COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 2886

Konkoly Observatory
Budapest
9 April 1986
HU ISSN 0374 - 0676

AH CEPHEI: A NEW PHOTOMETRIC TRIPLE STAR

The period of the bright early-type eclipsing binary AH Cep was discussed several years ago by Mayer and Tremko (1983) and thought to vary irregularly. However, the recent times of minima obtained with our Department's 65 cm telescope in Ondřejov strongly suggest another explanation. All published minima, i.e. those from papers by Mayer (1980) and Mayer and Tremko, as well as the new minima are given in Table I. In the column $O-C_1$ the comparison with the ephemeris found by Guarnieri et al. (1975) is presented:

$$\text{Min. I} = \text{J.D.hel. } 2434989.404 + 1\overset{d}{.}774759 \text{ E} \qquad (1)$$

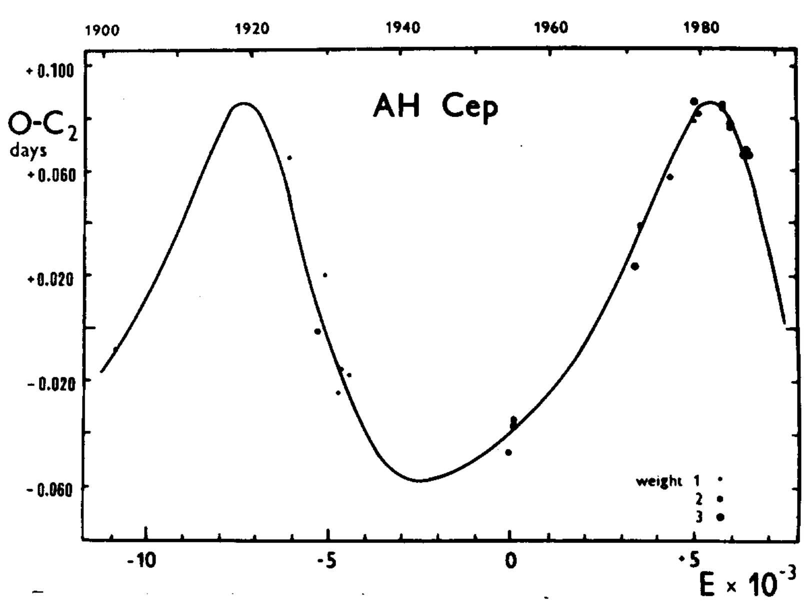

Figure 1

Table I

Minima of AH Cep

J.D.hel. +2400000	E	$O-C_1$	$O-C_2$	$O-C_3$	W	Source
15500.11:	-10981.5	+.222	-.0090	-.0024	1	1
24076.621	- 6149	+.210	+.0647	+.0151	1	2
25388.089	- 5410	+.131	-.0012	-.0129	2	3
25835.345	- 5158	+.148	+.0200	+.0189	1	1
26440.487	- 4817	+.097	-.0248	-.0135	1	1
26564.728	- 4747	+.105	-.0157	-.0021	1	1
26985.34	- 4510	+.099	-.0174	+.0034	1	1
34714.309	- 155	-.007	-.0467	-.0047	2	4
34981.420	- 4.5	+.002	-.0343	+.0058	2	5
34989.404	0	.000	-.0366	+.0035	3	5
40873.619	3315.5	+.0015	+.0236	-.0077	3	6
41196.637	3497.5	+.014	+.0388	+.0023	2	7
42647.507	4315	+.016	+.0577	-.0027	2	7
43779.813	4953	+.028	+.0787	+.0014	1	8
43815.3153	4973	+.0348	+.0862	+.0085	3	7
44010.532	5083	+.028	+.0814	+.0014	2	9
45200.499	5753.5	+.020	+.0844	-.0010	2	9
45223.570	5766.5	+.019	+.0837	-.0016	2	9
45562.5380	5957.5	+.0073	+.0761	-.0060	3	9
45579.398	5967	+.008	+.0761	-.0058	2	9
46343.4150	6397.5	-.0097	+.0670	+.0019	3	10
46358.5006	6406	-.0090	+.0672	+.0026	3	10
46359.3887	6406.5	-.0088	+.0680	+.0034	3	10

Sources: 1 - Zverev (1933), 2 - Moore (1936), 3 - Huffer and Eggen (1947), 4 - Nekrasova (1960), 5 - Guarnieri et al. (1975), 6 - Battistini et al. (1974), 7 - Mayer (1980), 8 - Hartigan and Binzel (1982), 9 - Mayer and Tremko (1983), 10 - this paper.

Values in the column $O-C_2$ are obtained using the ephemeris

$$\text{Min. I} = \text{J.D.hel. } 2434989.4406 + 1\overset{d}{.}7747413\ E \qquad (2)$$
$$\pm\ 20 \qquad \pm\ 18$$

These values are also plotted in Fig. 1. The curve drawn in this figure corresponds to a third-body light time effect, with the third-body orbit of the following parameters:

$P = (12830 \pm 170)\cdot P_o$, i.e. 62.3 ± 0.8 years

T_o (time of periastron) = J.D. 2445890 ± 360

$e = 0.534 \pm 0.023$

$\omega = 125^o \pm 8^o$

The semiamplitude of the light time effect is $0\overset{d}{.}0694 \pm 0\overset{d}{.}0024$. These values were obtained together with the ephemeris (2) by the least squares method. Weights applied in the solution are given in the column W. They are assigned according to the estimated accuracy σ of the times of minima: $W = 1$ for $\sigma \geq 0\overset{d}{.}01$, $W = 2$ for $0\overset{d}{.}01 > \sigma > 0\overset{d}{.}001$, and $W = 3$ for $\sigma \leq 0\overset{d}{.}001$. The corresponding O-C values may be found in the column $O-C_3$. Mean errors are given.

We realize that in several systems the explanation of period changes by a third body proved to be untenable when newer data were secured. In this case one must also see that the early times of minima are rather inaccurate. Therefore the significance of the favourable fact that the data now cover 1.4 of the long period is impaired. However, the present explanation is supported by the quite reasonable value of the mass function $f(m_3) = 0.45$, from which the minimum mass of the third body follows as 8 $M_\odot$ (under assumption $m_1 + m_2 = 25\ M_\odot$, as can be estimated from data collected by Batten et al. (1978)). If the new explanation is correct, then the period of AH Cep should be nearly constant in the next 6-7 years, having the value of about $1\overset{d}{.}77468$.

In the column $O-C_3$ one can see that the remaining differences - namely those of weight 3 - are larger than the observing errors. This could perhaps be again explained by a periodic behaviour; a period of 668 days, with amplitude $0\overset{d}{.}0060$ suits the data quite well. The corresponding fourth body would have a minimum mass of 7 $M_\odot$. The number of good measurements is, however, rather low, so the presence of this body should yet be proven.

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