

The LMC Centre Unfolding

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Abstract. We study star formation history and chemical evolution in the LMC Bar centre. With the HST PC and WFC plus uvby photometry, we find 30% of the stars younger than 200 My and evidence for reduced star formation 3 to 0.2 Gy ago. The overall [Fe/H] is -0.5. Many stars older than 4 Gy contradict a very young Bar.

1. Introduction

In the Bar of the Large Magellanic Cloud (LMC), stellar density and distance have prevented safe studies of star formation, stellar abundance and evolution. Image crowding prohibited precision turn-off photometry in colour magnitude diagrams (CMD), with spectroscopic abundance studies feasible for the brightest stars only. These data shed little light on star formation and chemical evolution.

2. Star formation and metallicity

The Hubble Space Telescope (HST) and its planetary and wide field camera (WFPC2) dramatically improve our studies of individual faint LMC Bar stars. This is due to the high image quality and combined PC and WFC image scales and fields of view. With the HST PC and uvby photometry, we derived a detailed CMD and metal abundances for the centre of the LMC Bar. We studied individual stars with $V(y) < 24$ (Ardeberg et al. 1997, 1999).

The PC study showed star formation over up to 9 Gy. It gave proof that close to 30% of the stars in the Bar centre are less than 500 My. There was evidence of a halt in star formation starting at least 2 Gy ago and ending with the recent burst of star formation. More exact determinations were impossible due to weak statistics of brighter stars, a consequence of the small PC field.

Since our first studies, based on PC data only, we added data from one WFC field. It covers 6400 arcsec², as compared to the PC field of 1200 arcsec². By combining PC and WFC data, we can profit from best spatial resolution, highest photometric accuracy and favourable number statistics.

For the luminosity function, we developed a new method, including stars individually unidentified but statistically measurable. The LF agrees well with the solar vicinity one, even in details. See Fig. 1, left. It is still rising at $V=26$. In both respects, it resembles the LF of LMC structures outside the Bar.

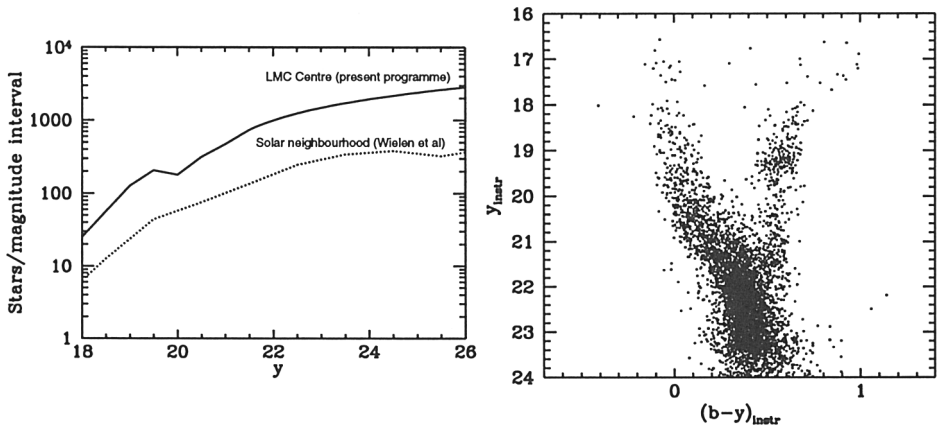


Figure 1. Left: Luminosity function compared to solar neighbourhood. Right: CMD from WF3 field. 6000 stars are included.

Fig. 1 (right) shows a tentative CMD. Of somewhat lower quality compared to PC data, for the brighter stars the WFC has important advantages. Comprising 6000 stars brighter than $V(y)=24$, the WFC CMD presents far better statistics than the PC CMD for $V(y)<22$. The improvement is even larger for stars around and above the upper turn-off region. Noteworthy is the tip of the main sequence as is the clump and the CMD morphology. The combined PC and WFC data improve population definition and star formation history, especially for stars younger than 3–4 Gy. With our new data, using the techniques described in Ardeberg et al. (1997), we improve our estimate of the upper age limit for the youngest population from 500 to 200 My. We confirm that 30% of the stars belong to this population. We improve the lower age limit of reduced star formation from 2 to 3 Gy. The improved CMD makes our morphology based estimate of metallicity safer while remaining at $[\text{Fe}/\text{H}] = -0.5$, close to the average result from our m_1 versus $(b-y)$ data obtained from PC observations. The latter data point to an evolutionary trend in $[\text{Fe}/\text{H}]$ over the latest 6 Gy, an evolution so far unknown to any detail.

3. Concluding remarks

Our results are highly relevant for the lively discussion of the evolution of the LMC Bar. We find little support for the current tendency (van den Bergh, in this volume) to classify the Bar as a young part of the LMC. This is contradicted by both our age determinations of stellar populations and by the trend in $[\text{Fe}/\text{H}]$ noted for the same stars. Further reduction and analysis will improve our CMD statistics and $[\text{Fe}/\text{H}]$ data, giving us a better handle on evolution.

References

- Ardeberg, A., Gustafsson, B., Linde, P., & Nissen, P.-E., 1997, *A&A*, 322, L13
 Ardeberg, A., et al. 1999, in *IAU Symp. No. 184*, in press