UV escape fraction and dust distribution of star forming galaxies at $z = 0 - 3$:

a new dust attenuation model

Haruka Kusakabe$^1$, Kazuhiro Shimasaku$^1$ and Ikkoh Shimizu$^2$

$^1$Dept. of Astronomy, Graduate School of Science, The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan; email: kusakabe@astron.s.u-tokyo.ac.jp

$^2$Dept. of Earth and Space Science, Graduate School of Science,Osaka University, 1-1 Machikaneyama, Toyonaka-city, Osaka 560-0043, Japan

Abstract. The UV escape fraction, $f_{\text{esc}}^{\text{UV}}$, is a key parameter determining the apparent SED of star forming galaxies. However, it is not well known how $f_{\text{esc}}^{\text{UV}}$ depends on the global geometry of dust distribution, nor how it evolves with time, although several models are proposed (e.g., Calzetti (2001)). We use ∼130 normal star-forming galaxies (114 at $z \sim 0$ from Cortese et al. (2012) and 15 at $z \sim 1–3$ from Magnelli et al. (2012) and Saintonge et al. (2013)), to find that the $z \sim 0$ galaxies show a relatively tight anti-correlation between $f_{\text{esc}}^{\text{UV}}$ and surface dust mass density, $\Sigma_d$ (See Fig. 1(a)). This correlation can be reproduced by a dust geometry model that well-mixed stars and dust follow the same exponential profile (Fig. 1(b)) with an effective mass-absorption coefficient $\kappa(1600\AA) = 7.6^{+3.3}_{-3.0} \times 10^4 \text{cm}^2 \text{g}^{-1}$, similar to the Milky Way value including absorption and scatter. The $z \sim 1–3$ galaxies are not inconsistent with this model. Our model can be easily implemented in semi-analytic models and cosmological hydrodynamics simulations (CHSs) of galaxy formation. Initial results for Shimizu et al. (2014)’s CHSs are presented.

Keywords. galaxies: evolution, infrared: galaxies, ultraviolet: galaxies, (ISM:) dust, extinction

Figure 1. (a)$\Sigma_d$ vs. $f_{\text{esc}}^{\text{UV}}$. The filled circles and triangles represent the data of $z \sim 0 - 3$ galaxies. The solid line (dashed lines) shows our model with the median (68%-range) $\kappa$ of the $z \sim 0$ sample. (b) Description of our model.

References


