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The Evolution of NGC 5128: Globular Clusters and Field Stars

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Abstract. As the nearest giant elliptical galaxy, NGC 5128 (Centaurus A) is an excellent place to use globular clusters (GCs) and host galaxy field stars to study galaxy evolution. We have performed a detailed investigation of this galaxy, comparing field star kinematics with the metallicities, ages, and kinematics of GCs. We used our sample of 780 planetary nebulae (PNe) to trace the kinematics of the field star population. Our survey for GCs bring the total number of confirmed GCs to 215. Using spectra of the brightest GCs to determine ages, we find that the metal-rich GCs have a mean age of approximately 4–5 Gyr, and that their kinematics are similar to those of the PNe. The metal-poor GCs have old ages similar to the Galactic GCs, and show a weaker kinematic correlation with the field stars. It is possible that NGC 5128 was formed by the merger of two or more disk galaxies at the time that the metal-rich clusters were formed.

1. Introduction

Globular clusters represent the fossil record of vigorous star formation that marks the evolutionary history of their host galaxies. Detailed investigations of these cosmic markers can provide leverage on the chemical and dynamical history of spheroidal stellar populations. Equally important are studies of the field stars that make up the bulk of a galaxy. One of the best galaxies for conducting an in-depth study is the nearby (3.5 Mpc) post-merger elliptical NGC 5128 (Centaurus A). We have conducted a *UBVRI* survey of the NGC 5128 GC system, and an [OIII] survey of its planetary nebula (PN) system, which trace the kinematics of the field stars. Spectroscopic follow-up provided radial velocities for both populations, bringing the total number of confirmed GCs to 215, and the total number of confirmed PNe to 780.

2. GC Colors, Ages, Kinematics, and Formation

The GC color distribution of NGC 5128 is distinctly bimodal. For old clusters, these trends in color are attributed to differences in metallicity. Spectroscopy, however, allows us to gain some leverage on GC ages. In Figure 1, we plot the age-sensitive Hβ index (Worthey et al. 1994) and the metallicity-sensitive $[MgFe]'$ index defined by Thomas, Maraston, & Bender (2003). The metal-poor clusters are consistent with being a universally old population (12–15 Gyr old). The bulk of the metal-rich GCs, however, appear to be significantly younger, having ages from 1–8 Gyr. We confirm the large rotation of the PNe, showing

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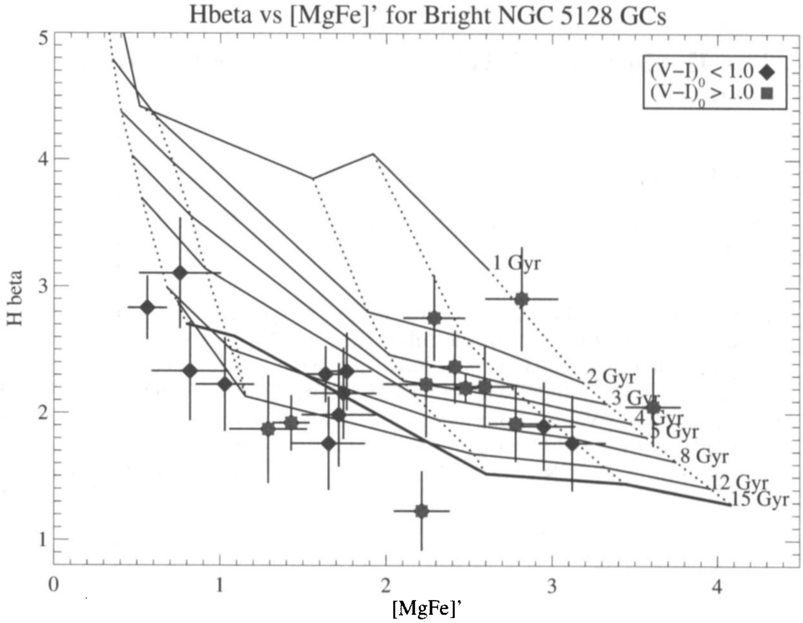

Figure 1. Hβ and $[MgFe]'$ Lick/IDS index measurements on the model grids from Thomas et al. (2003). Lines of constant metallicity (dotted) have values [m/H] = [-2.25, -1.35, -0.33, 0.0, +0.35] (left to right) at [α/Fe] = 0. Lines of constant age (solid) have values from 1–15 Gyr. This figure shows the index measurements for 23 bright, $(S/N)_{H\beta} > 40$, GCs.

that the rotation stays flat along the major axis at a level of 100 km/s out to 80 kpc. The metal-rich GCs have a velocity field that is similar to the PNe, exhibiting rotation at the level of 50 km/s, while the metal-poor clusters show less rotation. The kinematic association of the metal-rich GCs and the PNe, as well as the age determinations, point to a possible major merging event between two disk galaxies approximately 4–5 Gyr ago. This scenario is consistent with the results of merger simulations, which can produce strong rotation and young star clusters in the remnant.

References

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