Galaxy Evolution in Mass-Selected Samples

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Abstract. I summarize the recent results from the HDFS and K20 surveys that allow to trace the evolution of massive galaxies up to $z \simeq 3$. I show that the evolution of both the specific star–formation rate and of the stellar mass density suggest that, at $z > 1$, we observe the epoch where the evolution of massive objects becomes appreciable. At $z \simeq 1.8$, we indeed find that about 40% of the local density has been locked in massive galaxies. This is associated with a change in the physical properties of massive galaxies, with star–forming objects that contribute to a substantial fraction of the observed mass density. I quantitatively show that these results do not pose challenges to current $\Lambda - CDM$ models, but represent valuable constraints to understand the complex physical mechanisms involved in the assembly of massive galaxies.

1 Introduction

Thanks to the recent - and hopefully definitive - consolidation of the "concordance" cosmological scenario, that has removed the ambiguity about the cosmological parameters, observations at high redshift can be used to better constraint the complex baryonic mechanisms involved in this process. Within this framework, K–band surveys have long been recognized as ideal tools to study the process of mass assembly at high redshift. Albeit the relation between near–IR luminosity and stellar mass is not univocal, indeed, mass–selected galaxy samples can be extracted from these samples and used to constrain the basic features of theoretical models. In this contribution, I review the recent results from the HDFS and K20 surveys, both based on deep K-selected samples, forwarding the reader to other papers for a full discussion ([6], [7], Cimatti this volume).

2 Massive Galaxies at $z > 2$

We will first discuss the physical properties of the sample of galaxies at $z \geq 2$, as obtained from a sample of 75 objects at $K \leq 25$ in the HDFS, using star–formation rates and stellar masses obtained from best–fit to the spectral distribution. In particular, the measured specific star–formation rate $\dot{M}/M_*$ for the K–selected $z > 2$ sample is shown in Fig.1. At lower redshifts, the evolution of $\dot{M}/M_*$ has been studied by [1], of which we plot in fig.1 their average relations at $0.2 < z < 0.5$ and at $0.75 < z < 1$. We find that the trend of increasing $\dot{M}/M_*$ with z detected at $z \leq 1$ by [1] still continues at $z \simeq 3$. At the median value of the $M_* > 10^{10} M_\odot$ complete sample the average specific star–formation rate

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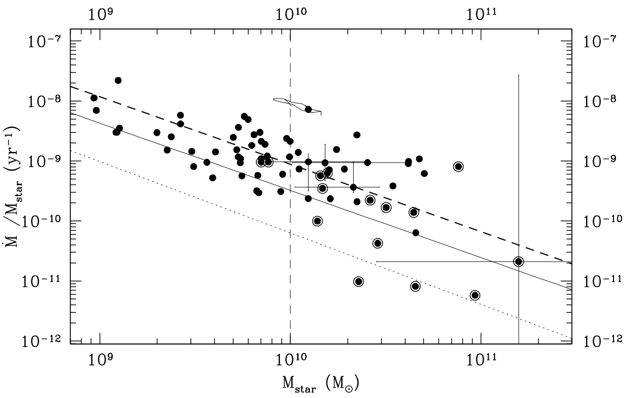

Fig. 1. Rest frame properties of $z > 2$ galaxies from spectral fitting of the HDFS sample. The vertical dashed line shows the rough estimated limit for mass completeness in the $z > 2$ sample. Specific star–formation rate as a function of stellar mass in the $z > 2$ sample of the HDFS, compared with the average relations at $0.2 < z < 0.5$ (thin dotted line) and at $0.75 < z < 1$ (solid line) from[1]. The thick dashed line correspond to our fit to the whole HDFS sample. Encircled points represent the objects with $J - K \geq 1.34$ discussed by [8]. Errorbars are shown for a few objects: the large errorbars on the most massive objects reflect the ambiguity in its nature, between passively–fading and dusty–star forming objects.

$< \dot{M}/M_* > \simeq 4 \times 10^{-10}$ yr^{-1} (note that the adoption of a Calzetti extinction curve would shift this it to a much higher value). The estimated average Scalo b parameter $SFR \times AGE/MASS$, is about 0.8 in this star–forming sample, suggesting a long duration of the starburst activity.

Only seven "red" objects are detected at both large $V - I \geq 1$ and $J - K \geq 1.5$, a combination that may be due to either a strongly absorbed star–forming galaxy or to a passively fading stellar population, an ambiguity that cannot be safely removed without spectroscopy, although we have found that the spectral fitting to the complete $UBVIJHK$ distribution slightly prefers the "passive" spectral model. These objects have $\dot{M}/M_* < 10^{-10}$ yr^{-1} i.e. more than 10 times lower that the typical $z \geq 2$ population if we adopt the "passively fading" fitting models. Given the ambiguity of their spectral classification, they can be used to obtain an upper limit to the fraction of "passively fading" galaxies: in the HDF–S, these objects contribute at most to about 25% of the total galaxy *number* density and up to $\simeq$ 40% of the total *stellar mass* density of the mass–complete subsample of $z \simeq 2$ galaxies.

3 The Cosmological Evolution of the Stellar Mass Density

While the properties of galaxies at the highest redshifts can be currently investigated only with small-area surveys like the HDFs, wider area surveys are