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A 16 deg^2 survey of emission-line galaxies at z<1.6 from HSC-SSP PDR2 and CHORUS

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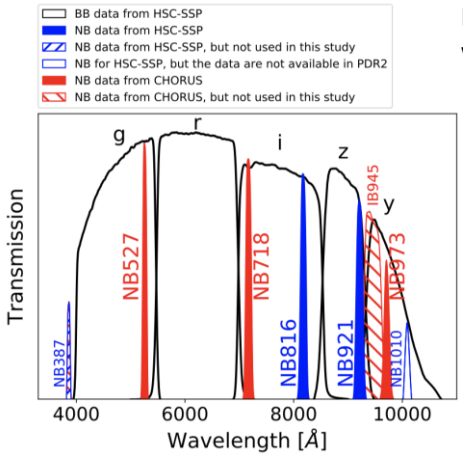
Abstract

We have conducted a comprehensive survey of emission-line galaxies at $z \lesssim 1.6$ based on narrowband (NB) imaging data taken with Hyper Suprime-Cam (HSC) on the Subaru telescope. In this paper, we update the catalogs of Hα, [OIII], and [OII] emission-line galaxies using the data from the second Public Data Release (PDR2) of Subaru Strategic Program (SSP) of HSC and Cosmic HydrOgen Reionization Unveiled with Subaru (CHORUS) survey along with the spectroscopic redshifts for 2,019 emission-line galaxies selected with the PDR1 data. The wider effective coverage of NB816 and NB921, 16.3 deg^2 and 16.9 deg^2 respectively, are available in the Deep and UltraDeep layers of HSC-SSP from the PDR2. The CHORUS survey provides us with data with additional three NBs (NB527, NB718, and NB973) in the COSMOS field in the UltraDeep layer (1.37 deg^2). The five NB datasets allow us to investigate the star-forming galaxies presenting emission-lines at 14 specific redshifts ranging from $z \sim 1.6$ down to $z \sim 0.05$. We revisit the distribution of large-scale structures and luminosity functions (LFs) for the emission-line galaxies with the large samples of 75,377 emission-line galaxies selected. The redshift revolution of LFs shows that the star formation rate densities (SFRDs) decreases monotonically from $z \sim 1.6$, which is consistent with the cosmic SFRD ever known. Our samples of emission-line galaxies covering a sufficiently large survey volume are useful to investigate the evolution of star-forming galaxies since the cosmic noon in a wide range of environments including galaxy clusters, filaments, and voids.

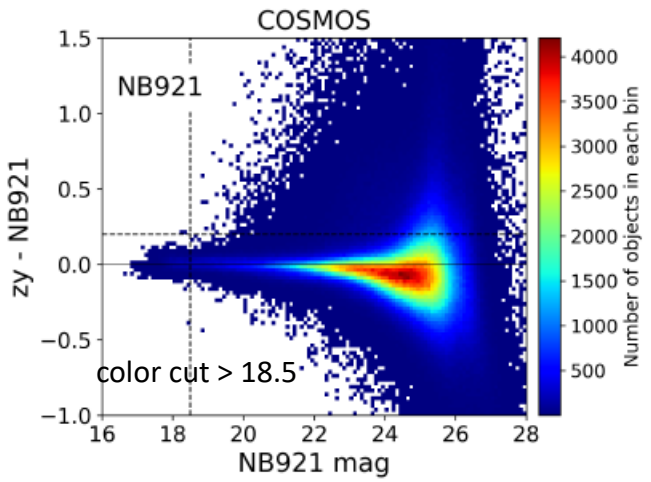
NB filter	λ_c (Å)	$\Delta\lambda$ (Å)	AREA† (deg^2)	Deep / UltraDeep layer: SXDS+XMM-LSS area (deg^2)	SXDS+XMM-LSS depth‡ (mag)	COSMOS area (deg^2)	COSMOS depth‡ (mag)	ELAIS-N1 area (deg^2)	ELAIS-N1 depth (mag)	DEEP2-3 area (deg^2)	DEEP2-3 depth (mag)
NB527*	5261	79	1.37 (1.76)	–	–	1.37 (1.76)	26.32	–	–	–	–
NB718*	7170	111	1.37 (1.76)	–	–	1.37 (1.76)	25.61	–	–	–	–
NB816	8177	113	16.28 (21.02)	5.16 (6.34)	25.43	1.37 (1.76)	25.58	4.79 (6.42)	24.90	4.97 (6.49)	24.82
NB921	9214	135	16.79 (22.09)	1.32 (1.76)	25.25	5.78 (7.50)	25.39	4.79 (6.42)	24.76	4.91 (6.41)	24.59
NB973*	9711	108	1.37 (1.76)	–	–	1.37 (1.76)	24.63	–	–	–	–



Redshifts of emission-line galaxies with the five NB filters

redshift	redshift range
0.050	0.042 – 0.058
0.092	0.084 – 0.101
0.246	0.237 – 0.254
0.404	0.393 – 0.414
0.411	0.400 – 0.422
0.432	0.421 – 0.443
0.479	0.471 – 0.488
0.633	0.621 – 0.644
0.840	0.826 – 0.853
0.923	0.908 – 0.938
0.939	0.928 – 0.950
1.193	1.178 – 1.208
1.471	1.453 – 1.489
1.605	1.590 – 1.619

line	filter	redshift	number	field: SXDS+XMM-LSS	COSMOS	ELAIS-N1	DEEP2-3
[OIII]	NB527	0.050	130	–	130	–	–
Hα	NB718	0.092	331	–	331	–	–
Hα	NB816	0.246	5400	1053	436	2603	1308
Hα	NB921	0.404	8532	571	2554	2479	2928
[OII]	NB527	0.411	729	–	729	–	–
[OIII]	NB718	0.432	1075	–	1075	–	–
Hα	NB973	0.479	919	–	919	–	–
[OIII]	NB816	0.633	10323	2910	748	3823	2842
[OIII]	NB921	0.840	14647	1678	6376	2872	3721
[OII]	NB718	0.923	1238	–	1238	–	–
[OIII]	NB973	0.939	1211	–	1211	–	–
[OII]	NB816	1.193	15301	3885	1666	5579	4171
[OII]	NB921	1.471	14586	2460	4878	4512	2736
[OII]	NB973	1.605	955	–	955	–	–



Filters used for the selection of emission-line galaxies

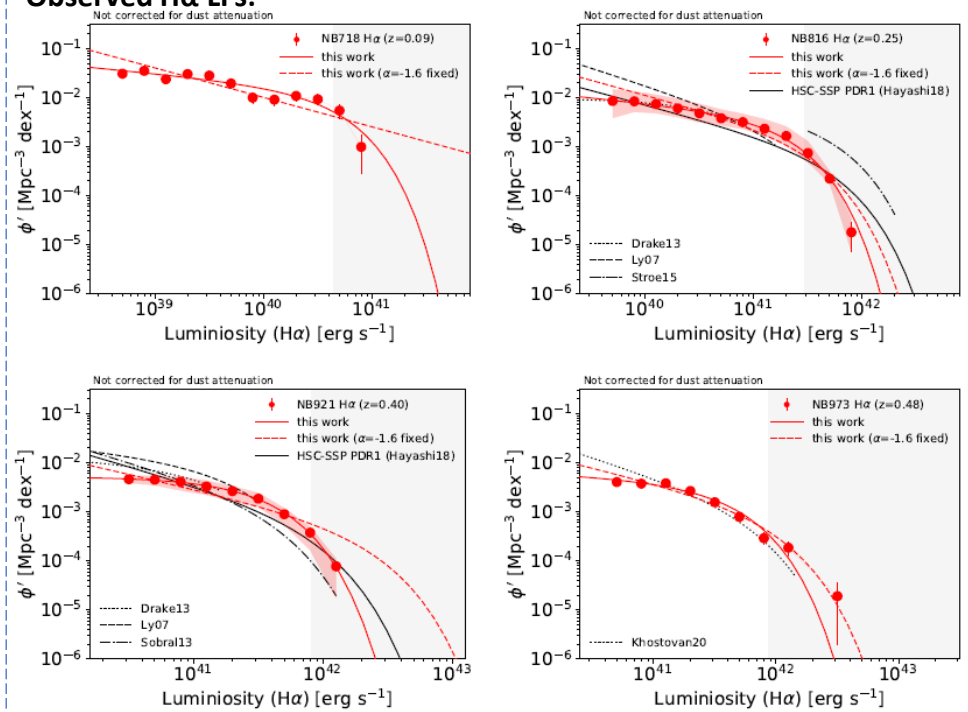
NB	BBs	weights	mag cut	color cut	EW_{obs}
NB527	g, r	0.674, 0.326	>18.5	>0.25	22Å
NB718	r, i	0.079, 0.921	>18.5	>0.25	32Å
NB816	i, z	0.631, 0.369	>18.5	>0.25	33Å
NB921	z, y	0.643, 0.357	>18.5	>0.20	35Å
NB973	z, y	0.052, 0.948	>18.5	>0.20	27Å

Altogether **75,377** emission-line galaxies.
The contamination rate (from spectroscopic redshift) is about 10 ~ 20 %.
AGN (X-ray/Radio counterpart) contribute about ~ 0.65% of all emission-line galaxies
No bias towards large EW lines (happened in PDR1)

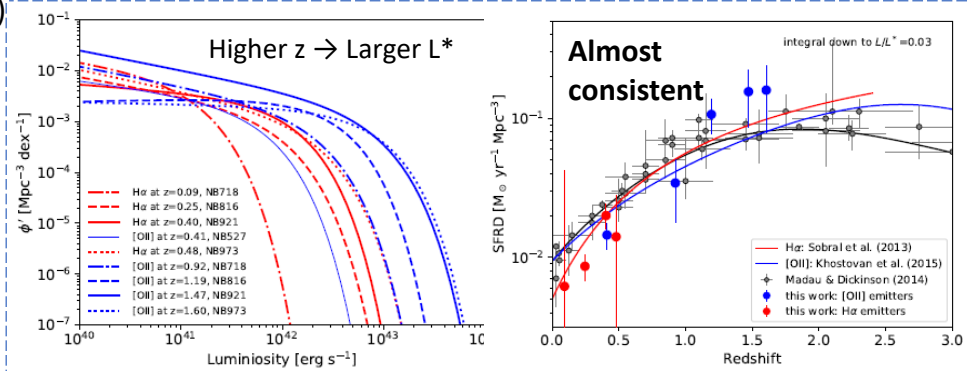
Schechter function: $\phi(L)dL = \phi^* \left(\frac{L}{L^*}\right)^{\alpha} \exp(-\frac{L}{L^*})\, d\left(\frac{L}{L^*}\right)$,

Hα/[NII]: Local galaxies from SDSS (Hayashi et al. 2018)

Observed Hα LFs:



1. The luminosity functions here are consistent with the PDR1 data.
2. May missing a fraction of emitters in the bright end (color cut, low-z).
3. Hα LFs: The faint end slope is flatter than other previous studies.



1. Flatter slope at faint end → lower luminosity density in Hα (5σ V.S 3σ)
2. Small survey volume from CHORUS data cause lower results