Galaxy Evolution across the Hubble Time
Proceedings IAU Symposium No. 235, 2006
F. Combes & J. Palouš, eds.

doi:10.1017/S1743921306010179

Luminosity Dependent Evolution of Lyman Break Galaxies from redshift 5 to 3

Iwata I.[1], Ohta K.[2], Tamura N.[3], Akiyama M.[3], Aoki K.[3], Ando M.[2], Kiuchi G.[2], and Sawicki M.[2,4]

[1]Okayama Astrophysical Observatory, National Astronomical Observatory of Japan, Kamogata, Asakuchi, Okayama, Japan 719-0232
email: iwata@oao.nao.ac.jp

[2]Department of Astronomy, Graduate School of Science, Kyoto University, Sakyo-ku, Kyoto, Japan 606-8502

[3]Subaru Telescope, National Astronomical Observatory of Japan, 650 North A'ohoku Place, Hilo, HI 96720

[4]Physics Department, University of California, Santa Barbara, CA 93106, USA

Abstract. The development of large ground-based telescopes and sensitive large format detectors, as well as the develepment of various techniques for the selection of high-z galaxies enabled us to construct large samples of galaxies in the early universe, as reported in the many contributions in this proceedings. The next major step for the comprehensive understanding of the galaxy evolution would be to explore the relationship of galaxies selected with different criteria at different epochs and find links between them. In this contribution we present the properties of Lyman break galaxies (LBGs) at $z \sim 5$ obtained by deep and wide blank field surveys, and through the comparison with samples at lower redshift ranges we discuss the evolution of star-forming galaxies in the early universe.

Keywords. galaxies: evolution, galaxies: high-redshift, galaxies: starburst

---

Our $z \sim 5$ LBG sample is based on the deep and wide surveys for the two independent blank fields (the region including the Hubble Deep Field – North and the J0053+1234) obtained with the Suprime-Cam attached to the 8.2 m Subaru Telescope. The total effective area after masking bright objects is 1,300 arcmin^2, and deep V, I_c and z'-band imaging enabled us to securely select V-dropout objects down to $z'_{\rm AB} = 26.5$ mag (for the HDF-N region) or 25.5 mag (for the J0053+1234 region). The number of LBG candidates in our sample is 850. It should be emphasized that the area coverage our survey is more than 100 times wider than the ACS field of the Hubble Ultra Deep Field and more than 4 times wider than the total area covered by the GOODS, and this wide field coverage has a crucial importance for reliable determination of the abundance of luminous objects. So our survey are able to explore both bright and faint parts of the LF reliably. The redshift of a part of our LBG candidates have been spectroscopically determined (Ando *et al.* 2004), and the validity of our color selection criteria have been confirmed.

In figure 1 we show the UV luminosity function (LF) of LBGs at $z \sim 5$ derived statistically from our sample with filled circles and a solid line (Iwata *et al.* in prep.). In this figure we also show the UVLF of LBGs at $z \sim 4$ and 3, taken from the deep survey by Sawicki and Thompson (2006). We found that in the luminous end of the UV LF there is no significant evolution from $z \sim 5$ to 3 ($\approx$1 Gyr), while in the fainter part, the gradual increase of number density is observed. This trend has been suggested in Iwata *et al.* (2003) but now it becomes much significant thanks to the improvement of the data.

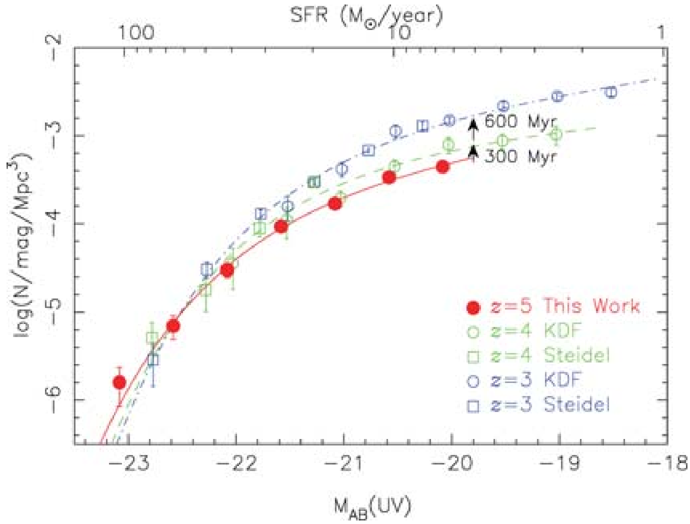

Figure 1. UV luminosity function of LBGs from $z = 5$ to 3.

This clear contrast in the UV LF suggests that the evolution of the LBGs is *differential* depending on the UV luminosity.

Our follow-up studies on the LBGs at $z \sim 5$ are on-going, and there are several intriguing results supporting the differential evolution of the LBGs; (1) in optical spectroscopy we found that in the UV luminous LBGs at $z \sim 5$ there is no or little Lymanα emission, and Lymanα equivalent widths depends on UV luminosity for LBGs at $z = 5$–6 (Ando *et al.* 2006). These trends suggest either the heavier dust attenuation in the luminous LBGs and/or the existence of massive neutral gas surrounding them. (2) Both restframe UV colors and UV-to-optical colors (obtained by the cross identification with Spitzer space telescope / IRAC images) show luminosity dependence; luminous objects tend to be red (Iwata *et al.* 2006). (3) From the SED fitting for LBGs at $z \sim 5$ with detections in the K'-band and IRAC 3–5 μm images, stellar masses as large as $> 10^{10} M_\odot$ have been estimated. It suggests a remarkable star formation in the first 1 Gyr of the universe. (4) Stronger clustering has been detected for the luminous LBGs at $z \sim 5$ than that for fainter ones, implying that luminous LBGs reside in massive dark matter haloes. From these findings we suggest that the evolution of star-forming galaxies in the first 2 Gyr of the universe could be well described with the biased evolution scenario: a galaxy population hosted by massive dark haloes start active star formation preferentially at early time of the universe, while less massive galaxies increase their number density later. To understand the origin of this differential evolution would be an important clue to clarify a star-formation process in the early universe.

References

Ando M. *et al.* 2004, *ApJ*, 610, 635

Ando M., Ohta K., Iwata I., Akiyama M., Aoki K., & Tamura N., 2006, *ApJ*, 645, L9

Iwata I. *et al.* 2003, *PASJ*, 55, 415

Iwata I., Ohta K., Ando M., Kiuchi G., Tamura N., Akiyama M., & Aoki K. 2006, in S. Arnouts, D. Burgarella, V. Le Brun, A. Mazure (eds.), *the Fabulous Destiny of Galaxies: Bridging Past and Present* (Marseille, Frontier Group), p. 205

Sawicki M., & Thompson D. 2006, *ApJ*, 642, 653

https://doi.org/10.1017/S1743921306010179 Published online by Cambridge University Press