

Eight Double-Mode RR Lyrae Variables

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#	Name	Other	Coord (J2000)	Type	Max	Min	System	Period	Epoch (JD)	type	Sp	Comment	L.Curve	Find.Chart	Data
1		USNO-A2.0 0900-00633070	02 42 27.13, +01 13 32.0	RR(B)	14.67	15.22	CV	(see Comments)	(see Comments)	max		Comm. 1	1.PNG	chart1.PNG	1.txt
2		USNO-A2.0 0900-06185055	08 51 47.16, +07 23 53.7	RR(B)	16.06	16.64	CV	(see Comments)	(see Comments)	max		Comm. 2	2.PNG	chart2.PNG	2.txt
3		USNO-A2.0 0975-06247049	09 27 30.68, +11 07 38.3	RR(B)	15.70	16.40	CV	(see Comments)	(see Comments)	max		Comm. 3	3.PNG	chart3.PNG	3.txt
4	AZ Com	GSC 1455-00265	12 53 50.10, +22 18 39.2	RR(B)	15.26	15.89	CV	(see Comments)	(see Comments)	max		Comm. 4	4.PNG	chart4.PNG	4.txt
5	GG Com	USNO-A2.0 1125-06699415	13 19 54.04, +29 42 22.2	RR(B)	15.71	16.35	CV	(see Comments)	(see Comments)	max		Comm. 5	5.PNG	chart5.PNG	5.txt
6		USNO-A2.0 0900-08370751	16 01 39.89, +03 25 58.9	RR(B)	15.11	15.71	CV	(see Comments)	(see Comments)	max		Comm. 6	6.PNG	chart6.PNG	6.txt
7		USNO-A2.0 0825-09556585	16 40 28.29, -00 42 39.1	RR(B)	15.80	16.46	CV	(see Comments)	(see Comments)	max		Comm. 7	7.PNG	chart7.PNG	7.txt
8		USNO-A2.0 0825-19238320	21 29 33.65, -00 43 30.0	RR(B)	14.38	14.88	CV	(see Comments)	(see Comments)	max		Comm. 8	8.PNG	chart8.PNG	8.txt

Comments:

1. The variability of USNO-A2.0 0900-00633070 was discovered by Sesar et al. (2010; Id. 2488976). They classified the variable as an RRC star with the light elements: Max = HJD 2453675.338 + 0.405047 x E. According to data from Catalina Surveys and from Sesar et al. (2010), it is actually a double-mode RR Lyrae star, type RR(B), with the light elements:

Mode	Frequency, c/d	Semi-amplitude, mag	Period, days	Epoch, JD
f_1	2.468800	0.173 (CV), 0.183 (r)	0.405055	2454700.620
f_0	1.842656	0.043 (CV), 0.044 (r)	0.542695	2454700.985

The period ratio of the first-overtone and fundamental modes is $P_1/P_0 = 0.7464$. J-H = 0.276 (2MASS).

2. The variability of USNO-A2.0 0900-0618505 was reported by Keller et al. (2008; Id. 104395.54). The AAVSO Variable Star Index (VSX; www.aavso.org/vsx/) suggests, on the base of observations from the Catalina Surveys Data Release 1 (Drake et al. 2009), type RRC, with the light elements: Max = HJD 2453466.780 + 0.285678 x E. This period is wrong. I reinvestigated the star using the same Catalina Surveys data. It is actually a double-mode RR Lyrae star, type RR(B), with the light elements:

Mode	Frequency, c/d	Semi-amplitude, CV mag	Period, days	Epoch, JD
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f_1	2.497758	0.154	0.400359	2454700.778
f_0	1.863846	0.063	0.536525	2454701.537
$f_1 + f_0$	4.36161	0.024	0.229273	2454700.610

The period ratio of the first-overtone and fundamental modes is $P_1/P_0 = 0.7462$. J–H = 0.320 (2MASS).

3. The variability of USNO-A2.0 0975-06247049 was reported by Keller et al. (2008; Id. 117937.655). The AAVSO Variable Star Index (VSX; www.aavso.org/vsx/) suggests, on the base of observations from the Catalina Surveys Data Release 1 (Drake et al. 2009), type RRAB with the elements: Max = HJD 2454448.960 + 0.416358 x E. I reinvestigated the star using the same Catalina Surveys data. It is actually a double-mode RR Lyrae star, type RR(B), with the light elements:

Mode	Frequency, c/d	Semi-amplitude, CV mag	Period, days	Epoch, JD
f_1	2.401773	0.147	0.416359	2454700.862
f_0	1.793893	0.063	0.557447	2454701.577
f_N	1.787729	0.057	0.559369	2454700.657

The period ratio of the first-overtone and fundamental modes is $P_1/P_0 = 0.7469$. J–H = 0.267 (2MASS). Probably a non-radial pulsation with the frequency f_N close to the fundamental mode f_0 is excited.

4. The variability of AZ Com was discovered by Hoffmeister (1964). Following Meinunger and Wenzel (1968), the GCVS lists it as an RRC star with the elements: Max = JD 2437696.590 + 0.39983 x E. According to Catalina Surveys data, it is actually a double-mode RR Lyrae star, type RR(B), with the light elements:

Mode	Frequency, c/d	Semi-amplitude, CV mag	Period, days	Epoch, JD
f_1	2.501000	0.188	0.399840	2454700.822
f_0	1.865233	0.075	0.536126	2454700.975
$f_1 - f_0$	0.635809	0.027	1.57280	2454701.85
$f_1 + f_0$	4.36626	0.022	0.229029	2454700.632

The period ratio of the first-overtone and fundamental modes is $P_1/P_0 = 0.7458$. J–H = 0.287 (2MASS).

5. The variability of GG Com was reported by Kinman et al. (1966). The variable is listed in the GCVS as an RRAB star without light elements (its GCVS epoch of maximum, JD 2437435.712, is from Plaut 1970). The AAVSO Variable Star Index (VSX; www.aavso.org/vsx/) suggests, on the base of observations from the Catalina Surveys Data Release 1 (Drake et al. 2009), type RRAB with the light elements: Max = HJD 2454141.91000 + 0.403333 x E. I reinvestigated the star using the same Catalina Surveys data as well as observations from Kinman et al. (1966). It is actually a double-mode RR Lyrae star, type RR(B), with the light elements:

$$\text{GG Com} = \text{CSS_J131954.0+294222}$$

Catalina Surveys data

Mode	Frequency, c/d	Semi-amplitude, CV mag	Period, days	Epoch, JD
f_1	2.479359	0.156	0.403330	2454700.518
f_0	1.849232	0.086	0.540765	2454700.774

$f_1 + f_0$	4.32861	0.047	0.231021	2454700.617
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Kinman et al. data

Mode	Frequency, c/d	Semi-amplitude, mag	Period, days	Epoch, JD
f_1	2.479365	0.204	0.403329	2437700.310
f_0	1.85014	0.148	0.54050	2437700.080
$f_1 - f_0$	0.62933	0.101	1.5890	2437700.65

The period ratio of the first-overtone and fundamental modes is $P_1/P_0 = 0.7459$ (Catalina) or 0.7462 (Kinman et al.). $J-H = 0.102$ (2MASS).

6. The variability of USNO-A2.0 0900-08370751 was discovered by Kraus et al. (2007; No. MG1 807002). The variable was classified as an RRAB star without light elements. According to Catalina Surveys data, it is actually a double-mode RR Lyrae star, type RR(B), with the light elements:

Mode	Frequency, c/d	Semi-amplitude, CV mag	Period, days	Epoch, JD
f_1	2.806017	0.191	0.356377	2454700.503
f_0	2.089362	0.066	0.478615	2454700.867

The period ratio of the first-overtone and fundamental modes is $P_1/P_0 = 0.7446$. $J-H = 0.295$ (2MASS).

7. The variability of USNO-A2.0 0825-09556585 was reported by Vivas et al. (2004; No. 496). The variable was classified as an RRC star with the light elements: $\text{Max} = \text{HJD } 2451236.9173 + 0.391583 \times E$. According to Catalina Surveys data, it is actually a double-mode RR Lyrae star, type RR(B), with the light elements:

Mode	Frequency, c/d	Semi-amplitude, CV	Period, days	Epoch, JD
f_1	2.553639	0.168	0.391598	2454700.955
f_0	1.905753	0.063	0.524727	2454701.015

The period ratio of the first-overtone and fundamental modes is $P_1/P_0 = 0.7463$. $J-H = 0.238$ (2MASS).

8. The variability of USNO-A2.0 0825-19238320 was discovered by Sesar et al. (2010; Id. 2464128). The variable was classified as an RRC star with the light elements: $\text{Max} = \text{HJD } 2453697.153 + 0.397669 \times E$. According to data from Catalina Surveys and from Sesar et al. (2010), it is actually a double-mode RR Lyrae star, type RR(B), with the light elements:

Mode	Frequency, c/d	Semi-amplitude, mag	Period, days	Epoch, JD
f_1	2.514686	0.172 (CV), 0.157 (r)	0.397664	2454700.550
f_0	1.878167	0.043 (CV), 0.046 (r)	0.532434	2454700.685
$f_1 + f_0$	4.39292	0.025 (CV)	0.227639	2454700.590
$f_1 - f_0$	0.636497	0.020 (r)	1.5711	2454701.58

The period ratio of the first-overtone and fundamental modes is $P_1/P_0 = 0.7469$. $J-H = 0.211$ (2MASS).

Remarks:

I present a new investigation of eight known RR Lyrae variable stars.

I analysed the [Catalina Surveys data](#) (Drake et al. 2009) using the period-search software developed by Dr. V.P. Goranskij for Windows environment. According to Catalina Surveys data (sometimes appended with data from other sources), the variables are double-mode RR Lyrae variables, pulsating in the first-overtone and fundamental modes.

Their period ratios, P_1/P_0 , are typical of radially pulsating double-mode RR Lyrae stars. Along with the light curves, I present power spectra of the RR Lyrae variables, for the raw data and after subtraction of the first-overtone oscillations. The structure of the power spectra shows that the secondary periods are real. The tabulated coordinates of the variables were drawn either from the 2MASS catalog or from the GCVS.

The column "Data" in the Table reproduces Catalina observations, with Julian Dates (instead of modified Julian Dates) reported.

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