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ADDITIONAL OBJECTIVE-PRISM SPECTRA OF VERY RED STARS

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ABSTRACT

Spectral types based on low-dispersion, objective-prism spectra are presented for nine very red stars. With one rather discordant exception, these spectral types agree with recent classifications based on multi-color photometry. Two of the California Institute of Technology objects are known carbon stars.

Observations of stars from the second list of very red objects found in the California Institute of Technology survey (Ulrich, Neugebauer, McCammon, Leighton, Hughes, and Becklin 1966) have been made with the Burrell Schmidt-type telescope of the Warner and Swasey Observatory. Not all of the stars have been observed yet, but in view of the publication of several spectral types based on multi-color photoelectric

TABLE 1

SPECTRAL TYPES OF VERY RED STARS

Star No. (CIT)*	Other Designation†	Spectral Type (Case System)	Other Spectral Type‡
4	.....	M7–10	.....
5	DO 259	C:	N (DO)
6	.....	C:	C
7	WX Ser	M8–9	M8.5
8	RU Her	M7	M7–M10
9	MW Her	M9	M9
11	.....	RM§	F0:Ia:
12	DG Cyg	M7	M8.5, M9
13	DO 228	.....	N (DO), C
14‖	.....	M8–10	M8.5

* CIT: Ulrich *et al.* (1966).

† DO 259: Lee, Gore, and Bartlett (1946). DO 228: Lee and Bartlett (1945) who note this as a new N-type variable.

‡ Spectral type based on multicolor photoelectric observations by Wing and Spinrad (Wiśniewski *et al.* 1967) unless otherwise noted.

§ RM: reddened early M.

‖ The star marked 14 on the finding chart (Ulrich *et al.* 1966) is DO 43669 (Lee *et al.* 1947) which is an early M star and not particularly red. The very red star is correctly identified by Ulrich *et al.* (1967).

observations (Wiśniewski, Wing, Spinrad, and Johnson 1967), it was felt that a comparison of our results would be of some interest.

Our spectral types, along with other relevant data, are shown in Table 1. A description of the objective-prism plate material and classification system can be found in Pesch (1967) and other papers referred to there. With the exception of CIT 11, our spectral types agree well with those of Wing and Spinrad, which are based on measurements with a spectrum scanner of twenty-six discrete wavelengths in the range 0.78–1.10 μ (Wing, Spinrad, and Kuhi 1967), plus four additional wavelengths (O I λ7774 Å, Ca II λ8662 Å, P_{11}, and Pδ) in the case of CIT 11 (Wing 1967). We have plates of CIT 11 in both the red and the near photographic infrared which show the λ6200 Å and λ7054 Å bands of

TiO. These absorption bands and the strongly tapered, wedge-shaped infrared spectrum lead us to classify this star as a reddened early M, similar to H-C 1, RM-WS70 (H-C 2), and H-C 6 (Pesch 1967). It is not clear how these observations can be reconciled with a spectral class of F0 Ia. The presence of the O I λ7774 Å blend with a strength characteristic of A0–F5 supergiants in a star whose near infrared spectrum is normally that of an early M star is reminiscent of the eclipsing system VV Cephei (Keenan and Hynek 1945, 1947). This could have some bearing on the case of CIT 11. Although the Paschen lines of hydrogen are also variable in VV Cephei (Keenan and Hynek 1947), they do not appear to become strong enough to mimic an F supergiant. However, Wing (1967) has indicated that the presence of Paschen lines in CIT 11 is somewhat uncertain.

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