BIMODAL DISTRIBUTIONS ON THE HORIZONTAL BRANCH

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ABSTRACT. We present preliminary versions of log g - log T_{eff} diagrams for a number of clusters with gaps in their blue horizontal branches and for two normal clusters.

1. INTRODUCTION

A number of clusters show a bimodal distribution of stars along the horizontal branch (HB). In some cases there is actually a gap in the distribution; in others there is just a paucity of stars in a certain temperature range. The most dramatic examples are clusters with prominent gaps in very blue HB's (NGC 6752, NGC 288, M 15). There is no theoretical reason to expect such gaps. Unfortunately the distribution of stars along the HB is a sensitive function of many parameters. Possibilities include age, helium abundance, [Fe/H], [CNO/Fe], and parameters which affect mass loss which includes, at a minimum, rotation and magnetic fields. Bimodal distributions in any of these or other parameters could produce gaps.

As with the infamous "Second Parameter" problem a precise understanding of mass loss is required. Changes of a few percent in the mass loss parameter dramatically affect the distribution of stars on the HB. Since an understanding of mass loss at this level seems a rather remote possibility, we have begun a long term project to understand the HB without a preoccupation with its obvious feature --- the temperature distribution of the stars. Part of this project involves log g - log T_{eff} diagrams for a number of "blue gap" clusters as compared to a number of "normal" clusters. We report here on the preliminary results of that survey.

2. THE OBSERVATIONS

Spectra with a resolution of 4 - 7 Å were obtained using the IIDS on the 2.1 m telescope at KPNO for M 15, M 92, M 3 and M 5 and the 2D-Frutti on the 4 m at CTIO for NGC 288. Fits to Kurucz atmospheres gave gravities and temperatures. The gravities depend on the widths of $H\beta$, $H\gamma$ and $H\delta$, the temperatures on the Balmer jump and the slope of the

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continuum. From the internal consistency of Hβ, Hγ and Hδ the errors in gravity are generally less than 0.10. Errors in log T_{eff} are 0.02 or smaller.

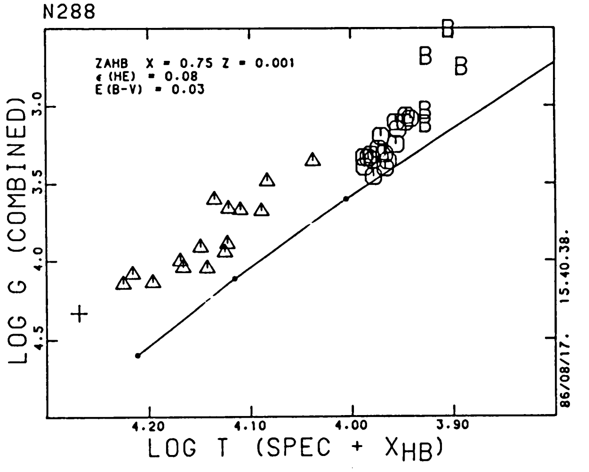

Fig. 1. The data for NGC288. The solid line is the ZAHB for the indicated composition. The same ZAHB fits the M 5 data well.

3. THE RESULTS

NGC 288 has a gap in the blue HB. Its metallicity is similar to M 5. It is a "too blue" 2nd parameter cluster. While the stars redward of the gap are close to the theoretical ZAHB, they do have systematically lower gravities than M 5. The stars blueward of the gap, the blue droop, are displaced significantly toward lower gravity. The blue droop does not seem to be an extension of the same ZAHB as the redder HB.

Coupled with our results for the other clusters we tentatively conclude: 1) There may be as much variety in cluster log g - log T_{eff} diagrams as in CM diagrams. 2) Some clusters (M 5 & M 92) fit the standard model pretty well. 3) In blue gap clusters the stars blueward of the gap, or blue droop, have (much?) lower gravities than if they lay on an extended HB. 4) The shift in the blue droop is in the direction which would result from rapid rotation or high helium abundances. The required change in either is very large. 5) Some clusters with fairly normal CM diagrams (M 3) show evidence for two overlapping populations in the log g - log T_{eff} diagram.

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