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Spectrophotometric study in the near-IR of a sample of Hα-selected galaxies with active star formation at $z = 0.84$

A. Sánchez de Miguel[1], J. Gallego[1], V. Villar[1], J. Zamorano[1], J. Acosta[2], P. G. Pérez-Gonzalez[1], and G. Barro[1]

[1] Universidad Complutense de Madrid,E-28040 Madrid, Spain; alex@astrax.fis.ucm.es
[2] Instituto de Astrofísica de Canarias, E-38205 La Laguna,Tenerife, Spain

Abstract

In this work we present the results of the spectroscopic analysis in the near-infrared J band of a sample of 48 star forming galaxies at $z = 0.84$. Half of the sample was selected by a narrow-band filter tuned to Hα at that redshift and the other half was selected by photometric redshifts at the same redshift. We provide Hα luminosities and star formation rates for all galaxies at that redshift. We were able to estimate metallicities from [NII]6584 Å for a sub sample of eight galaxies, two of the galaxies were from neckband selection. To analyze their physical properties we have computed their sizes, colors, stellar masses, extinctions and other parameters available in literature and in the Rainbow database. In particular the dependence of the stellar mass with the specific star formation rate and metallicity have been studied and compared with the results of other samples of galaxies at several redshifts. For a fixed mass, the metallicities of our galaxies are compatible than those similar at the local Universe, although with higher dispersion. This fact implies that selection in Hα is less biased than a selection in UV, since it includes galaxies with more evolved populations besides objects dominated by star formation. The comparison of the observed properties with models of evolution leads us to think that $z = 0.8$ star-forming galaxies have already undergone significant changes and begin to developed in a more passive way.

1 Introduction

This spectroscopic study complements the narrow band scan conducted by [5]. This study focuses on the redshift $z = 0.84$ in order to characterize this period of transition that is, according to the current paradigm, the transition phase from high z populations to the well stabilised Hubble sequence observed in the local universe. Our sample consists of a selection of objects selected for their excess emission in narrow-band filter with confirmed redshifts $z \sim 0.84$ and galaxies with redshift $z \sim 0.8$ selected by the photometric redshifts as a reference.

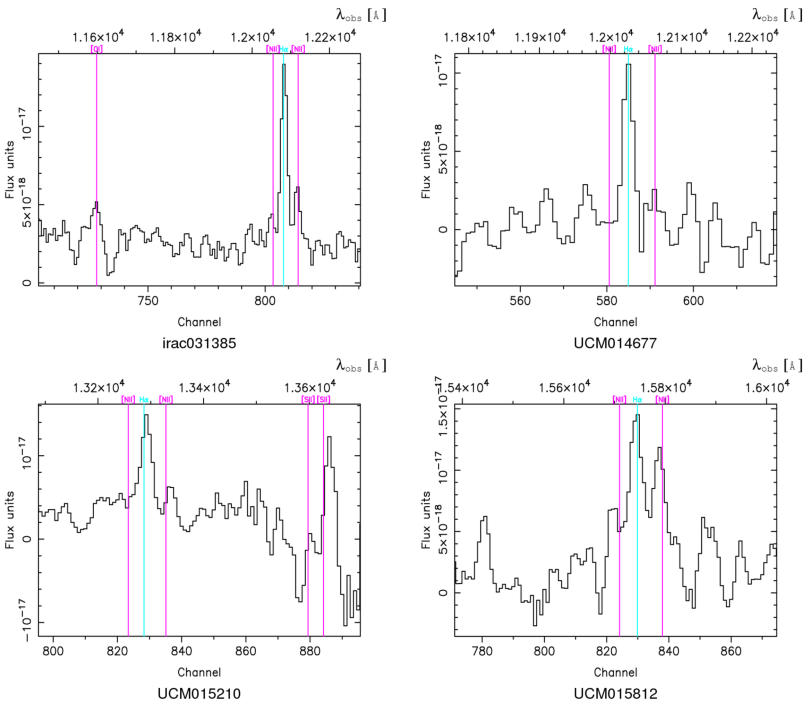

Figure 1: Example of spectra observed in the narrow-band survey and spectroscopic sample.

2 Observations

The observations of this study were made on days 1st, 2nd and 3rd of May 2007 using the William Herschel Telescope in La Palma with the intermediate resolution infrared spectrograph LIRIS (Long-slit Intermediate Resolution Infrared Spectrograph [2]). For the observations it was necessarily with a good seeing, but it was not necessarily photometric nights. For the realization of the observation we used a coded mask with holes for the guide stars.The spectral resolution is 6 Å/pixel and the plate scale is 0.25 ″/pixel. The array detector is a 1024×1024 Hawaii HgCdTe operating at 65 K. The slits are about 1 arcsecond. A simulator was used to calculate the optimum exposure time. Finally, we used sequences of 900 seconds for 6 cycles AB (Table 1, see Fig. 1).

3 Analysis

To measure the rate of star formation in this sample we chose Hα as an indicator. The calibration we used is the classical [1]. Once the spectra is reduced, spectrum fluxes can be compared with the narrow-band fluxes [5]. In Fig. 2 we see galaxies present in the study by [5]. In our study we obtained a star formation rate lower that seen in narrow filter. This is because the slit does not pick up all the light from the galaxy. In general the correspondence between the flux line and filter matches rather well, typically the spectrum flux is 2/3 of the

Table 1: Table of observations. At the top of the table we show the galaxies observed with the narrow filter [5]. At the bottom we show the rest of the galaxies

ID	z	$f_{\mathrm{H}\alpha}{}^{a}$	$L_{\mathrm{H}\alpha}{}^{b}$	$\mathrm{SFR}_{\mathrm{H}\alpha}{}^{c}$	EW	Lines^{d}	$12+\log(\mathrm{O/H})^{e}$
UCM014510	0.85	11 ± 3	3.7 ± 1.1	5.4	93	Hα, [OIII]	
UCM014904_2	0.84	0.2	0.1	0.2			
UCM014904_1	0.84	0.2	0.1	0.2			
UCM015144	0.74	1.1	0.3	0.9			
UCM015137	0.84	15 ± 3	5.0 ± 1.0	124.7	65	Hα	
UCM015645	0.83	35 ± 9	11.4 ± 3.0	28.5	279	Hα	
irac058869	0.84	18.2 ± 1.4	6.2 ± 0.5	16.8	28	Hα, [OIII]	
irac059550	0.84	20 ± 5	6.7 ± 5.5	32		Hα	
irac052591	0.84	64.3 ± 1.1	21.8 ± 0.4	154.5	144	Hα, [OIII]	
irac026097_2	0.84	22 ± 2	7.4 ± 0.7	6.3	84	Hα, [OIII]	
irac026097_1	0.84	22 ± 2	7.4 ± 0.7	6.3	84	Hα, [OIII]	
irac030618_1	0.84	24 ± 8	8.0 ± 2.7	50.8	265	Hα	
irac030618_2	0.84	24 ± 8	8.0 ± 2.7	50.8	265	Hα	
irac034603	0.84	19 ± 5	6.3 ± 1.6	32.8	152	Hα	
irac031385	0.84	23 ± 2	7.7 ± 0.7	46.9	80	Hα, [NII]	8.82
irac032266	0.84	23 ± 4	7.7 ± 1.2	46.8	191	Hα, [NII], [OIII]	8.76
irac034470	0.84	1.3 ± 0.6	0.4 ± 0.2	0.8	21	Hα	
UCM014524	0.73			998.6		Hα	
UCM014303	1.03	12 ± 3	6.5	23.3	95	Hα, [OIII]	
UCM014677	1.4					[OIII]	
UCM015464_2	1.03	5 ± 2	1.6 ± 0.7	5.6	60	Hα	
UCM015464_1	1.03	5 ± 2	1.6 ± 0.7	5.6	60	Hα	
UCM015210	0.83	25 ± 4	8.3 ± 1.5	29.9	109	Hα, [NII], [OIII]	8.58
UCM015812	1.4	39 ± 7	46.5 ± 8.9	166.3	187	Hα, [NII], [OIII]	8.83
irac068951	0.92	99 ± 18	42.1 ± 7.8	150.7	167	Hα, [NII]	8.72
irac054693	0.98	51 ± 39	25.4 ± 19.4	91.0	146	Hα, [NII]	
irac062302_1	1	208 ± 15	108.7 ± 7.9	388.8	77	Hα, [NII]	8.61
irac059903_1	1.41					[OIII]	
irac057060	0.74	187 ± 21	46.5 ± 5.2	166.4	105	Hα, [NII]	8.59
irac057713	1	125 ± 17	65.3 ± 8.6	233.6	89	Hα, [NII]	8.66
irac053026	0.76	111 ± 18	29.5 ± 4.9	105.5	84	Hα	
irac028940	0.85	0.90 ± 0.3		1.1		Hα	
irac031206	1.02	445 ± 37	244 ± 20	873.5	1136	Hα	
irac032685	0.93	2.2	1.0		3.4		
irac031388	0.68	32 ± 8	6.5 ± 1.6	23.3	267	Hα	
irac035188	0.85	16 ± 2	5.5 ± 0.8	19.5	109	Hα	
irac034541	0.78	13 ± 2	3.6 ± 0.6	12.9	118	Hα	
irac035135	1.01	18 ± 3	9.5 ± 1.7	33.9	124	Hα	

[a] 10^{-17} erg s^{-1} cm^{-2}
[b] 10^{42} erg s^{-1}
[c] $\mathrm{M}_{\odot}$ yr^{-1}
[d] [NII] refers to [NII]6584, and [OIII] refers to [OIII]5007
[e] Error $\sim \pm 0.15$, calibration from [3]

narrow band filter flux, and in average the complete sample follows the 1:1 line with a scatter of $\mathrm{R}^2 \sim 0.5$). In some cases such as IRAC031385, the flux measured is less reliable in the spectrum due to the obvious pollution [NII]6584, in others, as IRAC052591, the measured flux line is not reliable because of pollution sky line [OH]12112.6.

The calculation of metallicity has been performed following [3]. The average metallicity galaxies of this sample follows local metallicity, consistent with other studies at similar red-

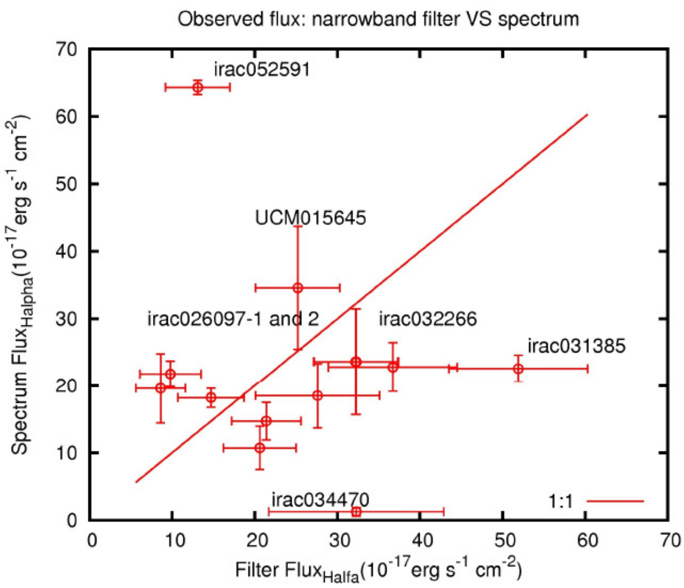

Figure 2: Common sample observed in this study and in the narrow band filter survey. We supply more details of the galaxies marked on the chart: irac026097_1 & 2 are at $z = 0.8336$ on the rim of the filter, so we obtain more signal than [5]; irac034470, the spectrum does not correspond to the same source; irac052591, is on the limit of the filter as well and the line is contaminated by a sky line; UCM015465, contaminated by a sky line; irac031385, is contaminated by [NII]6584; irac032266, is contaminated by [NII]6584 too.

shift. Differences in metallicity with other studies are mainly due to selection effects(Table 1). The discrepancies found are in agreement with the dispersion of metallicities measured by the SDSS [4].

There are 28 galaxies observed with the HST. In Fig. 3 , we show a mosaic of composite color images of a subset of star forming galaxies at $z = 0.84$. These include large and small spirals, mergers and spheroids. In this subsample we find 17 spirals, 7 compact galaxies and 4 possible mergers.

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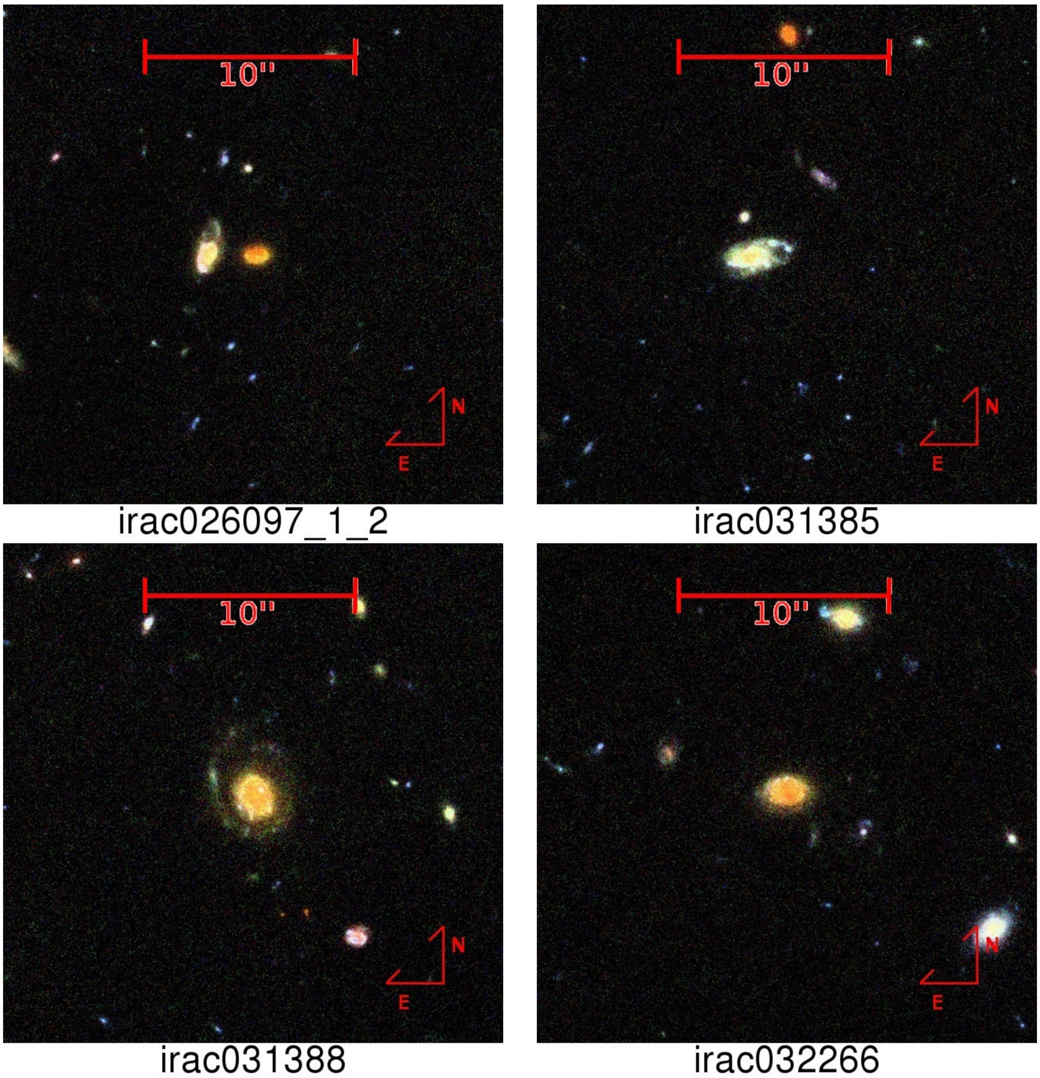

Figure 3: Color postage stamps of galaxies detected in Hα. Each image is $20'' \times 20''$. Color composition of ACS z, i, v bands as RGB colors.

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