.865
0.86-0.95	3	3	6	52.340	0.260	0.016	52.356
TOTAL	*20*	*16*	*36*	*92.820*	*26.617*	*1.597*	*94.417*
0.36-0.95	17	10	27	83.750	15.208	0.913	84.663
0.96-0.35	3	6	9	9.070	11.409	0.684	9.754

The values of P‴(U) have been again converted into P‴(B/U) values with the help of relation (1) and are given in the 7th column. Finally, the 8th column gives the values of P‴= P‴(B)+P‴(B/U) for the corresponding phase-interval.

The values of P‴ thus obtained were plotted in Fig. 3 as a function of phase.

From this figure too it is evident that the flare activity corresponding to the phase interval 0.36-0.95 is higher than the one corresponding to the rest of the period (phases 0.96-0.35). As a matter of fact, the total values of P‴ corresponding to the phase intervals 0.36-0.95 and 0.96-0.35 respectively are equal to 84.663 min and 9.754 min. However, a more thorough comparison of these figures cannot be done at this stage, because, contrary to the case of the Stephanion observations, for the observations published by Melkonyan et al. (1980) we do not know the total monitoring time corresponding to the successive phase-intervals, and therefore no determination of the values of P‴ per unit of monitoring time can be made.

The sets of data shown in Figures 2 and 3 indicate that the flare activity of BY Dra originates predominantly during only one part of its rotational period (phase-interval 0.36-0.95). Of course the number of flares on which this conclusion is based is small, despite the fairly long total monitoring time. This is almost inevitable, however, because of the scarcity of flaring on BY Dra. In order to statistically confirm our result, we performed a Mann-Whitney test (Siegel, 1956) using the SPSS software package. This test is

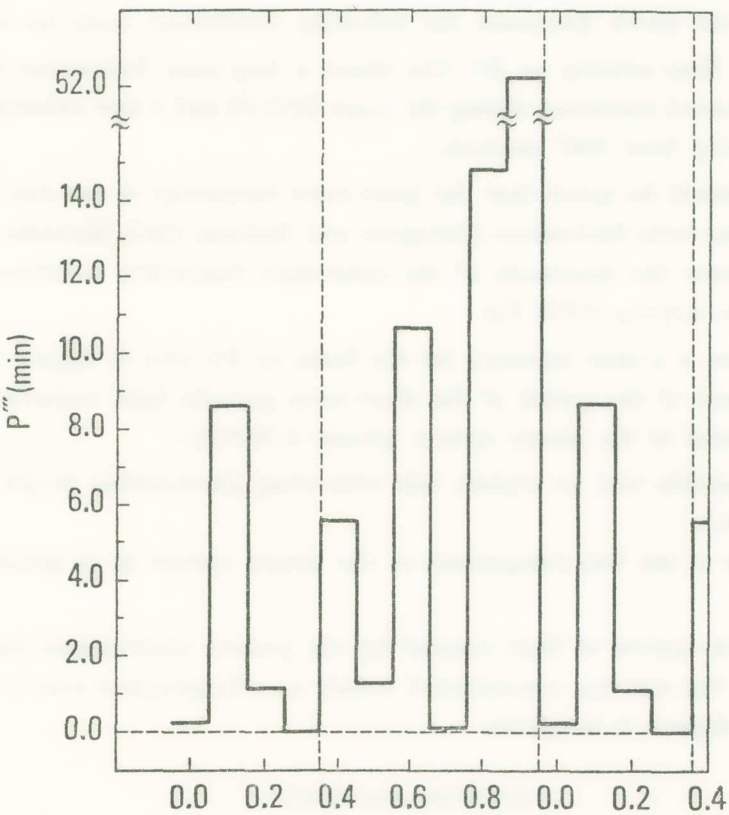

Fig. 3. Total values of the integrated flare intensity P‴ for all the flares observed during the successive phase-intervals of the short-term periodic light variation of BY Dra.

recommended for small samples and is not confined to any statistical distribution. Using this test we examined whether the observed flare activity during the above mentioned phase-interval (0.36-0.95), is significantly higher from that observed during the rest of the period (phase-interval 0.96-0.35). For the data (P''_2) presented in Fig. 2 the test gave $U = 4.5$. Thus, for a

2-tailed distribution, the probability, that the flare activity observed in the first interval is significantly higher than that in the second one, is P = 90.2%. The corresponding values for the data in Fig. 3 (P''') are U = 5.0 and P = 86.4%.

4. Discussion of the Results. Conclusions

From the above discussion the following conclusions could be drawn:

1) The flare activity on BY Dra shows a long-term fluctuation with a very pronounced maximum during the years 1973-75 and a new enhancement of the activity from 1987 onwards.

2) It should be noted that the quiet-state luminosity of the star shows a similar long-term fluctuation (Cutispoto and Rodono, 1992, Mavridis et al., 1982), whereby the maximum of the quiet-state luminosity coincides with that of flare activity (1973-75).

3) There is a clear tendency for the flares on BY Dra to appear during a certain part of the period of the short-term periodic light variation (BY Dra-syndrome) of the binary system (phases 0.36-0.95).

One possible way to explain this interesting phenomenon would be to assume that:

a) only one of the two components of the binary system is an active star, and

b) during the period of time covered by the present observations the flare activity on this star was concentrated mainly on a longitudinal zone covering about 220 degrees in longitude.

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REFERENCES

1. Andrews, A. D., Chugainov, P. F., Gershberg, R. E., Oskanyan, V. S.: 1969, IAU Comm. 27, Inf. Bull. Var. Stars, No. **326**.
2. Asteriadis, G., Avgoloupis, S., Mavridis, L. N., Varvoglis, P.: 1982, IAU Comm. 27, Inf. Bull. Var. Stars, No. **2210**.
3. Avgoloupis, S., Mavridis, L. N., Varvoglis, P.: 1987, IAU Comm. 27. Inf. Bull. Var. Stars, No. **2998**.
4. Avgoloupis, S., Mavridis, L. N., Varvoglis, P. P.: 1993a, private communication.
5. Avgoloupis, S., Mavridis, L. N.: 1993, private communication.
6. Avgoloupis, S., Mavridis, L. N., Seiradakis, J. H., Varvoglis, P. P.: 1993b, private communication.
7. Bopp, B. W., Evans, D. S.: 1973, MNRAS **164**, 343.
8. Chugainov, P. F.: 1966 IAU Comm. 27, Inf. Bull. Var. Stars, No. 122.
9. Contadakis, M. E., Kareklidis, G., Mahmout, F., Mavridis, L. N., Stavridis, D., Zervaki-Zoerou, E.: 1976, IAU Comm. 27, Inf. Bull. Var. Stars, No. **1181**.
10. Cutispoto, G., Rodono, M.: 1992, The Solar Cycle, ASP Conference Series, **27**, 465, in: Karen, L. H. (ed).
11. De Jager, C., Heise, J., Avgoloupis, S., et al: 1986, A&A **156**, 95.
12. Keenan, P. C.: 1980 PASP **92**, 548.
13. Mavridis, L. N., Varvoglis, P.: 1980, IAU Comm. 27, Inf. Bull. Var. Stars, No. **1891**.
14. Mavridis, L. N., Varvoglis, P.: 1982a, IAU Comm. 27, Inf. Bull. Var. Stars, No. **2209**.
15. Mavridis, L. N., Varvoglis, P.: 1982b, IAU Comm. 27, Inf. Bull. Var. Stars, No. **2174**.
16. Mavridis, L. N., Asteriadis, G., Mahmout, F. M.: 1982, Compendium in Astronomy, in: Mariolopoulos, E. G., Theocaris, P. S., Mavridis, L. N. (eds). Reidel, Dordrecht, p. 253.
17. Mavridis, L. N., Varvoglis, P. P.: 1993, private communication.
18. Melkonyan, A. S., Olah, K., Oskanyan, Jr A. V., Oskanyan, V. S.: 1980, Afz **16**, No. 1, 107.
19. Oskanyan, V. S., Evans, D. S., Lacy, C., McMillan, B. S.: 1977, ApJ **214**, 430.
20. Pettersen, B. R., Olah, K., Sandmann, W. H.: 1992, A&AS **96**, 497.
21. Rodono, M., Pazzani, V., Cutispoto, G.: 1983, Activity in Red-Dwarf Stars, IAU Coll. 71, in: Byrne, P. B., Rodono, M. (eds). Reidel, Dordrecht, p. 179.
22. Rodono, M., Cutispoto, G., Pazzani, V., et al.: 1986, A&A **165**, 135.
23. Rodono, M., Cutispoto, G.: 1992, A&AS **95**, 55.
24. Vogt, S. S., Fekel, F.: 1979, ApJ **234**, 958.

ΠΕΡΙΛΗΨΗ

Ἐξάρτηση τῆς δραστηριότητας σὲ ἐκλάμψεις τοῦ ἀστέρα BY Dra ἀπὸ τὴ φάση τῆς περιοδικῆς μεταβολῆς βραχείας διαρκείας τῆς λαμπρότητάς του.

Ἡ μακρὰ καὶ ἐξαιρετικὰ ὁμογενὴς σειρὰ φωτοηλεκτρικῶν παρατηρήσεων τοῦ ἀστέρα ἐκλάμψεων BY Dra ποὺ ἐκτελέσθηκαν στὸ Ἀστεροσκοπεῖο Στεφανίου Κορινθίας, κατὰ τὰ ἔτη 1973-92, συνδυάσθηκε μὲ τὸ πλούσιο ὑλικὸ φωτοηλεκτρικῶν παρατηρήσεων τοῦ ἴδιου ἀστέρα ποὺ συγκεντρώθηκε στὰ Ἀστεροσκοπεῖα Byurakan, Konkoly καὶ Matra κατὰ τὰ ἔτη 1971-75 γιὰ τὴ μελέτη τῆς δραστηριότητας σὲ ἐκλάμψεις τοῦ ἐν λόγω ἀστέρα κατὰ τὴν περίοδο 1971-92. Ἀπὸ τὴ μελέτη αὐτὴ προέκυψαν τὰ ἀκόλουθα συμπεράσματα: 1) Ἡ δραστηριότητα σὲ ἐκλάμψεις τοῦ ἀστέρα παρουσιάζει μιὰ διακύμανση μακρᾶς διαρκείας μὲ ἕνα πολὺ ἔντονο μέγιστο κατὰ τὴν περίοδο 1973-75 καὶ μιὰ νέα αὔξηση τῆς δραστηριότητας μετὰ τὸ 1987. 2) Ἡ λαμπρότητα τοῦ ἀστέρα σὲ κατάσταση ἠρεμίας παρουσιάζει μιὰ ἀνάλογη διακύμανση μακρᾶς διαρκείας, ὅπου τὸ μέγιστο τῆς λαμπρότητας συμπίπτει μὲ ἐκεῖνο τῆς δραστηριότητας σὲ ἐκλάμψεις. 3) Ὑπάρχει σαφὴς τάση ἐμφανίσεως τῶν ἐκλάμψεων τοῦ BY Dra κατὰ τὴ διάρκεια ἑνὸς συγκεκριμένου τμήματος τῆς περιόδου τῆς περιοδικῆς μεταβολῆς βραχείας περιόδου τῆς λαμπρότητας τοῦ ἀστέρα. Στὴν ἐργασία διερευνᾶται ἡ σημασία τοῦ τελευταίου αὐτοῦ ἐξαγομένου γιὰ τὴν ἑρμηνεία τοῦ φαινομένου τῆς δημιουργίας τῶν ἐκλάμψεων.