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PHOTOELECTRIC MINIMA TIMES OF GK CEPHEI AND VARIATIONS IN ITS PERIOD

The eclipsing binary star GK Cep (BV 382, BD+70° 1183, HD 205372, SAO 10069) has been observed photoelectrically during 1987 and 1988 from the National Observatory of Athens, Greece. The observations were made with a two-beam, multi-mode, nebular-stellar photometer attached to the 48-inches Cassegrain reflector at the Kryonerion Astronomical Station.

Reduction of the observations has been made as usual (Hardie, 1962) and the pass bands of the B and V filters used are in close accordance to the standard ones. The stars HD 205328 and HD 205284 were used for comparison and checking, respectively.

From our observations of GK Cep eleven new minima times (8 primaries and 3 secondaries) were derived using Kwee and Van Woerden's (1956) method and are the mean values of B and V colours. They are given in Table I, the successive columns of which give: the Hel. JD, the differences (O-C)₁ and (O-C)₁₁, the minimum type and the number N of the observed points.

In the residuals (O-C)₁ and (O-C)₁₁ the C's have been calculated using the following ephemeris formulae, respectively:

$$(I): \text{Min } I = 2438694.7063 + 0^d.936157.E$$

(due to Dworak, 1975)

and

$$(II): \text{Min } I = 2438694.683 + 0^d.9361669.E$$

(Krakow No.57, 1986)

TABLE I

(New photoelectric minima times of GK Cephei)

Hel. JD 2440000.+	(O-C) ₁ days	(O-C) ₁₁ days	Min Type	N
7063.5472	0.0654	0.0002	II	13
7064.4828	0.0678	-0.0004	II	18
7065.4193	0.0652	0.0000	II	17
7335.5029	0.0675	-0.0006	I	18
7449.5456	0.0678	-0.0004	I	18
7350.4812	0.0673	-0.0010	I	21
7351.4189	0.0688	0.0006	I	21
7394.4846	0.0713	0.0026	I	26
7395.4176	0.0671	-0.0006	I	31
7396.3564	0.0708	0.0023	I	31
7397.2882	0.0664	-0.0023	I	22

As is obvious from the (O-C) values presented in Table I, the period of GK Cep has changed and we tried to find out how this happened. Thus, from all the minima times of GK Cep found in the literature, Table II was made, the successive columns of which give: the Hel. JD; the residuals (O-C)₁, in

TABLE II
(Minima Times of GK Cephei, found in the literature)

Hel. JD 2430000.+	(O-C), days	E	Min Type	Obs. Kind	References
8606.7068	+0.0007	-94	I	pe	Ruiz et al. 1967
8622.636	+0.014	-77	I	pe	"
8627.7712	-0.0054	-71.5	II	pe	Gleim, 1967
8634.795	+0.003	-64	I	pe	Ruiz et al. 1967
8642.759	+0.004	-55.5	II	pe	"
8644.635	+0.008	-53.5	II	pe	"
8649.757	-0.014	-48	I	pe	"
8652.585	+0.006	-45	I	pe	"
8652.588	+0.009	-45	I	pe	"
8694.7047	-0.0016	0	I	pe	"
8694.7070	+0.0007	0	I	pe	Gleim, 1967
8700.7885	-0.0083	6.5	II	pe	Ruiz et al. 1967
8703.6015	-0.0038	9.5	II	pe	"
8708.7487	-0.0001	15	I	pe	"
8709.6866	+0.0018	16	I	pe	Gleim, 1967
8711.5587	+0.0016	18	I	pe	Ruiz et al. 1987
8731.6864	-0.0034	39.5	II	pe	Gleim, 1967
8748.5433	+0.0025	57.5	II	pe	"
8997.0911	+0.0061	323	I	pe	Ruiz et al. 1967
8997.5592	+0.0006	323.5	II	pe	"
9405.7367	+0.0137	759.5	II	pe	"
2440000.+					
0532.3881	+0.0056	1963	I	pe	Dworak, 1975
0532.3883	+0.0058	1963	I	pe	"
0542.2229	+0.0053	1973.5	II	pe	"
0542.2237	+0.0061	1973.5	II	pe	"
0845.5325	0.0000	2297.5	II	pe	"
0845.5327	+0.0002	2297.5	II	pe	"
0852.5476	-0.0006	2305	I	pe	"
0852.5488	+0.0006	2305	I	pe	"
0867.5257	-0.0010	2321	I	pe	"
0867.5265	-0.0002	2321	I	pe	"
0868.4625	-0.0003	2322	I	pe	"
0868.4632	+0.0004	2322	I	pe	"
0869.3972	-0.0018	2323	I	pe	"
0869.3976	-0.0014	2323	I	pe	"
0870.3347	-0.0005	2324	I	pe	Gleim, 1967
0870.3353	+0.0001	2324	I	pe	"
0876.4243	-0.0014	2330.5	II	pe	"
0876.4247	-0.0010	2330.5	II	pe	"
1080.5062	-0.0017	2548.5	II	pe	"
1080.5082	+0.0003	2548.5	II	pe	"
1964.9191	+0.0034	3474	I	pe	Isles, 1985
2685.5421	+0.0025	4261	I	pe	Dworak, 1976
3068.446	+0.0142	4672	I	v	BBSAG No. 31, 1977
3069.388	+0.0200	4673	I	v	"
3090.446	+0.0145	4695.5	II	v	"
3098.400	+0.0112	4704	I	v	"
3099.338	+0.0130	4705	I	v	"
3100.279	+0.0189	4706	I	v	"
3106.366	+0.0188	4712.5	II	v	BBSAG No. 32, 1977
3107.302	+0.0198	4713.5	II	v	BBSAG No. 31, 1977

Cont. of Table II

Hel. JD	(O-C) ₁ days	E	Min Type	Obs. Kind	References
2440000.+					
3159.246	+0.0070	4769	I	v	BBSAG No.32,1977
3173.283	+0.0016	4784	I	v	"
3369.398**	-0.0163**	4993.5	II	v	BBSAG No.37,1978
3392.362*	+0.0199	5018 *	II*	v	"
3399.375	+0.0117	5025.5	II	v	"
3464.439	+0.0128	5095	I	v	BBSAG No.35,1977
3488.314**	-0.0204**	5121.5	II	v	BBSAG No.36,1978
3517.327	+0.0079	5151.5	II	v	"
3589.399*	-0.0042	5228.5*	I *	v	BBSAG No.38,1978
3590.360*	+0.0207	5229.5*	I *	v	"
4937.516	+0.047	6668.5	II	pe	Isles,1985
5671.4680	+0.0517	7452.5	II	pe	"
5890.536	+0.0589	7686.5	II	v	BBSAG No.73,1984
6162.4943	+0.0636	7977	I	pe	Isles,1985
6236.383	-0.0041	8056	I	v	BBSAG No.77,1985
6279.450	-0.0003	8102	I	v	"
6287.4712	+0.0635	8110.5	II	pe	Pohl et al. 1987
6311.3413	+0.0616	8136	I	pe	"
6318.3636	+0.0636	8143.5	II	pe	"
6325.3847	+0.0627	8151	I	pe	"
6332.4057	+0.0625	8158.5	II	pe	"
6339.4287	+0.0643	8166	I	pe	"
6691.4264	+0.0670	8542	I	pe	"
7695.453	+0.065	9614.5	II	pe	BBSAG No.93,1990
7804.444**	-0.0061**	9731	I	v	"
7805.387**	+0.0008**	9732	I	v	"

Notations:

- * They found to be of different type than that reported in the reference
 ** They haven't taken into account in the diagrams 1,2 and 3 since their (O-C) values deviate too much from the others.

which the C's have been calculated using ephemeris formula given by the foregoing equation (I); the number E of the cycles passed; the minimum type; the kind of observation and the reference.

From the data presented in Table II, three visual minima types must be of different kind than that referred in the literature, as the number E of the cycles passed indicates. These, have been marked with an asterisk. Moreover, there are four visual minima times, marked with two asterisks, in which the (O-C)₁ values deviate too much from all the others and they haven't been taken into account.

From the data of Tables I and II, the diagrams, 1,2 and 3 were drawn, in which linear-linear, linear-quadratic and quadratic least square fitting has been achieved, respectively, and where crosses denote the photoelectric minima times, while squares the visual ones.

Unfortunately, there are not observed minima times for GK Cep from JD 2443000 till 2445000, and from the visual ones which cover only the interval from JD 2443100 till 2443900, two have not taken into account, since they deviate.

As one can see from the diagrams 1,2 and 3 the period of GK Cep from JD. 2438000 till 2443000 was almost constant, but after that it seems that there is a jump. More observations of

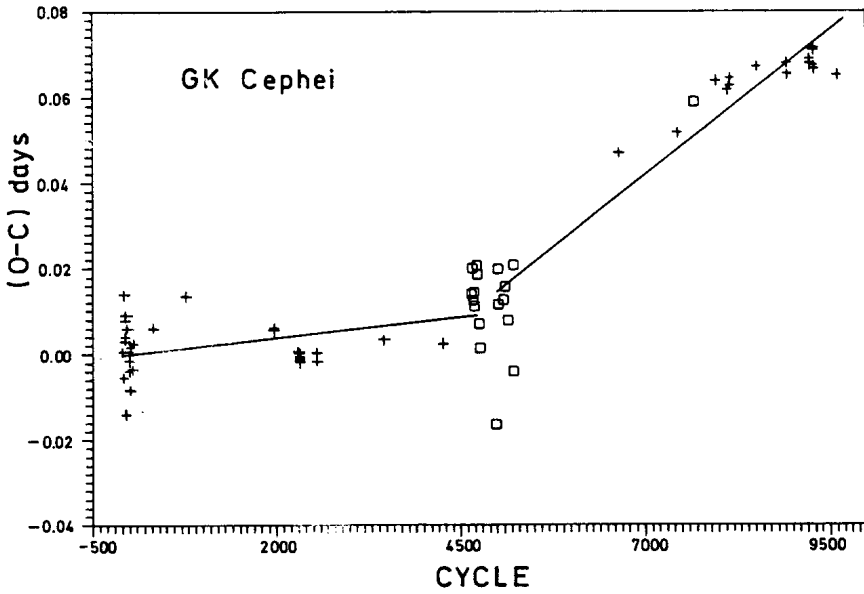


Figure 1 The (O-C) diagram of GK Cep according to Dworak's (1975) ephemeris formula. Linear-linear least squares fitting.

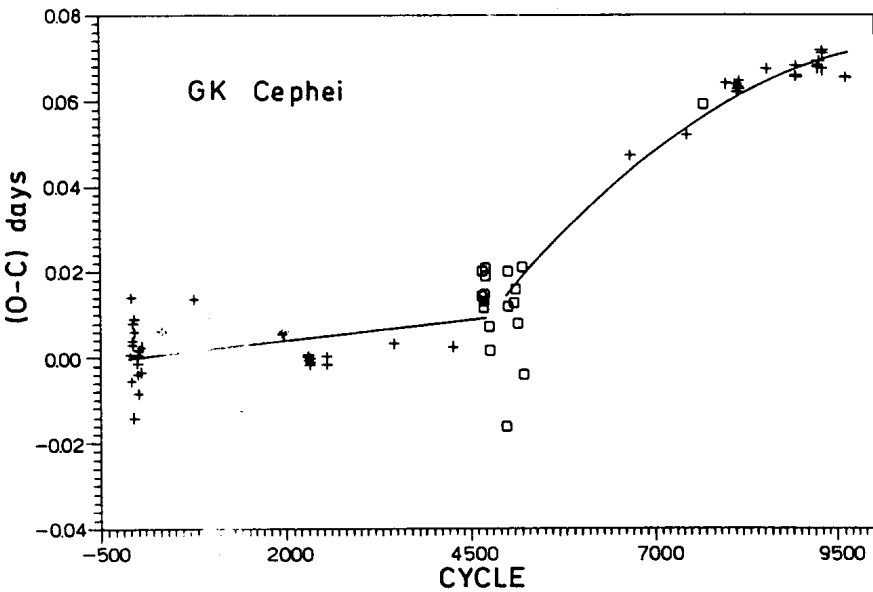


Figure 2 The (O-C) diagram of GK Cep according to Dworak's (1975) ephemeris formula. Linear-quadratic least squares fitting.

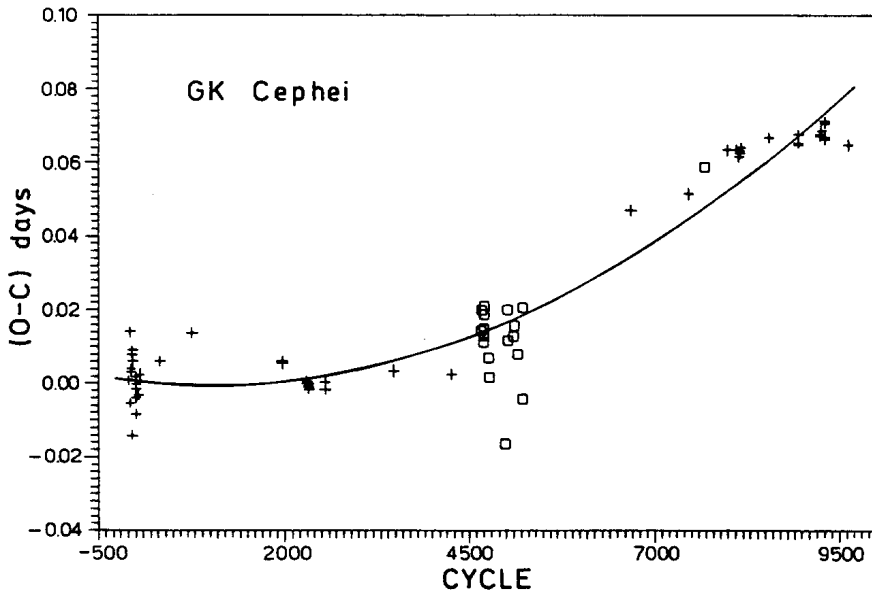


Figure 3 The (O-C) diagram of GK Cep according to Dworak's (1975) ephemeris formula. Quadratic least squares fitting.

its minima time are needed to see if this period increasing will be continued.

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