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THE ORBITAL ELEMENTS OF 25 G CRUCIS (HD 108250)

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RESUMEN

En base a 160 espectrogramas se han determinado los elementos orbitales de HD 108250; la aparente discrepancia entre la velocidad radial de esta estrella y su compañera física α_1 Crucis aparece eliminada.

ABSTRACT

Based on 160 spectrograms the orbital elements of HD 108250 have been determined; the apparent discrepancy between the radial velocity of this star and that of the physical companion α_1 Crucis is removed.

Key words: **RADIAL VELOCITIES — STARS, BINARIES.**

I. INTRODUCTION

The bright star 25 G Crucis = HD 108250 = HR 4729 [$\alpha = 12^h\ 20^m\ 57^s$; $\delta = -62^\circ\ 34'$ (1900.0); 4.84 mag.; B4 IV] was long known to have variable radial velocity. As far back is in 1916 Moore (1916) announced that five spectrograms of HD 108250 suggested a velocity range of some 60 km s^{-1}; however no further work was done on the star. HD 108250 is the distant companion (90″ apart) of α_1 Crucis but, although the proper motions of the objects are in keeping with a physical system, apparently there seemed to be a difference betwen the radial velocity of HD 108250 and that of α_1 Cru (cf. Thackeray and Hill 1974).

II. OBSERVATIONS

A few years ago we undertook to determining the orbital elements of HD 108250 and to this end we secured 46 spectrograms (dispersion 42 Å mm^{-1}) at Bosque Alegre Astrophysical Station of the Córdoba Observatory, in the years 1958 through 1965, and 116 spectrograms (dispersion 61 Å mm^{-1}) at the Cerro Tololo Inter-American Observatory, on six nights of April, 1968. The plates show a single-lined objects of B4 IV spectral type, in agreement with earlier classifications. Three plates were taken at different phases on 103a-F emulsion. No Hα emission can be detected on them.

We measured the spectra with the Grant measuring instrument of the La Plata Observatory by considering 10 lines, namely, the lines from H_6 through H_{10}, and the HeI lines at $\lambda\lambda$4471, 4026 and 3819 Å.

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TABLE 1

RADIAL VELOCITIES OF HD 108250

Hel.J.D. 2400000+	Phase P	V_{rad} km/s	O-C km/s	Hel.J.D. 2400000+	Phase P	V_{rad} km/s	O-C km/s
36252.721	0.525	-26	- 1	39962.735	0.724	-20	+ 8
36252.731	0.533	-31	- 5	39962.741	0.729	-27	0
36252.785	0.576	-37	- 6	39962.752	0.738	-12	+14
36252.836	0.618	-42	- 8	39962.758	0.743	- 6	+19
36252.846	0.627	-34	0	39962.765	0.749	-20	+ 4
36253.715	0.335	+23	+ 4	39962.772	0.754	- 8	+15
36253.734	0.351	+17	+ 2	39962.777	0.758	-28	- 6
36253.750	0.364	0	-11	39962.787	0.766	-20	0
36254.741	0.173	+40	-10	39962.794	0.772	-10	+ 9
36651.845	0.298	+36	+ 8	39962.799	0.777	-17	+ 1
36654.610	0.555	-21	+ 8	39962.806	0.782	-18	- 1
36654.622	0.565	-47	-16	39962.813	0.788	-24	- 8
36654.700	0.629	-30	+ 4	39962.829	0.801	- 9	+ 4
38131.656	0.154	+67	+16	39962.835	0.806	0	+12
38448.612	0.862	-11	-14	39962.841	0.810	- 8	+ 3
38449.797	0.829	-18	-12	39962.847	0.816	- 3	+ 6
38450.798	0.646	-25	+ 9	39964.576	0.227	+47	+ 4
38451.658	0.348	- 4	-20	39964.584	0.233	+35	- 7
38452.630	0.141	+41	-11	39964.592	0.240	+44	+ 2
38899.465	0.858	+ 8	+ 6	39964.600	0.247	+37	- 2
38899.651	0.010	+57	+16	39964.609	0.253	+45	+ 7
38900.452	0.654	-29	+ 4	39964.654	0.290	+32	+ 2
38900.530	0.728	-27	0	39964.664	0.298	+35	+ 7
38901.437	0.468	+ 5	+19	39964.671	0.305	+23	- 4
38901.477	0.500	-14	+ 7	39964.678	0.310	+33	+ 8
38901.495	0.515	-21	+ 2	39964.686	0.316	+22	- 2
38901.534	0.547	-27	+ 1	39964.698	0.326	+22	+ 1
38901.613	0.612	-52	-18	39964.706	0.333	+19	- 1
38901.635	0.630	-42	- 8	39964.713	0.338	+23	+ 5
38901.658	0.648	-36	- 2	39964.719	0.344	+14	- 3
38901.681	0.667	-30	+ 3	39964.725	0.349	+15	- 1
38902.530	0.360	+ 9	- 4	39964.800	0.410	0	0
38902.549	0.376	0	- 8	39964.807	0.415	- 7	- 5
38902.569	0.392	- 1	- 5	39964.813	0.420	+10	+13
38902.591	0.410	+ 6	+ 6	39964.818	0.424	+ 2	+ 6
38902.614	0.429	- 3	+ 2	39964.863	0.461	-12	+ 1
38902.638	0.448	-16	- 6	39964.878	0.473	- 6	+ 9
38902.663	0.468	- 7	+ 7	39965.489	0.972	+34	+ 1
38902.688	0.489	-19	0	39965.493	0.975	+28	- 5
38902.715	0.511	-13	+10	39965.498	0.979	+37	+ 3
38902.745	0.536	-17	+10	39965.527	0.003	+52	+13
38903.452	0.112	+53	+ 1	39965.531	0.006	+52	+12
38903.475	0.132	+68	+16	39965.536	0.010	+37	- 4
38903.517	0.166	+30	-21	39965.541	0.015	+47	+ 5
39962.673	0.674	-18	+15	39965.570	0.038	+39	- 7
39962.682	0.681	-27	+ 5	39965.575	0.042	+58	+12
39962.688	0.686	-12	+20	39965.580	0.046	+56	+ 9
39962.715	0.708	-25	+ 5	39965.587	0.052	+43	- 5
39962.723	0.714	-31	+ 2	39965.648	0.102	+46	- 6
39962.729	0.719	-24	+ 4	39965.653	0.105	+55	+ 3

TABLE 1

(CONTINUED)

Hel. J.D. 2400000+	Phase P	V_{rad} km/s	O-C km/s	Hel.J.D. 2400000+	Phase P	V_{rad} km/s	O-C km/s
39965.658	0.109	+51	- 1	39967.496	0.610	-41	- 7
39965.662	0.113	+51	- 1	39967.499	0.613	-38	- 4
39965.666	0.117	+50	- 2	39967.503	0.616	-36	- 2
39965.691	0.137	+51	- 1	39967.507	0.619	-36	- 2
39965.696	0.141	+55	+ 3	39967.510	0.622	-37	- 3
39965.702	0.146	+57	+ 5	39967.535	0.642	-40	- 6
39966.483	0.783	-25	- 8	39967.540	0.646	-42	- 8
39966.488	0.787	-27	-11	39967.543	0.648	-34	0
39966.491	0.790	-18	- 3	39967.548	0.653	-36	- 2
39966.495	0.793	-15	0	39967.567	0.668	-33	0
39966.499	0.796	-14	0	39967.571	0.671	-46	-13
39966.520	0.813	-11	- 1	39967.575	0.675	-37	- 4
39966.524	0.817	- 5	+ 4	39967.579	0.678	-43	-10
39966.528	0.820	-10	- 2	39967.582	0.681	-34	- 2
39966.532	0.823	-18	-11	39967.659	0.743	-28	- 3
39966.536	0.826	-10	- 3	39967.663	0.746	-25	- 1
39966.602	0.880	+ 8	0	39967.668	0.750	-27	- 4
39966.607	0.884	+ 3	- 6	39967.718	0.791	-15	0
39966.611	0.888	+ 5	- 5	39967.722	0.795	-16	- 2
39966.615	0.891	+18	+ 7	39967.726	0.798	-18	- 4
39966.619	0.894	+15	+ 3	39967.730	0.801	-13	0
39966.725	0.981	+29	- 6	39967.774	0.837	- 2	+ 2
39966.730	0.985	+29	- 7	39967.777	0.840	- 2	+ 1
39966.734	0.988	+35	- 1	39967.781	0.842	+ 2	+ 4
39966.738	0.991	+29	- 8	39967.785	0.846	- 5	- 4
39966.742	0.995	+29	- 9	39967.824	0.878	+ 5	- 2
39966.847	0.080	+'4	- 7	39968.515	0.442	-12	- 4
39966.851	0.083	+52	+ 1	39968.519	0.445	-14	- 5
39966.855	0.087	+43	- 8	39968.524	0.449	-16	- 6
39966.859	0.090	+53	+ 2	39968.528	0.453	-14	- 3

The distribution of the radial velocities from the Cerro Tololo spectrograms is such that they can be represented by only one value of the period, namely, 1.20 ± 0.05 days, no ambiguity being possible. After some trials by using the whole of the available material including the old values derived at the Lick Observatory, we were led to the value P = 1.225155 days where the first five decimal figures are significant. Table 1 lists also the phases that correspond to each velocity value; they were computed with this period, the origin having been set at T = Hel. J. D. 2,438,903.314, the time of periastron passage. The probable errors of the radial velocities from the two sets of plates are comparable: ±3.6 km s^{-1} in the case of the Córdoba plates, and ±3.4 km s^{-1} in the case of the Cerro Tololo spectra.

Table 2 gives the orbital elements as derived with the IBM 360/50 computer of the La Plata University by using the mean velocities from all lines. Separate orbital elements were computed for groups of lines and there is no significant difference in the results for K and e. Differences were found in the values of ω and γ; while differences in ω could hardly be meaningful considering the practically null value of

TABLE 2

ORBITAL ELEMENTS FOR HD 108250

P = 1.225155 ± 0.000005 days
T = Hel. J. D. 2,438,903.314 ± 0.003
e = 0.024 ± 0.014
ω = 314° ± 34°
γ = +8.4 ± 0.4 km s^{-1}
K = 43.1 ± 0.6 km s^{-1}
a sin i = 0.726 × 10^6 km

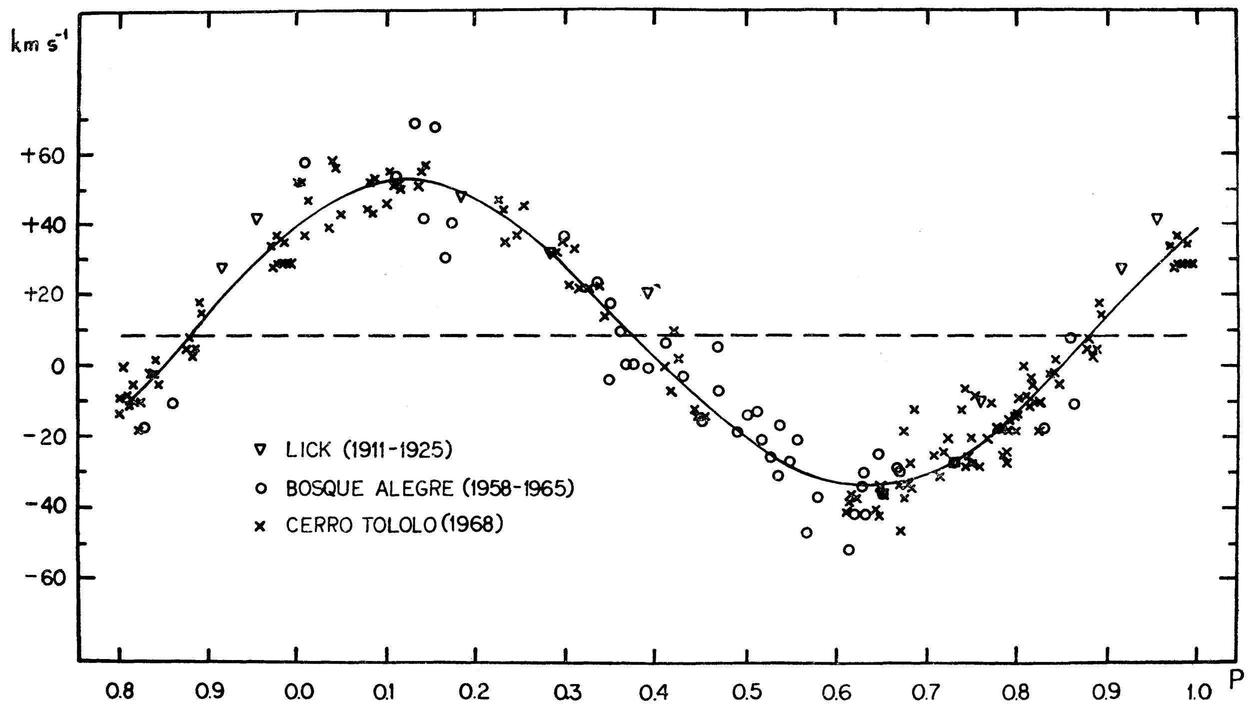

FIG. 1. Measured velocities and computed velocity curve of HD 108250.

eccentricity, the differences in γ are larger than what the mean error lead us to expect. However, the difference in γ may probably arise from not having taken the right blends in adopting the wavelength values.

Figure 1 shows the plot of the individual radial velocities and the velocity curve that corresponds to the derived orbital elements. In Figure 1 we have also plotted the six earliest radial velocities (1911-1925) given in the Catalogue of Observed Radial Velocities (1928); they fit quite well within the set of our radial velocities thus suggesting that the orbital elements in Table 2 have not changed in the interval 1911-1968.

Levato (1979) has made a determination of the rotational velocities of HD 108250 on the basis of our material. Because of the dispersion of our plates, Levato could only reach the conclusion that the rotational velocity has an upper limit of 40 km s^{-1}. Since synchronization between rotational and orbital velocities requires that v sin i = 43 km s^{-1} only higher dispersion material could tell whether or not v sin i is actually lower than the upper limit and answer the question as to whether or not synchronization does exist.

III. CONCLUSION

Our value of γ for HD 108250 agrees fairly well with that of α_1 Cru, namely, +7.5 km s^{-1} (Thackeray and Hill 1974) as it should be in the case of members of a physical system. Therefore, the apparent discrepancy in the radial velocities of the two objects, which must have arisen because no orbital coverage of HD 108250 was available before, no longer exists.

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