SPECTROGRAMS OF TEN HIGH-VELOCITY Me VARIABLE STARS

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ABSTRACT

Sample spectrograms, dispersion 9 A/mm, of ten long-period variables having high velocities show that the absorption spectra do not differ markedly from the spectra of ordinary giant stars. The bright lines appear to behave in about the same way as do those of other Me variables of similar types and periods.

When numerous high-velocity stars were found among the Me variables many years ago,[1,2] it was noticed that most of them had spectra earlier than M6e and periods between 150 and 250 days. These stars might appear to have a relationship to typical Me variables of periods exceeding 300 days paralleling that of RR Lyrae variables to "classical" cepheids and thus would now be assigned to population II. But no marked differences in

TABLE 1

DATA CONCERNING TEN HIGH-VELOCITY VARIABLES

STAR	DESIG.	PERIOD (DAYS)	MAG. AT MAX.	PREVIOUSLY OBSERVED			ADOPTED TYPE AT MAX.
				Spect.	Radial Vel. (Km/Sec)		
					Em.	Abs.	
X Mon	065*208*	156	7.3	M3e	+153	+160	M1e
S Gem	073723	293	8.8	M5e	+101	(+111)	M5e
S Lib	151520	193	8.5	M2e	+285	(+294)	M2e
RW Lib	151*723*	203	*8.6*	Se	+128	(+140)	?
X CrB	154536	240	9.0	M6e	−113	(−104)	M5e
RZ Sco	155*823*	160	8.8	M4e	−182	(−174)	M4e
W Lyr	181136	196	7 7	M4e	−183	−174	M3e
RT Cyg	194048	190	7.3	M2e	−126	−116	M2e
Z Cyg	195849	262	8.8	M5e	−173	(−166)	M5e
SV And	235939	316	8.6	M7e	− 99	(− 87)	M6e

spectroscopic behavior were found between these objects and variables of the same types and periods with smaller velocities. As far as could be determined, the absorption spectra were like those of ordinary giant stars. On these early low-dispersion spectrograms, the bright hydrogen lines and the dark *TiO* bands from λ 4500 to *Hβ* were well shown, but on most of them the continuous spectrum was too weak for satisfactory study of the dark atomic lines. In RT Cygni, however, well-exposed spectrograms showed an absorption-line spectrum[2,3] much like that of *α* Orionis, type cM2; but this behavior was probably an extreme example.

Recently, during the period of adjusting the coudé spectrograph of the 200-inch tele-

[1] P. W. Merrill, *Mt. W. Contr.*, No. 264; *Ap. J.*, **58**, 215, 1923.

[2] P. W. Merrill, *Mt. W. Contr.*, No. 649; *Ap. J.*, **99**, 171, 1941.

[3] Marjorie S. Pettit, *Pub. A.S.P.*, **56**, 107, 1944.

scope, I. S. Bowen has most generously obtained one or two spectrograms, dispersion 9 A/mm, for further study of each of the high-velocity stars listed in Tables 1 and 2. I am indebted to Mrs. Margaret W. Mayall, of the Harvard College Observatory, for photometric data.

Inspection of the recent spectrograms shows that the absorption spectra resemble those of ordinary giant stars, with possibly a tendency toward enhancement of those features which in normal stars indicate high absolute magnitude. The bright lines appear to behave in about the same way as do those of other Me variables of the same types and periods. Data on spectral types and measured velocities are in Table 2. The velocities

TABLE 2*

SPECTROGRAMS OF TEN HIGH-VELOCITY VARIABLES
(Dispersion 9 A/Mm)

Star	Plate Pc	Date 1951	Mag.	Days from Max.	Spect.	Radial Velocity (Km/Sec) and Numbers of Lines		
						Em.	Abs.	$A-E$
X Mon....	77	Mar. 28	7.4	− 6	M1e	+156.3 23	+165.9 63	+ 9.6
S Gem....	190†	Oct. 15	9.8	−11	M4e	+101.8 3	+107.4 8	+ 5.6
	199	Oct. 18	9.6	− 8	M4e	+ 99.6 3	+108.4 51	+ 8.8
S Lib.....	102	May 23	9.5	−24	.....	+292.8 3	.....	.....
RW Lib...	120	July 20	(9)	.....	.....	+125.1 3	.....	.....
	123	July 21	(9)	.....	(M4)e	+126.2 7	.....	.....
X CrB....	114	June 26	9.6	+14	M5e	(−114.2) 20	(−105.5) 30	+ 8.7
RZ Sco....	69	Mar. 23	10.8	−49	M5e	−175.3 3	−171.4 48	+ 3.9
W Lyr....	119	July 19	8.4	− 5	M3e	.....	.....	.....
	121	July 20	8.3	− 4	M3e	−182.7 6	−176.8 40	+ 5.9
RT Cyg...	76	Mar. 27	7.7	−17	M3e	−127.7 2	−115.3 76	+12.4
	103	May 23	8.5	+40	M3e	−127.4 15	−117.2 35	+10.2
Z Cyg.....	99‡	May 21	10.4	−42	M6e	−172.7 2	−166.5 16	+ 6.2
SV And...	244	Jan. 4§	9.2	− 6	M6e	− 99.6 6	− 90.2 42	+ 9.4

* The absorption spectrum of X Mon resembles that of β And gM0 more closely than it does that of α Cet gM2. It does not differ greatly from that of α Ori cM2, but the lines are not quite so strong and clear-cut. The bright hydrogen lines are very strong from $H\beta$ to the ultraviolet. The $H\epsilon$ line is about as strong as $H\zeta$. This circumstance is quite unusual at or before maximum light; it may be partly explained by the fact that the H absorption line of *Ca* II is unusually narrow. Emission of *Ca* II displaced shortward is visible at H and in lower intensity at K. In several respects the spectrum seems to correspond to a phase later than that indicated by the light-curve.

For the other stars the appearance of the spectrum is not unusual for the spectral type and for the phase in the light-cycle when the spectrogram was taken.

† Negative by O. C. Wilson.

‡ Plate Pd 99; dispersion 18 A/mm.

§ 1952.

show no significant deviations from those previously determined. The shortward displacement of the bright lines with respect to the dark lines, $A - E$, has about the same range as that previously observed for other comparable Me variables.[4]

There can be no doubt that Me variables with high velocities have a strong statistical preference for the shorter periods and the earlier spectral types. It is not known whether this preference is correlated with chemical composition. For a fair comparison between high-velocity and low-velocity variables, stars of comparable types and periods should be studied. But the spectra of Me variables change with phase and may differ from cycle to cycle. Hence a satisfactory comparison would be a formidable task. It would be interesting to find real chemical differences between the two groups of stars; but the present material seems to indicate that such differences, if any, are relatively minor.

[4] P. W. Merrill, *Mt. W. Contr.*, No. 644; *Ap. J.*, **93**, 380, 1941.