First IR-based implications for the dust attenuation and star formation of typical LAEs

Haruka Kusakabe[1], Kazuhiro Shimasaku[1,2], Kimihiko Nakajima[3], and Masami Ouchi[4,5]

[1] *Department of Astronomy, Graduate School of Science, The University of Tokyo*
[2] *Research Center for the Early Universe, The University of Tokyo*
[3] *Observatoire de Genève, Universitè de Genève*
[4] *Institute for Cosmic Ray Research, The University of Tokyo*
[5] *Kavli Institute for the Physics and Mathematics of the Universe (Kavli IPMU, WPI), The University of Tokyo*

Abstract

Measuring the IR luminosity of galaxies is crucial for reliably deriving their dust attenuation and stellar population. We stack publicly available deep Spitzer/MIPS 24 μm (Magnelli et al. 2011) and Herschel PACS images (Lutz et al. 2011; Elbaz et al. 2011; Magnelli et al. 2013) for 213 $z \simeq 2.18$ Lyα Emitters (LAEs) in the GOODS-South. We obtain a strong upper limit to the IR luminosity of typical high-redshift LAEs and constrain the attenuation curve for the first time. The very low 3σ upper limit $L^{3\sigma}_{\rm TIR}= 1.1 \times 10^{10} L_{\odot}$, obtained from the MIPS data, implies that LAEs have little contribution to the faint (≥ 100 μJy) number counts of submm galaxies by ALMA (Hatsukade et al. 2013; Ono et al. 2014). This $L^{3\sigma}_{\rm TIR}$ gives $IRX \equiv L_{\rm TIR}/L_{\rm UV} \leq 2.2$, or $A_{1600} \leq 0.9$ mag, indicating that dust attenuation is remarkably small. Indeed, the inferred escape fractions of Lyα, 16–37%, and of UV continuum, $\geq 44\%$, are both significantly higher than the cosmic averages at the same epoch (Hayes et al. 2011; Burgarella et al. 2013). We find that the SMC attenuation curve (Pettini et al. 1998) is consistent with the IRX and the UV slope $\beta = -1.4^{+0.2}_{-0.2}$ of our stacked LAE, while the Meurer's relation predicts a 3.8 times higher IRX at this β. SED fitting using the Calzetti curve (Meurer et al. 1999; Calzetti et al. 2000) also gives a ~ 10 times higher SFR than that calculated from the IR and UV luminosities, $SFR_{\rm tot,IR+UV} = 1.5$–$3.3$ $\rm M_{\odot}yr^{-1}$. Thus, the SMC curve is preferred. With the stellar mass $6.3^{+0.8}_{-2.0} \times 10^{8}\rm M_{\odot}$, our LAEs lie on a lower-mass extrapolation of the star formation main sequence at $z \sim 2$ (Daddi et al. 2007; Rodighiero et al. 2011). It suggests that the majority of $z \sim 2$ LAEs are mildly forming stars with relatively old ages of ~ 200 Myr. Note that adopting the Calzetti curve leads us to conclude that they are in the burst mode similar to brighter LAEs (Hagen et al. 2014; Vargas et al. 2014). Finally we will discuss the possibility of constraining the attenuation curve and star formation mode of luminous LAEs by ALMA.

Some of the details of this work are written in Kusakabe et al. (2014), ApJL, 800, L29