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A Survey for CH Stars in Globular Clusters

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Abstract. To determine the frequency of CH stars in metal-poor globular clusters, I have begun a survey using intermediate-band photometry and low-dispersion spectroscopy. In the preliminary analysis of one cluster, M 30, I have found that the photometry successfully selects stars with strong G-bands, while the low-dispersion spectra isolate those stars with the correct metallicities and radial velocities to be cluster members. In the M 30 sample, I have found three stars that have stronger G-bands than normal cluster stars of the same luminosity.

1. Introduction

While fairly common in the field, CH stars seem to be strangely lacking in globular clusters. The standard explanation for the existence of CH stars is that they received carbon-rich material from a binary companion while the companion was an AGB star (McClure & Woodsworth 1990). Therefore, this paucity of CH stars in globular clusters implies that there is a stellar-density-dependent factor to the formation of CH stars, such as the binary survival rate. However, some field CH stars have been found that are apparently not part of binary systems (Preston & Sneden 2001). The suggested method of formation for these stars hinges on their metal-poor status ([Fe/H]< -2.0) and the strong mixing found in some models of extremely low-metallicity stars (Fujimoto, Ikeda, & Iben 2000). Since globular cluster stars, if anything, are more prone to internal mixing than field stars, the lack of CH stars in globular clusters would indicate that another explanation is necessary. Finally, a low percentage of CH stars also limits the contribution of globular clusters to the halo field population, which is apparently much richer in stars with strong CH absorption (Beers et al. 1992). However, there have been no published surveys of a large number of globular clusters looking explicitly for CH stars, so true statistics are not known. Briley (1997) did not find any CH stars in his survey of 283 giants in 47 Tuc. Nor did Cohen (1999) in her spectra of 50 stars near the main-sequence turnoff in M 13. Smaller surveys of $\sim 5 - 35$ giants using spectra of other abundance work have only found about 8 CH stars, mostly in ω Cen.

2. The Survey

The survey was conducted on the duPont 100" telescope at Las Campanas. 18 clusters have been surveyed photometrically so far. These clusters had, in general, [Fe/H]< -1.5, and spanned a range of cluster densities and binary fractions. Photometric data was taken through two intermediate-band filters: one centered on the G-Band at 4305 Å and the other on a continuum region at 4570Å. Figure 1 shows that

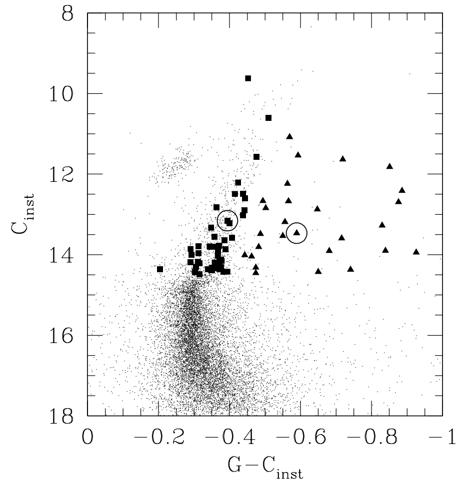

Fig. 1. The color-magnitude diagram for M 30 derived from two intermediate-band filters. "G" is a G-band filter and "C" is a continuum filter. Stars that have strong G-bands will show up on the right in the G-C axis. The large points mark the stars that had low dispersion spectra taken through slit masks. The two circled points indicate the stars whose spectra are shown in Figure 2.

these two filters separate the stars into a distinct red giant branch and a smattering of stars to the red. However, these two filters do not provide enough information to distinguish between G-band strong cluster members and metal-rich field stars, and so low-dispersion spectra are needed. Color-magnitude diagrams of clusters such as Figure 1 were used to select candidates for multi-slit observations. Six of the clusters have low-dispersion data from 3800Å-5100Å for a selection of stars. I use these spectra to measure the radial velocities, CaII H&K lines and Balmer lines to determine if the stars are actual cluster members. In M 30, most of the candidates are metal-rich field stars. However,

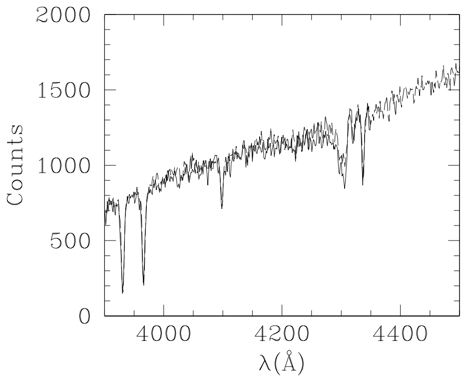

Fig. 2. Two spectra from the survey of M 30. They are similar in all respects except the strength of G-band. Future work includes calibrating the difference in carbon abundance.

three stars have both stronger G-bands and spectra that otherwise match spectra of cluster members (Figure 2). Work on calibrating G-band strengths, both in the spectra and the photometry, is underway, using a combination of model spectra and high-resolution spectra. The data for the rest of the clusters are being reduced, and data from the literature, in particular broadband colors, are being added to the analysis.

References

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