

An improved ephemeris for AB Persei

Recently several professionals put the eclipsing binary AB Persei on their agenda, because Delta-Scuti-pulsations of at least one of the components have been found (e.g. KIM ea 2003 or HAN ea 2005). Kim ea 2003 noted, that there is a number of incongruous periods in the literature. Namely the ephemeris of the GCVS fits new observations badly. I collected reported minimum times and give an improved ephemeris.

The English solicitor (lawyer) and devoted amateur astronomer Arthur Stanley WILLIAMS suspected the variability of AB Persei as early as 1905 and reported his photographic and visual results in 1924 (Williams 1924). A table in the appendix gives his and all further minimum times used in this paper. The GCVS 2001 announces a light variation between 10.4 and 11,4mag(P), a period of 7,16 days and classifies EA/SD. The visual amplitude of AB Persei is smaller than 0,7mag and makes visual observations difficult.

Visual and photographic minimum times until about 1960 were reported in two ways: As minima (minimum epochs) on one and as normal minima (normal minimum epochs) on the other side, the crucial term being the word "normal". A simple minimum usually was based on more or less scarce original observations. Several simple minima were phased into a normal epoch and means taken as a normal minimum. Eventual systematic errors of the basic simple minima were propagated into the derived normal minimum through unprecise provisional reduction periods. The light variation of AB Persei is generally slow and includes a shallow central part around minimum lasting many hours. During these hours with unprecise methods there cannot be perceived any brightness variation to some certainty. The phase guesses historical observers gave to their observations near minimum therefore were pretty bad, instead their minimum times were strongly influenced by the difference of only 0.16 days between a multiple solar day and the actual period of 7.16 days. Minimum times with unprecise methods become more reliable, if the observer collects during a longer time interval at least 50 original observations near minimum and reduces all data **immediately** into a normal epoch. This procedure is more robust against systematic biases. Early observers avoided it nevertheless, because they aimed not only at finding a minimum time, but also a period, which at their times often was not well established. I explain the greatest part of the strange systematic behaviour of the O-C-values in the diagram in figure 2 with such inadequacies.

The ephemeris of the GCVS $JD(\min 1) = 2422987,207 + 7,1602886 * E$ goes back to a work of Koch&Koch 1962 and represents well only the data until the 1950ies (epochs 0 2000 in the O-C-diagram, figure 2). Kreiner JM 2004 published an ephemeris, which represents well only the minimum times of the 1980ies (epochs 3000 3500). Before that Kreiner ea 2001 had given a global ephemeris representing all observations satisfactorily. In 2005 BAV amateur observer U. Schmidt won the first minimum time based on CCD-observations (IBVS 5657). The related prediction calculated with the hitherto best, latter Kreiner ea 2001 ephemeris is still far outside the limits of 3 mean errors of this CCD-observation and justifies another revision of the elements. A linear fit to the complete data set given in the appendix yields the following revised ephemeris:

$$JD(\min 1) = 2423080,35 + 7,160098 * E \text{ (this paper)}$$

$\pm \quad \quad \quad 3 \quad \quad \quad 7$

I took a set of photoelectric-(V) observations of the years 1990 until 1993 from the HIPPARCOS Catalogue and reduced the data with the new ephemeris. Hipparcos data near minimum are scarce and do not yield a separate time of minimum. The two marks in the light curve diagram in figure 1 indicate the prediction calculated with the new ephemeris and the one calculated with the GCVS ephemeris.

References:

- | | |
|--------------------------|---|
| GCVS_2001 | http://www.sai.msu.su/groups/cluster/gcvs/gcvs/ |
| HAN_ea | Publ. of the Astron.Soc.Japan, 57, 821 (2005) |
| KIM_ea | IBVS Nr. 5325 (2003) |
| KOCH_Joanne_C_&_KOCH_R_H | Astron.J. 67, 462 (1962) |
| KREINER_ea | An Atlas of O-C-Diagrams of Eclipsing Binaries, Cracow (2001) |
| KREINER_JM | Acta Astronomica, 54, 207 (2004) |
| SCMIDT_U | IBVS Nr. 5657 (referring authors Hübscher_ea) |
| TYCHO | HIPPARCOS_Nr_16920 (ESA, via Simbad, v. appendix_key, ca. 1993) |
| WILLIAMS_AS | Monthly Notices of the RAS, 84, 451 (1924) |

Ralf Meyer, Föhnheim 16, D-91717 Wassertrüdingen
Germany, Email: tigrayarajna@t-online.de

Figure 1: Light curve

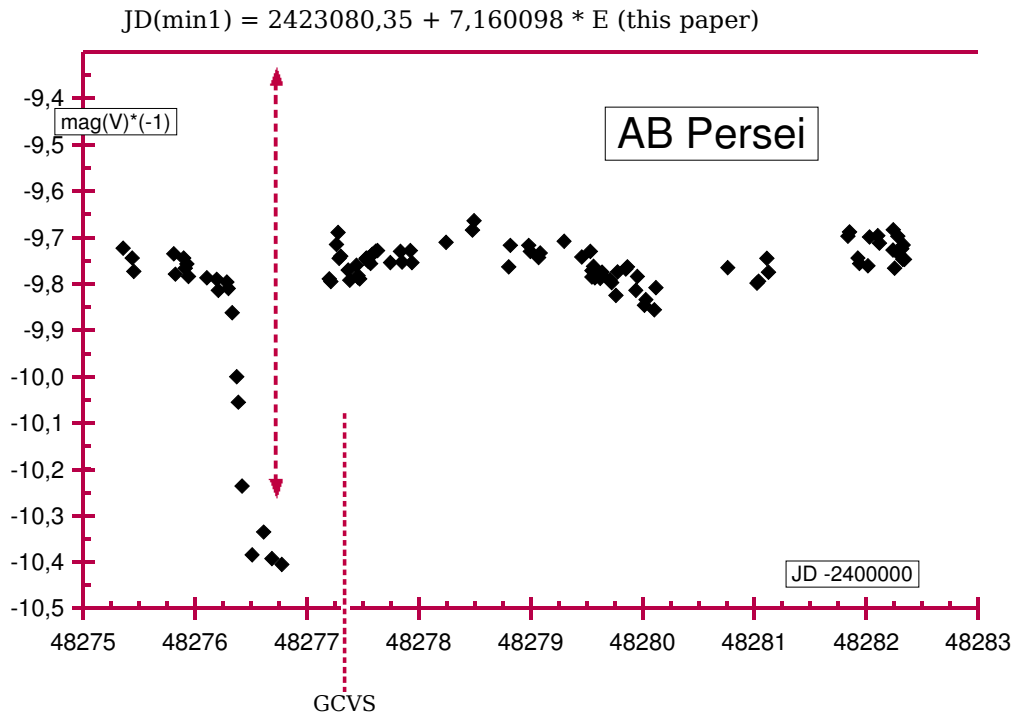
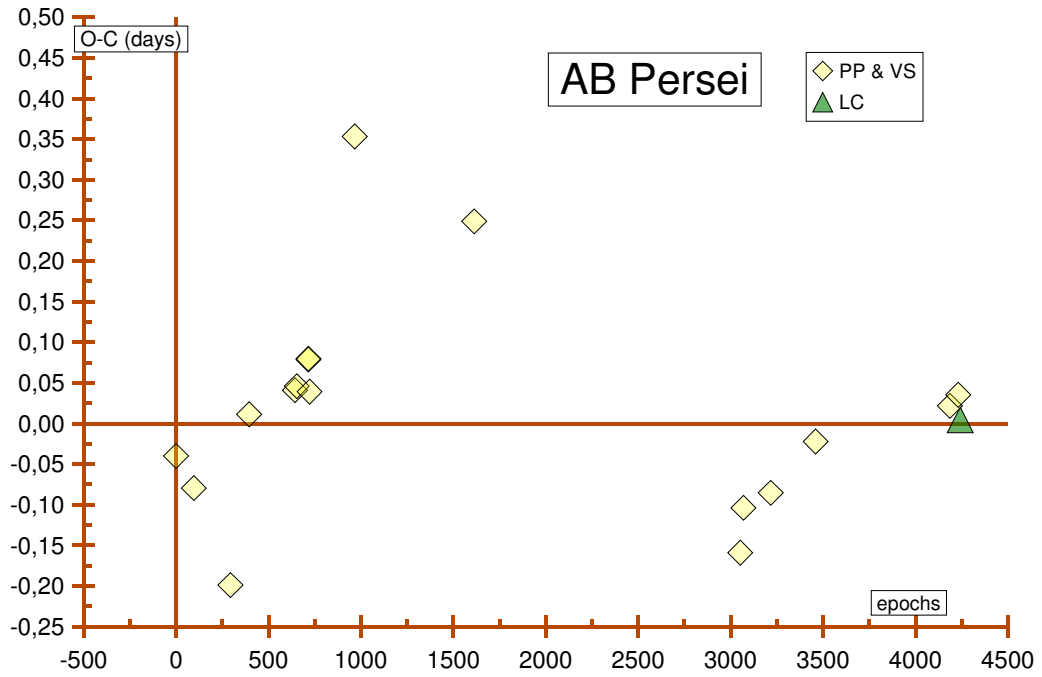


Figure 2: O-C-diagram, JD(min1) = 2423080,35 + 7,160098 * E (this paper, as above)



Appendix

Minimum times:

JD-2400000	Observer	method	reference (referr.auth.)	year	weight
23080,31	WILLIAMS_AS	VS_MNGM	MNRAS_84_451	1924	1
23767,64	WILLIAMS_AS	VS_MNGM	MNRAS_84_451	1924	1
25185,22	MERGENTALER_J	VS	AAC_27_159_(DWORAK)	1977	0
25908,60	SAKHAROV_GP	VS_MNGM	PZ_9_398_(LKD)	-	1
27684,334	LAUSE_F	VS	AN_260_293	1936	1
28207,059	LAUSE_F	VS	AN_260_293	1936	1
28249,980	WOODWARD_EDITH_J	PP	HB_917_7	1943	1
29997,358	GAPOSCHKIN_S	PP	HA_113_76_(LKD)	-	0
34629,837	KOCH_JC&KOCH_RH	PP	AJ_67_462	1962	0
44932,810	BRELSTAFF_T	VS	SAC_55_100_(LKD)	-	1
45054,587	BRELSTAFF_T	VS	VSSC_60_22_(LKD)	-	1
46114,300	BRELSTAFF_T	VS	VSSC_68_33_(LKD)	-	1
47854,267	BRELSTAFF_T	VS	VSSC_73_(LKD)	-	1
53052,542	MEYER_R	VS	BAVM_174	2005	1
53374,764	MEYER_R	VS	BAVM_174	2005	1
53453,4901	SCHMIDT_U	LC	IBVS_5657_(HUEBSCHER_EA)	2005	100

Key:

method: VS = visual, PP = photographic LC = photoelectric/CCD
MNGM indicates, that the author of the present paper calculated normal epochs from reported "small" minima (v. text).

references: AAC = Acta Astronomica (PL), AJ = Astron.J (USA), AN = Astron.Nachr. (D), BAVM = BAV Mitteilungen (Berlin, D), HA = Annals of the Harvard College Observatory (USA), HB = Harvard College Observatory Bulletin (USA), IBVS = Information Bulletin on Variable Stars (Budapest, HU), MNRAS = Monthly Notices of the RAS (UK), PZ = Variable Stars Moscow (RUS), SAC = Rocznik Astronomiczny (Cracow, PL), VSSC = Variable Star Section Circular (BAA, UK).

I took several times of minimum from the Lichtenknecker-Database (LKD) of the BAV (obtainable on CD-ROM from the office of the BAV, Münchener Straße 26, 10825 Berlin, Email braune.bav@t-online.de).

I found summaries of recent professional papers and access to the Hipparcos Catalogue in Simbad (<http://simbad.u-strasbg.fr/>)
