# ASYMPTOTIC GIANT BRANCH STARS IN THE MAGELLANIC CLOUDS

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ABSTRACT. Since the pioneering objective prism surveys by Westerlund (1960) and Blanco *et al.* (1980), the Magellanic Clouds have proved a fruitful site for exploring the evolution of AGB stars. We have used photometric techniques to extend the prism C-star surveys to M- and S-type AGB stars, constructing luminosity functions and obtaining spectra of individual stars for comparison with theoretical predictions. We have concentrated on the Large Magellanic Cloud (LMC), but we have recently obtained observations of luminous red giants in a region of the Small Magellanic Cloud (SMC). In this paper we compare the results from these studies of the two satellite systems.

Our SMC photometry is based on a series of V- and I- band plates taken with the du Pont 2.5 m telescope and covering a field of area 0.82 square degrees centred at $\alpha = 1^h9^m$, $\delta = -72°39'$. We have calibrated these data using the same techniques described in Reid *et al*. (1987 - RMT87) and have derived the AGB-star luminosity function by including all stars with $(V - I)_0 > 1.5$. Computing the bolometric magnitudes for an assumed distance modulus of 18.8, we derive the luminosity function shown in Figure 1.

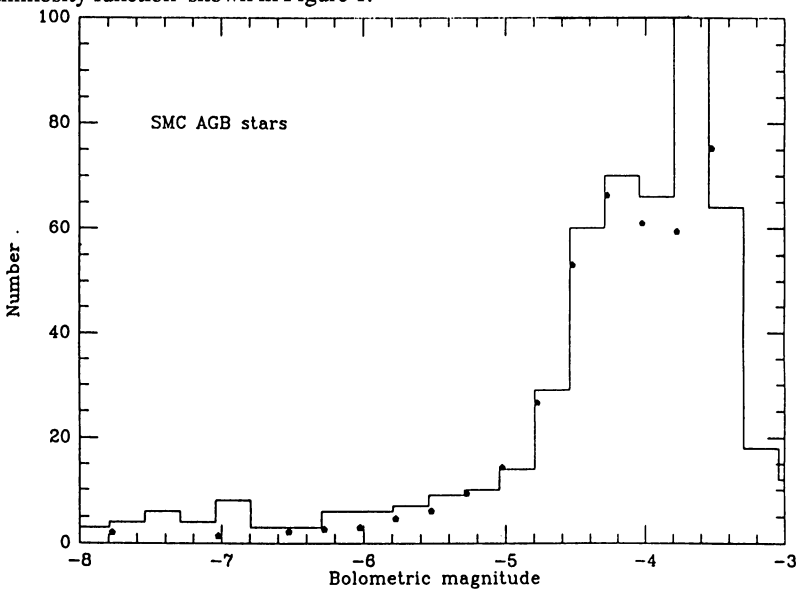


**Figure 1.** SMC AGB stars (histogram)



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We have compared these data with the results of of our study of the 15 square degree LMC (North) field (Reid & Mould 1984), scaling down the latter function by a factor of 10 (solid points), and there is a clear similarity between the two functions. The SMC field has proportionately more recent star formation than the LMC field, and this probably accounts for the excess of luminous red giants in the former field. As discussed below, we believe most of these stars to be young supergiants, rather than AGB stars. The agreement at fainter magnitude implies that the star-formation histories are similar for the intermediate age stars which provide the bulk of the lower luminosity AGB stars. The scarcity of luminous AGB stars ($M_{bol} < -6$) in these fields has long been known and is likely due to both the effects of convective overshoot reducing the upper mass limit for evolution onto the AGB (Chiosi *et al.* 1989), and mass loss removing stars prematurely from the AGB (Reid *et al.* 1990).

We have also obtained spectroscopy of the luminous AGB star candidates in both these two fields and in a third ~ 1 square degree field centred on Shapley III in the LMC (RMT87). In all three fields many of the giants are of early spectral type (< *K*4), showing no evidence for s-process elements. We have suggested that many of these stars are massive ($M > 10M_{\odot}$) core-helium burning supergiants. We can test this hypothesis in the Shapley III and SMC fields, in both of which there is a pronounced main-sequence in the colour magnitude diagram. Working from the composite colour-magnitude diagrams of galactic open clusters constructed by Mermilliod and Maeder (1986), the average ratio of the number of red super-giants to the number of stars on the main sequence in the range $-4 \leq M_v \leq -3$ is 0.2. This is for populations of age 10-20 Myrs. In the Shapley III field the observed ratio is 0.13, while in the SMC field the ratio is 0.15. Thus the observations are consistent with many of these stars being young supergiants - implying a substantial scarcity of luminous AGB stars in both systems.

However, as Wood *et al.* (1981) have shown in their surveys of long period variables in both Clouds, some AGB stars can be found near the theoretical peak luminosity ($M_{bol} \sim -7.3$) — but no C stars are known with $M_{bol} < -6$ in either cloud. Smith and Lambert (1989) have recently shown that Li is overabundant in five luminous SMC stars — a signature, they suggest, of hot-bottom burning, with C transformed to N and C-type AGB stars transformed to S-type giants. We have observations of several luminous ($M_{bol} < -6$) AGB stars in both Clouds, and several (but not all) of those stars also have strong Li $\lambda$ 6707, indicating that some degree of hot-bottom burning is probably present in both systems.

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