THE ABUNDANCE OF THE LMC GLOBULAR CLUSTER NGC 2213

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ABSTRACT: A new technique for determining accurate abundances in distant giants - Washington CCD photometry - has been applied to the intermediate-age LMC globular cluster NGC 2213. An abundance of -0.40 ± 0.15 was found from the analysis of 42 giants with V < 20, using data obtained with the 1.5 m telescope. Combined with published main-sequence photometry, the derived abundance indicates a true LMC distance modulus of 18.2 ± 0.2. A likely CN strong giant near the tip of the giant branch is identified. Abundances are also derived for a sample of 27 field giants. Results indicate that one could determine both the age and abundance of Magellanic Cloud clusters with high accuracy from Washington photometry using the 4 m in less than one hour of observing time per cluster.

1. INTRODUCTION

Despite the great progress made in recent years in obtaining high precision main-sequence photometry of Magellanic Cloud clusters, a nagging problem remains in our ability to use this information to determine accurate distances. Metal abundances in the clusters must be known to an accuracy of better than 0.2 dex before the distance modulus derived from main-sequence fitting can be trusted to better than 0.2 mag. Such accurate abundances have proven to be very difficult to achieve. Because of the faintness of the stars, we have been forced to rely on rather crude techniques: color-magnitude diagram morphology, integrated spectra or colors, or low resolution spectra of a few giants. These methods often yield uncertainties of 0.3 dex. It is therefore essential that our methods for determining metal abundance improve substantially before we can claim great confidence in distances derived from main-sequence fitting.

A technique that offers great promise is Washington CCD photometry. The filters are very broad (~ 1000Å) so that the system is very efficient. The system was designed to measure accurate temperatures of late-type giants, and to provide two independent abundance estimates. A recent recalibration of the Washington abundance indices demonstrates that the Fe abundance sensitivity of the Δ(C-M) index is comparable to or exceeds that of all other photometric

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or low resolution spectroscopic abundance indices at all metallicities. The system is also capable of detecting giants with strongly enhanced CN bands. By averaging together the abundance indices of many tens of giants per cluster, a mean abundance with an uncertainty as small as 0.1 dex should be attainable.

2. RESULTS

In order to investigate the ability of the system to obtain accurate abundances for Magellanic Cloud cluster giants, Washington CCD photometry of the LMC red globular cluster NGC 2213 was obtained on January 3, 1986 with the CTIO 1.5 m. The frames were reduced using DAOPHOT. The resulting photometry has internal errors less than 0.03 in C-M and < 0.02 in M-T_1, T_1 - T_2 and T_1 for most giants. These are sufficiently accurate for determining abundances.

After eliminating stars with large errors and those more distant than 1.5′, 42 giants remained for the abundance analysis. One of these, a star near the tip of the giant branch, shows evidence for abnormally strong CN absorption. The remaining giants fall closely about the relation for an abundance of -0.5 dex in the Δ(C-M) index. The scatter is somewhat worse in the Δ(M-T_1) index, as expected from its lessened abundance sensitivity, and the mean abundance is 0.2 dex higher than that given by the Δ(C-M) index. The final mean abundance is -0.40 ± 0.15.

VandenBerg (1985) isochrones of the appropriate metal abundance were then compared to the deep color-magnitude diagram of Da Costa, Mould and Crawford (1985). The best fit was provided by the 1.5 Gyr isochrone using a distance modulus of 18.2. The experience gained from this study shows that both the abundance and age of a Magellanic Cloud cluster could be accurately determined from Washington photometry in less than 1 hour of 4 m time.

REFERENCES

Da Costa, G. S., Mould, J. R. and Crawford, M. D. 1985 Astrophys. J. 297, 582.
VandenBerg, D. A. 1985 Astrophys. J. Suppl. 58, 711.

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