CONNECTION BETWEEN STELLAR MASS DISTRIBUTIONS WITHIN GALAXIES AND QUENCHING SINCE Z = 2

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Abstract

We study the history from $z \sim 2$ to $z \sim 0$ of the stellar mass assembly of quiescent and star-forming galaxies in a spatially resolved fashion. For this purpose we use multi-wavelength imaging data from the Hubble Space Telescope (HST) over the GOODS fields and the Sloan Digital Sky Survey (SDSS) for the local population. We present the radial stellar mass surface density profiles of galaxies with $M_* > 10^{10} M_\odot$, corrected for mass-to-light ratio (M_*/L) variations, and derive the half-mass radius (R_m), central stellar mass surface density within 1 kpc (Σ_1) and surface density at R_m (Σ_m) for star-forming and quiescent galaxies and study their evolution with redshift. At fixed stellar mass, the *half-mass sizes* of quiescent galaxies increase from $z \sim 2$ to $z \sim 0$ by a factor of $\sim 3-5$, whereas the half-mass sizes of star-forming galaxies increase only slightly, by a factor of ~ 2. The central densities Σ_1 of quiescent galaxies decline slightly (by a factor of $\lesssim 1.7$) from $z \sim 2$ to $z \sim 0$, while for star-forming galaxies Σ_1 increases with time, at fixed mass. We show that the central density Σ_1 has a tighter correlation with specific star-formation rate (sSFR) than Σ_m and for all masses and redshifts galaxies with higher central density are more prone to be quenched. Reaching a high central density ($\Sigma_1 \gtrsim 10^{10}\ M_\odot\ \mathrm{kpc}^2$) seems to be a prerequisite for the cessation of star formation, though a causal link between high Σ_1 and quenching is difficult to prove and their correlation can have a different origin.

❖　主な結果

- 星形成銀河の星質量分布が全体的に進化するのに対して、quiescent銀河では外縁部のみ（z~0–2）
- 中心1kpcの面密度はsSFRと強い相関 (大きいほどsSFR低)
- Σ_1が一定値を超えた星形成銀河の時間進化を考えたときの星質量分布は近傍の同質量quiescent銀河と良く合う

❖ Sample　**log($M_*/M_\odot$) > 10**

遠方（0.5<z<2.0）

- 3D-HST catalog
- GOODS-N & GOODS-S (340 arcmin^2)
- 2391個のstar-forming & quiescent（UVJ）

近傍（0.06<z<0.08）

- SDSS DR7
- 1000個のstar-forming & quiescent（urz）

各半径でSED fitting して質量算出

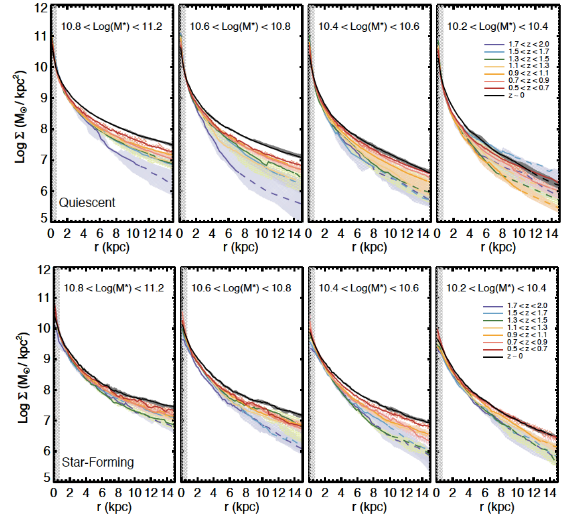
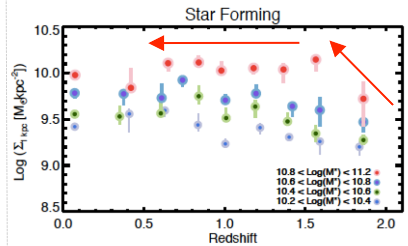


Fig. 7&8

銀河内の星質量分布の赤方偏移進化

Fig. 12a

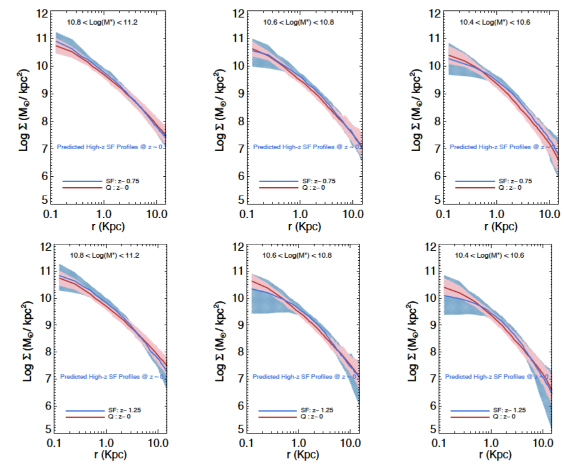
中心1kpcの密度進化



- quiescentの中心部密度はほぼ一定
- SFでは時間進化し、一定値に近づく
- 中心部密度が一定値を超えるとΔsSFRが急減

Fig. 20&21

星形成銀河のz~0までの進化をシミュレートしたときの星質量分布



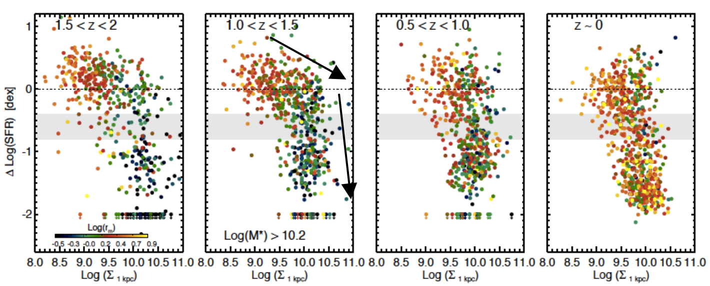


Fig. 14b

中心部密度とsSFR（メインシークエンスからのずれ）の相関

- 中心部密度が一定値（~10^{10} $M_\odot$/kpc^2; 赤方偏移、質量依存）を超えることがquenchingの必要条件？
  - bulge形成メカニズムは様々(disk instability, mergers of giant clumps, etc.)
- 中心部密度は全体の星質量と相関しているので、どちらがquenchingに重要なのかはまだ不明瞭