Remark on the mean sidereal period of the eclipsing variable with orbital eccentricity V 523 Sagittarii

Kort, J.J.M.A. de

TABLE 3 (*continued*)

6406·5403 6427·4543 incl 164s	168s	6427·4615 6441·4452 incl 164s	168s	6441·4523 6459·4080 incl 164s	168s	6459·4151 6469·3895 incl 164s	168s	6470·3346 7894·4415 incl 164s	168s	7894·4488 7912·4275 incl 164s	168s	7912·4344 7971·2725 incl 164s	168s	7543·0467 7988·0469 incl 164s	168s
3·86	4·94	3·82	5·07	3·78	5·39	3·76	5·16	3·91	—	3·86	5·11	4·06	5·11	4·16	—
3·83	4·97	3·85	5·15	3·80	5·14	3·82	5·06	3·84	5·17	3·82	5·23	3·97	5·53	4·10	5·05
3·81	5·10	3·79	5·16	3·77	5·31	3·77	5·17	3·87	5·18	3·86	5·28	3·99	5·46	4·12	5·26
3·81	5·47	3·89	5·15	3·76	5·25	3·68	5·08	3·88	5·23	3·82	5·24	3·98	5·41	4·11	5·16
3·80	5·43	3·91	5·20	3·72	5·31	3·77	5·15	3·91	—	3·85	5·19	3·98	5·41	4·16	—
3·85	5·57	3·85	5·24	3·81	5·24	3·73	5·20	3·86	5·30	—	—	3·97	5·44	4·14	5·57
—	—	3·89	5·17	3·79	—	3·73	5·19	3·86	5·35	3·83	5·40	4·06	5·50	—	—
3·82	5·52	3·88	5·16	3·79	5·38	3·70	5·22	3·87	5·33	3·81	5·51	4·02	5·46	—	—
3·83	5·37	3·86	5·25	3·75	5·38	3·80	5·32	3·90	5·32	3·84	5·53	3·96	—	4·16	5·07
3·86	5·47	3·90	5·22	3·72	5·30:	3·68	5·36	3·85	5·43	3·81	5·50	4·04	5·09	4·00	5·04
3·79	5·47	3·87	5·12	3·71	—	3·71	5·29	3·87	5·24	—	5·30	4·00	5·08	4·21	5·38
3·79	5·46	3·82	5·23	3·74	5·46	3·70	5·42	3·81	5·35	3·83	5·52	4·01	5·14	4·20	5·35
3·83	5·57	3·78	5·39	3·83	5·45	3·71	5·44	3·82	5·45	3·82	5·23:	4·01	5·12	4·22	5·31
3·74	5·14	3·78	5·33	3·74	5·43	3·72	—	3·86	—	3·75	5·47	3·93	5·48	4·21	5·25
3·73	5·16	3·81	5·36	3·76	5·40	3·69	5·32	3·89	5·41	3·74	5·37	3·96	5·57		
3·73	5·19	3·98	5·40	3·79	5·48	3·77	5·38	3·88	—	3·82	5·53	3·92	5·53		
3·74	5·10	3·88	5·37	3·76	5·34	3·76	5·45	3·87	5·46	3·82	5·30	3·97	—		
3·76	4·99	3·90	5·39	3·79	5·41	3·81	5·36	3·90	5·34	3·79	5·39	3·95	5·05		
3·79	5·02	3·89	5·47	3·78	5·39	3·78	5·47	3·92	5·45	3·77	5·28	3·91	5·01		
3·74	4·95	3·87	5·40	3·79	5·41	3·78	5·40	3·91	5·49	3·80	5·22	3·91	5·01		
3·75	5·10	3·87	5·46	—	—	3·81	5·40	3·92	5·48	3·88	5·06	3·93	5·06		
3·75	—	—	5·30	3·76	5·46	3·71	5·17	3·88	5·51	3·83	4·98	3·90	5·05		
3·73	4·89	3·98	5·54	3·77	5·56	3·72	5·34	3·85	5·52	3·73	4·95	3·85	5·14		
3·75	5·07	3·87	5·45	3·73	5·41	3·75	5·13	3·85	5·60	3·83	4·93	3·82	4·94		
—	—	3·86	5·46	3·71	5·46	3·78	5·06	3·85	5·41	3·70	5·04	3·93	5·23		
—	—	3·88	5·52	3·74	5·44:	3·75	5·05	3·93	5·39	3·81	4·96	3·91	5·24		
3·79	—	3·92	5·45	3·78	5·37	3·84	5·21	3·88	5·37	3·79	4·96	3·92	5·24		
3·73	5·14	3·91	5·45	3·74	5·23	3·85	5·08	—	—	3·78	4·95	3·94	5·30		
3·78	5·11	3·93	5·30	3·76	5·20	3·79	5·06	3·95	5·11	3·71	4·96	3·92	5·28		
3·80	5·22	3·93	5·35	3·80	5·21	3·82	5·02	—	—	3·80	5·01	3·92	5·28		
3·71	5·17	3·94	5·35	3·74	5·19	3·85	5·11	4·00	5·05	3·89	5·12	3·93	5·28		
3·75	—	3·87	5·37	3·78	4·95	3·81	5·08	3·99	5·14	3·79	5·11	3·90	5·32		
3·74	5·17	3·95	5·22	3·74	5·08	3·78	5·04	3·96	5·06	3·82	5·24	3·92	5·48		
3·75	5·12	3·93	5·33	3·72	5·12	3·81	5·07	3·92	5·13	3·84	5·22	3·90	5·29		
3·70	5·20	3·89	5·03	—	4·90	3·80	5·03	3·97	5·24	3·83	5·25	3·93	5·40		
3·79	5·19	3·92	5·13	3·80	5·00	3·82	4·99	3·97	5·19	3·84	5·29	3·92	5·44		
3·75	5·22	3·93	5·03	3·71	4·94	3·77	5·00	3·96	5·32	3·85	5·23	3·94	5·42		
3·83	5·26	3·91	5·00	3·78	4·98	3·80	5·00	4·00	5·23	3·78	5·18	3·90	5·38		
3·80	5·26	3·88	4·96	3·79	4·98	3·83	4·94	3·96	—	3·83	5·20	3·89	5·46		
3·79	5·38	3·90	5·03	3·79	4·97	3·79	4·96	3·99	5·49	—	—	3·90	5·52		
3·78	5·18	3·86	5·02	3·75	4·87	3·76	4·96	3·98	5·30	3·80	5·33	3·89	5·43		
3·79	5·31	3·90	4·97	3·74	4·97	3·78	4·97								

Remark on the mean sidereal period of the eclipsing variable with orbital eccentricity V 523 Sagittarii, by *J. de Kort.*

1. The two minima of an eclipsing variable have approximately linear ephemerides, even in the case of a marked speed of revolution of the apsides, at the times when the minor axis of the orbit is perpendicular to the line of sight.

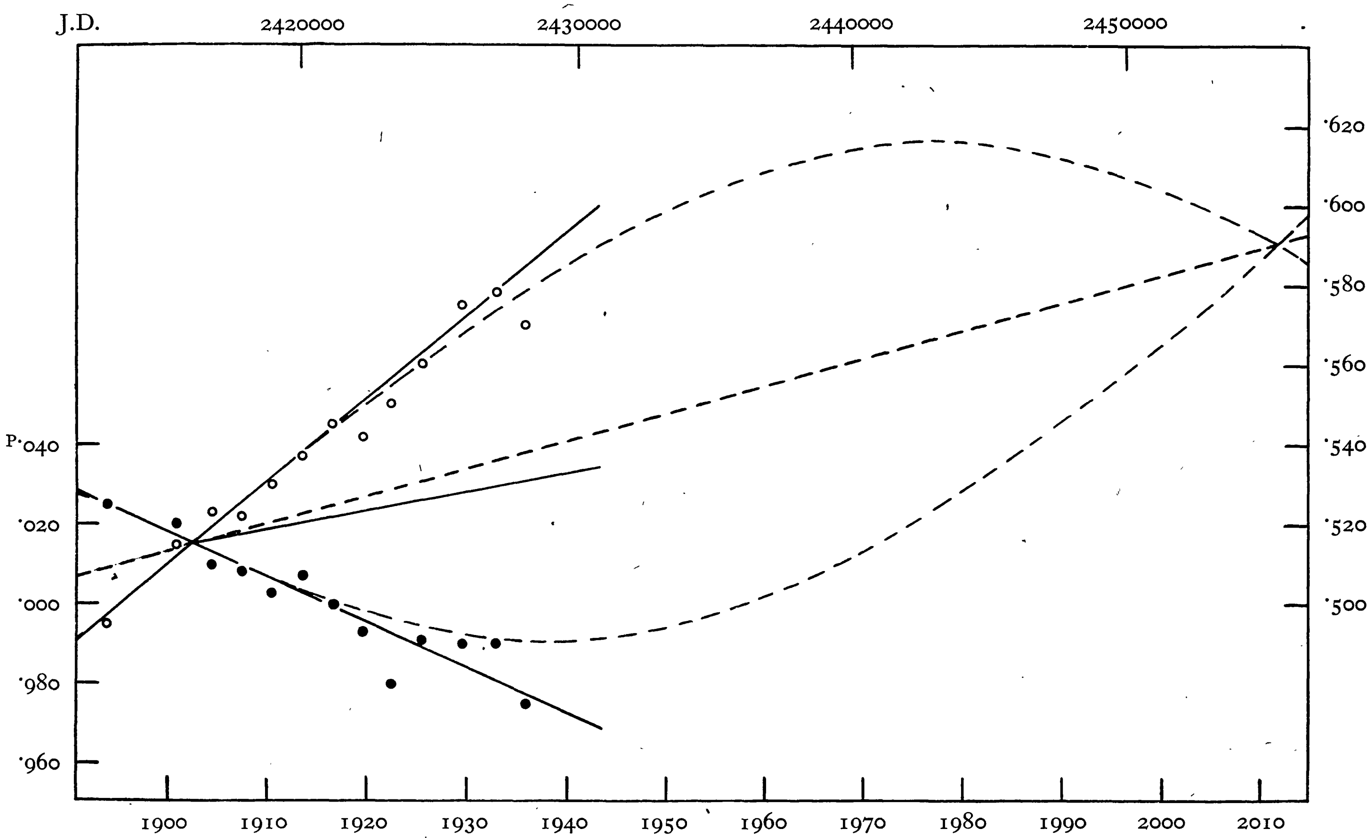
If $i = 90°$ and if the apsides advance, the two periods of the periastron and the apastron eclipse respectively are

$$\left(N - \frac{1 - e}{1 + e}\sqrt{1 - e^2}\right)\frac{P}{N - 1} \quad \text{and} \quad \left(N - \frac{1 + e}{1 - e}\sqrt{1 - e^2}\right)\frac{P}{N - 1}.$$

Here e is the eccentricity, NP the period of revolution of the apsides and N the number of sidereal orbital revolutions, per revolution of the apsides, so that P is the mean sidereal period of orbital revolution.

The two periods differ by $4Pe/(N-1)\sqrt{1-e^2}$ and their arithmetical mean is $(N - (1+e^2)/\sqrt{1-e^2})\,P/(N-1)$ or, approximately, $P\,(1 - 3e^2/2N)$.

2. As the term $3e^2/2N$, which is omitted in the discussion of V 523 Sgr in *H.B.* No. 909, 10 (1938), is somewhat larger than the relative uncertainty of the period, the observations published there will now be shortly discussed anew.



Abscissa: time of observation. Ordinate: phase as given in *H.B.* No. 909.

I used the seven first [1]) entries of Table I l.c. for a determination of the periods of the two minima. They are $2^{d}{\cdot}3238374 \pm {}^{d}{\cdot}0000018$ (m.e.) [2]) and $2^{d}{\cdot}3237899 \pm {}^{d}{\cdot}0000016$ (m.e.) with the difference ${}^{d}{\cdot}0000475 \pm {}^{d}{\cdot}0000024$ (m.e.) and the mean value $2^{d}{\cdot}3238138 \pm {\cdot}0000012$ (m.e.).

We then have the two following relations:

$$4\,P\,e\,/\,(N-1)\,\sqrt{1-e^2} = {}^{d}{\cdot}0000475, \qquad (1)$$

mean sidereal period = arithmetical mean period $+\ 3e^2\,P/2\,N$. (2)

Thus, if we assume e.g. $e = {\cdot}17$, we find $N = 33600$, a period of revolution of the apsides of 214 years and a correction mean sidereal period *minus* arithmetical mean period of $+\ {}^{d}{\cdot}0000031$, the mean sidereal period being $2^{d}{\cdot}3238169$.

In the accompanying diagram the ephemerides of the minima have been graphically represented according to this assumption.

For the case of regressing apsides the corresponding expressions can be deduced from those given above by reversion of the sign of N. The mean sidereal period, in that case, becomes $2^{d}{\cdot}3238107$.

A difference in width of the minima is not distinctly shown by the observations. On purpose no additional information has been taken from the observed widths.

It is shown by the diagram, that, apart from a small influence of the inclination [3]), the period of the apsides cannot be much shorter than the present value. In virtue of the relations (1) and (2) neither e nor the difference between mean sidereal period and arithmetical mean period will, therefore, be smaller than they are found here.

$N\,P = 214$ years and $e = {\cdot}17$ may thus be considered as inferior limits of the apsidal period and the eccentricity of V 523 Sgr [4]).

---

[1]) These eclipses have taken place close to the apsides, so that we may rely upon the linearity of their ephemerides.

[2]) The phases given in Table I and Figure 1, *H.B.* l.c. seem to have been computed with the reciprocal period ${}^{d-1}{\cdot}4303284$ instead of with ${}^{d-1}{\cdot}4303282$, which is noted in the text. The modified, larger, value, which removes a slight inconsistency in the quoted article and is, moreover, in better accordance with FERWERDA's epoch (*B.A.N.* No. 256, 65, 1934), is adopted here. The difference is of no importance, however, to our main argument, as a correction $+\ {}^{d}{\cdot}00000108$ applied to the orbital periods will account for a change from ${}^{d-1}{\cdot}4303284$ back into ${}^{d-1}{\cdot}4303282$.

[3]) It can be verified that over the interval of apsidal motion which is now considered the influence of the inclination is sufficiently accounted for, if e is replaced by $e\,(1 + \frac{1}{2}\,\mathrm{cotg}^2\,i)$. See e.g. J. STEIN S.J. „Die veränderlichen Sterne II", *Spec. Astr. Vat.* **6** (1924) p. 213–215.

[4]) After the completion of this remark it was noticed that RUSSELL (*Ap. J.* **90**, 651, 1939), taking account of the observed shapes of the minima, adopts $e = {\cdot}17$. The times of the minima suggest a somewhat higher value.

K 1278