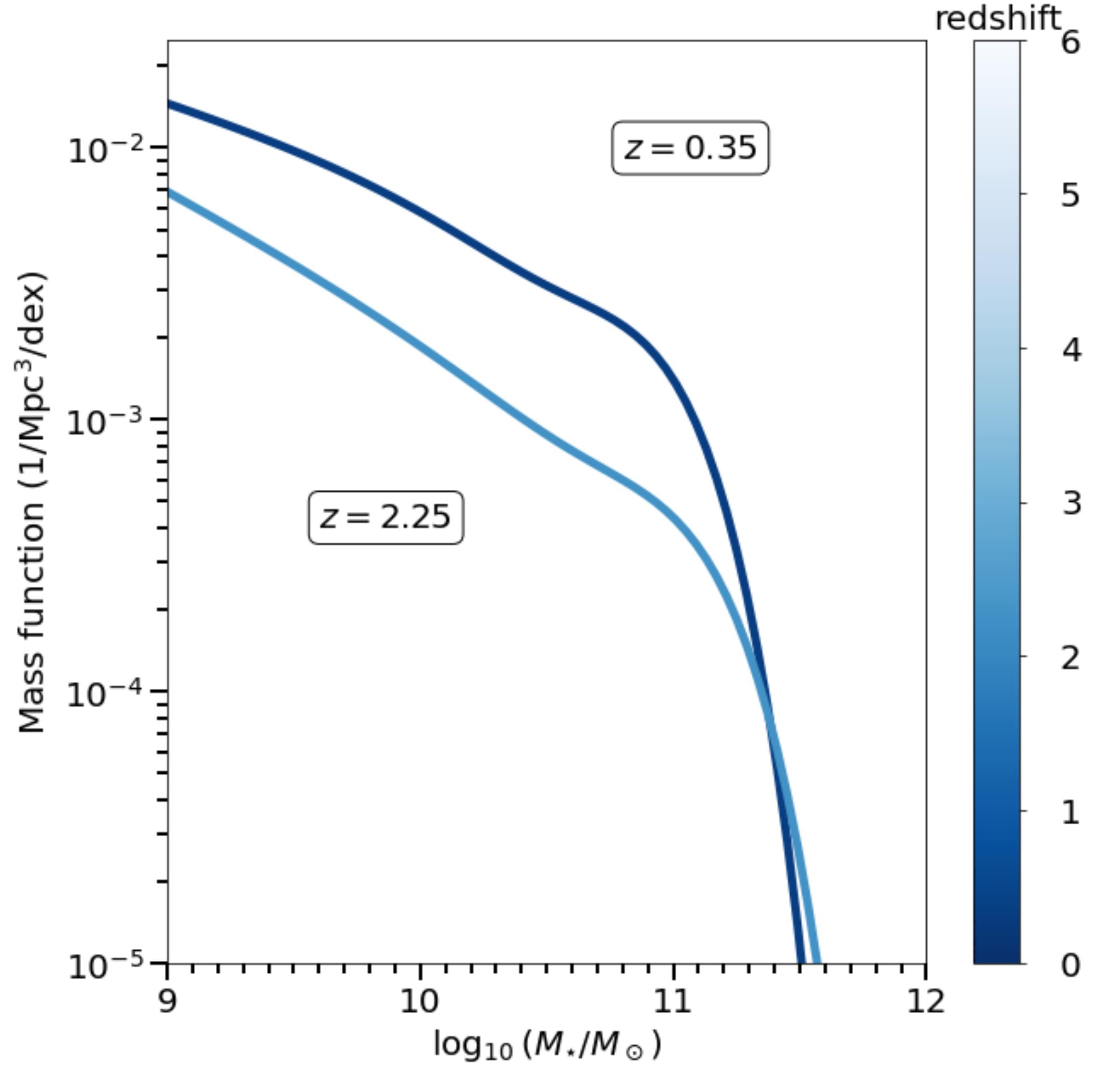


# The Herschel-ALMA view of the cosmic history of massive galaxies

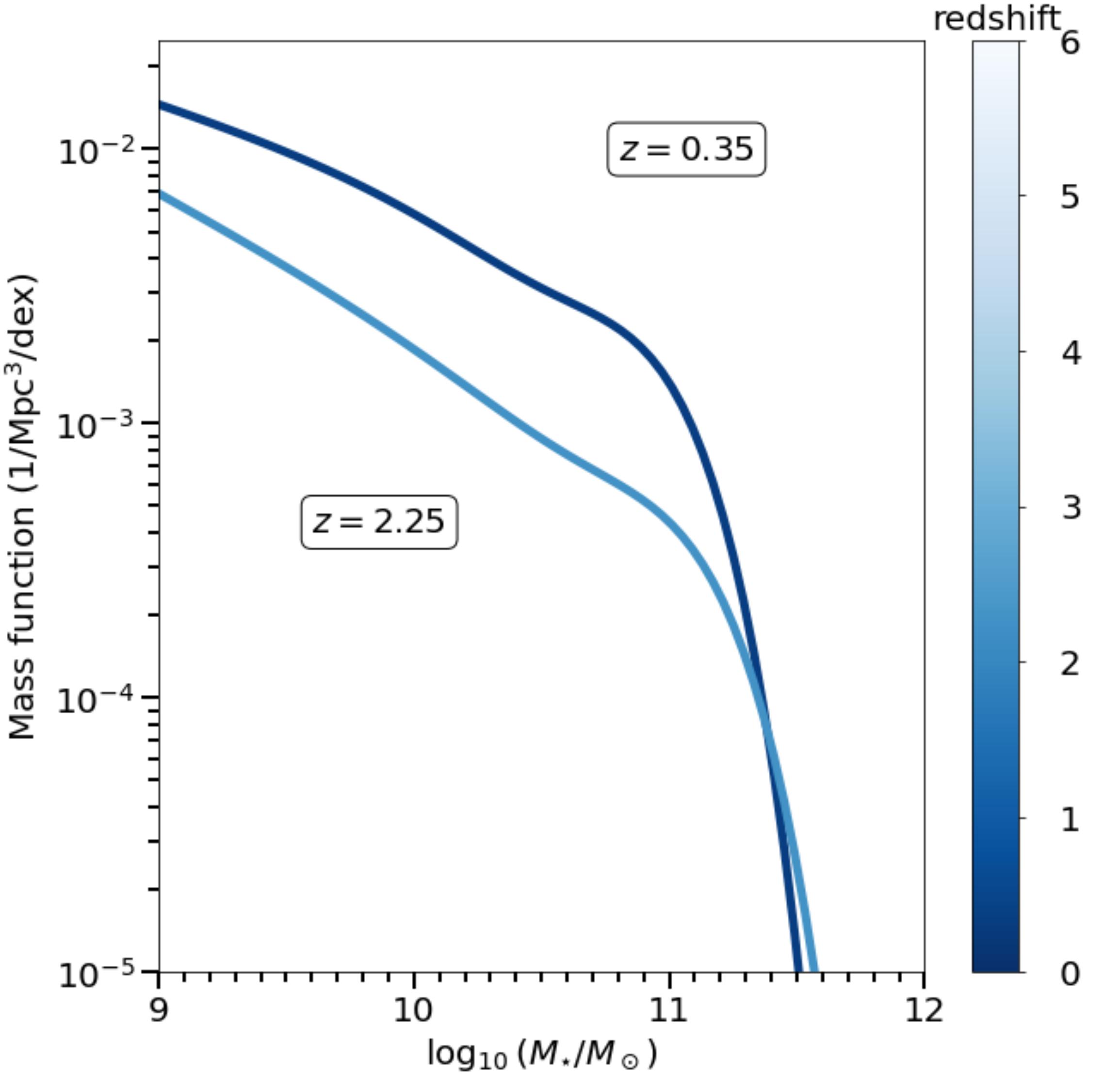
Lucas Leroy  
CEA Saclay

D. Elbaz, B. Magnelli, C. Gómez-Guijarro, E. Daddi, M. Xiao

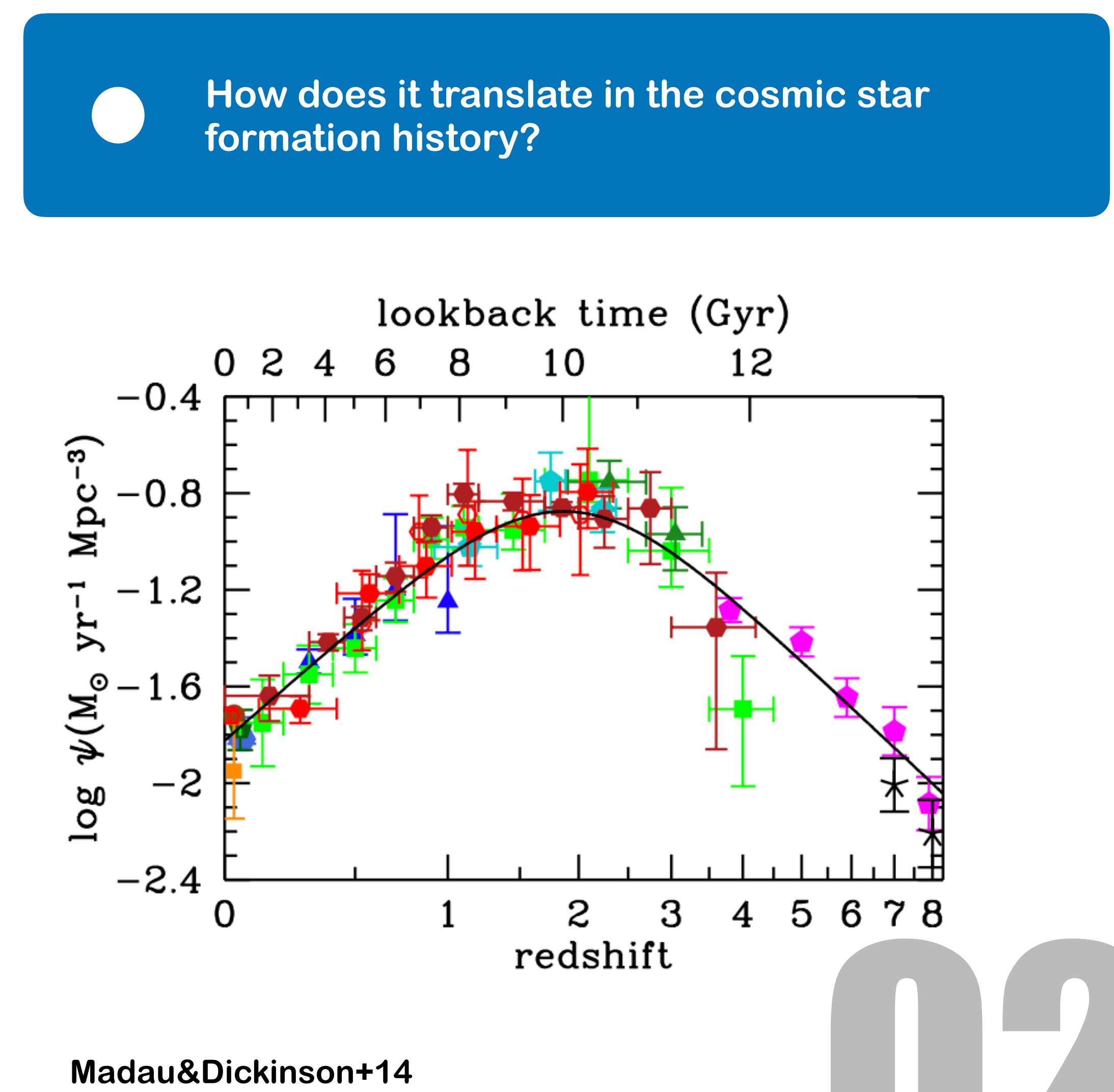
# How do galaxies grow?



# How do galaxies grow?

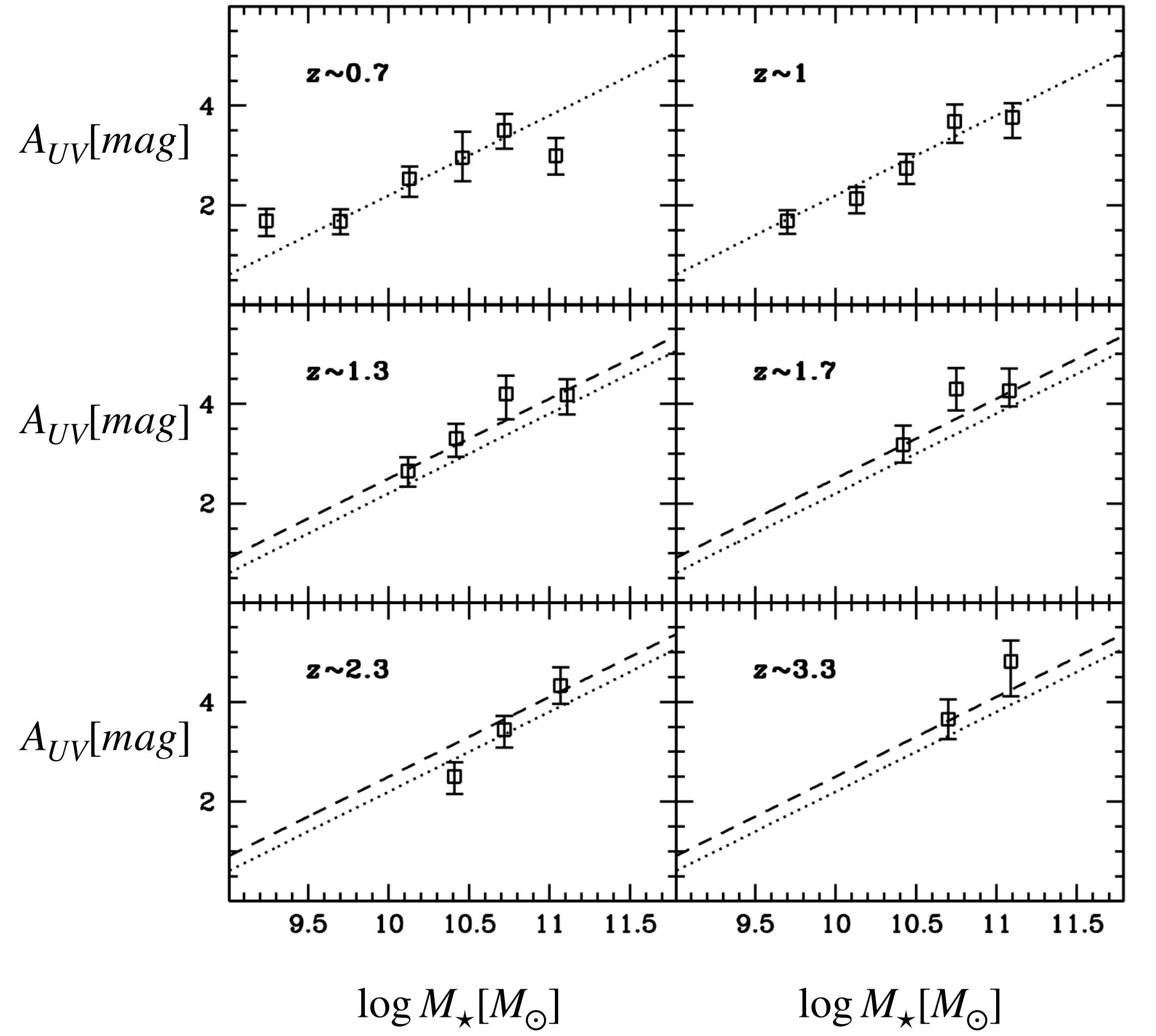


Davidzon+17



Madau&Dickinson+14

# The role of dust

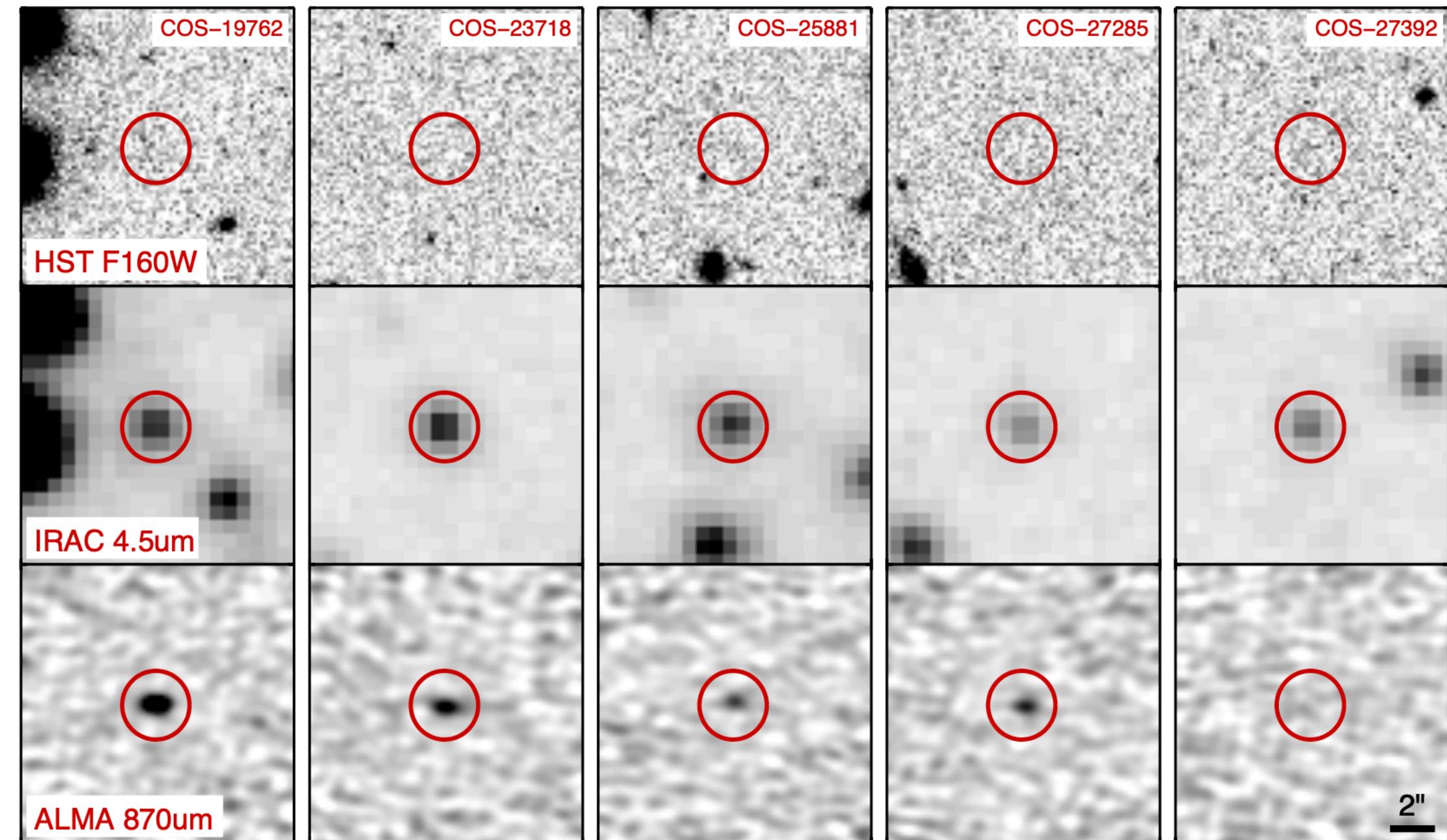
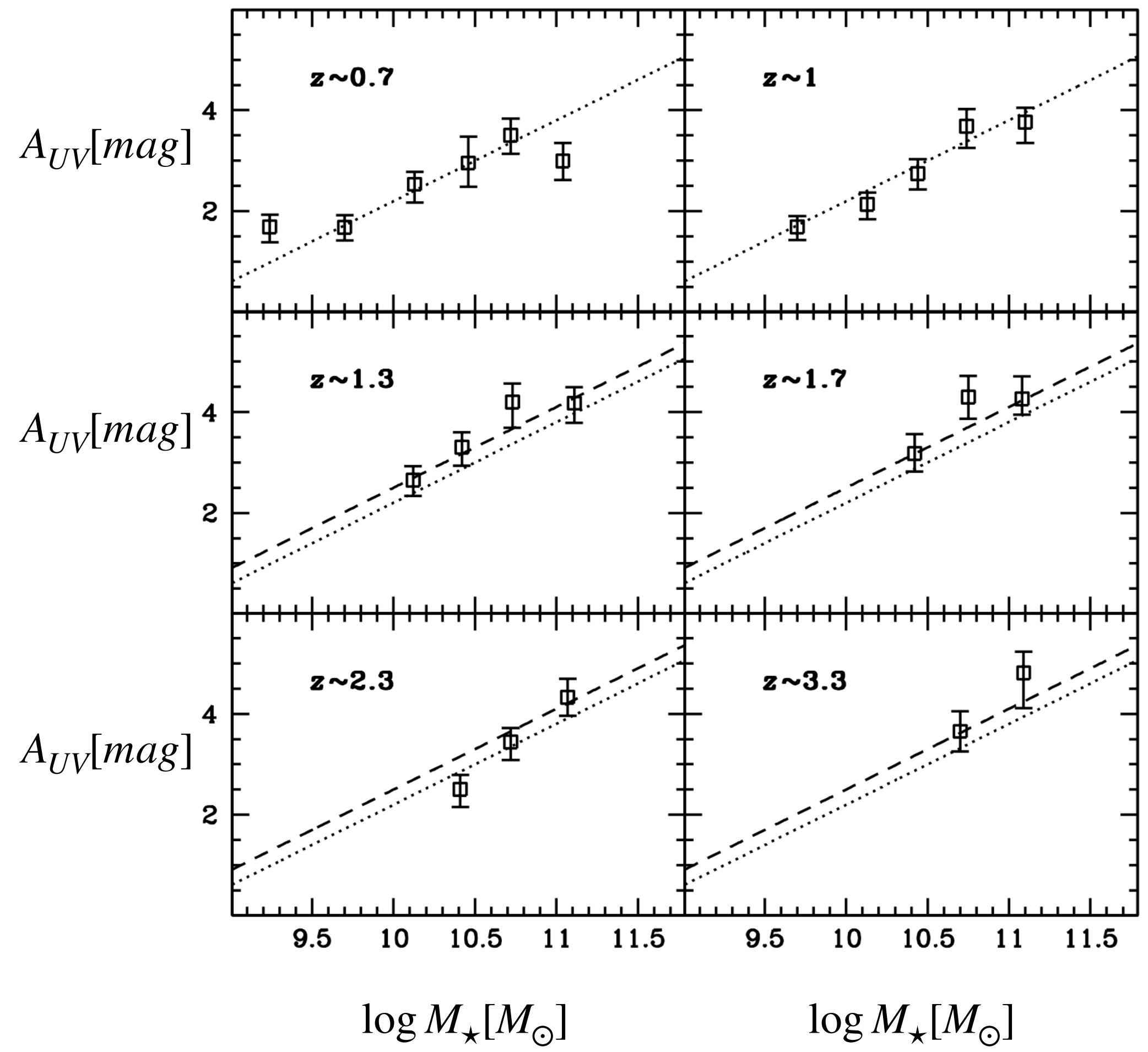


$\log M_\star [M_\odot]$

$\log M_\star [M_\odot]$

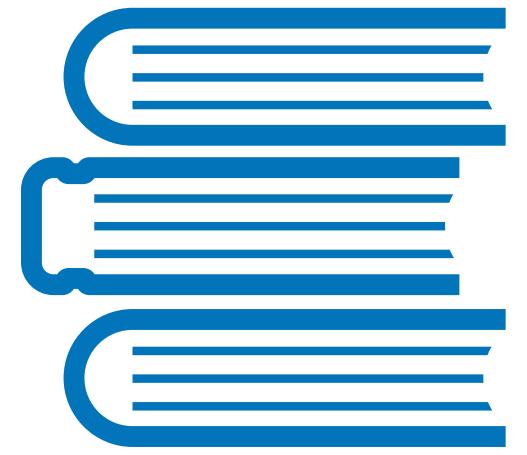
$$A_{UV} = 2.5 \times \log(SFR_{\text{IR}} / SFR_{\text{UV}}^{\text{obs}} + 1)$$

# The role of dust



H-dropout : high  $M_\star$ , very dusty

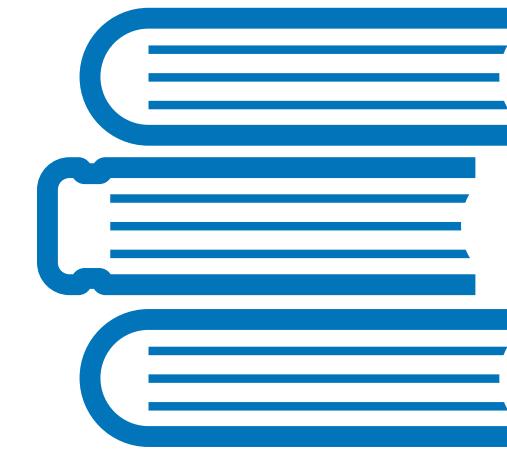
## What we do



Catalogues of H-band selected SFGs

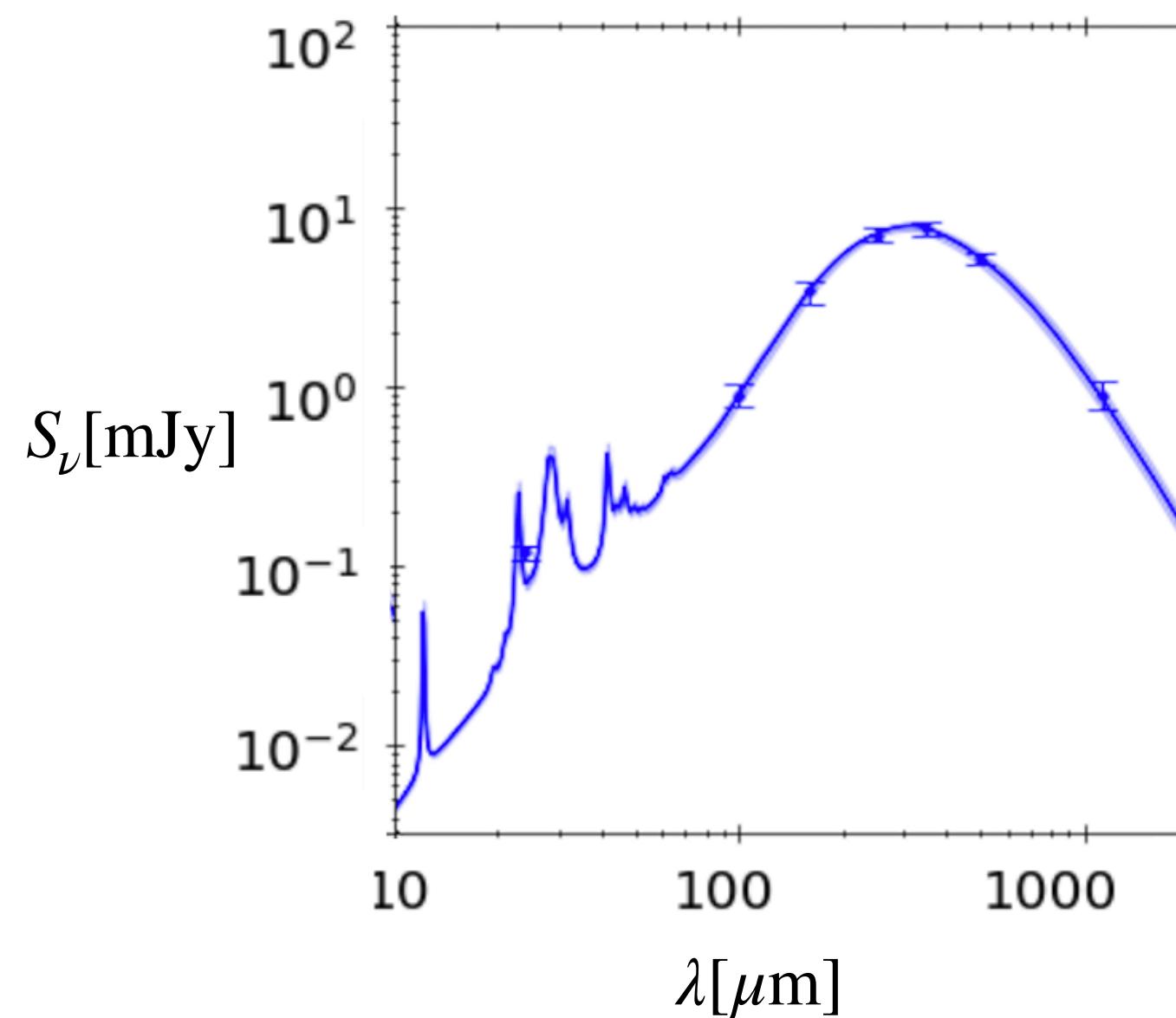
04

# What we do

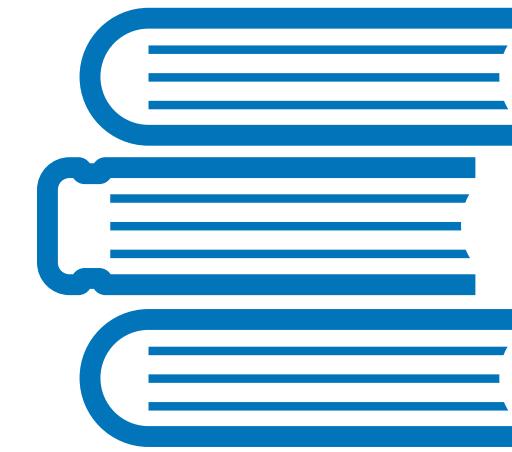


Catalogues of H-band selected SFGs

Improving photometry limits through stacking



# What we do

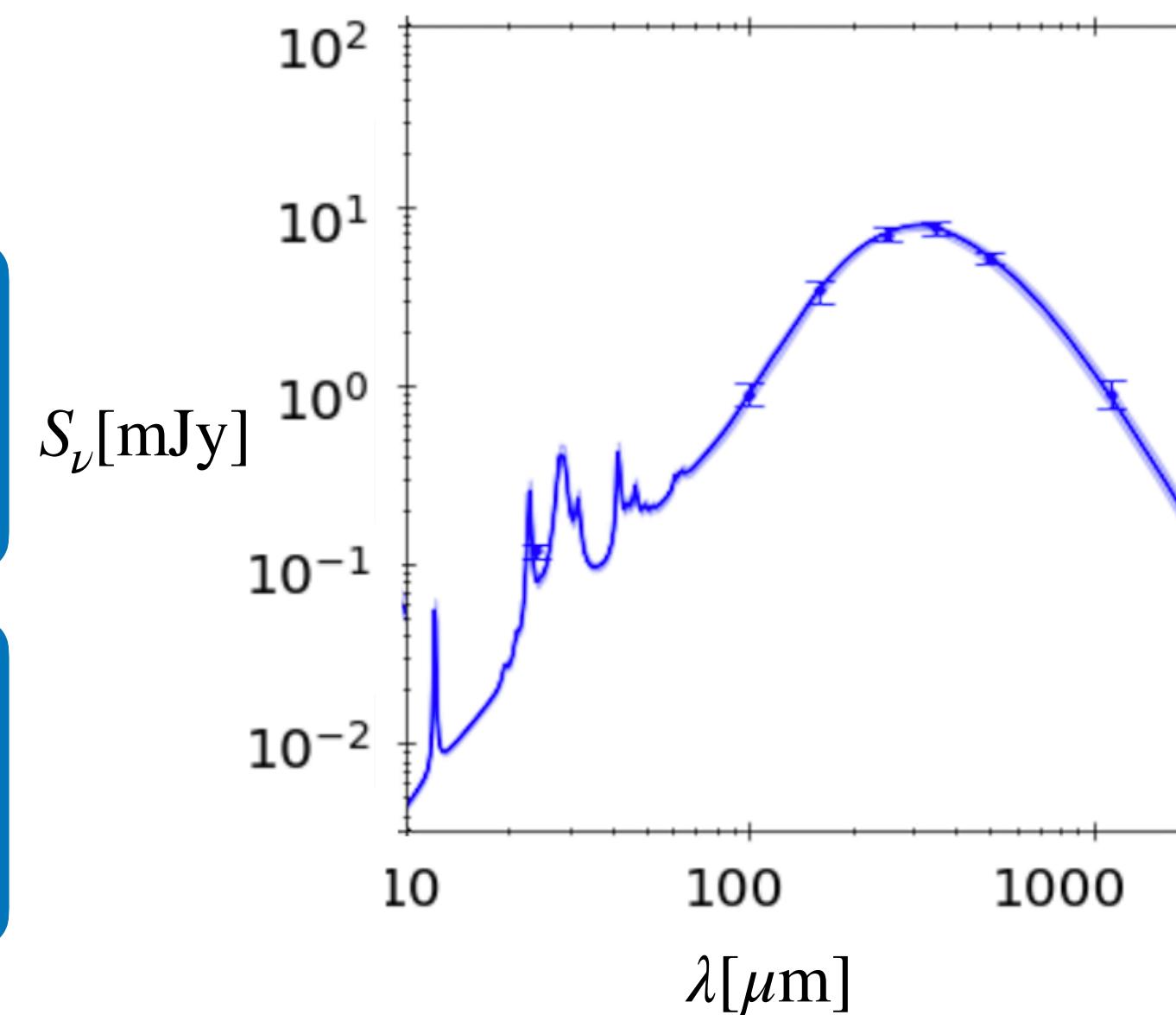


Catalogues of H-band selected SFGs

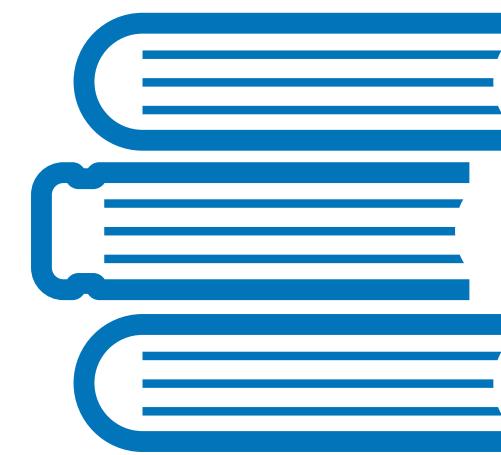
Improving photometry limits through stacking

In CANDELS deep fields :  
GOODS-South, GOODS-North, COSMOS and UDS

In 7 bands :  
MIPS 24 $\mu$ m, PACS 100 $\mu$ m and 160 $\mu$ m, SPIRE 250 $\mu$ m, 350 $\mu$ m, 500 $\mu$ m and ALMA 1.13mm



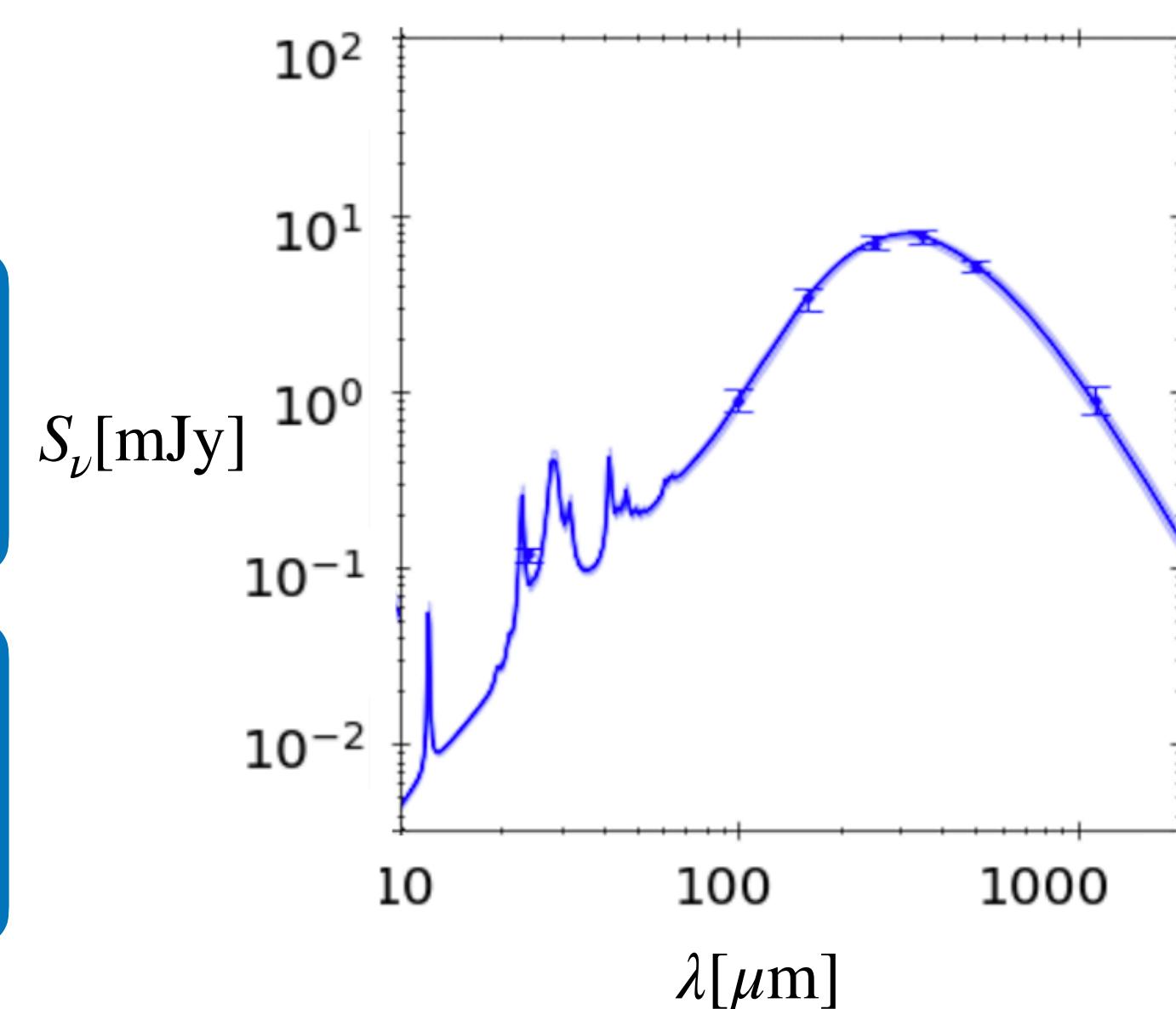
# What we do



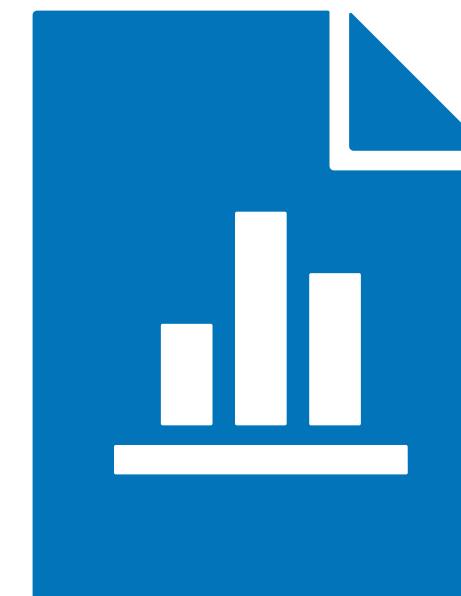
Catalogues of H-band selected SFGs

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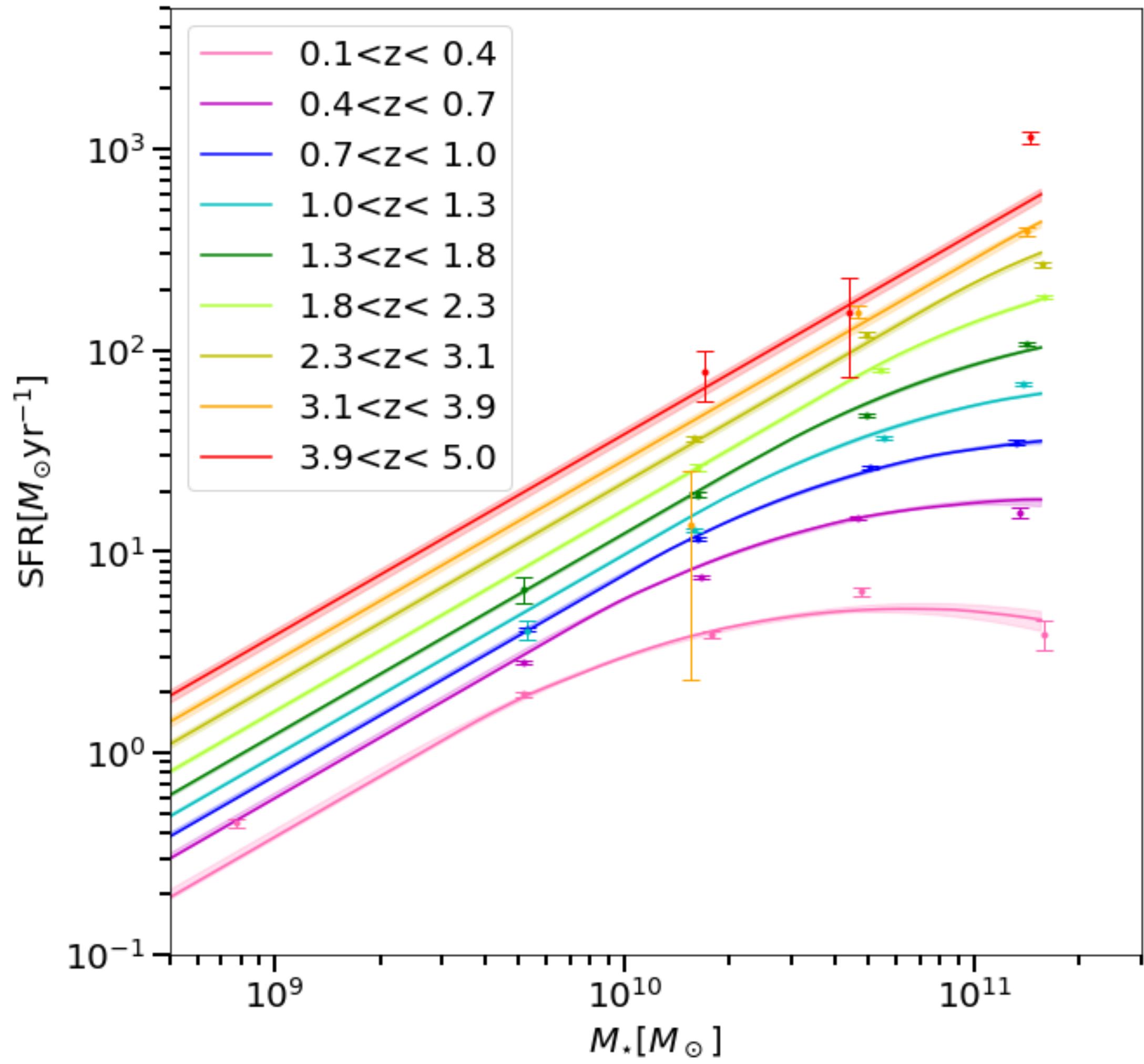
Improving photometry limits through stacking



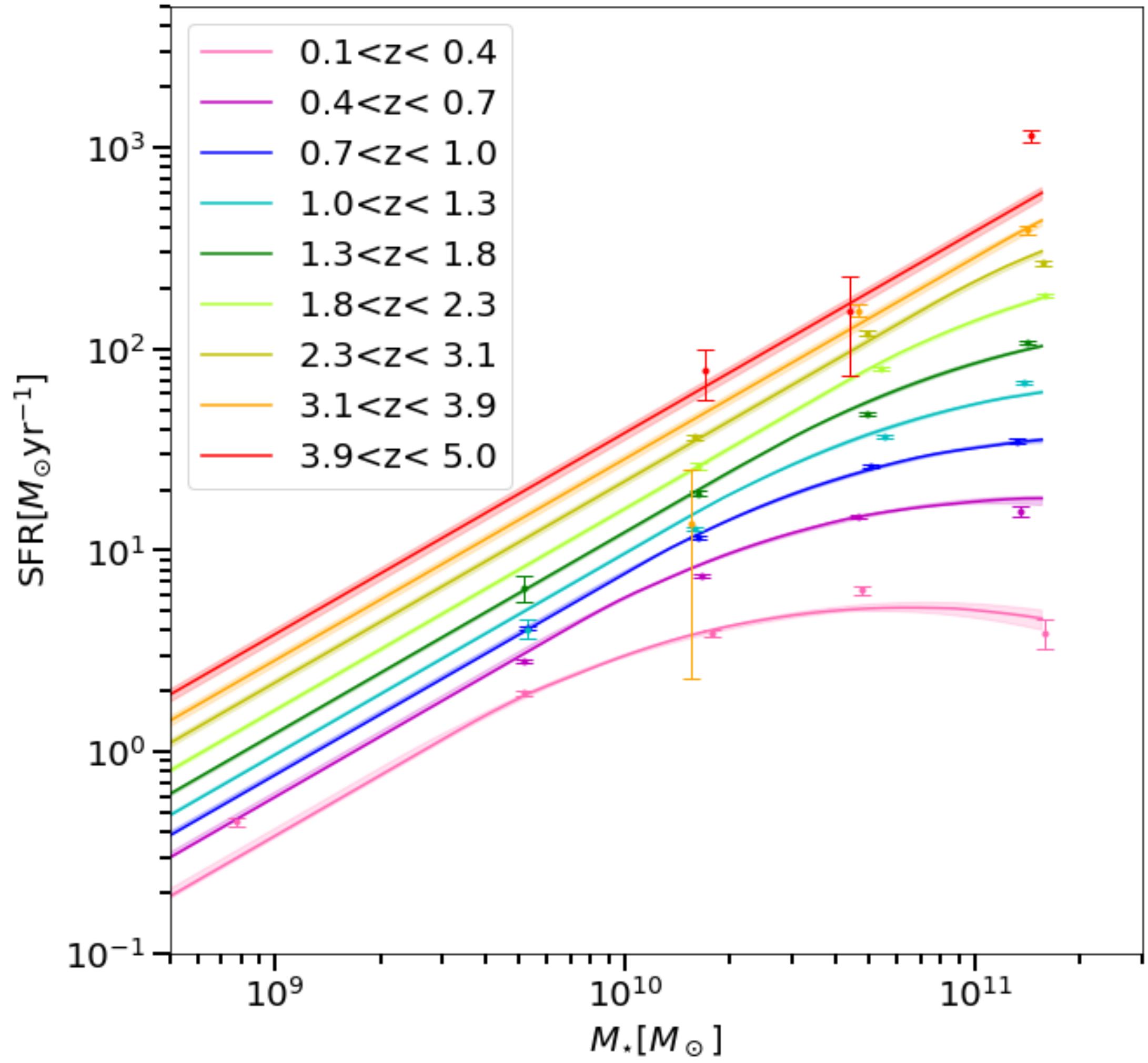
Deducing galaxies properties :  
 $SFR$ ,  $T_{\text{dust}}$ ,  $M_{\text{dust}}$

04

# The main sequence of star forming galaxies at $0 \leq z \leq 5$



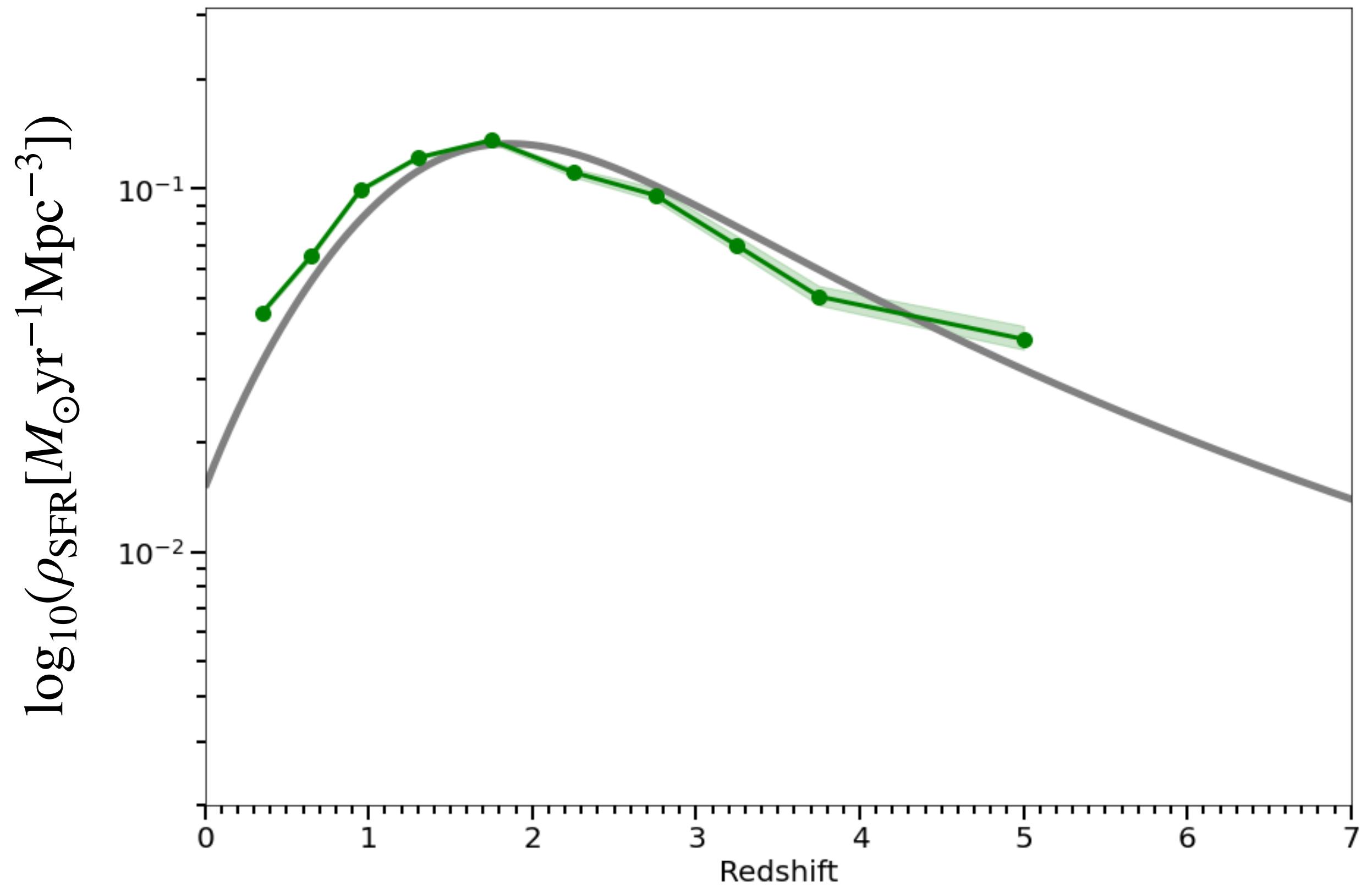
# The main sequence of star forming galaxies at $0 \leq z \leq 5$



● Increased normalisation with redshift

● Bending on the high mass end

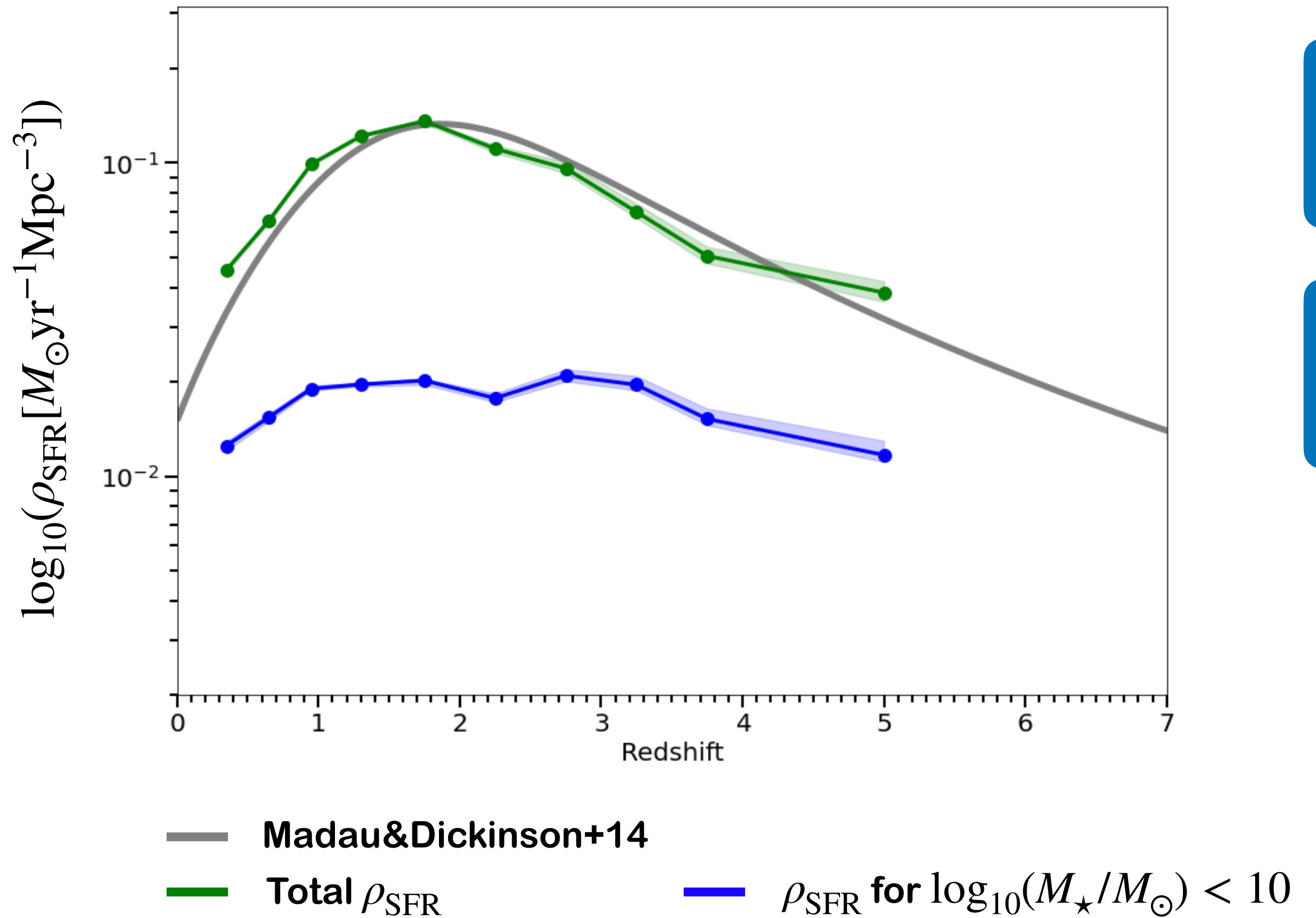
# The cosmic star formation history



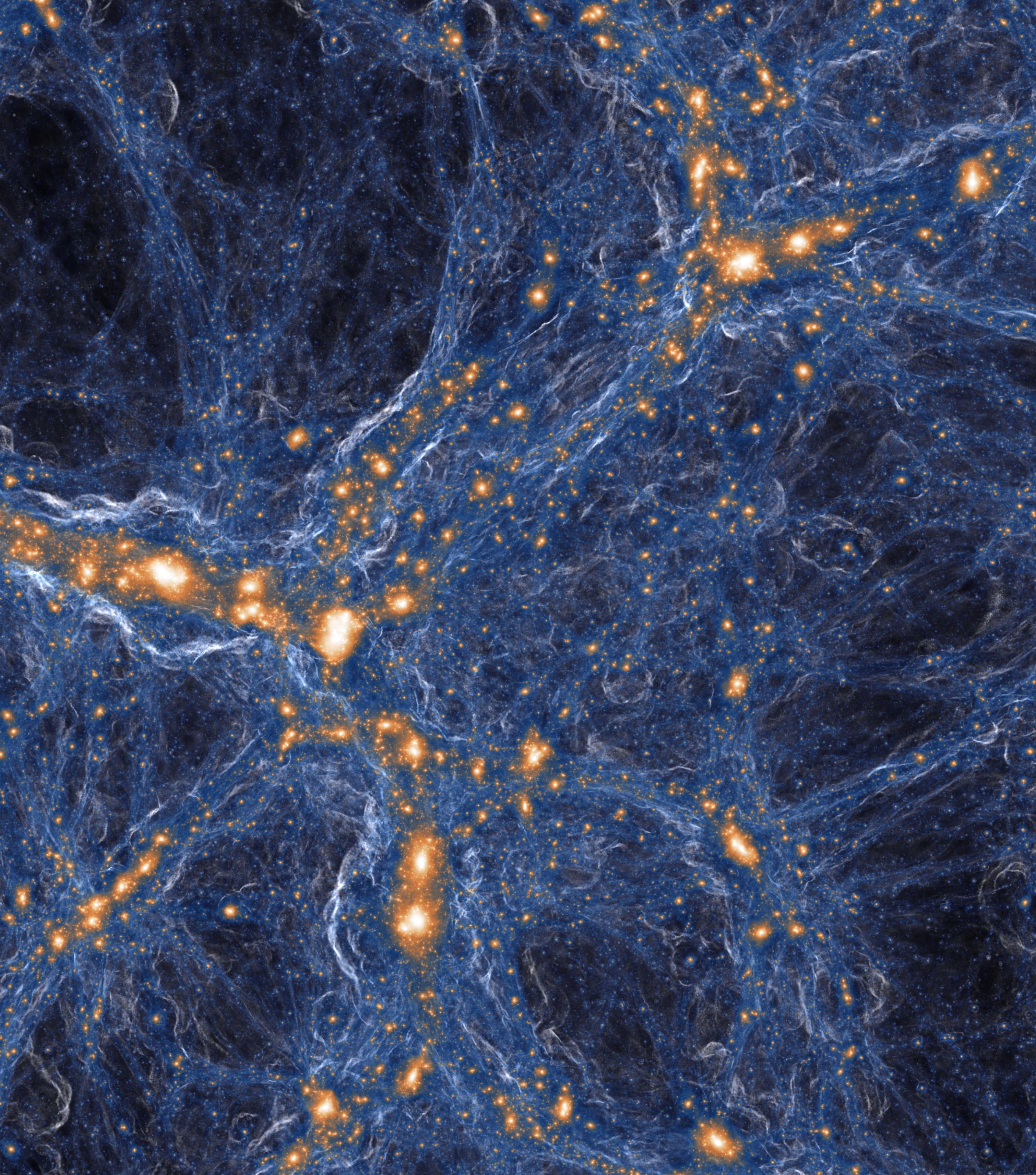
- Madau&Dickinson+14
- Total  $\rho_{\text{SFR}}$

● Madau & Dickinson  $\rho_{\text{SFR}}$  evolution still hold!

# The cosmic star formation history

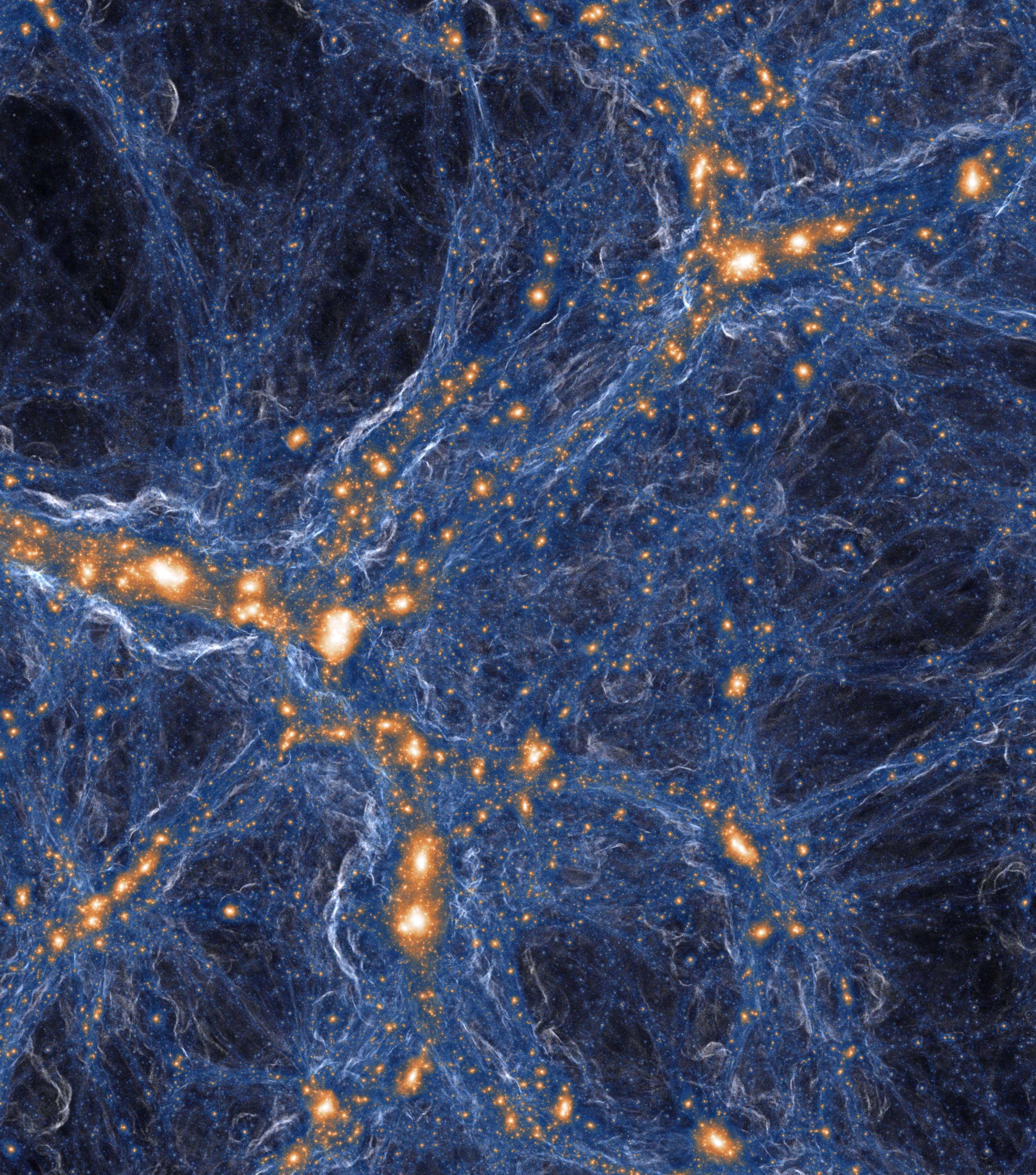


- Madau & Dickinson  $\rho_{\text{SFR}}$  evolution still hold!
- Lower mass galaxies contribution is nearly flat



# TNG100

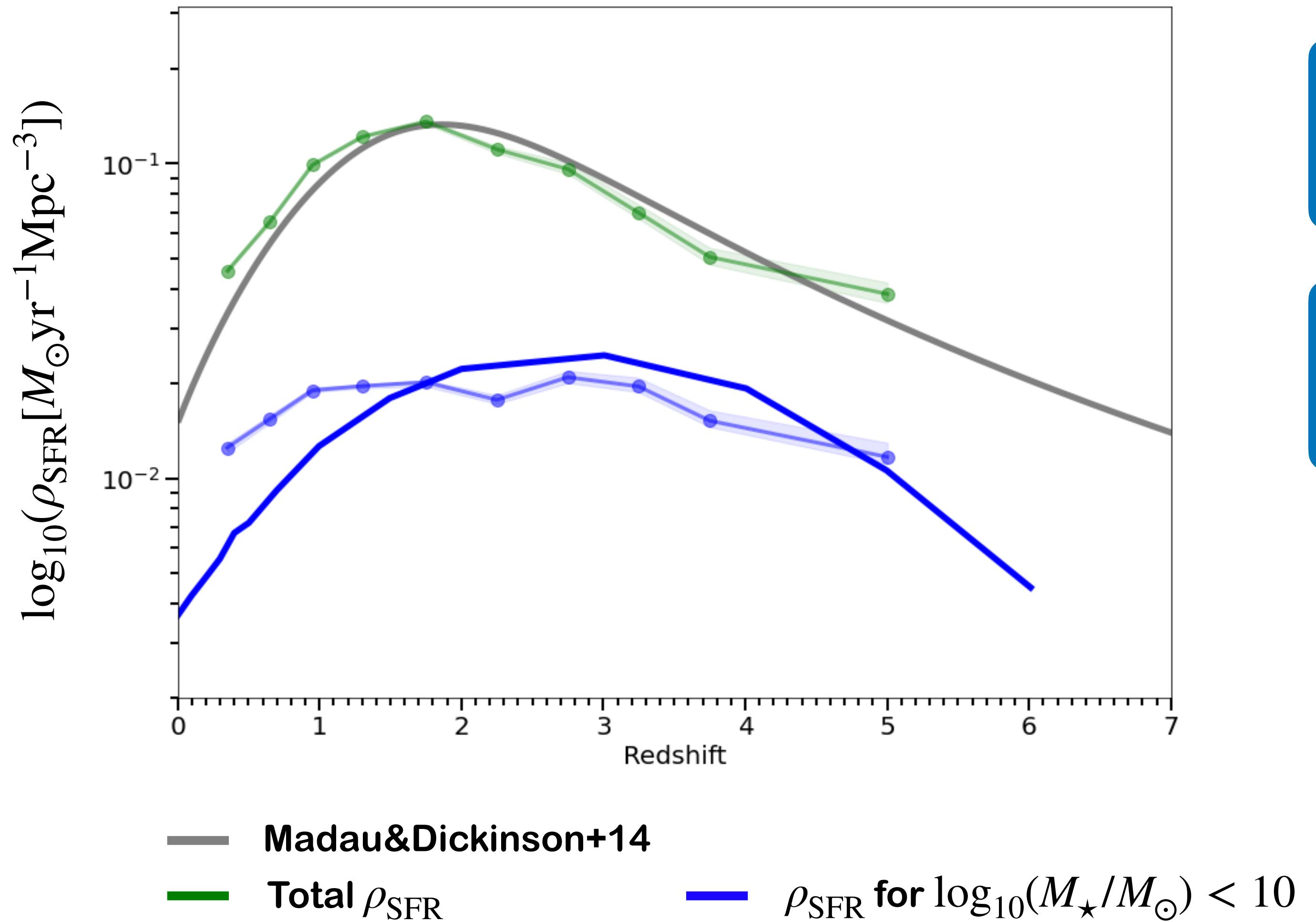
Credit: TNG Collaboration



# TNG100

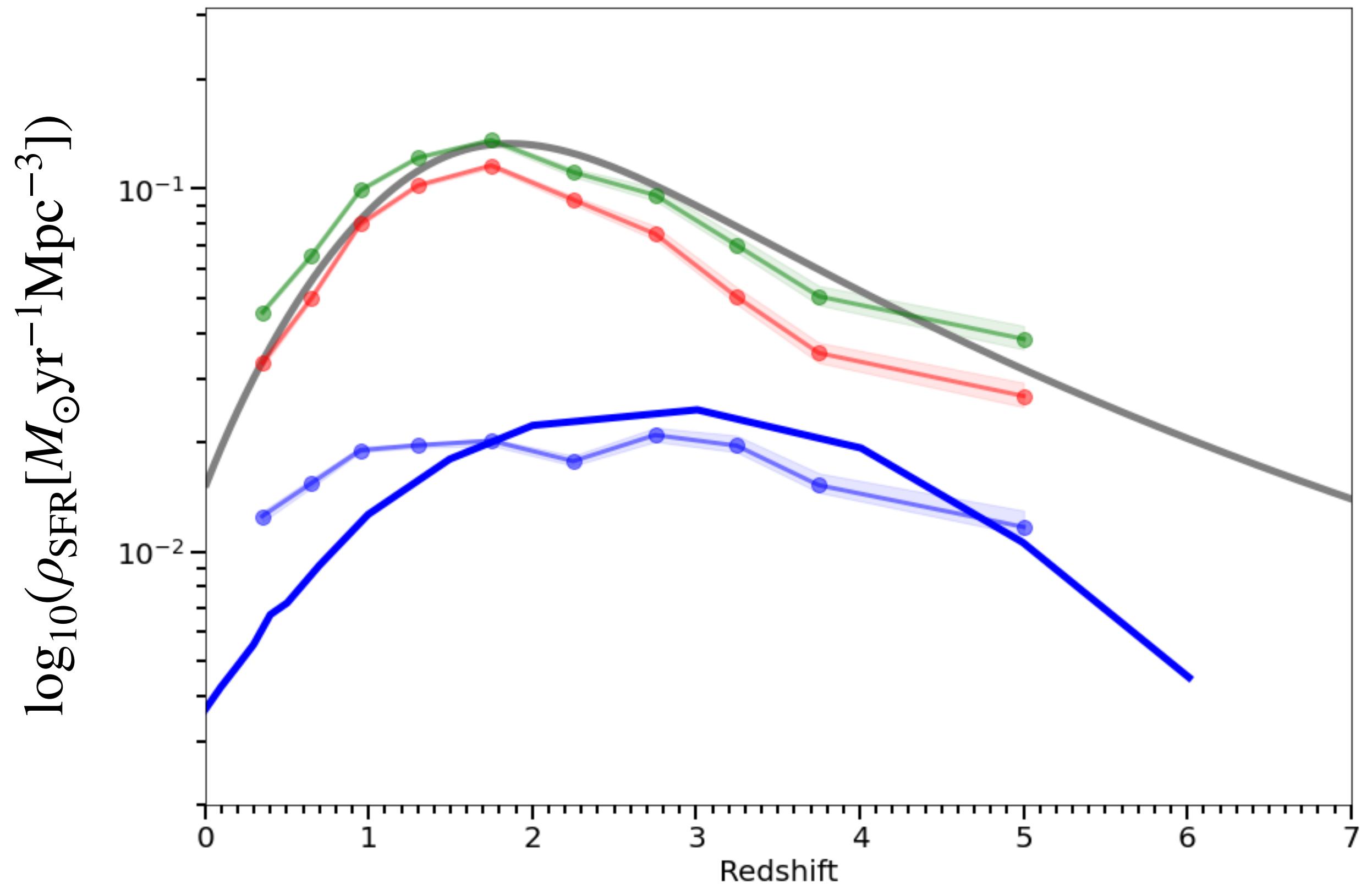
Can it reproduce the  
contribution?

# The cosmic star formation history



- Madau & Dickinson  $\rho_{\text{SFR}}$  evolution still hold!
- Lower mass galaxies contribution is nearly flat

# The cosmic star formation history

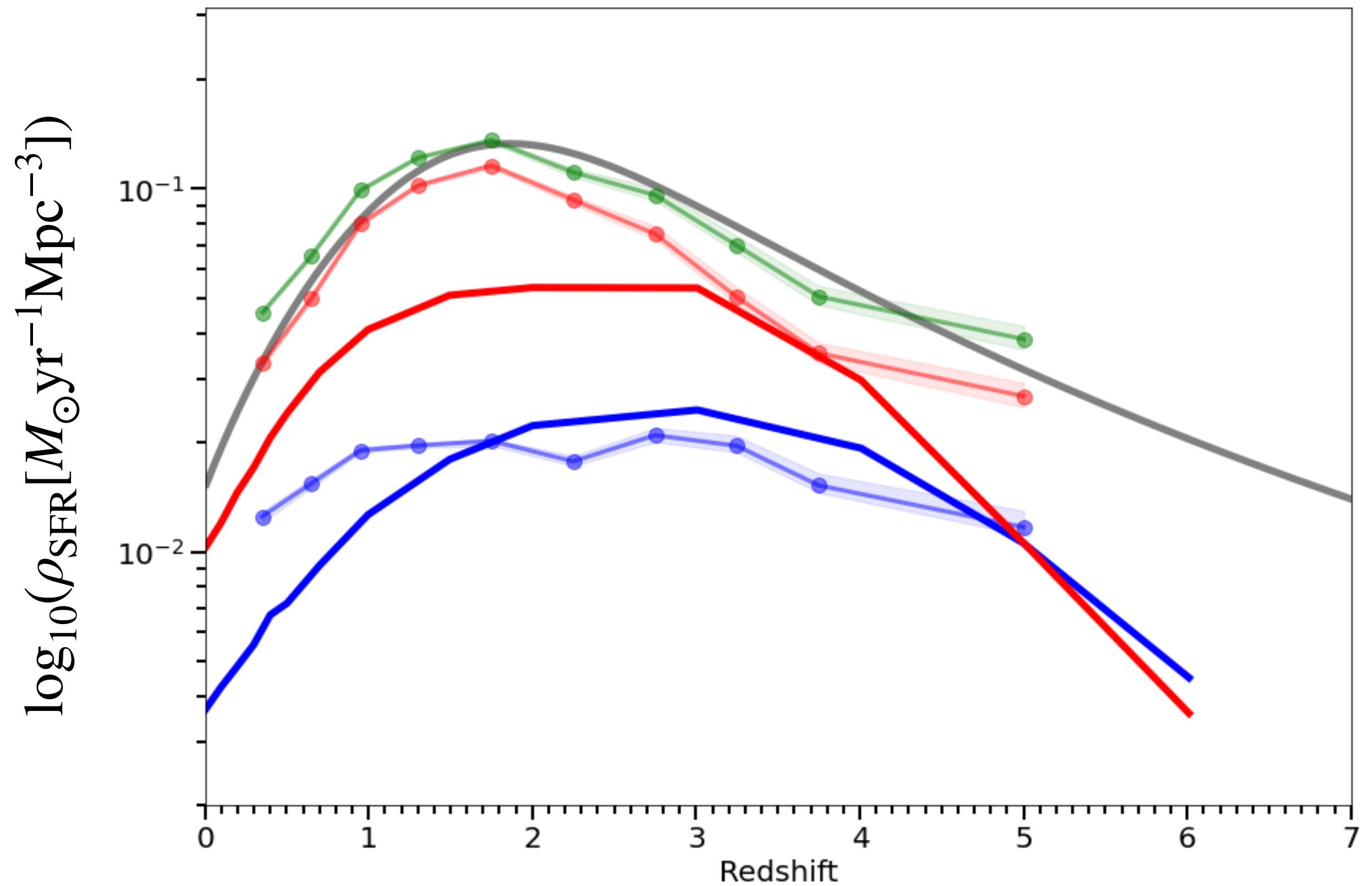


● Madau & Dickinson  $\rho_{\text{SFR}}$  evolution still hold!

● Lower mass galaxies contribution is nearly flat

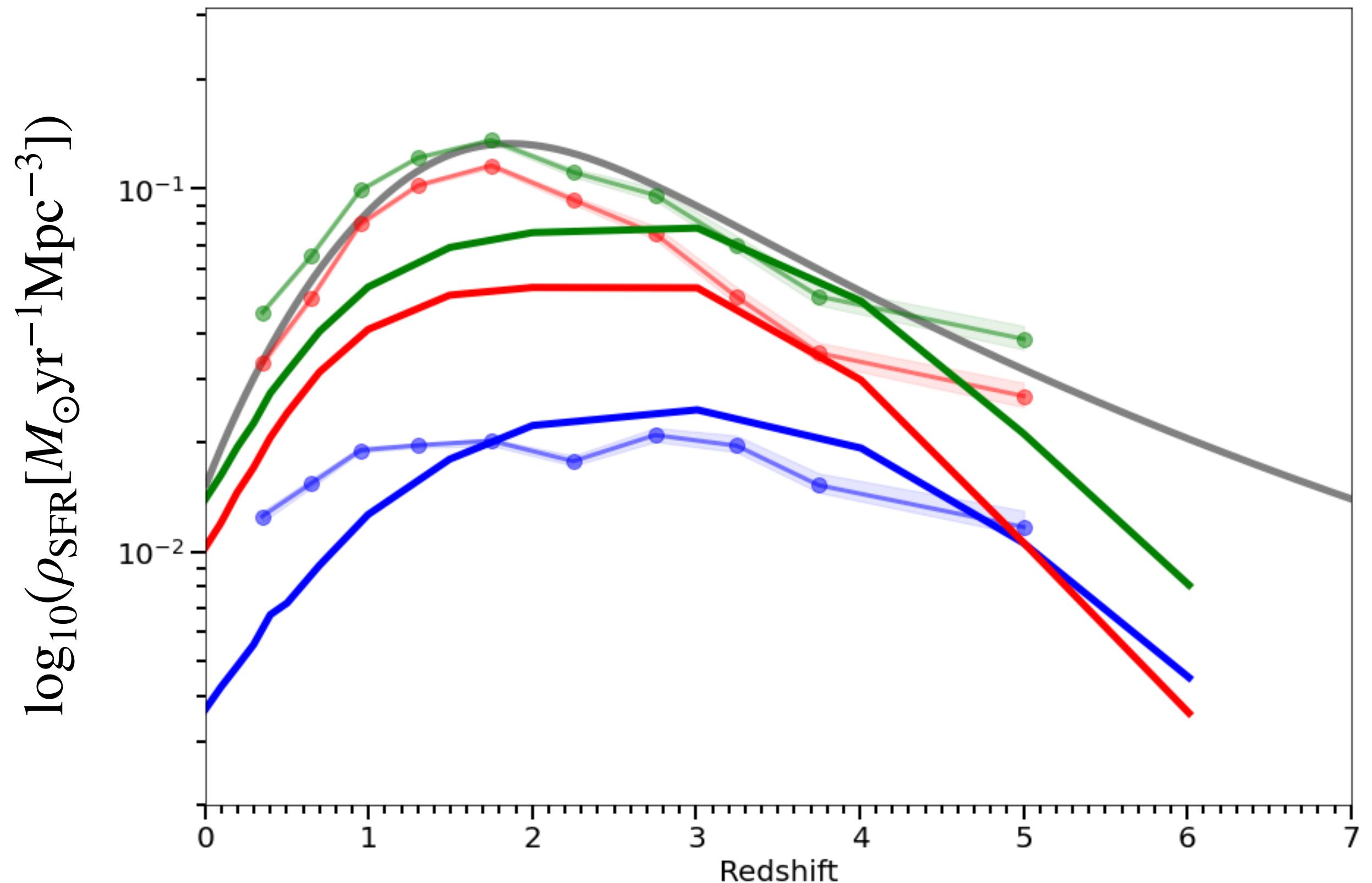
● Massive galaxies contribute for most of the  $\rho_{\text{SFR}}$  for  $0.3 \leq z \leq 5$

# The cosmic star formation history



- Madau & Dickinson  $\rho_{\text{SFR}}$  evolution still hold!
- Lower mass galaxies contribution is nearly flat
- Massive galaxies contribute for most of the  $\rho_{\text{SFR}}$  for  $0.3 \leq z \leq 5$

# The cosmic star formation history

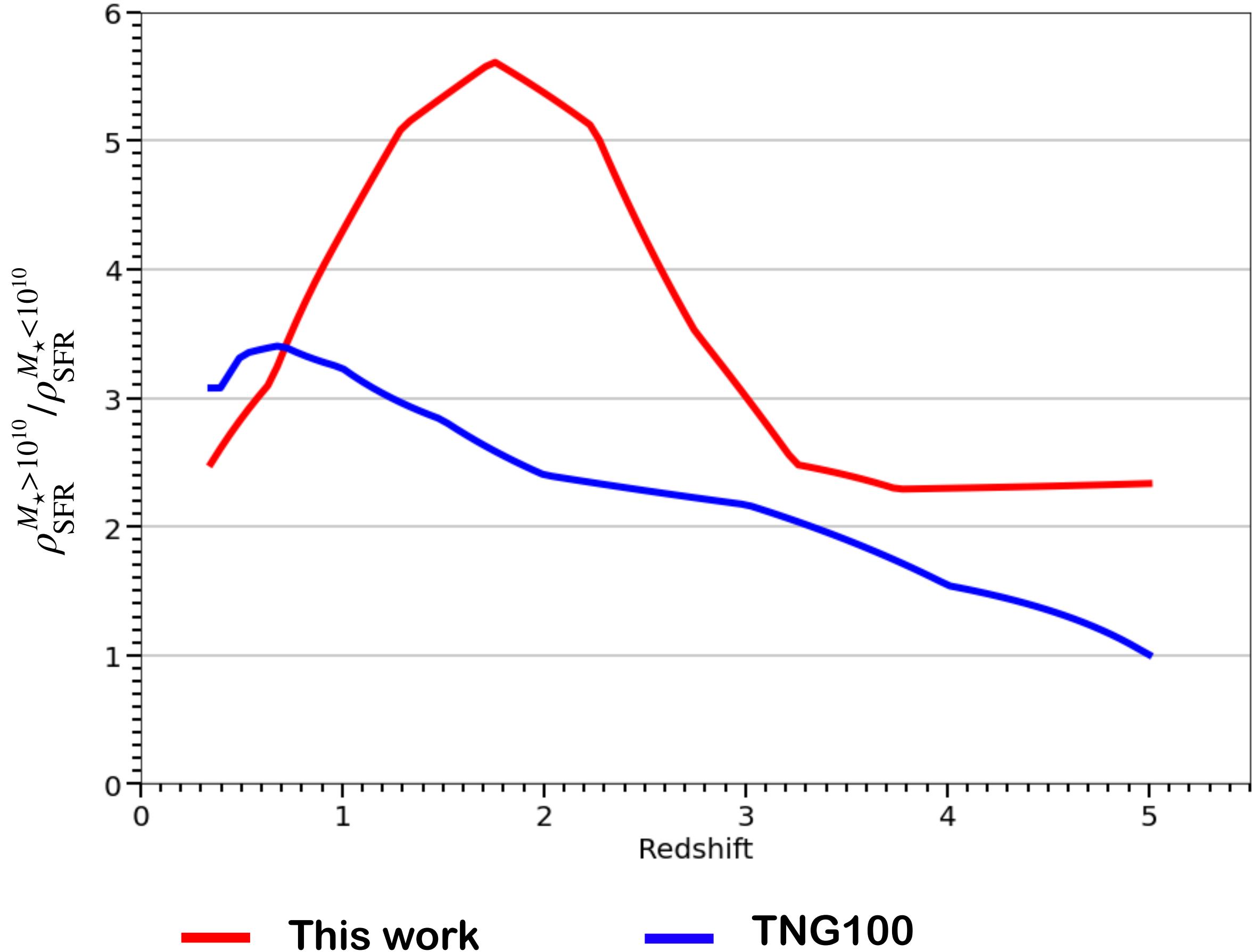


● Madau & Dickinson  $\rho_{\text{SFR}}$  evolution still hold!

● Lower mass galaxies contribution is nearly flat

● Massive galaxies contribute for most of the  $\rho_{\text{SFR}}$  for  $0.3 \leq z \leq 5$

# Looking at the ratio of the contribution : $\rho_{\text{SFR}}^{M_\star > 10^{10}} / \rho_{\text{SFR}}^{M_\star < 10^{10}}$

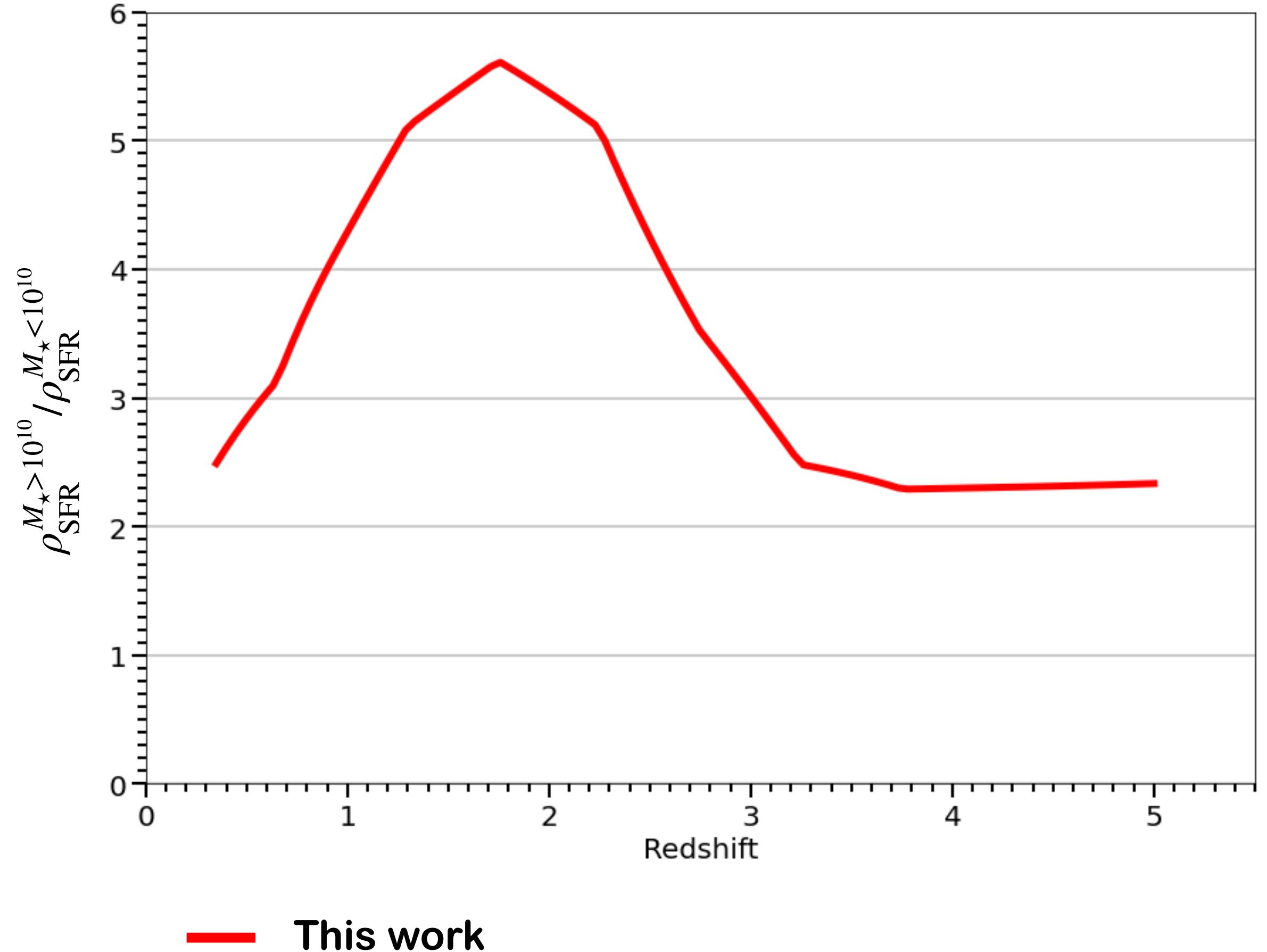


Lower mass galaxies contribution is nicely reproduced for  $z \geq 1.5$

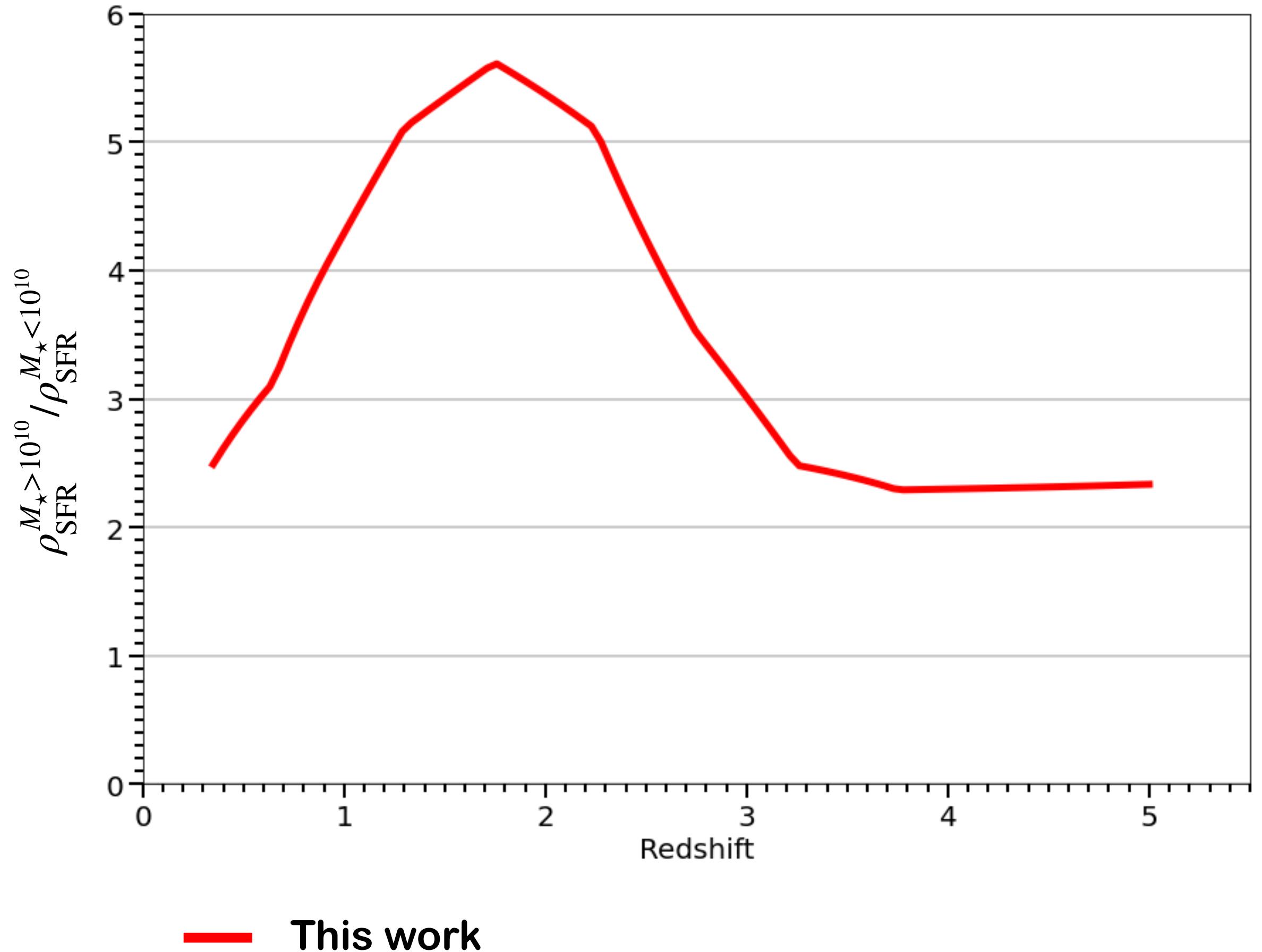
Massive galaxies contribution is underestimated at most redshift...

... which translate in an underestimation of the total  $\rho_{\text{SFR}}$  at most redshift

# Where does this disparity come from?

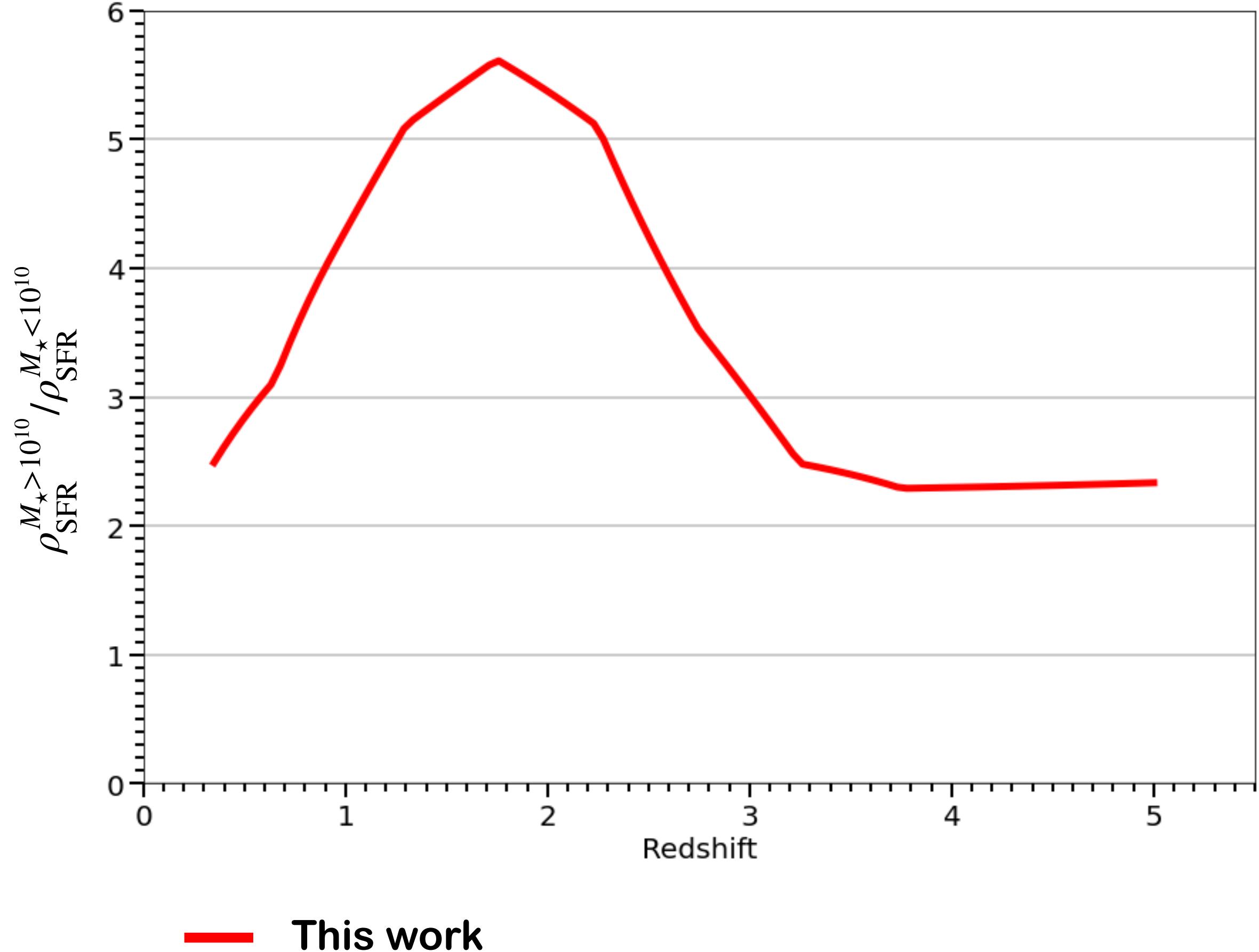


# Where does this disparity come from?



Are massive galaxies intrinsically more efficient?

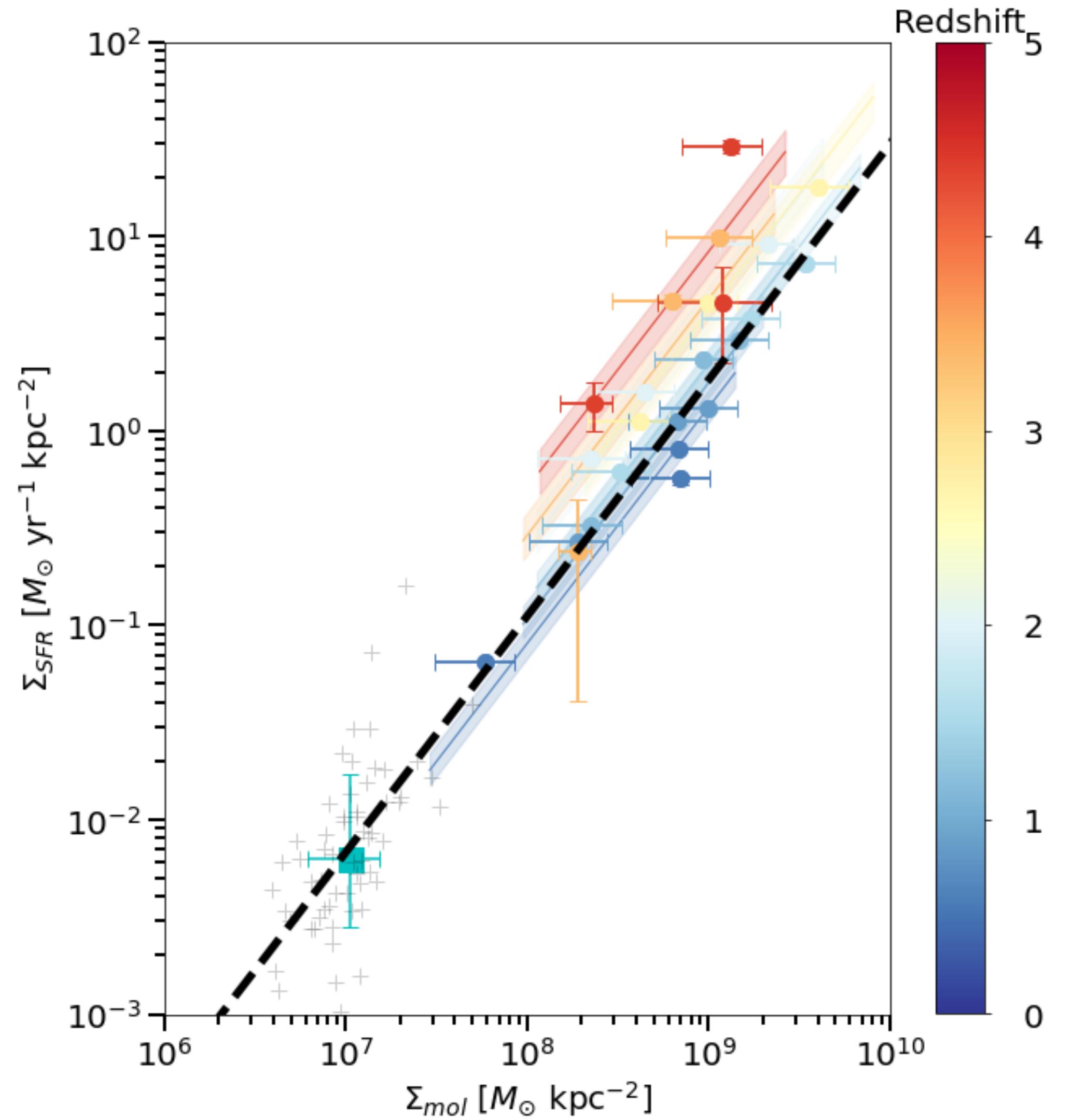
# Where does this disparity come from?



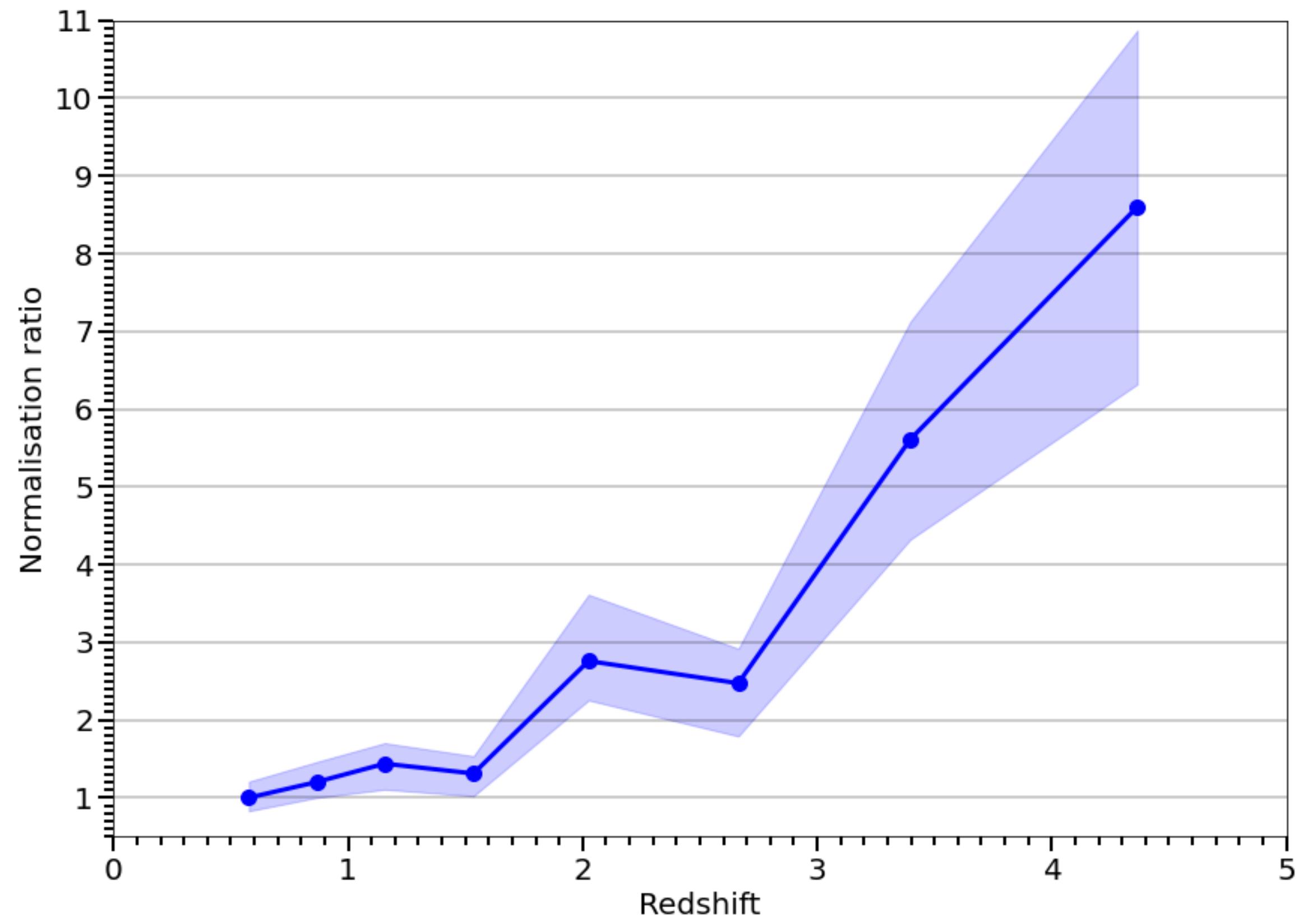
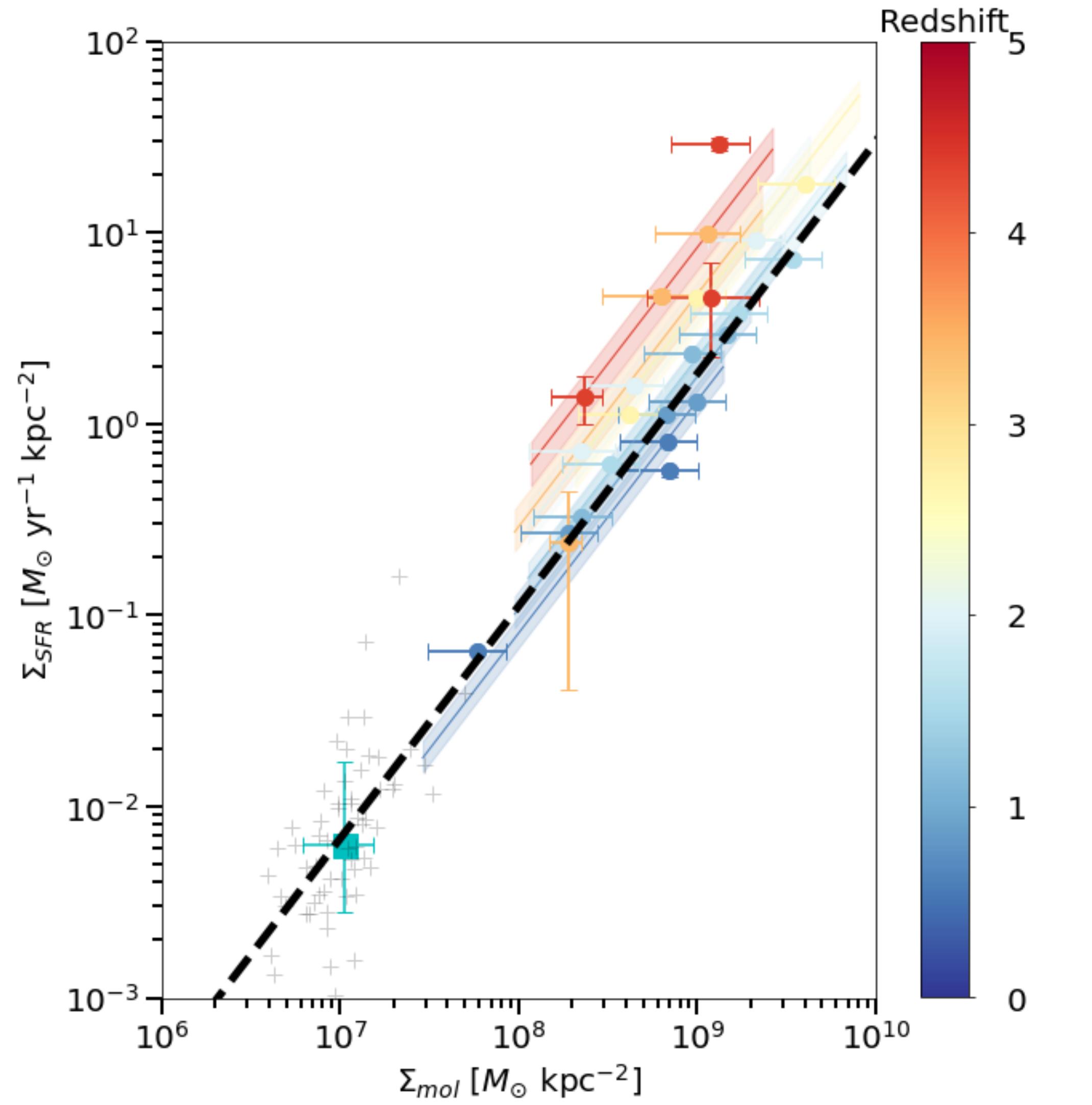
● Are massive galaxies intrinsically more efficient?

● Is it just a matter of the number of galaxies?

# The Schmidt-Kennicutt relation : $\Sigma_{\text{SFR}} - \Sigma_{\text{gas}}$



# The Schmidt-Kennicutt relation : $\Sigma_{\text{SFR}} - \Sigma_{\text{gas}}$



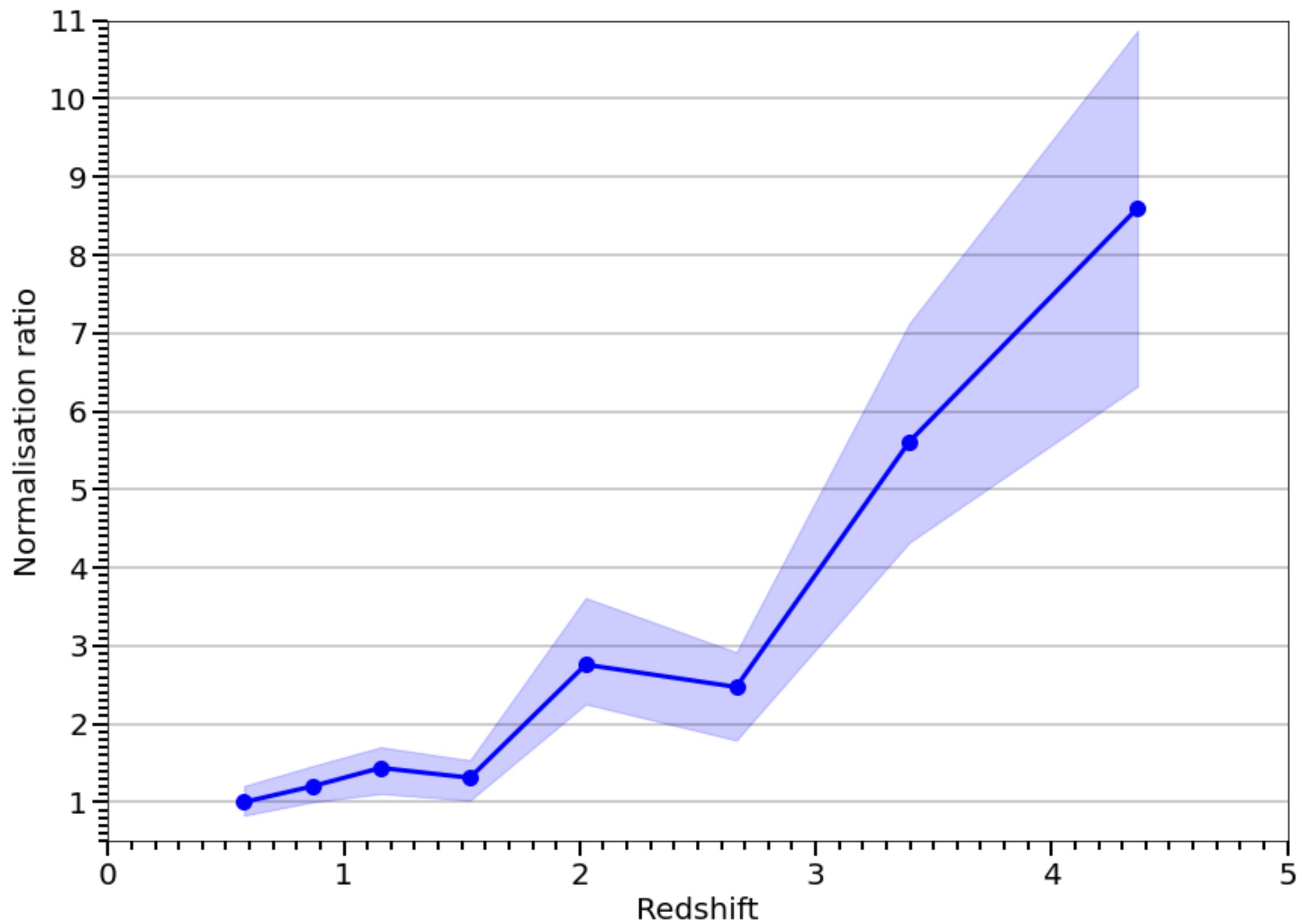
# The Schmidt-Kennicutt relation : $\Sigma_{\text{SFR}} - \Sigma_{\text{gas}}$



Non universality of the Schmidt-Kennicutt relation?



More complexity in our understanding of certain laws?



## Take-away message

- Massive galaxies contribute for most of the  $\rho_{\text{SFR}}$  for  $0.3 \leq z \leq 5$

- TNG100 fail to reproduce the behavior of massive galaxies

- Hints for non universal Schmidt-Kennicutt relation

# Thanks