

# THE DISTRIBUTION OF FIELD HORIZONTAL-BRANCH STARS IN THE GALACTIC HALO

A. G. Davis Philip<sup>†</sup>  
Dudley Observatory

Since the time allowed per paper at this joint discussion is short only one aspect of the stellar distribution at high galactic latitudes will be presented here, namely the distribution of field horizontal-branch stars (FHB) in the galactic halo. First, the method by which FHB stars are found will be described. Second, the density distribution of FHB stars will be compared with that of the RR Lyrae stars.

As part of a general program to study the stellar density distribution perpendicular to the galactic plane a number of possible FHB stars has been discovered. In each survey area objective prism plates (at a dispersion of 280 Å/mm. to a limiting magnitude of  $V = 14$ ) are taken with the Michigan Curtis Schmidt telescope at Cerro Tololo Inter-American Observatory or the Schmidt telescope at the Warner and Swasey Observatory. A set of direct plates are taken also to obtain photographic magnitudes for the stars with spectral classifications.

Four-color and  $H\alpha$  measures of the B and A stars allow the color excess in each region to be determined accurately. In the magnitude range 12 - 14 about half of the A-type stars measured had peculiar colors;  $c$ , indices that were 0.2 mag. or greater higher than the normal  $c$ , index for a star on the main sequence and  $m$ , indices that were 0.05 mag. or more lower than normal. These characteristics are identical to those measured for blue horizontal-branch (BHB) stars in globular clusters and to those of four well known FHB stars ( $-6^\circ 86$ , HD 86986, 109995, and 161817, Oke, Greenstein, and Gunn 1966). Radial velocities have been obtained for 33 FHB stars (Philip 1973). The velocity dispersion for this group of stars is  $\pm 113$  km/sec which tends to confirm their classification as Population II stars. Recently, Danford (1976) has confirmed the classification of many of these FHB stars in a photometric and spectroscopic study of halo horizontal-

<sup>†</sup> Visiting astronomer, Cerro Tololo Inter-American Observatory, which is operated by the Association of Universities for Research in Astronomy, under contract with the National Science Foundation.

branch stars.

In two areas, the north and south galactic poles, complete surveys have been made of all the early-type stars in  $\sim 30$  square degrees centered on each pole. There are not sufficient stars to do a conventional stellar density analysis but one can obtain an estimate of the density distribution of FHB stars by assuming a mean absolute magnitude  $M_V = 0.5$ , correct the apparent magnitude for the small amount of interstellar reddening and calculate the distance to each star. The stars can be divided into groups by distance from the galactic plane and the number of stars per  $10^6 \text{pc}^3$  calculated. If the stellar densities are plotted versus the perpendicular distance from the galactic plane one finds that the main sequence A2 - A7 stars at the NGP have densities in the range of a few tenths and A0 stars in the range of a few hundredths stars/ $10^6 \text{pc}^3$  (Uggren 1962, 1963). The RR Lyrae stars have densities of a few thousandths stars/ $10^6 \text{pc}^3$  (Kinman, Wirtanen, and Janes 1966).

The stellar density distributions of FHB stars at the galactic poles are quite similar and fall in the range of a few tenths stars/ $10^6 \text{pc}^3$ . For distances closer than one or two kpc. the volume of the cone surveyed and the number of FHB stars found are too small for density estimates to be made. For distances greater than five kpc. the apparent magnitudes of the FHB stars are below the spectral plate limit. It is interesting to note that in the range of two to four kpc., where the density estimates are best, the number of FHB stars is approximately ten times that of the RR Lyrae stars.

With the new thin prism on the Michigan Curtis Schmidt telescope it is possible to identify early-type stars to  $V = 16$  and thus FHB stars can be surveyed to distances of 10 kpc. If the ratio of FHB/RR Lyrae stars is ten to one out to these distances, and if the remainder of a globular cluster-like population (giants and main sequence Population II stars) then the density distribution of stars in the galactic halo will be much higher than previously estimated from the study of the distribution of Population I stars. Photometric data for over 75 FHB stars measured in the Stromgren four-color system will be made ready for publication in 1977. Additional measures are planned of stars in areas at  $l = 0^\circ$  and  $180^\circ$  so that complete surveys will be obtained.

#### REFERENCES

- Danford, S.C. 1976, Thesis, Yale University.  
 Kinman, T.D., Wirtanen, C.A., and Janes, K.A. 1966, *Ap. J. Supp.* **13**, 379.  
 Oke, J.B., Greenstein, J.L., and Gunn, J. 1966, *Stellar Evolution*, R.F. Stein and A.G.W. Cameron eds., (Plenum Press: New York) p. 399.  
 Philip, A.G.D. 1973, *Spectral Classification and Multicolor Photometry*, Ch. Fehrenbach and B.E.Westerlund eds., (Reidel: Dordrecht) p. 230.  
 Uggren, A.R. 1962, *A.J.* **67**, 37.  
 Uggren, A.R. 1963, *A.J.* **68**, 475.