A Model Prediction to the Nature of high-z Lyman Alpha Emitters

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INTRODUCTION

Lyman Alpha Emitter (LAE)

LAE is one of the most important galaxy pop. because of the following two reasons. (1) detecting redshifted Lyα emission with narrow-band filter is a powerful strategy to seek for high-z galaxies (e.g., z>6), and (2) they can be used as a probe of cosmic reionization because the strength and profile of Lyα emission could significantly be affected by IGM HI.

OBSERVATIONAL DATA OF LAE

The nature of LAE pop. and connection with other high-z galaxy pop. (e.g., LBG) have been poorly understood. However, their statistical properties (e.g., Lyα & UV luminosity function (LF), EW, dust extinction) have been more firmly established because of the increase of survey fields and available samples (e.g., Ouchi+08, 10).

Previous important information about LAE can be obtained through comparisons between the observed statistical quantities and theoretical models of LAE.

PREVIOUS THEORETICAL MODELS FOR LAE

There are several theoretical models for LAE in the framework of hierarchical galaxy formation with different approaches: analytic (e.g., Thommes & Meisenheimer05), cosmological hydrodynamical sim. (e.g., Nagamine+08), and semi-analytic model (e.g., Ono+10).

However, in all of them, the escape fraction of Lyα photons from their host galaxy (fesc) is oversimplified, although it is the most important ingredient: constant regardless of any physical parameter of the same amount with that for continuum photons. These assumptions are clearly inconsistent with the implications from observations (e.g., Kunth+98) and theoretical results from the surprise delay of Lyα time: (1) interstellar dust extinction, whose effects are incorporated into fesc, (2) supernova (SN) feedback, (3) ionization by the IGM HI.

Our Model for LAE

Our model is based upon an SAM, "Mitaka model" (Nagashima & Yoshii 04). It analytically computes merger history of DM halos based on ΛCDM, and then follows the evolution of baryons trapped in halos by using phenomenological models. As a result, the Mitaka model provides all of the physical quantities (e.g., SFH, Z, M*, dust amount) of galaxies at any redshift.

EXTENSIONS FOR LAEs

We developed a phenomenological model for fesc, which is physically motivated by both of theoretical and observational studies. The effects of interstellar dust extinction and galactic wind are incorporated as the following way:

\[ f_{esc} = f_{esc,0} \times \frac{1 - \exp(-d_{esc}/d)}{1 - \exp(-d_{esc}/d_{esc,0})} \]

... outflow starburst

\[ \frac{d_{esc}}{d_{esc,0}} = \frac{2^{1/2}}{2} \]

... outflow starburst

\[ d_{esc} = d_{esc,0} \]

We show model predictions to both the physical prop. of LAE and non-LAE at z=3-6. For these prop., LAE is not a single pop. but a mixture of starbursts with younger and massive, and quiescent & pre-outflow phase starbursts.

RESULTS

We show model predictions to the phys. prop. of LAE and non-LAE at z=3-6, for example. Here, model galaxies with M* < 10^10 M☉ - 20 or 14 ABmag are picked out. The former M* is reachable of the present obs., while the latter is much fainter than the present limit. We do not give any criteria neither for Lya nor UV cont. color. Hence, some galaxies (both LAE and non-LAE) may not be selected as LBG observationally because of their too red UV cont. slope.

DISCUSSIONS & CONCLUSION

We find that LAE is not a single pop. of young starburst with less massive and dust-free and its M*, age, and Z of LAE are very divers. This is consistent with the recent observational results (e.g., Ono+10).

Our model suggests that the necessary conditions to be LAE is high sSFR and large A1500. This result is considerably attributed to clumpy dust geometry. However, we do not consider it as an unique solution to fit all of obs. data consistently.