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THE ASSEMBLY OF EARLY-TYPE GALAXIES: COMBINING CLUSTERING AND LUMINOSITY FUNCTION MEASUREMENTS

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RESUMEN

Presentamos un estudio de la evolución de galaxias de tipo temprano (ETGs por sus siglas en inglés) que combina mediciones de acumulamiento y funciones de luminosidad. El acumulamiento nos permite inferir la masa de materia oscura de los halos anfitriones de las galaxias. Usamos predicciones del modelo ΛCDM para seguir estos halos hacia tiempos posteriores. Esta técnica demuestra que las ETGs de un dado corrimiento al rojo, evolucionan hacia galaxias más brillantes en un marco de referencia en reposo, evolucionadas pasivamente a este corrimiento al rojo menor. Nótese que esto indica que una selección por masa estelar a distintos corrimientos al rojo, no provee necesariamente muestras en una relación progenitor/descendiente. La comparación entre las ETGs de alto corrimiento al rojo y sus probables descendientes en $z = 0$ apunta a una mayor densidad de número de progenitores en un factor 3 a 11, lo que implica que se necesitan fusiones de galaxias para disminuír su densidad numérica hasta el presente. Dado que el producto de los cocientes de densidad de luminosidad entre progenitores y descendientes son cercanos al valor unitario, nuestros resultados muestran que no se necesitan eventos de alta formación estelar en ETGs desde $z = 1$, lo que indica que las fusiones son "secas", o sea, sin gas.

ABSTRACT

We present a study of the evolution of early-type galaxies (ETGs) that combines luminosity funciton and clustering measurements. The latter allows us to infer the typical dark-matter halo mass of the hosts of the galaxies. Using ΛCDM predictions, it is then possible to follow these haloes to a later time. This technique shows that ETGs at a given redshift evolve into brighter galaxies in the rest-frame passively evolved optical at lower redshifts. Notice that this indicates that a stellar-mass selection at different redshifts does not necessarily provide samples of galaxies in a progenitor-descendant relationship. The comparison between high redshift ETGs and their likely descendants at $z = 0$ points to a higher number density for the progenitors by a factor $3 - 11$, implying the need for mergers to decrease their number density by today. Because the progenitor-to-descendant ratios of luminosity density are consistent with the unit value, our results show no need for strong star-formation episodes in ETGs since $z = 1$, which indicates that the needed mergers are dry, i.e. gas free.

Key Words: galaxies: evolution — galaxies: formation — galaxies: statistics — cosmology: observations

1. INTRODUCTION

The study of the population of early type galaxies (ETGs) at different redshifts has been used extensively to test our knowledge of the galaxy formation process, in particular, the assembly of the stellar content of massive galaxies. Analyses of the evolution of the stellar mass and luminosity functions have found that high stellar mass ($M > 10^{11}$ h^{-1} $M_\odot$), passive galaxies do not show evolution in their comoving space density since $z \sim 1$ (Cimatti et al. 2002, 2004; McCarthy et al. 2004; Glazebrook et al. 2004; Daddi et al. 2005; Saracco et al. 2005; Bundy et al. 2006; Pérez-González et al. 2008; Marchesini et al. 2009). This result has been interpreted as evidence that the stellar content of such galaxies is already in place at high redshifts, ruling out the involvement of mergers (even dry, i.e., gas-free) since $z \sim 1$.

Recent statistical measurements of $z \sim 1$ to 3 galaxies, such as the stellar mass function (Perez-Gonzalez et al. 2008; Marchesini et al. 2009; but see Benson & Devereux 2010), the galaxy luminosity function (Marchesini & van Dokkum 2007), and SCUBA (Holland et al. 1999) number counts of $z \simeq 3$ galaxies detected in sub-millimetre bands, show little evolution in this galaxy population since these even higher redshifts. However, these results may still be subject to observational biases. For instance, Marchesini et al. (2010) showed that allowing for the existence of a previously unrecognized

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