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**A PHOTOMETRIC SURVEY OF SMALL-AMPLITUDE RED VARIABLES**

**Introduction.** Small-amplitude red variables (SARVs) are M giants which are pulsating with small amplitudes and with periods of 20 to 200 days (but typically 50 to 100 days). They are red giant or asymptotic giant branch stars. A detailed study of a typical SARV (EU Del) has been reported by Percy et al. (1989). As a long-term project, one of us (JRP) is accumulating and analyzing observations of SARVs using a variety of techniques and sources, in order to clarify the status of the hundreds of suspected or poorly documented SARVs in the *Yale Catalogue of Bright Stars*, as well as to understand the systematics, evolutionary status, pulsation properties, and other processes in these stars. In 1990 and 1991, observations of SARVs were made using the 0.4m "teaching telescope" on the main campus of the University of Toronto. The 1990 results were reported by Percy and Fleming (1992) and the 1991 results are reported here. The variables which have been discovered or confirmed in 1990 and 1991 will be followed up by the American Association of Variable Star Observers (AAVSO) photoelectric photometry program, or with the Automatic Photometric Telescope (APT) Service in Arizona.

**Observations and Results.** The observational procedures are the same as described by Percy and Fleming (1992). Tables of individual observations will be deposited in the IAU Commission 27 Archives of Unpublished Photoelectric Photometry (Breger 1988). The results are summarized in Table 1. The "remarks" column refers mainly to information from the *General Catalogue of Variable Stars* (GCVS: Kholopov 1985) and the *New Catalogue of Suspected Variables* (NSV: Kholopov 1982). Because our data are not as extensive or precise as those obtained by Percy and Fleming (1992), we have not shown individual light curves. Copies of these can be obtained from JRP, or from the archival data.

**HR 5590.** The amplitude is  $<0.10$  and the period, if any, is about 30 days. Unfortunately, the comparison stars show large scatter.

**HR 5594.** This star appears constant, but one of the comparison stars may be slightly variable.

**HR 5654 (FL Ser).** There is scatter in the comparison stars, so we cannot confirm the GCVS classification (Lc) or amplitude (0.23).

**HR 5879 (NSV 7269).** The range appears less than 0.05. The check star 5 Her (G8III) appears to be variable.

	HR	HD	V	SpT	Result	Remarks
Pgm	5590	132833	5.52	M0III	var?	VAR?
Co	5573	132132	5.53	K1III	var?	
Ch	5536	130970	6.18	K3III	var?	
Pgm	5594	132933	5.71	M0.5IIb	const?	VAR?
Co	5601	133165	4.40	K0.5III	const?	
Ch	5631	134047	6.16	K0III	const?	
Pgm	5654	134943	5.89	M4III	var?	FL Ser, Lb, $\Delta V=0.23$
Co	5692	136138	5.70	G8III	var?	
Ch	5740	137510	6.27	G0IV-V	var?	
Pgm	5879	140477	4.09	M4III	const?	VAR? 35 $\kappa$ Ser
Co	5924	142574	5.44	M0III	const?	
Ch	5966	143666	5.12	G8III	var	5 Her
Pgm	5932	142780	5.37	M3III	const?	VAR? 2 Her
Co	5950	143209	6.31	K0	const?	
Ch	5957	143435	5.62	gK5	const?	
Pgm	6010	145002	5.73	M3.5III	var?	FS Ser, $\Delta V=0.04$
Co	6014	145148	5.97	K0IV	const?	
Ch	6011	145085	5.91	gK5	const?	
Pgm	6056	146051	2.74	M0.5III	const	VAR? $\delta$ Oph
Co	6075	146791	3.24	G9.5III	const	2 $\epsilon$ Oph
Ch	6016	145206	5.37	K4III	var?	
Pgm	6107	147749	5.20	M2III	const?	VAR? 20 $v^1$ CrB
Co	6108	147767	5.39	K5III	const?	21 $v^1$ CrB
Ch	6043	145802	6.29	K2III	const?	
Pgm	6128	148349	5.23	M2.5III	var?	V2105 Oph, $\Delta V=0.06$
Co	-	145894	6.84	K0	var?	
Ch	-	144892	6.70	F6V+F8V	var?	
Pgm	6200	150450	4.90	M2.5III	const	VAR? 42 Her
Co	6183	150030	5.79	G8II	const	
Ch	-	149105	7.00	G0V	var?	
Pgm	6346	154356	6.69	M4III	var	VAR? 61 Her
Co	6336	154126	6.36	K0	const	
Ch	6328	153897	6.55	F5V	const	
Pgm	6495	157967	5.98	M4III	var	V640 Her, Lb, $\Delta V=0.17$
Co	6542	159353	5.69	gK0	const?	
Ch	6541	159332	5.64	F6V	const?	

	HR	HD	V	SpT	Result	Remarks
Pgm	6765	165625	5.06	M3III	const?	VAR? 98 Her
Co	6820	167193	6.12	K4III	const	
Ch	-	166842	6.67	K1III	const	
Pgm	6834	167654	6.01	M4III	const	VAR? $\Delta V=0.10$
Co	6866	168656	4.86	G8III	const	74 Oph
Ch	6857	168387	5.39	K2III	const?	
Pgm	7405	183439	4.44	M0III	const?	VAR? 6 $\alpha$ Vul
Co	7406	183491	5.81	K0III	const?	8 Vul
Ch	7421	184010	5.87	K0III-IV	const?	
Pgm	7414	183630	5.03	M1III	const	36 Aql
Co	7404	183387	6.25	K2	const	
Ch	7438	184663	6.38	F6IV	const?	
Pgm	7442	184786	5.96	M4.5III	var	VAR? $\Delta V=0.10$
Co	7427	184293	5.53	gK1	const?	
Ch	7451	184960	5.73	F7V	const?	
Pgm	7635	189319	3.47	M0III	const	VAR? 12 $\gamma$ Sge
Co	7662	190211	5.96	K3II-III	const	
Ch	7679	190608	5.10	K2III	const?	16 $\eta$ Sge

HR 5932 (NSV 7335). The variability, if any, appears small; there is larger-than-average scatter in all three stars.

HR 6010 (FS Ser). This star appears to be slightly variable. The GCVS amplitude is very small (0.04 in V), and we cannot confirm or refute it.

HR 6056 (NSV 7556). This star appears constant, but the NSV amplitude is small (0.03 in V) and not inconsistent with our result. The check star HR 6016 (K4III) may be slightly variable.

HR 6107 (NSV 7676). The variability, if any, is small. The NSV amplitude is 0.08 in V.

HR 6128 (V2105 Oph). The amplitude is at least 0.2 in V, and the time scale appears to be 30 days or more. The range, according to the GCVS, is 5.0 to 5.38 in V, which is consistent with our result.

HR 6200 (NSV 7896). Our five observations do not indicate any variability, but they are insufficient to rule out the small range (0.05 in V) given in the NSV.

HR 6346 (NSV 8159). This star is definitely variable. Our results are consistent with the NSV range of 0.2 in V. The time scale is not well-defined, but appears to be 30 days or more.

**HR 6495 (V640 Her).** The range is consistent with that given in the GCVS (0.17 in V). The time scale (based on our limited data) is about 100 days.

**HR 6765 (NSV 10208).** Our six observations do not indicate any variability. The NSV range is 0.13 in V.

**HR 6834 (NSV 10466).** Our five observations do not indicate any variability. The NSV range is 0.14 in V.

**HR 7405 (NSV 12069).** Our six observations are consistent with the NSV amplitude (0.07 in V), and a time scale of 50 days, but there is larger-than-average scatter in the comparison stars.

**HR 7414.** This star appears to be constant.

**HR 7635 (NSV 12638).** This star appears to be constant, though the time distribution of our six observations may have been such that the NSV amplitude of 0.09 in V was missed.

**Discussions and Conclusions.** The data which we obtained in 1991 were not as extensive and precise as the data obtained in 1990 (Percy and Fleming 1992), so our conclusions about the variability of individual stars are not as secure. The proportions of non-variable, possibly variable, and definite variable stars were about the same. The general correlations between spectral type, amplitude and time scale of variability (Percy and Fleming 1992, figure 3) remain the same.

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