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ON THE ORBITAL PERIOD CHANGES OF AK HERCULIS

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AK Her is a contact eclipsing binary of W UMa-type and the brighter component of the double star ADS 10408. Its companion is about 4 magnitudes fainter than the eclipsing pair and lies very close to it: at a distance of $4\farcs7$ in position angle 322°.

The variability of AK Her was reported by Pickering (1917) and the system has been observed photoelectrically many times (for details see at Tunca et al. 1987 and the references therein). The system exhibits variable light curve and an obvious O'Connell effect. Besides, AK Her is an X-ray source (Cruddace & Dupree, 1984).

So far, many studies have been made concerning its period variations and the detected periodicities are extended from 58 to 78 years. This is mainly due to the available observational material at the time of analysis, and secondly to the fact that the search for periodicities was based on the $O-C$ diagram, which depends on the ephemeris used. So, Schmidt & Herczeg (1959) found a periodicity of 64 yr; Woodward & Wilson (1977) of 58 yr; Barker & Herczeg (1979) of 78.03 yr; Glownia (1985) of 65.95 and Tunca et al. (1987) of 75.72 years. In this report besides the unpublished times of minimum light of AK Her that we present, we also examine its orbital period changes, which was found not to follow the sinusoidal variation proposed some years ago.

Our photoelectric observations of AK Her were carried out during 3 nights in 1985, 3 in 1986 and 4 in 1987 with the 1.2-m Cassegrain reflector at the Kryonerion Astronomical Station of the Athens National Observatory, Greece. Standard B and V filters and a two-beam, multi-mode, nebular-stellar photometer were used. The stars BD +16°3123 and BD +16°3124 were used for comparison and checking respectively, and reduction of the observations was made in the usual way (Hardie, 1962; Henden & Kaitchuk, 1987). The derived 10 new times of minimum light are presented in Table 1 the successive columns of which give the Hel. JD., the type of minimum and the $O-C$, where the C's were computed using the Kwee & van Woerden (1956) method; they are the mean values from the B & V observations and Woodward's (1942) light elements were used:

$$\text{Min I} = 2422977.254 + 0\overset{\text{d}}{.}42152207 \times E.$$

In order to construct the $O-C$ diagram of AK Her (Fig. 1), Tunca's et al. (1987) list of minimum light was used, together with our data (Table 1), and the list was completed

Table 1: The times of minimum light of AK Her, as derived from our photoelectric observations.

Hel. JD 2440000.+	Min. Type	Epoch	$O-C$ (days)
6210.3050	I	55117	0.0191
6210.5153	II	55117.5	0.0186
6212.4140	I	55122	0.0205
6597.4725	II	56035.5	0.0185
6598.3146	II	56037.5	0.0175
6977.4748	I	56937	0.0189
6978.5262	II	56939.5	0.0163
6979.3711	II	56941.5	0.0181
7011.4056	II	57017.5	0.0170

with up to date data, which are given in Table 2. In Fig. 1, the best fitted polynomial (for details see Kalimeris et al., 1994), used to describe the data, is presented by the heavy continuous line, while the sinusoidal term found by Tunca et al. (1987) is denoted by the dashed line.

The real orbital period variation $P(E)$, and its rate of change, were also computed, as it is described by Kalimeris et al. (1994, 1995), and from the Fourier spectrum of the $P(E)$ function, two periodicities were detected: viz. 76.17 ± 0.06 yr and 38.1 ± 0.1 yr, with amplitudes of 0.071 ± 0.002 sec and 0.077 ± 0.002 sec, respectively. The first periodicity is close to this of 78.03 yr found by Barker & Herczeg (1979) and to that of 75.72 yr found by Tunca et al. (1978); but, since it corresponds to the time interval for which observational data exist, it might not be true.

From the present analysis, which includes the most recent available data, it is shown, (Fig. 1), that the orbital period of AK Her *does not follow a sinusoidal variation.* This could not be detected from the observational material available at the time of the previous analyses and shows clearly that the period variations cannot be predicted. As regards the second periodicity of 38.1 yr it had not been detected before; but, since it is half of the long one more data are needed to assure its existence.

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Table 2: Photoelectric times of minimum light of AK Her, from the literature.

Hel. JD.	$O-C$ (days)	Epoch	Reference
2435933.576	0.0019	30737	AA 12, 200, 1962
2437168.412	−0.0148	33666.5	BAC 14, 1963
2437172.418	−0.0132	33676	BAC 14, 1963
2437356.643	0.0066	34113	BAV No. 15
2437505.427	−0.0067	34466	BAV No. 15
2437824.519	−0.0184	35358	BAV No. 15
2437881.413	−0.0069	35823	BAC 15, 1964
2438227.511	0.0100	36179	AN 188, 1964
2438590.454	0.0225	37040	BAC 16, 1965
2438595.503	0.0133	37052	BAC 16, 1965
2438614.479	0.0208	37097	BAC 16, 1965
2438620.372	0.0125	37111	BAC 16, 1965
2443717.426	0.0216	49203	AN 302, 1981
2443744.412	0.0302	49267	AN 302, 1981
2444372.4713	0.0216	50757	BBSAG 48, 1980
2446224.4309	0.0240	55150.5	IBVS 3078, 1987
2446228.4330	0.0215	55160	IBVS 3078, 1987
2446230.332	0.0238	55164.5	IBVS 3078, 1987
2446234.334	0.0213	55174	IBVS 3078, 1987
2446243.3987	0.0233	55195.5	IBVS 3078, 1987
2446244.4510	0.0218	55198	IBVS 3078, 1987
2446612.4410	0.0230	56071	IBVS 3078, 1987
2448100.4112	0.0203	59601	IBVS 3615, 1991
2450248.4941	0.0267	64697	IBVS 4472, 1997
2450259.45353	0.0266	64723	IBVS 4670, 1999
2450275.4751	0.0303	64761	IBVS 4555, 1998
2450310.4578	0.0267	64844	IBVS 4555, 1998
2450508.574	0.0275	65314	IBVS 4555, 1998
2450512.5802	0.0293	65323.5	IBVS 4555, 1998
2450635.6645	0.0291	65615.5	BBSAG 115, 1997
2450865.6038	0.0281	66161	IBVS 4633, 1998
2450866.6681	0.0386	66163.5	IBVS 4633, 1998
2450903.5413	0.0286	66251	IBVS 4633, 1998
2450971.4060	0.0282	66412	IBVS 4633, 1998

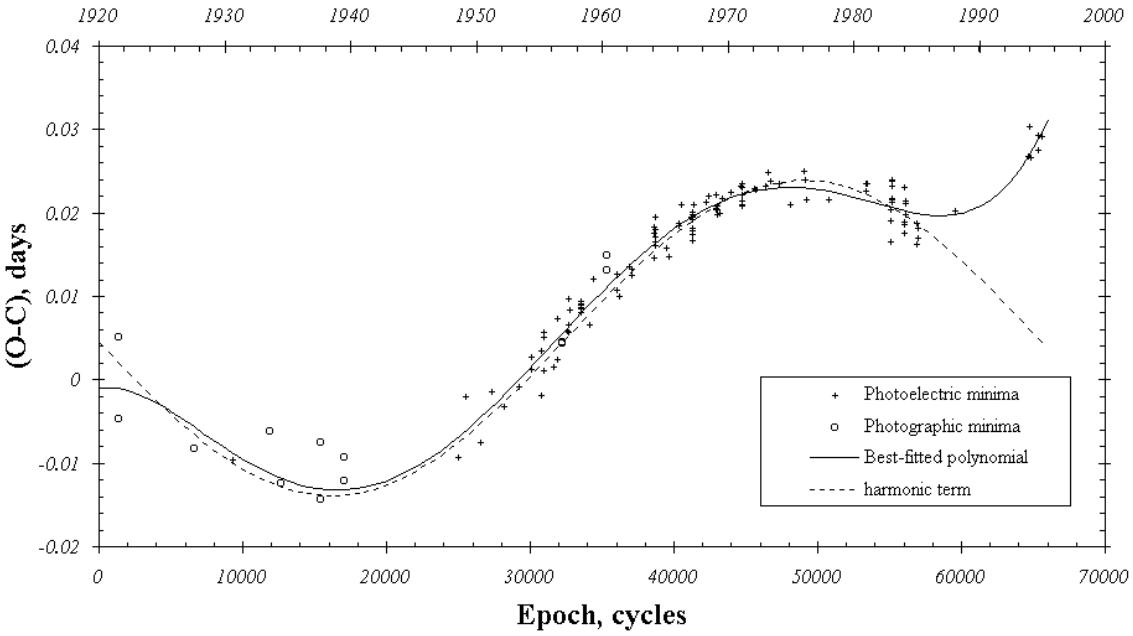

Figure 1. The $O-C$ diagram of AK Her and the best fitted polynomial (continuous line). The sinusoidal variation (dashed line), proposed by Tunca et al. (1987) is also given.

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