

New Data for Known Variables in Hercules

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#	Name	Other	Coord (J2000)	Type	Max	Min	System	Period	Epoch (JD)	type	Sp	Comment	L.Curve	Find.Chart	Data
1	HH Her	GSC 2582-01131	16 38 40.48, +31 38 44.2	CST	15.20		CV			other		Comm. 1	1.PNG	chart1.PNG	CSS_data_1.txt
2	V368 Her	USNO-A2.0 1050-08424914	17 10 31.09, +22 23 08.4	RRAB	15.03	15.50	CV	1.191475	2454703.677	max		Comm. 2	2.PNG	chart2.PNG	CSS_data_2.txt
3	V413 Her	GSC 2083-01605	17 31 35.62, +26 42 04.0	RRAB	14.94	15.64	CV	1.05523	2454800.740	max		Comm. 3	3.PNG	chart3.PNG	CSS_data_3.txt
4	V426 Her	GSC 2076-00046	17 35 29.05, +23 01 27.7	RRC	14.70	15.10	CV	0.326366	2454800.600	max		Comm. 4	4.PNG	chart4.PNG	CSS_data_4.txt
5	V470 Her	GSC 2061-01035	17 14 14.90, +24 02 20.5	EA	15.35	15.94	CV	2.50029	2454704.650	min		Comm. 5	5.PNG	chart5.PNG	CSS_data_5.txt
6	V517 Her	USNO-A2.0 1050-09017144	17 41 34.94, +19 24 56.4	RRAB	15.68	16.80	CV	0.480396	2454700.873	max		Comm. 6	6.PNG	chart6.PNG	CSS_MLS_data_6.txt
7	V541 Her	USNO-A2.0 1050-07920951	16 24 05.04, +18 48 24.4	RRAB	14.24	15.53	CV	(see Comments)	(see Comments)	max		Comm. 7	7.PNG	chart7.PNG	CSS_data_7.txt
8	V561 Her	USNO-A2.0 1125-08665758	17 51 30.05, +28 22 12.6	RRAB	15.63	16.43	CV	0.579976	2454800.770	max		Comm. 8	8.PNG	chart8.PNG	CSS_data_8.txt
9	V564 Her	USNO-A2.0 1275-09680880	17 58 17.42, +38 21 18.4	RRAB	14.51	15.32	CV	0.674476	2454600.835	max		Comm. 9	9.PNG	chart9.PNG	CSS_data_9.txt ISWASP_data_9.txt NSVS 5365334 NSVS 8065821 NSVS 8083188
10	V572 Her	USNO-A2.0 1125-09100646	18 11 38.37, +25 54 39.1	RRAB	14.46	15.54	CV	0.568058	2454500.949	max		Comm. 10	10.PNG	chart10.PNG	CSS_data_10.txt
11	V607 Her	GSC 2053-00046	16 40 54.50, +26 22 10.1	EA	12.7	13.49	CV	1.712532	2454000.91	min		Comm. 11	11.PNG	chart11.PNG	CSS_data_11.txt ISWASP_data_11.txt NSVS 7894581 ASAS 164054+2622.2
12	V630 Her	USNO-A2.0 1200-08902544	18 05 10.18, +31 56 17.3	RRAB	16.05	16.89	CV	0.607739	2454700.575	max		Comm. 12	12.PNG	chart12.PNG	CSS_data_12.txt
13	V678 Her	GSC 2035-00553	16 08 16.66, +24 42 13.7	EA	14.46	15.55	CV	1.453744	2454640.897	min		Comm. 13	13.PNG	chart13.PNG	CSS_data_13.txt
14	V680 Her	USNO-A2.0 1050-07806392	16 10 22.75, +21 48 26.6	RR(B)	15.31	15.98	CV	(see Comments)	(see Comments)	max		Comm. 14	14.PNG	chart14.PNG	CSS_data_14.txt LINEAR_data_14.txt
15	V689 Her	GSC 1505-01187	16 17 13.33, +16 38 54.0	CST	14.95		CV			other		Comm. 15	15.PNG	chart15.PNG	CSS_data_15.txt
16	V696 Her	GSC 1510-00169	16 28 08.71, +18 29 34.9	CST	14.2		CV			other		Comm. 16	16.PNG	chart16.PNG	CSS_data_16.txt
17	V699 Her	GSC 1510-01195	16 30 33.07, +17 00 47.0	CST	14.85		CV			other		Comm. 17	17.PNG	chart17.PNG	CSS_data_17.txt
18	V703 Her	USNO-A2.0 1050-08001562	16 33 26.50, +21 29 16.2	CST	16.4		CV			other		Comm. 18	18.PNG	chart18.PNG	CSS_data_18.txt
19	V710 Her	USNO-A2.0 1050-08116258	16 45 24.86, +18 27 36.1	CST	16.5		CV			other		Comm. 19	19.PNG	chart19.PNG	CSS_data_19.txt
20	V723 Her	GSC 3077-00895	17 11 11.84, +40 43 52.8	EA	14.35	15.00	CV	8.0634	2454273.48	min		Comm. 20	20.PNG	chart20.PNG	CSS_data_20.txt ISWASP_data_20.txt
21	V757 Her	GSC 3501-01689	17 13 22.83, +45 38 00.3	SR:	11.7	12.1	WASP	48.4	2454246	other		Comm. 21	21.PNG	chart21.PNG	ISWASP_data_21.txt NSVS 5266726 NSVS 5304463 NSVS 5332739
22	V769 Her	GSC 3512-00225	17 25 57.38, +47 02 51.1	LB	13.8	16.1	p			other	M3-M4III	Comm. 22	22.PNG	chart22.PNG	ISWASP_data_22.txt NSVS 5312353
23	V801 Her	GSC 0990-00681	17 20 23.89, +13 32 40.0	RRAB	14.44	15.19	CV	0.498371	2454600.670	max		Comm. 23	23.PNG	chart23.PNG	CSS_MLS_data_23.txt
24	V1070 Her	GSC 2619-00833	17 49 53.05, +37 08 39.8	EA	11.95	13.5	WASP	2.53210	2453182.648	min		Comm. 24	24.PNG	chart24.PNG	CSS_data_24.txt ISWASP_data_24.txt NSVS 8057960 NSVS 5358358 NSVS 8075737

Comments:

1. The variability of HH Her was discovered by Hoffmeister (1936). The variable was classified as a short-period star. Ahnert et al. (1941) classified HH Her as an RRC star with the elements: $JD(\max) = 2429721.650 + 0.29986 \times E$ (mag. range $15.^m5 - 15.^m8$ pg). However, according to CSS data, the star does not vary.

2. The variability of V368 Her was discovered by Hoffmeister (1959). Following Hoffmeister (1960), the variable was classified in the GCVS as an RR Lyrae star (RRAB) with the light elements: $JD(\max) = 2435953.440 + 0.543689 \times E$. This period is wrong. According to data from Catalina Surveys, the period is a little longer than one day (see Table). $M - m = 0.14$ P. $J - K = 0.501$ (2MASS).

3. The variability of V413 Her was discovered by Hoffmeister (1959), who suggested a period of 0.5137 days. Following Hoffmeister (1960), the variable was classified in the GCVS as an RR Lyrae star (RRC) with the light elements: $JD(\max) = 2435955.458 + 0.351742 \times E$. These period and type are wrong. According to data from Catalina Surveys, it is an RRAB star and its variability period is close to one day. $M - m = 0.15$ P. $J - K = 0.522$ (2MASS).
4. The variability of V426 Her was discovered by Hoffmeister (1959). Following Hoffmeister (1960), the variable was classified in the GCVS as an eclipsing binary (EW/KW) with the light elements $JD(\min) = 2427571.460 + 0.4921282 \times E$. According to data from Catalina Surveys, it is actually an RR Lyrae star (RRC). $M - m = 0.43$ P. $J - K = 0.256$ (2MASS).
5. The variability of V470 Her was discovered by Hoffmeister (1949). Hoffmeister (1960) found the star's Algol-like fades and also occasional brightenings. Thus, the GCVS gives the type 1S for the star (mag. range $15.^m1 - 16.^m0$ pg). However, Ponomareva (1969) found no H-alpha emission in the spectrum. According to data from Catalina Surveys, V470 Her is actually an eclipsing binary (type EA), $\text{MinII} = 15.53$ (CV). $D = 0.10$ P.
6. The variability of V517 Her was discovered by Hoffmeister (1949), the variable was classified as a possible short-period variable. Following Hoffmeister (1960), the variable was classified in the GCVS as an RR Lyrae star with the possible light elements $JD(\max) = 2429022.583 + 0.597303 \times E$. This period is not correct. According to data from Catalina Surveys, it is actually an RRAB star with $P = 0.480396$ days. $M - m = 0.11$ P. $J - K = 0.326$ (2MASS).
7. The variability of V541 Her was discovered by Hoffmeister (1966b), the variable was classified as an RR Lyrae variable star with undetermined light elements. Following Busch et al. (1974), the variable was classified in the GCVS as an RRAB star with the light elements $JD(\max) 2438503.541 + 0.568227 \times E$. Kinemuchi et al. (2006) derived the period 0.568234 days from the NSVS data. Drake et al. (2013) give the light elements $HJD(\max) = 2453469.9247 + 0.5681947 \times E$ based on data from Catalina Surveys. We reinvestigated the star using the same Catalina survey data and found that the star was an RRAB variable with two closely spaced frequencies. The light elements are the following:

Mode	Frequency, c/d	Semi-amplitude, CV mag	Period, days	Epoch, JD
f_1	1.759913	0.374	0.568210	2454800.593
f_2	1.781410	0.121	0.561353	2454800.880

$f_1 / f_2 = 0.9879$. The two close periods can also be interpreted as a Blazhko effect with the period of 46.5 days. $J - K = 0.201$ (2MASS).

8. The variability of V561 Her was discovered by Hoffmeister (1966a), the variable was classified in the GCVS as an RR Lyrae star without light elements. We confirm the RR Lyrae nature of this variable (RRAB type) according to data from Catalina Surveys. $M - m = 0.20$ P. $J - K = 0.239$ (2MASS).
9. The variability of V564 Her was discovered by Hoffmeister (1966b). Following Thänert (1974), the variable was classified in the GCVS as an RRAB star with the light elements $JD = 2429374.544 + 0.4028257 \times E$. According to the data from ROTSE-I/NSVS, SWASP, and Catalina surveys, this period is wrong. $M - m = 0.17$ P. $J - K = 0.290$ (2MASS). In the NSVS and 1SWASP, V564 Her is blended with GSC 3089-01435, so the amplitude of variability is underestimated.
10. The variability of V572 Her was discovered by Hoffmeister (1966a), the variable was classified as an RR Lyrae star with unknown period. We confirm the RR Lyrae nature of this variable (RRAB type) according to data from Catalina Surveys. The variability period is 0.568058 days. $M - m = 0.13$ P. $J - K = 0.297$ (2MASS).
11. V607 Her was reported by Hoffmeister (1968) as an Algol-type star without light elements. Following Busch et al. (1974), the variable was classified in the GCVS as an eclipsing variable star (EA/SD type) with the elements $JD(\min) = 2439538.619 + 3.425200 \times E$. This period is wrong. According to data from 1SWASP, ROTSE-I/NSVS, ASAS, and Catalina surveys, the period is twice shorter ($P = 1.712532$ days). $D = 0.14$ P. $\text{MinII} = 12.^m9$ (CV). From the 1SWASP data: $12.^m70 - 13.^m45$, $\text{MinII} = 12.^m83$ (WASP mag); from the ASAS-3: $12.^m8 - 13.^m6$ (V); from the ROTSE-I/NSVS: $13.^m13 - 13.^m85$, $\text{MinII} = 13.^m30$ (R).
12. The variability of V630 Her was discovered by Richter (1969). The variable was classified as an RR Lyrae star (RR) without light elements. Following Thänert (1974), the variable was classified in the GCVS as an RRAB star with the elements $JD(\max) = 2430103.513 + 0.476151 \times E$. This period is wrong. According to data from Catalina Surveys, $P = 0.607739$ days. $M - m = 0.15$ P. $J - K = 0.415$ (2MASS).
13. The variability of V678 Her was discovered by Hoffmeister (1968) who had found the Algol type and could not determine the light elements. Following Busch et al. (1974), the variable was classified in the GCVS as an EA star with the light elements $JD(\min) = 2439889.406 + 1.389665 \times E$. According to data from Catalina Surveys, the true period is somewhat longer. $D = 0.14$ P. $\text{MinII} = 14.^m60$ (CV).
14. The variability of V680 Her was discovered by Hoffmeister (1966b). The variable was classified as a possible short-period star without light elements. Following Busch et al. (1974), the variable was classified in the GCVS as an RR Lyrae star (RRAB) with the light elements $JD(\max) = 2439940.491 + 0.660136 \times E$. This period is wrong. According to data from Catalina Surveys and LINEAR, it is actually a double-mode RR Lyrae star that pulsates in the first-overtone and fundamental modes. The light elements are tabulated below.

Mode	Frequency, c/d	Semi-amplitude, Mag	Period, days	Epoch, JD
f_1	2.515141	0.146 (CV), 0.146 (LINEARmag)	0.397592	2454800.810
f_0	1.874555	0.092 (CV), 0.088 (LINEARmag)	0.533460	2454800.903
$f_1 + f_0$	4.38962	0.039 (CV)	0.227810	2454800.616
$f_1 - f_0$	0.640517	0.032 (CV)	1.56124	2454800.57

$P_1/P_0 = 0.7453$. $J - K = 0.295$ (2MASS).

15. The variability of V689 Her was reported by Richter (1969), rapid variations were suspected. Following Busch et al. (1974), the variable was classified in the GCVS as an eclipsing binary (type E), with a possible period of 3.07/N days (mag. range $15.^m6 - 16.^m0$ pg). According to data from Catalina survey, V689 Her is a constant star, its variability is not confirmed.
16. The variability of V696 Her was reported by Richter (1969). The variable was classified as an eclipsing star (E type) without light elements. Following Busch et al. (1974), the variable was classified in the GCVS as an IS: variable. (mag. range $15.^m6 - 16.^m6$ pg). Based on the data from Catalina survey, we do not confirm the star's variability.
17. The variability of V699 Her was discovered by Richter (1969). The variable was classified as a possible rapid variable. Following Busch et al. (1974), the variable was classified in the GCVS as an eclipsing binary (type EW/KE), mag. range $15.^m4 - 16.^m2$ (pg), with the light elements $JD(\min) = 2439529.600 + 0.614205 \times E$. According to data from Catalina Surveys, V699 Her is a constant star, its variability is not confirmed.

18. The variability of V703 Her was reported by Richter (1969). The variable was classified as a possible fast variable. Following Busch et al. (1974), the variable was classified in the GCVS as an RR Lyrae star (RR) without light elements, mag. range $15.^m3 - 16.^m1$ (pg). In contradiction with previous studies, data from Catalina Surveys shows V703 Her to be a constant star.

19. The variability of V710 Her was reported by Richter (1969). Following Busch et al. (1974), the variable was classified in the GCVS as a possible RR Lyrae star without light elements, mag. range $16.^m6 - 17.^m4$ (pg). According to data from Catalina Surveys, its variability is not confirmed.

20. The variability of V723 Her was discovered by Kurochkin (1977). Based on his results, the variable was classified in the GCVS as an eclipsing binary (type EA/SD:) with the light elements $JD(max) = 2440832.374 + 3.967052 \times E$. We confirm the eclipsing nature of this variable (EA type) using data from SWASP and Catalina Surveys but do not confirm the period. $D = 0.06$ P. $MinII = 14.^m61$ (CV). From the 1SWASP data: $14.^m4 - 15.^m0$ (SWASPmag), $MinII = 14.^m6$ (SWASPmag).

21. The variability of V757 Her was discovered by Kurochkin (1977). The variable was classified in the GCVS as a possible eclipsing binary (type E:) without light elements, mag. range $13.^m4 - 14.^m2$ (pg). Meinunger (1983) did not find any variability, V757 Her was classified as a red constant star with the magnitude $13.^m6$ (pg). According to ROTSE-I/NSVS and SWASP data, it is a possible SR star. From the ROTSE-I/NSVS data: $11.^m2 - 11.^m55$ in the R band; from the CSS data: $10.^m95 - 11.^m64$ (CV). $J - K = 0.978$ (2MASS), $B - V = 2.057$ (Tycho2).

22. The variability of V769 Her was discovered by Kurochkin (1977). From his data, the variable was classified as a possible long-period eclipsing binary (type E:), mag. range $13.^m8 - 16.^m1$ (pg). According to ROTSE-I/NSVS and SWASP data, V769 Her is an LB star. From the 1SWASP data: $11.^m6 - 11.^m95$ (1SWASPmag); from the ROTSE-I/NSVS data: $10.^m55 - 10.^m85$ in the R band. $J - K = 1.223$ (2MASS). Spectral type M3-M4III (FBS-L 1724+470, Gigoyan et al. 2010). NSVS and SWASP data shows the variable blended with GSC 3512-00114, the variability amplitude is underestimated.

23. The variability of V801 Her was discovered by Hoffmeister (1966a), the variable was classified as a slow variable, mag. range $15.^m0 - 15.^m5$ (pg). Following Gessner (1983), the variable was classified in the GCVS as a semiregular variable star (SR type, P = 268 days). According to data from Catalina Surveys, it is actually an RR Lyrae star (RRAB type). $M - m = 0.18$ P. $J - K = 0.320$ (2MASS).

24. The variability of V1070 Her was discovered by Akerlof et al. (2000) based on the ROTSE-I/NSVS data. Diethelm (2001) gives the EA type and the following light elements: $HJD = 2451265.8306 + 1.2661 \times E$. We reinvestigated the star using the same ROTSE-I/NSVS data and the data from SWASP and Catalina surveys. We confirm the eclipsing nature of this variable but with a twice longer orbital period. $D = 0.16$ P. $MinII = 12.^m1$ (WASPmag). From the ROTSE-I/NSVS data: $12.^m0 - 13.^m6$, $MinII = 12.^m1$ in the R band; from the CSS data: $11.^m75 - 13.^m1$ (CV).

Remarks:

We have looked through the GCVS list of variable stars in the constellation Hercules (Samus et al. 2007 – 2012), analyzed all available observations of these stars from the Catalina Surveys (Drake et al. 2009), SuperWASP (Butters et al. 2010), ROTSE-I/NSVS (Woźniak et al. 2004), ASAS-3 (Pojmanski 2002), and LINEAR (Sesar et al. 2011) online public archives and found twenty four stars for which the information contained in the GCVS and VSX databases (classification, light elements) can be verified or changed.

The SuperWASP observations are available as FITS tables which were converted into ASCII tables using the OMC2ASCII program as described by Sokolovsky (2007).

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