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Studies of Small-Amplitude Red Variables

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Abstract. We describe a survey of suspected small-amplitude red variables, and long-term (up to 10 years) monitoring of about two dozen such variables.

1. Introduction

Small-amplitude red variables (SARVs) are M giants and supergiants which are pulsating with small amplitudes (up to 2.5 mag) and with periods of 20 to 200 days or more. Most SARVs are bright stars. There are 164 known and 136 suspected SARVs among the approximately 500 M giants and supergiants in the Bright Star Catalogue. SARVs are believed to be part of a sequence of red variables extending from the so-called σ Librae stars with periods of 10 to 20 days, to the large-amplitude, long-period Mira stars. Many SARVs have a well-defined period, but the nature and cause of the irregularity (found in all of these stars) is not clear, nor is the pulsation mode. Many of these stars have a much longer secondary period, the nature of which is also not clear.

2. Observations

Standard photometric techniques were used, with a comparison and a check star for each variable. The internal scatter of the data ranges from 0.007 to slightly greater than 0.010.

1. We are engaged in an ongoing survey of known and suspected SARVs using: (a) the 0.4m teaching telescope of the University of Toronto; (b) the 0.25m Automatic Photometric Telescope on Mt. Hopkins AZ (Percy & Au 1994); (c) the AAVSO Photoelectric Photometry Program (Percy et al. 1994 and references therein).

2. Many SARVs have been monitored for up to a decade as part of the AAVSO's permanent photoelectric photometry program. The results presented in the table have been obtained by: (a) inspection of the light curves; (b) date-compensated discrete Fourier transform (Ferraz-Mello 1981) using a computer program kindly provided by E.P. Belserene; (c) autocorrelation analysis (Percy et al. 1993).

3. Results

For the stars in the survey program, the incidence and amplitude of variability increase with later spectral type. No such correlation is apparent in the monitoring program, probably because the stars in this program have been chosen for their large amplitude. Most of the stars in the monitoring program show clear periodicity. W Boo appears to be a double-mode pulsator. At least half of the stars show a long period, typically an order of magnitude longer than the "short" period. There is no clear correlation between period and spectral type. Stars of the same spectral type can have "short" periods differing by an order of magnitude. This may be partly because of the complexity of the variability, or because of luminosity differences between the stars. Or it may be due to the excitation of different modes in different stars.

Star	Sp T		GCVS		Results	
		Type	Range	Period	ΔV	Period(s)
TV Psc	M3-4 III	SR	0.77V	49.1	0.80	53.11, 1400:
RZ Ari	M6 III	SRb	0.39V	30	0.50	56:, 500:
ρ Per	M4 II-III	SRb	0.70V	50:	0.40	135, long:
CE Tau	M2 Iab-Ib	SRc	0.31V	165	0.65	272, 1200:
α Ori	M1-2 Iab	SRc	1.3V	2335	0.65	200:, 2000:
η Gem	M3 III	SRa+	0.75V	232.9	0.55	239.8
V614 Mon	C4,5 (R5)	SRb	0.35V	60:	0.45	80, long:
RS Cnc	M6e Ib-II	SRc:	1.5p	120:	1.40	228, long:
IN Hya	M4 III	SRb	0.60V	65:	0.90	100-150:
VY UMa	C6.3 (N0)	Lb	1.13V	–	0.50	200::
VW UMa	M2	SR	0.86V	610	0.5:	50:
FS Com	M5 III	SRb	0.8V	58:	0.55	55.51, long:
FP Vir	M4 III	SRb	0.63V	40:	0.80	70.1, long:
W Boo	M2-4 III	SRb:	0.67V	450:	0.40	24.71, 56.67
ST Her	M6-7 III	SRb	1.5p	148.0	1.05	500:
R Lyr	M5 III	SRb	1.12V	46:	0.60	53.41, long:
EU Del	M6.4 III	SRb	1.11V	59.7	0.95	62.74
U Del	M5 II-III	SRb	1.3B	110:	0.80	90, 1000
W Cyg	M4-6e III	SRb	2.1B	131.1	1.20	120:, 260:
V1339 Cyg	M3-6	SRb	1.2V	35:	0.40	50, 800:
μ Cep	M2e Ia	SRc	1.67V	730	0.75	850
χ Aqr	M3 III	Lb	0.16V	–	0.40	35, 250:
TX Psc	C7,2 (N0)	Lb	0.41V	–	0.50	144 and/or 278
XZ Psc	M5 II	Lb	0.36V	–	0.45	52.96

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