

COMMISSIONS 27 AND 42 OF THE IAU  
INFORMATION BULLETIN ON VARIABLE STARS

Number 3942

Konkoly Observatory  
Budapest  
15 October 1993  
HU ISSN 0324 - 0676

RAPID CHANGE OF PERIOD OF AP AURIGAE

[BAV Mitteilungen Nr. 67]

The  $\beta$  Lyr-type system AP Aur was discovered by A.S. Williams (Williams 1931). When constructing the database of minima of eclipsing binaries, D. Lichtenknecker first recognized the rapid change of the period of this system (Lichtenknecker 1983). His study of 23 then available minimum timings led to the quadratic formula (Lichtenknecker 1986):

$$\text{Min I} = \text{HJD } 2442443.620 + 0.5693473 \cdot E + 8.08 \cdot 10^{-10} \cdot E^2.$$

The period variation of AP Aur was studied recently by Zhang et al. (Zhang et al. 1993). Though 32 published minima timings were used together with new photoelectric ones, they could not match epoch numbers and observation properly. Jumps of half a period in their O-C-Diagram (Zhang et al., Fig 3a) are not real but a consequence of the collision between their theory and reality. A rather complicated system of ephemeris formulae resulted.

Stimulated by the note by Lichtenknecker, we put AP Aur on our observing program. Photoelectric observations were made at the private observatory of one of us (F.A.) with a 0.35 m automatic photoelectric telescope (Agerer 1988). The photometer was equipped with an uncooled EMI 9781A tube and Schott filters for B and V. One minimum (n. 86) was observed with a 20cm SC telescope, equipped with an uncoated CCD without filters. The minimum times are calculated using the Kwee - van Woerden method (Kwee, van Woerden 1956). 12 times of photoelectric minima were collected, which confirmed the ephemeris found. To expand our knowledge of period changes to the past, one of us (E.S.) investigated this star on 638 plates of the Sonneberg Sky Survey. 38 plates with weak images could be found. With this material at hand we were able to associate the epoch numbers and minimum timings without ambiguity (Table 1). There is one large gap remaining between the first two timings from the discovery plates and the visual observations by Williams. The normal minimum by Kukarkin (Kukarkin 1931) is not of great help. It is built up from 27 plate observations between 1919 and 1930. Moreover the author remarks, that 'die Zerstreuung der Beobachtungen sind gross' (the scatter of the observations is large). Therefore minima Nr. 1 - 3 were not used in calculating the new ephemeris. A least squares fit yields the following quadratic ephemeris:

$$\text{Min I} = \text{HJD } 2448273.5736 + 0.56936859 \cdot E + 9.063 \cdot 10^{-10} \cdot E^2 \quad (1)$$

$\pm 7 \qquad \qquad \pm 29 \qquad \qquad \pm 75$

Table 1: Observed times of minima for AP Aur, epochs and residuals computed with respect to the quadratic ephemeris derived in this paper.

N	JD hel.	W	T*	Epoch	(O-C)	Lit	N	JD hel.	W	T*	Epoch	(O-C)	Lit
	2400000+							2400000+					
1	15488.502	0	P::	-57586.5	-0.1328	[1]	44	42464.401	5	V:	-10203.0	0.0008	[8]
2	15846.517	0	P::	-56958.0	0.0993	[1]	45	42528.443	10	V	-10090.5	-0.0091	[9]
3	22842.95	0	F::	-44668.0	0.1243	[2]	46	42716.539	2	P	-9760.0	-0.0835	[20]
4	23080.520	10	V	-44250.5	0.0166	[1]	47	42756.490	2	P	-9690.0	0.0129	[20]
5	23399.340	10	V	-43690.5	0.0348	[1]	48	42782.370	10	V	-9644.5	-0.0125	[10]
6	23810.331	10	V	-42968.5	-0.0016	[1]	49	42831.332	2	P	-9558.5	-0.0147	[20]
7	24139.943	10	V	-42389.5	-0.0093	[1]	50	43250.340	2	P	-8822.5	-0.0498	[20]
8	26415.361	5	V:	-38392.5	-0.0649	[1]	51	43436.571	2	P	-8495.5	0.0028	[20]
9	26419.387	10	V	-38385.5	-0.0240	[1]	52	43933.332	2	P	-7623.0	0.0025	[20]
10	26771.233	10	V	-37767.5	-0.0051	[3]	53	44499.572	2	P	-6628.5	0.0183	[20]
11	26771.533	5	V:	-37767.0	0.0102	[3]	54	44631.369	2	P	-6397.0	0.0092	[20]
12	27760.679	20	F	-36029.5	-0.0055	[4]	55	45056.388	10	V	-5650.5	0.0027	[11]
13	27815.338	20	F	-35933.5	0.0004	[4]	56	45056.391	10	V	-5650.5	0.0057	[11]
14	28220.388	2	P	-35222.0	-0.0095	[20]	57	45254.425	2	P	-5302.5	-0.0971	[20]
15	28238.342	2	P	-35190.5	0.0114	[20]	58	45388.311	10	V	-5067.5	-0.0105	[12]
16	28425.617	2	P	-34861.5	-0.0149	[20]	59	45405.390	10	V	-5037.5	-0.0123	[12]
17	28494.522	2	P	-34740.5	0.0041	[20]	60	45648.515	2	P	-4610.5	-0.0040	[20]
18	28951.396	2	P	-33938.0	0.0097	[20]	61	45738.7672	40	E	-4452.0	0.0046	[13]
19	30622.613	2	P	-31002.5	0.0180	[20]	62	46377.8729	40	E	-3329.5	0.0020	[13]
20	31030.463	2	P	-30286.0	-0.0248	[20]	63	46436.8024	40	E	-3226.0	0.0024	[13]
21	31875.428	2	P	-28805.5	0.0493	[20]	64	46461.2810	40	E	-3183.0	-0.0016	[14]
22	35761.579	10	V	-21976.0	0.0118	[5]	65	46462.1380	40	E	-3181.5	0.0014	[14]
23	35778.652	2	P	-21946.0	0.0050	[20]	66	46464.1331	40	E	-3178.0	0.0037	[14]
24	35839.542	2	P	-21839.0	-0.0232	[20]	67	46716.637	2	P	-2734.5	-0.0050	[20]
25	35875.436	2	P	-21776.0	0.0031	[20]	68	46776.1381	40	E	-2630.0	-0.0024	[14]
26	36200.527	2	P	-21205.0	0.0068	[20]	69	47170.427	40	E	-1937.5	0.0016	[15]
27	36466.411	10	V	-20738.0	0.0135	[6]	70	47207.435	40	E	-1872.5	0.0009	[15]
28	36541.538	2	P	-20606.0	-0.0113	[20]	71	47469.623	20	F	-1412.0	-0.0040	[16]
29	36896.524	2	P	-19982.5	-0.0036	[20]	72	47526.2762	40	E	-1312.5	-0.0027	[14]
30	37018.361	2	P	-19768.5	-0.0038	[20]	73	47527.1318	40	E	-1311.0	-0.0011	[14]
31	37400.386	2	P	-19097.5	-0.0015	[20]	74	47541.371	20	F	-1286.0	0.0039	[16]
32	37562.601	2	P	-18812.5	-0.0467	[20]	75	47566.413	20	F	-1242.0	-0.0062	[16]
33	37636.625	2	P	-18682.5	-0.0362	[20]	76	47579.516	20	F	-1219.0	0.0014	[16]
34	37696.401	2	P	-18577.5	-0.0404	[20]	77	47586.3478	40	E	-1207.0	0.0008	[16]
35	37733.361	2	P	-18512.5	-0.0872	[20]	78	47592.3254	40	E	-1196.5	0.0000	[16]
36	38853.318	2	P	-16545.5	-0.0157	[20]	79	47803.5516	20	E:	-825.5	-0.0088	[17]
37	39352.574	2	P	-15668.5	-0.0703	[20]	80	47861.3520	40	E	-724.0	0.0008	[17]
38	39533.409	2	P	-15351.0	-0.0009	[20]	81	47861.6350	40	E	-723.5	-0.0009	[17]
39	40648.422	2	P	-13392.5	-0.0453	[20]	82	47947.3263	40	E	-573.0	0.0006	[17]
40	41217.576	2	P	-12393.0	0.0481	[20]	83	48273.5737	40	E	0.0	0.0001	[18]
41	41240.553	2	P	-12352.5	-0.0334	[20]	84	48308.3045	40	E	61.0	-0.0006	[18]
42	41717.371	2	P	-11515.0	-0.0435	[20]	85	48972.4712	40	E	1227.5	-0.0037	[19]
43	42443.609	10	V	-10239.5	-0.0099	[7]	86	49056.4591	40	E	1375.0	0.0020	[19]

[1]: A. Williams, [2]: B. Kukarkin, [3]: V. Tsesevich (1953), [4]: V. Nikonov, [5]: V. Tsesevich (1956), [6]: V. Tsesevich (1960), [7]: R. Diethelm(1975a), [8]: R. Diethelm(1975b), [9]: R. Diethelm(1975c), [10]: R. Diethelm(1976), [11]: Braune & Mundry (1982), [12]: Braune et al. (1983), [13]: D. Faulkner, [14]: R. Zhang et al., [15]: Hübscher & Lichtenknecker (1988), [16]: Hübscher et al. (1989), [17]: Hübscher et al. (1990), [18]: Hübscher et al. (1992), [19]: Hübscher et al. (1993), [20]: this paper

\* ) P denotes pg plate min., E photoel. min., F photographic series and V visual estimates. Those marked "::" were discarded.

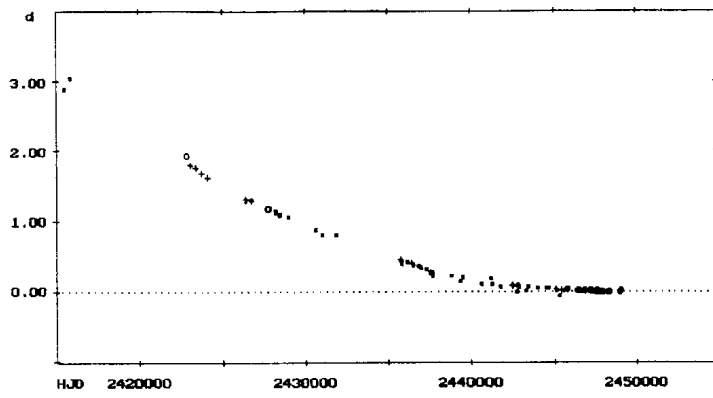


Figure 1: O-C-Diagram for AP Aur computed with respect to the linear ephemeris  $\text{Min I} = 2448273.5736 + 0.56936859 \cdot E$ .  
 ● represents photoelectric, ○ photographic series, + visual observations and □ photographic plate minima.

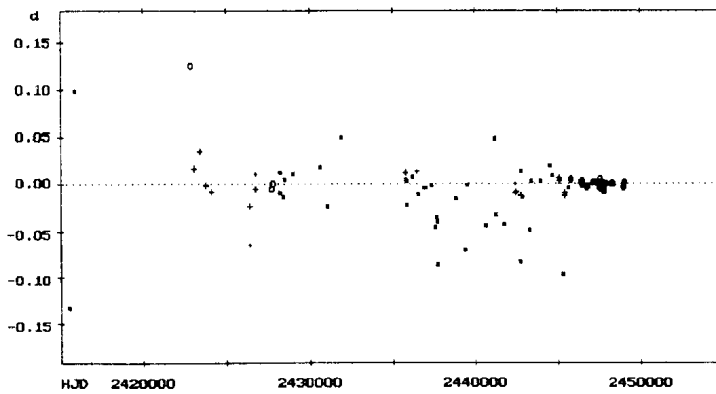


Figure 2: O-C-Diagram for AP Aur computed with respect to the new quadratic ephemeris (1). ● represents photoelectric, ○ photographic series, + visual observations and □ photographic plate minima.

F. AGERER  
 E. SPLITTGERBER  
 Bundesdeutsche Arbeitsgemeinschaft  
 für Veränderliche Sterne e.V. (BAV)  
 Munsterdamm 90  
 D-12169 Berlin  
 Germany

## References:

- Agerer, F.: 1988, BAV Rundbrief 37, 60.  
Braune, W., Mundry, E.: 1982 BAV Mitteilungen 34  
Braune, W. et al.: 1983 BAV Mitteilungen 36  
Diethelm, R.: 1975a BBSAG-Bulletin 20  
Diethelm, R.: 1975b BBSAG-Bulletin 21  
Diethelm, R.: 1975c BBSAG-Bulletin 22  
Diethelm, R.: 1976 BBSAG-Bulletin 27  
Faulkner, D.R.: 1986, Pub. astr. Soc. Pac. 98.690  
Hübscher, J., Lichtenknecker, D.: 1988 BAV Mitteilungen 50  
Hübscher, J. et al.: 1989 BAV Mitteilungen 52  
Hübscher, J. et al.: 1990 BAV Mitteilungen 56  
Hübscher, J. et al.: 1992 BAV Mitteilungen 59  
Hübscher, J. et al.: 1993 BAV Mitteilungen 62  
Kukarkin, B.W.: 1931, Variable Stars, 3.136  
Kwee, K.K., van Woerden, H.: 1956, Bull. Astr. Inst. Netherlands, 12.327  
Lichtenknecker, D.: 1983, BAV Rundbrief 32.37.  
Lichtenknecker, D.: 1986, BAV Rundbrief 35.43.  
Nikonov, V.B.: 1937, Bull. Abastumani astp. Obs. 1.15  
Tsesevich, V.P.: 1953, Izv. astr. Obs. Odessa 4.1.115  
Tsesevich, V.P.: 1956, Astr. Circ. 174.17  
Tsesevich, V.P.: 1960, Ecl. Bin. Circ. Krakow 1-32  
Williams, A.S.: 1931, Mon. Not. R. astr. Soc., 91.698  
Zhang, R.-X., et al.: 1993, ASP Conference Series, Vol. 38.322.