Lyα Rate of UV-bright Star-forming Galaxies at Redshift 7

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We perform a survey of star-formaing galaxies that are very bright in UV luminosities at redshift 7. Follow-up spectroscopy on these high-z galaxies is conducted, determining rest-frame equivalent widths (EW_0s) of the Lyα emissions, and the Lyα rate, which is a franction of star-formation galaxies showing strong Lyα emission of these galaxies [1]. Recent observational studies have revealed that the number density of bright star-formation galaxies may be larger than expected in previous observations. Also, the very bright galaxies may include metal-poor galaxies comprising a primordial stellar population [2]. It is crucial to increase the sample volume of such bright galaxies to discuss galaxy formation at this epoch.

We select star-forming galaxies (LBGs) using the public near-infrared (NIR) data set by UKIRT-UKIDSS and VISTA-UltraVISTA($J = 25.5$; 5σ) covering 1.65 square degrees. In order to apply z-dropout search, we conduct very deep z'-band imaging ($z \sim 26.5$; 5σ) with Subaru/Suprime-Cam. This data set enables us to investigate the very-bright LBGs at $z = 7$ with quite a low number density. We find 18 candidates of very bright galaxies ($M_{UV} < -21.75$). An optical follow-up spectroscopy was performed with Subaru/FOCAS on 9 candidates, in which a galaxy shows possible Lyα emission at $z = 7.168$ at S/N = 5.5 with $EW_0 = 3.7$ Å (Fig. 1). The other candidates show no significant emission lines ($EW_0 < 10$ Å).

Previous studies have suggested that the Lyα rate increases from $z = 4$ to $z = 6$. The Lyα rate is higher and more rapidly increases towards high redshifts for fainter star-forming galaxies. For galaxies with $M_{UV} > -21.75$, the Lyα rate may stop increasing and possibly decrease from $z = 6$ to $z \sim 7$ [3]. Our study for the first time discusses the Lyα rate ($EW_0 > 50$ or 55) for the very bright galaxies ($-23 < M_{UV} < -21.75$) (Fig. 2), deriving the following results: (1) An increase of the Lyα rate of the very-bright galaxies may level off at $z = 7$ and may be close to or lower than that at $z = 4$–6. (2) The Lyα rate of the very-bright galaxies at $z = 7$ may be at the same level or higher than that for fainter galaxies ($M_{UV} > -21.75$) at the same redshifts.

The very-bright galaxies are also important components to discuss cosmic reionization. The EW_0 distribution of our very-bright galaxy sample implies high neutral hydrogen rate at $z = 7$. An increase of a sample volume of the very-bright galaxies at this epoch is desiable to statistaically understand formation and evolution history and roles of this very bright population in the reionization.

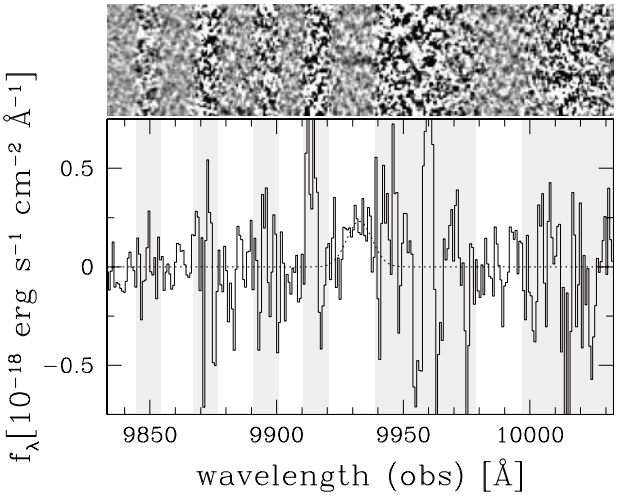

Figure 1: Spectrum of a Lyα emitter at $z = 7.168$.

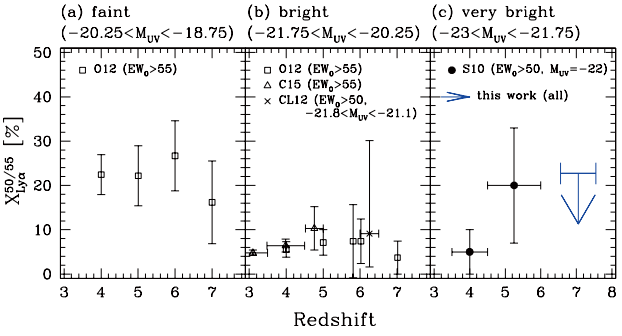

Figure 2: Evolution of Lyα rate in different magnitude ranges.

References

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