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The Globular Cluster System of NGC 1316

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Abstract. We have studied the Globular Cluster System of the merger galaxy NGC 1316 in Fornax, using CCD BVI photometry. Dividing the sample into red (presumably metal-rich) and blue (metal-poor) subpopulations at $B-I=1.75$, we find that they follow strikingly different angular distributions. The red clusters show a strong correlation with the galaxy elongation, but the blue ones are circularly distributed. An astonishingly low specific frequency for NGC 1316 of only $S_N = 0.9 \pm 0.2$ is derived, which confirms with a larger field a previous finding by Grillmair et al. (1999). Assuming a "normal" S_N of ~ 4 for early-type galaxies, we use stellar population synthesis models to estimate the merger age to about 2 Gyr, if an intermediate-age population were to explain the low S_N we observe. By fitting t_5 functions to the Globular Cluster Luminosity Function (GCLF), we derive the following turnover magnitudes: $m_B^T = 24.69 \pm 0.15$, $m_V^T = 23.87 \pm 0.20$ and $m_I^T = 22.72 \pm 0.14$. They support that NGC 1316, in spite of its outlying location, is at the same distance as the core of the Fornax cluster.

1. Introduction

The analysis of GCSs in elliptical galaxies can have different motivations. One of them is to gain insight into the formation of cluster systems by investigating the variety of GCS morphologies in relation to their host galaxy properties (see Ashman & Zepf 1997 and Harris 2000 for reviews). On the other hand, GCSs have been successfully used as distance indicators. This is of particular interest

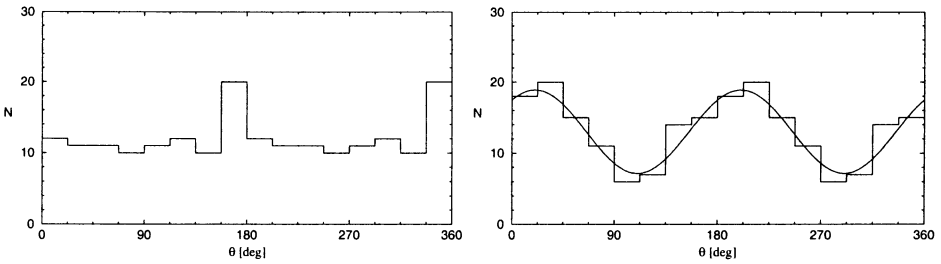

Figure 1. The angular distribution of blue (left) and red (right) subpopulations. The red clusters show a strong correlation with the PA of the galaxy. A fit of a double cosine function is overplotted for comparison.

if the galaxy has been host of a type Ia supernova, whose absolute magnitude can be derived, as has been the case for SN 1992A in NGC 1380 (Della Valle et al. 1998) and SN 1994D in NGC 4526 (Drenkhahn & Richtler 1999).

Both aspects are equally interesting with NGC 1316, the brightest galaxy in the Fornax cluster and also one of the brightest radio-galaxies. It is host of two supernovae type Ia and has been extensively studied as being the product of a merger event, a process which is believed to trigger the formation of many bright massive globular clusters.

2. Results

BVI CCD images were obtained at the 3.6m telescope at La Silla during 29-30 December, 1997. Standard procedures were applied to perform the photometry and cluster candidates were selected according to shape, colors and stellarity (see Gómez et al. 2001 for details).

A clear bimodality is not detected from the broadband colours. However, dividing the sample into red (presumably metal-rich) and blue (metal-poor) subpopulations at $B - I = 1.75$, we find that they follow strikingly different angular distributions. The red clusters show a strong correlation with the galaxy elongation, but the blue ones are circularly distributed.

By fitting t_5 functions to the GCLF, we derive the following turnover magnitudes: $m_B^T = 24.69 \pm 0.15$, $m_V^T = 23.87 \pm 0.20$, $m_I^T = 22.72 \pm 0.14$. They are near the limiting magnitude of our observations, so we do not make further conclusions regarding the luminosity of the SNe. However, assuming the absolute values: $M_B^T = -6.89 \pm 0.10$, $M_V^T = -7.60 \pm 0.08$ and $M_I^T = -8.47 \pm 0.10$ (Drenkhahn & Richtler 1999, Ferrarese et al. 2000), our turnovers support that NGC 1316 is at the same distance as the core of the Fornax cluster.

Using the radial profile of the cluster's density and the GCLF, we derive a specific frequency for NGC 1316 of $S_N = 0.9 \pm 0.2$. This is an extremely low value for a bright early-type galaxy, and confirms with a larger field the S_N found by Grillmair et al. (1999) using HST data. One possible explanation for this low value would be to assume that the merger caused, whether or not star clusters have been formed, a period of star formation, which nowadays constitute an

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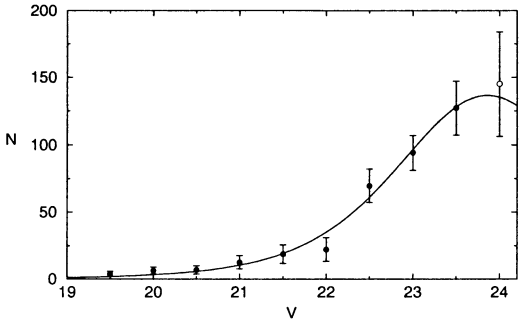

Figure 2. The GCLF for the V band. The last bin (open circle) was not used in the fit, as its center is beyond the limiting magnitude of our observations. The smooth curve is the fit of a t_5 function with $\sigma = 1.1$

intermediate-age population without strikingly differing in integral broad-band colours.

We assume that a "normal" specific frequency of early-type galaxies is 4. The question then is: How young must NGC 1316 be to lower that value to our value of 0.9? Using Worthey's stellar population models we get an age of 2 Gyr to account for the magnitude difference of 1.6 mag in comparison to an old population of 15 Gyr.

This is in good agreement with the mean stellar age of NGC 1316 given by Kuntscher & Davies (1998), who measured line strengths for early-type galaxies in Fornax. It also matches the merger age estimated by Mackie & Fabbiano (1998) and the spectroscopically derived ages by Goudfrooij et al. (2001) for the brightest globular clusters.

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