2015.07.24 astro-ph Seminar (担当 大澤)

The Dust Content and Opacity of Actively Star-forming Galaxies

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Abstract & Introduction

Do spatial distributions of dust grains in galaxies have typical forms, as do spatial distributions of stars? We investigate whether or not the distributions resemble uniform foreground screens, as commonly assumed by the high-redshift galaxy community. We use rest-frame infrared, ultraviolet, and Hα line luminosities of dust-poor and dusty galaxies at $z \sim 0$ and $z \sim 1$ to compare measured Hα escape fractions with those predicted by the Calzetti attenuation formula. The predictions, based on UV escape fractions, overestimate the measured Hα escape fractions for all samples. The interpretation of this result for dust-poor $z \sim 0$ galaxies is that regions with ionizing stars have more dust than regions with nonionizing UV-emitting stars. Dust distributions for these galaxies are nonuniform. The interpretation of the overestimates for dusty galaxies at both redshifts is less clear. If the attenuation formula is inapplicable to these galaxies, perhaps the disagreements are unphysical; perhaps dust distributions in these galaxies are uniform. If the attenuation formula does apply, then dusty galaxies have nonuniform dust distributions; the distributions are more uniform than they are in dust-poor galaxies. A broad range of Hα escape fractions at a given UV escape fraction for $z \sim 1$ dusty galaxies, if real, indicates diverse dust morphologies and the implausibility of the screen assumption.

- 銀河の減光・ダスト分布モデル: uniform foreground screen (←あまり正しくなさそう)
- stellar continuum と Hα で escape fraction が違う (local, dust-poor galaxy)
    - H-ionizing stars はよりダストによる吸収が深い領域にいる
- (high-z or local) dusty galaxy ではどうなの？
- dust-poor, dust-rich galaxy で extinction law が違った場合はどうなのか？
- extinction law の不定性を無視してはいけない……っぽい？

観測データ: GOODS-S, COSMOS, & UDS より 100μm, 1.6μm 測光値. HST 分光による Hα 強度.
領域によって利用できる測光値をできる限り利用.

物理量の導出: SED テンプレートフィッティングにより total LIR を導出.
rest frame 紫外の測光値より UV continuum の傾き β と 0.16μm luminosity を導出.

escape fraction の計算

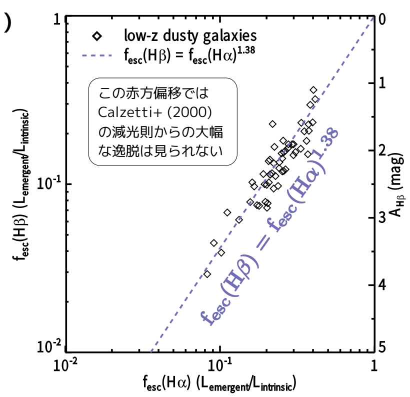
仮定1: total SFR = SFR by UV + IR
仮定2: total SFR = extinction corrected SFR by Hα

fesc(UV) = (observed UV SFR)/(total SFR)
fesc(Hα) = (observed Hα SFR)/(total SFR)

fesc(Hα) と fesc(UV) の関係をフィッティングで求めた (Fig. 1)

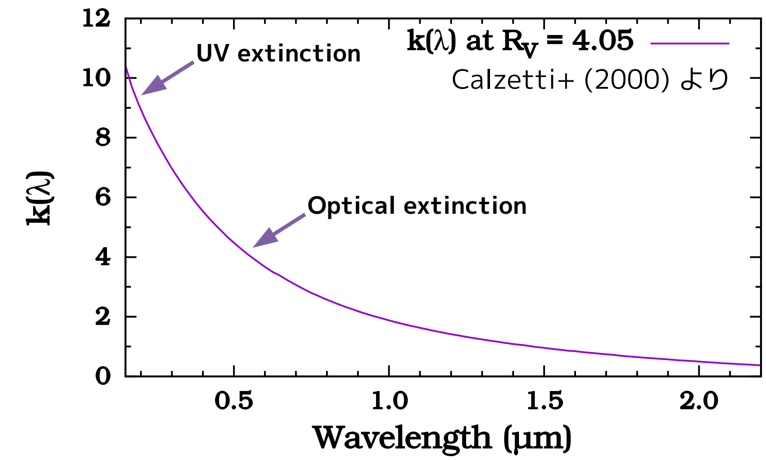
- 近傍 dust-poor 銀河については先行研究を再現
- 近傍 dusty 銀河, 遠方 dusty 銀河については q ~ 0.55
    - Hα escape fraction が大きい (= uniform distribution?)
    - フィッティングがだいぶお粗末である
    - upper limit の扱いや Hα luminosity completeness に問題？
- Calzetti+ (2000) 以外の減光曲線ではどうなの？
    - 傾きがもっと浅くなるらしい (not uniform なセンス)
    - もし真の fesc(Hα) が小さければ uniform を棄却できない
- fitting の分散が大きい
    - wrong assumption on star formation history (?)
    - Hβ/Hα をしっかり調べるとより詳細がわかるかも (?)

Figure 2. $f_{esc}(H\beta)$ as a function of $f_{esc}(H\alpha)$ for the low-redshift dusty galaxies



① Calzetti+(2000) Extinction Law

$$L_{\mathrm{emergent}}/L_{\mathrm{intrinsic}} = 10^{-A/2.5} = 10^{-E(B-V)k(\lambda)/2.5}$$



UV での減光量が Auv の場合: **fesc(UV) = e$^{-0.4A_{UV}}$**

Calzetti+ (2000) の減光則の場合: **fesc(Opt) ~ fesc(UV)$^{0.33}$**

Calzetti+ (1994, 1997) の結果: **fesc(Hα) ~ fesc(UV)$^{0.69}$**

Hα は continuum に比べて fesc が低い (=ローカルなダスト減光の影響)

② 結果

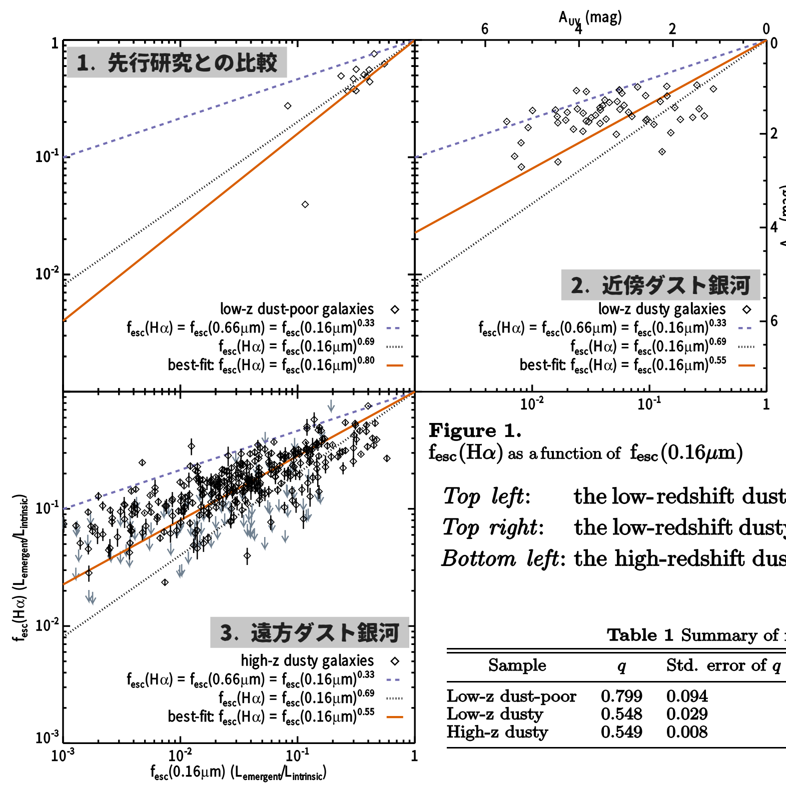


Figure 1.
$f_{esc}(H\alpha)$ as a function of $f_{esc}(0.16\mu m)$

Top left: the low-redshift dust-poor galaxies
Top right: the low-redshift dusty galaxies
Bottom left: the high-redshift dusty galaxies

Table 1 Summary of regressions

Sample	q	Std. error of q	Residual std. error	DOF
Low-z dust-poor	0.799	0.094	6.0	13
Low-z dusty	0.548	0.029	67.0	54
High-z dusty	0.549	0.008	6.6	320