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Ages and metallicities of Globular Clusters in M33

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Abstract. We present preliminary results of a wide–field spectroscopic study on star clusters in the spiral galaxy M 33. We derive for 42 star clusters both age and metallicity using the principles of the Bayesian statistic and the Lick indices. We find that M 33 globular clusters in our sample are relatively young ($\sim 8-9$ Gyr), none of them being as old as the oldest Galactic counterparts. This implies that this galaxy started forming most of its star clusters after the main episode of star formation took place in the big Local Group galaxies (Milky Way, M 31 and LMC), possibly together with the SMC.

Keywords. galaxies: star clusters, Local Group

1. Introduction

Our star cluster sample was taken from the studies of Christian & Schommer (1988), Mochejska *et al.* (1998), Chandar *et al.*(1999), Chandar *et al.*(2001). The total apparent magnitudes of our 90 clusters go from 16 to 21 in the V band. The GCs are distributed over a very large region around the galaxy so that wide–field observations are required.

The observational data have been acquired in three nights at the 4.2m William Herschel Telescope in La Palma during two different runs: one in 2002 and the second in 2003. We used AF2/WYFFOS, which is a multi-object, wide field, fibre spectrograph working at the prime focus of the telescope. The grism we have adopted is the R600B as we are interested in the wavelength region from 3800 Å to 6000 Å , where most of the Lick indices are located. The nominal resolution of the grism is 3 Å/pixel and the spectral range is $\sim$ 3080 Å; the measured arc and sky lines FWHM is $\sim$ 1.7 pixels, which translates into an instrumental wavelength FWHM of nearly $5-6$ Å.

After measuring the Lick indices, we used the methods of the Bayesian Statistics to derive ages and metallicities for our clusters. This means that in order to derive the correct age/metallicity of our sample we have to use (in the calculation of χ^2), indices that are proved to be not correlated. In our case we discard the iron lines and the magnesium lines, and adopt instead [MgFe], [MgFe]', Mg_1Fe and Mg_2Fe, which should be independent quantities.

The *prior* distribution of the models in the space of parameters has been generated interpolating between the high resolution SEDs from Bruzual & Charlot(2003) whose ages and metallicities range from 0.05 to 13.5 Gyr and from -2.3 and 0.4 in $\log(Z/Z_\odot)$.

This *prior* distribution is shown in Fig.1, left panel, where the M 33 GCs with errors on [MgFe] lower than 0.5 are indicated by the triangles (for the sake of comparison we also show the Sa galaxy M 104 GCs by squares without errorbars). The sample of M 33 GCs on display amounts to 45 objects (half of our entire sample).

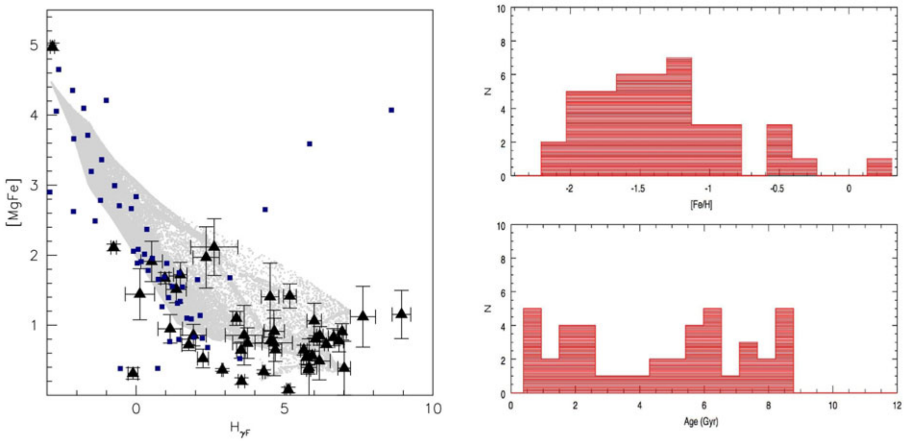

Figure 1. (*Left*) *Prior* distribution in the [MgFe] versus $H_{\gamma,F}$ plane. The grey area corresponds to theoretical indices with ages between 0.05 and 13.5 Gyr and [Fe/H] between -2.25 and 0.56 calculated from the PURE SEDs models of Bruzual & Charlot(2003). Triangles with errorbars represent M 33 GCs with error in [MgFe] less than 0.5, squares without errorbars represent the GCs of M 104 for comparison; (*Right*) Distributions of ages and metallicities of clusters for which we have a reliable determination of both parameters.

2. Results

Because of the low signal to noise ratio of some spectra the assignement of both age and metallicity is possible only for about half (42) of our GCs. Even so, it is a great improvement with respect to the previous knowledge as the only study of this kind (Chandar *et al.*(2002)) that made use of integrated spectra to derive age and metallicity is limited to 14 clusters. Histograms showing the distribution of ages and metallicities are given in Fig.1, right panel.

The ages we find are all younger than 10 Gyr, in other words all clusters in the sample are significantly younger than their counterparts in Milky Way, M 31 and the Large Magellanic Cloud. If our sample is really representative of the age distribution of the M 33 GCs, and we are not systematically missing the oldest objects, our result would imply a different scenario, where the majority of GCs in this galaxy have formed after the main episode of star formation that took place in the biggest galaxies of the Local Group.

The mean metallicity we derive is practically coincident with the mean metallicity of the metal–poor component of the Galactic GCS. In metallicity bins where the Galactic GCS shows the second peak (at ~ -0.5 in [Fe/H]) we find only a few clusters. This lends support to the idea that the metal-rich component of a GCS cluster is tightly correlated with the bulge size. In a galaxy like M 33 with a very small bulge, very few metal–rich GCs are expected.

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