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Binary peculiar star ωUMa — long-term variations of orbital elements

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The results of radial velocity measurements from our spectrograms and orbital elements computed from them and published data are presented. The established long-term irregular variatons of the elements may be explained by a mass transfer in the ωUMa system.

Key words: binary stars, peculiar stars, ωUMa.

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1. Introduction

The spectroscopic binary ωUMa (HD 94 334, HR 4248, Alp Si, m_V=4,68) was included into our spectroscopic and photometric investigation program of peculiar stars, as it was classified as a marginally Ap Si star by Bertaud and Floquet (1974). The spectral lines identification and selection of lines suitable for radial velocity measurements was made earlier and published by Hric (1984). This paper gives the results of our measurements and long-term evolution of orbital parameters based on all the data available so far.

The discovery of the spectroscopic binary nature of ωUMa was announced by Vogel (1903). The first spectroscopic orbit was published by Parker (1911). Batten (1967) determined orbital elements and mass function as follows:

time of periastron passage	T=2 435 185,246
longitude of periastron	ω=27°,3
eccentricity of elliptic orbit	e=0,305
period of orbital motion	P=15,8307 d
semi-amplitude of radial velocity curve	K=22,2 km/s
radial velocity of system's centre of gravity	V_0=—18,7 km/s
mass function	f(m)=0,015

2. Observational material

Our spectroscopic observational material consists of 16 spectrograms. The spectrograms with a dispersion of 0,85 nm/mm were obtained in the Coudé focus of the 2 m reflector of the Ondřejov Observatory and those with a dispersion 0,9 nm/mm also in the Coudé focus of the 2 m reflector at the National Astronomical Observatory of the Bulgarian Academy of Sciences in Rozhen. All the spectrograms cover the blue spectral region (λλ360-490 nm). All these plates were measured by laserinterferometer Abbé comparator at Skalnaté Pleso Observatory and radial velocities were computed by a code written by doctor Harmanec at the Ondřejov Observatory. The results of measurements on individual spectrograms are listed in Table 1.

Table 1

Observatory	No	JD Hel —2 400 000	RV (HI), km/s	N	RV (metals), km/s	N
O	2039	42 460,4832	—33,79±0,96	12	—38,80±4,28	16
,,	2045	42 464,4277	—14,13±1,47	14	—11,31±1,61	18
,,	2058	42 466,6776	+ 2,17±1,98	14	+ 1,73±2,15	14
,,	2060	42 467,3957	+ 7,24±1,49	13	+ 8,19±0,60	3
,,	2062	42 467,5790	+ 4,79±1,71	11	+ 2,28±1,61	11
,,	2064	42 469,5179	—13,92±1,41	13	—14,27±2,39	10
,,	2072	42 471,5561	—34,44±1,63	14	—33,33±3,17	13
,,	2094	42 478,5976	—33,99±4,06	10	—24,60±2,69	17
,,	2135	42 542,4138	—26,43±3,65	11	—25,70±2,77	12
,,	2137	42 543,4339	—18,71±6,40	6	—20,55±4,63	2
,,	4488	45 077,3225	—14,73±2,30	10	— 6,99±2,12	5
R	1297	45 275,6819	—38,27±1,68	14	—39,76±1,48	8
,,	1320	45 277,6720	—37,86±0,87	13	—38,01±2,06	8
,,	1394	45 341,7161	—37,31±2,09	13	—33,49±2,31	7
,,	2601	46 341,6229	—23,91±2,35	14	—24,97±1,86	8
,,	2608	46 342,6365	—19,99±1,27	12	—20,02±2,02	7

N — number of lines; O — Ondřejov; R — Rozhen

3. Compiled data and results

In addition to the 16 radial velocities values further data were compiled from: Parker (1911) — 51, Harper (1935) — 8, Ebbighausen (1959) — 104, and Beardsley (1969) — 17 values, having thus 196 RV values all together. The method of Fourier analysis was used to determine the orbital period. All the set of data was divided into four groups according to a period of observa-

Table 2

Group	JD Hel —2 400 000	Period, d	e	ω
1	17 687,7040—20 310,6250	15,83183	0,295	7°,26
		15,83019	0,300	9°,01
2	24 694,6010—30 402,9330	15,83183	0,318	29°,72
		15,83244	0,315	30°,33
3	35 975,7150—36 738,7640	15,83183	0,314	26°,61
		15,83415	0,318	27°,19
4	42 460,4832—46 342,6365	15,83183	0,282	26°,62
all		15,83084	0,289	25°,44
data	71 687,7040—46 342,6365	15,83183	0,305	20°,51

e — eccentricity of elliptic orbit; ω — longitude of periastron tions. A computing code written by doctor Harmanec was used to derive the exact period from the whole set of data as well as from each of the four groups. Table 2 lists the results of these procedures. The curve of RV for all 196 data is shown in Fig. 1. It is obvious that our observations fit the mean RV curve in the best way.

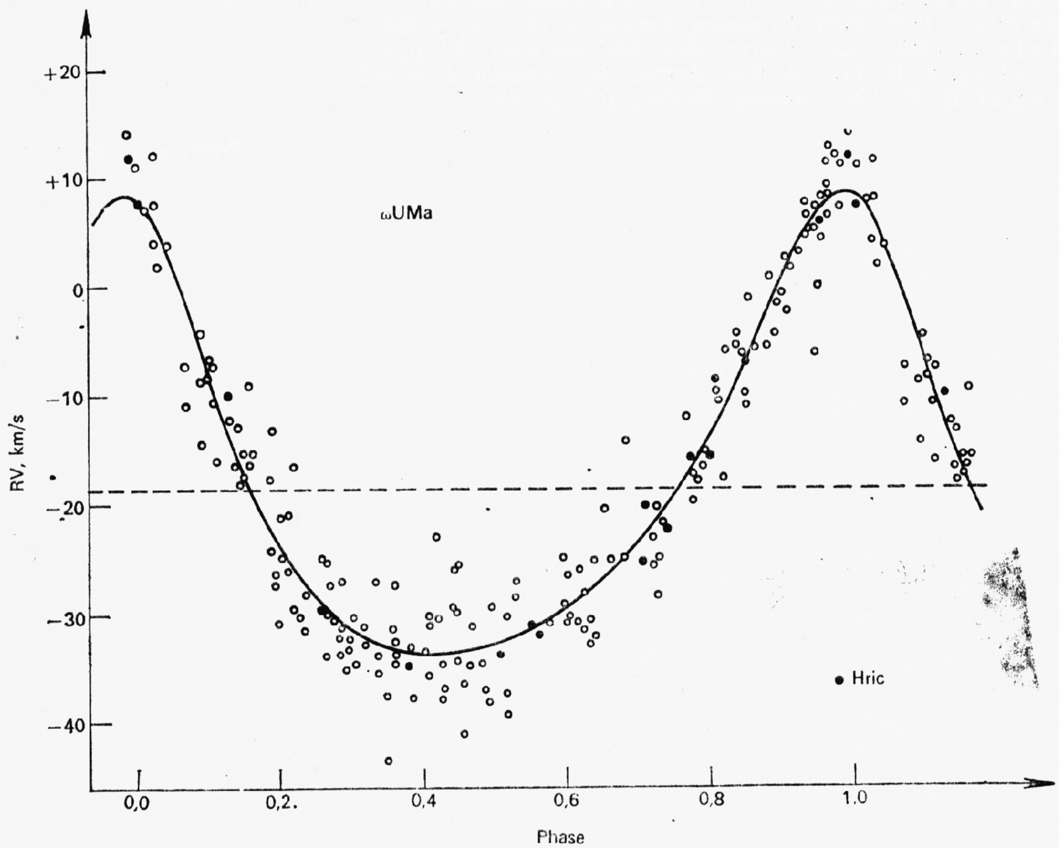

Fig. 1

4. Discussion

The data summarized in Table 2 indicate the long-term most probable irregular variations of orbital elements. This may be explained, for example, by mass transfer in the system that deforms the RV curve. Anyway, the apsidal motion discussed in earlier papers by P a r k e r (1911) and by E b b i g h a u s e n (1959) can be rejected with high confidence. In conclusion it should be noticed that our extensive photoelectric observations do not detect any light variability correlated with the orbital period. This implies low rate mass transfer or some other cause of the RV curve deformations such as precession of a rotating ring in the system.

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References

B a t t e n, A. H. 1967. Publ. Dominion Astrophys. Obs., **13**, p. 119.
B r a d s l e y, W. R. 1969. Publ. Allegheny Obs. Univ. Pittsburgh, VIII, No 7.
B e r t a u d, Ch., F l o q u e t, M. 1974. Astron. Astrophys. Suppl., **16**, p. 71.
E b b i g h a u s e n, E. G. 1959. Publ. Dominion Astrophys. Obs., **11**, p. 265.
H a r p e r. 1935. Publ. Dominion Astrophys. Obs., **6**, p. 226.
H r i c, L. 1984. Contr. Astron. Obs. Skalnaté Pleso, **13**, p. 9.
P a r k e r, T. H. 1911. J. Roy. Astron. Soc. Canada, **5**, p. 377.
V o g e l, H. C. 1903. Astron. Nachr., **163**, p. 145.

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