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Stellar Populations of Lyman Alpha Emitters at z ~ 4.86: A Comparison to LBGs

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Introduction

In recent years, there are many studies about the stellar populations of Lyman alpha emitters (LAEs) at various redshifts (e.g., Gawiser et al. 2006, 2007; Lai et al. 2007, 2008; Nilsson et al. 2007; Finkelstein et al. 2007, 2008a, b; Pirzkal et al. 2007). They found a large range of ages (1Myr-1Gyr) and stellar masses (10^6-10^{10}M☉) . Most LAEs are found to have low dust extinction; however, some are dusty. The interesting question is how do LAEs differ from other high-z galaxies (e.g., Lyman break galaxies (LBGs))? Although there are a number of papers concerning the stellar populations of LBGs at various redshifts (e.g., Shapley et al. 2001,2005; Stark et al. 2007; Verma et al. 2007; Yan et al. 2006; Eyles et al. 2007), there is no direct comparison of the stellar populations of LAEs and LBGs so far. In this work, by using the same SED model, we make a fair comparison between the stellar populations of LAEs and LBGs which are selected in the same field at the same redshift down to the same UV luminosity limit.

Data and SED fitting

Data set : Optical : Suprime-Cam (V, NB711, Ic and z' bands)
Infrared : IRAC (ch1-2 (3.6-4.5μm))
Field : GOODS-N and flanking field (~450 arcmin²)

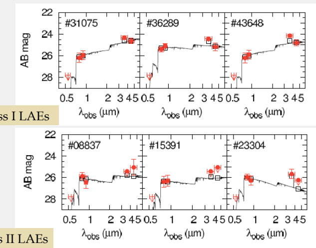
51 objects selected as LAEs at z = 4.86 using Suprime-Cam images → 30 objects have IRAC coverage. → 17 LAEs without contamination by neighboring objects in IRAC images

17 LAEs without contamination by neighboring objects are divided into 4 classes:
Class I: Detected in Ic, z', IRAC 3.6μm and 4.5μm images
Class II: Undetected in IRAC 3.6μm and/or 4.5μm images
Class III: Undetected in Ic and/or z' images
Class IV: Undetected in more than 2 images

10 LAEs from class I, II, and III are used to fit with model SEDs

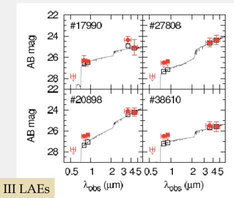
• Model parameters:

- Bruzual & Charlot (2003)
- Salpeter IMF 0.1-100 $M_\odot$
- 0.2$Z_\odot$ metallicity
- Calzetti dust extinction law (2000)
- Constant Star Formation History (CSF)
- Adding Hα line to IRAC 3.6μm band
- Fix redshift at z =4.86



Class I LAEs

Class II LAEs



Class III LAEs

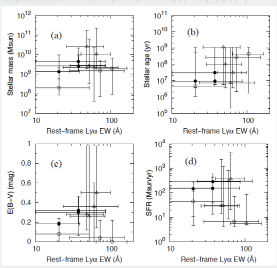
Results

Ranges of best estimated properties from SED fittings:

Stellar masses : 10^8-$10^{10.5}$ $M_\odot$	median : 2.4×10^9 $M_\odot$
Age : 4.6 Myr – 1.2 Gyr	median : 30.9 Myr
E(B-V) : 0.0 – 0.5 mag	median : 0.27 mag
SFRs : 5 - 363 $M_\odot$/yr	median : 189 $M_\odot$/yr

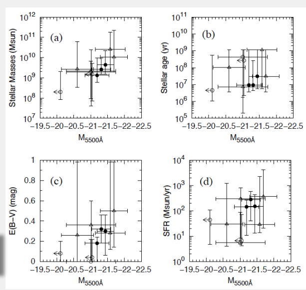
Most LAEs are young and low dust extinction but old age and dusty LAE is also acceptable!

Does Ly α equivalent width (EW) have correlation with the fitting results?



It seems that the color excess has correlation with Ly α EW. However, excluding class III LAEs which have very large uncertainty in E(B-V), the trend can not be seen.

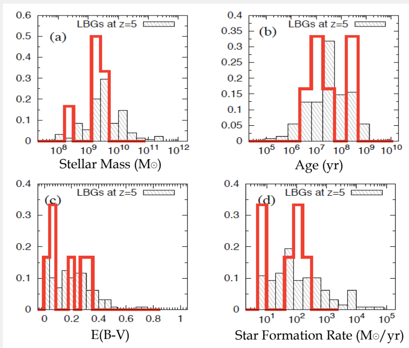
- Filled circle: class I LAE
- Open circle: class II LAE
- Open triangle: class III LAE



Good correlation between rest-frame optical luminosity and stellar masses

Comparison to LBGs: the same redshift, same field, same SED model

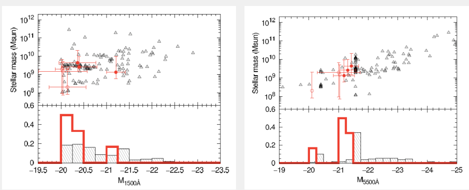
The difference between LAEs and LBGs at high redshift is one of the most interesting questions in the study of high-redshift galaxies. LBGs, which are used to compare with our results, are selected at the same redshift from the same field of observations (Yabe et al. 2009, ApJ, 693, 507). The stellar properties of LBGs are derived by using the same model parameters as described above. More recent progress of LBGs' study can be found in Yabe's poster. Since the different in model parameters may affect in different SED fitting results, using the same SED model will provide us unbiased comparison between LAEs and LBGs at the same redshift. In this work, we compare 6 LAEs from class I and II to 129 LBGs down to the same UV luminosity limit ($M_{1500Å}$ < -20 mag).



Although LAEs and LBGs have statistically comparable age and dust extinction.

LAEs averagely have
- **smaller stellar mass**
- **lower star formation rate** than LBGs at the same redshift.

* All histograms are normalized so that the area of the histogram equals unity.
* LAEs are illustrated in red histogram, whereas LBGs are in black.



* Class I and II LAEs are indicated in red filled and open circles, respectively, whereas LBGs are in open triangle.

- From the histogram of UV magnitude distribution, it can be seen that there is no LAEs at the bright end of the distribution. This confirms the deficiency of Ly α emission of bright LBGs claimed by Ando et al. (1990, ApJ, 645, L9).
- LAEs also distribute at the faint end of optical magnitude distribution of LBGs at the same redshift.
- Both LAEs and LBGs show good relation between the stellar mass and optical absolute magnitude.

If the deficiency of Ly α emission of bright objects is caused by dust absorption, we expected to see that LAEs are in less dusty and less chemically evolved environments suggesting they are younger than LBGs at the same redshift. We, however, cannot clearly see such differences in dust extinction and age between LAEs and LBGs. A larger number of LAE sample is desirable to ensure the trend.