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THE ORBIT OF THE SPECTROSCOPIC BINARY BOSS 1452

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ABSTRACT

Twenty-five spectrograms of the star Boss 1452 with single-prism dispersion are made the basis of a determination of the orbital elements. The measures depend for the most part on four lines, and the probable error of a plate is ± 3.1 km. per sec. The period is 2.93317 days, and eccentricity .030.

The star Boss 1452 (1900 $\alpha = 5^h 46.0^m$, $\delta = +59^\circ 52'$, visual magnitude 5.26, type A1) was announced as a spectroscopic binary in the first list of 100 spectroscopic binaries issued from this observatory, Volume I, page 168. The spectrum contains fairly well defined lines of hydrogen, the calcium K, the magnesium 4481 and numerous metallic lines all of which are too faint and elusive to measure except $\lambda 4549$ and occasionally $\lambda 4233$. The results, then, rest for the most part upon the four lines $\lambda\lambda 4481, 4340, 4101$ and 3933. The probable error of a plate as based upon the residuals from the curve representing the final elements is ± 3.1 km. per sec.

The period determined from the 1922 and 1923 observations taken in conjunction with the six obtained by Dr. J. S. Plaskett in 1918 and 1919 is 2.9331 days. The table of observations, normal places and preliminary elements follow:

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OBSERVATIONS OF BOSS 1452

Plate Number	Date	Julian Date	Phase	Velocity	Lines	Residual O-C
1025.....	1918 Dec. 10	2,421,938.924	0.604	+21.0		+ 5.0
1120.....	" 21	1,949.892	2.773	+67.8		- 1.2
1364.....	1919 Feb. 1	1,991.758	0.641	+ 6.2		- 3.7
1378.....	" 2	1,992.683	1.566	-76.4		- 0.1
1425.....	" 11	2,001.751	1.834	-60.1		- 2.4
1426.....	" 11	2,001.759	1.842	-51.9		+ 5.8
8302.....	1922 Nov. 2	3,361.980	1.073	-62.9	5	- 9.1
8346.....	" 11	3,370.907	1.200	-62.5	4	+ 3.8
8441.....	" 27	3,386.878	2.505	+31.8	4	- 8.9
8502.....	1923 Jan. 19	3,439.788	2.618	+66.9	1	+11.7
8535.....	" 28	3,448.755	2.786	+74.0	7	+ 3.9
8540.....	" 31	3,451.718	2.815	+70.5	4	- 0.7
8602.....	Feb. 26	3,477.743	2.442	+32.0	6	+ 0.4
8635.....	Mar. 2	3,481.728	0.561	+26.7	5	+ 4.1
8665.....	" 16	3,495.740	2.840	+75.5	5	+ 2.8
8678.....	" 19	3,498.721	2.888	+69.4	5	- 4.6
8699.....	" 24	3,503.656	1.956	-39.1	5	+ 4.7
8721.....	" 26	3,505.710	1.077	-57.1	4	- 2.8
8760.....	" 30	3,509.657	2.091	-26.5	6	- 2.2
8761.....	" 30	3,509.698	2.132	-15.3	6	+ 3.0
8774.....	April 2	3,512.639	2.140	-15.0	5	+ 1.9
8806.....	" 9	3,519.694	0.395	+52.7	4	+ 6.4
8807.....	" 9	3,519.705	0.406	+47.5	5	+ 1.6
8862.....	" 23	3,533.073	2.642	+54.7	6	- 3.1
8895.....	" 27	2,423,537.697	0.799	-20.7	8	- 5.0

NORMAL PLACES

	Mean Phase		Velo- city	Wt.	O-C			Mean Phase		Velo- city	Wt.	O-C	
	Prel.	Final			Prel.	Final		Prel.	Final			Prel.	Final
1	2.618	2.618	+66.9	0.2	+11.6	+11.7	11	1.198	1.200	-62.5	1.0	+2.5	+3.8
2	2.737	2.773	+67.8	1.0	+ 0.8	- 1.2	12	1.531	1.566	-76.4	1.0	-2.0	-0.1
3	2.801	2.800	+72.2	2.0	+ 0.8	+ 1.6	13	1.804	1.838	-56.0	2.0	+3.2	+1.7
4	2.865	2.864	+72.4	2.0	- 1.6	- 0.9	14	1.958	1.956	-39.1	1.0	+3.3	+4.7
5	.402	.401	+50.1	2.0	+ 5.8	+ 4.0	15	2.114	2.112	-20.9	2.0	-0.1	+0.4
6	.561	.561	+26.7	1.0	+ 6.5	+ 4.1	16	2.141	2.140	-15.0	1.0	+1.6	+1.9
7	.568	.604	+21.0	1.0	+ 1.9	+ 5.0	17	2.443	2.442	+32.0	0.5	+0.6	+0.4
8	.606	.641	+ 6.2	1.0	- 6.8	- 3.7	18	2.504	2.505	+31.8	1.0	-8.6	-8.9
9	1.071	1.073	-62.9	1.0	- 9.3	- 9.1	19	2.644	2.642	+54.7	1.0	-3.6	-3.1
10	1.079	1.077	-57.1	1.0	- 2.7	- 2.8	20	.802	.799	-20.7	1.0	-2.5	-5.0

PRELIMINARY ELEMENTS

$$\begin{aligned}
 P &= 2.9331 \text{ days} \\
 e &= .05 \\
 \omega &= 0^\circ \\
 \gamma &= -3.75 \text{ km.} \\
 K &= 75 \text{ km.} \\
 T &= \text{J.D. } 2,421,938.356
 \end{aligned}$$

Using these values as preliminary a set of twenty observation equations weighted as above was built up according to the Lehmann-Filhés method connecting the residuals with the six elements of the orbit. The different years were kept separate, since the period was included in the solution. For the sake of homogeneity the following transformations were made.

$$\begin{aligned}
 x &= \delta\gamma \\
 y &= \delta K \\
 z &= K.\delta e \\
 u &= -K.\delta\omega \\
 v &= -[4.87607] \delta\mu \\
 w &= [2.20756] \delta T
 \end{aligned}$$

OBSERVATION EQUATIONS FOR BOSS 1452

1.....	1.000x	+ .787y	+ .067z	- .676u	+ .000v	- .727w	- 11.6=0
2.....	1.000	+ .944	- .588	- .448	+ .729	- .489	- 0.8
3.....	1.000	+1.002	+ .806	- .307	- .003	- .337	- 0.8
4.....	1.000	+1.037	+ .947	- .162	- .010	- .178	+ 1.6
5.....	1.000	+ .641	- .325	+ .807	+ .069	+ .856	- 5.8
6.....	1.000	+ .319	- .871	+ .963	+ .042	+ .988	- 6.5
7.....	1.000	+ .305	- .887	+ .967	-1.489	+ .992	- 1.9
8.....	1.000	+ .224	- .954	+ .985	-1.452	+1.003	+ 6.8
9.....	1.000	- .664	+ .036	+ .700	- .051	+ .650	+ 9.3
10.....	1.000	- .675	+ .069	+ .688	+ .042	+ .639	+ 2.7
11.....	1.000	- .816	+ .510	+ .500	- .032	+ .458	- 2.5
12.....	1.000	- .942	+ .969	- .125	+ .164	- .113	+ 2.0
13.....	1.000	- .740	+ .261	- .613	+ .812	- .565	- 3.2
14.....	1.000	- .516	- .342	- .824	- .050	- .779	- 3.3
15.....	1.000	- .227	- .840	- .961	- .065	- .934	+ 0.1
16.....	1.000	- .172	- .897	- .975	- .070	- .954	- 1.6
17.....	1.000	+ .468	- .670	- .908	- .036	- .946	- 0.6
18.....	1.000	+ .589	- .441	- .842	+ .047	- .887	+ 8.6
19.....	1.000	+ .827	+ .190	- .629	- .064	- .679	+ 3.6
20.....	1.000	- .192	- .876	+ .970	+ .093	+ .947	+ 2.5

Owing to the small value of the eccentricity and the consequent similarity of the coefficients of u and w (corresponding to ω and T) it was necessary to consider T as fixed and to solve for the remaining elements. The normal equations were

$$\begin{array}{rcll}
 23.700x & +3.048y & -1.530z & -1.131u & - .503v & + .080 & = 0 \\
 11.363 & +1.800 & & - .319 & -1.323 & -3.177 & \\
 & 11.003 & & -1.873 & +3.684 & +2.560 & \\
 & & & 12.581 & -3.738 & - .795 & \\
 & & & & 6.251 & -13.197 &
 \end{array}$$

From these there resulted the following corrections:

$$\delta\gamma = -0.11 \text{ km.}$$

$$\delta K = +1.02 \text{ km.}$$

$$\delta e = -0.020$$

$$\delta\omega = -0^\circ.75$$

$$\delta P = +0.00007 \text{ days.}$$

The sum of the squares of the normal places was reduced about 12 per cent, dropping from 424.4 to 373.7. The final elements, with their probable errors, are given below, and a curve representing them and showing the individual observations accompanies the article.

FINAL ELEMENTS

$$P = 2.93317 \text{ days} \pm 0.00003 \text{ days}$$

$$e = 0.030 \pm 0.016$$

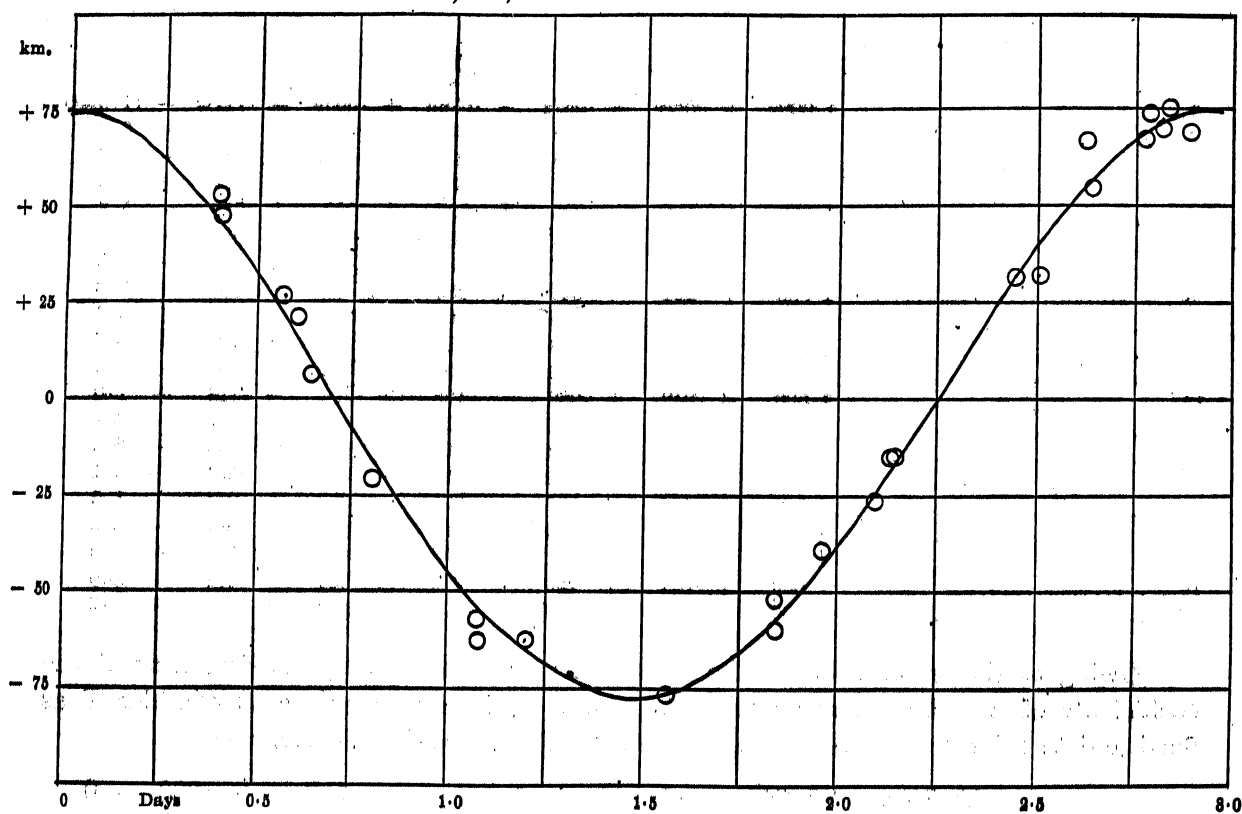
$$\omega = 359^\circ.25 \pm 0^\circ.81$$

$$\gamma = -3.86 \text{ km.} \pm 0.71 \text{ km.}$$

$$K = 76.02 \text{ km.} \pm 1.08 \text{ km.}$$

$$T = \text{J.D. } 2,421,938.356$$

$$a \sin i = 3,064,800 \text{ km.}$$



Radial Velocity Curve of Boss 1452 Showing Individual Observations.

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