Part 2. Globular Cluster Systems of Distant Galaxies

Section B. Poster Papers

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Michael Hilker reaches into his magic bag and pulls out yet another of the great t-shirts he designed.

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Globular Clusters in Dwarf Elliptical Galaxies

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Abstract.
We present preliminary results on the shape of the globular cluster luminosity function and the colors and inferred metallicities of the clusters in dwarf elliptical galaxies imaged with *HST*. The luminosity function (LF) of the GC candidates is consistent with a Gaussian-shaped LF similar to that in giant ellipticals. Also, with a mean color of $(V - I) = 0.94$, most of the GCs appear to be old and metal-poor ([Fe/H] $= -1.4$) like GCs in the Galaxy and in nearby giant ellipticals. This suggests that the bulk of the clusters were formed more than 10 Gyr ago.

1. Introduction

The properties of the globular clusters (GCs) in dwarf elliptical galaxies (dEs) can help us distinguish theories of dE formation and the importance of dE accretion on the formation of giant galaxies and their GC systems. Since GCs are composed of simple stellar populations, their integrated colors and magnitudes contain information about their ages and metallicities. A typical old, metal-poor $(Z = 0.02Z_{\odot})$ GC population in a giant galaxy has a mean color of $(V-I) \approx 0.95$ and a luminosity function that peaks at $M_V \approx -7.4$. Star clusters with ages of 5 Gyr would be about 0.2 mag bluer if they have the same metallicity (see Figure 7 of Whitmore et al. 1997). If $Z = 0.2Z_{\odot}$, then the young clusters will also have $(V - I) \approx 0.95$, but they will be ~ 0.5 mag brighter. Thus we can put reasonable constraints on the ages and metallicities of the clusters.

We have been undertaking a snapshot survey of dEs with the *Hubble Space Telescope* to study the properties of their star clusters and nuclei (see Miller et al. 1998). Here we present preliminary analysis of 69 galaxies observed over *HST* cycles 6, 7, and 9. In particular, we focus on the luminosity functions and color distributions. The contribution by Lotz et al. in this proceedings describes how the radial distributions may be affected by dynamical friction.

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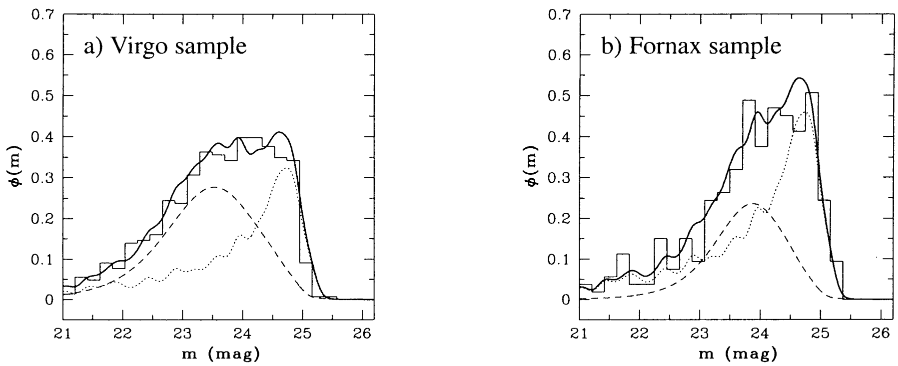

Figure 1. V-band GC luminosity functions for the Virgo (a) and Fornax (b) samples. The histograms are the LFs for all GC candidates with $r_{proj} < 60''$. The dotted curve is the scaled LF of background objects (objects with $r_{proj} > 60''$) taken from the entire snapshot sample. The dashed curve is the best-fitting t_5 distribution using the method of Secker & Harris (1993). The dark solid curve is the complete fit.

2. Composite Luminosity Functions

The majority of the snapshot galaxies are in the Virgo and Fornax Clusters. Since these galaxy clusters may have difference distances, we split the GC candidates into Virgo and Fornax samples to study their luminosity functions (LFs). Figure 1 shows preliminary results of fitting t_5 functions to the two samples. The t_5 is more robust to outliers that a Gaussian and seems to give a better fit (see Secker & Harris 1993). The peaks of the LFs are at $V^0 = 23.6 \pm 0.1$ and $V^0 = 23.8 \pm 0.2$ for Virgo and Fornax, respectively, with $\sigma_t \approx 0.5$. Given our assumed distance moduli of 31.2 and 31.4, these correspond to $M_V^0(\text{Virgo}) = -7.6 \pm 0.2$ and $M_V^0(\text{Fornax}) = -7.6 \pm 0.3$. These values are very similar to the GCLF peaks for giant galaxies, from Whitmore (1997) we find that $M_V^0(\text{Virgo}) = -7.31 \pm 0.26$ and $M_V^0(\text{Fornax}) = -7.6 \pm 0.2$ for the giants. Similarly, the peaks of the GCLF for the Milky Way and M31 are at $M_V^0 = -7.5 \pm 0.2$. However, these measurements are brighter than previous measurements in dwarfs by about 0.5 mag (Durrell et al. 1996). Background subtraction is critical to these results and our procedure will be scrutinized as the analysis is completed.

3. Color Distributions

Composite, background-subtracted, color distributions of the GCs in the Virgo and Fornax samples are shown in Figure 2. Both distributions can be represented by a single Gaussian with a peak at $(V-I)_0 = 0.94$. This color is the same as the mean color of the metal-poor globular clusters in the Galactic halo. Assuming that these clusters are old, the relation between $(V-I)$ and [Fe/H] from Couture et al. (1990) gives [Fe/H] $= -1.35$.

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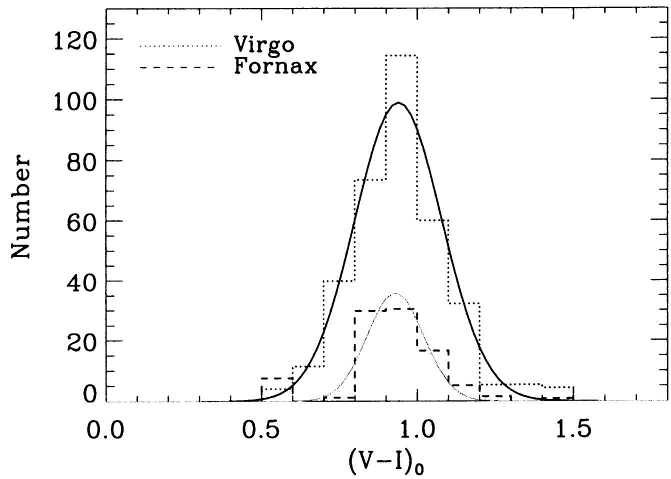

Figure 2. Color distribution of GCs in Virgo and Fornax samples. Objects were selected as in Figure 1 and the background has been subtracted. Both distributions are well fit by single Gaussians with peaks at $(V - I)_0 = 0.94$ and sigmas of 0.1 mag.

4. Summary

The basic properties of the GCSs of dE galaxies are remarkably similar to the properties of the metal-poor GC populations in giant ellipticals. The implication is that the clusters have comparable ages and metallicities. This supports scenarios where the metal-poor GC populations of giants are at least partially explained by the accretion of GC-rich dwarfs. This also argues against recent (within $\sim$ 6 Gyr) formation for a large fraction of the clusters. Data that is able to break the metallicity-age degeneracy in $(V - I)$ would provide better age estimates and allow us to see if some fraction of the clusters or nuclei are younger.

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