Low-mass passive and post-starburst galaxies at $z = 1.5$ - 2.0 in the UltraVISTA field

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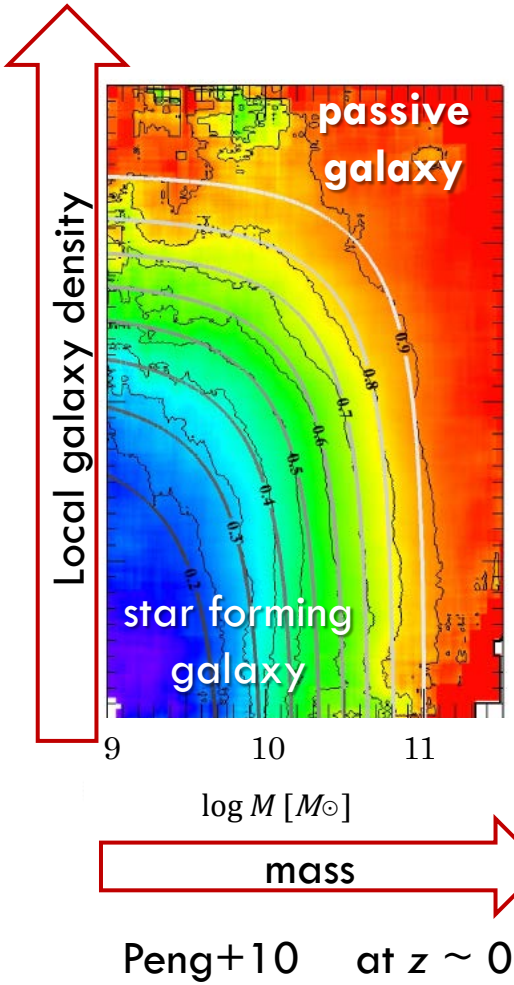
Introduction

Investigating how star formation stopped is important to understand star formation history of galaxies

star forming galaxy → **passive evolution galaxy**



Peng+10 at $z \sim 0$

The fraction of passive galaxies depends on both stellar mass & environment.

- Mass quenching
- Environmental quenching

Purpose

The mass function of passive galaxies at high redshift

Quenching mechanism in the early universe

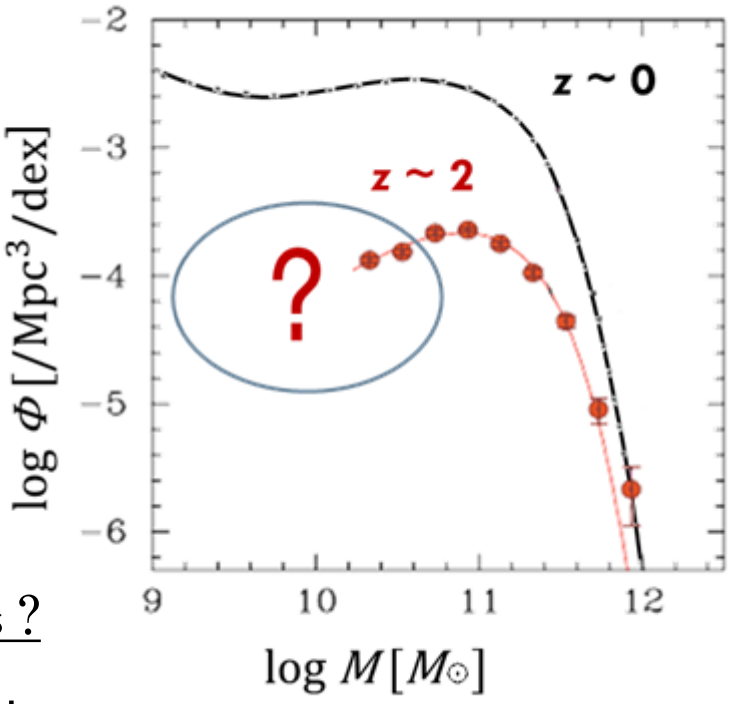
- $z \sim 1 - 2$

  Strong number density evolution of massive passive galaxies

How about low-mass of passive galaxies ?

Post-starburst galaxies are also important

The stellar mass function of passive galaxies



Arcila-Osejo+13

We investigated the low-mass end of the stellar mass function of passive and post-starburst galaxies at $z \sim 2.0$

Data

- UltraVISTA DR2 ultra-deep stripes (*Y J H* Ks - band data)

  0.73 square degree in the COSMOS field

- Subaru/SCam ultra-deep imaging (*z* - band data)

  Picking up the Balmer/4000Å break of the galaxy at $z \sim 2$

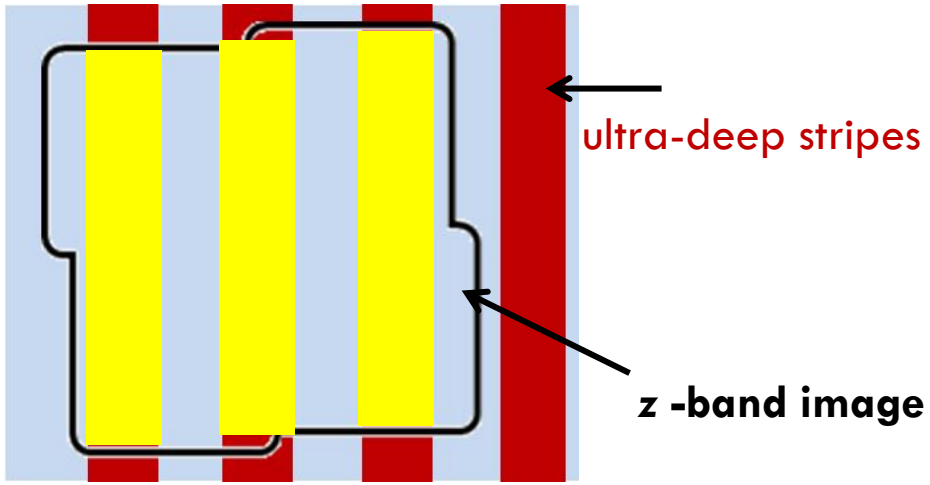
- limiting magnitude

  z = 26.8, Y = 25.8, J = 25.3, H = 25.0, Ks = 25.1

  AB magnitude (5σ, 1.8" aperture)

- 0.40 square degree

(overlaps with these data)



Analysis

1. Source detection on the *Ks*-band image

2. Color selection for passive & post-starburst galaxies at $z = 1.5 - 2.0$ with *z-J* v.s. *J-K* diagram

3. Removing contaminants with photo-z
   using *U, B, r, i, IA484, IA624, IA738, z, Y, J, H, Ks* bands
   (only high-quality data with <0.9" PSF FWHM)

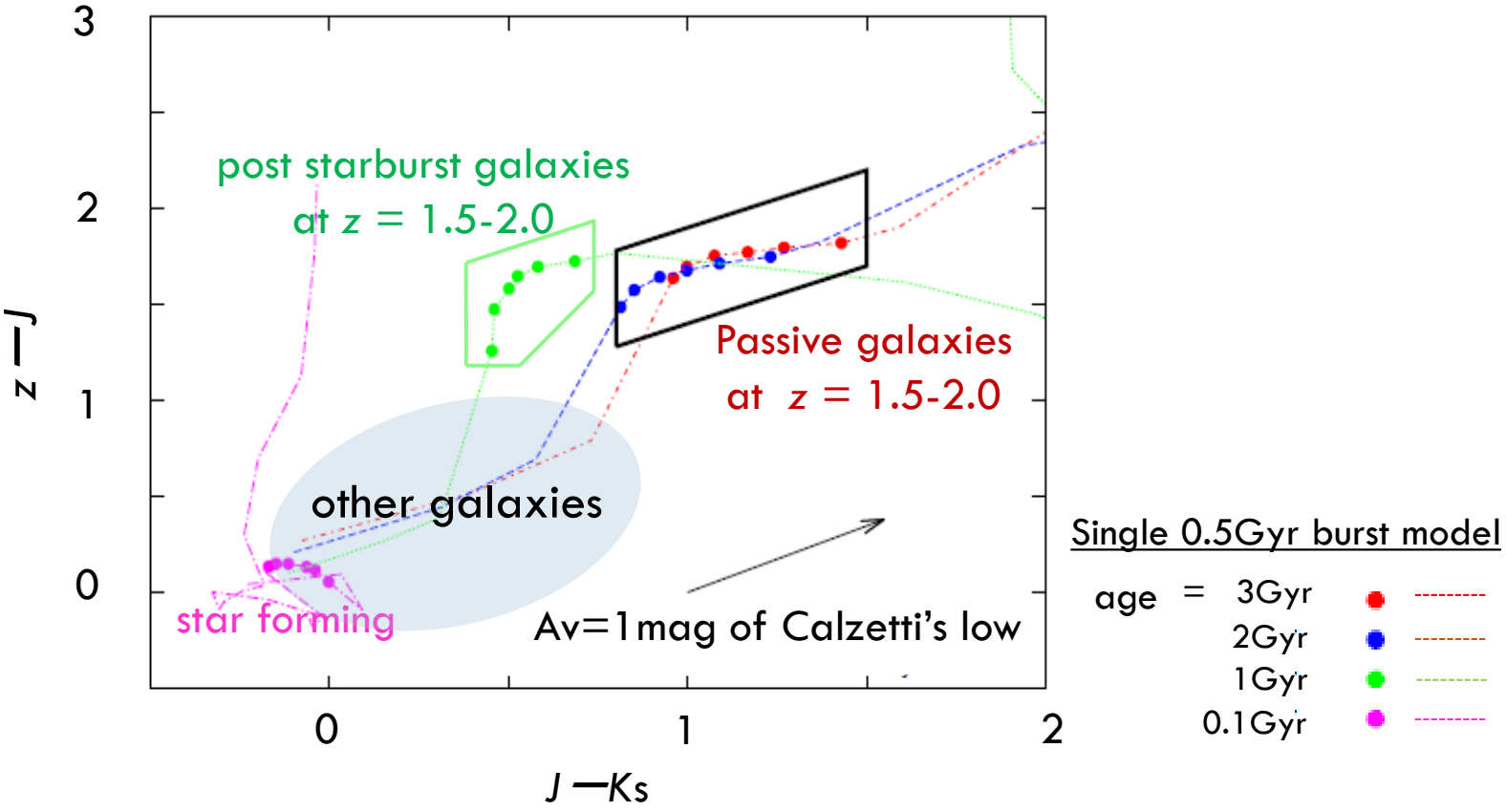
4. Estimate *Mv* and stellar mass from the SED fitting

5. Calculate completeness for the color selection as a function of *Mv*

6. Derive stellar mass function of passive & post-starburst galaxies at $z \sim 2$ with the 1/Vmax method

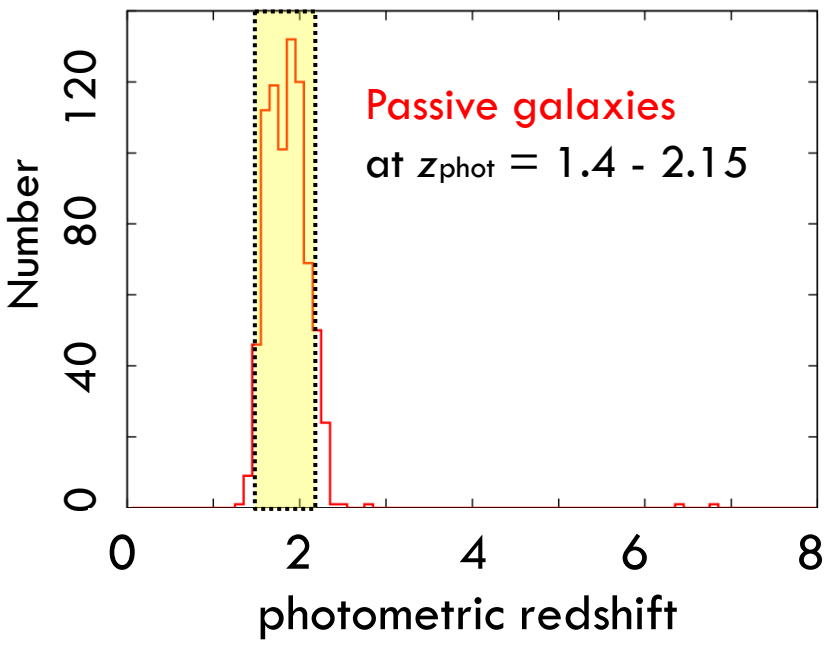
Color selection

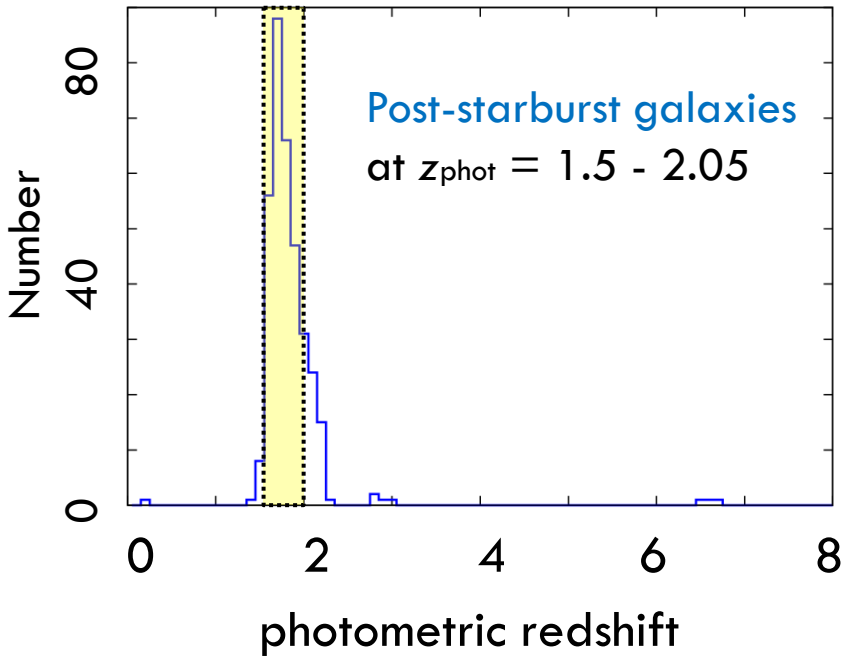
Selection for passive & post-starburst galaxies at z = 1.5 - 2.0



dots represent galaxies at z = 1.5, 1.6, 1.7, 1.8, 1.9, 2.0

Photometric redshift distribution





passive galaxies

728 samples

post-starburst galaxies

303 samples

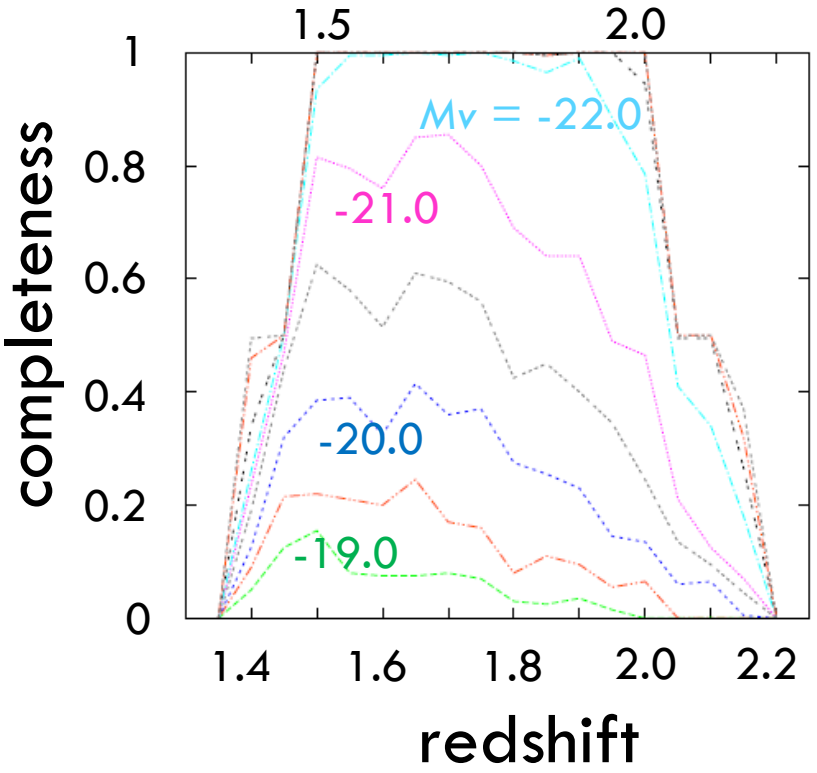
Completeness

Process of finding the completeness

1. Assuming SEDs of galaxies with each V-band absolute magnitude using single 0.5 Gyr burst models with ages of 1, 2 and 3 Gyr.

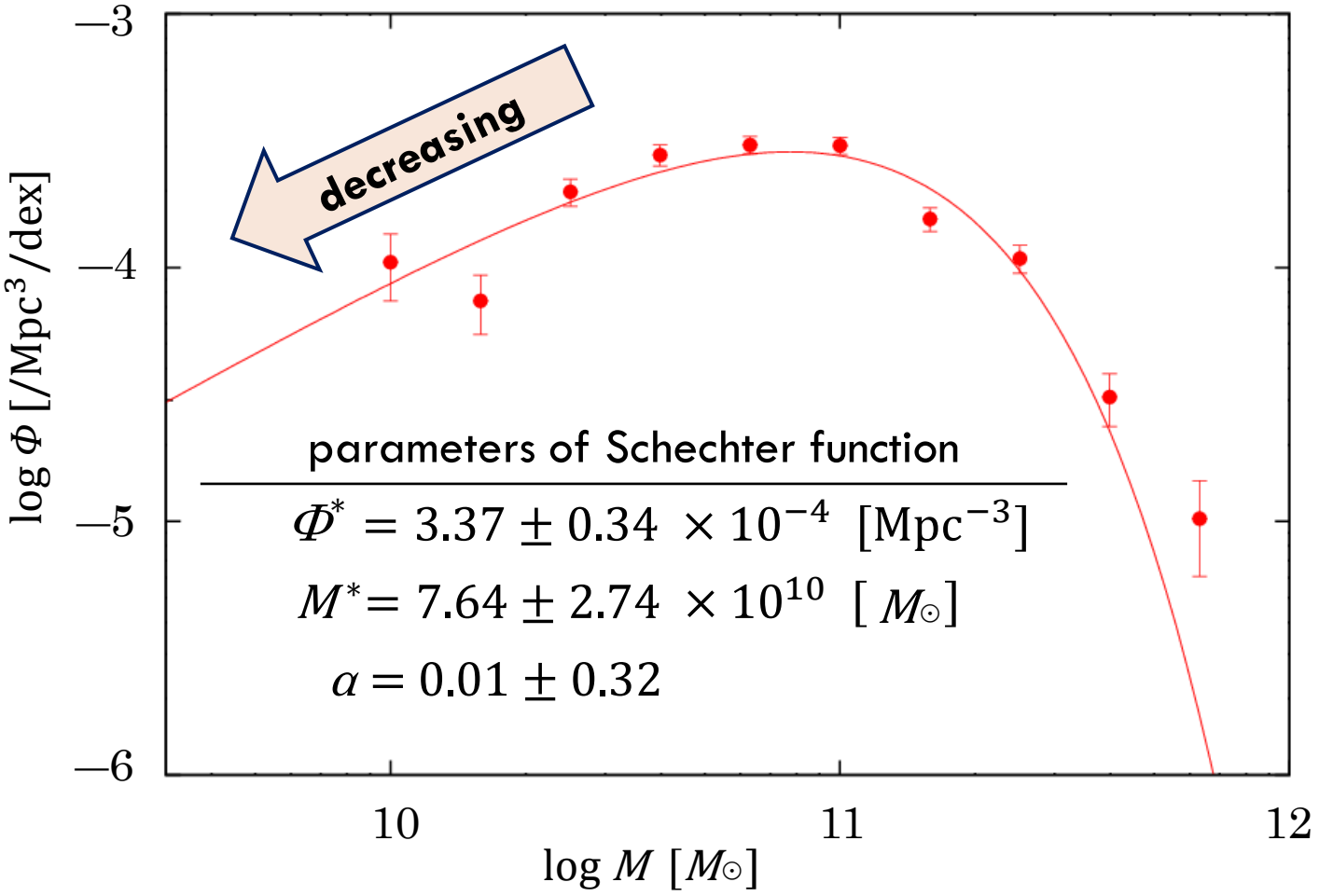
2. For these model SEDs at each redshift, we calculated the apparent magnitudes used in the color selection.
- Carried out Monte Carlo simulation adding the random photometric errors to the calculated apparent magnitudes.
- Performing the same color selection again.

3. We can estimate the completeness from the fraction of simulated objects which satisfy the selection criteria.



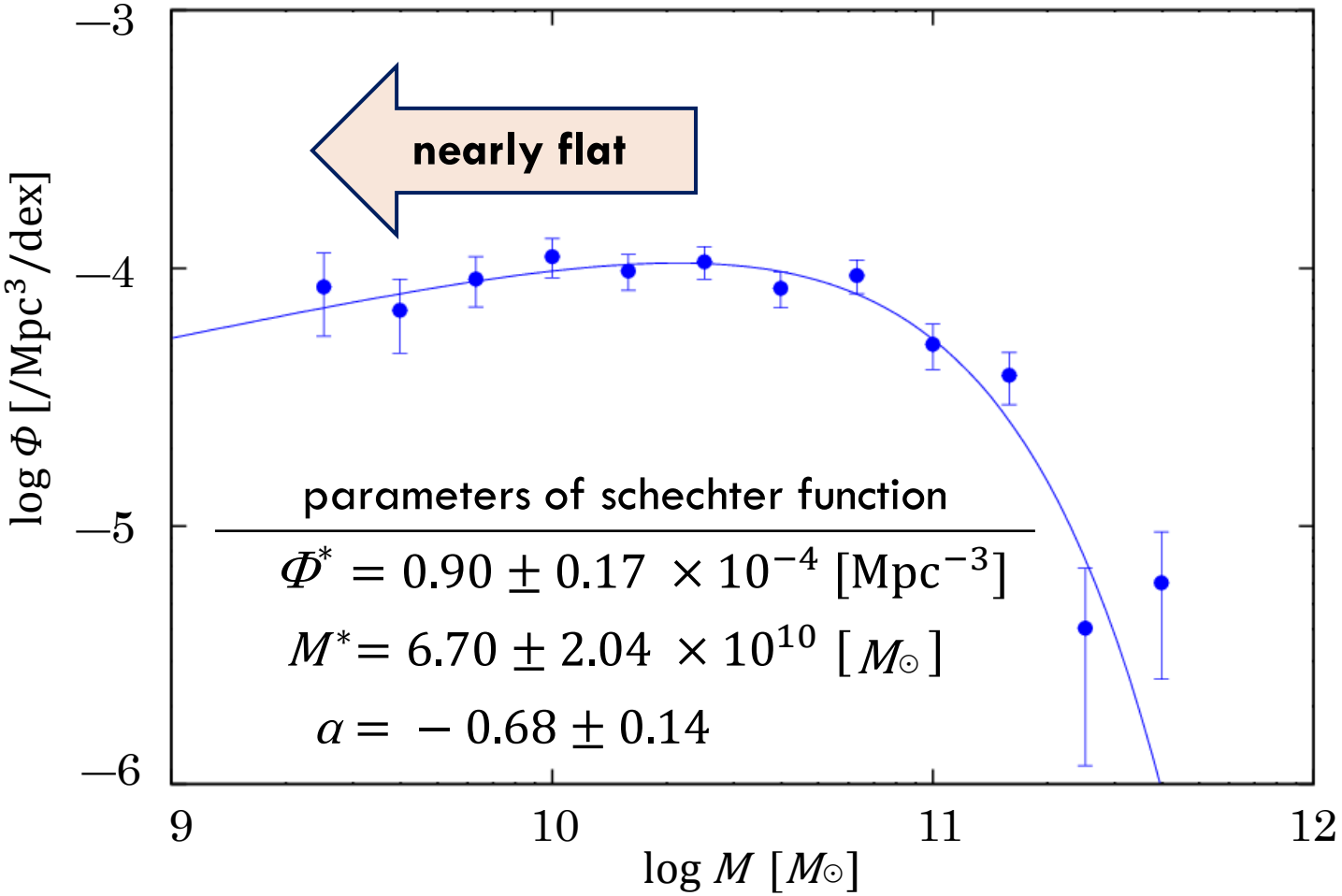
Completeness for passive galaxies

Stellar Mass Function of passive galaxies (at z = 1.4 - 2.15)



The number density of low-mass passive galaxies is relatively small.

Stellar Mass Function of post-starburst galaxies (at z = 1.5 - 2.05)

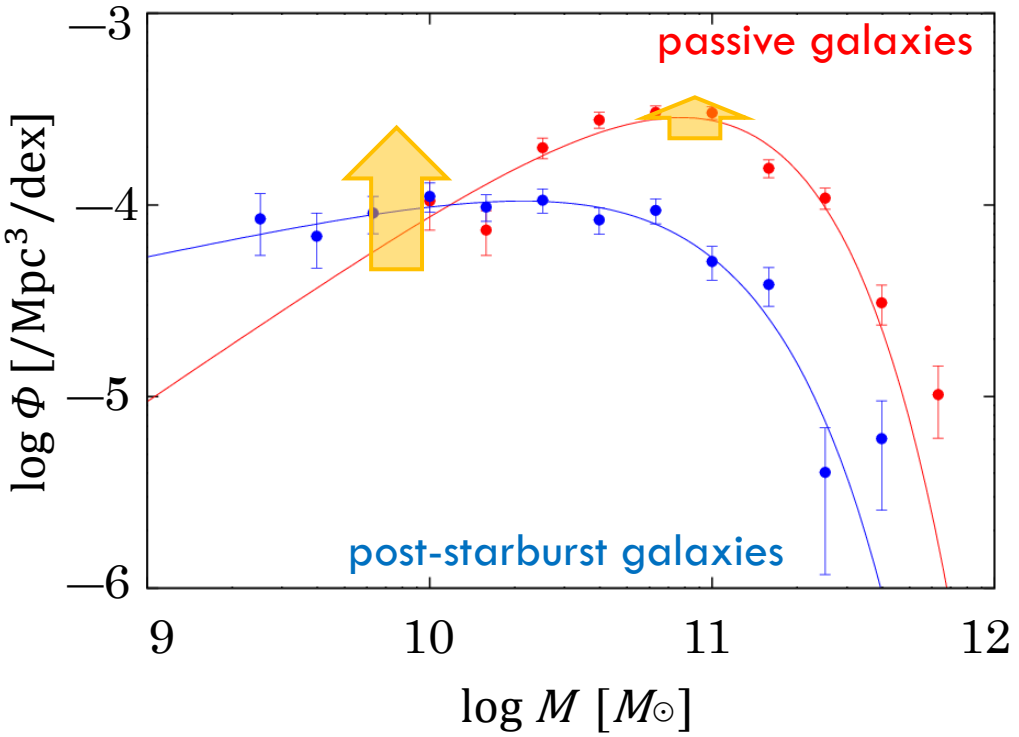


Post-starburst galaxies show flatter low-mass end slope.

Discussion

The low-mass end slopes are significantly different between passive and post-starburst galaxies.

Post-starburst galaxies dominate in number at low stellar mass.



Since post-starburst galaxies evolve into passive galaxies within ~1Gyr, these galaxies are expected to cause stronger evolution of the number density of the passive population at lower mass.

Mass & environmental quenching

- The number density of passive galaxies at $z = 1.4$ - 2.15 decreases with decreasing stellar mass

  ⟶ mass quenching has dominated by $z \sim 2$?

- Low-mass post-starburst galaxies show a similar number density with massive ones

  ⟶ environmental quenching may start to work ?

Future work

- Derive the stellar mass function of post-starburst galaxies at various redshifts and investigate the evolution of its shape and normalization.

- Investigate the environments of these post-starburst galaxies and its evolution.

Summary

- We investigated the stellar mass function of passive at $z = 1.4 - 2.15$ and post-starburst galaxies at $z = 1.5 - 2.05$ down to $10^{10}\ M_{\odot}$, using the ultra-deep Scam z-band and UltraVISTA DR2 data.
- We found that the number density for low-mass passive galaxies is smaller than massive galaxies.
- On the other hand, post-starburst galaxies show a significantly flatter low-mass end slope.
- If these post-starburst galaxies become passive galaxies, the number density of low-mass passive galaxies is expected to increase more rapidly than high-mass ones.