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New insight into the period variations in field Galactic RRab stars

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ABSTRACT

Context . The theory of stellar evolution can be more closely tested today with more RRab stars than in 2007.

Aims. We collected a lot of new very accurate times of maximum brightness of the galactic RRab stars in the GEOS database. We go on with automated telescopes and stimulate the interest of individual observers. We compare our results with other studies.

Methods. As in 2007, we analyzed the stars showing a clear O-C pattern (constant, parabolic or erratic) by means of different least-square methods, but we have now 246 RRab instead of 123.

Results. Clear evidence of period increases or decreases at constant rates has been found even with smaller rates thanks to the new very accurate data. The suggested evolutionary effects are nearer those of the theory but always too large. The number of increasing RRab is now twice this of decreasing one as found in Globular clusters RRab stars.

Key words. Astronomical data bases: miscellaneous – Stars: evolution – Stars: horizontal – branch – Stars: variables: RR Lyr.

1. Introduction

Since our first paper on the RRab period evolution (Le Borgne et al., 2007), we have gone on to fill up the GEOS RR Lyrae database (http://rr.ast.obs-mip.fr/dbrr-V1,0_0.php) with the times of maxima observed by the TAROT telescopes (Bringer et al., 1999), the team of individual observers collaborating with GEOS and by all the new times published in various papers. The GEOS RR Lyrae database being more and more known and used, more professional and amateur astronomers are publishing their times of maximum brightness, for instance, American and even Japanese. It is so that we have been able to double the number of RRab stars with enough times of maximum brightness during 50 till more than 120 years and showing a clear O-C pattern. It is the evolution of the period of these RRab stars that we have revisited here, obtaining some different results. We publish also the new elements of the period of more than 500 other RRab and RRc stars in order to give recent and coherent values calculated for all the laps of time covered by data in the GEOS database.

2. RR Lyrae period variations, preceding results

We have read the papers yet published on our subject. Generally, the data are providing from measurements of RR Lyrae in Globular Clusters because they are containing a great number of those variable stars with several common characteristics as distance, metallicity and ages. Our data are coming from RR Lyrae of the field of our Galaxy. We have thus a large panel of all kinds of RRab Lyrae and, if we do not study the RRc subtype, it is only because our data about them are nor numerous or accurate enough. So, we have obtained more general results on RRab with also insight into some details. Here are the published results that can be compared with ours.

P.G. Rathbun and H.A. Smith, 1997. We have here the study of the period changes of RRab and RRcd in seven Globular Clusters from data found in the literature. The authors found that "the observed rates of period change in RR Lyrae stars can be both an order of magnitude too large and of the wrong sign when compared to the expectations of stellar evolution theory". If they eliminate one of the clusters, they reduce but not eliminate the excess of RRab Stars showing large rates of period decrease compared to increase. They obtained also some RR Lyrae with irregular period changes.

J. Jurcsik et al., 2001. It is an analyse of the period changes in the ω centauri RR Lyrae stars. As concerns the RRab subtype, periods increases of 10^{-11} to 10^{-9} days days^{-1} dominates in most of these stars in agreement with evolutionary model predictions for the late redward phase of the horizontal-branch evolution. But there is also RRab with irregular period changes and one very large period decrease rate with no satisfactory explanation.

A. Kunder et al., 2011. Then years after the above-mentioned paper, the observed period variations of the RR Lyrae stars are always setting some problems to be explained by the theoretical models. The period rates of change are very similar for the RR Lyrae in Oosterhoff I and Oosterhoff II globular systems. There are everywhere more increasing periods than decreasing periods and the rates of change are too large.

J. Jurcsik et al., 2011. They have worked on a 120 years photometric monitoring of 134 RR (ab and c) Lyrae in M3. They arrived at the conclusion that the mean period-change rates are in harmony with the HB models, but that they are a great part of stars which period-changes are in contradiction.

J.-F. Le Borgne et al, 2007. In our first paper about the RRab of the field of the Galaxy period evolution, we had « only » 123 RRab in our data and we found that the decreasing periods were slightly less than the increasing periods. The period changes were larger than expected, the variations could be very complicated in some cases and the Blazhko effect was often surimposed on secular changes.

M. Sarka, 2013. This paper is very useful to know witch RRab have sure published Blazhko effect surimposed on the secular period variation.

3. New sample of data

With the great number of new maxima brightness added in the GEOS RR Lyrae database these six last years, we have doubled the number of RRab variables with at least 20 maxima covered 50 years or more given a valuable curve of the O-C's.

The new times of maxima are generally obtained from very good ccd measurements and they are nearly ten times more accurate than the visual and photographic instants of the beginning of the XXth century. We have now, for more and more RRab stars, a good idea on period variations at long, short and very short times. For example, if we know that an RRab has a strong Blazhko effect, we shall not be surprised to have an O-C light curve with oscillations of ± 0.02 day and a greater than usual sigma of the O-C's.

We have used the same method as described in Le Borgne et al., 2007. As concerns the results with our new sample of 246 stars instead of 123, the great differences are that the number of increasing periods is now twice this of the decreasing periods and that the constant periods are still more numerous.

Table 1: Inventory of the O-C patterns of the RRab stars of our new sample compared with this of 2007

Period	2013	2007
constant	116 (47%)	54 (44%)
increasing	63 (26%)	27 (22%)
decreasing	32 (13%)	21 (17%)
irregular	35 (14%)	21 (17%)
sum	246 (100%)	123 (100%)

4. The RRab with constant period

We have now 116 RRab with a constant period during at least 50 years (47% of our sample). We have been induced to change the constant classification for five RRab: the new accurate data allow us to determine the increase rate of RV Oct and AS Vir and the decrease rate of SZ Gem and ST Oph ; they also allow us to see that GV And has had a rapid period change. We have far more constant periods than found in Globular Clusters. We can think that they are evolving, for a great part of them, on the way to the blue where the evolution is very slow and, for a less part of them, on the beginning of the way to the red, where the rates of change are too faint to be detected with the accuracy of our data during a laps of time of only 50 to 120 years. There are probably more RRab of the field of the Galaxy in these stages of evolution than in the Globular Clusters.

5. The RRab with increasing period

The more different result of this paper compared with the one of 2007 is that we have now twice more increasing RRab (63) than decreasing one's (32). All the increasing RRab of 2007 have gone on to increase.

The mean dP/dt (10^{-10} d/d) of our new sample of 63 increasing period RRab is 8.13 (7.87 in 2007 with 32 stars) and the median is at 4.22 dP/dt (10^{-10} d/d) (4.47 in 2007) what meant that a few stars with a large rate of increase have a great weight on the mean result. Moreover, the new very accurate instants of maximum (see data of AA Aql and UY Cyg) are given us the possibility to determine lower rates of change.

If we take into account only the 27 stars of 2007, their mean dP/dt ($^{10-}$10d/d) is now 7.68 (7.87 in 2007) and their median rate of increase in now 3.98 (4.47 in 2007). When we observe during a longer time, the rate of increase is lower, probably because the little period irregularities are cancelling each other out.

Because their period is increasing, those RR Lyrae stars are evolving towards the red part of the horizontal branch.

6. The RRab with decreasing period

We have now 32 RRab (21 in 2007) with a monotonous rate of decreasing period. With the new instants of maximum light observed during these last six years, two RRab of our set of 2007 (RX Cet and SW Psc) have now to be considered as irregular period RRab Lyrae stars. They had high rates of change: dP/dt (10^{-10} d/d) was of -6.80 and -20.70 respectively and they have relatively long periods of 0.574 and 0.521 days.

The mean dP/dt (10^{-10} d/d) is now -7.31 with 32 stars (-7.56 in 2007 with 21 stars). It is -6.74 if we take into account only the 19 RRab remaining from 2007. The median dP/dt (10^{-10} d/d) is now -4.79 with 32 stars (-5.43 in 2007 with 21 stars). But if we consider only the 19 RRab remaining from 2007, the median dP/dt (10^{-10} d/d) is now -4.63. The rates are thus fainter with more observations as it is the case with the increasing RRab and it is interesting to see that the increasing and decreasing rates are not so different, higher for the mean one of increasing periods, but higher for the median one of decreasing periods.

Because their period is decreasing, those RR Lyrae stars are evolving towards the blue part of the horizontal branch.

Table 2: Refined linear elements for stars showing a constant period. The note B or B: indicates the stars having a published or probable published Blazhko effect

Star		Nmax	Time coverrage	From	To	Epoch	Error	Period	Error	s.d.	B.effect
			(years)			(HJD 2400000)		(d)		(d)	
ZZ	And	26	85.2	1926	2011	40339.7743	0.0013	0.55453309	0.00000005	0.0065	
AT	And	166	107	1906	2013	37005.2621	0.0016	0.61691448	0.00000006	0.0101	
DE	And	35	77.6	1935	2012	42123.885	0.0029	0.45363556	0.00000014	0.0171	
DR	And	99	54.8	1958	2013	48613.4395	0.0018	0.56311692	0.00000014	0.0149	B
GM	And	35	82.9	1929	2011	40775.7638	0.0033	0.70675915	0.00000024	0.0193	
OV	And	128	82.4	1929	2012	40879.6185	0.0012	0.47058093	0.00000006	0.0122	B:
V423	And	22	50.2	1938	1988	38278.1667	0.0035	0.48665476	0.00000027	0.0159	
XZ	Aps	82	75.9	1937	2013	42531.3845	0.0028	0.58726682	0.00000015	0.0203	
BS	Aps	77	55.9	1957	2013	46295.1866	0.0025	0.58255625	0.00000016	0.0201	B
EL	Aps	38	78	1935	2013	42240.0593	0.0062	0.57972235	0.00000031	0.0371	
EX	Aps	83	78.1	1935	2013	42189.9106	0.0016	0.47179954	0.00000006	0.0127	
SW	Aqr	178	100.9	1912	2013	38096.1164	0.0004	0.45930315	0.00000001	0.0045	
TZ	Aqr	80	98	1915	2013	38668.4466	0.0012	0.57119446	0.00000005	0.0083	
YZ	Aqr	71	118.3	1894	2012	34568.5566	0.0023	0.55193294	0.00000009	0.0192	
DN	Aqr	57	76.1	1936	2012	42327.9583	0.0031	0.63375488	0.00000019	0.0233	
OZ	Aql	22	62.9	1939	2002	40904.4303	0.0038	0.48079706	0.0000002	0.0127	
V782	Aql	27	54	1938	1992	38971.783	0.0061	0.64343895	0.00000064	0.0289	
V1069	Aql	21	54.1	1938	1992	38999.6198	0.0044	0.45597519	0.0000003	0.019	
V1070	Aql	23	73	1935	2008	41373.086	0.0046	0.36641791	0.00000019	0.0196	
TZ	Aur	237	99.8	1913	2013	38125.8807	0.0005	0.39167483	0.00000001	0.0042	
BH	Aur	118	107.6	1906	2013	36910.0668	0.0018	0.4560892	0.00000005	0.0064	
SV	Boo	24	94	1916	2010	38208.472	0.0022	0.58144226	0.0000001	0.0107	
SZ	Boo	39	97.9	1914	2012	38124.8604	0.0017	0.52282006	0.00000006	0.0064	
XX	Boo	40	87.1	1926	2013	40516.7743	0.0014	0.58140195	0.00000006	0.0055	
AH	Boo	20	50.4	1962	2012	46881.9995	0.0081	0.55433238	0.00000055	0.026	
SS	Cnc	132	104.9	1909	2013	37470.544	0.0009	0.36733852	0.00000002	0.0094	B
RX	CVn	68	105.8	1907	2013	36999.2685	0.0022	0.54002559	0.00000009	0.0171	
TZ	CVn	21	115.8	1897	2013	35195.0394	0.0041	0.55187903	0.00000018	0.0178	
AL	Cmi	71	85.1	1927	2013	40787.8972	0.0029	0.55051265	0.00000013	0.0187	
V870	Cas	28	51.1	1938	1989	38441.9482	0.0035	0.5198394	0.00000026	0.0184	
V746	Cen	25	65.8	1935	2001	39908.0927	0.0058	0.55140361	0.00000046	0.0273	
DX	Cep	108	108.8	1901	2010	35676.8752	0.0023	0.52604091	0.00000011	0.0236	
UU	Cet	67	95.1	1917	2012	38865.4954	0.0032	0.6060747	0.00000015	0.0232	B
SU	Col	25	64.2	1937	2001	40491.4822	0.0067	0.48735807	0.00000035	0.0302	B:
ST	Com	97	96.9	1916	2013	38648.0845	0.0017	0.59892796	0.00000008	0.0137	
SU	CrB	20	76.8	1934	2011	41685.6319	0.004	0.57300909	0.00000021	0.017	
W	Crt	48	77.9	1935	2013	42097.0093	0.0012	0.41201403	0.00000005	0.0066	
X	Crt	29	78.2	1935	2013	42139.8466	0.0026	0.7328368	0.00000016	0.0095	B
V838	Cyg	31	51.3	1958	2009	45725.4325	0.0051	0.48027943	0.00000034	0.0217	
BV	Del	31	82.7	1928	2011	40635.1892	0.0018	0.42345104	0.00000007	0.0099	
CD	Del	73	84	1929	2013	41205.9789	0.0027	0.49952634	0.00000012	0.0213	
CK	Del	55	84	1929	2013	41215.8965	0.0025	0.44279093	0.00000009	0.0188	
DX	Del	281	84.2	1929	2013	41186.454	0.0009	0.47261822	0.00000004	0.014	
BT	Dra	101	108.4	1905	2013	36650.2266	0.0022	0.58867333	0.00000009	0.0177	
RX	Eri	68	100.1	1912	2012	37992.6649	0.0014	0.58724619	0.00000005	0.0072	
SX	For	57	60.4	1952	2013	45268.5549	0.0021	0.60534097	0.00000013	0.0127	
GI	Gem	126	71.1	1941	2013	43335.1008	0.0009	0.43326662	0.00000003	0.0092	
TW	Her	331	100.9	1912	2013	38134.6309	0.0004	0.39959991	0.00000001	0.0058	
AF	Her	25	105	1907	2012	37003.1296	0.0054	0.63034195	0.00000025	0.0262	
BD	Her	85	113.1	1900	2013	35888.9723	0.0037	0.4739082	0.00000014	0.0338	B
DL	Her	78	80.9	1932	2013	41729.8152	0.0036	0.5916286	0.00000017	0.0149	B
EE	Her	34	56.9	1936	1993	38792.1805	0.0025	0.49553685	0.00000023	0.0134	
V469	Her	24	71	1934	2005	40507.4795	0.0107	0.52575244	0.00000063	0.0282	
V524	Her	122	56	1930	1986	36326.2267	0.0032	0.48186664	0.00000022	0.0326	
DD	Hya	46	69	1944	2013	43734.7266	0.0043	0.50176865	0.0000002	0.0141	B
ET	Hya	52	56.1	1957	2013	46099.3546	0.0021	0.685525	0.00000017	0.0148	
GO	Hya	74	84	1929	2013	40995.2447	0.0028	0.63643504	0.00000014	0.0218	
CH	Lac	38	83.1	1928	2011	40674.4613	0.0028	0.52456017	0.00000017	0.017	
RX	Leo	54	77.8	1935	2013	42083.2205	0.003	0.65341597	0.00000016	0.0083	
ST	Leo	163	87.2	1926	2013	40469.244	0.0006	0.47798392	0.00000002	0.006	
SU	Leo	26	98.2	1914	2012	38087.7426	0.004	0.47226483	0.00000013	0.0189	
WW	Leo	87	77.9	1935	2013	42158.1488	0.0018	0.60284627	0.00000009	0.0141	
AA	Leo	54	60	1953	2013	45464.0452	0.0022	0.59865299	0.00000016	0.0088	
AX	Leo	64	85	1927	2012	40766.8259	0.0024	0.72682693	0.00000014	0.0171	
V	LMi	78	100.8	1912	2013	37934.3852	0.0012	0.54391934	0.00000004	0.0049	
TV	Lib	98	117.1	1895	2012	34720.1721	0.0008	0.269624	0.00000002	0.0077	
TT	Lyn	109	70.2	1943	2013	43573.8301	0.0018	0.59743227	0.00000011	0.0153	
TW	Lyn	122	56.3	1956	2013	46026.6968	0.0013	0.48186063	0.00000007	0.0136	
CG	Lyr	35	84.2	1928	2012	40775.713	0.0039	0.50895781	0.00000016	0.0219	
CN	Lyr	180	112.1	1901	2013	36090.8415	0.0011	0.41138279	0.00000003	0.007	
CR	Lyr	41	75.3	1938	2013	42798.4326	0.0034	0.49341314	0.00000013	0.0205	
EZ	Lyr	140	115.4	1898	2013	35500.1134	0.0019	0.52526437	0.00000007	0.0189	
FN	Lyr	43	105.2	1907	2012	37009.6158	0.002	0.52739761	0.00000009	0.0102	
IO	Lyr	171	104	1909	2013	37558.5955	0.0012	0.57712193	0.00000005	0.0109	
KX	Lyr	75	72.5	1940	2012	42990.1175	0.0022	0.44090425	0.00000009	0.0175	B:
LX	Lyr	36	71.3	1940	2011	42780.1947	0.0032	0.54548437	0.00000017	0.0156	
NR	Lyr	37	71.8	1939	2011	42666.4049	0.002	0.68202859	0.00000015	0.0118	B:
V340	Lyr	20	71.6	1940	2012	42981.1741	0.0027	0.584455	0.00000014	0.011	
Z	Mic	23	51.1	1961	2012	46875.6145	0.0033	0.58692958	0.00000024	0.0122	B:
UW	Mon	22	73	1939	2012	42645.6678	0.0029	0.58236326	0.00000019	0.0104	
V430	Oph	25	66.1	1939	2005	41494.4812	0.0062	0.7009832	0.00000044	0.0273	
V445	Oph	42	97.1	1915	2012	38361.6275	0.0018	0.39702319	0.00000005	0.0103	
V531	Oph	25	64.4	1928	1992	37067.282	0.0034	0.55365322	0.00000022	0.0166	
V663	Oph	26	66	1928	1994	37471.2175	0.004	0.51131247	0.00000024	0.0203	
V570	Oph	21	53.9	1940	1994	39638.2611	0.0052	0.57485929	0.00000051	0.023	
V773	Oph	66	73.1	1933	2006	40524.4464	0.003	0.58568539	0.00000023	0.0226	
V785	Oph	45	78.1	1933	2011	41422.0717	0.0037	0.44957467	0.00000022	0.0247	
V788	Oph	38	72.3	1940	2012	42895.8638	0.0023	0.54712958	0.00000022	0.0141	B
V822	Oph	65	81	1931	2012	41275.4714	0.0027	0.53767807	0.00000021	0.0215	
V830	Oph	25	53.1	1940	1993	39535.2228	0.0054	0.57007605	0.00000053	0.0216	
V881	Oph	24	51.8	1940	1992	39279.9535	0.0049	0.52524644	0.00000034	0.0241	
V962	Oph	28	51.9	1940	1992	39266.5646	0.0039	0.51602572	0.00000027	0.0203	
V2033	Oph	24	52.1	1940	1992	39293.7349	0.0047	0.56582944	0.00000043	0.0201	
V2210	Oph	22	65.2	1940	2005	41717.465	0.0084	0.63809874	0.0000006	0.0265	
AO	Peg	31	86	1925	2011	40119.168	0.0017	0.54724348	0.00000008	0.0084	
CG	Peg	181	57.1	1956	2013	46125.7918	0.0011	0.46713709	0.00000007	0.0119	
DZ	Peg	116	102.8	1910	2013	37778.3365	0.0029	0.60734886	0.00000013	0.023	
ES	Peg	25	57.8	1951	2009	44522.1661	0.0037	0.53867628	0.00000022	0.0185	
ET	Peg	27	60.7	1951	2012	45052.465	0.0022	0.48983263	0.00000012	0.0116	
ET	Per	37	75.7	1936	2011	42000.546	0.0018	0.39401458	0.00000006	0.0109	
XX	Pup	52	82.1	1930	2013	41339.3395	0.0013	0.51719937	0.00000005	0.0071	
BB	Pup	30	78	1935	2013	42105.9137	0.0026	0.4805467	0.0000001	0.0131	
VW	Scl	68	77.9	1935	2012	42034.7766	0.002	0.51091447	0.00000008	0.0157	
VY	Ser	69	81.1	1932	2013	41642.5356	0.0034	0.71409651	0.00000023	0.0182	
AN	Ser	137	114.3	1899	2013	35577.21	0.0012	0.52207133	0.00000005	0.0116	B
DF	Ser	71	113.4	1900	2013	35751.1548	0.0014	0.43779655	0.00000004	0.0105	
RV	Sex	40	73.1	1940	2013	42998.2055	0.004	0.50341423	0.0000002	0.0253	
UX	Tri	158	55.5	1957	2012	46036.6311	0.0028	0.46892088	0.00000018	0.0287	
TU	UMa	281	99.2	1914	2013	38275.975	0.0011	0.55765759	0.00000005	0.0114	
UZ	UMa	55	75.9	1935	2011	42022.2686	0.0032	0.46687885	0.00000019	0.024	B
RX	UMi	36	79.4	1933	2012	41657.7478	0.0048	0.49043527	0.00000034	0.0272	
UU	Vir	63	110	1903	2013	36346.0555	0.001	0.47560653	0.00000003	0.006	
UV	Vir	74	82.9	1930	2013	41263.1685	0.0012	0.58708302	0.00000005	0.0066	
WY	Vir	38	91.6	1914	2005	37000.9662	0.0068	0.60935311	0.00000055	0.0415	B
AM	Vir	21	99	1914	2013	38320.806	0.0024	0.61508704	0.00000009	0.0094	
AV	Vir	57	99.9	1913	2013	38167.3533	0.0018	0.65690936	0.00000007	0.0074	

Table 3: Linear and parabolic elements of RRab stars showing a well-defined linearly increasing period. The note B or B: indicates the stars having a published or probable published Blazhko effect

Star	Nmax	Time cov (y)	from	to	Epoch (lin)	error	Period (d)	error	s.d.	Epoch (quad)	error	Period (d)	error	Quad. Term	error	s.d. (d)	quot s.d.	dP/dt	error	β (d Myr^{-1})	error	α (Myr^{-1})	error	B. effect
XX And	278	111	1902	2013	36028.795	0.002	0.72275488	0.00000011	0.028	36028.7654	0.0014	0.72275292	0.00000008	1.35E-10	4E-12	0.0134	2.1	3.7473E-10	1.228E-11	0.137	0.004	0.189	0.006	B
BN Aqr	109	116.2	1896	2012	34990.3891	0.0212	0.46965285	0.0000007	0.2051	34990.1517	0.0021	0.46964839	0.00000005	3.12E-10	2E-12	0.0135	15.2	1.3291E-09	8.44E-12	0.485	0.003	1.034	0.007	
BO Aqr	82	117.1	1895	2012	34796.2554	0.0043	0.69402343	0.00000022	0.0388	34796.2165	0.0042	0.69402272	0.00000015	1.02E-10	9E-12	0.0236	1.6	2.939E-10	2.503E-11	0.107	0.009	0.155	0.013	
AA Aql	212	100.9	1912	2013	38054.4257	0.0006	0.36178739	0.00000002	0.0069	38054.421	0.0005	0.36178724	0.00000002	7E-12	0	0.0048	1.4	3.785E-11	2.56E-12	0.014	0.001	0.038	0.003	
V341 Aql	167	101	1912	2013	38072.6438	0.0019	0.57802084	0.00000009	0.018	38072.6286	0.0014	0.57801983	0.00000008	6.3E-11	4E-12	0.0105	1.7	2.1651E-10	1.214E-11	0.079	0.004	0.137	0.008	
V508 Aql	26	71.7	1932	2004	40054.372	0.0082	0.62514372	0.00000051	0.0413	40054.3101	0.0064	0.62514413	0.00000021	2.42E-10	2.2E-11	0.0166	2.5	7.7343E-10	6.899E-11	0.282	0.025	0.452	0.04	
X Ari	167	98.1	1914	2013	38380.0237	0.0123	0.65115015	0.00000059	0.1027	38379.8904	0.0017	0.65114518	0.00000008	4.86E-10	4E-12	0.0111	9.3	1.4924E-09	1.259E-11	0.545	0.005	0.837	0.007	
RS Boo	455	112.9	1900	2013	35752.7181	0.0012	0.37733822	0.00000003	0.0197	35752.6999	0.0008	0.3773377	0.00000002	2.2E-11	1E-12	0.0098	2	1.1626E-10	3.14E-12	0.042	0.001	0.113	0.003	B
SW Boo	102	94.4	1918	2013	39074.8786	0.0225	0.51352965	0.00000085	0.1502	39074.664	0.0013	0.5135241	0.00000004	4.64E-10	2E-12	0.0063	23.9	1.8059E-09	7.57E-12	0.66	0.003	1.284	0.005	B:
UU Boo	142	106.1	1907	2013	37077.8862	0.0123	0.45692114	0.0000004	0.1053	37077.7551	0.0015	0.45691731	0.00000005	2.22E-10	2E-12	0.0093	11.3	9.7355E-10	7.33E-12	0.356	0.003	0.778	0.006	
RW Cnc	160	96.9	1916	2013	38640.3228	0.0043	0.54720511	0.00000016	0.0515	38640.2178	0.0046	0.54720474	0.00000008	1.56E-10	6E-12	0.0231	2.2	5.7137E-10	2.281E-11	0.209	0.008	0.381	0.015	B
TT Cnc	177	96.9	1916	2013	38658.0514	0.003	0.56345115	0.00000012	0.0262	38658.0109	0.0021	0.56344979	0.00000008	1.11E-10	4E-12	0.012	2.2	3.9336E-10	1.542E-11	0.144	0.006	0.255	0.01	B
AN Cnc	48	102.9	1910	2013	37515.8166	0.0034	0.54316099	0.00000013	0.0203	37515.7883	0.0029	0.54316027	0.00000009	5.7E-11	5E-12	0.0099	2	2.0842E-10	1.713E-11	0.076	0.006	0.14	0.012	
SW CVn	31	102	1910	2012	37417.1903	0.0177	0.44165835	0.00000052	0.0795	37416.9992	0.0032	0.4416562	0.00000005	2.02E-10	3E-12	0.0064	12.5	9.1341E-10	1.364E-11	0.334	0.005	0.755	0.011	
PS Cas	43	76.9	1936	2012	42223.5053	0.0059	0.44365356	0.00000025	0.038	42223.4498	0.0044	0.4436531	0.0000001	1.07E-10	7E-12	0.0149	2.5	4.8254E-10	3.206E-11	0.176	0.012	0.397	0.026	
EZ Cep	97	109.8	1901	2010	35451.4599	0.0037	0.37899943	0.00000012	0.0359	35451.4318	0.0033	0.37899918	0.00000008	2.9E-11	2E-12	0.0226	1.6	1.5514E-10	1.287E-11	0.057	0.005	0.15	0.012	
RR Cet	186	106.2	1906	2012	36896.6526	0.0011	0.55302807	0.00000004	0.0105	36896.6441	0.0008	0.55302763	0.00000003	2.5E-11	1E-12	0.0061	1.7	9.078E-11	4.75E-12	0.033	0.002	0.06	0.003	
RV Cet	46	82.2	1930	2012	41252.3405	0.0078	0.62340868	0.00000038	0.0268	41252.2801	0.0061	0.62340792	0.00000019	1.71E-10	1.4E-11	0.0126	2.1	5.4814E-10	4.388E-11	0.2	0.016	0.321	0.026	B
V Com	23	96	1916	2012	38525.9411	0.0063	0.46914433	0.0000002	0.029	38525.87	0.0036	0.46914433	0.00000004	7.5E-11	4E-12	0.0061	4.7	3.1774E-10	1.493E-11	0.116	0.005	0.247	0.012	
TX Com	21	59.1	1949	2008	43801.9762	0.0058	0.53647572	0.00000034	0.0252	43801.9227	0.0106	0.53647581	0.00000022	1.83E-10	3.4E-11	0.016	1.6	6.8122E-10	1.2635E-10	0.249	0.046	0.464	0.086	
UZ Com	26	70.1	1937	2007	41437.7553	0.0239	0.73695323	0.00000234	0.0953	41437.6296	0.0108	0.73695222	0.00000071	1.143E-09	7.3E-11	0.0286	3.3	3.1025E-09	1.9908E-10	1.133	0.073	1.538	0.099	
SZ CrB	28	52.5	1958	2011	46115.2494	0.0068	0.44862898	0.00000047	0.0254	46115.2225	0.0022	0.44862861	0.00000012	1.5E-10	8E-12	0.0065	3.9	6.6743E-10	3.476E-11	0.244	0.013	0.543	0.028	
TV CrB	168	111	1902	2013	36207.8186	0.0034	0.58461297	0.00000014	0.0432	36207.77	0.0036	0.5846123	0.0000001	8.7E-11	5E-12	0.0268	1.6	2.9616E-10	1.815E-11	0.108	0.007	0.185	0.011	
UY Cyg	167	111.8	1901	2013	36071.2015	0.0011	0.56070598	0.00000004	0.0099	36071.1925	0.001	0.56070563	0.00000004	2.1E-11	2E-12	0.0067	1.5	7.521E-11	5.36E-12	0.027	0.002	0.049	0.003	
DM Cyg	329	112.9	1900	2013	35907.0803	0.0018	0.41986046	0.00000005	0.0245	35907.0514	0.0006	0.41985917	0.00000002	5E-11	1E-12	0.0059	4.2	2.3896E-10	3.28E-12	0.087	0.001	0.208	0.003	B
IV Cyg	92	83.5	1928	2011	40577.5515	0.0082	0.33433497	0.00000036	0.0467	40577.541	0.0042	0.33433687	0.00000021	8.6E-11	5E-12	0.0234	2	5.1716E-10	3.153E-11	0.189	0.012	0.565	0.035	
V684 Cyg	36	52	1927	1980	34748.2214	0.0114	0.54097566	0.00000089	0.0684	34748.1358	0.0064	0.54097639	0.0000003	5.22E-10	3.1E-11	0.0227	3	1.9305E-09	1.1623E-10	0.705	0.043	1.303	0.079	
SU Dra	238	108.8	1904	2013	36433.3719	0.0017	0.66042059	0.00000008	0.0221	36433.3505	0.0012	0.66042007	0.00000005	6.7E-11	3E-12	0.0113	2	2.0143E-10	7.8E-12	0.074	0.003	0.111	0.004	
SW Dra	159	103.9	1909	2013	37404.9421	0.0014	0.56967128	0.00000006	0.0122	37404.9329	0.0012	0.56967083	0.00000005	2.9E-11	2E-12	0.0087	1.4	1.0353E-10	8.27E-12	0.038	0.003	0.066	0.005	
BD Dra	260	112.7	1900	2013	35949.6576	0.0167	0.58898832	0.00000055	0.1727	35949.2171	0.0129	0.58898237	0.00000026	6.19E-10	1.6E-11	0.0654	2.6	2.1014E-09	5.348E-11	0.768	0.02	1.303	0.033	B
SV Eri	78	108.2	1904	2012	36511.0942	0.0565	0.71380412	0.00000321	0.4167	36510.7601	0.0078	0.71377607	0.00000052	1.954E-09	2.6E-11	0.0477	8.7	5.4764E-09	7.236E-11	2	0.026	2.802	0.037	
BB Eri	46	60	1952	2012	45328.4687	0.0045	0.56990614	0.00000028	0.0127	45328.4325	0.0024	0.56990552	0.0000001	1.72E-10	9E-12	0.0042	3	6.0332E-10	3.175E-11	0.22	0.012	0.387	0.02	
VZ Her	300	114.4	1899	2013	35629.5826	0.0027	0.44032751	0.00000008	0.0428	35629.5229	0.0019	0.44032651	0.00000004	6.4E-11	2E-12	0.0172	2.5	2.9025E-10	7.4E-12	0.106	0.003	0.241	0.006	
AG Her	29	103.1	1907	2010	36538.2357	0.0088	0.64944435	0.00000042	0.0447	36538.1886	0.0083	0.64944408	0.00000025	1.12E-10	1.6E-11	0.0264	1.7	3.4546E-10	4.81E-11	0.126	0.018	0.194	0.027	
GY Her	37	105.5	1907	2012	36964.7188	0.0161	0.52438134	0.00000067	0.094	36964.6219	0.0094	0.5243787	0.00000032	2E-10	1.4E-11	0.0367	2.6	7.6348E-10	5.459E-11	0.279	0.02	0.532	0.038	
SV Hya	33	108.5	1904	2013	36622.7346	0.0113	0.47854511	0.00000037	0.0544	36622.6743	0.0054	0.47854367	0.00000015	8.9E-11	6E-12	0.0183	3	3.7318E-10	2.391E-11	0.136	0.009	0.285	0.018	B
UU Hya	69	98	1915	2013	38463.2339	0.0056	0.52386642	0.00000019	0.0293	38463.1538	0.0073	0.52386521	0.00000014	1.22E-10	1E-11	0.0163	1.8	4.6688E-10	3.816E-11	0.171	0.014	0.326	0.027	B
DH Hya	55	69	1944	2013	43781.6708	0.0021	0.48899977	0.0000001	0.0126	43781.6441	0.0021	0.48899956	0.00000005	6.5E-11	5E-12	0.0058	2.2	2.6713E-10	1.917E-11	0.098	0.007	0.2	0.014	
IV Lac	23	55.9	1948	2004	43082.1712	0.0042	0.40081612	0.0000002	0.0202	43082.131	0.0016	0.40081598	0.00000003	8.7E-11	3E-12	0.0033	6	4.3239E-10	1.58E-11	0.158	0.006	0.394	0.014	
RR Leo	416	114.2	1898	2013	35491.3231	0.0063	0.45239021	0.0000002	0.0963	35491.2299	0.0005	0.4523859	0.00000002	1.89E-10	1E-12	0.0064	15	8.3374E-10	2.74E-12	0.305	0.001	0.673	0.002	
TV Leo	65	100	1913	2013	38119.408	0.009	0.67285219	0.00000041	0.0634	38119.2955	0.0064	0.67284992	0.00000019	2.88E-10	1.4E-11	0.0229	2.8	8.5742E-10	4.178E-11	0.313	0.015	0.465	0.023	
AN Leo	28	100	1913	2013	38129.7659	0.0405	0.57204689	0.00000176	0.2063	38129.4644	0.0228	0.57204163	0.00000063	6.29E-10	4E-11	0.0635	3.2	2.2007E-09	1.393E-10	0.804	0.051	1.405	0.089	
X LMI	49	84.9	1928	2013	40832.8453	0.0092	0.68432591	0.00000053	0.0415	40832.79	0.0049	0.68432425	0.00000023	2.58E-10	1.6E-11	0.0161	2.6	7.5265E-10	4.598E-11	0.275	0.017	0.402	0.025	
U Lep	73	123.8	1889	2012	33682.7279	0.0049	0.58147582	0.00000015	0.023	33682.6881	0.0019	0.58147471	0.00000005	6.6E-11	2E-12	0.0062	3.7	2.2699E-10	7.54E-12	0.083	0.003	0.143	0.005	
DD Lyr	42	101	1910	2011	37371.9074	0.0096	0.37261934	0.00000033	0.0514	37371.8162	0.0074	0.37261818	0.00000016	8.6E-11	6E-12	0.0206	2.5	4.6105E-10	3.188E-11	0.168	0.012	0.452	0.031	
RV Oct	196	113.2	1900	2013	35789.3464	0.0031	0.57116501	0.00000014	0.0419	35789.313	0.0027	0.57116422	0.0000001	7.3E-11	4E-12	0.0261	1.6	2.5449E-10	1.457E-11	0.093	0.005	0.163	0.009	B
V942 Oph	38	65.5	1928	1993	37258.8531	0.0613	0.45821429	0.00000327	0.3602	37258.3823	0.0234	0.45821174	0.00000076	1.38E-09	5.5E-11	0.0833	4.3	6.0213E-09	2.3838E-10	2.199	0.087	4.8	0.19	
V960 Oph	21	61.1	1928	1989	36590.4137	0.0063	0.59358111	0.00000048	0.0287	36590.3841	0.0077	0.59358159	0.00000035	1.7E-10	3.6E-11	0.0199	1.4	5.717E-10	1.2254E-10	0.209	0.045	0.352	0.076	
V1089 Oph	28	66	1928	1994	37419.827	0.005	0.60453668	0.00000034	0.0245	37419.7983	0.0062	0.60453687	0.00000024	1.27E-10	2.3E-11	0.0167	1.5	4.2161E-10	7.56E-11	0.154	0.028	0.255	0.046	
V2334 Oph	23	65.8	1928	1994	37469.4192	0.0093	0.43865158	0.00000048	0.0424	37469.3577	0.0055	0.43865184	0.00000016	1.62E-10	1.2E-11	0.0137	3.1	7.3724E-10	5.471E-11	0.269	0.02	0.614	0.046	
VV Peg	183	99.8	1913	2013	38260.3821	0.0036	0.48838407	0.00000014	0.0458	38260.3255	0.0016	0.48838335	0.00000004	9.2E-11	2E-12	0.013	3.5	3.7737E-10	8.29E-12	0.138	0.003	0.282	0.006	
AV Peg	557	109.9	1903	2013	36419.2593	0.0028	0.39037651	0.00000009	0.0422	36419.2608	0.0005	0.39037281	0.00000003	9.3E-11	1E-12	0.0079	5.3	4.7398E-10	3.83E-12	0.173	0.001	0.443	0.004	
AR Per	257	112.5	1900	2013	35782.8077	0.0006	0.42554978	0.00000002	0.0075	35782.7965	0.0005	0.42554949	0.0000001	1.3E-11	1E-12	0.0039	1.9	6.199E-11	2.38E-12	0.023	0.001	0.053	0.002	
FM Per	48	73.6	1935	2009	41464.4319	0.0207	0.48923094	0.00000102	0.1373	41464.1109	0.0087	0.4892316	0.00000017	7.63E-10	1.9E-11	0.0228	6	3.1202E-09	7.739E-11	1.14	0.028	2.329	0.058	B:
RY Psc	71	100.2	1912	2012	37977.1914	0.0062	0.52973116	0.00000025	0.0468	37977.131	0.0047	0.52972959	0.00000015	1.23E-10	8E-12	0.0212	2.2	4.6319E-10	2.833E-11	0.169	0.01	0.319	0.02	B
V440 Sgr	26	81.1	1931	2012	41385.8428	0.0127	0.47747972	0.00000052	0.0546	41385.7693	0.0056	0.47747784	0.00000018	1.63E-10	1E-11	0.0151	3.6	6.8253E-10	4.011E-11	0.249	0.015	0.522	0.031	
AV Ser	72	84	1929	2013	41117.3986	0.0027	0.48756025	0.00000011	0.0222	41117.3484	0.0018	0.48755979	0.00000003	8.3E-11	3E-12	0.006	3.7	3.4089E-10	1.149E-11	0.125	0.004	0.255	0.009	
BH Ser	35	80.2	1931	2011	41064.4269	0.0085	0.43455354	0.00000039	0.0449	41064.3858	0.0032	0.43455227	0.00000013	1.14E-10	6E-12	0.0129	3.5	5.2433E-10	2.728E-11	0.192	0.01	0.441	0.023	
CS Ser	62	110.1	1903	2013	36344.8856	0.0049	0.52679445	0.00000016	0.0335	36344.8256	0.0029	0.52679355	0.00000006	7.8E-11	3E-12	0.0103	3.3	2.9495E-10	1.227E-11	0.108	0.004	0.205	0.009	
AS Vir	40	97.1	1916	2013	38687.8932	0.0074	0.55342603	0.0000003	0.0465	38687.8192	0.0102	0.55342524	0.00000021	1.24E-10	1.5E-11	0.0283	1.6	4.4991E-10	5.542E-11	0.164	0.02	0.297	0.037	B
BB Vir	67	101	1912	2013	37963.6284	0.0082	0.47110083	0.00000025	0.0403	37963.5406	0.004	0.47109955	0.00000008	1.1E-10	4E-12	0.0115	3.5	4.6831E-10	1.723E-11	0.171	0.006	0.363	0.013	B
BN Vul	158	114.2	1899	2013	35663.1325	0.0026	0.59413014	0.00000009	0.017	35663.1173	0.0019	0.59412892	0.0000001	5.7E-11	4E-12	0.0106	1.6	1.9055E-10	1.216E-11	0.07	0.004	0.117	0.007	
FK Vul	47	72	1938	2010	42323.7647	0.0048	0.4340533	0.00000022	0.0303	42323.7249	0.0052	0.43405255	0.00000015	9.3E-11	1E-11	0.0181	1.7	4.277E-10	4.704E-11	0.156	0.017	0.36	0.04	B

Table 4. Linear and parabolic elements for RRab stars showing a well defined linearly decreasing period. The note B or B: indicates the stars having a published or probable published Blazhko effect

Star	Nmax	Time (y)	From	To	Epoch(HJD)	Error	Period(d)	Error	s.d. (d)	Epoch(HJD)	Error	Period(d)	Error	Quad.term	Error	s.d.(d)	Quot s	dP/dt	Er	B?a	Error	Alpha	Error	B effect
SW And	530	119.6	1894	2013	34686.195	0.0035	0.44226835	0.00000011	0.062	34686.2466	0.0008	0.44227077	0.00000003	-1.02E-10	1.00E-12	0.012	5.2	-4.63E-10	3.96E-12	-0.169	0.001	-0.382	0.003	B:
SX Aqr	146	99.9	1913	2013	39796.2859	0.0023	0.53571193	0.0000001	0.0245	39796.3167	0.0016	0.53571206	0.00000004	-5.80E-11	2.00E-12	0.0111	2.2	-2.16E-10	9.08E-12	-0.079	0.003	-0.147	0.006	
BR Aqr	116	111.5	1901	2012	35854.6618	0.005	0.48187612	0.00000016	0.0472	35854.725	0.0015	0.48187761	0.00000004	-9.00E-11	2.00E-12	0.0089	5.3	-3.73E-10	6.75E-12	-0.136	0.002	-0.283	0.005	
CP Aqr	135	101	1912	2013	38067.4491	0.0021	0.46340469	0.00000008	0.0206	38067.4717	0.0012	0.46340578	0.00000005	-5.10E-11	2.00E-12	0.0084	2.5	-2.22E-10	8.58E-12	-0.081	0.003	-0.175	0.007	
TW Boo	171	98.9	1914	2013	38395.8079	0.0018	0.53227192	0.00000007	0.0157	38395.8345	0.0012	0.53227269	0.00000004	-5.90E-11	2.00E-12	0.0067	2.4	-2.21E-10	7.97E-12	-0.081	0.003	-0.151	0.005	
CM Boo	133	56.3	1957	2013	46174.2518	0.0026	0.60907536	0.00000022	0.028	46174.2873	0.0028	0.60907572	0.00000013	-2.51E-10	1.60E-11	0.0168	1.7	-8.23E-10	5.41E-11	-0.3	0.02	-0.493	0.033	
AH Cam	188	61.4	1951	2013	45104.3277	0.0048	0.3687259	0.0000002	0.0561	45104.45	0.0028	0.368727	0.00000006	-2.42E-10	5.00E-12	0.015	3.7	-1.31E-09	2.67E-11	-0.48	0.01	-1.301	0.026	B:
AP Cnc	25	78.1	1930	2008	40244.8539	0.0173	0.53294275	0.00000087	0.0661	40244.9428	0.0119	0.53294216	0.00000039	-2.47E-10	2.50E-11	0.0292	2.3	-9.26E-10	9.47E-11	-0.338	0.035	-0.634	0.065	
W CVn	165	111.3	1902	2013	36127.1723	0.0012	0.55175706	0.00000004	0.0126	36127.1991	0.0012	0.55175742	0.00000002	-3.90E-11	1.00E-12	0.0056	2.3	-1.40E-10	5.42E-12	-0.051	0.002	-0.093	0.004	
RV Cap	299	106.1	1906	2012	36818.6312	0.0025	0.44774558	0.00000012	0.0431	36818.6783	0.0024	0.44774702	0.00000009	-8.90E-11	4.00E-12	0.0245	1.8	-3.96E-10	1.59E-11	-0.145	0.006	-0.323	0.013	B:
RZ Cet	105	83	1929	2012	41126.2805	0.0095	0.51061034	0.00000038	0.0785	41126.4724	0.0065	0.51061227	0.00000013	-3.47E-10	1.10E-11	0.0233	3.4	-1.36E-09	4.17E-11	-0.496	0.015	-0.972	0.03	
S Com	148	102	1911	2013	37809.0658	0.0023	0.58658837	0.0000001	0.0225	37809.0957	0.0015	0.58658903	0.00000005	-6.70E-11	3.00E-12	0.0094	2.4	-2.28E-10	8.70E-12	-0.083	0.003	-0.142	0.005	
U Com	37	115.1	1896	2011	34677.726	0.0034	0.29273841	0.00000006	0.017	34677.7482	0.0043	0.29273863	0.00000006	-9.00E-12	2.00E-12	0.0118	1.4	-6.42E-11	1.04E-11	-0.023	0.004	-0.08	0.013	
UW Com	29	71.9	1937	2009	41769.3684	0.0143	0.53232097	0.00000094	0.0619	41769.475	0.0095	0.53232249	0.00000036	-4.00E-10	3.00E-11	0.0224	2.8	-1.50E-09	1.12E-10	-0.549	0.041	-1.03	0.077	
SZ Gem	129	90.8	1922	2013	39726.9363	0.0013	0.50113515	0.00000005	0.0102	39726.9497	0.0013	0.50113564	0.00000005	-3.40E-11	3.00E-12	0.0066	1.5	-1.35E-10	1.02E-11	-0.049	0.004	-0.099	0.007	
VX Her	242	97.3	1916	2013	38717.5461	0.0036	0.45536514	0.00000014	0.0403	38717.5831	0.001	0.45536697	0.00000004	-1.00E-10	2.00E-12	0.0094	4.3	-4.37E-10	6.74E-12	-0.16	0.002	-0.351	0.005	B:
V394 Her	113	82.1	1929	2011	40715.1923	0.0032	0.43605523	0.00000015	0.0326	40715.224	0.003	0.43605565	0.0000001	-8.00E-11	6.00E-12	0.02	1.6	-3.68E-10	2.71E-11	-0.135	0.01	-0.308	0.023	
CZ Lac	92	75.3	1937	2012	42472.1056	0.0157	0.43218855	0.00000065	0.1139	42472.3552	0.0121	0.43218975	0.00000025	-4.59E-10	1.90E-11	0.0424	2.7	-2.13E-09	9.00E-11	-0.776	0.033	-1.797	0.076	B:
RZ Lyr	508	118.2	1895	2013	34965.6013	0.0029	0.51124524	0.00000012	0.062	34965.6611	0.001	0.51124764	0.00000004	-1.27E-10	1.00E-12	0.0154	4	-4.95E-10	5.64E-12	-0.181	0.002	-0.354	0.004	B:
AW Lyr	43	85.4	1928	2013	40928.3544	0.0064	0.49743739	0.00000024	0.0318	40928.4822	0.0045	0.49743797	0.00000005	-1.87E-10	6.00E-12	0.0067	4.7	-7.52E-10	2.54E-11	-0.275	0.009	-0.552	0.019	
ST Oph	47	105	1908	2013	37266.4767	0.0016	0.45035586	0.00000005	0.0091	37266.4868	0.0018	0.45035599	0.00000004	-1.20E-11	2.00E-12	0.0062	1.5	-5.15E-11	6.98E-12	-0.019	0.003	-0.042	0.006	
V1095 Oph	32	64	1928	1992	37136.228	0.0068	0.45878367	0.00000036	0.0347	37136.2715	0.0074	0.4587837	0.00000022	-1.25E-10	1.70E-11	0.0212	1.6	-5.43E-10	7.58E-11	-0.198	0.028	-0.432	0.061	
V964 Ori	44	110.8	1902	2012	36034.2983	0.0221	0.50465131	0.00000073	0.1227	36034.4797	0.0021	0.5046552	0.00000006	-2.70E-10	2.00E-12	0.0071	17.2	-1.07E-09	9.62E-12	-0.391	0.004	-0.774	0.007	
BH Peg	198	81.3	1931	2012	41405.4967	0.004	0.64099151	0.00000024	0.0488	41405.5613	0.0022	0.6409929	0.00000009	-2.65E-10	7.00E-12	0.0166	3	-8.26E-10	2.12E-11	-0.302	0.008	-0.471	0.012	B:
V375 Per	38	74.9	1937	2011	42212.4143	0.0079	0.5460666	0.00000046	0.0483	42212.4607	0.0088	0.5460678	0.00000036	-1.67E-10	2.50E-11	0.0326	1.5	-6.13E-10	9.26E-11	-0.224	0.034	-0.41	0.062	
HK Pup	50	83.2	1929	2013	41116.4739	0.0139	0.73423364	0.000001	0.0981	41116.6104	0.0062	0.73423705	0.00000028	-7.15E-10	2.70E-11	0.0248	4	-1.95E-09	7.33E-11	-0.711	0.027	-0.969	0.037	
U Tri	55	100.4	1909	2009	36829.773	0.0011	0.44725247	0.00000004	0.0078	36829.783	0.0012	0.44725255	0.00000002	-1.20E-11	1.00E-12	0.0046	1.7	-5.19E-11	5.29E-12	-0.019	0.002	-0.042	0.004	
AB UMa	111	88.5	1924	2013	40258.0004	0.0043	0.59958186	0.0000002	0.0328	40258.0417	0.0039	0.59958364	0.00000017	-1.50E-10	1.10E-11	0.0194	1.7	-5.00E-10	3.52E-11	-0.183	0.013	-0.304	0.021	B:
AF Vir	60	80.5	1932	2013	41719.6887	0.0317	0.48375755	0.00000125	0.1692	41720.0735	0.0147	0.48376413	0.00000037	-7.87E-10	2.60E-11	0.0409	4.1	-3.26E-09	1.07E-10	-1.189	0.039	-2.458	0.081	
AT Vir	68	98.1	1915	2013	38490.3307	0.0156	0.52578966	0.00000055	0.0848	38490.5019	0.0027	0.52579419	0.00000008	-3.35E-10	4.00E-12	0.0087	9.7	-1.28E-09	1.62E-11	-0.466	0.006	-0.886	0.011	
CE Vul	21	84.1	1926	2010	40060.9862	0.0062	0.37048659	0.00000021	0.0239	40061.0083	0.0026	0.37048736	0.00000009	-4.10E-11	3.00E-12	0.0077	3.1	-2.20E-10	1.70E-11	-0.08	0.006	-0.217	0.017	
FH Vul	38	102	1909	2011	37196.2418	0.0116	0.40541737	0.00000037	0.0524	37196.2803	0.0028	0.40541963	0.00000011	-8.80E-11	3.00E-12	0.0111	4.7	-4.35E-10	1.57E-11	-0.159	0.006	-0.392	0.014	

7. The RRab with irregular period

14 % (35 stars) of our studied RRab of the field are showing one or more changes of period, sudden or not. The amplitude of the changes is clearly higher for irregular periods than when the periods are increasing or decreasing at a same rate with time. The amplitude of the O-C's of the group of irregular periods is about twice those of the increasing and decreasing periods. So the highest changes of period are occurring irregularly.

After a look at the O-C curves of the RRab with an irregular period, we obtain 10 stars with no significant direction of change, 12 stars with a period that has increased and 14 stars with a period that has decreased. The changes of period may be sudden or progressive and varied. They may occur rarely or very frequently according to the star. The case of three RRab has to be noted. The period of V759 Cyg remains constant during 55 years before a sudden increase, followed by a sudden decrease with the first period similar to the now-a-day's one. The period of SZ Hya remains constant during 36 years and, after a sudden decrease, it is pulsating since 77 years with the same new tempo. The period of WZ Hya decreases suddenly between two laps of time of 59 and 51 years of constant periods. This kind of change is probably due to a change occurring more inside the star, near the core or where radiation become convection. All that shows also that, if the data coverage should be changed or shifted in time, several RRab of the groups of irregular and constant period whould be inverted. On the other hand, the stars whose period has changes more than two times and in a varied way seem to remain irregular for a more long time.

Table 5: Refined elements for stars showing an irregular period. The note B or B: indicates the stars having a Blazhko effect or probable Blazhko effect published

Star	Nmax	Time	From	To	Epoch	Error	Period	Error	s.d.	B.effect
GV And	65	73.2	1937	2010	42124.2063	0.0119	0.52808984	0.00000074	0.085	B:
UY Boo	195	121.1	1890	2011	33572.8283	0.0219	0.65084684	0.00000099	0.2454	
Z CVn	158	101	1912	2013	37952.9574	0.0156	0.65384895	0.0000007	0.1886	B
RU CVN	116	103	1910	2013	37619.7427	0.0015	0.57325009	0.00000006	0.0159	
RZ CVn	94	87	1926	2013	40517.9539	0.0088	0.56740783	0.00000038	0.0297	
UZ CVn	225	111.9	1901	2012	35856.6026	0.0042	0.69778777	0.00000023	0.063	
AA CMi	160	109.9	1903	2013	36259.7013	0.0024	0.476324	0.00000008	0.0213	
RU Cet	97	122.8	1890	2012	33814.5918	0.0204	0.58628706	0.00000077	0.1787	B
RX Cet	137	122	1890	2012	33915.549	0.0064	0.57370032	0.00000028	0.072	B
RY Com	110	111.9	1901	2013	35915.5429	0.0063	0.46894315	0.00000018	0.0515	B
XZ Cyg	1789	109.2	1904	2013	36605.7097	0.0072	0.46657516	0.00000031	0.262	B
V759 Cyg	98	114.2	1898	2012	35285.2729	0.0302	0.36003715	0.00000086	0.2754	B
RW Dra	725	107	1906	2013	36968.3572	0.0075	0.4429184	0.0000003	0.2002	B
XZ Dra	516	97.9	1915	2013	38663.4169	0.0012	0.47649453	0.00000006	0.0251	B
BK Dra	332	113.9	1899	2013	35712.9982	0.0019	0.59207778	0.00000008	0.0293	
RR Gem	452	113	1900	2013	35744.3467	0.0125	0.39729437	0.0000003	0.238	B
AR Her	612	108	1905	2013	36788.9909	0.0049	0.47000515	0.00000018	0.114	B
SZ Hya	246	113.1	1900	2013	35723.2333	0.0503	0.53725819	0.00000173	0.6733	B
WZ Hya	71	110.1	1903	2013	36280.353	0.0187	0.53772366	0.00000065	0.1247	
SS Leo	114	112	1901	2013	35947.0162	0.0037	0.62634218	0.00000014	0.0244	
AE Leo	48	99.9	1913	2013	38090.8951	0.0173	0.62671271	0.00000094	0.1199	
RR Lyr	1466	114.2	1899	2013	35711.5842	0.0017	0.56683649	0.00000006	0.0419	B
AQ Lyr	191	109.5	1900	2009	35135.3375	0.0043	0.35716144	0.00000023	0.0553	B
CX Lyr	89	112.3	1900	2012	35666.0275	0.0114	0.61665982	0.00000046	0.0915	B
EM Mus	107	52.9	1960	2013	46819.8788	0.0017	0.46729163	0.00000009	0.0172	
AE Peg	61	108.7	1901	2009	35312.9613	0.0131	0.49671483	0.00000065	0.102	B:
TU Per	57	111.6	1900	2012	35640.077	0.0054	0.60706791	0.00000022	0.0365	
SW Psc	36	97	1912	2009	37399.3317	0.0121	0.5212654	0.00000055	0.0711	B:
V1176 Sgr	39	95	1917	2012	38781.318	0.0206	0.35480836	0.00000068	0.1285	
RU Scl	58	85.3	1927	2012	40665.195	0.0136	0.49334611	0.00000051	0.0745	
AR Ser	133	106.7	1901	2008	35108.5949	0.0086	0.57514206	0.00000063	0.0923	B:
AT Ser	57	112.5	1900	2013	35899.1237	0.0089	0.74655916	0.00000044	0.0631	
SS Tau	134	110.1	1902	2012	36166.7642	0.003	0.36991922	0.00000008	0.0345	
RV UMi	265	104.9	1908	2013	37291.1902	0.0017	0.46806318	0.00000006	0.0185	B
ST Vir	99	105.6	1907	2013	37079.0769	0.012	0.41083124	0.00000033	0.1054	B

8. Blazhko effect

We have searched for the relation between the occurrence of the Blazhko effect and the evolution of the period of our studied RRab stars. From our 247 RRab, we know that at least 48 are showing the Blazhko effect and that 13 more stars are probably also Blazhko stars. Moreover, only 13 RRab are certainly without Blazhko effect. As it is sure that more stars of our sample have a Blazhko effect, but that it has not yet been published by lack of suitable measurements or studies to find the Blazhko period and the amplitude of the phenomenon for example, we consider as Blazhko stars also the probable Blazhko RRab for the following statistics.

RRab with a constant period: 17 stars/116 = 15%
RRab with an increasing period: 16 stars/63 = 25%
RRab with a decreasing period: 8 stars/32 = 25%
RRab with an irregular period: 20 stars/35 = 57%

As Jurcsik et al., 2011 observed in M3, the percentage of Blazhko stars is very higher for irregular RRab and is the lowest for constant period RRab. Thus, more the period varies, more the Blazhko effect is occurring. More RRab with Blazhko effect are certainly still to be found. This search is very important in order to better understand the whole pulsation process in RR Lyrae stars. The publication of lack of Blazhko effect is also desirable.

9. The period and period changes of the field RRab – Conclusions

The average period of pulsation of our different groups of RRab of the field of the Galaxy (constant, increasing, decreasing and irregular) is not significant, the period depending on too much varied factors other than the evolutionary one. The only thing that we can mention is that the average period of the field RRab of our sample is 0.53 days, just a little shorter than in Oosterhoff I clusters (0.55 days) and much more shorter than in Oosterhoff II clusters (0.65 days). There is probably more younger RR Lyrae in the field than in the Globular Clusters of our Galaxy.

On the other hand, the period changes of the field RRab and their rate of change, the subject of this paper, and the obtained results are important because they can be compared with other results based on observation and with the theory of evolution. To obtain an evaluation of the mean period change of the field RRab all along their strip in the instability branch, we have to consider all our RRab. However, the RRab with irregular period were rejected from the calculation because it is impossible to give them a direction nor a rate of change.

The mean rate of change has been obtained with the sum of the positive rates (dP/dt) minus the sum of the negative rates. The result has been divided by the number of constant, increasing and decreasing stars (211 RRab):

$$+278.43\ dP/dt\ (10^{-10}\ d/d) / 211 = 1.32\ dP/dt\ (10^{-10}\ d/d)$$

the mean β ($dMyr^{-1}$) = 0.04 and the mean α (Myr^{-1}) = 0.09

Those results seem to be four times too high for stars pulsating as RRab Lyrae during 10^8 years, but we have to remain that all our stars do not begin their RR Lyrae track at the same place of the horizontal branch, and that they do not follow the same way of evolution. Furthermore, perhaps we have to observe during a longer time in order to much better smooth the short term irregularities.

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Annexe : New ephemerides of the RRab and the RRc non studied here, but having at least 20 maxima in the GEOS database and several other RR stars.

Star		Max	Time	From	To	Epoch	Error	Period	Error	Sigma
And	XY	17	57	1954	2011	45424.5014	0.0047	0.39872899	0.0000002	0.0191
And	BK	17	23	1990	2013	52355.1565	0.0022	0.42160388	0.00000037	0.0082
And	DM	40	74.9	1938	2013	42837.9417	0.0071	0.6304083	0.00000043	0.0445
And	DU	9	55.1	1957	2012	46115.1124	0.0604	0.60671412	0.00000468	0.1373
And	DY	24	23	1990	2013	52361.7378	0.0029	0.60308001	0.00000058	0.0089
And	FQ	19	43.5	1964	2008	46593.8834	0.0099	0.48974941	0.00000091	0.0306
And	FR	41	42.1	1964	2006	46327.1724	0.007	0.50397885	0.00000091	0.0327
And	FT	24	43.2	1964	2007	46525.6635	0.0174	0.49676526	0.00000124	0.0397
And	HK	28	29.6	1970	1999	46028.2645	0.0154	0.51012059	0.00000167	0.0393
And	HX	27	40.3	1970	2010	48184.8027	0.0081	0.65529773	0.00000078	0.0296
And	II	26	38.3	1970	2008	47818.2769	0.0077	0.56327909	0.00000068	0.0159
And	IN	29	35.3	1970	2005	47267.3041	0.0089	0.56987607	0.00000084	0.0183
And	IQ	24	35.2	1970	2005	47248.6151	0.011	0.48706521	0.00000091	0.0227
And	IR	21	41.1	1970	2011	48326.1725	0.0094	0.50528823	0.00000068	0.0191
And	IT	25	36.2	1970	2006	47433.8244	0.0146	0.57732266	0.00000139	0.03
And	IY	30	29.2	1970	1999	41297.9103	0.0023	0.48542596	0.00000041	0.0119
And	NR	29	42.3	1964	2006	46364.2859	0.0104	0.68186176	0.00000147	0.0391
And	NT	50	18.1	1964	1982	41955.4208	0.006	0.35165968	0.00000076	0.0425
And	NU	39	48.9	1964	2013	47583.5308	0.0051	0.31353564	0.00000024	0.0279
And	NW	35	18.3	1964	1982	41981.7496	0.0048	0.45365283	0.00000079	0.0284
And	NX	45	49	1964	2013	47593.6582	0.0028	0.64804703	0.00000026	0.0186
And	OX	38	47	1964	2011	47261.6769	0.0066	0.49340215	0.00000056	0.0274
And	OZ	29	47.1	1964	2011	47236.7215	0.0081	0.49603007	0.00000068	0.0308
And	V548	5	2.8	2009	2012	55654.7028	0.0145	0.50680526	0.00001752	0.0287
Ant	WY	32	21.6	1991	2013	52445.1052	0.0018	0.57434282	0.00000035	0.0051
Ant	BK	21	4.2	2009	2013	55636.3884	0.0006	0.51656965	0.00000054	0.0024
Aps	TY	55	45.8	1967	2013	48082.0046	0.0024	0.50169514	0.00000017	0.0062
Aps	ZZ	20	48.2	1959	2007	45489.0537	0.0104	0.37732162	0.00000046	0.0415
Aps	CK	33	54.2	1959	2013	46587.7345	0.0054	0.6236488	0.00000037	0.0312
Aps	DD	26	54.1	1959	2013	46610.2834	0.0079	0.64810622	0.00000055	0.0396
Aps	DI	20	54.8	1959	2014	46743.3052	0.0247	0.51917827	0.00000142	0.108
Aps	DZ	24	11.8	1957	1969	38187.6354	0.0107	0.55206437	0.00000393	0.0346
Aps	EV	21	48.1	1959	2007	45502.8941	0.0067	0.28340082	0.00000022	0.0275
Aps	LS	26	11.9	1957	1969	38211.3728	0.0074	0.47099066	0.00000227	0.0237
Aps	LU	43	56.2	1957	2013	46297.8807	0.0068	0.75503379	0.00000056	0.0402
Aqr	WZ	21	97.8	1915	2013	38595.0279	0.0042	0.49426187	0.00000014	0.0155
Aqr	AA	92	118.7	1894	2013	34815.1319	0.0032	0.60888791	0.00000014	0.0301
Aqr	BT	45	101.1	1912	2013	38083.4654	0.0081	0.406815	0.00000029	0.0502
Aqr	BU	20	84.6	1916	2001	36529.5192	0.0126	0.53101146	0.00000067	0.0392
Aqr	FU	31	41.2	1966	2007	46875.631	0.0107	0.31845439	0.00000069	0.0422
Aqr	FX	33	46.9	1966	2013	47932.6493	0.0064	0.58822395	0.00000063	0.0362
Aqr	FY	32	46.9	1966	2013	47924.5508	0.0047	0.50496097	0.00000044	0.0252
Aqr	GG	30	41.2	1966	2007	46876.0624	0.0073	0.65564632	0.00000105	0.0329
Aqr	GL	30	44.1	1966	2010	47415.0804	0.0086	0.40002443	0.00000068	0.0356
Aqr	GO	40	44.1	1966	2010	47431.6544	0.008	0.29376259	0.00000047	0.0331
Aqr	GP	19	14.1	1999	2013	53941.6465	0.0074	0.40524263	0.00000232	0.0294
Aqr	GQ	31	39.2	1966	2005	46546.0388	0.0126	0.48356826	0.00000139	0.0538
Aqr	GR	27	39.8	1966	2006	46631.986	0.0096	0.40275579	0.00000092	0.0389
Aqr	GU	30	40.1	1966	2006	46679.9871	0.0131	0.46528109	0.00000124	0.0484
Aqr	GW	19	47.1	1966	2013	47967.5951	0.0024	0.52597871	0.00000019	0.0105
Aqr	GX	25	54	1951	2005	43759.5757	0.0049	0.54731785	0.00000068	0.0245
Aqr	GY	30	45.1	1966	2011	47606.6845	0.01	0.46001051	0.00000093	0.0513
Aqr	HH	53	44	1966	2010	47388.7865	0.0076	0.57534053	0.00000073	0.0514
Aqr	OX	21	14.2	1999	2013	54003.1062	0.0039	0.52891925	0.00000099	0.0119
Aql	CH	7	54	1957	2011	45912.3638	0.0077	0.38918871	0.0000004	0.0169
Aql	V518	40	79.2	1932	2011	41391.6924	0.0062	0.40640859	0.00000025	0.0389
Aql	V525	15	77.9	1932	2010	41161.9468	0.0074	0.51568854	0.0000003	0.0273
Aql	V651	30	21.5	1941	1962	34023.9783	0.0059	0.51883472	0.00000084	0.0272
Aql	V668	21	6.8	1938	1945	30405.2128	0.0109	0.38915653	0.00000475	0.042
Aql	V672	50	76.3	1936	2012	42296.909	0.0091	0.52983168	0.00000049	0.0488
Aql	V706	15	80	1932	2012	41616.4484	0.0084	0.37724089	0.00000025	0.0319
Aql	V741	20	20.9	1938	1959	33007.0699	0.0097	0.61076604	0.00000196	0.0354
Aql	V751	36	71.9	1932	2004	40119.7242	0.0155	0.55751454	0.00000092	0.0919
Aql	V779	35	60.1	1934	1994	38554.2561	0.0156	0.39416598	0.00000082	0.0897
Aql	V793	10	23	1990	2013	52358.472	0.0182	0.39792133	0.00000229	0.0521
Aql	V831	21	49.2	1943	1992	39913.1452	0.008	0.57171893	0.00000076	0.0287
Aql	V896	25	33.3	1929	1962	31880.0798	0.0198	0.44307006	0.00000202	0.0988
Aql	V910	24	45	1941	1986	38441.3958	0.0148	0.99999994	0.00000231	0.0489
Aql	V1005	24	44.4	1936	1980	36415.9026	0.0058	0.62716825	0.00000057	0.0266
Aql	V1025	21	45.1	1936	1981	36604.1293	0.0047	0.55153928	0.00000044	0.0211
Aql	V1035	26	41.3	1938	1979	36614.8407	0.0075	0.45024317	0.00000063	0.0309
Aql	V1059	27	44.2	1936	1980	36460.5646	0.0072	0.48784974	0.00000065	0.036
Aql	V1065	26	42.2	1938	1980	36816.5951	0.0078	0.50899368	0.00000068	0.0379
Aql	V1068	20	41.9	1938	1980	36847.0634	0.0052	0.56379015	0.0000005	0.023
Aql	V1085	31	47.8	1930	1978	35023.8803	0.0061	0.50854067	0.00000052	0.0309
Aql	V1100	23	49.2	1943	1992	39912.6506	0.0062	0.54012203	0.00000055	0.0259

Star		Max	Time	From	To	Epoch	Error	Period	Error	Sigma
Aql	V1118	23	35.9	1929	1965	32383.9471	0.0074	0.58908527	0.00000081	0.0257
Aql	V1127	29	22	1944	1966	35338.9041	0.0073	0.35600421	0.00000094	0.0315
Aql	V1129	33	34.3	1928	1962	31703.6819	0.0061	0.45365353	0.00000048	0.0266
Aql	V1134	19	21.1	1945	1966	35498.2358	0.0086	0.50902016	0.00000157	0.0274
Aql	V1136	20	5.8	1961	1967	38597.4166	0.0098	0.57726684	0.00000696	0.0294
Aql	V1146	27	28	1939	1967	34577.2495	0.0087	0.73170216	0.00000183	0.0333
Aql	V1151	22	3.1	1961	1964	38117.8225	0.0065	0.60729453	0.00001294	0.0253
Aql	V1152	21	65.9	1928	1994	37486.9949	0.0106	0.42644811	0.00000101	0.0484
Aql	V1158	23	48	1941	1989	39002.344	0.0127	0.66188489	0.00000137	0.0366
Aql	V1172	21	49	1943	1992	39882.9691	0.008	0.54633654	0.00000074	0.0235
Aql	V1173	25	50.2	1943	1993	40103.3701	0.0177	0.50304638	0.00000149	0.0578
Aql	V1178	23	50.2	1943	1993	40101.1677	0.0106	0.60746995	0.00000102	0.0402
Aql	V1201	22	3.8	1961	1965	38242.9702	0.0127	0.40018662	0.00001093	0.0522
Aql	V1232	21	27.1	1939	1966	34404.087	0.0076	0.69993409	0.00000144	0.0216
Aql	V1264	40	38.7	1928	1967	32610.1697	0.0057	0.52402479	0.00000054	0.0297
Aql	V1704	5	12.5	1999	2011	53559.7937	0.0321	0.51515939	0.00000851	0.0716
Ara	S	19	22.6	1991	2014	52629.1347	0.0106	0.45186332	0.00000168	0.0306
Ara	MS	39	78	1935	2013	42239.2927	0.0034	0.52498669	0.00000014	0.0191
Ara	V387	20	1.8	1957	1959	36507.2842	0.0198	0.40494964	0.00003003	0.0442
Ara	V634	22	6.7	1957	1964	37274.7171	0.0064	0.62848491	0.00000565	0.0287
Ara	V636	20	6.1	1957	1963	37146.0419	0.0027	0.45589497	0.00000168	0.0109
Ara	V637	23	4.8	1957	1962	36915.2899	0.0085	0.38148698	0.00000504	0.0382
Ari	RW	26	76	1935	2011	41953.6691	0.0046	0.35428506	0.00000013	0.0225
Ari	SY	23	56.2	1957	2013	46335.6165	0.0016	0.5666797	0.00000011	0.0051
Ari	TU	24	98	1914	2012	38366.8672	0.0211	0.47164366	0.00000079	0.0885
Ari	TY	9	12.8	1998	2011	53511.5522	0.0269	0.32971998	0.00000473	0.0731
Ari	CD	4	1	2011	2012	56021.6682	0.004	0.32830252	0.00000771	0.0071
Aur	MV	26	80.1	1931	2012	41315.4648	0.0092	0.55358776	0.00000058	0.0425
Aur	NU	61	47.2	1965	2013	47682.4387	0.0057	0.53940802	0.00000044	0.0141
Aur	PY	22	42.9	1964	2007	46336.4262	0.0061	0.45714778	0.00000053	0.0212
Boo	ST	156	102.2	1911	2013	37837.8005	0.002	0.62229229	0.00000008	0.0195
Boo	TV	92	106.1	1906	2012	36708.7319	0.0049	0.31255989	0.0000001	0.035
Boo	WW	22	100.2	1912	2012	37777.1724	0.0121	0.47926938	0.00000043	0.053
Boo	AE	58	69.4	1941	2011	43012.275	0.0038	0.31489342	0.00000013	0.0277
Boo	AF	19	44.2	1962	2006	45834.6913	0.0204	0.53017025	0.00000147	0.0418
Boo	AG	26	48.9	1956	2005	44536.2716	0.0094	0.52210196	0.00000092	0.0377
Boo	AM	22	49.4	1962	2011	46688.6573	0.0084	0.46437942	0.00000048	0.0254
Boo	AX	21	42.9	1962	2005	45644.3483	0.0197	0.58712898	0.0000016	0.0403
Boo	AY	20	48.3	1962	2010	46481.6871	0.0066	0.61433997	0.00000053	0.0255
Boo	BB	28	42.8	1962	2005	45646.55	0.0075	0.47275073	0.00000059	0.0275
Boo	BE	31	4.4	1962	1966	38469.9979	0.0073	0.31061886	0.00000505	0.0397
Boo	BQ	22	48.4	1962	2010	46512.0275	0.0151	0.62031019	0.00000118	0.0462
Boo	BR	21	40.3	1962	2002	45020.5005	0.0182	0.30456127	0.00000082	0.0373
Boo	BS	20	4.4	1962	1966	38465.3778	0.0043	0.29615171	0.00000283	0.0193
Boo	BT	20	43.3	1962	2005	45569.7047	0.0209	0.67456027	0.00000194	0.0428
Boo	CQ	47	55.3	1957	2012	45964.5733	0.0076	0.28188241	0.00000027	0.0197
Boo	CS	66	54.2	1957	2011	45806.0398	0.0027	0.55338322	0.00000021	0.0215
Boo	DD	11	16	1996	2012	53095.6888	0.0143	0.33924236	0.00000204	0.0423
Boo	DG	29	60.9	1951	2012	44943.6316	0.0083	0.45867519	0.00000041	0.0443
Cae	U	53	24	1989	2013	52243.0717	0.0047	0.41978763	0.00000068	0.0169
Cae	V	20	13.2	2000	2014	54272.9973	0.0082	0.57091041	0.00000275	0.0308
Cam	RZ	25	101.9	1911	2012	37659.5818	0.0034	0.48045085	0.0000001	0.0116
Cam	TY	8	77.4	1934	2011	41706.839	0.0131	0.67007155	0.00000077	0.0323
Cam	UY	60	27.4	1985	2012	51183.1313	0.0009	0.26704174	0.00000007	0.0055
Cam	CN	19	16.6	1995	2012	53110.7695	0.0045	0.62144535	0.00000103	0.0116
Cam	LP	21	14.4	1999	2013	54009.8172	0.0091	0.57209387	0.00000244	0.0413
Cnc	SX	11	19.2	1992	2011	52137.0673	0.0029	0.51015935	0.00000055	0.0078
Cnc	AQ	141	114.9	1899	2013	35650.6626	0.0022	0.54851846	0.00000008	0.0263
Cnc	AS	39	24	1989	2013	52258.7716	0.0014	0.61753723	0.0000003	0.0054
Cnc	CQ	12	57.2	1953	2010	44827.9835	0.03	0.52465033	0.00000198	0.0819
Cnc	EF	77	29.1	1983	2012	50697.5603	0.0022	0.29578034	0.00000014	0.0166
Cnc	EZ	96	30.8	1983	2013	51011.8327	0.0009	0.54578246	0.00000012	0.0083
CVn	RR	19	98.1	1914	2012	38154.9095	0.0017	0.55860809	0.00000007	0.0058
CVn	SS	97	87.2	1926	2013	40536.7579	0.0035	0.47852325	0.00000012	0.0216
CVn	ST	66	87	1926	2013	40491.3378	0.0045	0.32905644	0.00000012	0.0339
CVn	SV	23	85	1928	2013	40860.841	0.0218	0.66811653	0.00000108	0.0665
CVn	TY	35	100	1911	2011	37386.0938	0.0042	0.51344561	0.0000003	0.0246
CVn	VW	42	99	1912	2011	37574.0988	0.0105	0.42498595	0.0000004	0.0483
CVn	WZ	23	65.5	1942	2008	42622.9117	0.0078	0.50939847	0.00000068	0.0291
CVn	XX	24	47	1963	2010	46690.7593	0.0146	0.51301048	0.00000103	0.032
CVn	XZ	13	52.9	1956	2009	45278.0237	0.0166	0.328128	0.00000073	0.0389
CVn	AP	19	46	1966	2012	47665.2851	0.0069	0.57463883	0.00000059	0.0288
CVn	AR	20	46.8	1964	2011	47075.9949	0.0191	0.62721025	0.00000169	0.0532
CVn	BN	62	49.2	1963	2012	47033.2827	0.0031	0.56363811	0.00000027	0.0233
Cma	GI	21	34.8	1964	1999	45097.5102	0.0225	0.45223697	0.00000175	0.048
Cmi	X	24	75.7	1936	2011	42086.1586	0.0082	0.57139578	0.00000048	0.0217
Cap	RZ	28	13.4	1999	2012	53740.7445	0.0006	0.40100716	0.00000017	0.0028
Cap	YZ	23	63.1	1942	2005	27628.0481	0.0064	0.27345695	0.00000011	0.0196
Car	TX	36	20	1993	2013	52779.706	0.0035	0.60113004	0.00000086	0.0125
Car	EE	39	20.1	1993	2013	52795.1473	0.0012	0.67871188	0.00000029	0.0041
Car	IU	90	78.7	1935	2013	42267.1657	0.0087	0.73708642	0.00000048	0.0621

Star		Max	Time	From	To	Epoch	Error	Period	Error	Sigma
Cas	HU	54	76.3	1936	2012	42350.9617	0.0024	0.41159507	0.00000008	0.0176
Cas	IU	59	78.1	1935	2013	42347.6562	0.0033	0.64941491	0.00000016	0.0145
Cas	QR	33	69.2	1935	2004	40710.9984	0.0096	0.48770766	0.00000046	0.0262
Cas	QY	26	74	1938	2012	42629.4082	0.0128	0.37800016	0.00000037	0.0643
Cas	V470	43	54.7	1957	2012	46193.2034	0.0333	0.87443413	0.00000513	0.2141
Cas	V568	56	19	1994	2013	53159.0843	0.0057	0.51404053	0.00000103	0.0173
Cen	AX	37	96.9	1914	2011	38021.7294	0.0063	0.51374402	0.00000021	0.0375
Cen	BI	76	13.4	2000	2013	53996.8539	0.0014	0.45319512	0.00000038	0.0074
Cen	KS	19	80.2	1928	2008	39989.8242	0.0056	0.39742358	0.00000016	0.0226
Cen	V371	19	72.8	1928	2001	38657.429	0.0081	0.44611629	0.00000028	0.0161
Cen	V499	31	76.8	1936	2013	42386.0245	0.0016	0.52121081	0.00000007	0.004
Cen	V671	31	60.3	1953	2013	45408.5361	0.0112	0.43767777	0.00000049	0.0625
Cep	RZ	432	122	1890	2012	33923.4493	0.0075	0.30866507	0.00000019	0.1509
Cep	AQ	18	57.3	1955	2012	45737.7445	0.0073	0.65144443	0.00000055	0.0164
Cep	EL	20	107.7	1903	2011	36017.6664	0.0088	0.41662189	0.00000025	0.0314
Cep	ET	56	8	2005	2013	55166.0311	0.0047	0.49911517	0.00000202	0.0338
Cep	FP	8	12.3	1999	2011	53570.4743	0.0029	0.46786209	0.00000077	0.0072
Cep	GZ	24	73.3	1934	2007	40833.7069	0.0129	0.69458324	0.00000132	0.0552
Col	RT	36	79	1934	2013	42207.5958	0.003	0.53657739	0.00000012	0.017
Col	RW	55	78.9	1935	2013	42223.6163	0.002	0.54561318	0.00000008	0.0087
Col	RX	57	76.2	1937	2013	42723.8912	0.0089	0.59373806	0.00000041	0.0563
Col	RY	44	22.1	1991	2013	52543.4591	0.0027	0.47883562	0.00000053	0.0106
Col	SU	27	76.3	1937	2013	42697.7439	0.0068	0.48735765	0.00000031	0.0318
Col	AV	41	13.9	2000	2013	54097.1886	0.0008	0.46875008	0.0000002	0.0037
Com	U	38	116	1896	2012	34832.8773	0.0034	0.29273841	0.00000006	0.0168
Com	Z	5	80.8	1922	2003	37902.2137	0.0042	0.54668167	0.00000016	0.0076
Com	TU	21	12.2	1999	2011	53497.088	0.0043	0.46188978	0.00000112	0.0128
Com	UV	20	53	1952	2005	43797.3826	0.024	0.61554596	0.0000017	0.0499
Com	XY	24	43.3	1962	2005	45569.4802	0.0242	0.6119111	0.00000202	0.0495
Com	YY	20	47.9	1962	2009	46406.9301	0.0102	0.73667077	0.00000097	0.0366
Com	AG	21	49.3	1962	2011	46672.453	0.0055	0.32243156	0.00000022	0.0221
Com	AH	23	46.1	1962	2008	46192.3024	0.0056	0.31015124	0.00000023	0.0245
Com	AR	20	3.9	1962	1966	38484.8791	0.0122	0.29130367	0.00000777	0.0484
Com	AT	27	40.9	1962	2003	45241.9734	0.0069	0.34446848	0.00000034	0.0254
Com	AY	20	4	1962	1966	38420.5617	0.0099	0.35455133	0.00000789	0.0419
Com	BP	20	42.9	1962	2005	45644.9175	0.0097	0.48368216	0.00000066	0.0199
Com	BW	20	37.3	1962	1999	44471.9073	0.0283	0.7336047	0.00000346	0.0708
Com	CR	13	40.9	1962	2003	45261.4167	0.0196	0.71940187	0.00000202	0.065
Com	CS	19	4	1962	1966	38478.9646	0.0114	0.30644009	0.00000818	0.0458
Com	CW	27	45.3	1962	2007	45934.9698	0.0151	0.33229713	0.00000067	0.0441
Com	CY	20	45.3	1962	2007	45936.4069	0.012	0.75787523	0.00000125	0.0387
Com	CZ	28	48	1962	2010	46555.4948	0.0097	0.29483949	0.00000036	0.0392
Com	DI	22	43	1962	2005	45624.8891	0.0291	0.70249688	0.00000278	0.0591
Com	DL	29	81.3	1931	2012	41189.9502	0.0058	0.43210488	0.00000037	0.0315
Com	DQ	26	3.9	1962	1966	38494.3971	0.0081	0.32037569	0.00000628	0.0363
Com	FL	26	4.4	1962	1966	38470.1771	0.0078	0.36376888	0.00000556	0.0399
Com	GU	6	42.2	1964	2006	46175.204	0.0059	0.49077853	0.00000045	0.0122
Com	HY	35	98	1911	2009	37044.5881	0.015	0.44861123	0.00000059	0.0782
CrA	WW	24	12.4	2001	2013	54218.385	0.0027	0.5594822	0.00000094	0.0095
CrA	V413	20	45.5	1967	2013	48109.8314	0.0036	0.58934138	0.00000029	0.0084
CrB	RV	278	104.8	1907	2012	36962.498	0.0248	0.33162879	0.00000081	0.4097
CrB	VY	33	39.2	1973	2012	48935.5354	0.009	0.46295131	0.00000066	0.0211
CrB	WX	9	28.6	1975	2004	47857.7706	0.017	0.48013349	0.00000172	0.034
CrB	AQ	51	15.9	1995	2011	71425.0625	0.0106	0.66542644	0.00000035	0.0067
Cru	SW	72	12.4	2000	2013	54125.515	0.0006	0.32778001	0.00000014	0.0036
Cyg	NQ	23	17.9	1936	1954	31666.9642	0.0015	0.31159172	0.00000021	0.0042
Cyg	V357	34	113.9	1898	2012	35396.3415	0.0085	0.52011259	0.00000053	0.048
Cyg	V781	75	6.8	1948	1955	33897.116	0.0008	0.43665159	0.00000041	0.0065
Cyg	V782	46	26.3	1928	1954	30299.157	0.0043	0.52363418	0.00000062	0.0121
Cyg	V783	57	27.9	1943	1971	36026.2363	0.0034	0.62069583	0.00000075	0.0133
Cyg	V784	39	9.2	1945	1954	33410.8861	0.0022	0.53410182	0.00000131	0.0124
Cyg	V785	73	27.5	1927	1954	30079.993	0.003	0.51417638	0.00000045	0.0098
Cyg	V790	47	7.3	1948	1955	34097.1943	0.0009	0.45604548	0.00000056	0.0062
Cyg	V791	61	67.1	1945	2012	43907.5669	0.0035	0.33804795	0.00000012	0.0186
Cyg	V794	46	63	1948	2011	44277.486	0.0042	0.51634806	0.00000022	0.0093
Cyg	V799	44	7.2	1947	1954	33744.2747	0.0029	0.65888191	0.00000262	0.019
Cyg	V800	44	8.3	1946	1954	33520.4876	0.0012	0.53115849	0.00000073	0.007
Cyg	V801	54	27.7	1948	1976	37885.8248	0.0025	0.51603885	0.00000035	0.008
Cyg	V802	64	84	1928	2012	40815.3195	0.0099	0.59561045	0.00000078	0.0451
Cyg	V804	49	7.3	1948	1955	34101.8352	0.0011	0.48249974	0.00000061	0.0076
Cyg	V808	98	14.5	1940	1955	32481.1006	0.0025	0.54786226	0.00000101	0.0174
Cyg	V817	32	6.5	1948	1954	33818.746	0.0047	0.54580109	0.00000283	0.0241
Cyg	V894	13	55.5	1956	2011	45708.5483	0.0033	0.57138534	0.00000024	0.0099
Cyg	V939	48	18.5	1995	2013	53175.2529	0.0034	0.38754052	0.00000052	0.022
Cyg	V1094	26	44.6	1935	1980	36119.8203	0.0062	0.68517074	0.00000071	0.0308
Cyg	V1104	20	23.9	1963	1987	42693.1166	0.0054	0.43638149	0.00000062	0.0214
Cyg	V1106	31	23.2	1963	1986	42500.942	0.0061	0.40763835	0.00000068	0.026
Cyg	V1111	36	22.5	1953	1975	38582.105	0.0071	0.55593078	0.0000017	0.0362
Cyg	V1122	24	23.2	1953	1976	38718.4402	0.0047	0.36324934	0.00000078	0.0212
Cyg	V1139	28	19.3	1960	1979	40676.2901	0.0078	0.59744235	0.00000222	0.0395
Cyg	V1369	31	84	1928	2012	40839.2218	0.0065	0.56546571	0.00000047	0.0344
Cyg	V1949	39	52.7	1959	2012	46522.7916	0.0138	0.49882615	0.00000096	0.0851

Star		Max	Time	From	To	Epoch	Error	Period	Error	Sigma
Cyg	V1962	14	31	1981	2012	50518.9424	0.0071	0.50834468	0.00000084	0.0171
Cyg	V2470	9	12.4	2000	2012	53839.1025	0.004	0.54857465	0.0000011	0.008
Del	RV	42	83.9	1928	2012	40859.3829	0.0091	0.49813192	0.00000044	0.0454
Del	SX	19	14.5	1999	2013	53968.0602	0.0026	0.61334056	0.00000072	0.0075
Del	ZZ	28	81.2	1929	2010	40655.9326	0.0045	0.52019155	0.00000019	0.0236
Del	AX	21	82.2	1929	2011	40807.4392	0.0197	0.56372575	0.00000092	0.0895
Del	BK	35	85	1928	2013	41042.041	0.0067	0.36040618	0.00000022	0.0306
Del	BM	45	85	1928	2013	41004.1044	0.0173	0.54115941	0.00000088	0.1141
Del	CD	27	78.3	1929	2007	40088.7085	0.0079	0.63093936	0.0000006	0.0383
Del	CP	29	64.9	1929	1994	37686.4407	0.0042	0.52747511	0.00000025	0.022
Del	CV	30	83.1	1929	2012	41005.1034	0.0053	0.73945557	0.00000037	0.0257
Del	CW	38	78.9	1929	2008	40348.4476	0.0154	0.58208889	0.0000008	0.0932
Del	CY	29	62	1929	1991	37183.8566	0.0072	0.45236602	0.00000039	0.0383
Del	DD	26	65.6	1928	1994	37510.7377	0.004	0.49024928	0.00000023	0.0203
Del	DE	32	64.9	1929	1994	37688.8101	0.0102	0.42269686	0.0000005	0.0572
Del	DG	26	54.1	1940	1994	39668.48	0.0046	0.49046993	0.00000034	0.0236
Del	DH	34	80.1	1929	2009	40427.6249	0.0037	0.59293942	0.00000024	0.0213
Del	DI	31	65.8	1928	1994	37536.612	0.0067	0.58032839	0.00000046	0.0344
Del	DS	62	83.8	1929	2013	41195.9591	0.0469	0.47614301	0.00000198	0.3463
Del	DU	34	84.9	1928	2013	40986.4416	0.0105	0.6514879	0.00000067	0.0609
Del	DW	33	76.8	1929	2006	39889.6119	0.0049	0.66077045	0.00000037	0.0278
Del	EF	34	83	1928	2011	40695.339	0.0031	0.44757903	0.00000014	0.0181
Del	EG	29	81.9	1928	2010	40490.6196	0.0208	0.32484144	0.00000059	0.1036
Del	EM	23	63	1940	2003	41298.1181	0.0052	0.58261504	0.00000032	0.0243
Del	EO	24	59	1940	1999	40557.8566	0.015	0.58004709	0.00000107	0.073
Del	FF	48	79.9	1931	2011	41243.0951	0.0063	0.61543825	0.00000046	0.0356
Del	FG	24	69.2	1940	2009	42434.8624	0.019	0.70396075	0.00000153	0.0868
Del	FI	20	54.2	1940	1994	39735.7264	0.0061	0.45166459	0.00000042	0.0268
Del	FL	28	54.2	1940	1994	39735.1686	0.005	0.48029226	0.00000031	0.0262
Del	FP	23	61.9	1940	2002	41087.5225	0.0096	0.30065892	0.00000029	0.0291
Del	FY	29	54	1940	1994	39706.7025	0.005	0.53481028	0.00000039	0.0264
Del	GK	27	52.1	1940	1992	39354.1703	0.0065	0.50458197	0.00000052	0.0331
Del	GO	28	54.1	1940	1994	39666.829	0.0129	0.54598059	0.00000102	0.0652
Del	GV	33	73.2	1940	2013	43219.1422	0.0061	0.54120835	0.0000004	0.0343
Del	GZ	73	85	1928	2013	41020.6917	0.0103	0.50562637	0.00000066	0.0856
Del	HS	26	52.2	1940	1992	39379.0205	0.008	0.32641405	0.00000041	0.039
Del	HT	31	53.9	1940	1994	39694.2464	0.0066	0.56991679	0.00000056	0.0362
Del	II	21	53.9	1940	1994	39695.4773	0.0104	0.40780837	0.00000048	0.0469
Dor	RT	39	13.1	2000	2013	54253.8575	0.0028	0.48283464	0.0000008	0.0104
Dor	VW	90	50	1963	2013	47508.8415	0.0012	0.57058577	0.00000008	0.0054
Dra	VZ	264	51.8	1961	2013	47025.9085	0.0015	0.32102645	0.00000012	0.0233
Dra	WY	52	117.1	1896	2013	35159.2157	0.0035	0.58894232	0.00000021	0.0206
Dra	AE	16	73	1939	2012	42818.6865	0.002	0.6026734	0.00000011	0.0073
Dra	AV	49	80.6	1930	2011	40981.4743	0.0077	0.55559323	0.00000038	0.0471
Dra	AW	49	110	1900	2010	35346.2844	0.0218	0.68720028	0.00000101	0.1215
Dra	BC	172	27	1986	2013	51701.3496	0.001	0.71958269	0.0000002	0.0048
Dra	CY	13	12.5	1999	2011	53553.5312	0.0044	0.53494903	0.00000162	0.0158
Dra	DD	49	25.2	1988	2013	51878.6411	0.0107	0.32679565	0.0000013	0.0742
Equ	RT	38	52.8	1959	2012	46450.4325	0.3086	0.44490961	0.00001883	1.1646
Eri	XY	42	13	2000	2013	54246.4378	0.0045	0.55425201	0.00000247	0.0266
Eri	BE	20	46.1	1965	2011	47474.3789	0.0133	0.57953816	0.00000119	0.0519
Eri	BK	20	98.1	1915	2013	38721.0661	0.0071	0.54814758	0.00000033	0.0318
For	RX	60	87.3	1926	2013	40677.7699	0.0056	0.59731304	0.00000023	0.0149
For	SS	36	49.2	1964	2013	47650.5564	0.0036	0.49542797	0.00000025	0.0117
For	SW	54	61.3	1952	2013	45453.9282	0.0036	0.8037558	0.00000029	0.0177
For	TV	23	8.1	1960	1968	38699.9326	0.0038	0.40774742	0.00000157	0.0162
Gem	AK	27	23.2	1989	2013	52105.0082	0.0009	0.34635904	0.00000012	0.004
Gem	EW	30	75.3	1936	2012	42252.0635	0.0159	0.52371029	0.00000069	0.0631
Gem	GQ	21	69.2	1941	2011	42966.3652	0.0065	0.5705656	0.00000032	0.0299
Gem	GU	19	69.9	1939	2009	42087.9727	0.007	0.39033088	0.00000027	0.0218
Gru	RW	24	60.8	1952	2013	45471.5568	0.0043	0.55030154	0.00000024	0.0199
Gru	SS	24	69.3	1936	2005	40984.0229	0.0248	0.48962112	0.0000011	0.0588
Gru	TZ	32	24.2	1935	1959	32414.6263	0.0069	0.70246999	0.00000122	0.0381
Gru	AO	24	50.5	1959	2009	45945.2738	0.0034	0.57260998	0.00000021	0.0157
Gru	AP	32	78.3	1935	2013	42292.9199	0.0091	0.50798455	0.00000039	0.0412
Gru	BG	23	34.6	1936	1971	34650.2728	0.0141	0.56013137	0.00000182	0.0673
Her	CW	16	78.4	1935	2013	42176.923	0.0087	0.62384692	0.0000005	0.0293
Her	EG	27	69.3	1930	1999	38757.0887	0.0078	0.48301482	0.00000053	0.0318
Her	EP	12	69.1	1943	2012	43615.2233	0.0107	0.42571963	0.00000039	0.0286
Her	GV	19	28.2	1934	1962	32696.8741	0.008	0.29145431	0.00000058	0.0312
Her	HN	23	76	1934	2010	41500.9778	0.0052	0.51588269	0.00000021	0.0232
Her	IP	17	10.9	2002	2013	54514.3039	0.0141	0.43382414	0.00000506	0.0517
Her	LS	83	76.9	1935	2012	42045.2158	0.0036	0.23080791	0.00000007	0.0186
Her	LW	13	67.9	1943	2011	43342.562	0.0097	0.31837585	0.00000027	0.0345
Her	OS	21	69.3	1940	2009	42323.2598	0.0095	0.39614103	0.00000032	0.0348
Her	OT	13	66.2	1939	2005	41464.4204	0.0189	0.61110197	0.00000104	0.0379
Her	OW	28	66.2	1939	2005	41467.8068	0.0123	0.58322224	0.00000069	0.0351
Her	OX	46	74.2	1939	2013	42931.1624	0.0053	0.75735398	0.00000034	0.0332
Her	OY	24	31.1	1939	1970	35060.1635	0.0046	0.33319429	0.00000032	0.0227
Her	V365	62	100.9	1911	2012	37750.8577	0.0118	0.61314652	0.00000083	0.0866
Her	V369	24	71	1934	2005	40507.4795	0.0107	0.52575244	0.00000063	0.0282

Star		Max	Time	From	To	Epoch	Error	Period	Error	Sigma
Her	V370	24	23.6	1934	1957	31855.4441	0.0066	0.6337166	0.00000141	0.0324
Her	V376	25	70.9	1934	2005	40517.3801	0.0087	0.35520433	0.00000036	0.0259
Her	V378	20	66	1939	2005	41418.7615	0.0149	0.35204419	0.00000056	0.0366
Her	V379	31	65.1	1934	1999	39445.1686	0.0152	0.67947609	0.0000012	0.0415
Her	V380	29	24.2	1934	1958	32131.9982	0.0048	0.50019544	0.0000008	0.0241
Her	V382	29	67	1938	2005	41252.0242	0.012	0.45560965	0.00000059	0.0331
Her	V385	33	68.9	1936	2005	40893.0896	0.0107	0.52814229	0.00000071	0.0392
Her	V388	21	66.9	1938	2005	41246.8683	0.019	0.64532281	0.00000132	0.0472
Her	V392	51	74.4	1937	2011	42255.6374	0.0043	0.52974129	0.00000024	0.0265
Her	V397	22	60	1939	1999	40362.578	0.014	0.55622462	0.0000009	0.0348
Her	V402	20	71	1934	2005	40507.5708	0.0127	0.33081047	0.00000048	0.0347
Her	V405	23	66	1939	2005	41420.4353	0.0132	0.58793627	0.00000085	0.035
Her	V406	20	18.3	1939	1957	32655.6465	0.0091	0.73689854	0.00000268	0.0406
Her	V414	22	65.1	1940	2005	41581.455	0.0188	0.6260489	0.0000013	0.0478
Her	V415	22	70.2	1935	2005	40741.6114	0.0158	0.54948335	0.00000095	0.0423
Her	V416	22	66.9	1938	2005	41246.7996	0.0167	0.5488382	0.00000099	0.0424
Her	V418	33	71.3	1939	2010	42337.6939	0.0077	0.37623577	0.00000032	0.038
Her	V422	22	19.1	1938	1957	32507.0173	0.0097	0.51585172	0.0000018	0.0434
Her	V424	23	60.4	1939	1999	40346.7643	0.0086	0.63070961	0.00000073	0.0303
Her	V425	24	71.2	1934	2005	40551.066	0.023	0.55714376	0.00000133	0.0562
Her	V428	21	18	1939	1957	32693.6772	0.0075	0.6417628	0.00000202	0.0343
Her	V429	21	64.2	1941	2005	41748.0714	0.0122	0.51834634	0.00000071	0.0308
Her	V431	35	18.5	1940	1958	33117.4289	0.0092	0.50043565	0.00000172	0.0492
Her	V434	38	66.9	1938	2005	41254.3973	0.0086	0.51440075	0.00000051	0.0303
Her	V437	20	66.9	1938	2005	41246.8841	0.0162	0.51636119	0.00000097	0.0423
Her	V439	49	22.5	1936	1958	32366.4379	0.0156	0.46041767	0.00000212	0.0835
Her	V442	56	107	1906	2013	36992.249	0.0079	0.4420865	0.00000025	0.051
Her	V448	9	55.1	1958	2013	46430.25	0.0045	0.65353416	0.00000032	0.0134
Her	V461	28	54	1959	2013	46619.472	0.0027	0.51300643	0.00000022	0.0129
Her	V467	36	65.9	1939	2005	41436.9023	0.014	0.68350063	0.00000107	0.0396
Her	V468	28	71	1934	2005	40506.8694	0.007	0.51063174	0.00000047	0.027
Her	V469	24	70.7	1934	2005	40621.5821	0.0081	0.59647174	0.0000005	0.0285
Her	V476	32	65.1	1940	2005	41586.5579	0.0117	0.55591547	0.00000075	0.0328
Her	V480	22	68.8	1936	2005	40911.6176	0.0139	0.65285506	0.00000111	0.0398
Her	V481	26	71.1	1934	2005	40565.3922	0.008	0.48102535	0.00000047	0.0243
Her	V483	24	70.2	1935	2005	40741.9584	0.0194	0.49428099	0.00000109	0.0642
Her	V484	27	70.9	1934	2005	40540.8006	0.0113	0.59369328	0.00000078	0.0312
Her	V486	56	78.4	1934	2012	41860.9634	0.0162	0.80593398	0.00000128	0.0749
Her	V491	28	71.2	1934	2005	40554.7162	0.0079	0.45965837	0.00000047	0.0246
Her	V494	30	68.3	1937	2005	41095.1859	0.015	0.71792475	0.00000122	0.0513
Her	V497	39	22.7	1934	1957	31872.5731	0.0037	0.39053079	0.00000049	0.0203
Her	V498	21	65.9	1939	2005	41436.7219	0.0112	0.38158003	0.00000048	0.0286
Her	V499	27	69.1	1936	2005	40859.9112	0.0096	0.32037086	0.0000004	0.0307
Her	V507	24	23.2	1934	1957	31784.1786	0.0046	0.54902638	0.0000007	0.0203
Her	V510	31	71.3	1934	2005	40555.3819	0.0174	0.60416288	0.00000124	0.0543
Her	V511	32	23.4	1934	1957	31864.5693	0.0077	0.63092913	0.0000015	0.041
Her	V514	37	71	1934	2005	40510.8032	0.0156	0.63397318	0.00000115	0.0562
Her	V534	7	11.6	2000	2011	53718.6929	0.0473	0.59980308	0.00001467	0.0916
Her	V542	20	49.1	1964	2013	47469.4888	0.0052	0.61940997	0.00000039	0.021
Her	V545	22	49	1963	2012	47101.7455	0.0029	0.59811266	0.00000022	0.0112
Her	V546	24	25.2	1964	1989	43159.8965	0.0034	0.4672577	0.00000051	0.0168
Her	V549	20	41	1964	2005	45984.849	0.007	0.58519748	0.00000089	0.0272
Her	V552	4	14.1	1999	2013	53910.823	0.0021	0.37851984	0.00000035	0.0039
Her	V558	29	30	1964	1994	44005.4961	0.0091	0.47310621	0.00000112	0.0482
Her	V564	25	29.1	1939	1968	34691.0305	0.0086	0.40282494	0.00000078	0.0421
Her	V593	18	49.2	1964	2013	47477.3011	0.0024	0.51649187	0.00000015	0.0103
Her	V613	19	28.2	1964	1992	43709.4165	0.0035	0.67165495	0.00000071	0.0153
Her	V623	32	34.5	1959	1993	42934.579	0.0053	0.48630278	0.00000063	0.0302
Her	V633	23	74.9	1938	2013	42800.9711	0.0037	0.48999267	0.00000019	0.0178
Her	V634	23	71.2	1934	2005	40549.3482	0.0099	0.51251363	0.00000061	0.0364
Her	V635	20	71	1935	2006	40886.7218	0.0098	0.49949118	0.00000055	0.0321
Her	V650	25	49.2	1964	2013	47500.9102	0.0033	0.51886896	0.00000022	0.0162
Her	V674	26	65.3	1940	2005	41629.6366	0.011	0.50425175	0.00000066	0.0389
Her	V698	27	49.1	1964	2013	47506.435	0.003	0.53615123	0.0000002	0.0145
Her	V734	5	40.1	1972	2012	48888.5227	0.0033	0.58099419	0.0000003	0.0063
Her	V753	23	39.7	1966	2006	46600.9591	0.0084	0.62915813	0.00000111	0.0225
Her	V759	32	42.9	1966	2009	47220.0701	0.0126	0.51240412	0.0000012	0.0465
Her	V778	21	7.2	1975	1982	43764.3902	0.01	0.64589001	0.00000675	0.0454
Her	V779	26	30.4	1975	2005	48001.2969	0.0196	0.61885186	0.00000257	0.0457
Her	V783	22	30	1975	2005	48081.3381	0.0125	0.49564347	0.00000126	0.0268
Her	V784	19	30.4	1975	2005	48001.9343	0.011	0.46388292	0.00000104	0.0236
Her	V787	27	30.3	1975	2005	48001.54	0.0199	0.5022791	0.00000204	0.0432
Her	V791	28	30.4	1975	2005	48002.5786	0.0097	0.46431544	0.00000099	0.0233
Her	V793	21	30.4	1975	2005	48003.3537	0.015	0.68248037	0.00000221	0.0345
Her	V794	21	30.4	1975	2005	48000.971	0.0132	0.62104678	0.00000171	0.0359
Her	V796	20	30.3	1975	2005	47990.8505	0.0152	0.55231374	0.00000171	0.0331
Her	V800	25	31.3	1974	2005	47845.6297	0.0249	0.61247394	0.00000325	0.0584
Her	V806	25	31.9	1973	2005	47725.5102	0.0156	0.37453527	0.00000124	0.0356
Her	V810	20	30.4	1975	2005	48000.9388	0.014	0.54622696	0.00000159	0.0308
Her	V813	21	6.6	1975	1981	43652.684	0.0043	0.54330709	0.00000269	0.0187
Her	V1013	7	14.2	1999	2013	53902.7675	0.0017	0.64472622	0.00000054	0.0044

Star		Max	Time	From	To	Epoch	Error	Period	Error	Sigma
Her	V1087	18	46.3	1964	2010	46958.4745	0.0022	0.46250665	0.00000019	0.0089
Her	V1124	6	14.2	1999	2013	53873.8553	0.0044	0.35512612	0.00000079	0.0097
Hor	UU	49	13.1	2000	2013	54259.9629	0.0011	0.64369325	0.00000043	0.0047
Hya	XX	37	77	1936	2013	42319.5115	0.0023	0.50775099	0.0000001	0.0119
Hya	BI	27	6.1	2007	2013	55254.4616	0.0002	0.52647332	0.00000015	0.0011
Hya	DG	57	69	1944	2013	43774.4144	0.006	0.42996448	0.00000023	0.0421
Hya	FX	26	60.7	1952	2013	45330.9972	0.0031	0.41733876	0.00000013	0.0144
Hya	FY	26	60.9	1952	2013	45353.6235	0.0033	0.63665022	0.00000021	0.0157
Hya	GL	15	83.2	1928	2011	40446.0155	0.0101	0.50593693	0.00000041	0.0385
Hya	IK	20	22.6	1991	2014	52624.8909	0.0151	0.65027563	0.0000032	0.0381
Hyi	TW	28	50	1963	2013	47508.6115	0.0024	0.67538067	0.0000002	0.007
Ind	V	35	78.3	1935	2013	42288.5859	0.0023	0.47960285	0.00000009	0.0136
Lac	XZ	61	85.5	1927	2012	40586.5901	0.0117	0.63024437	0.00000069	0.087
Lac	CQ	62	107.2	1906	2013	37043.801	0.0177	0.62005437	0.00000062	0.0683
Lac	PW	54	56.2	1956	2012	45953.6455	0.0038	0.51237088	0.00000028	0.0278
Leo	SW	17	80	1933	2013	41767.3317	0.005	0.55413972	0.00000022	0.0108
Leo	SZ	57	59.7	1954	2013	45735.9449	0.0105	0.5340847	0.00000067	0.0397
Leo	AH	22	19	1992	2011	52112.6297	0.0094	0.46630649	0.00000148	0.0201
Leo	AQ	17	81	1929	2010	40493.2623	0.0301	0.54975074	0.00000152	0.1195
Leo	AS	22	85.1	1928	2013	40844.7498	0.0123	0.54502385	0.0000005	0.0511
Leo	AV	21	79.2	1930	2010	40787.1981	0.0177	0.50029911	0.00000128	0.0665
Leo	BB	25	2	1962	1964	38098.7833	0.0028	0.31601842	0.00000341	0.0126
Leo	BT	27	79.2	1929	2008	40092.2668	0.0062	0.49972829	0.00000032	0.0319
Leo	BU	21	84.1	1928	2012	40692.2019	0.0116	0.59947109	0.0000008	0.0511
Leo	BX	27	48.4	1964	2012	47241.6982	0.0148	0.36284681	0.00000071	0.0759
Leo	CC	20	3.3	1961	1965	38249.1031	0.008	0.51255711	0.00001214	0.035
Leo	CM	25	48	1963	2011	46886.9024	0.0046	0.36169318	0.0000002	0.0229
Leo	DI	4	19.2	1992	2011	52163.9597	0.0316	0.57684916	0.0000056	0.0564
Leo	DL	14	21.2	1991	2012	52145.4508	0.0024	0.67385436	0.00000053	0.0088
Leo	DM	15	13	2000	2013	53977.2727	0.0018	0.52868144	0.00000071	0.0071
Leo	HO	31	12.8	1999	2012	53673.7986	0.0038	0.46141024	0.00000179	0.017
LMi	Y	30	28.9	1983	2012	50715.9118	0.0042	0.5244333	0.00000069	0.0174
LMi	VY	17	15.1	1997	2012	53249.7769	0.001	0.52614715	0.00000022	0.0027
Lep	AO	20	14.1	1999	2013	54085.8186	0.0034	0.56008585	0.00000091	0.0103
Lib	UX	9	82.9	1930	2013	41317.0024	0.0015	0.48317109	0.00000005	0.0029
Lib	VY	41	99.1	1914	2013	38340.1062	0.0021	0.53394044	0.00000008	0.0123
Lyn	RW	84	83.2	1930	2013	41168.307	0.0037	0.49856393	0.00000021	0.0328
Lyn	TV	73	91.5	1921	2013	39653.5781	0.002	0.24065138	0.00000005	0.0168
Lyr	Y	22	113.5	1899	2013	35739.3637	0.0017	0.5026957	0.00000005	0.0072
Lyr	WW	22	64.9	1948	2013	44622.9447	0.0023	0.51576755	0.00000012	0.0108
Lyr	DI	24	53	1960	2013	46842.6668	0.0079	0.41744963	0.00000039	0.0372
Lyr	EN	29	77.1	1934	2011	41781.2586	0.0087	0.70294631	0.00000066	0.0462
Lyr	HW	22	68.7	1930	1999	38756.2737	0.0189	0.29508386	0.00000065	0.0572
Lyr	HZ	23	34.4	1941	1975	36380.9235	0.0059	0.50677412	0.00000069	0.0281
Lyr	IK	23	72	1940	2012	43032.3874	0.0069	0.412312	0.00000023	0.0313
Lyr	IZ	25	73.2	1940	2013	43116.4396	0.0101	0.63496263	0.00000055	0.0216
Lyr	KM	69	72.1	1940	2012	43051.3879	0.0117	0.50043105	0.00000052	0.0971
Lyr	KN	42	73.5	1940	2013	43086.8017	0.0121	0.60148007	0.00000063	0.0335
Lyr	KR	19	67.7	1941	2009	42576.5339	0.0156	0.39577056	0.00000054	0.0398
Lyr	KU	22	8.5	1940	1948	31225.6548	0.007	0.57019787	0.00000449	0.0324
Lyr	LO	26	9.5	1940	1949	31482.4386	0.0079	0.36390853	0.00000192	0.0335
Lyr	LQ	39	9.6	1939	1948	31130.9379	0.0051	0.34512256	0.00000135	0.0291
Lyr	LR	27	18.1	1940	1958	32972.7102	0.0069	0.33847319	0.00000125	0.0288
Lyr	MW	64	73.9	1939	2013	43023.0069	0.0067	0.3978795	0.00000025	0.0486
Lyr	NQ	18	105.8	1907	2013	37166.4031	0.003	0.58778881	0.00000011	0.0089
Lyr	NX	32	7	1948	1955	34179.4792	0.0012	0.4981228	0.00000068	0.0059
Lyr	NZ	36	10.8	1948	1959	34735.4662	0.0053	0.61628384	0.0000041	0.0315
Lyr	V383	20	25.3	1953	1978	39150.4428	0.0171	0.60521491	0.00000391	0.0675
Lyr	V397	28	28.2	1949	1977	38188.5045	0.0089	0.45876242	0.00000121	0.0329
Lyr	V462	17	45.4	1968	2013	48230.819	0.0122	0.37251231	0.00000061	0.0498
Men	AV	25	5	2008	2013	55727.4164	0.0006	0.55495573	0.00000045	0.0019
Mon	VW	48	89.1	1899	1988	30993.2698	0.0109	0.60403145	0.00000059	0.0602
Mon	AI	53	81	1927	2008	40030.8074	0.0062	0.42580228	0.00000026	0.0259
Mon	DV	51	85.9	1927	2013	40943.1118	0.0048	0.41339497	0.00000015	0.0339
Mon	HL	52	28.4	1931	1960	31803.7439	0.0026	0.49923506	0.00000042	0.0181
Mon	IR	55	45	1941	1986	38487.6059	0.0036	0.45760942	0.00000034	0.0263
Mon	V376	30	28.4	1939	1967	34507.6078	0.0106	0.62293458	0.00000213	0.0576
Mon	V386	31	27	1929	1956	30553.0564	0.0126	0.33353389	0.00000117	0.063
Mon	V518	35	50.7	1939	1989	38618.5914	0.0085	0.34874309	0.00000057	0.0313
Mon	V535	34	68.9	1940	2009	42282.9222	0.008	0.33287048	0.00000029	0.0295
Mon	V895	6	15	1998	2013	53904.0156	0.0061	0.51315542	0.00000137	0.0145
Mus	ST	21	8.8	1960	1969	38751.2807	0.0034	0.46336819	0.00000132	0.0154
Mus	TX	56	20.2	1993	2013	52762.758	0.002	0.47322583	0.00000033	0.0061
Mus	CL	23	6	1961	1967	38510.6306	0.0044	0.48686761	0.00000248	0.017
Mus	ER	31	8.9	1960	1969	38763.7229	0.0033	0.36823389	0.00000113	0.0145
Mus	ES	37	8.9	1960	1969	38765.7404	0.0028	0.4249999	0.00000124	0.0136
Mus	ET	49	47.2	1959	2006	45306.3779	0.0162	0.22967361	0.00000051	0.0383
Mus	EU	21	32	1961	1993	43230.8369	0.0097	0.31214508	0.00000056	0.0201
Oct	Y	52	76.9	1936	2013	42431.2696	0.0031	0.64657237	0.00000015	0.0178
Oct	RY	54	78.3	1935	2013	42295.0788	0.0021	0.56344662	0.00000009	0.0128
Oct	SS	81	78.3	1935	2013	42317.6148	0.0018	0.62185336	0.00000008	0.0137

Sge	DH	36	46.5	1934	1981	36109.6404	0.0025	0.46958443	0.00000022	0.0145
Sge	DP	54	76.1	1935	2011	41887.9397	0.0061	0.48833739	0.00000035	0.0349
Sge	EH	23	77.2	1934	2011	41707.453	0.0162	0.59224849	0.00000083	0.0385
Sge	ER	55	46.3	1934	1981	36158.8041	0.0064	0.41843016	0.00000062	0.0459
Sge	ES	21	24.4	1935	1959	32399.1876	0.0048	0.56548222	0.0000008	0.0213
Sgr	V675	28	21.9	1991	2013	52495.6386	0.0019	0.64229107	0.00000041	0.005
Sco	V494	25	21.8	1991	2013	52473.3917	0.0038	0.4272888	0.00000055	0.0125
Sco	V559	25	45	1915	1960	28856.4725	0.0022	0.54077918	0.00000026	0.0107
Sco	V690	23	46.9	1966	2013	47866.1029	0.0015	0.49225441	0.0000001	0.0043
Sco	V765	22	6.3	2007	2013	55339.1816	0.0005	0.46366185	0.00000027	0.0019
Sco	V859	24	10.3	1960	1970	38952.7737	0.0063	0.46154898	0.00000184	0.0177
Scl	RW	33	116.2	1889	2005	32474.134	0.0053	0.45170781	0.0000002	0.0262
Scl	UZ	23	50.1	1963	2013	47461.4815	0.0011	0.44911975	0.00000006	0.0037
Scl	VX	31	41.1	1972	2013	49114.9631	0.0134	0.63705589	0.00000147	0.0362
Scl	WY	21	50.1	1963	2013	47438.5942	0.0091	0.463686	0.00000052	0.035
Scl	AE	35	13	2000	2013	54242.4169	0.0011	0.55011377	0.00000042	0.0051
Sct	BU	13	76	1929	2005	39683.9007	0.0275	0.42025173	0.00000139	0.0765
Ser	AP	8	68.8	1936	2005	40894.0951	0.0156	0.34079409	0.00000065	0.0435
Ser	AW	17	76.7	1936	2013	42352.4111	0.0029	0.59711009	0.00000014	0.0106
Ser	DY	10	90	1915	2005	37075.9249	0.0053	0.38621882	0.00000022	0.0168
Sex	T	52	85.1	1926	2011	40095.2773	0.0127	0.32470438	0.00000034	0.0911
Sex	V	9	21.2	1990	2011	51761.6303	0.0177	0.48801784	0.00000343	0.0451
Sex	RU	43	36	1974	2010	48727.3244	0.0034	0.35023178	0.00000027	0.022
Tau	YZ	9	22.2	1990	2013	52258.5747	0.0119	0.41147285	0.0000013	0.0295
Tau	BO	15	48.3	1964	2013	47529.1107	0.005	0.4451437	0.00000033	0.012
Tau	BR	23	22	1990	2012	52244.7096	0.005	0.39059378	0.00000085	0.0161
Tau	CN	22	59	1930	1989	36765.309	0.0218	0.64213214	0.00000215	0.094
Tau	CV	7	17.4	1991	2009	51688.1142	0.0169	0.47971631	0.00000369	0.0447
Tau	IY	23	83.1	1930	2013	41179.8291	0.0074	0.37649121	0.00000028	0.035
Tau	V415	20	15	1951	1966	36686.0916	0.0061	0.36854873	0.0000013	0.0238
Tel	GZ	28	78	1935	2013	42231.0756	0.008	0.45535065	0.0000003	0.0365
Tel	HH	33	76.9	1936	2013	42415.8821	0.0092	0.48207779	0.00000038	0.0437
Tel	HN	43	78	1935	2013	42249.6196	0.024	0.60034514	0.0000013	0.067
Tel	HY	30	75.9	1937	2013	42578.5559	0.0121	0.40250196	0.00000044	0.0661
Tri	TV	32	25.3	1988	2013	52013.5604	0.0077	0.70572876	0.00000228	0.0279
Tri	UY	30	41.2	1964	2005	46174.5914	0.0073	0.50943062	0.00000071	0.0278
Tri	VV	39	41.2	1964	2005	46174.7815	0.0113	0.53189659	0.0000012	0.0466
Tri	VX	37	37.2	1964	2001	45435.511	0.0073	0.63307526	0.00000111	0.0342
Tri	AT	32	12.9	1999	2012	53872.0901	0.0015	0.65260741	0.00000133	0.0084
Tri	BW	4	12	1999	2011	53688.999	0.0067	0.22245869	0.00000069	0.0117
TrA	RW	48	46	1967	2013	48149.4243	0.001	0.37403926	0.00000005	0.0032
TrA	IT	22	10.1	1959	1969	38630.5408	0.0096	0.47068698	0.00000324	0.0325
Tuc	W	73	78.2	1935	2013	42356.7355	0.0021	0.64223427	0.00000011	0.0131
Tuc	YY	41	78.3	1935	2013	42288.1899	0.0062	0.63490157	0.0000003	0.0375
Tuc	AE	78	13.1	2000	2013	54258.9306	0.0003	0.4145284	0.00000008	0.0016
Tuc	AG	20	46.2	1967	2013	48220.7584	0.0047	0.60258372	0.00000039	0.0105
Tuc	BK	39	54.5	1959	2013	46688.3928	0.004	0.55005994	0.00000024	0.023
UMa	SX	130	111.4	1899	2011	35342.739	0.0114	0.30712506	0.00000026	0.1291
UMa	UU	8	79.8	1933	2013	41860.1238	0.0236	0.64484254	0.00000118	0.0605
UMa	AX	52	45.4	1964	2010	47024.3661	0.0175	0.53496119	0.00000181	0.1044
UMa	BB	6	41.8	1969	2011	48017.699	0.0072	0.55905649	0.00000064	0.0153
UMa	BF	9	43.9	1969	2013	48316.2374	0.0082	0.50101803	0.0000007	0.0195
UMa	BK	14	50	1961	2011	46487.1673	0.013	0.38912951	0.00000063	0.0487
UMa	BN	9	39	1961	2000	44476.3652	0.0092	0.39990762	0.00000055	0.0218
UMa	EX	93	20.9	1993	2013	52828.5702	0.0009	0.5428344	0.00000018	0.0084
UMa	KT	97	20.7	1993	2013	52854.8221	0.0024	0.62730685	0.00000059	0.0233
UMa	MU	4	11.9	1999	2011	53482.0358	0.0052	0.26795393	0.00000067	0.0104
UMa	NS	5	13.9	2000	2013	54100.7488	0.0049	0.59912768	0.00000115	0.0087
Vel	AF	65	76	1937	2013	42539.9623	0.0049	0.52740488	0.0000002	0.0284
Vel	CD	41	78	1935	2013	42163.2183	0.0035	0.57351148	0.00000015	0.0208
Vel	FS	27	46.1	1967	2013	47976.9605	0.0041	0.47575864	0.00000025	0.0086
Vir	UZ	7	100.1	1913	2013	38166.306	0.017	0.45884305	0.00000049	0.0445
Vir	XZ	19	14.3	1994	2009	52316.458	0.0081	0.47720338	0.00000169	0.0175
Vir	AD	12	95.1	1915	2010	37966.2906	0.0132	0.55221629	0.00000059	0.0454
Vir	AE	14	77.6	1934	2012	41906.0257	0.0055	0.63386064	0.0000003	0.017
Vir	AR	8	50.3	1962	2012	46879.7837	0.005	0.53030695	0.00000036	0.0133
Vir	AU	15	98.1	1914	2012	38162.5591	0.0041	0.34323092	0.00000012	0.0159
Vir	BC	32	19	1994	2013	52947.0438	0.0019	0.56453683	0.00000046	0.0097
Vir	BQ	17	100	1913	2013	38127.4306	0.0142	0.63701944	0.00000052	0.0283
Vir	DG	21	41.9	1963	2005	45818.7099	0.0138	0.62125151	0.00000154	0.0331
Vir	DO	30	81.8	1931	2013	41518.949	0.004	0.53272702	0.00000015	0.0084
Vir	FU	18	44.9	1968	2013	48140.2859	0.0209	0.57433376	0.0000024	0.0639
Vir	OQ	4	10.3	1999	2010	53419.7324	0.0042	0.6039067	0.00000135	0.0073
Vir	V388	39	2	2011	2013	56044.2419	0.0003	0.54299212	0.00000075	0.0016
Vol	SV	75	40.8	1973	2013	49189.7167	0.0195	0.37844175	0.00000116	0.0477
Vul	EW	57	74.1	1925	1999	37901.3726	0.0069	0.46731086	0.00000063	0.0345
Vul	MQ	31	28.2	1949	1977	38189.9513	0.01	0.69904432	0.00000233	0.0412