THE FREQUENCY OF FAINT M GIANT STARS AT HIGH GALACTIC LATITUDES

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Based on the observations of M giant stars in the north galactic polar objective-prism survey of Upgren (1960) and the data summarized by Blanco (1965) the overall space density of all M-type giants as a function of distance from the galactic plane at the position of the sun can be approximated by,

$$\rho(z) = 9.0\ e^{-3.0z}, \qquad (1)$$

where z is in kpc and $\rho(z)$ is the number of stars per $10^6 pc^3$. This relationship is derived from the observed fall-off in space densities up to a distance of about 2 kpc.

The question arises as to the validity of extrapolation equation (1) to larger z distances so as to predict the number of faint M giants expected per unit area near the galactic poles. Adopting for the M giants a mean visual absolute magnitude of -1.0 (Blanco 1965), one finds that equation (1) predicts that less than one giant fainter than V≃12 should be expected in a region of 200 square degrees. This expectation formed the hypothesis of a thesis study (Sanduleak 1965) in which it was assumed that the very faint M stars detected in a deep, infrared objective-prism survey at the NGP were main-sequence stars, since this could not be ascertained spectroscopically on the very low-dispersion plates used.

The luminosity function for the assumed M dwarfs found in that thesis study showed an excess number of stars compared with other determinations such as that by Luyten (1968). It has been suggested that part of this discrepancy might result from the presence of an appreciable number of giants amongst the fainter stars. Conceivably, this might result if the densities beyond two kiloparsecs declined at a much slower rate than given by equation (1).

Various observers have obtained spectroscopic and photometric data for small samples drawn from this NGP survey. To date these studies have uncovered only three difinite giant stars having V>12.0. Two of these are the Mira-type variables T Com and FQ Com. The variablilty of

Edith A. Müller (ed.), Highlights of Astronomy, Vol. 4, Part II, 35-36.

https://doi.org/10.1017/S153929960000294X Published online by Cambridge University Press

the latter star was discovered by Kinman et al. (1966) during the course of a blink survey for RR Lyrae stars near the NGP. It was the only faint, new long-period variable detected in that survey which covered an area of 74 square degrees and reached a limiting magnitude of B$\sim$18.5. Although the Kinman et al. survey was not intended nor ideally suited for the detection of long period variables, this discovery rate suggests that the halo giants (at least of the Mira-type) are about as infrequent as would be inferred from equation (1).

The Sanduleak (1965) thesis was never published in detail. However, we recently (Sanduleak 1976) made available a catalog and finding charts for 273 probable dwarf stars of type M3 and later near the NGP. Nearly one-half of these stars, which have apparent magnitudes in the range $12<V<16$, were found to have published proper motions sufficiently large to indicate that they are nearby dwarfs. Luyten (1976) has now measured the proper motions of the remaining stars and finds that 14 of them (Nos. 46, 63, 64, 97, 159, 172, 200, 205, 213, 219, 226, 239, 262, and 274) have total proper motions smaller than 0.020. Given the observational errors involved, Luyten notes that the true motions might be close to zero for these stars and suggests that they might all be giants or subgiants. It would, of course, be of great interest if observers with access to sufficiently large telescopes would undertake to investigate this possibility.

However, even if, surprisingly, all of these small proper motion stars proved to be giants, it would set an upper limit of about 5% for the frequency of faint giants in our thesis study. This would be insufficient to account for the excess in our luminosity function which therefore must either be real or the result of observational errors or quite possibly a combination of both factors.

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