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Star formation history of stellar systems in an intermediate-age merger remnant

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Ultra-compact dwarfs (UCDs, Hilker et al. 1999) are a type of compact stellar system that lies in the mass-size parameter space between globular clusters (GCs) and compact elliptical galaxies (cEs). Although their physical properties do not have a precise definition, we could say that in a broad sense they are objects with $M_V < -9$ mag, stellar masses $>10^6$ $M_\odot$ (Forbes et al., 2020) and effective radii between 3 and 100 pc (Wittmann et al., 2016). Thus, UCD includes both massive GCs and nuclei of tidally stripped dwarf galaxies; in some cases, differentiating between them is not trivial.

In Sesto et al. (2018) we conducted a spectroscopic analysis of the GC system's inner zone associated to the intermediate-age merger remnant NGC 1316, based on multi-object spectroscopy obtained with the Gemini/GMOS camera. Currently, we are analyzing the most relevant physical properties of the different stellar systems associated with this galaxy, with the aim of classifying them as massive GCs or stripped nuclei of dwarf galaxies (Sesto et al., in prep.). In this work, we have focused on the behavior of two objects in our sample, which in addition to being intrinsically bright, had been reported as extended GCs by Norris et al. (2014). As a first step, we measured the effective radii using the ISHAPE profile-fitting code (Larsen, 1999), using images from the HST archive. This technique convolves the stellar Point-Spread Function with a presumed analytical model profile. This analysis confirmed that these are two extended objects, whose radii are larger than expected for a classical GC. Secondly, we determined their star formation history (SFH) using the full-spectrum fitting technique, with the code pPXF (Cappellari & Emsellem, 2004). This method finds the best combination of synthetic simple stellar population (SSP) models in order to fit the entire observed spectrum. We selected the SSP models from MILES libraries (Vazdekis et al., 2010), which cover an age range from 0.03 to 14 Gyr, metallicities $-2.27 < [Z/H] < 0.4$ dex, and values of $[\alpha/Fe]$=0.0 and 0.4 dex. We recovered the average of mass-weighted age and metallicity with pPXF by fitting 100 Monte Carlo realizations (see Figure 1). Finally, considering age and metallicity values previously obtained, we have estimated stellar masses assuming mass-to-light ratios from the SSP models of Maraston (2005).

ID	M_V (mag)	radii (pc)	Age (Gyr)	[Z/H] (dex)	Mass (M_{sun})
728	-11.65±0.009	12.5±0.8	1.9±0.3	0.26±0.1	4.5×10^6
636	-10.05±0.005	5.1±0.7	3.4±0.4	0.05±0.1	2.7×10^6
			11.1±0.7	0.05±0.1	

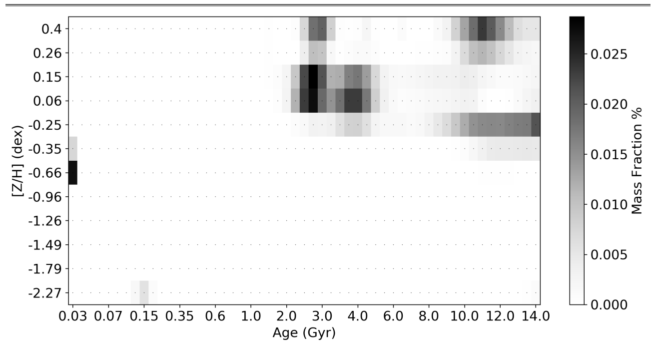

Figure 1. Top panel: the table displays the results obtained for the two stellar systems analyzed in this study. Bottom panel: mass-weighted age-metallicity diagram for ID=636, which allows the visualization of their SFH. The gray-scale represents the mass-weighted value assigned by pPXF to each SSP model.

All this information together (see table) seems to indicate that our sample is made up of objects of a different nature. On the one hand, we have a young, extended, and massive GC, which has formed the bulk of its stars in a single event (ID=728). On the other hand, we have a not-so-massive and extended object, with a complex SFH, which seems to indicate a galactic origin (ID=636).

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