Challenges in Panchromatic Modelling with Next Generation Facilities
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Propeties of H alpha emitters at z ∼ 2.3: Derivation of H alpha luminosity from multi-band photometry

Yasunori Terao[1], **Lee Spitler**[2] **and Kentaro Motohara**[1]

[1]Institute of Astronomy, Graduate School of Science, The University of Tokyo, 2-21-1, Osawa, Mitaka, Tokyo 181-0015, Japan

[2]Department of Physics and Astronomy, Macquarie University, Sydney, NSW 2109, Australia

Abstract. The measurement of Hα luminosity for large numbers of galaxies is important to investigate recent star formation history of galaxies. With SED fitting that includes emission line templates, we extract individual galaxy Hα luminosities from broad-band photometry. We compare Hα luminosity function with the result of a narrow-band survey, HiZELS, and find there are more luminous galaxies in Hα than previously reported. As a result, our derived star formation rate density at $z \sim 2.3$ turns out to be 2.2 times higher than previous studies. Most of the offset in the results can be explained by missing Hα in the HiZELS photometric aperture and different methods for dust extinction correction.

Keywords. galaxies: evolution, high-redshift, luminosity function, photometry

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1. Introduction

Hα emission line is one of the most important star formation rate (SFR) indicators. Since it originates from hydrogen ionized by most massive stars with shortest lifetime, Hα is sensitive to short time variation of star formation activities in galaxies. Therefore it enables us to investigate more recent star formation history (SFH) than other SFR indicators. However, spectroscopic measurement of Hα is observationally expensive. In this proceeding, we derive Hα luminosities of galaxies at $2.1 < z < 2.5$ from broad-band (BB) photometry. An advantage of the use of BB filters is wider redshift coverage than narrow-band (NB) filters, which achieves larger survey volume at fixed field of view. Moreover, our method can provide information on other emission lines and/or other redshft ranges using archive data.

2. Method

We use ZFOURGE catalog (Straatman *et al.* 2016) which contains photometry covering from 0.3 to 8 μm and Spitzer/MIPS 24 μm data. We select galaxies in $2.1 < z < 2.5$ based on photometric redshift, where Hα emission lines from galaxies fall into the ZFOURGE K_s band. Our sample consists of 2005 galaxies in COSMOS, UDS, and CDFS.

To extract Hα flux from BB photometry, we first derive stellar continuum flux from SED fitting by FAST (Kriek *et al.* 2009). Since observed fluxes are sums of stellar continuum and nebula emission lines, we use SED templates including emission lines to obtain reliable continuum fluxes. Then total emission line fluxes are derived from observed flux excesses, which are the differences between observed K_s fluxes and continuum fluxes from SED fitting. Finally we obtain Hα fluxes assuming its fraction in total emission lines.

We correct Hα luminosities for dust extinction following the procedure of Nordon *et al.* (2013). First UV attenuation of each galaxy is derived from a ratio between IR

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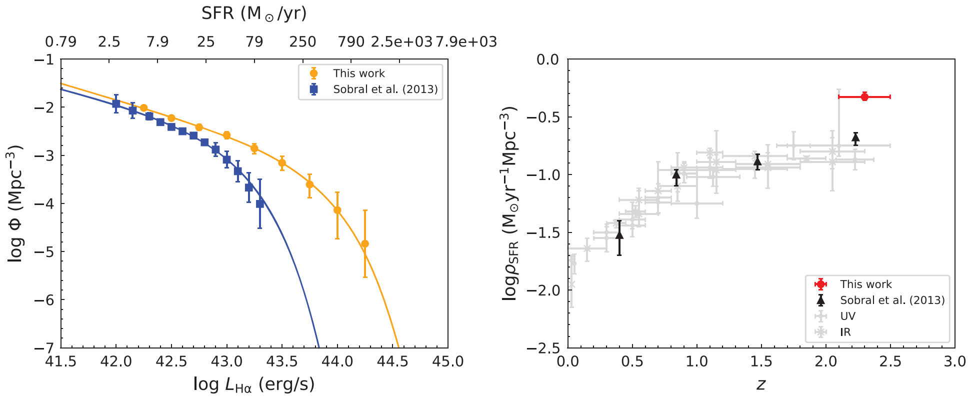

Figure 1. Left : Hα luminosity function corrected for dust extinction. Our results and that of Sobral *et al.* (2013) are shown in orange circles and blue squares, respectively. Each curve shows best-fit Schechter function. Right : SFRD as a function of redshift. Red circles and black triangles show ours and result from Sobral *et al.* (2013) measured with Hα. Results with UV or IR from previous studies summarized in Madau & Dickinson (2014) are shown in gray.

and UV SFRs. Then it is converted to Hα attenuation assuming the extinction law of Calzetti *et al.* (2000). For galaxies not detected at 24 μm, we assume no dust extinction.

3. Results & Discussions

The left panel of Figure 1 shows Hα luminosity functions corrected for dust extinction. Our luminosity function is located above the result from HiZELS (Sobral *et al.* 2013), which suggests there are more Hα luminous galaxies than previously reported. As a result, star formation rate density (SFRD) at $z \sim 2.3$ is 2.2 times higher than previous studies as shown in the right panel of Figure 1.

Most of the discrepancies between our results and Sobral *et al.* (2013) can be explained by missing Hα flux. As more massive galaxies tend to have more extended Ha profiles (Nelson *et al.* 2016), our simulation with the fixed (2") aperture and seeing of HiZELS data suggests that Sobral *et al.* (2013) may have missed at most 40% of Hα flux outside of their adopted aperture, while fluxes in ZFOURGE catalog are corrected to total fluxes using PSF models. In addition, Sobral *et al.* (2013) assumes Hα attenuation of 1 mag for all galaxies. Since more luminous galaxies are more attenuated, they may have underestimated intrinsic Hα luminosity for luminous galaxies.

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