Star Formation History from z = 0.4 to z = 0

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Abstract

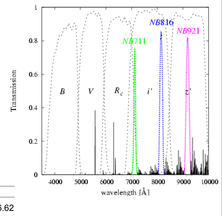
We have carried out a deep imaging survey for Hα λ6563 emitting galaxies from z = 0.40 to z = 0.06 in the ***Subaru Deep Field*** (SDF) using the Suprime-Cam on the Subaru Telescope. In this survey, We have 5 broad-band filters (B, V, R_C, i' and z') and 4 narrow-band filters (*NB*704, *NB*711, *NB*816, *NB*921). For the broad-band, *NB*816 and *NB*921 data are taken from the SDF project official photometric catalog. For *NB*704 and *NB*711 we made our photometric catalogs from the raw data taken from the SMOKA archive. The effective covered sky area is 875 arcmin^2 for *NB*704, *NB*816 and *NB*921, and 761 arcmin^2 for *NB*711. We have obtained 177 Hα emitter samples at z = 0.4, 233 at z = 0.24, 22 at z = 0.09 and 67 at z = 0.06. Since our survey samples only fainter Hα emitting galaxies, we also analyze brighter Hα emitters taken from the ***Sloan Digital Sky Survey*** (SDSS) data. Combining the SDF sample and the SDSS sample, we obtained an extinction-corrected Hα luminosity function at each redshift. Using the Kennicutt relation between the Hα luminosity and the star formation rate, the star formation rate densities (SFRDs) are estimated as xxxx $M_\odot$ yr^{-1} Mpc^{-3} at z = 0.4, xxxx $M_\odot$ yr^{-1} Mpc^{-3} at z = 0.24, xxxx $M_\odot$ yr^{-1} Mpc^{-3} at z = 0.09 and xxxx $M_\odot$ yr^{-1} Mpc^{-3} at z = 0.06.

1. Introduction

2. Data

Subaru Deep Field

- Centered on 13^h 24^m 38^s.9, +27^d 29′ 25″.9 (J2000)
- *B*, *V*, R_C, *i'*, *z'*, *NB*816, and *NB*921 Data are taken from the SDF project official photometric catalog.*1 We have used the *i'* selected samples.
- For *NB*704 and *NB*711 we made our photometric catalogs from the raw data taken from the SMOKA archive.*2



Bload-band filter parameters

	B	*V*	*R*	*i'*	*z'*
Limiting mag [mag]	28.45	27.74	27.80	27.43	26.62
Seeing FWHM ["]	0.98	0.98	0.98	0.98	0.98

Narrow-band filter parameters

	Center [Å]	FWHM [Å]	Redshift range	Limiting mag [mag]	Effective covered sky area [arcmin^2]	Survey volume [Mpc^3]
NB704	7046	100	0.07 ± 0.01	26.52	874	~~699~~
NB711	7126	73	0.09 ± 0.01	25.88	761	~~534~~
NB816	8150	120	0.24 ± 0.01	26.63	706	~~9737~~
NB921	9196	132	0.40 ± 0.01	26.54	874	~~52400~~

Sloan Digital Sky Survey

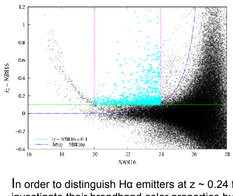
Our samples only fainter Hα emitting galaxies.

→ We also analyzed brighter Hα emitters taken from SDSS Data Release 4 (DR4) for *NB*704, *NB*711 and *NB*816.

*1 http://step.mtk.nao.ac.jp/sdf/project/
*2 http://smoka.nao.ac.jp/
*3 http://cas.sdss.org/astro/en/tools/search/sql.asp

3. Sample Selection

For example, we show Hα emitter sample selection for NB816. Selection manners are basically same for the other filters sample selection.

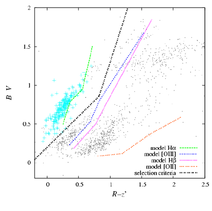


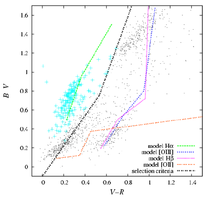
First, we choose the emitters (Hα, [OIII], Hβ, [OII]) from the catalog with the below criteria.

$$iz - NB816 > 0.1,$$
$$3\sigma_{iz-NB816} < 0.1,$$
$$NB816 > 20.$$

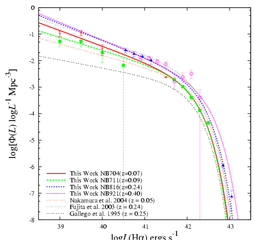
where $iz \equiv 0.57\,i' + 0.43\,z'$, $3\sigma_{iz\text{-}NB816}$ is a (iz – *NB*816) 3σ error of with a flat spectrum object. Proceeding this selection, we obtained 1341 emitter candidates (✦).

In order to distinguish Hα emitters at z ~ 0.24 from emission line objects at other redshifts, we investigate their broadband color properties by comparing the observed colors of our 1341 emitters with the model ones that are estimated by using the CWW model (Coleman, Wu & Weedman. 1980).





4. Hα Luminosity Function



Luminosity Function

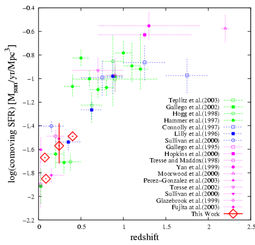
$$\Phi[\log L(\mathrm{H}\alpha)] \times \Delta \log L(\mathrm{H}\alpha) = \sum_i \frac{1}{V_i}$$

Schechter Function

$$\Phi(L)dL = \phi^*\left(\frac{L}{L^*}\right)^{\alpha} \exp\left(\frac{-L}{L^*}\right) d\left(\frac{L}{L^*}\right)$$

	z	log Φ^*	log L^*	α
NB 704	0.074 ± 0.008	-2.95 ± 0.06	41.92 ± 0.03	-1.59 ± 0.06
NB 711	0.086 ± 0.006	-2.90 ± 0.05	41.89 ± 0.03	-1.49 ± 0.08
NB 816	0.24 ± 0.01	-2.88 ± 0.23	42.03 ± 0.04	-1.63 ± 0.16
NB 921	0.40 ± 0.01	-3.01 ± 0.84	42.17 ± 0.61	-1.66 ± 0.36
Gallego et al. 1995	≤ 0.045	-3.2 ± 0.2	42.15 ± 0.08	-1.30 ± 0.2
Nakamura et al. 2004	~0.054	-3.02 ± 0.30	41.99 ± 0.10	-1.43 ± 0.1
Fujita et al. 2003	0.24 ± 0.02	-2.62 ± 0.34	41.95 ± 0.25	-1.53 ± 0.15

5. Star Formation Rate Density



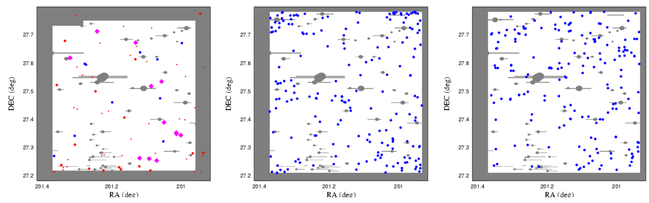
	L(Hα)	ρ_{obs}	log ρ_{obs}
NB 704	39.30	0.016	-1.80
NB 711	39.23	0.013	-1.87
NB 816	39.53	0.027	-1.58
NB 921	39.59	0.031	-1.51

$$L(\mathrm{H}\alpha) = \int_0^\infty \Phi(L)\,L\,dL = \Gamma(\alpha+2)\,\phi^*\,L^*$$

$$\mathrm{SFR} = 7.9\times10^{-42}\,L(\mathrm{H}\alpha)\,M_\odot\,\mathrm{yr}^{-1}$$

(Kennicutt 1998.)

6. Spatial Distribution



6. Discussion