CCD PHOTOMETRY IN THE CORE OF THE FORNAX DWARF GALAXY

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1. INTRODUCTION

The present study is concerned with the examination of properties of stars in the core of the Fornax dwarf spheroidal galaxy. Previous studies have shown that Fornax has a very diverse stellar population. Four of the globular clusters associated with Fornax were found to have metallicities significantly lower than the mean metallicity of the field population of the galaxy (Buonanno et al. 1985); these clusters point out an older, metal-poor population. Also, there are a number of luminous carbon stars, which are indicative of a much younger population (see Mould and Aaronson 1986). Studies of the field population of Fornax (Demers, Kunkel, and Hardy, 1979; Buonanno et al.,1985) have shown a dispersion in metallicity. We have measured a large sample of giant branch stars, enabling a good determination of mean properties of the Fornax stellar population, as well as allowing a comparison of stars as a function of distance from the center of Fornax.

2. OBSERVATIONS AND ANALYSIS

The data for the color-magnitude diagrams are from 13 overlapping CCD frames, taken on the PFCCD at CTIO. They cover an area of approximately 145 square arcmin. around the geometrical center of Fornax. Each region was observed in B, V, and R, with exposure times of approximately 1 minute. They were reduced with Stetson's DAOPHOT program and put on the standard system using Graham's E region standards. The magnitudes of stars shared in the overlap regions were compared and no systematic offsets were found between frames. At V = 18.4, the errors in V, B-V, and V-R are 0.03, 0.04, and 0.05 mag., respectively. At V = 20.8, the errors are 0.08, 0.16, and 0.13. As a further comparison, one frame has stars in common with the Buonanno et al. (1985) region A1. Within the errors, our photometry is on the same system as theirs.

There is a noticeable dispersion in color among stars in the giant branch of Fornax. The bluest stars lie along the ridge lines of metal-poor globular clusters such as M92. The reddest giants seem to be limited by the 47 Tuc ridge line, assuming the M_V of the horizontal branch varies with metallicity as given by Sandage (1982). If, instead, $(M_V)_{HB}$

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is defined to be +0.6, then there is a population of stars in Fornax more metal-rich than 47 Tuc. A mean giant branch ridge line was drawn for the color-magnitude diagram of the innermost stars, and we measure $\Delta V_{1.4} = 2.34$. Using Zinn and West's (1984) relation between $\Delta V_{1.4}$ and metallicity ([Fe/H] = 0.913 - 0.924 $\Delta V_{1.4}$), the mean metallicity of Fornax is found to be [Fe/H] = -1.25, with an error of approximately 0.3 dex. This agrees with the value found by Buonanno et al. (1985) for the field of Fornax. The distribution of stars about this mean giant branch remains roughly constant as a function of radius from the center of Fornax.

A more detailed analysis of the dispersion in B-V shows that there is an intrinsic spread in color, in excess of that caused by errors in the photometry. Two subsets of data ($19.2 < V < 20.0$ and $20.0 < V < 20.5$) were examined and, assuming that the error and intrinsic distributions in B-V are Gaussian, their intrinsic dispersions were measured. To convert this color spread to dispersion in metallicity, the difference in B-V between the Fornax ridge line and the giant branches of a number of globular clusters were plotted against [Fe/H]. Unfortunately, there is a large error associated with this calibration, possibly due to contamination of the giant branches by AGB stars. For both samples of data, σ([Fe/H]) is (very roughly) 0.10. Obviously, better measures of metallicity are needed for Fornax stars before a good value of the dispersion is known.

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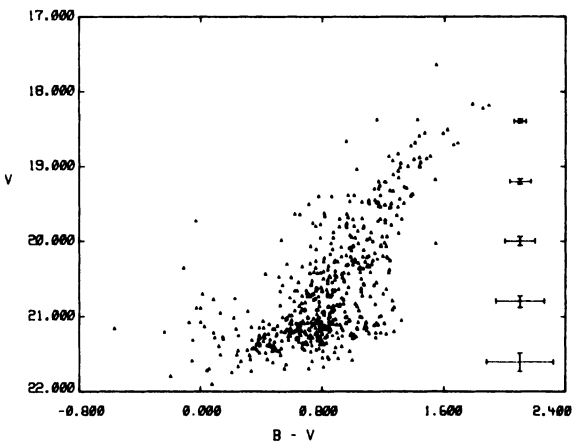

Fig. 1 CM diagram for one CCD field near the core of Fornax