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RAPID CHANGE OF PERIOD OF AP AURIGAE

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The β 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):

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

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 yealds the following quadratic ephemeris:

$$\begin{array}{lllll} \text{Min I} = \text{HJD} & 2448273.5736 + & 0.56936859 \cdot \text{E} + & 9.063 \cdot 10^{-10} \cdot \text{E}^2 & \\ & \pm 7 & \pm 29 & \pm 75 & \end{array} \qquad (1)$$

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. 2400000+	W	T*	Epoch	(O–C)	Lit	N	JD hel. 2400000+	W	T*	Epoch	(O–C)	Lit
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	31030.483	2	P	-30286.0	-0.0248	[20]	63	46436.8024	40	E	-3226.0	0.0024	[13]
21	31873.428	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.

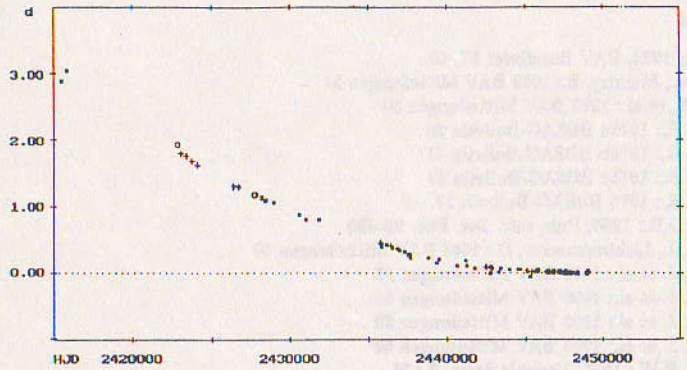

Figure 1: O–C–Diagram for AP Aur computed with respect to the linear ephemeris Min I = 2448273.5736 + 0.56936859 · E.
• represents photoelectric, o photographic series, + visual observations and □ photographic plate minima.

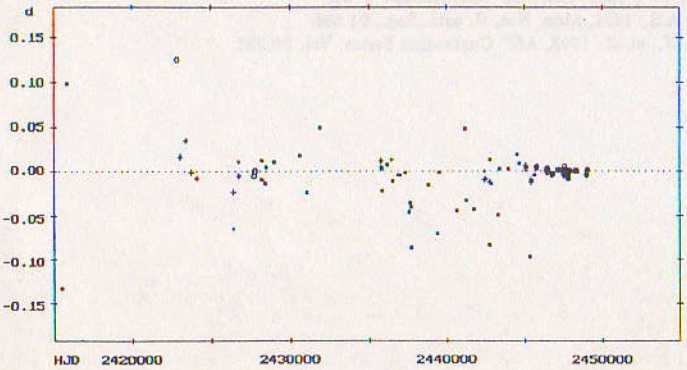

Figure 2: O–C–Diagram for AP Aur computed with respect to the new quadratic ephemeris (1). • represents photoelectric, o photographic series, + visual observations and □ photographic plate minima.

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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.