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THE RATES OF PERIOD CHANGE IN BS Aqr AND DY Her

The rate of change in the pulsational period is in fact a measurement of stellar evolution rate. So, it is important to record the times of light maximum and to study the rates of period change of pulsating variable stars.

Percy et al. (1980) collected forty-three times of light maximum occurred in the variable BS Aqr from 1935 to 1973 and five times of light maximum of BS Aqr in 1983 was observed by Meylan (1986). We observed the variable too in 1984, and obtained one moment of light maximum. These times, altogether forty-nine, are listed in Table 1.

Mahdy et al. (1980) collected sixty times of light maximum occurred in the variable DY Her from 1938 to 1979, including their own observational results. We obtained three times of light maximum of the variable in 1981. These moments, altogether sixty-three, are listed in Table 2.

We not only collected aforecited observational data, but also redetermined certain times of light maximum of BS Aqr and DY Her using the original data, and drew the O-C diagrams of them (Figures 1 and 2), computed their rates of period change.

If the linear fitting formula of the times of light maximum T_{max} with cycle number E is:

$$T_{max} = T_{01} + P_{01}E,$$

the quadratic fitting formula is:

$$T_{max} = T_{02} + P_{02}E + 0.5\beta E^2$$

then T_{01} , P_{01} , T_{02} , P_{02} and β of the variable stars are listed below:

star	T_{01} (HJD)	P_{01} (days)	T_{02} (HJD)	P_{02} (days)	β (day/cycle)
BS Aqr	2428095.3350	0.197822604	2428095.3303	0.197822854	-5×10^{-12}
	± 9	± 16	± 13	± 56	$\pm 1 \times 10^{-12}$
DY Her	2433439.4876	0.148631221	2433439.4868	0.148631303	-2.11×10^{-12}
	± 1	± 4	± 1	± 10	$\pm 0.25 \times 10^{-8}$

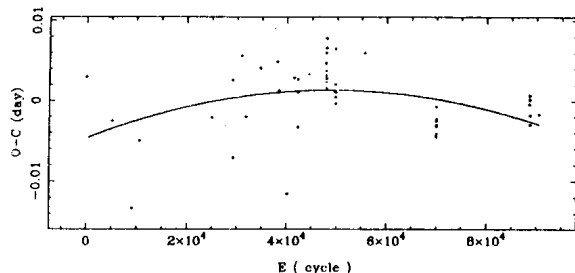


Figure 1. The O-C Diagram of BS Aqr

Table 1
Time of Light Maximum and O-C Residuals
of BS Aqr for Linear and Quadratic Fits

No.	T_{max}	E	$(O-C)_L$	$(O-C)_Q$	W.	Ref.
1	28095.338	0.0	0.0030	0.0077	1.0	An
2	29111.745	5138.0	-0.0025	0.0009	1.0	As
3	29899.266	9119.0	-0.0133	-0.0107	1.0	Sa
4	30187.304	10575.0	-0.0050	-0.0027	1.0	Sa
5	33027.446	24932.0	-0.0021	-0.0022	1.0	Sa
6	33862.460	29153.0	0.0026	0.0022	1.0	Sa
7	33888.365	29284.0	-0.0071	-0.0076	1.0	Sa
8	34211.422	30917.0	0.0056	0.0049	1.0	Sa
9	34400.335	31872.0	-0.0020	-0.0028	1.0	Sa
10	34961.366	34708.0	0.0041	0.0031	1.0	Sa
11	35631.392	38095.0	0.0049	0.0037	1.0	Sa
12	35696.472	38424.0	0.0013	0.0000	1.0	Sa
13	36040.0771	40161.0	-0.0115	-0.0128	0.1	Ki
14	36300.426	41477.0	0.0029	0.0015	1.0	Sa
15	36458.0904	42274.0	0.0027	0.0012	1.0	Sp
16	36460.854	42288.0	-0.0033	-0.0047	0.3	Sp
17	36461.8475	42293.0	0.0011	-0.0003	0.5	Sp
18	36874.112	44377.0	0.0033	0.0018	0.5	Ki
19	37561.3491	47851.0	0.0047	0.0031	0.5	TS
20	37561.5445	47852.0	0.0023	0.0007	0.5	TS
21	37562.5345	47857.0	0.0032	0.0016	0.5	TS
22	37563.5242	47862.0	0.0038	0.0022	0.5	TS
23	37564.5156	47867.0	0.0060	0.0045	0.5	TS
24	37582.5180	47958.0	0.0066	0.0050	0.5	TS
25	37583.3105	47962.0	0.0078	0.0062	0.5	TS
26	37584.2934	47967.0	0.0016	0.0000	0.5	TS
27	37584.4924	47968.0	0.0028	0.0012	0.5	TS
28	37911.4916	49621.0	0.0012	-0.0004	0.5	TS
29	37932.4617	49727.0	0.0021	0.0005	0.5	TS
30	37933.4552	49732.0	0.0065	0.0049	0.5	TS
31	37934.4383	49737.0	0.0005	-0.0011	0.5	TS
32	37946.3083	49797.0	0.0011	-0.0005	0.5	TS
33	37947.2960	49802.0	-0.0003	-0.0019	0.1	TS
34	39087.1561	55564.0	0.0060	0.0044	0.5	HP
35	41946.6714	70019.0	-0.0045	-0.0051	0.6	El
36	41946.8693	70020.0	-0.0044	-0.0050	0.5	El
37	41947.6620	70024.0	-0.0030	-0.0036	1.0	El
38	41947.8603	70025.0	-0.0025	-0.0031	0.5	El
39	41948.6500	70029.0	-0.0041	-0.0047	0.5	El
40	41948.8489	70030.0	-0.0030	-0.0036	0.5	El
41	41949.6400	70034.0	-0.0032	-0.0038	0.5	El
42	41950.6300	70039.0	-0.0023	-0.0029	1.0	El
43	41950.8295	70040.0	-0.0007	-0.0013	0.5	El
44	45612.7240	88551.0	-0.0004	0.0017	1.0	Me
45	45620.6380	88591.0	0.0007	0.0028	1.0	Me
46	45625.5830	88616.0	0.0002	0.0023	1.0	Me
47	45637.6470	88677.0	-0.0030	-0.0009	1.0	Me
48	45644.5720	88712.0	-0.0018	0.0003	1.0	Me
49	45997.0920	90494.0	-0.0017	0.0008	1.0	Pp

An=Andrews (1936) As=Ashbrook (1943)
 El=Elst (1976) HP=Harding and Penston (1966)
 Ki=Kinman (1961) Me=Meylan et al. (1986)
 Pp=Present paper Sa=Satanova (1961)
 Sp=Spinrad (1959) TS=Tremko and Sajtak (1964)

Table 2
Time of Light Maximum and O-C Residuals
of DY Her for Linear and Quadratic Fits

No.	T_{max}	E	$(O-C)_L$	$(O-C)_Q$	W.	Ref.
1	29068.390	-29409.0	-0.0020	0.0021	0.1	MS
2	33366.807	-489.0	0.0001	0.0009	0.1	As
3	33371.857	-455.0	-0.0034	-0.0026	0.1	As
4	33442.607	21.0	-0.0019	-0.0011	0.1	As
5	33501.614	418.0	-0.0014	-0.0007	0.1	As
6	33506.671	452.0	0.0021	0.0028	0.1	As
7	33507.563	458.0	0.0023	0.0030	0.1	As
8	33509.640	472.0	-0.0015	-0.0008	0.1	As
9	33767.5172	2207.0	0.0005	0.0011	0.5	BM
10	33775.837	2263.0	-0.0031	-0.0025	0.5	Sm
11	33815.5243	2530.0	-0.0003	0.0003	0.5	Sm
12	34068.940	4235.0	-0.0008	-0.0004	0.5	Sm
13	34097.923	4430.0	-0.0009	-0.0005	0.5	Sm
14	34118.881	4571.0	0.0001	0.0005	0.5	Sm
15	34119.771	4577.0	-0.0017	-0.0013	0.5	Sm
16	34123.785	4604.0	-0.0007	-0.0003	0.5	Sm
17	34133.744	4671.0	0.0000	0.0004	0.5	Sm
18	34134.785	4678.0	0.0005	0.0009	0.5	Sm
19	34137.755	4698.0	-0.0021	-0.0017	0.5	Sm
20	34139.689	4711.0	-0.0003	0.0001	0.5	Sm
21	34149.794	4779.0	-0.0022	-0.0018	0.5	Sm
22	34159.4570	4844.0	-0.0002	0.0002	0.5	LD
23	34162.4295	4864.0	-0.0004	0.0000	0.5	LD
24	34178.4818	4972.0	-0.0002	0.0001	0.5	LD
25	34180.4140	4985.0	-0.0002	0.0001	0.5	LD
26	34182.4950	4999.0	-0.0001	0.0003	0.5	LD
27	34184.4277	5012.0	0.0004	0.0008	0.5	LD
28	34188.4390	5039.0	-0.0013	-0.0009	0.5	LD
29	34875.5633	9662.0	0.0008	0.0009	0.5	BM
30	34888.4937	9749.0	0.0003	0.0004	0.5	BM
31	34945.4190	10132.0	-0.0001	-0.0001	0.5	BM
32	34956.4177	10206.0	-0.0001	-0.0001	0.5	BM
33	34960.4316	10233.0	0.0007	0.0007	0.5	BM
34	35241.789	12126.0	-0.0008	-0.0009	0.5	Fi
35	35241.939	12127.0	0.0006	0.0005	0.5	Fi
36	35249.817	12180.0	0.0011	0.0010	0.5	Fi
37	35622.881	14690.0	0.0008	0.0005	0.5	Fi
38	35631.799	14750.0	0.0009	0.0007	0.5	Fi
39	36336.757	19493.0	0.0010	0.0006	0.1	Sp
40	36337.797	19500.0	0.0006	0.0002	0.1	Sp
41	36337.945	19501.0	0.0000	-0.0005	0.1	Sp
42	36338.836	19507.0	-0.0008	-0.0013	0.1	Sp
43	36404.3850	19948.0	0.0018	0.0013	0.5	Br
44	36681.8780	21815.0	0.0003	-0.0002	1.0	HL
45	36694.8097	21902.0	0.0011	0.0006	1.0	HL
46	36695.7010	21908.0	0.0006	0.0001	1.0	HL
47	36696.7410	21915.0	0.0002	-0.0003	1.0	HL
48	36703.7267	21962.0	0.0002	-0.0003	1.0	HL
49	36704.7676	21969.0	0.0007	0.0002	0.5	HL
50	36730.4806	22142.0	0.0005	0.0000	0.5	Br
51	36733.7500	22164.0	0.0000	-0.0005	1.0	HL
52	36747.7226	22258.0	0.0013	0.0007	1.0	HL
53	36782.6496	22493.0	-0.0001	-0.0006	1.0	HL
54	37075.4538	24463.0	0.0006	0.0000	1.0	Br
55	38476.0061	33886.0	0.0009	0.0001	0.5	FA
56	39252.9024	39113.0	0.0018	0.0010	0.5	Ep
57	41508.3797	54288.0	0.0004	-0.0002	1.0	MS

continuation of Table 2

No.	T_{max}	E	$(O-C)_L$	$(O-C)_Q$	W.	Ref.
58	41840.4222	56522.0	0.0007	0.0002	1.0	GH
59	43341.7445	66623.0	-0.0010	-0.0009	1.0	BE
60	44050.4181	71391.0	-0.0010	-0.0007	1.0	MS
61	44755.2290	76133.0	0.0006	0.0013	0.5	Pp
62	45795.3485	83131.0	-0.0012	0.0001	1.0	Pp
63	45796.2407	83137.0	-0.0008	0.0005	0.5	Pp

Al=Alania (1954) As=Ashbrook (1954)
 BE=Breger et al. (1978) BM=Broglia and Masani (1955)
 Br=Broglia (1961) Ep=Epstein (1969)
 FA=Fitch et al. (1966) Fi=Fitch (1957)
 GH=Geyer and Hoffmann (1974) HL=Hardie and Lott (1961)
 LD=Lenouvel and Daguillon (1954) MS=Mahdy and Szeidl(1980)
 Pp=Present paper Sm=Smith(Ashbrook,1954)
 Sp=Spinrad (1959)

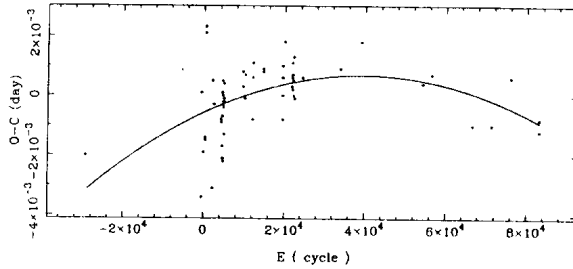


Figure 2. The O-C Diagram of DY Her

For both stars the rate of period change, β , is negative, this means that the periods of light variations are decreasing. They are respectively $-(0.9 \pm 0.2) \times 10^{-8}$ day/year and $-(0.52 \pm 0.06) \times 10^{-8}$ days/year.

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