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A table of orbits of visual binary stars (Errata: 6 44)

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BULLETIN OF THE ASTRONOMICAL INSTITUTES OF THE NETHERLANDS.

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COMMUNICATION FROM THE OBSERVATORY AT LEIDEN.

A Table of orbits of visual binary stars, by *W. H. van den Bos.*

The following table has been computed according to the principles set forth in *Union Observatory Circular* **68.** If more orbits for a system have been published one of them has been selected, generally the most recent one. In a few cases, when no definite selection could be made, more than one set is given.

For convenience the formulae given in the *Circular* are repeated here.

Ephemeris:

$$x = \rho\cos\theta = AX + FY$$
$$y = \rho\sin\theta = BX + GY$$
$$z = CX + HY$$
$$X = \cos E - e$$
$$Y = (1-e^2)^{\frac{1}{2}}\sin E$$

Tables of X and Y ($e = 0{\cdot}01, \ldots .0{\cdot}99$; $M = 0^\circ, \ldots .180^\circ$) will be published by the Union Observatory; in the mean time ÅSTRAND's tables may be used.

Natural elements *) from Campbell elements:

$$A = a(\cos\omega\cos\Omega - \sin\omega\sin\Omega\cos i)$$
$$B = a(\cos\omega\sin\Omega + \sin\omega\cos\Omega\cos i)$$
$$F = a(-\sin\omega\cos\Omega - \cos\omega\sin\Omega\cos i)$$
$$G = a(-\sin\omega\sin\Omega + \cos\omega\cos\Omega\cos i)$$

or:

$$A + G = 2a\cos(\omega+\Omega)\cos^2\tfrac{1}{2}i$$
$$A - G = 2a\cos(\omega-\Omega)\sin^2\tfrac{1}{2}i$$
$$B - F = 2a\sin(\omega+\Omega)\cos^2\tfrac{1}{2}i$$
$$-B - F = 2a\sin(\omega-\Omega)\sin^2\tfrac{1}{2}i$$

In all formulae i is taken above 90° for retrograde motion.

$$C = a\sin\omega\sin i$$
$$H = a\cos\omega\sin i$$

*) It will be seen that the "natural" elements are the Gaussian constants, well known in the practice of planetary orbits (OPPOLZER I, p. 17—18, WATSON, p. 93), A, B, C; F, G, H above being equivalent to $\sin a\sin A'$, $\sin b\sin B'$, $\sin c\sin C'$; $\sin a\cos A'$, $\sin b\cos B'$, $\sin c\cos C'$ in GAUSS' notation.

Equations very similar to those given in the text occur in THIELE's dissertation *Undersögelse af Omlöbsbevaegelsen i Dobbelstjerne-Systemet Gamma Virginis* (1866), p. 29. (Footnote added by W. DE S.)

Campbell elements from natural elements:

$$\tan(\omega+\Omega) = \frac{B-F}{A+G} \qquad \tan(\omega-\Omega) = \frac{-B-F}{A-G}$$

$$\tan^2\tfrac{1}{2}i = \frac{A-G}{A+G}\cdot\frac{\cos(\omega+\Omega)}{\cos(\omega-\Omega)} = \frac{-B-F}{B-F}\cdot\frac{\sin(\omega+\Omega)}{\sin(\omega-\Omega)}$$

Fix the quadrants of $\omega+\Omega$ and $\omega-\Omega$ by the preceding formulae, taking $\Omega < 180^\circ$, and find the semi axis major from one of them.

a (hypothetical parallax), C and H directly:

$$2p = A^2 + B^2 + F^2 + G^2$$
$$q = AG - BF$$
$$a^2 = p + (p+q)^{\frac{1}{2}}(p-q)^{\frac{1}{2}}$$
$$C^2 = a^2 - A^2 - B^2$$
$$H^2 = a^2 - F^2 - G^2$$
$$0 = AF + BG + CH$$

Relative radial velocity:

$$\frac{dz}{dt} = L\frac{dX}{dM} + N\frac{dY}{dM} = LX' + NY'$$

$$L = \frac{4{\cdot}737}{\pi}nC \qquad N = \frac{4{\cdot}737}{\pi}nH$$

$$L = \frac{K}{\sin 1^\circ}(1-e^2)^{\frac{1}{2}}\sin\omega$$

$$N = \frac{K}{\sin 1^\circ}(1-e^2)^{\frac{1}{2}}\cos\omega$$

Differential corrections:

$$\Delta x = X\Delta A + Y\Delta F + P_x\Delta e + Q_x n\Delta T + R_x\Delta n$$
$$\Delta y = X\Delta B + Y\Delta G + P_y\Delta e + Q_y n\Delta T + R_y\Delta n$$
$$\Delta v = X'\Delta L + Y'\Delta N + P_v\Delta e + Q_v n\Delta T + R_v\Delta n + \Delta\gamma$$

where

$$P_x = A\frac{\partial X}{\partial e} + F\frac{\partial Y}{\partial e} \qquad P_y = B\frac{\partial X}{\partial e} + G\frac{\partial Y}{\partial e} \qquad P_v = L\frac{\partial X'}{\partial e} + N\frac{\partial Y'}{\partial e}$$

$$Q_x = -A\frac{\partial X}{\partial M} - F\frac{\partial Y}{\partial M} \qquad Q_y = -B\frac{\partial X}{\partial M} - G\frac{\partial Y}{\partial M} \qquad Q_v = -L\frac{\partial X'}{\partial M} - N\frac{\partial Y'}{\partial M}$$

$$R_x = -(t-T)Q_x \qquad R_y = -(t-T)Q_y \qquad R_v = -(t-T)Q_v$$

and the partial differential coefficients are taken at once from the tables for X and Y by differencing.

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If the formulae for the radial velocity are put into practice it will be more convenient to take

$$X' = \frac{1}{\sin 1^\circ}\frac{dX}{dM} \qquad Y' = \frac{1}{\sin 1^\circ}\frac{dY}{dM}$$

and to multiply the expressions for L and N by $\sin 1^\circ$. These quantities become then of the same order as K, and at the same time X' and Y' will become convenient numbers.

Differential corrections in angle and distance:

$$\rho\,\Delta\theta \sin 1^\circ = \frac{1}{\rho}(-y\Delta x + x\Delta y) = -\sin\theta\,\Delta x + \cos\theta\,\Delta y$$

$$\Delta\rho = \frac{1}{\rho}(+x\Delta x + y\Delta y) = \cos\theta\,\Delta x + \sin\theta\,\Delta y$$

The arrangement of the table is sufficiently explained by the headings. The "No" given in the first column is that of BURNHAM's *General Catalogue* or INNES's *Reference Catalogue*. The year given in the last column is in most cases that of the last measures used, but in some cases the year of publication is given.

For the sake of uniformity four decimals in the INNES elements are given throughout (except for Capella, where five had to be given), but in most cases the last, and frequently the forelast, are only a result of computation.

No / star / α_{1900} / δ_{1900}	mags / Spec	P / T	a / n	e / i	ω / Ω	A / B	F / G	Authority
12755 Σ 3062	6·5 , 7·5	105·55 y	1″·44	0·4664	98°·68	— 0″·7726	— 1″·0390	DOBERCK 1905
h m 0 1·0 + 57° 53′	G5	1941·62	3°·4107	± 46°·08	37°·42	+ 0″·6521	— 0″·9847	*A. N.* 173, 257
21 Σ 2	6·8 , 7·1	215	0·64	0·472	337·1	— 0·5923	— 0·1971	RUSSELL 1917
0 3·8 + 79 10	A3	1890·8	1·674	± 109·1	166·5	+ 0·0584	+ 0·2457	*P. A.* 25, 668
104 OΣ 4	7·9 , 8·6	120	0·41	0·580	110·9	+ 0·3497	+ 0·1691	RUSSELL 1917
0 11·5 + 35 56	Go	1907·0	3·00	± 153·8	133·6	+ 0·1311	— 0·3679	*P. A.* 25, 668
270 A 111 AB	9·6 , 9·6	10·5	0·18	0·405	30·45	— 0·0315	+ 0·1527	AITKEN 1922
0 27·0 — 5 44	G5	1919·75	34·3	± 142·15	125·5	+ 0·1682	— 0·0031	*A. S. P.* 35, 259
314 Ho 212 AB	5·6 , 6·4	6·88	0·242	0·725	66·8	— 0·0084	— 0·2091	AITKEN 1912
0 30·1 — 4 9	Go	1925·91	52·33	± 53·45	38·7	+ 0·1630	— 0·0948	*Lick P.* 12, 5
335 β 395	6·4 , 6·6	25·0	0·66	0·171	152·7	+ 0·1598	+ 0·2481	AITKEN 1911
0 32·2 — 25 19	Ko	1924·50	14·40	± 76·0	112·8	— 0·5690	— 0·2241	*Lick P.* 12, 7
374 OΣ 18	7·8 , 9·8	182·75	0·96	0·50	202·9	+ 0·1552	+ 0·8803	HUSSEY 1899
0 37·2 + 3 37	F8	1949·50	1·9699	± 21·9	78·0	— 0·9371	+ 0·1948	*Lick P.* 5, 37
426 η Cas	3·64, 7·9	507·60	12·21	0·5220	88·92	— 10·2980	+ 1.7626	DOBERCK 1908
0 43·0 + 57 17	F8	1890·03	0·70922	± 31·62	99·22	— 1·4385	— 12·0815	*A. N.* 179, 383
482 Σ 73	6·1 , 6·7	114·8	1·01	0·75	71·3	— 0·7447	+ 0·1594	BOWYER 1904
0 49·6 + 23 5	Ko	1935·3	3·136	± 45·4	112·7	+ 0·0395	— 0·9703	*Mem. R. A. S.* 56, 23
1h37 p Eri	6·00, 6·03	218.9	8·025	0·721	301·40	+ 4·1298	+ 6·8795	DAWSON 1919 (eq. 1880)
1 36·0 — 56 42	G5, G5	1806·14	1·6446	± 114·26	1·03	+ 2·8892	— 1·5945	*A. J.* 32, 144
1015 Σ 186	6·9 , 6·9	136	1·15	0·67	226·8	— 0·4221	+ 0·7649	LEWIS 1903
1 50·7 + 1 21	Go	1894·0	2·65	± 73·9	42·6	— 0·7040	+ 0·4067	*Mem. R. A. S.* 56, 48
1036 β 513	4.8 , 7·2	63·3	0·66	0·385	341·6	+ 0·1722	— 0·5358	BENNOT 1925
1 53·7 + 70 25	A3	1904·8	5·687	± 31·5	90·5	+ 0·6278	+ 0·2037	*P. A.* 33, 307
1070 γ And BC	5·4 , 6·6	55·0	0·346	0·82	201·2	+ 0·1020	— 0·1184	HUSSEY 1900
1 57·8 + 41 51	Ao	1892·0	6·545	± 103·4	113·5	— 0·3074	+ 0·0849	*Lick P.* 5, 45
1144 Σ 228	6·4 , 7·3	167·4	0·974	0·313	303·7	+ 0·2925	— 0·3923	JACKSON 1912
2 7·6 + 47 1	Fo	1894·50	2·150	± 61·3	99·7	+ 0·5983	+ 0·7550	*Grw. Cat.* 206
1471 β 524 AB	5·6 , 6·7	33·33	0·16	0·60	325·0	— 0·1401	+ 0·0318	AITKEN 1912
2 47·4 + 37 56	Fo	1928·33	10.801	± 146·5	127·1	+ 0·0584	+ 0·1391	*Lick P.* 12, 20
1761 Σ 412 AB	6·7 , 6·8	270·0	0·49	0·555	348·	— 0·1352	+ 0·3488	AITKEN 1919
3 28·5 + 24 8	A2	1917·3	1·3333	± 139·4	97·0	+ 0·4663	+ 0·1455	*Lick B.* 11, 66

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No α_{1900}	star δ_{1900}	mags Spec	P T	a n	e i	ω ☊	A B	F G	Authority
2093	OΣ 77 AB	8·1 , 8·2	51·6 y	0″·44	0·846	287·6°	+ 0″·1336	— 0″·1556	VAN DEN BOS 1919
4 9·6	+ 31° 27	F8	1943·7	6°·98	± 65°·86	104°·2	+ 0″·1711	+ 0″·3932	*B. A. N.* 1, 82
2109	40 Eri BC	8·9 ,10·8	247·92	6·8945	0·4024	326·96	— 5·6304	— 2·3986	VAN DEN BOS 1925
4 10·7	— 7 49	B9, Mdp	1848·93	1·4521	± 108·45	150·96	+ 1·7654	+ 3·4239	*B. A. N.* 3, 128
2134	OΣ 79	7·2 , 9·0	88·9	0·57	0·625	129·8	— 0·3710	+ 0·0073	AITKEN 1912
4 14·2	+ 16 17	Go	1897·8	4·049	± 56·2	66·0	— 0·2342	— 0·4826	*Lick P.* 12, 30
2154	OΣ 82	7·4 , 9·0	97·94	0·94	0·50	68·1	+ 0·5502	— 0·5572	HUSSEY 1900
4 17·1	+ 14 49	Go	1932·97	3·6755	± 120·2	39·8	— 0·1126	— 0·6938	*Lick P.* 5, 60
2159	β 774	6·6 , 6·6	100·6	0·74	0·48	278·0	+ 0·0501	— 0·7165	DAWSON 1920
4 17·4	— 25 58	Fo	1923·22	3·579	± 50·0	161·7	+ 0·4795	+ 0·1672	*A. J.* 34, 17
2187	β 1185	8·0 , 8·6	28·9	0·25	0·20	301·6	+ 0·0977	+ 0·2074	AITKEN 1921
4 20·0	+ 18 38	Go	1917·8	12·4566	± 104·35	24·3	+ 0·1020	+ 0·0580	*Lick B* 11, 70
2230	Σ 554	5·7 , 9·0	148·3	1·036	0·790	157·92	— 0·9289	— 0·4330	V. D. BOS 1921 (eq. 1925)
4 24·4	+ 15 25	Fo	1888·30	2·428	± 109·0	8·88	— 0·2735	+ 0·2487	*M. N.* 81, 476
2381	β 883	7·7 , 7·7	16·61	0·19	0·445	190·0	— 0·1365	+ 0·1311	AITKEN 1912
4 45·7	+ 10 54	F5	1907·03	21·67	± 9·35	34·2	— 0·1321	— 0·1342	*Lick P.* 12, 35
2383	β 552	6·8 ,10·0	86·0	0·56	0·51	309·6	— 0·1077	— 0·5120	AITKEN 1917
4 46·2	+ 13 29	F5	1886·35	4·186	± 39·35	145·8	+ 0·4766	+ 0·0142	*Lick B.* 11, 71
2535	OΣ 98	5·9 , 6·7	190·48	1·22	0·2465	57·30	+ 0·6068	+ 0·6308	GORE 1887
5 2·4	+ 8 22	Fo P	1959·05	1·8900	± 135·05	99·58	+ 0·7708	— 0·9347	*M. N.* 47, 266
2597	Capella	0·8 , 0·8	104·022 d	0·05360	0·0086	114·30	+ 0·00581	— 0·04852	MERRILL 1921
5 9·3	+ 45 54	Go	JD 2422596·79	3·46081	— 138·92	38·70	— 0·04253	— 0·01757	*Ap. J.* 56, 44
3291	β 895 AB	7·9 , 7·9	45·7	0·255	0·88	289·9	+ 0·1251	+ 0·2058	VAN DEN BOS 1921
6 13·6	+ 28 28	A3	1914·31	7·87	± 60·7	22·7	— 0·0752	+ 0·1316	*B. A. N.* 2, 25
3596	Sirius	—1·6, 8·4	50·04	7·570	0·5945	145·69	— 2·4886	— 6·2215	AITKEN 1918
6 40·8	— 16 35	Ao, F	1894·133	7·194	+ 136·69	42·71	— 6·5227	+ 0·4490	*Lick B* 9, 184
3876	Σ 1037	7·2 , 7·2	120·4	0·870	0·932	254·1	— 0·5422	+ 0·6177	VAN BIESBROECK 1925
7 6·7	+ 27 24	F5	1920·57	2.991	± 141·0	31·4	+ 0·4308	+ 0·5940	*M. N.* 85, 480
4122	Castor	1·99, 2·85	306·28	6·060	0·5593	278·031	— 0·5583	+ 5·2385	RABE 1920
7 28·2	+ 32 6	Ao	1954·728	1·1754	± 113·207	32·546	+ 2·4490	+ 2·9469	*A. N.* 216, 52
			477·5	6·573	0·2875	247·32	— 3·6694	+ 3·7506	DOBERCK 1921
			1960·51	0·7539	± 116·10	42·12	+ 0·2792	+ 4·8946	*A. N. Jub. Nr.* 7
4187	Procyon	0·48,13·5	39·0	4·05	0·324	36·8	— 3·9790	+ 0·5771	BOSS 1905
7 34·1	+ 5 29	F5	1925·5	9·23	± 14·2	150·7	— 0·4640	— 3·9289	*P. G. C.* 267
4310	β 101	5·8 , 6·4	23·34	0·69	0·75	74·65	— 0·1469	+ 0·0802	AITKEN 1912
7 47·2	— 13 38	Go	1892·60	15·424	± 79·8	99·7	+ 0·1602	— 0·6613	*Lick P.* 12, 51
4355	OΣ 185	7·1 , 7·3	59·6	0·350	0·611	114·9	— 0·1690	— 0·2369	JACKSON 1914
7 52·1	+ 1 24	F8	1861·16	6·04	± 74·6	35·2	— 0·0161	— 0·2150	*Grw. Cat.* 210
4414	β 581	8·7 , 8·7	44·0	0·38	0·39	292·3	+ 0·1490	— 0·2418	AITKEN 1924
7 58·8	+ 12 35	G5	1909·75	8·182	± 47·7	116·1	+ 0·2336	+ 0·2730	*Lick B.* 12, 47
4477	ζ Cnc AB *)	6·02, 6·26	57·891	0·874	0·3337	179·80	— 0·8740	— 0·0031	SCHNAUDER 1914
8 6·5	+ 17 57	Go	1928·139	6·2186	180·0	.....	— 0·0031	+ 0·8740	*Dissertation*
	C + D, C	5·56	16·92	0·162	0·039	94·5	+ 0·0928	— 0·0535	
		Go	1909·6	21·27	± 128·5	73·5	— 0·0407	— 0·1526	

*) An important perturbation term is to be added.

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No star α_{1900} δ_{1900}	mags Spec	P T	a n	e i	ω Ω	A B	F G	Authority
4771 ε Hya AB	3·7 , 5·2	15·3 y	0″23	0·65	270°0	+ 0″1433	— 0″0572	AITKEN 1912
8h 41m·5 + 6° 47	F8	1900·97	23°5	+ 49°95	104°4	+ 0″0368	+ 0″2228	*Lick P.* 12, 59
4923 σ_2 UMa	4·9 , 8·4	470	4·76	0·799	25·5	— 1·1933	+ 3·2753	RUSSELL 1919
9 1·6 + 67 32	F8	1920·2	0·766	± 127·0	121·5	+ 4·3076	— 0·3963	*P. A.* 29, 97
5005 Σ 3121	7·8 , 8·1	34·00	0·6692	0·330	127·52	— 0·4240	— 0·4176	SEE 1895
9 12·0 + 29 0	Ko	1912·30	10·588	± 75·00	28·25	— 0·0719	— 0·3441	*Ev. St. Sy.* 96
5103 ω Leo	5·9 , 6·7	116·74	0·844	0·5601	122·10	+ 0·1957	+ 0·6861	DOBERCK 1903
9 23·1 + 9 30	Go	1957·56	3·0838	± 66·20	144·28	— 0·4961	— 0·2705	*A. N.* 173, 251
9h 40 ψ Arg	3·7 , 5·7	34·90	0·914	0·37	219·2	+ 0·6062	+ 0·0912	DAWSON 1924
9 26·8 — 40 2	F5	1936·79	10·316	± 56·2	116·8	— 0·4873	+ 0·6933	*A. J.* 36, 23
5223 φ UMa	5·1 , 5·5	112·663	0·34293	0·49745	9·237	— 0·3327	— 0·0664	DICK 1920 (eq. 1925)
9 45·3 + 54 32	A2	1883·576	3·19537	± 22·861	157·890	+ 0·0804	— 0·3097	*Diss.* (Zwiers-Orbit)
5235 AC 5	5·8 , 6·1	72·76	0·41	0·60	133·1	— 0·1930	— 0·3536	SCHOENBERG 1906
9 47·6 — 7 38	A2	1953·30	4·9478	± 142·86	17·95	— 0·3134	+ 0·1202	*A. N.* 178, 189
5734 ξ UMa A+a, B	4·41, 4·87	59·8096	2·5128	0·4108	129·213	+ 1·3538	— 0·5026	NØRLUND 1905
11 12·8 + 32 6	Go	1935·576	6·01912	+ 126·608	100·698	— 1·3609	— 2·0762	*A. N.* 170, 121 *)
11h 22 Bris 3574	8·0 , 8·6	342·0	4·54	0·58	0·0	+ 0·1980	— 3·4745	DAWSON 1921
11 20·4 — 61 6	K5	1918·48	1·0526	± 40·0	87·5	+ 4·5357	+ 0·1517	*A. J.* 34, 17
5805 OΣ 234	7·4 , 7·8	84·734	0·347	0·4225	218·370	+ 0·2994	— 0·1137	RIECHERT 1922 (eq. 1925)
11 25·4 + 41 50	F5	1883·532	4·2485	± 54·075	151·628	— 0·0181	+ 0·2428	*A. N.* 219, 229
5811 OΣ 235	5·7 , 7·0	71·9	0·78	0·40	135·0	— 0·5014	+ 0·2814	AITKEN 1912
11 26·7 + 61 38	F5	1909·0	5·007	± 43·6	78·5	— 0·4608	— 0·6201	*Lick P.* 12, 72
5951 β 794	7·0 , 8·3	63·1	0·34	0·41	126·9	+ 0·0632	+ 0·3196	AITKEN 1921
11 48·3 + 74 19	F8	1911·0	5·705	± 34·5	149·7	— 0·2965	+ 0·0081	*Lick B.* 11, 77
6028 Σ 3123	7·8 , 8·0	103·3	0·32	0·49	79·1	+ 0·2033	— 0·1388	SEE 1908
12 1·0 + 69 15	F5	1860·50	3·485	± 130·3	56·9	— 0·0603	— 0·2846	*M. N.* 68, 567
6158 Σ 1639	6·6 , 7·8	361	1·00	0·9258	300·9	— 0·5054	+ 0·5368	JACKSON 1920
12 19·4 + 26 8	A5	1888·10	0·997	± 136·4	78·4	+ 0·6280	+ 0·7658	*Grw. Cat.* 212
		690	1·30	0·945	343·5	— 1·2198	+ 0·3276	RUSSELL 1917
		1891·95	0·5217	± 155·0	145·9	+ 0·4217	+ 1·1425	*P. A.* 25, 668
12h 61 γ Cen	3·1 , 3·1	203·39	1·924	0·2958	285·03	+ 0·4826	+ 1·8592	DAWSON 1919
12 36·0 — 48 25	Ao	1851·50	1·7700	± 98·22	3·35	+ 0·2944	+ 0·0374	*A. J.* 32, 162
6243 γ Vir	3·65, 3·68	182·30	3·743	0·887	260·37	— 2·5519	+ 2·4569	DOBERCK 1907
12 36·6 — 0 54	Fo, Fo	1836·42	1·9747	± 150·13	40·43	+ 2·0298	+ 2·8065	*A. N.* 177, 161
6406 · Σ 1728	5·22, 5·22	25·87	0·665	0·522	278·6	+ 0·0974	+ 0·6416	RUSSELL 1917
13 5·1 + 18 3	F5	1911·74	13·916	± 89·87	12·6	+ 0·0202	+ 0·1437	*P. A.* 25, 668
6566 Σ 1768	5·2 , 7·5	220·4	1.205	0·8562	118·6	+ 0·2217	— 0·9506	JACKSON 1919
13 33·0 + 36 48	Fo	1860·26	1·6335	± 132·6	52·8	— 0·8924	— 0·6066	*Grw. Cat.* 213
6578 β 612	6·3 , 6·3	23·05	0·225	0·52	357·95	+ 0·1896	— 0·0732	AITKEN 1912
13 34·6 + 11 15	F2	1930·27	15.618	± 50·4	33·85	+ 0·1210	+ 0·1235	*Lick P.* 12, 86
6641 Σ 1785	7·8 , 8·2	193·55	2·549	0·4602	180·5	+ 2·3408	+ 0·7713	JACKSON 1019
13 44·5 + 27 29	K2	1913·29	1·8600	± 39·4	156·3	— 1·0088	+ 1·8124	*Grw. Cat.* 214
6711 β 1270	8·6 , 8·7	38·1	0·21	0·41	24·4	— 0·1783	— 0·0936	AITKEN 1920
13 58·8 + 8 58	F5	1911·58	9·449	± 20·5	126·1	+ 0·1066	— 0·1756	*Lick B.* 11, 79

*) There is a perturbation of 1·8 years period.

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No star α_{1900} δ_{1900}	mags Spec	P T	a n	e i	ω Ω	A B	F G	Authority
6832 Σ 1834	7·9 , 8·1	295·6 y	0″93	0·823	169°2	+ 0″2988	+ 0″1797	VAN DEN BOS 1921
14h 16·6 + 48° 58	F8	1901·73	1°2179	± 82°04	110°6	— 0″8636	— 0″1185	*Proc. Amst.* 30, 72
6842 β 1111 BC	7·4 , 7·4	40·53	0·235	0·238	144·35	— 0·2094	+ 0·0017	AITKEN 1919
14 18·5 + 8 54	Ao	1918·38	8·882	± 40·8	43·95	— 0·0579	— 0·1991	*A. S. P.* 31, 286
6913 A 570	6·6 , 6·8	28·45	0·202	0·171	219·9	+ 0·1364	— 0·1478	YOUNG 1923
14 27·9 + 27 7	A2	1924·88	12·65	± 144·2	170·9	— 0·1283	— 0·1036	*A. S. P.* 35, 221
14h 59 α Cen	0·33, 1·70	80·089	17·665	0·5208	52·132	+ 8·6725	— 13·4631	FINSEN 1926
14 32·8 — 60 25	Go, K5	1875·759	4·4950	+ 79·233	25·445	+ 7·0114	— 4·1624	*U. O. C.* 68
6955 ζ Boo	4·6 , 4·6	130	0·62	0·96	180	+ 0·3902	— 0·3708	HERTZSPRUNG 1916
14 36·4 + 14 9	A2	1898·0	2·77	± 140·3	129	— 0·4819	— 0·3002	*A. N.* 203, 394
6999 Σ 1879	7·6 , 8·6	177·9	0·789	0·623	148·3	+ 0·0221	— 0·5345	JACKSON 1919
14 41·4 + 10 5	F8	1868·14	2·023	± 128·8	70·6	— 0·7195	— 0·2513	*Grw. Cat.* 215
7001 OΣ 285	7·5 , 8·0	88·5	0·33	0·553	137·7	— 0·0490	— 0·3123	JACKSON 1917
14 41·7 + 42 48	F5	1882·64	4·067	± 154·4	41·7	— 0·3119	+ 0·0166	*Grw. Cat.* 216
7034 ξ Boo	4·7 , 6·7	151·425	4·874	0·5103	23·82	— 4·0640	+ 2·6120	DOBERCK 1920
14 46·8 + 19 31	G5	1909·36	2·37741	± 139·20	168·30	+ 2·3633	+ 2·9060	*A. N.* 214, 91
7120 Σ 1909	5·2 , 6·0	204·74	3·578	0·4451	25·03	+ 1·5267	— 1·1201	DOBERCK 1909
15 0·5 + 48 3	Go	1998·22	1·7583	± 83·07	58·73	+ 2·8658	— 1·0909	*A. N.* 182, 27
7251 η Crb	5·58, 6·08	41·56	0·89	0·2721	217·98	— 0·5123	+ 0·6518	LOHSE 1906
15 19·1 + 30 39	Go	1933·829	8·662	± 58·48	25·26	— 0·5583	— 0·0980	*Pub. Potsd.* 20, 119
7259 μ_2 Boo	7·2 , 7·8	224	1·30	0·53	339·0	— 1·2291	— 0·4213	COMSTOCK 1919
15 20·7 + 37 42	Ko	1864·6	1.607	± 138·0	177·2	— 0·2865	+ 0·9236	*A. J.* 33, 144
15h 55 γ Lup	3·6 , 3·8	104·3	0·78	0·314	2·9	— 0·0191	+ 0·0269	DAWSON 1919 (eq. 1910)
15 28·5 — 40 50	B3	1905·7	3·452	± 91·9	91·5	+ 0·7788	— 0·0388	*A. J.* 32, 112
7322 OΣ 298 AB	7·4 , 7·7	56·653	0·88349	0·58360	21·899	+ 0·8142	— 0·3418	CELORIA 1887 (eq. 1888)
15 32·5 + 40 8	Ko	1939·510	6·3545	± 65·847	2·130	+ 0·1653	+ 0·3229	*A. N.* 119, 163
7368 γ CrB	4·0 , 7·0	101	0·62	0·42	125	+ 0·1934	+ 0·1358	COMSTOCK 1919
15 38·6 + 26 37	Ao	1842·7	3·564	± 98	111	— 0·3067	— 0·4919	*A. J.* 33, 168
7416 π_2 UMi	7·0 , 8·0	115	0·42	0·80	165·0	— 0·3752	— 0·1574	AITKEN 1912
15 45·1 + 80 17	F2	1902·7	3·13	± 117·75	16·3	— 0·1624	+ 0·1508	*Lick P.* 12, 100
7487 ξ Sco AB	4·77, 5·07	44·70	0·72	0·75	343·6	+ 0·6955	— 0·0951	AITKEN 1912
15 58·9 — 11 6	F8	1905·39	8·054	± 29·1	27·2	+ 0·1577	+ 0·6297	*Lick P.* 12, 103
7561 Σ 2026	9·0 , 9·5	215·0	1·53	0·695	7·2	— 1·5144	+ 0·2164	COMSTOCK 1917
16 11·1 + 7 37	K5	1908·07	1·677	± 135·9	178·7	+ 0·1721	+ 1·0854	*A. J.* 31, 35
7642 Σ 2052	7·8 , 7·8	317·5	2·87	0·77	114·5	+ 0·7393	— 0·1663	JACKSON 1920
16 24·5 + 18 37	Ko	1920·21	1·134	± 105·0	93·1	— 1·1519	— 2·6244	*Grw. Cat.* 218
7649 λ Oph	4·0 , 6·1	110·3	1·328	0·86	96·7	— 0·6894	+ 0·5383	JACKSON 1919
16 25·9 + 2 12	Ao	1927·4	3·264	± 53·2	110·0	— 0·4158	— 1·2076	*Grw. Cat.* 219
7717 ξ Her	3·0 , 6·5	34·46	1·35	0·458	113·3	+ 0·3248	— 1·0529	COMSTOCK 1916
16 37·5 + 31 47	Go	1933·23	10·447	± 132·5	51·6	— 0·9388	— 0·7476	*A. J.* 30, 145
7748 D 15	8·7 , 9·0	126·1	0·935	0·435	147·0	+ 0·7996	+ 0·2101	JACKSON 1919
16 40·8 + 43 40	K5	1894·52	2·855	± 120·7	147·1	— 0·2076	— 0·6127	*Grw. Cat.* 220
7783 Σ 2107	6·8 , 8·3	221·95	0·853	0·522	123·5	+ 0·4663	+ 0·7135	RABE 1912
16 47·9 + 28 50	F5	1896·64	1·6215	± 23·35	179·6	— 0·6562	+ 0·4287	*A. N.* 198, 116
13364 Hu 1176	6·1 , 6·1	15·5	0·16	0·14	308·4	— 0·0715	+ 0·0538	AITKEN 1921
17 4·5 + 36 4	A5	1919·9	23·226	± 124·0	90·8	+ 0·0984	+ 0·1262	*Lick B.* 11, 83

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No α_{1900} h m	star δ_{1900} °	mags Spec	P T	a n	e i	ω ☊	A B	F G	Authority
17 31	Brisb.	5·6 , 8·4	y 100·9	″ 3·503	0·1675	° 315·21	— 2″3485	— 2″5901	VAN DEN BOS 1923
17 11·4	— 46 32	Ko	1912·61	° 3·568	± 48°80	175°44	+ 1″8181	— 1″4360	*B. A. N.* 2, 29 *)
7929	Melb. 4 AB	6·0 , 8·5	42·2	1·83	0·551	64·0	+ 0·2830	+ 1·4522	VOÛTE 1924
17 12·2	— 34 53	K2	1891·48	8·53	± 129·6	130·2	+ 1·2895	— 0·9262	*B. A. N.* 2, 181
8038	Σ 2173	5·9 , 6·2	46·0	1·06	0·18	322·2	— 0·7971	— 0·5228	AITKEN 1912
17 25·2	— 0 59	G5	1915·2	7·83	± 99·25	153·7	+ 0·2775	+ 0·4086	*Lick P.* 12, 116
8099	β 962	5·3 , 9·3	111	1·56	0·23	65·5	— 0·3376	+ 1·3844	RUSSELL 1917
17 34·0	+ 61 57	F8	1893·3	3·24	± 112·8	153·8	+ 0·7792	— 0·4018	*P. A.* 25, 668
8162	μ Her BC	10·0 ,10·5	43·23	1·30	0·20	182·0	— 0·6159	+ 0·5344	AITKEN 1912
17 42·6	+ 27 47	Mb	1923·43	8·328	± 63·15	60·8	— 1·1441	— 0·2467	*Lick P.* 12, 119
8303	τ Oph	5·34, 6·04	223·82	1·307	0·5338	17·75	+ 0·1400	— 0·5854	DOBERCK 1904
17 57·6	— 8 11	Fo	1814·79	1·6084	± 66·07	76.20	+ 1·2474	— 0·2665	*A. N.* 170, 102
17h 129	h 5014	5·77, 5·77	153·96	1·114	0·480	180·0	— 0·6743	— 0·6025	DAWSON 1924
17 59·6	— 43 26	A3	1839·68	2·3383	± 132·8	52·75	— 0·8867	+ 0·4581	*Unpublished orbit I*
			180·09	1·146	0·485	202·5	— 0·8071	— 0·4698	*Orbit II*
			1841·94	2·0000	± 138·2	60·41	— 0·7592	+ 0·7711	
			214·44	1·208	0·520	219·0	— 0·9512	— 0·3884	*Orbit III*
			1843·83	1·6788	± 144·8	65·82	— 0·6020	+ 1·0077	
8340	Σ 2272	4·1 , 6·1	87·710	4·495	0·49873	193·352	+ 1·8737	— 2·4735	PAVEL 1920
18 0·4	+ 2 31	Ko	1895·965	4·10443	— 121·257	122·184	— 3·9884	— 0·3302	*A. N.* 212, 350
8353	OΣ 341	7·3 , 8·2	19·75	0·30	0·96	149·0	+ 0·0027	+ 0·0766	AITKEN 1920
18 1·6	+ 21 26	Go	1917·85	18·2275	± 77·5	98·0	— 0·2593	— 0·1453	*Lick B.* 11, 85
8372	*A.C.* 15	5·2 , 9·7	53·51	1·11	0·763	93·7	— 0·8582	— 0·2324	LOHSE 1906
18 3·2	+ 30 33	F8	1941·35	6·728	± 38·3	75·0	+ 0·1558	— 1·0845	*P. Potsd.* 20, 159
8380	Σ 2281	5·8 , 7·3	423·5	1·33	0·70	299·9	— 0·0914	+ 0·5495	JACKSON 1919
18 4·6	+ 3 59	F2	1910·0	0·8501	± 106·3	71·1	+ 0·7321	+ 1·0305	*Grw. Cat.* 223
			220·0	1·02	0·550	324·9	+ 0·0993	+ 0·3358	RUSSELL 1917
			1913·5	1·6364	± 102.8	74·4	+ 0·8387	+ 0·5152	*P. A.* 25, 668
8679	A 88	7·2 , 7·2	12·12	0·176	0·273	270·0	— 0·0034	+ 0·1758	AITKEN 1912
18 33·2	— 3 17	F8	1922·22	29·70	+ 117·6	2·4	+ 0·0815	+ 0·0074	*Lick P.* 12, 129
8933	β 648	5·2 , 8·7	57·0	1·24	0·20	285·7	— 0·1434	+ 0·9022	GUSHEE 1925
18 53·3	+ 32 46	Go	1911·2	6·32	± 114·5	48·0	+ 0·5806	+ 0·7940	*P. A.* 33, 309
8966	Σ 2438	6·7 , 7·3	233·0	0·53	0·916	181·7	— 0·5298	+ 0·0157	SEE 1908
18 55·8	+ 58 5	A2	1882·50	1·5451	180·0	.....	+ 0·0157	+ 0·5298	*M. N.* 68, 568
8965	ζ Sgr	3·4 , 3·6	21·17	0·565	0·185	1·4	+ 0·1461	+ 0·1889	AITKEN 1900
18 56·2	— 30 1	A2	1921·54	17·005	± 110·6	75·5	+ 0·5456	— 0·0631	*Lick P.* 12 135
18h 113	γ CrA	5·01, 5·01	124·65	2·14	0·3321	169·55	— 0·9879	— 1·6667	DOBERCK 1909
18 59·7	— 37 12	F8	1878·46	2·8881	± 148·10	53·47	— 1·8872	+ 0·7516	*A. N.* 191, 125
9114	SE 2 BC	8·9 , 8·9	58	0·40	0·50	180	0·0000	— 0·1498	RUSSEL 1911
19 7·8	+ 38 37	G5	1894·0	6·2	± 112	90	— 0·4000	0·0000	*Lick P.* 12, 138
9319	Σ 2525	8·4 , 8·6	354·9	1·205	0·933	266·6	— 0·0881	+ 1·2017	JACKSON 1920
19 22·5	+ 27 7	F8	1887·31	1·014	± 142·5	1·0	+ 0·9529	+ 0·0777	*Grw. Cat.* 224

*) The Campbell elements given in *B. A. N.* 2, 29 are erroneous, but the apparent elements, formulae for ephemeris and ephemeris are correct. The sum of the masses with VOÛTE's parallax becomes 0·61 ⊙; a parallax of 0″·161 would give 1 ⊙.

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No α_{1900}	star δ_{1900}	mags Spec	P T	a n	e i	ω ☊	A B	F G	Authority
9605	δ Cyg	3·0 , 7·9	321·0 y	2″12	0·188	201·0°	— 0″5825	— 1″3007	JACKSON 1914
h m 19 41·8	° + 44 53	Ao	1941·6	1°122	± 132·2°	87·9°	— 1″9592	+ 0″8080	*Grw. Cat.* 225
9643	ζ Sge	5·2 , 6·2	25·20	0·32	0·85	65·0	+ 0·1396	— 0·2868	VAN BIESBROECK 1916
19 44·5	+ 18 53	A2	1914·11	14·286	± 101·9	4·6	— 0·0500	— 0·0511	*A. J.* 29, 164
9650	OΣ 387	7·0 , 8·0	128·0	0·566	0·179	305·0	— 0·4301	— 0·2743	JACKSON 1920
19 45·0	+ 35 4	F5	1946·7	2·813	± 128·5	146·4	— 0·0607	+ 0·4249	*Grw. Cat.* 226
9739	Ho 581	8·0 , 8·3	24·445	0·286	0·528	270·9	+ 0·0535	+ 0·2781	VAN BIESBROECK 1918
19 51·6	+ 41 36	Ko	1911·528	14·737	± 39·2	12·8	— 0·2151	+ 0·0668	*A.J.* 31, 169
9979	OΣ 400	7·5 , 8·5	84·4	0·428	0·48	340·6	— 0·3649	— 0·0050	MEIER 1922 (eq. 1925)
20 6·9	+ 43 39	G5	1885·1	4·263	± 117·5	143·9	+ 0·1848	+ 0·2344	*A. N.* 219, 232
10363	β Del	4·0 , 5·0	26·79	0·480	0·350	351·20	— 0·4733	— 0·0790	AITKEN 1912
20 32·9	+ 14 15	F5	1936·62	13·438	± 62·25	178·55	+ 0·0462	— 0·2189	*Lick P.* 12, 150
10559	Σ 2729	6·2 , 7·5	151·7	0·695	0·375	59·7	— 0·3915	+ 0·5580	JACKSON 1918
20 46·1	— 6 0	F2	1897·22	2·374	± 67·4	167·8	— 0·1513	— 0·2585	*Grw. Cat.* 227
10643	ε Equ	5·8 , 6·3	97·4	0·61	0·72	0·0	— 0·1763	+ 0·0458	RUSSELL 1916
20 54·1	+ 3 55	F5	1922·2	3·696	± 94·5	106·8	+ 0·5840	+ 0·0138	*A.J.* 30, 125
10829	δ Equ	5·3 , 5·4	5·70	0·27	0·39	164·5	— 0·2389	— 0·0819	AITKEN 1912
21 9·6	+ 9 36	F5	1924·15	63·2	± 99·0	21·0	— 0·1038	+ 0·0121	*Lick P.* 12, 158
10846	τ Cyg	3·8 , 8·0	47·0	0·91	0·22	105·5	+ 0·5344	+ 0·6680	AITKEN 1912
21 10·8	+ 37 37	Fo	1936·60	7·66	± 137·3	149·8	+ 0·4346	— 0·5956	*Lick P.* 12, 161
11125	24 Aqr	7·33, 7·83	71·00	0·659	0·893	275·87	+ 0·0835	— 0·5657	KUIPER 1923
21 34·4	— 0 30	F8	1922·94	5·070	± 66·78	147·19	+ 0·2540	+ 0·3331	*B. A. N.* 3, 147
11222	$\varkappa$ Peg AB	5·0 , 5·1	11·35	0·29	0·49	106·1	+ 0·0834	+ 0·0752	BURNHAM, LEWIS 1905
21 40·1	+ 25 11	F5	1920·5	31·72	± 102·5	109·2	— 0·0561	— 0·2689	*Mem. R. A. S.* 56, 653
11761	Kr 60 AB	9·3 ,10·8	44·27	2·46	0·38	171·0	+ 1·2971	— 1·8430	AITKEN 1924
22 24·5	+ 57 12	Ma	1925·82	8·1319	± 154·0	113·8	— 2·0837	— 1·2335	*Lick B.* 12, 45
11763	Σ 2912	5·6 , 7·0	136	0·72	0·534	180·0	+ 0·3269	+ 0·0604	VAN DEN BOS 1921
22 24·9	+ 3 55	F5	1905·0	2·65	± 84·6	117·0	— 0·6415	+ 0·0308	*B. A. N.* 3, 127
12143	A 417	6·3 , 6·3	23·82	0·245	0·404	261·3	+ 0·0149	+ 0·2327	AITKEN 1918
22 59·9	— 8 14	Fo	1917·68	15·113	± 56·35	21·6	— 0·1384	+ 0·0701	*Lick B.* 9, 191
12290	β 80	8·8 , 8·9	95·2	0·72	0·77	98·0	— 0·1705	— 0·6989	AITKEN 1916
23 13·8	+ 4 52	Ko	1905·0	3·782	± 22·95	6·2	+ 0·6419	— 0·1687	*A. S. P.* 28, 122
			85·7	0·79	0·773	288·9	— 0·1984	— 0·7627	JACKSON 1919
			1904·69	4·201	± 43·0	174·1	+ 0·5700	— 0·1093	*Grw. Cat.* 228
42 404	β 1266	8·0 , 8·1	40	0·22	0·33	133	— 0·0268	— 0·1840	AITKEN 1923
23 25·5	+ 30 17	F5	1909·8	9·0	± 132	46	— 0.1827	— 0·0460	*Lick B.* 11, 97
12696	Hdn 60	9·1 , 9·5	40·76	0·50	0·35	245·8	— 0·0386	— 0·2839	JACKSON 1914
23 56·3	+ 39 3	G5	1915·42	8·832	± 110·3	119·1	— 0·2560	+ 0·3639	*Grw. Cat.* 229
12701	β 733 AB	5·85,11·0	26·3	0·82	0·46	266·12	+ 0·4671	— 0·3238	BOWYER, FURNER 1904
23 56·9	+ 26 33	Go	1936·1	13·69	± 53·08	115·63	+ 0·1625	+ 0.7520	*M. N.* 66, 423

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