TWO MORE MAGELLANIC CLOUD CM DIAGRAMS[*]

J.R. MOULD[1], J B. JENSEN[1], G.S. DA COSTA[2], J. KRISTIAN[3], J.M. NEMEC[4]
1 *Palomar Observatory, California Inst. of Tech., Pasadena, Calif. 91125, USA*
2 *Anglo Australian Observatory, Epping, NSW, Australia*
3 *Observatories of the Carnegie Institution of Washington, Pasadena, Calif. 91101, USA*
4 *University of British Columbia, Vancouver, BC V6T 1W5, Canada*

ABSTRACT. Lindsay 11 and NGC 1806 are globular clusters in the Small and Large Magellanic Clouds (SMC and LMC) respectively. Both clusters have extended asymptotic giant branches with carbon stars at the tip. Colour-magnitude diagrams are fitted with appropriate isochrones which indicate that both clusters belong to the abundant population of intermediate age in the Magellanic Clouds.

1. NGC 1806

The 2.5-m du Pont telescope at the Las Campanas Observatory in Chile was used to observe the cluster with the aid of the CHUEI reimaging camera in the Cassegrain focal plane. The scale of the instrument is 2.4 pixels per arcsec. Exposures of the clusters were made through Thuan and Gunn red and green filters imaging onto an 800x800 Texas Instruments CCD. The seeing averaged 1.4" FWHN. Three 1000-second green exposures were taken on October 9 1983, followed by five 600-second red exposures. The data were flat-fielded, co-added, and calibrated following standard techniques.

To apply isochrones to globular clusters, corrections for distance and reddening have to be made. The distance modulus used for the LMC was 18.4 mag. The colour excess adopted was 0.10 mag in $E(B-V)$. Assuming the metallicity indicated by Schommer at this meeting, isochrones of Z=0.01 were fitted to the CM diagram. The VandenBerg (1985) isochrones used here are tabulated on the Johnson system, and B-V and V magnitudes had to be transformed to G-R and R.

The effects of convective overshooting add uncertainty to the isochrones. Inclusion of convective overshooting would brighten the isochrones by up to 0.3 mag (Da Costa *et al.* 1985). The isochrones are also subject to an uncertainty in transforming B-V to G-R, which may be as large as 0.08 mag in colour. The distance modulus of the LMC is uncertain to ±0.2 mag. Even after we have made allowance for these uncertainties it is clear that the age of NGC 1806 lies in the range 0.7-1.3 Gyrs (see Figure 1).

2. Lindsay 11

The 4-m telescope at the CTIO was used to observe the cluster at prime focus. The scale of the instrument is 0.6 arcsec per pixel. Exposures of the clusters were made through Johnson B and

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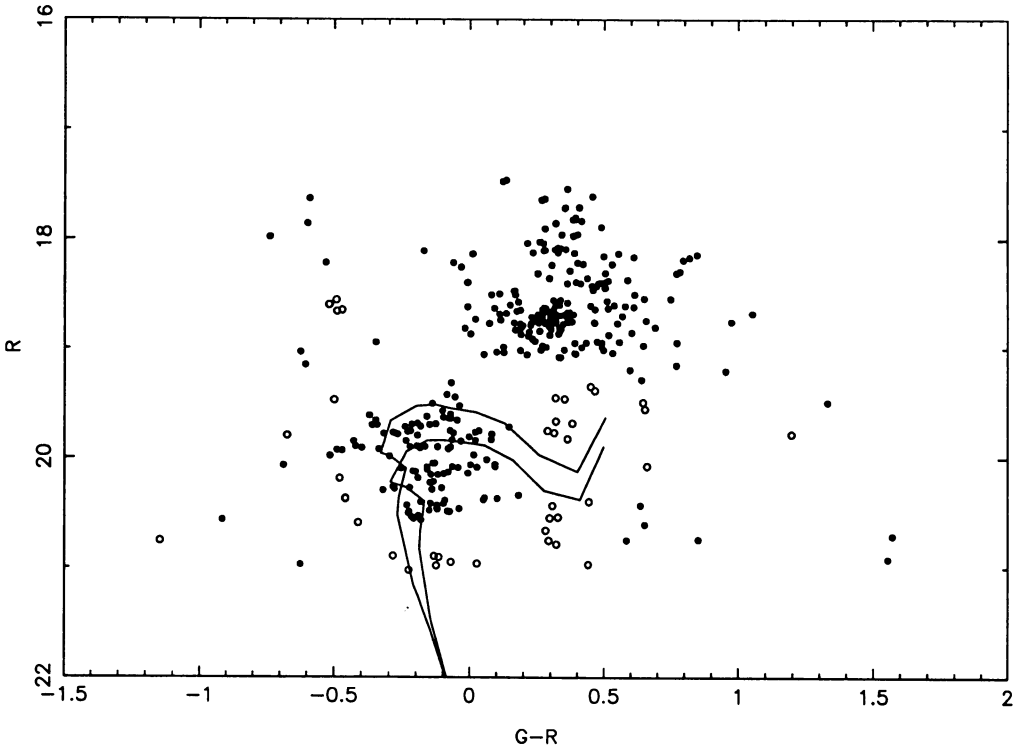
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Figure 1. Field-subtracted colour magnitude diagram of NGC 1806. Open circles indicate regions of the CM diagram where an excess of stars exists in the field used to correct cluster diagram for field stars. The superposed isochrones are 0.8 Gyrs, (above), and 1.0 Gyrs, (Below).

Kron-Cousins R filters imaging on to a 512x380 RCA CCD. Four 500-second blue exposures were taken in 1984 November 25, together with six 300-second red exposures. Calibration of the photometry from this run is incomplete, and the results are preliminary. The fitted isochrones in this case are Revised Yale Isochrones reddened by 0.06 in B-R. Since Lindsay 11 lies in a much less crowded field than NGC 1806, statistical field subtraction is not required. One can readily see from Figure 2 (left) that the brightest main sequence cluster stars are at R=20.9, and that the bulk of the field (Figure 2 right) consists of an older stellar population.

Both NGC 1806 and Lindsay 11 have two AGB carbon stars. Those in the former cluster are 1 magnitude brighter in apparent bolometric magnitude than those in the latter. This difference is larger than the distance modulus difference by about 0.5 mag. In the Magellanic Clouds cluster samples as a whole, a trend in this sense is seen (Frogel *et al.* 1990). This is understandable in terms of the theory of carbon star formation (Iben & Renzini 1983), either as a result of metallicity or age differences between the stellar populations. In younger clusters stars can reach higher luminosities on the AGB. In more metal-poor clusters, third dredge up is effective in producing carbon stars at lower luminosities.
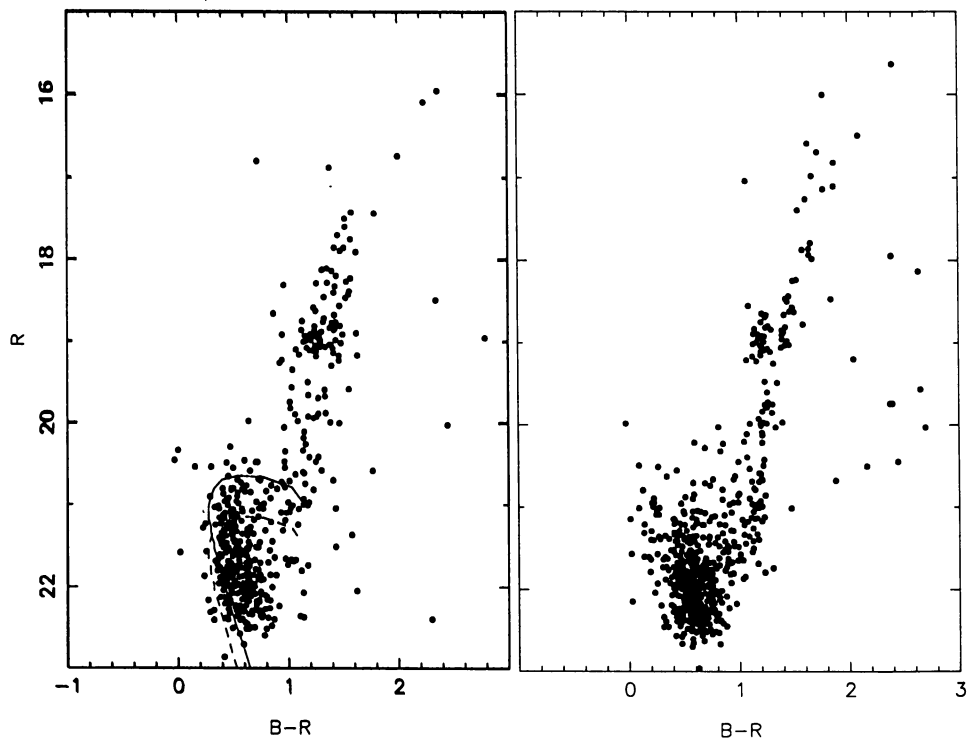
Figure 2. Colour magnitude diagrams of the cluster Lindsay 11 (left) within 120 pixels of the cluster centre, and (right) outside that radius. The superposed isochrones are 3 Gyrs, $Z = 0.001$. The solid curve is a fit with a short modulus for the SMC (18.8), and the dashed curve with a long modulus (19.3).

3. References

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