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CONFIRMATION OF THE RRd NATURE OF V458 HER

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V458 Her was discovered to be variable by Hoffmeister (1936). It was classified as an RRc type variable with a period of 0.3599801 days. From data in the Northern Sky Variability Survey (*NSVS*; Woźniak et al., 2004), Wils et. al (2006) found it to be a double-mode RR Lyrae type variable (RRd), with a fundamental period of 0.48374 days and a period ratio of 0.7442 (with the first overtone period having the largest amplitude, common among RRd stars). Szczygieł & Fabrycky (2007) cast some doubt on this classification because a significant secondary frequency couldn't be found in data from the All Sky Automated Survey (*ASAS-3*; Pojmanski & Maciejewski, 2005).

CCD observations were therefore performed with a 35-cm C14 and an SBIG ST-8 camera on 10 nights in July-August 2007 (*V* and *R_C* data) and on 14 nights in April-May 2008 (only *V* data) to verify the classification. The comparison stars used were GSC 1539-0959 (adopted magnitude *V* = 12.45 and *R* = 12.37 from the Tycho2 catalogue) and GSC 1539-1173. The median nightly standard deviation for the check star measurements was 0.02 mag. All data are available electronically.

The data were analysed using Period04 (Lenz & Breger, 2005). The presence of an additional frequency (the fundamental mode) and some of its combination frequencies with the first overtone mode were readily identified. Table 1 gives an overview of the frequencies identified, together with their amplitudes and phases. The values for the *R_C* data were calculated using the frequencies derived from the *V* data. The uncertainties on the values were derived from Monte Carlo simulations. The top panel of Fig. 1 presents a phase diagram of the *V* data, plotted with the first overtone period, the period with the largest amplitude. The bottom panel shows a phase diagram of the *V* data, prewhitened with the first overtone period and its harmonics (but not with the combination frequencies), and plotted with the fundamental period. The period ratio P_1/P_0 for V458 Her can then be calculated to be 0.7443, the amplitude ratio $A_1/A_0 = 3.1$.

The extended *ASAS-3* data set, including data from 2007 and 2008, now also clearly confirms the RRd nature of V458 Her. The frequencies derived from these data are $f_1 = 2.777932$ and $f_0 = 2.067709$, which again leads to $P_1/P_0 = 0.7443$, and also $A_1/A_0 = 3.7$.

This research made use of the SIMBAD and VizieR databases operated at the *Centre de Données Astronomiques (Strasbourg)* in France.

Table 1: Frequencies detected in V458 Her.

	Frequency c/d	Ampl. V mmag	Phase V degrees	Ampl. R_C mmag	Phase R_C degrees
f_1	2.777971(6)	208 ± 1	158.8 ± 0.3	175 ± 3	161 ± 1
f_0	2.067729(20)	67 ± 1	68.2 ± 0.9	50 ± 3	70 ± 4
$2f_1$	5.555942	27 ± 1	142.1 ± 1.9	33 ± 3	165 ± 6
$f_1 + f_0$	4.845700	29 ± 1	11.1 ± 2.0	13 ± 3	354 ± 11
$f_1 - f_0$	0.710242	16 ± 1	57.8 ± 3.5		
$3f_1$	8.333913	13 ± 1	137.2 ± 3.5	11 ± 3	135 ± 19
$2f_1 + f_0$	7.623671	12 ± 1	324.6 ± 4.9		
$4f_1$	11.111883	6 ± 1	140.7 ± 8.6		

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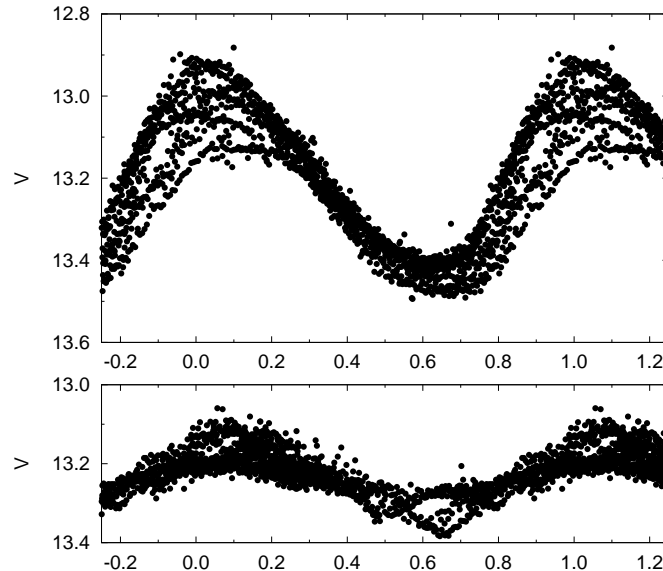


Figure 1. Top: phase diagram of the V458 Her V data, plotted with the first overtone period of 0.359975 days. Bottom: V data, prewhitened with the first overtone period, and plotted with the fundamental period.