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THE SPECTROSCOPIC ORBIT OF H.R. 6532 AND THE RADIAL VELOCITIES
OF TEN STARS

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ABSTRACT

Thirty-three single-prism spectrograms of the star H.R. 6532 ($\alpha = 17^{\text{h}} 27^{\text{m}}.6$, $\delta = +12^{\circ} 00'$) form the basis of the determination of its orbit. The period is 6.7984 days, the eccentricity .069 and semi-amplitude 50.18 km.

Ten stars of different types were selected from the Harvard Catalogue to fill in a program and the radial velocities of these are determined. From three to eight plates of each star were measured.

I—THE SPECTROSCOPIC ORBIT OF H.R. 6532

The star H.R. 6532 (1900 $\alpha = 17^{\text{h}} 27^{\text{m}}.6$, $\delta = +12^{\circ} 00'$, visual magnitude 6.18, type A₀) was found to be a spectroscopic binary by the first two plates secured in July 1921. Nineteen plates were secured in July and August from which a period of approximately 6.7 days was evident. Their distribution along the velocity curve was not such as to warrant a solution, without additional plates, and these have been obtained, fourteen in number, during the summer months of 1922. The thirty-three plates thus obtained form the basis of the solution.

In the latest Harvard Catalogue this star is classified as B9, but the line $\lambda 4026$ does not appear on any of the plates taken here. The principal lines used in measurement were $\lambda\lambda 4481$, 4549, 4233 and the silicon pair 4131 and 4128.

The following is the table of observations in which the phases are those given by the corrected period and periastron passage.

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OBSERVATIONS OF H.R. 6532

Plate Number	Date	Julian Date	Phase	Lines	Wt.	Velocity	O-C
6225	1921 July 12	2,422,883.745	5.591	6	.2	+20.9	+ 0.2
6246	" 15	2,886.790	1.836	2	.2	-53.3	- 1.3
6290	" 22	2,893.798	2.047	6	.2	-48.7	- 3.9
6327	" 28	2,899.767	1.218	5	.1	-65.7	- 1.9
6345	" 30	2,901.762	3.213	8	.2	- 1.3	- 2.3
6363	Aug. 1	2,903.800	5.251	2	.1	+27.8	- 2.8
6369	" 2	2,904.785	6.236	2	.2	- 7.6	+ 0.4
6379	" 4	2,906.744	1.396	2	.2	-61.8	+ 0.1
6381	" 6	2,908.751	3.403	8	.2	+ 9.4	- 1.4
6387	" 7	2,909.711	4.363	7	.2	+35.9	+ 2.6
6406	" 8	2,910.739	5.391	3	.1	+22.2	- 4.6
6420	" 10	2,912.718	0.572	5	.1	-63.8	- 5.5
6421	" 10	2,912.734	0.588	3	.1	-52.9	+ 5.7
6435	" 11	2,913.693	1.547	5	.2	-50.2	+ 9.0
6474	" 25	2,927.692	1.949	3	.1	-50.5	- 2.3
6475	" 25	2,927.709	1.966	5	.1	-61.0	-13.4
6493	" 28	2,930.662	4.919	4	.1	+39.9	+ 4.5
6494	" 28	2,930.683	4.939	4	.1	+33.0	- 2.0
6506	" 31	2,933.730	1.189	3	.1	-66.5	- 2.3
7687	1922 June 17	3,223.841	5.767	6	.2	+15.2	+ 0.6
7699	" 24	3,230.770	5.798	4	.2	+ 7.7	- 5.7
7713	" 25	3,231.768	6.795	2	.15	-38.6	- 2.7
7717	" 25	3,231.848	0.177	4	.15	-44.6	- 0.4
7725	" 26	3,232.782	1.111	7	.2	-64.0	+ 0.4
7740	" 28	3,234.714	3.043	5	.2	- 1.2	+ 4.6
7761	July 1	3,237.833	6.162	5	.2	+ 5.2	+ 9.2
7783	" 4	3,240.764	2.295	2	.1	-27.9	+ 8.1
7801	" 12	3,248.807	3.539	7	.2	+ 7.3	- 5.9
7825	" 18	3,259.736	2.670	2	.1	-18.1	+ 2.3
7827	" 19	3,255.734	3.668	5	.2	+20.5	+ 3.1
7840	" 23	3,259.790	0.926	7	.2	-68.1	- 4.1
7855	" 29	3,265.743	0.080	3	.2	-43.7	- 3.5
7926	Aug. 16	2,423,283.726	4.465	5	.2	+32.6	- 2.0

By the additional plates of 1922 the period was slightly modified and the value of 6.800 days satisfied all observations and was accepted as definite. Eleven pairs of the observations were grouped to form the normal places. Of these four pairs were taken on the same night, six pairs differed by one cycle each and one pair by five cycles. In the case of the pair differing by five cycles the observations occurred at minimum and it was quite evident that their grouping would not interfere with including the period in the least-squares solution.

NORMAL PLACES

	Mean Phase		Mean Velocity	Wt.	O-C	
	Prel.	Final			Prel.	Final
1.....	0.293	0.078	-43.7	.2	- 3.5	- 3.5
2.....	0.358	0.136	-41.6	.3	+ 1.4	+ 1.2
3.....	0.876	0.580	-58.4	.3	+ 0.8	- 0.1
4.....	1.140	0.924	-68.1	.2	- 5.2	- 4.2
5.....	1.332	1.110	-64.0	.2	- 0.4	+ 0.4
6.....	1.499	1.200	-66.1	.2	- 3.1	- 2.0
7.....	1.769	1.471	-56.0	.4	+ 3.2	+ 4.8
8.....	2.244	1.942	-51.0	.4	- 4.4	- 2.2
9.....	2.251	1.958	-55.8	.2	- 9.4	- 7.6
10.....	2.514	2.293	-27.9	.1	+ 9.1	+ 8.3
11.....	2.886	2.668	-18.1	.1	+ 4.0	+ 3.1
12.....	3.264	3.042	- 1.2	.2	+ 5.0	+ 4.7
13.....	3.606	3.307	+ 4.1	.4	- 3.4	- 0.4
14.....	3.821	3.602	+13.9	.4	- 1.4	- 1.0
15.....	4.661	4.363	+35.9	.2	+ 0.9	+ 2.6
16.....	4.676	4.465	+32.6	.2	- 3.4	- 1.9
17.....	5.223	4.930	+36.5	.2	+ 2.0	+ 1.3
18.....	5.620	5.321	+25.0	.2	- 1.2	- 4.1
19.....	5.895	5.591	+19.4	.2	+ 2.6	- 1.9
20.....	6.056	5.830	+11.4	.4	+ 1.3	- 0.6
21.....	6.383	6.161	+ 5.2	.2	+10.6	+ 8.9
22.....	6.535	6.236	- 7.6	.1	+ 5.5	- 0.2

The following preliminary elements formed the basis of the least-squares solution.

$$\begin{aligned}
 P &= 6.800 \text{ days} \\
 e &= 0.05 \\
 \omega &= 105^\circ \\
 T &= \text{J.D. } 2,422,877.850 \\
 K &= 50 \text{ km.} \\
 \gamma &= -13 \text{ km.}
 \end{aligned}$$

OBSERVATION EQUATIONS

1.....	1.000x	- .545y	- .771z	+ .895u	+ .361v	+ .930w	+ 3.500 = 0
2.....	1.000	- .600	- .853	+ .858	+ .314	+ .888	- 1.400
3.....	1.000	- .925	- .907	+ .459	+ .015	+ .438	- 0.800
4.....	1.000	- .999	- .564	+ .213	+ .066	+ .172	+ 5.200
5.....	1.000	-1.013	- .259	+ .048	+ .000	+ .000	+ 0.400
6.....	1.000	-1.001	+ .055	- .109	- .003	- .159	+ 3.100
7.....	1.000	- .924	+ .553	- .364	- .012	- .406	- 3.200
8.....	1.000	- .673	+ .977	- .703	- .006	- .710	+ 4.400
9.....	1.000	- .669	+ .978	- .707	- .036	- .713	+ 9.400
10.....	1.000	- .481	+ .925	- .836	- .297	- .819	- 9.100
11.....	1.000	- .182	+ .549	- .938	- .339	- .899	- 4.000
12.....	1.000	+ .135	- .040	- .941	- .318	- .892	- 5.000
13.....	1.000	+ .408	- .564	- .859	- .020	- .820	+ 3.400
14.....	1.000	+ .564	- .812	- .769	- .275	- .742	+ 1.400
15.....	1.000	+ .959	- .662	- .183	- .007	- .220	- 0.900
16.....	1.000	+ .968	- .685	- .170	- .085	- .208	+ 2.600
17.....	1.000	+ .949	+ .287	+ .320	+ .014	+ .273	- 2.000

OBSERVATION EQUATIONS—*Concluded*

18.....	1.000	+ .782	+ .876	+ .654	+ .016	+ .630	+ 1.200
19.....	1.000	+ .594	+1.022	+ .843	+ .005	+ .845	- 2.600
20.....	1.000	+ .460	+ .973	+ .929	+ .327	+ .946	- 1.300
21.....	1.000	+ .150	+ .576	+1.035	+ .389	+1.079	-10.600
22.....	1.000	- .004	+ .290	+1.048	+ .030	+1.099	- 5.500

where

$$x = \delta\gamma$$

$$y = \delta K$$

$$z = K \cdot \delta e$$

$$u = -K \cdot \delta\omega$$

$$v = -\frac{1000 K}{(1-e^2)^{\frac{3}{2}}} \cdot \delta\mu$$

$$w = \frac{K\mu}{(1-e^2)^{\frac{3}{2}}} \cdot \delta T$$

NORMAL EQUATIONS

$$\begin{array}{r}
 5.300x - .529y + .271z - .004u + .127v - .011w + .220 = 0 \\
 2.700 \quad - .025 + .122 - .099 + .155 - 2.392 \\
 \quad \quad 2.862 + .177 + .081 + .166 - 2.462 \\
 \quad \quad \quad 2.604 + .584 + 2.604 - 5.019 \\
 \quad \quad \quad \quad .202 + .583 - .394 \\
 \quad \quad \quad \quad \quad 2.619 - 5.212
 \end{array}$$

The solution of the normal equations resulted in the corrections

$$\delta\gamma = +0.21 \text{ km./sec.}$$

$$\delta K = +0.18 \text{ km.}$$

$$\delta e = +0.019$$

$$\delta\omega = +11^\circ 26$$

$$\delta P = -0.00157 \text{ days}$$

$$\delta T = +0.304 \text{ days}$$

and the corrected elements with their probable errors are

$$P = 6.7984 \pm 0.00065 \text{ days}$$

$$e = 0.069 \pm 0.013$$

$$\omega = 116^\circ.26 \pm 14^\circ.13$$

$$K = 50.18 \pm 0.91 \text{ km.}$$

$$\gamma = -12.79 \pm 0.62 \text{ km.}$$

$$T = \text{J.D. } 2,422,878.154 \pm 0.265 \text{ days}$$

$$a \sin i = 4,680,000 \text{ km.}$$

$$\frac{m^3 \sin^3 i}{(m + m_1)^2} = 0.0886 \odot$$

The probable error of a normal place of weight unity is ± 1.40 km. sec. and the probable error of a plate ± 2.94 km. sec. The least-squares solution reduced $\Sigma p v^2$ from 90.51 to 68.85.

II—RADIAL VELOCITIES OF TEN STARS

The stars for which observations are here given were placed on the observing programme of the writer for the past two summers as a matter of filling in. Eight stars were so taken on the first summer and four were added this year. Two of the first eight turned out to be binaries. The orbit of one binary, H.R. 5992, was completed last year and appeared as Vol. I, No. 28 of the Publications of this observatory. The orbit of the other binary, H.R. 6532, is given in the first part of this number. As the observatory does not contemplate an early publication of another list of radial velocities it has been thought advisable to include in this number the observations of the other ten stars.

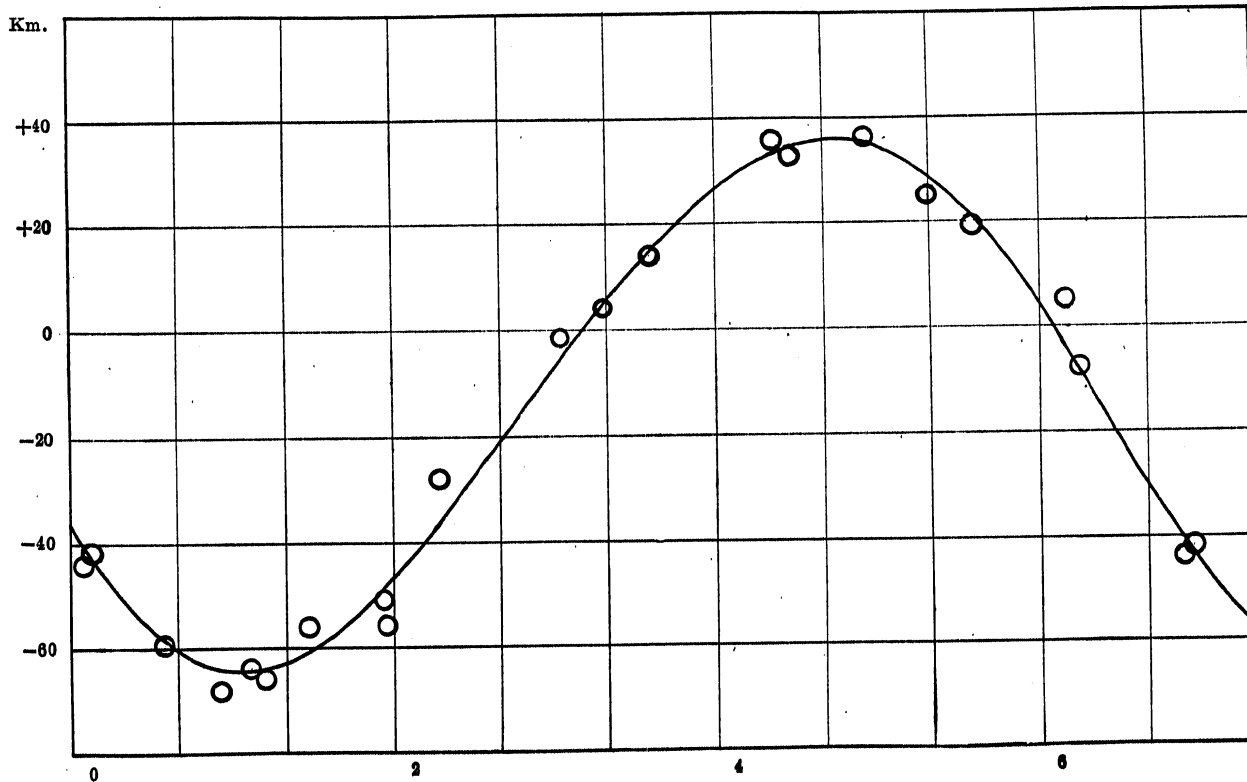
Star H.R.	Type Mag.	Date G.M.T.	Rad. Vel.	Regions Lines	Quality	Remarks
6057 16 ^h 09.3 ^m +06° 09'	G5 6.05	1922 June 28.772	-20.1	13=23	Good	A good spectrum.
		July 1.753	-19.0	13=23	"	
		" 12.770	-23.1	13=23	"	
		Aug. 6.700	-23.6	13=23	"	
			-21.5 ± 8	13=23		
6176 16 ^h 21.1 ^m +15° 42'	Aop 6.29	1921 June 11.776	+ 2.7	5	Weak	Spectrum rather diffuse.
		July 15.763	+ 2.0	8	Fair	
		" 22.772	- 7.3	8	Good	
		" 28.740	- 4.6	6	"	
		Aug. 1.734	- 3.9	8	"	
		" 8.707	+ 3.4	6	Fair	
		" 10.697	+ 3.2	6	Good	
		" 25.708	- 6.5	5	"	
		1922 June 25.741	+ 1.6	5	"	
			-1.0 ± 1.0			
6467 17 ^h 17 ^m .8 +48 17'	F2 6.32	1922 June 25.786	+31.4	1=23	Good	A good spectrum.
		" 28.799	+26.8	1=23	"	
		July 1.783	+31.1	1=23	"	
		" 23.765	+30.4	1=23	"	
			+29.9 ± 0.7			
6803 18 ^h 05 ^m .7 +16° 27'	F2 6.14	1921 July 12.774	- 9.4	4	Good	A fair spectrum, but too diffuse for measurement on the com- parator. The extreme range seems large, but even if vari- able the mean velocity will be very approximately the velo- city of the system.
		" 15.820	-17.2	4	Weak	
		" 22.824	- 7.3	6	Good	
		" 28.815	-18.6	5	"	
		Aug. 8.765	-15.5	7	"	
		" 10.753	-15.6	9	"	
		" 25.742	-12.5	6	"	
		" 28.710	-15.7	8	"	
		1922 June 25.811	- 4.3	11	"	
		July 29.786	-22.2	7	Fair	
		Aug. 24.811	-14.7	5	Weak	
			-13.9 ± 1.1			

II. RADIAL VELOCITIES OF TEN STARS—*Continued*

Star H.R.	Type Mag.	Date G.M.T.	Rad. Vel.	Regions Lines	Quality	Remarks
6820 18 ^h 09 ^m .0 +21° 51'	Ko 6.25	1922 June 25.874	-65.7	11=23	Good	A good spectrum.
		" 28.829	-70.9	15=23	"	
		July 23.823	-65.2	13=23	"	
		Aug. 26.767	-61.3	17=23	Weak	
			-66.0 ± 1.3			
6971 18 ^h 29 ^m .6 +30° 49'	B3 6.43	1921 July 3.894	-11.1	3	Fair	Most of the plates were rather under-exposed, and showed broad hydrogen and helium lines only. The K line of calcium was present on a couple of plates and on one showed a suggestion of duplicity.
		" 15.874	-14.7	6	"	
		" 22.857	-6.5	6	"	
		" 28.841	-11.7	6	"	
		Aug. 8.828	+13.6	5	"	
		" 10.797	+7.0	5	"	
		" 25.795	-0.2	4	"	
" 28.791	-5.3	4	"			
	-3.6 ± 2.3					
7008 18 ^h 34 ^m .7 +05° 10'	Gop 6.30	1921 July 22.899	-19.3	7	Fair	A fairly good spectrum but lines too diffuse for measurement on the comparator.
		Aug. 8.798	-23.7	14	"	
		" 10.775	-14.0	14	"	
		" 25.761	-21.0	5	"	
		" 28.748	-17.9	4	"	
		1922 June 28.857	-21.0	5	Weak	
		July 1.807	-19.9	9	Good	
			-19.5 ± 0.8			
7396 19 ^h 23 ^m .0 +14° 05'	A 6.26	1922 July 1.890	+21.8	4	Fair	This star is listed as A in H.A. 50 but is really B-type.
		" 12.927	+1.8	5	"	
		" 23.903	-7.0	4	"	
		" 29.855	+6.5	3	"	
		Sept. 1.760	+3.5	4	"	
	+5.3 ± 3.2					
7482 19 ^h 36 ^m .1 +20° 15'	F 6.44	1921 July 28.912	+12.4	9	Fair	This star, listed as an F-type in H.A., is really of type B. The spectrum is very good.
		Aug. 1.852	+12.9	5	Weak	
		" 8.859	+3.6	5	"	
		" 10.818	+7.1	5	Fair	
		" 25.827	-1.7	10	"	
		" 28.863	+1.6	2	Weak	
		1922 June 25.899	+3.8	9	Fair	
		July 12.906	+13.0	11	Good	
		" 23.874	+1.0	8	"	
		Aug. 6.856	+4.9	5	Fair	
	+5.9 ± 1.1					

II. RADIAL VELOCITIES OF TEN STARS—*Concluded*

Star H.R.	Type Mag.	Date G.M.T.	Rad. Vel.	Regions Lines	Quality	Remarks
7839 20 ^b 26 ^m .5 +20° 16'	A2 6.00	1921 July 22.924	-36.1	16	Good	A good spectrum.
		" 28.934	-40.9	15	"	
		Aug. 1.914	-43.8	18	"	
		" 8.884	-38.2	18	"	
		" 10.839	-39.8	16	"	
		" 25.850	-44.3	15	"	
		1922 July 1.966	-40.8	18	"	
		" 12.952	-45.2	18	"	
		" 23.927	-42.1	23	"	
				-41.2 ± 0.6		



Radial Velocity Curve of H.R. 6532

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