The Evolution of Mass- Size Relation for Lyman Break Galaxies from z=1 to z=7

Mosleh et al. 2012 ApJ 756,L12

M1 森下貴弘

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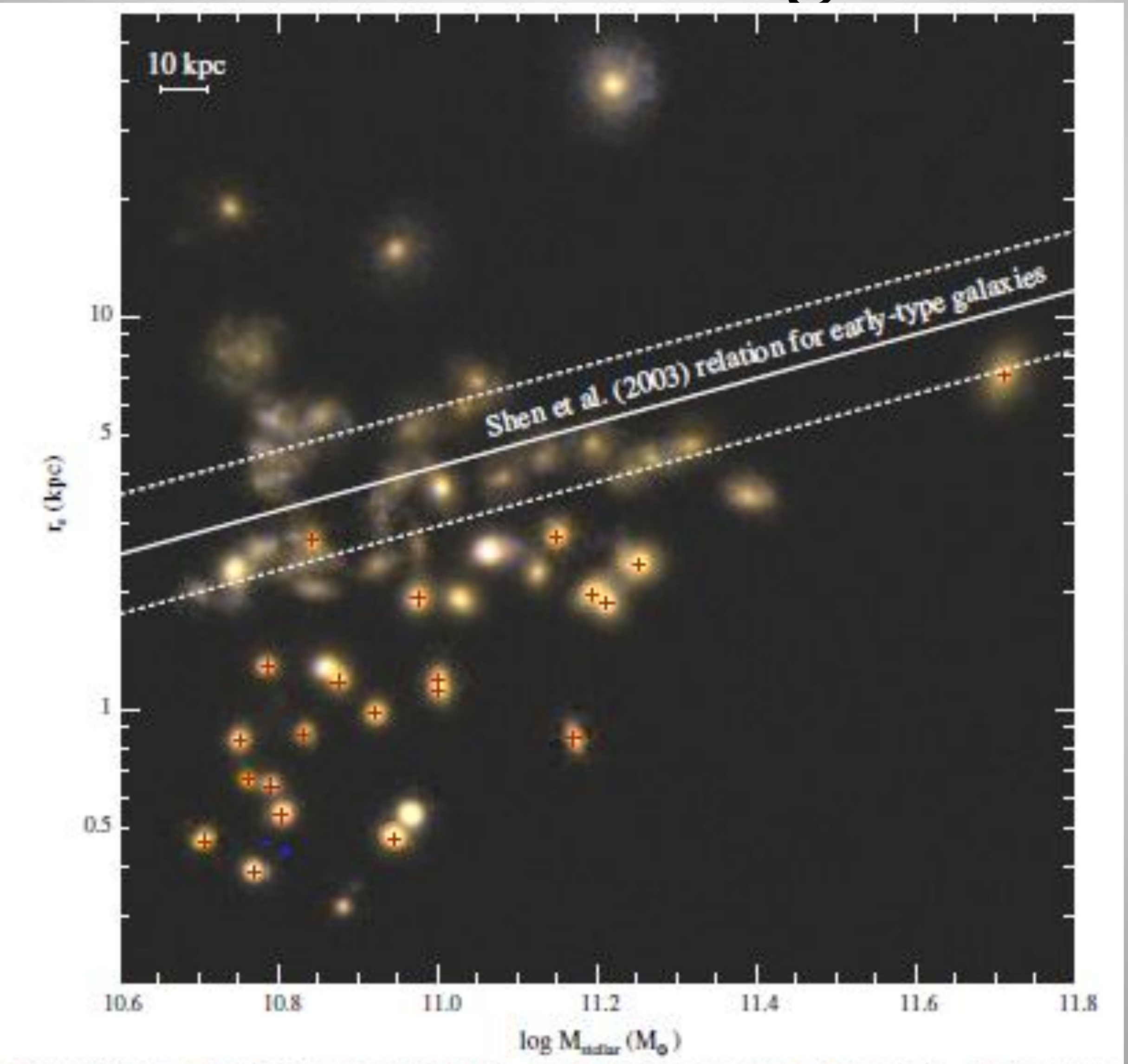
1. Introduction for the Evolution of Galaxies at high z



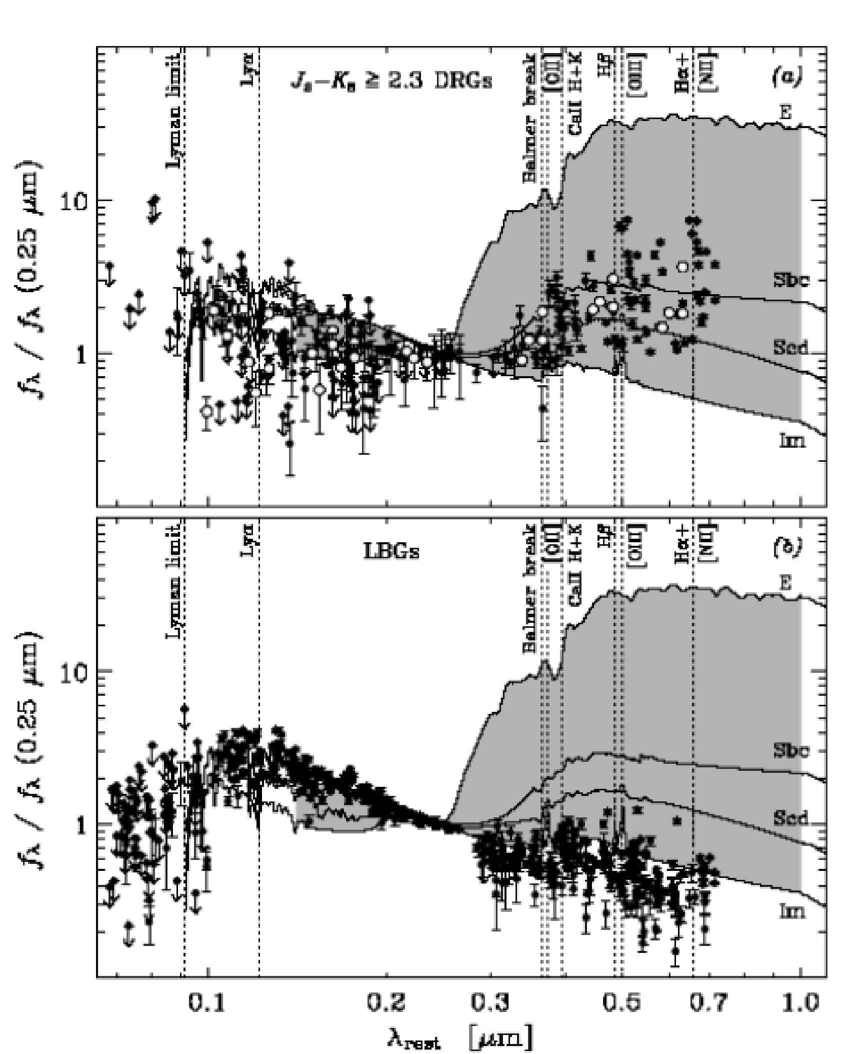
1. Introduction for the Evolution of Galaxies at high z

- Major merger ?
- Minor merger ?
- Inside-out ?
- Puffing-up ?

    - » … 解決できず。

- z~1-3の銀河を調べることが必要。

Introduction for the Lyman Break Galaxy (LBG)



Schreiber et al. 2004

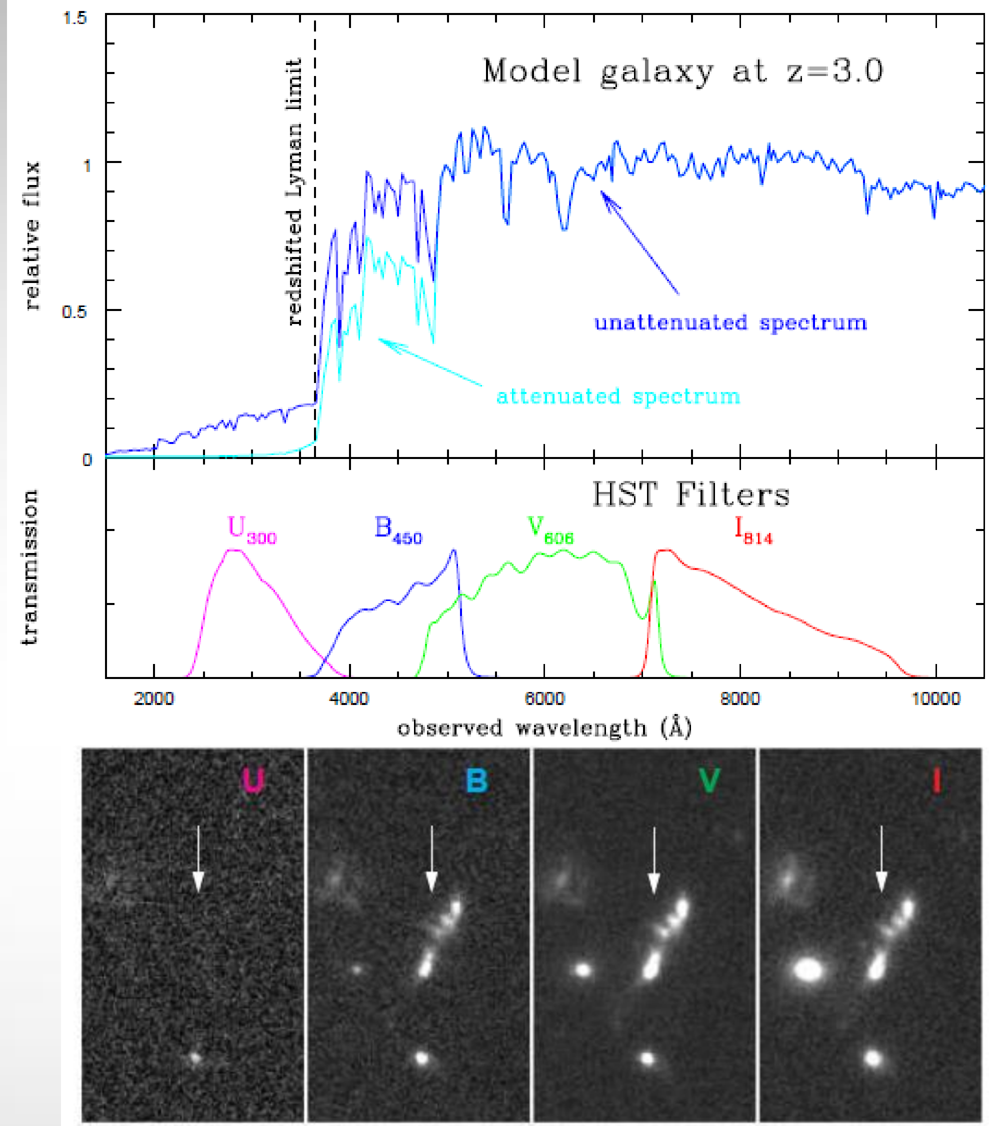
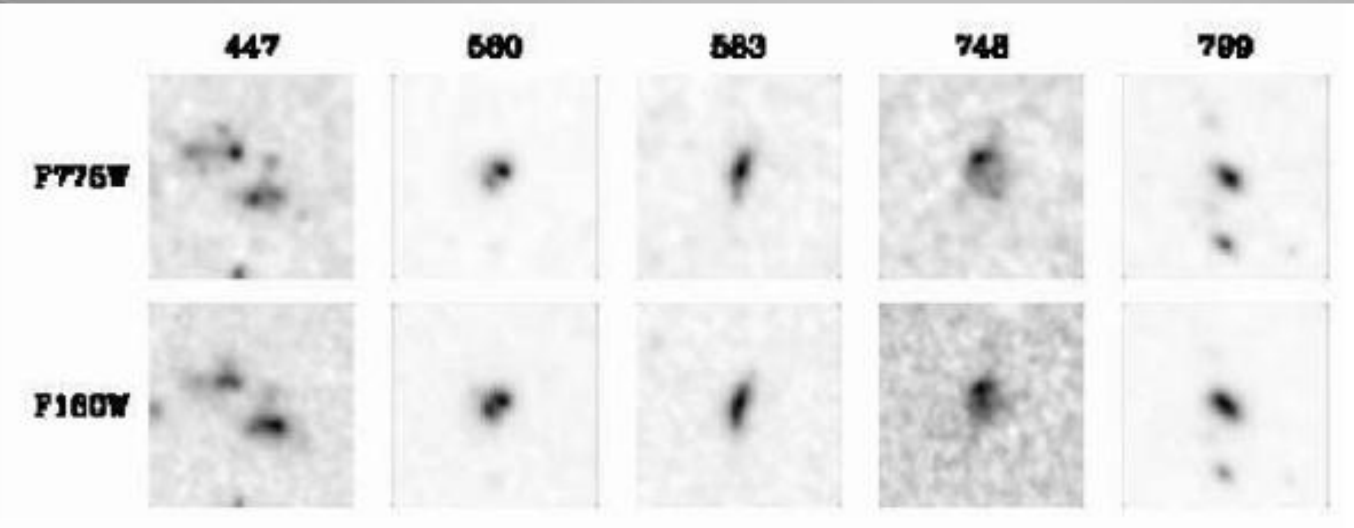
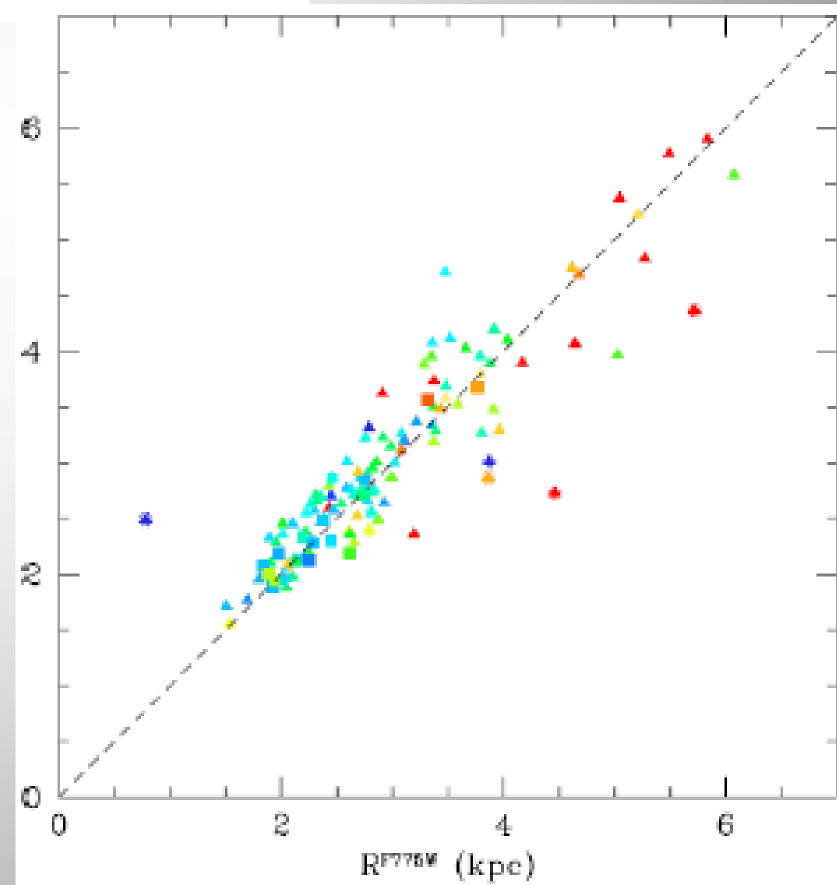


FIGURE 1. Illustration of the Lyman break technique as applied to the Hubble Deep Field. The upper panel shows a model spectrum of a star forming galaxy observed at $z = 3$. Its flat UV continuum is truncated by the 912Å Lyman limit, which is redshifted between the U_{300} and B_{450} filters (WFPC2 bandpasses shown below spectrum). In addition to photospheric absorption in the UV–emitting stars, the effects of intergalactic neutral hydrogen further suppress the continuum in the U_{300} and B_{450} bands. At bottom, an HDF galaxy is shown in the four WFPC2 bandpasses. Clearly visible at I_{814}, V_{606} and B_{450}, it vanishes in the U_{300} image. This galaxy has been spectroscopically confirmed to have $z = 2.8$.

Dickinson et al. 1998



Bond et al. 2010



Introduction for the Lyman Break Galaxy (LBG)

- Star-Forming Galaxy.
- Strong UV Emission.
- Selected by photometric dropout techniques.
- Compact Size.
- Stellar Gas Absorption (HI).

2.Data

- HST WFC3/IR over the HUDF and ERS field.
- Dropout sources at z~4 to 7.
  - > 679 in ERS and 345 in HUDF.
  - > B-, V-, i-, z-dropouts.

何色で見る？

- Rest-frame 2100Åに最も近いバンド。
- Sufficient S/N.
  - > $H_{160} < 28.5\ or\ 26.5,\ J_{125} < 28.5, 26.5,$ $Y_{105/098} < 28.3, 26.4$ for HUDF and ERS, respectively.
  - > 156 B-drops(z~4), 45 V-(z~5), 13 i-(z~6), 4 z-(z~7) . (あくまで、セレクション！)

3.Sizes

- GALFIT (Peng et al. 2010).
  - > Sersic profile.

$$\Sigma(r) = \Sigma(r_e)\exp[-b_n\{\left(\frac{r}{r_e}\right)^{\frac{1}{n}} - 1\}]$$

- TinyTim PSF (Krist 1995).

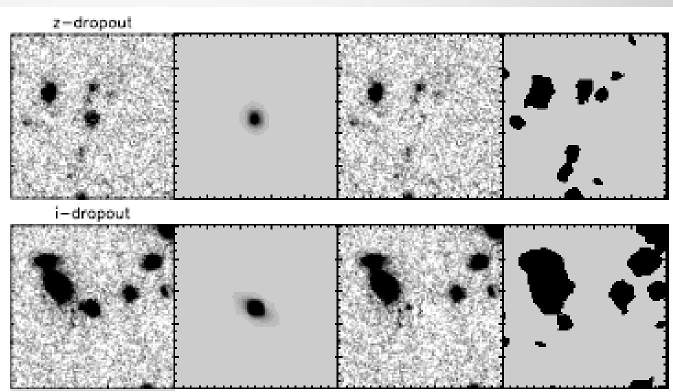


Figure 1. From left to right, *H*-band postage stamps (6″ × 6″), best-fit models from GALFIT, residual images and mask maps are shown for a *z*-dropout candidate (top row), and an *i*-dropout candidate (bottom row). The quality of the fits can be seen from the residual images.

Size Reliability

- ACS(高い分解能、小さいPSF)を使った時のサイズと比較。
  - －＞今回のサイズの確からしさ。
- モデル銀河を使った検証。
- K-correctionの影響を最小化したい。
  - －＞Y_{105} for B-dropouts, J_{125} for V-, H_{160} for i- and

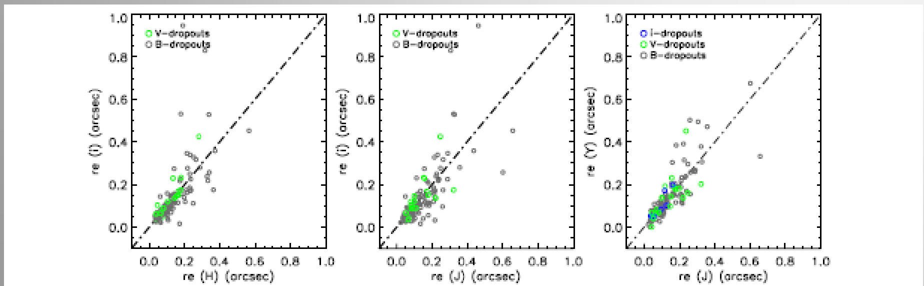
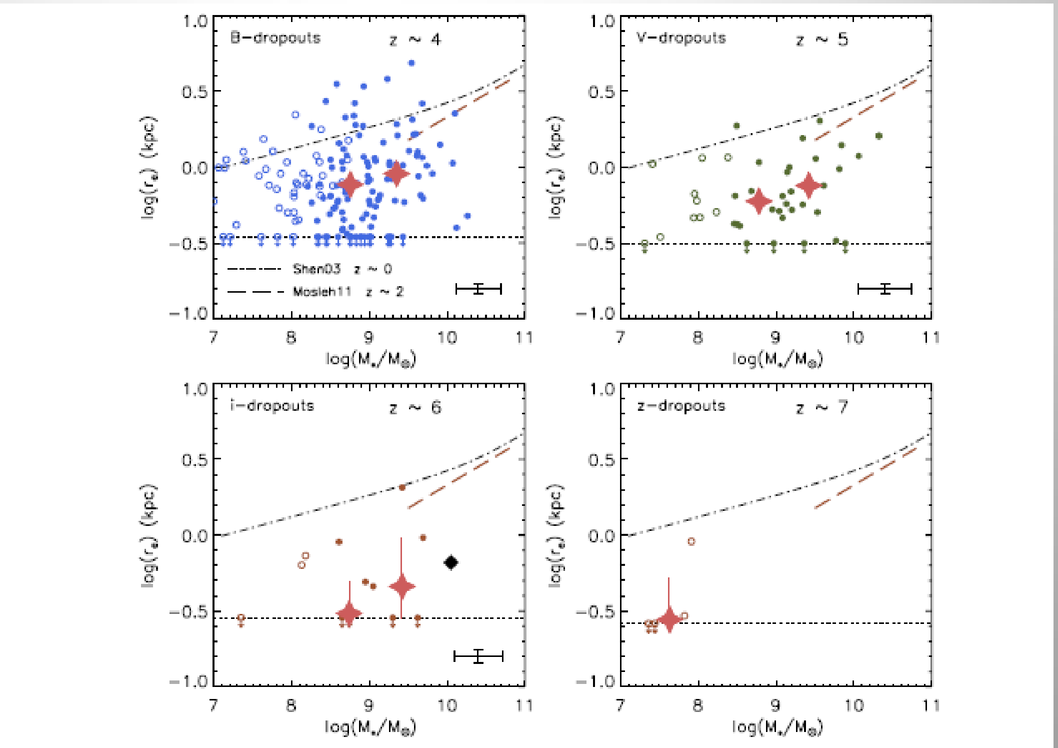


Figure 2. Comparison of sizes of dropout candidates measured in different filters with S/N > 10 in both the HUDF and ERS. Each color represents a different sample of dropout candidates. The correlation between estimated sizes in different bands is an indication of the reliability of our size measurements. The small offsets between sizes in different bands may be due to color gradients in the galaxies. The objects with large offsets from the one-to-one relation have generally a clumpy structure or multiple cores.

4.Results 1

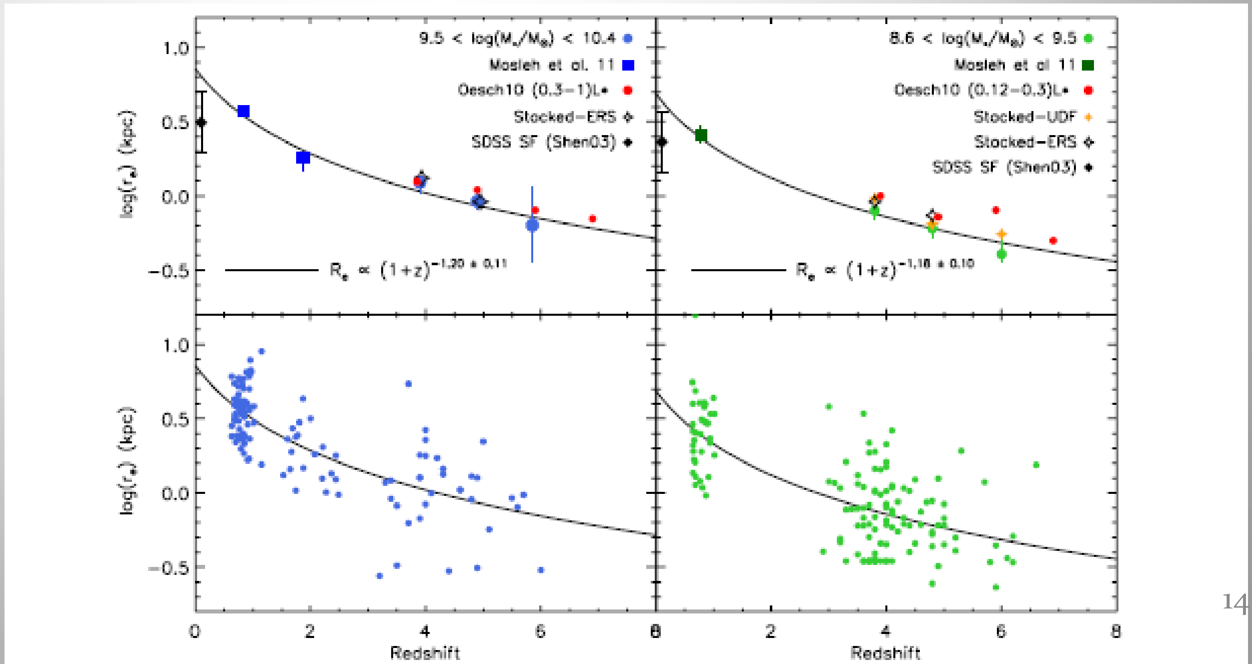
- 質量とサイズの相関。
  - －＞$r_e \propto M^{\alpha}$　(α=0.14, 0.17 for z~4 and z~5.)
  - －＞z~6,7はサンプル数が少ない。



4.Result 2

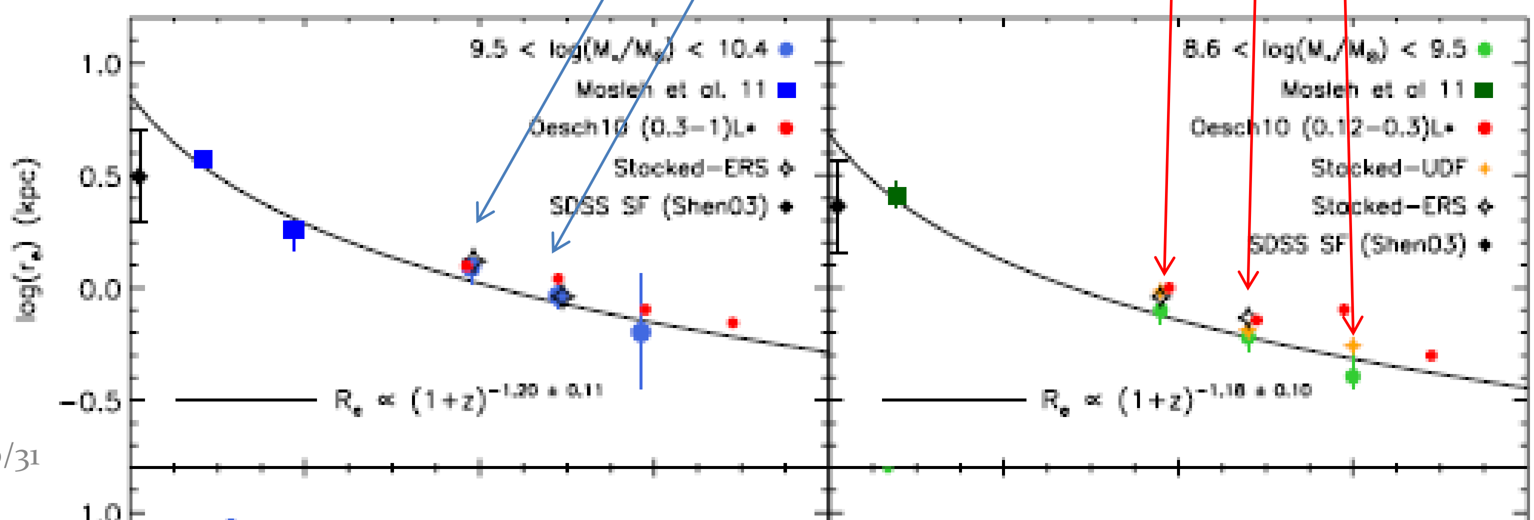
- Mass bins : 9.5<$\log(M_*/M_\odot)$<10.4 and 8.6<$\log(M_*/M_\odot)$<9.5

$-> r_e \propto (1+z)^{-1.20\pm0.11}$ and $(1+z)^{-1.18\pm0.10}$.



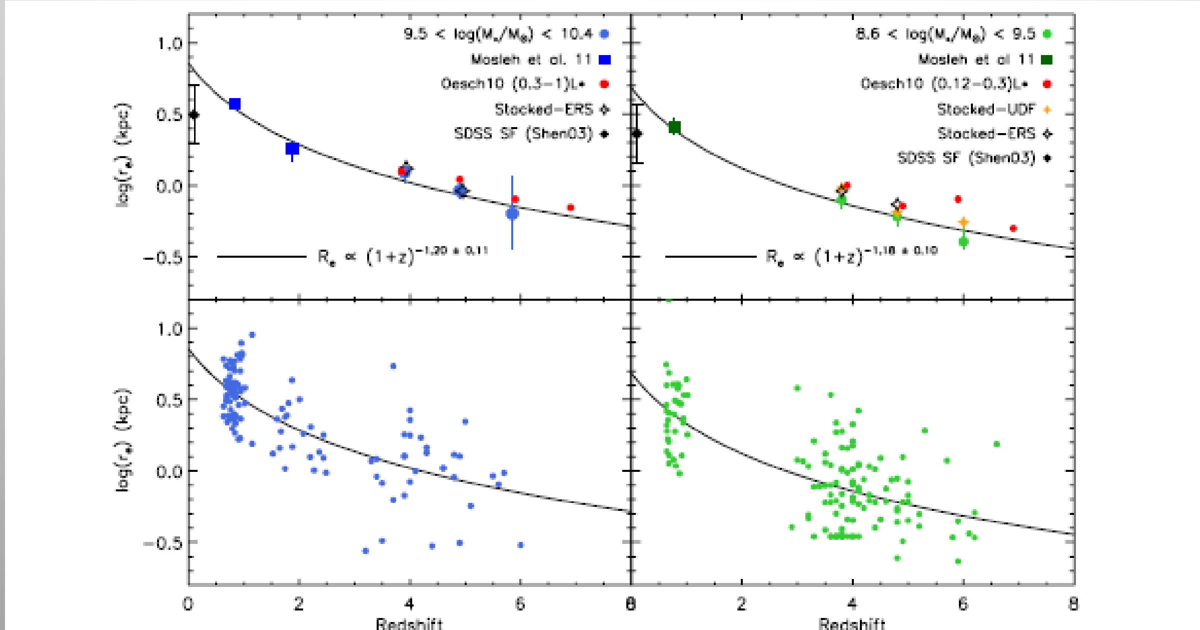
4.Result 3

- “Stacking can reproduce reliable average surface brightness.” (Hathi et al.2008/ Oesch et al.2010)
  - > not missing the light in the wings.



5. Discussion

- Consistent with the previous study.
- r_e-z関係は異なるMass binでも似た結果。



5. Discussion

- Comparison with Law et al. (2012) and Dahlen et al. (2007)
- "LBGs may evolve into UV-bright galaxies" at z~1.
- Similar to Compact Quiescents at z~2?

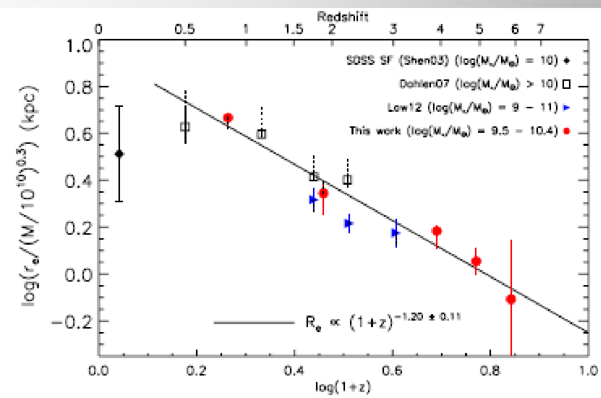


Figure 5. Comparison of sizes of UV-bright galaxies measured by different authors. In order to have a consistent comparison, sizes are normalized using $r_e \propto M^{0.30}$ for a stellar mass of 10^{10} $M_\odot$. The solid line is the best fit from our analysis ($r_e \propto (1+z)^{-1.20\pm0.11}$). The dotted lines represent the original (not normalized) size measurement. The black solid diamond is the median size of late-type galaxies at $z \sim 0$ for stellar masses around 10^{10} $M_\odot$ from Shen et al. (2003), with the measured dispersion shown as error bar. The sizes of UV-bright galaxies at fixed stellar mass increases rapidly toward later cosmic time. However, the sizes measured for local late-type galaxies are smaller than the sizes of UV-bright galaxies at $z \sim 1$. These samples most likely comprise intrinsically different galaxies.

(A color version of this figure is available in the online journal.)

5.Summary

- HUDF,ERSの領域のデータを使ってz~7までの銀河のM-r関係を調べた。
- Sizeはzに伴って驚異的に大きくなった。($r_e \propto (1+z)^{-1.2\pm0.11}$)
  - > z<3における先行研究と違わない結果。
- 進化は質量によらない。
- Local galaxiesとの進化の関連？
  - > 0<z<1では穏やかな進化が予測される(Barden et al.2005)
  - > しかし、この間ではLBGsが少ない。
  - > LBGsはz~1でUV-bright galaxies?
- 先行研究もあった。(30 Lyman break analogs, z<0.3 ;Overzier et al.2010)
  - > non Star Forming Galaxies.
- Mild Evolution between z~0-1?(Barden et al. 2005)

- “やはり”
z~1-3の間で予想以上の
サイズ進化が
起こっている？！

補足

Stellar Mass

- ACS, WFC3/IR, IRAC [3.6] [4.5].
- + Bruzual&Charlot (2003) stellar population models.
- + Salpeter (1955) IMF.