RevMexAA (Serie de Conferencias), **26**, 113–114 (2006)

STELLAR POPULATIONS IN ELLIPTICAL GALAXIES OF COMPACT GROUPS

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RESUMEN

Se presenta un análisis espectroscópico en el que se comparan galaxias elípticas de Grupos Compactos de Hickson (GCH) con sus homólogas del campo. El estudio de sus poblaciones estelares muestra que las galaxias de baja masa de los GCHs presentan cocientes de abundancias [Mg/Fe] elevados, que se interpretan como vestigio de un suceso que truncó su formación estelar

ABSTRACT

A spectroscopic analysis is presented, where elliptical galaxies in Hickson Compact Groups (HCG) are compared with their counterparts in the field. The stellar population study shows that low-mass galaxies in HCGs present an enhanced [Mg/Fe] abundance ratio, interpreted as a relic of an event which truncated their star formation

Key Words: **GALAXIES: ABUNDANCES — GALAXIES: ELLIPTICAL AND LENTICULAR, CD — GALAXIES: EVOLUTION — GALAXIES: INTERACTIONS**

1. INTRODUCTION

The compact groups of galaxies, with their high spatial densities and low velocity dispersions, are the ideal places for mergers. Although this interaction is generally associated with the star formation (SF) enhancement, recent hydrodynamical simulations by Di Matteo et al (2005), taking the feedback of the active galaxy nucleus into account, show that the starburst associated with the merger is followed by a massive gas depletion and a quench of the SF. This finding could explain the unexpected observation of a low SF level in HCGs (e.g. Iglesias-Páramo & Vílchez 1999), despite abundant traces of interactions (e.g. Mendes de Oliveira & Hickson 1994). Galaxies incorporated to the HCG environment have probably experienced mergers and should preserve traces of the past SF truncation events in their stellar populations. In the present study, we try to look for those traces by comparing the stellar populations of elliptical galaxies in HCGs with those of their counterparts in the field.

2. OBSERVATIONS AND REDUCTION

Our sample consists of 34 early-type galaxies, 22 of them located in HCGs and the remainder in the field. Long-slit spectra were obtained at the KPNO 2.1 m telescope with the GoldCam CCD spectrometer, with an intermediate 4.25 Å FWHM spectral resolution and a median Signal-to-Noise Ratio of 55. Details about the sample and basic reduction were published in (de la Rosa et al 2001a). For the present study, $R_{eff}/8$ and $R_{eff}/2$ apertures were extracted.

Although the present work compares subsamples of a homogeneous set, we have tried to avoid the bias introduced by the models, reduction methods and emission contamination. Therefore, we apply two alternative reduction schemes, those of Thomas et al (2003) (hereafter TMB03) and Vazdekis (1999) (hereafter Vaz99), to minimize and understand systematic effects introduced by the models.

We also have carried out a careful decontamination of the emission, by combining the results of two independent methods: one proposed by González (1993) and the other one by Caldwell et al (2003).

3. RESULTS

The stellar population parameters depend both on the galaxy mass and on its environment. We have chosen the σ_0 to represent mass and the *crossing time* to characterize the HCG environment. Several trends have been found.

(i) *Galaxies in HCGs are 1.3 Gyrs older, on average, than their counterparts in the field.* Qualitatively similar results has been already reported in the literature (de la Rosa et al 2001b; Proctor et al 2004; Mendes de Oliveira et al 2005).

(ii) *Total metallicities [Z/H] of the field galaxies are 0.10 dex larger, on average, than in HCGs.*

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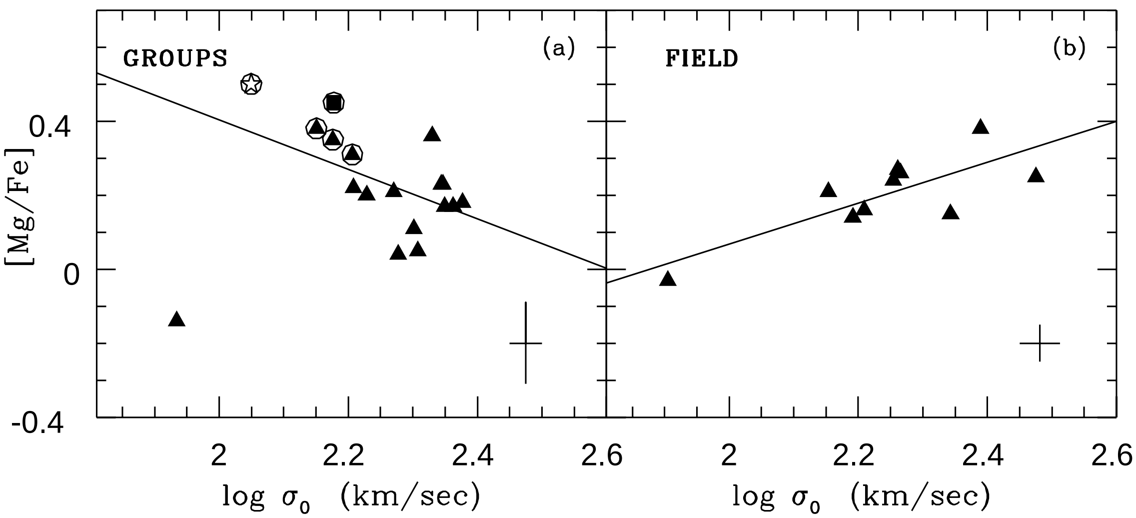

Fig. 1. Trends of [Mg/Fe] abundance ratios with log σ for (a) HCG and (b) field environments. Values were obtained with the TMB03 approach for central ($R_{eff}/8$) apertures. The encircled points in (a) represent galaxies with *anomalous* abundance ratios. The solid square (HCG 76d) has been taken from Mendes de Oliveira et al (2005) and the encircled star corresponds to galaxy HCG 59b, whose [Mg/Fe] value is only a lower limit. Average error bars are represented at the low right corners.

(iii) *The [Mg/Fe] abundance ratio increases with σ_0 for the field galaxies.* This result, shown in Figure 1(b), coincides with previous findings (e.g. Thomas et al 2005), interpreted as a *downsizing*, in which low-mass galaxies display more extended SF histories.

(iv) *Galaxies in HCGs show an anomalous trend in [Mg/Fe] vs log σ_0.* This result, shown in Figure 1(a), is a novel finding of this study. Encircled points show the largest departures from the corresponding field behaviour, which cannot be explained by the error bars. This effect, which is detected with both TMB03 and Vaz99 approaches, is especially prominent in the central apertures ($R_{eff}/8$) and weaker in the global ones ($R_{eff}/2$).

4. DISCUSSION

The anomalous behaviour of the [Mg/Fe] abundance ratio of the low-mass HCG galaxies can be interpreted as a result of a *merger + SF truncation* process. Soon after the SF has started in a galaxy, the [Mg/Fe] attains its maximum value, which steadily decreases as the Fe is incorporated to the new formed stars. Low-mass galaxies in the field evolve undisturbed until the SF has been completed and the [Mg/Fe] attains a minimum value. A field galaxy falling into the dense compact group environment, would likely merge and see their gas depleted by the feedback of the central supermassive black hole, as shown by the simulations. Without the gas, the SF is truncated and the stellar populations of the galaxy stop their Fe enrichment, keeping an enhanced [Mg/Fe] abundance ratio. As observed in Figure 1(a), the massive galaxies are exceptions to the SF truncation process. Due to the downsizing, the more massive galaxies have completed their SF long ago and nothing remains to be truncated after the merger.

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