A search for faint Hα-emitting galaxies at redshift z~0.84

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ABUSTRACT

We present the results of a search for Hα-emitting galaxies at redshift z=0.84. We used very deep near-infrared imaging data taken with the Multi-Object InfraRed Camera and Spectrograph (MOIRCS) on the Subaru Telescope. We observed a 28 $arcmin^2$ field in the Great Observatories Origins Deep Survey-North (GOODS-N) to investigate line emitters. Our data reached J～26.2 and NB119～25.0 (ABmag,5σ). By analyzing these imaging data, we found about 30 candidates of emission line objects. Among them, the redshifts of 3 objects have been confirmed by the spectroscopic studies in literature to be z ~ 0.84 and the photometric redshifts of 2 objects are consistent with z ~ 0.84. Therefore we obtained 5 Hα-emitting galaxies at z ~ 0.84.

Introduction

▹The star formation rate density

The star formation rate (SFR) density, ρ_{SFR}, is an important constraint on galaxy formation and evolution. It has been noted that ρ_{SFR} steeply increases from z = 0 to z ~ 1, and is constant between z ~ 2 and z ~ 5. Then it declines beyond z ~ 5. There are several SFR estimators. Hα emission is one of them, and the SFR density can be estimated from the Hα lumInosity function.

▹The Hα luminosity function

An approximate shape of the Hα luminosity function has been determined by previous works. However, there are few data at the faint end. Our data are deeper than previous studies, e.g., J(3σ) = 22.30 (Villar et al. 2008), J(3σ) ~ 22.8 (D.Sobral et al. 2009), and allow us to detectfainter objects and estimate a Hα luminosity function at the faint end function with high accuracy.

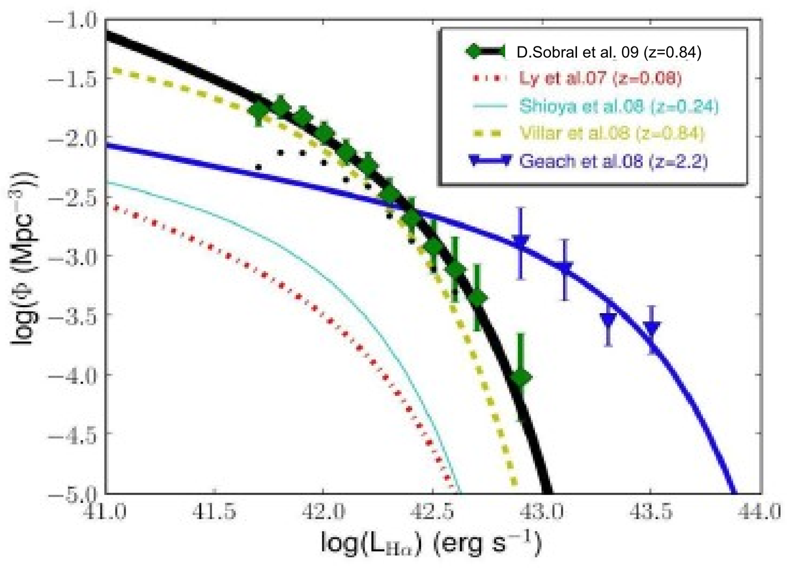

Fig1. The Hα luminosity (D.Sobral et al. 2009)

Observations

MOIRCS Deep Survey in GOODS-North Region (2006-2008)

▹Instrument : MOIRCS on the Subaru Telescope

Pixel scale = 0.117″

▹Field : GOODS-N GT-2

α(J2000) = 12h 36m46.s 62

δ(J2000) = + 62◦ 13′ 15.″ 6

field of view = 4'×7'=28arcmin

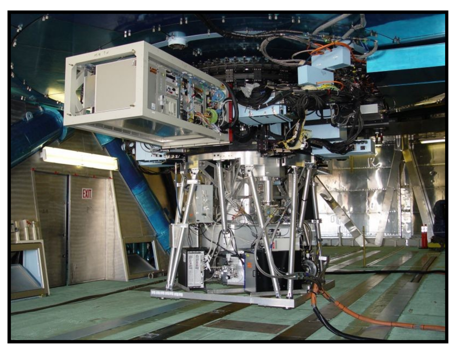
Fig2. MOIRCS

▹Filters :

Broad-Band filter

J(1.26μm/0.17μm), K(2.14μm/0.31μm)

Narrow-Band filter

NB119(1.19μm/0.014μm)

-----trace Hα line from z ~ 0.84

(the central wavelength/the bandwidth)

▹Exposure time [hours] :

28.2 (J), 28.0 (K), 30.0 (NB119)

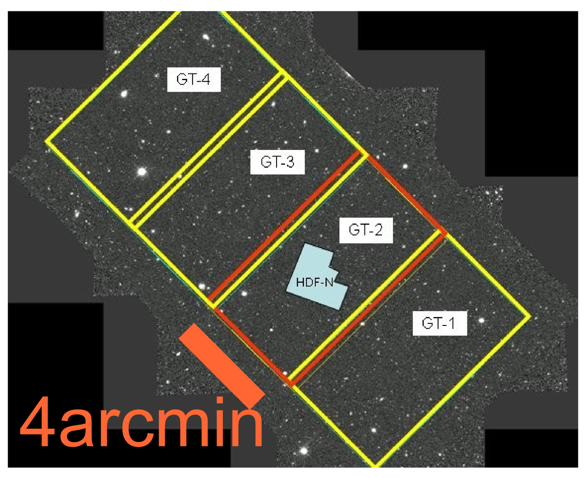

Fig3. GOODS-N

Method

▹Selection of narrowband excess objects

We used a narrowband technique to select NB119-excess objects. We made the catalog of the objects using Sextractor. Objects were extracted using the double-image mode. The narrowband frame is used as a reference image for detection, and then fluxes are measured in a 1”.2 diameter aperture. Candidates were selected the following criteria :

$$J - NB119 > 0.3 \quad (1)$$

$$J - NB119 > 5\sigma(J - NB119) \quad (2)$$

The former criterion corresponds EW > 50 Å, and the latter is the 5σ er- ror of the color(J-NB119), where σ is defined by the following formula :

$$5\sigma(J - NB119) = -2.5\log[1 - \sqrt{(f_{5\sigma_{NB119}})^2 + (f_{5\sigma_J})^2} / f_{NB119}]$$

We chose the higher level for the latter criteria than previous studies to detect more reliable candidates.

Results

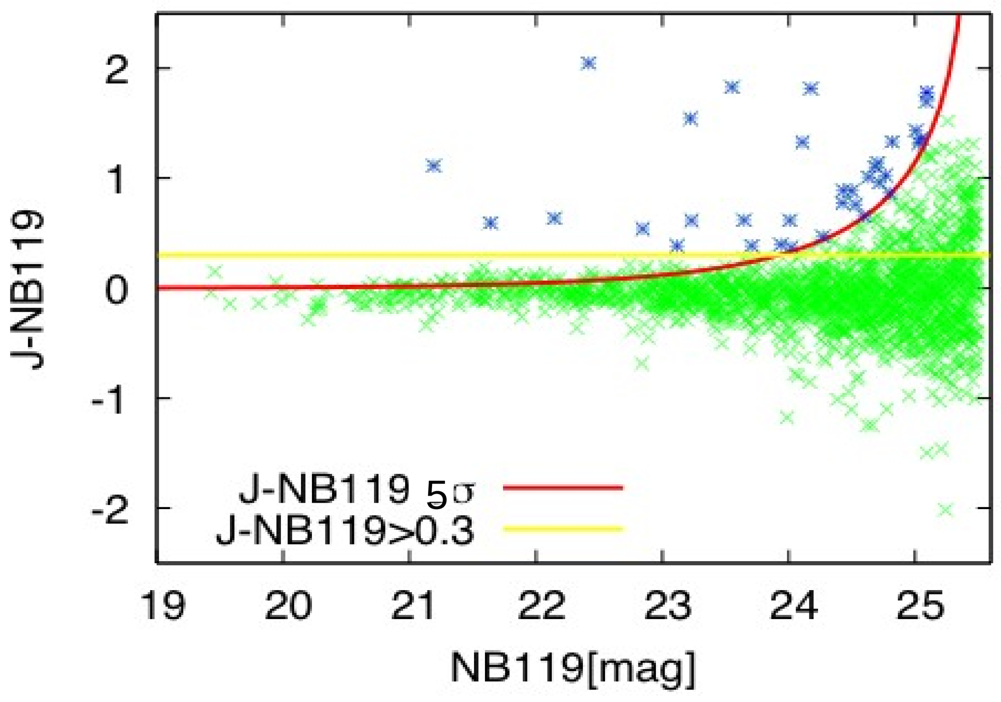

Fig4.Color-magnitude diagram for GOODS-N

We discard the Hα-emitters in the low S/N area, e.g., at the edge of the frame and bad pixels. The final area is about 20 $arcmin^2$. The yellow and red lines shows the criteria (1) and (2), respectively. All extracted sources are plotted in green. The candidate Hα emitters are replotted in blue. There are 30 sources which satisfy the criterion.

▹Selection of Hα emitters at z~0.84

The candidates of Hα emitters selected by the present criteria could be contaminated by other line emitters. Therefore we checked their spectroscopic redshifts or photometric redshifts.

Among 30 candidates, the redshifts of 6 have been confirmed by the spectroscopic studies in literature. For other 24 candidate, we obtained the photometric redshifts in the catalog of Kajisawa et al. (in preparation). As a result, we found 5 object (3 of 5 are measured spectroscopic redshifts) are consistent with z ~ 0.84. In figure 5, we show redshift of candidates.

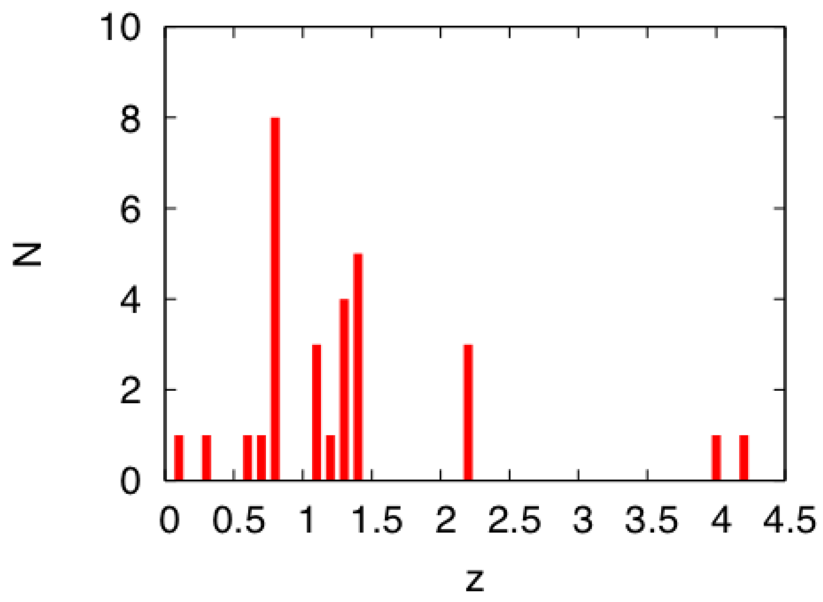

Fig5. Redshift histogram

▹The Hα luminosity

We estimated the Hα luminosities for detected Hα emitters. At this time we corrected them using the method of D.Sobral et al (2009). We measured $\log(L_{H\alpha}) \backsim 42.0$. Our study will enable us to plot a new point on the luminosity function at the faint end function.

Log(Hα)	M_v	U-V
40.76	-20.79	0.39
41.26	-20.25	0.19
41.46	-19.95	0.22
41.87	-19.53	-0.27
41.34	-18.24	-0.58

Fig6. The Hα luminosities

Future works

5 objects have been selected as Hα emitters using the narrowband technique, and we estimated the Hα luminosities of them roughly at this time. These Hα luminosities are not still corrected sufficiently, so we will correct these and then discuss the Hα luminosity function at the faint end.

Reference

Villar et al. 2008, ApJ, 677

D.Sobral et al. 2009, arXiv, 0901.4114v1

Shioya et al. 2008, ApJS, 175

Fujita et al. 2003, ApJ, 586