

## THE SPACE DENSITY OF M DWARFS - AN OBSERVATIONAL PROGRAM

Peter Pesch

Case Western Reserve University-Warner and Swasey Observatory

In spite of extensive proper motion surveys, there remains some uncertainty about the space density and the kinematics of late-type dwarf stars. This uncertainty is primarily due to the unknown kinematic bias introduced by the proper motion discovery technique.

A spectrographic search, especially one using an objective prism on a Schmidt telescope, can identify significant numbers of intrinsically (and actually) faint stars, free from any kinematic bias. To find faint and cool stars, one chooses an objective prism with low dispersion and emulsions sensitive to the red and near photographic infrared. At low dispersions, in this wavelength region, there are no reliable luminosity criteria. Thus Sanduleak conducted his survey in the direction of the north galactic pole, with the expectation that very few remote giants would contaminate his results. A catalog of 273 probable dwarf stars of type M3 and later (Sanduleak, N. 1976, *A.J.*, 81, 350) based on his objective prism survey in the direction of the north galactic pole is now available. Thanks to W.J. Luyten (1976, Proper Motion Survey with the Forty-Eight Inch Schmidt Telescope XLVI (Univ. Minnesota, Minneapolis)) proper motions have been measured for all of these stars.

Two independent programs to obtain photoelectric photometry have begun. Thanks to the kindness of the Hale Observatories, Pesch was able to observe 41 (51% of the catalog) stars in V,R,I (Kron System). Most of the 41 stars were of Sanduleak's spectral category b (types M3-M4) and in general, represent the brighter stars (in apparent magnitude) in the catalog. It is to be emphasized that no proper motion criterion was used in selecting these 41 stars. This is in distinction to a previous paper (Pesch, P. 1972, *Ap.J.*, 177, 519) where an even smaller sample of 27 stars from Sanduleak's unpublished thesis was selected for observation on the basis of low proper motion. Absolute visual magnitudes were determined using the observed R-I colors and the calibration of Gliese (Gliese, W. 1969, *Low Luminosity stars*, edited by S. S. Kumar (Gordon and Breach, New York), page 41). The 41 stars are characterized by median values of 1.1 mag., +11 mag., 40 pc and 33 km sec<sup>-1</sup> respec-

respectively, for  $R-I$ ,  $M_V$ , distance and tangential velocity (uncorrected for solar motion). The standard deviation about the mean tangential velocity is  $30 \text{ km sec}^{-1}$ ,

Image-tube slit spectra were obtained for 24 of the 41 stars. The spectra cover the wavelength region  $\lambda\lambda 3800-7200 \text{ \AA}$  at a dispersion of  $285 \text{ \AA mm}^{-1}$ , and were used for classification purposes. With 3 exceptions, the types were dM3-dM5; 4 showed hydrogen emission lines.

Conard C. Dahn at the U. S. Naval Observatory, Flagstaff station, has observed 62 stars from Sanduleak's catalog on the B,V,I system. Dahn selected the later and fainter stars to observe, so his 62 are primarily of spectral groups c and c+ (later than M3-M4), with only 10 stars in common with Pesch's sample of 41. Dahn's 62 stars are characterized by mean values of 0.022 sec of arc, 1.60 mag., 2.61 mag. and 11.8 mag. respectively, for photometric parallax, B-V, V-I and  $M_V$ . The dispersions in U and V are  $33.8 \text{ km sec}^{-1}$  and  $24.8 \text{ km sec}^{-1}$  respectively.

Although Sanduleak's catalog contains only 1/3 as many stars as the McCormick spectrographic survey (Vyssotsky, A.N. 1963, Basic Astronomical Data, edited by K. Aa. Strand Univ. Chicago P., Chicago, page 192) it refers to significantly less luminous stars. Because of the importance of this catalog, we plan to continue the observations until photoelectric photometry is available for all the stars in it. We feel that this is the most satisfactory way of learning what - if any - has been the effect of the kinematic bias on our understanding of the M dwarf population. Until that time we feel that discussions of fragmentary observations are premature.

To augment Sanduleak's sample and to investigate reports of a low observed space density of M stars in the south galactic pole, Pesch undertook a deep objective-prism survey in that direction at CTIO. Because the Curtis Schmidt telescope at CTIO is similar to the Burrell Schmidt of the Warner and Swasey Observatory, these two surveys are nearly identical. A catalog based on the CTIO data is now in preparation. To date it appears that the surface density is comparable and the catalog will contain approximately the same number of faint, late M stars. We also plan to observe these stars photoelectrically so as to obtain accurate magnitude and colors so that distances, etc. can be determined. It should be noted that although there is some overlap with the extensive photometry of Eggen (1976, Ap.J. Suppl., 30, 351), most of the stars in the forthcoming catalog have not been observed photometrically.