Luminosity Functions and Clustering Revealed with 4 Million Galaxies at z~2-7

Harikane et al. 2021a, ApJS in press, arXiv:2108.01090

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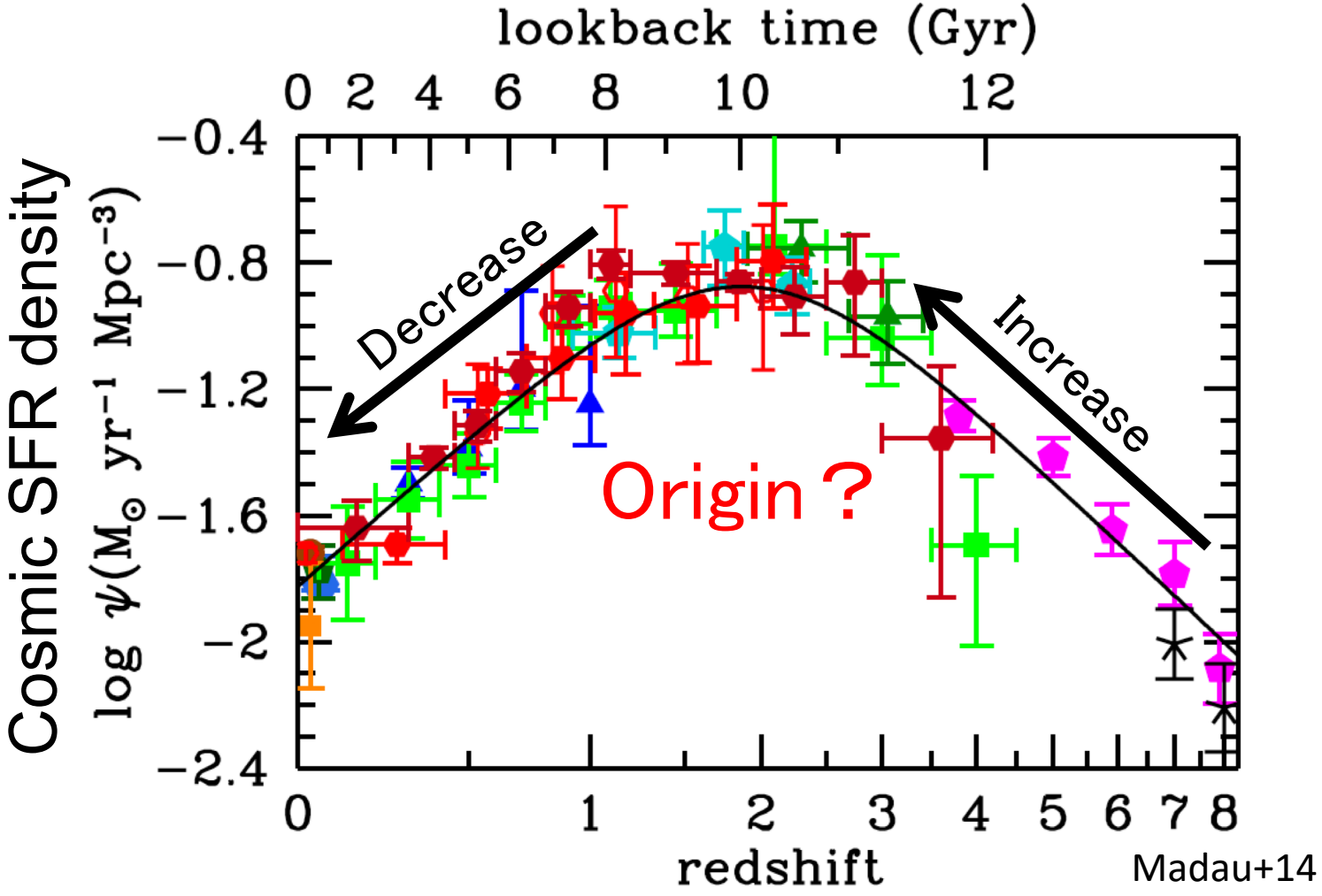
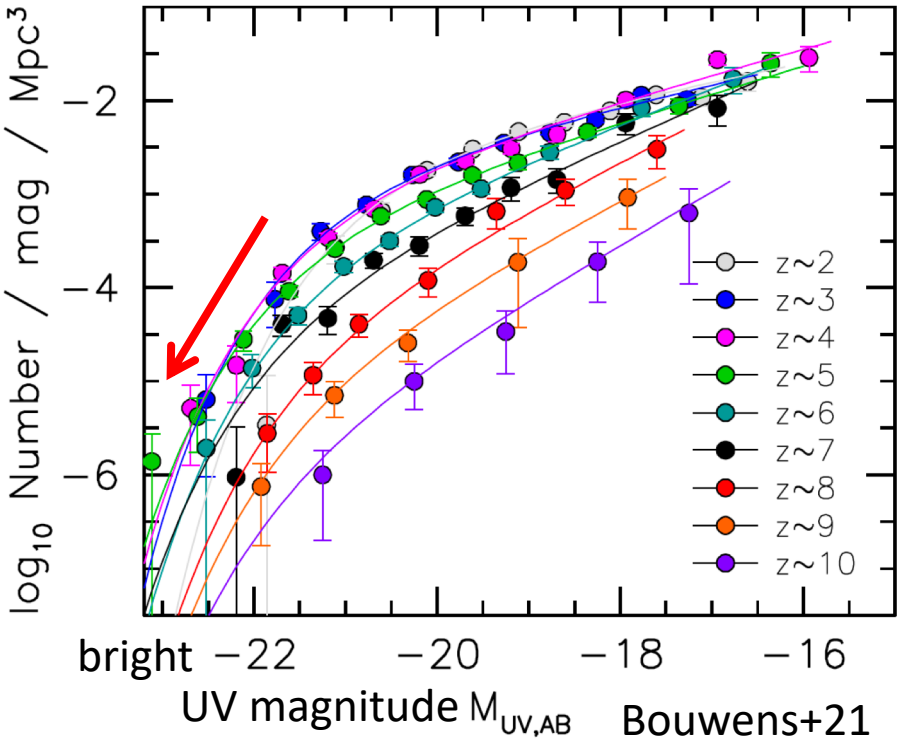
Cosmic Star Formation Rate Density



UV Luminosity Function

- Volume number density as a function of magnitude
- Schechter function: $\phi(L)dL = \phi^* \left(\frac{L}{L^*}\right)^{\alpha} \exp\left(-\frac{L}{L^*}\right) d\left(\frac{L}{L^*}\right)$

Exponential decline due to mass quenching (AGN feedback)?

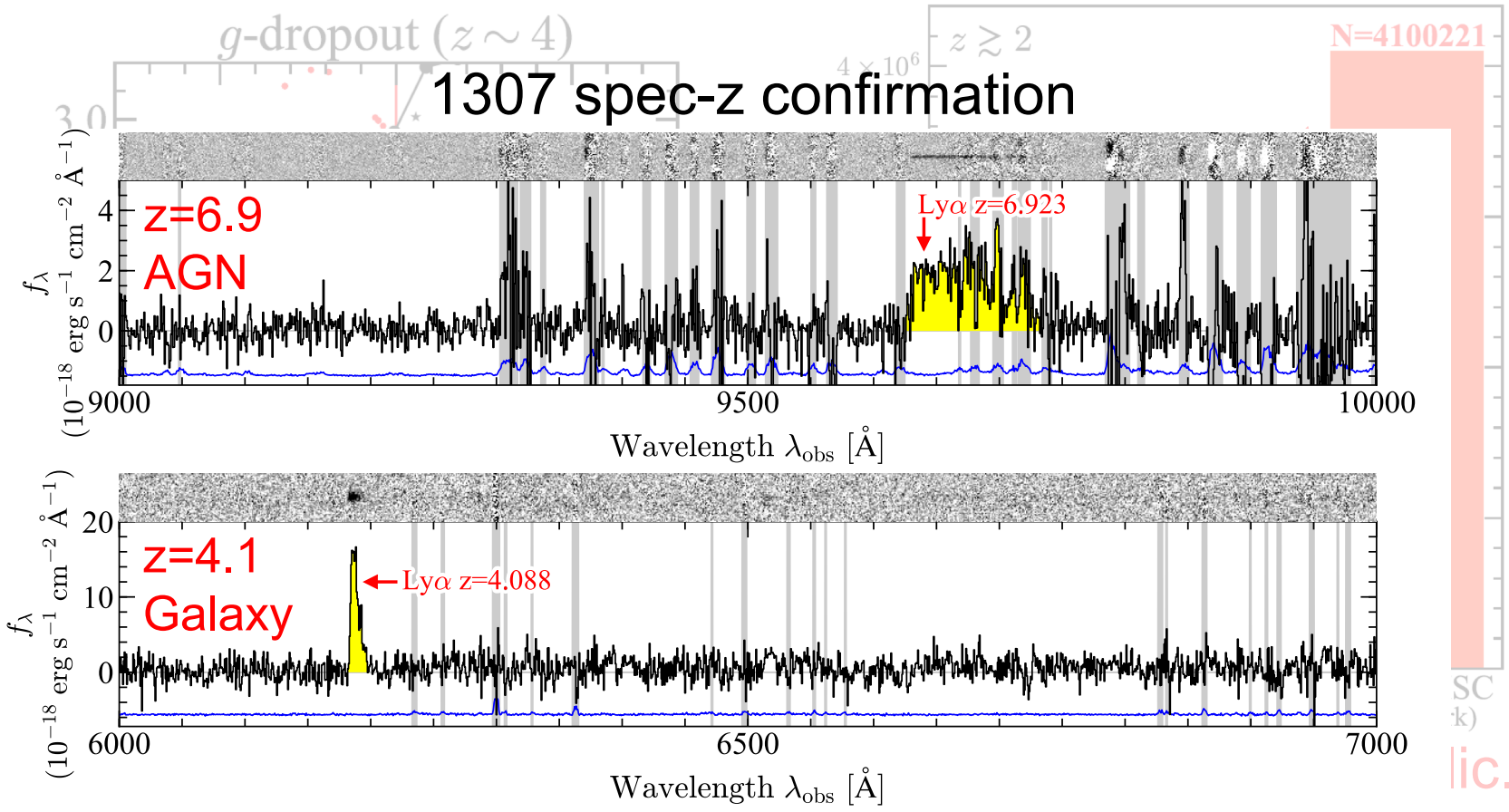


→ **HSC/SSP**

HSC Dropout Galaxy Selection

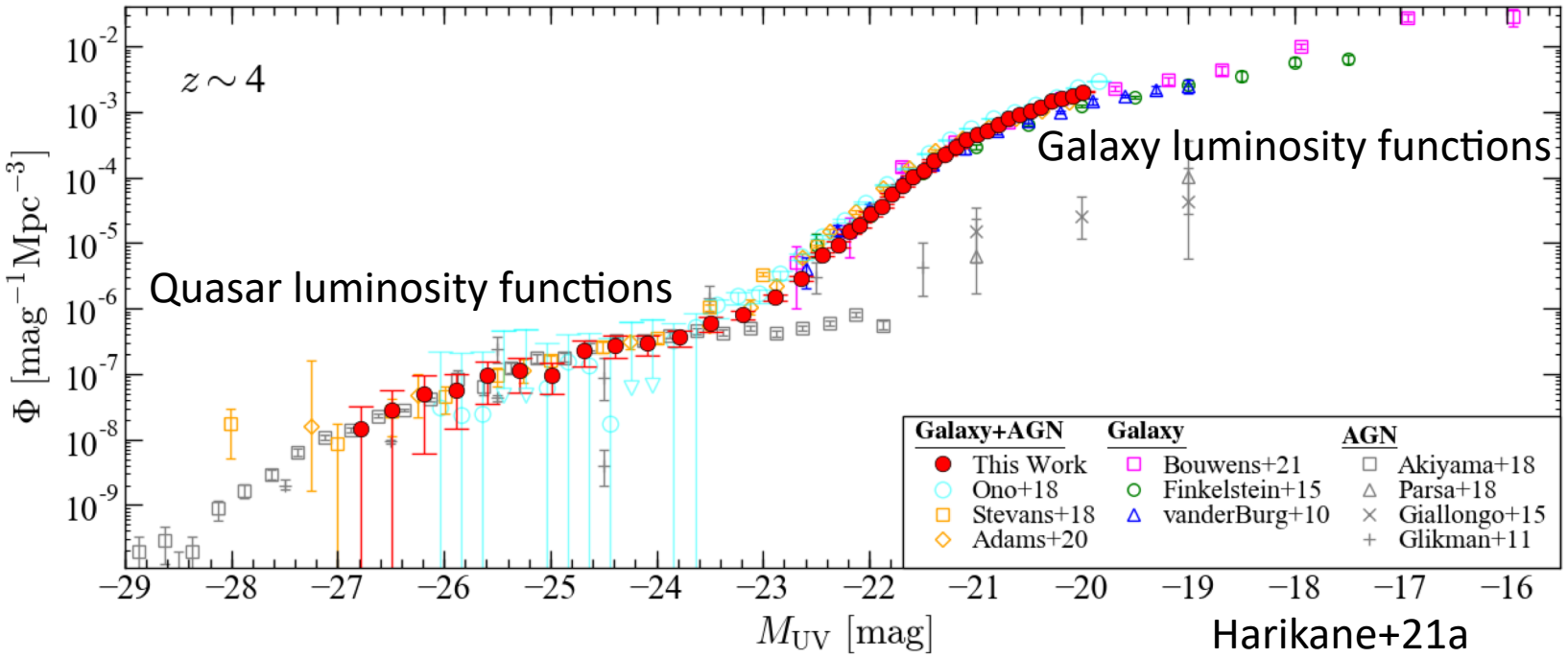
- HSC-SSP PDR2 Data
- 4,100,221 galaxies at z~2-7 (Harikane et al. 2021a)

GOLDRUSH
Great Optically Luminous Dropout Research Using Subaru HSC



UV Luminosity Function

- Very precise measurements thanks to HSC-SSP!
- AGN(galaxy)-dominated at M_{UV}<-24 (M_{UV}>-22) mag



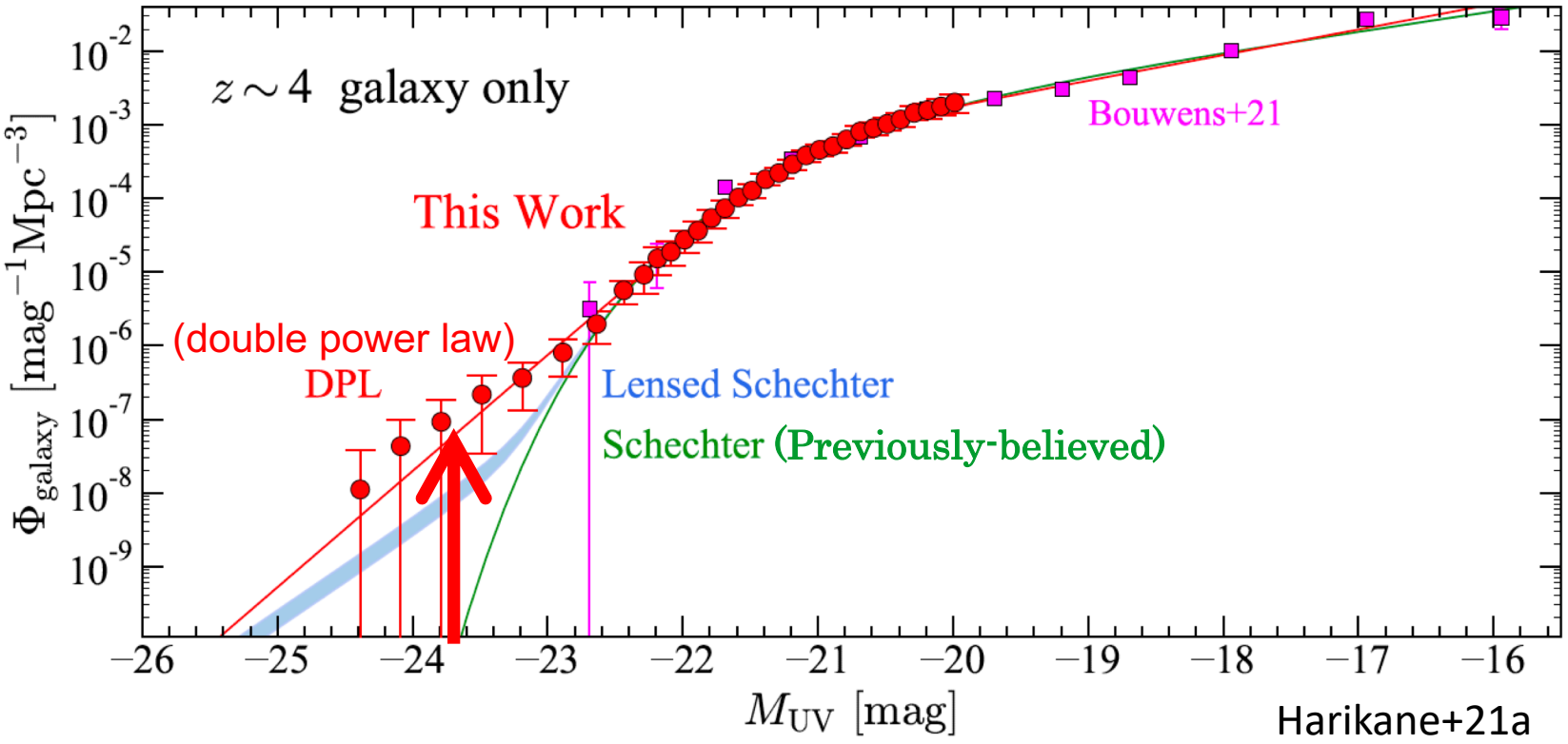
Harikane+21a

Galaxy Luminosity Function

$$\Phi_{\rm galaxy}(M_{\rm UV}) = f_{\rm galaxy}(M_{\rm UV})\Phi(M_{\rm UV})$$

From spec-z Galaxy+AGN

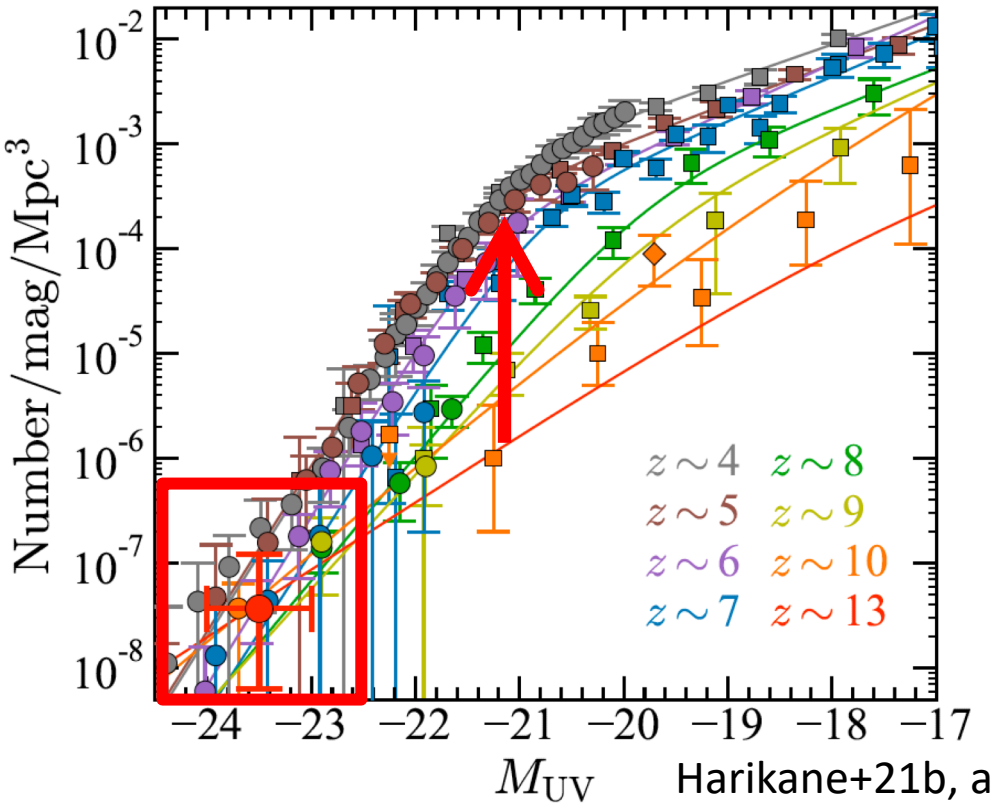
- Bright end excess beyond Schecher Func. at z~4-7
  - inefficient mass quenching, low dust, hidden AGNs?



Evolution of Galaxy Luminosity Function

- Rapid increase at M_{UV}~-21 mag (L*)
- Little evolution of bright galaxies from z~4-10 (13?)

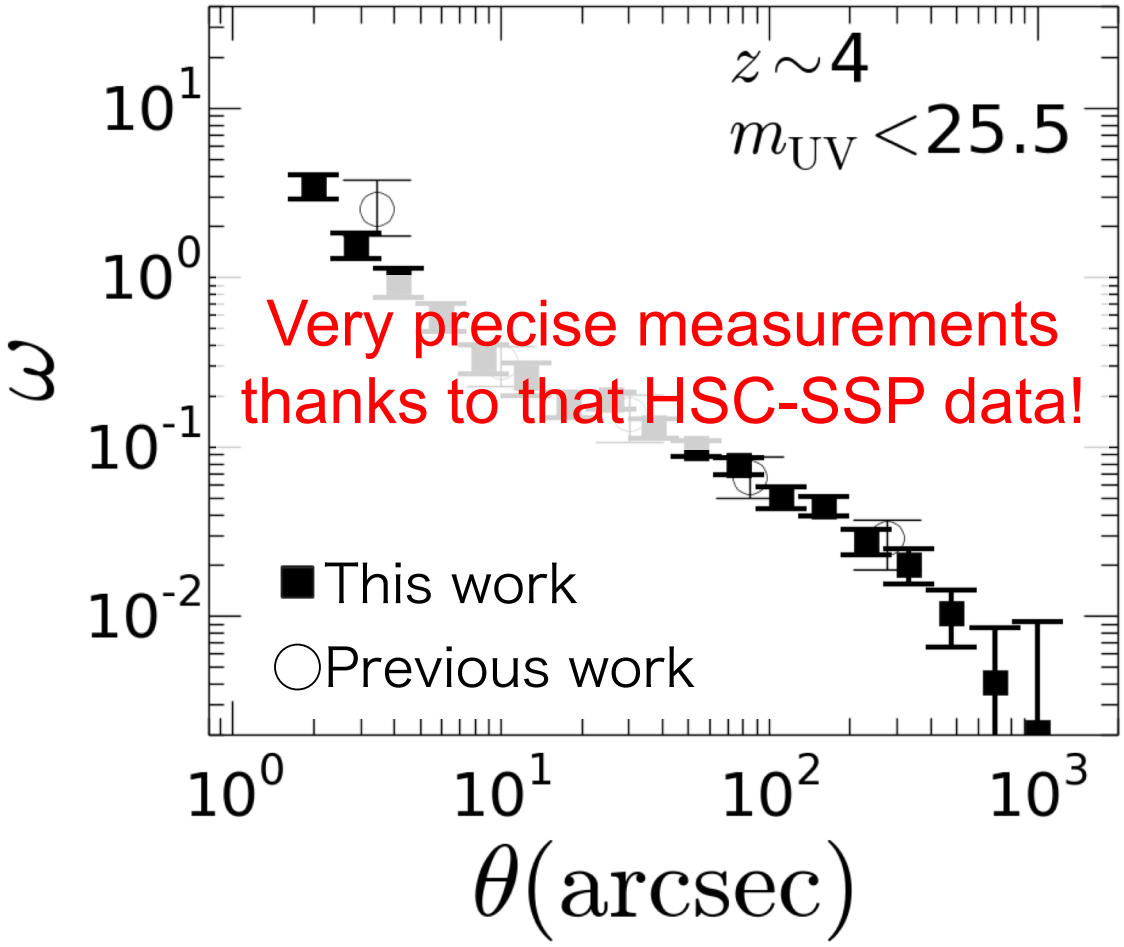
  -> relation to structure formation?



Harikane+21b, arXiv 2112.09141

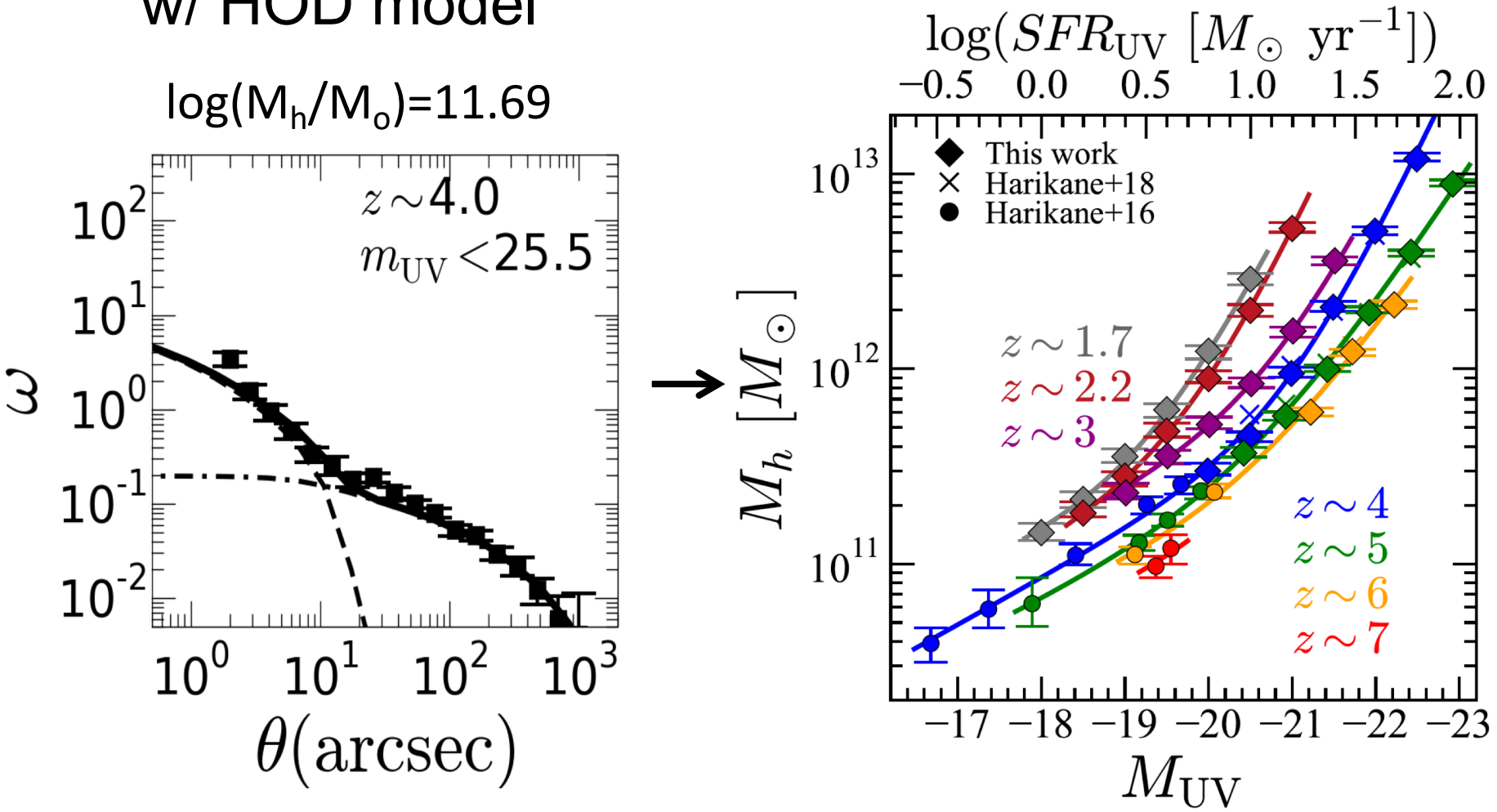
Angular Correlation Functions

- Estimate dark matter halo mass of z~2-7 galaxies



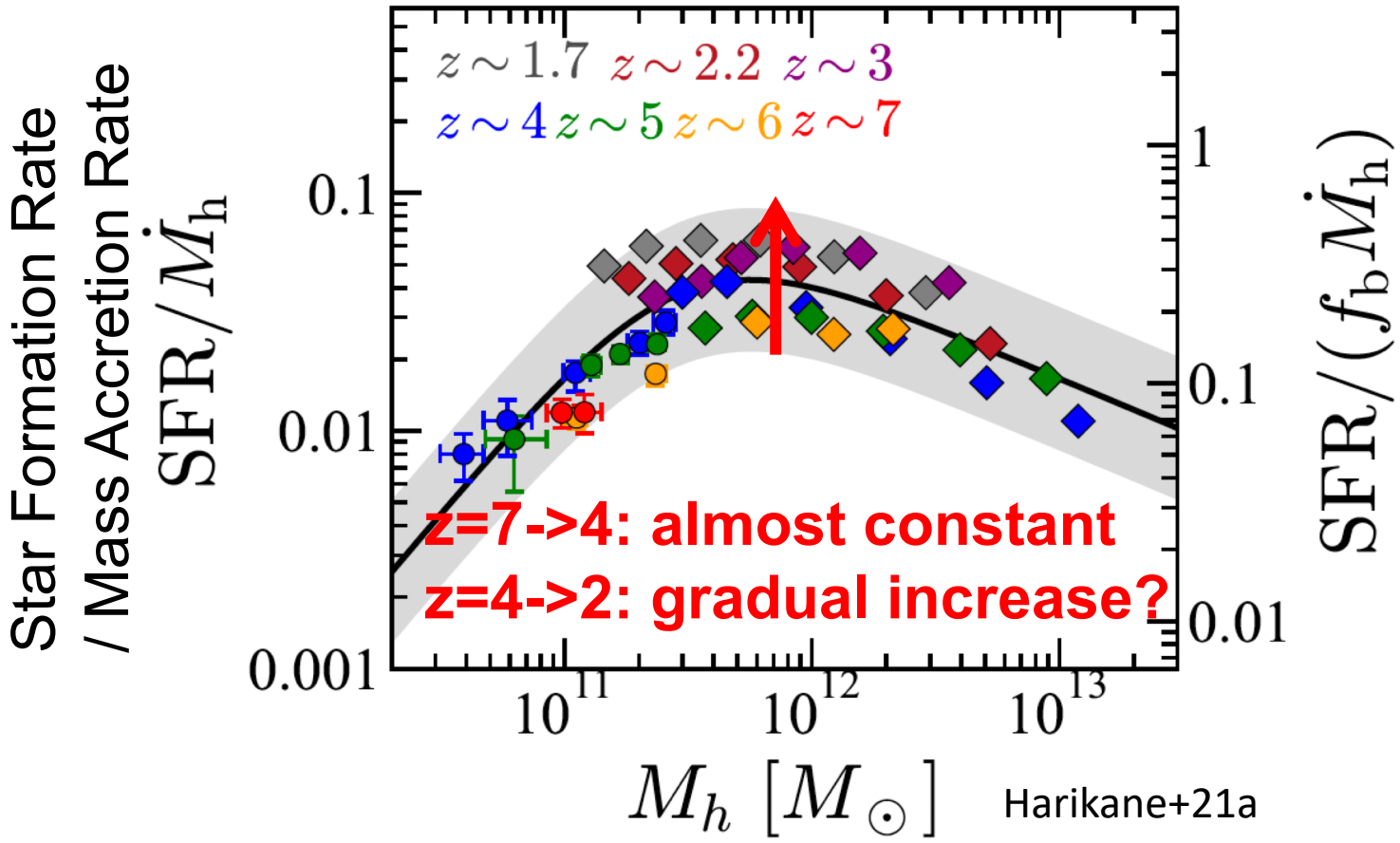
Angular Correlation Functions

- Estimate dark matter halo mass of z~2-7 galaxies w/ HOD model



Star Formation Efficiency (SFR/Accretion Rate)

- SFR from dust-corrected UV luminosity
- $\dot{M}_{\rm h}$:$\dot{M}_{\rm h}$ - $M_{\rm h}$ relation (Behroozi+15)



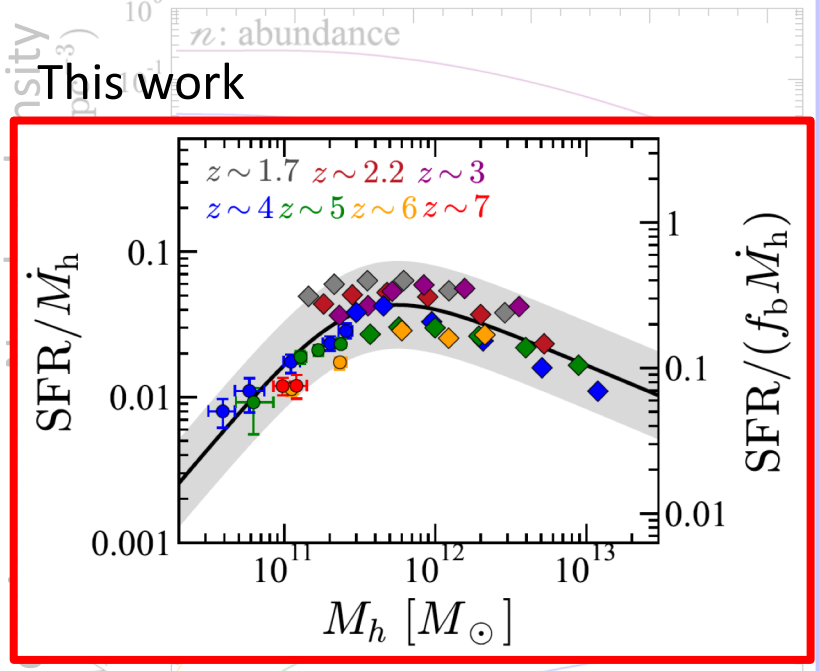
Cosmic SFR Density Evolution

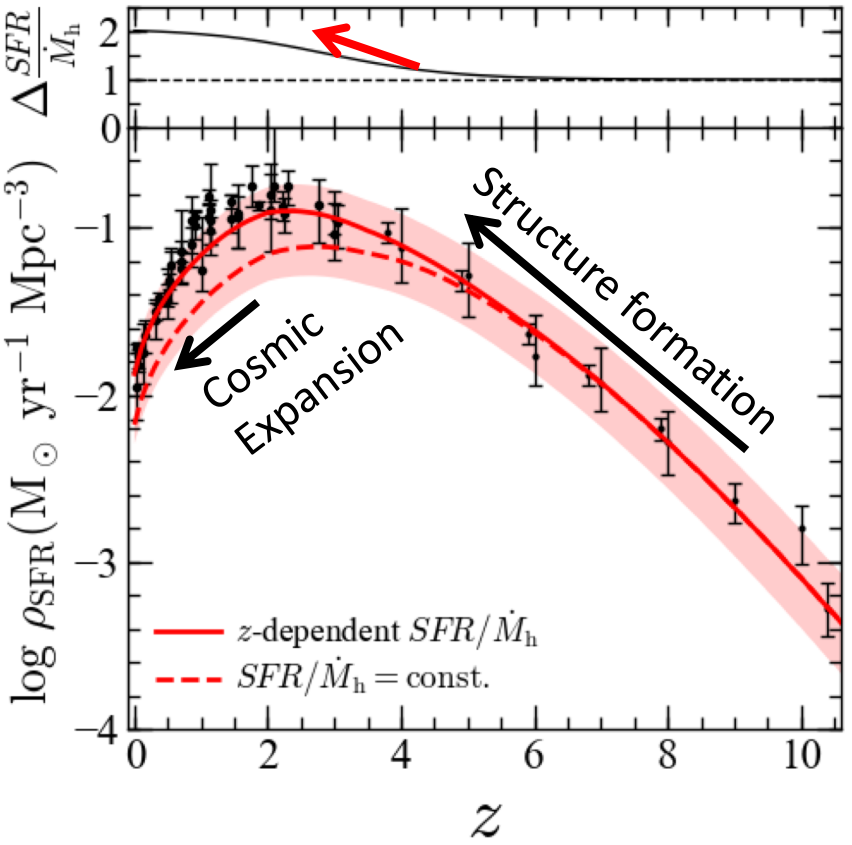
$$\rho_{\rm SFR} = \int dM_{\rm h} \frac{dn}{dM_{\rm h}} SFR = \int dM_{\rm h} \frac{dn}{dM_{\rm h}} \dot{M}_{\rm h}(M_{\rm h}, z) \frac{SFR}{\dot{M}_{\rm h}}$$

Number density | Accretion rate | This work

N-body simulation

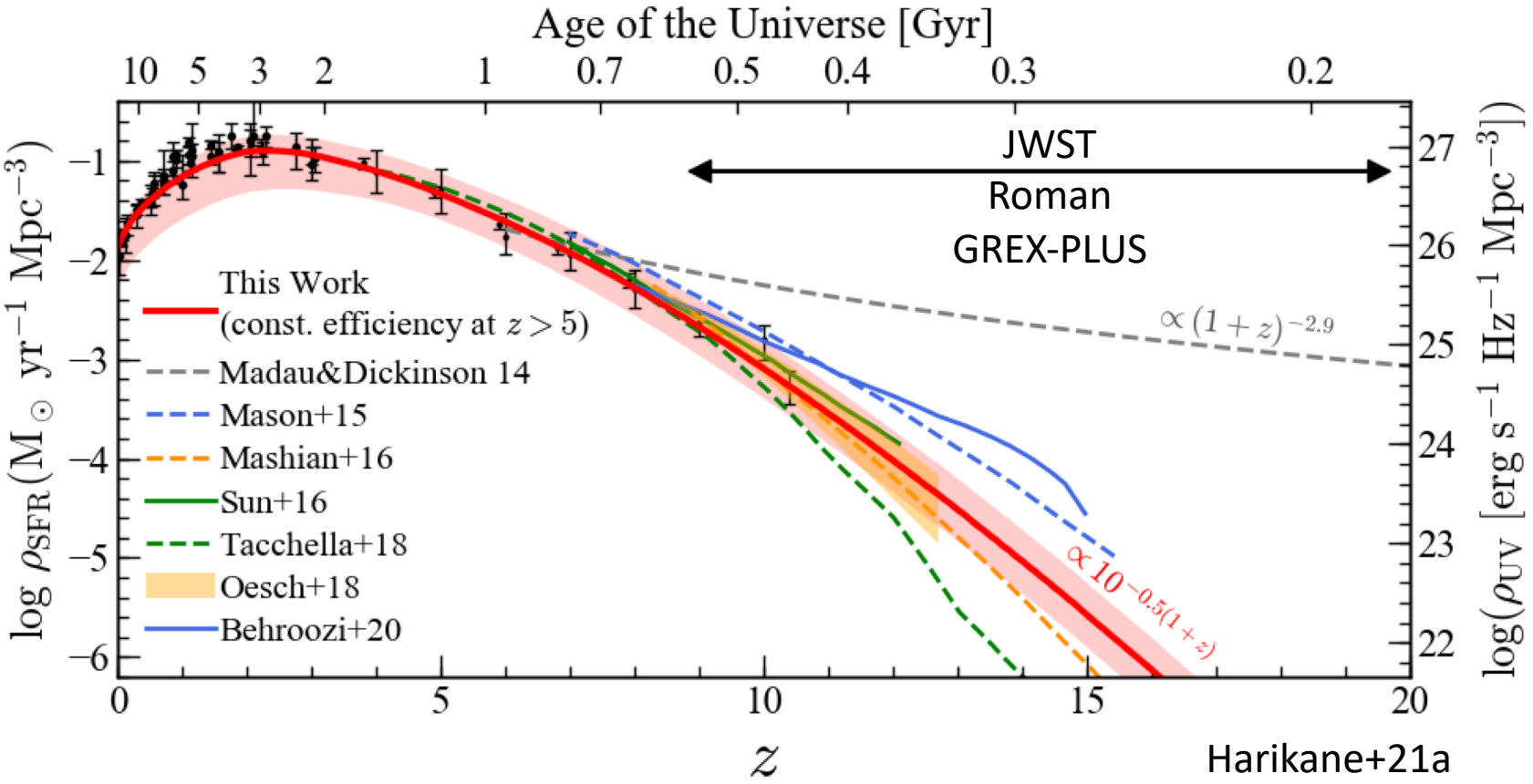
This work





SFR Density Evolution at z>10

- Constant efficiency -> rapid decrease at z>10

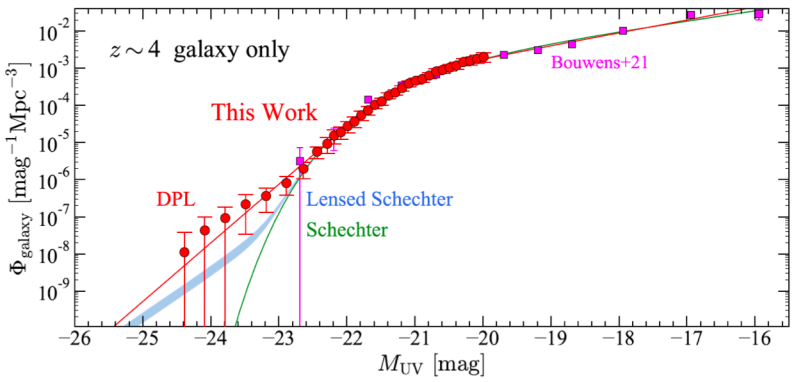


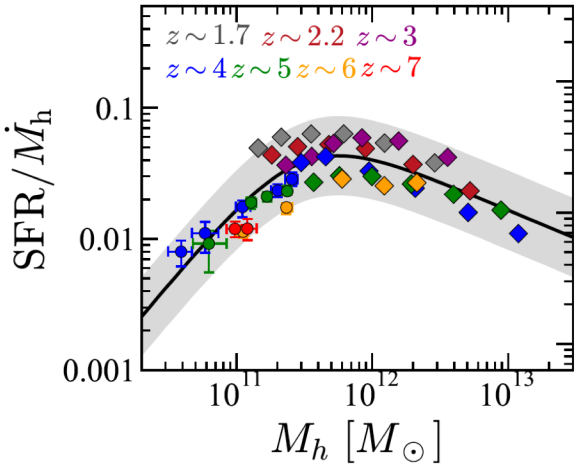
$$\rho_{\rm SFR}/[\rm M_\odot\ yr^{-1}\ Mpc^{-3}] = \frac{1}{61.7\times(1+z)^{-3.13}+1.0\times10^{0.22(1+z)}+2.4\times10^{0.50(1+z)-3.0}}$$

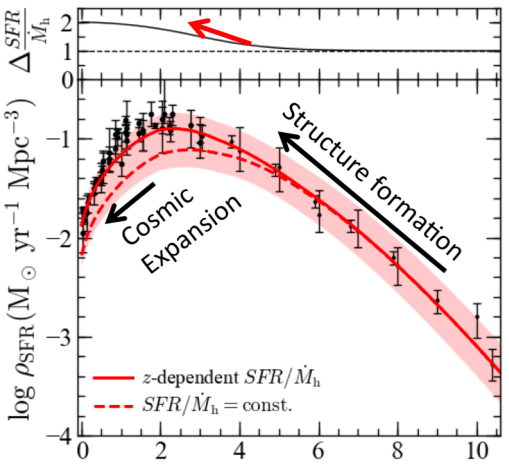
Summary

~4 Million galaxies at z~2-7 from Subaru/HSC data

- Bright end excess beyond the Schechter function
  - Inefficient mass quenching, low dust, hidden AGN?
- Star formation efficiency (SFR/Accretion Rate)
  - Almost constant efficiency at z>4
  - Rapid decrease at z>10?







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