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COMMUNICATION FROM THE OBSERVATORY AT LEIDEN

PHOTOELECTRIC OBSERVATIONS OF RR LYRAE,

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In 1947, 3038 photoelectric observations were made of RR Lyrae. These enabled us to study the changes that take place in the light-curve during the 41-day secondary period. It appeared that the variation is more complicated and that, besides the 41-day period, another period exists, about 3 times longer.

If the phase shift $\Delta\varphi$, for a point on the rising branch where Δm equals $-{}^{\rm m}{\cdot}300$, is the decimal fraction of E in PRAGER's elements: J.D. $2414856^{\rm d}{\cdot}408 + {}^{\rm d}{\cdot}56683735\ E$, it may be represented by the formula:

$$\Delta\varphi = {}^{\rm P}{\cdot}2908 - {}^{\rm P}{\cdot}000037\, t - {}^{\rm P}{\cdot}0173 \sin\frac{2\pi}{P_k}\, t - {}^{\rm P}{\cdot}0060 \cos\frac{2\pi}{P_k}\, t - {}^{\rm P}{\cdot}0060 \sin\frac{2\pi}{P_{k'}}\, t + {}^{\rm P}{\cdot}0024 \cos\frac{2\pi}{P_{k'}}\, t,$$

where the values $72^{\rm P}{\cdot}37$ and $108^{\rm P}{\cdot}55$ have been assumed for P_k and $P_{k'}$, respectively. From this formula it appears that the mean phase shift differs ${}^{\rm P}{\cdot}199$ from the value found by extrapolating BALAZS and DETRE's formula. The phase in the secondary period agrees with that given by BALAZS and DETRE.

Both periods P_k and $P_{k'}$ show themselves also in the variation of the shape of the light-curve.

At the phase in the secondary period P_k where the ascending branch of the light-curve is most retarded, it shows a flexure, which was hitherto masked by observational errors. At this same phase Dr STRUVE found some interesting features in the spectrum.

The observations of RR Lyrae were started in order to obtain the exact phase of light variation at the time of Dr STRUVE's observations of the radial velocity at the McDonald Observatory. The previous photometric observations, collected and extensively discussed by BALAZS and DETRE [1]), do not permit a reliable prediction of this phase as a consequence of the secondary period and other peculiarities of the light variation.

The Observations.

In March 1947 a provisional photoelectric equipment with a 1P21 RCA multiplier was attached to the 19″ reflector of the Leiden Observatory and its performance was sufficiently good to justify the start of the RR Lyrae programme. Some technical data of the instrument follow. Both primary mirror and Newton secondary of the reflector are aluminized, the aperture and focal length are 19 and 100 inch. The mounting is of the fork type, permitting quick and easy manipulation. At the Newton focus a diaphragm with a diameter of ·04 inch was placed. A guider telescope provided with crosswired eye piece, attached parallel to the tube of the reflector, permitted exact centring of the star on the diaphragm. After the light has passed the diaphragm it is projected by a simple cylindrical lens onto the cathode of the phototube as an elongated spot. The multiplier phototube was fed by 90-Volt batteries, one for each of the dynodes, and a 50-Volt battery for the anode circuit which included the galvanometer. This is a Leeds and Northrup type R 2500-g galvanometer having a sensitivity of 5×10^{-10} Ampère per millimetre for a scale distance of 1 metre. No colour filters were used and a large wavelength interval was active. In order to find the effective wavelength some stars with different colours were measured. These were selected from the list of SEARES, Ross and JOYNER [1]).

In Table 1 some data about these stars are reproduced from this list. The sixth column of the table contains measured magnitudes m_{pe}, with arbitrary zero point. Their internal mean error is $\pm\ {}^{\rm m}{\cdot}004$. By least squares the equations of the type

$$m_{pe} = a + b\, m_{pg} + c\, m_{pv}$$

were solved and the result was:

$$m_{pe} = -{}^{\rm m}{\cdot}622 + {\cdot}632\, m_{pg} + {\cdot}434\, m_{pv}.$$
$$\pm\ 160 \pm\ 20\ \ \pm\ 17$$

In the seventh column of Table 1 the computed magnitudes are given; the last column contains the residuals $O - C$. It appears therefore that the colour response of the instrument was intermediary between

[1]) *Mitteilungen der Sternwarte Budapest-Svábhegy*, No. 17, 1943.

[1]) 'Magnitudes and Colors of Stars North of + 80°'. F. H. SEARES, F. E. ROSS and M. C. JOYNER, Washington 1941.

photographic and photovisual. A similar colour sensitivity was found for other multiplier tubes. This result is at variance with KRON's, who found a photographic or even more violet response.

TABLE 1

BD	α (1900)	δ (1900)	m_{pg}	m_{pv}	$m_{pe}(O)$	$m_{pe}(C)$	O–C
°	h m	° ′					
83 91	3 33·7	83 14	7·51	7·68	7·485	7·463	+ ·022
80 55	1 38·8	80 23	7·00	7·10	6·866	6·889	− ·023
80 57	1 39·8	80 53	7·47	7·47	7·310	7·347	− ·037
80 65	1 57·9	81 0	7·00	6·84	6·784	6·776	+ ·008
81 13	0 32·2	81 56	6·88	6·39	6·531	6·504	+ ·027
82 76	2 54·3	82 31	7·93	7·04	7·476	7·451	+ ·025
82 51	2 1·4	83 6	7·35	6·44	6·848	6·823	+ ·025
80 58	1 44·6	80 25	8·26	7·02	7·630	7·651	− ·021
80 86	2 33·4	81 2	7·07	5·82	6·362	6·377	− ·015
83 56	2 20·3	83 23	7·98	6·62	7·290	7·300	− ·010

Most of the observations were made while the author operated the telescope and Mrs WALRAVEN read the galvanometer deflections. At some nights the observations were made by Dr P. TH. OOSTERHOFF and by Mr H. G. VAN BUEREN. The total number of observations of RR Lyrae during 1947 is 3038. Each observation consists of four readings of the deflection while the star was centred on the diaphragm, preceded and followed by two readings of the sky brightness, and the same for a comparison star. In this way, working intensely, the variable could be observed every two minutes. The readings of star and sky were registered with opposite sign on a printing adding machine, which then directly gave the intensity of the star.

TABLE 2

Star	Name	α (1947)	δ (1947)	m_{vis}	Sp.
		h m			
var.	RR Lyrae	19 23·8	42°41′	—	—
a	HD 183125	19 24·4	42 13	7·67	A2
b	HD 183383	19 25·7	42 7	7·38	B9
c	HD 182487	19 21·9	42 52	6·89	A0

Some data about the comparison stars are given in Table 2. In general two of the comparison stars, *a* and *b*, were used; when the variable was bright, *c* was also included. The reduction consisted in computing the difference in magnitude between variable and comparison star *a* in the following way. First, the mean of the difference between *a* and *b*, or *a* and *c*, was determined for each night, and this value was used to reduce the observed magnitude of star *b*, or of star *c*, to an indirect magnitude of star *a*.

Then the difference between variable and star *a* was computed, the indirect values for *a* being included. In deriving these differences an observed brightness was always compared to the mean of the preceding and following values of the comparison stars, in order to take into account the fact that the observations of different stars could not be made simultaneously, but were spaced with equal intervals in time. A correction for differential extinction, amounting to a few thousandths of a magnitude, had to be applied only to the earlier observations; when

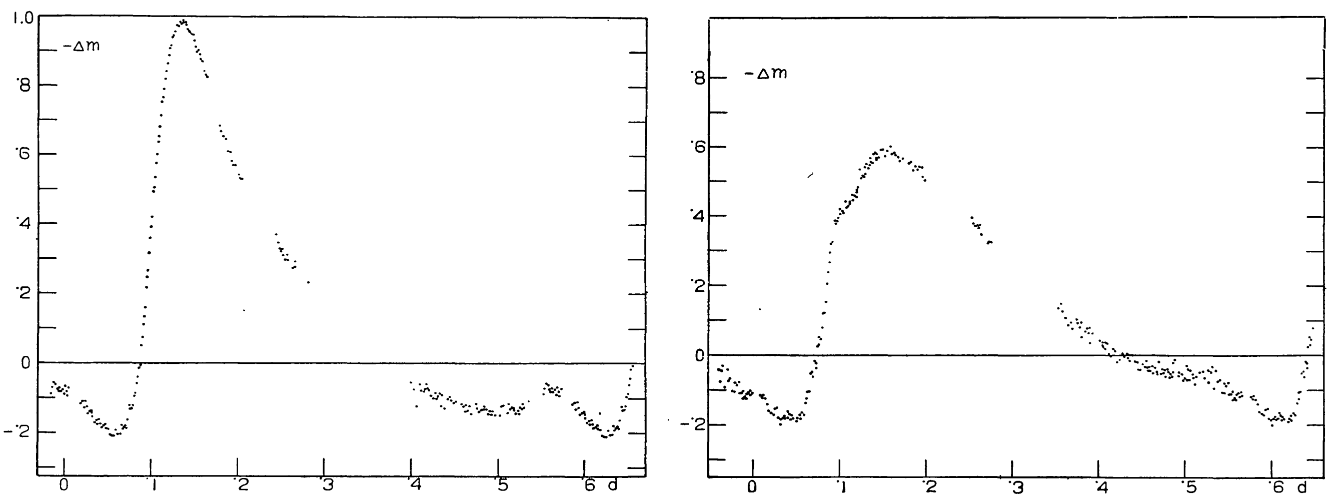
TABLE 3

Jul. Day −2430000	$m_a–m_b$	$m_a–m_c$	mean error of one observation
2285·5			
2286·5			
2287·5	·625		m·021
2288·5		1·202	·016
2289·5			
2300·5	·645	1·228	·010
2302·5	·645	1·230	·009
2314·5	·620	1·260	·085
2319·5	·648	1·203	·033
2328·5	·648	1·235	·018
2330·5	·635	1·232	·016
2333·5	·625	1·215	·025
2334·5	·638	1·220	·007
2335·5	·630		·015
2336·5	·628		·013
2348·5	·634		·008
2354·5	·628		·022
2361·5	·632		·012
2362·5	·648		·033
2363·5	·634		·012
2364·5	·625	1·222	·022
2374·5	·642		·010
2376·5	·642		·010
2379·5	·640		·013
2380·5	·642		·025
2381·5	·622	1·202	·017
2382·5	·628		·018
2385·5	·628	1·212	·012
2386·5	·628		·014
2389·5	·628	1·210	·014
2391·5	·625		·011
2394·5	·625		·009
2397·5	·630	1·228	·013
2398·5	·620	1·198	·012
2401·5	·620		·012
2406·5	·622	1·200	·010
2408·5	·622		·014
2409·5	·628		·012
2410·5	·622		·011
2414·5	·622	1·205	·014
2415·5	·625		·014
2418·5	·622		·009
2419·5	·625		·014
2420·5	·625		·009
2423·5	·622		·010
2424·5	·618	1·198	·014
2426·5	·622	1·208	·007
2427·5	·618	1·192	·008
2431·5	·628		·014
2432·5	·618	1·200	·025
2433·5	·620		·009
2441·5	·615		·011
2444·5	·620	1·198	·010
2453·5	·612		·014
2461·5	·618		·012
2465·5	·610		·021
2478·5	·610	1·188	·010
2486·5	·620	1·190	·011

the season had advanced it was negligible. In Table 3 the magnitude differences of stars *a* and *b*, $m_a - m_b$, and of stars *a* and *c*, $m_a - m_c$, have been compiled. The internal mean error of one determination of magnitude difference as found from the residuals from the mean of the night has been given in the fourth column. This mean error may be supposed to hold also for the observations of the variable.

It appears from the table that the differences in magnitude gradually grow smaller. This is not shown by the difference between *b* and *c*. There is some reason for suspicion with respect to the constancy of star *a*, which is supported by the fact that this star, HD 183125, has an abnormal spectrum, and its colour according to MÜNCH and TERRAZAS [1]), is redder than might be concluded from the spectral type. So it might have been better if another star had been used as a reference standard. The magnitude differences Δm between RR Lyrae and the reference star have been listed in Table 11 at the end of the article. In the first column of this table the heliocentric Julian Day is given. The last column will be discussed below. In order to give a visual impression of the accuracy of the observations, we reproduce two light-curves in Figure 1.

FIGURE 1



Examples of light-curves at different phases of the secondary period, directly composed of individual observations.

Our first aim will be to derive from our observations epochs which are necessary to find the phases of the primary period *P* of about $^{d}{\cdot}57$ and of the secondary period P_k of 41^{d}. The most accurate epochs can be derived from the ascending branches, and usually the epoch is determined as the moment at which the median brightness between minimum and maximum is reached.

In the case of RR Lyrae, however, the magnitude at maximum varies strongly, as does, less pronounced, also the magnitude at minimum and hence the median magnitude is not constant. For several nights of observing the median magnitude was unknown because the adjacent maximum and minimum had not been observed. In the following discussion therefore the epochs were determined for a fixed magnitude, for which the value $\Delta m = -{}^{m}{\cdot}300$ was chosen, which is near the average median magnitude. But even this procedure could not be strictly adhered to. Usually we first estimated which part of the ascending branch could be considered to be straight. The constants in the equation $\Delta m = a + b\,t$ were then solved by least squares from the observations on this straight part of the rising branch. Finally the value of *t* was determined for which Δm equals $-{}^{m}{\cdot}300$. Later in this article we shall see that the rising branch sometimes shows a flexure near the time of median brightness, where the increase in brightness is much slower than in the remaining parts of the rising branch or where the brightness may even be nearly constant for a short while. In such cases the least-squares solution has been made for observations on a straight part of the rising branch below the flexure and the epoch *t*, derived from an extrapolation of the linear equation does not coincide in this case with the time at which the variable actually reached brightness $\Delta m = -{}^{m}{\cdot}300$. Although this procedure introduces some arbitrariness it probably is as good as any other.

In Table 4 the solutions have been collected. The first column of this table gives the Julian Days of the moment at which Δm equals $-{}^{m}{\cdot}300$. The second column contains *b*, the units of time and magnitude

[1]) *Ap.J.* **103**, 371, 1946.

TABLE 4

J.D. − 2430000	*b* units m·001 d·0001	m.e. of one observation	*E*	J.D. − 2430000	*b* units m·001 d·0001	m.e. of one observation	*E*
2330·45942 ± 23	− 2·279 ± 67	± ·021 (m)	30827·2759 ± 4	2423·44104 ± 25	− 1·669 ± 38	± ·009 (m)	30991·3117 ± 4
2335·56726 ± 17	− 1·868 ± 40	± ·016	30836·2870 ± 3	2424·57235 ± 28	− 1·958 ± 61	± ·012	30993·3075 ± 5
2364·46864 ± 17	− 2·437 ± 63	± ·018	30887·2741 ± 3	2427·40908 ± 65	− 1·670 ± 100	± ·010	30998·3120 ± 11
2381·48992 ± 147	− 1·825 ± 203	± ·029	30917·3026 ± 26	2431·37117 ± 7	− 2·120 ± 19	± ·006	31005·3018 ± 1
2385·45737 ± 52	− 2·599 ± 215	± ·031	30924·3019 ± 9	2432·50300 ± 17	− 2·283 ± 48	± ·017	31007·2986 ± 3
2389·42056 ± 13	− 2·546 ± 52	± ·011	30931·2936 ± 2	2441·55535 ± 33	− 2·469 ± 75	± ·007	31023·2685 ± 6
2394·51674 ± 10	− 3·123 ± 49	± ·013	30940·2842 ± 2	2444·38660 ± 9	− 3·184 ± 47	± ·011	31028·2633 ± 2
2398·47627 ± 7	− 2·980 ± 35	± ·009	30947·2695 ± 1	2453·45823 ± 13	− 2·300 ± 51	± ·009	31044·2672 ± 2
2406·40912 ± 11	− 2·140 ± 31	± ·010	30961·2644 ± 2	2461·40569 ± 11	− 2·046 ± 35	± ·006	31058·2880 ± 2
2410·38275 ± 17	− 1·671 ± 31	± ·012	30968·2746 ± 3	2465·37691 ± 47	− 2·230 ± 150	± ·025	31065·2939 ± 8
2415·49042 ± 28	− 1·925 ± 65	± ·018	30977·2854 ± 5	2478·40449 ± 16	− 1·998 ± 40	± ·016	31088·2768 ± 3
2419·46609 ± 45	− 1·843 ± 89	± ·016	30984·2992 ± 8	2486·33583 ± 38	− 1·968 ± 93	± ·027	31102·2691 ± 7

being d·0001 and m·001. The mean error of one observation, as found from the residuals, is given in the third column. These may be compared to that found from the comparison stars in Table 3. The last column will be explained below. The observations which were used in the computation and their residuals ($O - C$) have been listed in Table 5.

TABLE 5

t	Δ*m*	*O–C*
−2432330·4400		
89	−·072	−·012
106	−·108	−·010
124	−·110	+·030
145	−·175	+·013
158	−·270	−·053
172	−·260	−·011
193	−·295	+·002
207	−·310	+·019
224	−·332	+·036
238	−·398	+·002
252	−·420	+·012
270	−·472	·000
283	−·500	+·002
297	−·542	−·008
311	−·582	−·014
336	−·645	−·022
349	−·640	+·012
−2432335·5500		
15	−·010	−·004
23	−·008	+·012
30	−·028	+·006
40	−·080	+·028
48	−·062	+·006
55	−·075	+·005
63	−·090	+·006
70	−·112	−·004
77	−·098	+·024
84	−·142	−·008
91	−·138	+·010

t	Δ*m*	*O–C*
−2432335·5500		
98	−·158	+·003
105	−·175	−·001
111	−·208	−·023
117	−·170	+·026
123	−·200	+·008
130	−·198	+·022
139	−·255	−·017
145	−·262	−·014
152	−·260	+·002
163	−·285	−·003
170	−·298	−·002
176	−·352	−·046
183	−·322	−·002
190	−·342	−·009
197	−·350	−·004
203	−·348	+·009
211	−·368	+·004
218	−·378	+·007
225	−·408	−·010
234	−·412	+·003
259	−·470	−·008
266	−·438	+·037
−2432364·4500		
64	−·012	−·010
76	−·012	+·019
86	−·032	+·023
95	−·088	−·011
104	−·090	+·009
114	−·148	−·024

t	Δ*m*	*O–C*
−2432364·4500		
125	−·185	−·035
135	−·158	+·016
145	−·195	+·004
158	−·205	+·025
168	−·258	−·003
177	−·260	+·017
185	−·305	−·009
196	−·350	−·026
206	−·355	−·007
217	−·395	−·021
225	−·395	−·001
236	−·418	+·003
248	−·438	+·012
255	−·472	−·005
263	−·468	+·018
−2432381·4600		
79	+·087	−·015
146	+·008	+·028
153	−·005	+·028
188	−·142	−·045
200	−·130	−·012
236	−·170	+·014
247	−·205	−·001
−2432385·4400		
49	−·008	−·032
73	−·040	−·002
91	−·080	+·005
122	−·109	+·057
127	−·160	+·018

t	Δ*m*	*O–C*
−2432385·4400		
136	−·177	+·025
149	−·276	−·040
171	−·316	−·023
184	−·342	−·016
196	−·352	+·006
−2432389·4000		
98	−·015	+·011
106	−·035	+·011
126	−·098	·000
135	−·130	−·010
153	−·182	−·016
176	−·220	+·005
190	−·257	+·003
205	−·310	−·012
219	−·332	+·002
233	−·382	−·012
257	−·417	+·014
260	−·447	−·008
282	−·482	+·013
−2432394·5000		
58	+·015	−·027
70	+·007	+·003
85	−·052	−·010
96	−·075	+·001
108	−·110	+·004
118	−·135	+·011
130	−·160	+·023
139	−·215	−·004
152	−·247	+·005

TABLE 5 (*continued*)

t	Δm	O–C
−2432394·5000		
163	−·265	+·021
174	−·317	+·003
185	−·360	−·008
197	−·392	·000
207	−·420	+·004
219	−·490	−·029
231	−·505	−·007
243	−·535	+·001
254	−·575	−·005
266	−·602	+·006
−2432398·4600		
66	+·002	+·014
79	−·062	−·012
94	−·092	+·003
106	−·137	−·006
119	−·162	+·008
130	−·195	+·007
140	−·240	−·008
152	−·262	+·006
163	−·297	+·003
176	−·350	−·010
188	−·380	−·005
200	−·415	−·004
212	−·460	−·014
226	−·488	·000
238	−·537	−·013
251	−·560	+·003
262	−·590	+·006
274	−·615	+·017
−2432406·3900		
59	−·022	−·005
73	−·048	−·001
83	−·075	−·007
94	−·097	−·006
113	−·110	+·022
118	−·145	−·002
133	−·170	+·005
147	−·215	−·010
159	−·232	−·001
173	−·260	+·001
186	−·277	+·012
198	−·302	+·013
210	−·345	−·005
223	−·367	+·001
238	−·415	−·015
251	−·445	+·017
266	−·460	·000
283	−·490	−·006
298	−·522	−·006
−2432410·3600		
41	+·008	+·003
61	−·035	−·013
82	−·072	−·016
100	−·067	+·019
115	−·120	−·008
127	−·137	−·005
141	−·137	+·018
153	−·165	+·011
166	−·172	+·025
179	−·217	+·001
195	−·262	−·016
207	−·260	+·006
219	−·285	+·001
233	−·315	−·006
245	−·335	−·006
257	−·352	−·003
270	−·375	−·004
288	−·415	−·014
301	−·427	−·005
315	−·437	+·009

t	Δm	O–C
−2432410·3600		
329	−·465	+·005
−2432415·4700		
49	−·025	−·024
60	−·030	−·008
71	−·055	−·011
84	−·050	+·018
99	−·080	+·018
113	−·122	+·002
128	−·125	+·028
140	−·157	+·019
154	−·205	−·002
170	−·242	−·008
183	−·270	−·011
196	−·297	−·013
208	−·322	−·015
223	−·330	+·006
234	−·390	−·033
252	−·382	−·010
260	−·387	+·020
−2432419·4500		
02	·000	+·007
15	−·028	+·003
29	−·055	+·001
46	−·085	+·003
69	−·132	−·002
87	−·182	−·018
104	−·195	·000
123	−·227	+·003
141	−·292	−·029
155	−·295	−·006
170	−·282	−·034
−2432423·2600		
26	+·005	+·003
39	−·020	−·006
55	−·042	−·002
65	−·047	+·010
74	−·060	+·012
87	−·097	−·005
98	−·110	+·002
111	−·140	−·006
124	−·167	−·013
137	−·172	−·006
149	−·187	+·012
161	−·222	−·004
173	−·255	−·017
187	−·260	·000
200	−·275	+·008
215	−·305	+·003
−2432424·5500		
72	+·002	+·005
84	−·032	−·005
95	−·048	·000
107	−·077	−·005
120	−·080	+·017
137	−·135	−·005
153	−·152	+·010
167	−·195	−·006
181	−·235	−·019
195	−·255	−·011
209	−·282	−·010
223	−·282	+·017
236	−·315	+·009
−2432427·3900		
52	−·065	+·003
65	−·085	+·005
80	−·130	−·015
97	−·152	−·009
109	−·150	+·013
124	−·180	+·008

t	Δm	O–C
−2432427·3900		
156	−·250	−·008
168	−·260	+·002
−2432431·3500		
72	−·010	−·006
91	−·042	+·002
113	−·092	−·002
129	−·125	−·001
144	−·145	+·011
157	−·185	−·001
172	−·207	+·009
184	−·240	+·001
197	−·265	+·003
208	−·305	−·013
221	−·322	−·002
232	−·347	−·005
243	−·365	+·001
255	−·392	·000
266	−·420	−·005
286	−·455	+·002
297	−·492	−·012
309	−·495	+·011
320	−·530	·000
331	−·550	−·002
−2432432·4800		
98	−·020	−·022
113	−·032	−·004
127	−·070	−·006
142	−·085	+·014
156	−·125	+·006
182	−·160	+·030
189	−·192	+·014
211	−·262	−·006
225	−·310	−·022
237	−·325	−·009
249	−·367	−·024
266	−·390	−·008
291	−·405	+·034
302	−·462	+·002
317	−·505	−·007
340	−·542	+·009
360	−·610	−·014
369	−·617	·000
−2432441·5600		
11	−·440	+·002
28	−·478	+·006
45	−·538	−·012
64	−·568	+·005
81	−·618	−·003
98	−·658	−·001
113	−·690	+·004
−2432444·3700		
77	−·020	−·003
89	−·052	+·003
104	−·095	+·007
118	−·150	+·003
134	−·182	+·016
143	−·248	−·021
164	−·280	+·014
175	−·338	−·010
186	−·382	−·018
214	−·440	+·012
228	−·505	−·007
240	−·540	−·004
251	−·572	−·002
264	−·610	+·002
276	−·640	+·010
−2432453·4400		
70	−·052	−·010
103	−·115	+·003

t	Δm	O–C
−2432453·4400		
126	−·170	·000
148	−·202	+·019
169	−·270	−·001
190	−·325	−·007
212	−·372	−·004
235	−·418	+·003
259	−·480	−·004
−2432461·3900		
33	−·052	−·006
48	−·078	−·001
62	−·100	+·006
79	−·128	+·012
97	−·180	−·003
110	−·212	−·008
124	−·230	+·002
142	−·272	−·002
159	−·310	−·006
172	−·332	−·002
186	−·362	−·002
201	−·382	+·008
−2432465·36		
43	−·038	−·020
58	−·045	+·007
71	−·070	+·011
88	−·135	−·016
103	−·132	+·020
119	−·160	+·028
132	−·220	−·003
145	−·242	+·004
158	−·320	−·055
189	−·352	−·008
201	−·352	+·019
−2432478·3800		
95	−·005	−·005
112	−·045	−·011
127	−·058	+·006
138	−·082	−·004
151	−·080	+·032
166	−·122	+·020
178	−·168	−·002
189	−·205	−·017
203	−·215	+·001
214	−·242	−·004
226	−·265	−·003
237	−·279	+·005
251	−·322	−·010
266	−·342	·000
276	−·395	−·033
286	−·412	−·030
297	−·412	−·008
308	−·430	−·004
323	−·452	+·004
334	−·475	+·003
345	−·472	+·028
356	−·510	+·012
368	−·538	+·008
−2432486·3200		
24	−·035	·000
45	−·062	+·014
64	−·087	+·027
82	−·142	+·008
99	−·165	+·018
120	−·242	−·018
138	−·292	−·032
160	−·332	−·029
180	−·360	−·018
203	−·425	−·037
239	−·438	+·020
258	−·500	−·004
276	−·485	+·047

The variations in the period.

We adapt our discussion to the scheme of BALAZS and DETRE by using the formula of PRAGER,

$$\text{Julian Day of median magn.} = 2414856{\cdot}408 + {}^{d}{\cdot}56683735\, E \qquad (1)$$

to compute E, of which the integer gives the cycle number and the decimal fraction the phase deviation $\Delta\varphi$, called $(B-R)_{Mgr}$ in BALAZS and DETRE's article, expressed in the primary period P. In the fourth column of Table 4 the values of E computed for the epochs in the first column of that table, are given. The phase deviation $\Delta\varphi$ is shown in Figure 2 (dots), as a function of the cycle number minus 30800 [1]).

This figure clearly shows the secondary period of about 72 cycles, but also it is clear that the points of the successive secondary cycles cannot be combined into one curve. The amplitude is varying and also the length of the secondary period is variable. This phenomenon might have been found earlier by BALAZS and DETRE if their observations had been more numerous. Now it revealed itself only by a large scatter of their $(B-R)_{Mgr}$. A similar unexpected large scattering has been noticed by OOSTERHOFF in the case of RS Boo [2]), another RR Lyrae-type variable with secondary period. It is very curious that in the case of the numerous and closely spaced observations of RR Lyrae by ZACHAROW [3]), which reveal this phenomenon distinctly, it was ascribed by BALAZS and DETRE to systematic errors. An annoying consequence of the effect is that it is now impossible to find the exact $\Delta\varphi$ at the time of STRUVE's observations between J.D. 2432340 and J.D. 2432380, corresponding to our cycle numbers 30840 and 30915. It was tried therefore to find an interpolation formula representing $\Delta\varphi$ for the whole interval covered by the observations. The secondary period had to be taken from BALAZS and DETRE's discussion.

Their formula, (9a):

$$P_k = 71^{P}{\cdot}83 \sin^{\circ}{\cdot}004168\,(E - 9870)$$

gives for $E = 30800$, the secondary period $P_k = 72^{P}{\cdot}37$ at the time of our observations.

The varying amplitude may be caused by another period. Its length was estimated as follows. We certainly had a large amplitude near $E = 31100$, and probably it was minimal near $E = 30900$ and $E = 31100$, i.e. the beat period P_b equals about 200 cycles. BALAZS and DETRE's figures show exceptionally large deviations for E equal to about 25130. Finally ZACHAROV's observations show a large amplitude for $E = 17540$ and $E = 16680$ (cf. BALAZS and DETRE's article, page 31). From these data it follows that the beat period may be close to 217 cycles. We assumed it to be exactly three times the secondary period P_k or $P_b = 217^{P}{\cdot}11$. This beat period may be caused by interference of the secondary period P_k with a third period P_k', being equal to $3/2\ P_k$ or to $3/4\ P_k$. It is directly seen from the run of $\Delta\varphi$ that we must choose $P_k' = 3/2\ P_k = 108^{P}{\cdot}55$. We then made a least-squares solution of the following type:

$$\Delta\varphi = a + bt + c \sin \frac{2\pi}{P_k} t + d \cos \frac{2\pi}{P_k} t + e \sin \frac{2\pi}{P_k'} t + f \cos \frac{2\pi}{P_k'} t,$$

the linear term $b\,t$ being introduced to account for the apparent decrease of the mean of $\Delta\varphi$. The unit of t is one cycle and its zero point is at $E = 30800{\cdot}3$. The result obtained is:

$$\Delta\varphi = {}^{P}{\cdot}2908 - {}^{P}{\cdot}000037\,t - {}^{P}{\cdot}0173 \sin \frac{2\pi}{P_k} t - {}^{P}{\cdot}0060 \cos \frac{2\pi}{P_k} t - {}^{P}{\cdot}0060 \sin \frac{2\pi}{P_k'} t + {}^{P}{\cdot}0024 \cos \frac{2\pi}{P_k'} t. \qquad (2)$$
$$\pm 12 \quad \pm 16 \quad \pm 6 \quad \pm 6 \quad \pm 6 \quad \pm 7$$

The phase deviations used in the computation are given in Table 6. Some of them are the mean of some observations having small weight, which is caused by the irregular shape of the ascending branch, at the time when the light-curve is most retarded. The other columns of the table contain the computed phase deviations and the residuals $O - C$. The solution is represented by the full-drawn line in Figure 2. There also the line $(a + b\,t)$ is shown. It was not considered worth while to repeat the elaborate computations for other lengths of the periods, for the following reasons. The representation of the observed values by the solution is quite satisfactory if the residuals in the well observed regions are compared to those in the other regions. Secondly, if there is a second and third period, it is probable that also other periods may exist. Moreover it is not necessary that the variations are strictly sinusoidal.

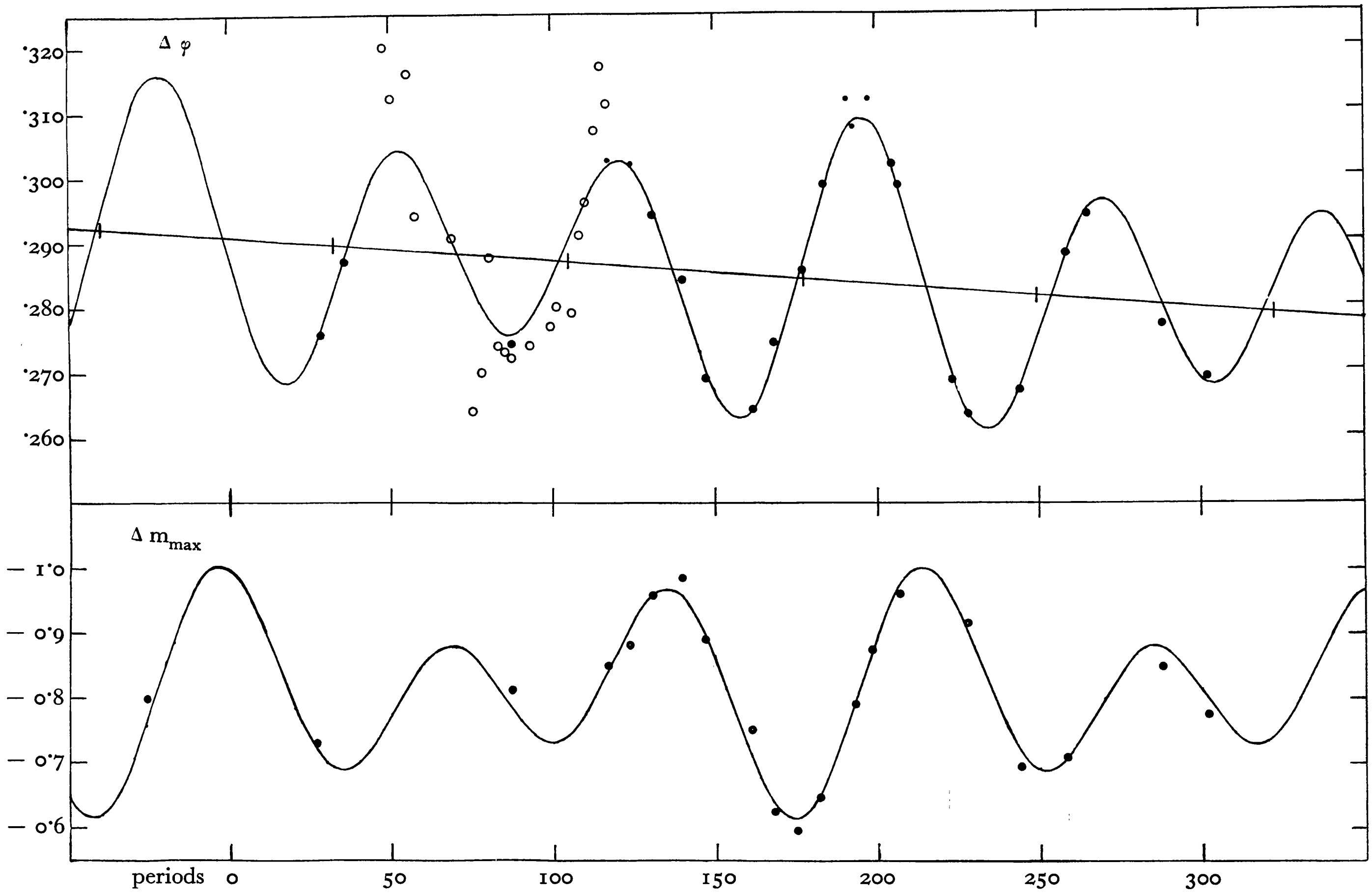
Let us now consider the constants of the solution. Constant a represents the present-day secular error

[1]) It should be noticed that the whole number subtracted by STRUVE and BLAAUW in order to get their cycle numbers is 30843; *Ap. J.* **108**, 60, 1948.

[2]) *B.A.N.* No. 369, 101, 1946, and private communication.

[3]) The results of this author are given in BALAZS and DETRE's article.

FIGURE 2



Above: Variation of phase shift of the epoch of median brightness. Dots – values observed photoelectrically; full-drawn curve – computed interpolation formula (2); open circles – epochs of mean radial velocity, as found by STRUVE and BLAAUW. Below: Variation of maximum magnitude. Dots – values observed photoelectrically; full-drawn curve – computed interpolation formula (3)

of PRAGER's formula and *b* its present rate of change. We may compare this quantity to the value predicted by BALAZS and DETRE, called by them $\overline{(B-R)}_{Mgr}$. These authors derived the formula:

$$\overline{(B-R)}_{Mgr} = {}^{\mathrm{d}}{\cdot}069 - {}^{\mathrm{d}}{\cdot}00000235\,E + {}^{\mathrm{d}}{\cdot}116 \sin^{\circ}{\cdot}00989\,(E - 15500),$$

which becomes, after inserting $E = 30800{\cdot}3 + t$, taking the first two terms of the Taylor development and expressing in periods instead of days:

$$\overline{(B-R)}_{Mgr} = {}^{\mathrm{P}}{\cdot}0923 - {}^{\mathrm{P}}{\cdot}0000351\,t.$$

It appears that our *a* deviates much from the predicted value, whereas *b* agrees well. The large discrepancy is not disturbing, as BALAZS and DETRE's formula had to be extrapolated. Probably $\overline{(B-R)}_{Mgr}$ reached a higher value and began to decrease later than according to the formula. This result is confirmed by one observation by GORDON and KRON [1]) of an epoch at Julian Day 2432061·8023, from which follows $E = 30353{\cdot}3179$ or $\Delta\varphi = {}^{\mathrm{P}}{\cdot}318$, much larger than the predicted maximum of $\overline{(B-R)}_{Mgr}$, which is ${}^{\mathrm{P}}{\cdot}217$. Our interpolation formula (2) gives at the time of GORDON and KRON's observation $\Delta\varphi = {}^{\mathrm{P}}{\cdot}326$.

Let us now consider the secondary period, which is represented by the third and fourth terms on the right-hand side of formula (2). These may be combined to ${}^{\mathrm{P}}{\cdot}0183 \sin \frac{2\pi}{P_k}(t - 32^{\mathrm{P}}{\cdot}38)$. The amplitude ${}^{\mathrm{P}}{\cdot}0183$ is smaller than that of BALAZS and DETRE, who found ${}^{\mathrm{P}}{\cdot}0265$. For this effect a probable explanation will be given below. The moments at which the phase, ψ, of the secondary period is zero can be found as $E_{\psi=0} = 30832^{\mathrm{P}}{\cdot}68 + n \times 72^{\mathrm{P}}{\cdot}37$, where *n* denotes a number of secondary cycles. It should be noted that

[1]) K. C. GORDON and G. E. KRON. *Ap.J.* **106**, 318, 1947.

these are not the moments at which $\Delta\varphi$ reaches its mean value. The moments for which $\psi = 0$ are indicated in Figure 2 by vertical dashes.

For this quantity $E_{\psi=0}$ BALAZS and DETRE also give a formula:

$$E_{\overline{(B-R)}_{Mgr}} = 171^{P}\cdot9 + 71^{P}\cdot83\,e - 103^{P}\cdot1 \cos^{\circ}\cdot30(e-136).$$

TABLE 6

t	$\Delta\varphi$ observed	$\Delta\varphi$ computed	$O-C$
	P	P	P
27	·2759	·2757	+·0002
36	·2870	·2888	−·0018
87	·2741	·2757	−·0016
122	·3021	·3021	·0000
131	·2936	·2949	−·0013
140	·2842	·2808	+·0034
147	·2695	·2700	−·0005
161	·2644	·2639	+·0005
168	·2746	·2711	+·0035
177	·2854	·2869	−·0015
184	·2992	·2992	·0000
193	·3101	·3081	+·0020
205	·3018	·3011	+·0007
207	·2986	·2981	+·0005
223	·2685	·2693	−·0008
228	·2633	·2634	−·0001
244	·2672	·2676	−·0004
258	·2880	·2879	+·0001
265	·2939	·2946	−·0007
288	·2768	·2801	−·0033
302	·2691	·2680	+·0011

Inserting $e = 427$, which is the number of secondary cycles elapsed at $E = 30832$, we find:

$$E_{\overline{(B-R)}_{Mgr}} = 30838^{P}\cdot4,$$

deviating only about 6 primary cycles from our result. This is a rather good agreement, which is, however, accidental, as also in this case the extrapolation of the earlier observations is uncertain.

Finally the last two terms of (2) give the interfering third period P_k' which is 3/2 times the secondary period P_k. They may be combined to:

$${}^{P}\cdot0064 \sin\frac{2\pi}{P_k'}(t - 60^{P}\cdot87).$$

The moments at which the phase χ of the third period is zero can be found as $E_{\chi=0} = 30861^{P}\cdot17 + m \times 108^{P}\cdot55$ where m denotes a number of cycles. Nothing more can be remarked about this period than that its reality seems assured. Its exact length and the question whether it is variable cannot be determined from the present observations. Long continuous series of observations will be necessary to study this, and still unknown periods, thoroughly.

The variations in the shape of the light-curve.

Together with the varying phase also the shape of the light-curve changes. This is shown most pronounced in the height of the maximum which varies within a wide range. The variations occur so quickly that the portions of light-curves observed within an interval of some days cannot be combined into one curve. Therefore the curves of Figure 1 do not represent real light-curves. When it was tried to combine observations of subsequent secondary periods it appeared that the influence of the third period manifested itself also in the shape of the light-curve. It turned out impossible to describe fully all variations of the light-curve during our observational period. The only thing we could do, was to obtain a system of mean light-curves, showing the variation in the period P_k. The real light-curves deviate more or less from these, depending on the phase of the beat period. The system of mean curves was obtained as follows. In order to distinguish clearly between phase shift and

TABLE 7

φ'	Δm
2285	**6·83**
·800	+ ·010
2286	**6·85**
·400	− ·190
·450	− ·112
·500	− ·054
·550	− ·016
·600	+ ·005
2287	**6·88**
·250	− ·394
·300	− ·294
·350	− ·227
·400	− ·178

φ'	Δm
2288	**6·90**
·060	− ·618
·080	− ·613
·100	− ·606
·150	− ·556
·200	− ·443
2289	**6·93**
·800	+ ·042
·840	+ ·075
·880	+ ·113
·900	+ ·132
·920	+ ·146
·940	+ ·120
·960	+ ·040
·980	− ·100

φ'	Δm
2300	**7·19**
·100	− ·796
·120	− ·792
·150	− ·726
·200	− ·578
·250	− ·466
·300	− ·375
2302	**7·24**
·625	+ ·077
·650	+ ·090
·675	+ ·110
·700	+ ·130
·725	+ ·142
·750	+ ·130
·775	+ ·107

φ'	Δm
2302	**7·24**
·800	+ ·107
·820	+ ·120
·840	+ ·140
2314	**7·54**
·800	+ ·074
2319	**7·66**
·800	+ ·080
·820	+ ·080
2328	**7·87**
·500	− ·041
·550	− ·002

φ'	Δm
2330	**7·93**
·990	− ·183
·000	− ·300
·010	− ·420
·020	− ·570
·030	− ·630
·040	− ·656
·060	− ·700
·080	− ·722
·100	− ·730
·120	− ·703
·150	− ·610
2333	**8·00**
·250	− ·415
·300	− ·325

φ'	Δm
2334	**8·02**
·150	− ·615
·200	− ·512
·250	− ·420
2335	**8·04**
·700	+ ·062
·725	+ ·047
·750	+ ·046
·775	+ ·057
·800	+ ·082
·820	+ ·107
·840	+ ·128
·860	+ ·150
·880	+ ·170
·900	+ ·188

φ'	Δm
2335	**8·04**
·920	+ ·194
·940	+ ·170
·960	+ ·096
·980	− ·090
·990	− ·200
·000	− ·300
·010	− ·406
2336	**8·06**
·500	− ·090
·550	− ·035
·600	+ ·011
·625	+ ·030
·650	+ ·046
·675	+ ·055

TABLE 7 (*continued*)

φ′	Δm
2336	**8·06**
·700	+ ·058
·725	+ ·062
2348	**8·35**
·650	+ ·108
·675	+ ·127
·700	+ ·145
·725	+ ·150
·750	+ ·145
·775	+ ·115
·800	+ ·095
·820	+ ·103
·840	+ ·130
·860	+ ·159
2354	**8·51**
·250	− ·416
·300	− ·326
·350	− ·236
·400	− ·150
·450	− ·065
·500	+ ·010
2361	**8·67**
·625	+ ·065
·650	+ ·073
·675	+ ·078
·700	+ ·070
·725	+ ·056
·750	+ ·045
·775	+ ·044
·800	+ ·046
·820	+ ·059
·840	+ ·072
2362	**8·70**
·400	− ·150
2363	**8·73**
·150	− ·604
·200	− ·478
·250	− ·377
2364	**8·76**
·900	+ ·150
·920	+ ·159
·940	+ ·150
·960	+ ·095
·980	− ·020
·990	− ·150
·000	− ·300
·010	− ·445
·020	− ·565
·030	− ·640
·040	− ·715
·060	− ·802
·080	− ·800
·100	− ·755
·120	− ·695
·150	− ·604
2374	**8·99**
·625	+ ·014
·650	+ ·022
·675	+ ·025
·700	+ ·030
·725	+ ·037
·750	+ ·048

φ′	Δm
2376	**9·05**
·150	− ·695
·200	− ·585
·250	− ·465
2379	**9·11**
·350	− ·295
·400	− ·212
·450	− ·142
·500	− ·077
·550	− ·018
·600	+ ·020
2380	**9·14**
·100	− ·870
·120	− ·820
·150	− ·745
·200	− ·608
·250	− ·470
2381	**9·17**
·840	+ ·134
·860	+ ·165
·880	+ ·186
·900	+ ·202
·920	+ ·202
·940	+ ·177
·960	+ ·107
·980	− ·090
·990	− ·187
·000	− ·262
·010	− ·328
·020	− ·375
·030	− ·430
·040	− ·522
·060	− ·682
·080	− ·815
·100	− ·850
·120	− ·810
·150	− ·725
2382	**9·18**
·625	+ ·070
·650	+ ·086
·675	+ ·099
·700	+ ·108
·725	+ ·116
·750	+ ·116
·775	+ ·106
·800	+ ·106
·820	+ ·127
·840	+ ·153
·860	+ ·190
2385	**9·27**
·980	− ·010
·990	− ·135
·000	− ·300
·010	− ·385
·020	− ·458
·030	− ·533
·040	− ·648
·060	− ·820
·080	− ·880
·100	− ·866
·120	− ·815
·150	− ·712
·200	− ·572

φ′	Δm
2386	**9·29**
·820	+ ·135
·840	+ ·144
·860	+ ·162
·880	+ ·180
·900	+ ·203
·920	+ ·218
·940	+ ·200
·960	+ ·130
·980	+ ·024
2389	**9·36**
·940	+ ·198
·960	+ ·126
·980	− ·022
·990	− ·155
·000	− ·300
·010	− ·450
·020	− ·545
·030	− ·630
·040	− ·727
·060	− ·905
·080	− ·955
2391	**9·40**
·550	+ ·075
·600	+ ·108
·625	+ ·120
·650	+ ·130
·675	+ ·136
·700	+ ·139
·725	+ ·136
·750	+ ·130
2394	**9·49**
·820	+ ·074
·840	+ ·085
·860	+ ·105
·880	+ ·140
·900	+ ·170
·920	+ ·200
·940	+ ·203
·960	+ ·158
·980	+ ·043
·990	− ·112
·000	− ·300
·010	− ·480
·020	− ·581
·030	− ·775
·040	− ·873
·060	− ·976
·080	− ·920
·100	− ·900
·120	− ·825
2397	**9·56**
·100	− ·830
·120	− ·760
·150	− ·663
·200	− ·502
2398	**9·58**
·840	+ ·066
·860	+ ·085
·880	+ ·112
·900	+ ·140
·920	+ ·167
·940	+ ·168
·960	+ ·134
·980	+ ·021
·990	− ·140

φ′	Δm
2398	**9·58**
·000	− ·300
·010	− ·480
·020	− ·615
·030	− ·739
·040	− ·810
·060	− ·885
·080	− ·888
·100	− ·837
·120	− ·771
2401	**9·65**
·940	+ ·150
·960	+ ·105
·980	− ·042
·990	− ·168
·000	− ·302
2406	**9·78**
·000	− ·300
·010	− ·434
·020	− ·522
·030	− ·590
·040	− ·649
·060	− ·730
·080	− ·749
·100	− ·718
·120	− ·677
2408	**9·82**
·675	+ ·010
·700	+ ·013
·725	+ ·018
2409	**9·85**
·350	− ·301
·400	− ·224
·450	− ·160
·500	− ·105
·550	− ·055
·600	− ·015
2410	**9·87**
·980	− ·104
·990	− ·202
·000	− ·300
·010	− ·402
·020	− ·464
·030	− ·500
·040	− ·527
·060	− ·580
·080	− ·620
·100	− ·620
·120	− ·600
·150	− ·558
·200	− ·465
2414	**9·97**
·060	− ·527
·080	− ·557
·100	− ·585
·120	− ·593
·150	− ·564
·200	− ·500
2415	**0·00**
·860	+ ·120
·880	+ ·150
·900	+ ·174
·920	+ ·180
·940	+ ·162
·960	+ ·082

φ′	Δm
2415	**0·00**
·980	− ·065
·990	− ·170
·000	− ·300
·010	− ·386
·020	− ·410
·030	− ·430
·040	− ·448
·060	− ·503
·080	− ·558
2418	**0·07**
·100	− ·604
·120	− ·644
·150	− ·625
·200	− ·550
·250	− ·453
·300	− ·357
2419	**0·10**
·880	+ ·180
·900	+ ·192
·920	+ ·186
·940	+ ·160
·960	+ ·067
·980	− ·095
·990	− ·195
·000	− ·290
·010	− ·325
·020	− ·334
·030	− ·345
·040	− ·373
·060	− ·462
·080	− ·558
·100	− ·632
·120	− ·650
2420	**0·11**
·650	+ ·044
·675	+ ·059
·700	+ ·077
·725	+ ·094
·750	+ ·088
·775	+ ·060
·800	+ ·073
·820	+ ·094
2423	**0·19**
·840	+ ·130
·860	+ ·170
·880	+ ·195
·900	+ ·210
·920	+ ·209
·940	+ ·160
·960	+ ·059
·980	− ·100
·990	− ·202
·000	− ·282
·010	− ·322
·020	− ·364
·030	− ·406
·040	− ·455
·060	− ·597
2424	**0·22**
·920	+ ·200
·940	+ ·164
·960	+ ·085
·980	− ·065
·990	− ·185
·000	− ·290
·010	− ·328

φ′	Δm
2424	**0·22**
·020	− ·353
·030	− ·383
·040	− ·456
·060	− ·636
·080	− ·760
2426	**0·26**
·120	− ·814
·150	− ·725
·200	− ·585
·250	− ·455
2427	**0·29**
·980	− ·106
·990	− ·192
·000	− ·270
·010	− ·340
·020	− ·416
·030	− ·500
·040	− ·600
·060	− ·790
·080	− ·874
·100	− ·853
·120	− ·802
2431	**0·39**
·960	+ ·107
·980	− ·063
·990	− ·166
·000	− ·300
·010	− ·416
·020	− ·535
2432	**0·41**
·980	− ·068
·990	− ·151
·000	− ·300
·010	− ·435
·020	− ·554
·030	− ·688
·040	− ·829
·060	− ·954
·080	− ·945
·100	− ·872
2433	**0·43**
·500	+ ·015
2440	**0·61**
·860	+ ·055
·880	+ ·085
·900	+ ·118
2441	**0·63**
·010	− ·440
·020	− ·580
·030	− ·714
·040	− ·824
2444	**0·70**
·960	+ ·140
·980	+ ·009
·990	− ·114
·000	− ·300
·010	− ·493
·020	− ·641
·030	− ·756
·040	− ·834
·060	− ·906
·080	− ·895
·100	− ·832

φ′	Δm
2444	**0·70**
·120	− ·756
2453	**0·92**
·900	+ ·165
·920	+ ·185
·940	+ ·166
·960	+ ·117
·980	− ·035
·990	− ·160
·000	− ·300
·010	− ·435
·020	− ·527
·030	− ·575
·040	− ·616
·060	− ·666
·080	− ·688
·100	− ·692
·120	− ·671
2461	**1·12**
·900	+ ·184
·920	+ ·190
·940	+ ·159
·960	+ ·092
·980	− ·070
·990	− ·180
·000	− ·300
·010	− ·385
·020	− ·397
·030	− ·407
·040	− ·451
·060	− ·568
·080	− ·678
·100	− ·706
·120	− ·702
2465	**1·21**
·920	+ ·180
·940	+ ·175
·960	+ ·100
·980	− ·056
·990	− ·168
·000	− ·300
·010	− ·365
2478	**1·53**
·960	+ ·098
·980	− ·075
·990	− ·193
·000	− ·300
·010	− ·430
·020	− ·505
·030	− ·602
·040	− ·695
·060	− ·816
·080	− ·844
·100	− ·800
2486	**1·7**
·960	+ ·095
·980	− ·065
·990	− ·178
·000	− ·300
·010	− ·413
·020	− ·495
·030	− ·590
·040	− ·675
·060	− ·770
·080	− ·772
·100	− ·738
·120	− ·682

variation in shape, from all phases computed with (1), which are given in the last column of Table 11, the amount given by (2) was subtracted, with as result the reduced phase φ'. In this way the variation of the phase deviation is eliminated and the rising branches of all light-curves pass through the same point. At this point the reduced phase φ' is zero. Then at a number of other phases φ', chosen with suitable intervals, the observed magnitudes Δm were read from the light-curves. These are collected in Table 7.

For each night at the top of the columns is given the Julian Day of midnight minus 2430000·5 and the phase ψ of the secondary period, together with the last figure of its cycle number e. Then for each reduced phase Δm is plotted against ψ, using different symbols for subsequent secondary cycles. In this way it is clearly demonstrated that most of the scatter is due to the change from cycle to cycle. Some of the graphs are shown in Figure 3. In the plots the mean curves are drawn, represented by dashed lines. The values of $-\Delta m$ at phase $\psi = 0$, ·1, ·2 etc., of these curves are given in Table 8.

TABLE 8

φ' \ ψ	·1	·2	·3	·4	·5	·6	·7	·8	·9	1·0	mean
·01	− ·347	− ·341	− ·376	− ·433	− ·468	− ·478	− ·459	− ·432	− ·401	− ·372	− ·411
·02	− ·375	− ·376	− ·445	− ·525	− ·578	− ·591	− ·566	− ·520	− ·478	− ·424	− ·488
·03	− ·383	− ·426	− ·527	− ·631	− ·714	− ·717	− ·654	− ·582	− ·505	− ·434	− ·557
·04	− ·438	− ·484	− ·592	− ·728	− ·815	− ·812	− ·741	− ·657	− ·570	− ·491	− ·633
·06	− ·550	− ·637	− ·759	− ·879	− ·939	− ·908	− ·831	− ·743	− ·657	− ·580	− ·748
·08	− ·652	− ·762	− ·858	− ·916	− ·936	− ·886	− ·833	− ·757	− ·673	− ·633	− ·791
·10	− ·713	− ·804	− ·849	− ·867	− ·859	− ·826	− ·782	− ·724	− ·673	− ·670	− ·777
·12	− ·712	− ·777	− ·807	− ·810	− ·800	− ·769	− ·726	− ·682	− ·650	− ·662	− ·740
·15	− ·672	− ·711	− ·725	− ·715	− ·684	− ·668	− ·636	− ·602	− ·590	− ·616	− ·662
·20	− ·564	− ·584	− ·577	− ·559	− ·535	− ·510	− ·486	− ·472	− ·477	− ·523	− ·529
·25	− ·463	− ·464	− ·452	− ·439	− ·424	− ·408	− ·394	− ·389	− ·401	− ·430	− ·426
·30	− ·360	− ·372	− ·366	− ·349	− ·329	− ·309	− ·294	− ·289	− ·297	− ·328	− ·329
·35	− ·292	− ·295	− ·286	− ·260	− ·236	− ·223	− ·214	− ·220	− ·238	− ·266	− ·253
·40	− ·214	− ·207	− ·189	− ·168	− ·151	− ·146	− ·153	− ·166	− ·185	− ·182	− ·176
·45	− ·140	− ·122	− ·096	− ·076	− ·068	− ·070	− ·084	− ·101	− ·121	− ·133	− ·101
·50	− ·086	− ·061	− ·021	+ ·008	+ ·014	+ ·004	− ·016	− ·038	− ·057	− ·083	− ·034
·55	− ·025	+ ·009	+ ·053	+ ·074	+ ·067	+ ·050	+ ·028	+ ·003	− ·018	− ·029	+ ·021
·60	+ ·015	+ ·050	+ ·085	+ ·104	+ ·099	+ ·076	+ ·046	+ ·015	− ·005	− ·007	+ ·048
·62	+ ·039	+ ·071	+ ·099	+ ·115	+ ·108	+ ·084	+ ·058	+ ·034	+ ·017	+ ·017	+ ·064
·65	+ ·049	+ ·081	+ ·108	+ ·121	+ ·115	+ ·095	+ ·068	+ ·044	+ ·025	+ ·026	+ ·073
·67	+ ·062	+ ·099	+ ·123	+ ·131	+ ·118	+ ·091	+ ·059	+ ·030	+ ·012	+ ·026	+ ·075
·70	+ ·077	+ ·117	+ ·138	+ ·139	+ ·119	+ ·085	+ ·084	+ ·024	+ ·016	+ ·036	+ ·080
·72	+ ·081	+ ·125	+ ·147	+ ·140	+ ·114	+ ·079	+ ·048	+ ·021	+ ·016	+ ·037	+ ·081
·75	+ ·080	+ ·120	+ ·144	+ ·132	+ ·102	+ ·068	+ ·038	+ ·019	+ ·017	+ ·042	+ ·076
·77	+ ·068	+ ·103	+ ·118	+ ·109	+ ·088	+ ·063	+ ·040	+ ·025	+ ·025	+ ·042	+ ·068
·80	+ ·084	+ ·104	+ ·105	+ ·096	+ ·081	+ ·064	+ ·045	+ ·029	+ ·031	+ ·057	+ ·070
·82	+ ·107	+ ·120	+ ·120	+ ·109	+ ·089	+ ·070	+ ·056	+ ·053	+ ·065	+ ·086	+ ·088
·84	+ ·137	+ ·144	+ ·138	+ ·118	+ ·088	+ ·068	+ ·062	+ ·068	+ ·086	+ ·109	+ ·102
·86	+ ·159	+ ·171	+ ·165	+ ·141	+ ·105	+ ·073	+ ·063	+ ·073	+ ·100	+ ·130	+ ·118
·88	+ ·180	+ ·190	+ ·180	+ ·158	+ ·129	+ ·101	+ ·083	+ ·089	+ ·118	+ ·150	+ ·138
·90	+ ·195	+ ·207	+ ·204	+ ·187	+ ·164	+ ·141	+ ·126	+ ·127	+ ·146	+ ·171	+ ·167
·92	+ ·196	+ ·201	+ ·199	+ ·188	+ ·173	+ ·156	+ ·150	+ ·155	+ ·164	+ ·183	+ ·176
·94	+ ·168	+ ·172	+ ·175	+ ·175	+ ·171	+ ·166	+ ·156	+ ·153	+ ·154	+ ·161	+ ·165
·96	+ ·088	+ ·094	+ ·103	+ ·112	+ ·123	+ ·125	+ ·121	+ ·113	+ ·099	+ ·090	+ ·107
·98	− ·081	− ·076	− ·057	− ·038	− ·016	− ·006	− ·015	− ·030	− ·054	− ·072	− ·044
·99	− ·189	− ·187	− ·175	− ·160	− ·144	− ·138	− ·141	− ·153	− ·173	− ·183	− ·164
·00	− ·294	− ·287	− ·281	− ·300	− ·300	− ·300	− ·300	− ·300	− ·300	− ·300	− ·296

The mean light-curve for each ψ was obtained by plotting this Δm against φ'. They are given in Figure 4. One of the most conspicuous features in these curves is the flexure on the rising branch which occurs near phase $\psi = $ ·1. While ψ is progressing, the maximum rises and the upper portion of the rising branch becomes steeper, the flexure also rises slowly and gradually fades out. In the mean curves of Figure 4 these effects are shown less sharply than in the real light-curves, as a consequence of smoothing out the variations with the third period. If, as in earlier discussions, the flexure is masked by the observational errors, the epoch of median magnitude will be found later than by our method of using the lower portion of the rising branch. This may be the explanation of our amplitude of the secondary variation being smaller than BALAZS and DETRE's. Another interesting feature of the light-curve is the secondary maximum just before minimum, which is most sharply defined near the phase $\psi = $ ·5, when also the primary maximum is highest. Near phase $\psi = 0$ this secondary maximum nearly disappears, leaving only a flat portion in the light-curve. During the secondary period the maximum, the minimum and the second-

FIGURE 3

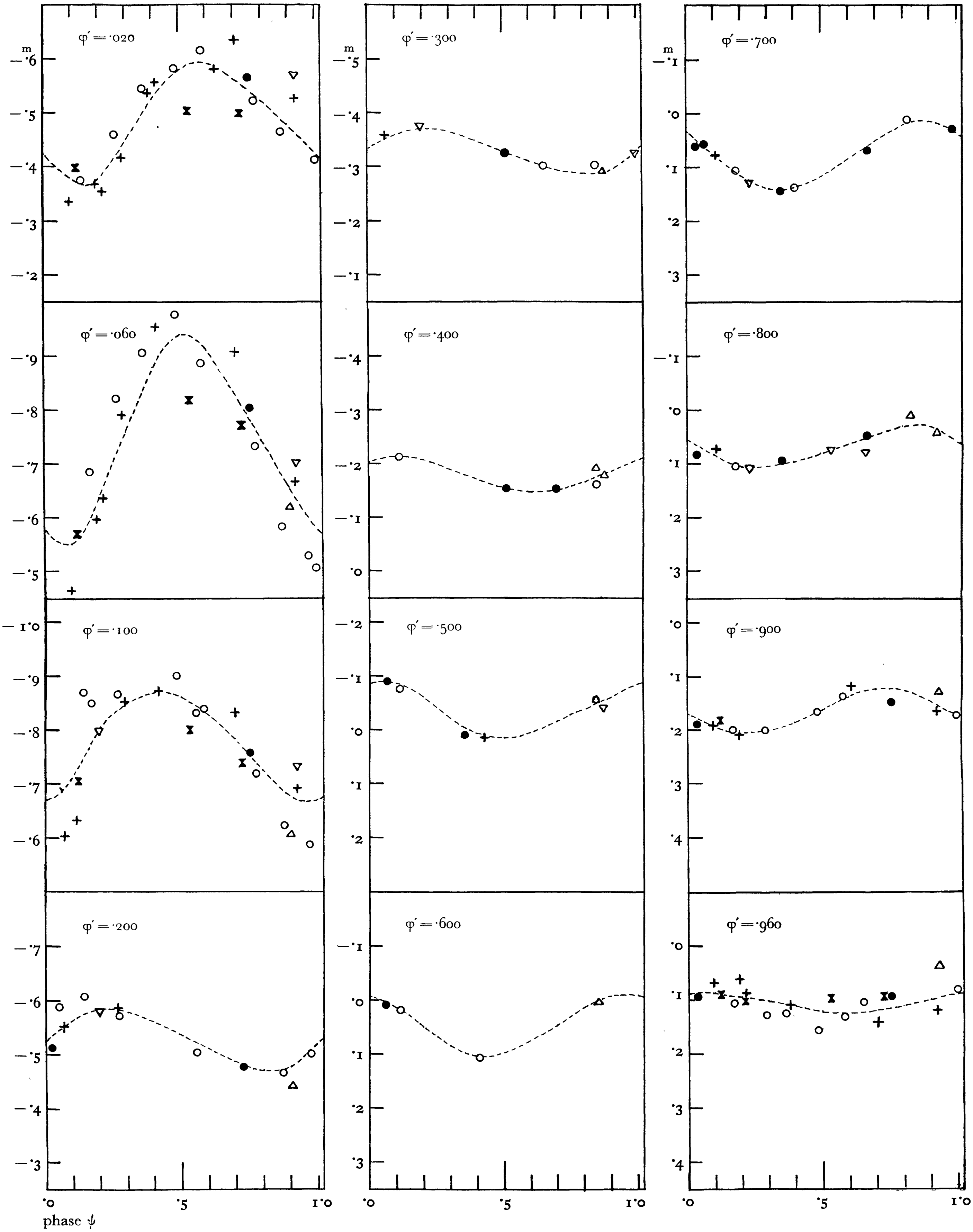
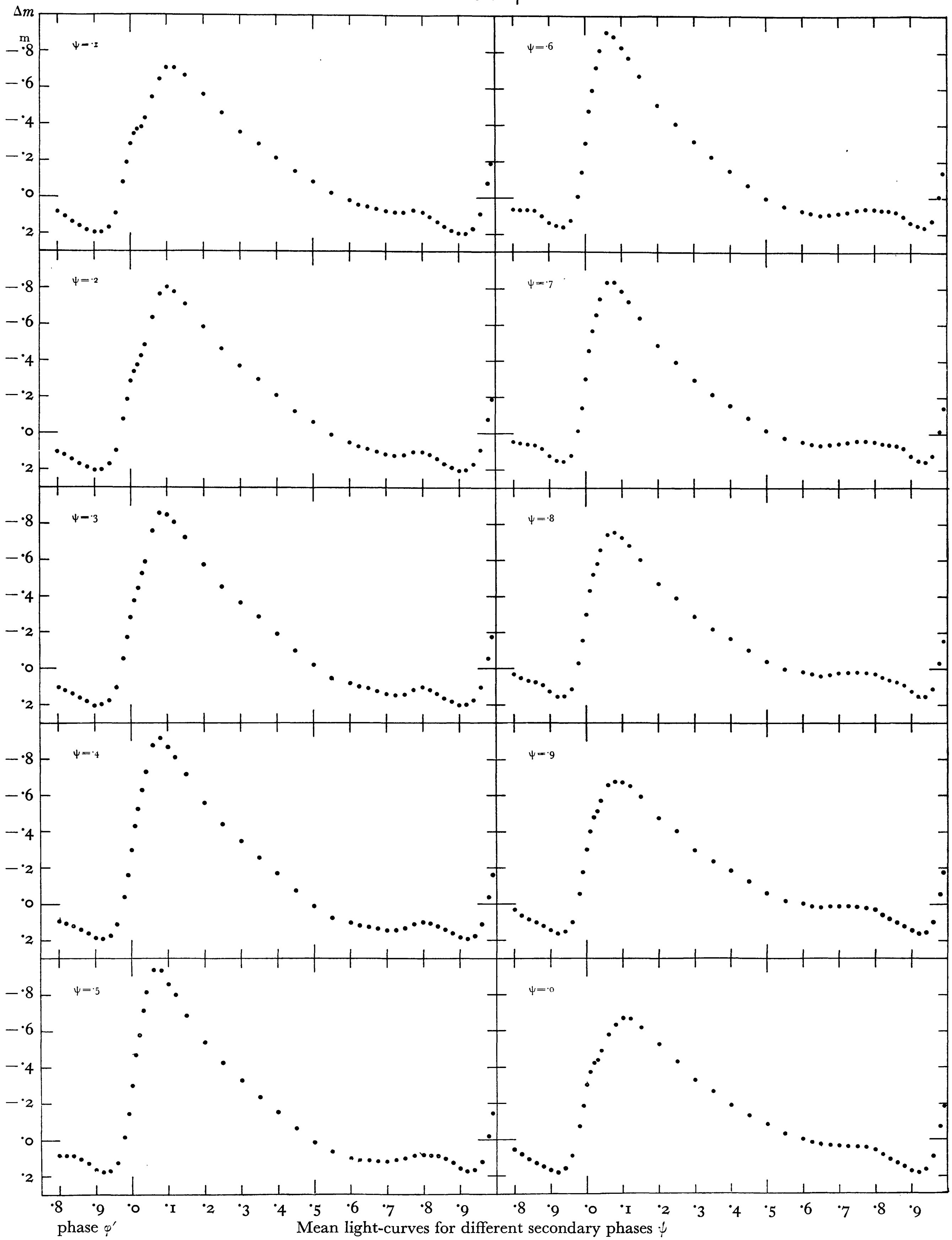

φ′ = ·020
φ′ = ·060
φ′ = ·100
φ′ = ·200
φ′ = ·300
φ′ = ·400
φ′ = ·500
φ′ = ·600
φ′ = ·700
φ′ = ·800
φ′ = ·900
φ′ = ·960
m
·0
·5
1·0
phase ψ

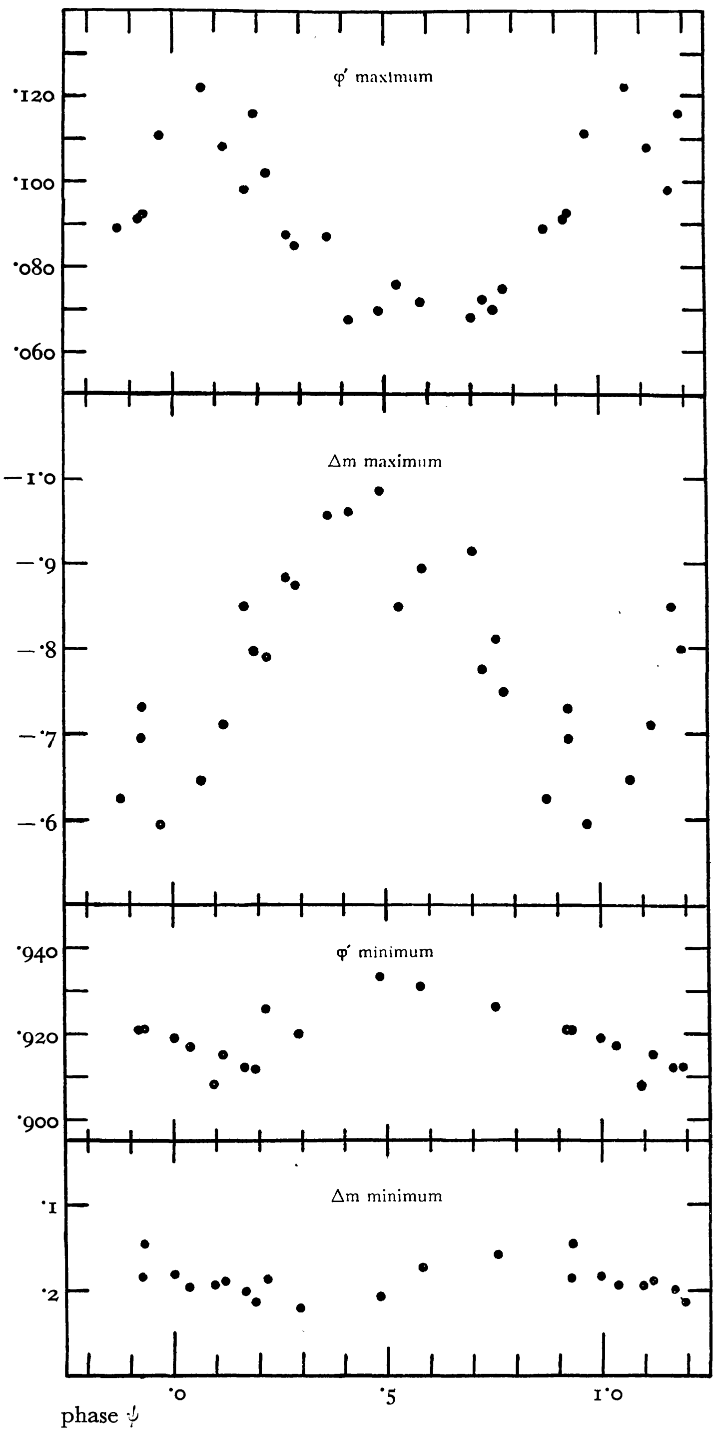
Figure 4



Mean light-curves for different secondary phases ψ ary maximum of the mean light-curves are varying both in height and in phase.

The variations are large for the maximum and much less pronounced for the minimum. Moreover the variations do not occur in the same phase, as can be seen in Figure 4. This is more clearly demonstrated in Figure 5, where the reduced phases and magnitudes of both maximum and minimum, as read from the observed light-curves, are plotted against ψ. It may be noted that in these graphs again much of the scattering is due to the third period. Figure 5 is based on the values given in Tables 9 and 10. The first columns of these tables contain the Julian Days of the observed maxima or minima. The reduced phases φ' were obtained by using the observed moments of median brightness in Table 4. If the adjacent moment of median brightness has not been observed, the value computed with the interpolation formula (2) was used.

FIGURE 5



Variation of phase and height of maximum and minimum. Successive secondary cycles have been combined into one.

Let us now consider the real light-curves. As has been stated already, these cannot be described in full detail. Nevertheless some idea could be obtained from the material by a careful study. It appeared thus that:

a). The system of light-curves described during a secondary period never coincides with the system of mean curves given in Figure 4.

b). The light-curves vary in shape most intensely when also the phase shift of the light-curve oscillates with its largest amplitude and vice versa.

c). The time required to run through the system of curves varies in the same way as the period of oscillation of the phase shift $\Delta\varphi$. For example, the time of most pronounced flexure always occurs just before maximum retardation of the light-curve.

d). The variations are strongest about the maximum of the light-curve, much less pronounced for the minimum, and are not perceptible for a large portion of the descending branch. Some of the above-mentioned effects are very clearly demonstrated by

TABLE 9

J.D. −2430000	*E*	Δm maximum	Δm computed	*O–C*	φ' maximum
		m	m	m	P
2300·505	30774·431	− ·798	− ·754	− ·044	·116
2330·514	827·372	− ·729	− ·719	− ·010	·096
2364·508	887·344	− ·810	− ·784	− ·026	·070
2381·544	917·398	− ·850	− ·839	− ·011	·095
2385·506	924·388	− ·882	− ·910	+ ·028	·086
2389·470	931·381	− ·955	− ·958	+ ·003	·087
2394·556	940·353	− ·985	− ·957	− ·028	·069
2398·517	947·341	− ·892	− ·900	+ ·008	·072
2406·452	961·340	− ·750	− ·712	− ·038	·076
2410·433	968·363	− ·625	− ·639	+ ·014	·088
2414·421	975·399	− ·593	− ·615	+ ·022	·111
2418·400	982·418	− ·645	− ·649	+ ·004	·122
2424·630	993·409	− ·790	− ·794	+ ·004	·102
2427·456	998·395	− ·875	− ·867	− ·008	·083
2432·543	31007·369	− ·960	− ·973	+ ·013	·067
2444·425	028·331	− ·915	− ·903	− ·012	·068
2453·510	044·359	− ·693	− ·720	+ ·027	·092
2461·467	058·396	− ·708	− ·706	− ·002	·108
2478·447	088·352	− ·848	− ·877	+ ·029	·075
2486·376	102·340	− ·775	− ·799	+ ·024	·072

the observed heights of the maxima of the light-curves. In Table 9 these maxima are given as they are read from the observed light-curves.

TABLE 10

J.D. −2430000	φ' minimum	Δm minimum
2289·608	·921	·145
2335·520	·917	·195
2364·426	·926	·160
2381·438	·909	·200
2386·545	·920	·218
2394·479	·933	·208
2398·437	·931	·175
2415·444	·919	·182
2419·414	·908	·194
2423·390	·910	·214
2453·413	·921	·185
2461·358	·915	·190
2465·335	·926	·185

The second column of the table gives the phase computed with formula (1) at the moment when the maximum is reached. In Figure 2 the observed heights are plotted against cycle numbers. Introducing again the secondary period P_k and the third period $P_k' = 3/2\ P_k$ we could find the least-squares solution representing the height of the maximum as a function of t, which is the time expressed in cycles with a zero-point at $E = 30800{\cdot}4$:

$$\begin{aligned}\Delta m_{max} = {}^{m}{\cdot}814 &- {}^{m}{\cdot}060 \sin\frac{2\pi}{P_k}t + {}^{m}{\cdot}116 \cos\frac{2\pi}{P_k}t \\ \pm {\cdot}006 &\pm {\cdot}008 \qquad\qquad \pm {\cdot}008 \\ &+ {}^{m}{\cdot}029 \sin\frac{2\pi}{P_k'}t + {}^{m}{\cdot}065 \cos\frac{2\pi}{P_k'}t. \qquad (3) \\ &\pm {\cdot}007 \qquad\qquad \pm {\cdot}010\end{aligned}$$

The maximum as computed with this formula is given as the full-drawn line in Figure 2. The residuals of the observed values are given in the fifth column of Table 9. It may be noted here that the third period P_k' exhibits itself in the maxima with about the same degree of certainty as in the phase shifts, although these quantities are observed entirely independently of each other.

The observed relation between the height of maximum and phase shift will have to be explained by the theory of the pulsation of stars like RR Lyrae. One might expect that the phase shift $\Delta\varphi$ is the integral result of a variation in period due to some periodic disturbance exhibiting itself also in the height of the maximum, and therefore the maximum magnitude should be correlated with the derivative of $\Delta\varphi$ with respect to time. It is not possible to decide whether this is really the case, for, although the observations can be satisfied by such a relation, it is also possible, and with better result, to represent the phase shift as proportional to the derivative of the height of maximum.

Comparison with the radial-velocity curves.

Before closing the discussion a few remarks will be made concerning the radial-velocity programme of RR Lyrae by STRUVE and BLAAUW [1]). One of the results of that programme, the epochs of median radial velocity, may be directly compared with our values from the light-curves. This has been done in Figure 2, where STRUVE and BLAAUW's observations are represented by open circles. The agreement of phase is good, but the amplitude of the radial-velocity values is larger than that predicted by our formula for the light-curves. However, the amplitude depends very much on the method applied in determining the phase shift of the light-curve. The large deviations at that phase of the secondary period where the light-curve is most retarded, would disappear if, in determining the epoch of mean magnitude, not only the lower portion, but the whole of the ascending branch were taken into account, with neglect of the flexure.

It may be noted that at about the same phase of the secondary period hydrogen emission lines have been found by STRUVE during the increase of the star's brightness. Therefore, this moment is interesting in more than one respect, and future observations of colour and spectral-line intensities may prove of great value for the study of this star.

[1]) *Ap.J.* **108**, 60, 1948.

TABLE 11

J.D. Hel. −2430000	Δm	phase	J.D. Hel. −2430000	Δm	phase	J.D. Hel. −2430000	Δm	phase	J.D. Hel. −2430000	Δm	phase
d	m	P	d	m	P	d	m	P	d	m	P
2285·5475	+·004	·0434	2285·5686	+·004	·0807	2286·5351	−·018	·7858	2286·5542	−·045	·8194
·5503	+·014	·0484				·5362	−·031	·7877	·5552	−·027	·8212
·5537	+·004	·0544	2286·4728	−·179	·6758	·5372	−·031	·7895	·5569	−·017	·8242
·5548	+·004	·0563	·4759	−·160	·6813	·5414	−·065	·7969	·5736	−·008	·8538
·5572	+·009	·0606	·4860	−·185	·6991	·5424	−·032	·7986	·5750	+·004	·8561
·5582	−·001	·0623	·4891	−·149	·7046	·5472	−·037	·8071	·5763	−·018	·8584
·5620	−·001	·0690	·5268	−·058	·7711	·5483	−·019	·8090			
·5645	+·022	·0734	·5279	−·066	·7730	·5493	−·017	·8108	2287·5310	−·338	·5427
·5655	+·021	·0752	·5292	−·061	·7753	·5531	−·017	·8175	·5320	−·368	·5445

TABLE 11 (*continued*)

J.D. Hel. −2430000	Δm	phase
d	m	P
2287·5331	−·366	·5464
·5452	−·344	·5677
·5459	−·308	·5690
·5559	−·271	·5866
·5570	−·287	·5886
·5580	−·272	·5903
·5635	−·282	·6000
·5649	−·262	·6025
·5660	−·252	·6044
·5975	−·203	·6600
·5985	−·198	·6618
·5996	−·183	·6637
·6054	−·193	·6740
·6061	−·176	·6752
·6072	−·170	·6771
·6142	−·170	·6863
·6134	−·180	·6881
2288·5450	−·681	·3316
·5460	−·662	·3333
·5492	−·597	·3390
·5502	−·597	·3407
·5523	−·565	·3444
·5533	−·595	·3462
·5561	−·671	·3512
·5595	−·635	·3572
·5616	−·567	·3609
·5651	−·645	·3670
·5685	−·635	·3730
·5727	−·616	·3804
·5755	−·620	·3854
·5775	−·620	·3889
·5830	−·563	·3938
·5845	−·610	·4013
·5872	−·588	·4060
·5900	−·583	·4110
·5928	−·576	·4159
·5956	−·536	·4208
·5983	−·580	·4256
·6025	−·558	·4330
·6053	−·566	·4380
·6108	−·598	·4477
·6136	−·529	·4526
·6281	−·431	·4782
·6309	−·421	·4831
·6336	−·447	·4879
·6364	−·394	·4928
·6385	−·409	·4965
·6406	−·399	·5002
·6433	−·374	·5050
2289·5319	+·063	·0726
·5347	+·033	·0776
·5367	+·048	·0811
·5399	+·053	·0867
·5437	+·011	·0935
·5503	+·058	·1051
·5534	+·061	·1106
·5568	+·055	·1166
·5596	+·075	·1215
·5624	+·088	·1264
·5651	+·073	·1312
·5686	+·114	·1374
·5852	+·122	·1667
·5894	+·110	·1741
·5915	+·052	·1778
·5928	+·124	·1801
·5935	+·127	·1813
·5956	+·115	·1850
·5984	+·180	·1900

J.D. Hel. −2430000	Δm	phase
d	m	P
2289·6012	+·112	·1949
·6025	+·130	·1972
·6053	+·220	·2021
·6081	+·134	·2071
·6095	+·127	·2095
·6109	+·170	·2120
·6115	+·161	·2131
·6199	+·046	·2279
·6254	+·119	·2376
·6268	·000	·2401
·6275	+·119	·2413
·6289	+·049	·2438
·6309	+·061	·2473
·6358	−·064	·2559
·6372	−·083	·2584
·6386	−·074	·2609
·6406	−·008	·2644
·6420	−·165	·2669
2300·4955	−·795	·4143
·4983	−·789	·4193
·5003	−·795	·4228
·5024	−·802	·4265
·5052	−·785	·4315
·5073	−·795	·4352
·5100	−·792	·4399
·5121	−·777	·4436
·5149	−·767	·4486
·5170	−·755	·4523
·5190	−·745	·4558
·5218	−·739	·4607
·5239	−·729	·4644
·5260	−·717	·4681
·5287	−·707	·4729
·5315	−·695	·4778
·5329	−·677	·4803
·5350	−·652	·4840
·5371	−·645	·4877
·5426	−·636	·4974
·5447	−·618	·5011
·5474	−·598	·5059
·5495	−·593	·5096
·5523	−·596	·5145
·5544	−·560	·5182
·5571	−·556	·5230
·5592	−·560	·5267
·5613	−·528	·5304
·5641	−·508	·5354
·5661	−·518	·5389
·5689	−·506	·5438
·5710	−·498	·5475
·5731	−·496	·5512
·5751	−·478	·5548
·5786	−·490	·5609
·5807	−·459	·5646
·5835	−·471	·5696
·5862	−·439	·5743
·5890	−·439	·5793
·5911	−·441	·5830
·5938	−·444	·5878
·5966	−·421	·5927
·6001	−·389	·5989
·6035	−·389	·6049
·6056	−·354	·6086
·6077	−·387	·6123
·6112	−·389	·6185
2302·4867	+·074	·9272
·4895	+·076	·9321
·4936	+·086	·9393

J.D. Hel. −2430000	Δm	phase
d	m	P
2302·4971	+·084	·9455
·4999	+·076	·9504
·5019	+·104	·9540
·5040	+·084	·9577
·5068	+·092	·9626
·5096	+·095	·9676
·5116	+·091	·9711
·5137	+·088	·9748
·5165	+·083	·9797
·5192	+·093	·9845
·5248	+·111	·9944
·5269	+·118	·9981
·5289	+·123	·0016
·5317	+·121	·0066
·5352	+·135	·0127
·5379	+·140	·0175
·5407	+·127	·0224
·5428	+·134	·0261
·5456	+·147	·0311
·5476	+·132	·0346
·5504	+·150	·0395
·5525	+·137	·0432
·5546	+·137	·0470
·5566	+·132	·0505
·5587	+·160	·0542
·5608	+·130	·0579
·5629	+·124	·0616
·5657	+·142	·0665
·5684	+·104	·0713
·5712	+·114	·0762
·5740	+·120	·0812
·5767	+·103	·0859
·5795	+·106	·0909
·5830	+·116	·0971
·5857	+·111	·1018
·5892	+·091	·1080
·5920	+·121	·1129
·5940	+·116	·1165
·5968	+·116	·1214
·5996	+·113	·1263
·6017	+·103	·1300
·6044	+·103	·1348
·6065	+·133	·1385
·6086	+·126	·1422
·6107	+·116	·1459
·6127	+·149	·1494
·6148	+·133	·1532
·6162	+·149	·1556
2314·4590	+·100	·0484
·4618	+·088	·0533
·4666	+·055	·0618
·4687	+·100	·0655
·4708	+·060	·0692
·4743	+·110	·0754
·4771	+·058	·0803
·4791	+·222	·0838
·4812	−·042	·0876
·4833	−·002	·0913
·4847	+·150	·0937
·4896	−·032	·1024
·4916	+·088	·1059
·4937	+·090	·1096
·5021	+·045	·1244
2319·5630	+·122	·0527
·5651	+·068	·0564
·5671	+·115	·0600
·5692	+·092	·0637
·5713	+·040	·0674

J.D. Hel. −2430000	Δm	phase
d	m	P
2319·5738	+·105	·0718
·5762	+·040	·0760
·5796	+·032	·0820
·5817	+·112	·0857
·5838	+·112	·0894
·5859	+·092	·0931
·5887	+·080	·0981
2328·4557	+·085	·7410
·4571	+·082	·7435
·4585	+·040	·7460
·4599	+·038	·7484
·4619	+·090	·7519
·4633	+·042	·7544
·4647	+·045	·7569
·4668	+·060	·7606
·4682	+·068	·7631
·4696	+·048	·7655
·4710	+·032	·7680
·4731	+·038	·7717
·4772	−·020	·7789
·4786	+·022	·7814
·4800	+·020	·7839
·4814	−·012	·7863
·4835	+·040	·7901
·4849	+·025	·7925
·4869	+·030	·7961
·4890	+·028	·7998
·4904	+·020	·8022
·4925	−·008	·8059
·4939	+·032	·8084
·4960	+·008	·8121
·4974	+·008	·8146
·4994	+·010	·8181
·5015	+·002	·8218
·5029	·000	·8243
2330·4489	−·072	·2574
·4506	−·108	·2604
·4524	−·110	·2635
·4545	−·175	·2672
·4558	−·270	·2695
·4572	−·260	·2720
·4593	−·295	·2757
·4607	−·310	·2782
·4624	−·332	·2812
·4638	−·398	·2836
·4652	−·420	·2861
·4670	−·472	·2893
·4683	−·500	·2916
·4697	−·542	·2941
·4711	−·582	·2965
·4736	−·645	·3009
·4749	−·640	·3032
·4763	−·628	·3057
·4777	−·672	·3082
·4791	−·652	·3106
·4805	−·638	·3131
·4826	−·638	·3161
·4836	−·655	·3186
·4854	−·652	·3218
·4871	−·692	·3248
·4888	−·700	·3278
·4906	−·672	·3309
·4920	−·698	·3334
·4937	−·700	·3364
·4954	−·720	·3394
·4968	−·692	·3419
·4986	−·722	·3450
·4996	−·715	·3468

TABLE 11 (*continued*)

J.D. Hel. −2430000	Δ*m*	phase	J.D. Hel. −2430000	Δ*m*	phase	J.D. Hel. −2430000	Δ*m*	phase	J.D. Hel. −2430000	Δ*m*	phase
d	m	P	d	m	P	d	m	P	d	m	P
2330·5010	−·708	·3493	2333·4821	−·338	·6085	2335·4367	+·058	·0567	2335·5463	+·090	·2501
·5020	−·705	·3510	·4842	−·268	·6122	·4377	+·042	·0585	·5475	+·068	·2522
·5034	−·732	·3535				·4391	+·080	·0609	·5485	+·090	·2539
·5041	−·720	·3547	2334·5155	−·638	·4316	·4409	+·048	·0641	·5495	+·088	·2557
·5055	−·720	·3572	·5172	−·628	·4346	·4423	+·032	·0666	·5506	+·015	·2577
·5069	−·738	·3597	·5190	−·608	·4377	·4436	+·098	·0689	·5515	−·010	·2592
·5079	−·712	·3614	·5204	−·592	·4402	·4471	+·045	·0751	·5523	−·008	·2607
·5086	−·722	·3627	·5217	−·598	·4425	·4489	+·075	·0782	·5530	−·028	·2619
·5107	−·695	·3664	·5231	−·595	·4450	·4502	+·070	·0805	·5540	−·080	·2637
·5121	−·725	·3689	·5249	−·578	·4481	·4516	+·070	·0830	·5548	−·062	·2651
·5131	−·715	·3706	·5263	−·572	·4506	·4530	+·108	·0855	·5555	−·075	·2663
·5142	−·750	·3726	·5277	−·580	·4531	·4548	+·108	·0886	·5563	−·090	·2677
·5156	−·730	·3750	·5294	−·580	·4561	·4565	+·082	·0916	·5570	−·112	·2689
·5170	−·705	·3775	·5308	−·558	·4585	·4579	+·088	·0941	·5570	−·098	·2702
·5180	−·748	·3793	·5329	−·565	·4623	·4603	+·080	·0983	·5584	−·142	·2714
·5197	−·698	·3823	·5336	−·562	·4635	·4617	+·112	·1008	·5591	−·138	·2726
·5208	−·722	·3842	·5349	−·560	·4658	·4631	+·110	·1033	·5598	−·158	·2739
·5232	−·722	·3884	·5370	−·548	·4695	·4645	+·105	·1058	·5605	−·175	·2751
·5246	−·712	·3909	·5391	−·540	·4732	·4655	+·128	·1075	·5611	−·208	·2762
·5260	−·635	·3934	·5408	−·540	·4762	·4669	+·125	·1100	·5617	−·170	·2772
·5274	−·682	·3959	·5426	−·528	·4794	·4680	+·128	·1129	·5623	−·200	·2783
·5288	−·715	·3983	·5447	−·518	·4831	·4690	+·115	·1137	·5630	−·198	·2795
·5305	−·655	·4013	·5461	−·508	·4855	·4700	+·110	·1155	·5639	−·255	·2811
·5319	−·725	·4038	·5474	−·515	·4878	·4714	+·108	·1179	·5645	−·262	·2822
·5333	−·740	·4063	·5488	−·505	·4903	·4725	+·120	·1199	·5652	−·260	·2834
·5343	−·648	·4080	·5502	−·510	·4928	·4745	+·108	·1234	·5663	−·285	·2853
·5354	−·688	·4100	·5516	−·502	·4952	·4759	+·110	·1259	·5670	−·298	·2866
·5361	−·680	·4112	·5530	−·485	·4977	·4780	+·142	·1296	·5676	−·352	·2876
·5371	−·640	·4130	·5544	−·485	·5002	·4794	+·112	·1320	·5683	−·322	·2889
·5378	−·635	·4142	·5558	−·480	·5027	·4811	+·140	·1350	·5690	−·342	·2901
·5388	−·720	·4160	·5572	−·488	·5051	·4825	+·155	·1375	·5697	−·350	·2913
·5409	−·648	·4197	·5586	−·482	·5076	·4857	+·150	·1432	·5703	−·348	·2924
·5416	−·595	·4209	·5599	−·472	·5099	·4888	+·122	·1486	·5711	−·368	·2938
·5423	−·688	·4221	·5613	−·480	·5124	·4902	+·165	·1511	·5718	−·378	·2951
·5433	−·625	·4239	·5627	−·482	·5148	·4919	+·155	·1541	·5725	−·408	·2963
·5447	−·615	·4264	·5655	−·455	·5198	·4930	+·160	·1560	·5734	−·412	·2979
·5458	−·535	·4283	·5669	−·465	·5222	·4940	+·182	·1578	·5759	−·470	·3023
·5475	−·630	·4313	·5683	−·442	·5247	·4950	+·162	·1596	·5766	−·438	·3035
			·5697	−·430	·5272	·4964	+·178	·1620			
2333·4241	−·460	·5061	·5711	−·418	·5296	·4975	+·162	·1640	2336·3982	−·137	·7530
·4255	−·495	·5086	·5731	−·415	·5332	·4989	+·162	·1664	·3999	−·152	·7560
·4269	−·448	·5111	·5738	−·422	·5344	·4999	+·155	·1682	·4020	−·122	·7597
·4286	−·450	·5141				·5009	+·172	·1700	·4048	−·105	·7646
·4303	−·435	·5171	2335·3933	+·032	·9801	·5023	+·175	·1724	·4076	−·082	·7695
·4321	−·428	·5202	·3950	+·070	·9831	·5075	+·192	·1816	·4114	−·095	·7763
·4345	−·430	·5245	·3964	+·068	·9856	·5120	+·188	·1896	·4135	−·075	·7800
·4363	−·428	·5277	·3975	+·058	·9876	·5159	+·185	·1964	·4190	−·102	·7897
·4383	−·408	·5312	·3995	+·038	·9911	·5169	+·178	·1982	·4204	−·090	·7921
·4408	−·405	·5356	·4009	+·038	·9936	·5180	+·218	·2001	·4218	−·082	·7946
·4425	−·408	·5386	·4020	+·095	·9955	·5190	+·178	·2029	·4232	−·097	·7971
·4442	−·392	·5426	·4034	+·042	·9980	·5200	+·235	·2037	·4246	−·050	·7995
·4460	−·400	·5448	·4048	+·102	·0004	·5214	+·185	·2061	·4284	−·070	·8062
·4477	−·378	·5478	·4068	+·062	·0040	·5228	+·190	·2086	·4298	−·077	·8087
·4501	−·375	·5520	·4079	+·055	·0059	·5239	+·185	·2105	·4315	−·065	·8117
·4519	−·352	·5552	·4093	+·042	·0084	·5252	+·208	·2128	·4333	−·080	·8149
·4540	−·378	·5589	·4107	−·002	·0108	·5263	+·190	·2148	·4350	−·032	·8179
·4557	−·362	·5619	·4186	+·020	·0248	·5277	+·195	·2173	·4367	−·062:	·8209
·4574	−·345	·5649	·4200	+·008	·0273	·5291	+·180	·2197	·4444	−·052	·8345
·4592	−·352	·5681	·4214	+·070	·0297	·5301	+·198	·2215	·4458	−·040	·8369
·4613	−·368	·5718	·4225	+·070	·0317	·5315	+·158	·2240	·4472	−·037	·8394
·4630	−·352	·5748	·4235	+·032	·0334	·5325	+·175	·2257	·4485	−·025	·8417
·4647	−·370	·5778	·4245	+·058	·0352	·5343	+·160	·2289	·4499	−·022	·8442
·4665	−·368	·5809	·4256	+·065	·0371	·5353	+·162	·2307	·4513	−·017	·8466
·4682	−·312	·5839	·4270	+·045	·0396	·5367	+·140	·2331	·4527	−·037	·8491
·4706	−·315	·5882	·4284	+·030	·0421	·5379	+·148	·2352	·4538	−·035	·8511
·4724	−·318	·5913	·4298	+·050	·0445	·5393	+·118	·2377	·4558	−·002	·8546
·4744	−·268	·5949	·4311	+·038	·0468	·5405	+·115	·2398	·4583	+·002	·8590
·4762	−·282	·5980	·4325	+·070	·0493	·5420	+·108	·2425	·4610	−·020	·8638
·4783	−·256	·6018	·4339	+·072	·0528	·5439	+·085	·2458	·4628	−·010	·8669
·4800	−·310	·6048	·4357	+·052	·0549	·5452	+·080	·2481	·4649	+·022	·8706

TABLE 11 (*continued*)

J.D. Hel. −2430000	Δm	phase
d	m	P
2336·4687	+·010	·8773
·4718	−·008	·8828
·4742	+·002	·8870
·4767	−·005	·8915
·4781	+·008	·8939
·4798	+·015	·8969
·4902	+·042	·9153
·4919	+·042:	·9183
·4954	+·040	·9244
·4968	+·025	·9269
·4982	+·035	·9294
·4996	+·035	·9319
·5006	+·045	·9336
·5020	+·065	·9361
·5038	+·042	·9393
·5058	+·030	·9428
·5076	+·052	·9460
·5090	+·090	·9484
·5107	+·050	·9514
·5121	+·055	·9539
·5138	+·057	·9567
·5156	+·052	·9601
·5196	+·040	·9624
·5183	+·050	·9648
·5197	+·062	·9673
·5215	+·037	·9705
·5239	+·047	·9747
·5256	+·067	·9777
·5270	+·055	·9802
·5284	+·062	·9827
·5301	+·050	·9857
·5347	+·060	·9938
·5360	+·047	·9961
·5374	+·062	·9985
·5392	+·055	·0017
·5409	+·070	·0047
·5426	+·067	·0077
·5444	+·072	·0109
·5461	+·040	·0148
·5479	+·070	·0171
·5496	+·075	·0201
·5517	+·057	·0238
·5534	+·067	·0268
·5555	+·087	·0305
·5579	+·065	·0347
2348·4027	+·075	·9310
·4053	+·115	·9356
·4081	+·102	·9405
·4121	+·105	·9476
·4179	+·110	·9525
·4185	+·095	·9589
·4218	+·122	·9647
·4256	+·122	·9714
·4280	+·118	·9756
·4301	+·128	·9793
·4326	+·132	·9837
·4346	+·135	·9873
·4371	+·152	·9917
·4402	+·148	·9972
·4426	+·155	·0014
·4444	+·142	·0046
·4464	+·155	·0081
·4485	+·135	·0118
·4517	+·150	·0174
·4534	+·145	·0204
·4555	+·152	·0241
·4572	+·138	·0271
·4631	+·140	·0376
·4649	+·165	·0407

J.D. Hel. −2430000	Δm	phase
d	m	P
2348·4666	+·162	·0437
·4694	+·150	·0487
·4711	+·140	·0517
·4732	+·152	·0554
·4749	+·120	·0584
·4770	+·150	·0621
·4787	+·145	·0651
·4805	+·130	·0683
·4843	+·120	·0750
·4871	+·112	·0799
·4885	+·110	·0824
·4902	+·088	·0854
·4923	+·115	·0891
·4944	+·100	·0928
·4978	+·092	·0988
·4999	+·102	·1025
·5020	+·095	·1062
·5041	+·152	·1099
·5069	+·090	·1148
·5086	+·100	·1178
·5103	+·095	·1208
·5128	+·120	·1252
·5145	+·108	·1282
·5187	+·122	·1356
·5201	+·132	·1381
·5228	+·120	·1429
·5246	+·120	·1461
·5263	+·155	·1491
·5287	+·168	·1533
·5308	+·140	·1570
·5326	+·158	·1602
·5346	+·160	·1637
·5364	+·155	·1669
·5385	+·190	·1706
·5409	+·168	·1748
2354·4184	−·400	·5437
·4208	−·405	·5480
·4224	−·418	·5508
·4245	−·378	·5545
·4283	−·345	·5612
·4314	−·345	·5667
·4349	−·352	·5729
·4373	−·358	·5771
·4401	−·358	·5820
·4434	−·332	·5878
·4476	−·332	·5953
·4512	−·300	·6016
·4550	−·290	·6083
·4571	−·300	·6120
·4592	−·278	·6157
·4620	−·270	·6207
·4646	−·298	·6252
·4670	−·245	·6295
·4703	−·240	·6353
·4726	−·238	·6394
·4752	−·238	·6439
·4780	−·218	·6489
·4839	−·202	·6593
·4865	−·200	·6639
·4884	−·205	·6672
·4903	−·210	·6706
·4924	−·172	·6743
·4943	−·178	·6776
·4986	−·118	·6852
·5009	−·165	·6893
·5030	−·162	·6930
·5049	−·158	·6963
·5116	−·118	·7082
·5137	−·135	·7119

J.D. Hel. −2430000	Δm	phase
d	m	P
2354·5158	−·098	·7156
·5182	−·085	·7198
·5202	−·078	·7233
·5219	−·115	·7263
·5240	−·098	·7300
·5257	−·062	·7330
·5307	−·050	·7419
·5326	−·088	·7452
·5342	−·060	·7480
·5360	−·035	·7512
·5379	−·060	·7546
·5399	−·028	·7581
·5420	−·022	·7618
·5439	−·035	·7651
·5460	−·008	·7689
·5481	−·018	·7726
·5498	−·002	·7756
·5519	−·022	·7793
2361·4129	+·080	·8833
·4148	+·055	·8866
·4166	+·065	·8898
·4181	+·082	·8924
·4197	+·072	·8953
·4221	+·048	·8995
·4238	+·058	·9025
·4254	+·050	·9053
·4311	+·040	·9154
·4330	+·068	·9187
·4350	+·050	·9223
·4391	+·080	·9295
·4426	+·072	·9357
·4456	+·082	·9410
·4471	+·062	·9436
·4494	+·088	·9477
·4537	+·078	·9552
·4561	+·088	·9595
·4580	+·068	·9628
·4605	+·068	·9672
·4626	+·082	·9709
·4636	+·068	·9727
·4732	+·072	·9896
·4751	+·042	·9930
·4775	+·130	·9970
·4796	+·022	·0009
·4818	+·050	·0048
·4837	+·102	·0082
·4864	+·058	·0129
·4882	+·032	·0161
·4956	+·045	·0292
·4982	+·050	·0337
·5006	+·045	·0380
·5028	+·038	·0419
·5051	+·050	·0459
·5070	+·050	·0493
·5093	+·045	·0533
·5114	+·035	·0570
·5132	+·048	·0602
·5150	+·040	·0634
·5245	+·072	·0801
·5266	+·068	·0838
·5287	+·035	·0876
·5306	+·035	·0909
·5327	+·058	·0946
·5350	+·050	·0987
·5370	+·045	·1022
·5391	+·062	·1059
·5416	+·065	·1103
·5436	+·080	·1138
·5457	+·110	·1175

J.D. Hel. −2430000	Δm	phase
d	m	P
2361·5478	+·082	·1212
·5502	+·075	·1255
·5520	+·060	·1287
2362·4115	−·185	·6450
·4138	−·180	·6490
·4166	−·192	·6540
·4190	−·135	·6582
·4209	−·155	·6616
·4230	−·182	·6653
·4264	−·188	·6713
·4282	−·160	·6744
·4310	−·165	·6794
·4320	−·208	·6811
·4339	−·120	·6845
·4357	−·120	·6877
·4395	−·092	·6944
·4454	−·078	·7048
·4471	−·092	·7078
2363·4176	−·600	·4199
·4202	−·610	·4245
·4223	−·602	·4282
·4242	−·585	·4315
·4263	−·568	·4353
·4282	−·558	·4386
·4313	−·558	·4441
·4336	−·548	·4481
·4358	−·528	·4520
·4377	−·518	·4554
·4415	−·500	·4621
·4435	−·478	·4656
·4457	−·500	·4695
·4480	−·480	·4735
·4502	−·515	·4774
·4523	−·450	·4811
·4546	−·458	·4852
·4567	−·448	·4889
·4619	−·445	·4981
·4640	−·432	·5018
·4659	−·432	·5051
·4678	−·430	·5085
·4695	−·418	·5115
·4716	−·390	·5152
·4737	−·382	·5189
·4752	−·390	·5215
·4770	−·382	·5247
·4787	−·375	·5277
2364·4036	+·148	·1594
·4052	+·108	·1622
·4066	+·110	·1647
·4078	+·132	·1668
·4092	+·165	·1693
·4104	+·168	·1714
·4118	+·142	·1738
·4131	+·208	·1761
·4145	+·195	·1786
·4158	+·180	·1809
·4175	+·128	·1839
·4194	+·135	·1873
·4211	+·182	·1903
·4225	+·168	·1927
·4241	+·130	·1955
·4255	+·162	·1980
·4274	+·168	·2014
·4288	+·165	·2038
·4312	+·145	·2081
·4326	+·162	·2105
·4343	+·125	·2135

TABLE 11 (*continued*)

J.D. Hel. −2430000	Δ*m*	phase
d	m	P
2364·4357	+·130	·2160
·4371	+·158	·2185
·4388	+·170	·2215
·4406	+·152	·2247
·4420	+·132	·2271
·4437	+·130	·2301
·4447	+·120	·2319
·4468	+·098	·2356
·4486	+·082	·2388
·4503	+·065	·2418
·4520	+·040	·2448
·4543	−·018	·2488
·4552	+·020	·2504
·4559	+·008	·2516
·4564	−·012	·2525
·4576	−·012	·2546
·4586	−·032	·2564
·4595	−·088	·2580
·4604	−·090	·2596
·4614	−·148	·2613
·4625	−·185	·2633
·4635	−·158	·2651
·4645	−·195	·2668
·4658	−·205	·2691
·4668	−·258	·2709
·4677	−·260	·2725
·4685	−·305	·2739
·4696	−·350	·2758
·4706	−·355	·2776
·4717	−·395	·2795
·4725	−·395	·2809
·4736	−·418	·2829
·4748	−·438	·2850
·4755	−·472	·2862
·4763	−·468	·2876
·4772	−·502	·2892
·4781	−·518	·2908
·4791	−·530	·2926
·4800	−·560	·2942
·4809	−·580	·2957
·4817	−·580	·2972
·4826	−·585	·2987
·4835	−·612	·3003
·4847	−·622	·3025
·4859	−·635	·3046
·4871	−·655	·3067
·4878	−·660	·3079
·4890	−·682	·3100
·4916	−·718	·3146
·4930	−·720	·3171
·4944	−·740	·3196
·4951	−·750	·3208
·4965	−·752	·3233
·4975	−·775	·3250
·4986	−·788	·3270
·4996	−·788	·3287
·5010	−·778	·3312
·5020	−·798	·3330
·5036	−·788	·3358
·5286	−·735	·3799
·5298	−·735	·3820
·5312	−·715	·3845
·5331	−·710	·3878
·5343	−·670	·3900
·5359	−·672	·3928
·5373	−·680	·3952
·5388	−·678	·3979
·5406	−·682	·4011
·5428	−·650	·4050
·5444	−·658	·4078

J.D. Hel. −2430000	Δ*m*	phase
d	m	P
2364·5456	−·665	·4099
·5475	−·648	·4132
·5493	−·635	·4164
·5506	−·635	·4187
·5524	−·625	·4219
·5538	−·620	·4244
·5555	−·610	·4274
·5569	−·588	·4298
2374·4563	−·005	·8941
·4594	−·002	·8996
·4632	+·017	·9063
·4664	+·017	·9119
·4761	−·015	·9290
·4789	−·035	·9340
·4865	−·035	·9474
·4903	−·017	·9514
·4985	−·042	·9685
·5004	−·042	·9719
·5070	−·020	·9835
·5086	−·012	·9864
·5223	−·032	·0105
·5242	−·040	·0139
·5261	−·042	·0172
·5400	−·048	·0389
·5419	−·048	·0451
·5428	−·065	·0467
2376·4637	−·722	·4355
·4656	−·697	·4389
·4675	−·695	·4422
·4693	−·695	·4454
·4710	−·695	·4484
·4734	−·687	·4526
·4752	−·672	·4558
·4772	−·665	·4593
·4790	−·662	·4625
·4877	−·602	·4778
·4894	−·585	·4808
·4918	−·617	·4851
·4939	−·605	·4888
·4962	−·595	·4928
·4984	−·565	·4967
·5081	−·567	·5138
·5102	−·505	·5175
·5123	−·510	·5212
·5144	−·510	·5249
·5165	−·497	·5286
·5184	−·547	·5320
2379·4294	−·265	·6675
·4320	−·245	·6721
·4337	−·237	·6751
·4355	−·235	·6783
·4431	−·240	·6917
·5058	−·080	·8023
·5075	−·065	·8953
·5101	−·082	·8099
·5120	−·082	·8132
·5221	−·030	·8311
·5242	−·007	·8348
·5263	−·027	·8385
·5280	−·017	·8415
·5376	−·012	·8584
·5393	−·015	·8614
·5416	−·002	·8655
·5433	−·005	·8685
·5547	−·017	·8886
·5561	−·025	·8910
·5577	−·020	·8939

J.D. Hel. −2430000	Δ*m*	phase
d	m	P
2379·5596	−·005	·8972
2380·4135	−·860	·4036
·4159	−·812	·4079
·4182	−·807	·4119
·4230	−·820	·4204
·4255	−·830	·4248
·4274	−·847	·4282
·4303	−·810	·4333
·4380	−·760	·4469
·4399	−·740	·4502
·4507	−·722	·4693
·4519	−·672	·4714
·4572	−·722	·4728
·4541	−·680	·4753
·4555	−·665	·4777
·4632	−·637	·4913
·4651	−·595	·4947
·4666	−·642	·4973
·4689:	−·607	·5014
·4711	−·652	·5053
·4864	−·530	·5322
·4888	−·510	·5365
·4902	−·495	·5389
·4928	−·502	·5435
·4941	−·480	·5458
·4956	−·467	·5485
·4979	−·462	·5525
·5005	−·432	·5571
2381·3993	+·060	·1428
·4012	+·120	·1461
·4028	+·185	·1489
·4047	+·150	·1523
·4128	+·160	·1666
·4151	+·170	·1706
·4168	+·180	·1736
·4184	+·195	·1765
·4283	+·187	·1939
·4302	+·220	·1973
·4332	+·197	·2026
·4342	+·207	·2043
·4439	+·202	·2214
·4462	+·195	·2255
·4483	+·192	·2292
·4510	+·220	·2340
·4618	+·140	·2530
·4641	+·142	·2571
·4660	+·142	·2604
·4679	+·087	·2638
·4746	+·008	·2756
·4753	−·005	·2768
·4788	−·142	·2830
·4800	−·130	·2851
·4836	−·170	·2915
·4847	−·205	·2934
·4889	−·267	·3008
·4908	−·267	·3042
·4921	−·287	·3065
·4926	−·295	·3074
·4940	−·335	·3098
·4953	−·327	·3121
·4964	−·352	·3141
·4977	−·352	·3164
·4991	−·357	·3188
·5005	−·390	·3213
·5027	−·395	·3252
·5032	−·407	·3261
·5046	−·387	·3285
·5057	−·412	·3305

J.D. Hel. −2430000	Δ*m*	phase
d	m	P
2381·5068	−·437	·3324
·5079	−·447	·3343
·5090	−·460	·3363
·5102	−·492	·3384
·5113	−·495	·3403
·5125	−·530	·3425
·5132	−·582	·3437
·5167	−·600	·3499
·5180	−·577	·3522
·5193	−·612	·3542
·5205	−·650	·3566
·5220	−·667	·3592
·5230	−·672	·3610
·5241	−·700	·3629
·5255	−·732	·3654
·5264	−·747	·3670
·5277	−·750	·3693
·5289	−·757	·3714
·5300	−·792	·3733
·5319	−·802	·3767
·5325	−·792	·3777
·5340	−·815	·3804
·5355	−·825	·3830
·5369	−·812	·3855
·5394	−·827	·3899
·5407	−·845	·3922
·5418	−·872	·3942
·5430	−·880	·3963
·5443	−·842	·3986
·5455	−·852	·4007
·5469	−·845	·4032
·5481	−·847	·4053
·5500	−·832	·4086
·5515	−·830	·4113
·5602	−·772	·4266
·5633	−·782	·4321
·5646	−·790	·4344
·5691	−·768	·4423
·5701	−·752	·4441
·5718	−·732	·4471
·5734	−·720	·4499
·5750	−·732	·4527
·5773	−·720	·4568
·5788	−·687	·4594
·5804	−·697	·4623
2382·4114	+·075	·9283
·4135	+·067	·9320
·4157	+·082	·9359
·4180	+·092	·9399
·4230	+·095	·9487
·4251	+·102	·9524
·4270	+·087	·9558
·4291	+·050	·9595
·4347	+·102	·9694
·4367	+·092	·9729
·4378	+·107	·9749
·4406	+·110	·9798
·4529	+·090	·0015
·4548	+·095	·0048
·4567	+·130	·0082
·4588	+·105	·0119
·4661	+·117	·0248
·4678	+·122	·0278
·4699	+·122	·0315
·4716	+·112	·0345
·4767	+·135	·0435
·4779	+·100	·0456
·4791	+·110	·0477
·4808	+·142	·0507

TABLE 11 (*continued*)

J.D. Hel. −2430000	Δ*m*	phase
d	m	P
2382·4850	+·102	·0581
·4861	+·095	·0601
·4874	+·140	·0624
·4888	+·100	·0648
·4942	+·122	·0744
·4956	+·132	·0768
·4972	+·105	·0796
·4984	+·075	·0818
·4998	+·110	·0842
·5017	+·127	·0827
·5036	+·100	·0909
·5051	+·112	·0936
·5097	+·100	·1017
·5121	+·102	·1059
·5137	+·135	·1088
·5152	+·092	·1114
·5225	+·145	·1243
·5239	+·170	·1268
·5249	+·105	·1285
·5269	+·142	·1320
·5315	+·140	·1402
·5322	+·127	·1414
·5333	+·157	·1433
·5345	+·167	·1455
·5364	+·180	·1488
·5374	+·160	·1506
2385·3961	+·138	·1938
·3985	+·218	·1980
·4449	−·008	·2799
·4473	−·040	·2841
·4491	−·080	·2873
·4517	−·090	·2919
·4522	−·118	·2928
·4523	−·118	·2930
·4525	−·142	·2933
·4527	−·152	·2937
·4529	−·186	·2940
·4534	−·162	·2949
·4536	−·182	·2953
·4537	−·188	·2954
·4546	−·248	·2970
·4548	−·270	·2974
·4550	−·280	·2977
·4551	−·305	·2979
·4567	−·312	·3007
·4569	−·322	·3011
·4576	−·315	·3023
·4584	−·342	·3037
·4596	−·352	·3058
·4614	−·372	·3090
·4629	−·370	·3117
·4631	−·410	·3120
·4643	−·410	·3141
·4645	−·418	·3145
·4647	−·405	·3148
·4648	−·420	·3150
·4652	−·430	·3157
·4662	−·438	·3175
·4671	−·445	·3191
·4683	−·450	·3212
·4692	−·450	·3228
·4713	−·488	·3265
·4716	−·498	·3270
·4725	−·500	·3286
·4735	−·538	·3304
·4747	−·538	·3325
·4760	−·580	·3348
·4765	−·592	·3357
·4773	−·608	·3371
2385·4784	−·612	·3390
·4794	−·658	·3408
·4812	−·665	·3439
·4815	−·680	·3445
·4826	−·700	·3464
·4839	−·732	·3487
·4850	−·748	·3506
·4860	−·778	·3524
·4872	−·782	·3545
·4885	−·785	·3568
·4895	−·802	·3586
·4907	−·808	·3607
·4918	−·820	·3626
·4928	−·832	·3644
·4942	−·860	·3669
·4952	−·865	·3686
·4963	−·852	·3706
·4982	−·865	·3739
·4992	−·882	·3757
·5004	−·878	·3778
·5017	−·870	·3801
·5032	−·892	·3828
·5046	−·880	·3852
·5065	−·872	·3886
·5076	−·885	·3905
·5088	−·882	·3926
·5107	−·855	·3960
·5121	−·868	·3985
·5131	−·868	·4002
·5140	−·872	·4018
·5152	−·862	·4039
·5164	−·860	·4060
·5176	−·848	·4082
·5187	−·832	·4101
·5199	−·842	·4122
·5209	−·832	·4140
·5234	−·822	·4184
·5249	−·820	·4210
·5261	−·802	·4232
·5272	−·810	·4251
·5286	−·788	·4276
·5301	−·772	·4302
·5313	−·768	·4323
·5324	−·765	·4343
·5338	−·768	·4367
·5346	−·762	·4382
·5359	−·762	·4404
·5364	−·750	·4413
·5374	−·740	·4431
·5385	−·712	·4450
·5412	−·715	·4498
·5428	−·755	·4526
·5433	−·708	·4535
·5445	−·705	·4556
·5456	−·695	·4576
·5466	−·680	·4593
·5484	−·688	·4625
·5496	−·672	·4646
·5506	−·670	·4664
·5517	−·652	·4683
·5529	−·638	·4704
·5541	−·645	·4726
·5551	−·645	·4743
·5563	−·630	·4764
2386·4835	+·122	·1122
·4859	+·142	·1164
·4887	+·132	·1213
·4915	+·155	·1263
·5002	+·152	·1416
2386·5064	+·137	·1526
·5144	+·185	·1667
·5168	+·167	·1709
·5245	+·180	·1845
·5272	+·180	·1893
·5307	+·225	·1954
·5335	+·195	·2004
·5408	+·225	·2133
·5432	+·220	·2175
·5460	+·215	·2224
·5481	+·217	·2261
·5529	+·272	·2364
·5550	+·202	·2383
·5571	+·185	·2420
·5620	+·190	·2507
·5634	+·172	·2531
·5654	+·150	·2567
·5668	+·122	·2591
·5689	+·102	·2628
·5710	+·130	·2665
·5731	+·070	·2702
·5752	+·058	·2740
·5776	+·030	·2782
·5793	+·007	·2812
·5811	−·038	·2844
·5832	−·070	·2881
2389·3824	+·207	·2263
·3841	+·215	·2293
·3860	+·182	·2327
·3897	+·170	·2392
·3916	+·182	·2426
·3940	+·195	·2468
·3973	+·167	·2526
·4003	+·092	·2579
·4032	+·055	·2630
·4085	+·012	·2724
·4098	−·015	·2747
·4106	−·035	·2761
·4126	−·098	·2796
·4135	−·130	·2812
·4153	−·182	·2844
·4176	−·220	·2884
·4190	−·257	·2909
·4205	−·310	·2936
·4219	−·332	·2960
·4233	−·382	·2985
·4257	−·417	·3027
·4260	−·447	·3033
·4282	−·482	·3071
·4314	−·515	·3128
·4328	−·542	·3151
·4340	−·565	·3174
·4363	−·615	·3214
·4382	−·637	·3248
·4395	−·665	·3271
·4415	−·690	·3306
·4439	−·710	·3348
·4449	−·762	·3366
·4477	−·805	·3415
·4490	−·842	·3438
·4506	−·870	·3467
·4525	−·877	·3500
·4545	−·900	·3535
·4562	−·912	·3565
·4581	−·930	·3599
·4602	−·952	·3636
·4623	−·960	·3673
·4640	−·927	·3703
·4660	−·962	·3738
2389·4683	−·950	·3779
·4701	−·952	·3811
·4720	−·952	·3844
2391·4194	+·058	·8200
·4219	+·078	·8244
·4248	+·125	·8295
·4284	+·060	·8358
·4306	+·080	·8397
·4324	+·080	·8429
·4342	+·075	·8461
·4363	+·062	·8498
·4380	+·072	·8528
·4395	+·080	·8554
·4412	+·095	·8584
·4452	+·102	·8655
·4468	+·088	·8683
·4482	+·102	·8708
·4498	+·095	·8736
·4518	+·090	·8771
·4539	+·125	·8808
·4555	+·092	·8837
·4573	+·130	·8868
·4620	+·105	·8951
·4638	+·098	·8983
·4658	+·110	·9018
·4677	+·115	·9052
·4700	+·112	·9092
·4775	+·118	·9225
·4793	+·122	·9256
·4809	+·120	·9285
·4826	+·138	·9315
·4844	+·135	·9346
·4861	+·122	·9376
·4880	+·145	·9410
·4939	+·118	·9514
·4957	+·128	·9546
·4975	+·140	·9577
·4999	+·135	·9620
·5018	+·132	·9653
·5034	+·125	·9682
·5050	+·130	·9710
·5082	+·145	·9766
·5099	+·135	·9796
·5114	+·148	·9823
·5135	+·138	·9860
·5152	+·154	·9890
·5216	+·150	·0003
·5239	+·122	·0043
·5255	+·122	·0071
·5299	+·148	·0149
·5317	+·118	·0181
·5334	+·132	·0211
·5350	+·128	·0239
·5365	+·128	·0265
·5382	+·135	·0295
·5413	+·142	·0350
·5428	+·140	·0377
·5441	+·145	·0400
·5456	+·128	·0426
·5472	+·128	·0454
·5486	+·118	·0479
·5500	+·130	·0504
2394·4026	+·020	·0828
·4040	+·090	·0853
·4054	+·070	·0878
·4070	+·058	·0906
·4094	+·062	·0948
·4111	+·075	·0978

TABLE II (*continued*)

J.D. Hel. −2430000	Δ*m*	phase	J.D. Hel. −2430000	Δ*m*	phase	J.D. Hel. −2430000	Δ*m*	phase	J.D. Hel. −2430000	Δ*m*	phase
d	m	P	d	m	P	d	m	P	d	m	P
2394·4126	+·082	·1005	2394·5290	−·652	·3058	2398·3976	+·075	·1307	2398·5082	−·872	·3258
·4139	+·072	·1028	·5303	−·680	·3081	·3993	+·080	·1337	·5096	−·900	·3283
·4154	+·080	·1054	·5314	−·712	·3101	·4011	+·097	·1369	·5112	−·882	·3311
·4175	+·077	·1091	·5325	−·750	·3120	·4030	+·092	·1403	·5126	−·888	·3336
·4191	+·090	·1120	·5338	−·767	·3143	·4051	+·105	·1440	·5139	−·885	·3359
·4205	+·067	·1144	·5349	−·790	·3162	·4067	+·115	·1468	·5155	−·888	·3387
·4220	+·082	·1171	·5363	−·820	·3187	·4085	+·115	·1500	·5169	−·888	·3412
·4236	+·095	·1199	·5375	−·840	·3208	·4101	+·127	·1528	·5182	−·897	·3435
·4251	+·072	·1225	·5389	−·865	·3233	·4118	+·130	·1558	·5207	−·897	·3479
·4385	+·117	·1462	·5402	−·885	·3256	·4138	+·125	·1593	·5223	−·900	·3507
·4401	+·112	·1490	·5416	−·907	·3281	·4160	+·132	·1632	·5239	−·878	·3535
·4418	+·132	·1520	·5430	−·917	·3305	·4186	+·122	·1678	·5253	−·882	·3560
·4436	+·110	·1552	·5443	−·940	·3328	·4219	+·152	·1736	·5268	−·860	·3587
·4456	+·125	·1587	·5458	−·947	·3355	·4236	+·145	·1766	·5282	−·860	·3611
·4470	+·147	·1612	·5472	−·955	·3379	·4252	+·150	·1794	·5297	−·832	·3638
·4489	+·142	·1645	·5484	−·972	·3401	·4271	+·167	·1828	·5315	−·840	·3669
·4504	+·140	·1672	·5498	−·977	·3425	·4345	+·175	·1958	·5330	−·840	·3696
·4516	+·145	·1693	·5513	−·975	·3452	·4353	+·190	·1972	·5354	−·830	·3738
·4528	+·157	·1714	·5526	−·985	·3475	·4369	+·160	·2001	·5369	−·817	·3765
·4550	+·172	·1753	·5540	−·982	·3499	·4386	+·162	·2030	·5384	−·807	·3791
·4565	+·165	·1779	·5552	−·982	·3521	·4397	+·180	·2049	·5408	−·788	·3834
·4582	+·177	·1809	·5566	−·990	·3545	·4421	+·172	·2092	·5422	−·795	·3858
·4597	+·162	·1836	·5582	−·982	·3574	·4437	+·197	·2121	·5430	−·785	·3872
·4617	+·175	·1871	·5595	−·980	·3596	·4446	+·160	·2136	·5447	−·765	·3902
·4630	+·185	·1894	·5608	−·972	·3619	·4468	+·155	·2175			
·4645	+·182	·1921	·5624	−·960	·3648	·4484	+·162	·2203	2401·4641	−·370	·5406
·4664	+·177	·1954	·5637	−·957	·3671	·4499	+·142	·2230	·4672	−·347	·5460
·4688	+·190	·1996	·5650	−·952	·3694	·4520	+·150	·2267	·4683	−·327	·5480
·4710	+·190	·2035	·5664	−·947	·3718	·4536	+·142	·2295	·4648	−·322	·5506
·4728	+·207	·2067	·5678	−·945	·3743	·4553	+·115	·2325	·4712	−·325	·5531
·4744	+·210	·2095	·5693	−·927	·3769	·4568	+·100	·2352	·4724	−·310	·5552
·4759	+·210	·2122	·5707	−·912	·3794	·4583	+·110	·2378	·4753	−·295	·5603
·4779	+·210	·2157	·5727	−·897	·3829	·4596	+·088	·2401	·4767	−·310	·5628
·4796	+·192	·2187	·5741	−·905	·3854	·4610	+·080	·2426	·4782	−·295	·5654
·4821	+·205	·2231	·5756	−·890	·3881	·4624	+·062	·2450	·4841	−·272	·5759
·4838	+·205	·2261	·5771	−·875	·3907	·4640	+·042	·2479	·4856	−·292	·5785
·4854	+·177	·2289	·5788	−·867	·3937	·4653	+·017	·2502	·4871	−·275	·5811
·4873	+·192	·2323	·5812:	−·842	·3979	·4666	+·002	·2525			
·4889	+·187	·2351	·5826	−·832	·4004	·4679	−·062	·2547	2406·3653	+·172	·1871
·4903	+·182	·2376	·5846	−·822	·4039	·4694	−·092	·2574	·3674	+·157	·1908
·4917	+·187	·2400				·4706	−·137	·2595	·3695	+·152	·1945
·4931	+·162	·2425	2397·3939	−·885	·3600	·4719	−·162	·2618	·3719	+·170	·1988
·4947	+·122	·2453	·3962	−·890	·3641	·4730	−·195	·2637	·3740	+·135	·2025
·4960	+·132	·2476	·3982	−·870	·3676	·4740	−·240	·2655	·3764	+·150	·2067
·4974	+·132	·2501	·4008	−·857	·3722	·4752	−·262	·2676	·3788	+·147	·2110
·4986	+·122	·2522	·4033	−·845	·3766	·4763	−·297	·2696	·3809	+·120	·2147
·5007	+·097	·2559	·4067	−·842	·3826	·4776	−·350	·2719	·3829	+·117	·2182
·5020	+·085	·2582	·4315	−·685	·4264	·4788	−·380	·2739	·3842	+·120	·2205
·5033	+·060	·2605	·4344	−·665	·4315	·4800	−·415	·2761	·3855	+·112	·2228
·5045	+·040	·2628	·4373	−·655	·4366	·4812	−·460	·2782	·3868	+·105	·2251
·5058	+·015	·2649	·4401	−·645	·4415	·4826	−·488	·2807	·3886	+·062	·2282
·5070	+·007	·2670	·4420	−·610	·4449	·4838	−·537	·2828	·3909	+·045	·2323
·5085	−·052	·2697	·4444	−·610	·4491	·4851	−·560	·2851	·3918	+·042	·2339
·5096	−·075	·2716	·4467	−·580	·4532	·4862	−·590	·2870	·3931	+·022	·2362
·5108	−·110	·2737	·4486	−·570	·4565	·4874	−·615	·2891	·3944	+·020	·2385
·5118	−·135	·2755	·4512	−·570	·4611	·4885	−·657	·2911	·3959	−·022	·2411
·5130	−·160	·2776	·4548	−·542	·4674	·4898	−·675	·2934	·3973	−·048	·2436
·5139	−·215	·2792	·4571	−·535	·4715	·4912	−·705	·2958	·3983	−·075	·2454
·5152	−·247	·2815	·4595	−·530	·4758	·4923	−·712	·2978	·3994	−·097	·2473
·5163	−·265	·2834				·4937	−·738	·3003	·4013	−·110	·2507
·5174	−·317	·2854	2398·3773	+·065	·0949	·4950	−·765	·3026	·4018	−·145	·2515
·5185	−·360	·2873	·3798	+·062	·0993	·4962	−·782	·3047	·4033	−·170	·2542
·5197	−·392	·2894	·3825	+·090	·1041	·4974	−·775	·3068	·4047	−·215	·2566
·5207	−·420	·2912	·3849	+·065	·1083	·4987	−·795	·3091	·4059	−·232	·2588
·5219	−·490	·2933	·3874	+·065	·1127	·5003	−·825	·3119	·4073	−·260	·2612
·5231	−·505	·2954	·3898	+·047	·1170	·5016	−·837	·3142	·4086	−·277	·2635
·5243	−·535	·2975	·3915	+·092	·1200	·5029	−·852	·3165	·4098	−·302	·2656
·5254	−·575	·2995	·3930	+·087	·1226	·5042	−·860	·3188	·4110	−·345	·2678
·5266	−·602	·3016	·3945	+·087	·1253	·5057	−·862	·3214	·4123	−·367	·2700
·5279	−·635	·3039	·3960	+·097	·1279	·5070	−·862	·3237	·4138	−·415	·2727

Table 11 (*continued*)

J.D. Hel. −2430000	Δ*m*	phase
d	m	P
2406·4151	−·445	·2750
·4166	−·460	·2776
·4183	−·490	·2806
·4198	−·522	·2833
·4214	−·542	·2861
·4228	−·555	·2886
·4242	−·562	·2910
·4256	−·588	·2935
·4273	−·595	·2965
·4292	−·627	·2999
·4305	−·660	·3022
·4316	−·645	·3041
·4330	−·655	·3066
·4343	−·682	·3089
·4356	−·682	·3112
·4369	−·692	·3134
·4383	−·712	·3159
·4405	−·717	·3198
·4418	−·732	·3221
·4432	−·745	·3246
·4445	−·732	·3269
·4460	−·757	·3295
·4476	−·740	·3323
·4491	−·747	·3350
·4505	−·752	·3374
·4519	−·732	·3399
·4535	−·750	·3427
·4549	−·755	·3452
·4564	−·752	·3479
·4586	−·747	·3517
·4605	−·732	·3551
·4618	−·722	·3574
·4634	−·732	·3602
·4655	−·725	·3639
·4670	−·692	·3666
·4688	−·700	·3697
·4702	−·705	·3722
·4719	−·687	·3752
·4736	−·692	·3782
·4753	−·667	·3812
·4772	−·670	·3846
·4794	−·677	·3884
·4808	−·657	·3909
·4827	−·637	·3942
2408·4869	+·012	·9300
·4894	+·003	·9344
·4915	+·017	·9381
·4948	+·007	·9439
·4967	+·037	·9473
·4987	−·005	·9508
·5000	+·010	·9531
·5046	−·012	·9612
·5063	+·032	·9642
·5089	+·035	·9688
·5106	+·010	·9718
·5120	+·002	·9743
·5139	−·005	·9776
·5154	+·020	·9803
·5228	+·020	·9933
·5246	+·032	·9965
2409·4173	−·297	·5714
·4197	−·310	·5746
·4220	−·282	·5797
·4240	−·277	·5832
·4264	−·257	·5875
·4296	−·260	·5931
·4310	−·252	·5956
·4328	−·245	·5987

J.D. Hel. −2430000	Δ*m*	phase
d	m	P
2409·4356	−·225	·6037
·4371	−·237	·6063
·4396	−·240	·6107
·4409	−·235	·6130
·4426	−·210	·6160
·4440	−·210	·6185
·4459	−·225	·6219
·4483	−·185	·6261
·4499	−·207	·6289
·4513	−·205	·6314
·4529	−·212	·6342
·4542	−·202	·6365
·4557	−·200	·6394
·4574	−·195	·6421
·4589	−·190	·6448
·4609	−·180	·6483
·4624	−·187	·6510
·4638	−·172	·6534
·5273	−·052	·7655
·5288	−·060	·7681
·5302	−·062	·7706
·5317	−·040	·7732
·5335	−·037	·7764
·5353	−·037	·7796
·5366	−·052	·7819
·5380	−·040	·7843
·5395	−·030	·7870
·5417	−·020	·7909
·5430	−·035	·7932
·5446	−·027	·7960
·5460	−·035	·7984
·5474	−·005	·8009
·5494	−·038	·8044
·5521	−·030	·8092
·5534	−·027	·8115
·5556	−·038	·8154
·5571	−·002	·8180
·5587	−·015	·8209
·5598:	−·018	·8228
2410·3618	+·052	·2377
·3641	+·008	·2417
·3661	−·035	·2452
·3682	−·072	·2490
·3700	−·067	·2521
·3715	−·120	·2548
·3727	−·137	·2569
·3741	−·137	·2594
·3753	−·165	·2615
·3766	−·172	·2638
·3779	−·217	·2661
·3795	−·262	·2689
·3807	−·260	·2710
·3819	−·285	·2731
·3833	−·315	·2756
·3845	−·335	·2777
·3857	−·352	·2798
·3870	−·375	·2821
·3888	−·415	·2853
·3901	−·427	·2876
·3915	−·437	·2901
·3929	−·465	·2925
·3947	−·465	·2957
·3965	−·502	·2989
·3980	−·495	·3015
·3995	−·497	·3042
·4014	−·510	·3075
·4028	−·515	·3100
·4041	−·522	·3123
·4055	−·537	·3148

J.D. Hel. −2430000	Δ*m*	phase
d	m	P
2410·4071	−·527	·3176
·4084	−·525	·3199
·4102	−·560	·3230
·4120	−·567	·3262
·4134	−·552	·3287
·4148	−·580	·3312
·4162	−·585	·3336
·4175	−·585	·3359
·4201	−·595	·3405
·4215	−·595	·3430
·4235	−·605	·3465
·4251	−·620	·3493
·4269	−·617	·3525
·4284	−·625	·3552
·4299	−·622	·3578
·4313	−·625	·3603
·4326	−·625	·3606
·4340	−·617	·3650
·4359	−·625	·3684
·4374	−·632	·3710
·4388	−·630	·3735
·4399	−·612	·3754
·4413	−·607	·3779
·4428	−·602	·3806
·4441	−·612	·3829
·4457	−·615	·3857
·4474	−·597	·3887
·4505	−·600	·3941
·4523	−·592	·3973
·4610	−·567	·4127
·4627	−·577	·4157
·4642	−·562	·4183
·4657	−·562	·4210
·4673	−·555	·4238
·4691	−·555	·4270
·4707	−·545	·4298
·4723	−·542	·4326
·4738	−·552	·4353
·4751	−·537	·4375
·4764	−·540	·4398
·4778	−·530	·4423
·4791	−·517	·4446
·4804	−·535	·4469
·4819	−·525	·4495
·4834	−·517	·4522
·4847	−·515	·4545
·4862	−·495	·4571
·4878	−·497	·4599
·4892	−·495	·4624
·4905	−·480	·4647
2414·3873	−·540	·3393
·3892	−·510	·3427
·3913	−·512	·3464
·3935	−·545	·3503
·3956	−·555	·3540
·3981	−·542	·3584
·4043	−·585	·3693
·4066	−·590	·3734
·4185	−·580	·3767
·4113	−·572	·3817
·4137	−·595	·3859
·4157	−·597	·3895
·4190	−·577	·3953
·4217	−·595	·4000
·4240	−·607	·4040
·4267	−·585	·4089
·4287	−·587	·4124
·4305	−·580	·4156
·4335	−·572	·4209

J.D. Hel. −2430000	Δ*m*	phase
d	m	P
2414·4356	−·562	·4246
·4380	−·567	·4288
·4456	−·557	·4422
·4474	−·557	·4454
·4510	−·535	·4517
·4531	−·550	·4554
·4557	−·540	·4600
·4574	−·547	·4630
·4602	−·545	·4680
·4626	−·512	·4722
·4647	−·500	·4759
2415·4088	+·117	·1415
·4102	+·120	·1439
·4120	+·115	·1471
·4150	+·125	·1524
·4168	+·140	·1556
·4185	+·160	·1586
·4209	+·160	·1628
·4226	+·165	·1658
·4243	+·170	·1688
·4259	+·155	·1716
·4277	+·150	·1747
·4296	+·180	·1781
·4316	+·182	·1817
·4329	+·202	·1840
·4350	+·180	·1877
·4363	+·172	·1900
·4377	+·180	·1924
·4395	+·180	·1956
·4411	+·162	·1984
·4426	+·170	·2011
·4440	+·185	·2036
·4455	+·175	·2062
·4472	+·180	·2092
·4509	+·190	·2157
·4524	+·180	·2184
·4539	+·180	·2210
·4555	+·170	·2258
·4572	+·165	·2268
·4590	+·170	·2300
·4607	+·137	·2330
·4621	+·122	·2335
·4635	+·105	·2380
·4652	+·102	·2410
·4666	+·050	·2434
·4681	+·045	·2461
·4694	+·062	·2484
·4715	+·015	·2521
·4726	+·020	·2540
·4736	+·038	·2558
·4749	−·025	·2581
·4760	−·030	·2600
·4771	−·055	·2619
·4784	−·050	·2642
·4799	−·080	·2669
·4813	−·122	·2694
·4828	−·125	·2720
·4840	−·157	·2741
·4854	−·205	·2765
·4870	−·242	·2794
·4883	−·270	·2817
·4896	−·297	·2840
·4908	−·322	·2861
·4923	−·330	·2888
·4934	−·390	·2907
·4952	−·382	·2939
·4960	−·387	·2953
·4973	−·387	·2976
·4986	−·397	·2999

TABLE 11 (*continued*)

J.D. Hel. −2430000	Δm	phase	J.D. Hel. −2430000	Δm	phase	J.D. Hel. −2430000	Δm	phase	J.D. Hel. −2430000	Δm	phase
d	m	P	d	m	P	d	m	P	d	m	P
2415·5002	−·422	·3027	2418·4652	−·475	·5335	2419·4901	−·352	·3416	2423·3477	+·122	·1471
·5018	−·410	·3055	·4707	−·450	·5432	·4918	−·382	·3446	·3493	+·130	·1499
·5032	−·415	·3080	·4730	−·445	·5472	·4931	−·422	·3469	·3508	+·130	·1525
·5046	−·410	·3105	·4747	−·437	·5502	·4945	−·407	·3493	·3527	+·142	·1559
·5065	−·447	·3138	·4779	−·432	·5559	·4969	−·430	·3536	·3541	+·142	·1583
·5087	−·425	·3177	·4799	−·425	·5594	·4982	−·472	·3559	·3560	+·170	·1617
·5099	−·430	·3198	·4826	−·425	·5642	·4994	−·447	·3580	·3587	+·182	·1665
·5113	−·440	·3223	·4848	−·422	·5681	·5006	−·452	·3601	·3604	+·157	·1695
·5128	−·447	·3249	·4879	−·395	·5735	·5018	−·480	·3622	·3728	+·200	·1913
·5145	−·467	·3279	·4902	−·382	·5776	·5030	−·497	·3643	·3747	+·190	·1947
·5160	−·452	·3306	·4924	−·377	·5815	·5046	−·515	·3672	·3768	+·200	·1984
·5173	−·465	·3329	·4942	−·377	·5846	·5059	−·525	·3695	·3784	+·192	·2012
·5188	−·460	·3355	·4966	−·365	·5889	·5074	−·532	·3721	·3798	+·197	·2037
·5200	−·475	·3376	·4983	−·375	·5919	·5089	−·537	·3747	·3813	+·187	·2063
·5206	−·480	·3387	·5004	−·350	·5956	·5113	−·560	·3790	·3828	+·207	·2090
·5228	−·490	·3426	·5077	−·322	·6085	·5127	−·572	·3814	·3845:	+·202	·2120
·5244	−·515	·3454	·5096	−·330	·6118	·5143	−·600	·3843	·3862	+·232	·2150
·5261	−·520	·3484	·5117	−·327	·6155	·5158	−·580	·3869	·3878	+·205	·2178
·5279	−·520	·3516				·5172	−·592	·3894	·3892	+·225	·2203
·5294	−·525	·3542	2419·3915	+·220	·1676	·5187	−·622	·3920	·3910	+·215	·2234
·5311	−·547	·3572	·3957	+·060	·1750	·5196	−·622	·3936	·3930	+·200	·2270
·5325	−·555	·3597	·3981	+·170	·1793	·5221	−·627	·3980	·3948	+·220	·2301
·5339	−·575	·3622	·4009	+·185	·1842	·5234	−·647	·4003	·3966	+·215	·2333
·5353	−·555	·3646	·4050	+·157	·1914	·5332	−·630	·4176	·3983	+·210	·2363
·5366	−·560	·3669	·4068	+·210	·1946	·5342	−·652	·4194	·3998	+·177	·2390
·5384	−·557	·3701	·4092	+·202	·1989	·5354	−·675	·4215	·4011	+·197	·2413
·5400	−·550	·3729	·4120	+·190	·2038	·5370	−·645	·4243	·4053	+·187	·2487
·5412	−·565	·3750	·4138	+·175	·2070				·4077	+·142	·2529
·5425	−·570	·3773	·4193	+·072	·2167	2420·4075	+·045	·9600	·4090	+·155	·2552
			·4234	+·180	·2239	·4089	+·055	·9625	·4101	+·135	·2571
2418·3830	−·555	·3885	·4250	+·175	·2267	·4103	+·052	·9650	·4119	+·125	·2603
·3850	−·610	·3920	·4266	+·185	·2296	·4117	+·057	·9674	·4133	+·107	·2628
·3869	−·600	·3953	·4287	+·165	·2333	·4134	+·070	·9704	·4137	+·087	·2635
·3884	−·610	·3980	·4311	+·165	·2375	·4151	+·067	·9734	·4149	+·087	·2656
·3891	−·632	·3992	·4328	+·150	·2405	·4198	+·057	·9817	·4160	+·060	·2676
·3915	−·640	·4035	·4352	+·157	·2447	·4214	+·065	·9846	·4170	+·065	·2693
·3932	−·632	·4065	·4368	+·135	·2475	·4230	+·075	·9874	·4184	+·055	·2718
·3945	−·630	·4087	·4384	+·132	·2504	·4243	+·062	·9897	·4195	+·055	·2737
·3960	−·645	·4114	·4405	+·085	·2541	·4259	+·060	·9925	·4204	+·035	·2753
·3972	−·645	·4135	·4420	+·067	·2567	·4276	+·060	·9955	·4215	+·022	·2773
·3990	−·647	·4167	·4434	+·060	·2592	·4318	+·097	·0029	·4226	+·005	·2792
·4004	−·640	·4192	·4445	+·067	·2611	·4330	+·085	·0050	·4239	−·020	·2815
·4025	−·650	·4229	·4458	+·010	·2634	·4346	+·065	·0078	·4255	−·042	·2843
·4037	−·637	·4250	·4471	+·008	·2657	·4360	+·072	·0103	·4265	−·047	·2861
·4051	−·642	·4274	·4494	+·002	·2698	·4374	+·080	·0128	·4274	−·060	·2877
·4068	−·640	·4304	·4502	·000	·2712	·4387	+·087	·0151	·4287	−·097	·2900
·4082	−·620	·4329	·4515	−·028	·2735	·4401	+·080	·0175	·4298	−·110	·2919
·4096	−·632	·4354	·4529	−·055	·2760	·4417	+·100	·0204	·4311	−·140	·2942
·4111	−·625	·4380	·4546	−·085	·2789	·4431	+·095	·0228	·4324	−·167	·2965
·4123	−·635	·4402	·4569	−·132	·2830	·4446	+·102	·0255	·4337	−·172	·2988
·4137	−·625	·4426	·4587	−·182	·2862	·4551	+·102	·0440	·4349	−·187	·3009
·4164	−·630	·4474	·4604	−·195	·2892	·4572	+·095	·0477	·4361	−·222	·3030
·4182	−·625	·4506	·4623	−·227	·2925	·4599	+·085	·0525	·4373	−·255	·3051
·4204	−·612	·4544	·4641	−·292	·2957	·4634	+·085	·0586	·4387	−·260	·3076
·4223	−·610	·4578	·4655	−·295	·2982	·4655	+·060	·0624	·4400	−·275	·3099
·4251	−·605	·4627	·4670	−·282	·3008	·4683	+·065	·0673	·4415	−·305	·3125
·4272	−·602	·4664	·4690	−·310	·3044	·4710	+·047	·0721	·4426	−·295	·3145
·4299	−·590	·4712	·4705	−·327	·3070	·4728	+·067	·0752	·4439	−·295	·3168
·4317	−·587	·4744	·4721	−·327	·3098	·4749	+·065	·0789	·4452	−·290	·3191
·4338	−·587	·4781	·4734	−·322	·3121	·4766	+·040	·0819	·4464	−·330	·3212
·4442	−·547	·4964	·4752	−·340	·3153	·4783	+·062	·0849	·4478	−·325	·3237
·4458	−·537	·4992	·4769	−·352	·3183	·4818	+·080	·0911	·4491	−·335	·3259
·4480	−·537	·5031	·4790	−·335	·3220	·4839	+·070	·0948	·4505	−·340	·3284
·4503	−·525	·5072	·4807	−·330	·3250	·4860	+·070	·0985	·4522	−·365	·3314
·4531	−·512	·5121	·4824	−·335	·3280	·4887	+·075	·1033	·4535	−·382	·3337
·4549	−·505	·5153	·4838	−·357	·3305	·4901	+·075	·1058	·4548	−·395	·3360
·4570	−·500	·5190	·4849	−·365	·3324	·4933	+·090	·1114	·4560	−·400	·3381
·4588	−·490	·5222	·4861	−·355	·3345	·4953	+·100	·1149	·4576	−·420	·3409
·4608	−·492	·5257	·4872	−·392	·3365	·4978	+·095	·1193	·4600	−·415	·3452
·4633	−·485	·5301	·4886	−·392	·3389	·5026	+·094	·1278	·4611	−·437	·3471

TABLE 11 (*continued*)

J.D. Hel. −2430000	Δ*m*	phase
d	m	P
2423·4623	−·450	·3492
·4634	−·455	·3512
·4646	−·457	·3533
·4656	−·470	·3551
·4669	−·492	·3573
·4682	−·510	·3596
·4693	−·532	·3616
·4703	−·547	·3639
·4719	−·555	·3662
·4730	−·587	·3681
·4743	−·582	·3704
·4754	−·602	·3723
·4769	−·650	·3750
·4793	−·672	·3792
·4805	−·660	·3813
2424·5222	+·135	·2191
·5245	+·195	·2231
·5261	+·207	·2260
·5279	+·202	·2291
·5292	+·190	·2314
·5305	+·180	·2337
·5346	+·195	·2410
·5367	+·170	·2447
·5381	+·160	·2471
·5398	+·140	·2501
·5418	+·175	·2537
·5424	+·150	·2547
·5438	+·122	·2572
·5467	+·105	·2623
·5481	+·100	·2648
·5495	+·080	·2672
·5499	+·082	·2679
·5511	+·065	·2701
·5522	+·052	·2720
·5534	+·052	·2741
·5548	+·045	·2766
·5559	+·022	·2785
·5572	+·002	·2808
·5584	−·032	·2829
·5595	−·048	·2849
·5607	−·077	·2870
·5620	−·080	·2893
·5637	−·135	·2923
·5653	−·152	·2951
·5667	−·195	·2976
·5681	−·235	·3001
·5695	−·255	·3025
·5709	−·282	·3050
·5723	−·282	·3075
·5736	−·315	·3098
·5749	−·320	·3121
·5764	−·312	·3147
·5778	−·330	·3172
·5795	−·335	·3202
·5811	−·337	·3230
·5823	−·362	·3251
·5837	−·352	·3276
·5850	−·387	·3299
·5865	−·362	·3325
·5878	−·370	·3348
·5890	−·392	·3369
·5903	−·425	·3392
·5915	−·407	·3412
·5928	−·437	·3436
·5941	−·460	·3459
·5953	−·462	·3480
·5966	−·495	·3503
·5979	−·517	·3526
·5992	−·515	·3549

J.D. Hel. −2430000	Δ*m*	phase
d	m	P
2424·6005	−·537	·3572
·6018	−·567	·3595
·6032	−·600	·3620
·6048	−·615	·3648
·6061	−·620	·3671
·6075	−·652	·3696
·6091	−·692	·3724
·6103	−·705	·3745
·6117	−·697	·3770
·6130	−·707	·3793
·6143	−·732	·3816
·6158	−·745	·3842
·6174	−·765	·3870
·6187	−·765	·3893
·6201	−·780	·3918
·6213	−·782	·3939
·6225	−·787	·3960
·6245	−·785	·3996
·6257	−·782	·4017
2426·3395	−·820	·4251
·3418	−·802	·4292
·3442	−·807	·4334
·3471	−·780	·4385
·3493	−·770	·4424
·3522	−·755	·4475
·3552	−·742	·4528
·3574	−·735	·4567
·3595	−·720	·4604
·4143	−·455	·5571
·4165	−·435	·5610
·4187	−·440	·5648
·4211	−·420	·5691
·4235	−·430	·5733
·4256	−·402	·5770
2427·3952	−·065	·2876
·3965	−·085	·2898
·3980	−·130	·2925
·3997	−·152	·2955
·4009	−·150	·2976
·4024	−·180	·3003
·4056	−·250	·3059
·4068	−·260	·3080
·4082	−·260	·3105
·4093	−·260	·3124
·4108	−·292	·3151
·4119	−·325	·3170
·4130	−·312	·3190
·4142	−·325	·3211
·4155	−·365	·3234
·4169	−·377	·3258
·4182	−·400	·3281
·4194	−·410	·3302
·4205	−·415	·3322
·4217	−·455	·3343
·4229	−·465	·3364
·4241	−·475	·3385
·4253	−·480	·3407
·4258	−·495	·3415
·4278	−·532	·3451
·4294	−·565	·3479
·4306	−·592	·3500
·4315	−·615	·3516
·4328	−·640	·3539
·4340	−·665	·3560
·4352	−·662	·3581
·4365	−·680	·3604
·4377	−·715	·3625
·4390	−·745	·3648

J.D. Hel. −2430000	Δ*m*	phase
d	m	P
2427·4402	−·762	·3669
·4413	−·760	·3689
·4425	−·785	·3710
·4436	−·800	·3729
·4447	−·817	·3749
·4463	−·822	·3777
·4475	−·845	·3798
·4488	−·845	·3821
·4499	−·865	·3841
·4513	−·870	·3865
·4524	−·887	·3885
·4537	−·875	·3908
·4550	−·860	·3931
·4561	−·862	·3950
·4572	−·870	·3969
·4584	−·875	·3990
·4595	−·870	·4010
·4607	−·870	·4031
·4618	−·865	·4050
·4631	−·857	·4073
·4642	−·862	·4093
·4660	−·842	·4125
·4664	−·845	·4132
·4677	−·840	·4155
·4689	−·822	·4176
·4699	−·815	·4193
·4713	−·817	·4218
·4724	−·812	·4237
·4736	−·832	·4259
·4751	−·815	·4285
·4762	−·827	·4305
·4775	−·820	·4327
·4790	−·790	·4354
·4808	−·797	·4386
·4821	−·765	·4409
2431·3450	+·137	·2557
·3467	+·122	·2587
·3488	+·105	·2624
·3506	+·075	·2656
·3530	+·062	·2698
·3554	+·055	·2740
·3572	−·010	·2772
·3591	−·042	·2806
·3613	−·092	·2844
·3629	−·125	·2873
·3644	−·145	·2899
·3657	−·185	·2922
·3672	−·207	·2949
·3684	−·240	·2970
·3697	−·265	·2993
·3708	−·305	·3012
·3721	−·322	·3035
·3732	−·347	·3054
·3743	−·365	·3074
·3755	−·392	·3095
·3766	−·420	·3114
·3786	−·455	·3150
·3797	−·492	·3169
·3809	−·495	·3190
·3820	−·530	·3210
·3831	−·550	·3229
·3841	−·565	·3247
·3856	−·605	·3273
2432·4848	+·080	·2665
·4865	+·040	.2695
·4881	+·025	·2723
·4898	−·020	·2753
·4913	−·032	·2780

J.D. Hel. −2430000	Δ*m*	phase
d	m	P
2432·4927	−·070	·2804
·4942	−·085	·2831
·4956	−·125	·2855
·4982	−·160	·2901
·4989	−·192	·2914
·5011	−·262	·2953
·5025	−·310	·2977
·5037	−·325	·2998
·5049	−·367	·3020
·5066	−·390	·3050
·5091	−·405	·3094
·5102	−·462	·3113
·5117	−·505	·3140
·5140	−·542	·3180
·5160	−·610	·3215
·5169	−·617	·3231
·5183	−·645	·3256
·5197	−·687	·3281
·5212	−·730	·3307
·5246	−·820	·3367
·5259	−·830	·3390
·5272	−·850	·3413
·5286	−·900	·3438
·5299	−·897	·3461
·5312	−·917	·3484
·5327	−·925	·3510
·5341	−·900	·3535
·5355	−·952	·3559
·5385	−·955	·3612
·5398	−·957	·3635
·5405	−·990	·3648
·5427	−·957	·3686
·5441	−·952	·3711
·5453	−·950	·3732
·5468	−·962	·3759
·5483	−·925	·3785
·5497	−·935	·3810
·5511	−·935	·3835
·5525	−·925	·3859
·5539	−·912	·3884
·5599	−·807	·3990
·5612	−·855	·4013
·5625	−·860	·4036
·5638	−·832	·4059
·5651	−·802	·4082
·5664	−·845	·4105
2433·3422	−·047	·7791
·3446	−·002	·7833
·3467	+·007	·7870
·3488	+·005	·7907
·3505	+·022	·7937
·3523	+·022	·7969
·3540	+·017	·7999
·3561	+·027	·8036
·3582	+·042	·8073
·3603	+·045	·8110
·3620	+·042	·8140
·3641	+·052	·8177
·3662	+·047	·8214
·3682	+·042	·8250
·3703	+·078	·8287
2440·3365	+·062	·1183
·3380	+·042	·1209
·3398	+·018	·1241
·3418	+·052	·1276
·3432	+·050	·1301
·3448	+·105	·1329
·3615	+·100	·1624

TABLE II (*continued*)

J.D. Hel. −2430000	Δm	phase
d	m	P
2440·3630	+·100	·1650
·3645	+·095	·1677
·3674	+·100	·1728
·3691	+·145	·1758
·3706	+·140	·1784
2441·5611	−·440	·2787
·5628	−·478	·2817
·5645	−·538	·2847
·5664	−·568	·2880
·5681	−·618	·2910
·5698	−·658	·2940
·5713	−·690	·2967
·5730	−·712	·2997
·5744	−·745	·3021
·5766	−·812	·3060
·5782	−·825	·3088
·5798	−·845	·3117
2444·3596	+·152	·2157
·3604	+·148	·2171
·3632	+·140	·2221
·3649	+·142	·2251
·3679	+·112	·2304
·3693	+·050	·2328
·3704	+·110	·2348
·3716	+·092	·2369
·3730	+·052	·2394
·3744	+·028	·2418
·3763	+·005	·2452
·3777	−·020	·2476
·3784	−·052	·2498
·3804	−·095	·2524
·3818	−·150	·2549
·3834	−·182	·2577
·3843	−·248	·2593
·3864	−·280	·2630
·3875	−·338	·2649
·3886	−·382	·2669
·3914	−·470	·2718
·3928	−·550	·2743
·3940	−·540	·2764
·3951	−·572	·2783
·3964	−·610	·2806
·3976	−·640	·2828
·3987	−·655	·2847
·3999	−·685	·2868
·4011	−·700	·2889
·4029	−·748	·2921
·4040	−·782	·2940
·4054	−·795	·2965
·4066	−·808	·2986
·4077	−·818	·3006
·4097	−·842	·3041
·4112	−·852	·3067
·4125	−·855	·3090
·4136	−·850	·3110
·4153	−·880	·3140
·4167	−·895	·3164
·4182	−·892	·3191
·4193	−·895	·3210
·4206	−·898	·3233
·4217	−·908	·3253
·4245	−·918	·3302
·4259	−·922	·3327
·4274	−·912	·3353
·4284	−·910	·3371
·4296	−·890	·3392
·4306	−·898	·3410
·4319	−·890	·3433

J.D. Hel. −2430000	Δm	phase
d	m	P
2444·4333	−·882	·3457
·4358	−·885	·3501
·4369	−·885	·3521
·4375	−·872	·3531
·4385	−·855	·3549
·4411	−·852	·3595
·4422	−·852	·3614
·4434	−·848	·3636
·4445	−·818	·3655
·4463	−·802	·3687
·4477	−·800	·3711
·4491	−·800	·3736
·4503	−·780	·3757
·4516	−·780	·3780
·4529	−·782	·3803
·4541	−·762	·3824
·4554	−·755	·3847
·4565	−·748	·3867
·4581	−·718	·3895
·4594	−·718	·3918
·4613	−·718	·3951
·4626	−·710	·3974
·4638	−·710	·3995
·4653	−·715	·4022
2453·3953	+·112	·1563
·3973	+·172	·1598
·3996	+·148	·1639
·4016	+·158	·1674
·4053	+·188	·1739
·4076	+·182	·1780
·4099	+·200	·1820
·4117	+·188	·1852
·4138	+·160	·1889
·4161	+·200	·1930
·4188	+·182	·1977
·4213	+·178	·2021
·4238	+·148	·2065
·4261	+·155	·2106
·4284	+·165	·2147
·4311	+·138	·2194
·4335	+·118	·2237
·4360	+·115	·2281
·4393	+·080	·2339
·4413	+·060	·2374
·4436	+·045	·2432
·4459	+·010	·2455
·4470	−·052	·2475
·4503	−·115	·2533
·4526	−·170	·2574
·4548	−·202	·2612
·4569	−·270	·2649
·4590	−·325	·2686
·4612	−·372	·2725
·4635	−·418	·2766
·4659	−·480	·2810
·4680	−·532	·2845
·4708	−·530	·2895
·4729	−·570	·2932
·4751	−·570	·2970
·4779	−·588	·3020
·4801	−·588	·3059
·4822	−·630	·3096
·4847	−·645	·3140
·4870	−·650	·3180
·4892	−·655	·3219
·4913	−·665	·3256
·4943	−·688	·3309
·4976	−·665	·3367
·4998	−·692	·3406

J.D. Hel. −2430000	Δm	phase
d	m	P
2453·5113	−·700	·3609
·5136	−·675	·3650
·5183	−·692	·3733
·5203	−·685	·3768
·5226	−·685	·3808
·5246	−·688	·3844
·5293	−·690	·3927
·5314	−·658	·3964
·5334	−·648	·3999
2461·3418	+·150	·1752
·3442	+·180	·1795
·3458	+·160	·1823
·3474	+·180	·1852
·3491	+·182	·1882
·3509	+·198	·1913
·3526	+·182	·1943
·3548	+·205	·1982
·3573	+·208	·2026
·3600	+·195	·2074
·3623	+·188	·2114
·3646	+·185	·2155
·3676	+·142	·2208
·3705	+·138	·2259
·3738	+·138	·2317
·3763	+·125	·2361
·3784	+·128	·2398
·3799	+·132	·2425
·3830	+·115	·2480
·3849	+·062	·2513
·3865	+·060	·2541
·3888	+·022	·2582
·3919	−·018	·2637
·3933	−·052	·2661
·3948	−·078	·2688
·3962	−·100	·2713
·3979	−·128	·2742
·3997	−·180	·2774
·4010	−·212	·2797
·4024	−·230	·2822
·4042	−·272	·2854
·4059	−·310	·2884
·4072	−·332	·2907
·4086	−·362	·2931
·4101	−·382	·2958
·4121	−·392	·2993
·4140	−·395	·3027
·4159	−·392	·3060
·4178	−·405	·3094
·4197	−·398	·3127
·4212	−·400	·3154
·4227	−·395	·3180
·4253	−·420	·3226
·4267	−·435	·3251
·4281	−·452	·3275
·4301	−·485	·3311
·4317	−·492	·3338
·4330	−·510	·3362
·4347	−·518	·3392
·4367	−·548	·3427
·4382	−·552	·3453
·4399	−·575	·3483
·4408	−·590	·3499
·4422	−·590	·3524
·4435	−·608	·3547
·4448	−·635	·3570
·4461	−·645	·3593
·4476	−·660	·3619
·4506	−·675	·3672
·4520	−·700	·3696

J.D. Hel. −2430000	Δm	phase
d	m	P
2461·4534	−·690	·3722
·4545	−·702	·3741
·4558	−·692	·3764
·4571	−·685	·3786
·4584	−·705	·3810
·4597	−·698	·3833
·4624	−·710	·3880
·4639	−·712	·3907
·4652	−·708	·3930
·4664	−·715	·3951
·4676	−·705	·3972
·4692	−·715	·4000
·4704	−·715	·4022
·4714	−·688	·4039
·4730	−·660	·4067
·4747	−·708	·4097
·4762	−·718	·4124
2465·3299	+·122	·2106
·3317	+·182	·2142
·3332	+·180	·2168
·3349	+·182	·2198
·3366	+·202	·2228
·3386	+·155	·2263
·3393	+·165	·2276
·3405	+·202	·2297
·3420	+·162	·2323
·3440	+·188	·2359
·3455	+·165	·2385
·3470	+·155	·2412
·3485	+·142	·2438
·3502	+·128	·2468
·3524	+·120	·2507
·3539	+·105	·2533
·3553	+·068	·2558
·3567	+·052	·2583
·3580	+·070	·2606
·3594	+·022	·2630
·3610	+·018	·2658
·3627	−·005	·2688
·3643	−·038	·2717
·3658	−·045	·2743
·3671	−·070	·2766
·3688	−·135	·2796
·3703	−·132	·2823
·3719	−·160	·2851
·3722	−·220	·2874
·3745	−·242	·2897
·3758	−·320	·2920
·3789	−·352	·2974
·3801	−·352	·2995
·3813	−·362	·3017
·3827	−·362	·3041
·3841	−·350	·3066
2478·3722	+·145	·2199
·3775	+·135	·2292
·3809	+·098	·2352
·3827	+·080	·2384
·3848	+·050	·2421
·3868	+·025	·2456
·3890	−·005	·2495
·3907	−·045	·2525
·3922	−·058	·2552
·3933	−·082	·2571
·3946	−·080	·2594
·3961	−·122	·2620
·3973	−·168	·2642
·3984	−·205	·2661
·3998	−·215	·2686

TABLE II (*continued*)

J.D. Hel. −2430000	Δ*m*	phase	J.D. Hel. −2430000	Δ*m*	phase	J.D. Hel. −2430000	Δ*m*	phase	J.D. Hel. −2430000	Δ*m*	phase
d	m	P	d	m	P	d	m	P	d	m	P
2478·4009	−·242	·2705	2478·4320	−·765	·3254	2486·3052	+·142	·2151	2486·3607	−·692	·3130
·4021	−·265	·2726	·4331	−·762	·3273	·3073	+·125	·2188	·3629	−·740	·3169
·4032	−·279	·2746	·4345	−·788	·3298	·3092	+·140	·2221	·3646	−·758	·3199
·4046	−·322	·2770	·4356	−·812	·3317	·3124	+·105	·2277	·3666	−·760	·3234
·4061	−·342	·2796	·4366	−·815	·3335	·3144	+·075	·2313	·3683	−·762	·3264
·4071	−·395	·2814	·4378	−·828	·3356	·3165	+·062	·2350	·3700	−·780	·3294
·4081	−·412	·2832	·4396	−·832	·3388	·3187	+·012	·2389	·3720	−·768	·3329
·4092	−·412	·2852	·4406	−·812	·3405	·3203	+·000	·2417	·3739	−·772	·3363
·4103	−·430	·2871	·4410	−·850	·3413	·3224	−·035	·2454	·3761	−·772	·3402
·4118	−·452	·2897	·4429	−·852	·3446	·3245	−·062	·2491	·3779	−·788	·3433
·4129	−·475	·2917	·4440	−·862	·3465	·3264	−·087	·2525	·3799	−·772	·3469
·4140	−·472	·2936	·4453	−·855	·3488	·3282	−·142	·2556	·3814	−·772	·3495
·4151	−·510	·2956	·4464	−·845	·3508	·3299	−·165	·2586	·3837	−·765	·3536
·4163	−·538	·2977	·4475	−·828	·3527	·3320	−·242	·2624	·3857	−·758	·3571
·4186	−·555	·3017	·4485	−·828	·3545	·3338	−·292	·2655	·3873	−·755	·3599
·4197	−·585	·3037	·4497	−·828	·3566	·3360	−·332	·2694	·3889	−·755	·3627
·4208	−·600	·3056	·4507	−·822	·3584	·3380	−·360	·2729	·3908	−·747	·3661
·4218	−·630	·3074	·4518	−·835	·3603	·3403	−·425	·2770	·3924	−·732	·3689
·4229	−·652	·3093	·4529	−·835	·3622	·3439	−·438	·2833	·3940	−·747	·3717
·4239	−·662	·3111	·4543	−·832	·3638	·3458	−·500	·2867	·3958	−·732	·3749
·4249	−·662	·3128	·4554	−·825	·3658	·3476	−·485	·2899	·3974	−·708	·3777
·4259	−·682	·3146	·4567	−·835	·3681	·3500	−·550	·2941	·3992	−·708	·3809
·4269	−·692	·3163	·4578	−·815	·3700	·3521	−·580	·2978	·4020	−·682	·3858
·4280	−·705	·3183	·4588	−·808	·3717	·3536	−·612	·3005	·4036	−·678	·3887
·4290	−·725	·3201	·4594	−·788	·3737	·3556	−·622	·3040	·4054	−·672	·3918
·4300	−·742	·3218	·4610	−·798	·3757	·3573	−·658	·3070	·4076	−·670	·3957
·4310	−·752	·3236				·3589	−·680	·3098	·4091	−·662	·3984

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